

NPM Motors

About NPM Motors

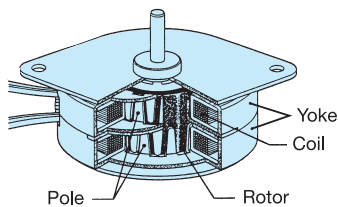
NPM motors are 2-coil permanent magnet motors. They are classified to the following two types:

- PF/PFC series stepping motors
- PTM/PTMC series synchronous motors

The PF/PFC series stepping motors adopting permanent magnet for the rotor core have been coping with customers' needs since their development in 1967 in full pursuit of high quality, high precision, high torque and low cost.

The PTM/PTMC series synchronous motors developed in 1964 as timing motors have been accepted favorably in every industrial field thanks to their excellent response and high precision.

Basic Structure of 2-phase Permanent Magnet Motor



When poles are magnetized by electric pulses applied to coils, poles attract the permanent magnet rotor core in reverse polarities, thereby starting the rotor rotating. Rotation of the rotor can be continued by alternately switching the direction of applied electric pulses to change polarities of poles. When supply of pulses to coils is stopped, poles are magnetized by the rotor core and the rotor stops rotating at the position where poles and the rotor core are attracted each other.

As described in page 3, there are two types of coil arrangements. One is for unipolar drive and the other for bipolar drive.

Models by Outer Diameters

OD (mm)	Stepping Motor	Synchronous Motor	
		Dual Direction Type	Single Direction Type
20	PFCU20	—	—
25	PF(C)25 PFCU25	PTM-24P	—
35	PF35 PF35T	PTM-12M8 PTM-24M PTM-24T	PTM-24B
42	PF(C)42 PFC42H PF(C)42T	PTM-12H8 PTM-24H PTMC-24S2	PTM-12K PTM-12E
55	PF(C)55 PFC55H	PTM-24F	—

Note: Outer diameters of gear head-equipped motors differ from the above. See the dimensional drawing of each model for details.

Insulation Class and Allowable Temperature Limit

Insulation Class	Y	A	E	B	F	H	C
Allowable Temperature Limit (°C)	90	105	120	130	155	180	>180

Terminology

Operating Voltage Range

The voltage range in which the motor can normally be driven.

Motor Speed

Number of revolutions per minute, which is determined by the number of rotor poles and supply frequency.

Rotating Direction

Viewed from the output shaft, clockwise rotation is expressed as CW and counterclockwise rotation, CCW.

Temperature Rise

Temperature rise the motor shows when driven. There are two measuring methods. The resistance method gives an average coil temperature by measuring coil temperatures based on increased coil resistance. The superficial method measures the surface temperature of motor.

Operating Temperature Range

Ambient temperature range in which the motor can normally be driven.

Dielectric Strength

Maximum voltage the part between the motor case and windings can withstand for one minute. The Electrical Appliance and Material Safety Law in Japan provides as follows:

- 500 Vac for one minute with operating voltage <30 V
- 1000 Vac for one minute with operating voltage 30 to 150 V
- 1500 Vac for one minute with operating voltage >150 V

Capacitor

With the reversible synchronous motors which can rotate in both clockwise and counterclockwise directions, the rotor is rotated by shifting the phase by 90° with a capacitor. Thus, reversible synchronous motors require a capacitor. The capacity of the capacitor differs depending on the motor model, rated voltage and supply frequency. Also, the capacitor should withstand a voltage >2 times higher than the rated voltage of the motor.

Continuous Rating

Specifications are continuously applicable to the rated output.

Intermittent Rating

Specifications are applicable for a specific time length to the rated output.

Abbreviations/Units

A

SI base unit for current (Ampere)

AC

Alternate current

CCW

Counterclockwise rotation

CW

Clockwise rotation

DC

Direct current

Hz

SI induced unit for frequency (cycles per second)

K

SI base unit for temperature (Kelvin)

PPS

Pulses per second

RPM

Revolutions per minute

V

SI induced unit for voltage (Volt)

Stepping Motors

Synchronization

Stepping motors rotate in proportion to the number of pulses. They are frequency synchronized motors, the speed of which can be varied by changing the frequency of pulse signal.

Open-loop Control

No position sensor required.

No Cumulative Error

While each step provides some angle tolerance, the step angle error is noncumulative.

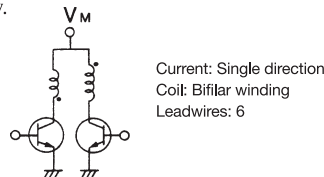
Excellent Response

Permanent magnet used for the rotor ensures

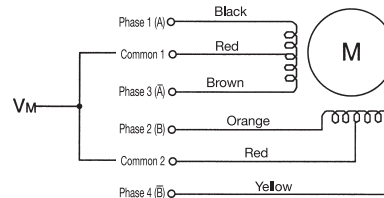
Features

Unipolar Drive

The basic circuit (constant-voltage) is as shown below.



Six leadwires are connected as shown below.



2-2 phase excitation sequence is as shown below.

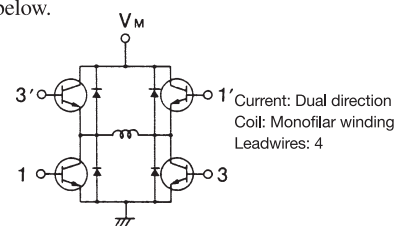
STEP	Black	Brown	Orange	Yellow	STEP
1	ON	OFF	ON	OFF	4
2	OFF	ON	ON	OFF	3
3	OFF	ON	OFF	ON	2
4	ON	OFF	OFF	ON	1

CW ↓ ↑ CCW

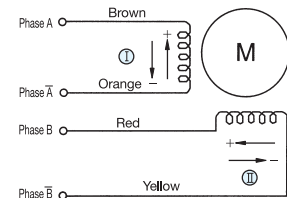
Table at the right shows comparison between bipolar drive and unipolar drive with parameters of unipolar drive referred to as 1.

Bipolar Drive

The basic circuit (constant-voltage) is as shown below.



Four leadwires are connected as shown below.



2-2 phase excitation sequence is as shown below.

STEP	Ⓐ	Ⓑ
1	+	+
2	-	+
3	-	-
4	+	-

CW ↓ ↑ CCW

	Unipolar	Bipolar
Number of transistors		
	1	2
To ensure the same temperature rise of motor	Current	1
	Torque	1
	High-speed performance	1
	Voltage	1
To obtain the same torque	Current	1
	Temperature rise	1
	High-speed performance	1
	Voltage	1

2-phase Stepping Motor

PF(C) - 42 T - 48 C 1 G 1/50

① ② ③ ④ ⑤ ⑥ ⑦ ⑧

① Series Designation

PF: Flying lead joint type, PFC: Connector joint type

See the dimensional drawings of PF(C)25, PF(C)42T and PF(C)55 for the difference.

② Outer Diameter in mm

③ Type

Blank: Standard type, T: Thin stack type, H: High-torque type

④ Steps per Revolution

48 (7.5°/step), 24 (15°/step)

⑤ Coil Rating

Standard coils are for unipolar drive.

B: 24Vdc, C: 12Vdc, D: 5Vdc

Various coil ratings are also available for selection according to required torque with operating voltage, current and frequency.

⑥ Magnet Material Type

1: Anisotropic ferrite magnet

2: Isotropic ferrite magnet

3: Neodymium magnet

⑦ Gear Head

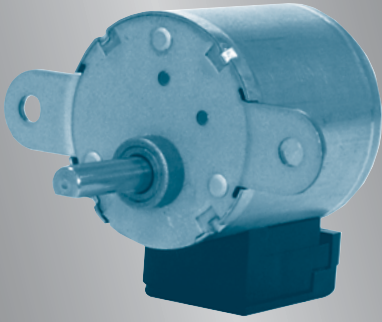
Blank: No gear head, G: Gear head integrated

⑧ Gear Ratio

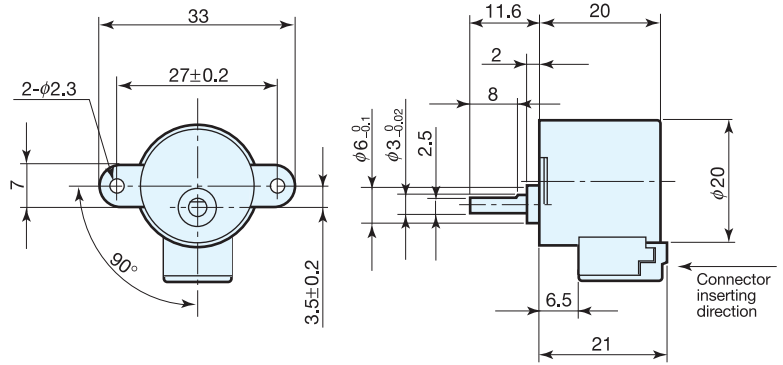
Written only for geared models

Model Number

PFCU20



Smallest NPM motor with gear head integrated

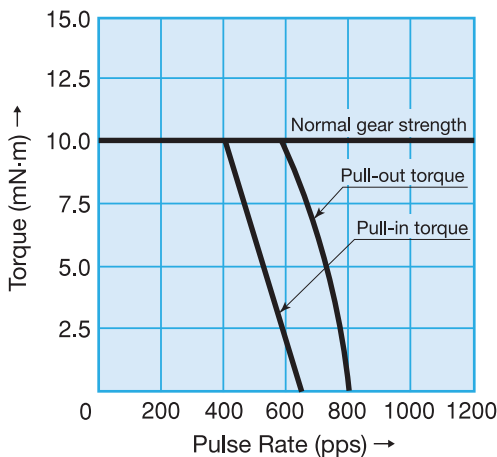


Typical Specifications

Particulars	Unit	PFCU20-40SG A2(1/10)
Winding Resistance*	Ω	160 ±7%
Winding Inductance*	mH	59 (1 Vrms, 1 kHz)
Supply Voltage (DC)	V	12
Terminal Voltage	V	11
Excitation Mode		2-2 phase
Gear Ratio, Backlash		1/10, 7° or less
Step Angle	°	0.9
Steps per Revolution		400
Operating Temperature Range	°C	-10 to +50
Insulation Class		Class E (allowable coil temperature)
Max. Operating Temperature (Case)	°C	+100
Max. Starting Pulse Rate*	pps	650 or more (with no load)
Max. Slewing Pulse Rate*	pps	800 or more (with no load)
Gear Strength (Ordinary)	mN·m	10
Gear Strength (Destruction)	mN·m	30
Temperature Rise	K	70
Mass	g	25

Values for asterisked particulars such as winding resistance are at the time of turning the power on with supply voltage 12V ±2% and at a normal ambient temperature 20°C ±5°C and a relative humidity 65% ±20%.
 Stated terminal voltage is with supply voltage 12V.
 Stated temperature rise is at the time of saturation.

Torque Curve [Pull-in torque, JL (load inertia) = 0 (calculated value)]



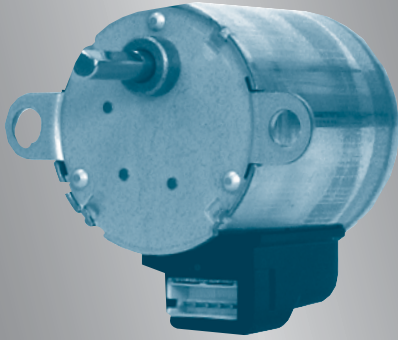
Torque curves are drawn for reference and not guaranteed.

Connector

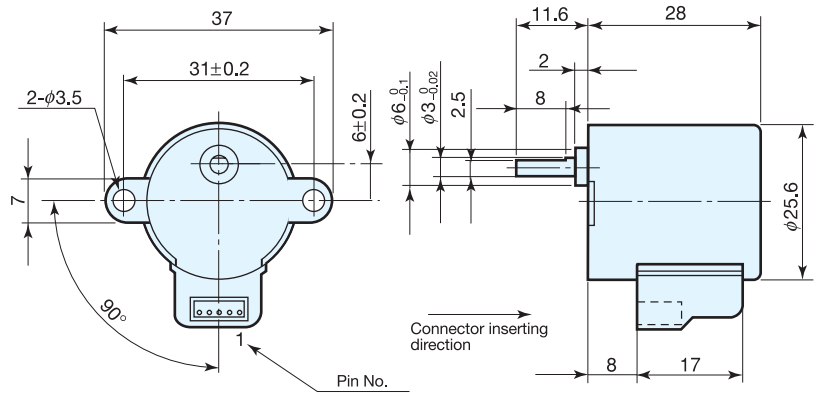
Applicable Housing: SHR-04V-S
 Applicable Contact: SSH-003T-P0.2-H
 (Manufacturer: J.S.T. Mfg. Co., Ltd.)

Applicable Wire: AWG 32 to 28 (outer diameter of covered wire: 0.4 to 0.8 mm)

PFCU25



Gear head-integrated NPM motor



Typical Specifications

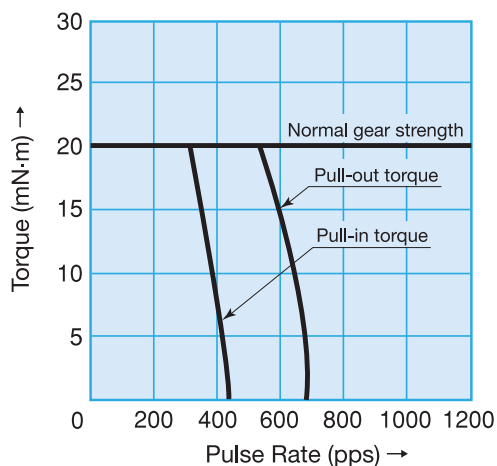
Particulars	Unit	PFCU25-24C1G (1/20)	PFCU25-24D1G (1/20)
Winding Resistance*	Ω	120 ±7%	16 ±7%
Winding Inductance*	mH	30 (1 Vrms, 1 kHz)	4.1 (1 Vrms, 1 kHz)
Supply Voltage (DC)	V	13.3	5.4
Terminal Voltage	V	12.5	4.6
Excitation Mode		2-2 phase	
Gear Ratio, Backlash		1/20, 7° or less	
Step Angle	°	0.75	
Steps per Revolution		480	
Operating Temperature Range	°C	-10 to +50	
Insulation Class		Class E (allowable coil temperature)	
Max. Operating Temperature (Case)	°C	+100	
Max. Starting Pulse Rate*	pps	420 or more (with no load)	
Max. Slewing Pulse Rate*	pps	680 or more (with no load)	
Gear Strength (Ordinary)	mN·m	20	
Gear Strength (Destruction)	mN·m	60	
Temperature Rise	K	70	
Mass	g	55	

Values for asterisked particulars such as winding resistance are at the time of turning the power on with supply voltage $12V \pm 2\%$ and at a normal ambient temperature $20^{\circ}C \pm 5^{\circ}C$ and a relative humidity $65\% \pm 20\%$.

Stated terminal voltage is with supply voltage 12V.

Stated temperature rise is at the time of saturation.

Torque Curve [Pull-in torque, JL (load inertia) = 0 (calculated value)]



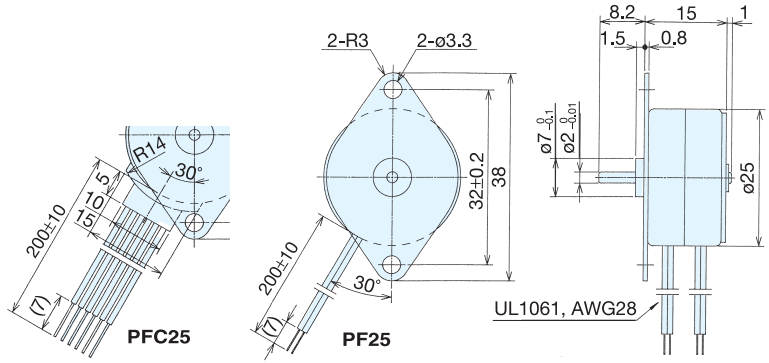
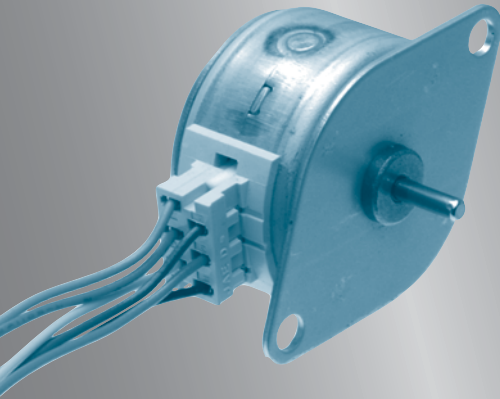
Torque curves are drawn for reference and not guaranteed.

Connector

Applicable Housing: ZHR-5
 Applicable Contact: SZH-002T-P0.5
 (Manufacturer: J.S.T. Mfg. Co., Ltd.)

Applicable Wire: AWG 28 to 26 (outer diameter of covered wire: 0.8 to 1.1 mm)

PF(C)25

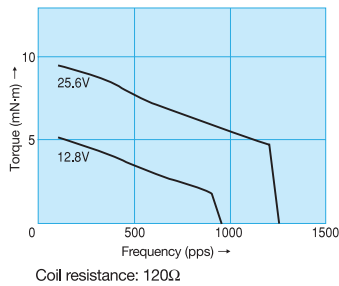


Specifications (Example for Unipolar Constant-voltage Operation)

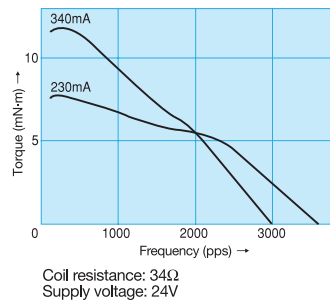
Particulars	Unit	PF(C)25-48			PF(C)25-24	
Excitation Mode		2-2 phase			2-2 phase	
Step Angle	°	7.5			7.5	
Step Angle Tolerance	%	±5			±5	
Rating		Continuous		Intermittent	Continuous	
Supply Voltage (DC)	V	12	5	24	12	5
Winding Resistance per Phase	Ω	120	16	120	120	16
Winding Inductance per Phase	mH	37	5.0	37	30	4.1
Rotor Inertia	kg·m ²	1.0 x 10 ⁻⁷				
Operating Temperature Range	°C	-10 to +50				
Temperature Rise	K	70		—	70	
Insulation Class		Class E (allowable coil temperature)				
Mass	g	35				

Torque Curve (Pull-out torque)

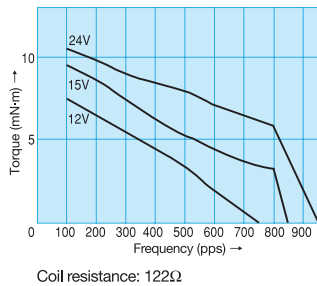
Unipolar Constant Voltage (48C1)



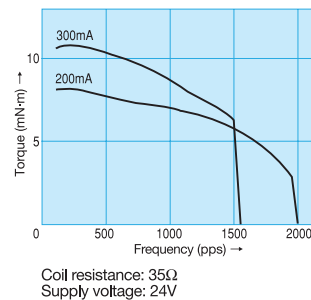
Unipolar Constant Current (48H1)



Bipolar Constant Voltage (48P1)



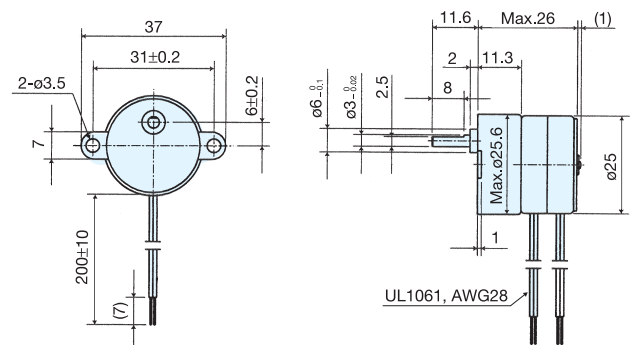
Bipolar Constant Current (48R1)



Torque curves are drawn for reference and not guaranteed.

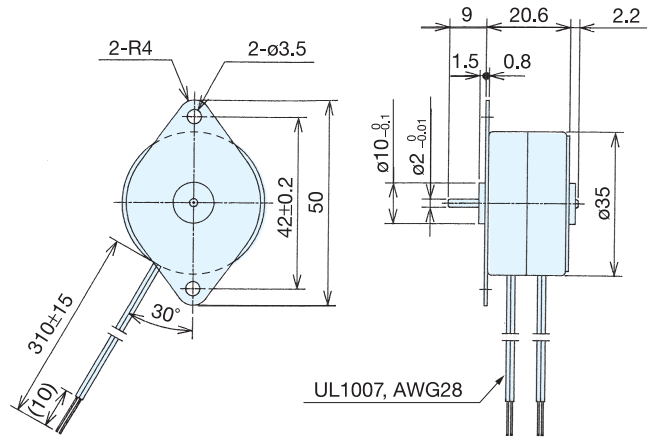
Dimensions of Geared Model

PF(C)25 with P Gear Head



Gear ratio	6/25	1/5	3/25	1/10	2/25	1/15	3/50	1/20
Max. allowable torque	20mN·m				50mN·m			
Gear ratio	1/25	1/30	1/50	1/60	1/75			
Max. allowable torque	70mN·m							
Gear ratio	1/100	1/120	1/125	1/150	1/200	1/250	1/300	1/20
Max. allowable torque	100mN·m							

PF35

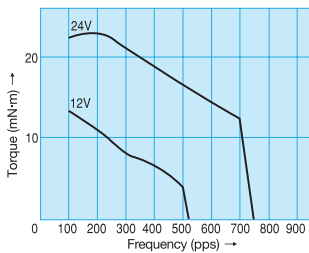


Specifications (Example for Unipolar Constant-voltage Operation)

Particulars	Unit	PF35-48				PF35-24		
		Continuous			Intermittent	Continuous		
Excitation Mode		2-2 phase				2-2 phase		
Step Angle	°	7.5				15		
Step Angle Tolerance	%	±5				±5		
Rating		Continuous			Intermittent	Continuous		
Supply Voltage (DC)	V	24	12	5	24	24	12	5
Winding Resistance per Phase	Ω	360	90	16	90	360	90	16
Winding Inductance per Phase	mH	202	48	8.9	48	148	37	6.7
Rotor Inertia	kg·m ²	4.5 x 10 ⁻⁷						
Operating Temperature Range	°C	-10 to +50						
Temperature Rise	K	55			—	55		
Insulation Class		Class E (allowable coil temperature)						
Mass	g	80						

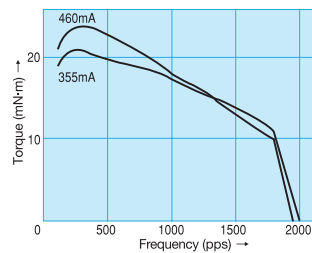
Torque Curve (Pull-out torque)

Unipolar Constant Voltage (48C1)



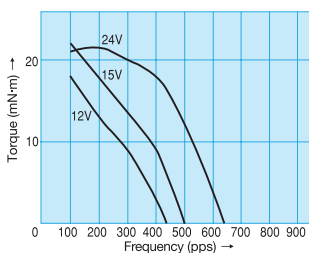
Coil resistance: 90Ω

Unipolar Constant Current (48071)



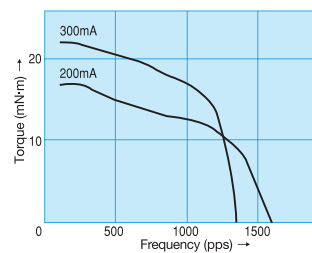
Coil resistance: 20Ω
Supply voltage: 24V

Bipolar Constant Voltage (48P1)



Coil resistance: 100Ω

Bipolar Constant Current (48181)

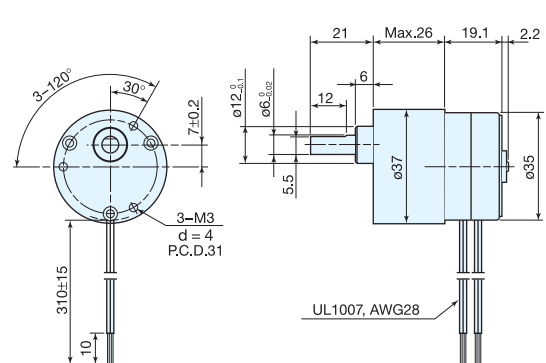


Coil resistance: 18Ω
Supply voltage: 24V

Torque curves are drawn for reference and not guaranteed.

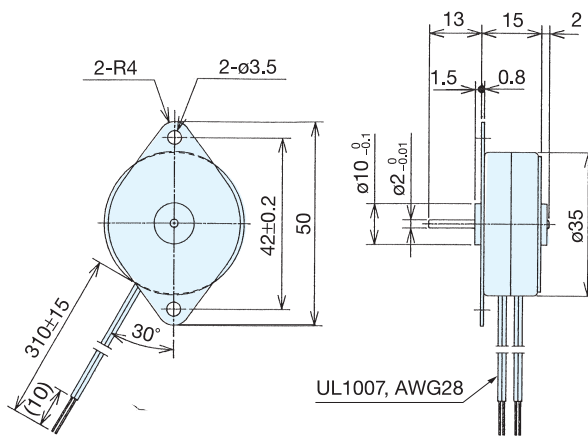
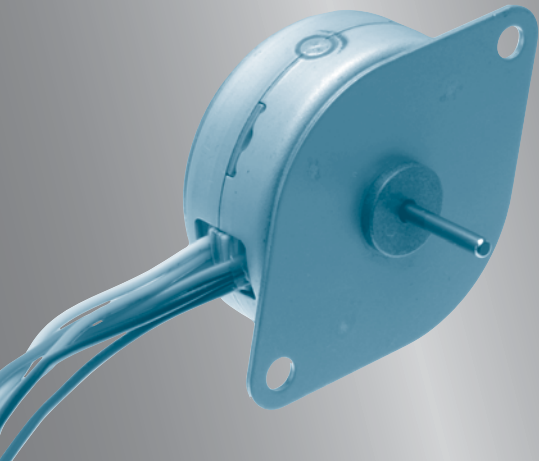
Dimensions of Geared Model

PF35 with M Gear Head



Gear ratio	1/5	1/6	1/10	1/18	1/30	
Max. allowable torque	100mN·m		200mN·m			
Gear ratio	1/40	1/50	1/60	1/75	1/90	1/100 1/120
Max. allowable torque	300mN·m					
Gear ratio	1/125	1/150	1/180	1/200	1/270	1/300
Max. allowable torque	600mN·m					

PF35T

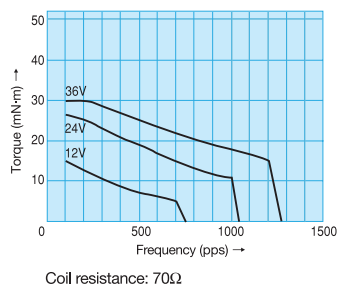


Specifications (Example for Unipolar Constant-voltage Operation)

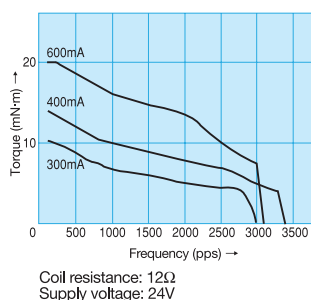
Particulars	Unit	PF35T-48			
Excitation Mode		2-2 phase			
Step Angle	°	7.5			
Step Angle Tolerance	%	±5			
Rating		Continuous			Intermittent
Supply Voltage (DC)	V	24	12	5	24
Winding Resistance per Phase	Ω	333	70	12	70
Winding Inductance per Phase	mH	152	30	5.5	30
Rotor Inertia	kg·m ²	2.7 × 10 ⁻⁷			
Operating Temperature Range	°C	-10 to +50			
Temperature Rise	K	70			—
Insulation Class		Class E (allowable coil temperature)			
Mass	g	77			

Torque Curve (Pull-out torque)

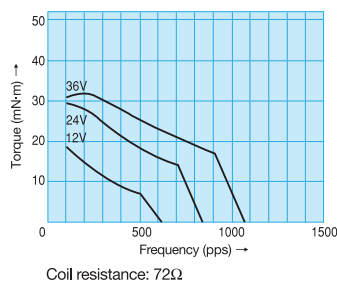
Unipolar Constant Voltage (48C1)



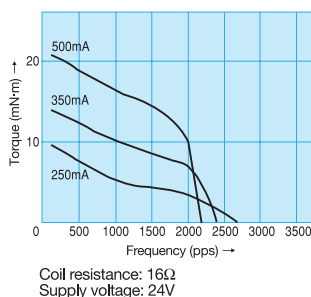
Unipolar Constant Current (48D1)



Bipolar Constant Voltage (48R1)



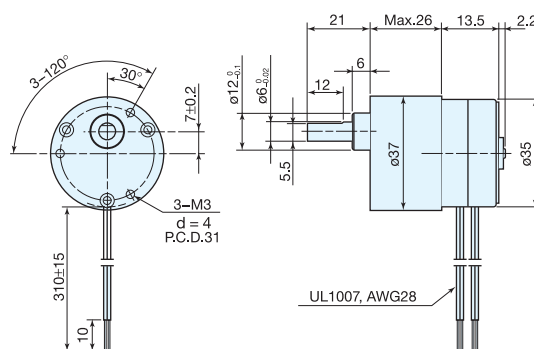
Bipolar Constant Current (48Q1)



Torque curves are drawn for reference and not guaranteed.

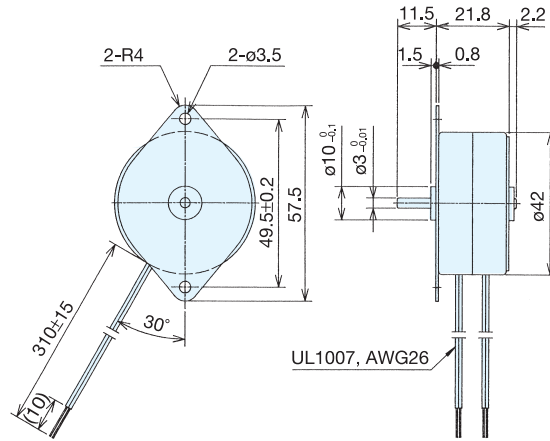
Dimensions of Geared Model

PF35T with M Gear Head



Gear ratio	1/5	1/6	1/10	1/18	1/30		
Max. allowable torque	100mN·m		200mN·m				
Gear ratio	1/40	1/50	1/60	1/75	1/90	1/100	1/120
Max. allowable torque	300mN·m						
Gear ratio	1/125	1/150	1/180	1/200	1/270	1/300	
Max. allowable torque	600mN·m						

PF42

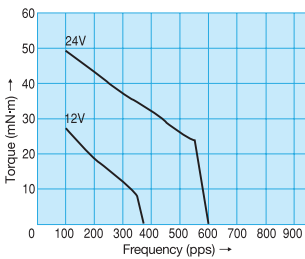


Specifications (Example for Unipolar Constant-voltage Operation)

Particulars	Unit	PF42-48				PF42-24		
		Continuous		Intermittent		Continuous		
Excitation Mode		2-2 phase				2-2 phase		
Step Angle	°	7.5				15		
Step Angle Tolerance	%	±5				±5		
Rating		Continuous		Intermittent		Continuous		
Supply Voltage (DC)	V	24	12	5	24	24	12	5
Winding Resistance per Phase	Ω	280	70	12	70	280	70	12
Winding Inductance per Phase	mH	140	36	6.1	36	130	35	5.9
Rotor Inertia	kg·m ²	16.8 x 10 ⁻⁷						
Operating Temperature Range	°C	-10 to +50						
Temperature Rise	K	55		—		55		
Insulation Class		Class E (allowable coil temperature)						
Mass	g	160						

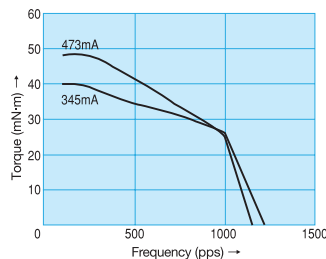
Torque Curve (Pull-out torque)

Unipolar Constant Voltage (48C1)



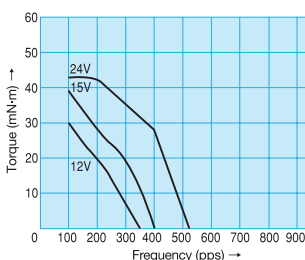
Coil resistance: 70Ω

Unipolar Constant Current (48I1)



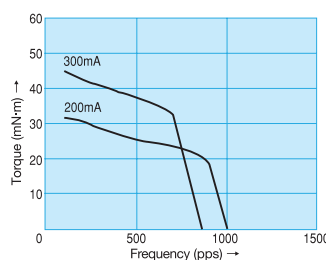
Coil resistance: 20Ω
Supply voltage: 24V

Bipolar Constant Voltage (48P1)



Coil resistance: 76Ω

Bipolar Constant Current (48Y1)

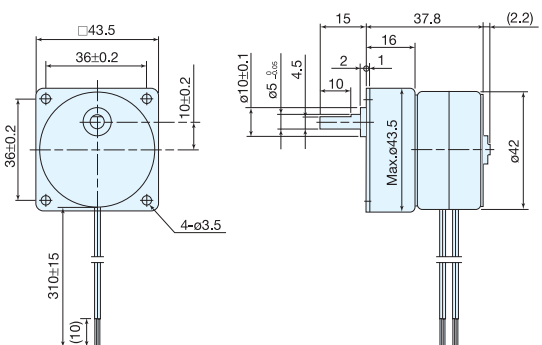


Coil resistance: 20Ω
Supply voltage: 24V

Torque curves are drawn for reference and not guaranteed.

Dimensions of Geared Model

PF42 with H Gear Head

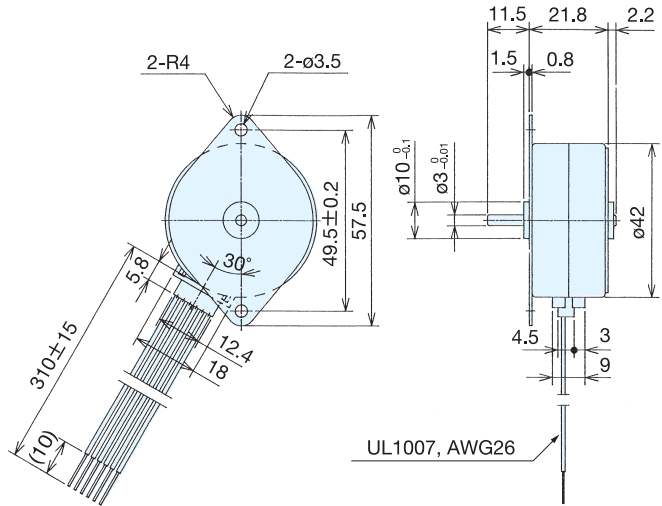
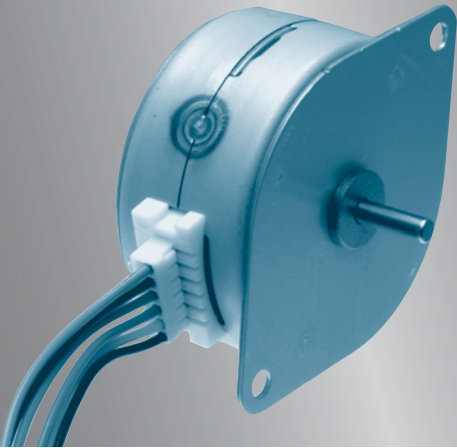


Gear ratio	6/25	1/5	3/25	1/10	2/25	1/15	3/50	1/20	1/25
Max. allowable torque	200mN·m				250mN·m				

Gear ratio	1/30	1/50	1/60	2/125	1/75
Max. allowable torque	300mN·m				

Gear ratio	1/100	1/120	1/125	1/150	1/200	1/300
Max. allowable torque	400mN·m					

PFC42H

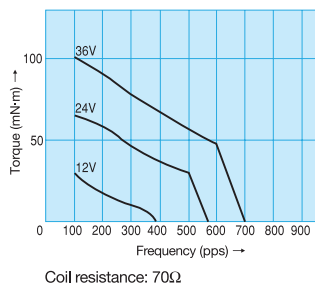


Specifications (Example for Unipolar Constant-voltage Operation)

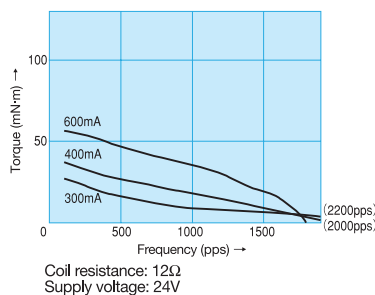
Particulars	Unit	PF42H-48			
Excitation Mode		2-2 phase			
Step Angle	°	7.5			
Step Angle Tolerance	%	±5			
Rating		Continuous			Intermittent
Supply Voltage (DC)	V	24	12	5	24
Winding Resistance per Phase	Ω	280	70	12	70
Winding Inductance per Phase	mH	140	39	6.6	39
Rotor Inertia	kg·m ²	27 × 10 ⁻⁷			
Operating Temperature Range	°C	-10 to +50			
Temperature Rise	K	55			—
Insulation Class		Class E (allowable coil temperature)			
Mass	g	160			

Torque Curve (Pull-out torque)

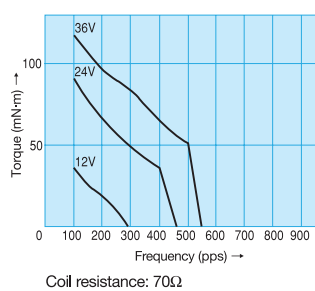
Unipolar Constant Voltage (48C1)



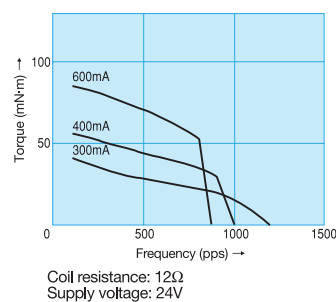
Unipolar Constant Current (48D1)



Bipolar Constant Voltage (48P1)

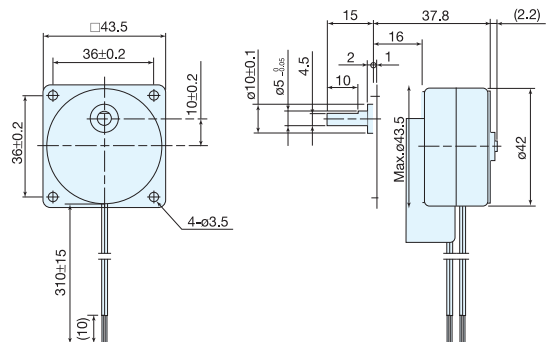


Bipolar Constant Current (48Q1)



Dimensions of Geared Model

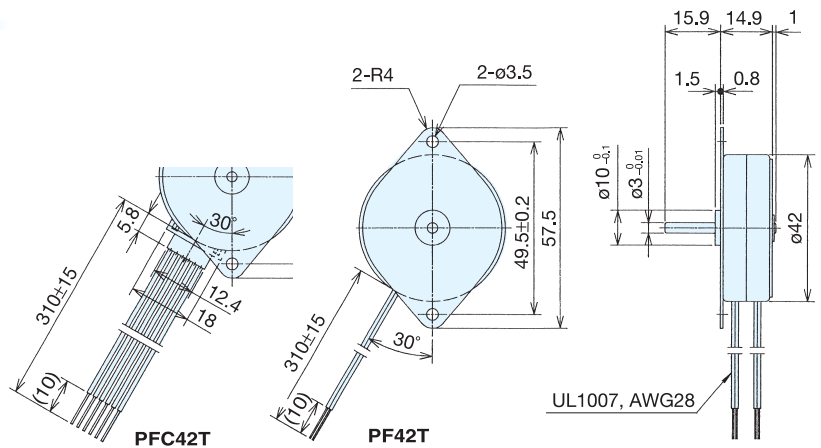
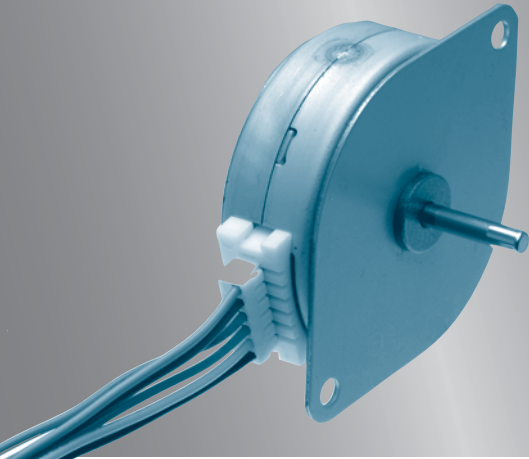
PFC42H with H Gear Head



Gear ratio	6/25	1/5	3/25	1/10	2/25	1/15	3/50	1/20	1/25
Max. allowable torque	200mN·m				250mN·m				
Gear ratio	1/30	1/50	1/60	2/125	1/75				
Max. allowable torque	300mN·m								
Gear ratio	1/100	1/120	1/125	1/150	1/200	1/300			
Max. allowable torque	400mN·m								

Torque curves are drawn for reference and not guaranteed.

PF(C)42T



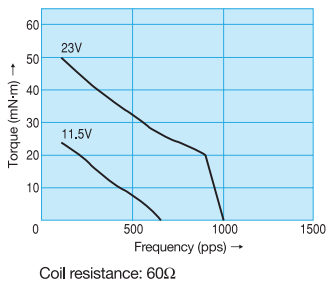
Specifications (Example for Unipolar Constant-voltage Operation)

Particulars	Unit					PF42T-96		
Excitation Mode						2-2 phase		
Step Angle	°					3.75		
Step Angle Tolerance	%					±5		
Rating		Continuous			Intermittent	Continuous		
Supply Voltage (DC)	V	24	12	5	24	24	12	5
Winding Resistance per Phase	Ω	250	60	9.5	60	250	60	9.5
Winding Inductance per Phase	mH	110	25	4.0	25	130	29	4.6
Rotor Inertia	kg·m ²	14.8 x 10 ⁻⁷						
Operating Temperature Range	°C	-10 to +55						
Temperature Rise	K	70			—	70		
Insulation Class		Class E (allowable coil temperature)						
Mass	g	105						

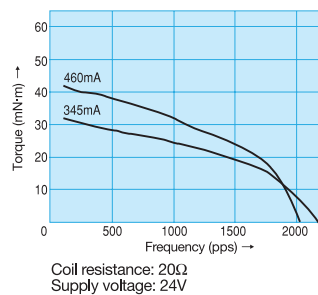
Torque Curve (Pull-out torque)

Dimensions of Geared Model

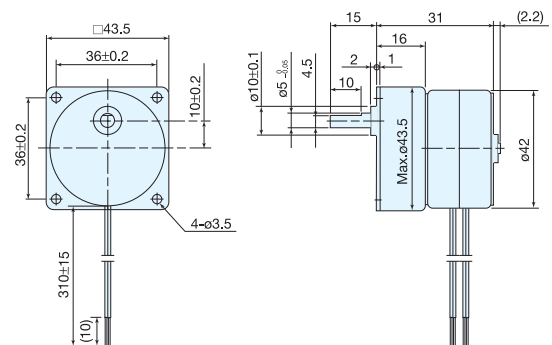
Unipolar Constant Voltage (48C1)



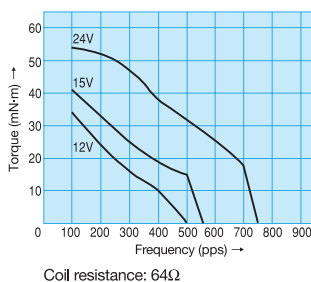
Unipolar Constant Current (48071)



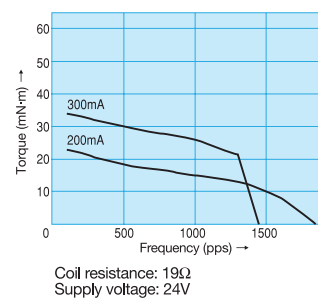
PF(C)42T with H Gear Head



Bipolar Constant Voltage (48P1)

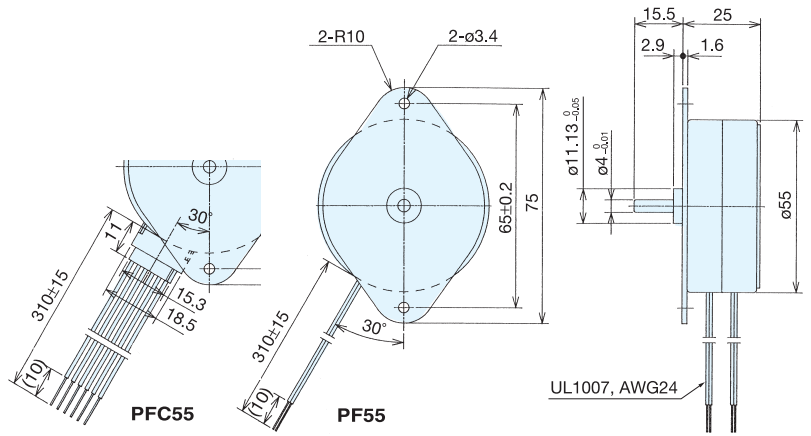
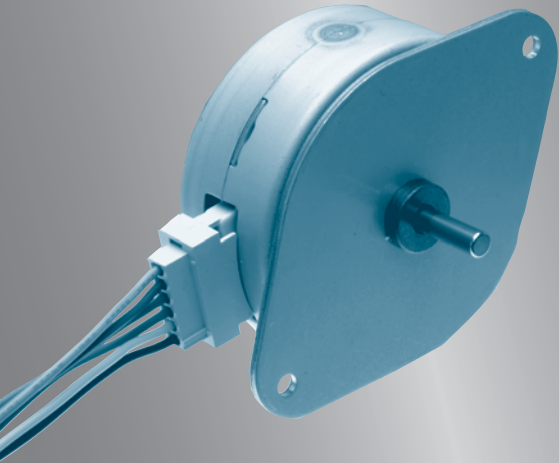


Bipolar Constant Current (48271)



Gear ratio	6/25	1/5	3/25	1/10	2/25	1/15	3/50	1/20	1/25
Max. allowable torque	200mN·m				250mN·m				
Gear ratio	1/30	1/50	1/60	2/125	1/75				
Max. allowable torque	300mN·m								
Gear ratio	1/100	1/120	1/125	1/150	1/200	1/300			
Max. allowable torque	400mN·m								

PF(C)55



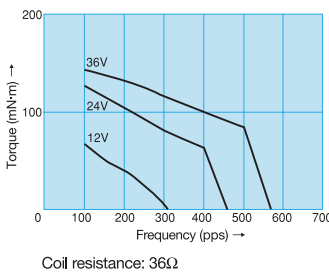
Specifications (Example for Unipolar Constant-voltage Operation)

Particulars	Unit	PF (C) 55-48			
Excitation Mode		2-2 phase			
Step Angle	°	7.5			
Step Angle Tolerance	%	±5			
Rating		Continuous			Intermittent
Supply Voltage (DC)	V	24	12	5	24
Winding Resistance per Phase	Ω	145	36	5	36
Winding Inductance per Phase	mH	145	37	4.6	37
Rotor Inertia	kg·m ²	40 x 10 ⁻⁷			
Operating Temperature Range	°C	-10 to +50			
Temperature Rise	K	55			—
Insulation Class		Class E (allowable coil temperature)			
Mass	g	300			

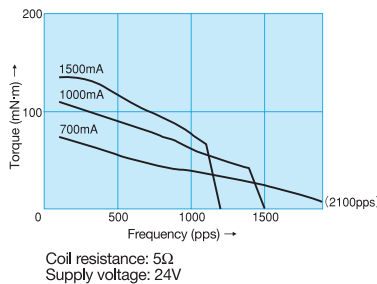
Torque Curve (Pull-out torque)

Dimensions of Geared Model

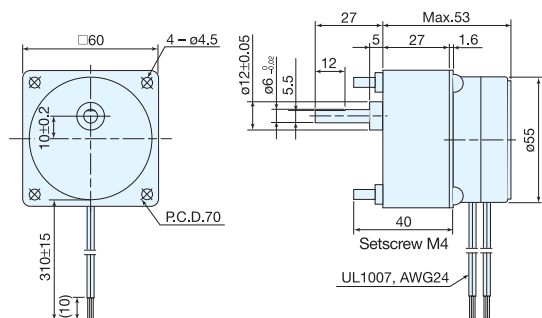
Unipolar Constant Voltage (48C1)



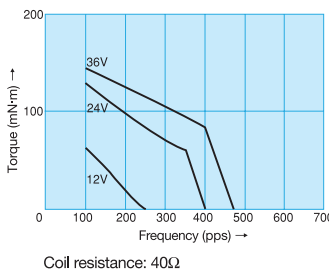
Unipolar Constant Current (48D1)



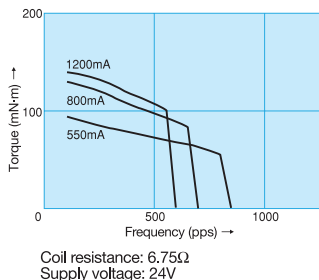
PF(C)55 with F Gear Head



Bipolar Constant Voltage (48P1)



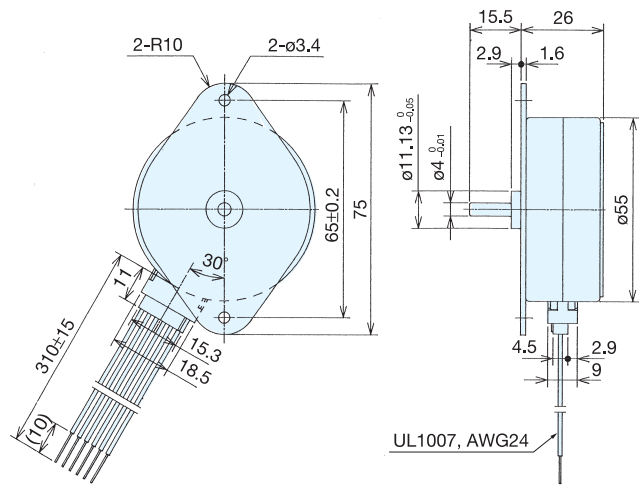
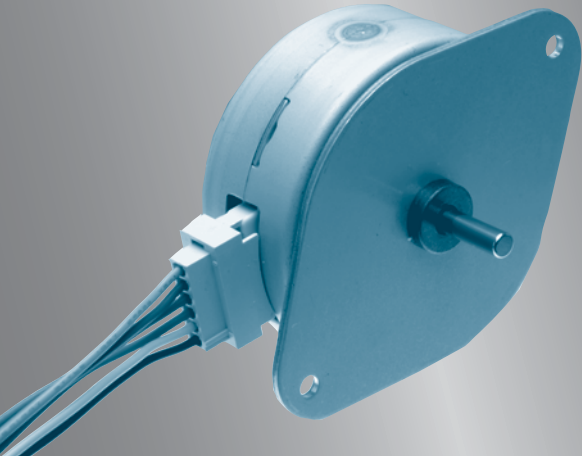
Bipolar Constant Current (48Q1)



Gear ratio	6/25	1/5	3/25	1/10	2/25	1/15	3/50	1/20
Max. allowable torque	400mN·m							
Gear ratio	1/25	1/30	1/50	1/60				
Max. allowable torque	700mN·m							
Gear ratio	2/125	1/75	3/250	1/100	1/125	1/150	1/250	1/300
Max. allowable torque	1000mN·m							

Torque curves are drawn for reference and not guaranteed.

PFC55H

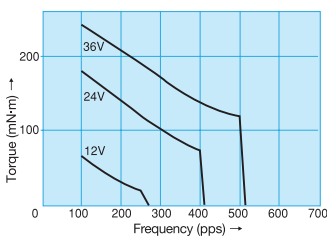


Specifications (Example for Unipolar Constant-voltage Operation)

Particulars	Unit	PFC55H-48			
Excitation Mode		2-2 phase			
Step Angle	°	7.5			
Step Angle Tolerance	%	±5			
Rating		Continuous		Intermittent	
Supply Voltage (DC)	V	24	12	5	24
Winding Resistance per Phase	Ω	145	36	5	36
Winding Inductance per Phase	mH	106	30	4.4	30
Rotor Inertia	kg·m ²	97 x 10 ⁻⁷			
Operating Temperature Range	°C	-10 to +50			
Temperature Rise	K	55		—	
Insulation Class		Class E (allowable coil temperature)			
Mass	g	300			

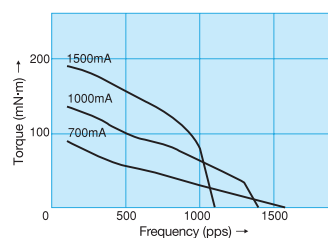
Torque Curve (Pull-out torque)

Unipolar Constant Voltage (48C1)



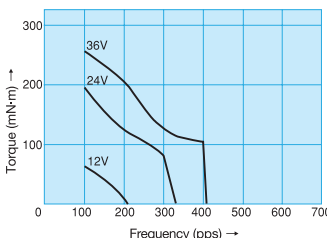
Coil resistance: 36Ω

Unipolar Constant Current (48D1)



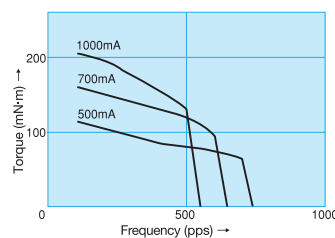
Coil resistance: 5Ω
Supply voltage: 24V

Bipolar Constant Voltage (48011)



Coil resistance: 40Ω

Bipolar Constant Current (48S1)

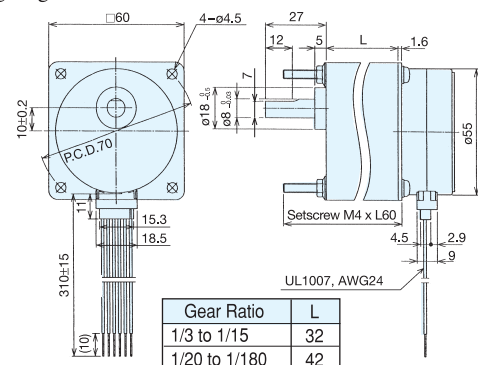


Coil resistance: 8Ω
Supply voltage: 24V

Dimensions of Geared Model

PFC55H with F(BB) Gear Head

F(BB) gear head provides ball bearing supports for all stages, thereby ensuring long service life.



Gear ratio	1/3	1/5	2/15	1/10	2/25	1/15	1/20
Max. allowable torque	400mN·m	500mN·m	600mN·m	800mN·m			
Gear ratio	1/25	1/30	1/50	1/60			
Max. allowable torque	900mN·m	1100mN·m	1600mN·m				
Gear ratio	1/75	1/100	1/125	1/150	1/180		
Max. allowable torque	2500mN·m						

Torque curves are drawn for reference and not guaranteed.

