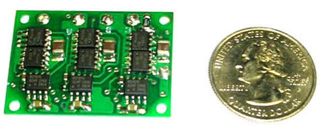
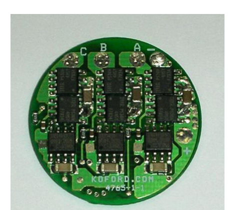
Koford Engineering can provide custom motors and drives to meet your needs. Typically these are modifications of existing proven designs. Examples include windings with a custom rpm/volt, custom housings to match motors from other vendors which are not longer available, custom shafts including lead screw shafts, shafts with cross holes, turned down diameter or custom lengths. Finned housing with a built in heat sink can be offered. Gearboxes with custom gear ratios can be made. Drives can be provided with pin headers instead of terminal blocks. Drives can be made with fan cooled housings with built in heat sinks, or totally enclosed waterproof housings, round configurations, and ultra minuature sizes, emi filters and lightening proteciton can be provided, the drive can be custom programed in various ways for example the drive can run at a specified rpm in a specified direction when power is provided, with no control signal required, The drive can accelerate the load at a specified ramp rate. The drive can oscillate the load reversing direction after a specified number of milliseconds. When a brake signal is provided the drive can stop the motor in a specific position and hold it there. See below for







KOFORD
ENGINEERING, LLC

# Hollow Shaft 1.9" (48mm) Slotless Brushless DC motor.

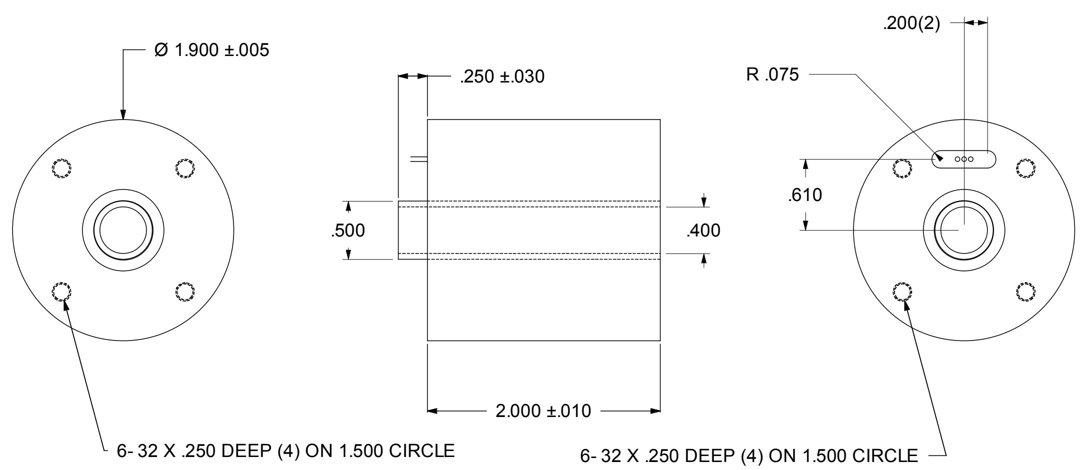
**• .400 Thru Hole** **•2,000 to 10,000 rpm** **•Very low heat rise**

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 vaccuum are available. Motors can be wound for other rpm then 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 ±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 Km | oz-in/√w | 1.1 | 1.2 | 1.2 |
| Winding resistance not including leads | ohm±15% | 20.1 | 4.96 | 1.88 |
| Peak output | watts | 1.7 | 7.1 | 18 |
| No load current | amp±50% | .04 | .06 | .09 |
| Velocity constant | rpm/volt | 265 | 525 | 833 |
| Torque constant Kt | oz-in/amp | 5.09 | 2.57 | 1.6 |
| Stall current | amps | .60 | 2.41 | 6.38 |
| Temperature rise free running | °C | 2 | 3 | 5 |
| Winding inductance | mH | 8.5 | 2.1 | .86 |
| Ambient temperature range -30°C to 100°C | | | | |

Values based on winding and magnet temperature of 20°C. Phase lead are 12" minimum and untrimmed lead resistance is .052Ω. Phase leads are 24 gauge stranded 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 |

**Ordering Information:** Please send your order to: mail@koford.com

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

Motor size — 4851
Type S=sensorless — S
Winding number — 525
Modifications A=none, V=Vacuum compatable — A

## Unit conversions

°F -32 ÷1.8=°C example: 212°F=100°C, °C x1.8+32=°F example: 100°C=212°F, in x 25.40=mm, mm x.03937= in., oz x 28.3495=g, oz-in x 7.06=mNm, mNm x .142=oz-in, Nm x 142=oz-in, rpm x .1047=rad $s^{-1}$, V/R/S x .1047=volts/rpm, 746 watts=1hp, lb-$in^2$ x .04144=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 sensititive. 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 x weight (oz.)/rpm=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 x 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.