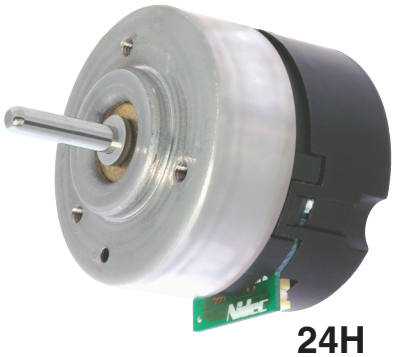
3-Phase Brushless DC Motors

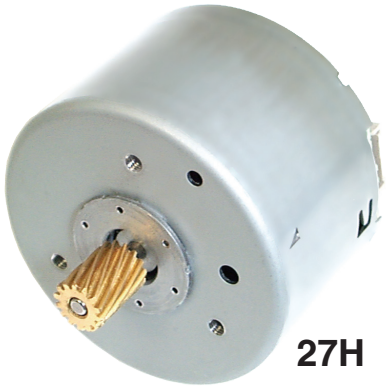
for Home Appliances and Office Equipment

13H

22H



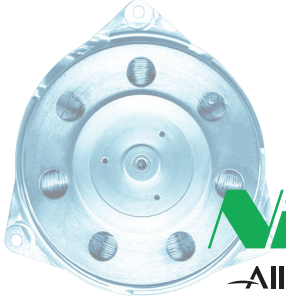
24H



27H

Electrical and Mechanical Characteristics

Parameter	Symbol	Conditions	Min.	Nom./Typ.	Max.	Units
Operating Voltage	V_M	12V Models	8.0	12	15	V
		24V Models	21.6	24	26.4	V
Operating Current	I_{RUN}	Model 13H-12, T_{RUN} = 4.0 mNm, V_M=12V, T_A = +20°C	—	0.30	—	A
		Model 13H-24, T_{RUN} = 4.0 mNm, V_M=24V, T_A = +20°C	—	0.23	—	A
		Model 22H-12, T_{RUN} = 30 mNm, V_M=12V, T_A = +20°C	—	1.75	—	A
		Model 22H-24, T_{RUN} = 30 mNm, V_M=24V, T_A = +20°C	—	0.85	—	A
		Model 24H-24, T_{RUN} = 30 mNm, V_M=24V, T_A = +20°C	—	0.75	—	A
		Model 27H-24, T_{RUN} = 30 mNm, V_M=24V, T_A = +20°C	—	0.90	—	A
Run Torque	T_{RUN}	Model 13H-12, Continuous Operation, V_M=12V, T_A = +20°C	—	—	5.2	mN·m
		Model 13H-24, Continuous Operation, V_M=24V, T_A = +20°C	—	—	4.5	mN·m
		Model 22H-12, Continuous Operation, V_M=12V, T_A = +20°C	—	—	22	mN·m
		Model 22H-24, Continuous Operation, V_M=24V, T_A = +20°C	—	—	27	mN·m
		Model 24H-24, Continuous Operation, V_M=24V, T_A = +20°C	—	—	20*	mN·m
		Model 27H-24, Continuous Operation, V_M=24V, T_A = +20°C	—	—	45	mN·m
Output Power	P_{OUT}	Model 13H-12, Continuous Operation, V_M=12V, T_A = +20°C	—	—	2.6	W
		Model 13H-24, Continuous Operation, V_M=24V, T_A = +20°C	—	—	2.5	W
		Model 22H-12, Continuous Operation, V_M=12V, T_A = +20°C	—	—	9.6	W
		Model 22H-24, Continuous Operation, V_M=24V, T_A = +20°C	—	—	11.0	W
		Model 24H-24, Continuous Operation, V_M=24V, T_A = +20°C	—	—	9.0*	W
		Model 27H-24, Continuous Operation, V_M=24V, T_A = +20°C	—	—	17.5	W
No Load Speed	ω_{NL}	Model 13H-12, V_M = 12V	—	6000	—	rpm
		Model 13H-24, V_M = 24V	—	8700	—	rpm
		Model 22H-12, V_M = 12V	—	4800	—	rpm
		Model 22H-24, V_M = 24V	—	5000	—	rpm
		Model 24H-24, V_M = 24V	—	5900	—	rpm
		Model 27H-24, V_M = 24V	—	4900	—	rpm
Rotor Inertia	J_M	13H Models	—	0.7	—	$g \cdot cm^2$
		22H Models	—	18.5	—	$g \cdot cm^2$
		24H Models	—	14.0	—	$g \cdot cm^2$
		27H Models	—	40.0	—	$g \cdot cm^2$
Sound Pressure	N_M	No Load, f = 0 to 20 kHz, 30 cm from Motor	—	—	50	dBA
Operating Temperature	T_A	Relative Humidity 5% - 90%, non-condensing	10	—	50	°C
Life Expectancy†	L_{10}	Continuous Operation, No Load, T_A = +20°C	5,000	—	—	hours
Motor Weight	W_M	13H Models	—	30	—	g
		22H Models	—	145	—	g
		24H Models	—	110	—	g
		27H Models	—	210	—	g



Note: Values of maximum current, torque and output power are typical under stated operating conditions with motors mounted on 170 cm^2 aluminum test fixtures.

* Motor only; no external heat transfer mechanism.

† L10 bearing life expectancy at relative humidity 5% - 90%, non-condensing, and nominal operating voltage: The point in time at which 90 percent of a sample lot can be expected to survive. Failure criteria for life testing that establishes this figure include a 20% reduction in speed or a 20% increase in operating current.

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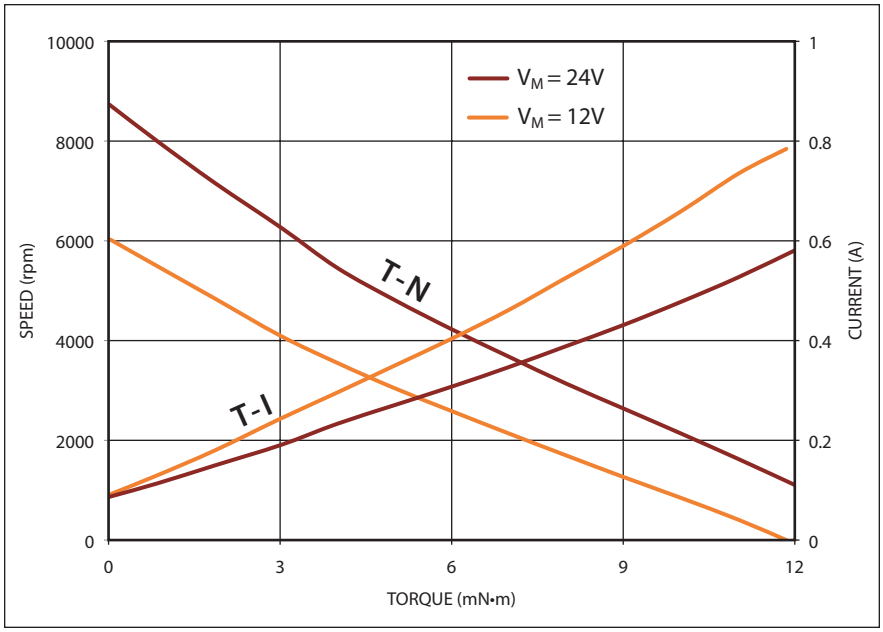
13H Brushless DC Motors

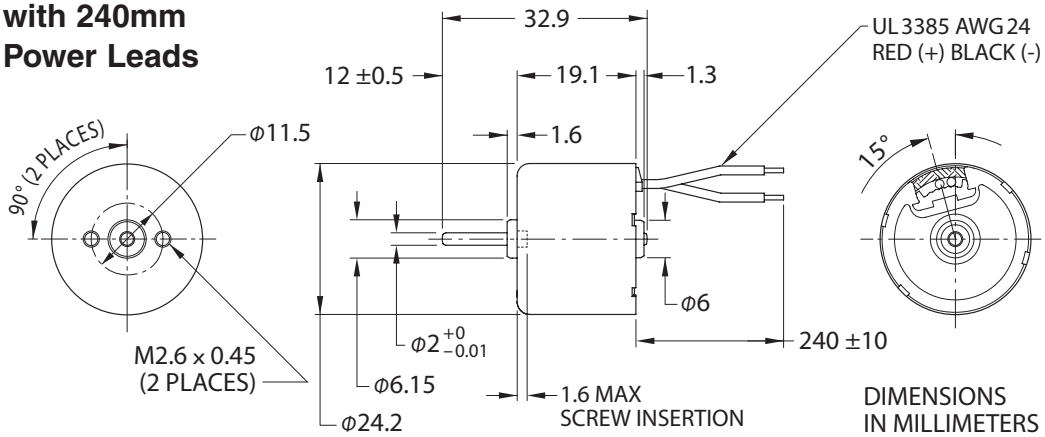
for Home Appliances and Office Equipment

- *3-Phase, 12-Pole Brushless DC Motors*
- *Clockwise Rotation (CCW Optional)*
- *Hall Effect Commutation*
- *Locked Rotor Protection**
- *Quiet Operation*
- *Comprehensive Control/Signal Functions Available*
- *Low Inertia*
- *Compact 24.2 (dia.) × 19.1mm Case*

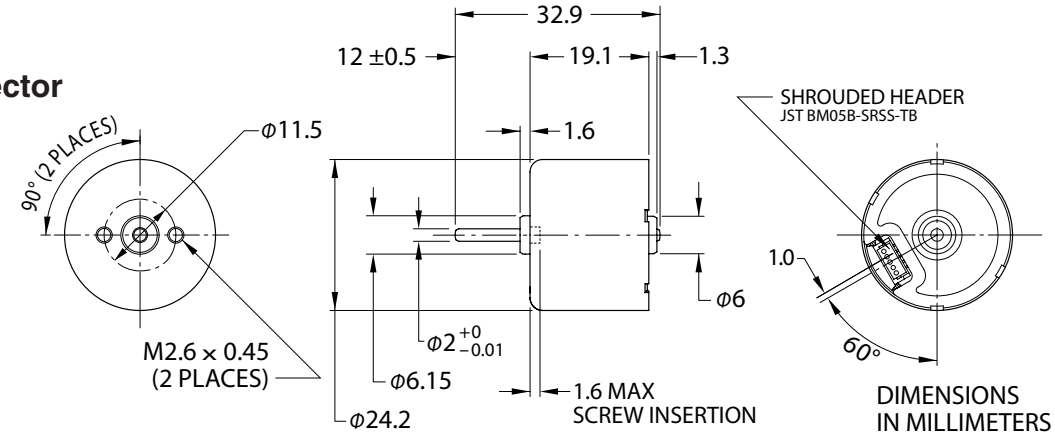


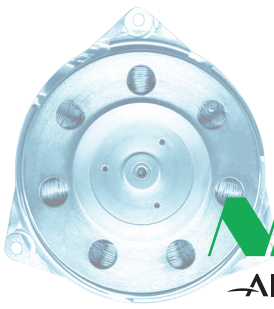
* Automatic shutdown at locked rotor condition: Restart at power OFF/ON.

13H Motor with 240mm Power Leads



13H Motor with Built-in 5-Pin Connector





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13H Brushless DC Motors

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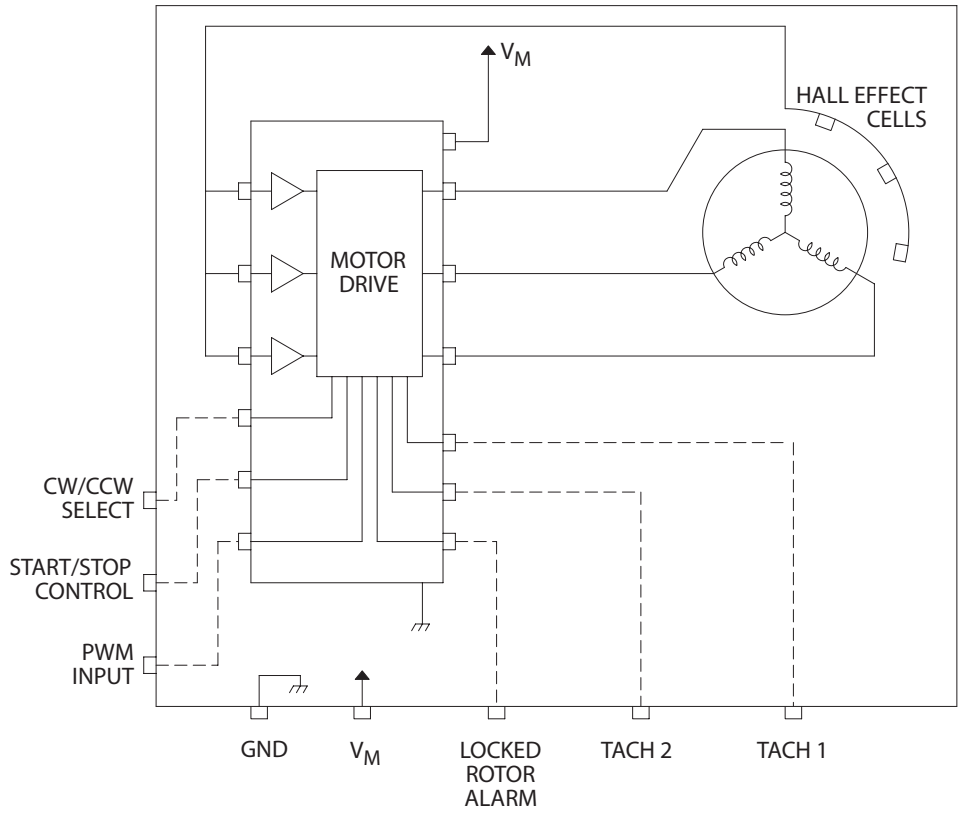
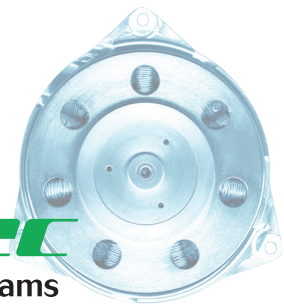
Motor and Drive Circuit Options

Feature	13H Standard	13H Options
Direction of Rotation (1)	CW	CCW (also see rotational direction control option below)
Shape of Motor Shaft	Round	D-Cut
Surface of Motor Shaft	Smooth	Knurled
Length of Motor Shaft	12 mm	7 mm or 22 mm
Bearing Type	Sleeve	Ball
Motor Terminations (2)		
Power In	V_M	—
Ground	GND	—
CW/CCW Select	—	High = CW/Low = CCW.
Start/Stop Control	—	High = Start/Low = Stop.
PWM Input	—	f_{in} = 500 Hz to 50 kHz, $V_{in(Low)}$ < 1.0V, $V_{in(High)}$ = 2.5 to 5.0V, duty cycle = 20% to 100%.
Locked Rotor Alarm	—	Open-collector circuit, high-pass/low-fail, I_C = 3.0 mA, maximum.
Tachometer 1	—	Open-collector circuit, I_C = 3.0 mA, maximum, square wave pulses per revolution = motor poles/2.
Tachometer 2	—	Open-collector circuit, I_C = 3.0 mA, maximum, square wave pulses per revolution = motor poles × 3/2.

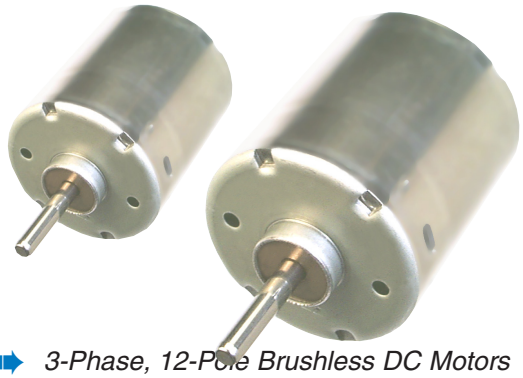
(1) Rotational orientation: Looking toward the load end of the motor shaft.
(2) Series 13H designs support any three (max.) of six motor termination options shown above.



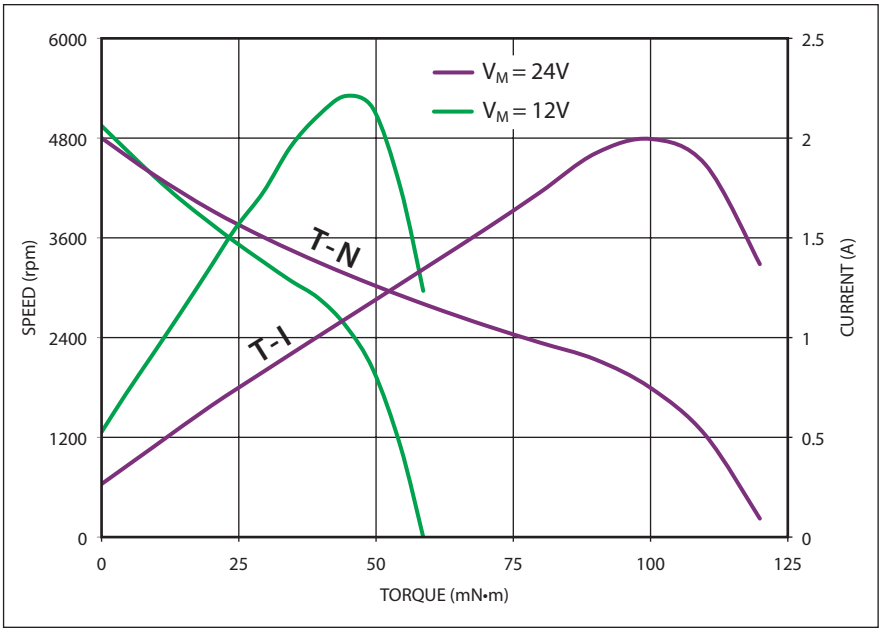


22H Brushless DC Motors

for Home Appliances and Office Equipment

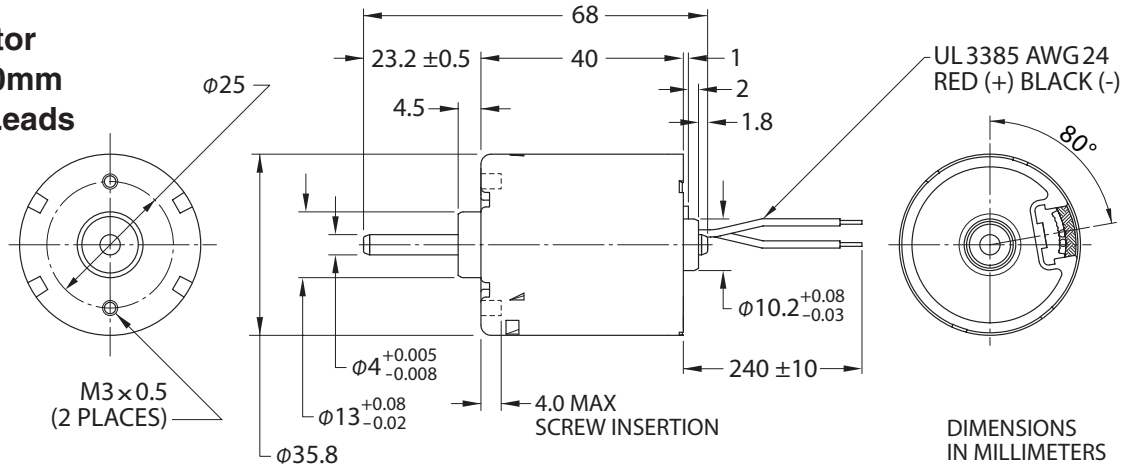


- *3-Phase, 12-Pole Brushless DC Motors*
- *Clockwise Rotation (CCW Optional)*
- *Hall Effect Commutation*
- *Locked Rotor Protection**
- *Quiet Operation*
- *Comprehensive Control/Signal Functions Available*
- *Low Inertia*
- *Compact 35.8 (dia.) × 40mm Case*

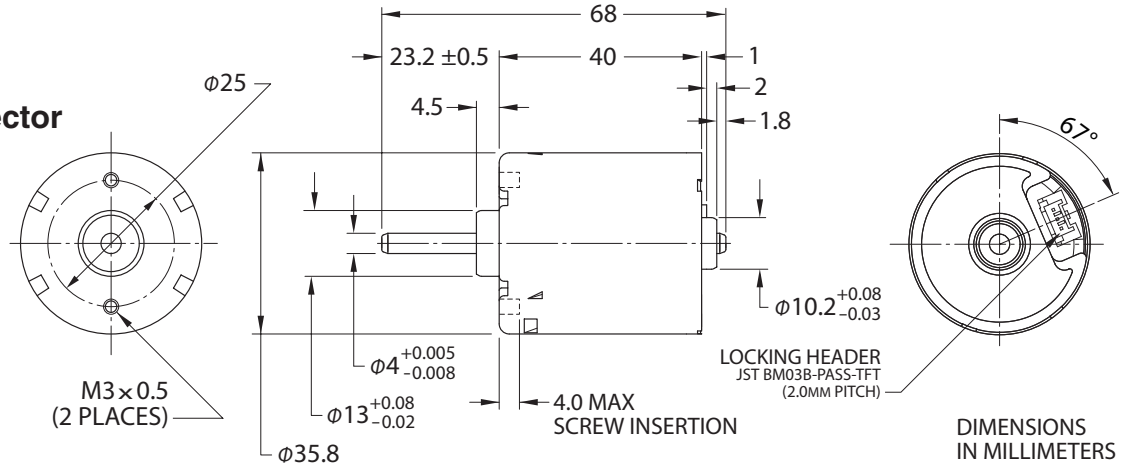


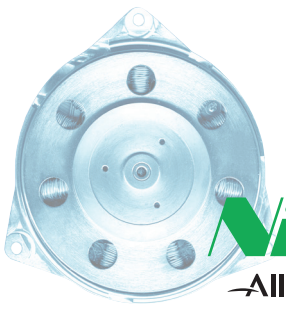
* Automatic shutdown at locked rotor condition: Restart at power OFF/ON.

22H Motor with 240mm Power Leads



22H Motor with Built-in 3-Pin Connector





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22H Brushless DC Motors

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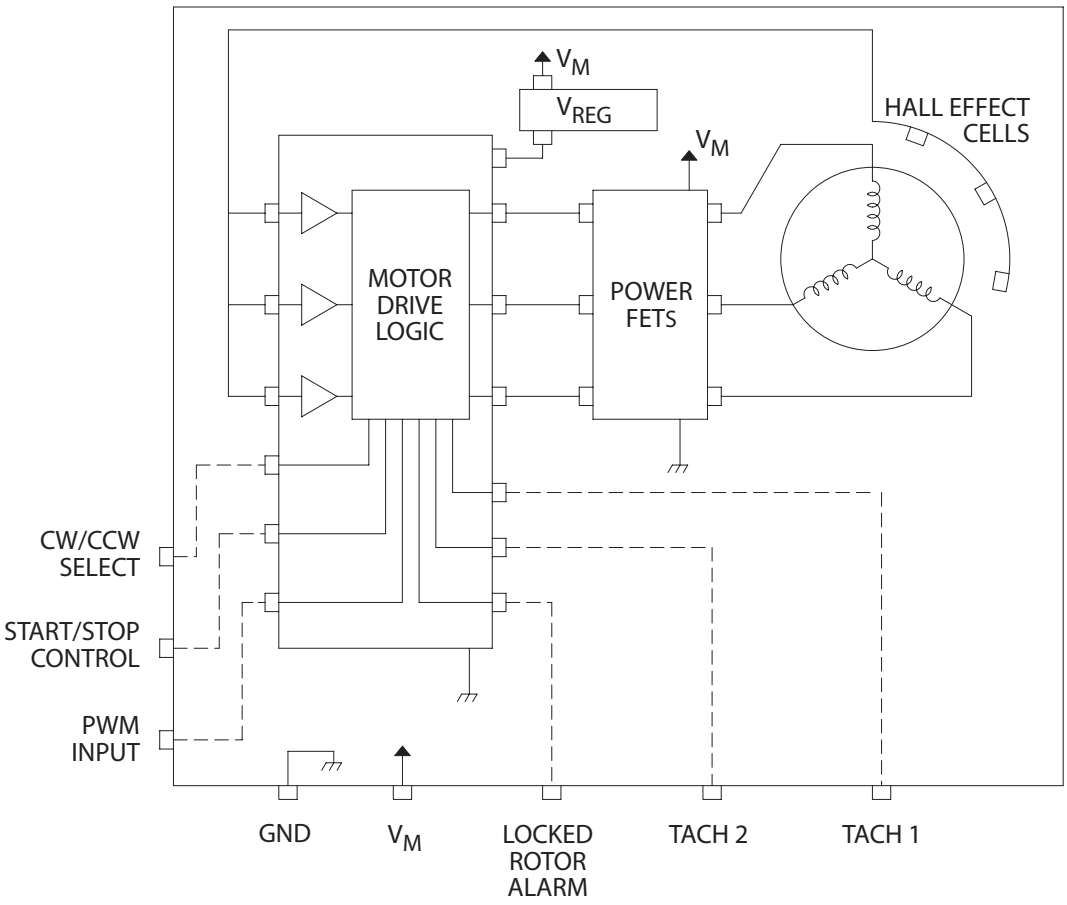
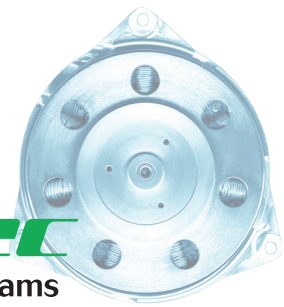
Motor and Drive Circuit Options

Feature	22H Standard	22H Options
Direction of Rotation (1)	CW	CCW (also see rotational direction control option below)
Shape of Motor Shaft	Round	D-Cut
Surface of Motor Shaft	Smooth	Knurled
Length of Motor Shaft	23.2mm	18.2mm or 28.2mm
Diameter of Motor Shaft	4.0mm	3.17mm
Bearing Type	Sleeve	Ball
Motor Terminations (2)		
Power In	V_M	—
Ground	GND	—
CW/CCW Select	—	High = CW/Low = CCW.
Start/Stop Control	—	High = Start/Low = Stop.
PWM Input	—	f_{in} = 500 Hz to 50 kHz, $V_{in(Low)}$ < 1.0V, $V_{in(High)}$ = 2.5 to 5.0V, duty cycle = 20% to 100%.
Locked Rotor Alarm	—	Open-collector circuit, high-pass/low-fail, I_C = 3.0 mA, maximum.
Tachometer 1	—	Open-collector circuit, I_C = 3.0 mA, maximum, square wave pulses per revolution = motor poles/2.
Tachometer 2	—	Open-collector circuit, I_C = 3.0 mA, maximum, square wave pulses per revolution = motor poles × 3/2.

(1) Rotational orientation: Looking toward the load end of the motor shaft.
(2) Series 22H designs support any four (max.) of six motor termination options shown above.





24H Brushless DC Motors

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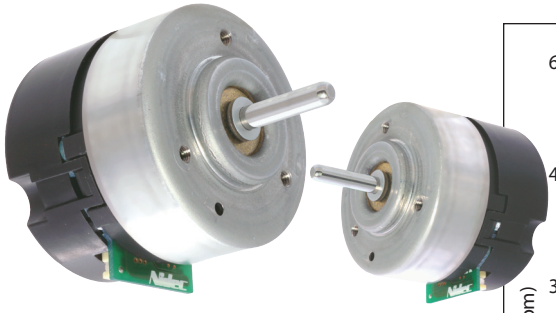
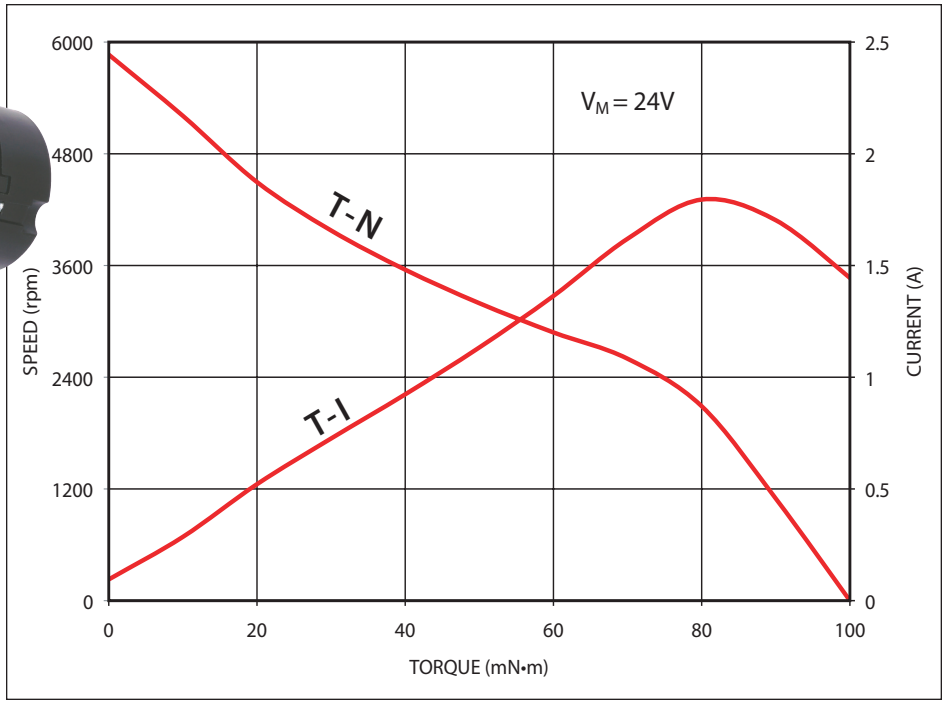
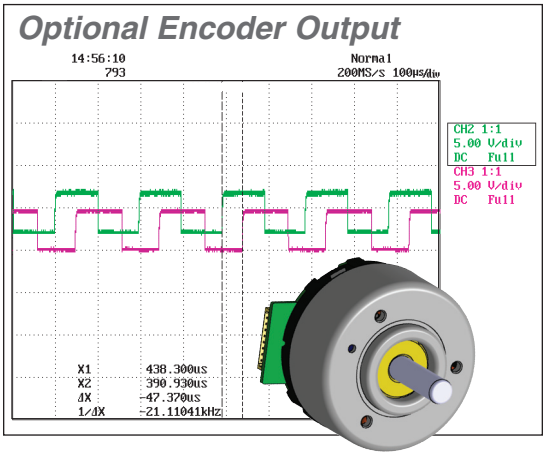


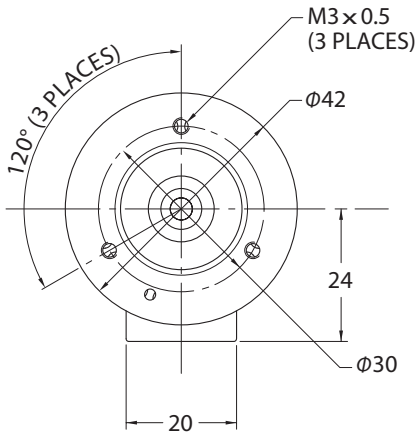


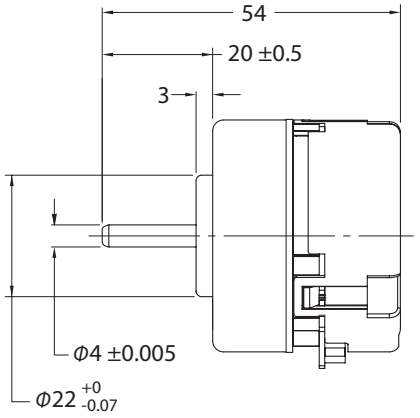
- *3-Phase, 12-Pole Brushless Motors*
- *Logic-Controlled Clockwise or Counterclockwise Rotation*
- *Hall Effect Commutation*
- *Quiet Operation*
- *Low Inertia*
- *PWM Speed Control/Brake Function*
- *Open-Drain Tachometer*
- *Optional Dual Channel Phase-Tracking Encoder*
- *Locked Rotor Protection**
- *Compact 42 (dia.) × 34mm Case*

* Automatic shutdown at locked rotor condition: Restart at power OFF/ON.

Optional Encoder Output







DIMENSIONS IN MILLIMETERS

Pinout

Pin	Function
1	Standard = No connection. Encoder option = Channel A output: 90° phase tracking, 100 pulses per revolution, HIGH = 5V, LOW = 0V.
2	Standard = Open-drain tachometer, six pulses per revolution, $I_{C(MAX)}$ = 3.0 mA. Encoder option = Channel B output: 90° phase tracking, 100 pulses per revolution, HIGH = 5V, LOW = 0V.
3	Standard = No connection. Encoder option = Logic supply, 5V ±0.5V.

Pin	Function
4	$V_{IN(HIGH)}$ = 2.0V to 5.0V or OPEN = Clockwise, $V_{IN(LOW)}$ <= 0.6V = Counterclockwise.
5	PWM: f_{in} = 20 kHz to 30 kHz, $V_{IN(LOW)}$ <= 0.6V, $V_{IN(HIGH)}$ = 2.0V to 5.0V, duty cycle = 20% to 100%.
6	Brake: $V_{IN(HIGH)}$ = 2.0V to 5.0V = OFF, $V_{IN(LOW)}$ <= 0.6V = ON (motor stop).
7	Supply ground.
8	Motor supply voltage, 24V, nominal.

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27H Brushless DC Motors

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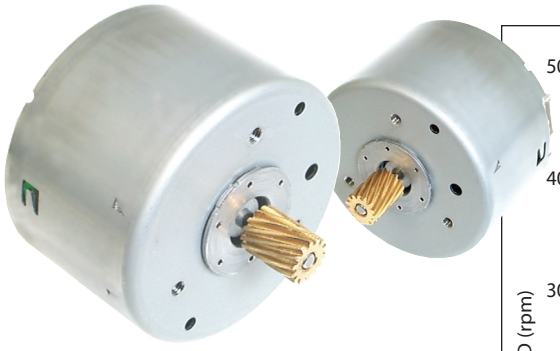
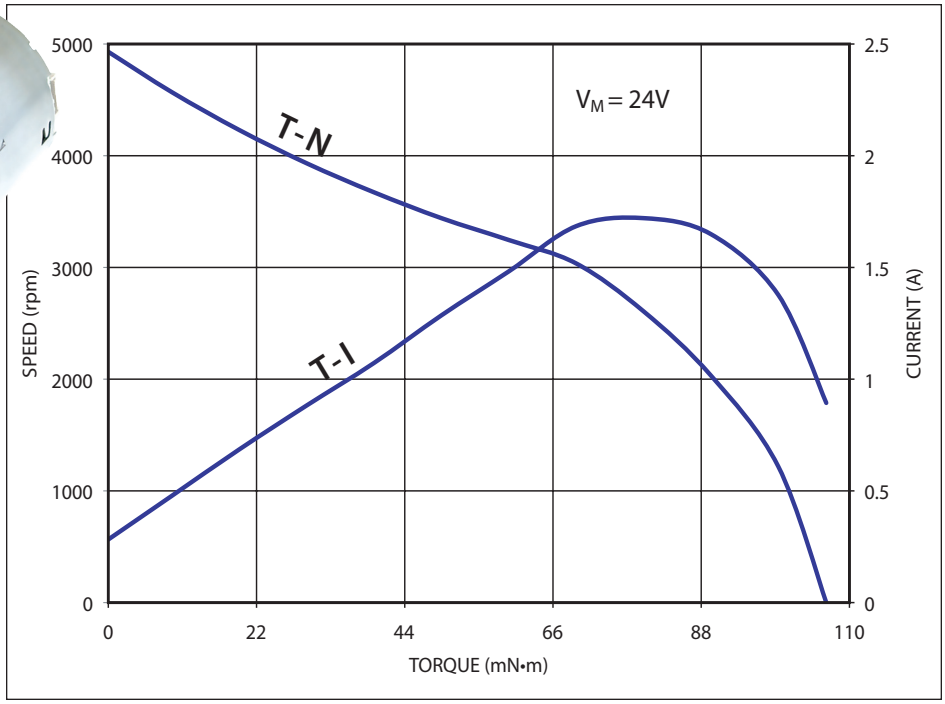
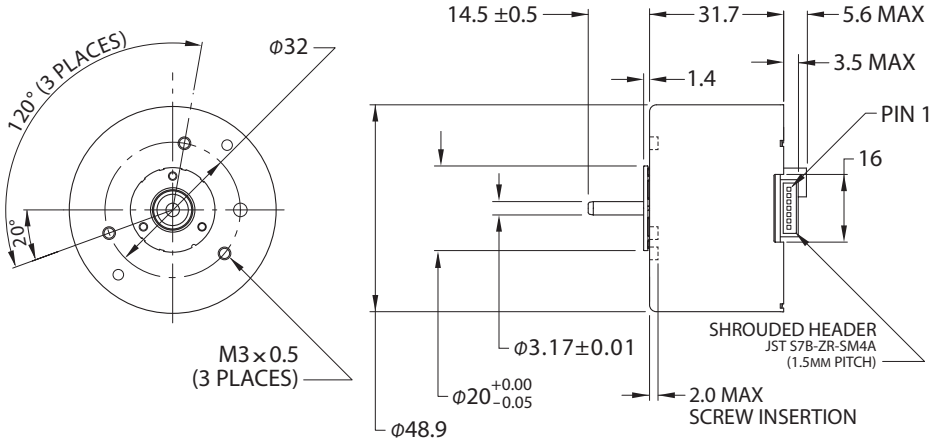




- *3-Phase, 12-Pole Brushless Motors*
- *Logic-Controlled Clockwise or Counterclockwise Rotation*
- *Hall Effect Commutation*
- *Quiet Operation*
- *Low Inertia*
- *PWM or PLL Speed Control*
- *Open-Collector Tachometer Circuit*
- *Locked Rotor Protection**
- *Compact 48.9 (dia.) × 31.7mm Case*

* Automatic shutdown at locked rotor condition: Restart at power OFF/ON.



DIMENSIONS IN MILLIMETERS

Motor Options *

Feature	27H Std	27H Option
Motor Shaft	Round	D-Cut
Shaft Surface	Smooth	Knurled

* Series 27H motors are semi-custom sleeve bearing designs with speed-control circuitry built into the motors. Control circuit parameters can be modified to meet application-specific requirements for speed and load conditions.

Pinout

Pin	Function
1	PLL version: PLL gain. PWM version: Open-collector tachometer, 20 pulses per revolution, $I_{C(MAX)}$ = 3.0 mA
2	PLL version: Speed lock (LOW) or open-collector tachometer. PWM version: Logic supply, +5V
3	PLL and PWM versions: HIGH = Clockwise, LOW = Counterclockwise.
4	PLL version: Clock in, rpm = 60 f_{CLK}/20. PWM version: Speed control, f_{in} = 500 Hz to 50 kHz, $V_{IN(LOW)}$ < 1.0V, $V_{IN(HIGH)}$ = 2.5 to 5.0V, duty cycle = 20% to 100%.

Pin	Function
5	PLL and PWM versions: HIGH = Start, LOW = Stop
6	PLL version: Logic supply, +5V. PWM version: Supply ground.
7	PLL version: Supply ground. PWM version: Motor supply voltage, 24V, nominal.
8	PLL Version: Motor supply voltage, 24 VDC, nominal

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Pinout