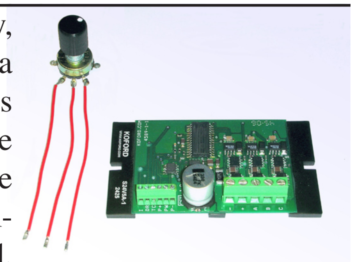
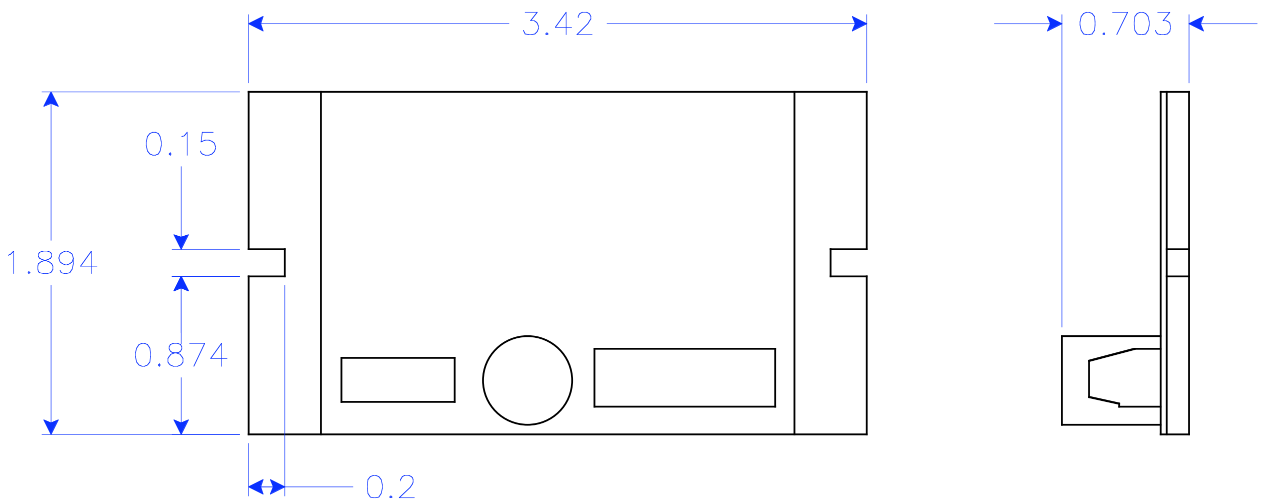
KOFORD ENGINEERING, LLC

S24V10A digital closed sensorless motor driver with brake 10A 12-32V



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. The brake input stops the motor by shorting the windings together. This method does not require an external braking resistor. The drive can be custom programed for your specific application.



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

EN=if not connected motor runs, 0V is off

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)

BK=brake, no connection if not used, 5V=brake on

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

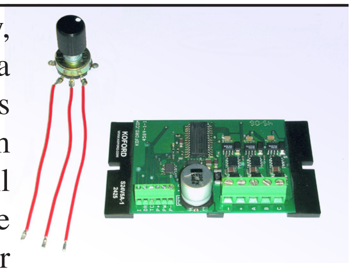
Ordering information:

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

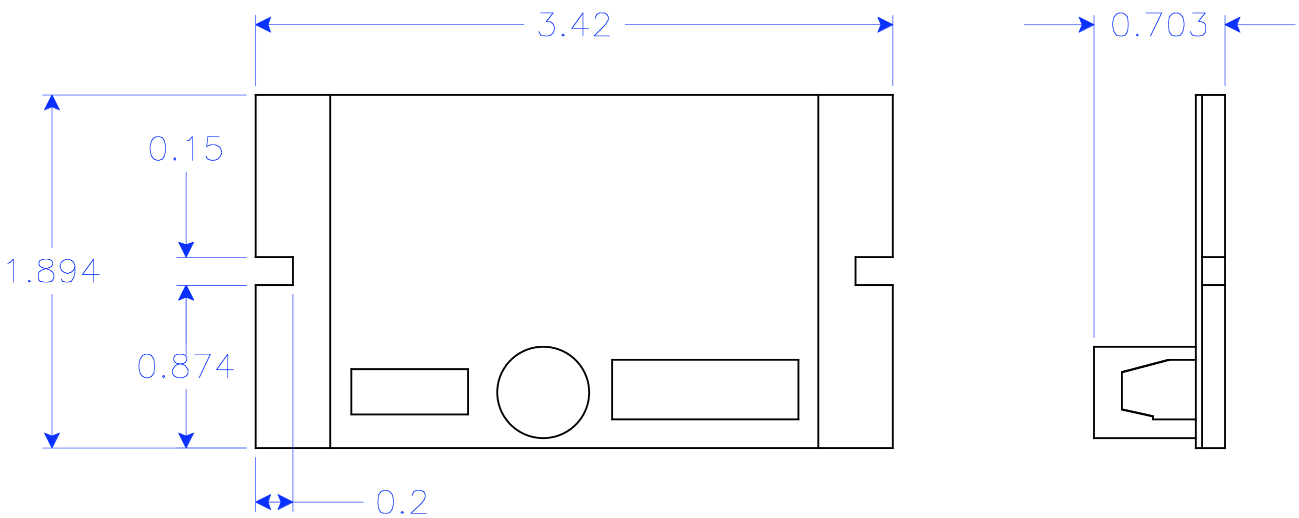
Part number: S24V10A-4 Digital drive with brake, tach, and direction

P1 Optional pot

S24V10A digital closed sensorless motor driver with temperature protection 10A 12-32V



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 exceeded. The motor can be restarted once the problem causing the overtemperature is resolved by cycling the power. 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.



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:

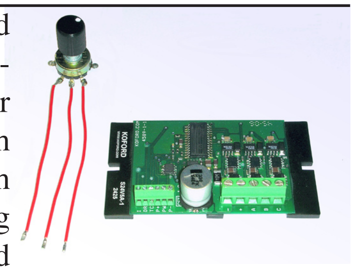
mail@koford.com•phone 937-695-1275•fax 937-695-0237•www.koford.com

Part number: S24V10A-3 Digital drive with tach, direction, and overtemperature protection

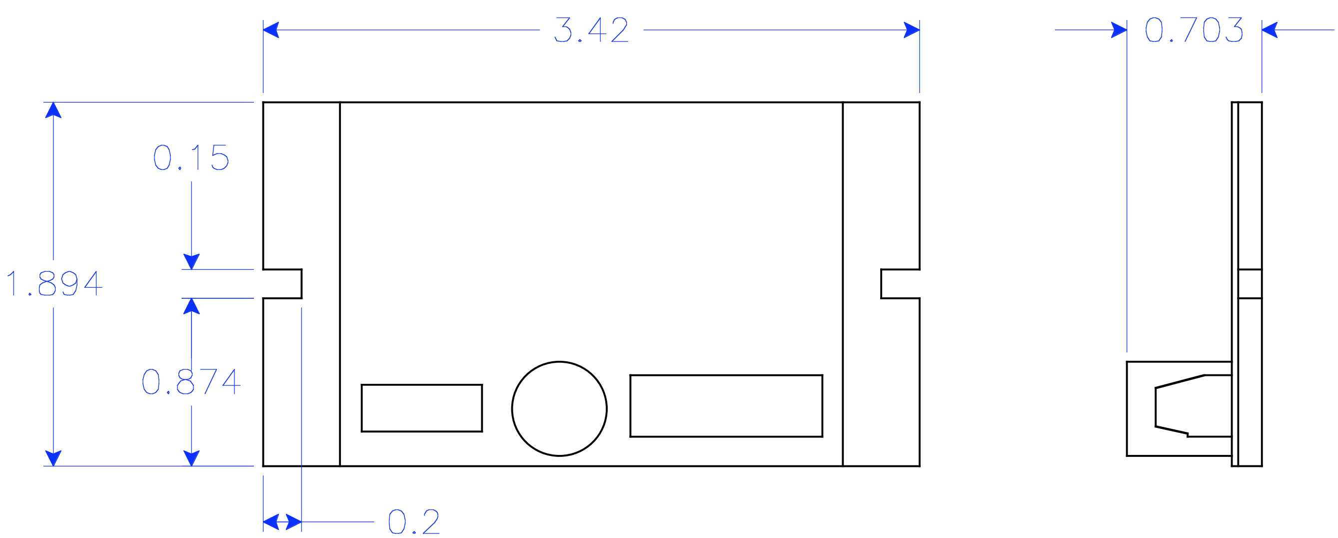
P1 Optional pot

KOFORD ENGINEERING, LLC

S24V10A sensorless motor driver 10A 12-32V



Ultra high efficiency miniature sensorless drive with 63kHz pwm frequency, designed for use with stand alone, digital or analog operation. 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-. For digital operation the unit will interface with a customers microcontroller using a PWM'd digital output. 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. 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.



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

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Part number: S24V10A-1 Full featured drive, tach, direction, current

S24V10A-2 Drive with direction

P1 Optional pot

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 100,000 rpm with this drive and 4 pole motors up to 50,000 rpm. 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.

4. The drive's current output 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. -4 version absorbs the braking energy in the motor. Therefore 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. -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 soft start with an align for .1 second at 28% duty cycle, a .11 second stepping ramp, .1 seconds in closed loop commutation at 50% duty cycle. The -3 and -4 will start higher inertia and more difficult loads and the start up may be custom programed. The or open loop control in response to a 0-5 volt signal 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. The drive can be restarted after the problem is corrected by cycling the power. 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.

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.

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 must 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.

The -3 has a thermistor input. This input is for motors equipped with thermistor temperature sensors for over-temperature 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.

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.

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.

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.