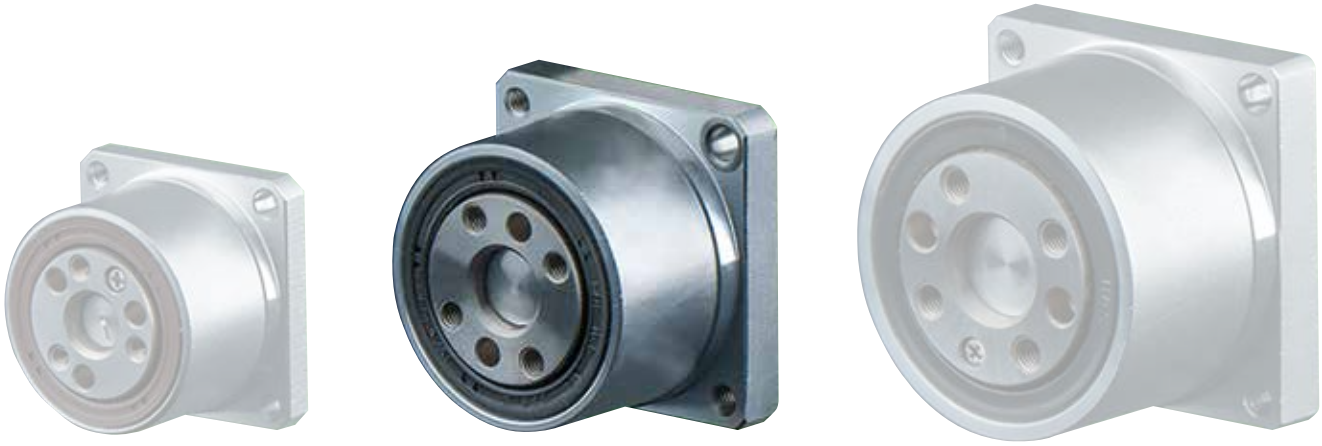
HarmonicDrive®

Compact Unit
CSF-Mini Series

NEW! Size 7



Size 5 | Size 7 | Size 8

Introducing the CSF-Mini size 7, a unitized miniature gearhead designed to mount to a servomotor of similar frame size.

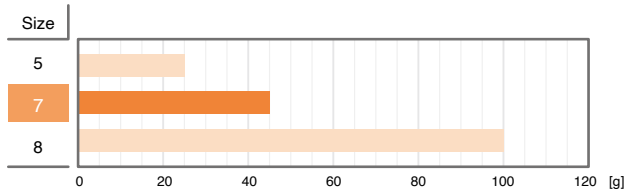
The introduction of frame size 7 fills the gap between existing CSF-Mini frame sizes 5 and 8, providing yet another opportunity for drive train optimization.

A compact four-point contact ball bearing is employed to support the rotating output facility, allowing external loads to be directly affixed (output flange or shaft are standard options).

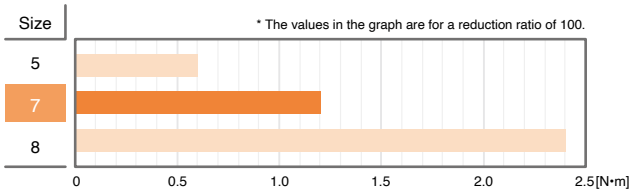
Features

The performance, size and shape of the CSF-Mini Series size 7 fills the gap between Sizes 5 and 8 allowing for optimal gearhead selection and drive train design.

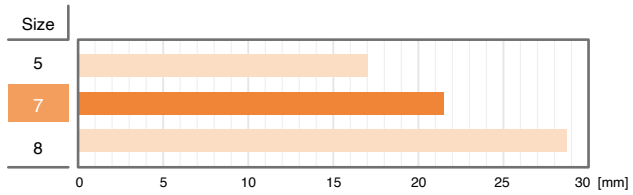
Mass Comparison



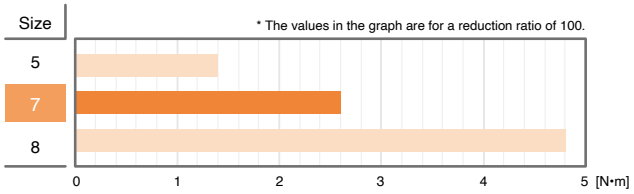
Rated Torque Comparison at Input Speed of 2000 rpm



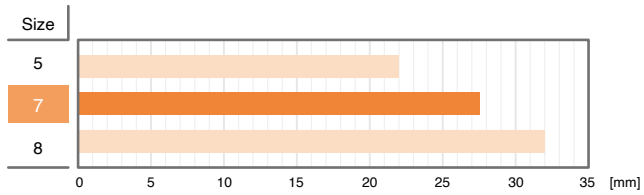
Length Comparison



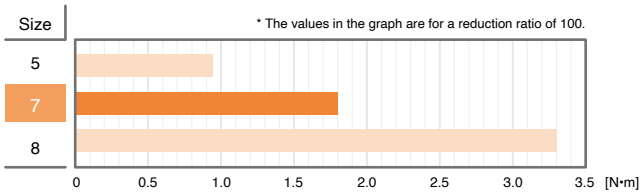
Allowable Peak Torque Comparison at Start/Stop



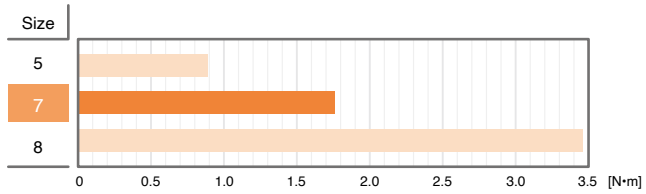
External □ Dimension Comparison



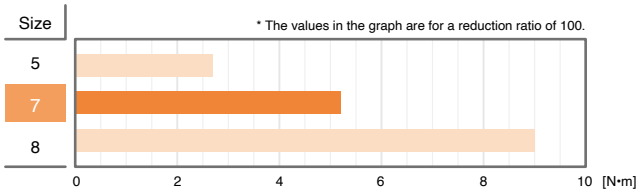
Limit for Average Torque Comparison



Limit for Moment Load Comparison



Maximum Allowable Momentary Torque Comparison



Ordering Code

CSF - 7 - 50 - 2XH - F - Specification

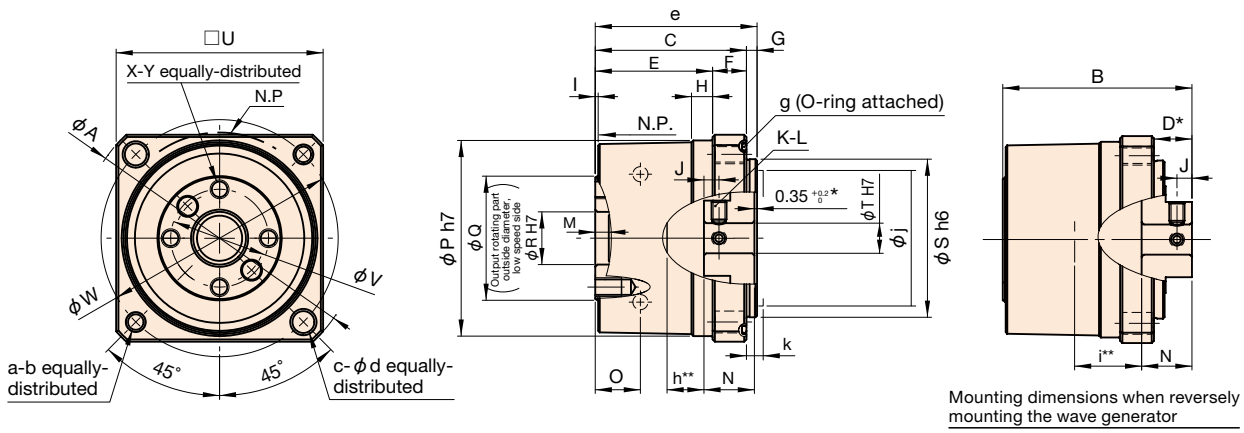
Model Name	Size	Reduction Ratio			Type	Special Specifications
CSF-Mini Series	7	30	50	100	2XH-J = Motor mounted type, shaft output 2XH-F = Motor mounted type, flange output	SP = Special specifications such as the shape or performance Blank = standard product

Rating Table

Size	Reduction Ratio	Rated Torque at Input Speed 2000 rpm	Allowable Peak Torque at Start/Stop	Limit for Average Torque	Maximum Allowable Momentary Torque	Allowable Maximum Input Rotation Speed	Allowable Average Input Rotation Speed	Moment of Inertia ($1/4GD^2$)
		N·m	N·m	N·m	N·m	rpm	rpm	kg·cm^2
7	30	0.48	1.0	0.77	1.8	8500	3500	1.0 x 10^{-3}
	50	0.8	1.8	1.1	3.5			
	100	1.2	2.6	1.8	5.2			

Outline Dimensions

Outline Dimensions: Flange Output 2XH-F



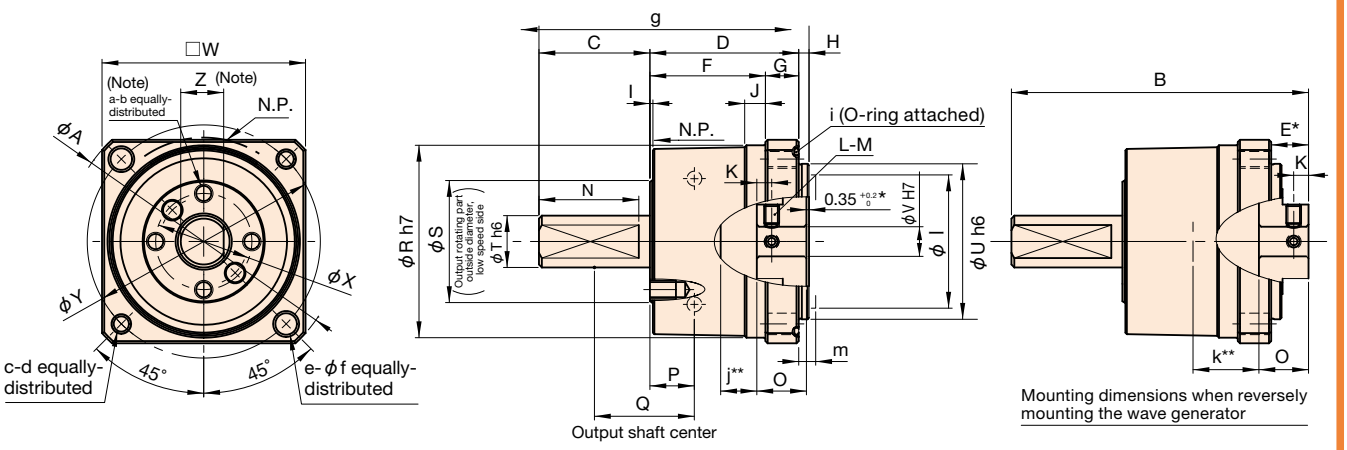
Dimension Table

[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

Outline Dimensions: 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

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 ** mean the allowable range of protrusion of the shaft from the wave generator.
- The flexspline 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^{-3}rad	0.87
	arc-min	3.0
50	×10^{-3}rad	0.73
	arc-min	2.5
100	×10^{-3}rad	0.73
	arc-min	2.5

Hysteresis Loss

Reduction Ratio \ Size		7
30	×10^{-4}rad	8.7
	arc-min	3.0
50	×10^{-4}rad	5.8
	arc-min	2.0
100	×10^{-4}rad	5.8

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	×10^{4}N·m/rad	0.017	0.017
		kgf·m/arc-min	0.005	0.005
	K2	×10^{4}N·m/rad	0.020	0.024
		kgf·m/arc-min	0.006	0.007
	K3	×10^{4}N·m/rad	0.027	0.030
		kgf·m/arc-min	0.008	0.009
	θ1	×10^{-4}rad	8.9	8.9
		arc-min	3.1	3.1
	θ2	×10^{-4}rad	21	19
		arc-min	7.3	6.7
Reduction Ratio 50	K1	×10^{4}N·m/rad	0.020	0.027
		kgf·m/arc-min	0.006	0.008
	K2	×10^{4}N·m/rad	0.030	0.037
		kgf·m/arc-min	0.009	0.011
	K3	×10^{4}N·m/rad	0.034	0.047
		kgf·m/arc-min	0.010	0.014
	θ1	×10^{-4}rad	7.4	5.6
		arc-min	2.5	1.9
	θ2	×10^{-4}rad	16	12
		arc-min	5.4	4.2
Reduction Ratio 100	K1	×10^{4}N·m/rad	0.030	0.044
		kgf·m/arc-min	0.009	0.013
	K2	×10^{4}N·m/rad	0.037	0.054
		kgf·m/arc-min	0.011	0.016
	K3	×10^{4}N·m/rad	0.044	0.064
		kgf·m/arc-min	0.013	0.019
	θ1	×10^{-4}rad	4.9	3.4
		arc-min	1.7	1.2
	θ2	×10^{-4}rad	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: cN·m]

Reduction Ratio \ Size	7
30	0.49
50	0.36
100	0.47

Ratcheting Torque

[Unit: cN·m]

Reduction Ratio \ Size	7
30	5.7
50	6.6
100	7.5

Buckling Torque

[Unit: cN·m]

Reduction Ratio \ Size	7
All Reduction Ratios	19

Efficiency Characteristics

The efficiency varies depending on the following conditions.

- Reduction Ratio
- Input Rotation Speed
- Load Torque
- Temperature
- Lubrication Condition (Lubrication Type and Amount)

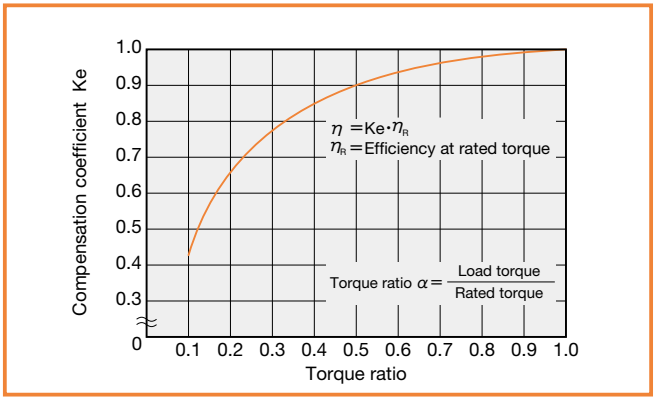
Measuring Condition

Lubrication Condition	Speed Reducer	Main Bearing
	Harmonic Grease® SK-2	Multemp HL-D*

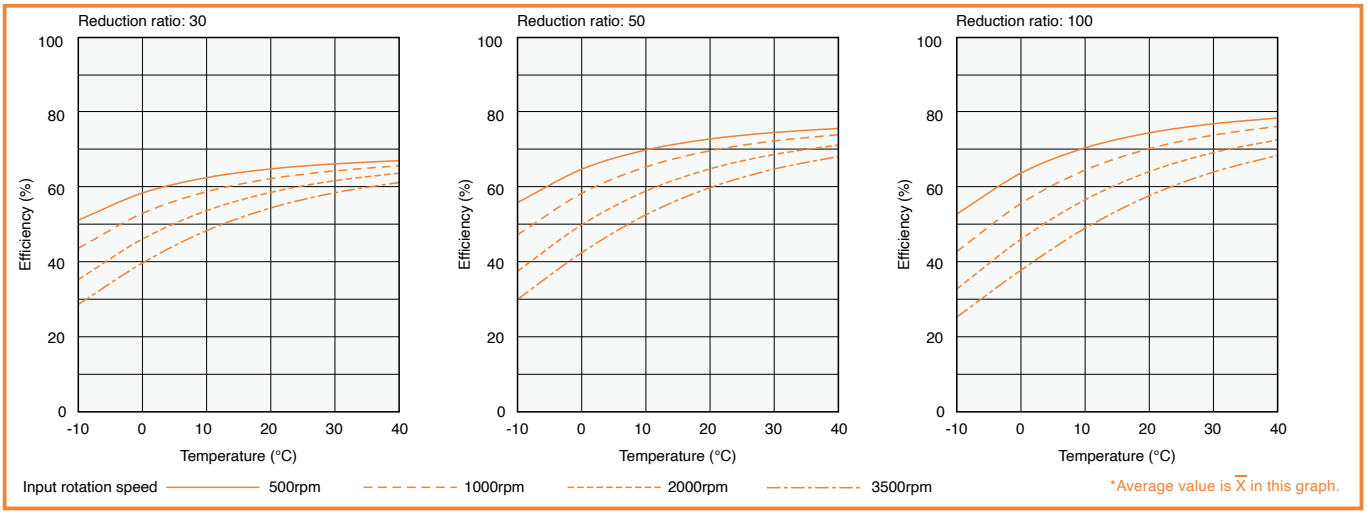
The torque value is measured after two or more hours run-in at 2000rpm input rotation speed.

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

Efficiency Compensation Coefficient



Efficiency at Rated Torque: Size 7



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 rpm input rotation speed.		

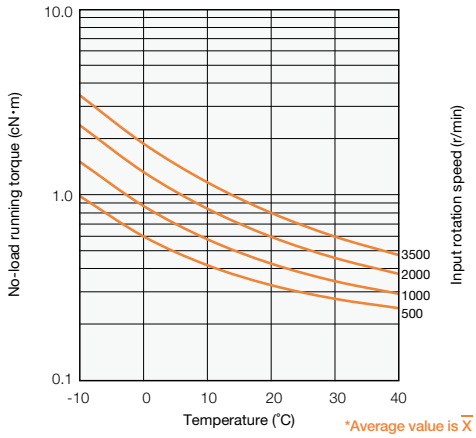
* "Multemp" is a registered trademark of KYODO YUSHI CO., LTD.

No-Load Running Torque Correction Quantity

[Unit: cN·m]

Reduction Ratio \ Size	7
30	0.30
50	0.13

No load running torque at reduction ratio 100



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

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 "Engineering Data" 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) ≤ Limit for 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.

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.

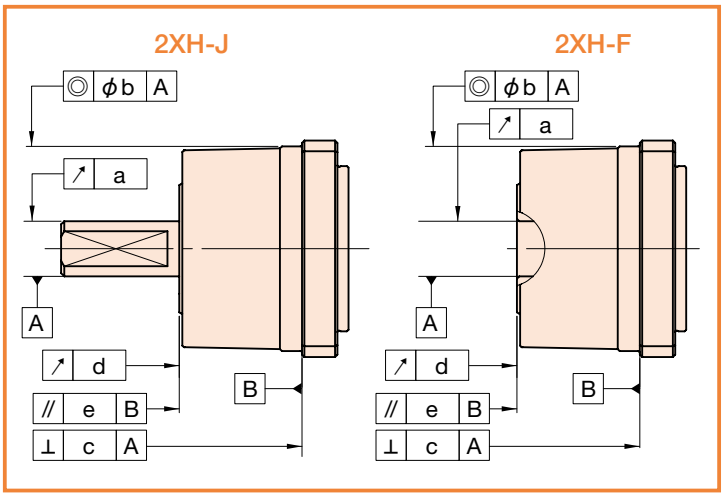
Lubrication Part	Speed Reducer	Main Bearing
Lubrication Agent to be used	Harmonic Grease® SK-2	Multemp HL-D
Manufacturers	Harmonic Drive Systems Inc.	Kyodo Yushi Co.,Ltd.
Base Oil	Purified Mineral Oil	Synthetic Hydrocarbon Oil
Thickener	Lithium Soap Base	Lithium Soap Base
Mixing Consistency (25°C) (Equivalent NLGI Consistency No.)	265 to 295 (No.2)	265 to 295 (No.2)
Drop Point	198°C	210°C
Appearance	Green	White

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	
		2XH-J	2XH-F
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 Output Flange	0.018	



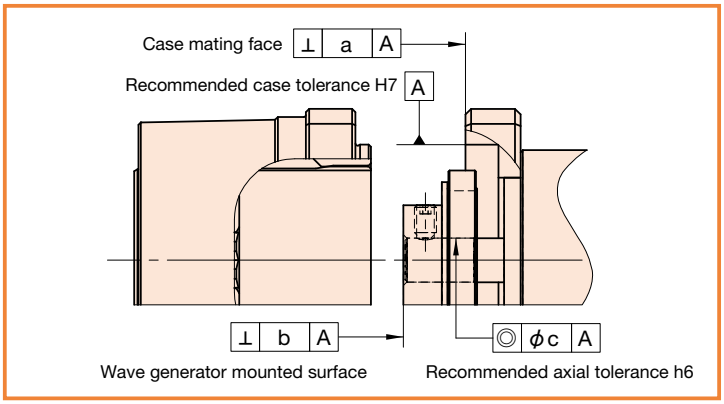
Installation Accuracy

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

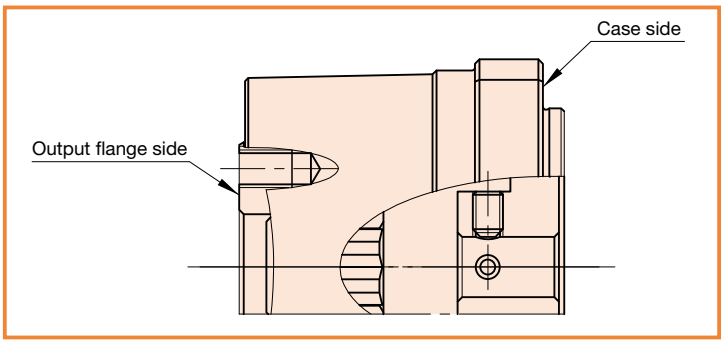
Recommended Installation Accuracy



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 fix the mounting flange with bolts.



Case Side Installation and Transmission Torque

(a-b equally-distributed part and c-d equally-distributed part in the P3 Outline drawing)

Item		Size 7
Number of Bolts		2
Bolt Size		M2.5
Mounting P.C.D	mm	31.5
Bolt Tightening Torque	N·m	0.49
	kgf·m	0.050
Thread Fit Minimum Length	mm	3.0
Bolt Transmission Torque	N·m	3.8
	kgf·m	0.39

* 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).

Output Flange Side Installation and Transmission Torque

(x-y equally-distributed part in the P3 Outline drawing)

Item		Size 7
Number of Bolts		4
Bolt Size		M2.5
Mounting P.C.D	mm	13
Bolt Tightening Torque	N·m	1.1
	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
* 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.
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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