福德机器人
FDROBOT

PRECISION HARMONIC REDUCER

Sichuan FDRobot Co., Ltd.

FD Precision,Ultimate Transmission

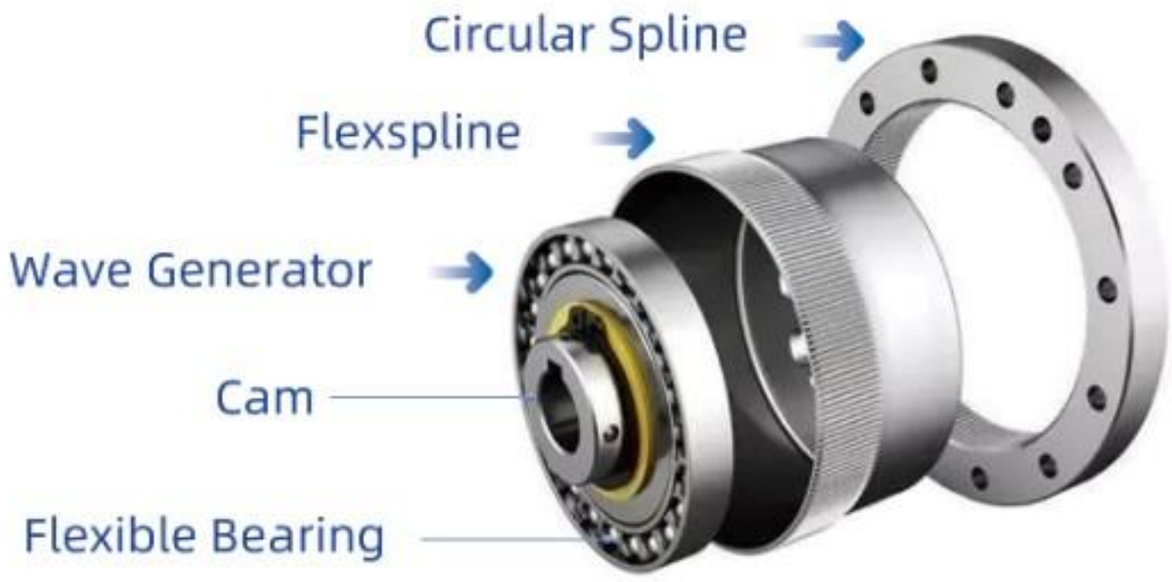
Components of a Harmonic Drive

The harmonic transmission device mainly consists of 3 basic components: wave generator, flexspline and circular spline.

■ **Wave Generator**: It consists of an elliptical cam and a flexible bearing, which is usually connected to the input shaft. The inner ring of the flexible bearing is fixed to the cam, and the outer ring is elastically shaped into an ellipse by means of ball rollers.

■ **Flexspline**: A metal elastomer part with a gear on the outer ring of the open part, which deforms with the rotation of the wave generator and is usually connected to the output shaft.

■ **Circular Spline**: Rigid internal gear, generally 2 teeth more than the flexspline, usually fixed to the casing.



0°

The circular spline engages the flexspline at the long axis of the ellipse.
The short axis is disengaged and the circular spline is fixed.

90°

After 90° clockwise rotation of the cam, the flexspline elastically deformed engagement position rotate in sequence.

180°

After 180° of clockwise rotation of the cam, the flexspline moves one tooth anticlockwise.

360°

After 360° of cam rotation, since the flexspline has two fewer teeth than the circular spline, the the flexspline will move 2 teeth counterclockwise.

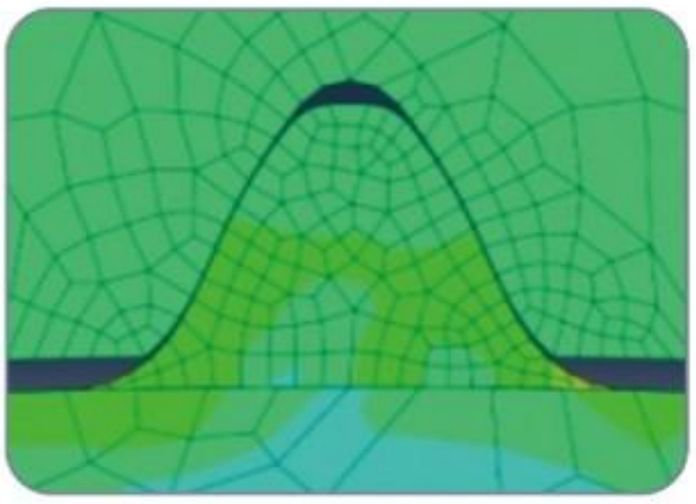
Classification of a Harmonic Reducer

Classification by torque	Standard torque type、 High torque type
Classification of flexspline structure	Hat type、 Cup type
Classification according to the height of the corkscrew	Ultra-thin type、Standard type
Classification by installation and use	Combination type、Component type

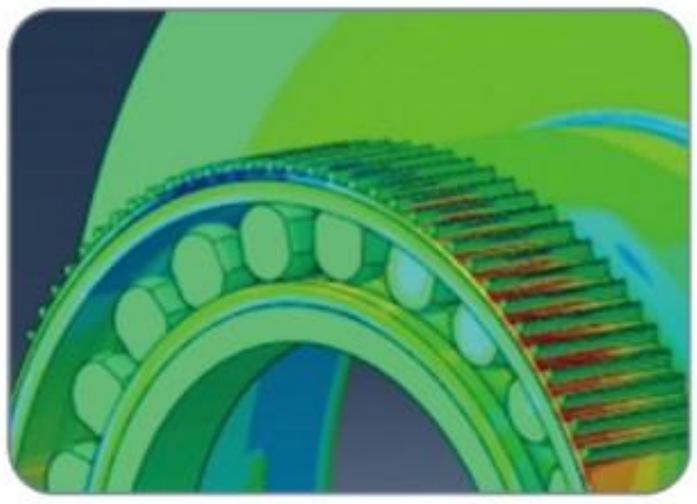
Technical Advantage

Adopting finite element simulation analysis and virtual prototype technology, systematic design of tooth structure, tooth surface stress, thickness of flexible wheel, strength of flexible bearing and other indicators, to ensure the optimisation of the theoretical design indicators, and at the same time, through a large number of processing, trial production, test to make corrections to the theoretical design.

New multi-section arc "RS tooth shape"



(Tooth shape simulation)



(Contact stress simulation)

The "RS tooth profile" overcomes the shortcomings of the previous harmonic meshing tooth profile, and through a series of innovative designs, greatly improves the service life of the flex wheel, with the following advantages:

- Optimised tooth height, optimum meshing distance to obtain a larger meshing volume, reducing the pressure on the tooth surface;
- Optimised tooth root curvature, reducing the risk of fracture failure;
- Smaller deformation of the flexure wheel required, resulting in a greatly increased flexure wheel life;
- Significantly higher ratio of meshing teeth, increasing the stiffness.

Specially Developed Flexible Bearings

Flexible bearing is the weakest link in the life of harmonic reducer, and it is one of the biggest factors affecting the life of the reducer to ensure precision. We use special materials and heat treatment technology to perfectly solve the problem of the life of the flexible bearing, to achieve the flexible bearing wear rate of orders of magnitude lower, the real can compete with the highest international level of indicators.

- Optimised bearing wear resistance design;
- Optimised tribological design;
- Optimised design of the retention bracket;
- Special material selection and the best heat treatment technology.

Advanced Bearing Wear Resistance Technology

Wear-resistant technology was not applied:

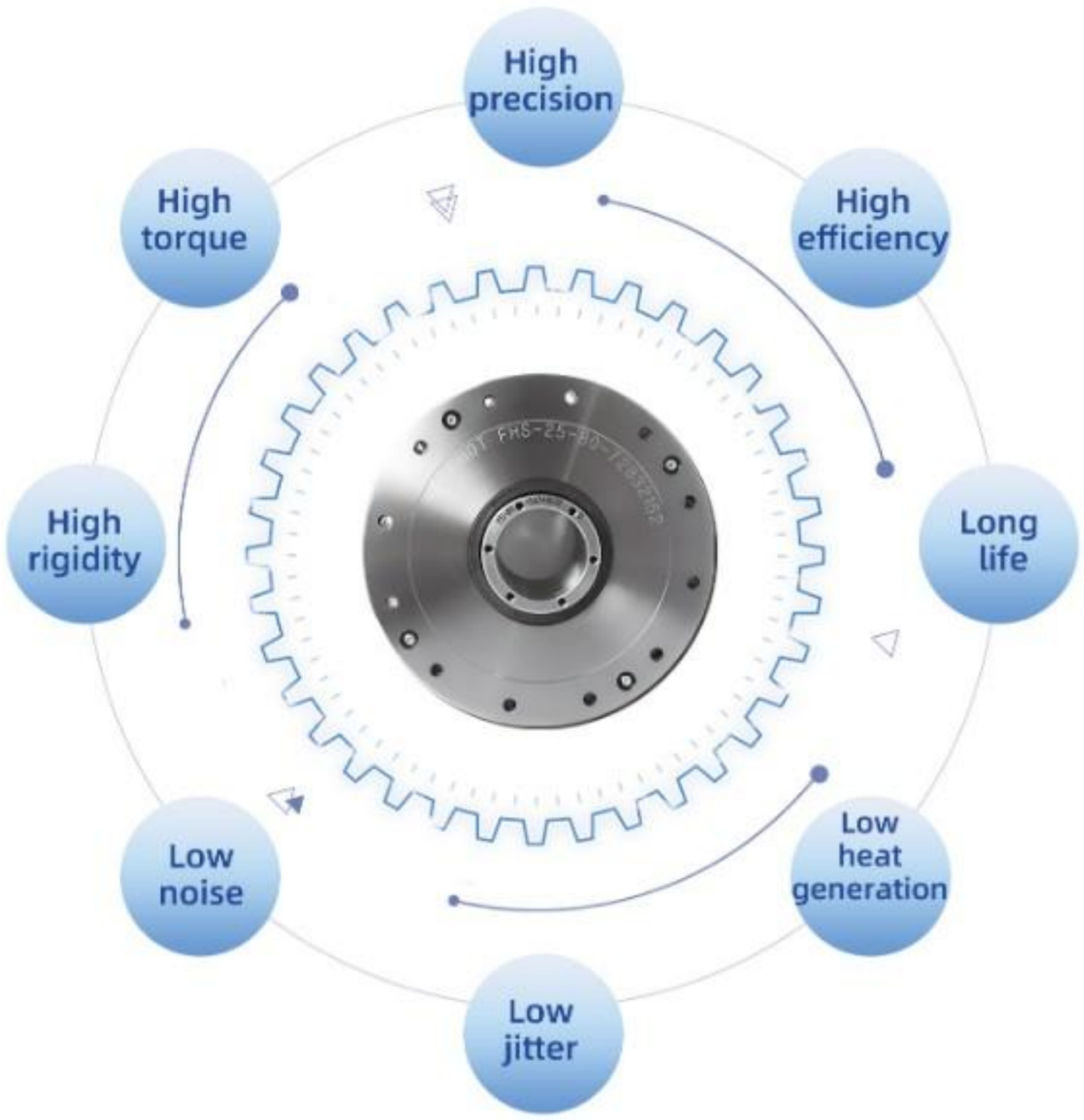
The surface of the steel balls is worn and abrasive.

With wear-resistant technology:

The surface of the steel balls is virtually wear-free and as bright as new.

On the basis of PVD traditional film technology, self-developed materials and low-temperature process are used to generate a nano-scale reinforced coating on the workpiece, which is resistant to metal adhesion sintering. Bearing wear is significantly reduced after the implementation of wear-resistant technology.

Core Competence



1 Advanced theoretical design

Advanced design means, new RS tooth shape, optimised flexible bearing, optimised flexible wheel design.

2 Advanced R&D design

Special material selection, adequate tribological design, special heat treatment process, optimised wear resistance design.

3 Advanced Manufacturing

Innovative processing equipment, optimised process flow, rigorous inspection apparatus, scientific quality management.

Common Reduction Ratios of Harmonic Reducer

Paradigm √ : Yes/Customisable - : No

Structure Type	Model Size	Standard Torque Model Reduction Ratio						High Torque Model Ratio					Customised Ratios
		30	50	80	100	120	160	50	80	100	120	160	
Standard Model	3	√	√	√	√	-	-	-	-	-	-	-	√
	5	√	√	√	√	-	-	-	-	-	-	-	√
	8	√	√	√	√	-	-	-	-	-	-	-	√
	11	√	√	√	√	-	-	√	√	√	-	-	√
	14	√	√	√	√	-	-	√	√	√	-	-	√
	17	√	√	√	√	√	-	√	√	√	√	-	√
	20	√	√	√	√	√	√	√	√	√	√	√	√
	25	√	√	√	√	√	√	√	√	√	√	√	√
	32	√	√	√	√	√	√	√	√	√	√	√	√
	40	-	√	√	√	√	√	√	√	√	√	√	√
	45	-	√	√	√	√	√	√	√	√	√	√	√
	50	-	√	√	√	√	√	√	√	√	√	√	√
	58	-	√	√	√	√	√	√	√	√	√	√	√
	65	-	√	√	√	√	√	√	√	√	√	√	√
	80	-	√	√	√	√	√	√	√	√	√	√	√
	90	-	√	√	√	√	√	√	√	√	√	√	√
	100	-	√	√	√	√	√	√	√	√	√	√	√
Ultra-thin Model	5	√	√	√	√	-	-	-	-	-	-	-	√
	8	√	√	√	√	-	-	-	-	-	-	-	√
	11	√	√	√	√	-	-	-	-	-	-	-	√
	14	-	√	√	√	-	-	-	-	-	-	-	√
	17	-	√	√	√	√	-	-	-	-	-	-	√
	20	-	√	√	√	√	√	-	-	-	-	-	√
	25	-	√	√	√	√	√	-	-	-	-	-	√
	32	-	√	√	√	√	√	-	-	-	-	-	√
	40	-	√	√	√	√	√	-	-	-	-	-	√
	45	-	√	√	√	√	√	-	-	-	-	-	√
	50	-	√	√	√	√	√	-	-	-	-	-	√

About customised ratios: For customised ratios, please consult our technical staff or authorised agents.

FHG(S)-AH

FHG(S)-AJ

FHG(S)-SJ

FHG(S)-SO

FHG(S)-SH

FCG(S)-AJ

Technical Data

Paradigm ◎:Excellent ○:Good △:Well

	Series Name		Product Characteristics									
			Variable Options		Torque:Weight ratio	Torque rigidityTorque rigidity	Rotational accuracy	Light weight	Flat shape	Hollow construction	Customised	Lifetime
			Peak Torque (Nm)	Reduction Ratio								
Standard component type	FHS-CJ	Standard Cam hat Type	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	—	◎	○
	FHS-CO	Standard cross slide hat type	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	—	◎	○
	FCS-CJ	Standard cam cup type	19 ~ 2650	50 ~ 160	○	○	◎	○	○	△	○	○
	FCS-CO	Standard cross slide cup type	19 ~ 2650	50 ~ 160	○	○	◎	○	○	△	○	○
	FCD-C	Ultra-thin Cup	12 ~ 823	50 ~ 160	◎	◎	◎	○	◎	◎	○	○
Standard combination type	FHS-AH	Standard hollow hat type	19 ~ 2650	50 ~ 160	○	◎	◎	△	△	◎	○	○
	FHS-AJ	Standard hollow hat type	19 ~ 2650	50 ~ 160	○	◎	◎	△	△	—	○	○
	FHS-SJ	Standard Cam hats	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	—	◎	○
	FHS-SO	Standard cross slide hat type	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	—	◎	○
	FHS-SH	Standard Simple Hollow hat	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	◎	◎	○
	FCS-AJ	Standard cam cup type	19 ~ 2650	50 ~ 160	○	○	◎	○	○	△	○	○
	FCS-AO	Standard cross slide cup type	19 ~ 2650	50 ~ 160	○	○	◎	○	○	△	○	○
	FCD-AH	Ultra-thin Hollow Cup	12 ~ 453	50 ~ 160	◎	◎	◎	○	◎	◎	○	○
	FCD-AJ	Ultra-thin small diameter cup type	12 ~ 823	50 ~ 160	◎	◎	◎	○	◎	○	○	○
	FHD-SH	Ultra-thin Simple Hollow Type	12 ~ 450	50 ~ 160	◎	○	◎	◎	◎	◎	◎	○
High-torque assembly type	FHG-CJ	High torsion cam hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	—	◎	◎
	FHG-CO	High torsion cross slide seat hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	—	◎	◎
	FCG-CJ	High-torque cam cup type	24 ~ 3400	50 ~ 160	◎	○	◎	○	○	△	○	◎
	FCG-CO	High-torque cross slide seat cup type	24 ~ 3400	50 ~ 160	◎	○	◎	○	○	△	○	◎
High-torque combination type	FHG-AH	High-torque hollow hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	△	△	◎	○	◎
	FHG-AJ	High-torque centre shaft hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	△	△	—	○	◎
	FHG-SJ	High-torque cam hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	—	◎	◎
	FHG-SO	High-torque cross slide hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	—	◎	◎
	FHG-SH	High-torque simple hollow hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	◎	◎	◎
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FCG(S)-AO

FCG(S)-CJ

FCG(S)-CO

FCD-AJ

FCD-C

FHD-SH

Application Scenarios.

Harmonic reducer is widely used in various robotics fields due to its advantages of high precision, strong load carrying capacity, small backlash, light weight and large reduction ratio. In addition, harmonic reducers have a wide range of applications in precision drive systems for communication devices, large telescopes, meteorological equipment, optical manufacturing equipment, semiconductor manufacturing equipment, numerical control machine tools, medical equipment, instruments, aerospace machines, and radar and other kinds of satellite ground receiving equipment. Therefore, harmonic reducer plays an important role in many industries.

Humanoid Robots

Composite Robots

Collaborative Robots

Medical Equipment

Pan-tilt Head

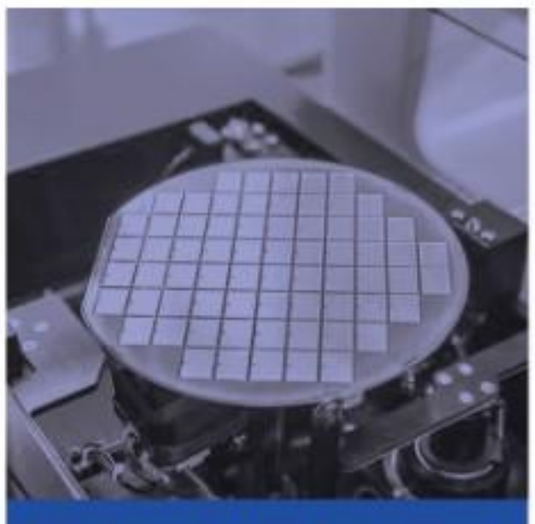
Precision Machine Tools

AGV

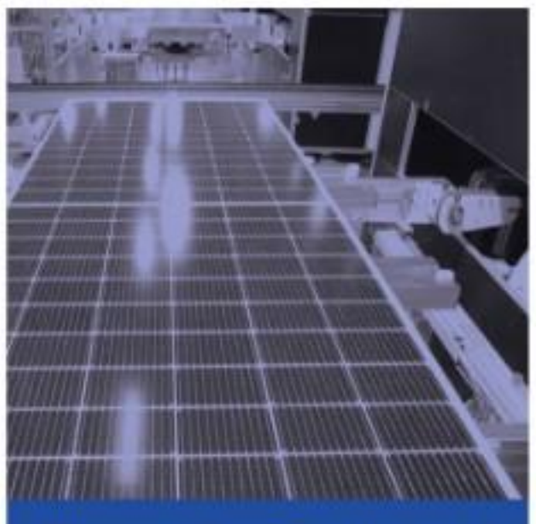
Communication Equipment

Military Industry

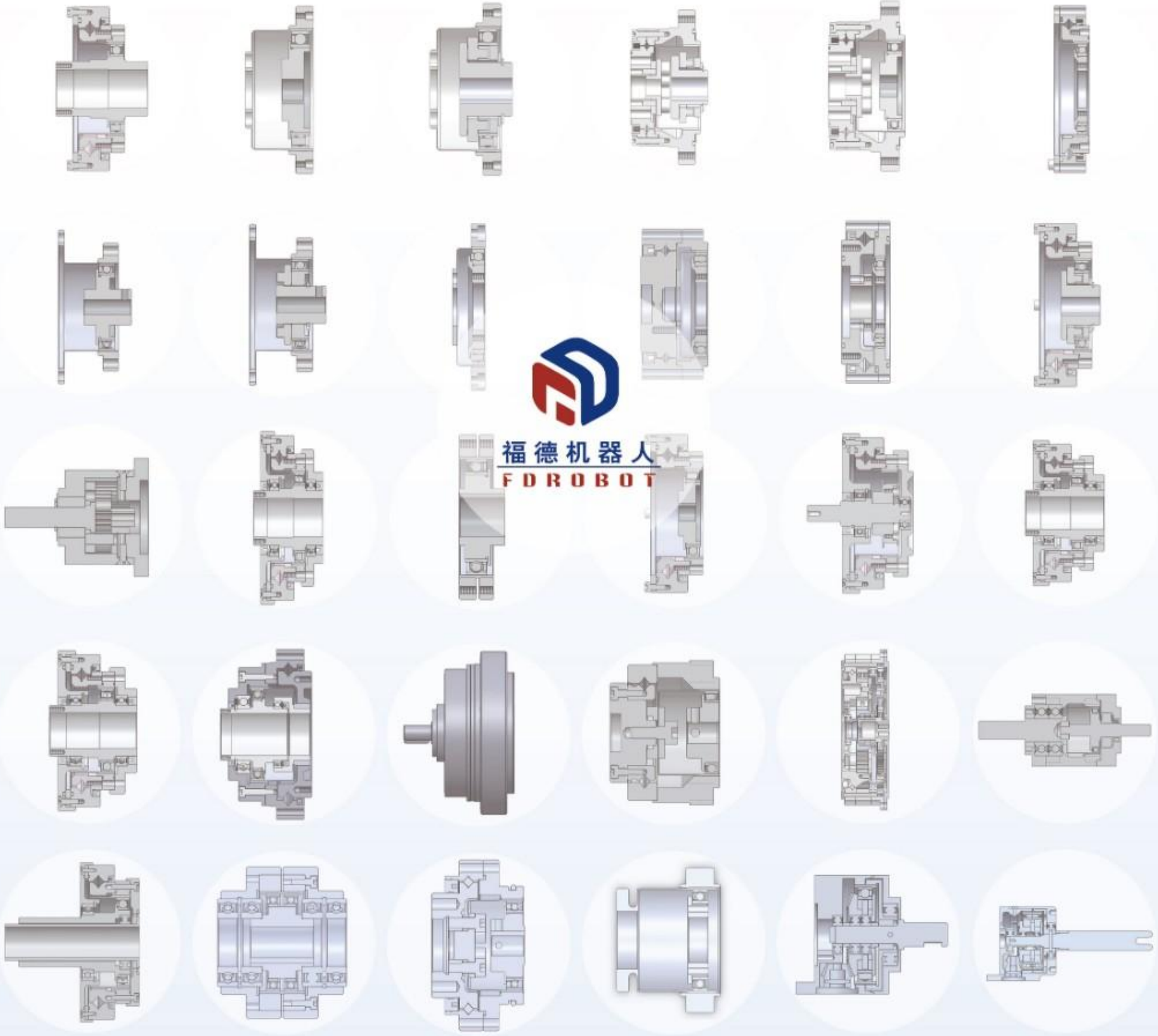
Aerospace



Semiconductor Equipment



Photovoltaic Equipment



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FDRobot specializes in product research and development, design, manufacturing, sales and service of robots and core components. It has more than 150 patents and software copyrights and has obtained ISO9001-2015 international quality system certification. In particular, we have conducted continuous and in-depth research on the commercialization of precision harmonic reducers, mastered the core technology of precision harmonic reducers and their complete sets of manufacturing processes and equipment, and launched a series of products with independent intellectual property rights: Harmonic Reducers, Integrated Joints, Collaborative Robots, Humanoid Robots, Composite Robots, etc.

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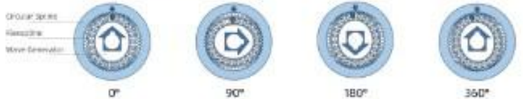

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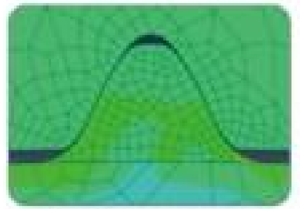
(Tooth shape simulation)


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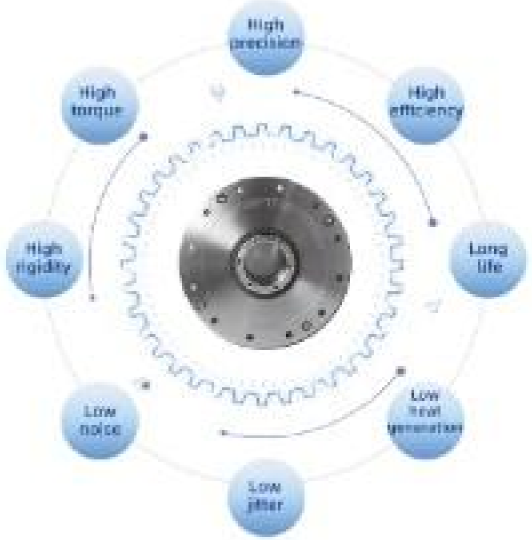

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	32	√	√	√	√	√	√	√	√	√	√	√	√
	40	-	√	√	√	√	√	√	√	√	√	√	√
	45	-	√	√	√	√	√	√	√	√	√	√	√
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	14	-	√	√	√	-	-	-	-	-	-	-	√
	17	-	√	√	√	√	-	-	-	-	-	-	√
	20	-	√	√	√	√	√	-	-	-	-	-	√
	25	-	√	√	√	√	√	-	-	-	-	-	√
	32	-	√	√	√	√	√	-	-	-	-	-	√
	40	-	√	√	√	√	√	-	-	-	-	-	√
	45	-	√	√	√	√	√	-	-	-	-	-	√
	50	-	√	√	√	√	√	-	-	-	-	-	√

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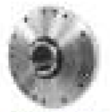
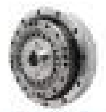
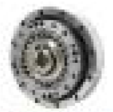
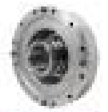
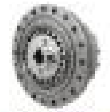

FHG(S)-AH


FHG(S)-AJ


FHG(S)-SJ


FHG(S)-SO

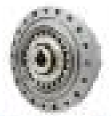

FHG(S)-SH

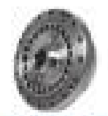

FCG(S)-AJ

Technical Data

Paradigm ◎:Excellent ○:Good △:Well

	Series Name		Variable Options: Peak Torque (Nm)	Variable Options: Reduction Ratio	Torque-weight ratio	Torsional rigidity	Rotational accuracy	Light weight	Flat shape	Hollow construction	Customised	Lifetime
Standard component type	FHS-CJ	Standard cam hat type	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	—	◎	○
	FHS-CO	Standard cross slide hat type	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	—	◎	○
	FCS-CJ	Standard cam cup type	19 ~ 2650	50 ~ 160	○	○	◎	○	○	△	○	○
	FCS-CO	Standard cross slide cup type	19 ~ 2650	50 ~ 160	○	○	◎	○	○	△	○	○
	FCD-C	Ultra-thin cup	12 ~ 823	50 ~ 160	◎	◎	◎	○	◎	◎	○	○
Standard combination type	FHS-AH	Standard hollow hat type	19 ~ 2650	50 ~ 160	○	◎	◎	△	△	◎	○	○
	FHS-AJ	Standard hollow hat type	19 ~ 2650	50 ~ 160	○	◎	◎	△	△	—	○	○
	FHS-SJ	Standard cam hub	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	—	◎	○
	FHS-SO	Standard cross slide hat type	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	—	◎	○
	FHS-SH	Standard simple hollow hat	19 ~ 2650	50 ~ 160	○	◎	◎	○	○	◎	◎	○
	FCS-AJ	Standard cam cup type	19 ~ 2650	50 ~ 160	○	○	◎	○	○	△	○	○
	FCS-AO	Standard cross slide cup type	19 ~ 2650	50 ~ 160	○	○	◎	○	○	△	○	○
	FCD-AH	Ultra-thin Hollow Cup	12 ~ 453	50 ~ 160	◎	◎	◎	○	◎	◎	○	○
	FCD-AJ	Ultra-thin small diameter cup type	12 ~ 823	50 ~ 160	◎	◎	◎	○	◎	○	○	○
	FHD-SH	Ultra-thin Simple Hollow type	12 ~ 450	50 ~ 160	◎	○	◎	◎	◎	◎	◎	○
High-torque assembly type	FHG-CJ	High-torque cam hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	—	◎	◎
	FHG-CO	High-torque cross slide seal hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	—	◎	◎
	FCG-CJ	High-torque cam cup type	24 ~ 3400	50 ~ 160	◎	○	◎	○	○	△	○	◎
	FCG-CO	High-torque cross slide seal cup type	24 ~ 3400	50 ~ 160	◎	○	◎	○	○	△	○	◎
High-torque combination type	FHG-AH	High-torque hollow hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	△	△	◎	○	◎
	FHG-AJ	High-torque center shaft hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	△	△	—	○	◎
	FHG-SJ	High-torque cam hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	—	◎	◎
	FHG-SO	High-torque cross slide hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	—	◎	◎
	FHG-SH	High-torque simple hollow hat type	24 ~ 3400	50 ~ 160	◎	◎	◎	○	○	◎	◎	◎
	FCG-AJ	High-torque cam cup type	24 ~ 3400	50 ~ 160	◎	○	◎	○	○	△	○	◎
	FCG-AO	High-torque cross slide cup type	24 ~ 3400	50 ~ 160	◎	○	◎	○	○	△	○	◎


FCG(S)-AO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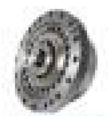
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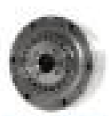
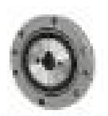
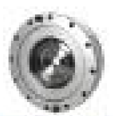

FCD-AJ


FCD-C


FHD-SH