

Precision Step Motors

Products

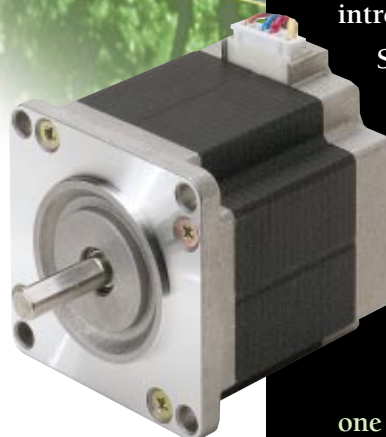
NIMB
CORPORATION

PEOPLE
PRODUCTS
VISION

A Minebea Group Company



Products



Keeping The World In Motion

An established industry leader in the design and manufacture of precision stepping motors, NMB Corporation offers a broad range of standard and custom designs for OEM users. New precision stepping motors are introduced and specified in this catalog: the new 17PM-K and 17PU-H SMH series are sheet metal construction type hybrid motors, our high-torque hybrid 17PM-K series, our new microstep, low-noise, high-torque 23LM/KM hybrid motor series, and added availability of the 15, 17 and 23 size permanent magnet motors. These new offerings reflect our commitment to advanced engineering design, leading-edge production technology and ongoing quality control programs that assure total customer satisfaction.

With our complete in-house volume production capabilities and one of the largest tool and die centers in the industry, NMB continues its dedication to vertical integration, which results in high product quality at competitive pricing schedules. The company's facilities allow for the internal production of miniature precision bearings, die casting, lamination stamping and injection molding.

A leader in materials research, automated production technology and continuous quality improvement, NMB has earned ISO 9001, ISO 9002 and QS 9000 certification. In addition, the company has been recognized for its pioneering environmental safety efforts since March 1993 with the award of ISO 14001 environmental certification in 1997. All NMB companies and subsidiaries are CFC and trichloroethane free.

As one of the Minebea group of companies, NMB has extensive resources at its disposal to satisfy the most demanding requirements of its worldwide customer base. Plus, our global technical support staff is always available to discuss solutions for your particular engineering application.

NMB
CORPORATION

P E O P L E
P R O D U C T S
V I S I O N

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ISO 14001

ISO 9001

ISO 9002

QS 9000



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HYBRID MOTORS

Motor Diameter	Model Number	Step Angle	Rated Voltage	Rated Current	Winding Resistance	Inductance	Holding Torque		Rotor Inertia		Page
Inches		Degrees	Volts	Amps	Ohms	mH	g-cm	oz-in	g-cm ²	oz-in ²	
1.4"	14PM-M204	1.8	12.00	0.18	65.0	24.0	330	5	11.0	0.060	7
	14PM-M206	1.8	5.20	0.40	13.0	4.8	330	5	11.0	0.060	
1.6"	16PY-Q207	0.9	10.00	0.25	40.0	8.5	380	5	13.0	0.071	8
	16PY-Q204	0.9	3.96	0.90	4.4	1.6	500	7	13.0	0.071	
	16PU-M003	3.75	4.20	0.70	6.0	4.0	700	10	17.0	0.093	9
1.7"	16PU-M006	3.75	7.60	0.40	19.5	10.5	700	10	17.0	0.093	
	17PM-K016V	1.8	8.80	0.40	22.0	19.5	1,500	21	34.0	0.186	10-11
	17PM-K017V	1.8	4.40	0.80	5.5	5.7	1,500	21	34.0	0.186	
	17PM-K018V	1.8	3.00	1.20	2.5	2.8	1,500	21	34.0	0.186	
	17PM-K316V	1.8	9.60	0.40	24.0	25.8	1,700	24	45.0	0.246	
	17PM-K301V	1.8	4.80	0.80	6.0	7.1	1,700	24	45.0	0.246	
	17PM-K303V	1.8	3.20	1.20	2.7	3.3	1,700	24	45.0	0.246	
	17PM-K111V	1.8	10.00	0.40	25.0	33.4	2,200	31	56.0	0.306	
	17PM-K101V	1.8	5.00	0.80	6.2	8.6	2,200	31	56.0	0.306	
	17PM-K103V	1.8	3.60	1.20	3.0	4.4	2,200	31	56.0	0.306	
	17PM-K402V*	1.8	6.00	0.80	7.5	7.0	3,400	47	75.0	0.410	
	17PW-M003	1.875	4.90	0.65	7.5	6.2	1,200	17	17.0	0.093	12
	17PS-M001V	3.6	3.20	0.40	7.9	5.4	450	6	17.0	0.093	13
	17PU-H008V	3.75	3.70	0.90	4.1	2.9	600	8	34.0	0.186	14
	17PU-H010V	3.75	4.80	0.80	6.0	3.4	750	10	34.0	0.186	
	17PU-H309V	3.75	6.10	0.80	7.6	5.2	1,000	14	45.0	0.246	
	17PU-H312V	3.75	9.50	0.50	19.0	17.0	1,000	14	45.0	0.246	
	17PM-K204VT**	1.8	2.40	0.80	3.0	2.6	1,250	17	28.0	0.153	
	17PM-K018VT**	1.8	3.50	1.00	3.5	2.7	1,700	24	34.0	0.186	15
	17PU-H204VT**	3.75	2.40	0.80	3.0	2.1	750	10	28.0	0.153	
	17PU-H018VT**	3.75	3.50	1.00	3.5	2.0	1,150	16	34.0	0.186	
2.3"	23LY-C205	0.9	4.00	1.10	3.6	5.3	3,000	42	55.0	0.301	16
	23LY-C201	0.9	5.50	0.78	7.1	8.3	3,000	42	55.0	0.301	
	23LY-C202	0.9	3.75	1.25	3.0	4.5	3,000	42	55.0	0.301	
	23LY-C301	0.9	3.00	1.70	1.8	4.5	4,000	56	110.0	0.601	
	23LY-C303	0.9	5.10	1.00	5.1	13.0	4,000	56	110.0	0.601	
	23LY-C305	0.9	6.00	0.85	7.1	18.0	4,000	56	110.0	0.601	
	23LY-C002	0.9	4.30	1.60	2.7	7.2	4,800	67	160.0	0.875	
	23LY-C001	0.9	8.50	0.85	10.0	30.0	4,800	67	160.0	0.875	
	23LM-C250V	1.8	3.00	1.50	2.0	2.5	3,200	44	55.0	0.301	17
	23LM-C213V	1.8	2.20	2.00	1.1	1.3	3,200	44	55.0	0.301	
	23LM-C343V	1.8	3.30	1.50	2.2	3.5	4,300	60	110.0	0.601	
	23LM-C355V	1.8	2.50	2.00	1.25	2.3	4,300	60	110.0	0.601	
	23LM-C047V	1.8	4.70	1.50	3.1	6.1	5,200	72	160.0	0.875	
	23LM-C055V	1.8	3.40	2.00	1.7	3.5	5,200	72	160.0	0.875	
	23LM-K250V	1.8	3.00	1.50	2.0	3.0	2,400	33	55.0	0.301	
	23LM-K213V	1.8	2.20	2.00	1.1	1.6	2,400	33	55.0	0.301	
	23LM-K343V	1.8	3.30	1.50	2.2	3.9	3,400	47	110.0	0.601	18
	23LM-K355V	1.8	2.50	2.00	1.25	2.6	3,400	47	110.0	0.601	
	23LM-K047V	1.8	4.70	1.50	3.1	6.5	4,000	56	160.0	0.875	
	23LM-K055V	1.8	3.40	2.00	1.7	3.7	4,000	56	160.0	0.875	
	23KM-C250V	1.8	3.30	1.50	2.2	2.6	4,400	61	150.0	0.820	
	23KM-C379V	1.8	4.10	1.50	2.7	3.6	8,000	111	230.0	1.257	
	23KM-C032V	1.8	5.10	1.50	3.4	5.4	9,500	132	280.0	1.530	
	23KM-C716V	1.8	6.30	1.50	4.2	6.8	14,000	194	440.0	2.405	19
	23KM-K250V	1.8	3.30	1.50	2.2	3.1	3,700	51	150.0	0.820	
	23KM-K379V	1.8	4.10	1.50	2.7	4.2	5,600	78	230.0	1.257	
	23KM-K032V	1.8	5.10	1.50	3.4	6.4	7,400	103	280.0	1.531	
	23KM-K716V	1.8	6.30	1.50	4.2	8.0	12,000	167	440.0	2.405	20

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HYBRID MOTORS (cont'd.)

Motor Diameter	Model Number	Step Angle	Rated Voltage	Rated Current	Winding Resistance	Inductance	Holding Torque	Rotor Inertia	Page
Inches		Degrees	Volts	Amps	Ohms	mH	g-cm	oz-in	g-cm ² oz-in ²
2.3" (cont'd.)	23LQ-C202V	5.0	3.90	1.10	3.5	4.0	2,300	32	55.0 0.301
	23LQ-C309V	5.0	6.75	1.00	6.75	8.6	3,100	43	110.0 0.601
	23LQ-C055V	5.0	3.40	2.00	1.7	2.7	3,600	50	160.0 0.875
3.4"	34PM-C101	1.8	3.00	4.00	0.75	3.5	20,000	278	1,100.0 6.014
	34PM-C108	1.8	12.00	1.00	12.0	56.0	20,000	278	1,100.0 6.014
	34PM-C007	1.8	5.50	1.25	4.4	14.5	12,000	167	560.0 3.062
	34PM-C049	1.8	1.70	4.70	0.36	1.7	12,000	167	560.0 3.062

*NMB's new 17 size high-torque motor **NMB's new sheet metal hybrid (SMH) motor series

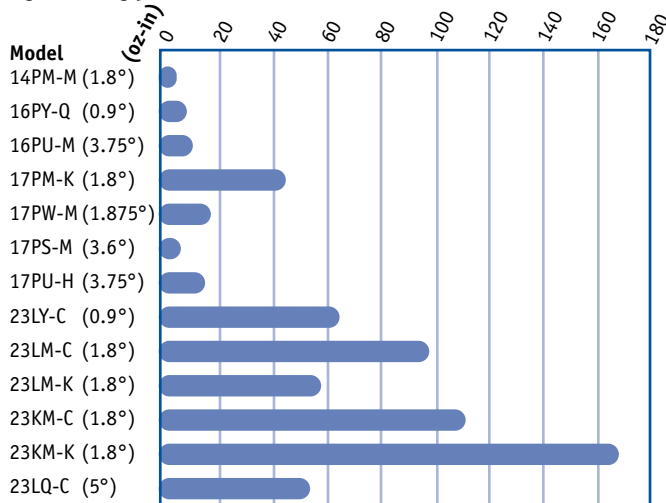
PERMANENT MAGNET MOTORS

Motor Diameter	Model Number	Step Angle	Rated Voltage	Rated Current	Winding Resistance	Inductance	Holding Torque	Rotor Inertia	Page
Inches		Degrees	Volts	Amps	Ohms	mH	g-cm	oz-in	g-cm ² oz-in ²
0.6"	06BJ-H005	18.0	5.0	0.25	20.0	7.0	27	0	0.06 0.0003
	06BJ-H012	18.0	12.0	0.12	100.0	37.0	30	0	0.06 0.0003
0.8"	08BJ-H007	18.0	3.8	0.19	20.0	7.0	40	1	0.2 0.001
	08BJ-H040	18.0	2.1	0.35	6.0	5.0	40	1	0.2 0.001
1.5"	15BA-H051P	15.0	8.0	0.23	35.0	18.0	165	2	4.0 0.022
	15BA-H073P	15.0	4.0	0.40	10.0	5.0	155	2	4.0 0.022
	15BA-H043P	15.0	2.0	0.80	2.5	3.4	220	3	4.0 0.022
	15BB-H051P	7.5	8.0	0.23	35.0	27.0	165	2	4.0 0.022
	15BB-H073P	7.5	4.0	0.40	10.0	6.7	155	2	4.0 0.022
	15BB-H170P	7.5	6.6	0.22	30.0	17.0	190	3	1.5 0.008
	15BB-H043P	7.5	2.0	0.80	2.5	4.5	205	3	4.0 0.022
1.7"	17BB-H262P	7.5	5.4	0.45	12.0	11.0	500	7	12.0 0.066
	17BB-H267P	7.5	7.5	0.30	25.0	19.0	480	7	12.0 0.066
	17BB-H240P	7.5	5.4	0.45	12.0	27.0	670	9	12.0 0.066
2.3"	23BB-H251P	7.5	5.0	0.75	6.6	9.0	1,200	17	30.0 0.164
	23BB-H252P	7.5	12.0	0.34	36.0	32.0	1,200	17	30.0 0.164
	23BB-H246P	7.5	4.9	0.75	6.5	17.0	1,400	19	30.0 0.164

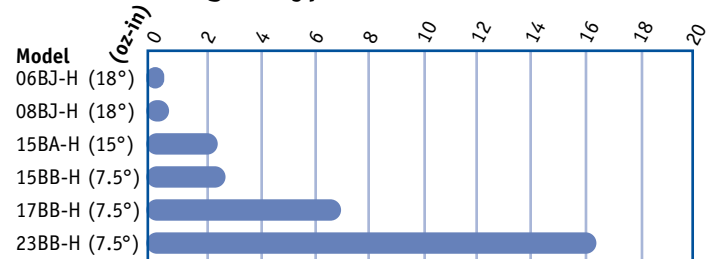
STEP MOTOR PERFORMANCE

Holding Torque Range

Hybrid Type



Permanent Magnet Type



PART NUMBERING SYSTEM

23 L M - K 0 01 - 01

Size

Motor O.D. in tenths of an inch.
(Example: Size 23 = 2.3" Dia.)

Type

B = Permanent Magnet
L = Precision, Hybrid
K = Precision, Hybrid
P = Precision, Hybrid

Step Angle

A = 15°
B = 7.5°
J = 18°
M = 1.8°
Q = 5.0°
S = 3.6°
U = 3.75°
W = 1.875°
Y = 0.9°

Versions

01 to 99 = standard
L1 to L9 = with leadscrew
G1 to G9 = with gear
P1 to P9 = with pulley

Different Windings

01 to 99

Motor Lengths

0 to 9

Motor Construction

C = 2 & 4 phase Hybrid
H = 2 & 4 phase PM
K = 2 & 4 phase Hybrid
M = 2 & 4 phase Hybrid
Q = 2 & 4 phase Hybrid

CUSTOM FEATURES

NMB will modify the step motors in this catalog to meet your application-specific requirements by customizing these features:

- Pulley/Gears
- Windings
- Re-Wire Ends
- Shaft
- Connector or Wire On Lead
- Termination
- Mount
- Tapped Encoder Holes

SIZE/STEP ANGLE MATRIX

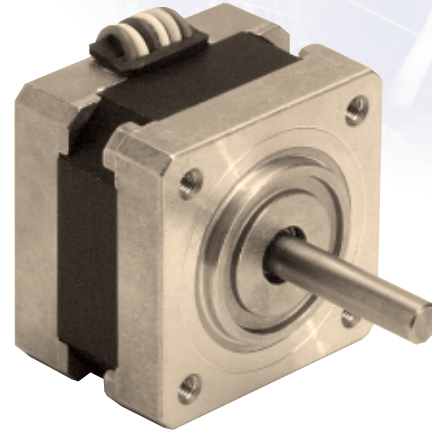
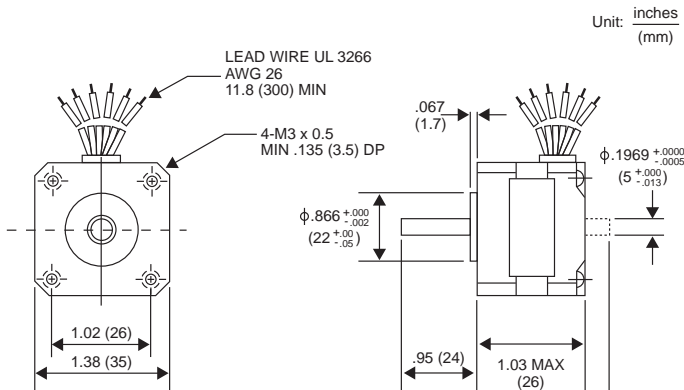
Size (x 0.1 inch)		06	08	14	15	16	17	23	34
Size (mm)		15	20	34	35	39	42	56	86
Step Angle (Degree)	0.9								
	1.8								
	1.875								
	3.6								
	3.75								
	5								
	7.5								
	15								
	18								

Hybrid Type

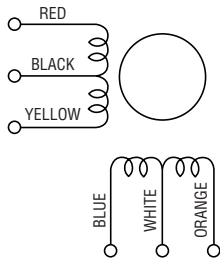
Permanent Magnet Type

14PM-M 1.8° HYBRID

14PM-M 1.8° HYBRID



WINDING DIAGRAM



GENERAL SPECIFICATIONS

Step Angle	1.8°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100M Ω Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence	See page 31

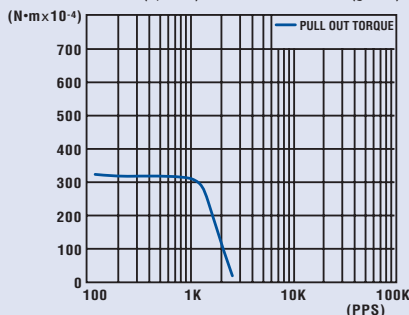
MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
14PM-M204	12.0	0.18	65.0	330	24.0	11.0	50	110
14PM-M206	5.2	0.4	13.0	330	4.8	11.0	50	110

TORQUE/SPEED CHARACTERISTICS

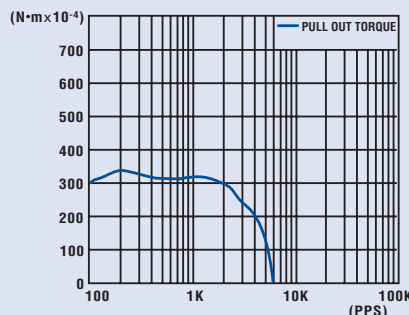
Model: 14PM-M204

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.18 (A/WDG) • Load Inertia: 34.0 (g-cm²)

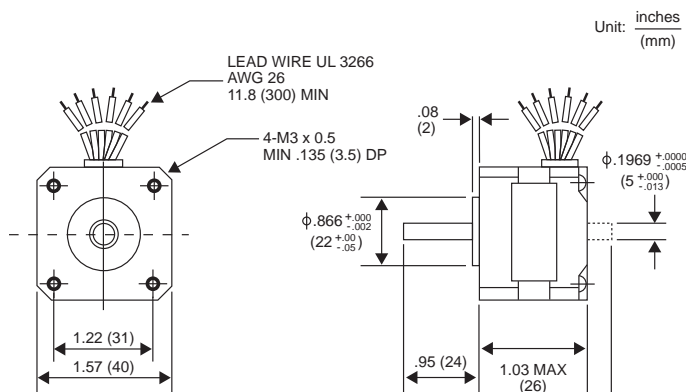
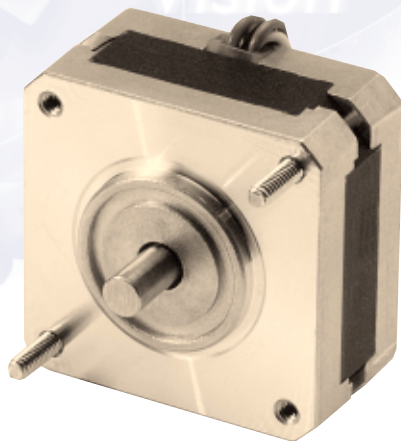


Model: 14PM-M206

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.40 (A/WDG) • Load Inertia: 34.0 (g-cm²)



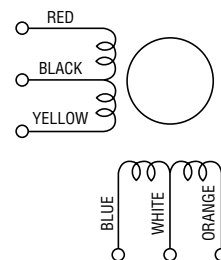
16PY-Q 0.9° HYBRID



GENERAL SPECIFICATIONS

Step Angle	0.9°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100MΩ Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence	See page 31

WINDING DIAGRAM



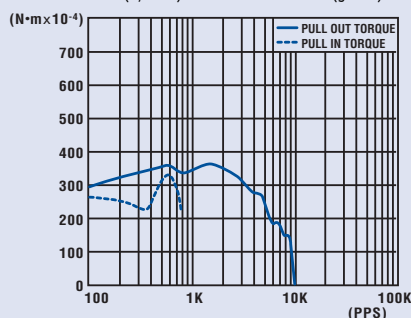
MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
16PY-Q207	10.00	0.25	40.00	380	8.5	13.0	30	120
16PY-Q204	3.96	0.90	4.40	500	1.6	13.0	30	120

TORQUE/SPEED CHARACTERISTICS

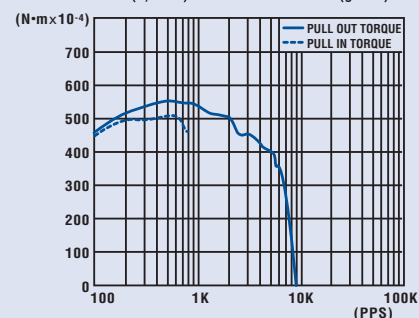
Model: 16PY-Q207

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.25 (A/WDG) • Load Inertia: 34.0 (g-cm²)



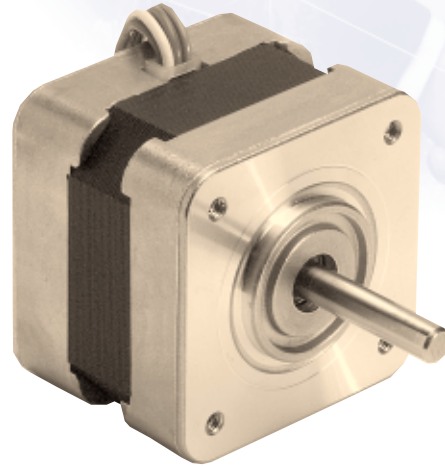
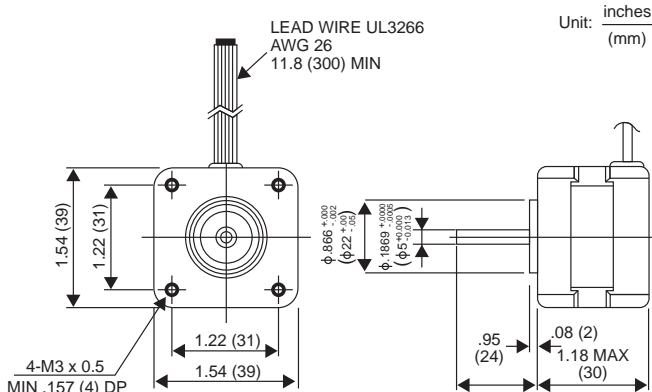
Model: 16PY-Q204

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.90 (A/WDG) • Load Inertia: 34.0 (g-cm²)

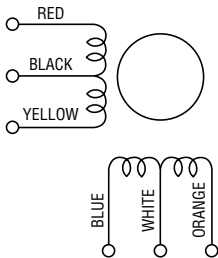


16PU-M 3.75° HYBRID

16PU-M 3.75° HYBRID



WINDING DIAGRAM



GENERAL SPECIFICATIONS

Step Angle	3.75°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100MΩ Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence	See page 31

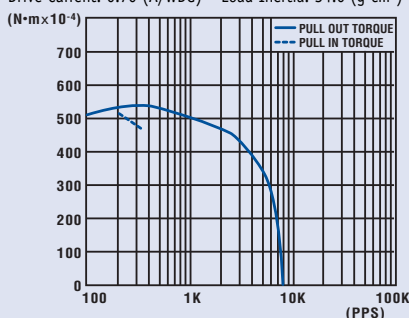
MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
16PU-M003	4.20	0.70	6.0	700	4.0	17.0	110	175
16PU-M006	7.60	0.40	19.5	700	10.5	17.0	110	175

TORQUE/SPEED CHARACTERISTICS

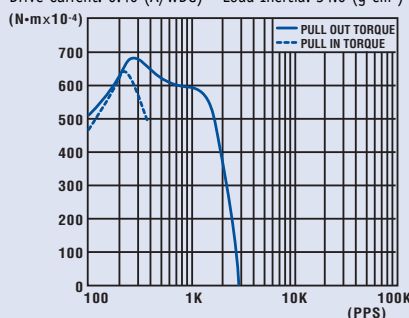
Model: 16PU-M003

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.70 (A/WDG) • Load Inertia: 34.0 (g-cm²)

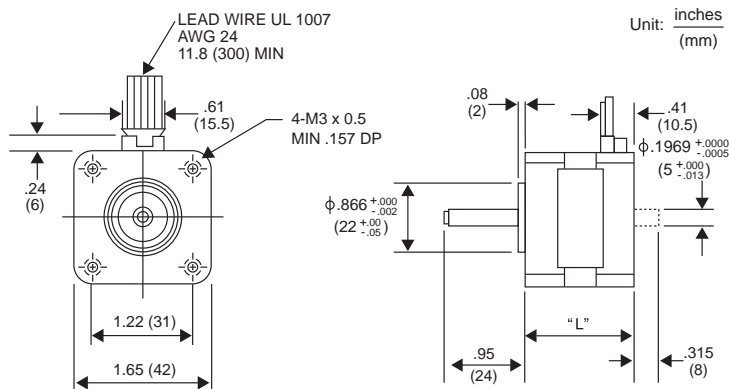


Model: 16PU-M006

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.40 (A/WDG) • Load Inertia: 34.0 (g-cm²)



17PM-K 1.8° HYBRID



P/N	"L"
17PM-K0XX	1.34 (34)
17PM-K3XX	1.50 (38.1)
17PM-K1XX	1.57 (42.1)
17PM-K4XX	1.85 (47)

WINDING DIAGRAM

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g·cm	Inductance mH	Rotor Inertia g·cm ²	Detent Torque g·cm	Weight g
17PM-K016V	8.80	0.40	22.00	1,500	19.5	34.0	80	200
17PM-K017V	4.40	0.80	5.50	1,500	5.7	34.0	80	200
17PM-K018V	3.00	1.20	2.50	1,500	2.8	34.0	80	200
17PM-K316V	9.60	0.40	24.00	1,700	25.8	45.0	100	250
17PM-K301V	4.80	0.80	6.00	1,700	7.1	45.0	100	250
17PM-K303V	3.20	1.20	2.70	1,700	3.3	45.0	100	250
17PM-K111V	10.00	0.40	25.00	2,200	33.4	56.0	120	300
17PM-K101V	5.00	0.80	6.20	2,200	8.6	56.0	120	300
17PM-K103V	3.60	1.20	3.00	2,200	4.4	56.0	120	300
17PM-K402V	6.00	0.80	7.50	3,400	7.0	75.0	200	350

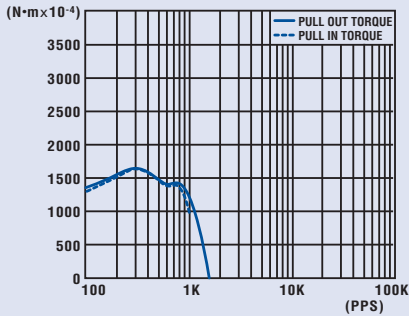
17PM-K 1.8° HYBRID

17PM-K 1.8° HYBRID

TORQUE/SPEED CHARACTERISTICS

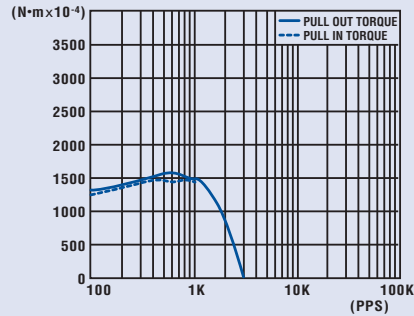
Model: 17PM-K016V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.40 (A/WDG) • Load Inertia: 34.0 (g-cm²)



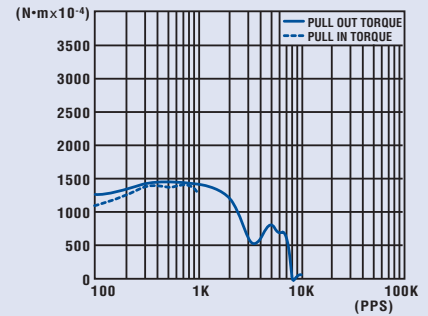
Model: 17PM-K017V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.80 (A/WDG) • Load Inertia: 34.0 (g-cm²)



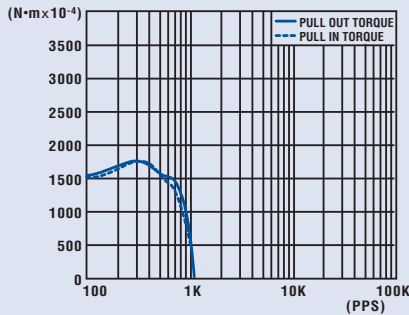
Model: 17PM-K018V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 1.20 (A/WDG) • Load Inertia: 34.0 (g-cm²)



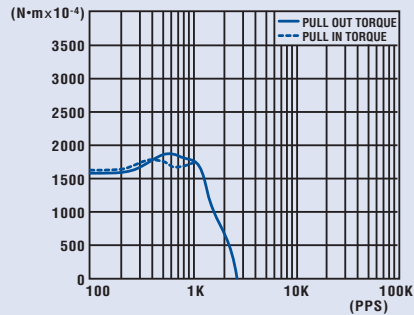
Model: 17PM-K316V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.40 (A/WDG) • Load Inertia: 34.0 (g-cm²)



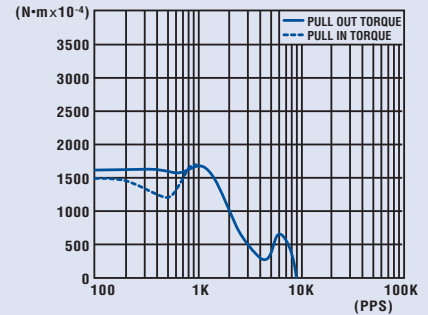
Model: 17PM-K301V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.80 (A/WDG) • Load Inertia: 34.0 (g-cm²)



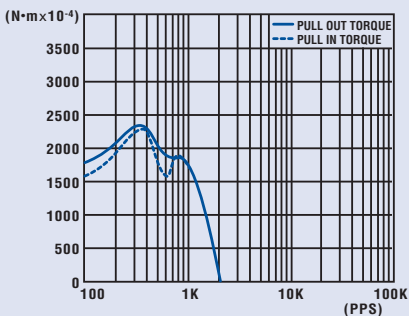
Model: 17PM-K303V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 1.20 (A/WDG) • Load Inertia: 34.0 (g-cm²)



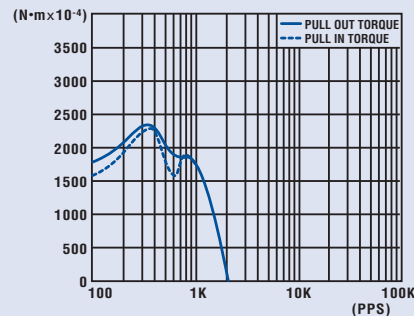
Model: 17PM-K111V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.40 (A/WDG) • Load Inertia: 34.0 (g-cm²)



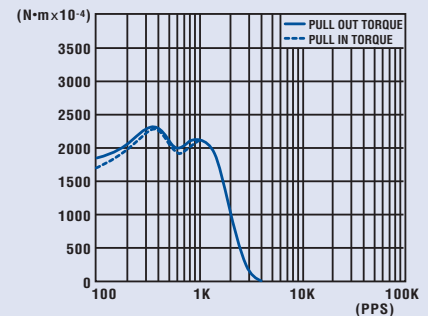
Model: 17PM-K101V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.80 (A/WDG) • Load Inertia: 34.0 (g-cm²)

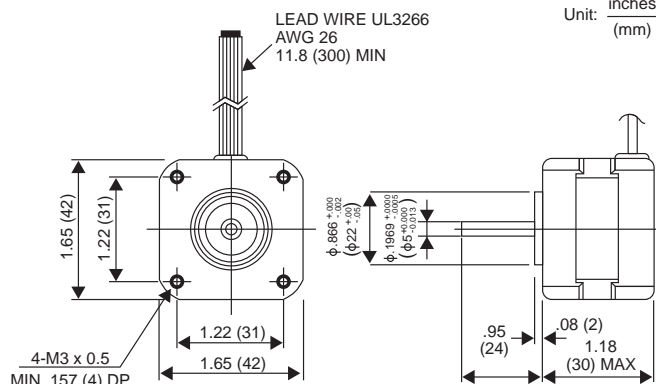
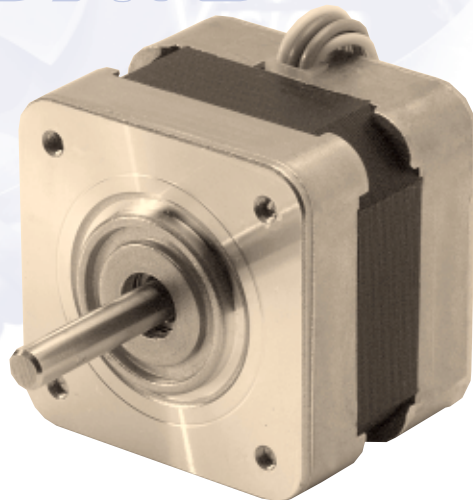


Model: 17PM-K103V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 1.20 (A/WDG) • Load Inertia: 34.0 (g-cm²)



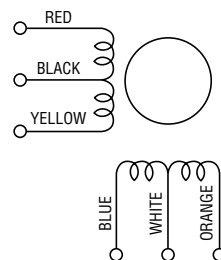
17PW-M 1.875° HYBRID



GENERAL SPECIFICATIONS

Step Angle	1.875°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100MΩ Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence	See page 31

WINDING DIAGRAM

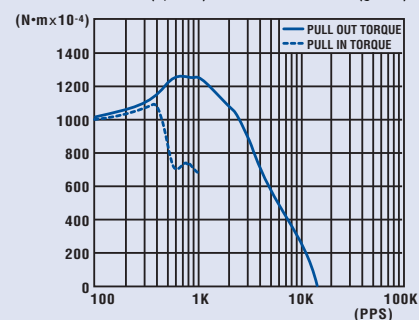


MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
17PW-M003	4.9	0.65	7.5	1,200	6.2	17.0	250	200

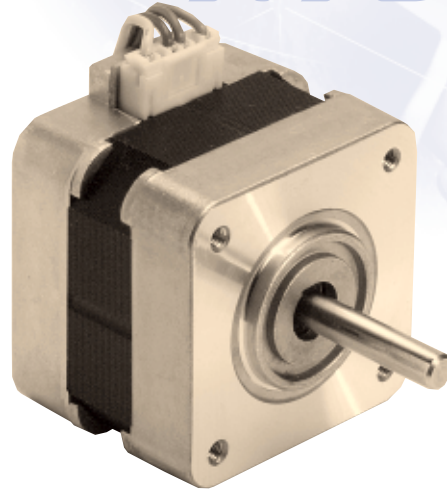
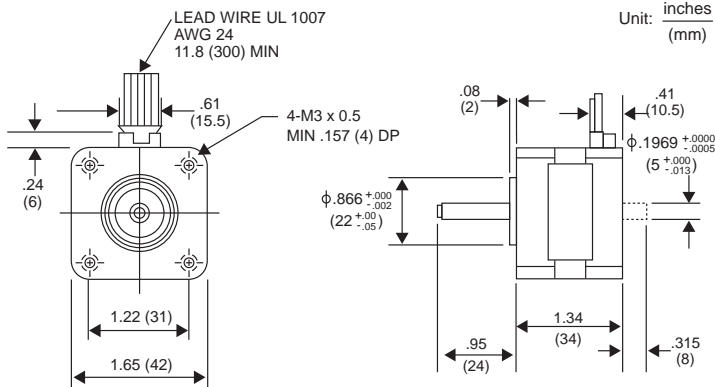
TORQUE/SPEED CHARACTERISTICS

Model: 17PW-M003
Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.65 (A/WDG) • Load Inertia: 34.0 (g-cm²)

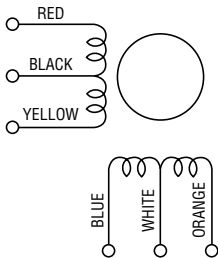


17PS-M 3.6° HYBRID

17PS-M 3.6° HYBRID



WINDING DIAGRAM



GENERAL SPECIFICATIONS

Step Angle	3.6°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100M Ω Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence	See page 31

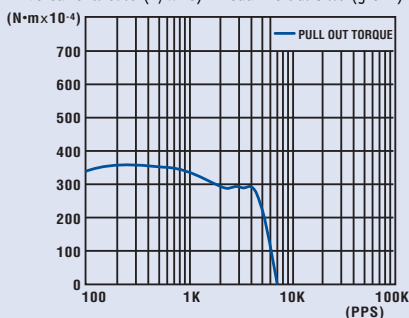
MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
17PS-M001V	3.2	0.4	7.9	450	5.4	17.0	50	200

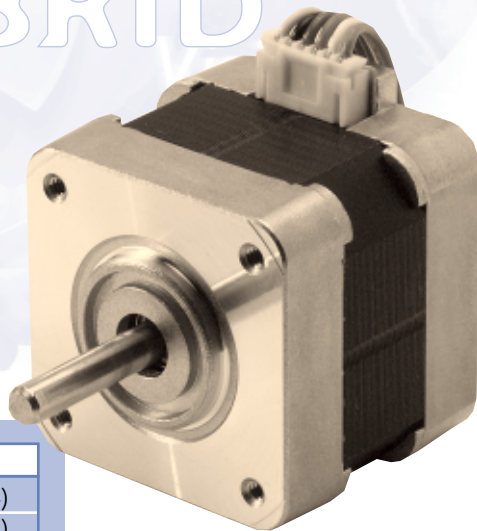
TORQUE/SPEED CHARACTERISTICS

Model: 17PS-M001V

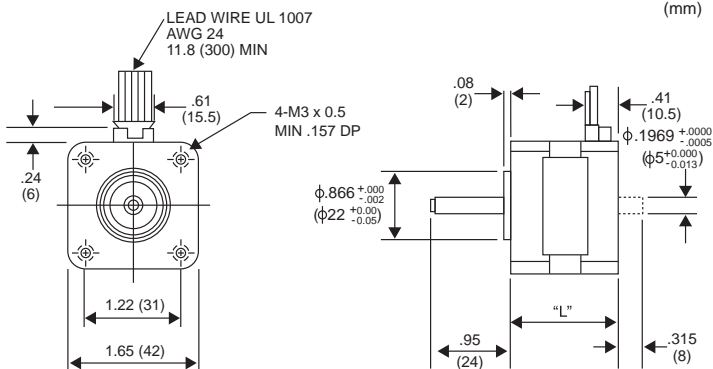
Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.40 (A/WDG) • Load Inertia: 34.0 (g-cm²)



17PU-H 3.75° HYBRID



Unit: inches
(mm)

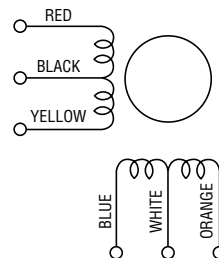


P/N	"L"
17PU-H0XX	1.34 (34)
17PU-H3XX	1.50 (38)

GENERAL SPECIFICATIONS

Step Angle	3.75°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100M Ω Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence	See page 31

WINDING DIAGRAM

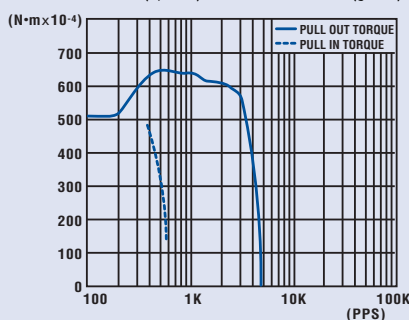


MODEL SPECIFICATIONS

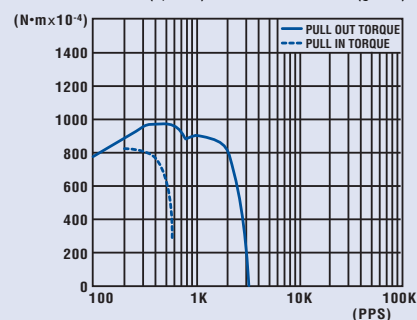
Model Number	Rated Voltage V	Rated Current/Phase A	Winding Resistance/Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
17PU-H008V	3.70	0.90	4.10	600	2.9	34.0	180	200
17PU-H010V	4.80	0.80	6.00	750	3.4	34.0	180	200
17PU-H309V	6.10	0.80	7.60	1,000	5.2	45.0	250	250
17PU-H312V	9.50	0.50	19.00	1,000	17.0	45.0	250	250

TORQUE/SPEED CHARACTERISTICS

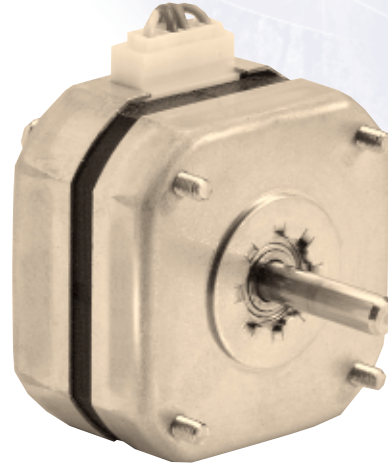
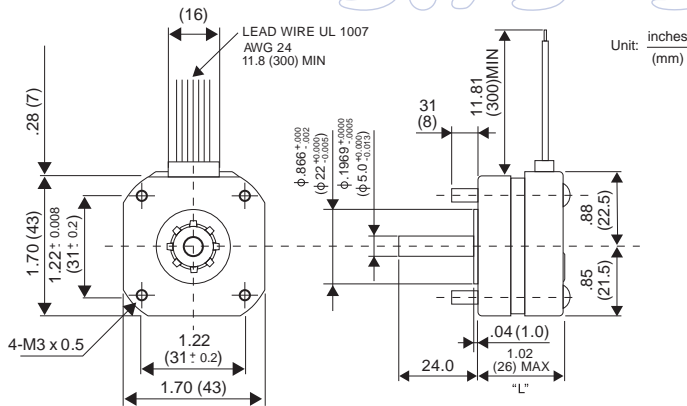
Model: 17PU-H010V
Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.80 (A/WDG) • Load Inertia: 34.0 (g-cm²)



Model: 17PU-H309V
Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.80 (A/WDG) • Load Inertia: 34.0 (g-cm²)



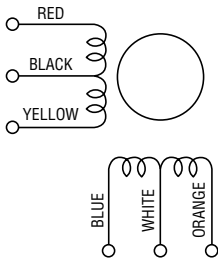
17PM-K 1.8° SMH HYBRID 17PU-H 3.75° SMH HYBRID



P/N	"L"
17PM-K2XX	1.02 (26)
17PM-K0XX	1.18 (30)
17PU-H2XX	1.02 (26)
17PU-H0XX	1.18 (30)

NOTE: Also available with winged mounting brackets.

WINDING DIAGRAM



GENERAL SPECIFICATIONS

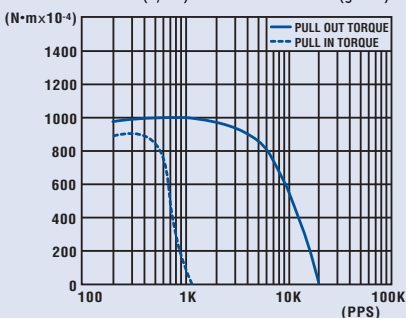
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100MΩ Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.10 mm Max. (450 g-load)
Switching Sequence	See page 31

MODEL SPECIFICATIONS

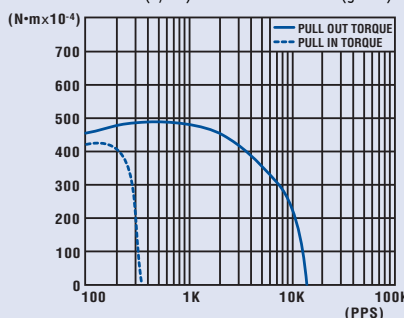
Model Number	Step Angle D	Rate Voltage V	Rated Current/Phase A	Winding Resistance/Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
17PM-K204VT	1.8	2.40	0.8	3.0	1,250	2.6	28.0	60	180
17PM-K018VT	1.8	3.50	1.0	3.5	1,700	2.7	34.0	70	220
17PU-H204VT	3.75	2.40	0.8	3.0	750	2.1	28.0	120	180
17PU-H018VT	3.75	3.50	1.0	3.5	1,150	2.0	34.0	150	220

TORQUE/SPEED CHARACTERISTICS

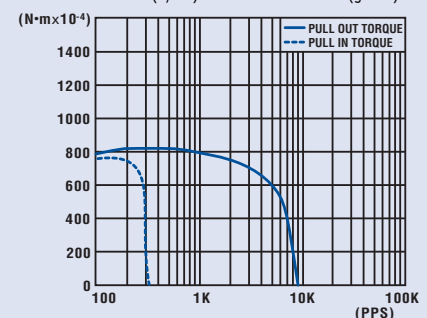
Model: 17PM-K204VT
Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.80 (A/PH) • Load Inertia: 27.0 (g-cm²)



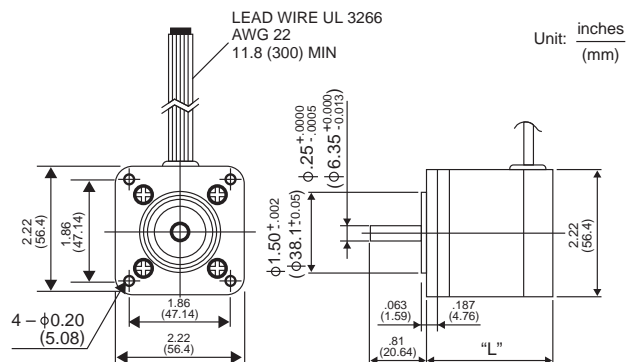
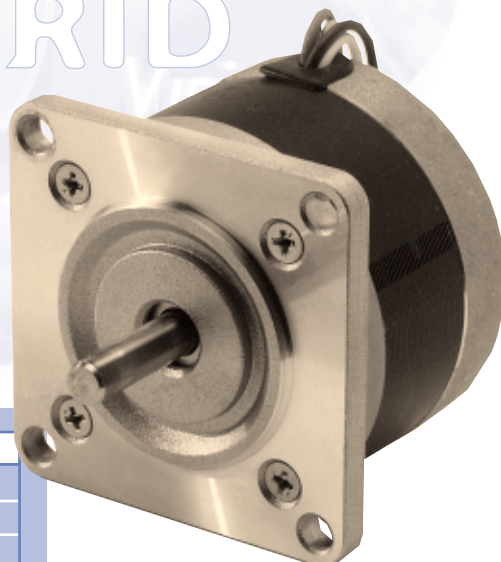
Model: 17PU-H204VT
Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.80 (A/PH) • Load Inertia: 27.0 (g-cm²)



Model: 17PU-H018VT
Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 1.00 (A/PH) • Load Inertia: 27.0 (g-cm²)



23LY-C 0.9° HYBRID

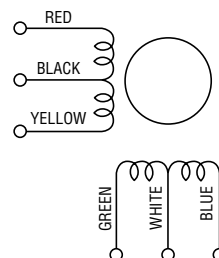


P/N	"L"
23LY-C2XX	1.61 (41.0)
23LY-C3XX	1.45 (49.5)
23LY-C0XX	2.22 (56.5)

GENERAL SPECIFICATIONS

Step Angle	0.9°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100MΩ Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence	See page 31

WINDING DIAGRAM



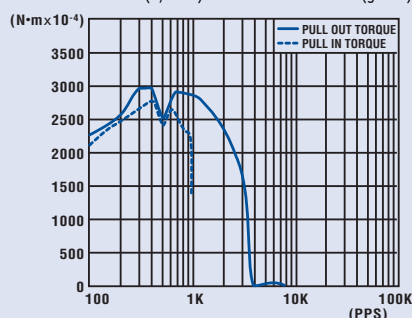
MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/Phase A	Winding Resistance/Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
23LY-C205	4.0	1.10	3.6	3,000	5.3	55.0	250	360
23LY-C201	5.5	0.78	7.1	3,000	8.3	55.0	250	360
23LY-C202	3.75	1.25	3.0	3,000	4.5	55.0	250	360
23LY-C301	3.0	1.70	1.8	4,000	4.5	110.0	300	450
23LY-C303	5.1	1.00	5.1	4,000	13.0	110.0	300	450
23LY-C305	6.0	0.85	7.1	4,000	18.0	110.0	300	450
23LY-C002	4.3	1.60	2.7	4,800	7.2	160.0	350	560
23LY-C001	8.5	0.85	10.0	4,800	30.0	160.0	350	560

TORQUE/SPEED CHARACTERISTICS

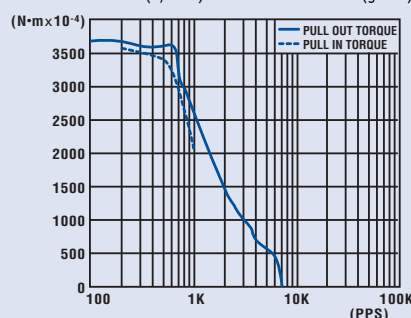
Model: 23LY-C202

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 1.25 (A/WDG) • Load Inertia: 172.0 (g-cm²)



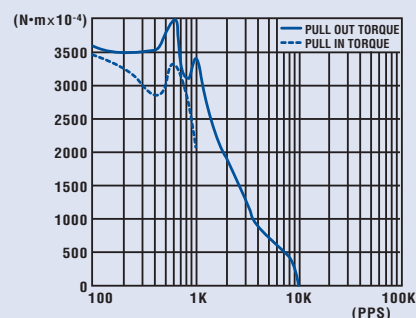
Model: 23LY-C305

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 0.80 (A/WDG) • Load Inertia: 166.0 (g-cm²)

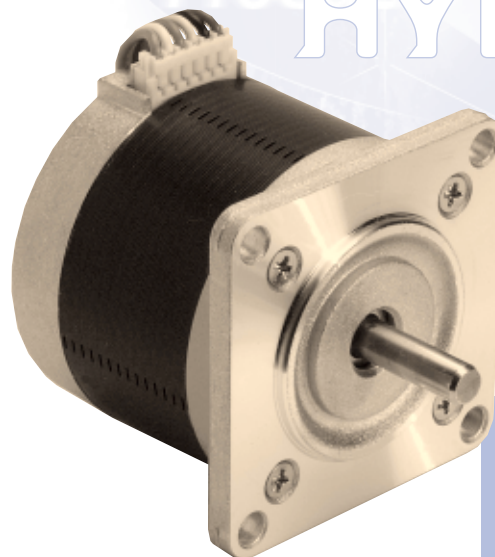
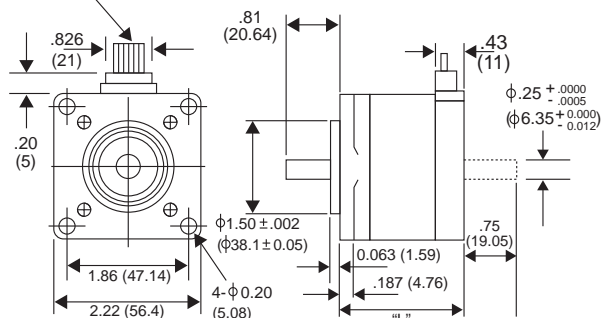


Model: 23LY-C002

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 1.60 (A/WDG) • Load Inertia: 147.0 (g-cm²)



2.3 LM-C 1.8° HYBRID

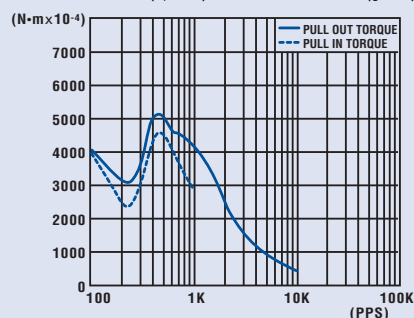
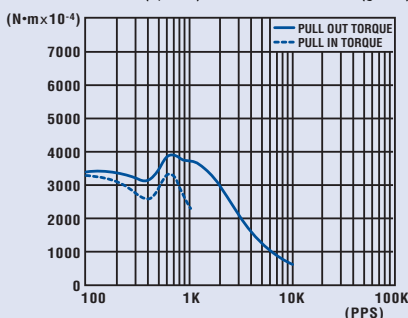
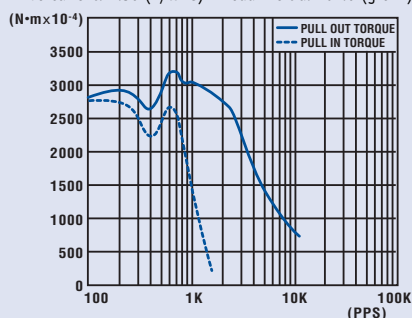
Unit: $\frac{\text{inches}}{(\text{mm})}$ 

P/N	"L"
23LM-C2XX	1.61 (41.0)
23LM-C3XX	1.95 (49.5)
23LM-C0XX	2.22 (56.5)

A schematic diagram of a transformer. It features a central circular core. On the left side of the core, there are three primary windings labeled RED, BLACK, and YELLOW from top to bottom. On the right side of the core, there are three secondary windings labeled BLUE, WHITE, and ORANGE from top to bottom. Each winding is represented by a series of loops around the core.

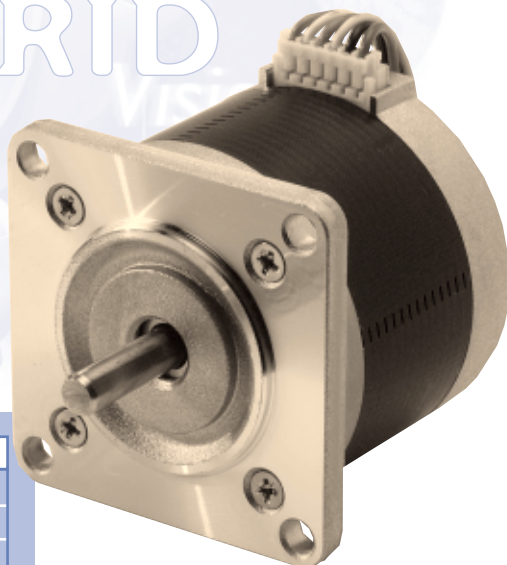
Step Angle	1.8°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance.....	100M Ω Min., 500 VDC
Dielectric Strength.....	500 VAC for 1 min.
Radial Play.....	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence.....	See page 31

Current/ Phase	Winding Resistance/ Phase	Holding Torque	Inductance	Rotor Inertia	Detent Torque	Weight
A	Ω	g-cm	mH	g-cm ²	g-cm	g
1.50	2.00	3,200	2.5	55.0	500	360
2.00	1.10	3,200	1.3	55.0	500	360
1.50	2.20	4,300	3.5	110.0	550	450
2.00	1.25	4,300	2.3	110.0	550	450
1.50	3.10	5,200	6.1	160.0	600	540
2.00	1.70	5,200	3.5	160.0	600	540



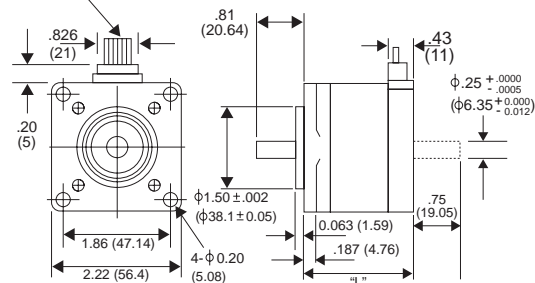
23LM-K 1.8° HYBRID

Microstep/
Low Noise Series



LEAD WIRE UL 1007
AWG 22
11.8 (300) MIN

Unit: inches
(mm)

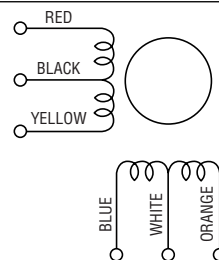


P/N	"L"
23LM-K2XX	1.61 (41.0)
23LM-K3XX	1.95 (49.5)
23LM-K0XX	2.22 (56.5)

GENERAL SPECIFICATIONS

Step Angle	1.8°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100M Ω Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence	See page 31

WINDING DIAGRAM



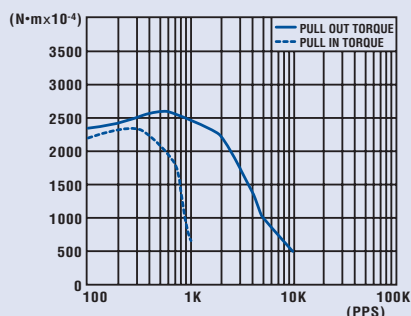
MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
23LM-K250V	3.00	1.50	2.00	2,400	3.0	55.0	180	360
23LM-K213V	2.20	2.00	1.10	2,400	1.6	55.0	180	360
23LM-K343V	3.30	1.50	2.20	3,400	3.9	110.0	230	450
23LM-K355V	2.50	2.00	1.25	3,400	2.6	110.0	230	450
23LM-K047V	4.70	1.50	3.10	4,000	6.5	160.0	260	540
23LM-K055V	3.40	2.00	1.70	4,000	3.7	160.0	260	540

TORQUE/SPEED CHARACTERISTICS

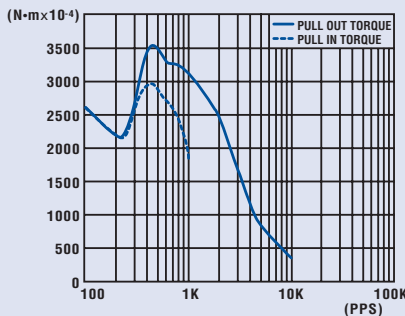
Model: 23LM-K250V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 1.50 (A/WDG) • Load Inertia: 161.0 (g-cm²)



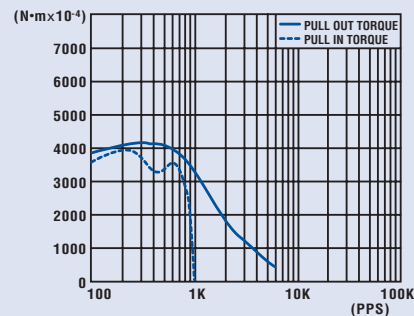
Model: 23LM-K343V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 1.50 (A/WDG) • Load Inertia: 161.0 (g-cm²)



Model: 23LM-K047V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
Drive Current: 1.50 (A/WDG) • Load Inertia: 161.0 (g-cm²)

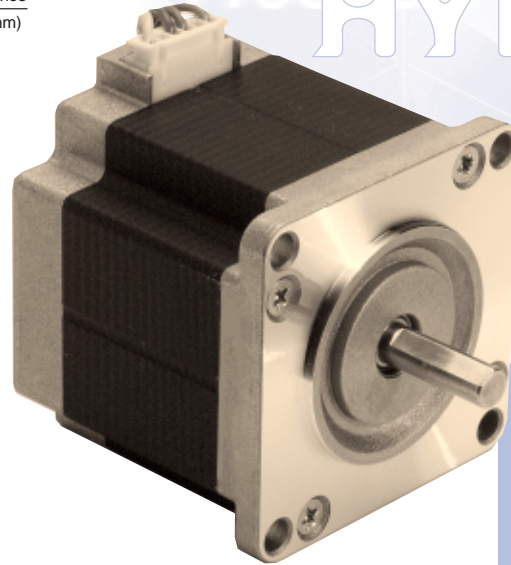
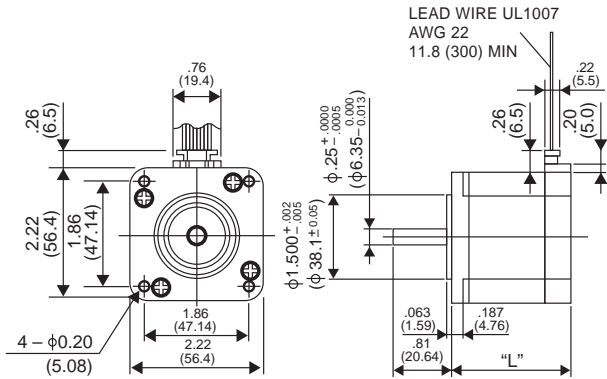


High Torque

23KM-C 1.8° HYBRID

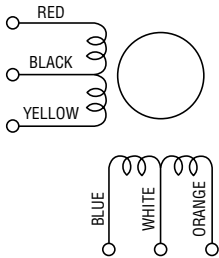
23KM-C 1.8° HYBRID

Unit: inches
(mm)



P/N	"L"
23KM-C2XX	1.65 (42)
23KM-C3XX	1.97 (50)
23KM-C0XX	2.13 (54)
23KM-C7XX	2.99 (76)

WINDING DIAGRAM



GENERAL SPECIFICATIONS

Step Angle 1.8°
 Step Angle Accuracy +/-5%
 Temperature Rise 80° C Max.
 Ambient Temperature Range -20° to +50° C
 Insulation Resistance 100MΩ Min., 500 VDC
 Dielectric Strength 500 VAC for 1 min.
 Radial Play 0.02 mm Max. (450 g-load)
 End Play 0.08 mm Max. (450 g-load)
 Switching Sequence See page 31

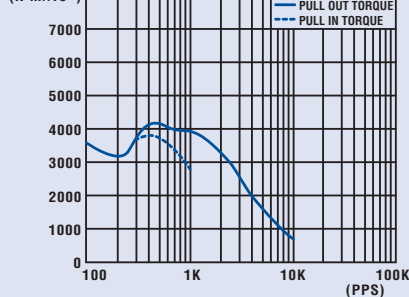
MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/Phase A	Winding Resistance/Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
23KM-C250V	3.30	1.50	2.20	4,400	2.6	150.0	200	470
23KM-C379V	4.10	1.50	2.70	8,000	3.6	230.0	300	590
23KM-C032V	5.10	1.50	3.40	9,500	5.4	280.0	350	680
23KM-C716V	6.30	1.50	4.20	14,000	6.8	440.0	600	1,050

TORQUE/SPEED CHARACTERISTICS

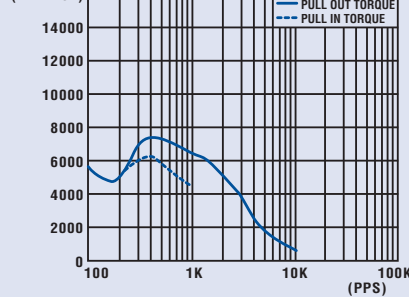
Model: 23KM-C250V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
 Drive Current: 1.50 (A/WDG) • Load Inertia: 161.0 (g-cm²)



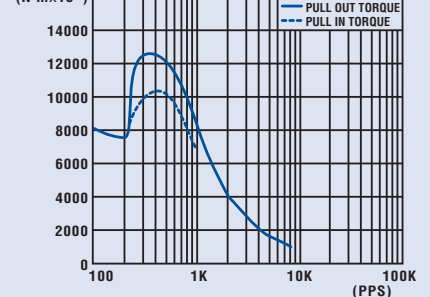
Model: 23KM-C379V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
 Drive Current: 1.50 (A/WDG) • Load Inertia: 161.0 (g-cm²)



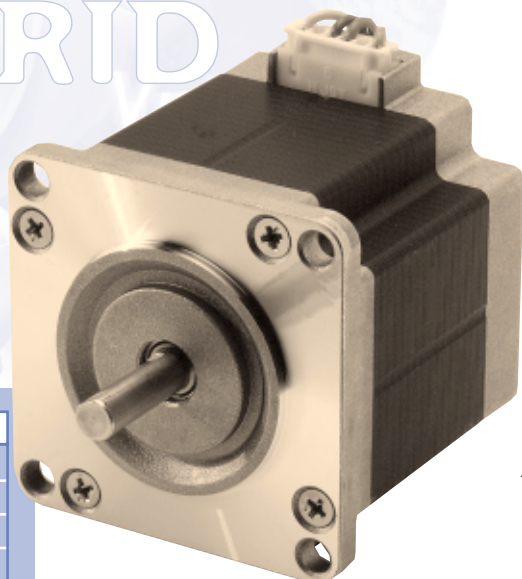
Model: 23KM-C716V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
 Drive Current: 1.50 (A/WDG) • Load Inertia: 161.0 (g-cm²)



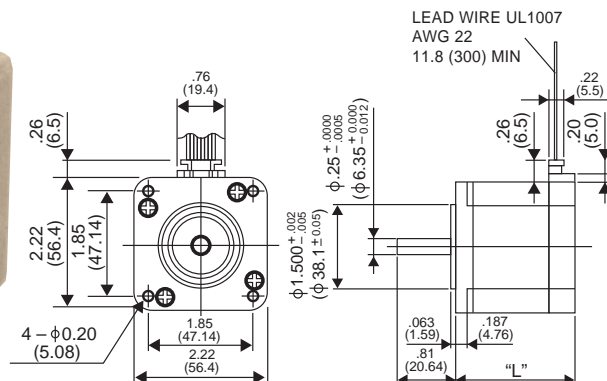
23KM-K 1.8° HYBRID

High Torque/
Microstep



Unit: $\frac{\text{inch}}{\text{mm}}$

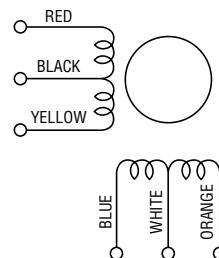
P/N	"L"
23KM-K2XX	1.65 (42)
23KM-K3XX	1.97 (50)
23KM-K0XX	2.13 (54)
23KM-K7XX	2.99 (76)



GENERAL SPECIFICATIONS

Step Angle 1.8°
 Step Angle Accuracy +/-5%
 Temperature Rise 80° C Max.
 Ambient Temperature Range -20° to +50° C
 Insulation Resistance 100M Ω Min., 500 VDC
 Dielectric Strength 500 VAC for 1 min.
 Radial Play 0.02 mm Max. (450 g-load)
 End Play 0.08 mm Max. (450 g-load)
 Switching Sequence See page 31

WINDING DIAGRAM



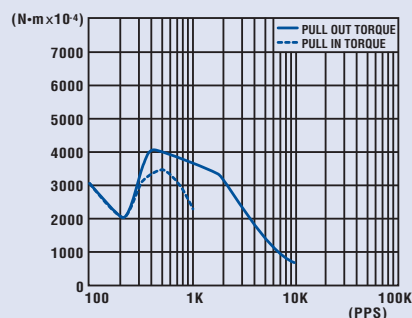
MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
23KM-K250V	3.30	1.50	2.20	3,700	3.1	150.0	200	470
23KM-K379V	4.10	1.50	2.70	5,600	4.2	230.0	300	590
23KM-K032V	5.10	1.50	3.40	7,400	6.4	280.0	350	680
23KM-K716V	6.30	1.50	4.20	12,000	8.0	440.0	600	1050

TORQUE/SPEED CHARACTERISTICS

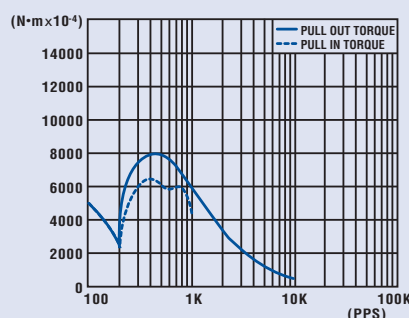
Model: 23KM-K250V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
 Drive Current: 1.50 (A/WDG) • Load Inertia: 161.0 (g-cm²)



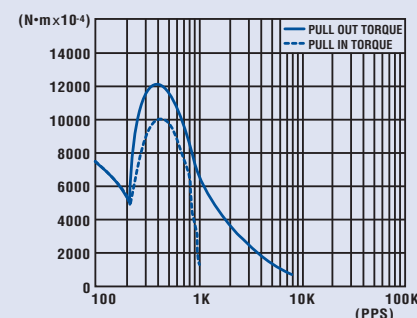
Model: 23KM-K032V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
 Drive Current: 1.50 (A/WDG) • Load Inertia: 161.0 (g-cm²)



Model: 23KM-K716V

Driver: Unipolar Chopper Dual • Supply Voltage: 24.0 (Volt)
 Drive Current: 1.50 (A/WDG) • Load Inertia: 161.0 (g-cm²)



23LQ-C5° HYBRID



Technical drawing of a mechanical part with dimensions in inches and millimeters. The drawing shows a cross-section of a cylindrical component with a central hole and a smaller hole on the right side. Dimensions are provided for various features:

- Top left hole: $.826$ (21)
- Top right hole: $.43$ (11)
- Central hole: $\phi 1.50 \pm .002$ ($\phi 38.1 \pm 0.05$)
- Right side hole: $\phi .25 \pm .000$ ($\phi 6.35 \pm 0.000$) and $\phi .25 \pm .000$ ($\phi 6.35 \pm 0.012$)
- Bottom left hole: $.20$ (5)
- Bottom right hole: $.75$ (19.05)
- Bottom center hole: $4-\phi .20$ (5.08)
- Bottom center hole: 1.85 (47.14)
- Bottom center hole: 2.20 (56.4)
- Bottom center hole: $.063$ (1.59)
- Bottom center hole: $.187$ (4.76)
- Bottom center hole: $.81$ (20.64)

A diagram of a 6-core cable. The top half shows three conductors labeled RED, BLACK, and YELLOW. The bottom half shows three conductors labeled BLUE, WHITE, and ORANGE. All conductors are connected to a central circular core.

Step Angle	5°
Step Angle Accuracy	+/-5%
Temperature Rise	80° C Max.
Ambient Temperature Range	-20° to +50° C
Insulation Resistance	100M Ω Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.02 mm Max. (450 g-load)
End Play	0.08 mm Max. (450 g-load)
Switching Sequence	See page 31

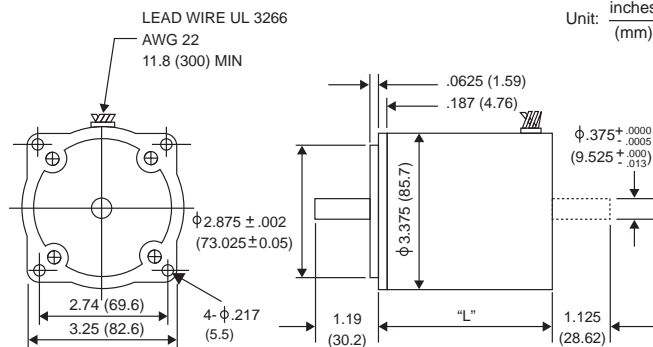
Model Number	Rated Voltage	Rated Current/Phase	Winding Resistance/Phase	Holding Torque	Inductance	Rotor Inertia	Detent Torque	Weight
	V	A	Ω	g-cm	mH	g-cm ²	g-cm	g
23LQ-C202V	3.9	1.1	3.50	2,300	4.0	55.0	370	360
23LQ-C309V	6.75	1.0	6.75	3,100	8.6	110.0	380	450
23LQ-C055V	3.4	2.0	1.70	3,600	2.7	160.0	450	540

TORQUE/SPEED CHARACTERISTICS

Figure 10 is a line graph showing Pull in and Pull out torque versus frequency. The y-axis represents torque in $\text{N} \cdot \text{m} \times 10^{-4}$, ranging from 0 to 3500. The x-axis represents frequency in PPS (Pulses Per Second), ranging from 100 to 100K on a logarithmic scale. Two curves are plotted: a solid line for 'PULL OUT TORQUE' and a dashed line for 'PULL IN TORQUE'. The pull out torque curve starts at approximately 2500 at 100 PPS, peaks at about 3000 at 300 PPS, and then drops to around 500 at 10K PPS. The pull in torque curve starts at approximately 2500 at 100 PPS, peaks at about 2500 at 200 PPS, and then drops sharply to around 500 at 10K PPS.

This graph shows the pull out torque (solid line) and pull in torque (dashed line) as a function of frequency in pulses per second (PPS) for the 1000W motor. The y-axis represents torque in $\text{N}\cdot\text{m}\times 10^{-4}$, ranging from 0 to 3500. The x-axis represents frequency in PPS on a logarithmic scale, ranging from 100 to 100,000. The pull out torque starts at approximately 1600 at 100 PPS, peaks at about 1900 between 400 and 1000 PPS, and then decreases to zero at approximately 4000 PPS. The pull in torque starts at approximately 1600 at 100 PPS and decreases linearly to zero at approximately 400 PPS.

34PM-C 1.8° HYBRID



P/N	"L"
34PM-C1XX	3.69 (93.7)
34PM-C0XX	2.44 (61.9)

WINDING DIAGRAM

A diagram of a 6-pin connector. On the left, three wires are bundled together and labeled 'RED', 'BLACK', and 'RED/WHITE' from top to bottom. On the right, three individual wires are shown, labeled 'GREEN', 'WHITE', and 'GREEN/WHITE' from left to right. A large circle is positioned between the two groups of wires, representing the connector's body.

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
34PM-C101	3.00	4.00	0.75	20,000	3.50	1,100.0	1,300	2,400
34PM-C108	12.00	1.00	12.00	20,000	56.00	1,100.0	1,300	2,400
34PM-C007	5.50	1.25	4.40	12,000	14.50	560.0	900	1,400
34PM-C049	1.70	4.70	0.36	12,000	1.65	560.0	900	1,400

Note: All models available with rear shafts.

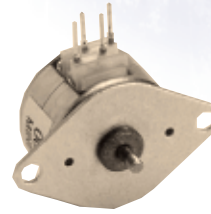
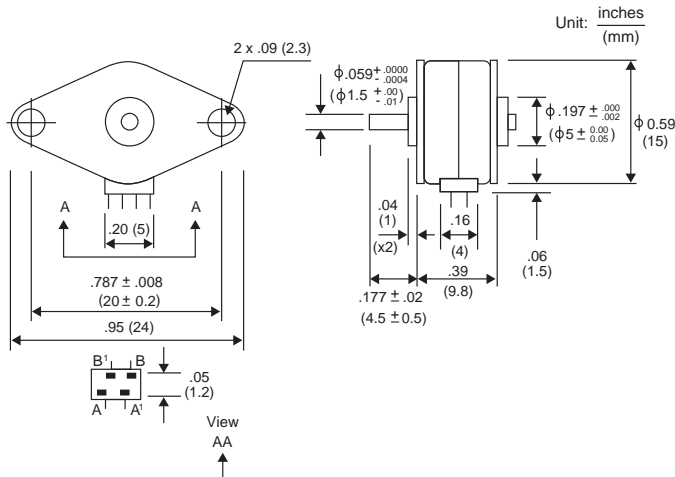
A line graph showing Pull Out Torque (KG-CM) on the y-axis (0 to 35) versus Pull In Torque (PPS) on the x-axis (logarithmic scale, 100 to 100K). The solid line represents the Pull Out Torque, which starts at approximately 16 KG-CM at 100 PPS, remains relatively constant until about 500 PPS, and then decreases to 0 at approximately 5000 PPS. The dashed line represents the Pull In Torque, which starts at approximately 16 KG-CM at 100 PPS, remains relatively constant until about 500 PPS, and then drops sharply to 0 at approximately 1000 PPS.

Frequency (PPS)	Pull Out Torque (N·m × 10⁻⁴)	Pull In Torque (N·m × 10⁻⁴)
100	10000	10000
1000	10800	8500
10000	3000	0
60000	0	0

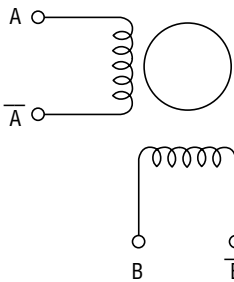
06BJ-H 18° PERMANENT MAGNET

06BJ-H 18°

PERMANENT MAGNET



WINDING DIAGRAM



GENERAL SPECIFICATIONS

Step Angle 18°
 Step Angle Accuracy +/- 1°
 Temperature Rise 80° C Max.
 Ambient Temperature Range -10° to +50° C
 Insulation Resistance 100MΩ Min., 500 VDC
 Dielectric Strength 500 VAC for 1 min.
 Radial Play 0.05 mm Max. (100 g-load)
 End Play 0.3 mm Max. (100 g-load)
 Switching Sequence See page 31

MODEL SPECIFICATIONS

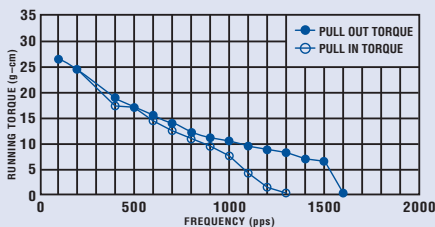
Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
06BJ-H005	5.0	0.25	20.0	27	7.0	0.06	2.5	8
06BJ-H012	12.0	0.12	100.0	30	37.0	0.06	2.5	8

Note: This size is available in a bipolar winding only.

TORQUE/SPEED CHARACTERISTICS

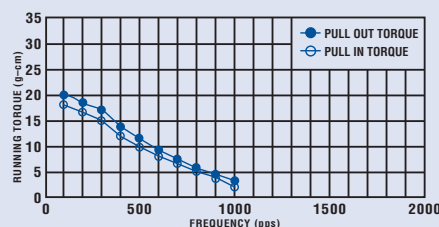
Model: 06BJ-H005

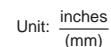
Driver: Bipolar L/R Drive Dual Step
 Supply Voltage: 5.0 (Volt)
 Drive Current: 0.25 (A/PH)



Model: 06BJ-H012

Driver: Bipolar L/R Drive Dual Step
 Supply Voltage: 12.0 (Volt)
 Drive Current: 12.0 (A/PH)





Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
Unipolar								
08BJ-H007	3.8	0.19	20.0	40	7.0	0.2	10	30
Bipolar								
08BJ-H040	2.1	0.35	6.0	40	5.0	0.2	10	30

The graph shows the relationship between running torque and frequency for two different torque types. The x-axis represents frequency in milliseconds (ms), ranging from 0 to 1500. The y-axis represents running torque in p-cm, ranging from 0 to 50. The 'PULL OUT TORQUE' is represented by a solid blue line with filled circles, and the 'PULL IN TORQUE' is represented by a dashed blue line with open circles. Both curves show a decreasing trend as frequency increases, with the pull out torque curve being consistently higher than the pull in torque curve.

FREQUENCY (ms)	PULL OUT TORQUE (p-cm)	PULL IN TORQUE (p-cm)
100	38	37
200	37	36
400	32	31
600	30	27
800	29	20
1000	27	10
1200	25	0
1400	23	-

TSBA-H 15° MAGNET



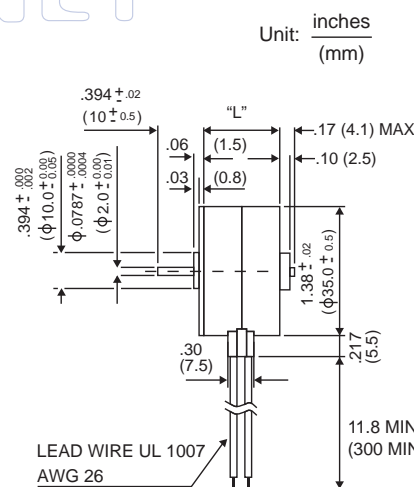
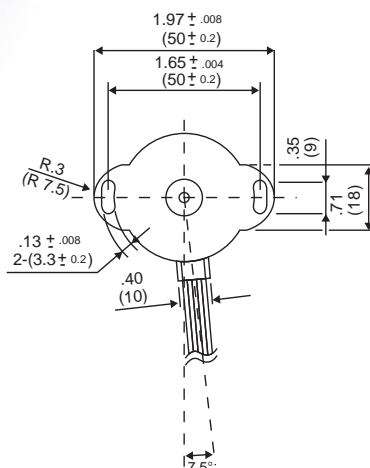
Step Angle	15°
Step Angle Accuracy.....	+/-1°
Temperature Rise.....	80° C Max.
Ambient Temperature Range	-10° to +50° C
Insulation Resistance.....	100M Ω Min., 500 VDC
Dielectric Strength.....	500 VAC for 1 min.
Radial Play.....	0.03 mm Max. (100 g-load)
End Play.....	0.3 mm Max. (100 g-load)
Switching Sequence.....	See page 31

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
Unipolar								
15BA-H051P	8.0	0.23	35.0	165	18.0	4.0	40	100
15BA-H073P	4.0	0.40	10.0	155	5.0	4.0	40	100
Bipolar								
15BA-H043P	2.0	0.80	2.5	220	3.4	4.0	40	100

A line graph showing the relationship between Running Torque (N-m) on the y-axis and Frequency (Hz) on the x-axis. The y-axis ranges from 0 to 250 in increments of 50. The x-axis ranges from 0 to 1500 in increments of 500. Two data series are plotted: 'PULL OUT TORQUE' (solid blue line with filled circles) and 'PULL IN TORQUE' (dashed blue line with open circles). The Pull Out Torque starts at 200 N-m at 250 Hz and decreases gradually to 140 N-m at 1350 Hz. The Pull In Torque starts at 200 N-m at 250 Hz and decreases sharply to 0 N-m at 550 Hz.

Frequency (Hz)	Pull Out Torque (N-m)	Pull In Torque (N-m)
250	200	200
400	185	115
550	175	0
700	155	-
1000	145	-
1200	140	-
1350	140	-

15BB-H 7.5° PERMANENT MAGNET



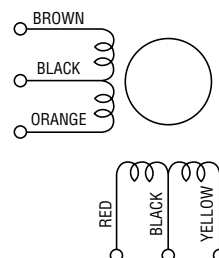
Unit: inches
(mm)

P/N	"L"
15BB-H0XX	.867 (20)
15BB-H1XX	.591 (15)

GENERAL SPECIFICATIONS

Step Angle 7.5°
 Step Angle Accuracy +/-0.5°
 Temperature Rise 80° C Max.
 Ambient Temperature Range -10° to +50° C
 Insulation Resistance 100MΩ Min., 500 VDC
 Dielectric Strength 500 VAC for 1 min.
 Radial Play 0.03 mm Max. (100 g-load)
 End Play 0.3 mm Max. (100 g-load)
 Switching Sequence See page 31

WINDING DIAGRAM

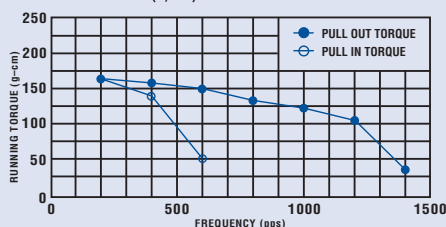


MODEL SPECIFICATIONS

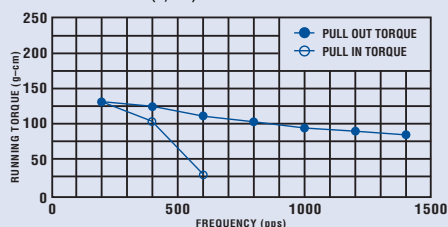
Model Number	Rated Voltage V	Rated Current/Phase A	Winding Resistance/Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
Unipolar								
15BB-H051P	8.0	0.23	35.0	165	27.0	4.0	30	100
15BB-H073P	4.0	0.40	10.0	155	6.7	4.0	30	100
15BB-H170P	6.6	0.22	30.0	190	17.0	1.5	35	65
Bipolar								
15BB-H043P	2.0	0.80	2.5	205	4.5	4.0	30	100

TORQUE/SPEED CHARACTERISTICS

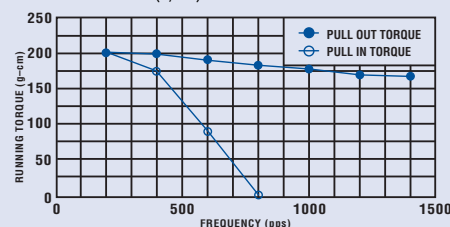
Model: 15BB-H051P
 Driver: Unipolar Chopper Dual
 Supply Voltage: 24.0 (Volt)
 Drive Current: 0.23 (A/PH)



Model: 15BB-H170P
 Driver: Unipolar Chopper Dual
 Supply Voltage: 24.0 (Volt)
 Drive Current: 0.22 (A/PH)



Model: 15BB-H043P
 Driver: Bipolar Chopper Dual
 Supply Voltage: 24.0 (Volt)
 Drive Current: 0.80 (A/PH)

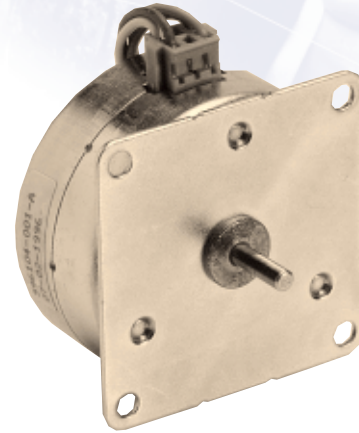
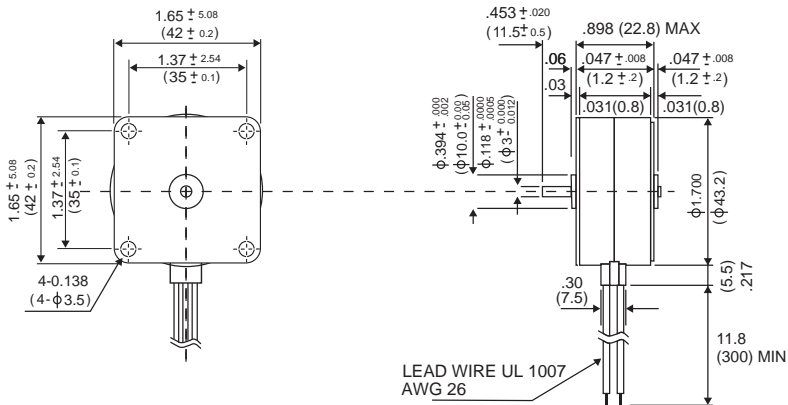


17BB-H 7.5° PERMANENT MAGNET

17BB-H 7.5°

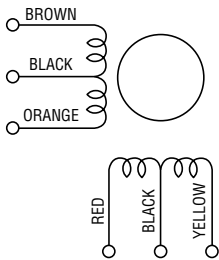
PERMANENT MAGNET

Unit: $\frac{\text{inches}}{(\text{mm})}$



NOTE: Also available with winged mounting brackets.

WINDING DIAGRAM



GENERAL SPECIFICATIONS

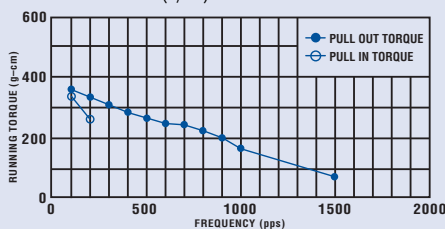
Step Angle	7.5°
Step Angle Accuracy	+/-0.5°
Temperature Rise	80° C Max.
Ambient Temperature Range	-10° to +50° C
Insulation Resistance	100M Ω Min., 500 VDC
Dielectric Strength	500 VAC for 1 min.
Radial Play	0.03 mm Max. (220 g-load)
End Play	0.3 mm Max. (220 g-load)
Switching Sequence	See page 31

MODEL SPECIFICATIONS

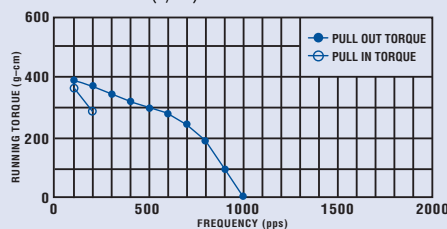
Model Number	Rated Voltage V	Rated Current/Phase A	Winding Resistance/Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
Unipolar								
17BB-H262P	5.4	0.45	12.0	500	11.0	12.0	80	140
17BB-H267P	7.5	0.30	25.0	480	19.0	12.0	80	140
Bipolar								
17BB-H240P	5.4	0.45	12.0	670	27.0	12.0	80	140

TORQUE/SPEED CHARACTERISTICS

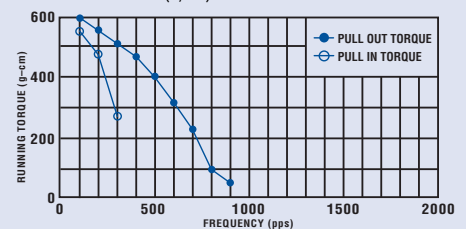
Model: 17BB-H262P
Driver: Unipolar Chopper Dual
Supply Voltage: 24.0 (Volt)
Drive Current: 0.45 (A/PH)



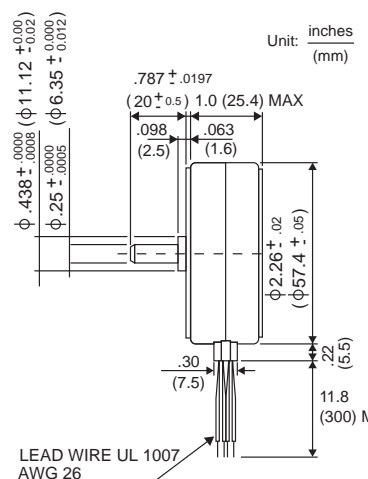
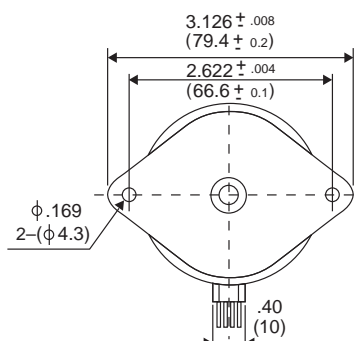
Model: 17BB-H267P
Driver: Unipolar Chopper Dual
Supply Voltage: 24.0 (Volt)
Drive Current: 0.30 (A/PH)



Model: 17BB-H240P
Driver: Bipolar Chopper Dual
Supply Voltage: 24.0 (Volt)
Drive Current: 0.45 (A/PH)



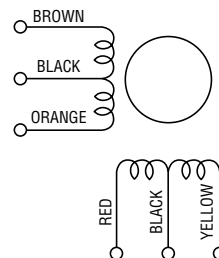
23BB-H 7.5° PERMANENT MAGNET



GENERAL SPECIFICATIONS

Step Angle 7.5°
 Step Angle Accuracy +/-0.5°
 Temperature Rise 80° C Max.
 Ambient Temperature Range -10° to +50° C
 Insulation Resistance 100MΩ Min., 500 VDC
 Dielectric Strength 500 VAC for 1 min.
 Radial Play 0.03 mm Max. (220 g-load)
 End Play 0.3 mm Max. (220 g-load)
 Switching Sequence See page 31

WINDING DIAGRAM



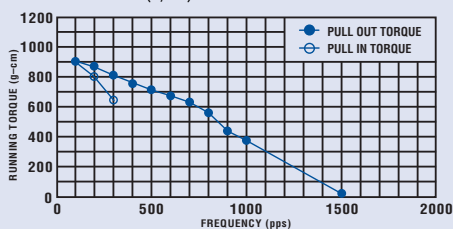
MODEL SPECIFICATIONS

Model Number	Rated Voltage V	Rated Current/ Phase A	Winding Resistance/ Phase Ω	Holding Torque g-cm	Inductance mH	Rotor Inertia g-cm ²	Detent Torque g-cm	Weight g
Unipolar								
23BB-H251P	5.0	0.75	6.6	1,200	9.0	30.0	150	280
23BB-H252P	12.0	0.34	36.0	1,200	32.0	30.0	150	280
Bipolar								
23BB-H246P	4.9	0.75	6.5	1,400	17.0	30.0	150	280

TORQUE/SPEED CHARACTERISTICS

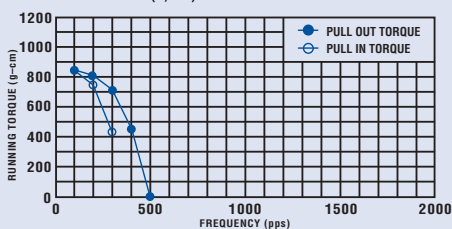
Model: 23BB-H251P

Driver: Unipolar Chopper Dual
 Supply Voltage: 24.0 (Volt)
 Drive Current: 0.75 (A/PH)



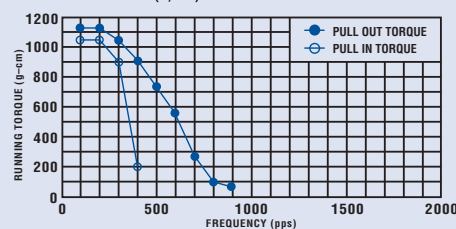
Model: 23BB-H252P

Driver: Unipolar Chopper Dual
 Supply Voltage: 24.0 (Volt)
 Drive Current: 0.32 (A/PH)



Model: 23BB-H246P

Driver: Bipolar Chopper Dual
 Supply Voltage: 24.0 (Volt)
 Drive Current: 0.75 (A/PH)



STEP MOTOR CONSTRUCTION

The advantage of step motors is that they can operate *open loop*, that is, they can stop at a predictable angle, rotate clockwise, counterclockwise, and vary speed without feedback. Step motors are electrically commutated, and need either a unipolar or bipolar driver to effect rotation.

Hybrid step motors from page 7 to 22 have electromagnetic poles, or *phases*, located radially around a magnetized rotor. When a phase is energized, it will pull the rotor magnetic pole into alignment. When phases are pulsed in rotation, called a *switching sequence* (refer to page 31) they create a rotating magnetic stator field. The rotor fields will continue to align themselves, thus causing rotation. Applying potential to one pole is called one *pulse*. One pulse will move the motor one step.

The amount of rotor movement in one pulse is called the *step angle*. On many of the motors, the step angle is 1.8 degrees. The error on each step is generally quite small, usually +/-5% as measured from a fitted centerline, and is referred to as *step angle accuracy*. The step error does not accumulate.

The *permanent magnet step motors*, from page 23 to 28, consist of bobbin wound coils and precision stamping. This construction is easier to assemble, and has a lower cost than hybrid motors. Permanent magnet step motors typically have a larger step angle and lower torque than hybrid motors of the same size.

TORQUE AND SPEED

Motor *torque* is the product of the motor's generated force, multiplied by the radius from the shaft center from where it is measured. The units are either grams-centimeters (g-cm), milliNewton meters (mNm) or ounce-inches (oz-in). Conversions for these rates, and for moments of inertia, are on page 31. At low pulse rates, the motor has a high torque output, and at high speeds, low torque.

At a particular high frequency the motor can only generate enough torque to keep the rotor moving. This is the *maximum response rate* at which the available torque is zero (refer to Figure 1).

To start rotation, some energy is used converting the rotor's inertia from a static to a dynamic state. During this special condition, starting from zero speed, the maximum torque developed is called *pull in torque*. Pull in torque will decrease as you increase frequency. At some point the torque developed from starting will be zero. This is the *maximum start/stop frequency*.

After reaching constant velocity (synchronism), the motor can be accelerated or *slewed up* even further to attain higher torque or higher speed. The maximum torque developed from slewing up is called *pull out torque*.

In this catalog, all torque and speed measurements are made at the rated current. If the motor is run at a current higher than the rated current, the torque speed curve will shift up proportionately. However, most of the increase is lost in heat. At a particular high current, the coil temperature will rise to the point at which the insulation is threatened. The *maximum temperature rise* is the maximum temperature increase the coil can withstand without affecting its insulation.

A major advantage of step motors is that with one or more phases left on, the rotor holds its position. If the rotor is forced from this holding position, it will attempt to move back. The maximum restoring torque a motor develops is called *holding torque*. It is the highest torque the motor can develop. In this catalog, the holding torque is measured at rated current with two phases on.

TORQUE SPEED GRAPH

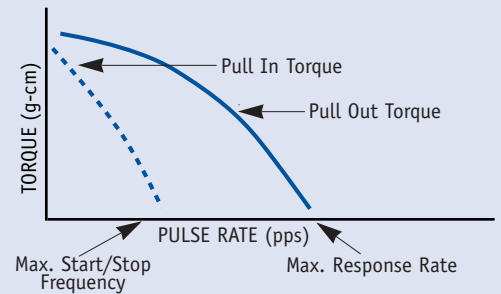


Figure 1

MOTOR TERMINOLOGY

WINDINGS

continued

Motors are wound to accept current in one direction, a *unipolar motor*, or in both directions, a *bipolar motor*. In general, a bipolar motor has more torque than a unipolar motor, except at high speeds. The switching sequences for unipolar and bipolar motors are different, and can be found on page 31. Winding diagrams for unipolar motors can be found on the data sheets.

To increase torque, motors can be run with two phases on simultaneously. This drive mode is called *dual phase* or *two phase on*. Motors can also be run *single phase*. A combination of both is called *half step mode*. Half step mode results in a rotor movement of one half the step angle, for example, from 1.8 degrees to 0.9 degrees. Further, by partially turning phases on and off you can continue to reduce the step angle. This drive mode is referred to as *microstepping*.

MOTOR SELECTION

Motor selection usually begins with determining the torque required. Since step motors run open loop, you need to know beforehand what the maximum torque required is. During any duty cycle, the load torque varies. Usually, the highest torque requirement is in accelerating the load from at rest to a set speed. The following variables must be known to determine the torque required to accelerate a load:

- Motor Speed (pps) accelerating from
- Motor Speed (pps) accelerating to
- Rotor Inertia (g-cm²)
- Load Inertia (must be less than 10X rotor inertia)
- Step Angle (degrees)

The acceleration component of the load, plus frictional loads, can be calculated as follows:

$$T_a = \alpha J + T_f$$

Where:

- T_a = Torque required to accelerate (g-cm)
- α = Angular acceleration (radians/sec²)
- J = Total inertia (g-cm sec²)
- T_f = Friction torque (g-cm²)

Inertia will include both load inertia and rotor inertia. Acceleration must be converted from radians per second to steps per second.

Converting for these factors we get:

$$T_a = (J_m + J_1) \times \frac{(f_2 - f_1) (2\pi\theta)}{\Delta t \times 360^\circ}$$

Where:

- J_m = Motor rotor inertia (g-cm sec²)
- J_1 = Load inertia (g-cm sec²)
- f_2 = Ending (high speed) frequency (pps)
- f_1 = Starting frequency (pps)
- Δt = Time for acceleration (sec)

DETERMINING TORQUE NEEDS

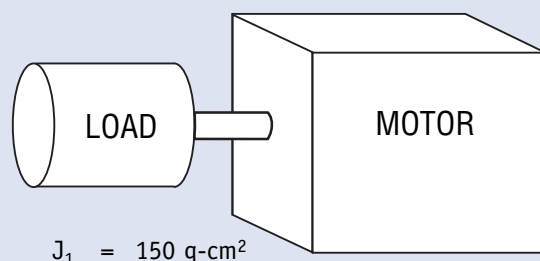


Figure 2

For example, assuming the assembly in Figure 2, what is the required torque to accelerate the load in .10 seconds from 0 to 1,000 pps?

For this example, we estimate the torque required for the load only, and input the acceleration of gravity into the inertia moment by dividing it by 980 cm/sec². From this we get:

$$T_a = \frac{150 \text{ g-cm}^2}{980 \text{ cm/s}^2} \times \frac{(1000\text{pps})2\pi \times 1.8^\circ}{.1 \text{ sec} \times 360^\circ}$$

$$= 52 \text{ g-cm}$$

To accelerate the load we would need at least 52 g-cm of torque, plus about 25% more for the motor rotor. An additional 50-100% is recommended as a safety margin, in case of load variance or worn parts. The total is about 130 g-cm at 1,000 pps. If a small step angle is required, a 14PM on page 7 has ample torque.

CONVERSION TABLES

ROTARY INERTIA CONVERSION TABLE

To convert from A to B, multiply by entry in table.

A	B	g-cm ²	oz-in ²	g-cm-s ²	Kg-cm ²	lb-in ²	oz-in-s ²	lb-ft ²	Kg-cm-s ²	lb-in-s ²	lb-ft-s ² or slug-ft ²
g-cm ²	1	1	5.46×10^{-3}	1.01×10^{-3}	10^{-3}	3.417×10^{-4}	1.41×10^{-5}	2.37×10^{-6}	1.01×10^{-6}	8.85×10^{-7}	7.37×10^{-8}
oz-in ²	182.9	182.9	1	.186	.182	.0625	2.59×10^{-3}	4.34×10^{-4}	1.86×10^{-4}	1.61×10^{-4}	1.34×10^{-5}
g-cm-s ²	980.6	980.6	5.36	1	.9806	.335	1.38×10^{-2}	2.32×10^{-3}	10^{-3}	8.67×10^{-4}	7.23×10^{-5}
Kg-cm ²	1000	1000	5.46	1.019	1	.3417	1.41×10^{-2}	2.37×10^{-3}	1.019×10^{-3}	8.85×10^{-4}	7.37×10^{-5}
lb-in ²	2.92×10^3	2.92×10^3	16	2.984	2.926	1	4.14×10^{-2}	6.94×10^{-3}	2.98×10^{-3}	2.59×10^{-3}	2.15×10^{-4}
oz-in-s ²	7.06×10^4	7.06×10^4	386.08	72.0	70.615	24.13	1	.1675	7.20×10^{-2}	6.25×10^{-2}	5.20×10^{-3}
lb-ft ²	4.21×10^5	4.21×10^5	2304	429.71	421.40	144	5.967	1	.4297	.3729	3.10×10^{-2}
Kg-cm-s ²	9.8×10^5	9.8×10^5	5.36×10^3	1000	980.66	335.1	13.887	2.327	1	.8679	7.23×10^{-2}
lb-in-s ²	1.129×10^6	1.129×10^6	6.177×10^3	1.152×10^3	1.129×10^3	386.08	16	2.681	1.152	1	8.33×10^{-2}
lb-ft-s ² or slug-ft ²	1.355×10^7	1.355×10^7	7.41×10^4	1.38×10^4	1.35×10^4	4.63×10^3	192	32.17	13.825	12	1

TORQUE CONVERSION TABLE

To convert from A to B, multiply by entry in table.

A	B	g-cm	oz-in	Kg-cm	lb-in	N-m	lb-ft	Kg-m
g-cm	1	1	1.388×10^{-2}	10^{-3}	8.679×10^{-4}	9.806×10^{-5}	7.233×10^{-5}	10^{-5}
oz-in	72.007	72.007	1	7.200×10^{-2}	6.25×10^{-2}	7.061×10^{-3}	5.208×10^{-3}	7.200×10^{-4}
Kg-cm	1000	1000	13.877	1	.8679	9.806×10^{-2}	7.233×10^{-2}	10^{-2}
lb-in	1.152×10^3	1.152×10^3	16	1.152	1	.112	8.333×10^{-2}	1.152×10^{-2}
N-m	1.019×10^4	1.019×10^4	141.612	10.197	8.850	1	.737	.101
lb-ft	1.382×10^4	1.382×10^4	192	13.825	12	1.355	1	.138
Kg-m	10^5	10^5	1.388×10^3	100	86.796	9.806	7.233	1

SWITCHING SEQUENCE TABLES

For clockwise rotation facing the mounting side.

Dual Phase Excitation					
Step	A	B	A ¹	B ¹	Common
1	-	-			+
2		-	-		+
3			-	-	+
4	-			-	+

Bipolar Dual Phase					
Step	A	B	A ¹	B ¹	
1	+	+	-	-	
2	-	+	+	-	
3	-	-	+	+	
4	+	-	-	+	

ORDERING INFORMATION AND WARRANTY

WARRANTY—NMB Corporation motors are warranted to be free of defects in materials and workmanship for a period of one year from date of delivery.

APPLICATION ENGINEERING—For application engineering consultation, contact your local NMB Corporation Sales Office to receive prompt assistance.

SPECIFICATIONS—NMB Corporation reserves the right to change specifications and prices without notice as required to permit improvements in motor design.

INVENTORY—This catalog is a technical guide for the designer of products using stepping motors. Please contact your local NMB Corporation Sales Office for information on the availability of specific stepping motors and drive characteristics listed herein. Most stepping motors shown here were manufactured to specific applications and thus are not available from inventory. NMB can modify any motor in this catalog to meet your particular requirements.

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