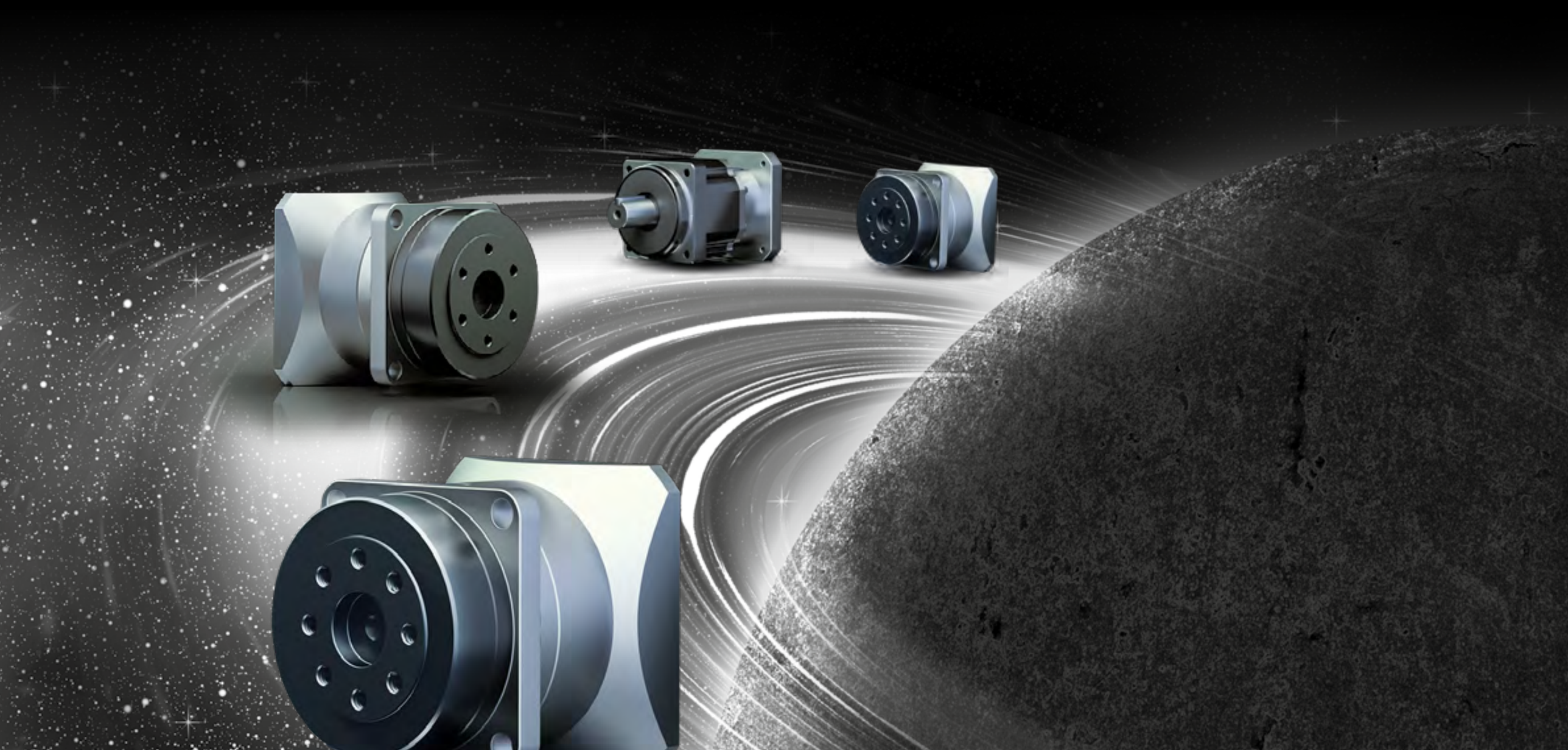
Harmonic Planetary Gears

Harmonic Drive SE



Content

Robotics, Handling & Automation | Mechanical Engineering |
Medical Technology | Special Environments | Aerospace

Our inspiration

With either Apollo 15 on the moon or in the depths of the rough oceans, for more than 50 years, we have been providing significant applications across the planet and beyond with our drive solutions. We, as an industry leader in high precision drive technology, have not only continued to expand our portfolio based on the unique Harmonic Drive® Strain Wave Gear but have also recognised the requirements of modern, trend setting markets and applications: The future of drive technology is intelligent, sustainable and efficient.

Thanks to their special characteristics, which have been continuously developed over decades, Harmonic Drive® Gears and Actuators are perfectly suited to important key industries, including robotics, handling & automation, mechanical engineering, medical technology, special environments and aerospace.

Highest precision and quality for our customers are key principles of our corporate culture. Eighty percent of our products that leave our factory in Limburg/Lahn are special versions and are therefore specially developed, designed and manufactured according to customer specifications - from space saving gear component sets to intelligent drive systems.

Due to the high complexity in the configuration of suitable drive technology components, we partner and advise our customers comprehensively. The proposed solution for the drive task to be realised is developed in close cooperation to enable the subsequent integration into the application environment without any problems. Vital for this are, on the one hand, the high flexibility and, on the other hand, the customised scope of services and the integration level. The result is an optimal, highly individualised drive solution.

Successfully shaping the future together with, and for our customers, in demanding industries is a sign of our innovative strength in the field of high precision drive technology.

Your global partner

You will find our sophisticated drive solutions all over the globe and even beyond - regardless of whether you are on the Red Planet or the Blue Planet: Motors, actuators and systems from Harmonic Drive SE are used wherever the highest demands are made on quality and reliability. Production and development sites at the highest technological level in Germany, Japan and USA, as well as subsidiaries in Europe and Asia, ensure that we can offer highly specialised and intelligent drive solutions and mechatronic systems worldwide.

Perhaps you will think of us the next time you fly beyond the horizon in an aircraft of the Airbus family: High precision Harmonic Drive® Gears for aviation help you fly safely and have the world at your feet right now.

„It is never a question as to whether it can be done –
it is only whether one cares to spend the time and effort.“

C. Walton Musser, Inventor of the Strain Wave Gear

Your idea, our engineering, your drive solution

We know that the configuration of suitable components is complex. Together with you, we can therefore develop a complete solution proposal for the drive task. Starting with the selection of the most suitable gears and the matching motor and sensor components, we can configure the complete drive axis for your application.

In doing so, we draw on decades of experience. Since 1970, we have been building on a sizeable number of complex drive solutions, giving our customers a definite technological edge. All design elements can be customised and optimally matched to each other. Integration into the application always takes place in close partnership with our customers. The key factors here are, on the one hand, the high flexibility and, on the other hand, the individual scope of services and the level of integration. The result will be optimal overall solution for your application.

In our modern development centre, a team of more than 40 designers and engineers is available on a daily basis. Up-to-date design and calculation tools, self designed tools for fast analytical calculations and equally established FEM supported methods are in place. In the directly connected test field, the newly developed actuators and drive systems are verified for performance and functionality with the help of specific test benches. The knowledge gained from this is fed back into development and gives the basis for further optimisation.

We produce your transmission solution beginning with lot size 1

In addition to a few standard products with higher quantities, our production is dominated by many specialised and diverse assemblies in smaller quantities down to lot size 1. This is because almost all products that leave our premises are configured together with you specifically according to your wishes and requirements and then manufactured in house. In order to achieve this high flexibility in production, we have developed an intelligent setup concept with which we can even manufacture lot size 1 economically.

Production lines per size enable us to change setups smoothly and therefore ensure maximum flexibility - even for small lot sizes. In order to meet these requirements throughout the entire value chain, we rely on longterm supplier relationships based on mutual partnership in the area of supply chain management, which we continuously develop into efficient supplier structures and therefore synchronise with our production system. In this way, we fulfil your wishes individually, no matter what the quantity.

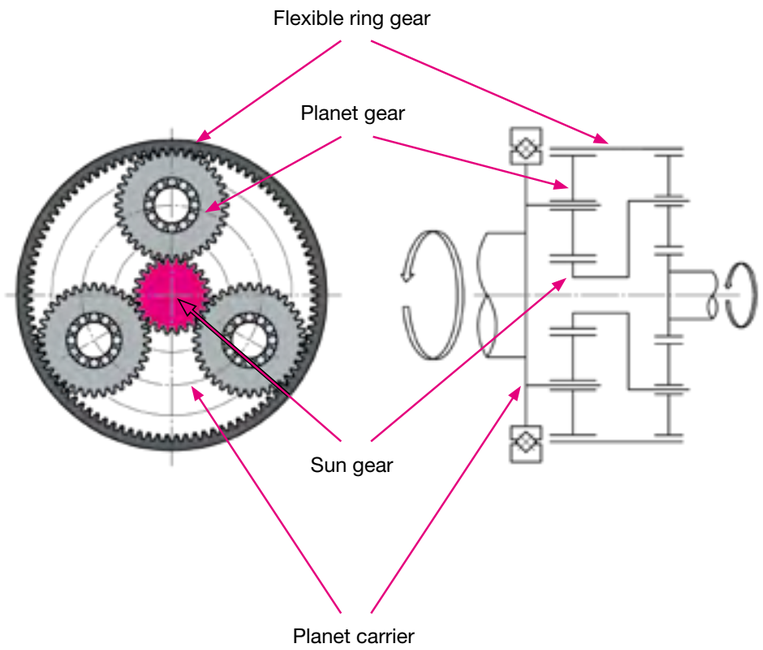
In the chapter „Individual solutions“ you will find a selection of customised designs that we can realise according to your wishes and requirements.

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.

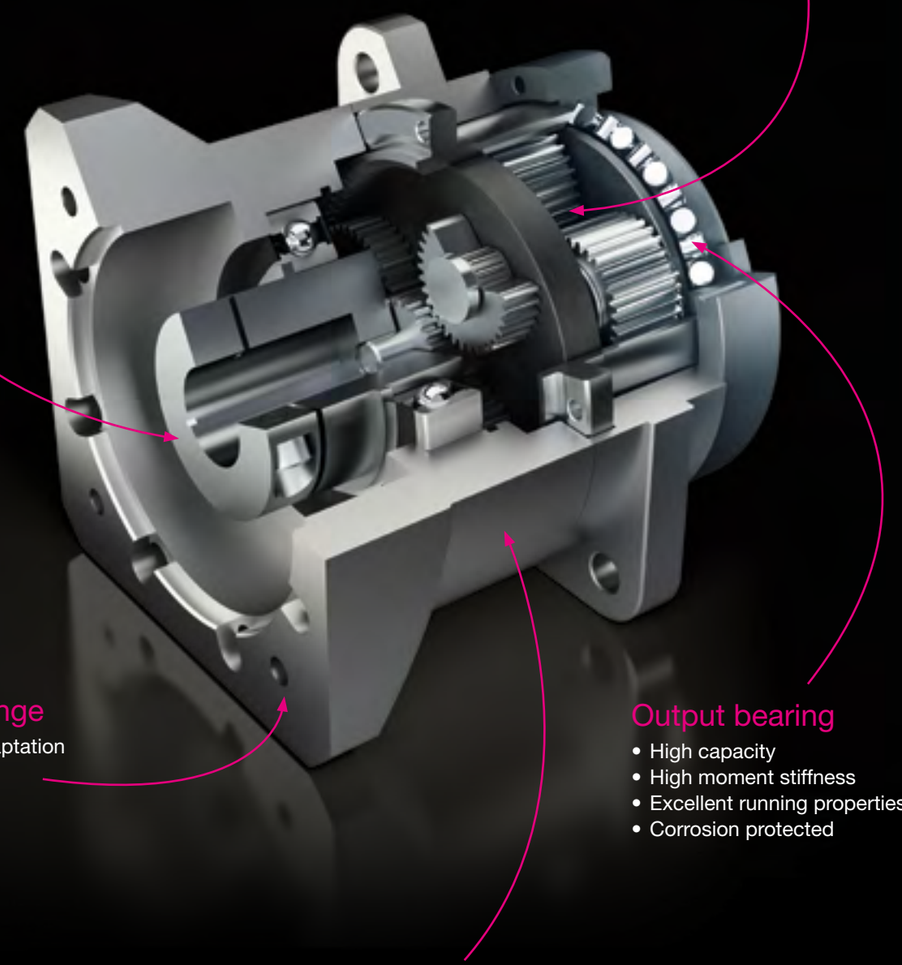


Harmonic Planetary Gear Set

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

Harmonic Drive® Gears

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

Catalogue
Harmonic Drive® Gears

GEAR COMPONENT SETS

CSG-/HFUC-2A

CPL-2A

CSD-2A

SHG-/HFUS-2A

GEARS WITH OUTPUT BEARING

CSG-/HFUC-2UH

CSF-ULW

CPU-M/H/S

CSD-2UH/2UF

SHG-/HFUS-2UH/2SH/2SO

SHD-2SH

CSF Mini

PMG

CSF-2UP

FBS-2UH

Harmonic Drive® Servo Actuators

Harmonic Drive® Servo Actuators 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.

Catalogue
Harmonic Drive® Mechatronics

SERVO ACTUATORS WITH HOLLOW SHAFT

IHD

BHA

CanisDrive®

AlopexDrive

FHA-C Mini

SERVO ACTUATORS WITH SOLID SHAFT

LynxDrive

FLA

Harmonic Planetary Gears

Harmonic Planetary Gears have lower gear ratios ususally 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®!

Catalogue
Harmonic Planetary Gears

HPN

HPGP

HPG-R

HPG

The proven gear components, output bearings, motors and encoder systems form the basis for different product groups of Harmonic Drive SE in the field of high precision drive technology. Harmonic Drive® Gears or Harmonic 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 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.

Harmonic Drive® Servo Actuators

The continuously increasing demands placed on servo actuators 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 SE 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. The latest IHD Series also has an integrated drive controller and a dual measuring system for direct control of the position at the gearbox output. This system can be easily implemented in the application by means of fieldbus interfaces.

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®.

Series	HPN	HPGP	HPG-R	HPG
				
Type	S	F	F	F
Torque capacity and service life	●●●	●●	●●	●
Low torsional backlash	●●	●●●	●●●	●●●
Small outer diameter	●●●	●●●	●●●	●●●
Short design	●	●●	●●	●●●
Noise generation	●●●	●●	●●●	●●
Low weight	●●	●●●	●●●	●●●
Chapter / Page	1 / 20	2 / 30	3 / 40	4 / 48
Key data				
Maximum torque [Nm]	9 … 752	10 … 2920	5 … 400	7.8 … 2200
Maximum input speed [rpm]	6000 … 10000	3000 … 10000	6000 … 10000	3000 … 10000
Backlash [arcmin]	≤5 / ≤7	≤1 / ≤3	≤1 / ≤3	≤1 / ≤3
Number of stages	1 ... 2	1 … 2	1 … 2	1 ... 2
Configurations				
Sizes	11 … 40	11 … 65	11 … 32	11 … 65
Ratio	3 … 50	4 … 45	5 … 45	3 … 50

Description:
S - Output shaft
F - Output flange

●●● perfect ●● optimal ● good

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.

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

Robotics, handling & automation

For a long time, robots have 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 aides are now entering fields which were unthinkable a short time ago. This cooperation between man and robot has become an important trend in recent years – one meets each other in some sense.

Mechanical engineering

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® 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.

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.

Special environments

The highest requirements for use in the harshest environmental conditions, such as extreme temperatures or other climatic peculiarities, can be achieved with Harmonic Drive® Products. System applications in defence, vacuum and safety technology or in the depths of our oceans are frequently confronted with such extreme conditions, where the integrated components have to prove themselves once again.

Aerospace

Our products have been working maintenance free in space for over 50 years, have been installed in aircraft for over 30 years and function under extreme low temperatures. Special materials, lightweight products and dry lubricants are specially developed for the aerospace industry.

Affordability combined with precision

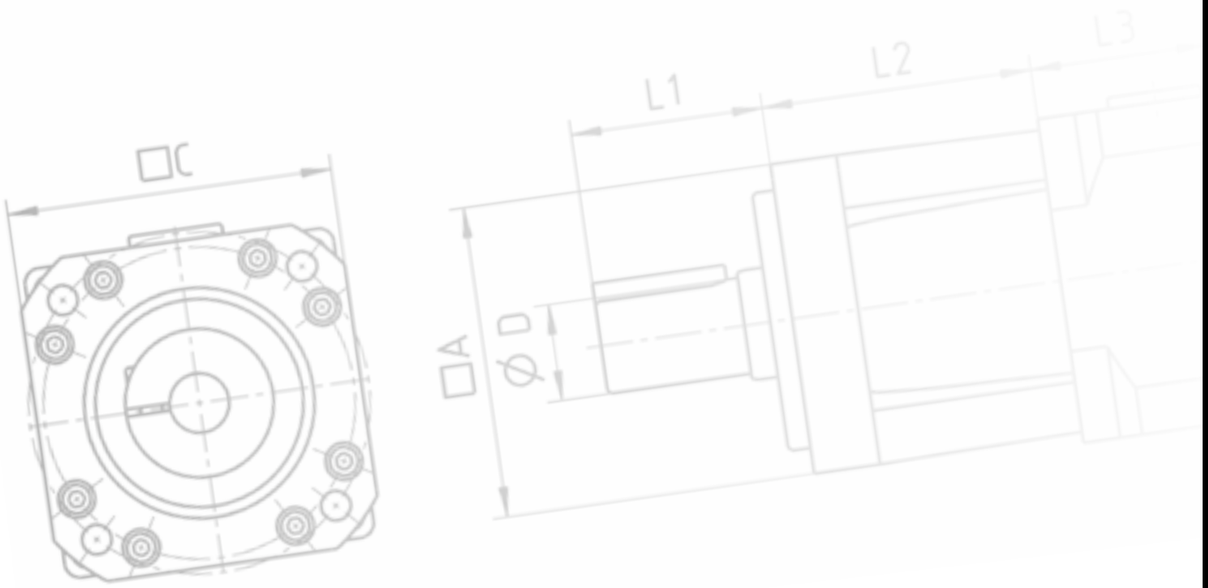
The HPN Series Planetary Gears are available in five sizes with thirteen gear ratios between 3 and 50. Offering repeated peak torque from 9 to 752 Nm with a backlash of just 5 (single-stage) to 7 (double-stage) arcmin, this gear series is ideal for low backlash applications. The outstanding price to performance ratio offers a precision gear solution where low backlash and cost represent a combined value.

The Planetary Gears HPN are an innovative mix between commercial and technical needs. Reduced cost with low backlash characteristics are the main features.

HPN Series is built around a helical gearing concept that exhibits very smooth running and is extremely quiet. To support your application load, the gears are provided with two widely spaced bearings on the output side. The gears are available with standard flanges for various motor types.

Based on a combination of high torque capacity and low backlash, HPN Planetary Gears offer a compact solution for your application. Standard servo motors can be simply coupled to the lifetime lubricated gears.

With the introduction of the new HPN Series we extend our portfolio to supply additional customer cost benefits.



Optimised for your applications:

- Low backlash
- High dynamic performance
- Low noise
- Direct motor adaptation
- Compact design
- Best possible price/performance ratio

Features

HPN

Ordering code

Table 1.1

Series	Size	Ratio													Version	Code for motor adaption
HPN	11A 14A 20A 32A 40A	3 3 3 3 3	4 4 4 4 4	5 5 5 5 5	7 7 7 7 7	10 10 10 10 10	15 15 15 15 15	20 20 20 20 20	25 25 25 25 25	30 30 30 30 30	35 35 35 35 35	40 40 40 40 40	45 45 45 45 45	50 50 50 50 50	J6, J8	xx.xx
Ordering code																
HPN	**-** **11A**			**-**			**4**				**-**				**J6**	**BH-AF1**

Table 1.2

Output	
Ordering code	**Description**
J6	Output shaft with key
J8	Output shaft without key

Table 1.3

Version	
Code for motor adaption	**Description**
xx.xx	Depending on motor type

HPN

Technical data

Table 1.4

	Unit	HPN-11A											
Number of stages		single stage				double stage							
Ratio	i [ ]	4	5	7	10	15	20	25	30	35	40	45	50
Repeated peak torque	T_R [Nm]	14	16	11	9	24	24	24	26	26	26	26	26
Rated torque	T_N [Nm]	14	14	11	9	18	22	20	25	26	26	26	26
Momentary peak torque	T_M [Nm]	40	40	40	40	40	40	40	40	40	40	40	40
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	10000											
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000											
Weight	m [kg]	0.44				0.57							
Backlash	[arcmin]	≤ 5				≤ 7							
Torsional stiffness	K_3 [x10³ Nm/rad]	2											
Ambient operating temperature	[°C]	0 … 40											
Output bearing [1]													
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	480											
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	640											

1) Calculated for an L50 life time of 20000 hours operating at an output speed of 100 rpm

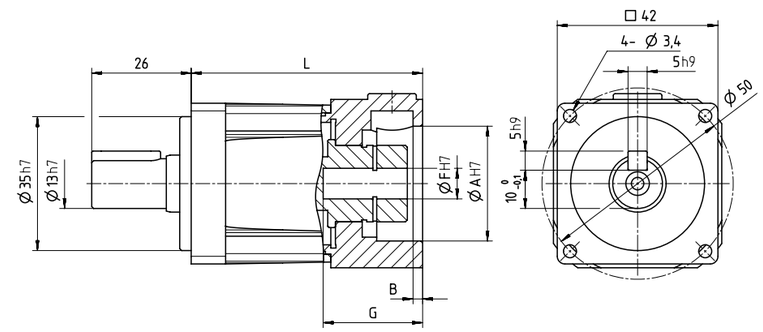
Table 1.5

	Unit	HPN-14A											
Number of stages		single stage					double stage						
Ratio	i [ ]	3	4	5	7	10	15	20	25	30	35	40	45	50
Repeated peak torque	T_R [Nm]	25	50	50	37	18	43	49	38	48	49	38	38	26
Rated torque	T_N [Nm]	22	28	29	30	18	30	30	30	40	40	30	30	26
Momentary peak torque	T_M [Nm]	89	110	107	100	79	97	100	102	98	99	100	100	94
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	6000												
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000												
Weight	m [kg]	0.95					1.3							
Backlash	[arcmin]	≤ 5					≤ 7							
Torsional stiffness	K_3 [x10³ Nm/rad]	9.3												
Ambient operating temperature	[°C]	0 … 40												
Output bearing [1]														
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	840												
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	900												

1) Calculated for an L50 life time of 20000 hours operating at an output speed of 100 rpm

Illustration 1.1

HPN-11A [mm]



A, B, F, G and L depends on the motor type

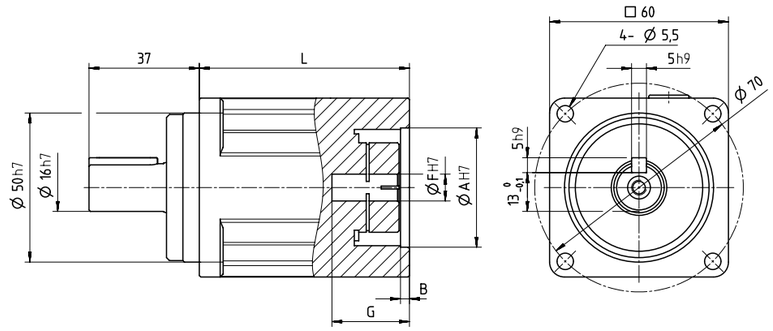
Table 1.6

[mm]

Length	single stage	double stage
L	60	80

Illustration 1.2

HPN-14A [mm]



A, B, F, G and L depends on the motor type

Table 1.7

[mm]

Length	single stage		double stage	
	min	max	min	max
L	70	75	95	100

Technical data

Table 1.8

	Unit	HPN-20A												
Number of stages		single stage					double stage							
Ratio	i [ ]	3	4	5	7	10	15	20	25	30	35	40	45	50
Repeated peak torque	T_R [Nm]	74	130	149	113	54	129	147	114	139	112	112	112	75
Rated torque	T_N [Nm]	51	80	80	80	54	80	80	80	80	80	80	80	75
Momentary peak torque	T_M [Nm]	226	256	256	256	216	256	256	256	250	256	256	256	216
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	6000												
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000												
Weight	m [kg]	2.6					3.2							
Backlash	[arcmin]	≤ 5					≤ 7							
Torsional stiffness	K_3 [x10³ Nm/rad]	26												
Ambient operating temperature	[°C]	0 … 40												
Output bearing [1]														
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	1800												
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	2200												

[1] Calculated for an L50 life time of 20000 hours operating at an output speed of 100 rpm

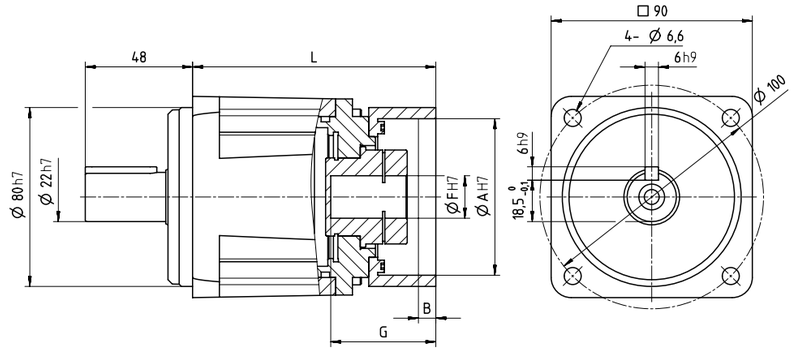
Table 1.9

	Unit	HPN-32A												
Number of stages		single stage					double stage							
Ratio	i [ ]	3	4	5	7	10	15	20	25	30	35	40	45	50
Repeated peak torque	T_R [Nm]	254	376	376	376	185	376	376	376	376	376	376	376	251
Rated torque	T_N [Nm]	153	198	200	200	185	200	200	200	250	250	300	300	251
Momentary peak torque	T_M [Nm]	625	625	625	625	625	625	625	625	625	625	625	625	625
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	6000												
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000												
Weight	m [kg]	6.5					7.2							
Backlash	[arcmin]	≤ 5					≤ 7							
Torsional stiffness	K_3 [x10³ Nm/rad]	94												
Ambient operating temperature	[°C]	0 … 40												
Output bearing [1]														
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	3900												
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	3800												

[1] Calculated for an L50 life time of 20000 hours operating at an output speed of 100 rpm

Illustration 1.3

HPN-20A [mm]



A, B, F, G and L depends on the motor type

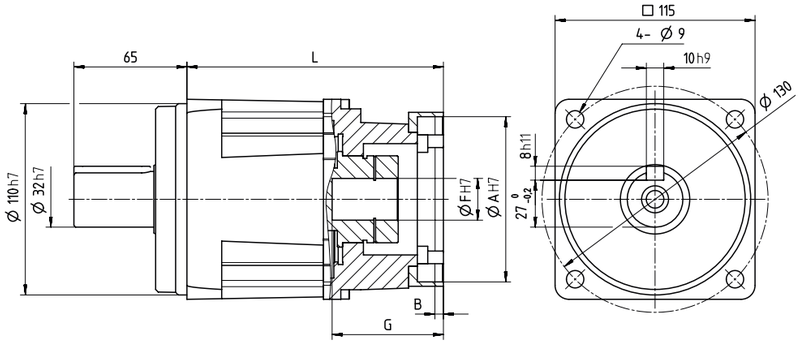
Table 1.10

[mm]

Length	single stage		double stage	
	min	max	min	max
L	104	122	126	144

Illustration 1.4

HPN-32A [mm]



A, B, F, G and L depends on the motor type

Table 1.11

[mm]

Length	single stage		double stage	
	min	max	min	max
L	130	169	167	190

Technical data

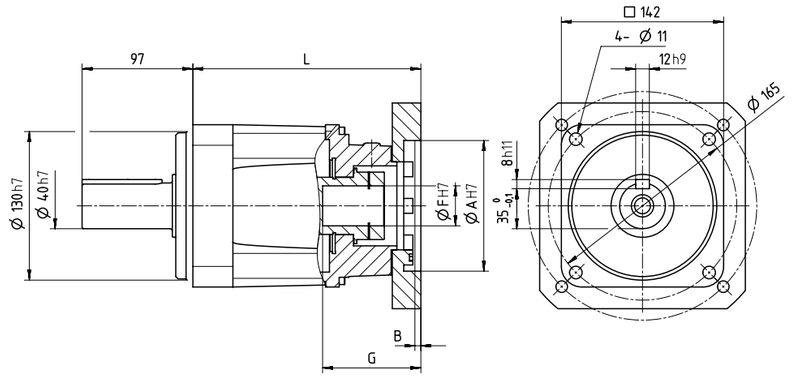
Table 1.12

	Unit	HPN-40A												
Number of stages		single stage					double stage							
Ratio	i [ ]	3	4	5	7	10	15	20	25	30	35	40	45	50
Repeated peak torque	T_R [Nm]	752	752	752	752	509	752	752	752	752	752	752	752	562
Rated torque	T_N [Nm]	440	460	480	510	480	530	600	650	650	700	700	700	562
Momentary peak torque	T_M [Nm]	1137	1265	1265	829	829	1265	1265	1127	1265	1127	1127	1127	1162
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	6000												
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000												
Weight	m [kg]	13					16							
Backlash	[arcmin]	≤ 5					≤ 7							
Torsional stiffness	K_3 [x10³ Nm/rad]	143												
Ambient operating temperature	[°C]	0 … 40												
Output bearing [1]														
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	5500												
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	5400												

[1] Calculated for an L50 life time of 20000 hours operating at an output speed of 100 rpm

Illustration 1.5

HPN-40A [mm]

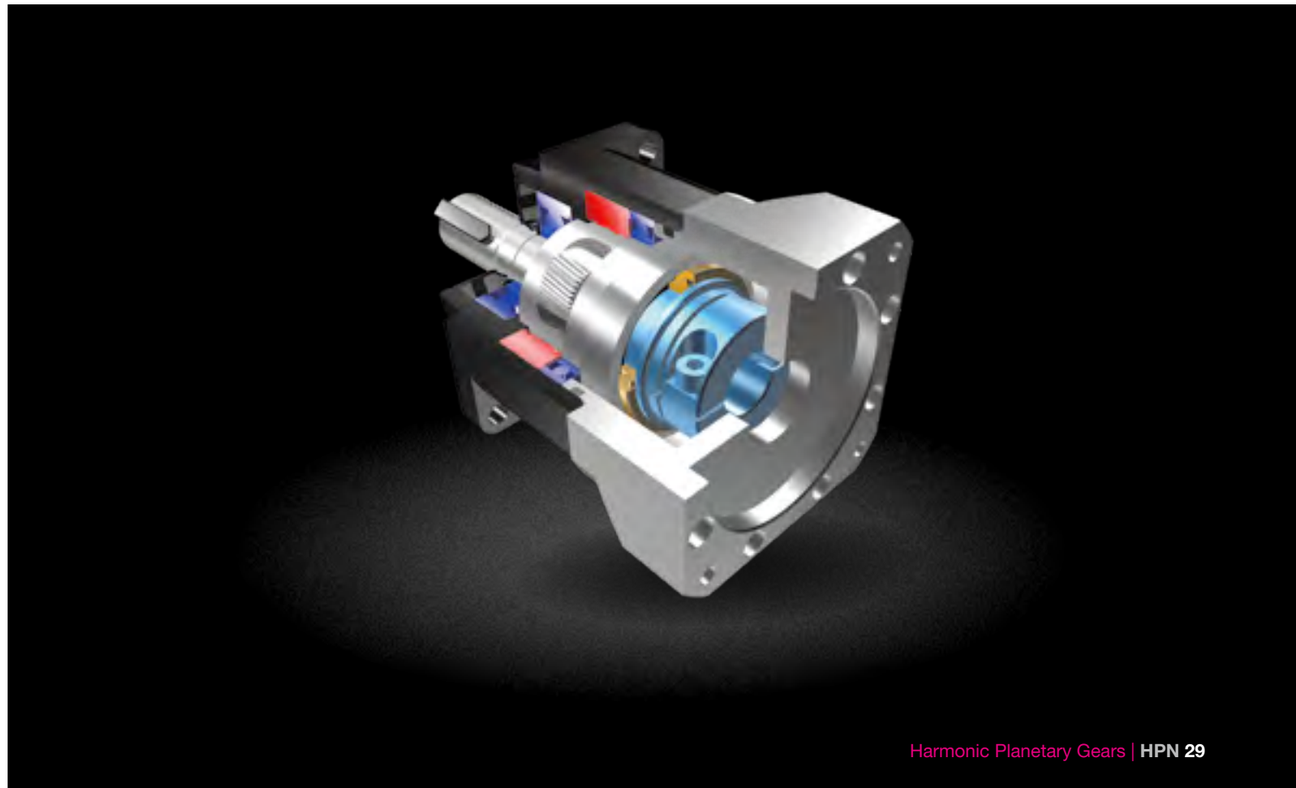


A, B, F, G and L depends on the motor type

Table 1.13

[mm]

Length	single stage		double stage	
	min	max	min	max
L	199	232	213	251



Enhanced performance with Permanent Precision®

HPGP Series Planetary Gears operate at higher speeds with lower ratios and there is often a need for the highest 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®!

The HPGP Series Planetary Gears are available in six sizes with eleven gear ratios between 4 and 45:1 offering repeatable peak torques from 10 to 2920 Nm. The precision output bearing with high tilting rigidity enables the direct introduction of high payloads without further support and thus permits simple and space saving designs.

HPGP enhanced series of Planetary Gears are available in three versions: with output flange, with smooth output shaft and output shaft with keyway.

Standard servo motors can be simply coupled to our Planetary Gears. Gearbox and motor together form a compact and lightweight system capable of withstanding high payloads ensuring stable machine properties with short cycle times are guaranteed.

Optimised for your applications:

- Permanent Precision®
- High torque density
- High dynamics
- Direct motor connection
- Integrated high capacity output bearing

Features

HPGP

Ordering code

Table 2.1

Series	Size	Ratio							Version	Code for motor adaption	Backlash class	Special design
HPGP	11A		5			21	37	45	FO, J20, J60	Depending on motor type	BL3	According to customer requirements
	14A		5	11	15	21	33	45	FO J2 J6		BL1 BL3	
	20A		5	11	15	21	33	45				
	32A		5	11	15	21	33	45				
	50A		5	11	15	21	33	45				
	65A	4	5	12	15	20	25					

Ordering code

HPGP	**-**	**14A**	**-**	**11**	**-**	**F0**	**-**	**E14.20**	**-**	**BL1**	**-**	**SP**

Table 2.2

Backlash class	
Ordering code	Backlash
BL1	≤ 1 arcmin
BL3	≤ 3 arcmin

Table 2.3

Code for motor adaption	
Ordering code	Description
Exx.xx	Depending on motor type

Table 2.4

Version	
Ordering code	Description
F0	Abtriebsflansch
J2/J20	Abtriebswelle ohne Passfeder
J6/J60	Abtriebswelle mit Passfeder

Technical data

Table 2.5

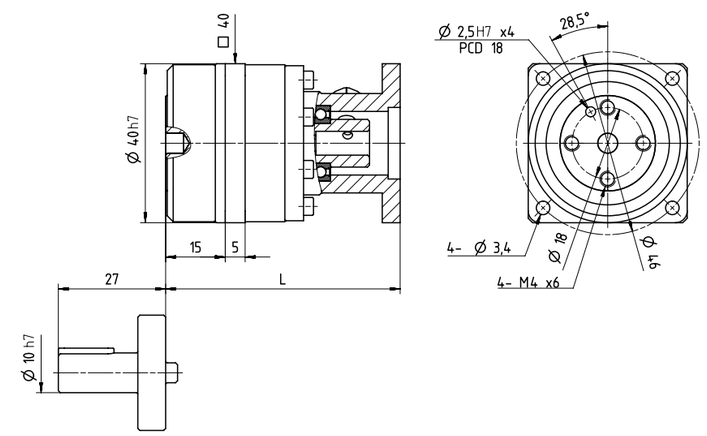
	Unit	HPGP-11			
Ratio	i [ ]	5	21	37	45
Repeated peak torque	T_R [Nm]	10	13	13	13
Average torque	T_A [Nm]	6.7	8.0	8.0	8.0
Rated torque	T_N [Nm]	3.4	4.6	4.6	4.6
Momentary peak torque	T_M [Nm]	20	20	20	20
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	10000			
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000			
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	0.24	0.18	0.07	0.05
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	0.40	0.19	0.07	0.05
Weight with output flange (F0)	m [kg]	0.14	0.20		
Weight with output shaft (Jx)	m [kg]	0.18	0.24		
Transmission accuracy	[arcmin]	< 5			
Repeatability	[arcmin]	< ±0.5			
Backlash	[arcmin]	≤ 3			
Torsional stiffness	K_3 [x10^3 Nm/rad]	2.2			
Ambient operating temperature	[°C]	0 … 40			
Output bearing					
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	280	440	520	550
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	430	660	780	830
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	9.5			

Table 2.6

	Unit	HPGP-14					
Ratio	i [ ]	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	30	30	30	30	30	30
Average torque	T_A [Nm]	17	20	20	20	20	20
Rated torque	T_N [Nm]	7.8	10	12	12	13	13
Momentary peak torque	T_M [Nm]	56	56	56	56	56	56
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	6000					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000					
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	1.7	1.8	1.6	0.90	0.29	0.27
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	2.3	1.9	1.7	0.93	0.30	0.28
Weight with output flange (F0)	m [kg]	0.42	0.51				
Weight with output shaft (Jx)	m [kg]	0.54	0.63				
Transmission accuracy	[arcmin]	< 4					
Repeatability	[arcmin]	< ±0.35					
Backlash	[arcmin]	≤ 3 or ≤ 1					
Torsional stiffness	K_3 [x10^3 Nm/rad]	4.7					
Ambient operating temperature	[°C]	0 … 40					
Output bearing							
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	470	600	650	720	830	910
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	700	890	980	1080	1240	1360
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	32.3					

Illustration 2.1

HPGP-11 [mm]



L depends on the motor type

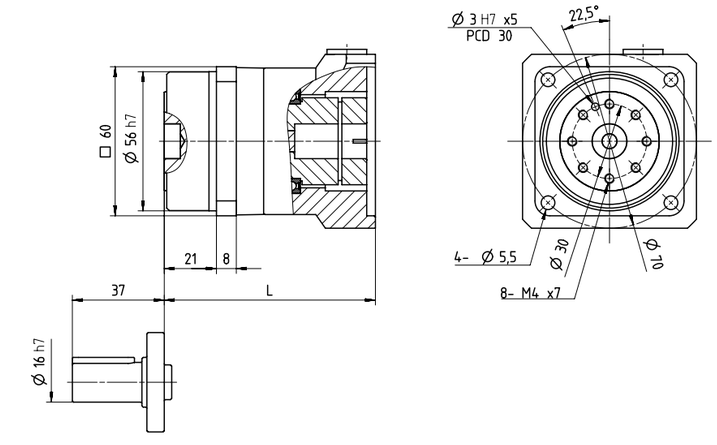
Table 2.7

[mm]

Length	single stage		double stage	
	min	max	min	max
L	55	65	60	70

Illustration 2.2

HPGP-14 [mm]



L depends on the motor type

Table 2.8

[mm]

Length	single stage		double stage	
	min	max	min	max
L	80	95	85	95

Technical data

Table 2.9

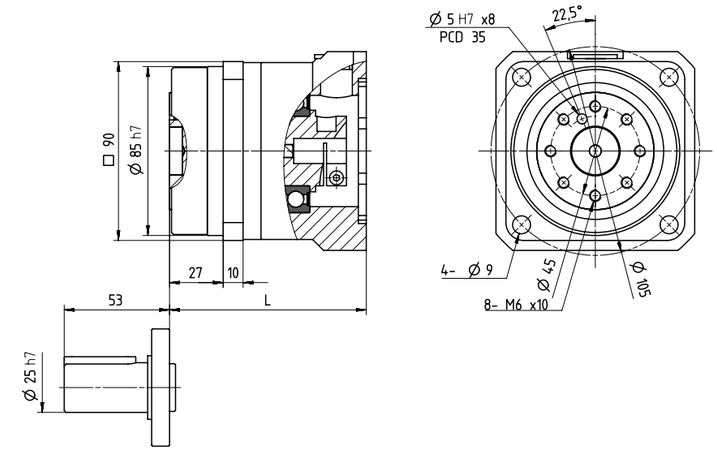
	Unit	HPGP-20					
Ratio	i [ ]	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	133	133	133	133	133	133
Average torque	T_A [Nm]	47	60	70	73	80	80
Rated torque	T_N [Nm]	21	26	32	33	39	39
Momentary peak torque	T_M [Nm]	217	217	217	217	217	217
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	6000					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000					
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	16	17	15	7.1	2.9	2.2
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	20	17	16	7.3	3.0	2.3
Weight with output flange (F0)	m [kg]	1.2	1.5	1.5	1.5	1.6	1.5
Weight with output shaft (Jx)	m [kg]	1.6	1.9	1.9	1.9	2.0	1.9
Transmission accuracy	[arcmin]	< 4					
Repeatability	[arcmin]	< ±0.25					
Backlash	[arcmin]	≤ 3 or ≤ 1					
Torsional stiffness	K_3 [x10^3 Nm/rad]	18					
Ambient operating temperature	[°C]	0 ... 40					
Output bearing							
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	980	1240	1360	1510	1729	1890
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	1460	1850	2030	2250	2580	2830
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	183					

Table 2.10

	Unit	HPGP-32					
Ratio	i [ ]	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	400	400	400	400	400	400
Average torque	T_A [Nm]	200	226	226	226	266	266
Rated torque	T_N [Nm]	87	104	122	130	143	143
Momentary peak torque	T_M [Nm]	650	650	650	650	650	650
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	6000					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000					
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	80	100	74	35	17	12
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	110	110	77	37	17	12
Weight with output flange (F0)	m [kg]	3.0	3.7	3.7	3.7	4.0	3.7
Weight with output shaft (Jx)	m [kg]	4.4	5.1	5.1	5.1	5.4	5.1
Transmission accuracy	[arcmin]	< 4					
Repeatability	[arcmin]	< ±0.25					
Backlash	[arcmin]	≤ 3 or ≤ 1					
Torsional stiffness	K_3 [x10^3 Nm/rad]	74					
Ambient operating temperature	[°C]	0 ... 40					
Output bearing							
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	1900	2410	2640	2920	3340	3670
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	2830	3590	3940	4360	4990	5480
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	452					

Illustration 2.3

HPGP-20 [mm]



L depends on the motor type

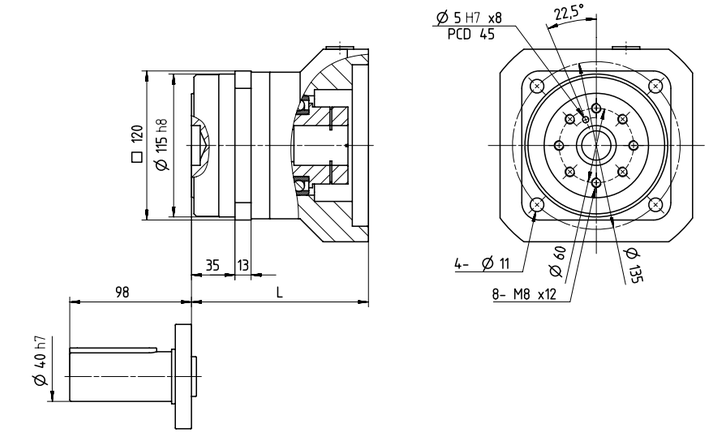
Table 2.11

[mm]

Length	single stage		double stage	
	min	max	min	max
L	90	105	95	105

Illustration 2.4

HPGP-32 [mm]



L depends on the motor type

Table 2.12

[mm]

Length	single stage		double stage	
	min	max	min	max
L	135	145	135	150

Technical data

Table 2.13

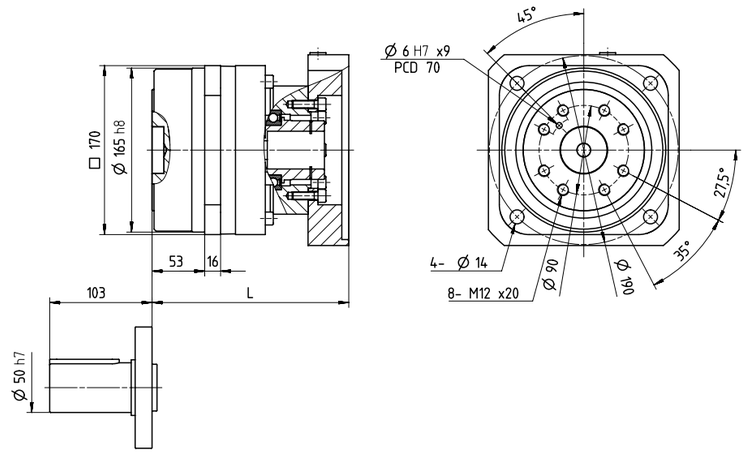
	Unit	HPGP-50					
Ratio	i [ ]	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	1130	1130	1130	1130	1130	1130
Average torque	T_A [Nm]	452	532	600	665	665	665
Rated torque	T_N [Nm]	226	266	306	346	359	359
Momentary peak torque	T_M [Nm]	1850	1850	1850	1850	1850	1850
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	4500					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	2000					
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	490	400	350	160	72	50
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	620	420	370	170	75	52
Weight with output flange (F0)	m [kg]	10	12				
Weight with output shaft (Jx)	m [kg]	13	15				
Transmission accuracy	[arcmin]	< 3					
Repeatability	[arcmin]	< ±0.25					
Backlash	[arcmin]	≤ 3 or ≤ 1					
Torsional stiffness	K_3 [x10^3 Nm/rad]	470					
Ambient operating temperature	[°C]	0 … 40					
Output bearing							
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	4350	5500	6050	6690	7660	8400
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	6490	8220	9030	9980	11400	12500
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	1076					

Table 2.14

	Unit	HPGP-65					
Ratio	i [ ]	4	5	12	15	20	25
Repeated peak torque	T_R [Nm]	2920	2920	2920	2920	2920	2920
Average torque	T_A [Nm]	1200	1330	1460	1730	2000	2000
Rated torque	T_N [Nm]	605	705	798	971	1060	1130
Momentary peak torque	T_M [Nm]	4500	4500	4500	4500	4500	4500
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	2500	3000				
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	2000					
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	3100	2100	2000	1900	730	680
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	4600	3000	2200	2000	780	720
Weight with output flange (F0)	m [kg]	22		37			
Weight with output shaft (Jx)	m [kg]	32		47			
Transmission accuracy	[arcmin]	< 3					
Repeatability	[arcmin]	< ±0.25					
Backlash	[arcmin]	≤ 3 or ≤ 1					
Torsional stiffness	K_3 [x10^3 Nm/rad]	1300					
Ambient operating temperature	[°C]	0 … 40					
Output bearing							
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	8860	9470	12300	13100	14300	15300
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	13200	14100	18300	19600	21400	22900
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	3900					

Illustration 2.5

HPGP-50 [mm]



L depends on the motor type

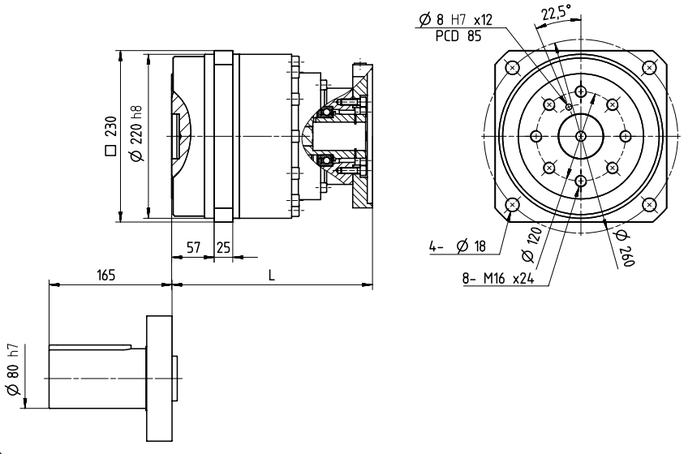
Table 2.15

[mm]

Length	single stage		double stage	
	min	max	min	max
L	180	200	180	200

Illustration 2.6

HPGP-65 [mm]



L depends on the motor type

Table 2.16

[mm]

Length	single stage		double stage	
	min	max	min	max
L	200	220	270	290

Precision gear with newly developed helical gearing

HPG Series Planetary Gears operate at higher speeds with lower ratios and there is often a need for the highest 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®!

The HPG-R Series planetary gear units are available in four sizes with eight gear ratios from 3 to 10 offering repeated peak torque from 5 and 400 Nm. The precision output bearing with high tilting rigidity allows direct introduction of high payloads without further support, thus providing a simple, space saving design.

The newly developed helical gearing, in combination with the flexible ring gear, ensures a long service life and low backlash gearbox. Further advantages of the helical gearing include uniform running behaviour and low noise.

HPG-R Series planetary gearboxes are available in three versions for the output: with output flange, with smooth output flange and with output shaft with keyway. The input shaft with integrated clamping elements allows standard servo motors to be simply coupled to the planetary gears creating a compact and lightweight system capable of withstanding high payloads and ensuring stable machine properties with short cycle times.

Optimised for your applications:

- Permanent Precision®
- Low noise
- Numerous gear ratios
- High dynamics
- Direct motor connection
- Integrated high capacity output bearing

Features

3. HPG-R

HPG-R

Ordering code

Table 3.1

Series	Size	Ratio								Version	Code for motor adaption	Backlash class	Special design
HPG	11R		4	5	6	7	8	9	10	F0, J20, J60	Depending on motor type	BL3	According to customer requirements
	14R	3	4	5	6	7	8	9	10	F0 J2 J6		BL1 BL3	
	20R	3	4	5	6	7	8	9	10				
	32R	3	4	5	6	7	8	9	10				
Ordering code													
HPG	**-**	**14R**	**-**			**10**			**-**	**F0**	**-**	**E14.20**	**-** **BL3** **-** **SP**

Table 3.2

Backlash class	
Ordering code	Backlash
BL1	≤ 1 arcmin
BL3	≤ 3 arcmin

Table 3.3

Code for motor adaption	
Ordering code	Description
Exx.xx	Depending on motor type

Table 3.4

Version	
Ordering code	Description
F0	Output flange
J2	Output shaft without key
J6	Output shaft with key

Technical data

Table 3.5

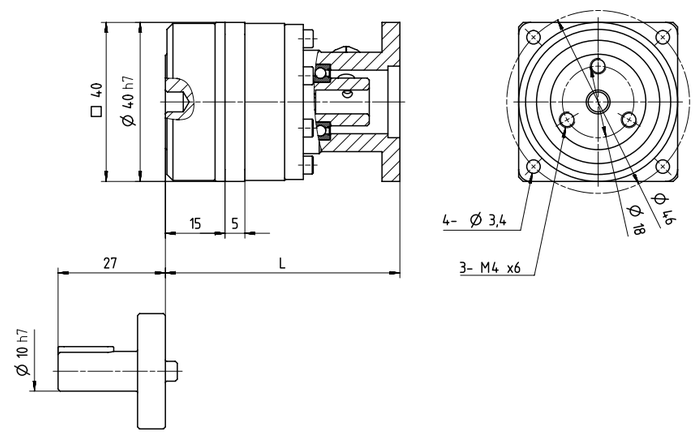
	Unit	HPG-11R						
Number of stages		single stage						
Ratio	i [ ]	4	5	6	7	8	9	10
Repeated peak torque	T_R [Nm]	10	10	10	9	7	6	5
Average torque	T_A [Nm]	6.3	6.5	6.5	7	7	6	5
Rated torque	T_N [Nm]	2.8	2.9	2.9	3.1	3.1	3.1	3.4
Momentary peak torque	T_M [Nm]	20						
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	10000						
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000						
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	0.84	0.53	0.36	0.27	0.2	0.16	0.13
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	1.1	0.69	0.47	0.35	0.26	0.21	0.17
Weight with output flange (F0)	m [kg]	0.19						
Weight with output shaft (Jx)	m [kg]	0.24						
Transmission accuracy	[arcmin]	< 5						
Repeatability	[arcmin]	< ± 0.33						
Backlash	[arcmin]	≤ 3						
Torsional stiffness	K_3 [x10^3 Nm/rad]	2.2						
Ambient operating temperature	[°C]	0 … 40						
Output bearing								
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	260	280	300	315	330	340	350
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	400	430	455	475	495	510	525
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	9.5						

Table 3.6

	Unit	HPG-14R							
Number of stages		single stage							
Ratio	i [ ]	3	4	5	6	7	8	9	10
Repeated peak torque	T_R [Nm]	20	30	30	30	26	20	17	15
Average torque	T_A [Nm]	9	16	16	16	18	18	17	15
Rated torque	T_N [Nm]	4	7	7.2	7.3	7.8	7.8	7.9	8.5
Momentary peak torque	T_M [Nm]	37	56						
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	5000	6000						
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000							
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	7.2	3.7	2.3	2.4	1.8	1.4	1.1	0.87
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	8.9	4.7	3	2.8	2.1	1.6	1.3	1
Weight with output flange (F0)	m [kg]	0.45							
Weight with output shaft (Jx)	m [kg]	0.55							
Transmission accuracy	[arcmin]	< 4							
Repeatability	[arcmin]	< ± 0.25							
Backlash	[arcmin]	≤ 3 or ≤ 1							
Torsional stiffness	K_3 [x10^3 Nm/rad]	4.7							
Ambient operating temperature	[°C]	0 … 40							
Output bearing									
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	405	440	470	500	525	545	565	580
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	600	655	700	740	775	810	840	865
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	32.3							

Illustration 3.1

HPG-11R [mm]



L depends on the motor type

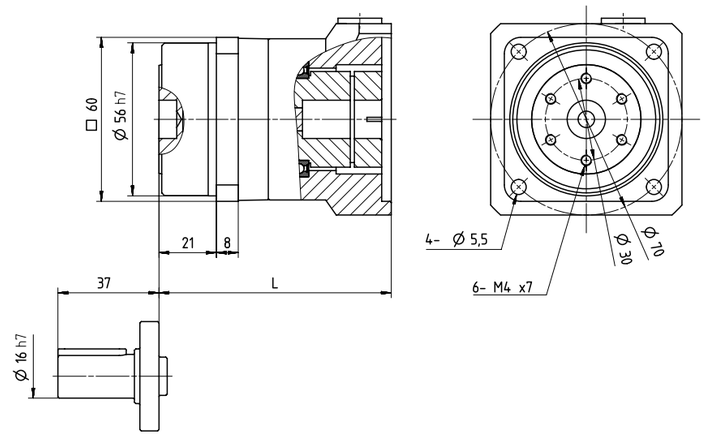
Table 3.7

[mm]

Length	single stage	
	min	max
L	55	65

Illustration 3.2

HPG-14R [mm]



L depends on the motor type

Table 3.8

[mm]

Length	single stage	
	min	max
L	80	95

Technical data

Table 3.9

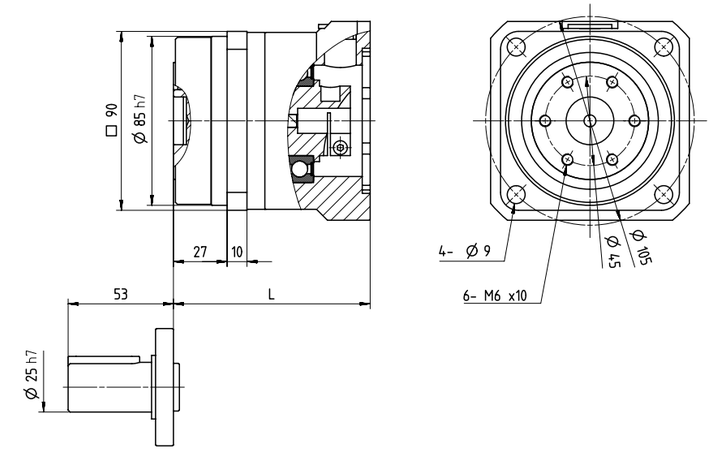
	Unit	HPG-20R							
Number of stages		single stage							
Ratio	i [ ]	3	4	5	6	7	8	9	10
Repeated peak torque	T_R [Nm]	90	133	133	126	108	84	73	65
Average torque	T_A [Nm]	25	51	53	53	56	56	57	61
Rated torque	T_N [Nm]	11	23	23	23	25	25	25	27
Momentary peak torque	T_M [Nm]	124	217						
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	4000	6000						
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000							
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	53	30	19	13	9.3	7	5.5	4.6
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	64	36	23	15	11	8.5	6.7	5.5
Weight with output flange (F0)	m [kg]	1.3							
Weight with output shaft (Jx)	m [kg]	1.7							
Transmission accuracy	[arcmin]	4							
Repeatability	[arcmin]	< ± 0.16							
Backlash	[arcmin]	≤ 3 or ≤ 1							
Torsional stiffness	K_3 [x10^3 Nm/rad]	18							
Ambient operating temperature	[°C]	0 … 40							
Output bearing									
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	0.84	0.92	0.98	1.05	1.1	1.14	1.18	1.2
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	1.25	1.35	1.41	1.52	1.6	1.65	1.73	1.8
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	183							

Table 3.10

	Unit	HPG-32R							
Number of stages		single stage							
Ratio	i [ ]	3	4	5	6	7	8	9	10
Repeated peak torque	T_R [Nm]	290	400	400	390	330	260	220	200
Average torque	T_A [Nm]	110	170	180	180	190	190	190	200
Rated torque	T_N [Nm]	50	77	80	80	85	85	86	92
Momentary peak torque	T_M [Nm]	507	650						
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	3600	6000						
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000							
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	280	130	79	55	41	33	26	22
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	350	170	110	73	55	43	34	28
Weight with output flange (F0)	m [kg]	3.1							
Weight with output shaft (Jx)	m [kg]	4.5							
Transmission accuracy	[arcmin]	4							
Repeatability	[arcmin]	< ± 0.16							
Backlash	[arcmin]	≤ 3 or ≤ 1							
Torsional stiffness	K_3 [x10^3 Nm/rad]	74							
Ambient operating temperature	[°C]	0 … 40							
Output bearing									
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	1.63	1.78	1.9	2	2.1	2.2	2.27	2.34
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	2.43	2.65	2.83	3	3.13	3.26	3.38	2.48
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	452							

Illustration 3.3

HPG-20R [mm]



L depends on the motor type

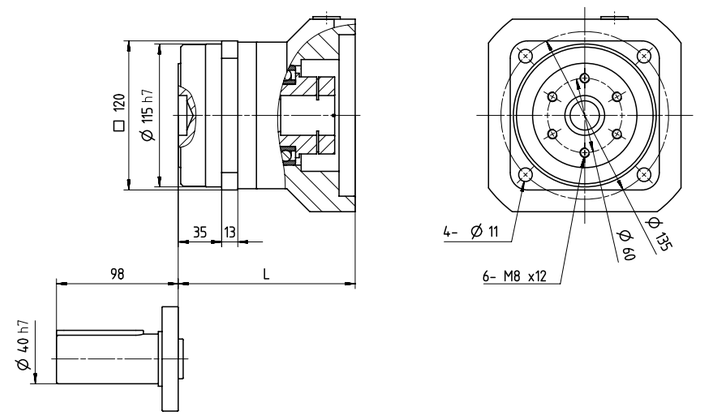
Table 3.11

[mm]

Length	single stage	
	min	max
L	90	105

Illustration 3.4

HPG-32R [mm]



L depends on the motor type

Table 3.12

[mm]

Length	single stage	
	min	max
L	135	145

Low gear ratios for high dynamics

The HPG Series Planetary Gears are available in six sizes with fifteen gear ratios between 3 and 50:1 offering repeatable peak torques from 4 to 2200 Nm. The precision output bearing with high tilting rigidity enables the direct introduction of high payloads without further support and thus permits simple and space saving designs.

HPG Series Planetary Gears are available in three versions for the output: with output flange, with smooth output shaft and with output shaft with keyway. On the input side there is a version for motor adaptation, or alternatively it is available with input shaft.

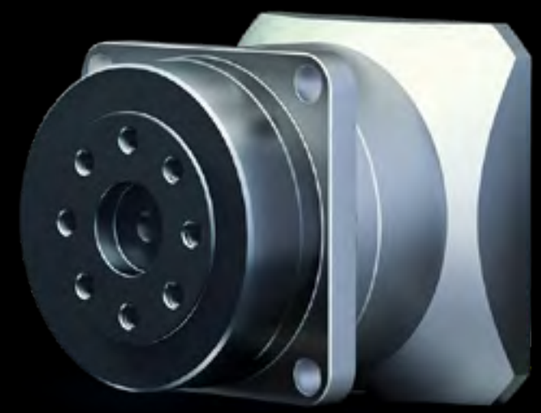
Standard servo motors can be simply coupled to our Planetary Gears. Gear and motor together form a compact and lightweight system capable of withstanding high payloads ensuring stable machine properties with short cycle times are guaranteed.

HPG Series Planetary Gears operate at higher speeds with lower ratios and there is often a need for the highest 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®!

Optimised for your applications:

- Permanent Precision®
- High dynamics
- Direct motor connection
- Integrated high capacity output bearing
- Optional with input shaft

Features



HPG

Ordering code

Table 4.1

Series	Size	Ratio								Backlash class	Version	Code for motor adaption	Special design
HPG	11B		5	9		21	37	45		BL3	F0 J2 J6	Exx.xx U1	According to customer requirements
	14A	3	5	11	15	21	33	45		BL3 BL1			
	20A	3	5	11	15	21	33	45					
	32A	3	5	11	15	21	33	45					
	50A	3	5	11	15	21	33	45					
	65A	4	5	12	15	20	25	40	50				

Ordering code

HPG	**-**	**14A**	**-**	**11**	**-**	**BL3**	**-**	**F0**	**-**	**E14.20**	**-**	**SP**

Table 4.2

Backlash class	
Ordering code	Backlash
BL3	≤ 3 arcmin
BL1	≤ 1 arcmin

Table 4.3

Code for motor adaption	
Ordering code	Description
Exx.xx	Depending on motor type
U1	Input shaft

Table 4.4

Version	
Ordering code	Description
F0	Output flange
J2	Output shaft without key
J6	Output shaft with key

Technical data

Table 4.5

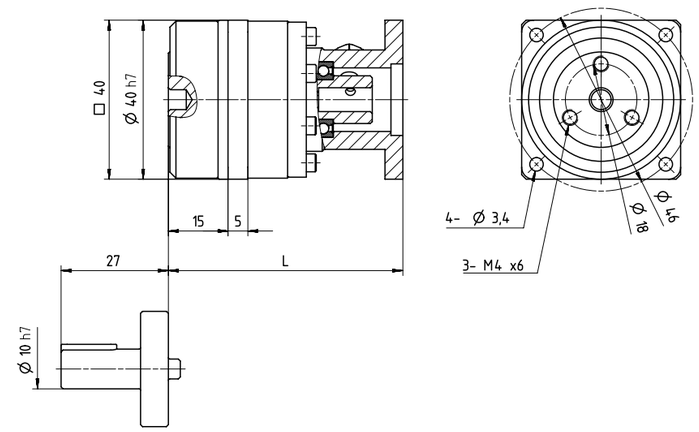
	Unit	HPG-11B				
Ratio	i [ ]	5	9	21	37	45
Repeated peak torque	T_R [Nm]	7.8	3.9	9.8	9.8	9.8
Average torque	T_A [Nm]	5.0	3.9	6.0	6.0	6.0
Rated torque	T_N [Nm]	2.5	2.5	3.5	3.5	3.5
Momentary peak torque	T_M [Nm]	20	20	20	20	20
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	10000				
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000				
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	0.21	0.07	0.18	0.066	0.048
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	0.36	0.12	0.19	0.068	0.049
Weight with output flange (F0)	m [kg]	0.14		0.20		
Weight with output shaft (Jx)	m [kg]	0.18		0.24		
Transmission accuracy	[arcmin]	< 5				
Repeatability	[arcmin]	< ±0.5				
Backlash	[arcmin]	≤ 3				
Torsional stiffness	K_3 [x10^3 Nm/rad]	2.2				
Ambient operating temperature	[°C]	0 … 40				
Output bearing						
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	280	340	440	520	550
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	430	510	660	780	830
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	9.5				

Table 4.6

	Unit	HPG-11B-U1				
Ratio	i [ ]	5	9	21	37	45
Repeated peak torque	T_R [Nm]	7.8	3.9	9.8	9.8	9.8
Average torque	T_A [Nm]	5.0	3.9	6.0	6.0	6.0
Rated torque	T_N [Nm]	2.5	2.5	3.5	3.5	3.5
Momentary peak torque	T_M [Nm]	20	20	20	20	20
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	10000				
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000				
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	0.72	0.58	0.63	0.52	0.50
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	0.87	0.63	0.64	0.52	0.50
Weight with output flange (F0)	m [kg]	0.2		0.26		
Weight with output shaft (Jx)	m [kg]	0.24		0.3		
Transmission accuracy	[arcmin]	< 5				
Repeatability	[arcmin]	< ±0.5				
Backlash	[arcmin]	≤ 3				
Torsional stiffness	K_3 [x10^3 Nm/rad]	2.2				
Ambient operating temperature	[°C]	0 … 40				
Output bearing						
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	280	340	440	520	550
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	430	510	660	780	830
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	9.5				

Illustration 4.1

HPG-11B [mm]



L depends on the motor type

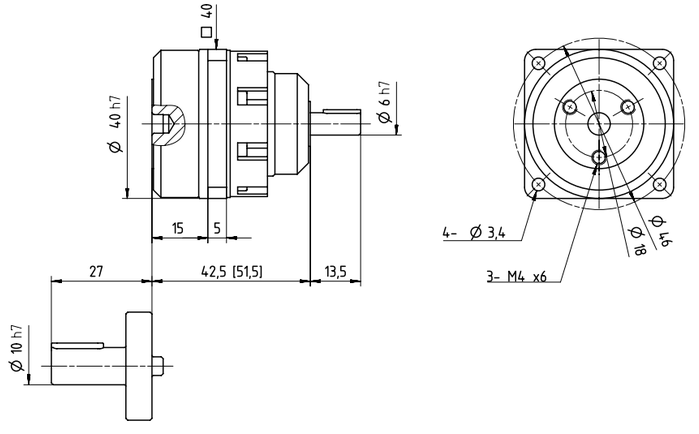
Table 4.7

[mm]

Length	single stage		double stage	
	min	max	min	max
L	55	65	60	70

Illustration 4.2

HPG-11B-U1 [mm]



[ ] double stage

Technical data

Table 4.8

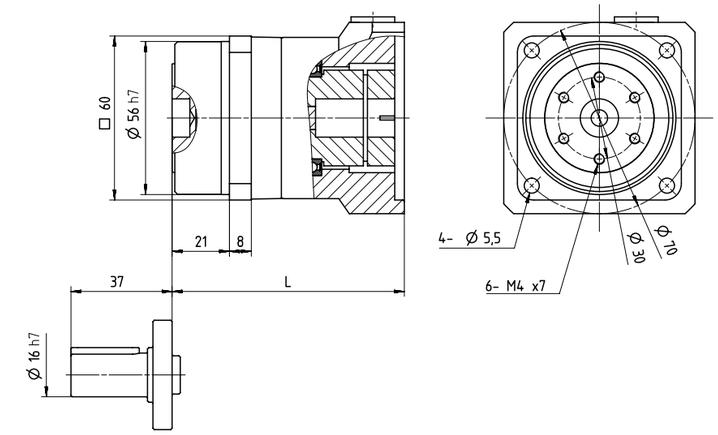
	Unit	HPG-14A						
Ratio	i [ ]	3	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	15	23	23	23	23	23	23
Average torque	T_A [Nm]	6.4	13	15	15	15	15	15
Rated torque	T_N [Nm]	3.0	6.0	8.0	9.0	9.0	10	10
Momentary peak torque	T_M [Nm]	56	56	56	56	56	56	56
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	5000	6000					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000						
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	5.7	2.1	1.6	1.4	0.89	0.29	0.27
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	7.7	2.6	1.9	1.7	0.92	0.30	0.28
Weight with output flange (F0)	m [kg]	0.4		0.5				
Weight with output shaft (Jx)	m [kg]	0.5		0.6				
Transmission accuracy	[arcmin]	< 4						
Repeatability	[arcmin]	< ±0.35						
Backlash	[arcmin]	≤ 3 or ≤ 1						
Torsional stiffness	K_3 [x10^3 Nm/rad]	4.7						
Ambient operating temperature	[°C]	0 … 40						
Output bearing								
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	400	470	600	650	720	830	910
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	600	700	890	980	1080	1240	1360
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	32.3						

Table 4.9

	Unit	HPG-14A-U1						
Ratio	i [ ]	3	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	15	23	23	23	23	23	23
Average torque	T_A [Nm]	6.4	13	15	15	15	15	15
Rated torque	T_N [Nm]	3	6	8	9	9	10	10
Momentary peak torque	T_M [Nm]	56	56	56	56	56	56	56
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	5000	6000					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000						
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	11	6.7	5.8	5.6	4.9	4.3	4.3
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	12	7.3	5.9	5.7	4.9	4.3	4.3
Weight with output flange (F0)	m [kg]	0.7		0.8				
Weight with output shaft (Jx)	m [kg]	0.8		0.9				
Transmission accuracy	[arcmin]	< 4						
Repeatability	[arcmin]	< ±0.35						
Backlash	[arcmin]	≤ 3 or ≤ 1						
Torsional stiffness	K_3 [x10^3 Nm/rad]	4.7						
Ambient operating temperature	[°C]	0 … 40						
Output bearing								
Dynamic radial load	$F_{R\ dyn\ (max)}$ [N]	400	470	600	650	720	830	910
Dynamic axial load	$F_{A\ dyn\ (max)}$ [N]	600	700	890	980	1080	1240	1360
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	32.3						

Illustration 4.3

HPG-14A [mm]



L depends on the motor type

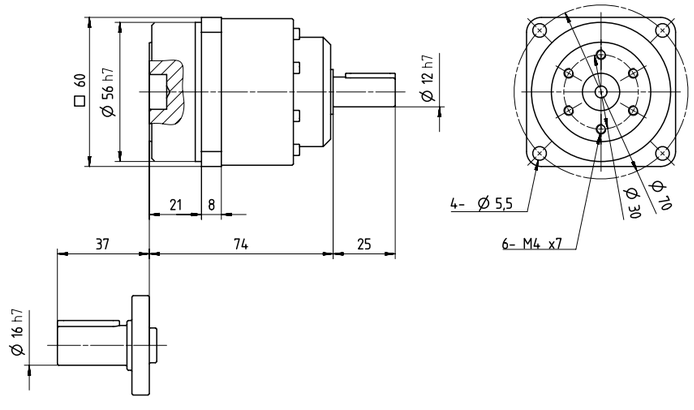
Table 4.10

[mm]

Length	single stage		double stage	
	min	max	min	max
L	80	95	85	95

Illustration 4.4

HPG-14A-U1 [mm]



Technical data

Table 4.11

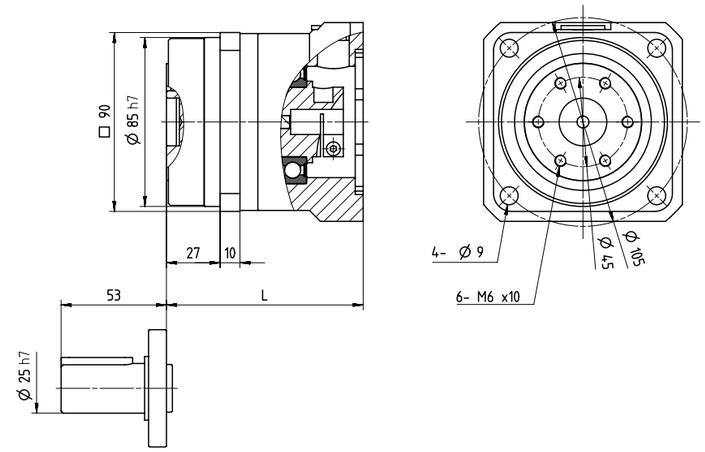
	Unit	HPG-20A						
Ratio	i [ ]	3	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	64	100	100	100	100	100	100
Average torque	T_A [Nm]	19	35	45	53	55	60	60
Rated torque	T_N [Nm]	9	16	20	24	25	29	29
Momentary peak torque	T_M [Nm]	124	217	217	217	217	217	217
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	4000	6000					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000						
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	46	17	15	14	6.9	2.3	2.2
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	57	21	16	14	7.1	2.4	2.2
Weight with output flange (F0)	m [kg]	1.2		1.4				
Weight with output shaft (Jx)	m [kg]	1.6		1.8				
Transmission accuracy	[arcmin]	< 4						
Repeatability	[arcmin]	< ±0.25						
Backlash	[arcmin]	≤ 3 or ≤ 1						
Torsional stiffness	K_3 [x10^3 Nm/rad]	18.5						
Ambient operating temperature	[°C]	0 … 40						
Output bearing								
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	0.84	0.98	1.24	1.36	1.51	1.73	1.89
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	1.25	1.41	1.85	2.03	2.25	2.58	2.83
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	183						

Table 4.12

	Unit	HPG-20A-U1						
Ratio	i [ ]	3	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	64	100	100	100	100	100	100
Average torque	T_A [Nm]	19	35	45	53	55	60	60
Rated torque	T_N [Nm]	9	16	20	24	25	29	29
Momentary peak torque	T_M [Nm]	124	217	217	217	217	217	217
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	4000	6000					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000						
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	69	40	31	30	23	19	18
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	80	44	32	30	23	19	18
Weight with output flange (F0)	m [kg]	2.0		2.1				
Weight with output shaft (Jx)	m [kg]	2.4		2.7				
Transmission accuracy	[arcmin]	< 4						
Repeatability	[arcmin]	< ±0.25						
Backlash	[arcmin]	≤ 3 or ≤ 1						
Torsional stiffness	K_3 [x10^3 Nm/rad]	18.5						
Ambient operating temperature	[°C]	0 … 40						
Output bearing								
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	0.84	0.98	1.24	1.36	1.51	1.73	1.89
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	1.250	1.41	1.85	2.03	2.25	2.58	2.83
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	183						

Illustration 4.5

HPG-20A [mm]



L depends on the motor type

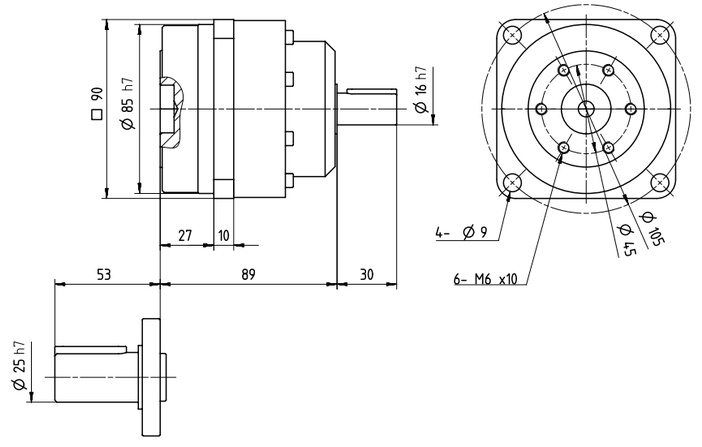
Table 4.13

[mm]

Length	single stage		double stage	
	min	max	min	max
L	90	105	95	105

Illustration 4.6

HPG-20A-U1 [mm]



Technical data

Table 4.14

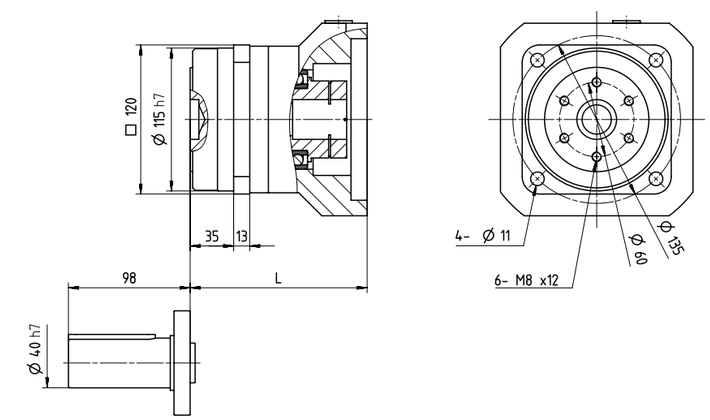
	Unit	HPG-32A						
Ratio	i [ ]	3	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	255	300	300	300	300	300	300
Average torque	T_A [Nm]	71	150	170	170	170	200	200
Rated torque	T_N [Nm]	31	66	88	92	98	108	108
Momentary peak torque	T_M [Nm]	507	650	650	650	650	650	650
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	3600	6000					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000						
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	200	73	78	62	34	12	11
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	280	100	84	65	36	13	12
Weight with output flange (F0)	m [kg]	2.9		3.5				
Weight with output shaft (Jx)	m [kg]	4.3		4.9				
Transmission accuracy	[arcmin]	< 4						
Repeatability	[arcmin]	< ± 0.25						
Backlash	[arcmin]	≤ 3 or ≤ 1						
Torsional stiffness	K_3 [x10^3 Nm/rad]	74.1						
Ambient operating temperature	[°C]	0 … 40						
Output bearing								
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	1.63	1.90	2.41	2.64	2.92	3.34	3.67
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	2.43	2.83	3.59	3.94	4.36	4.99	5.48
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	452						

Table 4.15

	Unit	HPG-32A-U1						
Ratio	i [ ]	3	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	255	300	300	300	300	300	300
Average torque	T_A [Nm]	71	150	170	170	170	200	200
Rated torque	T_N [Nm]	31	66	88	92	98	108	108
Momentary peak torque	T_M [Nm]	507	650	650	650	650	650	650
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	3600	6000					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	3000						
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	340	220	190	180	150	130	130
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	420	240	200	180	150	130	130
Weight with output flange (F0)	m [kg]	4.9		5.3				
Weight with output shaft (Jx)	m [kg]	6.3		6.9				
Transmission accuracy	[arcmin]	< 4						
Repeatability	[arcmin]	< ±0.25						
Backlash	[arcmin]	≤ 3 or ≤ 1						
Torsional stiffness	K_3 [x10^3 Nm/rad]	74.1						
Ambient operating temperature	[°C]	0 … 40						
Output bearing								
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	1.63	1.90	2.41	2.64	2.92	3.34	3.67
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	2.43	2.83	3.59	3.94	4.36	4.99	5.48
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	452						

Illustration 4.7

HPG-32A [mm]



L depends on the motor type

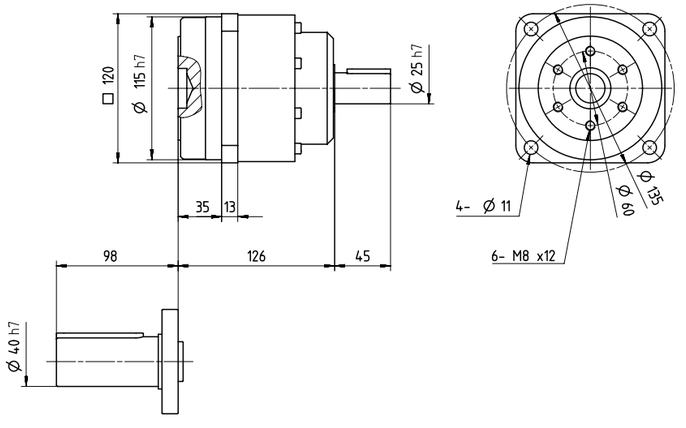
Table 4.16

[mm]

Length	single stage		double stage	
	min	max	min	max
L	135	145	135	150

Illustration 4.8

HPG-32A-U1 [mm]



Technical data

Table 4.17

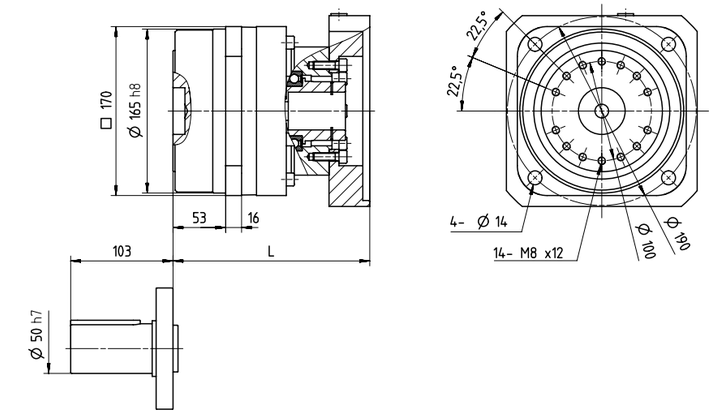
	Unit	HPG-50A						
Ratio	i [ ]	3	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	657	850	850	850	850	850	850
Average torque	T_A [Nm]	195	340	400	450	500	500	500
Rated torque	T_N [Nm]	97	170	200	230	260	270	270
Momentary peak torque	T_M [Nm]	1200	1850	1850	1850	1850	1850	1850
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	3000	4500					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	2000						
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	1300	480	330	290	160	60	60
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	1700	610	360	310	170	63	59
Weight with output flange (F0)	m [kg]	10		12				
Weight with output shaft (Jx)	m [kg]	13		15				
Transmission accuracy	[arcmin]	< 3						
Repeatability	[arcmin]	< ±0.25						
Backlash	[arcmin]	≤ 3 or ≤ 1						
Torsional stiffness	K_3 [x10^3 Nm/rad]	230						
Ambient operating temperature	[°C]	0 … 40						
Output bearing								
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	5.57	6.49	8.22	9.03	9.98	11.4	12.5
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	5.57	6.49	8.22	9.03	9.98	11.4	12.5
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	1076						

Table 4.18

	Unit	HPG-50A-U1						
Ratio	i [ ]	3	5	11	15	21	33	45
Repeated peak torque	T_R [Nm]	657	850	850	850	850	850	850
Average torque	T_A [Nm]	195	340	400	450	500	500	500
Rated torque	T_N [Nm]	97	170	200	230	260	270	270
Momentary peak torque	T_M [Nm]	1200	1200	1850	1850	1850	1850	1850
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	3000	4500					
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	2000						
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	1800	920	710	670	540	430	430
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	2100	1100	740	680	550	440	430
Weight with output flange (F0)	m [kg]	14		16				
Weight with output shaft (Jx)	m [kg]	17		19				
Transmission accuracy	[arcmin]	< 3						
Repeatability	[arcmin]	< ±0.25						
Backlash	[arcmin]	≤ 3 or ≤ 1						
Torsional stiffness	K_3 [x10^3 Nm/rad]	230						
Ambient operating temperature	[°C]	0 … 40						
Output bearing								
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	5.57	6.49	8.22	9.03	9.98	11.4	12.5
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	5.57	6.49	8.22	9.03	9.98	11.4	12.5
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	1076						

Illustration 4.9

HPG-50A [mm]



L depends on the motor type

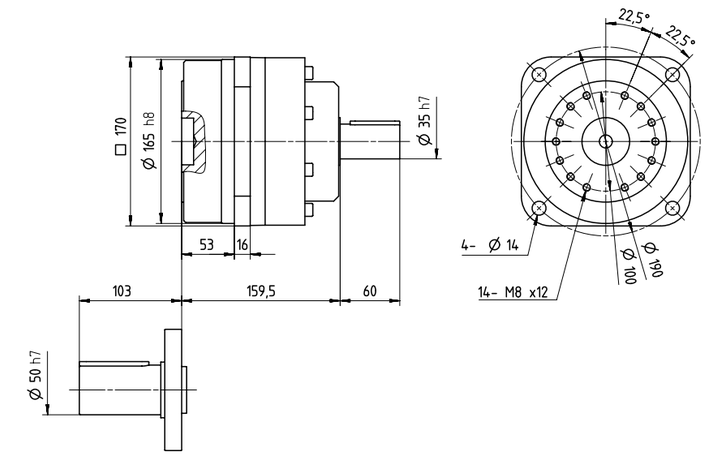
Table 4.19

[mm]

Length	single stage		double stage	
	min	max	min	max
L	180	200	180	200

Illustration 4.10

HPG-50A-U1 [mm]



Technical data

Table 4.20

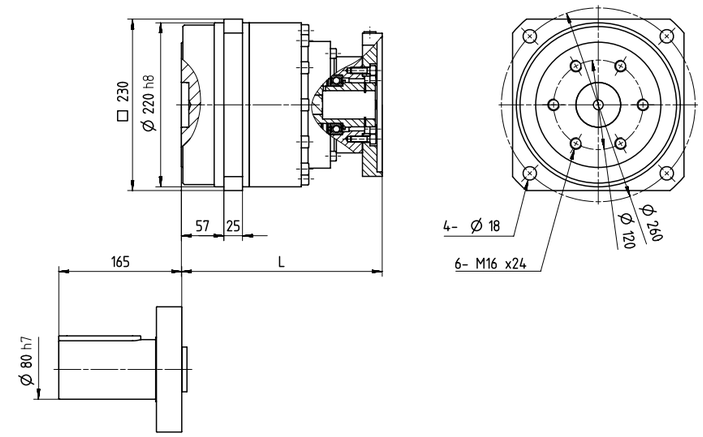
	Unit	HPG-65A							
Ratio	i [ ]	4	5	12	15	20	25	40	50
Repeated peak torque	T_R [Nm]	2200	2200	2200	2200	2200	2200	1900	2200
Average torque	T_A [Nm]	900	1000	1100	1300	1500	1500	1300	1500
Rated torque	T_N [Nm]	500	530	600	730	800	850	640	750
Momentary peak torque	T_M [Nm]	4500							
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	2500	3000						
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	2000							
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	2800	1800	1700	1600	650	610	130	120
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	4200	2700	1800	1700	710	650	150	130
Weight with output flange (F0)	m [kg]	22		37					
Weight with output shaft (Jx)	m [kg]	32		47					
Transmission accuracy	[arcmin]	< 3							
Repeatability	[arcmin]	< ±0.25							
Backlash	[arcmin]	≤ 3 or ≤ 1							
Torsional stiffness	K_3 [x10^3 Nm/rad]	1290							
Ambient operating temperature	[°C]	0 … 40							
Output bearing									
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	13.2	14.1	18.3	19.6	21.4	22.9	26.3	28.2
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	13.2	14.1	12.3	13.1	14.3	15.3	17.6	18.9
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	3900							

Table 4.21

	Unit	HPG-65A-U1							
Ratio	i [ ]	4	5	12	15	20	25	40	50
Repeated peak torque	T_R [Nm]	2200	2200	2200	2200	2200	2200	1900	2200
Average torque	T_A [Nm]	900	1000	1100	1300	1500	1500	1300	1500
Rated torque	T_N [Nm]	500	530	600	730	800	850	640	750
Momentary peak torque	T_M [Nm]	4500							
Maximum input speed (grease lubrication)	$n_{in\ (max)}$ [rpm]	2500	3000						
Average input speed (grease lubrication)	$n_{av\ (max)}$ [rpm]	2000							
Moment of inertia with output flange (F0)	J_{in} [x10^{-6} kgm^2]	4400	3400	3200	3100	2100	2100	1600	1600
Moment of inertia with output shaft (Jx)	J_{in} [x10^{-6} kgm^2]	5800	4300	3300	3200	2200	2100	1600	1600
Weight with output flange (F0)	m [kg]	33		48					
Weight with output shaft (Jx)	m [kg]	43		58					
Transmission accuracy	[arcmin]	< 3							
Repeatability	[arcmin]	< ±0.25							
Backlash	[arcmin]	≤ 3 or ≤ 1							
Torsional stiffness	K_3 [x10^3 Nm/rad]	1290							
Ambient operating temperature	[°C]	0 … 40							
Output bearing									
Dynamic radial load	$F_{R\ dyn\ (max)}$ [kN]	13.2	14.1	18.3	19.6	21.4	22.9	26.3	28.2
Dynamic axial load	$F_{A\ dyn\ (max)}$ [kN]	13.2	14.1	12.3	13.1	14.3	15.3	17.6	18.9
Dynamic tilting moment	$M_{dyn\ (max)}$ [Nm]	3900							

Illustration 4.11

HPG-65A [mm]



L depends on the motor type

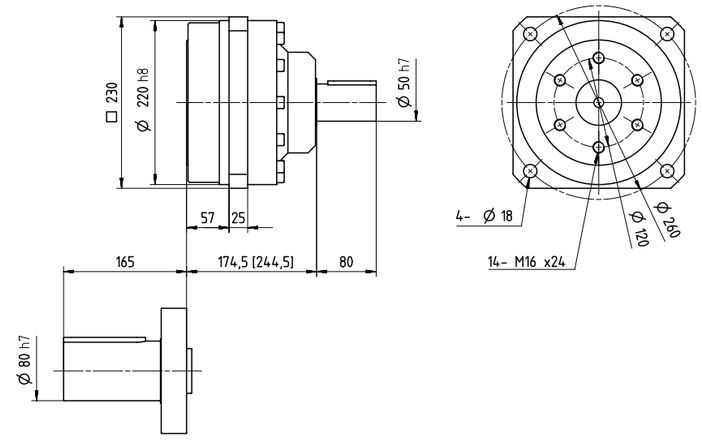
Table 4.22

[mm]

Length	single stage		double stage	
	min	max	min	max
L	200	220	270	290

Illustration 4.12

HPG-65A-U1 [mm]



[ ] double stage

PASSION GENERATES THE HIGHEST QUALITY

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