

• .400 Thru Hole

• 2,000 to 10,000 rpm

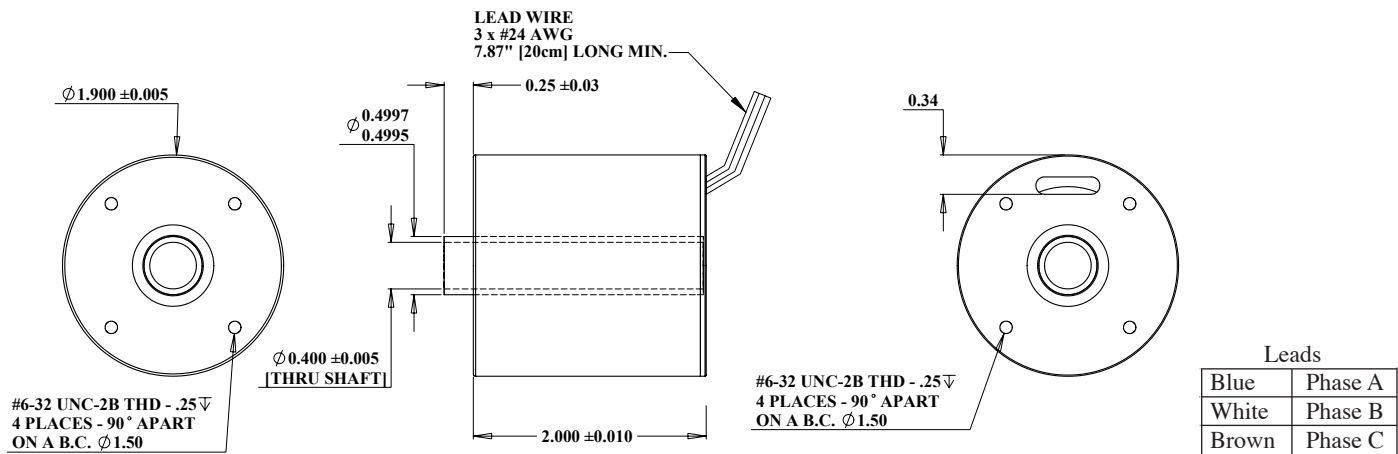
• Very low heat rise

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.

### Motor Data

Winding		167	833
Nominal supply voltage	volts	12	12
no load speed	rpm $\pm 12\%$	2,000	10,000
speed/torque slope	rpm/oz-in	434	540
Stall torque (theoretical)	oz-in	4.6	19.4
Motor constant Km	oz-in/ $\sqrt{w}$	1.7	1.6
Winding resistance not including leads	ohm $\pm 15\%$	21.1	.99
Peak output	watts	1.6	356
No load current	amp $\pm 50\%$	.02	.07
Velocity constant	rpm/volt	167	833
Torque constant Kt	oz-in/amp	8.1	1.6
Stall current	amps	.57	12.1
Temperature rise free running	$^{\circ}C$	1	4
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 $\Omega$ . Excess lead length should be trimmed. 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.



**Ordering Information:** mail@koford.com • phone 330-315-3061 • fax 937-695-0237 • www.koford.com

**Example:** Part Number 4851 S 167 H

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:  $100^{\circ}\text{C} = 212^{\circ}\text{F}$ ,  $\text{in} \times 25.40 = \text{mm}$ ,  
 $\text{mm} \times 0.03937 = \text{in.}$ ,  $\text{oz} \times 28.3495 = \text{g}$ ,  $\text{oz-in} \times 7.06 = \text{mNm}$ ,  $\text{mNm} \times .142 = \text{oz-in}$ ,  $\text{Nm} \times .142 = \text{oz-in}$ ,  
 $\text{Ncm} \times 1.42 = \text{oz-in}$ ,  $\text{rpm} \times .1047 = \text{rad s}^{-1}$ ,  $\text{V/R/S} \times .1047 = \text{volts/rpm}$ ,  $746 \text{ watts} = 1\text{hp}$ ,  $\text{lb-in}^2 \times$   
 $.04144 = \text{oz-in-sec}^2$

### **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.

### **Drive selection**

These motors can be driven by either the S18V15A or the S24V5A sensorless drives. The S24V5A is a PWM drive which will vary the speed from approximately 35% to 100% of full speed. The S18V15A drive requires operation from a variable voltage power supply with a current limit of 15 amps or less. For most applications a 3 to 5 amps supply will be suitable. These power supplies are readily available for electronics distributors. The speed of the motor when driven by the S18V15A is directly proportional to the input voltage to the drive, this results in a speed range of 25% to 100% (4-12V). Because the S18V15A does not use PWM it generates much less electrical noise then a conventional drive. For high precision applications it can be driven with a linear transistor to achieve for example a phase locked loop.

### **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 4,111 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. First keep the phase wires as short as physically possible and twist or braid them together and if necessary add a shield jacket terminated at one end. Add a 5,000 $\mu$ F cap at the input to the drive along with a common mode inductor. Add small inductors to each of the phase wires. If possible vary the input voltage to the drive rather than using the speed control. Place the drive and motor as close together as possible. Also consider enclosing the drive or motor and drive in a metal enclosure.