



**APEX DYNAMICS, INC.**

**PLANETARY GEARBOX**

**NEW GENERATION P-SERIES**

**PEII / PGII / PAII / PSII / PNII / PD / PL**

**PEIIR / PGIIR / PAIIR / PSIIR / PNIIR / PDR / PLR**



# New Generation P Series

## ► Features:

- Economic
- High efficiency
- Low noise
- Reduced backlash
- Optimized Inertia moment
- Limited temperature rise
- Long service life
- Flexible mounting diameters
- Minimized size and weight

The perfect servo planetary gearbox !  
The brand new APEX PII / PIIIR series.  
The PII / PIIIR series is an economic high precision planetary gearbox with excellent performance and quality. Our innovative PII / PIIIR series design features minimal size, light weight and high efficiency.



PEII



PEIIR



PGII



PGIIR



PAII



PAIIR



PSII



PSIIR



PNII



PNIIR



PD



PDR



PL



PLR

# ORDERING CODE

**PEII 090** – **010<sup>(1)</sup>** – **( )<sup>(2)</sup>** / **MOTOR**

**PEIIR 090** – **010<sup>(1)</sup>** – **( )<sup>(2)</sup>** / **MOTOR**

Motor Type :  
Manufacturer and Model

**Ratio<sup>(1)</sup>:**

**1-stage: 3, 4, 5, 7, 9<sup>(3)</sup>, 10**

**2-stage: 12<sup>(5)</sup>, 15, 16, 20, 25, 30, 35, 40, 50, 70, 81<sup>(3)</sup>, 100**

**3-stage<sup>(4)</sup>: 120, 160, 200, 280, 350, 500, 700, 1000**

**Gearbox Size:**

**PEII : PEII 050, PEII 070, PEII 090, PEII 120, PEII 155**

**PGII : PGII 040, PGII 060, PGII 080, PGII 120, PGII 160**

**PAII : PAII 042, PAII 060, PAII 090, PAII 115, PAII 142**

**PSII : PSII A, PSII B, PSII C, PSII D, PSII E**

**PNII : PNII 017, PNII 023, PNII 034, PNII 042, PNII 056**

**PD : PD 053, PD 064, PD 090, PD 110**

**PL : PL 070, PL 090, PL 120,**

**Ordering Example : PEII 090 - 010 / SIEMENS 1FT6 041 - 4AF71**  
**PAII 090 - 010 - S1 / SIEMENS 1FT6 041 - 4AF71**

**Gearbox Size:**

**PEIIR : PEIIR 050, PEIIR 070, PEIIR 090, PEIIR 120, PEIIR 155**

**PGIIR : PGIIR 040, PGIIR 060, PGIIR 080, PGIIR 120, PGIIR 160**

**PAIIR : PAIIR 042, PAIIR 060, PAIIR 090, PAIIR 115, PAIIR 142**

**PSIIR : PSIIR A, PSIIR B, PSIIR C, PSIIR D, PSIIR E**

**PNIIR : PNIIR 017, PNIIR 023, PNIIR 034, PNIIR 042, PNIIR 056**

**PDR : PDR 053, PDR 064, PDR 090, PDR 110**

**PLR : PLR 070, PLR 090, PLR 120**

**Ordering Example : PEIIR 090 - 010 / SIEMENS 1FT6 041 - 4AF71**  
**PAIIR 090 - 010 - S1 / SIEMENS 1FT6 041 - 4AF71**

(1) Ratio ( $i = N_{in} / N_{out}$ ).

(2) S1 = Smooth Output Shaft. S1 shaft is only provided for PAII / PAIIR series.  
S2 = Output Shaft with Key. This is the standard shaft for PII / PIIR gearbox.

(3) Only provided for PSII / PSIIR and PAII / PAIIR series.

(4) Only provided for PGII and PGIIR series.

(5) Only provided for PL and PLR series.

# PEII / PEIR Gearbox Performance

Model No.		Stages	Ratio <sup>(1)</sup>	Type	PEII 050	PEII 070	PEII 090	PEII 120	PEII 155
					PEIR 050	PEIR 070	PEIR 090	PEIR 120	PEIR 155
Nominal Output Torque T <sub>2N</sub>	Nm	1	3	All	16	42	110	217	430
			4		16	42	113	223	440
			5		15	40	118	220	435
			7		12	35	96	198	366
			10		10	27	68	155	295
		2	15		15	40	109	213	424
			16		16	42	116	228	452
			20		16	42	116	230	454
			25		15	40	123	228	450
			30		15	40	108	212	422
			35		12	35	100	206	382
			40		16	43	117	232	459
			50		15	40	123	228	450
			70		12	35	100	206	382
			100		10	27	70	162	308
Emergency Stop Torque T <sub>2NOT</sub>	Nm	1,2	3~100	All	3 times T <sub>2N</sub>				
Max. Acceleration Torque T <sub>2B</sub>	Nm	1,2	3~100	All	T <sub>2B</sub> = 60% of T <sub>2NOT</sub>				
No Load Running Torque <sup>(4)</sup>	Nm	1	3~10	PEII	0.05	0.10	0.40	0.80	2.50
				PEIR	0.10	0.15	0.45	0.85	2.55
		2	15~100	PEII	0.05	0.10	0.30	0.40	0.80
				PEIR	0.10	0.15	0.35	0.45	0.85
Backlash <sup>(2)</sup>	arcmin	1	3~10	PEII	≤ 8	≤ 7	≤ 6	≤ 6	≤ 6
				PEIR	≤ 12	≤ 11	≤ 10	≤ 10	≤ 10
		2	15~100	PEII	≤ 10	≤ 9	≤ 8	≤ 8	≤ 8
				PEIR	≤ 14	≤ 13	≤ 12	≤ 12	≤ 12
Torsional Rigidity	Nm/arcmin	1,2	3~100	All	0.9	2.2	8	12	16
Nominal Input Speed n <sub>1N</sub>	rpm	1,2	3~100	All	4,500	4,000	3,600	3,600	2,500
Max. Input Speed n <sub>1B</sub>	rpm	1,2	3~100	All	8,000	6,000	6,000	4,800	3,600
Max. Radial Load F <sub>2rB</sub> <sup>(3)</sup>	N	1,2	3~100	All	810	1,150	1,530	3,260	4,550
Max. Axial Load F <sub>2aB</sub> <sup>(3)</sup>	N	1,2	3~100	All	405	575	765	1,630	2,275
Service Life <sup>(5)</sup>	hr	1,2	3~100	All	20,000				
Operating Temp	°C	1,2	3~100	All	0° C ~ +90° C				
Degree of Gearbox Protection		1,2	3~100	All	IP65				
Lubrication		1,2	3~100	All	Synthetic lubrication grease				
Mounting Position		1,2	3~100	All	All directions				
Running Noise <sup>(4)</sup>	dB(A)	1,2	3~100	PEII	≤ 60	≤ 62	≤ 64	≤ 66	≤ 68
				PEIR	≤ 70	≤ 72	≤ 74	≤ 75	≤ 77
Max. bending moment based on the gearbox input flange Mb <sup>(6)</sup>	Nm	1,2	3~100	PEII	5	12	22	45	54
				PEIR	3	6	10	17	19
Efficiency η	%	1	3~10	PEII	≥ 97%				
				PEIR	≥ 93%				
		2	15~100	PEII	≥ 94%				
				PEIR	≥ 90%				

(1) Ratio (i = N<sub>in</sub> / N<sub>out</sub>).

(2) Backlash is measured at 2% of Nominal Output Torque T<sub>2N</sub>.

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load, By ratio smaller than 10, the noise value would be 3-5dB higher.

(5) For continuous operation, the service life time is less than 10,000 hrs.

(6) Max. motor weight\* (kg) =  $\frac{0.1 \times Mb}{\text{motor length (m)}}$

\*with symmetrically distributed motor weight

\*with horizontal and stationary mounting

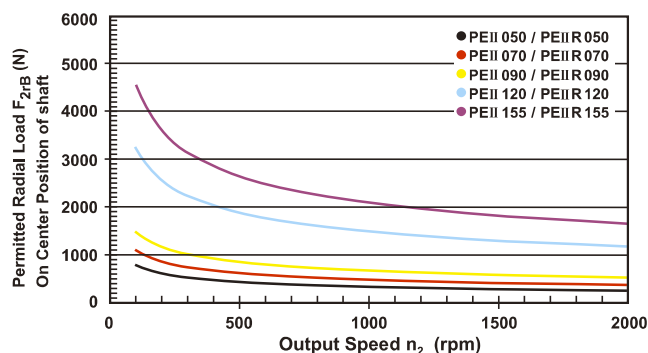
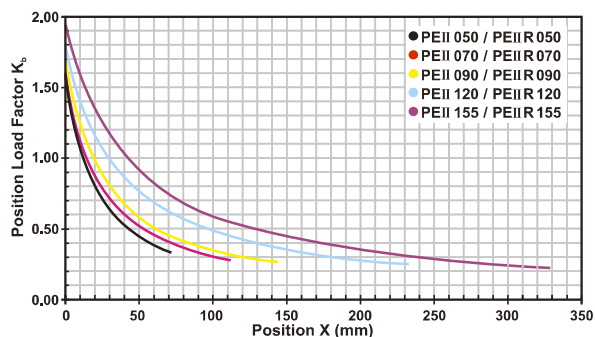
# PEII Gearbox Inertia

Model No.	PEII 050		PEII 070		PEII 090		PEII 120		PEII 155	
$\varnothing^{(A)}$ (C3)	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	0.10	0.10	0.12	0.10	-	-	-	-	-	-
11	0.16	0.16	0.19	0.16	-	-	-	-	-	-
14	-	-	0.22	0.20	0.36	0.24	-	-	-	-
19	-	-	1.53	1.51	1.70	1.58	2.20	1.73	-	2.18
24	-	-	-	-	2.24	2.12	2.74	2.27	4.52	2.73
28	-	-	-	-	2.68	2.55	3.17	2.70	4.94	3.15
32	-	-	-	-	-	-	7.77	7.30	9.70	7.91
35	-	-	-	-	-	-	10.80	10.30	12.80	11.00
38	-	-	-	-	-	-	14.00	13.50	16.00	14.20
42	-	-	-	-	-	-	-	-	24.50	-

# PEIIR Gearbox Inertia

Model No.	PEIIR 050		PEIIR 070		PEIIR 090		PEIIR 120		PEIIR 155	
$\varnothing^{(A)}$ (C3)	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	0.18	0.18	0.36	0.36	-	-	-	-	-	-
11	0.20	0.20	0.39	0.39	-	-	-	-	-	-
14	-	-	0.43	0.43	1.87	1.87	-	-	-	-
19	-	-	1.24	1.24	2.67	2.67	6.80	6.80	-	13.57
24	-	-	-	-	2.97	2.97	7.10	7.10	13.87	13.87
28	-	-	-	-	3.47	3.47	7.59	7.59	14.36	14.36
32	-	-	-	-	-	-	10.56	10.56	17.33	17.33
35	-	-	-	-	-	-	11.97	11.97	18.74	18.74
38	-	-	-	-	-	-	13.95	13.95	20.79	20.79
42	-	-	-	-	-	-	-	-	26.54	-

# Permitted Radial And Axial Loads<sup>(B)</sup>

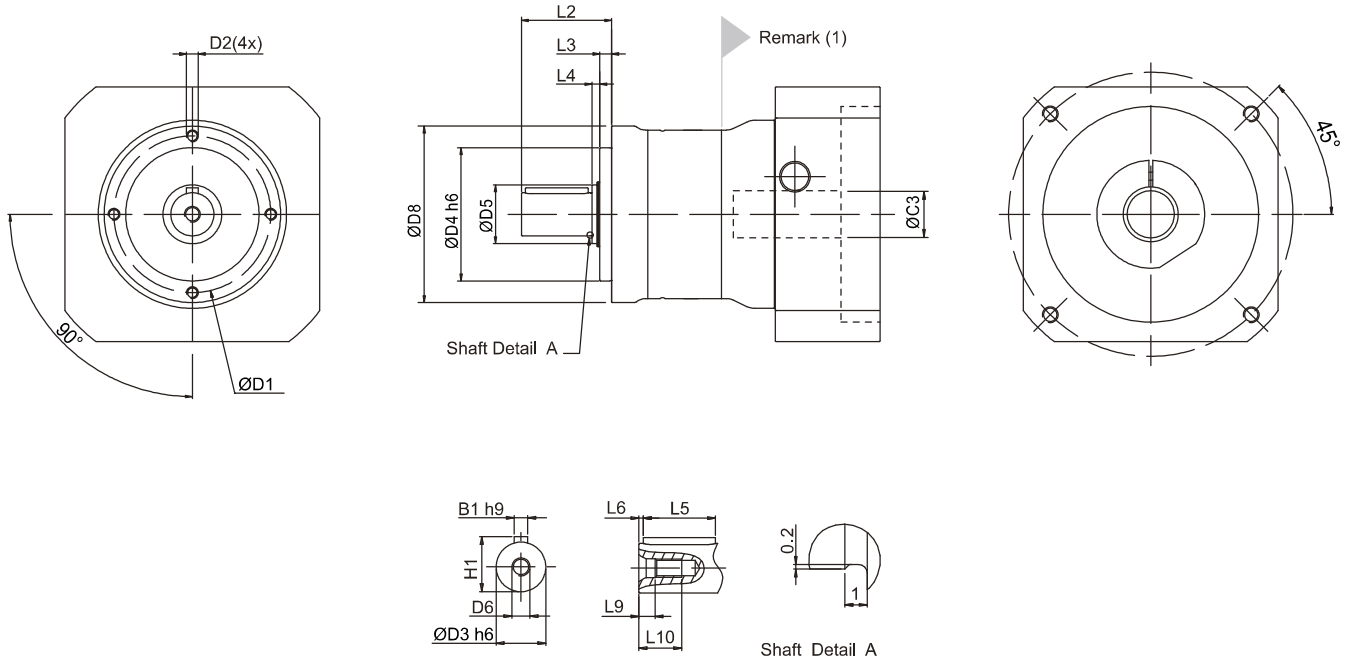


If radial force  $F_{2r}$  is not exerted on the center of the output shaft  $X < 1/2 L$  or  $X > 1/2 L$ , the permitted radial and axial loads can be calculated by the position load factor  $K_b$  on the above diagram.

Permitted radial load  $F_{2r}$  on center of output shaft  $X = 1/2 L$  for various output speeds. Values provided are for 20,000 hours<sup>(C)</sup> life.

- (A)  $\varnothing$  = Input shaft diameter.
- (B) Permitted loading values on the output shaft. Please refer to P. 33 glossary.
- (C) For Continuous Operation (S1), the service life reduced to 50%.

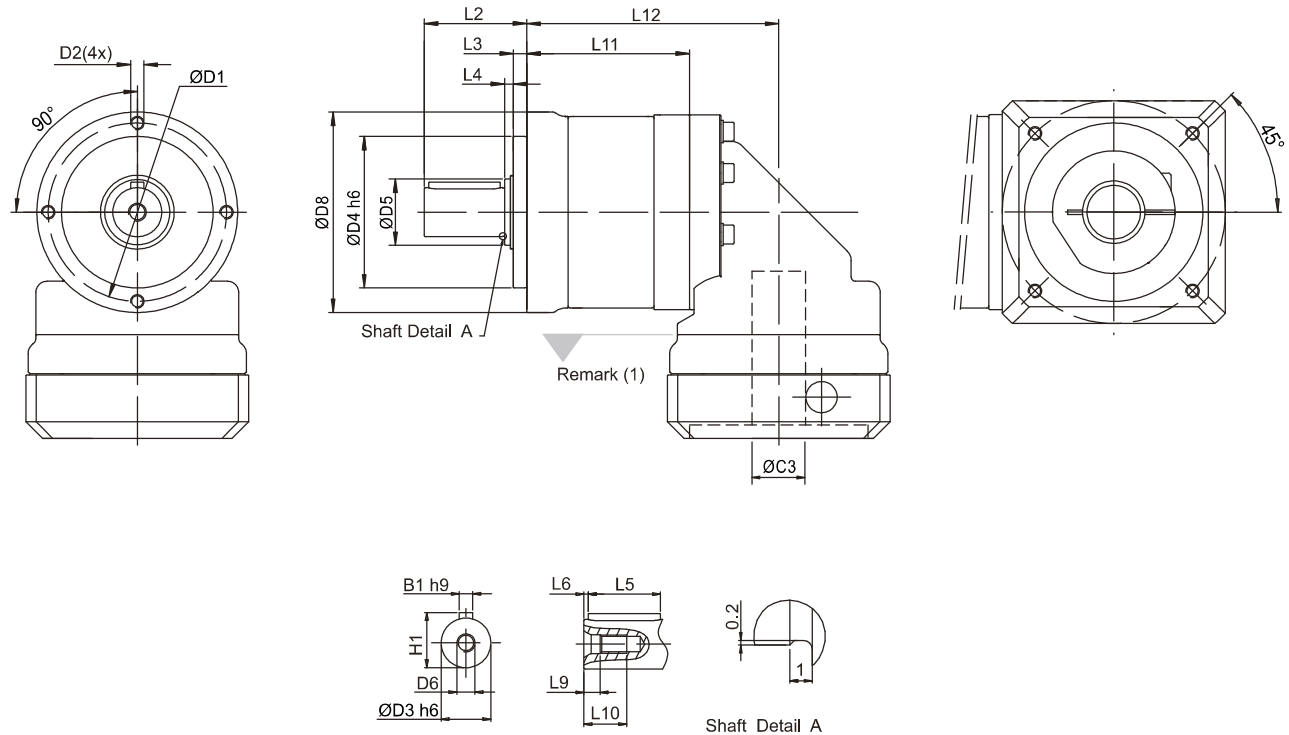
# PEII Series Dimension



Dimension	PEII 050		PEII 070		PEII 090		PEII 120		PEII 155	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	44		62		80		108		140	
D2	M4X9		M5X10		M6X12		M8X15		M10X18	
D3	h6	12	16	22	32	40				
D4	h6	35	52	68	90	120				
D5		17	22	30	40	55				
D6		M4X0.7P	M5X0.8P	M8X1.25P	M12X1.75P	M16X2P				
D8		50	70	90	120	155				
L2		24.5	36	46	70	97				
L3		4	4.5	6	7	9.5				
L4		2.5	3.5	4	5	5.5				
L5		14	25	32	50	70				
L6		2	2	2	4	6				
L9		4.5	4.8	7.2	10	12				
L10		10	12.5	19	28	36				
B1	h9	4	5	6	10	12				
H1		13.5	18	24.5	35	43				

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PEIR Series Dimension



Dimension	PEIR 050		PEIR 070		PEIR 090		PEIR 120		PEIR 155	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	44		62		80		108		140	
D2	M4X9		M5X10		M6X12		M8X15		M10X18	
D3	h6	12	16	22	32	40				
D4	h6	35	52	68	90	120				
D5	17		22		30		40		55	
D6	M4X0.7P		M5X0.8P		M8X1.25P		M12X1.75P		M16X2P	
D8	50		70		90		120		155	
L2	24.5		36		46		70		97	
L3	4		4.5		6		7		9.5	
L4	2.5		3.5		4		5		5.5	
L5	14		25		32		50		70	
L6	2		2		2		4		6	
L9	4.5		4.8		7.2		10		12	
L10	10		12.5		19		28		36	
L11	49.5	64.5	60	80	73	99.5	101	137	121	168.5
L12	74.5	89.5	89.5	109.5	113	139.5	152	188	178	225.5
B1	h9	4	5	6	10	12				
H1	13.5		18		24.5		35		43	

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PGII / PGIIR Gearbox Performance

Model No.	Stages <sup>(6)</sup>	Ratio <sup>(1)</sup>	Type	PGII 040	PGII 060	PGII 080	PGII 120	PGII 160		
				PGIIR 040	PGIIR 060	PGIIR 080	PGIIR 120	PGIIR 160		
Nominal Output Torque $T_{2N}$	1	3	All	16	42	110	217	430		
		4		16	42	113	223	440		
		5		15	40	118	220	435		
		7		12	35	96	198	366		
		10		10	27	68	155	295		
		15		15	40	109	213	424		
		16		16	42	116	228	452		
		20		16	42	116	230	454		
		25		15	40	123	228	450		
		30		15	40	108	212	422		
	2	35		12	35	100	206	382		
		40		16	43	117	232	459		
		50		15	40	123	228	450		
		70		12	35	100	206	382		
		100		10	27	70	162	308		
		3		120	19	50	137	-	-	
				160	16	43	118	-	-	
				200	16	43	118	-	-	
				280	12	35	99	-	-	
				350	12	35	99	-	-	
500	15		40	122	-	-				
700	12		35	99	-	-				
1000	10		27	70	-	-				
Emergency Stop Torque $T_{2NOT}$	Nm		1,2,3	3~1000	All	3 times $T_{2N}$				
Max. Acceleration Torque $T_{2B}$	Nm		1,2,3	3~1000	All	$T_{2B} = 60\%$ of $T_{2NOT}$				
No Load Running Torque <sup>(4)</sup>	1	3~10	PGII	0.05	0.10	0.40	0.80	2.50		
			PGIIR	0.10	0.15	0.45	0.85	2.55		
	2	15~100	PGII	0.05	0.10	0.30	0.40	0.80		
			PGIIR	0.10	0.15	0.35	0.45	0.85		
	3	120~1000	PGII	0.05	0.10	0.40	-	-		
			PGIIR	0.10	0.15	0.45	-	-		
Backlash <sup>(2)</sup>	1	3~10	PGII	$\leq 8$	$\leq 7$	$\leq 6$	$\leq 6$	$\leq 6$		
			PGIIR	$\leq 12$	$\leq 11$	$\leq 10$	$\leq 10$	$\leq 10$		
	2	15~100	PGII	$\leq 10$	$\leq 9$	$\leq 8$	$\leq 8$	$\leq 8$		
			PGIIR	$\leq 14$	$\leq 13$	$\leq 12$	$\leq 12$	$\leq 12$		
	3	120~1000	PGII	$\leq 12$	$\leq 11$	$\leq 10$	-	-		
			PGIIR	$\leq 16$	$\leq 15$	$\leq 14$	-	-		
Torsional Rigidity	Nm/arcmin	1,2,3	3~1000	All	0.5	2	8	12	16	
Nominal Input Speed $n_{1N}$	rpm	1,2,3	3~1000	All	4,500	4,000	3,600	3,600	2,500	
Max. Input Speed $n_{1B}$	rpm	1,2,3	3~1000	All	8,000	6,000	6,000	4,800	3,600	
Max. Radial Load $F_{2rB}$ <sup>(3)</sup>	N	1,2,3	3~1000	All	520	1,030	1,570	3,590	4,690	
Max. Axial Load $F_{2aB}$ <sup>(3)</sup>	N	1,2,3	3~1000	All	260	515	785	1,795	2,345	
Service Life <sup>(5)</sup>	hr	1,2,3	3~1000	All	20,000					
Operating Temp	°C	1,2,3	3~1000	All	0° C ~ +90° C					
Degree of Gearbox Protection		1,2,3	3~1000	All	IP65					
Lubrication		1,2,3	3~1000	All	Synthetic lubrication grease					
Mounting Position		1,2,3	3~1000	All	All directions					
Running Noise <sup>(4)</sup>	dB(A)	1,2,3	3~1000	PGII	$\leq 60$	$\leq 62$	$\leq 64$	$\leq 66$	$\leq 68$	
				PGIIR	$\leq 70$	$\leq 72$	$\leq 74$	$\leq 75$	$\leq 77$	
Max. bending moment based on the gearbox input flange $M_b$ <sup>(7)</sup>	Nm	1,2,3	3~1000	PGII	5	12	22	45	54	
				PGIIR	3	6	10	17	19	
Efficiency $\eta$	1	3~10	PGII	$\geq 97\%$						
			PGIIR	$\geq 93\%$						
	2	15~100	PGII	$\geq 94\%$						
			PGIIR	$\geq 90\%$						
	3	120~1000	PGII	$\geq 91\%$						
			PGIIR	$\geq 87\%$						

(1) Ratio ( $i = N_n / N_{min}$ ).(2) Backlash is measured at 2% of Nominal Output Torque  $T_{2N}$ .

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load. By ratio smaller than 10, the noise value would be 3-5dB higher.

(5) For continuous operation, the service life time is less than 10,000 hrs.

(6) 3-stage is available for following types: PGII040, PGII060, PGII080, PGIIR040, PGIIR060 and PGIIR080.

(7) Max. motor weight\* (kg) =  $\frac{0.1 \times M_b}{\text{motor length (m)}}$ 

\*with symmetrically distributed motor weight

\*with horizontal and stationary mounting



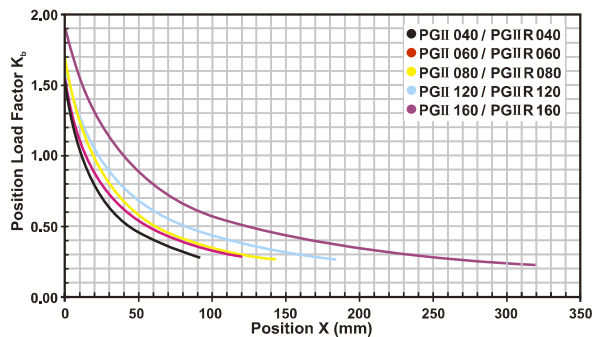
# PGII Gearbox Inertia

Model No.	PGII 040			PGII 060			PGII 080			PGII 120		PGII 160	
$\emptyset^{(A)}$ (C3)	1-st.	2-st.	3-st.	1-st.	2-st.	3-st.	1-st.	2-st.	3-st.	1-st.	2-st.	1-st.	2-st.
8	0.10	0.10	0.10	0.12	0.10	0.10	-	-	-	-	-	-	-
11	0.16	0.16	0.16	0.19	0.16	0.16	-	-	-	-	-	-	-
14	-	-	-	0.22	0.20	0.20	0.36	0.24	0.20	-	-	-	-
19	-	-	-	1.53	1.51	1.51	1.70	1.58	1.54	2.20	1.73	-	2.18
24	-	-	-	-	-	-	2.24	2.12	2.09	2.74	2.27	4.52	2.73
28	-	-	-	-	-	-	2.68	2.55	2.52	3.17	2.70	4.94	3.15
32	-	-	-	-	-	-	-	-	-	7.77	7.30	9.70	7.91
35	-	-	-	-	-	-	-	-	-	10.80	10.30	12.80	11.00
38	-	-	-	-	-	-	-	-	-	14.00	13.50	16.00	14.20
42	-	-	-	-	-	-	-	-	-	-	-	24.50	-

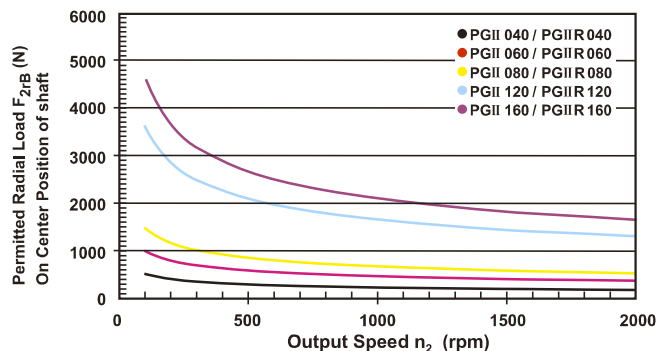
# PGIIR Gearbox Inertia

Model No.	PGIIR 040			PGIIR 060			PGIIR 080			PGIIR 120		PGIIR 160	
$\emptyset^{(A)}$ (C3)	1-st.	2-st.	3-st.	1-st.	2-st.	3-st.	1-st.	2-st.	3-st.	1-st.	2-st.	1-st.	2-st.
8	0.18	0.18	0.18	0.36	0.36	0.36	-	-	-	-	-	-	-
11	0.20	0.20	0.20	0.39	0.39	0.39	-	-	-	-	-	-	-
14	-	-	-	0.43	0.43	0.43	1.87	1.87	1.87	-	-	-	-
19	-	-	-	1.24	1.24	1.24	2.67	2.67	2.67	6.80	6.80	-	13.57
24	-	-	-	-	-	-	2.97	2.97	2.97	7.10	7.10	13.87	13.87
28	-	-	-	-	-	-	3.47	3.47	3.47	7.59	7.59	14.36	14.36
32	-	-	-	-	-	-	-	-	-	10.56	10.56	17.33	17.33
35	-	-	-	-	-	-	-	-	-	11.97	11.97	18.74	18.74
38	-	-	-	-	-	-	-	-	-	13.95	13.95	20.79	20.79
42	-	-	-	-	-	-	-	-	-	-	-	26.54	-

# Permitted Radial And Axial Loads<sup>(B)</sup>



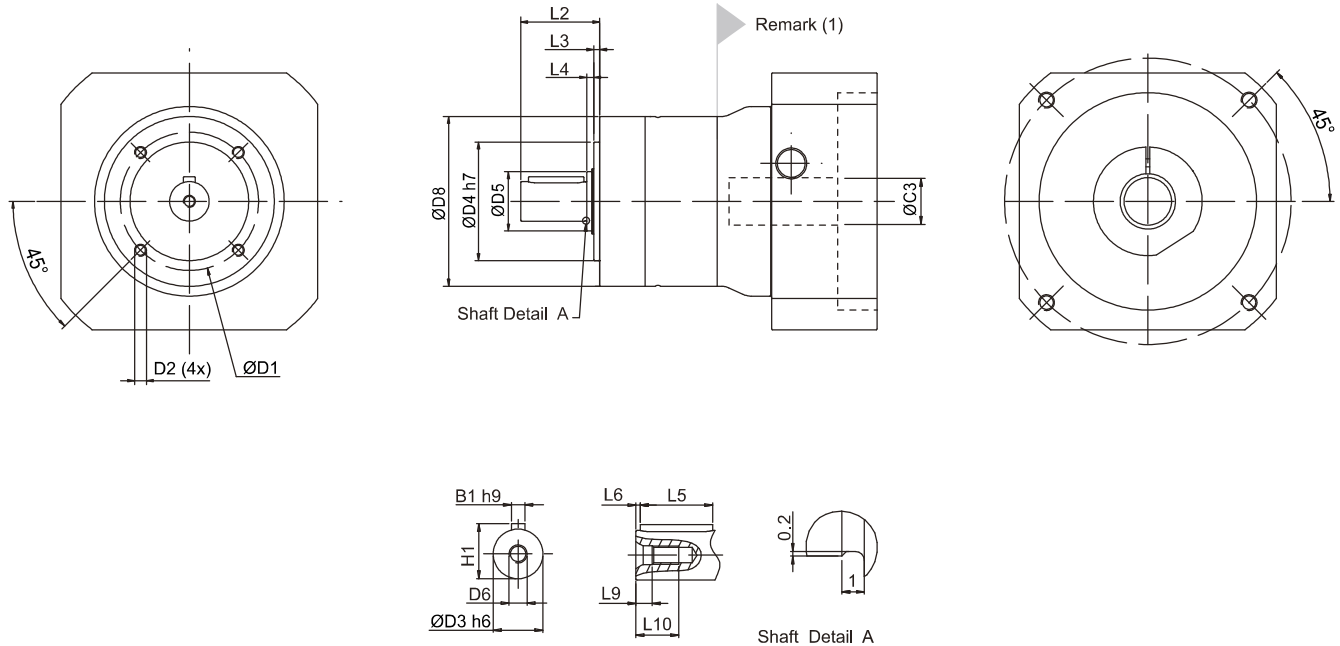
If radial force  $F_{2r}$  is not exerted on the center of the output shaft  $X < 1/2 L$  or  $X > 1/2 L$ , the permitted radial and axial loads can be calculated by the position load factor  $K_b$  on the above diagram.



Permitted radial load  $F_{2r}$  on center of output shaft  $X = 1/2 L$  for various output speeds. Values provided are for 20,000 hours<sup>(C)</sup> life.

- (A)  $\emptyset$  = Input shaft diameter.
- (B) Permitted loading values on the output shaft. Please refer to P. 33 glossary.
- (C) For Continuous Operation (S1), the service life reduced to 50%.

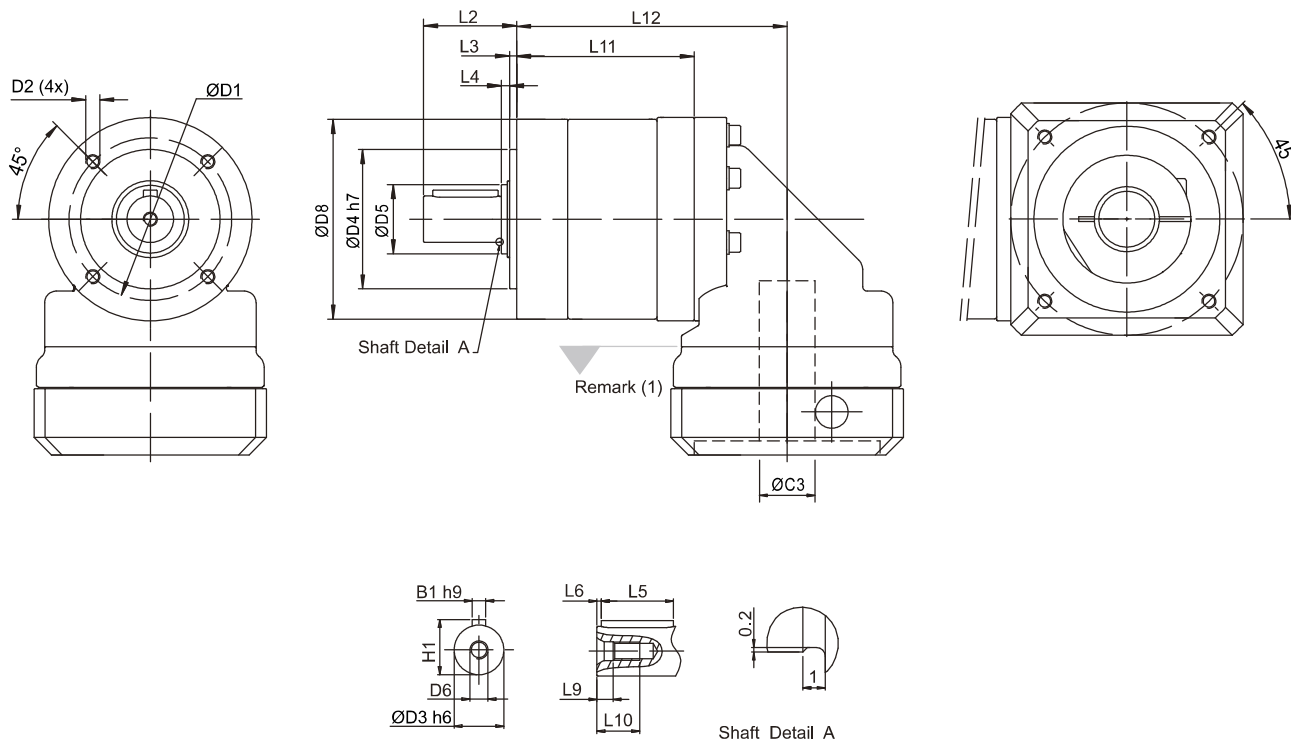
# PGII Series Dimension



Dimension	PGII 040			PGII 060			PGII 080			PGII 120			PGII 160			
	1-st.	2-st.	3-st.	1-st.	2-st.	3-st.	1-st.	2-st.	3-st.	1-st.	2-st.	-	1-st.	2-st.	-	
D1	34			52			70			100			145			
D2	M4X9			M5X10			M6X12			M10X18			M12X22			
D3	h6	10			14			20			25			40		
D4	h7	26			40			60			80			130		
D5	17			17			30			40			55			
D6	M3X0.5P			M5X0.8P			M6X1P			M10X1.5P			M16X2P			
D8	44			60			86			114			160			
L2	26			35			40			55			87			
L3	2			3			3			4			5			
L4	1			2			3.5			5			5.5			
L5	18			25			28			40			65			
L6	2.5			2.5			4			5			8			
L9	2.6			4.8			5			7.5			12			
L10	9			12.5			16.5			22			36			
B1	h9	3			5			6			8			12		
H1	11.2			16			22.5			28			43			

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PGII R Series Dimension



Dimension	PGII R 040			PGII R 060			PGII R 080			PGII R 120			PGII R 160		
	1-st.	2-st.	3-st.	1-st.	2-st.	3-st.	1-st.	2-st.	3-st.	1-st.	2-st.	-	1-st.	2-st.	-
D1	34			52			70			100			145		
D2	M4X9			M5X10			M6X12			M10X18			M12X22		
D3	h6	10		14		20		25		40		130		40	
D4	h7	26		40		60		80		130		130		130	
D5	17			17			30			40			55		
D6	M3X0.5P			M5X0.8P			M6X1P			M10X1.5P			M16X2P		
D8	44			60			86			114			160		
L2	26			35			40			55			87		
L3	2			3			3			4			5		
L4	1			2			3.5			5			5.5		
L5	18			25			28			40			65		
L6	2.5			2.5			4			5			8		
L9	2.6			4.8			5			7.5			12		
L10	9			12.5			16.5			22			36		
L11	53	68	82	66.5	86.5	105.5	76.5	103	128.5	104	140	-	125.5	173	-
L12	78	93	107	96	116	135	116.5	143	168.5	155	191	-	182.5	230	-
B1	h9	3		5		6		8		12		12		12	
H1	11.2			16			22.5			28			43		

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PA II / PA IIR Gearbox Performance

Model No.	Stages	Ratio <sup>(1)</sup>	Type	PAII 042	PAII 060	PAII 090	PAII 115	PAII 142	
				PAIIR 042	PAIIR 060	PAIIR 090	PAIIR 115	PAIIR 142	
Nominal Output Torque $T_{2N}$	1	3	AII	16	42	110	217	430	
		4		16	42	113	223	440	
		5		15	40	118	220	435	
		7		12	35	96	198	366	
		9		8	24	60	125	273	
		10		10	27	68	155	295	
		15		15	40	109	213	424	
	2	16		16	42	116	228	452	
		20		16	42	116	230	454	
		25		15	40	123	228	450	
		30		15	40	108	212	422	
		35		12	35	100	206	382	
		40		16	43	117	232	459	
		50		15	40	123	228	450	
		70		12	35	100	206	382	
		81		8	24	59	131	285	
		100		10	27	70	162	308	
Emergency Stop Torque $T_{2NOT}$	Nm	1,2	3~100	AII	3 times $T_{2N}$				
Max. Acceleration Torque $T_{2B}$	Nm	1,2	3~100	AII	$T_{2B} = 60\%$ of $T_{2NOT}$				
No Load Running Torque <sup>(4)</sup>	1	3~10	PAII	0.05	0.10	0.40	0.80	2.50	
			PAIIR	0.10	0.15	0.45	0.85	2.55	
	2	15~100	PAII	0.05	0.10	0.30	0.40	0.80	
			PAIIR	0.10	0.15	0.35	0.45	0.85	
Backlash <sup>(2)</sup>	1	3~10	PAII	$\leq 8$	$\leq 7$	$\leq 6$	$\leq 6$	$\leq 6$	
			PAIIR	$\leq 12$	$\leq 11$	$\leq 10$	$\leq 10$	$\leq 10$	
	2	15~100	PAII	$\leq 10$	$\leq 9$	$\leq 8$	$\leq 8$	$\leq 8$	
			PAIIR	$\leq 14$	$\leq 13$	$\leq 12$	$\leq 12$	$\leq 12$	
Torsional Rigidity	Nm/arcmin	1,2	3~100	AII	0.9	2.2	8	12	16
Nominal Input Speed $n_{1N}$	rpm	1,2	3~100	AII	4,500	4,000	3,600	3,600	2,500
Max. Input Speed $n_{1B}$	rpm	1,2	3~100	AII	8,000	6,000	6,000	4,800	3,600
Max. Radial Load $F_{2rB}$ <sup>(3)</sup>	N	1,2	3~100	AII	810	1,150	1,530	3,470	4,640
Max. Axial Load $F_{2aB}$ <sup>(3)</sup>	N	1,2	3~100	AII	405	575	765	1,735	2,320
Service Life <sup>(5)</sup>	hr	1,2	3~100	AII	20,000				
Operating Temp	°C	1,2	3~100	AII	0° C ~ +90° C				
Degree of Gearbox Protection		1,2	3~100	AII	IP65				
Lubrication		1,2	3~100	AII	Synthetic lubrication grease				
Mounting Position		1,2	3~100	AII	All directions				
Running Noise <sup>(4)</sup>	dB(A)	1,2	3~100	PAII	$\leq 60$	$\leq 62$	$\leq 64$	$\leq 66$	$\leq 68$
				PAIIR	$\leq 70$	$\leq 72$	$\leq 74$	$\leq 75$	$\leq 77$
Max. bending moment based on the gearbox input flange $M_b$ <sup>(6)</sup>	Nm	1,2	3~100	PAII	5	12	22	45	54
				PAIIR	3	6	10	17	19
Efficiency $\eta$	%	1	3~10	PAII	$\geq 97\%$				
				PAIIR	$\geq 93\%$				
	2	15~100	PAII	$\geq 94\%$					
			PAIIR	$\geq 90\%$					

(1) Ratio ( $i = N_{in} / N_{out}$ ).

(2) Backlash is measured at 2% of Nominal Output Torque  $T_{2N}$ .

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load, By ratio smaller than 10, the noise value would be 3-5dB higher.

(5) For continuous operation, the service life time is less than 10,000 hrs.

(6) Max. motor weight\* (kg) =  $\frac{0.1 \times Mb}{\text{motor length (m)}}$

\*with symmetrically distributed motor weight

\*with horizontal and stationary mounting

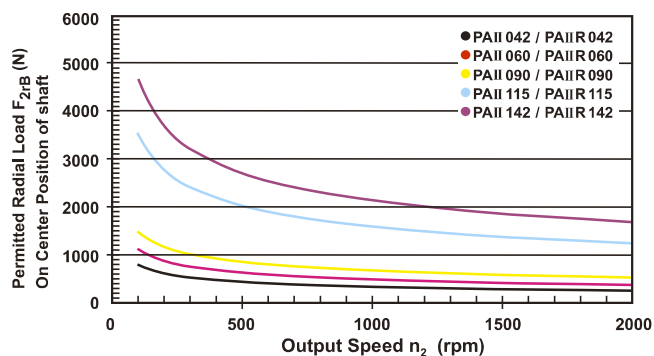
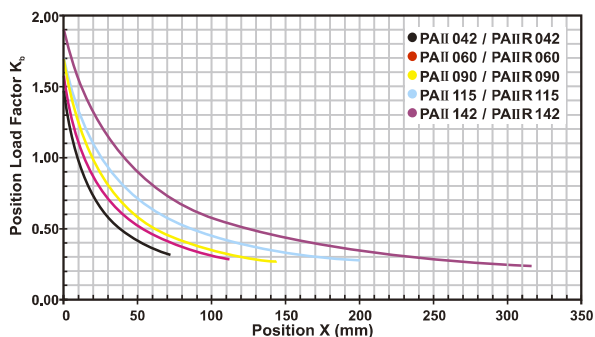
# PA II Gearbox Inertia

Model No.	PAII 042		PAII 060		PAII 090		PAII 115		PAII 142		
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	
$\emptyset^{(A)}$ (C3)											
8	0.10	0.10	0.12	0.10	-	-	-	-	-	-	
11	0.16	0.16	0.19	0.16	-	-	-	-	-	-	
14	-	-	0.22	0.20	0.36	0.24	-	-	-	-	
19	-	-	1.53	1.51	1.70	1.58	2.20	1.73	-	2.18	
24	-	-	-	-	2.24	2.12	2.74	2.27	4.52	2.73	
28	-	-	-	-	2.68	2.55	3.17	2.70	4.94	3.15	
32	-	-	-	-	-	-	7.77	7.30	9.70	7.91	
35	-	-	-	-	-	-	10.80	10.30	12.80	11.00	
38	-	-	-	-	-	-	14.00	13.50	16.00	14.20	
42	-	-	-	-	-	-	-	-	24.50	-	

# PAIIR Gearbox Inertia

Model No.	PAIIR 042		PAIIR 060		PAIIR 090		PAIIR 115		PAIIR 142	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
$\emptyset^{(A)}$ (C3)										
8	0.18	0.18	0.36	0.36	-	-	-	-	-	-
11	0.20	0.20	0.39	0.39	-	-	-	-	-	-
14	-	-	0.43	0.43	1.87	1.87	-	-	-	-
19	-	-	1.24	1.24	2.67	2.67	6.80	6.80	-	13.57
24	-	-	-	-	2.97	2.97	7.10	7.10	13.87	13.87
28	-	-	-	-	3.47	3.47	7.59	7.59	14.36	14.36
32	-	-	-	-	-	-	10.56	10.56	17.33	17.33
35	-	-	-	-	-	-	11.97	11.97	18.74	18.74
38	-	-	-	-	-	-	13.95	13.95	20.79	20.79
42	-	-	-	-	-	-	-	-	26.54	-

# Permitted Radial And Axial Loads<sup>(B)</sup>

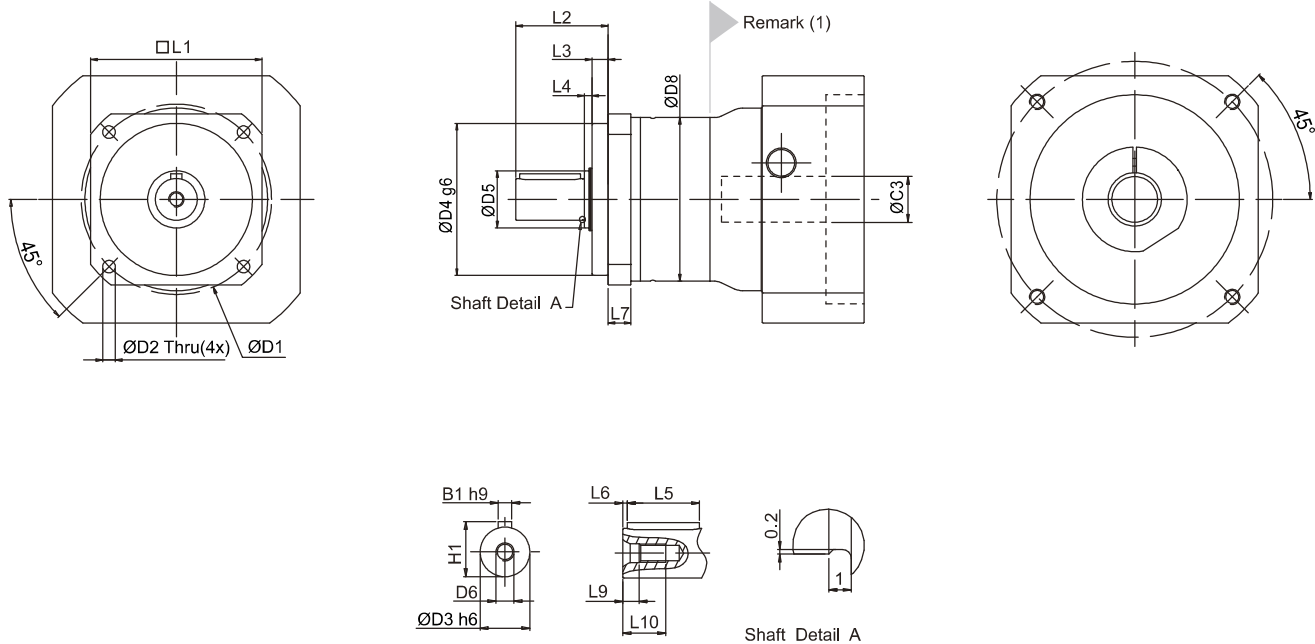


If radial force  $F_{2r}$  is not exerted on the center of the output shaft  $X < 1/2 L$  or  $X > 1/2 L$ , the permitted radial and axial loads can be calculated by the position load factor  $K_b$  on the above diagram.

Permitted radial load  $F_{2r}$  on center of output shaft  $X = 1/2 L$  for various output speeds. Values provided are for 20,000 hours<sup>(C)</sup> life.

- (A)  $\emptyset$  = Input shaft diameter.
- (B) Permitted loading values on the output shaft. Please refer to P. 33 glossary.
- (C) For Continuous Operation (S1), the service life reduced to 50%.

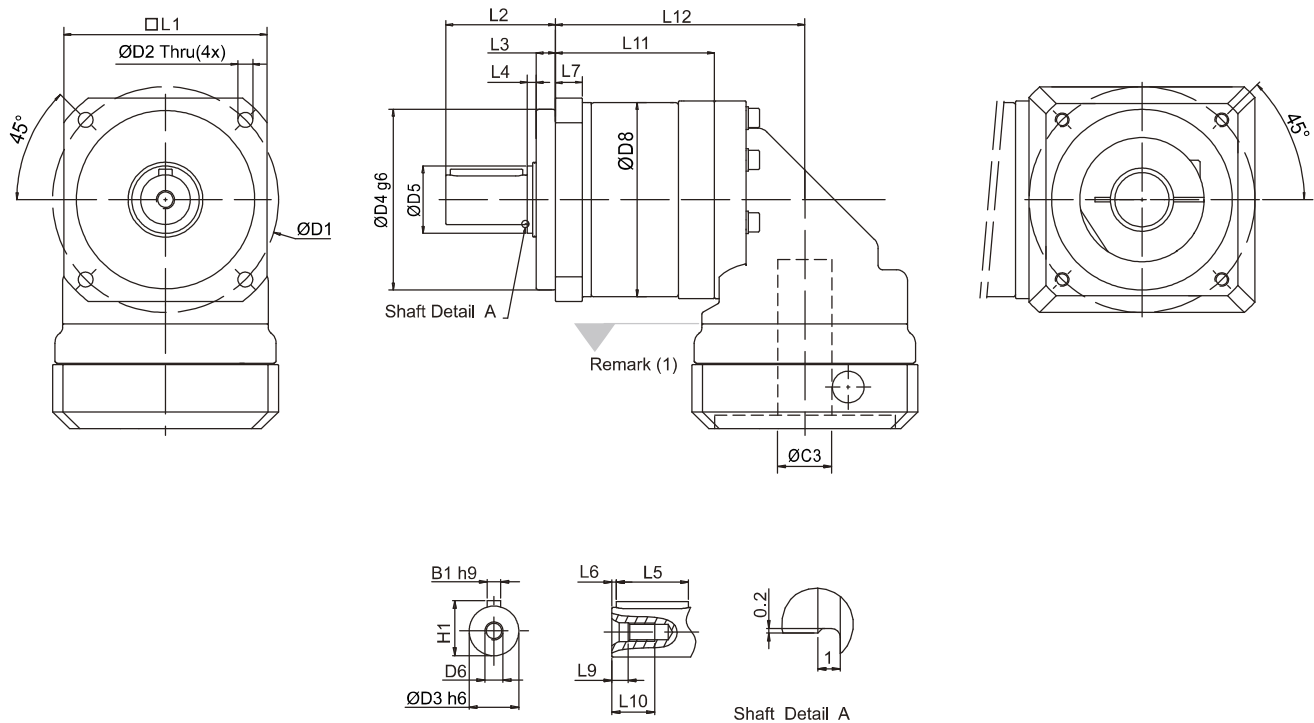
# PA II Series Dimension



Dimension	PAII 042		PAII 060		PAII 090		PAII 115		PAII 142	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	50		70		100		130		165	
D2	3.4		5.5		6.6		9		11	
D3	h6	13	16	22	32	40	40		40	
D4	g6	35	50	80	110	130	130		130	
D5	17		22		30		40		55	
D6	M4X0.7P		M5X0.8P		M8X1.25P		M12X1.75P		M16X2P	
D8	44		60		86		114		140	
L1	42		60		90		115		142	
L2	26		37		48.5		65		97	
L3	5.5		5.5		8.5		10		12.5	
L4	2.5		3.5		4		5		5.5	
L5	14		25		32		40		63	
L6	2		2		2		5		5	
L7	6.5		10		12		16		20	
L9	4.5		4.8		7.2		10		12	
L10	10		12.5		19		28		36	
B1	h9	5	5	6	10	12	12		12	
H1	15		18		24.5		35		43	

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PA IIR Series Dimension



Dimension	PA IIR 042		PA IIR 060		PA IIR 090		PA IIR 115		PA IIR 142	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	50		70		100		130		165	
D2	3.4		5.5		6.6		9		11	
D3 h6	13		16		22		32		40	
D4 g6	35		50		80		110		130	
D5	17		22		30		40		55	
D6	M4X0.7P		M5X0.8P		M8X1.25P		M12X1.75P		M16X2P	
D8	44		60		86		114		140	
L1	42		60		90		115		142	
L2	26		37		48.5		65		97	
L3	5.5		5.5		8.5		10		12.5	
L4	2.5		3.5		4		5		5.5	
L5	14		25		32		40		63	
L6	2		2		2		5		5	
L7	6.5		10		12		16		20	
L9	4.5		4.8		7.2		10		12	
L10	10		12.5		19		28		36	
L11	48	63	59	79	70.5	97	98	134	118	165.5
L12	73	88	88.5	108.5	110.5	137	149	185	175	222.5
B1 h9	5		5		6		10		12	
H1	15		18		24.5		35		43	

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PSII / PSIIIR Gearbox Performance

Model No.		Stages	Ratio <sup>(1)</sup>	Type	PSII A	PSII B	PSII C	PSII D	PSII E
					PSIIIR A	PSIIIR B	PSIIIR C	PSIIIR D	PSIIIR E
Nominal Output Torque $T_{2N}$	Nm	1	3	All	16	42	110	217	430
			4		16	42	113	223	440
			5		15	40	118	220	435
			7		12	35	96	198	366
			9		8	24	60	125	273
			10		10	27	68	155	295
			15		15	40	109	213	424
		2	16		16	42	116	228	452
			20		16	42	116	230	454
			25		15	40	123	228	450
			30		15	40	108	212	422
			35		12	35	100	206	382
			40		16	43	117	232	459
			50		15	40	123	228	450
			70		12	35	100	206	382
			81		8	24	59	131	285
			100		10	27	70	162	308
Emergency Stop Torque $T_{2NOT}$	Nm	1,2	3~100	All	3 times $T_{2N}$				
Max. Acceleration Torque $T_{2B}$	Nm	1,2	3~100	All	$T_{2B} = 60\%$ of $T_{2NOT}$				
No Load Running Torque <sup>(4)</sup>	Nm	1	3~10	PSII	0.05	0.10	0.40	0.80	2.50
				PSIIIR	0.10	0.15	0.45	0.85	2.55
		2	15~100	PSII	0.05	0.10	0.30	0.40	0.80
				PSIIIR	0.10	0.15	0.35	0.45	0.85
Backlash <sup>(2)</sup>	arcmin	1	3~10	PSII	$\leq 8$	$\leq 7$	$\leq 6$	$\leq 6$	$\leq 6$
				PSIIIR	$\leq 12$	$\leq 11$	$\leq 10$	$\leq 10$	$\leq 10$
		2	15~100	PSII	$\leq 10$	$\leq 9$	$\leq 8$	$\leq 8$	$\leq 8$
				PSIIIR	$\leq 14$	$\leq 13$	$\leq 12$	$\leq 12$	$\leq 12$
Torsional Rigidity	Nm/arcmin	1,2	3~100	All	0.6	1.5	6	10.5	18
Nominal Input Speed $n_{1N}$	rpm	1,2	3~100	All	4,500	4,000	3,600	3,600	2,500
Max. Input Speed $n_{1B}$	rpm	1,2	3~100	All	8,000	6,000	6,000	4,800	3,600
Max. Radial Load $F_{2rB}$ <sup>(3)</sup>	N	1,2	3~100	All	840	1,290	1,510	3,780	5,420
Max. Axial Load $F_{2aB}$ <sup>(3)</sup>	N	1,2	3~100	All	420	645	755	1,890	2,710
Service Life <sup>(5)</sup>	hr	1,2	3~100	All	20,000				
Operating Temp	°C	1,2	3~100	All	0° C ~ +90° C				
Degree of Gearbox Protection		1,2	3~100	All	IP65				
Lubrication		1,2	3~100	All	Synthetic lubrication grease				
Mounting Position		1,2	3~100	All	All directions				
Running Noise <sup>(4)</sup>	dB(A)	1,2	3~100	PSII	$\leq 60$	$\leq 62$	$\leq 64$	$\leq 66$	$\leq 68$
				PSIIIR	$\leq 70$	$\leq 72$	$\leq 74$	$\leq 75$	$\leq 77$
Max. bending moment based on the gearbox input flange $M_b$ <sup>(6)</sup>	Nm	1,2	3~100	PSII	5	12	22	45	54
				PSIIIR	3	6	10	17	19
Efficiency $\eta$	%	1	3~10	PSII	$\geq 97\%$				
				PSIIIR	$\geq 93\%$				
		2	15~100	PSII	$\geq 94\%$				
				PSIIIR	$\geq 90\%$				

(1) Ratio ( $i = N_{in} / N_{out}$ ).

(2) Backlash is measured at 2% of Nominal Output Torque  $T_{2N}$ .

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load, By ratio smaller than 10, the noise value would be 3-5dB higher.

(5) For continuous operation, the service life time is less than 10,000 hrs.

(6) Max. motor weight\* (kg) =  $\frac{0.1 \times Mb}{\text{motor length (m)}}$

\*with symmetrically distributed motor weight

\*with horizontal and stationary mounting



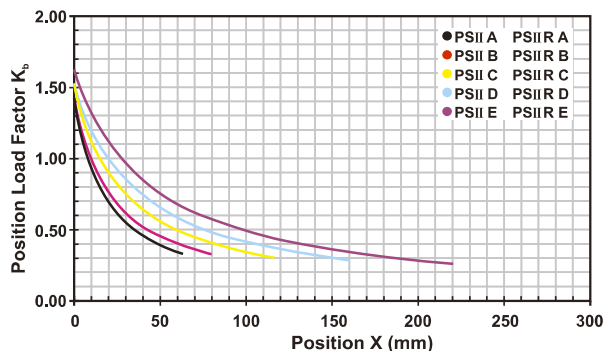
# PSII Gearbox Inertia

Model No.	PSII A		PSII B		PSII C		PSII D		PSII E	
$\varnothing^{(A)}$ (C3)	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	0.10	0.10	0.12	0.10	-	-	-	-	-	-
11	0.16	0.16	0.19	0.16	-	-	-	-	-	-
14	-	-	0.22	0.20	0.36	0.24	-	-	-	-
19	-	-	1.53	1.51	1.70	1.58	2.20	1.73	-	2.18
24	-	-	-	-	2.24	2.12	2.74	2.27	4.52	2.73
28	-	-	-	-	2.68	2.55	3.17	2.70	4.94	3.15
32	-	-	-	-	-	-	7.77	7.30	9.70	7.91
35	-	-	-	-	-	-	10.80	10.30	12.80	11.00
38	-	-	-	-	-	-	14.00	13.50	16.00	14.20
42	-	-	-	-	-	-	-	-	24.50	-

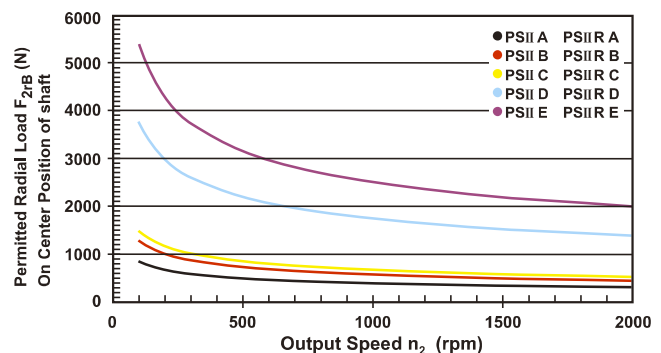
# PSIIR Gearbox Inertia

Model No.	PSIIR A		PSIIR B		PSIIR C		PSIIR D		PSIIR E	
$\varnothing^{(A)}$ (C3)	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	0.18	0.18	0.36	0.36	-	-	-	-	-	-
11	0.20	0.20	0.39	0.39	-	-	-	-	-	-
14	-	-	0.43	0.43	1.87	1.87	-	-	-	-
19	-	-	1.24	1.24	2.67	2.67	6.80	6.80	-	13.57
24	-	-	-	-	2.97	2.97	7.10	7.10	13.87	13.87
28	-	-	-	-	3.47	3.47	7.59	7.59	14.36	14.36
32	-	-	-	-	-	-	10.56	10.56	17.33	17.33
35	-	-	-	-	-	-	11.97	11.97	18.74	18.74
38	-	-	-	-	-	-	13.95	13.95	20.79	20.79
42	-	-	-	-	-	-	-	-	26.54	-

# Permitted Radial And Axial Loads<sup>(B)</sup>



If radial force  $F_{2r}$  is not exerted on the center of the output shaft  $X < 1/2 L$  or  $X > 1/2 L$ , the permitted radial and axial loads can be calculated by the position load factor  $K_b$  on the above diagram.



Permitted radial load  $F_{2r}$  on center of output shaft  $X = 1/2 L$  for various output speeds.

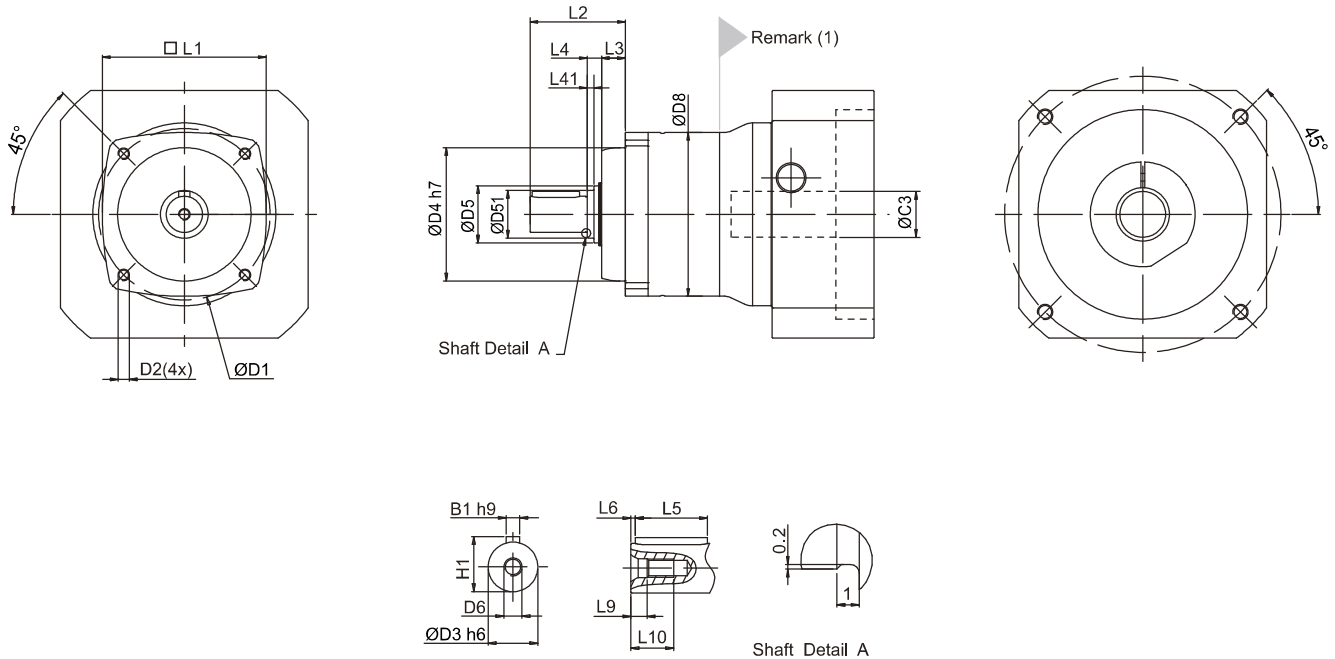
Values provided are for 20,000 hours<sup>(C)</sup> life.

(A)  $\varnothing$  = Input shaft diameter.

(B) Permitted loading values on the output shaft. Please refer to P. 33 glossary.

(C) For Continuous Operation (S1), the service life reduced to 50%.

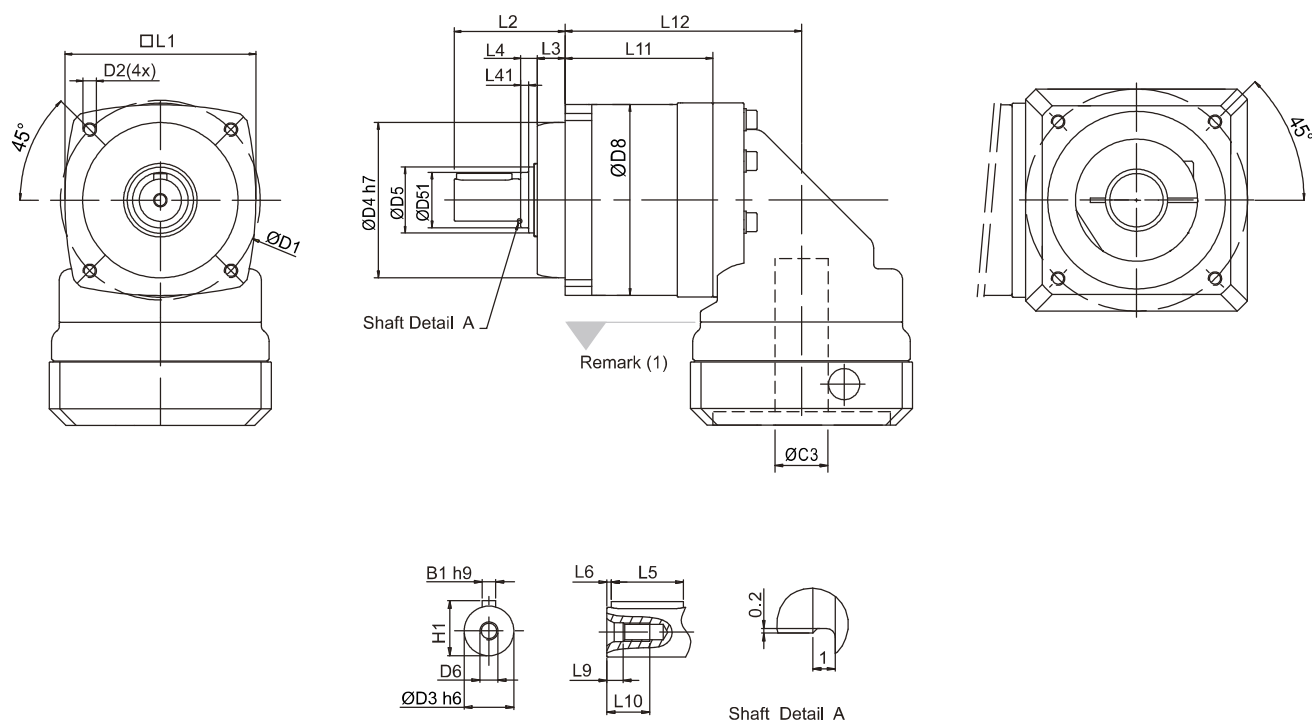
# PSII Series Dimension



Dimension	PSII A		PSII B		PSII C		PSII D		PSII E	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	47		60		90		115		135	
D2	M4X9		M5X10		M6X12		M8X18,5		M10X18	
D3	h6	10	12	19	24	32				
D4	h7	38	50	70	90	110				
D5	17		22		30		40		55	
D51	-		-		25		-		-	
D6	M3X0.5P		M4X0.7P		M6X1P		M8X1.25P		M12X1.75P	
D8	44		60		86		114		140	
L1	44		60		86		114		140	
L2	25		32		50		61		75	
L3	6.5		8.5		12.5		16		14.5	
L4	2.5		3.5		7.5		5		5.5	
L41	-		-		3.5		-		-	
L5	10		16		25		32		50	
L6	3		2		1		3		2	
L9	2.6		4.5		5		7.2		10	
L10	9		10		16.5		19		28	
B1	h9	3	4	6	8	10				
H1	11.2		13.5		21.5		27		35	

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PSIIR Series Dimension



Dimension	PSIIR A		PSIIR B		PSIIR C		PSIIR D		PSIIR E	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	47		60		90		115		135	
D2	M4X9		M5X10		M6X12		M8X18.5		M10X18	
D3	h6	10	12	19	24	32				
D4	h7	38	50	70	90	110				
D5		17	22	30	40	55				
D51		-	-	25	-	-				
D6	M3X0.5P		M4X0.7P		M6X1P		M8X1.25P		M12X1.75P	
D8	44		60		86		114		140	
L1	44		60		86		114		140	
L2	25		32		50		61		75	
L3	6.5		8.5		12.5		16		14.5	
L4	2.5		3.5		7.5		5		5.5	
L41	-		-		3.5		-		-	
L5	10		16		25		32		50	
L6	3		2		1		3		2	
L9	2.6		4.5		5		7.2		10	
L10	9		10		16.5		19		28	
L11	47	62	56	76	66.5	93	92	128	116	163.5
L12	72	87	85.5	105.5	106.5	133	143	179	173	220.5
B1	h9	3	4	6	8	10				
H1		11.2	13.5	21.5	27	35				

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PNII / PNIIR Gearbox Performance

Model No.	Stages	Ratio <sup>(1)</sup>	Type	PNII 017	PNII 023	PNII 034	PNII 042	PNII 056	
				PNIIR 017	PNIIR 023	PNIIR 034	PNIIR 042	PNIIR 056	
Nominal Output Torque $T_{2N}$	1	3	AII	16	42	110	217	430	
		4		16	42	113	223	440	
		5		15	40	118	220	435	
		7		12	35	96	198	366	
		10		10	27	68	155	295	
	2	15		15	40	109	213	424	
		16		16	42	116	228	452	
		20		16	42	116	230	454	
		25		15	40	123	228	450	
		30		15	40	108	212	422	
		35		12	35	100	206	382	
		40		16	43	117	232	459	
		50		15	40	123	228	450	
		70		12	35	100	206	382	
		100		10	27	70	162	308	
		Emergency Stop Torque $T_{2NOT}$		Nm	1,2	3~100	AII 3 times $T_{2N}$		
Max. Acceleration Torque $T_{2B}$	Nm	1,2	3~100	AII $T_{2B} = 60\%$ of $T_{2NOT}$					
No Load Running Torque <sup>(4)</sup>	1	3~10	PNII	0.05	0.10	0.40	0.80	2.50	
			PNIIR	0.10	0.15	0.45	0.85	2.55	
	2	15~100	PNII	0.05	0.10	0.30	0.40	0.80	
			PNIIR	0.10	0.15	0.35	0.45	0.85	
Backlash <sup>(2)</sup>	1	3~10	PNII	$\leq 8$	$\leq 7$	$\leq 6$	$\leq 6$	$\leq 6$	
			PNIIR	$\leq 12$	$\leq 11$	$\leq 10$	$\leq 10$	$\leq 10$	
	2	15~100	PNII	$\leq 10$	$\leq 9$	$\leq 8$	$\leq 8$	$\leq 8$	
			PNIIR	$\leq 14$	$\leq 13$	$\leq 12$	$\leq 12$	$\leq 12$	
Torsional Rigidity	Nm/arcmin	1,2	3~100	AII	0.90	1.50	6	12	14
Nominal Input Speed $n_{1N}$	rpm	1,2	3~100	AII	4,500	4,000	3,600	3,600	2,500
Max. Input Speed $n_{1B}$	rpm	1,2	3~100	AII	8,000	6,000	6,000	4,800	3,600
Max. Radial Load $F_{2rB}$ <sup>(3)</sup>	N	1,2	3~100	AII	480	1,100	1,580	3,500	5,420
Max. Axial Load $F_{2aB}$ <sup>(3)</sup>	N	1,2	3~100	AII	240	550	790	1,750	2,710
Service Life <sup>(5)</sup>	hr	1,2	3~100	AII	20,000				
Operating Temp	°C	1,2	3~100	AII	0° C ~ +90° C				
Degree of Gearbox Protection		1,2	3~100	AII	IP65				
Lubrication		1,2	3~100	AII	Synthetic lubrication grease				
Mounting Position		1,2	3~100	AII	All directions				
Running Noise <sup>(4)</sup>	dB(A)	1,2	3~100	PNII	$\leq 60$	$\leq 62$	$\leq 64$	$\leq 66$	$\leq 68$
				PNIIR	$\leq 70$	$\leq 72$	$\leq 74$	$\leq 75$	$\leq 77$
Max. bending moment based on the gearbox input flange $M_b$ <sup>(6)</sup>	Nm	1,2	3~100	PNII	5	12	22	45	54
				PNIIR	3	6	10	17	19
Efficiency $\eta$	%	1	3~10	PNII	$\geq 97\%$				
				PNIIR	$\geq 93\%$				
	2	15~100	PNII	$\geq 94\%$					
			PNIIR	$\geq 90\%$					

(1) Ratio ( $i = N_{in} / N_{out}$ ).

(2) Backlash is measured at 2% of Nominal Output Torque  $T_{2N}$ .

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load, By ratio smaller than 10, the noise value would be 3-5dB higher.

(5) For continuous operation, the service life time is less than 10,000 hrs.

(6) Max. motor weight\* (kg) =  $\frac{0.1 \times Mb}{\text{motor length (m)}}$

\*with symmetrically distributed motor weight

\*with horizontal and stationary mounting

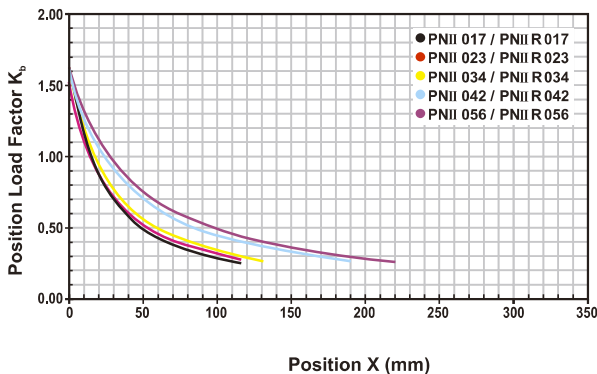
# PNII Gearbox Inertia

Model No.	PNII 017		PNII 023		PNII 034		PNII 042		PNII 056	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
$\emptyset^{(A)}$ (C3)										
8	0.10	0.10	0.12	0.10	-	-	-	-	-	-
11	0.16	0.16	0.19	0.16	-	-	-	-	-	-
14	-	-	0.22	0.20	0.36	0.24	-	-	-	-
19	-	-	1.53	1.51	1.70	1.58	2.20	1.73	-	2.18
24	-	-	-	-	2.24	2.12	2.74	2.27	4.52	2.73
28	-	-	-	-	2.68	2.55	3.17	2.70	4.94	3.15
32	-	-	-	-	-	-	7.77	7.30	9.70	7.91
35	-	-	-	-	-	-	10.80	10.30	12.80	11.00
38	-	-	-	-	-	-	14.00	13.50	16.00	14.20
42	-	-	-	-	-	-	-	-	24.50	-

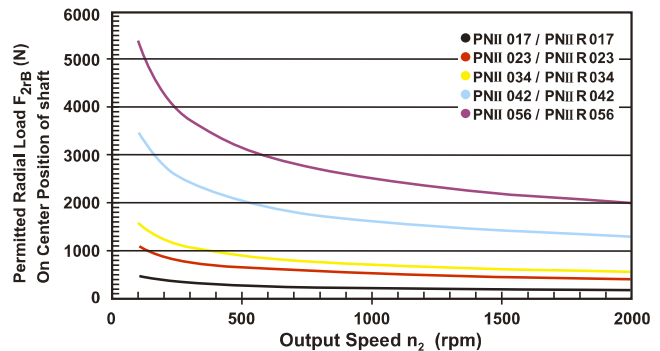
# PNII R Gearbox Inertia

Model No.	PNII R 017		PNII R 023		PNII R 034		PNII R 042		PNII R 056	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
$\emptyset^{(A)}$ (C3)										
8	0.18	0.18	0.36	0.36	-	-	-	-	-	-
11	0.20	0.20	0.39	0.39	-	-	-	-	-	-
14	-	-	0.43	0.43	1.87	1.87	-	-	-	-
19	-	-	1.24	1.24	2.67	2.67	6.80	6.80	-	13.57
24	-	-	-	-	2.97	2.97	7.10	7.10	13.87	13.87
28	-	-	-	-	3.47	3.47	7.59	7.59	14.36	14.36
32	-	-	-	-	-	-	10.56	10.56	17.33	17.33
35	-	-	-	-	-	-	11.97	11.97	18.74	18.74
38	-	-	-	-	-	-	13.95	13.95	20.79	20.79
42	-	-	-	-	-	-	-	-	26.54	-

# Permitted Radial And Axial Loads<sup>(B)</sup>



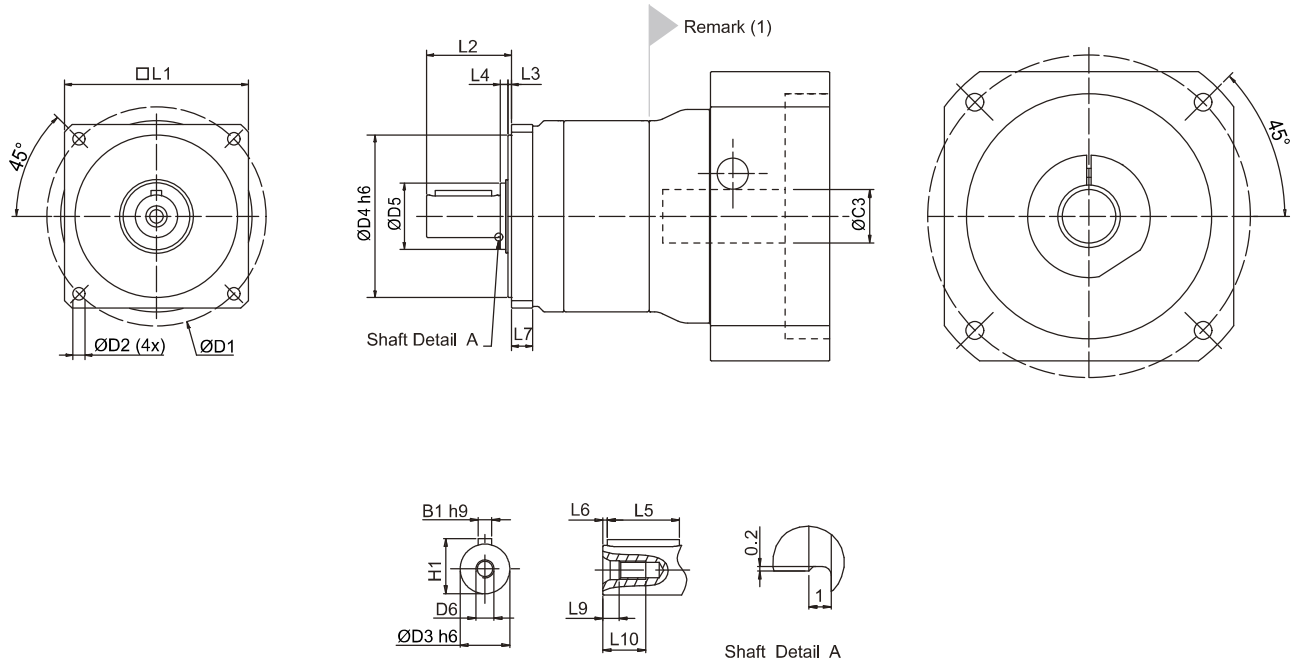
If radial force  $F_{2r}$  is not exerted on the center of the output shaft  $X < 1/2xL$  or  $X > 1/2xL$ , the permitted radial and axial loads can be calculated by the position load factor  $K_b$  on the above diagram.



Permitted radial load  $F_{2r}$  on center of output shaft  $X = 1/2 \times L$  for various output speeds. Values provided are for 20,000 hours<sup>(C)</sup> life.

- (A)  $\emptyset$  = Input shaft diameter.
- (B) Permitted loading values on the output shaft. Please refer to P. 33 glossary.
- (C) For Continuous Operation (S1), the service life reduced to 50%.

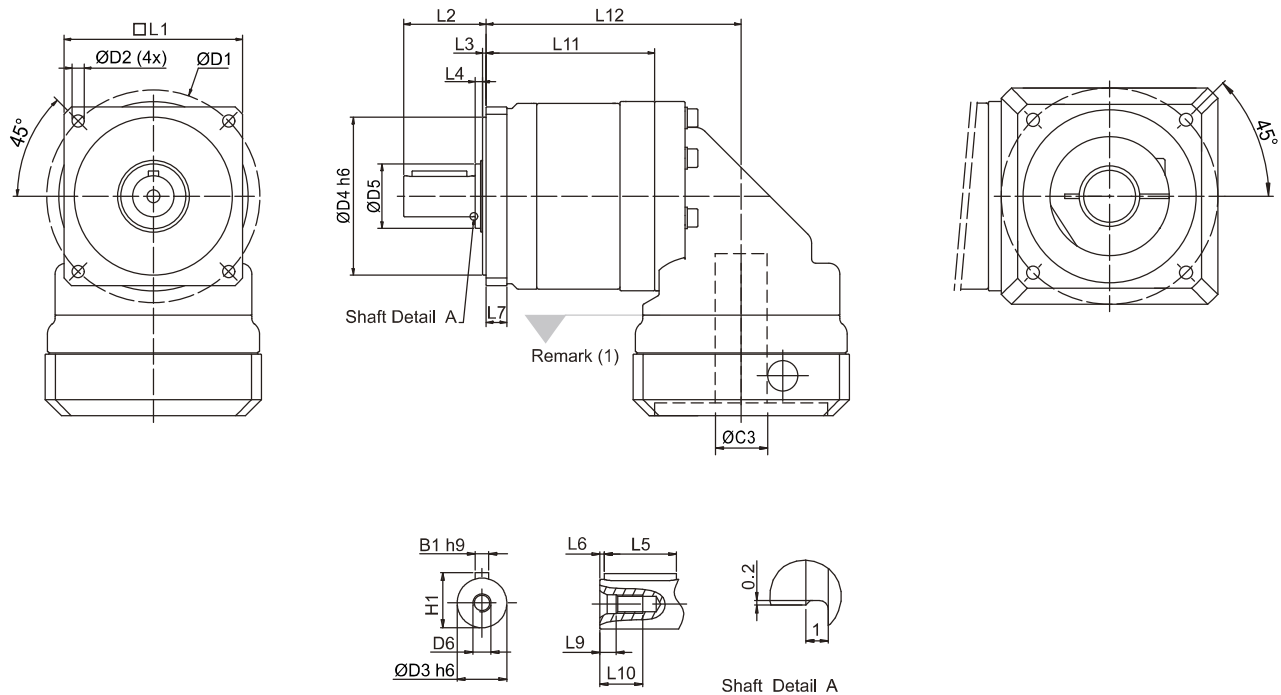
# PNII Series Dimension



Dimension	PNII 017		PNII 023		PNII 034		PNII 042		PNII 056	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	43.815		66.675		98.425		125.73		177.8	
D2	3.4		5.2		5.6		7.2		10.5	
D3	h6	12.7	12.7		19.05		25.4		38.1	
D4	h6	22	38.1		73.025		55.55		114.3	
D5	17		17		30		35		55	
D6	M4X0.7P		M4X0.7P		M6X1P		M10X1.5P		M16X2P	
L1	41.91		57.15		82.55		106.68		146.05	
L2	31.75		31.75		38.1		50.8		63.5	
L3	1.6		1.6		1.6		1.6		3.2	
L4	1		1		3.5		1.5		5.5	
L5	19.05		19.05		25.4		31.75		38.1	
L6	3.788		3.788		3.807		5.175		8.563	
L7	6.35		9.525		9.525		12.7		19.05	
L9	4.5		4.5		5		7.5		12	
L10	10		10		16.5		22		36	
B1	h9	3.175	3.175		4.763		6.35		9.525	
H1	14.125		14.125		21.163		28.2		42.275	

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PNIR Series Dimension



Dimension	PNIR 017		PNIR 023		PNIR 034		PNIR 042		PNIR 056	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	43.815		66.675		98.425		125.73		177.8	
D2	3.4		5.2		5.6		7.2		10.5	
D3 h6	12.7		12.7		19.05		25.4		38.1	
D4 h6	22		38.1		73.025		55.55		114.3	
D5	17		17		30		35		55	
D6	M4X0.7P		M4X0.7P		M6X1P		M10X1.5P		M16X2P	
L1	41.91		57.15		82.55		106.68		146.05	
L2	31.75		31.75		38.1		50.8		63.5	
L3	1.6		1.6		1.6		1.6		3.2	
L4	1		1		3.5		1.5		5.5	
L5	19.05		19.05		25.4		31.75		38.1	
L6	3.788		3.788		3.807		5.715		8.563	
L7	6.35		9.525		9.525		12.7		19.05	
L9	4.5		4.5		5		7.5		12	
L10	10		10		16.5		22		36	
L11	53.4	68.4	67.9	87.9	77.9	104.4	111.4	147.4	127.3	174.8
L12	78.4	93.4	97.4	117.4	117.9	144.4	162.4	198.4	184.3	231.8
B1 h9	3.175		3.175		4.763		6.35		9.525	
H1	14.125		14.125		21.163		28.2		42.275	

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PD / PDR Gearbox Performance

Model No.		Stages	Ratio <sup>(1)</sup>	Type	PD 053	PD 064	PD 090	PD 110
					PDR 053	PDR 064	PDR 090	PDR 110
Nominal Output Torque $T_{2N}$	Nm	1	3	All	16	42	110	217
			4		16	42	113	223
			5		15	40	118	220
			7		12	35	96	198
			10		10	27	68	155
		2	15		15	40	109	213
			16		16	42	116	228
			20		16	42	116	230
			25		15	40	123	228
			30		15	40	108	212
			35		12	35	100	206
			40		16	43	117	232
			50		15	40	123	228
			70		12	35	100	206
			100		10	27	70	162
			Emergency Stop Torque $T_{2NOT}$		Nm	1,2	3~100	All
Max. Acceleration Torque $T_{2B}$	Nm	1,2	3~100	All	$T_{2B} = 60\%$ of $T_{2NOT}$			
No Load Running Torque <sup>(4)</sup>	Nm	1	3~10	PD	0.05	0.10	0.40	0.80
				PDR	0.10	0.15	0.45	0.85
		2	15~100	PD	0.05	0.10	0.30	0.40
				PDR	0.10	0.15	0.35	0.45
Backlash <sup>(2)</sup>	arcmin	1	3~10	PD	$\leq 8$	$\leq 7$	$\leq 6$	$\leq 6$
				PDR	$\leq 12$	$\leq 11$	$\leq 10$	$\leq 10$
		2	15~100	PD	$\leq 10$	$\leq 9$	$\leq 8$	$\leq 8$
				PDR	$\leq 14$	$\leq 13$	$\leq 12$	$\leq 12$
Torsional Rigidity	Nm/arcmin	1,2	3~100	All	1.2	3	10.8	16.2
Nominal Input Speed $n_{1N}$	rpm	1,2	3~100	All	4,500	4,000	3,600	3,600
Max. Input Speed $n_{1B}$	rpm	1,2	3~100	All	8,000	6,000	6,000	4,800
Max. Radial Load $F_{2rB}$ <sup>(3)</sup>	N	1,2	3~100	All	1,045	880	1,615	3,675
Max. Axial Load $F_{2aB}$ <sup>(3)</sup>	N	1,2	3~100	All	523	440	808	1,838
Max. Tilting Torque $M_{2K}$	Nm	1,2	3~100	All	22	17	44	140
Service Life <sup>(5)</sup>	hr	1,2	3~100	All	20,000			
Operating Temp	°C	1,2	3~100	All	0° C ~ +90° C			
Degree of Gearbox Protection		1,2	3~100	All	IP65			
Lubrication		1,2	3~100	All	Synthetic lubrication grease			
Mounting Position		1,2	3~100	All	All directions			
Running Noise <sup>(4)</sup>	dB(A)	1,2	3~100	PD	$\leq 60$	$\leq 62$	$\leq 64$	$\leq 66$
				PDR	$\leq 70$	$\leq 72$	$\leq 74$	$\leq 75$
Max. bending moment based on the gearbox input flange $M_b$ <sup>(6)</sup>	Nm	1,2	3~100	PD	7	16	31	56
				PDR	4	9	16	25
Efficiency $\eta$	%	1	3~10	PD	$\geq 97\%$			
				PDR	$\geq 93\%$			
		2	15~100	PD	$\geq 94\%$			
				PDR	$\geq 90\%$			

(1) Ratio ( $i = N_{in} / N_{out}$ ).

(2) Backlash is measured at 2% of Nominal Output Torque  $T_{2N}$ .

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load, By ratio smaller than 10, the noise value would be 3-5dB higher.

(5) For continuous operation, the service life time is less than 10,000 hrs.

(6) Max. motor weight\* (kg) =  $\frac{0.1 \times Mb}{\text{motor length (m)}}$

\*with symmetrically distributed motor weight

\*with horizontal and stationary mounting



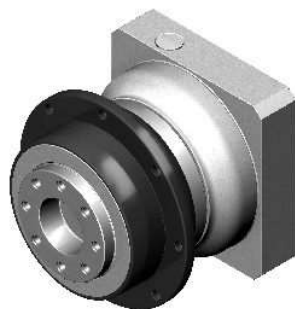
# PD Gearbox Inertia

Model No.	PD 053		PD 064		PD 090		PD 110	
$\varnothing^{(A)}$ (C3)	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	0.10	0.10	0.12	0.10	-	-	-	-
11	0.16	0.16	0.19	0.16	-	-	-	-
14	-	-	0.22	0.20	0.36	0.24	-	-
19	-	-	1.53	1.51	1.70	1.58	2.20	1.73
24	-	-	-	-	2.24	2.12	2.74	2.27
28	-	-	-	-	2.68	2.55	3.17	2.70
32	-	-	-	-	-	-	7.77	7.30
35	-	-	-	-	-	-	10.80	10.30
38	-	-	-	-	-	-	14.00	13.50
42	-	-	-	-	-	-	-	-

# PDR Gearbox Inertia

Model No.	PDR 053		PDR 064		PDR 090		PDR 110	
$\varnothing^{(A)}$ (C3)	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	0.18	0.18	0.36	0.36	-	-	-	-
11	0.20	0.20	0.39	0.39	-	-	-	-
14	-	-	0.43	0.43	1.87	1.87	-	-
19	-	-	1.24	1.24	2.67	2.67	6.80	6.80
24	-	-	-	-	2.97	2.97	7.10	7.10
28	-	-	-	-	3.47	3.47	7.59	7.59
32	-	-	-	-	-	-	10.56	10.56
35	-	-	-	-	-	-	11.97	11.97
38	-	-	-	-	-	-	13.95	13.95
42	-	-	-	-	-	-	-	-

(A)  $\varnothing$  = Input shaft diameter.

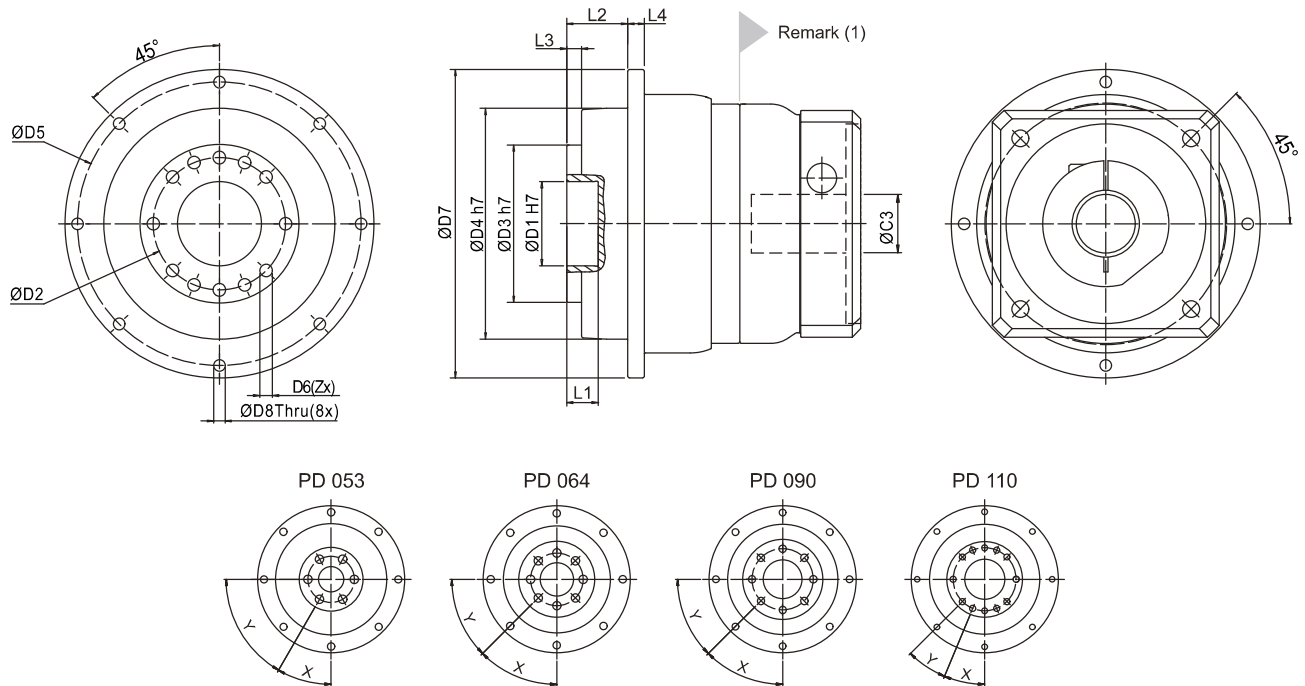


**PD**



**PDR**

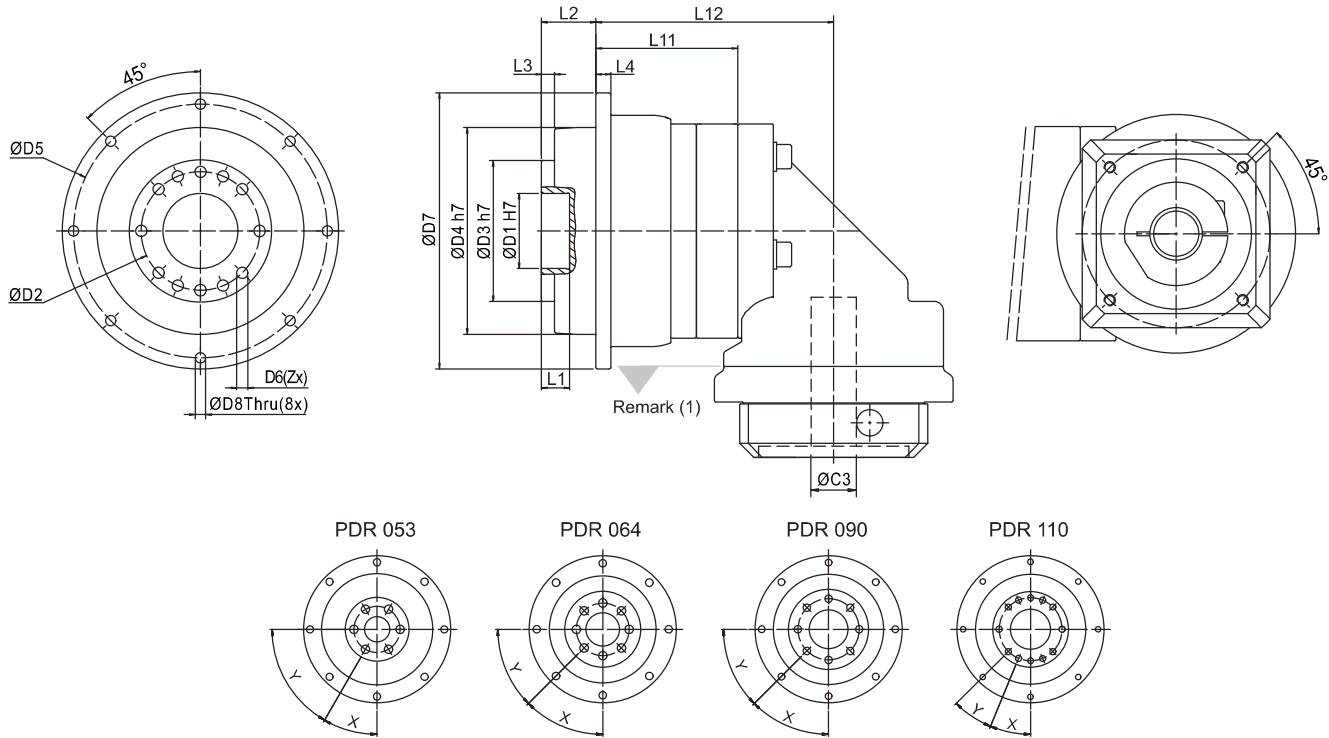
# PD Series Dimension



Dimension	PD 053		PD 064		PD 090		PD 110	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1 H7	12		20		31.5		40	
D2	22		31.5		50		63	
D3 h7	28		40		63		75	
D4 h7	53		64		90		110	
D5	64		79		109		135	
D6	M4x0.7Px8L		M5xX0.8Px8L		M6x1Px13.5L		M6x1Px13.5L	
D7	70		88		120		147	
D8	3.4		4.5		5.5		5.5	
L1	4		8		15		15	
L2	14.5		19.5		30		29	
L3	3		4		7		7	
L4	5		5		7		8	
X in Degree	30°		45°		45°		22.5°	
Y in Degree	60°		45°		45°		22.5°	
Z	6		8		8		12	

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PDR Series Dimension



Dimension	PDR 053		PDR 064		PDR 090		PDR 110	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1 H7	12		20		31.5		40	
D2	22		31.5		50		63	
D3 h7	28		40		63		75	
D4 h7	53		64		90		110	
D5	64		79		109		135	
D6	M4x0.7Px8L		M5X0.8Px8L		M6x1Px13.5L		M6X1Px13.5L	
D7	70		88		120		147	
D8	3.4		4.5		5.5		5.5	
L1	4		8		15		15	
L2	14.5		19.5		30		29	
L3	3		4		7		7	
L4	5		5		7		8	
L11	42.8	57.8	39.5	59.5	49.6	76.1	75.4	111.4
L12	67.8	82.8	69	89	89.6	116.1	126.4	162.4
X in Degree	30°		45°		45°		22.5°	
Y in Degree	60°		45°		45°		22.5°	
Z	6		8		8		12	

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PL / PLR Gearbox Performance

Model No.		Stages	Ratio <sup>(1)</sup>	Type	PL 070	PL 090	PL 120
					PLR 070	PLR 090	PLR 120
Nominal Output Torque $T_{2N}$	Nm	1	3	All	30	67	107
			4		39	86	137
			5		40	89	140
			7		37	80	128
			10		27	59	93
		2	12		31	69	109
			15		31	70	110
			16		39	86	137
			20		39	88	141
			25		40	89	140
			30		32	72	111
			35		36	80	130
			40		41	92	143
			50		42	90	143
			70		37	81	131
			100		27	59	93
			Emergency Stop Torque $T_{2NOT}$		Nm	1,2	3~10
Max. Acceleration Torque $T_{2B}$	Nm	1,2	3~10	All	$T_{2B} = 60\%$ of $T_{2NOT}$		
No Load Running Torque <sup>(4)</sup>	Nm	1	3~10	PL	0,10	0,40	0,80
				PLR	0,15	0,45	0,85
		2	12~100	PL	0,10	0,30	0,40
				PLR	0,15	0,35	0,45
Backlash <sup>(2)</sup>	arcmin	1	3~10	PL	$\leq 7$	$\leq 6$	$\leq 6$
				PLR	$\leq 11$	$\leq 10$	$\leq 10$
		2	12~100	PL	$\leq 9$	$\leq 8$	$\leq 8$
				PLR	$\leq 13$	$\leq 12$	$\leq 12$
Torsional Rigidity	Nm/arcmin	1,2	3~100	All	2,2	8	12
Nominal Input Speed $n_{1N}$	rpm	1,2	3~100	All	4,000	3,600	3,600
Max. Input Speed $n_{1B}$	rpm	1,2	3~100	All	6,000	6,000	4,800
Max. Radial Load $F_{2rB}$ <sup>(3)</sup>	N	1,2	3~100	All	2,600	3,100	6,550
Max. Axial Load $F_{2aB}$ <sup>(3)</sup>	N	1,2	3~100	All	1,300	1,550	3,275
Service Life <sup>(5)</sup>	hr	1,2	3~100	All	20,000		
Operating Temp	°C	1,2	3~100	All	0° C ~ +90° C		
Degree of Gearbox Protection		1,2	3~100	All	IP65		
Lubrication		1,2	3~100	All	Synthetic lubrication grease		
Mounting Position		1,2	3~100	All	All directions		
Running Noise <sup>(4)</sup>	dB(A)	1,2	3~100	PL	$\leq 62$	$\leq 64$	$\leq 66$
				PLR	$\leq 72$	$\leq 74$	$\leq 75$
Max. belt tension	N	1,2	3~100	All	560	950	1200
Max. bending moment based on the gearbox input flange $M_b$ <sup>(6)</sup>	Nm	2	12~100	PL	19	38	45
		2		PLR	10	17	14
Efficiency $\eta$	%	1	3~10	PL	$\geq 97\%$		
				PLR	$\geq 93\%$		
		2	12~100	PL	$\geq 94\%$		
				PLR	$\geq 90\%$		

(1) Ratio ( $i = N_{in} / N_{out}$ ).

(2) Backlash is measured at 2% of Nominal Output Torque  $T_{2N}$ .

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load, By ratio smaller than 10, the noise value would be 3-5dB higher.

(5) For continuous operation, the service life time is less than 10,000 hrs.

(6) Max. motor weight\* (kg) =  $\frac{0.1 \times M_b}{\text{motor length (m)}}$

\*with symmetrically distributed motor weight

\*with horizontal and stationary mounting

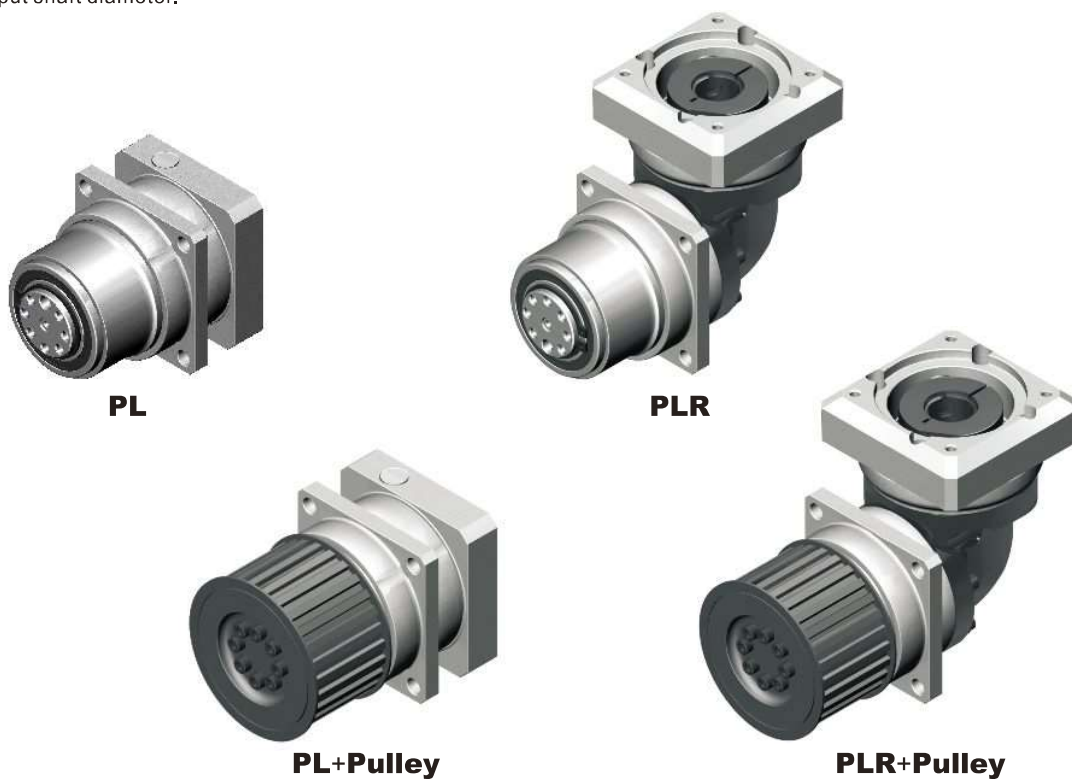
# PL Gearbox Inertia

Model No.	PL 070		PL 090		PL 120	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
$\varnothing^{(A)}$ (C3)						
8	0.12	0.10	-	-	-	-
11	0.19	0.16	-	-	-	-
14	0.22	0.20	0.36	0.24	-	-
19	1.53	1.51	1.70	1.58	2.20	1.73
24	-	-	2.24	2.12	2.74	2.27
28	-	-	2.68	2.55	3.17	2.70
32	-	-	-	-	7.77	7.30
35	-	-	-	-	10.80	10.30
38	-	-	-	-	14.00	13.50
42	-	-	-	-	-	-

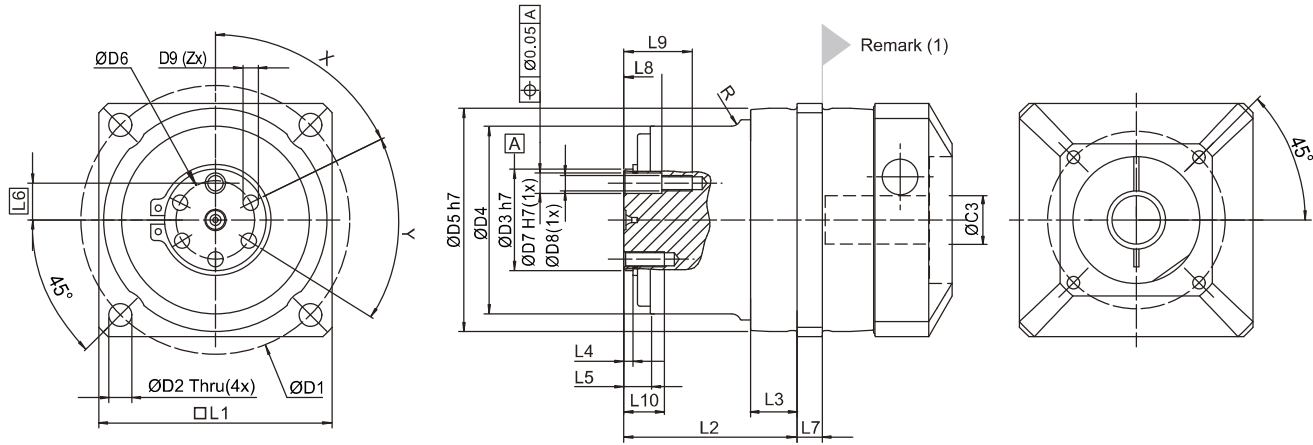
# PLR Gearbox Inertia

Model No.	PLR 070		PLR 090		PLR 120	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
$\varnothing^{(A)}$ (C3)						
8	0.36	0.36	-	-	-	-
11	0.39	0.39	-	-	-	-
14	0.43	0.43	1.87	1.87	-	-
19	1.24	1.24	2.67	2.67	6.80	6.80
24	-	-	2.97	2.97	7.10	7.10
28	-	-	3.47	3.47	7.59	7.59
32	-	-	-	-	10.56	10.56
35	-	-	-	-	11.97	11.97
38	-	-	-	-	13.95	13.95
42	-	-	-	-	-	-

(A)  $\varnothing$  = Input shaft diameter.



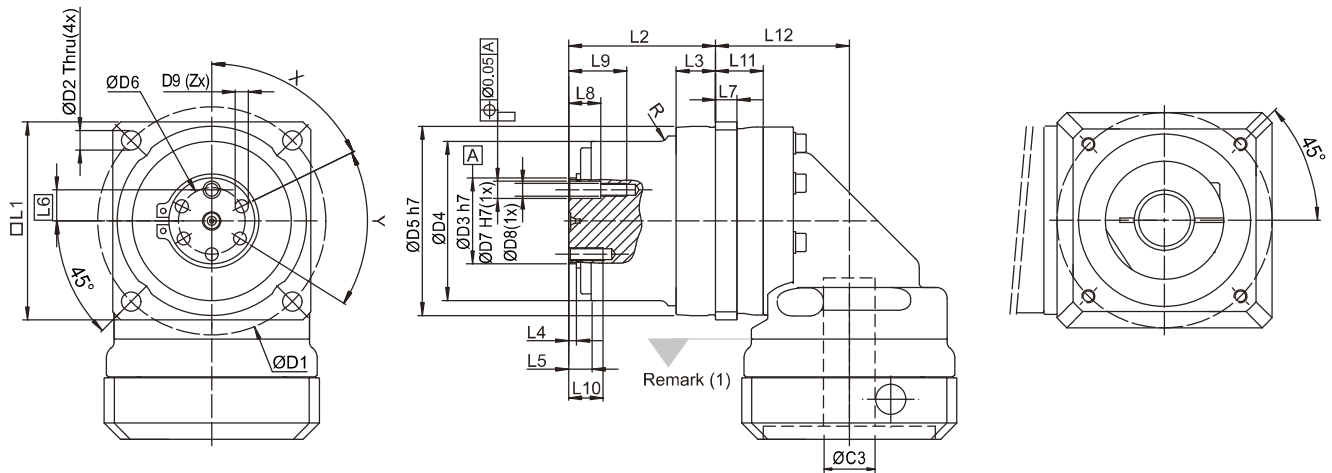
# PL Series Dimension



Dimension	PL 070		PL 090		PL 120	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	82		106		144	
D2	6.6		9		13	
D3 h7	25		40		50	
D4	58		74		100	
D5 h7	68		88		118	
D6	18		31		37	
D7 H7	6		8		8	
D8	M5X0.8P		M6X1P		M6X1P	
D9	M5X0.8P		M6X1P		M8X1.25P	
R	-		4		2	
L1	70		92		122	
L2	60.2		68.3		82.2	
L3	12.7		18.3		15.7	
L4	3.8		3.7		4.5	
L5	10		10.5		12.5	
L6	8.8		14.5		18.5	
L7	8		10		12	
L8	10		15		16	
L9	18.5		27		28	
L10	12		16		16	
X in Degree	64°		45°		45°	
Y in Degree	58°		45°		45°	
Z	5		7		7	

(1) Dimensions are related to motor interface. Please contact APEX for details.

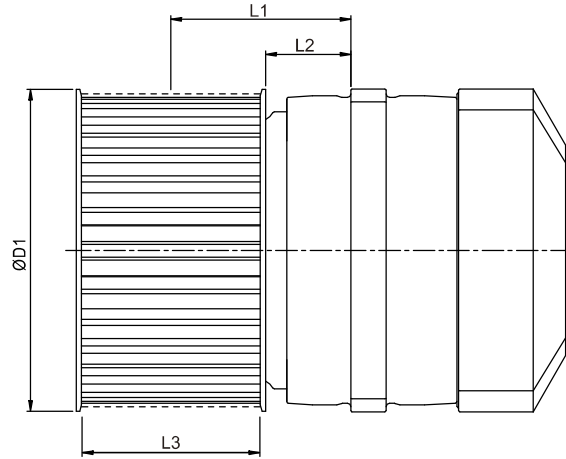
# PLR Series Dimension



Dimension	PLR 070		PLR 090		PLR 120	
	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1	82		106		144	
D2	6.6		9		13	
D3 h7	25		40		50	
D4	58		74		100	
D5 h7	68		88		118	
D6	18		31		37	
D7 H7	6		8		8	
D8	M5X0.8P		M6X1P		M6X1P	
D9	M5X0.8P		M6X1P		M8X1.25P	
R	-		4		2	
L1	70		92		122	
L2	60.2		68.3		82.2	
L3	12.7		18.3		15.7	
L4	3.8		3.7		4.5	
L5	10		10.5		12.5	
L6	8.8		14.5		18.5	
L7	8		10		12	
L8	10		15		16	
L9	18.5		27		28	
L10	12		16		16	
L11	16.8	36.8	22.2	48.9	34.8	71.1
L12	46.3	66.3	62.2	88.9	85.8	122.1
X in Degree	64°		45°		45°	
Y in Degree	58°		45°		45°	
Z	5		7		7	

(1) Dimensions are related to motor interface. Please contact APEX for details.

# PL+PULLEY Dimension



Reducer	Belt Pulley	D1	L1	L2	L3	Pitch P	No.of Teeth Z	Circumference Z*P	Inertia J	Mass m
						mm		mm/rotation	kgcm <sup>2</sup>	kg
PL 070 PLR 070	AT05-W50-T43	71	41.8	14.8	51	5	43	215	4.68	0.57
	HTD 5M-W50-T44	72.9	41.8	14.8	51	5	44	220	5.58	0.65
	5GT-W50-T44	72.9	41.8	14.8	51	5	44	220	5.58	0.65
PL 090 PLR 090	AT10-W50-T28	91.7	51.3	24.3	51	10	28	280	14.07	1.00
	HTD 8M-W50-T36	98.4	51.3	24.3	51	8	36	288	17.78	1.18
	8YU-W50-T36	98.4	51.3	24.3	51	8	36	288	17.78	1.18
PL 120 PLR 120	AT20-W75-T19	124.6	57.7	17.7	76	20	19	380	69.55	2.71
	HTD 14M-W75-T28	137	57.7	17.7	76	14	28	392	87.83	3.20

## PULLEY ORDERING CODE

**PUL070<sup>(1)</sup> – AT05<sup>(2)</sup> – B<sup>(3)</sup>**

**Pulley size corresponds to gearbox size:**

**PUL 070: PL 070, PLR 070**

**PUL 090: PL 090, PLR 090**

**PUL 120: PL 120, PLR 120**

**Ordering Example : PUL 070 - AT05 - B**

**PUL 090 - 8YU - N**

(1) Pulley size.

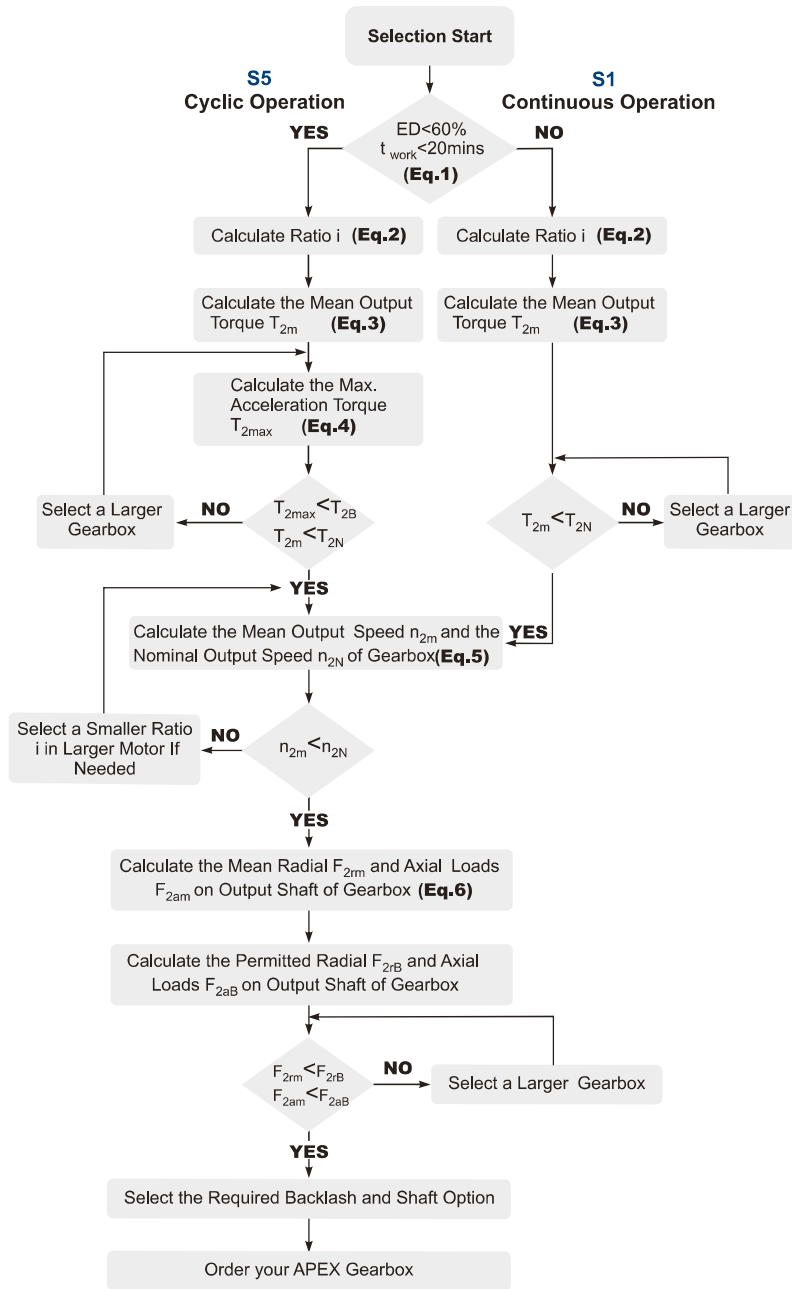
(2) Pulley specification.

(3) Pulley appearance. B = Manganese phosphate blackening (Standard)

N = Nickel plating



# Selection of the optimum gearbox



**Recommended (for S5 Cycle Operation)**

The general design is given for

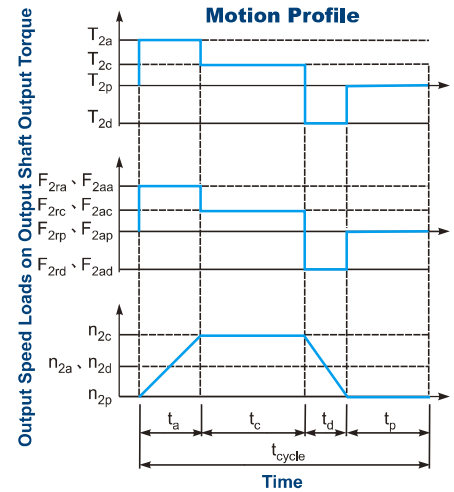
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

The optimal design is given for

$$\frac{J_L}{i^2} \cong J_m$$

$J_L$  Load Inertia

$J_m$  Motor Inertia



$$1. ED = \frac{t_a + t_c + t_d}{t_{cycle}} \times 100\%, t_{work} = t_a + t_c + t_d$$

Index : a. Acceleration, c. Constant, d. Deceleration, p. Pause **(Eq.1)**

$$2. i \cong \frac{n_m}{n_{work}}$$

$n_m$  Output Speed of the Motor

$n_{work}$  Working Speed **(Eq.2)**

$$3. T_{2m} = 3 \sqrt{\frac{n_{2a} \times t_a \times T_{2a}^3 + n_{2c} \times t_c \times T_{2c}^3 + n_{2d} \times t_d \times T_{2d}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

**(Eq.3)**

$$4. T_{2max} = T_{mB} \times i \times K_s \times \eta$$

where  $K_s$  is

$K_s$	No. of Cycles / hr
1.0	0 ~ 1,000
1.1	1,000 ~ 1,500
1.3	1,500 ~ 2,000
1.6	2,000 ~ 3,000
1.8	3,000 ~ 5,000

$T_{mB}$  Max. Output Torque of the Motor

$\eta$  Efficiency of the Gearbox **(Eq.4)**

$$5. n_{2a} = n_{2d} = \frac{1}{2} \times n_{2c}$$

$$n_{2m} = \frac{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}{t_a + t_c + t_d}$$

$$n_{2N} = \frac{n_{1N}}{i}$$

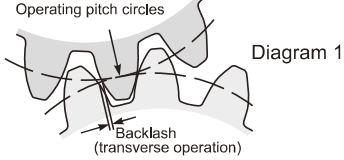
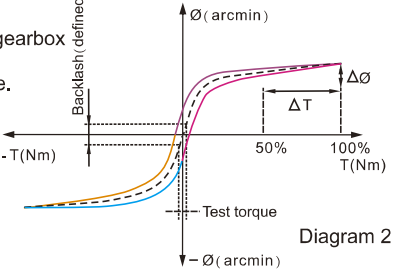
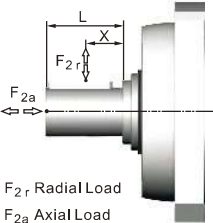
**(Eq.5)**

$$6. F_{2rm} = 3 \sqrt{\frac{n_{2a} \times t_a \times F_{2ra}^3 + n_{2c} \times t_c \times F_{2rc}^3 + n_{2d} \times t_d \times F_{2rd}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

$$F_{2am} = 3 \sqrt{\frac{n_{2a} \times t_a \times F_{2aa}^3 + n_{2c} \times t_c \times F_{2ac}^3 + n_{2d} \times t_d \times F_{2ad}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

**(Eq.6)**

# Glossary

Emergency Stop Torque $T_{2NOT}$	Nm	The Emergency Stop Torque is the maximum permitted torque at the output of gearbox. This may happen only occasionally and may not exceed 1,000 times during the whole service life.
Max. Acceleration Torque $T_{2B}$	Nm	Under the Cyclic Operation (S5), the Max. Acceleration Torque is the maximum torque which can be transmitted only briefly to the output of gearbox up to 1,000 cycles/hr.
No Load Running Torque	Nm	The No Load Running Torque is the min. torque to overcome the internal friction of a gearbox without loading*.
Nominal Input Speed $n_{1N}$	rpm	The Nominal Input Speed is the permitted input speed of gearbox by the Continuous Operation (S1) while the housing temperature does not exceed 90°C. This value is measured at environment temperature 25°C.
Max. Input Speed $n_{1B}$	rpm	The Max. Input Speed is the max. permitted input speed of gearbox by the Cyclic operation (S5). This value is measured at environment temperature 25°C and serves as the absolute limit of the gearbox.
Backlash	arcmin	The Backlash is the maximum angular measurement between two teeth of gears when the transverse operation occurs (refer to Diagram 1). The arcmin is the measurement unit for the backlash. One arcmin equals 1/ 60 degree, symbolized as 1'. 
Torsional Rigidity	Nm/arcmin	Torsional Rigidity is the quotient ( $\Delta T / \Delta \theta$ ) between the applied torque and resulting torsion angle. This value indicates how much torque is needed on the gearbox to rotate the output shaft for 1 arcmin. The Torsional Rigidity can be determined by Hysteresis Curve. <b>Hysteresis Curve</b> When the input shaft is locked, increase torque at the output slowly up to $T_{2B}$ in both directions and then release the torque gradually. According to the measured torque and torsion angle, a closed curve will be acquired as in the Diagram 2. 
Radial Load And Axial Load	N	The permitted radial and axial loads on output shaft of the gearbox depend on the design of the gearbox supporting bearings. 
Efficiency $\eta$	%	The transmission efficiency of the gears inside a gearbox (without friction).
Operating Temperature	°C	The Operating Temperature indicates the temperature of gearbox housing.
Degree of Protection		IP code stands for International Protection standard. The IP65 as example: the first IP number stands for protection degree against dust; the second IP number stands for protection against liquid.
Lubrication		APEX uses synthetic lubrication grease. Alternate greases are available, please contact APEX.
Running Noise	dB(A)	The Running Noise is measured depends on gearbox size, the ratio and the speed*. Higher speed usually induces higher noise level, while higher ratio induces lower noise level.
Moment of Inertia $J_1$	kg.cm <sup>2</sup>	The Moment of Inertia J1 is a measurement of the effort applied to an object to maintain its momentary condition at rest or rotating.
Breakaway Torque	Nm	The Breakaway Torque is the minimum torque to start the rotation from the input side of gearbox. A smaller size or a higher ratio gearbox requests less Breakaway Torque.
Back Driving Torque	Nm	The Back Driving Torque is the minimum torque to start the rotation from the output side of gearbox. A larger size or a higher ratio gearbox requires greater Back Driving Torque.

\* This value is measured at environment temperature 25°C and the input speed 3,000 rpm. If the Nominal Input Speed  $n_{1N}$  of gearbox is over 3,000 rpm, this value is measured by that specific Nominal Input Speed.

# Note



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**APEX TAIWAN NORTH  
ANDEK AUTOMATION CO.,LTD**  
TEL +886-02-82262655  
13F-5, No.2, Jian 8th Rd., Jhonghe Dist., New  
Taipei City 235, TAIWAN  
sales@andtek.com.tw  
www.apexdyna.com



**APEX TAIWAN CENTRAL  
ANDEK AUTOMATION CO.,LTD**  
TEL +886-04-23594286  
9F-6, No.925, Sec.4, Taiwan Blvd., Xitun Dist.  
Taichung City 407 TAIWAN  
sales@andtek.com.tw  
www.apexdyna.com



**APEX TAIWAN SOUTH  
MEN JENN ELECTRIC CO., LTD.**  
TEL +886-06-2337332 ~ 6  
No.774, Zhonghua Rd., Yongkang Dist., Tainan  
City 710, TAIWAN  
menjenn@ms24.hinet.net  
www.apexdyna.com



**APEX DYNAMICS INC. SHANGHAI**  
TEL +86-21-69220577  
No.128 ZHUYING ROAD QINGPU Industry Area,  
Shanghai, CHINA  
sales@apexdyna.cn  
www.apexdyna.com



**APEX DYNAMICS SHENZHEN, LTD.**  
TEL +86-755-32662323  
No. 1102A of D area , CFG mansion , Bao Yuan  
Road , Bao' an District , Shenzhen , CHINA.  
sales@szapexdyna.com  
www.szapexdyna.com



**APEX DYNAMICS BEIJING, LTD.**  
TEL +86-10-69570691  
NO.1,YaoPingRoad,SongZhuang Town, Tongzhou  
istrict, Beijing, CHINA.  
bjapexdyna@163.com  
www.bjapex.cn



**CHONGQING APEX DYNAMICS CO., LTD.**  
TEL +86-23-67686860  
406, Building 5, No.68,Jinyu Avenue, Beibu New  
Area, Chongqing, CHINA  
sales@cqapexdyna.com  
www.apexdyna.com



**APEX (XIAMEN) DYNAMICS TECHNOLOGY CO., LTD.**  
TEL +86-0592-720-5279  
Unit B-3,1F.,No.129,Jingquan Road, Jimei District,  
Xiamen, Fujian, CHINA  
sales@xmapexdyna.com  
www.xmapexdyna.com



**APEX DYNAMICS USA, INC.**  
TEL +1-631-2449040  
885 Marconi Avenue Ronkonkoma, NY 11779  
U.S.A.  
sales@apexdynamicsusa.com  
www.apexdynamicsusa.com



**APEX DYNAMICS KOREA**  
TEL +82-31-8179992  
1246-32, Seongsuk-dong, Ilsandong-gu, Goyang-city,  
Gyeonggi-Do, KOREA (R.O.K) 410-570  
sales@apexdynakorea.co.kr  
www.apexdynakorea.co.kr



**APEX DYNAMICS JAPAN**  
TEL +81-092-4511202  
1-13-3, Sannou, Hakata-ku, Fukuoka-shi 812-0015,  
JAPAN  
sales@apexdyna.jp  
www.apexdyna.jp



**APEX DYNAMICS SINGAPORE PTE LTD**  
TEL +65-62-626228  
3 South Buona Vista Road, #05-15 & #06-15.  
SINGAPORE 118136  
sales@apexdyna.com.sg  
www.apexdyna.com.sg



**APEX DYNAMICS (THAILAND) CO., LTD.**  
TEL +66-2-32662333  
73 Soi Ladkrabang 30, Kadkrabang Rd.,Bangkok  
10520, THAILAND  
sales@apexdyna.co.th  
www.apexdyna.co.th



**APEX DYNAMICS BV**  
TEL +31-492-509995  
Churchillaan 101 5705 BK Helmond, NETHERLANDS  
sales@apexdyna.nl  
www.apexdyna.nl  
www.apexdyna.be



**APEX DYNAMICS  
POLSKA SP. Z O.O.**  
TEL +48-12-6304728  
Krakowska 50, 32-083 Balice, POLAND  
sales@apexdyna.pl  
www.apexdyna.pl



**APEX DYNAMICS SPAIN, S.L.**  
TEL +34-93-6562990  
Poligono Industrial Molí dels Frases, Calle C nº  
12,08620 - Sant Vicenç dels Horts, Barcelona, SPAIN  
apexdyna@apexdyna.es  
www.apexdyna.es



**APEX DYNAMICS IRAN.**  
TEL +98-21-66593517  
APT#6, 3rd Flr, No.5, 3rd Kowsar St., Sattarkhan  
Ave., Tehran, IRAN  
alahyari@farasysco.com  
www.apexdyna.ir



**APEKS REDUKTOR VE DISLI SAN. TIC. LTD. STI.**  
TEL +90-232-4589960  
10042 Sok.No:10 AOSB Çiğli-İzmir, TURKEY  
sales@apexdyna.com.tr  
www.apexdyna.com.tr



**APEX DYNAMICS AUSTRALIA PTY LTD.**  
TEL +613-95-852739  
36 Taunton Drive, Cheltenham, Victoria 3192  
AUSTRALIA.  
sales@apexdyna.com.au  
www.apexdyna.com.au



**APEX DYNAMICS (I) JV**  
TEL +91-80-55345541  
GAT No. 279, KHED SHIVAPUR BAUG, TALUKA  
HAVELI PUNE- 412205 INDIA.  
sales@apexdyna.co.in  
www.apexdyna.co.in



**APEX DYNAMICS FRANCE SAS**  
TEL +33-160-135097  
11 - Burospace F - 91570 -  
Bièvres, FRANCE  
info@apexdyna.fr  
www.apexdyna.fr



**APEX DYNAMICS SWEDEN AB**  
TEL +46-75-2424444  
Fredrikbergsgatan 2 SE-573 92 Tranås, SWEDEN  
sales@apexdyna.se  
www.apexdyna.se



**PT.APEX DYNAMICS INDONESIA**  
TEL +62 21 2928 3681  
Rukan Aralia Blok HY43 no.11, Harapan Indah II,  
Bekasi - Jawa Barat, INDONESIA 17214  
sales@apexdyna.co.id  
www.apexdyna.co.id



**APEX DYNAMICS GERMANY GMBH**  
TEL +49-7181-9329955  
Spanninger Str. 9, 73650 Winterbach, GERMANY  
Langer@apexdynamics.de  
www.apexdynamics.de



**APEX DYNAMICS CZECH S.R.O.**  
TEL +420-577-663877  
tř. Tomáše Bati 1851 765 02 Otrokovice ČESKÁ  
REPUBLIKA  
info@apexdynaczech.cz  
www.apexdynaczech.cz



**APEX DYNAMICS РОССИЯ**  
TEL +7-495-2255452  
+7-495-6462422  
г.Москва, ул. Южнопортовая, дом 7, строение  
"С", 3-й этаж  
info@apexdynarussia.ru  
www.apexdynarussia.ru



**APEX DYNAMICS UK LIMITED**  
TEL +44-1827-253340  
2 Centurion Way, Centurion Park, Tamworth  
Staffs, B77 5PN, UK  
sales@apexdynamicsuk.com  
www.apexdynamicsuk.com



**APEX DYNAMICS SWITZERLAND AG**  
TEL +41-55-4517020 Talstrasse 24, CH-8852  
Altendorf, SWITZERLAND  
info@apexdyna.ch  
www.apexdyna.ch



**APEX DYNAMICS MOTION SDN BHD**  
TEL +60 7237 1055  
No.1, Jalan Perniagaan Setia 3, Taman  
Perniagaan Setia, 81100 Johor Bahru, Johor,  
MALAYSIA (Setia Business Park 2 @ Iskandar  
Malaysia)  
sales@apexdyna.com.sg  
www.apexdyna.com.sg



**APEX DYNAMICS BRAZIL**  
TEL +55-47-30298700  
Rua Senador Petrônio Portela, 47 - Bloco 5, Zona  
Industrial Norte - CEP 89218-575 - Joinville (SC)  
lucian@neoyama.com.br  
adriano.duarte@neoyama.com.br  
www.neoyama.com.br



**APEX DYNAMICS ITALY**  
TEL +39 02.36634521  
VIA E. DE AMICIS, 2 – 20091 BRESSO (MI)  
info@apexdynamics.it  
www.apexdynamics.it



## APEX DYNAMICS, INC.

No.10. Keyuan 3rd RD.Situn District, Taichung City 40763, Taiwan (R.O.C)  
Tel:886-4-24650219 | Fax:886-4-24650118  
sales@apexdyna.com | http://www.apexdyna.com

APEX-2017-11-PII/PIIR SERIES-2.0E-TWN

Printed in Taiwan

