



Automation for a Changing World

Delta Planetary Gearbox

PA Precision Series

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DELTA
Smarter. Greener. Together.

PA Precision Series Features

► High Rigidity, High Torque

Employs uncaged needle roller bearings with a set design including ring teeth, gearbox and helical gears for high rigidity and output torque

► High Precision

Backlash for 1-stage gearbox is under 8 arcmin.

Backlash for 2-stage gearbox is under 12 arcmin.

► High Efficiency

Efficiency for 1-stage model exceeds 95%

Efficiency for 2-stage model exceeds 92%

► Low Noise

Uses helical gears capable of meshing to ensure smooth and quiet operation

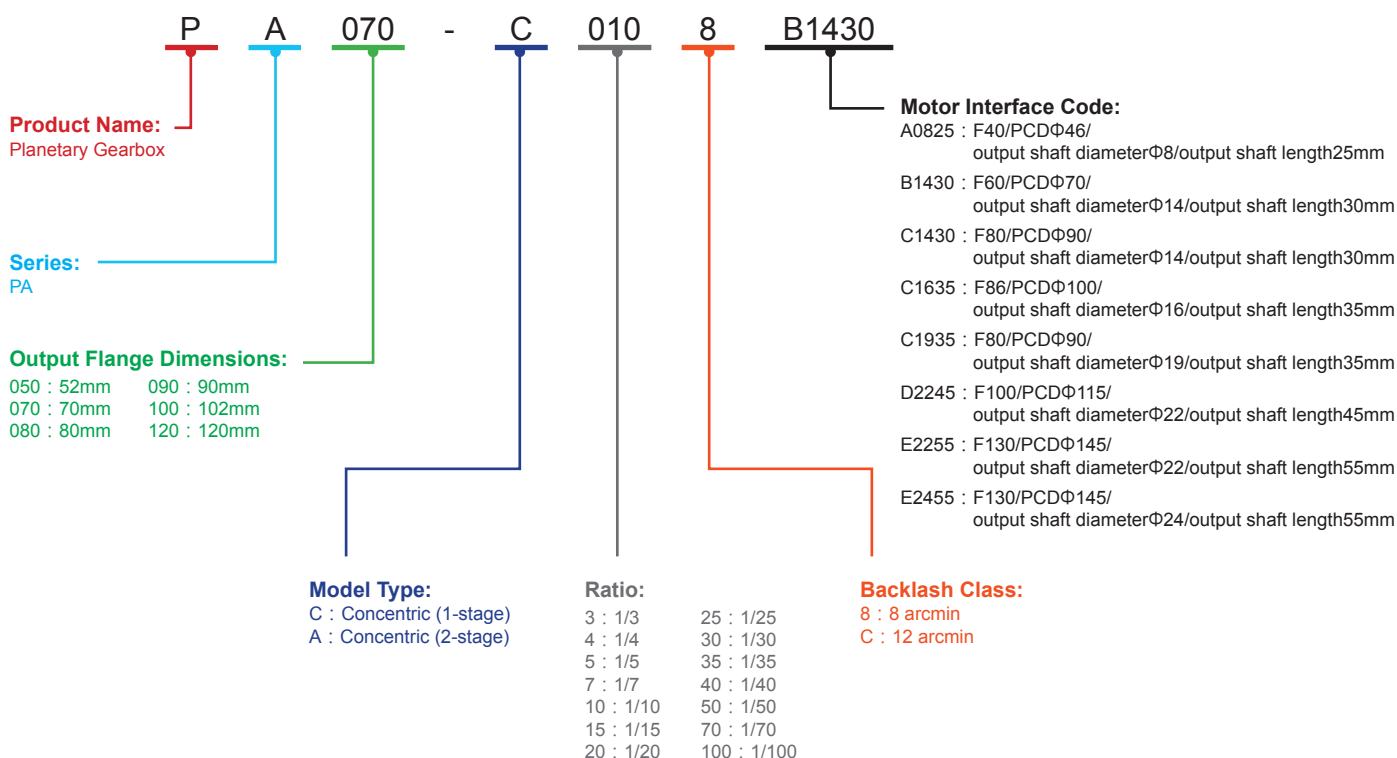
► Lifetime Lubrication

The protective class IP65 seal design avoids

leakage problems and requires no lubrication during the product's lifetime.



Model Explanation



PA Series Compatible Motor Table

Type	Motor Frame Code	Power Rating	Output Shaft Diameter (S) & Length (LR) (mm)	Stage	Ratio	Backlash Class	Compatible Gearbox Model No.
Concentric	F40	50W, 100W	Φ8 / 25	1-stage	3, 4, 5, 7, 10	8	PA050-CxxxxA0825
Concentric	F60	200W, 400W	Φ14 / 30	1-stage	3, 4, 5, 7, 10	8	PA050-CxxxxB1430 PA070-CxxxxB1430 PA080-CxxxxB1430
Concentric	F80	400W	Φ14 / 30	1-stage	3, 4, 5, 7, 10	8	PA080-CxxxxC1430 PA100-CxxxxC1430
Concentric	F80	750W	Φ19 / 35	1-stage	3, 4, 5, 7, 10	8	PA080-CxxxxC1935 PA090-CxxxxC1935
Concentric	F86	750W, 1kW	Φ16 / 35	1-stage	3, 4, 5, 7, 10	8	PA080-CxxxxC1635 PA090-CxxxxC1635 PA100-CxxxxC1635
Concentric	F100	1kW, 2kW	Φ22 / 45	1-stage	3, 4, 5, 7, 10	8	PA100-CxxxxD2245
Concentric	F130	300W, 500W, 600W, 800W, 900W 1kW, 1.3kW, 1.5kW, 1.8kW, 2kW	Φ22 / 55	1-stage	3, 4, 5, 7, 10	8	PA100-CxxxxE2255
Concentric	F130	3kW	Φ24 / 55	1-stage	3, 4, 5, 7, 10	8	PA100-CxxxxE2455 PA120-CxxxxE2455
Concentric	F40	50W, 100W	Φ14 / 30	2-stage	10, 15, 20, 25, 30, 35, 40, 50, 70, 100	12	PA050-AxxxxA0825
Concentric	F60	200W, 400W	Φ14 / 30	2-stage	10, 15, 20, 25, 30, 35, 40, 50, 70, 100	12	PA050-AxxxxB1430 PA070-AxxxxB1430 PA080-AxxxxB1430
Concentric	F80	400W	Φ14 / 30	2-stage	10, 15, 20, 25, 30, 35, 40, 50, 70, 100	12	PA080-AxxxxC1430 PA100-AxxxxC1430
Concentric	F80	750W	Φ19 / 35	2-stage	10, 15, 20, 25, 30, 35, 40, 50, 70, 100	12	PA080-AxxxxC1935 PA090-AxxxxC1935
Concentric	F86	750W, 1kW	Φ16 / 35	2-stage	10, 15, 20, 25, 30, 35, 40, 50, 70, 100	12	PA080-AxxxxC1635 PA090-AxxxxC1635 PA100-AxxxxC1635
Concentric	F100	1kW, 2kW	Φ22 / 45	2-stage	10, 15, 20, 25, 30, 35, 40, 50, 70, 100	12	PA100-AxxxxD2245
Concentric	F130	300W, 500W, 600W, 800W, 900W 1kW, 1.3kW, 1.5kW, 1.8kW, 2kW	Φ22 / 55	2-stage	10, 15, 20, 25, 30, 35, 40, 50, 70, 100	12	PA100-AxxxxE2255
Concentric	F130	3kW	Φ24 / 55	2-stage	10, 15, 20, 25, 30, 35, 40, 50, 70, 100	12	PA100-AxxxxE2455 PA120-AxxxxE2455

Specifications

PA Series

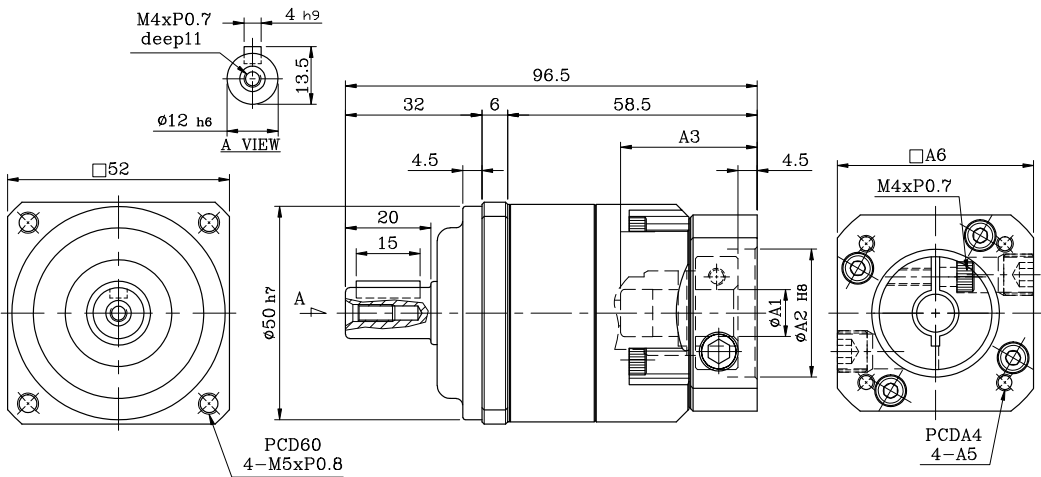
Items	Unit	Stage	Ratio	50	70	80	90	100	120
Rated Output Torque	Nm	1	3	19	54	112	112	165	286
			4	16	48	110	110	146	255
			5	16	45	108	108	160	264
			7	15	41	105	105	149	245
			10	14	40	100	100	141	234
		2	15	19	54	112	112	165	286
			20	16	48	110	110	146	255
			25	16	45	108	108	160	264
			30	19	41	112	112	165	286
			35	15	41	105	105	149	245
			40	16	39	110	110	146	255
			50	16	45	108	108	160	264
			70	15	41	105	105	149	245
			100	14	40	100	100	141	234
Max. Acceleration Torque	Nm	1,2	3 ~ 100	1.8 Times the Rated Output Torque					
Max. Output Torque	Nm	1,2	3 ~ 100	3 Times the Rated Output Torque					
Rated Input Speed	rpm	1,2	3 ~ 100	3,000					
Max. Input Speed	rpm	1,2	3 ~ 100	5,000					
Backlash	arcmin	1	3 ~ 10	≤ 8					
	arcmin	2	15 ~ 100	≤ 12					
Torsional Rigidity	Nm/arcmin	1,2	3 ~ 100	3	5	12	12	14	23
Max. Radial Force	N	1,2	3 ~ 100	350	800	1,200	1,200	3,200	5,220
Max. Axial Force	N	1,2	3 ~ 100	180	400	600	600	1,600	1,600
Service Life	hr	1,2	3 ~ 100	S5 Cycle Operation: > 20,000 (S1 Continuous Operation: > 10,000 hrs)					
Efficiency	%	1	3 ~ 10	≥ 97					
		2	15 ~ 100	≥ 95					
Operating Temperature		1,2	3 ~ 100	- 25°C ~ +90°C					
Lubrication		1,2	3 ~ 100	Synthetic Grease					
Protection Class		1,2	3 ~ 100	IP65					
Mounting Position		1,2	3 ~ 100	Any					
Noise Level	dB	1	3 ~ 10	≤ 58	≤ 58	≤ 60	≤ 60	≤ 65	≤ 67
		2	15 ~ 100	≤ 60	≤ 60	≤ 62	≤ 62	≤ 67	≤ 69
Weight ±2%	Kg	1	3 ~ 10	0.64	1.6	1.6	1.96	3.76	7.43
		2	15 ~ 100	0.96	2.1	2.8	3.06	5.92	10.3

Mass Moment of Inertia

Items	Unit	Stage	Ratio	50	70	80	90	100	120
Mass Moment of Inertia	kg.cm2	1	3	0.03	0.16	0.48	0.48	0.6	3.21
			4	0.03	0.14	0.38	0.38	0.45	2.64
			5	0.03	0.13	0.38	0.38	0.45	2.64
			7	0.03	0.13	0.38	0.38	0.45	2.62
			10	0.03	0.13	0.35	0.35	0.41	2.51
		2	15	0.03	0.13	0.41	0.41	0.45	2.64
			20~40	0.03	0.13	0.38	0.38	0.45	2.64
			50~100	0.03	0.13	0.38	0.38	0.45	2.51

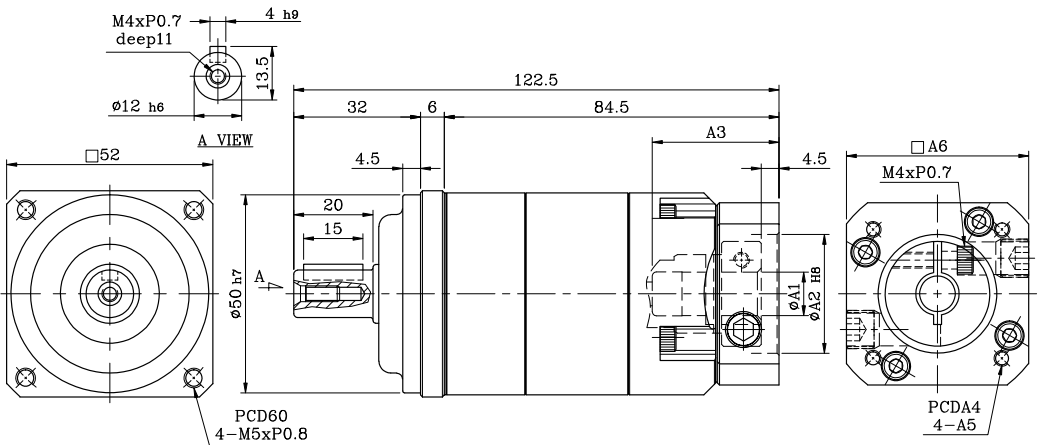
Dimensions

PA50 1-stage



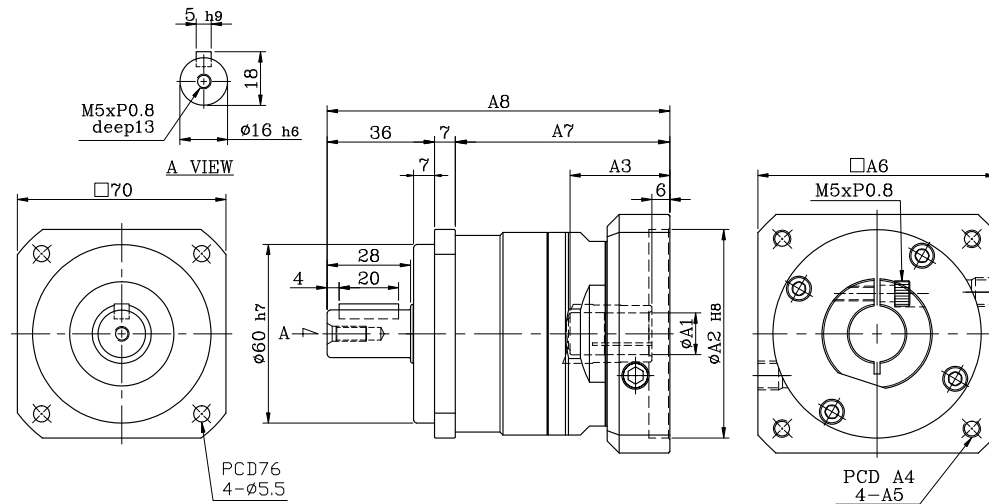
	Motor Interface Code	Φ A1	Φ A2	A3	A4	A5	A6
PA50	A0825	8	30	32	46	M4	46
	B1430	14	50	32	70	M5	60

PA50 2-stage



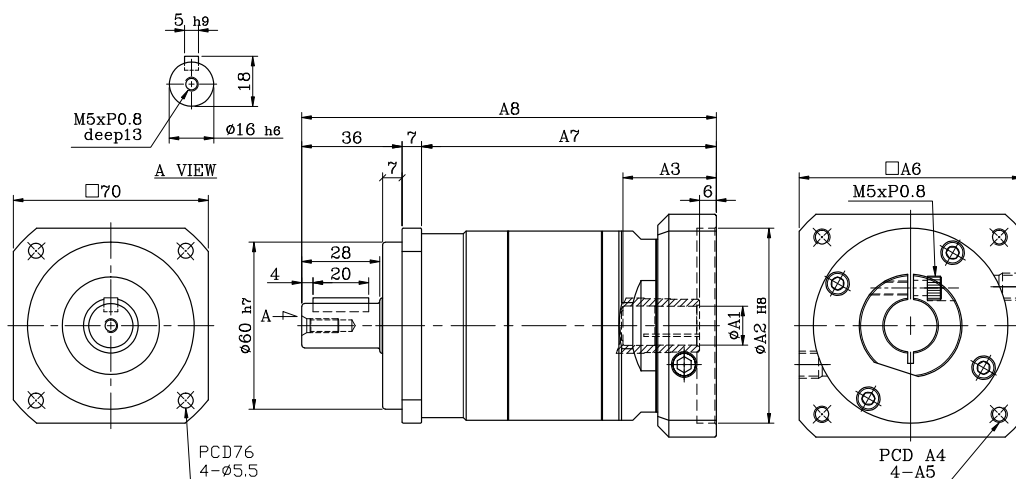
	Motor Interface Code	Φ A1	Φ A2	A3	A4	A5	A6
PA50	A0825	8	30	32	46	M4	46
	B1430	14	50	32	70	M5	60

PA70 1-stage



	Motor Interface Code	Φ A1	Φ A2	A3	A4	A5	A6	A7	A8
PA70	B1430	14	50	33.5	70	M5	64	72	115

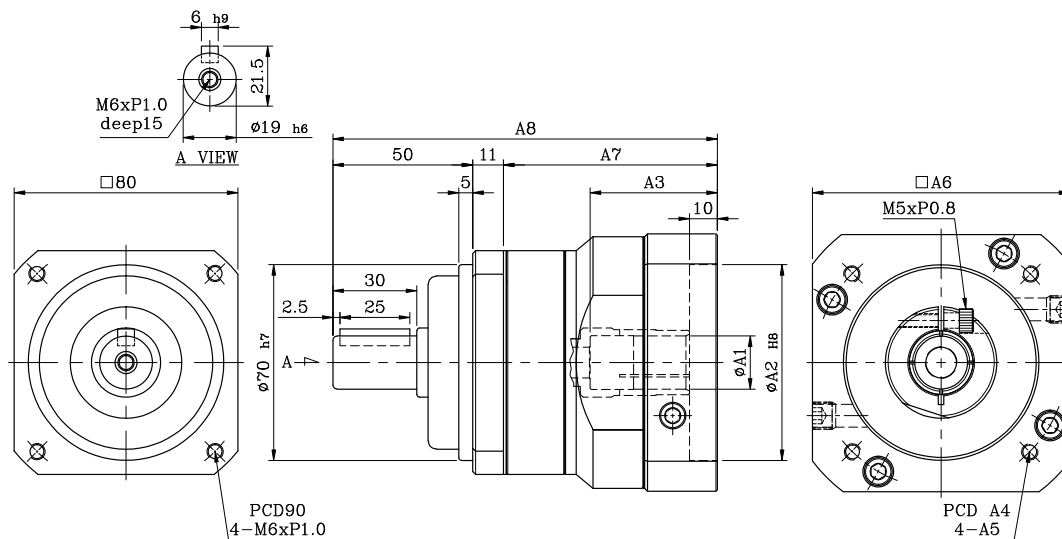
PA70 2-stage



	Motor Interface Code	Φ A1	Φ A2	A3	A4	A5	A6	A7	A8
PA70	B1430	14	50	33.5	70	M5	64	72	115

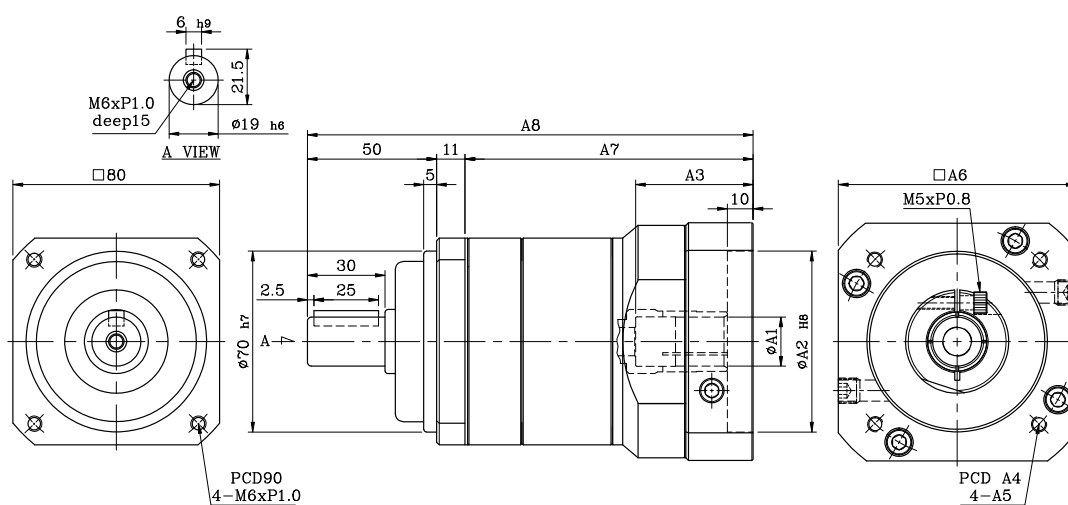
Dimensions

PA80 1-stage



	Motor Interface Code	Φ A1	Φ A2	A3	A4	A5	A6	A7	A8
PA80	B1430	14	50	33.5	70	M5	80	64.5	125.5
PA80	C1430	14	70	45.5	90	M6	92	76.5	137.5
PA80	C1935	19	70	45.5	90	M6	92	76.5	137.5
PA80	C1635	19	80	45.5	100	M6	92	76.5	137.5

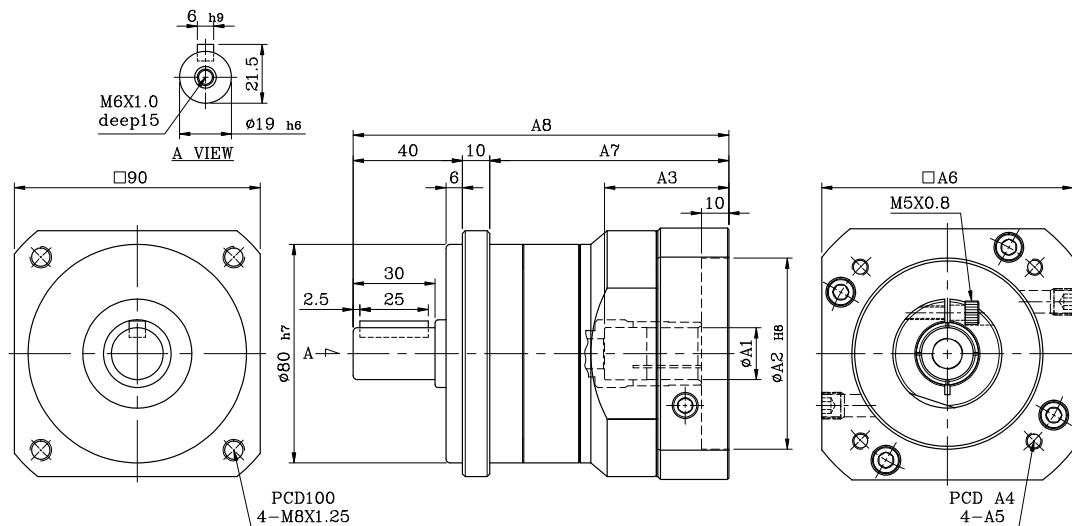
PA80 2-stage



	Motor Interface Code	Φ A1	Φ A2	A3	A4	A5	A6	A7	A8
PA80	B1430	14	50	33.5	70	M5	80	99.5	160.5
PA80	C1430	14	70	45.5	90	M6	92	111.5	172.5
PA80	C1935	19	70	45.5	90	M6	92	111.5	172.5
PA80	C1635	19	80	45.5	100	M6	92	111.5	172.5

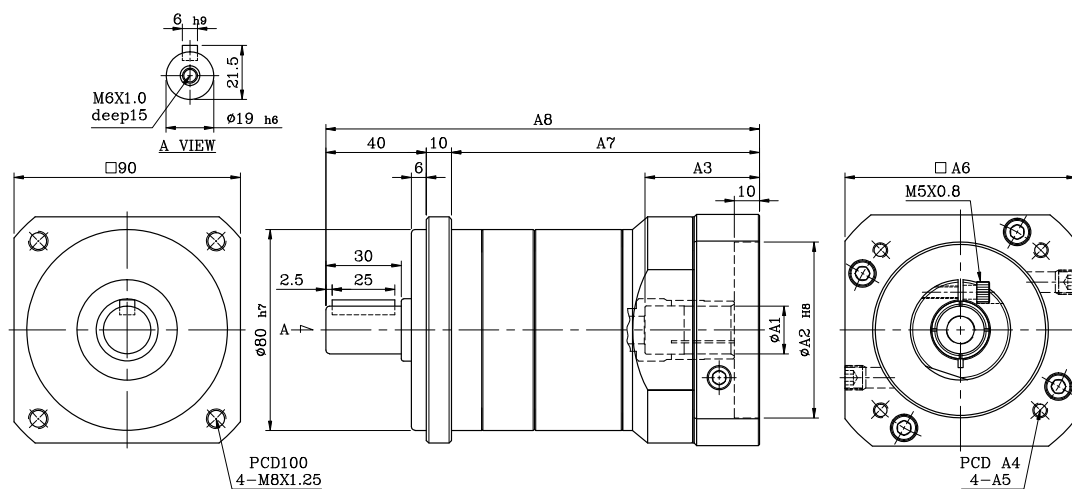
Dimensions

PA90 1-stage



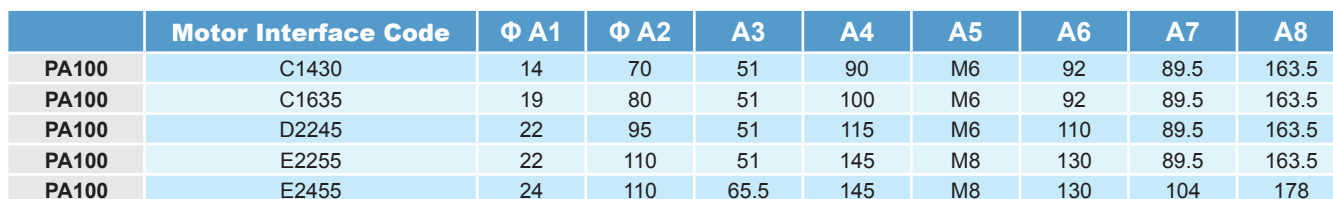
	Motor Interface Code	Φ A1	Φ A2	A3	A4	A5	A6	A7	A8
PA90	C1935	19	70	45.5	90	M6	92	87.5	137.5
PA90	C1635	19	80	45.5	100	M6	92	87.5	137.5

PA90 2-stage

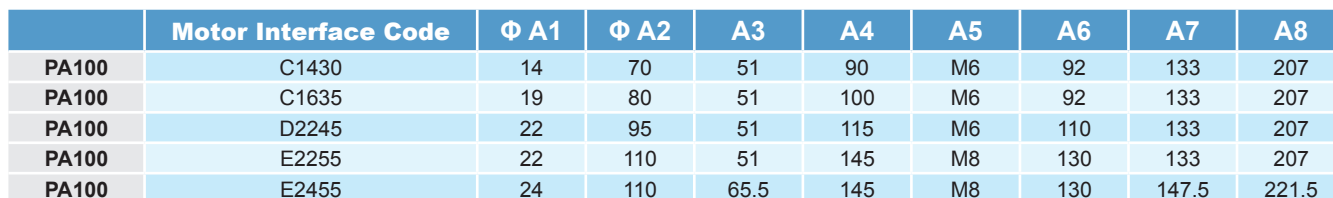


	Motor Interface Code	Φ A1	Φ A2	A3	A4	A5	A6	A7	A8
PA90	C1935	19	70	45.5	90	M6	92	122.5	172.5
PA90	C1635	19	80	45.5	100	M6	92	122.5	172.5

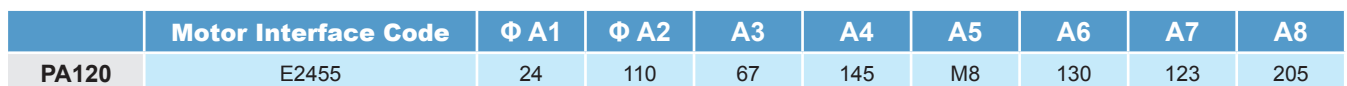
PA100 1-stage



PA100 2-stage



PA120 1-stage



	Motor Interface Code	Φ A1	Φ A2	A3	A4	A5	A6	A7	A8
PA120	E2455	24	110	67	145	M8	130	123	205

Calculation Method

- 01** Calculate Ratio i (Eq.1)
- 02** Calculate mean output torque T_{2m} (Eq.2)
Mean output torque $T_{2m} < \text{Nominal output torque } T_{2N}$
- 03** To determine Operation mode (S1 or S5)
S5: $ED < 60\%$
S5: $t_{work} < 20\text{min}$ (Eq.3)
- 04** If operation mode is (S5)
then calculate the Max. Acceleration Torque T_{2max} (Eq.4)
Max acceleration torque $T_{2max} < \text{acceleration torque } T_{2B}$
- 05** Calculate the Mean Output speed n_{2m} and
the Nominal Output speed n_{2N} of Gearbox (Eq.5)
 $n_{2m} < n_{2N}$
- 06** Calculate the mean radial force F_{2rm} (Eq.6)
mean radial force $F_{2rm} < \text{Max. radial force } F_{2rB}$
- 07** Calculate the mean Axial force F_{2am} (Eq.7)
mean axial force $F_{2am} < \text{Max. axial force } F_{2aB}$
- 08** Select the Required Backlash and Shaft Option
- 09** Order your LIMING Gearbox

Recommended (for S5 Cyclic Operation)

The general design is given for

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

The optimal design is given for

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

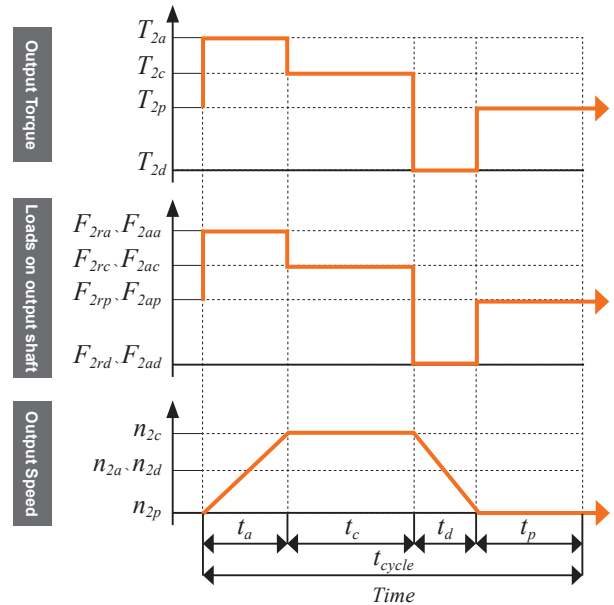
Where J_L is Load Inertia and J_m is Motor Inertia.

T_{2N} : please reference catalog "Rated Output Torque"

F_{2rB} : please reference catalog "Max. Radial Force"

Eq. 1 $i \cong \frac{n_m}{n_{work}}$

n_m is output speed of the motor,
 n_{work} is working speed



Eq. 2

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

Eq. 3

$$ED = \frac{t_a + t_c + t_d}{t_{cycle}} \cdot t_{work} = t_a + t_c + t_d$$

t_a is the time for acceleration, t_c is constant travel,
 t_d is the time for deceleration and t_p is the time for pause.

Eq. 4

$$T_{2max} = T_{mB} \cdot i \cdot k_s \cdot \eta$$

T_{mB} is the Max. output torque of the motor and
 η is the efficiency of the gearbox.

k_s service factor	
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

Eq. 5

$$n_{2a} = n_{2d} = \frac{n_{2c}}{2}$$

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

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

Eq. 6

$$F_{2rm} = \sqrt[3]{\frac{n_{2a} \cdot t_a \cdot F_{2ra}^3 + n_{2c} \cdot t_c \cdot F_{2rc}^3 + n_{2d} \cdot t_d \cdot F_{2rd}^3}{n_{2a} \cdot t_a + n_{2c} \cdot t_c + n_{2d} \cdot t_d}}$$

Eq. 7

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



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