



M.S.KENNEDY CORP.

40 AMP, 42V, SENSORLESS 3 PHASE BRUSHLESS DC MOTOR SPEED CONTROLLER

4412

4707 Dey Road Liverpool, N.Y. 13088

(315) 701-6751

FEATURES:

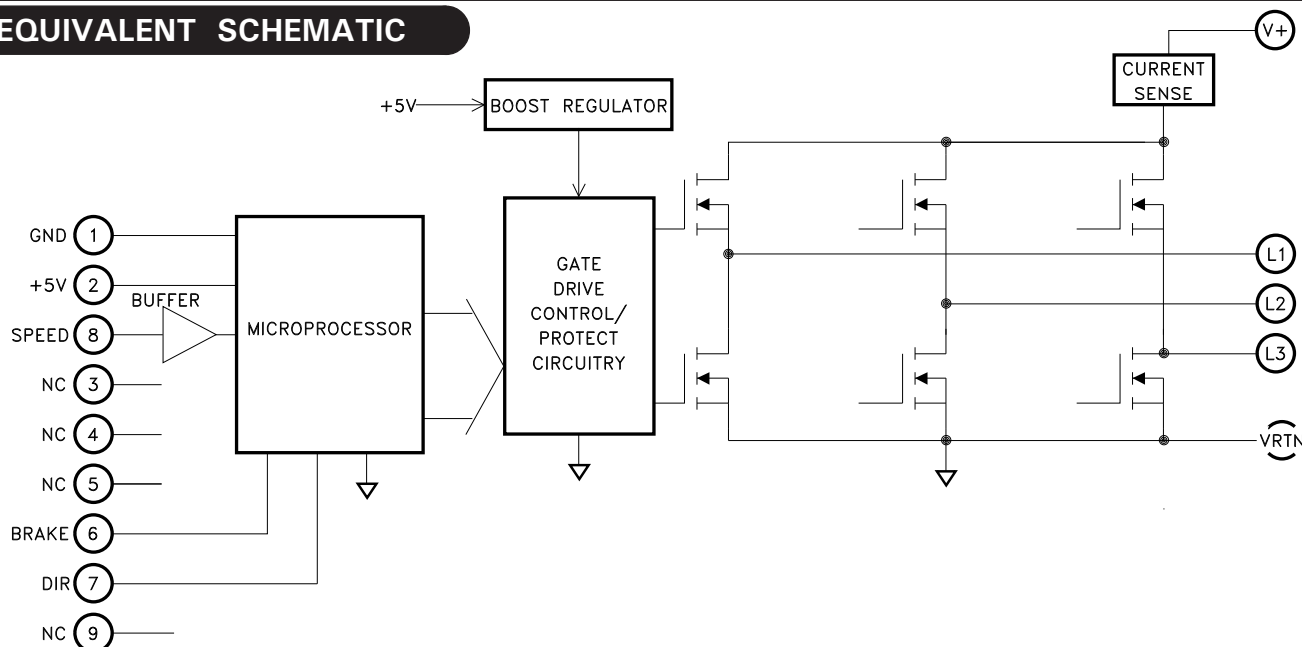
- 42V Maximum Supply Voltage: + 28V Nominal
- 40 Amps DC @ 70°C Case Temperature
- Sensorless Operation - No Hall Sensors Need for Commutation
- Shoot-Through/Cross Conduction Protection of Output Bridge
- Back EMF, Zero Crossing Detection Used for Commutation
- Pulse - by - Pulse 50 Amp Current Limit
- Open Frame PC Board Construction and Mounting
- Brake Function
- Forward / Reverse Selectable

DESCRIPTION:

The MSK 4412 is a brushless DC motor speed controller that is sensorless in operation. It uses back EMF (BEMF) from the motor to sense when to commutate. It does not rely on hall sensors for commutation. Because of the reliance on BEMF, the motor has to be turning at a minimum speed to produce enough BEMF to sense when to commutate. During startup, the motor is first "locked" in a known commutation state. The motor is then "open loop" force commutated at a very slow rate with increasing speed while checking for sufficient BEMF for closed loop commutation. Speed can be reliably controlled from that point to full speed. Speed is controlled by PWM duty cycle to change the voltage seen by the windings. There is a logic pin for changing direction, and also a pin for BRAKE. BRAKE halts PWM and commutation, and turns on all three low side MOSFETs. This action effectively shorts out any BEMF generated by the motor and acts as a resistance to turning. The MSK 4412 comes in an "open frame" PCB style module, meant to be bolted to a heatsink or bulkhead for dissipating output power.



EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Fan / Blower Speed Control
- Propulsion Control
- Robot Traction Velocity Control
- UAV Motor Speed Control
- Variable Speed Pump Control

PIN-OUT INFORMATION

PCB PADS

L 1 - A PHASE OUT
L 2 - B PHASE OUT
L 3 - C PHASE OUT
V + - + 28V IN
VRTN - + 28V GROUND RETURN

HEADER CONNECTION

1 - GROUND	6 - BRAKE
2 - + 5V	7 - DIR
3 - NC	8 - SPEED
4 - NC	9 - NC
5 - NC	

ABSOLUTE MAXIMUM RATINGS

High Voltage Supply. +42V
 Speed Command. +5V
 Brake, DIR. +5V
 Continuous Output Current @25°C. 40Amps DC
 Peak Output Current. 50 Amps (10 μ Sec.)
 +5V. +4.75V - +5.25V

Thermal Resistance R θ J-C. 1.0 C°/W
 Storage Temperature Range. -40°C to +85°C
 Solder Temperature. +300°C (10 Sec.)
 Case Operating Temperature. -40°C to +85°C
 Maximum Junction Temperatur. +150°C

ELECTRICAL SPECIFICATIONS

Parameter	MSK 4412			Units
	Min.	Typ.	Max.	
PWM Clock Frequency	19	20	21	KHz
+5V Quiescent Current (No PWM)	-	150	180	mA
+5V Current with PWM	-	160	250	mA
Brake, DIR Input's				
VIL	-	-	1.0	Volts
VIH	4.0	-	-	Volts
Input Current	-	-	1.0	uA
Speed Command Input Range	0	-	5	Volts
Speed Command Input Current	-	-	100	nA
Voltage Drop Across Bridge	-	-	1.0	Volts
Leakage Current @ 125°C Junction	-	0.1	-	mA
Diode VSD	-	0.9	1.2	Volts
trr	-	55	-	nSec
Deadtime	-	5	-	uSec
Current Limit	44	50	56	Amps

MSK 4412 PIN DESCRIPTIONS

V+ - Is the main power connection from the module to the power supply bus. The external wiring to the pin should be sized according to the RMS current required by the motor. The module has sufficient on board bypass capacitance for full current operation. However, there are times when additional capacitance is necessary depending on the requirements at the host system. Placement of external bypass capacitors shall be as close to the modules as practical.

A PHASE OUT, B PHASE OUT, C PHASE OUT- Are the connections to the motor phase windings from the module output. These wires should be sized according to the current requirements of the motor. Shielding of these wires may be necessary to help protect against EMI and should be grounded at VRTN. Shorts from these pins to V+ must be avoided as there are no short circuit provisions to V+.

VRTN - Is the power return connection from the module to the power supply bus. Wiring to this point should be sized according to required motor current. Any external bypassing should be done as close to this pin as practical. The ground return for the SPEED command, although connected to this point in the module, shall be returned through the GND pins on the connector so as not to experience large current - induced voltage drops at this point.

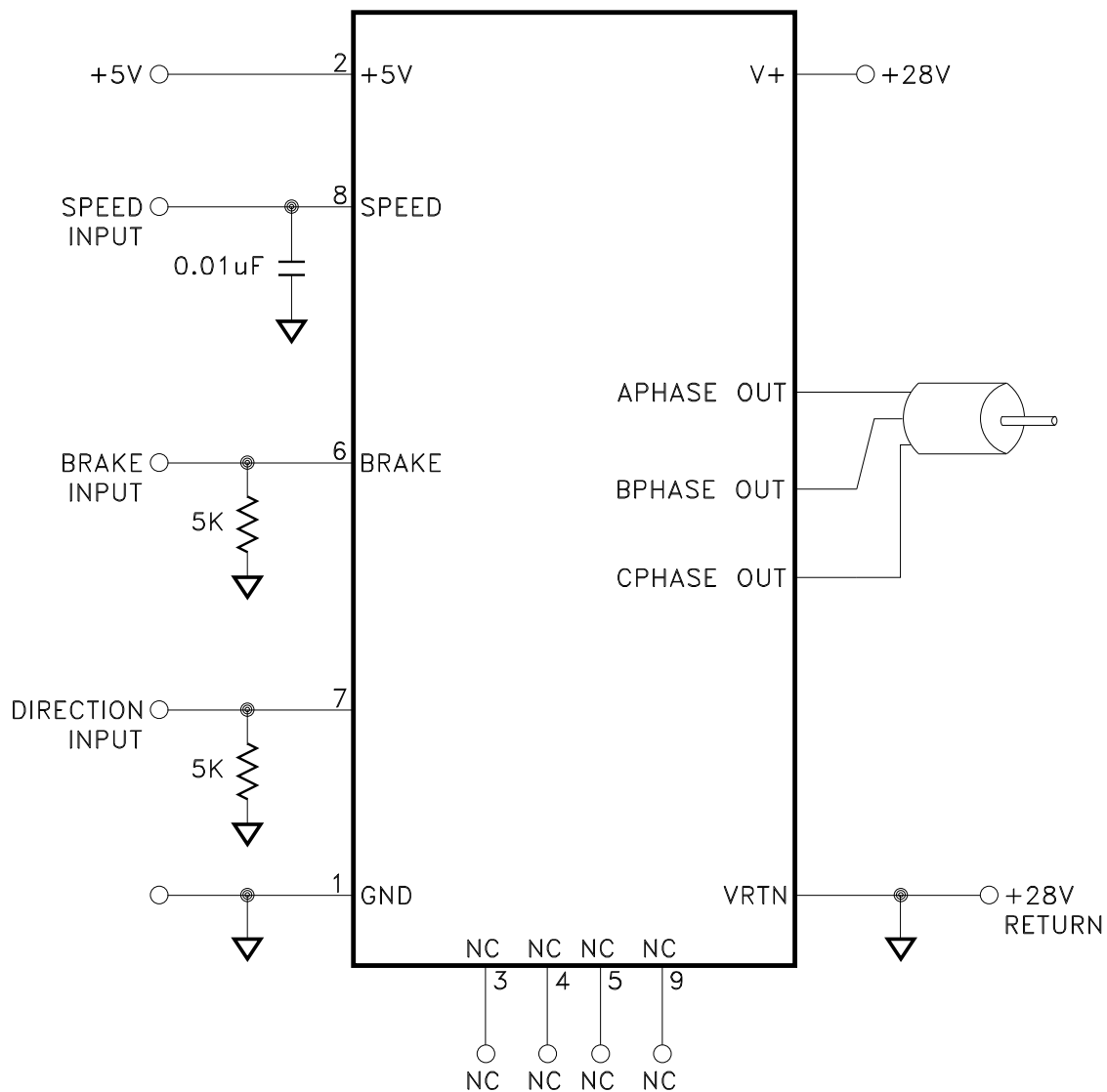
SPEED - Is the input for controlling the motor speed. The operational command voltage range shall be 0 volts to + 5 volts. 0 volts will correspond to the minimum duty cycle (5%), and 4.2 volts will correspond with the maximum duty cycle (100%). 4.2 volts to 5 volts will also correspond to a maximum duty cycle. Negative input voltages are to be avoided while the maximum positive input voltage shall not exceed + 5 volts.

DIR - Is the pin for controlling direction of the motor. If the direction is changed while the motor is spinning, the controller will gently go into "BRAKE" mode by turning all low-side MOSFETs on at a low duty cycle PWM. It will increase the duty cycle until full braking is achieved. The controller will then begin the start - up process in the reverse direction. A logic high will run the motor in one direction, and a logic low will run the motor in the opposite direction. If the logic levels don't correspond to the desired directions of the motor, simply swap any pair of the Phase Out windings and the motor will run opposite. This pin should be pulled low via a 5K resistor or grounded if not in use.

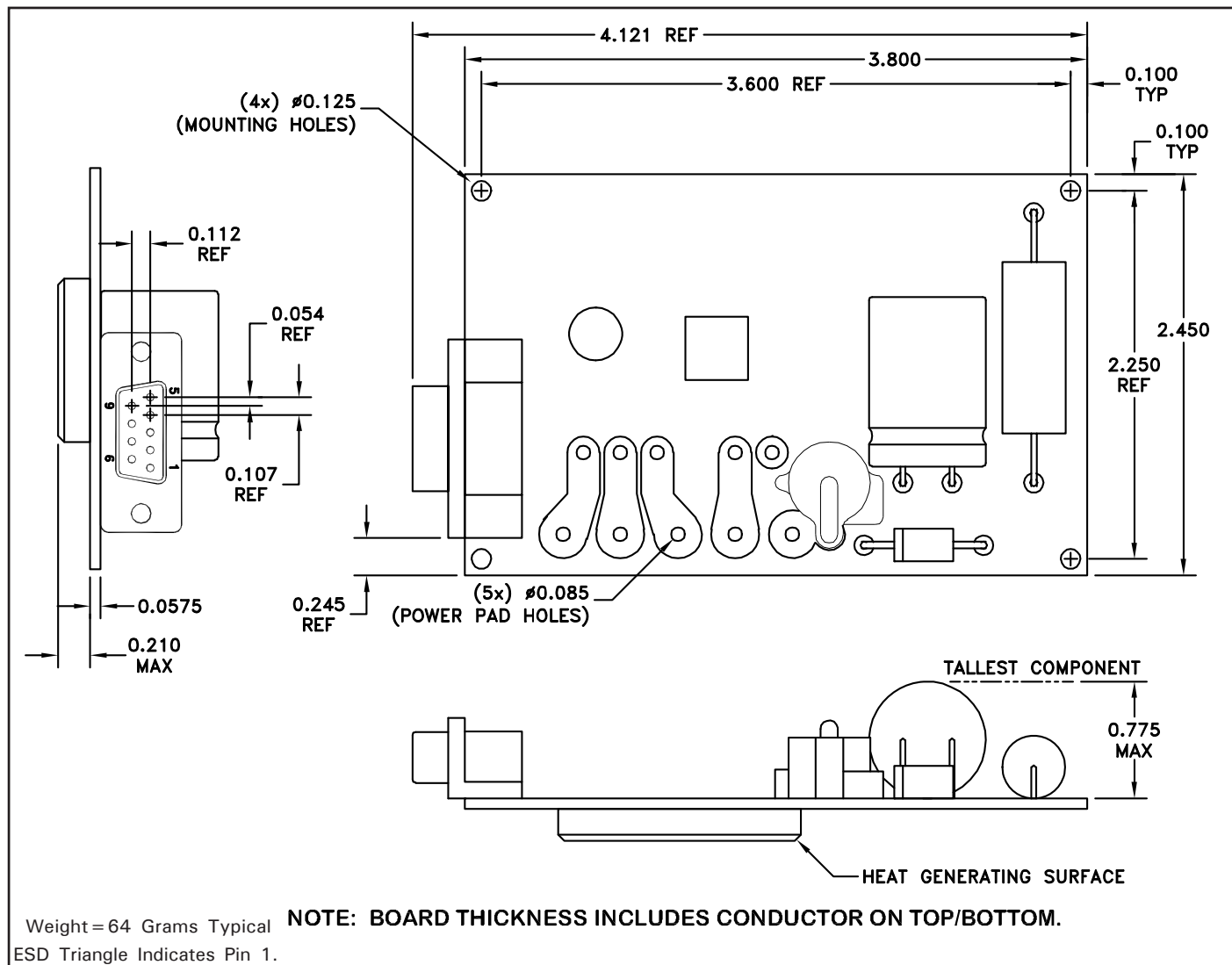
+ 5V - Is the pin that is used to supply the microprocessor, boost regulator, and in turn the gate drive control. Therefore it is important to keep this between + 4.75V - 5.25V and keep the supply as clean as possible.

BRAKE - Is the pin that will cause the module to go into BRAKE mode. BRAKE consists of stopping all commutation and PWM. It will then turn on all low - side MOSFETs. This will effectively short circuit any back EMF being generated by a spinning motor. A logic high will cause BRAKE mode to be initiated.

TYPICAL APPLICATION



MECHANICAL SPECIFICATIONS



NOTE: ALL DIMENSIONS ARE $\pm .010$ INCHES UNLESS OTHERWISE LABELED.

M.S. Kennedy Corp.
 4707 Dey Road Liverpool, New York 13088
 Phone (315) 701-6751
 FAX (315) 701-6752
www.mskennedy.com