

# **Kelly KDHD High Power Series/PM Motor Controller User's Manual**

**KDH12600D  
KDH12800D  
KDH12100D  
KDH12120D  
KDH12150D  
KDH12180D  
KDH14600D  
KDH14800D  
KDH14100D  
KDH14120D**

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# Chapter 1 Introduction

## 1.1 Overview

The manual introduces Kelly KDHD High Power motor controllers' features, installation and maintenance. Read the manual carefully and thoroughly before using the controller. If you have any questions, please contact the support center of Kelly Controls, LLC.

Kelly's programmable motor controllers provide efficient, smooth and quiet controls for electrical vehicles like golf cart, go-cart, electric motorcycle, fork lift, hybrid vehicle, as well as electric boat and industry motor speed control. It uses high power MOSFET, fast PWM to achieve efficiency 99% in most cases. Powerful microprocessor brings in comprehensive and precise control to the controllers. It also allows users to set parameters, conduct tests, and obtain diagnostic information quickly and easily.

## Chapter 2 Main Features and Specifications

### 2.1 General functions

- (1) Extended fault detection and protection. LED flashing code indicates fault sources.
- (2) Monitoring battery voltage. It will stop driving if battery voltage is too high. It will cut back then stop driving if voltage is going too low.
- (3) Built-in current loop and over current protection.
- (4) Motor temperature input and protection. Configurable range.
- (5) Cutting back current at low temperature and high temperature to protect battery and controller. The current will ramp down quickly if controller temperature is higher than 90°C, and shutdown at 100°C. Low temperature current ramping down usually starts at 0°C.
- (6) Configurable and programmable with RS-232. Software upgradeable. Windows GUI provided.
- (7) Supply voltage 10V-30V.

*Caution! Regeneration has braking effect, but can't replace mechanical brake. Mechanical brake is required to stop your vehicle. Regen isn't a safety feature! Controller may stop regen to protect itself (not you!).*

### 2.2 Features

- Intelligence with powerful microprocessor.
- Current limit and torque control.
- Low EMC.
- LED fault code.
- Voltage monitoring on voltage source 12V and 5V.
- Hardware over current protection.
- Hardware over voltage protection.
- Support torque mode, speed mode, and balanced mode operation.
- Configurable limit for motor current.
- Battery protection: current cutback, warning and shutdown at configurable high and low battery voltage.
- Rugged aluminum housing for maximum heat dissipation and harsh environment.
- Rugged high current terminals, and rugged aviation connectors for small signal.
- Thermal protection: current cut back, warning and shutdown on high temperature.
- Configurable high pedal protection: Disable operation if power up with high throttle.
- Easy installation: 0-5K two wires potentiometer can work.
- User program provided. Easy to use. No cost to customers.

### 2.3 Specifications

- Frequency of Operation: 16.6kHz.
- Standby Battery Current: < 0.5mA.
- Controller supply voltage range, PWR, 10V to 30V(24V is preferred).

- Standard Throttle Input: 0-5 Volts(3-wire resistive pot).
- Supply Current, 200mA @ 12V, or 2.5W
- Configurable battery voltage range, B+. Max operating range: 18V to 136V for 120V controllers; 18V to 180V for 144V controllers.
- Full Power Temperature Range: 0°C to 40°C (controller case temperature).
- Operating Temperature Range: -30°C to 90°C, 100°C shutdown (controller case temperature).
- Motor Current Limit, 1 minutes: 600A - 1800A, depending on the model.
- Motor Current Limit, continuous:240A - 900A, depending on the model.

## Chapter 3 Wiring and Installation

### 3.1 Mounting the Controller

The controller can be oriented in any position as clean and dry as possible, or shield with a cover to protect it from water and contaminants.

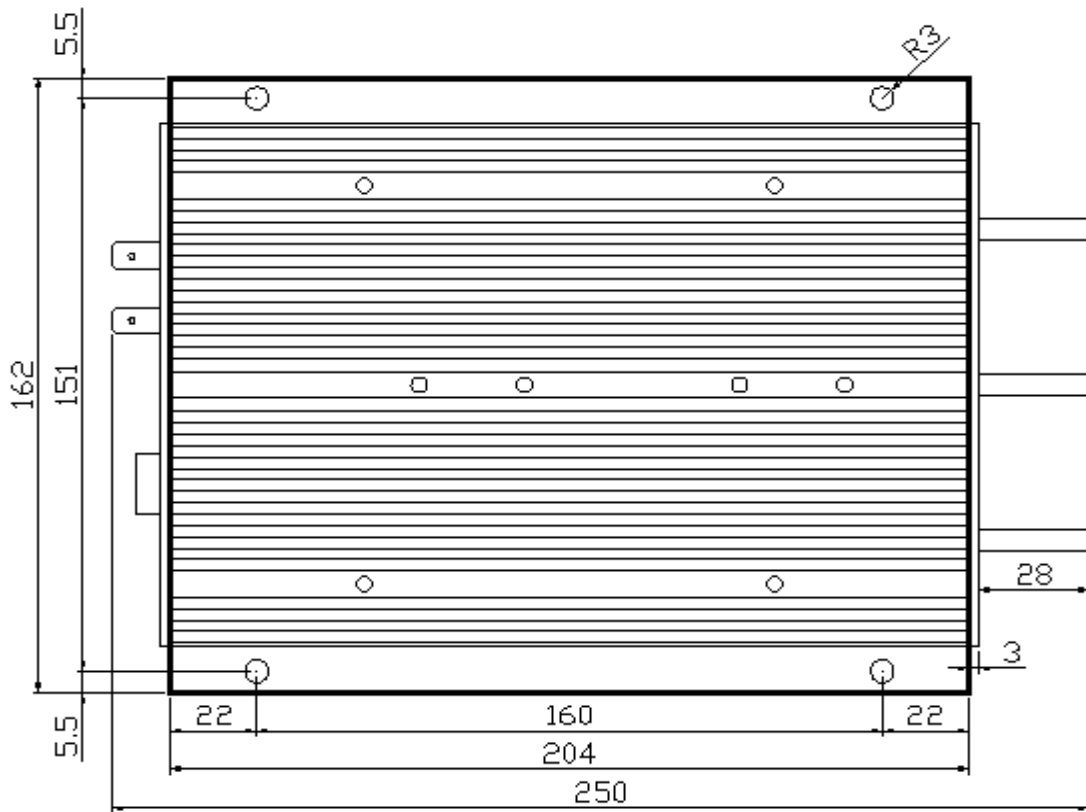
To ensure full rated output power, the controller should be fastened to a clean, flat metal surface with several screws. Applying silicon gel or other thermal conductive material to contact surface will enhance thermal performance.

Sufficient heat sink and air flow is required for high power application.

The case outline and mounting holes' dimensions are shown in Figure 1,2,3.

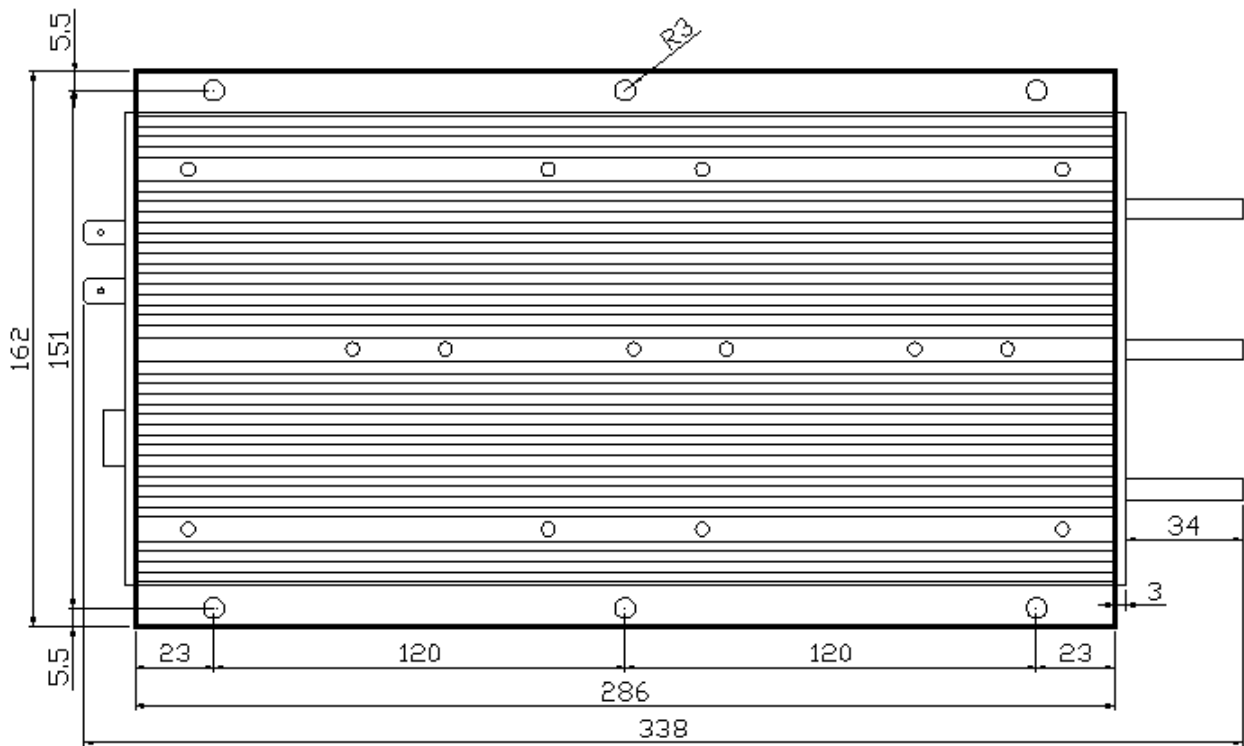
#### Caution:

- **RUNAWAYS** — Some conditions could cause the vehicle to run out of control. Disconnect the motor, or jack up the vehicle, and get the drive wheels off the ground before attempting any work on the motor control circuitry.
- **HIGH CURRENT ARCS** — Electric vehicle batteries can supply very high power, and arcs can occur if they are short circuit. Always turn off the battery circuit before working on the motor control circuit. Wear safety glasses, and use properly insulated tools to prevent short.



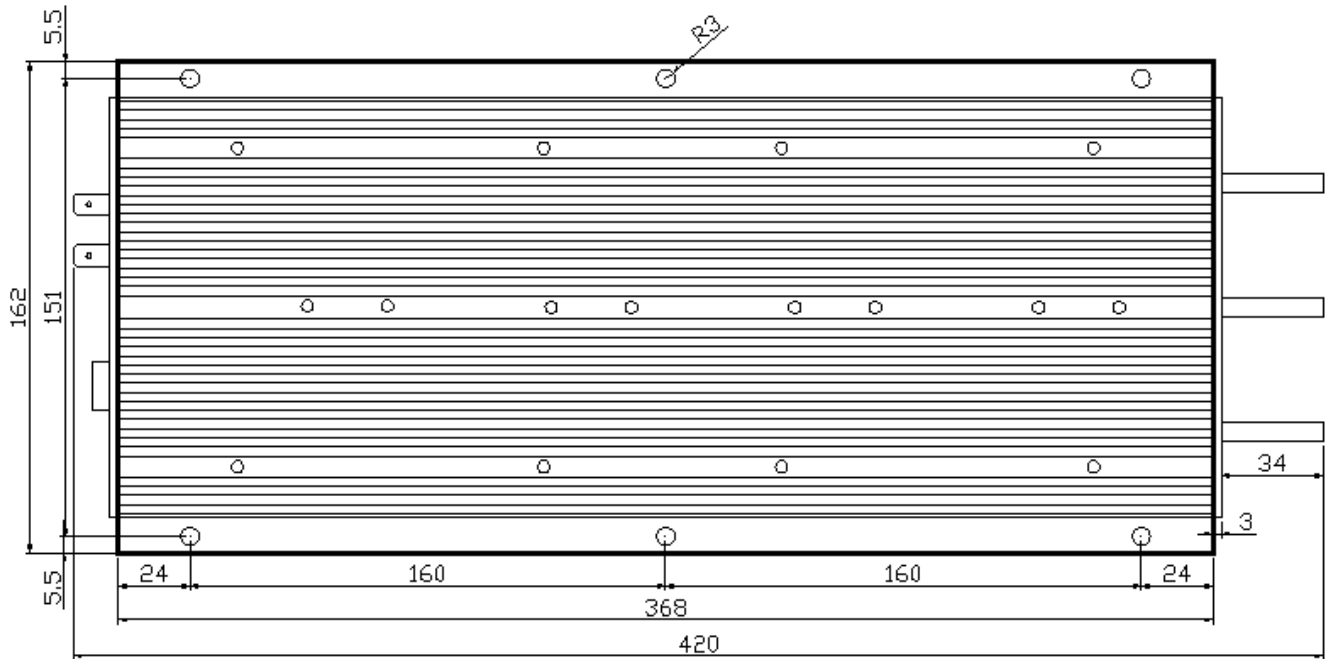
**Figure 1:** Height: 84 millimeters  
 Length: 204 millimeters

Controller models with above dimension: KDH12600D, KDH12800D, KDH14600D, KDH14800D



**Figure 2:** Height: 84 millimeters  
 Length: 286 millimeters

Controller models with above dimension: KDH12100D, KDH12120D  
 KDH14100D, KDH14120D



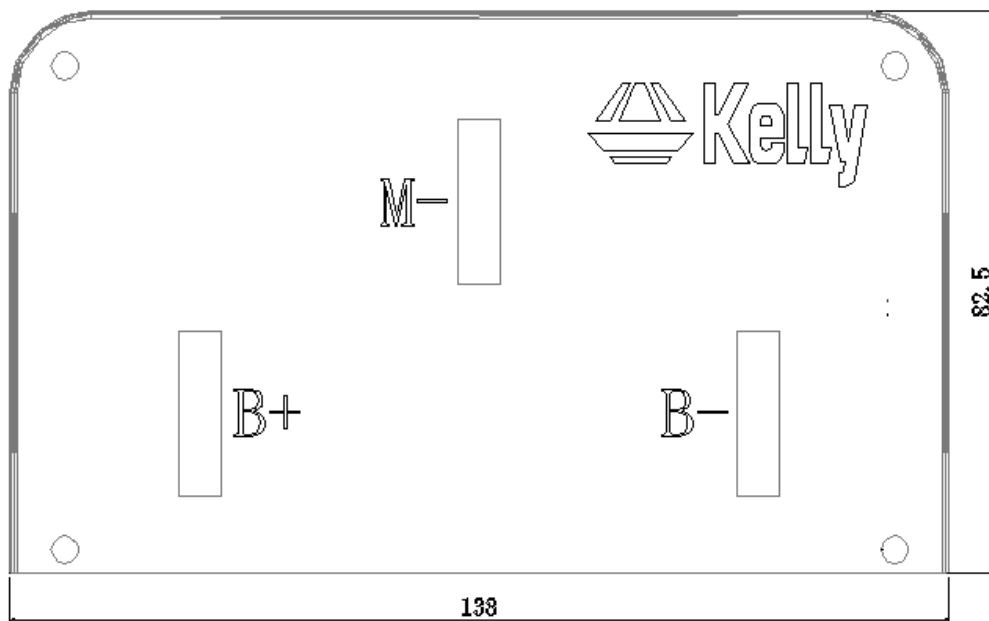
**Figure 3:** Height: 84 millimeters  
 Length: 368 millimeters

Controller models with above dimension: KDH12150D, KDH12180D

### 3.2 Connections

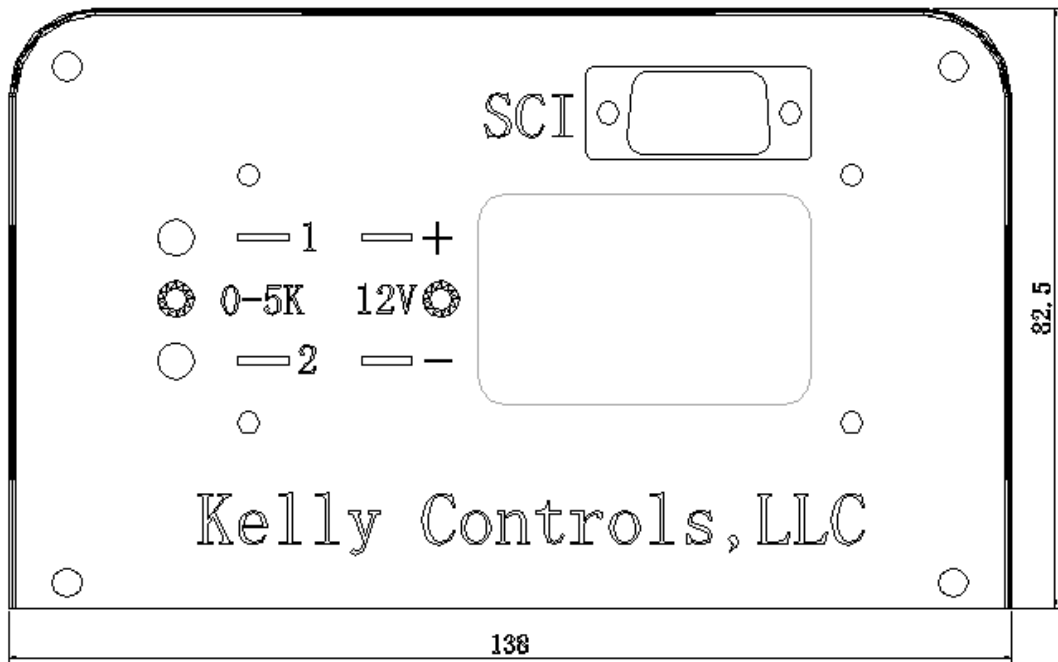
#### 3.2.1 Panel of KDHD Motor Controller:

Three thick metal bars and four sheetmetals provided for connecting to the battery, motor and control signals in the front of the controller shown as Figure 4,5.



**Figure 4:** Front panel of KDHD motor controller

**B+:** battery positive and armature positive  
**B-:** battery negative  
**M-:** armature negative



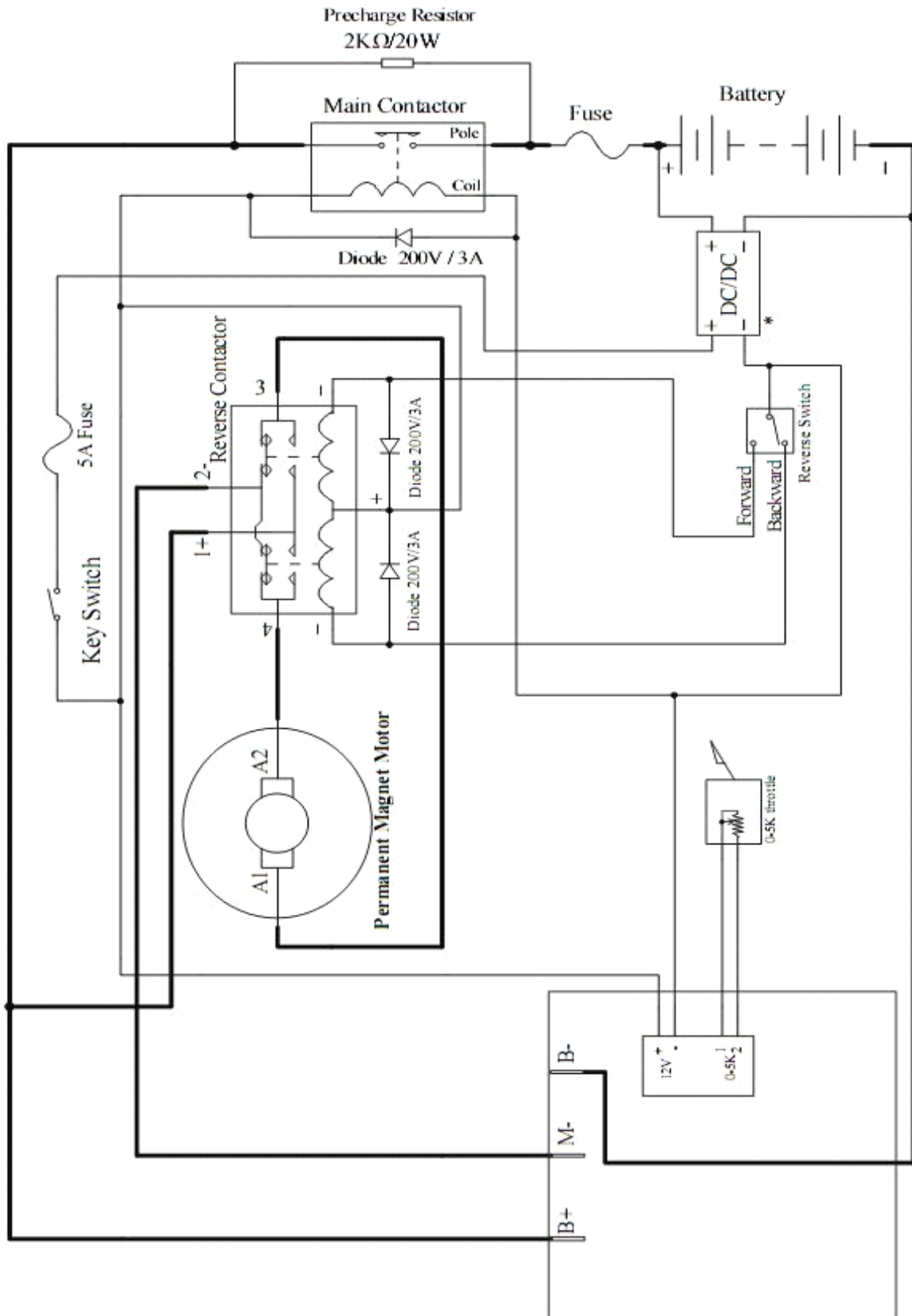
**Figure 5:** Back panel of KDHD motor controller

- 1: one end of 0-5K potentiometer
- 2: the other end of 0-5K potentiometer
- +: positive supply voltage of controller
- : negative supply voltage of controller
- SCI: SCI port

**Caution: Make sure all connections are correct before applying power. Otherwise it may damage the controller! Please securely wire B- before applying power. It's preferred to place contactor or breaker on B+. Don't connect RTN to B-. Please place precharge resistor on any breaker! It can cause damage without it!!!**

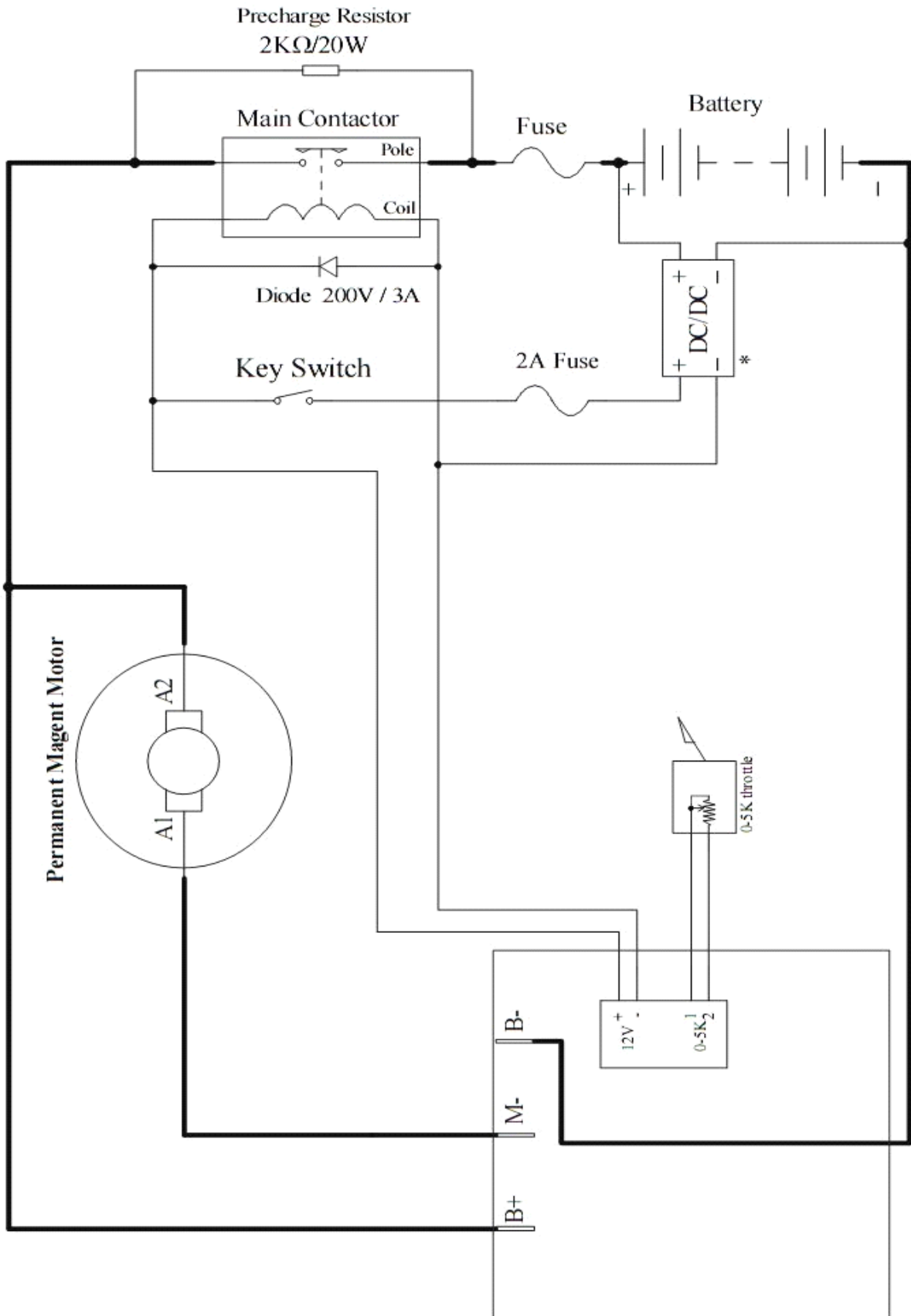






NOTE: Please securely wire B- before any other wiring. Never put contactor or break on B-. Don't connect 12V Return to B-.  
 \*10-30V can be used. 24V Isolated DC/DC Converter Is Preferred.

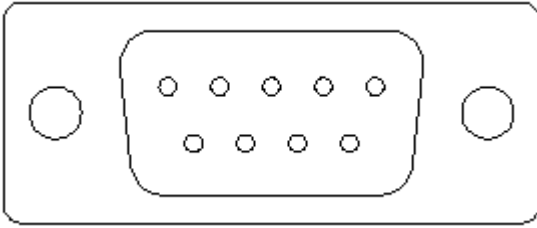
Figure 8: KDHD PM motor controller standard wiring



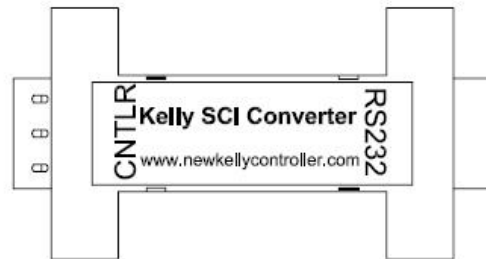
NOTE: Please security wire B- before any other wiring. Never put contactor or break on B-. Don't connect 12V Return to B-.  
 \*10-30V can be used. 24V Isolated DC/DC Converter Is Preferred.

Figure 9: KDHD PM motor controller standard wiring without Reversing Contactor

### 3.2.3 Communication Port



**Figure 10: SCI Port on Back Panel**



**Figure 11: SCI Converter**

A SCI port is provided to communicate with RS232 of host computer for calibration and configuration. Please note only a special SCI Converter provided by Kelly Controls can be used. Please use straight RS232 cable to connect with PC

## 3.3 Installation Checklist

Before operating the vehicle, complete the following checkout procedures. Use LED code as a reference. The LED codes are listed in Table 1.

### Caution:

- Put the vehicle up on blocks to get the drive wheels off the ground before beginning these tests.
- Do not allow anyone to stand directly in front of or behind the vehicle during the checkout.
- Make sure both the PWR switch and the brake are off
- Use well-insulated tools.

- Make sure the wire is connected correctly
- Turn the PWR switch on. The LED should blink, then keep on when the controller operates normally. If this does not happen, check continuity of the PWR and controller ground.
- The fault code will be detected automatically at restarting.
- With the brake switch open, select a direction and operate the throttle. The motor should spin in the selected direction. Please verify wiring and voltage if it doesn't operate. Also check fuse. The motor should run faster with increasing throttle. If not, refer to Table 1 LED code, and correct the fault according to the code.
- Take the vehicle off the blocks and drive it in a clear area. It should have smooth acceleration and good top speed.

## Chapter 4 Maintenance

There are no user-serviceable parts inside the controllers. Do not attempt to open the controller, or you will damage it. However, clearing the controller exterior periodically should be necessary.

The controller is inherently a high power device. When working with any battery powered vehicle, proper safety precautions should be taken. These include, but are not limited to: proper training, wearing eye protection, avoiding loose clothing and jewelry, and using insulated wrenches.

### 4.1 Cleaning

Although the controller requires virtually no maintenance after properly installation, the following minor maintenance is recommended in certain applications.

- Remove power by disconnecting the battery.
- Discharge the capacitors in the controller by connecting a load (such as a contactor coil or a horn) across the controller's B+ and B- terminals.
- Remove any dirt or corrosion from the bus bar area. The controller should be wiped down with a moist rag. Be sure it is dry before reconnecting the battery.
- Make sure the connections to the bus bars are tight. Use two wrenches for this task in order to avoid stressing the bus bars; the wrenches should be well insulated.

### 4.2 Configuration

You can configure the controller with a host computer through RS232.

- Use a standard RS232 cable and SCI connect to a host computer.
- Provide 10V to 30V supply to "+" "-" of controller's back panel.
- Do not connect B+, throttle and so on. The controller may display fault code, but it doesn't affect programming or configuration.

Download and setup the configuration software:

<http://www.kellycontroller.com/support.php>

## Table 1: LED CODES

### Green LED Code

LED Code	Explanation	Solution
Green Off	No power or not operating	<ol style="list-style-type: none"> <li>1. Check if all wires are correct.</li> <li>2. Check fuse and power supply.</li> </ol>
Green On	Normal operation	That's great! You got solution!
Green and Red LED Keep On		<ol style="list-style-type: none"> <li>1. Software is upgrading.</li> <li>2. Supply voltage too low or battery too high</li> <li>3. The controller is damaged. Please contact Kelly for warrantee.</li> </ol>

### Red LED Code

LED Code	Explanation	Solution
1,2    □    □□	Over voltage error	<ol style="list-style-type: none"> <li>1. Battery voltage is higher than max operating voltage of the controller. Please check the battery voltage and configuration.</li> <li>2. Please note there could be 2% error with Overvoltage setting.</li> </ol>
1,3    □    □□□	Low voltage error	<ol style="list-style-type: none"> <li>1. The controller will attempt to clear the fault code automatically after 5 second if battery voltage returns to normal.</li> <li>2. Check the battery voltage.</li> <li>3. Charge battery if necessary.</li> </ol>
1,4    □    □□□□	Over temperature warning	<ol style="list-style-type: none"> <li>1. The controller temperature is over 90°C. The controller will cut back current in the case. Stop or reduce output to ensure the temperature fall.</li> <li>2. Improve heat sink or airflow</li> </ol>
2,2    □□    □□	Internal voltage fault	<ol style="list-style-type: none"> <li>1. Check if the B+ and PWR voltage are correct, refer to B- or RTN. Could be PWR voltage low.</li> <li>2. Please check load on 5V supply. Could be high load on 5V. Incorrect pot wiring can load it heavily.</li> <li>3. The controller is damaged. Please contact Kelly for warrantee.</li> </ol>
2,3    □□    □□□	Over temperature	<ol style="list-style-type: none"> <li>1. The controller temperature is over 100°C. Controller stops driving in order to protect itself.</li> <li>2. Stop driving and wait for temperature fall. The controller will restart if temperature drops below 80°C.</li> </ol>
2,4    □□    □□□□	Throttle error at	<ol style="list-style-type: none"> <li>1. The throttle signal is higher than configured de</li> </ol>

		power up	ad zone at power-on 2. The fault will disappear if restarts or releases throttle.
3,1	ααα α	Frequent reset	It can be caused by over current, bad motor, bad ground wiring or so.

The Red LED flashes once at power on, then keeps off for normal operation. "1, 2" means it flashed once, then flashes twice after 1 second. The time between two flashes is 0.5 second. The pause time between one error code and another error code is 2 second.

## Contact Us:

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