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
Appendix B – Fuse Installation Guide
Appendix C – Contactor, Resistor Coil and Diode Installation
Appendix D – Vehicle Wiring Schematics
   - Club Car (5K-0)
   - EZ-GO (ITS)
   - 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 away 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.
**Controller Voltage Rating**

**Do Not Exceed**

This diagram assumes the controller is programmed out of the vehicle. See controller programming manual for more information.

Connecting DC Source

CAUTION: Observe polarity when connecting DC source.
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

For Technical Assistance please call us @ 315-701-0635
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.

   
   
   SW180 (500 Amp)  
   Be careful not to over tighten  
   SW80 (400 Amp)

   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.

   
   
   SW180  
   (M5 screws w/ lock washers)  
   SW80  
   (M4 screws w/ lock washers)

   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.

   
   
   SW180  
   Leave screw fairly loose.  
   SW80

   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.

200 Amp

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

400 Amp

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.
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.
- For controllers rated at 500 amps or more use ANN500.
- For controllers rated at 600 amps or more use ANN600.
- For controllers rated at 700 amps or more use ANN700.
- For controllers rated at 800 amps or more use ANN800.
- For controllers rated at 900 amps or more use ANN900.
- For controllers rated at 1000 amps or more use ANN1K.
- For controllers rated at 1100 amps or more use ANN1K1.
- For controllers rated at 1200 amps or more use ANN1K2.

You are installing them in your EZ-GO. You must be ordered for the exact car. The following are not programmable and must be ordered for your specific car:

- Non-Programmable Motor
- NP DC Series

NP Series motor controllers are designed to be stock replacement controllers for stock cars only. With a peak current rating they are not designed to be stock replacement controllers. Our NP Series motor controllers are not programmable.
**Performance Controllers for Shunt Wound DC Motors**

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

Sizes for 1204 & 1205 footprint

**REGEN MODEL #**

<table>
<thead>
<tr>
<th>Battery Voltage</th>
<th>300</th>
<th>400</th>
<th>500</th>
<th>600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Drop @ 100Amp</td>
<td>&lt;0.30V</td>
<td>&lt;0.10V</td>
<td>&lt;0.09V</td>
<td>&lt;0.08V</td>
</tr>
</tbody>
</table>

**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

**Series Model #**

<table>
<thead>
<tr>
<th>Battery Voltage</th>
<th>300</th>
<th>400</th>
<th>400L</th>
<th>500</th>
<th>650</th>
<th>300-72V</th>
<th>450-72V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Drop @ 100Amp</td>
<td>&lt;0.30V</td>
<td>&lt;0.13V</td>
<td>&lt;0.18V</td>
<td>&lt;0.09V</td>
<td>&lt;0.08V</td>
<td>&lt;0.16V</td>
<td>&lt;0.11V</td>
</tr>
</tbody>
</table>

**To properly install your D&D controller**

**Battery / Motor Cable Sizes**

<table>
<thead>
<tr>
<th>Controller</th>
<th>Min Wire AWG Standard Duty</th>
<th>Min Wire AWG Heavy Duty</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 Amp</td>
<td>OEM – 6 AWG</td>
<td>4 AWG</td>
</tr>
<tr>
<td>400 Amp</td>
<td>4 AWG</td>
<td>4 AWG</td>
</tr>
<tr>
<td>450 Amp</td>
<td>4 AWG</td>
<td>2 AWG</td>
</tr>
<tr>
<td>500 Amp</td>
<td>2 AWG</td>
<td>2 AWG</td>
</tr>
<tr>
<td>600 Amp</td>
<td>2 AWG</td>
<td>1/0 AWG</td>
</tr>
<tr>
<td>650 Amp</td>
<td>2 AWG</td>
<td>1/0 to 2/0 AWG</td>
</tr>
</tbody>
</table>

**Resistor & Diode Mounting**

**Pre-Charge Resistor Values**

<table>
<thead>
<tr>
<th>Battery Pack Voltage</th>
<th>Resistor Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>12V-36V</td>
<td>250 Ohm 10W</td>
</tr>
<tr>
<td>48V</td>
<td>470 Ohm 10W</td>
</tr>
<tr>
<td>72V</td>
<td>1000 Ohm 10W</td>
</tr>
</tbody>
</table>

**Protection Diodes across coils**

<table>
<thead>
<tr>
<th>Contactor Size</th>
<th>Diode</th>
<th>Diode Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock OEM 70-100Amp</td>
<td>1N4004</td>
<td>1A</td>
</tr>
<tr>
<td>200A and up</td>
<td>1N5408</td>
<td>3A</td>
</tr>
</tbody>
</table>

**Forward/Reverse Switch Sizing**

<table>
<thead>
<tr>
<th>Controller Amperage</th>
<th>F/R Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>400A or less</td>
<td>Stock/HD</td>
</tr>
<tr>
<td>450A or more</td>
<td>Heavy Duty</td>
</tr>
</tbody>
</table>

**Fuse Values**

<table>
<thead>
<tr>
<th>Controller Amperage</th>
<th>Fuse Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>400A or less</td>
<td>250A</td>
</tr>
<tr>
<td>450A or more</td>
<td>400A</td>
</tr>
</tbody>
</table>

**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

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

- Stock 100 AMP Use with Stock Controllers 300 AMPs and below [Stock F&R Switch]
- 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.