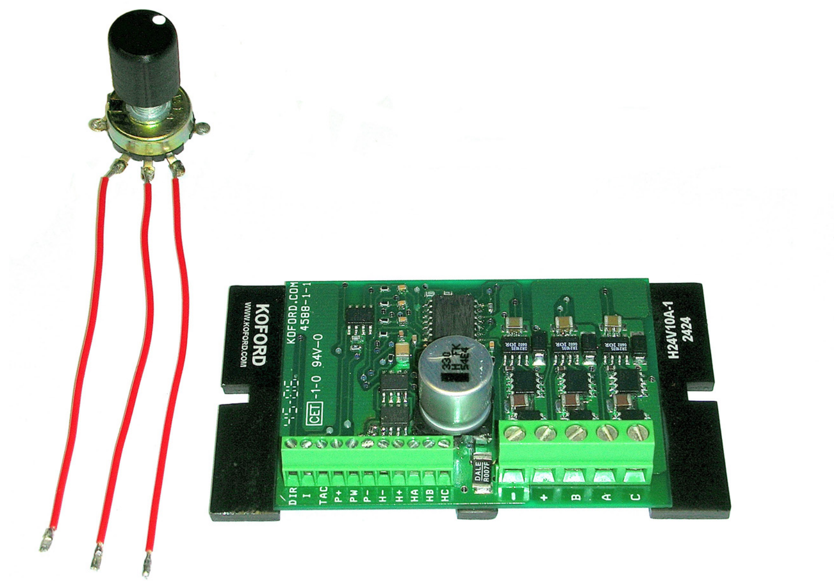
KOFORD
ENGINEERING, LLC



5 amp 48 volt sensorless motor drivers

Small, compact, no programing or set up required. Up to 99% efficiency, no inductors required for slotless or ironless motors.

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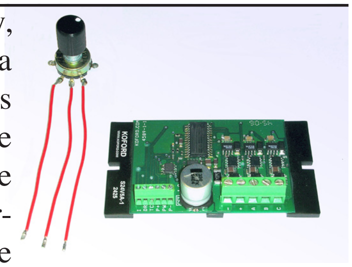
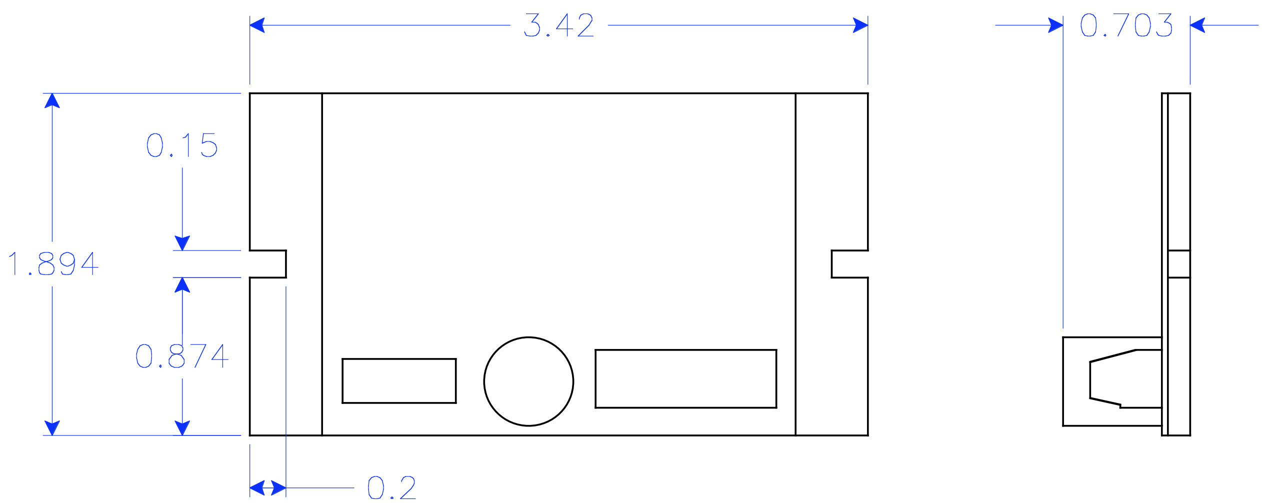
S48V5A digital closed sensorless motor driver with brake 5A 12-54V



Ultra high efficiency miniature sensorless digital drive with 37kHz pwm frequency, designed for use with stand alone, digital or analog operation. The digital design has a sophisticated start up which will start higher inertia loads than is typical for sensorless drives.The drive can be programed for open or closed loop speed control and can be custom programed for your specific application. The drive has no minimum inductance and will operate slotless or ironless brushless motors without the need for bulky, cumbersome inductors. For stand alone operation the optional speed pot can be ordered. Once power supply, motor and speed pot are connected, the motor can be operated without the need for any adjustments, set up or programing. For digital operation the unit will interface with a customers microcontroller. The microcontroller should be 5v or be a 3.3v with 5v interface capabilities. Speed input can be accomplished with a 0-5v analog input (less then 1mA) or a 100 hz to 100k Hz square wave with variable duty cycle. For operation in a single direction such as a pump, blower or beam chopper only power, the three motor leads, and the 0-5v speed input (or the speed pot) need to be connected. If reversible operation is required a SPDT switch can be added between DR and P- or a 0 or 5 volt signal from a microcontroller to DR can be used. If the switch is open the motor will run in the clockwise direction, if the switch is closed the motor will run in the counterclockwise direction. The Tach output is referenced to P-, and is a 5 volt square wave at 3 pulses per revolution per magnet pole pair (1000 hz=20,000 rpm, 2 pole motor). The EN input will turn off the motor if pulled to ground. To apply brake connect BK to P+ with a swich, or use an external 5v signal connected between BRK and P-. The CV-1 braking module should be used when braking if the drive is used with a power supply instead of a battery. The drive can be custom programed for your specific application, for example to run at a fixed speed when power or the enable is applied.



Terminal block positions (motor lead hook up for Koford motors).

P+=connect to one side of pot (5.0v) (red)
PW=connect to pot wiper (center terminal) (purple)
P-=connect to other side of pot (ground) (black)
EN=unconnected or 5v to run, 0v to turn motor off
DR=leave unconnected for forward direction, hook to P- for reverse
BK=unconnected or 0v=off, 5v=on

TC=tach/encoder output 3 pulses per revolution per magnet pole pair (1000 hz=20,000 rpm, 2 pole motor)
-=Connect to black (-) lead of power supply
+=Connect to red (+) lead of power supply
A=blue motor wire
B=white motor wire
C=brown motor wire

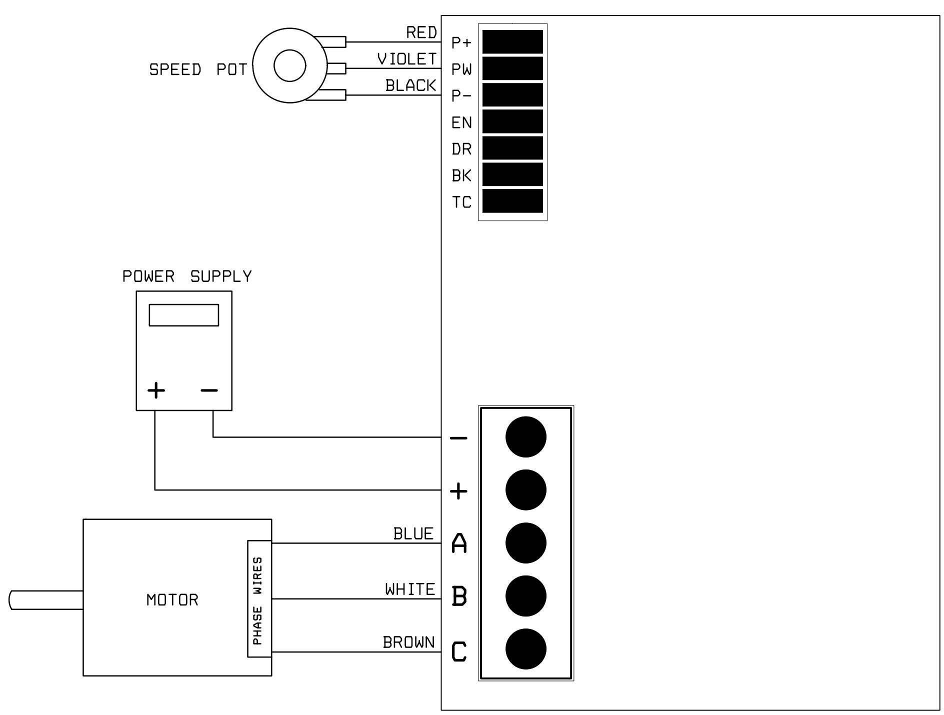
Ordering information:

please send the order to mail@koford.com

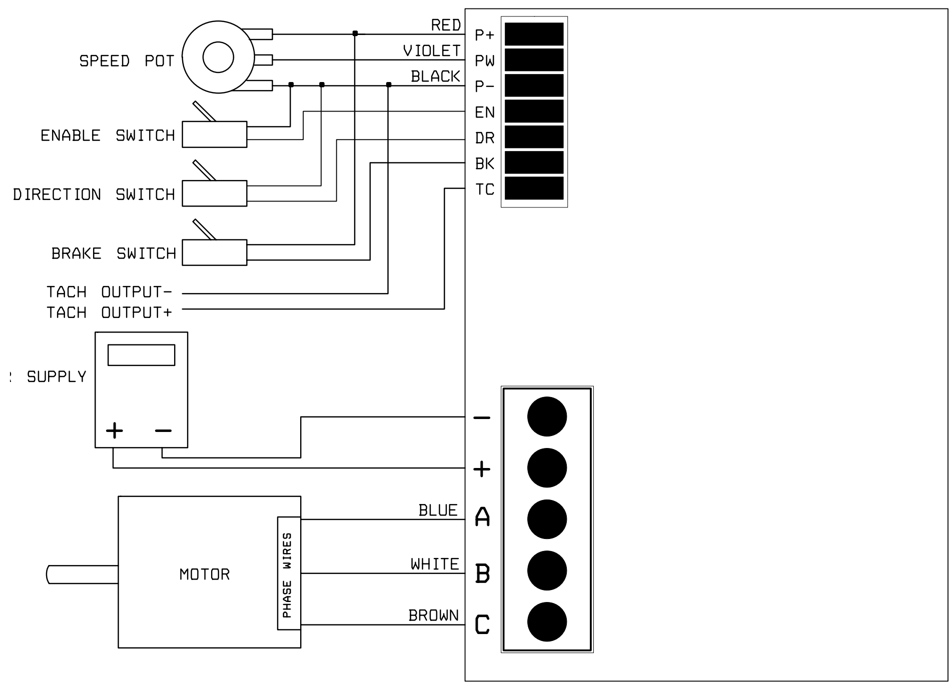
Part number: S48V5A-1A open loop drive with brake, tach, and direction 183k rpm 2p
S48V5A-1B closed loop drive 10k rpm 2p, 5k rpm 4p, 2.5k rpm 8p
S48V5A-1C closed loop drive 20k rpm 2p, 10k rpm 4p, 5k rpm 8p
S48V5A-1D closed loop drive 40k rpm 2p, 20k rpm 4p, 10k rpm 8p
S48V5A-1E closed loop drive 80k rpm 2p, 40k rpm 4p, 20k rpm 8p
S48V5A-1F closed loop drive 120k rpm 2p, 60k rpm 4p, 30k rpm 8p
P1 pot with knob and leads

The -1 version is open loop. The motor is off with a pw voltage of 0-.5V, and the duty cycle increases linearily from the minimum level up to 100% when pw=5.0v. Maximum speed with a two pole slotless motor is 183,000 rpm. The closed loop versions control the motor speed rather then duty cycle and are off at 0-.5v and then the speed ramps from the minimum up to the maximum as the pw voltage is increased. The duty cycle is automatically adjusted as needed to maintain speed under varying load conditions.

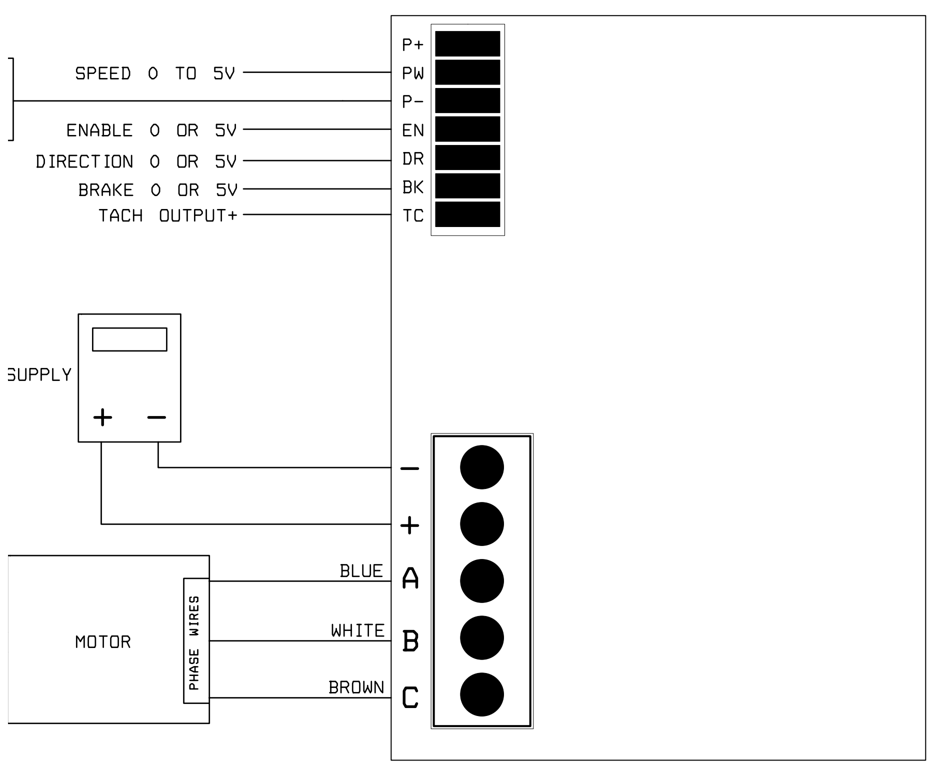
Stand alone operation with speed pot, motor direction can be reversed by switching Blue and White leads



Stand alone operation with speed pot and brake

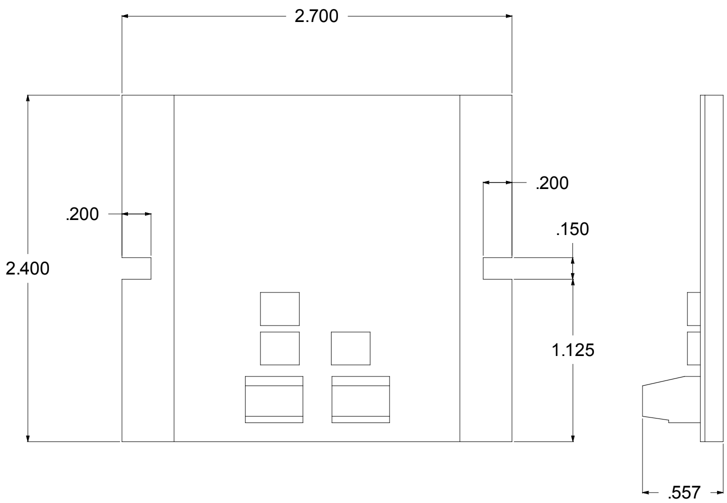


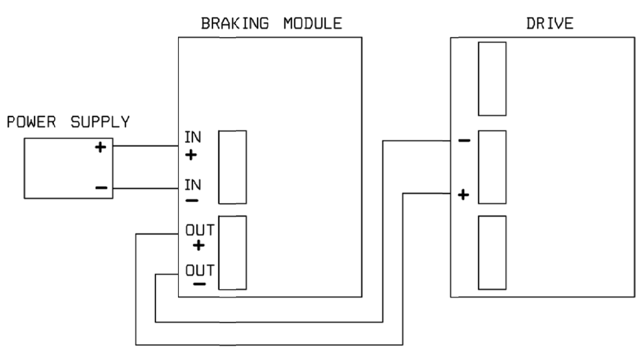
External control



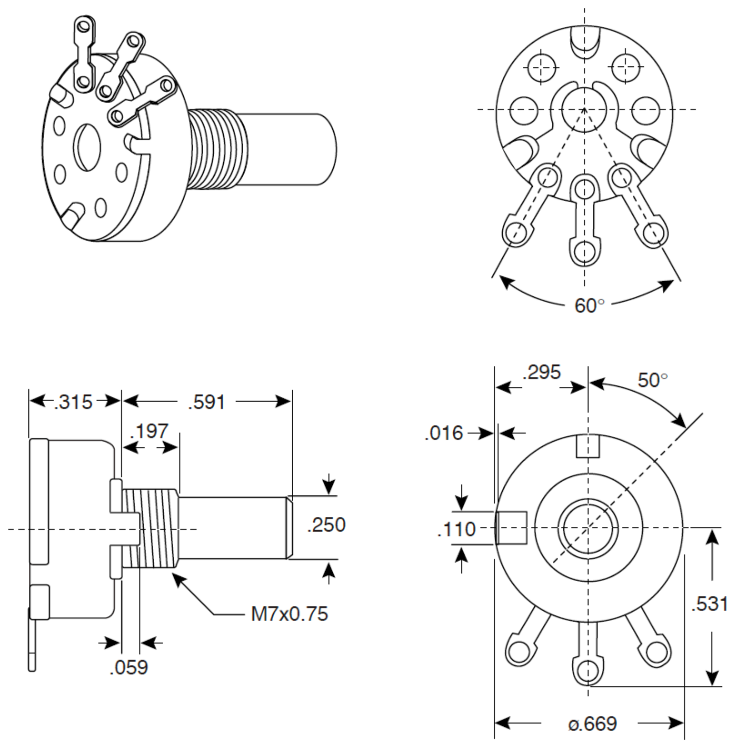
CV-1 10 Amp, 24V braking module

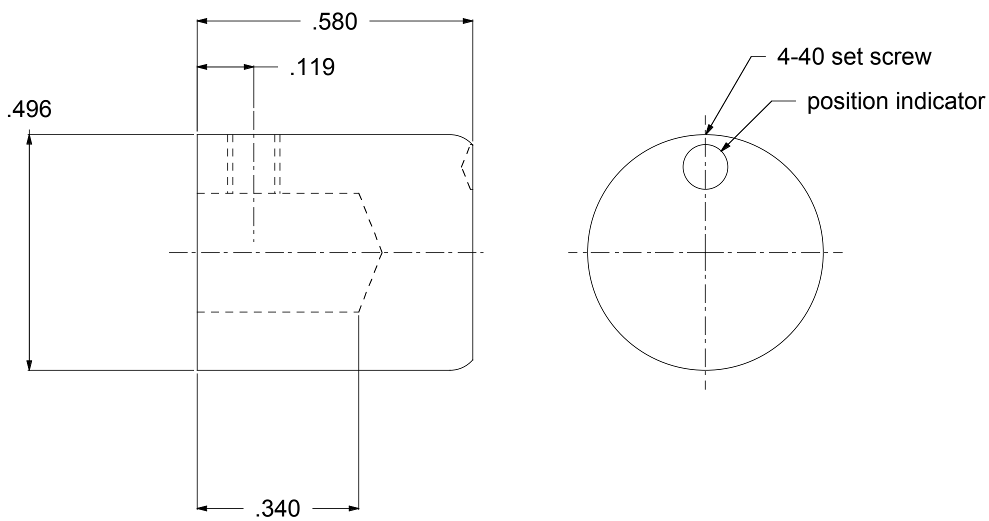
The CV-1 braking module is for use when a drive with braking function is connected to a power supply. If a battery supplies the power, the module is not needed. The module is needed on a system with a power supply because otherwise the regenerated energy would cause an overvoltage condition in the power supply. That would cause power supply shut off and/or power supply damage. The module contains Schottky diodes to prevent current backflow and also a TVS to absorb the transient braking energy. The TVS is needed because otherwise the braking energy would cause an overvoltage in the drive damaging it.





SPEED POT AND KNOB





Leads are 3.440" long stranded 22 gauge with TFE insulation.

<u>Notes</u>

1. Sensorless drives work best with slotless or ironless brushless motors. Most slotted motors will work reasonably well but a few will not.

2. The maximum speed depends on the characteristic of the motor, however Koford 2 pole motors will run well up to 183,000 rpm and 4 pole motors up to 90,000 rpm with the open loop (A) version.. Slotted motors will have a lower maximum speed which must be determined by testing.

3. When using a microcontroller to operate the drive a 5 volts output should be used and the pwm frequency should be 8Khz or more, otherwise filtering of the output will be required.

5. The current limiting of the drive limits the current delivered to the motor to slightly above 5 amps, this means that the current at the power supply will reach a maximum of slightly above 5 amps with the speed turned to maximum, if the speed is reduced then the current at the power supply will be proportionately reduced so as to maintain the current at the motor at a maximum of 5 amps.

6. The drive should preferably be mounted on a aluminum chassis or frame, or a aluminum heat sink. Drive heat rise is greatest at high currents, low duty cycles and continuous operation. If the application is 100% duty cycle, with normal indoor ambient temperature, the current is low compared to the rated current, or if the application is intermittent with on times for example of 1 minute and off times of at least 1 minute, then a heat sink will probably not be necessary. For high ambients forced air cooling directed at the board can help. For long term reliability, it is recommended that sufficient cooling be provided to prevent the hottest spot on the board from exceeding 100C. This can be checked with a portable infrared thermometer

7. Sensorless motors cannot operate near zero speed as they need back emf to determine the correct point of commutation. There is also a minimum duty cycle required for proper commutation which limits the speed range. If the motor has no load then the speed range may only be 30% to 100%. With a slight load the speed range may increase to 15% to 100%. At 50% of rated current the range is 12% to 100%. These values are approximate and depend on motor inductance and input voltage. If a wider speed range is required then either hall sensor motors may be used or the drive may need to be custom programed. Contact the factory for more information.

8. The motor direction can only be reversed when the speed pot or speed command is off. This prevents damage to the motor or drive which could result from trying to reverse the motor when it is running.

9. When the brake input is activated the motor leads are shorted together slowing the motor. The energy in the motor and load inertia is dissipated in the motor. With this approach there is no risk of overvoltage damage to the power supply or drive during braking and no need for a braking resistor. However the effect of motor temperature must be considered in the case of repetitive braking of a high inertia load. For maximum braking a steady 5 volt signal can be provided. For reduced deacceleration the braking signal can be PWM'd.

10. The motor rpm can be read using a multimeter with a frequency or tach function. 1000 hz=20,000 rpm with a 2 pole motor, 10,000 rpm with a 4 pole motor, 5,000 rpm with a 8 pole motor etc. The tach function on a scope can also be used or the output can be connected to a dataloger or interfaced with a 5 volt input capable micro, or a buffer can be used to bring the voltage down to 3.3v or lower if required.

11. If the motor rotor is locked or severely overload the drive will try to restart twice and if that fails will shut down. The drive can be restarted after the problem is corrected by cycling the power.

12. The direction of the motor can be changed with the direction input or by switching any two motor leads. The exact configuration of the drive is custom programed at the factory and does not require any user programing, switches or adjustments. The units are plug and play.

13. Precise speed control is possible with closed loop control (even ±1 rpm) but this is very much dependent on the motor (especially the bearings) and the stability of the power supply, and requires a constant load and speed command. Applications with very tight speed controls will benefit by using a motor with an encoder and the open loop drive and then externally closing the speed loop with a customer supplied control or Lab View.

14. The drive will operate both slotless and slotted motor, however results will be better with slotless motors. Slotted motors with a severe cog will be difficult to start especially if there is also a high inertia load. Designing the motor with low cog through the selection of the number of magnets and slots, as well as slot dimensions helps. Often skewing the magnets or laminations can greatly reduce cogging. Some lamination designs cannot be operated with a sensorless drive due to multiple back emf zero crossings, or near zero slope at the zero crossing. These problems can usually be remedied with sufficient skewing.