



## 48 volt 20 amp sensorless motor drivers

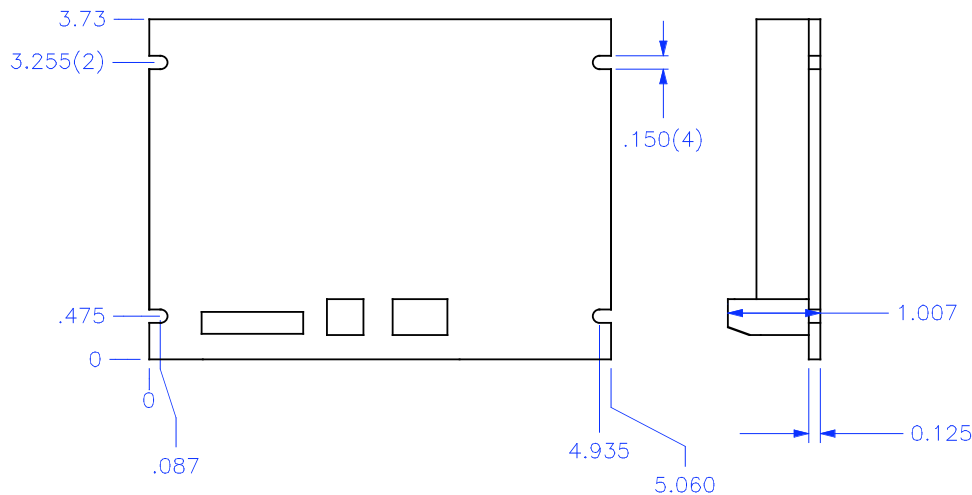
Small, compact, no programming or set up required. Up to 99% efficiency, no inductors required for slotless or ironless motors.

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Ultra high efficiency miniature sensorless drive with 37kHz 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. The drives can be operated in stand alone mode with a speed pot or with an 0-5v analog input or a 5v pwm input from a microcontroller or microprocessor. The motor is turned off for an PW input between 0 and .5 volts. Once power supply, motor and speed pot (if used) are connected, the motor can be operated without the need for any adjustments, set up or programming. Connector termination is not needed. If reversible operation is required a SPDT switch can be added between Dir and P- or a 5v signal may be used. If the speed pot is not used then either an 0-5v 1 ma input or a 5v or a 3.3v with 5v interface micro can be provided. If a pwm input is used the frequency should be above 8k or an RC filter should be used to smooth the signal. If the speed loop is closed externally the tach (TC) output which is a 5v square wave can be used. The TC output provides 3 pulses per revolution for a 2 pole motor, 6 for a 4 pole etc. A high impedance interface should be used. The direction is controlled by 0v (reverse) or 5v (forward) to the DR input. For analog operation the TAC output can be connected to a one shot, filtered and a DC voltage proportional to the rpm will result. To brake the motor use a switch between P+ and BK, or an external 5v signal. The brake function is accomplished by shorting the motor windings and does not require an external braking resistor. The drive weighs 6.5 oz. The operating temperature range is -55°C to 105°C. Keeping the surface that the drive is mounted to below 60°C will extend life. Drives can be custom programmed for optimum closed loop performance for a specific motor and application.



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

EN=enable, unconnected or 5v=on, 0v=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=unconnected or 0v=off, 5v=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:**

please send the order to mail@koford.com

Part number:

S48V20A-6 closed loop speed control 5v=5k rpm (2 pole), 2.5k (4 pole) with direction, tach and brake

S48V20A-8 closed loop speed control 5v=10k rpm (2 pole), 5k (4 pole) with direction, tach and brake

S48V20A-1 closed loop speed control 5v=20k rpm (2 pole), 10k (4 pole) with direction, tach and brake

S48V20A-2 closed loop speed control 5v=40k rpm (2 pole), 20k (4 pole) with direction, tach and brake

S48V20A-3 closed loop speed control 5v=80k rpm (2 pole), 40k (4 pole) with direction, tach and brake

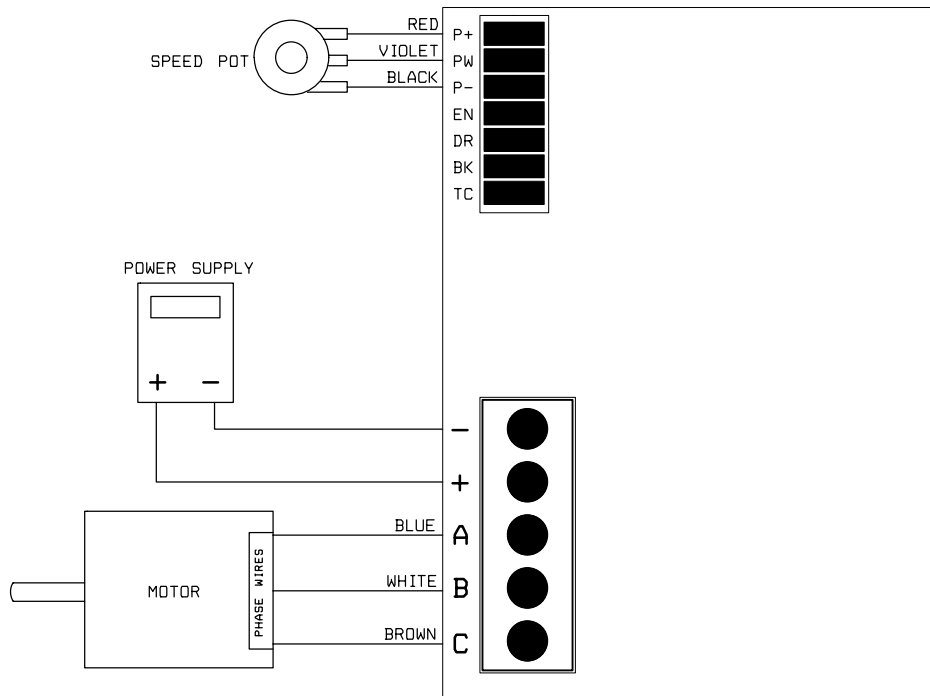
S48V20A-9 closed loop speed control 5v=200k rpm (2 pole), 100k (4 pole) with direction, tach and brake

S48V20A-5 duty cycle control (start up for .5 ohm or less motors), 5v=100% duty cycle, direction, tach and brake

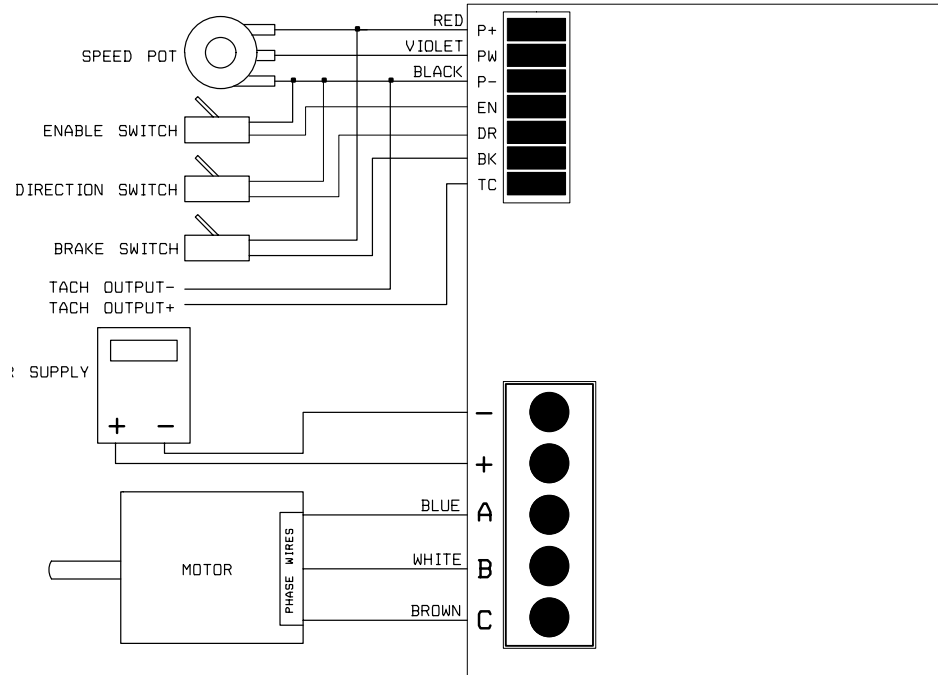
P1 Optional speed pot with knob and leads

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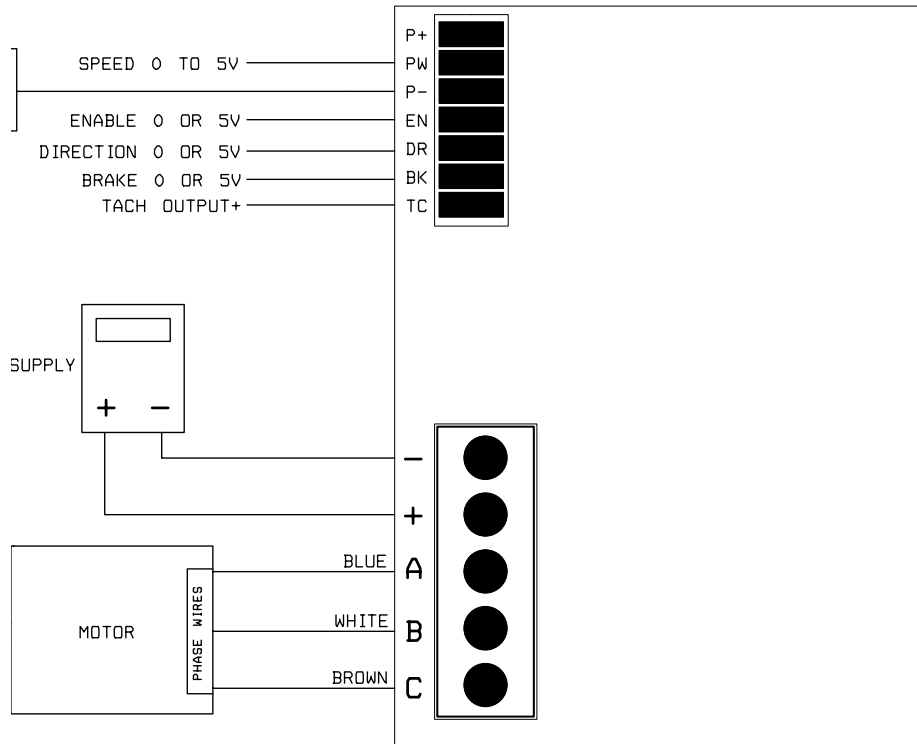
Stand alone operation with speed pot, motor direction can be reversed by switching any two leads with each other.



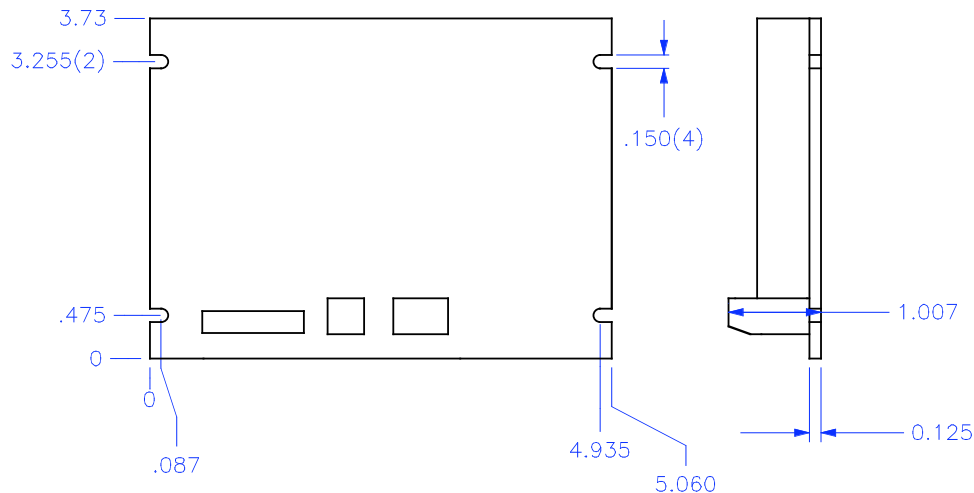
## Stand alone operation with speed pot and brake



## External control



Ultra high efficiency miniature sensorless drive with 37kHz 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. The drives can be operated in stand alone mode with a speed pot or with an 0-5v analog input or a 5v pwm input from a microcontroller or microprocessor. The motor is turned off for an PW input between 0 and .5 volts. Once power supply, motor and speed pot (if used) are connected, the motor can be operated without the need for any adjustments, set up or programming. Connector termination is not needed. If reversible operation is required a SPDT switch can be added between Dir and P- or a 5v signal may be used. If an external voltage input rather than the speed pot is to be used a 5v or a 3.3v with 5v interface micro is required. Input to the drive should be a 0-5v analog input (less than 1mA) or a 100 hz to 100k Hz square wave with variable duty cycle. The input signal should be adjusted so as to close the loop with the TC output which outputs a 5v square wave. The frequency equals 3 pulses per revolution for a 2 pole motor, 6 for a 4 pole etc. The direction is controlled by 0v (reverse) or 5v (forward) to the DR input. For analog operation the TAC output can be connected to a one shot, filtered and a DC voltage proportional to the rpm will result. The overtemperature shut down works with Koford motors with the temperature sensor option or any motor with a 5k thermistor. The drive shuts on motor off if the temperature exceeds 150°C and turns the motor back on when the temperature drops back below 150°C. The drive weighs 6.5 oz. The operating temperature range is -55°C to 105°C. Keeping the surface that the drive is mounted to below 60°C will extend life. Drives can be custom programmed for optimum closed loop performance for a specific motor and 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:**

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Part number:

S48V20A-4 closed loop speed control 5v=20k rpm (2 pole) with direction, tach and motor overtemp shutdown

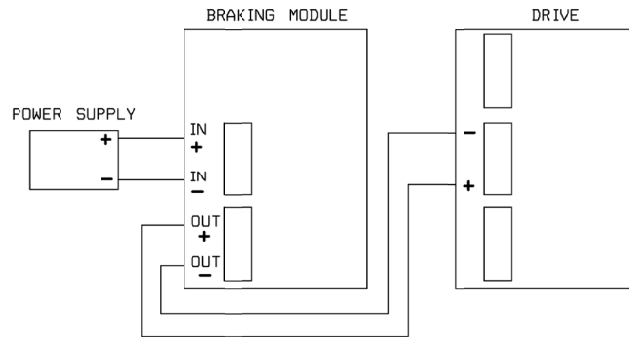
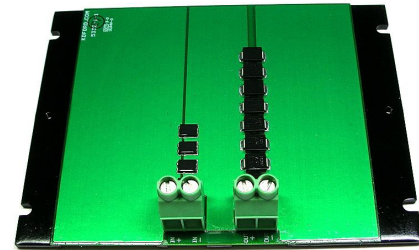
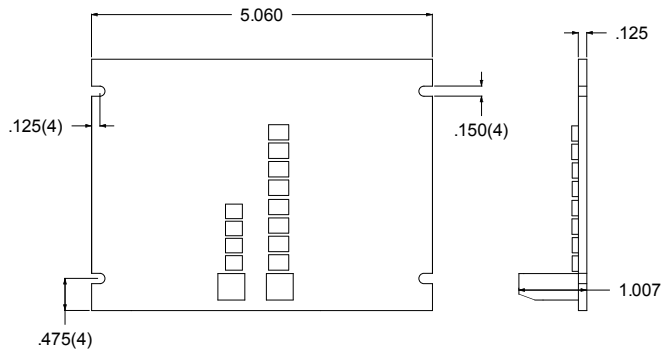
S48V20A-6 closed loop speed control 5v=40k rpm (2 pole) with direction, tach and motor overtemp shutdown

S48V20A-7 closed loop speed control 5v=80k rpm (2 pole) with direction, tach and motor overtemp shutdown

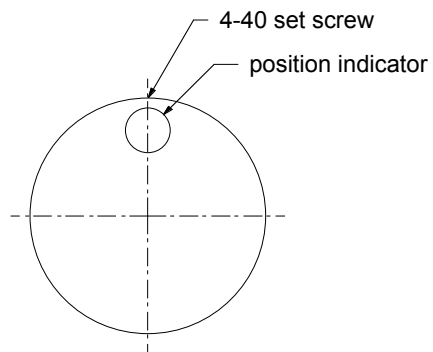
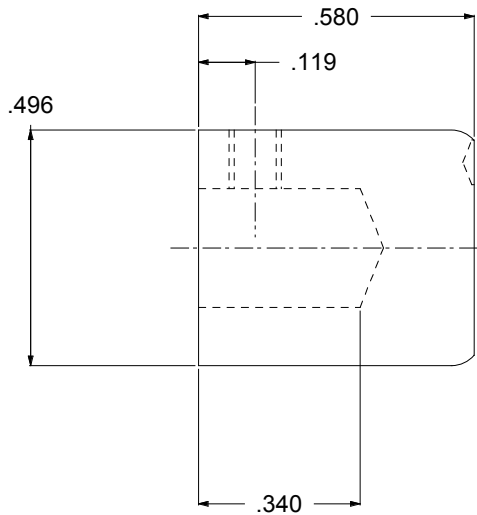
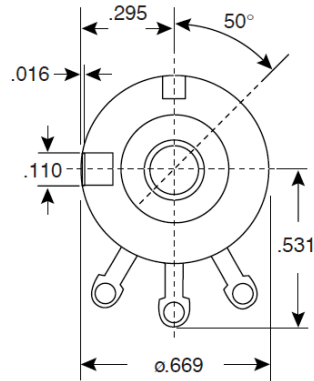
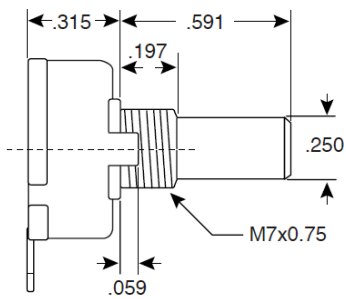
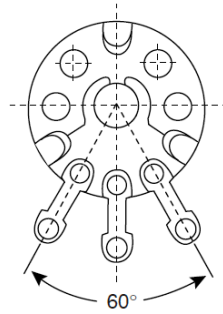
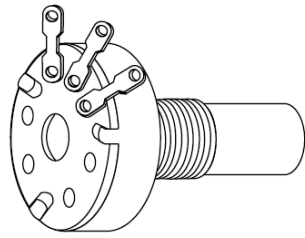
S48V20A-12 duty cycle control for use above 40,000 rpm only, 5v=100% duty cycle, direction tach and motor overtemperature shutdown

P1 Optional speed pot with knob and leads

The CV-4 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. Any externally powered inputs such as speed or brake must be turned off when drive power is turned off or drive damage may result.
2. Sensorless drives work best with slotless or ironless brushless motors. Most slotted motors will work reasonably well but a few will not. For best operation with slotted motors the inductance should be low, the cog low, the pole count low and the back emf in the zero crossing area should have low ripple.
3. The maximum speed depends on the characteristic of the motor, however Koford 2 pole motors will run well up to 120,000 rpm with the -5 or -12 versions of this drive and 4 pole motors up to 60,000 rpm. Slotted motors will have a lower maximum speed due to the higher inductance. Operation up to 180,000 rpm with a 2 pole motor is possible with special programming.
4. When using a microcontroller to control the drive a 5 volts output should be used. If the pwm frequency is greater than 8Khz no filtering is required, for lower frequencies an RC filter should be used.
5. The current limiting of the drive limits the current delivered to the motor to slightly above 20 amps, this means that the current at the power supply will reach a maximum of slightly above 20 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 20 amps. The current at the power supply is different than the power delivered to the motor unless the duty cycle (speed) is set to 100%. For example if the duty cycle (speed) is set to 50% then at a motor current of 20 amps the power supply current will be 10 amps.
6. A 20 amp or higher power supply should be used. If the power supply has foldback current limiting then the power supply must be rated for at least 25 amps.
7. The drive should preferably be mounted to an 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. The temperature of the hottest spot on the board can be checked with a portable infrared thermometer
8. 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 is operated at no load then the speed range may only be 20% to 100% due to energy stored in the motors inductance. With a slight load the speed range increases to 10% to 100%. At 50% of rated current the range is 15% to 100%. These values are approximate and depend on motor inductance, efficiency and input voltage. If a wider speed range is required contact the factory.
9. If the direction input is changed while the motor is running the drive will stop the motor and then restart in the opposite direction after a brief pause.
10. The motor rpm can be read using a multimeter with a frequency or tach function.  $1000 \text{ hz} = 20,000 \text{ rpm}$  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 datalogger or interfaced with a 5 volt input capable micro, or a buffer or resistor voltage divider can be used to bring the voltage down to 3.3v or lower if required.