SLOTLESS BRUSHLESS DC MOTORS

FRACTIONAL HORSEPOWER

ELINCO

MOTORS • CUSTOM AIR MOVING DEVICES • PRECISION PRODUCTS SINCE 1926

Zero-cogging and lower torque ripple

... no preferred rotor position due to absence of stator teeth.

High efficiencies

... more dense copper fill enables reduced stator resistance and winding losses.
... no stator tooth saturation and reduced core losses due to less stator iron.

Low noise levels

... no tooth lamination flux changes to generate electrical hum.

Low speed performance

... smooth, cogless, jitter-free direct drive operation down to a few degrees per minute.

High speed performance

... no high frequency teeth losses for increased efficiency.

Basic frame sizes available (frame number/nominal dia.)

12,000 - 30,000 RPM
16mm, 28mm and 36mm Diameters

34,000 - 47,000 RPM
27mm, 34mm, 39mm, 45mm and 49mm Diameters

...Custom frame sizes and windings available.

HP ranges (nominal)

Subfractional to 10 HP, and beyond

Torque Constants
Voltage Constants

...unlimited wide ranges, custom configured for each application: typically, K_T's of 1 through 600 oz.-in/amp and K_E's of 1 through 450 volts/1000 RPM.

Elinco International Inc. 1525 Kings Highway East, Fairfield, CT 06824
Ph. (203) 275-8885 Fax (203) 334-7792 sales@elincoinc.com www.elincoinc.com

SLOTLESS BRUSHLESS DC MOTORS

What is an Elinco slotless brushless DC (SBLDC) motor?

An Elinco slotless brushless DC (SBLDC) motor consists of a stator winding positioned inside a laminated stator ring (without conventional teeth) and a permanent magnet motor. This provides more peripheral space for the stator winding.

This also allows more magnet surface area and more air gap flux. Powerful rare earth magnets provide high torque to motor weight ratios. The absence of stator teeth enables more copper winding and power density which can develop more torque. It also eliminates torque cogging and minimizes audible noise.

We are experts in the design and fabrication of custom SBLDC motors and rotor/stator sets.

Elinco offers a great deal of flexibility, responsiveness, and expertise in the design and fabrication of custom SBLDC motors. There are few restrictions on physical dimension choices since stator laminations are simple annular rings, economical to produce, and high energy magnets are readily available in arcs and slabs of all sizes. There is freedom to choose magnetic and mechanical air gaps, number of poles, pole spans, back-iron thickness, magnetic densities, and copper fills, etc., for each specific application.

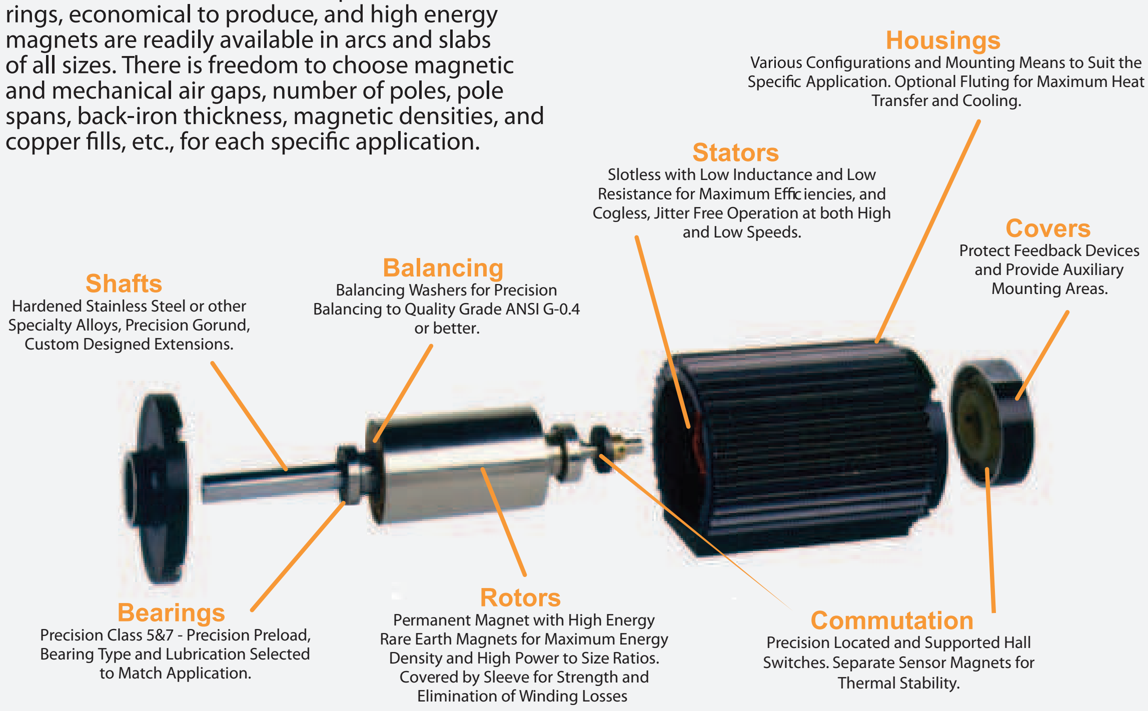
When others say they can't, we say we can... and do!

Whether the issue is speed, power, weight, size, efficiency, noise, torque ripple, heat rise, etc., each or all are optimized to achieve custom performance with relatively short design and response time.

Tooling charges for custom prototypes are nominal. Elinco has produced a wide range of sizes from 1" to over 10" in diameter, and basic tooling of many sizes is already available.

Elinco rotor/stator sets enable simplified OEM designs. Bearings, housings and alignment problems are eliminated, thus providing cost-effective, reliable solutions.

As the energy product of magnets increases and costs decrease, and the manufacture of the stator can be more mechanized and cost-effective, the slotless motor technology will be the logical choice for many brushless DC motor applications.



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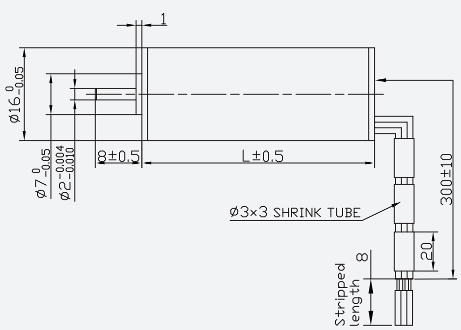
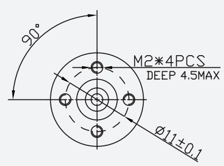
ELECTRICAL SPECIFICATIONS

Model	SL1628-12-270	SL1640-24-300	SL1656-24-300	SL2844-24-170	SL2866-24-170	SL3668-24-120
Nominal Voltage (VDC)	12	24	24	24	24	24
Inductance (mH) @1KHz	0.1±20%	0.16±20%	0.11±20%	0.22±20%	0.095±20%	0.12±20%
Resistance (Ω @25°C)	3.6±10%	4.9±10%	2.38±10%	2.1±10%	0.8±10%	0.47±10%
Number of Poles	2	2	2	2	2	2
No Load Speed (rpm)	27000±10%	30000±10%	29000±10%	17000±10%	17000±10%	12500±10%
No Load Current (A @25°C)	0.11±20%	0.11±20%	0.15±20%	0.35±20%	0.4±20%	0.6±20%
Rated Speed (rpm)	22000±10%	25000±10%	24000±10%	14000±10%	14000±10%	11000±10%
Rated Torque (mN.m)	1.6	4	10	24	54	77
Rated Power (W)	3.7	10	24	37	79	90
Peak Torque (mN.m)	4.8	12	30	75	162	300
Back EMF (mV/rpm)	0.34±10%	0.64±10%	0.67±10%	1.12±10%	1.13±10%	1.36±10%
Torque Constant (mN.m/A)	4.06±10%	7.5±10%	7.48±10%	13.25±10%	13.28±10%	17.41±10%
Operating Temperature Range (°C)	25° ~ +80°	-25° ~ +80°	-25° ~ +80°	25° ~ +80°	-25° ~ +80°	-25° ~ +80°
Length L (mm)	28	40	56	44	66	68
Weight (g)	29	42	64	135	225	380
Bearing	R-620ZZ NMB	R-620ZZ NMB	R-620ZZ NMB	623ZZ NMB	623ZZ NMB	605ZZ NSK

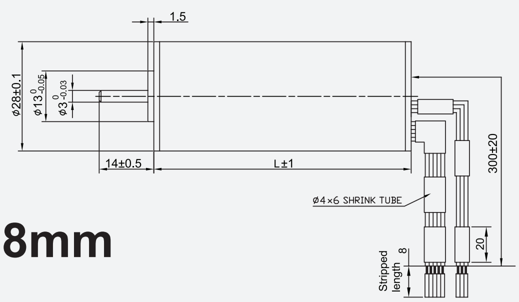
DIMENSIONS

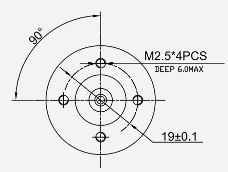




16mm

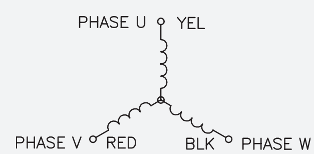
28mm

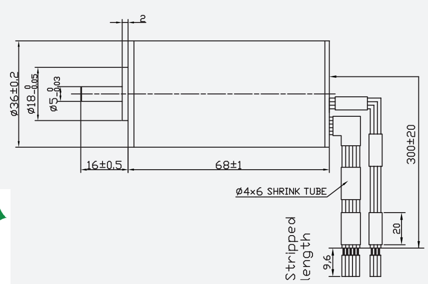


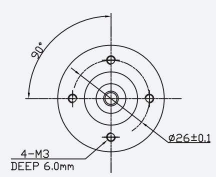


WIRING DIAGRAM

THREE–PHASE CONNECTING
STAR CONNECTION







36mm

RoHs Compliant

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DESIGN EXAMPLE

The following steps characterize the methodology used to realize the improvements indicated in the below table. Keep in mind that all of the models attempt to keep the KT similar to the sample motor.

1. Characterize existing motor by testing and disassembling a motor provided

1.1. Measure actual performance (resistance, inductance, back EMF)
1.2. Disassemble and measure active components (lamination, magnet, and winding)
1.3. Examine the winding layout

2. Create model in MotorSolve that duplicates the performance of the sample motor
2.1. Stator
2.1.1. Lamination (ID, OD, thickness, and length of stack)
2.1.2. Winding configuration (number of turns provided by Elinco)
2.1.3. Winding convention used in the models is shown by thin colored line graduating to broad colored line indicating start and finish of coil respectively in the cross section (see Fig. 3)
2.1.4. End turn length
2.1.5. Wire diameter
2.1.6. Slot fill
2.2. Rotor
2.2.1. Magnet (ID, OD, and length)
2.2.2. Material properties (validated by duplicating the back EMF of sample motor)

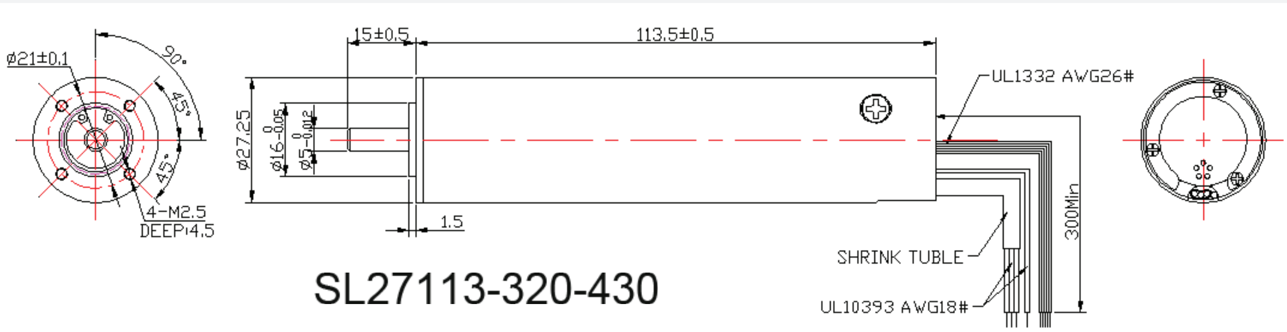
3. Use validated MotorSolve model for design iterations to improve KM
3.1. Design 1 – Improvement by changing winding configuration only
3.1.1. New winding configuration
3.1.2. Same lamination as sample
3.1.3. Same magnet as sample
3.2. Design 2 – Improvement by changing winding configuration and active materials
3.2.1. Use new winding configuration from above
3.2.2. Reduced lamination ID for reduction in magnetic air gap
3.2.3. Improved magnet material (same dimensions as sample motor)
3.3. Design 3 – Improvement by changing winding configuration, active materials and number of poles
3.3.1. Use new winding configuration for four pole motor to present maximum possible KM improvement in the frame size
3.3.2. Improved magnet material, four poles, and larger magnet ID & OD

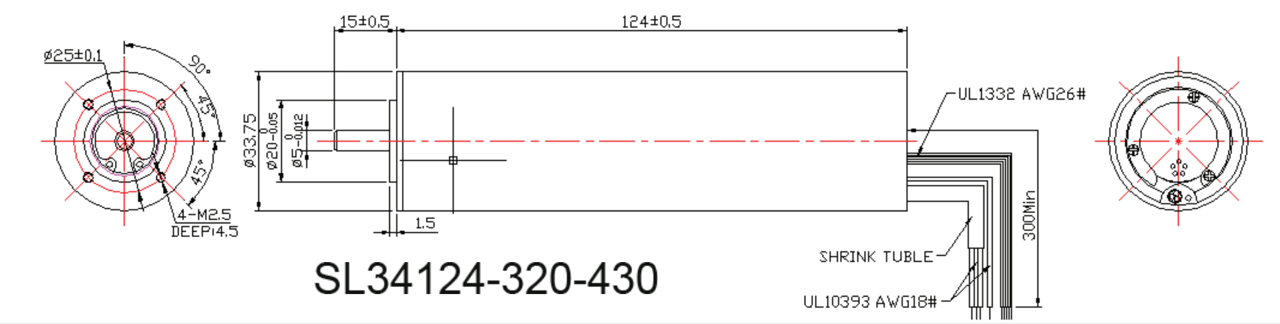
	SNxxxxxxxxxx xxxxxxxxxxxxx	Model of xxxxxxxxxx	Design 1	Design 2	Design 3
Lamination OD	24.6	24.6	24.6	24.6	24.6
Lamination ID	20	20	20	18.1	20
Lamination Thickness					
Stack Length	64.5	64.5	64.5	64.5	64.5
Coil OD					
Coil ID					
Coil Depth					
Mech Airgap					
Mag Airgap					
Mag OD					
Mag ID					
Mag Thickness					
End turn height					
Bare Magnet wire OD					
Magnet wire OD insulated					
EMF peak					
RLL					
KT	9.83	9.91	9.93	10.01	10.14
KM	3.16	3.21	4.26	4.52	4.98
Bare wire f ill f actor =	21.20%	26.80%	48.80%	52.05%	51.38%
Insulated wire f ill f actor =	26.30%	32.90%	58.70%	62.70%	67.90%
KM improvement over	N/A	1.70%	31%	39%	53%
Winding Factor	100%	100%	96.60%	96.60%	100%
B/H Ratio	0.59	0.59	0.59	0.76	1.00
Layers					
Coils per set 1 1 2 2 2					
T/C					
Rotor Inertia					

ELECTRICAL SPECIFICATIONS

Model	SL27113-320-430	SL34124-320-430	SL39119-320-460	SL45125-320-390	SL49180-320-330
Nominal Voltage (VDC)	320	320	320	320	320
Inductance (mH) @1KHz	3.8±20%	3.8±20%	1.84±20%	0.75±20%	0.8±20%
Resistance (Ω @25°C)	9.0±10%	9.0±10%	1.65±10%	1.35±10%	0.8±10%
Number of Poles	2	2	2	2	2
No Load Speed (rpm)	43270±10%	43200±10%	46500±10%	39500±10%	33500±10%
No Load Current (A)	0.05±10%	0.08±10%	0.1±10%	0.5±10%	1.0±10%
Rated Speed (rpm)	32000±10%	35500±10%	35000±10%	31150±10%	27000±10%
Rated Torque (mN.m)	450	460	550	705	920
Rated Power (W)	1500	1700	2000	2300	2600
Peak Torque (mN.m)	1125	1150	1375	1763	2300
Back EMF (mV/rpm)	5.23±10%	4.7±10%	4.9±10%	5.3±10%	6.54±10%
Torque Constant (mN.m/A)	69.2±6%	62.8±6%	63.5±6%	70.6±6%	12.5±6%
Peak Current (A)	17±10%	20±10%	24±10%	29±10%	27±10%
Length L (mm)	113	124	119	125	180
Weight (g)	320	532	696	710	1200

DIMENSIONS





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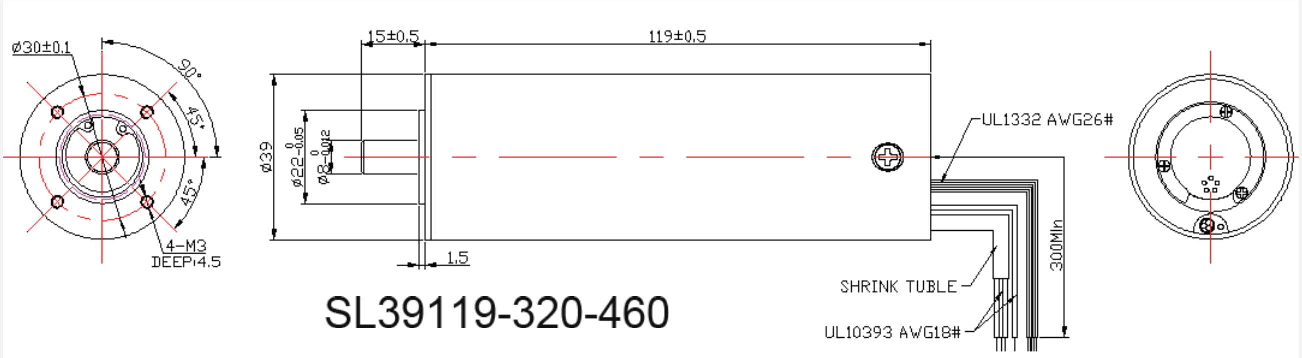
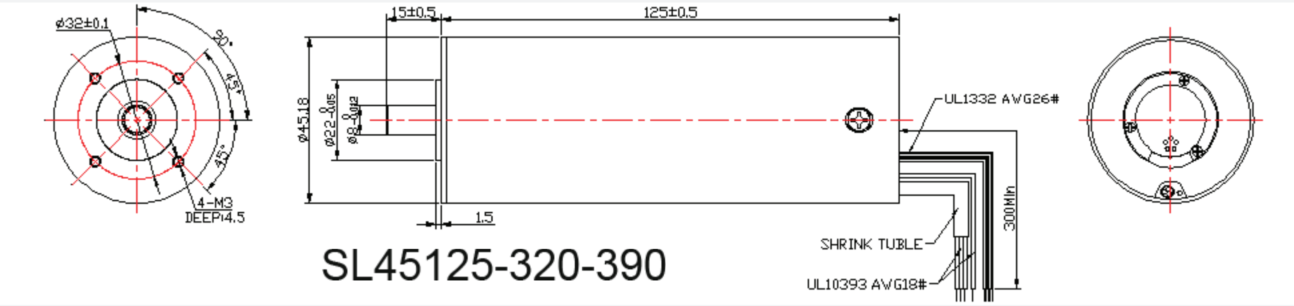

ø30±0.1
90°
45°
45°
4-M3
DEEP:4.5
15±0.5
119±0.5
ø39
ø22-0.05
ø8-0.012
1.5
UL1332 AWG26#
300Min
SHRINK TUBLE
UL10393 AWG18#
SL39119-320-460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90°
45°
45°
4-M3
DEEP:4.5
15±0.5
125±0.5
ø45.18
ø22-0.05
ø8-0.012
1.5
UL1332 AWG26#
300Min
SHRINK TUBLE
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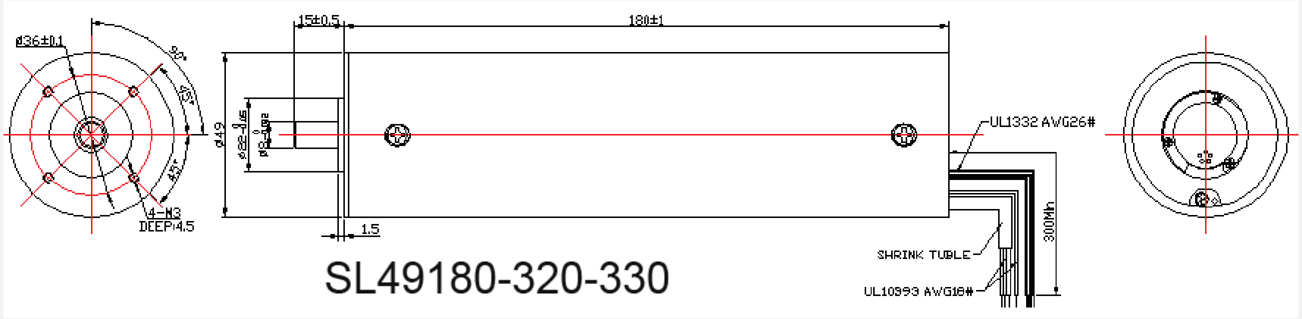
SL45125-320-390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90°
45°
45°
4-M3
DEEP:4.5
15±0.5
180±1
ø49
1.5
UL1332 AWG26#
300Min
SHRINK TUBLE
UL10393 AWG18#
SL49180-320-330

ELINCO ENGINEERING AVAILABLE

Elinco's Engineering Staff maintains a constant development program, which has developed hundreds of new units to meet difficult commercial and military specifications.

Elinco also designs and develops the product lines listed below.

Brushless DC Motors

- Standard NEMA Frame Sizes
- Gear Motors
- Drivers
- Speed Control
- High Efficiency
- Custom or OEM Products
- Special Windings

Slotless Brushless Motors

- Standard NEMA Frame Sizes
- Custom or OEM Products
- Zero Cogging and Low Torque Ripple
- Extreme Efficiency
- High Speed Performance

Fairfield Metro is a 1,100,000-square-foot (100,000 m2) commercial development and regional commuter rail station situated on 35 acres (140,000 m2) in the town of Fairfield, Connecticut. The in-fill station, located 1.8 miles (2.9 km) east of Fairfield station along Metro-North's New Haven Line, opened in December 2011

Elinco Corporate Headquarters and adjoining facility in background, all in front of the Fairfield Metro Train Station in Fairfield, CT

Elinco's Engineering Staff, with over 30 years experience in the specialized field of sub-fractional electrical rotary equipment, is available to tackle the toughest problems of heat, humidity, shock, vibration, torque,acceleration, weight, mounting and special design. Fast delivery on prototype units - forward complete electrical and mechanical requirements to:

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