HarmonicDrive®

CSG/CSF-LW-Lightweight Gear Unit

Now offering a NEW lightweight version of our CSG/CSF-2UH Gear Units!

30% lighter than our standard CSG/CSF-2UH!

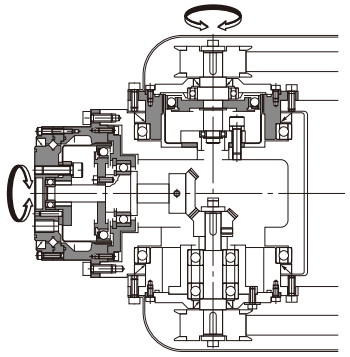
Using new lightweight materials and an optimized design, a 30% reduction in weight has been achieved without reducing the torque rating of the gear unit or changing the interface dimensions. This weight savings dramatically increases the "Torque Density" of the gear making it ideally suited for many applications including…

Industrial Robots – *allowing operation with higher acceleration rates and payload capacity*

Mobile Robots – *allowing lower weight designs which improves battery life without sacrificing performance*

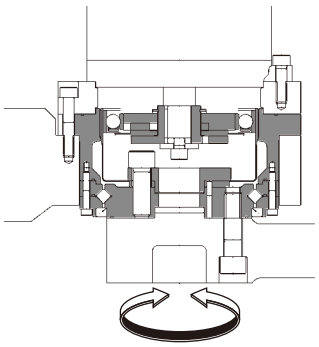
Application Examples

Robot Wrist



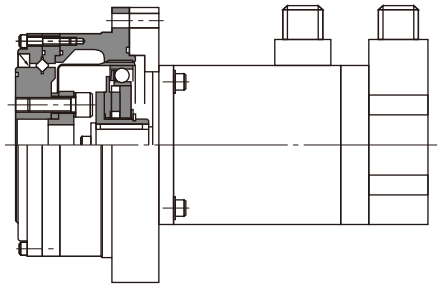
5th and 6th axis drive for the wrist of an Industrial Robot

SCARA Robot Arm



Drive for SCARA Robot

Direct Connection to a Servo Motor



Ordering Code

CSG - 25 - 100 - 2UH - LW - SP

Model	Size	Gear Ratio	Type		Special
CSG Series CSF Series	14~65	1:30~1:160	2UH (Unit Type)	Lightweight	(Custom Specification) leave blank for standard product

Rating Table

CSG Series

Size	Ratio	Rated Torque at 2000r/min		Limit for Repeated Peak Torque		Limit for AverageTorque		Limit for Momentory Peak Torque		Maximum Input Speed r/min		Limit for Average Input Speed r/min		Moment of Inertia	
		Nm	kgfm	Nm	kgfm	Nm	kgfm	Nm	kgfm	Oil	Grease	Oil	Grease	I $\times10^{-4}$kgm^2	J $\times10^{-5}$kgfms^2
14	50	7.0	0.7	23	2.3	9	0.9	46	4.7	14000	8500	6500	3500	0.033	0.034
	80	10	1.0	30	3.1	14	1.4	61	6.2						
	100	10	1.0	36	3.7	14	1.4	70	7.2						
17	50	21	2.1	44	4.5	34	3.4	91	9	10000	7300	6500	3500	0.079	0.081
	80	29	2.9	56	5.7	35	3.6	113	12						
	100	31	3.2	70	7.2	51	5.2	143	15						
	120	31	3.2	70	7.2	51	5.2	112	15						
20	50	33	3.3	73	7.4	44	4.5	127	13	10000	6500	6500	3500	0.193	0.197
	80	44	4.5	96	9.8	61	6.2	165	17						
	100	52	5.3	107	10.9	64	6.5	191	20						
	120	52	5.3	113	11.5	64	6.5	191	20						
	160	52	5.3	120	12.2	64	6.5	191	20						
25	50	51	5.2	127	13	72	7.3	242	25	7500	5600	5600	3500	0.413	0.421
	80	82	8.4	178	18	113	12	332	34						
	100	87	8.9	204	21	140	14	369	38						
	120	87	8.9	217	22	140	14	382	40						
	160	87	8.9	229	23	140	14	382	42						
32	50	99	10	281	29	140	14	497	51	7000	4800	4600	3500	1.69	1.72
	80	153	16	395	40	217	22	738	75						
	100	178	18	433	44	281	29	841	86						
	120	178	18	459	47	281	29	842	86						
	160	178	18	484	49	281	29	842	86						
40	50	178	18	523	53	255	26	892	91	5600	4000	3600	3000	4.50	4.59
	80	268	27	675	69	369	38	1270	130						
	100	345	35	738	75	484	49	1400	143						
	120	382	39	802	82	586	60	1488	156						
	160	382	39	841	86	586	60	1488	156						
45	50	229	23	650	66	345	35	1235	126	5000	3800	3300	3000	8.68	8.86
	80	407	41	918	94	507	52	1651	168						
	100	459	47	982	100	650	66	2041	208						
	120	523	53	1070	109	806	82	2288	233						
	160	523	53	1147	117	819	84	2483	253						
50	80	484	49	1223	125	675	69	2418	247	4500	3500	3000	2500	12.5	12.8
	100	611	62	1274	130	866	88	2678	273						
	120	688	70	1404	143	1057	108	2678	273						
	160	688	70	1534	156	1096	112	3185	325						
58	80	714	73	1924	196	1001	102	3185	325	4000	3000	2700	2200	27.3	27.9
	100	905	92	2067	211	1378	141	4134	422						
	120	969	99	2236	228	1547	158	4329	441						
	160	969	99	2392	244	1573	160	4459	455						
65	80	969	99	2743	280	1352	138	4836	493	3500	2800	2400	1900	46.8	47.8
	100	1236	126	2990	305	1976	202	6175	630						
	120	1236	126	3263	333	2041	208	6175	630						
	160	1236	126	3419	349	2041	208	6175	630						

1. Moment of Inertia: I=1/4GD^2
2. Please refer to the CSF/CSG Series catalog for an explanation of terms and technical information not included in this brochure.

CSF Series

Size	Ratio	Rated Torque at 2000r/min		Limit for Repeated Peak Torque		Limit for AverageTorque		Limit for Momentory Peak Torque		Maximum Input Speed r/min		Limit for Average Input Speed r/min		Moment of Inertia	
		Nm	kgfm	Nm	kgfm	Nm	kgfm	Nm	kgfm	Oil	Grease	Oil	Grease	I $\times10^{-4}$kgm^2	J $\times10^{-3}$kgfms^2
14	30	4.0	0.41	9.0	0.92	6.8	0.69	17	1.7	14000	8500	6500	3500	0.033	0.034
	50	5.4	0.55	18	1.8	6.9	0.70	35	3.6						
	80	7.8	0.80	23	2.4	11	1.1	47	4.8						
	100	7.8	0.80	28	2.9	11	1.1	54	5.5						
17	30	8.8	0.90	16	1.6	12	1.2	30	3.1	10000	7300	6500	3500	0.079	0.081
	50	16	1.6	34	3.5	26	2.6	70	7.1						
	80	22	2.2	43	4.4	27	2.7	87	8.9						
	100	24	2.4	54	5.5	39	4.0	108	11						
	120	24	2.4	54	5.5	39	4.0	86	8.8						
20	30	15	1.5	27	2.8	20	2.0	50	5.1	10000	6500	6500	3500	0.193	0.197
	50	25	2.5	56	5.7	34	3.5	98	10						
	80	34	3.5	74	7.5	47	4.8	127	13						
	100	40	4.1	82	8.4	49	5.0	147	15						
	120	40	4.1	87	8.9	49	5.0	147	15						
	160	40	4.1	92	9.4	49	5.0	147	15						
25	30	27	2.8	50	5.1	38	3.9	95	9.7	7500	5600	5600	3500	0.413	0.421
	50	39	4.0	98	10	55	5.6	186	19						
	80	63	6.4	137	14	87	8.9	255	26						
	100	67	6.8	157	16	108	11	284	29						
	120	67	6.8	167	17	108	11	304	31						
	160	67	6.8	176	18	108	11	314	32						
32	30	54	5.5	100	10	75	7.7	200	20	7000	4800	4600	3500	1.69	1.72
	50	76	7.8	216	22	108	11	382	39						
	80	118	12	304	31	167	17	568	58						
	100	137	14	333	34	216	22	647	66						
	120	137	14	353	36	216	22	686	70						
	160	137	14	372	38	216	22	686	70						
40	50	137	14	402	41	196	20	686	70	5600	4000	3600	3000	4.50	4.59
	80	206	21	519	53	284	29	980	100						
	100	265	27	568	58	372	38	1080	110						
	120	294	30	617	63	451	46	1180	120						
	160	294	30	647	66	451	46	1180	120						
45	50	176	18	500	51	265	27	950	97	5000	3800	3300	3000	8.68	8.86
	80	313	32	706	72	390	40	1270	130						
	100	353	36	755	77	500	51	1570	160						
	120	402	41	823	84	620	63	1760	180						
	160	402	41	882	90	630	64	1910	195						
50	50	245	25	715	73	350	36	1430	146	4500	3500	3000	2500	12.5	12.8
	80	372	38	941	96	519	53	1860	190						
	100	470	48	980	100	666	68	2060	210						
	120	529	54	1080	110	813	83	2060	210						
	160	529	54	1180	120	843	86	2450	250						
58	50	353	36	1020	104	520	53	1960	200	4000	3000	2700	2200	27.3	27.9
	80	549	56	1480	151	770	79	2450	250						
	100	696	71	1590	162	1060	108	3180	325						
	120	745	76	1720	176	1190	121	3330	340						
	160	745	76	1840	188	1210	123	3430	350						
65	50	490	50	1420	145	720	73	2830	289	3500	2800	2400	1900	46.8	47.8
	80	745	76	2110	215	1040	106	3720	380						
	100	951	97	2300	235	1520	155	4750	485						
	120	951	97	2510	256	1570	160	4750	485						
	160	951	97	2630	268	1570	160	4750	485						

1. Moment of Inertia: I=1/4GD^2.
2. Please refer to the CSF/CSG Series catalog for an explanation of terms and technical information not included in this brochure.
3. *Gear units size 50 and over with a gear ratio of 50:1 must use oil lubrication. If it is necessary to use grease, the rated torque is reduced by 50%.

No Load Running Torque

No-load running torque is the input torque (high speed shaft) which is required to rotate the Harmonic Drive® gear with no load applied to the output.

Measurement condition

Table 4-1

Ratio: 100			
Lubricant	Grease	Name	Harmonic grease SK-1A
			Harmonic grease SK-2
		Grease quantity	Recommended quantity
Torque value is measured after 2 hour run-in at 2000 rpm input. Please contact a sales engineer if you are using oil lubricant.			

Operating tempareture range

Table 4-3

[Grease]	SK-1A 0℃~+40℃
	SK2 0℃~+40℃

Note : Use the high temperature side in temperature rise 40 ℃ or less for ambient temperature.

Compensation Value for Each Ratio

The no load running torque of Harmonic Drive® gears varies with the gear ratio. The graphs indicate a value for ratio 100. For other gear ratios, add the compensation value from table 4-2.

Table 4-2

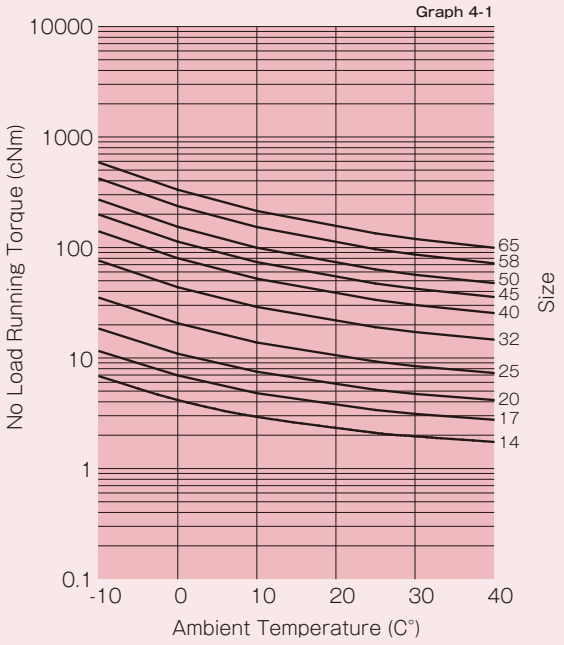
Unit type no load runing torque compensation Unit : cNm

Size \ Ratio	30	50	80	120	160
14	2.5	1.1	0.2	—	—
17	3.8	1.6	0.3	-0.2	—
20	5.4	2.3	0.5	-0.3	-0.8
25	8.8	3.8	0.7	-0.5	-1.2
32	16	7.1	1.3	-0.9	-2.2
40	—	12	2.1	-1.5	-3.5
45	—	16	2.9	-2.1	-4.9
50	—	21	3.7	-2.6	-6.2
58	—	30	5.3	-3.8	-8.9
65	—	41	7.2	-5.1	-12

No Load Running Torque for Ratio 100

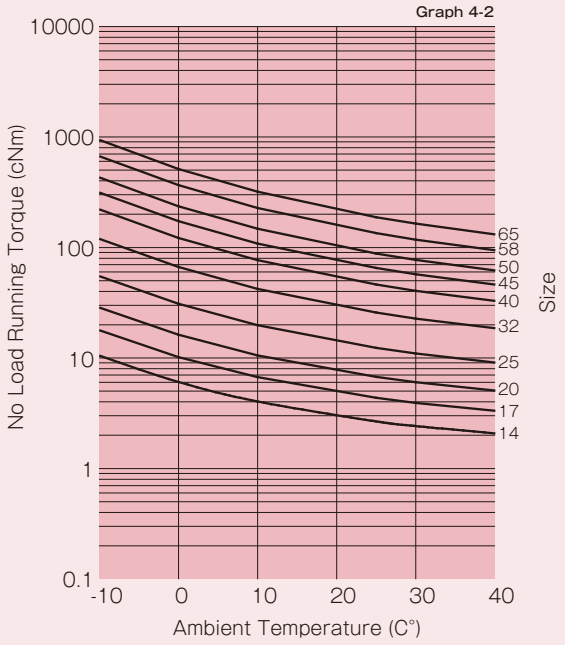
Input Speed 500r/min

Graph 4-1



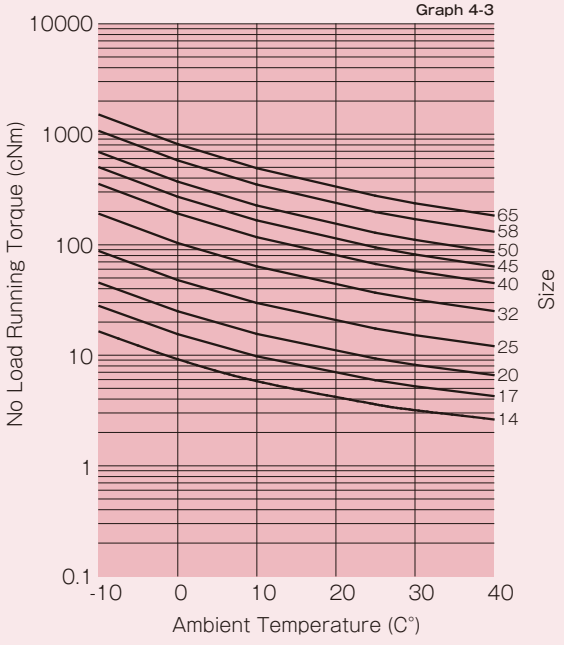
Input Speed 1000r/min

Graph 4-2



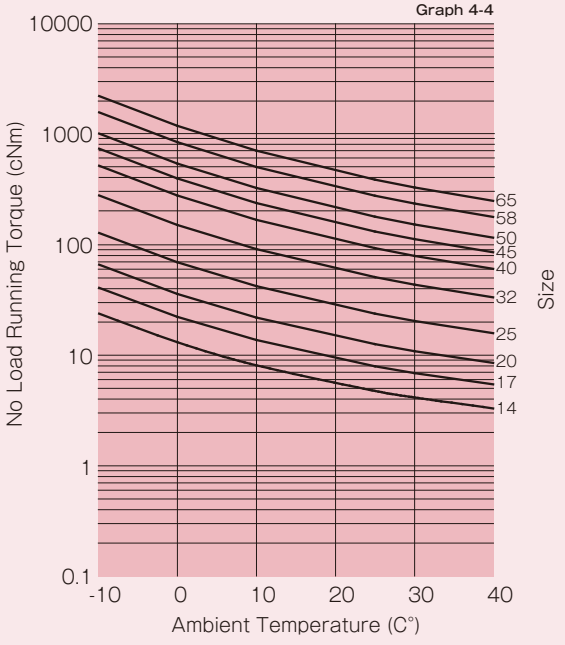
Input Speed 2000r/min

Graph 4-3



Input Speed 3500r/min

Graph 4-4



※The values in this graph are mean values($\bar{X}$). $\sigma \fallingdotseq \bar{X} \times 0.2$

Efficiency

The gear efficiency is affected by many factors. Efficiency depends on the gear ratio, input speed, load torque, temperature, quantity of lubricant and type of lubricant. Efficiency values shown in the tables shown below are for rated torque. If the actual load torque is below rated torque, a compensation factor must be used.

Load Torque ≥ Rated Torque : Efficiency = Efficiency from Graph
Load Torque < Rated Torque : Efficiency = Efficiency from Graph x Compensation Coefficient from Graph 5-1.

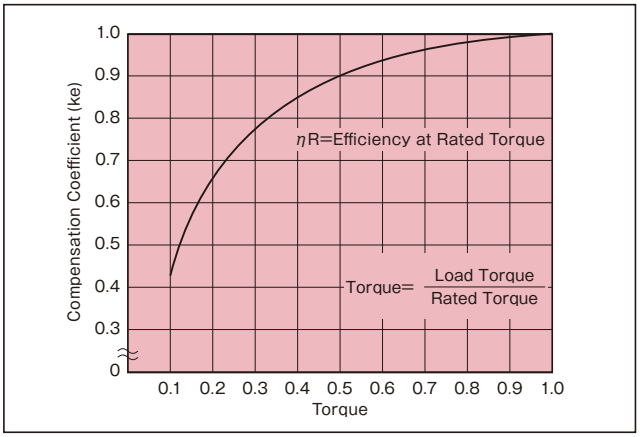
Measurement condition

Table 5-1

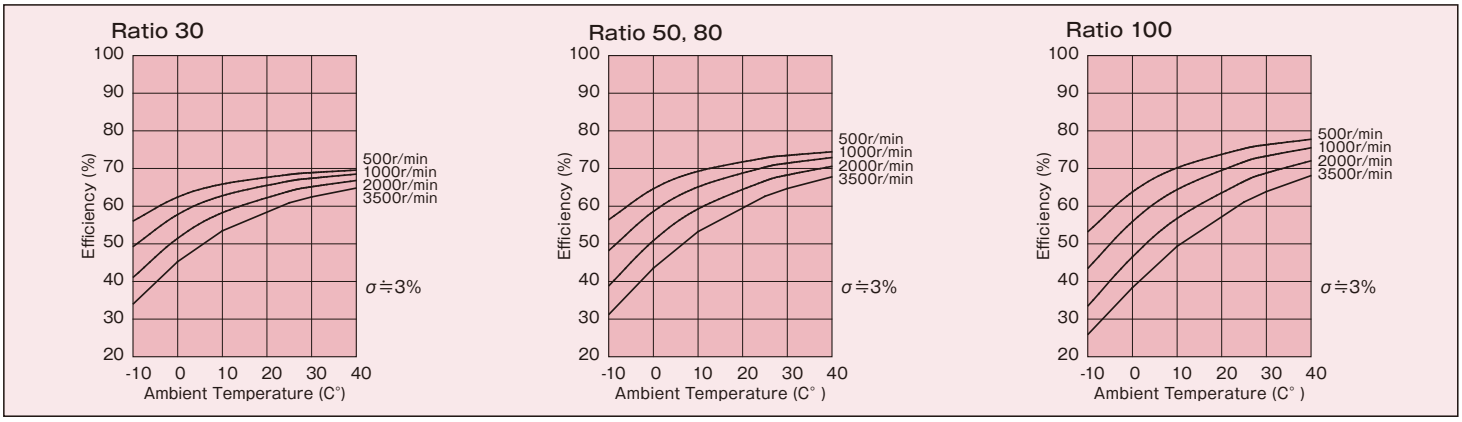
Installation	Based on recommended tolerance		
Load torque	Rated torque		
Lubricant	Grease	Name	Harmonic grease SK-1A
			Harmonic grease SK-2
		Grease quantity	Recommended quantity

Efficiency Compensation Coefficient

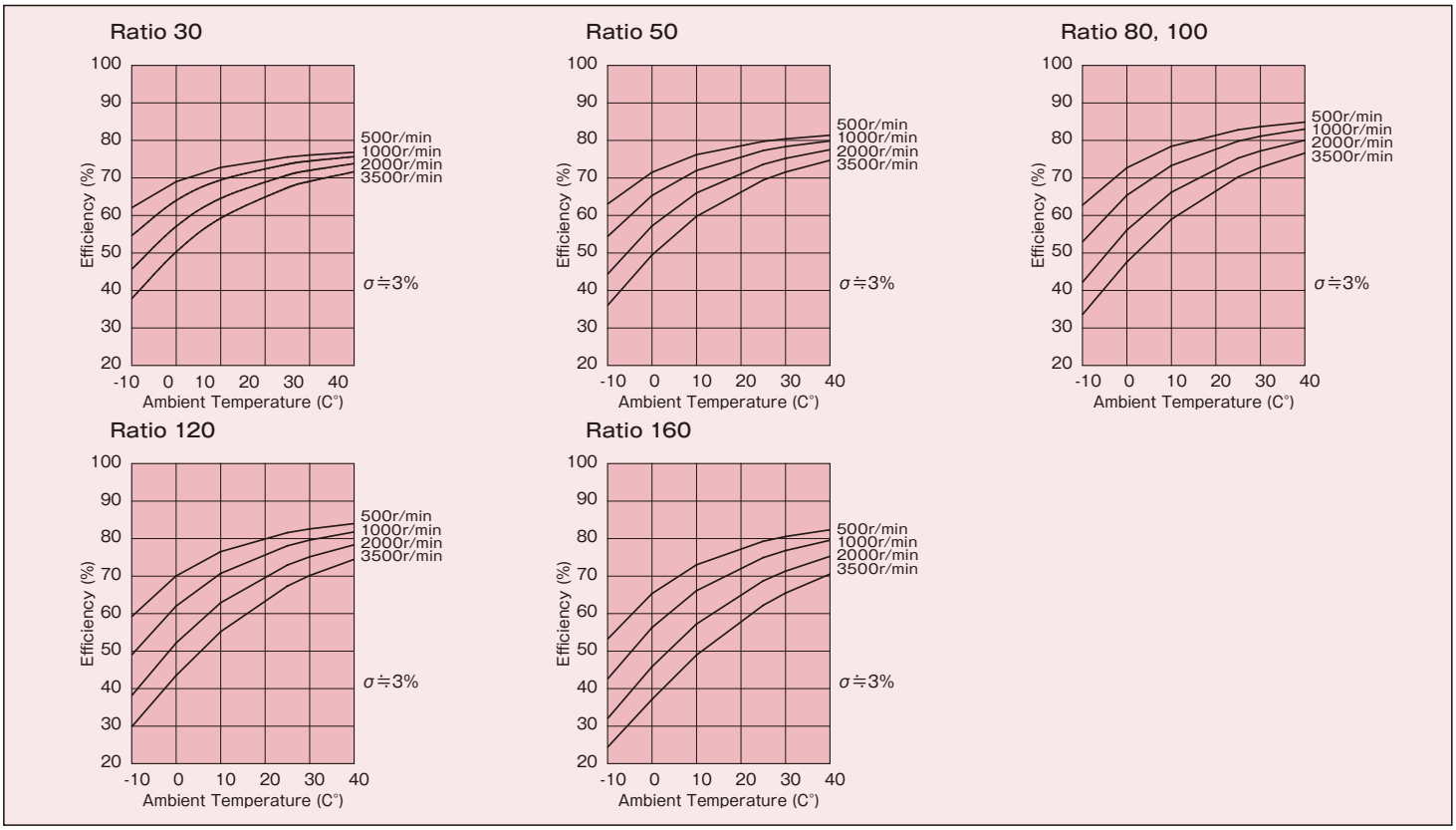
Graph 5-1



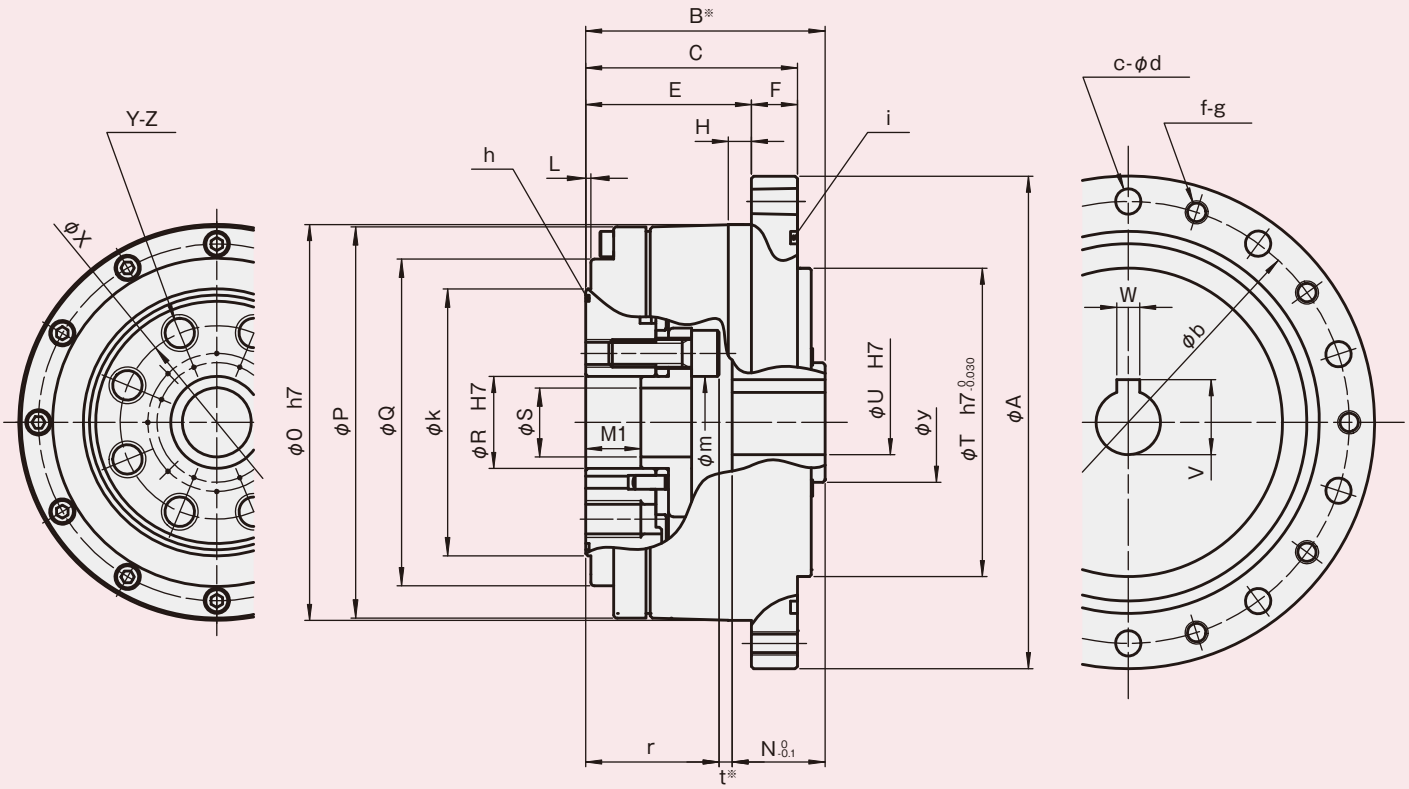
Efficiency Efficiency at Rated Torque (Size 14)

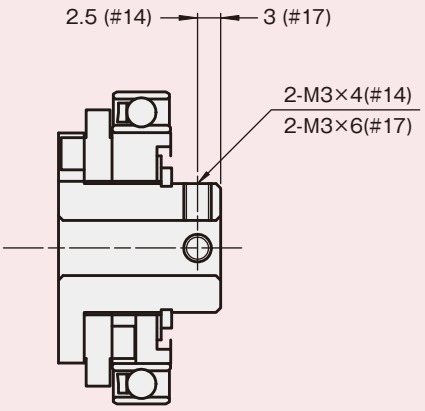


Efficiency at Rated Torque (Sizes 17-65)

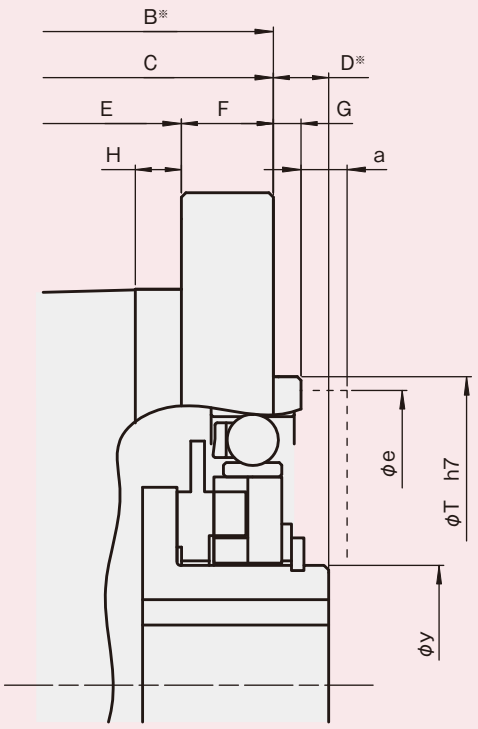


External Dimensions





No key on WG hub for #14, #17



Detailed drawing for input side

Please contact a sales engineer for installation drawings.
* Please Note: The bolts must not extend beyond the length of the threaded hole. If the length of thread engagement exceeds dimension 'Z', damage to the flexspine may occur. Please refer to installation drawing.

Dimension Table

Table 7-1
Unit: mm

Symbol \ Size		14	17	20	25	32	40	45	50	58	65
φA		73	79	93	107	138	160	180	190	226	260
B※		41 $^{0}_{-0.9}$	45 $^{0}_{-0.9}$	45.5 $^{0}_{-1.0}$	52 $^{0}_{-1.0}$	62 $^{0}_{-1.1}$	72.5 $^{0}_{-1.1}$	79.5 $^{0}_{-1.2}$	90 $^{0}_{-1.3}$	104.5 $^{0}_{-1.3}$	115 $^{0}_{-1.3}$
C		34	37	38	46	57	66.5	74	85	97	108.5
D※	CSG	7 $^{0}_{-0.4}$	8 $^{0}_{-0.4}$	7.5 $^{0}_{-0.4}$	6 $^{0}_{-0.5}$	5 $^{0}_{-0.6}$	6 $^{0}_{-0.6}$	5.5 $^{0}_{-0.6}$	5 $^{0}_{-0.6}$	7.5 $^{0}_{-0.6}$	6.5 $^{0}_{-0.6}$
	CSF	7 $^{0}_{-0.8}$	8 $^{0}_{-0.9}$	7.5 $^{0}_{-1.0}$	6 $^{0}_{-1.0}$	5 $^{0}_{-1.1}$	6 $^{0}_{-1.1}$	5.5 $^{0}_{-1.2}$	5 $^{0}_{-1.3}$	7.5 $^{0}_{-1.3}$	6.5 $^{0}_{-1.3}$
E		27	29	28	36	45	50.5	58	69	77	84.5
F		7	8	10	10	12	16	16	16	20	24
G		2	2	3	3	3	4	4	4	5	5
H		4	4	5	5	4.5	4.5	6	6	6	6
L		1.1	1.1	1.1	1.1	1.2	1.6	1.6	1	1.5	1.5
M1		9.4	9.5	9	12	15	5	6	8	10	10
M2		-	-	-	-	-	-	-	-	-	4
N $^{0}_{-0.1}$	CSG	18.5	20.7	21.5	21.6	23.6	29.7	30.5	34.8	38.3	44.6
	CSF	17.6	19.5	20.1	20.2	22	27.5	27.9	32	34.9	40.9
φOh7		56	63	72	86	113	127	148	158	186	212
φP		54.6	59.5	70	84.6	110	124.5	143	155	183	208
φQ		40.5	47.5	55.5	71	91.1	103	123	130	155	180
φR1H7		11	10	14	20	26	32	32	40	46	52
φR2H7		-	-	-	-	-	-	-	-	-	142
φS		8	7	10	15	20	24	25	32	38	44
φTh7		38	48	56	67(68)	90	110	124	135	156	177
φUH7		6	8	12	14	14	14	19	19	22	24
V		-	-	13.8 $^{+0.1}_{0}$	16.3 $^{+0.1}_{0}$	16.3 $^{+0.1}_{0}$	16.3 $^{+0.1}_{0}$	21.8 $^{+0.1}_{0}$	21.8 $^{+0.1}_{0}$	24.8 $^{+0.1}_{0}$	27.3 $^{+0.2}_{0}$
WJs9		-	-	4	5	5	5	6	6	6	8
φX		23	27	32	42	55	68	82	84	100	110
Y		6	6	8	8	8	8	8	8	8	8
Z		M4×8	M5×10	M6×9	M8×12	M10×15	M10×15	M12×18	M14×21	M16×24	M16×24
a		1	1	1.5	1.5	1.5	2	2	2	2.5	2.5
φb		65	71	82	96	125	144	164	174	206	236
c		6	8	8	10	14	10	16	18	16	12
φd		4.5	4.5	5.5	5.5	6.6	9	9	9	11	14
φe		38	45	53	66	86	106	119	133	154	172
f		6	8	8	10	14	10	16	18	16	12
g		M4	M4	M5	M5	M6	M8	M8	M8	M10	M12
h		29.0×0.50	34.5×0.80	40.64×1.14	53.28×0.99	S71	AS568-042	S100	S105	S125	S135
i		S50	S56	S67	S80	S105	S125	S145	S155	S180	S205
φk		31	38	45	58	78	90	107	112	135	155
φm		10	10.5	15.5	20	27	34	36	39	46	56
r		21.4	23.5	23	29	37	39.5	45.5	53	62.8	66.5
t※	CSG	1.1	0.8	1	1.4	1.4	3.3	3.5	2.2	3.4	3.9
	CSF	2	2	2.4	2.8	3	5.5	6.1	5	6.8	7.6
u※	CSG	5.1	5.8	6	7.4	9.4	13.3	15.5	16.2	19.4	19.9
	CSF	6	7	7.4	8.8	11	15.5	18.1	19	22.8	23.6
φy		14	18	21	26	26	32	32	32	40	48
Weight (kg)		0.32	0.46	0.64	1.1	2.2	3.5	5.1	7.0	11.3	16.2

Note 1: Dimensions in parentheses indicates values for 30:1 gear ratio.
Note 2: ※ Dimensions B, D, t and u indicate the location and tolerance of the wave generator flexspline and circular spline.
Please strictly comply with these dimensions since it influences performance and strength of the gear.

Weight Comparison

Unit: kg

Size	14	17	20	25	32	40	45	50	58	65
CSG Series standard unit type	0.52	0.68	0.98	1.5	3.2	5.0	7.0	8.9	14.6	20.9
CSG Series LW unit type	**0.32**	**0.46**	**0.64**	**1.1**	**2.2**	**3.5**	**5.1**	**7.0**	**11.3**	**16.2**
Weight ratio	62%	68%	65%	73%	69%	70%	73%	79%	77%	78%

Specification for Crossroller Bearing

Table 8-1

Size	Pitch Circle dp	Offset R	Basic Dynamic Rated Load C		Basic Static Rated Load Co		Allowable Moment Load Mc		Moment Stiffness Km	
	m	m	$\times 10^2$ N	kgf	$\times 10^2$ N	kgf	Nm	kgfm	$\times 10^4$ Nm/rad	kgfm/arc-min
14	0.035	0.0093	47.0	480	60.7	620	33.6	3.4	3.6	1.1
17	0.0425	0.0091	52.9	540	75.5	770	52.5	5.3	6.4	1.9
20	0.05	0.0098	57.8	590	90.0	920	74.6	7.6	10.5	3.1
25	0.064	0.0118	96.0	980	151	1540	128	13.1	19.8	5.9
32	0.083	0.0133	150	1530	250	2550	257	26.2	44.2	13.1
40	0.096	0.0148	213	2170	365	3720	369	37.7	74.6	22.1
45	0.111	0.0158	230	2350	426	4340	563	57.4	116	34.4
50	0.119	0.0180	348	3550	602	6140	622	63.5	140	48.5
58	0.141	0.0205	518	5290	904	9230	838	85.4	201	59.6
65	0.16	0.0185	556	5670	1030	10500	1525	156	331	108

Installation and Transmission Torque

Bolt connection to output flange and resulting transmission torque

Table 8-2

Size		14	17	20	25	32	40	45	50	58	65
Number of screws		6	6	8	8	8	8	8	8	8	8
Size of screws		M4	M5	M6	M8	M10	M10	M12	M14	M16	M16
Pitch circle diameter	mm	23	27	32	42	55	68	82	84	100	110
Screw Tightening Torque	Nm	4.5 (5.4)	9 (10.8)	15.3 (18.4)	37 (45)	74 (89)	74 (89)	128 (154)	205 (246)	319 (383)	319 (383)
	kgfm	0.46 (0.55)	0.92 (1.1)	1.56 (1.88)	3.8 (4.5)	7.6 (9.1)	7.6 (9.1)	13.1 (15.7)	20.9 (25.1)	32.5 (39.1)	32.5 (39.1)
Torque transmitting capacity	Nm	49 (58)	91 (109)	204 (245)	486 (580)	1019 (1220)	1258 (1510)	2200 (2624)	3070 (3690)	4980 (5981)	5480 (6579)
	kgfm	5 (5.9)	9.3 (11.2)	21 (25)	50 (59)	104 (124)	128 (154)	224 (268)	313 (377)	508 (610)	559 (671)

※Value in not parentheses is for CSF-2UH-LW. Value in parentheses is for CSG-2UH-LW.

Bolt connection to housing and resulting transmission torque

Table 8-3

Size		14	17	20	25	32	40	45	50	58	65
Number of screws		6	8	8	10	12	10	16	18	16	12
Size of screws		M4	M4	M5	M5	M6	M8	M8	M8	M10	M12
Pitch circle diameter	mm	65	71	82	96	125	144	164	174	206	236
Screw Tightening Torque [5]	Nm	3.2	3.2	6.4	6.4	10.8	26.5	26.5	26.5	51.9	90
	kgfm	0.33	0.33	0.65	0.65	1.1	2.7	2.7	2.7	5.3	9.2
Torque transmitting capacity	Nm	98	143	261	382	842	1488	2712	3237	5350	6649
	kgfm	10	14.6	26.6	39	85.9	152	277	330	546	678

1. Recommended bolt : JIS B 1176 hexagon socket head cap screw strength range : JIS B 1051 over 12.9
2. Torque coefficient : K=0.2
3. Clamp coefficient A=1.4
4. Coefficient of friction : μ=0.15

※ Strict compliance to the recommended screw tightening torques is especially important for the lightweight aluminum housing flange. Exceeding the recommended values (over tightening) can cause deformation of the housing flange under the bolt heads. This will result in the housing slipping under full torque loads.

* Please contact the sales office of Harmonic Drive Systems Inc. for more information. **http://www.hds.co.jp/**

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