Kelly Full Bridge Permanent Magnet Dc Motor Controller User's Manual

KPM48401KD
KPM48501KD
KPM72401KD
KPM72501KD

Rev.1.4
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Contents

Chapter1   Introduction

1.1 Overview

This manual introduces the Kelly KPM-KD motor controllers' features, their installation and their maintenance. Read the manual carefully and thoroughly before using the controller. If you have any questions, please contact the support center of Kelly Controls.

Kelly's programmable motor controllers provide efficient, smooth and quiet controls for electric vehicles like golf carts, go-carts, electric motorcycles, scooters, forklifts and hybrid vehicles, as well as electric boats and industrial motor speed control. It uses high power MOSFET's and, PWM to achieve efficiencies of up to 97% in most cases. A powerful microprocessor brings in comprehensive and precise control to the controllers. It also allows users to adjust parameters, conduct tests, and obtain diagnostic information quickly and easily.

Kelly's KPM-KD motor controller is full bridge or 4 quadrant controller. It provides fast and reliable electronic direction control. There is no arc, spark, or life limit on motor direction changes.

Kelly KPM-KD controller can do programming on PC software or APP in Android Tablet.

Both PC software and Android APP can provide one screen to monitor the controller parameters.KPM-KD can support Bluetooth connection function by wireless also.Customers may buy a Bluetooth converter from our website.Customers can do programming and monitor on Android Phone by using this Bluetooth converter.

KPM-KD has a friendly I/O terminals for customers to hook up the batteries and motor easily.
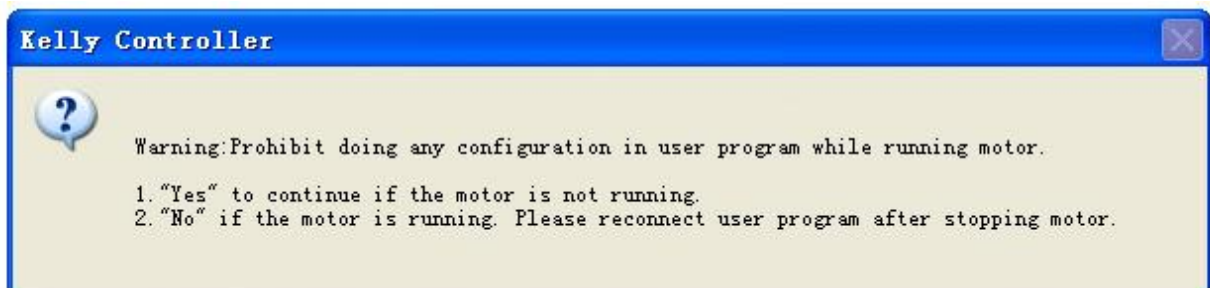
Chapter2 Main Features and Specifications

2.1 General functions

(1) Extended fault detection and protection.Customers can read the error code in PC software or in Android App also.

(2) Monitoring battery voltage. Stop driving if battery voltage is too high or too low.

(3) Built-in current loop and over current protection.

(4) Configurable motor temperature protection range.

(5) Current cutback at low temperature and high temperature to protect battery and controller. The current begins to ramp down at 90℃case temperature, shutting down at 100℃.

(6) Provision of a +5 volt output to supply various kinds of sensors, including Hall effect type.

(7) 4 switch inputs which are activated by connection to Ground. Default to throttle switch, two speed shift control switch,forward and reversing switch.1 switch input is activated by connection to 12V which is pin11 of controller.

(8) 3 analog 0-5V inputs that default to throttle input, brake input and motor temperature input.

(9) Meter function:Current meter can display both drive and regen current. Save shunt.

(10) Configurable boost switch. Enables the maximum output power achievable if the switch is turned on.Boost used the same pin as Brake_AN.Input 5V to activate this function.

(11) Configurable economy switch. Limits the maximum current to half if the switch is turned on.Economy used the same pin as Brake_AN.Input 5V to activate this function.You can not enable Boost and Economy function in the user program at the same time.

(12) Configurable speed in reversing direction.

(13) Enhanced regen brake function. A novel ABS technique provides powerful and smooth regen.The regen can happen at any speeds until zero speed.

(14) Joystick throttle. A bi-symmetrical 0-5V signal for both forwarding and reversing.Can be enabled or disabled in the user program.

(15) Configurable motor over-temperature detection and protection with the recommended thermistor KTY84-130/150 or KTY83-122.

(16) Using battery-powered.

(17) KPM-KD controller includes fuse and shunt on the top of the case.

(18) Bluetooth function.Required a small Bluetooth converter which can be purchased from our website in addition.Customers can use this function to do programming on Android Phone.

(19) Bluetooth converter is only useful for KPM-KD controller.PM controller can not support it.

2.2 Features

•Intelligence with powerful microprocessor.
•Synchronous rectification, ultra low drop, and fast PWM to achieve very high efficiency.
•Electronic reversing, no reversing contactor needed, fast direction change, high reliability and
  efficiency, low noise, no arc, no wearing, no life limit, easy maintenance.
•Voltage monitoring on voltage source 12V and 5V.
•Current limit and torque control. **Configurable torque mode and speed mode.**
•Low EMC.
•Battery protection: current cutback, warning and shutdown at configurable high and low
  battery voltage.
•Thermal protection: current cut back, warning and shutdown at high temperature.
•Configurable high pedal protection: the controller will not work if high throttle is detected at
  power on.
•Support three modes of regenerative braking: brake switch regen, release throttle regen,
  0-5V analog signal variable regen.
•Standard PC/Laptop computer or Android Tablet is used to do programming. No special tools
needed.
•User program provided. Customers can download user program from website for free. No cost
to customers.
  www.kellycontroller.com/support.php

2.3 Specifications

•Frequency of Operation: 16.6KHz.
•Standby Battery Current: < 0.5mA.
•5V or 12V Sensor Supply Current: 40mA.
•Controller supply voltage range, PWR, 18V to B+
•Supply Current,PWR,30mA Typical.
•Configurable battery voltage range,B+.Max operating voltage:18V to 1.25*Nominal Voltage.
•Standard Throttle Input: 0-5 Volts(3-wire resistive pot), 1-4 Volts(hall active throttle).
•Analog Brake and Throttle Input: 0-5 Volts.
•Full Power Temperature Range: 0℃ to 70℃ (MOSFET temperature).
•Operating Temperature Range: -40℃ to 100℃(MOSFET temperature).
•Motor Current Limit, 30s: 400A-500A.depending on the model.
•Motor Current Limit, continuous:160A-200A, depending on the model.
•Max Battery Current :Configurable.

Kelly Full Bridge Permanent Magnet DC Motor Controller KPM-KD					
Model	30s Current	Continuous Current	Rated Voltage	Voltage Range	Regen
KPM48401KD	400A	160A	48V	24V-48V	Yes
KPM48501KD	500A	200A	48V	24V-48V	Yes
KPM72401KD	400A	160A	72V	24V-72V	Yes
KPM72501KD	500A	200A	72V	24V-72V	Yes
Matching connectors of controller will be shipped for free.					

Chapter 3 Wiring and Installation

3.1 Mounting the Controller

The controller can be oriented in any position which should be as clean and dry as possible, and if necessary, shielded 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 four screws. Applying silicon grease or some other thermal conductive material to contact surface will enhance thermal performance.

Proper heat sinking and airflow are vital to achieve the full power capability of the controller.

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

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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 circuit.
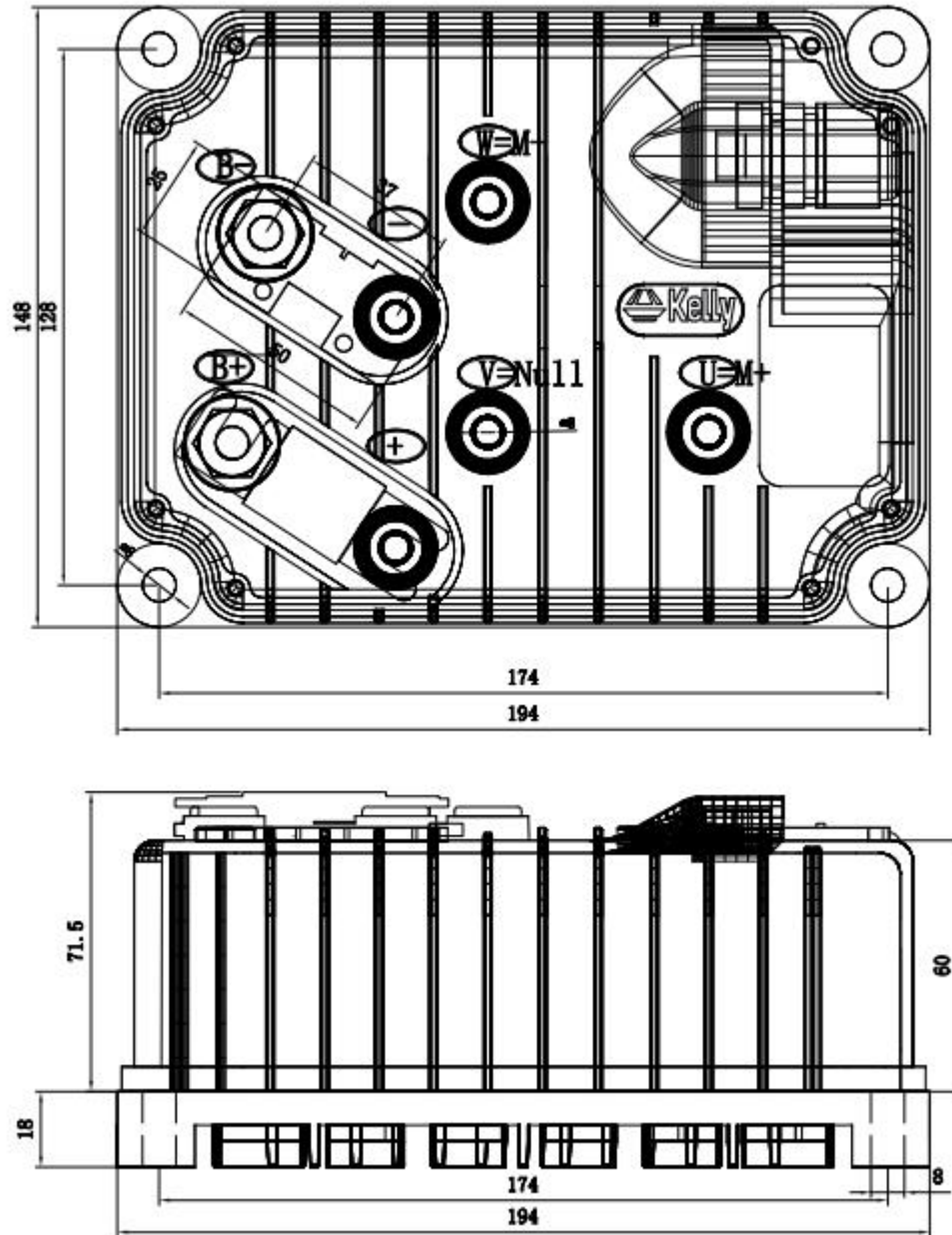
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Figure 1: mounting holes' dimensions (dimensions in millimeters)

3.2 Connections

B+: Battery positive (M8)
B-: Battery negative (M8)
U=M+: armature positive (M8)
V=Null
W=M-: armature negative (M8)

Pin Definition in waterproof connector DJ7091Y-2.3-11/21:

Orange REV-SW (14)	Black GND (6)	White FWD (12)
Red 12V (11)	Black GND (19)	D-Blue ECO (22)
	Pink PWR (7)	

DJ7091Y-2.3-11

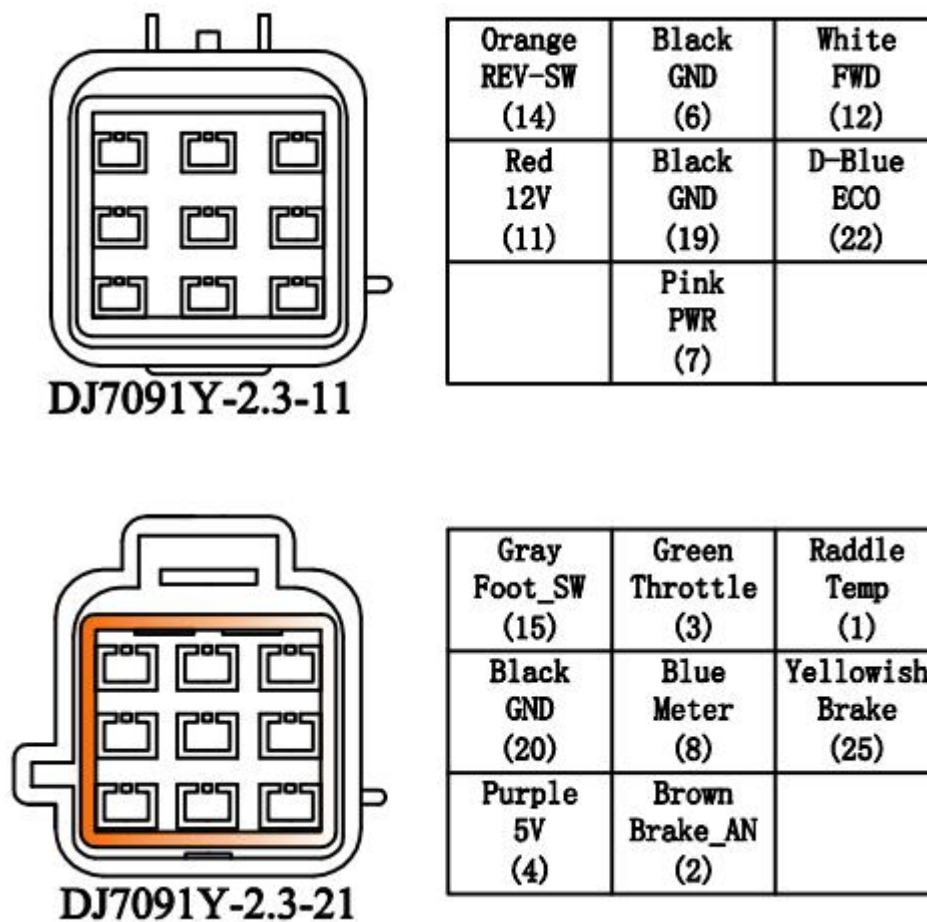| Gray Foot_SW (15)	Green Throttle (3)	Raddle Temp (1)
Black GND (20)	Blue Meter (8)	Yellowish Brake (25)
Purple 5V (4)	Brown Brake_AN (2)	

DJ7091Y-2.3-21

Figure 2: Pin definition in waterproof connectors

(14) REV_SW: Reverse switch input.   Orange

(6) GND: Signal return or power supply return.   Black

(12) FWD: Forward switch   White

(11) 12V:12V Source Red

(19) GND: Signal return.   Black

(22) ECO:Two Shift Speed Control.Dark Blue

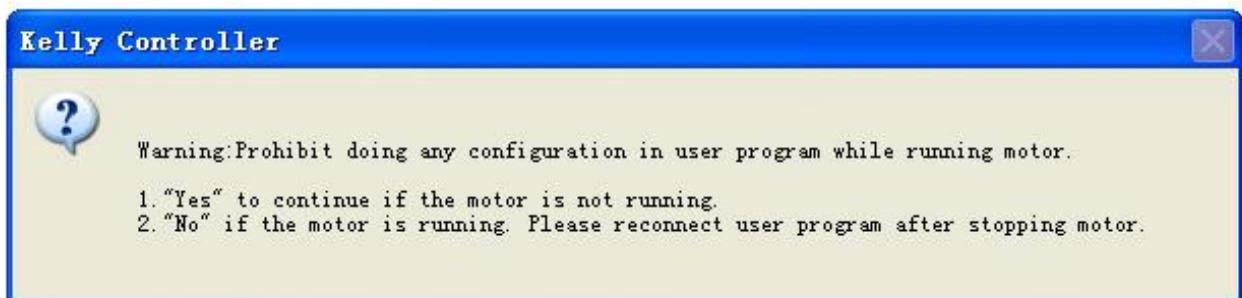(7) PWR: Controller power supply (input).   Pink

(15) Micro_SW: Throttle switch input.   Gray

(3) Throttle: Throttle analog input, 0-5V.   Green

(1) Temp: Motor temperature sensor or low level brake switch.   Raddle.

(20) GND: Signal return.   Black

(8) Meter: Current meter,<200mA   Dark Gray

(25)12V brake switch. Yellowish

(4) 5V: 5V supply output, <40mA.   Purple

(2) Brake_AN：Brake variable regen or Boost function.   Brown

Notes:

1. **All GND pins are internally connected.**
2. **Twist peripheral wires with PWR is the preferred for EMC.**
3. **Kelly Ammeter positive connect to 5V power supply of controller, negative to pin8.**
4. **12V only can be used for Switch or LED wiring, such as 12V brake switch(pin 25).**
5. **The current meter is installed between pin4 and pin8.Pin4 is going to positive of current meter,Pin8 is going to negative of current meter.**

Caution:
- **Do not apply power until you are certain the controller wiring is correct and has been double checked. Wiring faults will damage the controller.**
- **Ensure that the B- wiring is securely and properly connected before applying power.**
- **The preferred connection of the system contactor or circuit breaker is in series with the B+ line.**
- **All contactors or circuit breakers in the B+ line must have precharge resistors across their contacts. Lack of even one of these precharge resistors may severely damage the controller at switch-on.**

Kelly Controller

Warning:Prohibit doing any configuration in user program while running motor.

1. "Yes" to continue if the motor is not running.
2. "No" if the motor is running. Please reconnect user program after stopping motor.

3.2.2 Standard Wiring of KPM-KD Motor Controller
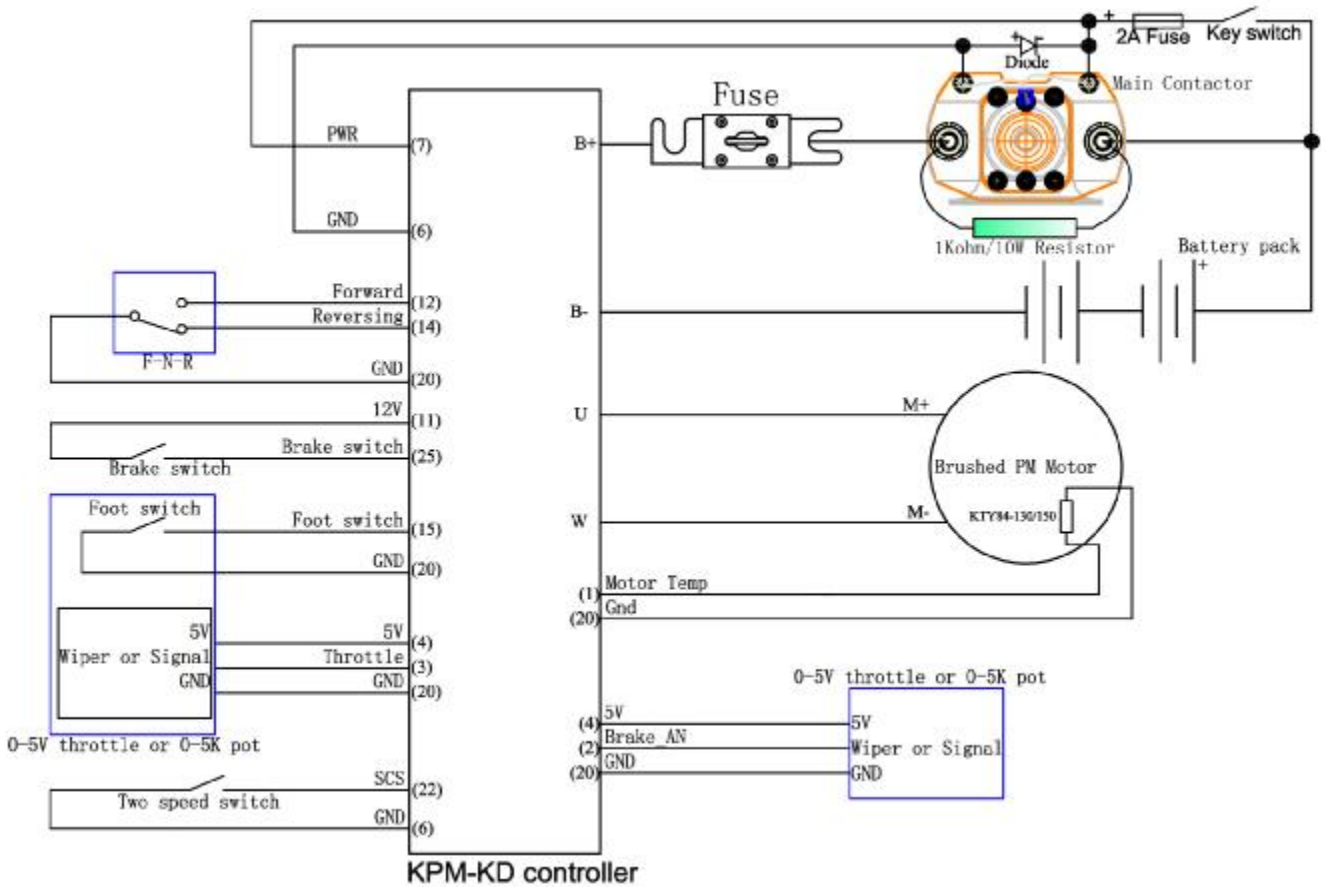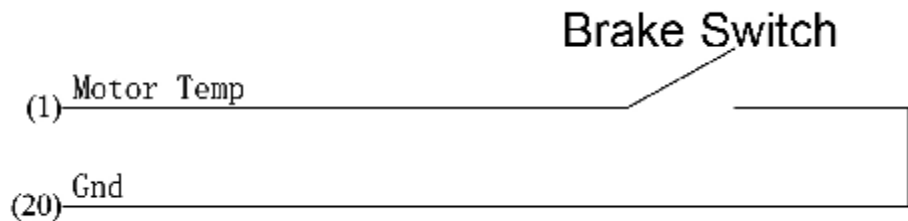

Figure 3: KPM motor controller standard wiring

3.2.2.1 The wiring diagram for low level brake switch function
 The Pin1=Temp can be used as low level brake switch also.

3.2.3 Communication Port
   A 4pin connector to RS232 converter is provided to communicate with host computer for calibration and configuration.
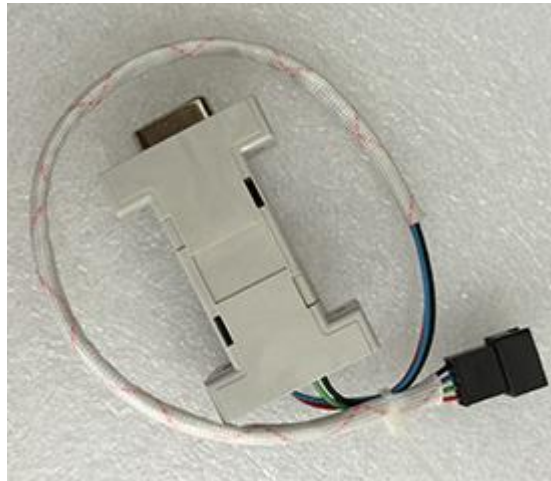
Figure 4: SM-4A to DB9(RS232) converter
(Customer may add an USB to RS232 cable in addition)

3.3 Installation Check List

Before operating the vehicle, complete the following checkout procedure. Use Beep Error code as a reference as 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 the PWR switch and the brake is off**
- **Use well-insulated tools.**

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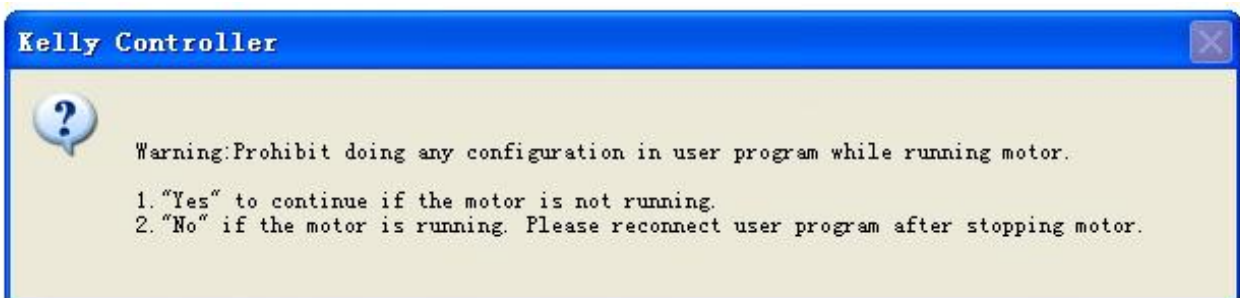
1. Make sure the wire is connected correctly
2. Turn the PWR switch on.
3. The fault code will be detected automatically at restart.
4. With the brake switch open, select a direction and operate the throttle. The motor should spin in the selected direction. Verify wiring or voltage and the fuse if it does not. The motor should run faster with increasing throttle. If not, refer to the Table 1 code, and correct the fault as determined by the fault code.
5. Take the vehicle off the blocks and drive it in a clear area. It should have smooth acceleration and good power.

Chapter 4   Maintenance
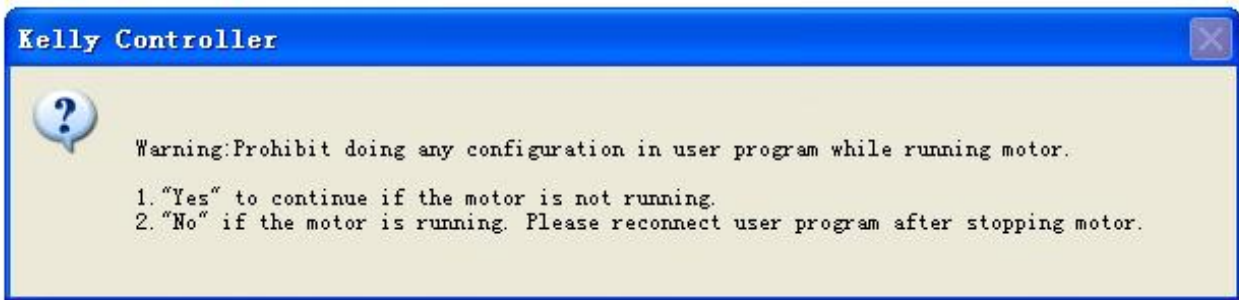
There are no user-serviceable parts inside the controllers. Do not attempt to open the controller as this will void your warranty. However, periodic, exterior cleaning of the controller should be carried out.

The controller is a high powered device. When working with any battery powered vehicle, proper safety precautions should be taken that include, but are not limited to, proper training, wearing eye protection, avoidance of loose clothing, hair and jewelry. Always use insulated tools.

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, starting with battery positive.
- Discharge the capacitors in the controller by connecting a load (such as a contactor coil, resistor 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. Make sure that the controller is dry before reconnecting the battery.
- Make sure the connections to the bus bars, if fitted, are tight. To avoid physically stressing the bus bars use two, well-insulated wrenches.

4.2 Configuration

1,You can configure the controller with a host computer through either an RS232 or USB port.

2,Disconnect motor wiring from controller for configuring existing parameters in the PC user program or Android APP. If this operation is too much extra job for you, please make sure the motor must be stopped before programming.

3,The controller may display fault code, but it doesn't affect programming or configuration.
Use a straight through RS232 cable or USB converter provided by Kelly to connect to a host computer. Provide >+18V to PWR（pin7）. Wire power supply return(supply negative) to any RTN pin or B-.

4,KPM-KD controller requires a SM-4A to DB9(RS232) converter besides USB to RS232 cable to support the communication.And customers may need a Z-TEK USB cable for Tablet with Android OS.It can support Bluetooth connection in Android Phone if customers use a Bluetooth converter.

5,The controller may display fault code in some conditions, but it doesn't affect programming or configuration of KPM-KD controller.

Download the free configuration software from：

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

Caution:
• **Make certain that the motor is disconnected before trying to run the Configuration Software!**
• **Configuration software will be regularly updated and published on the website. Please Update your Configuration Software regularly. You must uninstall the older version before updating.**
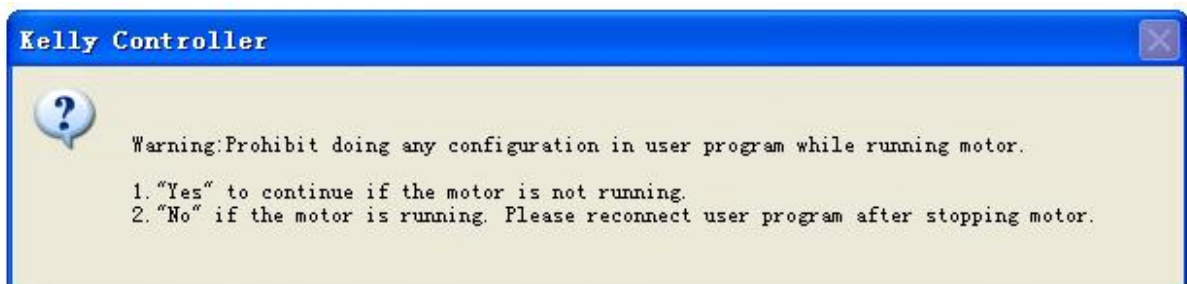
Table 1:   Beep Error CODES

Beep Error Code

Error Code	Explanation	Solution
Beep keeps sounding		1. Software still upgrading. 2. Supply voltage too low or battery too high 3. The controller is damaged. Contact Kelly about a warranty repair.

Beep Error Code

1,2	¤	¤¤	Over voltage error	1. Battery voltage is too high for the controller. Check battery volts and configuration. 2. Regeneration over-voltage. Controller will have cut back or stopped regen. 3. This only accurate to $\pm$ 2% upon Overvoltage setting.
1,3	¤	¤¤¤	Low voltage error	1. The controller will clear after 5 seconds if battery volts returns to normal. 2. Check battery volts & recharge if required.
1,4	¤	¤¤¤¤	Over temperature warning	1. Controller case temperature is above 90℃. Current will be limited. Reduce controller loading or switch Off until controller cools down. 2. Clean or improve heatsink or fan.
2,2	¤¤	¤¤	Internal volts fault	6. Measure that B+ & PWR are correct when measured to B- or RTN. 7. There may be excessive load on the +5V supply caused by too low a value of Regen or throttle potentiometers or incorrect wiring. 8. Controller is damaged. Contact Kelly about a warranty repair.
2,3	¤¤	¤¤¤	Over temperature	The controller temperature has exceeded 100℃. The controller will be stopped but will restart when temperature falls below 80℃.
2,4	¤¤	¤¤¤¤	Throttle error at power-up	Throttle signal is higher than the preset 'dead zone' at Power On. Fault clears when throttle is released.
3,1	¤¤¤	¤	Frequent reset	May be caused by over-voltage, bad motor intermittent earthing problem, bad wiring, etc.
3,2	¤¤¤	¤¤	Internal reset	May be caused by some transient fault condition like a temporary over-current, momentarily high or low battery voltage. This can happen during normal

			operation.
3,3	¤¤¤ ¤¤¤	Hall throttle is open or short-circuit	When the throttle is repaired, a restart will clear the fault.
3,4	¤¤¤ ¤¤¤¤	Non-zero throttle on direction change	Controller won't allow a direction change unless the throttle or speed is at zero. Fault clears when throttle is released.
4,1	¤¤¤¤ ¤	Regen or Start-up over-voltage	Motor drive is disabled if an over-voltage is detected at start-up or during regen. The voltage threshold detection level is set during configuration. The max threshold is about 1.25 times of controller rated voltage. I.e. you may set threshold lower than 60V for 48V controller.
4, 3	¤¤¤¤ ¤¤¤	Motor over-temperature	Motor temperature has exceeded the configured maximum. The controller will shut down until the motor temperature cools down.
Customers may read error codes or message in PC software or Android App.			

Contact Us:

Kelly Controls

Home Page:
http://www.KellyController.com

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