Kelly KD Brushed Motor Controller User's Manual

Devices Supported:

KD36200	KD48200	KD72200
KD36201	KD48201	KD72201
KD36202	KD48202	KD72202
KD36203	KD48203	KD72203
KD36300	KD48300	KD72300
KD36301	KD48301	KD72301
KD36302	KD48302	KD72302
KD36303	KD48303	KD72303
KD36400	KD48400	KD72400
KD36401	KD48401	KD72401
KD36402	KD48402	KD72402
KD36403	KD48403	KD72403
	KD48500	KD72500
	KD48501	KD72501
	KD48502	KD72502
	KD48503	KD72503
	KD48600	KD72600
	KD48601	KD72601
	KD48602	KD72602
	KD48603	KD72603

Rev.2.5
Feb. 2008

Contents

Chapter 1 Introduction

1.1 Overview

The manual introduces Kelly motor controller features, installation and maintenance. Read the manual carefully and thoroughly before use . If you have any questions, please contact the support center of Kelly Controls.

Kelly's programmable motor controllers provide efficient, smooth and quite controls for electrical vehicles like golf cart, electric motorcycle, fork lift, 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) The controller measures battery voltage. It won't drive motor if B+ is higher than the maximum operating voltage. It also stops driving if battery voltage is too low. You can identify the error from LED code. Under voltage threshold and over voltage threshold are configurable with PC GUI.
(2) The controller will close the main contactor after power on self-test. Then it waits a configurable time (default to 0.5s) for contactor bumping.
(3) Current loop and over current protection are built in for both field and armature. The field current is constant across all operation conditions except in the case of field weakening. Armature current is commanded by throttle position sensor.
(4) The armature current is trimmed down at low temperature and high temperature to protect battery and controller. The armature current will ramp down quickly over 90C. Both armature and field will shutdown at 100C. Low temperature current ramping down usually starts at 0C.
(5) Current cut back at low battery is built in every controller to extend battery life. *Caution! Excessive voltage drop on wiring may cause problem! Proper gauge of wire is required.*
(6) The max regeneration current is about half of max output current. *Caution! Regeneration can have braking effect, but it can't replace mechanical brake. The controller may shut down regen in some cases.*
(7) Max reverse speed is configurable to half of max forward speed

2.2 Features

•Intelligence with powerful microprocessor,
• Synchronous rectification, fast PWM, and very low drop to provide high efficient.
•Thermal enhanced rugged aluminum housing.
•Current loop and over current protection for both field coil and armature.
•Current multiplication. Usually the armature current is much higher than the current draw from battery.
•LED blinking code indicates fault sources.
•Battery protection: current cut back and turn off should battery voltage low.
•Thermal protection: current cut back at high temperature and low temperature to protect battery and controller.
• Critical parameters can be configured with GUI to best fit your application.

2.3 Optional Features (Terminals available on back side)

Following features are configurable through series communication with a host PC.
•"RLY" can be configured as a Peak and Hold Main Contactor coil driver.
•"PWM" is an output to drive Reverse Alarm.
• SW1 as Brake Switch is required for regeneration.
• 0-5V AN1 as Brake analog input can be configured for continuous variable regeneration.
• 0-5V AN2 can be configured as alternative throttle input.

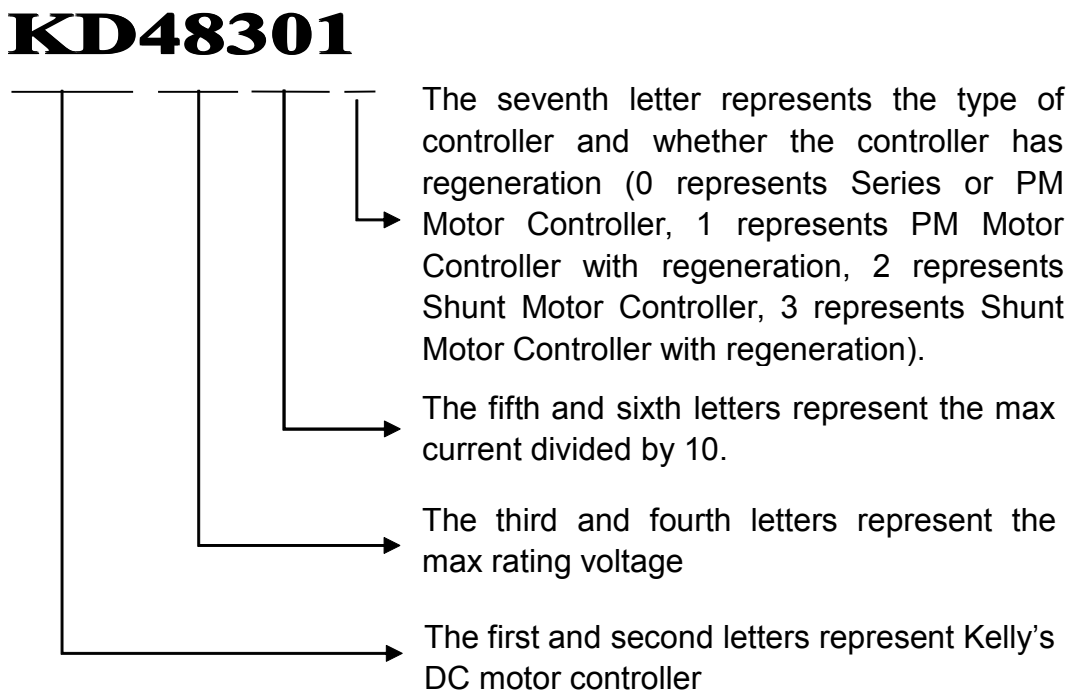
• SW2 can be configured as throttle switch
• SW3 can be used as 5V supply of sensors.

2.4 Specifications

• Frequency of Operation: 16.6 KHz.
• Standby Current: less than 3 m A.
• Controller power supply current, PWR, 150mA.
• Controller power supply voltage, PWR, 18V to 90V.
• Minimum operating voltage, B+, 18V.
• Max regeneration voltage, B+, 1.25* Nominal.
• Throttle Input: 0-5 K, 5-0 K ohms, 0-5 Volts.
• Full Power Operating Temperature Range: 0C to 50 C (controller case temperature).
• Operating Temperature Range: -30C to 90 C, 100C shutdown (controller case temperature).
• Peak and Hold Main Contactor Driver: 3A peak, 1A hold.
• Alarm Output: 200mA.
• Armature Current Limit, 1 minutes: 200A / 300A / 400A / 500A / 600A.
• Armature Current Limit, continuous: 80A / 120A / 160A / 200A / 240A.

2.5 Model

The naming regulation of the Kelly motor controller model:



Chapter 3 Wiring and Installation

3.1 Mounting the Controller

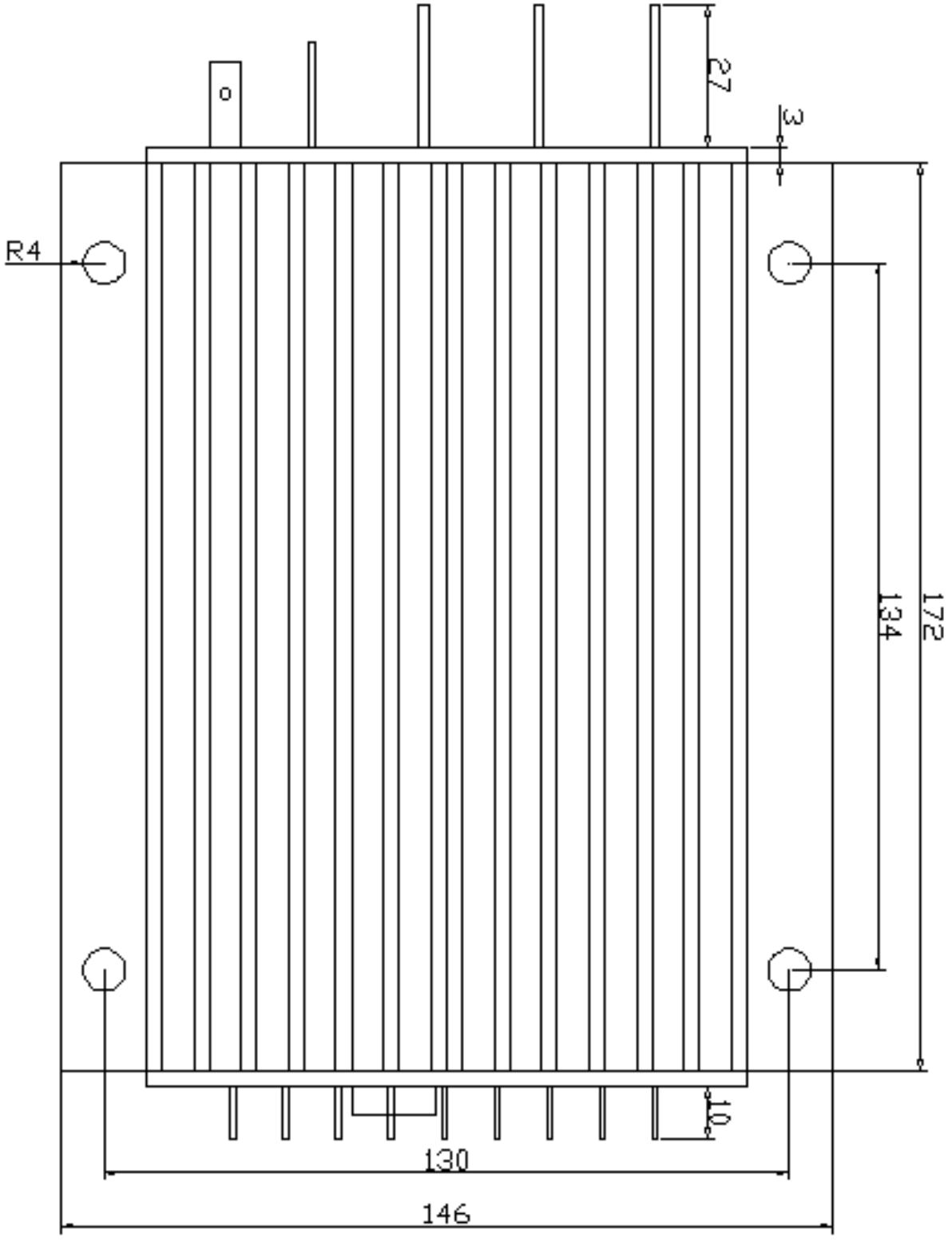
The controller can be oriented in any position as clean and dry as possible, or shield with a cover to protect it from water and contaminants.

To ensure full rated output power, the controller should be fastened to a clean, flat metal surface with four screws. The case outline and mounting hole dimensions are shown in Figure 1.

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.



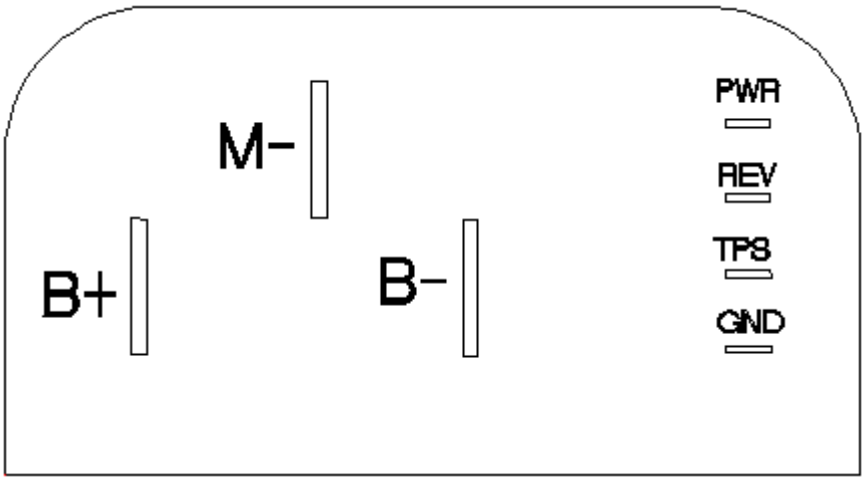
Tall: 62 millimeters

Figure 1: mounting hole dimensions (dimensions in millimeters)

3.2 Connections

3.2.1 Front Panel of Series Wound or PM Motor Controller:

Seven metal bars are provided for connections to the battery, motor and control signals in the front of the controller shown as Figure 2.



M-: output to motor
B+: battery positive
B-: battery negative
PWR: controller power supply, usually to key switch.
REV: reverse switch input
TPS: resistive throttle analog input
GND: TPS return and other signal ground

Figure 2: Front panel of Series Wound or PM Motor Controller

Caution: Make sure all connections are correct before apply 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 GND to B-.Please place precharge resistor on any breaker! It can cause damage without it!!!

1. Power switch: The vehicle should have a master switch to turn the controller on and off. PWR provides power for the controller. It is preferred that PWR provides power to switches, coils and other accessories. It must be capable of carrying the current.

2. Reverse switch input: Make sure the throttle is released before change direction, or controller will stop output. It is considered as reverse when the input reaches 0.7*PWR voltage

3. **Resistive throttle analog input:** 0-5K or 5-0K resistive throttle analog input. Default to 0-5K. Default effective zone is 20%-80%. Below 1K corresponds to zero speed and above 4K corresponds to full speed. If open, controller will take AN2 0-5V input as alternative.

3.2.2 Standard Wiring of Series Wound and PM Motor Controller

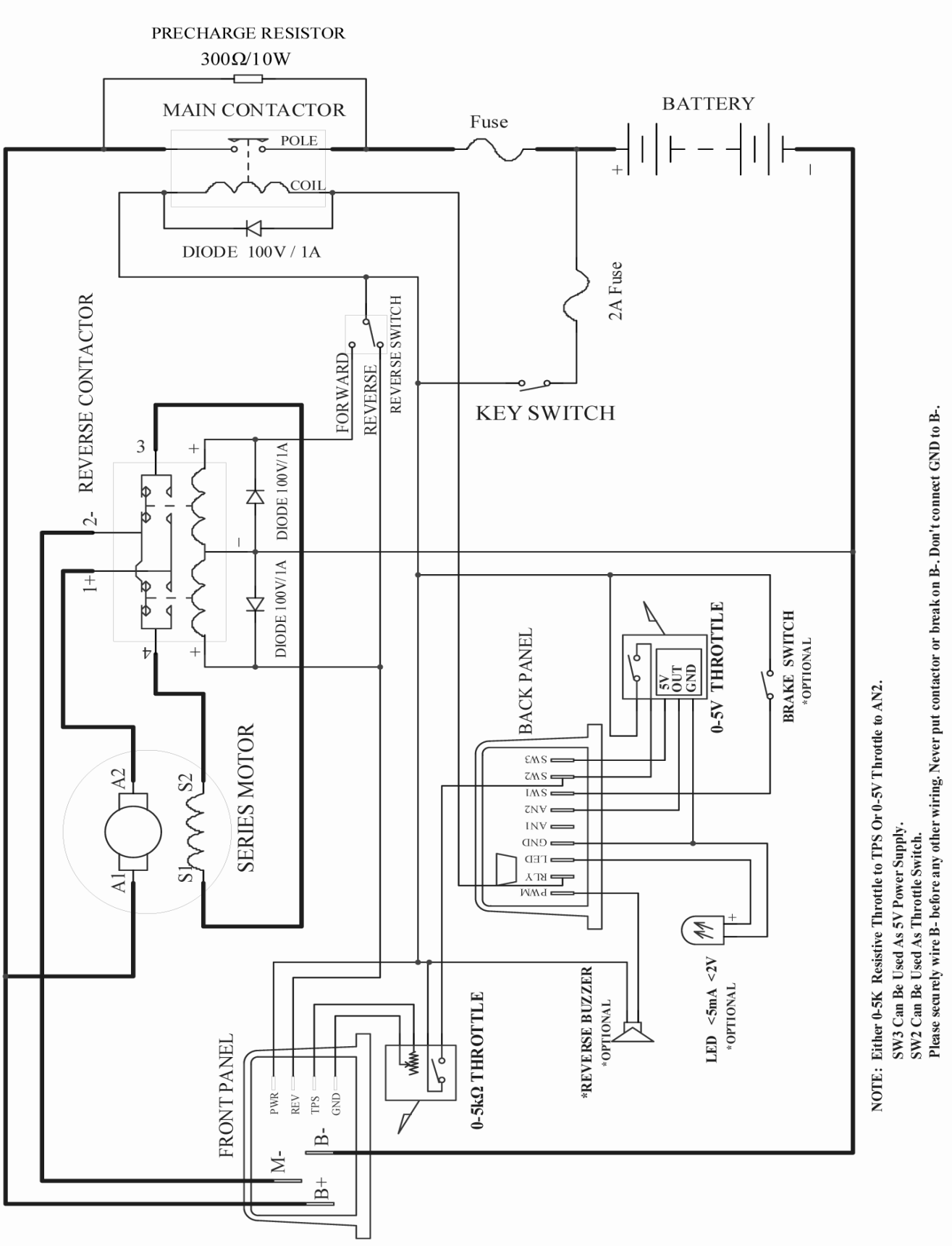


Figure 3: Series wound motor controller standard wiring

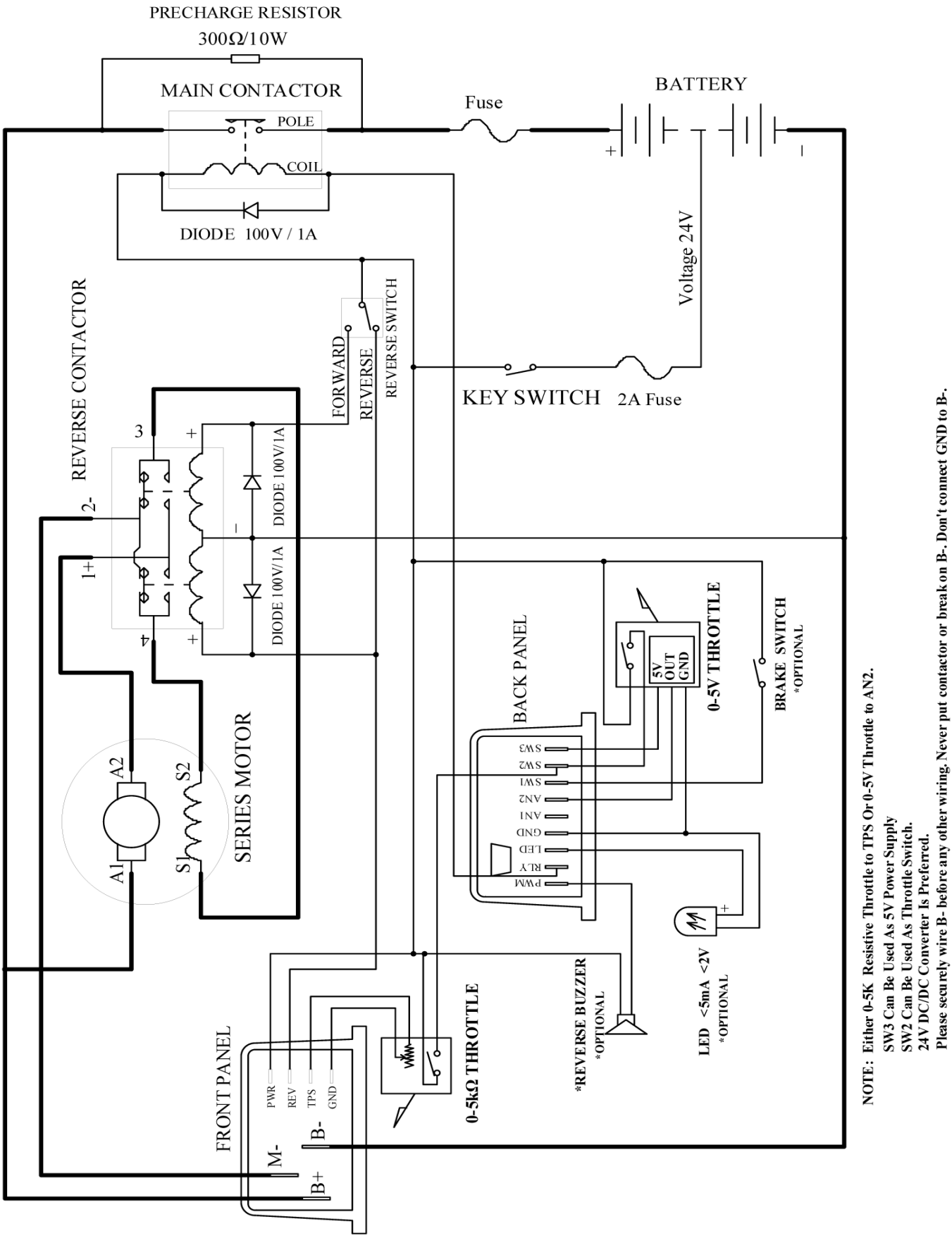


Figure 4: 72Vseries wound motor controller alternative wiring

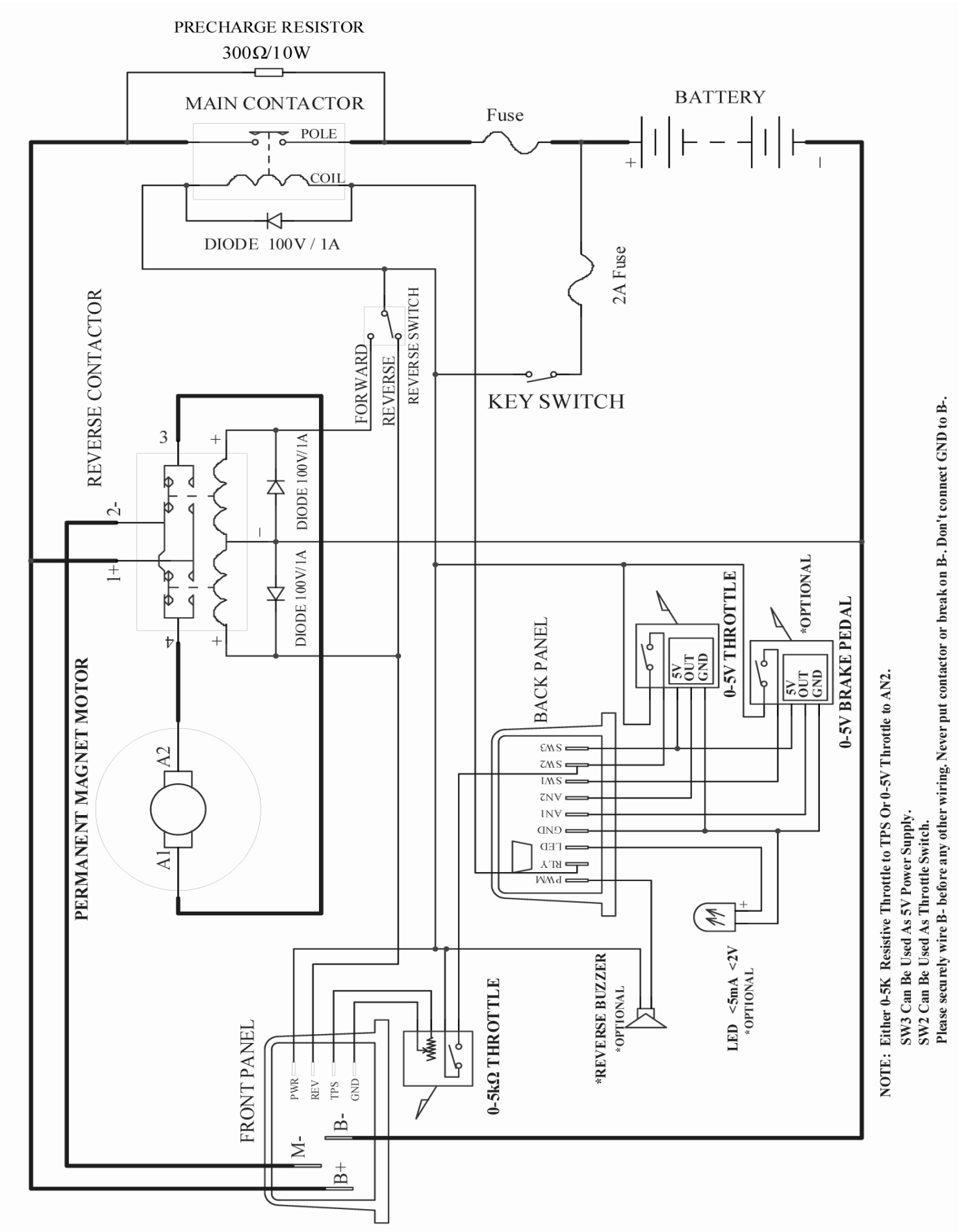


Figure 5: PM motor controller standard wiring

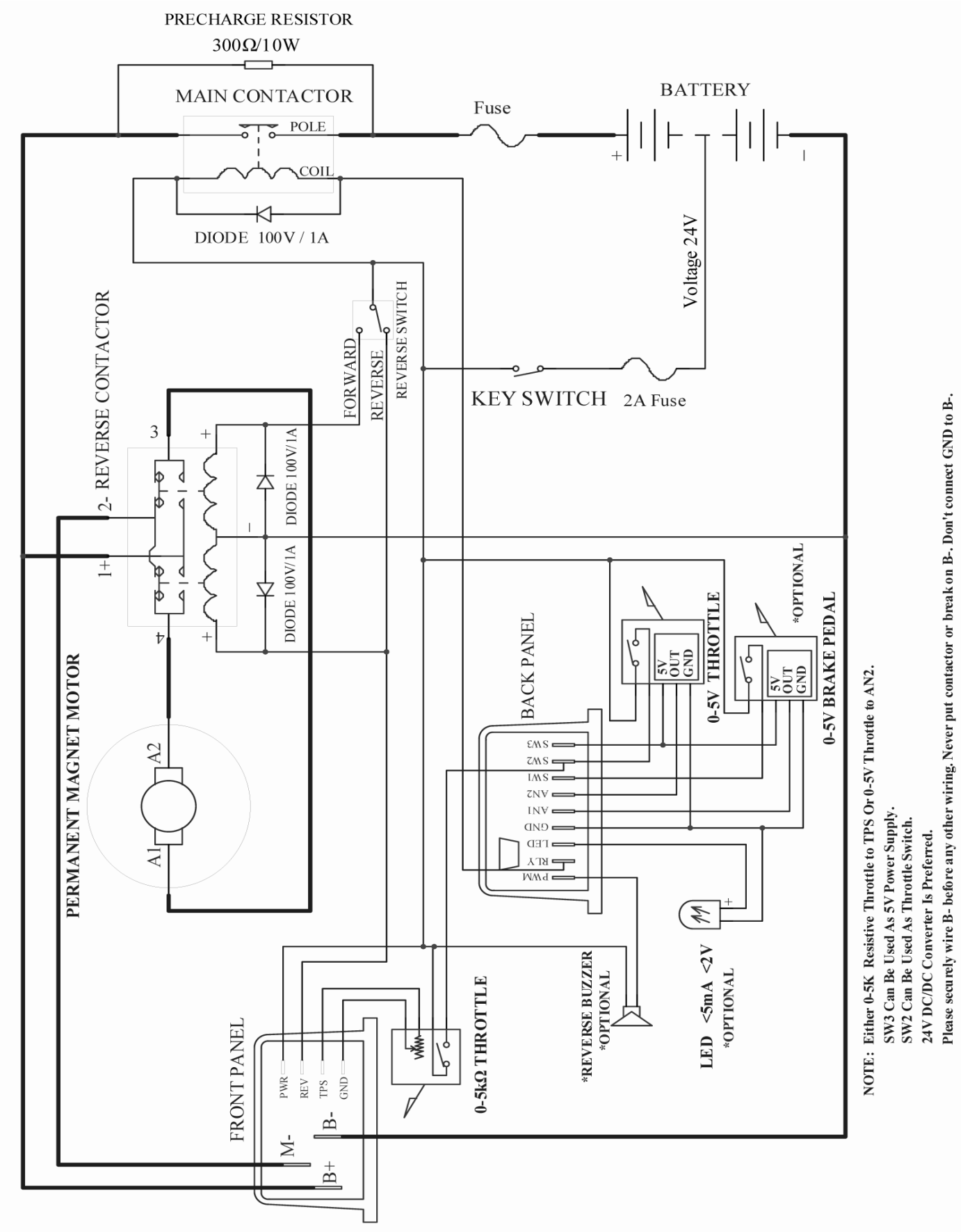
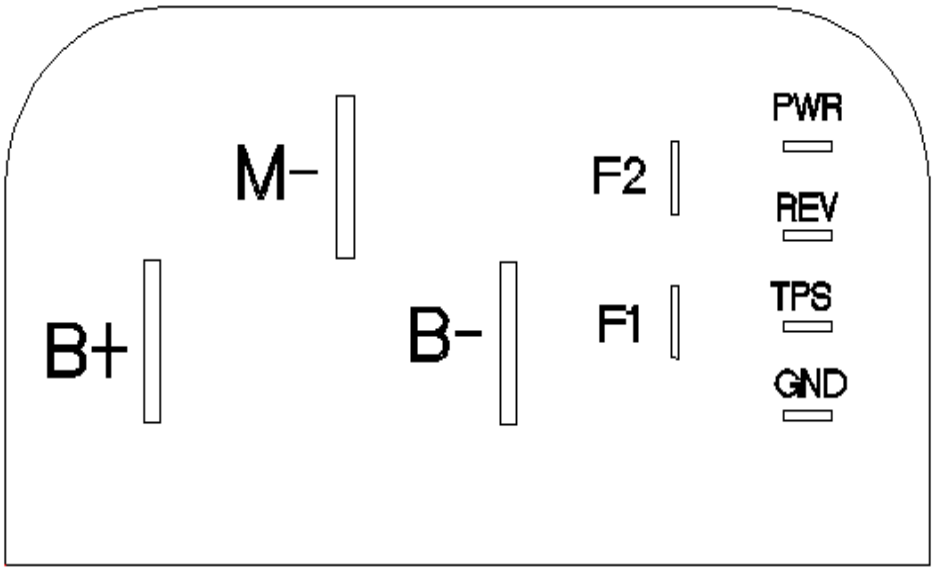


Figure 6: 72V PM motor controller alternative wiring

3.2.3 Front Panel of Sep/Ex and Shunt Motor Controller:

Nine metal bars are provided for connections to the battery, control signals, motor armature and field in the front of the controller.



M-:output to motor armature
B+: battery positive.
B-: battery negative
F1: field positive
F2: field negative
PWR: power switch input
REV: reverse switch input
TPS: resistive throttle analog input
GND: sensor return

Figure 7: Front Panel of Shunt Motor Controller

1. Power switch: The vehicle should have a master switch to turn the controller on and off. PWR provides power for the controller. It is preferred that PWR provides power to switches, coils and other accessories. It must be capable of carrying the current.
2. Reverse switch input: Make sure the throttle is released before change direction, or controller will stop output. It is considered as reverse when the input reaches 0.7*PWR voltage
3. Resistive throttle analog input: 0-5K or 5-0K resistive throttle analog input. Default to 0-5K. Default effective zone is 20%-80%. Below 1K corresponds to zero speed and above 4K corresponds to full speed. If open, controller will take AN2 0-5V input as alternative.
4. F1 and F2: Connect to motor field coil. Motor moves forward when current flow from F1 to F2, in the case of REV switch open.

3.2.4 Standard Wiring of Sep/Ex and Shunt Motor Controller:

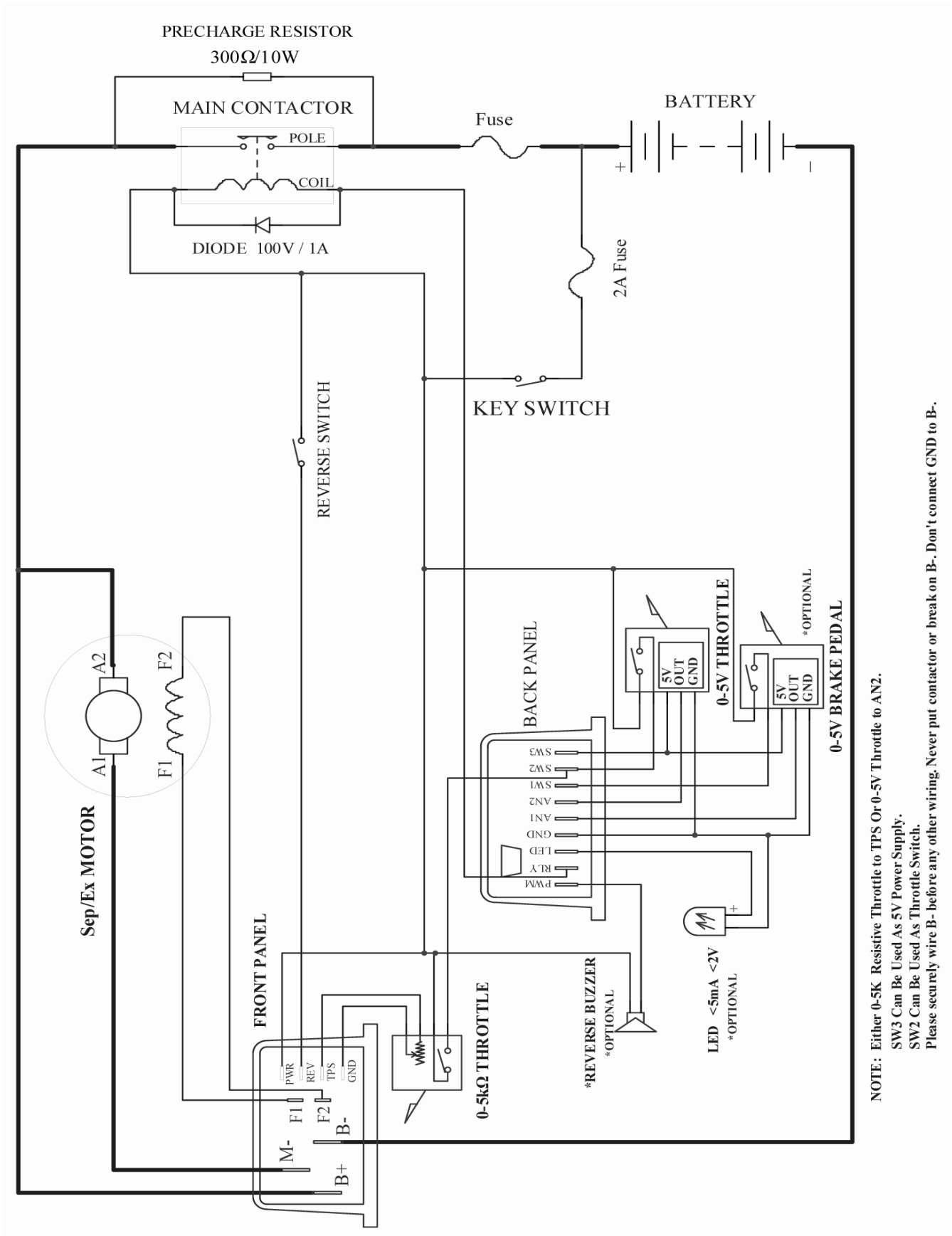


Figure 8: Sep-Ex Motor Controller Standard Wiring

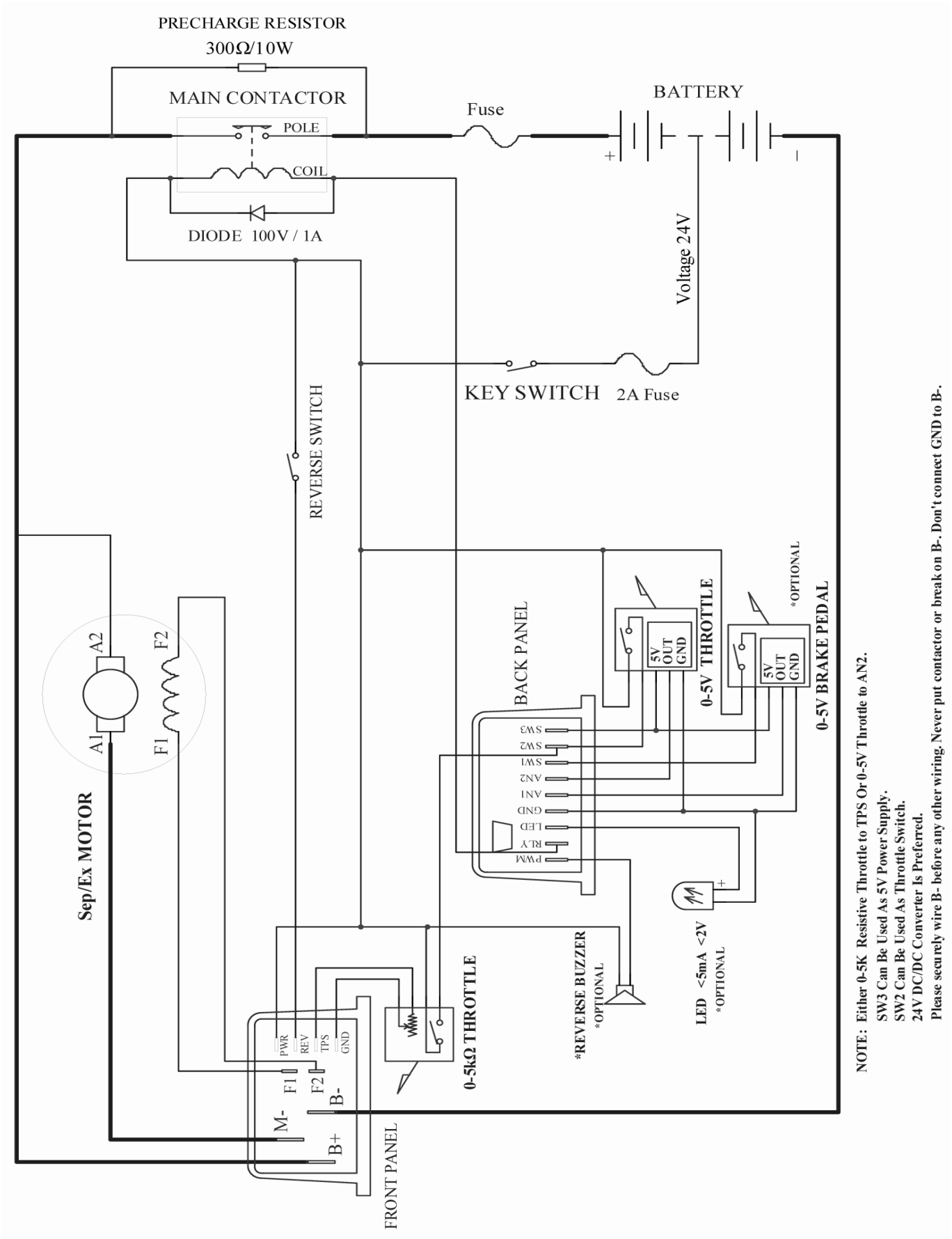


Figure 9: 72V Sep-Ex Motor Controller Alternative Wiring

3.2.5 Back Panel:

Nine metal bars and a communication port are provided on the back panel of each controller shown as Figure 10.

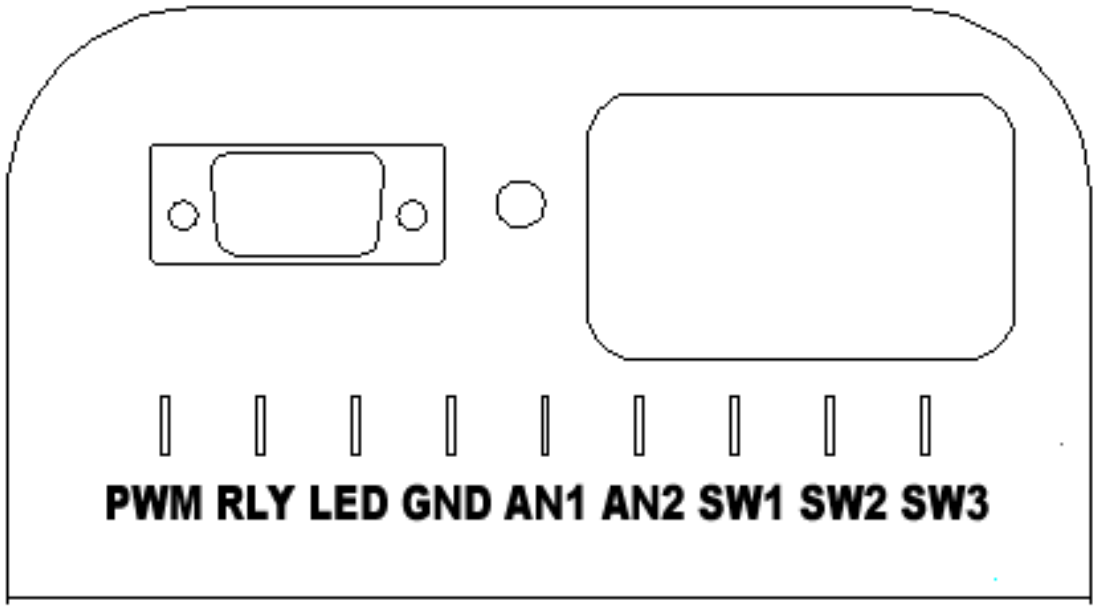


Figure 10: Back Panel of all Controllers

PWM: can drive one of following: reverse alarm.
RLY: main contactor coil driver.
LED: to anode of LED
GND: LED cathode and sensor return
AN1: 0-5V brake analog input.
AN2: 0-5V throttle analog input, as alternative of 0-5K TPS input.
SW1: brake switch input, active when apply PWR voltage
SW2: throttle switch input, active when apply PWR voltage
SW3: +5V 30mA output as sensor supply.

3.2.6 Communication Port

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

3.3 Installation Checkout

Before operating the vehicle, complete the following checkout procedure. 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 the PWR switch and the brake is off
- Use well-insulated tools.

- Make sure the wire is connected correctly
- Turn the PWR switch on. The LED should blink, then keeps on when the controller operates normally. If this does not happen, check PWR voltage and controller ground.
- The fault code will be detected automatically at restart.
- With the brake switch open, select a direction and operate the throttle. The motor should spin in the selected direction. If it does not, verify the wiring to the REV switches, REV contactors, Main contactor and motor. 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 actually no maintenance after properly installed, 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 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.

Table 1: LED CODES

LED Code		Explanation	Solution
Off	■■■■■■■■	No power or no operating	1. Check whether the connection is correct. 2. Check fuse and power supply switch.
On	□□□□□□□□	operate normally	
1,2	¤ ¤¤	Over voltage error	1. Battery voltage is higher than max operating voltage of the controller. Please check the battery voltage. 2. Over voltage at regeneration. Controller will cut back or stop regeneration .
1,3	¤ ¤¤¤	Low voltage error	1. The controller will attempt to clear the fault code automatically after 5 second if battery return to normal. 2. Check the battery voltage. 3. Charge battery if necessary.
1,4	¤ ¤¤¤¤	Temperature warning error	1. The controller temperature is over 90ºC. The controller will cut back current in the case. Stop or reduce output to ensure the temperature fall.
2,1	¤¤ ¤	Throttle sensor fault	1. Check whether the connecting is correct. 2. Check whether the throttle type is correct. 3. If configured 0-5V hall throttle, check if the voltage over 5V. 4. Whether connects to the front panel or the back panel according to configured throttle type.
2,2	¤¤ ¤¤	Internal voltage fault	1. Check whether the B+ and PWR voltage are correct. 2. Please check load on 5V supply. 3. The controller is damaged.
2,3	¤¤ ¤¤¤	Over temperature error	1. The controller temperature is over 100ºC. Controller stop driving in order to protect itself. 2. Stop driving and wait for temperature fall. Once temperature falls below 80 ºC, the controller will restart driving.
2,4	¤¤ ¤¤¤¤	Throttle error when startup	1. The throttle have signal at power-on(It is default to 20%-80% is effective.eg:0-5K throttle, think 1K is 1%,4K is 100%),can reset throttle Available In or set throttle safety switch by configurable. 2. Step on throttle at the same time when power-on, the fault will disappear restart or release throttle.
3,1	¤¤¤ ¤	The controllers reset times too much	1. Default will disappear after restart.

3,2	¤¤¤ ¤¤	Internal reset	Reset caused by over current or so. It is normal if occurring occasionally.
3,3	¤¤¤ ¤¤¤	Brake sensor error	1.Check whether the connecting is correct. 2.Chenk whether the connecting of throttle type is correct.
3,4	¤¤¤ ¤¤¤¤	Throttle have signal when change direction	The controller will stop output. It will get right after release throttle.
4,1	¤¤¤¤ ¤	Over voltage error when regeneration	Beyond the setting value of over voltage when regeneration or startup(can set the value of over voltage by configurable),the controller will shop regeneration. The voltage reduce to recovery voltage and release brake throttle, regeneration get right.
4,2	¤¤¤¤ ¤¤	Field error	1.Field do not reach setting current(can change by configurable software) . 2.Field open circuit, please check field connecting.
The LED flashes once at power on, then keeps on 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:

Kelly Controls, LLC

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

E-mail:
support@kellycontroller.com

Phone:
(001) 224 637 5092