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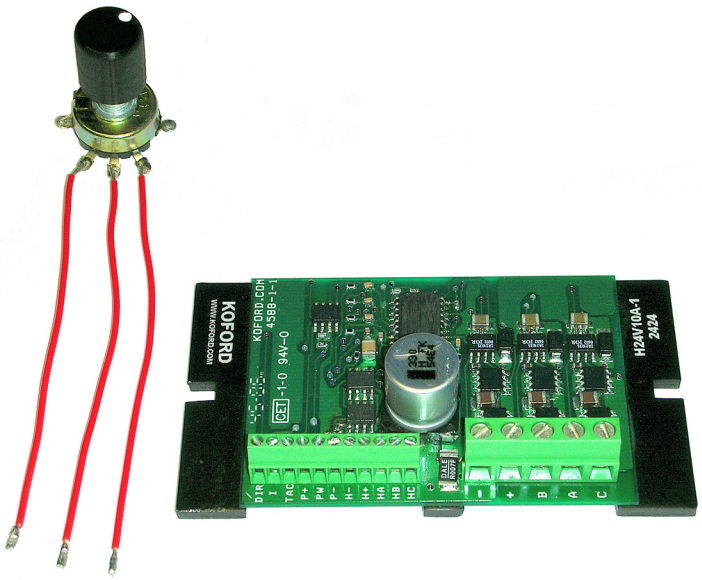
ENGINEERING, LLC



10 amp 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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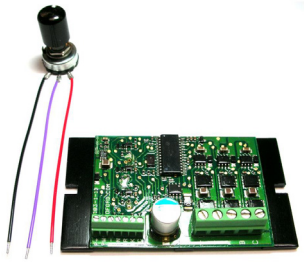
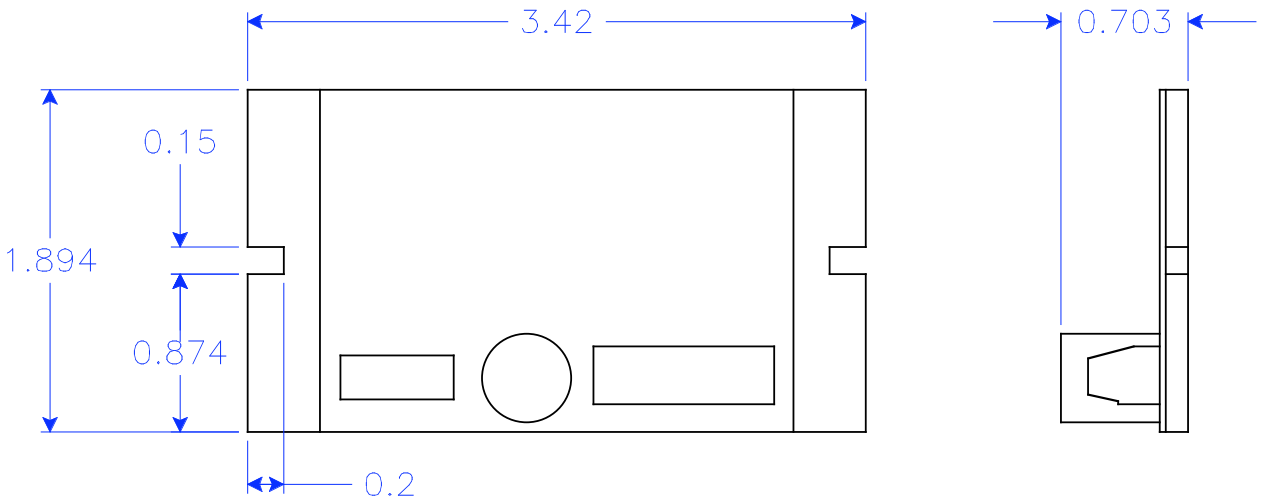
S24V10A digital sensorless motor driver with brake 10A 10-34V



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 BRK to P+ with a swich, or use an external 5v signal connected between BRK and BG. 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. The drive weighs 1.9 oz.



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:

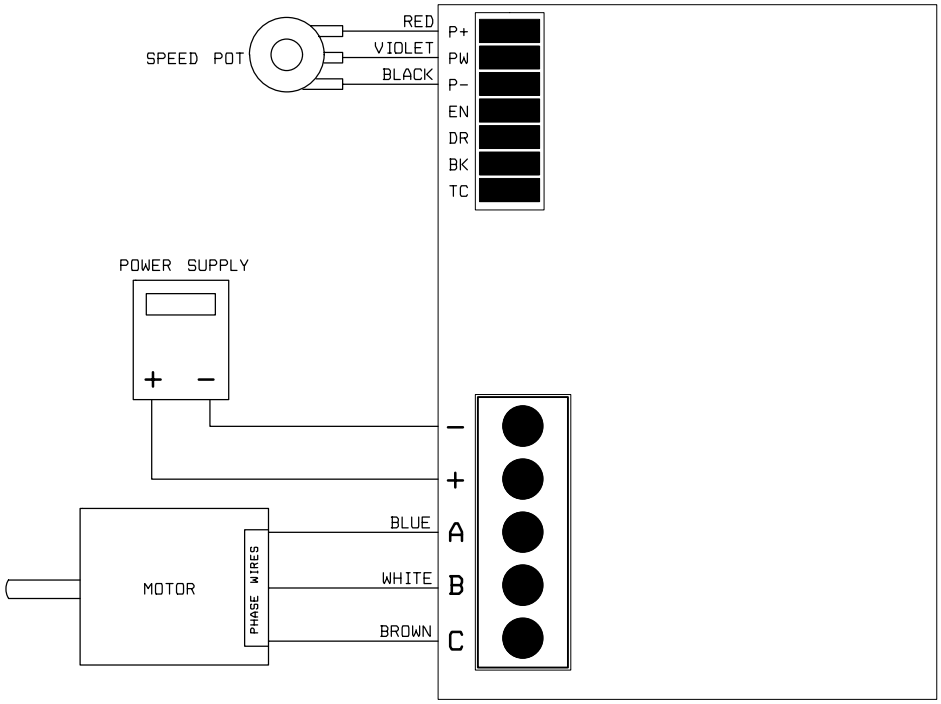
S24V10A-4H closed loop drive 5k rpm 2p, 2.5k rpm 4p, 1.25k 8p
S24V10A-4B closed loop drive 10k rpm 2p, 5k rpm 4p, 2.5k rpm 8p
S24V10A-4C closed loop drive 20k rpm 2p, 10k rpm 4p, 5k rpm 8p
S24V10A-4D closed loop drive 40k rpm 2p, 20k rpm 4p, 10k rpm 8p
S24V10A-4E closed loop drive 80k rpm 2p, 40k rpm 4p, 20k rpm 8p
S24V10A-4F closed loop drive 120k rpm 2p, 60k rpm 4p, 30k rpm 8p
S24V10A-4A open loop drive 100k rpm 2p, 50k rpm 4p, 25k rpm 8p
for winding resistances 12V<1.2Ω, 24V<2.4Ω
S24V10A-4H open loop drive 100k rpm 2p, 50k rpm 4p, 25k rpm 8p
for winding resistances, 12V less than 1.2Ω, 24V less than 2.4Ω
P1 pot with knob and leads

The closed loop speed control drives control the motor speed rather then duty cycle so that speed will remain steady under varying load. The drive is 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. At turn on the motor speed ramps to set speed in 1-2 seconds. For most applications the closed loop speed control is prefered.

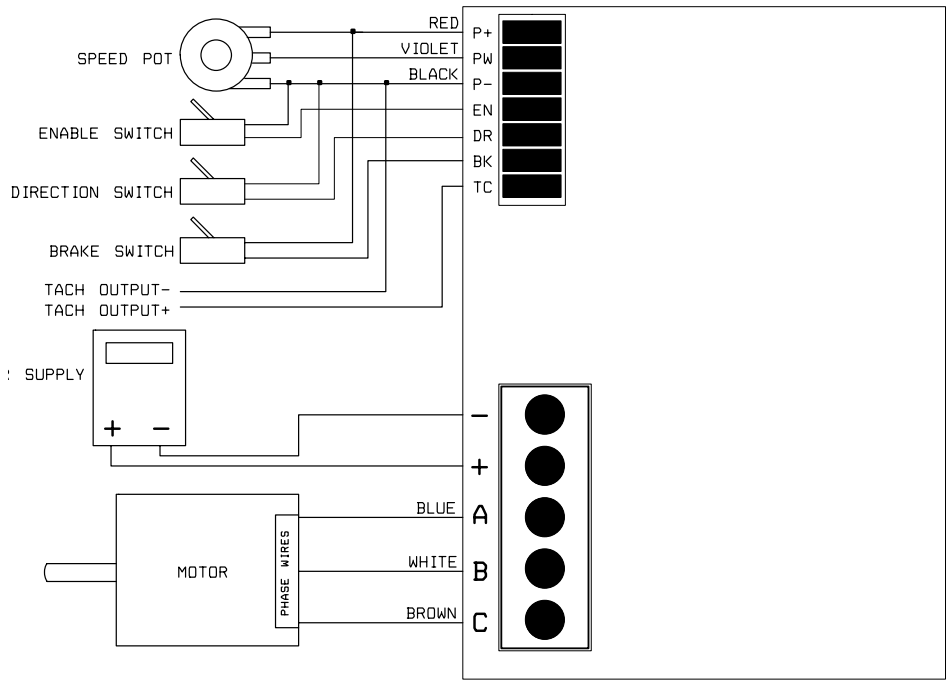
The -4A and -4H versions have open loop speed control. The motor is off with a pw voltage of 0-.5V, and the duty cycle increases linearily from the minimum level up to 100% when pw=5.0v. Maximum speed with a two pole slotless motor is over 100,000 rpm. This type will respond more quickly to changes in the speed command.

The minimum speed depends on the motor and the load but is usually 20% to 50% of the motors no load speed.

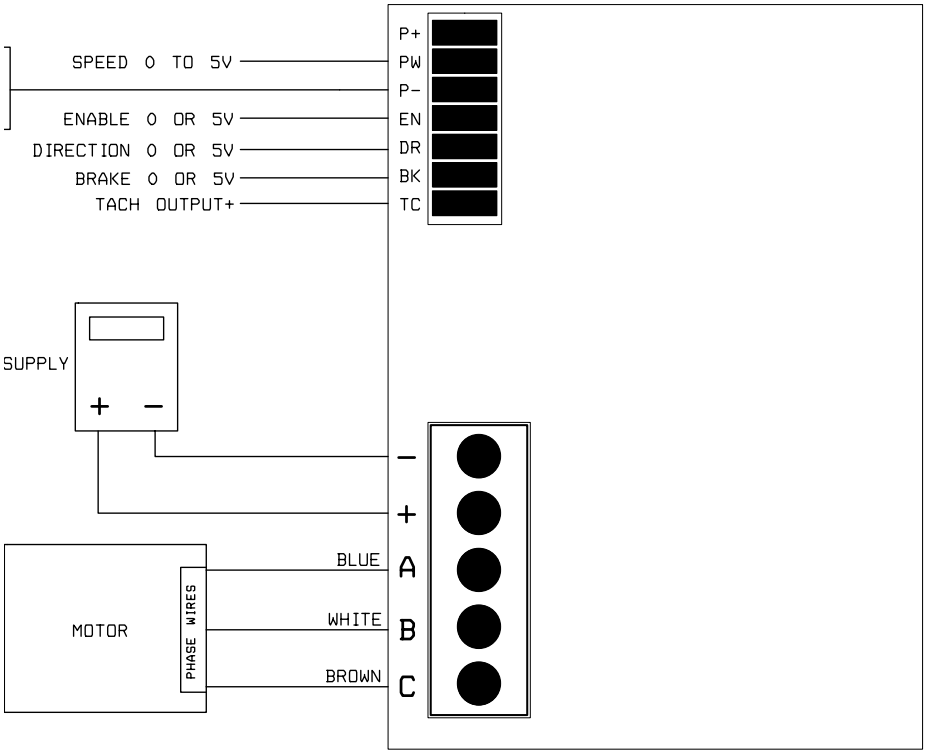
Stand alone operation with speed pot, motor direction can be reversed by switching Blue and White leads



Stand alone operation with speed pot and brake



External control



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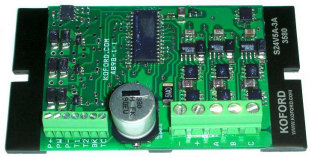
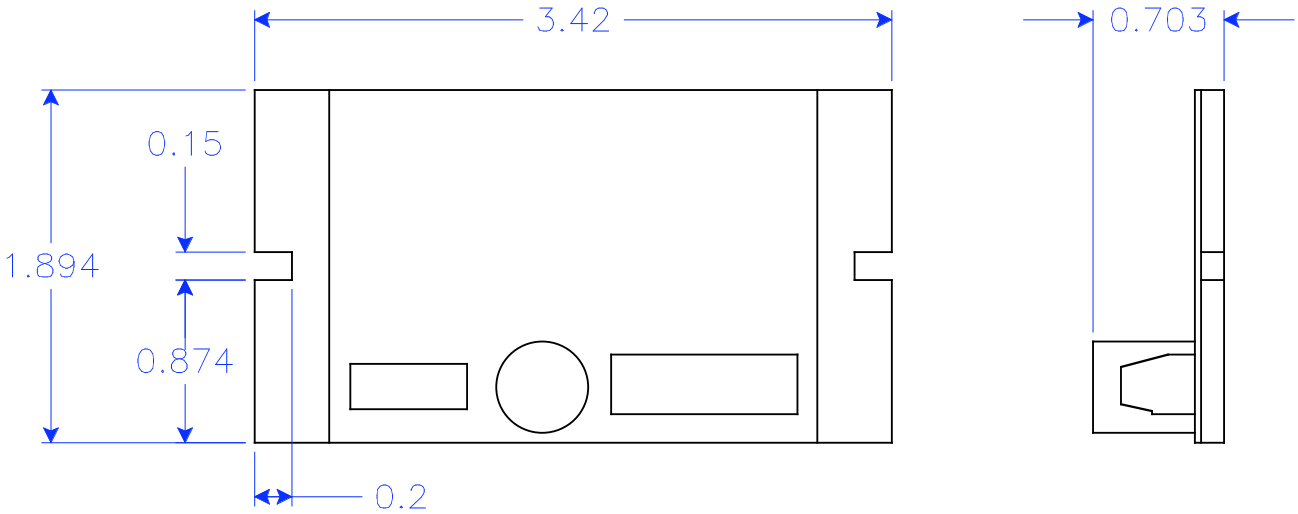
S24V10A digital sensorless motor driver with temperature protection 10A 10-34V



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.Open loop and closed loop versions are available and the drive 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. 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 temperature input interfaces directly with the thermisor output of a Koford motor and turns off the motor if a winding temperature of 150°C is reached, when the winding temperature drops to 100°C the motor will restart. If the motor does not have temperature sensors then these connection can be left open. The drive can be custom programed for your specific application. The drive weighs 1.9 oz.



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

DR=leave unconnected for clockwise direction, hook to P- for counterclockwise

TC=tach/encoder output 3 pulses per revolution per magnet pole pair (1000 hz=20,000 rpm, 2 pole motor)

T1 =Connect to red striped thermistor lead

T2 =Connect to black striped thermistor lead

P+=connect to one side of pot (5.0v)

PW=connect to pot wiper (center terminal)

P-=connect to other side of pot (ground)

-=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:

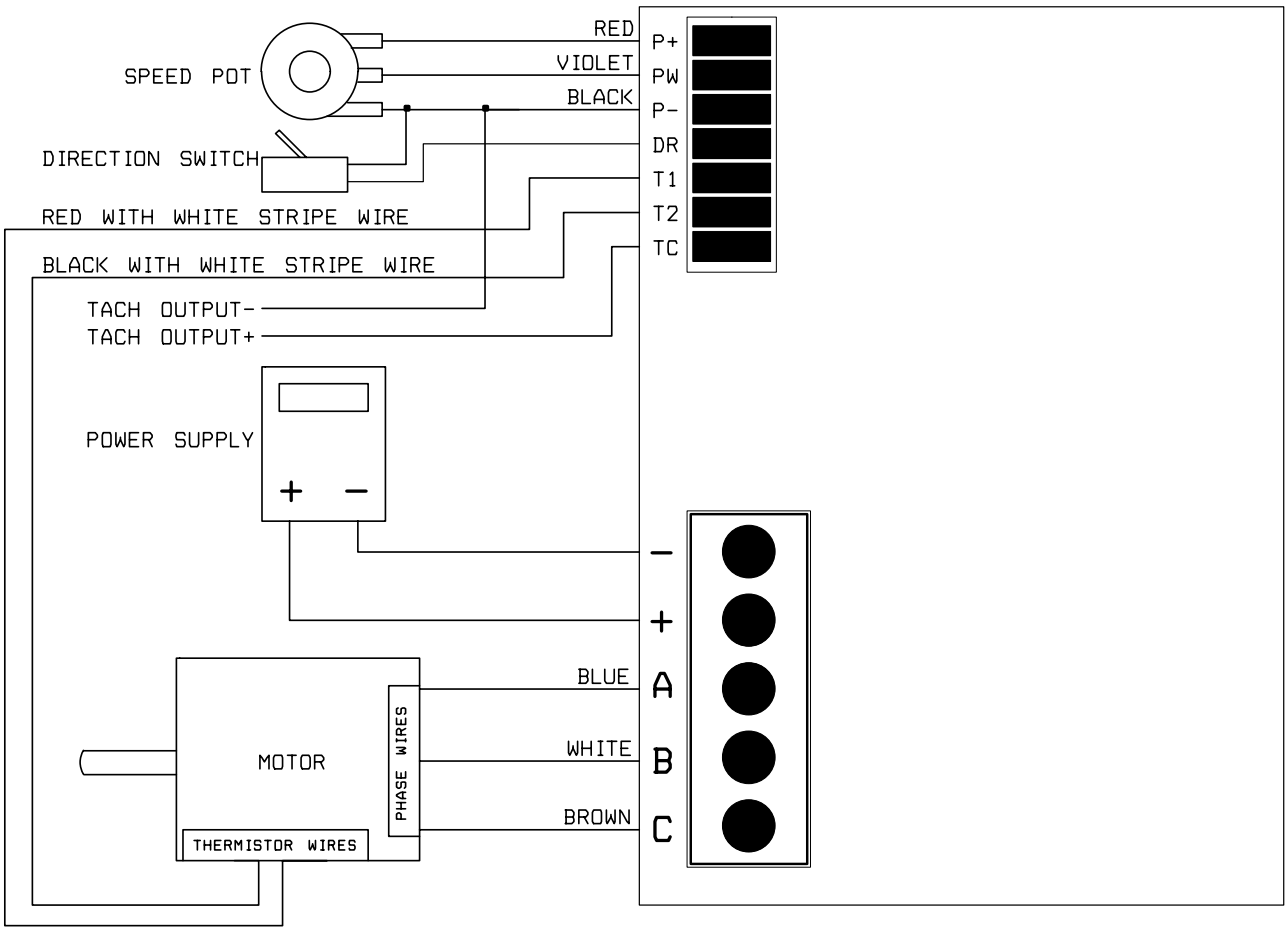
please send the order to mail@koford.com

Part number: S24V10A-3B closed loop drive 10k rpm 2p, 5k rpm 4p, 2.5k rpm 8p
S24V10A-3C closed loop drive 20k rpm 2p, 10k rpm 4p, 5k rpm 8p
S24V10A-3D closed loop drive 40k rpm 2p, 20k rpm 4p, 10k rpm 8p
S24V10A-3E closed loop drive 80k rpm 2p, 40k rpm 4p, 20k rpm 8p
S24V10A-3G closed loop drive 120k rpm 2p, 60k rpm 4p, 30k rpm 8p
S24V10A-3A open loop drive for use above 40k rpm, 100k rpm 2p
P1 pot with knob and leads

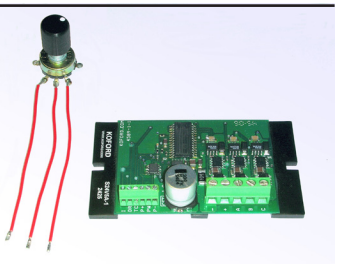
The -3A version has open loop speed control. The motor is off with a pw voltage of 0-.5V, and the duty cycle increases linearily from the minimum level up to 100% when pw=5.0v. Maximum speed with a two pole slotless motor is over 100,000 rpm. this version provides rapid response to a speed command. The closed loop versions control the motor speed rather then duty cycle so that speed will remain steady under varying load. The drive is off at 0-.5v and then the speed increases 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. for most applications the closed loop speed control should be used.

The minimum speed depends on the motor and the load but is usually 20% to 50% of the motors no load speed.

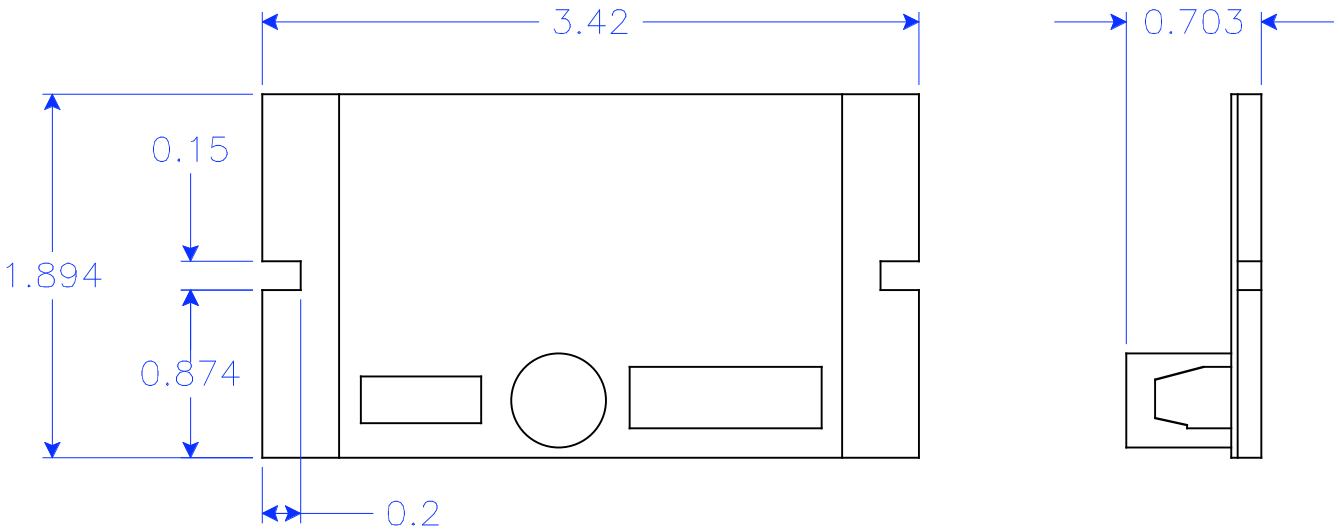
Stand alone operation with speed pot and motor temperature sensor



KOFORD ENGINEERING, LLC S24V10A sensorless motor driver 10A 12-32V



Analog ultra high efficiency miniature sensorless drive with 63kHz pwm frequency, designed for use with speed pot or 0-5v control input. The drive has no minimum inductance and will operate slotless or ironless brushless motors without the need for bulky, cumbersome inductors. Two types are available, a full featured -1 model which include tach and current output, and open loop speed control, and a lower cost -2 which deletes the tach and current output. The high PWM frequency reduces motor heating when operating at less then full speed. 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. If reversible operation is required a SPDT switch can be added between Dir and P-. 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 best results a RC filter should be used. The direction is controlled by 0v (reverse) or 5v (forward) to the DR input. The current output is a DC voltage at .5v per amp of motor current (not power supply current). For analog operation the TAC output can be connected to a one shot, filtered and a DC voltage proportional to the rpm will result. This drive will operate to 90,000 rpm with a 2 pole slotless motor. The drive weighs 1.9 oz.



Terminal block positions (motor lead hook up for Koford motors)
I=current output, .5V = 1A of motor current
DR=leave unconnected for forward direction, hook to P- for reverse
TC=tach/encoder output 3 pulses per revolution per magnet pole pair (1000 hz=20,000 rpm, 2 pole motor)

P+=connect to one side of pot (5.0v)
PW=connect to pot wiper (center terminal)
P-=connect to other side of pot (ground)
-=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

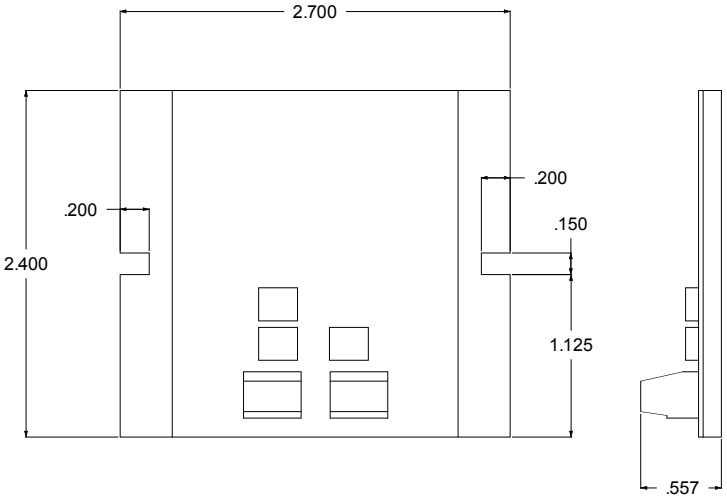
Ordering information:

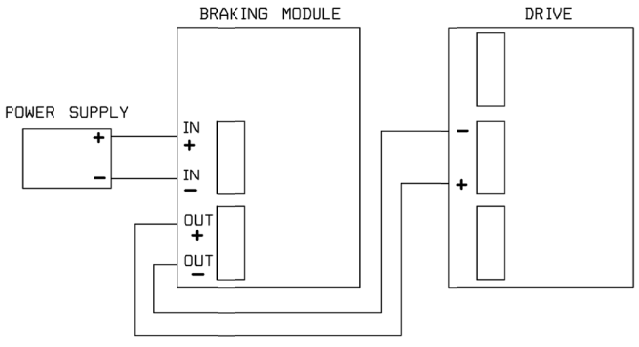
mail@koford.com•phone 937-695-1275•fax 937-695-0237•www.koford.com

Part number: S24V10A-1 Full featured drive, tach, direction, current
S24V10A-2 Drive with direction
P1 Optional pot

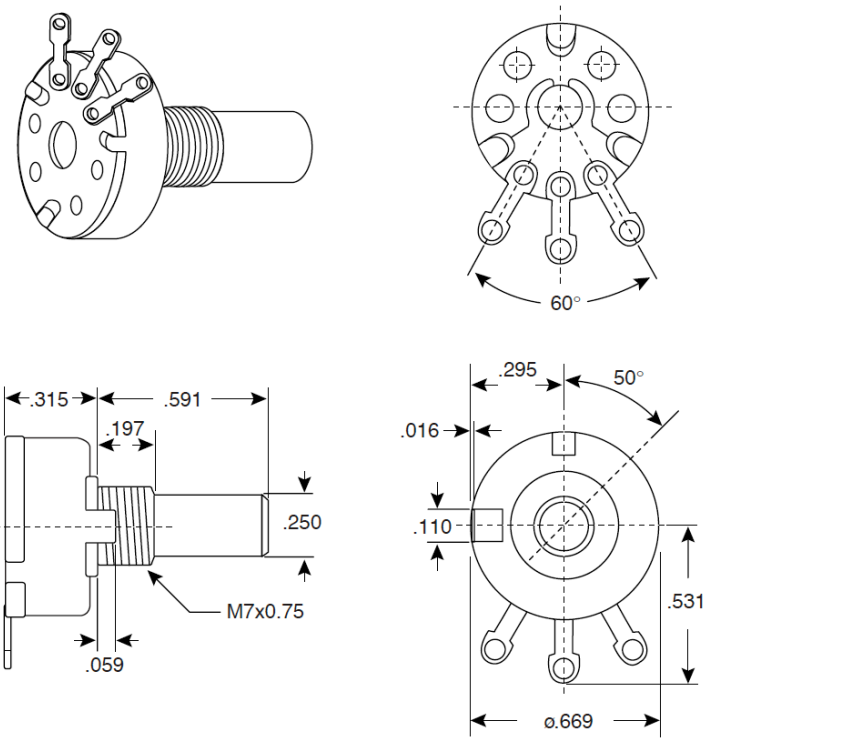
CV-1 10 Amp, 24V braking module

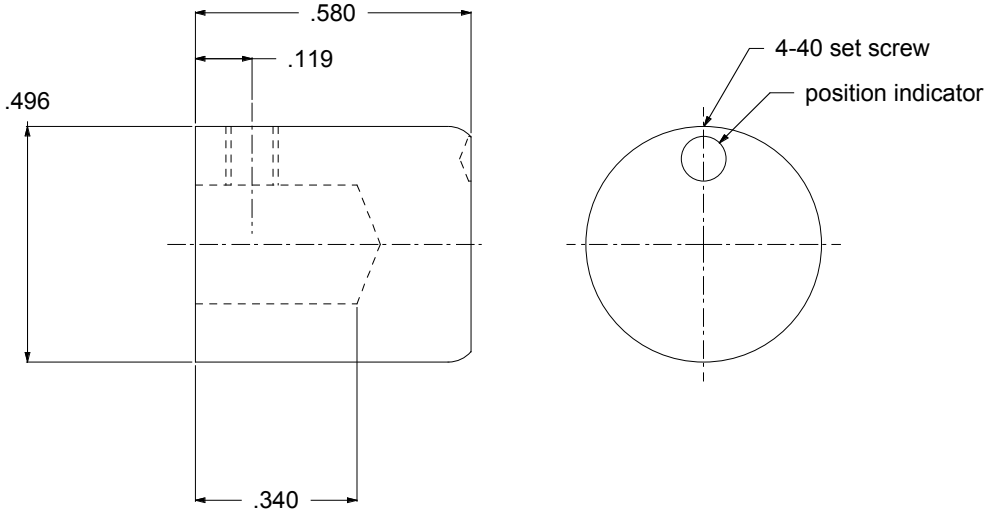
The CV-1 braking module is for use when a drive with braking function is connected to a power supply. If a battery supplies the power, the module is not needed. The module is needed on a system with a power supply because otherwise the regenerated energy would cause an overvoltage condition in the power 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.

Notes

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 80,000 rpm with these drives (96,500 for open loop digital drive) and 4 pole motors up to 40,000 rpm (48,250 for open loop digital drive). Slotted motors will have a lower maximum speed and may not be able to reach full current without stalling if they have a high pole count and large inductance. This must be determined by testing. The greater the inductance and the larger the pole count the lower the maximum speed and allowable load will be.

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

4. The drive's current output (-1 drives only) shows motor current, this is not the same as power supply current. A pwm drive acts much like a variable transformer to reduce the voltage and at the same time increase the current delivered to the motor. For example if the speed pot is set to 10% of maximum speed and the power supply shows 0.5 amp and 24 volts, the motor will see approximately 5 amps and 2.4 volts. This current sense output is approximate and is most accurate near full load current. The current can be used to indicate motor load or for use in current mode control.

5. The current limiting of the drive limits the current delivered to the motor to slightly above 10 amps, this means that the current at the power supply will reach a maximum of slightly above 10 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 10 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 50% to 100%. With a slight load the speed range increases to 20% to 100%. At 50% of rated current the range is 10% 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 special sensorless drives may be used. Contact the factory for more information about these.

8. The motor direction should only be reversed when the motor is stopped. Otherwise excessive voltages and currents can be produced potentially damaging the power supply and/or the drive.

9. Drives with the brake function regenerate the energy of the spinning motor and its load back to the power source when the brake input is activated. If this is a battery the battery will be recharged. For use with a power supply the CV-1 braking module should be used which will dissipate the energy of the spinning load (up to 10x the motor inertia) and isolate the voltage from the power supply. For higher inertia loads use the CV-2 braking module.

10. -3 and -4 versions can be factory programed with custom features and start up can be modified to meet customer requirements. These versions are most suitable if a soft start up or a difficult to start load is involved. -3 and -4 versions are available with closed loop speed control or open loop speed control. Other options such as controlling the speed according to an input from a thermistor or pressure sensor are also possible. The standard start up for the -3 and -4 is a ramp up that takes 200ms. The drive takes an additional 100ms to start up when power is turned on. If rapid start is is desired the drive should be powered up and the enable used to start the motor instead of turning power to the drive ona and off. The -3 and -4 will start higher inertia and more difficult loads and the start up may be custom programed for a specific motor and load if necessary. The open loop control version respons to a 0-5 volt signal on the PW input which can come from a microcontroller using a pwm output (8kHz or higher frequency), the optional speed pot, or an analog voltage. If the motor is stalled the drive will shut off after .1 seconds. After waiting for .5 seconds the drive will attempt to restart. This will continue until the motor start. This will not damage the motor or drive. When the speed input is set to zero volts the motor is turned off. If the input voltage is increased above .5 volts then the motor is started and runs at the minimum 15% duty cycle. If the speed input voltage is reduced below .5 volts the motor shuts off.

11. The -1 and -2 are open loop speed control only and start up is with 100% duty cycle so these drive will pull more current at start up than the -3 and -4. The motor will run at the minimum speed if the speed input is turned all the way down, to shut off the motor the input power must be shut off.

12. The direction of the motor can be changed with the direction input or by switching any two motor leads. On the -3 and -4 if the direction must be changed during operation then the motor will first stop before changing direction. On the -1 and -2 power should be shut off to the drive or at least the speed must be turned down to the minimum and time allowed for the motor to drop down in speed before the direction input is changed.

13. The -3 has a thermistor input. This input is for motors equipped with thermistor temperature sensors for overtemperature protection and is designed for the 5k sensor used in Koford motors. If the motor winding exceeds 150°C then the motor shuts until the temperature drops back below 150°C. Optionally the drive can be programed to shut down until the power is cycled.

14. The exact configuration is custom programed at the factory and does not require any programing, switches or adjustments by the user. The units are plug and play.

15. 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. For the highest precison and lowest settling time the use of an encoder, closing the speed loop with the encoder in an external speed control loop in conjunction with one of the open loop drives is recomended.

16. 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.