

• .400 Thru Hole

•3,012 to 24,360 rpm

•Very low heat rise

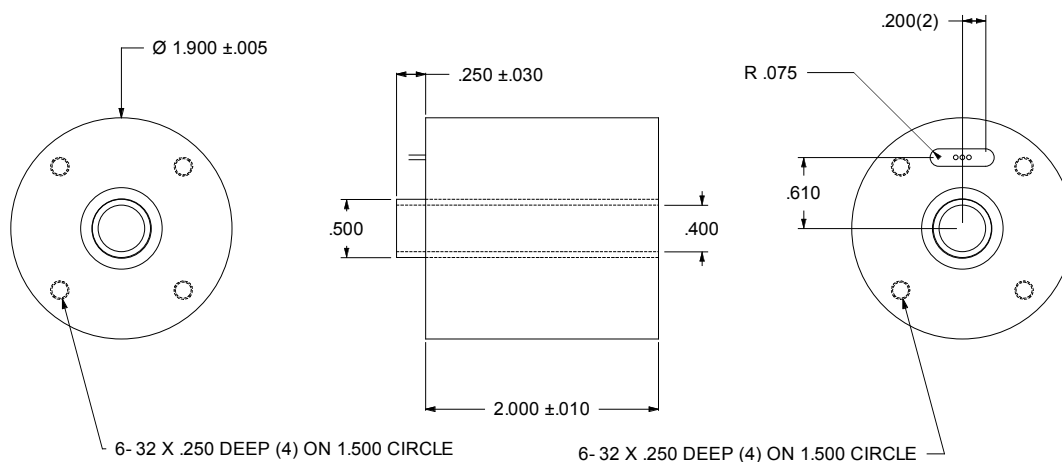
Slotless design is cog free, and provides very smooth rotation and very low heat rise to avoid affecting temperature sensitive components in scientific instruments and other devices. Typically these motors are used to rotate optics, filters, and mirrors mounted onto the end of the hollow motor shaft allowing laser beams passage through the center. Alternatively wires or other objects can pass through the center of the motor. The motors are driven by hall sensor drives such as our H24V5A-3A or H24V5A-3C. Versions of this motor suitable for operating in vacuum are available. Motors can be wound for other rpm than the speeds shown. Ceramic hybrid bearings are used for long life and low heat rise.



### Motor Data

Winding		251	502	1005	1015
Nominal supply voltage	volts	12	12	12	24
no load speed	rpm $\pm 12\%$	3,012	6,024	12,060	24,360
speed/torque slope	rpm/oz-in	940	960	990	1030
Stall torque (theoretical)	oz-in	2.8	5.6	11.3	22.6
Motor constant Km	oz-in/ $\sqrt{w}$	1.12	1.12	1.12	1.12
Winding resistance not including leads	ohm $\pm 15\%$	22.6	5.64	1.41	1.41
Peak output	watts	2	7	17	57
No load current	amp $\pm 50\%$	.04	.09	.15	.16
Velocity constant	rpm/volt	251	502	1005	1015
Torque constant Kt	oz-in/amp	5.32	2.66	1.33	1.33
Stall current	amps	.53	2.1	8.50	17.0
Temperature rise free running	$^{\circ}C$	3	5	8	18
Winding inductance	mH	11.6	2.9	.73	.73
Ambient temperature range $-30^{\circ}C$ to $100^{\circ}C$					

Values based on winding and magnet temperature of  $20^{\circ}C$ . Lead are 10" minimum and untrimmed phase lead resistance is  $.052\Omega$ . Phase leads are 24 gauge stranded TFE insulated, and hall leads are 28 gauge, TFE insulated. Axial force on bearing including during installation should not exceed 20 lb. Weight 9.4 oz.



Leads	
Blue	Phase A
White	Phase B
Brown	Phase C
Red	+5 volts
Black	Ground
Yellow	Sensor A
Orange	Sensor B
Green	Sensor C

**Ordering Information:** Please send your order to: [mail@koford.com](mailto:mail@koford.com)

**Example:** Part Number 4851 H 502 A

Motor size \_\_\_\_\_  
 Type H=hall sensor \_\_\_\_\_  
 Winding number \_\_\_\_\_

\_\_\_\_\_ Modifications A=none, V=Vacuum compatible

• .400 Thru Hole

• 2,000 to 10,000 rpm

• Very low heat rise

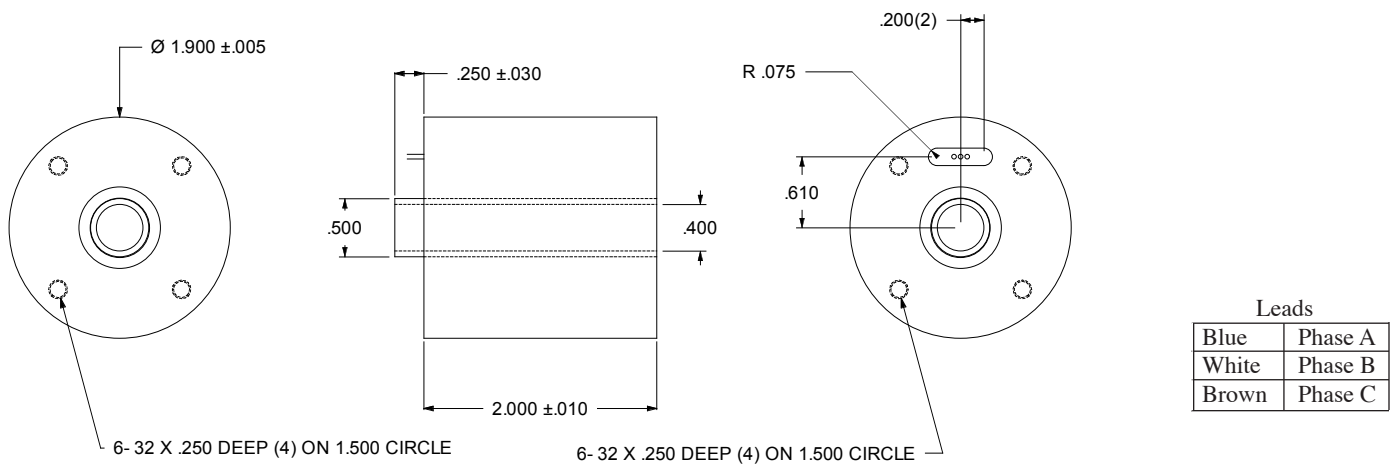
Slotless design is cog free, and provides very smooth rotation and very low heat rise to avoid affecting temperature sensitive components in scientific instruments and other devices. Typically these motors are used to rotate optics, filters, and mirrors mounted onto the end of the motor shaft. They are driven by sensorless drives such as our S18V15A or S24V5A. Versions suitable for operating in vacuum are available. Motors can be wound for other rpm than the speeds shown. Ceramic hybrid bearings are used for long life and low heat rise.



### Motor Data

Winding		265	525	833
Nominal supply voltage	volts	12	12	12
no load speed	rpm $\pm 12\%$	3,180	6,300	10,000
speed/torque slope	rpm/oz-in	1060	1046	1031
Stall torque (theoretical)	oz-in	3.0	6.2	10.2
Motor constant $K_m$	oz-in/ $\sqrt{w}$	1.1	1.2	1.2
Winding resistance not including leads	ohm $\pm 15\%$	20.1	4.96	1.88
Peak output	watts	1.7	7.1	18
No load current	amp $\pm 50\%$	.04	.06	.09
Velocity constant	rpm/volt	265	525	833
Torque constant $K_t$	oz-in/amp	5.09	2.57	1.6
Stall current	amps	.60	2.41	6.38
Temperature rise free running	$^{\circ}C$	2	3	5
Winding inductance	mH	8.5	2.1	.86
Ambient temperature range $-30^{\circ}C$ to $100^{\circ}C$				

Values based on winding and magnet temperature of  $20^{\circ}C$ . Phase lead are 12" minimum and untrimmed lead resistance is  $.052\Omega$ . Phase leads are 24 gauge stranded TFE insulated. Axial force on bearing including during installation should not exceed 20 lb. Weight 9.4 oz.



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**Example:** Part Number 4851 S 525 A

Motor size \_\_\_\_\_  
 Type S= sensorless \_\_\_\_\_  
 Winding number \_\_\_\_\_  
 Modifications A=none, V=Vacuum compatible

### **Unit conversions**

$^{\circ}\text{F} - 32 \div 1.8 = ^{\circ}\text{C}$  example:  $212^{\circ}\text{F} = 100^{\circ}\text{C}$ ,  $^{\circ}\text{C} \times 1.8 + 32 = ^{\circ}\text{F}$  example:  $100^{\circ}\text{C} = 212^{\circ}\text{F}$ ,  $\text{in} \times 25.40 = \text{mm}$ ,  
 $\text{mm} \times 0.03937 = \text{in.}$ ,  $\text{oz} \times 28.3495 = \text{g}$ ,  $\text{oz-in} \times 7.06 = \text{mNm}$ ,  $\text{mNm} \times .142 = \text{oz-in}$ ,  $\text{Nm} \times 142 = \text{oz-in}$ ,  
 $\text{rpm} \times .1047 = \text{rad s}^{-1}$ ,  $\text{V/R/S} \times .1047 = \text{volts/rpm}$ ,  $746 \text{ watts} = 1\text{hp}$ ,  $\text{lb-in}^2 \times .04144 = \text{oz-in-sec}^2$

### **Understanding Data Sheets**

When comparing Koford motors to data sheets for other motors be careful to note the conditions associated with the rated torque listed. For example many manufactures list continuous torque at stall or at rpm less then the maximum. Usually this is because these motors will overheat if run continuously at full speed even with no load.

### **Hall Sensors**

Like other semiconductor components hall sensors are electrostatic sensitive. Hall motors are supplied in electrostatic safe packaging and should be kept in the packaging until use. When trimming wire length, adding connectors, and hooking up motors, workers should be grounded to prevent electrostatic damage to the sensors.

### **Balancing**

Components attached to the motor shaft should be dynamically balanced to G6.3 or better and located as close to the motor body as possible if they have significant mass. G6.3 is equal to  $0.64 \times \text{weight (oz.)}/\text{rpm} = \text{unbalance in milli oz-in}$ . If the components have appreciable length they must be balance in 2 planes.

### **Motor technology**

The Koford Hollow Shaft 48 brushless series of motors are slotless sintered rare earth permanent magnet motors with unique technology. In addition to their large center hole they have very low heat rise and smooth cog free operation.

### **Operating speed**

Motors can be operated at any voltage lower then the specified voltage. Motors should not be operated more then 20% over the no load speeds listed.

### **Hall or Sensorless motor selection**

Hall sensor motors can operate from 0 to 100% of maximum speed, sensorless drives can operate from about 45% of maximum speed to 100%. Hall drives start immediately while sensorless drives take about .25 seconds to perform the start up routine. Hall drives will start immediately in the desired direction. Sensorless drives may have some reverse rotation at start up. Sensorless motors require hooking up only three wires and are less expensive.

### **Speed torque calculations**

A motors no load speed is equal to the supply voltage times the velocity constant (rpm/v). Under load the rpm will drop. To determine the approximate speed, use dyno data if listed, or use the speed torque slope from the data sheet. For example if the supply voltage is 6 volts and the rpm/volt is 833 then the no load speed will be 4,998 rpm. If the speed torque slope is 540 rpm/oz-in and a 0.5 oz-in load is applied to the shaft then the speed will be  $4,998 - (0.5 \times 540) = 4,728$  rpm. If there is extra wiring between the drive and the motor, or the supply and the drive, then the speed will drop at a more rapid rate due to the voltage drop in the wiring. A design margin of at least 15% should be used to allow for motor tolerances, so for example with the above motor the rpm can be expected to be at least 4,019 rpm.

### **Motor cooling**

These motor are designed for use with light loads and have very low heat rise so cooling is not usually an issue. If the heat rise must be further reduced, means such as mounting the motor to a substantial aluminum frame, or a cooling fan directed at the body of the motor will be effective.

### **Vacuum Applications**

The standard motors are suitable for low vacuum applications. For high vacuum applications use (option V). Vacuum grade motors are made with low outgassing material and baked before shipping. A vacuum bake by the customer immediately prior to use may be desirable to reduce initial pump down time. An important consideration is that in a vacuum there is no heat removal by air contacting the motor housing. Therefore the mounting of the motor should be made of highly thermally conductive material, such as copper or aluminum, should be of as heavy a cross section as possible, and should connect to a large surface exposed to the outside air. A liquid cooling jacket with a heat exchanger can also be used for the ultimate performance.

### **EMI**

Koford drives and motors have low levels of emi relative to other motors but in sensitive applications the following steps are suggested. The power supply, drive and if possible the motor should all be enclosed in a grounded metal enclosure. Power should enter the enclosure through a EMI filtered power entry connector. If it is desirable to minimize emi between the motor and other components in the housing the phase leads can be cut as short as possible and braided with each other to cancel out EMI.