HarmonicPlanetary®
HPN Value Series

Size
11, 14, 20, 32, 40
5 Sizes

Peak Torque
9Nm ~ 752Nm

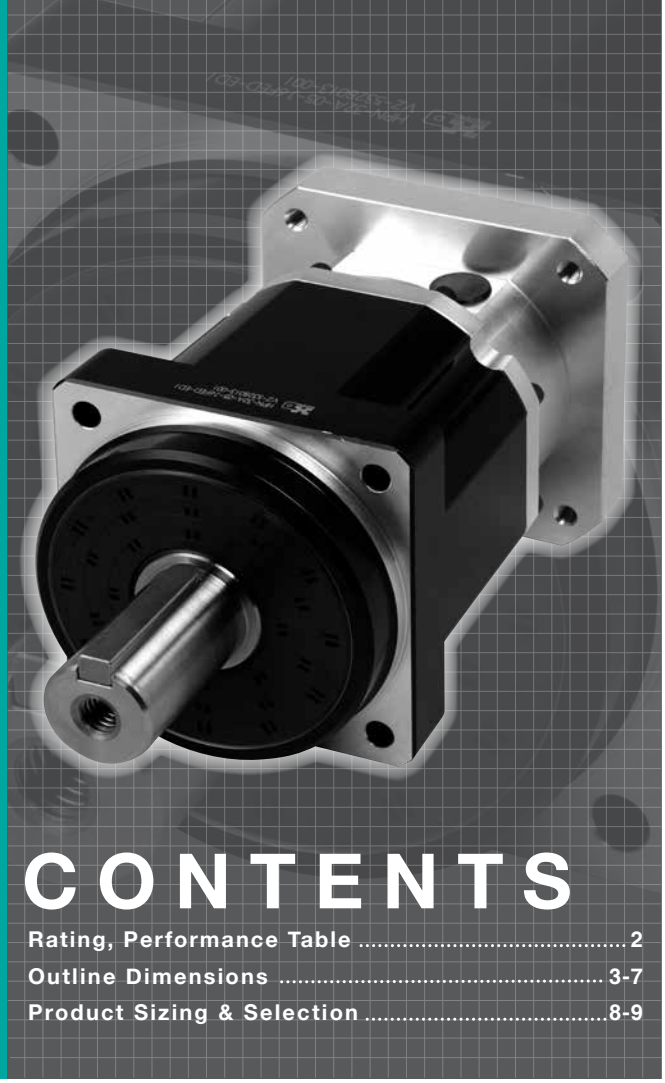
Reduction Ratio
Single stage: 3:1 to 10:1, Two stage: 13:1 to 31:1

Backlash
Single stage: < 5 arc-min, Two stage: < 7 arc-min

High Efficiency
Up to 97%

Output Bearing
A radial ball bearing is integrated with the output flange to provide high moment stiffness, high load capacity and precise positioning accuracy.

Easy mounting to a wide variety of servomotors
Quick Connect™ coupling



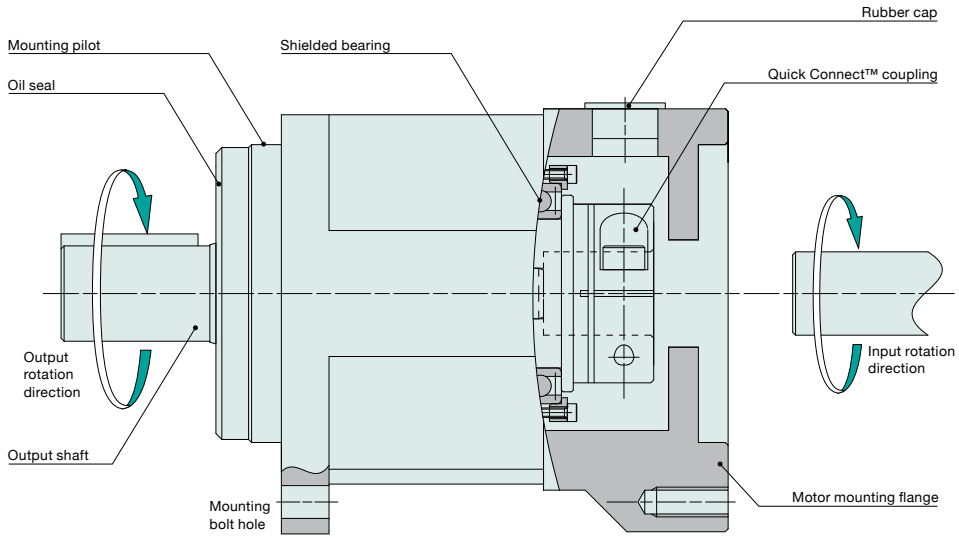
CONTENTS

HPN - 14 A - 05 - J6 Motor Model Number

Model Name	Size	Design Revision	Reduction Ratio	Output Configuration	Input Configuration
HarmonicPlanetary® HPN High Torque	11	A	4, 5, 7, 10, 16, 20, 30	J6: With a key and center tapped hole J8: Smooth shaft with center tapped hole	This code represents the motor mounting configuration. Please contact us for a unique part number based on the motor you are using.
	14				
	20		3, 4, 5, 7,1 0, 13, 21, 31		
	32				
	40				

Gearhead Construction

Figure 054-1



Rating Table

Please contact our sales office if you have any questions about our specifications or comparison with another company's products.

Table 055-1

Size	Number of Stages	Ratio	Rated Torque *1	Limit for Repeated Peak Torque *2	Limit for Momentary Peak Torque *3	Max. Average Rated Input Speed*4	Max. Input Speed (grease) *5	Allowable Radial Load *6	Allowable Axial Load *7
			Nm	Nm	Nm	rpm	rpm	rpm	rpm
11	1	4	14	14	40	3,000	10,000	240	280
		5	14	16	40			260	320
		7	11	11	40			280	360
		10	9	9	40			320	420
	2	16	18	24	40			360	460
		20	22	24	40			400	560
		30	25	26	40			480	640
14	1	3	22	25	89	3,000	6,000	380	340
		4	28	50	110			420	380
		5	29	50	107			450	410
		7	30	37	100			510	480
		10	18	18	79			570	580
	2	13	30	43	106			630	630
		21	30	50	99			740	780
		31	30	38	101			840	900
20	1	3	51	74	226	3,000	6,000	830	900
		4	80	130	256			920	1,100
		5	80	149	256			1,000	1,200
		7	80	113	256			1,100	1,400
		10	54	54	216			1,230	1,600
	2	13	80	130	256			1,350	1,850
		21	80	147	256			1,600	2,100
		31	80	113	256			1,800	2,200
32	1	3	153	254	625	3,000	6,000	1,800	2,000
		4	198	376	625			1,900	2,300
		5	200	376	625			2,000	2,500
		7	200	376	625			2,300	2,900
		10	185	185	625			2,600	3,200
	2	13	200	376	625			2,900	3,600
		21	200	376	625			3,400	3,800
		31	200	376	625			3,900	3,800
40	1	3	440	752	1,137	3,000	6,000	2,800	2,700
		4	460	752	1,265			3,100	3,000
		5	480	752	1,265			3,400	3,300
		7	510	752	829			3,800	3,800
		10	480	509	829			4,200	4,200
	2	13	530	752	823			4,500	4,500
		21	620	752	1,029			5,000	5,000
		31	700	752	1,097			5,500	5,400

*1: Rated torque is based on L_{50} life of 20,000 hours at rated input speed.
*2: The limit for torque during start and stop cycles.
*3: The limit for torque during emergency stops or from external shock loads. Always operate below this value. Calculate the number of permissible events to ensure it meets required operating conditions.
*4: Maximum average input speed is limited by heat generation in the speed reducer assuming a continuous operating speed or the average input speed of a motion profile. The actual limit for average input speed depends on the operating environment.
*5: Maximum instantaneous input speed.
*6: The load at which the output bearing will have 20,000 hour life at the rated input speed. (Axial load = 0 and radial load point is in the center of the output shaft.)
*7: The load at which the output bearing life will be 20,000 hours at the rated input speed. (Radial load = 0 and axial load point is in the center of the output shaft.)

Performance

Table 055-2

Size	Number of Stages	Reduction Ratio	Backlash	Noise*1	Torsional Stiffness	
			arc min	dB	kgfm/arc-min	X100N•m/rad
11	1	4	< 5	< 56*2	0.060	20
		5				
		7				
		10				
	2	16	< 7			
		20				
		30				
14	1	3*2	< 5	< 58*2	0.27	93
		4				
		5				
		7				
		10				
	2	13	< 7			
		21				
		31				
20	1	3*2	< 5	< 60*2	0.77	260
		4				
		5				
		7				
		10				
	2	13	< 7			
		21				
		31				

Table 055-3

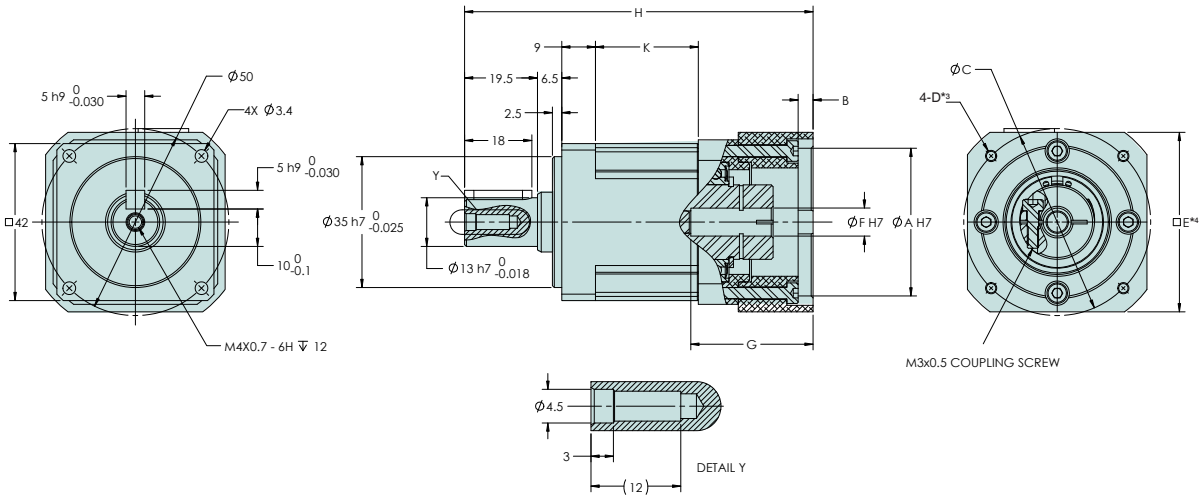
Size	Number of Stages	Reduction Ratio	Backlash	Noise*1	Torsional Stiffness	
			arc min	dB	kgfm/arc-min	X100N•m/rad
32	1	3*2	< 5	< 63*2	2.8	940
		4				
		5				
		7				
		10				
	2	13	< 7			
		21				
		31				
40	1	3*2	< 5	< 65*2	4.2	1430
		4				
		5				
		7				
		10				
	2	13	< 7			
		21				
		31				

*1: The above noise values are reference values.
*2: Contact us for noise values for sizes with a reduction ratio of 3.

HPN-11A Outline Dimensions

Figure 056-1

(Unit: mm)



(Note) The dimension tolerances that are not specified vary depending on the manufacturing method. Please check the confirmation drawing or contact us for dimension tolerances not shown on the drawing above. Output shaft configuration shown is J6 (with a key and center tapped hole). J8 configuration has no key.

Dimension Table

(Unit: mm) Table 056-1

	A (H7)		B	C		F (H7)		G		H*1	K	Mass(kg)*2
	Min.	Max.*4	Max.	Min.	Max.*4	Min.	Max.	Min.	Max.			
Single Stage	30	42	3	35	49	4.8	9	15	26	86.5	27.5	0.44
Two Stage										106	47	0.57

Refer to the confirmation drawing for detailed dimensions. Dimensions of typical products are shown. Please contact us for other mounting options if the configurations shown above are not suitable for your particular motor.
*1 May vary depending on motor interface dimensions.
*2 The mass will vary slightly depending on the ratio and on the inside diameter of the input shaft coupling.
*3 Tapped hole for motor mounting screw.
*4 E dimension is dependent on motor selection.

Moment of Inertia

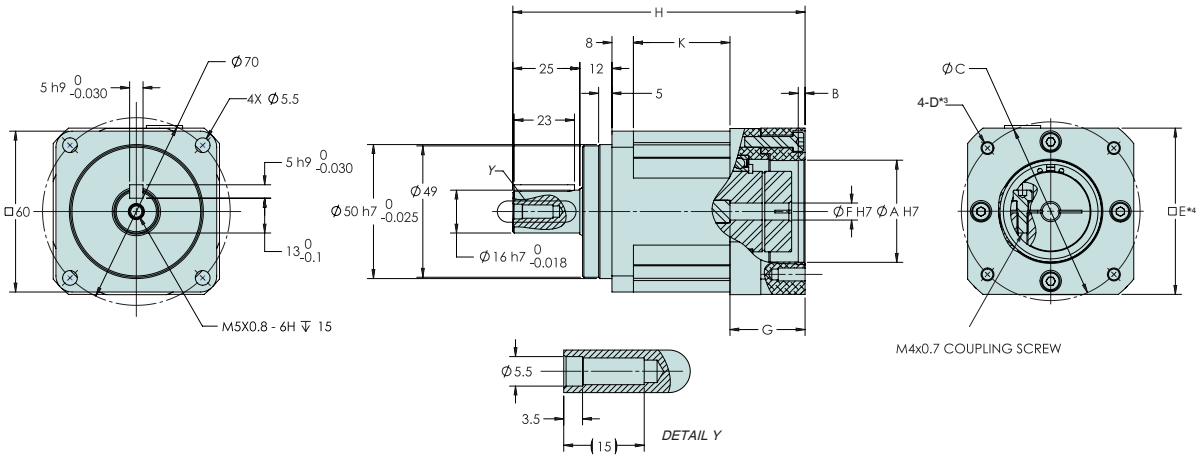
(10^{-4} kgm^2) Table 056-2

	Coupling \ Ratio	4	5	7	10	16	20	30
HPN 11A	1	0.042	0.04	0.038	0.037	0.04	0.04	0.038

HPN-14A Outline Dimensions

Figure 057-1

(Unit: mm)



(Note) The dimension tolerances that are not specified vary depending on the manufacturing method. Please check the confirmation drawing or contact us for dimension tolerances not shown on the drawing above. Output shaft configuration shown is J6 (with a key and center tapped hole). J8 configuration has no key.

Dimension Table

(Unit: mm) Table 057-1

	Flange	Coupling	A (H7)		B	C		F (H7)		G		H*1	K	Mass(kg)*2
			Min.	Max.*1	Max.	Min.	Max.*1	Min.	Max.	Min.	Max.			
Single Stage	1	1	30	39	5	35	49	4.8	8	17	25	107	36	0.95
Two Stage												132	61	1.3
Single Stage	2	2	50	59	5	56	74	4.8	14	24	31	112	36	1.2
Two Stage												137	61	1.6

Refer to the confirmation drawing for detailed dimensions. Dimensions of typical products are shown. Please contact us for other mounting options if the configurations shown above are not suitable for your particular motor.
*1 May vary depending on motor interface dimensions.
*2 The mass will vary slightly depending on the ratio and on the inside diameter of the input shaft coupling.
*3 Tapped hole for motor mounting screw.
*4 E dimension is dependent on motor selection.

Moment of Inertia

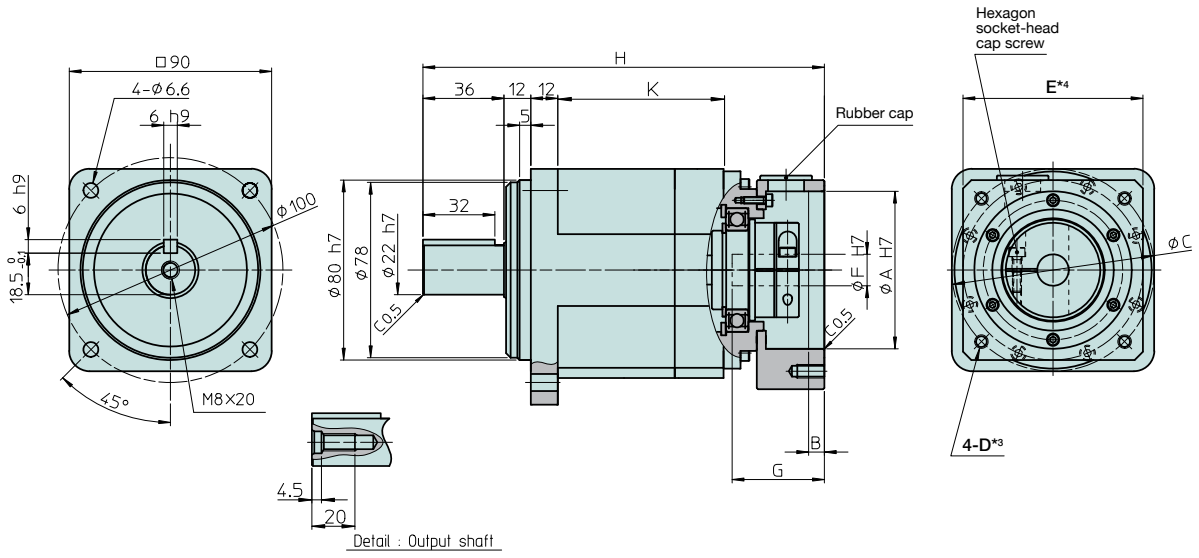
(10^{-4} kgm^2) Table 057-2

	Ratio / Coupling	3	4	5	7	10	13	21	31
HPN 14A	1	0.24	0.21	0.2	0.19	0.19	0.2	0.2	-
	2	0.124	0.096	0.083	0.072	0.066	0.049	0.043	0.041

HPN-20A Outline Dimensions

Figure 058-1

(Unit: mm)



(Note) The dimension tolerances that are not specified vary depending on the manufacturing method. Please check the confirmation drawing or contact us for dimension tolerances not shown on the drawing above. Output shaft configuration shown is J6 (with a key and center tapped hole). J8 configuration has no key.

Dimension Table

(Unit: mm) Table 058-1

	Flange	Coupling	A (H7)		B	C		F (H7)		G*1		H*1	K	Mass(kg)*2
			Min.	Max.*1	Max.	Min.	Max.*1	Min.	Max.	Min.	Max.			
Single Stage	1	1	38	85	7	58	110	8	25	21	42	151.8	52	3
Two Stage										19.5	36	173.5	73.7	3.7
Single Stage	2	2	50	125	7	58	155	4.8	25	45	66	169.8	52	5
Two Stage										43.5	60	191.5	73.7	6

Refer to the confirmation drawing for detailed dimensions. Dimensions of typical products are shown. Please contact us for other mounting options if the configurations shown above are not suitable for your particular motor.
*1 May vary depending on motor interface dimensions.
*2 The mass will vary slightly depending on the ratio and on the inside diameter of the input shaft coupling.
*3 Tapped hole for motor mounting screw.
*4 E dimension is dependent on motor selection.

Moment of Inertia

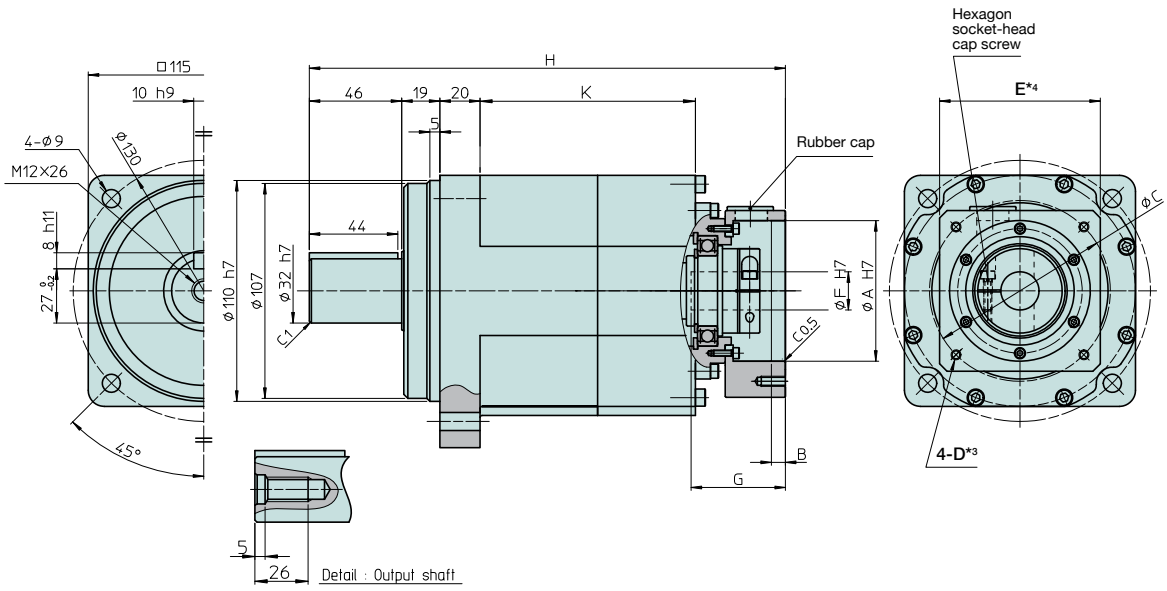
(10^{-4} kgm^2) Table 058-2

	Ratio / Coupling	3	4	5	7	10	13	21	31
HPN 20A	1	1.2	1	1	0.9	0.87	0.9	0.88	0.87

HPN-32A Outline Dimensions

Figure 059-1

(Unit: mm)



(Note) The dimension tolerances that are not specified vary depending on the manufacturing method. Please check the confirmation drawing or contact us for dimension tolerances not shown on the drawing above. Output shaft configuration shown is J6 (with a key and center tapped hole). J8 configuration has no key.

Dimension Table

(Unit: mm) Table 059-1

	Flange	Coupling	A (H7)		B	C		F (H7)		G*1		H*1	K	Mass(kg)*2
			Min.	Max.*1	Max.	Min.	Max.*1	Min.	Max.	Min.	Max.			
Single Stage	1	1	50	85	7	77	110	15.5	25	20	46	195	58.5	6.6
	2	2	70	125	7	77	155	15.5	28	47	69	212.5	58.5	7.7
	3	3	70	215	6.5	77	260	21.5	41	47	85	233.5	58.5	9.3
Two Stage	4	4	50	85	7	58	110	8	25	21	42	232	107.2	7.9
	5	4	50	125	7	58	155	8	25	44	65	255	107.2	9.1

Refer to the confirmation drawing for detailed dimensions. Dimensions of typical products are shown. Please contact us for other mounting options if the configurations shown above are not suitable for your particular motor.
*1 May vary depending on motor interface dimensions.
*2 The mass will vary slightly depending on the ratio and on the inside diameter of the input shaft coupling.
*3 Tapped hole for motor mounting screw.
*4 E dimension is dependent on motor selection.

Moment of Inertia

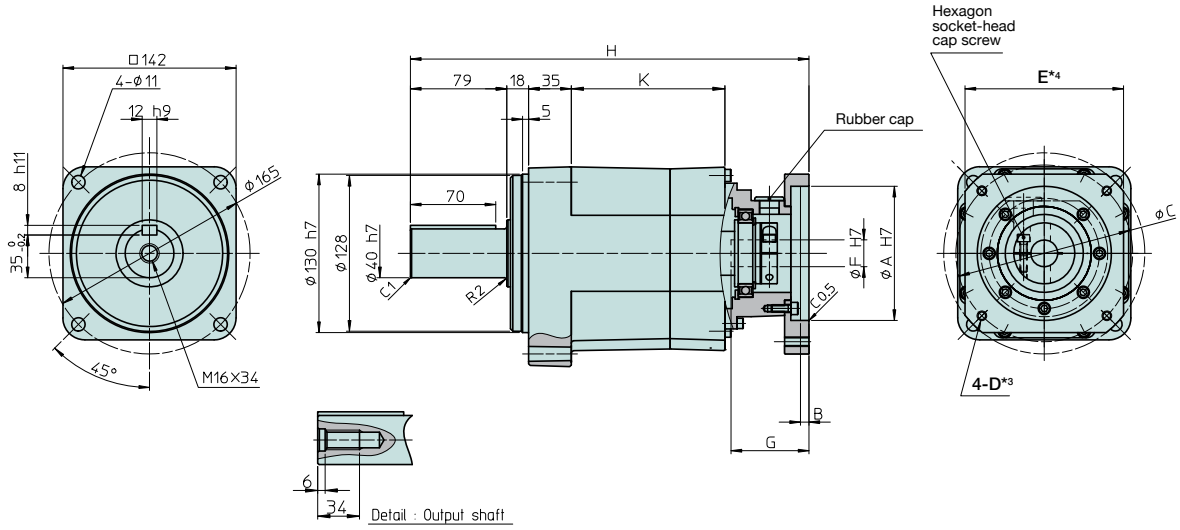
(10^{-4} kgm^2) Table 059-2

	Coupling \ Ratio	3	4	5	7	10	13	21	31
HPN 32A	1	2.3	1.7	1.5	1.3	1.2	-	-	-
	2	5	3.8	3.3	2.9	2.7	-	-	-
	3	7.5	6.2	5.7	5.3	5.3	-	-	-
	4	-	-	-	-	-	1.3	1.1	1

HPN-40A Outline Dimensions

Figure 060-1

(Unit: mm)



(Note) The dimension tolerances that are not specified vary depending on the manufacturing method. Please check the confirmation drawing or contact us for dimension tolerances not shown on the drawing above. Output shaft configuration shown is J6 (with a key and center tapped hole). J8 configuration has no key.

Dimension Table

(Unit: mm) Table 060-1

	Flange	Coupling	A (H7)		B	C		F (H7)		G*1		H*1	K	Mass(kg)*2
			Min.	Max.*1	Max.	Min.	Max.*1	Min.	Max.	Min.	Max.			
Single Stage	1	1	70	215	6.5	78	260	15.5	41	34.5	72	295.5	81	17
	2	2	70	175	6.5	78	225	15.5	42	39	105	328.5	81	16
	3	3	70	125	7	78	155	15.5	24	47	77	282.5	81	13
Two Stage	4	4	70	125	7	78	155	15.5	28	47	69	309.5	126	17
	5	5	70	215	6.5	77	260	21.5	41	47	85	348	126	18

Refer to the confirmation drawing for detailed dimensions. Dimensions of typical products are shown. Please contact us for other mounting options if the configurations shown above are not suitable for your particular motor.
*1 May vary depending on motor interface dimensions.
*2 The mass will vary slightly depending on the ratio and on the inside diameter of the input shaft coupling.
*3 Tapped hole for motor mounting screw.
*4 E dimension is dependent on motor selection.

Moment of Inertia

(10^{-4} kgm^2) Table 060-2

	Ratio / Coupling	3	4	5	7	10	13	21	31
HPN 40A	1	14	9.1	7.3	6.2	5.4	-	-	-
	2	15	11	8.8	7.3	6.5	-	-	-
	3	10.2	6.9	5.4	4.1	3.4	-	-	-
	4	-	-	-	-	-	4.5	3.5	3.4
	5	-	-	-	-	-	7	6	5.8

Product Sizing & Selection

To fully utilize the excellent performance of the HPN HarmonicPlanetary® gearheads, check your operating conditions and, using the flowchart, select the appropriate size gear for your application.

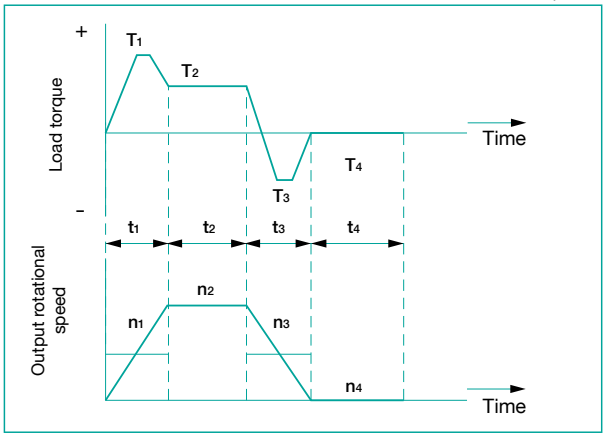
In general, a servo system rarely operates at a continuous load and speed. The input speed, load torque change and a comparatively large torque is applied during start and stop. Unexpected impact torques may also be applied.

Check your operating conditions against the following load torque pattern and select a suitable size based on the flowchart shown on the right. Also check the life and static safety coefficient of the cross roller bearing and input side main bearing (input shaft type only).

Checking the load torque pattern

Review the load torque pattern. Check the specifications shown in the figure below.

Graph 080-1



Obtain the value of each load torque pattern.

Load torque	T_1 to T_n (Nm)
Time	t_1 to t_n (sec)
Output rotational speed	n_1 to n_n (rpm)

<Normal operation pattern>

Starting	T_1, t_1, n_1
Steady operation	T_2, t_2, n_2
Stopping (slowing)	T_3, t_3, n_3
Idle	T_4, t_4, n_4

<Maximum rotational speed>

Max. output rotational speed	no *max* ≧ n_1 to n_n
Max. input rotational speed	ni *max* $n_1 \times R$ to $n_n \times R$
(Restricted by motors)	R: Reduction ratio

<Impact torque>

When impact torque is applied	T_s

<Required life>

L_{50} = L (hours)

Flowchart for selecting a size

Please use the flowchart shown below for selecting a size. Operating conditions must not exceed the performance ratings.

Calculate the average load torque applied on the output side from the load torque pattern: T*av* (Nm).

$$Tav = \sqrt[10/3]{\frac{|n_1| \cdot t_1 \cdot |T_1|^{10/3} + |n_2| \cdot t_2 \cdot |T_2|^{10/3} + \cdots + |n_n| \cdot t_n \cdot |T_n|^{10/3}}{n_1 \cdot t_1 + n_2 \cdot t_2 + \cdots + n_n \cdot t_n}}$$

Calculate the average output speed based on the load torque pattern: no av (rpm)

$$no\ av = \frac{|n_1| \cdot t_1 + |n_2| \cdot t_2 + \cdots + |n_n| \cdot t_n}{t_1 + t_2 + \cdots + t_n}$$

Make a preliminary model selection with the following condition: T*av* ≦ Average load torque (Refer to rating table). — NG

OK

Determine the reduction ratio (R) based on the maximum output rotational speed (no *max*) and maximum input rotational speed (ni *max*).

$$\frac{ni\ max}{no\ max} \geqq R$$

(A limit is placed on ni *max* by motors.)
Calculate the maximum input speed (ni *max*) from the maximum output speed (no *max*) and the reduction ratio (R).

ni *max*=no *max* • R

Calculate the average input speed (ni *av*) from the average output speed (no *av*) and the reduction ratio (R): ni *av* = no *av*·R ≦ Max. average input speed (nr). — NG

OK

Check whether the maximum input speed is equal to or less than the values in the rating table.
ni *max* ≦ maximum input speed (rpm) — NG

OK

Check whether T1 and T3 are within peak torques (Nm) on start and stop in the rating table. — NG

OK

Check whether T_S is equal to or less than the momentary max. torque (Nm) value from the ratings. — NG

OK

Calculate the lifetime and check whether it meets the specification requirement.
Tr: Output torque
n_r: Max. average input speed

$$L_{10} = 20{,}000 \cdot \left(\frac{T_r}{Tav}\right)^{10/3} \cdot \left(\frac{n_r}{ni\ av}\right) \text{ (Hour)}$$

— NG

OK

The model number is confirmed.

Refer to the Caution note below.

Review the operation conditions, size and reduction ratio.

Caution

If the expected operation will result in conditions where;
i) Actual average load torque (Tav) > Permissible maximum value of average load torque or
ii) Actual average input rotational speed (ni av) > Permissible average input rotational speed (nr), then please check its effect on the speed reducer temperature rise or other factors. Consider selecting the next larger speed reducer, reduce the operating loads or take other means to ensure safe use of the gear. Exercise caution especially when the duty cycle is close to continuous operation.

Example of model number Selection

Value of each load torque pattern.

Load torque	T_n (Nm)		
Time	t_n (sec)		
Output rotational speed	n_n (rpm)		
<Normal operation pattern>			
Starting	T_1 = 70 Nm,	t_1 = 0.3 sec,	n_1 = 60 rpm
Steady operation	T_2 = 18 Nm,	t_2 = 3 sec,	n_2 = 120 rpm
Stopping (slowing)	T_3 = 35 Nm,	t_3 = 0.4 sec,	n_3 = 60 rpm
Idle	T_4 = 0 Nm,	t_4 = 5 sec,	n_4 = 0 rpm

<Maximum rotational speed>
Max. output rotational speed: no *max* = 120 rpm
Max. input rotational speed: ni *max* = 5,000 rpm (Restricted by motors)

<Impact torque>
When impact torque is applied: T_S = 180 Nm

<Required life>
L_{50} = 30,000 (hours)

Calculate the average load torque applied to the output side based on the load torque pattern: T*av* (Nm).

$$Tav = \sqrt[10/3]{\frac{|60\text{rpm}|\cdot 0.3\text{sec}\cdot|70\text{Nm}|^{10/3}+|120\text{rpm}|\cdot 3\text{sec}\cdot|18\text{Nm}|^{10/3}+|60\text{rpm}|\cdot 0.4\text{sec}\cdot|35\text{Nm}|^{10/3}}{|60\text{rpm}|\cdot 0.3\text{sec}+120\text{rpm}|\cdot 3\text{sec}+|60\text{rpm}|\cdot 0.4\text{sec}|}}$$

Calculate the average output speed based on the load torque pattern: no *av* (rpm)

$$\text{no } av = \frac{|60\text{rpm}|\cdot 0.3\text{sec}+|120\text{rpm}|\cdot 3\text{sec}+|60\text{rpm}|\cdot 0.4\text{sec}+|0\text{rpm}|\cdot 5\text{sec}}{0.3\text{sec}+3\text{sec}+0.4\text{sec}+5\text{sec}}$$

▼

Make a preliminary model selection with the following conditions. T*av* = 30.2 Nm ≦ 80 Nm. (**HPN-20A-31** is tentatively selected based on the average load torque (see the rating table) of size 20 and reduction ratio of 31.) → NG

OK ▼

Determine a reduction ratio (R) from the maximum output speed (no *max*) and maximum input speed (ni *max*).

$$\frac{5{,}000\text{ rpm}}{120\text{ rpm}} = 41.7 \geqq 31$$

Calculate the maximum input speed (ni *max*) from the maximum output speed (no *max*) and reduction ratio (R): ni *max* = 120 rpm • 31 = 3,720 rpm

▼

Calculate the average input speed (ni *av*) from the average output speed (no *av*) and reduction ratio (R):
ni *av* = 46.2 rpm•31= 1,432 rpm ≦ Max average input speed of size 20 3,000 rpm → NG

OK ▼

Check whether the maximum input speed is equal to or less than the values specified in the rating table.
ni *max* = 3,720 rpm ≦ 600 rpm (maximum input speed of size 20) → NG

OK ▼

Check whether T_1 and T_3 are within peak torques (Nm) on start and stop in the rating table.
T_1 = 70 Nm ≦ 113 Nm (Limit for repeated peak torque, size 20)
T_3 = 35 Nm ≦ 113 Nm (Limit for repeated peak torque, size 20) → NG

OK ▼

Check whether Ts is equal to or less than limit for momentary torque (Nm) in the rating table.
T_S = 180 Nm ≦ 256 Nm (momentary max. torque of size 20) → NG

OK ▼

Calculate life and check whether the calculated life meets the requirement.

$$L_{50} = 20{,}000 \cdot \left(\frac{80\text{Nm}}{30.2\text{ Nm}}\right)^{10/3} \cdot \left(\frac{3{,}000\text{ rpm}}{1{,}432\text{ rpm}}\right) = 25{,}809{,}937\text{ (hours)} \geqq 30{,}000\text{ (hours)}$$

→ NG

OK ▼

The selection of model number HPN-20A-31 is confirmed from the above calculations.

Refer to the Caution note at the bottom of page 61.

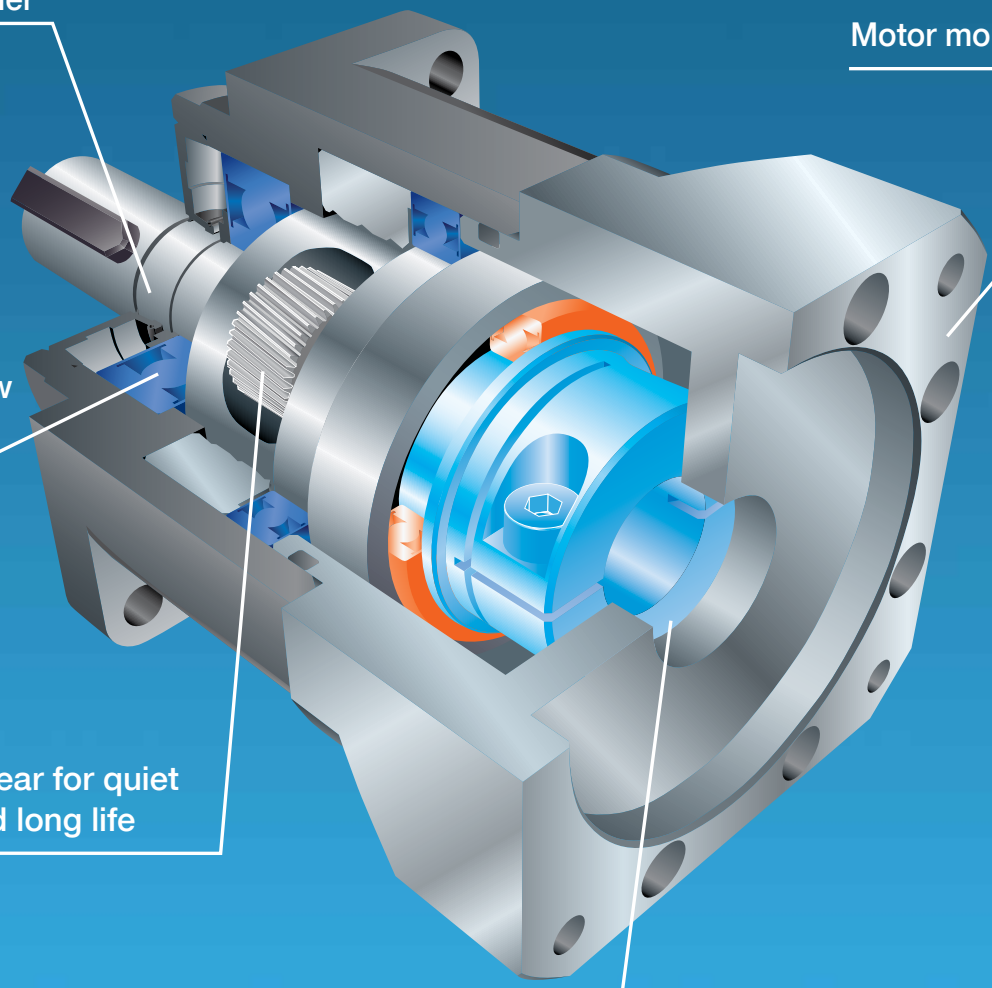
Review the operation conditions, size and reduction ratio.

HarmonicPlanetary® HPN Value Series

HPN Precision Planetary Gearheads are Quiet, Lightweight and Compact with Low Cost and Quick Delivery.

HPN Planetary gearheads feature a robust design utilizing helical gears for quiet performance and long life. These gearheads are available with short lead times and are designed to couple to any servomotor with our Quick Connect™ coupling. HPN gearheads are suitable for use in a wide range of applications for precision motion control and positioning. HPN Harmonic Planetary® gears are available in 5 sizes: 11, 14, 20, 32, and 40, with reduction ratios ranging from 3:1 to 31:1.

- **Backlash: One Stage <5 arc-min**
  Two Stage <7 arc-min
- **Low gear ratios, 3:1 to 31:1**
- **High efficiency**
- **Helical gearing**
- **Quiet design: Noise <58dB (Size 14)**


Integrated output shaft and carrier
Motor mounting flange
Deep groove, output bearings allow high shaft loads
Ground helical gear for quiet performance and long life
Quick Connect™ coupling for easy mounting of any servomotor

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