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BLMD-10C6-1P-S14 Low Voltage Brushless DC Motor Driver

Product Datasheet

BLMD-10C6-1P-S14 is a low voltage, three phase, six step, full wave and hall sensor Brushless DC Motor Driver. This driver is suitable for 18 to 60VDC power supply. Rated output current of the three phases is 10ADC.

- Three Phase MOSFETs H-Bridge (20kHz PWM)
- Hall Sensor Electrical Phasing 120°/240°
- Reference Voltage for Hall Sensors--Vhall
- Speed Frequency Generator--FG
- Forward/Reverse Direction--F/R
- Run Enable/Disable--En
- Open Loop Stepless Speed Control--ADJ
- System Malfunction Fault Output--FLT
- Dynamic Braking--BRK (Conditional)
- Over Current Limit/Undervoltage Lockout--OCUV

BLMD - 10 C 6 - 1P - S 14
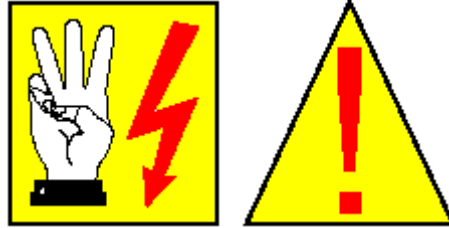
| Brushless Motor Driver | Rated Output: 10ADC | Current Limit | Max Input: 60VDC | One Phase Protection | S: Sensor SL: Sensorless | Sub-series |

Please read Safety Warning below carefully before installing and operating this driver!

- **This product should be installed and serviced by a qualified technician, electrician, or electrical maintenance person familiar with its operation and the hazards involved.**

- **Be sure to eliminate body static electricity when operation.**

- **To connect or disconnect J3 or J4 when power on is FORBIDDEN. J3 or J4 phase missing is FORBIDDEN.**

- **Do not touch the PCB board, and/or other circuits connected to it, when power on. Eye protection must be worn and insulated tools must be used when working under power.**

- **All output and input terminals are NOT isolated.**

Absolute Maximum Ratings

(The Absolute Maximum Ratings are those values beyond which the safety of the driver cannot be guaranteed)

Parameter	Symbol	Value	Unit
Power Supply Voltage	+VM	60	VDC
Peak Output Current	I_A, I_B, I_C	15 peak (Approximate)	ADC
Rated Output Current	I_A, I_B, I_C	10	ADC
Max Controllable Motor Speed	One Magnetic Pole-pair Rotor	40000	rpm
Hall Reference Voltage Output Current	I_{Hall}	20	mA
Digital Inputs Voltage	Ha, Hb, Hc, F/R, EN, BRK	-0.3 to 6.5	V
FG, FLT, OCUV Output Voltage	FG, FLT, OCUV	-0.3 to 6.5	V
FG, FLT, OCUV Output Current	I_{FG}, I_{FLT}, I_{OCUV}	5 (Sink Only)	mA
Speed Control Input Voltage	ADJ	-0.3 to 6.5	V
CFB, TFB Output Current	I_{CFB}, I_{TFB}	5 (Source and Sink)	mA
Max Temperature of the Sink	Ts	85	C
Operating Ambient Temperature Range	Ta	-20 to +85	C

Electrical Characteristics

(J1=24VDC, Ta=20C, unless otherwise noted)

Parameter	Symbol	Min	Typical	Max	Unit

J1--Power Supply

Parameter	Symbol	Min	Typical	Max	Unit
Supply Voltage	+VM	18	-	60	VDC
Quiescent Supply Current	I_Q	-	60	80	mA

Vhall--Reference Voltage for Hall Sensors

Parameter	Symbol	Min	Typical	Max	Unit
Output Volt	V_{hall}	-	5.2	-	VDC
Output Current	I_{hall}	-	-	20	mA

Ha, Hb, Hc--Hall Digital Inputs

Parameter	Symbol	Min	Typical	Max	Unit
High Threshold Volt	V_{IH}	3.0	2.2	-	V
Low Threshold Volt	V_{IL}	-	1.7	0.8	V
High State Current	I_{IH}	-	0	-	mA
Low State Current	I_{IL}	-	-5	-	mA

FG--Speed Frequency Generator Digital Output

Parameter	Symbol	Min	Typical	Max	Unit
High State Volt	V_{OH}	-	5.2	-	V
Low State Volt	V_{OL}	-	0.8	-	V
Source Current	I_{OH}	-1	0	-	mA
Sink Current	I_{OL}	-	-	5	mA

F/R, EN, BRK--Digital Inputs

High Threshold Volt	V$_{IH}$	3.0	2.2	-	V
Low Threshold Volt	V$_{IL}$	-	1.7	0.8	V
High State Current	I$_{IH}$	-75	-	-10	uA
Low State Current	I$_{IL}$	-300	-	-10	uA

ADJ--Open Loop Stepless Speed Control Analog Input

100% PWM	V$_{UP}$	-	4.2	4.5	V
0% PWM	V$_{DN}$	1.2	1.5	-	V

FLT, OCUV--Digital Output

High State Volt	V$_{OH}$	-	3	-	V
Low State Volt	V$_{OL}$	-	1	-	V
Source Current	I$_{OH}$	-1	0	-	mA
Sink Current	I$_{OL}$	-	-	5	mA

Current Limit

Peak Current	I$_A$, I$_B$, I$_C$	-	15	-	ADC
Average Current	I$_A$, I$_B$, I$_C$	-	10 (Approx.)	-	ADC

Undervoltage Lockout

Supply Voltage	UV	-	18	-	VAC

Junction Table

Junction	Pin	Type	Function
J1	+VM	Power Supply	DC Power Supply, Positive Line
	GND	-	Power Supply GND, Negative Line
J2	FG	Digital Output	Speed Frequency Generator, TTL Compatible
	F/R	Digital Input	Forward/Reverse Direction, TTL Compatible
	EN	Digital Input	Run Enable/Disenable, TTL Compatible
	UP	Voltage Divider	Potentiometer Up Pin
	ADJ	Analog Input	Open Loop Stepless Speed Control
	DN	Voltage Divider	Potentiometer Down Pin
	FLT	Digital Output	System Malfunction Output, TTL Compatible
	BRK	Digital Input	Dynamic Braking, TTL Compatible
	GND	-	Signals GND
	OCUV	Digital Output	Over Current Limit/Undervoltage Lockout
J3	A	Driver Output	A Phase Winding Driver
	B	Driver Output	B Phase Winding Driver
	C	Driver Output	C Phase Winding Driver

| J4 | GND | - | Hall Sensors GND |
	Ha	Digital Input	A Hall Sensor, TTL Compatible
	Hb	Digital Input	B Hall Sensor, TTL Compatible
	Hc	Digital Input	C Hall Sensor, TTL Compatible
	Vhall	Reference Output	Reference Voltage for Hall Sensors

Main Functions Description

J1--Power Supply:

A stabilized power supply or battery is recommended. The Max Supply Voltage must be less than 60VDC. Please see the "Absolute Maximum Ratings" for proper operation.

J3--A, B, C Three Phase Winding Driver:

The driver output circuit is shown in right figure. Three Phase, Full wave, H-Bridge could drive either Y or Delta winding motor. Please see "Commutation Truth Table" for details.

The use of 20kHz pulse width modulation at the three bottom MOSFETs provides an energy efficient method of controlling the motor speed by varying the average voltage applied to each stator winding during the commutation sequence.

To connect or disconnect J3 when power on is FORBIDDEN! J3 phase missing is FORBIDDEN!
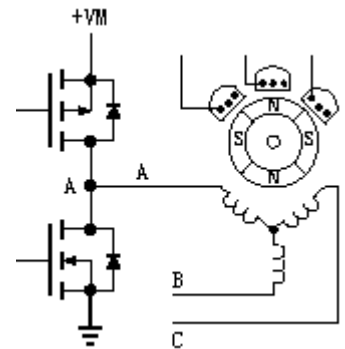
Vhall--Reference Voltage for Hall Sensors:

This reference power could output only 20mA for hall sensors. It is FORBIDDEN to supply any other loads!

Ha, Hb, Hc--Hall Digital Inputs:

TTL compatible. The internal circuit is shown in right figure. Please see "Commutation Truth Table" for details.

The hall sensor electrical phasing must be 120°/240°, 60°/300° is FORBIDDEN. And Ha, Hb, Hc signals must be connected correctly according to A, B, C windings. Otherwise the driver and motor may be damaged!

To connect or disconnect J4 when power on is FORBIDDEN! J4 phase missing is FORBIDDEN!
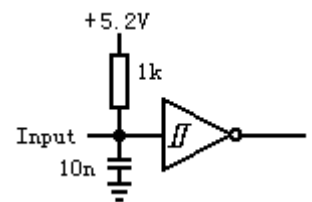
FG--Speed Frequency Generator Digital Output:

TTL compatible. Open collector output. The internal circuit is shown in right figure.

Its frequency is directly proportional to the motor speed. Pulse duty cycle is about 50%. The output waveforms are shown in left figure.

FG (Hz) = Speed (rpm) * N * 3 / 60. N means the number of magnetic pole-pairs (NOT POLES) of the rotor.
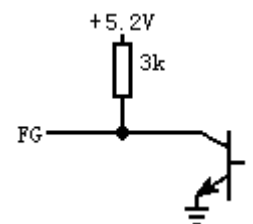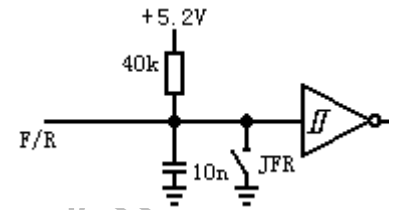
F/R--Forward/Reverse Direction Digital Input:

TTL compatible. The internal circuit is shown in right figure. Please see "Commutation Truth Table" for details.

When F/R signal is high or float, the direction of motor rotation is forward. When F/R is low, it is reverse. The running direction also depends on the structure of BLDC motor.

JFR switch could change the direction on board. But when using J2-F/R pin as signal source, please set JFR OPEN. Otherwise the J2-F/R signal will be invalid.

Reversing when running is FORBIDDEN! That means the motor must be disable (En=0) and speed down to quiescence first, then give F/R reverse signal, then enable (En=1) and speed up.

En--Run Enable/Disenable Digital Input:

TTL compatible. The internal circuit is shown in right figure. Please see "Commutation Truth Table" for details.

A logic high or float at En pin causes the motor to run, while a low causes motor to coast and ABC three phases output Z state.
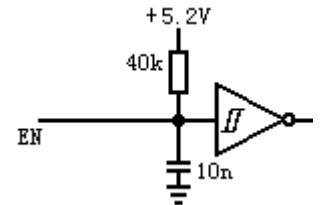
ADJ--Open Loop Stepless Speed Control Analog Input:

Analog signal. The internal circuit is shown in right figure. There are three ways to control speed: (Please see "Application Circuit Examples" for details)

First, connect the top side and bottom side of a 10kOhm potentiometer to the UP pin and DN pin of J2 separately. And connect the middle pin of the potentiometer to ADJ pin.

Second, using an operational amplifier (or D/A). Connect the output of operational amplifier (or D/A) directly to ADJ pin.

Third, connect a filtered pulse width modulation signal directly to ADJ pin. The external filter RC>2ms and f>10kHz is recommended.

When the input voltage of ADJ is lower than 1.5V, the output PWM of three phases is 0%. When the input voltage of ADJ is higher than 4.2V, the output PWM of three phases is 100%.
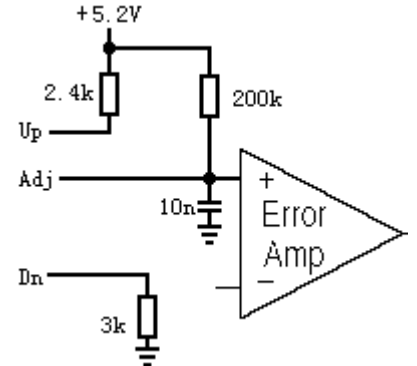
FLT--System Malfunction Digital Output:

TTL compatible. Open collector output. The internal circuit is shown in right figure. Please see "Commutation Truth Table" for details.

A logic high means the motor works normally. A logic low means there are something wrong and causes the FLT Led on and ABC three phases output Z state.
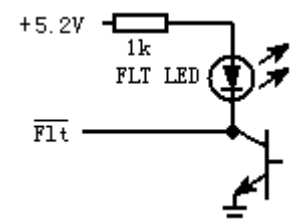
BRK--Dynamic Braking Digital Input (Conditional):

TTL compatible. The internal circuit is shown in right figure.

Using this function need high qualify engineer and additional external circuits. Incorrect operation will cause over voltage, over current and other serious results. The default setting of this function is DISABLED. That means any operation on this pin is invalid. Please contact us for technical supports if you want this function, and ask for additional Appendix Datasheets.
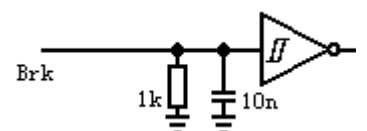
Over Current Limit, Undervoltage Lockout and OCUV Digital Output:

An internal current limit circuit is inside this driver in order to protect J3 H-Bridges. 15ADC peak current limitation value is set, and average current is about 10ADC. When over current is active, OCUV Led is on.

An undervoltage lockout has been incorporated to prevent damage to the IC and the MOSFETs. When power supply +VM<18VDC, driver turns off, and auto-restart when voltage goes up.

OCUV is TTL compatible. Open collector output. The internal circuit is shown in right figure. Please see "Commutation Truth Table" for details.

A logic high means the motor works normally. A logic low means over current OR undervoltage occurs, and causes the OCUV Led on and ABC three phases output Z state.
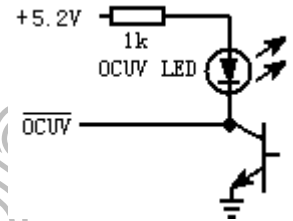
Commutation Truth Table

Hall Inputs			Control Inputs			Over Temp	Over Crnt	H-Bridge Driver			Signal Outputs	
Ha	Hb	Hc	F/R	EN	BRK			A	B	C	FLT	OCUV
X	X	X	X	X	X	Act	X	Z	Z	Z	1	0
X	X	X	X	X	X	X	Act	Z	Z	Z	1	0
1	1	1	X	X	0	Inact	Inact	Z	Z	Z	0	1
0	0	0	X	X	0	Inact	Inact	Z	Z	Z	0	1
1	1	1	X	X	1	Inact	Inact	0	0	0	0	1
0	0	0	X	X	1	Inact	Inact	0	0	0	0	1
Six Valid Combinations (Figure Below)			X	0	1	Inact	Inact	0	0	0	0	1
			X	0	0	Inact	Inact	Z	Z	Z	0	1
			X	1	1	Inact	Inact	0	0	0	1	1
			1/0	1	0	Inact	Inact	Normal Commutation (Figure Below)			1	1

Normal Commutation Waveforms, F/R=1
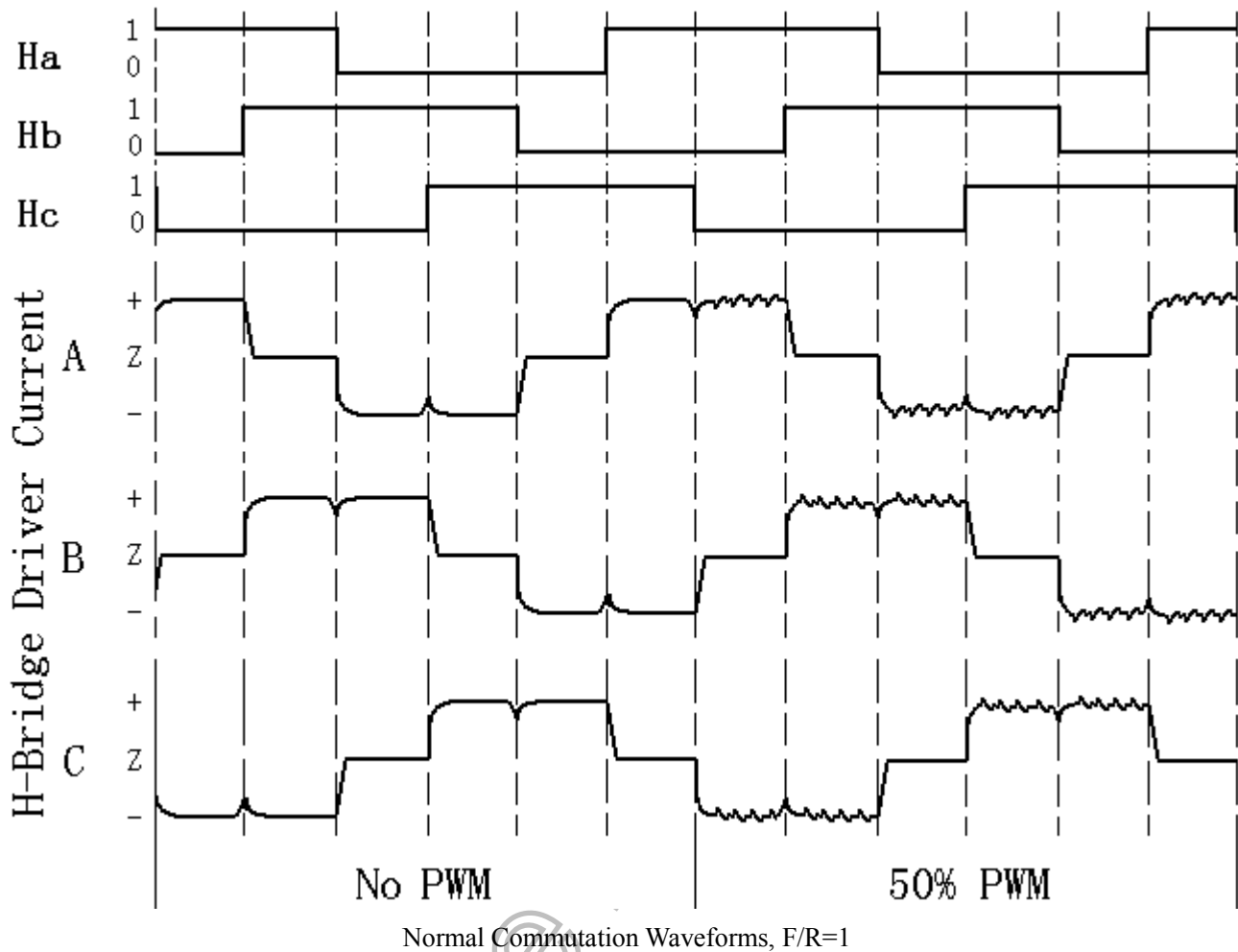
Note: "1"=High, "0"=Low, "X"=Don't care, "Z"=High impedance, "+"= Positive current, "-"=Negative current

Driver Dimension and Connection Diagram (Unit: mm)

The driver dimension is 80 (L) X 55 (W) X 45 (H). The approximate weight of the driver is 135g (including intrinsic sink, not including lines).

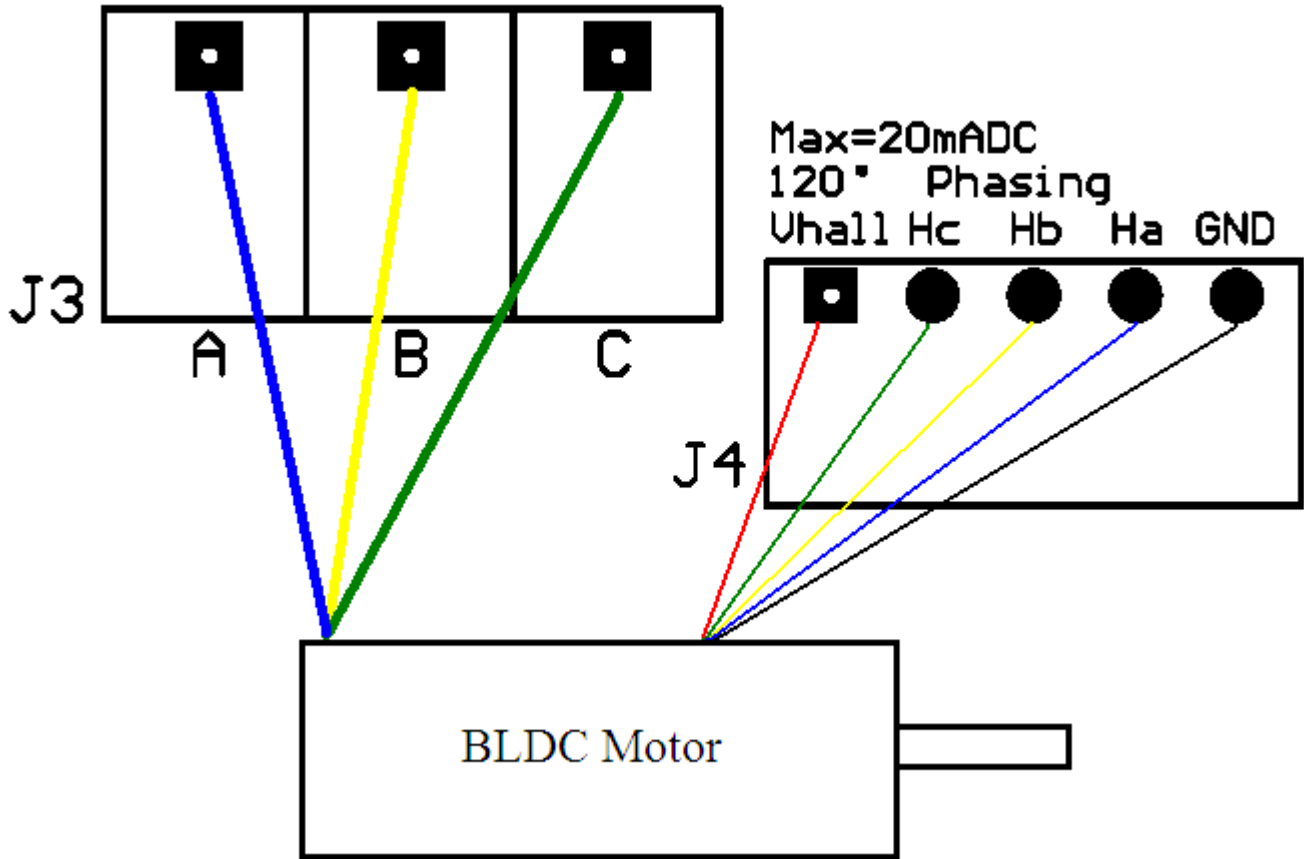The size of the sink can be custom-ordered according to the motor power, heating and cooling of the application.

If the surface temperature of the sink is higher than 85C, cooling fan must be installed. Otherwise the driver would be damaged.

Application Circuit Examples

Max=20mADC
120° Phasing
Vhall Hc Hb Ha GND

J3

A   B   C

J4
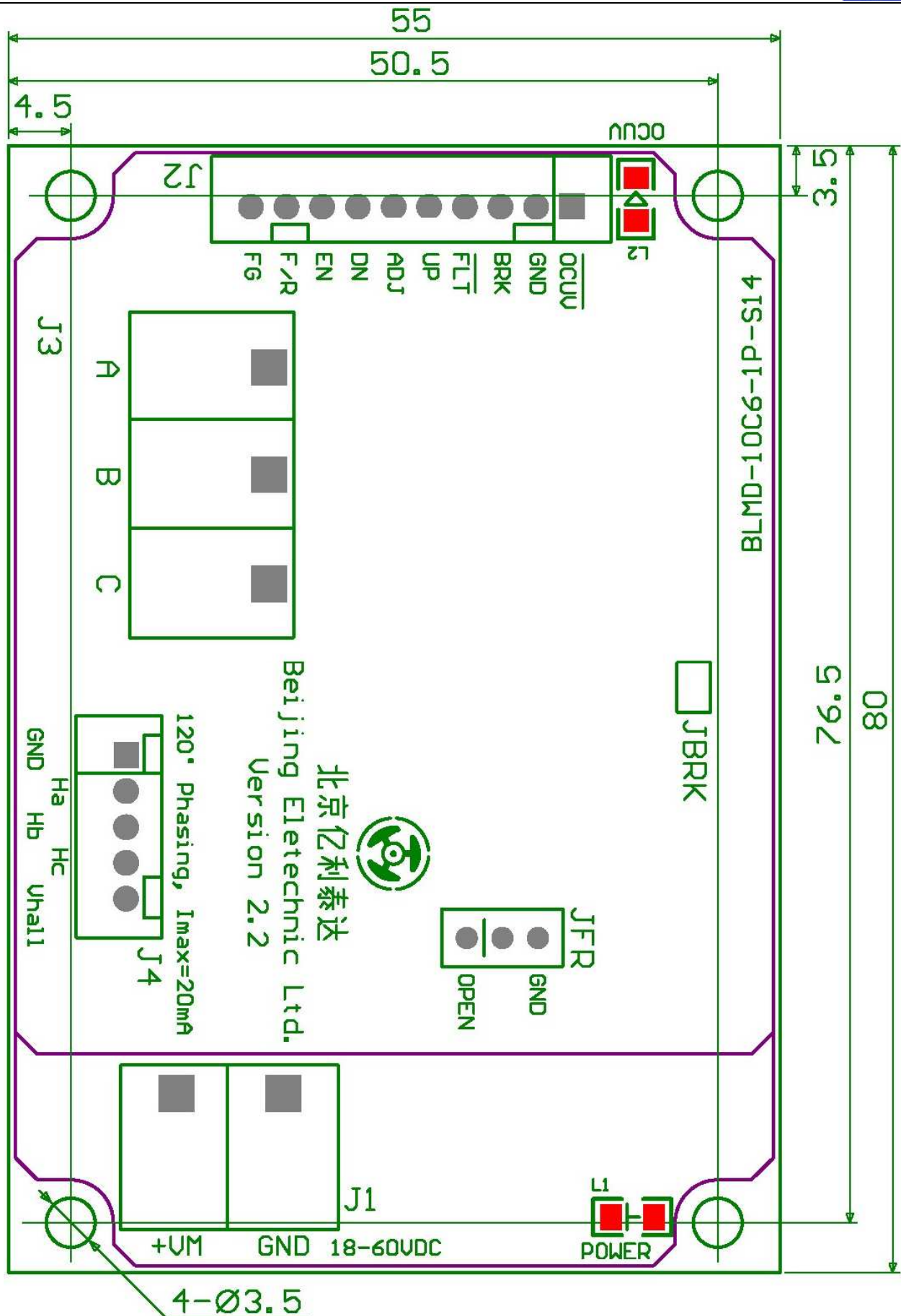
BLDC Motor

The Connection of BLDC Motor

$\overline{OCUV}$ GND BRK $\overline{FLT}$ UP ADJ DN EN FR FG

J2

10kΩ
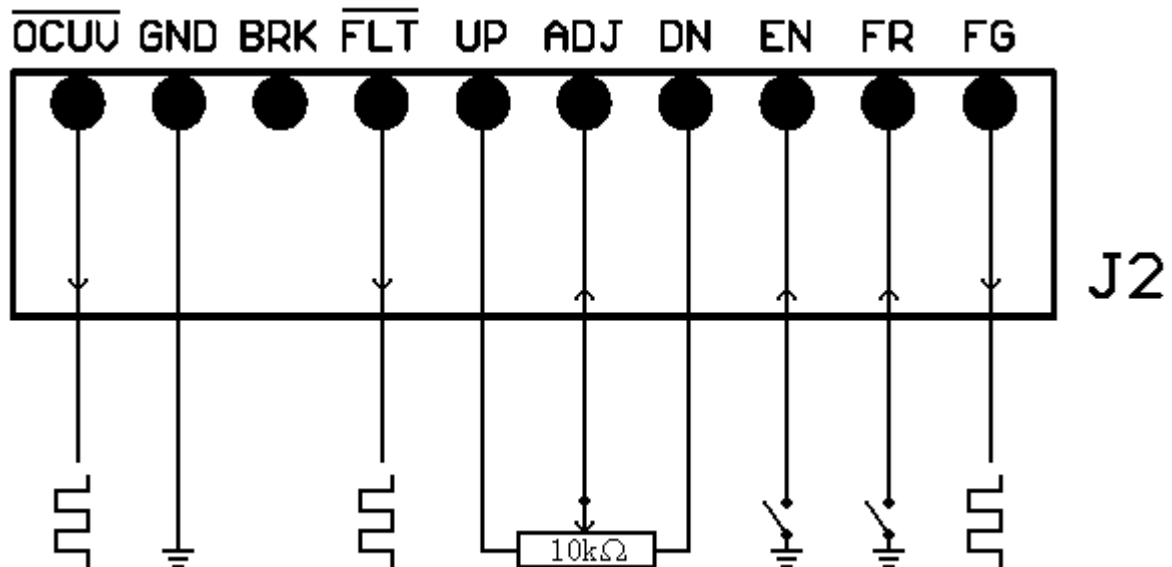
The Connection of Mechanical Switches and Potentiometer Speed Control
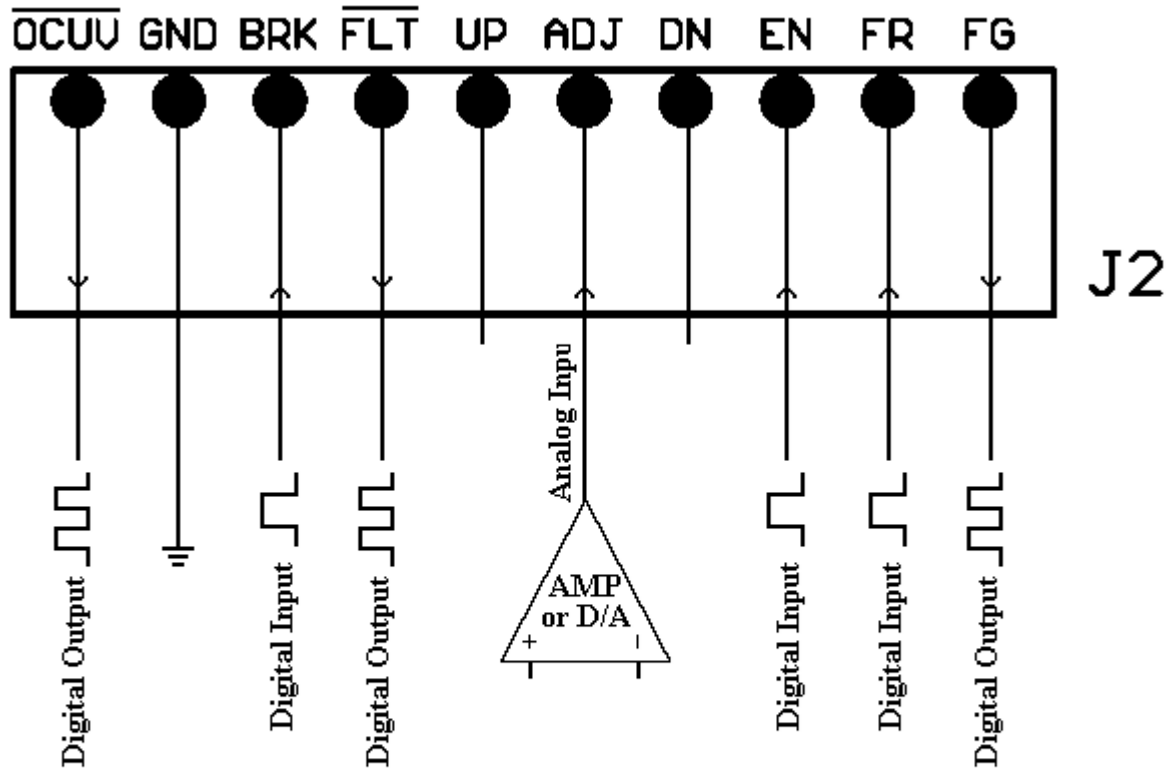
The Connection of Digital Control and Operational Amplifier (or D/A) Speed Control

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