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# Operators Manual SPM/SPB



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# WARNINGS

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## Safety Notes:

When working on electric vehicles, sudden unexpected events can occur, it's recommended to:

- Place the drive axle on jack stands—wheels off the floor.
- When working on wiring or batteries, always remove rings and watches.
- Use the proper safety equipment, eye protection, and insulated tools.
- Never connect a computer while the vehicle is being charged.
- Disconnect batteries before installing or working on the controller.
- Wear safety glasses.
- Because hydrogen can build up due to gassing from the batteries, work in a well ventilated area.
- Make sure the battery pack is fused.
- Do not clean the controller with a high PSI pressure washer.
- When cleaning batteries, take precautions to keep the battery acid from splashing on the controller.

Note:

It is the installer's responsibility to ensure the correct equipment (ie. wire, motor, solenoid, fuse etc) is installed in the car.

## READ AND SAVE THESE INSTRUCTIONS

# USABILITY STATEMENT

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Alltrax Inc's lines of Series and Shunt Motor Controllers are intended for use with motors only. Any application or usage that does not meet these criteria WILL NOT be covered by warranty. Also, any requests for design assistance or technical support outside the scope of the product intended use may be denied. Alltrax assumes no liability for any damage or injury as a result of use of the motor controllers in a non-traction or process motor application. See the warranty at the end of this manual.

**WARNING:** Use of this product for other than these specified uses may be highly dangerous and lead to serious injuries or death.

**WARNING:** The use of this product for the production of Plasma Assisted Hydrogen, Brown's Gas, HHO (H<sub>2</sub>O Hydrogen Electrolysis) or any other type of gas is prohibited. Generation and storage of these gasses is extremely dangerous and poses a significant risk of explosion, fire, property damage and serious injury or death.

# SPM/SPB PRODUCT OVERVIEW

Thank you for purchasing the Alltrax Motor Controller. The SPM is a new design in the field of electric vehicle motor controls, embodying all we've learned from the past 15 years of design, manufacture, use and abuse of our DCP, AXE and DCX products. The SPM looks different because we listened - Topside wiring and re-locatable mounting feet ease installation.

The SPM is different because we've taken full advantage of technology changes to craft a very sophisticated yet simple and reliable drive. The SPM is also a complete thermal solution - no external heatsink required. The drive style and user interface are like no other - Torque and Speed are graphically adjustable, you can re-curve the throttle response from buttery smooth to neck snapping wild.

Alltrax motor controls are manufactured at our factory located in Southern Oregon on a vertically integrated process by a dedicated crew. Starting with raw electronic parts and sheet copper, we use robotic pick and place equipment to assemble circuit boards, custom tools to shear and punch copper into heatsinks and busbars, then it's soldered in a reflow oven and wave solder machine. Automated test equipment calibrates and verifies proper operation at circuit board level, units are then encapsulated for water and vibration proofing and dyno tested.

# FEATURES

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- **Supports 10 Different Throttles**

The SPM/SPB features 10 throttles including all of the common golf cart throttles and some speciality throttles such as pump mode, 0-5v and a USB throttle.

- **Main Solenoid Control**

This controller offers main relay control for safety. When the solenoid is wired to the Rly Coil + and - tabs, the main solenoid drive is under KSI hardware and software control.

- **Adaptive “Auto Range” Throttle**

Auto range throttle learns the actual throttle range of the sensor and scales to this. Eliminates dead band in throttle response at both ends of pedal travel. The throttle can also be set manually with the Absolute Throttle Mode.

- **USB Programming Port**

USB interface is high speed, and you can program the controller without an external power supply - unit is USB powered for programming.

- **Programmable Throttle and Brake Curves**

The SPM has the ability to provide independent torque (current) control or speed (voltage) control to the motor at any throttle position.

- **Programmable Battery Current Limit**

For applications where battery current limiting is critical, the SPM has an adjustable battery current limit setting. As the controller approaches the battery current limit, it will limit the output power to keep the battery current under the limit setting.

- **High Speed Current Limit**

The SPM features a 3 stage current limit architecture which provides smooth motor current control, responds in less than 50 microseconds to excessively high average current and in less than 3 microseconds to large fault currents.

- **Color Coded Power Terminals**

To aid in installation, the high current connections are color coded. The B+ is Red, the B- is Black, the M- is Blue and A2 is Green.

- **Integrated Heatsink with Active Fan Cooling**

Thermostatically fan cooled, no external heatsink required. Dramatically increases continuous power compared to conduction cooled drives. Fan is field replaceable with 1 screw and fastons.

- **Flexi-Mount System**

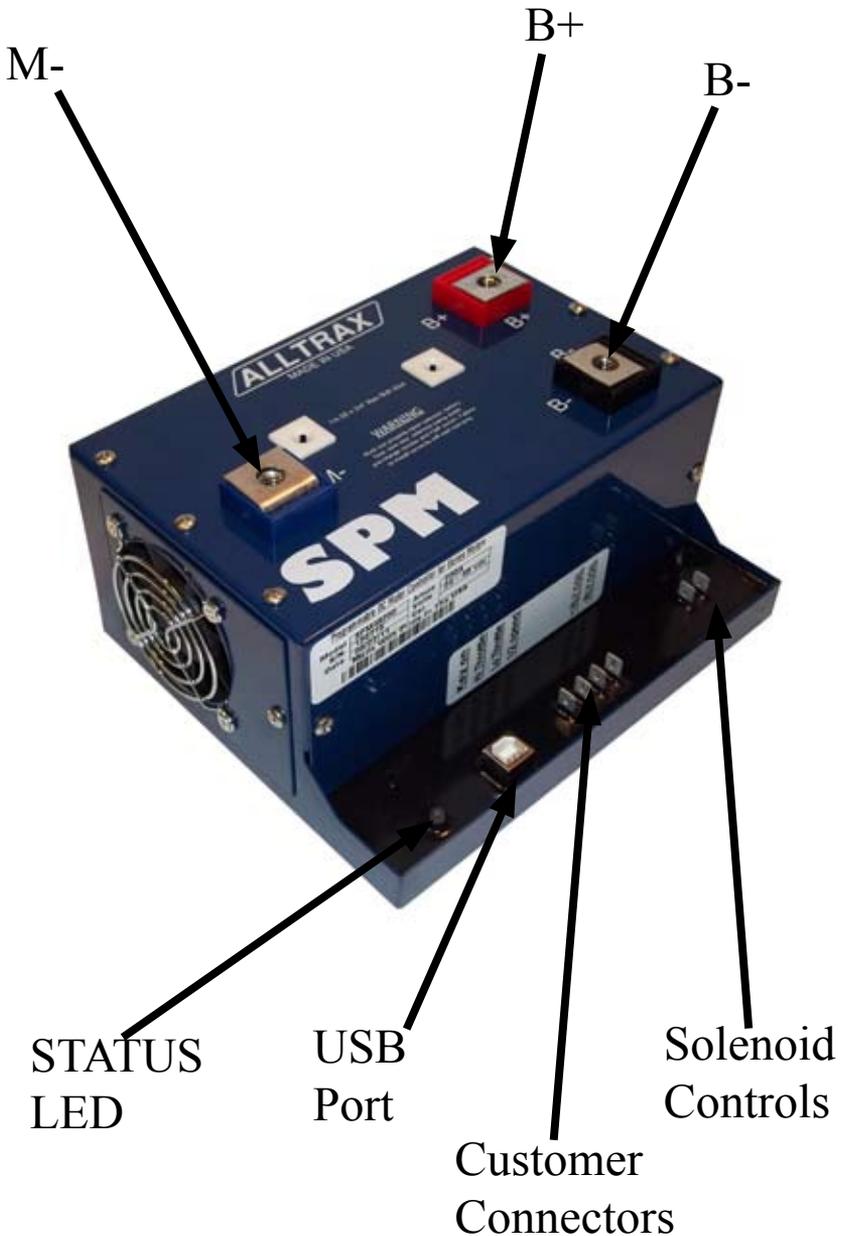
With no fixed holes for mounting, the Flexi-mount system allows for an almost infinite combination of mounting options.

- **Feature Rich HD Models (Coming Soon)**

The SPM has Feature Rich Models available with sealed connectors, speed sensor, motor temperature, throttle and rev limiting inputs.

# SPM LAYOUT

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# SPM SPECIFICATIONS



Model	Peak (Amps)	2 Min (Amps)	5 Min (Amps)	Continuous (Amps)
SPM48225 <sup>1</sup>	200/225 <sup>2</sup>	200	150	125
SPM48300 <sup>1</sup>	300/350 <sup>2</sup>	300 (1.5min)	230	210
SPM48400 <sup>1</sup>	400/460 <sup>2</sup>	400	320	300
SPM48500 <sup>1</sup>	500/575 <sup>2</sup>	500	420	380
SPM48600 <sup>1</sup>	600/690 <sup>2</sup>	600	500	450
SPM48800 <sup>1</sup>	800/920 <sup>2</sup>	800 (1.5min)	600	550
SPM72200 <sup>1</sup>	200/225 <sup>2</sup>	200	175	150
SPM72300 <sup>1</sup>	300/350 <sup>2</sup>	300	250	220
SPM72400 <sup>1</sup>	400/460 <sup>2</sup>	400 (1.5min)	300	270
SPM72500 <sup>1</sup>	500/575 <sup>2</sup>	500	420	380
SPM72650 <sup>1</sup>	650/740 <sup>2</sup>	650	500	450

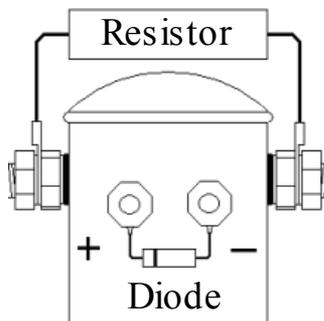
Note<sup>1</sup>: SPB, EZ and HD Models have the same specifications as the parent model

Note<sup>2</sup>: The larger number represents the value when the "Peak Amp Mode" is enabled in the Alltrax Toolkit program.

<b>Type:</b>	Series Motor Controller
<b>Operating Frequency:</b>	18kHz
<b>Controller Voltage, KSI &amp; Reverse:</b>	SPM48XXX 24-48V nom, 62V max SPM72XXX 24-72V nom, 90V max SPM48800 36-48V, nom, 62V max
<b>Operating Temperature:</b>	-25°C to 85°, shutdown @ 95°C
<b>Standby Current (Power up):</b>	<1W nom, <8W Fan on
<b>KSI &amp; Rev Pin Input Current:</b>	<20mA
<b>Relay Drive Current:</b>	5A peak, 1A Cont.
<b>Plug Brake Current:</b>	SPBXX200 -100A current limited SPBXX400 - 150A current limited
<b>Throttles Supported:</b>	0-5k, 5k-0, E-Z-GO ITS, Club Cart 5k-0 3 Wire (MCOR), 0-5v, Taylor Dunn 6v-10.5v, USB Throttle, Yamaha 0-1k, Absoute Mode

# INSTALLATION

## Resistor & Diode Mounting



The diode across the coil terminals safely dissipates the energy when the coil is turned off. Installation Dependant, refer to applicable drawing.



Contactor Size	Diode	Diode Current
70A-200A Solenoid	1N4004	1A
400A-550A Solenoid	1N5408	3A
600A or larger Solenoid	MR754	6A

The resistor typically seen across the contactors big terminals pre-charges the filter capacitors in the controller. This minimizes arcing across the contactor terminals when closing.

Battery Voltage	Resistor
36V	220-250 Ohm 10W
48V	470 Ohm 10W
72V	1000 Ohm 10W



## F/R Switch

The forward/reverse switch is an often overlooked part of the upgrade process. In a series motor, all of the motor current will pass through the F/R switch. An undersized F/R Switch is as bad as an undersized solenoid or small wire gauge.

For higher amperage controllers (>600A), it is suggested that a change-over contactor set up be used. These are large enough to handle the higher currents without over heating the contacts and they provide the user the ability to change direction by flipping a switch.

<b>Controller Amperage</b>	<b>F/R Size</b>
400A or less	Stock/HD
450A to 650A	Heavy Duty/Change-Over Contactor
650A or more	Change-Over Contactor



Change-over contactors are multiple contactors bound together that allow the user to change the polarity of the voltage going to the motor thus reversing direction. It works exactly the same as the manual F/R switch, except that it uses coil drive contactors. See the installation drawings for how to wire up a change-over contactor.

## ***Contactors (Solenoids)***

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The solenoid is the primary disconnect of the battery pack in the case of the an emergency. In order to be effective, the solenoid needs to be properly rated for the current that will be drawn from the batteries. It is VERY important that the solenoid be rated correctly. It is the only way to disconnect the batteries from the motor/controller loop in case of a failure. Too small of a solenoid increases the likelihood that the contacts will weld together and not be able open.

### **UNACCEPTABLE**



#### **Stock 70 AMP**

Used with older ClubCars vehicles

**DO NOT Use with  
Alltrax Controller**

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### **STANDARD DUTY**

Flat lands with moderate speed and torque performance expectations.



#### **Stock 100 AMP**

Use with SPM/SPB 200A or 300A controllers.

## HEAVY DUTY

High performance, high speed, maximum torque, pulling loads, hilly terrain or Hunting Buggies.



**Performance 200 AMP**  
(600amp Inrush) Use with 300  
and 400 AMP Controllers



**Heavy Duty 200 AMP**  
(800A surge) Use with 300 to  
500 AMP Controllers



**Heavy Duty 400 AMP**  
(1000A surge) Use with 500 and  
600 AMP Controllers  
Suggested types:  
SW200  
MZJ400 (Shown)

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## EXTREME DUTY



**Extreme Duty 600A+ AMP**  
(1000A + surge) Use with 600-  
800 AMP Controllers.

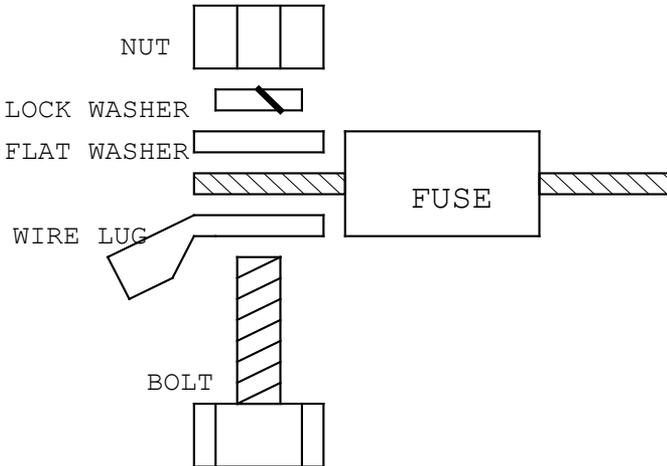
# Fuse

Any application where there is a battery pack, a fuse must be installed. A fuse will open the battery circuit and prevent any serious damage from occurring.

The fuse should be installed on or between the battery terminals. The main B+, B- or in-between 2 batteries is an acceptable location. The fuse must be rated for pack voltage and fault current.



Controller Amperage	Fuse Rating
400A or less	250A
450A to 650A	400A
650A or more	600A



**Diagram: Fuse terminal hardware**

## **Wiring**

Wiring and battery health in an electric vehicle are very important and overlooked during performance upgrades. Wiring size is important for safety and proper operation of the vehicle. Undersized wires will affect the performance of controllers and can overheat. Wires should be crimped with proper sized terminals and tools to provide a clean low resistance connection.

Controller	Min. Wire AWG Standard Duty	Min. Wire AWG Heavy Duty
200/300A	OEM -6 AWG	4 AWG
400A	4 AWG	4 AWG
500A	2 AWG	1/0 AWG
600A	1/0 AWG	2/0 AWG
650A	1/0 AWG	2/0 AWG
800A	2/0AWG	4/0 AWG

### **Power Wiring**

When running wiring for the vehicle care must be taken for proper wire routing. Power wiring should be of proper sizing and ran as low in the framework of the vehicle as practical. Lengths of power wire runs need to be kept short and pairs of wires from common circuits should be grouped together to reduce EMC emissions. Secure all power wiring to the vehicle framework.

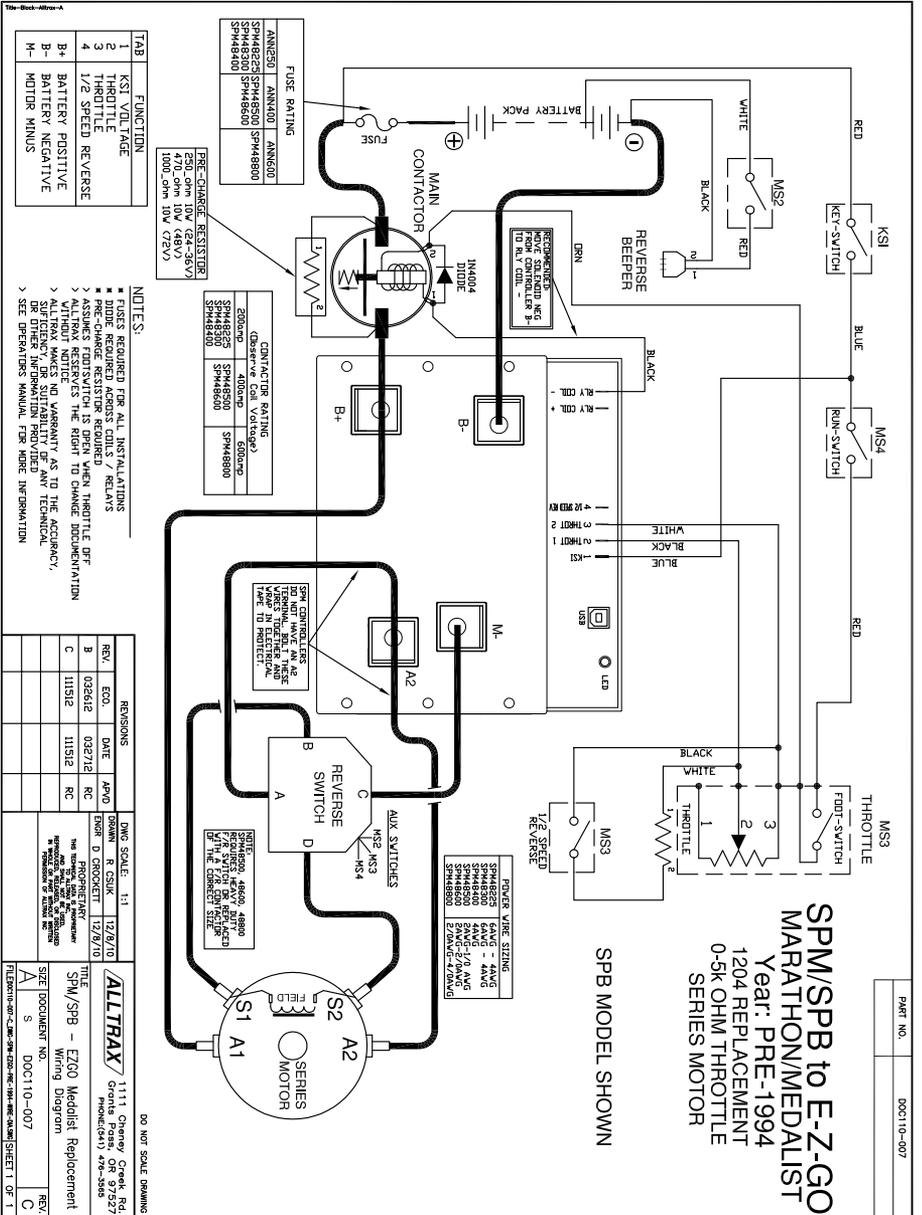
### **Signal Wiring**

Signal wires should be keep as short as practical. Care should be taken to protect the wires sharp edges and rubbing. Consider the use of split loom or braided wire sheathing. Fasten bundles securely to framework. Do not route the signal wires together in the same bundle with power wires.

# **INSTALLATION DRAWINGS**

Don't see a drawing that suites your needs?  
Visit our website for full sized, updated and more drawings.  
[www.alltraxinc.com](http://www.alltraxinc.com)

# PRE-1994 EZGO

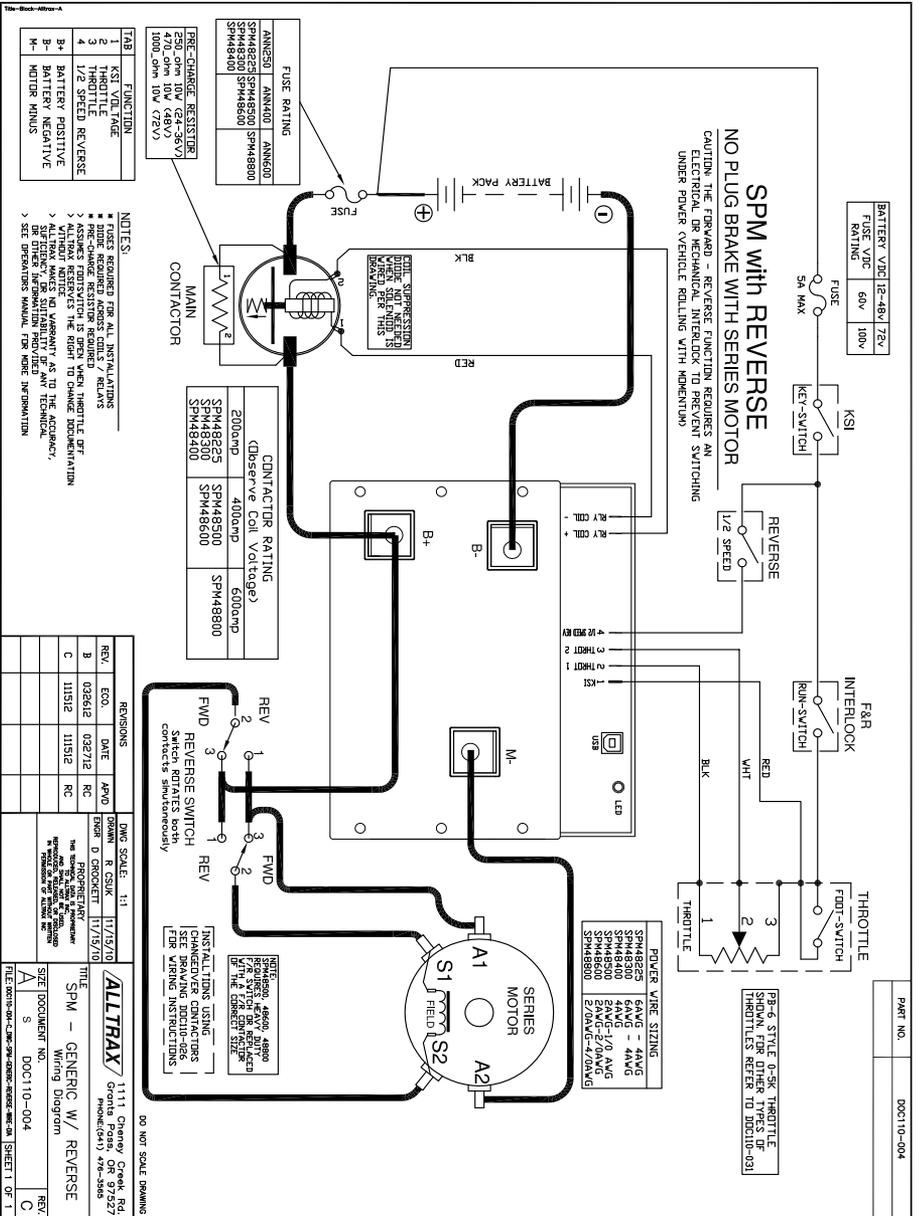








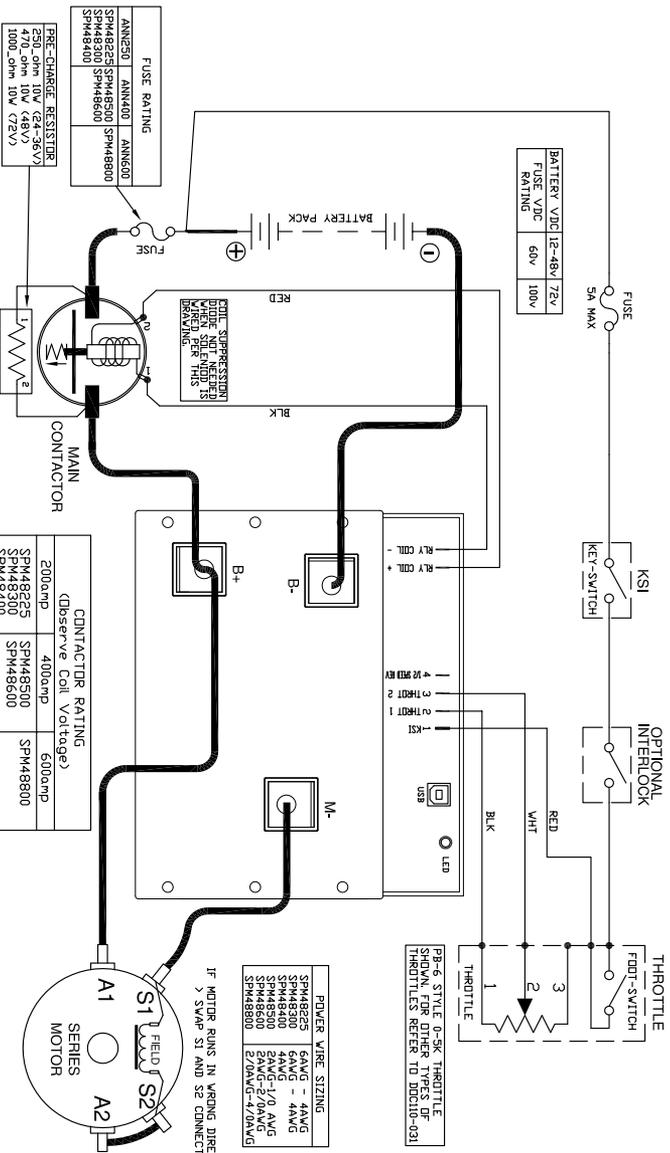
# GENERIC, SERIES WITH REVERSE



# GENERIC, SERIES W/O REVERSE

## SPM - GENERIC WIRING NO REVERSE

PART NO. DDC110-003



**TAB FUNCTION**

1	KSI	VOLTAGE
2	THROTTLE	
3	THROTTLE	
4	1/2 SPEED	REVERSE
B+	BATTERY POSITIVE	
B-	BATTERY NEGATIVE	
M-	MOTOR MINUS	

- NOTES:**
- > FUSES REQUIRED FOR ALL INSTALLATIONS
  - > PRE-CHARGE RESISTOR REQUIRED
  - > PRE-CHARGE RESISTOR REQUIRED
  - > ASSUMES FOOT SWITCH IS OPEN WHEN THROTTLE DEF.
  - > WITHOUT NOTICE
  - > ALL OTHER WORKS ON VARIANTS AS NOTED IN ACCORDANCE.
  - > SEE OPERATIONS MANUAL FOR MORE INFORMATION

**PRE-CHARGE RESISTOR**

250 ohm 10W (62.5V)
470 ohm 10W (48V)
1000 ohm 10W (72V)

**REVISIONS**

REV.	ECO.	DATE	APPRO.	DESCR.	BY	CHKD.	DATE
B	032612	032712	RC				11/15/10
C	111512	111512	RC				

**ALLTRAX** 1111 Chavez Court, Rd.  
Grass Valley, CA 95727  
Phone: (531) 478-3865

SPM - SERIES GENERIC NO REVERSE  
Wiring Diagram

SIZE DOCUMENT DDC110-003

REV. C

THEORY OF OPERATION SHEET 1 OF 1

# CONTROLLER MOUNTING

The SPM/SPB uses a universal mounting system. The mounting feet of the controller can be placed in numerous positions to deal with most installations.

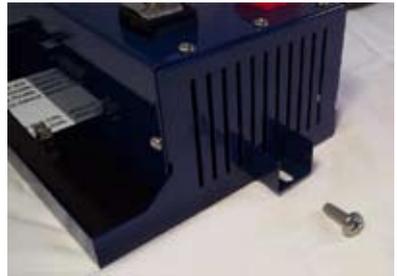
There are 2 types of mounting feet:

One mounts to the grill, the others mount to the front and rear as shown.



Flexi-mount system

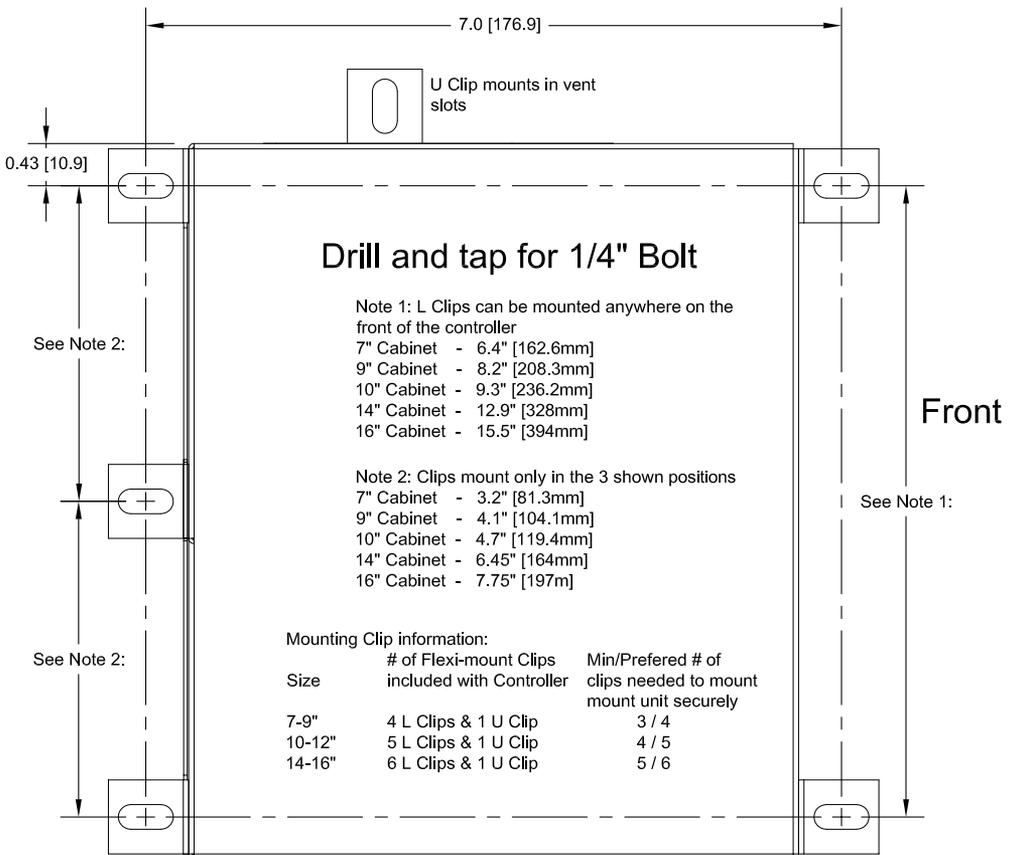
U Clip mounted on controller



Clip mounted on controller

Mounting the controller is a fairly simple process. It fits most standard hole patterns and it is recommended the controller be held down with at least 3 clips. EZGO Vehicles have a special way to be mounted on the stock heatsink shown on the next page. An aftermarket bracket may also be used for your application.

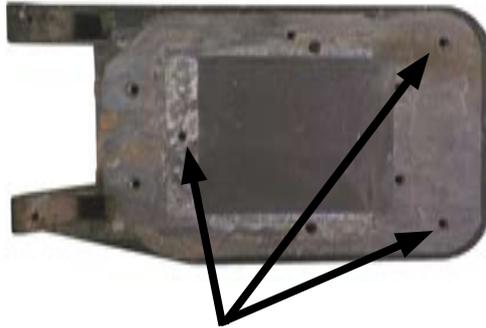
Below is a suggested drill template for creating mounting holes for the SPM controller. Drill and tap the mounting surface for 1/4"x20 bolts.



# E-Z-GO CONTROLLER MOUNTING

The E-Z-GO Medalist and TXT style of carts use a mounting plate on the passenger side of the vehicle. The SPM/SPB controller mounts slightly differently than the stock controller. Once the controller is mounted, the cover will not go back on the cart. The controller is weather/water resistant and does not need the cover.

Note: 14" and 16" SPM controllers will not fit on the stock E-Z-GO heatsink as shown. An alternative mount will have to be fabricated using the dimensions on page 24.



The controller mounts to these 3 holes.

Mounting the controller uses 3 of the Flex-Mount Clips (supplied with the controller), 3 1/4x20x1/2" bolts and 3 1/4x20 flat washers (bolts and washers not included). Install the 1st clip in the center



## ***E-Z-GO Mounting (cont.)***

The 2 remaining clips install in the front of the controller. Line them up with the 2 holes shown on the previous page. Tighten down all the bolts.



The controller will sit like the above picture in your vehicle. The stock cover will not go back over the controller.

Also visit our website for instructional videos on the Flexi-mount system and installation.

Note: EZGO vehicles with the 74014G02P Controller Mount bracket. The SPM controller will not fit this mount. It needs to be replaced with the OEM 73083G01 mount.



# PROGRAMMING THE CONTROLLER

Controllers ordered for stock configurations are pre-programmed from Alltrax and it is not necessary to re-program unless the customer has specific needs. If the controller does need to be programmed it can be done via a USB A to B cable and the Alltrax Toolkit program. Visit our website for more information on programming the controller including the Alltrax Toolkit Manual (DOC113-002) and instructional videos.



The cable to is the USB-A to B. This is the most common USB printer style cable available.

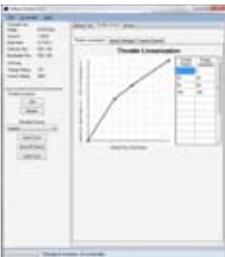
Settings Screen



Monitor Screen



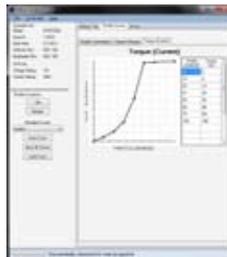
Linearization Curve



Speed Curve



Torque Curve



# BLINK CODES

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The throttle code blinks on controller power up and alarm codes blink when the alarm happens. All alarms are self clearing so when the alarm event is over, the controller resumes normal operation, except for the Short Circuit alarm that needs a power off cycle to clear the alarm.

## Throttle codes:

1 Green LED Flash	=	0-5k throttle
2 Green LED Flash	=	5K-0 throttle
3 Green LED Flash	=	0-5V throttle
4 Green LED Flash	=	EZGO ITS throttle
5 Green LED Flash	=	0-1k Yamaha throttle
6 Green LED Flash	=	6 to 10.5 Taylor Dunn throttle
7 Green LED Flash	=	Club Car 5k-0 3 wire throttle
8 Green LED Flash	=	Reserved
9 Green LED Flash	=	Pump
10 Green LED Flash	=	USB Throttle
11 Green LED Flash	=	Absolute Throttle

## Normal Display Status:

Solid Green Light	=	Controller Ready to Run
Solid Red Light	=	Controller in programming mode
Solid Yellow Light	=	Throttle is wide open and the controller is <u>NOT</u> in Current Limit
Blinking Yellow Light	=	Throttle is wide open, but the controller is in Current Limit

## Error Codes:

SPM error codes are different than the AXE/DCX alarm codes in that they will flash Green and Red, instead of just Red.

1 Green and 1 Red LED Flash	=	Short Circuit
1 Green and 2 Red LED Flash	=	Battery Under Voltage
1 Green and 3 Red LED Flash	=	Battery Over Voltage
1 Green and 4 Red LED Flash	=	M- Over temperature
1 Green and 5 Red LED Flash	=	Bus Bar Over temperature
1 Green and 6 Red LED Flash	=	Pre-charge Failure
2 Green and 1 Red LED Flash	=	Under Temp
2 Green and 2 Red LED Flash	=	Not Used
2 Green and 3 Red LED Flash	=	High Throttle Over range
2 Green and 4 Red LED Flash	=	High Throttle Under range
2 Green and 5 Red LED Flash	=	Low Throttle Over range
2 Green and 6 Red LED Flash	=	Low Throttle Under range
3 Green and 1 Red LED Flash	=	Uncalibrated throttle
3 Green and 2 Red LED Flash	=	Bad Variable Set Loaded





# WARRANTY STATEMENT

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Alltrax, Inc., (hereafter Alltrax) warrants that the product purchased is free from defects in materials or workmanship for a period of 2 years from the date of manufacture. This warranty does not apply to defects due directly or indirectly to misuse, abuse, negligence, accidents, repairs, improper installation, submersion, alterations or use contrary to any instructions provided by Alltrax in verbal or written form.

In the event you should need warranty repair, contact Alltrax at (541) 476-3565 to receive warranty service authorization instructions for returning the defective product to Alltrax for evaluation. Products or parts shipped by customer to Alltrax must be sent postage paid and packaged appropriately for safe shipment. Alltrax is not responsible for customer products received without warranty service authorization and may be rejected.

Alltrax reserves the right to repair or replace merchandise at its option at no cost to the customer, except for shipping costs of sending the defect item to Alltrax. Replacement shall mean furnishing the customer with a new equivalent product to the defective item. Alltrax also reserves the right to make changes to any of its products or specifications without notice.

Alltrax assumes no liability for applications assistance or customer product design. Customers shall be responsible for evaluating the appropriateness of the use of any Alltrax product in any application. Customers shall provide adequate design and operating safeguards that are in compliance with standard practices of other similar applications or any standards of any governing agency.

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