

DOMESTIC

PowerDrive[®]
&

ACCU* ⚡ *POWER

BATTERY CHARGERS

Club Car[®]

2005 MAINTENANCE & SERVICE MANUAL

Manual No. 102680414 Edition Code 1204A00000

FOREWORD

Club Car battery chargers are designed and built to provide unsurpassed performance efficiency among chargers in their class; however, proper maintenance and repair are essential for achieving maximum service life and continued safe and reliable operation.

This manual provides detailed information for the maintenance and repair of domestic Club Car battery chargers, and should be thoroughly reviewed prior to servicing the charger. The procedures provided herein must be properly implemented, and the DANGER, WARNING, and CAUTION statements must be heeded.

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

It is the policy of Club Car, Inc. to assist its distributors and dealers in continually updating their service knowledge and facilities so they can provide prompt and efficient service for vehicle owners. Regional technical representatives, vehicle service seminars, periodic service bulletins, maintenance and service manuals, and other service publications also represent Club Car's continuing commitment to customer support.

This manual covers all aspects of typical battery charger service; unique situations, however, do sometimes occur when servicing a charger. If it appears that a service question is not answered in this manual, you may write to us at: Club Car, Inc.; P.O. Box 204658; Augusta, Georgia 30917; Attention: Technical Services, or contact a Club Car Technical Service Representative at (706) 863-3000, ext. 3580.

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This manual effective August 2, 2004.

WARNING

- **Read Section 1 – Safety before attempting any service on a Club Car vehicle or charger.**
- **Before servicing a Club Car vehicle or charger, read complete section(s) and any referenced information that may be relevant to the 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 dealers and will, when applicable, appear in future editions of this manual.*

Club Car, Inc. reserves the right to change specifications and designs at any time without notice and without the obligation of making changes to units previously sold.

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., P.O. Box 204658, Augusta, GA 30917-4658, USA, Attention: Warranty Administration.

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SECTION 1 – SAFETY

To ensure the safety of those servicing Club Car vehicles or battery chargers, and to protect the vehicles and battery chargers from damage resulting from improper service or maintenance, the procedures in this manual must be followed.

It is important to note that throughout this manual there are statements labeled DANGER, WARNING, or CAUTION. These special statements relate to specific safety issues, and must be read, understood, and heeded before proceeding with procedures. There are also statements labeled NOTE, which provide other essential service or maintenance information.

DANGER

- A DANGER indicates an immediate hazard that will result in severe personal injury or death.

WARNING

- A WARNING indicates an immediate hazard that could result in severe personal injury or death.

CAUTION

- A CAUTION with the safety alert symbol indicates a hazard or unsafe practice that could result in minor personal injury or product or property damage.

CAUTION

- A CAUTION without the safety alert symbol indicates a potentially hazardous situation that could result in property damage.

GENERAL WARNING

The following safety statements must be heeded whenever the vehicle or battery charger is being operated, repaired, or serviced. Service technicians should become familiar with these general safety statements, which can be found throughout this manual. Also, other specific warnings appear throughout this manual and on the vehicle and battery charger.

DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries.**
- **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 15 minutes. Call a physician immediately.**

 WARNING

- Do not leave children unattended on vehicle.
- Only trained technicians should repair or service the vehicle or battery charger. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair.
- Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle and battery charger.
- Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.
- Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.
- Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.
- Wear safety glasses or approved eye protection when servicing the vehicle or battery charger. Wear a full face shield and rubber gloves when working on or near batteries.
- Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle or battery charger.
- 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.
- Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.
- For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
- Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle or switch in the NEUTRAL position. Chock the wheels when servicing the vehicle.
- IQ System vehicles:
Place Tow/Run switch in the TOW position before disconnecting or connecting the batteries. Failure to heed this warning could result in a battery explosion or severe personal injury.
- All electric vehicles:
To avoid unintentionally starting the vehicle, disconnect the batteries as shown (Figure 1-1, Page 1-3, Figure 1-2, Page 1-3, or Figure 1-3, Page 1-3).
- IQ System vehicles:
After disconnecting the batteries, wait 90 seconds for the controller capacitors to discharge.
- PowerDrive System 48 vehicles:
After disconnecting the batteries, discharge the controller capacitors as follows:
 - Turn key switch to ON and place the Forward/Reverse handle or switch in REVERSE.
 - Slowly press the accelerator pedal and keep it pressed until the reverse warning buzzer can no longer be heard. When the buzzer stops sounding, the controller capacitors are discharged.
- Never push objects of any kind into the battery charger case through the ventilation slots. Failure to heed this warning could result in an electrical short circuit that could result in a fire.
- Do not use a battery charger if the cord, plug, or receptacle is damaged in any way. Replace worn or damaged parts immediately. Failure to heed this warning could result in a fire, property damage, severe personal injury, or death.
- Do not use a battery 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.

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- **External battery chargers:**
Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.
- **Onboard battery chargers:**
Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and remove the battery charger from the vehicle. See Onboard Charger Removal, Section 4, Page 4-30.
- If wires are removed or replaced make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.
- Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.

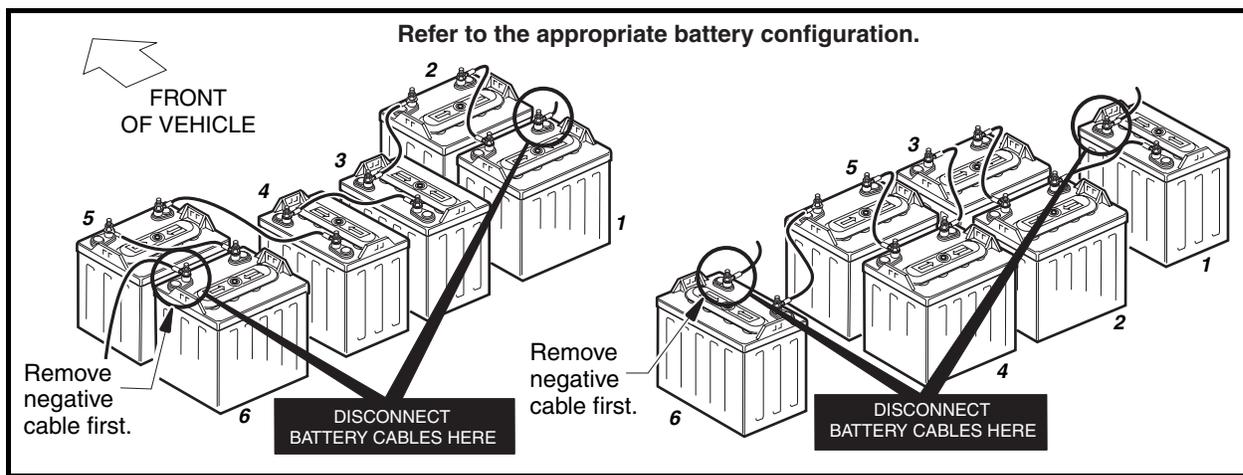


Figure 1-1 PowerDrive System 48 Battery Configuration

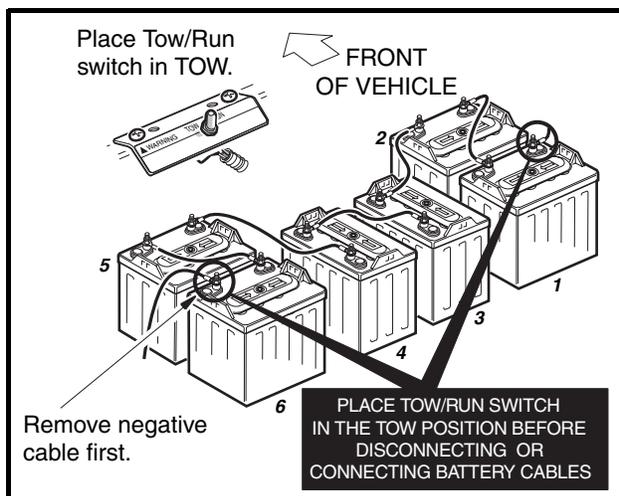


Figure 1-2 DS IQ System Battery Configuration

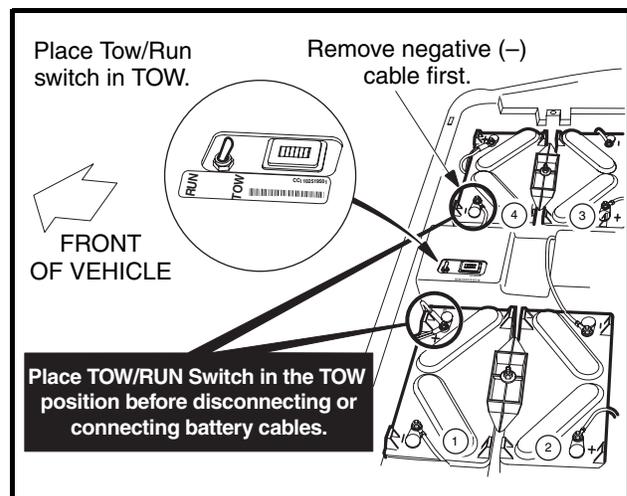


Figure 1-3 Precedent IQ System Battery Configuration

SECTION 2 – CHARGER IDENTIFICATION AND SPECIFICATIONS

GENERAL INFORMATION

There are several different Club Car battery charger models available. It is important to properly identify the battery charger type and model number before attempting to service a Club Car battery charger. **See Battery Charger Identification on page 2-4.**

SPECIFICATIONS

POWERDRIVE 48 VOLT EXTERNAL CHARGER SPECIFICATIONS	PowerDrive Battery Charger			PowerDrive Battery Charger		
	17930-11 (101802201)	17930-18 (101802202)	17930-19 (101802203)	IC3645B12A 4ASC1 (102496401)	IC3645B12A 4BSC1 (102496402)	IC3645B12A 4CSC1 (102496403)
AC input						
AC voltage: 105-128 VAC (acceptable range)	•	•	•	•	•	•
Frequency: 60 Hz.	•	•	•	•	•	•
Power consumption						
Max. AC current (amps)	10.71	10.71	10.71	9.0	9.0	9.0
DC output						
DC voltage (VDC) (start of charge cycle)	48	48	48	48	48	48
DC current (amps) (start of charge cycle)	17	17	17	15	15	15
DC voltage (VDC) (end of charge cycle)	60	60	60	60	60	60
DC current (amps) (end of charge cycle)	3.5	3.5	3.5	3.5	3.5	3.5
Dimensions/Weight						
Case – overall length	10.25 in. (26 cm)	10.25 in. (26 cm)	10.25 in. (26 cm)	7.3 in. (18.5 cm)	7.3 in. (18.5 cm)	7.3 in. (18.5 cm)
Case – overall width	8.687 in. (22.1 cm)	8.687 in. (22.1 cm)	8.687 in. (22.1 cm)	8.0 in. (20.3 cm)	8.0 in. (20.3 cm)	8.0 in. (20.3 cm)
Case – overall height	9.0 in. (22.9 cm)	9.0 in. (22.9 cm)	9.0 in. (22.9 cm)	8.6 in. (21.8 cm)	8.6 in. (21.8 cm)	8.6 in. (21.8 cm)
AC cord length	74 in. (188 cm)	108 in. (274.3 cm)	108 in. (274.3 cm)	74 in. (188 cm)	108 in. (274.3 cm)	108 in. (274.3 cm)
DC cord length	103 in. (261.6 cm)	144 in. (365.8 cm)	240 in. (609.6 cm)	103 in. (261.6 cm)	144 in. (365.8 cm)	240 in. (609.6 cm)
Weight	31 lb (14.1 kg)	31.6 lb (14.3 kg)	33 lb (15.0 kg)	24 lb (10.9 kg)	24.6 lb (11.2 kg)	26 lb (11.8 kg)
Mounting configuration						
Mounting: Set on shelf, wall mount with keyhole, or hang securely from ceiling.	•	•	•	•	•	•

POWERDRIVE 2 48 VOLT EXTERNAL CHARGER SPECIFICATIONS	PowerDrive 2 Battery Charger		
Model number (CCI P/N)	22110-11 (101802204)	22110-18 (101802205)	22110-19 (101802206)
AC input			
AC voltage: 105-128 VAC (acceptable range)	•	•	•
Frequency: 60 Hz.	•	•	•
Power consumption			
Max. AC current (amps)	9.0	9.0	9.0
DC output			
DC voltage (VDC) (start of charge cycle)	48	48	48
DC current (amps) (start of charge cycle)	13	13	13
DC voltage (VDC) (end of charge cycle)	60	60	60
DC current (amps) (end of charge cycle)	3.5	3.5	3.5
Dimensions/Weight			
Case – overall length	6.5 in. (16.5 cm)	6.5 in. (16.5 cm)	6.5 in. (16.5 cm)
Case – overall width	7.75 in. (19.7 cm)	7.75 in. (19.7 cm)	7.75 in. (19.7 cm)
Case – overall height	7.785 in. (19.8 cm)	7.785 in. (19.8 cm)	7.785 in. (19.8 cm)
AC cord length	74 in. (188 cm)	108 in. (274.3 cm)	108 in. (274.3 cm)
DC cord length	103 in. (261.6 cm)	144 in. (365.8 cm)	240 in. (609.6 cm)
Weight	24 lb (10.9 kg)	24.6 lb (11.2 kg)	26 lb (11.8 kg)
Mounting configuration			
Mounting: Set on shelf, wall mount with keyhole, or hang securely from ceiling.	•	•	•

48 VOLT POWERDRIVE ONBOARD CHARGER SPECIFICATIONS	PowerDrive Battery Charger (Onboard)		
Model number (CCI P/N)	17935-10 (101814301)	17935-20 (101814303)	17935-30 (101814304)
AC input			
AC voltage: 105-128 VAC (acceptable range)	•	•	•
Frequency: 60 Hz.	•	•	•
Power consumption			
Max. AC current (amps)	10.71	10.71	10.71
Specifications continued on next page...			

48 VOLT POWERDRIVE ONBOARD CHARGER SPECIFICATIONS	PowerDrive Battery Charger (Onboard)		
Model number (CCI P/N)	17935-10 (101814301)	17935-20 (101814303)	17935-30 (101814304)
DC output			
DC voltage (VDC) (start of charge cycle)	48	48	48
DC current (amps) (start of charge cycle)	17	17	17
DC voltage (VDC) (end of charge cycle)	60	60	60
DC current (amps) (end of charge cycle)	3.5	3.5	3.5
Dimensions/Weight			
Case – overall length	10.25 in. (26 cm)	10.25 in. (26 cm)	10.25 in. (26 cm)
Case – overall width	8.687 in. (22.1 cm)	8.687 in. (22.1 cm)	8.687 in. (22.1 cm)
Case – overall height	9.437 in. (24 cm)	9.437 in. (24 cm)	9.437 in. (24 cm)
AC cord length	17 ft. (5.2 m) (retractable)	17 ft. (5.2 m) (retractable)	17 ft. (5.2 m) (retractable)
DC cord length	80.5 in. (204.5 cm)	129.5 in. (328.9 cm)	162.5 in. (412.8 cm)
Weight	37 lb (16.8 kg)	37.7 lb (17.1 kg)	38.2 lb (17.3 kg)
Mounting Configuration			
Mounting: Onboard (secured to the vehicle)	•	•	•

BATTERY CHARGER IDENTIFICATION

The battery charger can be identified by the model number printed on the charger. Refer to the appropriate section of this manual, as indicated in the chart below, for information on troubleshooting and repairing the battery charger. Do not attempt to service a battery charger that cannot be properly identified. If a charger cannot be identified, contact your local Club Car dealer or distributor.

BATTERY CHARGER NAME AND MODEL NUMBER	REFER TO
PowerDrive Battery Charger 17930-11 (101802201)	Section 3 – PowerDrive Charger (External)
PowerDrive Battery Charger 17930-18 (101802202)	
PowerDrive Battery Charger 17930-19 (101802203)	
PowerDrive Battery Charger (Onboard) 17935-10 (101814301)	Section 4 – Carryall 6 and TransPorter PowerDrive Charger (Onboard)
PowerDrive 2 Battery Charger 22110-11 (101802204)	Section 5 – PowerDrive 2 Charger (External)
PowerDrive 2 Battery Charger 22110-18 (101802205)	
PowerDrive 2 Battery Charger 22110-19 (101802206)	
PowerDrive Battery Charger IC3645B12A4ASC1 (102496401)	Section 6 – GE PowerDrive Charger (External)
PowerDrive Battery Charger IC3645B12A4BSC1 (102496402)	
PowerDrive Battery Charger IC3645B12A4CSC1 (102496403)	
PowerDrive Battery Charger (Onboard) 17935-20 (101814303)	Optional equipment. Contact your Club Car technical repre- sentative or the Club Car Tech- nical Hotline for service concerns.
PowerDrive Battery Charger (Onboard) 17935-30 (101814304)	

SECTION 3 – POWERDRIVE CHARGER (EXTERNAL)

⚠ DANGER

- See General Warning, Section 1, Page 1-1.

⚠ WARNING

- See General Warning, Section 1, Page 1-1.
- The battery charger DC plug must be pulled slowly from the receptacle (Figure 3-5, Page 3-6). Jerking or pulling the DC cord out quickly could cause arcing that could damage the plug and receptacle and could cause batteries to explode (Figure 3-6, Page 3-6).

GENERAL INFORMATION

This section includes information pertaining to service of the PowerDrive battery charger (model numbers 17930-11, 17930-18, and 17930-19). Do not attempt to service a battery charger that has not been properly identified. If a charger cannot be properly identified, contact your local Club Car dealer or distributor.

The PowerDrive battery charger is automatic and has no external controls (**Figure 3-1, Page 3-1**). When the charger is connected, there is a 2 to 15 second delay before charging begins.

NOTE: All vehicles except Precedent: 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.

The onboard computer, having recorded the amount of energy consumed as the vehicle was used, 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 necessary has been returned to the batteries.

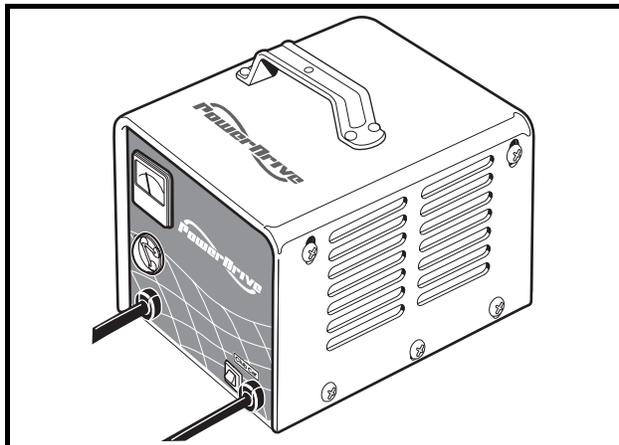


Figure 3-1 PowerDrive Battery Charger

POWERDRIVE EXTERNAL CHARGER FEATURES

- **Charge Interlock**

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

- **Long-Term Storage Charge**

IQ System, PowerDrive, and Precedent vehicles with 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, unplug the charger DC cord, wait 15 seconds for the computer to reset, and plug the charger back in. **See following WARNING.** This will ensure the batteries are at their optimum charge prior to returning the vehicle to service.

WARNING

- **The charger plug must be pulled slowly from the receptacle. Jerking or pulling the DC cord out quickly could cause arcing and burning that could damage the plug and receptacle and could cause batteries to explode.**

BATTERY WARNING LIGHT

Precedent, PowerDrive, PowerDrive Plus and IQ System vehicles feature a dash mounted battery warning light (above the steering column) that, 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 onboard computer.

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

- The battery 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 replenish the batteries and will complete the charge during the next charge cycle.
- When the charger DC cord is unplugged during a charge cycle, the battery warning light will illuminate and remain illuminated for 10 seconds (25 seconds for Precedent vehicles) if the charge is less than 90% complete but the vehicle has enough power for 60 minutes of operation. This will alert the operator that the vehicle may be used, but that it must be charged to completion as soon as possible.
- The battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals (25 seconds, at 10 second intervals for Precedent vehicles), 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 battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals (25 seconds, at 10 second intervals for Precedent vehicles), during a charge cycle (with the DC plug still connected) if AC power to the charger is interrupted. The light will go out when AC power is restored.

THE CHARGE CIRCUIT

The vehicle charge circuit consists of the following:

- charger receptacle
- receptacle fuse link
- onboard computer
- 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 vehicle, 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 (on all vehicles except Precedent vehicles), and the 18-gauge gray wire from the onboard computer. On all vehicles except Precedent vehicles, also check connections of the fuse link located on the charger receptacle (**Figure 3-2, Page 3-3 or Figure 3-3, Page 3-4**).

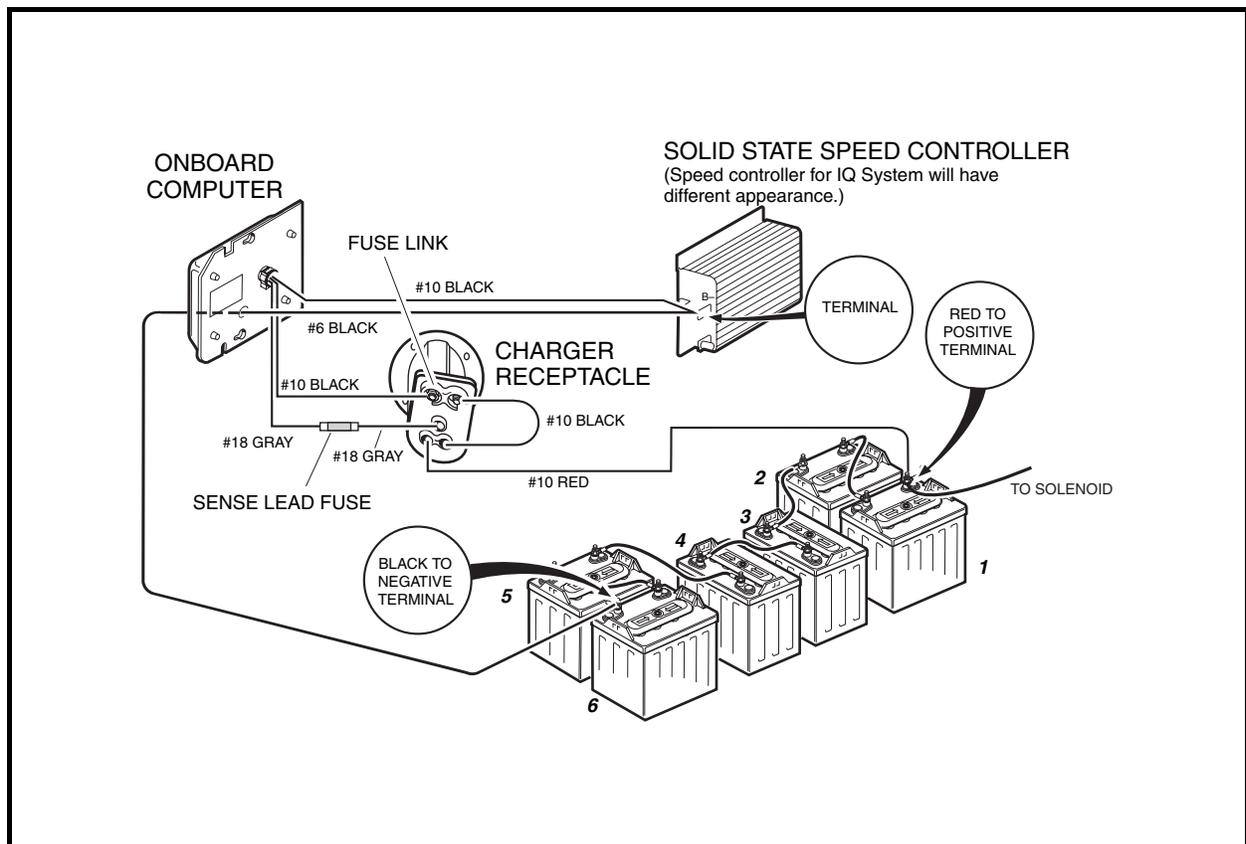


Figure 3-2 Charge Circuit and Battery Configuration – DS, Turf 1, Carryall 1 and DS Villager 4 Vehicles

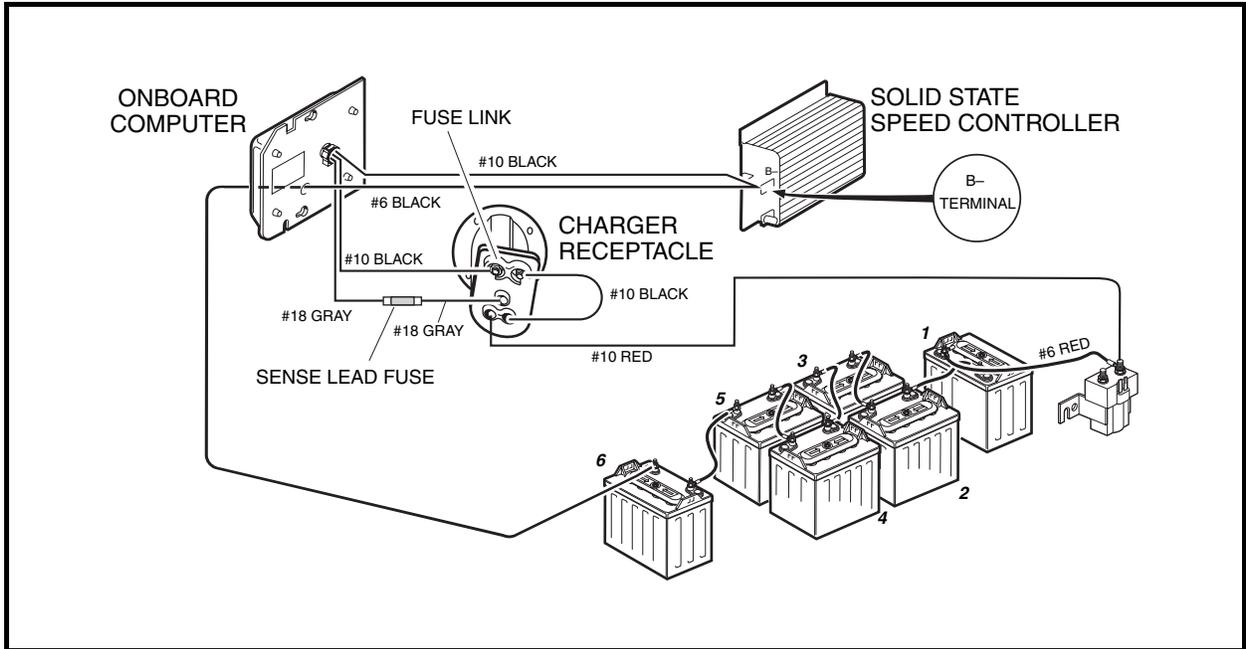


Figure 3-3 Charge Circuit and Battery Configuration – Turf 2, Carryall 2 and Villager 6 and 8 Vehicles

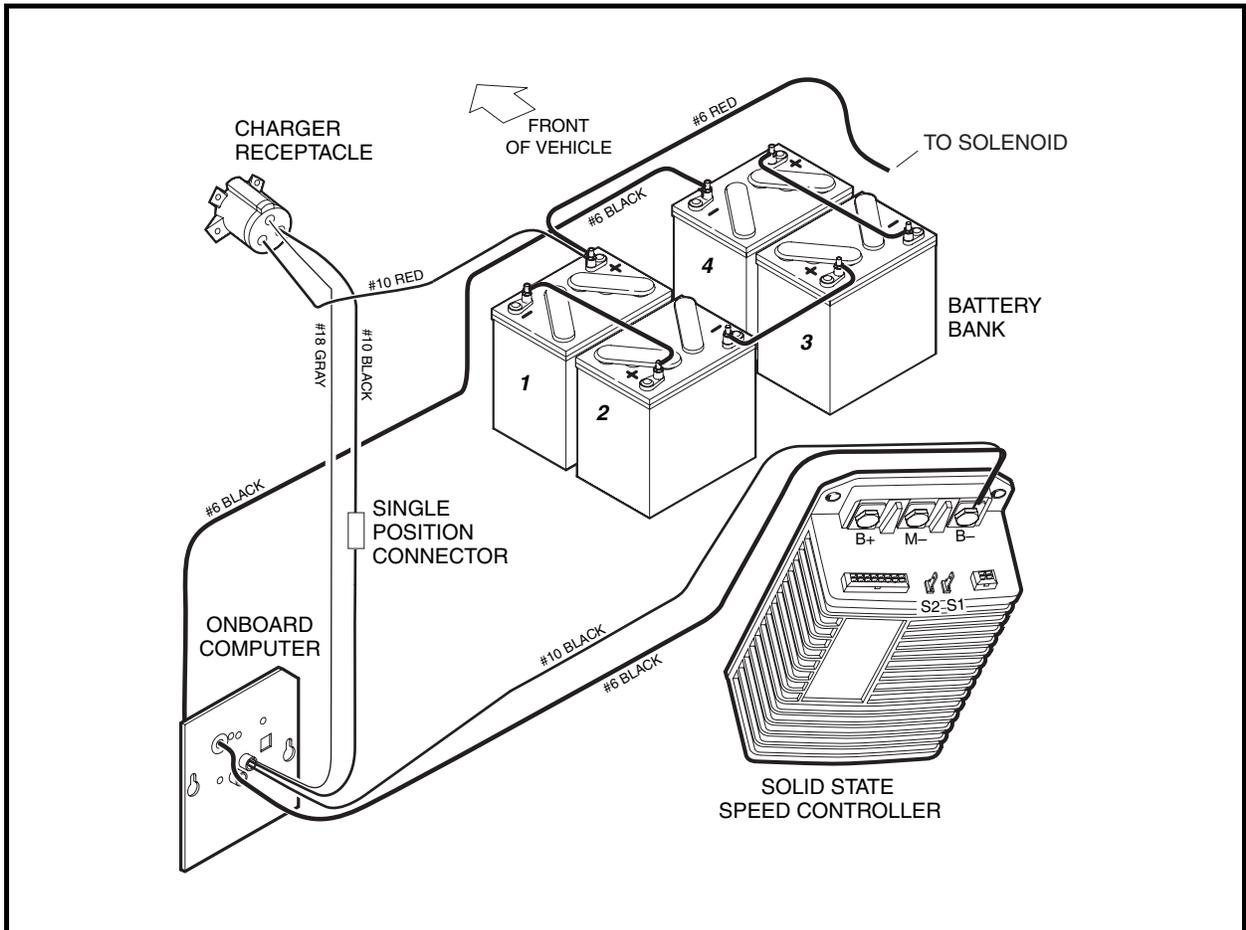


Figure 3-4 Charge Circuit and Battery Configuration – Precedent Vehicles

CHARGER INSTALLATION AND OPERATION

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

DANGER

- The charging area must be ventilated. Hydrogen level in the air must never exceed 2%. The total volume of air in the charging area must be changed five times per hour. Exhaust fans should be located at the highest point of the roof. Contact a local HVAC engineer.
- Do not charge the vehicle batteries with the vehicle covered or enclosed. Any enclosure or cover should be removed or unzipped and pulled back when batteries are being charged. An accumulation of hydrogen gas could result in an explosion.

WARNING

- Do not bypass the sense lead fuse (not applicable to Precedent vehicles).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.
- The battery charger DC plug must be pulled slowly from the receptacle (Figure 3-5, Page 3-6). Jerking or pulling the DC cord out quickly could cause arcing that could damage the plug and receptacle and could cause batteries to explode (Figure 3-6, Page 3-6).
- Do not connect the charger to battery packs that are not compatible with the DC output voltage specified on the charger. Overheating and transformer burnout will result.
- Do not use a battery charger if the cord, plug, or receptacle is damaged in any way. Replace worn or damaged parts immediately. Failure to heed this warning could result in a fire, property damage, severe personal injury, or death.
- Do not use a battery 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.
- 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.
- 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. The use of an improper extension cord could result in fire or electric shock.
- 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.
- Do not block or cover the charger ventilation slots. The slots provide ventilation and prevent the charger from overheating.
- Do not allow clothing, blankets, or other materials to cover the charger.
- Do not allow the charger to operate for more than 30 minutes at 19 or more amperes.
- Install surge arrestors on incoming AC power lines. Surge arrestors will help protect electrical components in the charger and on the vehicle from all but direct or close lightning strikes.

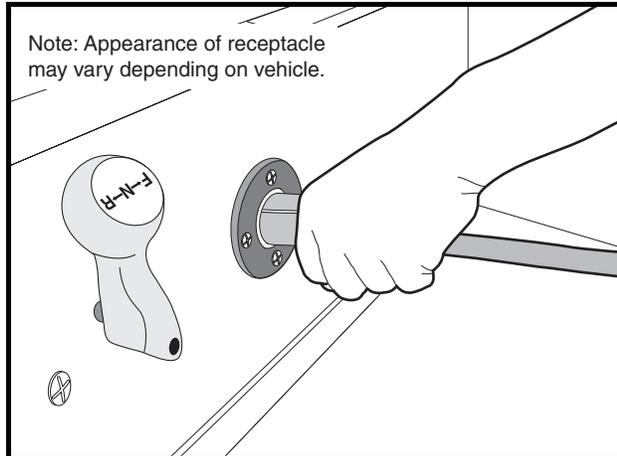


Figure 3-5 Charger Receptacle

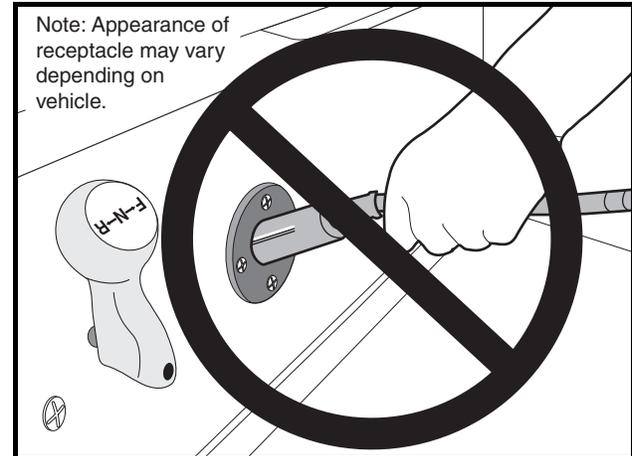


Figure 3-6 Incorrect DC Plug Removal

AC POWER CONNECTION

The AC line to which the charger is to be connected must be of the proper AC input voltage for the charger and must be capable of supplying sufficient current. **See Section 2 – Charger Identification and Specifications.**

With charger DC cord disconnected, connect the power supply cord to an AC supply. **See Section 2 – Charger Identification and Specifications.**

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 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 should be avoided. If an extension cord must be used, use a three-conductor no. 12 AWG (American Wire Gauge) or no. 14 SWG (British Standard Wire Gauge), heavy-duty cord with ground, properly wired and in good electrical condition. Keep it as short as possible (no more than 12 feet (3.7 m)). Place all cords so they will not be stepped on, tripped over, or otherwise subject to damage or stress.

Ensure that the charger ventilation slots are unobstructed and that there is adequate ventilation.

CHARGING BATTERIES

⚠ WARNING

- Do not bypass the sense lead fuse (not applicable to Precedent vehicles).
- Be sure the fuse link is clean and tight (not applicable to Precedent vehicles).
- Be sure all wire connections at the receptacle are clean and tight.
- Do not rock or bend the plug. To connect the charger plug to the vehicle receptacle, grasp the plug handle and push the plug straight into the receptacle (Figure 3-5, Page 3-6).
- Do not pull on the DC cord (Figure 3-6, Page 3-6). Do not twist, rock or bend the plug. To disconnect the charger plug from the vehicle receptacle, grasp the plug by the handle and pull the plug straight out of the receptacle.
- Do not connect a charger to the receptacle if the charger cord, plug, or the vehicle receptacle is broken, damaged in any manner, or does not make a good electrical connection. Fire or personal injury can result. Have it replaced by a qualified service person immediately. Failure to follow these instructions could result in damage to the charger cord, the plug, and (or) the vehicle receptacle.

- **Do not use a charger if:**
 - **The plug is too loose or does not make a good connection.**
 - **The plug and receptacle feel hotter than normal during charge.**
 - **The plug pin or receptacle contacts are bent or corroded.**
 - **The plug, receptacle, or cords are cut, worn, have any exposed wires or are damaged in any way.**
- **Using the charger with any of the above symptoms could result in a fire, property damage, personal injury, or death.**

1. With the charger DC cord disconnected from the vehicle charger receptacle, connect the AC power supply cord to an AC outlet designed to provide the proper AC voltage for the charger.
2. Connect the charger DC plug to the vehicle charger receptacle located on the seat support panel (**Figure 3-5, Page 3-6**). The charger will activate automatically within 2 to 15 seconds after the DC plug is connected. **See following WARNING.**

⚠ WARNING

- **Do not rock or bend the DC plug. To connect the charger plug to the vehicle receptacle, grasp the plug handle and push the plug straight into the receptacle (Figure 3-5, Page 3-6).**
3. **All vehicles except Precedent:** 10 to 20 seconds after the charger activates, it will shut off again to run a self-diagnostic program (the ammeter will drop to 0). Charging will resume in a few moments (ammeter will return to previous rate of charge).
 4. **All vehicles:** 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 the nominal input voltage. Higher AC line voltages increase the initial charge rate while lower AC line voltages reduce the initial charge rate.
 5. **All vehicles except Precedent:** Monitor the ammeter for about 30 seconds. Under normal operating conditions (when the charger is on and the batteries are discharged), 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.*

Batteries should be put on charge at the end of each day even if the vehicle has been used for only a short amount of time (even if for only 10 minutes).

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.

New batteries will not deliver their full range until the vehicle has been driven and recharged from 20 to 50 times.

*Vehicles should be restricted to 40 to 50 energy units of discharge (or 36 holes of golf) between charges until the batteries have been properly seasoned (20 to 50 charge cycles). For maximum battery life, Club Car recommends that electric vehicles always be recharged after 40 to 50 energy units of discharge or each night in order to avoid deep discharging the batteries. Charging between rounds will also extend battery life; use the CDM (Communication Display Module) (CCI P/N 101831801). **See Communication Display Module in Section 11 of the appropriate maintenance and service manual.***

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 the wall 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. **See following NOTE.**

NOTE: Monitor the charge cycle to make sure the charger turns off properly. If the charge cycle is interrupted, and the batteries are less than 90% charged, the battery warning light will illuminate intermittently. **See Battery Warning Light on page 3-2.**

3. If the charger does not operate exactly as described above, refer to the wiring diagram and make sure that the vehicle is wired correctly (**Figure 3-2, Page 3-3** or **Figure 3-3, Page 3-4**) and that the internal charger wiring is correct (**Figure 3-7, Page 3-8**).

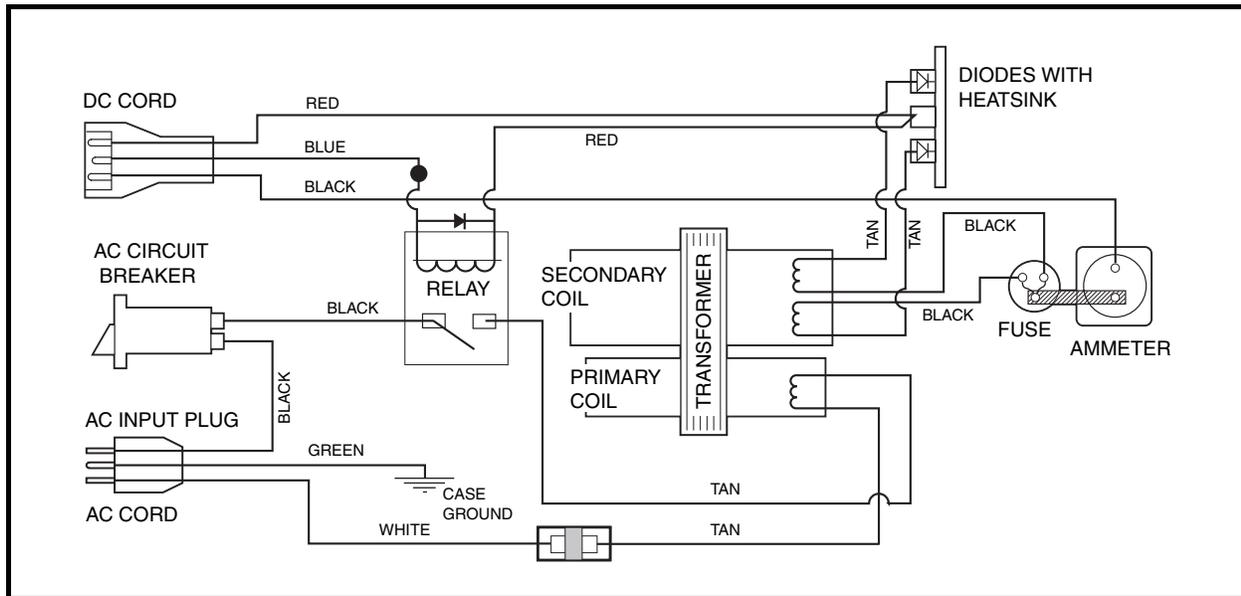


Figure 3-7 PowerDrive Battery Charger Wiring Diagram (External Charger)

DC CORD AND PLUG INSPECTION

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 or receptacle show signs of corrosion or the plug is difficult to insert or remove, the receptacle contacts and plug terminals should be cleaned with a good electrical contact cleaner. The plug should then be inserted and removed several times to ensure ease of insertion, ease of removal, and good electrical contact. **See Charger Receptacle in Section 12 of the appropriate maintenance and service manual for receptacle removal and installation. See also DC Cord Removal on page 3-23. See following NOTE.**

NOTE: If the warning tag has been damaged or removed from the DC cord, have it replaced immediately.

CHECKING BATTERY CONDITION AFTER A CHARGE CYCLE

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

It is common practice for technicians to check the condition of a set of batteries after they have been charged to ensure they have received a complete charge before the vehicle is used. With IQ System, PowerDrive, and Precedent vehicles, this is not necessary; the onboard computer controls and monitors the charge cycle. If any problem occurs 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 chart in the maintenance and service manual appropriate for your battery charger. If you do not have this publication, contact your Club Car representative. If the specified test procedures identify no 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 near the end of a charge cycle should be approximately 59 to 63 volts.

START CHARGE CYCLE

1. Disconnect the DC plug from the vehicle charger receptacle.
2. Wait 20 seconds, then reconnect the DC cord to the vehicle receptacle. **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. **All vehicles except Precedent:** 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 continues. If the batteries are close to being fully charged, the charge cycle will begin and the charge current will begin to taper within a few minutes.

TROUBLESHOOTING

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

⚠ DANGER

- Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.

⚠ WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 3-7, Page 3-8).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.

Use the following Troubleshooting Guide for troubleshooting PowerDrive external battery chargers (model numbers 17930-11, 17930-18, and 17930-19). The Troubleshooting Guide encompasses the entire battery charging circuit. Test procedures specified in the Troubleshooting Guide can be found on the following pages.

POWERDRIVE BATTERY CHARGER TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Relay does not close, no transformer hum and ammeter does not move	Batteries disconnected	See Section 13 – Batteries in the appropriate maintenance and service manual
	Battery voltage is too low	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 3-13
	Poor connection between plug and receptacle	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 3-13
	DC plug and cord	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 3-13 and Test Procedure 5 – Charger DC Circuit Continuity Test on page 3-18
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 3-15
	Gray sense lead fuse is blown (not applicable to Precedent vehicles)	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 3-13
	Receptacle fuse link is blown (not applicable to Precedent vehicles)	See Section 12 – Electrical Components in the appropriate maintenance and service manual
	Poor connection at 10-gauge black wire or 18-gauge gray wire at the OBC (applicable to Precedent vehicles only)	Check wire connections
Relay closes with an audible click but no transformer hum and ammeter does not move	Improper AC outlet voltage	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 3-15
	Failed AC plug and cord	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 3-15
	Internal AC breaker	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 3-15
	Transformer primary coil	Test Procedure 6 – Transformer on page 3-18
	Relay	Test Procedure 8 – Continuity on page 3-20
	Failed ammeter	Replace ammeter
Relay closes and transformer hums but ammeter does not move	Blown charger fuse	Test Procedure 4 – Diodes on page 3-16
	Both Diodes failed	Test Procedure 4B – Both Diodes Failed on page 3-17
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 3-15
	Failed transformer	Test Procedure 6 – Transformer on page 3-18
Relay operates intermittently	Failed charger relay	Test Procedure 8 – Continuity on page 3-20
Single charger fuse link blows	Diode failed	Test Procedure 4A – Single Diode Failure on page 3-16
	Loose internal fuse connection	Tighten connection
Troubleshooting Guide continued on next page...		

POWERDRIVE BATTERY CHARGER TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Both charger fuse links blow or receptacle fuse link blows	Battery is wired in reverse polarity	Check vehicle wiring
	DC cord is wired in reverse polarity	Check battery charger wiring
	Both diodes failed	Test Procedure 4B – Both Diodes Failed on page 3-17
Charger output is low	One diode failed	Test Procedure 4A – Single Diode Failure on page 3-16
	Transformer coil short-circuit failure	Test Procedure 6 – Transformer on page 3-18
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 3-15
Charger turns off too soon	AC power supply was shut off	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 3-15
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 3-15
	Batteries may be fully charged	Test Procedure 7 – Battery State of Charge Test on page 3-20
Charger goes to 16 hour time out	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 3-15
	Extremely discharged batteries or cold temperature	Recharge batteries
	Failed or weak battery	See Section 13 – Batteries in the appropriate maintenance and service manual
AC line fuse blows or AC circuit breaker trips	AC cord is shorted	Test Procedure 8 – Continuity on page 3-20
	Failed transformer	Test Procedure 6 – Transformer on page 3-18
	Incorrect charger wiring	Check battery charger wiring
Battery warning light illuminates for ten seconds at four second intervals (with DC charger cord plugged in) (25 seconds, at 10 second intervals for Precedent vehicles)	AC power interrupted	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 3-15
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 3-15
	Charger failure	See Testing Charger Operation on page 3-8
	16 hour time out	See Battery Warning Light on page 3-2
	Battery or batteries need to be replaced	See Section 13 – Batteries in the appropriate maintenance and service manual
Battery warning light illuminates for ten seconds at four second intervals (with DC charger cord unplugged) (25 seconds, at 10 second intervals for Precedent vehicles)	Batteries are getting close to full discharge capacity	Recharge batteries (golf round may be completed first)
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 3-15
	Battery or batteries need to be replaced	See Section 13 – Batteries in the appropriate maintenance and service manual

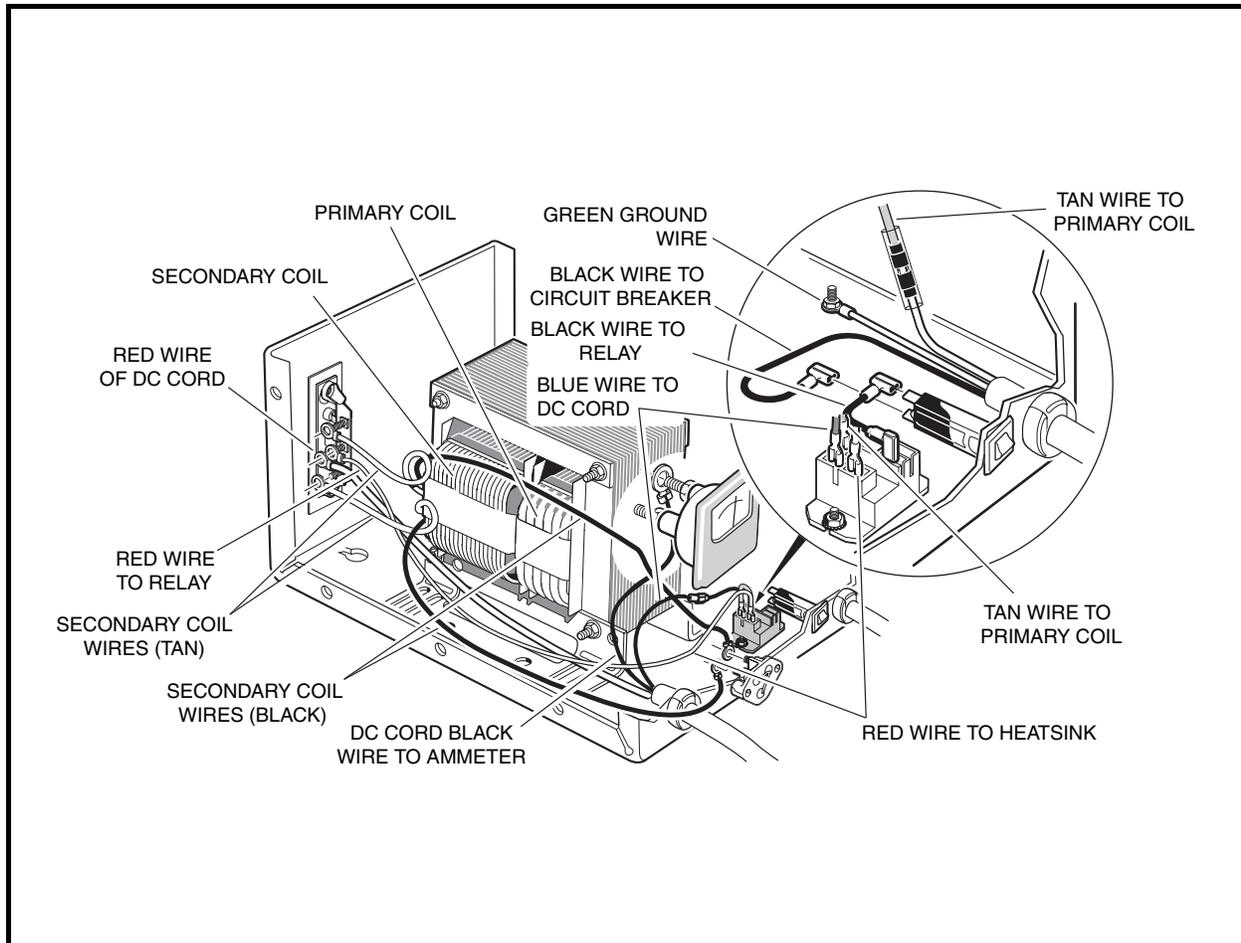


Figure 3-8 PowerDrive Battery Charger

TEST PROCEDURES

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

INDEX OF TEST PROCEDURES

1. Battery Voltage and DC Plug and Receptacle
2. Onboard Computer
3. AC Power and Continuity Test of AC Circuit
4. Diodes
5. Charger DC Circuit Continuity Test
6. Transformer
7. Battery State of Charge Test
8. Continuity

TEST PROCEDURE 1 – BATTERY VOLTAGE AND DC PLUG AND RECEPTACLE

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

1. Check the DC plug and the vehicle charger receptacle for damage, dirt, corrosion, or any condition that might prevent a sound 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:
 - **DS, Turf 1, Carryall 1, and DS Villager 4 vehicles:** Verify that the 10-gauge red wire from the charger receptacle is connected to the positive (+) post of battery no. 1 (**Figure 3-2, Page 3-3**).
 - **Turf 2, Carryall 2, Carryall 6, Villager 6, Villager 8, and TransPorter vehicles:** Verify that the 10-gauge red wire from the charger receptacle is connected to the same large post of the solenoid as the 6-gauge red wire that connects to the positive (+) post of battery no. 1 (**Figure 3-3, Page 3-4**).
 - **Precedent vehicles:** Verify that the 10-gauge red wire from the charger receptacle is connected to the positive (+) post of battery no. 1 (**Figure 3-4, Page 3-4**).

All vehicles except Precedent:

- 3.1. Make sure the two nuts that secure the two 10-gauge black wires to the receptacle fuse assembly are tight (**Figure 3-9, Page 3-13**).
- 3.2. 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. **See following WARNING.**

⚠ WARNING

- Do not bypass the sense lead fuse.

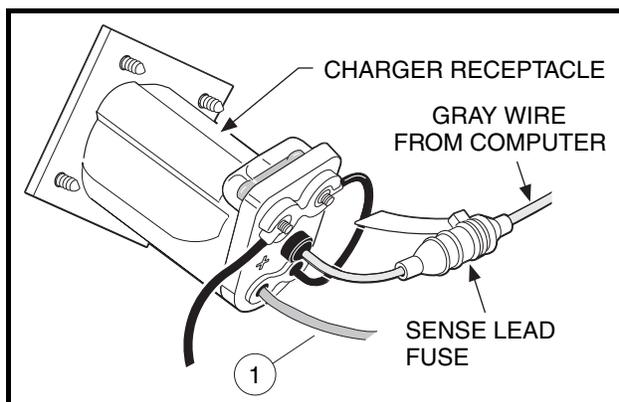
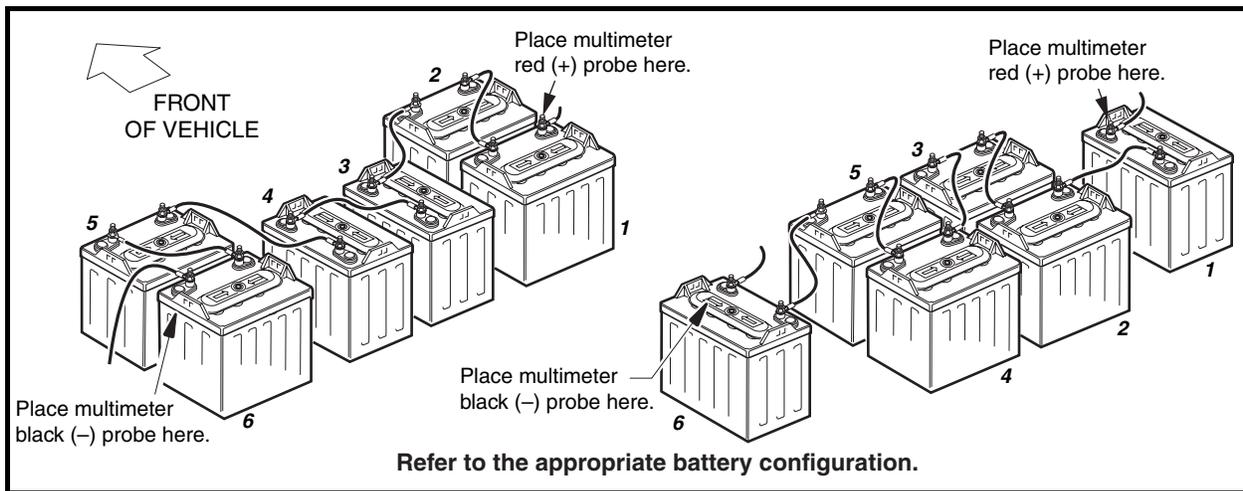


Figure 3-9 Receptacle Wire Connections (all vehicles except Precedent)

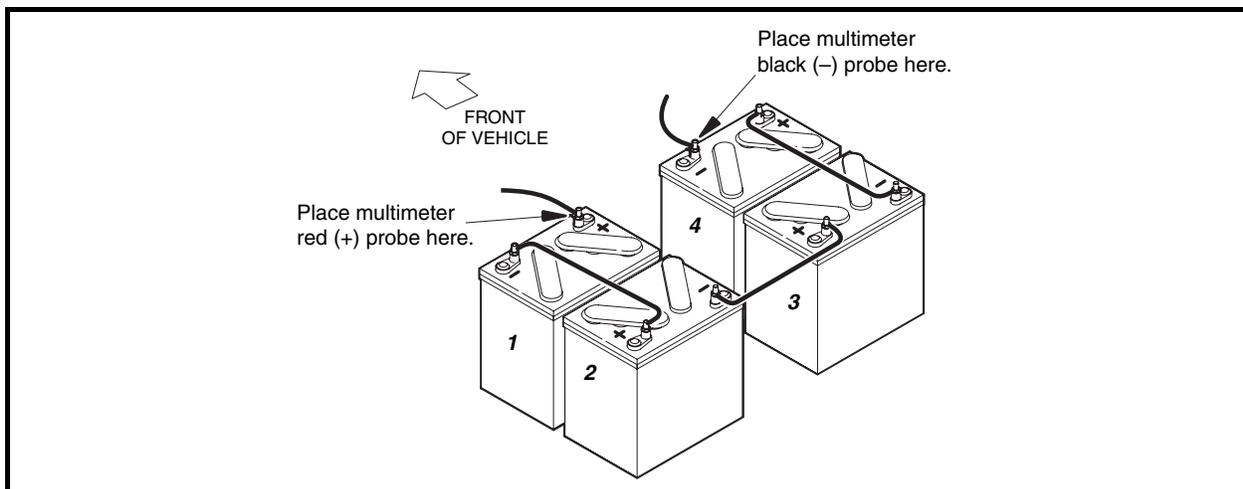
- 3.3. Remove the gray sense lead fuse and check it for continuity with a multimeter set to 200 ohms. The resistance should be less than 2 ohms.

Test Procedure 1 – Battery Voltage and DC Plug and Receptacle, Continued:

- With a 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 3-10, Page 3-14**). Normal no-load voltage should be between 50 and 52 volts for fully charged batteries. The voltage of the battery pack must be over 32 volts DC to allow the onboard computer to close the charger relay. If battery pack voltage is too low to start charger, temporarily bypass the charger relay. **See Charging a Battery Pack that has Low Voltage on page 3-29.**

**Figure 3-10 PowerDrive Battery Configuration****Precedent vehicles only:**

- With a 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. 4 (**Figure 3-11, Page 3-14**). Normal no-load voltage should be between 50 and 52 volts for fully charged batteries. The voltage of the battery pack must be over 32 volts DC to allow the onboard computer to close the charger relay. If battery pack voltage is too low to start charger, temporarily bypass the charger relay. **See Charging a Battery Pack that has Low Voltage on page 3-29.**

**Figure 3-11 Precedent Battery Configuration**

TEST PROCEDURE 2 – ONBOARD COMPUTER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

1. 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 that AC power is present.
2. Check the AC circuit breaker on the front of the charger and reset it if necessary.
3. Insert the DC cord from the second charger into the receptacle of the 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 on page 3-9.**
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.

TEST PROCEDURE 3 – AC POWER AND CONTINUITY TEST OF AC CIRCUIT

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

1. Disconnect AC cord from the wall outlet and 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 to 500 volts AC, check incoming AC voltage. Insert multimeter test probes into AC wall outlet; voltage should be between 105 and 128 volts. If proper voltage is not present, have building wiring checked by a licensed electrical contractor.
5. Check continuity of the AC circuit.
 - 5.1. Remove the charger cover.
 - 5.2. Bypass the relay.
 - 5.2.1. To bypass the relay, remove the black wire (3) from the AC circuit breaker and disconnect the tan wire (4) from the relay. Connect the tan wire (4) to the AC circuit breaker (**Figure 3-17, Page 3-19**).
 - 5.3. With relay bypassed, there should be continuity across the AC cord blades (**Figure 3-12, Page 3-15**).

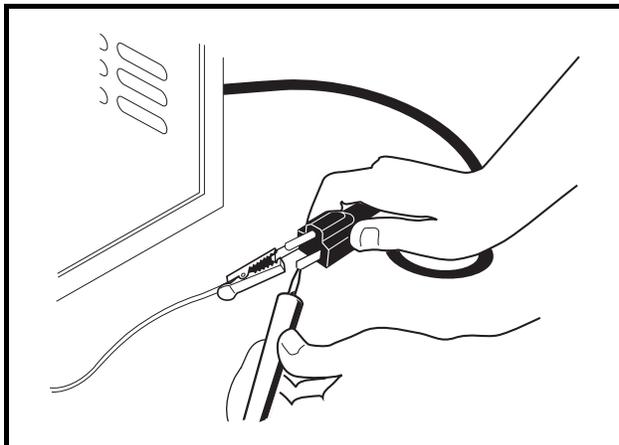


Figure 3-12 AC Cord Test

Test Procedure 3 – AC Power and Continuity Test of AC Circuit, Continued:

6. If the circuit is not complete, check the wiring of the AC cord, transformer primary coil wires, and internal AC circuit breaker (**Figure 3-17, Page 3-19**).
7. If the charger is wired correctly, check the continuity of the AC cord, transformer primary coil, and the internal AC circuit breaker individually. **See Test Procedure 8 – Continuity on page 3-20.**
8. When troubleshooting and repairs are complete, properly connect the relay wiring. **See following WARNING.**

 WARNING

- **The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.**

TEST PROCEDURE 4 – DIODES

Use Test Procedure 4A – Single Diode Failure on page 3-16 for single diode failures and testing of individual diodes. If both diodes have failed, use Test Procedure 4B – Both Diodes Failed on page 3-17.

Test Procedure 4A – Single Diode Failure

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

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

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect one transformer secondary coil wire from the diode terminal (**Figure 3-13, Page 3-17**).
4. Using a low voltage continuity tester or multimeter set to the diode test function, connect the red (+) test probe to the diode mounting plate and the black (–) test probe to a diode terminal and note the reading (**Figure 3-13, Page 3-17**).
5. Reverse test probes and check each diode again and note the reading (**Figure 3-14, Page 3-17**). A diode is designed to conduct current in one direction only. If a diode conducts current (shows continuity) in both directions, the entire heatsink with diodes must be replaced. If a diode does not conduct current (does not show continuity) in either direction, the entire heatsink must be replaced.
6. On rare occasions, a single fuse link may blow 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 tightness for the fuse link connections is 22 in-lb (2.5 N·m).

7. Ensure that the charger is wired properly and all connections are clean and tight. **See following CAUTION.**

CAUTION

- If connections are not clean and tight, excessive heat will be created and the charger may become damaged.

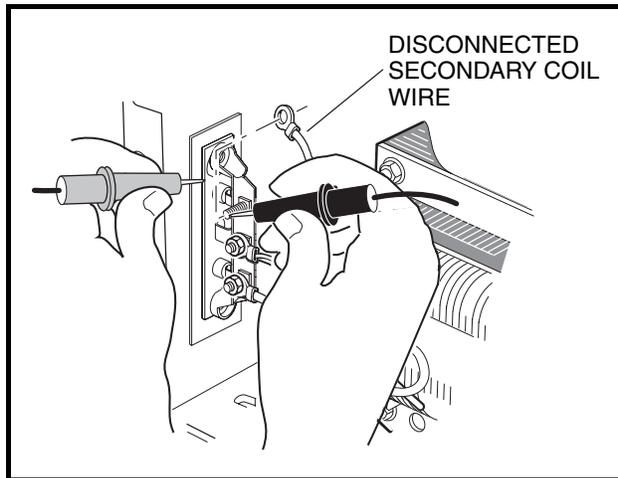


Figure 3-13 Diode Test

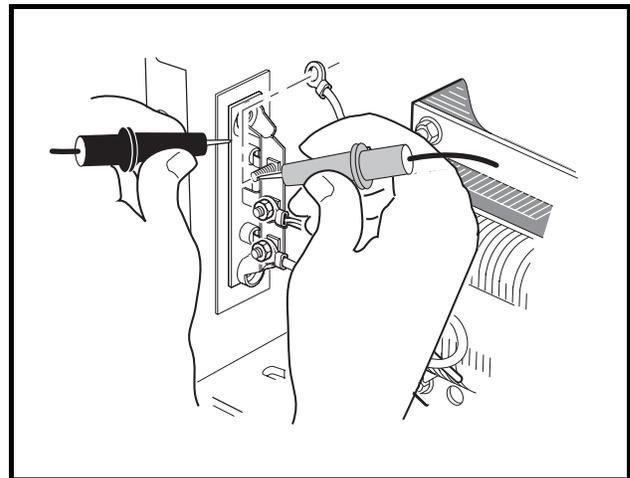


Figure 3-14 Diode Test – Probes Reversed

Test Procedure 4B – Both Diodes Failed

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

To check the diodes, use Test Procedure 4A – Single Diode Failure on page 3-16. 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 and the AC circuit breaker may trip off. If both diodes have failed open or closed, the entire heatsink must be replaced. To determine why both diodes failed:

1. Check the batteries and the receptacle to ensure that they are wired in the correct polarity (**Figure 3-2, Page 3-3 or Figure 3-3, Page 3-4**). Also check the voltage and polarity at the receptacle.
2. Make sure the charger is wired correctly: The DC cord red wire should be connected to the center terminal of the heatsink, the DC cord blue wire should be connected to the relay coil, and the DC cord black wire should be connected to the left side of the ammeter (when viewed from inside the charger) (**Figure 3-7, Page 3-8**). If a reverse polarity connection is made between the charger and the batteries, both fuse links will blow when the DC cord is connected to the vehicle, whether or not the AC cord is plugged into an outlet.
3. On rare occasions, both diodes may fail as a result of a lightning strike at the charging location.
4. Excessive heat due to a loose connection may also cause both fuse links to blow. Be sure fuse connections are tightened to 22 in-lb (2.5 N·m).
5. Ensure that the charger and vehicle are wired properly and all connections are clean and tight.

TEST PROCEDURE 5 – CHARGER DC CIRCUIT CONTINUITY TEST

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Using a continuity tester (CCI P/N 1011273) or multimeter set to 200 ohms, connect the test probes to the pins marked (+) and (–) on the DC plug (**Figure 3-15, Page 3-18**). Note the reading.
3. Reverse the test probes and check the DC plug again (**Figure 3-16, Page 3-18**). The circuit should show continuity in only one direction.
4. If the circuit does not show continuity in either direction and the charger fuse is not blown, individually check all connections and the continuity of the DC cord and ammeter. **See Test Procedure 8 – Continuity on page 3-20**. Also check the diodes (heatsink). **See Test Procedure 4 – Diodes on page 3-16**.
5. 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 – Diodes on page 3-16**. If diodes have not failed, check the DC cord for a short circuit. **See Test Procedure 8 – Continuity on page 3-20**.
6. Remove the DC cord blue wire from the red wire connected to the charger relay and check continuity between the positive and negative pins and middle pin on the DC plug (**Figure 3-7, Page 3-8 and Figure 3-8, Page 3-12**). There should be no continuity.

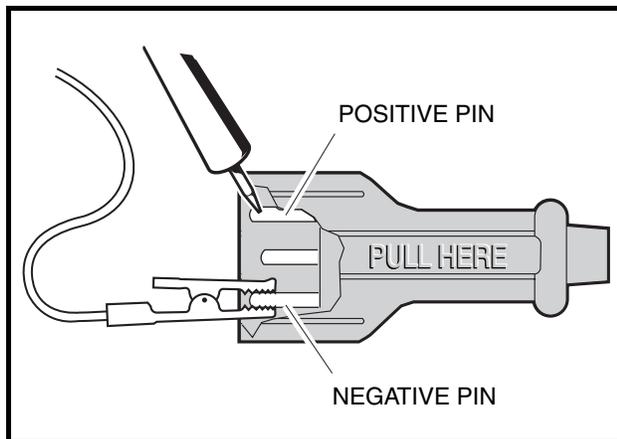


Figure 3-15 DC Plug Test

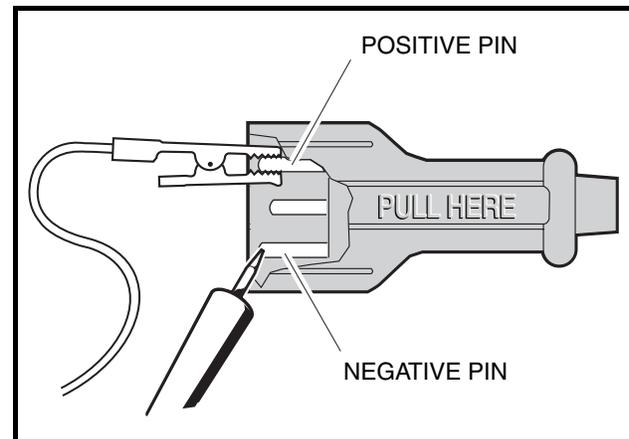


Figure 3-16 DC Plug Test – Probes Reversed

TEST PROCEDURE 6 – TRANSFORMER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

Failure of the transformer may be caused by aging or a short circuit in adjacent coil turns. If the transformer has failed, the ammeter will indicate low output or no output; however, the transformer may hum. A blown AC line fuse or tripped AC circuit breaker in the charger or the storage facility may be caused by an improperly wired charger or a failed transformer.

An AC circuit test should be done before performing this test procedure to ensure the continuity of the AC cord, internal AC circuit breaker, and charger wiring. **See Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 3-15**.

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect transformer secondary coil wires (1 and 5) from the heatsink (**Figure 3-17, Page 3-19**).

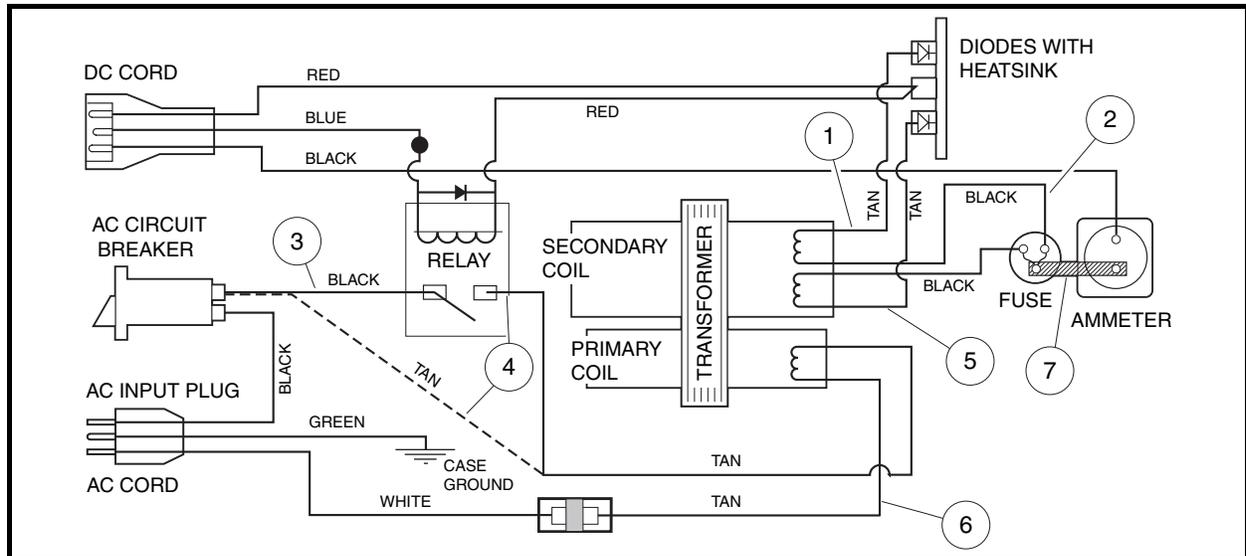


Figure 3-17 Transformer Test Wiring Diagram

4. To apply AC power directly to the transformer primary coil, the relay must be bypassed.
 - 4.1. To bypass the relay, remove the black wire (3) from the AC circuit breaker and disconnect the tan wire (4) from the relay. Connect the tan wire (4) to the AC circuit breaker (**Figure 3-17, Page 3-19**). See following **DANGER**.

⚠ DANGER

- Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.
5. Make sure the secondary coil wires are not touching one another. With the relay bypassed, insert the AC plug into an outlet. If the AC line fuse blows or AC circuit breaker trips, the transformer is shorted internally and must be replaced.
 6. If the AC line fuse does not blow or the AC circuit breaker does not trip, check the transformer secondary coil voltage.
 7. Disconnect AC cord from the wall outlet.
 8. Using alligator clips and a multimeter set to 500 volts AC, connect the multimeter probes to the secondary transformer coil wires (1 and 5).
 9. Connect the AC cord to the wall outlet and monitor the multimeter for the secondary coil voltage. If measured voltage is approximately 85 volts AC or lower for the secondary coil, the transformer is shorted internally and must be replaced (**Figure 3-17, Page 3-19**).
 10. If the voltage reading is normal (86 volts AC or higher), the transformer is operational. Disconnect the AC plug from the wall receptacle and check the continuity of the DC circuit. See **Test Procedure 5 – Charger DC Circuit Continuity Test on page 3-18**.
 11. When troubleshooting and repairs are complete, properly connect relay wiring. See following **WARNING**.

⚠ WARNING

- The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.

TEST PROCEDURE 7 – BATTERY STATE OF CHARGE TEST

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

1. With the batteries fully charged, disconnect the DC charger plug for approximately 20 seconds and then reconnect it. The ammeter should jump to a reading between 14 and 18 amps and then taper to below 5 amps within 15 minutes.
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 – Onboard Computer on page 3-15. See following NOTE.

NOTE: Batteries near the end of their useful lives may not allow the battery charge current to taper below 5 amps. See Section 13 – Batteries in the appropriate maintenance and service manual.

TEST PROCEDURE 8 – CONTINUITY

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

AC Cord

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the green wire (2) from charger case and position it so it does not touch any metal part of the charger (**Figure 3-18, Page 3-20**).
4. Disconnect the black wire (1) of AC cord from charger AC circuit breaker (3).
5. Disconnect the AC cord white wire (4) from the primary coil tan wire.
6. Using a multimeter set for 200 ohms, place the red (+) probe on the terminal at the end of the black wire (1). Test for continuity on each of the flat blades and then on the round pin of the AC plug. The tester should indicate continuity on one flat blade only. If any other reading is obtained, the AC cord and plug must be replaced.
7. Place 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 round pin of the AC plug (**Figure 3-18, Page 3-20**). The tester should indicate continuity on only the round pin. If any other reading is obtained, the AC cord and plug must be replaced.
8. Place the red (+) probe on the white wire (4) and check for continuity on both flat blades and on the ground pin of the AC plug. The tester should indicate continuity on only one flat blade. If any other reading is obtained, the AC cord and plug must be replaced.

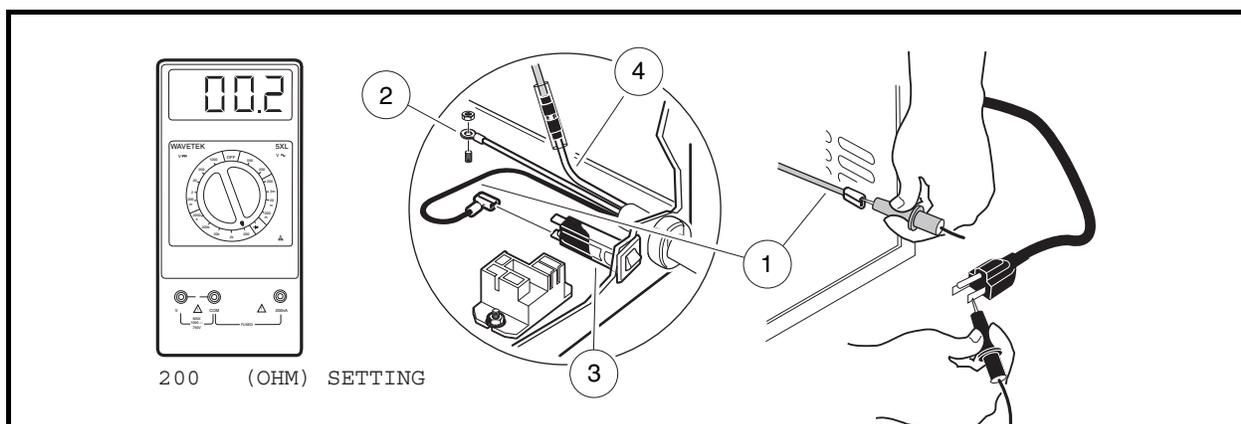


Figure 3-18 AC Cord and Plug Continuity Test

DC Cord

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. To check the continuity of the DC cord, disconnect the black wire of the DC cord from the ammeter **(Figure 3-19, Page 3-23)**.
4. Disconnect the red wire of the DC cord from the heatsink.
5. Disconnect the blue wire from the red wire assembly that connects to the charger relay.
6. Place the clip of the continuity tester on the red wire of the DC cord.
7. Place the continuity test probe on the positive (+) pin of the DC plug (positive (+) and negative (-) pins are identified on the plug). If tester does not indicate continuity, the DC cord must be replaced.
8. Place the continuity test probe on the negative (-) pin of the DC plug. The tester should indicate no continuity. If tester registers continuity, the DC cord must be replaced.
9. Place the continuity test probe on the unmarked (middle) pin of the DC plug. The tester should indicate no continuity. If tester registers continuity, the DC cord must be replaced.
10. Move the continuity tester clip to the black wire of the DC cord.
11. Place the continuity test probe on the negative (-) pin of the DC plug. The tester should indicate continuity. If tester does not indicate continuity, the DC cord must be replaced.
12. Place the continuity test probe on the unmarked (middle) pin of the DC plug. The tester should indicate no continuity. If tester registers continuity, the DC cord must be replaced.
13. Move continuity test probe to the blue wire of the DC cord. Check for continuity at the middle pin. The tester should indicate continuity. If tester does not indicate continuity, replace DC cord.

Transformer

The PowerDrive battery charger transformer has two sets of coils: a primary coil and a secondary coil **(Figure 3-17, Page 3-19)**.

Primary Coil

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect terminals from transformer (tan) primary coil transformer wires (4 and 6) **(Figure 3-17, Page 3-19)**.
4. Place the continuity tester probes on the disconnected primary coil transformer wires. The tester should indicate continuity. If tester does not indicate continuity, replace the transformer.

Secondary Coil

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove the transformer (tan) secondary coil wire (1) from the upper terminal of the heatsink **(Figure 3-17, Page 3-19)**.
4. Remove the other transformer (tan) secondary coil wire (5) from the bottom terminal of the heatsink and place the continuity test clip on the ammeter buss bar (7) **(Figure 3-17, Page 3-19)**. Test for continuity between the buss bar and each of the secondary coil wires (tan). The tester should indicate continuity between the buss bar and both of the secondary coil wires. If tester does not indicate continuity on both secondary coil wires, replace transformer. Ensure that the fuse is intact and not blown.

Test Procedure 8 – Continuity, Continued:**Voltage Suppressor – Failed Closed**

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Using a multimeter set to the diode test function ($\rightarrow|$), place the black (-) probe of the multimeter on the sense lead pin (short pin) of the DC plug. Place the red (+) probe on the positive (+) pin of the DC plug. The multimeter should indicate no tone. If a tone is emitted (indicating a closed circuit) then the voltage suppressor has failed and should be replaced. **See following NOTE.**

NOTE: All vehicles except Precedent: Repeated failure of sense lead fuses is a symptom of a voltage suppressor that has failed in a closed condition.

Precedent vehicles only: Failure of the onboard computer due to a blown internal sense lead fuse is a symptom of a voltage suppressor that has failed in a closed condition.

Relay

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove black (3) and tan (4) wires from contact terminals of the relay (**Figure 3-17, Page 3-19**). Place continuity test probes on contact terminals of the relay. The tester should indicate no continuity. If tester indicates continuity, the relay contacts have failed closed and the relay must be replaced.
4. Place continuity test probes on contact terminals of relay. With batteries connected, insert DC plug into receptacle. The tester should indicate continuity. If tester does not indicate continuity, relay must be replaced.

Ammeter

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the black wire from the left ammeter post (as viewed from inside the charger).
4. Place the continuity tester clip on one of the ammeter posts.
5. Place the continuity test probe on the other ammeter post. The tester should indicate continuity. If the tester does not indicate continuity, replace the ammeter.

AC Circuit Breaker

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the wires from the AC circuit breaker.
4. Place the continuity test probes on the two terminals of the AC circuit breaker. The tester should indicate continuity. If the tester does not indicate continuity, replace the AC circuit breaker.

CHARGER REPAIRS

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

⚠ WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 3-7, Page 3-8).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.

DC CORD

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

DC Cord Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove the DC cord black wire (4) from the ammeter by loosening the nut (1). Support the terminal as the nut is loosened to prevent rotation of the connection (Figure 3-20, Page 3-23).
4. Remove nut attaching the red wire (6) of the charger DC cord to the heatsink.
5. Remove the wire tie that secures the DC cord wire to the secondary coil wire (tan).
6. Remove the wire tie on the DC cord near the strain relief bushing.
7. Disconnect the DC cord blue wire from the red wire assembly that connects to the charger relay (Figure 3-19, Page 3-23).
8. Using pliers, squeeze the strain relief bushing and remove the DC cord (Figure 3-19, Page 3-23).

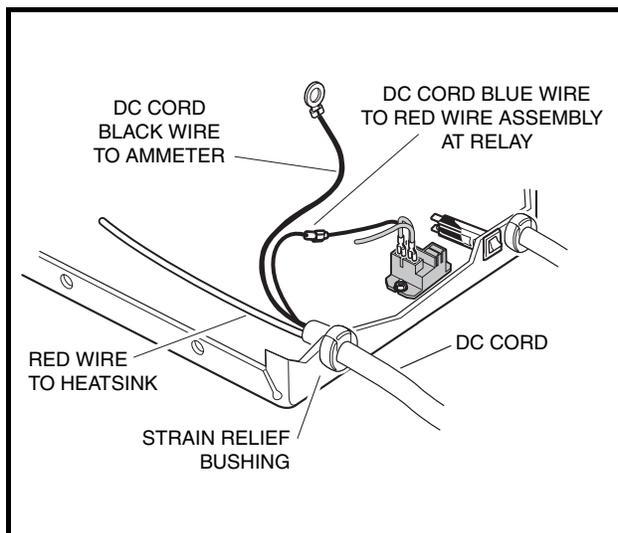


Figure 3-19 DC Cord

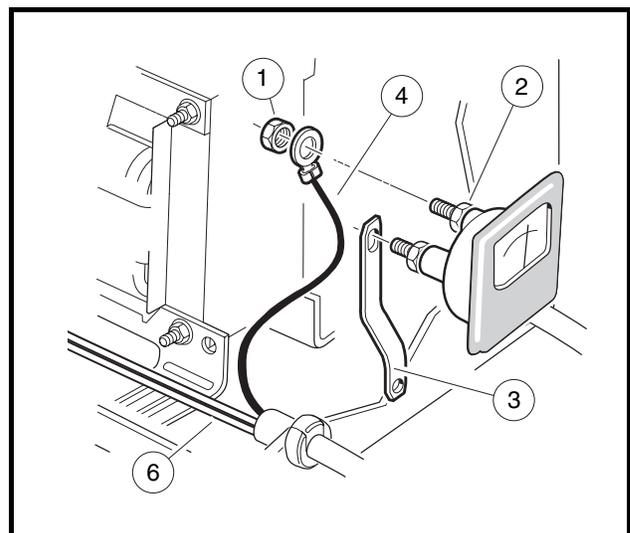


Figure 3-20 DC Cord Replacement

DC Cord Installation

1. Insert the leads of the new DC cord through the hole in the charger base.
2. Attach the red wire of the new DC cord to the center terminal of the heatsink and tighten the nut to 18 in-lb (2.0 N·m) (**Figure 3-19, Page 3-23**).
3. Attach the blue wire of the new DC cord to the red wire assembly at the charger relay (**Figure 3-19, Page 3-23**).
4. Attach black wire (4) of the new DC cord to ammeter. Install nut (1) onto post of ammeter slightly more than finger tight. While holding the inside nut (2), tighten the outside nut (1) 1/4 turn (**Figure 3-20, Page 3-23**). **See following CAUTION.**

CAUTION

- **Do not allow ammeter post to rotate as the nut is tightened. Rotation of the post could result in a damaged ammeter.**
5. Using pliers, put the strain relief bushing on the cord and insert it into the charger base.
 6. Tie the wires together as they were before the wire tie was removed. **See following WARNING.**

WARNING

- **Make sure wiring is properly routed and secured. Failure to properly route and secure wiring could result in charger malfunction, property damage, or severe personal injury.**
7. Position the charger cover on the base. Install the mounting screws, starting with the bottom holes. Tighten the screws to 11 in-lb (1.2 N·m).

HEATSINK

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

Heatsink Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove both secondary coil transformer wires (tan) from the heatsink (**Figure 3-7, Page 3-8 and Figure 3-8, Page 3-12**).
4. Remove the two red wires from the heatsink.
5. Remove the nuts and bolts that secure the heatsink to the case.

Heatsink Installation

1. Place heatsink against charger base. Make sure clear plastic insulator sheet is between the heatsink and the charger base. Install the nuts and bolts that secure the heatsink to the case. Tighten the bolts to 18 in-lb (2.0 N·m) (**Figure 3-7, Page 3-8 and Figure 3-8, Page 3-12**).
2. Connect the red wire from the DC cord and the red wire from the charger relay to the center terminal post on the heatsink. Tighten nut to 18 in-lb (2.0 N·m).
3. Connect one of the secondary coil transformer wires (tan) to the bottom terminal post of the heatsink. Tighten nut to 18 in-lb (2.0 N·m).

4. Connect the other secondary coil transformer wire (tan) to the top terminal post of the heatsink. Tighten nut to 18 in-lb (2.0 N·m).
5. Install the charger cover and check charger for proper operation.

TRANSFORMER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

Transformer Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the tan primary coil wire from the charger relay (**Figure 3-7, Page 3-8 and Figure 3-8, Page 3-12**).
4. Disconnect the AC cord white wire from the primary coil tan wire.
5. Remove the wire tie that secures the DC cord wire to the secondary coil wire (tan).
6. Disconnect the two tan secondary coil transformer wires from the heatsink (**Figure 3-7, Page 3-8 and Figure 3-8, Page 3-12**).
7. Disconnect the two black secondary coil transformer wires from the fuse.
8. Remove the four bolts and nuts that mount the transformer to the case and remove the transformer.

Transformer Installation

1. Install the transformer with secondary coil to the rear of the charger case. Tighten the four bolts and nuts to 28 in-lb (3.2 N·m) (**Figure 3-8, Page 3-12**).
2. Connect one secondary coil transformer wire (black) to one terminal of the fuse. Tighten nut to 22 in-lb (2.5 N·m).
3. Connect the other secondary coil transformer wire (black) to the remaining terminal of the fuse. Tighten nut to 22 in-lb (2.5 N·m).
4. Connect one secondary coil transformer wire (tan) to the top terminal post of the heatsink. Tighten nut to 18 in-lb (2.0 N·m).
5. Connect the other secondary coil transformer wire (tan) to the bottom terminal post of the heatsink. Tighten nut to 18 in-lb (2.0 N·m).
6. Connect the tan primary coil transformer wire to the charger relay.
7. Connect the other tan primary coil transformer wire to the white wire from the AC cord.
8. Tie the wires together as they were before the wire tie was removed. **See following WARNING.**

⚠ WARNING

- **Make sure wiring is properly routed and secured. Failure to properly route and secure wiring could result in charger malfunction, property damage, or severe personal injury.**

9. Install the charger cover and check charger for proper operation.

AMMETER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

Ammeter Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the black wire from the DC cord (5), and the buss bar (3) from the ammeter (**Figure 3-21, Page 3-26**).
4. Remove the two nuts (2) that secure the ammeter to the charger face.
5. Remove the ammeter from the face of the charger.

Ammeter Installation

1. Place the ammeter in position in the charger face (**Figure 3-21, Page 3-26**).
2. Install nuts (2) and tighten until ammeter is firmly secured.
3. Connect the black wire of the DC cord (5) to the left (as viewed from inside the charger) post of the ammeter.
4. Connect the buss bar (3) from the fuse link to the right post of the ammeter. Place flat washers on both sides of the buss bar.
5. Thread nuts (4) onto both posts of ammeter until just past finger tight. While holding the inside nut, tighten the outside nut (4) 1/4 turn. **See following CAUTION.**

CAUTION

- Do not allow ammeter post to rotate as the nut is tightened. Rotation of the post could result in a damaged ammeter.

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

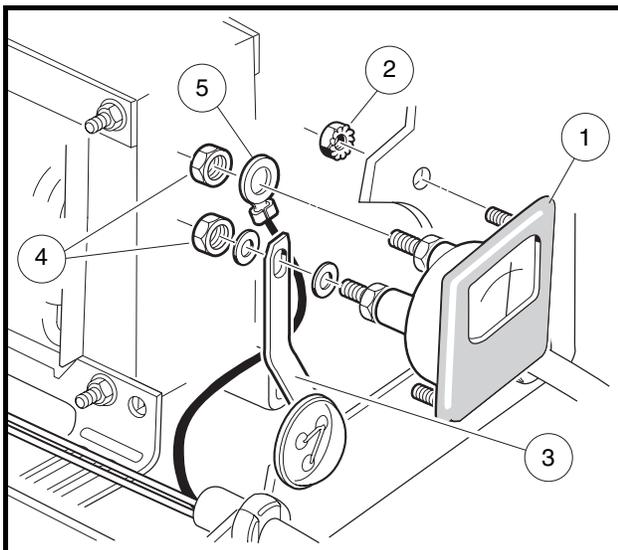


Figure 3-21 Ammeter

FUSE LINK

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

Fuse Link Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove both black secondary coil transformer wires and the buss bar from the back of the fuse link assembly (**Figure 3-21, Page 3-26**).
4. Remove screws from the front of the charger and remove the fuse link assembly.

Fuse Link Installation

1. Place clear 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 buss bar (3) over the center branch of the fuse assembly and ammeter post (**Figure 3-21, Page 3-26**). Tighten to 22 in-lb (2.5 N·m).
3. Install a secondary coil transformer wire (black) onto one of the two remaining terminals on the back of the fuse assembly. Install the remaining secondary coil transformer wire (black) onto the remaining terminal. Tighten to 22 in-lb (2.5 N·m).
4. Install the charger cover.

VOLTAGE SUPPRESSOR

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

The voltage suppressor, which is incorporated into a wire assembly in the charger, 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 on page 3-20.**

Voltage Suppressor Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove nut attaching voltage suppressor (18-gauge red wire) to heatsink (**Figure 3-22, Page 3-29**).
4. Disconnect the blue and red wires from the relay.
5. Disconnect the DC cord blue wire at the quick disconnect terminal.
6. Remove the voltage suppressor and wire assembly from the charger.

Voltage Suppressor Installation

1. Install in reverse order of removal. Tighten nut attaching voltage suppressor (18-gauge red wire) to heatsink 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 (**Figure 3-22, Page 3-29**).

CHARGER RELAY

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

Charger Relay Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect all wires from the relay (**Figure 3-22, Page 3-29**).
4. Remove two nuts and lock washers attaching relay to the charger case.
5. Remove the relay.

Charger Relay Installation

1. Install in reverse order of removal. Connect wires as shown (**Figure 3-22, Page 3-29**). Tighten nut securing relay to charger base to 18 in-lb (2.0 N·m).

CHARGER AC CIRCUIT BREAKER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

AC Circuit Breaker Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the two black wires attached to the AC circuit breaker (**Figure 3-22, Page 3-29**).
4. With a pair of pliers, squeeze in the retaining tabs on the sides of the AC circuit breaker and remove the circuit breaker through the mounting hole in the face of the charger.

AC Circuit Breaker Installation

1. Install in reverse order of removal.

CHARGER AC CORD

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

AC Cord Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the AC cord black wire from the AC circuit breaker (**Figure 3-22, Page 3-29**).
4. Disconnect the AC cord white wire from the primary coil tan wire.
5. Disconnect the AC cord green wire from the charger base (**Figure 3-22, Page 3-29**).
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 3-22, Page 3-29**).
2. Connect the black wire to the AC circuit breaker, the white wire to the primary coil, and the green wire to the charger base. Tighten the screw on the green (ground) wire terminal to 18 in-lb (2.0 N·m).
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.

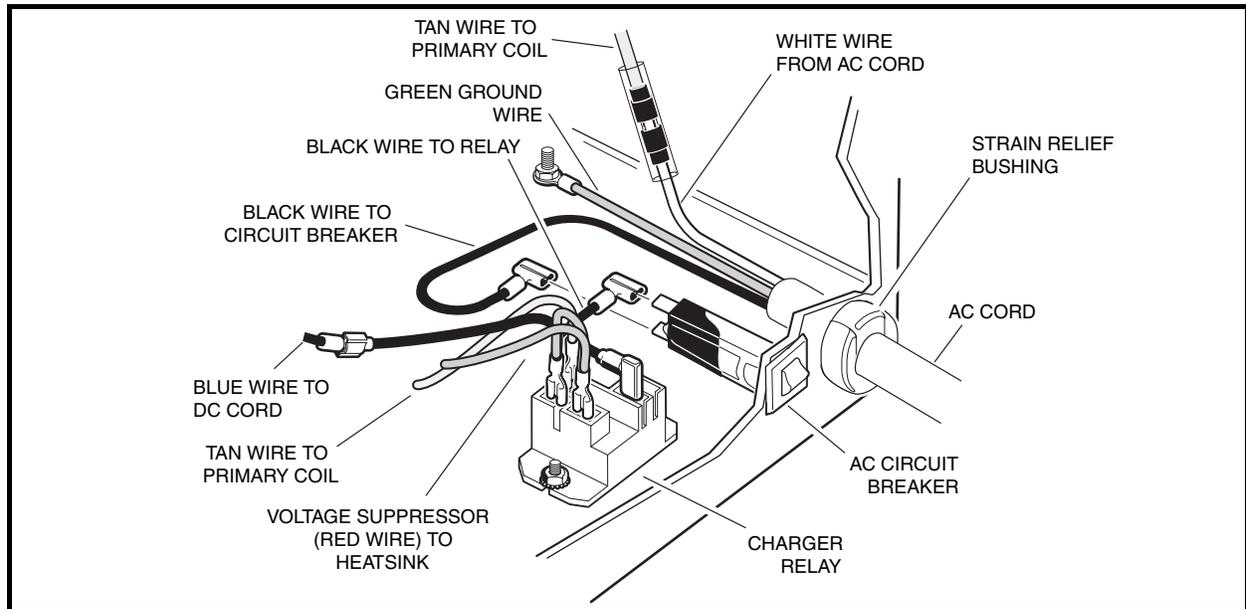


Figure 3-22 Charger Relay

CHARGING A BATTERY PACK THAT HAS LOW VOLTAGE

See General Warning, Section 1, Page 1-1. See additional WARNING on page 3-1.

If battery pack voltage is below 34 volts, the charger will not activate. The charger relay will have to be bypassed to activate the charger. See following WARNING.

⚠ WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 3-7, Page 3-8).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.

1. Turn key switch OFF and place the Forward/Reverse handle in the NEUTRAL position. Leave the batteries connected.
2. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
3. Remove the charger cover.
4. To apply AC power directly to the transformer primary coil, the relay must be bypassed.
 - 4.1. To bypass the relay, remove the black wire (3) from the AC circuit breaker and disconnect the tan wire (4) from the relay. Connect the tan wire (4) to the AC circuit breaker (Figure 3-23, Page 3-30). See following DANGER.

11. Allow the charger to continue charging the batteries until the charger shuts off automatically.
12. 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 in the appropriate maintenance and service manual.**

SECTION 4 – CARRYALL 6 AND TRANSPORTER POWERDRIVE CHARGER (ONBOARD)

⚠ DANGER

- See General Warning, Section 1, Page 1-1.

⚠ WARNING

- See General Warning, Section 1, Page 1-1.

GENERAL INFORMATION

This section includes information pertaining to service of the onboard PowerDrive battery charger (model numbers 17935-10, 17935-20, and 17935-30) as installed on the Carryall 6 or TransPorter vehicle only. For battery charger models other than those listed above, refer to the appropriate section in the appropriate battery charger maintenance and service manual.

Do not attempt to service a battery charger that has not been properly identified. If a charger cannot be properly identified, contact your local Club Car dealer or distributor.

For battery chargers with model numbers listed above that are installed in vehicles other than Carryall 6 and TransPorter vehicles, contact your local Club Car dealer or distributor.

The PowerDrive battery charger is automatic and has no external controls (**Figure 4-1, Page 4-1**). When the charger is connected, there is a 2 to 15 second delay before charging begins. The onboard computer (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 shuts off automatically, preventing the possibility of either undercharging or overcharging. **See following NOTE.**

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.

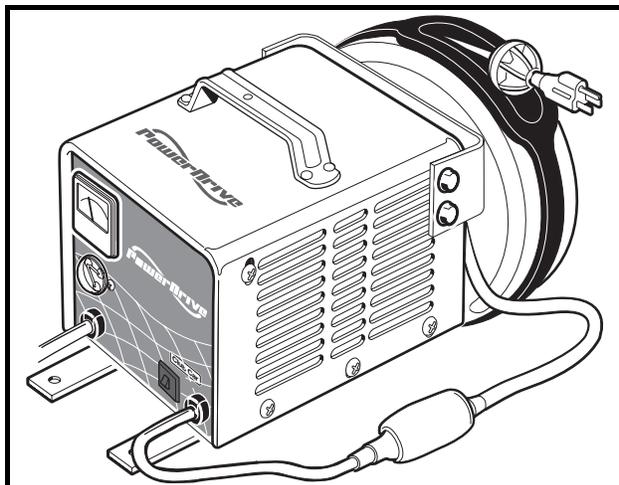


Figure 4-1 Onboard PowerDrive Battery Charger

POWERDRIVE ONBOARD CHARGER FEATURES

- **Charge Interlock:** When the AC power cord is inserted into a wall 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 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 AC cord from the wall outlet, wait 15 seconds and then plug the AC cord back in. The charger will activate. Allow the vehicle to complete one full charge cycle before putting it into service.

BATTERY WARNING LIGHT

The PowerDrive System 48 vehicle features a dash-mounted battery warning light that alerts the operator to any problems with the batteries or charging system. The battery warning light is controlled by the onboard computer (OBC).

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

- The battery 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 AC cord is unplugged during a charge cycle, 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 operator that the vehicle may be used, but that it must be charged to completion as soon as possible.
- The battery 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 CHARGE CIRCUIT

For Carryall 6 and TransPorter vehicles with onboard chargers, the charge circuit consists of the following:

- onboard charger
- onboard computer
- batteries

The black wire from the charger is connected to the terminal block. The 10-gauge black wire from the onboard computer connects to the terminal block, 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 red wire of the charger is connected to the large post of the solenoid (battery side). The blue wire (sense lead) from the charger is connected to the sense lead fuse, which is connected to the gray wire from the onboard computer (**Figure 4-2, Page 4-3**).

To check the charge circuit, check the connections between the 18-gauge gray wire from the OBC, the sense lead fuse, DC cord red wire, DC cord black wire, and the wire connections between the batteries.

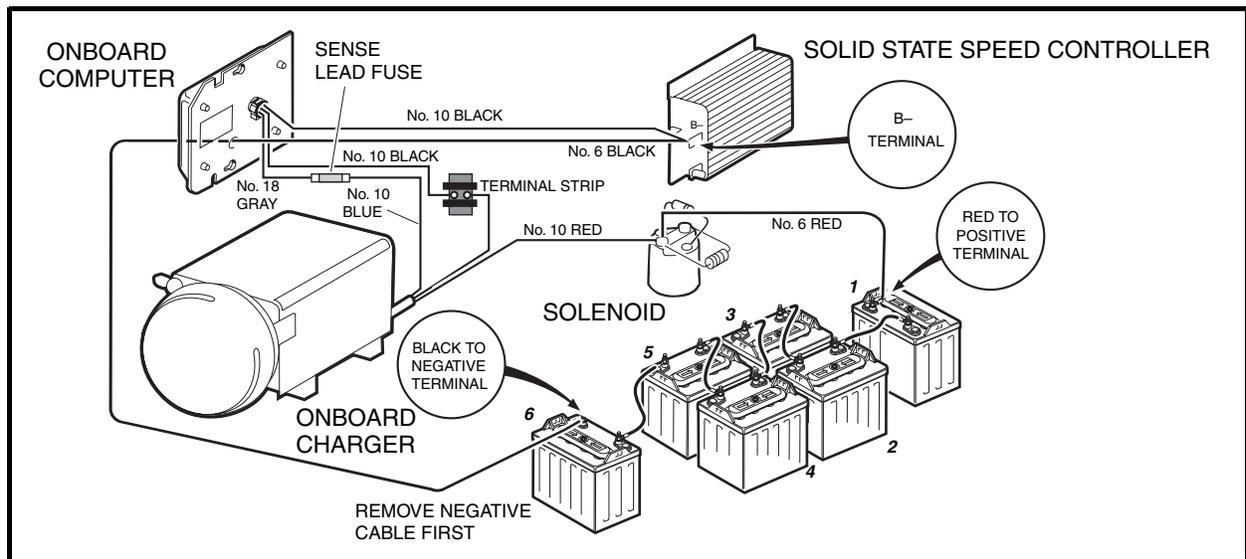


Figure 4-2 Charge Circuit and Battery Configuration – Carryall 6 and Transporter Vehicles

CHARGER OPERATION

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- The charging area must be ventilated. Hydrogen level in the air must never exceed 2%. The total volume of air in the charging area must be changed five times per hour. Exhaust fans should be located at the highest point of the roof. Contact a local HVAC engineer.
- Do not charge the vehicle batteries with the vehicle covered or enclosed. Any enclosure or cover should be removed or unzipped and pulled back when batteries are being charged. An accumulation of hydrogen gas could result in an explosion.

⚠ WARNING

- Do not bypass the sense lead fuse.
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and remove the battery charger from the vehicle. See Onboard Charger Removal on page 4-30.
- Do not connect the charger to battery packs that are not compatible with the DC output voltage specified on the charger. Overheating and transformer burnout will result.
- Do not use a battery charger if the cord, plug, or receptacle is damaged in any way. Replace worn or damaged parts immediately. Failure to heed this warning could result in a fire, property damage, severe personal injury, or death.
- Do not use a battery 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.

WARNING CONTINUED ON NEXT PAGE...

⚠ WARNING

- 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.
- 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 an extension cord. AC outlet must accept grounded three-blade plug. The use of an extension cord could result in fire or electric shock.
- Do not operate a battery 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.
- 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.
- Do not block or cover the charger ventilation slots. The slots provide ventilation and prevent the charger from overheating.
- Do not allow clothing, blankets, or other materials to cover the charger.
- Do not allow the charger to operate for more than 30 minutes at 19 or more amperes.
- Install surge arrestors on incoming AC power lines. Surge arrestors will help protect electrical components in the charger and on the vehicle from all but direct or close lightning strikes.

AC Power Connection

The AC line to which the charger is to be connected must be of the proper AC input voltage for the charger and must be capable of supplying sufficient current. **See Section 2 – Charger Identification and Specifications.**

Connect the power supply cord to an AC supply. **See Section 2 – Charger Identification and Specifications.**

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. 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.

Place the charger AC cord so it will not be stepped on, tripped over, or otherwise subject to damage or stress. The use of an extension cord with the onboard charger should be avoided.

Do not place items in the compartment where the battery charger is installed. Ensure that the charger ventilation slots are unobstructed.

Normal Charger Operation

1. With the charger DC cord disconnected from the vehicle charger receptacle, connect the AC power supply cord to an AC outlet designed to provide the proper AC voltage for the charger.
2. The charger will activate automatically within 2 to 15 seconds.
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 the nominal input voltage. Higher AC line voltages increase the initial charge rate while lower AC line voltages reduce the initial charge rate.
4. Monitor the ammeter for about 30 seconds. Under normal operating conditions (when the charger is on and the batteries are discharged), 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 CAUTION and NOTE.**

CAUTION

- Do not connect an external charger to the receptacle of a vehicle equipped with an onboard charger while the onboard charger is activated. Charging overload will damage the onboard computer and may cause battery damage.

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.

Batteries should be put on charge at the end of each day even if the vehicle has been used for only a short amount of time (even if for only 10 minutes).

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.

New batteries will not deliver their full range until the vehicle has been driven and recharged from 20 to 50 times.

Vehicles should be restricted to 40 to 50 energy units of discharge (or 36 holes of golf) between charges until the batteries have been properly seasoned (20 to 50 charge cycles). For maximum battery life, Club Car recommends that electric vehicles always be recharged after 40 to 50 energy units of discharge or each night in order to avoid deep discharging the batteries. Charging between rounds will also extend battery life; use the CDM (Communication Display Module) (CCI P/N 101831801). **See Communication Display Module in Section 11 of the appropriate maintenance and service manual.**

Testing Charger Operation

1. Connect the AC power supply cord to a 120-volt AC, 60-hertz, single-phase outlet. The charger relay should not close immediately, but should close with an audible click after a delay of 2 to 15 seconds. **See following NOTE.**

NOTE: Monitor the charge cycle to make sure the charger turns off properly. If the charge cycle is interrupted, and the batteries are less than 90% charged, the battery warning light will illuminate intermittently. **See Battery Warning Light on page 4-2.**

2. If the charger does not operate exactly as described above, refer to the wiring diagram and make sure that the vehicle is wired correctly (**Figure 4-2, Page 4-3**) and that the internal charger wiring is correct (**Figure 4-3, Page 4-5**).

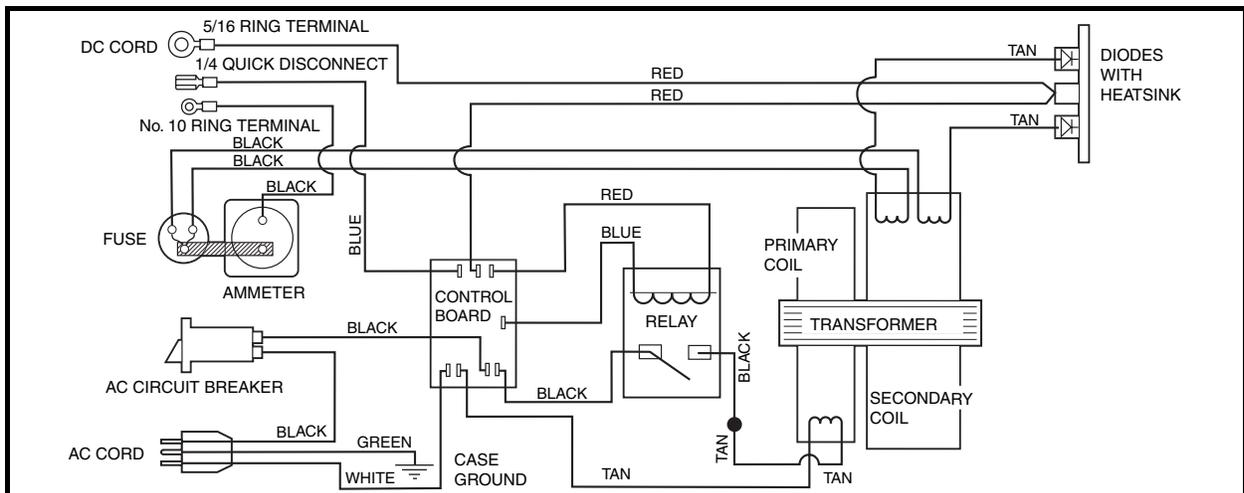


Figure 4-3 PowerDrive Onboard Battery Charger Wiring Diagram

CHECKING BATTERY CONDITION

See General Warning, Section 1, Page 1-1.

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 battery charger this practice is not necessary. The onboard computer controls and monitors the charge cycle. If any problem occurs 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 chart. **See Troubleshooting on page 4-7.** If the specified test procedures identify no problems, plug the AC cord into a wall outlet and let it charge until the charger shuts off automatically. If a problem is found, correct it and then charge the vehicle. Normal battery voltage near the end of a charge cycle should be approximately 59 to 63 volts DC while the charger is still operating.

Start Charge Cycle

1. Disconnect the AC plug from the wall outlet.
2. Wait 20 seconds, then reconnect the AC cord to the wall outlet. **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 continues. If the batteries are close to being fully charged, the charge cycle will begin and the charge current will begin to taper within a few minutes.

TROUBLESHOOTING

See General Warning, Section 1, Page 1-1.

DANGER

- Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.

WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 4-3, Page 4-5).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and remove the battery charger from the vehicle. See Onboard Charger Removal on page 4-30.

Use the following Troubleshooting Guide for troubleshooting PowerDrive onboard battery chargers (model numbers 17935-10, 17935-20, and 17935-30) installed in Carryall 6 and TransPorter vehicles. The Trouble-

shooting Guide encompasses the entire battery charging circuit. Test procedures specified in the Troubleshooting Guide can be found on the following pages.

POWERDRIVE ONBOARD BATTERY CHARGER TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Relay does not close, no transformer hum and ammeter does not move	Batteries disconnected	Connect batteries (Figure 4-2, Page 4-3)
	Battery voltage is too low	Test Procedure 1 – Battery Voltage on page 4-9
	Improper vehicle or battery charger wiring	See Figure 4-2, Page 4-3 and Figure 4-3, Page 4-5
	DC circuit	Test Procedure 5 – Charger DC Circuit Continuity Test on page 4-14
	Onboard computer malfunction	Test Procedure 2 – Control Board on page 4-10
	Gray sense lead fuse is blown	Test Procedure 1 – Battery Voltage on page 4-9
	Control board malfunction	Test Procedure 2 – Control Board on page 4-10
Relay closes with an audible click but no transformer hum and ammeter does not move	Improper AC line voltage	Test Procedure 3 – AC Power and Continuity Check of AC Circuit on page 4-11
	Failed AC plug and cord	Test Procedure 3 – AC Power and Continuity Check of AC Circuit on page 4-11
	Failed AC cord reel	Test Procedure 8 – Continuity on page 4-16
	Internal AC breaker	Test Procedure 3 – AC Power and Continuity Check of AC Circuit on page 4-11
	Transformer primary coil	Test Procedure 6 – Transformer on page 4-15
	Relay	Test Procedure 8 – Continuity on page 4-16
Relay closes and transformer hums but ammeter does not move	Blown charger fuse	Test Procedure 4 – Diodes on page 4-12
	Both Diodes failed	Test Procedure 4B – Both Diodes Failed on page 4-13
	Onboard computer malfunction	Test Procedure 2 – Control Board on page 4-10
	Failed transformer	Test Procedure 6 – Transformer on page 4-15
	Failed ammeter	Replace ammeter
Relay operates intermittently	Failed charger relay	Test Procedure 8 – Continuity on page 4-16
Single charger fuse link blows	Diode failed	Test Procedure 4A – Single Diode Failure on page 4-12
	Loose internal fuse connection	Tighten connection
Troubleshooting Guide continued on next page...		

POWERDRIVE ONBOARD BATTERY CHARGER TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Both charger fuse links blow or receptacle fuse link blows	Battery is wired in reverse polarity	Check vehicle wiring
	DC cord is wired in reverse polarity	Check battery charger wiring
	Both diodes failed	Test Procedure 4B – Both Diodes Failed on page 4-13
Charger output is low	One diode failed	Test Procedure 4A – Single Diode Failure on page 4-12
	Transformer coil short-circuit failure	Test Procedure 6 – Transformer on page 4-15
	Onboard computer malfunction	Test Procedure 2 – Control Board on page 4-10
Charger turns off too soon	AC power supply was shut off	Test Procedure 3 – AC Power and Continuity Check of AC Circuit on page 4-11
	Onboard computer malfunction	Test Procedure 2 – Control Board on page 4-10
	Batteries may be fully charged	Test Procedure 7 – Battery State of Charge Test on page 4-16
Charger goes to 16 hour time out	Onboard computer malfunction	Test Procedure 2 – Control Board on page 4-10
	Extremely discharged batteries or cold temperature	Recharge batteries
	Failed or weak battery	See Section 13 – Batteries in the appropriate maintenance and service manual
AC line fuse blows or AC circuit breaker trips	AC cord is shorted	Test Procedure 8 – Continuity on page 4-16
	Failed transformer	Test Procedure 6 – Transformer on page 4-15
	Incorrect charger wiring	Check battery charger wiring
Battery warning light illuminates for ten seconds at four second intervals	AC power interrupted	Test Procedure 3 – AC Power and Continuity Check of AC Circuit on page 4-11
	Onboard computer malfunction	Test Procedure 2 – Control Board on page 4-10
	Charger failure	See Testing Charger Operation on page 4-5
	16 hour time out	See Battery Warning Light on page 4-2
	Battery or batteries need to be replaced	See Section 13 – Batteries in the appropriate maintenance and service manual
	Batteries are getting close to full discharge capacity	Recharge batteries as soon as possible

TEST PROCEDURES

See General Warning, Section 1, Page 1-1.

INDEX OF TEST PROCEDURES

1. Battery Voltage
2. Control Board
3. AC Power and Continuity Check of AC Circuit
4. Diodes
5. Charger DC Circuit Continuity Test
6. Transformer
7. Battery State of Charge Test
8. Continuity

TEST PROCEDURE 1 – BATTERY VOLTAGE

See General Warning, Section 1, Page 1-1.

1. Check the wire connections between the vehicle and battery charger (**Figure 4-2, Page 4-3**).
 - 1.1. Verify that the 10-gauge red wire from the battery charger is connected to the battery side of the solenoid on the large post.

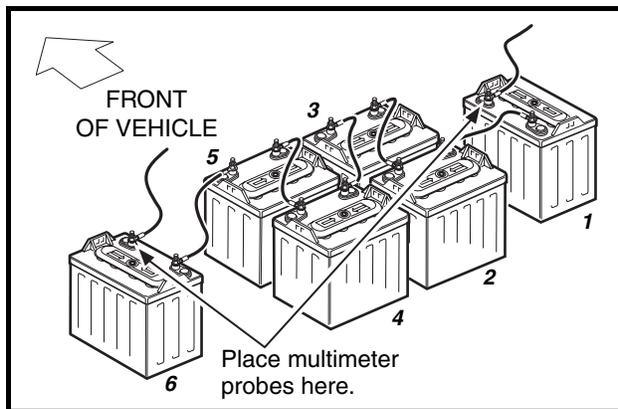


Figure 4-4 Battery Configuration – Carryall 6 and Transporter Vehicles

- 1.2. Verify the connection of the 10-gauge black wire from the onboard computer and the 10-gauge black wire from the battery charger at the terminal strip on the component mounting plate.
- 1.3. Check the connections of the 18-gauge gray wire from the charger to the sense lead fuse, and from the sense lead fuse to the onboard computer gray wire. **See following WARNING.**

⚠ WARNING

- Do not bypass the sense lead fuse.

- 1.4. Remove the gray sense lead fuse and check it for continuity with a multimeter set to 200 ohms. The resistance should be less than 2 ohms.

Test Procedure 1 – Battery Voltage, Continued:

2. With a 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 4-4, Page 4-9**). Normal no-load voltage should be between 50 and 52 volts for fully charged batteries. The voltage of the battery pack must be over 32 volts DC to allow the onboard computer to close the charger relay. If battery pack voltage is too low to start charger, temporarily bypass the charger relay. **See Charging a Battery Pack that has Low Voltage on page 4-28.**

TEST PROCEDURE 2 – CONTROL BOARD

See General Warning, Section 1, Page 1-1.

DC Circuit Test

1. Disconnect AC cord from outlet. DC cord red, black, and blue wires remain connected to the vehicle. All wires remain connected to the control board. Set multimeter to 200 volts DC.
2. Place black (–) probe of multimeter on terminal with blue DC cord wire and red (+) probe to terminal with red relay wire (**Figure 4-5, Page 4-10**).

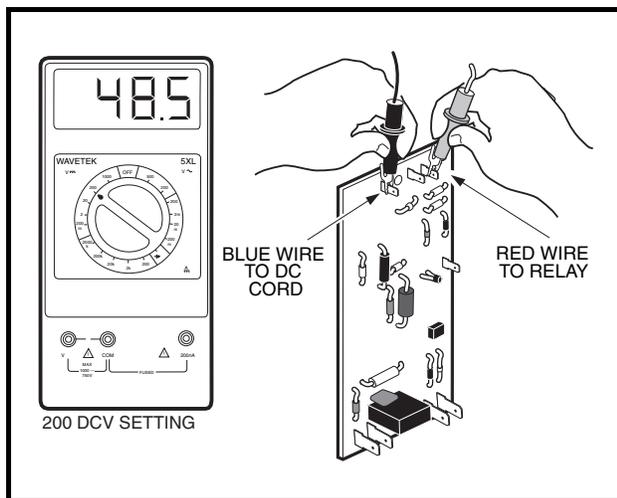


Figure 4-5 DC Circuit Test

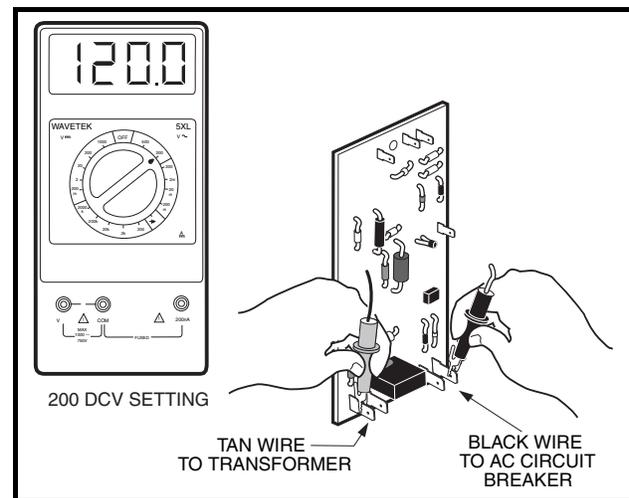


Figure 4-6 AC Circuit Test

3. Multimeter should indicate full battery voltage (approximately 47-50 volts). If reading is incorrect, replace control board.

AC Circuit Test

1. Disconnect AC cord from outlet. DC cord red, black, and blue wires remain connected to vehicle. Set multimeter to volts AC.
2. Disconnect tan wire from transformer primary coil at terminal on control board (**Figure 4-7, Page 4-11**). **See following DANGER.**

 DANGER

- Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.

3. Place black (–) probe of multimeter, set to 200 volts AC, onto terminal with black AC circuit breaker wire. Connect red (+) probe to terminal from which tan transformer wire was disconnected (**Figure 4-6, Page 4-10**).
4. Connect AC cord to outlet. Reading should be approximately 110 to 128 volts AC.
5. If reading is incorrect, replace control board.

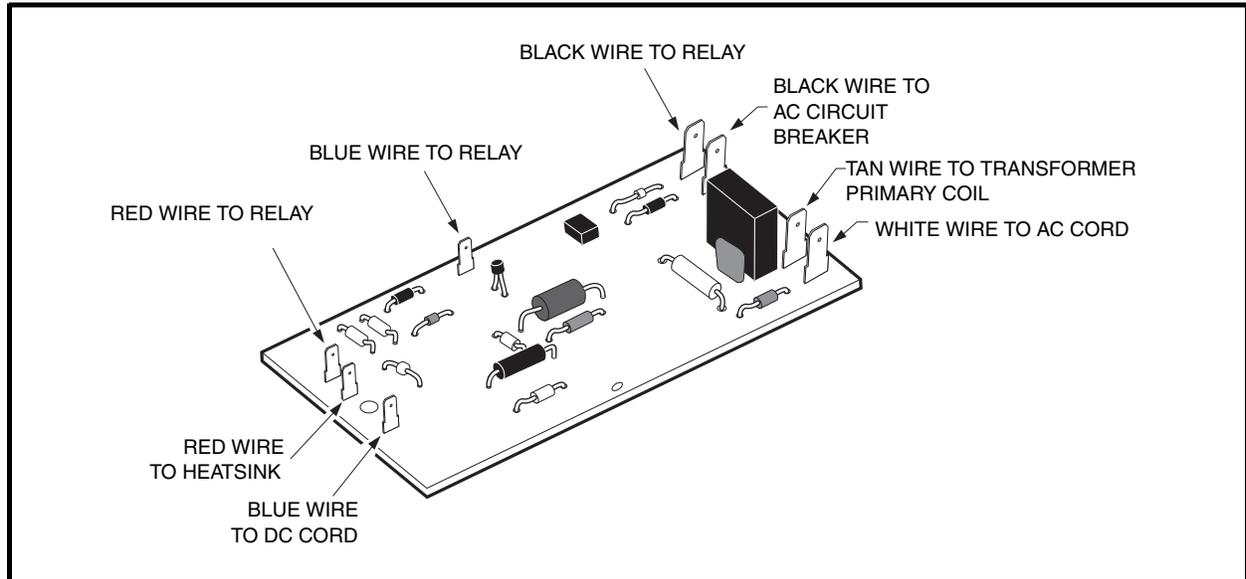


Figure 4-7 Control Board

TEST PROCEDURE 3 – AC POWER AND CONTINUITY CHECK OF AC CIRCUIT

See General Warning, Section 1, Page 1-1.

1. Disconnect the AC power supply cord from the wall outlet.
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 to 500 volts AC, check incoming AC voltage. Insert multimeter test probes into AC wall outlet; voltage should be between 105 and 128 volts. If proper voltage is not present, have building wiring checked by a licensed electrical contractor.
5. Check continuity of the AC circuit.
 - 5.1. Remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
 - 5.2. Remove the charger cover.
 - 5.3. Bypass the relay.
 - 5.3.1. To bypass the relay, remove the black wire (3) from the AC circuit breaker and disconnect the black wire (4) from the relay. Connect the black wire (4) to the AC circuit breaker (**Figure 4-13, Page 4-15**).
 - 5.4. With relay bypassed, there should be continuity across the AC cord blades (**Figure 4-8, Page 4-12**).
6. If the circuit is not complete, check the wiring of the AC cord, AC cord reel, transformer primary coil wires, and internal AC circuit breaker (**Figure 4-13, Page 4-15**).

Test Procedure 3 – AC Power and Continuity Check of AC Circuit, Continued:

7. If the charger is wired correctly, check the continuity of the AC cord, AC cord reel, transformer primary coil, and the internal AC circuit breaker individually. **See Test Procedure 8 – Continuity on page 4-16.**
8. When troubleshooting and repairs are complete, properly connect the relay wiring. **See following WARNING.**

 WARNING

- **The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.**

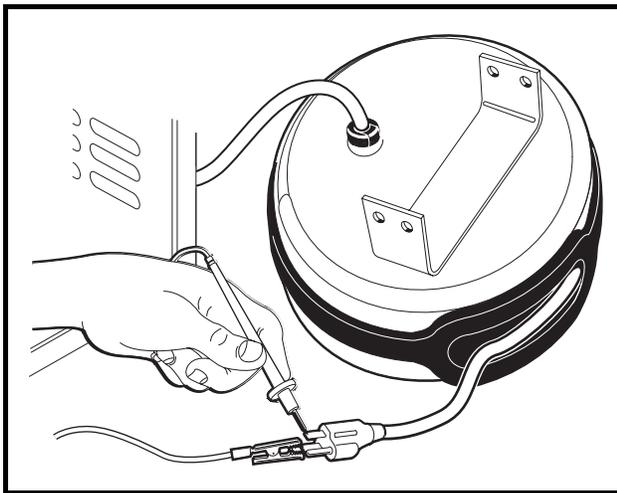


Figure 4-8 AC Circuit Continuity Test

TEST PROCEDURE 4 – DIODES

Use Test Procedure 4A – Single Diode Failure on page 4-12 for single diode failures and testing of individual diodes. If both diodes have failed, use Test Procedure 4B – Both Diodes Failed on page 4-13.

Test Procedure 4A – Single Diode Failure

See General Warning, Section 1, Page 1-1.

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

1. Disconnect AC cord from the wall outlet.
2. Remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
3. Remove the charger cover.
4. Disconnect one transformer secondary coil wire from the diode terminal (**Figure 4-9, Page 4-13**).
5. Using a low voltage continuity tester or multimeter set to the diode test function, connect the red (+) test probe to the diode mounting plate and the black (–) test probe to a diode terminal and note the reading (**Figure 4-9, Page 4-13**).

6. Reverse test probes and check each diode again and note the reading (**Figure 4-10, Page 4-13**). A diode is designed to conduct current in one direction only. If a diode conducts current (shows continuity) in both directions, the entire heatsink with diodes must be replaced. If a diode does not conduct current (does not show continuity) in either direction, the entire heatsink must be replaced.
7. On rare occasions, a single fuse link may blow 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 tightness for the fuse link connections is 22 in-lb (2.5 N·m).
8. Ensure that the charger is wired properly and all connections are clean and tight. **See following CAUTION.**

CAUTION

- If connections are not clean and tight, excessive heat will be created and the charger may become damaged.

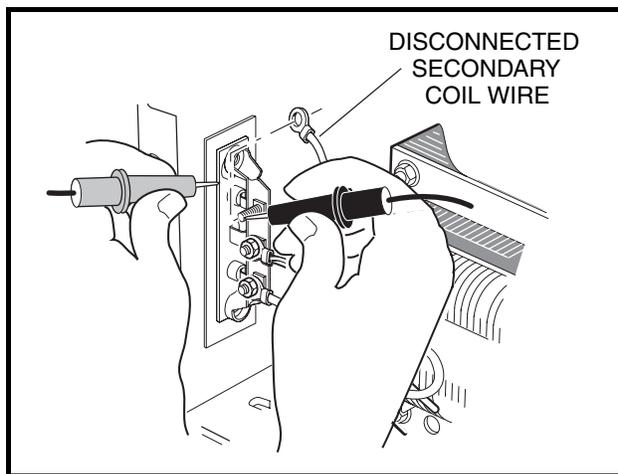


Figure 4-9 Diode Test

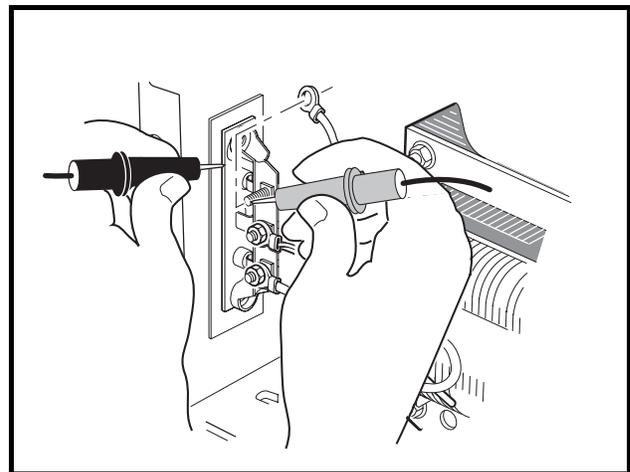


Figure 4-10 Diode Test – Probes Reversed

Test Procedure 4B – Both Diodes Failed

See General Warning, Section 1, Page 1-1.

To check the diodes, use Test Procedure 4A – Single Diode Failure on page 4-12. 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 and the AC circuit breaker may trip off. If both diodes have failed open or closed, the entire heatsink must be replaced. To determine why both diodes failed:

1. Check the batteries and the receptacle to ensure that they are wired in the correct polarity. (**Figure 4-2, Page 4-3**).
2. Make sure the charger is wired correctly: The DC cord red wire should be connected to the center terminal of the heatsink, the DC cord blue wire should be connected to the control board, and the DC cord black wire should be connected to the left side of the ammeter (when viewed from inside the charger) (**Figure 4-3, Page 4-5**). If a reverse polarity connection is made between the charger and the batteries, both fuse links will blow when the DC cord is connected to the vehicle, whether or not the AC cord is plugged into an outlet.
3. Make sure the charger is wired to the vehicle correctly; the DC cord red wire should be connected to the same large post as the 6-gauge red wire connected to the positive (+) post of battery no. 1. The DC cord blue wire should be connected to the sense lead fuse. The DC cord black wire should be connected to the terminal block located on the vehicle component mounting plate (**Figure 4-2, Page 4-3**). If a reverse polarity connection is made between the charger and the batteries, both fuse links will blow when the DC cord is connected to the vehicle, whether or not the AC cord is plugged into an outlet.

4. On rare occasions, both diodes may fail as a result of a lightning strike at the charging location.
5. Excessive heat due to a loose connection may also cause both fuse links to blow. Be sure fuse connections are tightened to 22 in-lb (2.5 N-m).
6. Ensure that the charger and vehicle are wired properly and all connections are clean and tight.

TEST PROCEDURE 5 – CHARGER DC CIRCUIT CONTINUITY TEST

See General Warning, Section 1, Page 1-1.

1. Disconnect the AC cord from the wall outlet.
2. Disconnect the batteries as instructed. **See General Warning, Section 1, Page 1-1.**
3. Disconnect the DC cord blue wire from the sense lead fuse (**Figure 4-2, Page 4-3**).
4. Disconnect the DC cord red wire from the large post of the solenoid.
5. Disconnect the DC cord black wire from the terminal strip located on the vehicle component mounting plate.
6. Using a continuity tester (CCI P/N 1011273) or multimeter set to 200 ohms, connect the test probes to the DC cord black wire removed from the terminal strip and the DC cord red wire removed from the large solenoid post (**Figure 4-11, Page 4-14**). Note the reading.
7. Reverse the test probes and check the DC cord again (**Figure 4-12, Page 4-14**). The circuit should show continuity in only one direction.
8. If the circuit does not show continuity in either direction and the charger fuse is not blown, individually check all connections and the continuity of the DC cord and ammeter. **See Test Procedure 8 – Continuity on page 4-16.** Also check the diodes (heatsink). **See Test Procedure 4 – Diodes on page 4-12.**
9. 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 – Diodes on page 4-12.** If diodes have not failed, check the DC cord for a short circuit. **See Test Procedure 8 – Continuity on page 4-16.**
10. Remove the DC cord blue wire from the control board and check continuity between the DC cord red, black, and blue wires (**Figure 4-3, Page 4-5**). There should be no continuity.

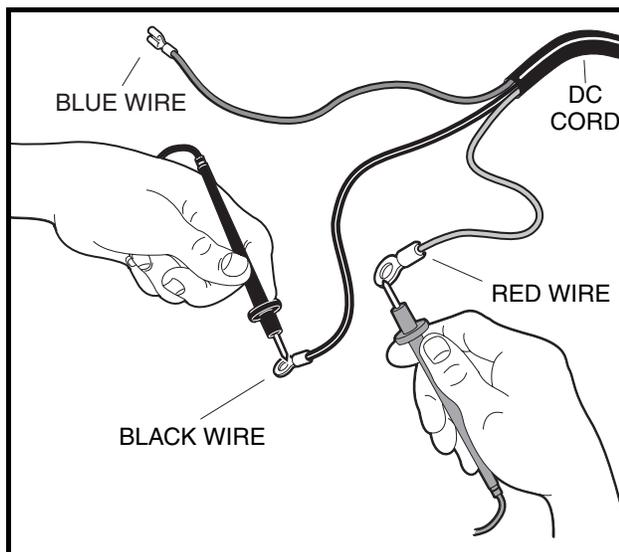


Figure 4-11 DC Cord Test

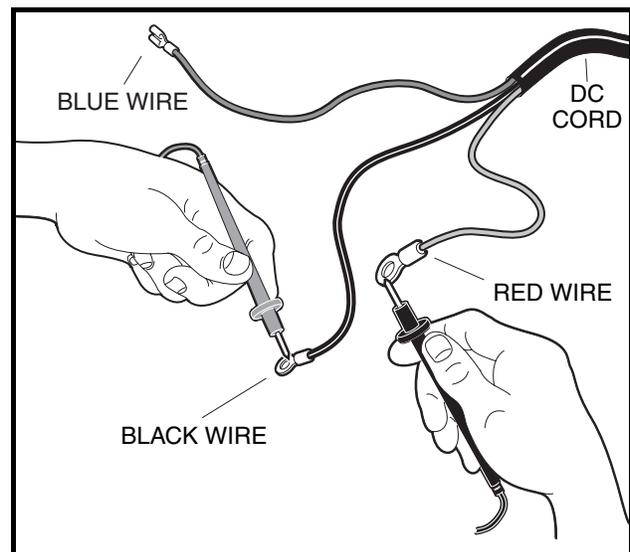


Figure 4-12 DC Cord Test – Probes Reversed

TEST PROCEDURE 6 – TRANSFORMER

See General Warning, Section 1, Page 1-1.

Failure of the transformer may be caused by aging or a short circuit in adjacent coil turns. If the transformer has failed, the ammeter will indicate low output or no output; however, the transformer may hum. A blown AC line fuse or tripped AC circuit breaker in the charger or the storage facility may be caused by an improperly wired charger or a failed transformer.

An AC circuit test should be done before performing this test procedure to ensure the continuity of the AC cord, AC cord reel, internal AC circuit breaker, and charger wiring. **See Test Procedure 3 – AC Power and Continuity Check of AC Circuit on page 4-11.**

1. Disconnect AC cord from the wall outlet.
2. Remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
3. Remove the charger cover.
4. Disconnect transformer secondary coil wires (1 and 5) from the heatsink (**Figure 4-13, Page 4-15**).
5. To apply AC power directly to the transformer primary coil, the relay must be bypassed.
 - 5.1. To bypass the relay, remove the black wire (3) from the AC circuit breaker and disconnect the black wire (4) from the relay. Connect the black wire (4) to the AC circuit breaker (**Figure 4-13, Page 4-15**). **See following DANGER.**

⚠ DANGER

- **Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.**

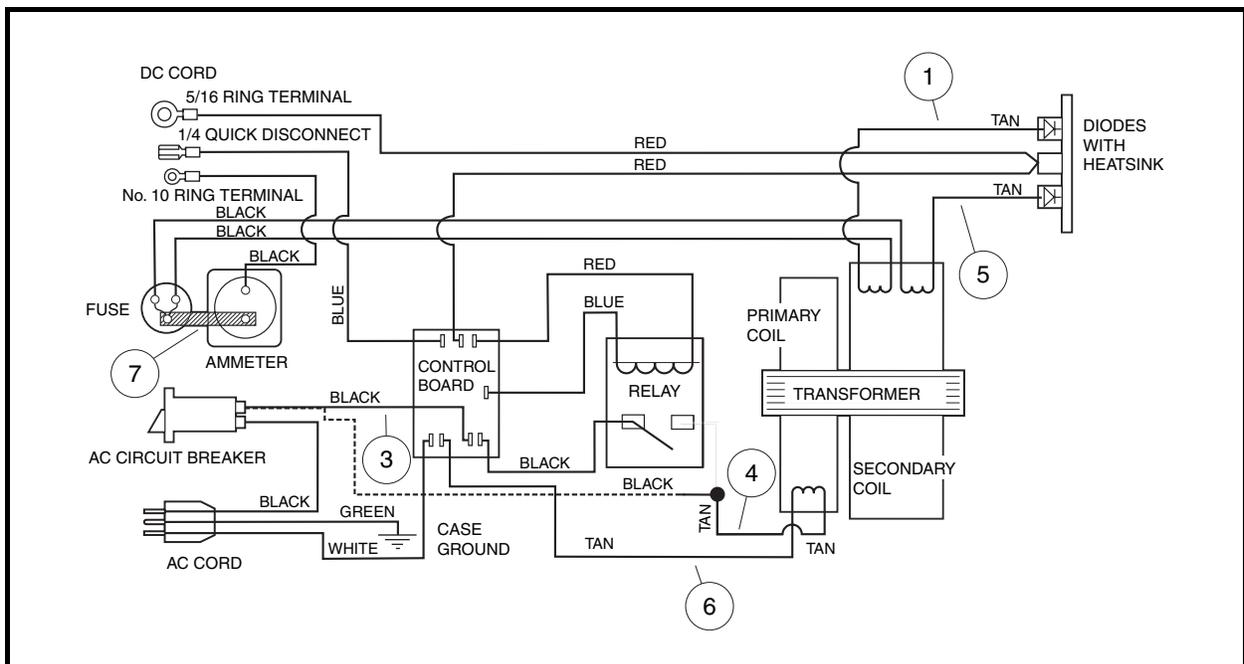


Figure 4-13 Transformer Test Wiring Diagram

Test Procedure 6 – Transformer, Continued:

6. Make sure the secondary coil wires are not touching one another. With the relay bypassed, insert the AC plug into an outlet. If the AC line fuse blows or AC circuit breaker trips, the transformer is shorted internally and must be replaced.
7. If the AC line fuse does not blow or the AC circuit breaker does not trip, check the transformer secondary coil voltage.
8. Disconnect AC cord from the wall outlet.
9. Using alligator clips and a multimeter set to 500 volts AC, connect the multimeter probes to the secondary transformer coil wires (1 and 5).
10. Connect the AC cord to the wall outlet and monitor the multimeter for the secondary coil voltage. If measured voltage is approximately 85 volts AC or lower for the secondary coil, the transformer is shorted internally and must be replaced (**Figure 4-13, Page 4-15**).
11. If the voltage reading is normal (86 volts AC or higher), the transformer is operational. Disconnect the AC plug from the wall receptacle and check the continuity of the DC circuit. **See Test Procedure 5 – Charger DC Circuit Continuity Test on page 4-14.**
12. When troubleshooting and repairs are complete, properly connect the relay wiring. **See following WARNING.**

 WARNING

- **The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.**

TEST PROCEDURE 7 – BATTERY STATE OF CHARGE TEST

See General Warning, Section 1, Page 1-1.

1. With the batteries fully charged, disconnect the DC charger plug for approximately 20 seconds and then reconnect it. The ammeter should jump to a reading between 14 and 18 amps and then taper to below 5 amps within 15 minutes.
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 – Control Board on page 4-10. See following NOTE.**

NOTE: Batteries near the end of their useful lives may not allow the battery charge current to taper below 5 amps. **See Section 13 – Batteries in the appropriate maintenance and service manual.**

TEST PROCEDURE 8 – CONTINUITY

See General Warning, Section 1, Page 1-1.

Short AC Cord and Retractable Cord Reel

Check continuity of the short AC cord and retractable cord reel at the same time.

1. Disconnect the AC cord from the wall outlet.
2. Remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
3. Remove the charger cover.

4. Disconnect the green wire (2) from charger case and position it so it does not touch any metal part of the charger (**Figure 4-14, Page 4-17**).
5. Disconnect the black wire (1) of the short AC cord from charger AC circuit breaker.
6. Disconnect the AC cord white wire (4) from the control board.
7. Using a multimeter set for 200 ohms, place the red (+) probe on the terminal at the end of the black wire (1) (**Figure 4-14, Page 4-17**). Test for continuity on each of the flat blades and then on the round pin of the AC plug (on the retractable cord reel). The tester should indicate continuity on one flat blade only. If any other reading is obtained, the short AC cord and retractable cord reel must be tested independently of each other.
8. Place 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 round pin of the AC plug (on the retractable cord reel) (**Figure 4-14, Page 4-17**). The tester should indicate continuity on only the round pin. If any other reading is obtained, the short AC cord and retractable cord reel must be tested independently of each other.
9. Place the red (+) probe on the white wire (4) and check for continuity on both flat blades and on the ground pin of the AC plug (on the retractable cord reel). The tester should indicate continuity on only one flat blade. If any other reading is obtained, the short AC cord and retractable cord reel must be tested independently of each other.
10. If the correct readings are obtained in all of the previous steps, the short AC cord and the retractable cord reel are functioning properly. If any of the readings are incorrect, proceed to the following test procedures to determine which of the two components has failed.

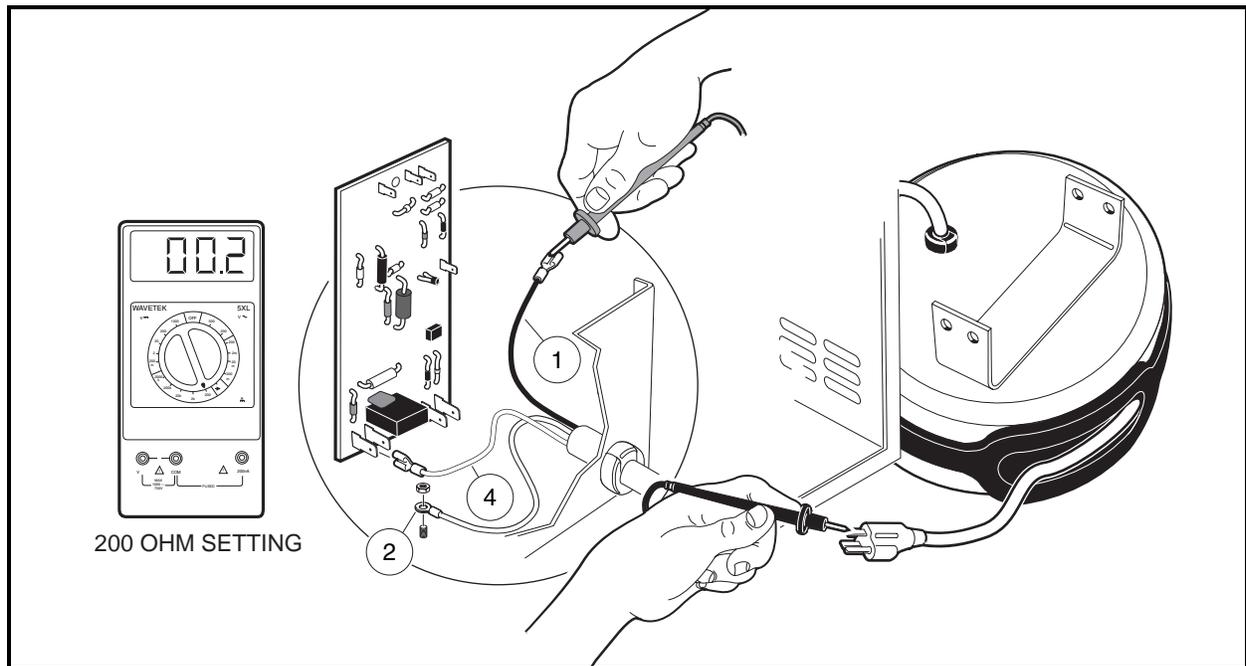


Figure 4-14 AC Cord and Retractable Cord Reel Continuity Test

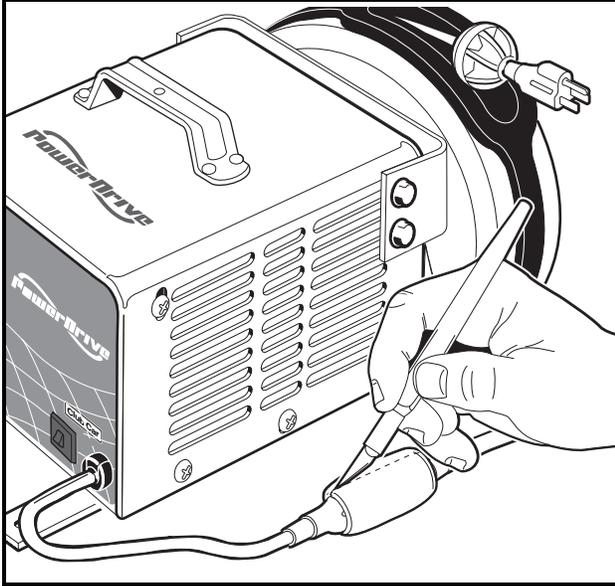
Short AC Cord without Retractable Cord Reel

Check continuity of the short AC cord without the retractable cord reel.

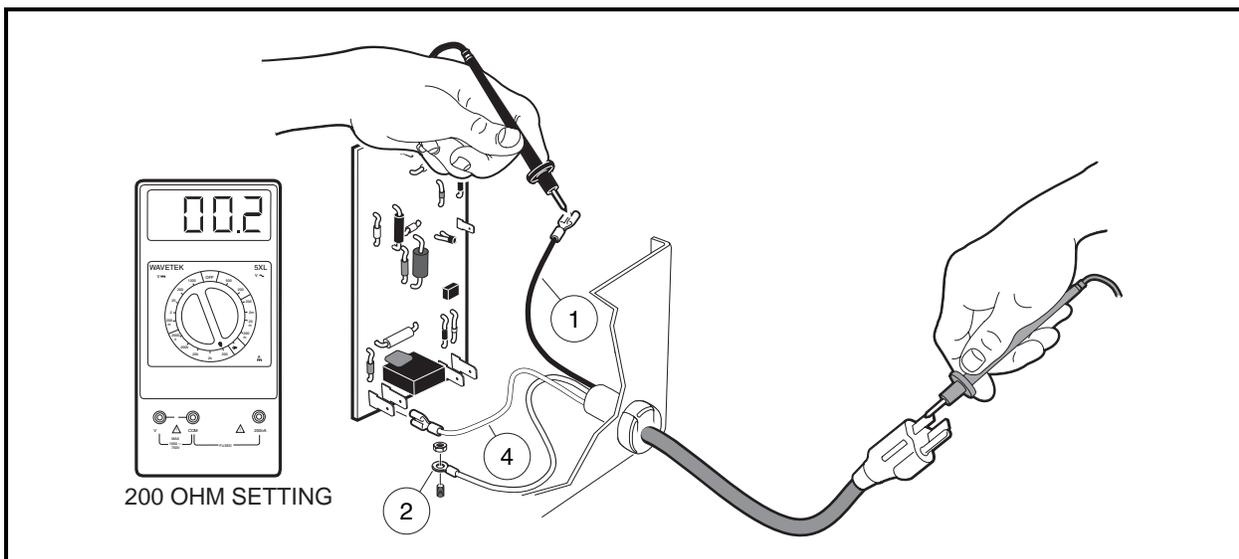
1. Disconnect the AC cord from the wall outlet.
2. Remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**

Test Procedure 8 – Continuity, Continued:

3. Remove the heatshrink from the AC cord connection between the short AC cord and the retractable cord reel by gently cutting the heatshrink tubing (**Figure 4-15, Page 4-18**).

**Figure 4-15 Heatshrink Removal**

4. Disconnect the short AC cord from the retractable cord reel.
5. Remove the charger cover.
6. Disconnect the green wire (2) from charger case and position it so it does not touch any metal part of the charger (**Figure 4-16, Page 4-18**).

**Figure 4-16 Short AC Cord Test**

7. Disconnect the black wire (1) of AC cord from charger AC circuit breaker.
8. Using a multimeter set for 200 ohms, place the red (+) probe on the terminal at the end of the black wire (1). Test for continuity on each of the flat blades and then on the round pin of the AC plug. The tester should indicate continuity on one flat blade only. If any other reading is obtained, the short AC cord must be replaced.
9. Place 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 round pin of the AC plug. The tester should indicate continuity on only the round pin. If any other reading is obtained, the AC cord and retractable cord reel must be tested independently of each other.
10. Disconnect the AC cord white wire (4) from the primary coil tan wire. Place the red (+) probe on the white wire (4) and check for continuity on both flat blades and on the ground pin of the AC plug. The tester should indicate continuity on only one flat blade. If any other reading is obtained, the AC cord and retractable cord reel must be tested independently of each other.
11. If the correct readings are obtained in all of the previous steps, the short AC cord is functioning properly. Proceed to the following test procedure to test the retractable cord reel.

Retractable Cord Reel

Check continuity of the AC cord and retractable cord reel at the same time.

1. Disconnect the AC cord from the wall outlet.
2. Remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
3. Remove the heatshrink from the AC cord connection between the short AC cord and the retractable cord reel by gently cutting the heatshrink tubing (**Figure 4-15, Page 4-18**).
4. Disconnect the short AC cord from the retractable cord reel.
5. Using a multimeter set for 200 ohms, place the red (+) probe in one of the flat blade openings of the cord reel receptacle (1) (**Figure 4-17, Page 4-19**). Test for continuity at the cord reel AC plug (2) on each of the flat blades and then on the round pin of the AC plug. The tester should indicate continuity on one flat blade only. If any other reading is obtained, the cord reel must be replaced.

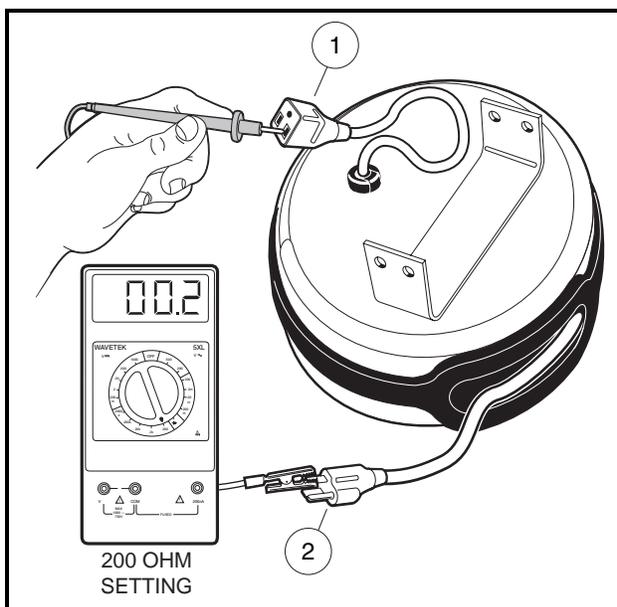


Figure 4-17 Retractable Cord Reel Test

Test Procedure 8 – Continuity, Continued:

6. Place the red (+) probe into the other flat blade opening of the cord reel receptacle (1). Test for continuity on the cord reel AC plug (2) on each of the flat blades and then on the round pin of the AC plug. The tester should indicate continuity on one flat blade only. If any other reading is obtained, the cord reel must be replaced.
7. Place the red (+) probe into the top-center opening of the cord reel receptacle (1). Test for continuity on the cord reel AC plug (2) on each of the flat blades and then on the round pin of the AC plug. The tester should indicate continuity on only the round pin. If any other reading is obtained, the retractable cord reel must be replaced.
8. If the correct readings are obtained in all of the previous steps, the retractable cord reel is functioning properly.

DC Cord

1. Disconnect the AC cord from the wall outlet and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
2. Remove the charger cover.
3. To check the continuity of the DC cord, disconnect the black wire of the DC cord from the ammeter **(Figure 4-18, Page 4-22).**
4. Disconnect the red wire of the DC cord from the heatsink.
5. Disconnect the blue wire from the control board.
6. Using a multimeter set for 200 ohms, place the red (+) probe on the red wire of the DC cord. Test for continuity on each of the wires on the other end of the DC cord. The tester should indicate continuity on the red DC cord wire only. If any other reading is obtained, the DC cord must be replaced.
7. Place the red (+) probe on the blue wire of the DC cord. Test for continuity on each of the wires on the other end of the DC cord. The tester should indicate continuity on the blue DC cord wire only. If any other reading is obtained, the DC cord must be replaced.
8. Place the red (+) probe on the black wire of the DC cord. Test for continuity on each of the wires on the other end of the DC cord. The tester should indicate continuity on the black DC cord wire only. If any other reading is obtained, the DC cord must be replaced.

Transformer

The PowerDrive battery charger transformer has two sets of coils: a primary coil and a secondary coil **(Figure 4-13, Page 4-15).**

Primary Coil

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
2. Remove the charger cover.
3. Disconnect terminals from transformer (tan) primary coil transformer wires (4 and 6) **(Figure 4-13, Page 4-15).**
4. Place the continuity test probes on the disconnected primary transformer coil wires. The tester should indicate continuity. If tester does not indicate continuity, replace the transformer.

Secondary Coil

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
2. Remove the charger cover.

3. Remove the transformer (tan) secondary coil wire (1) from the upper terminal of the heatsink (**Figure 4-13, Page 4-15**).
4. Remove the other transformer (tan) secondary coil wire (5) from the bottom terminal of the heatsink and place the continuity test clip on the ammeter buss bar (7) (**Figure 4-13, Page 4-15**). Test for continuity between the buss bar and each of the secondary coil wires (tan). The tester should indicate continuity between the buss bar and both of the secondary coil wires. If tester does not indicate continuity on both secondary coil wires, replace transformer. Ensure that the fuse is intact and not blown.

Relay

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
2. Remove the charger cover.
3. Remove black wires from contact terminals of the relay (**Figure 4-13, Page 4-15**). Place continuity test probes on contact terminals of the relay. The tester should indicate no continuity. If tester indicates continuity, the relay contacts have failed closed and the relay must be replaced.

Ammeter

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
2. Remove the charger cover.
3. Disconnect the black wire from the left ammeter post (as viewed from inside the charger).
4. Place the continuity tester clip on one of the ammeter posts.
5. Place the continuity test probe on the other ammeter post. The tester should indicate continuity. If the tester does not indicate continuity, replace the ammeter.

AC Circuit Breaker

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
2. Remove the charger cover.
3. Disconnect the wires from the AC circuit breaker.
4. Place the continuity test probe on the two terminals of the AC circuit breaker. The tester should indicate continuity. If the tester does not indicate continuity, replace the AC circuit breaker.

CHARGER REPAIRS

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (**Figure 4-3, Page 4-5**).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**

DC CORD

DC Cord Removal

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**
2. Remove the charger cover.
3. Remove the DC cord black wire (4) from the ammeter by loosening the nut (1). Support the terminal as the nut is loosened to prevent rotation of the connection (**Figure 4-19, Page 4-22**).
4. Remove nut attaching the red wire (6) of the charger DC cord to the heatsink.
5. Remove the wire tie that secures the DC cord wire to the secondary coil wire (tan).
6. Remove the wire tie on the DC cord near the strain relief bushing.
7. Disconnect the DC cord blue wire from the control board (**Figure 4-18, Page 4-22**).
8. Using pliers, squeeze the strain relief bushing and remove the DC cord (**Figure 4-18, Page 4-22**).

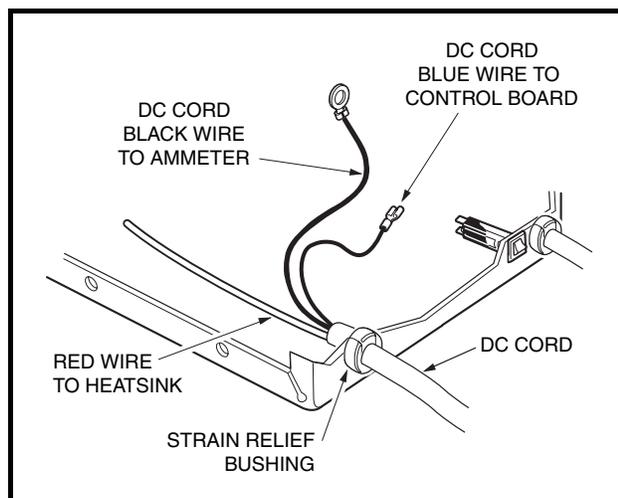


Figure 4-18 DC Cord

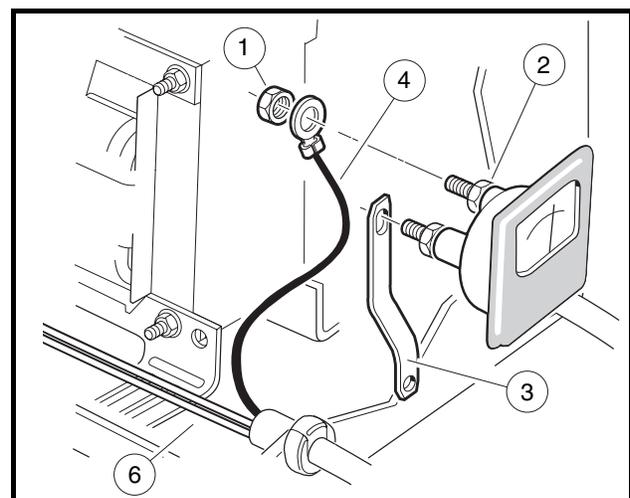


Figure 4-19 DC Cord Replacement

DC Cord Installation

1. Insert the leads of the new DC cord through the hole in the charger base.
2. Attach the red wire of the new DC cord to the center terminal of the heatsink and tighten the nut to 18 in-lb (2.0 N·m) (**Figure 4-18, Page 4-22**).
3. Attach the blue wire of the new DC cord to the control board (**Figure 4-18, Page 4-22**).
4. Attach black wire of the new DC cord to ammeter. Install nut (1) onto post of ammeter slightly more than finger tight. While holding the inside nut (2), tighten the outside nut (1) 1/4 turn (**Figure 4-19, Page 4-22**). **See following CAUTION.**

CAUTION

- Do not allow ammeter post to rotate as the nut is tightened. Rotation of the post could result in a damaged ammeter.

5. Using pliers, put the strain relief bushing on the cord and insert it into the charger base.

6. Tie the wires together as they were before the wire ties were removed. **See following WARNING.**

WARNING

- **Make sure wiring is properly routed and secured. Failure to properly route and secure wiring could result in charger malfunction, property damage, or severe personal injury.**
7. Position the charger cover on the base. Install the mounting screws, starting with the bottom holes. Tighten the screws to 11 in-lb (1.2 N·m).

HEATSINK

Heatsink Removal

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30. See preceding WARNING.**
2. Remove the charger cover.
3. Remove both secondary coil transformer wires (tan) from the heatsink (**Figure 4-3, Page 4-5**).
4. Remove the two red wires from the heatsink.
5. Remove the nuts and bolts that secure the heatsink to the case.

Heatsink Installation

1. Place heatsink against charger base. Make sure clear plastic insulator sheet is between the heatsink and the charger base. Install the nuts and bolts that secure the heatsink to the case. Tighten the bolts to 22 in-lb (2.5 N·m) (**Figure 4-3, Page 4-5**).
2. Connect the red wire from the DC cord and the red wire from the control board to the center terminal post on the heatsink. Tighten nut to 18 in-lb (2.0 N·m).
3. Connect one of the secondary coil transformer wires (tan) to the bottom terminal post of the heatsink. Tighten nut to 18 in-lb (2.0 N·m).
4. Connect the other secondary coil transformer wire (tan) to the top terminal post of the heatsink. Tighten nut to 18 in-lb (2.0 N·m).
5. Install the charger cover and install the charger in the vehicle. **See Onboard Charger Installation on page 4-31.**
6. Check charger for proper operation.

TRANSFORMER

See General Warning, Section 1, Page 1-1.

Transformer Removal

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30. See WARNING on page 4-21.**
2. Remove the charger cover.
3. Disconnect the black primary coil wire from the charger relay (**Figure 4-3, Page 4-5**).
4. Disconnect the tan primary coil wire from the control board.
5. Remove the wire tie that secures the DC cord wire to the secondary coil wire (tan).
6. Disconnect the two tan secondary coil transformer wires from the heatsink (**Figure 4-3, Page 4-5**).

Transformer Removal, Continued:

7. Disconnect the two black secondary coil transformer wires from the fuse.
8. Remove the four bolts and nuts that mount the transformer to the case and remove the transformer.

Transformer Installation

1. Install the transformer with secondary coil to the rear of the charger case. Tighten the four bolts and nuts to 28 in-lb (3.2 N·m) (**Figure 4-3, Page 4-5**).
2. Connect one secondary coil transformer wire (tan) to the top terminal post of the heatsink. Tighten nut to 18 in-lb (2.0 N·m).
3. Connect the other secondary coil transformer wire (tan) to the bottom terminal post of the heatsink. Tighten nut to 18 in-lb (2.0 N·m).
4. Connect one secondary coil transformer wire (black) to one terminal of the fuse assembly. Tighten nut to 22 in-lb (2.5 N·m).
5. Connect the other secondary coil transformer wire (black) to the remaining terminal of the fuse assembly. Tighten nut to 22 in-lb (2.5 N·m).
6. Connect the black primary coil transformer wire to the charger relay.
7. Connect the other primary coil transformer wire to the control board.
8. Tie the wires together as they were before the wire tie was removed. **See following WARNING.**

 WARNING

- **Make sure wiring is properly routed and secured. Failure to properly route and secure wiring could result in charger malfunction, property damage, or severe personal injury.**

9. Install the charger cover and install the charger in the vehicle. **See Onboard Charger Installation on page 4-31.**
10. Check charger for proper operation.

AMMETER

See General Warning, Section 1, Page 1-1.

Ammeter Removal

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30. See WARNING on page 4-21.**
2. Remove the charger cover.
3. Disconnect the black wire from the DC cord (5), and the buss bar (3) from the ammeter (**Figure 4-20, Page 4-25**).
4. Remove the two nuts (2) that secure the ammeter to the charger face.
5. Remove the ammeter from the face of the charger.

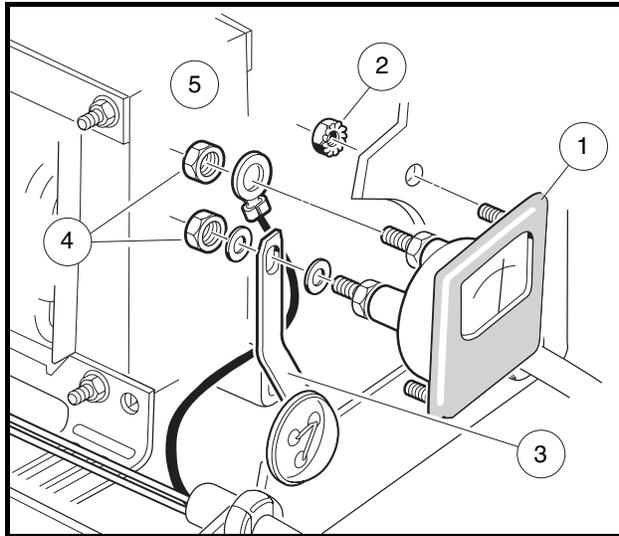


Figure 4-20 Ammeter

Ammeter Installation

1. Place the ammeter in position in the charger face (**Figure 4-20, Page 4-25**).
2. Install nuts (2) and tighten until ammeter is firmly secured.
3. Connect the black wire of the DC cord (5) to the left (as viewed from inside the charger) post of the ammeter.
4. Connect the buss bar (3) from the fuse link to the right post of the ammeter. Place flat washers on both sides of the buss bar.
5. Thread nuts (4) onto both posts of ammeter until just past finger tight. While holding the inside nut, tighten the outside nut (4) 1/4 turn. **See following CAUTION.**

CAUTION

- Do not allow ammeter post to rotate as the nut is tightened. Rotation of the post could result in a damaged ammeter.
6. Install the charger cover and install the charger in the vehicle. **See Onboard Charger Installation on page 4-31.**
 7. Check charger for proper operation.

FUSE LINK

See General Warning, Section 1, Page 1-1.

Fuse Link Removal

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30. See WARNING on page 4-21.**
2. Remove the charger cover.
3. Remove both black secondary coil transformer wires and the buss bar from the back of the fuse link assembly (**Figure 4-20, Page 4-25**).
4. Remove screws from the front of the charger and remove the fuse link assembly.

Fuse Link Installation

1. Place clear 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 buss bar (3) over the center branch of the fuse assembly and ammeter post (**Figure 4-20, Page 4-25**). Tighten to 22 in-lb (2.5 N·m).
3. Install a secondary coil transformer wire (black) onto one of the two remaining terminals on the back of the fuse assembly. Install the remaining secondary coil transformer wire (black) onto the remaining terminal. Tighten to 22 in-lb (2.5 N·m).
4. Install the charger cover and install the charger in the vehicle. **See Onboard Charger Installation on page 4-31.**
5. Check charger for proper operation.

CHARGER RELAY

See General Warning, Section 1, Page 1-1.

Charger Relay Removal

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30. See WARNING on page 4-21.**
2. Remove the charger cover.
3. Disconnect all wires from the relay (**Figure 4-21, Page 4-26**).
4. Remove two nuts and lock washers securing relay to the charger base.
5. Remove the relay.

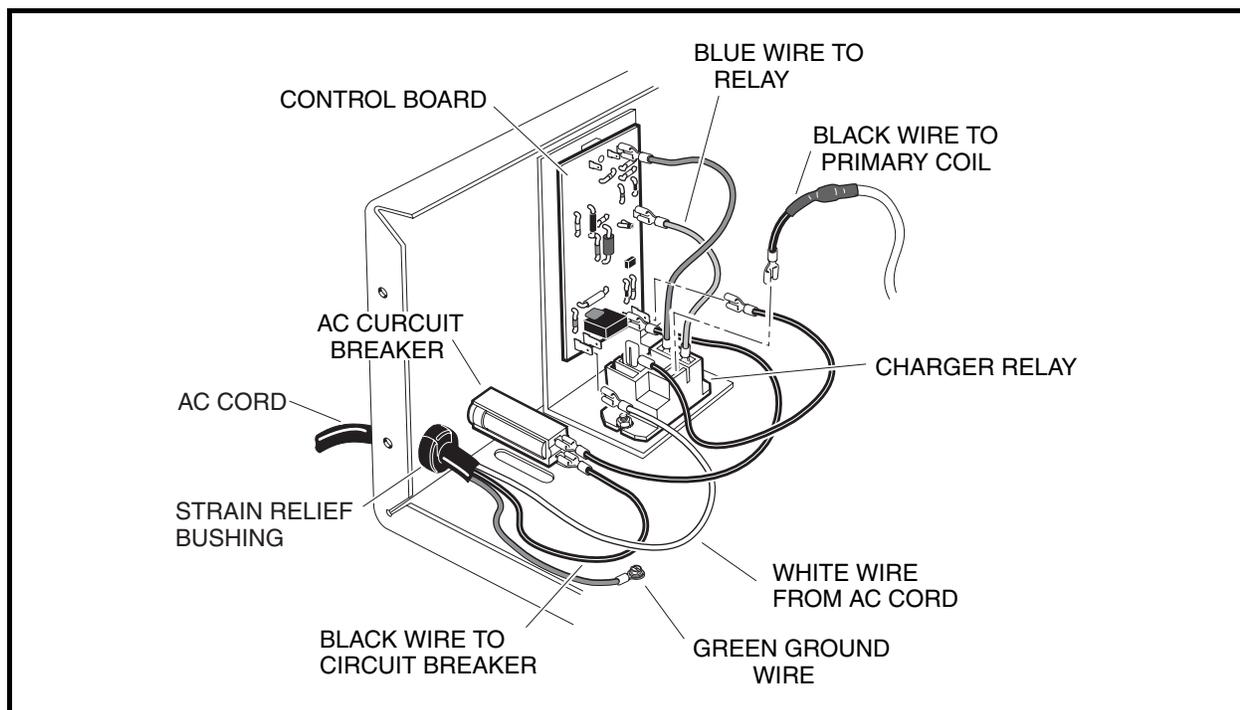


Figure 4-21 Charger Relay

Charger Relay Installation

1. Install in reverse order of removal. Connect wires as shown (**Figure 4-21, Page 4-26**). Tighten nut securing relay to charger base to 18 in-lb (2.0 N·m).

CHARGER AC CIRCUIT BREAKER

See General Warning, Section 1, Page 1-1.

AC Circuit Breaker Removal

1. Disconnect the AC cord and remove the battery charger from the vehicle. See **Onboard Charger Removal on page 4-30**. See **WARNING on page 4-21**.
2. Remove the charger cover.
3. Disconnect the two black wires attached to the AC circuit breaker (**Figure 4-21, Page 4-26**).
4. With a pair of pliers, squeeze in the retaining tabs on the sides of the AC circuit breaker and remove the circuit breaker through the mounting hole in the face of the charger.

AC Circuit Breaker Installation

1. Install in reverse order of removal.

CHARGER AC CORD AND RETRACTABLE CORD REEL

See General Warning, Section 1, Page 1-1.

Short AC Cord Removal

1. Disconnect the AC cord and remove the battery charger from the vehicle. See **Onboard Charger Removal on page 4-30**. See **WARNING on page 4-21**.
2. Remove the charger cover.
3. Disconnect the AC cord black wire from the AC circuit breaker (**Figure 4-21, Page 4-26**).
4. Disconnect the AC cord white wire from the control board.
5. Disconnect the AC cord green wire from the charger base (**Figure 4-21, Page 4-26**).
6. Use a pair of pliers to grip the strain relief bushing and remove it and the AC cord from the charger.

Short 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 4-21, Page 4-26**).
2. Connect the black wire to the AC circuit breaker, the white wire to the control board, and the green wire to the charger base (**Figure 4-3, Page 4-5**). Tighten the screw on the green (ground) wire terminal to 18 in-lb (2.0 N·m).
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 and install the charger in the vehicle. See **Onboard Charger Installation on page 4-31**.
6. Check charger for proper operation.

RETRACTABLE AC CORD REEL

See General Warning, Section 1, Page 1-1.

Retractable AC Cord Reel Removal

1. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30. See WARNING on page 4-21.**
2. Remove the charger cover.
3. Remove the heatshrink from the AC cord connection between the short AC cord and the retractable cord reel by gently cutting the heatshrink tubing (**Figure 4-15, Page 4-18**).
4. Disconnect the short AC cord from the retractable cord reel.

Retractable AC Cord Reel Installation

1. Install in reverse order of removal.

CHARGING A BATTERY PACK THAT HAS LOW VOLTAGE

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 4-3, Page 4-5).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30.**

If battery pack voltage is below 34 volts, the charger will not activate. The charger relay will have to be bypassed to activate the charger.

1. Turn key switch OFF and place the Forward/Reverse handle in the NEUTRAL position.
2. Disconnect the AC cord and remove the battery charger from the vehicle. **See Onboard Charger Removal on page 4-30. See WARNING on page 4-21.**
3. Remove the charger cover.
4. To apply AC power directly to the transformer primary coil, the relay must be bypassed.
 - 4.1. To bypass the relay, remove the black wire (3) from the AC circuit breaker and disconnect the black wire (4) from the relay. Connect the black wire (4) to the AC circuit breaker (**Figure 4-22, Page 4-29**). **See following DANGER.**

⚠ DANGER

- Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.
5. Install the charger cover and install the charger in the vehicle. **See Onboard Charger Installation on page 4-31.**
 6. Plug the AC cord into an electrical outlet.
 7. 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. A charger operating with a bypassed relay could short circuit and possibly cause a fire.

- After one or two hours, disconnect the AC cord and remove the battery charger from the vehicle. See **Onboard Charger Removal on page 4-30**. See **WARNING on page 4-21**.
- Disconnect the transformer wire (4) from AC circuit breaker and connect it to the relay. Connect the short black wire (3) from the control board to the AC circuit breaker (**Figure 4-3, Page 4-5**). See following **WARNING**.

⚠ WARNING

- The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.

- Install the charger cover and install the charger in the vehicle. See **Onboard Charger Installation on page 4-31**.
- Plug the AC cord into an electrical outlet.
- Allow the charger to continue charging the batteries until the charger shuts off automatically.
- 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 in the appropriate maintenance and service manual**.

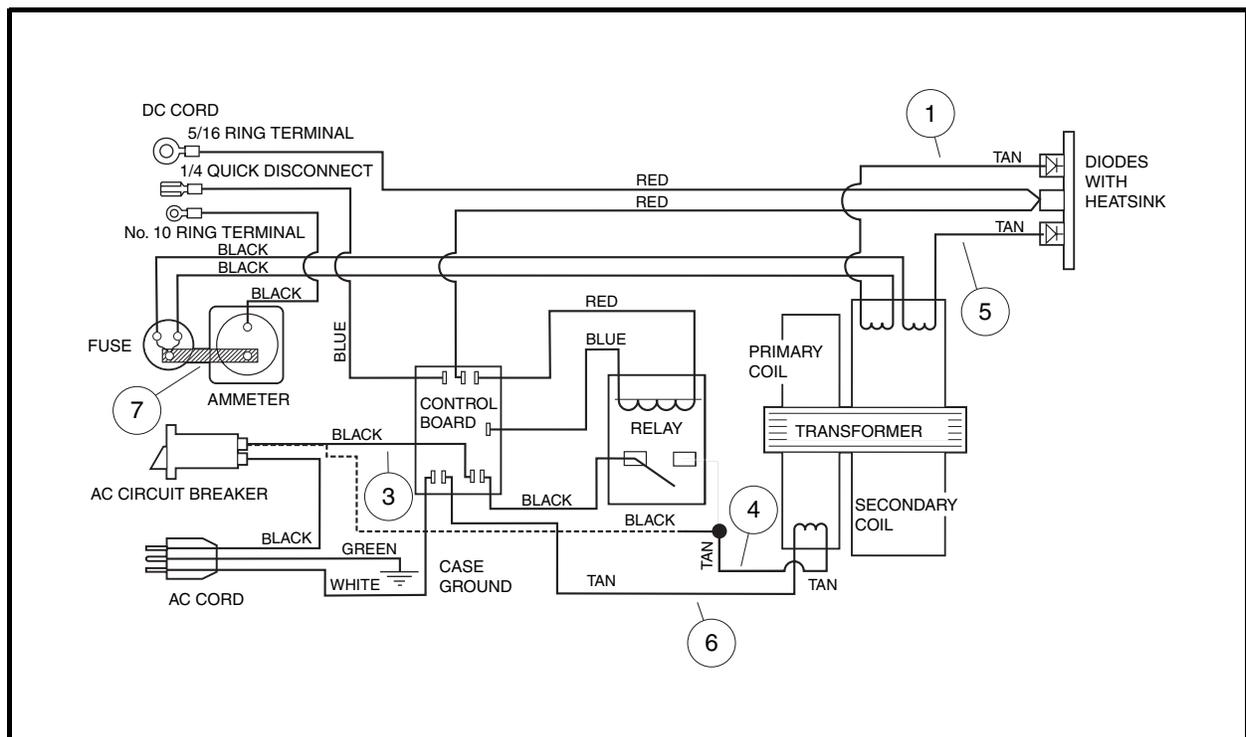


Figure 4-22 PowerDrive Onboard Charger Wiring Diagram (Relay Bypassed)

ONBOARD CHARGER REMOVAL AND INSTALLATION

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 4-3, Page 4-5).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and remove the battery charger from the vehicle. See Onboard Charger Removal on page 4-30.

Onboard Charger Removal

1. Disconnect the batteries as instructed. See General Warning, Section 1, Page 1-1.
2. Remove four bolts (21), flat washers (22), lock washers (23) and nuts (24) from charger mounting brackets (Figure 4-23, Page 4-30).

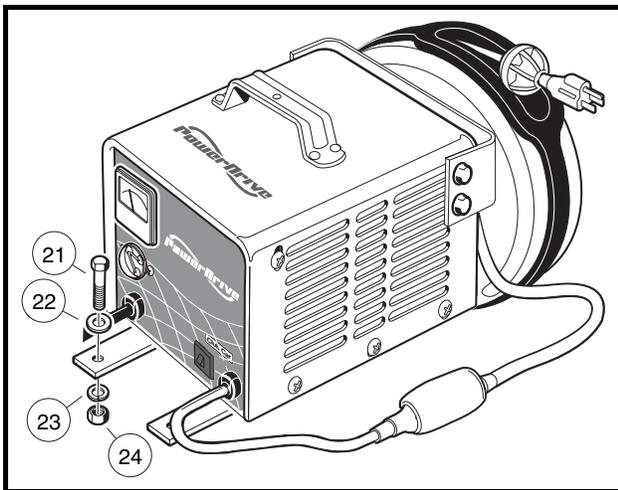


Figure 4-23 Onboard Charger with Reel

3. Remove black plastic component cover from the electrical component mounting plate.
4. Remove 10-gauge black charger DC cord wire (19) from the terminal strip (Figure 4-24, Page 4-31).
5. Remove 10-gauge red charger DC cord wire (23) from large post of solenoid (Figure 4-25, Page 4-31).
6. Disconnect the 10-gauge charger DC cord blue wire (17) from the sense lead fuse (Figure 4-24, Page 4-31).
7. Cut wire tie that secures DC cord to wiring harness.
8. Remove four screws from the AC cord bezel and remove cord from bezel.
9. Lift charger and reel assembly from vehicle.

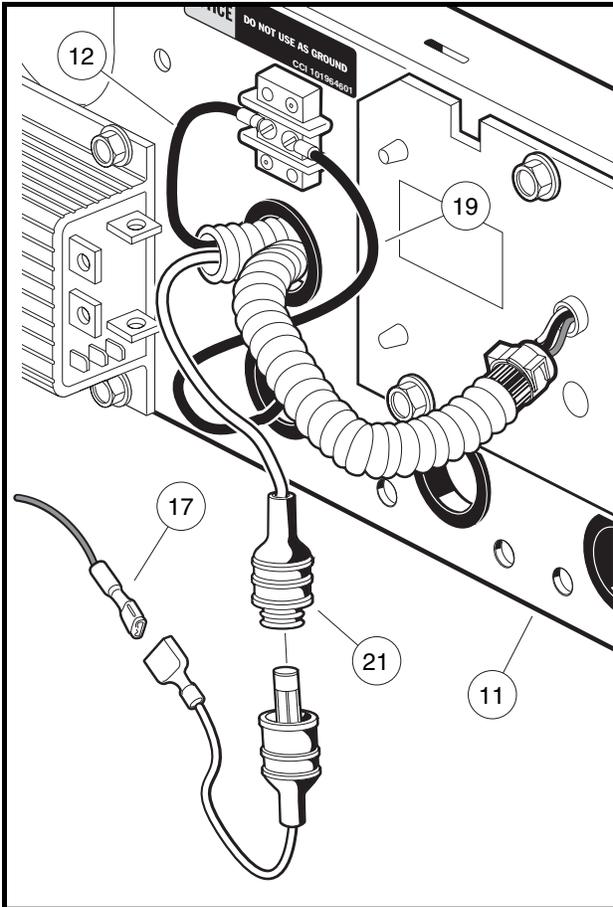


Figure 4-24 Charger DC Cord Black Wire and Blue Wire

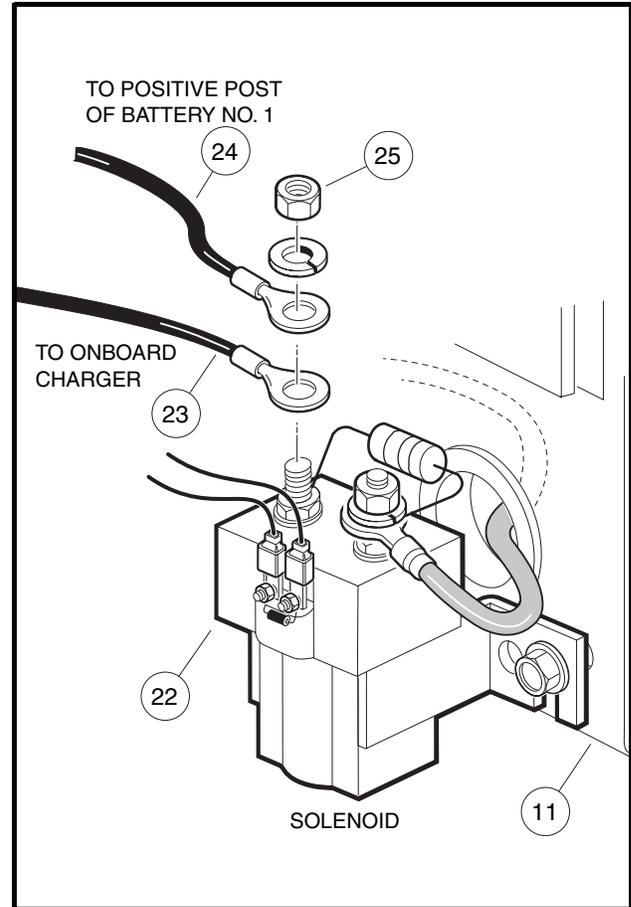


Figure 4-25 Charger DC Cord Red Wire

Onboard Charger Installation

1. Installation is reverse of removal. Tighten four screws connecting AC cord bezel to frame to 12 in-lb (2.5 N·m).
2. Connect battery cables, positive (+) cable first, and tighten to 110 in-lb (12.4 N·m).

SECTION 5 – POWERDRIVE 2 CHARGER (EXTERNAL)

⚠ DANGER

- See General Warning, Section 1, Page 1-1.

⚠ WARNING

- See General Warning, Section 1, Page 1-1.
- The battery charger DC plug must be pulled slowly from the receptacle (Figure 5-4, Page 5-5). Jerking or pulling the DC cord out quickly could cause arcing that could damage the plug and receptacle and could cause batteries to explode (Figure 5-5, Page 5-5).

GENERAL INFORMATION

This section includes information pertaining to service of the PowerDrive 2 battery charger (model numbers 22110-11, 22110-18, and 22110-19). Do not attempt to service a battery charger that has not been properly identified. If a charger cannot be properly identified, contact your local Club Car dealer or distributor.

The PowerDrive 2 battery charger is automatic and has no external controls (**Figure 5-1, Page 5-1**). When the charger is connected, there is a 2 to 15 second delay before charging begins.

NOTE: All vehicles except Precedent: 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.

The onboard computer, having recorded the amount of energy consumed as the vehicle was used, 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 necessary has been returned to the batteries.

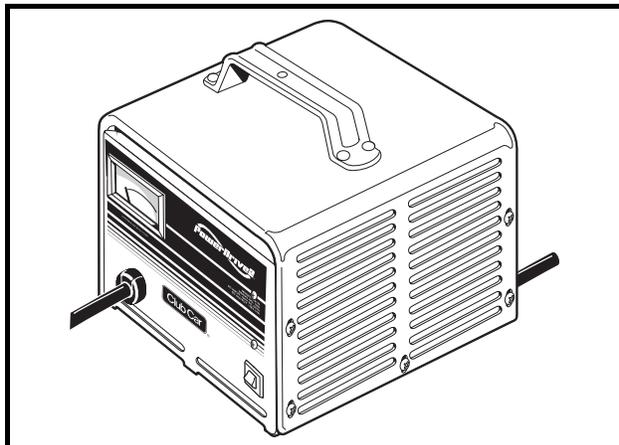


Figure 5-1 PowerDrive 2 Battery Charger

POWERDRIVE 2 BATTERY CHARGER FEATURES

- **Charge Interlock**

PowerDrive 2 battery charger DC plugs have three pins rather than two blades common on most standard charger plugs. Two of these pins are the positive and negative leads as on standard chargers; the third pin is a sensing lead that is the communication link between the charger and the onboard computer. When the charger plug is plugged into the vehicle receptacle, the onboard computer locks out the vehicle 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**

IQ System, PowerDrive, and Precedent vehicles with PowerDrive 2 chargers are designed to be left connected with AC power to the charger during off-season storage. The onboard computer will automatically activate the charger every 15 days. To return the vehicle to service, unplug the charger DC cord, wait 15 seconds for the computer to reset, and plug the charger back in. **See following WARNING.** This will ensure the batteries are at their optimum charge prior to returning the vehicle to service.

WARNING

- **The charger plug must be pulled slowly from the receptacle (Figure 5-4, Page 5-5). Jerking or pulling the DC cord out quickly could cause arcing and burning that could damage the plug and receptacle and could cause batteries to explode (Figure 5-5, Page 5-5).**

BATTERY WARNING LIGHT

Precedent, IQ System and PowerDrive vehicles, feature a dash mounted warning light (above the steering column) that, 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 onboard computer.

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

- The battery 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 replenish the batteries and will complete the charge during the next charge cycle.
- When the charger DC cord is unplugged during a charge cycle, the battery warning light will illuminate and remain illuminated for 10 seconds (25 seconds for Precedent vehicles) if the charge is less than 90% complete but the vehicle has enough power for 60 minutes of operation. This will alert the operator that the vehicle may be used, but that it must be charged to completion as soon as possible.
- The battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals (25 seconds, at 10 second intervals for Precedent vehicles), 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 battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals (25 seconds, at 10 second intervals for Precedent vehicles), during a charge cycle (with the DC plug still connected) if AC power to the charger is interrupted. The light will go out when AC power is restored.

THE CHARGE CIRCUIT

The vehicle charge circuit consists of the following:

- charger receptacle
- receptacle fuse link
- onboard computer
- 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 vehicle, 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 (on all vehicles except Precedent vehicles), and the 18-gauge gray wire from the onboard computer. On all vehicles except Precedent vehicles, also check connections of the fuse link located on the charger receptacle (**Figure 5-2, Page 5-3 or Figure 5-3, Page 5-4**).

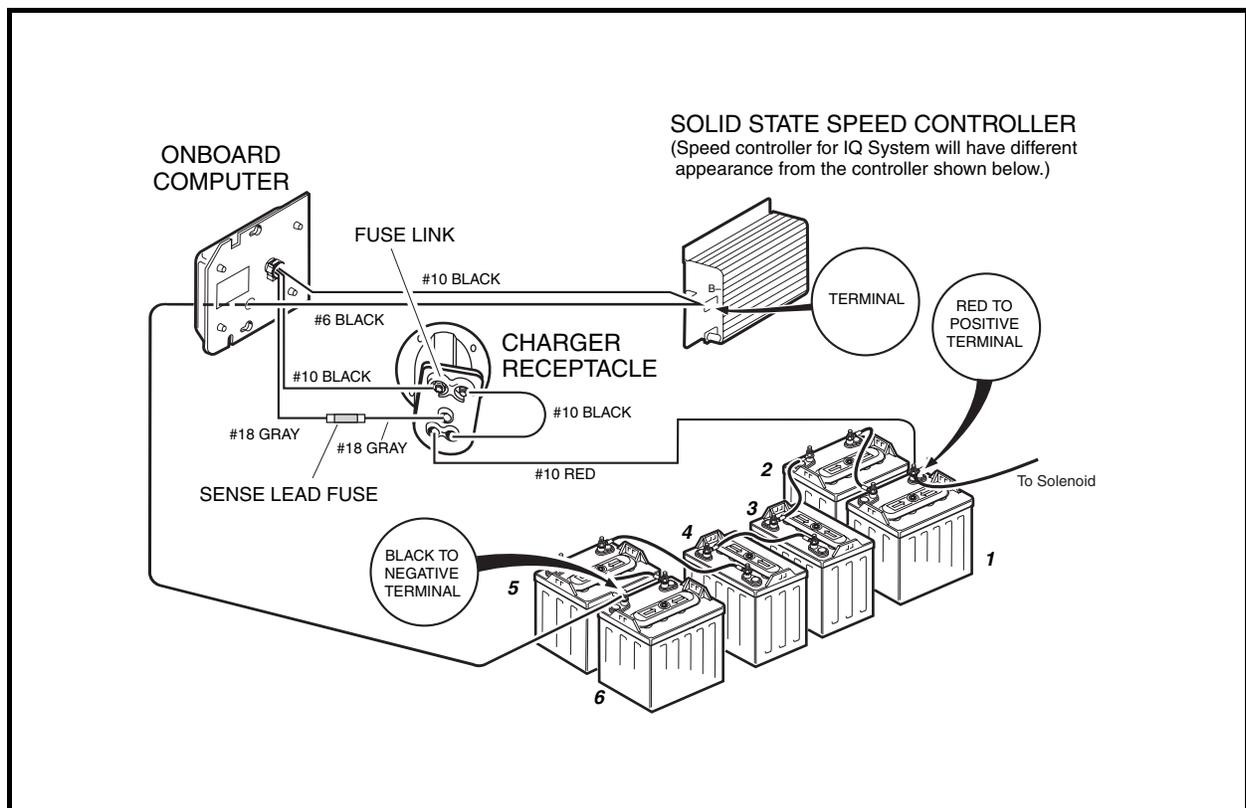


Figure 5-2 Charge Circuit and Battery Configuration – DS Vehicles

⚠ WARNING

- Do not bypass the sense lead fuse (not applicable to Precedent vehicles).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.
- The battery charger DC plug must be pulled slowly from the receptacle (Figure 5-4, Page 5-5). Jerking or pulling the DC cord out quickly could cause arcing that could damage the plug and receptacle and could cause batteries to explode (Figure 5-5, Page 5-5).
- Do not connect the charger to battery packs that are not compatible with the DC output voltage specified on the charger. Overheating and transformer burnout will result.
- Do not use a battery charger if the cord, plug, or receptacle is damaged in any way. Replace worn or damaged parts immediately. Failure to heed this warning could result in a fire, property damage, severe personal injury, or death.
- Do not use a battery 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.
- 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.
- 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. The use of an improper extension cord could result in fire or electric shock.
- 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.
- Do not block or cover the charger ventilation slots. The slots provide ventilation and prevent the charger from overheating.
- Do not allow clothing, blankets, or other materials to cover the charger.
- Do not allow the charger to operate for more than 30 minutes at 19 or more amperes.
- Install surge arrestors on incoming AC power lines. Surge arrestors will help protect electrical components in the charger and on the vehicle from all but direct or close lightning strikes.

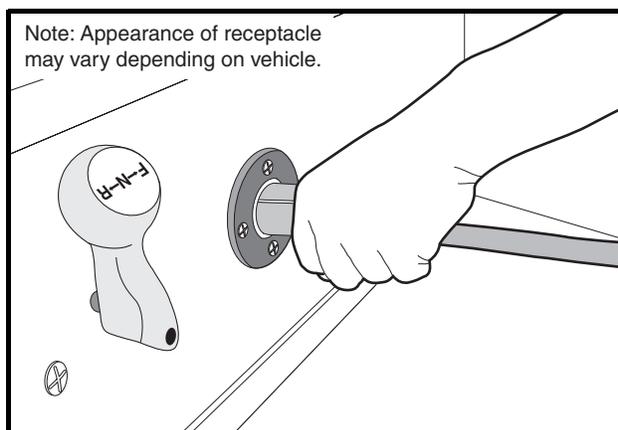


Figure 5-4 Charger Receptacle

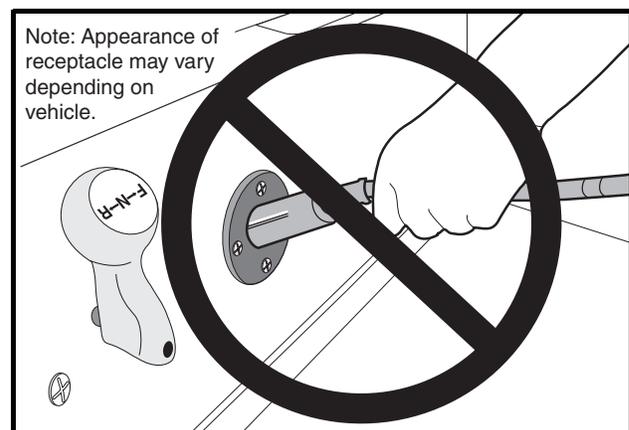


Figure 5-5 Incorrect DC Plug Removal

AC POWER CONNECTION

The AC line to which the charger is to be connected must be of the proper AC input voltage for the charger and must be capable of supplying sufficient current. **See Section 2 – Charger Identification and Specifications.**

With charger DC output cord disconnected, connect the power supply cord to an AC supply. **See Section 2 – Charger Identification and Specifications.**

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 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 should be avoided. If an extension cord must be used, use a three-conductor no. 12 AWG (American Wire Gauge) or no. 14 SWG (British Standard Wire Gauge), heavy-duty cord with ground, properly wired and in good electrical condition. Keep it as short as possible (no more than 12 feet (3.7 meters)). Place all cords so they will not be stepped on, tripped over, or otherwise subject to damage or stress.

Ensure that the charger ventilation slots are unobstructed and that there is adequate ventilation.

CHARGING BATTERIES

⚠ WARNING

- Do not bypass the sense lead fuse (not applicable to Precedent vehicles).
 - Be sure the fuse link is clean and tight (not applicable to Precedent vehicles).
 - Be sure all wire connections at the receptacle are clean and tight.
 - Do not rock or bend the plug. To connect the charger plug to the vehicle receptacle, grasp the plug handle and push the plug straight into the receptacle (Figure 5-4, Page 5-5).
 - Do not pull on the DC cord (Figure 5-5, Page 5-5). Do not twist, rock or bend the plug. To disconnect the charger plug from the vehicle receptacle, grasp the plug by the handle and pull the plug straight out of the receptacle.
 - Do not connect a charger to the receptacle if the charger cord, plug, or the vehicle receptacle is broken, damaged in any manner, or does not make a good electrical connection. Fire or personal injury can result. Have it replaced by a qualified service person immediately. Failure to follow these instructions could result in damage to the charger cord, the plug, and (or) the vehicle receptacle.
 - Do not use a charger if:
 - The plug is too loose or does not make a good connection.
 - The plug and receptacle feel hotter than normal during charge.
 - The plug pin or receptacle contacts are bent or corroded.
 - The plug, receptacle, or cords are cut, worn, have any exposed wires or are damaged in any way.
 - Using the charger with any of the above symptoms could result in a fire, property damage, personal injury, or death.
1. With the charger DC cord disconnected from the vehicle charger receptacle, connect the AC power supply cord to an AC outlet designed to provide the proper AC voltage for the charger.

2. Connect the charger DC plug to the vehicle charger receptacle located on the seat support panel (**Figure 5-4, Page 5-5**). The charger will activate automatically within 2 to 15 seconds after the DC plug is connected. **See following WARNING.**

⚠ WARNING

- **Do not rock or bend the DC plug. To connect the charger plug to the vehicle receptacle, grasp the plug handle and push the plug straight into the receptacle (Figure 5-4, Page 5-5).**
3. **All vehicles except Precedent:** 10 to 20 seconds after the charger activates, it will shut off again to run a self-diagnostic program (the ammeter will drop to 0). Charging will resume in a few moments (ammeter will return to previous rate of charge).
 4. **All vehicles:** 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 the nominal input voltage. Higher AC line voltages increase the initial charge rate while lower AC line voltages reduce the initial charge rate.
 5. **All vehicles except Precedent:** Monitor the ammeter for about 30 seconds. Under normal operating conditions (when the charger is on and the batteries are discharged), 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.*

Batteries should be put on charge at the end of each day even if the vehicle has been used for only a short amount of time (even if for only 10 minutes).

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.

New batteries will not deliver their full range until the vehicle has been driven and recharged from 20 to 50 times.

*Vehicles should be restricted to 40 to 50 energy units of discharge (or 36 holes of golf) between charges until the batteries have been properly seasoned (20 to 50 charge cycles). For maximum battery life, Club Car recommends that electric vehicles always be recharged after 40 to 50 energy units of discharge or each night in order to avoid deep discharging the batteries. Charging between rounds will also extend battery life; use the CDM (Communication Display Module) (CCI P/N 101831801). **See Communication Display Module in Section 11 of the appropriate maintenance and service manual.***

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 the wall 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. **See following NOTE.**

NOTE: *Monitor the charge cycle to make sure the charger turns off properly. If the charge cycle is interrupted, and the batteries are less than 90% charged, the battery warning light will illuminate intermittently. **See Battery Warning Light on page 5-2.***

Testing Charger Operation, Continued:

3. If the charger does not operate exactly as described above, refer to the wiring diagram and make sure that the vehicle is wired correctly (**Figure 5-2, Page 5-3**) and that the internal charger wiring is correct (**Figure 5-6, Page 5-8**).

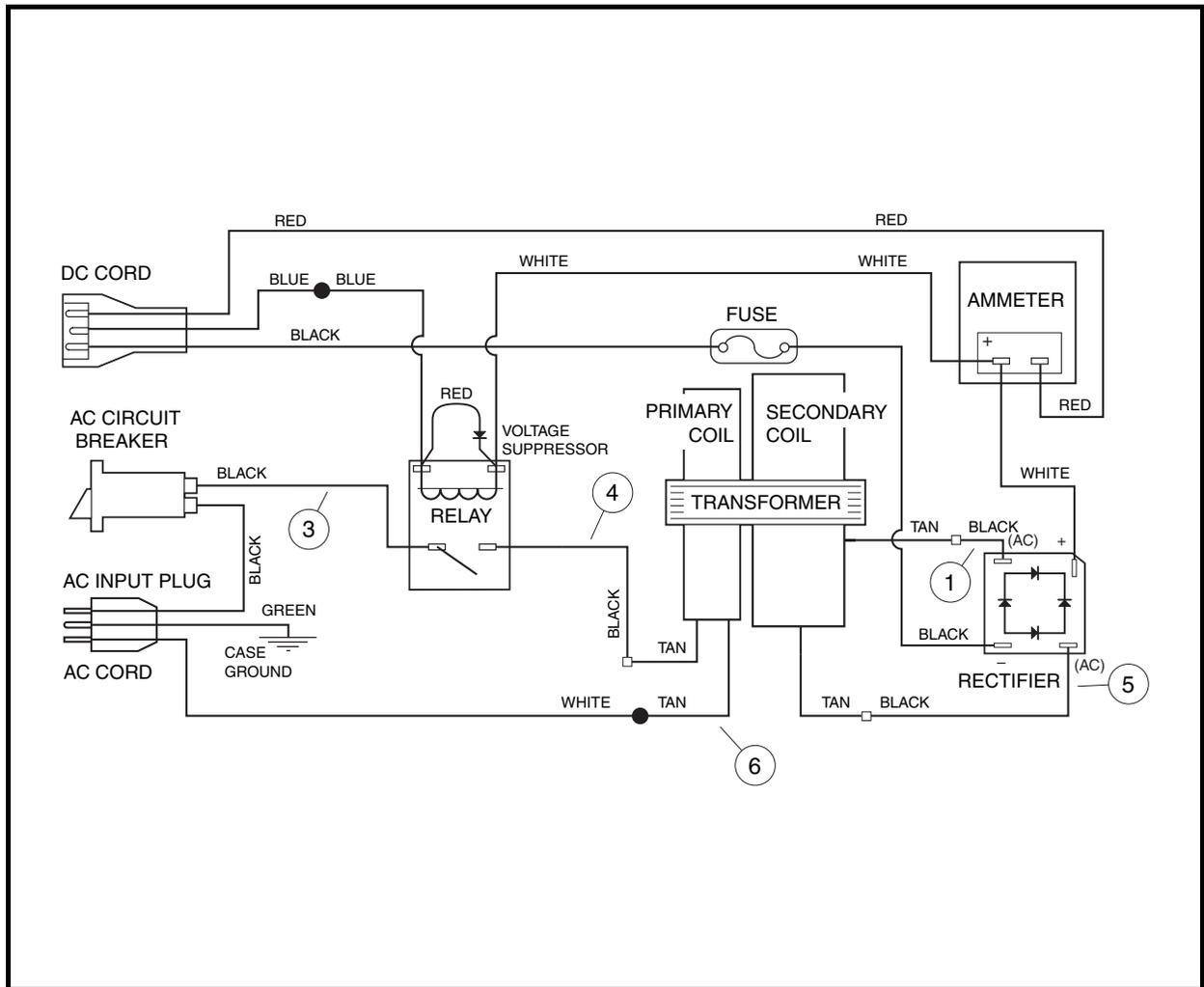


Figure 5-6 PowerDrive 2 Battery Charger Wiring Diagram (External Charger)

DC CORD AND PLUG INSPECTION

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 or receptacle show signs of corrosion or the plug is difficult to insert or remove, the receptacle contacts and plug terminals should be cleaned with a good electrical contact cleaner. The plug should then be inserted and removed several times to ensure ease of insertion, ease of removal, and good electrical contact. **See Charger Receptacle in Section 12 of the appropriate maintenance and service manual for receptacle removal and installation. See also DC Cord Removal on page 5-24. See following NOTE.**

NOTE: *If the warning tag has been damaged or removed from the DC cord, have it replaced immediately.*

CHECKING BATTERY CONDITION AFTER A CHARGE CYCLE

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

It is common practice for technicians to check the condition of a set of batteries after they have been charged to ensure they have received a complete charge before the vehicle is used. With IQ System, PowerDrive, and Precedent vehicles, this is not necessary; the onboard computer controls and monitors the charge cycle. If any problem occurs during a charge cycle, the battery warning light, located above the steering column in the center dash panel, will illuminate intermittently. **See following NOTE.**

If the battery warning light is illuminated after a charge cycle, refer to the troubleshooting chart in the maintenance and service manual appropriate for your battery charger. If you do not have this publication, contact your Club Car representative. If the specified test procedures identify no 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 near the end of a charge cycle should be approximately 59 to 63 volts.

START CHARGE CYCLE

1. Disconnect the DC plug from the vehicle charger receptacle.
2. Wait 20 seconds, then reconnect the DC cord to the vehicle receptacle. **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. **All vehicles except Precedent:** 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 continues. If the batteries are close to being fully charged, the charge cycle will begin and the charge current will begin to taper within a few minutes.

TROUBLESHOOTING

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

⚠ DANGER

- Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.

⚠ WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 5-6, Page 5-8).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.

Use the following Troubleshooting Guide for troubleshooting PowerDrive 2 external battery chargers (model numbers 22110-11, 22110-18, and 22110-19). The Troubleshooting Guide encompasses the entire battery charging circuit. Test procedures specified in the Troubleshooting Guide can be found on the following pages.

POWERDRIVE 2 BATTERY CHARGER TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Relay does not close, no transformer hum and ammeter does not move	Batteries disconnected	See Section 13 – Batteries in the appropriate maintenance and service manual
	Battery voltage is too low	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 5-13
	Poor connection between plug and receptacle	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 5-13
	DC plug and cord	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 5-13 and Test Procedure 5 – Charger DC Circuit Continuity Test on page 5-17
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 5-15
	Gray sense lead fuse is blown (not applicable to Precedent vehicles)	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 5-13
	Receptacle fuse link is blown (not applicable to Precedent vehicles)	See Section 12 – Electrical Components in the appropriate maintenance and service manual
	Poor connection at 10-gauge black wire or 18-gauge gray wire at the OBC (applicable to Precedent vehicles only)	Check wire connections
Relay closes with an audible click but no transformer hum and ammeter does not move	Improper AC outlet voltage	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 5-15
	Failed AC plug and cord	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 5-15
	Transformer primary coil	Test Procedure 6 – Transformer on page 5-18
	Relay	Test Procedure 8 – Continuity on page 5-20
	Failed ammeter	Replace ammeter
Relay closes and transformer hums but ammeter does not move	Blown charger fuse	Test Procedure 8 – Continuity on page 5-20
	Failed rectifier	Test Procedure 4 – Rectifier on page 5-16
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 5-15
	Failed transformer	Test Procedure 6 – Transformer on page 5-18
Relay operates intermittently	Failed charger relay	Test Procedure 8 – Continuity on page 5-20
Charger fuse link blows or receptacle fuse link blows	Failed rectifier	Test Procedure 4 – Rectifier on page 5-16
	Loose internal fuse connection	Tighten connection
	Battery is wired in reverse polarity	Check vehicle wiring
	DC cord is wired in reverse polarity	Check battery charger wiring
Troubleshooting Guide continued on next page...		

POWERDRIVE 2 BATTERY CHARGER TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Charger output is low	Failed rectifier	Test Procedure 4 – Rectifier on page 5-16
	Transformer coil short-circuit failure	Test Procedure 6 – Transformer on page 5-18
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 5-15
Charger turns off too soon	AC power supply was shut off	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 5-15
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 5-15
	Batteries may be fully charged	Test Procedure 7 – Battery State of Charge Test on page 5-20
Charger goes to 16 hour time out	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 5-15
	Extremely discharged batteries or cold temperature	Recharge batteries
	Failed or weak battery	See Section 13 – Batteries in the appropriate maintenance and service manual
AC line fuse blows or AC circuit breaker trips	AC cord is shorted	Test Procedure 8 – Continuity on page 5-20
	Failed transformer	Test Procedure 6 – Transformer on page 5-18
	Incorrect charger wiring	Check battery charger wiring
Battery warning light illuminates for ten seconds at four second intervals (with DC charger cord plugged in) (25 seconds, at 10 second intervals for Precedent vehicles)	AC power interrupted	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 5-15
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 5-15
	Charger failure	See Testing Charger Operation on page 5-7
	16 hour time out	See Battery Warning Light on page 5-2
	Battery or batteries need to be replaced	See Section 13 – Batteries in the appropriate maintenance and service manual
Battery warning light illuminates for ten seconds at four second intervals (with DC charger cord unplugged) (25 seconds, at 10 second intervals for Precedent vehicles)	Batteries are getting close to full discharge capacity	Recharge batteries (golf round may be completed first)
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 5-15
	Battery or batteries need to be replaced	See Section 13 – Batteries in the appropriate maintenance and service manual

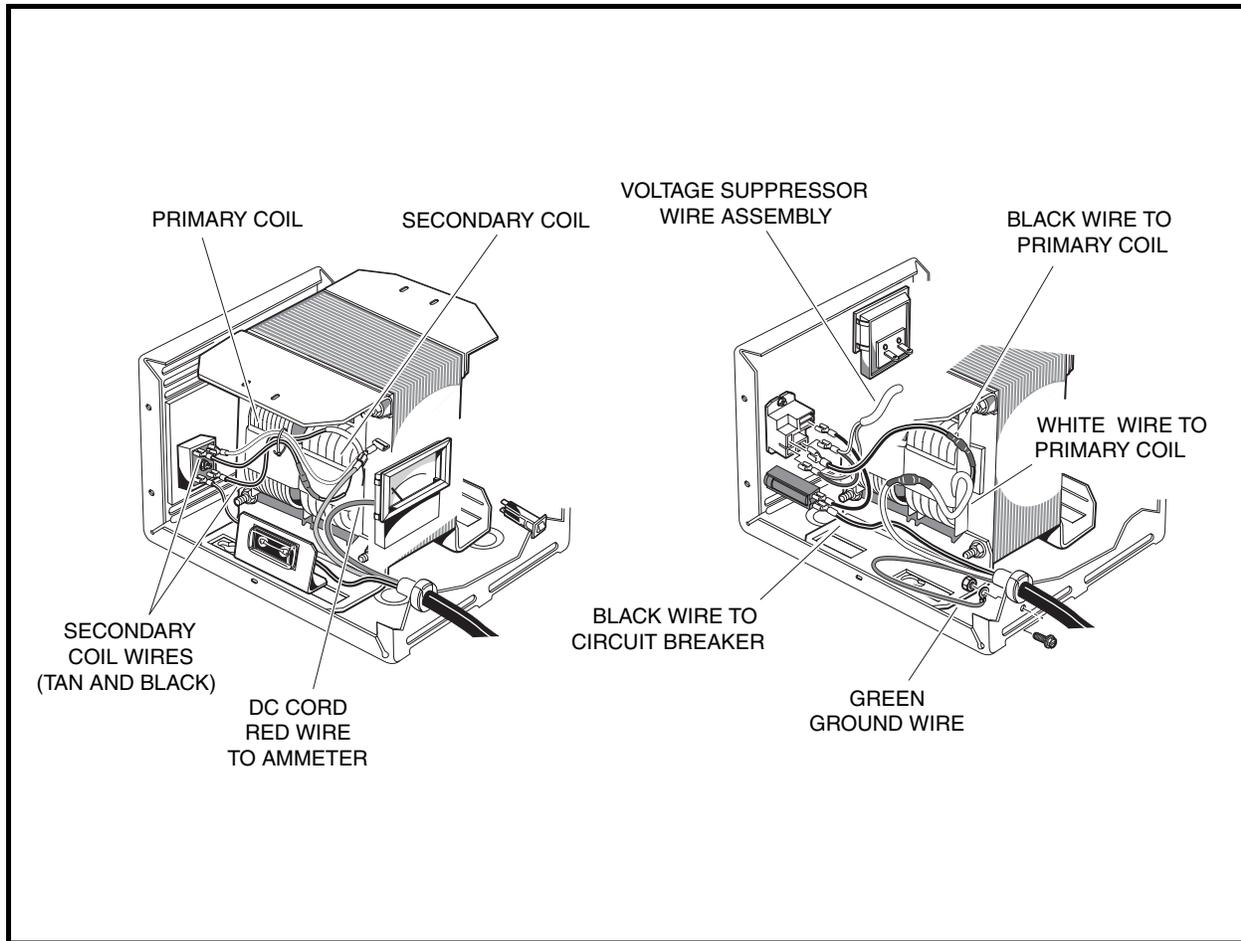


Figure 5-7 PowerDrive 2 Battery Charger

TEST PROCEDURES

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

INDEX OF TEST PROCEDURES

1. Battery Voltage and DC Plug and Receptacle
2. Onboard Computer
3. AC Power and Continuity Test of AC Circuit
4. Rectifier
5. Charger DC Circuit Continuity Test
6. Transformer
7. Battery State of Charge Test
8. Continuity

TEST PROCEDURE 1 – BATTERY VOLTAGE AND DC PLUG AND RECEPTACLE

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

1. Check the DC plug and the vehicle charger receptacle for damage, dirt, corrosion, or any condition that might prevent a sound 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:
 - **DS vehicles:** Verify that the 10-gauge red wire from the charger receptacle is connected to the positive (+) post of battery no. 1 (**Figure 5-2, Page 5-3**).
 - **Precedent vehicles:** Verify that the 10-gauge red wire from the charger receptacle is connected to the positive (+) post of battery no. 1 (**Figure 5-3, Page 5-4**).

DS vehicles only:

- 3.1. Make sure the two nuts that secure the two 10-gauge black wires to the receptacle fuse assembly are tight (**Figure 5-8, Page 5-13**).
- 3.2. 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.

⚠ WARNING

- Do not bypass the sense lead fuse.

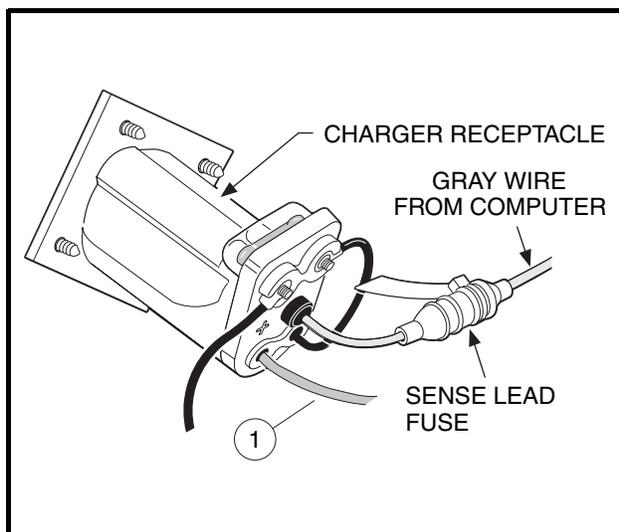
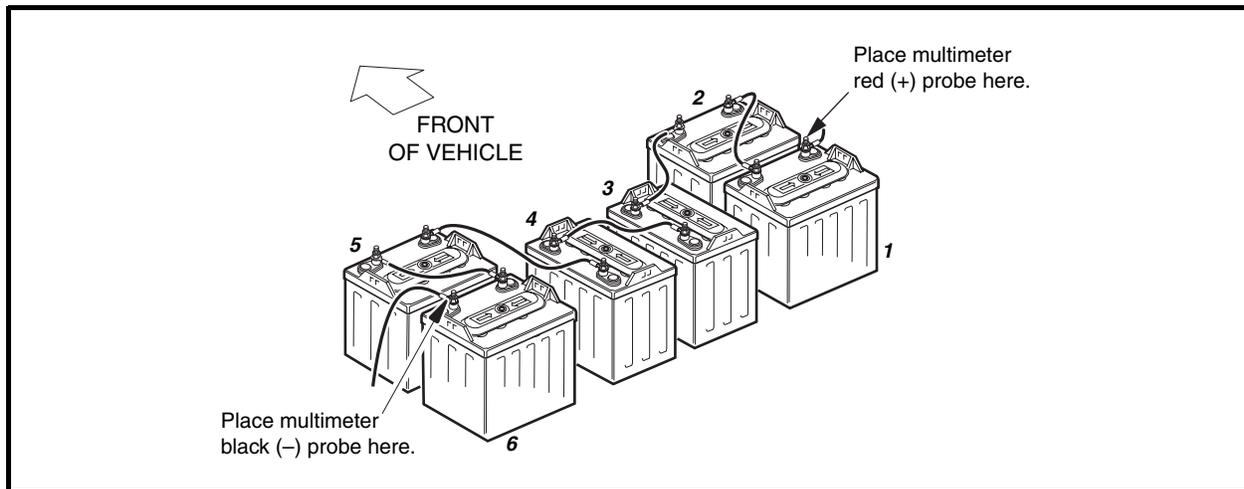


Figure 5-8 Receptacle Wire Connections (all vehicles except Precedent)

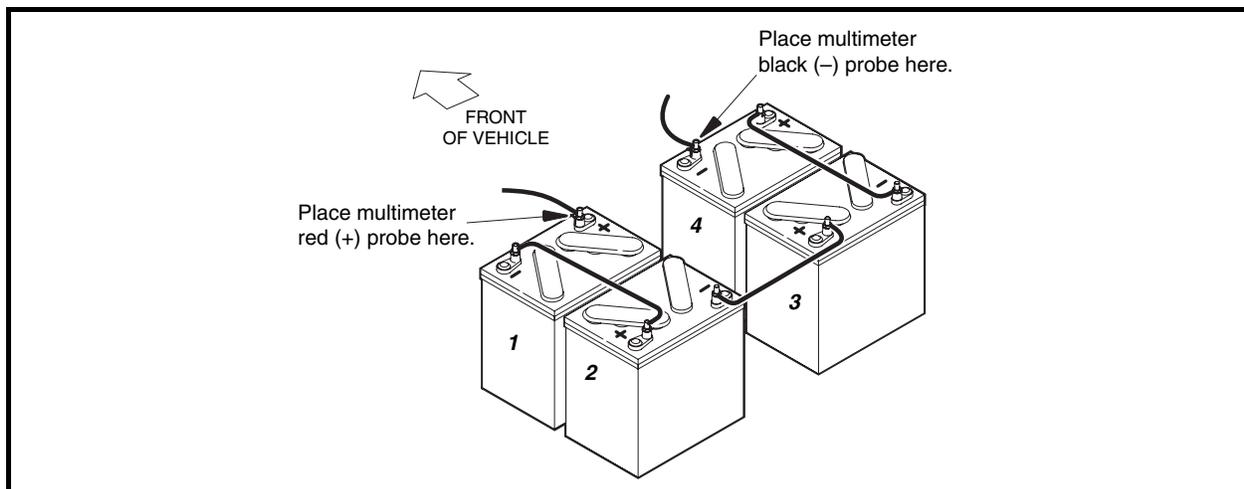
- 3.3. Remove the gray sense lead fuse and check it for continuity with a multimeter set to 200 ohms. The resistance should be less than 2 ohms.

Test Procedure 1 – Battery Voltage and DC Plug and Receptacle, Continued:

4. With a 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 5-9, Page 5-14**). Normal no-load voltage should be between 50 and 52 volts for fully charged batteries. The voltage of the battery pack must be over 32 volts DC to allow the onboard computer to close the charger relay. If battery pack voltage is too low to start charger, temporarily bypass the charger relay. **See Charging a Battery Pack that has Low Voltage on page 5-30.**

**Figure 5-9 DS Battery Configuration****Precedent vehicles only:**

5. With a 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. 4 (**Figure 5-10, Page 5-14**). Normal no-load voltage should be between 50 and 52 volts for fully charged batteries. The voltage of the battery pack must be over 32 volts DC to allow the onboard computer to close the charger relay. If battery pack voltage is too low to start charger, temporarily bypass the charger relay. **See Charging a Battery Pack that has Low Voltage on page 5-30.**

**Figure 5-10 Precedent Battery Configuration**

TEST PROCEDURE 2 – ONBOARD COMPUTER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

1. 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 that AC power is present.
2. Check the AC circuit breaker on the front of the charger and reset it if necessary.
3. Insert the DC cord from the second charger into the receptacle of the 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 on page 5-9.**
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.

TEST PROCEDURE 3 – AC POWER AND CONTINUITY TEST OF AC CIRCUIT

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

1. Disconnect AC cord from the wall outlet and 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 to 500 volts AC, check incoming AC voltage. Insert multimeter test probes into AC wall outlet; voltage should be between 105 and 128 volts. If proper voltage is not present, have building wiring checked by a licensed electrical contractor.
5. Check continuity of the AC circuit.
 - 5.1. Remove the charger cover.
 - 5.2. Bypass the relay.
 - 5.2.1. To bypass the relay, remove the black wire (3) from the AC circuit breaker and disconnect the black wire (4) from the relay. Connect the black wire (4) to the AC circuit breaker (**Figure 5-16, Page 5-19**).
 - 5.3. With relay bypassed, there should be continuity across the AC cord blades (**Figure 5-11, Page 5-15**).

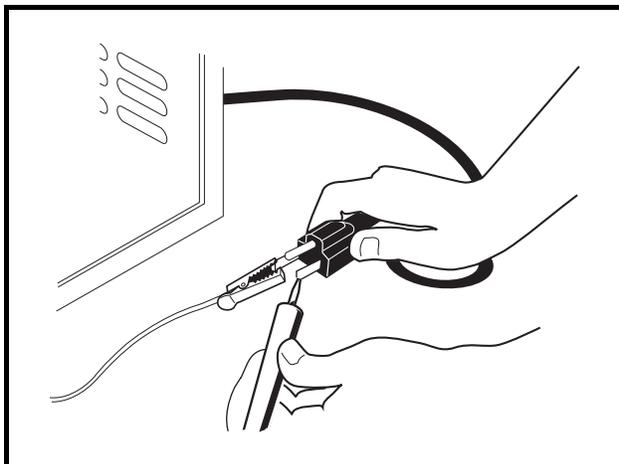


Figure 5-11 AC Cord Test

Test Procedure 3 – AC Power and Continuity Test of AC Circuit, Continued:

6. If the circuit is not complete, check the wiring of the AC cord, transformer primary coil wires, and internal AC circuit breaker (**Figure 5-16, Page 5-19**).
7. If the charger is wired correctly, check the continuity of the AC cord, transformer primary coil, and the internal AC circuit breaker individually. **See Test Procedure 8 – Continuity on page 5-20.**
8. When troubleshooting and repairs are complete, properly connect the relay wiring. **See following WARNING.**

⚠ WARNING

- The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.

TEST PROCEDURE 4 – RECTIFIER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

The rectifier converts the AC voltage from the transformer secondary coil to DC voltage. This conversion is necessary since the batteries require DC voltage for charging. A failed or improperly wired rectifier could result in little or no battery charging current or a tripped AC circuit breaker.

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect all four wires from the rectifier (**Figure 5-12, Page 5-16**).

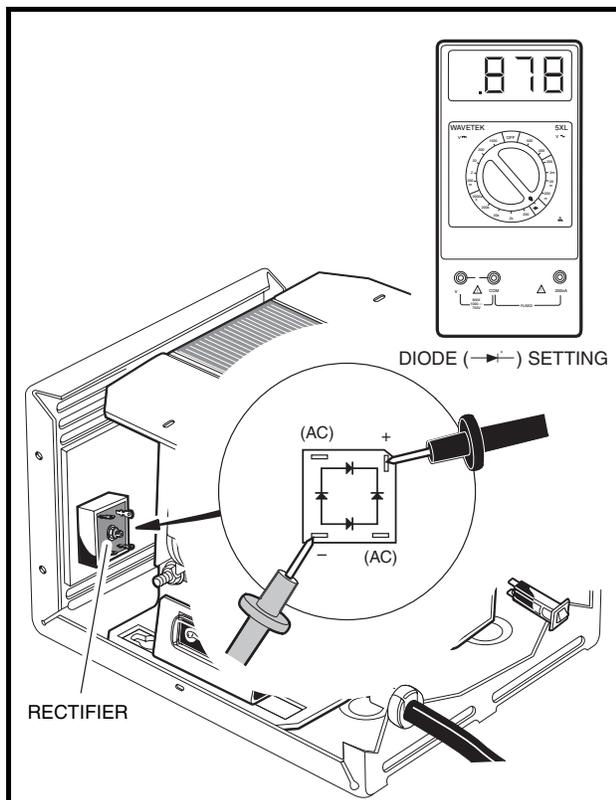


Figure 5-12 Rectifier Test

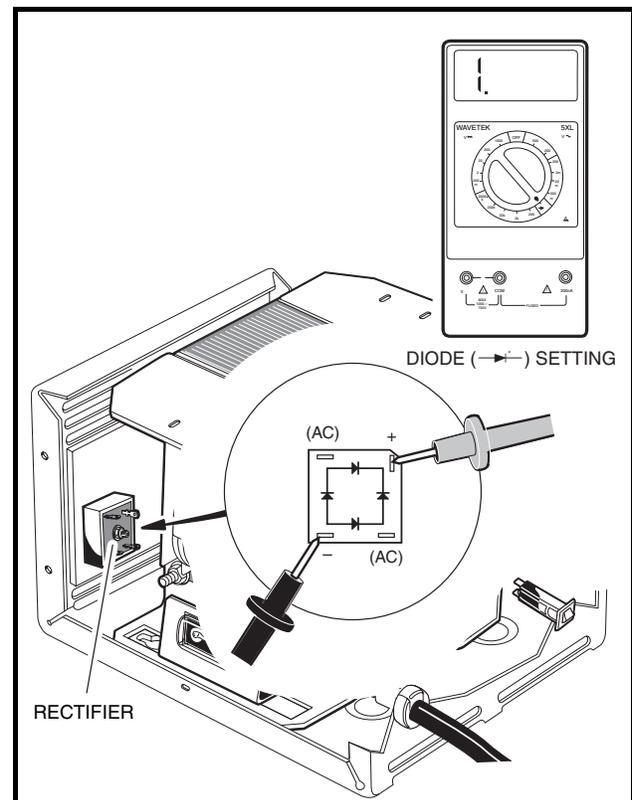


Figure 5-13 Rectifier Test – Probes Reversed

4. Using a multimeter set to the diode test function ($\rightarrow|$), place the black (-) probe of the multimeter on the positive (+) terminal of the rectifier. Move the positive (+) probe to each of the remaining three rectifier terminals and note the readings (**Figure 5-12, Page 5-16**).
 - 4.1. The multimeter should indicate approximately 878 mV with the positive (+) probe on the negative (-) rectifier terminal.
 - 4.2. The multimeter should indicate approximately 483 mV with the positive (+) probe on one of the AC rectifier terminals.
 - 4.3. The multimeter should indicate approximately 483 mV with the positive (+) probe on the other AC rectifier terminal.
 - 4.4. If any other reading is obtained, the rectifier has failed and must be replaced.
5. Using a multimeter set to the diode test function ($\rightarrow|$), place the black (-) probe of the multimeter on the negative (-) terminal of the rectifier. Move the positive (+) probe to each of the remaining three rectifier terminals and note the readings (**Figure 5-13, Page 5-16**). The multimeter should indicate an overload (no continuity) for all three of the remaining rectifier terminals. If any other reading is indicated, the rectifier has failed and must be replaced.
6. On rare occasions, the rectifier may fail as a result of a lightning strike at the charging location.
7. Ensure that the charger is wired properly and all connections are clean and tight. **See following CAUTION.**

CAUTION

- If connections are not clean and tight, excessive heat will be created and the charger may become damaged.

TEST PROCEDURE 5 – CHARGER DC CIRCUIT CONTINUITY TEST

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

1. Disconnect the AC cord from the wall outlet and the DC cord from the vehicle charger receptacle.
2. Using a multimeter set to the diode test function ($\rightarrow|$), place the positive (+) probe of the multimeter on the pin marked positive (+) on the DC plug (**Figure 5-14, Page 5-17**). Place the negative probe (-) on the pin marked negative (-). The multimeter should indicate an overload (no continuity).

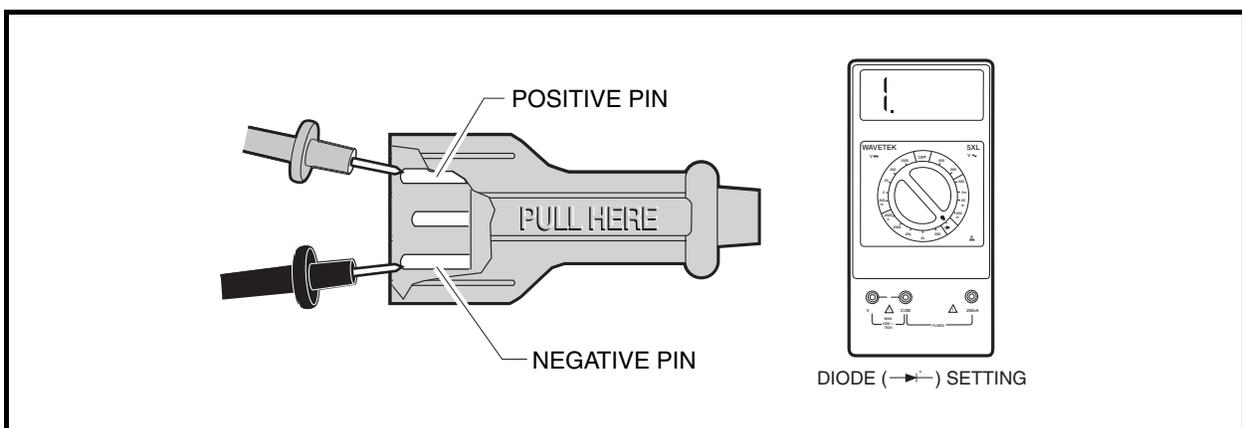


Figure 5-14 DC Plug Test

Test Procedure 5 – Charger DC Circuit Continuity Test, Continued:

3. Reverse the test probes and check the DC plug again (**Figure 5-15, Page 5-18**). The multimeter should indicate approximately 878 mV.
4. If multimeter readings are incorrect, check the battery charger wiring (**Figure 5-6, Page 5-8**).
5. If the multimeter indicates an overload (no continuity) in both directions, and the charger fuse is not blown, individually check all connections and the continuity of the DC cord and ammeter. **See Test Procedure 8 – Continuity on page 5-20.** Also check the rectifier. **See Test Procedure 4 – Rectifier on page 5-16.**
6. If the multimeter indicates a voltage reading in both directions, a short circuit exists in the charger DC circuit, usually caused by a failed rectifier. **See Test Procedure 4 – Rectifier on page 5-16.** If the rectifier has not failed, check the DC cord for a short circuit. **See Test Procedure 8 – Continuity on page 5-20.**

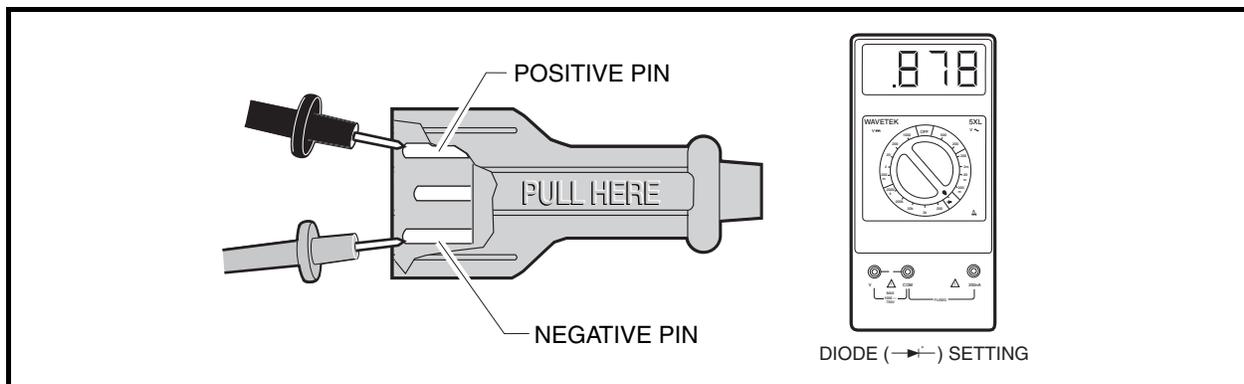


Figure 5-15 DC Plug Test – Probes Reversed

TEST PROCEDURE 6 – TRANSFORMER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

Failure of the transformer may be caused by aging or a short circuit in adjacent coil turns. If the transformer has failed, the ammeter will indicate low output or no output; however, the transformer may hum. A blown AC line fuse or tripped AC circuit breaker in the charger or the storage facility may be caused by an improperly wired charger or a failed transformer.

An AC circuit test should be done before performing this test procedure to ensure the continuity of the AC cord, internal AC circuit breaker, and charger wiring. **See Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 5-15.**

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the two black transformer secondary coil wires (1 and 5) from the rectifier (**Figure 5-16, Page 5-19**).
4. To apply AC power directly to the transformer primary coil, the relay must be bypassed.
 - 4.1. To bypass the relay, remove the black wire (3) from the AC circuit breaker and disconnect the black wire (4) from the relay. Connect the black wire (4) to the AC circuit breaker (**Figure 5-16, Page 5-19**). **See following DANGER.**

TEST PROCEDURE 7 – BATTERY STATE OF CHARGE TEST

See **General Warning, Section 1, Page 1-1**. See additional **WARNING** on page 5-1.

1. With the batteries fully charged, disconnect the DC charger plug for approximately 20 seconds and then reconnect it. The ammeter should jump to a reading between 12 and 14 amps and then taper to below 5 amps within 15 minutes.
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 – Onboard Computer on page 5-15**.

NOTE: Batteries near the end of their useful lives may not allow the battery charge current to taper below 5 amps. See **Section 13 – Batteries in the appropriate maintenance and service manual**.

TEST PROCEDURE 8 – CONTINUITY

See **General Warning, Section 1, Page 1-1**. See additional **WARNING** on page 5-1.

Fuse

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the DC cord black wire from the fuse and position it so it does not touch any metal part of the charger (**Figure 5-18, Page 5-24**).
4. Using a multimeter set for 200 ohms, place the red (+) probe on one fuse terminal and the black (–) probe on the other fuse terminal. The tester should indicate continuity. If the tester does not indicate continuity, then the fuse has failed and must be replaced.

AC Cord

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the green wire (2) from charger case and position it so it does not touch any metal part of the charger (**Figure 5-17, Page 5-20**).

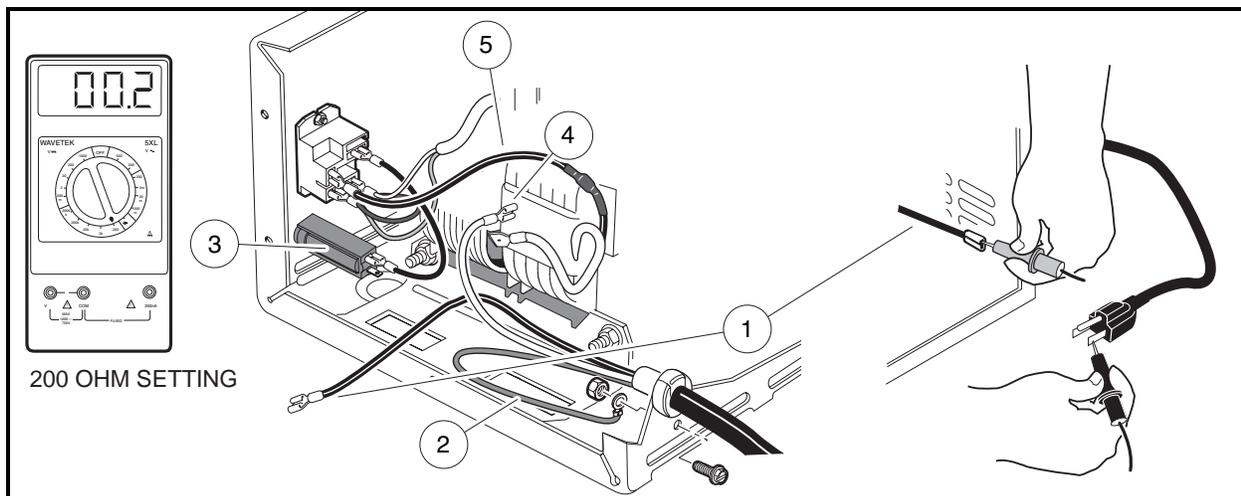


Figure 5-17 AC Cord and Plug Continuity Test

4. Disconnect the black wire (1) of AC cord from charger AC circuit breaker (3).
5. Carefully cut the heatshrink that insulates the AC cord white wire (4) where it connects to the tan primary coil wire.
6. Disconnect the AC cord white wire (4) from the primary coil tan wire.
7. Using a multimeter set for 200 ohms, place the red (+) probe on the terminal at the end of the black wire (1). Test for continuity on each of the flat blades and then on the round pin of the AC plug. The tester should indicate continuity on one flat blade only. If any other reading is obtained, the AC cord and plug must be replaced.
8. Place 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 round pin of the AC plug (**Figure 5-17, Page 5-20**). The tester should indicate continuity on only the round pin. If any other reading is obtained, the AC cord and plug must be replaced.
9. Place the red (+) probe on the white wire (4) and check for continuity on both flat blades and on the ground pin of the AC plug. The tester should indicate continuity on only one flat blade. If any other reading is obtained, the AC cord and plug must be replaced.
10. If the correct readings were obtained, install the AC cord. **See AC Cord Installation on page 5-30.**

DC Cord

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. To check the continuity of the DC cord, disconnect the black wire of the DC cord from the fuse (**Figure 5-18, Page 5-24**).
4. Disconnect the red wire of the DC cord from the ammeter.
5. Disconnect the blue wire from the blue wire assembly that connects to the charger relay.
6. Place the clip of the continuity tester on the red wire of the DC cord.
7. Place the continuity test probe on the positive (+) pin of the DC plug (positive (+) and negative (-) pins are identified on the plug). If tester does not indicate continuity, the DC cord must be replaced.
8. Place the continuity test probe on the negative (-) pin of the DC plug. The tester should indicate no continuity. If tester indicates continuity, the DC cord must be replaced.
9. Place the continuity test probe on the unmarked (middle) pin of the DC plug. The tester should indicate no continuity. If tester indicates continuity, the DC cord must be replaced.
10. Move the continuity test probe to the black wire of the DC cord.
11. Place the continuity test probe on the negative (-) pin of the DC plug. The tester should indicate continuity. If tester does not indicate continuity, the DC cord must be replaced.
12. Place the continuity test probe on the unmarked (middle) pin of the DC plug. The tester should indicate no continuity. If tester indicates continuity, the DC cord must be replaced.
13. Move continuity test probe to the blue wire of the DC cord. Check for continuity at the middle pin. The tester should indicate continuity. If tester does not indicate continuity, replace DC cord.

Transformer

The PowerDrive 2 battery charger transformer has two sets of coils: a primary coil and a secondary coil (**Figure 5-16, Page 5-19**).

Primary Coil

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Carefully cut the heatshrink that insulates the AC cord white wire (4) where it connects to the tan primary coil wire (**Figure 5-17, Page 5-20**).
4. Disconnect terminals from transformer (tan and black) primary coil transformer wires (4 and 6) (**Figure 5-16, Page 5-19**).
5. Place the continuity tester probes on the disconnected primary coil wires. The tester should indicate continuity. If tester does not indicate continuity, replace the transformer.
6. If the correct readings were obtained, install the AC cord and connect the transformer primary coil wires. **See AC Cord Installation on page 5-30.**

Secondary Coil

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove the transformer (black) secondary coil wire (1) from the rectifier (**Figure 5-16, Page 5-19**).
4. Remove the other transformer (black) secondary coil wire (5) from the rectifier.
5. Place the continuity tester probes on the disconnected secondary coil wires. The tester should indicate continuity. If tester does not indicate continuity, replace the transformer.

Voltage Suppressor – Failed Closed

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Using a multimeter set to the diode test function ($\rightarrow|$), place the black (-) probe of the multimeter on the sense lead pin (short pin) of the DC plug. Place the red (+) probe on the positive (+) pin of the DC plug. The multimeter should indicate no tone. If a tone is emitted (indicating a closed circuit) then the voltage suppressor has failed and should be replaced. **See following NOTE.**

NOTE: All vehicles except Precedent: Repeated failure of sense lead fuses is a symptom of a voltage suppressor that has failed in a closed condition.

Precedent vehicles only: Failure of the onboard computer due to a blown internal sense lead fuse is a symptom of a voltage suppressor that has failed in a closed condition.

Relay

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove black wires (3 and 4) from contact terminals of the relay (**Figure 5-6, Page 5-8**). Place continuity test probes on contact terminals of the relay. The tester should indicate no continuity. If tester indicates continuity, the relay contacts have failed closed and the relay must be replaced.
4. Place continuity test probes on contact terminals of relay. With batteries connected, insert DC plug into receptacle. The tester should indicate continuity. If tester does not indicate continuity, relay must be replaced.

Ammeter

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the white wire from the left ammeter terminal (as viewed from inside the charger).
4. Place the continuity tester clip on one of the ammeter posts.
5. Place the continuity test probe on the other ammeter post. The tester should indicate continuity. If the tester does not indicate continuity, replace the ammeter.

AC Circuit Breaker

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the wires from the AC circuit breaker.
4. Place the continuity test probe on the two terminals of the AC circuit breaker. The tester should indicate continuity. If the tester does not indicate continuity, replace the AC circuit breaker.

CHARGER REPAIRS

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (**Figure 5-6, Page 5-8**).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.

DC CORD

DC Cord Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove the DC cord black wire from the fuse by loosening the nut on the fuse (**Figure 5-18, Page 5-24**).
4. Remove the DC cord red wire from the ammeter.
5. Remove the DC cord blue wire from the blue wire located in the fiberglass sheathing.
6. Using pliers, squeeze the strain relief bushing and remove the DC cord.

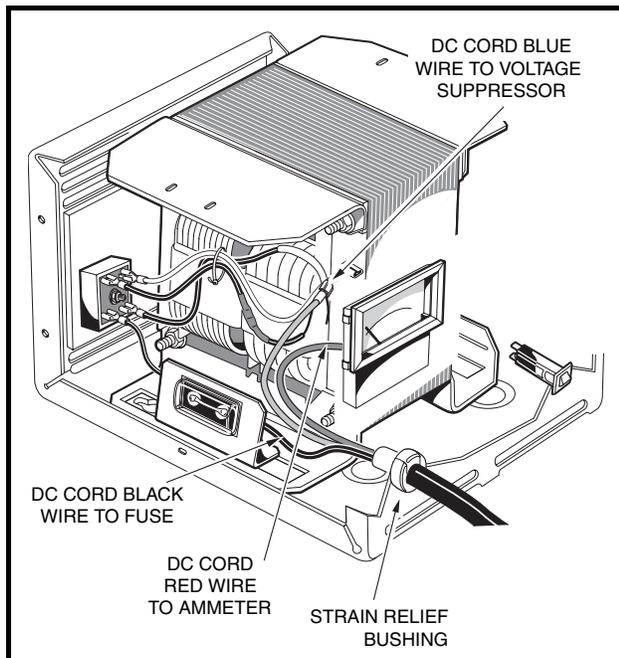


Figure 5-18 DC Cord

DC Cord Installation

1. Insert the leads of the new DC cord through the hole in the charger base.
2. Attach the red wire of the new DC cord to the ammeter (**Figure 5-18, Page 5-24**).
3. Attach the blue wire of the new DC cord to the blue wire located in the fiberglass sheathing.
4. Attach black wire of the new DC cord to fuse. Install the nut onto post of the fuse and tighten to 23 in-lb (2.6 N·m). **See following WARNING.**

⚠ WARNING

- **Make sure wiring is properly routed and secured. Failure to properly route and secure wiring could result in charger malfunction, property damage, or severe personal injury.**
5. Using pliers, put the strain relief bushing on the cord and insert it into the charger base.
 6. Position the charger cover on the base. Install the mounting screws, starting with the bottom holes. Tighten the screws to 11 in-lb (1.2 N·m).

RECTIFIER

Rectifier Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove all four wires from the rectifier (**Figure 5-6, Page 5-8**).
4. Remove the nut (1), lock washer (2), and screw (3) from the rectifier and remove the rectifier from the heatsink (**Figure 5-19, Page 5-25**).

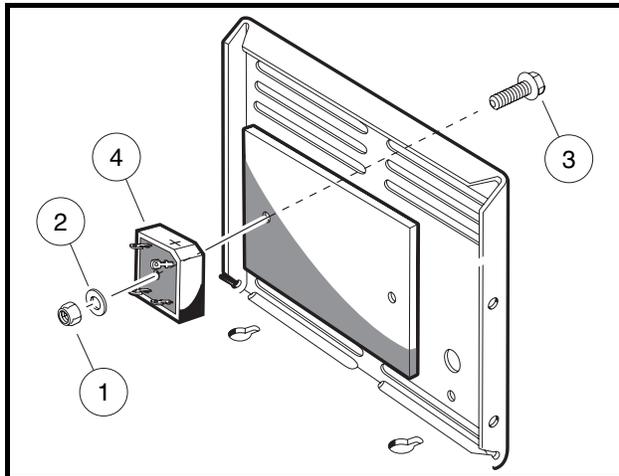


Figure 5-19 Rectifier

Rectifier Installation

1. Thoroughly clean the heatsink plate in the area where the rectifier will be mounted.
2. Apply a liberal amount of white thermal paste to the flat portion of the rectifier to ensure good thermal conductivity from the rectifier to the heatsink plate.
3. Place the rectifier against the heatsink plate so that the notch in the rectifier is oriented as shown (**Figure 5-19, Page 5-25**). Install the screw (3), lock washer (2), and nut (1) through the hole in the charger case, heatsink plate, and rectifier. Tighten the nut to 8 in-lb (0.9 N·m).
4. Connect the white wire from the ammeter to the positive (+) terminal of the rectifier (**Figure 5-6, Page 5-8**). **See following NOTE.**

NOTE: The positive (+) terminal of the rectifier is marked on the edge of the rectifier case. The positive terminal can also be identified by its orientation and the notch in the rectifier case.

5. Connect the two black transformer secondary coil wires to the AC terminals on the rectifier.
6. Connect the black wire from the charger fuse to the negative (–) rectifier terminal. **See following CAUTION.**

CAUTION

- **Improper wiring of the rectifier could result in damage to the rectifier and cause the AC circuit breaker to trip.**

7. Install the charger cover and check charger for proper operation.

TRANSFORMER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

Transformer Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the black primary coil wire (5) from the charger relay (**Figure 5-17, Page 5-20**).
4. Carefully cut the heatshrink that insulates the AC cord white wire (4) where it connects to the tan primary coil wire.
5. Disconnect the AC cord white wire (4) from the primary coil tan wire.
6. Remove the wire tie that secures the two black transformer secondary coil wires to the white wire from the ammeter.
7. Disconnect the two black secondary coil transformer wires (1 and 5) from the rectifier (**Figure 5-6, Page 5-8**).
8. Using a 1/8 inch (3 mm) drill bit, drill the rivets that secure the transformer to the case and remove the transformer.

Transformer Installation

1. Install the transformer with primary coil to the rear of the charger case. Secure the transformer to the case with two rivets.
2. Connect the two black secondary coil transformer wires (1 and 5) to the AC terminals of the rectifier (**Figure 5-6, Page 5-8**).
3. Connect the black transformer primary coil wire (4) to the charger relay.
4. Place a piece of heatshrink tubing over the AC cord white wire.
5. Connect the AC cord white wire to the tan primary coil wire (**Figure 5-17, Page 5-20**).
6. Slide the heatshrink tubing over the connection and apply heat to the heatshrink to insulate the connection between the AC cord white wire and the tan primary coil wire. **See following WARNING.**

⚠ WARNING

- **Make sure the electrical connections are properly insulated. Failure to properly insulate electrical connections in the charger could result in a short circuit.**

7. Tie the wires together as they were before the wire tie was removed. **See following WARNING.**

⚠ WARNING

- **Make sure wiring is properly routed and secured. Failure to properly route and secure wiring could result in charger malfunction, property damage, or severe personal injury.**

8. Install the charger cover and check charger for proper operation.

AMMETER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

Ammeter Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the DC cord red wire (1) and the white wires (3 and 4) from the ammeter (**Figure 5-20, Page 5-27**).
4. Press the locking tabs on each side of the ammeter and remove the ammeter by gently pushing the ammeter through the front of the charger case.

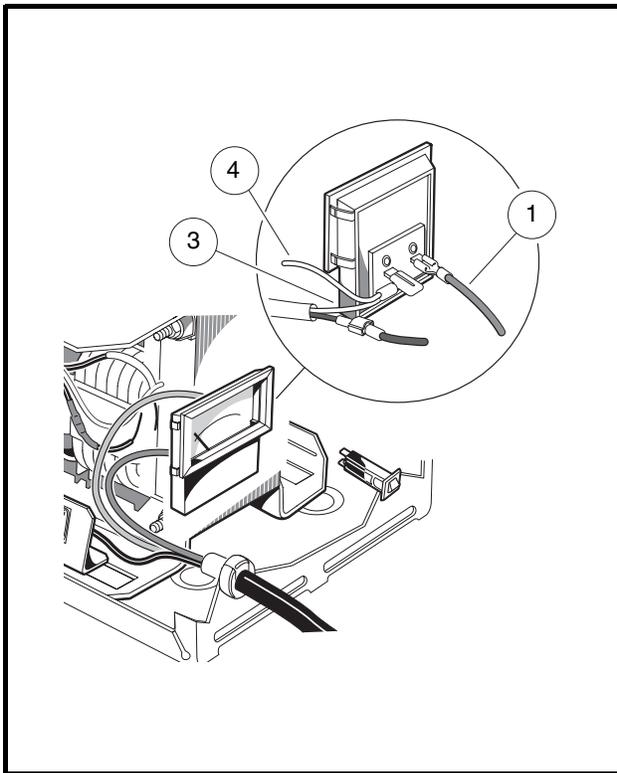


Figure 5-20 Ammeter

Ammeter Installation

1. Place the ammeter in position in the charger face and ensure that the locking tabs are secure (**Figure 5-20, Page 5-27**).
2. Connect the DC cord red wire (1) and the white wire (3) to the ammeter terminals.
3. Install the charger cover.
4. Plug the charger into the vehicle and check ammeter for proper operation.

FUSE LINK

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

Fuse Link Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Gently press the fuse toward the transformer to remove the fuse from the mounting tab.
4. Remove the two nuts securing the two black wires to the fuse terminals and remove the fuse.

Fuse Link Installation

1. Connect the short black wire from the rectifier to one of the fuse terminal posts and install the nut. Tighten nut to 23 in-lb (2.6 N·m).
2. Connect the DC cord black wire to the other fuse terminal post and install the nut. Tighten nut to 23 in-lb (2.6 N·m).
3. Gently press the fuse assembly into the mounting tab so that the fuse link is visible from the side of the charger.
4. Install the charger cover.

VOLTAGE SUPPRESSOR

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

The voltage suppressor, which is incorporated into a wire assembly in the charger, 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 on page 5-20.**

Voltage Suppressor Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the white wires (3 and 4) from the ammeter (**Figure 5-20, Page 5-27**).
4. Disconnect the white wire from the positive (+) terminal of the rectifier.
5. Disconnect the blue, red, and white wires from the relay.
6. Disconnect the DC cord blue wire at the quick disconnect terminal.
7. Remove the voltage suppressor and wire assembly from the charger.

Voltage Suppressor Installation

1. Install in reverse order of removal. **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.

CHARGER RELAY

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

Charger Relay Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect all wires from the relay (**Figure 5-6, Page 5-8**).
4. Remove two screws, nuts, and lock washers attaching relay to the charger case.
5. Remove the relay.

Charger Relay Installation

1. Install in reverse order of removal. Connect wires as shown (**Figure 5-6, Page 5-8**). Tighten nut securing relay to charger base to 18 in-lb (2.0 N·m).

CHARGER AC CIRCUIT BREAKER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

AC Circuit Breaker Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the two black wires attached to the AC circuit breaker (**Figure 5-6, Page 5-8**).
4. With a pair of pliers, squeeze in the retaining tabs on the sides of the AC circuit breaker and remove the circuit breaker through the mounting hole in the face of the charger.

AC Circuit Breaker Installation

1. Install in reverse order of removal.

CHARGER AC CORD

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

AC Cord Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the AC cord black wire from the AC circuit breaker.
4. Carefully cut the heatshrink that insulates the AC cord white wire (4) where it connects to the tan primary coil wire (**Figure 5-17, Page 5-20**).
5. Disconnect the AC cord white wire (4) from the primary coil tan wire.
6. Disconnect the AC cord green wire from the charger base.
7. 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.
2. Connect the AC cord black wire to the AC circuit breaker.
3. Place a piece of heatshrink tubing over the AC cord white wire.
4. Connect the AC cord white wire to the tan primary coil wire (**Figure 5-17, Page 5-20**).
5. Slide the heatshrink tubing over the connection and apply heat to the heatshrink to insulate the connection between the AC cord white wire and the tan primary coil wire. **See following WARNING.**

⚠ WARNING

- **Make sure the electrical connections are properly insulated. Failure to properly insulate electrical connections in the charger could result in a short circuit.**
6. Connect the green wire to the charger base. Tighten the screw and nut on the green (ground) wire terminal to 18 in-lb (2.0 N·m).
 7. Position the strain relief bushing on the AC cord.
 8. Using pliers, install the strain relief bushing and AC cord into the mounting hole in the charger face.
 9. Install the charger cover.

CHARGING A BATTERY PACK THAT HAS LOW VOLTAGE

See General Warning, Section 1, Page 1-1. See additional WARNING on page 5-1.

If battery pack voltage is below 34 volts, the charger will not activate. The charger relay will have to be bypassed to activate the charger. **See following WARNING.**

⚠ WARNING

- **Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 5-6, Page 5-8).**
 - **Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.**
1. Turn key switch OFF and place the Forward/Reverse handle in the NEUTRAL position. Leave the batteries connected.
 2. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
 3. Remove the screws securing the charger cover and remove the cover from the charger.
 4. To apply AC power directly to the transformer primary coil, the relay must be bypassed.
 - 4.1. To bypass the relay, remove the black wire (3) from the AC circuit breaker and disconnect the black wire (4) from the relay. Connect the black wire (4) to the AC circuit breaker (**Figure 5-21, Page 5-31**). **See following DANGER.**

⚠ DANGER

- **Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.**

5. Plug the DC cord into the charger receptacle *first*, and then plug the AC cord into an electrical outlet.
6. 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. A charger operating with a bypassed relay could short circuit and possibly cause a fire.**
7. 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.
 8. Disconnect the transformer wire (4) from AC circuit breaker and connect it to the relay. Connect the short black wire (3) from the relay to the AC circuit breaker (Figure 5-21, Page 5-31). **See following WARNING.**

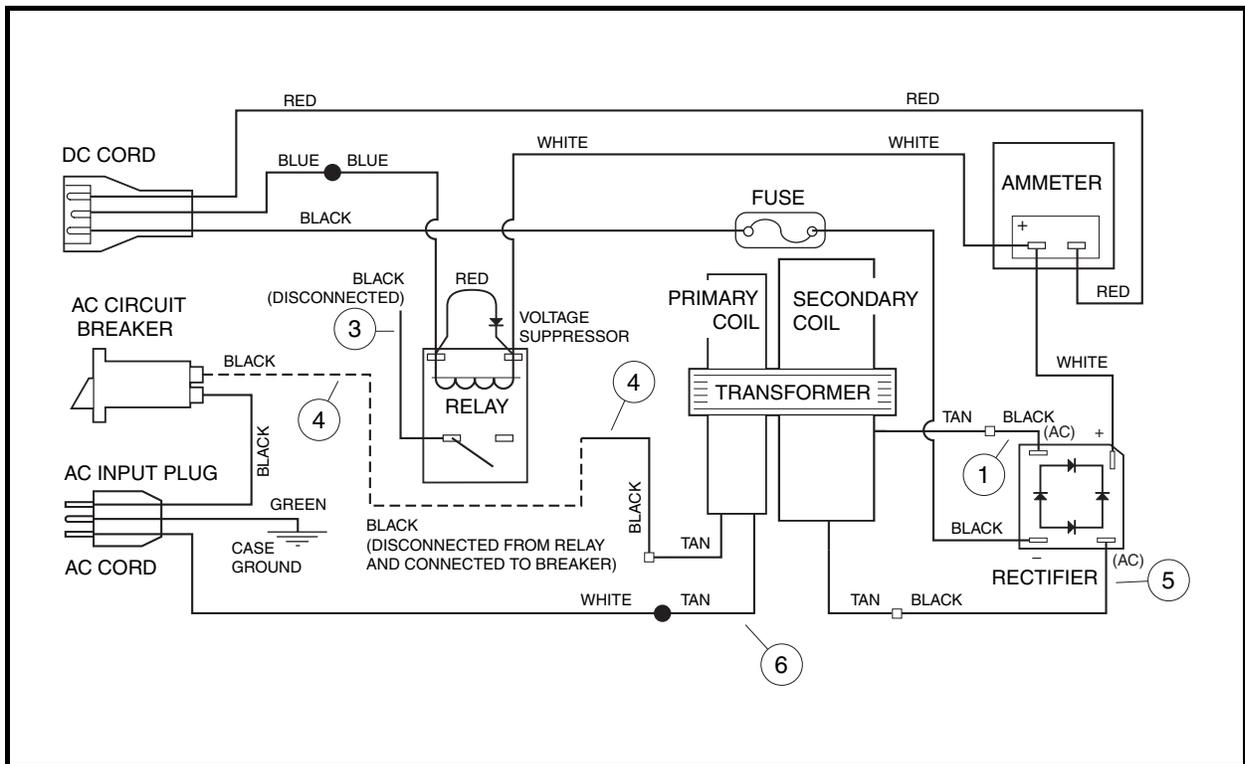


Figure 5-21 PowerDrive 2 Charger Wiring Diagram (Relay Bypassed)

⚠ WARNING

- **The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.**
9. Install the charger cover and the retaining screws.
 10. Plug the DC cord into the charger receptacle and plug the AC cord into an electrical outlet.
 11. Allow the charger to continue charging the batteries until the charger shuts off automatically.

12. 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 in the appropriate maintenance and service manual.**

SECTION 6 – GE POWERDRIVE CHARGER (EXTERNAL)

⚠ DANGER

- See General Warning, Section 1, Page 1-1.

⚠ WARNING

- See General Warning, Section 1, Page 1-1.
- The battery charger DC plug must be pulled slowly from the receptacle (Figure 6-4, Page 6-5). Jerking or pulling the DC cord out quickly could cause arcing that could damage the plug and receptacle and could cause batteries to explode (Figure 6-5, Page 6-5).

GENERAL INFORMATION

This section includes information pertaining to service of the GE PowerDrive battery charger (model numbers IC3645B12A4ASC1, IC3645B12A4BSC1, and IC3645B12A4CSC1). Do not attempt to service a battery charger that has not been properly identified. If a charger cannot be properly identified, contact your local Club Car dealer or distributor.

The GE PowerDrive battery charger is automatic and has no external controls (Figure 6-1, Page 6-1). When the charger is connected, there is a 2 to 15 second delay before charging begins.

NOTE: All vehicles except Precedent: 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.

The onboard computer, having recorded the amount of energy consumed as the vehicle was used, 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 necessary has been returned to the batteries.

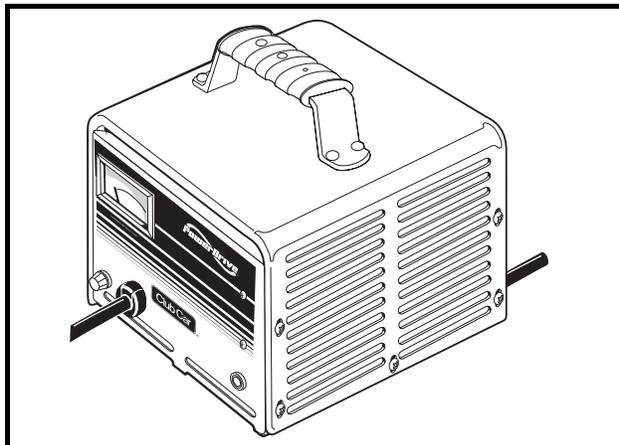


Figure 6-1 GE PowerDrive Battery Charger

GE POWERDRIVE BATTERY CHARGER FEATURES

- **Charge Interlock**

GE PowerDrive battery charger DC plugs have three pins rather than two blades common on most standard charger plugs. Two of these pins are the positive and negative leads as on standard chargers; the third pin is a sensing lead that is the communication link between the charger and the onboard computer. When the charger plug is plugged into the vehicle receptacle, the onboard computer locks out the vehicle 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**

IQ System, PowerDrive, and Precedent vehicles with GE PowerDrive chargers are designed to be left connected with AC power to the charger during off-season storage. The onboard computer will automatically activate the charger every 15 days. To return the vehicle to service, unplug the charger DC cord, wait 15 seconds for the computer to reset, and plug the charger back in. **See following WARNING.** This will ensure the batteries are at their optimum charge prior to returning the vehicle to service.

WARNING

- **The charger plug must be pulled slowly from the receptacle (Figure 6-4, Page 6-5). Jerking or pulling the DC cord out quickly could cause arcing and burning that could damage the plug and receptacle and could cause batteries to explode (Figure 6-5, Page 6-5).**

BATTERY WARNING LIGHT

Precedent, IQ System and PowerDrive vehicles, feature a dash mounted warning light (above the steering column) that, 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 onboard computer.

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

- The battery 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 replenish the batteries and will complete the charge during the next charge cycle.
- When the charger DC cord is unplugged during a charge cycle, the battery warning light will illuminate and remain illuminated for 10 seconds (25 seconds for Precedent vehicles) if the charge is less than 90% complete but the vehicle has enough power for 60 minutes of operation. This will alert the operator that the vehicle may be used, but that it must be charged to completion as soon as possible.
- The battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals (25 seconds, at 10 second intervals for Precedent vehicles), 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 battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals (25 seconds, at 10 second intervals for Precedent vehicles), during a charge cycle (with the DC plug still connected) if AC power to the charger is interrupted. The light will go out when AC power is restored.

THE CHARGE CIRCUIT

The vehicle charge circuit consists of the following:

- charger receptacle
- receptacle fuse link
- onboard computer
- 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 vehicle, 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 (on all vehicles except Precedent vehicles), and the 18-gauge gray wire from the onboard computer. On all vehicles except Precedent vehicles, also check connections of the fuse link located on the charger receptacle (**Figure 6-2, Page 6-3 or Figure 6-3, Page 6-4**).

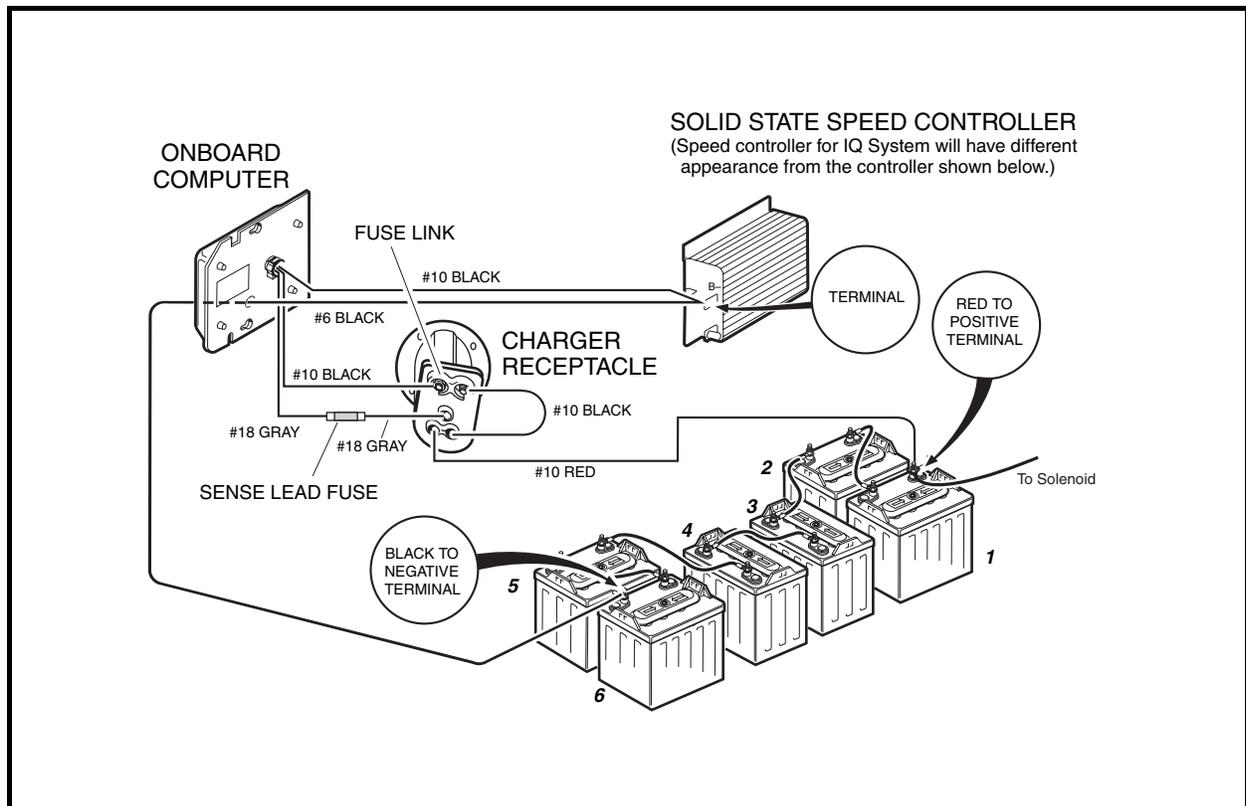


Figure 6-2 Charge Circuit and Battery Configuration – DS Vehicles

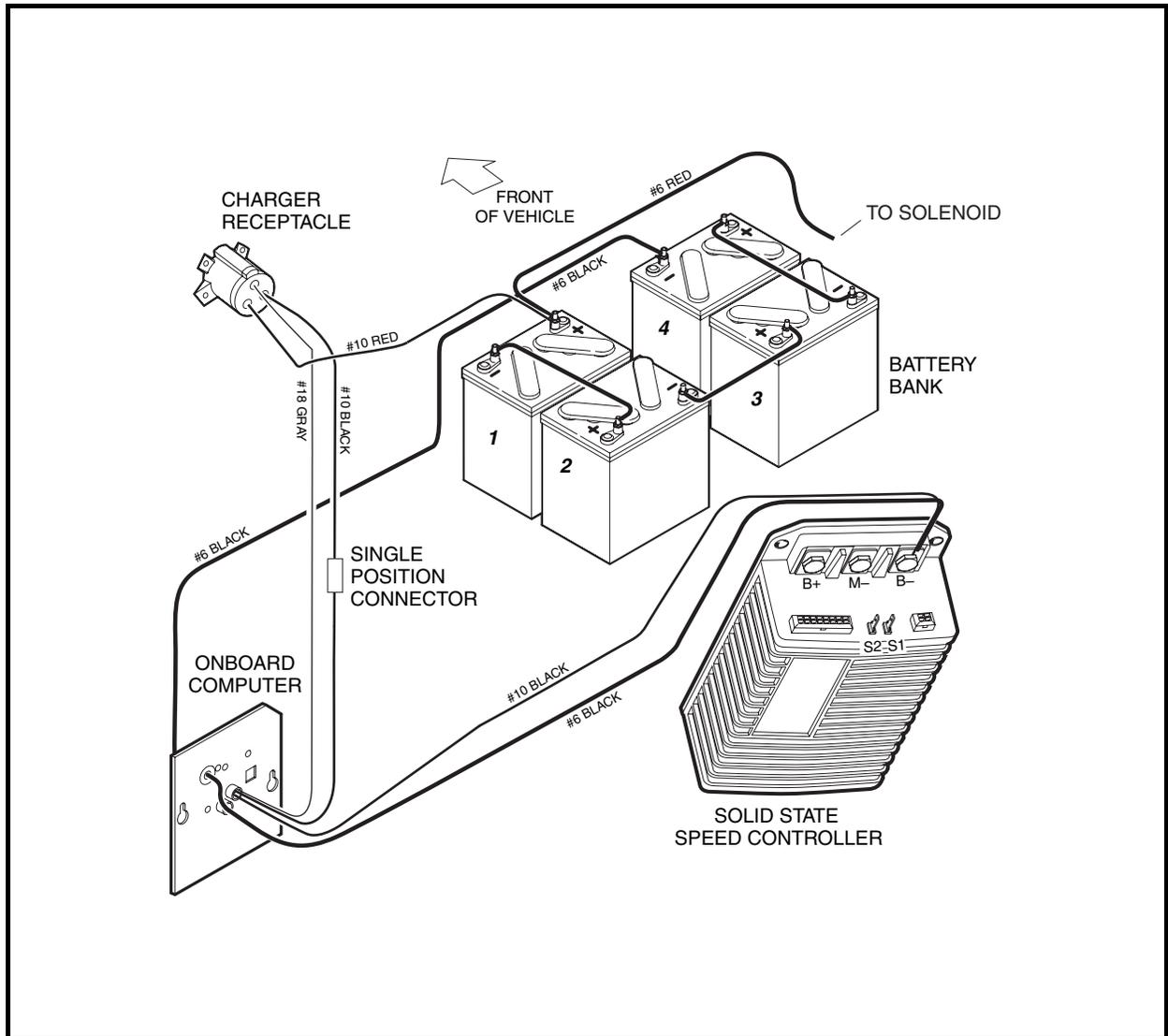


Figure 6-3 Charge Circuit and Battery Configuration – Precedent Vehicles

CHARGER INSTALLATION AND OPERATION

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

⚠ DANGER

- The charging area must be ventilated. Hydrogen level in the air must never exceed 2%. The total volume of air in the charging area must be changed five times per hour. Exhaust fans should be located at the highest point of the roof. Contact a local HVAC engineer.
- Do not charge the vehicle batteries with the vehicle covered or enclosed. Any enclosure or cover should be removed or unzipped and pulled back when batteries are being charged. An accumulation of hydrogen gas could result in an explosion.

⚠ WARNING

- Do not bypass the sense lead fuse (not applicable to Precedent vehicles).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.
- The battery charger DC plug must be pulled slowly from the receptacle (Figure 6-4, Page 6-5). Jerking or pulling the DC cord out quickly could cause arcing that could damage the plug and receptacle and could cause batteries to explode (Figure 6-5, Page 6-5).
- Do not connect the charger to battery packs that are not compatible with the DC output voltage specified on the charger. Overheating and transformer burnout will result.
- Do not use a battery charger if the cord, plug, or receptacle is damaged in any way. Replace worn or damaged parts immediately. Failure to heed this warning could result in a fire, property damage, severe personal injury, or death.
- Do not use a battery 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.
- 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.
- 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. The use of an improper extension cord could result in fire or electric shock.
- 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.
- Do not block or cover the charger ventilation slots. The slots provide ventilation and prevent the charger from overheating.
- Do not allow clothing, blankets, or other materials to cover the charger.
- Do not allow the charger to operate for more than 30 minutes at 19 or more amperes.
- Install surge arrestors on incoming AC power lines. Surge arrestors will help protect electrical components in the charger and on the vehicle from all but direct or close lightning strikes.

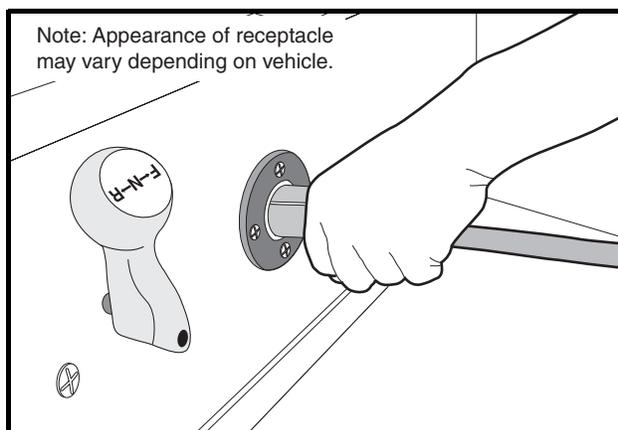


Figure 6-4 Charger Receptacle

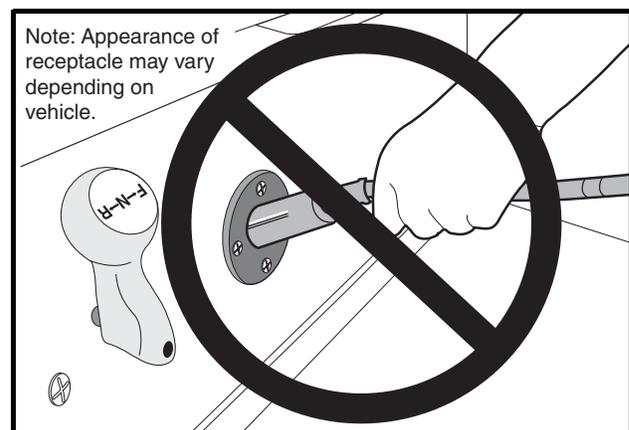


Figure 6-5 Incorrect DC Plug Removal

AC POWER CONNECTION

The AC line to which the charger is to be connected must be of the proper AC input voltage for the charger and must be capable of supplying sufficient current. **See Section 2 – Charger Identification and Specifications.**

With charger DC output cord disconnected, connect the power supply cord to an AC supply. **See Section 2 – Charger Identification and Specifications.**

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 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 should be avoided. If an extension cord must be used, use a three-conductor no. 12 AWG (American Wire Gauge) or no. 14 SWG (British Standard Wire Gauge), heavy-duty cord with ground, properly wired and in good electrical condition. Keep it as short as possible (no more than 12 feet (3.7 meters)). Place all cords so they will not be stepped on, tripped over, or otherwise subject to damage or stress.

Ensure that the charger ventilation slots are unobstructed and that there is adequate ventilation.

CHARGING BATTERIES

⚠ WARNING

- Do not bypass the sense lead fuse (not applicable to Precedent vehicles).
 - Be sure the fuse link is clean and tight (not applicable to Precedent vehicles).
 - Be sure all wire connections at the receptacle are clean and tight.
 - Do not rock or bend the plug. To connect the charger plug to the vehicle receptacle, grasp the plug handle and push the plug straight into the receptacle (Figure 6-4, Page 6-5).
 - Do not pull on the DC cord (Figure 6-5, Page 6-5). Do not twist, rock or bend the plug. To disconnect the charger plug from the vehicle receptacle, grasp the plug by the handle and pull the plug straight out of the receptacle.
 - Do not connect a charger to the receptacle if the charger cord, plug, or the vehicle receptacle is broken, damaged in any manner, or does not make a good electrical connection. Fire or personal injury can result. Have it replaced by a qualified service person immediately. Failure to follow these instructions could result in damage to the charger cord, the plug, and (or) the vehicle receptacle.
 - Do not use a charger if:
 - The plug is too loose or does not make a good connection.
 - The plug and receptacle feel hotter than normal during charge.
 - The plug pin or receptacle contacts are bent or corroded.
 - The plug, receptacle, or cords are cut, worn, have any exposed wires or are damaged in any way.
 - Using the charger with any of the above symptoms could result in a fire, property damage, personal injury, or death.
1. With the charger DC cord disconnected from the vehicle charger receptacle, connect the AC power supply cord to an AC outlet designed to provide the proper AC voltage for the charger.

2. Connect the charger DC plug to the vehicle charger receptacle located on the seat support panel (**Figure 6-4, Page 6-5**). The charger will activate automatically within 2 to 15 seconds after the DC plug is connected. **See following WARNING.**

⚠ WARNING

- **Do not rock or bend the DC plug. To connect the charger plug to the vehicle receptacle, grasp the plug handle and push the plug straight into the receptacle (Figure 6-4, Page 6-5).**
3. **All vehicles except Precedent:** 10 to 20 seconds after the charger activates, it will shut off again to run a self-diagnostic program (the ammeter will drop to 0). Charging will resume in a few moments (ammeter will return to previous rate of charge).
 4. **All vehicles:** 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 the nominal input voltage. Higher AC line voltages increase the initial charge rate while lower AC line voltages reduce the initial charge rate.
 5. **All vehicles except Precedent:** Monitor the ammeter for about 30 seconds. Under normal operating conditions (when the charger is on and the batteries are discharged), 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.*

Batteries should be put on charge at the end of each day even if the vehicle has been used for only a short amount of time (even if for only 10 minutes).

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.

New batteries will not deliver their full range until the vehicle has been driven and recharged from 20 to 50 times.

*Vehicles should be restricted to 40 to 50 energy units of discharge (or 36 holes of golf) between charges until the batteries have been properly seasoned (20 to 50 charge cycles). For maximum battery life, Club Car recommends that electric vehicles always be recharged after 40 to 50 energy units of discharge or each night in order to avoid deep discharging the batteries. Charging between rounds will also extend battery life; use the CDM (Communication Display Module) (CCI P/N 101831801). **See Communication Display Module in Section 11 of the appropriate maintenance and service manual.***

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 the wall 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. **See following NOTE.**

NOTE: *Monitor the charge cycle to make sure the charger turns off properly. If the charge cycle is interrupted, and the batteries are less than 90% charged, the battery warning light will illuminate intermittently. **See Battery Warning Light on page 6-2.***

Testing Charger Operation, Continued:

3. If the charger does not operate exactly as described above, refer to the wiring diagram and make sure that the vehicle is wired correctly (**Figure 6-2, Page 6-3**) and that the internal charger wiring is correct (**Figure 6-6, Page 6-8**).

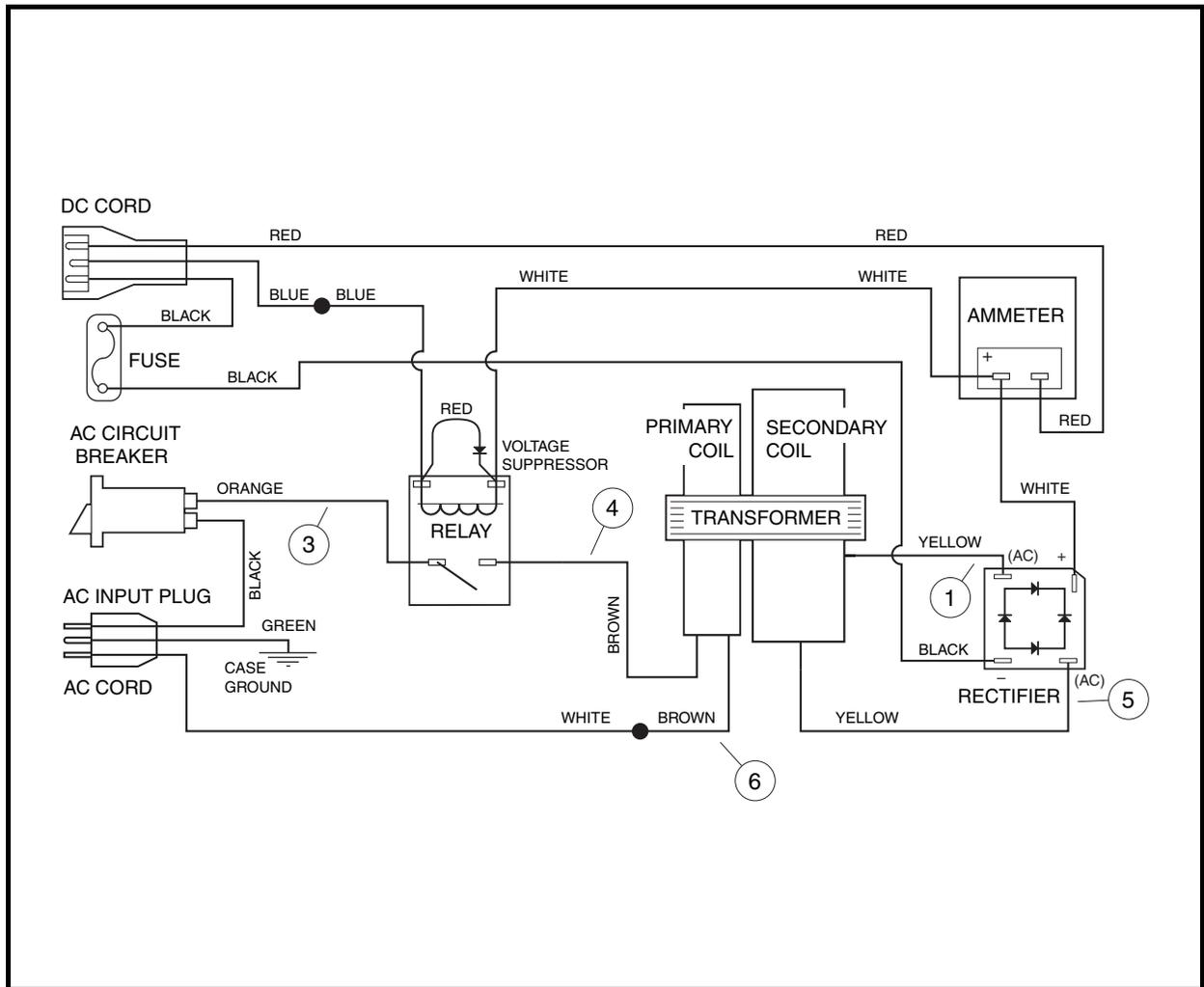


Figure 6-6 GE PowerDrive Battery Charger Wiring Diagram (External Charger)

DC CORD AND PLUG INSPECTION

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 or receptacle show signs of corrosion or the plug is difficult to insert or remove, the receptacle contacts and plug terminals should be cleaned with a good electrical contact cleaner. The plug should then be inserted and removed several times to ensure ease of insertion, ease of removal, and good electrical contact. **See Charger Receptacle in Section 12 of the appropriate maintenance and service manual for receptacle removal and installation. See also DC Cord Removal on page 6-24. See following NOTE.**

NOTE: *If the warning tag has been damaged or removed from the DC cord, have it replaced immediately.*

CHECKING BATTERY CONDITION AFTER A CHARGE CYCLE

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

It is common practice for technicians to check the condition of a set of batteries after they have been charged to ensure they have received a complete charge before the vehicle is used. With IQ System, PowerDrive, and Precedent vehicles, this is not necessary; the onboard computer controls and monitors the charge cycle. If any problem occurs during a charge cycle, the battery warning light, located above the steering column in the center dash panel, will illuminate intermittently. **See following NOTE.**

If the battery warning light is illuminated after a charge cycle, refer to the troubleshooting chart in the maintenance and service manual appropriate for your battery charger. If you do not have this publication, contact your Club Car representative. If the specified test procedures identify no 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 near the end of a charge cycle should be approximately 59 to 63 volts.

START CHARGE CYCLE

1. Disconnect the DC plug from the vehicle charger receptacle.
2. Wait 20 seconds, then reconnect the DC cord to the vehicle receptacle. **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. **All vehicles except Precedent:** 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 continues. If the batteries are close to being fully charged, the charge cycle will begin and the charge current will begin to taper within a few minutes.

TROUBLESHOOTING

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

⚠ DANGER

- Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.

⚠ WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 6-6, Page 6-8).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.

Use the following Troubleshooting Guide for troubleshooting PowerDrive external battery chargers (model numbers 22110-11, 22110-18, and 22110-19). The Troubleshooting Guide encompasses the entire battery charging circuit. Test procedures specified in the Troubleshooting Guide can be found on the following pages.

GE POWERDRIVE BATTERY CHARGER TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Relay does not close, no transformer hum and ammeter does not move	Batteries disconnected	See Section 13 – Batteries in the appropriate maintenance and service manual
	Battery voltage is too low	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 6-13
	Poor connection between plug and receptacle	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 6-13
	DC plug and cord	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 6-13 and Test Procedure 5 – Charger DC Circuit Continuity Test on page 6-17
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 6-15
	Gray sense lead fuse is blown (not applicable to Precedent vehicles)	Test Procedure 1 – Battery Voltage and DC Plug and Receptacle on page 6-13
	Receptacle fuse link is blown (not applicable to Precedent vehicles)	See Section 12 – Electrical Components in the appropriate maintenance and service manual
	Poor connection at 10-gauge black wire or 18-gauge gray wire at the OBC (applicable to Precedent vehicles only)	Check wire connections
Relay closes with an audible click but no transformer hum and ammeter does not move	Improper AC outlet voltage	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 6-15
	Failed AC plug and cord	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 6-15
	Transformer primary coil	Test Procedure 6 – Transformer on page 6-18
	Relay	Test Procedure 8 – Continuity on page 6-20
	Failed ammeter	Replace ammeter
Relay closes and transformer hums but ammeter does not move	Blown charger fuse	Test Procedure 8 – Continuity on page 6-20
	Failed rectifier	Test Procedure 4 – Rectifier on page 6-16
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 6-15
	Failed transformer	Test Procedure 6 – Transformer on page 6-18
Relay operates intermittently	Failed charger relay	Test Procedure 8 – Continuity on page 6-20
Charger fuse blows or receptacle fuse link blows	Failed rectifier	Test Procedure 4 – Rectifier on page 6-16
	Loose internal fuse connection	Tighten connection
	Battery is wired in reverse polarity	Check vehicle wiring
	DC cord is wired in reverse polarity	Check battery charger wiring
Troubleshooting Guide continued on next page...		

GE POWERDRIVE BATTERY CHARGER TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Charger output is low	Failed rectifier	Test Procedure 4 – Rectifier on page 6-16
	Transformer coil short-circuit failure	Test Procedure 6 – Transformer on page 6-18
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 6-15
Charger turns off too soon	AC power supply was shut off	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 6-15
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 6-15
	Batteries may be fully charged	Test Procedure 7 – Battery State of Charge Test on page 6-20
Charger goes to 16 hour time out	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 6-15
	Extremely discharged batteries or cold temperature	Recharge batteries
	Failed or weak battery	See Section 13 – Batteries in the appropriate maintenance and service manual
AC line fuse blows or AC circuit breaker trips	AC cord is shorted	Test Procedure 8 – Continuity on page 6-20
	Failed transformer	Test Procedure 6 – Transformer on page 6-18
	Incorrect charger wiring	Check battery charger wiring
Battery warning light illuminates for ten seconds at four second intervals (with DC charger cord plugged in) (25 seconds, at 10 second intervals for Precedent vehicles)	AC power interrupted	Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 6-15
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 6-15
	Charger failure	See Testing Charger Operation on page 6-7
	16 hour time out	See Battery Warning Light on page 6-2
	Battery or batteries need to be replaced	See Section 13 – Batteries in the appropriate maintenance and service manual
Battery warning light illuminates for ten seconds at four second intervals (with DC charger cord unplugged) (25 seconds, at 10 second intervals for Precedent vehicles)	Batteries are getting close to full discharge capacity	Recharge batteries (golf round may be completed first)
	Onboard computer malfunction	Test Procedure 2 – Onboard Computer on page 6-15
	Battery or batteries need to be replaced	See Section 13 – Batteries in the appropriate maintenance and service manual

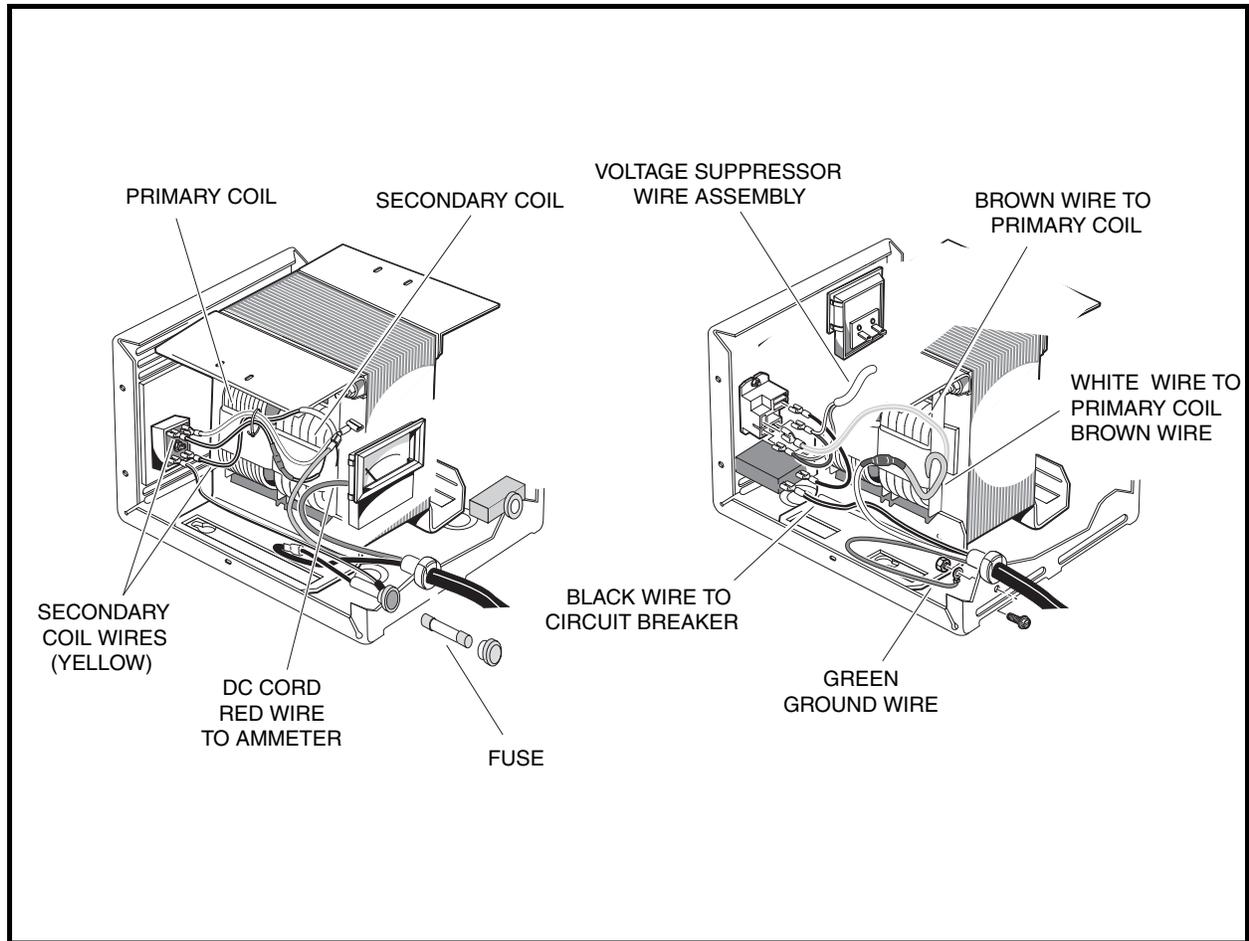


Figure 6-7 GE PowerDrive Battery Charger

TEST PROCEDURES

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

INDEX OF TEST PROCEDURES

1. Battery Voltage and DC Plug and Receptacle
2. Onboard Computer
3. AC Power and Continuity Test of AC Circuit
4. Rectifier
5. Charger DC Circuit Continuity Test
6. Transformer
7. Battery State of Charge Test
8. Continuity

TEST PROCEDURE 1 – BATTERY VOLTAGE AND DC PLUG AND RECEPTACLE

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

1. Check the DC plug and the vehicle charger receptacle for damage, dirt, corrosion, or any condition that might prevent a sound 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:
 - **DS vehicles:** Verify that the 10-gauge red wire from the charger receptacle is connected to the positive (+) post of battery no. 1 (**Figure 6-2, Page 6-3**).
 - **Precedent vehicles:** Verify that the 10-gauge red wire from the charger receptacle is connected to the positive (+) post of battery no. 1 (**Figure 6-3, Page 6-4**).

DS vehicles only:

- 3.1. Make sure the two nuts that secure the two 10-gauge black wires to the receptacle fuse assembly are tight (**Figure 6-8, Page 6-13**).
- 3.2. 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.

⚠ WARNING

- Do not bypass the sense lead fuse.

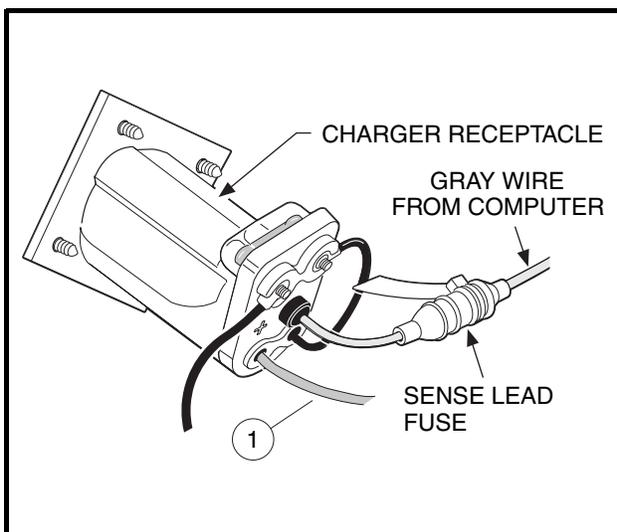
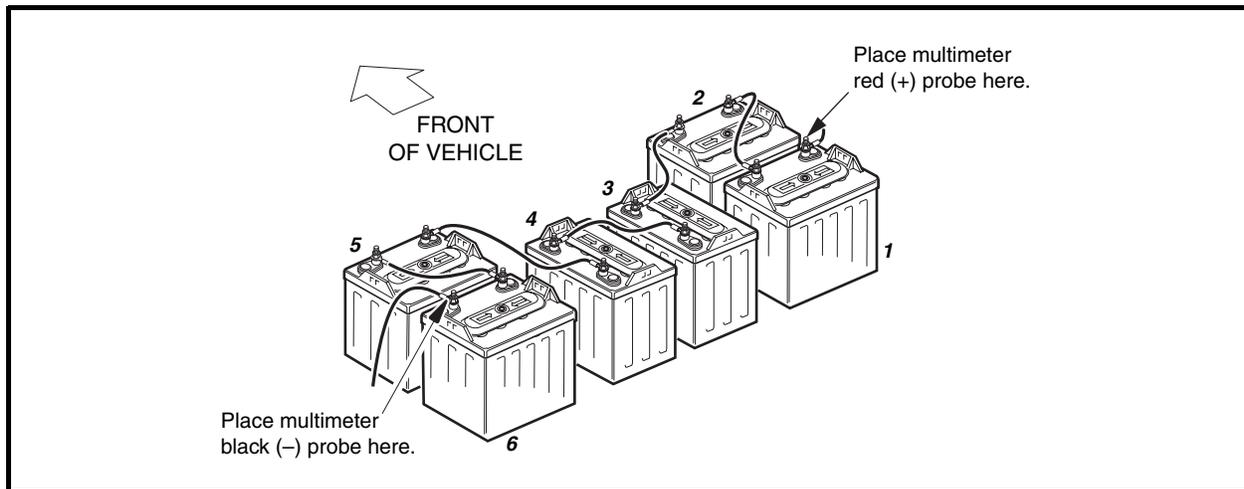


Figure 6-8 Receptacle Wire Connections (all vehicles except Precedent)

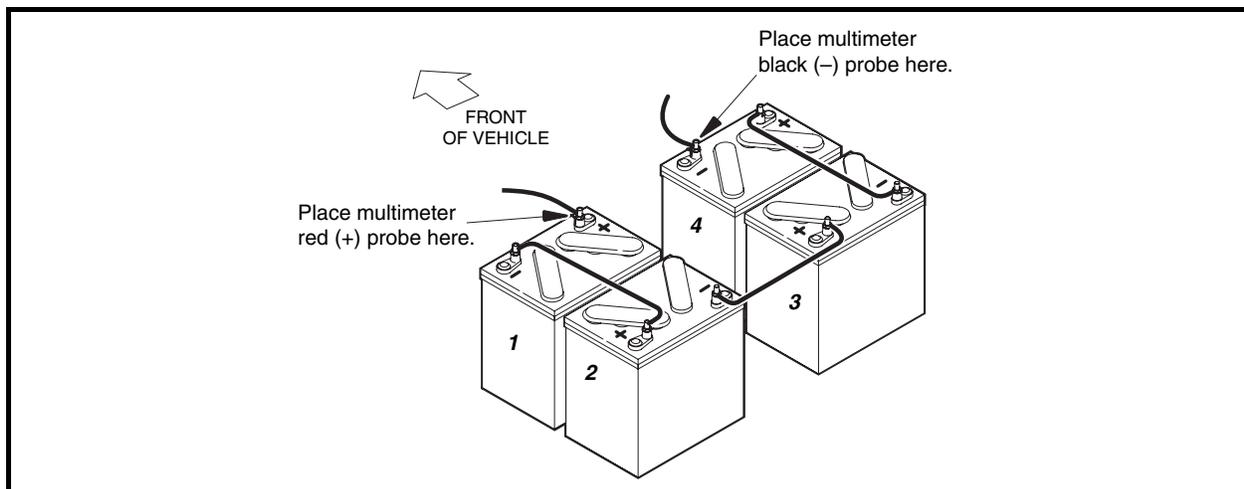
- 3.3. Remove the gray sense lead fuse and check it for continuity with a multimeter set to 200 ohms. The resistance should be less than 2 ohms.

Test Procedure 1 – Battery Voltage and DC Plug and Receptacle, Continued:

- With a 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 6-9, Page 6-14**). Normal no-load voltage should be between 50 and 52 volts for fully charged batteries. The voltage of the battery pack must be over 32 volts DC to allow the onboard computer to close the charger relay. If battery pack voltage is too low to start charger, temporarily bypass the charger relay. **See Charging a Battery Pack that has Low Voltage on page 6-30.**

**Figure 6-9 DS Battery Configuration****Precedent vehicles only:**

- With a 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. 4 (**Figure 6-10, Page 6-14**). Normal no-load voltage should be between 50 and 52 volts for fully charged batteries. The voltage of the battery pack must be over 32 volts DC to allow the onboard computer to close the charger relay. If battery pack voltage is too low to start charger, temporarily bypass the charger relay. **See Charging a Battery Pack that has Low Voltage on page 6-30.**

**Figure 6-10 Precedent Battery Configuration**

TEST PROCEDURE 2 – ONBOARD COMPUTER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

1. 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 that AC power is present.
2. Check the AC circuit breaker on the front of the charger and reset it if necessary.
3. Insert the DC cord from the second charger into the receptacle of the 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 on page 6-9.**
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.

TEST PROCEDURE 3 – AC POWER AND CONTINUITY TEST OF AC CIRCUIT

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

1. Disconnect AC cord from the wall outlet and 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 to 500 volts AC, check incoming AC voltage. Insert multimeter test probes into AC wall outlet; voltage should be between 105 and 128 volts. If proper voltage is not present, have building wiring checked by a licensed electrical contractor.
5. Check continuity of the AC circuit.
 - 5.1. Remove the charger cover.
 - 5.2. Bypass the relay.
 - 5.2.1. To bypass the relay, remove the orange wire (3) from the AC circuit breaker and disconnect the orange wire (4) from the relay. Connect the brown wire (4) to the AC circuit breaker (**Figure 6-16, Page 6-19**).
 - 5.3. With relay bypassed, there should be continuity across the AC cord blades (**Figure 6-11, Page 6-15**).

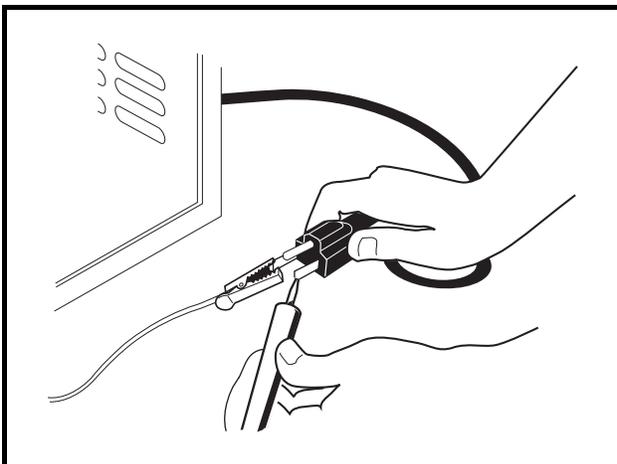


Figure 6-11 AC Cord Test

Test Procedure 3 – AC Power and Continuity Test of AC Circuit, Continued:

6. If the circuit is not complete, check the wiring of the AC cord, transformer primary coil wires, and internal AC circuit breaker (**Figure 6-16, Page 6-19**).
7. If the charger is wired correctly, check the continuity of the AC cord, transformer primary coil, and the internal AC circuit breaker individually. **See Test Procedure 8 – Continuity on page 6-20.**
8. When troubleshooting and repairs are complete, properly connect the relay wiring. **See following WARNING.**

⚠ WARNING

- The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.

TEST PROCEDURE 4 – RECTIFIER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

The rectifier converts the AC voltage from the transformer secondary coil to DC voltage. This conversion is necessary since the batteries require DC voltage for charging. A failed or improperly wired rectifier could result in little or no battery charging current or a tripped AC circuit breaker.

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect all four wires from the rectifier (**Figure 6-12, Page 6-16**).

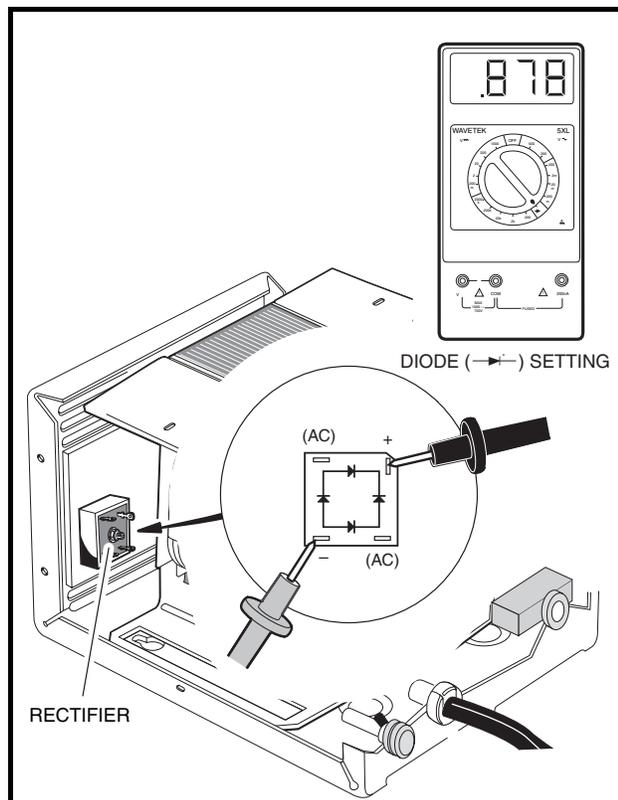


Figure 6-12 Rectifier Test

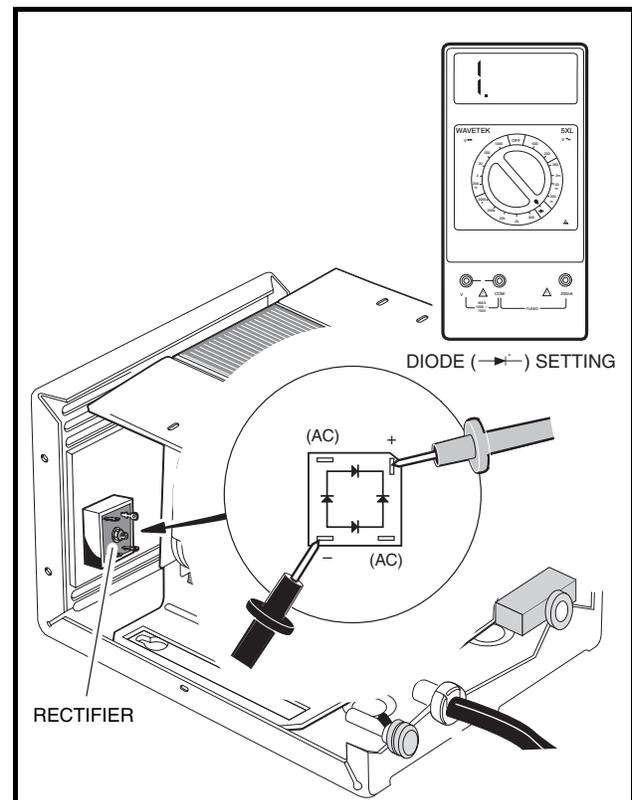


Figure 6-13 Rectifier Test – Probes Reversed

4. Using a multimeter set to the diode test function ($\rightarrow|$), place the black (-) probe of the multimeter on the positive (+) terminal of the rectifier. Move the positive (+) probe to each of the remaining three rectifier terminals and note the readings (**Figure 6-12, Page 6-16**).
 - 4.1. The multimeter should indicate approximately 878 mV with the positive (+) probe on the negative (-) rectifier terminal.
 - 4.2. The multimeter should indicate approximately 483 mV with the positive (+) probe on one of the AC rectifier terminals.
 - 4.3. The multimeter should indicate approximately 483 mV with the positive (+) probe on the other AC rectifier terminal.
 - 4.4. If any other reading is obtained, the rectifier has failed and must be replaced.
5. Using a multimeter set to the diode test function ($\rightarrow|$), place the black (-) probe of the multimeter on the negative (-) terminal of the rectifier. Move the positive (+) probe to each of the remaining three rectifier terminals and note the readings (**Figure 6-13, Page 6-16**). The multimeter should indicate an overload (no continuity) for all three of the remaining rectifier terminals. If any other reading is indicated, the rectifier has failed and must be replaced.
6. On rare occasions, the rectifier may fail as a result of a lightning strike at the charging location.
7. Ensure that the charger is wired properly and all connections are clean and tight. **See following CAUTION.**

CAUTION

- If connections are not clean and tight, excessive heat will be created and the charger may become damaged.

TEST PROCEDURE 5 – CHARGER DC CIRCUIT CONTINUITY TEST

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

1. Disconnect the AC cord from the wall outlet and the DC cord from the vehicle charger receptacle.
2. Using a multimeter set to the diode test function ($\rightarrow|$), place the positive (+) probe of the multimeter on the pin marked positive (+) on the DC plug (**Figure 6-14, Page 6-17**). Place the negative probe (-) on the pin marked negative (-). The multimeter should indicate an overload (no continuity).

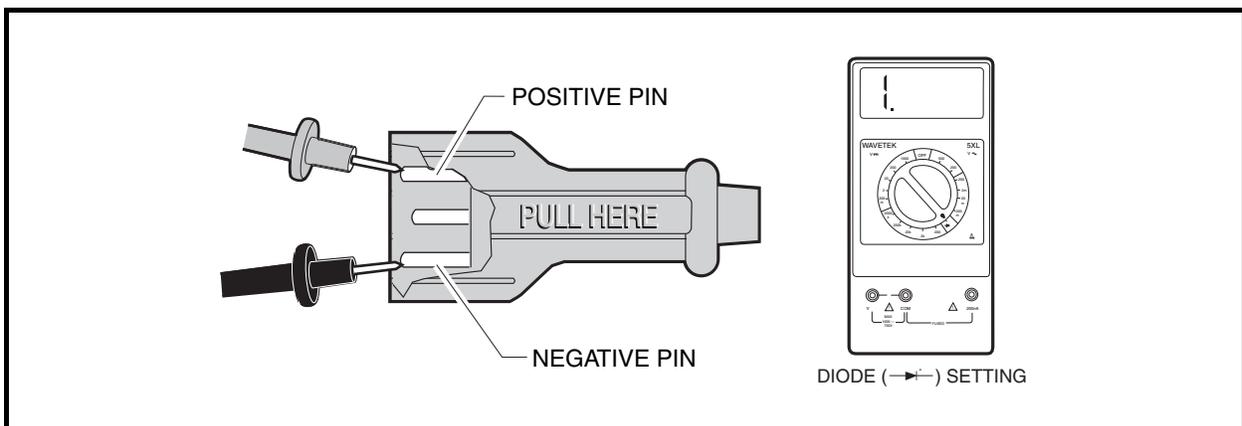


Figure 6-14 DC Plug Test

Test Procedure 5 – Charger DC Circuit Continuity Test, Continued:

3. Reverse the test probes and check the DC plug again (**Figure 6-15, Page 6-18**). The multimeter should indicate approximately 878 mV.
4. If multimeter readings are incorrect, check the battery charger wiring (**Figure 6-6, Page 6-8**).
5. If the multimeter indicates an overload (no continuity) in both directions, and the charger fuse is not blown, individually check all connections and the continuity of the DC cord and ammeter. **See Test Procedure 8 – Continuity on page 6-20.** Also check the rectifier. **See Test Procedure 4 – Rectifier on page 6-16.**
6. If the multimeter indicates a voltage reading in both directions, a short circuit exists in the charger DC circuit, usually caused by a failed rectifier. **See Test Procedure 4 – Rectifier on page 6-16.** If the rectifier has not failed, check the DC cord for a short circuit. **See Test Procedure 8 – Continuity on page 6-20.**

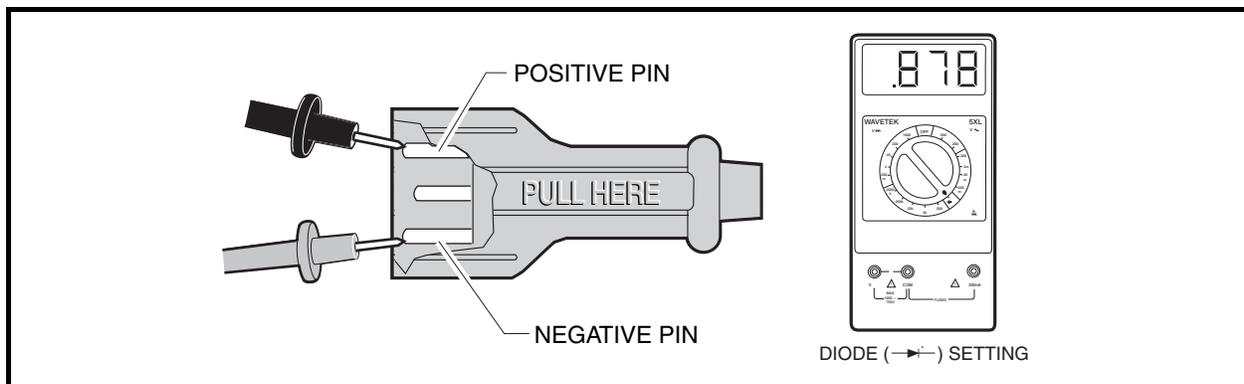


Figure 6-15 DC Plug Test – Probes Reversed

TEST PROCEDURE 6 – TRANSFORMER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

Failure of the transformer may be caused by aging or a short circuit in adjacent coil turns. If the transformer has failed, the ammeter will indicate low output or no output; however, the transformer may hum. A blown AC line fuse or tripped AC circuit breaker in the charger or the storage facility may be caused by an improperly wired charger or a failed transformer.

An AC circuit test should be done before performing this test procedure to ensure the continuity of the AC cord, internal AC circuit breaker, and charger wiring. **See Test Procedure 3 – AC Power and Continuity Test of AC Circuit on page 6-15.**

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the two yellow transformer secondary coil wires (1 and 5) from the rectifier (**Figure 6-16, Page 6-19**).
4. To apply AC power directly to the transformer primary coil, the relay must be bypassed.
 - 4.1. To bypass the relay, remove the orange wire (3) from the AC circuit breaker and disconnect the brown wire (4) from the relay. Connect the brown wire (4) to the AC circuit breaker (**Figure 6-16, Page 6-19**). **See following DANGER.**

⚠ DANGER

- **Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.**
5. Make sure the secondary coil wires are not touching one another. With the relay bypassed, insert the AC plug into an outlet. If the AC line fuse blows or AC circuit breaker trips, the transformer is shorted internally and must be replaced.
 6. If the AC line fuse does not blow or the AC circuit breaker does not trip, check the transformer secondary coil voltage.
 7. Disconnect AC cord from the wall outlet.
 8. Using alligator clips and a multimeter set to 500 volts AC, connect the multimeter probes to the secondary transformer coil wires (1 and 5).
 9. Connect the AC cord to the wall outlet and monitor the multimeter for the secondary coil voltage. If measured voltage is approximately 42.5 volts AC or lower for the secondary coil, the transformer is shorted internally and must be replaced (**Figure 6-16, Page 6-19**).
 10. If the voltage reading is normal (43 volts AC or higher), the transformer is operational. Disconnect the AC plug from the wall receptacle and check the continuity of the DC circuit. **See Test Procedure 5 – Charger DC Circuit Continuity Test on page 6-17.**
 11. When troubleshooting and repairs are complete, properly connect the relay wiring. **See following WARNING.**

⚠ WARNING

- **The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.**

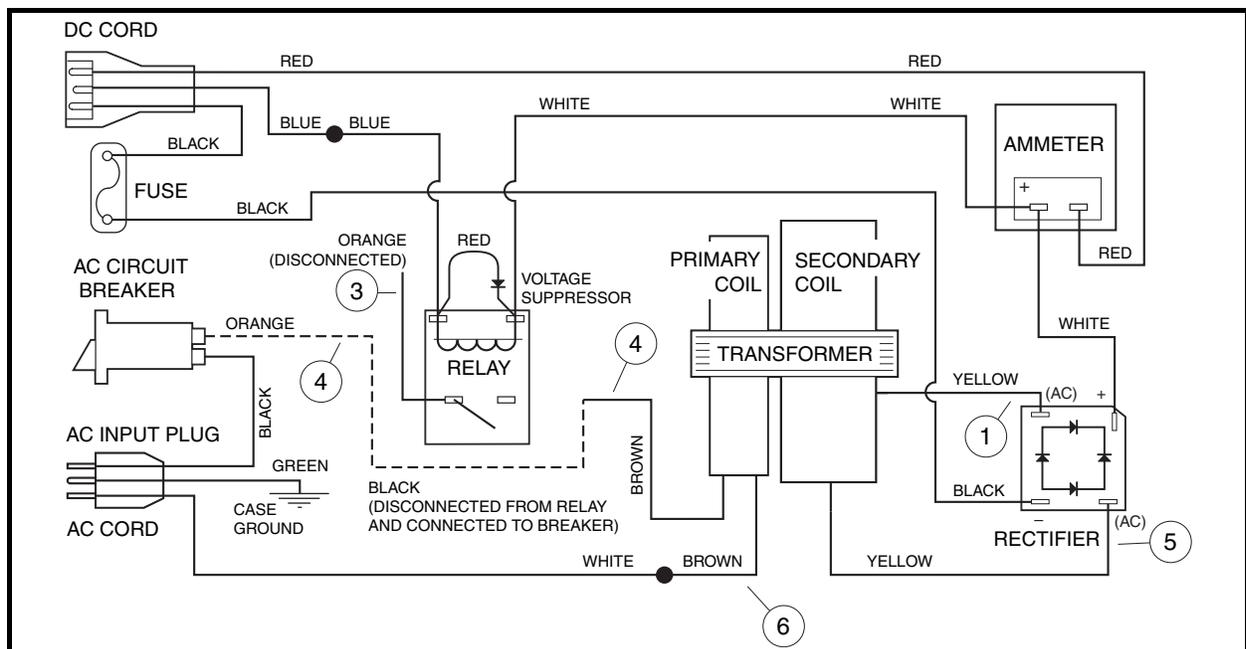


Figure 6-16 Transformer Test Wiring Diagram

TEST PROCEDURE 7 – BATTERY STATE OF CHARGE TEST

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

1. With the batteries fully charged, disconnect the DC charger plug for approximately 20 seconds and then reconnect it. The ammeter should jump to a reading between 12 and 14 amps and then taper to below 5 amps within 15 minutes.
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 – Onboard Computer on page 6-15.

NOTE: Batteries near the end of their useful lives may not allow the battery charge current to taper below 5 amps. See Section 13 – Batteries in the appropriate maintenance and service manual.

TEST PROCEDURE 8 – CONTINUITY

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

Fuse

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove the fuse from the fuse holder on the front of the battery charger.
4. Using a multimeter set for 200 ohms, place the red (+) probe on one fuse terminal and the black (–) probe on the other fuse terminal. The tester should indicate continuity. If the tester does not indicate continuity, then the fuse has failed and must be replaced.

AC Cord

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the green wire (2) from charger case and position it so it does not touch any metal part of the charger (Figure 6-17, Page 6-20).

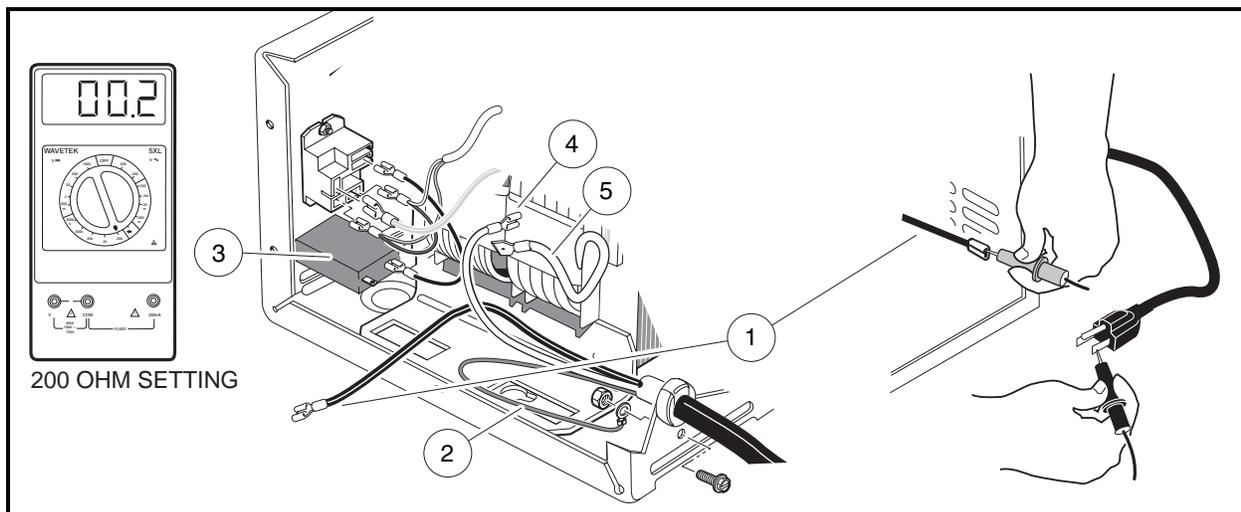


Figure 6-17 AC Cord and Plug Continuity Test

4. Disconnect the black wire (1) of AC cord from charger AC circuit breaker (3).
5. Disconnect the AC cord white wire (4) from the primary coil brown wire.
6. Using a multimeter set for 200 ohms, place the red (+) probe on the terminal at the end of the black wire (1). Test for continuity on each of the flat blades and then on the round pin of the AC plug. The tester should indicate continuity on one flat blade only. If any other reading is obtained, the AC cord and plug must be replaced.
7. Place 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 round pin of the AC plug (**Figure 6-17, Page 6-20**). The tester should indicate continuity on only the round pin. If any other reading is obtained, the AC cord and plug must be replaced.
8. Place the red (+) probe on the white wire (4) and check for continuity on both flat blades and on the ground pin of the AC plug. The tester should indicate continuity on only one flat blade. If any other reading is obtained, the AC cord and plug must be replaced.
9. If the correct readings were obtained, install the AC cord. **See AC Cord Installation on page 6-30.**

DC Cord

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. To check the continuity of the DC cord, disconnect the black wire of the DC cord from the fuse (**Figure 6-18, Page 6-24**).
4. Disconnect the red wire of the DC cord from the ammeter.
5. Disconnect the blue wire from the blue wire assembly that connects to the charger relay.
6. Place the clip of the continuity tester on the red wire of the DC cord.
7. Place the continuity test probe on the positive (+) pin of the DC plug (positive (+) and negative (-) pins are identified on the plug). If tester does not indicate continuity, the DC cord must be replaced.
8. Place the continuity test probe on the negative (-) pin of the DC plug. The tester should indicate no continuity. If tester indicates continuity, the DC cord must be replaced.
9. Place the continuity test probe on the unmarked (middle) pin of the DC plug. The tester should indicate no continuity. If tester indicates continuity, the DC cord must be replaced.
10. Move the continuity test probe to the black wire of the DC cord.
11. Place the continuity test probe on the negative (-) pin of the DC plug. The tester should indicate continuity. If tester does not indicate continuity, the DC cord must be replaced.
12. Place the continuity test probe on the unmarked (middle) pin of the DC plug. The tester should indicate no continuity. If tester indicates continuity, the DC cord must be replaced.
13. Move continuity test probe to the blue wire of the DC cord. Check for continuity at the middle pin. The tester should indicate continuity. If tester does not indicate continuity, replace DC cord.

Transformer

The GE PowerDrive battery charger transformer has two sets of coils: a primary coil and a secondary coil (**Figure 6-16, Page 6-19**).

Primary Coil

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect terminals from transformer (brown) primary coil transformer wires (4 and 6) (**Figure 6-16, Page 6-19**).
4. Place the continuity tester probes on the disconnected primary coil wires. The tester should indicate continuity. If tester does not indicate continuity, replace the transformer.
5. If the correct readings were obtained, install the AC cord and connect the transformer primary coil wires. **See AC Cord Installation on page 6-30.**

Secondary Coil

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove the transformer (yellow) secondary coil wire (1) from the rectifier (**Figure 6-16, Page 6-19**).
4. Remove the other transformer (yellow) secondary coil wire (5) from the rectifier.
5. Place the continuity tester probes on the disconnected secondary coil wires. The tester should indicate continuity. If tester does not indicate continuity, replace the transformer.

Voltage Suppressor – Failed Closed

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Using a multimeter set to the diode test function ($\rightarrow\text{+}$), place the black (–) probe of the multimeter on the sense lead pin (short pin) of the DC plug. Place the red (+) probe on the positive (+) pin of the DC plug. The multimeter should indicate no tone. If a tone is emitted (indicating a closed circuit) then the voltage suppressor has failed and should be replaced. **See following NOTE.**

NOTE: All vehicles except Precedent: Repeated failure of sense lead fuses is a symptom of a voltage suppressor that has failed in a closed condition.

Precedent vehicles only: Failure of the onboard computer due to a blown internal sense lead fuse is a symptom of a voltage suppressor that has failed in a closed condition.

Relay

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove orange and brown wires (3 and 4) from contact terminals of the relay (**Figure 6-6, Page 6-8**). Place continuity test probes on contact terminals of the relay. The tester should indicate no continuity. If tester indicates continuity, the relay contacts have failed closed and the relay must be replaced.
4. Place continuity test probes on contact terminals of relay. With batteries connected, insert DC plug into receptacle. The tester should indicate continuity. If tester does not indicate continuity, relay must be replaced.

Ammeter

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the white wire from the left ammeter terminal (as viewed from inside the charger).
4. Place the continuity tester clip on one of the ammeter posts.
5. Place the continuity test probe on the other ammeter post. The tester should indicate continuity. If the tester does not indicate continuity, replace the ammeter.

AC Circuit Breaker

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the wires from the AC circuit breaker.
4. Place the continuity test probe on the two terminals of the AC circuit breaker. The tester should indicate continuity. If the tester does not indicate continuity, replace the AC circuit breaker.

CHARGER REPAIRS

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

WARNING

- Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 6-6, Page 6-8).
- Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.

DC CORD

DC Cord Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove the DC cord black wire from the fuse holder (**Figure 6-18, Page 6-24**).
4. Remove the DC cord red wire from the ammeter.
5. Remove the DC cord blue wire from the blue wire located in the fiberglass sheathing.
6. Using pliers, squeeze the strain relief bushing and remove the DC cord.

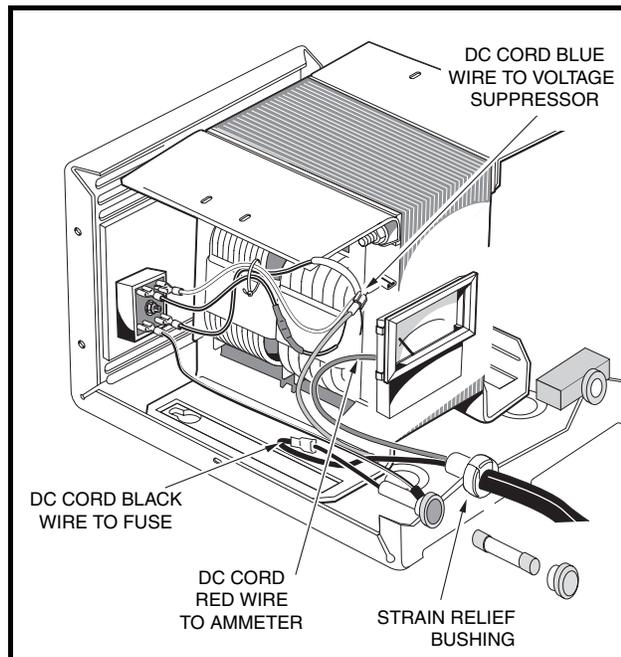


Figure 6-18 DC Cord

DC Cord Installation

1. Insert the leads of the new DC cord through the hole in the charger base.
2. Attach the red wire of the new DC cord to the ammeter (**Figure 6-18, Page 6-24**).
3. Attach the blue wire of the new DC cord to the blue wire located in the fiberglass sheathing.
4. Attach black wire of the new DC cord to the fuse holder. **See following WARNING.**

⚠ WARNING

- **Make sure wiring is properly routed and secured. Failure to properly route and secure wiring could result in charger malfunction, property damage, or severe personal injury.**
5. Using pliers, put the strain relief bushing on the cord and insert it into the charger base.
 6. Position the charger cover on the base. Install the mounting screws, starting with the bottom holes. Tighten the screws to 11 in-lb (1.2 N·m).

RECTIFIER

Rectifier Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Remove all four wires from the rectifier (**Figure 6-6, Page 6-8**).
4. Remove the nut (1) and screw (2) from the rectifier and remove the rectifier from the heatsink (**Figure 6-19, Page 6-25**).

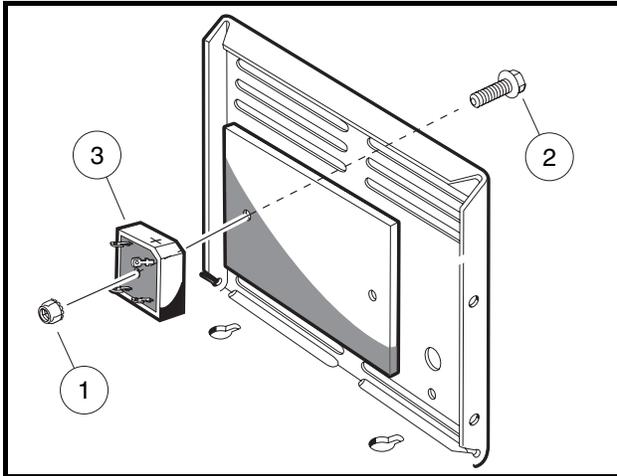


Figure 6-19 Rectifier

Rectifier Installation

1. Thoroughly clean the heatsink plate in the area where the rectifier will be mounted.
2. Apply a liberal amount of white thermal paste to the flat portion of the rectifier to ensure good thermal conductivity from the rectifier to the heatsink plate.
3. Place the rectifier against the heatsink plate so that the notch in the rectifier is oriented as shown (**Figure 6-19, Page 6-25**). Install the screw (2) and nut (1) through the hole in the charger case, heatsink plate, and rectifier. Tighten the nut to 8 in-lb (0.9 N-m).
4. Connect the white wire from the ammeter to the positive (+) terminal of the rectifier (**Figure 6-6, Page 6-8**). **See following NOTE.**

NOTE: The positive (+) terminal of the rectifier is marked on the edge of the rectifier case. The positive terminal can also be identified by its orientation and the notch in the rectifier case.

5. Connect the two yellow transformer secondary coil wires to the AC terminals on the rectifier.
6. Connect the black wire from the charger fuse holder to the negative (–) rectifier terminal. **See following CAUTION.**

CAUTION

- **Improper wiring of the rectifier could result in damage to the rectifier and cause the AC circuit breaker to trip.**

7. Install the charger cover and check charger for proper operation.

TRANSFORMER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

Transformer Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the brown primary coil wire (4) from the charger relay (**Figure 6-6, Page 6-8**).
4. Disconnect the AC cord white wire (5) from the primary coil brown wire (**Figure 6-17, Page 6-20**).
5. Disconnect the two yellow secondary coil transformer wires (1 and 5) from the rectifier (**Figure 6-6, Page 6-8**).
6. Using a 1/8 inch (3 mm) drill bit, drill the rivets that secure the transformer to the case and remove the transformer.

Transformer Installation

1. Install the transformer with primary coil to the rear of the charger case. Secure the transformer to the case with two rivets.
2. Connect the two yellow secondary coil transformer wires (1 and 5) to the AC terminals of the rectifier (**Figure 6-6, Page 6-8**).
3. Connect the brown transformer primary coil wire (4) to the charger relay.
4. Connect the AC cord white wire to the brown primary coil wire (**Figure 6-17, Page 6-20**). See following WARNING.

⚠ WARNING

- Make sure the electrical connections are properly insulated. Failure to properly insulate electrical connections in the charger could result in a short circuit.
 - Make sure wiring is properly routed and secured. Failure to properly route and secure wiring could result in charger malfunction, property damage, or severe personal injury.
5. Install the charger cover and check charger for proper operation.

AMMETER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

Ammeter Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the DC cord red wire (1) and the white wires (3 and 4) from the ammeter (**Figure 6-20, Page 6-27**).
4. Press the locking tabs on each side of the ammeter and remove the ammeter by gently pushing the ammeter through the front of the charger case.

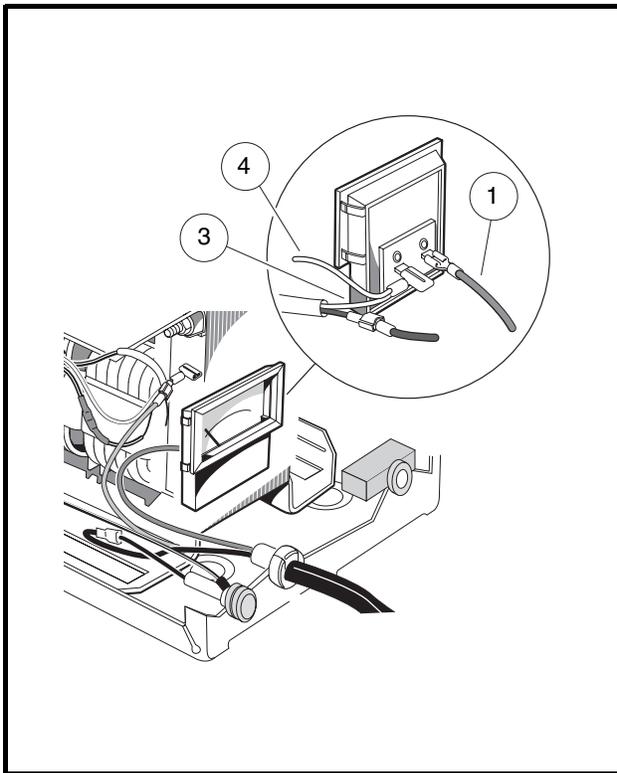


Figure 6-20 Ammeter

Ammeter Installation

1. Place the ammeter in position in the charger face and ensure that the locking tabs are secure (**Figure 6-20, Page 6-27**).
2. Connect the DC cord red wire (1) and the white wire (3) to the ammeter terminals.
3. Install the charger cover.
4. Plug the charger into the vehicle and check ammeter for proper operation.

FUSE

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

Fuse Link Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Gently press the fuse holder and rotate counterclockwise.
4. Pull the fuse out of the fuse holder.

Fuse Link Installation

5. Install in reverse order of removal. See following WARNING.

WARNING

- Use only properly-rated fuses in the battery charger.

VOLTAGE SUPPRESSOR

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

The voltage suppressor, which is incorporated into a wire assembly in the charger, 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 on page 6-20.

Voltage Suppressor Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the white wires (3 and 4) from the ammeter (**Figure 6-20, Page 6-27**).
4. Disconnect the white wire from the positive (+) terminal of the rectifier.
5. Disconnect the blue, red, and white wires from the relay.
6. Disconnect the DC cord blue wire at the quick disconnect terminal.
7. Remove the voltage suppressor and wire assembly from the charger.

Voltage Suppressor Installation

1. Install in reverse order of removal. 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.

CHARGER RELAY

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

Charger Relay Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect all wires from the relay (**Figure 6-6, Page 6-8**).
4. Remove two screws, nuts, and lock washers attaching relay to the charger case.
5. Remove the relay.

Charger Relay Installation

1. Install in reverse order of removal. Connect wires as shown (**Figure 6-6, Page 6-8**). Tighten nut securing relay to charger base to 18 in-lb (2.0 N·m).

CHARGER AC CIRCUIT BREAKER

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

AC Circuit Breaker Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the orange and black wires attached to the AC circuit breaker (**Figure 6-6, Page 6-8**).
4. With a pair of pliers, squeeze in the retaining tabs on the sides of the AC circuit breaker and remove the circuit breaker through the mounting hole in the face of the charger.

AC Circuit Breaker Installation

1. Install in reverse order of removal.

CHARGER AC CORD

See General Warning, Section 1, Page 1-1. See additional WARNING on page 6-1.

AC Cord Removal

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Remove the charger cover.
3. Disconnect the AC cord black wire from the AC circuit breaker (**Figure 6-17, Page 6-20**).
4. Disconnect the AC cord white wire (4) from the primary coil brown wire.
5. Disconnect the AC cord green wire from the charger base.
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.
2. Connect the AC cord black wire to the AC circuit breaker.
3. Connect the AC cord white wire to the tan primary coil wire (**Figure 6-17, Page 6-20**). See following **WARNING**.

⚠ WARNING

- **Make sure the electrical connections are properly insulated. Failure to properly insulate electrical connections in the charger could result in a short circuit.**
4. Connect the green wire to the charger base. Tighten the screw and nut on the green (ground) wire terminal to 18 in-lb (2.0 N·m).
 5. Position the strain relief bushing on the AC cord.
 6. Using pliers, install the strain relief bushing and AC cord into the mounting hole in the charger face.
 7. Install the charger cover.

CHARGING A BATTERY PACK THAT HAS LOW VOLTAGE

See General Warning, Section 1, Page 1-1. See additional **WARNING** on page 6-1.

If battery pack voltage is below 34 volts, the charger will not activate. The charger relay will have to be bypassed to activate the charger. See following **WARNING**.

⚠ WARNING

- **Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 6-6, Page 6-8).**
 - **Prior to servicing the charger, disconnect the AC power supply cord from the wall outlet and the DC plug from the vehicle charger receptacle.**
1. Turn key switch OFF and place the Forward/Reverse handle in the NEUTRAL position. Leave the batteries connected.
 2. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
 3. Remove the screws securing the charger cover and remove the cover from the charger.
 4. To apply AC power directly to the transformer primary coil, the relay must be bypassed.
 - 4.1. To bypass the relay, remove the orange wire (3) from the AC circuit breaker and disconnect the brown wire (4) from the relay. Connect the brown wire (4) to the AC circuit breaker (**Figure 6-21, Page 6-31**). See following **DANGER**.

⚠ DANGER

- **Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.**
5. Plug the DC cord into the charger receptacle *first*, and then plug the AC cord into an electrical outlet.

- 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. A charger operating with a bypassed relay could short circuit and possibly cause a fire.**

- 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.
- Disconnect the transformer wire (4) from AC circuit breaker and connect it to the relay. Connect the short orange wire (3) from the relay to the AC circuit breaker (**Figure 6-21, Page 6-31**). **See following WARNING.**

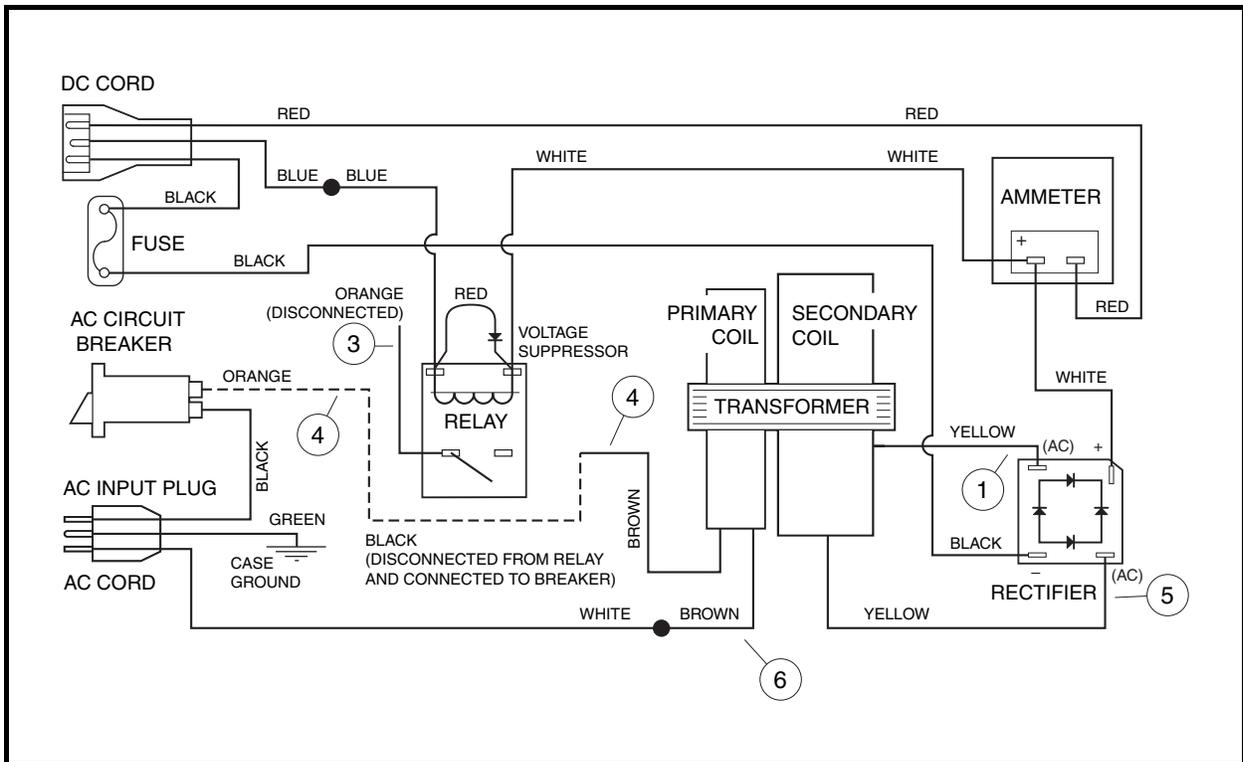


Figure 6-21 GE PowerDrive Charger Wiring Diagram (Relay Bypassed)

⚠ WARNING

- The relay wiring must be properly connected prior to placing the charger back into normal service. Failure to properly connect the relay wiring could result in property damage, severe personal injury, or death.**

- Install the charger cover and the retaining screws.
- Plug the DC cord into the charger receptacle and plug the AC cord into an electrical outlet.
- Allow the charger to continue charging the batteries until the charger shuts off automatically.

12. 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 in the appropriate maintenance and service manual.**

The following index is grouped in sections, one section for each type of battery charger in the manual. Make sure that the battery charger has been properly identified before using the index. **See Battery Charger Identification, Section 2, Page 2-4.**

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