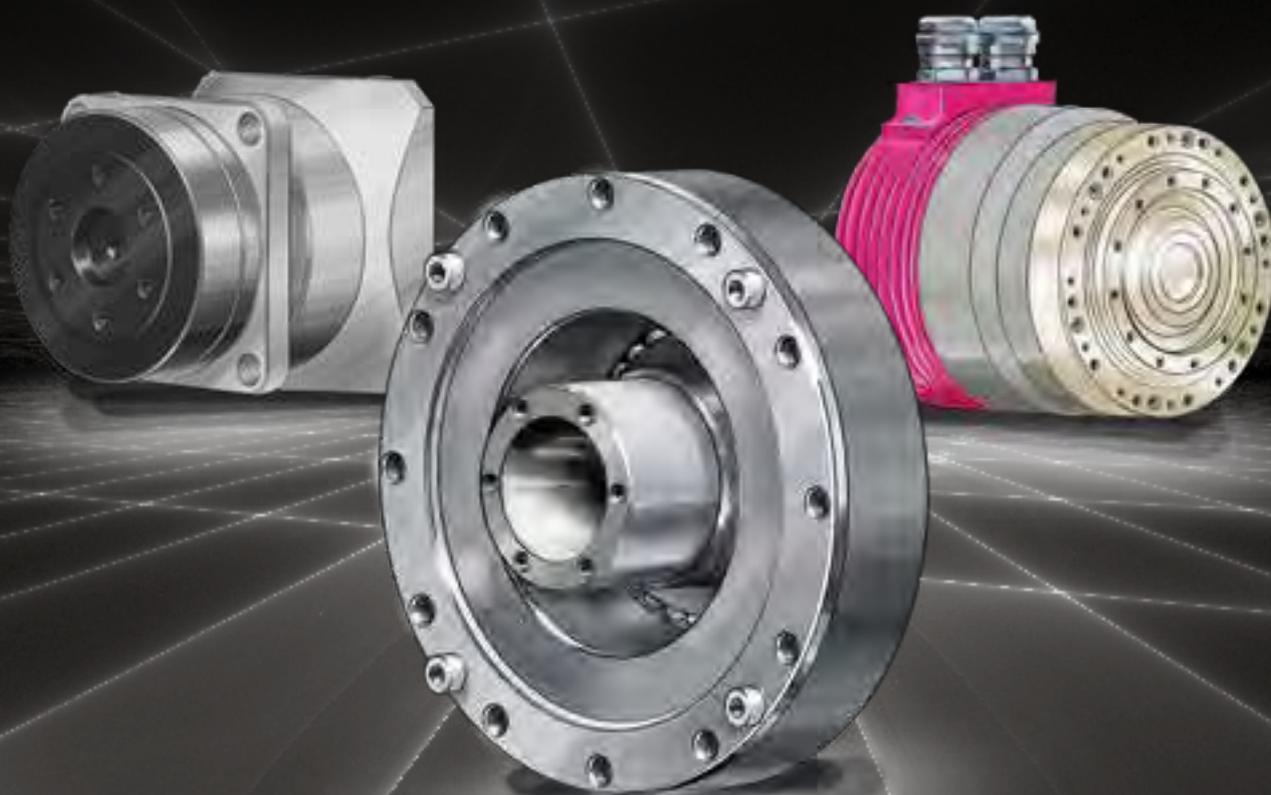


# Harmonic Drive® Product world



Harmonic  
Drive AG

Gears | Planetary gears | Servo products





Harmonic  
Drive AG

Product World from Harmonic Drive AG offers you an overview of our product groups - gears, planetary gears and servo products.

The constant progress of gear technology requires both continuous development of components with the same level of specialist knowledge and maximum accessibility.

Further information together with an individual, application related consultation can be provided by one of our sales staff.

**Please feel free to contact us.**



Harmonic  
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## Harmonic Drive® Gears

Harmonic Drive® Gears consist of three individual components - Circular Spline, Flexspline and Wave Generator. Gear component sets extremely compact design ensures installation in applications with the most demanding space requirements. Gears with output bearing ease integration by combining the precise component sets with high capacity tilt resistant output bearings.

### GEAR COMPONENT SETS



CSG-2A



SHG-2A



CPL-2A



CSD-2A

## Harmonic Planetary Gears

Harmonic Planetary Gears have lower gear ratios usually operating higher speeds where there is often the need for very high precision. Our special design with a flexible ring gear in the output stage means that we guarantee constant high precision over the entire lifetime - we call this Permanent Precision®!



HPN



HPGP



HPG-R

## Harmonic Drive® Servo Products

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

### SERVO ACTUATORS WITH HOLLOW SHAFT



CanisDrive®



AlopexDrive®



FHA-C Mini

## Harmonic Drive® SolutionKit®

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.



GEARS WITH OUTPUT BEARING



CSG-2UH



CPU-M/H/S



CSD-2UH/2UF



CSF Mini



CSF-2UP



SHG-2UH/2SH/2SO



SHD-2SH

SERVO ACTUATORS WITHOUT HOLLOW SHAFT



LynxDrive®



BDA

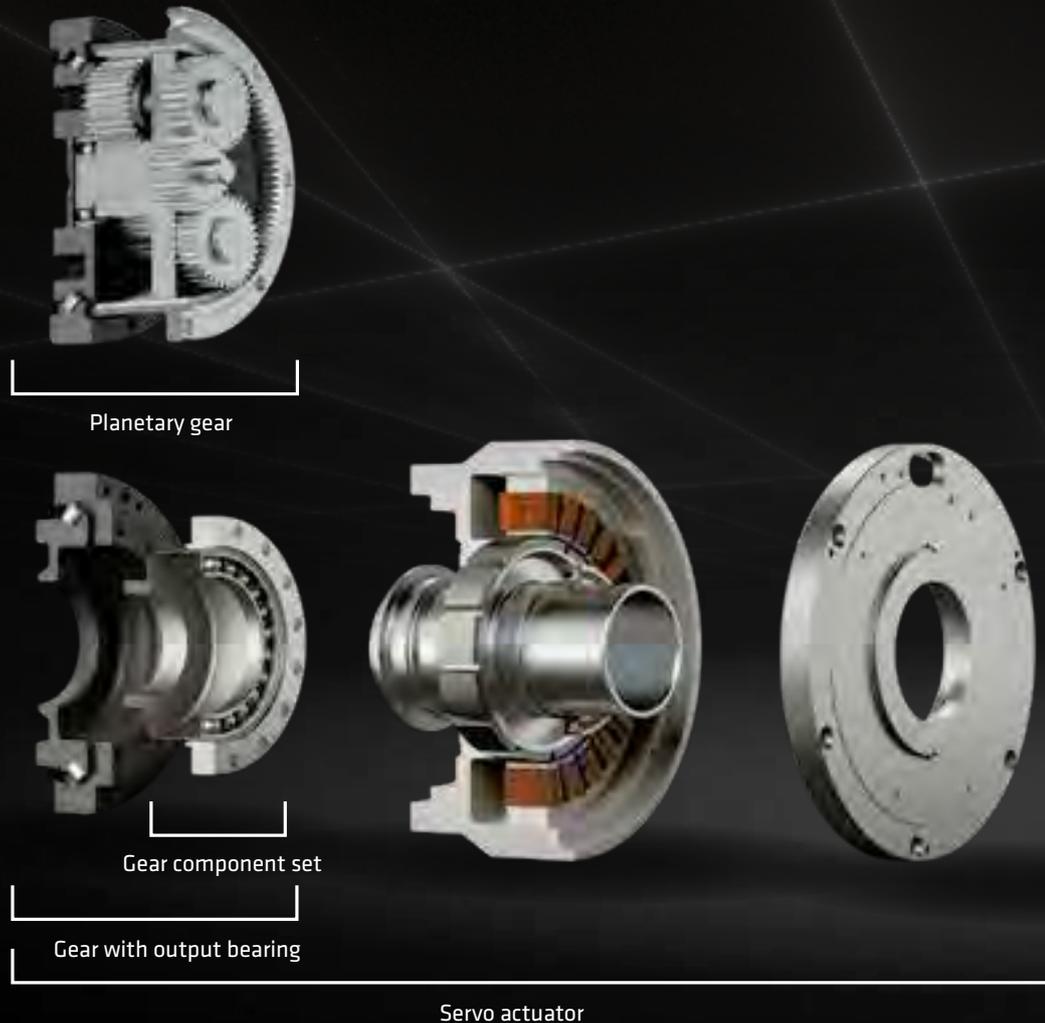


FLA



RSF Mini





## Harmonic Drive® Gears

### Gear Component Sets

Harmonic Drive® Gear Component Sets work according to the strain wave gear principle and are characterised by high single stage gear ratios, zero backlash and precise motion as well as maximum torques with low weight and compact dimensions. Consisting of only three components Circular Spline, Flexspline and Wave Generator, they enable maximum flexibility in design integration. Harmonic Drive® Gear Component Sets are ideal for applications with existing output bearings. By using the existing bearings and housing structure, they can be used to achieve both a low total weight and a compact design within the application.

### Gears with output bearing

Harmonic Drive® Gears with output bearings combine precise gear component sets with a tilt resistant cross roller or four point contact bearing. Due to its compact design and its high concentricity and accuracy, the output bearing complements perfectly with the strain wave gear. Different gear types allow use in different gear configurations. Motor mounted gearboxes provide the prerequisites for providing direct and easy interfacing of servomotors to the gear with little engineering and assembly expense. The hollow shaft gear allows the central implementation of supply cables and shafts.

The proven gear components, output bearings, motors and encoder systems form the basis for different product groups of Harmonic Drive AG in the field of high precision drive technology. Harmonic Drive® Gears or Planetary Gears are the starting point for all products. In combination with a servo motor and a motor feedback system, highly integrated, compact and powerful servo actuators are created.



## Harmonic Planetary Gears

Requirements of the market for gears that support high speeds or low ratios often require the highest precision. Harmonic Planetary Gears meet this requirement. Due to their integrated motor connection with clamping element and motor flange, they allow easy mounting of servo motors. The special design with a flexible ring gear in the last stage ensures consistently high precision over the entire service life - we call this Permanent Precision®.

## Harmonic Drive® Servo Products

The continuously increasing demands placed on servo drives require, among other things, perfect interaction between the motor, gears, motor feedback system and controller. To guarantee characteristics such as precision and dynamics, servo actuators from Harmonic Drive AG have a high degree of compatibility.

The option to choose between a zero backlash strain wave gear and a low backlash planetary gear. The tilt resistant output bearing enables the direct attachment of high payloads without additional support and thus permits a simple and space saving design. In addition, there are numerous possible combinations for the motor winding and the motor feedback system as well as choices for brakes, connecting cables and connectors. Due to the flexibility in the configuration of the motor winding and the motor feedback system, the compatibility with almost all servo controllers of the market is guaranteed.

# Principle of operation Harmonic Drive® Strain Wave Gear

Highly precise and backlash free gear component sets form the central element of Harmonic Drive® Gears and Servo Actuators. Harmonic Drive® Gear Component Sets consist of only three precision components:

## Circular Spline

The Circular Spline is designed as a rigid ring with internal teeth. The Circular Spline has two teeth more than that of Flexspline.

## Flexspline

The Flexspline is a high strength, torsionally stiff yet flexible component with external teeth, which reliably transmits high loads.

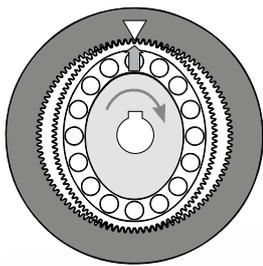
## Wave Generator

The Wave Generator is the driven element of the transmission. The elliptical shaped Wave Generator is fitted with a specially designed thin race ball bearing assembly.

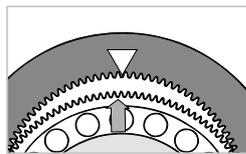
By inserting the Wave Generator into the Flexspline, the Flexspline assumes the elliptical shape of the Wave Generator. The rotating Wave Generator causes the Flexspline to radially deform.

The assembled gear has two diametrically opposed tooth engagement areas around the major axis of the ellipse. The rotation of the Wave Generator causes the meshing of Flexspline with the Circular Spline to move around circumference. Since the Flexspline has two teeth less than the Circular Spline, rotating the Wave generator leads to a relative movement between the Flexspline and the Circular Spline.

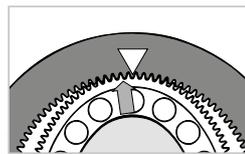
Harmonic Drive® Gears and Servo Actuators are used wherever zero backlash, extraordinary precision and high reliability are required – in all areas where drive technology is required.



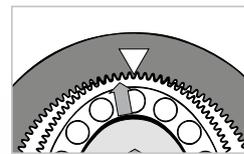
1. Start



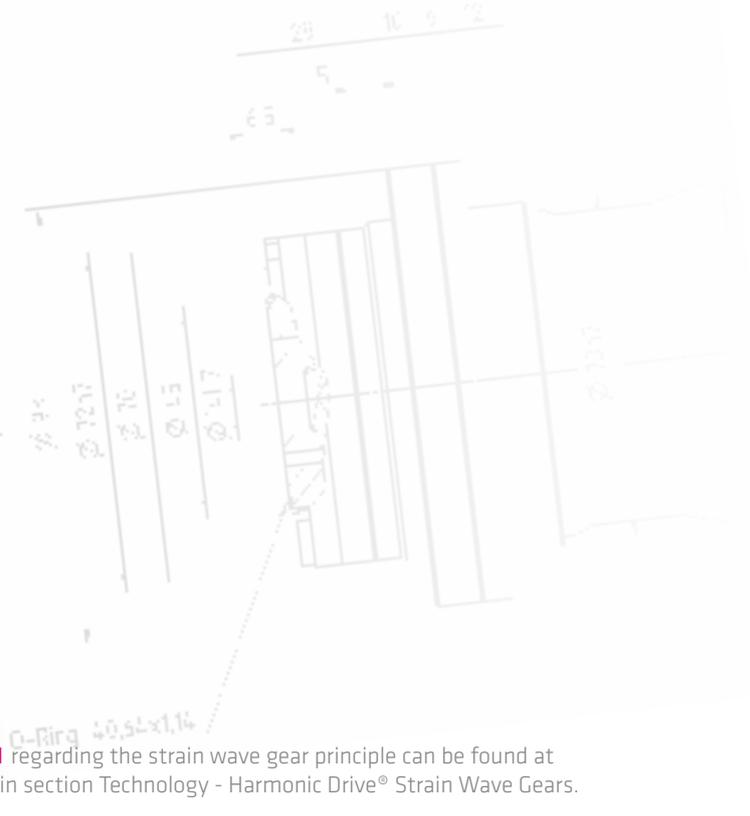
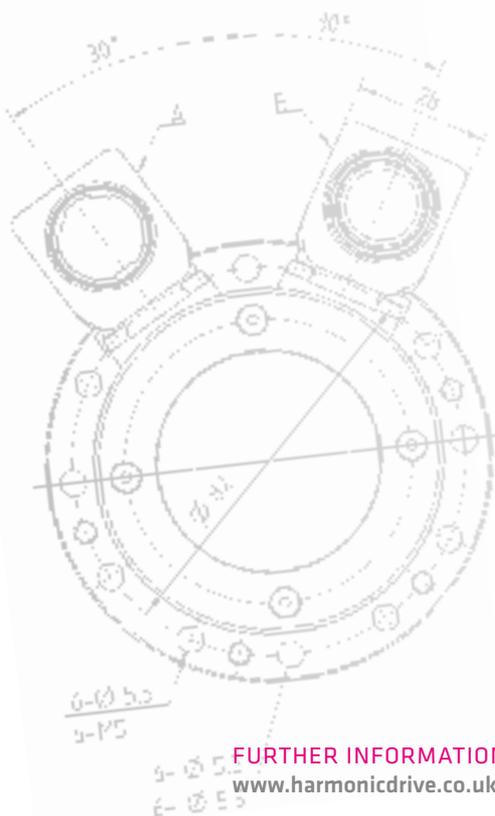
2. 1/4 Input rotation



3. 1/2 Input rotation



4. 3/4 Input rotation



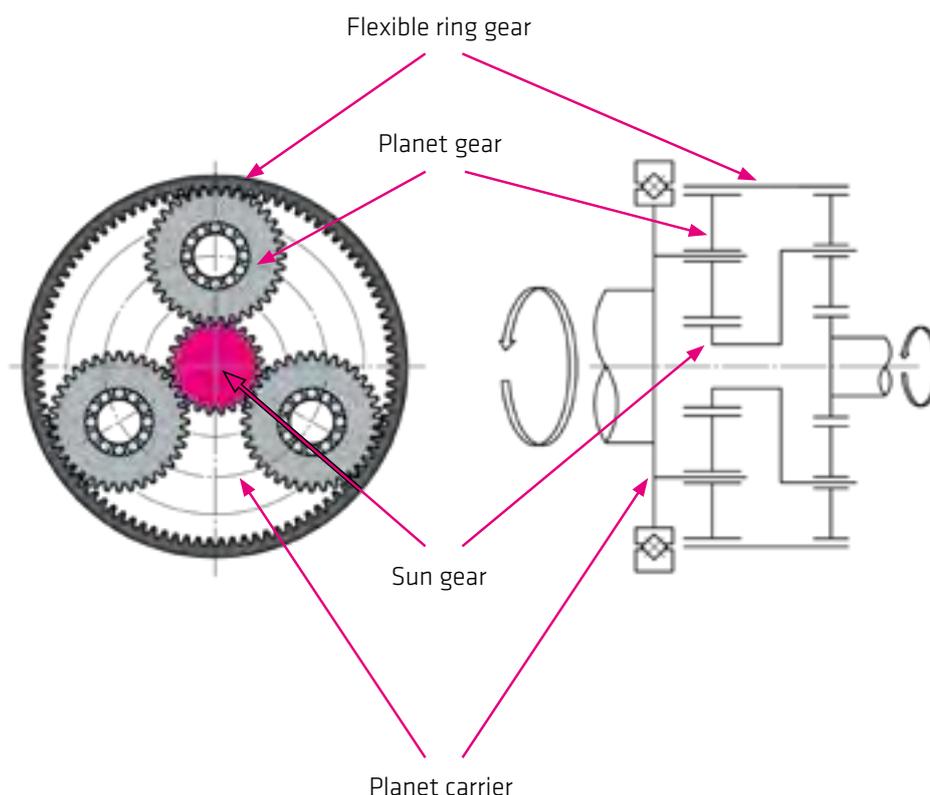
## High precision gears with low backlash



There is often a need for highest precision at higher speeds with lower ratios. Our special design with a flexible ring gear in the output stage means that we guarantee constant high precision over the entire lifetime - we call this Permanent Precision®!

The outstanding feature of Harmonic Planetary Gears is the flexible ring gear. This is the result of the engineering and manufacturing know how within the Harmonic Drive® Group. By using a flexible ring gear the planetary gears achieve a backlash of < 3 minutes of arc without requiring an additional backlash adjustment mechanism. For sizes 14 to 65 the backlash can be reduced to lower than one minute or arc.

Until now highly accurate gears and/or an additional adjustment mechanism were necessary to minimise backlash. Tight gear engagement for conventional planetary gears leads to torque ripple and a worsening of noise and wear characteristics. To avoid this problem the planetary gears feature a flexible internally toothed ring gear, thereby exploiting many years of Harmonic Drive® experience with thin walled components. The flexible ring gear ensures that backlash is minimised and that all planet gears share the load equally.



## Harmonic Planetary Gear Set

Containing:

- Ring gear
- Planet carrier
- Sun gear
- Planet gear

### Clamping element

- Tangential clamping
- Customer specific solution

### Motor flange

- Flexible adaptation

### Output bearing

- High capacity
- High moment stiffness
- Excellent running properties
- Corrosion protected

### Gear housing

- High strength aluminium
- Corrosion protected

**FURTHER INFORMATION** regarding the planetary gear principle can be found at [www.harmonicdrive.co.uk](http://www.harmonicdrive.co.uk) in section Technology - Harmonic Planetary Gears.

## Technology comparison between strain wave gears and planetary gears

In order to meet the requirements of various industrial applications, Harmonic Drive AG offers both strain wave gears and planetary gears as well as servo actuators based on these gear principles.

Harmonic Drive® Strain Wave Gears are available with single stage reduction ratios from 30 to 160:1 and are characterised by high torque capacity at low weight, highest accuracy and compact dimensions. They are ideally suited for precise positioning tasks or applications with limited installation space.

To cover the range of precise drive technology for high speeds, Harmonic Drive AG offers planetary gears. These are defined by permanent precision, high dynamics and continuous running capability and are ideally suited for applications with higher speeds or continuous operation. They can typically be implemented as single stage units with reduction ratios from 3 to 10:1. Higher gear reduction ratios require multi-stage gears. The tables below show the suitability of the respective gear principle for selected characteristic values and offer a guideline for selecting the appropriate gear technology.

	Low weight	
Gear Ratio	Harmonic Planetary Gears	Harmonic Drive® Strain Wave Gears
< 30	••	-
30-80	••	••
> 80	•	•••

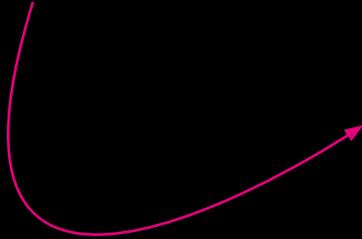
	Short design	
Gear Ratio	Harmonic Planetary Gears	Harmonic Drive® Strain Wave Gears
< 30	••	-
30-80	•	••
> 80	•	•••

	Precision	
Gear Ratio	Harmonic Planetary Gears	Harmonic Drive® Strain Wave Gears
< 30	••	-
30-80	•	•••
> 80	•	•••

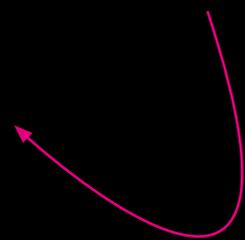
	Dynamics	
Gear Ratio	Harmonic Planetary Gears	Harmonic Drive® Strain Wave Gears
< 30	•••	-
30-80	•••	••
> 80	•••	••

••• perfect •• optimal • good

Planetary gear



Strain wave gear



Robotics and Automation | Machine tools | Semiconductor technology | Medical | Packaging machines | Special environments



## Our inspiration

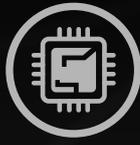
Your business drives us. For every individual set of requirements, we have an equally diverse range of solutions: four out of every five products that leave our company are special versions, developed, designed, and produced to customer specifications – from space saving gear component sets to customised 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.



**Harmonic Drive AG**

## Far beyond the horizon

Our highly developed drive solutions can be found all over the world and even above it – whether it's a red or blue planet: gears, actuators and systems from Harmonic Drive AG are used wherever the highest demands are placed on quality and reliability. It is no wonder that our pioneering mechatronic products are used today in a wide range of key industries.

Thanks to local sites worldwide and close cooperation with our parent company in Japan and our sister company in the USA, we ensure that you can benefit from customised Harmonic Drive® Solutions around the globe – we are there where you need us, crossing national borders and time zones with ease, and facing tricky challenges with enthusiasm.



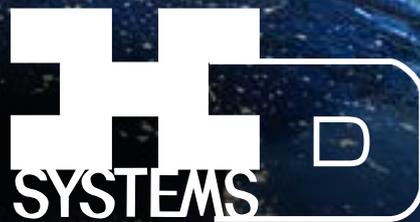
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H

We successfully meet the requirements of our customers from a wide range of industries. The driving force behind our success is creativity and customer focus: more than 80% of our solutions are developments that we have designed and produced ourselves for specific purposes – from applications in optical machines in India to communications engineering in South Africa.

Let us know what you need: we are sure to have the ideal solution for your requirements.

Maybe you will think of us the next time you travel the globe in a plane from the Airbus range, where high precision Harmonic Drive® Gears for aviation help ensure that you have a safe flight and put the world at your feet.

armonic  
rive AG



It is always fascinating to find out the areas where our products are used. Here you will find a selection of the industries in which we are represented.



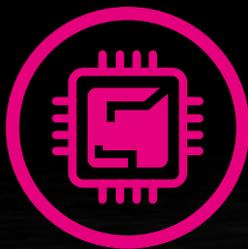
### Robotics and Automation

Robots have for a long time been taking over tasks which are too monotonous for humans to produce to the highest quality. With modern programming and performance improvements from drive technology, these helpers are now entering fields which were unthinkable a short while ago. This cooperation between man and robot has become an important trend in recent years – one meets each other in some sense.



### Machine tools

Is it possible to strike a Euro coin at a distance of a hundred metres? It is not only possible but must absolutely be achievable if high value machine tools are to be manufactured. Harmonic Drive AG products are used in particular at sites where space is limited. The layout in such cases is not defined by torque but rather by rigidity or by hollow shaft diameter.



### Semiconductor technology

Moore's Law, which predicts a doubling of the performance of electronic components every 18 months, remains valid. What is innovative today may tomorrow be obsolete and uneconomical. Due to constant development, Harmonic Drive AG products can keep pace with these demands: whether this is to do with miniaturisation, clean room compatibility or the field of greater reliability.

Challenge us with your application – together we can find the appropriate solution.

## Medical technology

It is not only world class athletes who want to be fit again quickly after an operation, and today in most cases, recovery is being supported by more technologies which permit targeted training of the body parts affected. The secret of success is programmable movement sequences which can be implemented via a precision actuator. Reliable and precise drive technology is also a fundamental design requirement in the field of surgery.



## Packaging machines

The fact that foods must not only be packaged attractively but also in such a way that they can keep their valuable ingredients and taste for as long as possible, is clearly one of the key disciplines in packaging technology. However, there are other fields too where products must be packaged in such a way as to use resources sparingly and to ensure they are safe in transport. In addition to the handling of several materials, high efficiency is decisive for market success.



## Special Environments

40 years without any maintenance in space or 30 years of being built in to aircraft wings or under daily temperature changes between -60 °C to +40 °C – these are indicators of the reliability and quality of our products. New demands, such as special materials, extremely light constructions or dry lubrication have been developed for aerospace and defence purposes, only for them later to find use in our industrial products.



Harmonic Drive®  
Gears





Harmonic  
Drive AG

# Harmonic Drive® Gears

Harmonic Drive® Gears operate according to the strain wave gear principle and are characterised by high, single stage gear ratios, zero backlash and precise movement together with high torque, low weight and compact dimensions. The gears with output bearing can also accommodate high bearing loads.



# Harmonic Drive® Gear Component Sets

Harmonic Drive® Gear Component Sets work according to the strain wave gear principle and are characterised by high single stage gear ratios, zero backlash and precise motion as well as maximum torques with low weight and compact dimensions. Consisting of only three components Circular Spline, Flexspline and Wave Generator, they enable maximum flexibility in design integration. Harmonic Drive® Gear Component Sets are ideal for applications with existing output bearings. By using the existing bearings and housing structure, they can be used to achieve both a low total weight and a compact design within the application.



	Torque capacity	Accuracy	Lifetime	Low weight	Short design	Small outer diameter	Large hollow shaft
CSG-2A	●●●	●●●	●●●	●●	●●	●●●	●
SHG-2A	●●●	●●●	●●●	●●	●●	●●	●●●*
CPL-2A	●●	●●●	●●	●●●	●●	●●●	●●●
CSD-2A	●	●●●	●	●●●	●●●	●●●	●●

●●● perfect ●● optimal ● good

\* Special version of the Wave Generator as a hollow shaft

# Gear Component Sets

CSG-2A



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SHG-2A



Page 28

CPL-2A

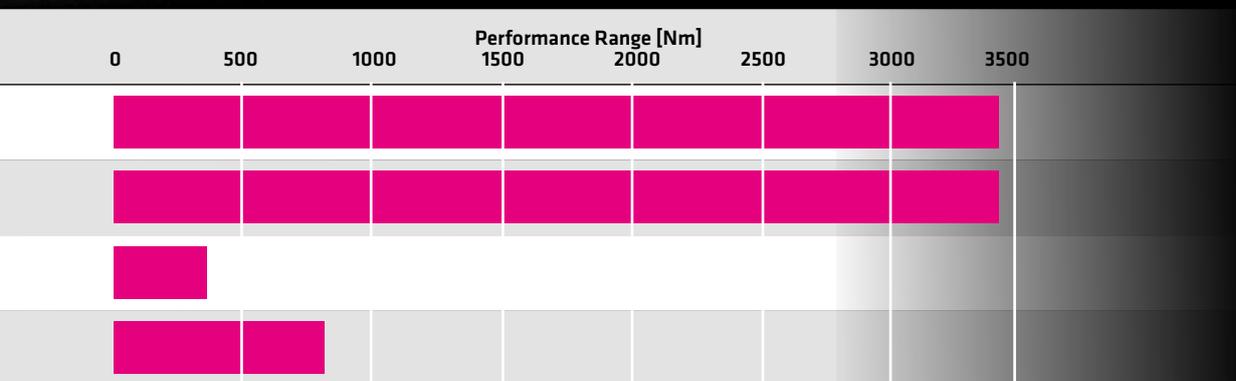


Page 30

CSD-2A



Page 32



## Performance ranges

The following tables provide an overview of the performance ranges of the gear component sets and enable preselection of the series for your application.

### CSG-2A



Page 26

Table 24.1

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	23	3419
Maximum input speed	$n_{in(max)}$ [rpm]	2800	8500
Average torque	$T_A$ [Nm]	9	2041
Transmission accuracy	[arcmin]	< 1	< 1.5
Ratio	$i$ [ ]	50	160
Outer dimension	A [mm]	50	215
Length	L [mm]	28.6	83.1

### SHG-2A



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Table 24.2

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	23	3419
Maximum input speed	$n_{in(max)}$ [rpm]	2800	8500
Average torque	$T_A$ [Nm]	9	2041
Transmission accuracy	[arcmin]	1.5	2
Ratio	$i$ [ ]	50	160
Outer dimension	A [mm]	60	276
Length	L [mm]	28.5	83

Table 25.1

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	9	372
Maximum input speed	$n_{in(max)}$ [rpm]	4800	8500
Average torque	$T_A$ [Nm]	6.8	216
Transmission accuracy	[arcmin]	< 1	< 2
Ratio	$i$ [ ]	30	160
Outer dimension	A [mm]	50	110
Length	L [mm]	23.6	42.1
Hollow shaft diameter	$d_H$ [mm]	13.5	36

## CPL-2A



Page 30

Table 25.2

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	12	823
Maximum input speed	$n_{in(max)}$ [rpm]	3500	8500
Average torque	$T_A$ [Nm]	4.8	590
Transmission accuracy	[arcmin]	< 1	< 1.5
Ratio	$i$ [ ]	50	160
Outer dimension	A [mm]	50	170
Length	L [mm]	11	33
Hollow shaft diameter	$d_H$ [mm]	11	50

## CSD-2A



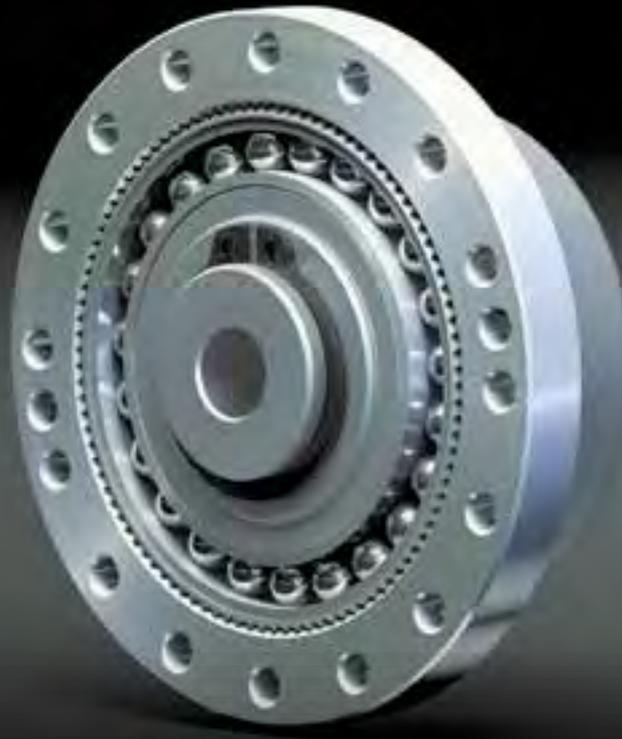
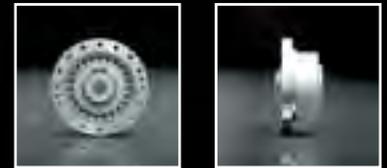
Page 32

# Highest torque capacity and lifelong precision

The CSG-2A Series Gear Component Sets are characterised by maximum torque capacity and service life with a small outer diameter as well as lifelong precision and freedom from backlash.

## Features

- Highest torque capacity
- Outstanding lifelong precision with zero backlash
- Long lifetime
- Large torque range
- Ideal for applications using integrated output bearing arrangement



# CSG-2A

Table 26.1

Torque capacity	Accuracy	Lifetime	Low weight	Short design	Small outer diameter	Large hollow shaft
•••	•••	•••	••	••	•••	•

••• perfect •• optimal • good

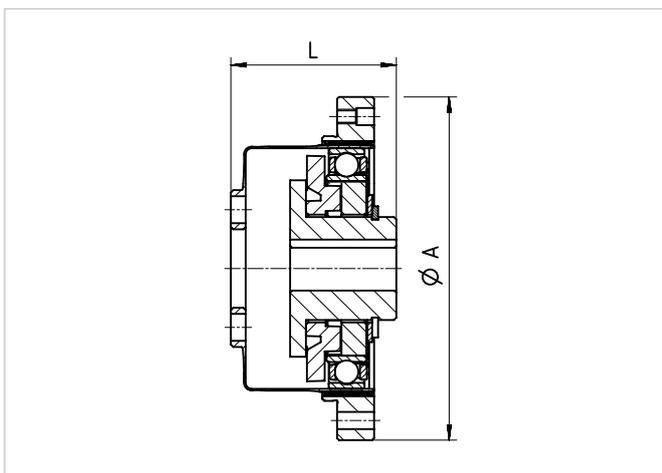
## Technical data

Table 271

Size	Ratio $i$ [ ]	Data gear			Dimensions	
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Outer dimension A [mm]	Length L [mm]
		14	50 80 100	23 30 36	8500	9 14 14
17	50 80 100	44 56 70	7300	34 35 51	60	32.6
20	120 50 80 100	70 73 96 107	6500	51 44 61 64	70	33.6
25	160 50 80 100	120 127 178 204	5600	64 64 72 113	85	37.1
32	160 50 80 100	229 281 395 433	4800	140 140 217 281	110	44.1
40	120 160 50 80 100	802 841 650 918 982	4000	281 255 369 484 586	135	53.1
45	160 80 100 120	1147 1223 1274 1404	3800	586 345 507 650	155	58.6
50	160 80 100 120	1534 1924 2067 2236	3500	806 819 675 866	170	64.1
58	160 80 100 120	1534 1924 2067 2236	3000	1057 1096 1001 1378	195	75.6
65	160 80 100 120	2392 2743 2990 3263	2800	1547 1573 1352 1976	215	83.1
		3419		2041		

## Dimensions

Illustration 27.2



## High overload capacity and service life

The SHG-2A Series Gear Component Sets are characterised by maximum torque capacity, service life and overload capacity and are available with a large hollow shaft options.

### Features

- Highest torque capacity
- Long lifetime
- High torque range
- Options available with large hollow shafts for the passage of supply cables or shafts
- Ideal for applications using integrated output bearing arrangement



# SHG-2A

Table 28.1

Torque capacity	Accuracy	Lifetime	Low weight	Short design	Small outer diameter	Large hollow shaft
●●●	●●●	●●●	●●	●●	●●	●●●*

\* Special version of the Wave Generator as a hollow shaft

●●● perfect ●● optimal ● good

## Technical data

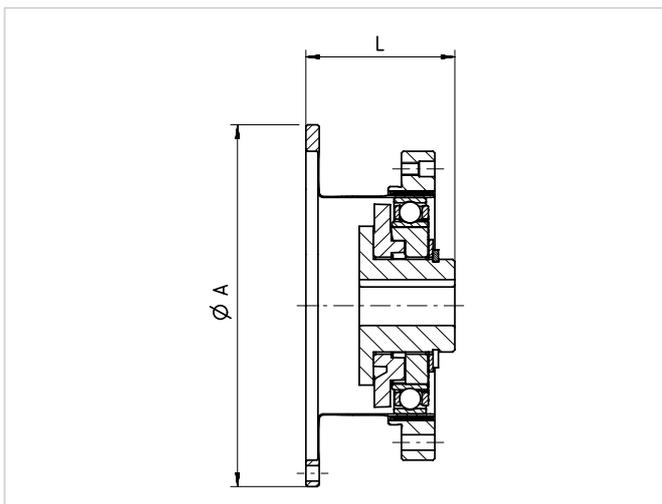
Table 29.1

Size	Ratio $i [ ]$	Data gear			Dimensions		
		Maximum torque $T_R [Nm]$	Maximum input speed $n_{in(max)} [rpm]$	Average torque $T_A [Nm]$	Outer dimension $A [mm]$	Length $L [mm]$	max. hollow shaft diameter <sup>1)</sup> $d_H [mm]$
14	50	23	8500	9	60	28.5	14
	80	30		14			
	100	36		14			
17	50	44	7300	34	72	32.5	19
	80	56		35			
	100	70		51			
20	120	70	6500	51	82	33.5	21
	50	73		44			
	80	96		61			
25	100	107	5600	64	104	37	29
	120	113		64			
	160	120		64			
32	50	127	4800	72	134	44	36
	80	178		113			
	100	204		140			
40	120	217	4000	140	164	53	46
	160	229		140			
	50	281		140			
45	80	395	3800	217	190	58.5	52
	100	433		281			
	120	459		281			
50	160	484	3500	281	214	64	60
	80	523		255			
	100	675		369			
58	120	738	3000	484	240	75.5	70
	160	802		586			
	80	841		586			
65	50	650	2800	345	276	83	80
	80	918		507			
	100	982		650			
	120	1070		806			
	160	1147		819			
	80	1223		675			
	100	1274		866			
	120	1404		1057			
	160	1534		1096			
	80	1924		1001			
	100	2067		1378			
	120	2236		1547			
	160	2392		1573			
	80	2743		1352			
	100	2990		1976			
	120	3263		2041			
	160	3419		2041			

<sup>1)</sup> Special version of the Wave Generator as a hollow shaft

## Dimensions

Illustration 29.2



## The lightweight gear with large hollow shaft

The CPL-2A Series Gear Component Sets are characterised by low weight and low moment of inertia and are perfectly suited for moving axes and highest dynamics.

### Features

- High torques at the lowest weight
- High dynamics due to reduced moment of inertia
- Large hollow shaft for the passage of supply cables and shafts
- Small outer diameter
- Ideal for applications using integrated output bearing arrangement



# CPL-2A

Table 30.1

Torque capacity	Accuracy	Lifetime	Low weight	Short design	Small outer diameter	Large hollow shaft
••	•••	••	•••	••	•••	•••

••• perfect •• optimal • good

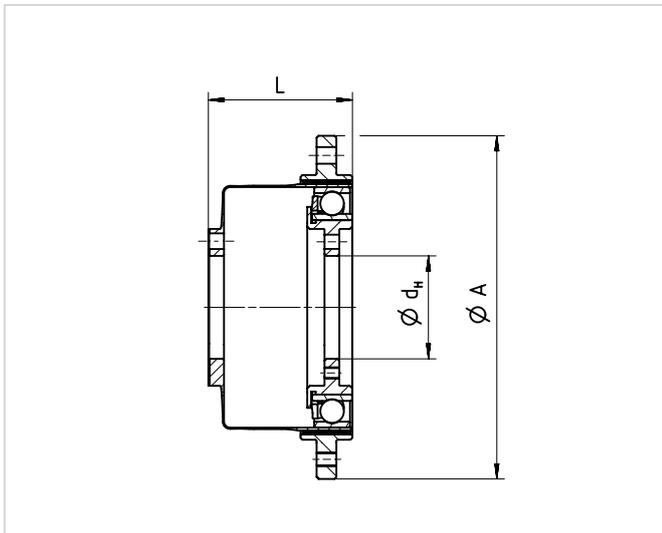
## Technical data

Table 31.1

Size	Ratio $i$ [ ]	Data gear			Dimensions		
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Outer dimension $A$ [mm]	Length $L$ [mm]	Hollow shaft diameter $d_H$ [mm]
14	30	9	8500	6.8	50	23.6	13.5
	50	18		6.9			
	80	23		11			
	100	28		11			
17	30	16	7300	12	60	26.7	18
	50	34		26			
	80	43		27			
	100	54		39			
20	120	54	6500	39	70	29	21
	30	27		20			
	50	56		34			
	80	74		47			
	100	82		49			
25	120	87	5600	49	85	34.1	26
	160	92		49			
	30	50		38			
	50	98		55			
	80	137		87			
	100	157		108			
32	120	167	4800	108	110	42.1	36
	160	176		108			
	30	100		75			
	50	216		108			
	80	304		167			
	100	333		216			
	120	353		216			
	160	372		216			

## Dimensions

Illustration 31.2

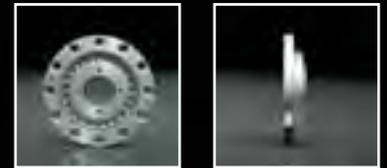


## Compact, lightweight and precise

The CSD-2A Series Gear Component Sets are characterised by the shortest design, low weight and a large hollow shaft and are suitable for applications with a small installation space.

### Features

- Short design
- Low weight
- Large hollow shaft for the passage of supply cables and shafts
- High dynamics due to reduced moment of inertia
- Ideal for applications using integrated output bearing arrangement



## CSD-2A

Table 32.1

Torque capacity	Accuracy	Lifetime	Low weight	Short design	Small outer diameter	Large hollow shaft
•	•••	•	•••	•••	•••	••

••• perfect •• optimal • good

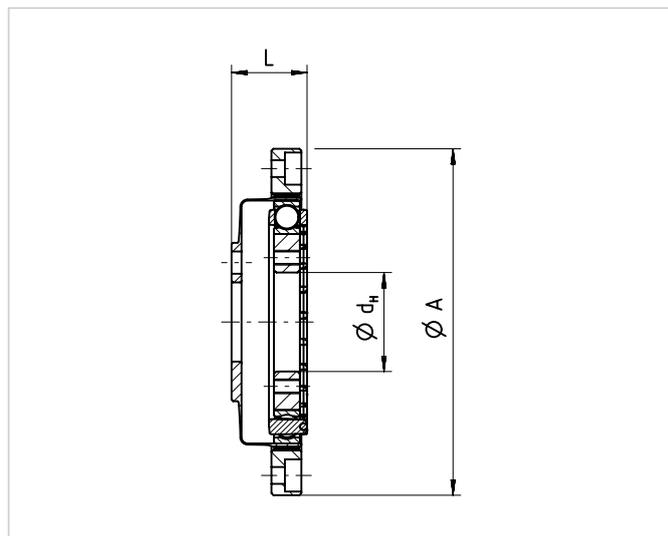
## Technical data

Table 33.1

Size	Ratio $i$ [ ]	Data gear			Dimensions		
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Outer dimension A [mm]	Length L [mm]	Hollow shaft diameter $d_H$ [mm]
14	50	12	8500	4,8	50	11	11
	80	16		7,7			
	100	19		7,7			
17	50	23	7300	18	60	12,5	11
	80	29		19			
	100	37		27			
	120	37		27			
20	50	39	6500	24	70	14	20
	80	51		33			
	100	57		34			
	120	60		34			
	160	64		34			
25	50	69	5600	38	85	17	24
	80	96		60			
	100	110		75			
	120	117		75			
	160	123		75			
32	50	151	4800	75	110	22	32
	80	213		117			
	100	233		151			
	120	247		151			
	160	261		151			
40	50	281	4000	137	135	27	40
	80	364		198			
	100	398		260			
	120	432		315			
	160	453		316			
50	50	500	3500	247	170	33	50
	80	659		363			
	100	686		466			
	120	756		569			
	160	823		590			

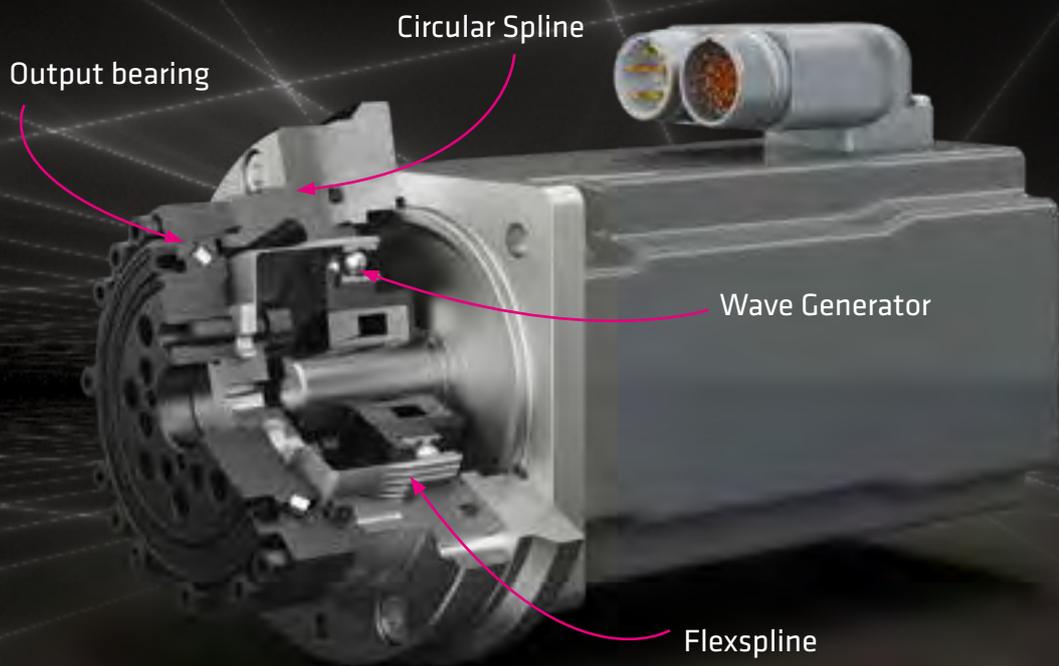
## Dimensions

Illustration 33.2



# Harmonic Drive® Gears with output bearing

Harmonic Drive® Gears with output bearings combine precise gear component sets with a tilt resistant cross roller or four point contact bearing. Due to its compact design and its high concentricity and accuracy, the output bearing complements perfectly with the strain wave gear. Different gear types allow use in different gear configurations. While motor mounted gears provide the prerequisites for providing direct and easy interfacing of servomotors to the gear with little engineering and assembly expense. The hollow shaft gear allows the central implementation of supply cables and shafts.



	Torque capacity	Accuracy	Lifetime	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Direct motor attachment
CSG-2UH	●●●	●●	●●●	●●	●●	●	●●	-	●●●
CPU-M	●●	●●●	●●	●●●	●●	●●	●●	-	●●●
CPU-H	●●	●●●	●●	●●●	●	●	●●	●●●	-
CPU-S	●●	●●●	●●	●●●	●	●	●●	-	●
CSD-2UH	●	●●	●	●●	●●●	●●●	●●●	-	●●
CSD-2UF	●	●●	●	●●●	●●	●●●	●●	●●	●●
CSF Mini	●●	●●	●●	●	●●●	●	●●	-	●●●
CSF-2UP	●●	●●	●●	●●●	●	●●	●	-	●●●
SHG-2UH	●●●	●●	●●●	●●●	●	●	●●	●●●	-
SHG-2SO	●●●	●●	●●●	●●●	●●	●●	●●	-	●●
SHG-2SH	●●●	●●	●●●	●●●	●●	●●	●●	●●●	-
SHD-2SH	●	●●	●	●●	●●●	●●●	●●	●●	●●

●●● perfect ●● optimal ● good

# Gears with output bearing

CSG-2UH



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CPU-M/H/S



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CSD-2UH/2UF



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CSF Mini



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CSF-2UP



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SHG-2UH/2SO/2SH

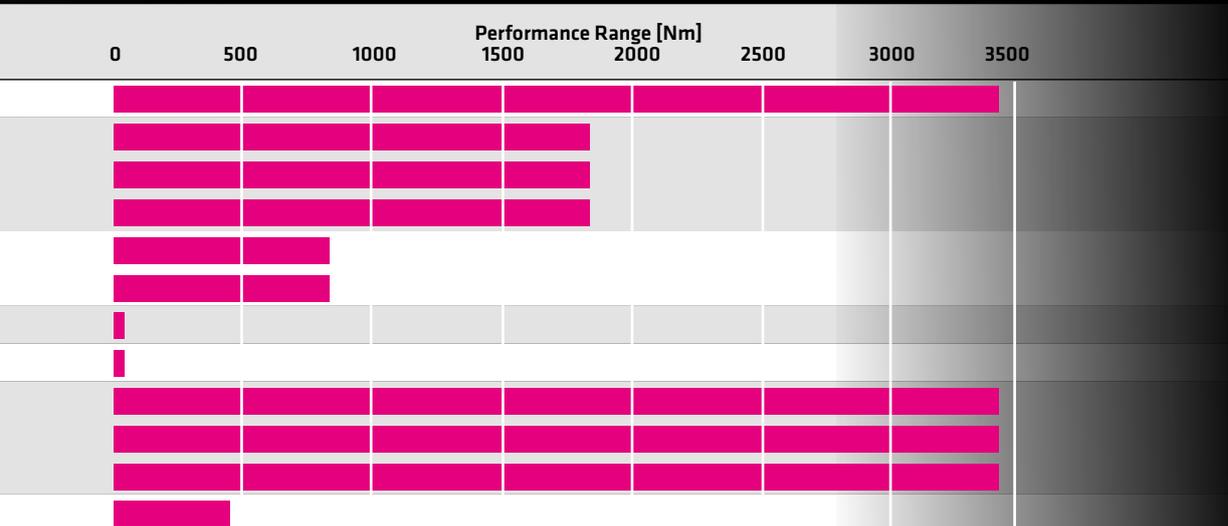


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SHD-2SH



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## Performance ranges

The following tables provide an overview of the performance ranges of the gears with output bearing and enable preselection of the series for your application.

### CSG-2UH



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Table 36.1

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	23	3419
Maximum input speed	$n_{in(max)}$ [rpm]	2800	8500
Average torque	$T_A$ [Nm]	9	2041
Transmission accuracy	[arcmin]	< 1	< 1.5
Ratio	$i$ [ ]	50	160
Dynamic radial load	$F_{R\ dyn(max)}$ [N]	1928	22602
Dynamic axial load	$F_{A\ dyn(max)}$ [N]	2878	29371
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	41	1860
Outer dimension	A [mm]	73	260
Length	L [mm]	41	115

### CPU-M/H/S



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Table 36.2

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	9	1840
Maximum input speed	$n_{in(max)}$ [rpm]	3000	8500
Average torque	$T_A$ [Nm]	6.8	1210
Transmission accuracy	[arcmin]	< 0.5	< 2
Ratio	$i$ [ ]	30	160
Dynamic radial load	$F_{R\ dyn(max)}$ [N]	1450	38400
Dynamic axial load	$F_{A\ dyn(max)}$ [N]	2880	37300
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	73	2222
Outer dimension	A [mm]	78	255
Length	L [mm]	32	150
Hollow shaft diameter <sup>1)</sup>	$d_H$ [mm]	14	70

<sup>1)</sup> Only CPU-H

### CSD-2UH/2UF



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Table 36.3

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	12	823
Maximum input speed	$n_{in(max)}$ [rpm]	3500	8500
Average torque	$T_A$ [Nm]	4.8	590
Transmission accuracy	[arcmin]	1	1.5
Ratio	$i$ [ ]	50	160
Dynamic radial load	$F_{R\ dyn(max)}$ [N]	674	6200
Dynamic axial load	$F_{A\ dyn(max)}$ [N]	1010	9260
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	41	849
Outer dimension	A [mm]	55	170
Length	L [mm]	22	62.5
Hollow shaft diameter <sup>1)</sup>	$d_H$ [mm]	9	37

<sup>1)</sup> Only 2UF

Table 37.1

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	0.13	28
Maximum input speed	$n_{in(max)}$ [rpm]	8500	10000
Average torque	$T_A$ [Nm]	0.1	11
Transmission accuracy	[arcmin]	< 1.5	< 10
Ratio	$i$ [ ]	30	100
Dynamic radial load	$F_{R dyn(max)}$ [N]	36	550
Dynamic axial load	$F_{A dyn(max)}$ [N]	130	1800
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	0.27	13.2
Outer dimension	A [mm]	13	53
Length	L [mm]	20.5	95.4

## CSF Mini



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Table 37.2

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	1.8	28
Maximum input speed	$n_{in(max)}$ [rpm]	8500	8500
Average torque	$T_A$ [Nm]	1.4	11
Transmission accuracy	[arcmin]	< 1	< 2
Ratio	$i$ [ ]	30	100
Dynamic radial load	$F_{R dyn(max)}$ [N]	1163	5357
Dynamic axial load	$F_{A dyn(max)}$ [N]	200	500
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	15	75
Outer dimension	A [mm]	50	75
Length	L [mm]	24.8	33.5

## CSF-2UP



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Table 37.3

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	23	3419
Maximum input speed	$n_{in(max)}$ [rpm]	2800	8500
Average torque	$T_A$ [Nm]	9	2041
Transmission accuracy	[arcmin]	< 1	< 1.5
Ratio	$i$ [ ]	50	160
Dynamic radial load	$F_{R dyn(max)}$ [N]	2039	40000
Dynamic axial load	$F_{A dyn(max)}$ [N]	3044	60000
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	74	2740
Outer dimension	A [mm]	70	284
Length	L [mm]	28.5	128
Hollow shaft diameter	$d_H$ [mm]	14	80

## SHG-2UH/2SO/2SH



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Table 37.4

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	12	453
Maximum input speed	$n_{in(max)}$ [rpm]	4000	8500
Average torque	$T_A$ [Nm]	4.8	316
Transmission accuracy	[arcmin]	< 1	< 1.5
Ratio	$i$ [ ]	50	160
Dynamic radial load	$F_{R dyn(max)}$ [N]	1022	7610
Dynamic axial load	$F_{A dyn(max)}$ [N]	1525	11359
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	37	424
Outer dimension	A [mm]	70	170
Length	L [mm]	17.5	33
Hollow shaft diameter	$d_H$ [mm]	11	40

## SHD-2SH



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# CSG-2UH

Gear with output bearing

## Motor mounted gear with highest torque capacity and service life

The CSG-2UH Series Gears consist of a precise CSG Gear Component Set and a tilt resistant output bearing. They are ideal for direct motor mounting and are characterised by maximum torque capacity and a long service life.

### Features

- Direct motor attachment possible
- Integrated tilt resistant output bearing
- Highest torque capacity and service life thanks to optimised gear component set
- Outstanding lifelong precision with zero backlash
- Large torque range



# CSG-2UH

Table 38.1

Torque capacity	Accuracy	Lifetime	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Direct motor attachment
•••	••	•••	••	••	•	••	-	•••

••• perfect •• optimal • good

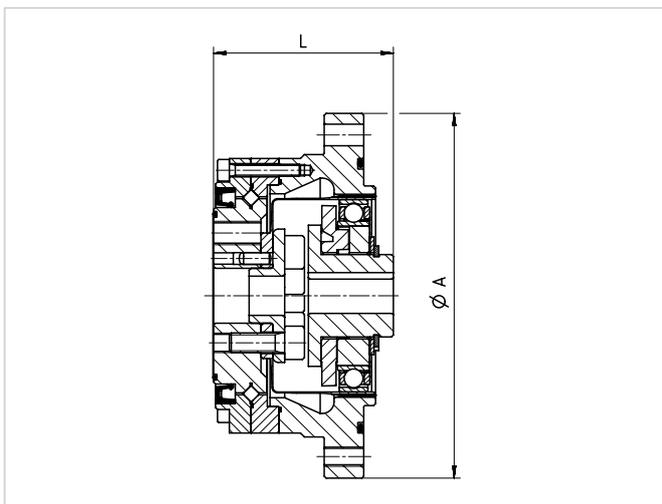
## Technical data

Table 39.1

Size	Ratio $i$ [ ]	Data gear			Data output bearing			Dimensions	
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Dynamic radial load $F_{R dyn(max)}$ [N]	Dynamic axial load $F_{A dyn(max)}$ [N]	Dynamic tilting moment $M_{dyn(max)}$ [Nm]	Outer dimension A [mm]	Length L [mm]
14	50	23	8500	9	1928	2878	41	73	41
	80	30		14					
	100	36		14					
17	50	44	7300	34	2148	3207	64	79	45
	80	56		35					
	100	70		51					
20	120	70	6500	51	2354	3511	91	93	45.5
	50	73		44					
	80	96		61					
25	100	107	5600	64	3904	5827	156	107	52
	120	113		64					
	160	120		64					
32	50	127	4800	72	6101	7926	313	138	62
	80	178		113					
	100	204		140					
40	120	217	4000	140	8652	11242	450	160	72.5
	160	229		140					
	50	281		140					
45	80	395	3800	217	9368	12174	686	180	79.5
	100	433		281					
	120	459		281					
50	160	484	3500	281	14155	18393	759	190	90
	50	523		255					
	80	675		369					
58	100	738	3000	484	21091	27409	1180	226	104.5
	120	802		586					
	160	841		586					
65	50	650	2800	345	22602	29371	1860	260	115
	80	918		507					
	100	982		650					
	120	1070		806					
	160	1147		819					
	80	1223		675					
	100	1274		866					
	120	1404		1057					
	160	1534		1096					
	80	1924		1001					
	100	2067		1378					
	120	2236		1547					
	160	2392		1573					
	80	2743		1352					
	100	2990		1976					
	120	3263		2041					
	160	3419		2041					

## Dimensions

Illustration 39.2



## Flexible gear configuration and reinforced output bearing

The CPU Series Gears consist of a precise HFUC Gear Component Set and a tilt resistant output bearing. They are available with hollow shaft, input shaft or for direct motor mounting.

### Features

- Three versions for different installation applications
- Highest transmission accuracy
- Integrated tilt resistant output bearing
- Optional corrosion protection
- Large torque range



CPU-M

Gear for direct motor mounting



CPU-H

Hollow shaft gear to feed through supply lines for further gear systems



CPU-S

with input shaft to drive with spur gear stage or belt stage

## CPU-M/H/S

Table 40.1

	Torque capacity	Accuracy	Lifetime	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Direct motor attachment
CPU-M	••	••••	••	••••	••	••	••	-	•••
CPU-H	••	••••	••	••••	•	•	••	•••	-
CPU-S	••	••••	••	••••	•	•	••	-	-

••• perfect •• optimal • good

## Technical data

Table 41.1

Size	Ratio i [ ]	Data gear			Data output bearing			Dimensions		
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Dynamic radial load $F_{R\ dyn(max)}$ [N]	Dynamic axial load $F_{A\ dyn(max)}$ [N]	Dynamic tilting moment $M_{dyn(max)}$ [Nm]	Outer dimension A [mm]	Length M / H / S L [mm]	Hollow shaft diameter (only H) $d_H$ [mm]
14	30	9	8500	6,8	1450	2880	73	78	32 / 46 / 55	14
	50	18		6,9						
	80	23		11						
	100	28		11						
17	30	16	7300	12	2300	4600	114	88	37 / 51.5 / 61.5	19
	50	34		26						
	80	43		27						
	100	54		39						
20	120	54	6500	39	8600	15800	172	98	41.5 / 55 / 73.5	21
	30	27		20						
	50	56		34						
	80	74		47						
25	100	82	5600	49	12700	19200	254	116	46 / 59 / 86.5	29
	120	87		49						
	160	92		49						
	30	50		38						
32	50	98	4800	55	14600	22300	578	148	56 / 79 / 100.5	36
	80	137		87						
	100	157		108						
	120	167		108						
40	160	176	4000	108	27500	42000	886	180	65.5 / 90 / 117.5	46
	30	100		75						
	50	216		108						
	80	304		167						
45	100	333	3800	216	34600	52300	1253	206	68 / 90.6 / 124	52
	120	353		216						
	160	372		216						
	50	402		196						
50	80	519	3500	284	37300	56100	1558	222	78.5 / 110.5 / 138.5	60
	100	568		372						
	120	617		451						
	160	647		451						
58	50	500	3000	265	38400	57700	2222	255	86.5 / 115.5 / 150	70
	80	706		390						
	100	755		500						
	120	823		620						
	160	882		630						
	50	715		175						
	80	941		519						
	100	980		666						
	120	1080		813						
	160	1180		843						
	50	1020		260						
	80	1480		770						
	100	1590		1060						
	120	1720		1190						
	160	1840		1210						

## Dimensions

Illustration 41.2

CPU-M

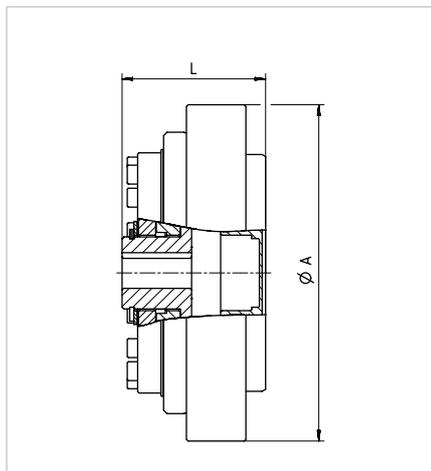


Illustration 41.3

CPU-H

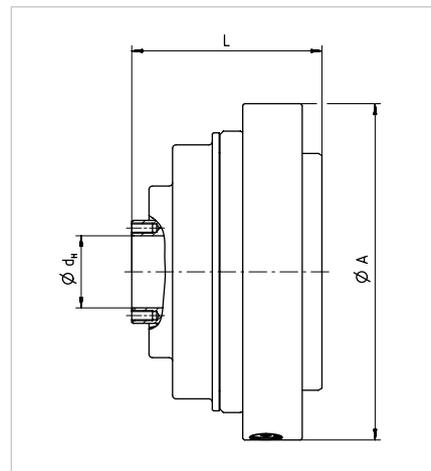
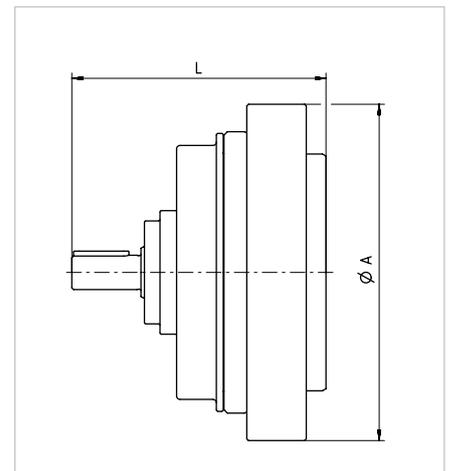


Illustration 41.4

CPU-S



## Compact and lightweight precision gear

The CSD-2UH/2UF Series Gears consist of a short mounting CSD Gear Component Set and a tilt resistant output bearing. They are characterised by a short design, lowest weight and excellent corrosion protection.

### Features

- Shortest construction
- Lowest weight
- Integrated tilt resistant output bearing
- Optional hollow shaft
- Direct motor attachment possible



**CSD-2UH**

Gear for direct motor mounting with small outer diameter



**CSD-2UF**

Short Hollow shaft gear with integrated output bearing with highest load capacity

# CSD-2UH/2UF

Table 42.1

	Torque capacity	Accuracy	Lifetime	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Direct motor attachment
CSD-2UH	•	••	•	•••	•••	•••	•••	-	••
CSD-2UF	•	••	•	•••	•••	•••	••	••	••

••• perfect •• optimal • good

## Technical data

Table 43.1

Size	Ratio $i [ ]$	Data gear			Data output bearing			Dimensions		
		Maximum torque $T_R [Nm]$	Maximum input speed $n_{in(max)} [rpm]$	Average torque $T_A [Nm]$	Dynamic radial load 2UH / 2UF $F_{R dyn(max)} [N]$	Dynamic axial load 2UH / 2UF $F_{A dyn(max)} [N]$	Dynamic tilting moment 2UH / 2UF $M_{dyn(max)} [Nm]$	Outer dimension 2UH / 2UF $A [mm]$	Length 2UH / 2UF $L [mm]$	Hollow shaft diameter (only 2UF) $d_H [mm]$
14	50	12	8500	4.8	674 / 828	1010 / 1240	41 / 91	55 / 70	25 / 22	9
	80	16		7.7						
	100	19		7.7						
17	50	23	7300	18	758 / 1490	1130 / 2220	64 / 124	62 / 80	26.5 / 22.7	9
	80	29		19						
	100	37		27						
	120	37		27						
20	50	39	6500	24	828 / 2090	1240 / 3120	91 / 187	70 / 90	29.7 / 26.8	18
	80	51		33						
	100	57		34						
	120	60		34						
	160	64		34						
25	50	69	5600	38	1380 / 3120	2050 / 4660	156 / 258	85 / 110	37.1 / 31.5	22
	80	96		60						
	100	110		75						
	120	117		75						
32	50	151	4800	75	2150 / 5470	3210 / 8170	313 / 580	112 / 142	43 / 37	29
	80	213		117						
	100	233		151						
	120	247		151						
	160	261		151						
40	50	281	4000	137	3050 / 6200	4560 / 9260	450 / 849	126 / 170	51.7 / 45	37
	80	364		198						
	100	398		260						
	120	432		315						
	160	453		316						
50 <sup>1)</sup>	50	500	3500	247	4990 / -	7440 / -	759 / -	157 / -	62.5 / -	-
	80	659		363						
	100	686		466						
	120	756		569						
	160	823		590						

<sup>1)</sup> Only version CSD-2UH

## Dimensions

Illustration 43.2

CSD-2UH

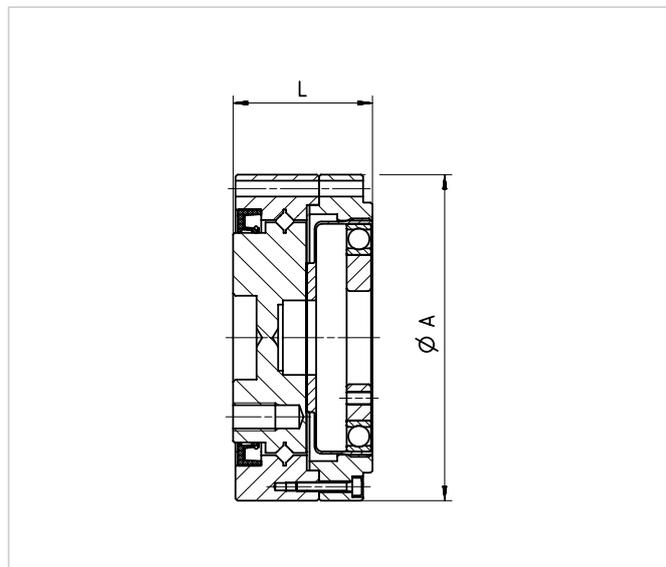
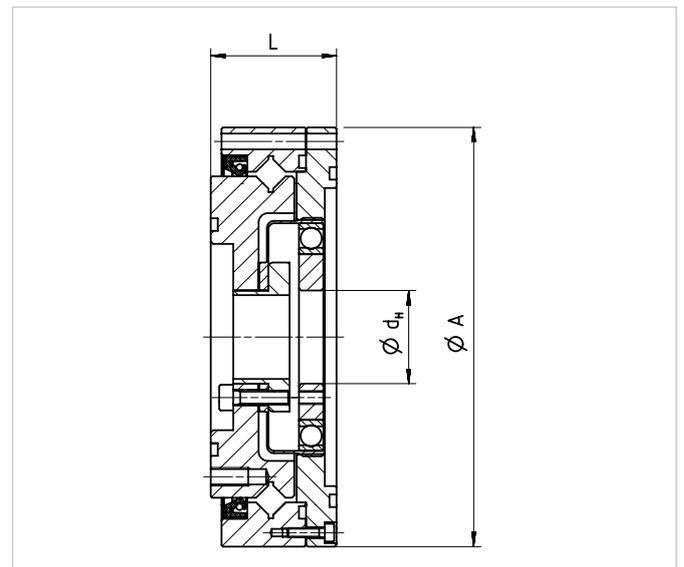


Illustration 43.3

CSD-2UF



# CSF Mini

Gear with output bearing

## Precision gear for low torque range

The CSF Mini Series Gears consist of an HFUC Gear Component Set and an output bearing. They are suitable for applications with low torques and are characterised by highest precision and the lowest weight.

### Features

- Six versions for different installation applications
- Lowest weight
- Integrated output bearing
- Direct motor attachment possible
- For precise applications in small torque ranges



# CSF Mini

Table 44.1

Torque capacity	Accuracy	Lifetime	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Direct motor attachment
••	••	••	•	•••	•	••	-	•••

••• perfect •• optimal • good

## Technical data

Table 45.1

Size	Ratio $i$ [ ]	Data gear			Data output bearing			Dimensions	
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Dynamic radial load $F_{R\ dyn(max)}$ [N]	Dynamic axial load $F_{A\ dyn(max)}$ [N]	Dynamic tilting moment $M_{dyn(max)}$ [Nm]	Outer dimension 1U / 1U-CC 2XH-J / 1U-F 1U-CC-F / 2XH-F A [mm]	Length 1U / 1U-CC 2XH-J / 1U-F 1U-CC-F / 2XH-F L [mm]
3	30	0.13	10000	0.1	36	130	0.27	13 / 13	27 / 20.5
	50	0.21		0.13				- / -	- / -
	100	0.3		0.23				- / -	- / -
5	30	0.5	10000	0.38	90	270	0.89	20.4 / 20.4	37 / 30.5
	50	0.9		0.53				22 / 20.4	27 / 27
	100	1.4		0.94				20.4 / 22	20.5 / 20.5
8	30	1.8	8500	1.4	200	630	3.46	30.7 / 30.7	65.5 / 51
	50	3.3		2.3				32 / 30.7	51 / 45.5
	100	4.8		3.3				30.7 / 32	31 / 31
11	30	4.5	8500	3.4	300	1150	6.6	40.9 / 40.9	82.5 / 64.3
	50	8.3		5.5				43 / 40.9	64.3 / 56.5
	100	11		8.9				40.9 / 43	38.3 / 38.3
14	30	9	8500	6.8	550	1800	13.2	51.1 / 51.1	95.4 / 70
	50	18		6.9				53 / 51.1	70 / 70.4
	80	23		11				51.1 / 53	45 / 45
	100	28		11					

## Dimensions

Illustration 45.2 CSF-1U-F

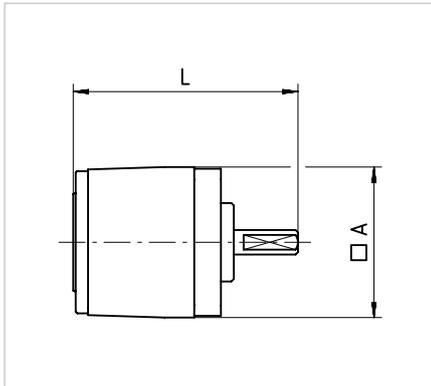


Illustration 45.3 CSF-1U-CC

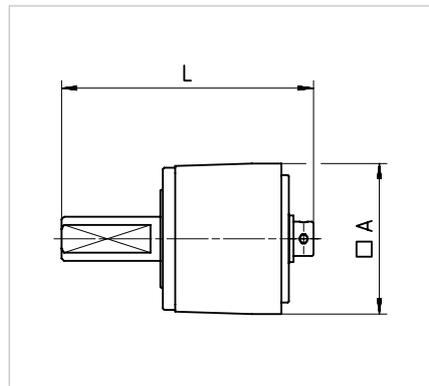


Illustration 45.4 CSF-1U

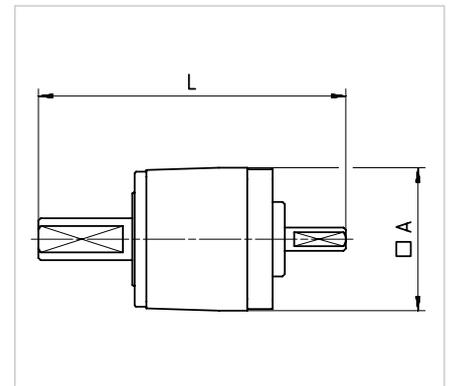


Illustration 45.5 CSF-1U-CC-F

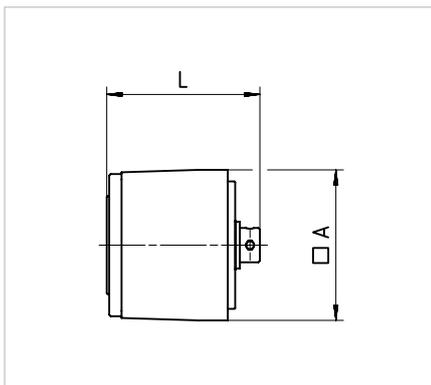


Illustration 45.6 CSF-2XH-J

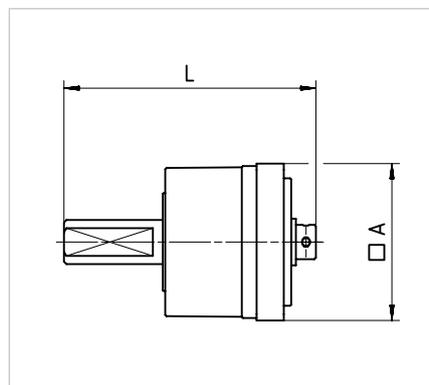
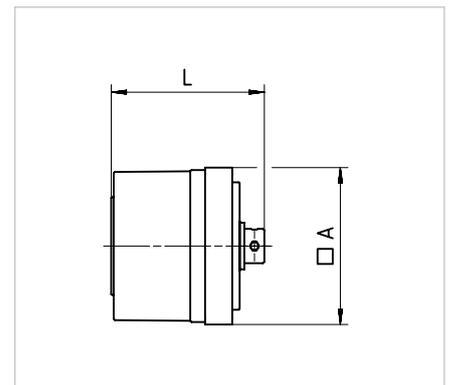


Illustration 45.7 CSF-2XH-F



# CSF-2UP

Gear with output bearing

## Short gear for direct motor mount with high capacity tilt resistant output bearing

The CSF-2UP Series Gears consist of an HFUC Gear Component Set and a tilt resistant output bearing. They are suitable for direct motor mounting in precision applications with low torque requirements.

### Features

- Integrated tilt resistant output bearing
- Direct motor attachment possible
- For precise applications in small torque ranges
- Short design



# CSF-2UP

Table 46.1

Torque capacity	Accuracy	Lifetime	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Direct motor attachment
••	••	••	•••	•	••	•	-	•••

••• perfect •• optimal • good

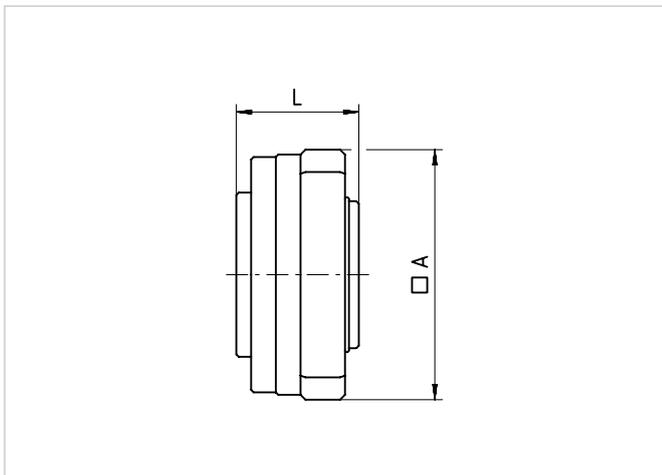
## Technical data

Table 471

Size	Ratio $i$ [ ]	Data gear			Data output bearing			Dimensions	
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Dynamic radial load $F_{R\ dyn(max)}$ [N]	Dynamic axial load $F_{A\ dyn(max)}$ [N]	Dynamic tilting moment $M_{dyn(max)}$ [Nm]	Outer dimension A [mm]	Length L [mm]
8	30	1.8	8500	1.4	1163	200	15	50	24.8
	50	3.3		2.3					
	100	4.8		3.3					
11	30	4.5	8500	3.4	2857	300	40	60	27
	50	8.3		5.5					
	100	11		8.9					
14	30	9	8500	6.8	5357	500	75	75	33.5
	50	18		6.9					
	100	28		11					

## Dimensions

Illustration 472



## The Robot gear

The SHG Series Gears consist of an SHG Gear Component Set and a tilt resistant output bearing. They are available in three versions for different installation situations and are characterised by a large hollow shaft, maximum torque capacity and service life. They are, therefore, ideal for robotics applications.

### Features

- Large hollow shaft for the passage of supply cables or shafts
- Highest torque capacity with low weight
- Long lifetime
- Integrated tilt resistant output bearing
- Large torque range



**SHG-2UH**

Hollow shaft gear to feed through supply lines for further gear systems



**SHG-2SO**

Gear for direct motor mounting



**SHG-2SH**

Hollow shaft gear without input bearing and input and output flange for integration into existing housing structure

# SHG-2UH/2SO/2SH

Table 48.1

	Torque capacity	Accuracy	Lifetime	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Direct motor attachment
SHG-2UH	●●●	●●	●●●●	●●●●	●	●	●●	●●●	-
SHG-2SO	●●●	●●	●●●●	●●●●	●●	●●	●●	-	●●
SHG-2SH	●●●	●●	●●●●	●●●●	●●	●●	●●	●●●	-

●●● perfect ●● optimal ● good

## Technical data

Table 49.1

Size	Ratio $i [ ]$	Data gear			Data output bearing			Dimensions		
		Maximum torque $T_R [Nm]$	Maximum input speed $n_{in(max)} [rpm]$	Average torque $T_A [Nm]$	Dynamic radial load $F_{R dyn(max)} [N]$	Dynamic axial load $F_{A dyn(max)} [N]$	Dynamic tilting moment $M_{dyn(max)} [Nm]$	Outer dimension 2UH / 250 / 2SH $A [mm]$	Length 2UH / 250 / 2SH $L [mm]$	Hollow shaft diameter (only 2UH, 2SH) $d_H [mm]$
14	50	23	8500	9	2039	3044	74	74 / 70 / 70	52.5 / 28.5 / 36.5	14
	80	30		14						
	100	36		14						
17	50	44	7300	34	3664	5468	124	84 / 80 / 80	56.5 / 32.5 / 40.5	19
	80	56		35						
	100	70		51						
20	120	70	6500	51	5150	7687	187	95 / 90 / 90	51.5 / 33.5 / 42	21
	50	73		44						
	80	96		61						
	100	107		64						
	120	113		64						
	160	120		64						
25	50	127	5600	72	7708	11504	258	115 / 110 / 110	55.5 / 37 / 45.5	29
	80	178		113						
	100	204		140						
	120	217		140						
32	160	229	4800	140	13480	20119	580	147 / 142 / 142	65.5 / 44 / 53.5	36
	50	281		140						
	80	395		217						
	100	433		281						
40	120	459	4000	281	15243	22750	849	175 / 170 / 170	79 / 53 / 66	46
	160	484		281						
	50	523		255						
	80	675		369						
	100	738		484						
45	120	802	3800	586	27375	40858	1127	195 / 190 / 190	85 / 58 / 71.5	52
	160	841		586						
	50	650		345						
	80	918		507						
50	100	982	3500	650	28792	42973	1487	220 / 214 / 214	93 / 64 / 78	60
	120	1070		806						
	160	1147		819						
	80	1223		675						
58	100	1274	3000	866	30831	46017	2180	246 / 240 / 240	106 / 75.5 / 90	70
	120	1404		1057						
	160	1534		1096						
	80	1924		1001						
65	100	2067	2800	1378	40000	60000	2740	284 / 276 / 276	128 / 83 / 107	80
	120	2236		1547						
	160	2392		1573						
	80	2743		1352						
	100	2990		1976						
	120	3263		2041						
	160	3419		2041						

## Dimensions

Illustration 49.2

SHG-2UH

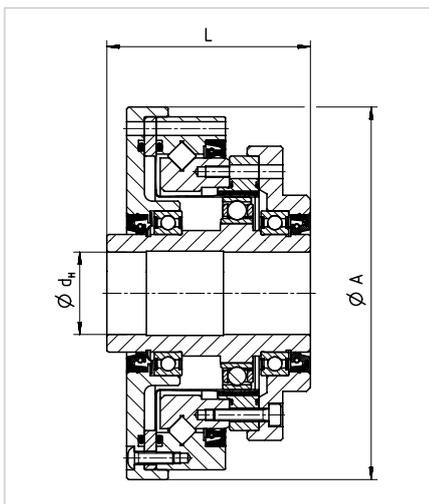


Illustration 49.3

SHG-250

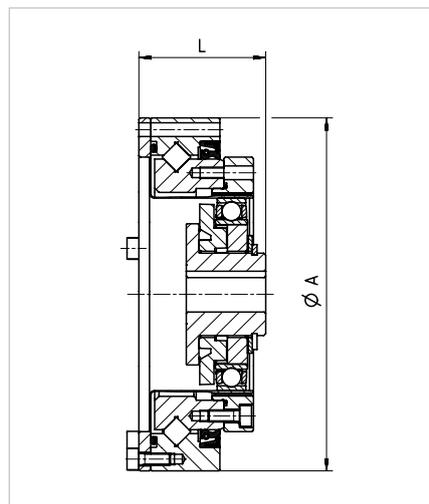
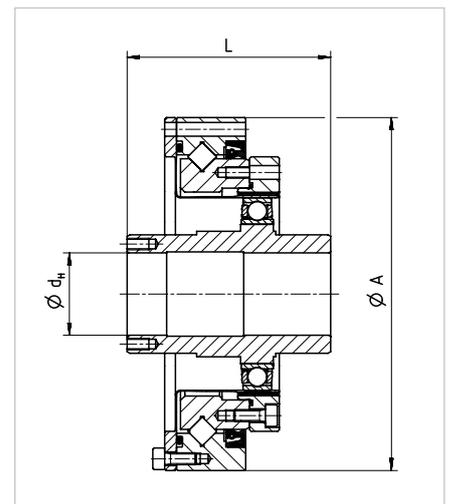


Illustration 49.4

SHG-2SH



# SHD-2SH

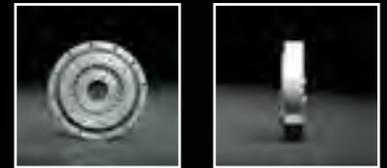
Gear with output bearing

## Light and short hollow shaft gear

The SHD-2SH Series Gears consist of a short mounting SHD Gear Component Set and a tilt resistant output bearing. Extremely short construction and lightweight, they are ideal for installations with small space or mobile applications.

### Features

- Short design
- Low weight
- Hollow shaft for the passage of supply cables or shafts
- Direct motor attachment possible
- Integrated tilt resistant output bearing



# SHD-2SH

Table 50.1

Torque capacity	Accuracy	Lifetime	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Direct motor attachment
•	••	•	••	•••	•••	••	••	••

••• perfect •• optimal • good

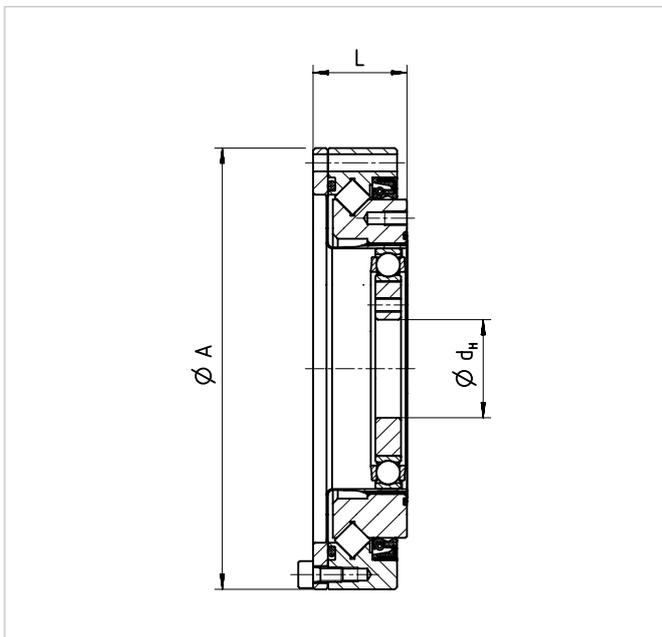
## Technical data

Table 51.1

Size	Ratio i [ ]	Data gear			Data output bearing			Dimensions		
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Dynamic radial load $F_{R\ dyn(max)}$ [N]	Dynamic axial load $F_{A\ dyn(max)}$ [N]	Dynamic tilting moment $M_{dyn(max)}$ [Nm]	Outer measure A [mm]	Length L [mm]	Hollow shaft diameter $d_H$ [mm]
14	50	12	8500	4.8	1022	1525	37	70	17.5	11
	80	16		7.7						
	100	19		7.7						
17	50	23	7300	18	1832	2735	62	80	18.5	15
	80	29		19						
	100	37		27						
	120	37		27						
20	50	39	6500	24	2572	3839	93	90	19	20
	80	51		33						
	100	57		34						
	120	60		34						
25	50	69	5600	38	3840	5732	129	110	22	24
	80	96		60						
	100	110		75						
	120	117		75						
32	50	151	4800	75	6730	10044	290	142	27.9	32
	80	213		117						
	100	233		151						
	120	247		151						
40	50	281	4000	137	7610	11359	424	170	33	40
	80	364		198						
	100	398		260						
	120	432		315						
	160	453		316						

## Dimensions

Illustration 51.2



Harmonic  
Planetary Gears





Harmonic  
Drive AG

# Harmonic Planetary Gears

Harmonic Planetary Gears have lower gear ratios usually operating higher speeds where there is often the need for very high precision. Our special design with a flexible ring gear in the output stage means that we guarantee constant high precision over the entire lifetime.

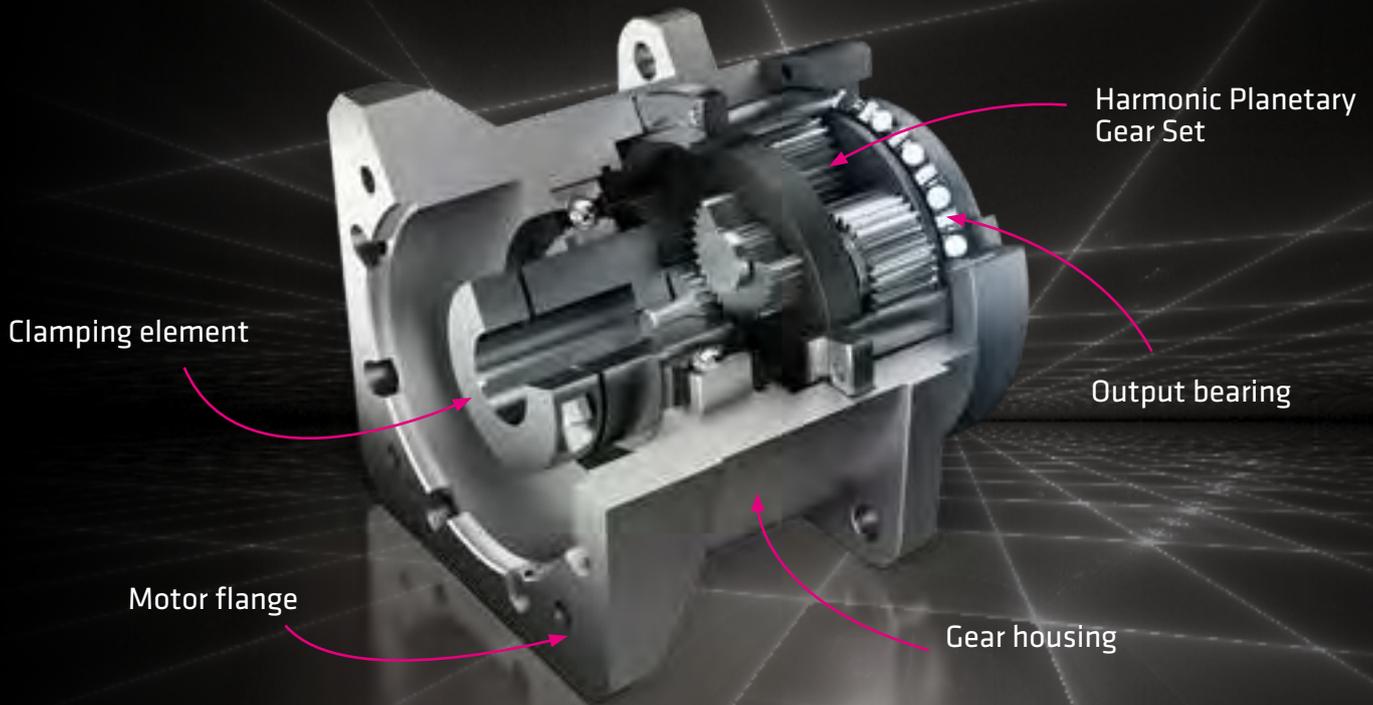


# Harmonic Planetary Gears

Requirements of the market for gears that support high speeds or low ratios often require the highest precision. Harmonic Planetary Gears meet this requirement. Due to their integrated motor connection with clamping element and motor flange, they allow easy mounting of servo motors. The special design with a flexible ring gear in the last stage ensures consistently high precision over the entire service life - we call this Permanent Precision®.

HPGP and HPG-R Series Planetary Gears offer high accuracy and low backlash (standard 3 arcmin; optional 1 arcmin) with maximum flexibility. Many special designs and individual adaptations are possible to suit customer specific applications, including food grade options in addition to the variants for integration to standard servo motors.

HPN Series Planetary Gears serve as an introduction to the world of Harmonic Drive® precision. These are ideally suited for applications where precision and economy are required. In addition, standard servo motors from all leading manufacturers can be easily and cost effectively adapted to the gears.



	Torque capacity	Accuracy	Lifetime	Load capacity output bearing	Low weight	Low weight	Small outer diameter	Good price
HPN	●●●	●	●●	●●●	●●	●	●●	●●●
HPGP	●●	●●	●●●	●●	●●	●●●	●●	●●
HPG-R	●●	●●	●●●	●●	●●	●●●	●●	●●

●●● perfect ●● optimal ● good

# Harmonic Planetary Gears

HPN



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HPGP

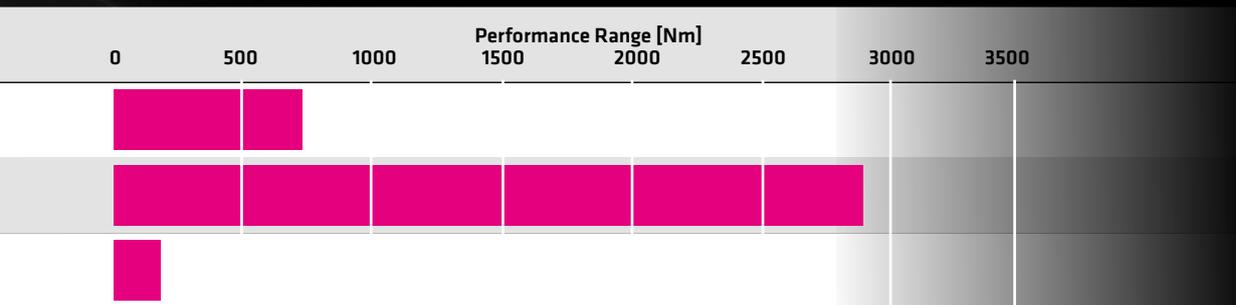
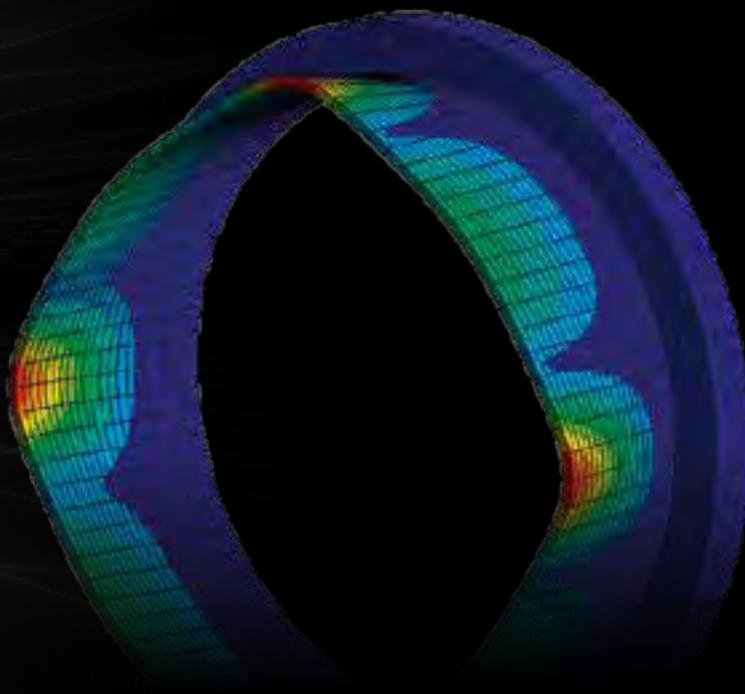


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HPG-R



Page 62



## Performance ranges

The following tables provide an overview of the performance ranges of the planetary gears and enable preselection of the series for your application.

### HPN



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Table 56.1

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	9	752
Maximum input speed	$n_{in(max)}$ [rpm]	6000	10000
Rated torque	$T_N$ [Nm]	9	700
Transmission accuracy	[arcmin]	< 10	< 5
Ratio	$i$ [ ]	3	50
Dynamic radial load	$F_{R,dyn(max)}$ [N]	480	5500
Dynamic axial load	$F_{A,dyn(max)}$ [N]	640	5400
Outer dimension	A [mm]	42	142
Length	L [mm]	86	348

### HPGP



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Table 56.2

	Symbol [Unit]	from	to
Maximum torque	$T_R$ [Nm]	10	2920
Maximum input speed	$n_{in(max)}$ [rpm]	2500	10000
Average torque	$T_A$ [Nm]	6.7	2000
Transmission accuracy	[arcmin]	< 3	< 5
Ratio	$i$ [ ]	4	45
Dynamic radial load	$F_{R,dyn(max)}$ [N]	280	15300
Dynamic axial load	$F_{A,dyn(max)}$ [N]	430	22900
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	9.5	3900
Outer dimension	A [mm]	40	230
Length	L [mm]	82	455

## HPG-R

Table 57.1

	<b>Symbol [Unit]</b>	<b>from</b>	<b>to</b>
Maximum torque	$T_R$ [Nm]	5	400
Maximum input speed	$n_{in(max)}$ [rpm]	3600	10000
Average torque	$T_A$ [Nm]	5	200
Transmission accuracy	[arcmin]	4	< 5
Ratio	$i$ [ ]	3	10
Dynamic radial load	$F_{R\ dyn(max)}$ [N]	260	2340
Dynamic axial load	$F_{A\ dyn(max)}$ [N]	400	3380
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	9.5	452
Outer dimension	A [mm]	40	120
Length	L [mm]	82	243



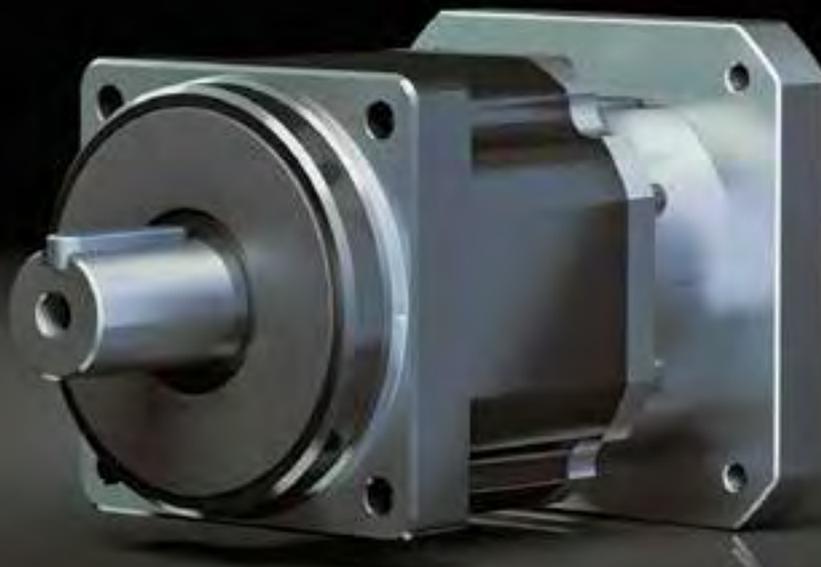
Page 62

# The introduction to Harmonic Drive® precision

The HPN Series Planetary Gears offer a cost effective solution without compromising on quality and performance. The helical gearing provides high torque, low noise and long life.

## Features

- Low noise due to optimised toothing
- High torque capacity
- Integrated, tilt resistant output bearing
- Direct motor attachment possible
- Optimal price to performance ratio



HPN

Table 58.1

Torque capacity	Accuracy	Lifetime	Load capacity output bearing	Low weight	Short design	Small outer diameter	Good price
•••	•	••	•••	••	•	••	•••

••• perfect •• optimal • good

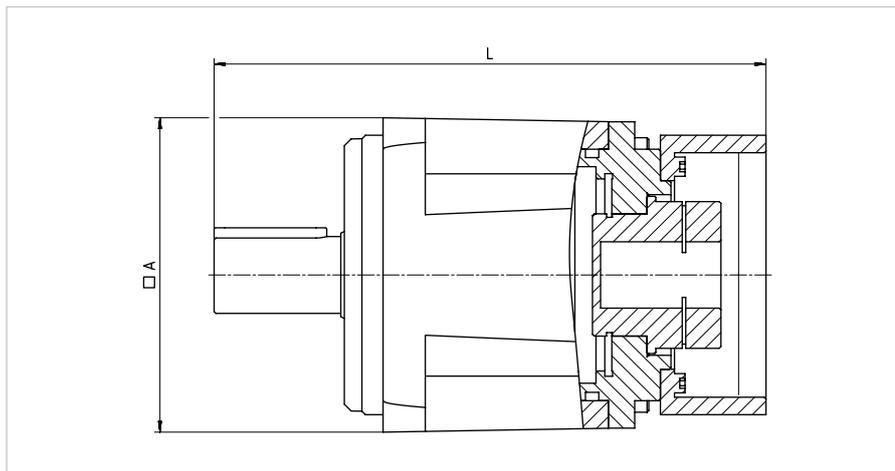
Table 59.1

Size	Ratio $i$ [ ]	Data gear			Data output bearing		Dimensions		
		Maximum torque	Maximum input speed	Rated torque	Dynamic radial load	Dynamic radial load	Outer dimension A [mm]	Length	
		$T_R$ [Nm]	$n_{in(max)}$ [rpm]	$T_N$ [Nm]	$F_{R\ dyn(max)}$ [N]	$F_{A\ dyn(max)}$ [N]		min. L [mm]	max. L [mm]
11	4	14	10000	14	480	640	42	86	
	5	16		14					
	7	11		11					
	10	9		9					
	15	24		18					
	20	24		22					
	25	24		20					
	30	26		25					
	35	26		26					
	40	26		26					
45	26	26							
50	26	26	106						
3	25	22							
14	4	50	6000	28	840	900	60	107	112
	5	50		29					
	7	37		30					
	10	18		18					
	15	43		30					
	20	49		30					
	25	38		30					
	30	48		40					
	35	49		40					
	40	38		30					
45	38	30							
50	26	26	132						
3	74	51							
20	4	130	6000	80	1800	2200	90	152	170
	5	149		80					
	7	113		80					
	10	54		54					
	15	129		80					
	20	147		80					
	25	114		80					
	30	139		80					
	35	112		80					
	40	112		80					
45	112	80							
50	75	75	174						
3	254	153							
32	4	376	6000	198	3900	3800	115	195	234
	5	376		200					
	7	376		200					
	10	185		185					
	15	376		200					
	20	376		200					
	25	376		200					
	30	376		250					
	35	376		250					
	40	376		300					
45	376	300							
50	251	251	232						
3	752	440							
40	4	752	6000	460	5500	5400	142	296	329
	5	752		480					
	7	752		510					
	10	509		480					
	15	752		530					
	20	752		600					
	25	752		650					
	30	752		650					
	35	752		700					
	40	752		700					
45	752	700							
50	562	562	310						
3	752	440							

Harmonic Planetary Gears

Dimensions

Illustration 59.2

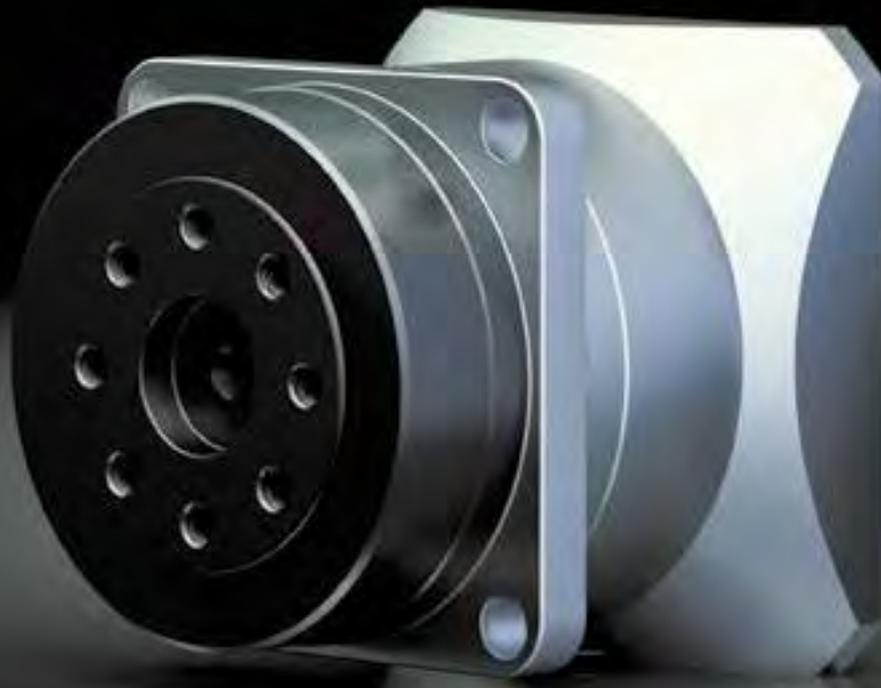
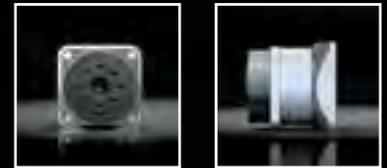


# Performance enhanced precision gear for high dynamics

The HPGP Series Planetary Gears consist of a planetary gear set with flexible ring gear in a compact construction, with tilt resistant output bearing. They are ideal for applications that require high accuracy and maximum dynamics.

## Features

- Permanent Precision® for lifetime accuracy
- High torque capacity
- High dynamics due to low moment of inertia
- Direct motor attachment possible
- Integrated, tilt stable output bearing



# HPGP

Table 60.1

Torque capacity	Accuracy	Lifetime	Load capacity output bearing	Low weight	Short design	Small outer diameter	Good price
••	••	•••	••	••	•••	••	••

••• perfect •• optimal • good

## Technical data

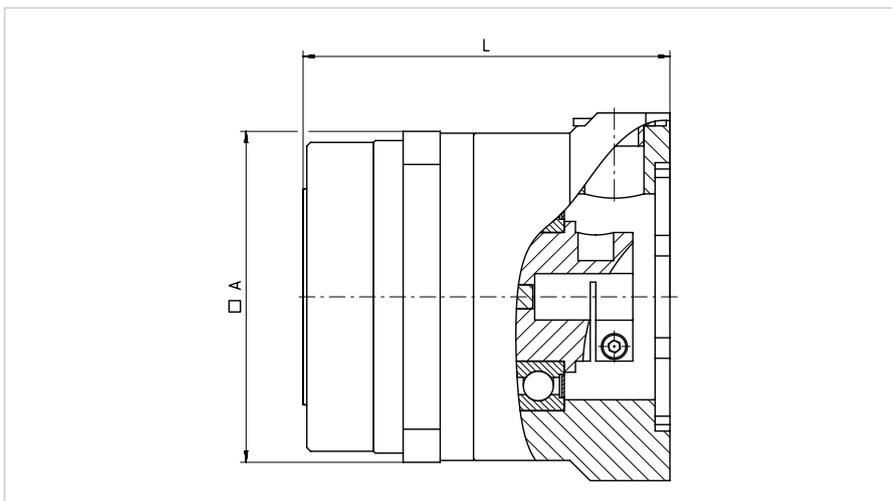
Table 61.1

Size	Ratio $i$ [ ]	Data gear			Data output bearing			Dimensions			
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Dynamic radial load $F_{R dyn(max)}$ [N]	Dynamic axial load $F_{A dyn(max)}$ [N]	Dynamic tilting moment $M_{dyn(max)}$ [Nm]	Outer dimension $A$ [mm]	Length		
									min $L$ [mm]	max $L$ [mm]	
11	5	10	10000	6.7	280	430	9.5	40	55	65	
	21	13		8	440	660			60	70	
	37	13		8	520	780			80	95	
	45	13		8	550	830			85	95	
14	5	30	6000	17	470	700	32.3	60	80	95	
	11	30		20	600	890			85	95	
	15	30		20	650	980			90	105	
	21	30		20	720	1080			95	105	
20	33	30	6000	20	830	1240	183	90	90	105	
	45	30		20	910	1360			95	105	
	5	133		47	980	1460			135	145	
	11	133		60	1240	1850			135	150	
32	15	133	6000	70	1360	2030	452	120	135	150	
	21	133		73	1510	2250			180	200	
	33	133		80	1729	2580			180	200	
	45	133		80	1890	2830			200	220	
50	5	400	4500	200	1900	2830	1076	170	200	220	
	11	400		226	2410	3590			270	290	
	15	400		226	2640	3940			270	290	
	21	400		226	2920	4360			270	290	
65	33	400	2500	266	3340	4990	3900	230	270	290	
	45	400		266	3670	5480			270	290	
	4	2920		1200	8860	13200			270	290	
	5	2920		1330	9470	14100			270	290	
65	12	2920	3000	1460	12300	18300	3900	230	270	290	
	15	2920		1730	13100	19600			270	290	
	20	2920		2000	14300	21400			270	290	
	25	2920		2000	15300	22900			270	290	

Harmonic Planetary Gears

## Dimensions

Illustration 61.2

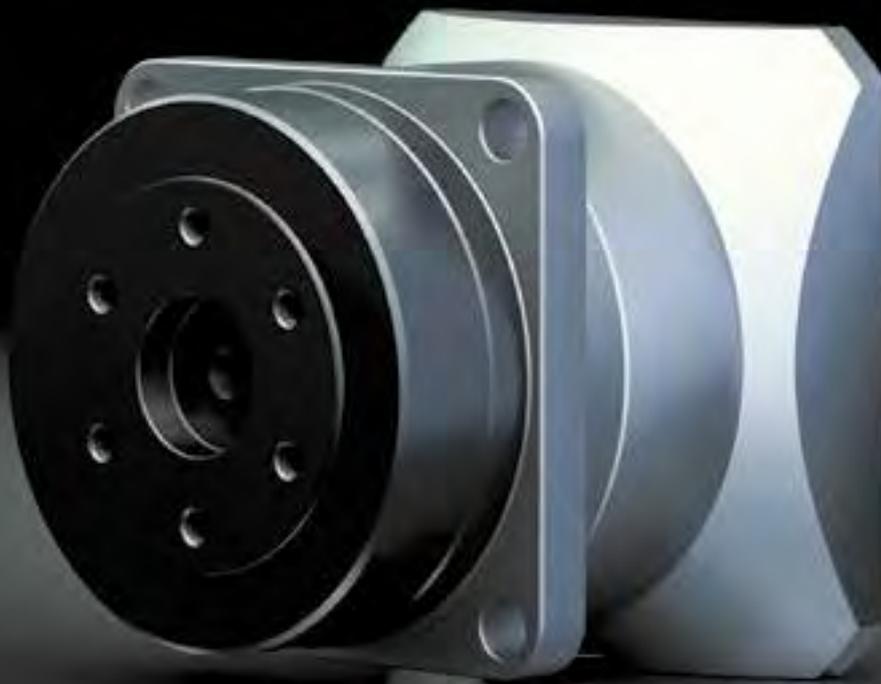
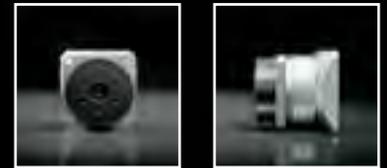


## Precision gear with new helical toothing

The HPG-R Series Planetary Gears consist of a planetary gear set with helical toothing in a compact construction, with tilt resistant output bearing. The newly developed gearing gives quiet operation in combination with higher torque capacity.

### Features

- Permanent Precision® for lifetime accuracy
- Low noise due to optimised toothing
- Large number of reduction ratios enables optimal machine design
- Direct motor attachment possible
- Integrated, tilt stable output bearing



# HPG-R

Table 62.1

Torque capacity	Accuracy	Lifetime	Load capacity output bearing	Low weight	Short design	Small outer diameter	Good price
••	••	•••	••	••	•••	••	••

••• perfect •• optimal • good

## Technical data

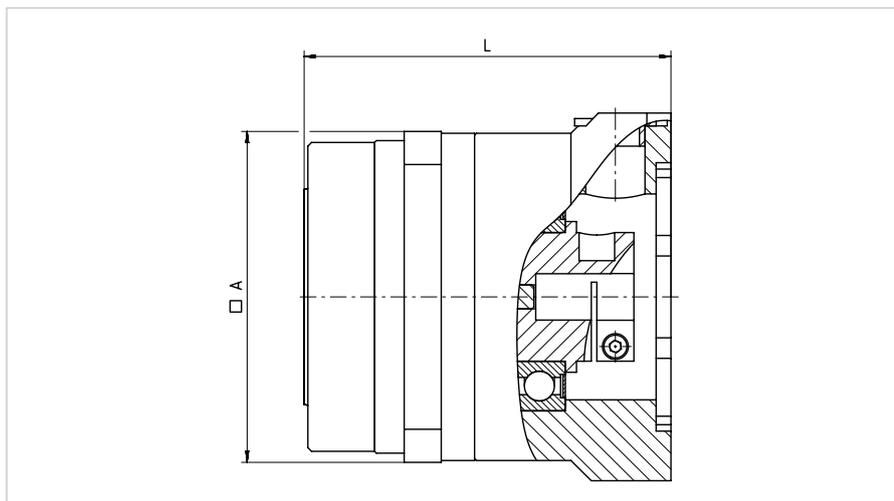
Table 63.1

Size	Ratio i [ ]	Data gear			Data output bearing			Dimensions		
		Maximum torque $T_R$ [Nm]	Maximum input speed $n_{in(max)}$ [rpm]	Average torque $T_A$ [Nm]	Dynamic radial load $F_{R\ dyn(max)}$ [N]	Dynamic axial load $F_{A\ dyn(max)}$ [N]	Dynamic tilting moment $M_{dyn(max)}$ [Nm]	Outer dimension A [mm]	Length L [mm]	
								min	max	
11	4	10	10000	6.3	260	400	9.5	40	55	65
	5	10		6.5	280	430				
	6	10		6.5	300	455				
	7	9		7	315	475				
	8	7		7	330	495				
	9	6		6	340	510				
	10	5		5	350	525				
14	3	20	5000	9	405	600	32.3	60	80	95
	4	30	6000	16	440	655				
	5	30		16	470	700				
	6	30		16	500	740				
	7	26		18	525	775				
	8	20		18	545	810				
	9	17		17	565	840				
10	15	15		580	865					
20	3	90	4000	25	840	1250	183	90	90	105
	4	133	6000	51	920	1350				
	5	133		53	980	1410				
	6	126		53	1050	1520				
	7	108		56	1100	1600				
	8	84		56	1140	1650				
	9	73		57	1180	1730				
10	65	61		1200	1800					
32	3	290	3600	110	1630	2430	452	120	135	145
	4	400	6000	170	1780	2650				
	5	400		180	1900	2830				
	6	390		180	2000	3000				
	7	330		190	2100	3130				
	8	260		190	2200	3260				
	9	220		190	2270	3380				
10	200	200		2340	3480					

Harmonic Planetary Gears

## Dimensions

Illustration 63.2







Harmonic  
Drive AG

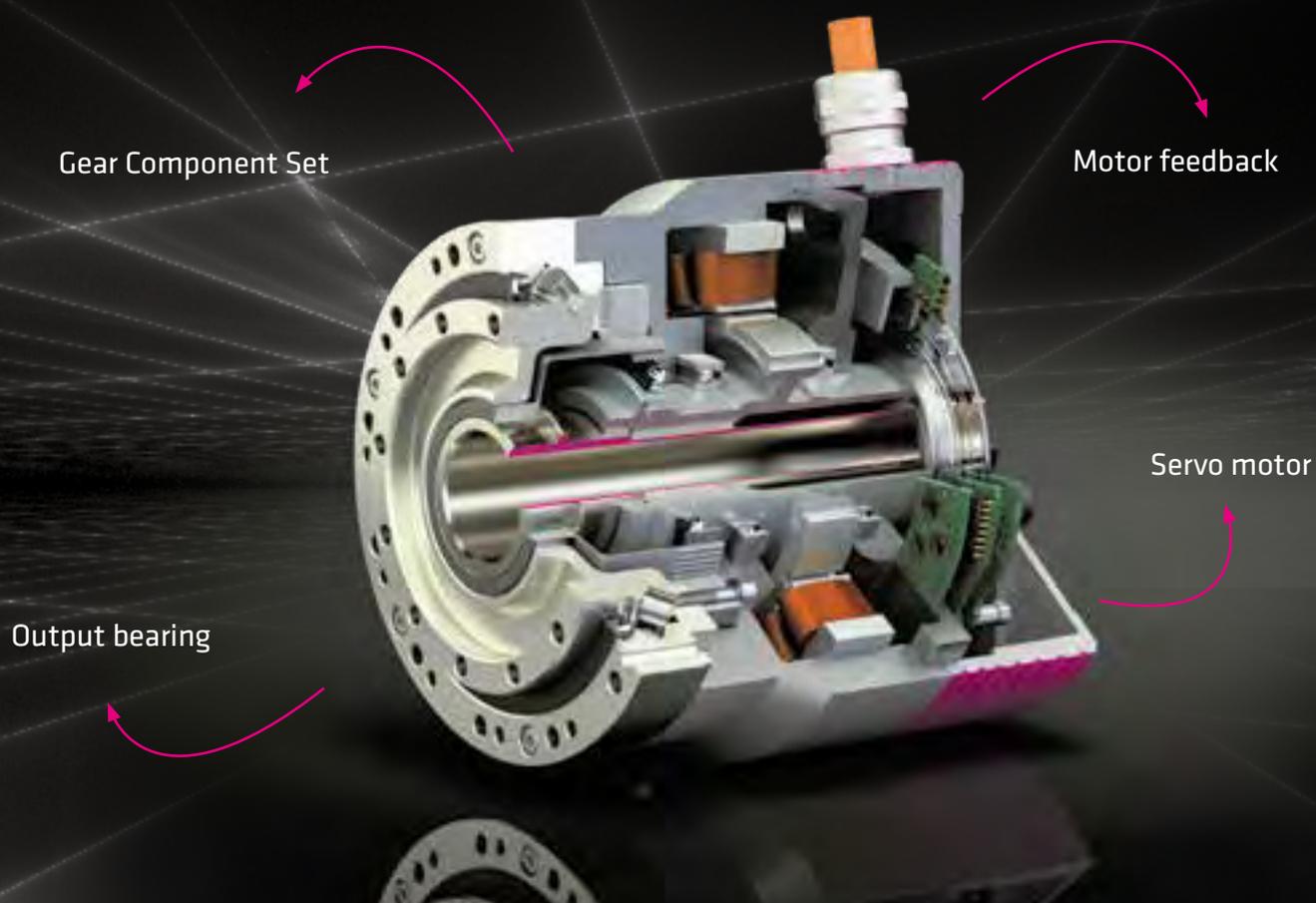
# Harmonic Drive® Servo Products

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

The continuously increasing demands placed on servo drives require, among other things, perfect interaction between the motor, gears, motor feedback system and controller. To guarantee characteristics such as precision and dynamics, servo actuators from Harmonic Drive AG have a high degree of compatibility.

The option to choose between a zero backlash strain wave gear and a low backlash planetary gear. The tilt resistant output bearing enables the direct attachment of high payloads without additional support and thus permits a simple and space saving design.

In addition, there are different options for the motor winding and feedback system, as well as choice for a brake, connectors and connecting cable providing numerous combinations. Due to the flexibility in the configuration, the servo actuators are compatible with almost all servo controllers on the market.



	Torque capacity	Accuracy	Dynamic	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Temperature range	Variable feedback systems
CanisDrive®	●●●	●●●	●	●●●	●	●●	●●	●●●	●●	●●●
AlopexDrive®	●●	●●●	●	●●●	●	●●	●●	●●●	●●●	●●●
FHA-C Mini FHA-C Mini-MZE	●● ●●	●●● ●●●	●● ●●	●●● ●●●	●● ●●	●●● ●●	● ●	●●● -	● ●	● ●
LynxDrive®	●●	●●●	●●	●●	●	●●	●●●	-	●●	●●●
BDA	●●	●●	●●●	●●	●●	●	●●●	-	●●	●●
FLA	●	●	●●●	●	●●●	●●●	●	-	●	●
RSF Mini	●●	●●	●●●	●	●●●	●	●●●	-	●	●

●●● perfect ●● optimal ● good

# Harmonic Drive® Servo Products

CanisDrive®



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AlopexDrive®



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FHA-C Mini



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LynxDrive®



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BDA



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FLA

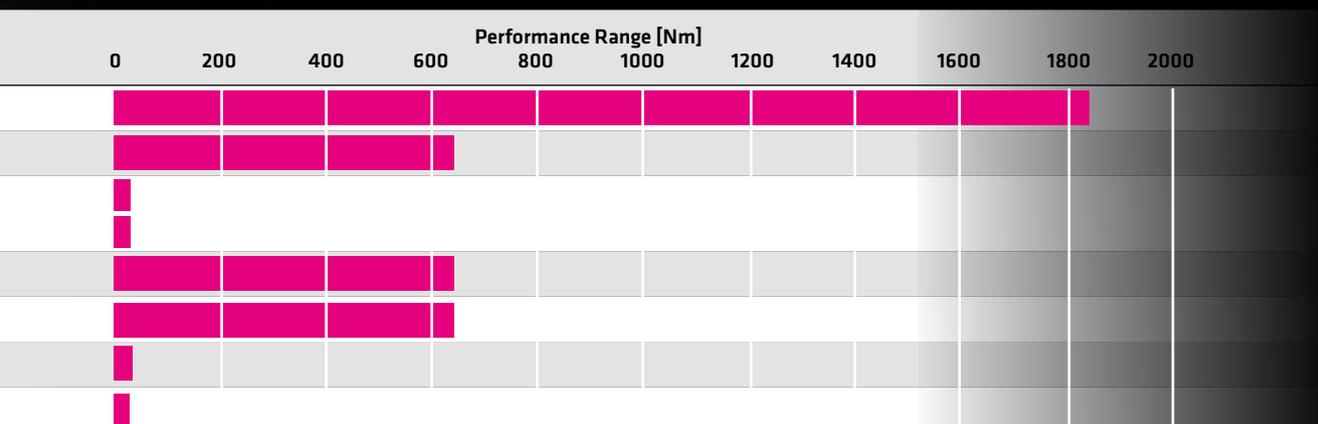


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RSF Mini



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## Performance ranges

The following tables provide an overview of the performance ranges of the servo products and enable preselection of the series for your application.

### CanisDrive®



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Table 68.1

	Symbol [Unit]	from	to
Maximum torque	$T_{max}$ [Nm]	23	1840
Maximum output speed	$n_{max}$ [rpm]	19	170
Continuous stall torque	$T_0$ [Nm]	9	1210
Transmission accuracy	[arcmin]	< 0.5	< 1.5
Ratio	$i$ [ ]	50	160
Dynamic radial load	$F_{R\ dyn. (max)}$ [N]	1450	38400
Dynamic axial load	$F_{A\ dyn. (max)}$ [N]	2880	57700
Dynamic tilting moment	$M_{dyn. (max)}$ [Nm]	73	2222
Outer dimension	A [mm]	81	255
Length	L [mm]	97.5	208
Hollow shaft diameter	$d_h$ [mm]	12	65.5

### AlopexDrive®



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Table 68.2

	Symbol [Unit]	from	to
Maximum torque	$T_{max}$ [Nm]	9	647
Maximum output speed	$n_{max}$ [rpm]	25	283
Continuous stall torque	$T_0$ [Nm]	6.8	420
Transmission accuracy	[arcmin]	< 0.5	< 1.5
Ratio	$i$ [ ]	30	160
Dynamic radial load	$F_{R\ dyn. (max)}$ [N]	1450	27500
Dynamic axial load	$F_{A\ dyn. (max)}$ [N]	2880	42000
Dynamic tilting moment	$M_{dyn. (max)}$ [Nm]	73	886
Outer dimension	A [mm]	81	180
Length	L [mm]	97.5	158
Hollow shaft diameter	$d_h$ [mm]	12	39

### FHA-C Mini



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Table 68.3

	Symbol [Unit]	from	to
Maximum torque	$T_{max}$ [Nm]	1.8	28
Maximum output speed	$n_{max}$ [rpm]	60	200
Continuous stall torque	$T_0$ [Nm]	0.75	6.8
Transmission accuracy	[arcmin]	< 1.5	< 2.5
Ratio	$i$ [ ]	30	100
Dynamic radial load	$F_{R\ dyn. (max)}$ [N]	1163	5357
Dynamic axial load	$F_{A\ dyn. (max)}$ [N]	200	500
Dynamic tilting moment	$M_{dyn. (max)}$ [Nm]	15	75
Outer dimension	A [mm]	50	75
Length	L [mm]	48.5	66
Hollow shaft diameter <sup>1)</sup>	$d_h$ [mm]	6.2	13.5

<sup>1)</sup> FHA-C Mini-MZE without hollow shaft



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BDA



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FLA



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RSF Mini



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Table 69.1

	Symbol [Unit]	from	to
Maximum torque	$T_{max}$ [Nm]	9	1180
Maximum output speed	$n_{max}$ [rpm]	22	283
Continuous stall torque	$T_0$ [Nm]	6.8	850
Transmission accuracy	[arcmin]	< 1	< 2
Ratio	$i$ [ ]	30	160
Dynamic radial load	$F_{R\ dyn(max)}$ [N]	1928	14155
Dynamic axial load	$F_{A\ dyn(max)}$ [N]	2878	18393
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	41	759
Outer dimension	A [mm]	73	190
Length	L [mm]	126	249

Table 69.2

	Symbol [Unit]	from	to
Maximum torque	$T_{max}$ [Nm]	9.8	647
Maximum output speed	$n_{max}$ [rpm]	25	381
Continuous stall torque	$T_0$ [Nm]	6	451
Transmission accuracy	[arcmin]	< 1.5	< 5
Ratio	$i$ [ ]	21	160
Dynamic radial load	$F_{R\ dyn(max)}$ [N]	440	8652
Dynamic axial load	$F_{A\ dyn(max)}$ [N]	660	11242
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	9.5	450
Outer dimension	A [mm]	40	160
Length	L [mm]	161	338

Table 69.3

	Symbol [Unit]	from	to
Maximum torque	$T_{max}$ [Nm]	1.8	34
Maximum output speed	$n_{max}$ [rpm]	50	500
Continuous stall torque	$T_0$ [Nm]	0.6	13
Transmission accuracy	[arcmin]	-	-
Ratio	$i$ [ ]	8	100
Dynamic radial load	$F_{R\ dyn(max)}$ [N]	-	-
Dynamic axial load	$F_{A\ dyn(max)}$ [N]	29	318
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	1.2	2.4
Outer dimension	A [mm]	71	100
Length	L [mm]	39.8	51.8

Table 69.4

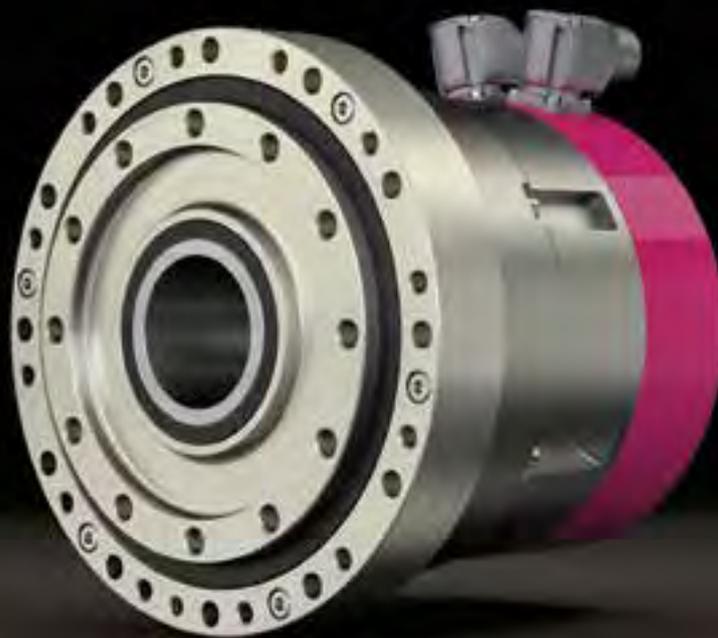
	Symbol [Unit]	from	to
Maximum torque	$T_{max}$ [Nm]	0.13	28
Maximum output speed	$n_{max}$ [rpm]	60	333
Continuous stall torque	$T_0$ [Nm]	0.04	9
Transmission accuracy	[arcmin]	2	10
Ratio	$i$ [ ]	30	100
Dynamic radial load	$F_{R\ dyn(max)}$ [N]	36	392
Dynamic axial load	$F_{A\ dyn(max)}$ [N]	98	392
Dynamic tilting moment	$M_{dyn(max)}$ [Nm]	0.27	-
Outer dimension	A [mm]	13	50
Length	L [mm]	47	168.5

# Highest power density and lifelong precision

The CanisDrive® Series Servo Actuators consist of a synchronous servo motor and a backlash free gear with output bearing. A large hollow shaft, excellent accuracy and small volume together with outstanding torque density, durability and reliability characterise this servo actuator.

## Features

- Outstanding, lifelong precision
- Large hollow shaft
- Various feedback systems
- Integrated, tilt resistant output bearing
- Third party controller compatibility
- High corrosion protection



CanisDrive®

Table 70.1

Torque capacity	Accuracy	Dynamic	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Temperature range	Variable feedback systems
•••	•••	•	•••	•	••	••	•••	••	•••

••• perfect •• optimal • good

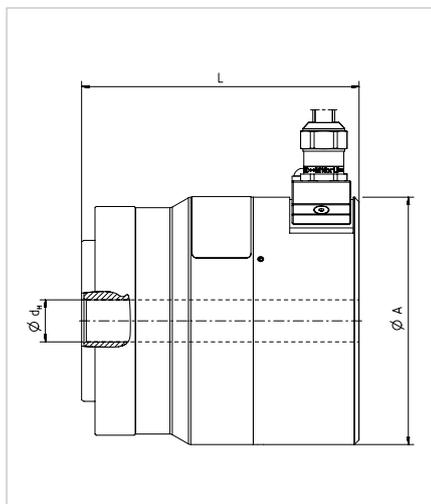
## Technical data

Table 71.1

Size	Ratio $i$ [ ]	Data actuator			Data output bearing			Dimensions		
		Maximum torque $T_{max}$ [Nm]	Maximum output speed $n_{max}$ [rpm]	Continuous stall torque $T_0$ [Nm]	Dynamic radial load $F_{R\ dyn\ (max)}$ [N]	Dynamic axial load $F_{A\ dyn\ (max)}$ [N]	Dynamic tilting moment $M_{dyn\ (max)}$ [Nm]	Outer dimension A [mm]	Length L [mm]	Hollow shaft diameter $d_H$ [mm]
14	50	23	170	9	1450	2880	73	81	97.5	12
	80	30	106	14						
	100	36	85	14						
17	50	44	146	33	2300	4600	114	92	104	16
	80	56	91	35						
	100	70	73	51						
20	120	70	61	51	8600	15800	172	106	118	18
	50	73	130	33						
	100	107	65	64						
25	120	113	54	64	12700	19200	254	128	132.5	27
	50	127	112	72						
	100	204	56	140						
32	50	281	96	79	14600	22300	578	148	145	32
	80	395	60	123						
	100	433	48	154						
40	120	459	40	185	27500	42000	886	180	158	39
	50	523	80	134						
	80	675	50	223						
50	100	738	40	279	37300	56100	1558	222	197.5	55.5
	120	802	33	335						
	160	841	25	446						
58	50	715	70	122	38400	57700	2222	255	208	65.5
	80	941	44	519						
	100	980	35	666						
58	120	1080	29	813	38400	57700	2222	255	208	65.5
	160	1180	22	843						
	50	1020	60	177						
58	80	1480	38	770	38400	57700	2222	255	208	65.5
	100	1590	30	1060						
	120	1720	25	1190						
160	1840	19	1210							

## Dimensions

Illustration 71.2



## Motor feedback system

Table 71.3

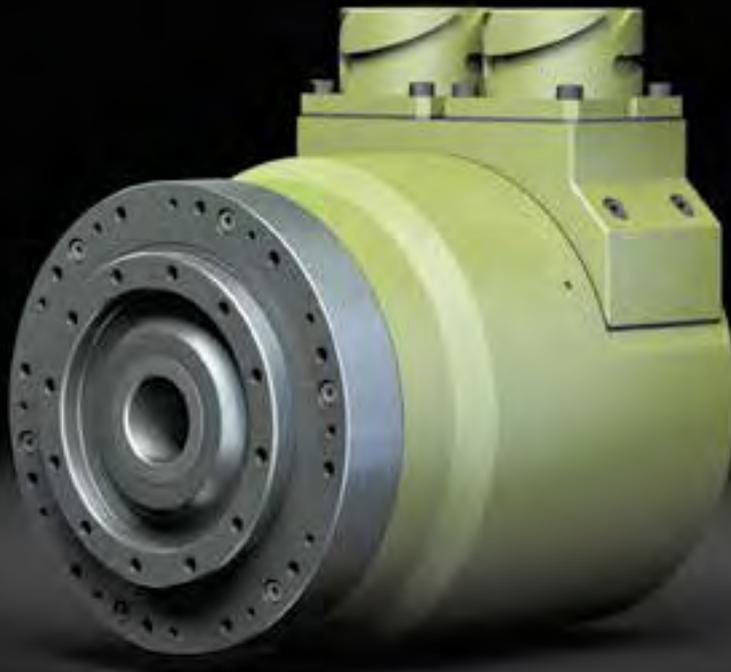
Type	Ordering Code	Incremental signal		Multi-turn	
		Signal form	Signal	Function Multi-turn	Protocol
Multi-turn Absolute	MZE	-	-	external battery	EnDat® 2.2 / 22
	MIH / MHH	sinusoidal	1V <sub>SS</sub>	mechanical	HIPERFACE®
	MGSi	sinusoidal	1V <sub>SS</sub>	internal battery	SSI
	MGS <sub>e</sub>	sinusoidal	1V <sub>SS</sub>	external battery	SSI
Singleturn Absolute	SIE	sinusoidal	1V <sub>SS</sub>	-	EnDat® 2.1 / 01
	SZE	-	-	-	EnDat® 2.2 / 22
	SIH / SHH	sinusoidal	1V <sub>SS</sub>	-	HIPERFACE®
Incremental	DCO	square wave	RS-422	-	-
Resolver	ROO	-	-	-	-

## Largest hollow shaft for extreme environmental conditions

The AlopexDrive® Series Servo Actuators with central hollow shaft are especially suited for mobile applications. Designed with synchronous servo motor and a CPU-H Gear with output bearing, and with its high degree of protection and excellent corrosion resistance, the range is ideally suited for use in extreme environmental conditions and low temperatures.

### Features

- Outstanding, lifelong precision
- Suitable for extreme environmental conditions
- Large hollow shaft
- Integrated, tilt resistant output bearing
- Various feedback systems
- High corrosion protection



AlopexDrive®

Table 72.1

Torque capacity	Accuracy	Dynamic	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Temperature range	Variable feedback systems
••	•••	•	•••	•	••	••	•••	•••	•••

••• perfect •• optimal • good

## Technical data

Table 73.1

Size	Ratio i [ ]	Data actuator			Data output bearing			Dimensions		
		Maximum torque $T_{max}$ [Nm]	Maximum output speed $n_{max}$ [rpm]	Continuous stall torque $T_0$ [Nm]	Dynamic radial load $F_{R\ dyn (max)}$ [N]	Dynamic axial load $F_{A\ dyn (max)}$ [N]	Dynamic tilting moment $M_{dyn (max)}$ [Nm]	Outer dimension A [mm]	Length L [mm]	Hollow shaft diameter $d_H$ [mm]
14	30	9	283	6.8	1450	2880	73	81	97.5	12
	50	18	170	6.9						
	80	23	106	11						
	100	28	85	11						
17	30	16	220	12	2300	4600	114	92	104	16
	50	34	132	26						
	80	43	83	27						
	100	54	66	39						
	120	54	55	39						
20	30	27	200	19	8600	15800	172	106	118	18
	50	56	120	32						
	80	74	75	47						
	100	82	60	49						
	120	87	50	49						
	160	92	38	49						
25	30	50	187	38	12700	19200	254	128	132.5	27
	50	98	112	55						
	80	137	70	87						
	100	157	56	108						
	120	167	47	108						
	160	176	35	108						
32	30	100	160	44	14600	22300	578	148	145	32
	50	216	96	71						
	80	304	60	119						
	100	333	48	154						
	120	353	40	179						
	160	372	30	216						
40	50	402	80	125	27500	42000	886	180	158	39
	80	519	50	208						
	100	568	40	260						
	120	617	33	314						
	160	647	25	420						

## Dimensions

## Motor feedback system

Illustration 73.2

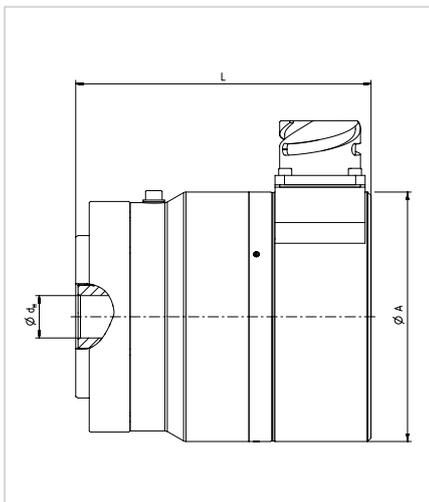


Table 73.3

Type	Ordering Code	Incremental signal		Multi-turn	
		Signal form	Signal	Function Multi-turn	Protocol
Multi-turn Absolute	MZE	-	-	external battery	EnDat® 2.2 / 22
	MIH / MHH	sinusoidal	1V <sub>SS</sub>	mechanical	HIPERFACE®
	MGSi	sinusoidal	1V <sub>SS</sub>	internal battery	SSI
	MGS <sub>e</sub>	sinusoidal	1V <sub>SS</sub>	external battery	SSI
Singleturn Absolute	SXS	sinusoidal	1V <sub>SS</sub>	-	SSI
	SZS	-	-	-	SSI
	SIH / SHH	sinusoidal	1V <sub>SS</sub>	-	HIPERFACE®
Incremental	DCO	square wave	RS-422	-	-
	CXO	sinusoidal	1V <sub>SS</sub>	-	-
Resolver	ROO	-	-	-	-

## Compact mini servo actuator

The FHA-C Mini Series Servo Actuators consist of a synchronous servo motor and backlash free gear with output bearing. The tilt resistant output bearing can allow direct attachment of high payloads without the necessity of further support and thus provides a cost effective and space saving design essential for small installation space. For motor feedback, either an incremental RS-422 or a multiturn absolute EnDat® 2.2/22 are available.

### Features

- Compact, lightweight design
- Integrated, tilt resistant output bearing
- Outstanding, lifelong precision
- Various feedback systems
- High dynamics
- Compact construction



FHA-C Mini  
with hollow shaft

FHA-C Mini-MZE  
with Multi-turn Absolute Encoder

## FHA-C Mini

Table 74.1

	Torque capacity	Accuracy	Dynamic	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Temperature range	Variable feedback systems
Mini Mini-MZE	••	••••	••	••••	••	••••	•	•••• -	•	•

••• perfect •• optimal • good

## Technical data

Table 75.1

FHA-C Mini										
Size	Ratio $i$ [ ]	Data actuator			Data output bearing			Dimensions		
		Maximum torque $T_{max}$ [Nm]	Maximum output speed $n_{max}$ [rpm]	Continuous stall torque $T_0$ [Nm]	Dynamic radial load $F_{R\ dyn(max)}$ [N]	Dynamic axial load $F_{A\ dyn(max)}$ [N]	Dynamic tilting moment $M_{dyn(max)}$ [Nm]	Outer dimension A [mm]	Length L [mm]	Hollow shaft diameter $d_H$ [mm]
8	30	1.8	200	0.75	1163	200	15	50	48.5	6.2
	50	3.3	120	1.5						
	100	4.8	60	2						
11	30	4.5	200	1.8	2857	300	40	60	56	8
	50	8.3	120	2.9						
	100	11	60	4.2						
14	30	9	200	3.5	5357	500	75	75	66	13.5
	50	18	120	4.7						
	100	28	60	6.8						

Table 75.2

FHA-C Mini-MZE										
Size	Ratio $i$ [ ]	Data actuator			Data output bearing			Dimensions		
		Maximum torque $T_{max}$ [Nm]	Maximum output speed $n_{max}$ [rpm]	Continuous stall torque $T_0$ [Nm]	Dynamic radial load $F_{R\ dyn(max)}$ [N]	Dynamic axial load $F_{A\ dyn(max)}$ [N]	Dynamic tilting moment $M_{dyn(max)}$ [Nm]	Outer dimension A [mm]	Length L [mm]	Hollow shaft diameter $d_H$ [mm]
8	30	1.8	200	0.75	1163	200	15	50	61.8	-
	50	3.3	120	1.5						
	100	4.8	60	2						
11	30	4.5	200	1.8	2857	300	40	60	68.5	-
	50	8.3	120	2.9						
	100	11	60	4.2						
14	30	9	200	3.5	5357	500	75	75	78	-
	50	18	120	4.7						
	100	28	60	6.8						

## Dimensions

Illustration 75.3

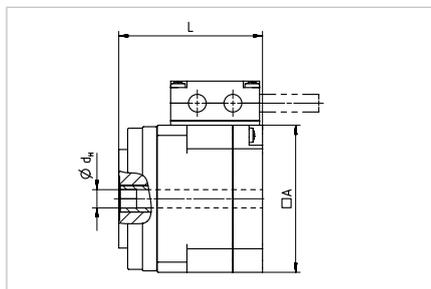
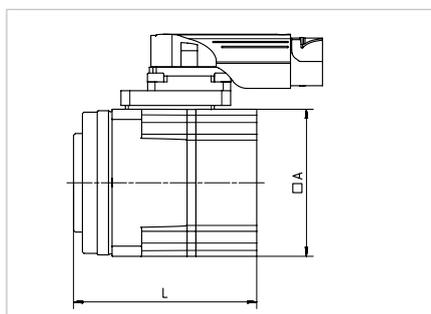


Illustration 75.5



## Motor feedback system

Table 75.4

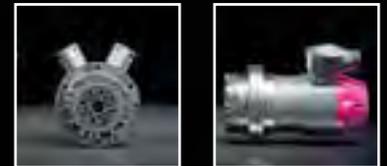
Type	Ordering Code	Incremental signal		Multi-turn	
		Signal form	Signal	Function Multi-turn	Protocol
Multi-turn Absolute	MZE	-	-	external battery	EnDat® 2.2 / 22
Incremental	D200	square wave	RS-422	-	-

## Compact design with high corrosion protection

The LynxDrive® Series Servo Actuators consist of a synchronous servo motor and a backlash free gear with output bearing. The slim design of the LynxDrive® Servo Actuator is particularly interesting for applications where space is limited.

### Features

- Compact, lightweight design
- Small outer diameter
- High corrosion protection
- Outstanding, lifelong precision
- Various feedback systems
- Third party controller compatibility



LynxDrive®

Table 76.1

Torque capacity	Accuracy	Dynamic	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Temperature range	Variable feedback systems
••	••••	••	••	•	••	••••	-	••	••••

•••• perfect •• optimal • good

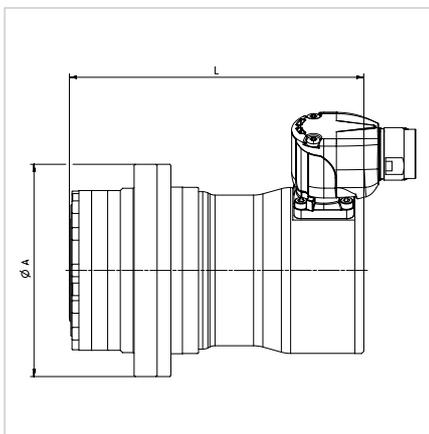
## Technical data

Table 77.1

Size	Ratio $i$ [ ]	Data actuator			Data output bearing			Dimensions	
		Maximum torque	Maximum output speed	Continuous stall torque	Dynamic radial load	Dynamic axial load	Dynamic tilting moment	Outer dimension	Length
		$T_{max}$ [Nm]	$n_{max}$ [rpm]	$T_0$ [Nm]	$F_{R\ dyn\ (max)}$ [N]	$F_{A\ dyn\ (max)}$ [N]	$M_{dyn\ (max)}$ [Nm]	A [mm]	L [mm]
14	30	9	283	6.8	1928	2878	41	73	126
	50	18	170	6.9					
	100	28	85	11					
17	30	16	243	12	2148	3207	64	79	129
	50	34	146	26					
	100	54	73	39					
20	30	27	217	20	2354	3511	91	93	159
	50	56	130	34					
	80	74	81	47					
	100	82	65	49					
	120	87	54	49					
	160	92	41	49					
25	30	50	160	38	3904	5827	156	111	174
	50	98	96	56					
	80	137	60	87					
	100	157	48	109					
	120	167	40	109					
	160	176	30	109					
32	30	100	160	67	6101	7926	313	138	184
	50	216	96	108					
	80	304	60	167					
	100	333	48	216					
	120	353	40	216					
	160	372	30	216					
40	50	402	80	181	8652	11242	450	160	192
	80	519	50	283					
	100	568	40	371					
	120	617	33	450					
	160	647	25	450					
50	50	715	70	123	14155	18393	759	190	249
	80	941	44	522					
	100	980	35	672					
	120	1080	29	818					
	160	1180	22	850					

## Dimensions

Illustration 77.2



## Motor feedback system

Table 77.3

Type	Ordering Code	Incremental signal		Multi-turn	
		Signal form	Signal	Function Multi-turn	Protocol
Multi-turn Absolute	MEE	sinusoidal	$1V_{SS}$	mechanical	EnDat® 2.2 / 01
	MKE	sinusoidal	$1V_{SS}$	mechanical	EnDat® 2.1 / 01
	MGH	sinusoidal	$1V_{SS}$	mechanical	HIPERFACE®
Resolver	ROO	-	-	-	-

# Highest dynamics with economical design

The BDA Series Servo Actuators consist of a synchronous servo motor and either a backlash free gear or for higher dynamics a planetary gear, both with output bearing. The series offers high dynamics with the smallest outer diameter.

## Features

- Outstanding, lifelong precision
- Flexible speed range due to different transmission technologies
- Optimally matched components
- Ready to connect servo actuator
- Integrated, tilt resistant output bearing
- High dynamics



### BDA-HFUC

Servo actuator with zero backlash, compact strain wave gear

### BDA-HPG

Servo actuator with dynamic planetary gear

# BDA

Table 78.1

Torque capacity	Accuracy	Dynamic	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Temperature range	Variable feedback systems
••	••	•••	••	••	•	•••	-	••	••

••• perfect •• optimal • good

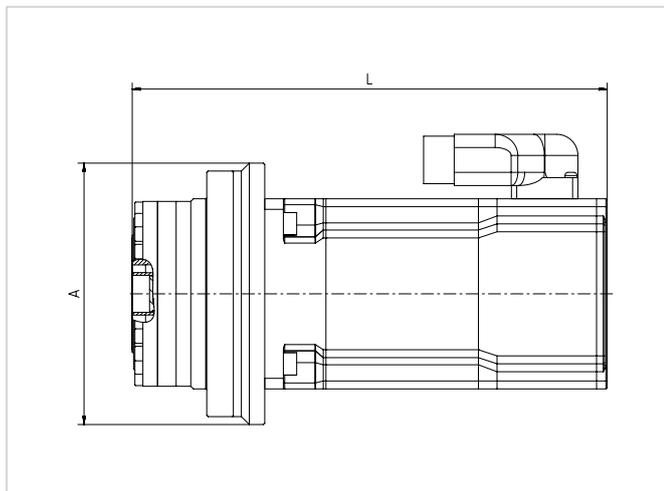
## Technical data

Table 79.1

Size	Gear type	Ratio i [ ]	Data actuator			Data output bearing			Dimensions	
			Maximum torque $T_{max}$ [Nm]	Maximum output speed $n_{max}$ [rpm]	Continuous stall torque $T_0$ [Nm]	Dynamic radial load $F_{R\ dyn (max)}$ [N]	Dynamic axial load $F_{A\ dyn (max)}$ [N]	Dynamic tilting moment $M_{dyn (max)}$ [Nm]	Outer dimension A [mm]	Length L [mm]
			14	HFUC	50	18	160	6.9	1928	2878
		100	28	80	11					
17	HFUC	50	34	146	26	2148	3207	64	∅ 79	196
		100	54	73	39					
20	HFUC	50	56	120	34	2354	3511	91	∅ 99	172
		100	82	60	49					
		160	92	38	49					
25	HFUC	50	98	112	55	3904	5827	156	∅ 107	208
		100	157	56	108					
		160	176	35	108					
32	HFUC	50	216	96	108	6101	7926	313	∅ 138	230
		100	333	48	216					
		160	372	30	216					
40	HFUC	50	402	80	196	8652	11242	450	∅ 160	284
		100	568	40	372					
		160	647	25	451					
11	HPG	21	9.8	381	6	440	660	9.5	□40	201
		37	9.8	216	6	520	780			
14	HPG	21	23	286	15	720	1080	32.3	□72	219
		33	23	182	15	830	1240			
20	HPG	21	100	238	55	1510	2250	183	□87	267
		33	100	152	60	1729	2580			
32	HPG	21	300	190	170	2920	4260	452	□104	338
		33	300	121	200	3340	4990			

## Dimensions

Illustration 79.2



## Motor feedback system

Table 79.3

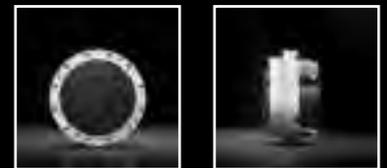
Type	Ordering Code	Incremental signal		Multi-turn	
		Signal form	Signal	Function Multi-turn	Protocol
Multi-turn Absolute	MGH	sinusoidal	1V <sub>ss</sub>	mechanical	HIPERFACE®
Resolver	ROO	-	-	-	-

## Ultra flat and ultra light

The FLA ultra flat and ultra light series of servo actuators combine high precision and high performance transmission with a compact and highly efficient DC brushless motor. It is available with a highly dynamic and efficient Harmonic Planetary Gear or with a high precision and high torque Harmonic Drive® Strain Wave Gear. Due to its short, compact design, the FLA is used where space is at a premium.

### Features

- Compact and light
- Integrated, tilt resistant output bearing
- Optimally matched components
- Short design
- Low noise
- Excellent efficiency



FLA

Table 80.1

Torque capacity	Accuracy	Dynamic	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Temperature range	Variable feedback systems
•	•	•••	•	•••	•••	•	-	•	•

••• perfect •• optimal • good

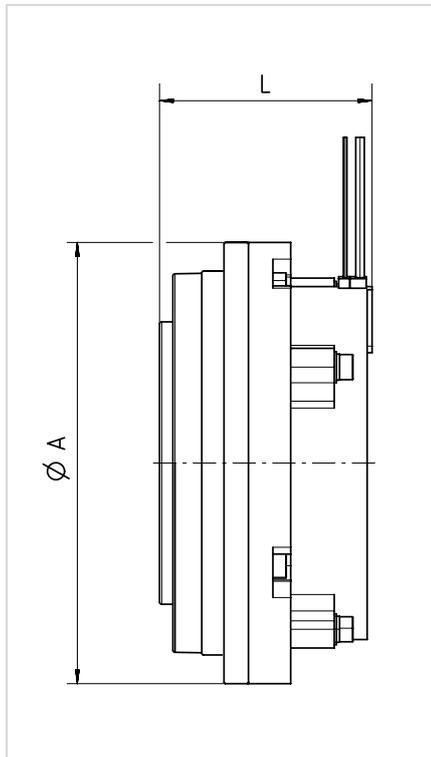
## Technical data

Table 81.1

Size	Gear type	Ratio i [ ]	Data actuator			Data output bearing			Dimensions	
			Maximum torque $T_{max}$ [Nm]	Maximum output speed $n_{max}$ [rpm]	Continuous stall torque $T_0$ [Nm]	Dynamic radial load $F_{R\ dyn (max)}$ [N]	Dynamic axial load $F_{A\ dyn (max)}$ [N]	Dynamic tilting moment $M_{dyn (max)}$ [Nm]	Outer dimension A [mm]	Length L [mm]
			11	FB	50	6.7	100	1.7	-	29
		100	11	50	2.4					
14	FB	50	11.2	100	2.6	-	78	1.6	85	45.3
		100	18.2	50	3.8					
17	FB	50	23	100	7.9	-	171	2	92	51.8
		100	34	50	11.4					
20	FB	50	33	80	13	-	318	2.4	100	51.4
11	HP	8	1.8	500	0.6	-	29	1.2	71	39.8
14	HP	8	3.7	500	1.2	-	78	1.6	85	43.3
17	HP	9	7.3	500	3	-	171	2	92	48.7
20	HP	9	12.1	400	4.1	-	318	2.4	100	47.8

## Dimensions

Illustration 81.2



## Motor feedback system

Table 81.3

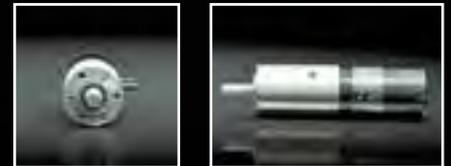
Type	Ordering Code	Incremental signal		Multi-turn	
		Signal form	Signal	Function Multi-turn	Protocol
Hall Sensor	H	square wave	Open Collector	-	-

## Precision gear with synchronous motor in 24V- /48V- version

The RSF Mini Series Servo Actuators consist of a compact synchronous servo motor and a CSF Mini Gear with output bearing. High dynamics, low weight and a small outer diameter characterise the RSF range.

### Features

- Compact and light
- High dynamics
- Low weight
- Small outer diameter
- Outstanding, lifelong precision



# RSF Mini

Table 82.1

Torque capacity	Accuracy	Dynamic	Tilt resistant	Low weight	Short design	Small outer diameter	Large hollow shaft	Temperature range	Variable feedback systems
••	••	•••	•	•••	•	•••	-	•	•

••• perfect •• optimal • good

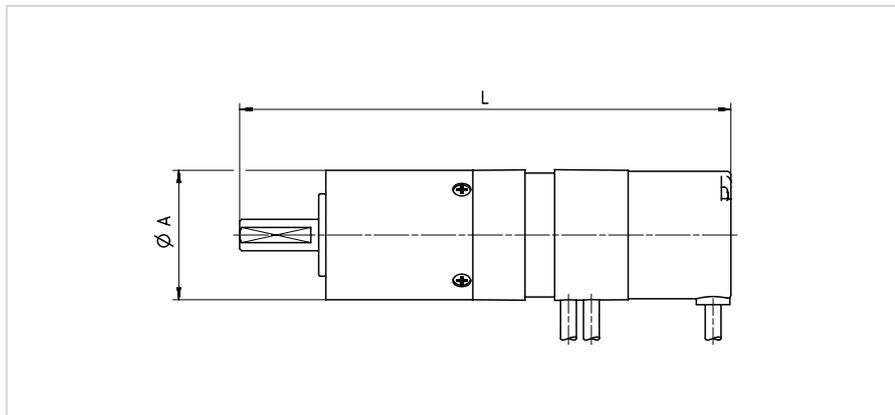
## Technical data

Table 83.1

Size	Ratio $i$ [ ]	Data actuator			Data output bearing			Dimensions	
		Maximum torque	Maximum output speed	Continuous stall torque	Dynamic radial load	Dynamic axial load	Dynamic tilting moment	Outer dimension	Length
		$T_{max}$ [Nm]	$n_{max}$ [rpm]	$T_0$ [Nm]	$F_{R\ dyn\ (max)}$ [N]	$F_{A\ dyn\ (max)}$ [N]	$M_{dyn\ (max)}$ [Nm]	A [mm]	L [mm]
3	30	0.13	333	0.04	36	130	0.27	13	47
	50	0.21	200	0.08					
	100	0.3	100	0.12					
5	30	0.5	333	0.28	90	270	0.89	20	58.1
	50	0.9	200	0.44					
	100	1.4	100	0.65					
8	30	1.8	200	0.95	196	98	-	33	124.3
	50	3.3	120	1.7					
	100	4.8	60	3.5					
11	30	4.5	200	1.7	245	196	-	40	141.7
	50	8.3	120	3					
	100	11	60	5.7					
14	30	9	200	2.5	392	392	-	50	168.5
	50	18	120	4.5					
	100	28	60	9					

## Dimensions

Illustration 83.2



## Motor feedback system

Table 83.3

Type	Ordering Code	Incremental signal		Multi-turn	
		Signal form	Signal	Function Multi-turn	Protocol
Incremental	E020 E050	square wave	Open Collector	-	-
	F100	square wave	RS-422	-	-





Harmonic  
Drive AG

# Harmonic Drive<sup>®</sup> SolutionKit<sup>®</sup>

The SolutionKit<sup>®</sup> 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.

## Customised component diversity

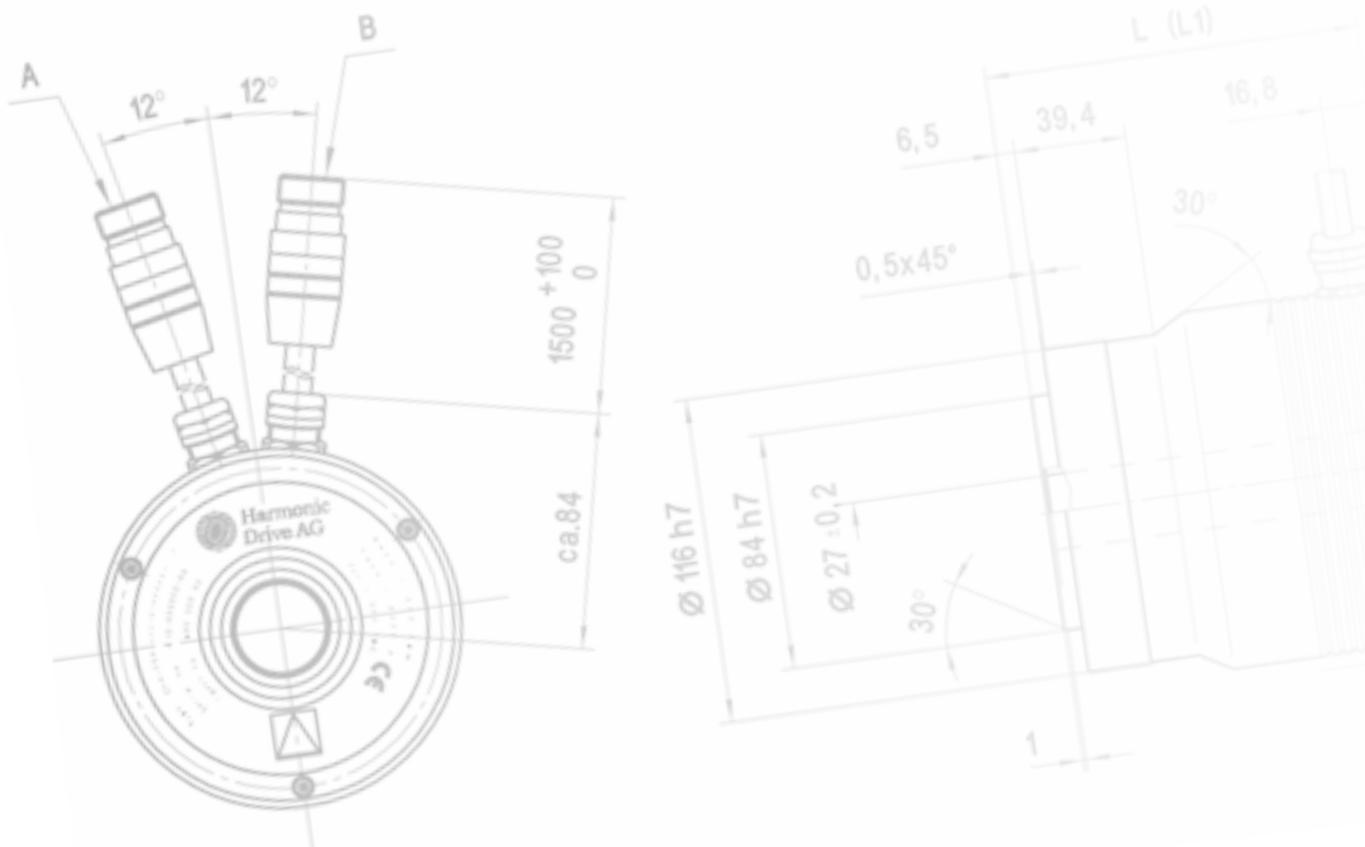
Your application places demands on the actuation system, which cannot be easily resolved by our standard products?

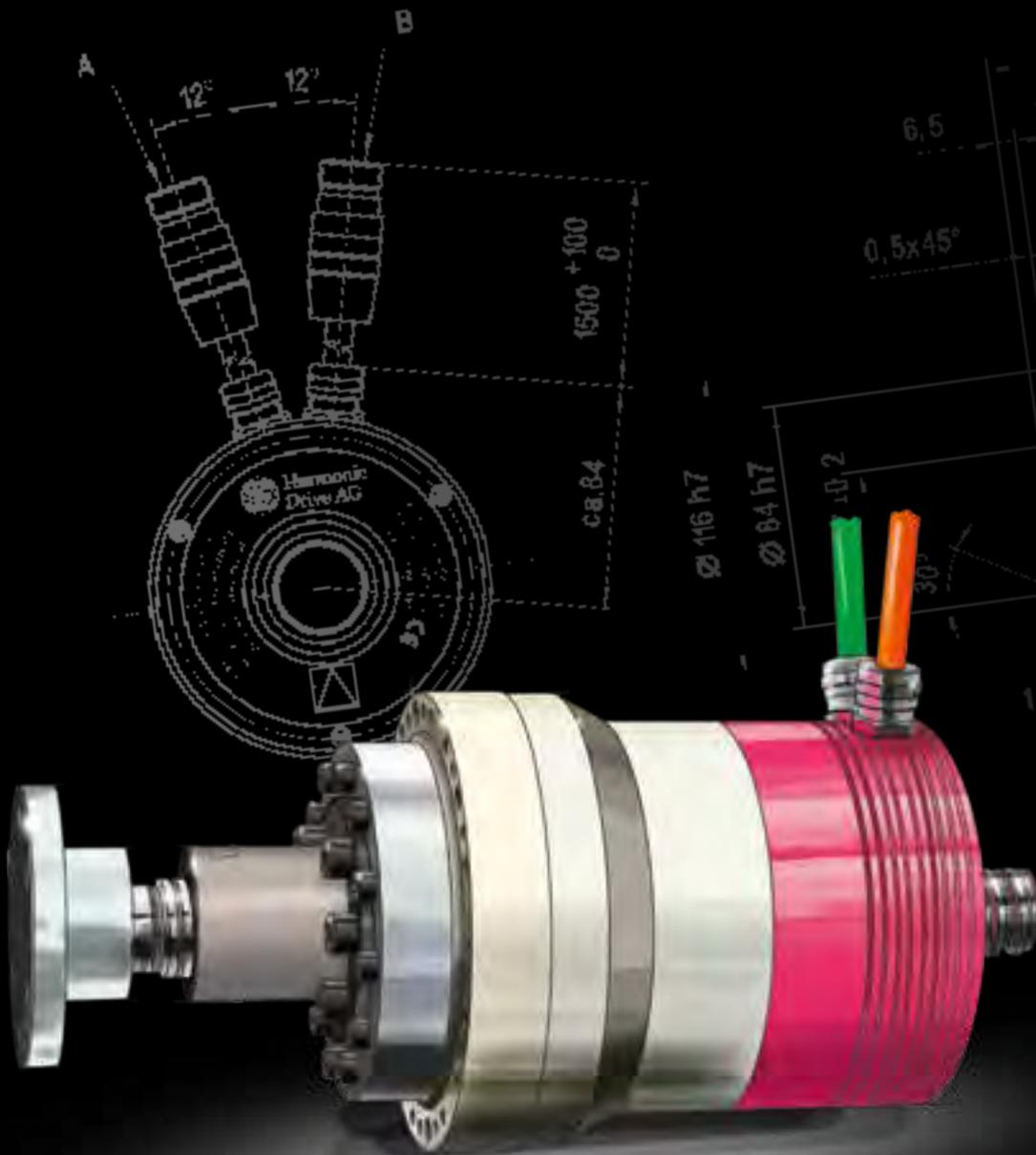
SolutionKit® enables a new combination with proven and reliable components, which means customer specific solutions can be achieved quickly and flexibly.

Thanks to the wide variety of characteristics of our actuator solutions, many customer applications can be satisfied with proven standard products. However, certain applications require adjustments to interfaces or environmental conditions. With the combination of high precision gear technology, compact servo motors and electronic components, customer specific mechatronic solutions with a high degree of customisation are created within a short time frame.

In order to achieve shorter development times, technologically sophisticated components such as gears, motor windings, rotors and motor feedback systems are implemented unchanged, recombined and supplemented with additional components.

SolutionKit® is consistently steered to the expectations of the market and the requirements of our customers.

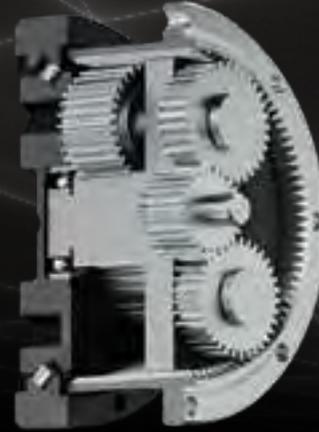




## Gear technology

zero backlash, high precision and reliable

- Based on proven standard technology
- Torque range up to 3500Nm
- Ratios from 3:1 to 160:1
- Designed as strain wave gear or planetary gear
- Two stage version with reduction ratios up to 10,000:1



## Spindle modules

high precision linear technology from the modular system

- Ball screw spindles in tolerance class T5 (optional T3)
- Spindle diameter matched to the gear
- Flexible spindle lengths for optimum adaptation to the application
- Bellows module to protect the spindle from contamination

## Output Bearings

precise and durable technology in the shortest possible space

- Compact design for easy and space saving installation
- Cross roller bearing or four point bearing versions
- Highest concentricity and axial run out
- High payloads and torsional stiffness
- Direct attachment of high payloads without further support

## Additional parts

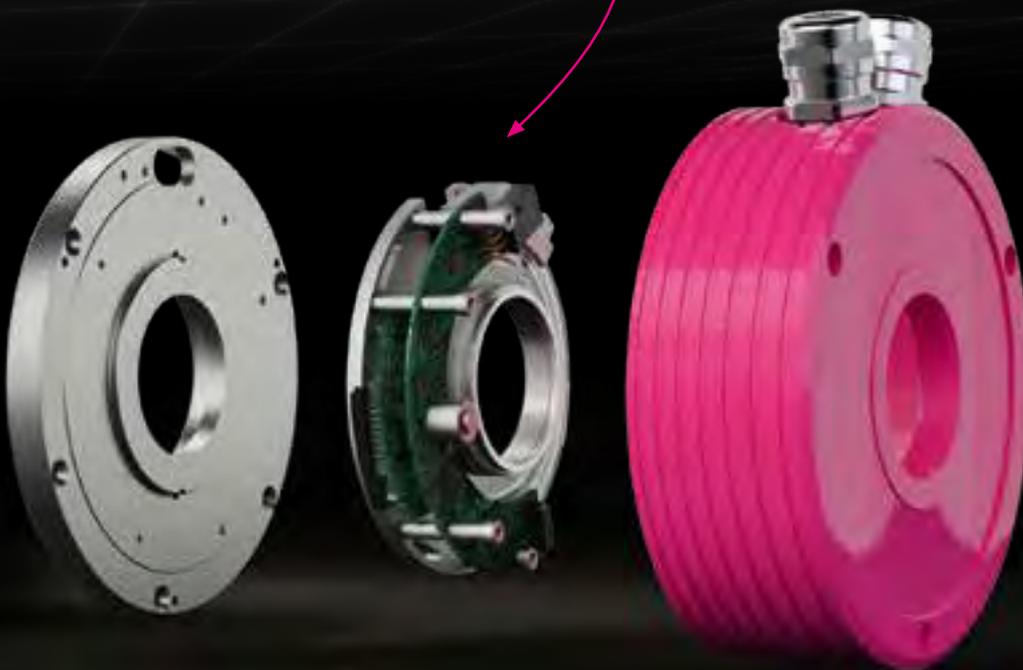
extensive component selection for tailor made solutions

- Brake modules (hollow shaft or solid shaft)
- Cables and connectors for special applications
- Industry standard connectors
- Connectors and cable glands for mobile applications
- Cable glands

## Motor feedback systems

compatible with the industry standard

- Protocols to industry standard
  - HIPERFACE®
  - EnDat®
  - SSI
- Hollow shaft/Solid shaft
- Functional safety performance



## Motor Technology

synchronous servo motors with optimised characteristics

- Voltage levels from 24V to 600V
- Temperature range from -50 °C bis 110 °C
- Designs for hollow shaft or solid shaft motors
- Wide range of standard windings available
- Short, compact design
- Robust construction and fully encapsulated

## Special requirements

100% designed to the application

- Comprehensive corrosion protection
- Extended temperature range
- Vibration and shock tested
- EMV compliant design (industry/MIL standard)

A-Z

A B C D E F G H I J K L M N O P Q R S T U V  
A B C D E F G H I J K L M N O P Q R S T U V W X



Harmonic  
Drive AG

W X Y Z

# Glossary

Clarification of the technical data  
used in the catalogue.

## Technical data

### Average torque $T_A$ [Nm]

When a variable load is applied to the gear, an average torque should be calculated for the complete operating cycle. This value should not exceed the specified  $T_A$  limit.

### Continuous stall torque $T_0$ [Nm]

Allowable actuator stall torque.

### Dynamic axial load $F_{A \text{ dyn (max)}}$ [N]

With bearing rotating this is the maximum allowable axial load, with no additional radial forces or tilting moments applied.

### Dynamic radial load $F_{R \text{ dyn (max)}}$ [N]

With bearing rotating this is the maximum allowable radial load, with no additional axial forces or tilting moments applied.

### Dynamic tilting moment $M_{\text{dyn (max)}}$ [Nm]

With bearing rotating this is the maximum allowable tilting moment, with no additional axial forces or radial forces applied.

### Hollow shaft diameter $d_H$ [mm]

Free inner diameter of the continuous axial hollow shaft.

### Maximum input speed $n_{\text{in (max)}}$ [rpm]

Maximum allowed input speed for gearing with grease lubrication.

### Maximum speed $n_{\text{max}}$ [rpm]

The maximum output speed. Due to heating issues, this may only be momentarily applied during the operating cycle. The maximum output speed can occur any number of times as long as the rated speed is greater than the permissible continuous operation calculated in the duty cycle.

### Maximum torque $T_{\text{max}}/T_R$ [Nm]

Specifies the maximum allowable acceleration and braking torques. For highly dynamic processes, this is the maximum torque available for a short period. The maximum torque can be parameterized by the control unit where the maximum

current can be limited. The maximum torque can be applied as often as desired, as long as the average torque is within the permissible continuous operation calculated in the duty cycle.

### Rated torque $T_N$ [Nm]

The rated torque is a reference torque for the calculation of the gear life. When loaded with the rated torque and running at rated speed the gear will reach the average life  $L_{50}$ . The rated torque  $T_N$  is not used for the dimensioning of the gear.

### Ratio $i$ [ ]

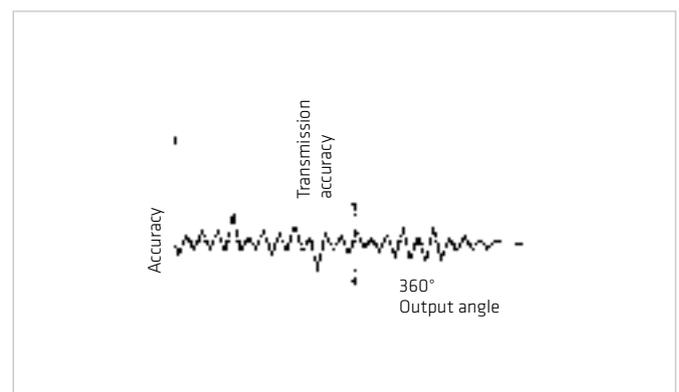
The ratio is the reduction of input speed to the output speed. Note for Harmonic Drive® Gears: The standard version has the Wave Generator as the input drive element, the output element of the Flexspline and the Circular Spline is fixed to the housing. Since the direction of rotation of the drive (Wave Generator) to output reverses (Flexspline), a negative ratio for results calculations in which the direction of rotation must be considered.

### Size

The frame size is derived from the pitch circle diameter of the gear teeth in inches multiplied by 10.

### Transmission accuracy [arcmin]

The transmission accuracy of the gear represents a linearity error between input and output angle. The transmission accuracy is measured for one complete output revolution using a high resolution measurement system. The measurements are carried out without direction reversal. The transmission accuracy is defined as the sum of the maximum positive and negative differences between theoretical and actual output rotation angle.



## Labelling, Guidelines and Regulations

### CE Marking

With the CE marking, the manufacturer or EU importer declares in accordance with EU regulation, that by affixing the CE mark the product meets the applicable requirements in the harmonisation legislation established the Community.



### REACH Regulation

REACH is an European Community Regulation on chemicals. REACH stands for Registration, Evaluation, Authorisation and Restriction of Chemicals.



### RoHS EU Directive

The RoHS EU Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment.



## Closing remarks

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