

D&D Motor Systems, Inc.

Programmable Series Controller

Manual & Schematics

BE ADVISED, D&D Motor Systems, Inc. does not design and manufacture controllers. We provide them as an extension to our existing motor product line so that our customers may enjoy more of a one stop shopping environment. If we cannot handle any of your basic technical questions, we will refer you to our off-site technical service customer representatives.

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Appendix A – Programming the Controller out of the Vehicle

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- *Club Car (5K-0)*
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- *Yamaha (0-1K)*
- *Controllers with Plug Braking (0-5K)*
- *Non-Programmable Controllers*

Appendix E – Controller Specifications

A. Series Controller Information

1. Controller Product Overview

This motor controller employs modern power MOSFETs to provide extremely low "on" resistance, in both the main switch function and freewheel diode. Synchronous freewheel rectification permits extended high power operation over similar sized controllers due to increased efficiency. A microprocessor based control system monitors numerous functions, and a windows interface allows the user to change all operating parameters and perform status monitoring.

2. Required Accessories

These components are not supplied with the controller. For your safety and that of others, some basic precautionary measures must be employed when designing, working on, and driving electric vehicles.

- Use a contactor in the battery circuit, rated for the amperage and voltage of the system.
- Use a fuse rated for the voltage and available fault current of the battery.
- Safety interlocks must be employed to prevent energization of the controller while the vehicle is unoccupied or charging.

Controllers have failure modes which can result in runaway (stuck throttle) conditions. This controller has been designed to prevent and preclude as many of those from ever occurring as possible. Please follow the Recommended Controller Wiring System document in this manual. Failure to do so could result in damage to the controller, and serious injury or death to vehicle occupants or bystanders.

2.1 Battery Contactor

The main battery contactor needs to be chosen for it's ability to carry the intended continuous battery current, and to interrupt the peak battery pack DC voltage.



2.2 Main Fuse

- The main fuse needs to be sized to protect the wiring in the drive system.
- Fuse DC voltage rating must be greater than the peak battery voltage.
- Fuse current rating equal to or less than amperage rating of controller.



Most high current fuses have very long tolerance (2 minutes or more) up to 50 - 100% overloads. Thus a 300A fuse likely won't open in a 500A vehicle application. Most Golf OEM vehicles may not have a fuse and must be added with these performance controller upgrades. When carts are equipped with large controllers, the wire gauge must be made larger. This in turn permits higher fault currents, due to the reduced wiring resistance. Under these conditions, we strongly recommend the addition of a fuse to prevent catastrophic battery failure or fire in the event of an electrical system failure.

2.3 Safety Disconnect

The safety disconnect provides a way to disconnect the battery pack from the controller and contactor. It may be a circuit breaker, a mechanical switch, or a large removable connector.

Make sure it is rated for the current capacity and DC Voltage of your system. Some installations disconnect both the positive and negative leg of the battery pack. Most golf cart type vehicles do not have a battery disconnect.

2.4 Drive Motors

The motor controller is designed to operate with series wound brush commutated DC motors rated for operation from 12- 72 VDC. Operation with compound and permanent magnet motors is possible.

3. Controller Installation

Choose a location outside the drivers compartment to mount the controller. Any mounting position is acceptable. It is recommended that you protect the controller from direct contact with water, as the electrical connections can corrode. In high moisture environments, seal the electrical connections with silicone or grease. Mount the controller as close to the motor as is reasonably possible. Ideally, your motor leads should be less than 4 feet long. Making a twisted pair out of the motor leads will reduce RF emissions. Some carts employ small (6AWG) wiring. For 400A controllers, a minimum of 4AWG wire should be used in light weight carts. 2AWG to 1/0 is appropriate for higher amperage controllers and heavier vehicles. High current wiring to the motor controller should use 5/16" mounting hole ring terminals of tinned copper. Bolt them to the controller using 5/16" hardware.

3.1 Contactor Coil Diode:

CAUTION: A Diode (1A, 100V) MUST BE USED across the solenoid/contactor coil (and any other relays that may be installed to control lights or accessories). The Cathode or banded end faces the positive terminal. These diodes are required to prevent the speed sensor from producing erroneous signals.



3.2 Pre-charge Resistor:

The controller has a fair amount of DC filter capacitance. When the contactor closes to apply power to the controller, the capacitors can arc the contactor. The pre-charge resistor will apply a low current to the capacitors to prevent any arcing and keep the capacitors at bus voltages. It also acts as a discharge snubber that helps dissipate the arc when the contactor disengages. (see schematics for proper value).



4. LED Status Indicator

The series controllers have a bicolor front panel LED. This LED displays a variety of information each time the controller is powered up, by series of blinks. Count the number of green blinks to identify the type of throttle the controller is configured for. *After* the blink code indicating throttle type, the LED will stay green if there are no errors.

LED Blink Codes:

At power up the number of green blinks indicates the configured throttle type:

- 1 Green = 0-5k
- 2 Green = 5k-0
- 3 Green = 0-5V
- 4 Green = EZ-GO inductive (ITS)
- 5 Green = Yamaha 0-1K
- 6 Green = Taylor-Dunn 6-10.5V
- 7 Green = CLUBCAR 5K-0, 3-wire

Normal display status:

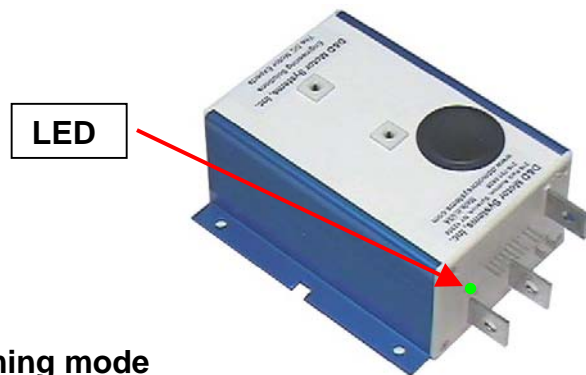
- Solid Green:** Controller ready to run
- Solid Red:** Controller in programming mode
- Solid Yellow:** Controller throttle is wide open, controller is supplying max output, and is not in current limit.

Error code display:

Number of **RED** blinks indicates any error conditions that might exist.

- 1 Red** = Throttle Position Sensor Over Range. Check for open wires.
- 2 Red** = Under Temperature. Controller below -25C.
- 3 Red** = HPD. Throttle hasn't gone to zero during this power on cycle.
- 4 Red** = Over Temperature. Controller over 95C.
- 5 Red** = unused for series controllers.
- 6 Red** = Battery Under Voltage detected. Battery V < undervoltage slider.
- 7 Red** = Battery Over Voltage detected. Battery V > overvoltage slider.

Errors are self clearing when the fault is corrected.



5. Programming

This controller may be programmed to change operating characteristics such as throttle response rate, throttle type, top speed and braking force. Go to www.ddmotorsystems.com and download the free software tool WebControllerPRO.exe (see software installation manual). The interface, "WEBControllerPRO", is a utility program which operates on Windows NT/XP operating systems. The program provides a fairly intuitive way to tune and calibrate the motor controllers operating parameters. The controller uses either COM1 through COM7 serial port, RS-232 logic levels, 9600 baud, 8 data bits, 1 stop bit, no parity.

Use a standard DB-9 pin / RS-232 serial interface cable to connect the controller to the PC. If your computer is not provided with a DB-9 pin serial port a USB to RS-232 Serial adapter / converter is available through www.tigerdirect.com and other sources.

If you need the entire programming kit, we do sell them. Please contact us if you need a kit.

Note: The controllers RS-232 serial port is referenced to the B- battery connection. Beware any possible ground loop faults which could damage both the Controller and PC, plus the person doing the work! Disconnect all battery charging sources while programming your Controller.

If programming your controller when it is connected to the vehicle, refer to the wiring schematics. If you want to program the controller while out of the vehicle, refer to the attached sheet: "Appendix A"

B. General Information

1. LIMITED WARRANTY

D&D Motor Systems, Inc. warrants every product it sells to be 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 or alterations. We shall in no event be liable for death, injuries to persons or property or for incidental, contingent or consequential damages arising through the use of our products. D&D Motor Systems, Inc. specifically disclaims the implied warranties of merchantability and fitness for a particular purpose, however some areas do not allow limitations on how long an implied warranty lasts, so the preceding exclusion may not apply to you. This is D&D Motor Systems, Inc. sole written warranty, no other warranty is expressed or implied.

In the event you should need warranty repair, Please see the Return Procedure below. D&D Motor Systems reserves the right to repair or replace merchandise at its option. D&D Motor Systems reserves the right to make changes to any of its products or specifications without notice.

2. Return Procedure

Call D&D Motor Systems, Inc. at (315) 701-0635

Fax us at (315) 701-0859

Explain the nature of the problem to our service personnel and we will provide you with return directions. You pay shipping to us, we pay the return shipping to you as long as the warranty is accepted. Package the controller securely in original shipping box if at all possible, we are not responsible for damage in shipping.

APPENDIX B

FUSE INSTALLATION GUIDE

We recommend that all motor controller applications have a fuse in the battery circuit. Many vehicles do not have a fuse, follow these guidelines to determine a suitable location. Fuse may be installed anywhere in the battery string, or at either + or - end of the battery pack, where it connects to controller or solenoid.

Controller Rated Current:

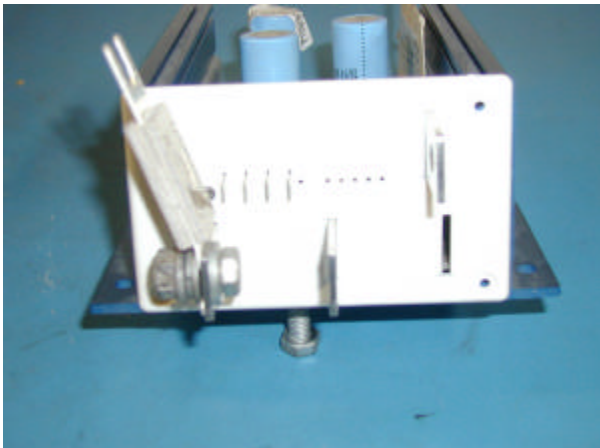
400 amps or less
450 amps or more

Recommended Fuse:

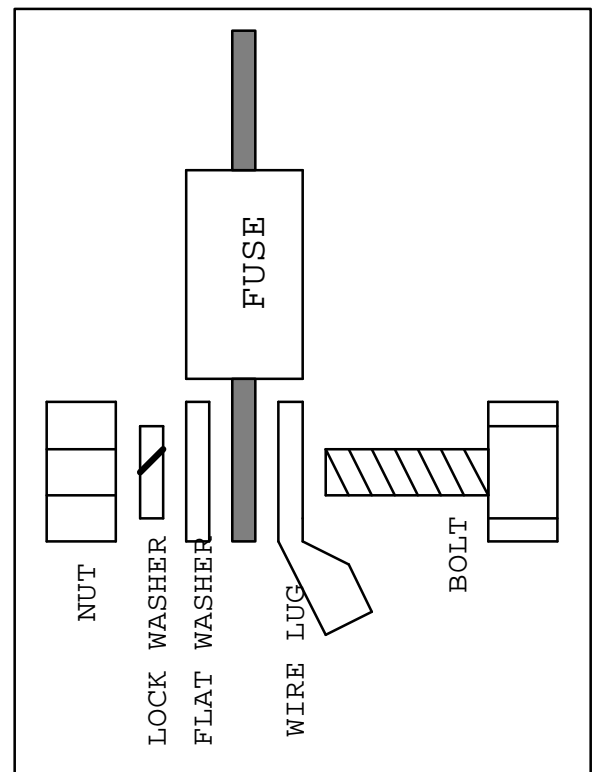
ANN250 Bussman or Littelfuse
ANN400



Example 1: On Battery



Example 2: On controller B- bar



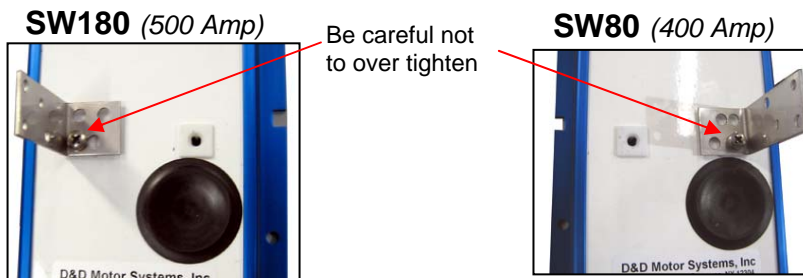
APPENDIX C

Contactor (solenoid), Resistor Coil and Diode Installation Guide

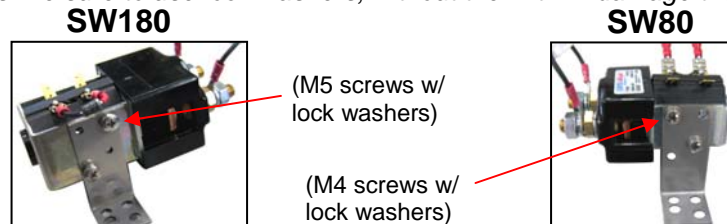


Always wear appropriate eye protection! Place car in tow position before disconnecting the batteries!

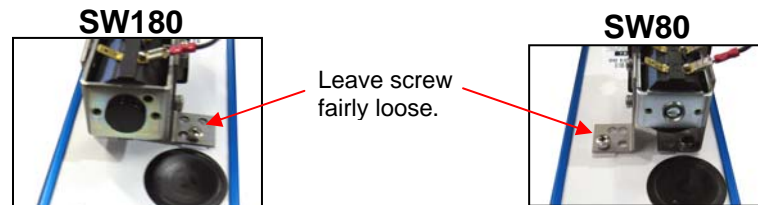
1. Begin by placing the car in the tow position! Disconnect both the positive and negative main power connections to the battery pack.
2. Remove all existing power cables. Remove the rear body inspection cover. Disconnect the activation wiring from the motor, controller, solenoid and run/tow switch. Remove the controller and solenoid from the heat sink.
3. At this point identify the parts that are to be installed.
4. Mount the solenoid.
 - a. Mount the 1st solenoid bracket on top of the controller (use your existing ¼ mounting screws). Note the position for the appropriate solenoid in the pictures below. *Mount using hole closest to corner of bracket: Left side of controller for the SW180, Right side of controller for the SW80.*



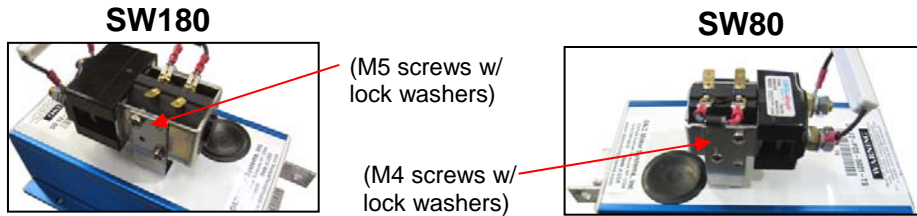
- b. Mount the 2nd bracket to the solenoid. *Mount the bracket to the Right side of the SW180. Mount the bracket to the Left side of the SW80. Uses 2 of the 4 mounting holes. Be sure to use lock washers, without them it will damage the solenoid.*



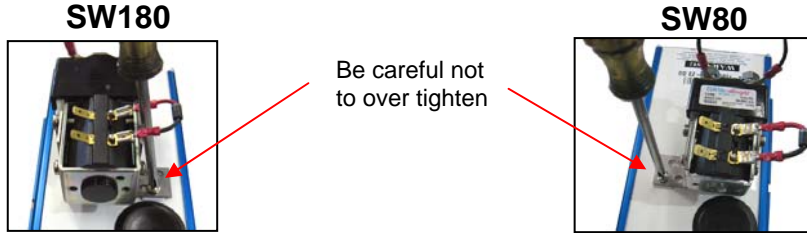
- c. Now mount the solenoid, with bracket attached, to the top of the controller in the remaining hole. At this point only keep screw fairly loose.



- d. Now line up 2 holes on the bracket with the threaded holes on the solenoid and fasten screws. *Be sure to use lock washers, without them it will damage the solenoid. (see pictures on the next page)*



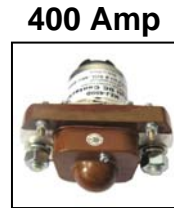
e. Now tighten down the screw from Step 6 above.



f. Other Solenoids.

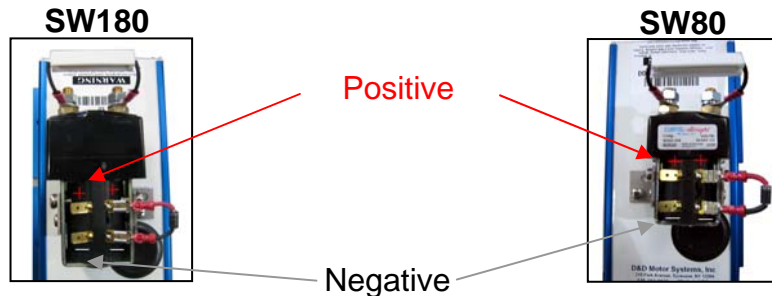


Note: For the 200 amp solenoid, mount as illustrated in the picture to the left.



Note: For the 400 amp solenoid depicted to the left, mount in the existing location on the vehicle.

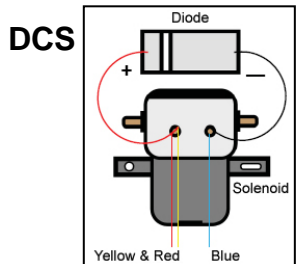
5. Install the resistor across the two large solenoid terminals. Install the diode across the two small solenoid terminals. **Tech Tip:** All connections on the motor, controller and solenoid use connections requiring the double wrench technique. Distorting or damaging connection points are not covered by warranty.



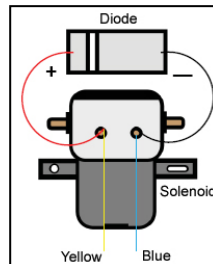
The solenoid has two small terminals for activation. Across these two terminals is a diode. Connections to the diode must be correct! Failure to do so will cause harm to the system and is not covered by warranty.

E-Z-GO: DCS: The Yellow activation wire must connect to the diode red lead (positive). The blue activation wire must connect to the black diode lead (negative). The red accelerator switch wire connects to the red diode lead with the yellow wire.

E-Z-GO: PDS: The Yellow activation wire must connect to the diode red lead (positive). The blue activation wire must connect to the black diode lead (negative).



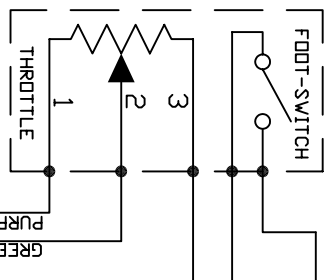
Note: 200 amp Solenoid depicted in this section.



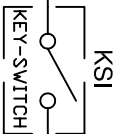
6. Connect all motor and controller connections according to proper wiring diagram.

THROTTLE MAY INCLUDE INTERLOCKS NOT SHOWN

THROTTLE



KSI LOGIC POWER



MR752
-DR-
6A06

FUSE
5A MAX

BATTERY VDC	12-48V 72V
FUSE VDC RATING	60V 100V

PART NO. Doc100-044
1/19/2007

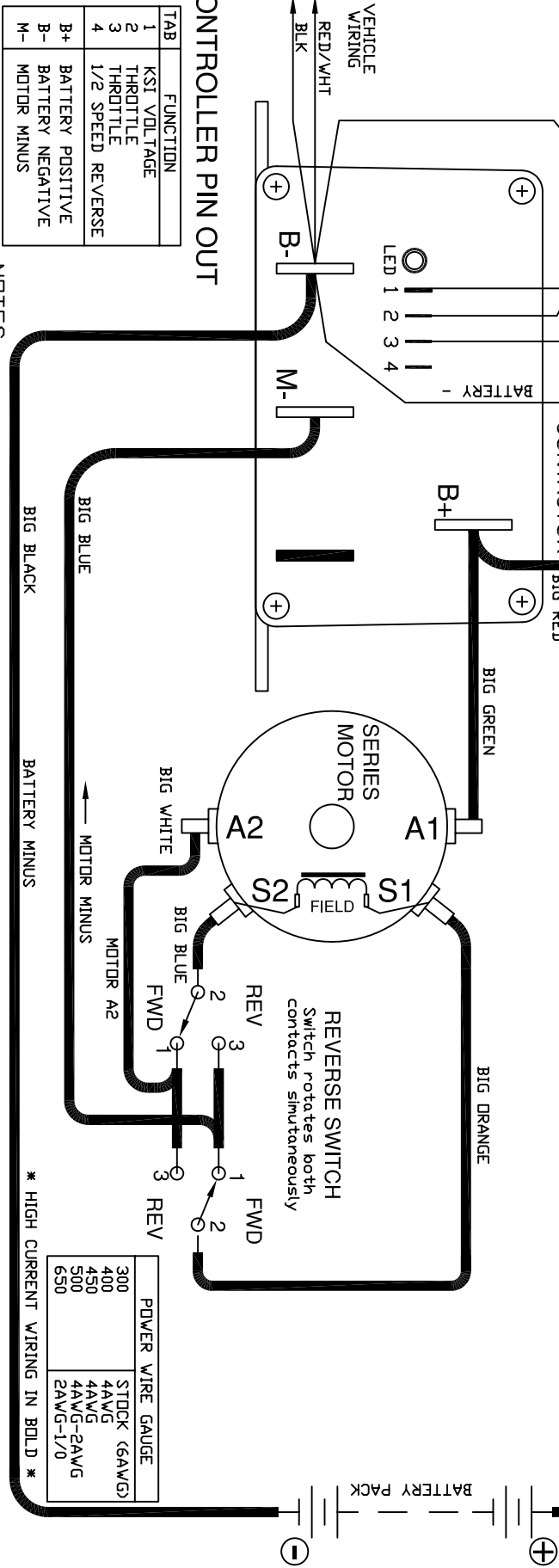
SOL. COIL

CONTACTOR RATING (Observe Coil Voltage)	400amp	450	650
250amp	300	400	450
300	400	450	650

PRE-CHARGE RESISTOR	250_ohm 10W (24-36V)	470_ohm 10W (48V)	1000_ohm 10W (72V)
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ANN250	ANN400
300	450
400	650

Series - CLUB CAR Year: 1996 and NEWER SERIES MOTOR



BATTERY MINUS

* HIGH CURRENT WIRING IN BOLD *

POWER WIRE GAUGE	STOCK (6AWG)	4AWG	4AWG-2AWG	2AWG-1/0
300	400	450	500	650

CONTROLLER PIN OUT

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
- * DIODE REQUIRED ACROSS COILS / RELAYS
- * PRE-CHARGE RESISTOR REQUIRED
- > ASSUMES FOOTSWITCH IS OPEN WHEN THROTTLE OFF WITHOUT NOTICE
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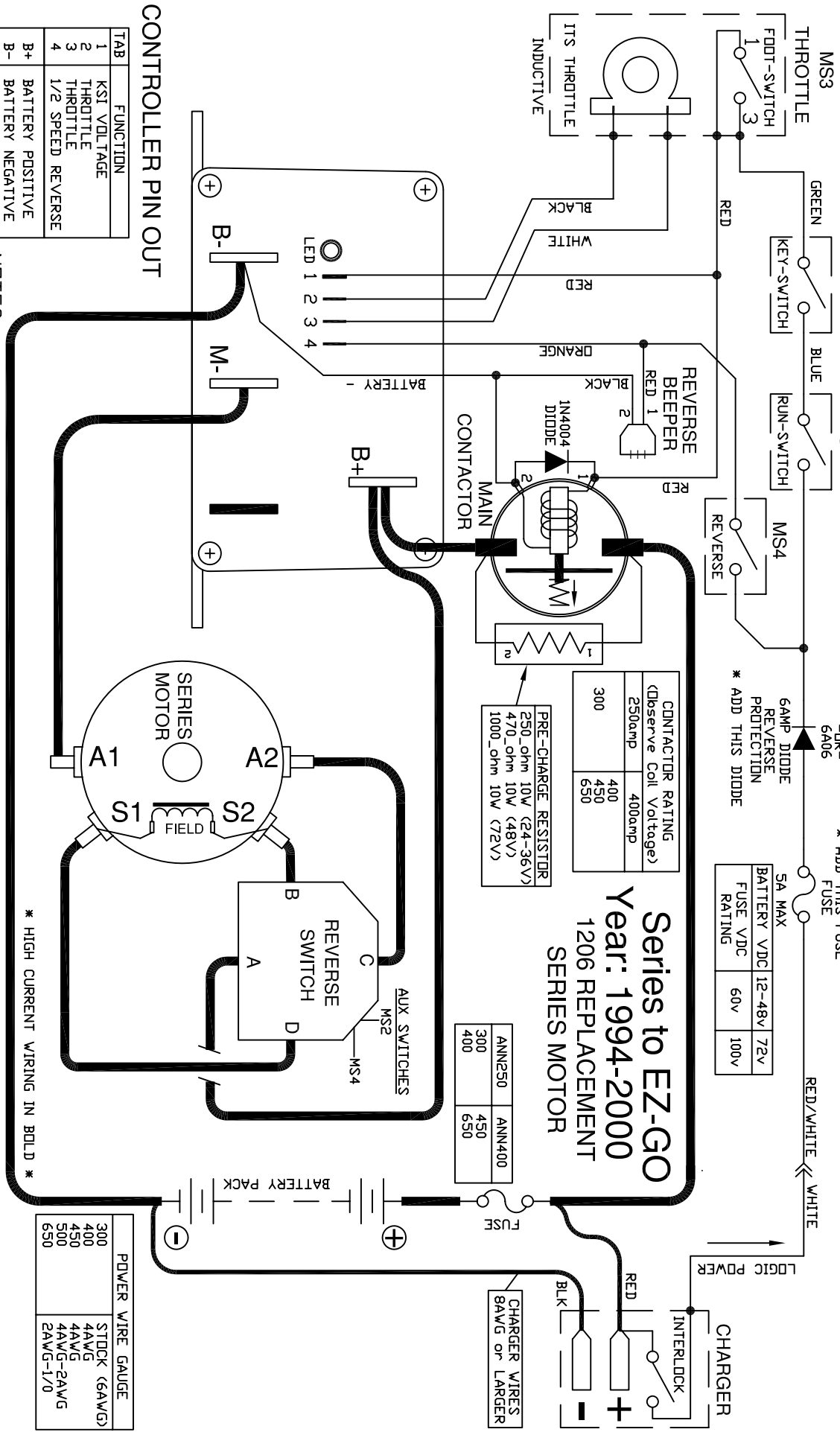
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Series-Club Car 1996 and Newer	Writing Diagram
SIZE DOCUMENT NO.	Doc100-044
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FILE: _DWC-Swiss-Clubcar-1996-wire-dwg SHEET 1of1

DIODE NOT SHOWN ON ORIGINAL SCHEMATIC

MR752 * ADD THIS FUSE
-DR-6A06

PART NO. Doc100-043
12/19/2006



CONTACTOR RATING (Observe Coil Voltage)	
250amp	400amp
300	400
	450
	650

PRE-CHARGE RESISTOR	
250_ohm	10W (24-36V)
470_ohm	10W (48V)
1000_ohm	10W (72V)

ANNES50	
300	ANN400
400	450
	650

POWER WIRE GAUGE	
300	STDC (6AWG)
400	4AWG
450	4AWG
500	4AWG-2AWG
650	2AWG-1/0

CONTROLLER PIN OUT

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

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* HIGH CURRENT WIRING IN BOLD *

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					111306

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TITLE
Series EZGO - 1206 Replacement
Wiring Diagram

SIZE DOCUMENT NO.
A S Doc100-043

FILE: Irqgn-EZGO-Wire-Diagng

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SHEET 1 of 1

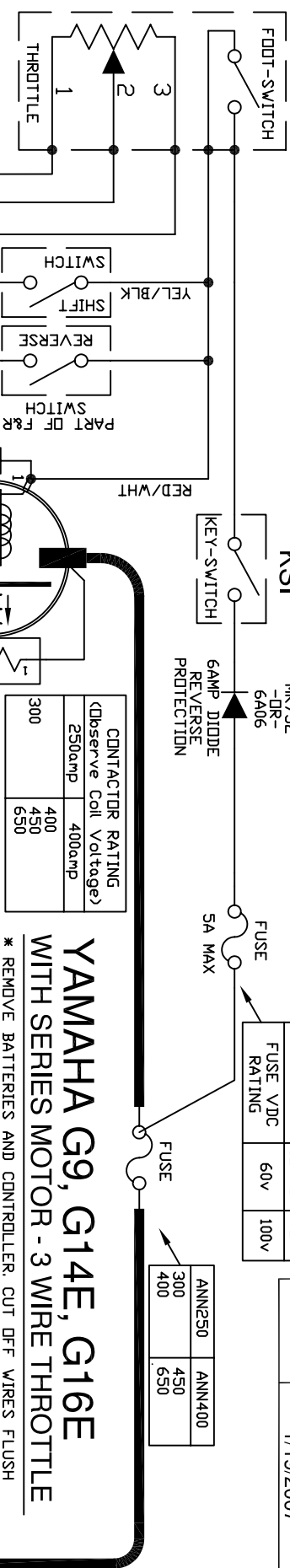
THROTTLE
FDDT-SWITCH
THROTTLE

DIODE NOT SHOWN ON ORIGINAL SCHEMATIC
KSI
MR752
-DR-
6A06

BATTERY VDC 12-48V 72V
FUSE RATING 60V 100V

PART NO. Doc100-050
1/19/2007

ANN250 ANN400
300 450
400 650



**YAMAHA G9, G14E, G16E
WITH SERIES MOTOR - 3 WIRE THROTTLE**

- * REMOVE BATTERIES AND CONTROLLER. CUT OFF WIRES FLUSH WITH FACEPLATE OF OLD CONTROLLER
- * CRIMP 3/16" RING TERM ON YEL/BLK WIRE. CONNECT TO SOLENOID WITH RED/WHT WIRE. CUT OFF BLUE WIRE FLUSH W/CONNECTOR
- * CRIMP 1/4" FEMALE SPADE TO WIRES. CONNECT AS SHOWN
- * BEND CONTROLLER IN CAR BACK TOWARDS BATTERIES, DRILL NEW HOLES FOR CONTROLLER AND INSTALL.
- * CONNECT LARGE WIRES TO CONTROLLER AS FOLLOWS:
 - > A2 TO M- < B+ TO B+ < B- TO B-
- * RECONNECT THROTTLE SENSOR PLUG AND PINK WIRE
- * CUT OFF BROWN WIRE AND TAPE END (DR HEATSHRINK)
- * ADD RESISTOR ACROSS SOLENOID (NOT INCLUDED)
- * ADD DIODE ACROSS SOLENOID COIL (NOT INCLUDED)

PRE-CHARGE RESISTOR

250_ohm 10W (24-36V)
470_ohm 10W (48V)
1000_ohm 10W (72V)

CONTACTOR RATING
(Observe Coil Voltage)

250amp	400amp
300	400
	450
	650

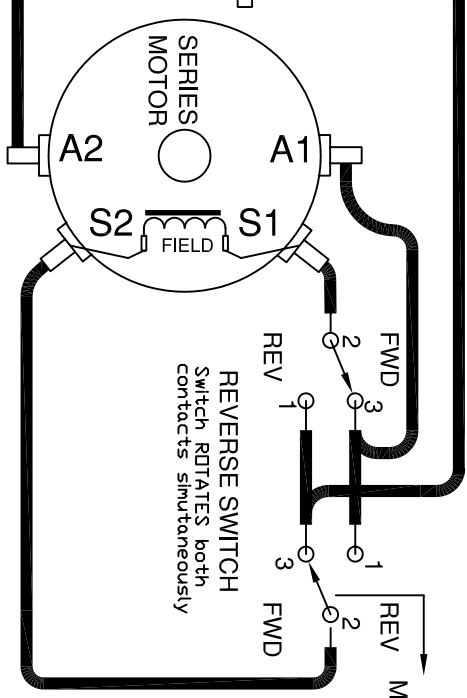
CONTROLLER PIN OUT

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

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BIG BLACK



TO REVERSE MICROSWITCH

WIRE GAUGE	STOCK (6AWG)
300	4AWG
400	4AWG
450	4AWG
500	4AWG-2AWG
650	2AWG-1/0

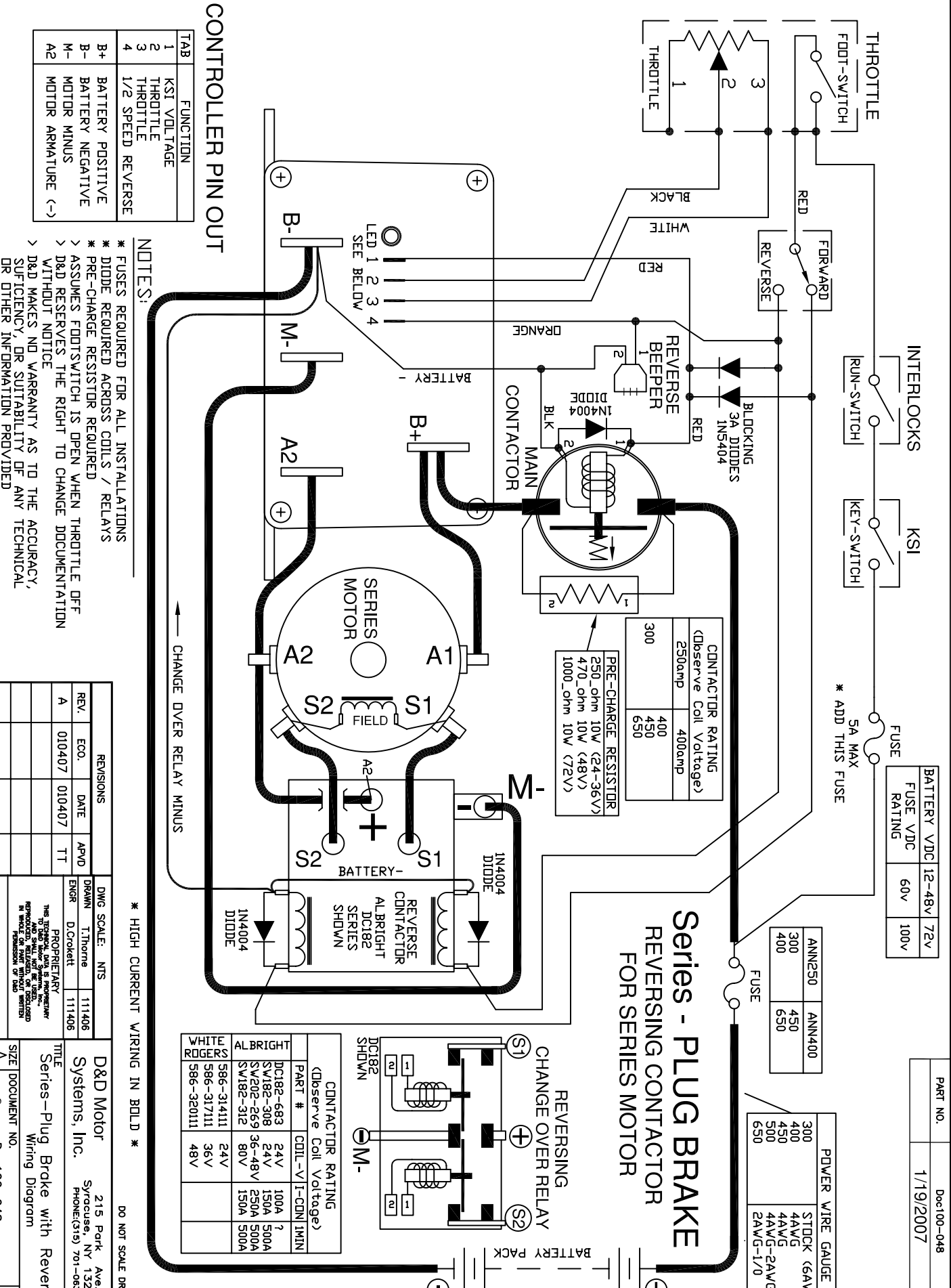
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BATTERY VDC	FUSE VDC RATING	FUSE VDC RATING
12-48V	60V	100V

POWER WIRE GAUGE		
ANN250	ANN400	
300	450	STOCK (6AWG)
400	500	44WG
450	550	44WG-2AWG
500	650	2AWG-1/0

CONTACTOR RATING (Observe Coil Voltage)	PRE-CHARGE RESISTOR
250amp	250_ohm 10W (24-36V)
400amp	470_ohm 10W (48V)
400	1000_ohm 10W (72V)
450	
650	

CONTACTOR RATING (Observe Coil Voltage)			
PART #	COIL-V-I-COM IN/IN	AL BRIGHT	DC182 SHOWN
DC182-683	24V 100A	?	
SV182-308	24V 150A	500A	
SV202-269	36-48V 250A	500A	
SV182-312	80V 150A	500A	
SV86-314111	24V 36V		
SV86-317111	36V 48V		
SV86-320111			

CONTROLLER PIN OUT

TAB	FUNCTION
1	KSI VOLTAGE
2	THROTTLE
3	THROTTLE
4	1/2 SPEED REVERSE
B+	BATTERY POSITIVE
B-	BATTERY NEGATIVE
M-	MOTOR MINUS
A2	MOTOR ARMATURE (-)

NOTES:

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Series-Plug Brake with Reverse Wiring Diagram

SIZE DOCUMENT NO. Doc100-048

REV. A

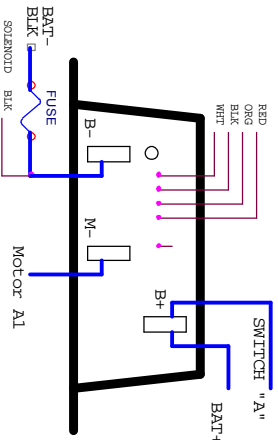
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SHEET 1 of 1

NP CONTROLLER INSTALLATION GUIDE

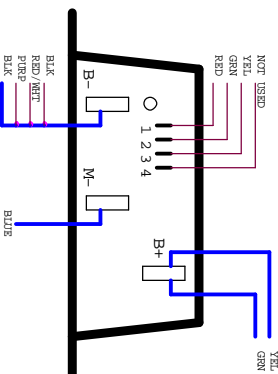
E-Z-GO

Wiring Diagrams



E-Z-GO 5 PIN HOOKUP

300NP (ITS) & 400NP (ITS) Have the EZ-GO 5-Pin Connector for EZ Installation, with ITS Throttle.



CLUB CAR HOOKUP

300NP (5K-0) & 400NP (5K-0) for Club Car are for 96 and newer cars with 5K-0 3wire Throttle.

Club Car

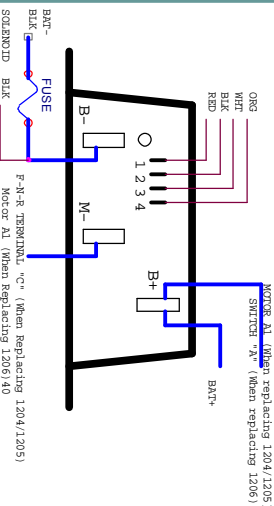
Wiring Diagram

Recommendation

D&D recommends that all motor controller applications have a fuse in the battery circuit. Many vehicles do not have a fuse, and will need to have one installed. The following fuses manufactured by Bussman or Littelfuse are acceptable: For controllers rated at 400 amps or less use ANN250. On controllers rated at 450 amps or more use ANN400.

300NP (0-5K) & 400NP (0-5K) for EZ-GO are for 94 and older cars with 0-5K Throttle

E-Z-GO HOOKUP



E-Z-GO HOOKUP

NP DC Series Non-Programmable Motor Controllers

Our NP Series motor controllers are designed to be stock replacement controllers for stock cars only. With a peak current rating they are not designed for lifted or high performance vehicles. For a high performance controller order our Programmable Series DC motor controllers. NP controllers are not programmable and must be ordered for the exact car you are installing them in.

D&D Motor Systems, Inc.
215 Park Ave.
Syracuse, NY 13204
www.ddmotorsystems.com
Phone: 315-701-0635
Fax: 315-701-0859

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email: sales@ddmotorsystems.com

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www.ddmotorsystems.com

Choose Motor/Controller

Use our Motor/Controller
Selection Guide to locate a motor
based on your performance needs.

Performance Controllers for Shunt Wound DC Motors

- *Programmable
- *All MOSFET design
- *Throttles:
~0-5K ohms
~5K-0 ohms
~ITS



Sizes for 1204 & 1205 footprint

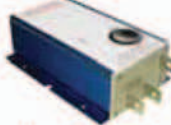
REGEN MODEL #	300	400	500	600
Battery Voltage	24-48V	24-48V	24-48V	24-48V
Current Limit	300A	400A	500A	600A
2 Minute Rating	300A	400A	500A	600A
5 Minute Rating	150A	210A	300A	350A
60 Minute Rating	135A	160A	250A	250A
Voltage Drop @100Amp	<0.30V	<0.10V	<0.09V	<0.08V

Features:

- Reverse does not require changeover relay
- 30 Amp Field Coil
- Configurations Available in DCS, PDS, PD+, G-19, IQ
- 2Amp Contactor Drive
- Reverse Horn Output

Performance Controllers for Series Wound + Perm-Mag DC Motors

- *Programmable
- *ALL MOSFET design
- *Throttles:
~0-5K ohms
~5K-0 ohms
~0-1K ohms
~ITS



Sizes for 1204 & 1205 footprint

SERIES MODEL #	300	400	400L	500	650	300-72V	450-72V
Battery Voltage	24-48V	24-48V	24-48V	24-48V	24-48V	24-72V	24-72V
Current Limit	300A	400A	400A	500A	650A	300A	450A
2 Minute Rating	300A	400A	400A	500A	650A	300A	450A
5 Minute Rating	200A	300A	300A	350A	400A	200A	350A
60 Minute Rating	135A	150A	175A	250A	250A	125A	200A
Voltage Drop @100Amp	<0.30V	<0.13V	<0.18V	<0.09V	<0.08V	<0.16V	<0.11V

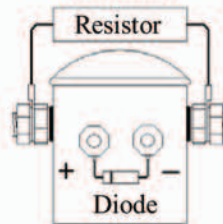
* Plug Brake versions available for most all models

To properly install your D&D controller

Battery / Motor Cable Sizes

Controller	Min wire AWG Standard Duty	Min Wire AWG Heavy Duty
300 Amp	OEM - 6 AWG	4 AWG
400 Amp	4 AWG	4 AWG
450 Amp	4 AWG	2 AWG
500 Amp	2 AWG	2 AWG
600 Amp	2 AWG	1/0 AWG
650 Amp	2 AWG	1/0 to 2/0 AWG

Resistor & Diode Mounting



White Band(Positive)

Pre-Charge Resistor Values

Battery Pack Voltage	Resistor Value
12V-36V	250 Ohm 10W
48V	470 Ohm 10W
72V	1000 Ohm 10W

Protection Diodes across coils

Contacteur Size	Diode	Diode Current
Stock OEM 70-100Amp	1N4004	1A
200A and up contactors	1N5408	3A

Forward/Reverse Switch Sizing

Controller Amperage	F/R Size
400A or less	Stock/HD
450A or more	Heavy Duty



Fuse Values ANN or ANL type



Controller Amperage	Fuse Rating
400A or less	250A
450A or more	400A

Contactors (Solenoids)

Standard Duty— Flat lands with speed and torque and slight or moderate performance expectations



Stock 70 AMP
Used with Stock
Controllers.
**DO NOT Use with
D&D Controller**



Stock 100 AMP
Use with Stock
Controllers 300
AMPS and below
[Stock F&R Switch]

Heavy Duty— Maximum performance, high speed, maximum torque, pulling loads, hilly terrain or hunting buggies.



Performance 200 AMP
Use with 300 and 400
AMP Controllers
[HD F&R Switch]



Heavy Duty 400 AMP
Use with 500 and 600
AMP Controllers
[HD F&R Switch]

Note: Incorrect contactor can cause controller failure.