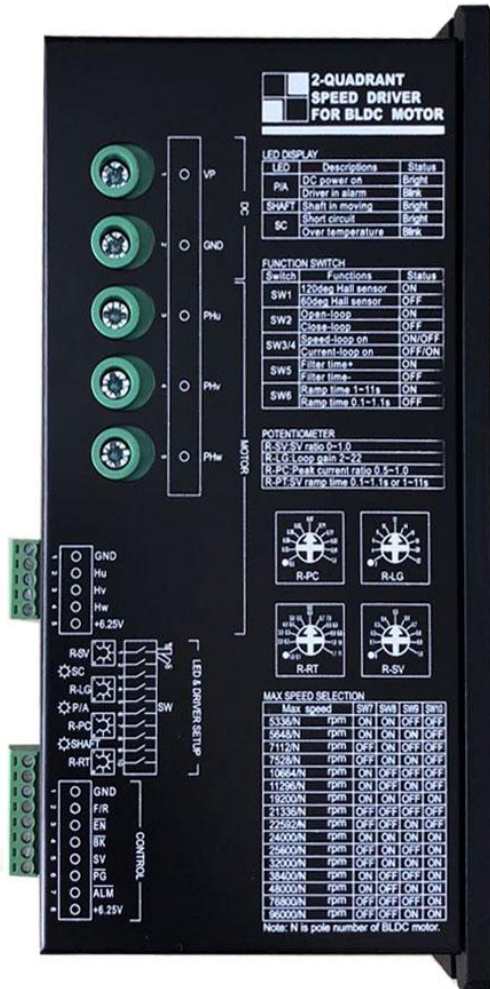




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H系列无刷直流电机驱动器 选型指南与注意事项

H Series Brushless DC Motor Driver Model Selection Guide

Ver. 1.0

南京埃克特自动化科技有限公司 AKT Automation Technology Co., Ltd.

www.aktmotor.com

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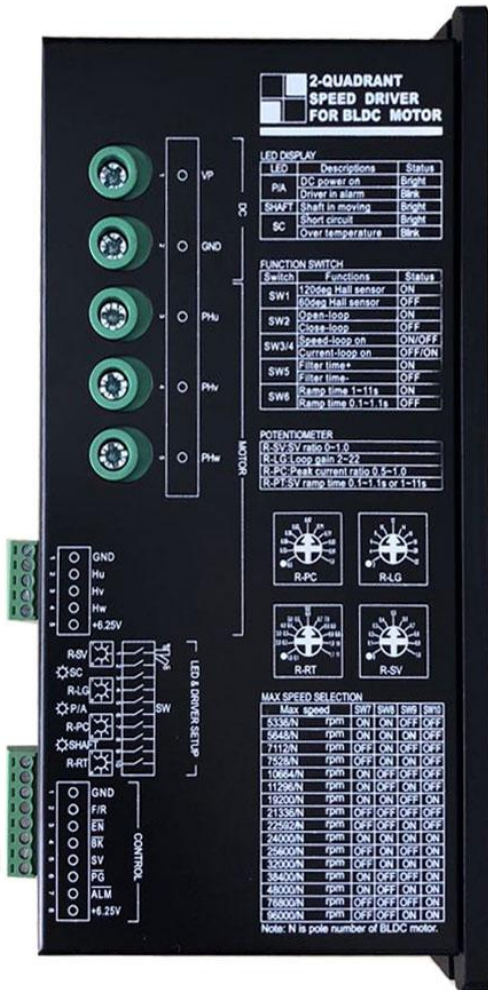
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确定驱动器电压

客户根据所使用的电机的额定电压来选择驱动器电压参数。

Confirm the driver's voltage

Customer needs to confirm the driver's voltage according to the motor's rated voltage.



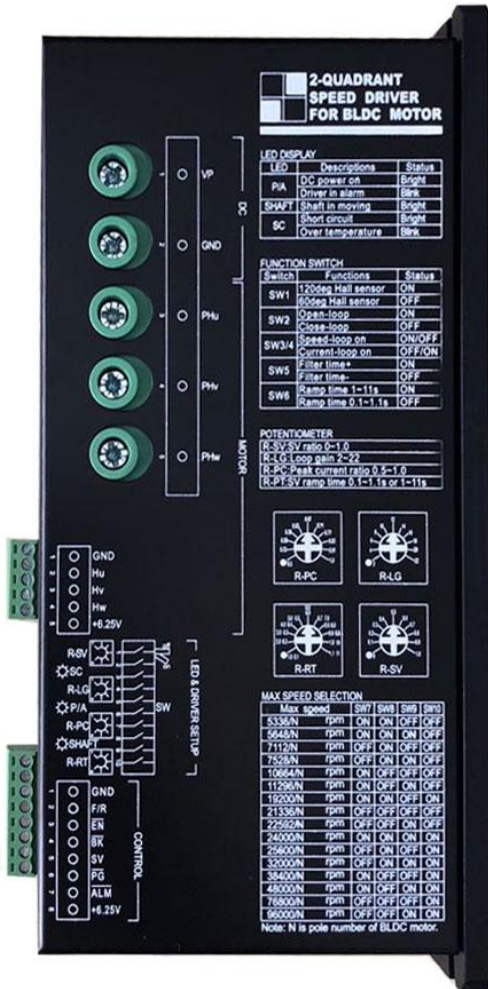
Voltage	24VDC	NOTE 1.DIELECTRIC STRENGTH: 600V@2mA/1S 2.Rotation: CW
Phase	3	
Poles	4	
Line to line resistance	TBD±10%ohms	
Line to line inductance	TBD±20% mH	
Rated torque	0.16N.m	
Rated Current	3.7A	
Rated speed	4000rpm	
Rated output power	67w	
No-load speed	5200rpm	
Class insulation	B	



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确定驱动器峰值电流

如果已知电机的额定输入电流（或最高输入电流） $I_r(A)$ ，则峰值电流 $I_p(A) \geq (2 \times I_r + \text{余量})$ ，余量是考虑过载情况。

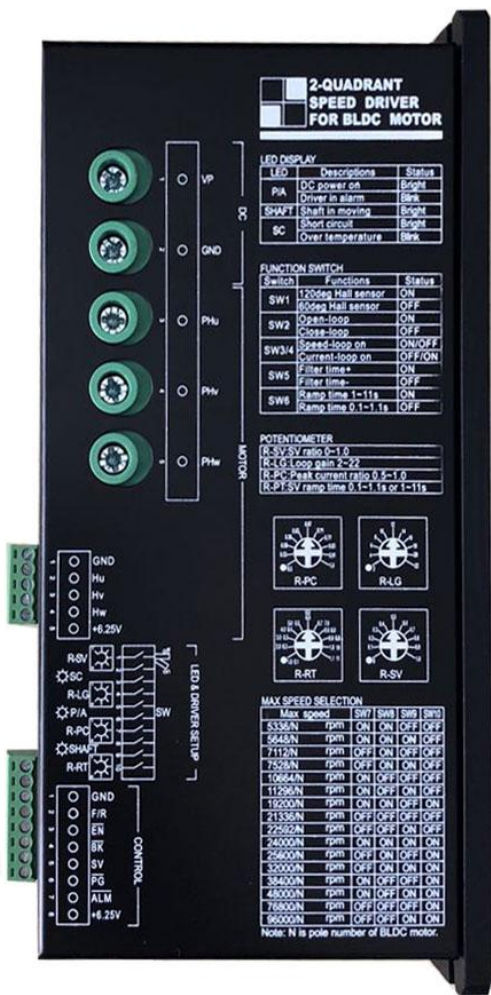
Confirm the driver' peak current

If you already know the rate input current (or the maximum input current) $I_r(A)$ of the motor, then the peak current $I_p(A) \geq (2 \times I_r + \text{margin})$, the margin value regards to the over load situation.

	Voltage	24VDC	NOTE
E	Phase	3	1.DIELECTRIC STRENGTH: 600V@2mA/1S 2.Rotation: CW
	Poles	4	
	Line to line resistance	TBD±10%ohms	
	Line to line inductance	TBD±20%mh	
	Rated torque	0.16N.m	
	Rated Current	3.7A	
	Rated speed	4000rpm	
	Rated output power	67w	
	No-load speed	5200rpm	
	Class insulation	B	



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确定驱动器峰值电流

如果已知电机的额定输出功率（或最高输出功率） $P_r(W)$ ，和驱动电压 $V_r(V)$ ，则峰值电流 $I_p(A) \geq (4 \times P_r / V_r)$ ，已考虑了10~20%余量。

Confirm the driver' peak current

If you already know the rate output power (or the maximum output power) $P_r(W)$ and the driving voltage $V_r(V)$ of the motor, then the peak $I_p(A) \geq (4 \times P_r / V_r)$, 10~20% margin value has already been considered.

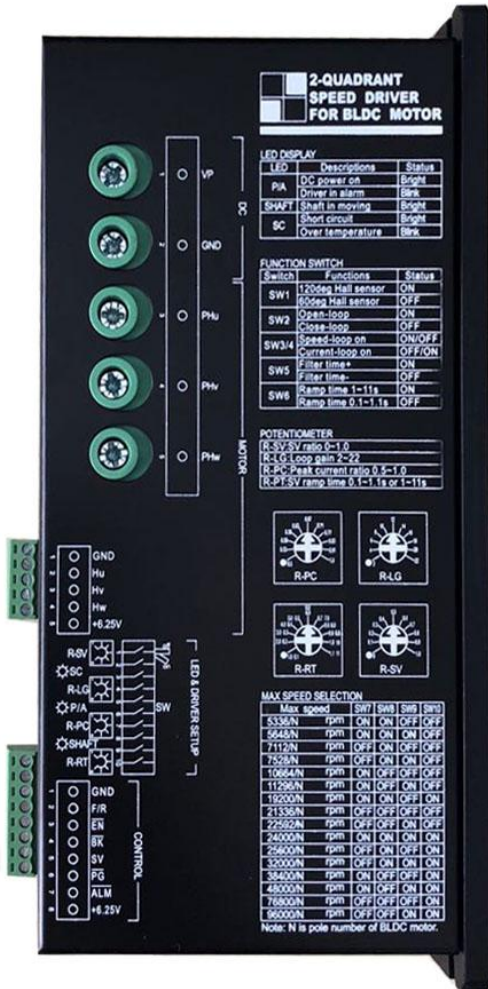
Voltage	24VDC	NOTE 1.DIELECTRIC STRENGTH: 600V@2mA/1S 2.Rotation: CW
Phase	3	
Poles	4	
Line to line resistance	TBD±10%ohms	
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Rated Current	3.7A	
Rated speed	4000rpm	
Rated output power	67w	
No-load speed	5200rpm	
Class insulation	B	



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确定象限

本系列产品为两象限运动控制的速度闭环系统，即正向驱动和反向驱动，转矩与转速同方向，没有动态制动功能（转速与转矩方向相反，如向下放重物），不能用于四象限的控制领域，这一点务必注意。所以精确定位、急速加减速、快速响应的频繁正反转等四象限运动伺服控制是不适用的。

Confirm the quadrants

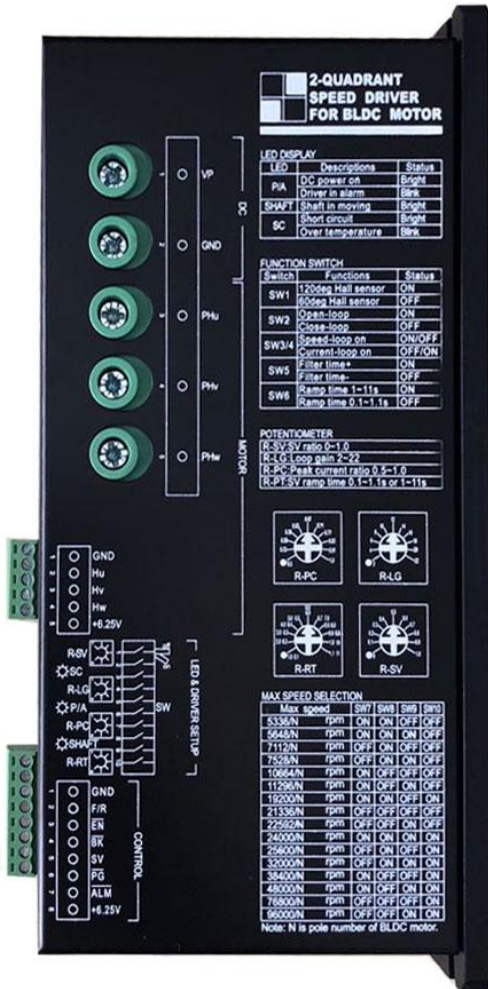
H Series Brushless DC motor driver is a two quadrants close loop motion control system of speed, which is forward drive and reverse drive control. The torque and the speed are in the same orientation. It doesn't includes the dynamic braking function (the torque and the speed are in the different orientation, for example: lower the heavy thing). You should not use this driver in the four quadrants control field. So, precise positioning, rapidly acceleration or deceleration, frequency forward and reverse with rapidly response and any other four quadrants servo motion control applications are unserviceable.



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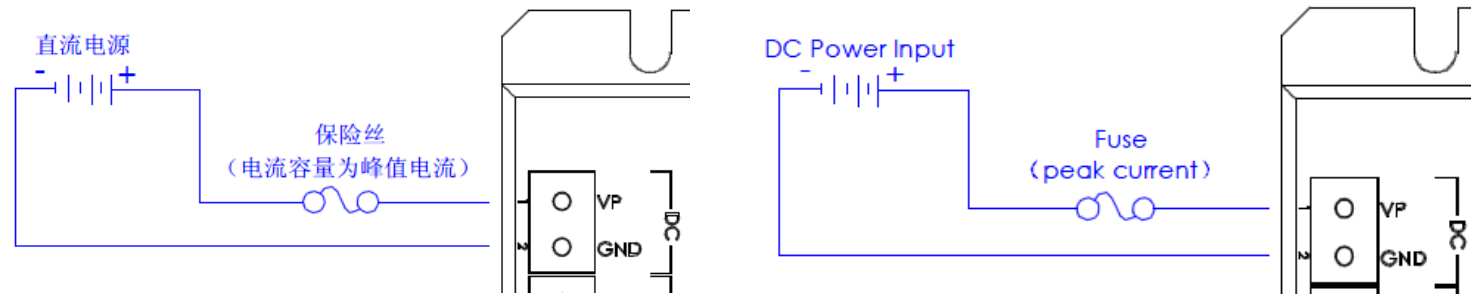


驱动电源

用户的供电电源应满足在空载到满载电流下，电压必须在规定的范围内。外部进线务必设定保险丝，容量不小于连续电流，以免扩大故障引起不可维修的烧毁或火灾。VP为电源正极，GND为电源负极。

Driving power supply

User's power supply should make sure the voltage keeps in the specified range from no load current to full load current. Fuse is necessary in the external incoming wire, the capacity should not less than the continuous current in order to avoid the un-repairable damage or fire disaster. VP is the power's positive electrode, GND is the power's negative electrode.

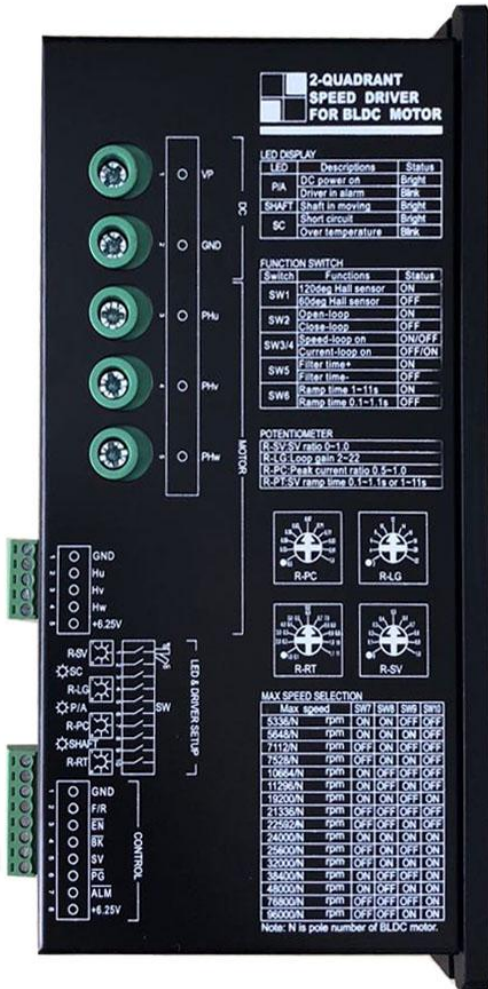




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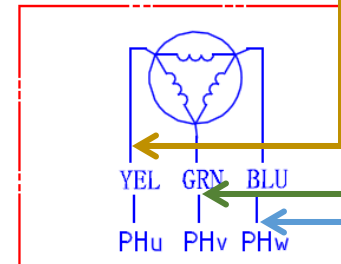
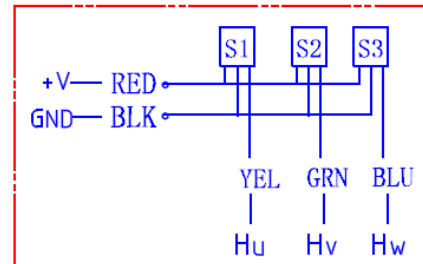
电机绕组

对应与每一组霍尔信号组合，绕组都有一组正确相序与之对应，务必按照正确相序接线。

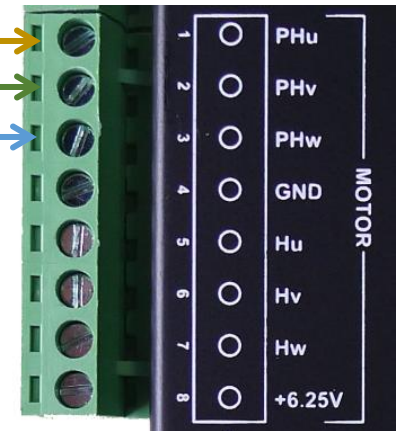
Motor winding

Please make sure to connect each phase of the winding wires to the correct phase port according to the connection diagram.

接线图:

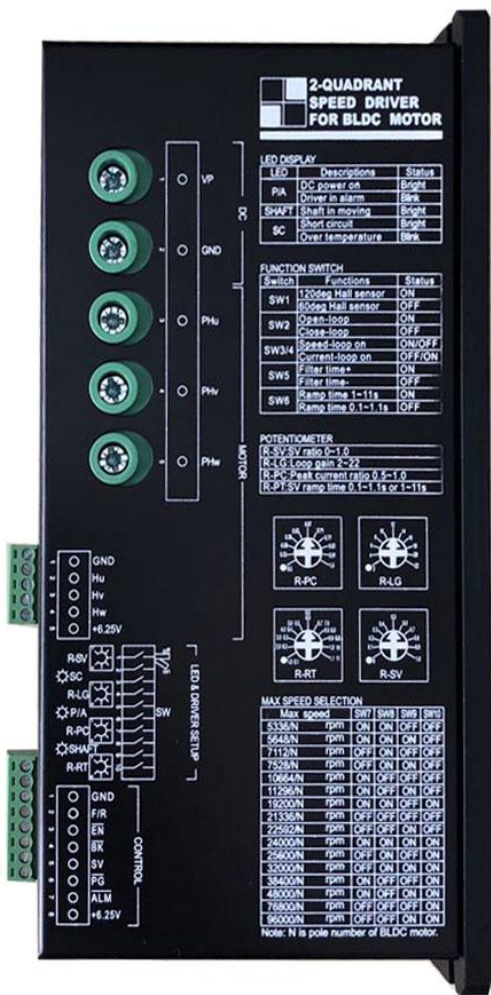


备注: "+V"处的供电电压为5VDC 到 +20VDC





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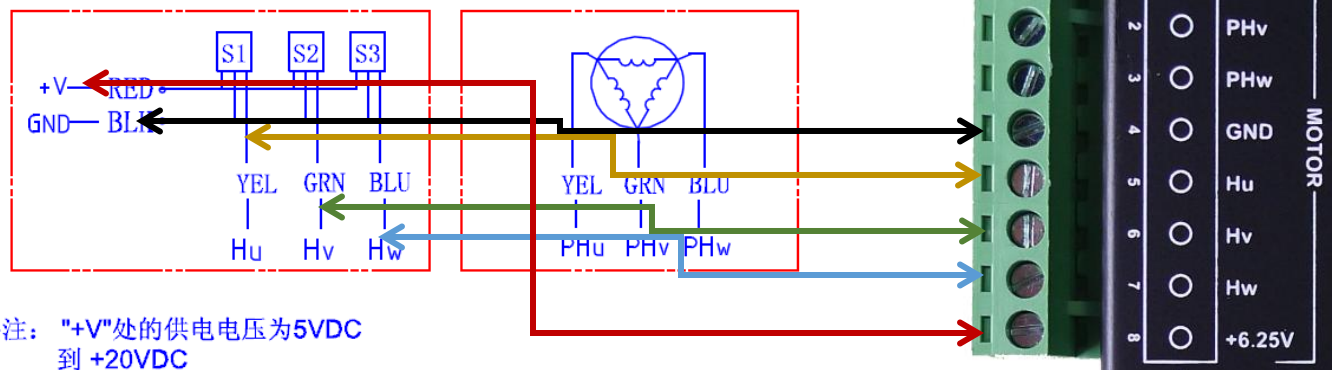
霍尔传感器端口

内部电路请见接口电路，霍尔信号供电电源为6.25V，霍尔元件为开关型，务必确认霍尔相位与相序，并正确设置接线。

Hall sensor port

Hall signal power supply is 6.25V. Hall element is switch type. Please make sure to connect each phase of hall signal wires to the correct phase port according to the connection diagram.

接线图:



备注: "+V"处的供电电压为5VDC 到 +20VDC



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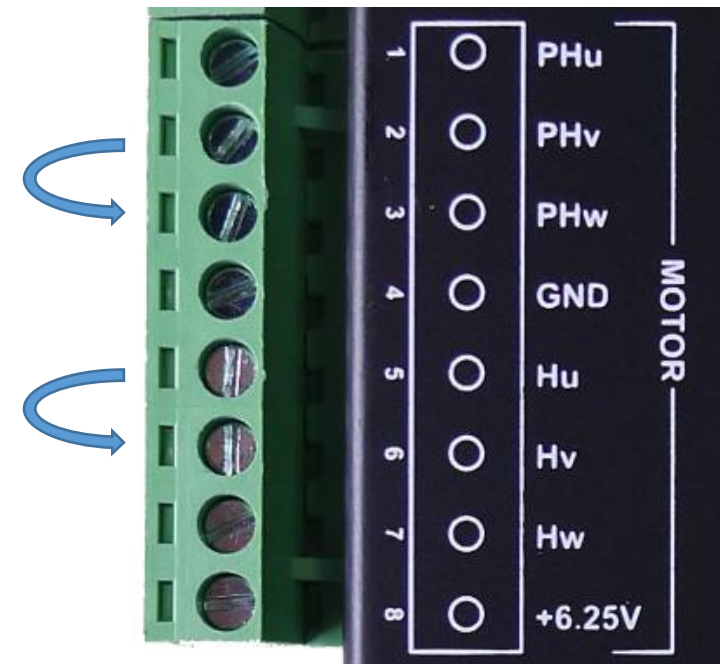
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改变电机的旋转正方向

当电机旋转正方向与客户要求相反时，通过换接线可以改变电机正转向。霍尔信号前两相Hu和Hv对调，同时绕组后两相PHv和PHw对调。

Change motor's positive direction of rotation

When the motor's positive direction of rotation is different from the user's requirement, you can change motor's positive direction of rotation by exchange the wire's connection. Exchange the Hu and Hv phase in Hall sensor, meanwhile, exchange the PHv and PHw phase in winding.

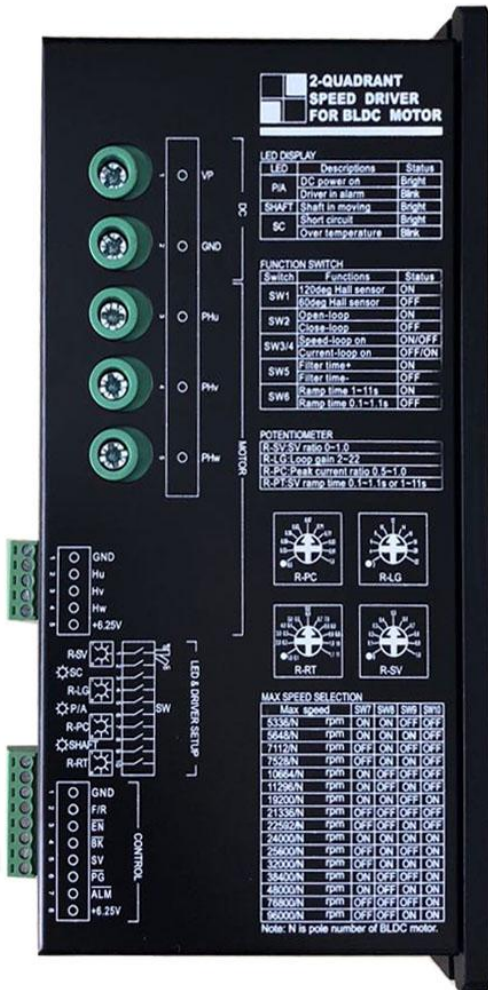




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LED显示

P/A——电源指示，当驱动器正常上电后为绿色常亮，当驱动器进入故障报警状态时为绿色闪烁，EN非使能一次或断电可以清除报警。

SHAFT——转轴状态指示，当电机转轴转动时绿色常亮，不转时不亮。该指示灯熄灭前不要碰到转轴及转动部分，以免发生危险。

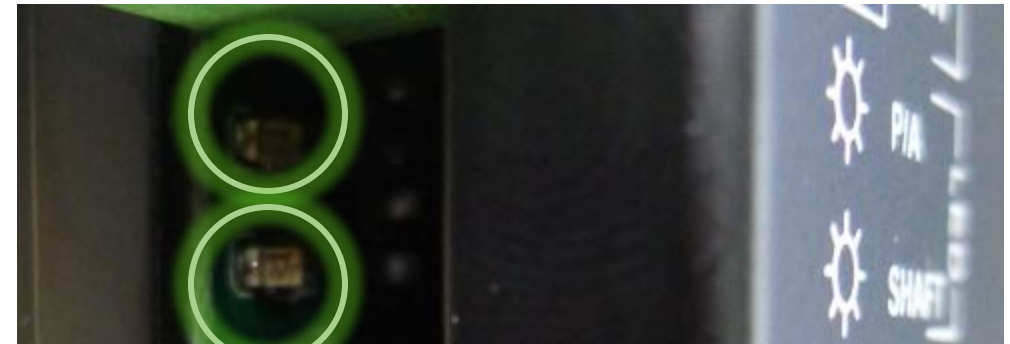
SC——短路与过温指示，当电机绕组内部由于绝缘破坏而发生匝间短路时为红色常亮，它只能断电清除。当外壳温度过温时为红色闪烁，EN 可以清除。

LED indicator

P/A: ——Power indicator LED. When starting power supply in normal, LED keeps green brighten. When in alarm state, LED will be green blinking. The alarm can be reset by EN disable once or power off.

SHAFT——Shaft status indicator LED. When motor shaft is moving, LED keeps green brighten. When moving stopped, LED turns dark. In order to avoid the danger, do not touch the shaft and the related components when this LED brightens.

SC—— Short circuit & over temperature indicator LED. When the internal motor winding due to insulation damage and cause turn - to - turn short circuit, LED keeps red brighten, it can only be reset by cutting off power. LED will be red blinking when the shell temperature is too hot, EN can clear.

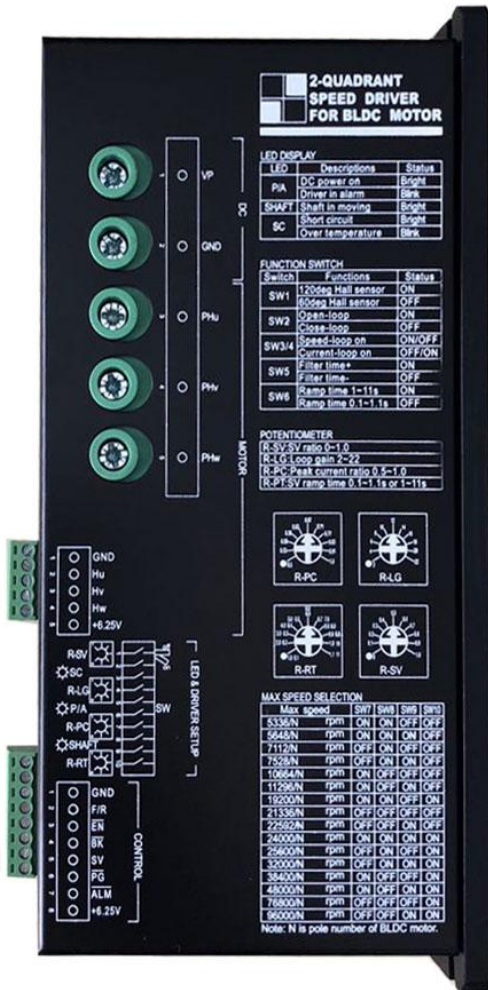




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功能开关设置

本10位贴片拨码开关ON为下拨，OFF为上拨。

SW1——霍尔相位设定，ON=120度电角度。OFF=60度电角度。出厂默认ON

SW2——开闭环设定，ON=开环工作。OFF=闭环工作。出厂默认OFF。

SW3/4 ——环路选择，ON/OFF=选择速度环。OFF/ON选择电流环。OFF/OFF=开环工作时不选择任何环路。两环路不能同时选择。出厂默认ON/OFF。

SW5——环路滤波强弱，ON=滤波效果增强，运转更加平滑，环路反应变慢。
OFF=滤波效果减弱，运转平滑性减弱，环路反应加快。出厂默认ON。

SW6——指令升降速时间分段，ON=1~11秒可调，OFF=0.1~1.1秒可调。指令升降速按照RC充放电指数型升降。出厂默认OFF。

Function switch setting

ON= downward, OFF= upward.

SW1——SW1 -- Hall phase setting, ON=120 ° electrical angle. OFF=60 ° electrical angle. Default: ON

SW2——Open/Close loop, ON=open loop, OFF=close loop, Default: OFF.

SW3/4——Loop selection, ON/OFF= select the velocity loop. OFF/ON select current loop. OFF/OFF= select no loop when in open loop work. You can't select both loops. Default: ON/OFF.

SW5——Loop filter time, ON=filter effect will be enhanced, running smoothness will be improved, loop response will be slower, OFF=filter effect will be drop off, running smoothness will be reduced, loop response will be faster. Default: ON.

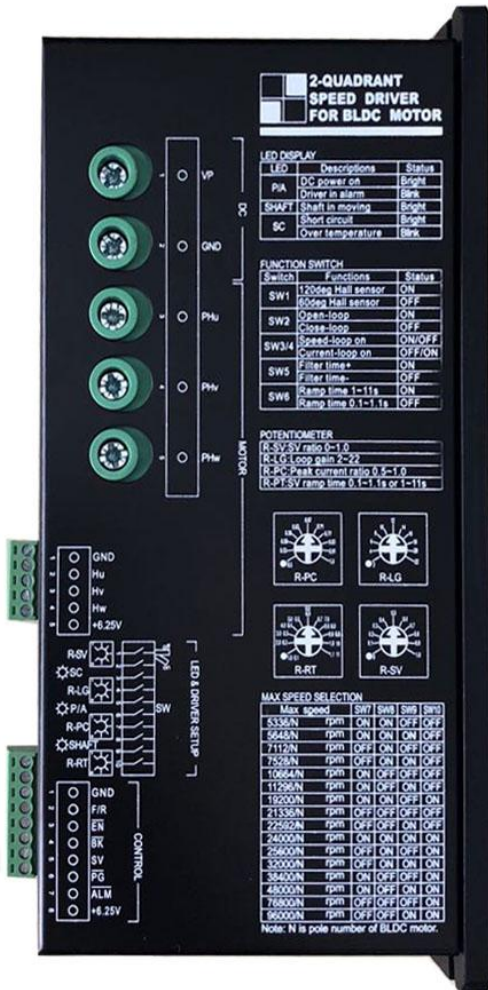
SW6=SV ramp time setting, ON=1~11 seconds adjustable. OFF=0.1~1.1 seconds adjustable. According to the RC electric sufficient and discharge index control. Default: OFF.



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转速范围开关设置

在满幅指令下，为了在不同转速段获得最佳的分辨率，请设定等于或高于你所使用的最高转速一档。见盖板图示表格，其中N为电机极数。SW7, 8, 9, 10四位开关设定请见盖板表格。出厂默认ON/ON/ON/ON,也就是8极3000转/分。

Speed range switch setting

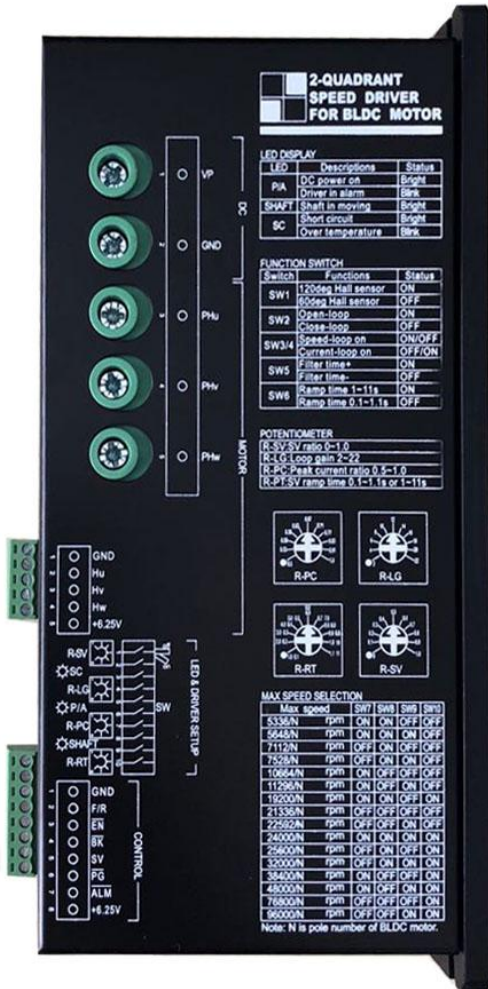
When under full amplitude command, In order to get the most suitable resolution in each different speed range, please set the switch and let the corresponding speed equal or larger than your maximum speed. N=motor pole number. Please find SW7,8,9,10 in the table which printed in the driver cover. Default setting is ON/ON/ON/ON, which means 8 poles, 3000rpm.



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电位器设置

10刻度单圈电位器，请轻轻操作，用力过大会损坏。

R-SV=指令衰减比率设定0-1.0，线性刻度，比率=内部有效指令/外部名义指令。

通过调节电位器，可以精确校准外部指令与结果的关系。出厂默认0.5。

R-LG=环路增益设定2-22，线性刻度，数值越大环路灵敏度越高，同时超调也会加大，增加不稳定性，一般不用调节。出厂默认8。

R-PC=峰值电流设定比率0.5-1.0，非线性刻度（见盖板图示），比率=实际峰值电流/名义峰值电流，实际连续电流为实际峰值电流的一半，根据电机要求合理设定，出厂默认1.0。

R-RT=指令升降速时间设定0.1-1.1秒或1-11秒，线性刻度，结合SW6 开关分档设定。为了平滑阶跃指令输入，采用RC 充放电指数型升降。当使用SV=0V 停止时，由于很长的拖尾导致停止时间延长，如果结合EN停止功能，可以消除拖尾。出厂默认0.4。

Potentiometer setting

10 scales single-turn potentiometer, please operate it gently. You may damage it if you operate it too hard.

R-SV=Reference ratio, 0-1.0. Linear scale. Ratio=Internal effective command/external nominal command.

By adjust the potentiometer, you can precisely calibrating the relationship between the external command and the result.

Default is 0.5.

R-LG= Loop gain setting 2~22, linear scale. The larger the value is, the higher the loop sensitivity is, and the overshoot will also increase, the instability will increased. Generally, no adjustment is needed. Default is 8.

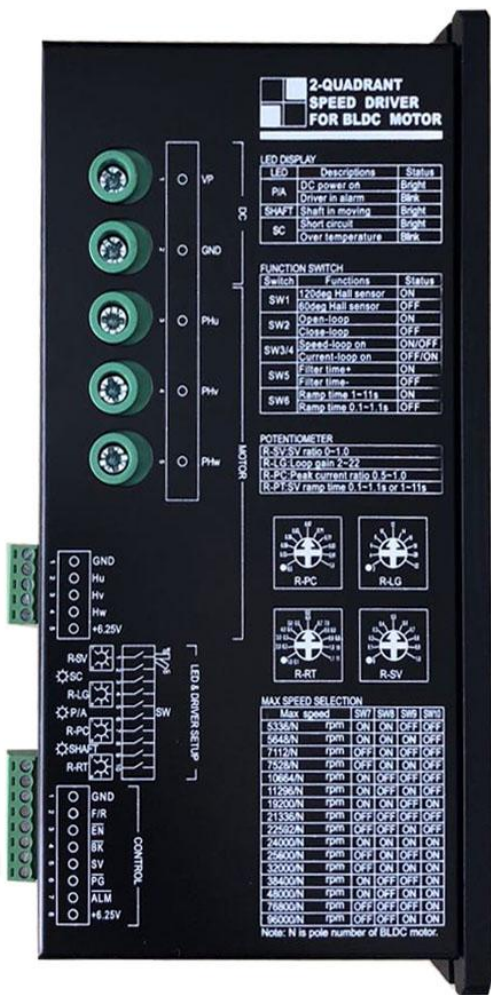
R-PC=Peak current ratio, 0.5-1.0. Nonlinear scale (check the diagram printed in the driver cover). Ratio=Actual peak current/nominal peak current. Actual continuous current is half of actual peak current. Please make the reasonable setting according to the motor's requirement. Default is 1.0.

R-RT=SV ramp time setting 0.1-1.1 seconds or 1-11 seconds, linear scale, combined with SW6 switch setting. In order to smooth the step command input, it use the RC electric sufficient and discharge index to control. When SV=0V is used to stop, the stopping time is prolonged due to the long trailing. If combined with EN stopping function, trailing can be eliminated.

Default is 0.4.



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控制端口

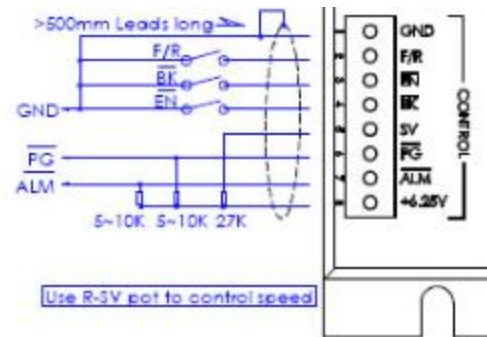
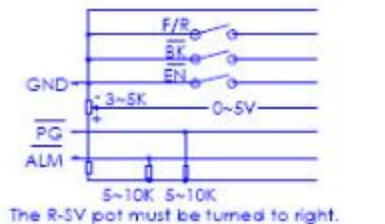
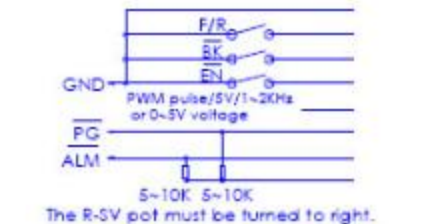
F/R=正反转控制，高电平或悬空为正转，低电平或接地为反转。本驱动器具有安全正反转功能，当运转中突然改变转向时，可以实现平滑过度反转，避免冲击。

EN=使能控制（起停），高电平或悬空时驱动器不工作，电机处于自由状态，低电平或接地时驱动器开始工作，非使能一次，可以在线清除报警状态。但是短路报警不能在线清除，只能断电清除。本驱动器有安全启动功能，当上电时，如果电机转轴还在运转，即使使能，驱动器也要等电机轴速度降为零时才会驱动运转。

Control port

F/R----Forward/Reverse control. High level or Open=Forward. Low level or Grounding=Reverse. This driver has the function of safe rotation. When the direction is suddenly changed in operation, it can realize smooth excessive reversal and avoid impact.

EN-----Enable/Disable (Start/Stop) control. High level or Open=Driver doesn't work, motor is in free status. Low level or Grounding=Driver start to work. Disable once to reset alarm on line. But short circuit alarm can not be reset online, only to cutting power supply to reset. This driver has a safe start function. If the motor is running when the power is on, even if it is enabled, the driver will not drive until the motor speed is reduced to zero.





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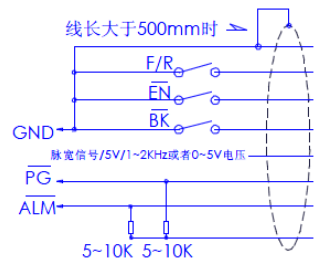
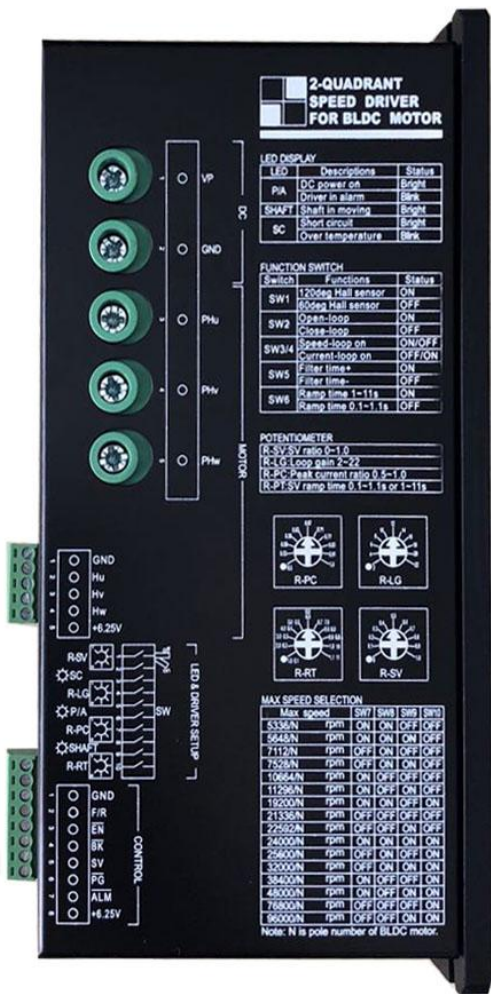
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控制端口

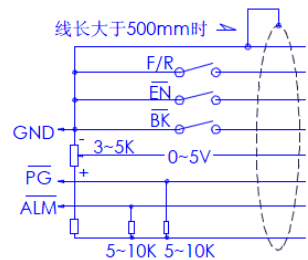
BK=刹车控制，通过功率管将电机绕组短接实现快速制动，没有维持力。由于短接电流是不可控的，刹车能量太大时会损坏功率管，因此刹车时的转速务必要低于安全刹车转速Ns。

Control port

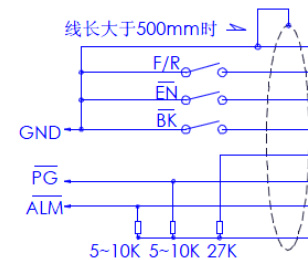
BK= Braking control, It use power tube to short connect the motor winding in order to make prompt braking. It doesn't have maintenance energy, also, as the short circuit current is uncontrollable, if the brake energy is too much, the power tube will be damaged. So the speed when braking must less than safety braking speed.



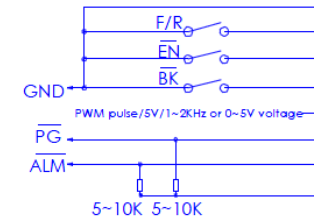
用脉宽信号或者外加电压控制转速



用外部电位器控制转速

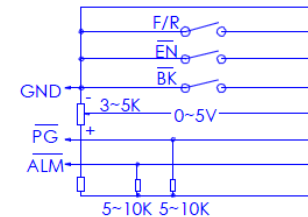


用内置电位器控制转速



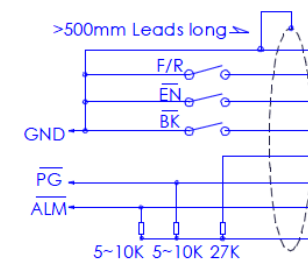
The R-SV pot must be turned to right.

Use PWM pulse or SV voltage to control speed

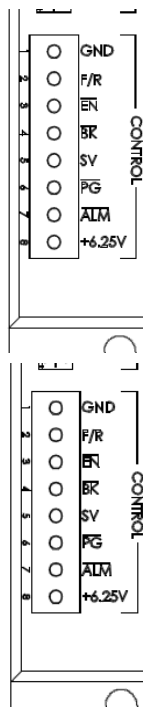


The R-SV pot must be turned to right.

Use additional pot to control speed



Use R-SV pot to control speed

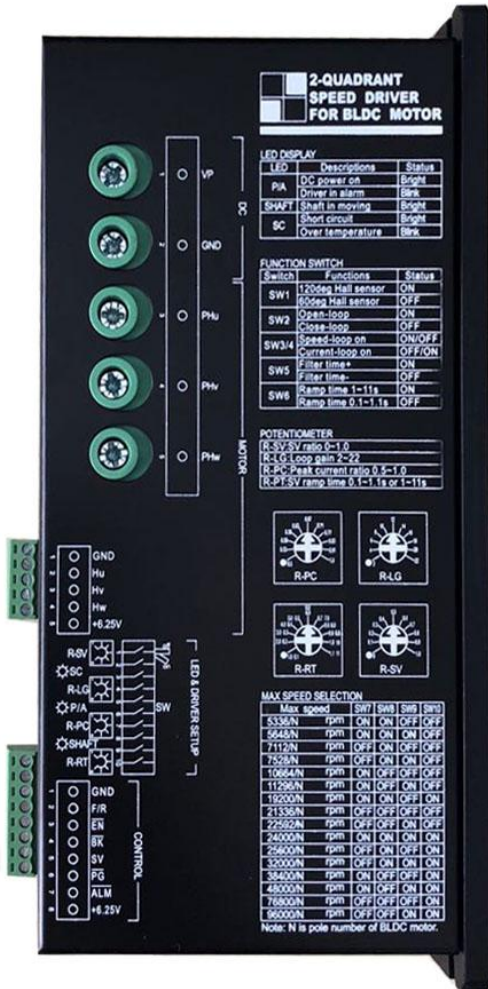




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控制端口

SV=控制指令电压0-5V，输入电阻112K，注意不要超范围输入，高于5V后，环路可能会失去控制。幅值5V，频率100-200Hz的PWM指令可以直接输入（升速时间设定0.3-0.5秒），线性度会低一些。通过加装内置F/V转换模块，也可以输入5V幅值，0-3KHz的脉冲频率指令。

Control port

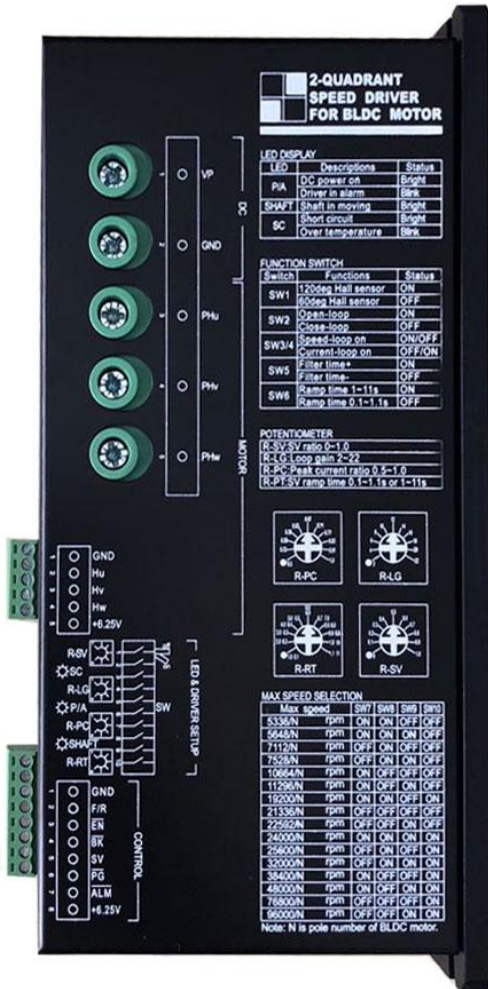
SV=Analog reference voltage: 0~5V. Input impedance: 112K. Do not over input. When the voltage is over 5V, the loop will out of control. PWM command with 5V amplitude and 100~200Hz frequency can be input directly (Ramp time: 0.3-0.5 seconds), linearity may reduce a bit. When added a internal F/V conversion module, it can also can input 5V amplitude, 0~3KHz pulse frequency command.



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控制端口

PG=转速脉冲输出，OC 输出，耐压30V，电流最大10mA。该脉冲频率正比于电机转速，可以订制与霍尔同频率（型号后缀-F）或者6 倍于霍尔频率。与霍尔同频率时，输出为方波，电机转速 (rpm) =120*PG 频率 (Hz) /N，其中N 为电机极数。当6倍于霍尔频率时，输出为30μs宽度的窄脉冲，电机转速 (rpm) =20*PG频率 (Hz) /N。对于方波来说，容易被捕获，而对于6倍频来说，精度、分辨率更高。

Control port

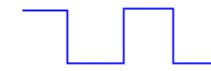
PG=Speed pulse output in OC (30Vmax/5mA). This signal can be made in synchronize to one phase hall sensor signal (model number with suffix letter -F) or 6 times frequency multiplier. The motor speed is in proportion to the frequency. Motor speed(rpm) = PG frequency(Hz) x 120/N. N is the pole number of motor. Or, motor speed(rpm) = PG frequency(Hz) x 120/N/6 (6 times frequency multiplier). When in 6 times frequency multiplier, it outputs 30μs width narrow pulse, the accuracy and resolution will be higher.



与一相霍尔同步



一相霍尔六倍频



1x Hall sensor frequency per phase



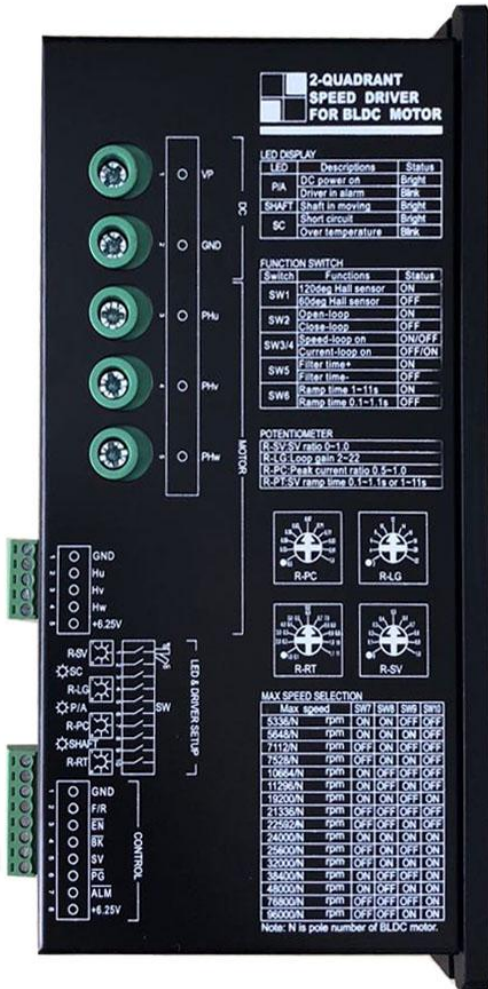
6x Hall sensor frequency per phase



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控制端口

ALM=报警输出，OC输出，当处于报警时，三极管导通。报警的条件如下：

- 1) 无霍尔信号或霍尔信号不正确或相位不对。
- 2) 供电电压欠压或过压。
- 3) 驱动器壳体过热
- 4) 过载连续超过时间6S 或更长时间断续过载。
- 5) 电机绕组短路

Control port

ALM=alarm output. OC output. When in alarm, triode will conduct.

Alarm conditions as below:

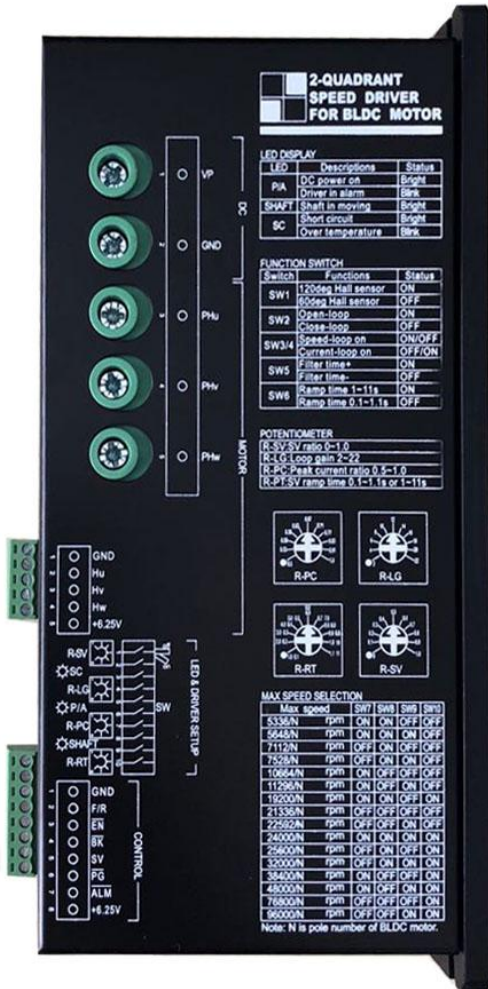
- 1) No Hall signal or Hall signal incorrect or phase position incorrect.
- 2) Power supply under-voltage or over-voltage.
- 3) Driver's shell is too hot.
- 4) continuous overload over 6 seconds or longer time intermittent overload.
- 5) Motor Winding short circuit.



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确定使用温度

客户根据使用条件合理选择使用温度范围，
 一般室内选择-10~+45℃，室外选择-40~+65℃。

Confirm the operating temperature

Customer should make a choice of the driver's operating temperature range type according the wording condition.

In general, if the driver is working indoor, you can choose the driver with -10~+45℃ temperature range. If the driver is working outdoor, you need to choose the driver with -40~+65℃ temperature range.



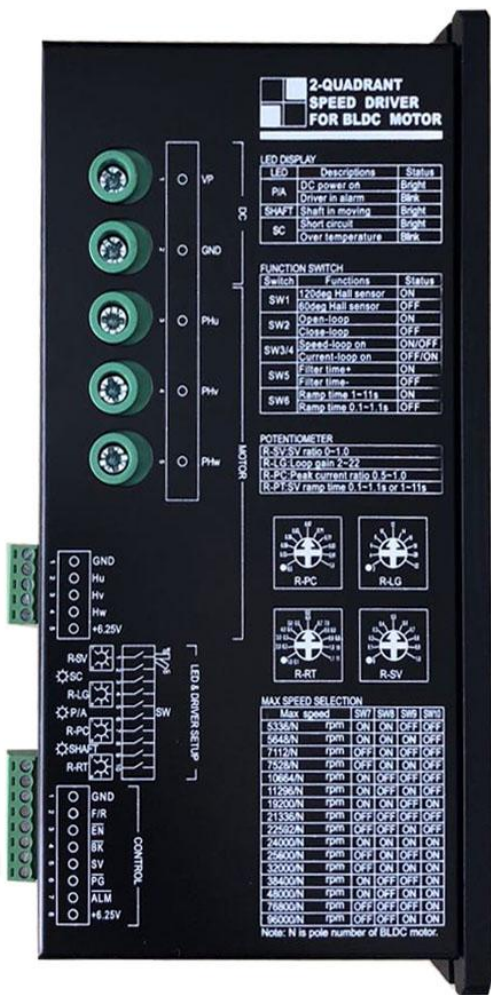
室内 Indoor
 -10~+45℃



室外 Outdoor
 -40~+65℃



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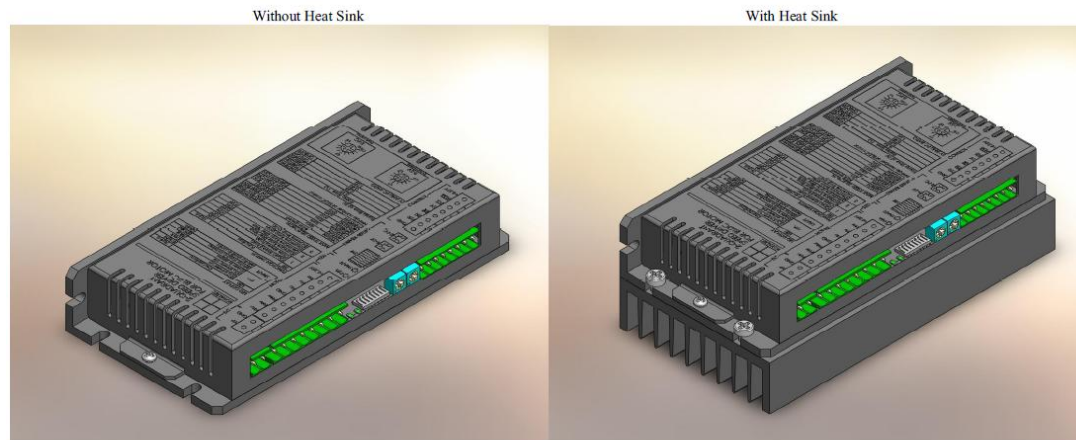


加装散热器

驱动器内置了60 °C或80 °C的温控器，当底板温度超过时，会过温保护报警。经常发生过温应采取加装散热器或风扇等措施，视使用条件而定。

Installing a Heat Sink

The driver integrated a temperature controller of 60 °C or 80 °C, which will take over-temperature protection when the temperature of the bottom plate exceeds. If the over temperature alarm often occurred, it should take measures such as installing a heat sink or fan, depending on the use conditions.

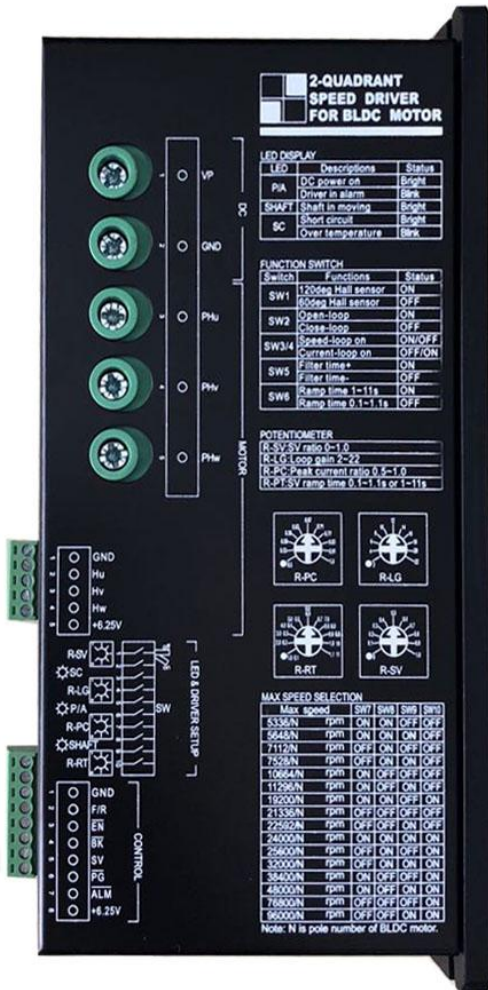




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引线干扰

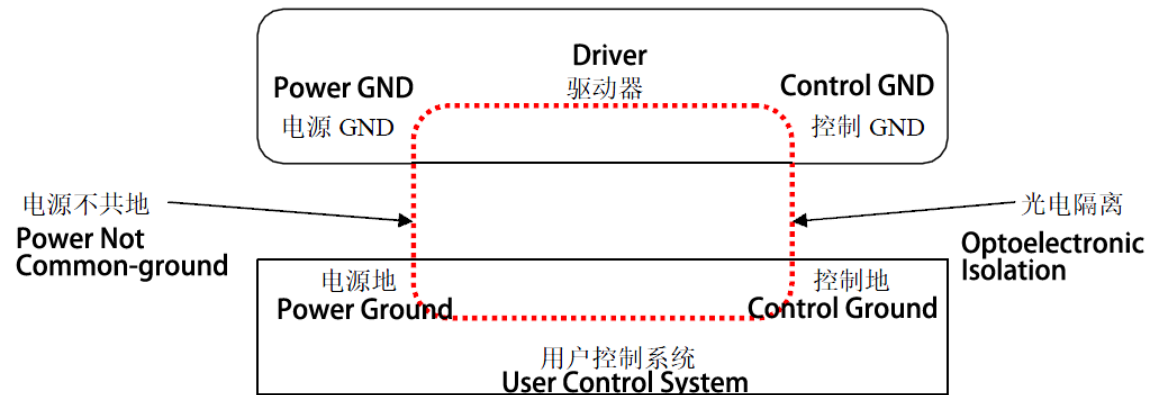
绕组线可能干扰霍尔信号，因此霍尔线与绕组线应分开走线，不能两者缠绕在一起。干扰可以使驱动器工作不正常，当电机与驱动器的连线太长时（大于2m），应采用屏蔽线将绕组线与霍尔线分开。当多台同时共地使用或线长等原因电磁干扰严重时（不能正常工作），请使用光电耦合器将霍尔端、控制端口隔离。当使用屏蔽线时，屏蔽层接驱动器外壳。端口光电隔离器可以由用户自己制作，也可以向本公司购买。

当如下图所示，形成封闭的地环时，将产生严重的共地干扰，务必要将封闭环剪断，避免使用共地电源，或使用光电隔离控制。

Lead wire interference

Winding wire may affect Hall signal. So the Hall wire and the winding wire should run separately. These two wires should not intertwined. The interference may cause the driver doesn't work. When the connecting wire between the motor and driver is too long (over 2 meters), it should use shielded wire to separate the winding wire and Hall wire apart. When more than one set grounding in the same time or other reasons which cause serious interference (Unable to work well), please use optoelectronic coupler to isolate the Hall port and control port. When use the shielded wires, shield should connect to the driver's cover. The optoelectronic coupler can be made by the user themselves or purchased from our company.

When the situation appears like the figure below, it will cause the closed ground loop and cause serious common-ground interference. Please make sure to cut off the closed loop, avoid using common-ground power supply or use optoelectronic isolation to control.

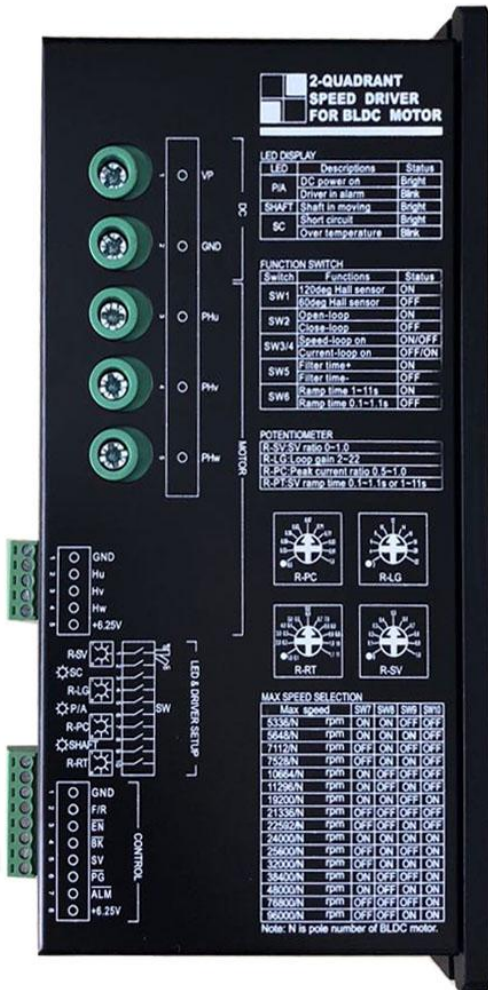




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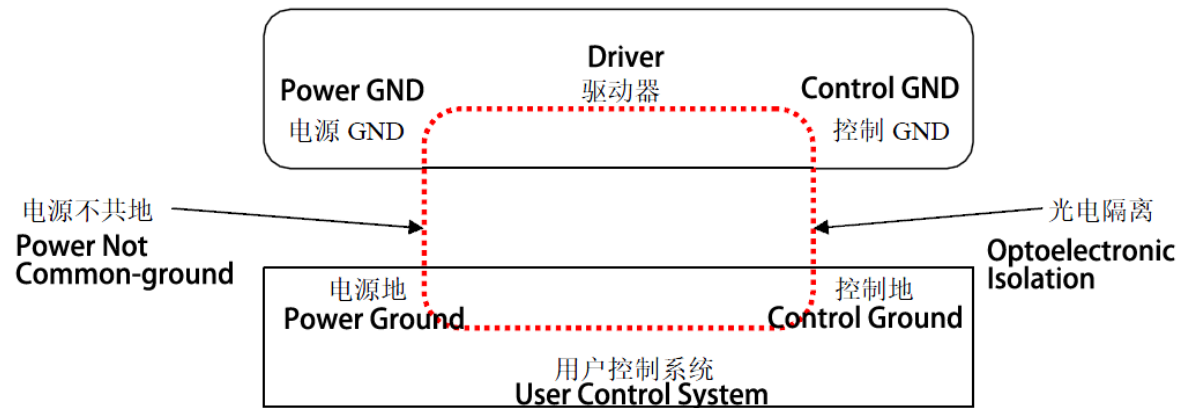


电机绝缘要求

为保证驱动器安全工作，霍尔地与电机绕组之间、霍尔地与机壳之间、绕组与机壳之间直流绝缘电阻应大于100兆欧（500VDC）

Motor isolation requirement

In order to make sure the driver works safety, the DC insulation resistance between Hall ground and motor winding / Hall ground and motor housing / motor winding and housing should more than 100Mohm (500VDC)

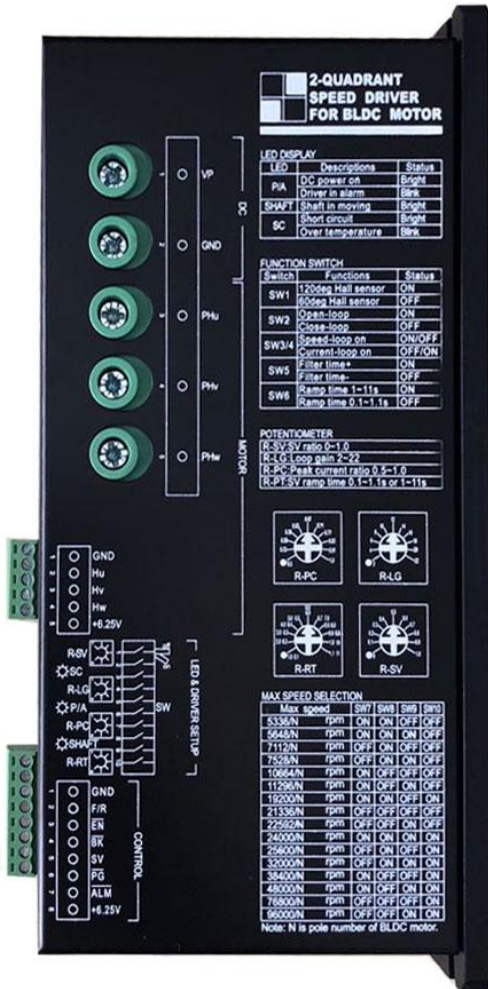




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电机电感

本驱动器不能用于空心杯等无铁芯式极低电感的电机。如果要用，应绕组外串电感器。

Motor inductance

This driver is not suitable for the motor without iron core and extra low inductance such as coreless motor. If is necessary to use, please add the external inductor.

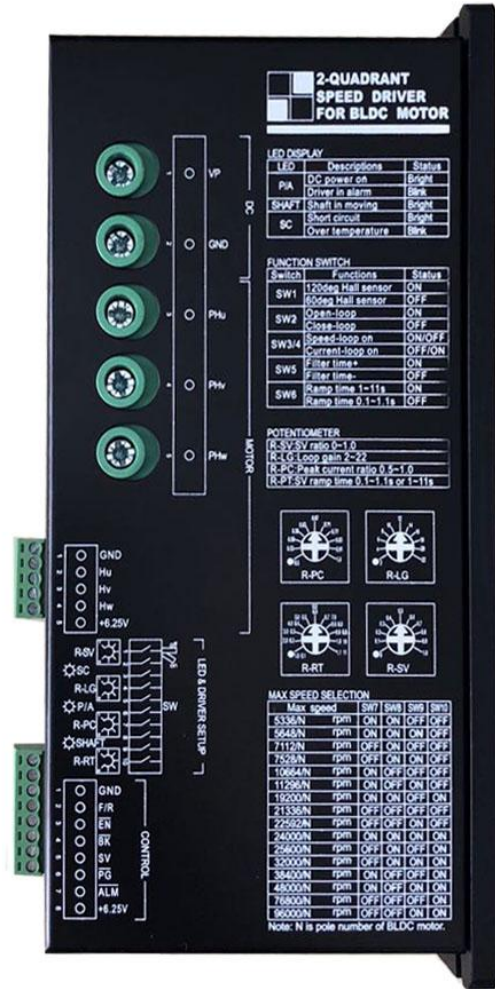




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谢谢观看!

Thank you for watching!

如有疑问，请联系我们!

If you have any questions, please don't be hesitate to contact us!

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