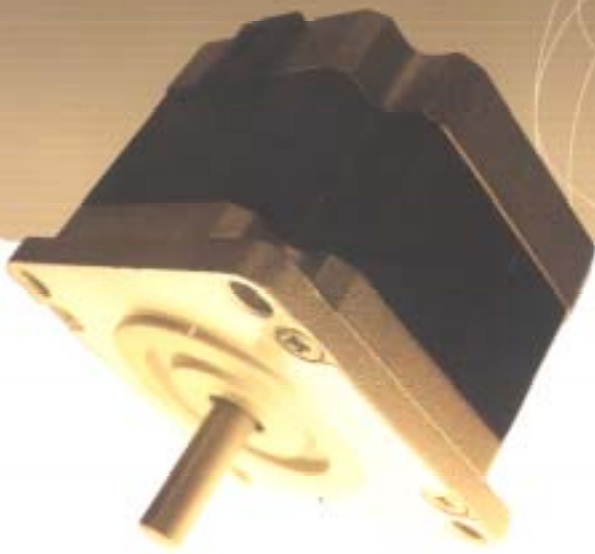




SAEHAN ELECTRONICS CO., LTD.

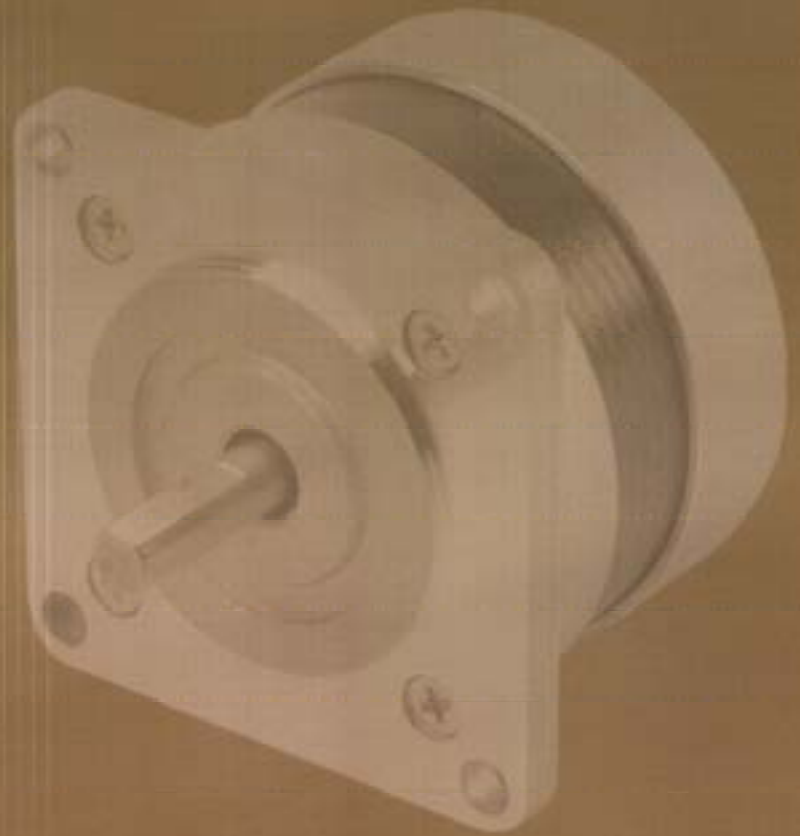
Hybrid Type
STEPPING MOTOR



www.saehanworld.com



SAEHAN ELECTRONICS CO., LTD.

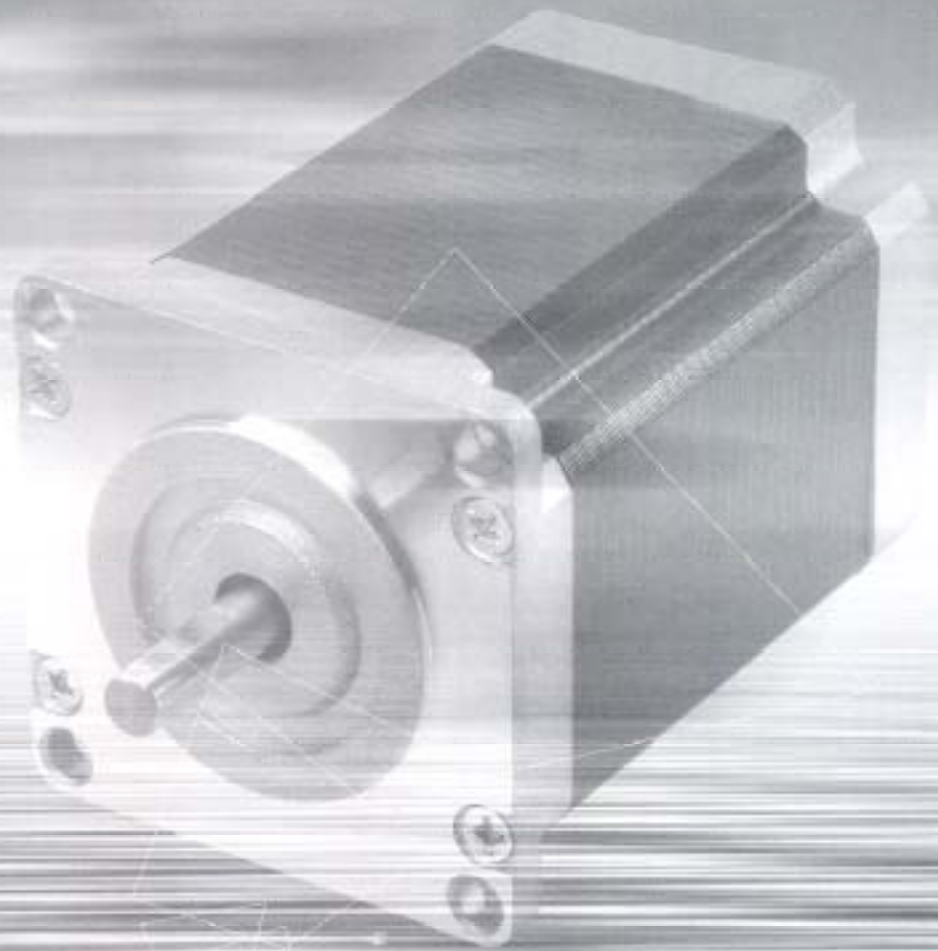


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Hybrid Stepping Motor

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SAEHAN ELECTRONICS CO., LTD.

BRIEF HISTORY

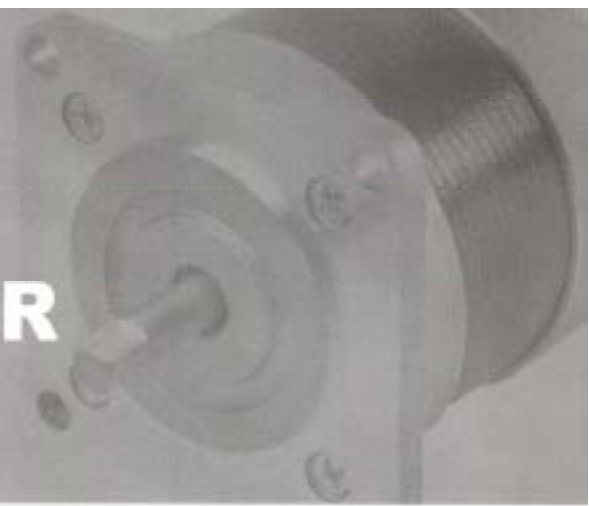
- 2002 NEW FACTORY ESTABLISHED IN CHINA DONGGUAN.
- 2002 CERTIFIED ISO 9000 (2000 YEAR)
- 1998 CERTIFIED ISO 9002

- 1997 AWARDED AND CERTIFIED FOR "100PPM" OF QUALITY CONTROL
MANUFACTURE WITH THE PRECISION PARTS.

- 1996 QT SAEHAN IN SINGAPORE WAS ESTABLISHED
- 1987 DEVELOPED THE HYBRID STEPPING MOTOR AND EXPORT TO JAPAN
- 1986 PRODUCE A HIGH PRECISION MACHINING PARTS.
- 1985 POINTED AS A GOOD S&M ENTERPRISE BY THE GOVERNMENT
- 1971 SAEHAN ELECTRONICS CO., LTD. WAS FOUNDED

ISO9000

EXPLANATION OF STEPPING MOTOR



1. What is a Stepping Motor?

A Stepping Motor is a special electric motor which is operated with DC (Direct Current) and its stator windings, generate rotating power by drawing a rotor with electromagnetic force produced angle (step angle) by changing over stator windings which feed current. This is also called a Pulse Motor or a Stepper Motor.

2. Types of Stepping Motor

1) Variable Reluctance Type

This is such type that draws and rotates a teeth shaped rotor made of electromagnetic mild steel, through the electromagnetic force produced by stator winding. It is called simply VR type.

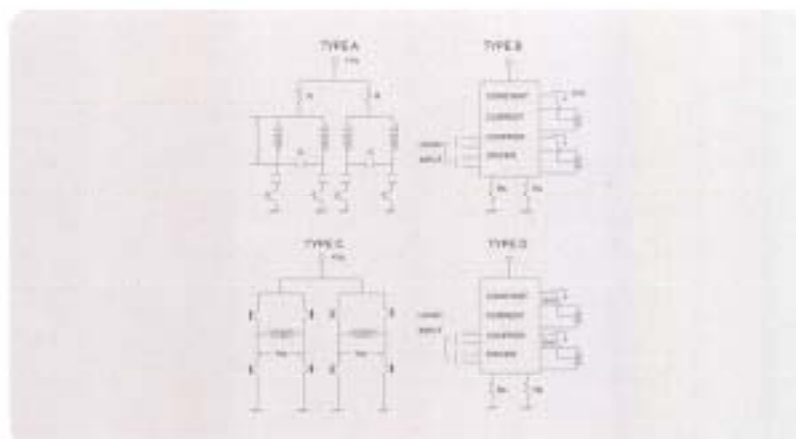
2) Permanent Magnet Type

This is of such type that draws and rotates a rotor using permanent magnet, through the electromagnetic force produced by stator windings, therefore, it generates holding torque even at time of no excitation, it is called simply PM type.

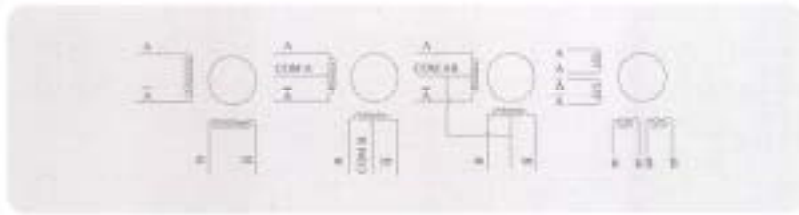
3) Hybrid Type

This is the type in which the above two types of VR and PM are combined. Another type of stepping motor that has a permanent motor or the synchronous inductor operated under the combined principles of permanent magnet and variable reluctance. The hybrid stepping motor, together with the VR stepping motor are the most commonly used step motors in the industry. The most popular step angle for the hybrid stepping motor is 1.8 degrees, or 200 steps per revolution.

3. Driver Circuit Method



4. Lead wire



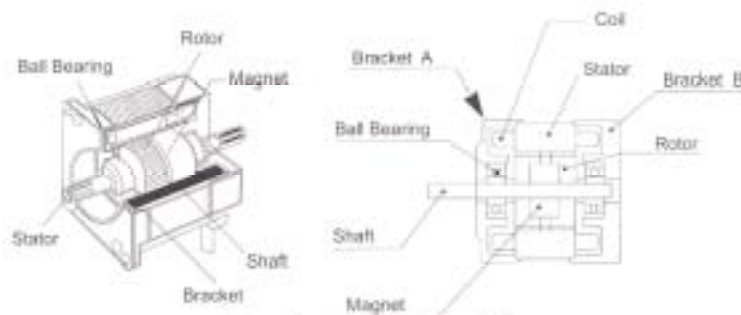
5. The Characteristics of Stepping Motor

Stepping motors are driven by a device to excite stator windings in the specified sequence. Connect the motor with this kind of driving unit and provide input pulse signals. The rotor will rotate through a fixed angle and stay at rest until the next input pulse is provided. If input signals are given in sequence, the rotor will rotate with a stepped motion. Because the input signal is usually given in pulses, the aggregate rotation angle of the output shaft is proportional with the total number of input pulses and the rotation speed is proportional with the frequency of input pulse.

- 1) Rotation angle is proportional with the number of input pulses.
- 2) Rotation speed is proportional with the frequency of input pulses.
- 3) Without receiving an input signal the rotor keeps the same position at rest.
- 4) The motor is capable of immediate stop.

6. Stepping Motor Mechanical Construction

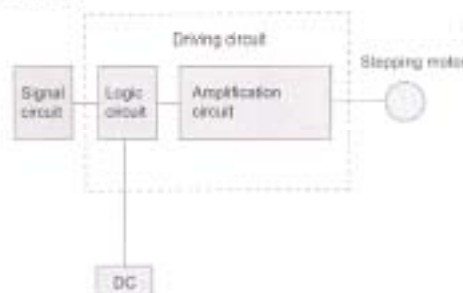
The construction of Hybrid type is characterized by having a coil, multi-toothed stator and pole with permanent magnet. This construction offers small step angle, sufficient torque and speed.



Stator Construction Fig. 6-1

7. Driving System of Stepping Motor

7-1) Construction of Driving Circuit



The DC power supply is switched to each phase in sequence to operate stepping motor. Ordinary DC or AC power supply will not run stepping motor unless the driving circuit includes a switching circuit. The signal circuit is used to generate pulses, change or stop frequencies, and to generate reversing signals. The logic circuit distributes signal pulses to each wire according to the number of phase and the excitation method. The amplification circuit amplifies the signal pulses from the logic to sufficient strength to excite the stepping motor. The characteristics of a stepping motor vary widely depending on its driving circuit. Due consideration should be given to this fact when selecting a stepping motor. The capacity of the DC power supply varies according to the driving system and excitation method.

7-2) Excitation methods

The stepping motor has a system to drive a rotor by exciting the fixed number of wirings. Stepping motors are classified according to the number of phases to be excited as follows


7-2-1) Single-phases excitation

Always only one phase is excited in the system. This method requires less input power and only raises the temperature a little. Thus it does not require a large power supply. Where the oscillation at each stepping damp less quickly, racing may occur.

7-2-1) Single-phases excitation

0: Excitati phase

	Single-phase excitati on	Two-phase excitati on	Half-Step excitati on
Input pulse	1 2 3 4	1 2 3 4	1 2 3 4 5 6 7 8
1	0	0 0	0 0 0 0
2	0	0 0	0 0 0 0
3	0	0 0	0 0 0 0
4	0	0 0	0 0 0 0



Two phase are always-excited. Because one phase remains excited even when an excitation current is switched from one phase to another, oscillation is suppressed. Because the driving torque is always provides, racing is reduced and automatic frequency is raised. Required input current is twice as large as single-phase excitation system.

7-2-2) Two-phase (full-step) excitation

Two phase are always-excited. Because one phase remains excited even when an excitation current is switched from one phase to another, oscillation is suppressed. Because the driving torque is always provides, racing is reduced and automatic frequency is raised. Required input current is twice as large as single-phase excitation system.

7-2-3) Half-step excitation

This system combines single-phase and two phase excitation. This reduces the step angle to half of that of the single phase and two phase excitation and the response frequency becomes double.

7-3) Drive Methods

The use of the correct control system is the key to achieving the desired performance characteristics in a stepping motor.

7-3-1) Uni-polar and bi-polar operations

A stepping motors are available with either 2 phase bipolar or 4 phase unipolar winding. A unipolar, sometimes called a bifilar winding, has 2 coils wound on the stator and the stator flux is reversed by energizing one coil or the other coil alternatively. The unipolar drive is used for reasons of simplicity and low cost a bipolar, sometimes called a monofilar winding, has one coil wound on the stator and stator flux is reversed by reversing the current in the winding. It produce more torque at low to medium s/second compared to unipolar drive.

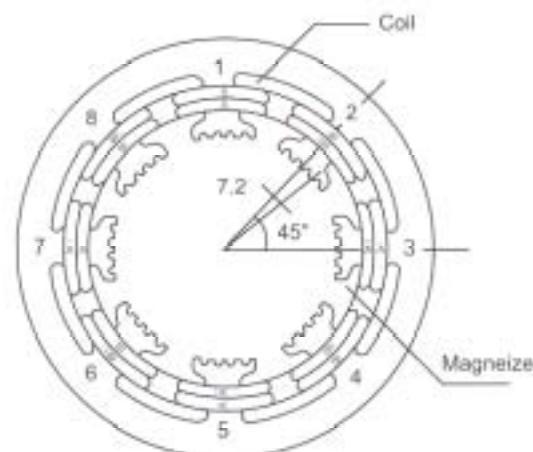
7-3-2) Series resistance drive

To obtain improved performance from a motor, it can be done by adding a series resistor in series with the phase winding and raising the power supply voltage. Series resistance used in this manner changes the winding to resistance ratio(L/R) and reduces the winding rise time and produces a higher torque. It is an inexpensive and simple method requiring no additional electronics.

7-3-3) Chopper drive

The chopper drive utilizes a current sensor in the control circuit and energize a higher supply voltage than the phase winding rated voltage. The current sensor turns off whenever the current exceeds a predetermined high level and turn on whenever the current falls below a predetermined low level.

8. Stepping Motor Principle



Stator & Coil Winding
Fig. 8-1

When the coils of phase A are energized as shown in Fig. 8-1 the teeth alignment of the motor is as shown. When the excitation is shifted from phase A to phase B, as shown in Fig. 8-1 the pole teeth of the motor will move to the right by 1/4 of a tooth pitch. Starting from the position shown in Fig. 8-1 if the windings on phase A are again energized but with a polarity opposite to that of Fig. 8-1 and phase B is de-energized, the moving part will shift to the right by one more step increment. thus the control sequence of the motor for bidirectional control is easily established. In fact, if a cosine current is applied to phase A and a sine current to B, then the two currents being 90 degrees out of phase will cause the motor to move by any increment corresponding to an incremental change of the exciting currents. Thus the step resolution can be made as small as desired.

6) Pull-in and Pull-out Rate

The maximum steps/second at which a loaded motor can start or follow without losing steps.

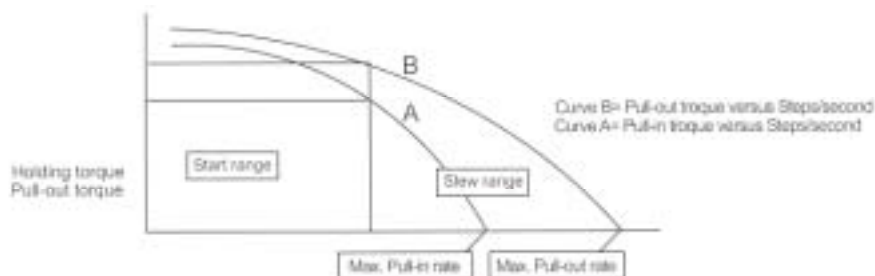


Fig. 10-1

7) Slewing Characteristics

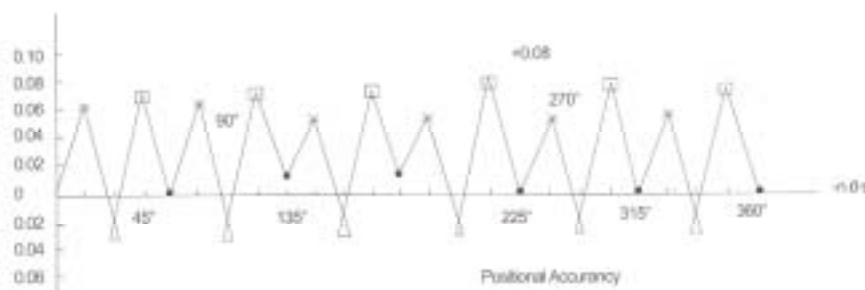
After starting a motor in the self starting characteristic range, the pulse frequency is gradually increased. The relation between the frictional load torque and the maximum pulse frequency with which the motor can synchronize is called the slewing characteristic.

8) Maximum Slew Pulse Rate

The maximum frequency with which the motor can synchronize with the pulse train an unloaded stepping motor starts with a frequency below the maximum starting pulse rate and enters the slewing characteristics range.

9) Positional Accuracy of Stepping Motor

In used the term of "positional accuracy" to define the accuracy is defined as the largest angular error value between the theoretical rest position and the actual rest position of the motor shaft. The accuracy is measured in a full revolution of 360 degrees of the motor shaft Fig. 10-2 shows that the angular errors of actual rest positions from the theoretical positions always remain within the value of positional accuracy. The rotor can start from and position of stop at any position. Thus, the angular error at each step does not accumulate after numerous revolutions of the motor shaft.

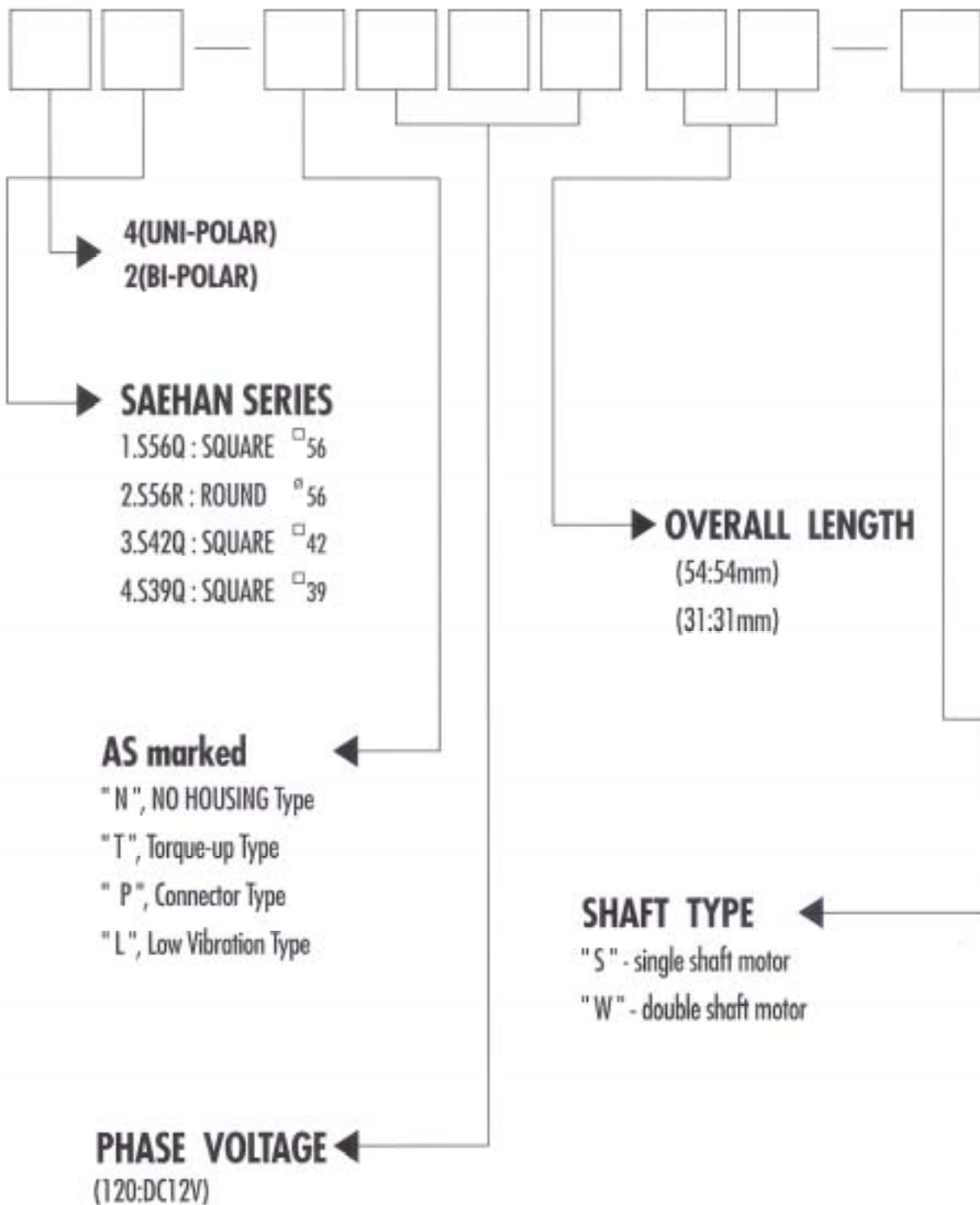


Graph of Angular error for positioning

Fig. 10-2

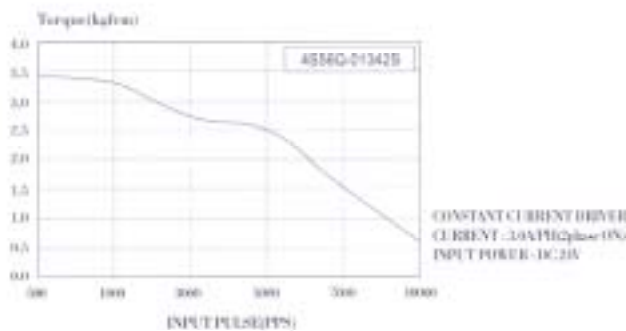
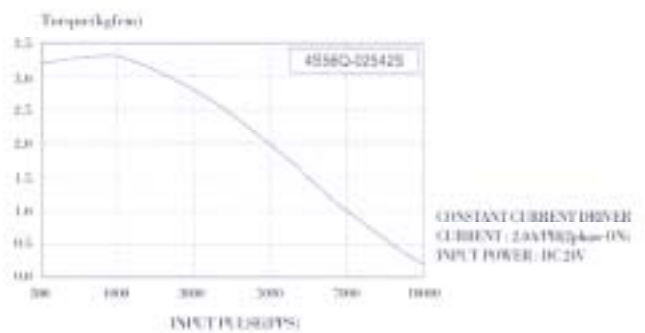
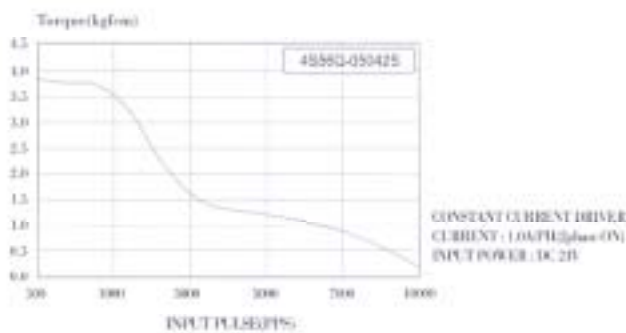
Part Number Ordering System

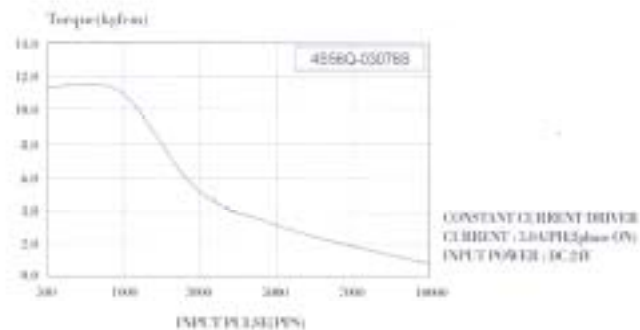
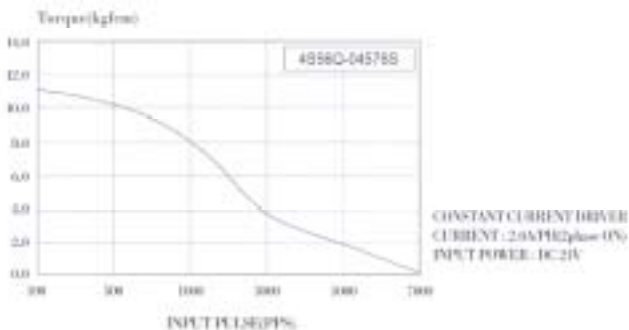
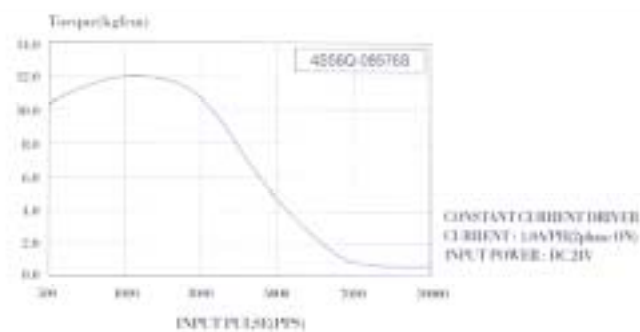
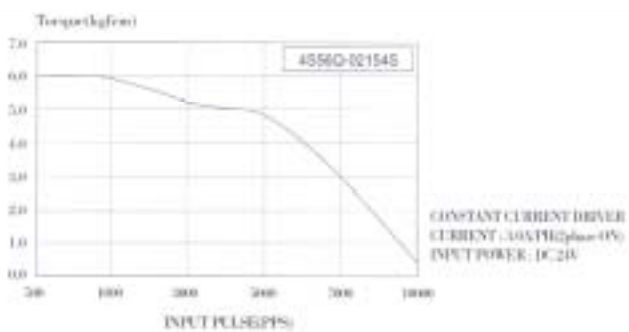
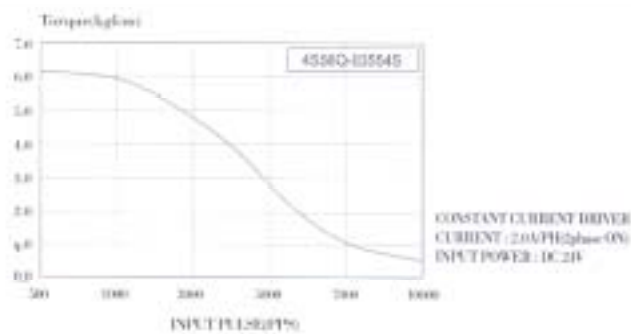
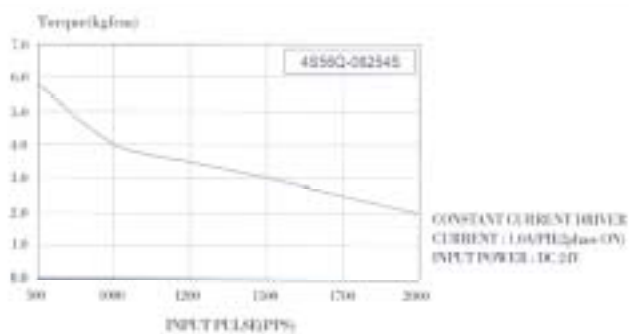
EXAMPLE



GENERAL SPECIFICATIONS

Step Angle	1.8°
Positional Accuracy	±5% max
Number of Phase	2 or 4
Temperature Rise	80 deg max
Insulation Resistance	100M Ω / minute at DC 500V
Dielectric Strength	AC 800V / minute
Insulation Class	B class
Number of Lead Wire	4, 5, 6, or 8
Lead Wire	UL 3252 or 1007 AWG #22, L=300mm
Operation Ambient Temperature	-10°C ~ +50°C
Radial Play	0.03mm(0.5kg load)max
Axial Play	0.08mm(0.7kg load)max

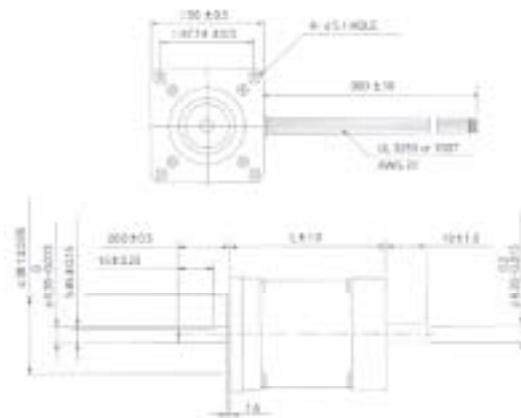




56R Series



Dimension Specification



Wiring Diagram



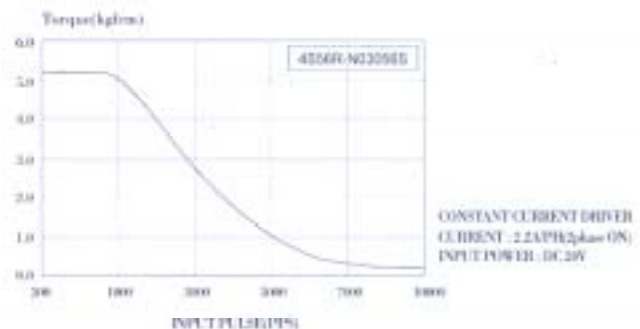
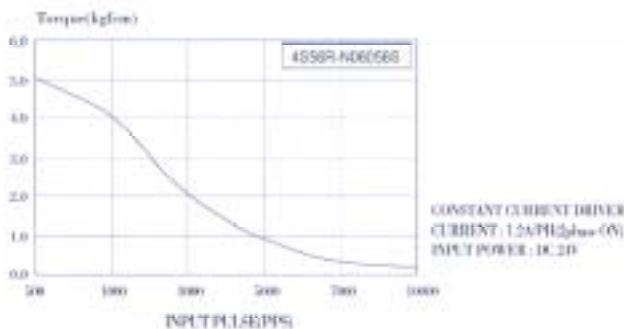
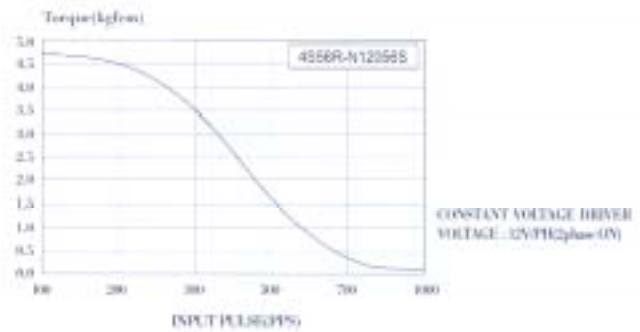
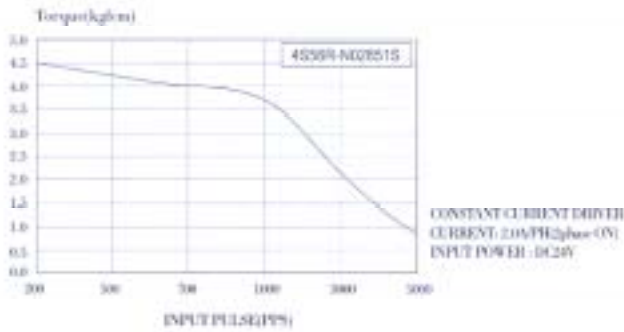
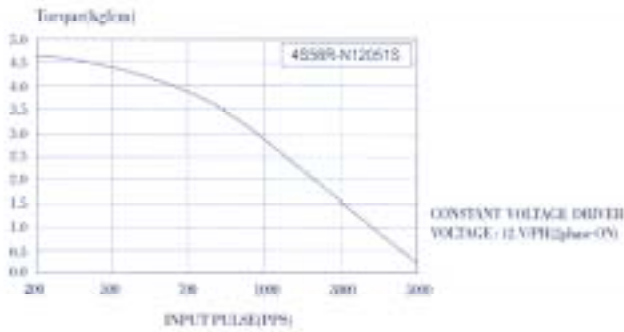
Specifications

MODEL NO.	VOLTAGE (V)	CURRENT (A/phase)	RESISTANCE (Ω /phase)	INDUCTANCE (mH/phase)	HOLDING TORQUE (gf · cm)	DETENT TORQUE (gf · cm)	ROTOR INERTIA (g · cm ²)	WEIGHT (g)	LENGTH (mm)
4S56R-N12051S	12.0	0.6	20.0	30.0	5.0	400	120	500	51
4S56R-N02851S	2.8	2.0	1.4	2.0					
4S56R-N12066S	12.0	0.6	20.0	38.0	6.0	450	155	620	56
4S56R-N06066S	6.0	1.2	5.0	9.8					
4S56R-N03066S	3.0	2.2	1.4	2.9					

It is possible to produce a stepping motor by order

GENERAL SPECIFICATIONS

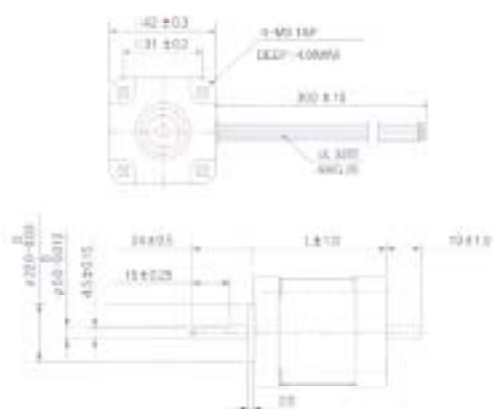
Step Angle	1.8°
Positional Accuracy	± 5% max
Number of Phase	2 or 4
Temperature Rise	80 deg max
Insulation Resistance	100M Ω / minute at DC 500V
Dielectric Strength	AC 800V / minute
Insulation Class	B class
Number of Lead Wire	4, 5, 6, or 8
Lead Wire	UL 3262 or 1007 AWG #22, L=300mm
Operation Ambient Temperature	-10°C ~ +50°C
Radial Play	0.03mm(0.5kg load)max
Axial Play	0.08mm(0.7kg load)max



42Q-T Series



Dimension Specification



Wiring Diagram



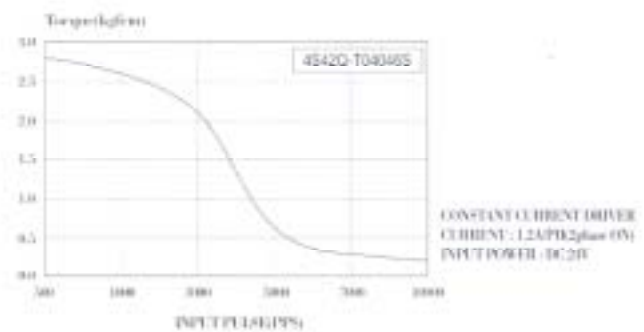
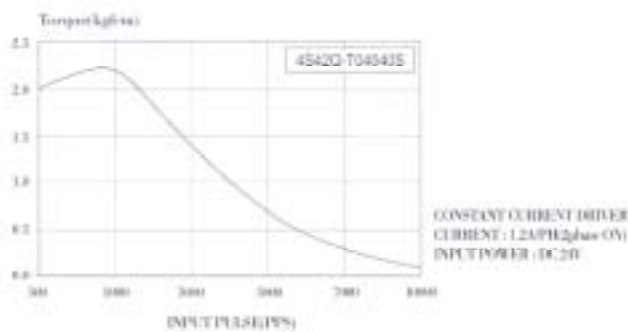
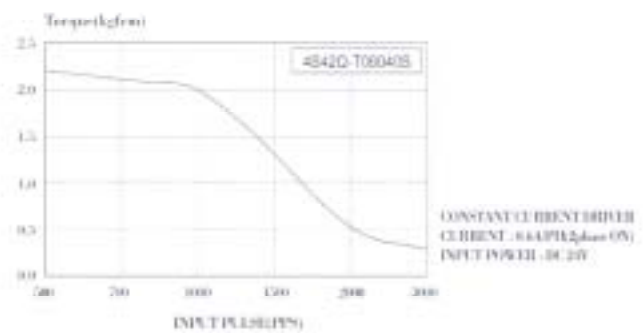
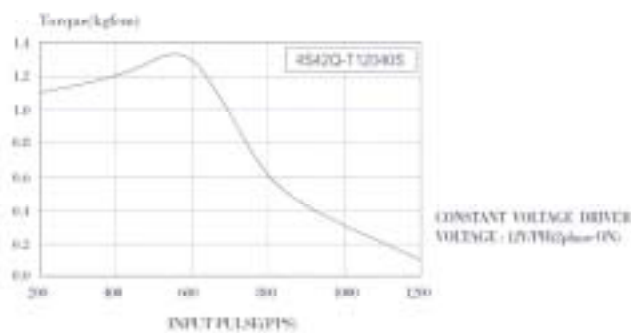
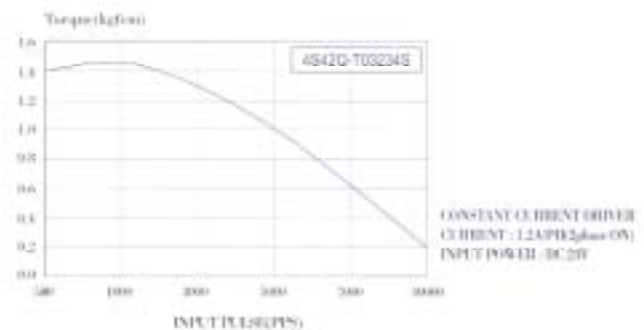
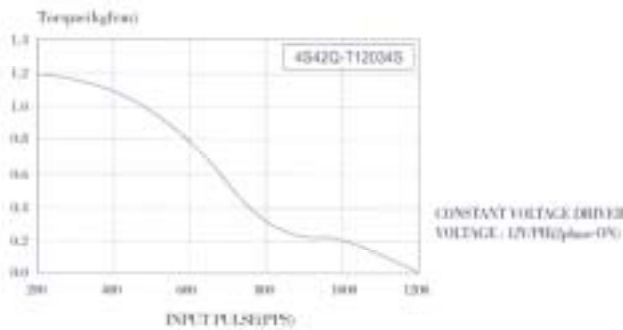
Specifications

MODEL NO.	VOLTAGE (V)	CURRENT (A/phase)	RESISTANCE (Ω /phase)	INDUCTANCE (mH/phase)	HOLDING TORQUE (kgf · cm)	DETENT TORQUE (gf · cm)	ROTOR INERTIA (g · cm ²)	WEIGHT (g)	LENGTH (mm)
4S42Q-T12034S	12.0	0.3	40	23	1.6	120	33	200	34
4S42Q-T03234S	3.2	1.2	27	1.8					
4S42Q-T12040S	12.0	0.4	30.0	27.0	2.5	140	53	250	40
4S42Q-T06040S	6.0	0.6	10.0	9.5					
4S42Q-T04040S	4.0	1.2	3.3	3.2					
4S42Q-T04046S	4.0	1.2	3.3	3.0	3.2	200	60	340	46

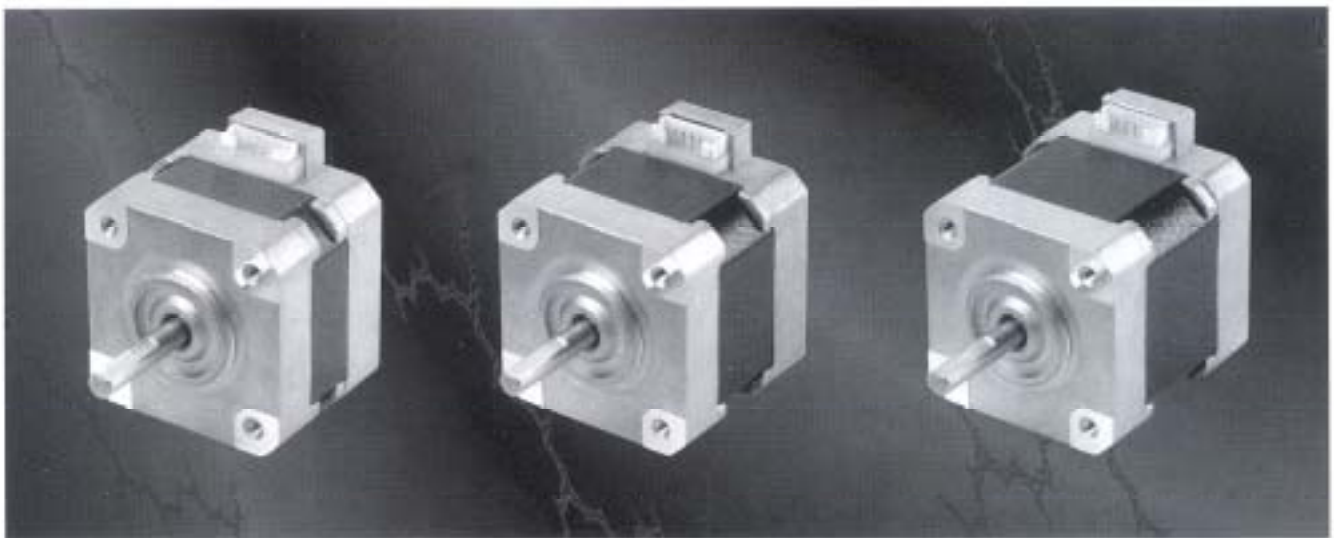
It is possible to produce a stepping motor by order

GENERAL SPECIFICATIONS

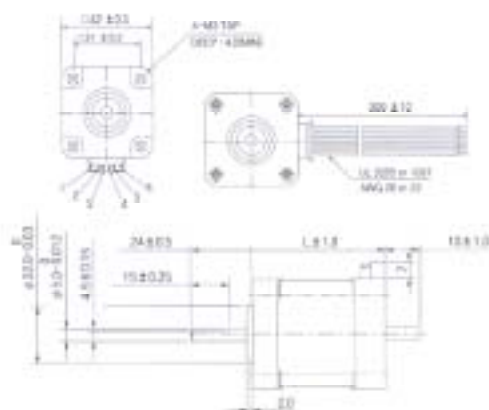
Step Angle	1.8°
Positional Accuracy	±5% max
Number of Phase	2 or 4
Temperature Rise	70 deg max
Insulation Resistance	100M Ω / minute at DC 500V
Dielectric Strength	AC 500V / minute
Insulation Class	B class
Number of Lead Wire	4, 5, 6
Lead Wire	UL 3265 AWG #24 or #26, L<300mm
Operation Ambient Temperature	-10°C ~ +50°C
Radial Play	0.03mm/0.4kg load max
Axial Play	0.08mm/0.5kg load max



42Q-P Series



Dimension Specification



Wiring Diagram



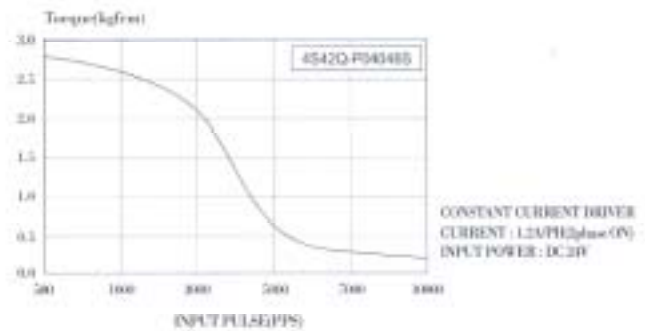
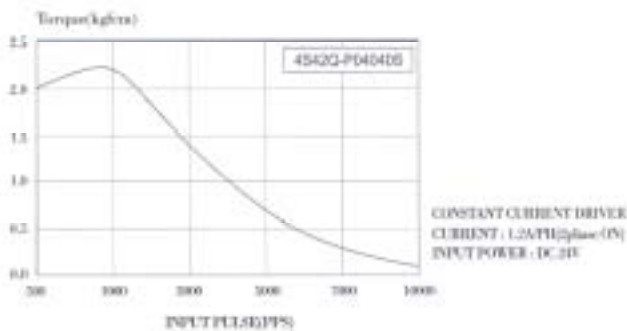
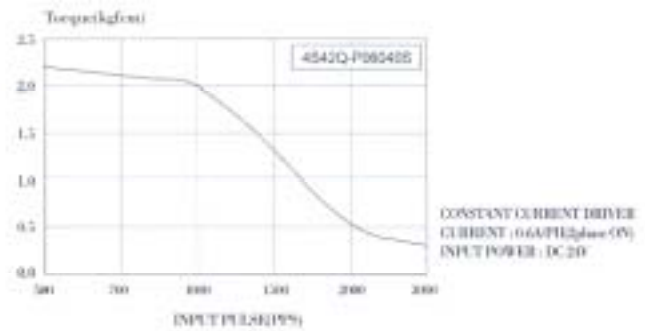
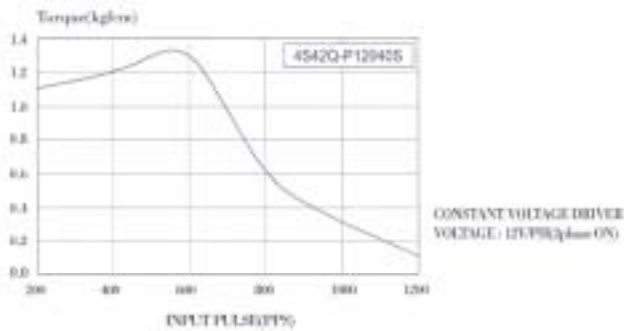
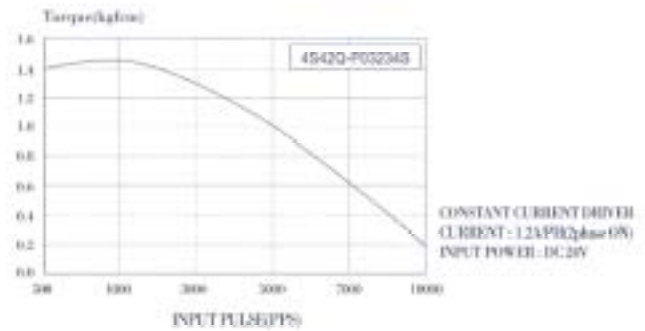
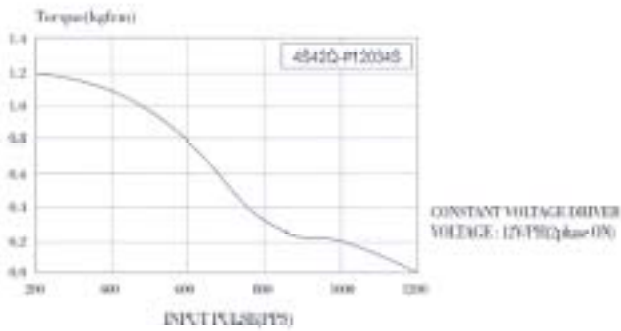
Specifications

MODEL NO.	VOLTAGE (V)	CURRENT (A/phase)	RESISTANCE (Ω/phase)	INDUCTANCE (mH/phase)	HOLDING TORQUE (kgf·cm)	DETENT TORQUE (gf·cm)	ROTOR INERTIA (g·cm ²)	WEIGHT (g)	LENGTH (mm)
4S42Q-P12034S	12.0	0.3	40	23.0	1.6	120	33	200	34
4S42Q-P03234S	3.2	1.2	2.7	1.8					
4S42Q-P12040S	12.0	0.4	30.0	27.0	2.5	140	53	250	40
4S42Q-P06040S	6.0	0.6	10.0	9.5					
4S42Q-P04040S	4.0	1.2	3.3	3.2					
4S42Q-P04046S	4.0	1.2	3.3	3.0	3.2	200	60	340	46

It is possible to produce a stepping motor by order

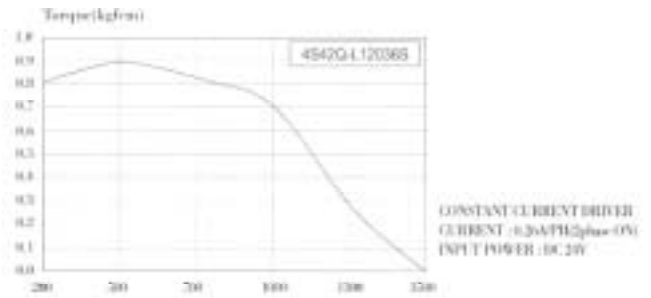
GENERAL SPECIFICATIONS

Step Angle	1.8°
Positional Accuracy	+5% max
Number of Phase	2 or 4
Temperature Rise	70 deg max
Insulation Resistance	100M Ω / minute at DC 500V
Dielectric Strength	AC 500V / minute
Insulation Class	B class
Number of Lead Wire	4, 5, 6
Lead Wire	UL 3255 AWG #24 or #26, L=300mm
Operation Ambient Temperature	-10°C ~ +50°C
Radial Play	0.03mm(0.4kg load)max
Axial Play	0.06mm(0.5kg load)max

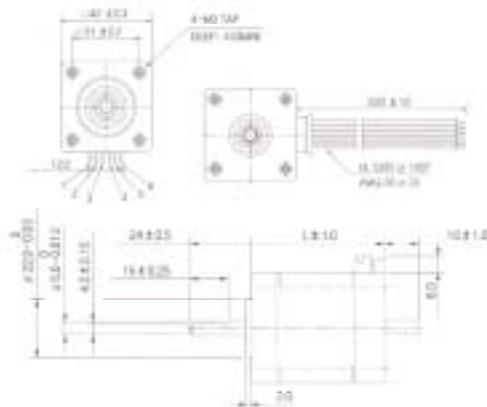


42Q-L Series

[LOW VIBRATION]



Dimension Specification



Wiring Diagram

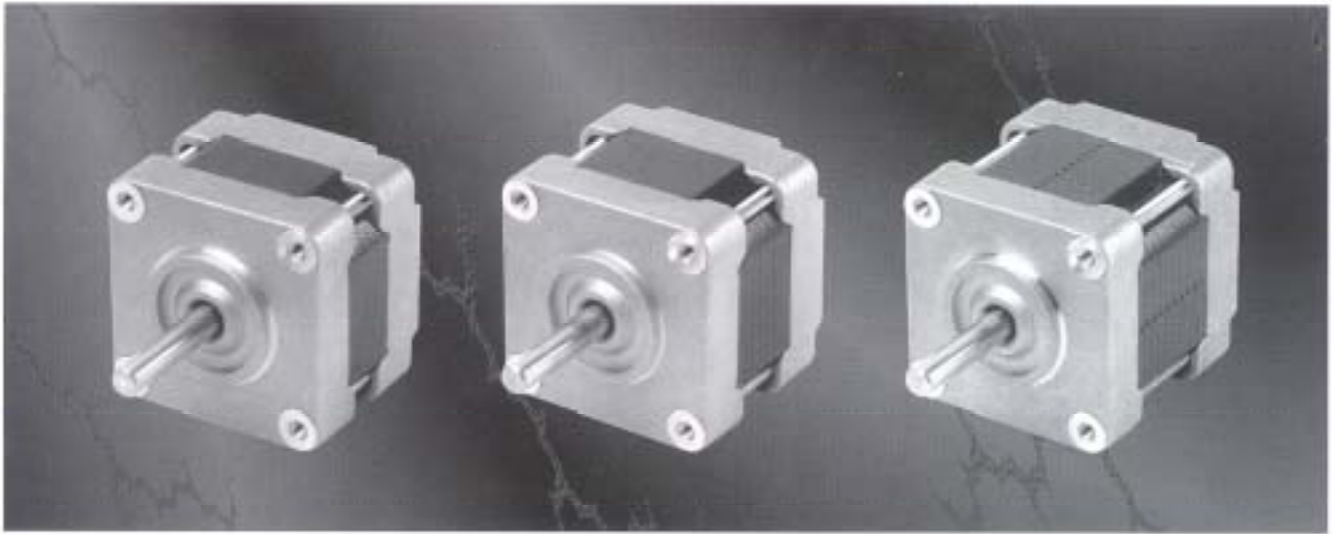


Specifications

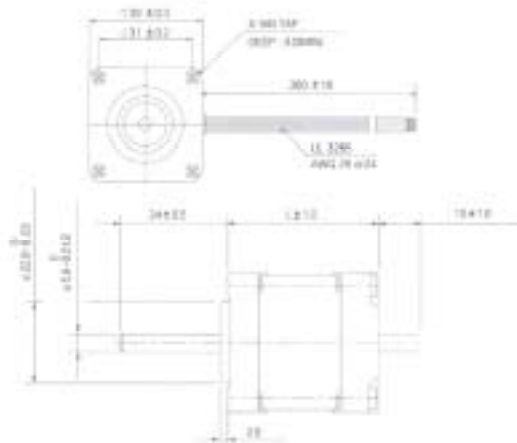
MODEL NO.	VOLTAGE (V)	CURRENT (A/phase)	RESISTANCE (Ω /phase)	INDUCTANCE (mH/phase)	HOLDING TORQUE (kgf · cm)	DETENT TORQUE (gf · cm)	ROTOR INERTIA (g · cm ²)	WEIGHT (g)	LENGTH (mm)
4S42Q-L12036S	12.0	0.26	45	28	1.2	60	48	220	36

It is possible to produce a stepping motor by order

39Q Series



Dimension Specification



Wiring Diagram



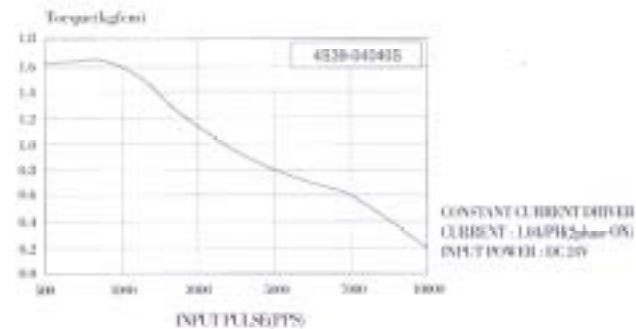
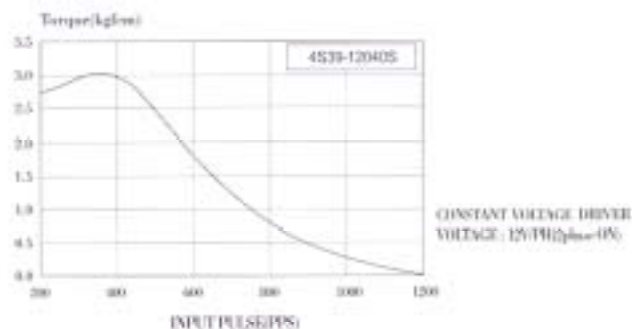
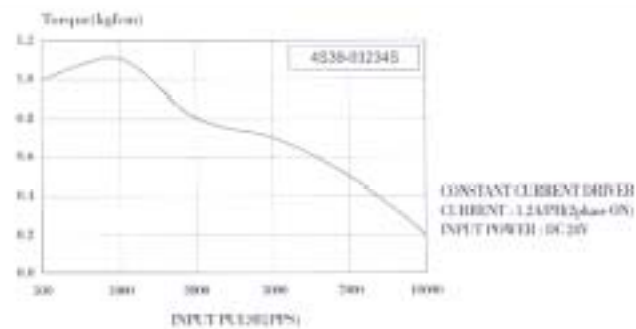
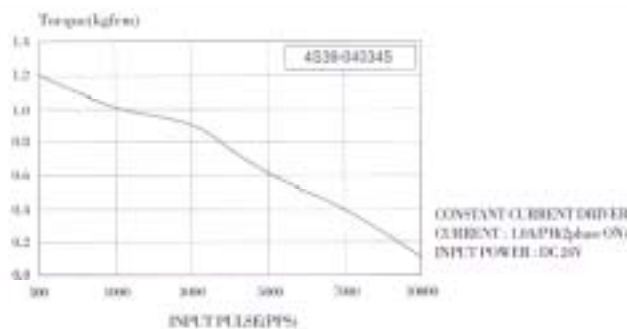
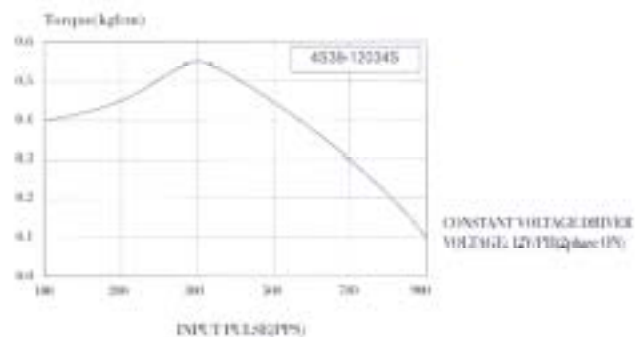
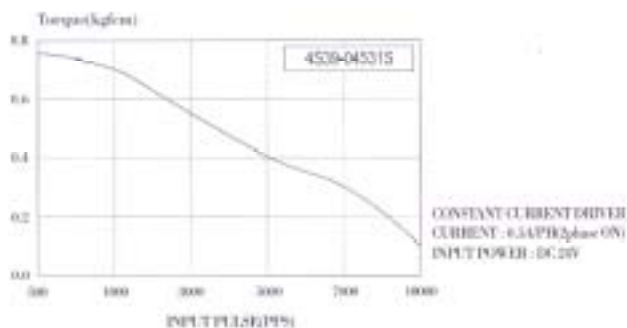
Specifications

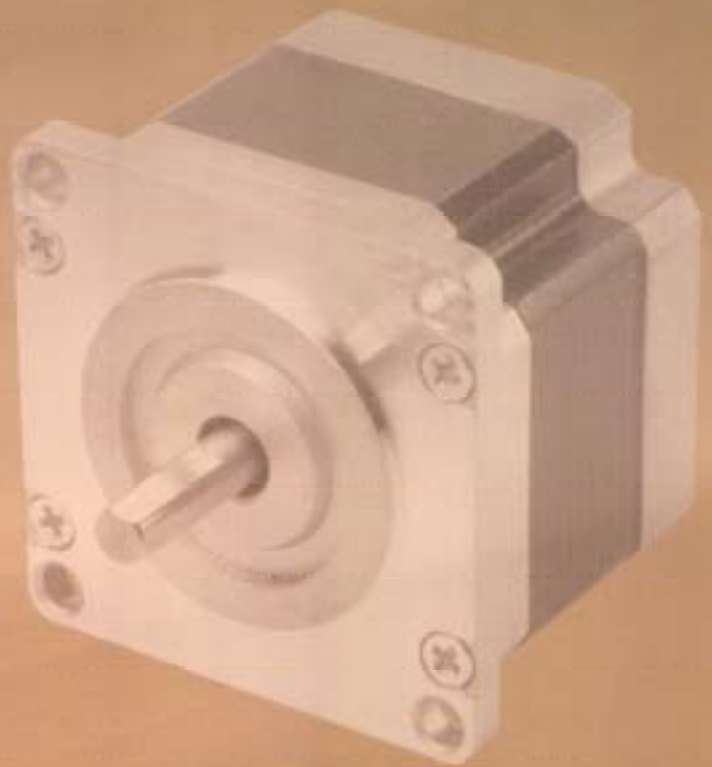
MODEL NO.	VOLTAGE (V)	CURRENT (A/phase)	RESISTANCE (Ω /phase)	INDUCTANCE (mH/phase)	HOLDING TORQUE (kgf · cm)	DETENT TORQUE (μ f · cm)	ROTOR INERTIA (g · cm ²)	WEIGHT (g)	LENGTH (mm)
4S39Q-04531S	4.5	0.5	9.0	6.0	1.0	70	16	180	31
4S39Q-12034S	12.0	0.16	75.0	85.0	1.1	90	20	200	34
4S39Q-04034S	4.0	1.0	4.0	4.2					
4S39Q-03234S	3.2	1.2	2.7	2.3					
4S39Q-12040S	12.0	0.4	30.0	33.0	1.8	100	30	250	40
4S39Q-04040S	4.0	1.0	4.0	3.7					

It is possible to produce a stepping motor by order

GENERAL SPECIFICATIONS

Step Angle	1.8°
Positional Accuracy	±5% max
Number of Phase	2 or 4
Temperature Rise	70 deg max
Insulation Resistance	100M Ω / minute at DC 500V
Dielectric Strength	AC 500V / minute
Insulation Class	B class
Number of Lead Wire	4, 5, 6
Lead Wire	UL 3262 AWG #24 or #26 L=300mm
Operation Ambient Temperature	-10°C ~ +50°C
Radial Play	0.03mm(0.4kg load)max
Axial Play	0.08mm(0.5kg load)max





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