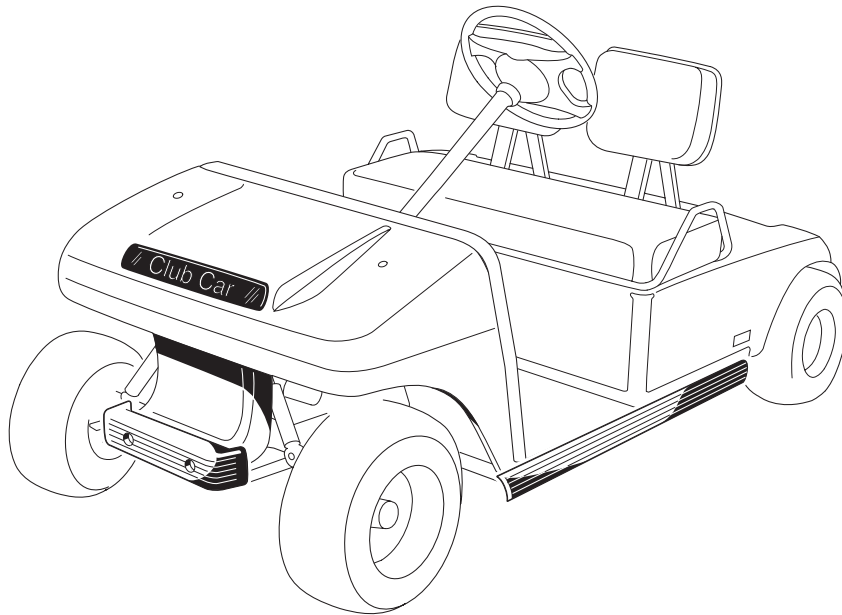


**1998-1999
Maintenance and
Service Manual
Supplement**



PowerDrive Plus Vehicles

Manual Number 101968405
Edition Code 0299C1208B

FOREWORD

The Club Car PowerDrive Plus electric vehicle is engineered and built to provide the ultimate in performance efficiency. However, timely and appropriate vehicle maintenance and repair is essential for long-term vehicle performance and continued safe and reliable service.

This supplement provides detailed information for the maintenance and repair of PowerDrive Plus electric vehicles and should be used in conjunction with the 1998/1999 DS Golf Car Maintenance and Service Manual, Publication Part No. 101968401. If you do not have the 1998/1999 DS Golf Car Maintenance and Service Manual, you may order one from your local Club Car representative.

This supplement and the 1998/1999 DS Golf Car Maintenance and Service Manual should be thoroughly reviewed prior to servicing the vehicle. The procedures provided herein must be properly implemented, and the CAUTION, WARNING, and DANGER statements must be heeded.

This supplement was written for the vehicle technician who already possesses basic knowledge and skills in electrical and mechanical repair. *If the technician does not have such basic knowledge and skills, attempted service or repairs to the vehicle may render the vehicle unsafe.* For this reason, Club Car advises all repairs and/or service be performed by an authorized Club Car distributor/dealer representative or by a Club Car factory trained technician.

This service supplement, along with the appropriate Maintenance and Service Manual, covers all aspects of typical service requirements for the PowerDrive Plus electric vehicle. If you need additional information, you may write to us at: Club Car, Inc.; P.O. Box 204658; Augusta, GA 30917 or contact a Club Car technical service representative at (706) 863-3000, ext. 3580.

©1999 Club Car, Inc.

Club Car, PowerDrive, PowerDrive Plus,
are registered trademarks of Club Car, Inc.

This manual effective August 18, 1997

WARNING

- READ SECTION 1–SAFETY IN THE MAINTENANCE AND SERVICE MANUAL BEFORE ATTEMPTING ANY SERVICE ON THIS VEHICLE.
- BEFORE SERVICING VEHICLE, READ COMPLETE SECTION(S) AND ANY REFERENCED INFORMATION RELEVANT TO SERVICE OR REPAIR TO BE PERFORMED.

NOTE

- THIS MANUAL REPRESENTS THE MOST CURRENT INFORMATION AT THE TIME OF PUBLICATION. CLUB CAR, INC. IS CONTINUALLY WORKING TO FURTHER IMPROVE OUR VEHICLES AND OTHER PRODUCTS. THESE IMPROVEMENTS MAY AFFECT SERVICING PROCEDURES. ANY MODIFICATION AND/OR SIGNIFICANT CHANGE IN SPECIFICATIONS OR PROCEDURES WILL BE FORWARDED TO ALL CLUB CAR DISTRIBUTORS AND DEALERS AND WILL, WHEN APPLICABLE, APPEAR IN FUTURE EDITIONS OF THIS MANUAL.
- DAMAGE TO A VEHICLE OR COMPONENT THEREOF NOT RESULTING FROM A DEFECT OR WHICH OCCURS DUE TO UNREASONABLE OR UNINTENDED USE, OVERLOADING, ABUSE, OR NEGLECT (INCLUDING FAILURE TO PROVIDE REASONABLE OR NECESSARY MAINTENANCE AS INSTRUCTED IN THE VEHICLE OWNER'S MANUAL), ACCIDENT OR ALTERATION, INCLUDING INCREASING VEHICLE SPEED BEYOND FACTORY SPECIFICATIONS OR MODIFICATIONS WHICH AFFECT THE STABILITY OF THE VEHICLE OR THE OPERATION THEREOF, WILL VOID THE WARRANTY.
- CLUB CAR, INC. RESERVES THE RIGHT TO CHANGE SPECIFICATIONS AND DESIGNS AT ANY TIME WITHOUT NOTICE AND WITHOUT INCURRING ANY OBLIGATION OR LIABILITY WHATSOEVER.
- THERE ARE NO WARRANTIES EXPRESSED OR IMPLIED IN THIS MANUAL. SEE THE LIMITED WARRANTY FOUND IN THE VEHICLE OWNER'S MANUAL OR WRITE TO CLUB CAR, INC.

SECTION 10—PERIODIC MAINTENANCE

General Information	10-1
Daily Pre-Operation Safety Checklist	10-2
Periodic Service Schedule	10-3
Lubrication	10-4
Vehicle Capacities	10-4

SECTION 11—ELECTRICAL SYSTEM AND TESTING

General Information	11-1
Electrical Circuits	11-4
The Control Circuit	11-4
The Power Circuit	11-7
Electric Motor	11-10
The Charge Circuit	11-10
Index of Test Procedures	11-11
Diagnostic Flow Charts	11-11
Test Procedures	11-14
The Communication Display Module (CDM)	11-22
Using The Cdm To Retrieve Data From The Onboard Computer	11-23
CDM Troubleshooting Guide	11-24

SECTION 12—ELECTRICAL COMPONENTS

Key Switch	12-2
Forward/Reverse (F&R) Rocker Switch	12-3
Accelerator Pedal Limit Switch	12-4
Reverse Buzzer	12-5
Main Solenoid	12-5
Dynamic Braking Solenoid	12-6
Onboard Computer (OBC)	12-7
Solid State Speed Controller	12-9
Charger Receptacle Assembly	12-9
Receptacle Fuse Link	12-10
Multi-step Potentiometer	12-11
Multi-step Potentiometer Arm Adjustment	12-13
Multi-step Potentiometer Arm Brush Replacement	12-14
Multi-step Potentiometer Adjustment	12-15
Resistors	12-15
Battery Warning Light	12-16
Energy Displacement Module	12-18
Tow/Run Switch	12-19

SECTION 13—BATTERIES

General Information	13-1
Common Misconceptions About Batteries	13-3
Replacing Batteries	13-4
Battery Care	13-5
Preventive Maintenance	13-5
Self-Discharge	13-5
Electrolyte Level	13-5
Mineral Content	13-6
Vibration Damage	13-6
Battery Charging	13-6
General Information	13-6
Charger Shuts Off After 16 Hours	13-7
Deep Discharge	13-7
Early Excessive Discharging	13-7
Incoming AC Service	13-7
Fleet Rotation	13-7
Numbering Vehicles and Chargers	13-7
Battery Testing	13-8
Battery Charger Test	13-8
On-Charge Voltage Test	13-8
Hydrometer Test	13-8
Discharge Test	13-11
Battery Troubleshooting Examples	13-13
Battery Storage	13-14
Charging Battery Pack With Low Voltage	13-14

SECTION 14—POWERDRIVE BATTERY CHARGER

General Information	14-1
PowerDrive Charging Features	14-2
Battery Warning Light	14-3
The Charge Circuit	14-3
Charger Installation and Use	14-3
Checking Battery Condition After A Charge Cycle	14-7
Start Charge Cycle	14-7
Troubleshooting	14-8
Troubleshooting Guide	14-9
Test Procedures	14-12
General	14-12
Plug and Cord Replacement	14-20
Charger Cord and Plug Replacement	14-20

Charger Repairs	14-21
Heat Sink Assembly	14-21
Transformer	14-22
Ammeter	14-22
Fuse Link	14-23
Voltage Suppressor	14-23
Charger Relay	14-24
Charger AC Circuit Breaker	14-25
Charger AC Cord	14-25

SECTION 15—MOTOR

General Information	15-1
External Motor Testing	15-2
Motor	15-3
Testing and Inspecting Individual Components	15-5
Armature	15-5
Field Windings	15-6
Motor Components	15-8
Bearing Inspection	15-8
Bearing Removal	15-8
Guide Ring Inspection	15-8
Reconditioning the Motor	15-9
Motor Assembly	15-10
Motor Installation	15-12
Motor Speed Sensor	15-12

SECTION 16—TRANSAXLE

General Information	16-2
Lubrication	16-2
Axle Shaft and Bearing	16-2
Axle Shaft	16-2
Axle Bearing	16-6
Transaxle	16-8
Transaxle Removal	16-8
Transaxle Disassembly, Inspection and Assembly	16-10
Transaxle Disassembly and Inspection	16-10
Transaxle Assembly	16-12
Shimming the Transaxle	16-14
Transaxle Installation	16-14

SECTION 10—PERIODIC MAINTENANCE

WARNING

- IF ANY PROBLEMS ARE FOUND DURING SCHEDULED INSPECTION OR SERVICE, DO NOT OPERATE THE VEHICLE UNTIL REPAIRS ARE MADE. FAILURE TO MAKE NECESSARY REPAIRS COULD RESULT IN FIRE, PROPERTY DAMAGE, SEVERE PERSONAL INJURY, OR DEATH.
- ALWAYS WEAR SAFETY GLASSES OR APPROVED EYE PROTECTION WHILE SERVICING VEHICLE. WEAR A FULL FACE SHIELD WHEN WORKING WITH BATTERIES.
- ONLY TRAINED MECHANICS SHOULD REPAIR OR SERVICE THIS VEHICLE. ANYONE DOING EVEN SIMPLE REPAIRS OR SERVICE SHOULD HAVE KNOWLEDGE AND EXPERIENCE IN GENERAL ELECTRICAL AND MECHANICAL REPAIR. FOLLOW ALL PROCEDURES EXACTLY AND HEED ALL WARNINGS STATED IN THIS MANUAL.
- TURN KEY SWITCH **OFF**, PLACE FORWARD/REVERSE ROCKER SWITCH IN THE **NEUTRAL** POSITION, AND REMOVE KEY PRIOR TO SERVICING.
- MOVING PARTS! - DO NOT ATTEMPT TO SERVICE THE VEHICLE WHILE IT IS RUNNING.
- HOT! - DO NOT ATTEMPT TO SERVICE HOT MOTOR OR RESISTORS. FAILURE TO HEED THIS WARNING COULD RESULT IN SEVERE BURNS.
- ALWAYS USE INSULATED TOOLS WHEN WORKING NEAR BATTERIES OR ELECTRICAL CONNECTIONS.
- TO AVOID UNINTENTIONALLY STARTING THE VEHICLE, PLACE THE TOW SWITCH IN THE **TOW** POSITION AND DISCONNECT BATTERIES AS SHOWN IN **FIGURE 10-1, PAGE 10-2**, THEN DISCHARGE THE CONTROLLER AS FOLLOWS:
 - PLACE THE FORWARD/REVERSE ROCKER SWITCH IN THE **REVERSE** POSITION AND LISTEN FOR THE REVERSE BUZZER. IF THE REVERSE BUZZER DOES NOT SOUND, THE CAPACITORS ARE DISCHARGED.
 - IF THE REVERSE BUZZER SOUNDS, TURN THE KEY SWITCH TO THE **ON** POSITION AND DEPRESS THE ACCELERATOR PEDAL UNTIL THE BUZZER CAN NO LONGER BE HEARD.
- IMPROPER MAINTENANCE OR USE OF THE VEHICLE COULD RESULT IN DECREASED VEHICLE PERFORMANCE OR SEVERE PERSONAL INJURY.
- LIFT ONLY ONE END OF THE VEHICLE AT A TIME. BEFORE LIFTING, LOCK THE BRAKES AND CHOCK THE WHEELS THAT REMAIN ON THE FLOOR. USE A SUITABLE LIFTING DEVICE (CHAIN HOIST OR HYDRAULIC FLOOR JACK) WITH 1000 LBS. (454 KG.) MINIMUM LIFTING CAPACITY. DO NOT USE LIFTING DEVICE TO HOLD VEHICLE IN RAISED POSITION. ALWAYS USE APPROVED JACKSTANDS OF PROPER WEIGHT CAPACITY TO SUPPORT VEHICLE.

GENERAL INFORMATION

To ensure continued reliable performance of the PowerDrive Plus vehicle, a Preventive Maintenance program should be established and followed. Preventive maintenance consists of the regular performance of scheduled vehicle service and maintenance procedures, and is the only way to ensure the vehicle provides the safe, reliable, and economical service it is designed to deliver. The following charts provide recommended service intervals for the lubrication and maintenance of the PowerDrive Plus vehicle. Note that critical areas such as brake operation, accelerator operation, steering and tires should be performed daily. These checks can easily be performed when moving the vehicle from the storage facility to the starting line. Any vehicle that is not functioning properly should be removed from service until it has been repaired.

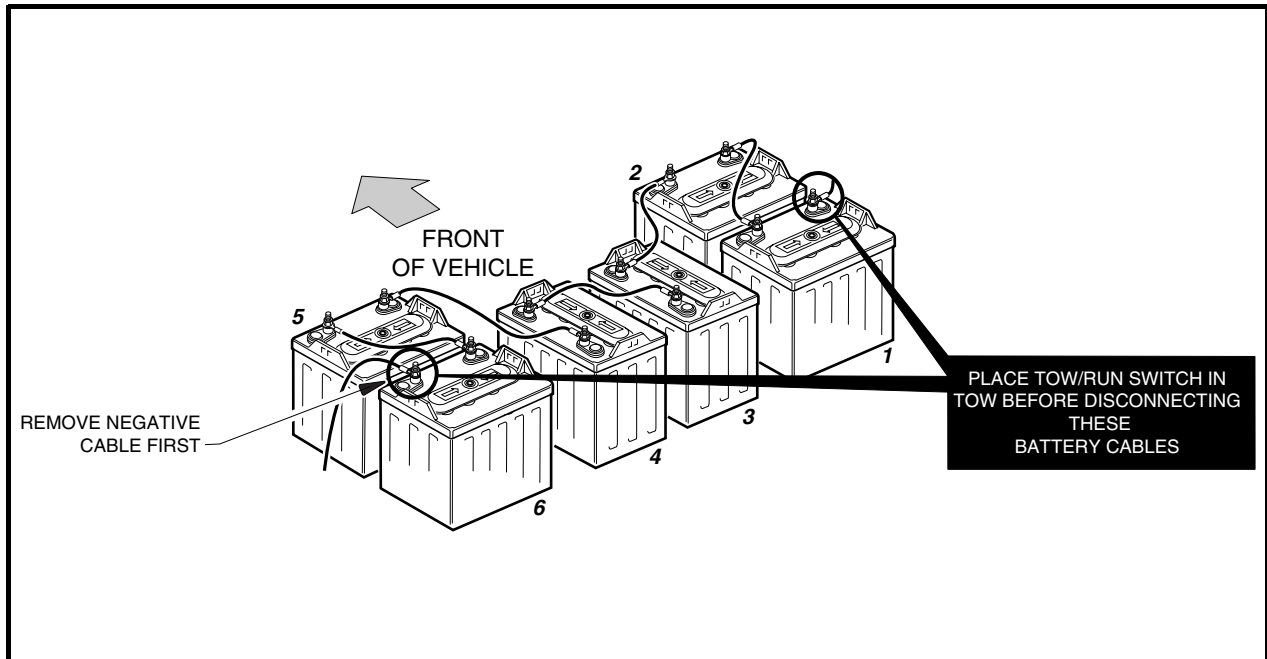


Figure 10-1 Battery Bank for PowerDrive Plus Vehicle

DAILY PRE-OPERATION SAFETY CHECKLIST

Inspect and drive the vehicle. Use the Pre-operation Checklist and Performance Inspection in Section 3–General Information located in the 1998/1999 DS Maintenance and Service Manual as a guide to check the following items.

- Vehicle warning decals
- Brake system
- Park brake
- Reverse warning buzzer
- Steering and linkages
- Proper acceleration and maximum speed
- Batteries
- Accelerator Switch

In addition, check the items listed below:

- Tires: Visually inspect for wear, damage and proper inflation.
- Forward/Reverse switch: Check for proper operation. **See Section 3–General Information, Controls, in the 1998/1999 DS Maintenance and Service Manual.**

PERIODIC SERVICE SCHEDULE

WARNING

- SERVICE, REPAIRS, AND ADJUSTMENTS MUST BE MADE PER INSTRUCTIONS IN THE 1998/1999 DS GOLF CAR MAINTENANCE & SERVICE MANUAL AND THIS SUPPLEMENT.

NOTE

- IF THE VEHICLE IS CONSTANTLY SUBJECTED TO HEAVY USE OR SEVERE OPERATING CONDITIONS, THE PREVENTATIVE MAINTENANCE PROCEDURE SHOULD BE PERFORMED MORE OFTEN THAN RECOMMENDED IN THE SERVICE AND LUBRICATION SCHEDULES.
- BOTH THE PERIODIC SERVICE SCHEDULE AND PERIODIC LUBRICATION SCHEDULE MUST BE FOLLOWED TO KEEP VEHICLE IN OPTIMUM OPERATING CONDITION.

PERIODIC SERVICE SCHEDULE

REGULAR INTERVAL	SERVICE	
Daily Service by Owner	Batteries	Charge batteries (after each use only).
Weekly Service by Owner	Batteries	Check electrolyte level. Add water as necessary per Section 13–Batteries.
Monthly Service by Owner or Trained Technician	Batteries	Wash battery tops and clean terminals with baking soda/ water solution. Dispose of waste water properly.
	Tires	Check air pressure and adjust as necessary. See Vehicle Capacities Chart on Page 10-4.
	Multi-step Potentiometer	Check for cracks or other damage; make sure switch is securely fastened to frame. Check movable contact for correct operation.
	General Vehicle	Wash battery compartment and underside of vehicle. Dispose of waste water properly.
Semi-annual Service by Trained Technician Only (Every 50 hours of operation or 100 rounds of golf).	Brake System	Check brake shoes; replace if necessary. See Section 6, in the DS Maintenance and Service Manual.
		Lubricate brake slides per Lubrication Schedule. See Section 6 in the DS Maintenance and Service Manual.
		Check brake cables for damage; replace as required.
	Electrical wiring and connections	Check for tightness and damage.
	Forward and Reverse (F&R) Rocker Switch	Check condition of wire connections. Make sure connections are tight.
	Front Wheel Alignment and Camber	Check and adjust as required. See Section 7 in the DS Maintenance & Service Manual.
Annual Service by Trained Technician Only (Every 100 hours of operation or 200 rounds of golf).	Batteries	If batteries are not performing as expected, refer to Section 13–Batteries.

WARNING

- IF ANY PROBLEMS ARE FOUND, DO NOT OPERATE THE VEHICLE UNTIL REPAIRS ARE MADE. FAILURE TO MAKE NECESSARY REPAIRS COULD RESULT IN FIRE, PROPERTY DAMAGE, SEVERE PERSONAL INJURY, OR DEATH.

LUBRICATION

PERIODIC LUBRICATION SCHEDULE

REGULAR INTERVAL	SERVICE	PLACE*	RECOMMENDED LUBRICANT
Semi-Annually by Owner or Trained Technician (Every 50 hours of operation or every 100 rounds of golf).	Brake pedal shaft bearings	1.	Dry Moly Lube - Club Car Part No. 1012151
	Brake Linkage and Pivots	2.	Dry Moly Lube - Club Car Part No. 1012151
	Accelerator push rod pivots and mounts	3.	Dry Moly Lube - Club Car Part No. 1012151
	Forward/Reverse Switch Contacts and charger receptacle	4.	WD 40
	Brake Slides	5.	Dry Moly Lube - Club Car Part No. 1012151
	Front Suspension (5 fittings)	6.	Chassis Lube - EP NLGI Grade 2
Annually by Trained Technician Only (Every 100 hours of operation or 200 rounds of golf)	Check/fill transaxle to plug level	7.	22 oz. (.67 liter) SAE 30 WT. API Class SE, SF, or SG Oil (or higher)
	Inspect front wheel bearings (Repack as necessary)	8.	Chassis Lube - EP NLGI Grade 2

*See Figure 10-2 below.

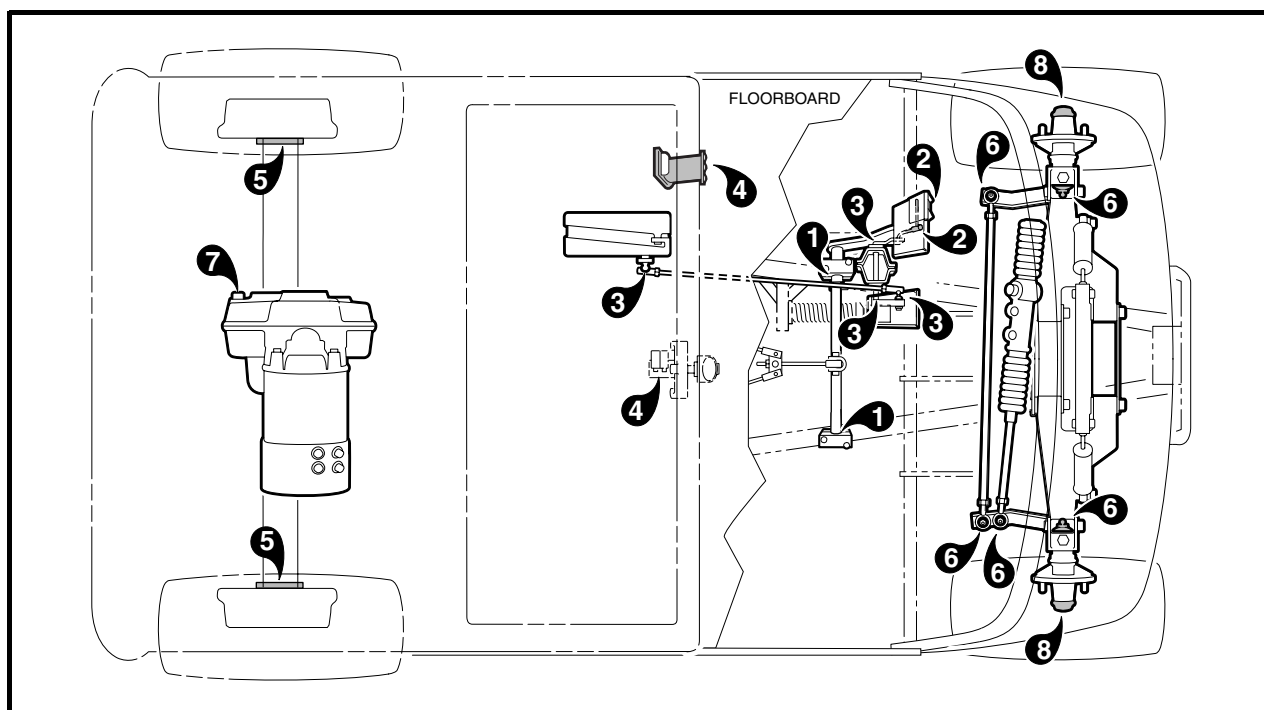


Figure 10-2 Vehicle Lubrication Points

VEHICLE CAPACITIES

CAPACITIES	
Transaxle	22 oz. (.67 liters)
Tire Pressure	18-20 psi (124-138 kPa)

SECTION 11—ELECTRICAL SYSTEM AND TESTING

DANGER

- THE BATTERY WIRES MUST REMAIN CONNECTED WHILE PERFORMING SOME TEST PROCEDURES.
- RAISE THE REAR END OF THE VEHICLE AND SUPPORT ON JACKSTANDS. REAR WHEELS SHOULD BE OFF THE GROUND WHILE PERFORMING ALL TEST PROCEDURES.
- BATTERY - EXPLOSIVE GASES! DO NOT SMOKE. KEEP SPARKS AND FLAMES AWAY. VENTILATE WHEN CHARGING OR USING IN AN ENCLOSED SPACE. ALWAYS WEAR FULL FACE SHIELD WHEN WORKING ON OR NEAR BATTERIES.
- USE EXTREME CAUTION WHEN USING TOOLS, WIRES, OR METAL OBJECTS NEAR BATTERIES! A SHORT CIRCUIT AND (OR) SPARK COULD CAUSE AN EXPLOSION.
- BATTERY - POISON! CONTAINS ACID! CAUSES SEVERE BURNS. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. ANTIDOTES:
 - EXTERNAL: FLUSH WITH WATER. CALL A PHYSICIAN IMMEDIATELY.
 - INTERNAL: DRINK LARGE QUANTITIES OF MILK OR WATER. FOLLOW WITH MILK OF MAGNESIA OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.
 - EYES: FLUSH WITH WATER FOR FIFTEEN MINUTES. CALL PHYSICIAN IMMEDIATELY.

WARNING

- ONLY TRAINED TECHNICIANS SHOULD REPAIR OR SERVICE THIS VEHICLE. ANYONE DOING EVEN SIMPLE REPAIRS OR SERVICE SHOULD HAVE KNOWLEDGE AND EXPERIENCE IN GENERAL MECHANICAL AND ELECTRICAL REPAIR. FOLLOW ALL PROCEDURES EXACTLY AND HEED ALL WARNINGS STATED IN THIS MANUAL.
- ALWAYS WEAR SAFETY GLASSES OR APPROVED EYE PROTECTION WHILE SERVICING VEHICLE.
- TURN KEY SWITCH **OFF**, PLACE FORWARD/REVERSE ROCKER SWITCH IN THE **NEUTRAL** POSITION, AND REMOVE KEY PRIOR TO SERVICING.
- DO NOT WEAR LOOSE CLOTHING. REMOVE JEWELRY SUCH AS RINGS, WATCHES, CHAINS, ETC. BEFORE SERVICING VEHICLE.
- ALWAYS USE INSULATED TOOLS WHEN WORKING NEAR BATTERIES OR ELECTRICAL CONNECTIONS. WHEN BATTERIES ARE CONNECTED, USE EXTREME CAUTION TO AVOID SHORTING OF COMPONENTS OR WIRING.
- TO AVOID UNINTENTIONALLY STARTING THE VEHICLE, PLACE TOW/RUN SWITCH IN **TOW**, THEN DISCONNECT BATTERIES AS SHOWN IN **FIGURE 11-9, PAGE 11-10** WHEN PERFORMING TESTS THAT DO NOT REQUIRE THE ELECTRICAL SYSTEM TO BE ENERGIZED.

GENERAL INFORMATION

The PowerDrive Plus vehicle uses a 48-volt electrical system that is powered by six eight-volt lead-acid batteries and includes an onboard computer. The electrical system in a PowerDrive Plus vehicle uses a shunt wound 3.2 hp motor and includes several additional features.

- **Shunt Wound Motor:** Unlike a series wound motor which increases or decreases the current flow (amperage) through the armature and field coils at the same rate, a shunt wound motor is able to vary the amount of amperage passing through the field coils separately from the current flow passing through the armature.
- **Motor Braking:** Under certain conditions a shunt wound motor also has the ability to act as an electrical brake to slow the vehicle. There are three features of the PowerDrive Plus electrical system which will activate the motor braking function: *Zero Speed Detect*, *Pedal Down Motor Braking*, and *Pedal Up Motor Braking*.

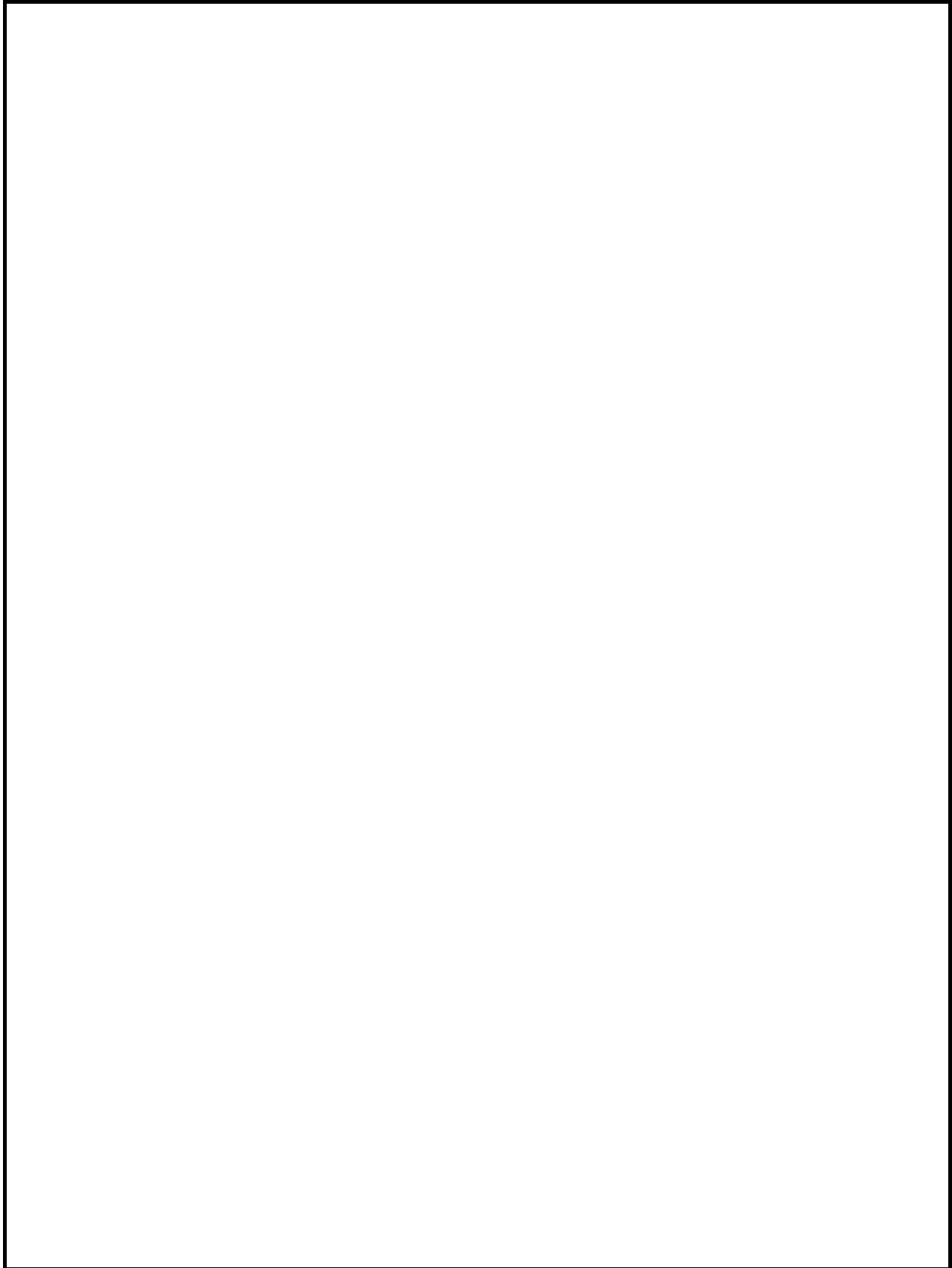


Figure 11-1 Wiring Schematic - Place Holder for Fold-out Drawing

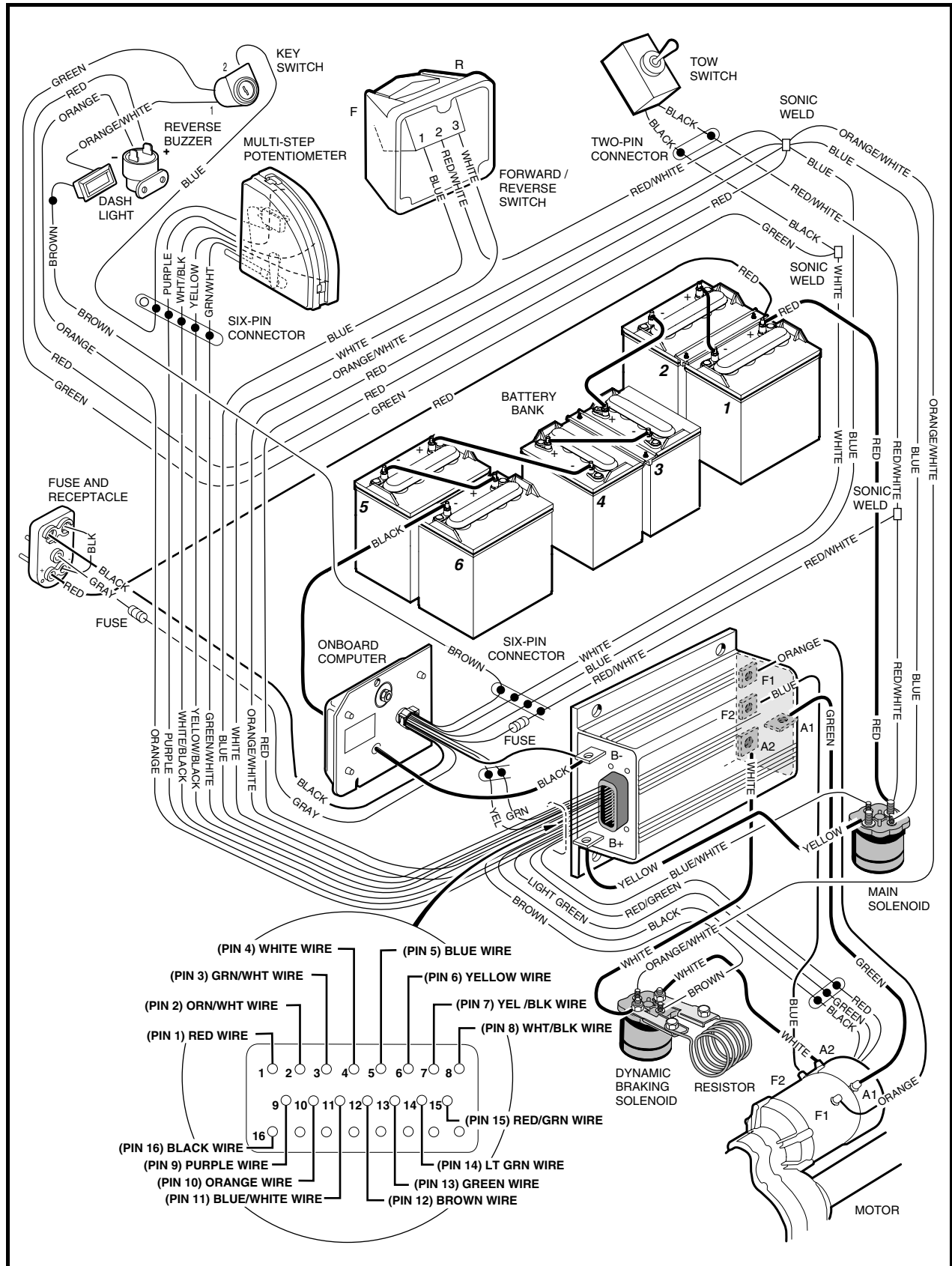


Figure 11-2 Wiring Diagram

- **Zero Speed Detect:** This prevents the vehicle from rolling away uncontrolled should the driver park on a slope and leave the vehicle without locking the park brake. The vehicle will roll at about 1 mph. If the zero speed detect function remains engaged for two seconds or more, a warning buzzer will sound to alert the driver that motor braking has been activated.

⚠ WARNING

- ZERO SPEED DETECT MAY NOT HOLD THE VEHICLE ON VERY STEEP GRADES. DO NOT OPERATE VEHICLE ON SLOPES EXCEEDING 20% GRADES.

- **Pedal Down Motor Braking:** This feature helps to control vehicle downhill speed. When vehicle speed exceeds approximately 15 mph motor braking is activated, which holds top speed to approximately 13-15 mph. Motor braking is automatically disengaged when vehicle speed slows below approximately 13 mph.
- **Pedal Up Motor Braking:** When vehicle speed is above 12 mph, releasing the accelerator pedal will activate motor braking, which slows the vehicle to approximately 9 mph. Once vehicle speed slows to below approximately 9 mph with the accelerator pedal still released, motor braking will be deactivated and the vehicle will coast freely.
- **Motor/Generator:** During motor braking, the motor acts as a generator which creates electrical current. The PowerDrive Plus electrical system has two current generating functions: *Regenerative Braking* and *Dynamic Braking*.
- **Regenerative Braking:** When motor braking is activated, the vehicle motor acts as a generator, slowing the vehicle as it creates energy that is used to charge the batteries.
- **Dynamic Braking:** If the batteries are at or near full charge and do not require an additional charge, the energy created as the motor slows the vehicle is disposed of through the energy displacement module.
- **Tow/Run Switch:** When the Tow/Run switch is in the RUN position, the vehicle will function normally. When the switch is in the TOW position, power to the OBC and controller is shut off, disabling the vehicle operating circuit and zero speed detect, allowing the vehicle to be towed.
- **Motor Protection Circuit:** If the vehicle is held in position on an incline by partially depressing the accelerator pedal instead of the brake, motor overheating could result. The motor protection circuit reduces the possibility of motor damage during this circumstance.
- **High Pedal Detect:** This function prevents unexpected vehicle movement if the key switch is turned ON after the accelerator is depressed. The vehicle will not move until the accelerator is depressed again.
- **Onboard Computer (OBC):** The OBC, 1) monitors battery condition, 2) monitors the rate of discharge while the vehicle is in use, 3) determines the amount of charge required based on the amount of use and shuts the charger off when this number is reached, 4) determines when to activate regenerative motor braking, 5) stores operating data which can be read by the Communication Display Module (CDM) and 6) locks out vehicle movement while the charger is plugged in.

ELECTRICAL CIRCUITS

Read DANGER and WARNING on page 11-1.

The PowerDrive Plus vehicle has three distinct circuits: 1) the Control Circuit (**Figure 11-5, Page 11-8**), 2) the Power Circuit (**Figure 11-7, Page 11-9**), and 3) the Charge Circuit (**Figure 11-8, Page 11-10**).

THE CONTROL CIRCUIT

The Control Circuit consists of three individual circuits, 1) Onboard Computer Circuit (**Figure 11-4, Page 11-6**), 2) Solid State Speed Control Circuit (**Figure 11-5, Page 11-8**), and 3) Tow Switch Circuit (**Figure 11-6, Page 11-9**).

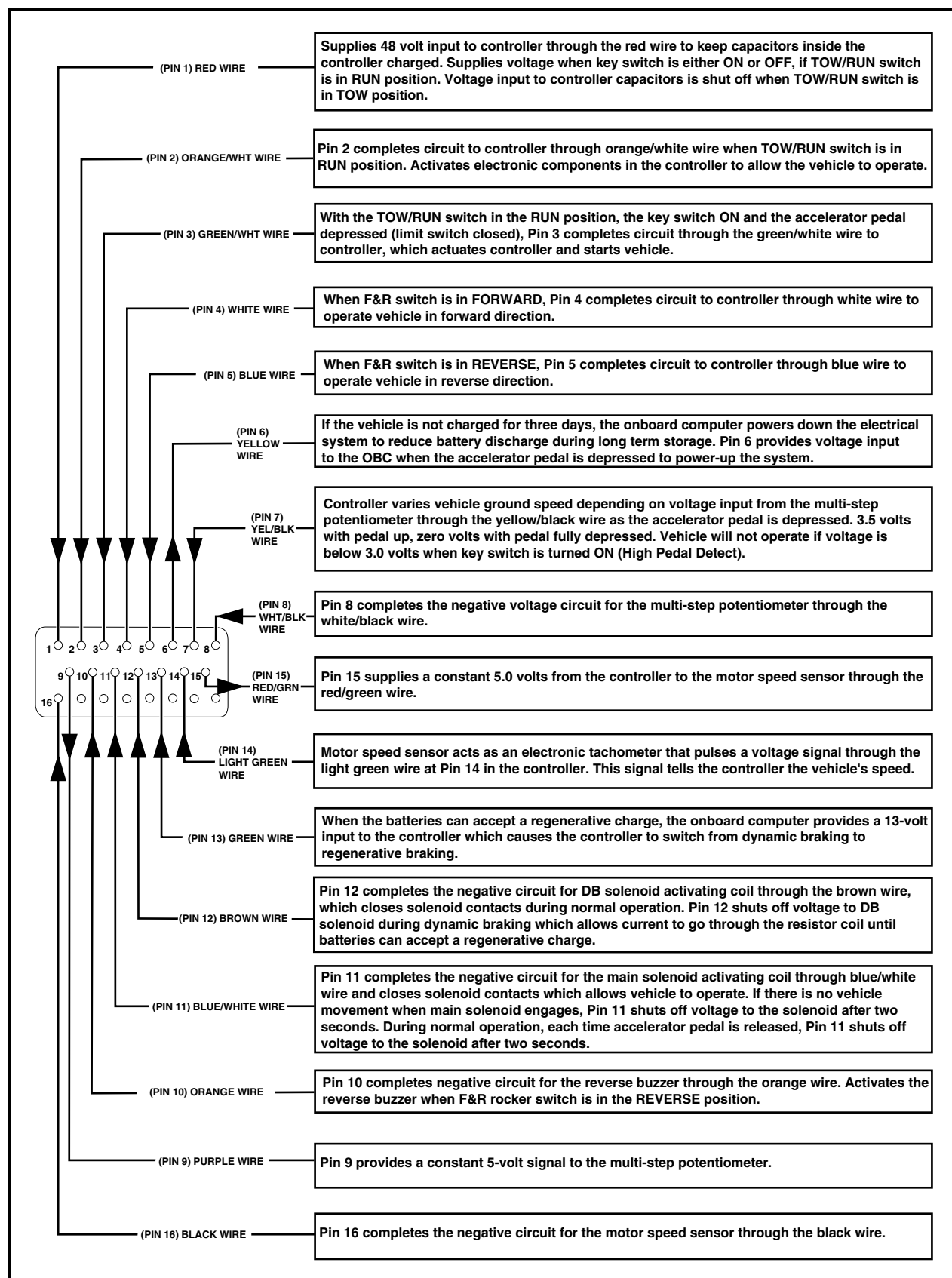


Figure 11-3 23-Pin Connector Plug

Onboard Computer Circuit

The onboard computer (OBC) circuit performs the following functions:

1. Provides power to the solenoids, Forward/Reverse switch, controller capacitors and reverse buzzer.
2. Powers down the electrical system during long term storage to reduce battery discharge.
3. Activates regenerative braking when the batteries can accept a regenerative charge.
4. Turns the charger ON and OFF during the charge cycle.
5. Locks out the motor speed controller to prevent the vehicle from moving during the charge cycle.
6. Illuminates the dash warning light if there is a problem with the batteries.
7. Sends a signal from the dash light to the optional Communication Display Module.

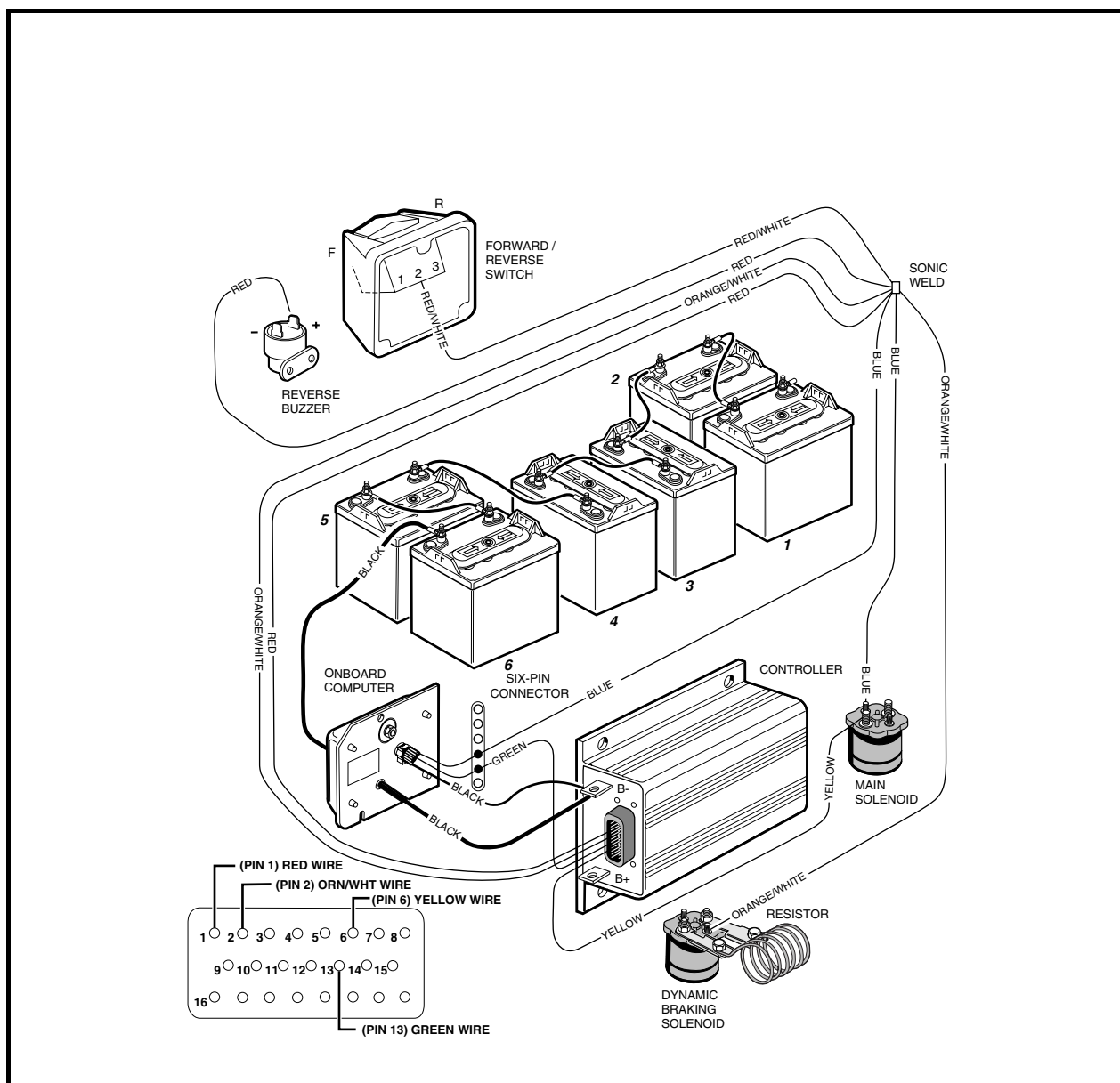


Figure 11-4 Onboard Computer Circuit

Battery Warning Light

The dash light performs two functions for the vehicle's electrical system:

Warning Light: The warning light alerts the operator to any problems with the batteries or charging system. The warning light will illuminate under the following conditions:

1. Battery no-load voltage drops below 48 volts.
2. Batteries have discharged more than 75% of rated capacity.
3. AC power is interrupted during the charge cycle (DC plug is still connected).
4. Charge cycle times out at 16 hours.
5. When the DC cord is unplugged before the charge cycle is completed, the warning light will illuminate for 10 seconds if the charge is less than 90% complete.

LED Light: In addition to the warning light, there is an infrared LED in the dash light assembly which transmits an infrared signal from the OBC. This signal is received by the optional Communication Display Module which provides information on the condition of the vehicle and batteries. **See page 11-22.**

Solid State Speed Control Circuit

The Control Circuit performs the following functions:

1. Monitors vehicle ground speed through the motor speed sensor.
2. Regulates vehicle ground speed by using the multi-step potentiometer to determine accelerator pedal position.
3. Activates the reverse buzzer when the Forward/Reverse rocker switch is in REVERSE.
4. Regulates direction of vehicle movement through the Forward/Reverse switch.
5. Activates the solenoids.

Tow/Run Switch Circuit

The Tow/Run switch performs the following functions:

1. Provides power to the key switch and the dash warning light when in the RUN position.
2. Provides power to the No. 18 white OBC wire when in the RUN position.
3. Deactivates the vehicle's control circuit when in the TOW position.

THE POWER CIRCUIT

The function of the power circuit is to supply voltage from the battery pack to the motor. When regenerative motor braking is activated, the power circuit will direct motor-generated current to either the batteries or the energy displacement module, depending on the battery pack state of charge.

The Power Circuit consists of:

- Battery Pack (six eight-volt batteries)
- Solid State Speed Controller
- Electric Motor
- Solenoid Contacts
- Energy Displacement Module (Resistor Coil)
- All 6 Gauge Power Wires

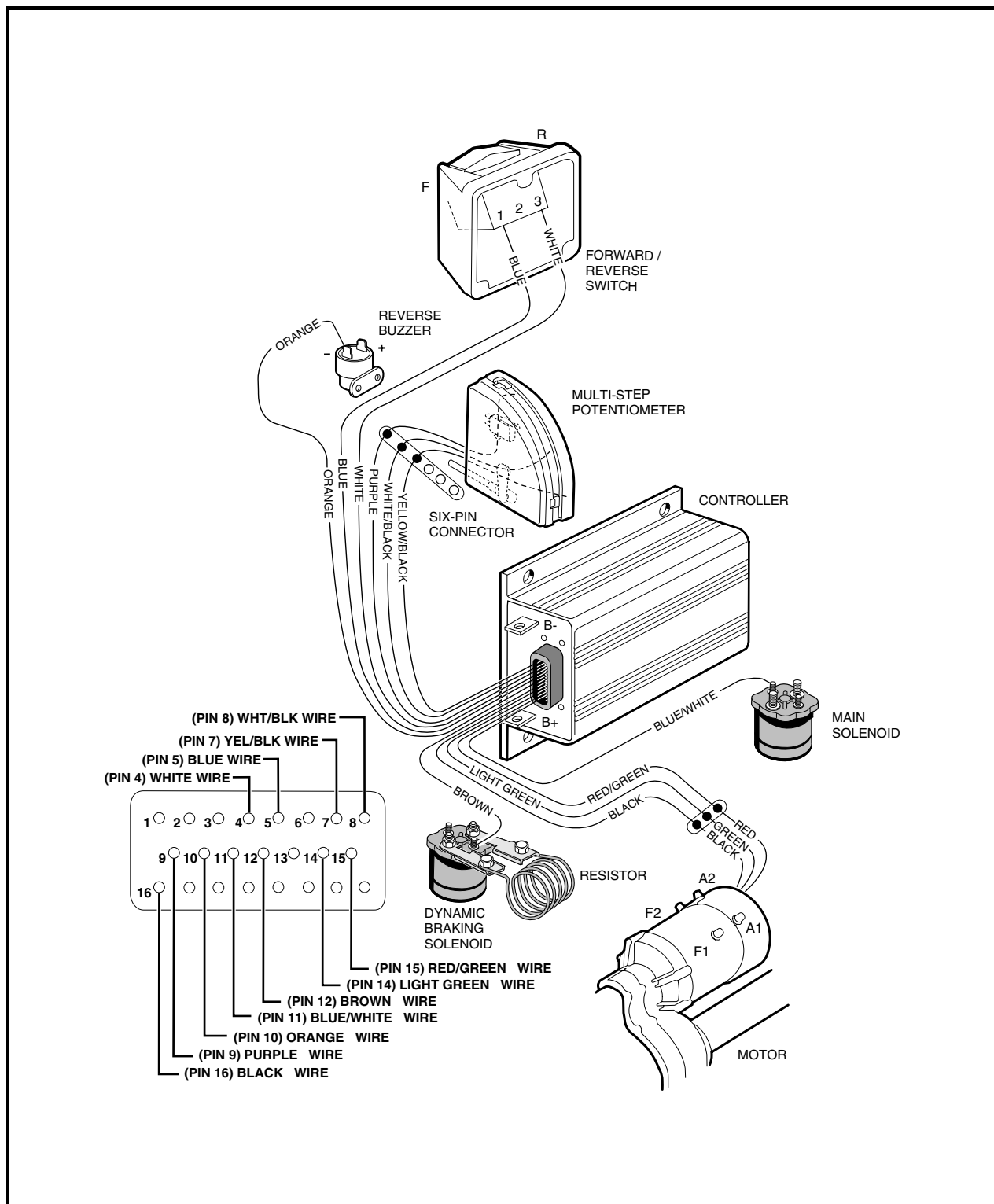


Figure 11-5 Solid State Speed Control Circuit

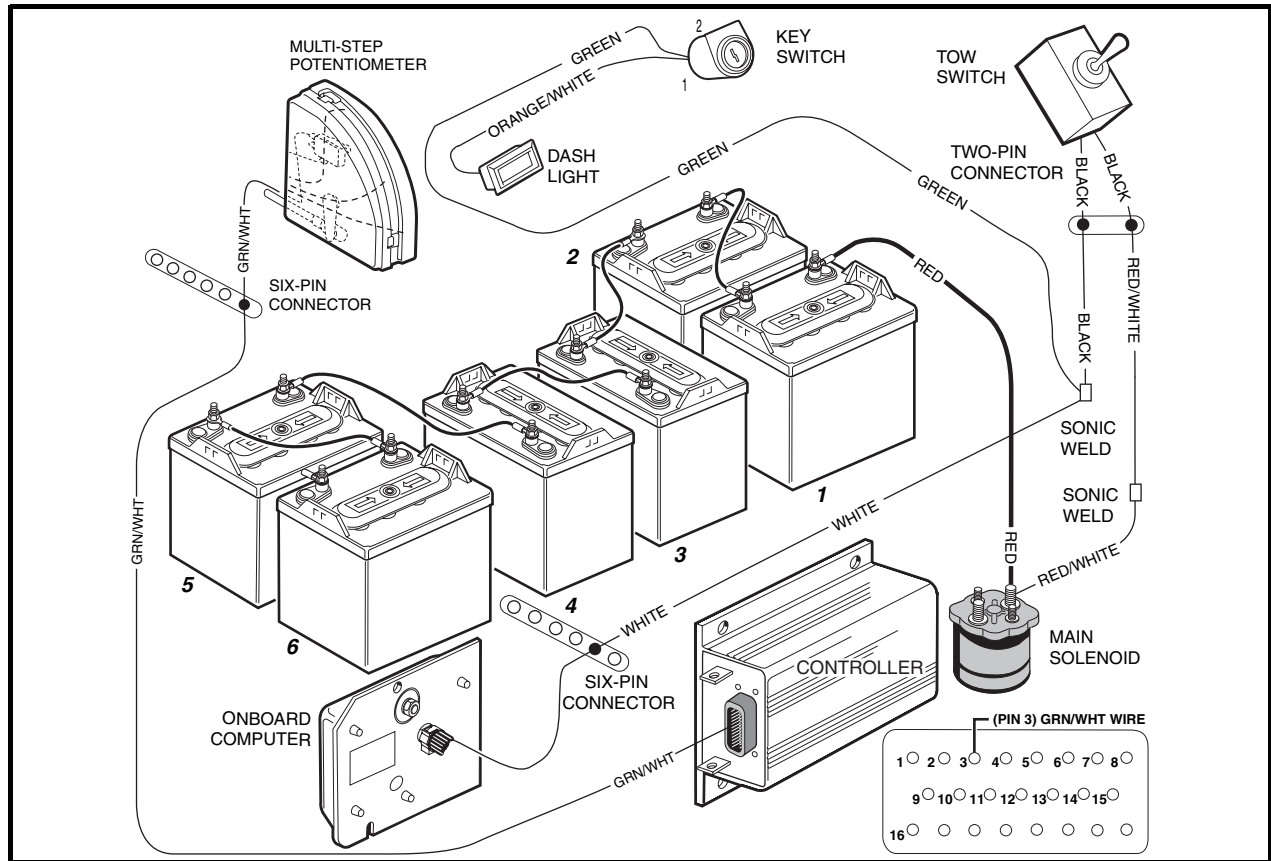


Figure 11-6 Tow Switch Circuit/Components

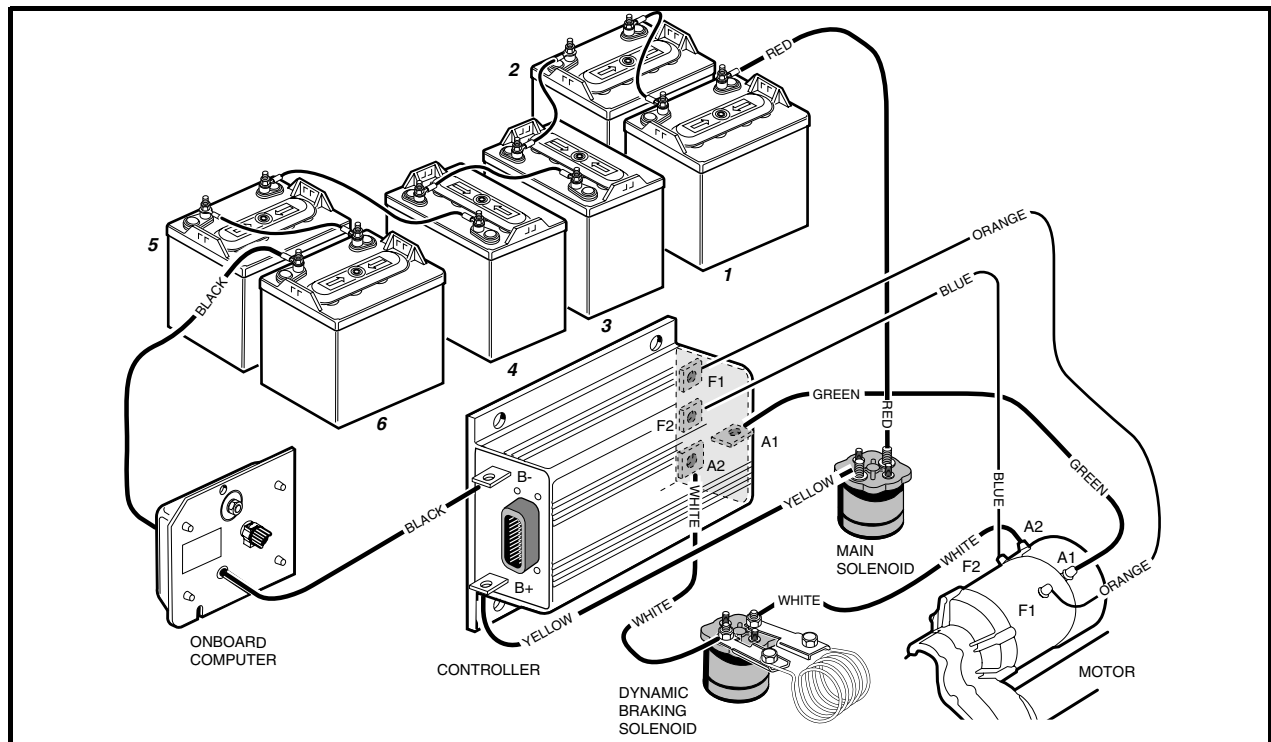


Figure 11-7 Power Circuit

ELECTRIC MOTOR

The electric motor is discussed in **Section 15–Motor**.

THE CHARGE CIRCUIT

The charge circuit consists of the onboard computer, battery charger, DC charger plug, charger receptacle, receptacle fuse link and the battery pack. The charge circuit supplies current from the battery charger to the batteries when the DC cord is plugged into the vehicle's charger receptacle. The batteries will be discussed in **Section 13–Batteries**.

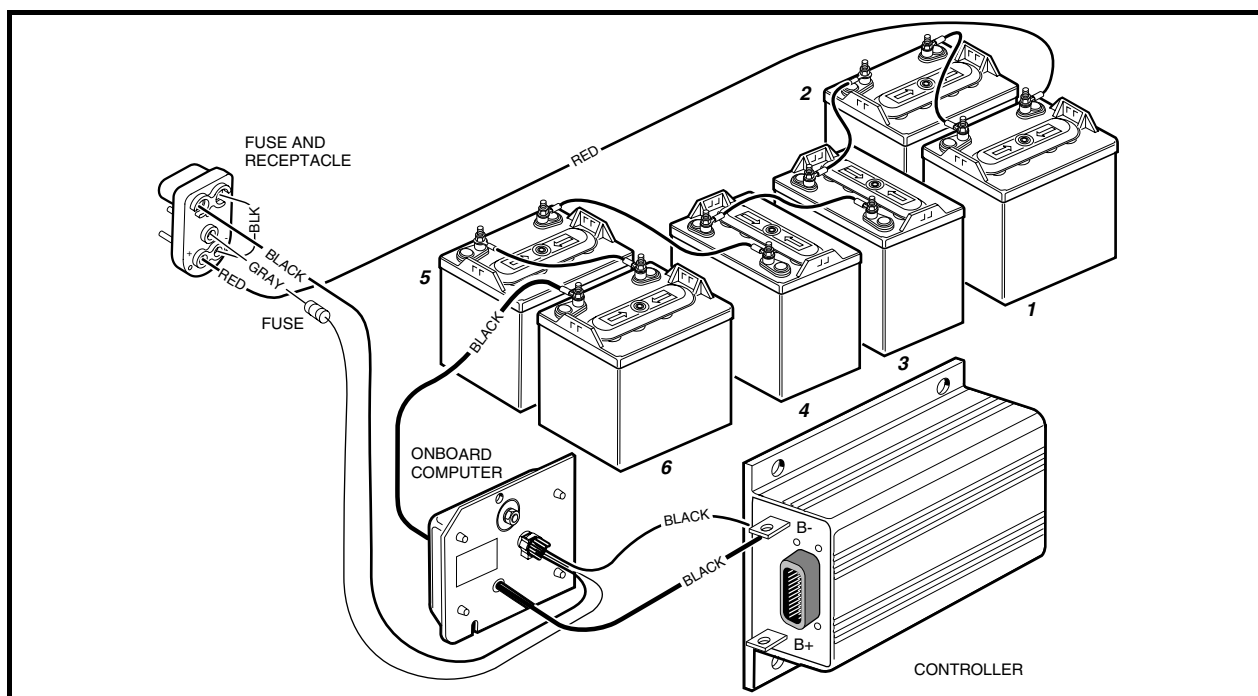


Figure 11-8 Charge Circuit

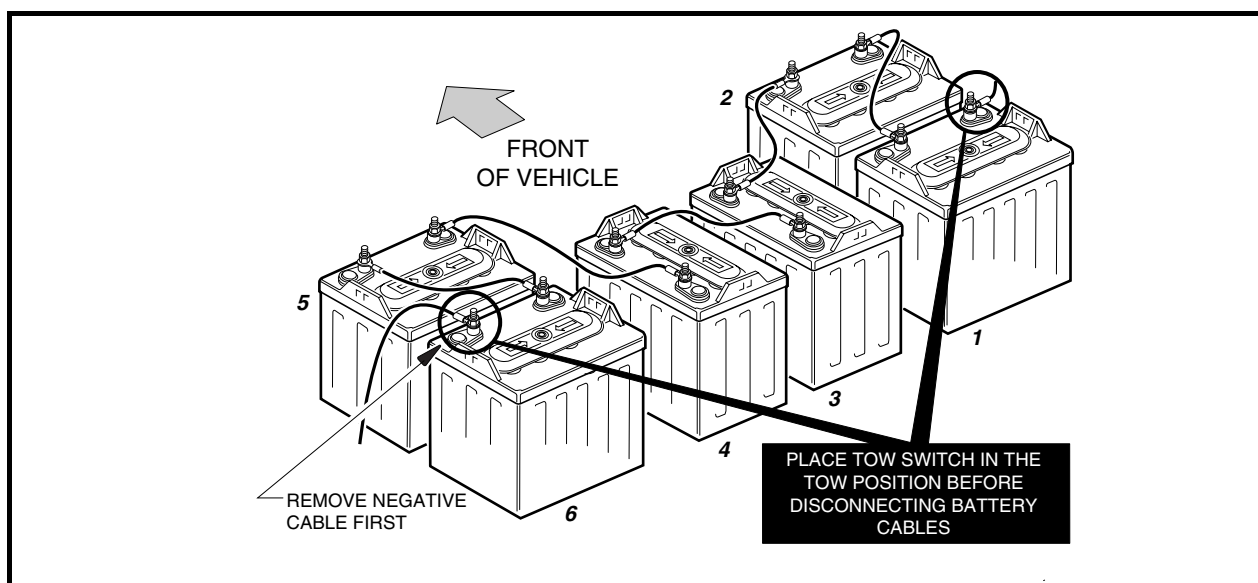


Figure 11-9 PowerDrive Plus Battery Configuration

⚠ DANGER

- **MOST OF THE FOLLOWING TEST PROCEDURES ARE PERFORMED WITH THE BATTERIES CONNECTED TO THE ELECTRICAL SYSTEM.**
- **RAISE THE REAR END OF THE VEHICLE AND SUPPORT ON JACKSTANDS. CHOCK FRONT TIRES.**
- **WEAR SAFETY GLASSES WHEN PERFORMING CIRCUIT TESTS. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SEVERE PERSONAL INJURY OR DEATH.**

⚠ WARNING

- IF A TEST PROCEDURE REQUIRES THE BATTERIES TO BE DISCONNECTED, PLACE THE RUN/TOW SWITCH IN THE **TOW** POSITION FIRST, THEN DISCONNECT THE BATTERIES.
- BEFORE ANY TESTS OR REPAIRS ARE PERFORMED, THE CAPACITORS INSIDE THE CONTROLLER MUST BE DISCHARGED. THE CAPACITORS WILL NORMALLY SELF-DISCHARGE AFTER THE BATTERY CABLES ARE DISCONNECTED, HOWEVER, TO ENSURE THE CAPACITORS ARE DISCHARGED PLACE THE FORWARD/REVERSE ROCKER SWITCH IN **REVERSE** AND LISTEN FOR THE REVERSE BUZZER.
 - IF THE REVERSE BUZZER DOES NOT SOUND, AFTER THE BATTERY CABLES ARE DISCONNECTED, THE CAPACITORS ARE DISCHARGED.
 - IF THE REVERSE BUZZER SOUNDS, TURN THE KEY SWITCH TO THE **ON** POSITION AND DEPRESS THE ACCELERATOR PEDAL UNTIL THE BUZZER CAN NO LONGER BE HEARD.

INDEX OF TEST PROCEDURES

1. **Battery Pack Voltage, Page 11-14**
2. **Voltage Output From OBC, Page 11-14**
3. **Voltage At Main Solenoid Activating Coil, Page 11-15**
4. **Multi-step Potentiometer Voltage, Page 11-15**
5. **A1 and A2 Motor Voltage, Page 11-16**
6. **Tow/Run Switch, Page 11-16**
7. **Battery Pack Voltage (Under Load), Page 11-17**
8. **Dynamic Braking Solenoid Activating Coil, Page 11-17**
9. **Key Switch and Limit Switch Circuit, Page 11-17**
10. **23-Pin Connector in the Controller, Page 11-18**
11. **OBC SCR Circuit, Page 11-18**
12. **OBC Gray Wire and Fuse, Page 11-19**
13. **Voltage at Charger Receptacle Red Wire, Page 11-19**
14. **Motor Speed Sensor, Page 11-19**
15. **Main Solenoid Continuity, Page 11-20**
16. **Forward/Reverse Rocker Switch, Page 11-20**
17. **Reverse Buzzer, Page 11-21**
18. **Reboot Onboard Computer, Page 11-22**

DIAGNOSTIC FLOW CHARTS

The diagnostic flow charts included in this section may be used as a reference when performing test procedures on the PowerDrive Plus vehicle. More detailed system testing instructions follow.

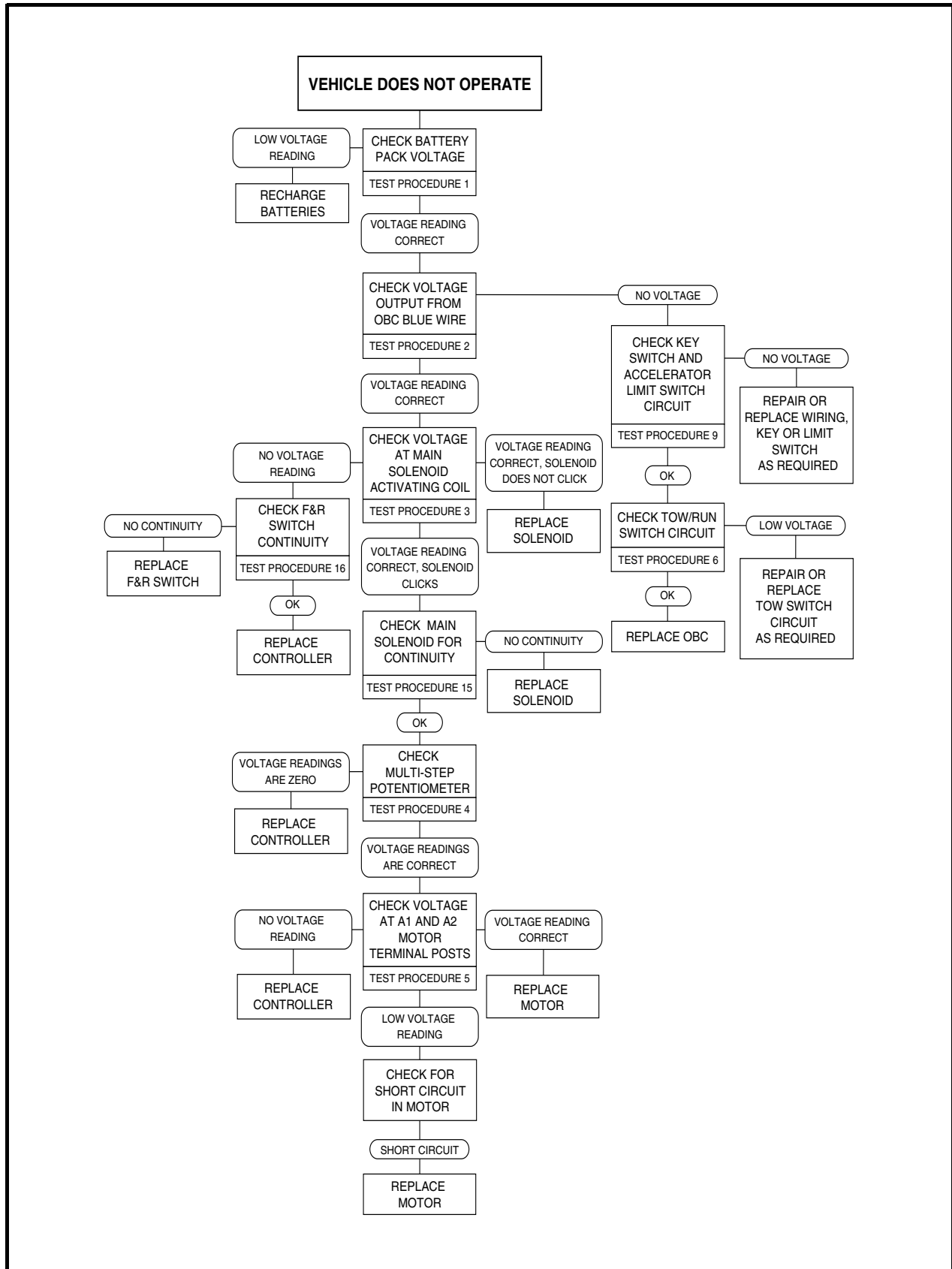


Figure 11-10 Flow Chart 1 - Vehicle Does Not Operate

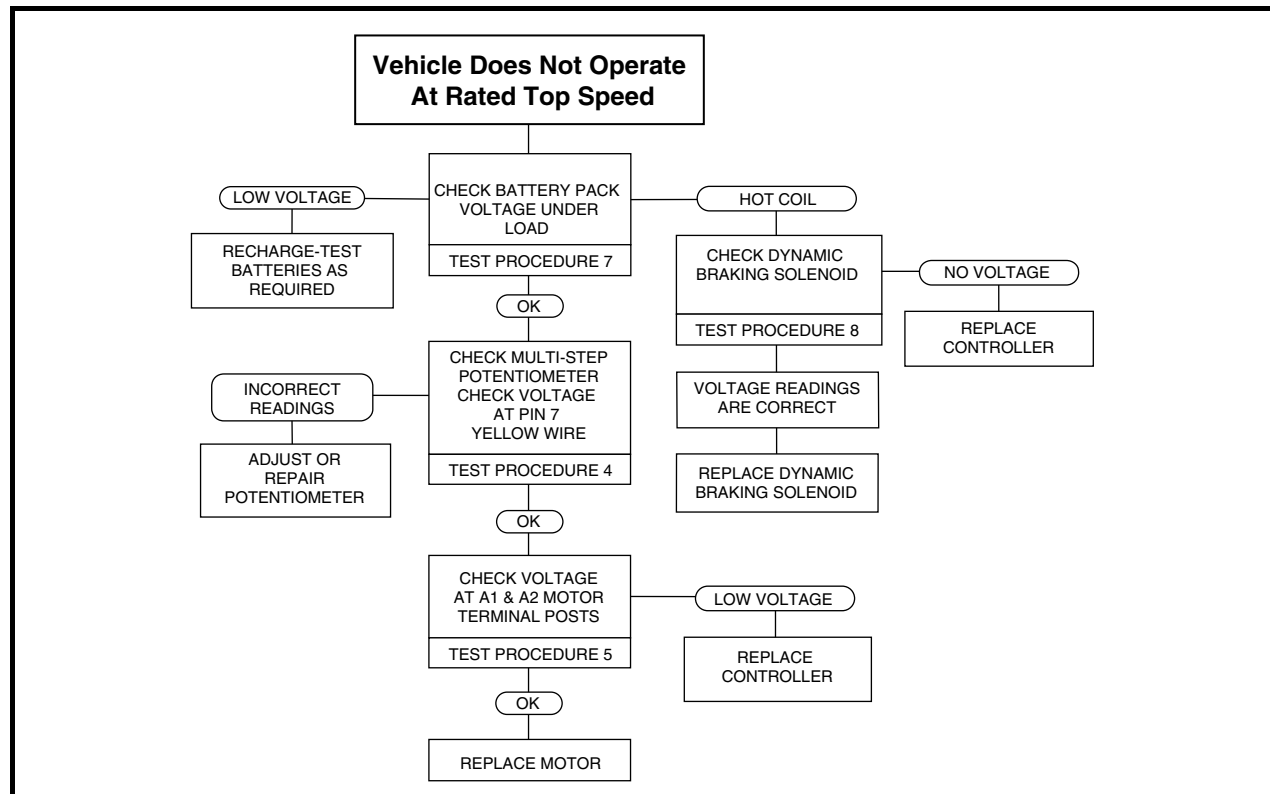


Figure 11-11 Flow Chart 2 - Vehicle Does Not Operate at Rated Top Speed

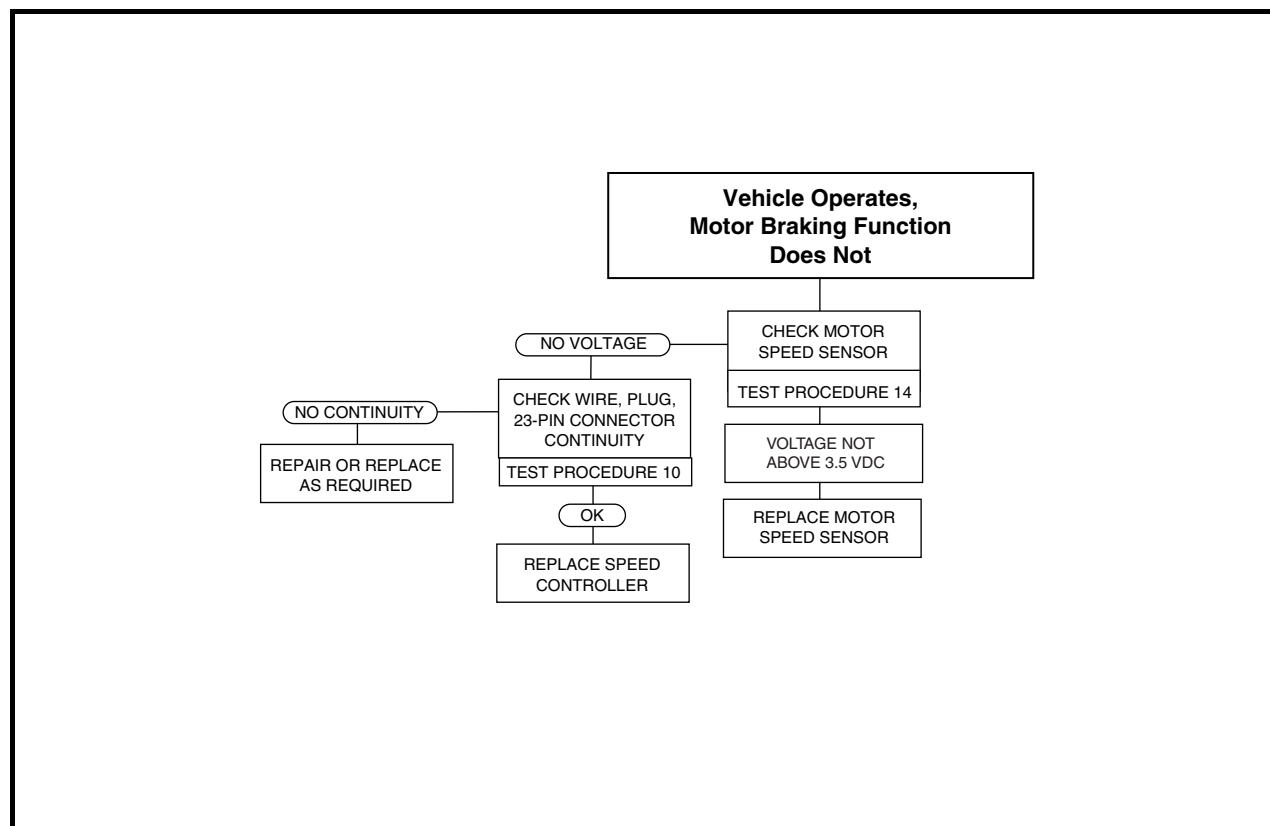


Figure 11-12 Flow Chart 3 - Vehicle Operates, No Motor Braking

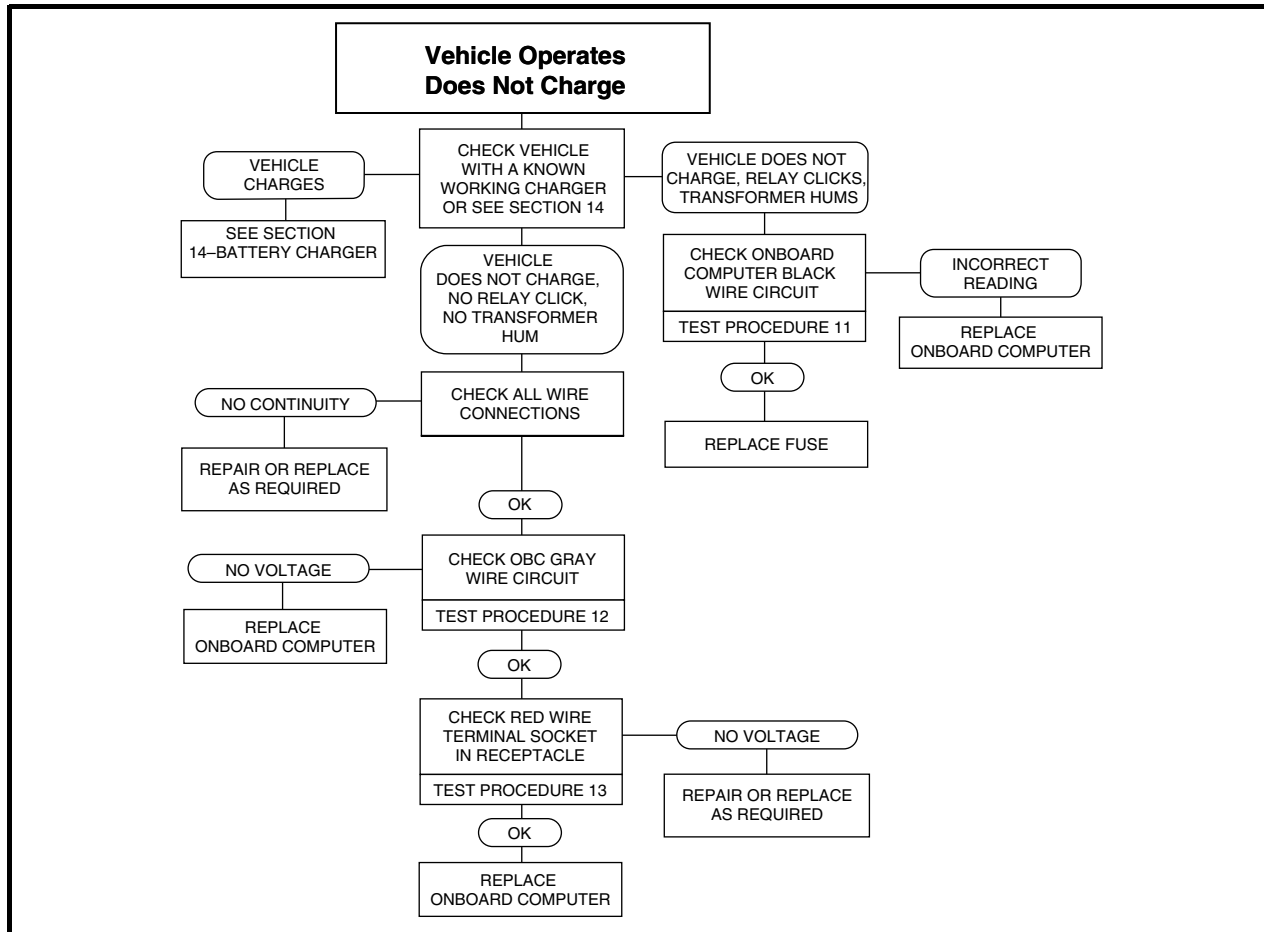


Figure 11-13 Flow Chart 4 - Vehicle Operates, Does Not Charge

TEST PROCEDURES

Read **DANGER** and **WARNING** on page 11-11.

Test Procedure 1 - Battery Pack Voltage

With batteries connected and using a multimeter set to 200 volts DC, place the black lead on battery No. 6 negative post and place the red lead on battery No. 1 positive post. Record the reading for reference, (this information will be referred to as **full battery voltage** and will be useful when performing other test procedures as well).

The voltage reading must be above 32 volts to activate the solenoid to operate the vehicle. If the reading is below 32 volts, test and recharge the batteries. The battery charger will not turn on if the battery voltage is below 32 volts. The charger relay will need to be by-passed to activate the charger. **See WARNING on page 11-11.**

Test Procedure 2 - Voltage Output From Onboard Computer

1. With batteries connected and using a multimeter set to 200 volts DC, place black lead on battery No. 6 negative post and red lead (with insulation probe) on blue onboard computer wire (at a point between the OBC and the six-pin connector). The reading should be approximately 48-50 volts (full battery voltage). If the reading is zero volts, proceed to step 2. If the reading is 48-50 volts, proceed to Test 3. **See WARNING on page 11-11.**
2. If reading is not 48-50 volts, place insulation probe on blue 18 gauge wire at a point between OBC six-pin connector and main wire harness. If reading is zero volts, check blue wire terminal connectors inside six-pin connector at OBC six-pin connector. Make sure pins are properly aligned inside housing. Make sure wire colors match.

3. If reading is zero volts, plug the charger DC cord into the vehicle charger receptacle. If the dash light illuminates for 10 seconds, the OBC is now activated and the reading at the OBC blue wire should be approximately 48-50 volts. When the DC cord is disconnected, the solenoids should click on for two seconds and then click off. If the vehicle now operates normally, the DC cord has powered up the electrical system. The electrical system should also power-up when the accelerator pedal is depressed. To check the accelerator pedal function, **see Test Procedure 4.**
4. If the dash light illuminates and the solenoids do not click:
 - 4.1. Using a multimeter set to 200 volts DC, place black lead on battery number 6 and place red lead (with insulation probe) on blue 18 gauge wire at OBC six-pin connector.
 - 4.2. With Tow/Run switch in the RUN position, the voltage reading should be approximately 48 volts.
 - 4.3. If the reading is zero volts, replace the OBC.
5. If the dash light does not illuminate and the solenoids do not click, check the OBC activation circuit.
 - 5.1. Using a multimeter set to 200 volts DC, place the black lead on battery No. 6 negative post and place the red lead (with insulation probe) on the red 18 gauge wire (with the yellow fuse holder) located on the OBC side of the fuse holder. The reading should be approximately 48 volts.
 - 5.2. If reading is zero volts, test fuse and fuse holder (located in red 18 gauge wire). Using a multimeter set to 200 $\frac{3}{4}$, connect red (+) lead to one end of fuse and connect black (-) lead to other end of fuse. Multimeter should indicate continuity.
 - 5.3. Place wire probe on the 18 gauge red/white wire (harness side of six-pin connector). Multimeter should indicate 48 volts. If voltage is correct, check connections in the six-pin connector. If connections are correct, OBC activation circuit has failed. Replace OBC.

Test Procedure 3 - Voltage At Main Solenoid Activating Coil

1. Place Tow/Run switch in TOW and wait 10 seconds before proceeding. **See WARNING on page 11-11.** Using a multimeter set to 200 volts DC, place black lead on small post with blue/white wire and place red lead on small post with blue wire.
2. Place Tow/Run switch in RUN. Solenoid should activate for 2-3 seconds and then deactivate. When solenoid clicks, voltage reading should be approximately 48 volts (full battery voltage). If the voltage reading is 48 volts and the solenoid does not click, replace the solenoid.
3. If the voltage reading is zero volts, replace speed controller. **See WARNING on page 11-11.**

Test Procedure 4 - Multi-Step Potentiometer (Wiper Switch) Voltage

1. Place Tow/Run switch in RUN. Using a multimeter set to 20 volts DC, place black lead on battery No. 6 negative post and place red lead (with insulation probe) on purple wire at a point between the six-pin connector and wiper switch. The reading should be approximately 3.75 volts. **See WARNING on page 11-11.**
2. If reading is zero volts, check the purple wire continuity from the connector to the controller, the purple wire continuity from the connector to the wiper switch, and the six-pin connector at the wiper switch. If all of the continuity readings are correct, replace the controller.
3. With multimeter set to 200 volts DC, place the red lead on battery No. 1 positive post and the black lead (with insulation probe) on the white/black wire at a position between the six-pin connector and the wiper switch. The reading should be approximately 48-50 volts.
4. If reading is zero volts, check white/black wire continuity from six-pin connector to 23-pin connector. Check white/black wire continuity from six-pin connector to wiper switch. Check terminal positions in six-pin connector at the wiper switch. If all of the continuity readings are correct, replace the speed controller.
5. With multimeter set to 20 volts DC, place the black lead on battery No. 6 negative post and the red lead (with insulation probe) on the No. 18 yellow wire at a point between the six-pin connector and the wiper switch. The reading should be approximately 3.75 volts with the pedal up. Slowly depress the accelerator pedal and note the readings on the multimeter. As the pedal is depressed, the reading will decrease in increments until it reaches zero volts when the pedal is fully depressed.

Test Procedure 4—Multi-step Potentiometer (Wiper Switch) Voltage, Continued:

6. If reading does not decrease as pedal is depressed, check movable contact and resistors in wiper switch.
7. If the reading is not zero volts with the pedal fully depressed, the vehicle will not operate at rated top speed. Check the resistors and adjustment of the wiper switch assembly.
 - 7.1. Disconnect the six-pin connector at multi-step potentiometer.
 - 7.2. Using a multimeter set to 20K ohms, connect black (-) lead of multimeter to purple wire terminal end (located in six-pin connector on potentiometer). Connect red (+) lead (with insulation probe) to yellow wire at six-pin connector.
 - 7.3. Measure resistance while depressing the accelerator pedal. The measured resistance should increase incrementally in six steps:

1st Step:	910 ohms (approx.)
2nd Step:	1660 ohms (approx.)
3rd Step:	2570 ohms (approx.)
4th Step:	3570 ohms (approx.)
5th Step:	4570 ohms (approx.)
6th Step:	5570 ohms (approx.)

NOTE

- IF AN INCREASE IN RESISTANCE FROM 0 TO (APPROXIMATELY) 5000 OHMS IS OBTAINED WHEN THE ACCELERATOR PEDAL IS DEPRESSED WITHOUT EXCEEDING (APPROXIMATELY) 7000 OHMS, THEN THE SPEED SWITCH RESISTOR ASSEMBLY IS IN GOOD CONDITION.

- 7.4. If the resistance steps were not correct and the accelerator pedal is properly adjusted, then replace the defective resistor(s). **See Section 12—Components.**
- 7.5. Reconnect six-pin connector assembly.
8. If reading is zero volts, check continuity of yellow wire and six-pin connector terminal at wiper switch.

Test Procedure 5 - A1 and A2 Motor Voltage

1. Using a multimeter set to 200 volts DC, place the black lead on the A2 motor terminal (white wire) and connect the red lead to the A1 (green wire) motor terminal. **See DANGER on page 11-11.**
2. With Tow/Run switch in RUN, place Forward/Reverse switch in FORWARD, turn key switch ON and slowly depress accelerator pedal.
3. As the accelerator pedal is depressed, the voltage reading should increase from approximately 5 volts when the accelerator limit switch closes, to approximately 48 volts with the accelerator pedal fully depressed.
 - 3.1. If there is no voltage reading, check the wiper switch (**see Test Procedure 4**) and the continuity of the large post of the main solenoid (**see Test Procedure 15**).
 - 3.2. Disconnect battery wires. Check continuity on A1 and A2 motor terminal posts and continuity of the F1 and F2 motor terminal posts. Also, check continuity of all motor wires. **See Section 15—Motor.**

Test Procedure 6 - Tow/Run Switch

1. Using a multimeter set on 200 volts DC, connect black lead to negative post of battery No. 6 and connect red lead (with insulation probe) on black wire on two-pin connector on Tow/Run switch. (Connect the insulation probe to the black wire on the wire harness side of the two-pin connector). **See WARNING on page 11-11.**
2. With the Tow/Run switch in the RUN position, the reading should be approximately 48-50 volts. With the switch in the TOW position, the reading should be zero volts.
3. If the reading is not zero volts with the switch in the TOW position, replace the switch.
4. If the reading is zero volts with switch in the RUN position, check continuity of the two-pin connector and the red/white 18 gauge wire from the large post of the solenoid to the two-pin connector at the Tow/Run switch.

5. If the continuity readings are correct, replace the Tow/Run switch.

Test Procedure 7 - Battery Pack Voltage (Under Load)

1. Before proceeding with this test procedure, the batteries must be fully charged. Using a 36 to 48-volt battery discharge machine (Club Car No. 101831901), connect the positive (+) lead of the discharge machine to battery No. 1 positive post and connect the negative (-) lead to battery No. 6 negative post. Record reading from discharge machine. **See WARNING on page 11-11.**
2. Record the voltage reading of battery pack while under load, as displayed on the discharge machine (discharge machine is ON).
3. A fully charged set of batteries in good condition should read between 46-49 volts while under load.
4. A reading of 32-46 volts indicates discharged or defective batteries. Each battery should be checked with a multimeter while under load.
5. A reading of 32 volts or less will not activate discharge machine. Batteries are deeply discharged or defective.
6. Recording the battery pack voltage reading while under load provides a more accurate diagnosis of the condition of the batteries. When the discharge machine is ON, it places the battery pack under load and many times can help determine if one or more batteries in the set are defective. Testing battery voltage while the batteries are not under load will not always indicate the true condition of the batteries.
7. If batteries test okay and vehicle runs slow, test the dynamic braking solenoid for proper operation.
8. Drive vehicle approximately 100 ft. with the accelerator pedal half way depressed to the floor. Stop the vehicle and check the resistor coil on the dynamic braking solenoid by placing hand close to (but not touching) the coil. If the coil is hot, replace the solenoid.

WARNING

- DO NOT TOUCH THE ENERGY DISPLACEMENT MODULE (RESISTOR COIL); IT MAY BE EXTREMELY HOT. A HOT ENERGY DISPLACEMENT MODULE COULD CAUSE SEVERE BURNS.

Test Procedure 8 - Dynamic Braking Solenoid Activating Coil

1. With key switch ON and Forward/Reverse switch in FORWARD, place Tow/Run switch in RUN. Using a multimeter set to 200 volts DC, place the red lead on battery No. 1 positive post and the black lead on the brown wire at the dynamic braking solenoid small post. With the accelerator pedal up, the reading should be less than 1 volt. With the accelerator pedal depressed, the reading should be 48-50 volts (full battery voltage). **See WARNING on page 11-11.**
2. If the reading is not approximately 48 volts when the accelerator pedal is depressed, check the continuity of the brown wire and check pin 12 in the 23-pin connector (**see Test Procedure 10**). If the connector and continuity readings are correct, replace the controller. If the reading is approximately 48 volts proceed to step 3.
3. Using a multimeter set to 200 volts DC, place black lead on battery No. 6 negative post and place red lead on the orange/white wire at dynamic braking solenoid small post. The reading should be 48 to 50 volts (full battery voltage) with the accelerator pedal either up or fully depressed, key switch OFF and the Forward/Reverse rocker switch in NEUTRAL and Tow/Run switch in RUN. If reading is zero volts, check continuity of the orange/white wire to the blue OBC wire in the six-pin connector located at the OBC. If the continuity of the orange/white wire to the blue OBC wire in the six-pin connector is present, replace the dynamic braking solenoid.

Test Procedure 9 - Key Switch and Limit Switch Circuit

1. Using a multimeter set to 200 volts DC, place the black lead on battery No. 6 negative post and place the red lead (with insulation probe) on the green/white wire at the wiper switch six-pin connector (harness side). **See WARNING on page 11-11.**
2. With Tow/Run switch in RUN, key switch ON, and Forward/Reverse rocker switch in FORWARD, the voltage reading should be zero volts. When the accelerator pedal is depressed, the voltage reading should be approx-

- imately 48 volts (full battery voltage). If the voltage reading is zero with the accelerator pedal depressed, check the key switch and limit switch circuit using the following test procedures.
- 2.1. Using a multimeter set to 200 volts DC, place black lead on battery No. 6 negative post and place red lead (with insulation probe) on blue wire between six-pin connector and wiper switch, the reading should be approximately 48 volts (full battery voltage).
 - 2.2. If the reading is zero volts, check the key switch continuity and the continuity of the blue wire that goes from the key switch to the six-pin connector at the wiper switch.
 - 2.3. If the reading is approximately 48 volts, proceed to step 3.
 3. Using a multimeter set to 200 volts DC, place the black lead on battery No. 6 negative post and place the red lead (with insulation probe) on the blue wire at the wiper switch six-pin connector (harness side). With the key switch ON and the Tow/Run switch in the RUN position, the reading should be approximately 48 volts (full battery voltage).
 - 3.1. If the reading is zero volts, check the position of the terminal pins and sockets in the six-pin connector and make sure wire colors match. Check the blue wire on each side of the six-pin connector (at the wiper switch) and make sure it is securely crimped to the terminal.
 - 3.2. If the reading is approximately 48 volts, proceed to step 4.
 4. Using a multimeter set to 200 volts DC, place the black lead on battery No. 6 negative post and place the red lead (with insulation probe) on the green/white wire at a point between the wiper switch and the six-pin connector. With the Tow/Run switch in the RUN position, the key switch ON, the Forward/Reverse rocker switch in NEUTRAL and the accelerator pedal depressed, the reading should be approximately 48 volts (full battery voltage).
 - 4.1. If the reading is zero volts, test the continuity of the accelerator limit switch and the green/white wire.
 - 4.2. If the reading is approximately 48 volts, proceed to step 5.
 5. Place black lead of multimeter (set to 200 volts DC) on negative post of battery No. 6 and red lead (with insulation probe) on the green/white wire at a point between the six-pin connector and the wire harness conduit. With the key switch ON and the accelerator pedal depressed, the reading should be approximately 48 volts.
 - 5.1. If reading is zero volts, make sure the terminals are properly seated in the plug housing and the green/white wire is securely crimped to the terminal in the six-pin connector at the wiper switch.
 - 5.2. If the reading is approximately 48 volts, check the green/white wire at the pin 3 position in the 23-pin connector to make sure the terminal socket is properly seated in the plug and the wire is securely crimped to the terminal. **See Test Procedure 10.**

Test Procedure 10 - 23-Pin Connector

1. With Tow/Run switch in the TOW position, disconnect 23-pin connector from controller. Insert small sized screwdriver under plug clip and turn to release clip from connector. Inspect terminal ends inside plug to ensure they are in position and seated in plug housing. If any terminals look like they are not pushed all the way into the connector, then disconnect the red cap in plug housing before terminal sockets are repositioned. After the terminal has been pushed into the housing, gently pull on the wire to ensure it is locked into place. Once the terminal socket is in position, press the red cap down until it snaps into place. **See WARNING on page 11-11.**
2. Check wires in the plug to make sure none are broken at the terminal pin crimp. Repair or replace as required.
3. When connecting the 23-pin connector to the controller, push plug into controller receptacle with enough force to lock plug into place. An audible click will be heard when plug is properly seated to the controller.

Test Procedure 11 - Onboard Computer Silicon Controlled Rectifier (SCR) Circuit

1. A silicon controlled rectifier (SCR) acts as a switch between the two black wires in the OBC to complete the negative

side of the circuit to allow the charger to charge the batteries. **See WARNING on page 11-11.**

2. A black 10 gauge wire is connected to the battery negative (B-) terminal on the controller and goes to the onboard computer. Another black 10 gauge wire is attached to the onboard computer and goes to the charger receptacle.
3. Use the following procedure to test the SCR:
 - 3.1. Using a multimeter set to 200 volts DC, place the red lead on the positive post of battery No. 1 and place the black lead on the receptacle fuse terminal that has the black 10 gauge OBC wire attached to it. The reading should be approximately 36-42 volts.
 - 3.2. If the reading is zero volts, check the black 10 gauge wire connections at the controller and receptacle. Check the continuity of the black 10 gauge wires. If the wires and connections are okay, the SCR has failed. Replace the OBC. If the reading is correct, proceed to step 4.
4. Plug in AC and DC cords. When charger relay clicks ON, reading should be approximately 48 volts (full battery voltage). If the reading does not rise from approximately 40 volts to full battery voltage when the DC cord is plugged in and the relay clicks ON, check the receptacle fuse and black wire terminal socket in the receptacle.

Test Procedure 12 - OBC Gray Wire and Fuse

1. Using a multimeter set to 200 volts DC, connect red lead to positive post of battery No. 1 and black lead (with insulation probe) to gray 16 gauge wire at a point between fuse and receptacle. Reading should be approximately 48 volts. If reading is zero volts, check gray wire fuse and fuse holder. **See WARNING on page 11-11.**
2. If the reading in step 1 is 48 volts, plug the DC cord into the vehicle's charger receptacle. The voltage reading should drop to approximately 4.0 volts before the charger relay clicks on.
3. When the charger relay is activated, the reading should rise to approximately 48 volts.
4. If voltage does not drop to approximately 4.0 volts when the DC cord is plugged in and then rise to approximately 48 volts when the charger relay clicks ON, the gray wire circuit in the OBC has failed. Replace the OBC.

Test Procedure 13 - Voltage At Charger Receptacle Red Wire Socket

1. Using a multimeter set to 200 volts DC, place the black lead on the negative post of battery No. 6 and place the red lead on the charger receptacle socket connected to the red 10 gauge wire. The reading should be 48-50 volts (full battery voltage). **See WARNING on page 11-11.**
2. If the reading is zero volts, check the continuity of the 10 gauge red wire from the positive post of battery No. 1 to the receptacle socket.

Test Procedure 14 - Motor Speed Sensor

1. Disconnect the three-pin connector at the motor speed sensor. **See WARNING on page 11-11.**
2. Check voltage at black wire:
 - 2.1. Using a multimeter set to 200 volts DC, place the red lead on battery No. 1 positive post and place the black lead on the black wire terminal socket in the three-pin connector. The voltage reading should be 48 to 50 volts (full battery voltage).
 - 2.2. If the reading is zero volts, check the continuity of the black wire from the 23-pin connector to the three-pin connector. If the continuity is correct, replace the controller.
3. Check voltage at red/green wire:
 - 3.1. With Tow/Run switch in RUN and using a multimeter (set on 20 volts DC), place black lead on battery No. 6 negative post and place red lead on red/green wire terminal socket in three-pin connector. Voltage reading should be from 5.01 to 5.08 volts.
 - 3.2. If the voltage reading is zero volts, check the continuity of the red/green wire from the 23-pin connector

- to the three-pin connector. If the wire continuity is correct, replace the controller.
- 3.3. If the reading is below 3.50 volts, replace the controller.
 - 3.4. If the voltage reading is correct, proceed to step No. 4.
 4. Check voltage at light green wire:
 - 4.1. Using a multimeter set on 20 volts DC, place the black lead on battery No. 6 negative post and place the red lead on the light green wire female terminal in the three-pin connector. The voltage reading should be from 4.60 to 4.90 volts.
 - 4.2. If the voltage is zero volts, check the continuity of the light green wire from the 23-pin connector to the three-pin connector. If the continuity is correct, replace the controller.
 - 4.3. If reading is below 3.50 volts, check wire/plug continuity and replace the controller if necessary.
 5. Reconnect the three-pin connector at the motor speed sensor. Using a multimeter set to 20 volts DC, place the black lead on battery No. 6 negative post and place the red lead (with insulation probe) on the green wire between the three-pin connector and the motor speed sensor.
 - 5.1. Raise one rear wheel off ground. Slowly turn the rear wheel to rotate the motor armature. As the armature rotates, the voltage reading should alternate from zero to approximately 4.85 volts. The voltage reading will fluctuate from zero to 4.85 volts and back to zero four times for each revolution of the motor armature.
 - 5.2. If there is no voltage reading, or the voltage reading is not above 3.50, replace the motor speed sensor.
 6. If vehicle does not operate and the main solenoid does not click, but the dynamic braking solenoid does click when the key switch is turned ON or OFF, the motor speed sensor may be shorted. To test for this condition, disconnect the motor speed sensor and attempt to drive the vehicle. If the vehicle operates normally, replace the motor speed sensor. If the dynamic braking solenoid continues to click each time the key switch is turned ON or OFF with the motor speed sensor disconnected, replace the controller.

NOTE

- THE VOLTAGE READING OF 4.85 IS AN APPROXIMATE READING. THE ACTUAL READING MAY VARY FROM 4.50 TO 4.90 VOLTS.

Test Procedure 15 - Main Solenoid Continuity

1. Raise rear wheel off ground. Using a multimeter set to 200k ohms, place the black lead on the main solenoid large post with the yellow 6 gauge wire and place the red lead on the large post with the red 6 gauge wire. The reading should be no continuity. **See DANGER and WARNING on page 11-11.**
2. With Tow/Run switch in RUN, turn the key switch to ON, place the Forward/Reverse rocker switch in FORWARD and depress the accelerator pedal. The solenoid should click and the meter should show continuity. If the reading is no continuity, replace the solenoid.

Test Procedure 16 - Forward/Reverse Rocker Switch

1. Disconnect the three wires from the rocker switch. Using a multimeter set to ohms, place the black lead on the white wire terminal 3 position on the rocker switch, and place the red lead at the red/white wire terminal 2 position. With the switch in NEUTRAL or REVERSE, there should be no continuity. With the switch in FORWARD, there should be continuity. If the readings are incorrect, replace the switch. **See WARNING on page 11-11.**
2. Place the black lead on the blue wire terminal 1 position on the rocker switch and place the red lead on the red/white wire terminal. With the switch in REVERSE, there should be continuity. If the readings are incorrect, replace the switch.

Test Procedure 17 - Reverse Buzzer

1. If the vehicle will not move and the solenoids do not click, place the Forward/Reverse rocker switch in the REVERSE position and listen for the reverse warning buzzer to sound. **See WARNING on page 11-11.**
 - 1.1. If the buzzer sounds, it is an indication that the Tow/Run switch and the OBC are operating properly and sending a voltage signal to the other components in the electrical system. Test the voltage at the main solenoid activating coil. **See Test Procedure 3.**
 - 1.2. If the buzzer does not sound, the OBC or controller may be defective and should be tested. **See Test Procedure 2. See also following NOTE.**

NOTE

- THE BUZZER WILL NOT SOUND IF IT HAS FAILED. USE THE FOLLOWING PROCEDURE TO TEST THE BUZZER.

2. Place Tow switch in the TOW position and disconnect the battery wires (negative cable first).
3. Remove the center dash:
 - 3.1. Remove the plastic cap covering the screw on each side of the center dash panel. Loosen (but do not remove) these screws.
 - 3.2. Insert screwdriver at the top center of the dash between dash and cowl brace. Gently pry center dash out from under edge of cowl brace.
 - 3.3. Pull dash out approximately 1 in. from the frame and then bend the top right corner of the dash inward while pulling the top of the panel out and down. **See following NOTE.**

NOTE

- BENDING THE TOP RIGHT CORNER OF THE CENTER DASH INWARD DURING REMOVAL WILL PREVENT THE CONTACTS ON THE BACK OF THE KEY SWITCH FROM TOUCHING THE METAL FRAME AROUND THE DASH.

- 3.4. Slide the dash panel up the steering column by snapping the top out and then rotating the panel out and up.
 - 3.5. Disconnect the orange and red wires from the buzzer. Make sure the wire terminals on the key switch do not touch vehicle frame.
4. Reconnect the battery wires (positive cable first) and tighten to 110 in.lb (12.4 N-m). Coat with Battery Protector Spray (Club Car Part No. 1014305) to minimize corrosion.
5. Place the Forward/Reverse rocker switch in REVERSE.
6. Using a multimeter, set to 200 volts DC, place the black lead on battery No. 6 negative post and place the red lead on the red wire terminal end that was disconnected from the reverse buzzer. The reading should be approximately 48 volts (full battery voltage).
 - 6.1. If the voltage reading is correct, proceed to step 7.
 - 6.2. If reading is zero volts, check red wire continuity and voltage output of OBC. **See Test Procedure 2.**
 - 6.3. If the continuity readings are not correct, repair or replace the red wire.
 - 6.4. If the continuity readings are correct, proceed to step 7.
7. Place the F&R switch in REVERSE. Using a multimeter set to 200 volts DC, place the black lead on the orange wire terminal end (that was disconnected from the reverse buzzer) and place the red lead on battery No. 1 positive post. The reading should be approximately 48 volts (full battery voltage).

- 7.1. If the voltage reading is correct in steps 6 and 7, replace the reverse buzzer.
- 7.2. If reading is zero volts, check orange wire continuity and connection at Pin 10 in 23-Pin connector.
- 7.3. If there is no continuity in the orange wire, or the Pin 10 terminal in the 23-Pin connector is not properly seated, repair or replace as required.
- 7.4. If the orange wire continuity and 23-Pin connector are correct and there is no voltage at the orange wire, replace the controller.

Test Procedure 18–Rebooting Onboard Computer

It is possible the Onboard Computer (OBC) can become “locked up”, causing the OBC solenoid lockout circuit to malfunction. If this condition is suspected, restart the computer as follows:

1. Place the Tow/Run switch in the TOW position.
2. Disconnect the batteries, negative cable first, as shown (**Figure 11-9, Page 11-10**).
3. Discharge the controller as instructed in the WARNING on page 11-11.
4. Reconnect the batteries, positive cable first, and tighten terminals to 110 in.lb (12.4 N-m).
5. Place Tow/Run switch in the RUN position.
6. Test the drive vehicle. If the problem has been fixed, the vehicle will function normally. If the problem still exists, refer to the diagnostic flow charts beginning on page 11-11.

THE COMMUNICATION DISPLAY MODULE (CDM)

The CDM can be used to retrieve from the onboard computer four important items of information that can be useful in troubleshooting the PowerDrive Plus vehicle. To access one of these items, the item's corresponding Function Code must be selected on the CDM. This is done by pressing the Function Button until the desired function code is displayed in the window. **See Figure 11-14, Page 11-23 for CDM features.** Releasing the button when the desired code is displayed will display the data. Function codes and corresponding data are as follows:

- **F1 - Battery voltage:**

This displays the battery pack's current state of charge. A reading of less than 48 volts indicates that the batteries need to be charged. If a reading of less than 48 volts is obtained immediately after a charge cycle, there may be a problem in the charge circuit.

- **F2 - Energy units removed since last charge cycle:**

If the display reads over 75 (the vehicle Battery Warning Light should be illuminated), the vehicle batteries need to be recharged before being used again. This data can be used to make sure all vehicles in a fleet receive equal usage on a short term basis.

- **F3 - Total accumulated energy units removed since initial vehicle start-up:**

This information is most useful in making sure that all vehicles in a fleet receive equal usage over long periods of time.

- **F4 - Last charge termination type (1 = incomplete, 2 = DVDT, 4 = normal, 8 = max. timer):**

A **1, 2, 4, or 8** will be displayed.

1 - Indicates the last charge cycle was incomplete and the batteries were not fully charged. Batteries should be charged again at the earliest opportunity.

2 - Indicates a back-up charge program was employed by the OBC to complete the charge cycle. A DVDT charge may be displayed the first few times a new set of batteries is charged, and the first time a set of batteries is charged after the batteries have been disconnected and reconnected. A problem may exist if persistent DVDT readings are obtained.

4 - Indicates the last charge cycle was normal.

8 - Indicates the charger ran for sixteen hours and shut itself off without completing the charge cycle. This means there may be a problem in the charge circuit.

The CDM also has a low battery signal which indicates when CDM batteries are weak and need replacing. Weak batteries in the CDM may cause CDM to register inaccurate information or no information.

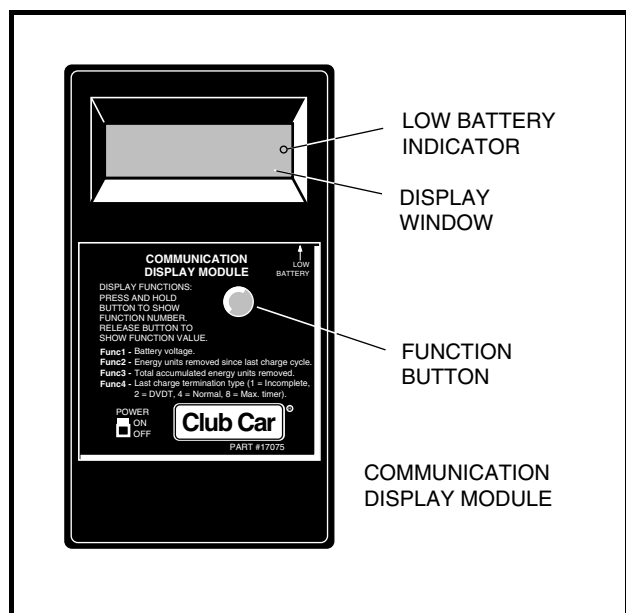


Figure 11-14 CDM

USING THE CDM TO RETRIEVE DATA FROM THE ONBOARD COMPUTER

1. Turn the CDM ON.
2. Position CDM on seat bottom so it is aligned directly with the battery warning light. Ensure CDM infrared LED receiver is pointed at battery warning light and there is a clear path between them. **See following NOTE.**

NOTE

- IF, BY POSITIONING CDM ON SEAT BOTTOM CDM IS UNABLE TO COLLECT DATA STREAM FROM OBC, HOLD CDM APPROXIMATELY 6 IN. FROM BATTERY WARNING LIGHT.

3. Wait approximately 30 seconds for a value to appear in the display window.
4. If a value does not appear in the display window after 30 seconds, try adjusting the aim of the CDM and repeating step 3 until a value appears. If there is still no reading, check for weak batteries in the CDM.

Once a value has been obtained in the display window, the CDM may be removed from its receiving position and the data reviewed. The CDM will hold the values for F1, F2, F3, and F4 until the CDM is turned OFF or it receives another line of data from the same or another onboard computer. Use the following procedure to review the data stored in the CDM:

- The value currently displayed will be F1 (battery voltage).
- To view F2, press and hold the button on the CDM. When "Func 2" appears in the display window, release the button. The value for F2 will then be displayed.
- To view F3, press and hold the button on the CDM until "Func 3" appears in the display window. Release the button. The value for F3 will be displayed.

- To view F4, press and hold the button on the CDM until "Func 4" appears in the display window. Release the button. The value for F4 will be displayed

CDM TROUBLESHOOTING GUIDE

Use the following chart as a starting point for troubleshooting problems with communication between the CDM and onboard computer. Contact your Club Car representative for more comprehensive information.

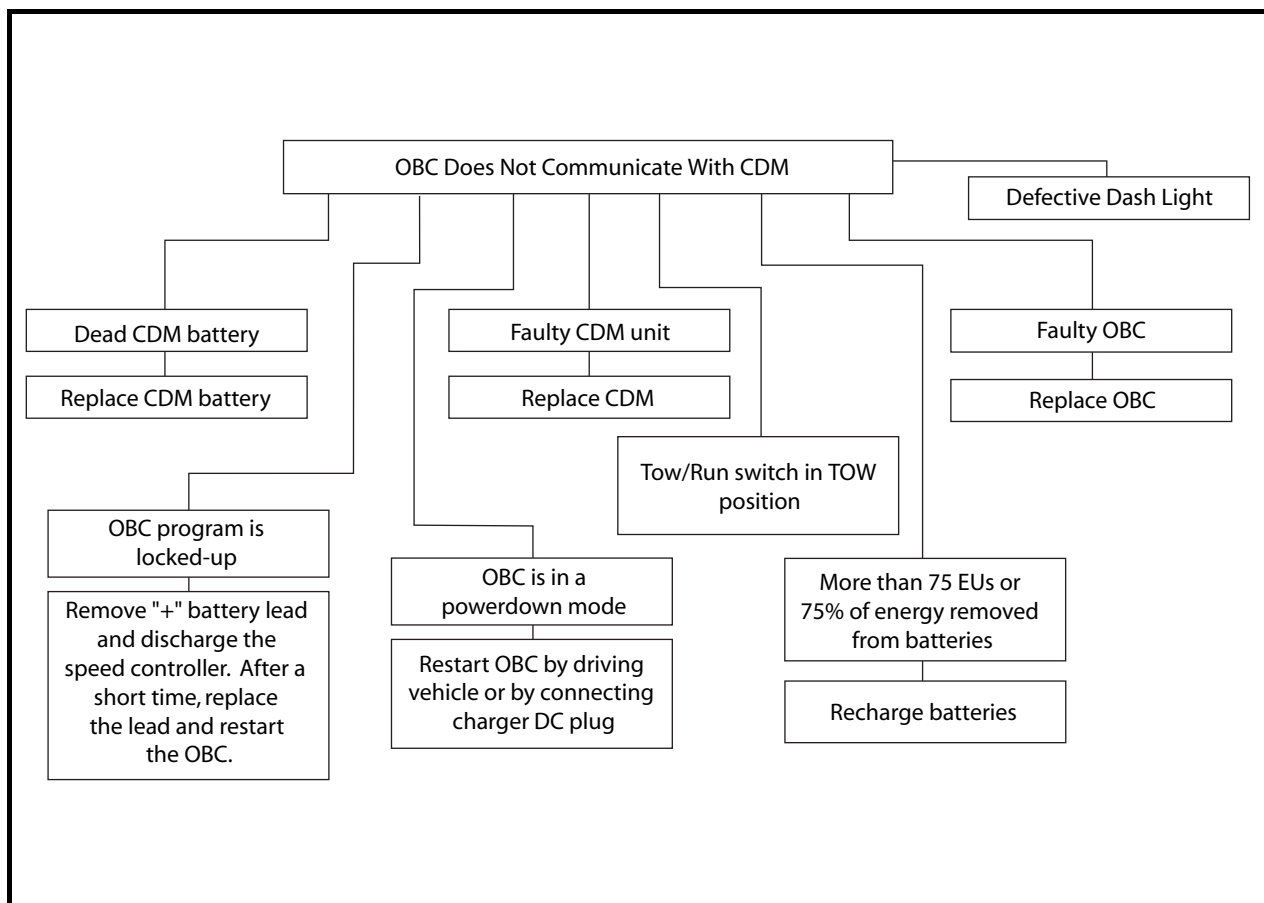


Figure 11-15 Flow Chart-CDM Troubleshooting Guide

SECTION 12—ELECTRICAL COMPONENTS

DANGER

- **BATTERY - EXPLOSIVE GASES! DO NOT SMOKE. KEEP SPARKS AND FLAMES AWAY. VENTILATE WHEN CHARGING OR USING IN AN ENCLOSED SPACE. ALWAYS WEAR FULL FACE SHIELD WHEN WORKING ON OR NEAR BATTERIES.**
- **USE EXTREME CAUTION WHEN USING TOOLS, WIRES, OR METAL OBJECTS NEAR BATTERIES! A SHORT CIRCUIT AND (OR) SPARK COULD CAUSE AN EXPLOSION.**
- **BATTERY - POISON! CONTAINS ACID! CAUSES SEVERE BURNS. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. ANTIDOTES:**
 - **EXTERNAL: FLUSH WITH WATER. CALL A PHYSICIAN IMMEDIATELY.**
 - **INTERNAL: DRINK LARGE QUANTITIES OF MILK OR WATER. FOLLOW WITH MILK OF MAGNESIA OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.**
 - **EYES: FLUSH WITH WATER FOR FIFTEEN MINUTES. CALL PHYSICIAN IMMEDIATELY.**

WARNING

- ONLY TRAINED TECHNICIANS SHOULD REPAIR OR SERVICE THIS VEHICLE. ANYONE DOING EVEN SIMPLE REPAIRS OR SERVICE SHOULD HAVE KNOWLEDGE AND EXPERIENCE IN GENERAL MECHANICAL AND ELECTRICAL REPAIR. FOLLOW ALL PROCEDURES EXACTLY AND HEED ALL WARNING STATEMENTS IN THIS MANUAL.
- ALWAYS WEAR SAFETY GLASSES OR APPROVED EYE PROTECTION WHILE SERVICING VEHICLE. WEAR A FULL FACE SHIELD WHEN WORKING WITH BATTERIES.
- PLACE THE TOW/RUN SWITCH IN THE **TOW** POSITION BEFORE CONNECTING OR DISCONNECTING BATTERY WIRES.
- BEFORE PERFORMING ANY TESTS OR REPAIRS, MAKE SURE CAPACITORS ARE DISCHARGED. PLACE THE TOW/RUN SWITCH IN THE **TOW** POSITION, DISCONNECT BATTERY WIRES, PLACE FORWARD/REVERSE ROCKER SWITCH IN **REVERSE** AND LISTEN FOR THE REVERSE BUZZER:
 - IF THE REVERSE BUZZER DOES NOT SOUND, THE CAPACITORS ARE DISCHARGED.
 - IF THE REVERSE BUZZER SOUNDS, TURN THE KEY SWITCH **ON** AND DEPRESS THE ACCELERATOR PEDAL UNTIL THE BUZZER CAN NO LONGER BE HEARD.
- DO NOT WEAR LOOSE CLOTHING. REMOVE JEWELRY SUCH AS RINGS, WATCHES, CHAINS, ETC. BEFORE SERVICING VEHICLE.
- ALWAYS USE INSULATED TOOLS WHEN WORKING NEAR BATTERIES OR ELECTRICAL CONNECTIONS. WHEN BATTERIES ARE CONNECTED, USE EXTREME CAUTION TO AVOID SHORT CIRCUITS IN COMPONENTS OR WIRING.
- TO AVOID UNINTENTIONALLY STARTING THE VEHICLE, DISCONNECT BATTERIES AS SHOWN IN **FIGURE 12-1, PAGE 12-2** WHEN PERFORMING TESTS THAT DO NOT REQUIRE THE ELECTRICAL SYSTEM TO BE ENERGIZED.

CAUTION

- IF WIRES ARE REMOVED OR REPLACED MAKE SURE WIRING AND/OR WIRING HARNESS IS PROPERLY ROUTED AND SECURED TO VEHICLE FRAME. FAILURE TO PROPERLY ROUTE AND SECURE WIRING COULD RESULT IN VEHICLE MALFUNCTION, PROPERTY DAMAGE OR PERSONAL INJURY.

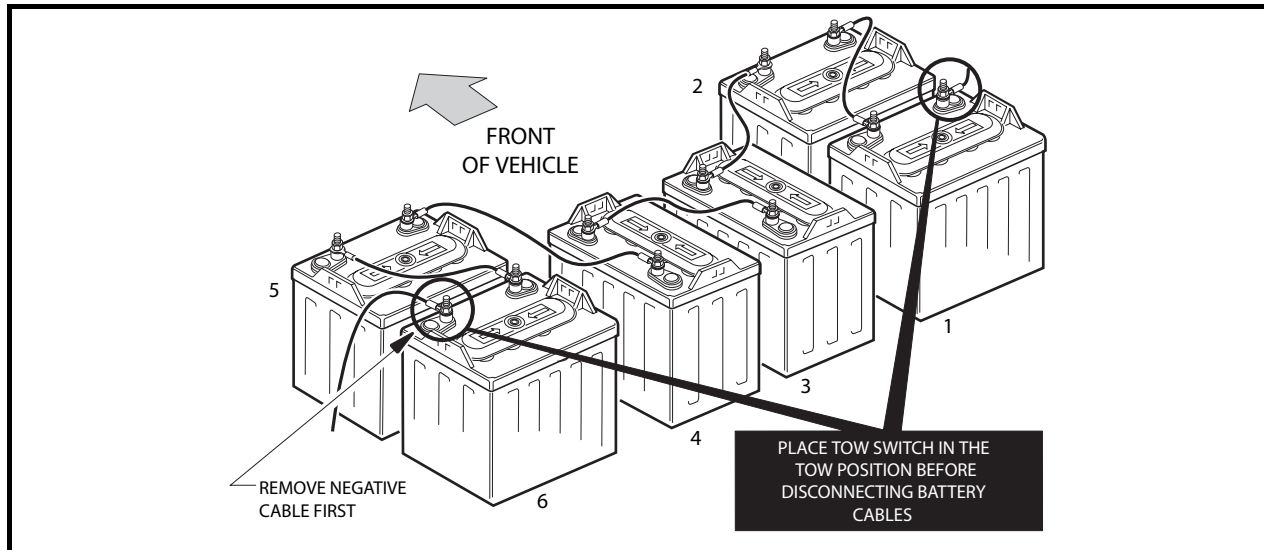


Figure 12-1 PowerDrive Plus Battery Configuration

KEY SWITCH

Read DANGER and WARNING above.

The key switch is mounted next to the steering column on the center dash panel.

Testing The Key Switch

See Test Procedure 9, Section 11, Page 11-17.

Key Switch Removal

1. Place Tow/Run switch in the TOW position and disconnect batteries (**Figure 12-1, Page 12-2**). See **DANGER and WARNING on page 12-1**.
2. Discharge the speed controller. See instructions in **WARNING on Page 12-1**.
3. Remove center dash.
 - 3.1. Remove the plastic cap covering the screw on each side of the center dash.
 - 3.2. Loosen (but do not remove) the screw on each side of the center dash panel.
 - 3.3. Insert screwdriver at top center of center dash between dash and cowl brace. Gently pry center dash out from under edge of cowl brace.
 - 3.4. Pull center dash out approximately one inch from the frame and then bend the top right corner of the center dash panel inward while pulling the top of the panel out and down. See following **NOTE**.

NOTE

- BENDING THE TOP RIGHT CORNER OF THE CENTER DASH INWARD DURING REMOVAL WILL PREVENT THE TERMINALS (7) ON THE BACK OF THE KEY SWITCH FROM TOUCHING THE METAL FRAME AROUND THE DASH (**FIGURE 12-2, PAGE 12-3**).

4. Slide center dash panel up steering column by snapping top out and then rotating the panel out and up.
5. Disconnect the wires from the key switch. Do not allow wires to touch.
6. From the back of the dash panel, push down on the retaining tabs surrounding the key switch (4) and remove the key switch cap (8). Hold the key switch and remove the switch retaining nut (6) from the outside of the dash panel (**Figure 12-2, Page 12-3**).

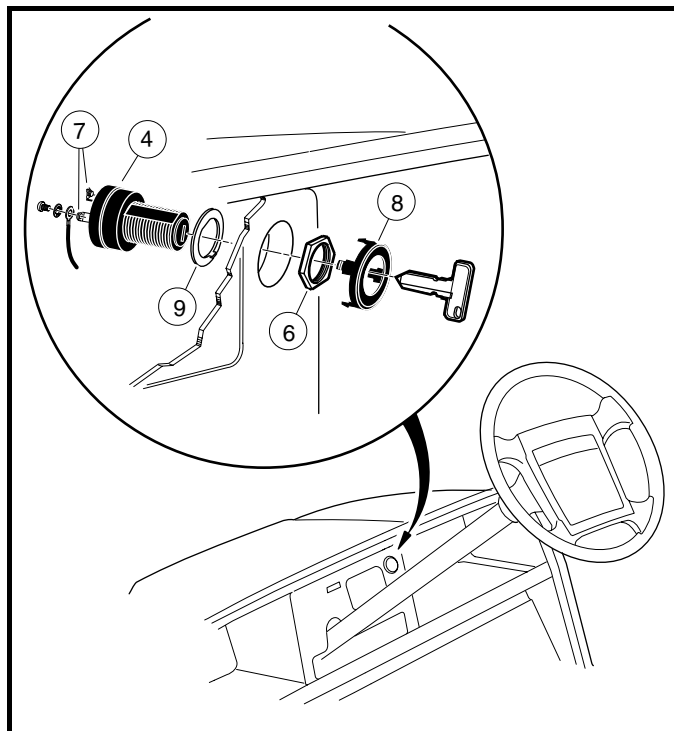


Figure 12-2 Key Switch

Key Switch Installation

1. Position key switch in the center dash, then install and tighten the switch retaining nut (6) to 40 in.lb (4.5 N-m). Press the plastic cap (8) into place on the outside of the center dash (**Figure 12-2, Page 12-3**).
2. Connect the wires to the key switch terminals (**see Section 11, Figure 11-2, Page 11-3**) and then coat the terminals with Battery Protector Spray (Club Car Part No. 1014305).
3. Install center dash by reversing removal procedure. Make sure key switch terminals (7) do not touch frame and the center dash panel is properly seated and snapped into place (**Figure 12-2, Page 12-3**).
4. Reconnect battery wires (positive wire first) and tighten to 110 in.lb (12.4 N-m). Place Tow/Run switch in RUN.

FORWARD/REVERSE (F&R) ROCKER SWITCH

Read **DANGER** and **WARNING** on page 12-1.

Testing the Forward/Reverse rocker switch

See Test Procedure 16, Section 11, Page 11-20.

Forward/Reverse (F&R) Rocker Switch Removal

1. Remove three self tapping screws (3) that hold F&R rocker switch case (2) to body (**Figure 12-3, Page 12-4**).
2. Remove red/white (4), blue (5), and white (6) 18 gauge wires from rocker switch (**Figure 12-3, Page 12-4**).
3. Depress locking tabs (1) on each end of switch and push switch out of case (**Figure 12-3, Page 12-4**).

Forward/Reverse (F&R) Rocker Switch Installation

1. Depress locking tabs (1) on each end of switch and push switch into case (**Figure 12-3, Page 12-4**).
2. Connect red/white (4), blue (5), and white (6) 18 gauge wires to rocker switch (**Figure 12-3, Page 12-4**).
3. Install the three self tapping screws (3) that hold the F&R rocker switch case (2) to the body (**Figure 12-3, Page 12-4**). Tighten to 20 in.lb (2.2 N-m).

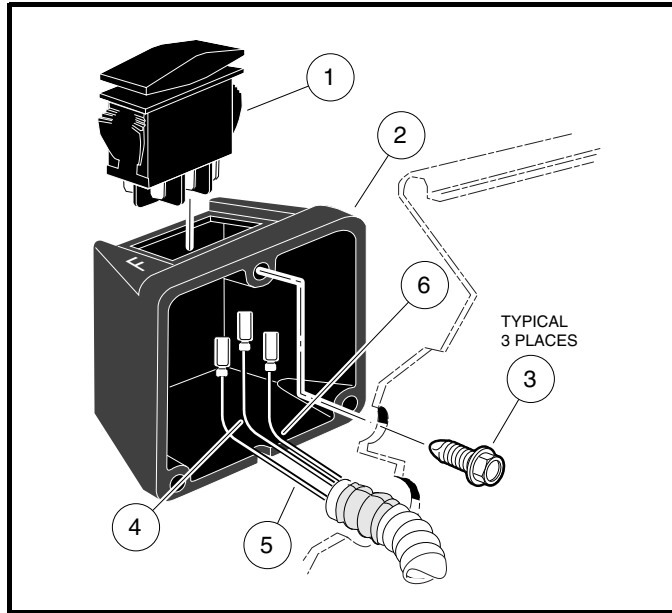


Figure 12-3 Forward/Reverse Rocker Switch

ACCELERATOR PEDAL LIMIT SWITCH

Read **DANGER** and **WARNING** on page 12-1.

Testing the Accelerator Pedal Limit Switch

See Test Procedure 5, Section 11, Page 11-16.

Accelerator Pedal Limit Switch Removal

1. Place Tow/Run switch in the TOW position, disconnect batteries (negative cable first) (**Figure 12-1, Page 12-2**) and discharge speed controller.
2. Remove the No. 5 and No. 6 batteries from the vehicle.
3. Remove the cover from the wiper switch housing.
4. Disconnect the accelerator rod from the ball stud on the wiper switch.
5. Remove and retain the screws, lock washers, and nuts attaching the limit switch to the wiper switch.
6. Disconnect the green/white and blue wires from the limit switch.

Accelerator Pedal Limit Switch Installation

1. Position the Accelerator Pedal Limit switch on the wiper switch body and install the mounting screws, lock washers, and nuts. Tighten the screws to 5 in.lb (0.6 N-m).
2. Connect the accelerator rod ball joint to the ball stud on the wiper switch.
3. Connect the green/white wire to the normally closed (NC) terminal and the blue wire to the common (COM) terminal of the limit switch. The normally open (NO) terminal should have **no** wire attached.
4. Install the cover on the wiper switch (make sure all three tabs snap into place).
5. Install and connect the No. 5 and No. 6 batteries, leaving the No. 6 negative (-) post disconnected.
6. Connect battery cables to battery No. 1 positive (+) first, then connect cable to battery No. 6 negative (-). Tighten terminals to 110 in.lb (12.4 N-m).
7. Place Tow/Run switch in RUN.

REVERSE BUZZER

Read **DANGER** and **WARNING** on page 12-1.

Testing the Reverse Buzzer

See Test Procedure 17, Section 11, Page 11-21.

Reverse Buzzer Removal

1. Place Tow/Run switch in the TOW position, disconnect batteries (**Figure 12-1, Page 12-2**) and discharge speed controller.
2. Remove center dash. **See Remove Center Dash, page 12-2.**
3. Disconnect the 18 gauge red and orange wires from reverse buzzer.
4. Remove the two screws from the reverse buzzer. Remove the reverse buzzer from the center dash panel.

Reverse Buzzer Installation

1. Install the reverse buzzer in the reverse order of removal. Tighten screws to 4 in.lb (0.45 N-m).
2. Reconnect battery wires (positive cable first) and tighten to 110 in.lb (12.4 N-m). Place Tow/Run switch in the RUN position.

MAIN SOLENOID

Read **DANGER** and **WARNING** on page 12-1.

The main solenoid is located on the passenger side of the electrical component mounting plate.

Testing the Main Solenoid

See Test Procedure 3, Section 11, Page 11-15.

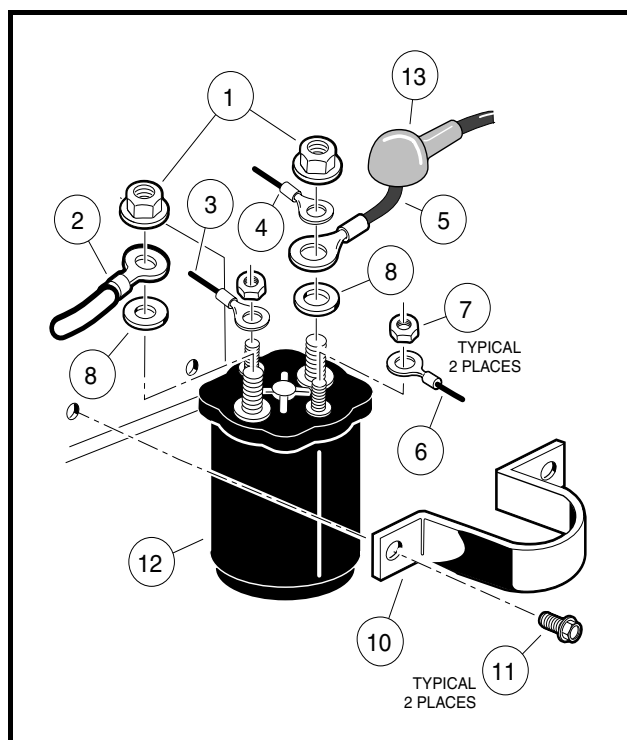


Figure 12-4 Main Solenoid

Main Solenoid Removal

1. Place Tow/Run switch in the TOW position and disconnect batteries. **See Figure 12-1, Page 12-2.**
2. Remove the rear body access door.
3. Disconnect all wires from the solenoid (12) (**Figure 12-4, Page 12-5**).
4. Loosen, but do not remove, one of the thread rolling screws (11) that hold the solenoid mounting bracket (10) to the component mounting plate (**Figure 12-4, Page 12-5**).
5. Lift the solenoid (12) up and out of the mounting bracket (10) (**Figure 12-4, Page 12-5**).

Main Solenoid Installation

1. Mount solenoid (12) onto component mounting plate with mounting bracket (10) (**Figure 12-4, Page 12-5**).
2. Tighten thread rolling screws (11) to 20 in.lb (2.2 N-m) (**Figure 12-4, Page 12-5**).
3. Install washers (8), wires (2, 4 and 13) and lock nuts (1) onto large mounting posts. Tighten nuts to 60 in.lb (6.7 N-m) (**Figure 12-4, Page 12-5**). **See Section 11, Figure 11-1, Page 11-2 for wire destinations.**
4. Install wires (3 and 6) and nuts (7) onto small mounting posts. Tighten to 18 in.lb (2.0 N-m) (**Figure 12-4, Page 12-5**).
5. Install rear body access door.
6. Connect batteries (positive cable first) (**Figure 12-1, Page 12-2**) and tighten to 110 in.lb (12.4 N-m). Place Tow/Run switch in RUN.

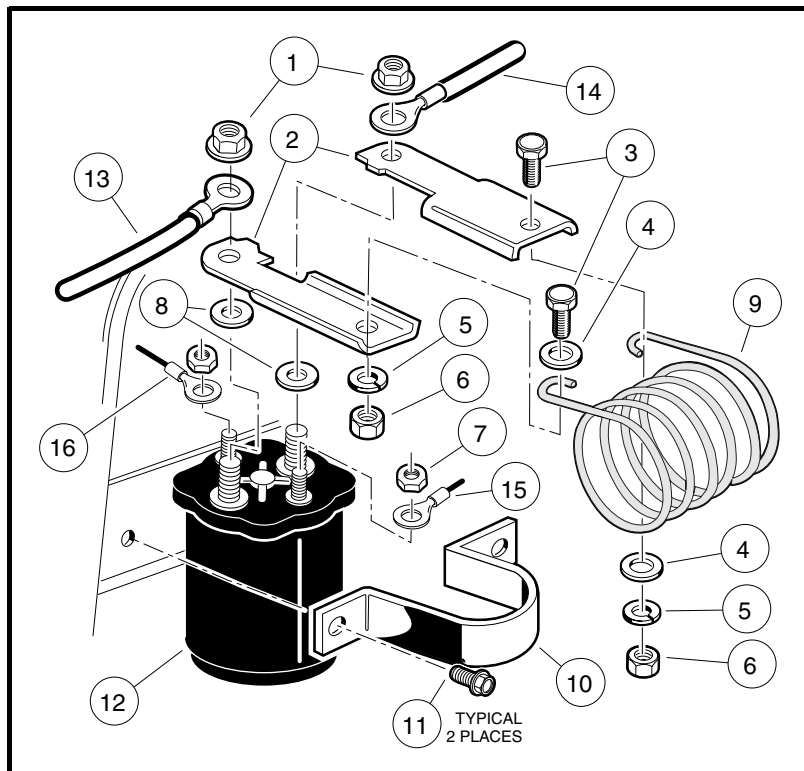


Figure 12-5 Dynamic Braking Solenoid

DYNAMIC BRAKING SOLENOID

Read DANGER and WARNING on page 12-1.

The dynamic braking solenoid is located on the driver side of the electrical component mounting plate.

Testing the Dynamic Braking Solenoid

See Test Procedure 8, Section 11, Page 11-17.

Dynamic Braking Solenoid Removal

1. Place Tow/Run switch in the TOW position, disconnect the batteries and discharge the controller (**Figure 12-1, Page 12-2**).
2. Remove the rear body access door.
3. Disconnect all wires from the solenoid (12) (**Figure 12-5, Page 12-6**).
4. Loosen, but do not remove, one of the self tapping screws (11) that hold the solenoid mounting bracket (10) to the component mounting plate (**Figure 12-5, Page 12-6**).
5. Lift the solenoid (12) up and out of the mounting bracket (10) (**Figure 12-5, Page 12-6**).

Dynamic Braking Solenoid Installation

1. Mount solenoid onto component mounting plate with mounting bracket (10) (**Figure 12-5, Page 12-6**).
2. Tighten thread rolling screws (11) to 60 in.lb (6.7 N-m) (**Figure 12-5, Page 12-6**).
3. Install washers (8), mounting tabs (2), wires (13, 14) and flanged lock nuts (1) onto large mounting posts. Tighten nuts to 60 in.lb (6.7 N-m) (**Figure 12-5, Page 12-6**). See Section 11, Figure 11-1, Page 11-2 for correct wire destinations.
4. Install wires (15, 16) and nuts (7) onto small mounting posts. Tighten nuts to 18 in.lb (2.0 N-m) (**Figure 12-5, Page 12-6**).
5. Install rear body access door.
6. Connect batteries (positive cable first) and tighten to 110 in.lb (12.4 N-m) (**Figure 12-1, Page 12-2**). Place Tow/Run switch in RUN.

ONBOARD COMPUTER (OBC)

Read DANGER and WARNING on page 12-1.

Testing the Onboard Computer

See Test Procedures 2, 11 and 12, Section 11, Page 11-14, Page 11-18 and Page 11-19.

Onboard Computer Removal

1. Place Tow/Run switch in the TOW position and disconnect the batteries (**Figure 12-1, Page 12-2**).
2. Remove rear body access door and unplug six pin connector (16) at OBC (**Figure 12-6, Page 12-8**).
3. Remove black 10 gauge and 6 gauge wires (9 and 14) from controller B- terminal (**Figure 12-6, Page 12-8**).
4. Disconnect the gray wire fuse holder at the charger receptacle.
5. Disconnect the black 10 gauge wire (8) at the charger receptacle.
6. Cut the wire tie that secures the OBC wire harness to the I-beam.
7. Loosen, do not remove, self tapping screws (17) holding OBC to component mounting plate (**Figure 12-6, Page 12-8**).
8. Slide OBC towards outside of vehicle and align heads of self tapping screws (17) with the two holes in the OBC face plate (**Figure 12-6, Page 12-8**). Pull OBC towards rear of vehicle and remove from component mounting plate.

Onboard Computer Installation

1. Place Tow/Run switch in the TOW position and disconnect the batteries (**Figure 12-1, Page 12-2**).
2. Remove the rear body access door.
3. Install OBC onto component mounting plate by aligning two holes on OBC face plate with two holes on component mounting plate. Slide OBC towards inside of vehicle and align heads of self tapping screws (17) with smaller part of two holes in OBC face plate (**Figure 12-6, Page 12-8**). Tighten screws to 60 in.lb (6.7 N-m).

Onboard Computer Installation, Continued:

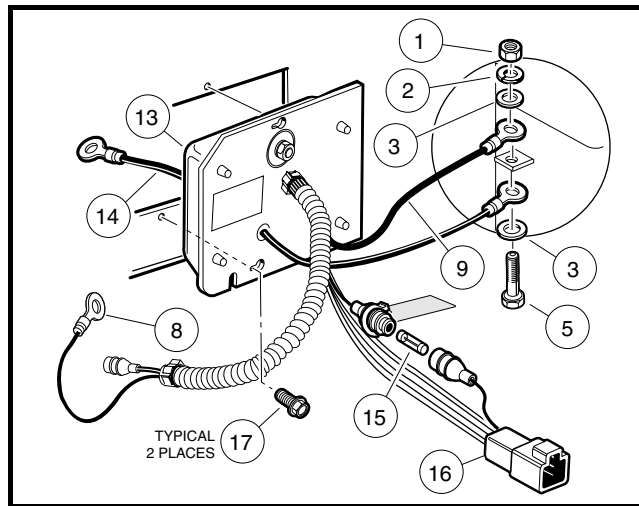


Figure 12-6 Onboard Computer

4. Attach wire tie so the OBC wire harness is secured to the I-beam.
5. Connect the black 10 gauge wire (8) to the charger receptacle.
6. Connect the gray wire fuse holder to the charger receptacle.
7. Connect black 10 and 6 gauge wires (9 and 14) to controller B- terminal (**Figure 12-6, Page 12-8**).
8. Plug the six-pin connector (16) into the OBC (**Figure 12-6, Page 12-8**).
9. Install the rear body access door.
10. Reconnect battery cables (positive cable first) and tighten to 110 in.lb (12.4 N-m) (**Figure 12-1, Page 12-2**). Place Tow/Run switch in RUN.

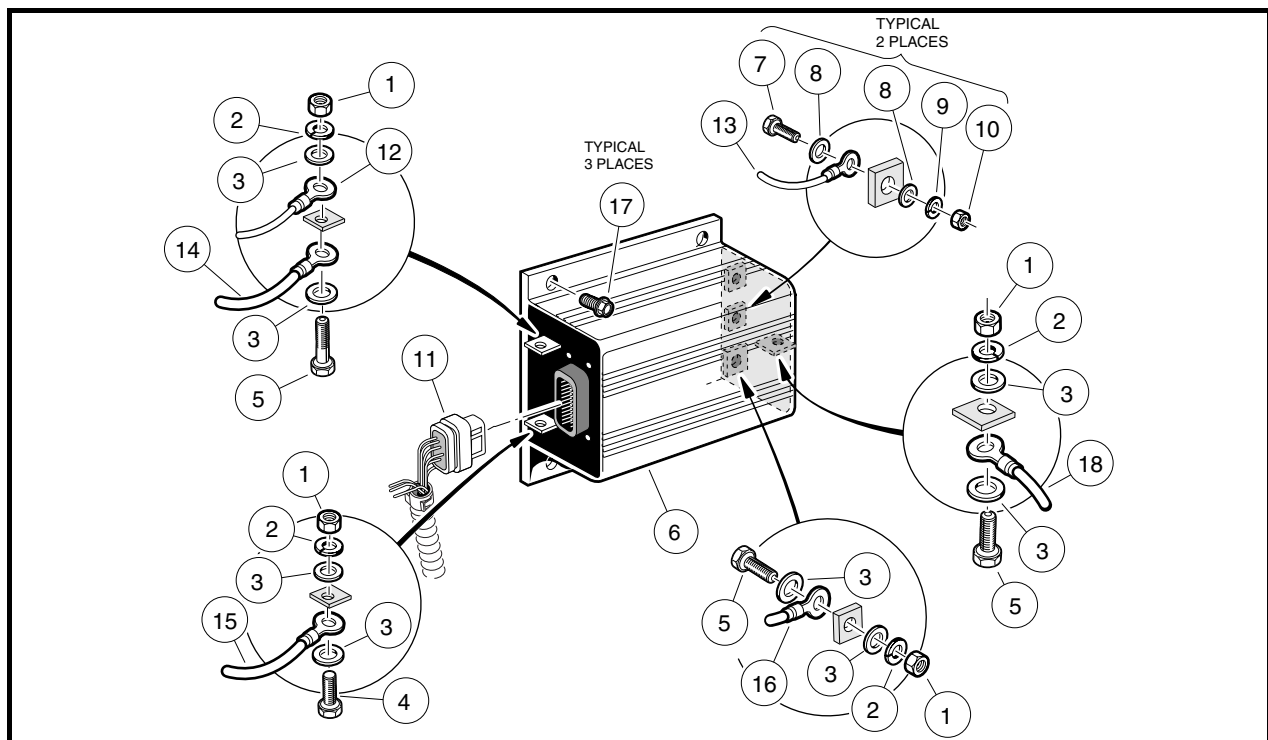


Figure 12-7 Speed Controller

SOLID STATE SPEED CONTROLLER

Read DANGER and WARNING on page 12-1.

Testing the Solid State Speed Controller

See Test Procedure 5, Section 11, Page 11-16.

Speed Controller Removal

1. Place Tow/Run switch in the TOW position and disconnect the batteries. **See Figure 12-1, Page 12-2.**
2. Remove the rear body access door.
3. Disconnect all wires from the speed controller (6) (**Figure 12-7, Page 12-8**).
4. Remove the three self tapping screws (17) that hold the controller (6) to the component mounting plate and remove the controller from the vehicle (**Figure 12-7, Page 12-8**).

Speed Controller Installation

1. Install the three self tapping screws (17) that hold the controller (6) to the component mounting plate and tighten to 60 in.lb (6.7 N-m) (**Figure 12-7, Page 12-8**).
2. Install wires (12, 13, 14, 15, 16 and 18) as illustrated in **Figure 12-7, Page 12-8**. Tighten nuts (1) to 9 ft.lb (12.2 N-m). Tighten nut (10) to 32 in.lb (3.6 N-m). **See Section 11, Figure 11-1, Page 11-2 for wire destinations.**
3. Install rear body access door.
4. Reconnect battery cables (positive cable first) and tighten to 110 in.lb (12.4 N-m) (**Figure 12-1, Page 12-2**). Place Tow/Run switch in RUN.

CHARGER RECEPTACLE ASSEMBLY

Read DANGER and WARNING on page 12-1.

Testing the Charger Receptacle

See Test Procedure 13, Section 11, Page 11-19.

NOTE

- DISASSEMBLY OF THE CHARGER RECEPTACLE, FOR THE PURPOSE OF REMOVAL OR INSTALLATION, IS NOT RECOMMENDED.

Charger Receptacle Removal

1. Place Tow/Run switch in the TOW position and disconnect the batteries. **See Figure 12-1, Page 12-2.**
2. Remove the 10 gauge red wire (4) from the positive post of battery No. 1 (**Figure 12-8, Page 12-10**).
3. Remove black 10 gauge OBC wire (5) from charger receptacle assembly (**Figure 12-8, Page 12-10**).
4. Disconnect the gray wire (9) from the receptacle at the yellow fuse holder (**Figure 12-8, Page 12-10**).
5. Remove the four screws (1) that secure the charger receptacle bezel (8) to the receptacle backing plate and to the vehicle body (**Figure 12-8, Page 12-10**).
6. Move the receptacle assembly toward the front of the vehicle and tilt receptacle upwards in order for the receptacle to pass through the hole in the vehicle body.

Charger Receptacle Installation

1. Insert the 10 gauge red wire (4) and the 18 gauge gray wire (3) through the hole in the vehicle body and the receptacle backing plate (**Figure 12-8, Page 12-10**).
2. Insert receptacle into vehicle body.

Charger Receptacle Installation, Continued:

3. Install the four screws (1) that secure the receptacle assembly to the vehicle body and receptacle backing plate (8). Tighten screws to 11 in.lb (1.2 N-m) (**Figure 12-8, Page 12-10**).
4. Connect 18 gauge gray wire (9) to yellow fuse holder. Make sure fuse (11) is installed in fuse holder.
5. Connect the 10 gauge black wire (5) to the receptacle fuse link (6) on the charger receptacle assembly (**Figure 12-8, Page 12-10**).
6. Connect the 10 gauge red wire (4) to the positive post of battery No. 1.
7. Connect battery cables (positive cable first) and tighten to 110 in.lb (12.4 N-m) (**Figure 12-1, Page 12-2**). Place Tow/Run switch in RUN.

RECEPTACLE FUSE LINK

The fuse link on the PowerDrive Plus vehicle should not blow under normal operating conditions. However, if the fuse link has blown, the vehicle will not charge and the fuse must be replaced. The fuse link is mounted on top of the charger receptacle in the battery compartment.

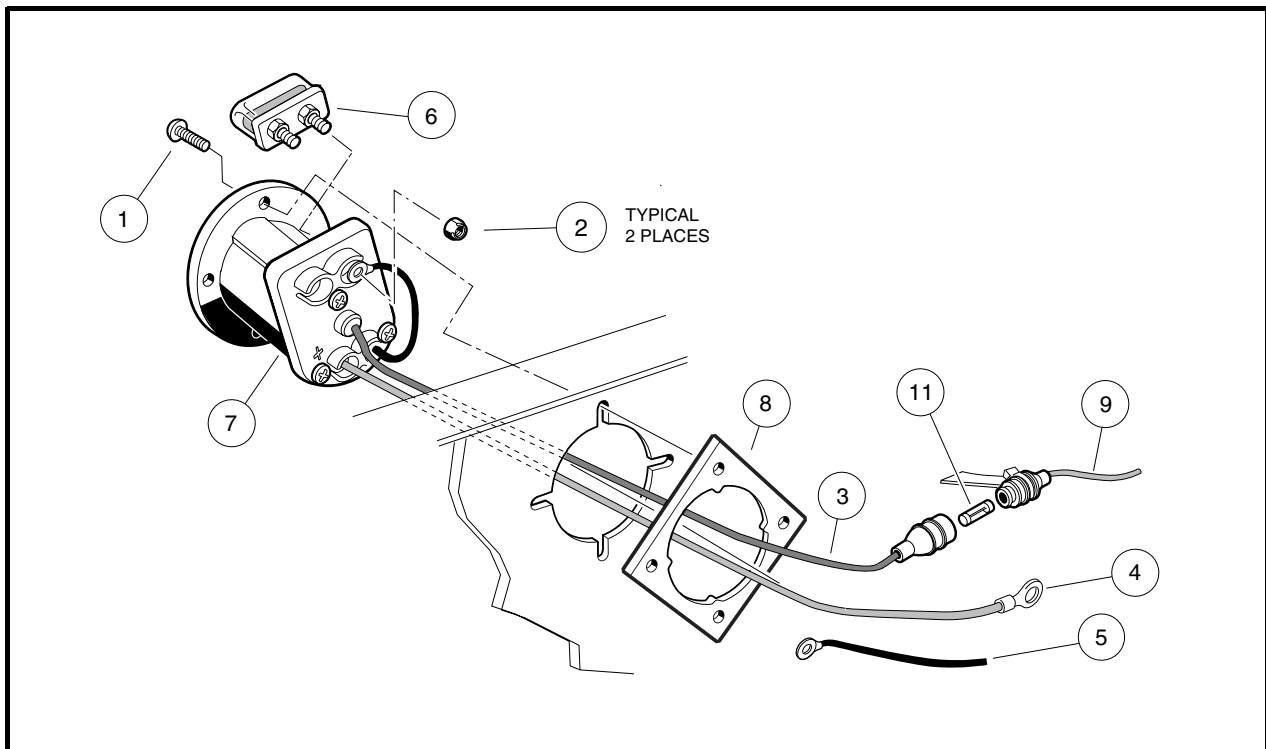


Figure 12-8 Charger Receptacle

Receptacle Fuse Link Removal

1. Remove the fuse link assembly (6) from the charger receptacle (7) by removing the two nuts and washers used to secure the 10 gauge black wire from the computer (5) and the 10 gauge black wire to the receptacle (**Figure 12-8, Page 12-10**).
2. Remove the fuse link (6) from the charger receptacle (**Figure 12-8, Page 12-10**).

Receptacle Fuse Link Installation

1. Insert the two fuse link mounting posts into the mounting holes in the charger receptacle.
2. Place the two 10 gauge black wires in their original positions on the fuse link mounting posts.
3. Install nuts (2) on fuse link mounting posts and tighten to 19 in.lb (2.1 N-m) (**Figure 12-8, Page 12-10**).

MULTI-STEP POTENTIOMETER

Read **DANGER** and **WARNING** on page 12-1.

Testing the Multi-step Potentiometer

See Section 11, Test Procedure 4, Page 11-18.

Multi-step Potentiometer Removal

1. Place Tow/Run switch in the TOW position and disconnect the batteries (**Figure 12-1, Page 12-2**).
2. Remove the battery wire connecting batteries No. 5 and No. 6 and the battery wire connecting batteries No. 5 and No. 4 (**Figure 12-1, Page 12-2**).
3. Remove the hold-down bracket from the No. 5 and No. 6 batteries and then remove the No. 5 and No. 6 batteries from the vehicle (**Figure 12-1, Page 12-2**).
4. Slide back the ball stud retainer on the potentiometer end of the accelerator rod (1) and disconnect the accelerator rod from the multi-step potentiometer (**Figure 12-9, Page 12-12**).
5. Disconnect the six-pin connector (2) from the wire harness, at the multi-step potentiometer (**Figure 12-9, Page 12-12**).
6. Remove the nuts (6) and washers (7) from underneath the I-Beam and lift the multi-step potentiometer assembly from the frame. Remove the shim plate (8) (**Figure 12-9, Page 12-12**).

Multi-step Potentiometer Disassembly

1. Remove nuts (30) and slide bolt (29) out of potentiometer housing (**Figure 12-13, Page 12-17**).
2. Remove the nut (32) and bell crank (34) (**Figure 12-13, Page 12-17**).
3. Slide the wiper arm assembly out of the housing (1) (**Figure 12-13, Page 12-17**).
4. Remove the spring cotter pin (if present) (18) and disassemble the wiper arm assembly. Unscrew the adjustment screw (23), retainer nut (19), and spring (21). Remove all thread locking compound (if present) from the threads using gasket remover (**Figure 12-13, Page 12-17**).
5. To remove the bearings (22) (**Figure 12-13, Page 12-17**) lightly tap them from the back with a punch.

Multi-step Potentiometer Assembly

1. Install bearings (22) into the potentiometer housing by lightly tapping them with a plastic hammer. Make sure the collars of the bearings are flush against the housing (**Figure 12-13, Page 12-17**).
2. With spring (21) in place, hold wiper arm (26) and carrier (20) together (**Figure 12-13, Page 12-17**). See following **CAUTION**.

CAUTION

- MAKE SURE THE SPRING IS IN THE RECESSED AREA OF THE WIPER ARM. IF THE SPRING IS NOT IN PLACE, THE WIPER ARM MAY BREAK IF FORCED.

3. Install the adjustment screw (23) and nut (19) (**Figure 12-13, Page 12-17**).

NOTE

- WIPER ARM SHOULD BE ADJUSTED AFTER THE POTENTIOMETER IS FULLY ASSEMBLED.

4. Slide the wiper arm assembly (20) into the potentiometer housing and install the bell crank (34). If ball stud (33) was removed, insert it through the bell crank with ball stud facing down and away from housing and install the nut (35). While holding ball stud with a wrench, tighten the nut to 5 ft.lb (7 N-m) (**Figure 12-13, Page 12-17**).

Multi-step Potentiometer Assembly, Continued:

5. While holding the bell crank so the arm does not exert a load on the housing, install the nut (32) and tighten to 9 ft.lb (12 N-m) **(Figure 12-13, Page 12-17)**.
6. Install screw (29), lock washer (9), and nut (30) through potentiometer housing **(Figure 12-13, Page 12-17)**.
7. Install nuts (30) and yellow 18 gauge wire (8) onto the screw and tighten to 40 in.lb (4.5 N-m).

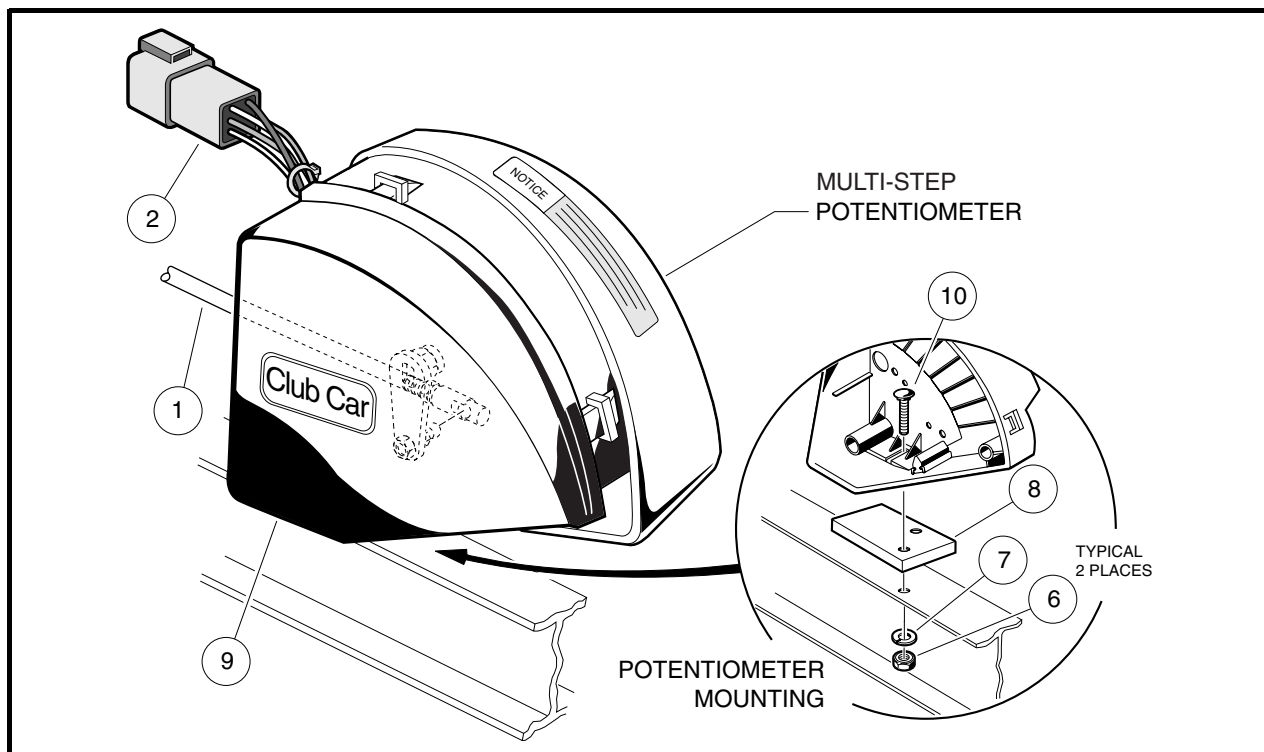
⚠ WARNING

- MAKE SURE WIPER ARM ROTATES FREELY IN POTENTIOMETER HOUSING. IF ARM BINDS OR STICKS, IT MUST BE REPLACED.

8. Adjust the potentiometer arm. **See Page 12-13.**

Multi-step Potentiometer Installation**⚠ CAUTION**

- BEFORE INSTALLING THE WIPER SWITCH, INSPECT THE HOUSING FOR CRACKS OR DAMAGE. IF THE HOUSING IS DAMAGED, THE ENTIRE HOUSING WITH FIXED CONTACTS MUST BE REPLACED.

**Figure 12-9 Multi-step Potentiometer Mounting**

1. Position shim plate (8) on frame I-Beam with mounting holes properly aligned **(Figure 12-9, Page 12-12)**.
2. Push locking tabs out of retainers, and remove potentiometer cover (9) **(Figure 12-9, Page 12-12)**.
3. Position the potentiometer on the shim plate and frame with mounting holes aligned and insert the mounting bolts (10) through the potentiometer base, the shim plate, and the frame as shown **(Figure 12-9, Page 12-12)**.
4. Hold the mounting bolts in place while installing the washers (7) and nuts (6). Tighten nuts to 36 in.lb (4.1 N-m) **(Figure 12-9, Page 12-12)**.

⚠ WARNING

- AFTER INSTALLING THE WIPER SWITCH, MAKE SURE IT IS SECURELY FASTENED TO THE VEHICLE FRAME.

5. Connect the six-pin connector to the wire harness at the multi-step potentiometer.
6. Connect the accelerator rod (1) to the potentiometer (**Figure 12-9, Page 12-12**).
7. Make sure wiper contact is positioned squarely on the last stationary contact when the accelerator pedal is depressed; otherwise, top vehicle speed will not be achieved.
8. Make sure wiper switch and pedal group are properly adjusted. **See Section 5–Accelerator and Brake Pedal Group in the Maintenance and Service Manual.**
9. Install and connect the No. 5 and No. 6 batteries leaving the No. 6 negative (–) post disconnected. Tighten terminals to 110 in.lb (12.4 N-m).
10. Reconnect battery cables to battery No. 1 positive (+) first, then connect cable to battery No. 6 negative (–). Tighten terminals to 110 in.lb (12.4 N-m). Place the Tow/Run switch in the RUN position.
11. Drive the vehicle and inspect it for proper operation.

⚠ CAUTION

- DO NOT OPERATE VEHICLE WITHOUT WIPER SWITCH COVER IN PLACE. OPERATING THE VEHICLE WITHOUT THE COVER ALLOWS DIRT, DUST, AND WATER TO CONTAMINATE THE WIPER SWITCH, WHICH COULD CAUSE THE SWITCH TO FAIL OR MALFUNCTION.

MULTI-STEP POTENTIOMETER ARM ADJUSTMENT

The contact surfaces on the multi-step potentiometer arm brush and fixed contacts must be parallel to ensure efficient operation of the multi-step potentiometer (**Figure 12-10, Page 12-14**). Adjust arm contact as follows:

1. Place Tow/Run switch in the TOW position and disconnect battery cables, negative cable first (**Figure 12-1, Page 12-2**). Remove the No. 5 and No. 6 batteries from the vehicle and remove the cover from the multi-step potentiometer.
2. Test the multi-step potentiometer arm and fixed contacts for proper adjustment:
 - 2.1. With a dry erase marker, completely coat each of the fixed contacts.
 - 2.2. Sweep the multi-step potentiometer arm brush back and forth across the fixed contacts. Scraping of the ink should show contact on at least 30% of the surface on each fixed contact. If 30% contact is not shown, surface contact should be adjusted.
3. To adjust surface contact, remove the spring cotter pin (if present) (18) and turn the adjustment screw (23) (**Figure 12-13, Page 12-17**) until the surfaces of the multi-step potentiometer arm brush and fixed contacts are parallel (**Figure 12-10, Page 12-14**). **See following NOTE.**

NOTE

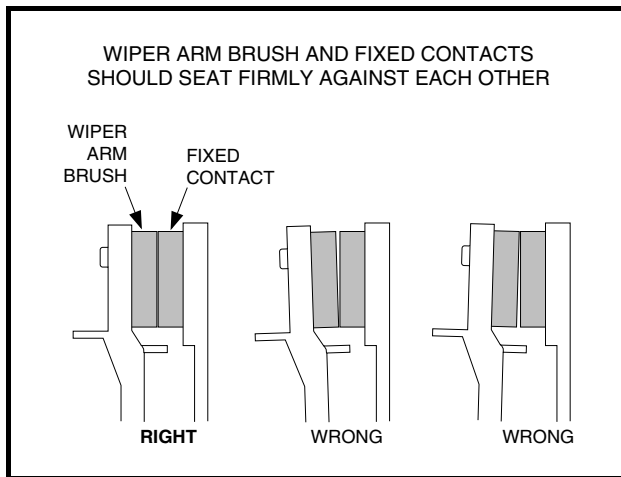
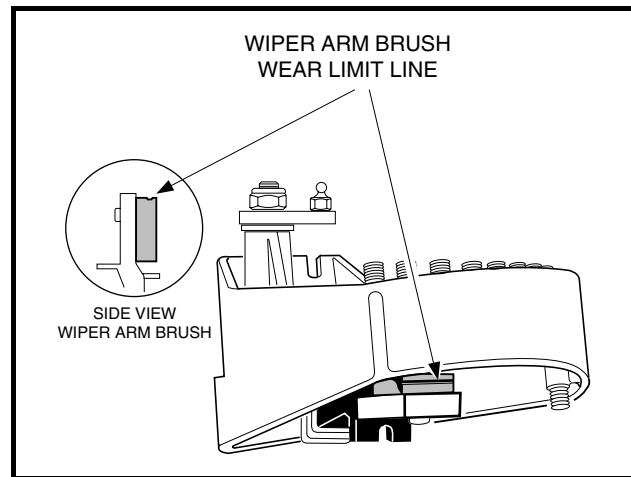
- A MID-MODEL YEAR DESIGN CHANGE RESULTED IN THE REMOVAL OF THE SPRING COTTER PIN (18) AND THE REPLACEMENT OF THE HEX NUT (19) WITH A NYLON LOCK NUT (**FIGURE 12-13, PAGE 12-17**). USE OF A LOCKING COMPOUND IS NOT NECESSARY IN CONJUNCTION WITH A NYLON LOCK NUT.
- IF THE MULTI-STEP POTENTIOMETER ARM BRUSH IS WORN TO OR BEYOND THE WEAR LIMIT LINE (**FIGURE 12-11, PAGE 12-14**) IT SHOULD BE REPLACED. IF ANY OF THE FIXED CONTACTS ARE EXCESSIVELY WORN, PITTED, OR BURNED, THE ENTIRE HOUSING, WITH FIXED CONTACTS, MUST BE REPLACED.
- A THREAD LOCKING COMPOUND HAS BEEN PLACED ON THE THREADS OF THE CONTACT STUDS TO PREVENT REMOVAL OF THE FIXED CONTACTS.

Multi-step Potentiometer Arm Adjustment, Continued:

4. After adjustment has been made, apply one drop of Loctite® 290 thread locking compound to the adjustment screw (23) at the hex nut (19). Then install the spring cotter pin (18) through the hole in the adjustment screw (Figure 12-13, Page 12-17). See preceding NOTE.

MULTI-STEP POTENTIOMETER ARM BRUSH REPLACEMENT

1. Place Tow/Run switch in the TOW position and disconnect battery cables, negative cable first.
2. Remove battery Nos. 5 and 6 from the vehicle (Figure 12-1, Page 12-2).
3. Disconnect accelerator rod from ball stud and place the wiper switch arm on the topmost fixed contact.
4. Remove the first nut (30), and lock washer (9) from the bolt (29) and remove the 18 gauge yellow wire (8) (Figure 12-13, Page 12-17).

**Figure 12-10 Wiper Arm Brush and Fixed Contacts****Figure 12-11 Wiper Arm Brush Wear Limit Line**

5. Remove the second and third nuts (30) from the bolt (29) and then remove the bolt from the potentiometer housing (1) (Figure 12-13, Page 12-17).
6. Remove the fourth nut (30) and wire (42) from the bolt (29) (Figure 12-13, Page 12-17).
7. Replace the wiper arm brush (27) as follows (Figure 12-13, Page 12-17).
 - 7.1. Remove screw (25) and lock washer (14). Pull arm assembly away from fixed contacts (Figure 12-13, Page 12-17).
 - 7.2. Remove the brush by pulling the wire through the hole in the wiper arm.
 - 7.3. Install new wiper arm brush assembly (27) (Figure 12-13, Page 12-17).
 - 7.4. Install screw (25) and lock washer (14) through wiper arm into brush. Tighten screw to 7 in.lb (0.8 N-m) (Figure 12-13, Page 12-17).
8. Install arm brush wire terminal (42) onto the bolt (29) and then install the nut (30). Thread the nut against the arm brush wire terminal and tighten it to 40 in.lb (4.5 N-m) (Figure 12-13, Page 12-17).
9. Install the bolt (29) through the potentiometer housing (1) and then install the two nuts (30) onto the bolt. Tighten the nuts to 40 in.lb (4.5 N-m) (Figure 12-13, Page 12-17).
10. Install the 18 gauge yellow wire onto the bolt (29), then install the lock washer (9) and nut (30). Tighten nut to 40 in.lb (4.5 N-m) (Figure 12-13, Page 12-17).
11. Connect the accelerator rod to the ball stud.
12. Check wiper arm brush contact for proper adjustment. See Page 12-13.
13. Check accelerator and brake pedal adjustment. See Section 5–Accelerator and Brake Pedal Group in the Maintenance and Service Manual.

14. Install potentiometer cover and install and connect the No. 5 and No. 6 batteries leaving the No. 6 negative (-) post disconnected. Tighten terminals to 110 in.lb (12.4 N-m).
15. Reconnect battery cables to battery No. 1 positive (+) first, then connect cable to battery No. 6 negative (-). Tighten terminals to 110 in.lb (12.4 N-m). Place the Tow/Run switch in the RUN position.

MULTI-STEP POTENTIOMETER ADJUSTMENT

Each of the adjustments listed in the following WARNING affects multi-step potentiometer adjustment. To ensure proper vehicle operation, if any one item requires adjustment, all must be checked, and adjusted if necessary, in the order listed.

WARNING

- TO PROPERLY ADJUST MULTI-STEP POTENTIOMETER, CHECK, AND ADJUST IF NECESSARY, THE FOLLOWING ITEMS IN THE ORDER LISTED:
 - BRAKE PEDAL AND CABLE ADJUSTMENT. **SEE SECTION 5-ACCELERATOR AND BRAKE PEDAL GROUP IN MAINTENANCE AND SERVICE MANUAL.**
 - ACCELERATOR ROD ADJUSTMENT. **SEE SECTION 5-ACCELERATOR AND BRAKE PEDAL GROUP IN MAINTENANCE AND SERVICE MANUAL.**
 - ACCELERATOR PEDAL STOP ADJUSTMENT. **SEE SECTION 5-ACCELERATOR AND BRAKE PEDAL GROUP IN MAINTENANCE AND SERVICE MANUAL.**
 - PARK BRAKE ADJUSTMENT. **SEE SECTION 5-ACCELERATOR AND BRAKE PEDAL GROUP IN MAINTENANCE AND SERVICE MANUAL.**
- FAILURE TO CHECK ALL ADJUSTMENTS IN THE ORDER LISTED COULD RESULT IN IMPROPER VEHICLE OPERATION, PROPERTY DAMAGE, OR SEVERE PERSONAL INJURY.

RESISTORS

Resistor Removal

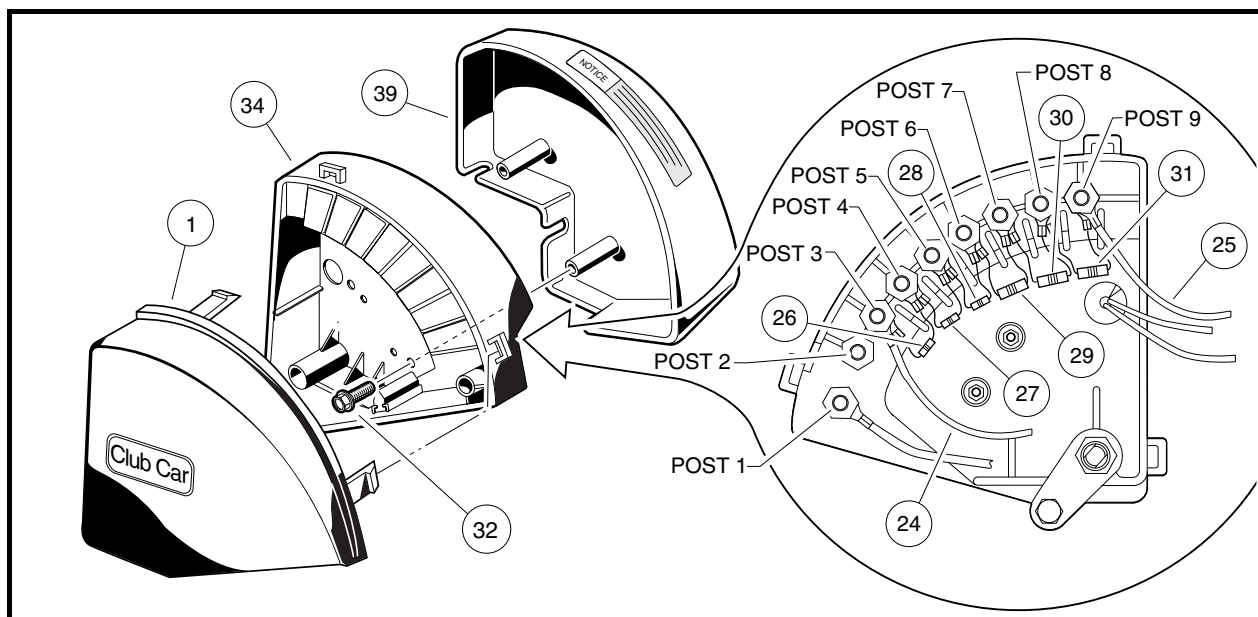
1. Push locking tabs out of the retainers and remove multi-step potentiometer cover (1) (**Figure 12-12, Page 12-16**).
2. Remove the two thread-rolling screws (32) and resistor protector cover (39) from the multi-step potentiometer (**Figure 12-12, Page 12-16**).
3. Remove the seven 1/4-20 hex nuts securing the resistors to the multi-step potentiometer.
4. Remove the six resistors from the multi-step potentiometer.

Resistor Installation

1. Install the 910 ohm resistor assembly (26) (color bands white, brown, and gold) onto the third and fourth threaded posts (**Figure 12-12, Page 12-16**). **See following NOTE.**

NOTE

- THE COLOR BANDS ON THE RESISTORS DO NOT NEED TO BE ORIENTED IN ANY PARTICULAR DIRECTION WHEN INSTALLED.
2. Install the 750 ohm resistor assembly (27) (color bands violet, green, brown, and gold) onto the fourth and fifth threaded posts (**Figure 12-12, Page 12-16**).
 3. Install the 910 ohm resistor assembly (28) (color bands white, brown and gold) onto the fifth and sixth threaded posts (**Figure 12-12, Page 12-16**).
 4. Install the 1000 ohm resistor assembly (29) (color bands brown, black, red, and gold) onto the sixth and seventh threaded posts (**Figure 12-12, Page 12-16**).

Resistor Installation, Continued:**Figure 12-12 Resistors**

5. Install the 1000 ohm resistor assembly (30) (color bands brown, black, red, and gold) onto the seventh and eighth threaded posts (**Figure 12-12, Page 12-16**).
6. Install the 1000 ohm resistor assembly (31) (color bands brown, black, red, and gold) onto the eighth and ninth threaded posts (**Figure 12-12, Page 12-16**).
7. Make sure the purple wire (24) is connected to the third threaded post and the white/black wire (25) is connected to the ninth threaded post (**Figure 12-12, Page 12-16**).

⚠ WARNING

- MAKE SURE WIRES ARE CONNECTED TO WIPER SWITCH CONTACTS EXACTLY AS STATED. IF THEY ARE NOT, THE VEHICLE COULD START IN A SPEED OTHER THAN FIRST.

8. Install seven 1/4-20 hex nuts onto the threaded posts (with resistors attached) and tighten to 40 in.lb (4.5 N-m) (**Figure 12-12, Page 12-16**).
9. Coat all terminals with Battery Protector Spray (Club Car Part Number 1014305) to minimize corrosion.

BATTERY WARNING LIGHT

Read DANGER and WARNING on page 12-1.

Testing the Battery Warning Light

1. Turn key switch OFF, place Tow/Run switch in TOW and place Forward/Reverse rocker switch in NEUTRAL.
2. Disconnect the six-pin connector at the OBC.
3. Remove the wedge lock from the six-pin connector housing that is connected to the vehicle wire harness. Remove the brown wire from the connector plug.
4. Using a jumper wire with an alligator clip at each end, connect one alligator clip to the negative post of battery No. 1 and the other alligator clip to the brown wire terminal socket that was removed from the six-pin connector plug.

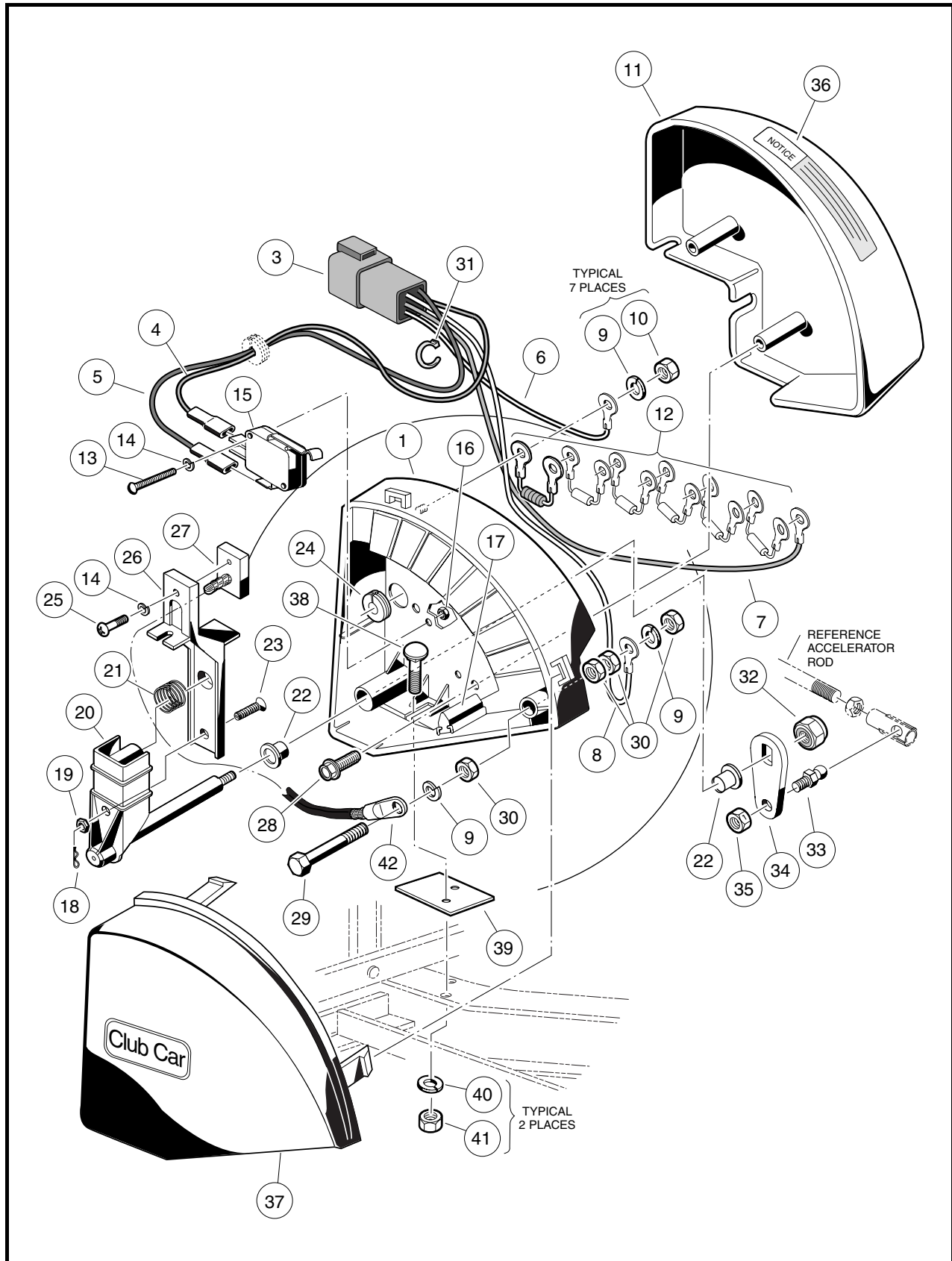


Figure 12-13 Multi-step Potentiometer

Testing the Battery Warning Light, Continued:

5. Install the wedgelock in the six-pin connector housing and reconnect the six-pin connector plug. Place the Tow/Run switch in the RUN position and the battery light should illuminate. If the light does not illuminate, replace the battery warning light assembly.

Battery Warning Light Removal

1. Place Tow/Run switch in TOW and disconnect the battery wires as shown (**Figure 12-1, Page 12-2**).
2. Remove center dash. **See Remove Center Dash on Page 12-2.**
3. Disconnect the brown wire at the spade terminal and remove the orange/white wire from the key switch. Do not allow wires to touch.
4. Depress the two retaining tabs and remove the light from the center dash.

Battery Warning Light Installation

1. Install in reverse order of removal. Reconnect battery wires (positive cable first) and tighten to 110 in.lb (12.4 N-m). Place Tow/Run switch in the RUN position.

ENERGY DISPLACEMENT MODULE

Read **DANGER** and **WARNING** on page 12-1.

Energy Displacement Module Removal

1. Place Tow/Run switch in the TOW position and disconnect battery cables (**Figure 12-1, Page 12-2**).
2. Remove the two 1/4 in. nuts, lock washers, flat washers and bolts that secure the coil to the mounting tabs and remove coil (**Figure 12-5, Page 12-6**).

Energy Displacement Module Installation

1. Installation is reverse of removal. Position the coil ends as shown in **Figure 12-5, Page 12-6** and tighten the nuts (6) to 75 in.lb (8.5 N-m). **See also Figure 12-14, Page 12-18. See following CAUTION.**

⚠ CAUTION

- BE SURE ALL WIRES ARE SECURED IN PLACE SO THEY DO NOT COME INTO CONTACT WITH THE COIL.

2. Reconnect battery cables (positive cable first) and tighten to 110 in.lb (12.4 N-m). Place the Tow/Run switch in the RUN position.

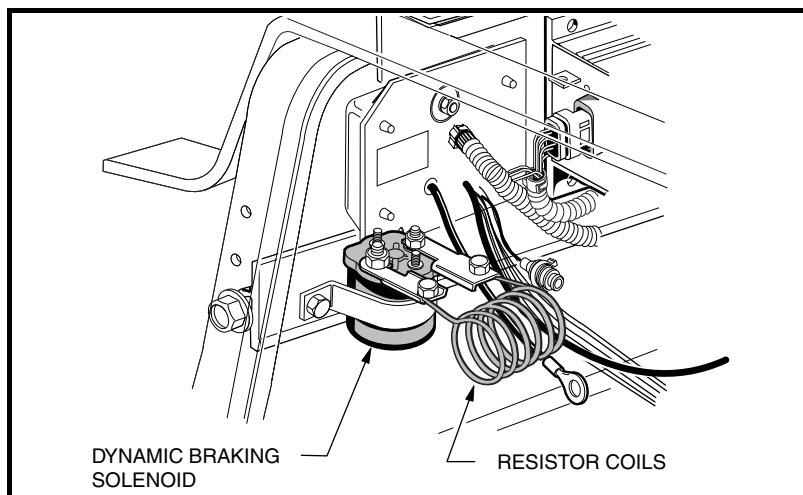


Figure 12-14 Energy Displacement Module

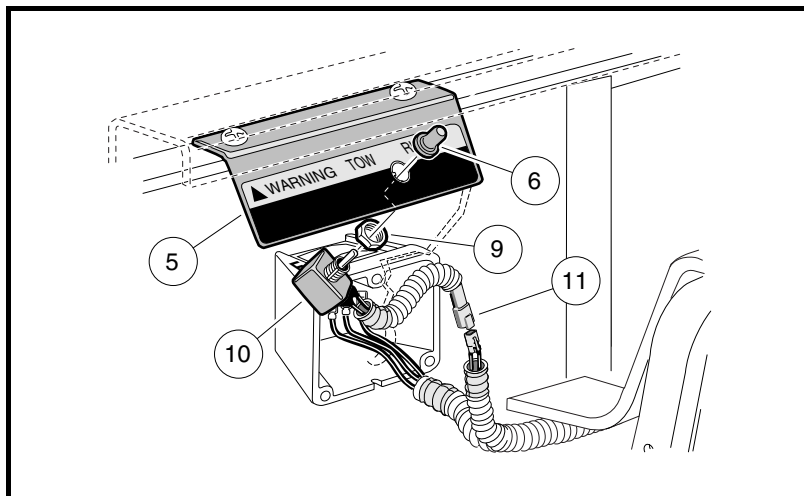


Figure 12-15 Tow/Run Switch

TOW/RUN SWITCH

Read **DANGER** and **WARNING** on page 12-1.

Testing the Tow/Run Switch

See Section 11, Test Procedure 6, Page 11-16.

Tow/Run Switch Removal

1. Place Tow/Run switch in TOW and disconnect the battery wires as shown (**Figure 12-1, Page 12-2**).
2. Remove Tow/Run switch boot/hex nut (6) (**Figure 12-15, Page 12-19**).
3. Remove nut (9) and Tow/Run switch (10) from bracket (5) (**Figure 12-15, Page 12-19**).
4. Disconnect two-pin connector (11) and remove switch (**Figure 12-15, Page 12-19**).

Tow/Run Switch Installation

1. Installation is reverse of removal. Make sure groove on switch is aligned with tang on bracket. If knurled nut is present, tighten nut (9) to 23 in.lb (2.6 N-m). Tighten Tow/Run switch boot/hex nut (6) to 16 in.lb (1.8 N-m) (**Figure 12-15, Page 12-19**).
2. Reconnect battery wires, positive cable first, and tighten to 110 in.lb (12.4 N-m). Coat terminals with Battery Protector Spray (Club Car Part No. 1014305) to minimize corrosion.
3. Place Tow/Run switch in the RUN position.

SECTION 13–BATTERIES

DANGER

- **BATTERY - EXPLOSIVE GASES! DO NOT SMOKE. KEEP SPARKS AND FLAMES AWAY. VENTILATE WHEN CHARGING OR USING IN AN ENCLOSED SPACE. ALWAYS WEAR FULL FACE SHIELD AND RUBBER GLOVES WHEN WORKING ON BATTERIES.**
- **USE EXTREME CAUTION WHEN USING TOOLS, WIRES, OR METAL OBJECTS NEAR BATTERIES! A SHORT CIRCUIT AND (OR) SPARK COULD CAUSE AN EXPLOSION.**
- **BATTERY - POISON! CONTAINS ACID! CAUSES SEVERE BURNS. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. ANTIDOTES:**
 - EXTERNAL: FLUSH WITH WATER. CALL A PHYSICIAN IMMEDIATELY.
 - INTERNAL: DRINK LARGE QUANTITIES OF MILK OR WATER. FOLLOW WITH MILK OF MAGNESIA OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.
 - EYES: FLUSH WITH WATER FOR FIFTEEN MINUTES. CALL PHYSICIAN IMMEDIATELY.

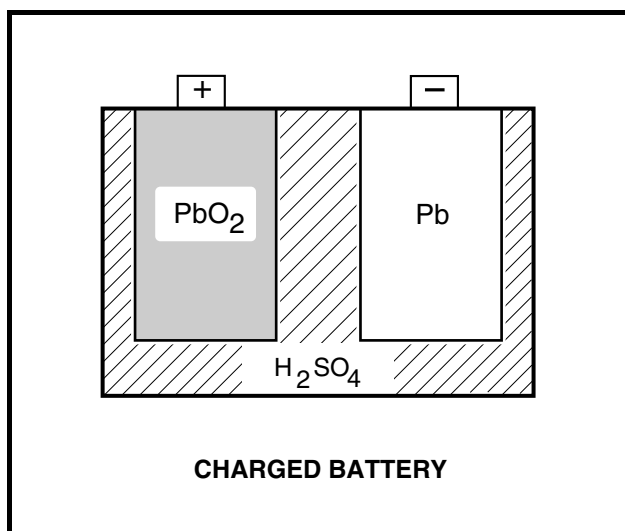
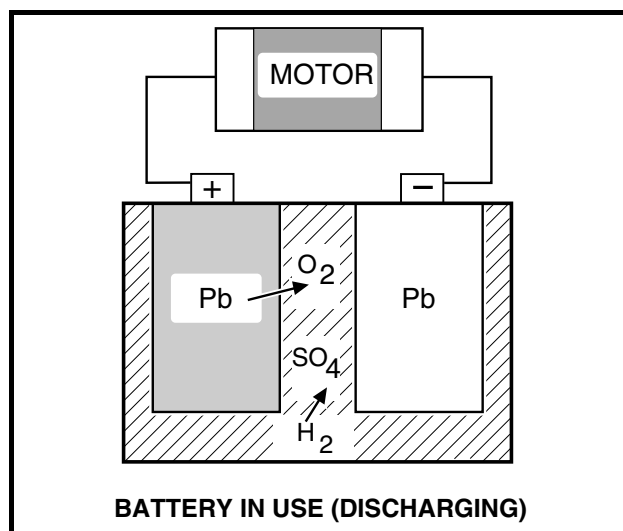
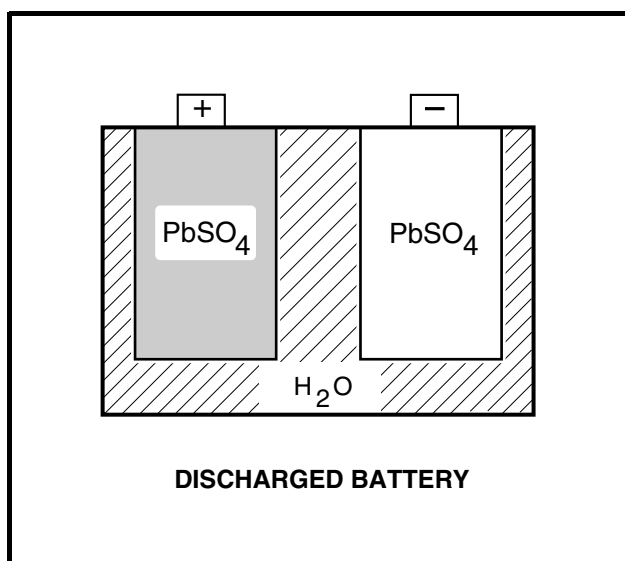
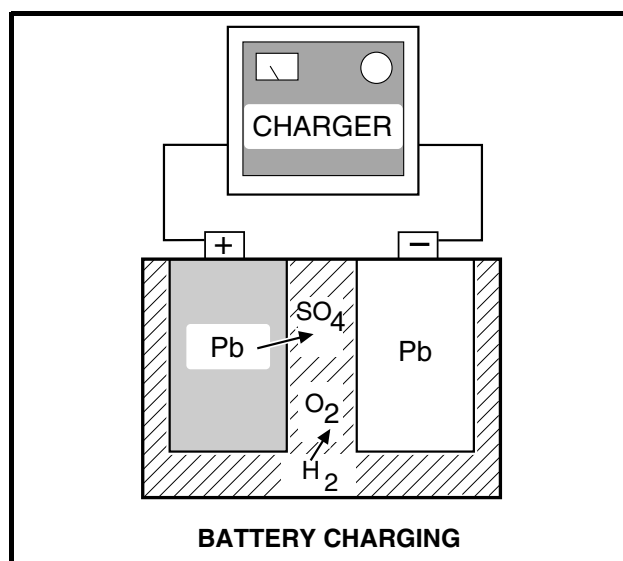
WARNING

- ONLY TRAINED TECHNICIANS SHOULD REPAIR OR SERVICE THIS VEHICLE. ANYONE DOING EVEN SIMPLE REPAIRS OR SERVICE SHOULD HAVE KNOWLEDGE AND EXPERIENCE IN GENERAL ELECTRICAL REPAIR. FOLLOW ALL PROCEDURES EXACTLY AND HEED ALL WARNINGS STATED IN THIS MANUAL.
- ALWAYS WEAR APPROVED EYE PROTECTION WHILE SERVICING VEHICLE. WEAR A FULL FACE SHIELD AND RUBBER GLOVES WHEN WORKING WITH BATTERIES.
- TURN KEY SWITCH **OFF**, PLACE FORWARD/REVERSE ROCKER SWITCH IN **NEUTRAL**, AND REMOVE KEY PRIOR TO SERVICING.
- DO NOT WEAR LOOSE CLOTHING. REMOVE JEWELRY SUCH AS RINGS, WATCHES, CHAINS, ETC. BEFORE SERVICING VEHICLE.
- ALWAYS USE INSULATED TOOLS WHEN WORKING NEAR BATTERIES OR ELECTRICAL CONNECTIONS.
- BEFORE PERFORMING TESTS OR REPAIRS MAKE SURE CAPACITORS ARE DISCHARGED. PLACE TOW/RUN SWITCH IN **TOW**, DISCONNECT BATTERY WIRES, PLACE FORWARD/REVERSE ROCKER SWITCH IN **REVERSE** AND LISTEN FOR THE REVERSE BUZZER:
 - IF THE BUZZER DOES NOT SOUND, THE CAPACITORS ARE DISCHARGED.
 - IF THE REVERSE BUZZER SOUNDS, TURN THE KEY SWITCH **ON** AND DEPRESS THE ACCELERATOR PEDAL UNTIL THE BUZZER CAN NO LONGER BE HEARD.
- TO AVOID UNINTENTIONALLY STARTING THE VEHICLE, PLACE THE TOW/RUN SWITCH IN THE **TOW** POSITION AND DISCONNECT BATTERIES AS SHOWN IN **FIGURE 13-5, PAGE 13-4**.

GENERAL INFORMATION

The batteries supplied with a PowerDrive Plus vehicle are different from those supplied with automobiles. The outward appearance of these two batteries is similar, but the operating characteristics are very different. The PowerDrive Plus vehicle battery is known as a “deep cycle” battery, and the automotive battery is known as a “starting, lighting and ignition” (SLI) battery. They should never be substituted for one another.

An automotive battery has to deliver high cranking currents of 300-400 amperes at a sufficient voltage for several seconds and maintain an accessory load of 10-25 amperes in stop and go driving. The energy removed from an automotive battery is immediately replaced by the alternator or generator. As a result, the automotive battery operates at 90 to 100% of full charge at all times.

General Information, Continued:**Figure 13-1 Charged Battery****Figure 13-2 Discharging Battery****Figure 13-3 Discharged Battery****Figure 13-4 Charging Battery**

The batteries supplied with an electric vehicle must supply 100% of the energy required to operate the vehicle. These batteries therefore, receive deep discharge down to 30% to 40% of their full charge capacity. Then they must be recharged, hence the name "deep cycle." The average amperage draw is considered to be 56 amps on a 48 volt vehicle, although it varies greatly depending on the vehicle and how it is operated. PowerDrive Plus vehicle batteries are specifically designed to handle this type of service.

The rechargeable lead-acid battery turns chemical energy into electrical energy and vice versa. The main active elements within a battery are the positive plates, the negative plates and the electrolyte (sulfuric acid). Another very important element (but inactive) is the separator. The separator does exactly what its name implies - it separates the material of the positive and negative plates and prevents them from touching each other, which would create electrical shorts. The separator is porous enough to allow charged ions to pass through between the positive and negative plates, but not allow the two materials to contact each other.

Whenever two unlike metals are immersed in an acid solution, an electric current is generated.

In a “deep cycle” battery, the negative plates contain lead (Pb) and the positive plates contain lead dioxide (PbO₂). These plates are immersed in a sulfuric acid solution (H₂SO₄) (**Figure 13-1, Page 13-2**).

During discharge, the chemical reaction inside the battery causes the sulfate (SO₄) to break away from the H₂ (**Figure 13-2, Page 13-2**).

The sulfate (SO₄) combines with the lead (Pb) on both plates, forming lead sulfate (PbSO₄). The oxygen (O₂) from the positive plates combines with hydrogen (H) from the electrolyte to form water (H₂O) (**Figure 13-3, Page 13-2**).

The result is two similar metals, lead sulfate (PbSO₄) immersed in water (H₂O). This will not generate electricity since the battery is completely discharged.

When a discharged battery is connected to a charger, the process is reversed. The sulfate (SO₄) is forced from the plates back into the electrolyte to make sulfuric acid (H₂SO₄). The oxygen returns to the positive plate to make lead dioxide (PbO₂) (**Figure 13-4, Page 13-2**).

The result is a charged battery that is again capable of generating electricity (**Figure 13-1, Page 13-2**).

COMMON MISCONCEPTIONS ABOUT BATTERIES

The chart below describes some of the more common misconceptions that are associated with the PowerDrive Plus vehicle batteries and battery care.

PROBLEM	MISCONCEPTION AND REALITY
1. Deep Discharge	Misconception- “This vehicle is running slowly, but we can run it until it stops.” Reality- This statement is wrong. Avoid deep discharge of batteries whenever possible. See Battery Charging, Page 13-6.
2. Early Excessive Discharging	Misconception- “These are new batteries. They can run all day.” Reality- This statement is wrong also. New batteries do not reach their full capacity until they have been used and recharged 20 to 50 times.
3. Mineral Content	Misconception- “Tap water will do for our batteries.” Reality- Your tap water might be OK, but have it checked first. See Battery Care, Page 13-5
4. Self-Discharge	Misconception- “Dirt and corrosion on the battery won’t hurt anything.” Reality- Wrong again. Dirt and corrosion might provide a path for current to flow and allow the batteries to self-discharge. See Battery Care, Page 13-5.
5. Overwatering	Misconception- “Batteries can be filled to the level indicator at night, so it won’t have to be done in the morning.” Reality- Under most circumstances, water should be added <i>after</i> charging. See Battery Care, Page 13-5.
6. Underwatering	Misconception- “Checking the water takes too much time; it can be checked once a month.” Reality- Insufficient watering can ruin batteries. Water level should be checked weekly. See Battery Care, Page 13-5.
7. Vibration Damage	Misconception- “You should tighten battery hold-downs as tight as you can.” Reality- Battery hold-downs should be tightened to specification. Hold-downs that are too tight or too loose can cause battery damage. See Battery Care, Page 13-5.

REPLACING BATTERIES

Read **DANGER** and **WARNING** on page 13-1.

⚠ WARNING

- TO PREVENT ELECTROLYTE LEAKAGE FROM THE BATTERY VENTS, BATTERIES MUST BE KEPT IN AN UPRIGHT POSITION. TIPPING A BATTERY BEYOND A 45° ANGLE IN ANY DIRECTION CAN ALLOW A SMALL AMOUNT OF ELECTROLYTE TO LEAK OUT THE VENT HOLE. DO NOT EXCEED THIS 45° ANGLE WHEN LIFTING, CARRYING, OR INSTALLING BATTERIES. BATTERY ACID CAN CAUSE SEVERE PERSONAL INJURY TO SKIN OR EYES, AND CAN DAMAGE CLOTHING.

1. Before removing batteries, note the orientation of the batteries and the connecting wires. First, place the Tow/Run switch in the TOW position. Disconnect the batteries and discharge the controller as described in the WARNING on page 13-1. Then remove remaining wires and batteries. **See Figure 13-5, Page 13-4 for PowerDrive Plus Vehicle battery wiring.**
2. Visually inspect the new batteries for any damage that may have occurred in transit.
3. If old battery cables are going to be reused, inspect them for broken or frayed wires, damaged terminals, or worn insulation. Remove any corrosion on the connectors. One cup of bicarbonate of soda (baking soda) in a gallon of water and a bristle brush do an excellent job of neutralizing and removing the corrosion. Be careful not to allow this baking soda solution to enter the battery.

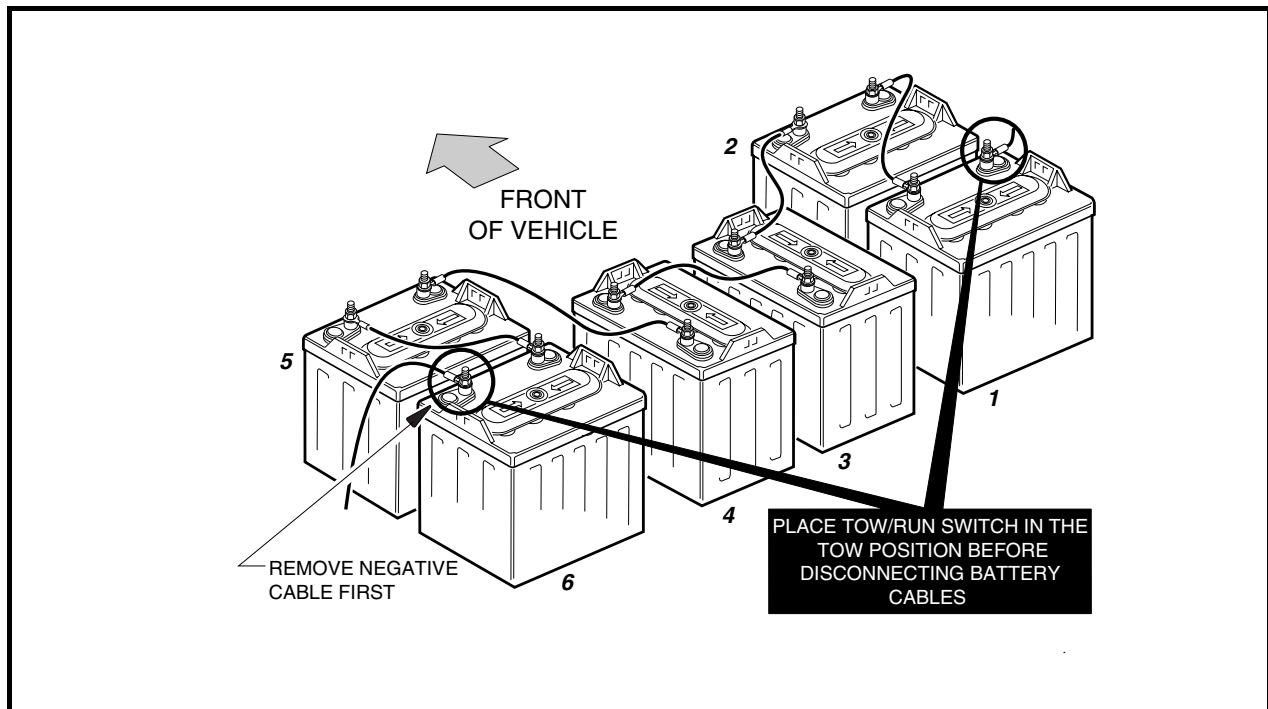


Figure 13-5 PowerDrive Plus Battery Configuration

4. Check and clean the battery rack and hold-downs. The nuts and bolts on the hold-downs may corrode. It is therefore advised that they be cleaned periodically and replaced as necessary.
5. Install batteries in the proper orientation (**Figure 13-5, Page 13-4**). Install battery hold-downs. The hold-downs should be tight enough so batteries do not move while vehicle is in motion, but not so tight as to crack or buckle battery case. Tighten to 40 in.lb (4.5 N-m), alternating between hold-down bolts.

6. Install wires in proper sequence (**Figure 13-5, Page 13-4**). Install black wire to negative post of battery No. 6 last. Make sure all connections are tight. Tighten to 110 in.lb (12.4 N-m). Coat all terminals with Battery Protector Spray (CLUB CAR Part No.1014305) to minimize future corrosion.
7. Give the batteries a full charge prior to operation. This ensures all the batteries are fully charged and the cells are equalized prior to use.
8. Place Tow/Run switch in the RUN position.

BATTERY CARE

Read **DANGER** and **WARNING** on page 13-1.

PREVENTIVE MAINTENANCE

To keep batteries in good operating condition, follow these steps on a regular basis.

1. Any corrosion build-up on or around batteries should be removed immediately. Terminal connections should be clean and tight. Any frayed or worn wires should be replaced. After all cables have been connected, coat all terminals with Battery Protector Spray (CLUB CAR Part No.1014305) to help prevent future corrosion.
2. Batteries should be kept clean and dry to prevent self-discharge. Any dirt, grime or acid spillage should be removed. Wash batteries with a bristle brush using water and bicarbonate of soda (baking soda - 1 cup per gallon of water). Rinse with water. Do not allow solution to enter battery through the vent cap holes. **See Self-Discharge below.**
3. Maintain proper electrolyte level. **See Battery Electrolyte Level, Figure 13-6, Page 13-6.**
4. Batteries should be properly charged every day they are used. Check the batteries periodically to see that they are in a full state of charge. **See Battery Charging, Page 13-6.**
5. Keep hold-downs tight. **See Vibration Damage, Page 13-6.**

SELF-DISCHARGE

Dirty batteries can provide a path for a small current draw that can slowly discharge batteries, thus wasting valuable energy. To prevent self-discharge, batteries should always be kept clean.

Hot weather also has an effect on a battery's self-discharge rate. The higher the temperature, the quicker a set of batteries will discharge. In hotter climates, therefore, batteries should be checked more often. When storing batteries, keep in a cool place. **See Battery Storage, Page 13-14.**

ELECTROLYTE LEVEL

CAUTION

- DO NOT ALLOW BATTERY ACID FROM BATTERY CAPS OR HYDROMETER TO DRIP ONTO THE FRONT OR REAR BODY OF THE VEHICLE. BATTERY ACID WILL CAUSE PERMANENT DAMAGE. WASH IMMEDIATELY.

Add water only after charging unless the electrolyte is below the level of the plates. If the electrolyte level is below the level of the plates, add just enough water to cover the plates and then charge the batteries. After charging, fill with water to the level indicator. Filling a battery to the level indicator before charging will result in overfilling because the electrolyte level will rise during charging and some of the electrolyte may bubble out of the cap. This reduces the batteries capacity and corrodes the metal parts around the battery.

The electrolyte level should be checked weekly to be sure electrolyte is at its proper level (**Figure 13-6, Page 13-6**). Never allow the electrolyte level to fall below the tops of the plates because this will cause the exposed part of the plate to become permanently inactive. For best results, use a battery watering gun for adding water. Check the electrolyte level more frequently in hot weather or when batteries are old.

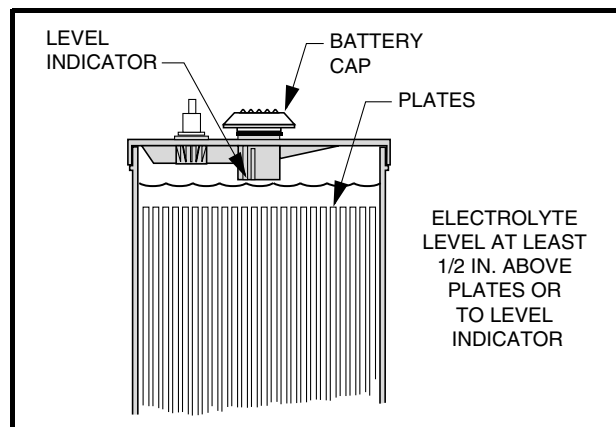


Figure 13-6 Battery Electrolyte Level

MINERAL CONTENT

For the longest battery life, use distilled water in batteries. However, if tap water is going to be used, be sure the mineral contents are below these levels:

IMPURITY	ALLOWABLE CONTENT IN PARTS PER MILLION
Suspended Matter	Trace
Total Solids	100.00
Calcium and Magnesium Oxides	40.0
Iron	5.0
Ammonia	8.0
Organic Matter	50.0
Nitrates	10.0
Nitrites	5.0
Chloride	5.0
Contact your local water department for this analysis.	

VIBRATION DAMAGE

The battery hold-downs should always be tight enough to keep the battery from bouncing. Battery life may be severely shortened if the battery hold-downs are too loose. Hold-downs should be tightened to 40 in.lb (4.5 N-m). Excessive vibration causes the plates to shed prematurely and shortens the life of the battery. It may also cause acid to leak out of the vent caps and corrosion to build up on surrounding metal parts. The acid which is lost reduces the capacity of the battery and cannot be replaced. Battery hold-downs should NOT be so tight as to crack or buckle the battery case. This may cause leaks which would dry up a cell or cause internal shorts. **See Replacing Batteries, Page 13-4.**

BATTERY CHARGING

Read DANGER and WARNING on page 13-1.

GENERAL INFORMATION

The charger supplied with the PowerDrive Plus electric vehicle resolves the most common problems associated with battery charging. Undercharging and overcharging are prevented provided the charger is allowed to shut off

by itself. Also, all cells are automatically given an equalization charge at low current, which prolongs battery life. Batteries should never be left in a discharged state, as this too affects the internal components and can reduce the capacity of the battery. The batteries should be charged every day they are used. However, the batteries should not be charged if they have not been used.

CHARGER SHUTS OFF AFTER 16 HOURS

This may be due to, 1) new batteries, 2) hard use or 3) cold temperatures. A catch-up charge may be necessary when these conditions are present. On those days when all or some of the vehicles do not get used, check the batteries for state of charge. Any battery with a specific gravity lower than 1.250 will need a catch-up charge. If the problem continues after a catch-up charge has been performed, refer to **Section 14–PowerDrive Battery Charger**.

DEEP DISCHARGE

Never discharge batteries to the point the vehicle will no longer operate. This will considerably shorten the cycle life of the batteries, and may permanently damage the batteries. It is possible the batteries will not accept a recharge if they are completely discharged. The deeper the discharge, the harder it is on the batteries. For this reason, it is recommended that PowerDrive Plus vehicle batteries be charged after each use (provided the charge cycle will not be interrupted and the charger will be allowed to shut off automatically). Placing the batteries on charge after each use reduces the depth of discharge and prolongs battery life.

EARLY EXCESSIVE DISCHARGING

When vehicle batteries are new, they do not reach their full capacity until they have been used and recharged 20 to 50 times. If they are excessively discharged early in their life, their effective service life will be shortened. It is advisable to limit the use of any vehicle with new batteries for at least the first four weeks and then gradually increase their range.

INCOMING AC SERVICE

Make sure the incoming AC line service is sufficient. If circuit breakers are tripping, fuses blow during the night or the charger does not give the required starting rate when perfectly good batteries are put on charge, an AC line problem exists. The electrical service to your vehicle storage facility should be sufficient to deliver 115 volts (minimum 105 volts, maximum 128 volts) and 10.7 amps per charger with all the chargers turned on. If not, consult your local power company or electrical contractor.

FLEET ROTATION

Rotate your vehicles. It is very hard on batteries if the last vehicles in at night are the first ones out in the morning. Spread the workload evenly, giving all vehicles the same amount of use. This will keep your fleet in balance and will not overwork certain sets of batteries.

NOTE

- WHEN VEHICLES ARE BEING ROTATED, THE CLUB CAR CDM (COMMUNICATION DISPLAY MODULE) CAN BE A VERY HELPFUL SERVICE TOOL. MONITORING THE VALUE OF FUNCTION 3 WITH THE CDM SIMPLIFIES VEHICLE USAGE SCHEDULING. **SEE SECTION 11, PAGE 13-22.**

NUMBERING VEHICLES AND CHARGERS

Return the vehicles to the same charger each night if possible. Numbering the vehicles and the chargers and returning each vehicle to its designated charger each night can significantly reduce the amount of time spent troubleshooting a problem.

BATTERY TESTING

Read DANGER and WARNING on page 13-1.

Four tests have been developed to help diagnose problems with batteries that have not performed as expected. Each test becomes progressively more detailed and time-consuming. It is therefore suggested to begin with the first test and follow through with the other tests until the problem has been found as outlined in the Battery Troubleshooting Chart (**Figure 13-7, Page 13-9**).

BATTERY CHARGER TEST

The easiest way to monitor the condition of a vehicle's batteries is simply to observe the reading on the battery charger ammeter at the end of the charge cycle. After a full charge, disconnect the charger DC plug, wait 20 to 30 seconds and reconnect the charger DC plug. The ammeter needle will jump to 15 amps or more and then taper into the 5 to 8 amp range within 10 to 20 minutes, indicating good, fully charged batteries.

Continued poor performance may indicate a problem in the vehicle electrical system, brakes or battery charger. If the problem is not found in the vehicle or charging system, proceed to the on-charge voltage test. Batteries that remain at 8 amps or higher should be tested further using the on-charge voltage test.

ON-CHARGE VOLTAGE TEST

When the batteries are fully charged, disconnect the charger DC plug. Wait 20 to 30 seconds and reconnect the DC plug to restart the charger. After 5 minutes, use a multimeter to check and record the voltage of the battery set as well as the individual batteries. Set the meter to 200 volts DC. Place the red (+) probe at the positive post of battery No. 1 and the black (-) probe at the negative post of battery No. 6 (**Figure 13-5, Page 13-4**). Record reading. Then set multimeter to 20 volts DC and place the red (+) probe at the positive terminal and the black (-) probe at the negative terminal of each battery. Record the readings.

The on-charge voltage for the set should read between 56.0 volts and 63.0 volts depending on the age and state of charge of the batteries being tested. If individual batteries read between 9.8 and 10.5 volts, the vehicle may not have been fully charged when the problem occurred. Send the vehicle back out to see if the problem reoccurs. If the problem persists, go to hydrometer test. If any battery reads below 9.3 volts or differs by more than 0.7 volts from the other batteries, replace the battery. If readings are below 9.8 volts but within 0.7 volts of each other, the batteries are old. Old batteries may have enough capacity left to last several more months. Go to hydrometer test. **See Troubleshooting Chart, Figure 13-7, Page 13-9, and examples on following pages.**

HYDROMETER TEST

A hydrometer measures the specific gravity of the battery's electrolyte. The higher the specific gravity, the higher the state of charge of the batteries. A fully charged battery should read between 1.250 and 1.280 at 80°F. Never add acid to batteries to obtain a higher specific gravity.

Performing the Hydrometer Test

1. Be sure batteries have sufficient electrolyte to cover plates by approximately 1/2 in. and are fully charged prior to beginning test. If water must be added, recharge the batteries before performing the hydrometer test.
2. Remove the vent cap. Using a battery thermometer (CLUB CAR part No.1011767), record the electrolyte temperature of the No. 2 cell.
3. Squeeze the rubber bulb of the hydrometer and insert into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
4. When the float rises off the bottom, adjust the electrolyte level so that the float rides free of the bottom but does not strike the top of the glass tube. Remove the hydrometer from the cell and release the pressure from the bulb.
5. Hold the hydrometer vertically, ensuring that the float is not touching the sides of the barrel. Hold the hydrometer at eye level and read the scale at the level of electrolyte (**Figure 13-8, Page 13-10**).
6. Record the reading. Return the electrolyte to the cell from which it was taken. Replace vent cap.

BATTERY TROUBLESHOOTING CHART

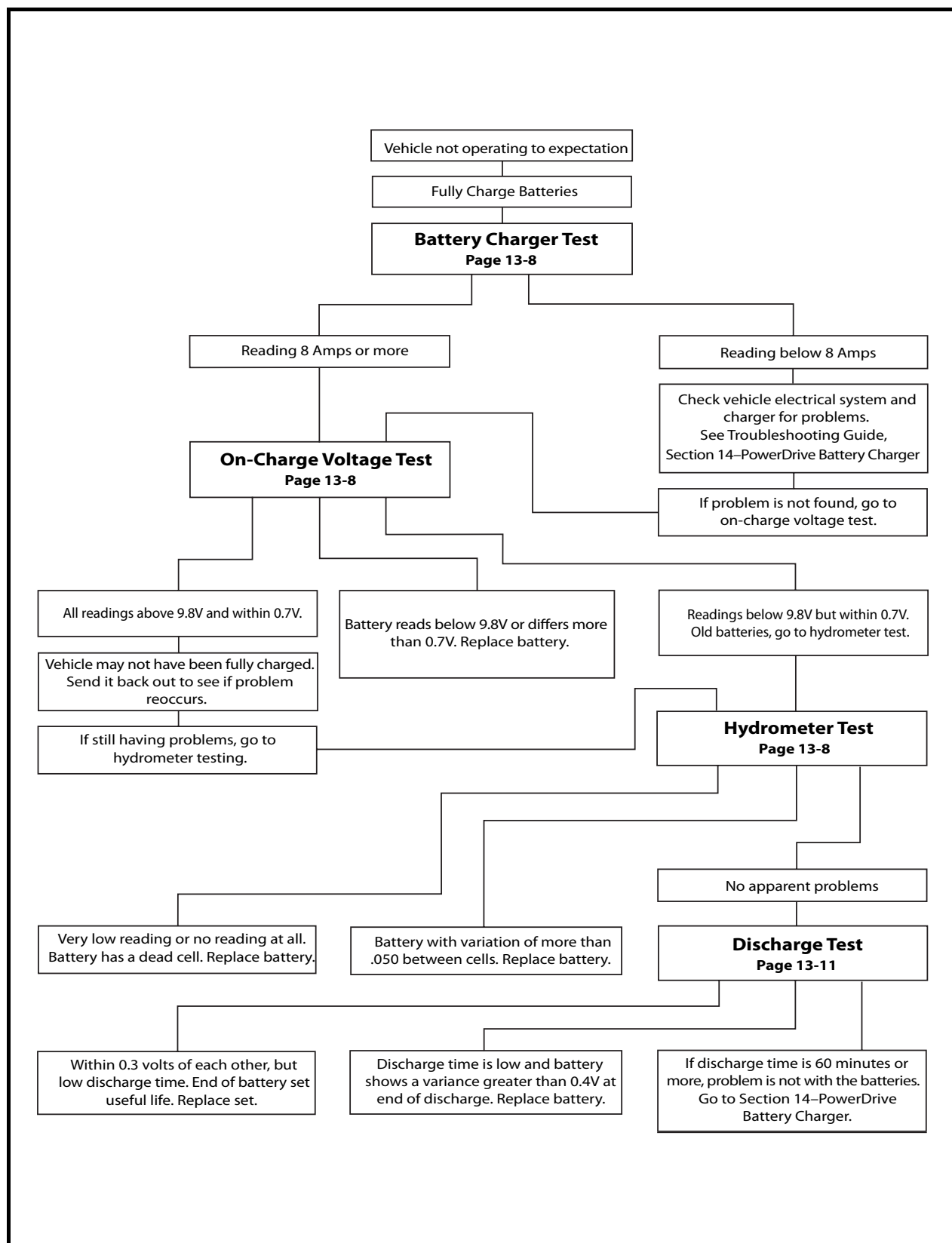


Figure 13-7 Troubleshooting Chart

7. Repeat steps 2 through 6 on all cells.

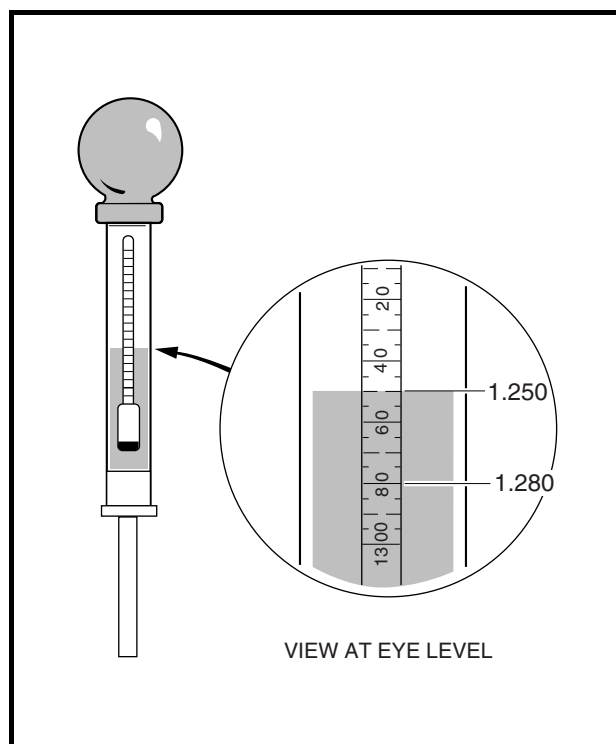


Figure 13-8 Hydrometer

Hydrometer Calibration

Most hydrometers are calibrated to read correctly at 80°F. The readings obtained as described above must be corrected for temperature. For each 10°F above 80°F, add .004 to the reading. For each 10°F below 80°F, subtract .004 from the reading.

Interpreting the Results of the Hydrometer Test

The approximate state of charge can be determined from the following table:

SPECIFIC GRAVITY AT 80°	STATE OF CHARGE
1.250 - 1.280	100%
1.220 - 1.240	75%
1.190 - 1.210	50%
1.160 - 1.180	25%

If the difference between the cells is .020 or more, the low cell should be suspected. It may require a catch-up charge or it may be a weak cell. When the variations between cells reach .050 or more, the battery with the low cell should be replaced.

CAR NO.	BATTERY NO.	ELECTROLYTE TEMP.	CORRECTION FACTOR	CORRECTED SPECIFIC GRAVITY			CELL 4	REQUIRED ACTION
				CELL 1	CELL 2	CELL 3		
12	1	20°F	-.024	1.275-.024=1.251	1.280-.024=1.256	1.280-.024=1.256	1.280-.024=1.256	Good Battery-Fully Charged
35	6	90°F	+.004	1.155+.004=1.159	1.165+.004=1.169	1.160+.004=1.164	1.165+.004=1.169	Discharged Battery-Recharge
54	3	50°F	-.012	1.260-.012=1.248	1.200-.012=1.188	1.270-.012=1.258	1.270-.012=1.258	Bad No. 2 Cell
69	5	80°F	.000	1.250-0=1.250	1.255-0=1.255	1.230-0=1.230	1.250-0=1.250	Weak No. 3 Cell-Catch-up Charge
38	2	100°F	+.008	1.200+.008=1.208	1.180+.008=1.188	1.170+.008=1.178	1.180+.008=1.188	Discharged Battery-Recharge and Recheck
22	4	80°F	.000	1.240-0=1.240	1.245-0=1.245	Float Does Not Rise	1.250-0=1.250	No.3 Cell Dead-Replace Battery

DISCHARGE TEST

If the previous tests have failed to identify the problem, conduct a discharge test. The discharge test comes closest to simulating actual vehicle operating conditions by continuously drawing amps from the batteries until voltage drops to 42.0 volts.

The discharge test is the hardest test on the batteries and the most time-consuming to perform. Use the battery discharge tester (CLUB CAR Part No.101831901).

Performing the Discharge Test

1. Be sure the batteries are fully charged and that the electrolyte level is correct in all cells.
2. Connect the tester leads to the positive (+) post of battery No.1 and negative (-) post of battery No. 6.

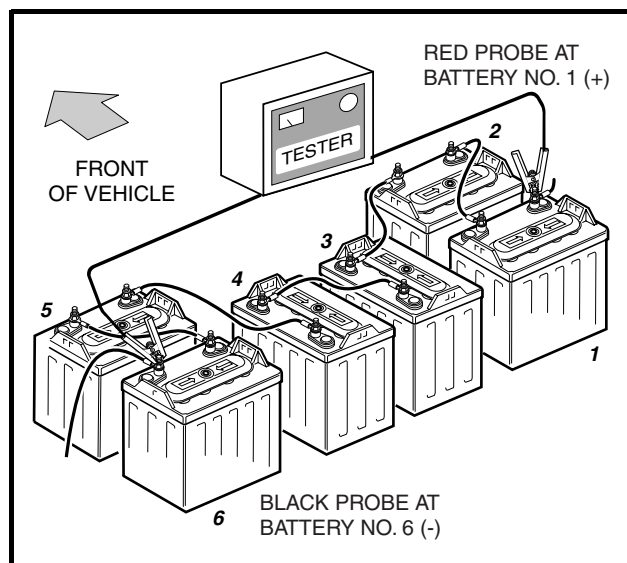


Figure 13-9 Discharge Test

3. Check and record the electrolyte temperature of the battery packs. Check cell No. 2 in each battery (second cell from positive post).
4. Reset discharge machine and turn the tester ON.
5. When the batteries have been discharging for approximately 60 minutes, set the discharge machine to function 3 and check battery set voltage. Check voltage every 10 minutes throughout the rest of the test. As soon as the battery

set voltage reaches .5 volts above the shut-off point (42.0 volts), use a multimeter to measure individual battery voltages. Measure and record the voltage of each battery to the nearest .01 volt.

NOTE

- THE TESTER WILL SHUT OFF AUTOMATICALLY WHEN SHUT-OFF VOLTAGE IS REACHED.

Interpreting Discharge Test Results

1. If discharge time is 60 minutes or higher, the problem is not with the batteries.
2. If discharge times are low, compare individual battery voltages recorded in step 5. If any battery shows a 0.4 volt or greater variance, the battery is defective or nearing the end of its useful life and should be discarded or grouped with other batteries at or around same voltage. The voltage of a defective battery will drop more rapidly near the end of the discharge than that of a sound battery.

BATTERY VOLTAGES						BATTERY CONDITION
1	2	3	4	5	6	
7.00	7.00	7.00	7.00	7.00	7.00	EXCELLENT
7.07	7.07	7.22	6.50	7.07	7.07	BATTERY NO. 4 IS NEAR END OF USEFUL LIFE
7.20	7.20	6.67	7.33	6.27	7.33	BATTERY NOS. 3 AND 5 ARE NEAR END OF USEFUL LIFE

3. If all the batteries are within 0.30 volts of each other, but the discharge time is low, the batteries are approaching the end of their life and the whole set will have to be replaced. In general, vehicles that discharge in less than 60 minutes at 78° F on the discharge test will typically not hold a charge for an entire work shift. However, discharge time is dependent on the electrolyte temperature. The table shown gives the discharge times, at various temperatures, of a set of batteries that delivers 62 minutes at 80°F.

ELECTROLYTE TEMP. °F	DISCHARGE TIME TO SHUT-OFF POINT	ELECTROLYTE TEMP. °F	DISCHARGE TIME TO SHUT-OFF POINT
40 - 49	40 Minutes	85 - 89	64 Minutes
50 - 59	45 Minutes	89 - 99	66 Minutes
60 - 64	50 Minutes	100 - 109	68 Minutes
65 - 69	54 Minutes	110 - 119	70 Minutes
70 - 74	57 Minutes	120 - 129	72 Minutes
75 - 79	60 Minutes	130 - 150	74 Minutes
80 - 84	62 Minutes		

BATTERY TROUBLESHOOTING EXAMPLES

The following information represents a few examples of troubleshooting battery problems.

Example 1

Vehicle No. 68 was suspected of having a defective battery due to its performance. As a result, the battery charger test was performed. After a full charge, the battery charger ammeter read 8.0 amps. Next, the on-charge voltage test was performed and the following results were recorded:

BATTERY NO.	1	2	3	4	5	6
ON-CHARGE VOLTAGE	10.15	10.60	9.80*	10.16	10.56	10.61

*Battery No. 3 appears to be suspect. Battery Nos. 1 and 4 are also suspect. Next, a hydrometer test should be conducted on all batteries.

Hydrometer test results:

BATTERY NO.	1	2	3	4	5	6
	SPECIFIC GRAVITY					
CELL 1 (POSITIVE POST)	1.200*	1.265	1.300	1.250	1.280	1.260
CELL 2	1.285	1.275	1.290	1.270	1.295	1.265
CELL 3	1.265	1.270	1.275	1.265	1.280	1.275
CELL 4 (NEGATIVE POST)	1.275	1.270	1.285	1.265	1.275	1.275

*After the hydrometer test, it appears that battery No. 1 is the problem. Next, the discharge test was performed.

Discharge test results:

BATTERY NO.	1	2	3	4	5	6
DISCHARGE VOLTAGE	5.44*	7.33	7.73	7.15	7.43	7.41

*After a discharge test which lasted 45 minutes, battery No. 1 is clearly shown to be the problem. Battery No. 4 should be watched a little more closely but appears to be okay. Battery No. 1 should be replaced with a battery that has about the same age and usage as the other batteries.

Example 2

Vehicle No. 70 was also suspected of having a defective battery due to its performance. The battery charger test showed 7.0 amps after a full charge. After confirming there were no problems with the electrical system, charger or brakes, the on-charge voltage was recorded as follows:

BATTERY NO.	1	2	3	4	5	6
ON-CHARGE VOLTAGE	10.48	9.77*	10.53	10.57	10.55	10.33

*Battery No. 2 was immediately suspected as the problem. After checking battery No. 2 with a hydrometer, it was discovered that the negative post cell was completely dead. Battery No. 2 should be replaced with a battery that has the same age and usage as the other batteries.

BATTERY STORAGE

Read DANGER and WARNING on page 13-1.

When storing batteries during the off-season or when maintaining a replacement stock, follow these guidelines:

1. Keep the batteries clean and free of corrosion as outlined in Battery Care, page 13-5.
2. Batteries that are in vehicles for winter storage should be left disconnected in the vehicles if the batteries are not going to be connected to a charger.
3. Fully charge the batteries prior to storage.
4. Store in a cool area. The colder the area in which the batteries are stored the less the batteries will self-discharge. Batteries stored at 0°F will discharge very little over a four-month period. Batteries stored at 80°F will have to be recharged every few weeks.
5. PowerDrive Plus vehicles and PowerDrive Chargers are designed to be left connected, with AC power to the charger ON, during off-season storage. The PowerDrive storage charge feature will automatically charge the batteries as needed throughout the storage period.

CHARGING BATTERY PACK WITH LOW VOLTAGE

Read DANGER and WARNING on page 13-1.

⚠ WARNING

- ALWAYS UNPLUG THE ELECTRICAL CORDS BEFORE ATTEMPTING ANY REPAIRS TO THE CHARGER. FIRST UNPLUG THE AC CORD FROM THE OUTLET AND THEN UNPLUG THE DC CORD FROM THE VEHICLE.

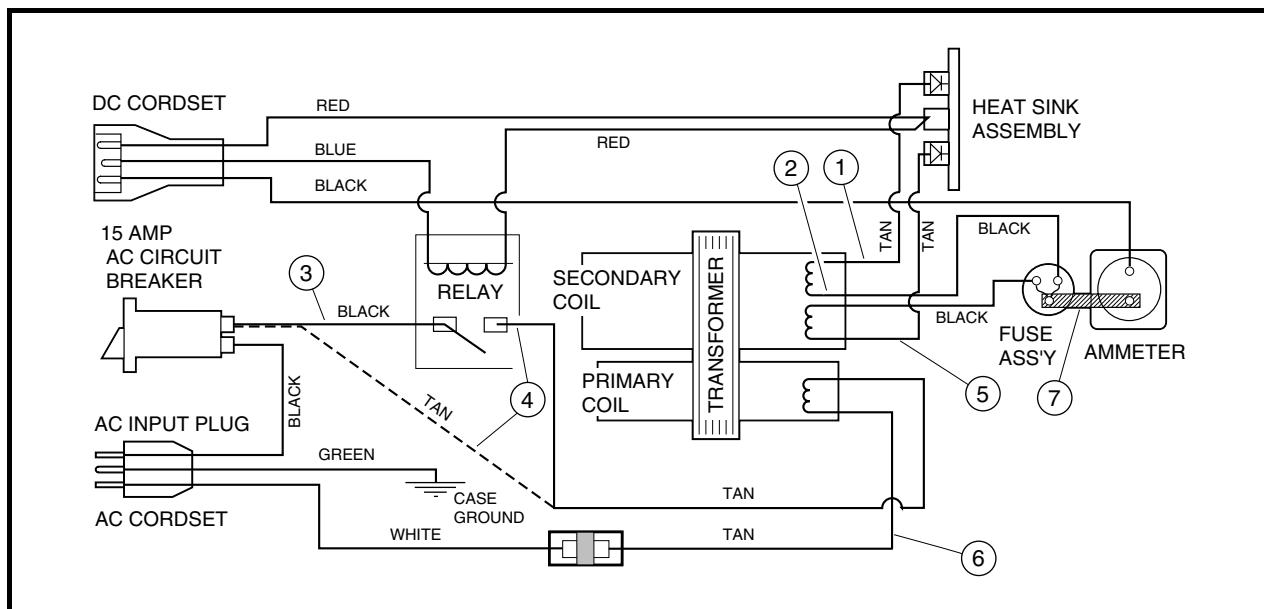


Figure 13-10 PowerDrive Charger Wiring Diagram

1. Turn the key switch OFF and place the Forward/Reverse rocker switch in NEUTRAL. Leave the batteries connected and leave the 23-Pin connector plug connected to the controller.
2. If battery pack voltage is below 34 volts, the charger will not activate. The charger relay will have to be bypassed in order for the charger to activate.
3. Disconnect the DC cord from the charger receptacle and unplug the AC cord from the electrical outlet.

4. Remove the eight screws securing the charger cover and remove the cover from the charger.
5. Inside the charger, locate the black wire (3) that goes from the circuit breaker to the relay and disconnect it from the circuit breaker terminal. Make sure this wire does not touch the charger housing or any other charger components (**Figure 13-10, Page 13-14**).
6. Disconnect the transformer wire (4) from the relay and then connect this wire to the open terminal on the circuit breaker (**Figure 13-10, Page 13-14**).
7. Plug the DC cord into the charger receptacle *first*, and then plug the AC cord into an electrical outlet.
8. The charger should activate and begin to charge the batteries. Allow the charger to operate for one or two hours. **See following WARNING.**

WARNING

- DO NOT LEAVE THE VEHICLE UNATTENDED WHILE IT IS CHARGING. THE CHARGER OPERATING WITH A BYPASSED RELAY COULD SHORT AND POSSIBLY CAUSE A FIRE.

9. After one or two hours, disconnect the charger AC cord from the electrical outlet *first*. Then disconnect the DC cord from the charger receptacle in the vehicle.
10. Disconnect the transformer wire from the circuit breaker and connect it to the relay. Reconnect the short black wire from the relay to the circuit breaker.
11. Install the charger cover and the eight retaining screws.
12. Plug the DC cord into the charger receptacle and plug the AC cord into an electrical outlet.
13. Allow the charger to continue charging the batteries until the charger shuts off automatically.
14. When the charge cycle is complete, test the batteries again. If the battery pack voltage is above 34 volts and the vehicle will not operate, it will be necessary to troubleshoot the vehicle's electrical system to determine which electrical component has failed. **See Section 11–Electrical System and Testing.**

SECTION 14—POWERDRIVE BATTERY CHARGER

DANGER

- **BATTERY - EXPLOSIVE GASES! DO NOT SMOKE. KEEP SPARKS AND FLAMES AWAY. VENTILATE WHEN CHARGING OR USING IN AN ENCLOSED SPACE. ALWAYS WEAR FULL FACE SHIELD AND RUBBER GLOVES WHEN WORKING ON BATTERIES.**
- **USE EXTREME CAUTION WHEN USING TOOLS, WIRES, OR METAL OBJECTS NEAR BATTERIES! A SHORT CIRCUIT AND (OR) SPARK COULD CAUSE AN EXPLOSION.**
- **BATTERY - POISON! CONTAINS ACID! CAUSES SEVERE BURNS. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. ANTIDOTES:**
 - **EXTERNAL: FLUSH WITH WATER. CALL A PHYSICIAN IMMEDIATELY.**
 - **INTERNAL: DRINK LARGE QUANTITIES OF MILK OR WATER. FOLLOW WITH MILK OF MAGNESIA OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.**
 - **EYES: FLUSH WITH WATER FOR FIFTEEN MINUTES. CALL PHYSICIAN IMMEDIATELY.**

WARNING

- ONLY TRAINED TECHNICIANS SHOULD REPAIR OR SERVICE THIS VEHICLE. ANYONE DOING EVEN SIMPLE REPAIRS OR SERVICE SHOULD HAVE KNOWLEDGE AND EXPERIENCE IN GENERAL ELECTRICAL REPAIR. FOLLOW ALL PROCEDURES EXACTLY AND HEED ALL WARNINGS STATED IN THIS MANUAL.
- ALWAYS WEAR APPROVED EYE PROTECTION WHILE SERVICING VEHICLE. WEAR A FULL FACE SHIELD AND RUBBER GLOVES WHEN WORKING WITH BATTERIES.
- TURN KEY SWITCH **OFF**, PLACE FORWARD/REVERSE ROCKER SWITCH IN **NEUTRAL**, AND REMOVE KEY PRIOR TO SERVICING.
- DO NOT WEAR LOOSE CLOTHING. REMOVE JEWELRY SUCH AS RINGS, WATCHES, CHAINS, ETC. BEFORE SERVICING VEHICLE.
- ALWAYS USE INSULATED TOOLS WHEN WORKING NEAR BATTERIES OR ELECTRICAL CONNECTIONS.
- BEFORE PERFORMING TESTS OR REPAIRS AND TO AVOID UNINTENTIONALLY STARTING THE VEHICLE, MAKE SURE CAPACITORS ARE DISCHARGED. PLACE TOW SWITCH IN **TOW**, DISCONNECT BATTERY WIRES AS SHOWN IN **FIGURE 14-3, PAGE 14-6**, PLACE FORWARD/REVERSE ROCKER SWITCH IN **REVERSE** AND LISTEN FOR THE REVERSE BUZZER:
 - IF THE BUZZER DOES NOT SOUND, THE CAPACITORS ARE DISCHARGED.
 - IF THE REVERSE BUZZER SOUNDS, TURN THE KEY SWITCH **ON** AND DEPRESS THE ACCELERATOR PEDAL UNTIL THE BUZZER CAN NO LONGER BE HEARD.

GENERAL INFORMATION

The PowerDrive Battery Charger is an integral part of the PowerDrive Plus electrical system, and one is included with every PowerDrive Plus vehicle. Because it is controlled by the PowerDrive onboard computer (OBC) it can be used with PowerDrive Plus or PowerDrive System 48 vehicles only. The charger is automatic and has no external controls; when it is plugged into the vehicle receptacle, there is a 2 to 15 second delay before charging begins (**Figure 14-1, Page 14-2**). The OBC records the amount of energy consumed as the vehicle is used, then directs the charger to replace exactly the amount of energy needed to fully replenish the batteries. The charger then shuts off automatically, preventing the possibility of either undercharging or overcharging. The computer accomplishes this by detecting when the exact amount of energy required has been returned to the batteries.

NOTE

- SHORTLY AFTER CHARGING BEGINS, THE CHARGER WILL SHUT OFF IN ORDER TO RUN A SELF-DIAGNOSTIC PROGRAM (AMMETER WILL DROP TO ZERO). CHARGING WILL RESUME IN A FEW MOMENTS (AMMETER RETURNS TO PREVIOUS RATE OF CHARGE). THIS WILL BE REPEATED AT ONE HOUR AND AT TWO HOURS INTO THE CHARGE CYCLE.

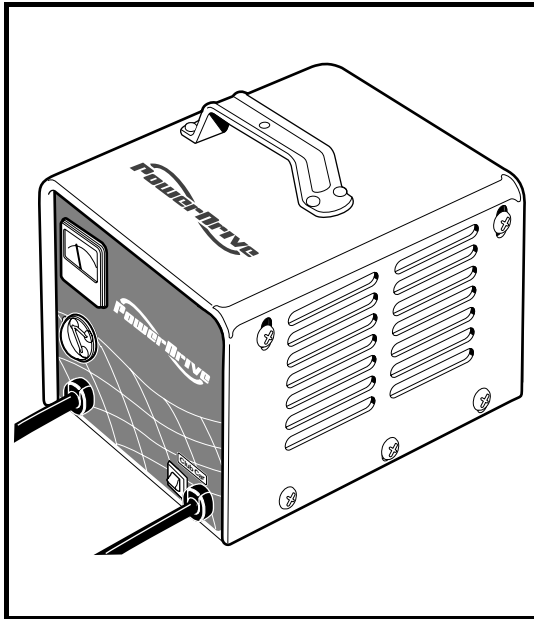


Figure 14-1 PowerDrive Battery Charger

POWERDRIVE CHARGING FEATURES

- **Charge Interlock**

PowerDrive Battery Charger DC plugs have three pins rather than two blades that most standard charger plugs have. Two of these pins are the positive and negative leads as on standard chargers; the third pin is a sensing lead which is the communication link between the charger and the onboard computer. When the charger plug is inserted into the vehicle receptacle, the onboard computer locks out the vehicle's drive system. This prevents the possibility of driving the vehicle while the charger is plugged in and potentially damaging the vehicle and charger.

- **Long Term Storage Charge**

PowerDrive Plus vehicles and PowerDrive Chargers are designed to be left connected, with AC power to the charger, during off-season or long term storage. The onboard computer will automatically activate the charger every 15 days. To return the vehicle to service, disconnect the DC cord from the vehicle, wait 15 seconds and then plug the DC cord back in. The charger will activate. Allow the vehicle to complete one full charge cycle before putting it into service.

- **Charger Disconnect**

The computer communication pin is shorter than the positive and negative pins in the charger DC plug. In the event the charger plug is pulled from the receptacle while the charger is in operation, the computer communication link will be disconnected first, which will shut the charger off before the positive and negative pins disconnect. This will help prevent possible damage to the plug and receptacle due to arcing.

BATTERY WARNING LIGHT

The PowerDrive vehicle features a dash mounted warning light (above steering column) which, when the vehicle is in operation, indicates low battery voltage, or, when the vehicle is being charged, indicates a charging problem. The battery warning light is controlled by the PowerDrive Plus onboard computer.

When the batteries receive an incomplete charge because 1) the DC power cord is disconnected, 2) AC power to the charger is interrupted, 3) automatic charger shut-off occurs after 16 hours of operation, or 4) the charger malfunctions, the warning light will indicate as follows:

- The warning light will not illuminate if the charge is 90% or more complete. The onboard computer will retain in memory the amount of charge needed to fully replenish the batteries and will complete the charge during the next charge cycle.
- When the charger DC cord is unplugged, the warning light will illuminate and remain illuminated for 10 seconds if the charge is less than 90% complete but the vehicle has enough power for 60 minutes of operation. This will alert the fleet operator that the vehicle may be used, but that it must be charged to completion as soon as possible.
- The warning light will repeatedly illuminate for 10 seconds, at 4 second intervals, if the charger times out at 16 hours and the batteries are not sufficiently charged. This indicates an abnormal charge cycle. The charger and batteries should be checked by your Club Car distributor/dealer.
- The warning light will repeatedly illuminate for 10 seconds, at 4 second intervals, during a charge cycle (DC plug is still connected) if AC power to the charger is interrupted. The warning light will go out when AC power is restored.

THE CHARGE CIRCUIT

The vehicle charge circuit consists of the charger receptacle, fuse link, onboard computer and the batteries. The negative terminal of the receptacle is connected to the onboard computer. The 10 gauge black wire from the onboard computer connects to the B- terminal on the speed controller, and the 6 gauge black wire (also on the controller B- terminal) goes through the onboard computer and connects to the negative (-) post of battery No. 6. The positive terminal of the charger receptacle is connected to the positive post of battery No. 1. The gray wire (sense lead) from the charger receptacle is connected to the sense lead fuse, which is connected to the gray wire from the onboard computer. If the charger works with one vehicle, but does not work with another, then most likely the problem is in the vehicle charge circuit. Check the connections between the 18 gauge gray wire from the charger receptacle, the sense lead fuse and the 18 gauge gray wire from the onboard computer. Also check connections of the fuse link assembly located on the charger receptacle (**Figure 14-2, Page 14-5**).

CHARGER INSTALLATION AND USE

Read DANGER and WARNING on page 14-1.

WARNING

- DO NOT BYPASS THE SENSE LEAD FUSE!
- DISCONNECT BOTH THE AC AND DC PLUGS BEFORE WORKING ON THE CHARGER OR CHANGING THE CHARGER CORD.
- TO CONNECT THE CHARGER PLUG TO THE VEHICLE RECEPTACLE, GRASP THE PLUG AND PUSH IT STRAIGHT INTO THE RECEPTACLE. DO NOT ROCK OR BEND THE PLUG.

WARNING CONTINUED ON FOLLOWING PAGE...

⚠ WARNING

- TO DISCONNECT THE CHARGER FROM THE VEHICLE RECEPTACLE, GRASP THE PLUG AND PULL IT STRAIGHT OUT OF THE RECEPTACLE. DO NOT PULL ON THE CORD. DO NOT TWIST, ROCK, OR BEND THE PLUG.
- DO NOT CONNECT THE CHARGER TO BATTERY PACKS THAT ARE NOT COMPATIBLE WITH THE DC OUTPUT VOLTAGE SPECIFIED ON THE CHARGER. OVERHEATING AND TRANSFORMER BURN-OUT WILL RESULT.
- DO NOT USE THE CHARGER IF THE PLUG, CORD, OR RECEPTACLE HAVE BEEN DAMAGED IN ANY WAY. USE OF THE CHARGER WITH ANY OF THESE CONDITIONS COULD RESULT IN A FIRE, PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH.
- DO NOT USE THE CHARGER IF:
 - THE DC PLUG DOES NOT MAKE A GOOD CONNECTION.
 - THE PLUG AND RECEPTACLE FEEL HOTTER THAN NORMAL.
 - THE PLUG PINS OR RECEPTACLE CONTACTS ARE BENT OR CORRODED.
 - THE PLUG, RECEPTACLE, OR CORDS ARE CUT, WORN, OR HAVE ANY EXPOSED WIRES.
 - THE PLUG, CORDS, CHARGER, OR RECEPTACLE ARE DAMAGED.
- USING THIS CHARGER WITH ANY OF THE ABOVE CONDITIONS COULD RESULT IN FIRE, PERSONAL INJURY, OR PROPERTY DAMAGE. REPAIR OR REPLACE WORN OR DAMAGED PARTS BEFORE USING THE CHARGER.
- EACH CHARGER SHOULD HAVE ITS OWN 15 OR 20 AMPERE BRANCH CIRCUIT PROTECTION (CIRCUIT BREAKER OR FUSE), IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE ANSI/NFPA 70, AND LOCAL CODES AND ORDINANCES. IMPROPER AC SUPPLY CIRCUIT PROTECTION MAY RESULT IN A FIRE.

Each PowerDrive Plus electric vehicle is supplied with a fully automatic, external battery charger as standard equipment.

To reduce the risk of electric shock, the battery charger must be grounded. The charger is equipped with an AC electric cord with an equipment-grounding conductor and a grounding type plug. It is for use on a nominal 120- volt, 60-hertz single phased circuit. The AC plug must be connected to an appropriate receptacle that is properly installed and grounded in accordance with the National Electric Code and all local codes and ordinances.

The use of an extension cord with the charger is not recommended. If an extension cord must be used, use a three-conductor No. 12 AWG cord with ground, properly wired and in good electrical condition. Keep it as short as possible (no more than twelve feet). Position all cords so they will not be stepped on, tripped over, or otherwise subject to damage or stress. **See following WARNING.**

Provide adequate ventilation for the charger. Keep all charger ventilation openings at least two inches away from walls and other objects. **See following WARNING.**

⚠ WARNING

- IMPROPER CONNECTION OF THE EQUIPMENT-GROUNDING CONDUCTOR CAN RESULT IN AN ELECTRICAL SHOCK.
- DO NOT USE AN ADAPTER TO PLUG CHARGER INTO A TWO-BLADE OUTLET OR EXTENSION CORD. EXTENSION CORD OR OUTLET MUST ACCEPT GROUNDED THREE-BLADE PLUG.

WARNING CONTINUED ON FOLLOWING PAGE...

⚠ WARNING

- THE USE OF AN IMPROPER EXTENSION CORD COULD RESULT IN FIRE OR ELECTRIC SHOCK.
- DO NOT OPERATE THIS CHARGER IF IT HAS RECEIVED A SHARP BLOW, WAS DROPPED, OR WAS OTHERWISE DAMAGED. MAKE SURE IT IS OPERATING PROPERLY BEFORE PUTTING IT BACK IN USE.
- DO NOT ALLOW CLOTHING, BLANKETS, OR OTHER MATERIALS TO COVER THE CHARGER.
- CHARGERS CAN IGNITE FLAMMABLE MATERIALS AND VAPORS. DO NOT USE NEAR FUELS, GRAIN DUST, SOLVENTS, THINNER, OR OTHER FLAMMABLES.
- KEEP CHARGER DRY - DO NOT EXPOSE TO RAIN. STORE INDOORS.

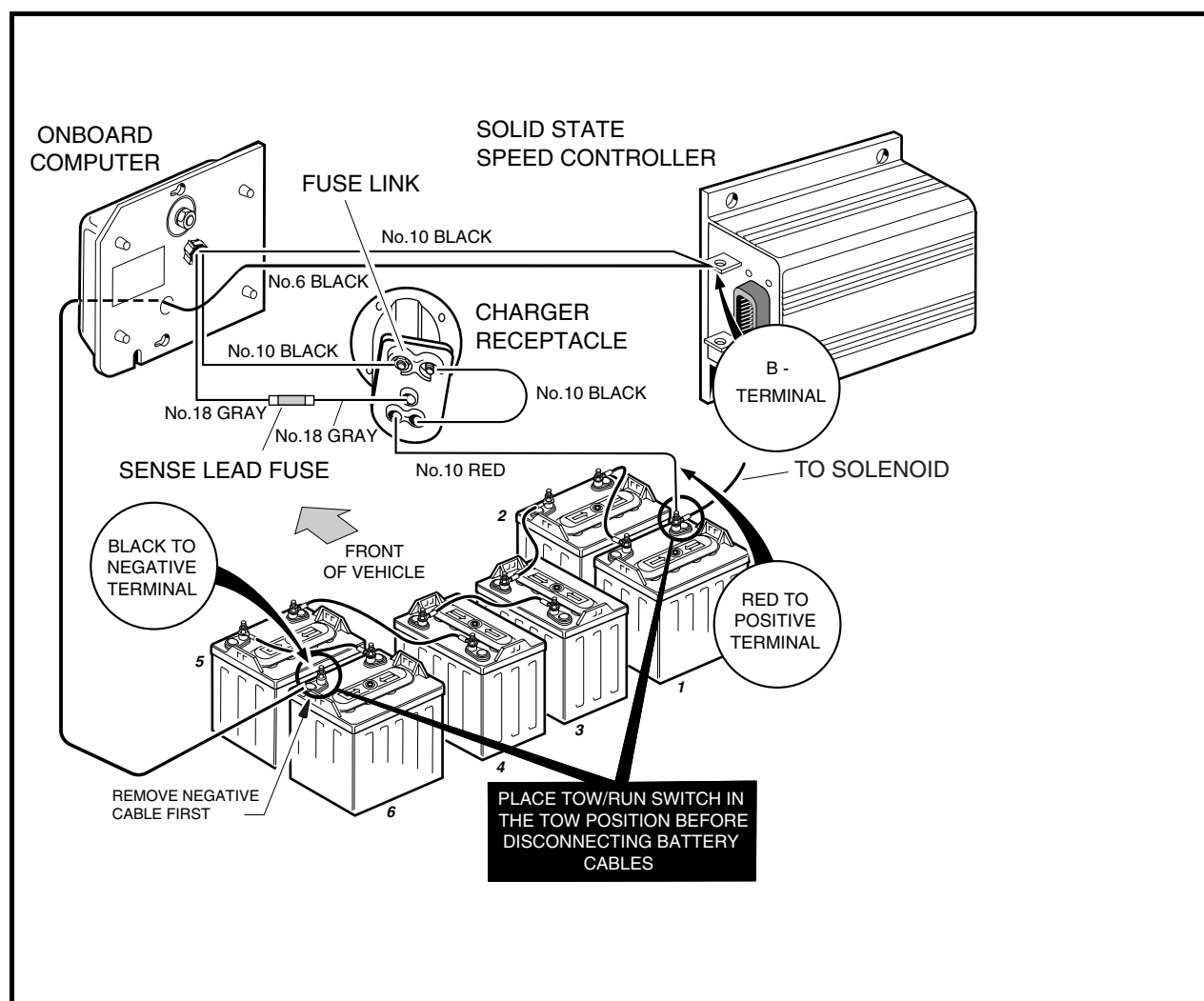


Figure 14-2 Charge Circuit

Normal Charger Operation

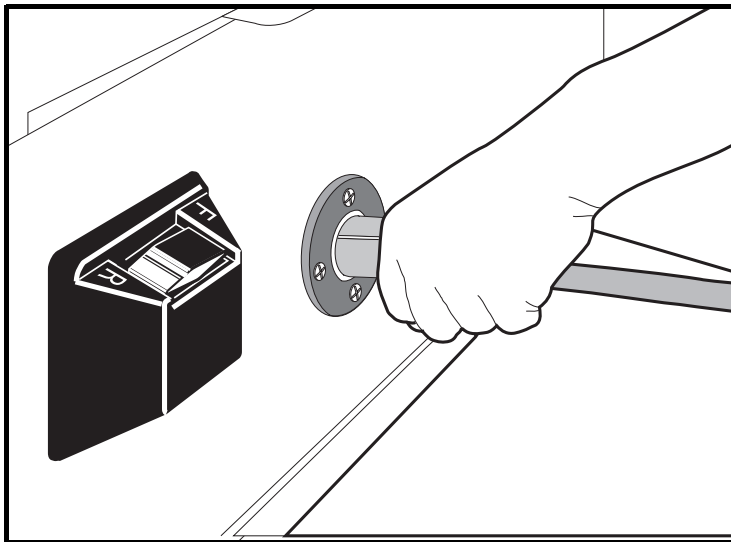
1. With the charger DC output cord disconnected from the batteries, connect the power supply cord to a 120-volt, 60-hertz single phase outlet.
2. Connect charger DC plug to charger receptacle located on the seat support panel (**Figure 14-3, Page 14-6**). The charger will activate automatically within 2 to 15 seconds after the DC plug is connected.

Normal Charger Operation, Continued:

3. Monitor the ammeter for the correct charge rate. The initial charge rate will vary from 15 to 19 amps, depending upon the condition and depth of discharge of the batteries. Slight variations in the initial charge rate may also result from AC line input voltages which are higher or lower than 120 volts. Higher line voltages increase the initial charge rate while lower line voltages reduce the initial charge rate.
4. Monitor the ammeter for about 30 seconds. Under normal operating conditions (when the charger is plugged into a vehicle with discharged batteries), the ammeter will drop to zero for 2 to 3 seconds at the beginning of each charge cycle in order to perform a self-diagnostic test. This test will be repeated at one hour and two hours into the charge cycle. **See following NOTE.**

NOTE

- IF THE BATTERIES ARE IN A FULLY CHARGED STATE AND THE VEHICLE HAS NOT BEEN DRIVEN, THE ONBOARD COMPUTER WILL NOT PERFORM THE SELF-DIAGNOSTIC TEST.
- WHEN AIR TEMPERATURES FALL BELOW 65°F (18.3°C), BATTERIES CHARGED IN UNHEATED AREAS SHOULD BE PLACED ON CHARGE AS SOON AS POSSIBLE AFTER USE. COLD BATTERIES REQUIRE MORE TIME TO FULLY CHARGE.

**Figure 14-3 Charger Receptacle****Testing Charger Operation**

1. With the DC plug disconnected from the vehicle charger receptacle, insert the AC cord into an outlet. The charger relay should NOT close. A multimeter set to volts DC and connected across the DC plug positive (+) and negative (-) pins should indicate zero volts. No transformer hum should be heard.
2. Disconnect the AC cord from its outlet and connect the DC plug to the receptacle. The charger relay should close with an audible "click" after a 2 to 15 second delay.
3. If the charger does not operate as in steps 1 or 2 above, refer to the wiring diagram (**Figure 14-4, Page 14-7**) and make sure the charger is wired correctly.

Always monitor the first charge cycle to make sure the charger turns off properly. If the DC cord is disconnected during a charge, and the batteries are less than 90% charged, the battery warning light will illuminate intermittently. **See Battery Warning Light, Page 14-3.**

CHECKING BATTERY CONDITION AFTER A CHARGE CYCLE

Read DANGER and WARNING on page 14-1.

It is common practice for technicians to check the condition of a set of batteries after they have charged to ensure they have received a complete charge before the vehicle is used. With the PowerDrive Plus this practice is not necessary. The onboard computer controls and monitors the charge cycle. If there is any problem during a charge cycle, the battery warning light, located above the steering column in the center dash panel, will illuminate intermittently. If the battery warning light is illuminated after a charge cycle, refer to the Troubleshooting Guide and Flow Charts on pages 14-8 through 14-12. If the specified test procedures do not identify any problems, plug the DC cord into the vehicle and let it charge until the charger shuts off automatically. If a problem is found, correct it and then charge the vehicle. Normal voltage toward the end of a charge cycle should be approximately 59 to 63 volts while the charger is still operating.

START CHARGE CYCLE

1. Disconnect the DC plug from the vehicle's charger receptacle.
2. WAIT 20 SECONDS, then reconnect the DC cord. **See following NOTE.**

NOTE

- THE CHARGER WILL NOT OPERATE UNLESS A DELAY OF APPROXIMATELY 20 SECONDS IS OBSERVED.

3. Monitor the ammeter for the charge rate. If the vehicle has not been driven since the last charge cycle and the batteries are fully charged, the onboard computer will not perform a self-diagnostic test. The charge cycle will begin and the ammeter will NOT drop to zero. If the vehicle has been driven, even if only a few feet, the onboard computer will perform the self-diagnostic test; the ammeter will drop to zero for 2 to 3 seconds before the charge cycle begins.

WARNING

- KNOWLEDGE OF BATTERY CHARGER WIRING AND COMPONENT TERMINOLOGY IS REQUIRED BEFORE ATTEMPTING ANY REPAIRS (**FIGURES 14-4 AND 14-5, PAGES 14-7 AND 14-8**).

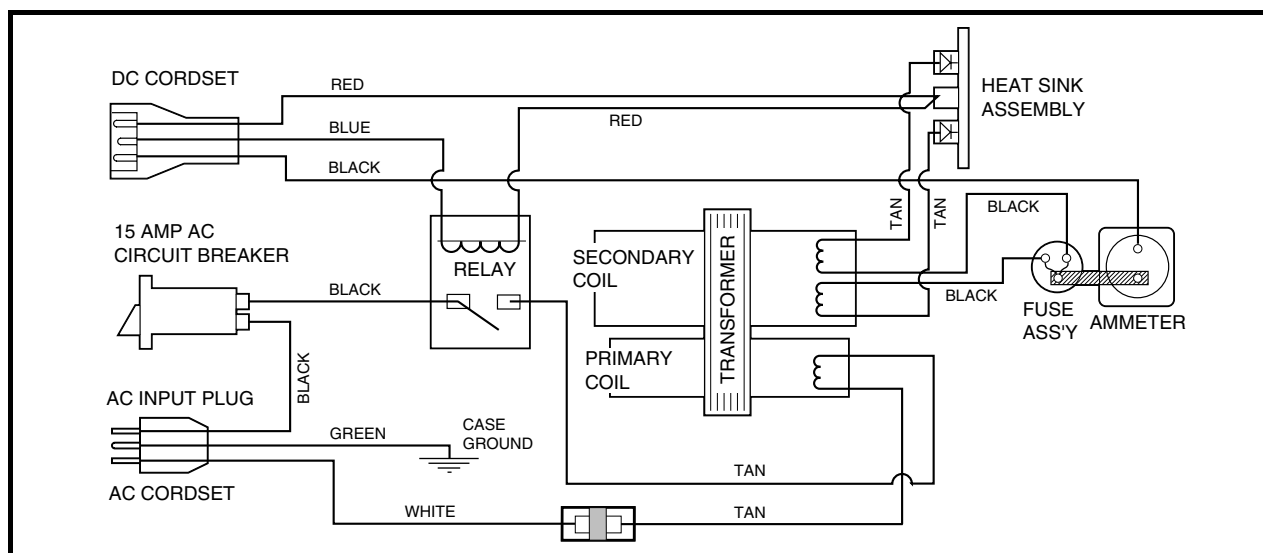


Figure 14-4 PowerDrive Battery Charger Wiring Diagram

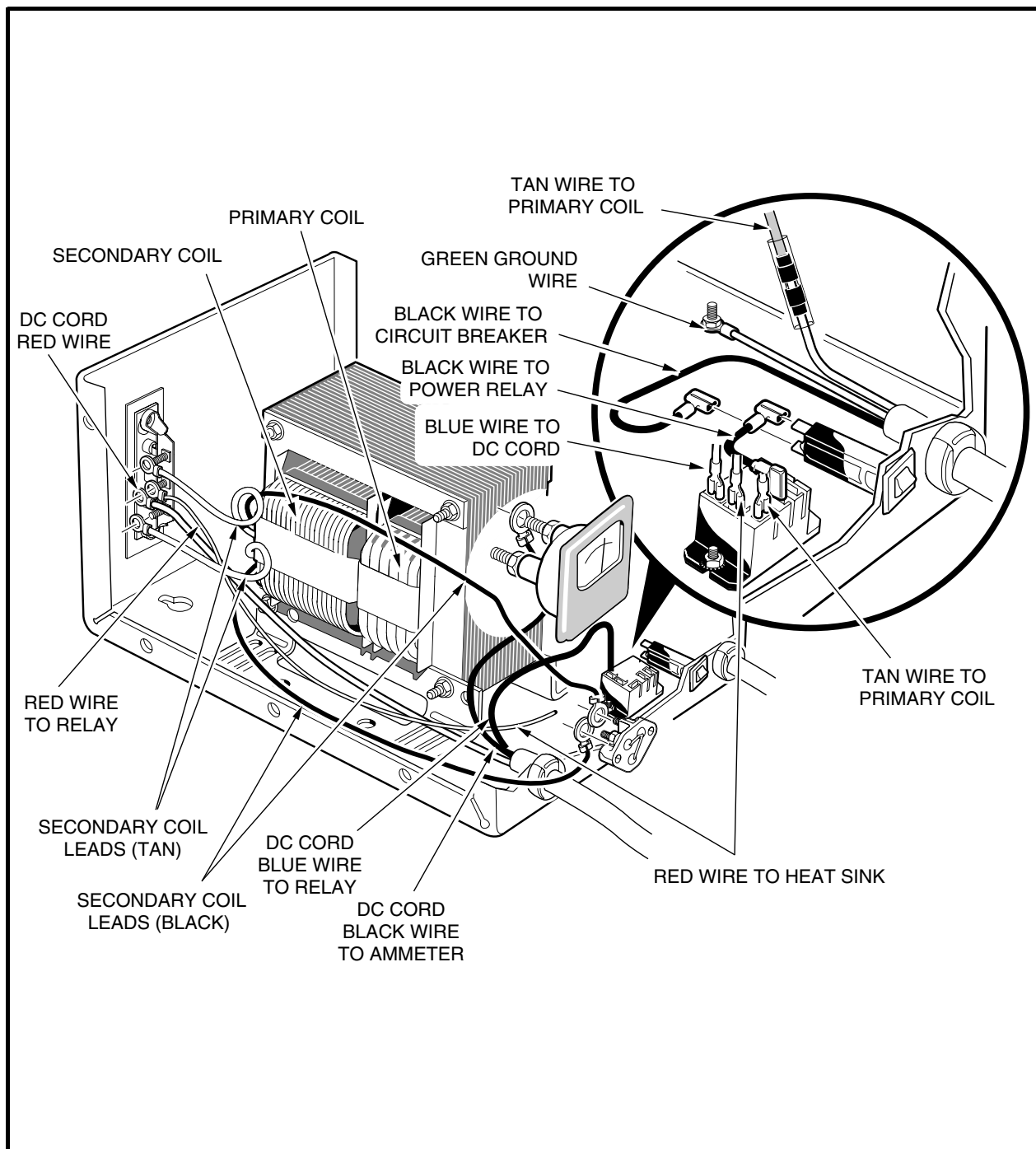


Figure 14-5 PowerDrive Battery Charger

TROUBLESHOOTING

Read DANGER and WARNING on page 14-1.

Use the following information (Pages 14-9 through 14-12) as guides for troubleshooting PowerDrive Plus vehicles. The Troubleshooting Guide on pages 14-9 and 14-10 encompasses the entire vehicle electrical system. The flow charts on pages 14-10 through 14-12 refers specifically to the onboard computer and battery charger. Test procedures specified in these charts can be found on the pages immediately following.

TROUBLESHOOTING GUIDE

POWERDRIVE BATTERY CHARGER TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	REFER TO
1. Relay does not close, no transformer hum and ammeter does not move.	1) Batteries disconnected.	Section 13–Batteries
	2) Battery voltage is too low.	Test Procedure 1, Page 14-12
	3) Poor connection between plug and receptacle.	Test Procedure 1, Page 14-12
	4) DC plug and cord.	Test Procedures 1 and 5, Pages 14-12 & 14-16
	5) Onboard computer malfunction.	Test Procedure 2, Page 14-13
	6) Gray sense lead fuse is blown.	Test Procedure 1, Page 14-12
	7) Receptacle fuse link is blown.	Section 12–Electrical Components
2. Relay closes with an audible click but no transformer hum and ammeter does not move.	1) Improper AC outlet voltage.	Test Procedure 3, Page 14-14
	2) Failed AC plug and cord.	Test Procedure 3, Page 14-14
	3) Internal AC breaker.	Test Procedure 3, Page 14-14
	4) Transformer primary coil.	Test Procedure 6, Page 14-16
	5) Relay	Test Procedure 8, Page 14-17
3. Relay closes and transformer hums but ammeter does not move.	1) Blown charger fuse.	Test Procedure 4, Page 14-14
	2) Both diodes failed.	Test Procedure 4B, Page 14-15
	3) Onboard computer malfunction.	Test Procedure 2, Page 14-13
	4) Failed transformer.	Test Procedure 6, Page 14-16
4. Relay operates intermittently.	1) Blown fuse on red lead from OBC.	Section 11–Electrical System & Testing
	2) Defective charger relay.	Test Procedure 8, Page 14-17
5. Single charger fuse link blows.	1) Diode failed.	Test Procedure 4-A, Page 14-14
	2) Loose internal fuse connection.	Tighten connection.
6. Both charger fuse links blow or receptacle fuse link blows.	1) Battery is wired in reverse polarity.	Test Procedure 4-B, Page 14-15
	2) DC cord is wired in reverse polarity.	Test Procedure 4-B, Page 14-15
	3) Both diodes failed.	Test Procedure 4-B, Page 14-15
7. Charger output is low.	1) One diode failed.	Test Procedure 4-A, Page 14-14
	2) Transformer coil short-circuit failure.	Test Procedure 6, Page 14-16
	3) Onboard computer malfunction.	Test Procedure 2, Page 14-13
8. Charger turns off too soon.	1) AC power supply was shut off.	Test Procedure 3, Page 14-14
	2) Onboard computer malfunction.	Test Procedure 2, Page 14-13
	3) Batteries may be fully charged.	Test Procedure 7, Page 14-17

POWERDRIVE BATTERY CHARGER TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
9. Charger goes to 16 hour time out.	1) Onboard computer malfunction.	Test Procedure 2, Page 14-13
	2) Extremely discharged batteries or cold temperature.	Recharge batteries.
	3) Defective battery.	Section 13–Batteries
10. AC line fuse or circuit breaker blows.	1) AC cord is shorted.	Test Procedure 8, Page 14-17
	2) Failed transformer.	Test Procedure 6, Page 14-16
11. Battery trouble light illuminates for ten seconds, at four second intervals (with DC charger cord plugged in).	1) AC power interrupted.	Test Procedure 3, Page 14-14
	2) Onboard computer malfunction.	Test Procedure 2, Page 14-13
	3) Charger failure.	See page 14-7
	4) 16 hour time out.	See page 14-3
	5) Battery or batteries need to be replaced.	Section 13–Batteries
12. Battery trouble light illuminates for ten seconds, at four second intervals (with DC charger cord disconnected)	1) Batteries are getting close to full discharge capacity.	Recharge batteries (golf round may be completed first).
	2) Onboard computer malfunction.	Test Procedure 2, Page 14-13
	3) Battery or batteries need to be replaced.	Section 13–Batteries

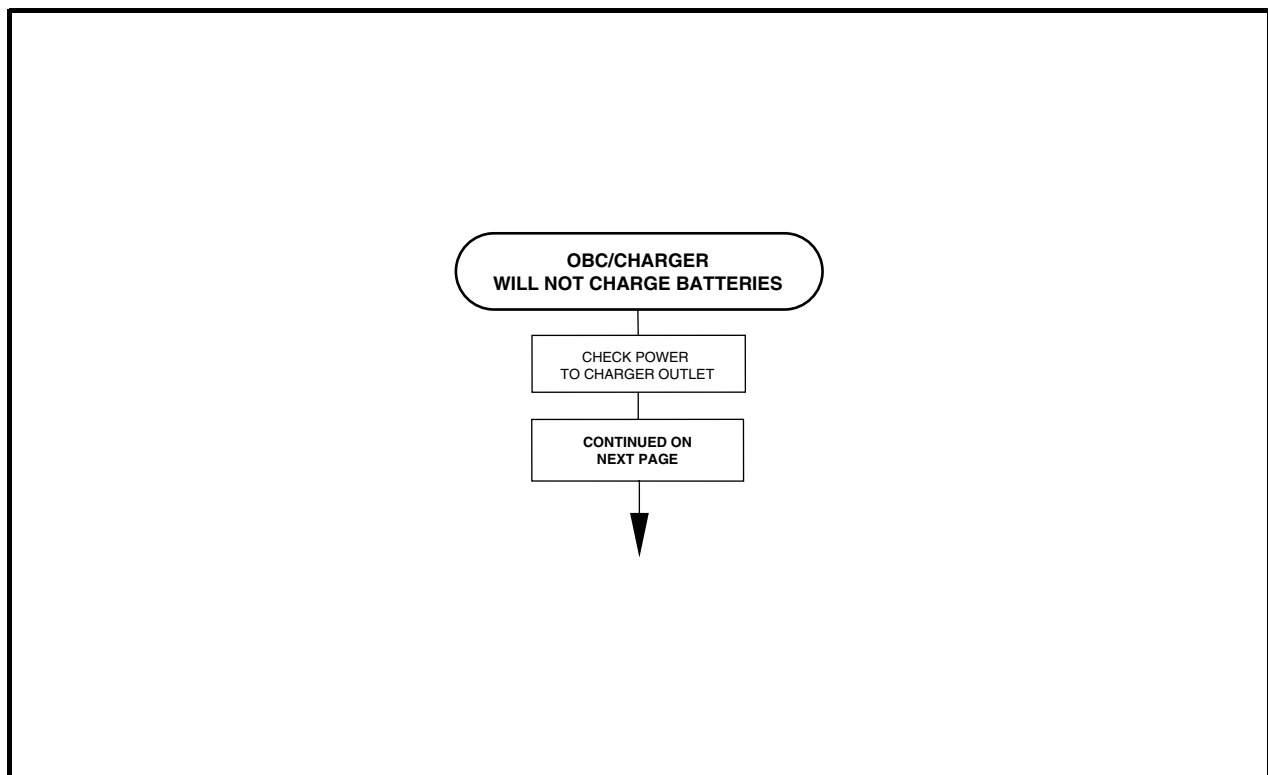


Figure 14-6 Flow Chart

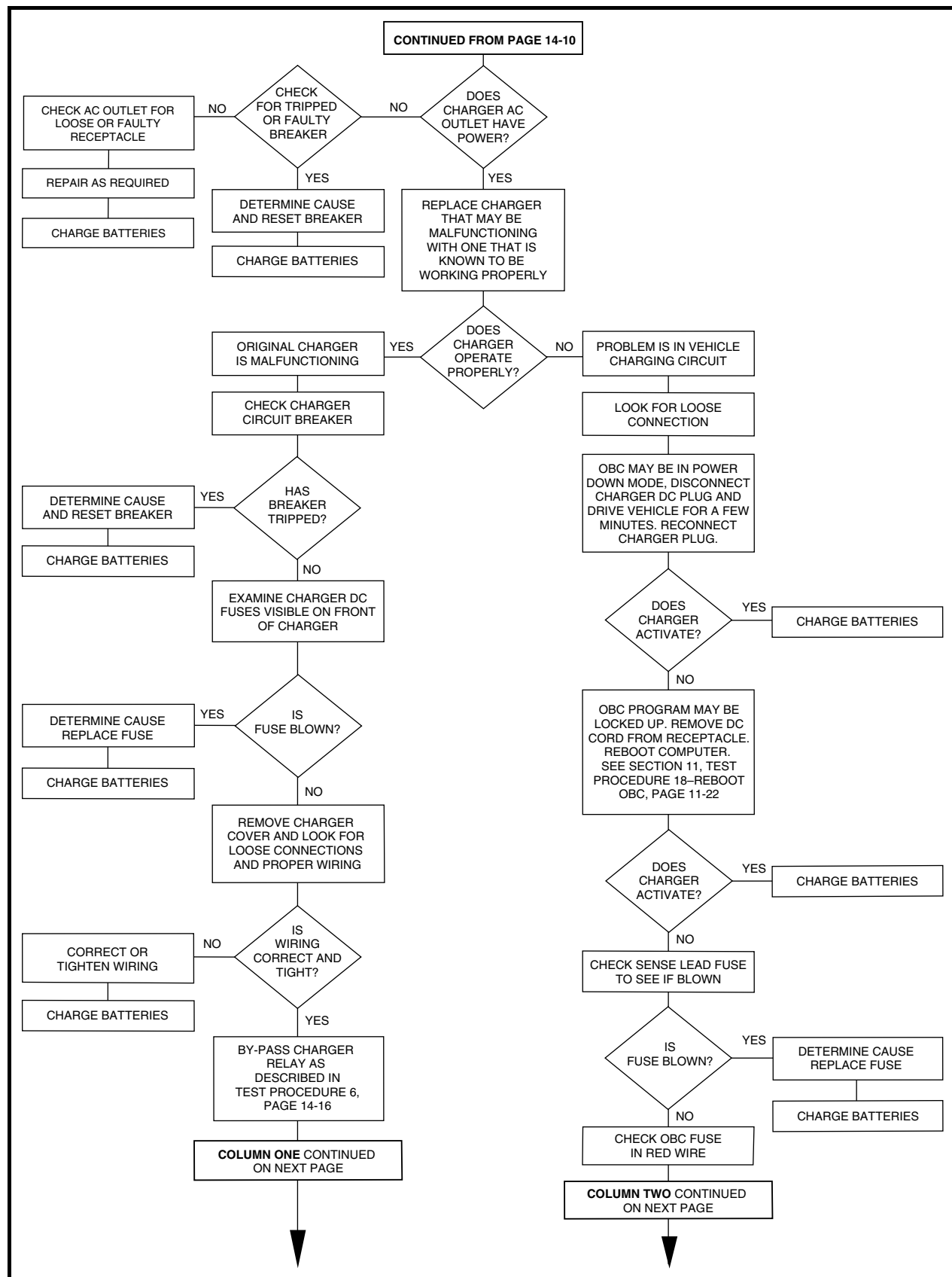


Figure 14-7 Flow Chart, Continued

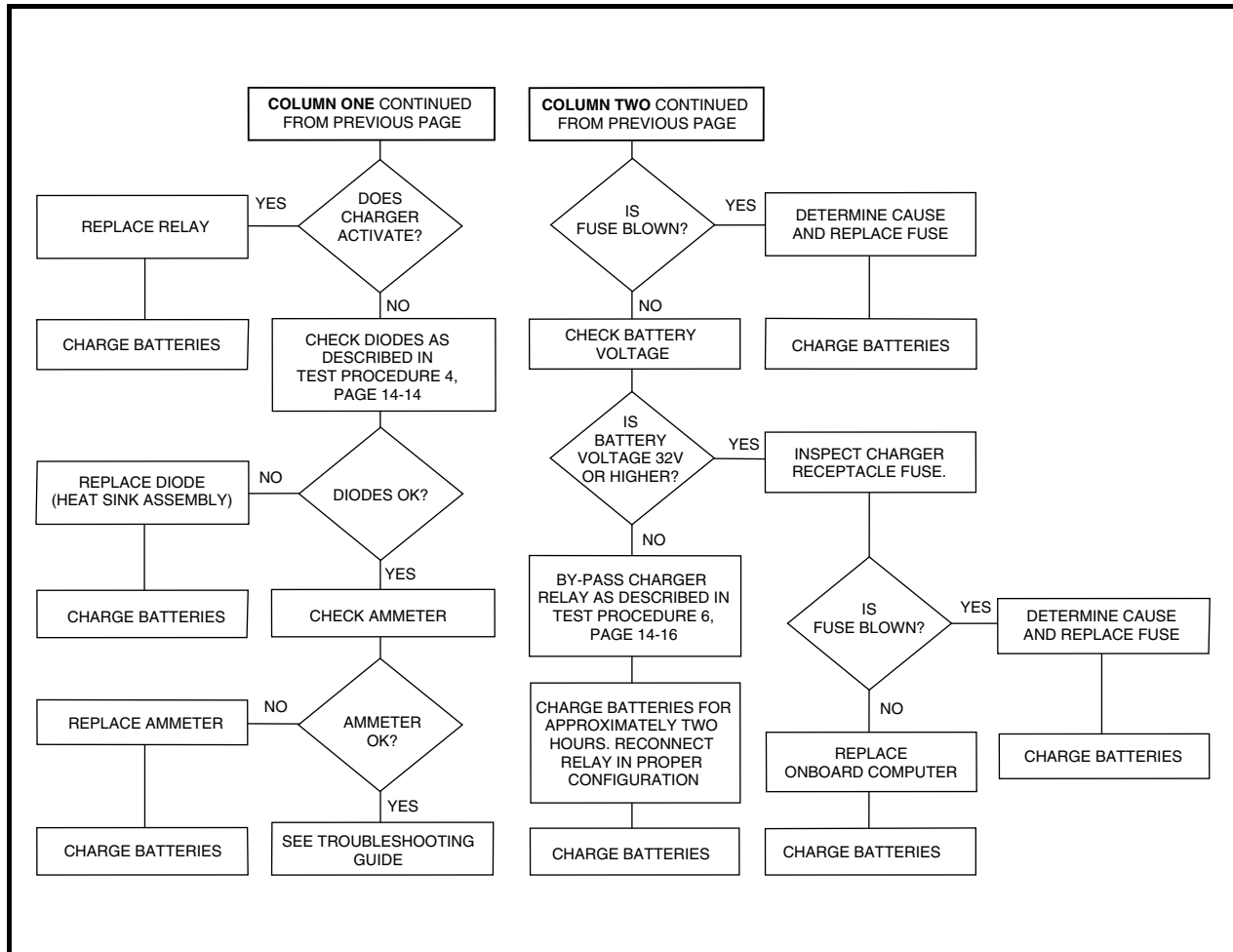


Figure 14-8 Flow Chart, Continued

TEST PROCEDURES

Read **DANGER** and **WARNING** on page 14-1.

GENERAL

The charger uses DC battery voltage through the onboard computer to close the charger relay which activates the charger AC circuit. When the charger is operating properly, there is a 2 to 15 second delay after the DC cord is plugged into the vehicle before the relay closes. This delay allows time for the DC plug to make a secure connection with the receptacle before the AC circuit is activated and AC power is supplied to the primary coil of the transformer. When the relay closes an audible “click” can be heard, and then as power is supplied, the transformer should hum and the ammeter should indicate the charge rate.

Test Procedure 1 - Battery Voltage Too Low or Faulty Connection Between Plug and Receptacle

1. Check the DC plug and receptacle for damage, dirt, corrosion, or any condition that might prevent a good electrical connection.
2. Inspect the receptacle contacts to ensure that they are not damaged and they are firmly seated within the receptacle.
3. Check the wire connections to the charger receptacle:

- 3.1. Verify the 10 gauge red wire from the charger receptacle is connected to the positive post of battery No. 1 (**Figure 14-10, Page 14-13**).
- 3.2. Make sure the two nuts that secure the two 10 gauge black wires to the receptacle fuse assembly are tight (**Figure 14-9, Page 14-13**).
- 3.3. Check the connections of the 18 gauge gray wire from the receptacle to the sense lead fuse, and from the sense lead fuse to the onboard computer gray wire (**Figure 14-9, Page 14-13**).

⚠ WARNING

- DO NOT BYPASS THE SENSE LEAD FUSE!

- 3.4. Remove the gray sense lead fuse assembly and check its continuity with a multimeter set to 200 ohms ($\frac{3}{4}$). The resistance should be less than 2 ohms.
4. With multimeter set to 200 volts DC, measure the voltage of the battery pack between the positive post of battery No. 1 and the negative post of battery No. 6 (**Figure 14-10, Page 14-13**). Normal no-load voltage will be 50 to 52 volts for fully charged batteries. The voltage of the battery pack must be over 32 volts DC in order to allow the onboard computer to close the charger relay. If battery pack voltage is too low to start charger, **see Section 13–Batteries, Charging Battery Pack With Low Voltage**.

Test Procedure 2 - Onboard Computer

1. Check the circuit breaker on the front of the charger and reset if necessary.
2. Select a second charger that is normally connected to another vehicle and is known to operate properly. Leave the AC cord of the second charger connected to the AC outlet that it normally is connected to. This will ensure AC power is present.
3. Insert the DC cord from the second charger into the receptacle of vehicle that is not charging properly
4. If the second charger fails in the same manner as the first charger, then the vehicle charging circuit is not functioning properly. **See Troubleshooting, Page 14-8**.
5. Connect the first charger into another vehicle that is known to be functioning properly. If the charger performs as it should, then the charger is not in need of repair.

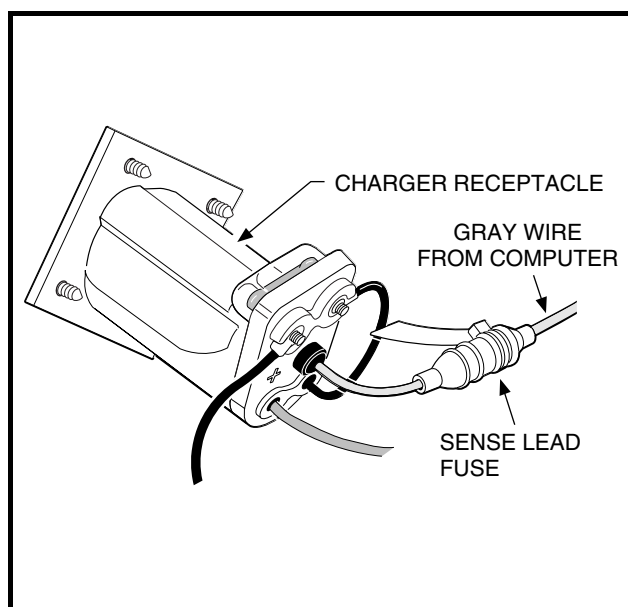


Figure 14-9 Receptacle Wire Connections

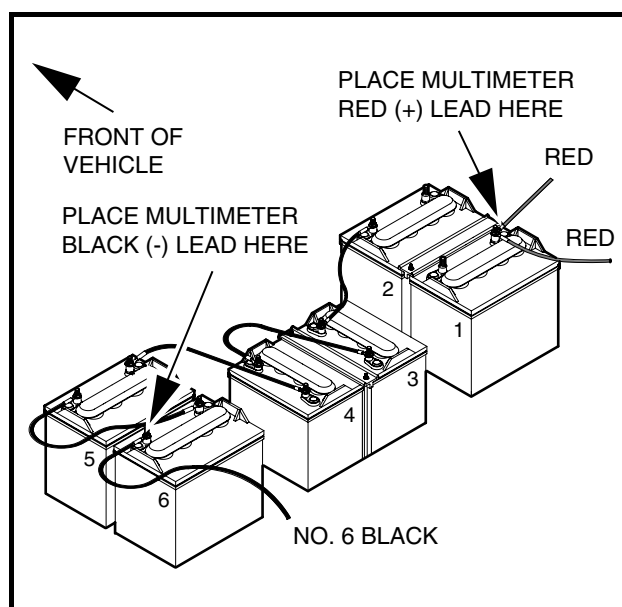


Figure 14-10 Battery Pack

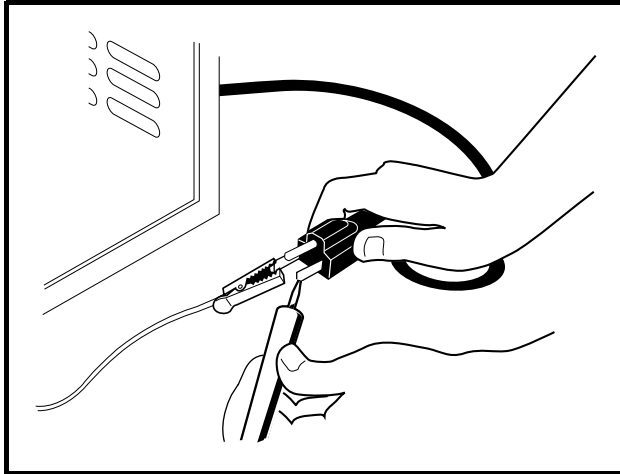


Figure 14-11 Test AC Cord

Test Procedure 3 - AC Power and Continuity Check of AC Circuit

1. Disconnect the AC power supply cord from its outlet and the DC plug from the vehicle receptacle.
2. Check the AC circuit breaker on the front of the charger and reset it if necessary.
3. Check the AC line fuse or circuit breaker in the storage facility.
4. With a multimeter set at 500 volts AC, check incoming AC voltage. Insert blades into outlet; voltage should be 105 to 128 volts. If proper voltage is not present, have building wiring checked by a licensed electrical contractor.
5. Remove charger cover and check continuity of the AC circuit:
 - 5.1. Disconnect the tan lead (from the primary coil) and the black lead (from the circuit breaker) from the charger relay. Connect the tan lead to the circuit breaker (**Figure 14-16, Page 14-17**).
 - 5.2. With relay bypassed, there should be continuity across AC cord blades (**Figure 14-11, Page 14-14**).
6. If the circuit is not complete, check the wiring of the AC cord, transformer primary coil leads, internal AC circuit breaker, and jumper wire (**Figure 14-16, Page 14-17**).
7. If the charger is wired correctly, check the continuity of the AC cord, transformer primary coil, and the jumper wire individually (**Test Procedure 8**).

⚠ WARNING

- ALWAYS DISCONNECT THE ELECTRICAL CORDS BEFORE ATTEMPTING ANY REPAIRS TO THE CHARGER. FIRST DISCONNECT THE AC CORD FROM THE OUTLET AND THEN DISCONNECT THE DC CORD FROM THE VEHICLE.

Test Procedure 4 - Diodes

Use test procedure 4A for single diode failures and testing of diodes. If both diodes have failed, use test procedure 4B.

Procedure 4A - Single Diode Failure

A single diode failure is indicated by one fuse link blowing (closed circuit diode) or by the charger output being low (open circuit diode). If a diode has failed, the entire heat sink assembly must be replaced. To check diodes:

1. Disconnect the AC cord from its outlet and the DC plug from the receptacle, then remove the charger cover.
2. Disconnect one transformer secondary coil lead from the diode terminal (**Figure 14-12, Page 14-15**).
3. Using a low voltage continuity tester or multimeter set to diode test function, connect the red (+) tester lead to the diode mounting plate and the black (-) tester lead to a diode terminal and note the reading (**Figure 14-**

12, Page 14-15).

4. Reverse the tester leads and check each diode again and note the reading (**Figure 14-13, Page 14-15**). A diode is designed to conduct current in one direction only; if a diode conducts current (shows continuity) in both directions, the complete heat sink assembly with diodes must be replaced. If a diode does not conduct current (does not show continuity) in either direction, the entire heat sink assembly must be replaced.
5. On rare occasions, a single fuse link may melt due to excessive heat. This can be caused by a loose internal fuse connection. Check all three fuse connections inside the charger to be sure they are clean and tight. The proper torque on the fuse link connections is 20 in.lb (2.2 N-m).
6. Be sure the charger is wired properly and all connections are clean and tight. **See following WARNING.**

⚠ WARNING

- IF CONNECTIONS ARE NOT CLEAN AND TIGHT, EXCESSIVE HEAT COULD RESULT WHICH MAY DAMAGE THE CHARGER.

Procedure 4B - Both Diodes Fail

To check the diodes, use diode test procedure 4A. If both diodes have failed closed, both charger fuse links will be blown. If both diodes have failed open, the relay will close and the transformer will hum, but the ammeter will not indicate any output. If both diodes have failed open or closed, the entire heat sink assembly must be replaced. To determine why both diodes failed:

1. Check the batteries and the receptacle to be sure they are wired in the correct polarity. Also check the voltage and polarity at the receptacle.
2. Make sure the charger DC plug is wired correctly; the red wire should be connected to the center terminal of the heat sink assembly, the blue wire should be connected to the relay coil, and the black wire should be connected to the left side of the ammeter (when viewed from inside the charger). If a reverse polarity connection is made between the charger and the batteries, both fuse links will blow when the DC cord is plugged into the vehicle, whether or not the AC cord is plugged into an outlet.
3. On rare occasions, both diodes may fail as the result of a lightning strike at the charging location.
4. Excessive heat due to a loose connection may also cause both fuse links to melt. Be sure fuse connections are tightened to 20 in.lb (2.2 N-m).
5. Be sure the charger is wired properly and all connections are clean and tight.

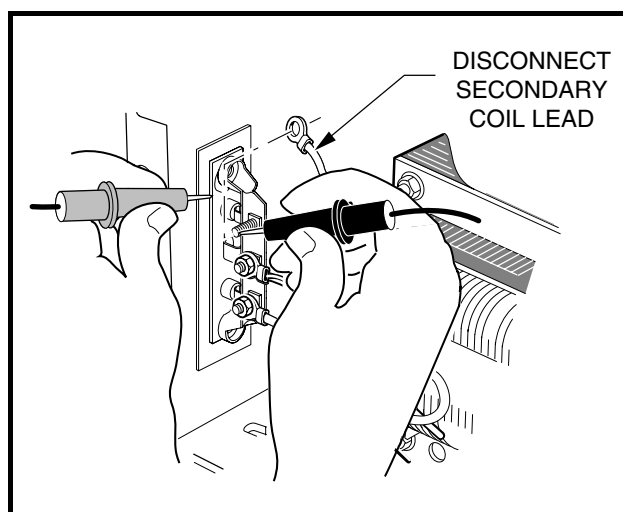


Figure 14-12 Diode Test

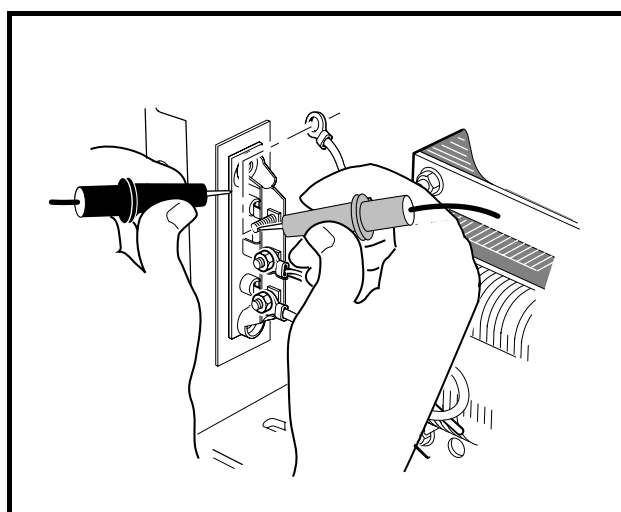


Figure 14-13 Diode Test-Reverse Probe Position

Test Procedure 5 - Charger DC Circuit Continuity Test

1. Using a continuity tester (Club Car Part No. 1011273) or multimeter set to 200 ohms, connect the test leads to the pins marked (+) and (-) on the DC plug (**Figure 14-14, Page 14-16**) and note the readings.
2. Reverse the test leads and check the DC plug again (**Figure 14-15, Page 14-16**). The circuit should show continuity in only one direction.
3. If the circuit does not show continuity in either direction and the charger fuse is not blown, individually check the continuity of the DC plug and cord (**Test Procedure 8**), ammeter (**Test Procedure 8**), diodes (**Test Procedure 4A**), and all connections.

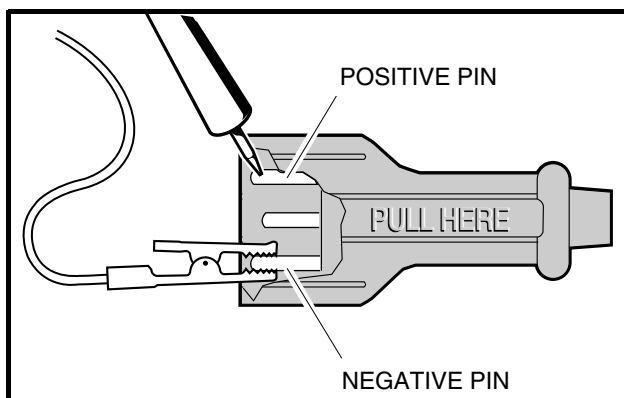


Figure 14-14 DC Plug Test Leads

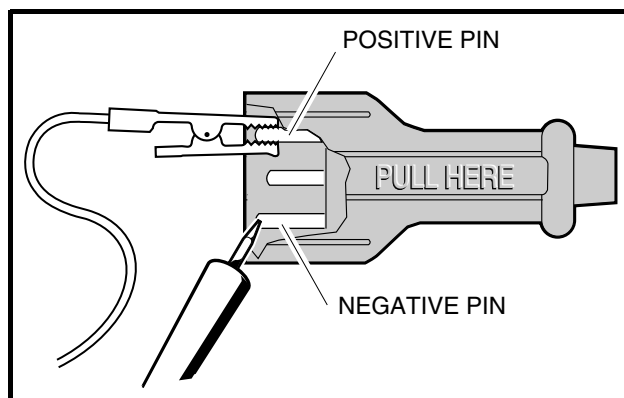


Figure 14-15 DC Plug Reverse Test Leads

4. If the circuit shows continuity in both directions, a short circuit exists in the charger DC circuit, usually caused by failed diodes. **See Test Procedure 4.** If diodes have not failed, check the DC output cord for a short circuit as described in **Test Procedure 8**.
5. Remove the blue wire from the charger relay and check the continuity between the positive and negative pins and the middle pin on the DC plug (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**). There should be no continuity.

Test Procedure 6 - Transformer

Failure of the transformer may be caused by aging or a short circuit in adjacent coil turns. If the transformer has failed, the ammeter would indicate low output or no output; however, transformer may hum. A blown AC line fuse or circuit breaker in the charger and/or storage facility may be caused by a failed transformer. To test the transformer:

1. Disconnect transformer secondary coil leads Nos. 1 and 5 from heat sink assembly (**Figure 14-16, Page 14-17**).
2. To apply AC power directly to the transformer primary coil, the relay must be bypassed.
3. To bypass the relay, remove the black wire (3) from the circuit breaker and disconnect the tan wire (4) from the relay. Connect the tan wire to the circuit breaker (**Figure 14-16, Page 14-17**).
4. Be sure secondary coil leads are not touching one another. With relay bypassed, insert AC plug into an outlet. If AC line fuse or circuit breaker blows, the transformer is shorted internally and must be replaced.
5. If the AC line fuse or circuit breaker does not blow, check the transformer secondary voltage across lead Nos. 1 and 5 using a multimeter set to 500 volts AC. If measured voltages are approximately 85 volts AC or lower for the secondary coil, the transformer is shorted internally and must be replaced (**Figure 14-16, Page 14-17**). **See following DANGER.**

⚠ DANGER

- DO NOT ALLOW SECONDARY COIL LEADS TO TOUCH ONE ANOTHER. THERE ARE APPROXIMATELY 120 VOLTS PRESENT.

6. If the transformer output measurements are 86 volts AC or higher, disconnect the AC plug from its outlet.
7. If the voltage readings are normal, the transformer is good. Refer to Test Procedure 5 for further tests of the DC circuit.

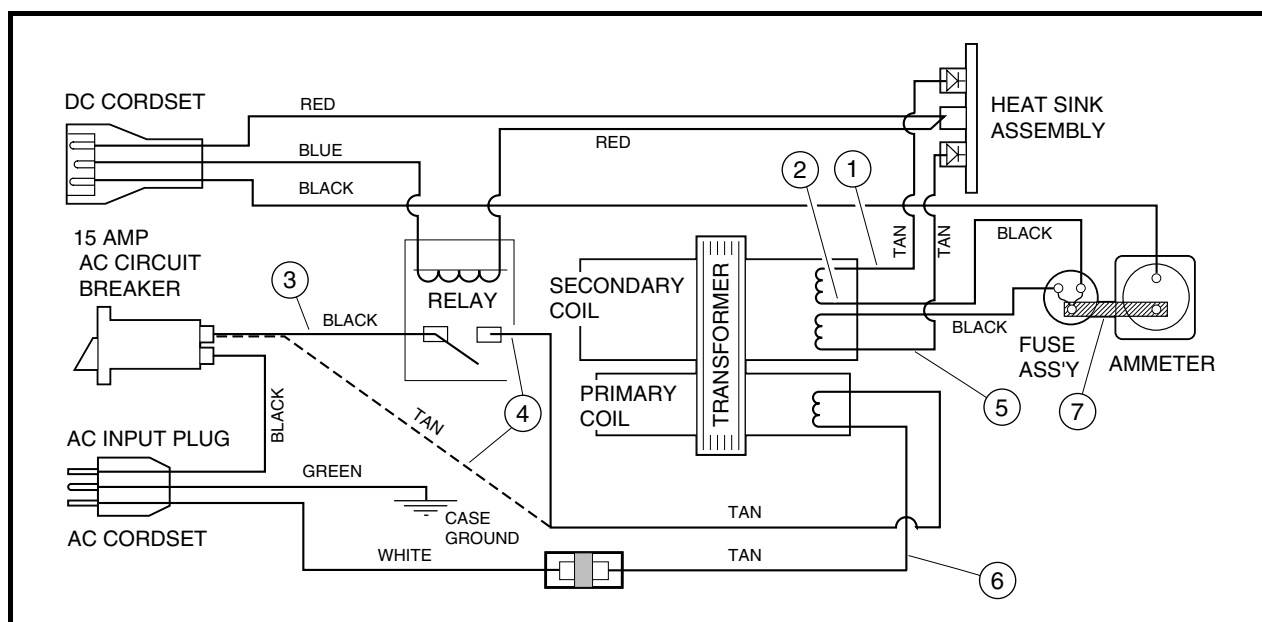


Figure 14-16 Transformer Test Wiring Diagram

Test Procedure 7 - Battery State of Charge

1. After the charger has shut off, disconnect the DC charger plug for approximately 20 seconds and then reconnect it. The ammeter should jump to 14 to 18 amps and then taper to below 5 amps within 15 minutes. If it does taper to below 5 amps within 15 minutes, batteries are fully charged and the charger is functioning properly.
2. If the charger does not taper to below 5 amps within 15 minutes, batteries may not be receiving a full charge and the onboard computer should be checked. **See Test Procedure 2.**

NOTE

- OLD BATTERIES NEAR THE END OF USEFUL SERVICE MAY NOT TAPER TO BELOW 5 AMPS. **SEE SECTION 13-BATTERIES.**

Test Procedure 8 - Continuity

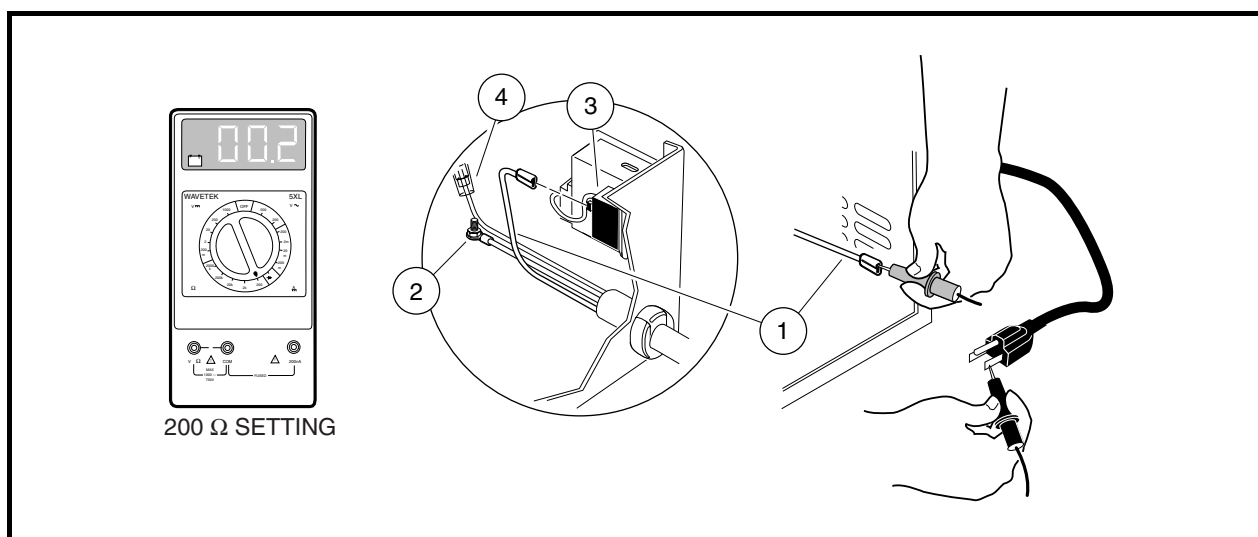
AC Cord and Plug

Check continuity of the AC cord (**Figure 14-17, Page 14-18**).

1. Disconnect the AC cord from its outlet and the DC plug from the receptacle, then remove the charger cover.
2. Disconnect black wire (1) of AC cord from charger AC circuit breaker (3) (**Figure 14-17, Page 14-18**).
3. Disconnect green wire (2) from charger case and position it so it does not touch any metal part of the charger (**Figure 14-17, Page 14-18**).

Test Procedure 8–Continuity, Continued:

4. Using a multimeter, set for 200 ohms, place the red probe on the terminal at the end of the black wire (1) (**Figure 14-17, Page 14-18**). Test for continuity on each of the flat blades and then on the ground pin of the AC plug. Continuity should register on one flat blade only. If any other reading is obtained, the AC cord and plug must be replaced.
5. Put the red probe on the end of the green wire (2) and with the black probe check for continuity on both flat blades and on the ground pin of the AC plug (**Figure 14-17, Page 14-18**). Tester should register continuity on only the ground pin. If continuity registers on either of the flat blades, or does not register on the ground pin, the AC cord and plug must be replaced.
6. Disconnect the white wire (4) from the tan wire (**Figure 14-17, Page 14-18**). Put red probe on the white wire and check for continuity on both flat blades and on the ground pin of the AC plug (**Figure 14-17, Page 14-18**). Tester should register continuity on only one flat blade. If any other reading is obtained, the AC cord and plug must be replaced.

**Figure 14-17 AC Cord Plug and Continuity Test****DC Cord and Plug**

1. Disconnect the AC cord from its outlet and the DC plug from the receptacle, then remove the charger cover.
2. To check the continuity of the DC cord, disconnect the black wire of the DC cord from the ammeter (**Figure 14-18, Page 14-20**).
3. Disconnect the red wire of the DC cord from the heat sink assembly (**Figure 14-18, Page 14-20**).
4. Disconnect the blue wire from the relay (**Figure 14-18, Page 14-20**).
5. Place the clip of the continuity tester on the red wire of the DC cord (**Figure 14-18, Page 14-20**).
6. Place the continuity tester probe on the positive (+) pin of the DC plug (the positive (+) pin and negative (-) pin are identified on the plug). If tester does not register continuity, cord and plug must be replaced.
7. Place the continuity tester probe on the negative (-) pin of the DC plug. Tester should register no continuity. If tester registers continuity, cord and plug must be replaced.
8. Place the continuity tester probe on the unmarked (middle) pin of the DC plug. Tester should register no continuity. If tester registers continuity, cord and plug must be replaced.
9. Move the continuity tester clip to the black wire of the DC cord (**Figure 14-18, Page 14-20**).
10. Place the continuity tester probe on the negative (-) pin of the DC plug. Tester should register continuity. If tester does not register continuity, cord and plug must be replaced.

11. Place the continuity tester probe on the unmarked (middle) pin of the DC plug. Tester should register no continuity. If tester registers continuity, cord and plug must be replaced.
12. Move continuity tester probe to the blue wire of the DC cord (**Figure 14-18, Page 14-20**). Check for continuity at the middle pin. Tester should register continuity. If tester does not register continuity, replace DC cord.

Transformer

WARNING

- BEFORE PERFORMING THIS TEST, BE SURE THE AC PLUG IS NOT CONNECTED TO AN AC OUTLET.

The PowerDrive battery charger transformer has two coils; a primary coil and a secondary coil (**Figure 14-16, Page 14-17**).

Primary Coil

1. Disconnect both AC and DC cords and remove charger cover. **See preceding WARNING.**
2. Disconnect terminals from transformer tan primary leads (4) and (6) (**Figure 14-16, Page 14-17**).
3. Place the continuity tester leads on the disconnected primary coil leads. Tester should register continuity. If tester does not register continuity, replace the transformer.

Secondary Coil

1. Disconnect both AC and DC cords and remove charger cover. **See preceding WARNING.**
2. Remove the transformer (tan) secondary coil lead (1) from the upper terminal of the heat sink assembly (**Figure 14-16, Page 14-17**). **See following DANGER.**

DANGER

- DO NOT ALLOW SECONDARY COIL LEADS TO TOUCH ONE ANOTHER. THERE ARE APPROXIMATELY 120 VOLTS PRESENT.

3. Remove the other transformer (tan) secondary coil lead (5) from the bottom terminal of the heat sink assembly and place the tester clip on the ammeter bus bar (7) (**Figure 14-16, Page 14-17**). Place the continuity leads on each (tan) secondary coil lead. Tester should register continuity. If tester does not register continuity, replace transformer. Be sure the fuse is intact and not blown.

Voltage Suppressor - Failed Closed

1. Disconnect both AC and DC plugs. **See preceding WARNING.**
2. Connect red (+) lead of multimeter (with alligator clips) to the positive pin of the DC plug.
3. Connect black (-) clip to the sense lead pin (short pin) of the DC plug. Multimeter should indicate no continuity. If continuity is registered (indicating a closed circuit) then voltage suppressor has failed and should be replaced. **See following NOTE.**

Relay

1. Disconnect both AC and DC plugs and remove charger cover. **See preceding WARNING.**
2. Remove the black (3) and tan (4) wires from the contact terminals of the relay (**Figure 14-16, Page 14-17**). Place continuity tester leads on contact terminals of the relay. Tester should register no continuity. If tester registers continuity, the relay contacts are welded shut and the relay must be replaced.
3. Place continuity leads on contact terminals of relay. With batteries connected, insert the DC plug into the receptacle. Tester should register continuity. If tester does not register continuity, the relay must be replaced.

NOTE

- FAILURE IN A CLOSED CONDITION CAN ALSO BE DETERMINED BY PLUGGING THE CHARGER INTO A VEHICLE, THEN UNPLUGGING CHARGER AND VISUALLY INSPECTING THE SENSE LEAD FUSE AT THE GRAY WIRE. IF FUSE IS BLOWN, THEN VOLTAGE SUPPRESSOR HAS FAILED CLOSED AND BOTH FUSE AND VOLTAGE SUPPRESSOR SHOULD BE REPLACED. THE VOLTAGE SUPPRESSOR CANNOT BE TESTED FOR FAILURE IN AN OPEN CONDITION. FAILURE IN AN OPEN CONDITION WILL HAVE NO AFFECT ON VEHICLE CHARGING OPERATION DUE TO THE EXISTENCE OF A SIMILAR COMPONENT LOCATED IN THE ONBOARD COMPUTER.

Ammeter

Check continuity of the ammeter:

1. Disconnect both AC and DC plugs and remove charger cover. **See preceding WARNING.**
2. Disconnect the black wire from the left ammeter post (as viewed from inside the charger).
3. Place the continuity tester clip on one of the ammeter posts.
4. Place the continuity tester probe on the other ammeter post. The tester should register continuity. If the tester does not register continuity, replace ammeter.

PLUG AND CORD REPLACEMENT

Read **DANGER** and **WARNING** on page 14-1.

The charger cord, plug, and receptacle are wear items and should be inspected daily. Visually inspect them for cracks, loose connections, and frayed wiring; they must be replaced when worn or damaged. If charger plug and receptacle show signs of corrosion or become difficult to insert and remove, the receptacle contacts and plug blades may be cleaned with a good electrical contact cleaner or lightly sprayed with WD-40® brand spray lubricant.

See Section 12, Page 14-9 for charger receptacle replacement.

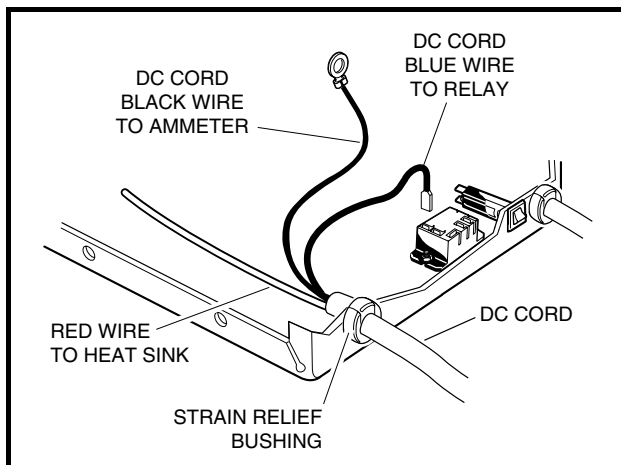


Figure 14-18 DC Cord

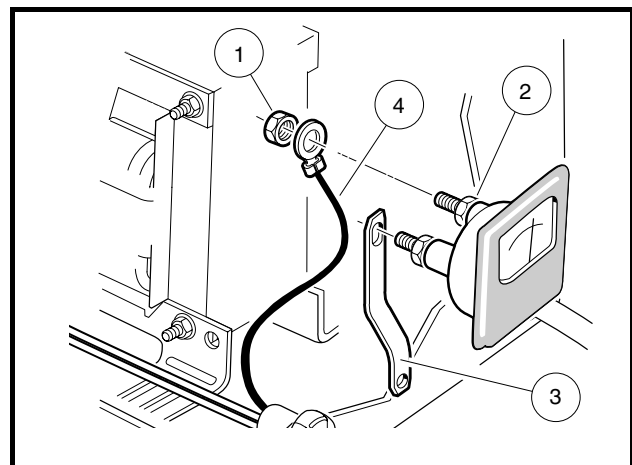


Figure 14-19 Charger Cord Installation

CHARGER CORD AND PLUG REPLACEMENT

Charger Cord and Plug Removal

1. Disconnect the AC and DC plugs. **See preceding WARNING.**
2. Remove the charger cover.
3. Remove the black lead of the charger DC cord (4) from the ammeter by loosening the nut (1). Support the terminal as the nut is loosened to prevent rotation of the connection (**Figure 14-19, Page 14-20**).
4. Remove nut attaching red lead of charger DC cord onto the heat sink assembly (**Figure 14-18, Page 14-20**).

5. Remove the terminal on the blue charger DC cord lead at the relay (**Figure 14-18, Page 14-20**).
6. Using pliers, squeeze the strain relief bushing and remove the cord set (**Figure 14-18, Page 14-20**).

Charger Cord and Plug Installation

1. Insert the leads of the new cord through the hole in the charger base.
2. Attach the red lead of the new cord set to the center terminal of the heat sink and tighten the nut to 14 in.lb (1.6 N-m) (**Figure 14-18, Page 14-20**).
3. Attach the blue lead of new cord set to the charger relay (coil) terminal (**Figure 14-18, Page 14-20**).
4. Attach the black lead of the new cord to the ammeter. Install nut (1) onto post of ammeter slightly more than finger tight. While holding the outside nut (1), turn the inside nut (2) counterclockwise 1/4 turn (**Figure 14-19, Page 14-20**). See following **CAUTION**.

CAUTION

- DO NOT ALLOW AMMETER POST TO ROTATE AS THE NUT IS TIGHTENED. IF IT IS ALLOWED TO ROTATE, THE AMMETER COULD BE DAMAGED.

5. Using pliers, put the strain relief bushing on the cord and insert into the charger base.
6. Position the charger cover on the base. Install the attachment screws, starting with the bottom holes. Tighten the screws to 11 in.lb (1.2 N-m).

CHARGER REPAIRS

Read **DANGER** and **WARNING** on page 14-1.

WARNING

- ALWAYS DISCONNECT THE ELECTRICAL CORDS BEFORE ATTEMPTING ANY TESTS OR REPAIRS TO THE CHARGER. FIRST DISCONNECT THE AC CORD FROM THE AC OUTLET AND THEN DISCONNECT THE DC CORD FROM THE VEHICLE.

HEAT SINK ASSEMBLY

Heat Sink Assembly Removal

1. Remove charger cover. See preceding **WARNING**.
2. Remove both secondary transformer leads (tan) from the heat sink assembly (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
3. Remove the two red wires from the heat sink assembly (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
4. Remove the nuts and bolts that secure the heat sink assembly to the case.

Heat Sink Assembly Installation

1. Place heat sink against charger base. Make sure clear plastic insulator sheet is between the heat sink and the charger base. Install the nuts and bolts that secure the heat sink assembly to the case. Tighten the bolts to 22 in.lb (2.4 N-m) (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
2. Connect the red wire from the DC cord and the red wire from the charger relay to the center terminal post on the heat sink assembly. Tighten nut to 18 in.lb (2.0 N-m) (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
3. Connect one of the secondary transformer leads (tan) to the bottom terminal post of the heat sink assembly. Tighten nut to 18 in.lb (2.0 N-m) (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).

4. Connect the other secondary transformer lead (tan) to the top terminal post of the heat sink assembly. Tighten nut to 18 in.lb (2.0 N-m) (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
5. Replace charger cover and check charger for proper operation.

TRANSFORMER

Transformer Removal

1. Remove the charger cover. **See preceding WARNING.**
2. Disconnect tan primary coil lead from the charger relay, then disconnect the tan primary coil lead from the white wire in the AC cord (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
3. Disconnect the two tan secondary transformer leads from the heat sink assembly (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
4. Disconnect the two black secondary transformer leads from the fuse assembly (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
5. Remove four bolts and nuts mounting transformer to case and remove transformer (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).

Transformer Installation

1. Install the transformer with the secondary coil to the rear of the charger case. Tighten the four bolts and nuts to 28 in.lb (3.2 N-m) (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
2. Connect one secondary transformer lead (tan) to the top terminal post of the heat sink assembly (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**). Tighten nut to 18 in.lb (2.0 N-m).
3. Connect the other secondary transformer lead (tan) to the bottom terminal post of the heat sink assembly (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**). Tighten nut to 18 in.lb (2.0 N-m).
4. Connect one secondary transformer lead (black) to one terminal of the fuse assembly (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**). Tighten nut to 22 in.lb (2.5 N-m).
5. Connect the other secondary transformer lead (black) to the remaining terminal of the fuse assembly (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**). Tighten nut to 22 in.lb (2.5 N-m).
6. Connect the tan primary lead to the charger relay (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
7. Connect other tan primary lead to white wire from AC cord (**Figures 14-4 and 14-5, Pages 14-7 and 14-8**).
8. Replace charger cover and check charger for proper operation.

AMMETER

Ammeter Removal

1. Remove charger cover. **See preceding WARNING.**
2. Disconnect black wire from DC cord (5), and bus bar (3) from ammeter (**Figure 14-20, Page 14-23**).
3. Remove the two nuts (2) that secure the ammeter to the charger face (**Figure 14-20, Page 14-23**).
4. Remove the ammeter from the face of the charger.

Ammeter Installation

1. Place the ammeter in position in the charger face (**Figure 14-20, Page 14-23**).
2. Install the nuts (2) and tighten until ammeter is firmly secured (**Figure 14-20, Page 14-23**).
3. Connect the black wire of the DC cord (5) to the left (as viewed from inside the charger) post of the ammeter (**Figure 14-20, Page 14-23**).
4. Connect the bus bar (3) from the fuse link to the right post of the ammeter. Place flat washers on both sides of the bus bar (**Figure 14-20, Page 14-23**).
5. Thread nuts onto both posts of the ammeter until just past finger tight. While holding the outside nut, turn the inside nut counterclockwise 1/4 turn (**Figure 14-20, Page 14-23**). **See following CAUTION.**

⚠ CAUTION

- DO NOT ALLOW AMMETER POST TO ROTATE AS THE NUT (4) IS TIGHTENED. IF IT IS ALLOWED TO ROTATE, THE AMMETER COULD BE DAMAGED (**FIGURE 14-20, PAGE 14-23**).

6. Replace the charger cover. Plug the charger into the vehicle and check ammeter for proper operation.

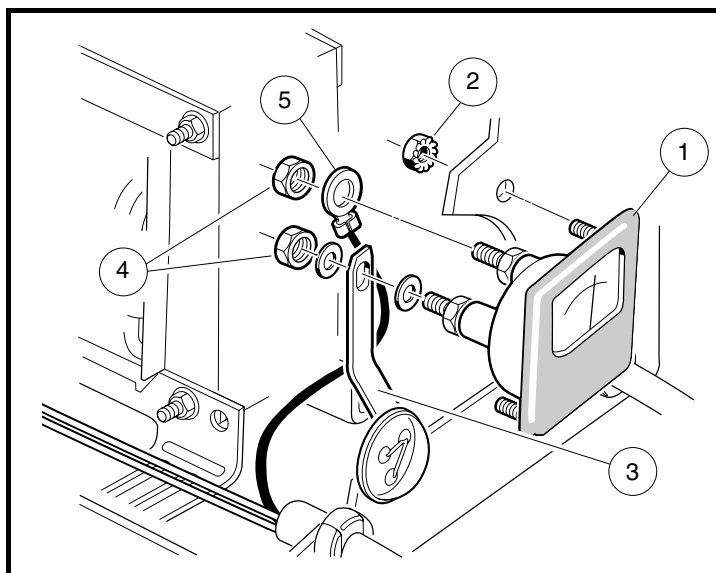


Figure 14-20 Ammeter Removal

FUSE LINK

Fuse Link Removal

1. Disconnect the AC and DC cords. **See WARNING on page 14-21.**
2. Remove the charger cover.
3. Remove both black secondary transformer leads and the bus bar from the back of the fuse link assembly (**Figure 14-20, Page 14-23**).
4. Remove screws from the front of the charger and remove the fuse link assembly.

Fuse Link Installation

1. Place plastic cover over fuse assembly and install mounting screws from front of charger face. The center branch of the fuse assembly should be in the upper left corner when viewed from the front of the charger.
2. Install the bus bar over the center branch of the fuse assembly and ammeter post (**Figure 14-20, Page 14-23**). Tighten to 27 in.lb (3.0 N-m).
3. Install a secondary transformer lead (black) to one of the two remaining terminals on the back of the fuse assembly. Install the remaining secondary transformer lead (black) to the remaining terminal (**Figure 14-20, Page 14-23**). Tighten to 27 in.lb (3.0 N-m).
4. Replace charger cover.

VOLTAGE SUPPRESSOR

The voltage suppressor protects the onboard computer by capturing very high, but very brief voltage spikes which occur due to the collapse of the electrical field in the charger relay when the charger is disconnected from the vehicle. **See also Test Procedure 8—Continuity, Voltage Suppressor, Page 14-19.**

Voltage Suppressor Removal

1. Disconnect the AC and DC cords. **See WARNING on page 14-21.**
2. Remove charger cover.
3. Remove nut attaching voltage suppressor (18 gauge red wire) to heat sink (**Figure 14-21, Page 14-24**).
4. Disconnect blue wire to DC cord at quick disconnect terminal (**Figure 14-21, Page 14-24**).
5. Disconnect voltage suppressor from charger relay (**Figure 14-21, Page 14-24**).

Voltage Suppressor Installation

1. Install in reverse order of removal. Tighten nut attaching voltage suppressor (18 gauge red wire) to heat sink to 18 in.lb (2.0 N-m). **See following NOTE.**

NOTE

- THE CHARGER RELAY BLADE CONNECTOR IS LOCATED OFF-CENTER WITHIN THE RELAY HOUSING. WHEN CONNECTING VOLTAGE SUPPRESSOR SLIP-ON CONNECTOR TO RELAY BLADE CONNECTOR, MAKE SURE SLIP-ON CONNECTOR IS POSITIONED SO THAT FLAT SIDE OF CONNECTOR IS CLOSEST TO RELAY HOUSING. **SEE FIGURE 14-21, PAGE 14-24.**

CHARGER RELAY

Charger Relay Removal

1. Disconnect the AC and DC cords. **See WARNING on page 14-21.**
2. Remove the charger cover.
3. Disconnect the red, blue, black, and primary coil wires from the relay (**Figure 14-21, Page 14-24**).
4. Remove the two nuts and lock washers attaching relay to charger base (**Figure 14-21, Page 14-24**).
5. Remove the relay.

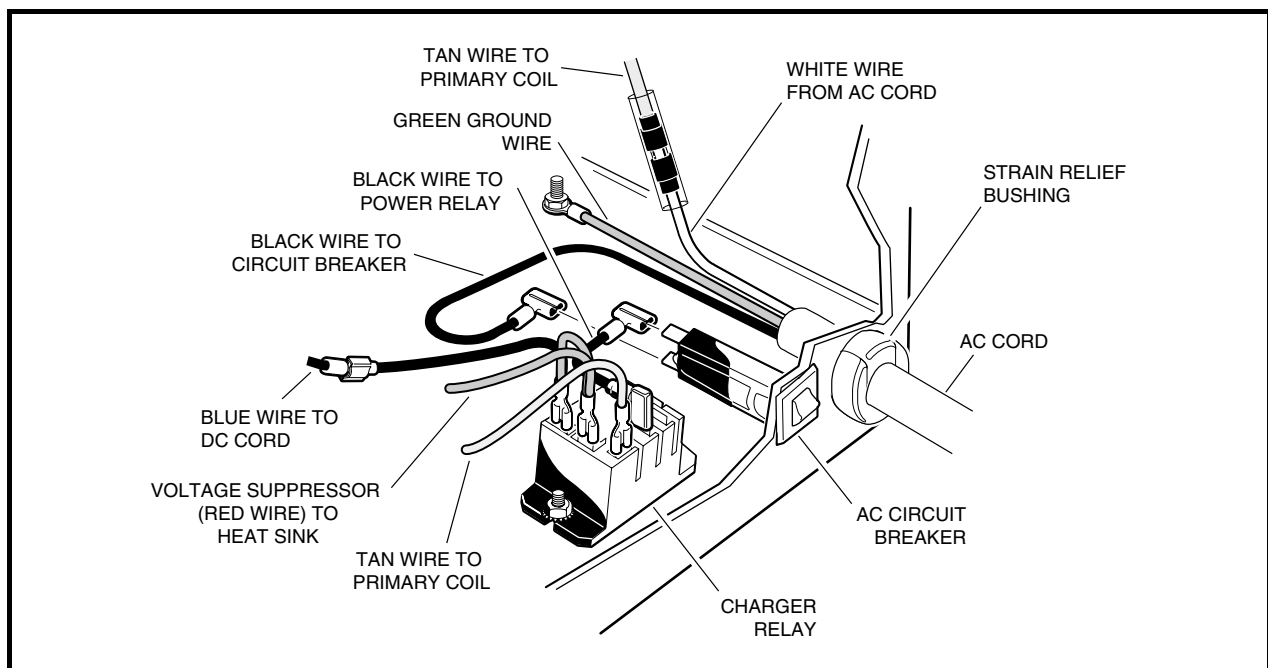


Figure 14-21 Charger Relay

Charger Relay Installation

1. Install in reverse order of removal. Connect wires as shown in **Figure 14-21, Page 14-24**. Tighten nut connecting relay to charger base to 18 in.lb (2.0 N-m).

CHARGER AC CIRCUIT BREAKER

AC Circuit Breaker Removal

1. Disconnect the AC and DC cords. **See WARNING on page 14-21.**
2. Remove the charger cover.
3. Disconnect the two black wires attached to circuit breaker (**Figure 14-21, Page 14-24**).
4. With a pair of pliers, squeeze in the retaining tabs on the sides of the circuit breaker and remove the circuit breaker through its mounting hole in the face of the charger (**Figure 14-21, Page 14-24**).

AC Circuit Breaker Installation

1. Install in reverse order of removal.

CHARGER AC CORD

AC Cord Removal

1. Disconnect the AC and DC cords. **See WARNING on page 14-20.**
2. Remove the charger cover.
3. Disconnect the AC cord black wire at the circuit breaker (**Figure 14-21, Page 14-24**).
4. Disconnect the AC cord white wire at the primary coil tan wire (**Figure 14-21, Page 14-24**).
5. Disconnect the AC cord green wire at the charger base (**Figure 14-21, Page 14-24**).
6. Use a pair of pliers to grip the strain relief bushing and remove it and the AC cord from the charger.

AC Cord Installation

1. Insert the black, white, and green leads of the new AC cord into the charger through the hole in the charger face (**Figure 14-21, Page 14-24**).
2. Connect the black wire to the circuit breaker, the white wire to the primary coil, and the green wire to the charger base (**Figure 14-21, Page 14-24**). **See following NOTE.**

NOTE
<ul style="list-style-type: none">• MAKE SURE THE GREEN (GROUND) WIRE IS TIGHTLY SECURED TO THE CHARGER BASE.

3. Position the strain relief bushing on the AC cord.
4. Using pliers, install the strain relief bushing and AC cord into the mounting hole in the charger face.
5. Install the charger cover.

SECTION 15–MOTOR

DANGER

- **BATTERY - EXPLOSIVE GASES! DO NOT SMOKE. KEEP SPARKS AND FLAMES AWAY. VENTILATE WHEN CHARGING OR USING IN AN ENCLOSED SPACE. ALWAYS WEAR FULL FACE SHIELD WHEN WORKING ON OR NEAR BATTERIES.**
- **USE EXTREME CAUTION WHEN USING TOOLS, WIRES, OR METAL OBJECTS NEAR BATTERIES! A SHORT CIRCUIT AND (OR) SPARK COULD CAUSE AN EXPLOSION.**
- **BATTERY - POISON! CONTAINS ACID! CAUSES SEVERE BURNS. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. ANTIDOTES:**
 - **EXTERNAL: FLUSH WITH WATER. CALL A PHYSICIAN IMMEDIATELY.**
 - **INTERNAL: DRINK LARGE QUANTITIES OF MILK OR WATER. FOLLOW WITH MILK OF MAGNESIA OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.**
 - **EYES: FLUSH WITH WATER FOR FIFTEEN MINUTES. CALL PHYSICIAN IMMEDIATELY.**

WARNING

- ONLY TRAINED TECHNICIANS SHOULD REPAIR OR SERVICE THIS VEHICLE. ANYONE DOING EVEN SIMPLE REPAIRS OR SERVICE SHOULD HAVE KNOWLEDGE AND EXPERIENCE IN GENERAL MECHANICAL AND ELECTRICAL REPAIR. FOLLOW ALL PROCEDURES EXACTLY AND HEED ALL WARNINGS STATED IN THIS MANUAL.
- WEAR SAFETY GLASSES OR APPROVED EYE PROTECTION WHILE SERVICING VEHICLE.
- PLACE THE TOW/RUN SWITCH IN THE **TOW** POSITION BEFORE CONNECTING OR DISCONNECTING BATTERY WIRES.
- BEFORE PERFORMING ANY TESTS OR REPAIRS THAT DO NOT REQUIRE THE ELECTRICAL SYSTEM TO BE ENERGIZED, MAKE SURE CAPACITORS ARE DISCHARGED. PLACE THE TOW/RUN SWITCH IN THE **TOW** POSITION, DISCONNECT BATTERY WIRES, PLACE FORWARD/REVERSE ROCKER SWITCH IN **REVERSE** AND LISTEN FOR THE REVERSE BUZZER:
 - IF THE REVERSE BUZZER DOES NOT SOUND, THE CAPACITORS ARE DISCHARGED.
 - IF THE REVERSE BUZZER SOUNDS, TURN THE KEY SWITCH **ON** AND DEPRESS THE ACCELERATOR PEDAL UNTIL THE BUZZER CAN NO LONGER BE HEARD.
- DO NOT WEAR LOOSE CLOTHING. REMOVE JEWELRY SUCH AS RINGS, WATCHES, CHAINS, ETC. BEFORE SERVICING VEHICLE.
- ALWAYS USE INSULATED TOOLS WHEN WORKING NEAR BATTERIES OR ELECTRICAL CONNECTIONS. WHEN BATTERIES ARE CONNECTED, USE EXTREME CAUTION TO AVOID SHORT CIRCUITS IN COMPONENTS OR WIRING.
- TO AVOID UNINTENTIONALLY STARTING THE VEHICLE, DISCONNECT BATTERIES AS SHOWN IN **FIGURE 15-1, PAGE 15-2.**

GENERAL INFORMATION

The PowerDrive Plus vehicle is equipped with a 48-volt DC, shunt wound, reversible traction motor. The shunt wound motor is designed for use on the PowerDrive Plus vehicle only. Club Car recommends motors requiring major repair be sent to a qualified motor repair shop. However, there are many relatively simple tasks that can be performed by a technician with general knowledge and experience in electric motor repair.

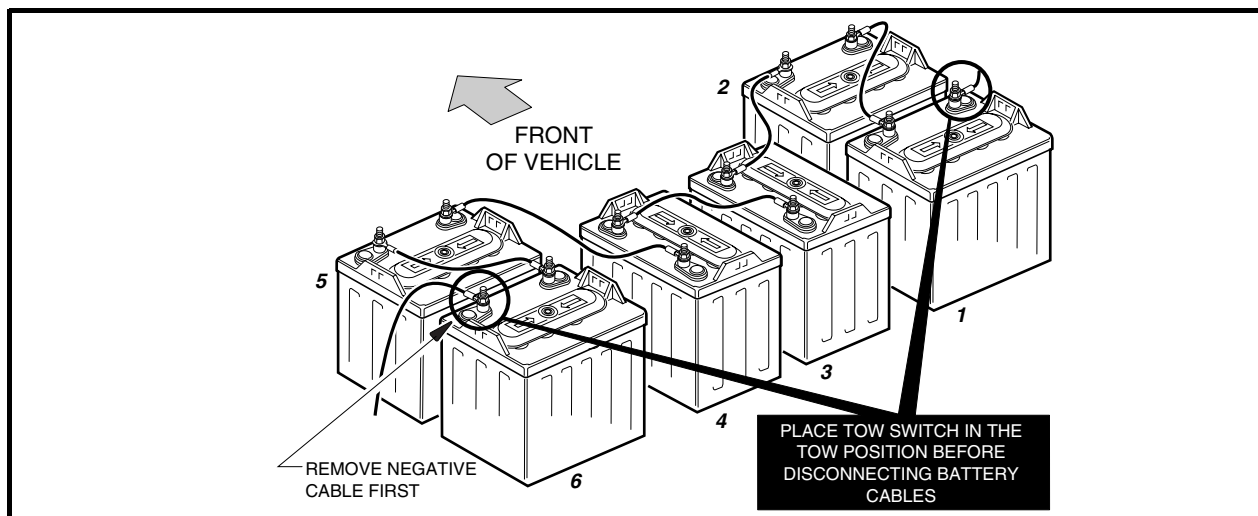


Figure 15-1 PowerDrive Plus Battery Configuration

EXTERNAL MOTOR TESTING

Read **DANGER** and **WARNING** on page 15-1.

Using a multimeter or continuity tester the following tests can be performed without disassembling the motor.

Test Procedure 1 - Internal Short Circuit

1. Place Tow/Run switch in the TOW position and disconnect the batteries (**Figure 15-1, Page 15-2**).
2. Using two wrenches to prevent posts from turning, disconnect wires from terminals on motor.

NOTE

- TAG THE MOTOR WIRES FOR IDENTIFICATION BEFORE DISCONNECTING.

3. Using a multimeter set to 200 ohms ($\frac{3}{4}$), place black (-) probe on motor housing. Scratch through paint to ensure a good connection. Place red (+) probe on A1, A2, F1, and F2 terminals respectively (**Figure 15-1, Page 15-2**). Multimeter should indicate no continuity. If readings are incorrect, motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal, Page 15-3.**
 - 3.1. An incorrect reading from the A1 or A2 terminal indicates three possible problems; a grounded A1 or A2 terminal, a grounded wire in the brush area, or a grounded armature/commutator. An incorrect reading for the F1 or F2 terminal indicates a possible grounded F1 or F2 terminal or field coil.

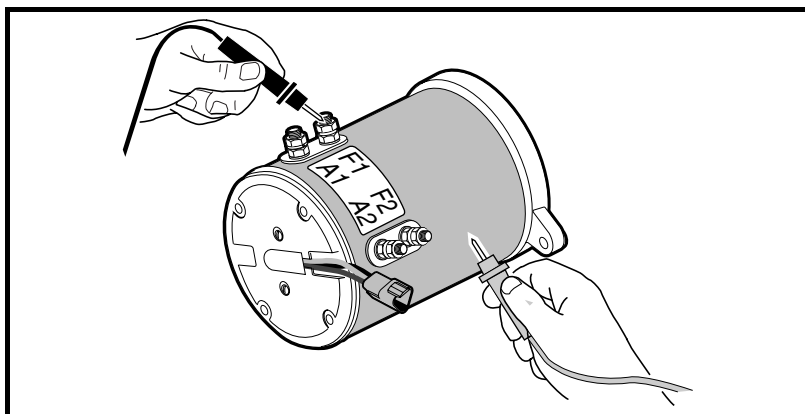


Figure 15-1 Test for Motor Short Circuit

Test Procedure 2 - Armature Circuit Open

1. Place Tow/Run switch in the TOW position and disconnect the batteries (**Figure 15-1, Page 15-2**).
2. Using two wrenches to prevent post from turning, disconnect wires from the A1 and A2 terminals on the motor. Using a multimeter set to 200 ohms ($\frac{3}{4}$), place the red (+) probe on the A1 terminal and black (-) probe on the A2 terminal (**Figure 15-1, Page 15-2**). The multimeter should indicate continuity. If the reading is incorrect, a possible open or poor contact in a brush assembly and/or open armature windings may be the cause. The motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal.**

Test Procedure 3 - Field Circuit Open

1. Place Tow/Run switch in the TOW position and disconnect the batteries (**Figure 15-1, Page 15-2**).
2. Using two wrenches to prevent post from turning, disconnect wires from the motor F1 and F2 terminals. Using a multimeter set to 200 ohms, place the red (+) probe on the F1 terminal and the black (-) probe on the F2 terminal (**Figure 15-1, Page 15-2**). The multimeter should indicate continuity. If the reading is incorrect, a possible open field coil or bad connections at the terminals may be the cause. The motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal.**

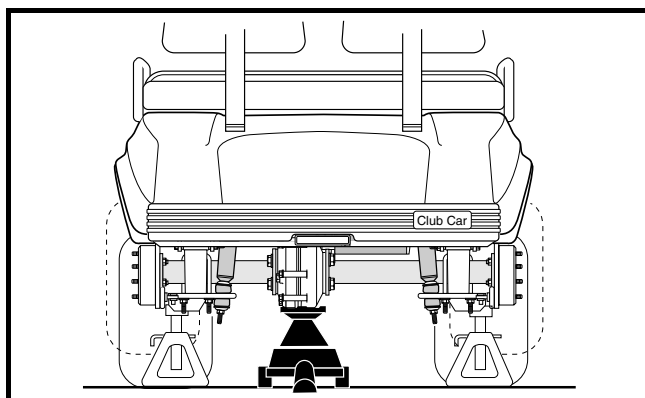


Figure 15-2 Lift Vehicle with Floor Jack

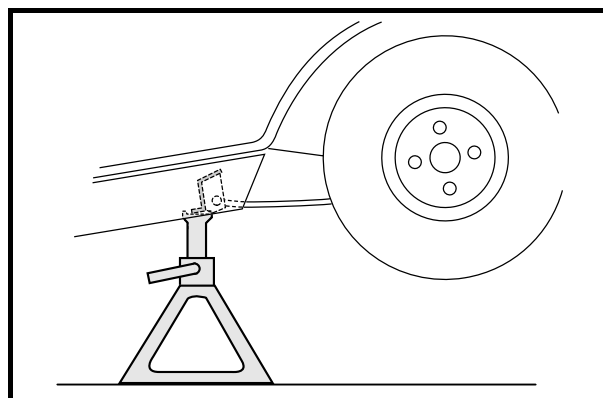


Figure 15-3 Support Vehicle with Jackstands

MOTOR

Read **DANGER** and **WARNING** on page 15-1.

Motor Removal

1. Place Tow/Run switch in TOW and disconnect battery cables, negative cable first (**Figure 15-1, Page 15-2**).
2. Disconnect motor wires. Use two wrenches to prevent post from turning. Label wires to ensure proper reconnection. **See NOTE on page 15-2.**
3. Slightly loosen all the lug nuts on both rear wheels.
4. Place floor jack under transaxle and raise rear of vehicle (**Figure 15-2, Page 15-3**) then place jackstands under frame cross-member between the spring mount and the side stringer, just forward of each rear wheel. Lower the vehicle to let the jackstands support the vehicle (**Figure 15-3, Page 15-3**). **See following WARNING.**

⚠ WARNING

- LIFT ONLY ONE END OF THE VEHICLE AT A TIME. BEFORE LIFTING, LOCK THE BRAKES AND CHOCK THE WHEELS THAT REMAIN ON THE FLOOR. USE A SUITABLE LIFTING DEVICE (CHAIN HOIST OR HYDRAULIC FLOOR JACK) WITH 1000 LBS. (454 KG.) MINIMUM LIFTING CAPACITY. DO NOT USE LIFTING DEVICE TO HOLD VEHICLE IN RAISED POSITION. ALWAYS USE APPROVED JACKSTANDS OF PROPER WEIGHT CAPACITY TO SUPPORT THE VEHICLE.

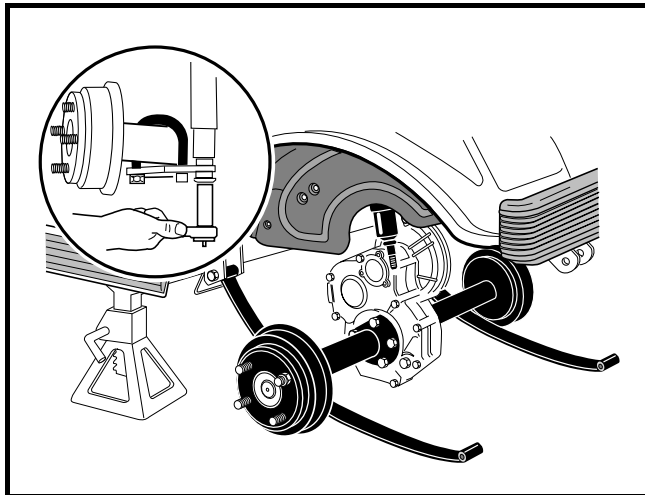
Motor Removal, Continued:

5. Remove both rear wheels.
6. Remove the nut, cup washer, and bushing from the bottom side of the shock absorber. Compress the shock absorber (pushing upwards) to move it out of the way.
7. Remove the nuts and bolts mounting the rear leaf springs to the shackles (**Figure 15-4, Page 15-4**).
8. To gain easier access to the motor, lower the transaxle as low as it will go. If more room is needed, remove the jack from beneath the transaxle and allow the springs to rest on the floor (**Figure 15-4, Page 15-4**).
9. Remove the four bolts that mount the motor to the transaxle (**Figure 15-17, Page 15-13**).

⚠ CAUTION

- DO NOT PLACE FINGERS OR HANDS UNDER MOTOR DURING REMOVAL. SEVERE INJURY COULD RESULT IF FINGERS OR HANDS ARE CAUGHT BETWEEN MOTOR AND AXLE TUBE.

10. Carefully slide the motor away from the transaxle until the motor spline disengages the pinion and then remove the motor from the vehicle.

**Figure 15-4 Lower Axle****Motor Disassembly**

1. Before beginning disassembly, place match marks on the motor end shield and stator shell, then place the motor in a vice with wooden blocks as shown (**Figure 15-5, Page 15-5**).
2. Remove the four bolts (8) securing the end shield (10) to the stator shell (2) (**Figure 15-5, Page 15-5**).
3. Remove the two screws (9) attaching the end shield to the bearing retainer (**Figure 15-5, Page 15-5**).
4. Slide the armature (17) out of the opposite end of the stator shell (**Figure 15-5, Page 15-5**).
5. Remove two screws (11) attaching brush rigging (12) to the stator shell (2) (**Figure 15-8, Page 15-7**).
6. Mark the brush terminal posts (A1 and A2) (13) to identify their positions in the stator shell and winding assembly, then remove the nuts (6) and flat washers (5) (**Figure 15-8, Page 15-7**). From the outside, push the posts through the stator shell wall into the interior of the stator shell and winding assembly.
7. Carefully remove the brush rigging and the terminal posts from the stator shell.
8. To remove brush springs (14) from the rigging, lift the spring extensions out and over the brush mounts and then slide the springs off their mounting tabs (**Figure 15-6, Page 15-5**).

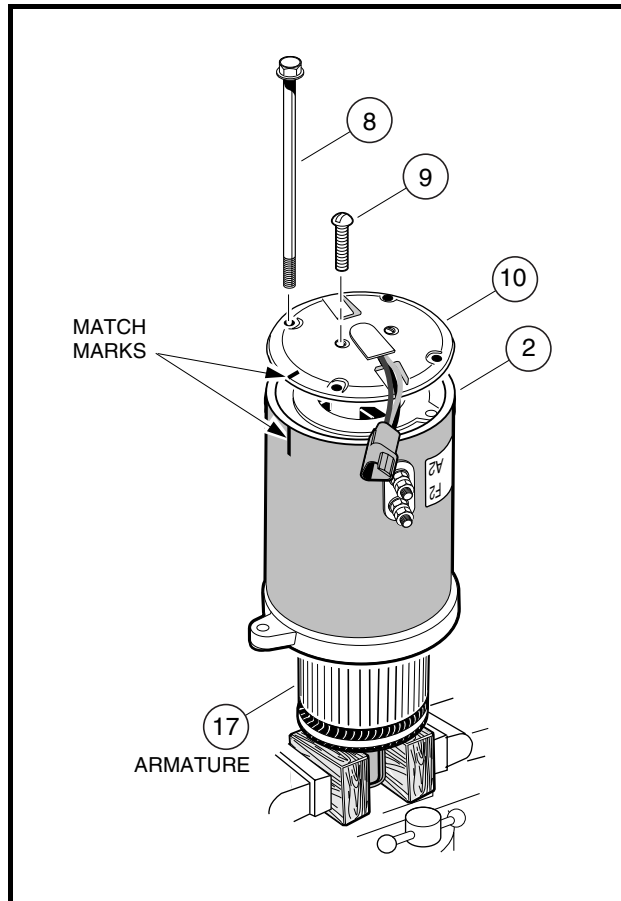


Figure 15-5 Motor Disassembly

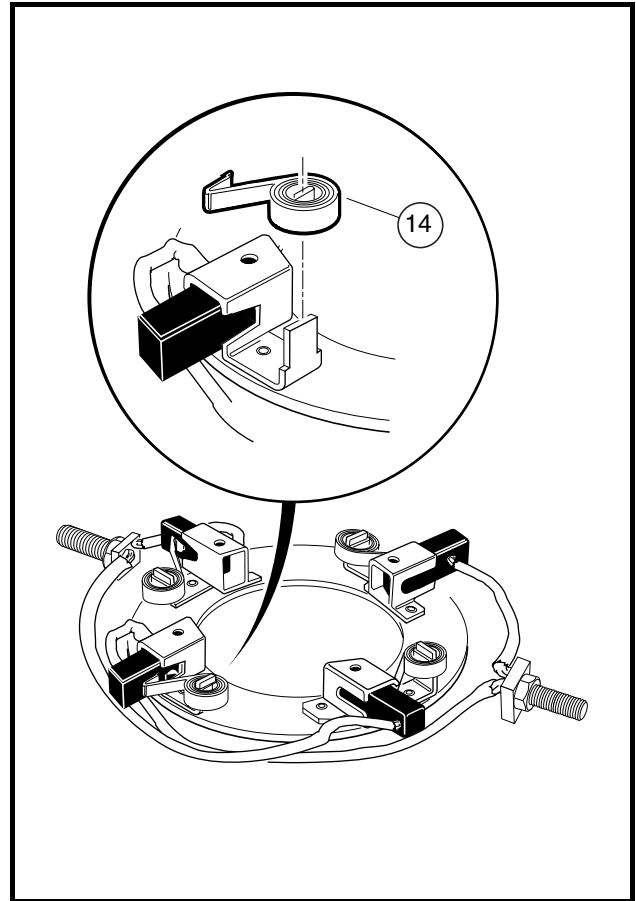


Figure 15-6 Brush Spring Removal

TESTING AND INSPECTING INDIVIDUAL COMPONENTS

Read **DANGER** and **WARNING** on page 15-1.

ARMATURE

1. Disassemble the motor and carefully inspect the armature for the following defects:
 - Burned, charred or cracked insulation.
 - Improperly cured varnish.
 - Thrown solder.
 - Flared armature windings.
 - Damaged armature core laminations.
 - Worn, burned or glazed commutators.
 - Dirty or oily commutators.
 - Raised commutator bars.
 - Worn armature bearing or shaft.

A dirty or oily commutator should be cleaned and wiped dry. Abnormalities identified during the inspection can help determine original cause of failure. Slight roughness of the commutator can be polished smooth with 400 grit or finer sandpaper. **See following CAUTION and NOTE.**

⚠ CAUTION

- NEVER USE EMERY CLOTH TO SMOOTH THE COMMUTATOR. PARTICLES OF EMERY ARE CONDUCTIVE AND MAY SHORT-CIRCUIT THE COMMUTATOR BARS. NEVER USE OIL OR LUBRICANTS ON THE COMMUTATOR OR BRUSHES.

NOTE

- OIL ON THE COMMUTATOR MAY INDICATE A FAULTY TRANSAXLE INPUT SHAFT OIL SEAL.

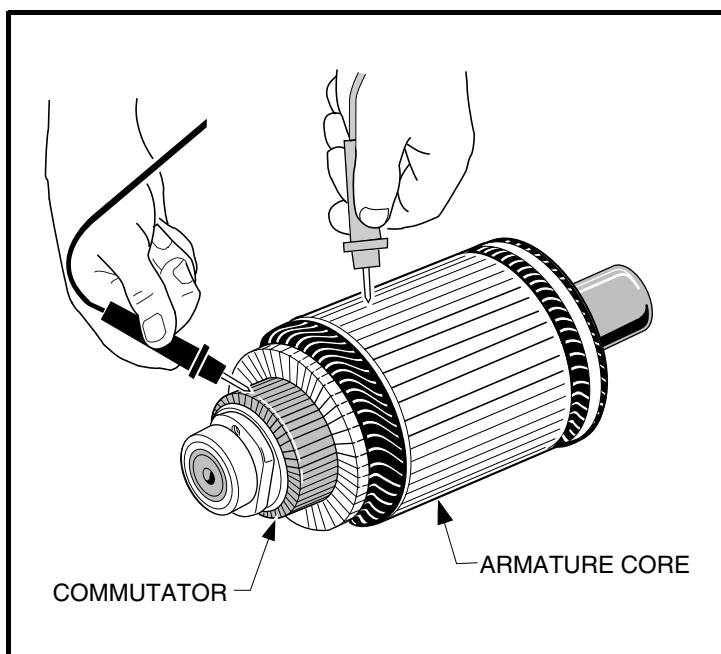
Armature Ground Test**⚠ CAUTION**

- DO NOT SUBMERGE THE ARMATURE IN SOLVENT.

NOTE

- BEFORE TESTING THE ARMATURE, WIPE IT CLEAN WITH A CLEAN CLOTH. REMOVE ANY CARBON DUST AND METAL PARTICLES FROM BETWEEN THE COMMUTATOR BARS.

1. With a multimeter set to 200 ohms, place one probe on the commutator and the other on the armature core. The multimeter should indicate no continuity (**Figure 15-7, Page 15-6**). If the reading is incorrect, replace the motor.

**Figure 15-7 Armature****FIELD WINDINGS**

Burned or scorched insulation on the field windings indicates the motor has overheated due to overloads or grounded or shorted coil windings. If the insulation on the field windings is scorched, replace the motor or the stator shell assembly.

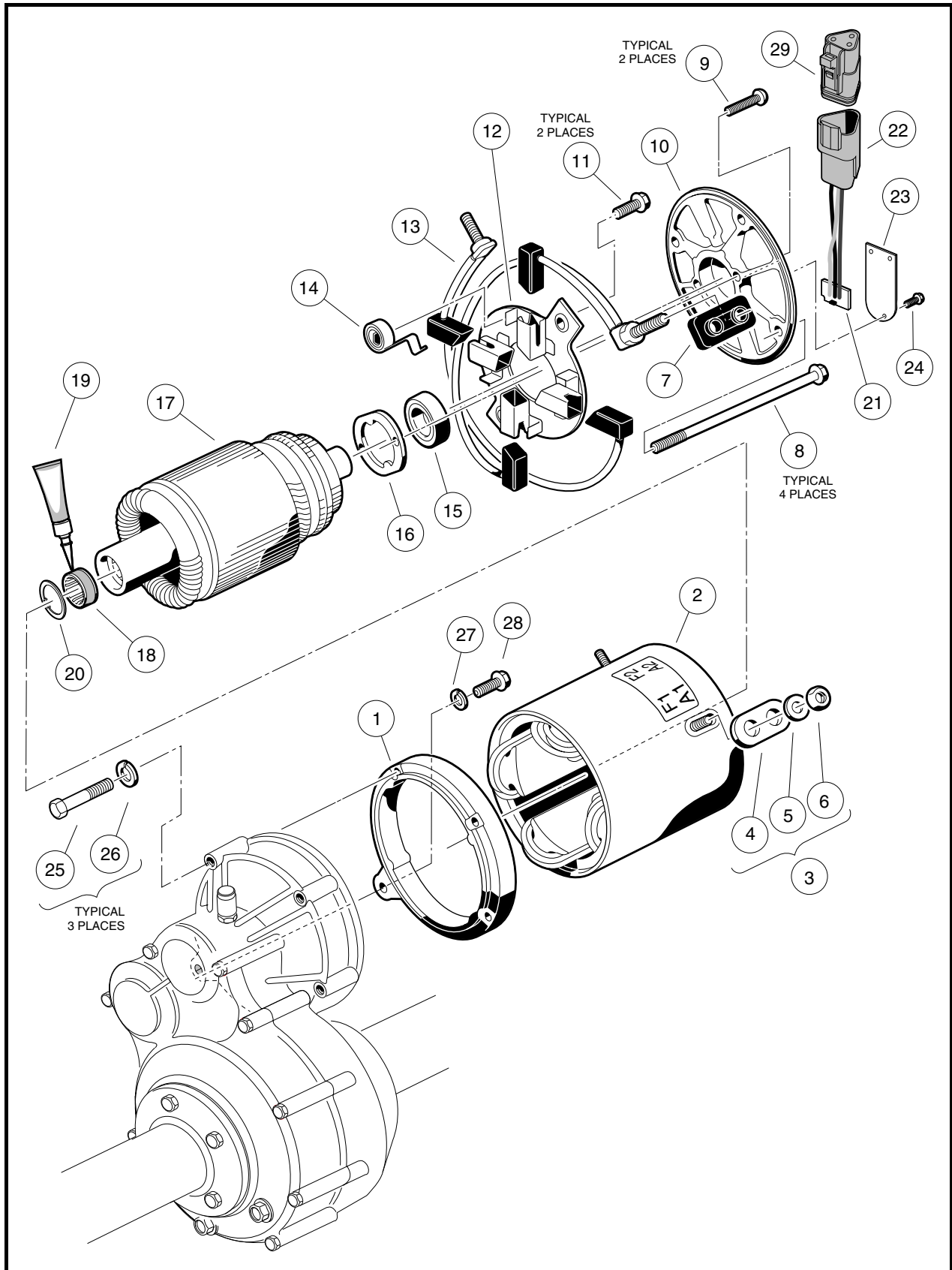


Figure 15-8 Motor

MOTOR COMPONENTS

1. Inspect the insulators (4 and 7) for cracks or other damage (**Figure 15-8, Page 15-7**).
2. Inspect the brushes (13) for damage or excessive wear (**Figure 15-8, Page 15-7**). If brushes need to be replaced, **see NOTE in step 2, page 15-10**.
3. Inspect the brush springs (14). Replace springs that are discolored from heat (light gold or blue tinted). Replace springs which apply a force of less than 16 oz. (**Figure 15-9, Page 15-8**).

CAUTION

- WHEN CHECKING BRUSH SPRING TENSION, DO NOT OVER-EXTEND THE SPRING. USING EXCESSIVE FORCE WILL DAMAGE THE SPRING.

BEARING INSPECTION

1. Using a clean cloth, wipe the carbon dust off of the bearing. Inspect the bearing by spinning it by hand and checking for both axial (A) and radial (B) play (**Figure 15-10, Page 15-8**).
2. Replace the bearing if it is noisy, does not spin smoothly, or has excessive play. Check the bearing and replace if rusted, worn, cracked, or if there is an abnormal color change in the metal of the bearing. Do not remove the bearing unless it is to be replaced.

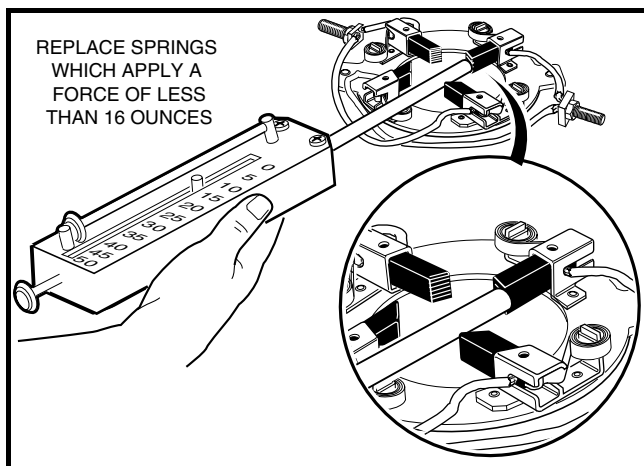


Figure 15-9 Check Brush Springs

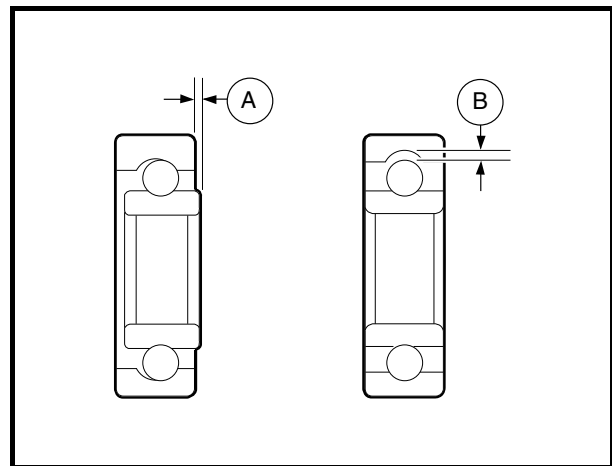


Figure 15-10 Inspect Bearing

BEARING REMOVAL

1. Place the wedge attachment tool (Club Car Part No. 1012812) between the bearing (15) and the armature (**Figures 15-8 and 15-12, Pages 15-7 and 15-11**). Make sure the wedge attachment tool is supporting the inner race of the bearing. If a press is not available, secure a bearing puller (Club Car Part No. 1012811) to the bearing and pull the bearing off of the end of the armature shaft. Support the shaft so it will not drop when the bearing is removed (**Figure 15-12, Page 15-11**). Discard the bearing.

GUIDE RING INSPECTION

NOTE

- FOR 1999 VEHICLES WITH SERIAL NUMBER 9912-752697 AND GREATER, THE GUIDE RING (18) AND SNAP RING (20) HAVE BEEN ELIMINATED (**FIGURE 15-8, PAGE 15-7**).

1. Insert the alignment and installation tool (**Figure 15-11, Page 15-9**) into the output end of the motor shaft and into the guide ring, stopping the tool before it reaches the armature splines. Turn the alignment tool in the shaft. If guide ring moves and armature does not move, the guide ring must be replaced (**Figure 15-11, Page 15-9**).

2. To fabricate a guide ring installation tool, glue a guide ring (Club Car Part No. 101789101) onto an input shaft (Club Car Part No. 1013764) and allow the glue to set (**Figure 15-11, Page 15-9**).

Guide Ring Removal

1. Using snap ring pliers, remove the snap ring (20) (**Figure 15-8, Page 15-7**).
2. Insert fingers of a seal puller (Club Car Part No. 1012809) through guide ring (18) (approximately 3/4 in. (19 mm) into the shaft). Turn the adjusting block to expand the fingers until they are wedged under the bottom edge of the guide ring. Remove the guide ring by quickly and forcefully sliding the ram up the tool shaft and against the stop (**Figure 15-13, Page 15-11**). The guide ring may also be removed using a small pry bar.

Guide Ring Installation

1. Coat the outside surface of the new guide ring with a thin film of guide ring adhesive (Club Car Part No. 101813201), then slide the guide ring onto the guide ring installation tool (**Figure 15-11, Page 15-9**) next to the guide ring already in place. Mating the splines of the input shaft with the splines in the armature shaft, insert the input shaft into the armature shaft until the new guide ring is seated against the end of the armature splines. Remove the guide ring installation tool from the armature. Make sure the guide ring remains seated.
2. After the guide ring is installed, allow the glue to set for 24 hours before installing the snap ring (20) and installing the motor onto the transaxle (**Figure 15-8, Page 15-7**).

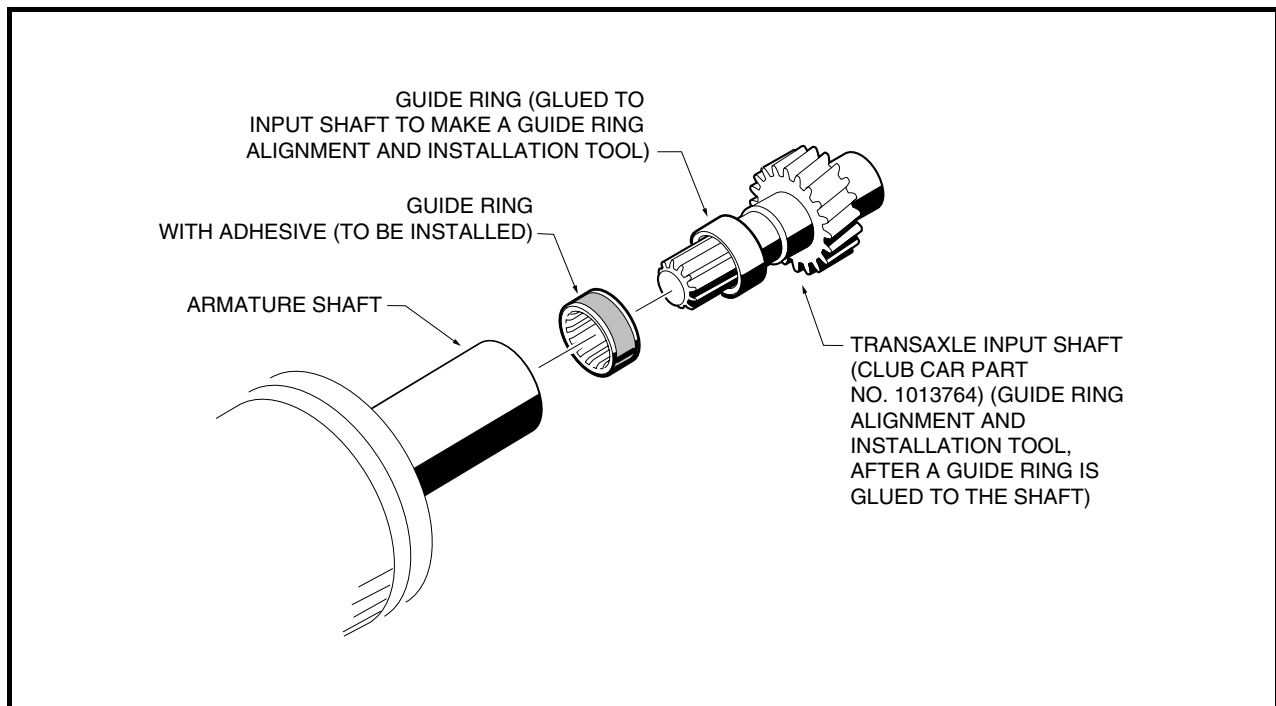


Figure 15-11 Guide Ring

RECONDITIONING THE MOTOR

Read DANGER and WARNING on page 15-1.

Motor reconditioning must be performed by a qualified motor repair technician. The use of proper tools and methods is absolutely essential for successful motor reconditioning.

Motor Specifications

Any rework must be performed by a qualified technician. Motor service specifications are listed in the table below.

ITEM	SERVICE LIMIT
Commutator diameter (minimum)	2.265 in. (66.675 mm)
Commutator concentric with armature shaft within	.001 in. (0.0508 mm)
Limit depth of cut when machining commutator	.005 in. (0.127 mm)
Bar to bar run out should not exceed	.0002 in. (.00508 mm)
If undercut of segment insulator is less than .016 in. (0.406 mm), it should be undercut to	.031 in. (0.8 mm)
Machined face of Commutator	8-16 micro in.
Field coil resistance (PowerDrive Plus 48 Volt, 3.20 Hp.)	1.32353 $\frac{3}{4}$

MOTOR ASSEMBLY

Read **DANGER** and **WARNING** on page 15-1.

1. If the bearing has been removed, replace the bearing:
 - 1.1. Press new bearing onto armature. Use an arbor press that exerts pressure on inner race only. **See following NOTE.**

NOTE

- MAKE SURE THE BEARING RETAINER (16) (**FIGURE 15-8, PAGE 15-7**) IS POSITIONED ON THE ARMATURE SHAFT BEFORE THE BEARING IS PRESSED ON.
- AN ARBOR WITH AN OUTSIDE DIAMETER OF LESS THAN 5/8 IN. (16MM) SHOULD BE USED TO PRESS THE BEARING ON.

2. Install the brushes. **See following NOTE.**

NOTE

- WHEN INSTALLING NEW BRUSHES, REMOVE AND REPLACE BRUSHES ONE AT A TIME. THIS METHOD ENSURES THE TERMINALS AND BRUSHES WILL BE PROPERLY POSITIONED IN THE RIGGING.
- WHEN REPLACING BRUSHES, REPLACE ALL FOUR BRUSHES. NEVER REPLACE ONLY TWO.
- INSTALL THE BRUSHES IN THE SAME RIGGING 180° APART FROM EACH OTHER.

3. With brush rigging (12) facing down and held slightly above stator shell (2), insert the two terminal posts through insulators in stator shell wall at the A1 and A2 positions. Insert brush holder screws (11) through the rubber sealed holes in the rigging and into the threaded holes in the mounting bracket (**Figure 15-8, Page 15-7**). Tighten the screws to 20 in.lb (2.2 N-m). **See also Figure 15-14, Page 15-13.**
4. One at a time, push brush spring extensions back from brushes and slide brushes back until they are completely retracted into their mounting slots. Then position brush springs against sides of brushes so spring pressure will hold them in the retracted position (**Figure 15-6, Page 15-5**).
5. Slide the armature, bearing end first, into the stator shell. Make sure the brushes are held back while positioning the armature for proper commutator/brush contact. Release the brushes and place the springs outside the brushes so the brushes are being held against the commutator. **See following CAUTION.**
6. Install end shield onto the stator shell.

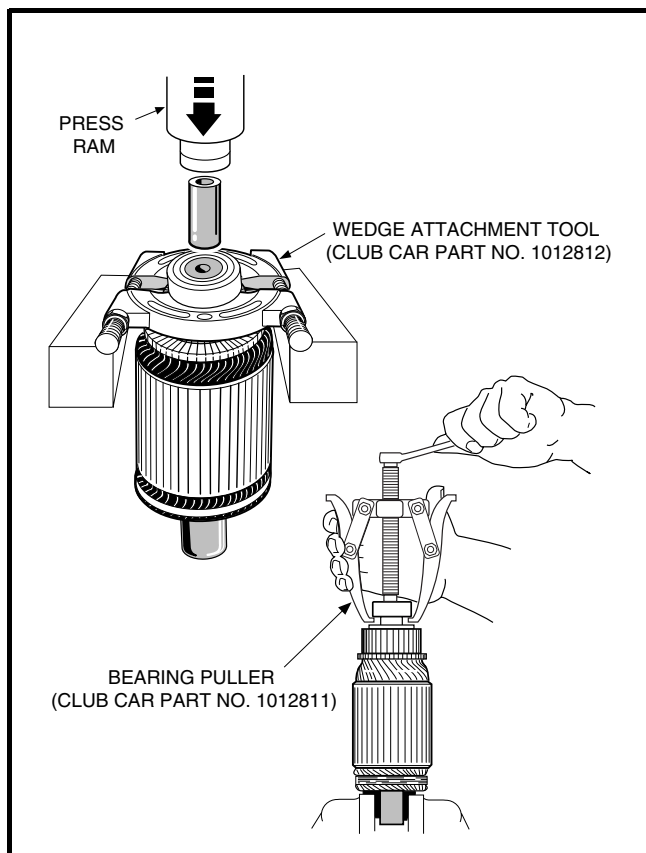


Figure 15-12 Bearing Removal

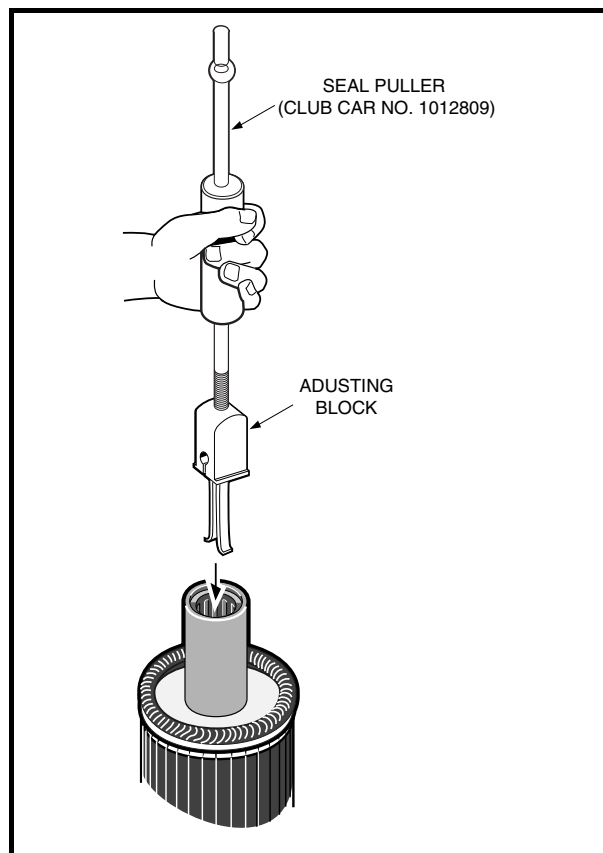


Figure 15-13 Guide Ring Removal

⚠ CAUTION

- IF THE MOTOR IS BEING ASSEMBLED WITH THE ARMATURE STANDING ON END AS THE COMMUTATOR IS POSITIONED, MAKE SURE THE BRUSHES ARE HELD BACK. DO NOT ALLOW THE BRUSHES TO SUPPORT THE WEIGHT OF THE STATOR SHELL. THE BRUSHES CAN BE EASILY DAMAGED BY THIS WEIGHT.

6.1. Attach the end shield (10) to bearing retainer (16) by aligning the two holes in the bearing retainer with the two mating holes in the end shield and installing the screws (9) (**Figure 15-8, Page 15-7**). Tighten the screws to 17 in.lb (1.9 N-m). **See following NOTE.**

NOTE

- USE A LONG SCREW WITH SAME THREAD SPECIFICATIONS AS MOUNTING SCREWS TO MAINTAIN HOLE ALIGNMENT WHILE STARTING FIRST MOUNTING SCREW (**FIGURE 15-15, PAGE 15-13**).

6.2. Align the match marks on the end shield and the stator shell, then install the four screws (8) (**Figure 15-8, Page 15-7**). Tighten the screws to 90 in.lb (10 N-m).

NOTE

- MAKE SURE THE MOTOR SPEED SENSOR LEAD LOCATED ON THE END SHIELD IS ALIGNED WITH THE F2 AND A2 TERMINALS ON THE MOTOR HOUSING.

Motor Assembly, Continued:

7. Make sure the armature turns freely. If it doesn't turn freely, disassemble the motor to find the problem. Make sure the bearing is properly seated in the end shield when assembling the motor.

MOTOR INSTALLATION**Read DANGER and WARNING on page 15-1.**

1. Apply Molykote G[®] lubricant to the female splines of the motor armature shaft.
2. Slide the motor onto the transaxle input shaft. Rotate the motor until the locating bolt mounting hole on the motor is aligned with its mounting hole in the transaxle case. Install the bolt (28) (thread in only a few turns) with lock washer (27) (**Figure 15-8, Page 15-7**). **See also Figure 15-16, Page 15-13.** Do not tighten the bolt at this time.
3. Install, but do not tighten the three 1/4-20 bolts (25) with lock washers (26) that mount the motor to the transaxle (**Figure 15-8, Page 15-7**). **See following CAUTION.**

CAUTION

- MAKE SURE THE MOTOR IS PROPERLY SEATED IN THE TRANSAXLE HOUSING.

4. Finger tighten the four bolts, moving from bolt (C) to bolts (A, B, and D) until the motor is seated. With one wheel jacked up so it is off the ground, rotate the axle to make sure the motor is not binding on the transaxle input shaft (**Figure 15-17, Page 15-13**).
5. Tighten lower 1/4 in. bolt (C). Next, tighten bolt (A), then tighten center bolt (B) at the top. Tighten bolts to 65 in.lb (7.3 N-m). Tighten the 5/16 in. bolt (D) to 155 in.lb (17.5 N-m) (**Figure 15-17, Page 15-13**).
6. Install the motor wires. Make sure they are connected to the correct terminals. Tighten the terminal retaining nuts to 65 in.lb (7.3 N-m). **See following NOTE.**

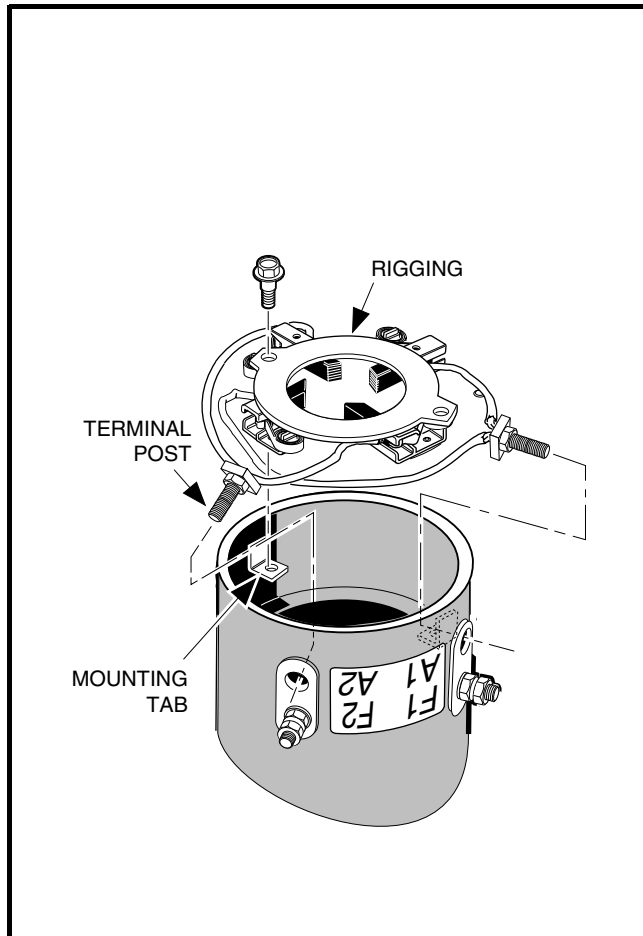
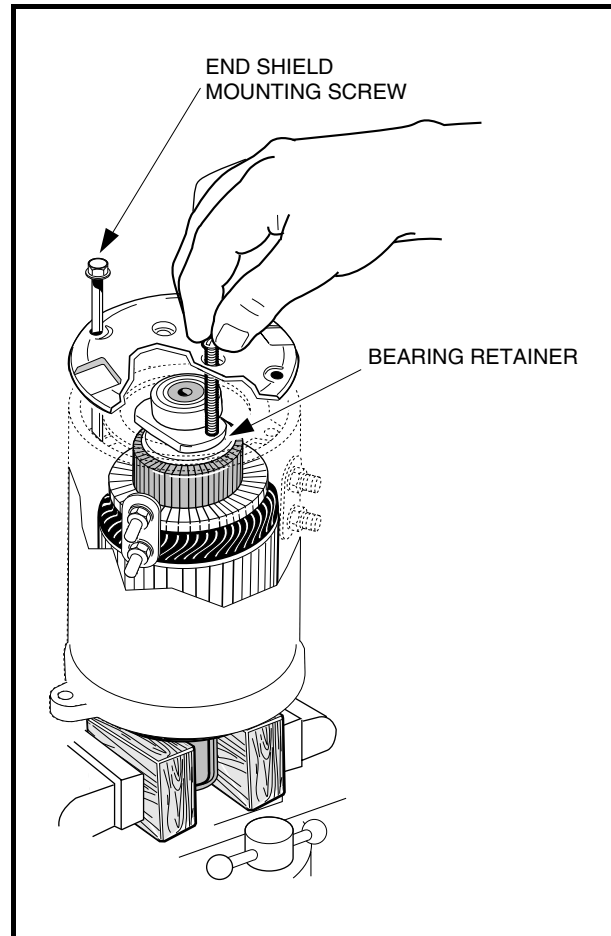
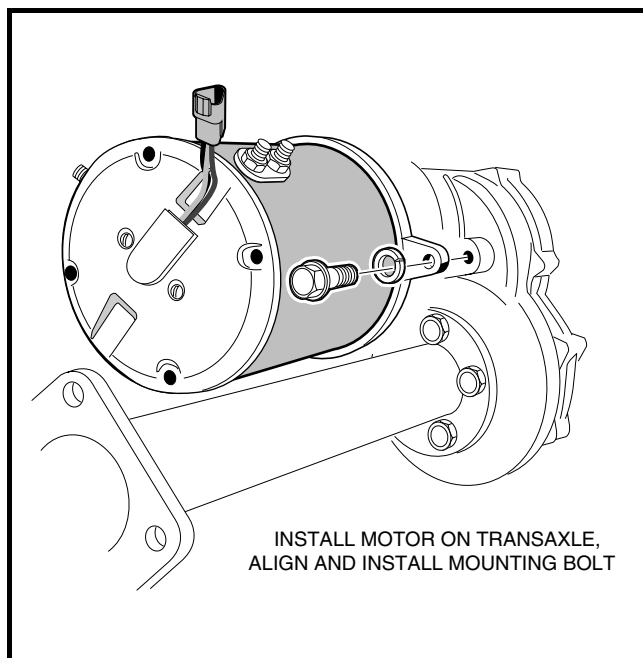
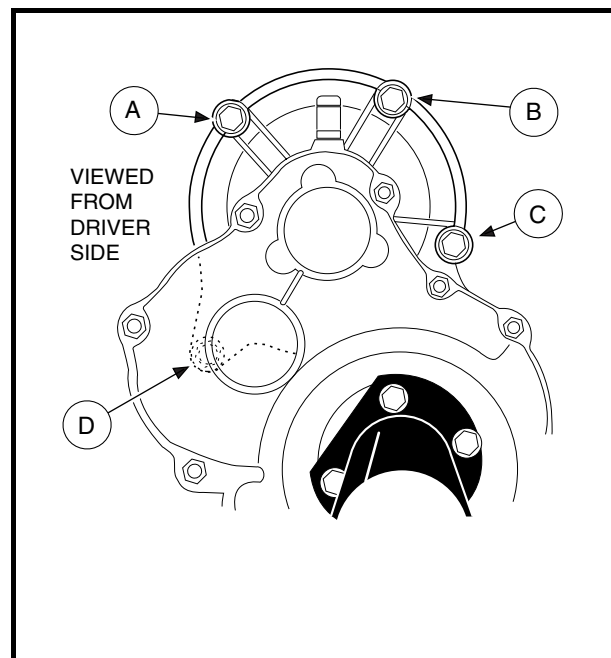
NOTE

- THE MOTOR WIRES SHOULD HAVE BEEN TAGGED FOR IDENTIFICATION WHEN THEY WERE DISCONNECTED. IF THE WIRES WERE NOT TAGGED, SEE WIRING DIAGRAM IN **SECTION 11, FIGURE 11-1, PAGE 11-2**.

7. If using a chain hoist, lower the vehicle and guide the leaf springs into the shackles. If using a floor jack, raise the transaxle until the leaf springs can be guided into the shackles.
8. Insert mounting bolts through spring shackles and bushings in leaf spring eyes and install lock nuts. Tighten bolts to 23 ft.lb (31 N-m). **See Section 9–Rear Suspension in the Maintenance and Service Manual.**
9. Install the shock absorbers. Tighten nut until rubber bushing expands to the size of the cup washer.
10. If removed, reinstall wheels. **See Section 8–Wheels and Tires in the Maintenance and Service Manual.** Tighten lug nuts to 55 ft.lb (74.6 N-m).
11. Connect the battery cables (positive cable first). Tighten cables to 110 in.lb (12.4 N-m) (**Figure 15-1, Page 15-2**). Coat terminals with Batter Protector Spray (Club Car Part No. 1014305) to minimize corrosion. Place Tow switch in the RUN position.

MOTOR SPEED SENSOR**Read DANGER and WARNING on page 15-1.****Testing the Motor Speed Sensor**

See Test Procedure 14, Section 11, Page 11-19.

**Figure 15-14 Brush Installation****Figure 15-15 End Shield Installation****Figure 15-16 Motor Installation****Figure 15-17 Motor Mount**

Motor Speed Sensor Removal

1. Place Tow/Run switch in the TOW position and disconnect battery cables (**Figure 15-1, Page 15-2**).
2. Disconnect the three-pin connector (22) (**Figure 15-18, Page 15-14**).
3. Remove the three retaining screws (24) from the retaining plate (23) located on the motor end shield (10) (**Figure 15-18, Page 15-14**).
4. Remove motor speed sensor (21) from recessed area on motor (**Figure 15-18, Page 15-14**).

Motor Speed Sensor Installation

1. Position the motor speed sensor (21) in the recessed area on the motor. Sensor should fit flush against the motor (**Figure 15-18, Page 15-14**).
2. Position retaining plate (23) over motor speed sensor and align the three retaining plate holes with motor end shield holes. Install three retaining screws (24) (**Figure 15-18, Page 15-14**).
3. Reconnect the three-pin connector (22) (**Figure 15-18, Page 15-14**).
4. Reconnect battery cables (positive cable first) and tighten to 110 in.lb (12.4 N-m). Coat terminals with Batter Protector Spray (Club Car Part No. 1014305) to minimize corrosion. Place Tow/Run switch in the RUN position (**Figure 15-1, Page 15-2**).

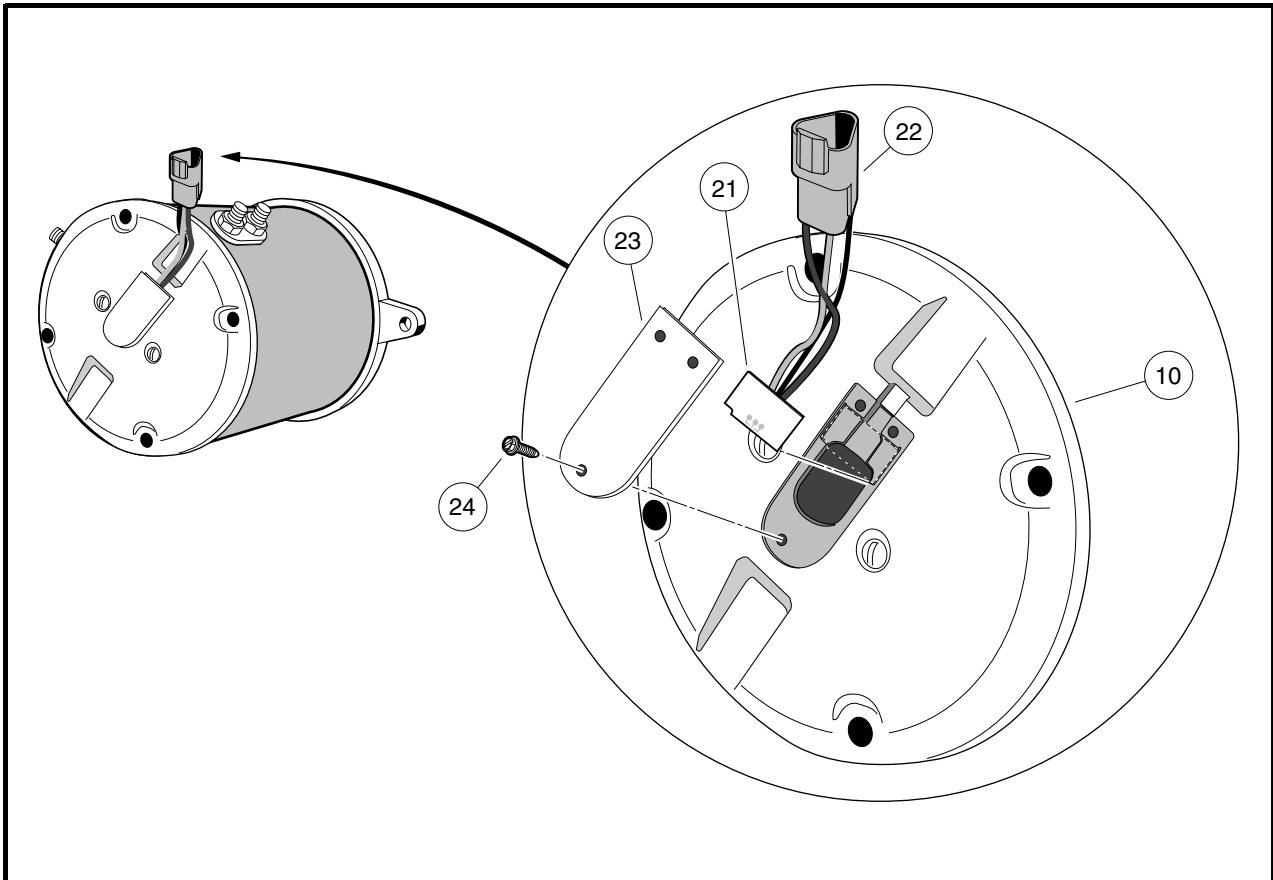


Figure 15-18 Installing the Motor Speed Sensor

DANGER

- **BATTERY - EXPLOSIVE GASES! DO NOT SMOKE. KEEP SPARKS AND FLAMES AWAY. VENTILATE WHEN CHARGING OR USING IN AN ENCLOSED SPACE. ALWAYS WEAR FULL FACE SHIELD WHEN WORKING ON OR NEAR BATTERIES.**
- **USE EXTREME CAUTION WHEN USING TOOLS, WIRES, OR METAL OBJECTS NEAR BATTERIES! A SHORT CIRCUIT AND (OR) SPARK COULD CAUSE AN EXPLOSION.**
- **BATTERY - POISON! CONTAINS ACID! CAUSES SEVERE BURNS. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. ANTIDOTES:**
 - **EXTERNAL: FLUSH WITH WATER. CALL A PHYSICIAN IMMEDIATELY.**
 - **INTERNAL: DRINK LARGE QUANTITIES OF MILK OR WATER. FOLLOW WITH MILK OF MAGNESIA OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.**
 - **EYES: FLUSH WITH WATER FOR FIFTEEN MINUTES. CALL PHYSICIAN IMMEDIATELY.**

WARNING

- ONLY TRAINED MECHANICS SHOULD REPAIR OR SERVICE THIS VEHICLE. ANYONE DOING EVEN SIMPLE REPAIRS OR SERVICE SHOULD HAVE KNOWLEDGE AND EXPERIENCE IN GENERAL ELECTRICAL AND MECHANICAL REPAIR. FOLLOW ALL PROCEDURES EXACTLY AND HEED ALL WARNINGS STATED IN THIS MANUAL.
- WEAR SAFETY GLASSES OR APPROVED EYE PROTECTION WHILE SERVICING VEHICLE.
- TURN KEY SWITCH **OFF**, PLACE FORWARD/REVERSE ROCKER SWITCH IN THE **NEUTRAL** POSITION, AND REMOVE KEY BEFORE SERVICING THE VEHICLE.
- MOVING PARTS! - DO NOT ATTEMPT TO SERVICE THE VEHICLE WHILE IT IS RUNNING.
- USE INSULATED TOOLS WHEN WORKING NEAR BATTERIES OR ELECTRICAL CONNECTIONS.
- LIFT ONLY ONE END OF THE VEHICLE AT A TIME. BEFORE LIFTING, LOCK THE BRAKES AND CHOCK THE WHEELS THAT REMAIN ON THE FLOOR. USE A SUITABLE LIFTING DEVICE (CHAIN HOIST OR HYDRAULIC FLOOR JACK) WITH 1000 LBS. (454 KG.) MINIMUM LIFTING CAPACITY. DO NOT USE LIFTING DEVICE TO HOLD VEHICLE IN RAISED POSITION. ALWAYS USE APPROVED JACKSTANDS OF PROPER WEIGHT CAPACITY TO SUPPORT THE VEHICLE.
- TO AVOID UNINTENTIONALLY STARTING VEHICLE, PLACE TWO SWITCH IN **TOW**, THEN DISCONNECT BATTERIES AS SHOWN IN **SECTION 11, FIGURE 11-9, PAGE 11-10** AND DISCHARGE THE CONTROLLER AS FOLLOWS:
 - TURN KEY SWITCH **ON**, PLACE FORWARD/REVERSE ROCKER SWITCH IN **REVERSE**.
 - SLOWLY DEPRESS THE ACCELERATOR PEDAL AND KEEP IT DEPRESSED UNTIL THE REVERSE WARNING BUZZER CAN NO LONGER BE HEARD. WHEN THE BUZZER STOPS SOUNDING, THE CONTROLLER IS DISCHARGED.

GENERAL INFORMATION

There are two types of transaxles used in the manufacture of the electric vehicle. The different transaxles are identified by the orientation of the gear case bolts. The Type G transaxle has gear case bolt heads toward the passenger side of the vehicle. The Type K transaxle has gear case bolt heads toward the driver side of the vehicle. Please note the parts used in these transaxles are not interchangeable with one another. Service and repair procedures specific to each transaxle are noted throughout this section.

LUBRICATION

There are two plugs located on the lower half of the transaxle housing. The upper plug (as viewed when the vehicle is on a level surface), is used as a lubricant level indicator. When the vehicle is parked on a level surface, the lubricant level should be even with the bottom of the hole. The lower plug is for draining the lubricant.

When draining the lubricant, the upper plug should be removed so the lubricant will drain faster. Be sure the drain plug is reinstalled before refilling.

NOTE

- RECYCLE OR DISPOSE OF USED OIL OR LUBRICANT IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

AXLE SHAFT AND BEARING

Read DANGER and WARNING on page 16-1.

AXLE SHAFT

Axle Shaft and Oil Seal Removal

1. Place chocks at the front wheels. Loosen lug nuts on rear wheels and lift the rear of the vehicle with a chain hoist or floor jack. Place jackstands under the axle tubes to support the vehicle.
2. Remove the rear wheel and brake drum. **See Section 6–Wheel Brake Assemblies and Section 8–Wheels and Tires in the Maintenance and Service Manual.**
3. Using 90° internal snap ring pliers, remove the internal retaining ring (6) from the axle tube (**Figures 16-4 or 16-5, Pages 16-4 or 16-5**). **See also Figure 16-1, Page 16-3.**
4. Remove the axle, retaining ring, and bearing assembly by pulling the axle straight out of the housing.
5. Use a 16 in. (40 cm) rolling wedge bar (**Figure 16-2, Page 16-3**) to remove oil seal. Insert the wedge bar underneath the seal lip and pry out oil seal (**Figure 16-3, Page 16-3**). **See following CAUTION.**

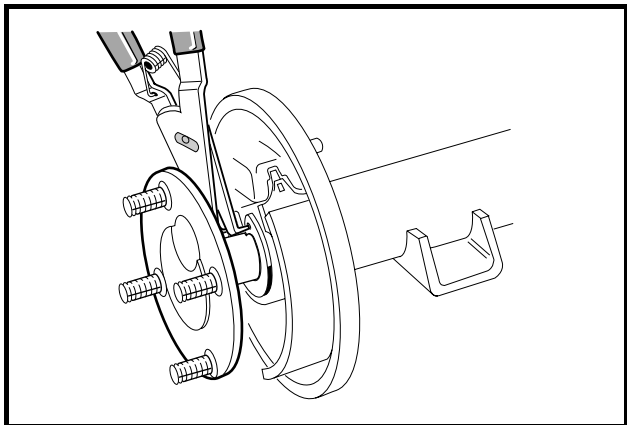


Figure 16-1 Axle Tube

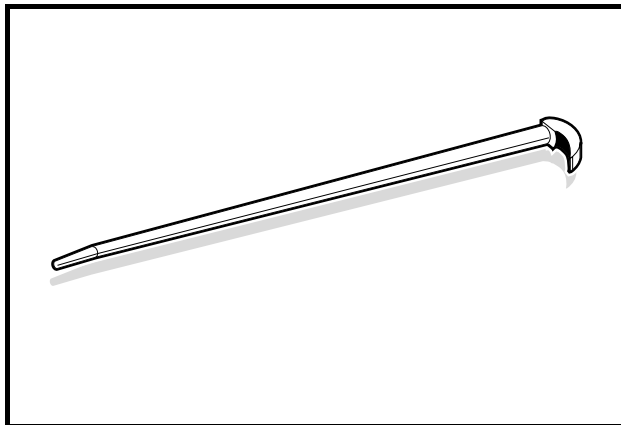


Figure 16-2 Rolling Wedge Bar

⚠ CAUTION

- DO NOT SCAR OR DAMAGE THE INSIDE SURFACES OF THE TUBE WHEN REMOVING THE OIL SEAL. A DAMAGED TUBE MIGHT HAVE TO BE REPLACED.

6. Inspect the axle shaft assembly to be sure the bearing and collar have not slipped and are still seated against the shoulder on the axle shaft.
7. Inspect bearing (5) (**Figure 16-4, Page 16-4 or Figure 16-5, Page 16-5**). If the bearing in a Type K transaxle is worn or damaged, replace bearing. If the bearing in a Type G transaxle is worn or damaged, see following NOTE at Axle Bearing.

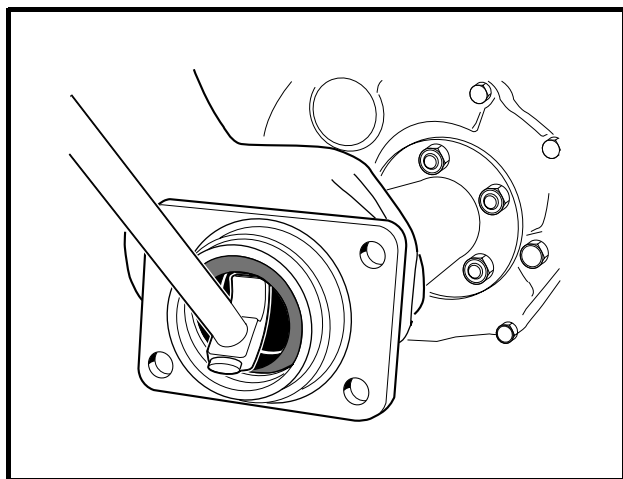


Figure 16-3 Seal Lip

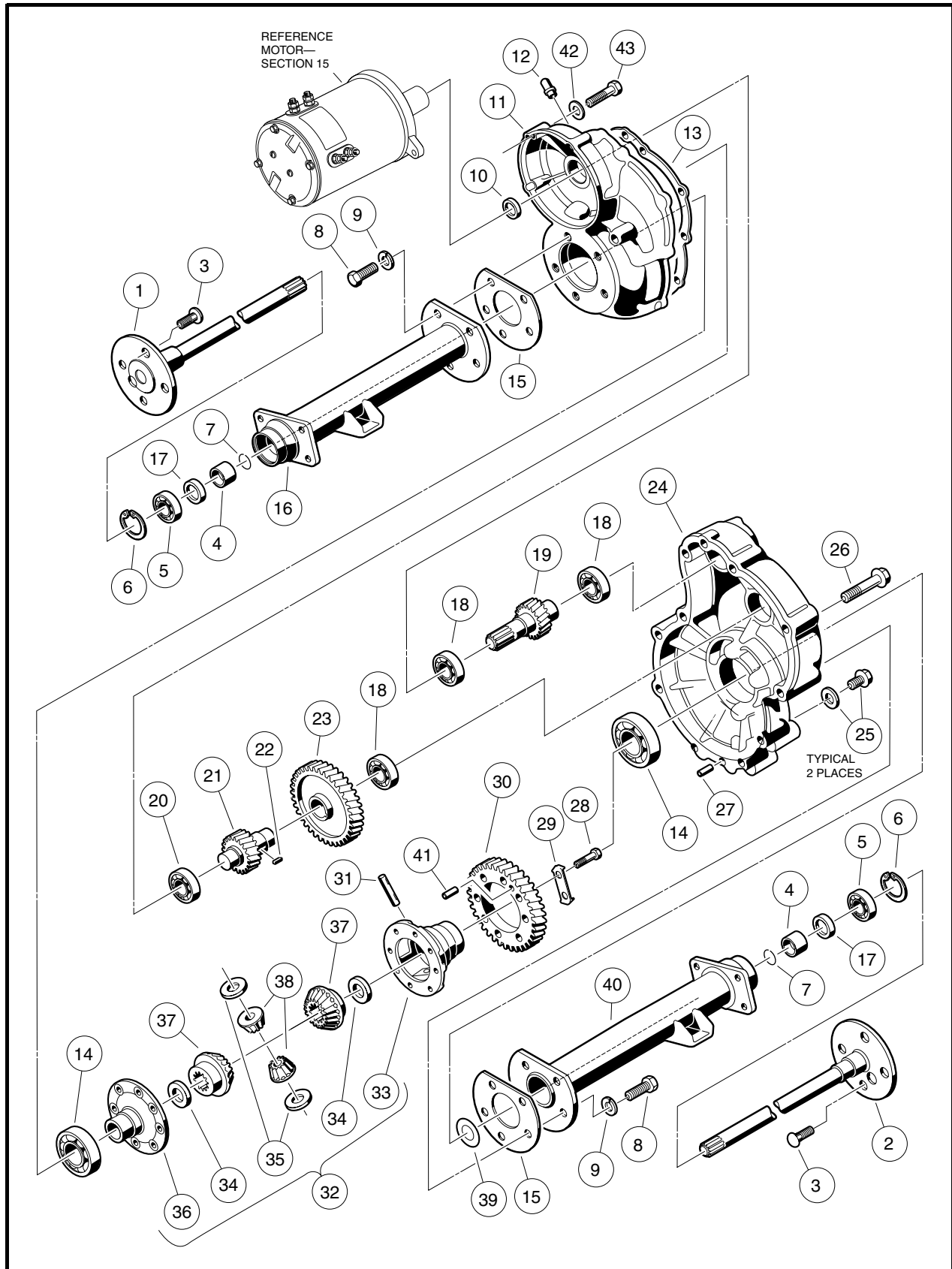


Figure 16-4 Transaxle - Type K

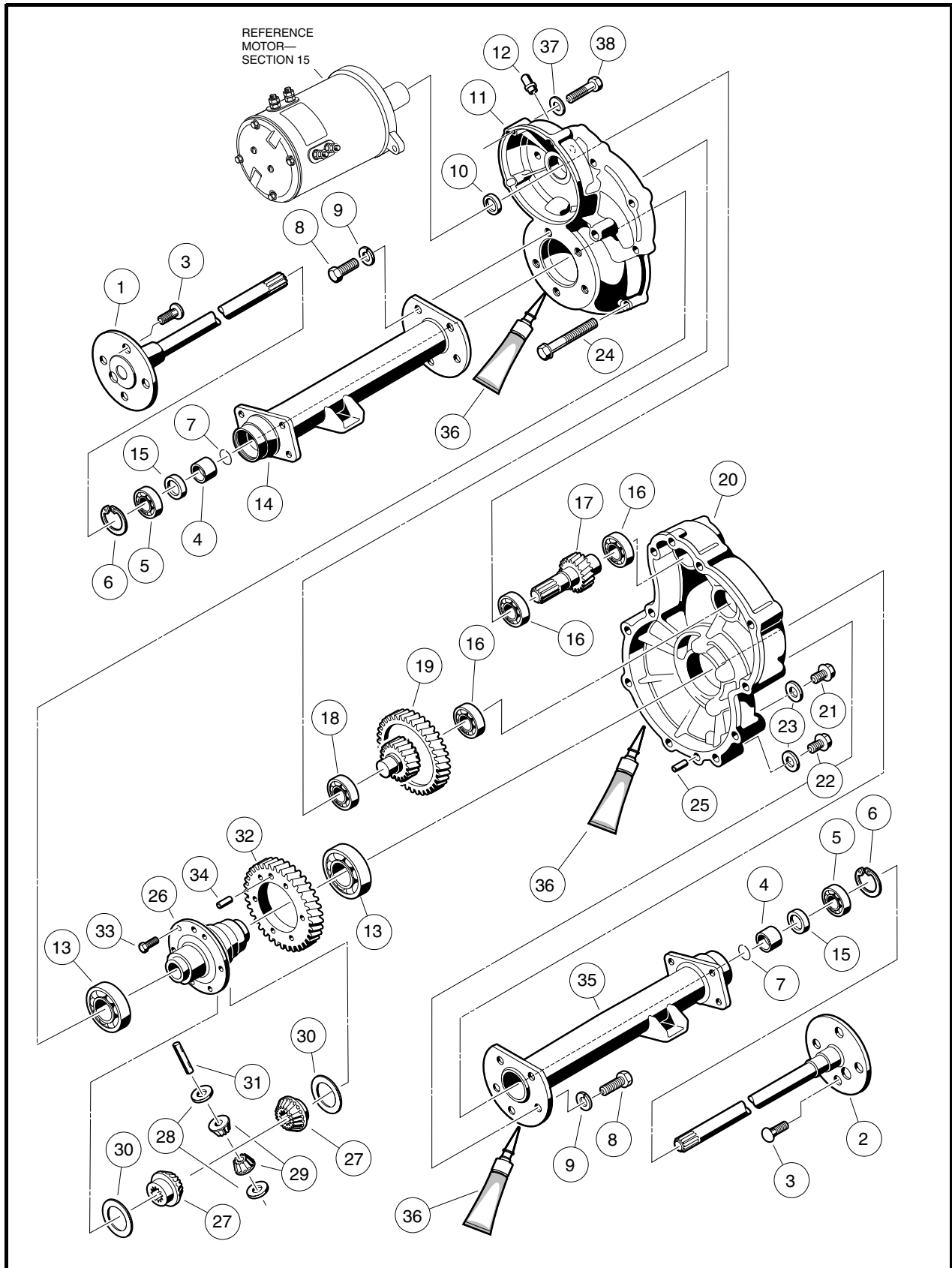


Figure 16-5 Transaxle - Type G

AXLE BEARING**NOTE**

- DO NOT REMOVE AXLE BEARING FROM A TYPE G TRANSAXLE. IF BEARING IS WORN OR DAMAGED, THE ENTIRE AXLE ASSEMBLY (1 OR 2) MUST BE REPLACED (**FIGURE 16-5, PAGE 16-5**).

Axle Bearing Removal (Type K Transaxle Only)

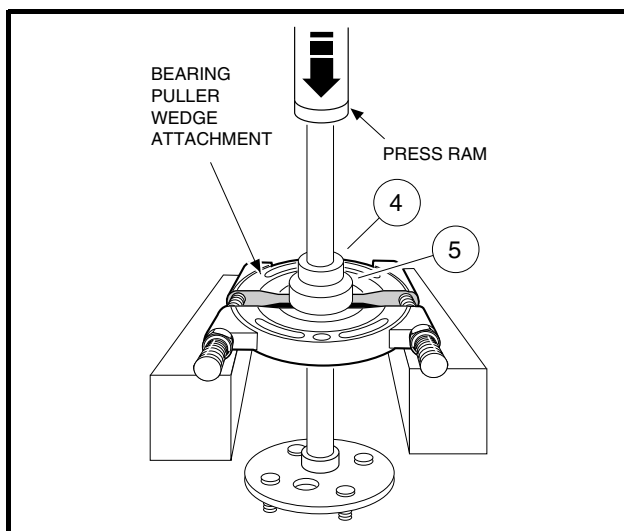
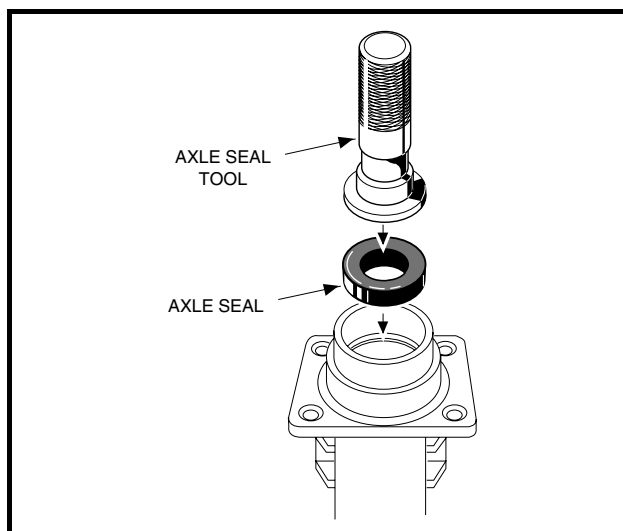
1. Remove the retaining ring (7) from the axle shaft (**Figure 16-4, Page 16-4**).
2. Place a bearing puller wedge attachment (Club Car Part No. 1012812) on the axle shaft between the wheel mounting flange and the bearing.
3. Press bearing (5) and collar (4) off together (**Figure 16-6, Page 16-6**).

CAUTION

- DO NOT TIGHTEN THE BEARING PULLER WEDGE ATTACHMENT AGAINST THE AXLE SHAFT. THIS COULD DAMAGE THE AXLE SHAFT WHEN PRESSING OFF THE BEARING AND COLLAR.

NOTE

- IT MAY BE NECESSARY TO HEAT THE COLLAR BEFORE THE COLLAR CAN BE REMOVED.

**Figure 16-6 Bearing and Collar****Figure 16-7 Axle Seal Tool**

Axle Bearing Installation (Type K Transaxle Only)

1. If removed, place retaining ring (6) on axle shaft (1 or 2) (**Figure 16-4, Page 16-4**). The retaining ring will be loose on the axle shaft until it is installed into the axle tube.
2. Apply two drops of Loctite® 271 to the inside of the collar.

CAUTION

- APPLY LOCTITE 271® TO INSIDE OF COLLAR ONLY, NOT TO THE SHAFT, SO THE LOCTITE WILL BE PUSHED AWAY FROM THE BEARING AS THE COLLAR AND BEARING ARE PRESSED ON. IF LOCTITE GETS ON OR IN THE BEARING, THE BEARING MUST BE REPLACED.
- THE COLLAR SHOULD BE REMOVED NO MORE THAN TWO TIMES. IF A BEARING IS REMOVED A THIRD TIME, THE SHAFT AND COLLAR WILL NOT GIVE A PROPER FIT.

3. Place the bearing and the collar on the shaft (note, this is a sealed bearing). **See following CAUTION.**

CAUTION

- IF THE BEARING WAS REMOVED FROM THE SHAFT, REPLACE BEARING WITH A NEW ONE.

4. Place the bearing puller wedge attachment against the collar and press on both the bearing and collar. **See CAUTION on page 16-6.**
5. Install retaining ring (7) into the groove on the axle shaft (**Figure 16-4, Page 16-4**).

Axle Shaft and Oil Seal Installation

1. Clean bearing and seal seats in the axle tube (16 or 40) (**Figure 16-3, Page 16-3**) or (14 or 35) (**Figure 16-5, Page 16-5**).
2. Place new seal (17) (**Figure 16-4, Page 16-4**) or (15) (**Figure 16-5, Page 16-5**) in axle tube with seal lip facing away from the bearing. Use an axle seal tool (Club Car Part No. 1014162) and mallet to tap it in until it seats firmly in position (**Figure 16-7, Page 16-6**). A hydraulic press may also be used with the axle seal tool.
3. Clean the shaft splines and then insert the shaft, splined end first, through the seal and into the axle tube. Be careful not to damage the seal. Then advance the shaft through the inner bearing and rotate it to align the shaft splines with the splined bore of the differential side gear. Continue advancing the shaft until the bearing seats against the axle tube shoulder.
4. Using snap ring pliers, install retaining ring (6) inside axle tube (**Figure 16-4 or 16-5, Pages 16-4 or 16-5**).

NOTE

- **TYPE G TRANSAXLES:** IF RETAINING RING (6) MUST BE REPLACED, THE ENTIRE AXLE SHAFT ASSEMBLY (1 OR 2) MUST BE REPLACED (**FIGURE 16-5, PAGE 16-5**).

5. Place a 1/4 in. to 3/8 in. (6 to 10 mm) diameter rod against the retaining ring and tap lightly at four to five locations around the retaining ring to ensure it is properly seated.

WARNING

- BE SURE THE RETAINING RING IS PROPERLY SEATED IN ITS GROOVE. IF THE RING IS NOT PROPERLY INSTALLED, THE AXLE ASSEMBLY WILL SEPARATE FROM THE TRANSAXLE AND DAMAGE THE AXLE ASSEMBLY AND OTHER COMPONENTS. LOSS OF VEHICLE CONTROL COULD RESULT, CAUSING SEVERE PERSONAL INJURY.

TRANSAXLE

Read **DANGER** and **WARNING** on page 16-1.

TRANSAXLE REMOVAL

1. Place chocks at the front wheels and slightly loosen lug nuts on both rear wheels.
2. Place a floor jack under the transaxle and raise the rear of the vehicle. Position jackstands under the frame cross-member between the spring mount and the side stringer, just forward of each rear wheel. Lower the vehicle to let the jackstands support the vehicle (**Figure 16-8, Page 16-8**).
3. Remove rear wheels, then thread one lug nut onto stud on each rear hub. This will keep brake drums on hubs.
4. Remove the cotter pins (1), brake cable clevis pins (2), and cable retaining E-clips (3). Disconnect the brake cables (4) (**Figure 16-9, Page 16-8**).
5. Disconnect the shock absorbers from their lower mounts (**Figure 16-10, Page 16-8**).
6. Disconnect the four motor wires. Use two wrenches to prevent the studs from turning.
7. With a floor jack supporting the transaxle, remove lower spring shackle nuts and bolts. Position shackles so they are clear of springs (**Figure 16-11, Page 16-8**).

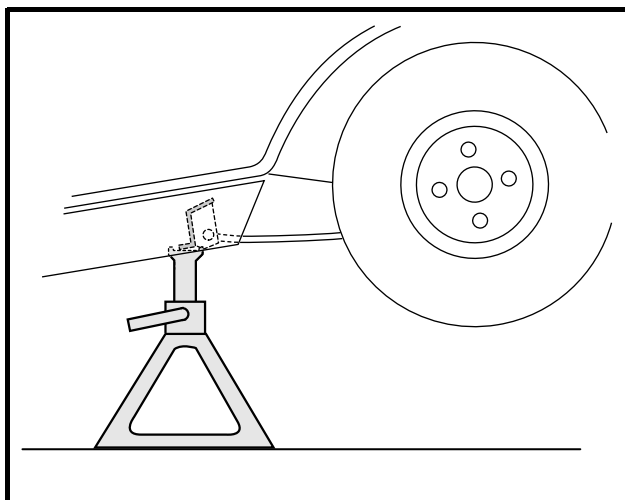


Figure 16-8 Support Vehicle on Jackstands

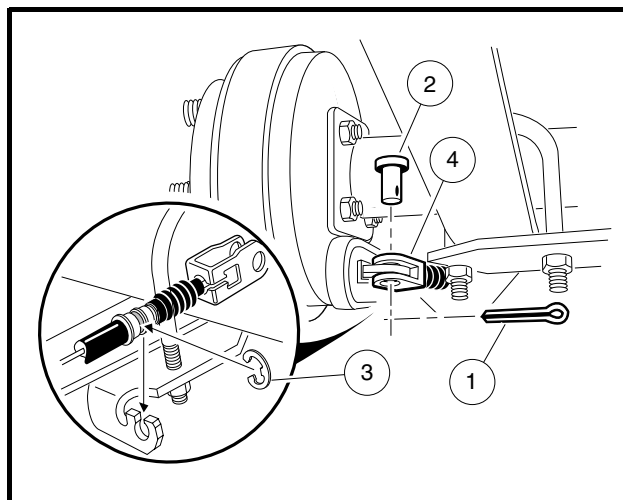


Figure 16-9 Disconnect Brakes

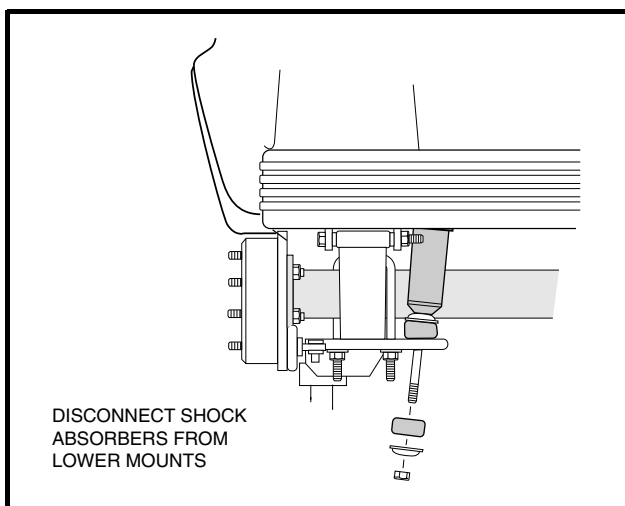


Figure 16-10 Disconnect Shocks

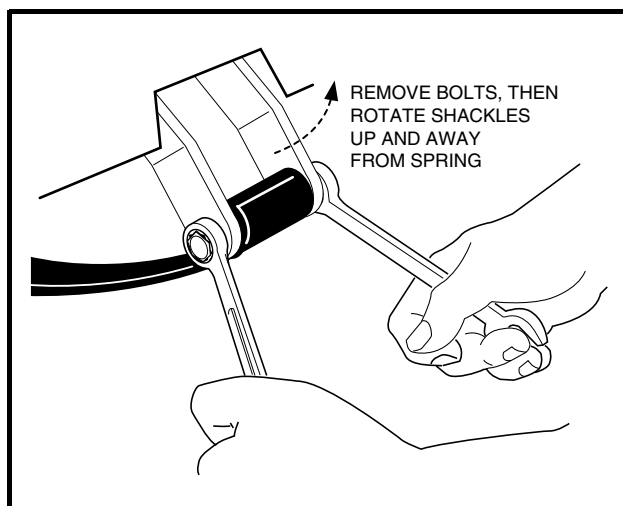


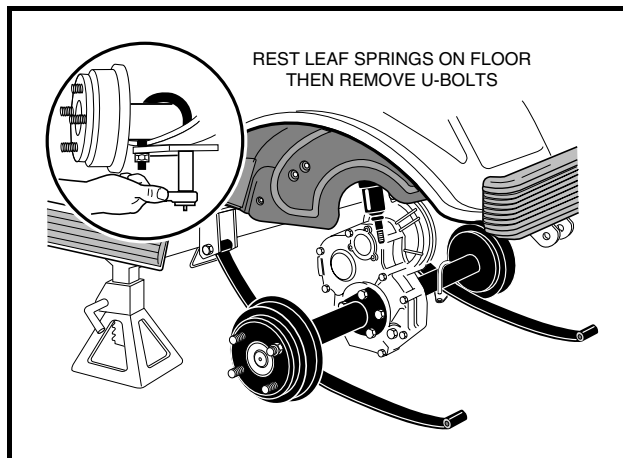
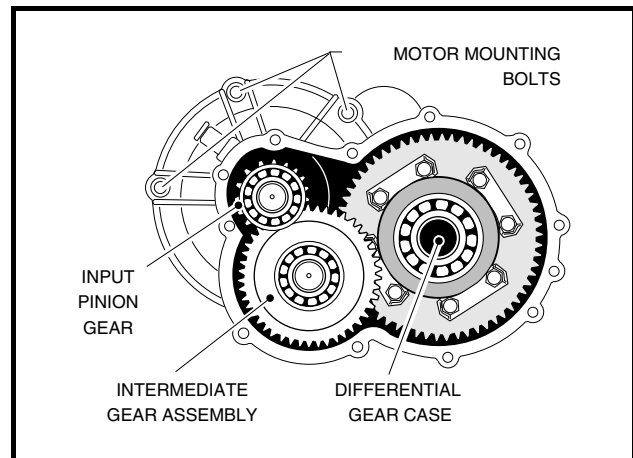
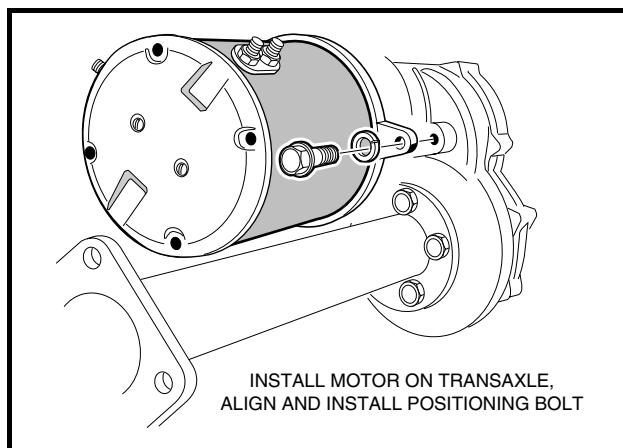
Figure 16-11 Shackles

Transaxle Removal, Continued:

8. If a chain hoist was used to raise the vehicle, lift the vehicle high enough to permit easy access and clearance for removal of the motor. If a floor jack was used to raise the vehicle, lower the transaxle enough to permit easy access and clearance for removal of the motor.
9. Remove three motor mounting bolts (**Figure 16-13, Page 16-8**), and the motor positioning bolt (**Figure 16-21, Page 16-12**), mounting the motor to the transaxle.

⚠ WARNING

- MOTOR WEIGHS APPROXIMATELY 42 LBS. USE CARE WHEN SLIDING MOTOR OFF INPUT SHAFT IN STEP 9. FINGERS MAY GET PINCHED WHEN MOTOR DISENGAGES.

**Figure 16-12 Leaf Springs****Figure 16-13 Motor Mounting Bolts****Figure 16-14 Motor Positioning Bolt**

10. Carefully remove the motor from the transaxle. Slide the motor away from the transaxle until the motor spline becomes disengaged from the input shaft, then lift motor out. **See preceding WARNING.**
11. If a floorjack was used, pull floorjack from beneath the transaxle and allow the springs to rest on the floor.
12. Remove the U-bolts attaching the transaxle to the leaf springs (**Figure 16-12, Page 16-9**).
13. Carefully lift each end of the transaxle off its positioning pin (on the leaf spring) and slide the transaxle to the rear and out of the vehicle.
14. If removal of the brake assemblies is required, see Section 6–Wheel Brake Assemblies in the 1998/1999 DS Vehicle Maintenance and Service Manual.

TRANSAXLE DISASSEMBLY, INSPECTION AND ASSEMBLY

Read **DANGER** and **WARNING** on page 16-1.

TRANSAXLE DISASSEMBLY AND INSPECTION

1. To detach axle tubes (16 and 40) (**Figure 16-4, Page 16-4**) or (14 and 35) (**Figure 16-5, Page 16-5**) from transaxle housing, remove bolts and lock washers (8 and 9) (**Figure 16-4 or 16-5**). See following **NOTE**.

NOTE

- **TYPE K TRANSAXLES ONLY:** SHIMS ARE LOCATED BETWEEN THE DRIVER SIDE AXLE TUBE AND DIFFERENTIAL CASE BEARING. DO NOT DAMAGE SHIMS. IF SHIMS ARE REMOVED, SET THEM ASIDE FOR REINSTALLATION.

2. Remove 10 bolts (26) (**Figure 16-4, Page 16-4**) or 11 bolts, (24) (**Figure 16-5, Page 16-5**) that hold housing together.
3. Pull the halves of the housing apart. If necessary, tap lightly on the spline of the input pinion.

CAUTION

- TO PREVENT DAMAGE TO THE HOUSING MATING SEAL SURFACES, USE CAUTION WHEN SEPARATING HALVES.

4. Remove input pinion gear (19) (**Figure 16-4, Page 16-4**) or (17) (**Figure 16-5, Page 16-5**) by pulling gear out while rocking intermediate gear assembly. Lift intermediate gear assembly and differential gear case unit out simultaneously.

CAUTION

- DO NOT DAMAGE GEARS. USE EXTREME CARE WHEN HANDLING THEM.

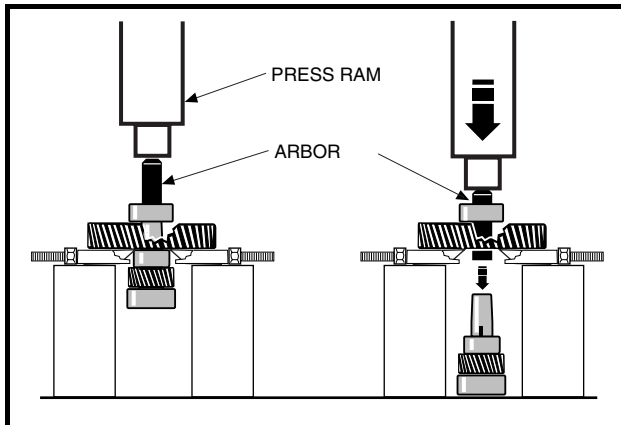


Figure 16-15 Intermediate Gear Assembly

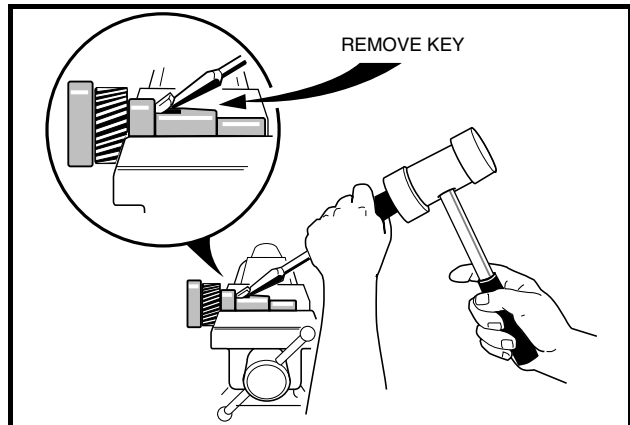


Figure 16-16 Remove Key

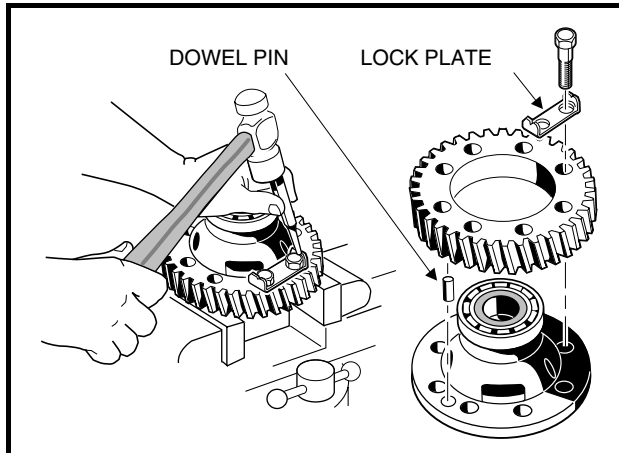
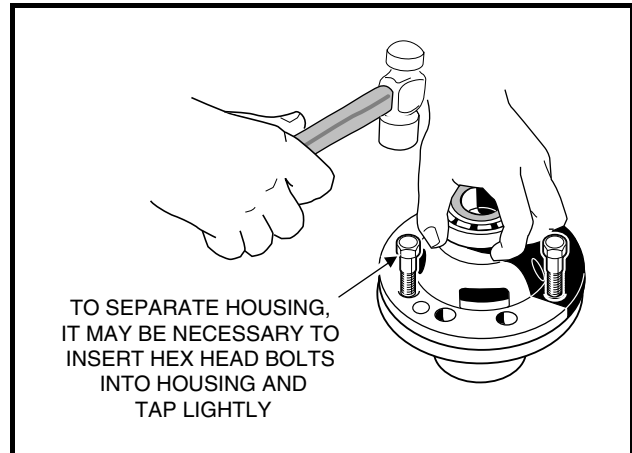
5. Use a bearing puller or arbor press to remove bearings (18) (**Figure 16-4, Page 16-4**) or (16) (**Figure 16-5, Page 16-5**) from the input pinion gear. If the oil seal (10) is damaged, replace it (**Figures 16-4 or 16-5, Pages 16-4 or 16-5**). See also **Figure 16-15, Page 16-10**.

CAUTION

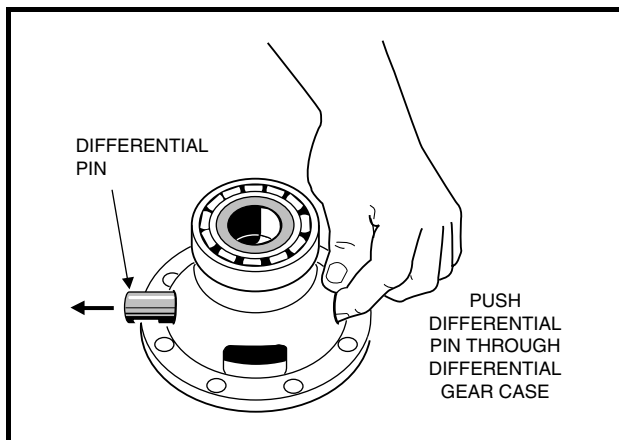
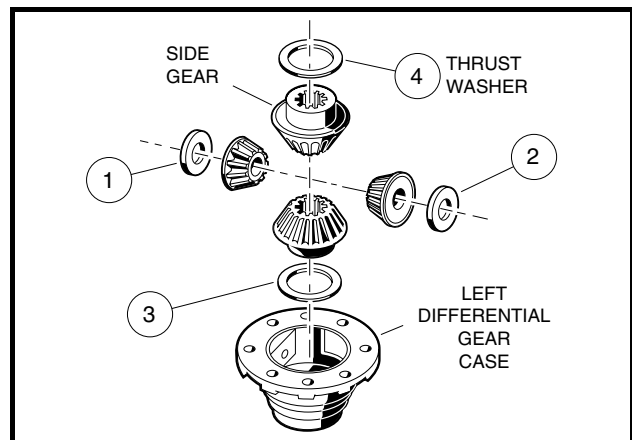
- DO NOT REUSE BEARINGS AFTER REMOVING THEM. REPLACE BEARINGS WITH NEW ONES.

Transaxle Disassembly and Inspection, Continued:

6. To disassemble the intermediate gear assembly, press off together the bearing (18) (Figure 16-4, Page 16-4) or (16) (Figure 16-5, Page 16-5) and the gear (23) (Figure 16-4, Page 16-4) or (19) (Figure 16-5, Page 16-5). See also Figure 16-15, Page 16-10.
7. **Type K transaxles:** Remove key (22) (Figure 16-4, Page 16-4). See also Figure 16-16, Page 16-10.
8. Press the bearing (20) (Figure 16-4, Page 16-4) or (18) (Figure 16-5, Page 16-5) off the intermediate gear assembly.

**Figure 16-17 Lock Plate (Type K Only)****Figure 16-18 Separate Housing**

9. Disassemble the differential gear case:
 - 9.1. **Type K transaxles:** Bend the bolt lock plates (29) down onto the ring gear (30) (Figure 16-4, Page 16-4). See also Figure 16-17, Page 16-11.
 - 9.2. Remove eight hex bolts (28) (Figure 16-4, Page 16-4) or four hex bolts (33) (Figure 16-5, Page 16-5) that secure the ring gear to the differential case.
 - 9.3. Remove the ring gear. Retain dowel pin from between the ring gear and differential case for reassembly.
 - 9.4. Separate the differential gear case housing. If necessary, reinstall two of the hex bolts (removed previously in step 9.2.) into the differential gear unit and, while holding the unit slightly above the work area, lightly tap the bolt heads (Figure 16-18, Page 16-11). Remove the two bolts.
 - 9.5. Remove the differential pin (31) by pushing pin through differential gear case from one side (Figures 16-4 or 16-5, Pages 16-4 or 16-5). See also Figure 16-19, Page 16-11.

**Figure 16-19 Differential Pin****Figure 16-20 Left Differential**

- 9.6. Remove the idler gears and thrust plates (38 and 35) (**Figure 16-4, Page 16-4**) or (29 and 28) (**Figure 16-5, Page 16-5**).
- 9.7. Remove the differential gears and thrust plates (34 and 37) (**Figure 16-4, Page 16-4**) or (30 and 27) (**Figure 16-5, Page 16-5**). **See also Figure 16-20, Page 16-11.**
- 9.8. Inspect the bearings (14) (**Figure 16-4, Page 16-4**) or (13) (**Figure 16-5, Page 16-5**) of the differential case and replace them if they are damaged. To remove them, press them off. **See CAUTION at bottom of page 16-10.**
10. Inspect parts for wear or damage. Any worn or damaged parts should be replaced. **See following NOTE.**

NOTE

- DAMAGED OR WORN GEARS SHOULD BE REPLACED AS SETS.

TRANSAXLE ASSEMBLY

CAUTION

- DO NOT PRESS AGAINST THE BEARING OUTER RACE.
- **TYPE K TRANSAXLES:** GASKET (13) FACES OF THE HOUSING MUST BE CLEAN AND SMOOTH. USE ONLY A NEW GASKET THAT IS NOT TORN OR DAMAGED. THE GASKET MUST LIE FLAT AGAINST THE HOUSING FACES (**FIGURE 16-4, PAGE 16-4**).
- THE HOUSING AND ALL PARTS MUST BE WIPED CLEAN AND DRY BEFORE REASSEMBLY.

1. If bearings (14) (**Figure 16-4, Page 16-4**) or (13) (**Figure 16-5, Page 16-5**) were removed during disassembly, install new bearings using an arbor press.
2. Assemble the differential gear case:
 - 2.1. Install the pin (31) (**Figures 16-4 or 16-5, Pages 16-4 or 16-5**). Apply a small amount of oil to all thrust plates and to both ends of the pin.
 - **Type K transaxles:**
 - 2.2. While aligning the dowel pin, assemble the two halves of the differential gear case (33 and 36) and reinstall the output gear (30) (**Figure 16-4, Page 16-4**).
 - 2.3. Install eight hex bolts (28) and the bolt lock plates (29) (**Figure 16-4, Page 16-4**). Tighten the bolts to 18 ft.lb (24 N-m).
 - 2.4. Bend the edges of the bolt locking tabs securely against the flats of the bolt heads to prevent the bolts from loosening and possibly causing damage (**Figure 16-17, Page 16-11**).
 - 2.5. If the large gear (23) was removed from the intermediate gear, insert key (22) into the keyway in the shaft and then press the large gear and the bearing (18) onto the shaft. Be sure the key is properly positioned in the keyway before attempting to press on the large gear and bearing (**Figure 16-4, Page 16-4**).
 - **Type G transaxles:**
 - 2.6. Install four hex bolts (33) and output gear (32). Tighten bolts to 51 ft.lb (69 N-m) (**Figure 16-5, Page 16-5**).
 - **All Transaxles:**
3. Press a new bearing (20) (**Figure 16-4, Page 16-4**) or (18) (**Figure 16-5, Page 16-5**) onto the intermediate gear assembly.
4. Press new bearing (18) (**Figure 16-4, Page 16-4**) or (16) (**Figure 16-5, Page 16-5**) onto input pinion gear.
5. Apply grease to the lip of the new oil seal (10) (**Figures 16-4 or 16-5, Pages 16-4 or 16-5**) and install the seal using a transaxle pinion seal tool (Club Car Part No. 1014161). The lip of the oil seal should face the inside of the transaxle housing. Make sure the seal is firmly seated.

Transaxle Assembly, Continued:

6. Install the differential assembly, the intermediate gear assembly, and the input pinion gear simultaneously. Be sure all bearings are seated properly in the housing. Rotate the input shaft to check for smooth gear operation (**Figure 16-13, Page 16-9**).
7. Install both dowel pins (27) (**Figure 16-4, Page 16-4**) or (25) (**Figure 16-5, Page 16-5**) in transaxle housing (24 or 20).
8. Install left half of transaxle housing:
 - **For Type K transaxles:**
 - 8.1. Place a new gasket (13) (**Figure 16-4, Page 16-4**) in position on the mating face of the housing. Use the dowel pins to position the gasket. Make sure all holes are aligned.
 - 8.2. Install left half of transaxle housing (24) (**Figure 16-4, Page 16-4**).
 - 8.3. Install the ten bolts (26) and tighten to 69 in.lb (7.8 N-m) (**Figure 16-4, Page 16-4**).
 - 8.4. If the axle tube (16 and 40) was removed, install the shims (39), (if the shims were removed) and a new gasket. Install the axle tube with five lock washers and bolts (9 and 8) (**Figure 16-4, Page 16-4**). Tighten the bolts to 22 ft. lb (30 N-m).

NOTE

- **TYPE K TRANSAXLES:** IF THE DIFFERENTIAL CASE (33 AND 36), THE TRANSAXLE HOUSING (11 AND 24) OR AXLE TUBE (16 AND 40) (**FIGURE 16-4, PAGE 16-4**) WAS REPLACED, SEE SHIMMING THE TRANSAXLE ON PAGE 16-14.

- **For Type G transaxles:**

- 8.5. Place 1/8 in. bead of three bond liquid gasket on mating face of housing. **See following NOTE.**

NOTE

- TYPE G TRANSAXLES DO NOT USE A GASKET ON THE MATING FACE OF THE HOUSING. USE AN 1/8 IN. BEAD OF THREE BOND LIQUID GASKET INSTEAD.

- 8.6. Install left half of transaxle housing (20) (**Figure 16-5, Page 16-5**).
- 8.7. Install eleven bolts in the case housing and tighten to 19 ft.lb (25.7 N-m). Type G transaxles have no shims or gasket.
- 8.8. Install axle tube with lock washers and bolts (9 and 8) (**Figure 16-5, Page 16-5**). Tighten the bolts to 36 ft.lb (49 N-m).
- **For all transaxles:**
 9. Install the brake assemblies as instructed in Section 6—Wheel Brake Assemblies.
 10. Apply a small amount of grease to the lip of the oil seal (17) (**Figure 16-4, Page 16-4**) or (15) (**Figure 16-5, Page 16-5**).
 11. Clean the splines on the axle shaft (1 and 2). Rotate the axle to align the shaft splines with the splined bore of the differential side gear. Push the shaft in until the bearing seats against the shoulder in the axle tube (**Figures 16-4 and 16-5, Pages 16-4 and 16-5**).
 12. Install the retaining ring (6) (**Figures 16-4 and 16-5, Pages 16-4 and 16-5**) in the axle tube. **See WARNING on page 16-6.**
 13. Make sure the drain plug is installed in the transaxle and tightened to 23 ft.lb (31 N-m). Fill the transaxle, through the level indicator hole, with 22 ounces of SAE 30 API Class SE, SF, or SG oil (a higher grade may also be used). Install and tighten the level indicator plug to 23 ft.lb (31 N-m).

SHIMMING THE TRANSAXLE

Type K Transaxles Only

If the differential case (36 and 33), transaxle housing (11 and 24), or axle tube (16 or 40) has been replaced, the transaxle may need new shims. To determine whether new shims are necessary, the transaxle must be completely assembled except for the short axle tube (16) and both axle shafts (1 and 2) (**Figure 16-4, Page 16-4**).

1. Stand the transaxle on end, on the axle tube.
2. Using a depth gauge, measure the distance from the gasket seal surface of the axle tube (gasket must be removed) to the outer race of the bearing (14) on the differential case assembly (32) (**Figure 16-4, Page 16-4**)
See also Figure 16-21, Page 16-14.
3. Use the following chart to determine whether shimming is required and, if so, how many shims (Club Car Part No. 1013781) should be used.

Distance from gasket seal surface to outer race or bearing - INCHES (MM)	SHIMS REQUIRED
Up to .134 inches (3.4 mm)	0
.134 -.142 inches (3.4 - 3.6 mm)	1
.142 -.150 inches (3.6 - 3.8 mm)	2
.150 -.155 inches (3.8 - 3.9 mm)	3

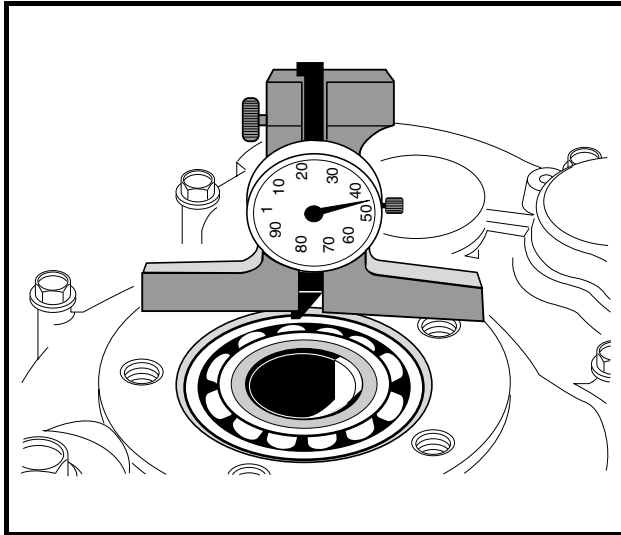


Figure 16-21 Depth Gauge

TRANSAXLE INSTALLATION

Read DANGER and WARNING on page 16-1.

1. If using a chain hoist, raise the vehicle and place transaxle in position on the jackstands. If using a floor jack, lower the jackstands to their lowest settings and place the transaxle in position on the jackstands.
2. Align the center hole in the saddle of the transaxle with the alignment pin in the leaf spring assembly.
3. Install the two U-bolts, lockwashers, and nuts. Tighten the nuts to 25 ft.lb (34 N-m). Tighten the U-bolt nuts so an equal amount of thread is visible on each leg of the bolt.

Transaxle Installation, Continued:

4. Install the motor. **See Section 15–Motor.**
5. If using a chain hoist, lower the vehicle while guiding the leaf springs into the rear spring shackles. If using a floor jack, raise the differential while guiding the leaf springs into the rear spring shackles. Then raise the jackstands to support the transaxle.
6. Reconnect the four motor wires. Tighten the retaining nuts to 65 in.lb (7.3 N-m) using two wrenches to prevent the motor studs from turning. **See following NOTE.**

NOTE

- IF THE MOTOR WIRES WERE NOT TAGGED WHEN DISCONNECTED, **SEE SECTION 11, FIGURE 11-1, WIRING DIAGRAM** FOR PROPER CONNECTION.

7. Insert bolts through the spring shackles and bushings in the leaf spring eyes. Secure bolts with lock nuts. Tighten to 15 ft.lb (20.3 N-m).
8. Connect the brake cables.
9. Install the shock absorbers. Tighten shock absorber retaining nuts until the rubber bushings expand to the same size as the cup washers.
10. Install the rear wheels. Finger tighten lug nuts.
11. Lift the vehicle and remove the jackstands.
12. Lower vehicle and tighten the lug nuts (using a criss-cross pattern) to 55 ft.lb (74.6 N-m).
13. Test drive the vehicle to check for proper operation.



NOTES



NOTES



Club Car, Inc.
P.O. Box 204658
Augusta, GA 30917-4658
USA

Web	www.clubcar.com
Phone	1.706.863.3000
	1.800.ClubCar
Int'l	+1 706.863.3000
Fax	1.706.863.5808