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HarmonicDrive®
Compact Unit Type
CSF- mini Series

Size 7 Added to the Lineup

Size 5

Size 7

Size 8

New variations added to Size 7

Input shaft type
(Shaft output type)

Input shaft type
(Flange output type)

Motor-mounted type
(Shaft output type)

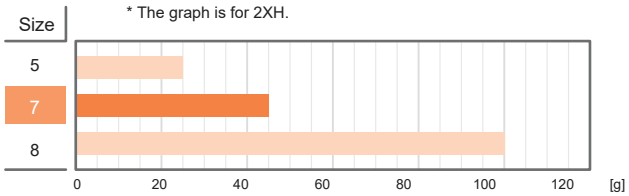
Motor-mounted type
(Flange output type)

The CSF-mini series is a product that combines the compact sizes of Harmonic Drive® into easy-to-use units.
Size 7 has been added to complement the performance and shape of existing sizes 5 and 8.
Additionally, new variations of complete units with an input shaft have been added to allow customers to select the most suitable product.
The “compact four-point contact ball bearing” that has been developed uniquely by HDS is used as the main bearing to enable direct support of the external load.

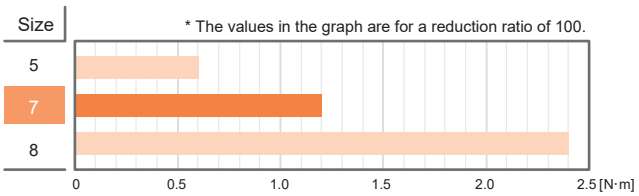
Feature

Optimal selection is possible due to the performance and shape that complement existing sizes 5 and 8.

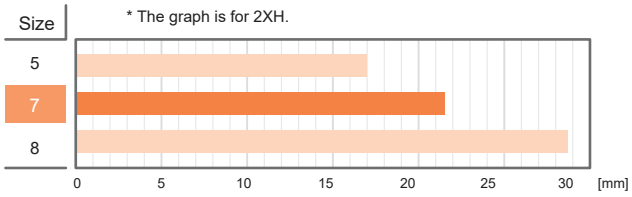
Mass comparison



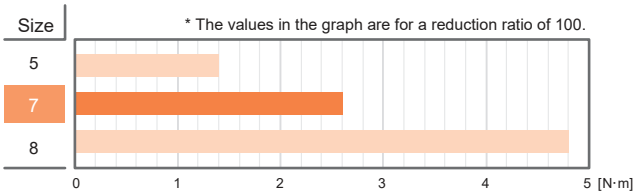
Rated torque comparison at input speed of 2000 r/min



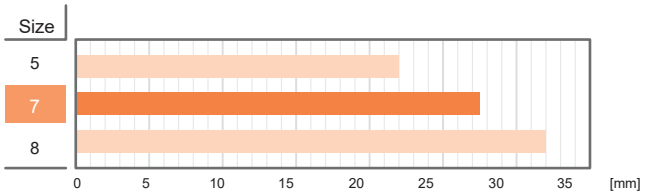
Total length comparison



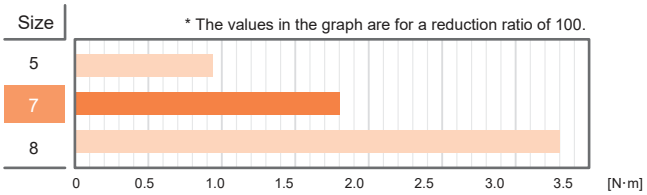
Comparison of limit for repeated peak torque



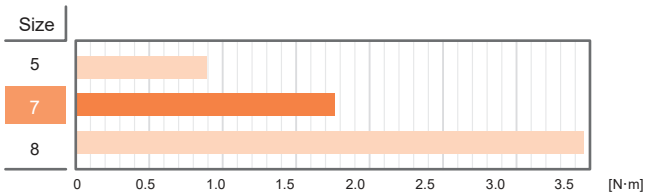
External dimensions comparison



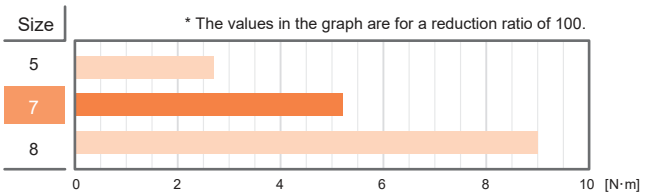
Limit for average torque comparison



Limit for moment load comparison



Maximum allowable momentary torque comparison



Ordering code

CSF - 7 - 50 - 1U - F - Specifications

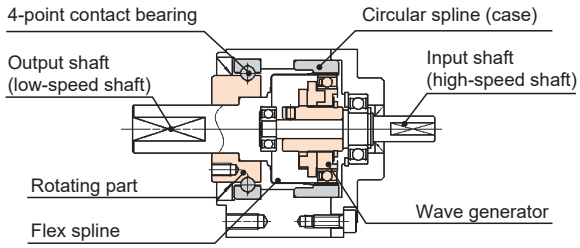
Model name	Size	Reduction ratio	Type	Special specifications
CSF-mini series	7	30 50 100	1U = Input shaft type, shaft output type 1U-F = Input shaft type, flange output type 1U-CC = 1U shape motor-mounted type, shaft output type 1U-CC-F = 1U shape motor-mounted type, flange output type 2XH-J = Mounted type, shaft output type 2XH-F = Mounted type, flange output type	SP = Special specifications such as the shape or performance No symbol = Standard product

Structures and types of the CSF-mini series

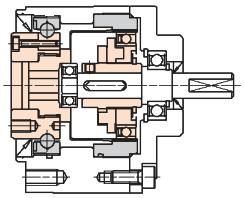
Input shaft type

This is a complete type unit with an input shaft. It can handle inputs such as belts, gears, and couplings.

Shaft output type: 1U



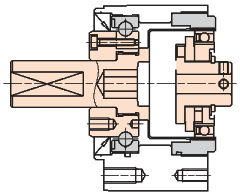
Flange output type: 1U-F



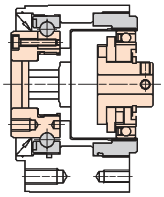
Motor-mounted type

This gear head is designed to be combined with a high-performance small servo motor. It boasts the best output characteristics among gears of the same size.

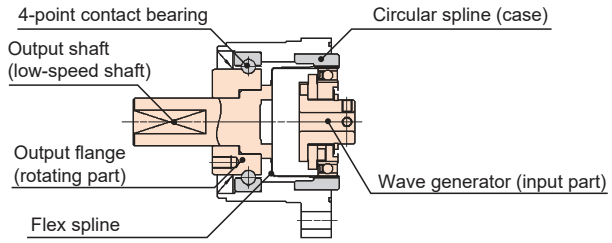
1U shape shaft output type: 1U-CC



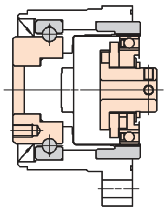
1U shape flange output type: 1U-CC-F



Shaft output type: 2XH-J



Flange output type: 2XH-F



* When the circular spline (case) is fixed, the rotation direction of the output shaft is opposite to that of the input shaft (wave generator).

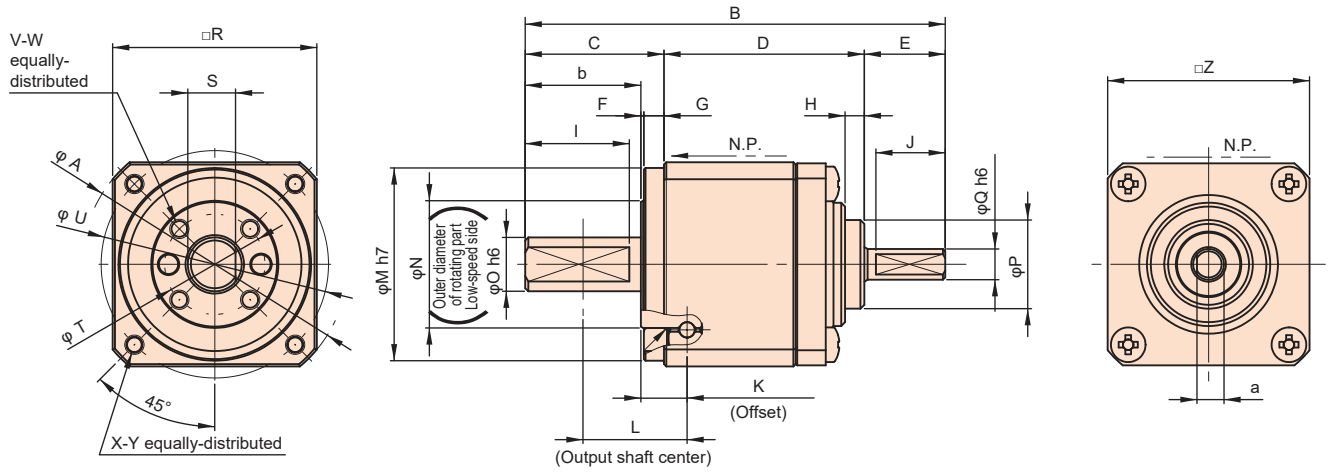
Rating Table

Size	Reduction ratio	Rated torque at input speed 2000 r/min	Limit for repeated peak torque	Limit for average torque	Limit for momentary peak torque	Permissible maximum input speed	Permissible average input speed	Moment of inertia* ($1/4GD^2$)
		N·m	N·m	N·m	N·m	r/min	r/min	kg·cm^2
7	30	0.48	1.0	0.77	1.8	8500	3500	1.2×10^{-3}
	50	0.8	1.8	1.1	3.5			1.0×10^{-3}
	100	1.2	2.6	1.8	5.2			

* The value in the upper column of the moment of inertia is for the 1U type, while the value in the lower column is for the 2XH type.

Outline drawing

Outline drawing: Shaft output 1U



(Note) The D cut of the output shaft (low-speed shaft) has no relationship with the V-W tap in terms of the position. Pay attention to this when using the product.

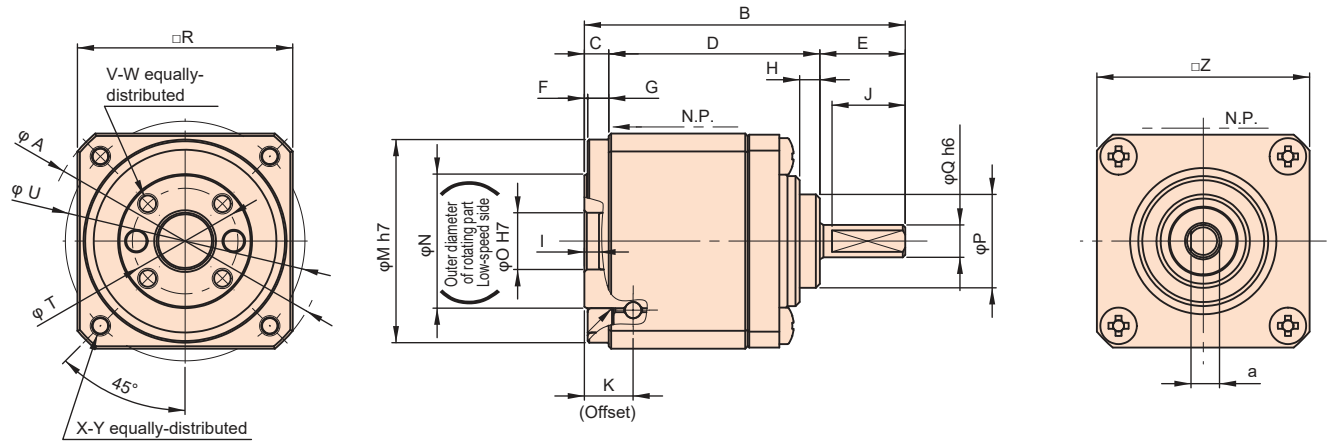
Dimension table

[Unit: mm]

Size \ Symbol	φA	B	C	D	E	F	G	H	I	J	K	L	φM h7	φN	φO h6
7	34.5	54.5	18	26	10.5	0.4	2.6	2.5	13.5	9	6	13.5	25	16.5	7

Size \ Symbol	φP	φQ h6	□R	S	φT	φU	V	W	X	Y	□Z	a	b	Weight (g)
7	11.5	4	26.5	6.2	13	29.5	4	M2.5x3.5	4	M2.5x5	26.2	3.5	15	79

Outline drawing: Flange output 1U-F



Dimension table

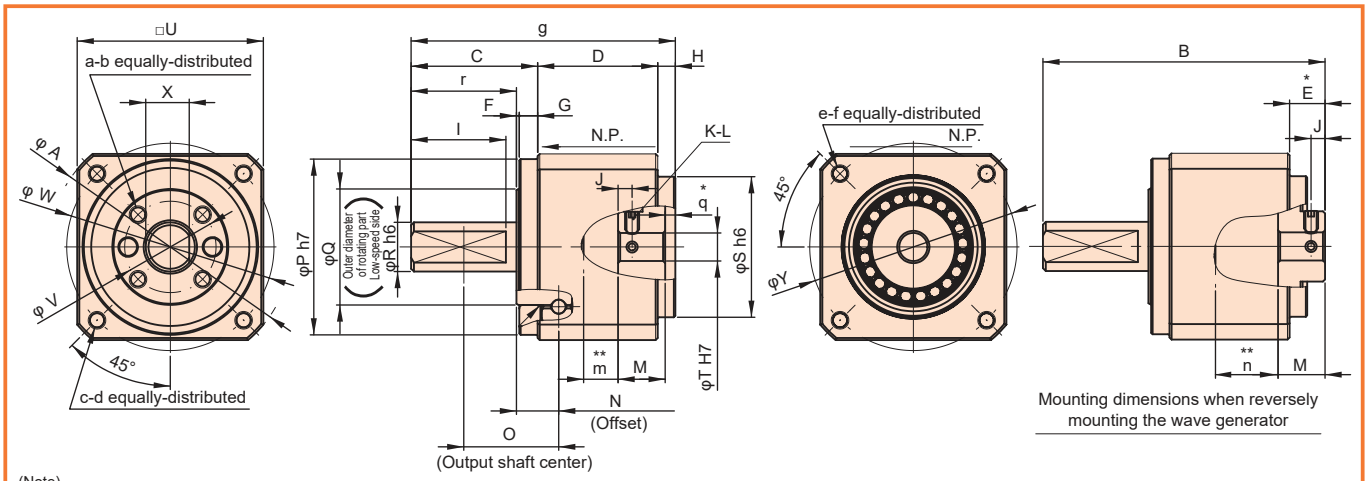
[Unit: mm]

Size \ Symbol	φA	B	C	D	E	F	G	H	I	J	K	φM h7	φN	φO H7
7	34.5	39.5	3	26	10.5	0.4	2.6	2.5	1.7	9	6	25	16.5	7

Size \ Symbol	φP	φQ h6	□R	φT	φU	V	W	X	Y	□Z	a	Weight (g)
7	11.5	4	26.5	13	29.5	4	M2.5x3.5	4	M2.5x5	26.2	3.5	74

Outline drawing

Outline drawing: Shaft output 1U-CC



(Note)
The D cut of the output shaft (low-speed shaft) has no relationship with the a-b tap in terms of the position. Pay attention to this when using the product.
The dimensions marked with * indicate the mounting position in the shaft direction and tolerance range of the three parts that form HarmonicDrive®.
The dimensions marked with ** indicate the allowable range of protrusion of the shaft from the wave generator.

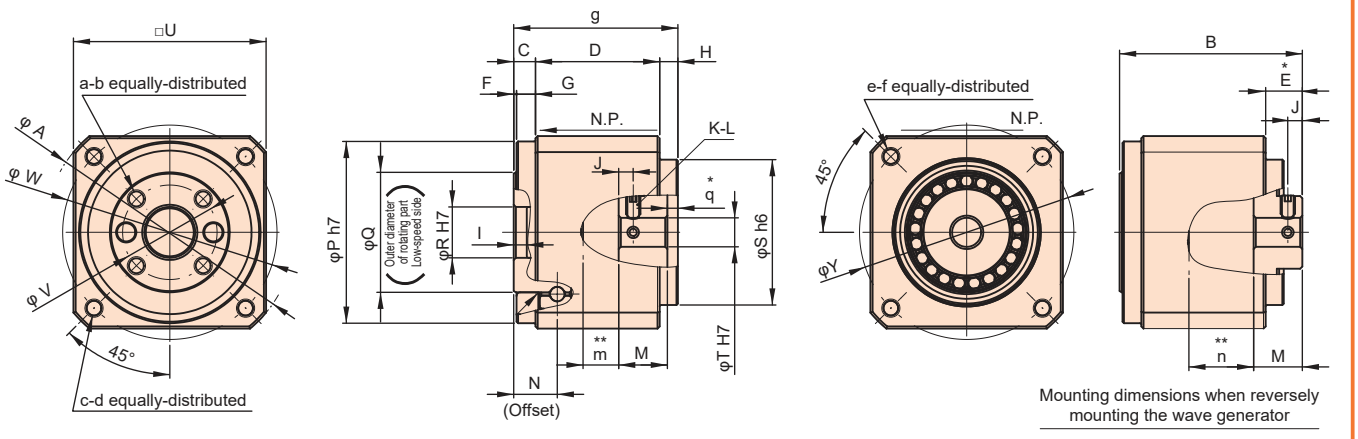
Dimension table

[Unit: mm]

Size \ Symbol	φA	B	C	D	E	F	G	H	I	J	K	L	M	N	O	φP h7	φQ	φR h6	φS h6
7	34.5	40.15	18	17.1	$5.055^{\ 0}_{-0.2}$	0.4	2.6	2.5	13.5	2	2	M2 x 3	6.7	6	13.5	25	16.5	7	20

Size \ Symbol	φT H7	□U	φV	φW	X	φY	a	b	c	d	e	f	g	m	n	q	r	Weight (g)
7	4	26.5	13	29.5	6.2	29.5	4	M2.5 x 3.5	4	M2.5 x 5	4	M2.5 x 5	37.6	4.9	8.9	$1.45^{+0.2}_{\ 0}$	15	55

Outline drawing: Flange output 1U-CC-F



(Note)
The dimensions marked with * indicate the mounting position in the shaft direction and tolerance range of the three parts that form HarmonicDrive®.
The dimensions marked with ** indicate the allowable range of protrusion of the shaft from the wave generator.

Dimension table

[Unit: mm]

Size \ Symbol	φA	B	C	D	E	F	G	H	I	J	K	L	M	N	φP h7	φQ	φR H7	φS h6
7	34.5	25.15	3	17.1	$5.05^{\ 0}_{-0.2}$	0.4	2.6	2.5	1.7	2	2	M2x3	6.7	6	25	16.5	7	20

Size \ Symbol	φT H7	□U	φV	φW	φY	a	b	c	d	e	f	g	m	n	q	Weight (g)
7	4	26.5	13	29.5	29.5	4	M2.5 x 3.5	4	M2.5 x 5	4	M2.5 x 5	22.6	4.9	8.9	$1.45^{+0.2}_{\ 0}$	50

Wave generator hole diameter dimensions

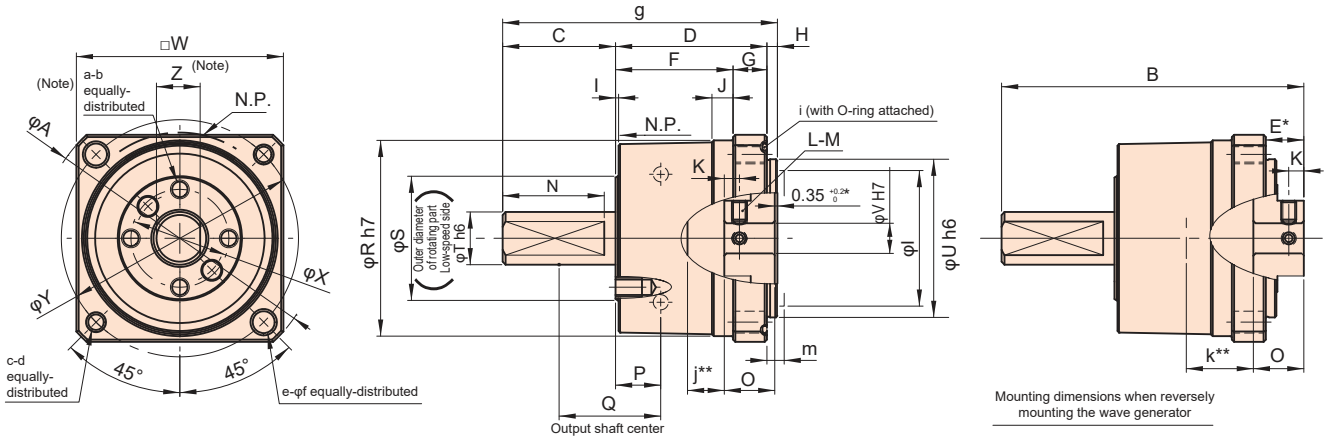
Symbol	Dimension (Unit: mm)
T H7	2 to 7

Notes:
1. For Size 7, the standard product is the rigid type.
2. The set screw dimensions may change depending on the hole diameter.
3. Keyway can be machined depending on the hole diameter.
4. If the hole diameter dimensions are changed, all products are special-specification products.

- The dimensions marked with * mean the mounting position in the shaft direction and tolerance range of the three parts (wave generator, flex spline, and circular spline) that form HarmonicDrive® These dimensions affect the performance and strength. Be sure to maintain these dimensions.
- The dimensions marked with ** indicate the allowable range of protrusion of the shaft from the wave generator.
- When the product is delivered, a wave generator is not incorporated.

Outline drawing

Outline drawing: Shaft output 2XH-J



(Note) The D cut of the output shaft (low-speed shaft) has no relationship with the a-b tap in terms of the position. Pay attention to this when using the product.

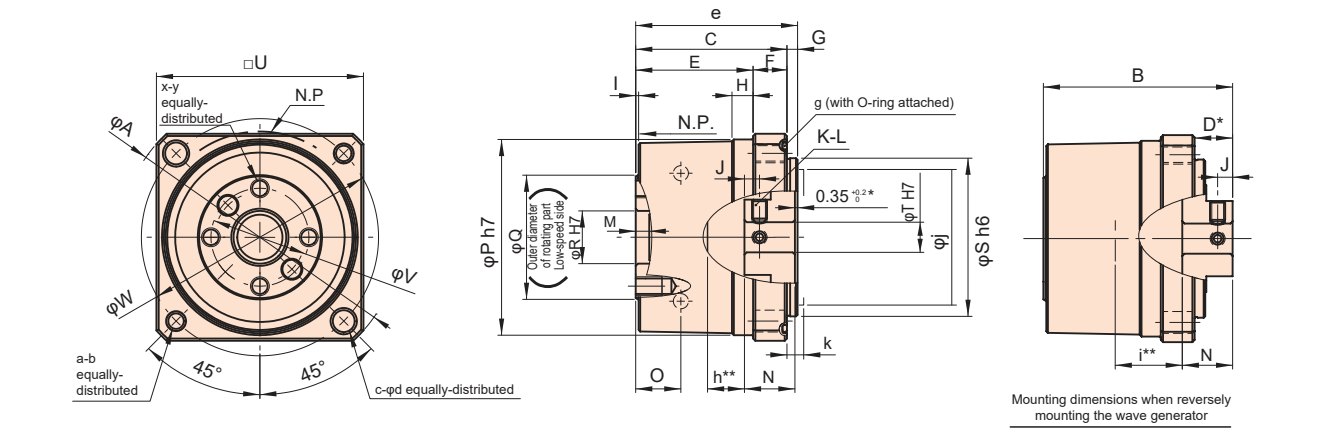
Dimension table

[Unit: mm]

Size \ Symbol	φA	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	φR h7	φS	φT h6
7	37	40.15	15	20.1	$5.05^{0}_{-0.2}$	15.6	4.5	1.4	0.4	2.8	2	2	M2x3	13.5	6.7	6	13.5	26	16.5	7

Size \ Symbol	φU h6	φV H7	□W	φX	φY	Z	a	b	c	d	e	φf	g	h	i	j	k	φl	m	Weight (g)
7	21	4	27.5	13	31.5	6.2	4	M2.5x3.5	2	M2.5	2	2.9	36.5	-	23.6x0.8	4.9	8.9	18	2	50

Outline drawing: Flange output 2XH-F



Dimension table

[Unit: mm]

Size \ Symbol	φA	B	C	D	E	F	G	H	I	J	K	L	M	N	O	φP h7	φQ	φR H7
7	37	25.15	20.1	$5.05^{0}_{-0.2}$	15.6	4.5	1.4	2.8	0.4	2	2	M2x3	1.7	6.7	6	26	16.5	7

Size \ Symbol	φS h6	φT H7	□U	φV	φW	X	Y	a	b	c	φd	e	f	g	h	i	φj	k	Weight (g)
7	21	4	27.5	13	31.5	4	M2.5x3.5	2	M2.5	2	2.9	21.5	-	23.6x0.8	4.9	8.9	18	2	45

Wave generator hole diameter dimension

Symbol	Dimension (Unit: mm)
2XH-F: φT H7	2 to 7
2XH-J: φV H7	

Notes:
1. For Size 7, the standard product is the rigid type.
2. The set screw dimensions may change depending on the hole diameter.
3. Keyway can be machined depending on the hole diameter.
4. If the hole diameter dimensions are changed, all products are special-specification products.

- The dimensions marked with * mean the mounting position in the shaft direction and tolerance range of the three parts (wave generator, flex spline, and circular spline) that form HarmonicDrive® These dimensions affect the performance and strength. Be sure to maintain these dimensions.
- The dimensions marked with ** indicate the allowable range of protrusion of the shaft from the wave generator.
- The flex spline deforms elastically. To prevent it from coming into contact with the case, the inner wall dimensions should be φj•k/φl•m or more.
- When the product is delivered, a wave generator is not incorporated.

Rotational transmission error

Reduction ratio \ Size		7
30	×10⁻³rad	0.87
	arc-min	3.0
50	×10⁻³rad	0.73
	arc-min	2.5
100	×10⁻³rad	0.73
	arc-min	2.5

Hysteresis loss

Reduction ratio \ Size		7
30	×10⁻⁴rad	8.7
	arc-min	3.0
50	×10⁻⁴rad	5.8
	arc-min	2.0
100	×10⁻⁴rad	5.8
	arc-min	2.0

Stiffness (spring constant)

Symbol \ Size			7	
			2XH-J	2XH-F
T1		N·m	0.15	0.15
		kgf·m	0.015	0.015
T2		N·m	0.40	0.40
		kgf·m	0.041	0.041
Reduction ratio 30	K1	×10⁴N·m/rad	0.017	0.017
		kgf·m/arc-min	0.005	0.005
	K2	×10⁴N·m/rad	0.020	0.024
		kgf·m/arc-min	0.006	0.007
	K3	×10⁴N·m/rad	0.027	0.030
		kgf·m/arc-min	0.008	0.009
	θ1	×10⁻⁴rad	8.9	8.9
		arc-min	3.1	3.1
	θ2	×10⁻⁴rad	21	19
		arc-min	7.3	6.7
Reduction ratio 50	K1	×10⁴N·m/rad	0.020	0.027
		kgf·m/arc-min	0.006	0.008
	K2	×10⁴N·m/rad	0.030	0.037
		kgf·m/arc-min	0.009	0.011
	K3	×10⁴N·m/rad	0.034	0.047
		kgf·m/arc-min	0.010	0.014
	θ1	×10⁻⁴rad	7.4	5.6
		arc-min	2.5	1.9
	θ2	×10⁻⁴rad	16	12
		arc-min	5.4	4.2
Reduction ratio 100	K1	×10⁴N·m/rad	0.030	0.044
		kgf·m/arc-min	0.009	0.013
	K2	×10⁴N·m/rad	0.037	0.054
		kgf·m/arc-min	0.011	0.016
	K3	×10⁴N·m/rad	0.044	0.064
		kgf·m/arc-min	0.013	0.019
	θ1	×10⁻⁴rad	4.9	3.4
		arc-min	1.7	1.2
	θ2	×10⁻⁴rad	12	8.1
		arc-min	4.0	2.8

* Torsional stiffness shows the reference values. The lower limit value is approximately 80% of the displayed value.

Starting torque

[Unit: cN·m]

Reduction ratio \ Size	7
30	0.87
50	0.59
100	0.44

Speed-up starting torque

[Unit: N·m]

Reduction ratio \ Size	7
30	0.49
50	0.36
100	0.47

Ratcheting torque

[Unit: N·m]

Reduction ratio \ Size	7
30	5.7
50	6.6
100	7.5

Buckling torque

[Unit: N·m]

Reduction ratio \ Size	7
Total reduction ratio	19

No-load running torque

Measuring condition

Lubrication condition	Speed reducer	Main bearing
	Harmonic Grease® SK-2	Multemp HL-D*

The torque value is measured after two or more hours run-in at 2000 r/min input speed.

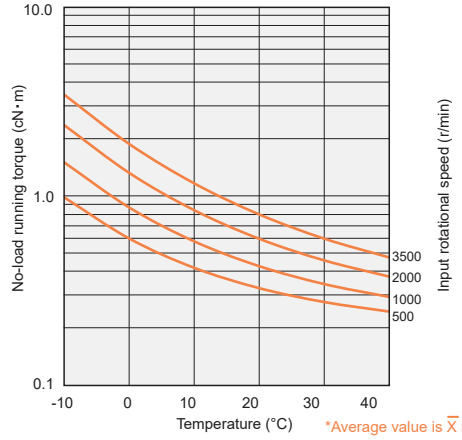
* "Multemp" is a registered trademark of KYODO YUSHI CO., LTD.

No-load running torque correction quantity

[Unit: cN·m]

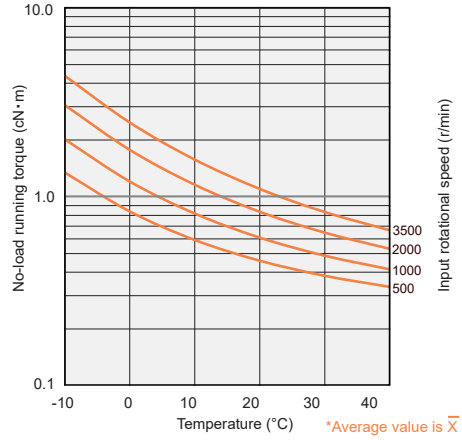
Reduction ratio \ Size	7
30	0.30
50	0.13

CSF7-2XH/CSF-7-1U-CC: No load running torque at reduction ratio 100



*Average value is $\bar{X}$ in this graph.

CSF-7-1U: No load running torque at reduction ratio 100



*Average value is $\bar{X}$ in this graph.

Lubrication

The standard lubrication method for the CSF-mini series is grease lubrication. The product is shipped while the grease is sealed, and adding or application of the grease is not required when installing the product. The following grease is used as the lubrication agent.

Lubrication part	Speed reducer	Main bearing
Lubrication agent to be used	Harmonic Grease® SK-2	Multemp HL-D
Manufacturers	Harmonic Drive Systems Inc.	Kyodo Yushi Co. Ltd:
Base oil	Purified mineral oil	Synthetic hydrocarbon oil
Thickener	Lithium soap base	Lithium soap base
Mixing consistency (25°C) (Equivalent NLGI consistency No.)	265 to 295 (No.2)	265 to 295 (No.2)
Drop point	198°C	210°C
Appearance	Green	White

Efficiency characteristics

The efficiency varies depending on the following conditions.

- Reduction ratio
- Input rotational speed
- Load torque
- Temperature
- Lubrication condition (Lubrication type and amount)

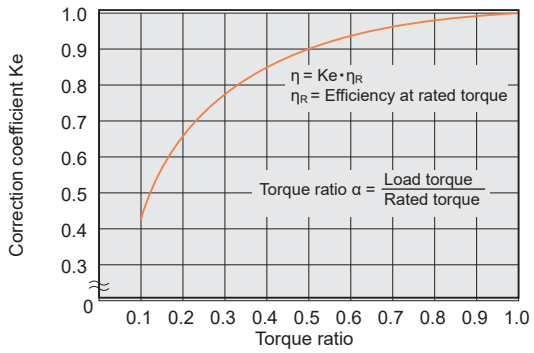
Measuring condition

Lubrication condition	Speed reducer	Main bearing
	Harmonic Grease® SK-2	Multemp HL-D*

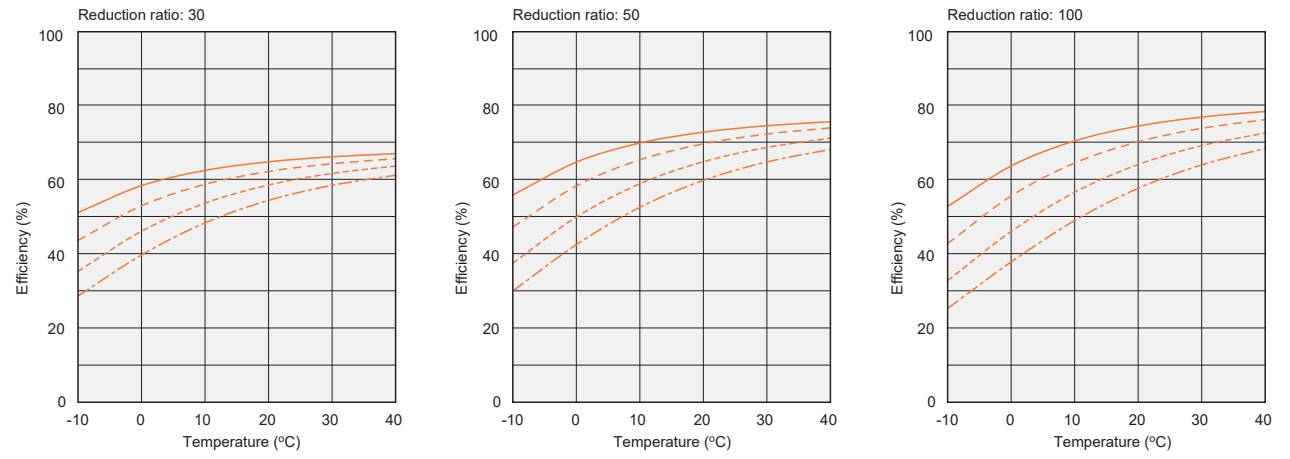
The torque value is measured after two or more hours run-in at 2000 r/min input speed.

* "Multemp" is a registered trademark of KYODO YUSHI CO., LTD.

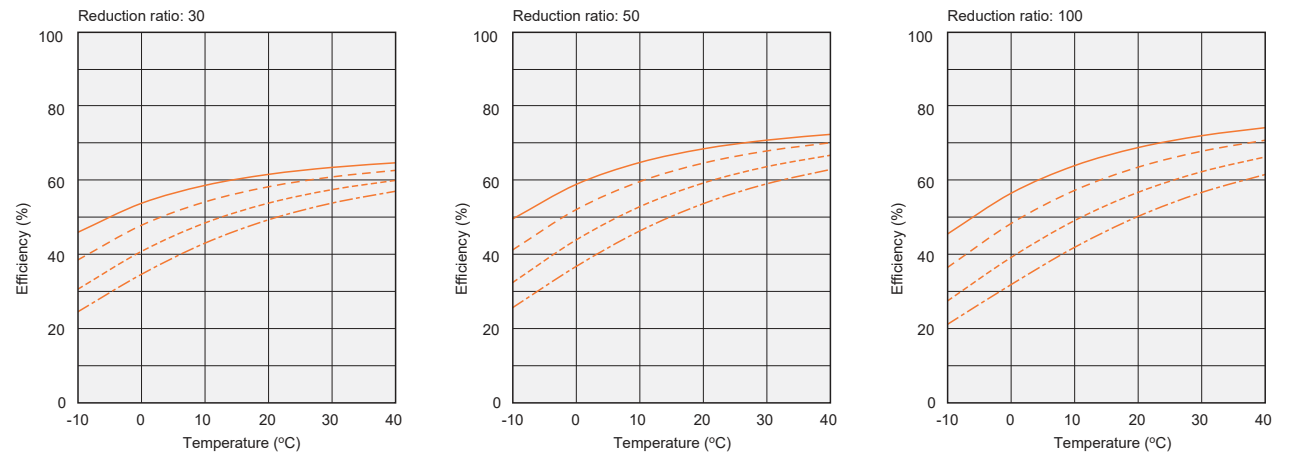
Efficiency compensation coefficient



CSF-7-2XH /CSF-7-1U-CC: Efficiency at rated torque



CSF-7-1U: Efficiency at rated torque



Mechanical accuracy

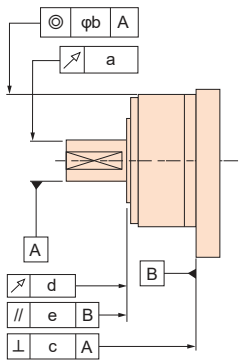
The CSF-mini series uses the high-precision 4-point contact ball bearing for the main bearing to achieve high mechanical accuracy of the output part.
The mechanical accuracies of the output shaft and output flange are shown below.

[Unit: mm]

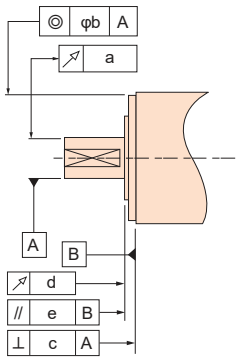
Symbol	Accuracy Item	Size 7	
		Shaft output	Flange output
a	Output shaft tip runout	0.030	-
	Output shaft inside diameter runout	-	0.005
b	Installation spigot concentricity	0.040	
c	Installation surface squareness	0.020	
d	Output flange runout	0.005	
e	Parallelism between the installation surface and the output flange	0.018	

Shaft output

2XH-J

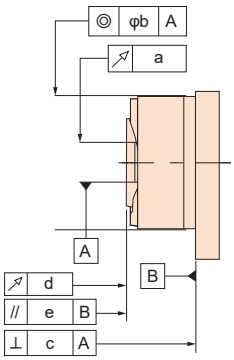


1U / 1U-CC

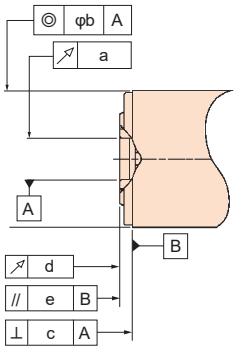


Flange output

2XH-F



1U-F / 1U-CC-F



Specifications of the main bearing

The CSF-mini series is equipped with the precision 4-point contact ball bearing to directly support the external load (output part).
To achieve the full performance of the CSF-mini series, check the maximum moment load, life of the 4-point contact ball bearing and static safety coefficient.

Procedure for checking

For details of the procedure for checking, refer to "Checking main roller bearing" in the "Technical Material" in the HarmonicDrive® General Catalog.

(1) Checking the maximum moment load (M max)

Obtaining the maximum moment load (M max) → Maximum moment load (M max) ≤ Allowable moment load (Mc)

(2) Checking the life

Obtaining the average radial load (Frav) and average axial load (Faav) → Obtaining the radial load coefficient (X) and axial load coefficient (Y) → Calculating the life and checking it

(3) Checking the static safety coefficient

Obtaining the static equivalent radial load (Po) → Checking the static safety coefficient (fs)

Main bearing specifications

Size	Pitch circle of ball	Offset	Basic rated load		Limit for moment load	Moment stiffness	Allowable radial load	Allowable axial load
	dp	R	Basic dynamic load rating C	Basic static load rating C0				
	mm	mm	$\times 10^2$ N	$\times 10^2$ N	N·m	N•m / rad	N	N
7	17	6	14.4	12.1	1.76	1510	140	440

* Basic dynamic load rating is the certain static radial load at which the basic dynamic load life of the bearing is 1 million rotations.
* Basic static load rating is the static load that produces a certain level of contact stress (4.2kN/mm^2) at the center of the contact area between the rolling contact area under the maximum load and raceway.
* Limit for moment load is the maximum moment load that can be applied to the output shaft, within which basic performance is maintained and operation is possible.
* Moment stiffness shows the reference values. The lower limit value is approximately 80% of the displayed value.

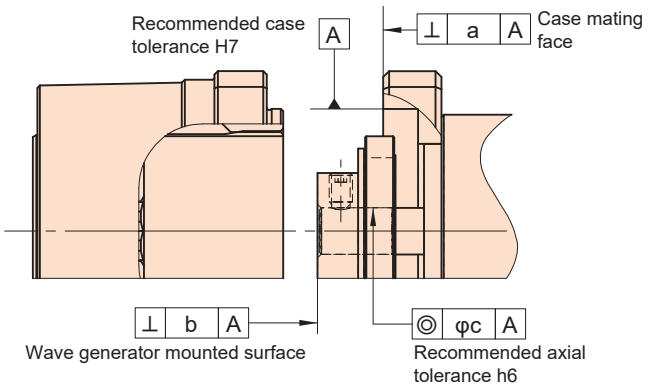
Installation Accuracy

When installing, ensure that you retain the recommended accuracy shown below in order to fully realize the excellent performance of the CSF-mini series.

[Unit: mm]

Symbol	Accuracy Item	Size
		7
a	Case mating face squareness	0.008
b	Wave generator mounted surface	0.005
c	Input shaft concentricity	0.005

Recommended installation accuracy



Allowable load for the input part

The input part of the input shaft type is supported by two rows of deep-groove ball bearings. Check the load applied to the input part to ensure that the performance of the input shaft type is fully utilized. The figure "Bearing support point" shows the bearing support point. See the table "Bearing specifications for the input part" for the dimensions of a and b. The graph "Relationship between thrust load and radial load" shows the relationship between the maximum allowable radial load and thrust load for each size. The values are based on an average input speed of 2,000 r/min and a basic rated life of L10 = 7,000 h.

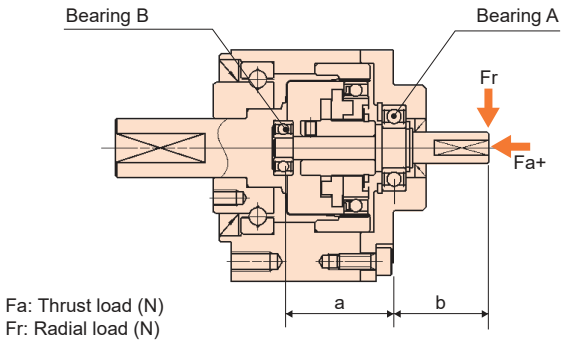
Example: When a thrust load (Fa) of 8 N is applied to the input shaft of size 14, the maximum allowable radial load (Fr) is 20 N.

* Due to its structure, the input shaft moves in the axial direction when an external force is applied. This is not abnormal.

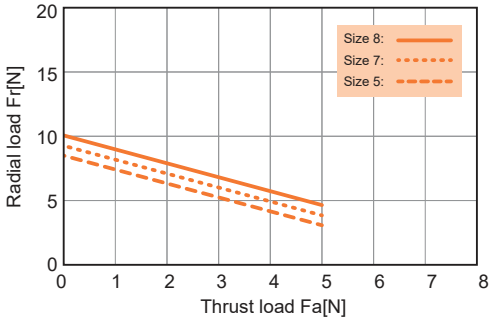
Bearing specifications for the input part

Size	Bearing A			Bearing B			Distance between bearings a	Input shaft projection length b	Maximum radial load
	Size	Basic dynamic load rating Cr [N]	Basic static load rating C0r [N]	Size	Basic dynamic load rating Cr [N]	Basic static load rating C0r [N]	a [mm]	b [mm]	Fr [N]
7	MR126	715	292	MR126	715	292	10.45	16.50	9

Bearing support point



Relationship between thrust load and radial load

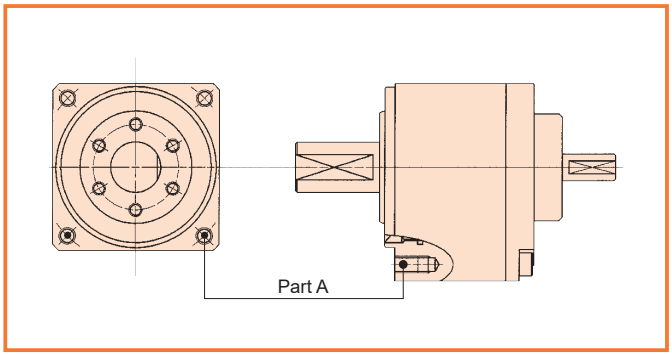


Installation and transmission torque

Installation to the device

When installing the CSF-mini series to the device, check the flatness of the installation surface and check for any burrs around the tap, and attach the mounting flange to bolts.

Mounting flange



Bolt tightening torque for the mounting flange

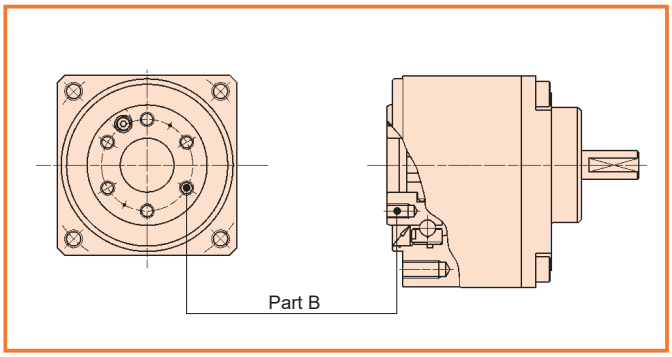
Item \ Type		1U	1U-CC		2XH-J
		Part A	Part A	Part C	Part A
Number of bolts		4			2
Bolt size		M2.5			
Mounting P.C.D.	mm	29.5			31.5
Bolt tightening torque	N·m	0.49			
	kgf·m	0.05			
Thread fit minimum length	mm	3			
Bolt transmission torque	N·m	7.2			3.8
	kgf·m	0.73			3.9

* Recommended bolt name : JIS B 1176 Hexagon socket head bolt (Strength classification: 12.9 or higher in JIS B 1051)
* Torque coefficient: K=0.2, tightening coefficient: A=1.4, Friction coefficient of the joining surfaces: μ=0.15
* Use washers to avoid direct contact with the bolt seat on the aluminum.
* When using two tap holes of the case, the recommended drill hole diameter on the other side is φ3.0 (positional tolerance of φ0.25).

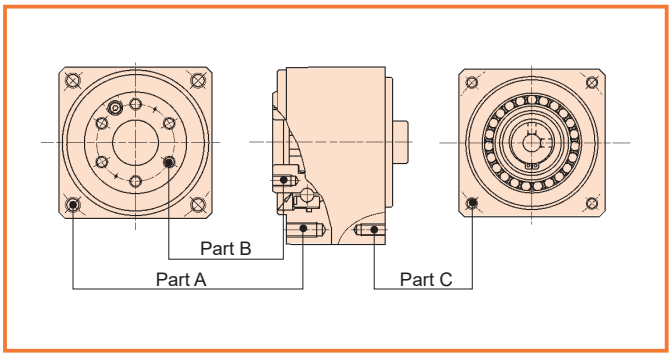
Load attachment to the output part

When attaching a load to the output part of the CSF-mini series, consider the specifications of the main bearing.

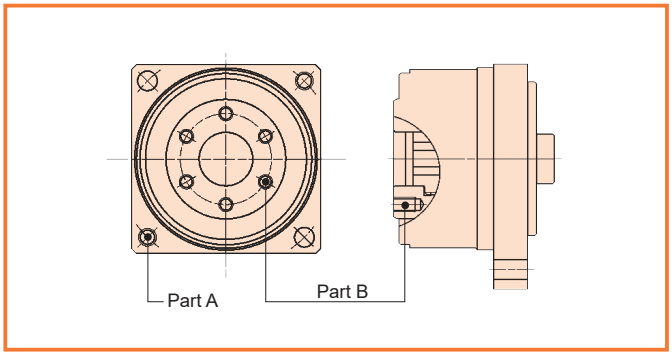
Mounting flange (1U-F)



Mounting flange (1U-CC-F)



Mounting flange (2XH-F)



Bolt tightening torque for the mounting flange (flange output type)

Item \ Size		1U-F	1U-CC-F	2XH-F
		Part B		
Number of bolts		4		
Bolt size		M2.5		
Mounting P.C.D.	mm	13.0		
Bolt tightening torque	N·m	1.0		
	kgf·m	0.11		
Bolt transmission torque	N·m	7.2		
	kgf·m	0.73		

* Recommended bolt name : JIS B 1176 Hexagon socket head bolt (Strength classification: 12.9 or higher in JIS B 1051)
* Torque coefficient: K=0.2, tightening coefficient: A=1.4, Friction coefficient of the joining surfaces: μ=0.15
* Use washers to avoid direct contact with the bolt seat on the aluminum.
* When using two tap holes of the case, the recommended drill hole diameter on the other side is φ3.0 (positional tolerance of φ0.25).
* When installing pulleys and pinions for shaft output, do not apply any shock to the output shaft. Doing so may cause deterioration of precision or failure of the speed reducer.

■ Operational precautions

Use only in a specified environment. When Harmonic Drive® is used, please ensure the following environmental conditions are complied with:
● Ambient temperature: 0 to 40°C ● No splashing of water or oil ● Do not expose to corrosive or explosive gas
● No dust such as metal powder
* For other precautions and warranty, refer to the Harmonic Drive® General Catalog.

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