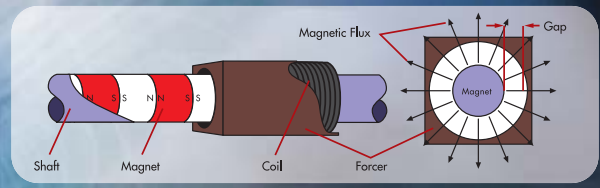
Shaft motor - a new next-generation actuator

Shaft motors are motors with a simple construction that drives using magnetic circuits consisting only of permanent magnets and coils, and which feature a diverse range of characteristics. These characteristics include precision positioning and high-, low-, and constant-speed driving, making the range of applications highly diverse. As a specialist motor manufacturer, Nippon Pulse Motor has integrated its unique control and communication technology through technical and production collaboration with shaft motor developer GMC HillstoneCo., Ltd.(http://www.ghc.co.jp), and has further combined linear encoders, encoder guides, and mechanical systems to meet customers' requirements and provide systems for use as the ideal actuators for their individual applications.

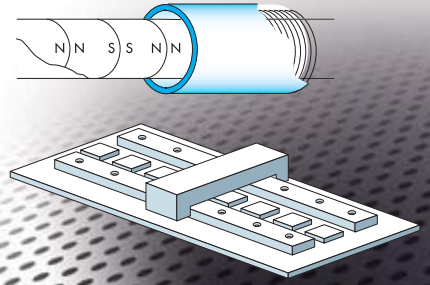


• What are shaft motors?

Shaft motors are direct drive linear servo motors that consist of a shaft with laminated magnets and cylindrically wound coils controlled by the flow of current.

Shaft-motor and linear-motor construction

In addition to the obvious difference between the cylindrical and flat configurations, the other difference are that the magnetic circuits of most motors - including linear motors - are made of magnetic iron, while shaft motors are not. For this reason, there are no adsorption force between the shaft and the forcer (coil), thereby totally eliminating cogging.



Outstanding features of shaftmotors

- Capable of high thrust
  2340 N - Single forcer (S500Q Model)
  9360 B - 4 forcers of S500Q Model
  (Tandem + Parallel Drive)
- Quiet due to the absence of friction (The only mechanical contact section is the linear guide. Fully non-contact operation is possible using an air slider.)
- Coreless construction reduces overall weight
- Simplified unit construction allows a stroke of up to 3.6 m
- High resolution ideal for precise positioning (The resolution is changed up to the linear encoder scale to be used)
- High-speed drive (6.5 m/s)
- Low-speed drive (8 µm/s)
- Virtually no speed fluctuations (±0.006% at 100 mm/s)
- Durable construction, capable of operating in a vacuum
- Compact and lightweight compared with other linear motors

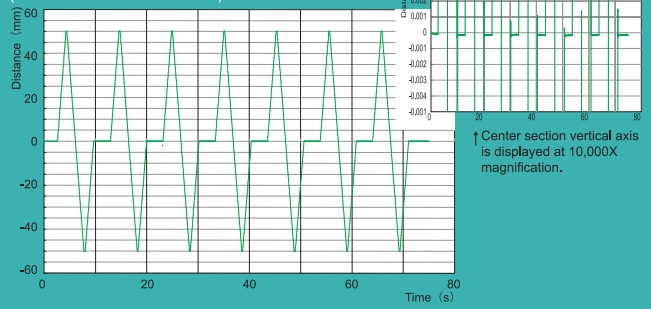
• We provide optimum actuator modules that maximize the features corresponding to customers' particular requirements.

Shaft-Motor Operating Performance

Shaft motors possess a number of outstanding operating performance characteristics due to their simple construction.

1. Precision

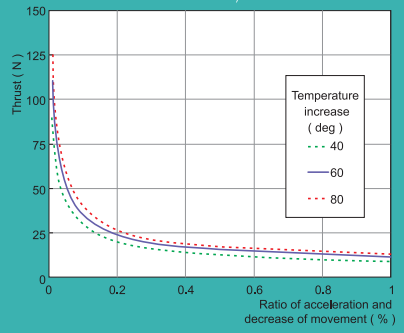
Static positioning performance
(encoder resolution : 8.6 nm)



† Center section vertical axis is displayed at 10,000X magnification.

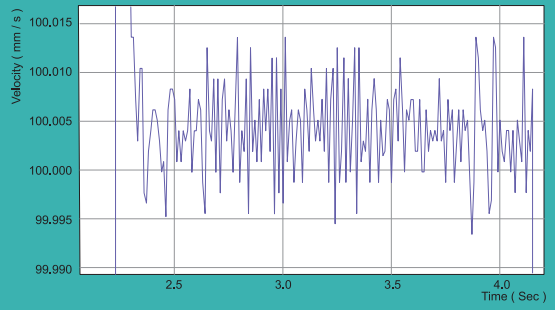
2. Duty curve

(Relation of Thrust, Temperature Rise and proportion for acceleration and decrease of movement)

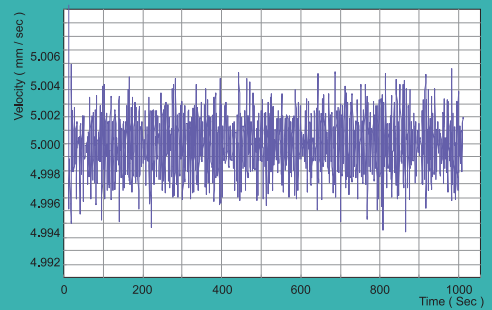


3. Speed fluctuations

(High Speed : 100mm / Sec)



(Low Speed : 5mm / Sec)



NPM Specification and Dimension

Model No.	Motor Characteristics				Forcer Dimension (Refer to the Shaft Motor Dimension below)							Shaft Dimension (Refer to the Shaft Motor Dimension below)						Forcer Code
	Thrust		Current		Forcer							Model No.	Gap	Diameter	Standard stroke range	Stroke vs Support length		Maximum stroke	
	Rated	Acceleration	Rated	Acceleration	Length	Forcer width	Weight	Mounting pitch		Mounting screw	Bore diameter					Stroke	Support length		
	(N)	(N)	(A)	(A)	**A** (mm)	**B** (mm)	(kg)	**P** (mm)	**P1** (mm)	**M×ℓ** (mm)	**ϕD1**		**G** (mm)	**ϕD**	(mm)	(mm)	**L2** (mm)	(mm)	
S040D	0.29	1.2	0.3	1.1	25	10±0.3	0.01	21.5	4±0.3	4-M2 x 1.3	5	S040	0.5	4±0.1	20, 30, 40	~40	5	40	D
S040T	0.45	1.8			34		0.01	30.5											T
S040Q	0.58	2.3			43		0.01	39.5											Q
S040X	0.94	3.8	0.6	2.2	79		0.04	48.5											X
S080D	1.8	7.2	0.80	3.4	40	20±0.3	0.05	34	10±0.3	4-M3 x 5	9	S080	0.5	8±0.1	25, 50~200 (50 Separation)	~230	10	230	D
S080T	2.7	10.7			55		0.06	49										215	T
S080Q	3.5	14.0			70		0.08	64										200	Q
S120D	4.5	18	0.40	1.6	64	25±0.3	0.09	56	12±0.3	4-M3 x 5	13	S120	0.5	12±0.2	50~1050 (50 Separation)	~350	25	1541	D
S120T	6.6	27			88		0.12	80								351~800	40	1517	T
S120Q	8.9	36			112		0.16	104								801~	60	1493	Q
S160D	10	40	0.60	2.5	80	30±0.3	0.15	70	16±0.3	4-M3 x 5	17	S160	0.5	16±0.2	100~1050 (50 Separation)	~350	25	1755	D
S160T	15	60			110		0.2	100								351~800	40	1745	T
S160Q	20	81			140		0.3	130								801~	60	1715	Q
S200D	18	72	0.60	2.4	94	40±0.3	0.3	84	20±0.3	4-M4 x 6	21.5	S200	0.75	20±0.2	100~1550 (50 Separation)	~300	25	2471	D
S200T	28	112			130		0.5	120								301~700	40	2435	T
S200Q	38	152			166		0.7	156								701~	60	2399	Q
S250D	40	160	1.3	5.1	120	50±0.3	0.8	105	25±0.3	4-M6 x 9	26.5	S250	0.75	25±0.2	100~1050 (50 Separation)	~700	50	2615	D
S250T	60	240			165		1.1	150								701~1500	70	2570	T
S250Q	75	300			210		1.5	195										2525	Q
S250X	140	560	2.4	9.6	390		2.9	375								1501~	100	1710	X
S320D	56	226	1.2	5.0	160	60±0.3	1.2	140	30±0.3	4-M8 x 12	34	S320	1	32±0.2	100~2000 (50 Separation)	~750	50	2310	D
S320T	85	338			220		1.7	200								751~1500	70	2250	T
S320Q	113	451			280		2.2	260										2190	Q
S320X	226	902	2.5	9.96	520		4.2	320								1501~	100	1950	X
S350D	104	416	1.5	6.0	160	60±0.3	1.3	140	30±0.3	4-M8 x 12	37	S350	1	35±0.2	100~2000 (50 Separation)	~750	50	2120	D
S350T	148	592			220		1.9	200								751~1500	70	2060	T
S350Q	190	760	2.7	10.8	280		2.4	260								1501~	100	2000	Q
S427D	100	400	3.0	12	220	80±0.3	3.0	200	50±0.3	4-M8 x 12	46	S427	1.65	42.7±0.2	100~3000 (50 Separation)	~550	60	3180	D
S427T	150	600			310		4.2	290								551~1000	80	3090	T
S427Q	200	800			400		5.4	380								1001~	100	3000	Q
S435D	116	464	3.0	12	220	80±0.3	3.0	200	50±0.3	4-M8 x 12	46	S435	1.25	43.5±0.2	100~2000 (50 Separation)	~550	60	2180	D
S435T	175	700			310		4.2	290								551~1000	80	2090	T
S435Q	233	932			400		5.4	380								1001~	100	2000	Q
S500D	289	1156	3.8	15.2	240	100 x 105 ±0.3	10	80+80	80±0.3	6-M8 x 13	53.5	S500	1.75	50±0.2	100~2000 (50 Separation)	~750	80	3380	D
S500T	440	1760	5.8	23.2	330		13	125+125								751~1000	100	3290	T
S500Q	585	2340	7.7	30.8	420		15	170+170										3200	Q
L250D	34	138	1.3	5.2	120	50±0.3	0.8	105	25±0.3	4-M6 x 9	29.0	L250	2.00	25±0.2	100~1550 (50 Separation)	~700	50	3680	D
L250T	52	207			165		1.1	150								701~1500	70	3590	T
L250Q	69	276			210		1.5	195								1501~	100	3500	Q
L320D	55	218	1.3	5.0	160	60±0.3	1.3	140	30±0.3	4-M8 x 12	37	L320	2.50	32±0.2	100~2000 (50 Separation)	~750	50	3640	D
L320T	82	327			220		1.9	200								751~1500	70	3580	T
L320Q	109	436			280		2.6	260								1501~	100	3520	Q

Note 1) These are specification for 23°C. The value rated in the table means value at temperature of 110K at the surface of the coils inside.

Note 2) Please contact us for details on support length of S500D, S500T and S500Q

Note 3) Total shaft lengths are requested with the calculating formula below by the data in Tables 1 & 2 in the above.

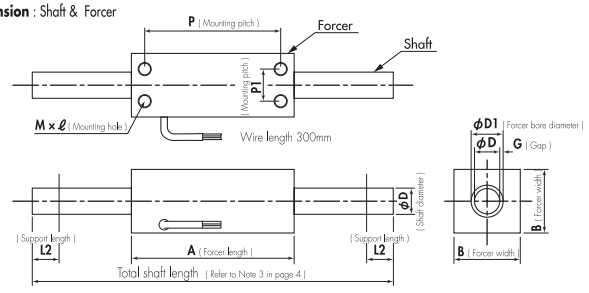
Total Shaft Length (mm) = Stroke + Forcer Length + Shaft Support Length x 2

○ Forcers with a digital hall sensor installed for magnetic position detection are available as optional.

○ Shaft Motor installation manual is available.

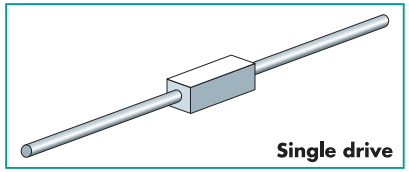
○ Motor selection software "SMART" is available.

Shaft Motor Dimension : Shaft & Forcer

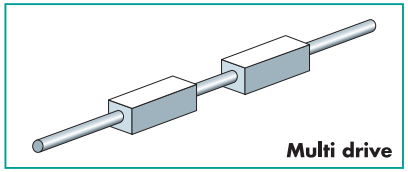


Shaft Motor Drive System

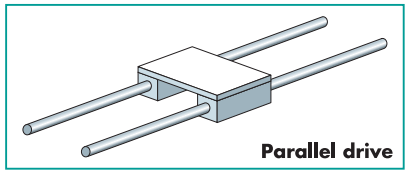
The single-shaft drive uses a control system matched to the combination of a shaft and a forcer so as to enable control system to suit the specific requirements, even for complex movement.



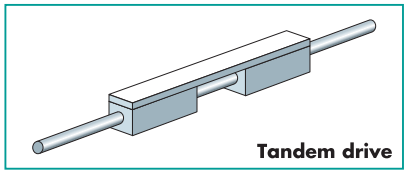
This is the basic drive system: One servo driver drives one shaft motor. X and Y shafts can be used to create and XY stage.



Multiple forcers can be driven independently on single shaft, thereby creating complex movements. Each forcer can be moved independently by an independent servo driver.



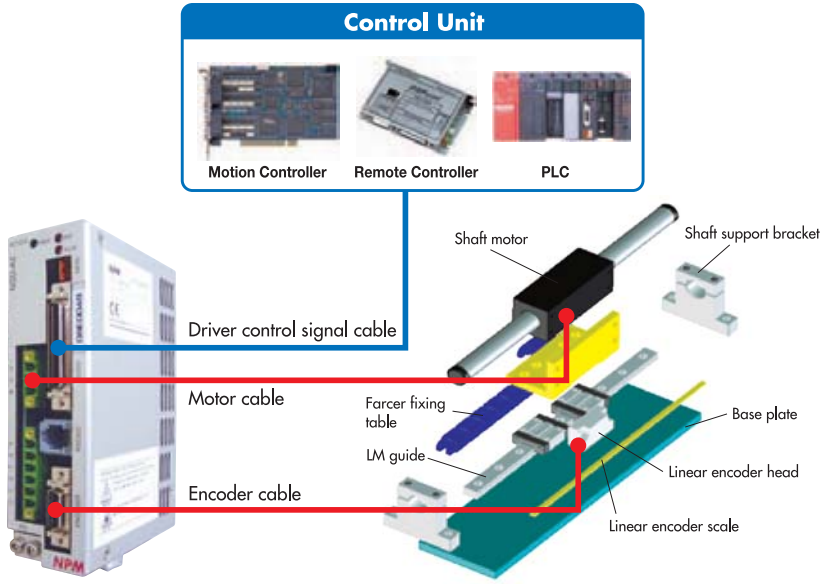
Multiple forcers can be used in parallel as shown. Effective for driving large and heavy load. Multiple forcers can be driven by single servo driver.



Multiple forcers can be used on the same shaft in tandem as shown to multiply the thrust. Multiple forcers can be driven by single servo driver.

Shaft Motor System Diagram

The following diagram shows the typical peripheral devices and components to configure a system using the Linear Shaft Motor. The LM guide is a necessary part of a system up to the application, demand specification. If the shaft is fixed, the forcer will be moving while the shaft will be moving if the forcer is fixed in the system.



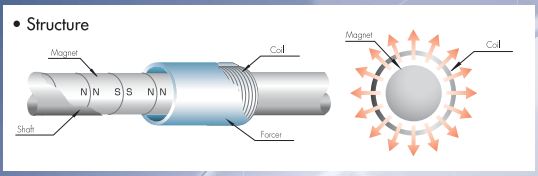
NPM NP ROBO

SLP High Performance Linear-Single Axis Stage with Shaft Motor Technologies

• The Benefits of Shaft Motors

This high-precision drive unit boasts high thrust (high degree of acceleration) as well as being coreless. The coil unit catches the magnetic field generated by the NS magnet arrayed inside of the shaft (magnetic) without any waste.

• Structure



Because it can change the outer magnetic field into force in a full 360 degrees, even with a short coil length, large force is gained.

The high-quality SLP Single Axis Stage lineup meets all manner of needs.