2009-2011 Electric Precedent Maintenance and Service Manual

IQ System and Excel System Vehicles

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FOREWORD

Club Car vehicles are designed and built to provide the ultimate in performance efficiency; 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 the electric Precedent vehicles, and should be thoroughly reviewed prior to servicing the vehicle. 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 possesses 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 may render the vehicle 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, LLC 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, periodic service bulletins, maintenance and service manuals, and other service publications also represent Club Car's continuing commitment to customer support.

Club Car offers a full line of training and continuing education classes for technicians who want to learn more about our products. For more information, contact your local dealer or Club Car's Technical Services department for a list of upcoming classes.

This manual covers all aspects of typical vehicle service; however, unique situations sometimes occur when servicing a vehicle. If it appears that a service question is not answered in this manual, please contact your nearest authorized Club Car dealer or distributor for assistance. You may also write to us at: Club Car, LLC, P.O. Box 204658; Augusta, GA 30917–4658 USA, Attention: Technical Services.

⚠ WARNING

- **Read See Section 1 – Safety. before attempting any service on the vehicle.**
- **Before servicing vehicle, 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, LLC is continually working to further improve its 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, LLC 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, LLC, P.O. BOX 204658, Augusta, Georgia 30917-4658 USA, Attention: Warranty Department.

This manual effective August 4, 2008

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SECTION 1 – SAFETY

To ensure the safety of those servicing Club Car vehicles, and to protect the vehicles from possible 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 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.**

CAUTION

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

GENERAL WARNINGS

The following safety statements must be heeded whenever the vehicle is being operated, repaired, or serviced. Other specific safety statements appear throughout this manual and on the vehicle.

⚠ 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 area. 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

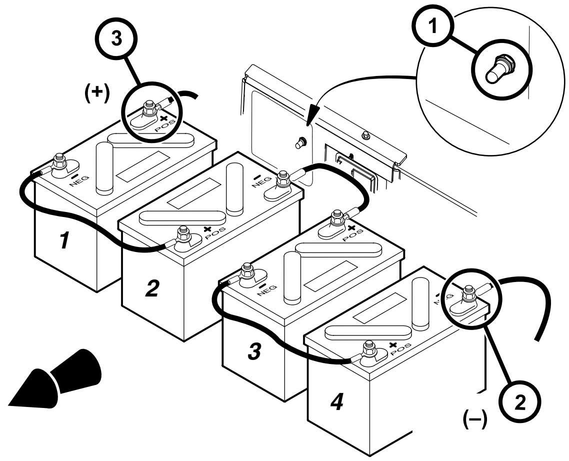
- **Only trained technicians should service or repair the vehicle or battery charger. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **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.**
- **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.**
- **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.**
- **Check the vehicle for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**
- **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.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Prior to leaving the vehicle unattended or servicing the vehicle, set the park brake, turn the key switch OFF, remove the key, and place the Forward/Reverse switch in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **Disconnect charger plug before servicing vehicle.**
- **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.**
- **To avoid unintentionally starting an electric vehicle, disconnect the batteries and discharge the controller. See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
- **Do not leave children unattended on vehicle.**

DISABLING THE VEHICLE

1. Set the park brake.
2. Turn the key switch OFF and remove the key.
3. Place the Forward/Reverse control in the NEUTRAL position.
4. In addition, chock the wheels if servicing or repairing the vehicle.

DISCONNECTING THE BATTERIES – ELECTRIC VEHICLES

1. Disable the vehicle. **See Disabling the Vehicle on page 1-2.**
2. 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.
3. Disconnect the batteries, negative (–) cable first, as shown **(Figure 1-1)** or **(Figure 1-2)**.
4. After disconnecting the batteries, wait 90 seconds for the controller capacitors to discharge.



(Viewed from driver side of vehicle)
1. Place TOW/RUN Switch in TOW before disconnecting or connecting battery cables.
2. Remove negative battery cable.
3. Remove positive battery cable.
Connect battery cables in reverse order.

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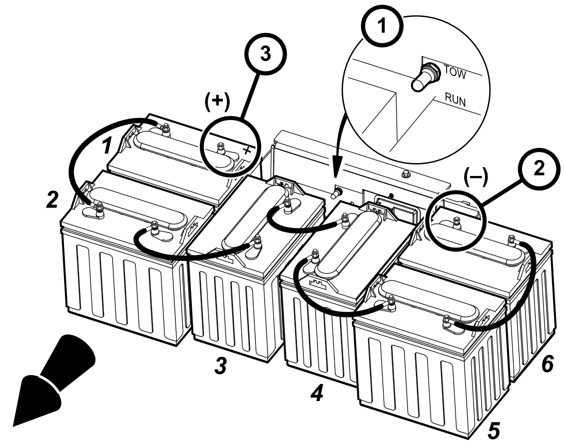
Figure 1-1 Battery Cable Removal – 4x12-Volt Battery Configuration



(Viewed from driver side of vehicle)
1. Place TOW/RUN Switch in TOW before disconnecting or connecting battery cables.
2. Remove negative battery cable.
3. Remove positive battery cable.
Connect battery cables in reverse order.

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Figure 1-2 Battery Cable Removal – 6x8-Volt Battery Configuration

CONNECTING THE BATTERIES – ELECTRIC VEHICLES

1. Ensure the Tow/Run switch is in the TOW position.
2. Connect the battery cables, positive (+) cable first.
3. Tighten battery terminals to 110 in-lb (12.4 N·m).
4. Coat terminals with Battery Terminal Protector Spray (P/N 1014305) to minimize corrosion.

RECYCLING LEAD-ACID BATTERIES

⚠ WARNING

- **Lead-acid batteries contain lead (Pb), other metals, acids and other compounds. If improperly handled, they can contaminate both water and soil, causing environmental damage and personal injury.**

Lead-acid batteries are identified by the symbol shown below and should be properly recycled **(Figure 1-3)**. They cannot be disposed as municipal waste and must be collected separately. Responsibility for environmental protection must be shared, not only by the manufacturers of the batteries, but by people who use the batteries as well. Please contact your nearest Club Car dealer or distributor for information on how to properly recycle your batteries.

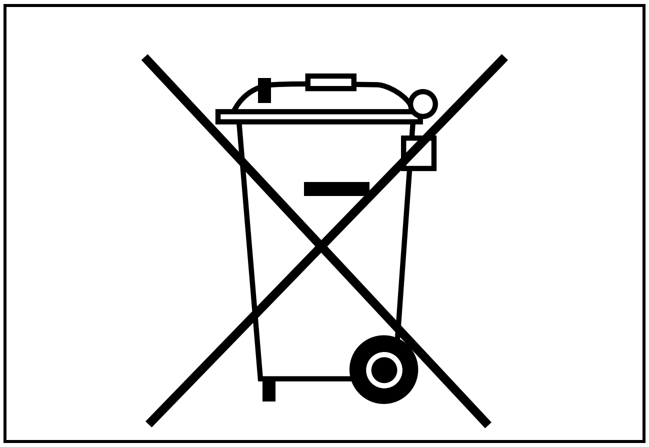

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Figure 1-3 Dispose of Lead-acid Batteries Properly

INTERNATIONAL SAFETY SYMBOLS ON BATTERIES

Anyone using, repairing, or servicing the vehicle must understand and heed the safety symbols on the vehicle battery or batteries.

1. Shield eyes.
2. Read and follow operating instructions.
3. No smoking, no open flames, no sparks.
4. Keep away from children.
5. Battery acid hazard.
6. Explosive gas hazard.

Refer to General Warnings for more information.

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Figure 1-4 International Safety Symbols on Batteries

SECTION 2 – VEHICLE SPECIFICATIONS

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SPECIFICATIONS	TWO-PASSENGER ELECTRIC VEHICLE	FOUR-PASSENGER ELECTRIC VEHICLE
POWER SOURCE		
Drive motor: Direct drive, 48 volts DC, shunt-wound, 3.1 hp	•	•
Transaxle: Double reduction helical gear with 12.3:1 direct drive axle	•	•
Electrical system: 48 volts DC, reduced speed reverse	•	•
Batteries: High capacity, deep cycle	•	•
Charger: Automatic, 48-volt; UL and CSA listed	•	•
STEERING/SUSPENSION/BRAKES		
Steering: Self-adjusting rack and pinion	•	•
Suspension: Front and rear tapered mono-leaf springs with dual hydraulic shocks	•	•
Brakes: Dual rear wheel self-adjusting brakes with cast iron drums and single brake pedal with automatic-release park brake	•	•
BODY/CHASSIS		
Frame/Chassis: Aluminum and composite	•	•
Front and rear body: Dupont Surlyn© Reflections	•	•
Body finish: High-gloss molded-in color	•	•
Tires: 18 x 8.5 – 8 tubeless, 4 ply rated	•	•
DIMENSIONS/WEIGHT		
Overall length	91.5 in. (232 cm)	104 in. (264 cm)
Overall width	47.25 in. (120 cm)	47.25 in. (120 cm)
Overall height (with canopy)	68.5 in. (174 cm)	71 in. (180 cm)
Overall height (at steering wheel)	48.0 in. (122 cm)	48.0 in. (122 cm)
Wheelbase	65.5 in. (166 cm)	65.5 in. (166 cm)
Ground clearance	4.5 in. (11 cm)	4.5 in. (11 cm)
Front wheel tread	34.5 in. (88 cm)	34.5 in. (88 cm)
Rear wheel tread	38.6 in. (98 cm)	38.6 in. (98 cm)
Weight (standard electric vehicle with canopy, with batteries) For vehicles with six 8-volt batteries, add 54 lb. (24.5 kg).	855 lb. (388 kg)	970 lb. (440 kg)
Forward speed	12-15 mph (19-24 km/h)	
Curb clearance circle (diameter)	17 ft - 4in. (528 cm)	17 ft - 4 in. (528 cm)
Standard seating capacity	2	4
LIQUID CAPACITIES		
Transaxle	22 oz. (.67 liters)	22 oz. (.67 liters)

TABLE CONTINUED ON NEXT PAGE

SPECIFICATIONS	TWO-PASSENGER ELECTRIC VEHICLE	FOUR-PASSENGER ELECTRIC VEHICLE
TIRE PRESSURE		
Front and rear	18-20 psi (1.24-1.38 bars)	18-20 psi (1.24-1.38 bars)

SECTION 3 – GENERAL INFORMATION

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

Important features unique to the different models covered in this manual are highlighted. Club Car, LLC recommends the owner/operator read and understand this manual and pay special attention to features specific to their vehicle(s).

Refer to the owner's manual provided with the vehicle for information on the following topics:

- Pre-Operation and Daily Safety Checklist
- Controls and Indicators
- Driving Instructions
- Towing
- Transporting on a Trailer
- Subsequent Owner Registration
- Warranties

SERIAL NUMBER IDENTIFICATION

The serial number of the vehicle is printed on a bar code decal mounted below the passenger side cup holder **(Figure 3-1, Page 3-2)**.

The two letters at the beginning of the serial number indicate the vehicle model. The following four digits indicate the model year and production week during which the vehicle was built. The six digits following the hyphen represent the unique sequential number assigned to each vehicle built within a given model year.

NOTE: *Have the vehicle serial number available when ordering parts or making inquiries.*

Excel System vehicles have serial number prefix PD, PH, PJ, PK, PU, or PV.

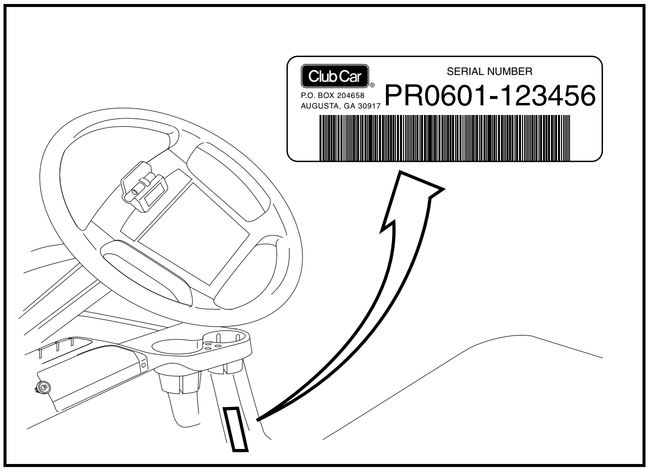

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Figure 3-1 Serial Number Decal

SAFETY COMMITTEE

If the golf car is to be rented or is part of a fleet, we strongly recommend that a safety committee be appointed. One of the main concerns of this committee should be the safe operation of the golf cars.

This should include at a minimum:

- Where golf cars should be driven.
- Ensuring that proper warnings of driving hazards are displayed and visible. See below for list of signs available from Club Car Service Parts Department.
- Who should and who should not drive golf cars.
- Instructing first time drivers.
- Maintaining golf cars in a safe driving condition
- How various rules are to be enforced.

The safety committee should include all these items and such others as the committee feels necessary or appropriate.

STORAGE

See General Warnings on page 1-1.

⚠ WARNING

- **Turn the key switch OFF, remove the key, and leave the Forward/Reverse switch in the NEUTRAL position during storage. This is to prevent unintentionally starting the vehicle or a fire hazard.**
- **Do not attempt to charge frozen batteries or batteries with bulged cases. Discard the battery. Frozen batteries can explode.**

⚠ CAUTION

- **Batteries in low state of charge will freeze at low temperatures.**
- **To avoid exposing electrical components to moisture and subsequent damages, do not use any type of pressure washing or steam cleaning equipment to wash the vehicle.**
- **Place Tow/Run switch in the TOW position.**

PREPARING THE ELECTRIC VEHICLE FOR EXTENDED OFF-SEASON STORAGE

1. Fully charge batteries. See Section 18 – Batteries.
2. Batteries should be clean and free of corrosion. Wash tops and terminals of batteries with a solution of baking soda and water (1 cup (237 mL) baking soda per 1 gallon (3.8 L) of water). Rinse solution off batteries. Do not allow this solution to enter the batteries. Be sure terminals are tight. Let the terminals dry and then coat them with Battery Terminal Protector Spray (P/N 1014305).
3. Store vehicle in a cool, dry place. This will minimize battery self-discharge.
4. Adjust tires to recommended tire pressure. See Section 2 – Vehicle Specifications.
5. Perform all semiannual periodic lubrication. **See Periodic Lubrication Schedule on page 10-6.**
6. Thoroughly clean front body, rear body, seats, battery compartment, and underside of vehicle.
7. Do not engage the park brake. Chock the wheels to prevent the vehicle from rolling.
8. Keep batteries fully charged during storage.
   - Leave battery chargers plugged in during storage. The onboard computer (OBC) will automatically activate the charger when necessary.
   - If the battery charger is left plugged in during extended storage, check the electrolyte level and charger function monthly to ensure that proper operation is maintained. To check charger function, disconnect the DC cord (stationary charger) from the vehicle or the AC cord (onboard charger) from the power source, wait five seconds, then reconnect it. The charger is functioning properly if the ammeter indicates current.

NOTE: The OBC keeps track of the time spent in storage mode. When the OBC detects that the storage charge cycles may have depleted the available electrolyte, it will stop the charger from further operation. *Disconnecting then reconnecting the DC cord (stationary charger) or AC cord (onboard charger) indicates the electrolyte levels have been maintained and allows the OBC to resume operation.*

While in storage, the Tow/Run switch should be in Tow. When in Tow mode, the amber battery warning light will not illuminate. Do not attempt to use the battery light as an indication of battery state while in storage.

- If AC power is off for 7 days or longer, the OBC will not function or charge the vehicle again until it has been restarted. To restart the computer, make sure AC power has been restored, disconnect the DC cord (stationary charger) from the vehicle or the AC cord (onboard charger) from the power source, wait five seconds, then reconnect it.

CAUTION

- **Be sure to check the batteries and charger monthly to maintain correct battery water level and to ensure the charger is operating correctly during storage.**

- If the charger cannot remain plugged in, AC power will not be available during extended storage, or electrolyte levels will not be maintained, then disconnect the batteries for storage **(Figure 1-1, Page 1-3)** or **(Figure 1-2, Page 1-3)**.

RETURNING THE STORED ELECTRIC VEHICLE TO SERVICE

1. If necessary, connect batteries.
2. Fully charge batteries.

⚠ WARNING

- **Do not attempt to charge frozen batteries or batteries with bulged cases. Discard the battery. Frozen batteries can explode.**

3. Adjust tire to recommended pressure. See Section 2 – Vehicle Specifications.
4. Perform the Pre-Operation and Daily Safety Checklist. **See Owner's Manual.**

SECTION 4 – BODY AND TRIM

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

CLEANING THE VEHICLE

See General Warnings on page 1-1.

CAUTION

- **Do not use detergents or cleaning solvents that contain ammonia, aromatic solvents, or alkali materials on body panels or seats.**

- **Do not allow battery acid to drip on body panels. Battery acid will cause permanent damage. Wash spilled battery acid from body panels immediately.**

Club Car Precedent vehicles are equipped with Surlyn® front and rear bodies. Use only commercially available automotive cleaners with a sponge or soft cloth for normal cleaning. A garden hose at normal residential water pressure is adequate.

Club Car does not recommend any type of pressure washing or steam cleaning. Such a process (especially if the vehicle has a Surlyn rear body that is removed) will expose electrical components to moisture. Moisture entering electrical components can result in water damage and subsequent component failure.

Use non-abrasive wax products. Do not use abrasive leveling or rubbing compounds; these will permanently dull the gloss. Battery acid, fertilizers, tars, asphalt, creosote, paint, or chewing gum should be removed immediately to prevent possible stains. **See following CAUTION and NOTE.**

CAUTION

- **Use of leveling or rubbing compounds will permanently dull finish of vehicle.**

- **Do not apply wax products to the black plastic material of the front and rear underbody, the front bumper, or the textured area of the rear beauty panel marked “NO STEP.” Wax will cause these surfaces to become discolored.**

NOTE: *Dispose of waste water properly.*

SEAT

To preserve seat appearance, clean regularly with mild soap or detergent applied with a sponge or soft cloth. Use a soft bristle brush to clean areas that are especially soiled. Use the following guidelines:

Light Soiling: A solution of 10% liquid dish soap and warm water applied with a soft, damp cloth is recommended. A soft bristle brush may be used if necessary. Wipe off any residue with a water dampened cloth.

Difficult Stains: Dampen a soft, white cloth with a solution of 10% household bleach (sodium hypochlorite) and 90% water. Rub gently to remove stain, then rinse with a water dampened cloth to remove bleach concentration.

More Difficult Stains: Perform previous procedure using full-strength bleach, or allow bleach to puddle on affected area for approximately 30 minutes. Rinse with a water dampened cloth to remove any remaining bleach concentration.

CAUTION

- **To prevent damage to the vehicle when removing difficult stains or heavy soiling, remove the seat bottom from the vehicle first.**

FRONT AND REAR BODY REPAIR

See General Warnings on page 1-1.

STRESS LINES OR STREAKS

Repeatedly flexing the Surlyn body can cause white stress lines or streaks in the finish. To remove them:

1. Hold a heat gun 12 inches (30 cm) away from the affected area, with the gun on its lowest heat setting.
2. Slowly wave the heat gun back and forth over the affected area until the streak fades.
3. It may be necessary to move the gun closer to the body to fade the streak, but under no circumstance should the gun be held closer than 6 inches (15 cm) to the body. **See following CAUTION.**

CAUTION

- **Holding the heat gun too close to the body could melt the body or damage the finish.**

MINOR IMPACT DAMAGE/DEFORMATIONS

Minor impact damage to a Surlyn body can be repaired using a procedure similar to the one used to remove stress lines. To remove deformations resulting from minor impact damage:

1. Hold a heat gun 12 inches (30 cm) away from the affected area, with the gun on its lowest heat setting.
2. Periodically remove the heat gun and bend the body, using a push block, in the opposite direction of the deformation.
3. Continue heating and bending the body until the original shape returns. Under no circumstance should the gun be held closer than 6 inches (15 cm) to the body. **See preceding CAUTION.**

MINOR SCRATCHES AND SURFACE BLEMISHES

For minor scratches or blemishes in the Surlyn body that do not penetrate the finish:

1. Thoroughly clean the affected area using a strong, non-abrasive detergent and hot water, then clean with Ultra-Kleen® Solvent Cleaner to remove any oil-based contaminants.
2. Lightly buff imperfection with a clean soft cloth or buff pad. Do not use any kind of rubbing (abrasive) compound on body assemblies.
3. Wax the entire body part to restore luster and weather protection.

GOUGES, PUNCTURES, TEARS, LARGE SCRATCHES, AND ABRASIONS

Touch-up is not recommended. Replace the entire body part or have it repaired by a professional paint and body repair shop with experience repairing Surlyn bodies.

FRONT BODY

See General Warnings on page 1-1.

FRONT BODY REMOVAL

1. Remove the four screws (2) and pull the brow cap (1) from the brow and fascia assembly (4) **(Figure 4-1, Page 4-4)**.
2. Pull the front beauty panel (3) up and away from the brow and fascia assembly (4), disengaging the snap tabs.
3. If the vehicle is equipped with a canopy, loosen the canopy support cover then loosen, but do not remove, the front canopy support bolts. If there is no canopy, remove the non-canopy cover.
4. Remove the five screws (8) and lift the brow and fascia assembly (4) from the front underbody.
5. Remove the five screws (7) to separate the front fascia (6) from the brow (5).

FRONT BODY INSTALLATION

1. Install fascia (6) to brow (5) with five screws (7). Tighten screws to 3.3 ft-lb (4.5 N·m) **(Figure 4-1, Page 4-4)**.
2. Install brow and fascia assembly (4) to front underbody with five screws (8). Tighten screws to 1.8 ft-lb (2.5 N·m).
3. Install front beauty panel (3) over brow (5). Tabs on the forward edge of the front beauty panel should fit into slots between the fascia and the brow.
4. Position brow cap (1) to cover the edge of both the brow (5) and the front beauty panel (3). Secure brow cap (1) with four screws (2). Tighten screws to 25 in-lb (2.8 N·m).

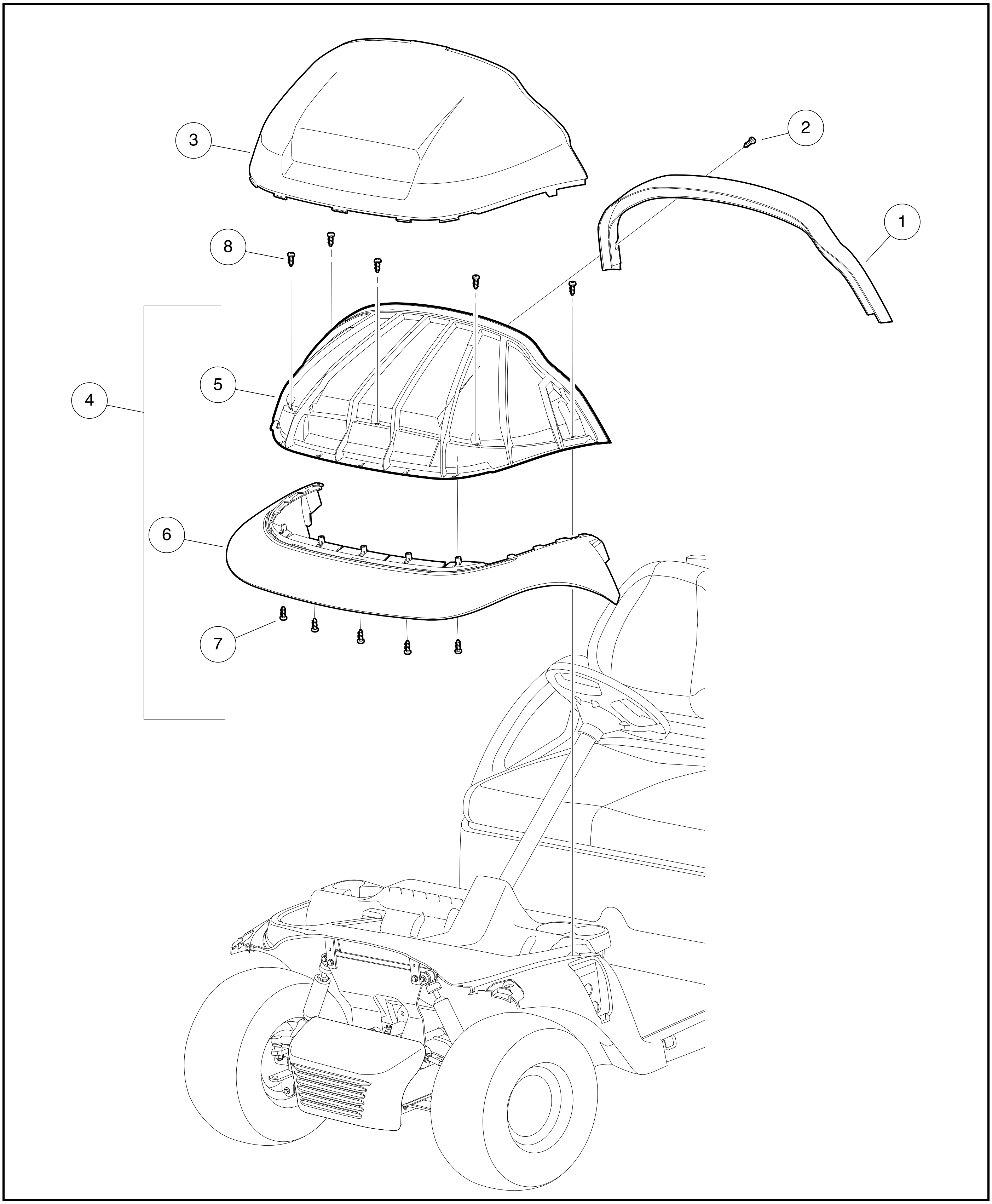

Figure 4-1 Front Body

FRONT BUMPER

The underbody bracket (1) connects the front suspension to the front underbody **(Figure 4-2, Page 4-5)**. Each bracket is secured in place by two taptite screws (2) tightened to 13 ft-lb (17.6 N·m).

The front bumper (3) is attached to the vehicle frame rails by nuts (5) and bolts (4). The nuts (5) need to go on top of the bumper attaching brackets, always insert the bolts (4) through the bottom. The nuts are tightened to 13.3 ft-lb (18 N·m).

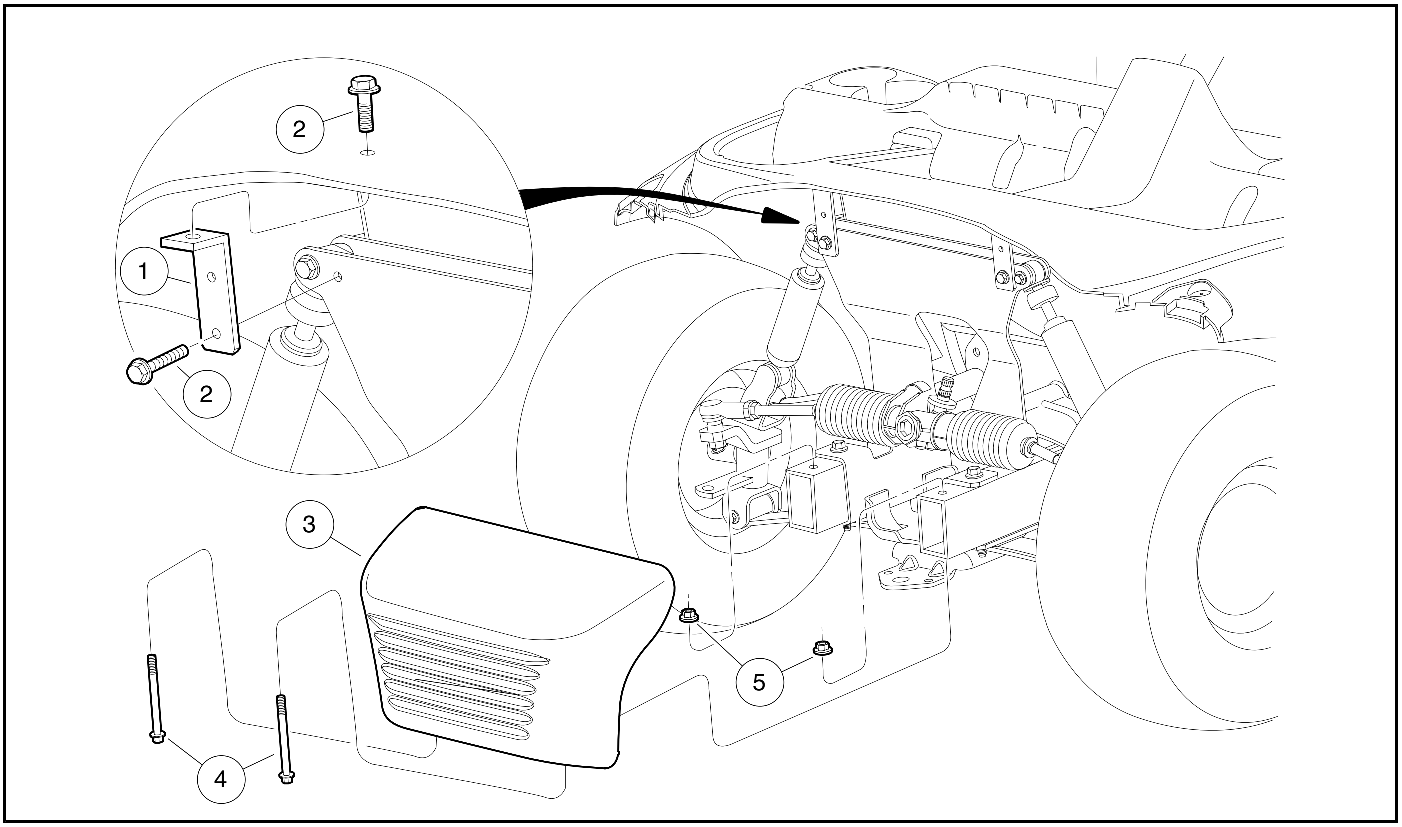

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Figure 4-2 Bracket and Front Bumper

INSTRUMENT PANEL

See General Warnings on page 1-1.

INSTRUMENT PANEL REMOVAL

1. Remove two screws (1) at sides and one screw (2) on top of instrument panel (3) **(Figure 4-3, Page 4-6)**.
2. Tilt instrument panel up to release it from the dash assembly (4).
3. Disconnect the electrical connector on the passenger side of the instrument panel (3) and remove the panel.
4. Remove two screws (5) and plastic rivet (6) and remove dash assembly (4) from vehicle.

INSTRUMENT PANEL INSTALLATION

1. Position dash assembly (4) on vehicle. Make sure tabs on the forward edge engage to front underbody. Secure assembly in place with two screws (5) and plastic rivet (6) **(Figure 4-3, Page 4-6)**. Tighten screws to 8.8 ft-lb (12 N·m).
2. Install the instrument panel.
   - 2.1. Connect the electrical connector on the instrument panel to the harness connector.
   - 2.2. Position the instrument panel (3) on the dash assembly. Make sure tabs on upper edge properly engage with the corresponding slots on the dash assembly. Ensure that there are no wires exposed or pinched during positioning.
   - 2.3. Secure instrument panel to the dash assembly with screws (1 and 2). Tighten screws to 1.8 ft-lb (2.5 N·m).

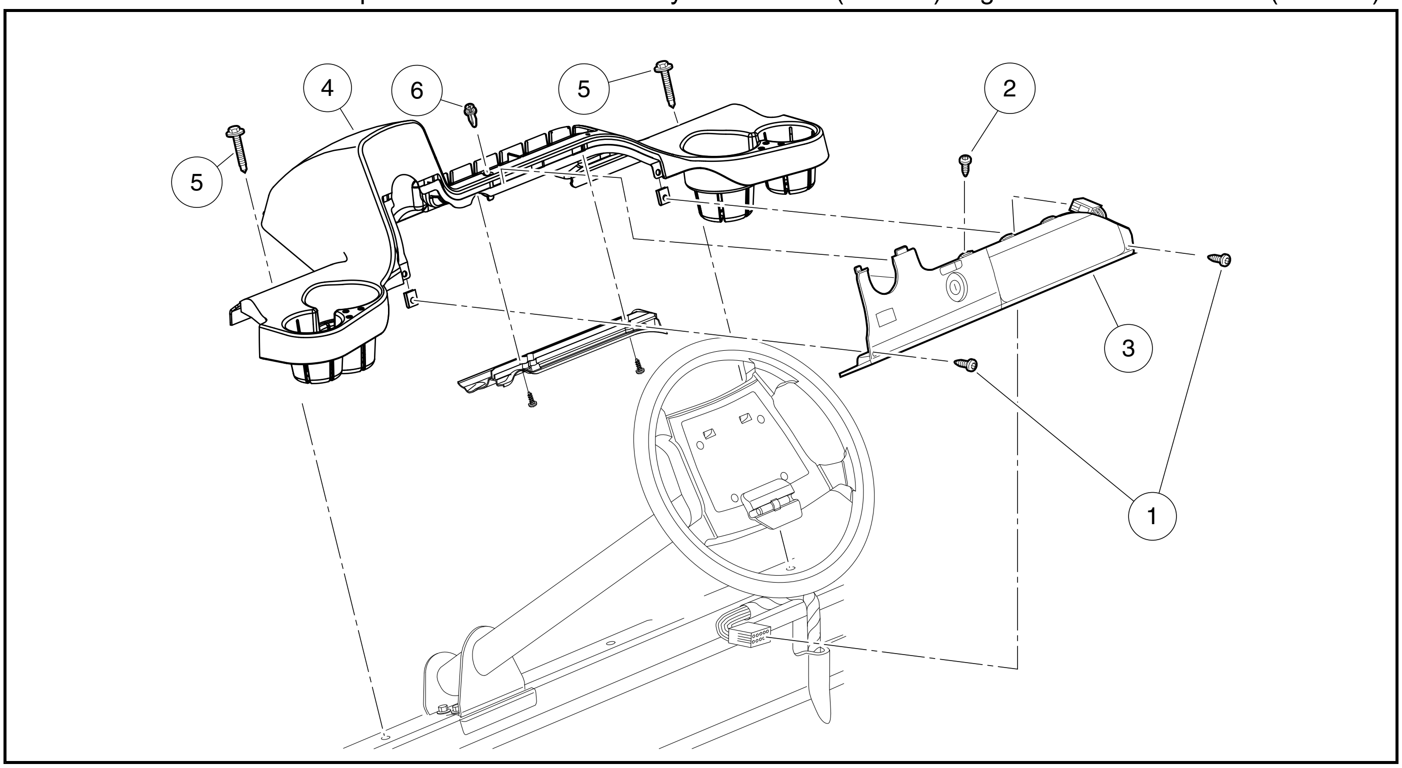

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Figure 4-3 Instrument Panel

FLOOR MAT AND RETAINERS

See General Warnings on page 1-1.

The floor mat retainers secure the floor mat to the vehicle and also provide a clean appearance to the side of the vehicle. Normally, if only the floor mat (3) needs to be removed, the screws (2) must be removed to allow the floor mat to be slid from beneath the retainers (1) **(Figure 4-4, Page 4-7)**.

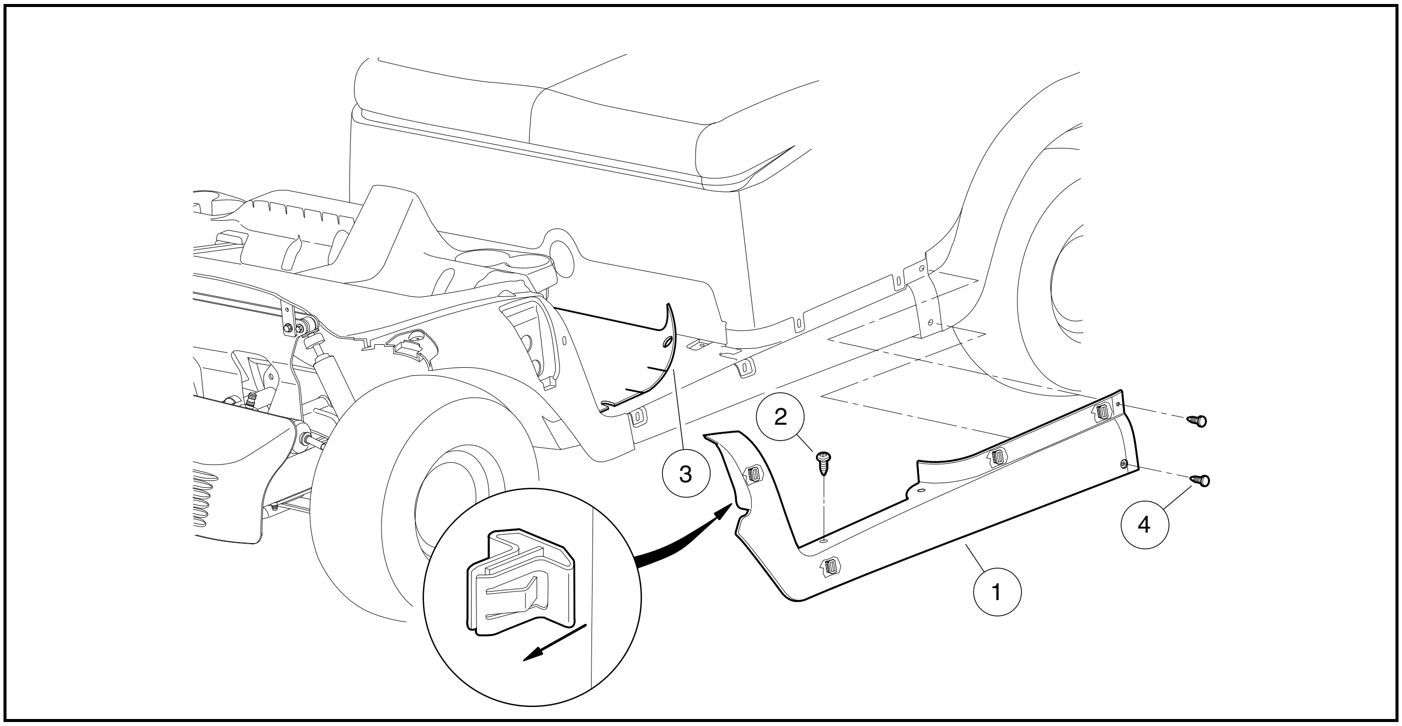

Figure 4-4 Floor Mat Retainer

FLOOR MAT RETAINER REMOVAL

1. Remove screws (2) from top of retainer (1) **(Figure 4-4, Page 4-7)**.
2. Remove push rivets (4) from rear corners of retainer.
3. Carefully pull on retainer to separate the trim clips from their respective slots. Trim clips do not normally need to be removed from the retainer.

FLOOR MAT RETAINER INSTALLATION

1. Position the retainer on the vehicle and press firmly to engage the trim clips to the vehicle **(Figure 4-4, Page 4-7)**.
2. Ensure the floor mat is properly positioned beneath the top flange of the retainer and loosely install two screws (2).
3. Install two push rivets (4) at the rear corners of the retainer.
4. Tighten screws (2) to 4.4 ft-lb (6.0 N·m).

KICK PLATE AND CHARGER RECEPTACLE BEZEL

See General Warnings on page 1-1.

KICK PLATE AND CHARGER RECEPTACLE BEZEL REMOVAL

1. If charger bezel (4) requires removal, use charger bezel tool (P/N 102562401) to remove bezel from the kick plate **(Figure 4-5, Page 4-8)**.
2. Remove floor mat. **See Floor Mat and Retainers on page 4-7.**
3. Remove three screws (1) that hold the kick plate (2) to the vehicle.
4. Remove the two front screws (3) that hold the beauty panel to the vehicle. Raise the forward portion of the rear beauty panel to disengage it from the tabs on the upper portion of the kick plate.
5. Remove kick plate from vehicle.

KICK PLATE AND CHARGER RECEPTACLE BEZEL INSTALLATION

1. Position the kick plate (2) on the vehicle and secure with three screws (1) **(Figure 4-5, Page 4-8)**. Ensure front lower edge of rear beauty panel mates with the kick plate. Tighten screws to 3.3 ft-lb (4.5 N·m).
2. Install two front screws (3) to secure the rear beauty panel. Tighten screws to 3.7 ft-lb (5 N·m).
3. Install floor mat. **See Floor Mat and Retainers on page 4-7.**
4. Snap charger bezel (4) in place on the kick plate.

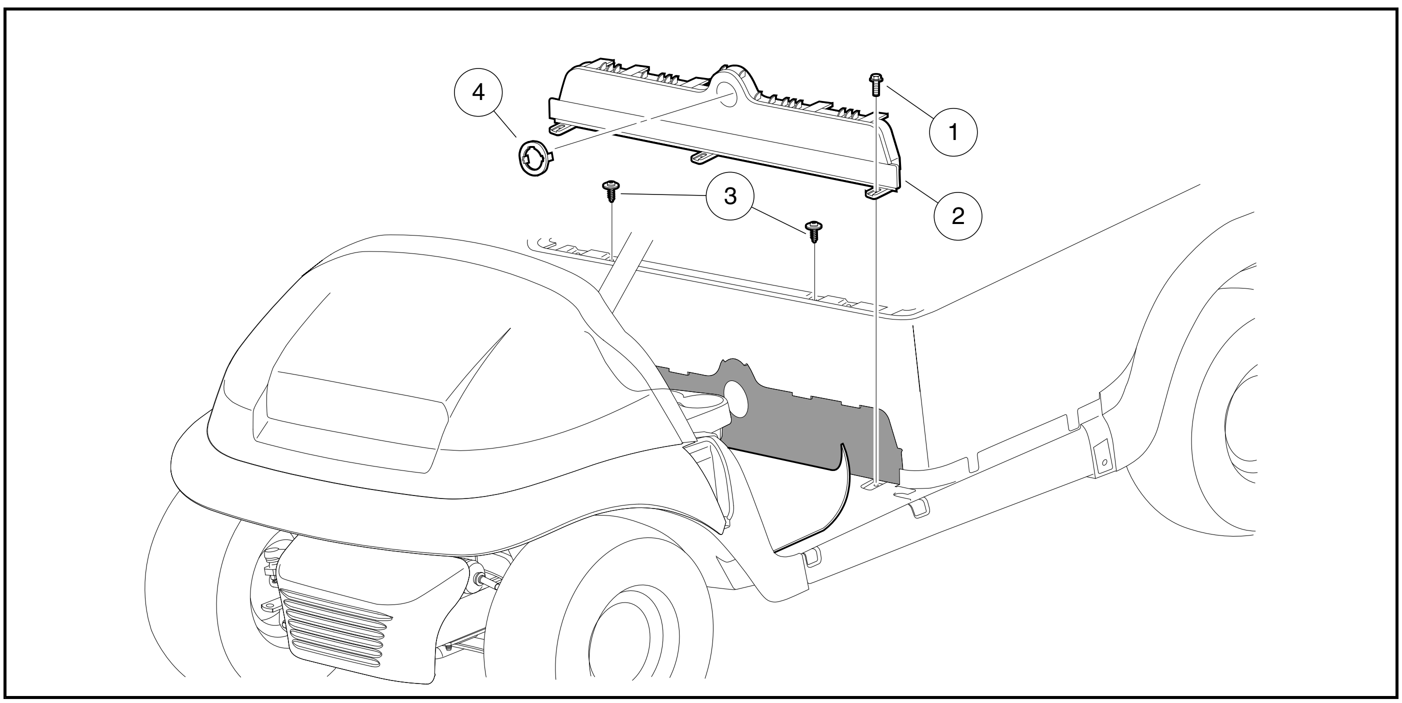

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Figure 4-5 Kick Plate and Charger Receptacle Bezel

REAR BODY – TWO-PASSENGER VEHICLES

See General Warnings on page 1-1.

UNIVERSAL ACCESSORY MOUNTING

The Structural Accessory Module (SAM) includes two threaded inserts on both the driver side and the passenger side **(Figure 4-6, Page 4-9)**. These inserts serve as common attachment points (1) for various accessories. Accessories that can be mounted to the SAM include single or dual sand bottles, sand bucket, and the club cleaner.

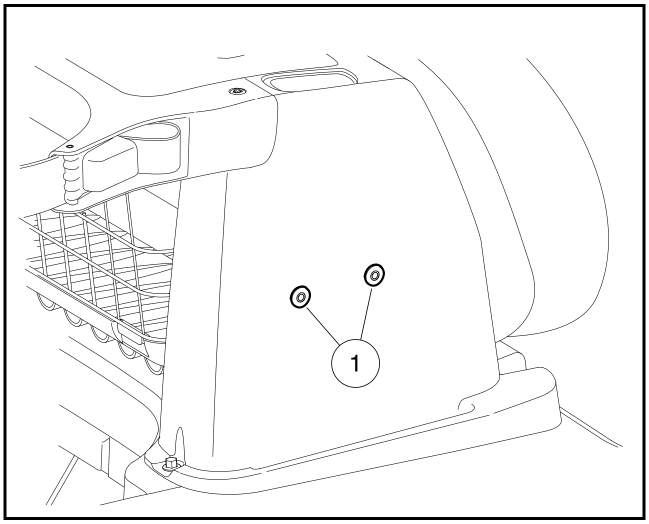

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Figure 4-6 Universal Accessory Mounting

BACKREST AND STRUCTURAL ACCESSORY MODULE (SAM)

SAM Removal

1. If the vehicle has a canopy, the rear upright supports must be removed from the SAM.
2. Remove four bolts (4) to release the SAM (3) from the vehicle **(Figure 4-7, Page 4-10)**.

SAM Installation

Position the SAM (3) over its mounting holes and secure with four screws (4). Tighten screws to 53 in-lb (6 N·m).

Backrest

The backrest (1) is secured to the SAM (3) with two screws (2) **(Figure 4-7, Page 4-10)**. When replacing the backrest, tighten screws (2) to 5.9 ft-lb (8 N·m).

Bag Rack Removal

1. Remove two screws (10) to release the bag hoop (6) and related components from the SAM (3) **(Figure 4-7, Page 4-10)**.
2. Bag strap (8) may be released by removing two plastic barrel connectors (9) and one screw (12).
3. Bag strap buckles (7) may be snapped out of bag hoop (6).

Bag Rack Installation

Installation is the reverse of removal. Tighten screw (12) to 4.8 ft-lb (6.5 N·m) and screws (10) to 44 in-lb (5 N·m).

Sweater Basket

The sweater basket (11) is secured to the bag hoop assembly by three screws (12). Tabs on the upper edge of the basket align with holes in the bag hoop (6) for installation purposes. Tighten screws (12) to 44 in-lb (5 N·m) for steel wire sweater basket or 31 in-lb (3.5 N·m) for molded-plastic sweater basket **(Figure 4-7, Page 4-10)**.

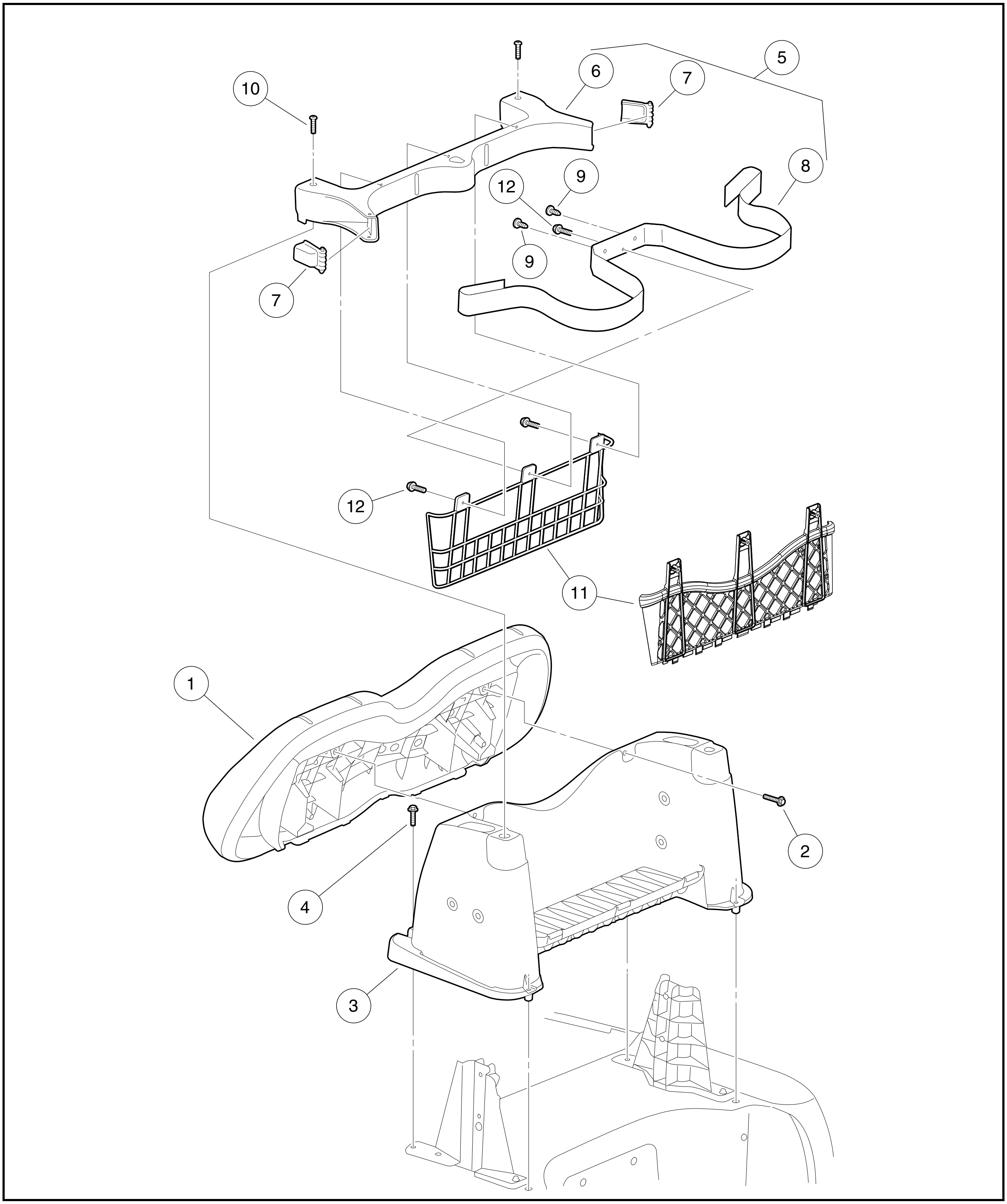

Figure 4-7 Backrest and SAM

REAR BODY COMPONENTS (TWO-PASSENGER)

Rear Beauty Panel Removal

1. Remove SAM. **See SAM Removal on page 4-9.**
2. Remove one screw (3) from each canopy support bracket (1 and 2) **(Figure 4-8, Page 4-12)**. Remove canopy supports.
3. Remove four screws (13) attaching the rear beauty panel (12) to the fuel bucket.
4. Remove two screws (14) and remove Forward/Reverse switch housing (15) from vehicle.
5. Disconnect electrical wires from the Forward/Reverse switch (16).
6. Lift rear beauty panel from vehicle.

Rear Beauty Panel Installation

1. Install rear beauty panel (12) on vehicle. Make sure body clips (17) on the rear of the beauty panel engage the mating slot in the rear underbody. Secure beauty panel in place with four screws (13). Tighten screws to 3.7 ft-lb (5 N·m) **(Figure 4-8, Page 4-12)**.
2. Connect the three wires to the Forward/Reverse switch (16) as shown.
3. Position the Forward/Reverse switch housing (15) on the front of beauty panel (12) and secure with two screws (14). Tighten screws to 20 in-lb (2.3 N·m).
4. Position canopy support brackets (1 and 2) on vehicle and secure each with one screw (3). Tighten screws to 53 in-lb (6 N·m).

Access Panel

Access panel (6) is secured to the rear underbody (4) with two push rivets (7) **(Figure 4-8, Page 4-12)**. When replacing the panel, insert push rivets (7) to hold the panel in place.

Rear Underbody Removal

1. Remove four screws (5) attaching the rear underbody (4) to vehicle **(Figure 4-8, Page 4-12)**.
2. Remove two screws (18) and washers (23) that attach the underbody to the two liners (8 and 9).
3. Lift the rear edge of the rear underbody (4) until the front portion slides out from beneath the front underbody. Remove the rear underbody from the vehicle.

Rear Underbody Installation

Install rear underbody (4) on the vehicle **(Figure 4-8, Page 4-12)**. Install two washers (23) and screws (18) to secure the underbody to the two wheel liners (8 and 9) and install four screws (5) to secure the underbody to the vehicle. Tighten screws (5 and 18) to 3.7 ft-lb (5 N·m).

Wheel Liner Removal

NOTE: *The wheel liners changed from molded-plastic to steel in late 2009 model year.*

Remove bolts (10) to release liners (8 and 9) from vehicle **(Figure 4-8, Page 4-12)**.

Wheel Liner Installation

Position liners (8 and 9) on vehicle and secure with bolts (10). Bolts (10) thread into J-clips (11) attached to the inner-frame rail. Tighten bolts to 53 in-lb (6 N·m) for molded-plastic liners or 123 in-lb (14 N·m) for steel liners.

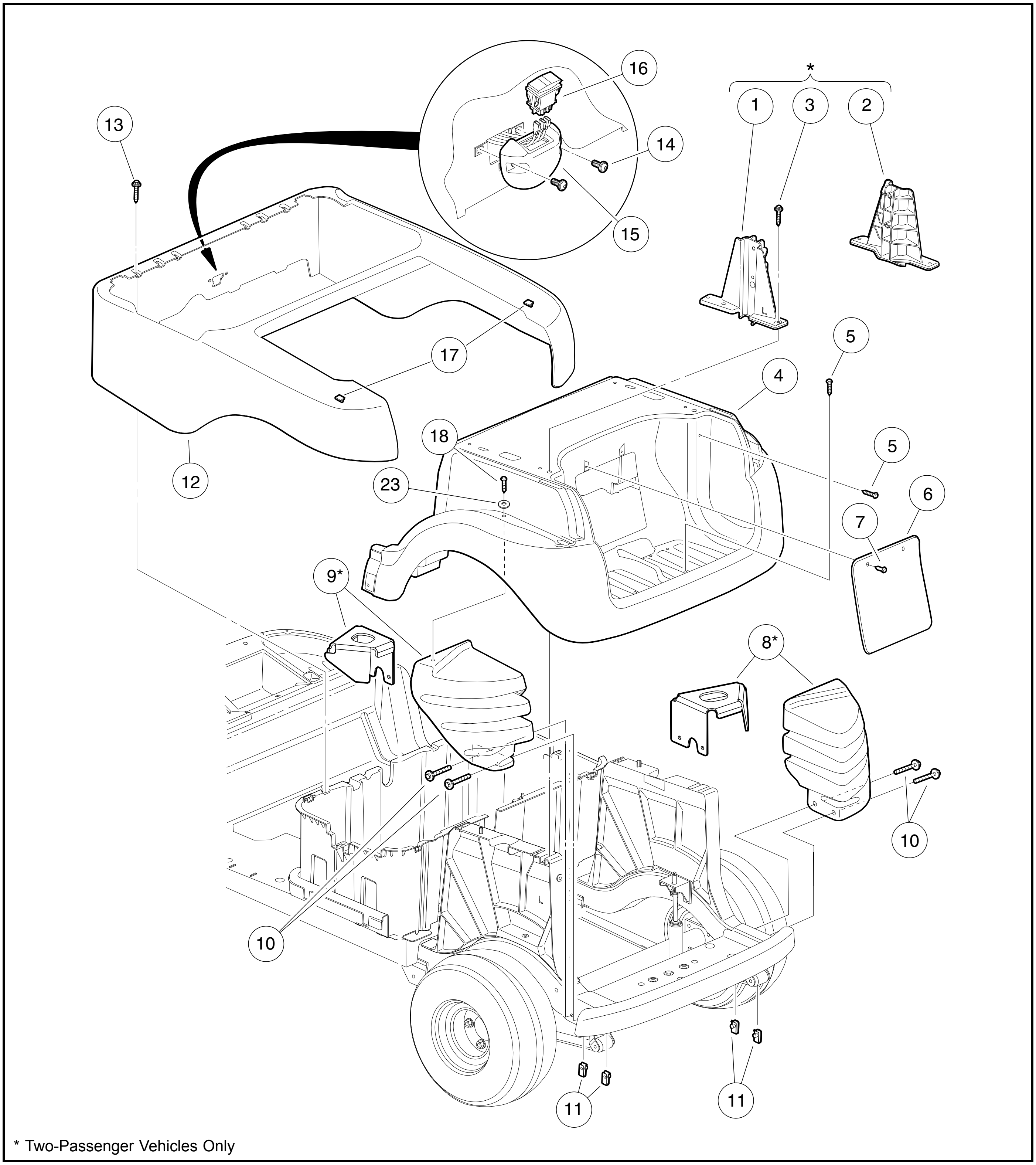

Figure 4-8 Rear Body Components

REAR BODY – FOUR-PASSENGER VEHICLES

See General Warnings on page 1-1.

SEAT BACKS

Seat Back Removal

Remove screws (9 or 13) securing seat back (8 or 11) to seat support and remove the seat back **(Figure 4-9, Page 4-13)**.

Seat Back Installation

Secure seat back (8 or 11) to seat support with screws (9 or 13). Tighten screws to 71 in-lb (8 N·m) **(Figure 4-9, Page 4-13)**.

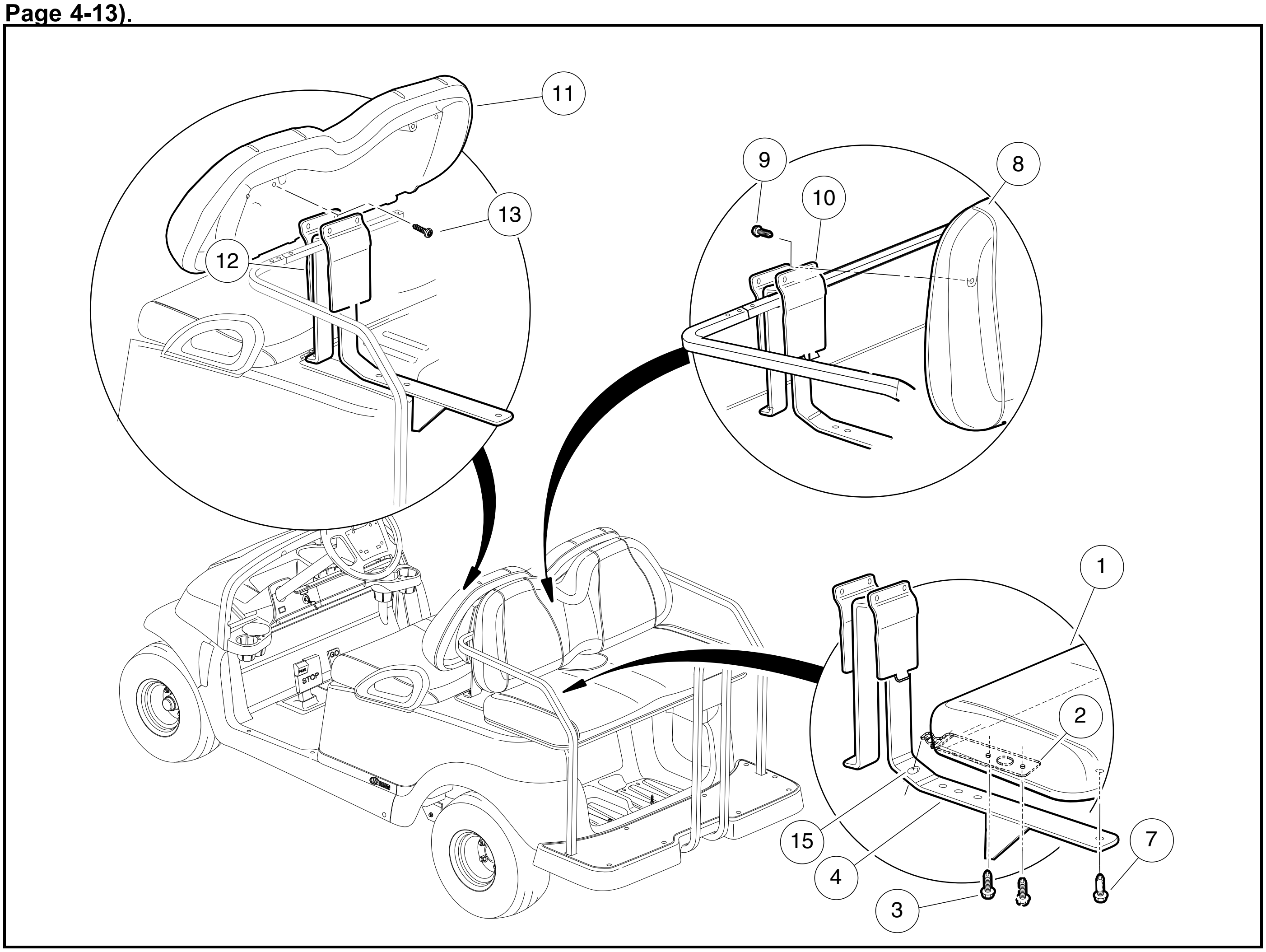

Figure 4-9 Seats (Four-Passenger Vehicles)

SEAT SUPPORT

Seat Support Removal

1. Remove screws (8 and 11) securing the rear hip restraints (6) and remove the hip restraints from the vehicle **(Figure 4-10, Page 4-14)**.
2. Remove the screws (5) and bolts (4) from the seat support (3) and remove the seat support from the vehicle.

Seat Support Installation

1. Install in the reverse order of removal.
2. Tighten bolts (4) to 53 in-lb (6 N·m). Tighten screws (5) to 44 in-lb (5 N·m). Tighten bolts (8 and 11) to 124 in-lb (14 N·m) **(Figure 4-10, Page 4-14)**.

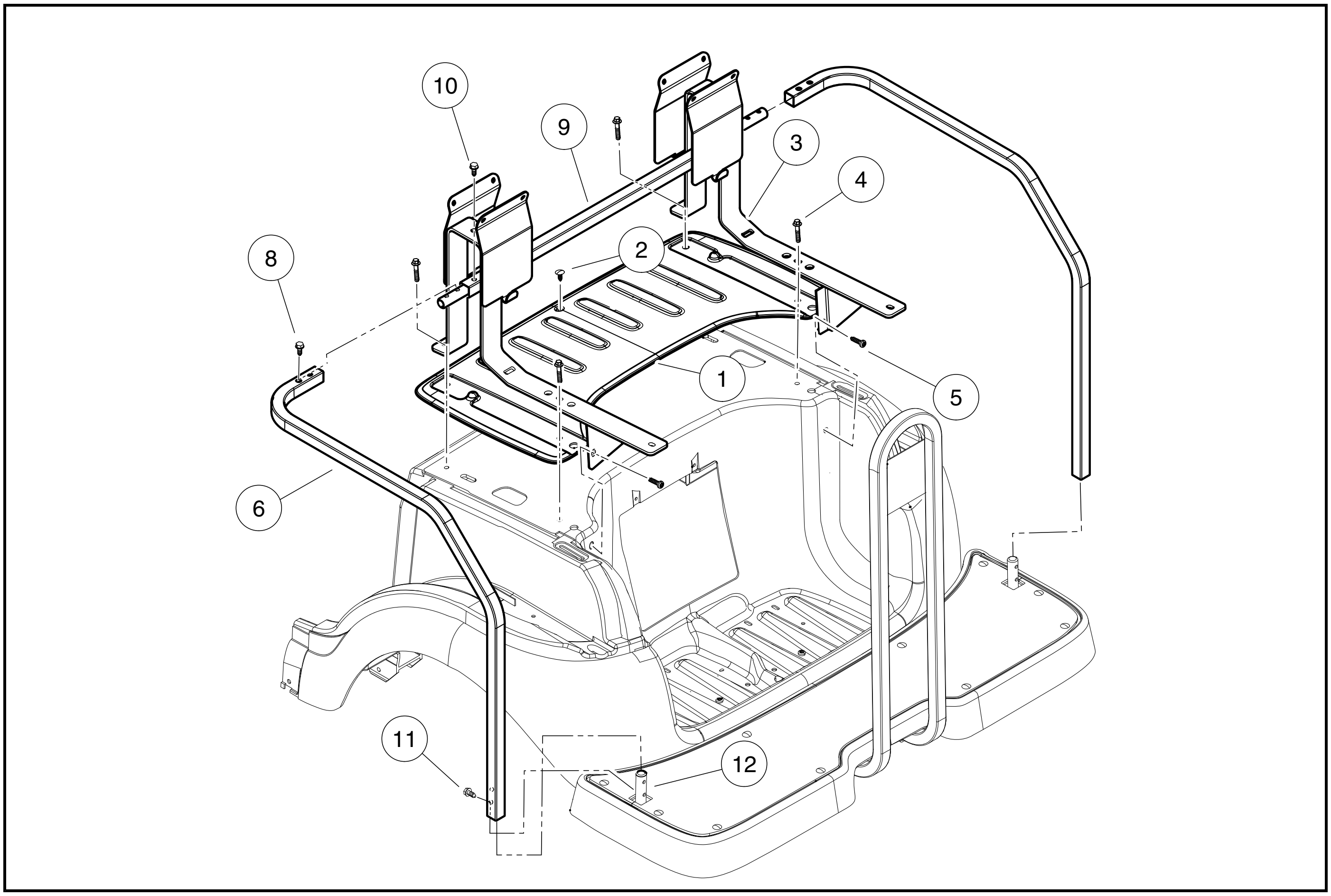

Figure 4-10 Seat Supports (Four-Passenger Vehicles)

FOOT DECK

Foot Deck Removal

1. Remove screws (8 and 11) securing the rear hip restraints (6) and remove the hip restraints from the vehicle **(Figure 4-10, Page 4-14)**.
2. Remove the four bolts (2) securing the foot deck (1) to the vehicle frame **(Figure 4-11, Page 4-15)**.

Foot Deck Installation

1. Install foot rest in reverse order of removal.
2. Tighten bolts (2) to 123 in-lb (14 N·m) **(Figure 4-11, Page 4-15)**.

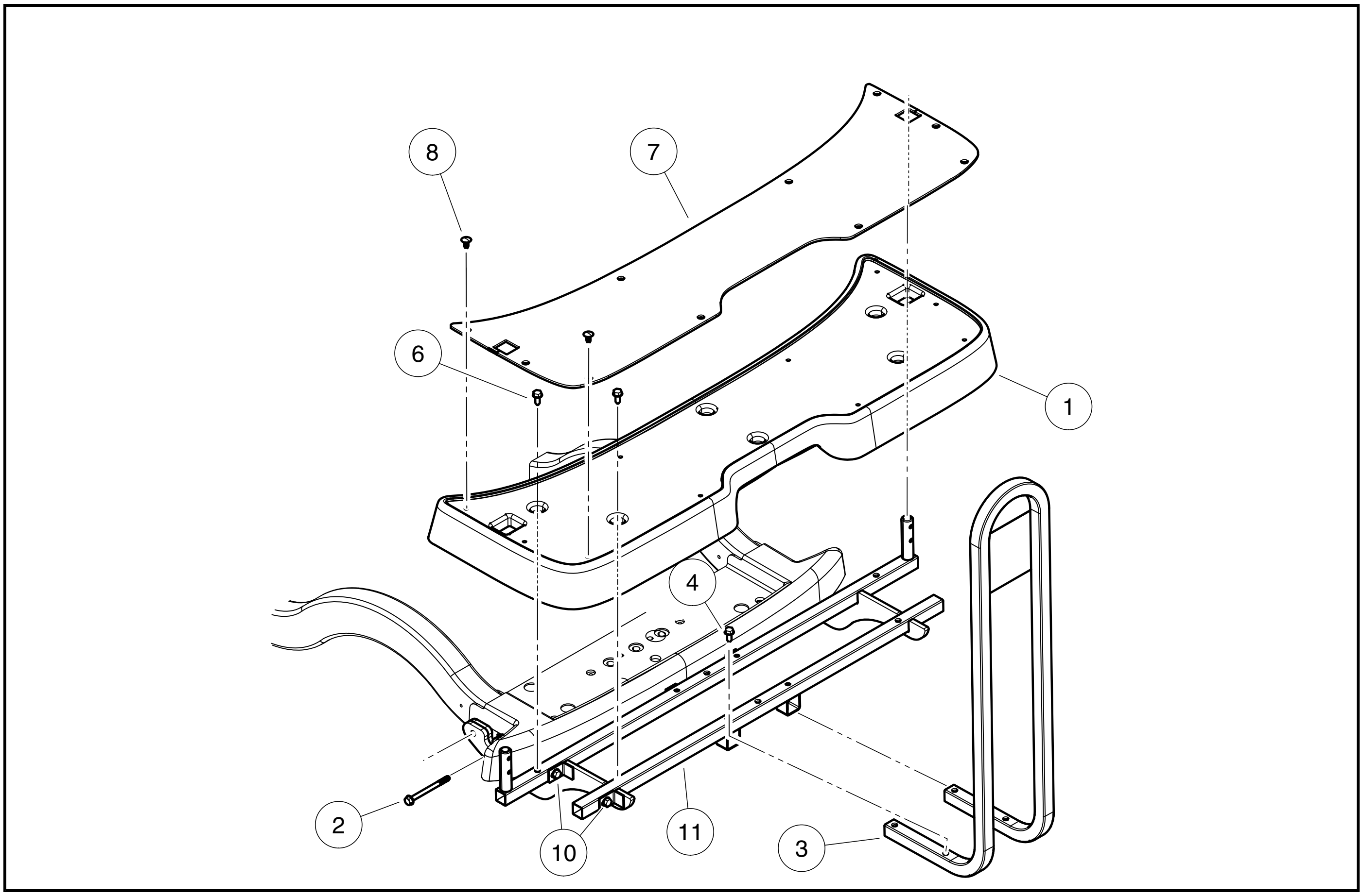

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Figure 4-11 Foot Deck (Four-Passenger Vehicles)

REAR BODY COMPONENTS (FOUR-PASSENGER)

Rear Beauty Panel Removal

1. Remove seat support. **See Seat Support Removal on page 4-13.**
2. Remove four screws (13) attaching the rear beauty panel (12) to the fuel bucket **(Figure 4-8, Page 4-12)**.
3. Remove two screws (14) and remove the Forward/Reverse switch housing (15) from vehicle.
4. Disconnect electrical wires from the Forward/Reverse switch (16).
5. Lift rear beauty panel from vehicle.

Rear Beauty Panel Installation

1. Install rear beauty panel (12) on vehicle. Make sure body clips (17) on the rear of the beauty panel engage the mating slot in the rear underbody. Secure beauty panel in place with four screws (13). Tighten screws to 3.7 ft-lb (5 N·m) **(Figure 4-8, Page 4-12)**.
2. Connect the three wires to the Forward/Reverse switch (16) as shown.
3. Position the Forward/Reverse switch housing (15) on the front of beauty panel (12) and secure with two screws (14). Tighten screws to 20 in-lb (2.3 N·m).
4. Install seat support. **See Seat Support Installation on page 4-14.**

Access Panel

Access panel (6) is secured to the rear underbody (4) with two push rivets (7) **(Figure 4-8, Page 4-12)**. When replacing the panel, insert push rivets (7) to hold the panel in place.

Rear Underbody Removal

1. Remove four screws (5) attaching the rear underbody (4) to vehicle **(Figure 4-8, Page 4-12)**.

2. Lift the rear edge of the rear underbody (4) until the front portion slides out from beneath the front underbody. Remove the rear underbody from the vehicle.

Rear Underbody Installation

Install rear underbody (4) on the vehicle **(Figure 4-8, Page 4-12)**. Install four screws (5) to secure the underbody to its vehicle. Tighten screws (5 and 18) to 3.7 ft-lb (5 N·m).

CANOPY – TWO-PASSENGER

See General Warnings on page 1-1.

CAUTION

- **To prevent damage to the canopy, do not remove the canopy supports (3, 7, and 10) from the vehicle without first removing the canopy (1) (Figure 4-12, Page 4-17).**

TWO-PASSENGER CANOPY REMOVAL

1. Remove the two nuts (9) and two bolts (8) from the canopy (1) and each front canopy support (7 and 10) **(Figure 4-12, Page 4-17)**.
2. Remove the nuts (5) and bolts (4) from the canopy (1) and each rear support (3).
3. Lift canopy (1) away from front canopy supports (7 and 10) and rear supports (3).
4. Remove screws (14) securing front canopy support covers to front body.
5. Slide canopy support covers (12 and 13) up front canopy supports (7 and 10) to gain access to bolts (11).
6. Remove two bolts (11) from each front canopy support (7 and 10) and remove canopy supports from the vehicle.
7. Remove bolt (6) from each rear support (3) and pull rear supports from vehicle.

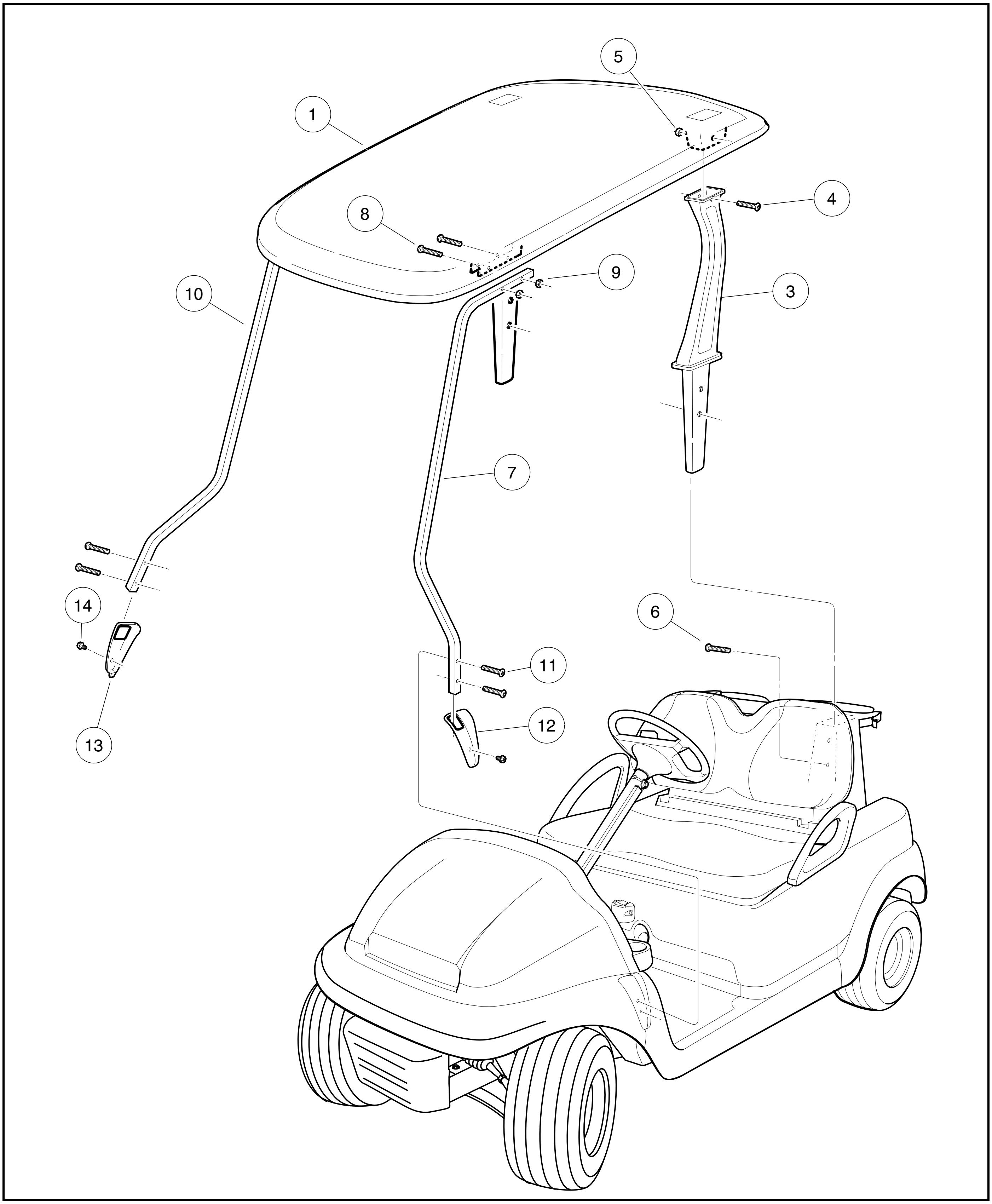

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Figure 4-12 Precedent Two-Passenger Canopy

TWO-PASSENGER CANOPY INSTALLATION

1. Install the front canopy supports.
   1.1. Ensure the front supports are properly oriented to the correct side of the vehicle as shown **(Figure 4-12, Page 4-17)**. The lower profile of each support follows the profile of the vehicle. If the supports are placed on the wrong side of the vehicle, they will not follow the vehicle's profile.
   1.2. Align the holes in the lower portion of each front support (7 and 10) with the corresponding holes in the vehicle. Insert two bolts (11) through each front support into the threaded holes in the vehicle. The bolts are color-coded with gold thread lock. Only finger-tighten the bolts at this time.
   1.3. Slide the covers (12 and 13) over the front supports. The covers are marked DRIVER and PASS to identify them as going on the driver side or passenger side respectively. Do not install the screws (14) yet.
2. Insert the two rear canopy supports (3) into the openings on the top of the Structural Accessory Module (SAM).
3. From the inside of the basket, insert bolt (6) through the basket wall and into each support. The bolts are color-coded with blue thread-lock. Finger-tighten the bolts to avoid cross-threading the threads in the supports. **See following CAUTION.**

CAUTION

- **Using tools to thread the bolts could prevent proper feel of the bolt as it captures the female threads in the support. This could result in damage to the components.**

4. Position the canopy on top of the front and rear supports. Ensure that the front supports are properly positioned between the molded tabs on the underside of the canopy and that the molded protrusions at the rear of the canopy extend into the top of the rear supports.
5. Secure the canopy to the front supports with four bolts (8) and lock nuts (9). Use two bolts on each support, inserting the bolts from the inside. Tighten the lock nuts to 50 in-lb (5.6 N·m).
6. Secure the canopy to the rear supports with two bolts (4) and locknuts (5).Tighten the lock nuts to 50 in-lb (5.6 N·m).
7. At the rear supports (3), tighten the two bolts (6) to 88 in-lb (10 N·m).
8. At the front supports (7 and 10), tighten the four bolts (11) to 18.4 ft-lb (25 N·m).
9. Position each cover (12 and 13) over its respective support. A hole in each cover should be aligned with a corresponding hole in the support. Secure the cover to the support with a screw (14). Tighten the screws (14) to 31 in-lb (4.6 N·m).

CANOPY – FOUR-PASSENGER

See General Warnings on page 1-1.

CAUTION

- **To prevent damage to the canopy, do not remove the canopy supports (1 and 6) from the vehicle without first removing the canopy (9) (Figure 4-13, Page 4-20).**

FOUR-PASSENGER CANOPY REMOVAL

1. Remove the two nuts (12), two bolts (11), and spacers (10) from the canopy (9), and each front canopy support (1) **(Figure 4-13, Page 4-20)**.

2. Remove the nuts (14) and bolts (13) from the canopy (9) and the rear support (6).
3. Lift canopy (9) away from front canopy supports (1) and rear support (6).
4. Remove screws (5) securing front canopy support covers to front body.
5. Slide canopy support covers (4) up front canopy supports (1) to gain access to bolts (2).
6. Remove two bolts (2) from each front canopy support (1) and remove the canopy supports from the vehicle.
7. Remove two bolts (8) from the rear support (3) and remove rear support from vehicle.

FOUR-PASSENGER CANOPY INSTALLATION

1. Install the front canopy supports.
   - 1.1. Ensure the front supports are properly oriented to the correct side of the vehicle as shown **(Figure 4-13, Page 4-20)**. The lower profile of each support follows the profile of the vehicle. If the supports are placed on the wrong side of the vehicle, they will not follow the vehicle's profile.
   - 1.2. Align the holes in the lower portion of each front support (1) with the corresponding holes in the vehicle. Insert two bolts (2) through each front support into the threaded holes in the vehicle. The bolts are color-coded with gold thread lock. Only finger-tighten the bolts at this time.
   - 1.3. Slide the front support covers (4) over the front supports (1). The covers are marked DRIVER and PASS to identify them as going on the driver side or passenger side respectively. Do not install the screws (5) yet.
2. Remove the two bolts that secure the hip restraint (15) to the seat supports (7).
3. Align the rear canopy support (6) with the top of the seat supports (7) and secure with two bolts (8) as shown. Tighten the hardware to 124 in-lb (14 N·m).
4. Secure the front of the canopy (9) to the front supports (1) with four spacers (10), bolts (11), and cap-nuts (12). Tighten the hardware to 10 ft-lb (13.6 N·m).
5. Secure the rear of the canopy (9) to the rear canopy support (6) with four bolts (13) and cap-nuts (14). Tighten the hardware to 10 ft-lb (13.6 N·m).
6. Tighten the four bolts (2) installed in step 1.2 to 18 ft-lb (25 N·m).
7. Secure each front support cover (4) with one screw (5). Tighten the hardware to 31 in-lb (4.6 N·m).

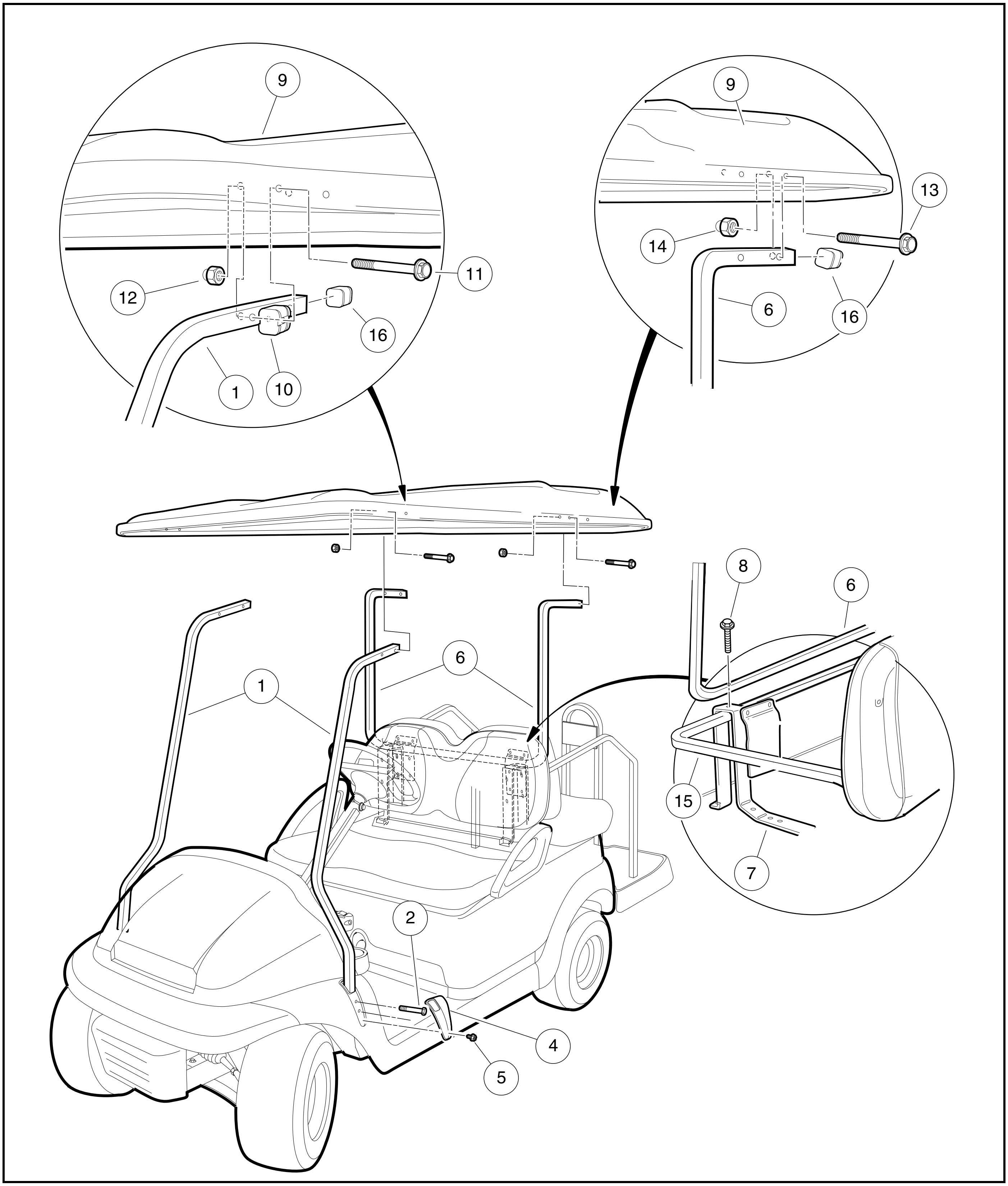

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Figure 4-13 Precedent Four-Passenger Canopy

CANOPY (MONSOON VERSION) – FOUR-PASSENGER

See General Warnings on page 1-1.

CAUTION

- **To prevent damage to the canopy, do not remove the canopy supports (1, 2, 8 and 9) from the vehicle without first removing the canopy (13) (Figure 4-16, Page 4-24).**

MONSOON CANOPY REMOVAL

1. Remove the two nuts (17), two washers (16), and two bolts (15) from the canopy (13) at each front canopy support (8 and 9) **(Figure 4-16, Page 4-24)**.
2. Remove the four bolts (18) from the canopy (13) at each rear support (1 and 2).
3. Lift canopy (13) off the canopy supports.
4. Remove screws (12) securing front canopy support covers (11) to front body.
5. Slide canopy support covers (11) up front canopy supports (8 and 9) to gain access to bolts (10).
6. Remove two bolts (10) from each front canopy support (8 and 9) and remove the canopy supports from the vehicle.
7. Remove the four nuts (7), eight washers (6), and four bolts (5) securing each rear canopy support (1 and 2) and remove the canopy supports from the vehicle **(Figure 4-14, Page 4-22)**.

MONSOON CANOPY INSTALLATION

1. Secure the rear canopy supports.
   1.1. Position each rear canopy support (1 and 2) to the side of the seat support assembly (3) as shown **(Figure 4-14)**. Make sure the bottom of the strut is in the hole (4) in the rear body to allow for water drainage.
   1.2. Secure each rear canopy support (1 and 2) to the seat support assembly with four 1/4-20 x 1- hex head bolts (5), eight 1/4-inch flat washers (6) and four 1/4-20 nylon lock nuts (7). Tighten hardware to 80 in-lb (9 N·m).

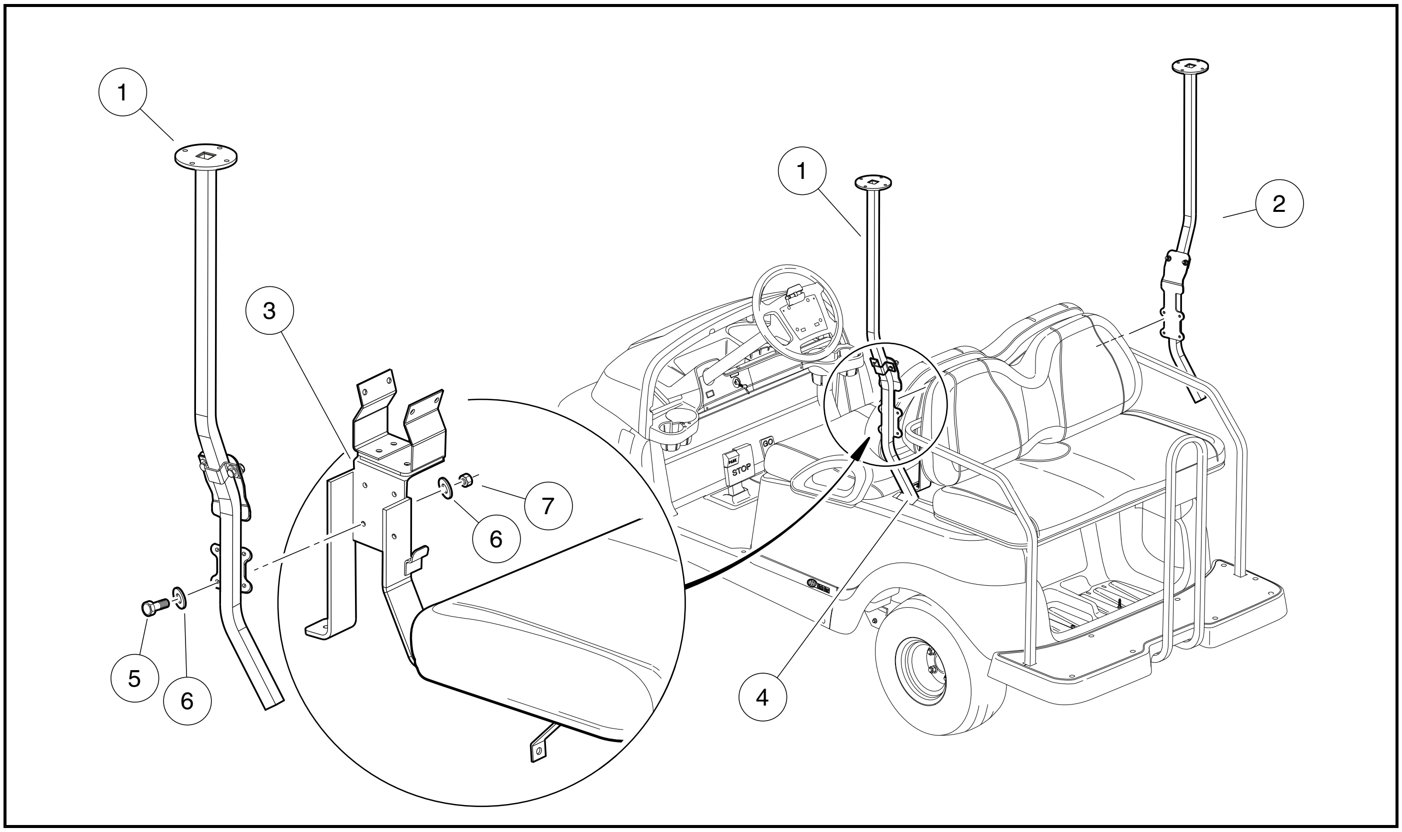

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Figure 4-14 Secure Rear Supports to Seat Support Bracket

2. Attach the front canopy supports.
   2.1. Ensure the front supports are properly oriented to the correct side of the vehicle as shown **(Figure 4-15)**. The lower profile of each support follows the profile of the vehicle. If the supports are placed on the wrong side of the vehicle, they will not follow the vehicle's profile.
   2.2. Align the holes in the lower portion of each front support (8 and 9) with the corresponding holes in the vehicle **(Figure 4-16)**. Insert two M8-1.25 x 65 torx button-head bolts (10) through each front support into the threaded holes in the vehicle. The bolts are color-coded with gold thread lock. Only finger-tighten the bolts at this time.
   2.3. Slide the front support covers (11) over the front supports (8 and 9). The covers are marked DRIVER and PASS to identify them as going on the driver side or passenger side respectively **(Figure 4-16)**. Do not install the M6 hex-head screws (12) yet.

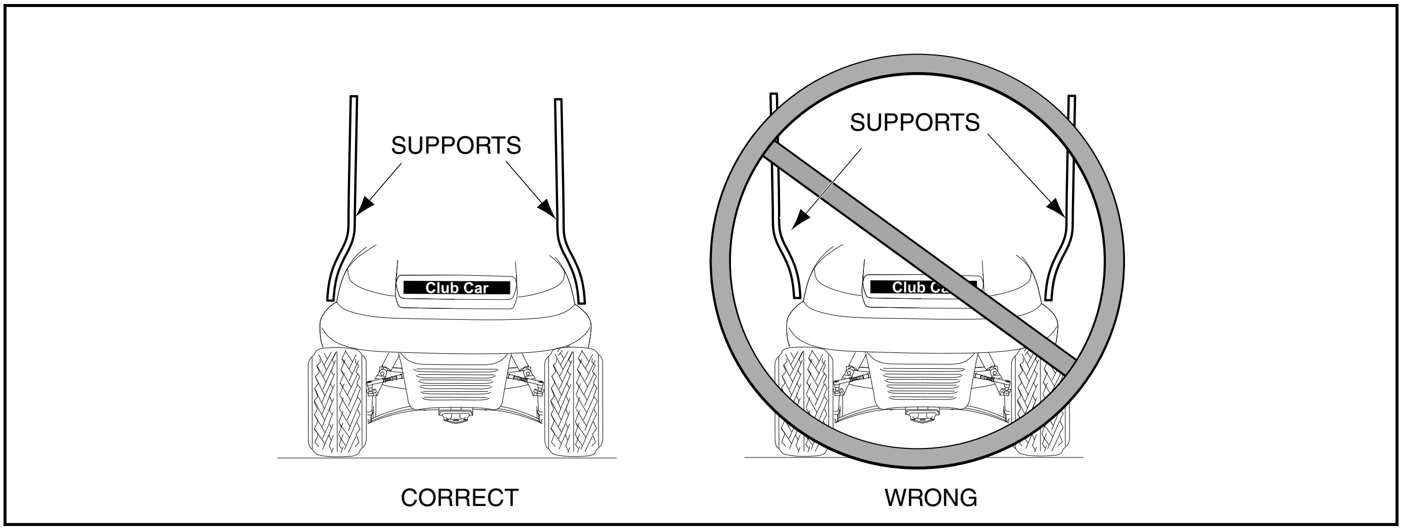

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Figure 4-15 Properly Orient the Front Supports

3. With the aid of an assistant, position the canopy (13) to the top of the front supports (8 and 9) and rear supports (1 and 2).
4. Secure the front canopy brackets (under the canopy) (14) to the front supports (8 and 9) with four 1/4-20 x 1-1/2 hex head bolts (15), eight 1/4-inch flat washers (16) and four 1/4-20 nylon lock nuts (17). Tighten the hardware to 80 in-lb (9 N·m).
5. Secure the rear of the canopy (13) to each rear canopy support (1 and 2) with four M6-1.0 x 25 flanged head bolts (18). Tighten the hardware to 80 in-lb (9 N·m).
6. At the bottom of the front supports (8 and 9), tighten the four M8-1.25 x 65 torx button-head bolts (10) to 18.4 ft-lb (25 N·m).
7. Secure each front support cover (11) with one M6 hex-head screw (12). Tighten the hardware to 31 in-lb (4.6 N·m).
8. Secure the tube plugs (19) into the end of each canopy support (1 and 14).

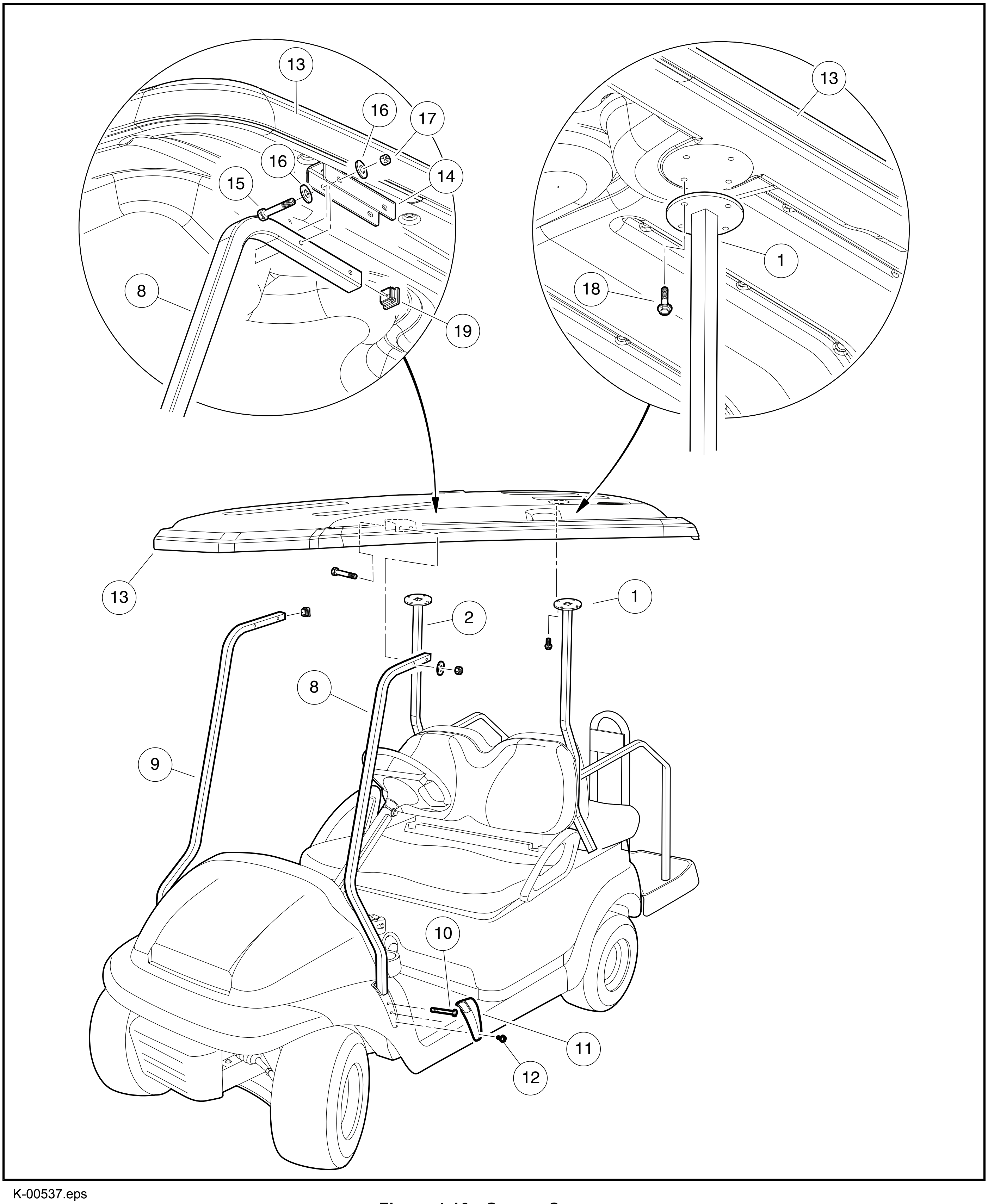

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Figure 4-16 Secure Canopy

SECTION 5 – ACCELERATOR AND BRAKE PEDAL GROUP

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

PEDAL GROUP – THROTTLE POSITION SENSOR

See General Warnings on page 1-1.

PEDAL GROUP REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove screws (1). Pull floor mat retainer (3) away from the vehicle **(Figure 5-1, Page 5-1)**.
3. Pull floor mat (2) over the pedal group to gain access to the pedal group hardware.
4. Remove fastener (10) and lift off cover plate (7) **(Figure 5-2, Page 5-2)**.
5. Loosen jam nuts (4 and 5) on each side of turnbuckle (6).

NOTE: *Nut (4) has a left-hand thread.*

6. Loosen turnbuckle (6) until the threaded rod (8) from the pedal group (11) is free of the turnbuckle **(Figure 5-2, Page 5-2)**.

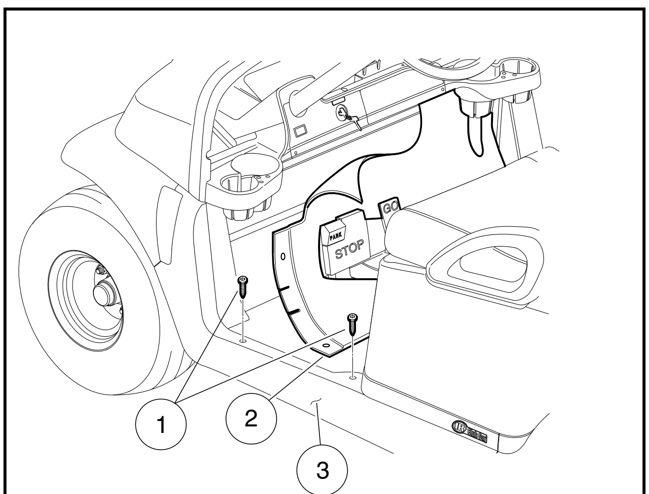

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Figure 5-1 Pedal Group Access

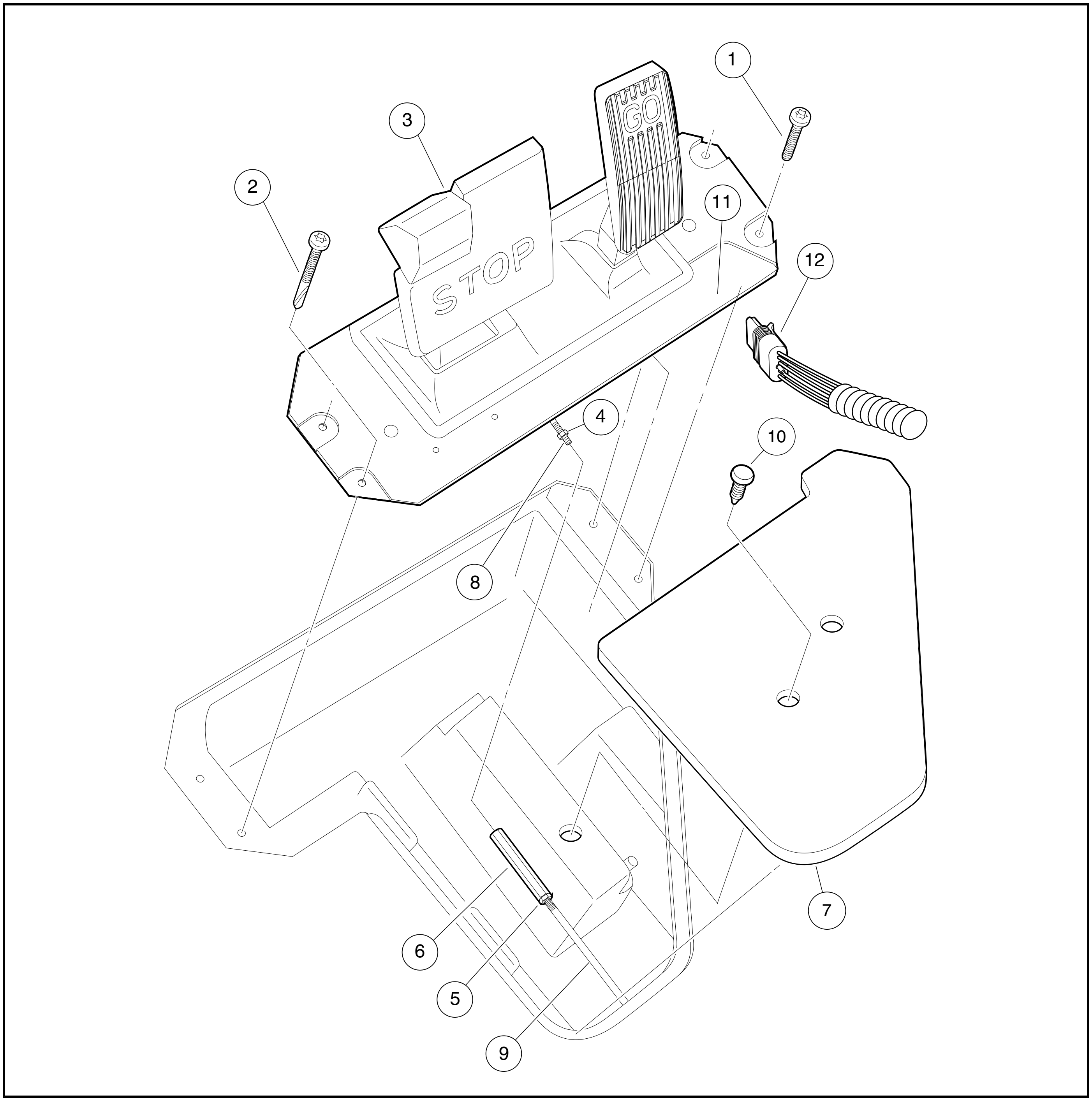

Figure 5-2 Pedal Group (with TPS)

7. Remove two screws (2) on the driver side of the pedal group and two screws (1) on the passenger side of the pedal group.
8. Disconnect six-pin connector (12) from throttle position sensor.
9. Lift pedal group from vehicle.

THROTTLE POSITION SENSOR (TPS)

The pedal group for the Precedent electric vehicle includes a throttle position sensor mounted on the side of the accelerator pedal assembly. The throttle position sensor detects the position of the accelerator pedal and sends a corresponding voltage to the motor controller. The throttle position sensor itself is not intended to be replaced. If sensor is determined to need replacing through test procedures found in this manual, the accelerator pedal assembly must be replaced. **See Accelerator Pedal Removal on page 5-6.**

PEDAL GROUP INSTALLATION

1. Connect the wire harness (12) to the throttle position sensor **(Figure 5-2, Page 5-2)**.
2. Position the pedal group in vehicle and secure with two screws (2) on the driver side and two screws (1) on the passenger side. Tighten driver side screws (2) to 97 in-lb (11 N·m). Tighten passenger side screws (1) to 18 in-lb (2 N·m).
3. Remove the turnbuckle (6) and apply Loctite 242 to the threaded ends of both the rod from the pedal group (8) and the brake actuator rod (9). Connect the rods using the turnbuckle (6). Ensure the ends of the brake cables do not slip out of the brake equalizer during this procedure.
4. Adjust the brake cable equalizer tension. **See Brake Cable Equalizer Adjustment on page 6-10.**
5. Place floor cover plate (7) over the floor opening and secure with fastener (10) **(Figure 5-2, Page 5-2)**.
6. Install the floor mat (2) over the pedal group. Make sure tabs on floor mat sides are beneath the sill (3). Tighten screws (1) to 53 in-lb (6 N·m) **(Figure 5-1, Page 5-1)**.

PEDAL GROUP – MCOR

See General Warnings on page 1-1.

PEDAL GROUP REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove screws (1). Pull floor mat retainer (3) away from the vehicle **(Figure 5-3, Page 5-4)**.
3. Pull floor mat (2) over the pedal group to gain access to the pedal group hardware.

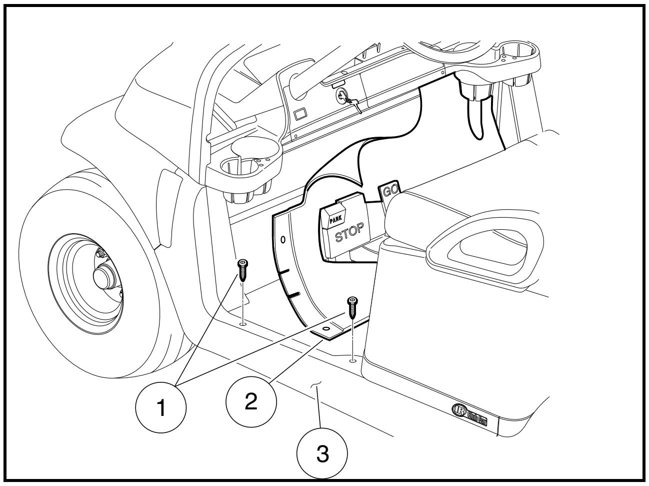

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Figure 5-3 Pedal Group Access

4. Remove fastener (10) and lift off cover plate (7) **(Figure 5-4, Page 5-5)**.
5. Loosen jam nuts (4 and 5) on each side of turnbuckle (6).

NOTE: *Nut (4) has a left-hand thread.*

6. Loosen turnbuckle (6) until the threaded rod (8) from the pedal group (11) is free of the turnbuckle **(Figure 5-4, Page 5-5)**.
7. Remove two screws (2) on the driver side of the pedal group and two screws (1) on the passenger side of the pedal group.
8. Disconnect the electrical connectors (12) at the MCOR (13).
9. Lift pedal group from vehicle.

PEDAL GROUP INSTALLATION

1. Connect the wire harness (12) to the MCOR (13) **(Figure 5-4, Page 5-5)**.
2. Position the pedal group in vehicle and secure with two screws (2) on the driver side and two screws (1) on the passenger side. Tighten driver side screws (2) to 97 in-lb (11 N·m). Tighten passenger side screws (1) to 18 in-lb (2 N·m).
3. Remove the turnbuckle (6) and apply Loctite 242 to the threaded ends of both the rod from the pedal group (8) and the brake actuator rod (9). Connect the rods using the turnbuckle (6). Ensure the ends of the brake cables do not slip out of the brake equalizer during this procedure.
4. Adjust the brake cable equalizer tension. **See Brake Cable Equalizer Adjustment on page 6-10.**
5. Place floor cover plate (7) over the floor opening and secure with fastener (10) **(Figure 5-2, Page 5-2)**.
6. Install the floor mat (2) over the pedal group. Make sure tabs on floor mat sides are beneath the sill (3). Tighten screws (1) to 53 in-lb (6 N·m) **(Figure 5-1, Page 5-1)**.

MCOR

The pedal group for the Precedent electric vehicle includes a Motor Controller Output Regulator (MCOR) mounted on the side of the pedal group. The MCOR detects the position of the GO pedal and sends a corresponding voltage to the motor controller.

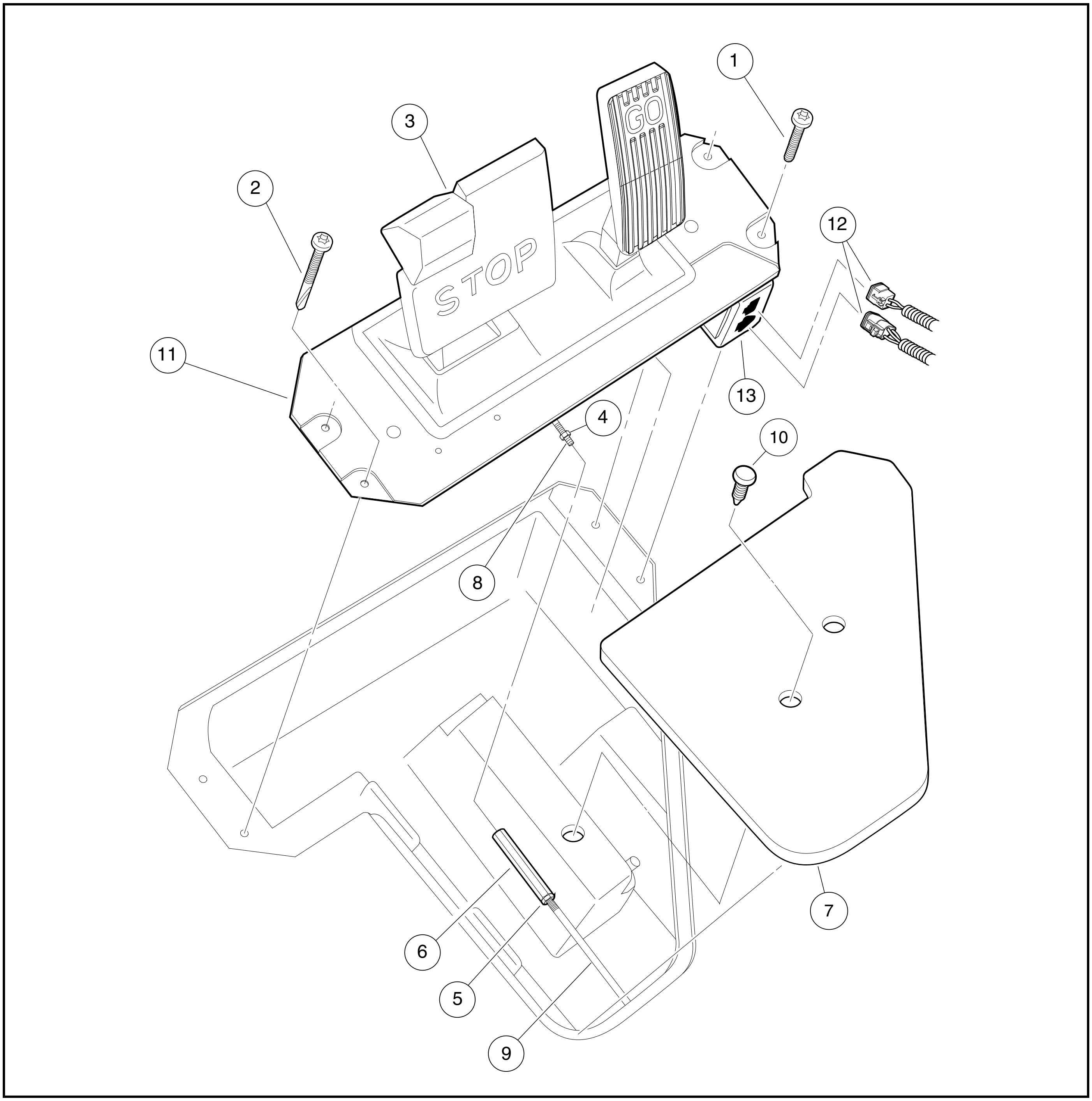

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Figure 5-4 Pedal Group (with MCOR)

DEBRIS SHIELDS

Debris shields on the top face of the pedal group prevent excessive debris from contacting the moving parts of the pedal group. Both shields (4 and 5) are held in place by tabs that snap into the pedal group mounting plate **(Figure 5-5, Page 5-7)**.

ACCELERATOR PEDAL REMOVAL

1. Remove pedal group from vehicle. **See Pedal Group Removal on page 5-1.**
2. **Vehicles with an MCOR:** Remove the MCOR. **See MCOR Removal on page 17-8.**
3. Remove debris shields (4 and 5) **(Figure 5-5, Page 5-7)**.
4. Remove four screws (13) securing accelerator pedal assembly (9) to pedal group mounting plate and pull accelerator pedal assembly through bottom of pedal group mounting plate.

ACCELERATOR PEDAL INSTALLATION

1. Insert accelerator pedal assembly (9) through bottom of pedal group mounting plate and secure with four screws (13) **(Figure 5-5, Page 5-7)**.
2. Tighten screws (13) to 38 in-lb (4.3 N·m)
3. Install debris shields (4 and 5).
4. **Vehicles with an MCOR:** Install the MCOR. **See MCOR Installation on page 17-8.**
5. Install pedal group in vehicle. **See Pedal Group Installation on page 5-3.**

BRAKE PEDAL REMOVAL

1. Remove pedal group from vehicle. **See Pedal Group Removal on page 5-1.**
2. Remove debris shields (4 and 5) **(Figure 5-5, Page 5-7)**.
3. Remove four screws (12) securing brake pedal assembly (10) to pedal group mounting plate and pull brake pedal assembly through bottom of pedal group mounting plate.

BRAKE PEDAL INSTALLATION

1. Insert brake pedal assembly (10) through bottom of pedal group mounting plate and secure with four screws (12) **(Figure 5-5, Page 5-7)**.
2. Tighten screws (12) to 100 in-lb (11.3 N·m)
3. Install debris shields (4 and 5).
4. Install pedal group in vehicle. **See Pedal Group Installation on page 5-3.**

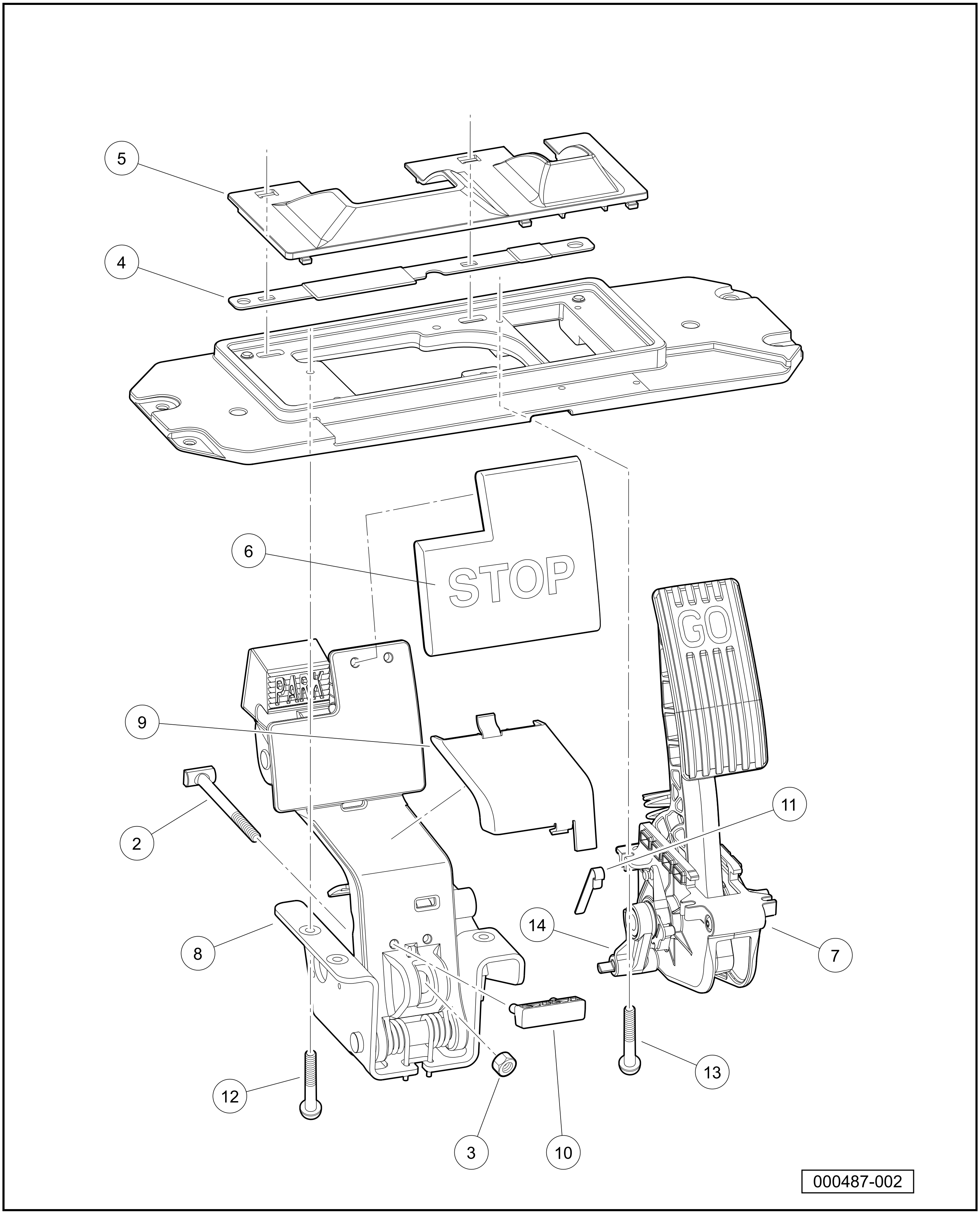


Figure 5-5 Accelerator Pedal Assembly and Brake Pedal Assembly

SECTION 6 – WHEEL BRAKE ASSEMBLIES

6

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

Asbestos Dust Warning

- **Some aftermarket brake shoes contain asbestos fiber, and asbestos dust is created when these brake mechanisms are handled. Wear approved eye and respiratory protection when disassembling and cleaning brake mechanisms. Inhalation of asbestos could result in severe personal injury or death. Do not use compressed air or aerosol sprays to clean the brake mechanism. Clean brake mechanism using the negative pressure enclosure/hepa vacuum system or low pressure/wet cleaning method per OSHA/29 CFR - 1910.1001.**

GENERAL INFORMATION

Precedent Golf Cars are equipped with self-adjusting, mechanically-expanding shoe drum brakes on each rear wheel.

BRAKE SHOE REMOVAL

See General Warnings on page 1-1. See also Asbestos Dust Warning on page 6-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels. Loosen, but do not remove, lug nuts on rear wheels and lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the axle tubes to support the vehicle. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
3. Gain access to the pedal group by removing the floor mat and access panel. **See Pedal Group Removal on page 5-1.**
4. Loosen the two jam nuts (1 and 3) on either side of turnbuckle (2) **(Figure 6-1, Page 6-2)**. Note that the forward jam nut (1) is a left-hand thread. Thread each nut approximately 1/2 inch (12.7 mm) away from the turnbuckle.
5. Loosen turnbuckle (2) to release tension on the equalizer bracket (4) that pulls on the heads of the brake cables.
6. Remove the rear wheels and then the brake drums. If the brake drums were easily removed, proceed to step 8.

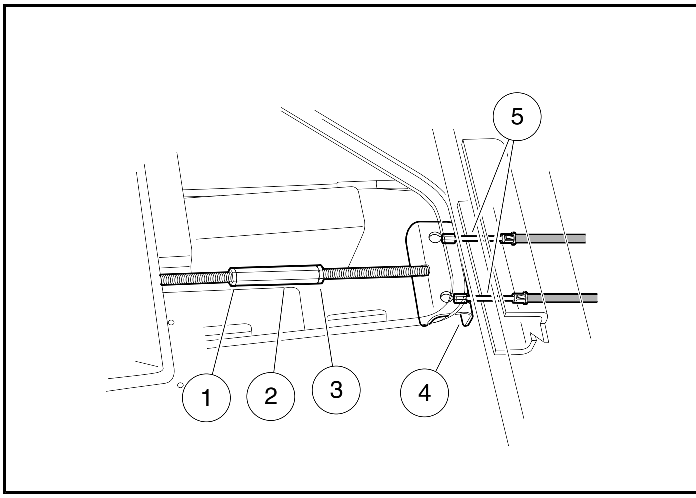
⚠ CAUTION

- **Worn or damaged brake drums cannot be machined to refinish them. Replace as necessary.**

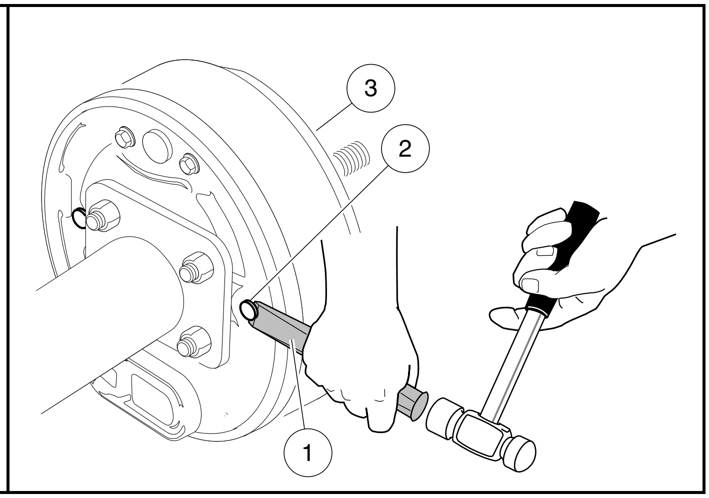
NOTE: *When servicing vehicles with severely worn brake shoes and when the drums cannot be removed by normal methods, proceed to step 7 to minimize damage to the brake cluster and brake components.*

7. Remove brake drums and badly worn brake shoes.

7.1. On the back of each brake cluster assembly, locate the heads of two brake shoe retainer pins. It may be necessary to remove sealant material around the head of each pin.



636
Figure 6-1 Loosen Turnbuckle

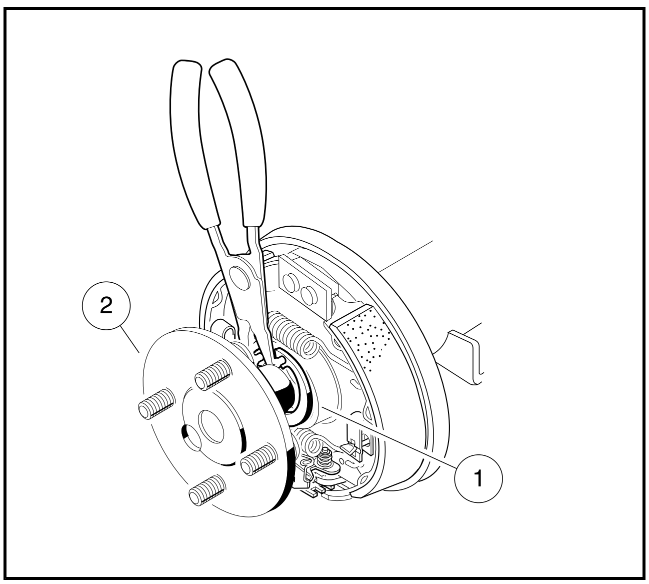


1400-18100-10220
Figure 6-2 Shoe Retainer Pins

7.2. Insert a 1/2 inch x 5/8 inch cold chisel (1) under the head (2) of each pin and shear them off as illustrated **(Figure 6-2, Page 6-2)**. This will release the shoes from the backing plate, allowing them to pivot away from the inside of the brake drum (3), which should then allow the brake drum to be pulled free. After completing step 8, skip step 9.

NOTE: *Although step 8 allows easier access to the brake shoes, it is not imperative to do so in order to remove the brake shoes.*

8. Remove the axle.
   8.1. Using 90° snap ring pliers (P/N 1012560), remove the axle retaining ring (1) **(Figure 6-3, Page 6-2)**.
   8.2. Pull the axle shaft (2) from the axle tube **(Figure 6-3, Page 6-2)**.



2400-23600-10221
Figure 6-3 Remove Axle Retaining Ring

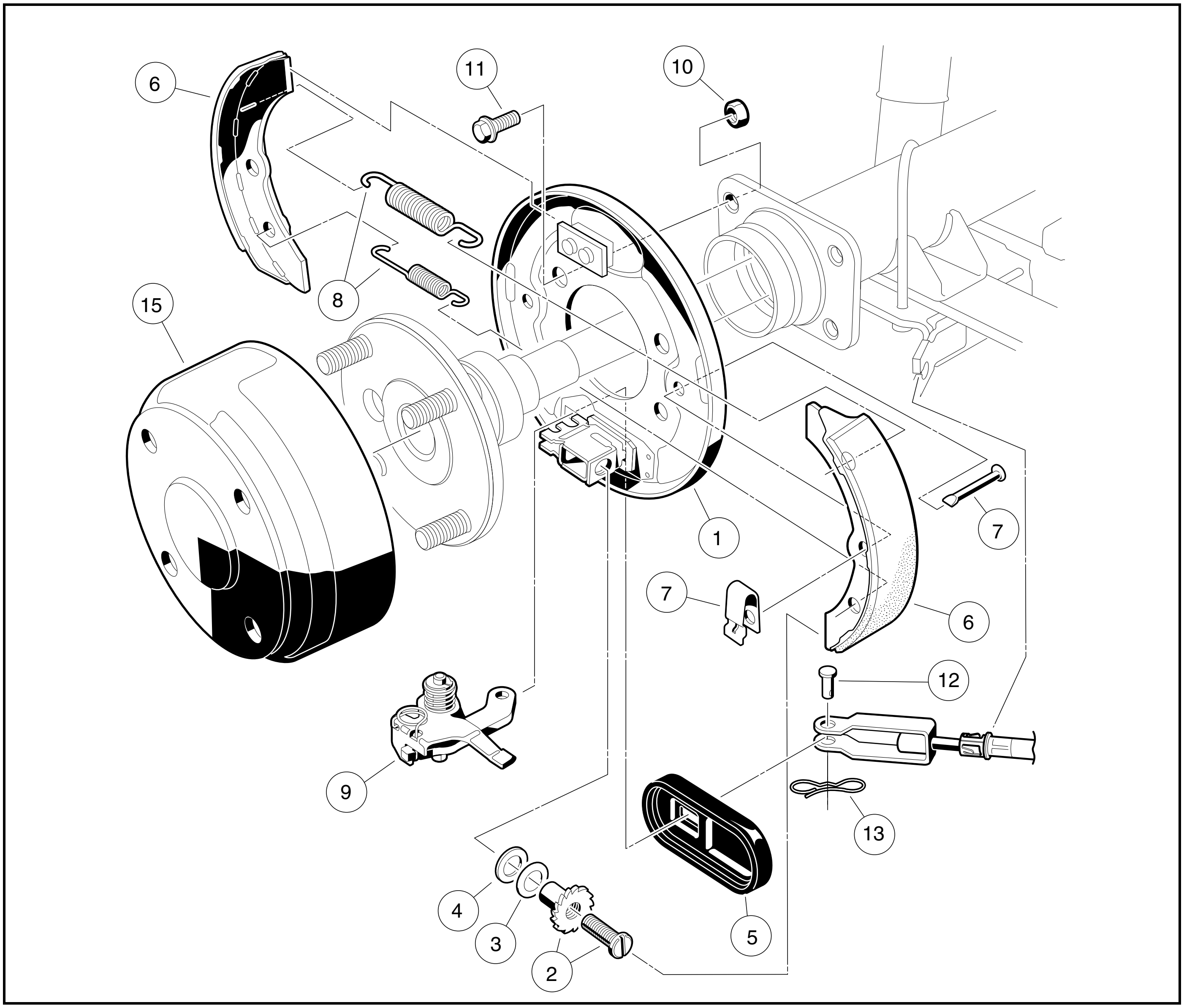


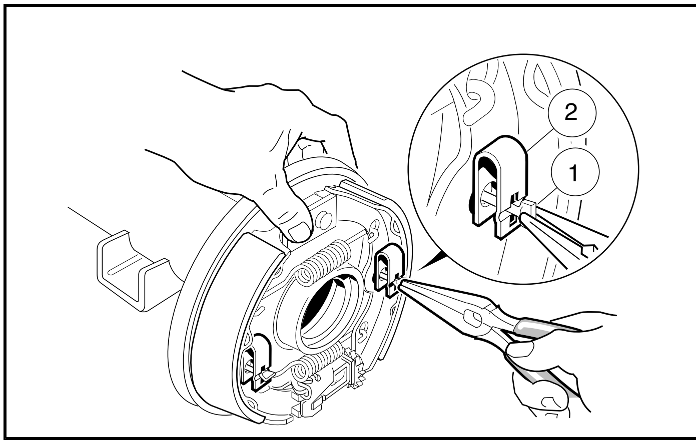
Figure 6-4 Self-adjusting Wheel Brake Assembly

9. Using needle nose pliers, turn the clip retainer pin (1) 90° to remove the shoe retainer clip (2) **(Figure 6-5, Page 6-4)**.

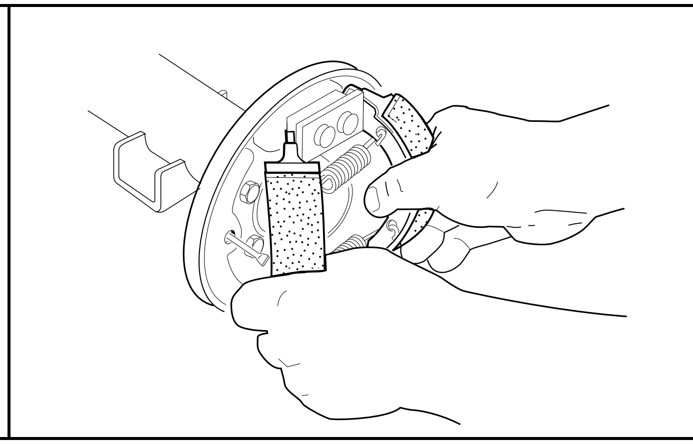
⚠ CAUTION

- **The brake shoes are under pressure and can release suddenly when brake shoe retainers are removed.**

10. Grasp both brake shoes and pull them, together with the springs, out of the brake assembly as shown **(Figure 6-6, Page 6-4)**.
11. Remove adjuster wheel (1) with two washers (2 and 3) from the backing plate **(Figure 6-7, Page 6-4)**.



1400-18100-10222
Figure 6-5 Remove Shoe Retainer Clip



1400-17700-10225
Figure 6-6 Remove Brake Shoes

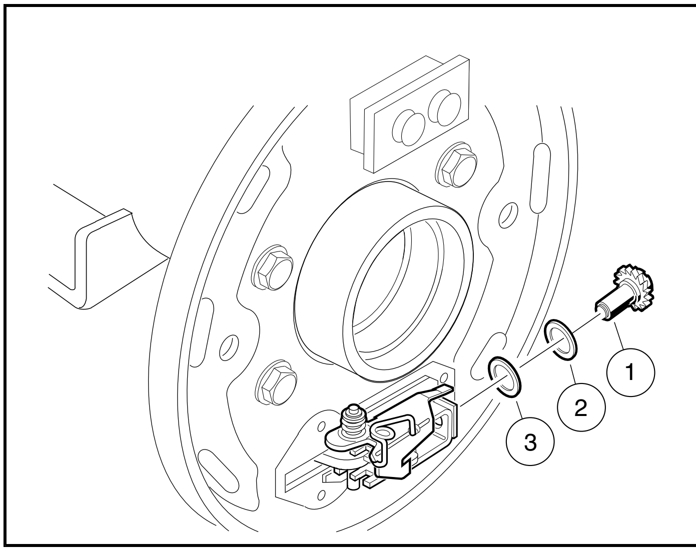


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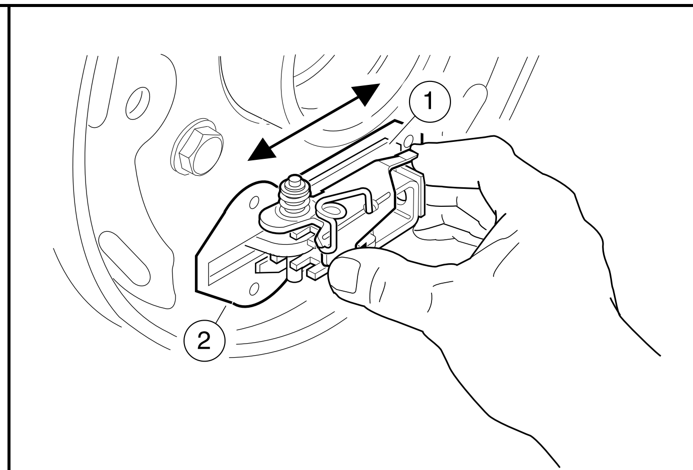
Figure 6-7 Remove Adjuster Wheel



1. Slide
2. Slide Plate (If Equipped)

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Figure 6-8 Lubricate Slide

BRAKE ASSEMBLY CLEANING

See General Warnings on page 1-1. See also Asbestos Dust Warning on page 6-1.

NOTE: *Later model vehicles are no longer equipped with the slide plate.*

1. Carefully clean the brake backing plate and all of its mechanical components.
2. Remove the rubber boot from backing plate and wipe with a clean damp cloth.
3. For vehicles equipped **with** a slide plate (2) **(Figure 6-8, Page 6-4)**, lubricate the slide plate with dry moly lubricant (P/N 1012151). For vehicles equipped **without** a slide plate (2), lubricate the backing plate, where the slide operates, with dry moly lubricant (P/N 1012151).
4. Lubricate the slide (1) with dry moly lubricant (P/N 1012151). After lubricating, work slide back and forth against backing plate to ensure that it slides smoothly and easily. Install rubber boot onto backing plate.

⚠ WARNING

- **Apply grease carefully when performing the following steps. Do not allow any grease to get onto the friction surfaces of the brake shoe pads or the brake drum. Failure to heed this warning could cause diminished brake performance, possibly resulting in property damage or severe personal injury.**

5. Use a small brush to carefully apply a light coat of white lithium NLGI #2 grease (Dow Corning® BR2-Plus or equivalent) on each of the six raised bosses on the brake backing plate **(Figure 6-9, Page 6-5)**. **See preceding WARNING.**
6. Use a small brush to carefully apply a light coat of white lithium NLGI #2 grease (Dow Corning BR2-Plus or equivalent) to each end of both brake shoes and into the slots in the brake shoe mounting block as shown **(Figure 6-10, Page 6-5)**. **See preceding WARNING.**

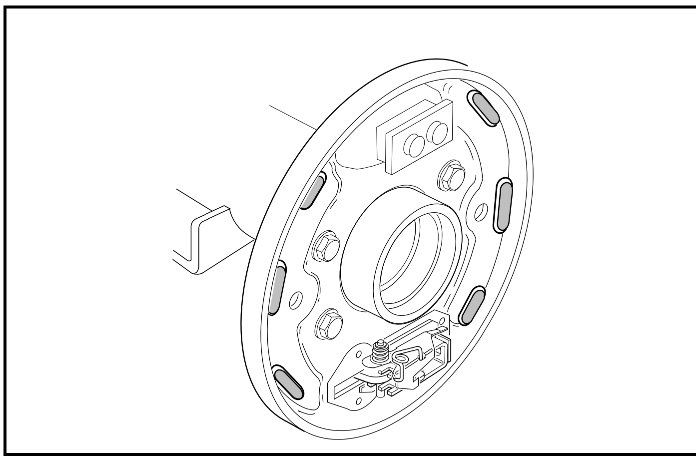

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Figure 6-9 Apply Grease On Bosses

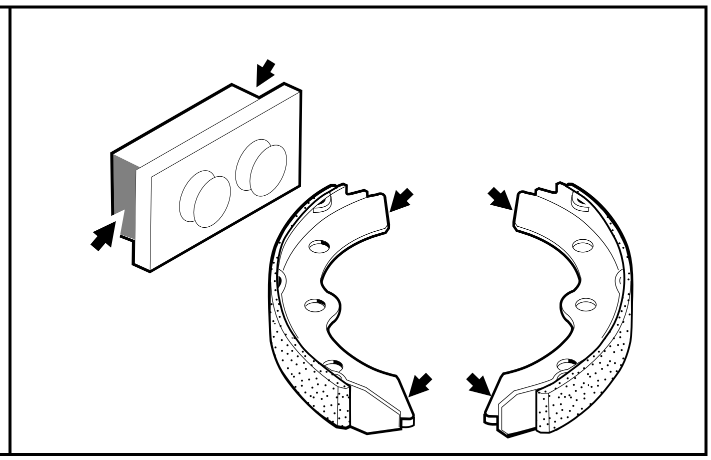

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Figure 6-10 Apply Grease To Brake Shoes and Slots

7. Use a small brush to carefully apply a light coat of white lithium NLGI #2 grease (Dow Corning BR2-Plus or equivalent) to the brake adjuster assembly, adjuster wheel shoe slots, and the shaft of the adjuster wheel as shown **(Figure 6-11, Page 6-6)**. **See preceding WARNING.**
8. Install the adjuster wheel (1) and two washers (2 and 3) into the adjuster assembly **(Figure 6-7, Page 6-4)**.

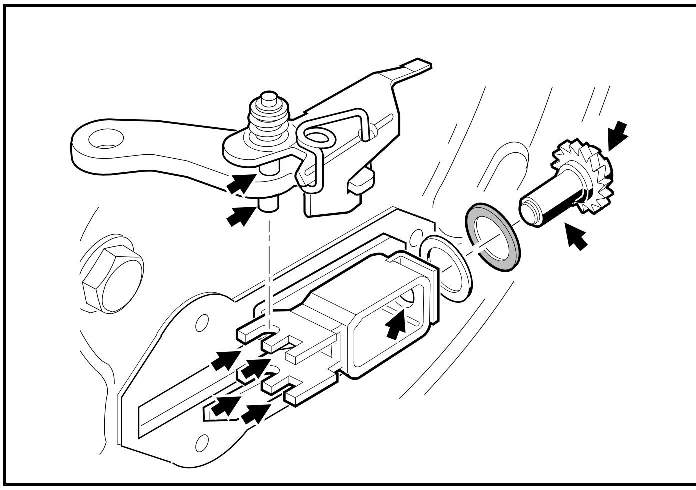

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Figure 6-11 Apply Grease To Brake Adjuster

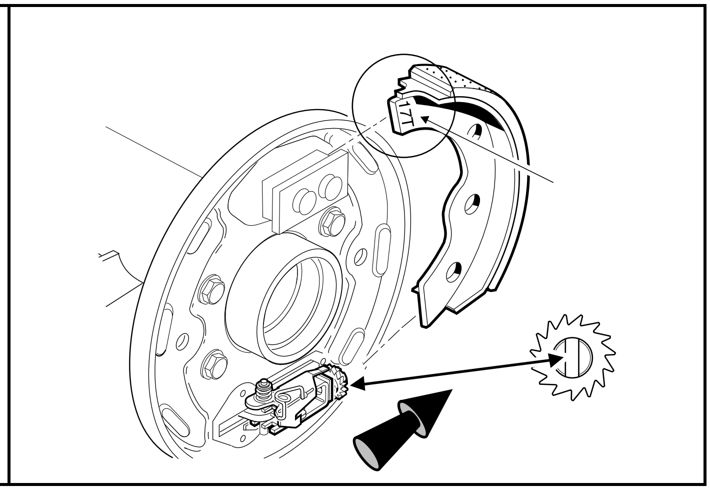

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Figure 6-12 Install Adjuster Wheel, Trailing Shoe

BRAKE SHOE INSTALLATION

See General Warnings on page 1-1. See also Asbestos Dust Warning on page 6-1.

1. Turn the adjusting wheel screw so that the shoe slot is vertical, then position the trailing shoe in the slots in the shoe mounting block and adjuster assembly **(Figure 6-12, Page 6-6)**. **See following NOTE.**

NOTE: *The trailing shoe has 17T stamped into the tip of the shoe flange **(Figure 6-12, Page 6-6)**. The leading shoe is stamped 17L. When installing the shoes, the stamping on both shoes should be oriented to the top of the brake assembly. When installing the shoes on the passenger side of the vehicle, the side of the trailing shoe flange marked 17T should be facing out and be visible. On the driver side, the 17L on the leading shoe should be facing out and be visible.*

*When installed on the backing plate, the **leading** shoe (stamped 17L) is **always** oriented toward the **rear** of the vehicle.*

2. Install the shoe retainer clip, using pliers to compress the clip (1) while turning the retainer pin (2) into position **(Figure 6-13, Page 6-7)**.
3. Attach the springs onto the trailing shoe already installed. Then hold the leading shoe next to the trailing shoe, correctly oriented, and attach the springs to it **(Figure 6-14, Page 6-7)**.

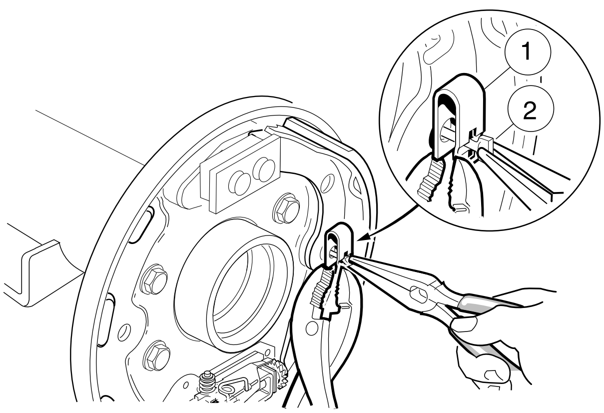

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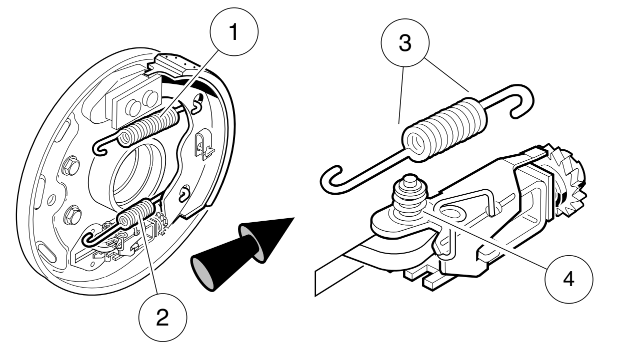
Figure 6-13 Install Trailing Shoe Retainer Clip



1. Bronze Spring 2. Silver Spring 3. Coils of Silver Spring 4. Adjustment Lever Spring
NOTE: The silver spring (2) is mounted with the coils (3) to the side of the adjustment lever spring (4).

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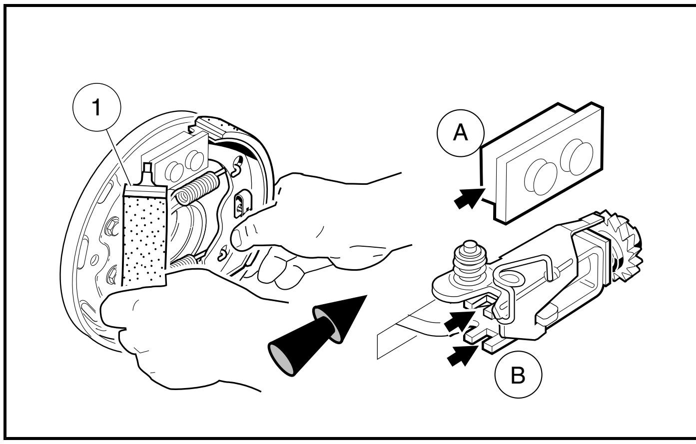
Figure 6-14 Attach Springs

4. While maintaining spring attachment on both shoes, position tips of leading shoe (1) in the mounting slots and then push shoe into place. Hold shoe in position and install retaining clip **(Figure 6-15, Page 6-8)**.
5. After the shoes are installed, move them together up and down and side to side to make sure that they will easily slide approximately 1/4 to 3/8 inch (6.3 to 9.5 mm) without binding **(Figure 6-16, Page 6-8)**.



646
Figure 6-15 Install Leading Shoe

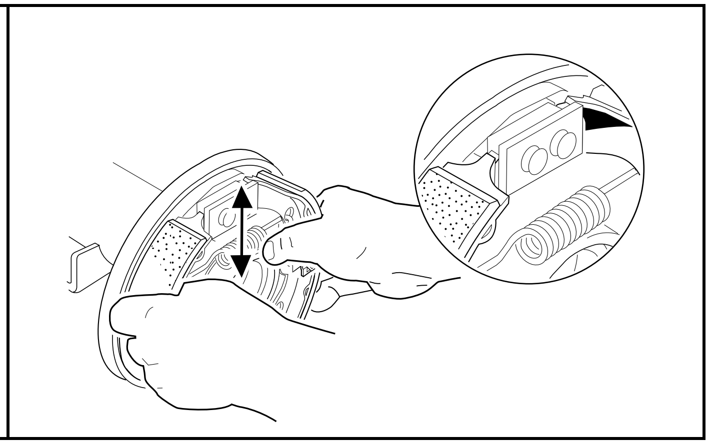


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Figure 6-16 Check Shoe Positions

6. Place a flatblade screwdriver under the adjusting arm (1) and raise the arm off of the adjusting wheel (2). While holding the arm (1) up, turn the wheel (2) upward until it stops **(Figure 6-17, Page 6-8)**. Remove the screwdriver.

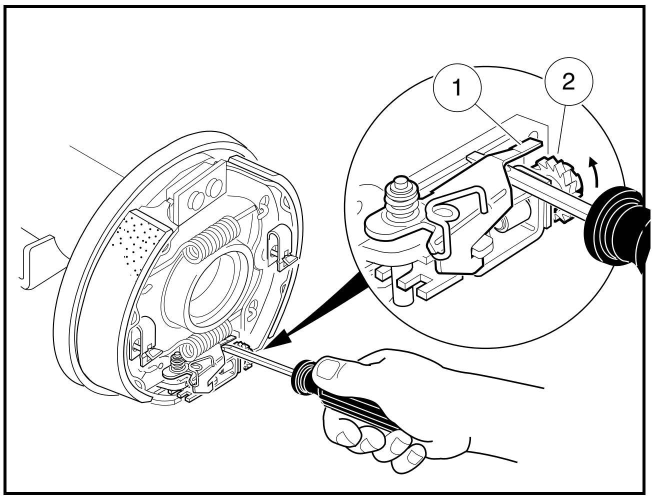

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Figure 6-17 Set Adjusting Wheel

7. Install the rear axle onto the transaxle. **See following NOTE.**

NOTE: *There is a LEFT and RIGHT side axle. The splined portions on the axles that insert into the transaxle case are two different lengths. The longest length spline is the LEFT, or driver side axle.*

7.1. Insert the splined end of the axle shaft into the axle tube. Be careful not to damage the seal on the inside of the axle tube hub. Advance the shaft through to the bearing on the shaft, and rotate it to align the shaft splines with the splined bore of the differential gear. Continue advancing the shaft until the bearing on the axle is firmly seated within the axle tube hub seat.

7.2. Using 90° internal snap ring pliers (0.090 tip) (P/N 1012560), attach the internal retaining ring into the axle tube hub so that it seats against the axle bearing assembly and into the machined slot in the inside wall of the axle tube hub **(Figure 6-3, Page 6-2)**.

7.3. Place a 1/4 to 3/8 - inch (6 - 10 mm) diameter rod against the retaining ring and tap lightly at four or five locations to ensure it is properly seated. **See following WARNING and CAUTION.**

⚠ WARNING

- **Be sure retaining ring is properly seated in groove. If ring is not properly installed, the axle assembly will separate from the transaxle and damage the axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.**

⚠ CAUTION

- **Before installing axle shaft, clean any residual oil from the exposed end of the axle tube and from the oil seal area.**

8. Install the brake drum, and make sure that it is properly seated. **See following NOTE.**

NOTE: *If drum installation is difficult, the brake shoes may need to be adjusted vertically in the mounting slots.*

9. After the drum is installed, make sure the axle and drum turn freely and then install the wheel. **See Wheel Installation on page 8-1.**
10. Remove the turnbuckle (2) and apply Loctite 242 to the threaded ends of both the rod from the pedal group (6) and the brake actuator rod (5) **(Figure 6-20, Page 6-14)**. Connect the rods using the turnbuckle. Ensure the ends of the brake cables do not slip out of the brake equalizer during this procedure.
11. Adjust brake cable equalizer. **See Brake Cable Equalizer Adjustment on page 6-10.**

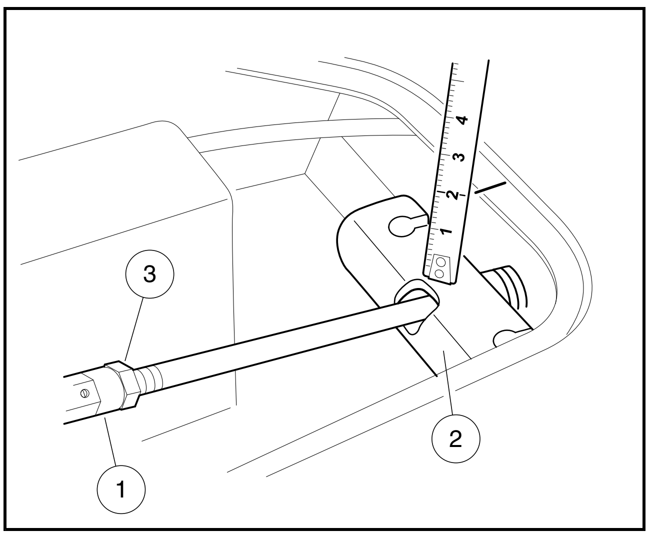

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Figure 6-18 Equalizer Adjustment

BRAKE CABLE EQUALIZER ADJUSTMENT

See General Warnings on page 1-1. See also Asbestos Dust Warning on page 6-1.

1. After maintenance on the brake system is complete, lower the vehicle onto the floor. With the brake pedal in the full up or at rest position, adjust the turnbuckle (1) until the proper brake tension is achieved **(Figure 6-18, Page 6-9)**. The turnbuckle is properly adjusted when the distance from the top of the equalizer (2) to the upper flange surface is 2 inches ± 1/16 inch (51 mm ± 1.6 mm).
2. Ensure that both threaded rods are visible in the witness holes of the turnbuckle (1) before the jam nuts (3) are tightened.
3. Snug the front and rear jam nuts to their respective surfaces, then back the nuts off 1/4 - 3/8 inch (6.4 - 9.5 mm) and apply Loctite 242 on the threads for both front and rear jam nuts.
4. Tighten the rear jam nut first (labeled 1 of 2) to 156 in-lb (17.5 N·m) **(Figure 6-18, Page 6-9)**, then tighten the front jam nut to 156 in-lb (17.5 N·m). **See following WARNING.** For optimal performance, drive the vehicle and apply the brakes approximately 20 times to burnish the shoes, center the clusters, and adjust the brake mechanism.

⚠ WARNING

- **Reduced braking force could result if the jam nuts are not tightened in the proper sequence.**

5. Once steps 2 and 4 are complete, recheck the 2-inch specification listed in step 1. If the measurement has not changed, the adjustment is complete. If the measurement has changed, perform steps 1 through 4 again.
6. Replace access panel and floor mat.
   - 6.1. Place floor cover plate (7) over the floor opening and secure with fastener (10) **(Figure 5-2, Page 5-2)**.
   - 6.2. Install the floor mat (2) over the pedal group. Make sure tabs on floor mat sides are beneath the sill (3). Tighten screws (1) to 53 in-lb (6 N·m) **(Figure 5-1, Page 5-1)**.

BRAKE CLUSTER REMOVAL AND INSTALLATION

See General Warnings on page 1-1. See also Asbestos Dust Warning on page 6-1.

BRAKE CLUSTER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and loosen the lug nuts on the rear wheels. Lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the axle tubes to support the vehicle. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Gain access to the pedal group by removing the floor mat and access panel. **See Pedal Group Removal on page 5-1.**
4. Loosen the two jam nuts (1 and 3) on either side of turnbuckle (2) **(Figure 6-1, Page 6-2)**. Note that the forward jam nut (1) is a left-hand thread. Thread each nut approximately 1/2 inch (12.7 mm) away from the turnbuckle.
5. Loosen turnbuckle (2) to release tension on the equalizer bracket (4) that pulls on the heads of the brake cables.
6. Remove lug nuts and rear wheels and then the brake drums.

NOTE: *When servicing vehicles with self-adjusting brakes with badly worn brake shoes and when the drums cannot be removed by normal methods, perform Step 7 of* ***Brake Shoe Removal on page 6-1****, then continue with this procedure.*

Although step 7 below allows easier access to the brake shoes, it is not imperative to do so in order to remove the brake shoes.

7. Remove the axle.
   - 7.1. Using 90° snap ring pliers (P/N 1012560), remove the axle retaining ring (1) **(Figure 6-3, Page 6-2)**.
   - 7.2. Pull the axle shaft (2) from the axle tube **(Figure 6-3, Page 6-2)**.
8. Remove bow tie locking pin (13) and clevis pin (12) from brake cable **(Figure 6-4, Page 6-3)**.
9. Remove four bolts (11) and lock nuts (10) that mount the brake assembly to the transaxle **(Figure 6-4, Page 6-3)**.
10. Remove brake assembly from transaxle.

BRAKE CLUSTER INSTALLATION

1. Install in reverse order of disassembly. Use new bow tie locking pins when installing brake cables.

⚠ CAUTION

- **Before installing axle shaft, clean any residual oil from the exposed end of the axle tube and from the oil seal area.**

2. Be sure bolts (11) (P/N 1014153) and new lock nuts (10) (P/N 1013924) are used to mount the brake assembly **(Figure 6-4, Page 6-3)**.
3. Tighten nuts to 17 ft-lb (23.0 N·m). If torquing the bolt heads, torque to 30 ft-lb (40.6 N·m).
4. Install the rear axle onto the transaxle. **See following NOTE.**

NOTE: *There is a LEFT and RIGHT side axle. The splined portions on the axles that insert into the transaxle case are two different lengths. The longest length spline is the LEFT, or driver side axle.*

4.1. Insert the splined end of the axle shaft into the axle tube. Be careful not to damage the seal on the inside of the axle tube hub. Advance the shaft through to the bearing on the shaft, and rotate it to align the shaft splines with the splined bore of the differential gear. Continue advancing the shaft until the bearing on the axle is firmly seated within the axle tube hub seat.

4.2. Using 90° internal snap ring pliers (0.090 tip) (P/N 1012560), attach the internal retaining ring into the axle tube hub so that it seats against the axle bearing assembly and into the machined slot in the inside wall of the axle tube hub.

4.3. Place a 1/4 to 3/8 - inch (6 - 10 mm) diameter rod against the retaining ring and tap lightly at four or five locations to ensure it is properly seated. **See following WARNING.**

⚠ WARNING

- **Be sure retaining ring is properly seated in groove. If ring is not properly installed, the axle assembly will separate from the transaxle and damage the axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.**

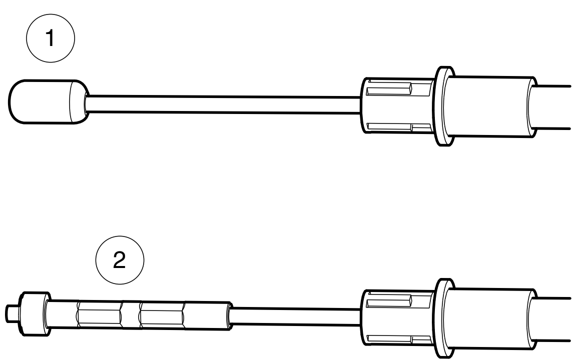
5. Tighten lug nuts on rear wheels, using a crisscross pattern, to 55 ft-lb (74.6 N·m). **See Wheel Installation on page 8-1.**
6. Adjust the brakes. **See Brake Cable Equalizer Adjustment on page 6-10.**

BRAKE CABLE REMOVAL AND INSTALLATION

See General Warnings on page 1-1. See also Asbestos Dust Warning on page 6-1.

NOTE: *Beginning with Precedent vehicle serial number PD0918-020874, a new brake cable design* ***(Figure 6-19, Page 6-13)*** *and equalizer bracket design are used. The previous brake cable design for Precedent vehicles is no longer available through Service Parts. If a brake cable replacement becomes necessary for a Precedent built prior to the serial number listed above, then both brake cables and equalizer bracket must be replaced. Brake cable designs and/or equalizer bracket designs must not be mixed. Individual component parts from this kit will be available from Service Parts should replacement of either cable or the equalizer bracket become necessary on vehicles manufactured after the vehicle incorporation serial number listed above, or on earlier vehicles that have already been retrofitted with this kit.*

Installation of the new brake cables and brake equalizer will not replace nor eliminate the need for scheduled preventive maintenance. Brake systems require preventive maintenance and should not be neglected. Brake cleaning, lubrication and adjustments remain the same and should be performed as shown to optimize brake performance and service life. ***See Periodic Service Schedule, Section 10, Page 10-3.***



1. Previous Design
2. New Design

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Figure 6-19 Brake Cable Redesign

BRAKE CABLE REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels.
3. Gain access to the pedal group by removing the floor mat and access panel. **See Pedal Group Removal on page 5-1.**
4. Loosen the two jam nuts (1 and 3) on either side of turnbuckle (2) **(Figure 6-20, Page 6-14)**. Note that the forward jam nut (1) is a left-hand thread. Thread each nut approximately 1/2 inch (12.7 mm) away from the turnbuckle.
5. Loosen turnbuckle (2) until the bolt (5) is free of the turnbuckle.

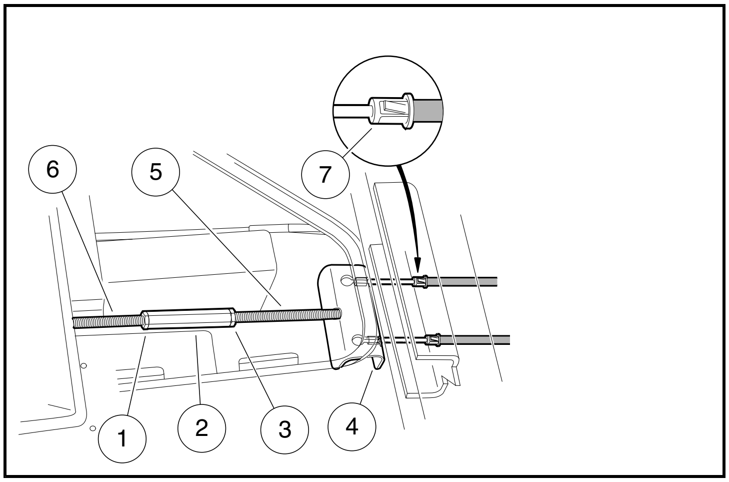

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Figure 6-20 Loosen Brake Cables

6. Rotate the bolt (5) and equalizer bracket (4) to the upright position then slip the cable heads out of the bracket.
7. Remove nut (1) from the bolt (2) that secures front of the leaf spring **(Figure 6-22, Page 6-14)**. Do not remove bolt (2).
8. Remove the mounting tab (3) of the brake cable from the bolt.
9. Using brake cable release tool (P/N 102555501), compress the retaining clips (7) on the end of the cable housing enough to slide the cable end out of the hole in the frame **(Figure 6-20, Page 6-14)**.
10. Remove bow tie locking pin (1) and the clevis pin (2) from the brake lever on each wheel and pull the clevis (3) away from the lever. **(Figure 6-21, Page 6-14)**.
11. Using brake cable release tool (P/N 102555501), compress the retaining clips on the end of the cable housing enough to slip the cable end out of the bracket (4) and remove the brake cable from the vehicle.

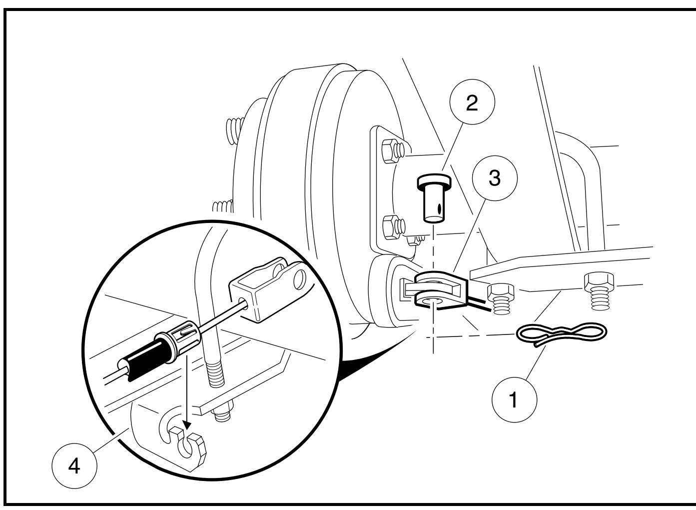

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Figure 6-21 Disconnect Cables at Rear Brakes

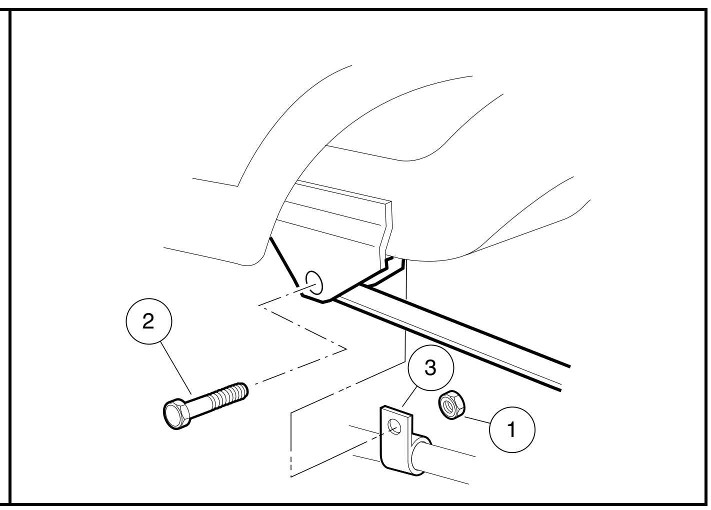

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Figure 6-22 Brake Cable Mounting Tab

BRAKE CABLE INSTALLATION

⚠ WARNING

- **2009 model year Precedent vehicles had a running change in brake cable design (Figure 6-19, Page 6-13). Never mix components of the different designs. See NOTE at beginning of this section.**

NOTE: *The driver-side and passenger-side brake cables are not interchangeable. The driver-side cable is shorter than the passenger-side cable. Make sure the correct cable is used on the correct side.*

Be sure to orient the cable so that the clevis end goes to the wheel rather than to the equalizer bracket.

1. Insert the end of the new brake cable through the hole in the frame **(Figure 6-20, Page 6-14)**. Push on the cable housing so the clips on the housing ends secure the housing in the hole.
2. Hold the bolt (5) and the equalizer bracket (4) in the upright position and slip the cable head through the hole on top of the bracket. Pivot the equalizer to the horizontal position to capture the cable heads in the equalizer.
3. Insert the rear cable housing into the shock mount bracket (4) **(Figure 6-21, Page 6-14)**. Push the cable housing end into the bracket to ensure the clips on the housing end secure the cable in position.
4. At the rear wheel brake, connect the cable to the brake actuator arm using new clevis pin (2) and new bow tie locking pin (1) **(Figure 6-21, Page 6-14)**.
5. Place tab (3) on cable housing over the forward leaf spring mounting bolt (2) **(Figure 6-22, Page 6-14)**. Install nut (1). Tighten nut to 18.4 ft-lb (25 N·m).
6. Adjust the brakes. **See Brake Cable Equalizer Adjustment on page 6-10.**

SECTION 7 – STEERING AND FRONT SUSPENSION

7

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

GENERAL INFORMATION

Steering is controlled through a rack and pinion steering assembly that is connected by a steering column to a steering wheel. No manual adjustment to the rack and pinion gear assembly is required. A spring loaded self-adjusting mechanism is incorporated into the assembly.

STEERING WHEEL

See General Warnings on page 1-1.

STEERING WHEEL REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. If scorecard holder is secured to steering wheel with screws, remove the two mounting screws (8) **(Figure 7-3, Page 7-3)**.
3. Remove the scorecard holder plate (1).
4. Match mark the steering wheel (7) and steering column shaft (9) so when the steering wheel is removed it can be placed back in exactly the same position on steering column shaft.
5. Loosen the steering wheel bolt (6) and back it off approximately 1/4 inch (6 mm). Do not remove the bolt.
6. If it is difficult to remove the steering wheel, use the steering wheel puller (P/N 102061201) to remove steering wheel.
   6.1. Place the puller anvil (4) through the top opening of the steering wheel **(Figure 7-1, Page 7-2)**.
   6.2. Insert the anvil feet through the two slots in the base plate (marked "B") (5) as shown **(Figure 7-1, Page 7-2)**.
   6.3. Rotate the anvil screw (6) clockwise until the base plate contacts the bottom of the steering wheel where it attaches to the steering column **(Figure 7-2, Page 7-2)**.
   6.4. Using a 1/2 inch drive air impact wrench, tighten the anvil screw (6) until the steering wheel breaks free from the steering shaft.
   6.5. Remove the steering wheel puller.
   6.6. Remove the steering wheel bolt (6) and the steering wheel (7) from the steering column (9) **(Figure 7-3, Page 7-3)**.

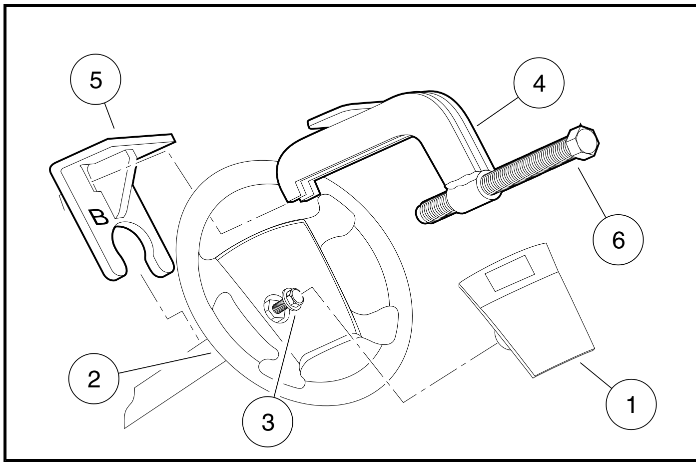

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Figure 7-1 Steering Wheel Removal

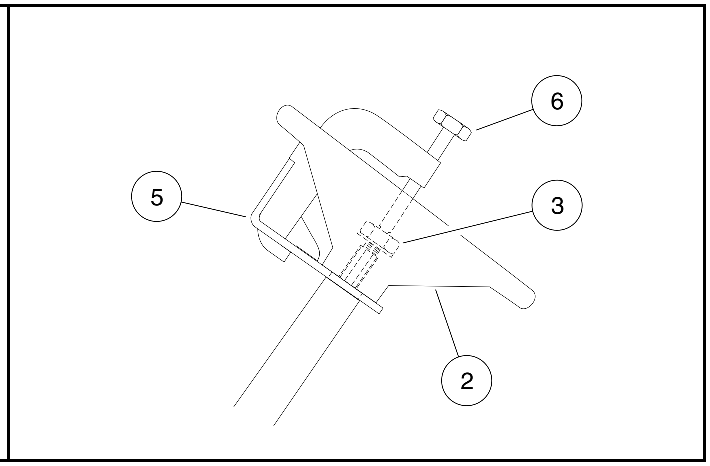

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Figure 7-2 Steering Wheel Puller

STEERING WHEEL INSTALLATION

NOTE: *To minimize corrosion and to make future removal of the steering wheel easier, apply a small amount of oil or anti-seize compound to steering shaft before installing the steering wheel.*

1. Install the steering wheel (7) on the steering column shaft (9). Be sure to align the match marks placed on the wheel and steering column in step 4 above **(Figure 7-3, Page 7-3)**.
2. Install the steering wheel bolt (6) and tighten to 40.6 ft-lb (55 N·m).
3. Install the scorecard plate (1).
4. If required, install the plate mounting screws (8). Tighten screws to 16 in-lb (1.8 N·m).

STEERING COLUMN

See General Warnings on page 1-1.

STEERING COLUMN REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the steering wheel as previously instructed.
3. Remove the dash insert, instrument panel, dash assembly, and front bumper. See Section 4 – Body and Trim.
4. Remove the bolt (11) that secures the steering column universal joint to the pinion shaft of the steering gear **(Figure 7-3, Page 7-3)**.
5. Remove the four bolts (10) that secure the steering column to the frame.
6. Remove the steering column from the vehicle.

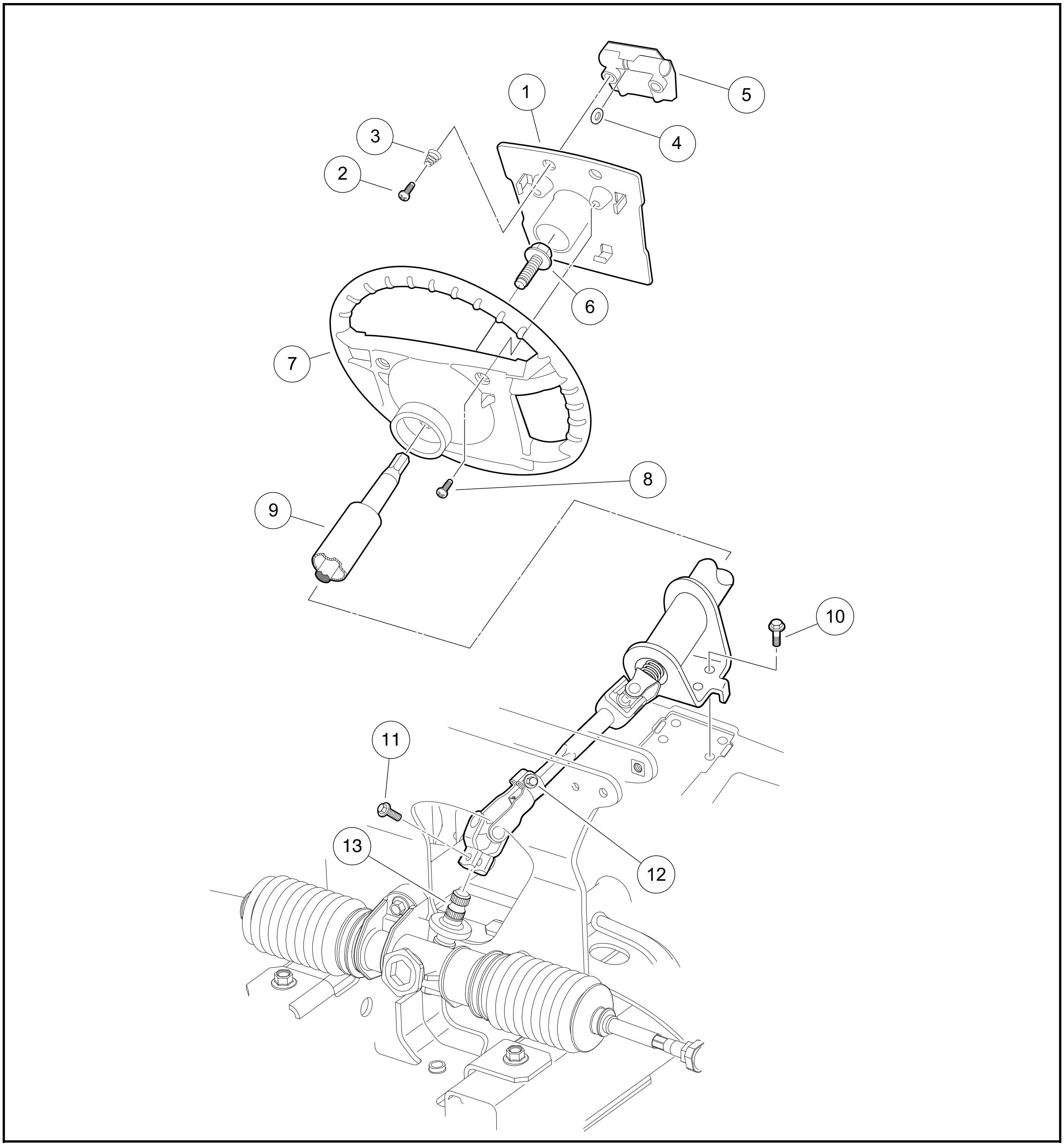

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Figure 7-3 Steering Column

STEERING COLUMN INSTALLATION

1. For ease of assembly and to prevent corrosion, apply a light coat of anti-seize or lubricating compound to the splined stud extending from the steering gear.

2. Insert the end of the steering column with the universal joint through the front underbody. Install universal joint onto pinion shaft of steering gear. Loosely install bolt (11). Do not tighten until steering column is mounted to frame in step 3 **(Figure 7-3, Page 7-3)**.
3. Align the holes in the steering column mounting bracket with holes in the vehicle frame. Secure column to frame with four bolts (10). Tighten bolts to 18.4 ft-lb (25 N·m).
4. Tighten universal joint bolt (11) to 18.4 ft-lb (25 N·m). Verify the upper universal joint bolt (12) torque is 18.4 ft-lb (25 N·m).
5. Install front bumper, dash assembly, dash insert, and instrument panel. See Section 4 – Body and Trim.

RACK AND PINION

See General Warnings on page 1-1.

CAUTION

- **Front impacts that bend tie rods and/or drag links can possibly damage internal steering gear components. See Rack and Pinion Inspection on page 7-4. The manufacturer recommends inspecting the rack and pinion and replacing if damaged.**

RACK AND PINION INSPECTION

Look for obvious damage to the chassis, where the rack and pinion is mounted, and the rack and pinion housing. Particularly check the housing for broken mounting points.

Compare the toe-in against the specification. **See Toe-in Adjustment on page 7-12.**

If obvious visible damage is found, such as a bent tie rod, check the steering gear for abnormal free-play, noise, binding or clunking while it is under a load. With the steering system fully assembled and all four tires on the ground/floor, turn the steering wheel from stop to stop. While turning, feel for any binding, clunking or tight/loose spots. Listen for unusual noises. Replace the rack and pinion as an assembly if any is found.

In the event of an known impact and obvious visible damage is not found in the method described above, disconnect the tie rods and/or drag links from the spindles. Turn the steering wheel from stop to stop. While turning, feel for any binding or tight/loose spots. Listen for unusual noises. Replace the rack and pinion as an assembly if any is found.

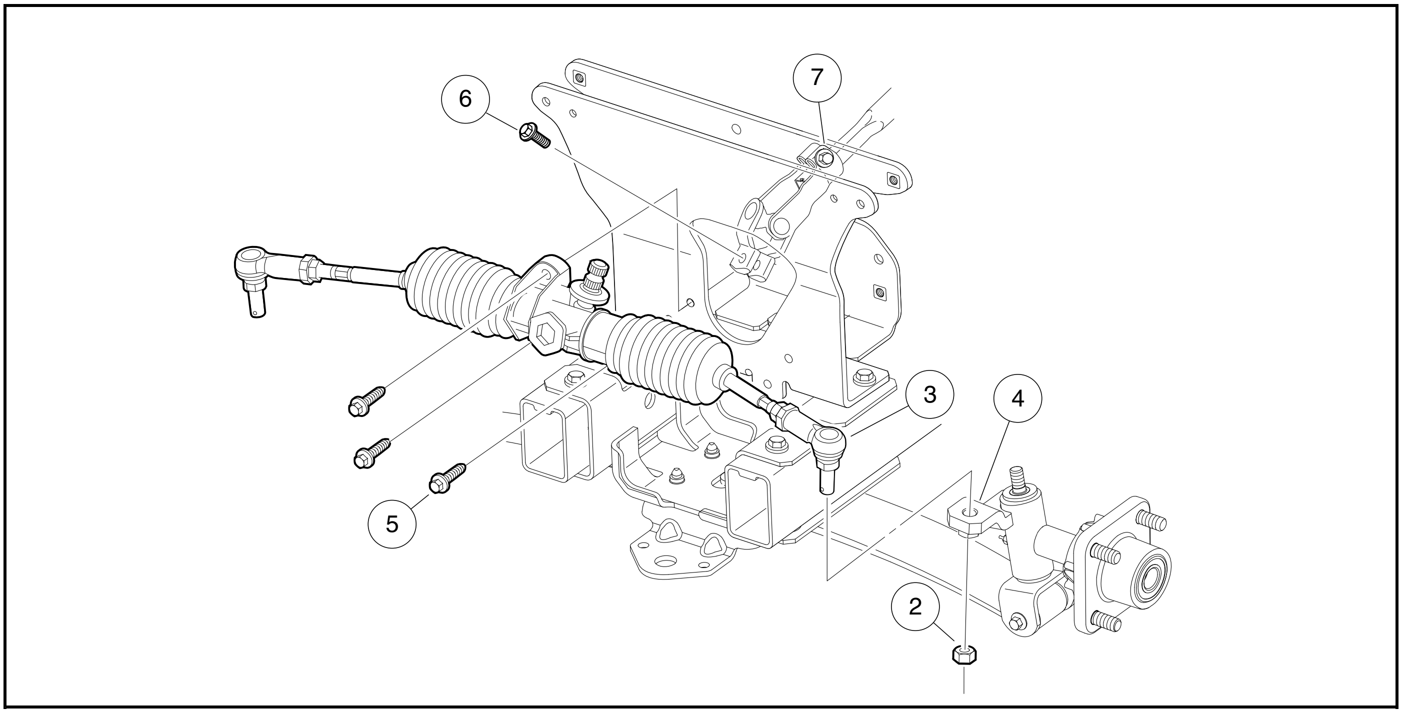

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Figure 7-4 Rack and Pinion Removal

RACK AND PINION REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the front bumper as instructed. See Section 4 – Body and Trim.
3. Remove the tie rod end retaining nuts (2) **(Figure 7-4, Page 7-5)**.
4. Remove the tie rod ends (3) from the spindle assemblies.
5. Remove the three bolts (5) from the steering rack and pinion assembly mounting bracket.
6. Remove the upper bolt (7) from the universal joint, then remove the rack and pinion assembly and universal joint from the vehicle.

RACK AND PINION DISASSEMBLY

NOTE: *Only the rack and pinion manufactured by Mando can be disassembled for repair. A rack and pinion manufactured by Sona is not serviceable and must be replaced as an assembly. They can be identified by the following characteristics:*

- **Bellows:** Mando has their name on bellows; Sona does not
- **Tie Rod Drag Link Color:** Mando is yellow dichromate; Sona is grey dichromate

1. Remove the two tie rod ends (12) and inspect for excessive wear **(Figure 7-5, Page 7-7)**.
2. Remove clamps (10 and 21) from bellows (9) **(Figure 7-5, Page 7-7)**.

NOTE: *If the dust seal bellows are secured with a metal clamp, remove the clamp. Do not reuse the clamp when the rack and pinion is reassembled. Use a plastic wire tie to secure the dust seal bellows.*

3. Remove the two hex nuts (11) and slide off both of the dust seal bellows (9) from ball joints (8).

4. Remove rack screw nut (14), rack guide screw (13), rack guide pressure spring (15) and the rack guide (16).
5. Remove bolt (6) and slide universal joint off the pinion shaft **(Figure 7-4, Page 7-5)**.
6. Remove the dust seal **(Figure 7-6, Page 7-8)**.
7. Remove the large snap ring (4) **(Figure 7-7, Page 7-8)**.
8. Remove pinion (5) from the housing (17) **(Figure 7-8, Page 7-8)**. If removal is difficult, install the universal joint onto the pinion and place a fork or a large open-end wrench under the universal joint **(Figure 7-8, Page 7-8)**. Gently pry the pinion from the housing and then remove the universal joint.
9. If the ball bearing (4) **(Figure 7-5, Page 7-7)** has been damaged, remove the C-type stop ring (16) **(Figure 7-7, Page 7-8)** and press the bearing off **(Figure 7-9, Page 7-8)**.
10. Inspect the bushing (7) and needle bearing (6) for excessive wear. If wear is excessive, replace the entire assembly **(Figure 7-5, Page 7-7)**.
11. Inspect the ball joints (8) for wear. If one or both of the ball joints (8) are excessively worn, remove and replace the ball joint from the rack (18).
12. Remove the rack (18) from housing (17).

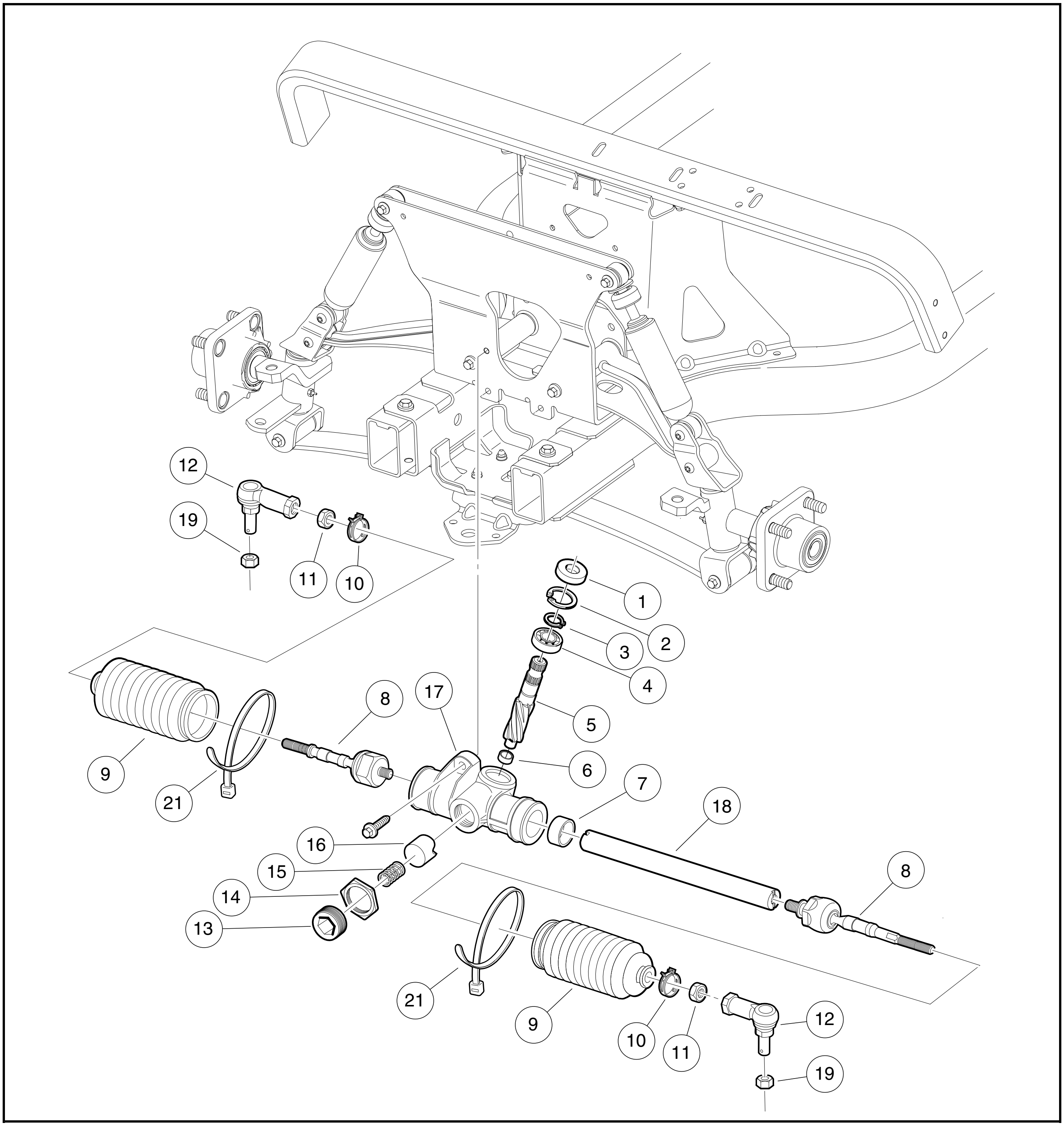

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Figure 7-5 Steering Gear

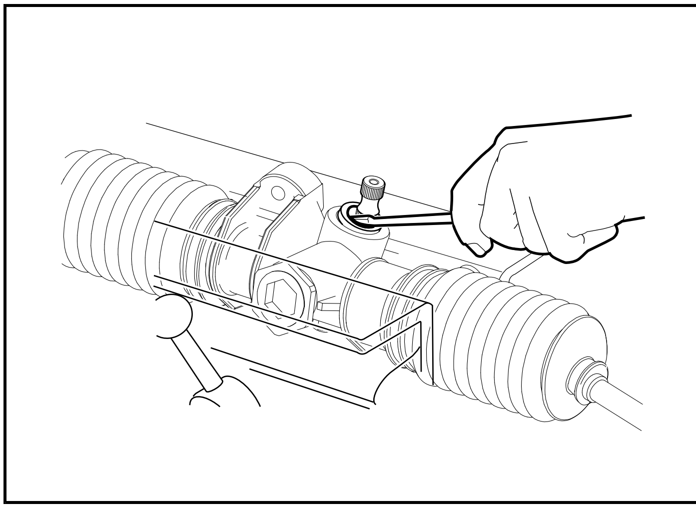

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Figure 7-6 Remove Dust Seal

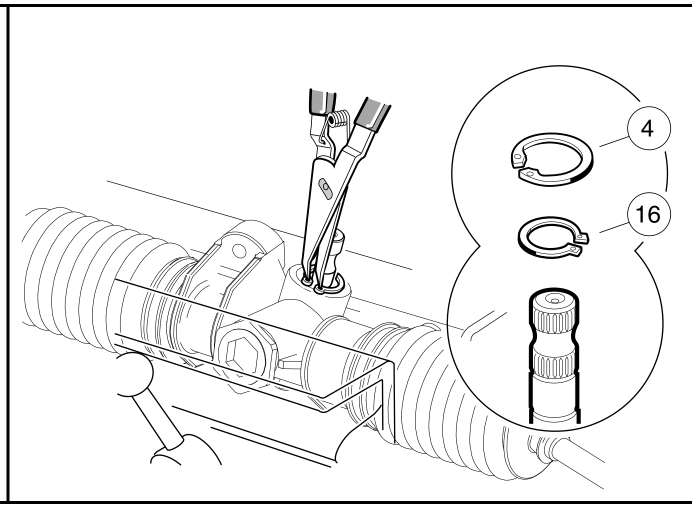

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Figure 7-7 Pinion Snap Rings

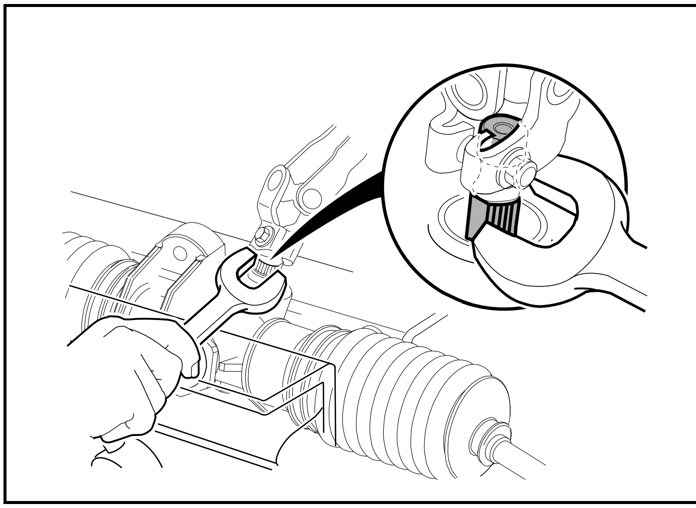

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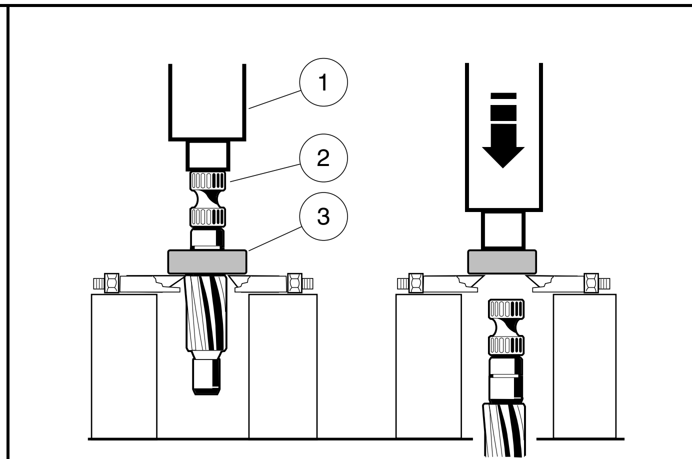
Figure 7-8 Remove Pinion from Housing



1. Press Ram 2. Pinion Gear 3. Bearing

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Figure 7-9 Remove Bearing from Pinion

RACK AND PINION ASSEMBLY

1. Apply a liberal amount of EP grease to the teeth of the rack (18), then slide the rack through the bushing (7) and housing (17) **(Figure 7-5, Page 7-7)**.

CAUTION

- **In step 2, do not press against the outer race of the bearing.**

2. If the pinion bearing (4) was removed, grease a new bearing before installation. Press new bearing onto pinion shaft, exerting all pressure on the inner race. Then install the C-type stop ring (3). **See previous CAUTION.**
3. Install pinion (5) and bearing (4) assembly into the housing (17). Make sure the rack gear teeth will mesh with the gear teeth on the pinion. The rack may need to be rotated slightly while lightly tapping on the pinion-bearing assembly with a rubber mallet. **See following CAUTION.**

CAUTION

- **Do not force the pinion-bearing assembly into the housing. The gear teeth or the small bearing could be damaged.**

4. Install the large snap ring (2).
5. Use a socket (1) to apply pressure evenly and press in a new dust seal (2) **(Figure 7-10, Page 7-10)**.
6. Apply a small amount of grease to the rack guide (16) where it comes into contact with the rack (18) **(Figure 7-5, Page 7-7)**.
7. Install the ball joints (8) onto the rack (18) by securing the rack in a vise using wood blocks between the rack and the jaws of the vise to protect the rack from damage. Tighten the ball joints to 60 ft-lb (81 N·m).
8. Tap a flange into the notch on the rack **(Figure 7-11, Page 7-10)**.
9. Place a few drops of Loctite 222 to the threads of the rack screw nut (14) **(Figure 7-5, Page 7-7)**.
10. Install the rack guide (16), pressure spring (15) and rack guide screw (13). The screw should be threaded-in until it bottoms out and then backed out 1/4 turn **(Figure 7-5, Page 7-7)**.
11. To minimize corrosion, apply a light coat of anti-seize lubricating compound to the splines of the pinion shaft.
12. Install lower end of the universal joint (2) onto pinion shaft and secure with bolt (1) **(Figure 7-13, Page 7-10)**. Tighten bolt (1) to 15 ft-lb (20.3 N·m).
13. To adjust rotational resistance (preload), insert a 3/8-inch, 1/4-drive, deep-well socket into the steering column (upper) end of the universal joint (2) and tighten the bolt (1) to 15 ft-lb (20.3 N·m) **(Figure 7-13, Page 7-10)**.
14. Use a torque wrench connected to the 3/8-inch deep-well socket to measure the resistance of the rack and pinion. Rotational resistance should measure 7 to 15 in-lb (0.8 to 1.7 N·m).
15. If measured resistance is not 7 to 15 in-lb (.8 to 1.7 N·m), adjust the screw (13) until correct setting is achieved. Tighten the nut (14) to 28 ft-lb (38 N·m) **(Figure 7-12, Page 7-10)**.

NOTE: *When tightening the nut (14), make sure the screw (13) does not change adjustment* ***(Figure 7-12, Page 7-10)****.*

16. Remove the 3/8-inch, 1/4-drive, deep-well socket from the steering column end of the universal joint (2).
17. Install the two dust seal bellows (9) **(Figure 7-5, Page 7-7)**.
18. Install new bellows clamps (wire ties) (10 and 21).
19. Install the tie rod ends (12) to each end of rack (18). Tighten the tie rod end jam nuts (11) to 26 ft-lb (35 N·m) **(Figure 7-5, Page 7-7)**.

RACK AND PINION INSTALLATION

1. To minimize corrosion, apply a light coat of anti-seize lubricating compound to the end of the steering column shaft.
2. Simultaneously slide the universal joint over the square end of the steering column shaft and position the assembly over the mounting holes in the chassis.
3. Install three screws to secure the assembly to the chassis. Tighten screws to 22 ft-lb (30 N·m).
4. Install the upper universal joint bolt (7) and tighten to 18.4 ft-lb (25 N·m) **(Figure 7-4, Page 7-5)**.
5. Install the tie rod ends (3) into the left- and right-hand spindle tabs (4), and then install the retaining nuts (2) **(Figure 7-4, Page 7-5)**. **See following WARNING.**

⚠ WARNING

- **Do not operate vehicle until toe-in is adjusted and ball joints are secured.**

6. Adjust the toe-in. **See Toe-in Adjustment on page 7-12.**

7. Test drive vehicle before returning it to service.

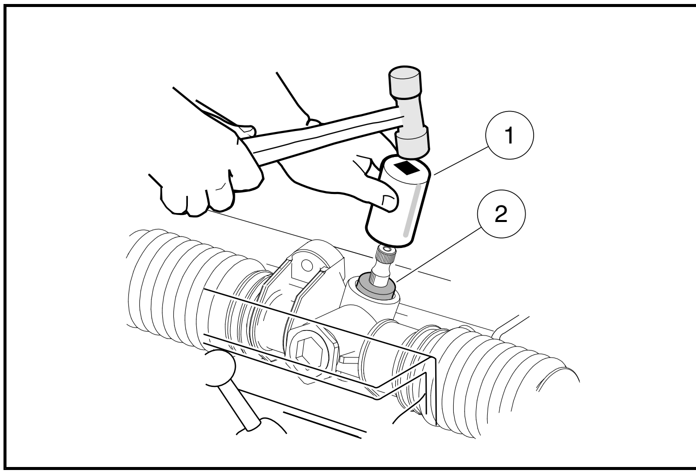

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Figure 7-10 Press In Dust Seal

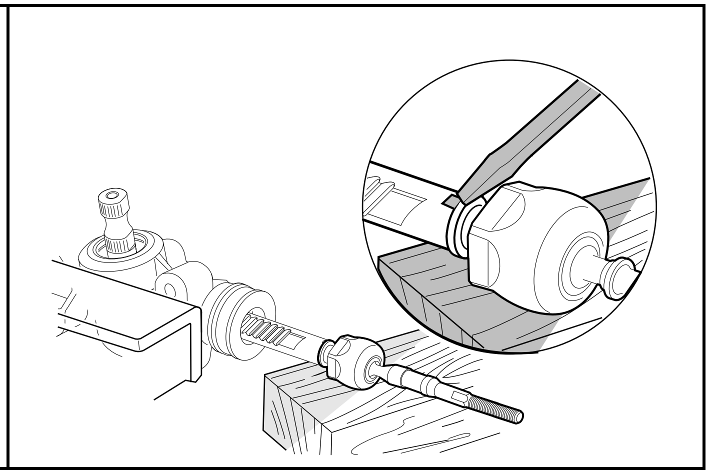

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Figure 7-11 Install Ball Joint

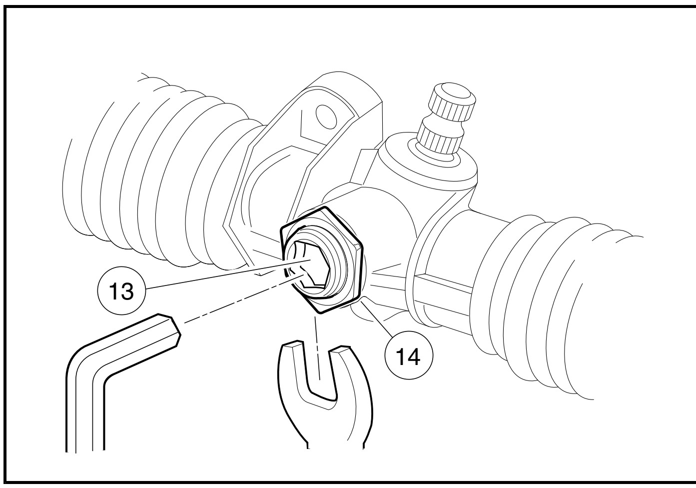

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Figure 7-12 Rack and Pinion Adjustment

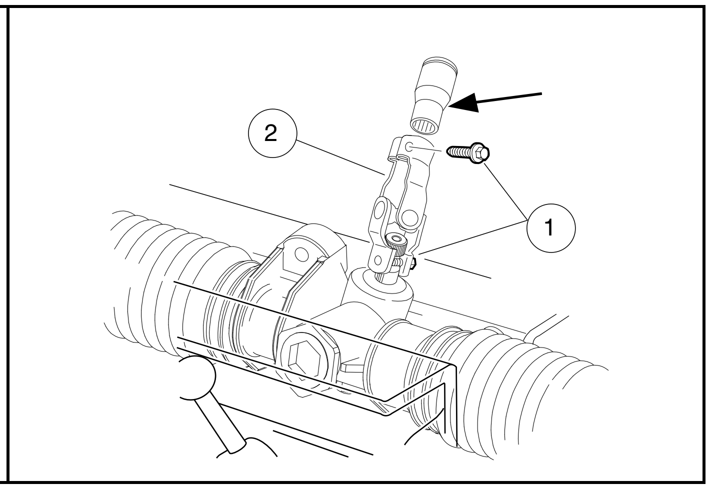

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Figure 7-13 Rack and Pinion Resistance

FRONT SUSPENSION

See General Warnings on page 1-1.

LUBRICATION

Two grease fittings are provided (one in each spindle housing). Lubricate these fittings at the recommended interval with the proper lubricant. **See Periodic Lubrication Schedule on page 10-6.**

CAUTION

- **To ensure proper lubrication, raise front of vehicle to lubricate. See General Warnings on page 1-1.**

WHEEL ALIGNMENT

Wheel alignment is limited to equalizing the camber angle of each front wheel and adjusting toe-in of the front wheels.

NOTE: *Prior to making any front suspension adjustments, inspect components for wear or damage and repair or replace as necessary.*

Camber Adjustment

1. Check each front wheel with a framing square. At the floor (or ground), there should be an equal amount of space between each tire and the framing square **(Figure 7-14, Page 7-12)**.
2. Loosen, but do not remove, the four bolts (17) that secure the leaf spring (13) to the bottom spring plate (16) **(Figure 7-20, Page 7-17)**. **See also Figure 7-15, Page 7-12.**
3. Loosen, but do not remove, the hex nut (8) on the adjustment eccentric (7) **(Figure 7-15, Page 7-12)** in the center of the spring. **See also Figure 7-20, Page 7-17.**
4. Use a 7 mm deep well socket to rotate the eccentric **(Figure 7-15, Page 7-12)**.
5. After adjusting camber, use a crisscross pattern to tighten the four spring retaining bolts (17) **(Figure 7-20, Page 7-17)** to 37 ft-lb (50 N·m). Then roll the vehicle forward one full tire revolution and recheck the camber. **See also Figure 7-14, Page 7-12.**
6. Tighten the hex nut (8) on the adjustment eccentric (7) to 10 ft-lb (13.5 N·m) **(Figure 7-15, Page 7-12)**. **See also Figure 7-20, Page 7-17.**

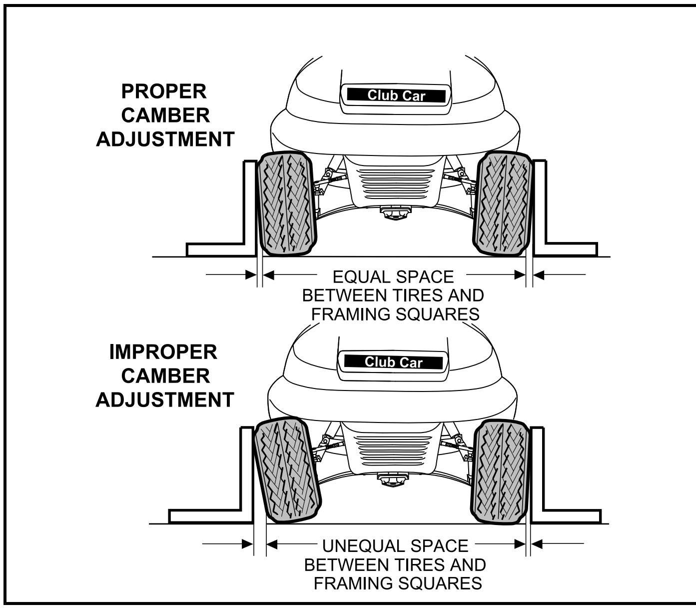

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Figure 7-14 Check Camber

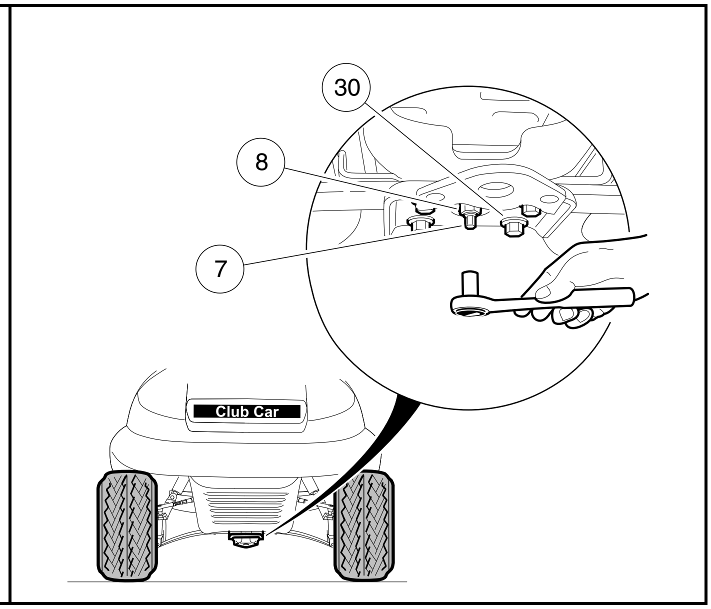

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Figure 7-15 Adjust Camber

Toe-in Adjustment

1. On a level surface, roll the vehicle forward, then stop. Make sure the front wheels are pointed straight ahead. Do not turn the steering wheel again during this procedure.
2. On each front tire, mark (as closely as possible) the center of the tread face that is oriented toward the rear of the vehicle. The marks should be even with the bottom surfaces of the vehicle frame.
3. Measure the distance between the marks on the rear-facing surfaces of the tires, and then roll the vehicle forward one and a half wheel revolutions until the marks appear on the forward facing surfaces of the tires at about the same height from the floor **(Figure 7-16, Page 7-12)**.

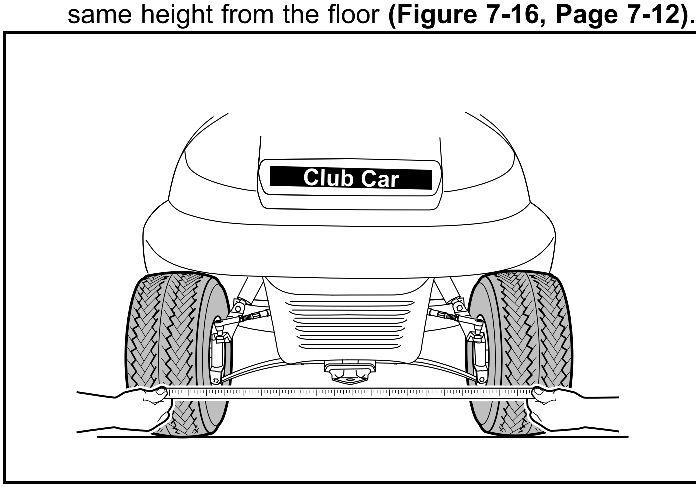

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Figure 7-16 Check Toe-In

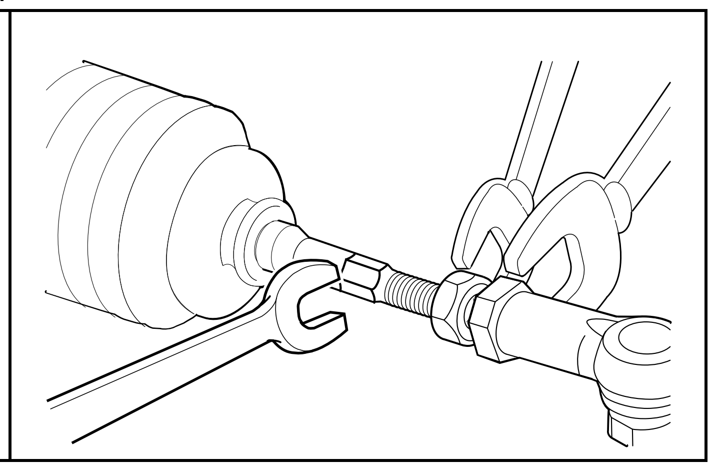

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Figure 7-17 Adjust Toe-In

4. Measure the distance between the marks on the forward-facing surfaces of the tires **(Figure 7-16, Page 7-12)**.

NOTE: *The front measurement must be less than the rear measurement.*

5. Subtract the measurement on the front of the tires from the measurement on the rear of the tires. The difference is the toe-in. Proper toe-in is 3/8 inch ± 1/8 inch (9.5 mm ± 3.2 mm).
6. If adjustment is necessary, proceed as follows:
   6.1. Loosen the jam nuts on both ends of each drag link **(Figure 7-17, Page 7-12)**.

6.2. Rotate both of the drag links equally. To increase the toe-in, rotate both drag links counterclockwise. To decrease the toe-in, rotate both drag links clockwise. Maintain an equal distance from the ball joint to the end of the threads on each drag link **(Figure 7-18, Page 7-13)**.

6.3. Tighten jam nuts to 26 ft-lb (35 N·m).

6.4. Check the toe-in, and repeat the adjustment procedure if necessary.

6.5. After toe-in adjustment is made and with wheels in the straight ahead position, the steering wheel should be at the center of its travel. There should be equal travel to the left and right.

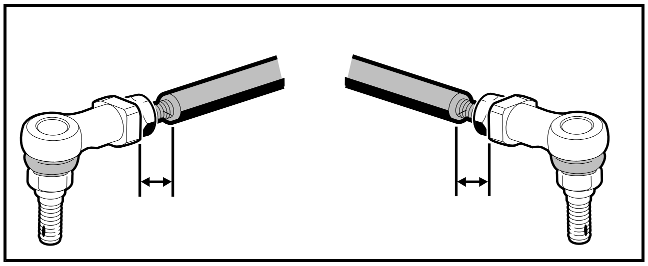

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Figure 7-18 Adjust Both Drag Links To An Equal Distance

FRONT SUSPENSION COMPONENTS

See General Warnings on page 1-1.

TIE ROD END REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Loosen jam nuts (13) to allow later rotation of the tie rod ends (12) **(Figure 7-19, Page 7-16)**.
3. Remove the and retaining nuts (14).
4. Lift male thread of tie rod from the hole in the spindle tab.
5. Remove the tie rod ends from the steering gear.
6. To minimize corrosion, apply a light coat of anti-seize lubricating compound to the threads where the tie rod ends are installed.

TIE ROD INSTALLATION

1. Thread tie rod ends (12) onto steering gear to a depth of 1/2 inch (12.5 mm) **(Figure 7-19, Page 7-16)**.

⚠ WARNING

- **The tie rod ends must be threaded into the rod at least 5/16 of an inch (8 mm). Failure to thread deep enough may cause tie rod ends to separate from the rod during adjustment or while being operated, possibly resulting in loss of vehicle control and severe personal injury.**

2. Install tie rod ends (12) into the spindle tabs. Install the retaining nuts (14) **(Figure 7-19, Page 7-16)**.
3. Adjust wheel toe-in. **See Toe-in Adjustment on page 7-12.**

LEAF SPRING REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Loosen lug nuts on both front wheels and raise front of vehicle with a chain hoist or floor jack. Place jack stands under the aluminum rails of the vehicle frame just aft of the front suspension. Lower the vehicle onto the jack stands. **See General Warnings on page 1-1.**
3. Remove both front wheels.
4. Remove the bolts (8) from the bottom of each kingpin (7) **(Figure 7-20, Page 7-17)**.
5. Remove the four bolts (17) and bottom spring plate (16).
6. Remove leaf spring (13).
7. Check the condition of the urethane bushings (15) and steel sleeves (14). Replace any that are worn or damaged.

LEAF SPRING INSTALLATION

1. Install urethane bushings (15) and steel sleeves (14) into leaf spring eyes **(Figure 7-20, Page 7-17)**.
2. Install leaf spring (13), bottom spring plate (16), and four bolts (17). Using a crisscross pattern sequence, tighten bolts to 37 ft-lb (50 N·m).
3. Install spring in kingpins (7) with bolts (8). Tighten to 30 ft-lb (41 N·m).
4. Install the wheels and finger tighten the lug nuts.
5. Lower the vehicle and finish tightening lug nuts (using a crisscross pattern) to 55 ft-lb (74.6 N·m).
6. Adjust camber and toe-in. **See Wheel Alignment on page 7-11.**

KINGPIN AND STEERING SPINDLE REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the front hub. **See Front Hub Removal on page 7-18.**
3. Remove retaining nuts (14), then remove tie rod ends (12) from the tabs on the spindles **(Figure 7-19, Page 7-16)**.
4. Remove the nut (1) from the top of the kingpin (7) **(Figure 7-20, Page 7-17)**.
5. Raise the upper clevis from the kingpin.
6. Slide the spindle (3) off the kingpin (7).
7. Remove the wave washer (6) and inspect it. If the washer is broken or has a wave bottom to wave crest height dimension of less than 0.040 inch (1 mm), it must be replaced.
8. Remove bolt (8) from bottom of kingpin (7) and remove kingpin.
9. Inspect the kingpin and spindle. If either is worn or damaged, it must be replaced.
10. Inspect the bushings (4). If the bushings are worn or damaged, remove them and press in new ones.

KINGPIN AND STEERING SPINDLE INSTALLATION

1. Inspect all parts and replace them as necessary.
2. Install the kingpin (7) over the leaf spring eye. Insert the bolt (8) **(Figure 7-20, Page 7-17)**. Tighten the bolt to 30 ft-lb (41 N·m).

3. Install the wave washer (6) on the kingpin.
4. Install the steering spindle on the kingpin. Place upper clevis over the kingpin threads and install nut (1). Tighten the nut to 70 ft-lb (95 N·m).
5. Attach the tie rod ends (12) to the spindle tabs, then install and tighten the nuts (14) to 70 ft-lb (95 N·m) **(Figure 7-19, Page 7-16)**.
6. Install front hub and wheel. **See Hub Installation on page 7-18.**

CONTROL ARM REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Loosen lug nuts on both front wheels and raise front of the vehicle with a chain hoist or floor jack. Place jack stands under the front aluminum rails of the vehicle frame and lower the vehicle onto the jack stands.
3. Remove wheel.
4. Remove bolts (17) and move rack and pinion to allow clearance for bolt (19) **(Figure 7-19, Page 7-16)**.
5. Remove bolts (11 and 19).
6. Remove the control arm (6).
7. Inspect the bushings (7) and sleeves (8 and 9) in the control arm and replace them if necessary.

CONTROL ARM INSTALLATION

1. Install the control arm in reverse order of removal. Tighten the control arm bolts (11 and 19) to 30 ft-lb (41 N·m) **(Figure 7-19, Page 7-16)**. Tighten three rack and pinion mounting bolts (17) to 22 ft-lb (30 N·m)
2. Install the wheels and adjust the wheel alignment as instructed on page 7-11.

SHOCK ABSORBER REMOVAL

1. Inspect the shock absorbers for fluid leakage at the point where the shaft enters the shock absorber body. Leaking shock absorbers should be replaced.
2. Remove the upper bolt (18) **(Figure 7-19, Page 7-16)**.
3. Remove the lower bolt (10).
4. Remove the shock absorber.

SHOCK ABSORBER INSTALLATION

NOTE: *When installing shock absorbers, make sure front shocks have identical part numbers.*

1. Install the shock absorber by reversing the removal procedure.
2. Tighten the bolts to 16 ft-lb (21 N·m).

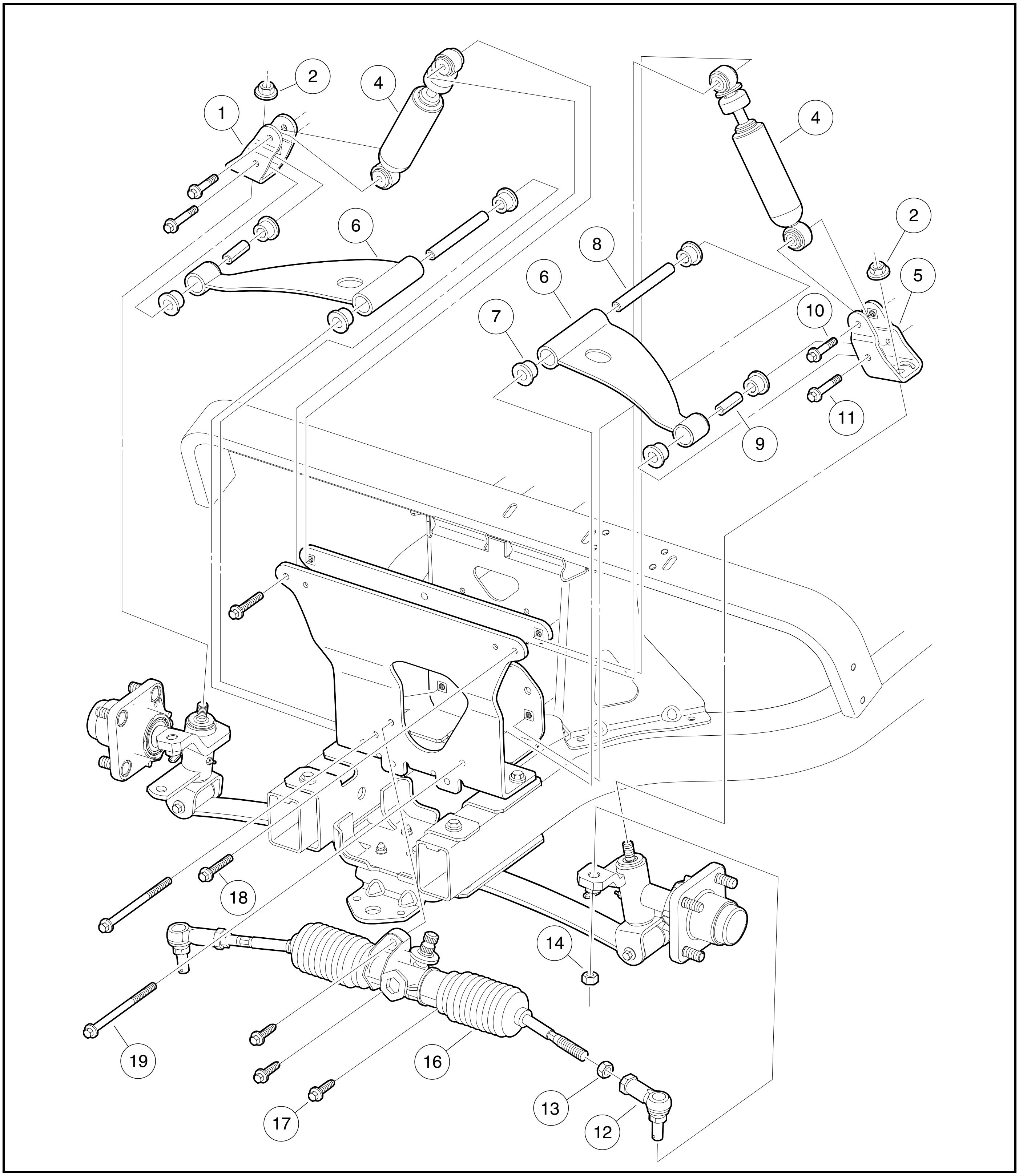

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Figure 7-19 Upper Front Suspension Assembly

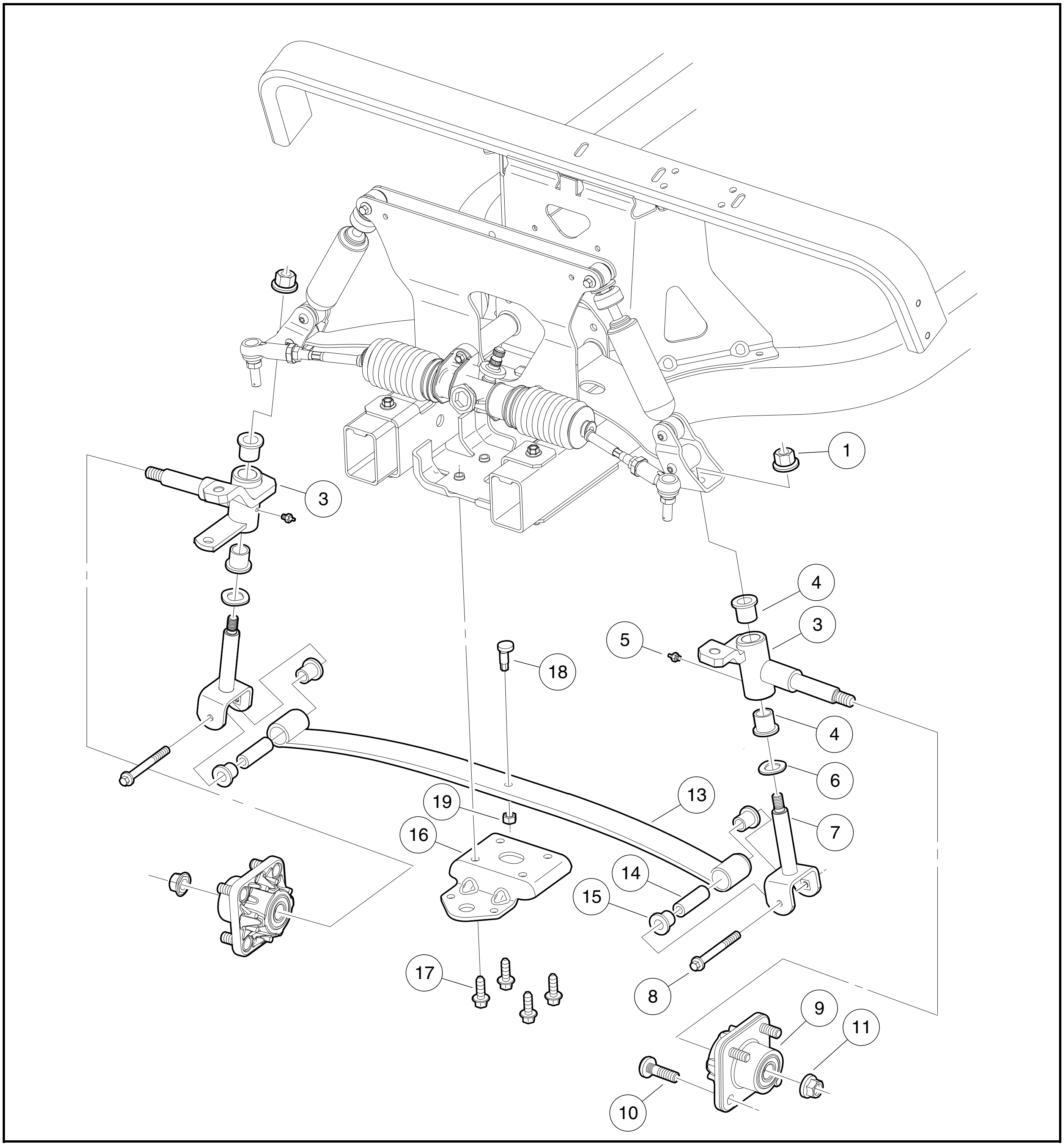

Figure 7-20 Lower Front Suspension Assembly

FRONT WHEEL BEARINGS AND HUBS

See General Warnings on page 1-1.

NOTE: *The front wheel bearings are pressed into the spindle and are not serviceable. If excessive free-play is detected the entire hub should be replaced.*

FRONT WHEEL FREE PLAY INSPECTION

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Raise the front of the vehicle.
3. Use your hands to attempt to rock the wheel and hub assembly back and forth on the spindle. Movement of the wheel and hub on the spindle indicates that the hub bearing is worn; therefore, the hub assembly must be replaced. **See Front Hub Removal on page 7-18.**

FRONT HUB REMOVAL

1. Remove the front wheels. **See Wheel Removal on page 8-1.**
2. Remove dust cap (12) and lock nut (11) **(Figure 7-20, Page 7-17)**.
3. Slide the hub assembly (9) off of the spindle shaft (3).
4. Lightly sand spindle shaft to clean away any light rust.
5. Inspect the surface of the spindle shaft for surface damage. It should be clean and smooth. If severe pitting from rust or corrosion has occurred, replace the spindle assembly. **See Kingpin and Steering Spindle Removal on page 7-14.**

HUB INSTALLATION

1. Clean and apply a light coat of anti-seize lubricant to the spindle shaft (3).
2. Slide the hub assembly (9) onto the spindle shaft **(Figure 7-21, Page 7-19)**.
3. Install a new flanged lock nut (11) and tighten to 50 ft-lb (68 N·m).
4. Rotate the hub. The hub should rotate smoothly without binding, side play, or any indication of rough spots.
5. Repeat the procedure for the opposite wheel.
6. Install wheels and finger-tighten lug nuts.
7. Lower the vehicle and finish tightening lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).

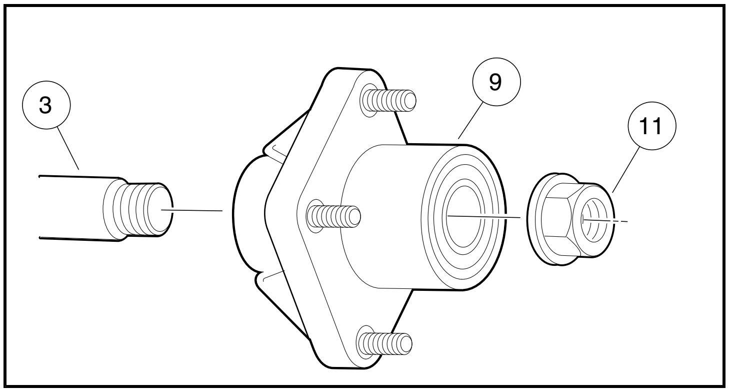

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Figure 7-21 Front Wheel Hub

SECTION 8 – WHEELS AND TIRES

8

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

GENERAL INFORMATION

Maximum tire life and good vehicle handling qualities are directly related to proper wheel and tire care.

- Keep tires properly inflated. See Section 2 – Vehicle Specifications.
- Keep lug nuts properly tightened.
- Keep the front end aligned and adjusted.

⚠ WARNING

- **Tires affect vehicle handling. When selecting a replacement tire, use only original equipment or comparable tires.**

WHEELS

See General Warnings on page 1-1.

WHEEL REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Slightly loosen the lug nuts on the wheel to be removed.
3. Raise the end of the vehicle from which the wheel is to be removed. Make sure that the wheels are off the ground. **See General Warnings on page 1-1.**
4. Remove the lug nuts and remove the wheel.

WHEEL INSTALLATION

1. Install wheel(s) and tighten the lug nuts, using a crisscross pattern, until they are snug.
2. Lower the vehicle and finish tightening lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).

TIRES

See General Warnings on page 1-1.

TIRE REMOVAL

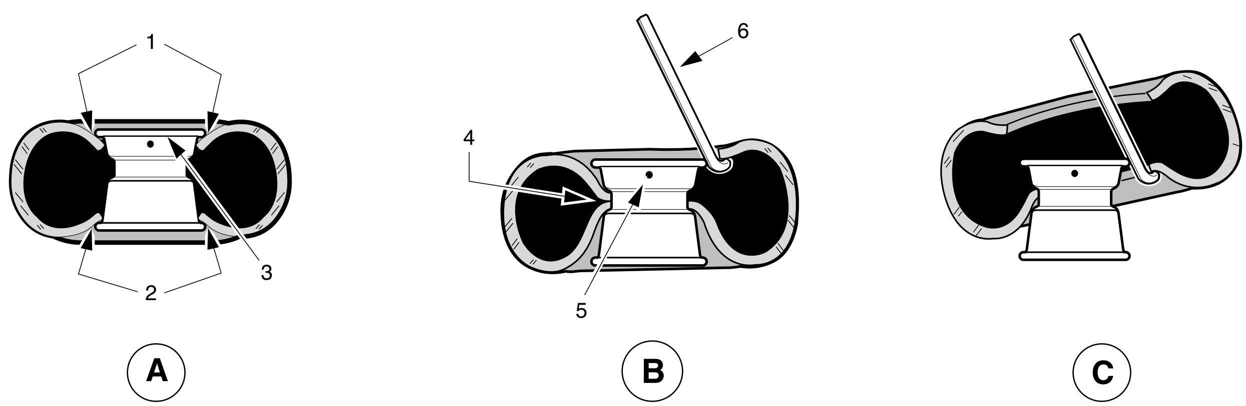
NOTE: *Tire must be removed or installed from the valve stem side of the rim.*

1. Remove the tire and wheel assembly from the vehicle as instructed above.
2. Remove the valve cap and valve core and allow air to escape from the tire.
3. If possible, use a tire machine to remove the tire from the rim.
   3.1. If a tire machine is not available, loosen both tire beads by applying pressure to the tire side walls and pushing the tire bead away from the rim flange and into the rim well **(Figure 8-1, Page 8-2, Detail A)**.
   3.2. With the valve stem side of the wheel up, use a tire tool to carefully start the upper bead over the edge of the wheel rim **(Figure 8-1, Page 8-2, Detail B)**.

CAUTION

- **To avoid damage to the tire, do not use excessive force when starting the bead over the edge of the rim.**

4. When top bead is free of the rim, pull the bead from the bottom side of the rim up into the upper part of the rim well. Insert the tire tool under the lower bead as shown **(Figure 8-1, Page 8-2, Detail C)** and carefully pry the lower bead over the rim flange.
5. Once the lower bead is started over the rim flange, the tire can be removed from the rim by hand.



1. Upper Tire Beads 2. Lower Tire Beads 3. Rim Flange 4. Tire Beads Positioned In Rim Well 5. Valve Stem Side Up 6. Tire Tool

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Figure 8-1 Tire Removal

TIRE REPAIR

1. Determine the location and cause of the air leak:
   1.1. Remove the wheel. **See Wheel Removal on page 8-1.** Inflate the tire to no more than 20 psi (1.38 Bars).
   1.2. Immerse the tire in water and then mark the point where bubbles are formed by escaping air.
   1.3. Determine the cause of the air leak. **See following NOTE.**

NOTE: *An air leak could be due to a punctured casing, faulty valve core, improperly seated valve stem, or improperly seated tire bead.*

Small holes in the casing can be plugged using a standard automotive tubeless tire repair kit available at your local Club Car dealer.

2. When the cause of the air leak has been determined, remove tire from the rim and repair as required. **See Tire Removal on page 8-2.**

TIRE INSTALLATION

⚠ WARNING

- **While mounting or inflating tire, keep hands, fingers, etc. from exposed areas between the tire bead and rim.**

1. Clean both tire beads to remove dirt or other foreign matter.
2. Where the tire beads seat, clean the wheel rim with a wire brush. Wipe away any debris with a clean cloth.

NOTE: *Because tubeless tires require a perfect seal in order to seat, keeping the tire and rim clean is very important.*

3. Apply a liberal amount of tire-mounting lubricant (soap and water solution) to both tire beads and rim flanges.
4. Install the tire on the rim from the valve stem side. If there is no tire machine available, use a rubber mallet and tire iron.
5. Remove the valve core, and position tire so that both beads are on the rim flange narrow bead seats.
6. Place tire and wheel assembly against wall in upright position and push it against wall while inflating tire to 30-35 psi (2.07-2.42 Bars). The three-point contact (wall, floor, and hand) will help ensure that beads snap into place and form a proper seal as tire is inflated **(Figure 8-2, Page 8-4)**. **See following WARNING.**

⚠ WARNING

- **Do not use a compressed air source with pressure over 100 psi (6.90 Bars). Due to low pressure requirements of a small tire, over-inflation could be reached almost instantly with a high pressure air supply. Over-inflation could cause tire to explode, possibly resulting in severe personal injury.**

7. Quickly remove the air nozzle and install the valve core.
8. Adjust air pressure in tire to recommended pressure. See Section 2 – Vehicle Specifications.
9. Immerse the wheel and tire assembly in water to make sure there are no leaks.

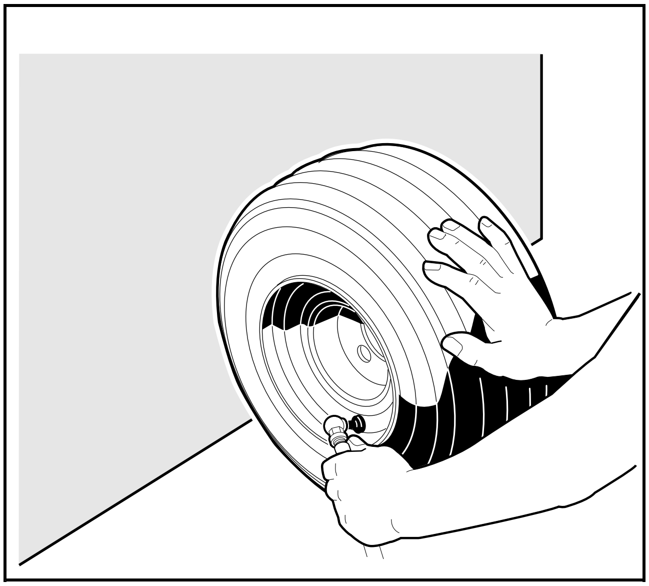

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Figure 8-2 Inflate Tire

SECTION 9 – REAR SUSPENSION

9

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

GENERAL INFORMATION

The rear suspension and powertrain of the vehicle move independently from the vehicle frame. It consists of two leaf springs controlled by two shock absorbers mounted between the springs and the vehicle frame.

SHOCK ABSORBERS

See General Warnings on page 1-1.

SHOCK ABSORBER REMOVAL AND INSPECTION

1. Check shock absorbers (7) for damage or fluid leakage at the point where the shaft enters the shock absorber body. Replace damaged or leaking shock absorbers **(Figure 9-3, Page 9-4 or Figure 9-4, Page 9-6)**.
2. To remove a shock absorber, remove the nut (5), cup washer (9) and rubber bushings (10) from the stem at the top of the shock absorber.
3. Remove the nut (5), cup washer (9), and rubber bushings (10) from lower mounting stem.
4. Compress the shock absorber to remove it.

SHOCK ABSORBER INSTALLATION

1. To install, reverse the removal procedure.
2. On the upper and lower shock absorber mounting stems, tighten the nuts until the rubber bushing expands to the size of the cup washer.

LEAF SPRINGS (TWO-PASSENGER VEHICLES)

See General Warnings on page 1-1.

LEAF SPRING REMOVAL (TWO-PASSENGER VEHICLES)

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Loosen, but do not remove, lug nuts on tire and wheel assembly on the side from which the spring is to be removed. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame crossmember forward of the spring mounting tabs. Lower the vehicle to let the jack stands support the vehicle **(Figure 9-1, Page 9-3)**. **See following WARNING.**

⚠ WARNING

- **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.**

3. Place a floor jack under the transaxle differential casing to support, but not lift, the drivetrain. Raise it just enough to relieve tension on the shock absorbers without compressing them.
4. Remove the tire and wheel assembly on the side from which the spring is to be removed.
5. Remove the bow tie locking pin (1) and the clevis pin (2) at the brake lever and brake cable connection, and remove cable end (3) from the brake lever **(Figure 9-2, Page 9-3)**. Detach the brake cable from the shock mount bracket (4). **See Brake Cable Removal, Section 6, Page 6-13.**
6. Remove the nut (5), cup washer (9), and rubber bushings (10) from the lower mounting stem of the shock absorber **(Figure 9-3, Page 9-4)**.
7. Remove the nuts (13) and the U-bolt (11) securing the spring to the transaxle. Remove the shock mount bracket (15) and the U-bolt.
8. Remove the bolt (17) and nut (2) attaching the rear of the spring to the shackle (1).
9. Remove the nut (2) and bolt (17) attaching the front of the spring to the vehicle frame and remove the spring.
10. Inspect the bushings (4) and sleeves (3) in the spring eyes and replace them if they are worn or damaged.

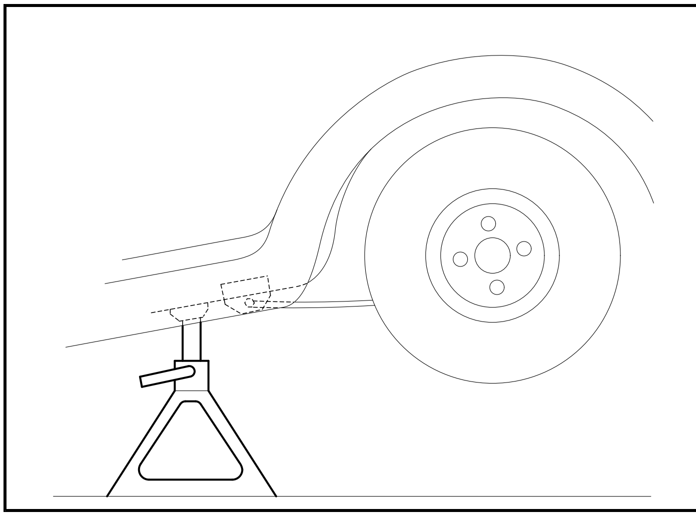

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Figure 9-1 Support Vehicle on Jack Stands

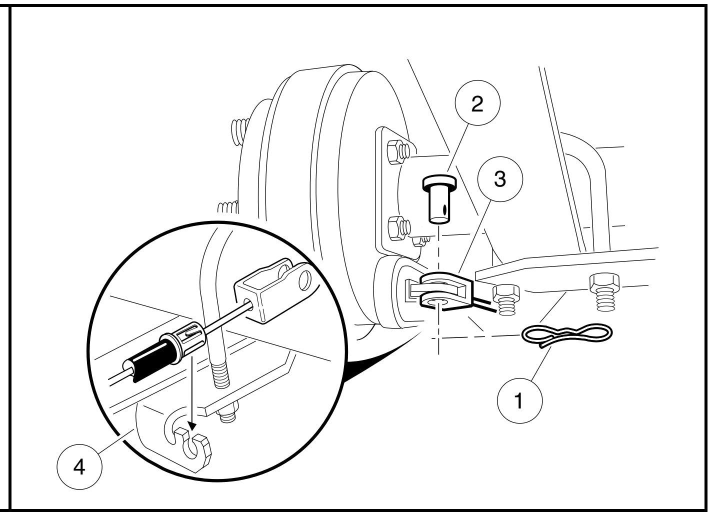

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Figure 9-2 Disconnect Brake Cable

LEAF SPRING INSTALLATION (TWO-PASSENGER VEHICLES)

1. To install the springs, reverse the removal procedure. **See following CAUTION.**

⚠ CAUTION

- **When positioning the spring on the transaxle, be sure to insert the locating bolt on the spring in the locating hole in the transaxle saddle.**

2. Tighten the nuts on the U-bolts to 25 ft-lb (34 N·m) and tighten nuts (2) on spring mounting bolts (17) to 15 ft-lb (20.3 N·m) **(Figure 9-3, Page 9-4)**.
3. Install tire and wheel assembly. **See Wheel Installation, Section 8, Page 8-1.**

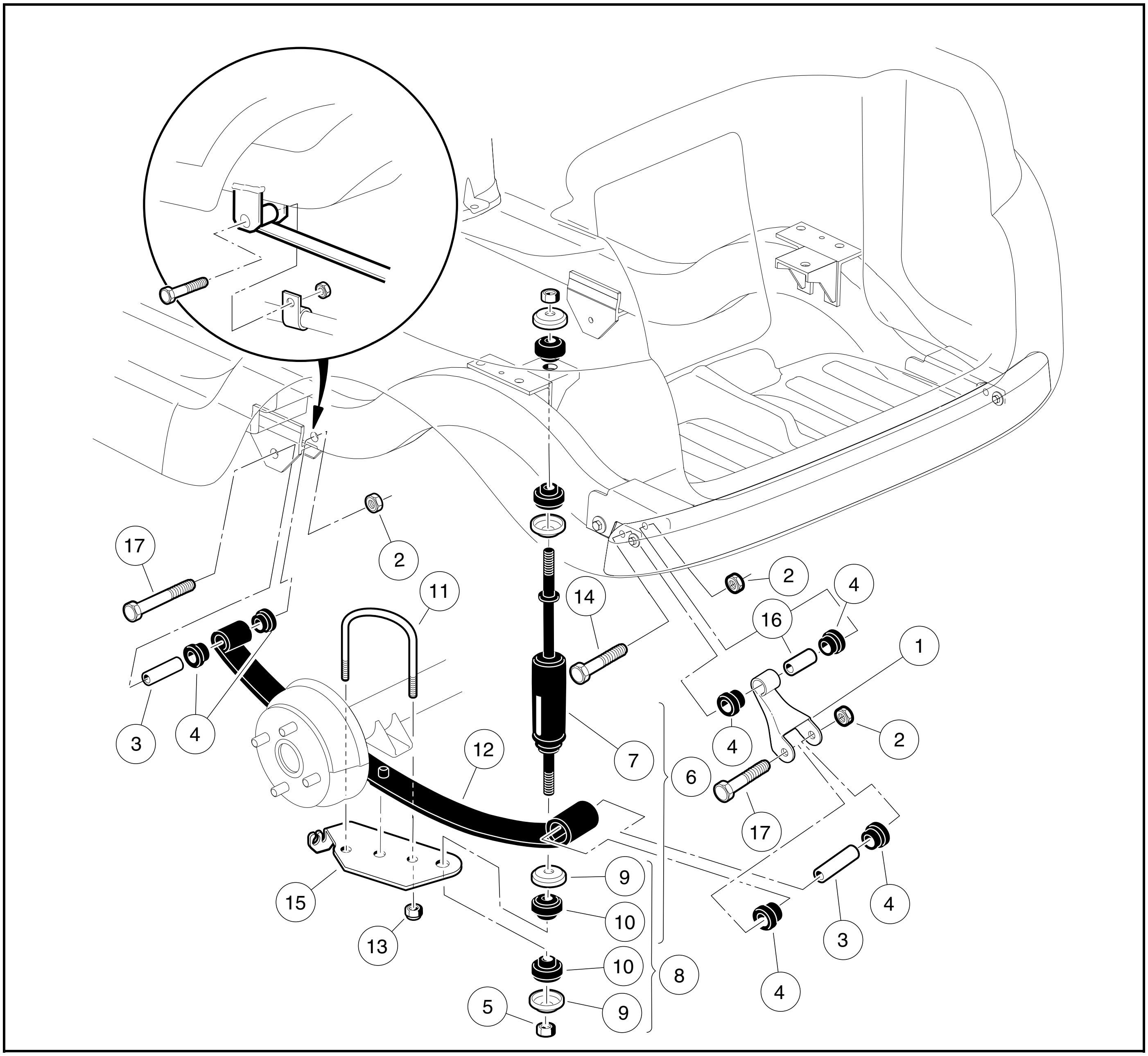


Figure 9-3 Rear Suspension Assembly and Mounting (Two-Passenger Vehicles)

LEAF SPRINGS (FOUR-PASSENGER VEHICLES)

See General Warnings on page 1-1.

LEAF SPRING REMOVAL (FOUR-PASSENGER VEHICLES)

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

2. Loosen, but do not remove, lug nuts on tire and wheel assembly on the side from which the spring is to be removed. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame crossmember forward of the spring mounting tabs. Lower the vehicle to let the jack stands support the vehicle **(Figure 9-1, Page 9-3)**. **See following WARNING.**

⚠ WARNING

- **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.**

3. Place a floor jack under the transaxle differential casing to support, but not lift, the drivetrain. Raise it just enough to relieve tension on the shock absorbers without compressing them.
4. Remove the tire and wheel assembly on the side from which the spring is to be removed.
5. Remove the bow tie locking pin (1) and the clevis pin (2) at the brake lever and brake cable connection, and remove cable end (3) from the brake lever **(Figure 9-2, Page 9-3)**. Detach the brake cable from the shock mount bracket (4). **See Brake Cable Removal, Section 6, Page 6-13.**
6. Remove the nut (5), cup washer (9), and rubber bushings (10) from the lower mounting stem of the shock absorber **(Figure 9-4, Page 9-6)**.
7. Remove the nuts (13) and the U-bolt (11) securing the spring and jounce bumper to the transaxle. Remove the shock mount bracket (15), jounce bumper bracket (20), and the U-bolt (11).
8. Remove the bolt (17) and nut (2) attaching the rear of the spring to the shackle (1).
9. Remove the nut (2) and bolt (17) attaching the front of the spring to the vehicle frame and remove the spring.
10. Inspect the bushings (4) and sleeves (3) in the spring eyes and replace them if they are worn or damaged.

LEAF SPRING INSTALLATION (FOUR-PASSENGER VEHICLES)

1. To install the springs, reverse the removal procedure. **See following CAUTION.**

⚠ CAUTION

- **When positioning the spring on the transaxle, be sure to insert the locating bolt on the spring in the locating hole in the transaxle saddle.**

2. Tighten the nuts on the U-bolts to 25 ft-lb (34 N·m) and tighten nuts (2) on spring mounting bolts (17) to 15 ft-lb (20.3 N·m) **(Figure 9-4, Page 9-6)**.
3. Install tire and wheel assembly. **See Wheel Installation, Section 8, Page 8-1.**

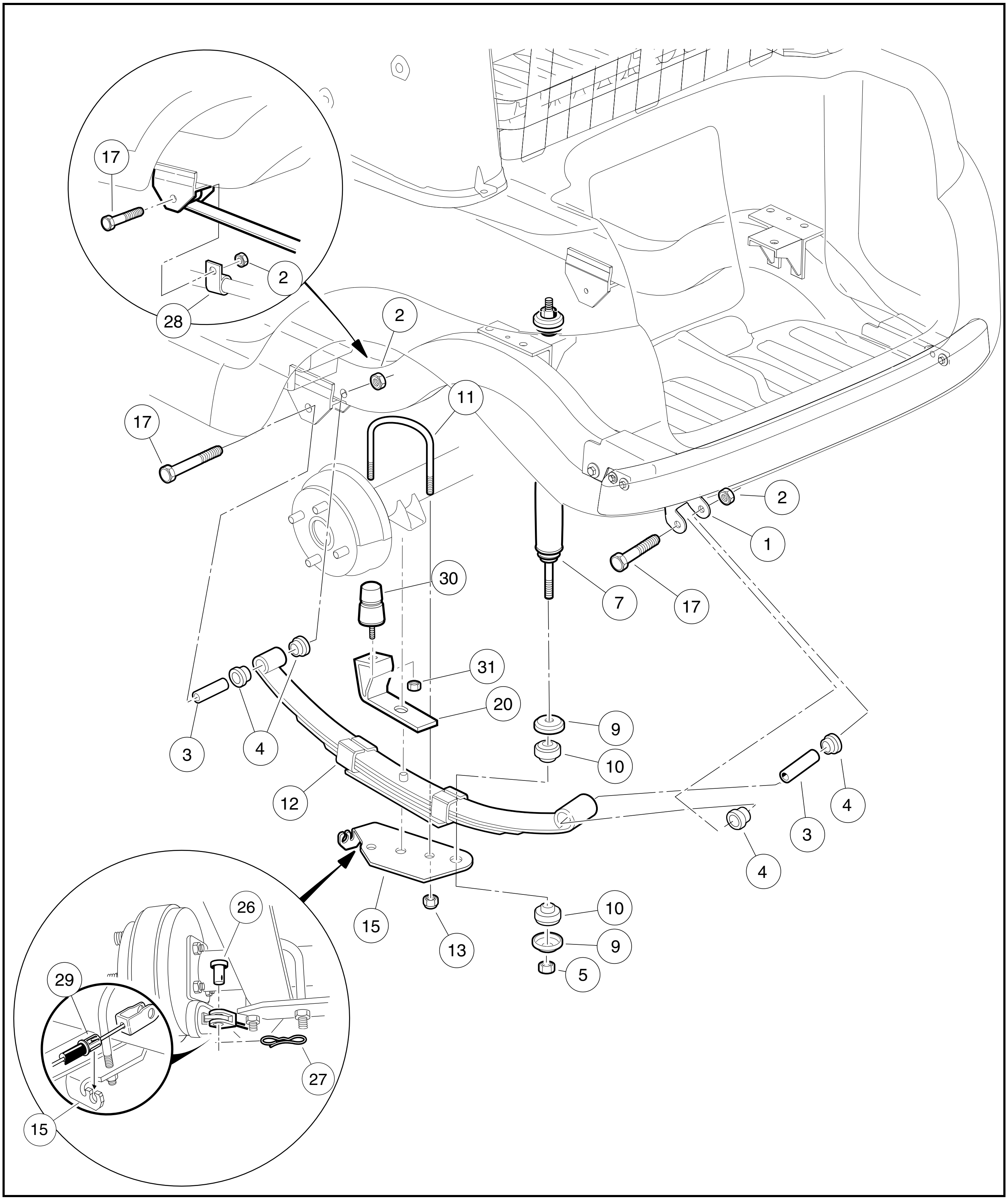


Figure 9-4 Rear Suspension Assembly and Mounting (Four-Passenger Vehicles)

GENERAL WARNING

The following safety statements must be heeded whenever the vehicle 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 safety statements appear throughout this manual and on the vehicle.

⚠ DANGER

- **See General Warnings on page 1-1.**
- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using 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.**

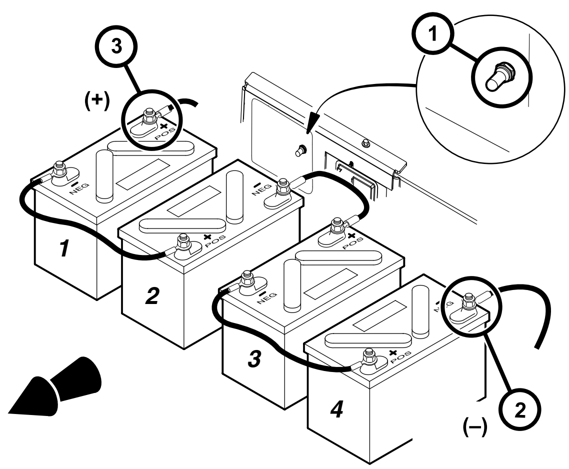
⚠ WARNING

- **See General Warnings, Section 1, Page 1-1.**
- **Only trained technicians should repair or service the vehicle. 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 affixed to the vehicle.**
- **Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance or severe personal injury.**
- **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.**
- **Check the vehicle owner's manual for proper location of all vehicle warning decals and make sure they are in place and are easy to read.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. 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 vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot motor. Failure to heed this warning could result in severe burns.**

WARNING CONTINUED ON NEXT PAGE

⚠ WARNING

- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Turn key switch OFF and remove key, place Forward/Reverse switch in the NEUTRAL position, and chock the wheels prior to servicing the vehicle.**
- **Place Tow/Run switch in the TOW position before disconnecting or connecting the batteries.**
- **To avoid unintentionally starting the vehicle, place Tow/Run switch in the TOW position, then disconnect the batteries as shown (Figure 10-1, Page 10-2) and (Figure 10-2, Page 10-2).**
- **After disconnecting the batteries, wait 90 seconds for the controller capacitors to discharge.**
- **If wires are removed or replaced, make sure wiring and wire harness is 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.**



(Viewed from driver side of vehicle)
1. Place TOW/RUN Switch in TOW before disconnecting or connecting battery cables.
2. Remove negative battery cable.
3. Remove positive battery cable.

Connect battery cables in reverse order.

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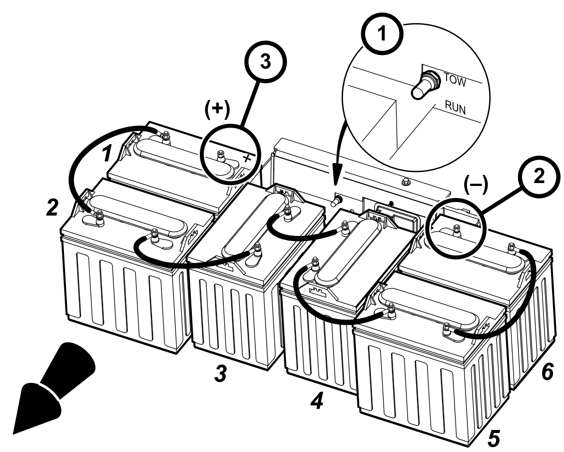
Figure 10-1 Battery Cable Removal – 4 x 12 Volt Battery Configuration



(Viewed from driver side of vehicle)
1. Place TOW/RUN Switch in TOW before disconnecting or connecting battery cables.
2. Remove negative battery cable.
3. Remove positive battery cable.

Connect battery cables in reverse order.

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Figure 10-2 Battery Cable Removal – 6 x 8 Volt Battery Configuration

GENERAL INFORMATION

To ensure trouble-free vehicle performance, it is very important to follow an established preventive maintenance program. Regular and consistent vehicle maintenance can prevent vehicle downtime and expensive repairs that can result from neglect. Any vehicle not functioning correctly should be removed from use until it is properly repaired. This will prevent further damage to the vehicle and avoid the possibility of injury due to unsafe conditions.

Contact your local Club Car distributor/dealer to perform all repairs and semiannual and annual periodic service.

PERIODIC SERVICE SCHEDULE

⚠ WARNING

- **Service, repairs, and adjustments must be made per instructions in the appropriate section of this manual.**
- **If any problems are found during scheduled inspection or service, do not operate the vehicle until repairs are made. Failure to make necessary repairs could result in fire, property damage, severe personal injury, or death.**

NOTE: *If the vehicle is constantly subjected to heavy use or severe operating conditions, the preventive maintenance procedure should be performed more often than recommended in the periodic service and lubrication schedules.*

Both the Periodic Service Schedule and the Periodic Lubrication Schedule must be followed to keep vehicle in optimum operating condition.

PERIODIC SERVICE SCHEDULE – ELECTRIC VEHICLES		
REGULAR INTERVAL	**SERVICE**	
Daily service by owner	Pre-Operation and Daily Safety Checklist	See Pre-Operation and Daily Safety Checklist in the appropriate Owner's Manual
	Performance Inspection	See Performance Inspection in the appropriate Owner's Manual
	Batteries	Charge batteries (after each daily use only).
Weekly service by owner	Batteries (For vehicles NOT equipped with the Single-Point Watering System)	Check electrolyte level. Add water if necessary. **See Battery Care – Vehicles Without the Single-Point Watering System on page 18-18.**
Monthly service by owner or trained technician	Batteries (For vehicles equipped with the Single-Point Watering System). Water monthly or according to the established watering interval.	Water the batteries. Observe that water flow occurs and no water overflows from any cell. **See Battery Care on page 18-16.**
	Batteries	Wash battery tops and clean terminals with baking soda/water solution. Apply Battery Terminal Protector Spray (P/N 1014305) to battery terminals.
	Tires	Check air pressure and adjust if necessary. See Section 2 – Vehicle Specifications.
	General vehicle	Thoroughly wash vehicle including the underside.
Initial (one-time) inspection by owner or trained technician after six weeks of use	Batteries (For vehicles newly equipped with the Single Point Watering System)	For vehicles newly equipped with the SPWS, manually check battery electrolyte levels of all cells to verify correct valve operation. **See Initial Maintenance of the SPWS on page 18-25.**
Semiannual service by trained technician only (every 50 hours of operation or 100 rounds of golf)	Brake system	Check brake shoes; replace if necessary.
		Lubricate brake system per Lubrication Schedule.
		Check brake cables for damage; replace if necessary.
		Check brake cable equalizer adjustment; adjust if necessary.
	Electrical wiring and connections	Check for tightness and damage; replace if necessary.
	Front wheel alignment and camber	Check and adjust as required. See Section 7 – Steering and Front Suspension.
Annual service by owner or trained technician (every 100 hours of operation or 200 rounds of golf)	Batteries (For vehicles equipped with the Single Point Watering System)	Manually check battery electrolyte levels of all cells to verify correct valve operation. **See Battery Care on page 18-16.**

TABLE CONTINUED ON NEXT PAGE

PERIODIC SERVICE SCHEDULE – ELECTRIC VEHICLES		
REGULAR INTERVAL	**SERVICE**	
Annual service by trained technician only (every 100 hours of operation or 200 rounds of golf)	Batteries	If batteries are not performing as expected, **see Batteries on page 18-1**.
	Pedal group	Lubricate all rotating joints. **See Periodic Lubrication Schedule on page 10-6.**
	General Vehicle	Check for loose hardware; tighten if necessary.

PERIODIC LUBRICATION SCHEDULE

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

PERIODIC LUBRICATION SCHEDULE			
REGULAR INTERVAL	**SERVICE**	**LUBRICATION POINT**	**RECOMMENDED LUBRICANT**
Semiannually by owner or trained technician (every 50 hours of operation or 100 rounds of golf)	Charger receptacle	1	WD-40
	Brake system, per maintenance and service manual.	2	Dry Moly Lube (P/N 1012151), white lithium grease NLGI #2
	Front suspension (two fittings)	3	Chassis Lube - EP NLGI Grade 2
Annually by trained technician only (every 100 hours of operation or 200 rounds of golf)	Check/fill transaxle to plug level	4	22 oz. (0.67 liters) SAE 30 WT. API Class SE, SF, or SG Oil (or higher)
	Pedal group	5	Dupont™ Performance Dry Multi-Use Lubricant

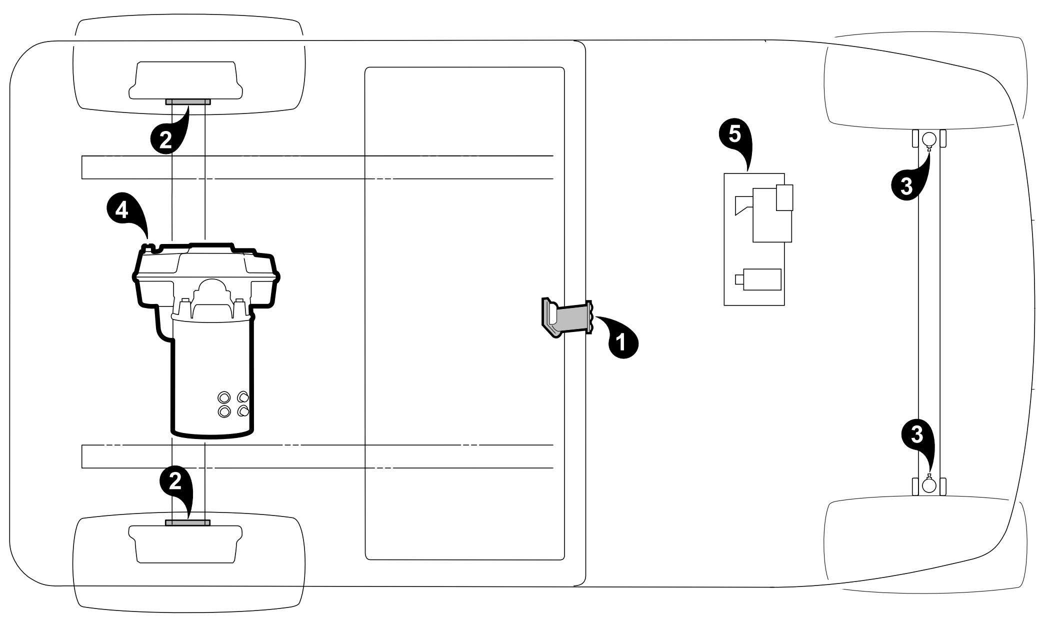

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Figure 10-3 Vehicle Lubrication Points

SECTION 11 – IQ SYSTEM TROUBLESHOOTING – TPS

11

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**
- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

GENERAL INFORMATION

NOTE: *Many 2009 model year Precedent vehicles have had the pedal group reworked to use an MCOR in place of the throttle position sensor. If this is the case, see* ***IQ System Troubleshooting – MCOR on page 12-1*** *or* ***Excel System Troubleshooting – MCOR on page 14-1*** *for troubleshooting and system diagnosis. For a vehicle that still uses the throttle position sensor, use this section.*

Starting early 2010 model year with Serial Number PQ1009-082079, all electric Precedent vehicles were factory-equipped with an MCOR sensor in the Gen II pedal group. The pedal group has its own serial number with a prefix that also changed as follows:

Gen II pedal group equipped with throttle position sensor (before reverting to MCOR):	either PGE1 or PBE1(with brake light switch)
Gen II pedal group equipped with MCOR:	either PGE2 or PBE2(with brake light switch)

The IQ System vehicle uses a 48-volt electrical system that is powered by four 12-volt lead-acid batteries or six 8-volt lead-acid batteries and includes an onboard computer. The IQ System vehicle uses a shunt-wound 3.2 hp motor and includes several additional features.

- **Shunt-Wound Motor:** The shunt-wound motor, unlike a series motor, is designed so that the speed controller is able to vary the amount of current passing through the field coils independently from the current passing through the armature.
- **Motor Braking:** Under certain conditions a shunt-wound motor also has the ability to act as an electrical brake to slow the vehicle. There are three features of the IQ electrical system which will activate the motor braking function: Walk Away Braking, Pedal Down Motor Braking, and Pedal Up Motor Braking (adjustable with the IQDM-P handset).
- **Walk Away Braking:** This prevents the vehicle from rolling away uncontrolled should the driver park on a slope and leave the vehicle without locking the park brake. The vehicle will roll at about 1 mph (1.6 km/h). If the walk away braking function remains engaged for two seconds or more, a warning buzzer will sound to alert the driver that motor braking has been activated.

⚠ WARNING

- **Walk Away Braking will not limit vehicle speed to 1 mph (1.6 km/h) on very steep grades. Do not operate vehicle on slopes exceeding 20% grades.**

WIRING DIAGRAMS

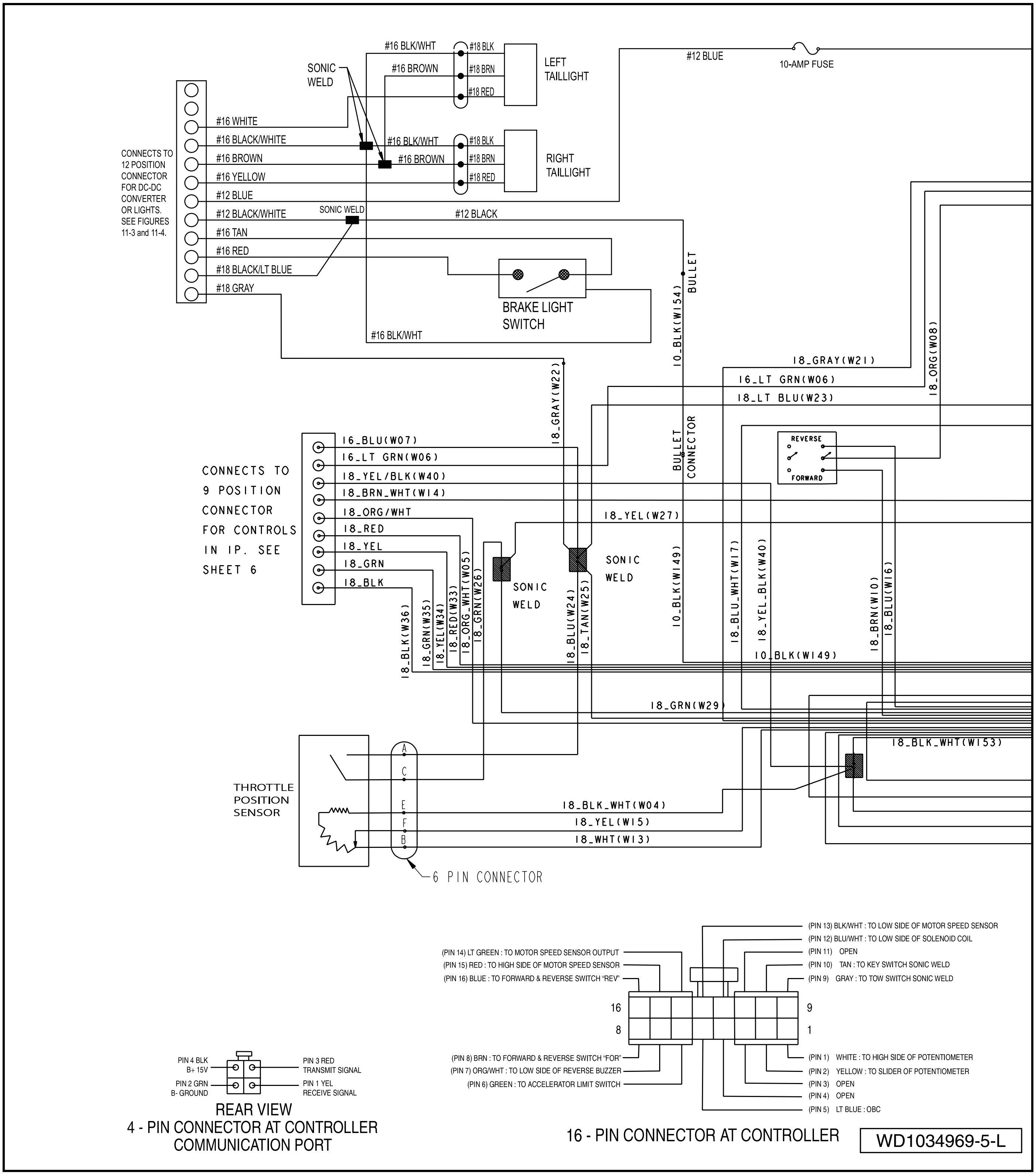


Figure 11-1 Wiring Diagram – IQ System with TPS

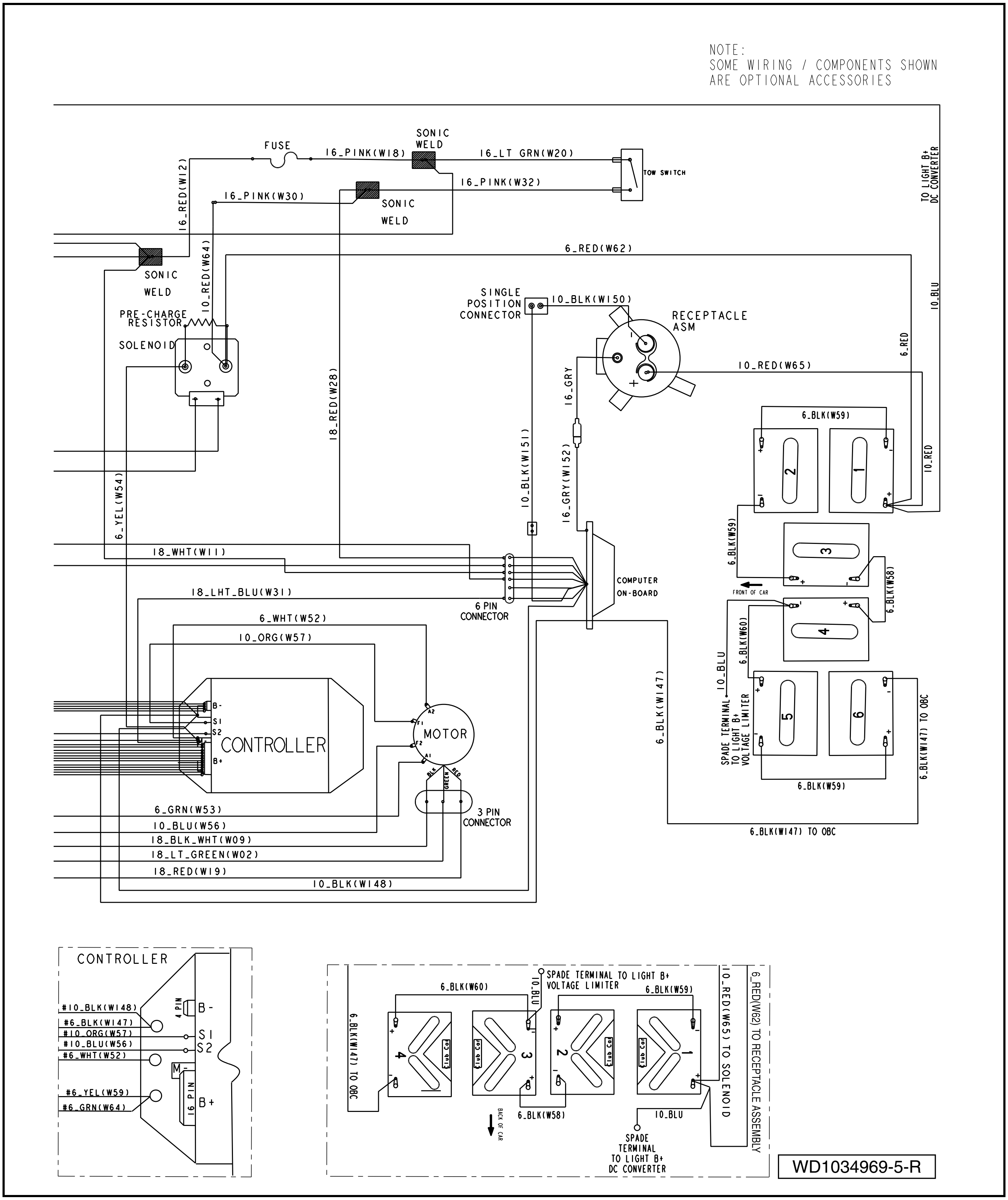


Figure 11-2 Wiring Diagram – IQ System with TPS (Continued)

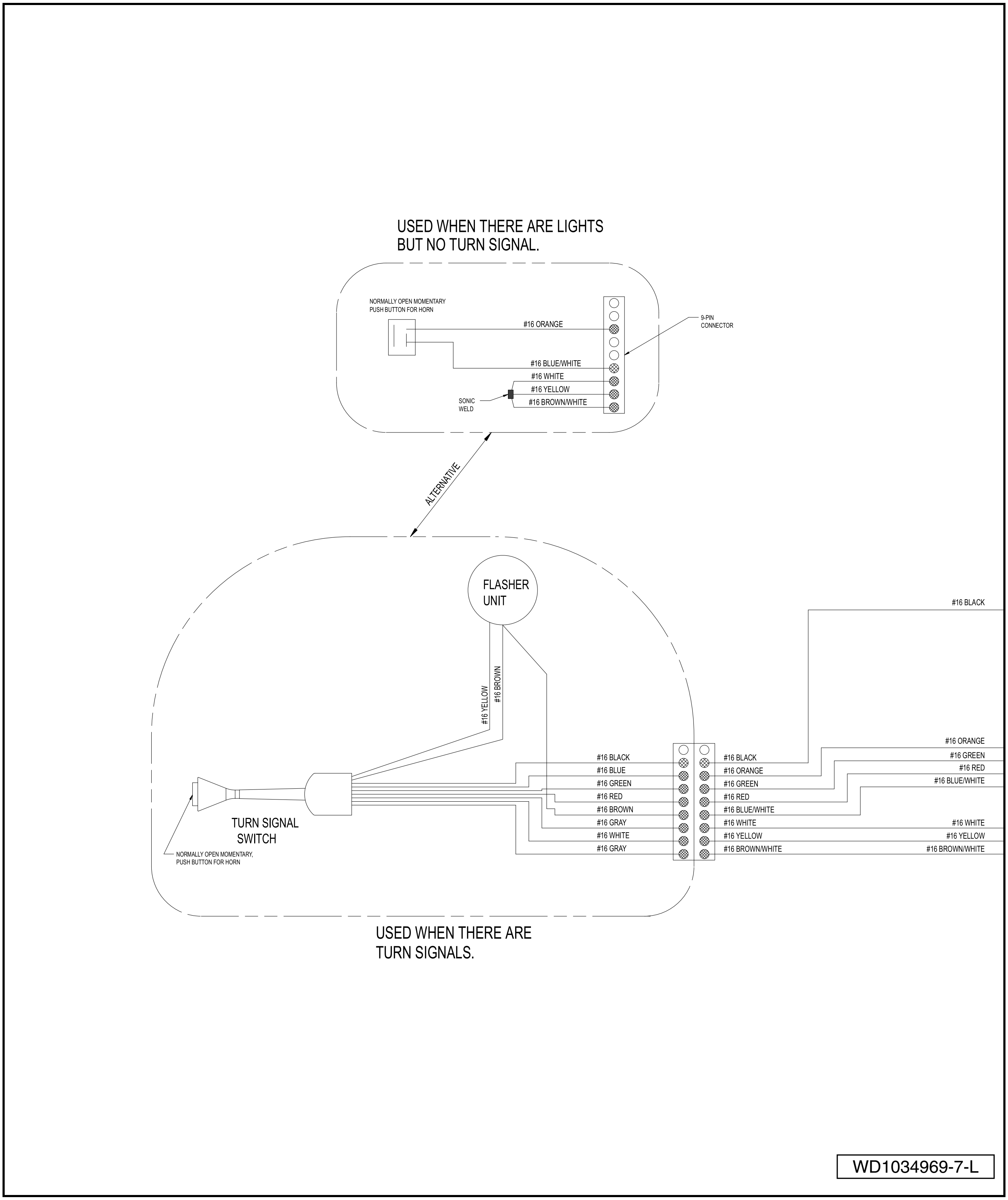


Figure 11-3 Precedent Electric Vehicle Accessory Wiring Diagram

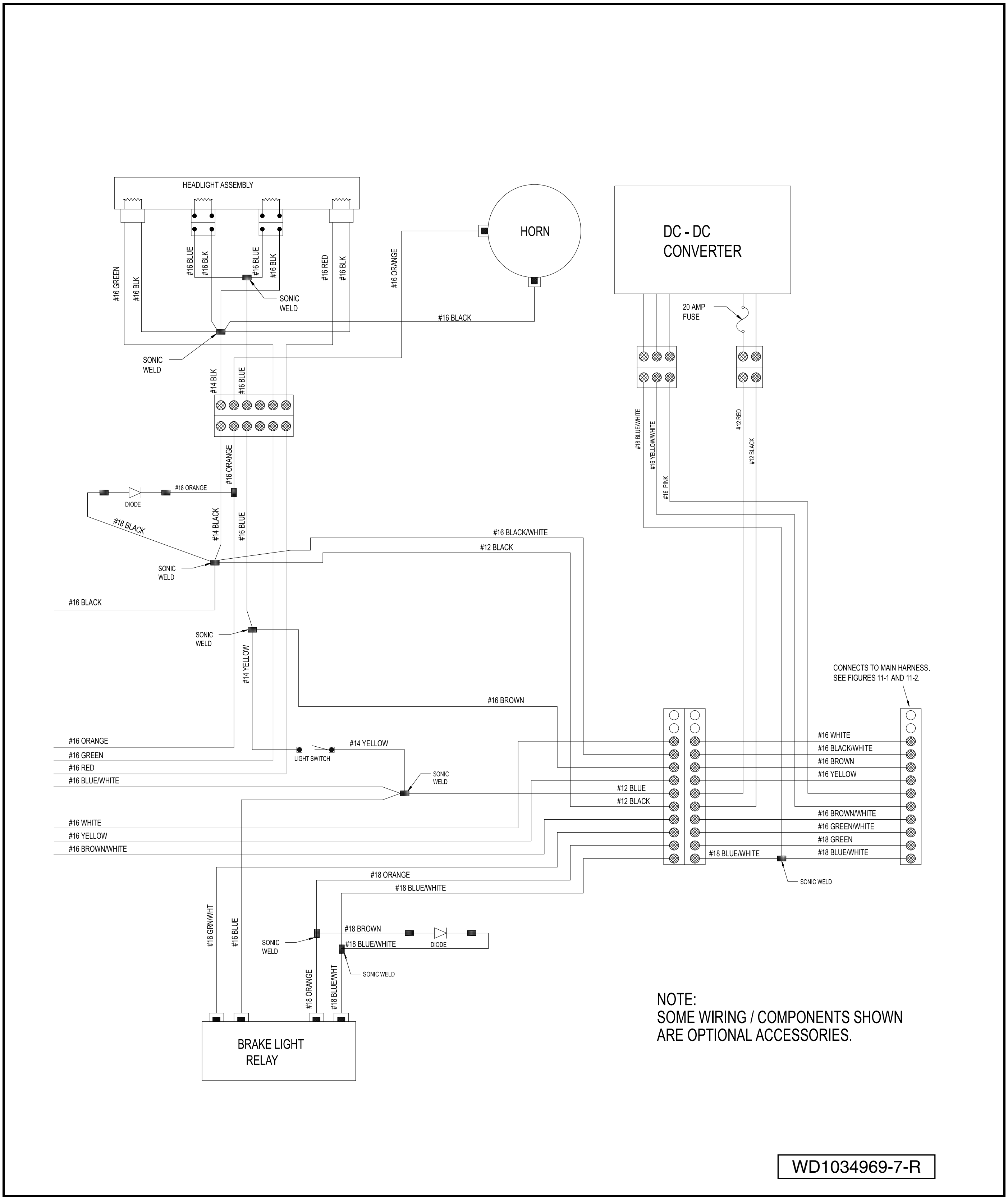


Figure 11-4 Precedent Electric Vehicle Accessory Wiring Diagram (Continued)

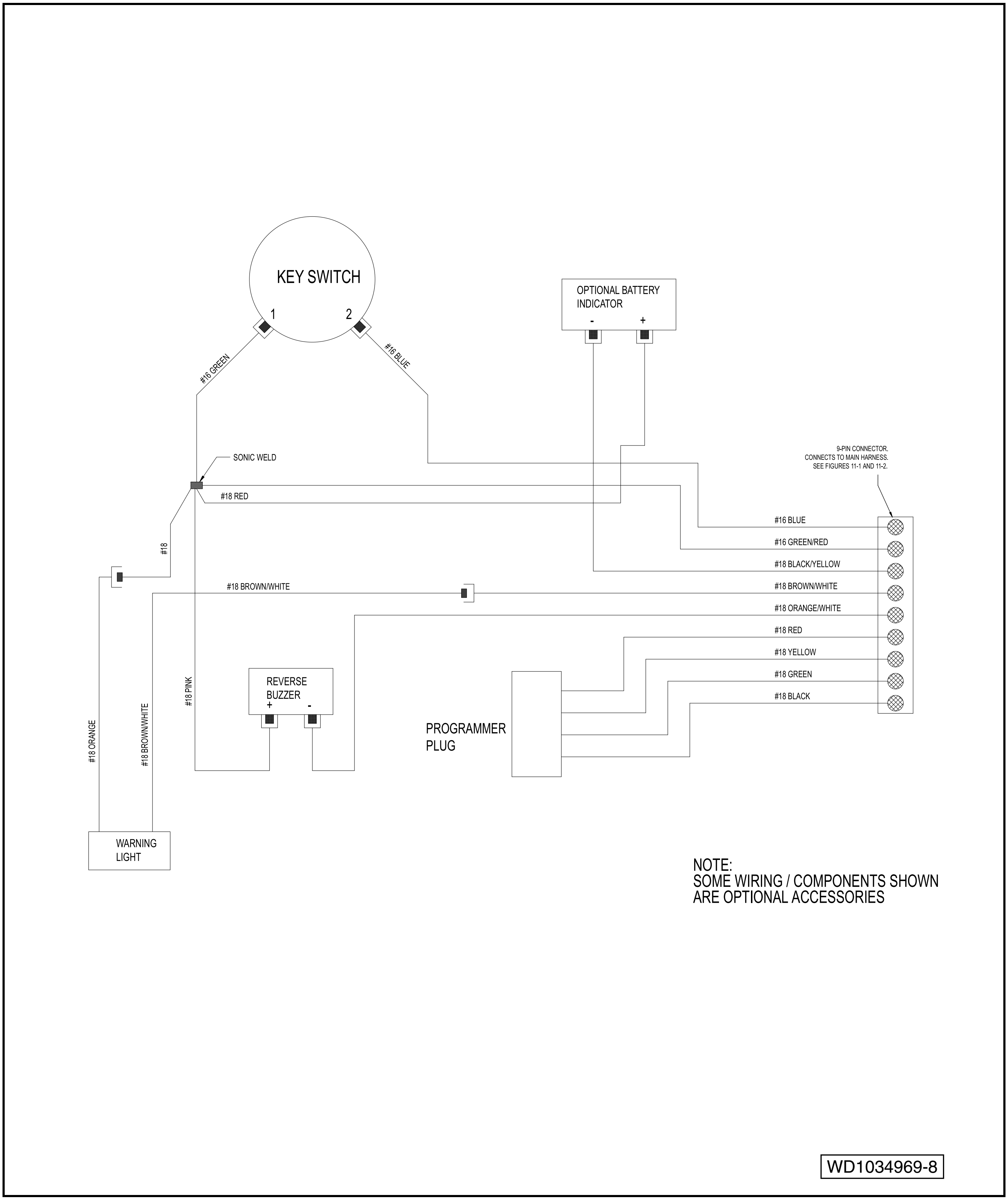


Figure 11-5 Precedent Electric Vehicle Instrument Panel Wiring Diagram

- **Pedal Down Motor Braking:** This feature helps to control vehicle downhill speed. Motor braking is activated when the vehicle reaches the programmed top speed and holds the vehicle at that speed. Motor braking is automatically disengaged when vehicle speed slows below the programmed top speed.
- **Pedal Up Motor Braking:** When vehicle speed is above 11 mph (17.7 km/h), releasing the accelerator pedal will activate motor braking, which slows the vehicle speed. Once vehicle speed slows to below approximately 11 mph (17.7 km/h), with the accelerator pedal still released, motor braking will be deactivated and the vehicle will coast freely. This feature is selectable. Contact your Club Car dealer/distributor to inquire about this selectable feature.
- **Regenerative Braking**: When motor braking is activated, the vehicle motor acts as a generator, slowing the vehicle as it creates energy that is used to charge the batteries.
- **Tow/Run Switch:** When the Tow/Run switch is in the RUN position, the vehicle will function normally. When the switch is in the TOW position, power to the OBC and controller is shut off, disabling the vehicle operating circuit and walk away braking, allowing the vehicle to be towed.
- **Motor Protection Circuit:** The operator should never attempt to hold the vehicle on an incline by pressing the accelerator pedal instead of the brake pedal, as motor overheating could result. By reducing the current to the motor during such an occurrence, the motor protection circuit reduces the possibility of motor damage. When this situation arises, a *motor stall fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See Motor Stall on page 15-11.**
- **High Pedal Detect:** This function prevents unexpected vehicle movement if the key switch is turned ON after the accelerator is pressed, or the accelerator pedal is pressed when Forward/Reverse switch is used to change the direction of travel. The vehicle will not move until the accelerator is released and pressed again. When this situation arises, a *HPD fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See HPD on page 15-11.**
- **Onboard Computer (OBC):** The OBC, 1) monitors battery condition, 2) monitors the number of energy units used by the vehicle, 3) determines the number of energy units required to recharge the batteries and shuts the charger off when this number is reached, 4) determines when to activate regenerative motor braking, 5) locks out vehicle movement while the charger is plugged into the vehicle charger receptacle, 6) stores operating data, which can be read by the Communication Display Module (CDM). **See Communication Display Module (CDM) on page 11-35.**

TROUBLESHOOTING

The following troubleshooting guides will be helpful in identifying operating difficulties should they occur. The guides include the symptom, probable cause(s) and suggested checks. The procedures used in making these checks can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING THE VEHICLE WITH THE IQDM

NOTE: *2009 Precedent IQ electric vehicles equipped with the Gen II Pedal Assembly will produce a reoccurring Throttle Fault 1 fault code registered in the vehicle's controller fault history when taking readings with the IQDM diagnostic module. This occurs due to the Gen II Pedal Assembly having a modular electric throttle with a throttle position sensor instead of an MCOR. The 1510 series controller that is used with IQ System cars requires a constant low voltage signal from the MCOR to signal there are no broken wires, loose connector plugs, etc. between the controller and MCOR. The throttle position sensor loses this connection when the key switch is turned off, prompting the controller to instantly register the appropriate Throttle Fault 1 code in fault history. The code can be cleared but will return every time the key switch is turned OFF. It has no ill effect on the operation of the vehicle and should not be interpreted as a fault that necessitates replacement of the vehicle's accelerator pedal assembly that contains the throttle position sensor.*

There are circumstances in which a legitimate Throttle Fault 1 fault code will register. If the vehicle does have an issue with the throttle position sensor or its wiring, the fault code will be present in the Current

Faults menu with the key switch in the ON position. This fault code will also most likely be accompanied by a non-operational vehicle.

The Excel system uses a 1515 series controller that has software preventing this fault code from registering when the key is switched off. Future IQ system controllers will have software to prevent this as well.

Club Car recommends the use of the IQDM handset for troubleshooting vehicles equipped with the IQ electrical system. Troubleshooting Guide 1 is to be used in conjunction with the IQDM handset. See IQ Display Module (IQDM) and IQDM-P Diagnostics: IQ System on page 15-1 for operating instructions. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the IQDM while the vehicle is in motion. A technician can monitor the IQDM while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

In the event that the vehicle is not functioning properly after completing Troubleshooting Guide 1, the technician should proceed to Troubleshooting Guide 2.
If an IQDM handset is unavailable, the technician should proceed to Troubleshooting Guide 2.

TROUBLESHOOTING GUIDE 1

The following troubleshooting guide is intended for use with an IQDM handset. **See following NOTE.**

NOTE: *Before troubleshooting the vehicle, check the diagnostic history from the Special Diagnostics Menu. Note any fault codes.*

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Test Menu – THROTTLE % value does not increase as the accelerator pedal is pressed or Diagnostic Menu – THROTTLE FAULT 1 fault code	Loose or disconnected six-pin connector at the throttle position sensor or broken wire	Repair and/or connect the six-pin connector to the throttle position sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed throttle position sensor	Test Procedure 4 – Throttle Position Sensor Voltage on page 11-16
Test Menu – HEATSINK °C indicates that temperature is above 85 °C (145 °F) or Diagnostic Menu – THERMAL CUTBACK fault code	Over-adjusted brakes	Section 6 – Wheel Brake Assemblies
	Vehicle is over-loaded	Ensure that vehicle is not over-loaded before returning to operation
Test Menu – ARM PWM value does not reach 100% when vehicle is at full speed	Failed throttle position sensor	Test Procedure 4 – Throttle Position Sensor Voltage on page 11-16
Test Menu – SPEED PULSES menu item indicates that speed pulses are OFF when the vehicle is in motion or Diagnostic Menu – SPEED SENSOR fault code	Loose or disconnected motor speed sensor or broken wire	Repair and/or connect the three-pin connector to the motor speed sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed motor speed sensor	Test Procedure 21 – Motor Speed Sensor on page 11-31

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Test Menu – FOOT INPUT menu item indicates that the throttle position sensor internal limit switch is always ON or always OFF.	Loose or disconnected six-pin connector at the throttle position sensor or broken wire	Repair and/or connect the six-pin connector to the throttle position sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed throttle position sensor	Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 11-20
Test Menu – FORWARD INPUT and/or REVERSE INPUT does not indicate the correct reading or Diagnostic Menu – PROC/WIRING fault code	Loose or disconnected Forward/Reverse rocker switch (quick disconnect terminals) or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected Forward/Reverse rocker switch (three-pin connector) or broken wire	Repair and/or connect the three-pin connector from the Forward/Reverse switch to the wire harness
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed Forward/Reverse rocker switch	Test Procedure 23 – Forward/Reverse Rocker Switch on page 11-32
Test Menu – MAIN CONT (solenoid) does not indicate ON when the solenoid should be activated. or Diagnostic Menu – MAIN CONT DNC (main contactor (solenoid) did not close) fault code	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
	Loose, broken, or disconnected wire(s) at solenoid or B+ speed controller terminal	Repair and/or connect the loose or disconnected wire(s)
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed solenoid	Replace solenoid. **See Solenoid Removal on page 17-13.**
Test Menu – KEY INPUT does not indicate ON when key switch is in the ON position	Loose or disconnected wires at key switch terminals or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed key switch	Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 11-20
Diagnostic Menu – THROTTLE FAULT 1 fault code	Loose or disconnected six-pin connector at the throttle position sensor or broken wire	Repair and/or connect the six-pin connector to the throttle position sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed throttle position sensor	Test Procedure 4 – Throttle Position Sensor Voltage on page 11-16

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Diagnostic Menu – HW FAILSAFE (Hardware Failsafe) fault code	Armature drive FET's (field-effect transistors) inside speed controller have failed	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
Diagnostic Menu – MAIN WELDED (main solenoid contacts welded) fault code	solenoid contacts have failed closed	Replace solenoid. **See Solenoid Removal on page 17-13.**
Diagnostic Menu – MAIN DRIVER ON or MAIN DRIVER OFF fault code	Speed controller logic malfunction	Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.** Reconnect the batteries and see if the symptom returns.
	Failure of the FET that controls the solenoid coil	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
Diagnostic Menu – MAIN COIL FAULT fault code or Diagnostic Menu – MAIN DROPOUT fault code	Solenoid coil has failed in an open condition	Replace solenoid. **See Solenoid Removal on page 17-13.**
Diagnostic Menu – FIELD MISSING fault code	Loose or disconnected motor field coil wires at motor or speed controller or broken wire	Repair and/or connect the field coil wires
	Failure of the motor field windings	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Failure of the FET's that control field current	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
Diagnostic Menu – HPD (high pedal detect) fault code	Operator error	Train operators to fully remove foot from accelerator pedal before turning key switch to the ON position or changing the selected direction with the Forward/Reverse switch
Diagnostic Menu – LOW BATTERY fault code	Batteries require charging	Place batteries on battery charger and allow them to fully charge
	Improperly maintained or failed batteries	See Section 18 – Batteries.
Diagnostic Menu – MOTOR STALL fault code	Operator error	Train operators to use the brake to hold the vehicle on a hill, rather than holding the vehicle on a hill using the accelerator pedal
Diagnostic Menu – OPEN ARMATURE fault code	Loose or disconnected motor armature wires at motor or speed controller or broken wire	Repair and/or connect the motor armature wires
	Failure of the motor armature or brushes	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Failure of the FET's that control armature current	Replace the speed controller. **See Speed Controller Removal on page 17-12.**

TROUBLESHOOTING GUIDE 2

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle does not operate	Batteries – Batteries discharged	Charge batteries
	Batteries – Battery connections	Check vehicle wiring. **See Wiring Diagrams on page 11-2.**
	Battery charger is connected to the vehicle – Solenoid lockout feature has disabled the vehicle	Disconnect the battery charger from the vehicle.
	Onboard computer failure	Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 11-15
	Key switch and throttle position sensor limit switch circuit	Check for loose or disconnected wires at key switch and throttle position sensor
	Failed key switch	Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 11-20
	Failed throttle position sensor	Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 11-20. See also Test Procedure 4 – Throttle Position Sensor Voltage on page 11-16.
	Forward/Reverse rocker switch	Test Procedure 23 – Forward/Reverse Rocker Switch on page 11-32
	Solenoid – loose wires	Test Procedure 3 – Solenoid Activating Coil on page 11-15
	Solenoid – failed coil	Test Procedure 3 – Solenoid Activating Coil on page 11-15
	Speed controller thermal cutback	Allow controller to cool and ensure that vehicle is not over-loaded before returning to operation
	16-pin connector at speed controller	Check for loose or disconnected wires at the 16-pin connector. **See also Test Procedure 9 – 16-Pin Connector on page 11-21.**
	High pedal detect	Cycle accelerator pedal
	Motor stall	Cycle accelerator pedal
	Motor Failure	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 17-12.**

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle runs slowly	Speed sensor disconnected or failed	Test Procedure 21 – Motor Speed Sensor on page 11-31
	Incorrect speed setting	To change the programmed top speed of the vehicle, an IQDM-P handset must be used
	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 11-2.**
	Batteries – Batteries discharged	Charge batteries
	Throttle position sensor malfunction	Test Procedure 4 – Throttle Position Sensor Voltage on page 11-16
	Motor – loose wires	Inspect and tighten all wire connections at the motor.
	Failed motor	Replace motor. **See Motor Removal on page 20-3.**
	Vehicle is over-loaded	Ensure that vehicle is not over-loaded before returning to operation.
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 17-12.**
	Brakes – improperly adjusted	See Section 6 – Wheel Brake Assemblies.
	Tires – under-inflated or flat tires	See Section 8 – Wheels and Tires.
Vehicle operates, but motor braking function does not	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 11-2.**
	Speed sensor disconnected or failed	Test Procedure 21 – Motor Speed Sensor on page 11-31
Vehicle will run in forward, but not in reverse or will run in reverse but not forward	Forward/Reverse rocker switch – improperly wired	Test Procedure 23 – Forward/Reverse Rocker Switch on page 11-32
	Motor – improperly wired	Check motor wiring. **See Wiring Diagrams on page 11-2.**
	Speed controller – improperly wired or failed speed controller FET	Check vehicle wiring. **See Wiring Diagrams on page 11-2.**
Vehicle operates, but battery charger does not charge batteries	Onboard computer – gray wire	Test Procedure 19 – Onboard Computer Gray Wire on page 11-30
	Battery charger connections – loose wires at receptacle or batteries	Check wire connections and tighten if necessary.
	Battery charger	Refer to the appropriate battery charger maintenance and service manual.

TEST PROCEDURES

Using the following procedures, the entire IQ electrical system can be tested without major disassembly of the vehicle.

⚠ WARNING

- **If wires are removed or replaced, make sure wiring and wire harness is properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.**

For many tests the electronics module cover must be removed to gain access to the various components that are mounted on the component mounting plate. **See Electronics Module Cover on page 17-5.** **See following WARNING.**

⚠ WARNING

- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

After test procedures are completed, be sure to replace the cover. **See Electronics Module Cover on page 17-5.** **See following CAUTION.**

CAUTION

- **Exposure to water may damage electronic components.**
  - **Do not operate vehicle without the cover properly installed.**
  - **Do not direct a water stream in area of the cover.**

Index of Test Procedures

21 – Motor Speed Sensor
22 – Solenoid Continuity
23 – Forward/Reverse Rocker Switch
24 – Reverse Buzzer
25 – Rebooting the Onboard Computer
26 – Battery Warning Light

TEST PROCEDURE 1 – Batteries / Voltage Check

See General Warnings on page 1-1.

NOTE: *The batteries must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in the Battery section of this manual.* ***See Battery Care, Section 18, Page 18-16.***

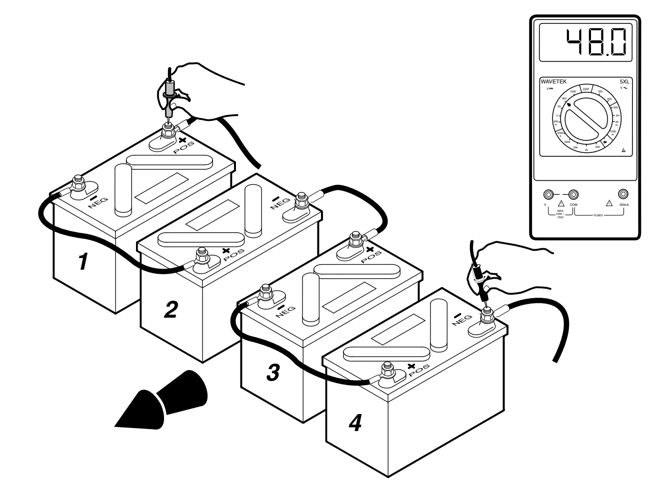
The battery voltage can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **Batteries / Voltage Check without the IQDM Handset**.

Batteries / Voltage Check with the IQDM Handset

1. Connect the IQDM to the vehicle. **See Plugging the Handset into the Vehicle, Section 15, Page 15-1.**
2. Access the Test menu and select BATT VOLTAGE by using the SCROLL DISPLAY buttons. The IQDM should indicate at least 48 volts with the batteries fully charged. If not, check for loose battery connections or a battery installed in reverse polarity. **Refer to Batteries on page 18-1 for further details on battery testing.**

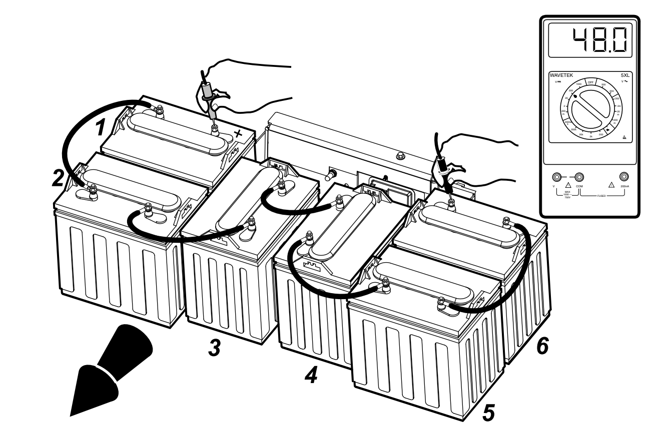
Batteries / Voltage Check without the IQDM Handset

1. With batteries connected and using a multimeter set to 200 volts DC, place red (+) probe on the positive (+) post of battery no. 1 and the black (–) probe on the negative (–) post of battery no. 4 **(Figure 11-6, Page 11-14)** or battery no. 6 **(Figure 11-7, Page 11-14)**. The multimeter should indicate at least 48 volts with the batteries fully charged. If not, check for loose battery connections or a battery installed in reverse polarity. Refer to Batteries on page 18-1 for further details on battery testing.



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

Figure 11-6 Battery Voltage Test – 4 x 12 Volt Battery Configuration



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

Figure 11-7 Battery Voltage Test – 6 x 8 Volt Battery Configuration

TEST PROCEDURE 2 – Onboard Computer Solenoid Lockout Circuit

See General Warnings on page 1-1.

The solenoid lockout circuit disables the vehicle when the battery charger is plugged into the vehicle. Use the following procedure to test the solenoid lockout circuit:

1. With batteries connected, place the Tow/Run switch in the RUN position.
2. Using a multimeter set to 200 volts DC, place black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and red (+) probe (with insulation-piercing probe) on the light blue onboard computer wire (at a point between the OBC and the six-pin connector). The reading should be approximately 38-42 volts (full battery voltage). If the reading is not 38-42 volts, proceed to step 3. If the reading is 38-42 volts, proceed to Test Procedure 3 – Solenoid Activating Coil on page 11-15.
3. Place insulation-piercing probe on the light blue 18-gauge wire at a point between OBC six-pin connector and main wire harness. If reading is 38-42 volts, check the wire terminal connectors inside six-pin connector at OBC six-pin connector. Make sure pins are properly aligned inside housing. Make sure wire colors match and are connected to the correct terminals.
4. If reading is zero volts, plug the charger DC cord into the vehicle charger receptacle. If the dash light illuminates for 10 seconds, the OBC is now powered-up. Unplug the DC cord; the reading at the OBC light blue wire should be approximately 38-42 volts. If the vehicle now operates normally, the DC cord has powered up the electrical system. The electrical system should also power-up when the accelerator pedal is pressed. To check the accelerator pedal function, see Test Procedure 4 – Throttle Position Sensor Voltage on page 11-16.
5. If the dash light illuminates for 10 seconds and the vehicle does not operate:
   - 5.1. Using a multimeter set to 200 volts DC, place black (–) probe on battery number 4 and place red (+) probe (with insulation-piercing probe) on light blue 18-gauge wire at OBC six-pin connector.
   - 5.2. With Tow/Run switch in the RUN position, the voltage reading should be approximately 48 volts.
6. If the dash light does not illuminate and the vehicle does not operate, check the OBC activation circuit.
   - 6.1. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the red 18-gauge wire located on the OBC side of the six-pin connector. The reading should be approximately 48 volts. If the reading is incorrect, test the Tow/Run switch and connecting wires. **See Tow/Run Switch on page 11-18.**
   - 6.2. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the red 18-gauge wire (harness side of six-pin connector). Multimeter should indicate 48 volts. If voltage is correct, check connections in the six-pin connector. If connections are correct, OBC activation circuit has failed. Replace OBC.

TEST PROCEDURE 3 – Solenoid Activating Coil

See General Warnings on page 1-1.

NOTE: *Be aware that one of two different solenoids may be found on the vehicle. Visually, the production solenoid is smaller than the service replacement. On the labels, the larger service replacement solenoid has SOL0605 and the smaller production solenoid has SOL5006. Internally, specifications and test results differ between the two.*

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Access the solenoid by removing the electronics module cover. **See Electronics Module Cover on page 17-5.**
3. Remove the two small wire terminals from the solenoid.
4. Place red (+) probe of the multimeter on the positive (+) solenoid terminal. Place the black (–) probe on the other small solenoid terminal.

– A reading of 200 to 250 ohms should be obtained for factory-installed solenoids **(Figure 11-8, Page 11-16)**. If not, replace the solenoid.

– A reading of 180 to 190 ohms should be obtained for service replacement solenoids **(Figure 11-9, Page 11-16)**. If not, replace the solenoid.

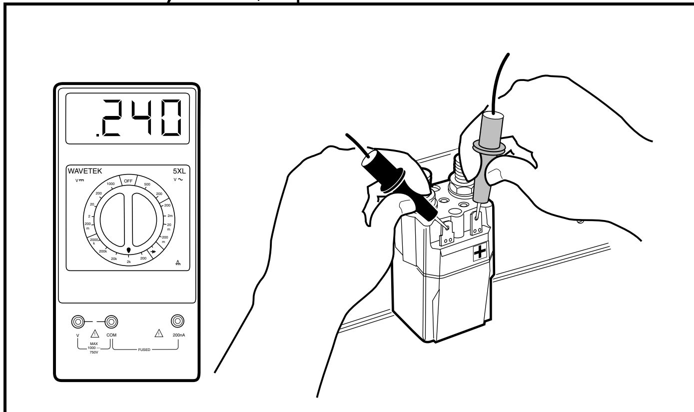


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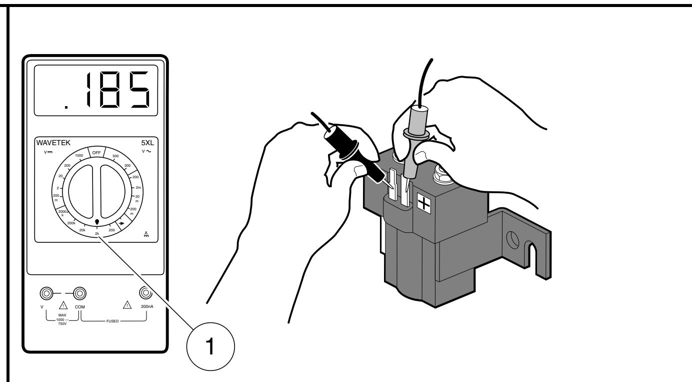
Figure 11-8 Activating Coil Test – Factory-installed Solenoid



2k Ohm Setting

2500-20000-10283
Figure 11-9 Activating Coil Test – Service Replacement Solenoid

TEST PROCEDURE 4 – Throttle Position Sensor Voltage

See General Warnings on page 1-1.

The accelerator position, which is proportional to the throttle position sensor voltage, can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **Throttle Position Sensor Voltage Test without the IQDM Handset**.

Throttle Position Sensor Voltage Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. Connect the IQDM to the vehicle.
3. Access the Test menu and select THROTTLE % by using the SCROLL DISPLAY buttons.
4. The IQDM should indicate 0 % with the pedal not pressed. While monitoring the IQDM display screen, slowly press the accelerator pedal. As the pedal is pressed, the IQDM should indicate a rise from 0 % (pedal not pressed) to 100 % (pedal fully pressed).
5. If the throttle position sensor does not operate as described in previous step, proceed to **Throttle Position Sensor Voltage Test without the IQDM Handset.**

Throttle Position Sensor Voltage Test without the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
2. With key switch OFF and batteries connected, place Tow/Run switch in RUN. Using a multimeter set to 200 volts DC, place red (+) probe on battery no. 1 positive post and place black (–) probe (with insulation-piercing probe)

on the black/white wire at a point close to the six-pin connector at the throttle position sensor. The reading should be approximately 48-50 volts (full battery voltage).

3. If reading is zero volts, check the black/white wire continuity from the six-pin connector at the throttle position sensor to the 16-pin connector at the speed controller. Check terminal positions in six-pin connector at the throttle position sensor and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.
4. With multimeter set to 20 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the white wire at a point close to the six-pin connector at the throttle position sensor. The reading should be approximately 4.65 volts.
5. If reading is zero volts, check the white wire continuity from the six-pin connector at the throttle position sensor to the 16-pin connector at the speed controller. Check terminal positions in six-pin connector at the throttle position sensor and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.
6. Turn key switch ON and, with multimeter set to 20 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the yellow wire at a point close to six-pin connector at the throttle position sensor. The reading should be approximately 0.30 volts with the pedal up. Slowly press the accelerator pedal and note the readings on the multimeter. As the pedal is pressed, the reading should increase until it reaches 4.15 to 4.45 volts when the pedal is fully pressed.
7. If reading does not increase as the pedal is pressed, replace the accelerator pedal assembly. **See Accelerator Pedal Removal on page 5-6.**
8. If the reading is not between 4.15 and 4.45 volts with the pedal fully pressed, the vehicle will not operate at rated top speed. Replace the accelerator pedal assembly. **See Accelerator Pedal Removal on page 5-6.**

TEST PROCEDURE 5 – A1 and A2 Motor Voltage

See General Warnings on page 1-1.

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

2. With the batteries connected and using a multimeter set to 200 volts DC, place the black (–) probe on the A2 motor terminal (white wire) and connect the red (+) probe to the A1 (green wire) motor terminal.
3. With Tow/Run switch in the RUN position, place the Forward/Reverse switch in the FORWARD position, turn key switch to the ON position and slowly press accelerator pedal.
4. As the accelerator pedal is pressed, the voltage reading should increase from approximately 5 volts RMS when the throttle position sensor activates, to approximately 48 volts RMS with the accelerator pedal fully pressed. **See following NOTE.**

NOTE: *Voltage can vary depending on controller speed setting as well as which zone a Guardian equipped vehicle is located.*

Example: *Speed setting 1 may only read 30 volts.*

4.1. If there is no voltage reading, check the throttle position sensor. **See Test Procedure 4 – Throttle Position Sensor Voltage on page 11-16.** Also check the continuity of the large posts of the solenoid. **See Test Procedure 22 – Solenoid Continuity on page 11-32.**

4.2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

4.3. Check continuity on A1 and A2 motor terminal posts and continuity of the F1 and F2 motor terminal posts. Also, check continuity of all motor wires. See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).

TEST PROCEDURE 6 – Tow/Run Switch

See General Warnings on page 1-1.

Tow/Run Switch Test with the IQDM Handset

1. With the Tow/Run switch in the RUN position, connect the IQDM to the vehicle.
2. Immediately after the IQDM is connected to the vehicle, the screen should display a copyright notice and the IQDM model number.
3. If the IQDM display screen is blank, drive the vehicle a short distance to activate the onboard computer.
4. If the IQDM display screen begins to work after the vehicle has been driven, turn the key switch to the OFF position and proceed to step 5; otherwise, perform the following procedure, **Tow/Run Switch Test without the IQDM Handset**.
5. With the IQDM still connected to the vehicle, place the Tow/Run Switch in the TOW position and wait 90 seconds.
6. If the IQDM display screen goes blank after 90 seconds, the Tow/Run switch and connecting wires are operating correctly.
7. If the IQDM display screen is still active after 90 seconds, the switch has failed closed. Replace the Tow/Run switch. **See Tow/Run Switch Removal on page 17-6.**

Tow/Run Switch Test without the IQDM Handset

1. With the batteries connected and using a multimeter set on 200 volts DC, connect the black (–) probe to the negative post of battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) and connect red (+) probe (with insulation-piercing probe) on the pink wire close to the connector on the Tow/Run switch.

⚠ WARNING

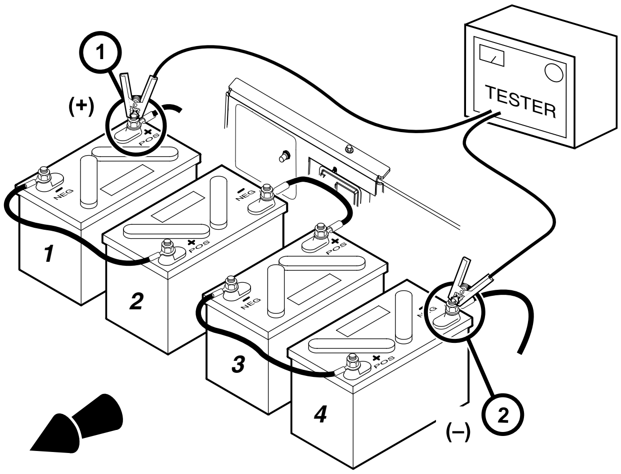
- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. With the Tow/Run switch in the RUN position, the reading should be approximately 48-50 volts. With the switch in the TOW position, the reading should be below approximately 5 volts.
3. If the reading is above 5 volts with the switch in the TOW position, replace the switch.
4. If the reading is below 5 volts with switch in the RUN position, check continuity of the pink 16-gauge wire from the large post of the solenoid to the connector at the Tow/Run switch.
5. If the continuity readings are correct, replace the Tow/Run switch.

TEST PROCEDURE 7 – Battery Pack Voltage (Under Load)

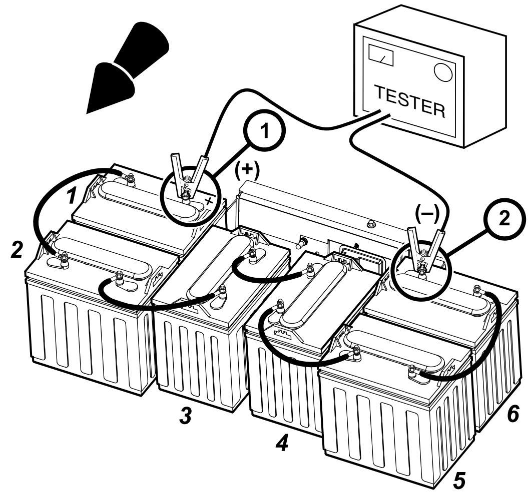
See General Warnings on page 1-1.

1. Be sure the batteries are fully charged and that the electrolyte level is correct in all cells.
2. Connect the tester leads to the positive (+) post of battery no.1 and negative (–) post of battery no. 4 **(Figure 11-10, Page 11-19)** or battery no. 6 **(Figure 11-11, Page 11-19)**.



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

2500-30100-10410
Figure 11-10 Battery Discharge Test – 4 x 12 Volt Battery Configuration



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

2500-30100-10411
Figure 11-11 Battery Discharge Test – 6 x 8 Volt Battery Configuration

3. Turn the discharge machine on and record the voltage reading of battery pack while under load.
4. A fully charged set of batteries in good condition should read between 46-49 volts while under load.
5. A reading of 32-46 volts indicates discharged or failed batteries. Each battery should be checked with a multimeter while under load.
6. A reading of 32 volts or less will not activate discharge machine. If the voltage of the batteries is below 32 volts, the batteries are deeply discharged or have failed.
7. Recording the battery pack voltage reading while under load provides a more accurate diagnosis of the condition of the batteries. When the discharge machine is ON, it places the battery pack under load and many times can help determine if one or more batteries in the set have failed. Testing battery voltage while the batteries are not under load will not always indicate the true condition of the batteries. For more information about the batteries, refer to Batteries on page 18-1.

TEST PROCEDURE 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit

See General Warnings on page 1-1.

Key Switch and Throttle Position Sensor Limit Switch Circuit Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
2. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
3. Connect the IQDM to the vehicle.
4. Test the key switch.
   - 4.1. Access the Test menu and select KEY INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the key switch is in the OFF position.
   - 4.2. While monitoring the IQDM display screen, turn the key switch to the ON position. The IQDM should indicate ON.
   - 4.3. If the IQDM does not indicate that KEY INPUT is ON when the key switch is in the ON position, proceed to the following procedure, **Key Switch and Throttle Position Sensor Limit Switch Circuit Test without the IQDM Handset**. If the key switch functions as described, proceed to the following step. **See following NOTE.**

NOTE: *The key switch MUST function properly in order to test the throttle position sensor limit switch with the IQDM handset.*

5. Test the throttle position sensor limit switch.
   - 5.1. Select FOOT INPUT on the Test menu by using the SCROLL DISPLAY buttons on the IQDM.
   - 5.2. The IQDM should indicate that FOOT INPUT is OFF when the accelerator pedal is not pressed, regardless of the key switch position.
   - 5.3. With the key switch in the ON position, press the accelerator pedal. The IQDM should indicate that FOOT INPUT is ON when the accelerator pedal is pressed.
6. If any reading is obtained that is not described in steps 4 and 5, perform the following steps:
   - 6.1. Check the wiring of the key switch and throttle position sensor. **See Wiring Diagrams on page 11-2.**
   - 6.2. Check the continuity of the key switch wires and the throttle position sensor limit switch wires.
7. If the problem was not found, proceed to the following procedure, **Key Switch and Throttle Position Sensor Limit Switch Circuit Test without the IQDM Handset**.

Key Switch and Throttle Position Sensor Limit Switch Circuit Test without the IQDM Handset

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
4. Test the key switch.
   - 4.1. Remove the instrument panel. **See Key Switch Removal on page 17-1.**
   - 4.2. Using a multimeter set to 200 ohms, place the red (+) probe on the key switch terminal with the blue wire. Place the black (–) probe on the other key switch terminal.
   - 4.3. With the key switch in the OFF position, the multimeter should indicate that continuity is not present.
   - 4.4. With the key switch in the ON position, the multimeter should indicate that continuity is present.

4.5. If any other reading is obtained, replace the key switch. **See Key Switch Removal on page 17-1.**

4.6. If the key switch operates as described in the previous steps, install the instrument panel in the reverse order of removal and proceed to the following step.

5. Test the throttle position sensor limit switch. **See following NOTE.**

NOTE: *Make sure that the key switch is operating correctly and that the key switch and instrument panel are properly installed before proceeding.*

5.1. With batteries connected and using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire close to the six-pin connector on the throttle position sensor. **See following WARNING.**

⚠ WARNING

- **The Forward/Reverse switch must be in the neutral position to avoid personal injury due to contact with rotating wheels.**

5.2. With Tow/Run switch in the RUN position, key switch in the ON position, and Forward/Reverse rocker switch in the NEUTRAL position, the voltage reading should be zero volts. When the accelerator pedal is pressed, the voltage reading should be approximately 48 volts (full battery voltage).

5.3. If the voltage reading is 48 volts when the accelerator pedal is not pressed, replace the accelerator pedal assembly. **See Accelerator Pedal Removal on page 5-6.**

5.4. If the voltage reading is zero volts when the accelerator pedal is pressed, check for voltage to the limit switch using the following test procedure.

5.4.1. Using a multimeter set to 200 volts DC, place black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the place red (+) probe (with insulation-piercing probe) on the blue wire where it connects to the throttle position sensor. With the key switch ON, the reading should be approximately 48 volts (full battery voltage).

5.4.2. If the reading is zero volts, check the continuity of the blue wire that goes from the key switch to the throttle position sensor.

5.4.3. If the reading is approximately 48 volts, replace the accelerator pedal assembly. **See Accelerator Pedal Removal on page 5-6.**

TEST PROCEDURE 9 – 16-Pin Connector

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Disconnect the 16-pin connector from the speed controller. Inspect terminal ends inside plug to ensure they are in position and seated in plug housing. If any terminals look like they are not pushed all the way into the connector, gently push the terminals until they are firmly seated in the 16-pin connector. After each terminal has been pushed into the housing, gently pull on the wire to ensure it is locked into place.
3. Check wires in the plug to make sure none are broken at the terminal pin crimp. Repair or replace as required.
4. Check the wire colors of each wire and make sure that the colors for each pin position match the wire colors in the wiring diagram. **See Wiring Diagrams on page 11-2.**
5. When connecting the 16-pin connector to the controller, push plug into controller receptacle with enough force to lock plug into place. An audible click will be heard when plug is properly seated to the controller.

A procedure is provided for testing each of the wires in the 16-pin connector. Refer to the following chart for the appropriate procedure for each pin in the 16-pin connector.

If the results of any of the referenced procedures are different from those described in the procedure, check the continuity of the wires in the wire harness and test the connected components with the appropriate test procedures. **See Index of Test Procedures.**

SPEED CONTROLLER 16-PIN CONNECTOR WIRE	FUNCTION	TEST PROCEDURE
Pin 1 – White (18-gauge)	To high side of throttle position sensor	Test Procedure 10 – Pins 1, 2, and 13 on page 11-22
Pin 2 – Yellow (18-gauge)	Pedal position signal from throttle position sensor	
Pin 3 – Open (No wire)		
Pin 4 – Open (No wire)		
Pin 5 – Light Blue (18-gauge)	OBC	Test Procedure 11 – Pin 5 on page 11-22
Pin 6 – Green (18-gauge)	To throttle position sensor limit switch for accelerator pedal input	Test Procedure 12 – Pin 6 on page 11-24
Pin 7 – Orange/White (18-gauge)	To low side of reverse buzzer	Test Procedure 13 – Pin 7 on page 11-24
Pin 8 – Brown (18-gauge)	Forward signal from FNR	Test Procedure 14 – Pins 8 and 16 on page 11-25
Pin 9 – Gray (18-gauge)	To Tow switch sonic weld	Test Procedure 15 – Pin 9 on page 11-26
Pin 10 – Tan (18-gauge)	To key switch sonic weld	Test Procedure 16 – Pin 10 on page 11-27
Pin 11 – Open (no wire)		
Pin 12 – Blue/White (18-gauge)	To low side of solenoid coil	Test Procedure 17 – Pin 12 on page 11-28
Pin 13 – Black/White (18-gauge)	Negative (-) side of motor speed sensor and throttle position sensor	Test continuity of wire and perform Test Procedure 10 – Pins 1, 2, and 13 on page 11-22 and Test Procedure 21 – Motor Speed Sensor on page 11-31
Pin 14 – Light Green (18-gauge)	To motor speed sensor output	Test continuity of each wire and perform Test Procedure 21 – Motor Speed Sensor on page 11-31
Pin 15 – Red (18-gauge)	Positive (+) side of motor speed sensor	
Pin 16 – Blue (18-gauge)	Reverse signal from FNR	Test Procedure 14 – Pins 8 and 16 on page 11-25

TEST PROCEDURE 10 – Pins 1, 2, and 13

See General Warnings on page 1-1.

Pins 1, 2, and 13 in the 16-pin connector provide a connection point from the throttle position sensor to the speed controller. Two wires simply supply 4.65 volts to the sensor. The sensor varies the voltage according to pedal position and sends that voltage signal to the controller through the third wire. See chart above. To test these wires, **see Test Procedure 4 – Throttle Position Sensor Voltage on page 11-16**.

TEST PROCEDURE 11 – Pin 5

See General Warnings on page 1-1.

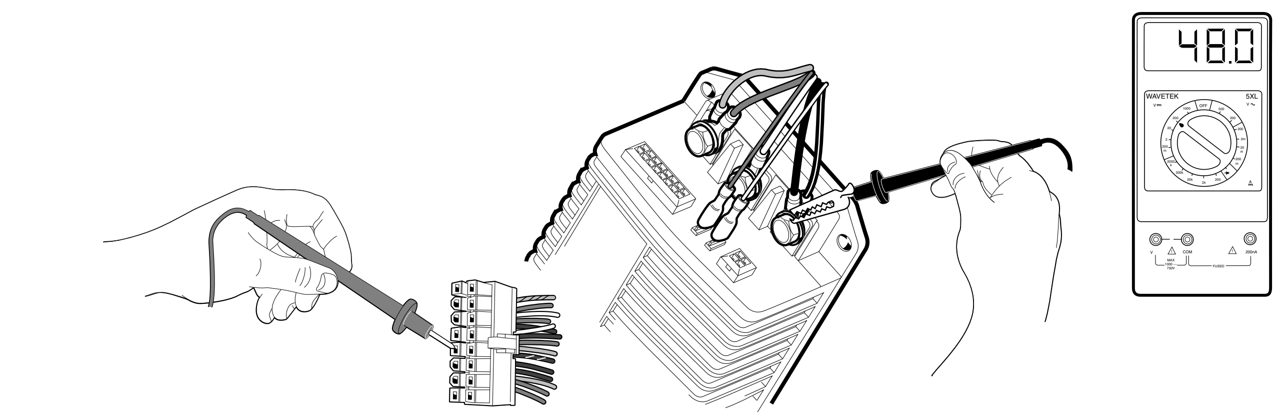
Pin 5 in the 16-pin connector provides a connection point for the solenoid lockout circuit from the onboard computer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 5 (light blue wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 11-12, Page 11-23)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**



200 DCV Setting (reading with OBC powered-up and battery charger disconnected)

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Figure 11-12 Pin 5 Test

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position.
7. The multimeter should indicate zero volts DC at this time.
8. While monitoring the multimeter, plug the battery charger into the vehicle charger receptacle.
9. After a short delay, the onboard computer should power-up (come out of sleep mode), charger relay should click, and the ammeter on the charger should indicate that the vehicle batteries are being charged.
10. The multimeter should indicate zero volts DC while the charger is connected to the vehicle.
11. While observing the multimeter, disconnect the DC plug from the vehicle charger receptacle.
12. The multimeter should indicate full battery voltage when the charger is not connected to the vehicle.
13. If any other reading is obtained, check the following items:
    – Continuity of the wires in the wire harness
    – Onboard computer for proper operation. **See Test Procedure 19 – Onboard Computer Gray Wire on page 11-30.**
    – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 11-18.**

TEST PROCEDURE 12 – Pin 6

See General Warnings on page 1-1.

Pin 6 in the 16-pin connector provides a connection point for the throttle position sensor limit switch to the speed controller. A 48 volt signal is sent through this wire when the accelerator pedal is pressed, completing the circuit inside the throttle position sensor. To test this wire, **see Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 11-20**.

TEST PROCEDURE 13 – Pin 7

See General Warnings on page 1-1.

Pin 7 in the 16-pin connector provides a connection point for the reverse buzzer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Place a jumper wire with an alligator clip between the B– terminal of the speed controller (use alligator clip for this connection) and pin 7 (orange/white wire) of the 16-pin connector **(Figure 11-13, Page 11-25)**. **See following CAUTION.**

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position.
7. The reverse buzzer should sound when the Tow/Run switch is in the RUN position.
8. If any other activity is observed, check the following items:
   – Continuity of the wires in the wire harness

   – Reverse buzzer for proper operation. **See Test Procedure 24 – Reverse Buzzer on page 11-33.**

   – Tow/Run switch for proper operation. **See Tow/Run Switch on page 11-18.**

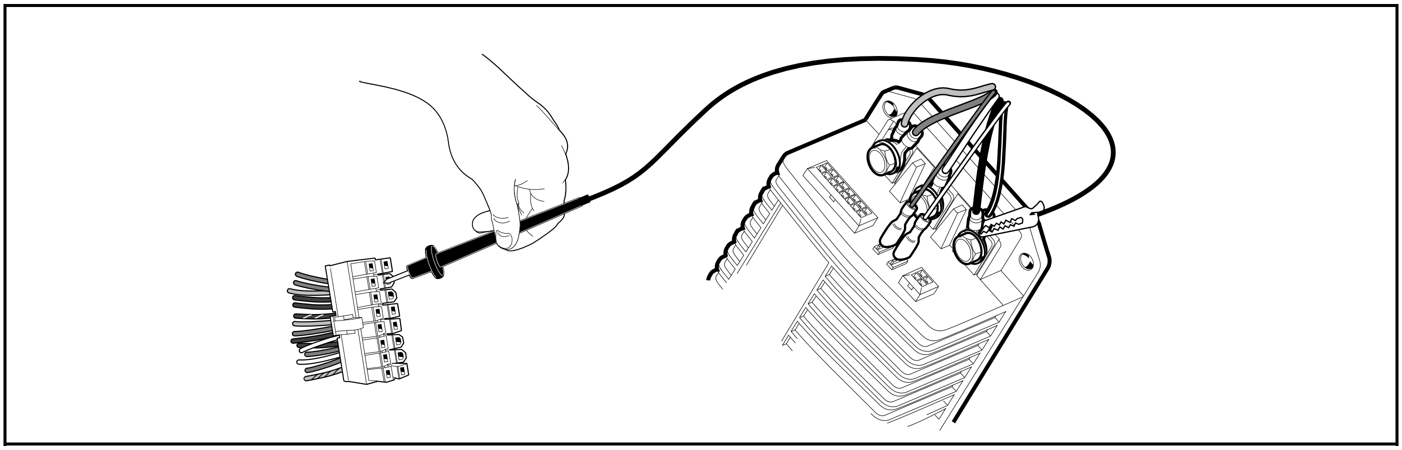

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Figure 11-13 Pin 7 Test

TEST PROCEDURE 14 – Pins 8 and 16

See General Warnings on page 1-1.

Pins 8 and 16 in the 16-pin connector provide a connection point for the Forward/Reverse rocker switch to the speed controller. The switch provides a +48 volt signal to the speed controller through pin 8 when the Forward/Reverse switch is in the FORWARD position and provides a +48 volt signal on pin 16 when the Forward/Reverse switch is in the REVERSE position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame crossmember between the spring mount and side stringer, just forward of each rear wheel. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 8 (brown wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 11-14, Page 11-26)**.

CAUTION

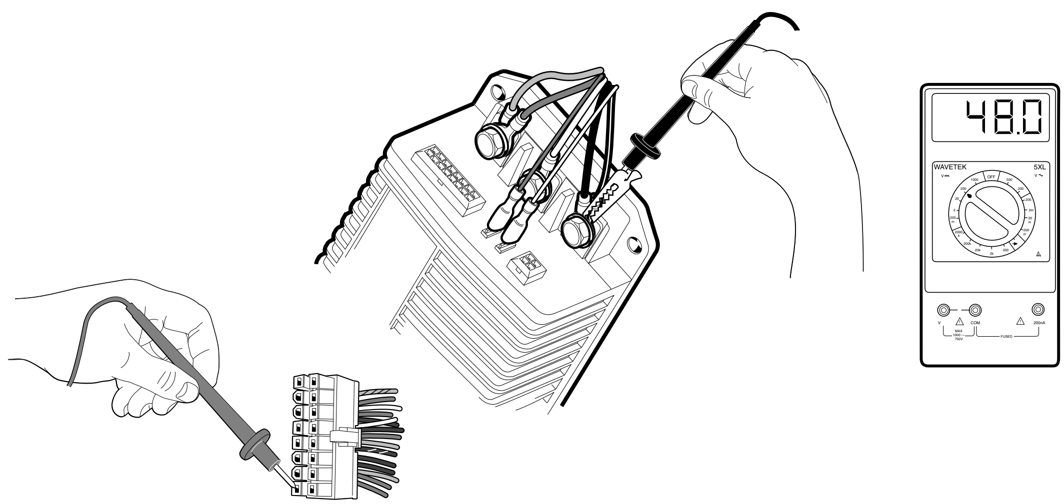
- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position and the Forward/Reverse switch in the NEUTRAL position. The multimeter should indicate zero volts DC at this time.
7. While monitoring the multimeter, place the Forward/Reverse switch in the REVERSE position. The multimeter should still indicate zero volts.
8. Place the Forward/Reverse switch in the FORWARD position. The multimeter should indicate full battery voltage (approximately 48 volts).
9. Insert the red (+) probe of the multimeter into pin 16 (blue wire) of the 16-pin connector. Leave the black (–) probe (alligator clip) connected to the B– terminal of the speed controller. **See previous CAUTION.**
10. Place the Forward/Reverse switch in the NEUTRAL position. The multimeter should indicate zero volts DC at this time.
11. While monitoring the multimeter, place the Forward/Reverse switch in the FORWARD position. The multimeter should still indicate zero volts.

12. Place the Forward/Reverse switch in the REVERSE position. The multimeter should indicate full battery voltage (approximately 48 volts).
13. If any other reading is obtained, check the following items:
    – Continuity of the wires in the wire harness

    – Forward/Reverse switch for proper operation. **See Test Procedure 23 – Forward/Reverse Rocker Switch on page 11-32.**

    – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 11-18.**



200 DCV Setting (reading with Tow/Run switch in RUN and Forward/Reverse switch in FORWARD)

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Figure 11-14 Pins 8 and 16 Test

TEST PROCEDURE 15 – Pin 9

See General Warnings on page 1-1.

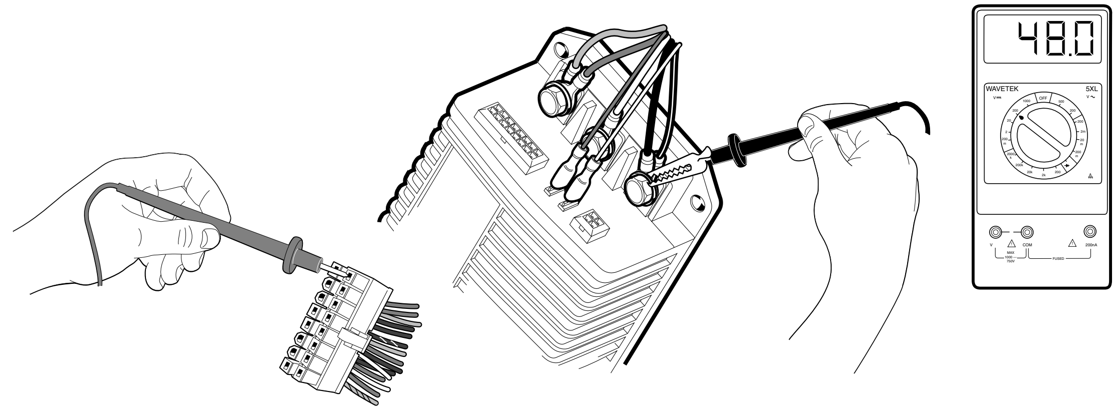
Pin 9 in the 16-pin connector provides a connection point for the Tow/Run switch to the speed controller. The switch provides a +48 volt signal to the speed controller through pin 9 when the Tow/Run switch is in the RUN position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 9 (gray wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 11-15, Page 11-27)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. With the Tow/Run switch in the TOW position, the multimeter should indicate zero volts.
7. Place the Tow/Run switch in the RUN position.



200 DCV Setting (reading with Tow/Run switch in RUN position)

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Figure 11-15 Pin 9 Test

8. With the Tow/Run switch in the RUN position, the multimeter should indicate full battery voltage (approximately 48 volts).
9. If any other reading is obtained, check the following items:
   – Continuity of the wires in the wire harness

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 11-18.**

TEST PROCEDURE 16 – Pin 10

See General Warnings on page 1-1.

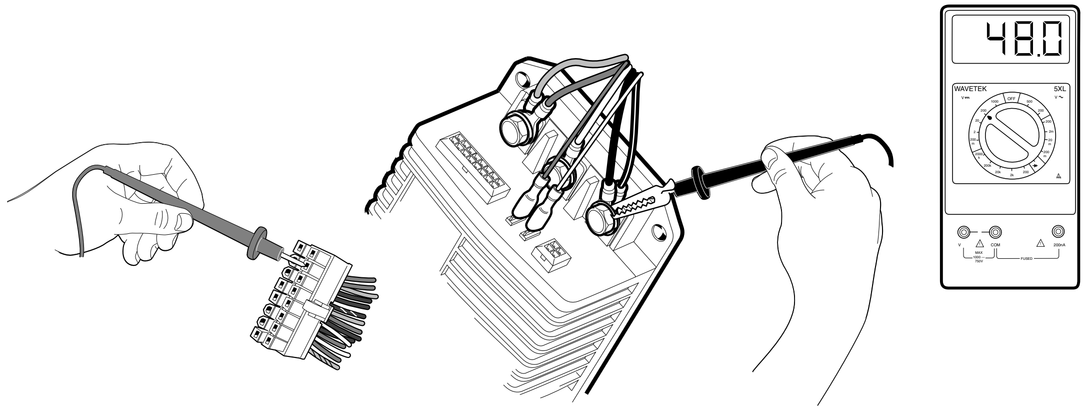
Pin 10 in the 16-pin connector provides a connection point for the key switch to the speed controller. The key switch provides a +48 volt signal to the speed controller through pin 10 when the key switch is in the ON position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 10 (tan wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 11-16, Page 11-28)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. With the Tow/Run switch in the TOW position, the multimeter should indicate zero volts.
7. Place the Tow/Run switch in the RUN position and the key switch in the ON position.



200 DCV Setting (reading with Tow/Run switch in RUN and key switch in the ON position)

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Figure 11-16 Pin 10 Test

8. With the key switch in the ON position, the multimeter should indicate full battery voltage (approximately 48 volts). With the key switch in the OFF position, the reading should be zero volts.
9. If any other reading is obtained, check the following items:
   – Continuity of the wires in the wire harness
   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 11-18.**
   – Key switch for proper operation. **See Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 11-20.**

TEST PROCEDURE 17 – Pin 12

See General Warnings on page 1-1.

Pin 12 in the 16-pin connector provides a connection point for the solenoid coil to the speed controller. The speed controller activates the solenoid coil by providing a ground to the solenoid coil at the appropriate time.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Place a jumper wire with an alligator clip between the B– terminal of the speed controller (use alligator clip for this connection) and pin 12 (blue/white wire) of the 16-pin connector **(Figure 11-17, Page 11-29)**. **See following CAUTION.**

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position and the key switch in the ON position.

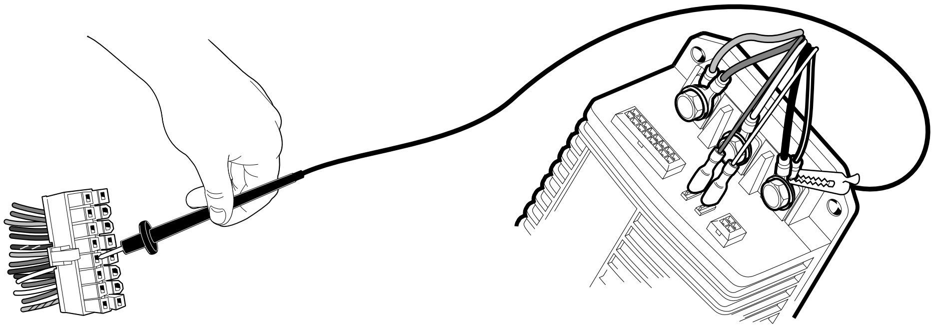
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Figure 11-17 Pin 12 Test

7. The solenoid should click when the key switch is placed in the ON position.
8. If any other activity is observed, check the following items:
   – Continuity of the wires in the wire harness

   – Reverse buzzer for proper operation. **See Test Procedure 24 – Reverse Buzzer on page 11-33.**

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 11-18.**

   – Key switch for proper operation. **See Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 11-20.**

   – Solenoid for proper operation. **See Test Procedure 22 – Solenoid Continuity on page 11-32.**

TEST PROCEDURE 18 – Onboard Computer Silicon-Controlled Rectifier (SCR) Circuit

See General Warnings on page 1-1.

The silicon controlled rectifier (SCR), located inside the onboard computer, acts as a switch on the negative side of the circuit.

This allows the onboard computer (OBC) to control the battery charging current.

Use the following procedure to test the SCR:

1. With batteries connected and using a multimeter set to 200 volts DC, place the red (+) probe on the positive post of battery no. 1 and place the black (–) probe on the charger receptacle socket that has the black 10-gauge wire attached to it. The reading should be approximately 36-42 volts.
2. If the reading is zero volts, check the black 10-gauge wire connection to the OBC connector. Check the continuity of the black 10-gauge wires. If the wires and connections are okay, the SCR has failed. Replace the OBC. If the reading is correct, proceed to the following step.
3. Plug in AC and DC cords. When the battery charger relay clicks on, reading should be approximately 48 volts (full battery voltage). If the reading does not rise from approximately 40 volts to full battery voltage when the DC cord is plugged in and the relay clicks on, check the following items:
   – Black wire terminal socket in the charger receptacle.

   – Onboard computer gray wire. **See Test Procedure 19 – Onboard Computer Gray Wire on page 11-30.**

   – Red wire at the charger receptacle. **See Test Procedure 20 – Voltage at Charger Receptacle Red Wire Socket on page 11-30.**

TEST PROCEDURE 19 – Onboard Computer Gray Wire

See General Warnings on page 1-1.

1. With batteries connected and the DC cord disconnected, pull back on the boot (1) on the gray wire (2) connection at the OBC (3) **(Figure 11-18, Page 11-30)**. Using a multimeter set to 200 volts DC, connect the red (+) probe to the positive post of battery no. 1 and black (–) probe to gray 16-gauge wire at the OBC connection (4). Reading should be approximately 48 volts. If reading is zero volts, replace the OBC.

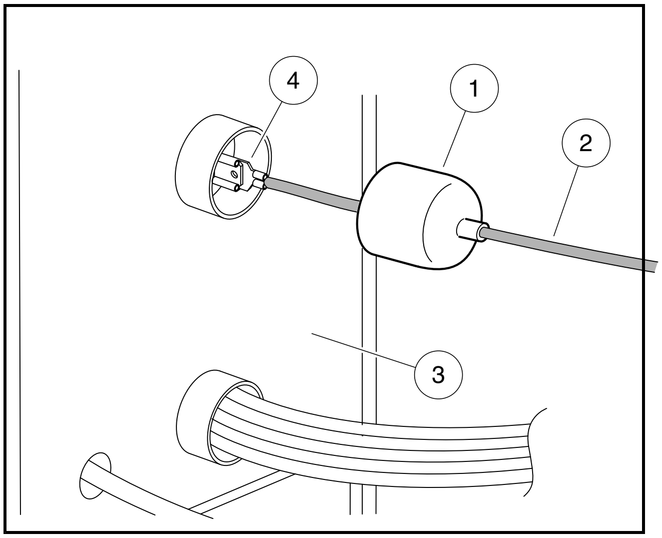

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Figure 11-18 OBC Connections

2. If the reading in step 1 is 48 volts, plug the DC cord into the vehicle's charger receptacle. The voltage reading should drop to approximately 4.0 volts before the charger relay clicks on.
3. When the charger relay is activated, the reading should rise to approximately 48 volts.
4. If voltage does not drop to approximately 4.0 volts when the DC cord is plugged in and then rise to approximately 48 volts when the charger relay clicks on, the gray wire circuit in the OBC has failed. Replace the OBC.

TEST PROCEDURE 20 – Voltage at Charger Receptacle Red Wire Socket

See General Warnings on page 1-1.

1. With batteries connected, DC cord disconnected, and using a multimeter set to 200 volts DC, place the black (–) probe on the negative post of battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) and place the red (+) probe on the charger receptacle socket connected to the red 10-gauge wire. The reading should be 48-50 volts (full battery voltage).
2. If the reading is zero volts, check the continuity of the 10-gauge red wire from the positive post of battery no. 1 to the receptacle socket.

TEST PROCEDURE 21 – Motor Speed Sensor

See General Warnings on page 1-1.

Motor Speed Sensor Test with the IQDM Handset

⚠ CAUTION

- **Perform the following procedure only on a level surface. To avoid injury or property damage, ensure that the path of the vehicle is clear before pushing vehicle.**

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Access the Test menu and select SPEED PULSES by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the vehicle is at rest.
4. While monitoring the IQDM display screen, slowly push the vehicle a short distance (about 3 feet (1 meter)). The IQDM should indicate ON for speed sensor pulses while the wheels are in motion.
5. If the IQDM does not indicate ON while the wheels are in motion, proceed to the following procedure, **Motor Speed Sensor Test without the IQDM Handset**.

Motor Speed Sensor Test without the IQDM Handset

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. With batteries connected, disconnect the three-pin connector at the motor speed sensor.
3. Check voltage at black/white wire:
   - 3.1. Using a multimeter set to 200 volts DC, place the red (+) probe on the battery no. 1 positive post and place the black (–) probe on the black/white wire terminal socket in the three-pin connector. The voltage reading should be 48 to 50 volts (full battery voltage).
   - 3.2. If the reading is zero volts, check the continuity of the black/white wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.
4. Check voltage at the red wire:
   - 4.1. With Tow/Run switch in the RUN position and using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place red (+) probe on red wire terminal socket in three-pin connector. The voltage reading should be approximately 15-16 volts.
   - 4.2. If the voltage reading is zero volts, check the continuity of the red wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the wire continuity is correct, replace the speed controller.
   - 4.3. If the reading is below 14 volts, replace the speed controller.
   - 4.4. If the voltage reading is correct, proceed to the following step.
5. Check voltage at the light green wire:
   - 5.1. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the light green wire female terminal in the three-pin connector at the motor speed sensor. The voltage reading should be from 4.60 to 4.90 volts.
   - 5.2. If the voltage is zero volts, check the continuity of the light green wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.
   - 5.3. If reading is below 3.50 volts, check the continuity of the wires and plug and replace the speed controller if necessary.

6. Reconnect the three-pin connector at the motor speed sensor. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire between the three-pin connector and the motor speed sensor.
   6.1. Raise one rear wheel off ground. Slowly turn the rear wheel to rotate the motor armature. As the armature rotates, the voltage reading should alternate from zero to approximately 4.85 volts. The voltage reading will fluctuate from zero to 4.85 volts and back to zero four times for each revolution of the motor armature.

NOTE: *The voltage reading of 4.85 is an approximate reading. The actual reading may vary from 4.50 to 5.00 volts.*

   6.2. Replace the speed sensor if:
   - There is no voltage reading.
   - The voltage reading is not above 3.50.
   - The voltage reading does not fluctuate as the motor is turned.

TEST PROCEDURE 22 – Solenoid Continuity

See General Warnings on page 1-1.

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
3. Disconnect the three wires that are crimped together from the forward large post of the solenoid.
4. Using a multimeter set to 200k ohms, place the black (–) probe on one solenoid large post and place the red (+) probe on the other large post. The reading should be no continuity.
5. Connect the three wires crimped together to the forward large solenoid post. Install washer and nut on large solenoid post and tighten to 77 in-lb (8.7 N·m).
6. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

7. Place the Tow/Run switch in the RUN position, turn the key switch to the ON position, place the Forward/Reverse rocker switch in the FORWARD position, and press the accelerator pedal. The solenoid should click and the multimeter should indicate continuity. If the reading is no continuity, replace the solenoid.

TEST PROCEDURE 23 – Forward/Reverse Rocker Switch

See General Warnings on page 1-1.

Forward/Reverse Rocker Switch Test with the IQDM Handset

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Test FORWARD INPUT.

3.1. Access the Test menu and select FORWARD INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or REVERSE position.

3.2. Place the Forward/Reverse switch in the FORWARD position. The IQDM should indicate that FORWARD INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on page 11-2.** Also check the 16-pin connector at the speed controller. **See Test Procedure 9 – 16-Pin Connector on page 11-21.**

4. Test REVERSE INPUT.

4.1. Access the Test menu and select REVERSE INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or FORWARD position.

4.2. Place the Forward/Reverse switch in the REVERSE position. The IQDM should indicate that REVERSE INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on page 11-2.** Also check the 16-pin connector at the speed controller. **See Test Procedure 9 – 16-Pin Connector on page 11-21.**

5. If the IQDM displays readings other than those described above and the wiring is found to be correct, proceed to the following procedure, **Forward/Reverse Rocker Switch Test without the IQDM Handset**.

Forward/Reverse Rocker Switch Test without the IQDM Handset

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the two screws securing the rocker switch case to the vehicle body.
3. Remove switch from car. **See Forward/Reverse Rocker Switch Removal on page 17-3.**
4. Disconnect the three wires from the rocker switch. Using a multimeter set to 200 ohms, place the black (–) probe on the brown wire terminal 3 position on the rocker switch, and place the red (+) probe on the orange wire terminal 2 position. With the switch in NEUTRAL or REVERSE, there should be no continuity. With the switch in FORWARD, there should be continuity. If the readings are incorrect, replace the switch.
5. Place the black (–) probe on the blue wire terminal 1 position on the rocker switch and place the red (+) probe on the orange wire terminal. With the switch in REVERSE, there should be continuity. If the readings are incorrect, replace the switch.

TEST PROCEDURE 24 – Reverse Buzzer

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the instrument panel. **See Key Switch Removal on page 17-1.**
3. Disconnect the orange/white and pink wires from the reverse buzzer.
4. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
5. Place the key switch in the OFF position and the Tow/Run switch in the RUN position.
6. Using a multimeter set to 200 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the pink wire terminal end that was disconnected from the reverse buzzer. The reading should be approximately 48 volts (full battery voltage).

6.1. If the voltage reading is correct, proceed to step 7.

6.2. If reading is zero volts, check pink wire continuity and Tow/Run switch. **See Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 11-15. See also Test Procedure 6 – Tow/Run Switch on page 11-18.**

6.3. If the continuity readings are not correct, repair or replace the pink wire.

6.4. If the continuity readings are correct, proceed to step 7.

7. Place the Forward/Reverse switch in REVERSE. Using a multimeter set to 200 volts DC, place the black (–) probe on the orange/white wire terminal end (that was disconnected from the reverse buzzer) and place the red (+) probe on battery no. 1 positive post. The reading should be approximately 48 volts (full battery voltage).
   7.1. If the voltage reading is correct, replace the reverse buzzer.
   7.2. If reading is zero volts, check orange/white wire continuity and connection at Pin 7 in 16-Pin connector.
   7.3. If there is no continuity in the orange/white wire, or the Pin 7 terminal in the 16-Pin connector is not properly seated, repair or replace as required.
   7.4. If the orange/white wire continuity and 16-Pin connector are correct and there is no voltage at the orange wire, replace the controller.

TEST PROCEDURE 25 – Rebooting the Onboard Computer

See General Warnings on page 1-1.

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

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

NOTE: *Wait at least 90 seconds for the capacitors in the speed controller to discharge. The capacitors in the speed controller must be fully discharged in order to reboot the OBC.*

2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
3. Place Tow/Run switch in the RUN position.
4. Test drive the vehicle. If the vehicle functions normally the problem is corrected. If the problem still exists, refer to Wiring Diagrams on page 11-2.

TEST PROCEDURE 26 – Battery Warning Light

See General Warnings on page 1-1.

1. Reboot the OBC and drive the vehicle a short distance. When vehicle is first driven, the battery warning light should illuminate for 10 seconds. **See Test Procedure 25 – Rebooting the Onboard Computer on page 11-34.** If the battery warning light does not illuminate when rebooting the OBC, proceed to step 2.
2. Turn key switch OFF, place Tow/Run switch in TOW and place Forward/Reverse rocker switch in NEUTRAL.
3. Disconnect the six-pin connector at the OBC.
4. Remove the wedge lock from the six-pin connector housing that is connected to the vehicle wire harness. Remove the brown/white wire from the connector plug.
5. Using a jumper wire with an alligator clip at each end, connect one alligator clip to the negative post of battery no. 1 and the other alligator clip to the brown/white wire terminal socket that was removed from the six-pin connector plug.
6. Install the wedgelock in the six-pin connector housing and reconnect the six-pin connector plug. Place the Tow/Run switch in the RUN position and the battery light should illuminate. If the light does not illuminate, replace the battery warning light assembly.

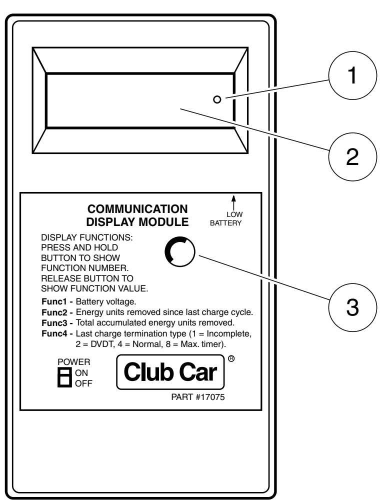
BATTERY WARNING LIGHT

IQ System and Excel 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 if the charge is less than 90% complete but the vehicle has enough power for 60 minutes of operation. This will alert the fleet operator that the vehicle may be used, but that it must be charged to completion as soon as possible.
- The 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 battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals, 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 battery warning light will flash quickly, after inserting the DC plug, indicating the charger's voltage suppressor has failed closed.

COMMUNICATION DISPLAY MODULE (CDM)



1. Low Battery 2. Display Window 3. Function Button

2500-19200-10300

Figure 11-19 CDM

The CDM can be used to retrieve from the onboard computer four important items of information that can be useful in troubleshooting the IQ System vehicle. To access one of these items, the item's corresponding Function Code must be selected on the CDM. This is done by pressing the Function Button until the desired function code is displayed in the window. **See Figure 11-19, Page 11-35 for CDM features.** Releasing the button when the desired code is displayed will display the data. Function codes and corresponding data are as follows:

- **F1 – Battery voltage:**
- This displays the battery pack's current state of charge. A reading of less than 48 volts indicates that the batteries need to be charged. If a reading of less than 48 volts is obtained immediately after a charge cycle, there may be a problem in the charge circuit.
- **F2 – Energy units removed since last charge cycle:**
- If the display reads over 75 (the vehicle battery warning light should be illuminated), the vehicle batteries need to be recharged before being used again. This data can be used to make sure all vehicles in a fleet receive equal usage on a short-term basis.
- **F3 – Total accumulated energy units removed since initial vehicle start-up:**
- This information is most useful in making sure that all vehicles in a fleet receive equal usage over long periods of time.
- **F4 – Last charge termination type (1 = incomplete, 2 = DVDT, 4 = normal, 8 = max. timer):**
- A **1**, **2**, **4**, or **8** will be displayed.
- **1** – Indicates the last charge cycle was incomplete and the batteries were not fully charged. Batteries should be charged again at the earliest opportunity.
- **2** – Indicates a back-up charge program was employed by the OBC to complete the charge cycle if a normal charge (4) is not possible. DVDT refers to an increase in voltage within a time period. The OBC monitors battery voltage during charging and will terminate the charge when the voltage does not increase within the time period. A DVDT charge may be displayed the first few times a new set of batteries is charged, and the first time a set of batteries is charged after the batteries have been disconnected and reconnected. A problem may exist if persistent DVDT readings are obtained.
- **4** – Indicates the last charge cycle was normal.
- **8** – Indicates the charger ran for sixteen hours and shut itself off without completing the charge cycle. This means there may be a problem in the charge circuit.

The CDM also has a low battery indicator, which illuminates when CDM batteries are weak and need to be replaced. Weak batteries in the CDM may cause the CDM to register inaccurate information or no information.

USING THE CDM TO RETRIEVE DATA FROM THE ONBOARD COMPUTER

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

NOTE: *If, by positioning CDM on seat bottom, the CDM is unable to collect the data stream from the onboard computer, hold CDM approximately 6 inches (15.2 cm) from battery warning light.*

3. Wait approximately 30 seconds for a value to appear in the display window.
4. If a value does not appear in the display window after 30 seconds, try adjusting the aim of the CDM and repeating step 3 until a value appears. If there is still no reading, check for weak batteries in the CDM.
   - 4.1. Adjust aim of CDM.
   - 4.2. Drive vehicle a short distance to ensure OBC is not in powerdown mode.
   - 4.3. Check for weak batteries in CDM.

4.4. If reading is still not obtained, go to the CDM Troubleshooting Guide on page 11-38.

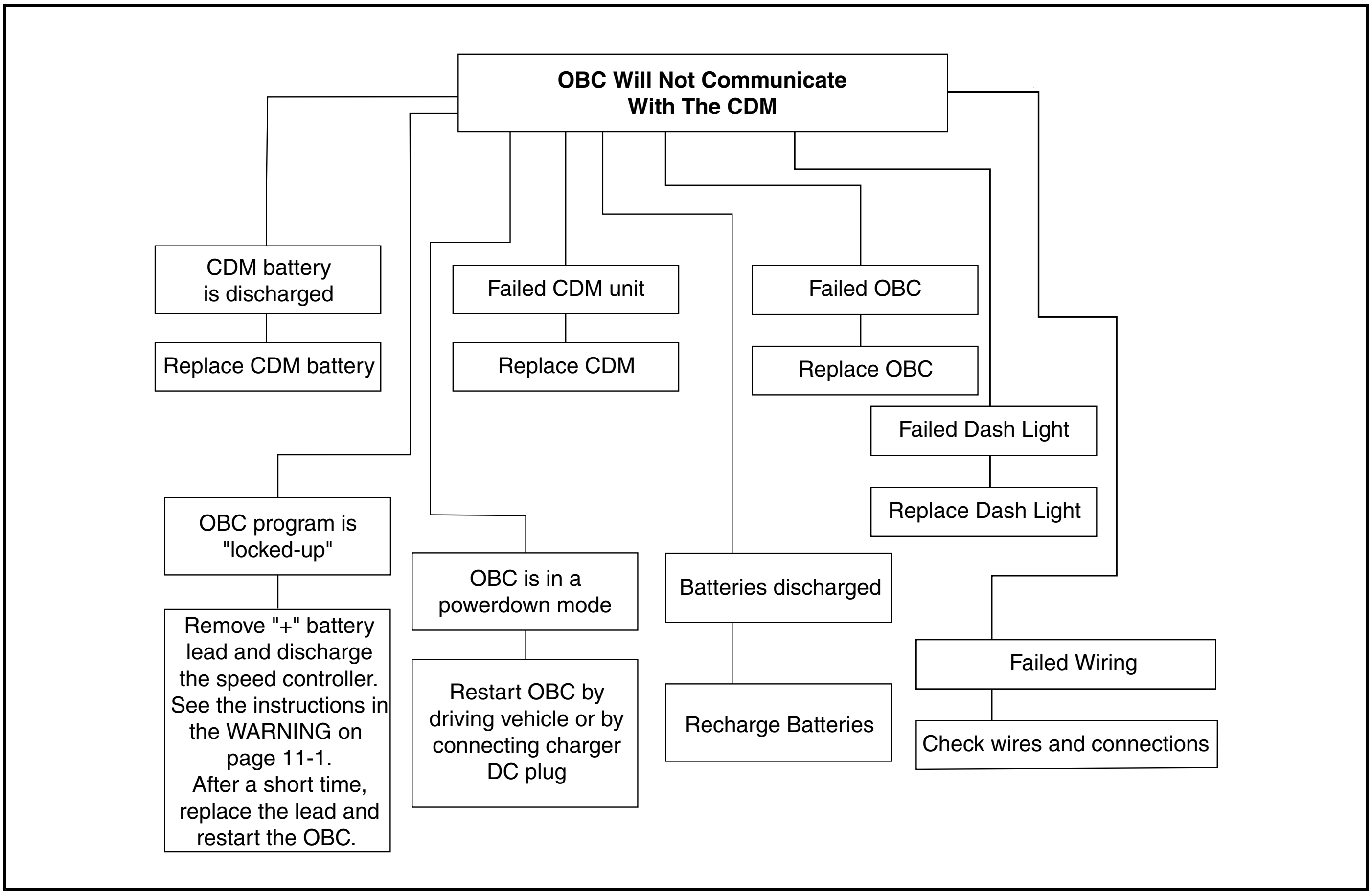
Once a value has been obtained in the display window, the CDM may be removed from its receiving position and the data reviewed. The CDM will hold the values for F1, F2, F3, and F4 until the CDM is turned OFF or it receives another line of data from the same or another onboard computer. Use the following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

- The value currently displayed will be F1 (battery voltage).
- To view F2, press and hold the button on the CDM. When “Func 2” appears in the display window, release the button. The value for F2 will then be displayed.
- To view F3, press and hold the button on the CDM until “Func 3” appears in the display window. Release the button. The value for F3 will be displayed.
- To view F4, press and hold the button on the CDM until “Func 4” appears in the display window. Release the button. The value for F4 will be displayed.

NOTE: *The values of all four functions can be recalled by pressing and releasing the CDM button.*

CDM TROUBLESHOOTING GUIDE

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



2500-19200-10301

Figure 11-20 Flow Chart – CDM Troubleshooting Guide

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**
- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

GENERAL INFORMATION

NOTE: *Many 2009 model year Precedent vehicles have had the pedal group reworked to use an MCOR in place of the throttle position sensor. Use this troubleshooting section for system diagnosis. For a vehicle that still uses the throttle position sensor, see **Excel System Troubleshooting – TPS on page 13-1** or **IQ System Troubleshooting – TPS on page 11-1**.*

Starting early 2010 model year with Serial Number PQ1009-082079, all electric Precedent vehicles were factory-equipped with an MCOR sensor in the Gen II pedal group. The pedal group has its own serial number with a prefix that also changed as follows:

Gen II pedal group equipped with throttle position sensor (before reverting to MCOR):	either PGE1 or PBE1(with brake light switch)
Gen II pedal group equipped with MCOR:	either PGE2 or PBE2(with brake light switch)

The IQ System vehicle uses a 48-volt electrical system that is powered by four 12-volt lead-acid batteries or six 8-volt lead-acid batteries and includes an onboard computer. The IQ System vehicle uses a shunt-wound 3.2 hp motor and includes several additional features.

- **Shunt-Wound Motor:** The shunt-wound motor, unlike a series motor, is designed so that the speed controller is able to vary the amount of current passing through the field coils independently from the current passing through the armature.
- **Motor Braking:** Under certain conditions a shunt-wound motor also has the ability to act as an electrical brake to slow the vehicle. There are three features of the IQ electrical system which will activate the motor braking function: Walk Away Braking, Pedal Down Motor Braking, and Pedal Up Motor Braking (adjustable with the IQDM-P handset).
- **Walk Away Braking:** This prevents the vehicle from rolling away uncontrolled should the driver park on a slope and leave the vehicle without locking the park brake. The vehicle will roll at about 1 mph (1.6 km/h). If the walk away braking function remains engaged for two seconds or more, a warning buzzer will sound to alert the driver that motor braking has been activated.

⚠ WARNING

- **Walk Away Braking will not limit vehicle speed to 1 mph (1.6 km/h) on very steep grades. Do not operate vehicle on slopes exceeding 20% grades.**

WIRING DIAGRAMS

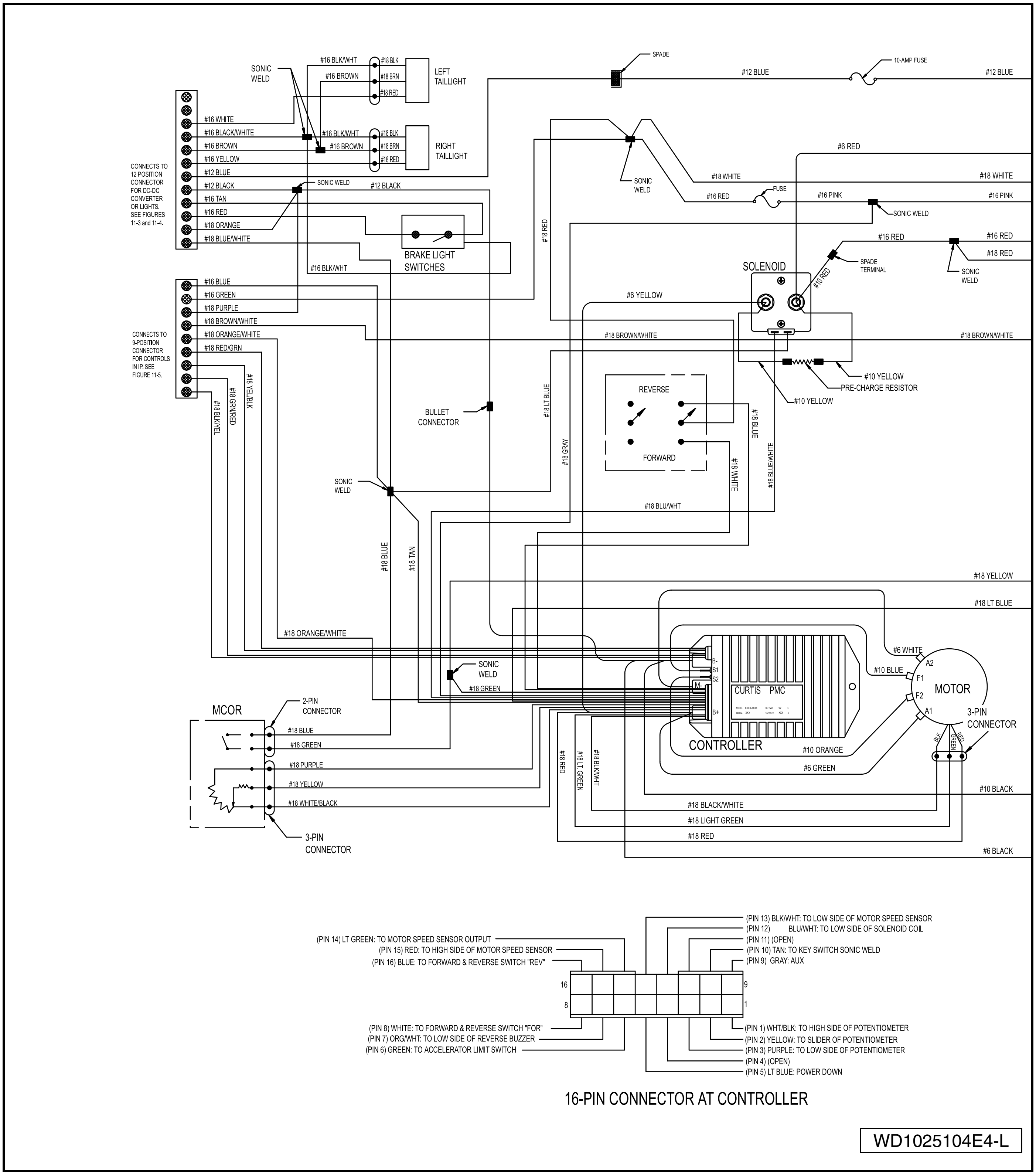


Figure 12-1 Wiring Diagram – IQ System with MCOR

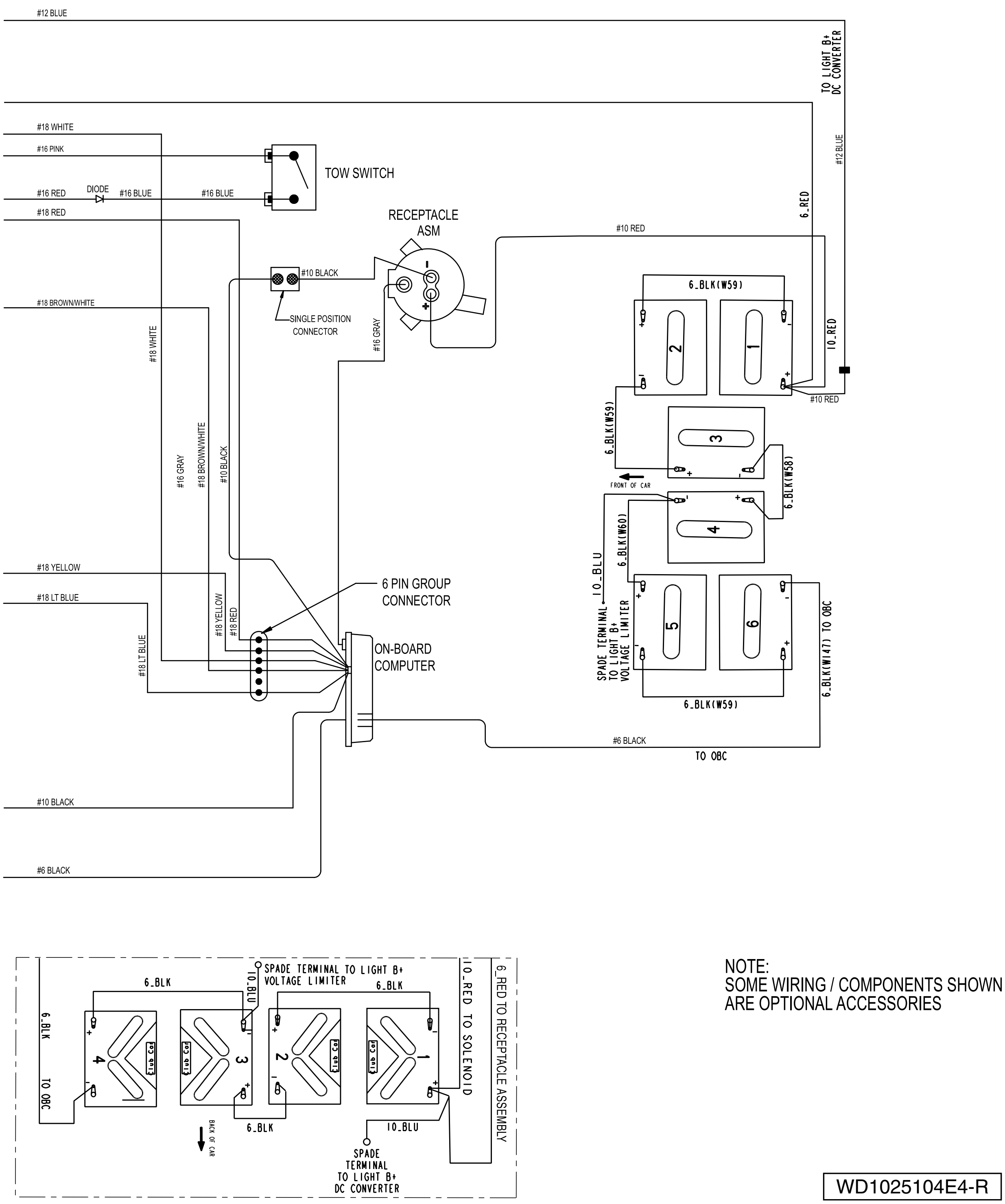


Figure 12-2 Wiring Diagram – IQ System with MCOR (Continued)

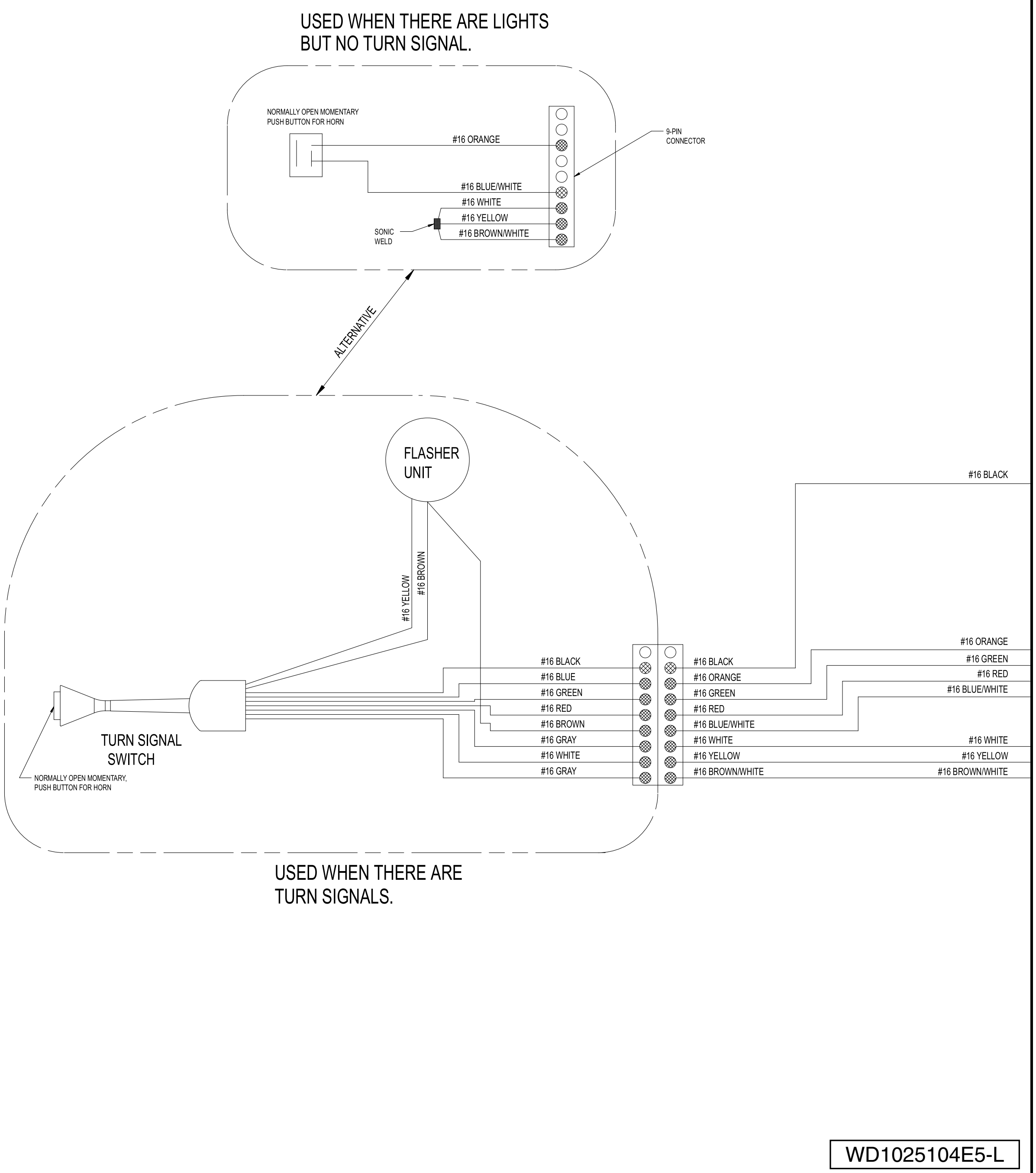


Figure 12-3 Precedent Electric Vehicle Accessory Wiring Diagram

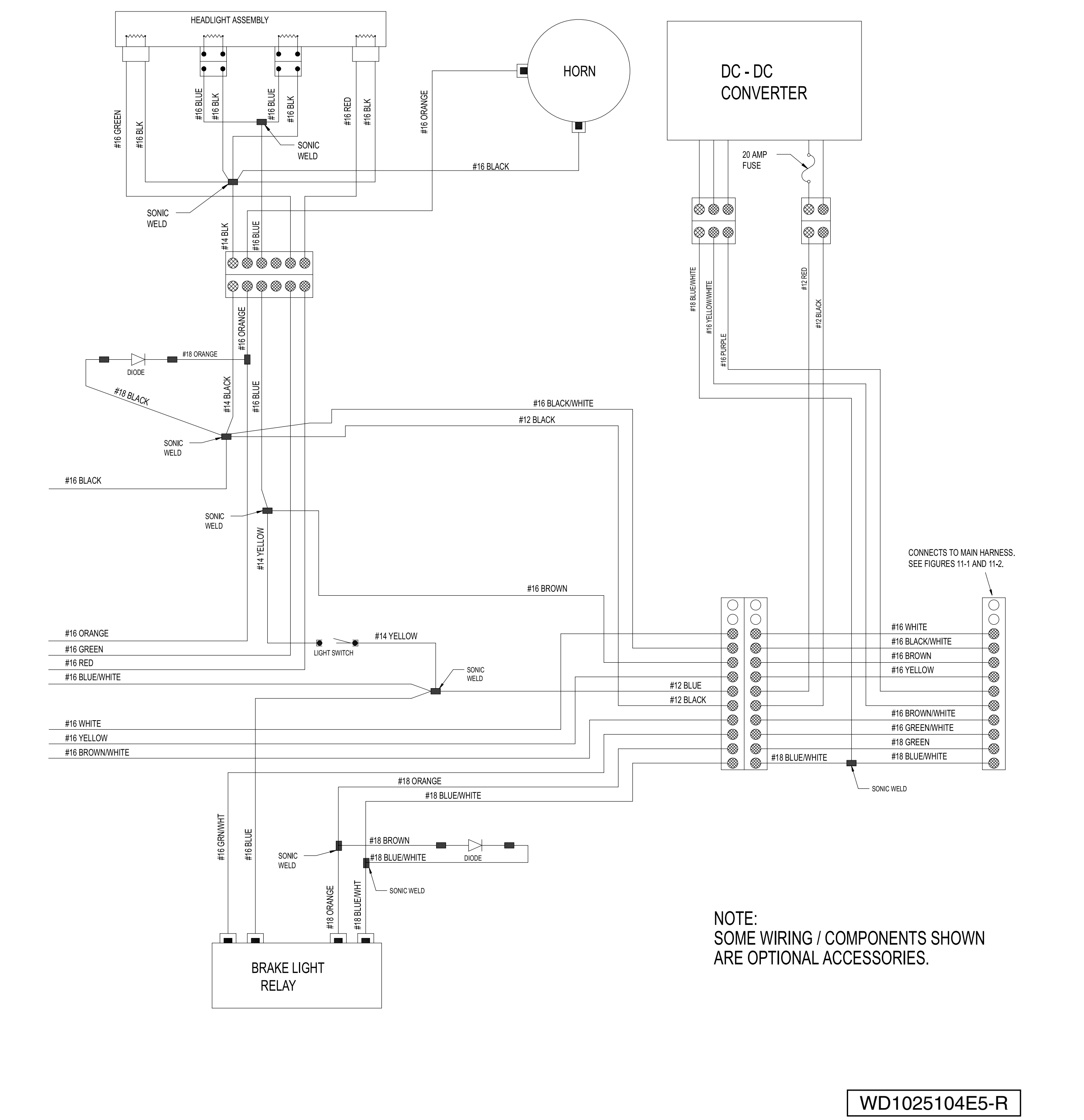


Figure 12-4 Precedent Electric Vehicle Accessory Wiring Diagram (Continued)

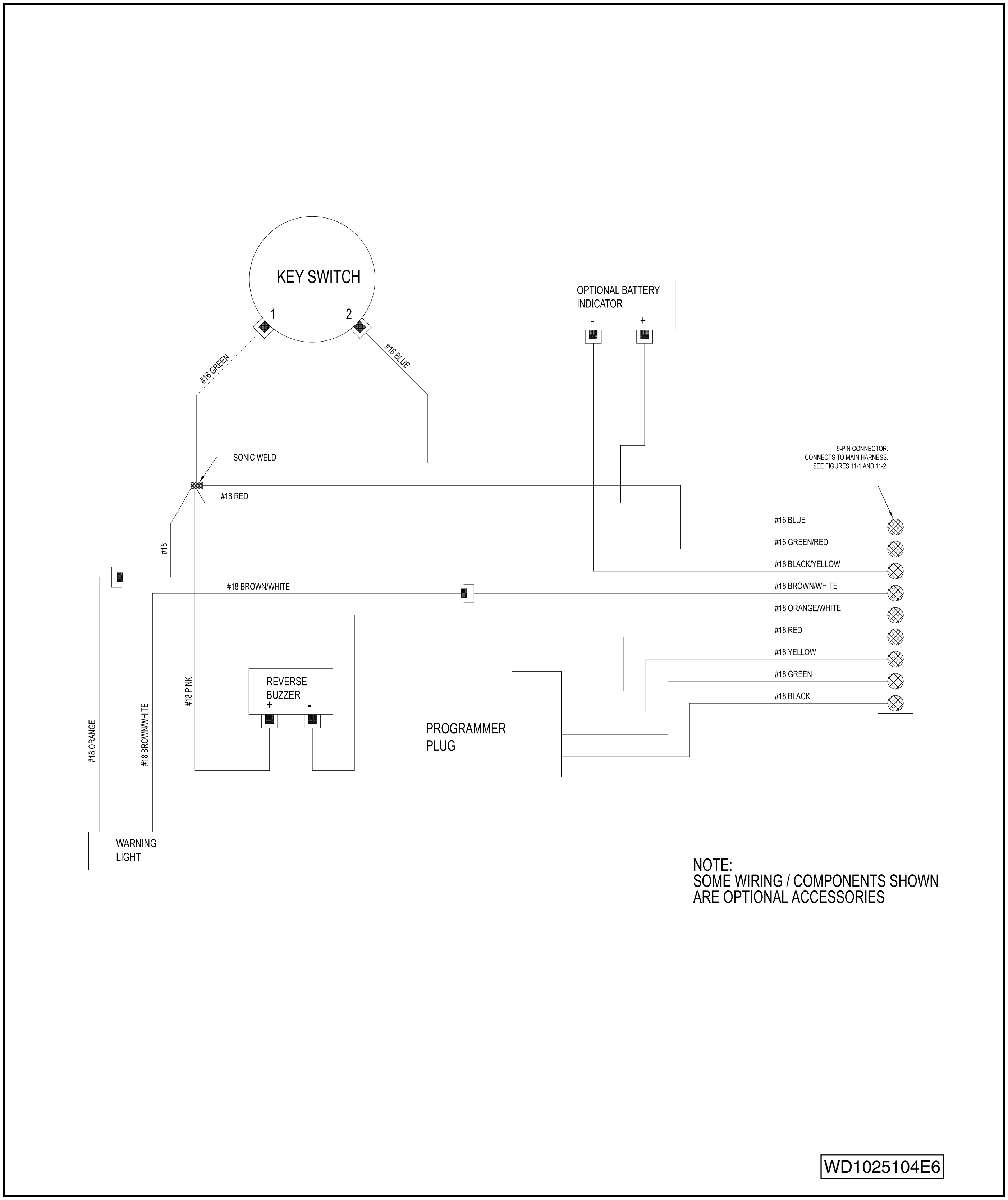


Figure 12-5 Precedent Electric Vehicle Instrument Panel Wiring Diagram

- **Pedal Down Motor Braking:** This feature helps to control vehicle downhill speed. Motor braking is activated when the vehicle reaches the programmed top speed and holds the vehicle at that speed. Motor braking is automatically disengaged when vehicle speed slows below the programmed top speed.
- **Pedal Up Motor Braking:** When vehicle speed is above 11 mph (17.7 km/h), releasing the accelerator pedal will activate motor braking, which slows the vehicle speed. Once vehicle speed slows to below approximately 11 mph (17.7 km/h), with the accelerator pedal still released, motor braking will be deactivated and the vehicle will coast freely. This feature is selectable. Contact your Club Car dealer/distributor to inquire about this selectable feature.
- **Regenerative Braking**: When motor braking is activated, the vehicle motor acts as a generator, slowing the vehicle as it creates energy that is used to charge the batteries.
- **Tow/Run Switch:** When the Tow/Run switch is in the RUN position, the vehicle will function normally. When the switch is in the TOW position, power to the OBC and controller is shut off, disabling the vehicle operating circuit and walk away braking, allowing the vehicle to be towed.
- **Motor Protection Circuit:** The operator should never attempt to hold the vehicle on an incline by pressing the accelerator pedal instead of the brake pedal, as motor overheating could result. By reducing the current to the motor during such an occurrence, the motor protection circuit reduces the possibility of motor damage. When this situation arises, a *motor stall fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See Motor Stall on page 15-11.**
- **High Pedal Detect:** This function prevents unexpected vehicle movement if the key switch is turned ON after the accelerator is pressed, or the accelerator pedal is pressed when Forward/Reverse switch is used to change the direction of travel. The vehicle will not move until the accelerator is released and pressed again. When this situation arises, a *HPD fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See HPD on page 15-11.**
- **Onboard Computer (OBC):** The OBC, 1) monitors battery condition, 2) monitors the number of energy units used by the vehicle, 3) determines the number of energy units required to recharge the batteries and shuts the charger off when this number is reached, 4) determines when to activate regenerative motor braking, 5) locks out vehicle movement while the charger is plugged into the vehicle charger receptacle, 6) stores operating data, which can be read by the Communication Display Module (CDM). **See Communication Display Module (CDM) on page 12-39.**

TROUBLESHOOTING

The following troubleshooting guides will be helpful in identifying operating difficulties should they occur. The guides include the symptom, probable cause(s) and suggested checks. The procedures used in making these checks can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING THE VEHICLE WITH THE IQDM

Club Car recommends the use of the IQDM handset for troubleshooting vehicles equipped with the IQ electrical system. Troubleshooting Guide 1 is to be used in conjunction with the IQDM handset. See IQ Display Module (IQDM) and IQDM-P Diagnostics: IQ System on page 15-1 for operating instructions. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the IQDM while the vehicle is in motion. A technician can monitor the IQDM while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

In the event that the vehicle is not functioning properly after completing Troubleshooting Guide 1, the technician should proceed to Troubleshooting Guide 2.

If an IQDM handset is unavailable, the technician should proceed to Troubleshooting Guide 2.

TROUBLESHOOTING GUIDE 1

The following troubleshooting guide is intended for use with an IQDM handset. **See following NOTE.**

NOTE: *Before troubleshooting the vehicle, check the diagnostic history from the Special Diagnostics Menu. Note any fault codes.*

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Test Menu – THROTTLE % value does not increase as the accelerator pedal is pressed or Diagnostic Menu – THROTTLE FAULT 1 fault code	Loose or disconnected three-pin connector at the MCOR or broken wire	Repair and/or connect the three-pin connector to the MCOR
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed MCOR	Test Procedure 4 – MCOR Voltage on page 12-16
Test Menu – HEATSINK °C indicates that temperature is above 85 °C (145 °F) or Diagnostic Menu – THERMAL CUTBACK fault code	Over-adjusted brakes	Section 6 – Wheel Brake Assemblies
	Vehicle is over-loaded	Ensure that vehicle is not over-loaded before returning to operation
Test Menu – ARM PWM value does not reach 100% when vehicle is at full speed	Failed MCOR	Test Procedure 4 – MCOR Voltage on page 12-16
Test Menu – SPEED PULSES menu item indicates that speed pulses are OFF when the vehicle is in motion or Diagnostic Menu – SPEED SENSOR fault code	Loose or disconnected motor speed sensor or broken wire	Repair and/or connect the three-pin connector to the motor speed sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed motor speed sensor	Test Procedure 21 – Motor Speed Sensor on page 12-34
Test Menu – FOOT INPUT menu item indicates that the MCOR internal limit switch is always ON or always OFF.	Loose or disconnected two-pin connector at the MCOR or broken wire	Repair and/or connect the two-pin connector to the MCOR
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed MCOR	Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 12-21
Test Menu – FORWARD INPUT and/or REVERSE INPUT does not indicate the correct reading or Diagnostic Menu – PROC/WIRING fault code	Loose or disconnected Forward/Reverse rocker switch (quick disconnect terminals) or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected Forward/Reverse rocker switch (three-pin connector) or broken wire	Repair and/or connect the three-pin connector from the Forward/Reverse switch to the wire harness
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed Forward/Reverse rocker switch	Test Procedure 23 – Forward/Reverse Rocker Switch on page 12-35

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Test Menu – MAIN CONT (solenoid) does not indicate ON when the solenoid should be activated. or Diagnostic Menu – MAIN CONT DNC (main contactor (solenoid) did not close) fault code	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING “To avoid unintentionally starting...” in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
	Loose, broken, or disconnected wire(s) at solenoid or B+ speed controller terminal	Repair and/or connect the loose or disconnected wire(s)
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed solenoid	Replace solenoid. **See Solenoid Removal on page 17-13.**
Test Menu – KEY INPUT does not indicate ON when key switch is in the ON position	Loose or disconnected wires at key switch terminals or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed key switch	Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 12-21
Diagnostic Menu – THROTTLE FAULT 1 fault code	Loose or disconnected three-pin connector at the MCOR or broken wire	Repair and/or connect the three-pin connector to the MCOR
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed MCOR	Test Procedure 4 – MCOR Voltage on page 12-16
Diagnostic Menu – HW FAILSAFE (Hardware Failsafe) fault code	Armature drive FET’s (field-effect transistors) inside speed controller have failed	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING “To avoid unintentionally starting...” in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
Diagnostic Menu – MAIN WELDED (main solenoid contacts welded) fault code	solenoid contacts have failed closed	Replace solenoid. **See Solenoid Removal on page 17-13.**
Diagnostic Menu – MAIN DRIVER ON or MAIN DRIVER OFF fault code	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING “To avoid unintentionally starting...” in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
	Failure of the FET that controls the solenoid coil	Replace the speed controller. **See Speed Controller Removal on page 17-12.**

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Diagnostic Menu – MAIN COIL FAULT fault code or Diagnostic Menu – MAIN DROPOUT fault code	Solenoid coil has failed in an open condition	Replace solenoid. **See Solenoid Removal on page 17-13.**
Diagnostic Menu – FIELD MISSING fault code	Loose or disconnected motor field coil wires at motor or speed controller or broken wire	Repair and/or connect the field coil wires
	Failure of the motor field windings	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Failure of the FET's that control field current	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
Diagnostic Menu – HPD (high pedal detect) fault code	Operator error	Train operators to fully remove foot from accelerator pedal before turning key switch to the ON position or changing the selected direction with the Forward/Reverse switch
Diagnostic Menu – LOW BATTERY fault code	Batteries require charging	Place batteries on battery charger and allow them to fully charge
	Improperly maintained or failed batteries	See Section 18 – Batteries.
Diagnostic Menu – MOTOR STALL fault code	Operator error	Train operators to use the brake to hold the vehicle on a hill, rather than holding the vehicle on a hill using the accelerator pedal
Diagnostic Menu – OPEN ARMATURE fault code	Loose or disconnected motor armature wires at motor or speed controller or broken wire	Repair and/or connect the motor armature wires
	Failure of the motor armature or brushes	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Failure of the FET's that control armature current	Replace the speed controller. **See Speed Controller Removal on page 17-12.**

TROUBLESHOOTING GUIDE 2

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle does not operate	Batteries – Batteries discharged	Charge batteries
	Batteries – Battery connections	Check vehicle wiring. **See Wiring Diagrams on page 12-2.**
	Battery charger is connected to the vehicle – Solenoid lockout feature has disabled the vehicle	Disconnect the battery charger from the vehicle.
	Onboard computer failure	Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 12-15
	Key switch and MCOR limit switch circuit	Check for loose or disconnected wires at key switch and MCOR
	Failed key switch	Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 12-21
	Failed MCOR	Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 12-21. See also Test Procedure 4 – MCOR Voltage on page 12-16.
	Forward/Reverse rocker switch	Test Procedure 23 – Forward/Reverse Rocker Switch on page 12-35
	Solenoid – loose wires	Test Procedure 3 – Solenoid Activating Coil on page 12-16
	Solenoid – failed coil	Test Procedure 3 – Solenoid Activating Coil on page 12-16
	Speed controller thermal cutback	Allow controller to cool and ensure that vehicle is not over-loaded before returning to operation
	16-pin connector at speed controller	Check for loose or disconnected wires at the 16-pin connector. **See also Test Procedure 9 – 16-Pin Connector on page 12-23.**
	High pedal detect	Cycle accelerator pedal
	Motor stall	Cycle accelerator pedal
	Motor Failure	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 17-12.**

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle runs slowly	Speed sensor disconnected or failed	Test Procedure 21 – Motor Speed Sensor on page 12-34
	Incorrect speed setting	To change the programmed top speed of the vehicle, an IQDM-P handset must be used
	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 12-2.**
	Batteries – Batteries discharged	Charge batteries
	MCOR malfunction	Test Procedure 4 – MCOR Voltage on page 12-16
	Motor – loose wires	Inspect and tighten all wire connections at the motor.
	Failed motor	Replace motor. **See Motor Removal on page 20-3.**
	Vehicle is over-loaded	Ensure that vehicle is not over-loaded before returning to operation.
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 17-12.**
	Brakes – improperly adjusted	See Section 6 – Wheel Brake Assemblies.
	Tires – under-inflated or flat tires	See Section 8 – Wheels and Tires.
Vehicle operates, but motor braking function does not	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 12-2.**
	Speed sensor disconnected or failed	Test Procedure 21 – Motor Speed Sensor on page 12-34
Vehicle will run in forward, but not in reverse or will run in reverse but not forward	Forward/Reverse rocker switch – improperly wired	Test Procedure 23 – Forward/Reverse Rocker Switch on page 12-35
	Motor – improperly wired	Check motor wiring. **See Wiring Diagrams on page 12-2.**
	Speed controller – improperly wired or failed speed controller FET	Check vehicle wiring. **See Wiring Diagrams on page 12-2.**
Vehicle operates, but battery charger does not charge batteries	Onboard computer – gray wire	Test Procedure 19 – Onboard Computer Gray Wire on page 12-33
	Battery charger connections – loose wires at receptacle or batteries	Check wire connections and tighten if necessary.
	Battery charger	Refer to the appropriate battery charger maintenance and service manual.

TEST PROCEDURES

Using the following procedures, the entire IQ electrical system can be tested without major disassembly of the vehicle.

⚠ WARNING

- **If wires are removed or replaced, make sure wiring and wire harness is properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.**

For many tests the electronics module cover must be removed to gain access to the various components that are mounted on the component mounting plate. **See Electronics Module Cover on page 17-5.** **See following WARNING.**

⚠ WARNING

- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

After test procedures are completed, be sure to replace the cover. **See Electronics Module Cover on page 17-5.** **See following CAUTION.**

CAUTION

- **Exposure to water may damage electronic components.**
  - **Do not operate vehicle without the cover properly installed.**
  - **Do not direct a water stream in area of the cover.**

Index of Test Procedures

21 – Motor Speed Sensor
22 – Solenoid Continuity
23 – Forward/Reverse Rocker Switch
24 – Reverse Buzzer
25 – Rebooting the Onboard Computer
26 – Battery Warning Light

TEST PROCEDURE 1 – Batteries / Voltage Check

See General Warnings on page 1-1.

NOTE: *The batteries must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in the Battery section of this manual.* ***See Battery Care, Section 18, Page 18-16.***

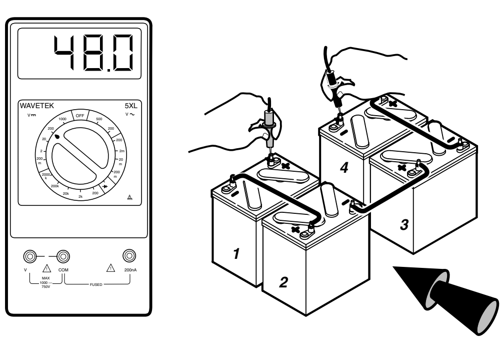
The battery voltage can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **Batteries / Voltage Check without the IQDM Handset**.

Batteries / Voltage Check with the IQDM Handset

1. Connect the IQDM to the vehicle. **See Plugging the Handset into the Vehicle, Section 15, Page 15-1.**
2. Access the Test menu and select BATT VOLTAGE by using the SCROLL DISPLAY buttons. The IQDM should indicate at least 48 volts with the batteries fully charged. If not, check for loose battery connections or a battery installed in reverse polarity. **Refer to See Section 18 – Batteries. for further details on battery testing.**

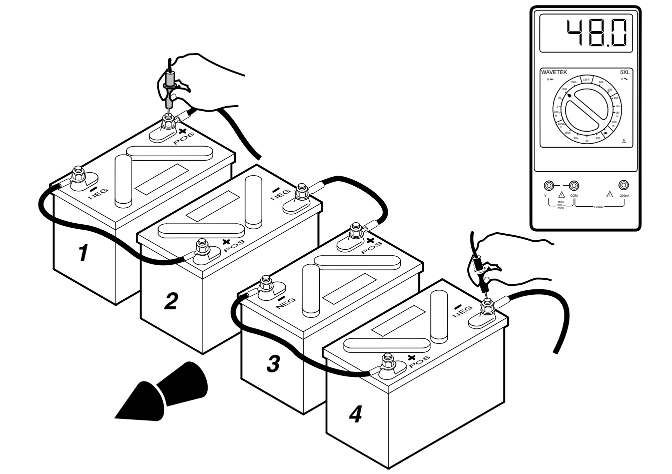
Batteries / Voltage Check without the IQDM Handset

1. With batteries connected and using a multimeter set to 200 volts DC, place red (+) probe on the positive (+) post of battery no. 1 and the black (–) probe on the negative (–) post of battery no. 4 **(Figure 12-6, Page 12-14) and (Figure 12-7, Page 12-15)** or battery no. 6 **(Figure 12-8, Page 12-15)**. The multimeter should indicate at least 48 volts with the batteries fully charged. If not, check for loose battery connections or a battery installed in reverse polarity. Refer to See Section 18 – Batteries. for further details on battery testing.



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

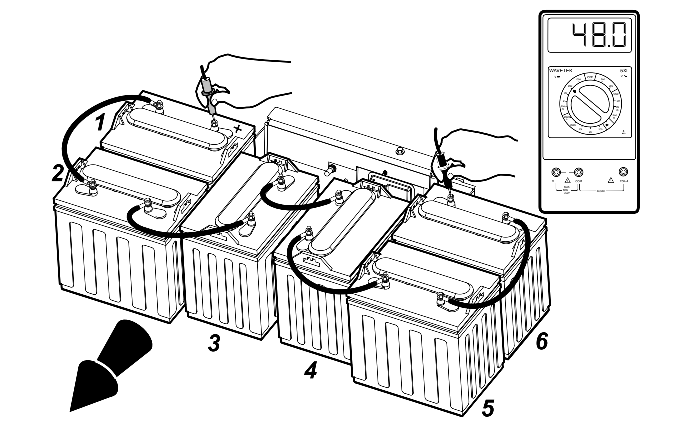
Figure 12-6 Battery Voltage Test – Style A Battery Configuration



(Viewed from driver side of vehicle)

1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

Figure 12-7 Battery Voltage Test – Style B Battery Configuration



(Viewed from driver side of vehicle)

1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

Figure 12-8 Battery Voltage Test – Style C Battery Configuration

TEST PROCEDURE 2 – Onboard Computer Solenoid Lockout Circuit

See General Warnings on page 1-1.

The solenoid lockout circuit disables the vehicle when the battery charger is plugged into the vehicle. Use the following procedure to test the solenoid lockout circuit:

1. With batteries connected, place the Tow/Run switch in the RUN position.
2. Using a multimeter set to 200 volts DC, place black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and red (+) probe (with insulation-piercing probe) on the light blue onboard computer wire (at a point between the OBC and the six-pin connector). The reading should be approximately 38-42 volts (full battery voltage). If the reading is not 38-42 volts, proceed to step 3.. If the reading is 38-42 volts, proceed to Test Procedure 3 – Solenoid Activating Coil on page 12-16.
3. Place insulation-piercing probe on the light blue 18-gauge wire at a point between OBC six-pin connector and main wire harness. If reading is 38-42 volts, check the wire terminal connectors inside six-pin connector at OBC six-pin connector. Make sure pins are properly aligned inside housing. Make sure wire colors match and are connected to the correct terminals.
4. If reading is zero volts, plug the charger DC cord into the vehicle charger receptacle. If the dash light illuminates for 10 seconds, the OBC is now powered-up. Unplug the DC cord; the reading at the OBC light blue wire should be approximately 38-42 volts. If the vehicle now operates normally, the DC cord has powered up the electrical system. The electrical system should also power-up when the accelerator pedal is pressed. To check the accelerator pedal function, see Test Procedure 4 – MCOR Voltage on page 12-16.
5. If the dash light illuminates for 10 seconds and the vehicle does not operate:
   - 5.1. Using a multimeter set to 200 volts DC, place black (–) probe on battery number 4 and place red (+) probe (with insulation-piercing probe) on light blue 18-gauge wire at OBC six-pin connector.
   - 5.2. With Tow/Run switch in the RUN position, the voltage reading should be approximately 48 volts.
6. If the dash light does not illuminate and the vehicle does not operate, check the OBC activation circuit.
   - 6.1. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the red 18-gauge wire located on the OBC side of the six-pin connector. The reading should be approximately 48 volts. If the reading is incorrect, test the Tow/Run switch and connecting wires. **See Tow/Run Switch on page 12-19.**

6.2. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the red 18-gauge wire (harness side of six-pin connector). Multimeter should indicate 48 volts. If voltage is correct, check connections in the six-pin connector. If connections are correct, OBC activation circuit has failed. Replace OBC.

TEST PROCEDURE 3 – Solenoid Activating Coil

See General Warnings on page 1-1.

NOTE: *Be aware that one of two different solenoids may be found on the vehicle. Visually, the production solenoid is smaller than the service replacement. On the labels, the larger service replacement solenoid has SOL0605 and the smaller production solenoid has SOL5006. Internally, specifications and test results differ between the two.*

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Access the solenoid by removing the electronics module cover. **See Electronics Module Cover on page 17-5.**
3. Remove the two small wire terminals from the solenoid.
4. Place red (+) probe of the multimeter on the positive (+) solenoid terminal. Place the black (–) probe on the other small solenoid terminal.
   – A reading of 200 to 250 ohms should be obtained for factory-installed solenoids **(Figure 12-9, Page 12-16)**. If not, replace the solenoid.

   – A reading of 180 to 190 ohms should be obtained for service replacement solenoids **(Figure 12-10, Page 12-16)**. If not, replace the solenoid.

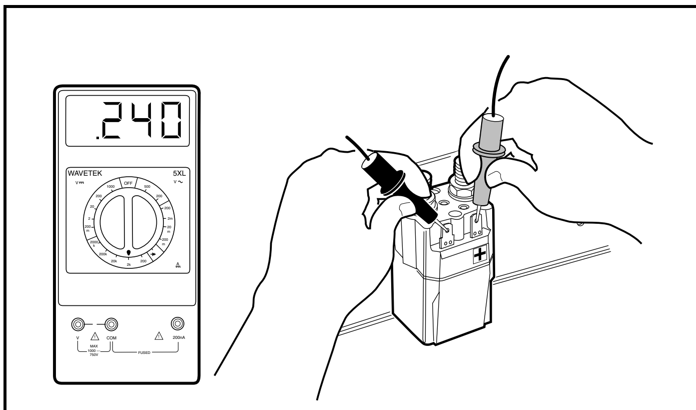
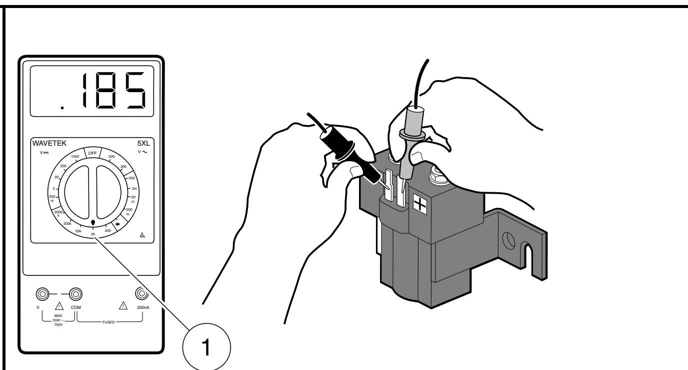


Figure 12-9 Activating Coil Test – Factory-installed Solenoid



1. 2k Ohm Setting

2500-20000-10283

Figure 12-10 Activating Coil Test – Service Replacement Solenoid

TEST PROCEDURE 4 – MCOR Voltage

See General Warnings on page 1-1.

The accelerator position, which is proportional to the MCOR voltage, can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **MCOR Voltage Test without the IQDM Handset**.

MCOR Voltage Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. Connect the IQDM to the vehicle.
3. Access the Test menu and select THROTTLE % by using the SCROLL DISPLAY buttons.
4. The IQDM should indicate 0 % with the pedal not pressed. While monitoring the IQDM display screen, slowly press the accelerator pedal. As the pedal is pressed, the IQDM should indicate a rise from 0 % (pedal not pressed) to 100 % (pedal fully pressed).
5. If the MCOR does not operate as described in previous step, proceed to **MCOR Voltage Test without the IQDM Handset.**

MCOR Voltage Test without the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. With the batteries connected, place Tow/Run switch in RUN. Using a multimeter set to 200 volts DC, place red (+) probe on battery no. 1 positive post and place black (–) probe (with insulation-piercing probe) on the purple wire at a point close to the three-pin connector at the MCOR. The reading should be approximately 48-50 volts (full battery voltage).
3. If reading is zero volts, check the purple wire continuity from the three-pin connector at the MCOR to the 16-pin connector at the speed controller. Check terminal positions in three-pin connector at the MCOR and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.
4. With multimeter set to 20 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the white/black wire at a point close to the three-pin connector at the MCOR. The reading should be approximately 4.65 volts.
5. If reading is zero volts, check the white/black wire continuity from the three-pin connector at the MCOR to the 16-pin connector at the speed controller. Check terminal positions in three-pin connector at the MCOR and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.
6. With multimeter set to 20 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the no. 18 yellow wire at a point close to three-pin connector at the MCOR. The reading should be approximately 0.32 volts with the pedal up. Slowly press the accelerator pedal and note the readings on the multimeter. As the pedal is pressed, the reading should increase until it reaches 4.65 volts when the pedal is fully pressed.
7. If reading does not increase as the pedal is pressed, replace the MCOR.
8. If the reading is not approximately 4.60 volts with the pedal fully pressed, the vehicle will not operate at rated top speed. Check the MCOR resistance.
   - 8.1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
   - 8.2. Disconnect the 16-pin connector at the speed controller.
   - 8.3. Using a multimeter set for 20k ohms, connect the red (+) probe of the multimeter to the yellow wire at the MCOR three-pin connector with an insulation piercing probe. Connect black (–) probe to the purple wire with an insulation-piercing probe.

8.4. With the accelerator pedal fully up (not pressed), the multimeter should read approximately 1k ohms.

8.5. Slowly press the accelerator pedal while monitoring the multimeter. The resistance should rise as the pedal is pressed. When the pedal is all the way to the floor, the multimeter should indicate between 5.67k ohms and 7.43k ohms.

8.6. Using a multimeter set for 20k ohms, connect the red (+) probe of the multimeter to the yellow wire at the MCOR three-pin connector with an insulation piercing probe. Connect black (–) probe to the white/black wire with an insulation-piercing probe.

8.7. With the accelerator pedal fully up (not pressed), the multimeter should indicate between 5.67k ohms and 7.43k ohms.

8.8. Slowly press the accelerator pedal while monitoring the multimeter. The resistance should drop as the pedal is pressed. When the pedal is all the way to the floor, the multimeter should indicate approximately 1k ohms.

8.9. If the MCOR does not operate as described, replace the MCOR. **See MCOR Removal on page 17-8.**

TEST PROCEDURE 5 – A1 and A2 Motor Voltage

See General Warnings on page 1-1.

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

2. With the batteries connected and using a multimeter set to 200 volts DC, place the black (–) probe on the A2 motor terminal (white wire) and connect the red (+) probe to the A1 (green wire) motor terminal.
3. With Tow/Run switch in the RUN position, place the Forward/Reverse switch in the FORWARD position, turn key switch to the ON position and slowly press accelerator pedal.
4. As the accelerator pedal is pressed, the voltage reading should increase from approximately 5 volts RMS when the MCOR limit switch closes, to approximately 48 volts RMS with the accelerator pedal fully pressed.

NOTE: *Voltage can vary depending on controller speed setting as well as which zone a Guardian equipped vehicle is located.*

Example: *Speed setting 1 may only read 30 volts.*

4.1. If there is no voltage reading, check the MCOR. **See Test Procedure 4 – MCOR Voltage on page 12-16.** Also check the continuity of the large posts of the solenoid. **See Test Procedure 22 – Solenoid Continuity on page 12-35.**

4.2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

4.3. Check continuity on A1 and A2 motor terminal posts and continuity of the F1 and F2 motor terminal posts. Also, check continuity of all motor wires. See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).

TEST PROCEDURE 6 – Tow/Run Switch

See General Warnings on page 1-1.

Tow/Run Switch Test with the IQDM Handset

1. With the Tow/Run switch in the RUN position, connect the IQDM to the vehicle.
2. Immediately after the IQDM is connected to the vehicle, the screen should display a copyright notice and the IQDM model number.
3. If the IQDM display screen is blank, drive the vehicle a short distance to activate the onboard computer.
4. If the IQDM display screen begins to work after the vehicle has been driven, turn the key switch to the OFF position and proceed to step 5; otherwise, perform the following procedure, **Tow/Run Switch Test without the IQDM Handset**.
5. With the IQDM still connected to the vehicle, place the Tow/Run Switch in the TOW position and wait 90 seconds.
6. If the IQDM display screen goes blank after 90 seconds, the Tow/Run switch and connecting wires are operating correctly.
7. If the IQDM display screen is still active after 90 seconds, the switch has failed closed. Replace the Tow/Run switch. **See Tow/Run Switch Removal on page 17-6.**

Tow/Run Switch Test without the IQDM Handset

1. With the batteries connected and using a multimeter set on 200 volts DC, connect the black (–) probe to the negative post of battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) and connect red (+) probe (with insulation-piercing probe) on the pink wire close to the connector on the Tow/Run switch.

⚠ WARNING

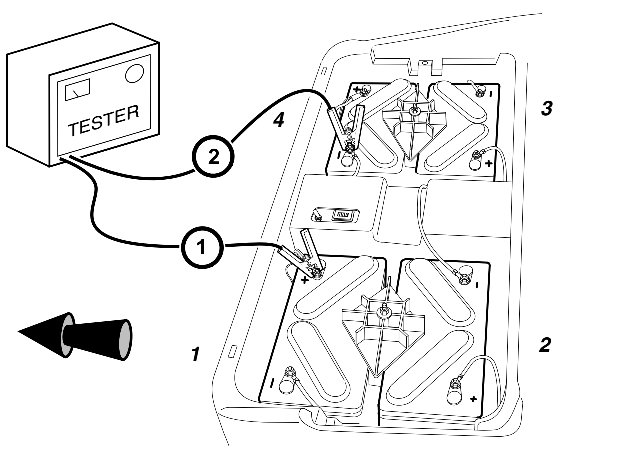
- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. With the Tow/Run switch in the RUN position, the reading should be approximately 48-50 volts. With the switch in the TOW position, the reading should be below approximately 5 volts.
3. If the reading is above 5 volts with the switch in the TOW position, replace the switch.
4. If the reading is below 5 volts with switch in the RUN position, check continuity of the blue 16-gauge wire (becomes a red wire after diode) from the large post of the solenoid to the connector at the Tow/Run switch.
5. If the continuity readings are correct, replace the Tow/Run switch.

TEST PROCEDURE 7 – Battery Pack Voltage (Under Load)

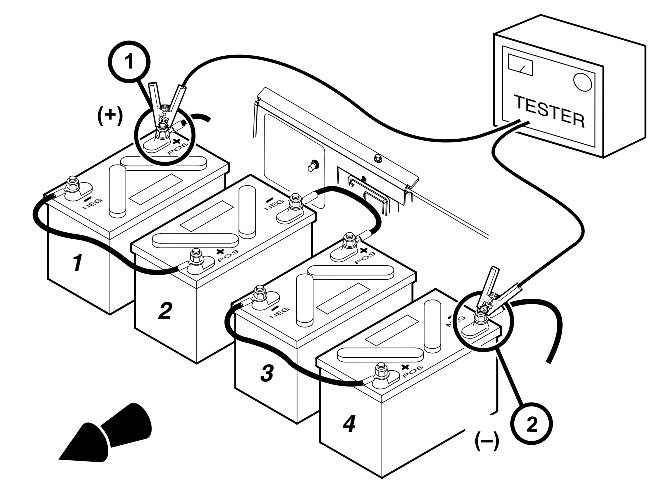
See General Warnings on page 1-1.

1. Be sure the batteries are fully charged and that the electrolyte level is correct in all cells.
2. Connect the tester leads to the positive (+) post of battery no.1 and negative (–) post of battery no. 4 **(Figure 12-11, Page 12-20 and Figure 12-12, Page 12-20)** or battery no. 6 **(Figure 12-13, Page 12-20)**.



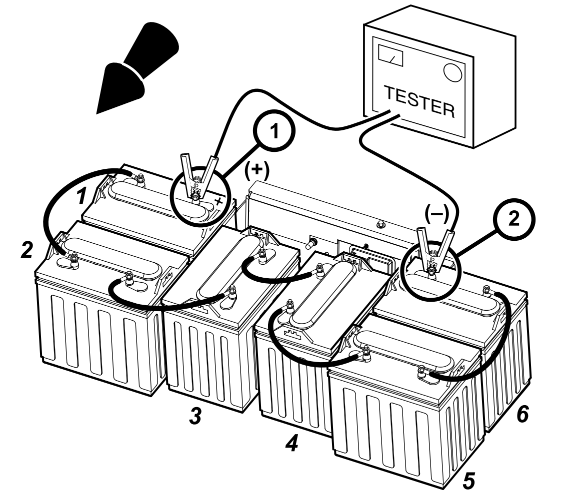
(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

2500-30100-10409
Figure 12-11 Battery Discharge Test – Style A Battery Configuration



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

2500-30100-10410
Figure 12-12 Battery Discharge Test – Style B Battery Configuration



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

2500-30100-10411
Figure 12-13 Battery Discharge Test – Style C Battery Configuration

3. Turn the discharge machine on and record the voltage reading of battery pack while under load.
4. A fully charged set of batteries in good condition should read between 46-49 volts while under load.

5. A reading of 32-46 volts indicates discharged or failed batteries. Each battery should be checked with a multimeter while under load.
6. A reading of 32 volts or less will not activate discharge machine. If the voltage of the batteries is below 32 volts, the batteries are deeply discharged or have failed.
7. Recording the battery pack voltage reading while under load provides a more accurate diagnosis of the condition of the batteries. When the discharge machine is ON, it places the battery pack under load and many times can help determine if one or more batteries in the set have failed. Testing battery voltage while the batteries are not under load will not always indicate the true condition of the batteries. For more information about the batteries, refer to See Section 18 – Batteries. .

TEST PROCEDURE 8 – Key Switch and MCOR Limit Switch Circuit

See General Warnings on page 1-1.

Key Switch and MCOR Limit Switch Circuit Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
2. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
3. Connect the IQDM to the vehicle.
4. Test the key switch.
   - 4.1. Access the Test menu and select KEY INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the key switch is in the OFF position.
   - 4.2. While monitoring the IQDM display screen, turn the key switch to the ON position. The IQDM should indicate ON.
   - 4.3. If the IQDM does not indicate that KEY INPUT is ON when the key switch is in the ON position, proceed to the following procedure, **Key Switch and MCOR Limit Switch Circuit Test without the IQDM Handset**. If the key switch functions as described, proceed to the following step. **See following NOTE.**

NOTE: *The key switch MUST function properly in order to test the MCOR limit switch with the IQDM handset.*

5. Test the MCOR limit switch.
   - 5.1. Select FOOT INPUT on the Test menu by using the SCROLL DISPLAY buttons on the IQDM.
   - 5.2. The IQDM should indicate that FOOT INPUT is OFF when the accelerator pedal is not pressed, regardless of the key switch position.
   - 5.3. With the key switch in the ON position, press the accelerator pedal. The IQDM should indicate that FOOT INPUT is ON when the accelerator pedal is pressed.
6. If any reading is obtained that is not described in steps 4 and 5, perform the following steps:
   - 6.1. Check the wiring of the key switch and MCOR. **See Wiring Diagrams on page 12-2.**
   - 6.2. Check the continuity of the key switch wires and the MCOR limit switch wires.
7. If the problem was not found, proceed to the following procedure, **Key Switch and MCOR Limit Switch Circuit Test without the IQDM Handset**.

Key Switch and MCOR Limit Switch Circuit Test without the IQDM Handset

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**

3. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
4. Test the key switch.
   4.1. Remove the instrument panel. **See Key Switch Removal on page 17-1.**
   4.2. Using a multimeter set to 200 ohms, place the red (+) probe on the key switch terminal with the blue wire. Place the black (–) probe on the other key switch terminal.
   4.3. With the key switch in the OFF position, the multimeter should indicate that continuity is not present.
   4.4. With the key switch in the ON position, the multimeter should indicate that continuity is present.
   4.5. If any other reading is obtained, replace the key switch. **See Key Switch Removal on page 17-1.**
   4.6. If the key switch operates as described in the previous steps, install the instrument panel in the reverse order of removal and proceed to the following step.
5. Test the MCOR limit switch. **See following NOTE.**

NOTE: *Make sure that the key switch is operating correctly and that the key switch and instrument panel are properly installed before proceeding.*

   5.1. With batteries connected and using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire close to the two-pin connector on the MCOR. **See following WARNING.**

⚠ WARNING

- **The Forward/Reverse switch must be in the neutral position to avoid personal injury due to contact with rotating wheels.**

   5.2. With Tow/Run switch in the RUN position, key switch in the ON position, and Forward/Reverse rocker switch in the NEUTRAL position, the voltage reading should be zero volts. When the accelerator pedal is pressed, the voltage reading should be approximately 48 volts (full battery voltage).
   5.3. If the voltage reading is 48 volts when the accelerator pedal is not pressed, replace the MCOR. **See MCOR Removal on page 17-8.**
   5.4. If the voltage reading is zero volts when the accelerator pedal is pressed, check the limit switch circuit using the following test procedures.
      5.4.1. Using a multimeter set to 200 volts DC, place black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the place red (+) probe (with insulation-piercing probe) on the blue wire where it connects to the MCOR. With the key switch ON, the reading should be approximately 48 volts (full battery voltage).
      5.4.2. If the reading is zero volts, check the continuity of the blue wire that goes from the key switch to the MCOR.
      5.4.3. If the reading is approximately 48 volts, proceed to the following step.
      5.4.4. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire where it connects to the MCOR. With the Tow/Run switch in the RUN position, the key switch ON, the Forward/Reverse rocker switch in NEUTRAL and the accelerator pedal pressed, the reading should be approximately 48 volts (full battery voltage).
      5.4.5. If the reading is zero volts, test the continuity of the MCOR limit switch and the green wire. If the limit switch does not pass the continuity test, replace the MCOR. **See MCOR Removal on page 17-8.**

TEST PROCEDURE 9 – 16-Pin Connector

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Disconnect the 16-pin connector from the speed controller. Inspect terminal ends inside plug to ensure they are in position and seated in plug housing. If any terminals look like they are not pushed all the way into the connector, gently push the terminals until they are firmly seated in the 16-pin connector. After each terminal has been pushed into the housing, gently pull on the wire to ensure it is locked into place.
3. Check wires in the plug to make sure none are broken at the terminal pin crimp. Repair or replace as required.
4. Check the wire colors of each wire and make sure that the colors for each pin position match the wire colors in the wiring diagram. **See Wiring Diagrams on page 12-2.**
5. When connecting the 16-pin connector to the controller, push plug into controller receptacle with enough force to lock plug into place. An audible click will be heard when plug is properly seated to the controller.

A procedure is provided for testing each of the wires in the 16-pin connector. Refer to the following chart for the appropriate procedure for each pin in the 16-pin connector.

If the results of any of the referenced procedures are different from those described in the procedure, check the continuity of the wires in the wire harness and test the connected components with the appropriate test procedures. **See Index of Test Procedures.**

<table>
<tr><th>SPEED CONTROLLER 16-PIN CONNECTOR WIRE</th><th>TEST PROCEDURE</th></tr>
<tr><td>Pin 1 – White/Black (18-gauge)</td><td rowspan="3">Test Procedure 10 – Pins 1, 2, and 3 on page 12-24</td></tr>
<tr><td>Pin 2 – Yellow (18-gauge)</td></tr>
<tr><td>Pin 3 – Purple (18-gauge)</td></tr>
<tr><td>Pin 4 – Open (No wire)</td><td></td></tr>
<tr><td>Pin 5 – Light Blue (18-gauge)</td><td>Test Procedure 11 – Pin 5 on page 12-25</td></tr>
<tr><td>Pin 6 – Green (18-gauge)</td><td>Test Procedure 12 – Pin 6 on page 12-26</td></tr>
<tr><td>Pin 7 – Orange/White (18-gauge)</td><td>Test Procedure 13 – Pin 7 on page 12-27</td></tr>
<tr><td>Pin 8 – White (18-gauge)</td><td>Test Procedure 14 – Pins 8 and 16 on page 12-28</td></tr>
<tr><td>Pin 9 – Gray (18-gauge)</td><td>Test Procedure 15 – Pin 9 on page 12-29</td></tr>
<tr><td>Pin 10 – Tan (18-gauge)</td><td>Test Procedure 16 – Pin 10 on page 12-30</td></tr>
<tr><td>Pin 11 – Open (no wire)</td><td></td></tr>
<tr><td>Pin 12 – Blue/White (18-gauge)</td><td>Test Procedure 17 – Pin 12 on page 12-31</td></tr>
<tr><td>Pin 13 – Black/White (18-gauge)</td><td rowspan="3">Test continuity of each wire and perform Test Procedure 21 – Motor Speed Sensor on page 12-34</td></tr>
<tr><td>Pin 14 – Light Green (18-gauge)</td></tr>
<tr><td>Pin 15 – Red (18-gauge)</td></tr>
<tr><td>Pin 16 – Blue (18-gauge)</td><td>Test Procedure 14 – Pins 8 and 16 on page 12-28</td></tr>
</table>

TEST PROCEDURE 10 – Pins 1, 2, and 3

See General Warnings on page 1-1.

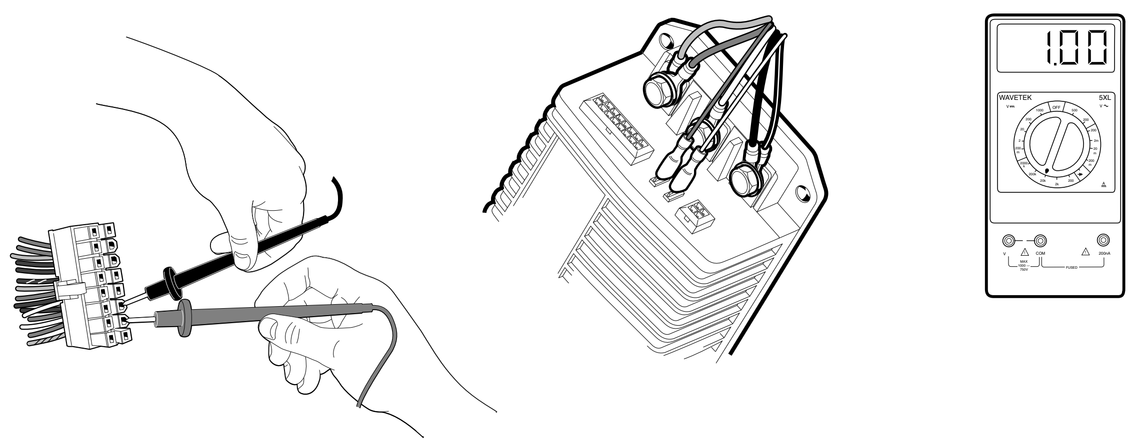
Pins 1, 2, and 3 in the 16-pin connector provide a connection point from the MCOR potentiometer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 20k ohms, insert the red (+) probe of the multimeter into pin 2 (yellow wire) of the 16-pin connector. **See following CAUTION.** Insert the black (–) probe into pin 3 (purple wire) of the 16-pin connector **(Figure 12-14, Page 12-24)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. With the accelerator pedal fully up (not pressed), the multimeter should read approximately 1k ohms.
6. Slowly press the accelerator pedal while monitoring the multimeter. The resistance should rise as the pedal is pressed. When the pedal is all the way to the floor, the multimeter should indicate between 5.67k ohms and 7.43k ohms.



20k Ohm Setting (reading with pedal not pressed)

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Figure 12-14 Pins 1, 2, and 3 Test

7. Using a multimeter set for 20k ohms, insert the red (+) probe of the multimeter into pin 2 (yellow wire) at the 16-pin connector. Connect the black (–) probe into pin 1 (white/black wire). **See previous CAUTION.**
8. With the accelerator pedal fully up (not pressed), the multimeter should indicate between 5.67k ohms and 7.43k ohms.
9. Slowly press the accelerator pedal while monitoring the multimeter. The resistance should drop as the pedal is pressed. When the pedal is all the way to the floor, the multimeter should indicate approximately 1k ohms.
10. If any other reading is observed, check the continuity of the wires in the wire harness.

TEST PROCEDURE 11 – Pin 5

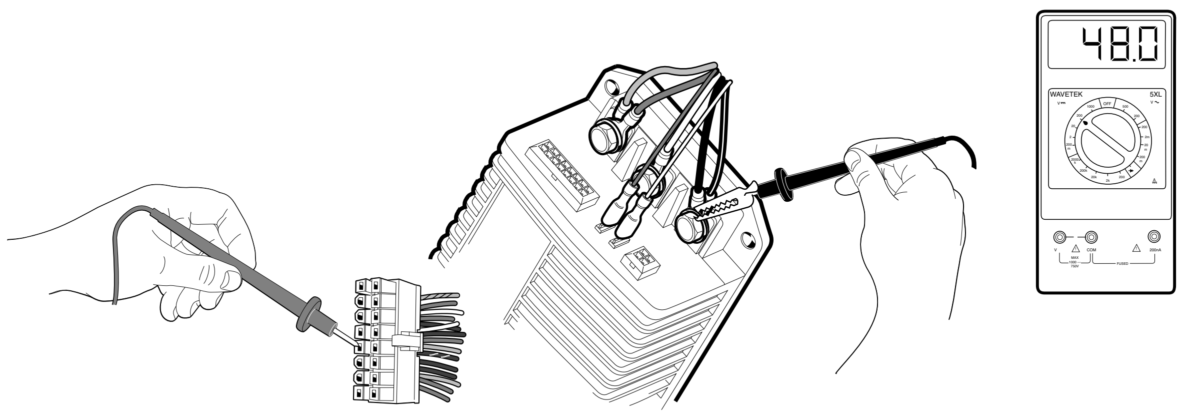
See General Warnings on page 1-1.

Pin 5 in the 16-pin connector provides a connection point for the solenoid lockout circuit from the onboard computer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 5 (light blue wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 12-15, Page 12-25)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**



200 DCV Setting (reading with OBC powered-up and battery charger disconnected)

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Figure 12-15 Pin 5 Test

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position.
7. The multimeter should indicate zero volts DC at this time.
8. While monitoring the multimeter, plug the battery charger into the vehicle charger receptacle.
9. After a short delay, the onboard computer should power-up (come out of sleep mode), charger relay should click, and the ammeter on the charger should indicate that the vehicle batteries are being charged.
10. The multimeter should indicate zero volts DC while the charger is connected to the vehicle.
11. While observing the multimeter, disconnect the DC plug from the vehicle charger receptacle.
12. The multimeter should indicate full battery voltage when the charger is not connected to the vehicle.
13. If any other reading is obtained, check the following items:
    – Continuity of the wires in the wire harness

    – Onboard computer for proper operation. **See Test Procedure 19 – Onboard Computer Gray Wire on page 12-33.**

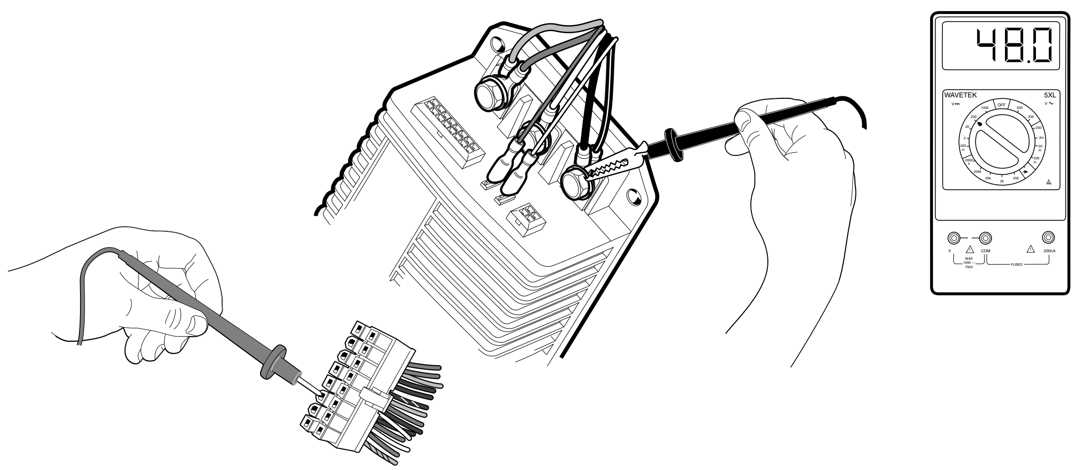
– Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 12-19.**

TEST PROCEDURE 12 – Pin 6

See General Warnings on page 1-1.

Pin 6 in the 16-pin connector provides a connection point for the MCOR limit switch to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.



200 DCV Setting (reading with OBC powered-up and accelerator pedal pressed)

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Figure 12-16 Pin 6 Test

4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 6 (green wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 12-16, Page 12-26)**.

⚠ CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position, key switch in the ON position, and Forward/Reverse switch in the FORWARD position.
7. The multimeter should indicate zero volts DC at this time.
8. While monitoring the multimeter, slowly press the accelerator pedal and hold the pedal at approximately 20% of full travel.
9. After a short delay, the onboard computer should power-up (come out of sleep mode).
10. The multimeter should indicate full battery voltage (approximately 48 volts) when the accelerator pedal is pressed.
11. While observing the multimeter, release the accelerator pedal.

12. The multimeter should indicate zero volts when the accelerator pedal is not pressed.
13. If any other reading is obtained, check the following items:
    – Continuity of the wires in the wire harness
    – Onboard computer for proper operation. **See Test Procedure 19 – Onboard Computer Gray Wire on page 12-33.**
    – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 12-19.**
    – Key switch and MCOR limit switch for proper operation. **See Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 12-21.**

TEST PROCEDURE 13 – Pin 7

See General Warnings on page 1-1.

Pin 7 in the 16-pin connector provides a connection point for the reverse buzzer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Place a jumper wire with an alligator clip between the B– terminal of the speed controller (use alligator clip for this connection) and pin 7 (orange/white wire) of the 16-pin connector **(Figure 12-17, Page 12-28)**. **See following CAUTION.**

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position.
7. The reverse buzzer should sound when the Tow/Run switch is in the RUN position.
8. If any other activity is observed, check the following items:
    – Continuity of the wires in the wire harness
    – Reverse buzzer for proper operation. **See Test Procedure 24 – Reverse Buzzer on page 12-36.**
    – Tow/Run switch for proper operation. **See Tow/Run Switch on page 12-19.**

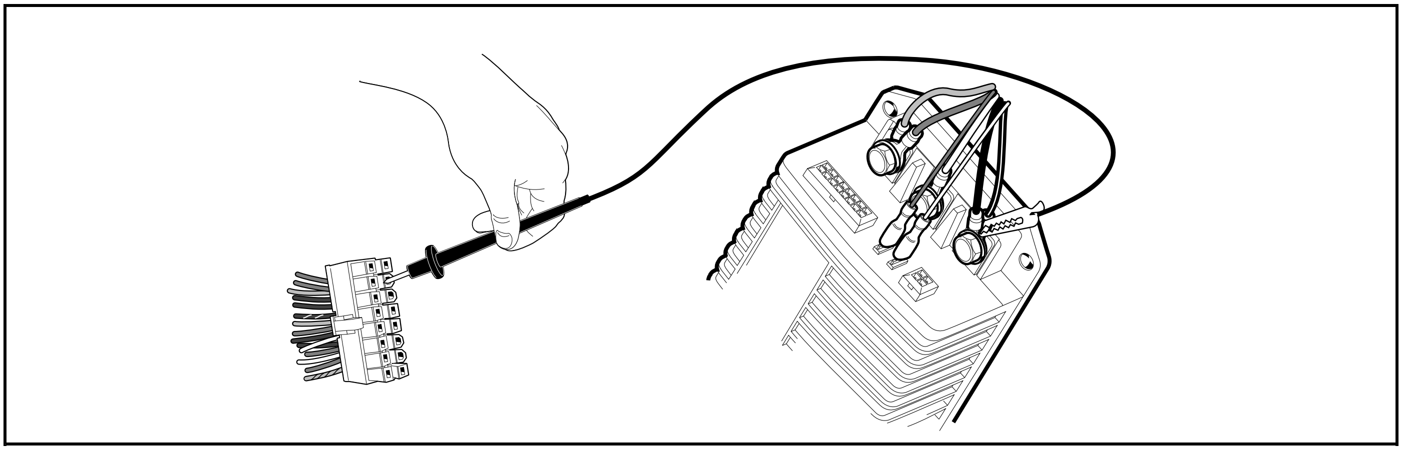

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Figure 12-17 Pin 7 Test

TEST PROCEDURE 14 – Pins 8 and 16

See General Warnings on page 1-1.

Pins 8 and 16 in the 16-pin connector provide a connection point for the Forward/Reverse rocker switch to the speed controller. The switch provides a +48 volt signal to the speed controller through pin 8 when the Forward/Reverse switch is in the FORWARD position and provides a +48 volt signal on pin 16 when the Forward/Reverse switch is in the REVERSE position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame crossmember between the spring mount and side stringer, just forward of each rear wheel. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 8 (white wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 12-18, Page 12-29)**.

CAUTION

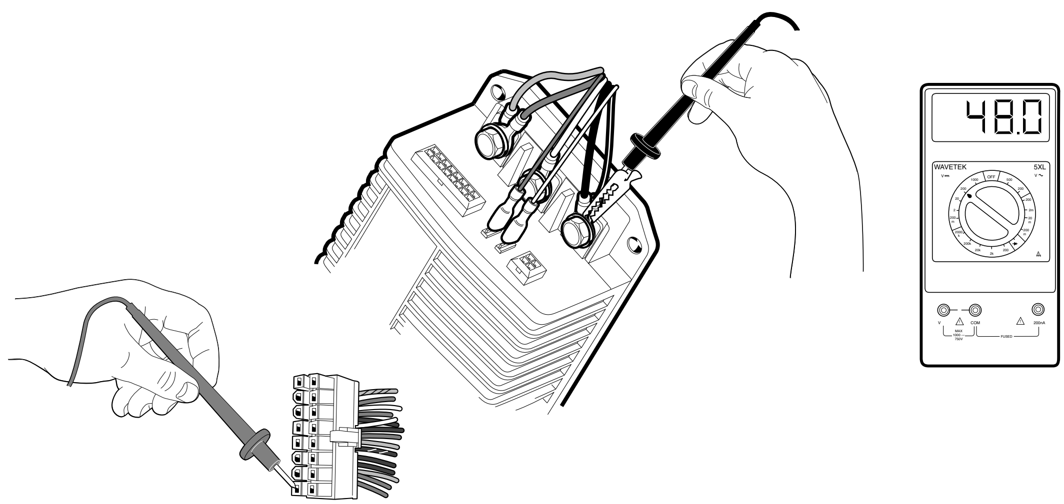
- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position and the Forward/Reverse switch in the NEUTRAL position. The multimeter should indicate zero volts DC at this time.
7. While monitoring the multimeter, place the Forward/Reverse switch in the REVERSE position. The multimeter should still indicate zero volts.
8. Place the Forward/Reverse switch in the FORWARD position. The multimeter should indicate full battery voltage (approximately 48 volts).
9. Insert the red (+) probe of the multimeter into pin 16 (blue wire) of the 16-pin connector. Leave the black (–) probe (alligator clip) connected to the B– terminal of the speed controller. **See previous CAUTION.**
10. Place the Forward/Reverse switch in the NEUTRAL position. The multimeter should indicate zero volts DC at this time.
11. While monitoring the multimeter, place the Forward/Reverse switch in the FORWARD position. The multimeter should still indicate zero volts.

12. Place the Forward/Reverse switch in the REVERSE position. The multimeter should indicate full battery voltage (approximately 48 volts).
13. If any other reading is obtained, check the following items:
    – Continuity of the wires in the wire harness

    – Forward/Reverse switch for proper operation. **See Test Procedure 23 – Forward/Reverse Rocker Switch on page 12-35.**

    – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 12-19.**



200 DCV Setting (reading with Tow/Run switch in RUN and Forward/Reverse switch in FORWARD)

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Figure 12-18 Pins 8 and 16 Test

TEST PROCEDURE 15 – Pin 9

See General Warnings on page 1-1.

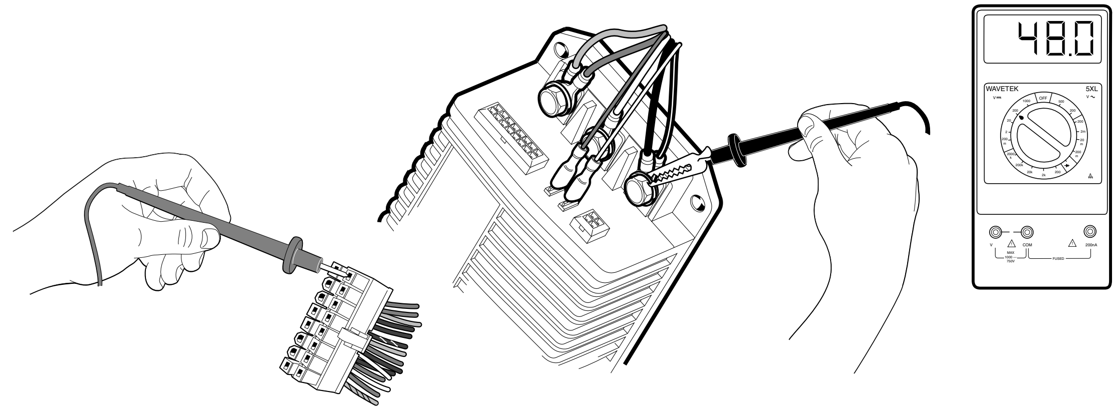
Pin 9 in the 16-pin connector provides a connection point for the Tow/Run switch to the speed controller. The switch provides a +48 volt signal to the speed controller through pin 9 when the Tow/Run switch is in the RUN position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 9 (gray wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 12-19, Page 12-30)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. With the Tow/Run switch in the TOW position, the multimeter should indicate zero volts.
7. Place the Tow/Run switch in the RUN position.



200 DCV Setting (reading with Tow/Run switch in RUN position)

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Figure 12-19 Pin 9 Test

8. With the Tow/Run switch in the RUN position, the multimeter should indicate full battery voltage (approximately 48 volts).
9. If any other reading is obtained, check the following items:
   – Continuity of the wires in the wire harness

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 12-19.**

TEST PROCEDURE 16 – Pin 10

See General Warnings on page 1-1.

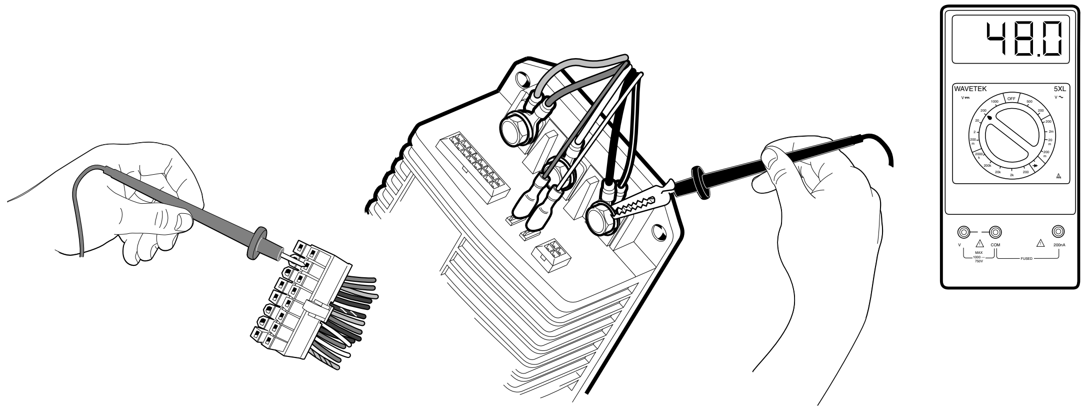
Pin 10 in the 16-pin connector provides a connection point for the key switch to the speed controller. The key switch provides a +48 volt signal to the speed controller through pin 10 when the key switch is in the ON position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 10 (tan wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 12-20, Page 12-31)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. With the Tow/Run switch in the TOW position, the multimeter should indicate zero volts.
7. Place the Tow/Run switch in the RUN position and the key switch in the ON position.



200 DCV Setting (reading with Tow/Run switch in RUN and key switch in the ON position)

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Figure 12-20 Pin 10 Test

8. With the key switch in the ON position, the multimeter should indicate full battery voltage (approximately 48 volts). With the key switch in the OFF position, the reading should be zero volts.
9. If any other reading is obtained, check the following items:
   – Continuity of the wires in the wire harness
   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 12-19.**
   – Key switch for proper operation. **See Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 12-21.**

TEST PROCEDURE 17 – Pin 12

See General Warnings on page 1-1.

Pin 12 in the 16-pin connector provides a connection point for the solenoid coil to the speed controller. The speed controller activates the solenoid coil by providing a ground to the solenoid coil at the appropriate time.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Place a jumper wire with an alligator clip between the B– terminal of the speed controller (use alligator clip for this connection) and pin 12 (blue/white wire) of the 16-pin connector **(Figure 12-21, Page 12-32)**. **See following CAUTION.**

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position and the key switch in the ON position.

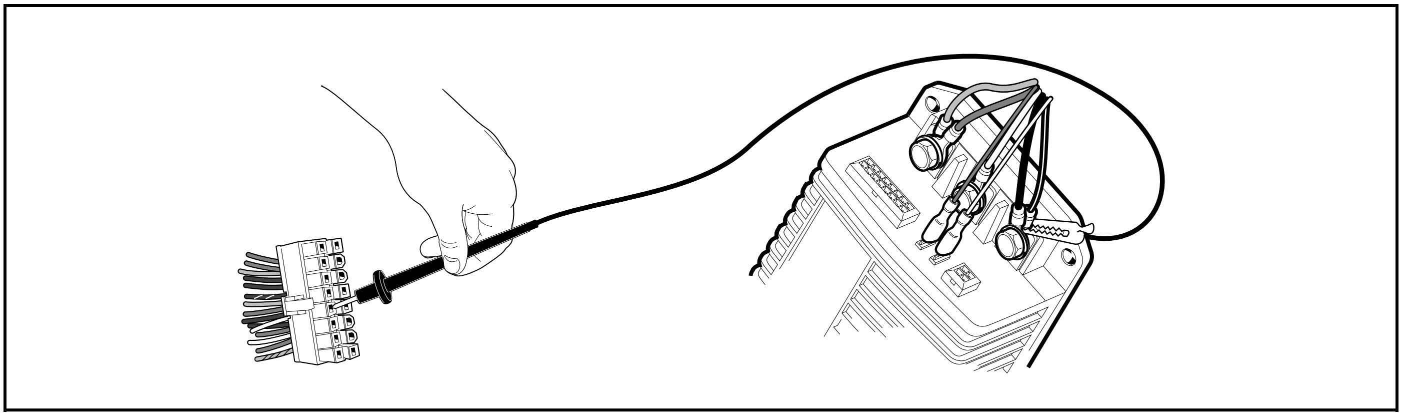

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Figure 12-21 Pin 12 Test

7. The solenoid should click when the key switch is placed in the ON position.
8. If any other activity is observed, check the following items:
   – Continuity of the wires in the wire harness

   – Reverse buzzer for proper operation. **See Test Procedure 24 – Reverse Buzzer on page 12-36.**

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 12-19.**

   – Key switch for proper operation. **See Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 12-21.**

   – Solenoid for proper operation. **See Test Procedure 22 – Solenoid Continuity on page 12-35.**

TEST PROCEDURE 18 – Onboard Computer Silicon-Controlled Rectifier (SCR) Circuit

See General Warnings on page 1-1.

The silicon controlled rectifier (SCR), located inside the onboard computer, acts as a switch on the negative side of the circuit.

This allows the onboard computer (OBC) to control the battery charging current.

Use the following procedure to test the SCR:

1. With batteries connected and using a multimeter set to 200 volts DC, place the red (+) probe on the positive post of battery no. 1 and place the black (–) probe on the charger receptacle socket that has the black 10-gauge wire attached to it. The reading should be approximately 36-42 volts.
2. If the reading is zero volts, check the black 10-gauge wire connection to the OBC connector. Check the continuity of the black 10-gauge wires. If the wires and connections are okay, the SCR has failed. Replace the OBC. If the reading is correct, proceed to the following step.
3. Plug in AC and DC cords. When the battery charger relay clicks on, reading should be approximately 48 volts (full battery voltage). If the reading does not rise from approximately 40 volts to full battery voltage when the DC cord is plugged in and the relay clicks on, check the following items:
   – Black wire terminal socket in the charger receptacle.

   – Onboard computer gray wire. **See Test Procedure 19 – Onboard Computer Gray Wire on page 12-33.**

   – Red wire at the charger receptacle. **See Test Procedure 20 – Voltage at Charger Receptacle Red Wire Socket on page 12-33.**

TEST PROCEDURE 19 – Onboard Computer Gray Wire

See General Warnings on page 1-1.

1. With batteries connected and the DC cord disconnected, pull back on the boot (1) on the gray wire (2) connection at the OBC (3) **(Figure 12-22, Page 12-33)**. Using a multimeter set to 200 volts DC, connect the red (+) probe to the positive post of battery no. 1 and black (–) probe to gray 16-gauge wire at the OBC connection (4). Reading should be approximately 48 volts. If reading is zero volts, replace the OBC.

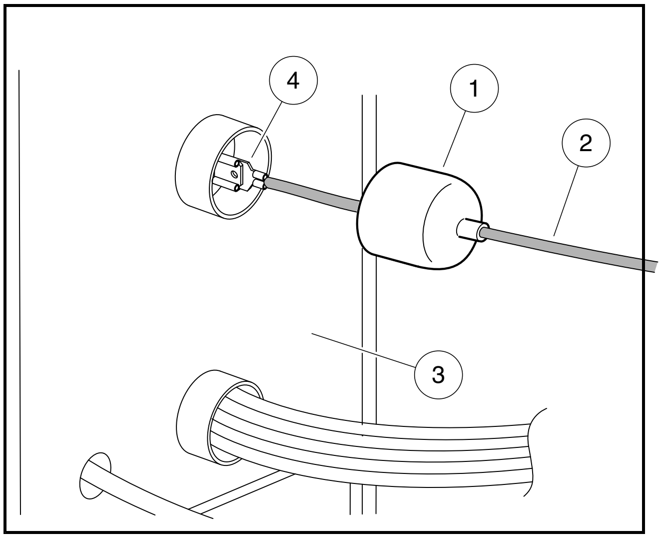

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Figure 12-22 OBC Connections

2. If the reading in step 1 is 48 volts, plug the DC cord into the vehicle's charger receptacle. The voltage reading should drop to approximately 4.0 volts before the charger relay clicks on.
3. When the charger relay is activated, the reading should rise to approximately 48 volts.
4. If voltage does not drop to approximately 4.0 volts when the DC cord is plugged in and then rise to approximately 48 volts when the charger relay clicks on, the gray wire circuit in the OBC has failed. Replace the OBC.

TEST PROCEDURE 20 – Voltage at Charger Receptacle Red Wire Socket

See General Warnings on page 1-1.

1. With batteries connected, DC cord disconnected, and using a multimeter set to 200 volts DC, place the black (–) probe on the negative post of battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) and place the red (+) probe on the charger receptacle socket connected to the red 10-gauge wire. The reading should be 48-50 volts (full battery voltage).
2. If the reading is zero volts, check the continuity of the 10-gauge red wire from the positive post of battery no. 1 to the receptacle socket.

TEST PROCEDURE 21 – Motor Speed Sensor

See General Warnings on page 1-1.

Motor Speed Sensor Test with the IQDM Handset

⚠ CAUTION

- **Perform the following procedure only on a level surface. To avoid injury or property damage, ensure that the path of the vehicle is clear before pushing vehicle.**

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Access the Test menu and select SPEED PULSES by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the vehicle is at rest.
4. While monitoring the IQDM display screen, slowly push the vehicle a short distance (about 3 feet (1 meter)). The IQDM should indicate ON for speed sensor pulses while the wheels are in motion.
5. If the IQDM does not indicate ON while the wheels are in motion, proceed to the following procedure, **Motor Speed Sensor Test without the IQDM Handset**.

Motor Speed Sensor Test without the IQDM Handset

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. With batteries connected, disconnect the three-pin connector at the motor speed sensor.
3. Check voltage at black/white wire:
   - 3.1. Using a multimeter set to 200 volts DC, place the red (+) probe on the battery no. 1 positive post and place the black (–) probe on the black/white wire terminal socket in the three-pin connector. The voltage reading should be 48 to 50 volts (full battery voltage).
   - 3.2. If the reading is zero volts, check the continuity of the black/white wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.
4. Check voltage at the red motor speed sensor wire:
   - 4.1. With Tow/Run switch in the RUN position and using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place red (+) probe on red wire terminal socket in three-pin connector. The voltage reading should be approximately 15-16 volts.
   - 4.2. If the voltage reading is zero volts, check the continuity of the red wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the wire continuity is correct, replace the speed controller.
   - 4.3. If the reading is below 14 volts, replace the speed controller.
   - 4.4. If the voltage reading is correct, proceed to the following step.
5. Check voltage at the light green wire:
   - 5.1. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the light green wire female terminal in the three-pin connector at the motor speed sensor. The voltage reading should be from 4.60 to 4.90 volts.
   - 5.2. If the voltage is zero volts, check the continuity of the light green wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.
   - 5.3. If reading is below 3.50 volts, check the continuity of the wires and plug and replace the speed controller if necessary.

6. Reconnect the three-pin connector at the motor speed sensor. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire between the three-pin connector and the motor speed sensor.
   6.1. Raise one rear wheel off ground. Slowly turn the rear wheel to rotate the motor armature. As the armature rotates, the voltage reading should alternate from zero to approximately 4.85 volts. The voltage reading will fluctuate from zero to 4.85 volts and back to zero four times for each revolution of the motor armature.

NOTE: *The voltage reading of 4.85 is an approximate reading. The actual reading may vary from 4.50 to 5.00 volts.*

   6.2. Replace the speed sensor if:
   - There is no voltage reading.
   - The voltage reading is not above 3.50.
   - The voltage reading does not fluctuate as the motor is turned.

TEST PROCEDURE 22 – Solenoid Continuity

See General Warnings on page 1-1.

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
3. Disconnect the three wires that are crimped together from the forward large post of the solenoid.
4. Using a multimeter set to 200k ohms, place the black (–) probe on one solenoid large post and place the red (+) probe on the other large post. The reading should be no continuity.
5. Connect the three wires crimped together to the forward large solenoid post. Install washer and nut on large solenoid post and tighten to 77 in-lb (8.7 N·m).
6. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

7. Place the Tow/Run switch in the RUN position, turn the key switch to the ON position, place the Forward/Reverse rocker switch in the FORWARD position, and press the accelerator pedal. The solenoid should click and the multimeter should indicate continuity. If the reading is no continuity, replace the solenoid.

TEST PROCEDURE 23 – Forward/Reverse Rocker Switch

See General Warnings on page 1-1.

Forward/Reverse Rocker Switch Test with the IQDM Handset

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Test FORWARD INPUT.

3.1. Access the Test menu and select FORWARD INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or REVERSE position.

3.2. Place the Forward/Reverse switch in the FORWARD position. The IQDM should indicate that FORWARD INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on page 12-2.** Also check the 16-pin connector at the speed controller. **See Test Procedure 9 – 16-Pin Connector on page 12-23.**

4. Test REVERSE INPUT.

4.1. Access the Test menu and select REVERSE INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or FORWARD position.

4.2. Place the Forward/Reverse switch in the REVERSE position. The IQDM should indicate that REVERSE INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on page 12-2.** Also check the 16-pin connector at the speed controller. **See Test Procedure 9 – 16-Pin Connector on page 12-23.**

5. If the IQDM displays readings other than those described above and the wiring is found to be correct, proceed to the following procedure, **Forward/Reverse Rocker Switch Test without the IQDM Handset**.

Forward/Reverse Rocker Switch Test without the IQDM Handset

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the two screws securing the rocker switch case to the vehicle body.
3. Remove switch from car. **See Forward/Reverse Rocker Switch Removal on page 17-3.**
4. Disconnect the three wires from the rocker switch. Using a multimeter set to 200 ohms, place the black (–) probe on the white wire terminal 3 position on the rocker switch, and place the red (+) probe on the red wire terminal 2 position. With the switch in NEUTRAL or REVERSE, there should be no continuity. With the switch in FORWARD, there should be continuity. If the readings are incorrect, replace the switch.
5. Place the black (–) probe on the blue wire terminal 1 position on the rocker switch and place the red (+) probe on the red wire terminal. With the switch in REVERSE, there should be continuity. If the readings are incorrect, replace the switch.

TEST PROCEDURE 24 – Reverse Buzzer

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the instrument panel. **See Key Switch Removal on page 17-1.**
3. Disconnect the orange/white and pink wires from the reverse buzzer.
4. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
5. Place the key switch in the OFF position and the Tow/Run switch in the RUN position.
6. Using a multimeter set to 200 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the pink wire terminal end that was disconnected from the reverse buzzer. The reading should be approximately 48 volts (full battery voltage).

6.1. If the voltage reading is correct, proceed to step 7.

6.2. If reading is zero volts, check pink wire continuity and Tow/Run switch. **See Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 12-15. See also Test Procedure 6 – Tow/Run Switch on page 12-19.**

6.3. If the continuity readings are not correct, repair or replace the pink wire.

6.4. If the continuity readings are correct, proceed to step 7.

7. Place the Forward/Reverse switch in REVERSE. Using a multimeter set to 200 volts DC, place the black (–) probe on the orange/white wire terminal end (that was disconnected from the reverse buzzer) and place the red (+) probe on battery no. 1 positive post. The reading should be approximately 48 volts (full battery voltage).
   7.1. If the voltage reading is correct, replace the reverse buzzer.
   7.2. If reading is zero volts, check orange/white wire continuity and connection at Pin 7 in 16-Pin connector.
   7.3. If there is no continuity in the orange/white wire, or the Pin 7 terminal in the 16-Pin connector is not properly seated, repair or replace as required.
   7.4. If the orange/white wire continuity and 16-Pin connector are correct and there is no voltage at the orange wire, replace the controller.

TEST PROCEDURE 25 – Rebooting the Onboard Computer

See General Warnings on page 1-1.

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

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

NOTE: *Wait at least 90 seconds for the capacitors in the speed controller to discharge. The capacitors in the speed controller must be fully discharged in order to reboot the OBC.*

2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
3. Place Tow/Run switch in the RUN position.
4. Test drive the vehicle. If the vehicle functions normally the problem is corrected. If the problem still exists, refer to Wiring Diagrams on page 12-2.

TEST PROCEDURE 26 – Battery Warning Light

See General Warnings on page 1-1.

1. Reboot the OBC and drive the vehicle a short distance. When vehicle is first driven, the battery warning light should illuminate for 10 seconds. **See Test Procedure 25 – Rebooting the Onboard Computer on page 12-37.** If the battery warning light does not illuminate when rebooting the OBC, proceed to step 2.
2. Turn key switch OFF, place Tow/Run switch in TOW and place Forward/Reverse rocker switch in NEUTRAL.
3. Disconnect the six-pin connector at the OBC.
4. Remove the wedge lock from the six-pin connector housing that is connected to the vehicle wire harness. Remove the brown/white wire from the connector plug.
5. Using a jumper wire with an alligator clip at each end, connect one alligator clip to the negative post of battery no. 1 and the other alligator clip to the brown/white wire terminal socket that was removed from the six-pin connector plug.
6. Install the wedgelock in the six-pin connector housing and reconnect the six-pin connector plug. Place the Tow/Run switch in the RUN position and the battery light should illuminate. If the light does not illuminate, replace the battery warning light assembly.

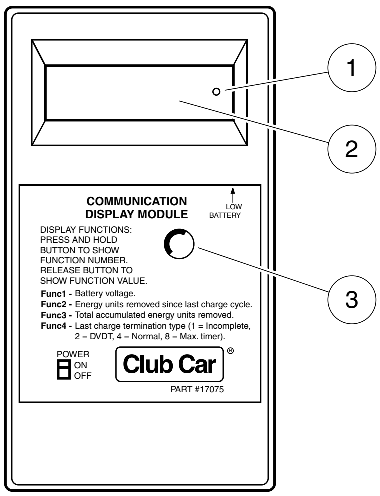
BATTERY WARNING LIGHT

IQ System and Excel 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 if the charge is less than 90% complete but the vehicle has enough power for 60 minutes of operation. This will alert the fleet operator that the vehicle may be used, but that it must be charged to completion as soon as possible.
- The 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 battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals, 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 battery warning light will flash quickly, after inserting the DC plug, indicating the charger’s voltage suppressor has failed closed.

COMMUNICATION DISPLAY MODULE (CDM)



1. Low Battery 2. Display Window 3. Function Button

2500-19200-10300

Figure 12-23 CDM

The CDM can be used to retrieve from the onboard computer four important items of information that can be useful in troubleshooting the IQ System vehicle. To access one of these items, the item's corresponding Function Code must be selected on the CDM. This is done by pressing the Function Button until the desired function code is displayed in the window. **See Figure 12-23, Page 12-39 for CDM features.** Releasing the button when the desired code is displayed will display the data. Function codes and corresponding data are as follows:

- **F1 – Battery voltage:**
- This displays the battery pack's current state of charge. A reading of less than 48 volts indicates that the batteries need to be charged. If a reading of less than 48 volts is obtained immediately after a charge cycle, there may be a problem in the charge circuit.
- **F2 – Energy units removed since last charge cycle:**
- If the display reads over 75 (the vehicle battery warning light should be illuminated), the vehicle batteries need to be recharged before being used again. This data can be used to make sure all vehicles in a fleet receive equal usage on a short-term basis.
- **F3 – Total accumulated energy units removed since initial vehicle start-up:**
- This information is most useful in making sure that all vehicles in a fleet receive equal usage over long periods of time.
- **F4 – Last charge termination type (1 = incomplete, 2 = DVDT, 4 = normal, 8 = max. timer):**
- A **1**, **2**, **4**, or **8** will be displayed.
- **1** – Indicates the last charge cycle was incomplete and the batteries were not fully charged. Batteries should be charged again at the earliest opportunity.
- **2** – Indicates a back-up charge program was employed by the OBC to complete the charge cycle if a normal charge (4) is not possible. DVDT refers to an increase in voltage within a time period. The OBC monitors battery voltage

during charging and will terminate the charge when the voltage does not increase within the time period. A DVDT charge may be displayed the first few times a new set of batteries is charged, and the first time a set of batteries is charged after the batteries have been disconnected and reconnected. A problem may exist if persistent DVDT readings are obtained.

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

The CDM also has a low battery indicator, which illuminates when CDM batteries are weak and need to be replaced. Weak batteries in the CDM may cause the CDM to register inaccurate information or no information.

USING THE CDM TO RETRIEVE DATA FROM THE ONBOARD COMPUTER

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

NOTE: *If, by positioning CDM on seat bottom, the CDM is unable to collect the data stream from the onboard computer, hold CDM approximately 6 inches (15.2 cm) from battery warning light.*

3. Wait approximately 30 seconds for a value to appear in the display window.
4. If a value does not appear in the display window after 30 seconds, try adjusting the aim of the CDM and repeating step 3 until a value appears. If there is still no reading, check for weak batteries in the CDM.
   - 4.1. Adjust aim of CDM.
   - 4.2. Drive vehicle a short distance to ensure OBC is not in powerdown mode.
   - 4.3. Check for weak batteries in CDM.
   - 4.4. If reading is still not obtained, go to the CDM Troubleshooting Guide on page 12-40.

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

- The value currently displayed will be F1 (battery voltage).
- To view F2, press and hold the button on the CDM. When “Func 2” appears in the display window, release the button. The value for F2 will then be displayed.
- To view F3, press and hold the button on the CDM until “Func 3” appears in the display window. Release the button. The value for F3 will be displayed.
- To view F4, press and hold the button on the CDM until “Func 4” appears in the display window. Release the button. The value for F4 will be displayed.

NOTE: *The values of all four functions can be recalled by pressing and releasing the CDM button.*

CDM TROUBLESHOOTING GUIDE

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

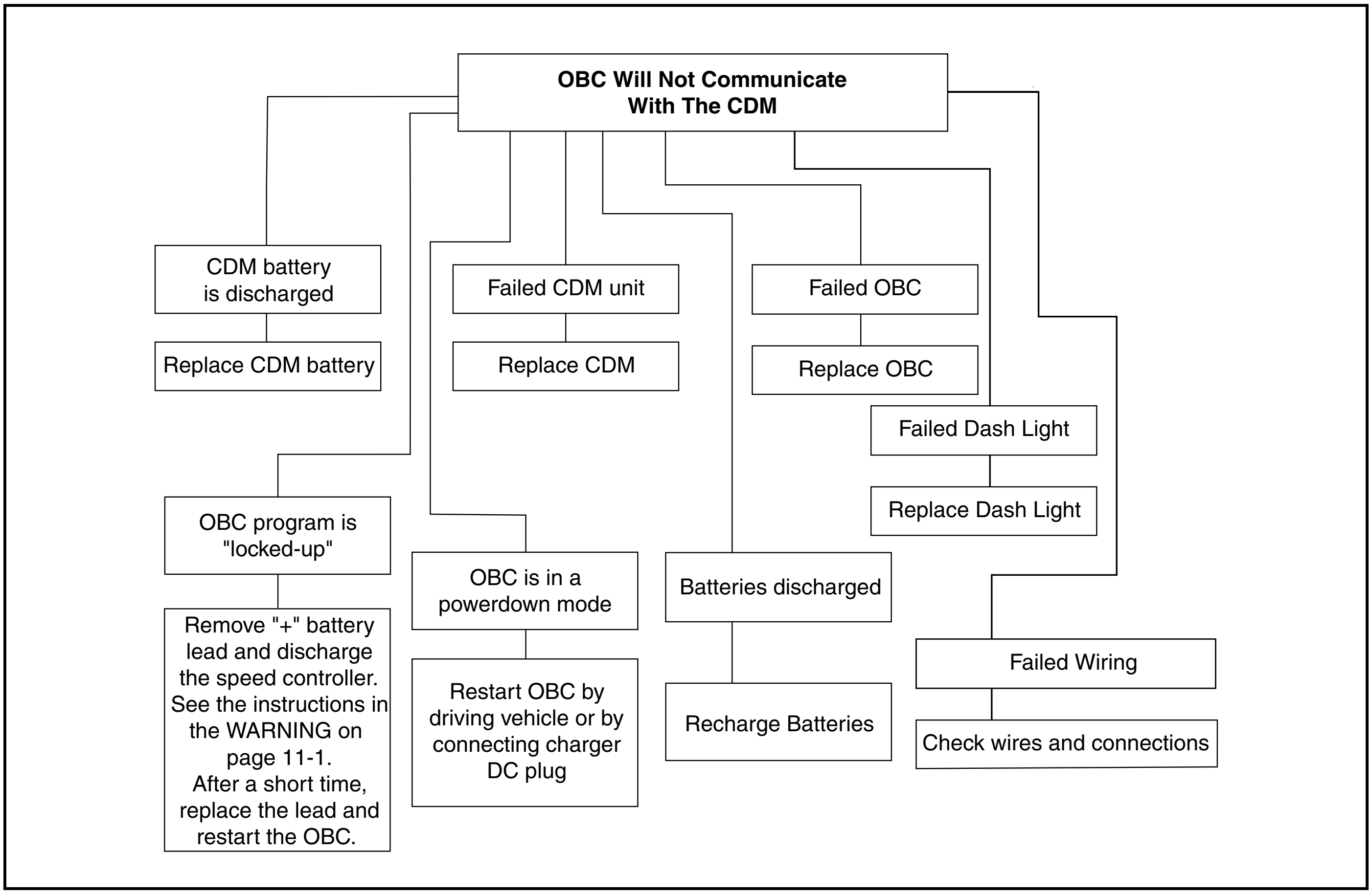


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Figure 12-24 Flow Chart – CDM Troubleshooting Guide

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**
- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

GENERAL INFORMATION

NOTE: *Many 2009 model year Precedent vehicles have had the pedal group reworked to use an MCOR in place of the throttle position sensor. If this is the case, see* ***IQ System Troubleshooting – MCOR on page 12-1*** *or* ***Excel System Troubleshooting – MCOR on page 14-1*** *for troubleshooting and system diagnosis. For a vehicle that still uses the throttle position sensor, use this section.*

Starting early 2010 model year with Serial Number PQ1009-082079, all electric Precedent vehicles were factory-equipped with an MCOR sensor in the Gen II pedal group. The pedal group has its own serial number with a prefix that also changed as follows:

Gen II pedal group equipped with throttle position sensor (before reverting to MCOR):	either PGE1 or PBE1(with brake light switch)
Gen II pedal group equipped with MCOR:	either PGE2 or PBE2(with brake light switch)

The Excel System vehicle uses a 48-volt electrical system that is powered by four 12-volt lead-acid batteries or six 8-volt lead-acid batteries and includes an onboard computer. The Excel System vehicle uses a shunt-wound 3.2 hp motor and includes several additional features.

DIFFERENCES BETWEEN THE EXCEL AND IQ SYSTEMS

- Excel is used in Precedent models only.
- Excel utilizes the 1515 controller instead of the 1510A.
- The Excel 1515 controller uses half-bridge technology allowing cooler operating temperatures and increased motor braking.
- The Excel minimum motor braking speed has been lowered to almost zero.
- Excel has higher energy output during regenerative braking due to the lowered minimum motor braking speed.
- The Excel accelerator pedal has more control of downhill speed.
- When parked on a hill, the Excel vehicle resists sudden acceleration after the park brake is released.

- The programmed speed of the Excel vehicle can now range from 5 to 19.2 mph with fine adjustments in 0.1 mph increments.
- Excel provides mileage readings.
- Excel has more diagnostics available.
- Excel offers the ability to change software. See Section 16 – IQ Display Module (IQDM) and IQDM-P Diagnostics: Excel System.

FEATURES

- **Shunt-Wound Motor:** The shunt-wound motor, unlike a series motor, is designed so that the speed controller is able to vary the amount of current passing through the field coils independently from the current passing through the armature.
- **Motor Braking:** Under certain conditions a shunt-wound motor also has the ability to act as an electrical brake to slow the vehicle. There are two features of the Excel electrical system that will activate the motor braking function: Walk Away Braking and Motor Braking (adjustable with the IQDM-P handset).
- **Walk Away Braking:** This prevents the vehicle from rolling away uncontrolled should the driver park on a slope and leave the vehicle without locking the park brake. The vehicle will roll at about 1 mph (1.6 km/h). If the walk away braking function remains engaged for two seconds or more, a warning buzzer will sound to alert the driver that motor braking has been activated.

⚠ WARNING

- **Walk Away Braking will not limit vehicle speed to 1 mph (1.6 km/h) on very steep grades. Do not operate vehicle on slopes exceeding 20% grades.**

- **Motor Braking:** When going down an incline with the accelerator pedal partially pressed, the motor braking function will activate to assist the operator in maintaining a speed less than the speed setting. For example, if the vehicle is going down an incline with the accelerator pedal pressed half way, the motor braking function will activate to assist the operator in maintaining a speed approximately half of the speed setting defined in the Program Menu.
- **Regenerative Braking**: When motor braking is activated, the vehicle motor acts as a generator, slowing the vehicle as it creates energy that is used to charge the batteries.
- **Tow/Run Switch:** When the Tow/Run switch is in the RUN position, the vehicle will function normally. When the switch is in the TOW position, power to the OBC and controller is shut off, disabling the vehicle operating circuit and walk away braking, allowing the vehicle to be towed.
- **Motor Protection Circuit:** The operator should never attempt to hold the vehicle on an incline by pressing the accelerator pedal instead of the brake pedal, as motor overheating could result. By reducing the current to the motor during such an occurrence, the motor protection circuit reduces the possibility of motor damage. When this situation arises, a *motor stall fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See Motor Stall on page 16-13.**
- **High Pedal Detect:** This function prevents unexpected vehicle movement if the key switch is turned ON after the accelerator is pressed. The vehicle will not move until the accelerator is released and pressed again. When this situation arises, a *HPD fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See HPD on page 16-12.**
- **Onboard Computer (OBC):** The OBC, 1) monitors battery condition, 2) monitors the number of energy units used by the vehicle, 3) determines the number of energy units required to recharge the batteries and shuts the charger off when this number is reached, 4) determines when to activate regenerative motor braking, 5) locks out vehicle movement while the charger is plugged into the vehicle charger receptacle, 6) stores operating data, which can be read by the Communication Display Module (CDM). **See Communication Display Module (CDM) on page 13-35.**

WIRING DIAGRAMS

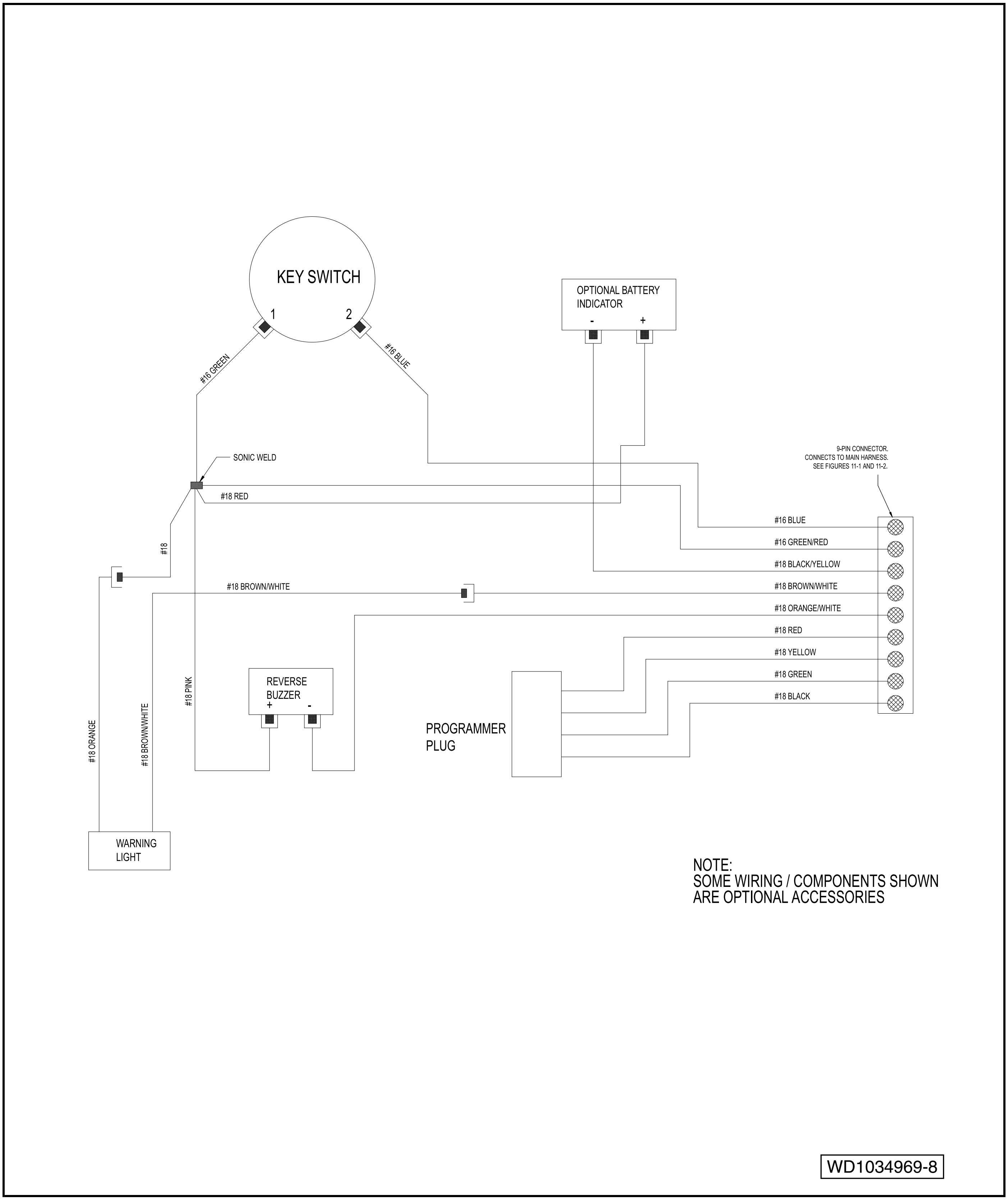


Figure 13-1 Precedent Electric Vehicle Instrument Panel Wiring Diagram

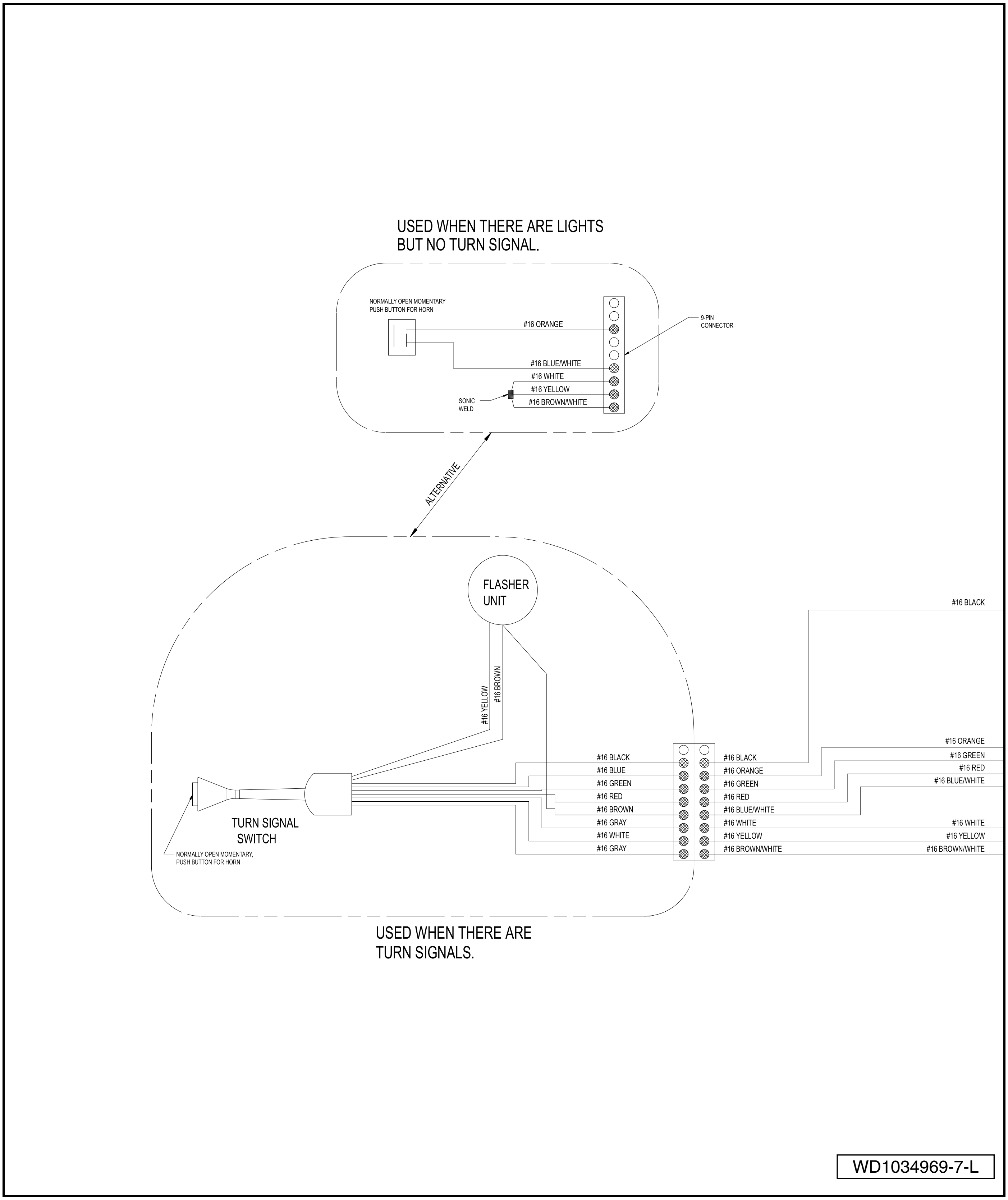


Figure 13-2 Precedent Electric Vehicle Accessory Wiring Diagram

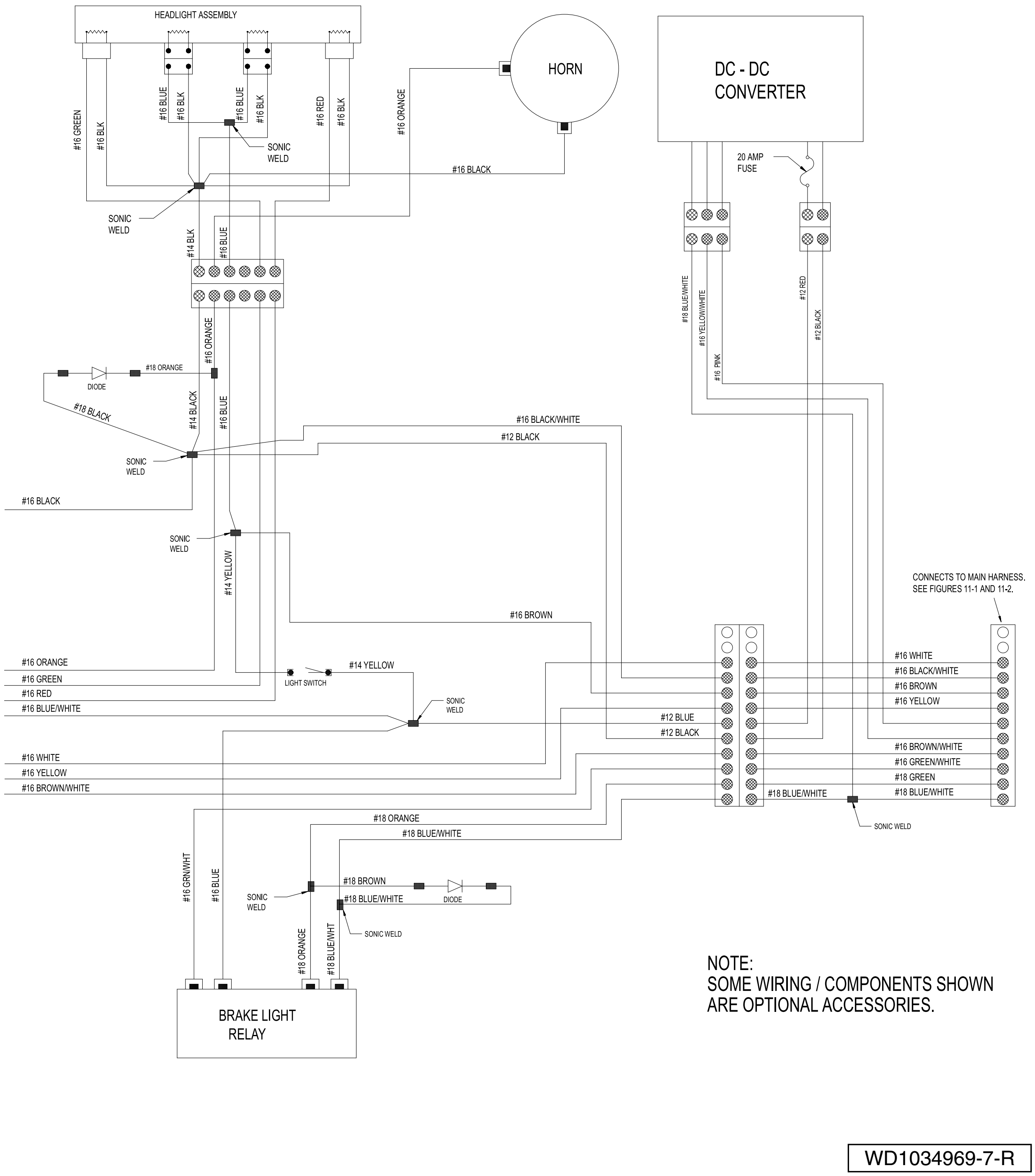


Figure 13-3 Precedent Electric Vehicle Accessory Wiring Diagram (Continued)

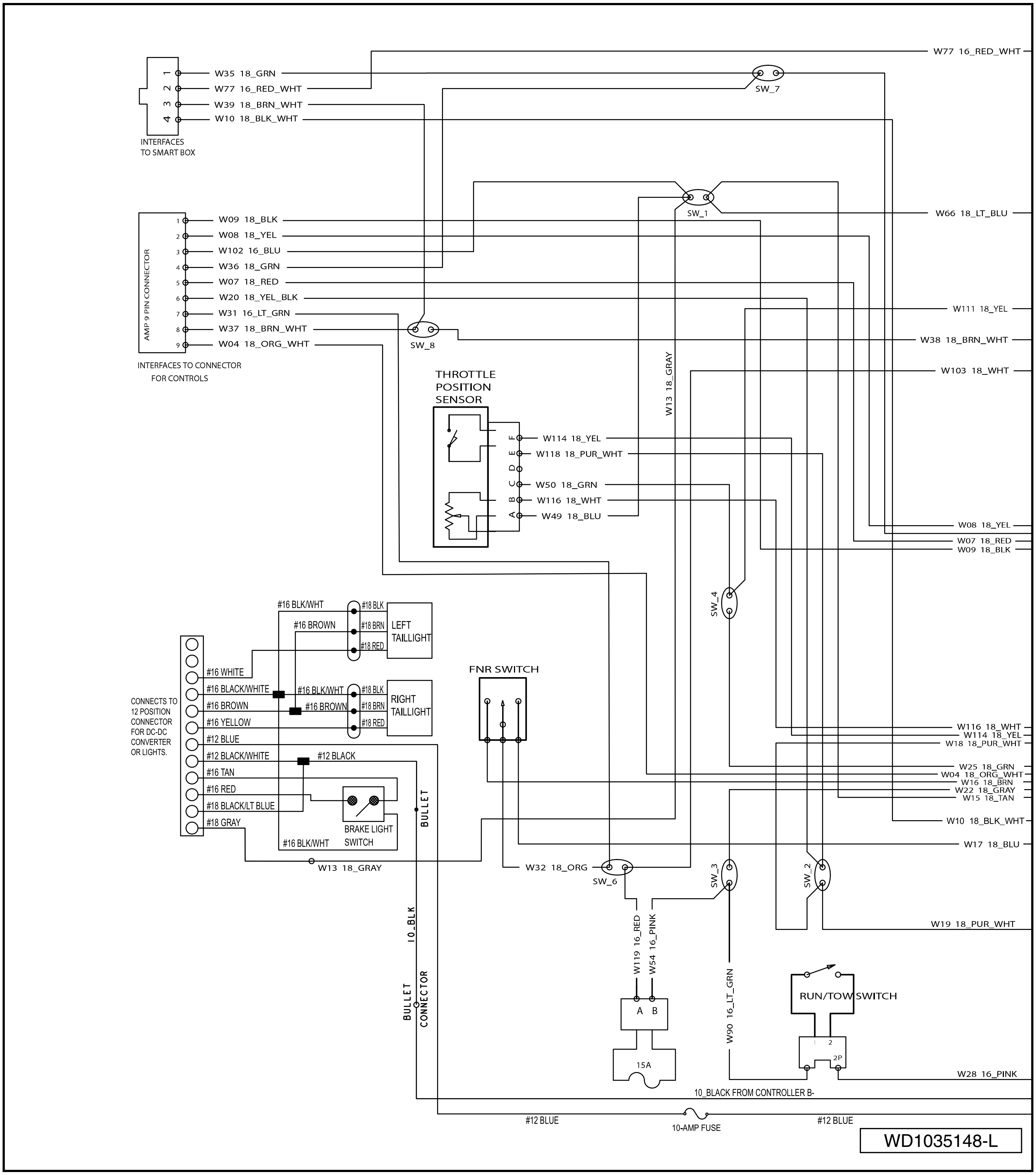


Figure 13-4 Wiring Diagram – Excel System with TPS

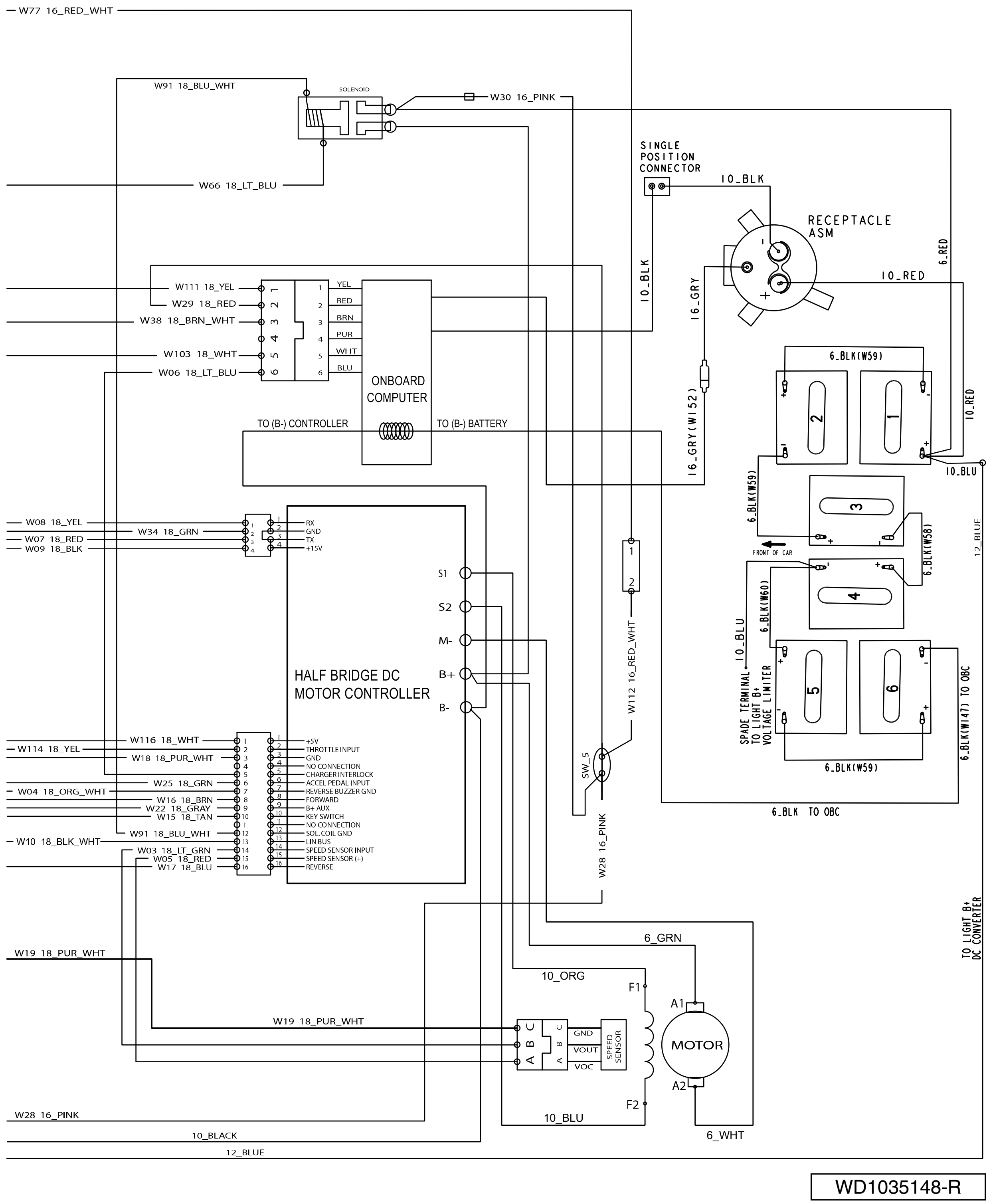


Figure 13-5 Wiring Diagram – Excel System with TPS (Continued)

TROUBLESHOOTING

The following troubleshooting guides will be helpful in identifying operating difficulties should they occur. The guides include the symptom, probable cause(s) and suggested checks. The procedures used in making these checks can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING THE VEHICLE WITH THE IQDM

Club Car recommends the use of the IQDM handset for troubleshooting vehicles equipped with the Excel electrical system. Troubleshooting Guide 1 is to be used in conjunction with the IQDM handset. **See IQ Display Module (IQDM) and IQDM-P Diagnostics: Excel System on page 16-1** for operating instructions. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the IQDM while the vehicle is in motion. A technician can monitor the IQDM while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

In the event that the vehicle is not functioning properly after completing Troubleshooting Guide 1, the technician should proceed to Troubleshooting Guide 2.
If an IQDM handset is unavailable, the technician should proceed to Troubleshooting Guide 2.

TROUBLESHOOTING GUIDE 1

The following troubleshooting guide is intended for use with an IQDM handset. **See following NOTE.**

NOTE: *Before troubleshooting the vehicle, check the diagnostic history from the Special Diagnostics Menu. Note any fault codes.*

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Test Menu – THROTTLE % value does not increase as the accelerator pedal is pressed or Diagnostic Menu – THROTTLE FAULT fault code	Loose or disconnected six-pin connector at the throttle position sensor or broken wire	Repair and/or connect the six-pin connector to the throttle position sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed throttle position sensor	Test Procedure 4 – Throttle Position Sensor Voltage on page 13-16
Test Menu – HEATSINK °C indicates that temperature is above 85 °C (145 °F) or Diagnostic Menu – THERMAL CUTBACK fault code	Over-adjusted brakes	Section 6 – Wheel Brake Assemblies
	Vehicle is over-loaded	Ensure that vehicle is not over-loaded before returning to operation
Test Menu – ARM PWM value does not reach 100% when vehicle is at full speed	Failed throttle position sensor	Test Procedure 4 – Throttle Position Sensor Voltage on page 13-16

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Test Menu – SPEED PULSES menu item indicates that speed pulses are OFF when the vehicle is in motion or Diagnostic Menu – SPEED SENSOR fault code	Loose or disconnected motor speed sensor or broken wire	Repair and/or connect the three-pin connector to the motor speed sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed motor speed sensor	Test Procedure 21 – Motor Speed Sensor on page 13-31
Test Menu – FOOT INPUT menu item indicates that the throttle position sensor internal limit switch is always ON or always OFF.	Loose or disconnected six-pin connector at the throttle position sensor or broken wire	Repair and/or connect the six-pin connector to the throttle position sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed throttle position sensor	Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 13-20
Test Menu – FORWARD INPUT and/or REVERSE INPUT does not indicate the correct reading	Loose or disconnected Forward/Reverse rocker switch (quick disconnect terminals) or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected Forward/Reverse rocker switch (three-pin connector) or broken wire	Repair and/or connect the three-pin connector from the Forward/Reverse switch to the wire harness
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed Forward/Reverse rocker switch	Test Procedure 23 – Forward/Reverse Rocker Switch on page 13-32
Test Menu – MAIN CONT DRIVER (solenoid) does not indicate ON when the solenoid should be activated. or Diagnostic Menu – MAIN CONT DNC (main contactor (solenoid) did not close) fault code	Speed controller logic malfunction	Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.** Reconnect the batteries and see if the symptom returns.
	Loose, broken, or disconnected wire(s) at solenoid or B+ speed controller terminal	Repair and/or connect the loose or disconnected wire(s)
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed solenoid	Replace solenoid. **See Solenoid Removal on page 17-13.**
Test Menu – KEY INPUT does not indicate ON when key switch is in the ON position	Loose or disconnected wires at key switch terminals or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed key switch	Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 13-20

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Diagnostic Menu – THROTTLE FAULT fault code	Loose or disconnected six-pin connector at the throttle position sensor or broken wire	Repair and/or connect the six-pin connector to the throttle position sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed throttle position sensor	Test Procedure 4 – Throttle Position Sensor Voltage on page 13-16
Diagnostic Menu – HW FAILSAFE (Hardware Failsafe) fault code	Armature drive FET's (field-effect transistors) inside speed controller have failed	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
Diagnostic Menu – MAIN WELDED (main solenoid contacts welded) fault code	solenoid contacts have failed closed	Replace solenoid. **See Solenoid Removal on page 17-13.**
Diagnostic Menu – MAIN DRIVER ON or MAIN DRIVER OFF fault code	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
	Failure of the FET that controls the solenoid coil	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
Diagnostic Menu – MAIN COIL FAULT fault code or Diagnostic Menu – MAIN DROPOUT (1 or 2) fault code	Solenoid coil has failed in an open condition	Replace solenoid. **See Solenoid Removal on page 17-13.**
Diagnostic Menu – FIELD MISSING fault code	Loose or disconnected motor field coil wires at motor or speed controller or broken wire	Repair and/or connect the field coil wires
	Failure of the motor field windings	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Failure of the FET's that control field current	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
Diagnostic Menu – HPD (high pedal detect) fault code	Operator error	Train operators to fully remove foot from accelerator pedal before turning key switch to the ON position or changing the selected direction with the Forward/Reverse switch
Diagnostic Menu – LOW BATTERY fault code	Batteries require charging	Place batteries on battery charger and allow them to fully charge
	Improperly maintained or failed batteries	See Section 18 – Batteries.
Diagnostic Menu – MOTOR STALL fault code	Operator error	Train operators to use the brake to hold the vehicle on a hill, rather than holding the vehicle on a hill using the accelerator pedal

TROUBLESHOOTING GUIDE 2

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle does not operate	Batteries – Batteries discharged	Charge batteries
	Batteries – Battery connections	Check vehicle wiring. **See Wiring Diagrams on page 13-3.**
	Battery charger is connected to the vehicle – Solenoid lockout feature has disabled the vehicle	Disconnect the battery charger from the vehicle
	Onboard computer failure	Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 13-15
	Key switch and throttle position sensor limit switch circuit	Check for loose or disconnected wires at key switch and throttle position sensor
	Failed key switch	Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 13-20
	Failed throttle position sensor	Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 13-20. See also Test Procedure 4 – Throttle Position Sensor Voltage on page 13-16.
	Forward/Reverse rocker switch	Test Procedure 23 – Forward/Reverse Rocker Switch on page 13-32
	Solenoid – loose wires	Test Procedure 3 – Solenoid Activating Coil on page 13-15
	Solenoid – failed coil	Test Procedure 3 – Solenoid Activating Coil on page 13-15
	Speed controller thermal cutback	Allow controller to cool and ensure that vehicle is not over-loaded before returning to operation
	16-pin connector at speed controller	Check for loose or disconnected wires at the 16-pin connector. **See also Test Procedure 9 – 16-Pin Connector on page 13-21.**
	High pedal detect	Cycle accelerator pedal
	Motor stall	Cycle accelerator pedal
	Motor Failure	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 17-12.**
	Motor – Motor connections	Check for loose or disconnected wires
	Speed controller – Motor and power connections	Check for loose or disconnected wires

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle runs slowly	Speed sensor disconnected or failed	Test Procedure 21 – Motor Speed Sensor on page 13-31
	Incorrect speed setting	To change the programmed top speed of the vehicle, an IQDM-P handset must be used
	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 13-3.**
	Batteries – Batteries discharged	Charge batteries
	throttle position sensor malfunction	Test Procedure 4 – Throttle Position Sensor Voltage on page 13-16
	Motor – loose wires	Inspect and tighten all wire connections at the motor.
	Failed motor	Replace motor. **See Motor Removal on page 20-3.**
	Vehicle is over-loaded	Ensure that vehicle is not over-loaded before returning to operation.
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 17-12.**
	Brakes – improperly adjusted	See Section 6 – Wheel Brake Assemblies.
	Tires – under-inflated or flat tires	See Section 8 – Wheels and Tires.
Vehicle operates, but motor braking function does not	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 13-3.**
	Speed sensor disconnected or failed	Test Procedure 21 – Motor Speed Sensor on page 13-31
Vehicle will run in forward, but not in reverse or will run in reverse but not forward	Forward/Reverse rocker switch – improperly wired	Test Procedure 23 – Forward/Reverse Rocker Switch on page 13-32
	Motor – improperly wired	Check motor wiring. **See Wiring Diagrams on page 13-3.**
	Speed controller – improperly wired or failed speed controller FET	Check vehicle wiring. **See Wiring Diagrams on page 13-3.**
Vehicle operates, but battery charger does not charge batteries	Onboard computer – gray wire	Test Procedure 19 – Onboard Computer Gray Wire on page 13-30
	Battery charger connections – loose wires at receptacle or batteries	Check wire connections and tighten if necessary.
	Battery charger	Refer to the appropriate battery charger maintenance and service manual.

TEST PROCEDURES

Using the following procedures, the entire electrical system can be tested without major disassembly of the vehicle.

⚠ WARNING

- **If wires are removed or replaced, make sure wiring and wire harness is properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.**

For many tests the electronics module cover must be removed to gain access to the various components that are mounted on the component mounting plate. **See Electronics Module Cover on page 17-5.** **See following WARNING.**

⚠ WARNING

- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

After test procedures are completed, be sure to replace the cover. **See Electronics Module Cover on page 17-5.** **See following CAUTION.**

CAUTION

- **Exposure to water may damage electronic components.**
  - **Do not operate vehicle without the cover properly installed.**
  - **Do not direct a water stream in area of the cover.**

Index of Test Procedures

21 – Motor Speed Sensor
22 – Solenoid Continuity
23 – Forward/Reverse Rocker Switch
24 – Reverse Buzzer
25 – Rebooting the Onboard Computer
26 – Battery Warning Light

TEST PROCEDURE 1 – Batteries / Voltage Check

See General Warnings on page 1-1.

NOTE: *The batteries must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in the Battery section of this manual.* ***See Battery Care on page 18-16.***

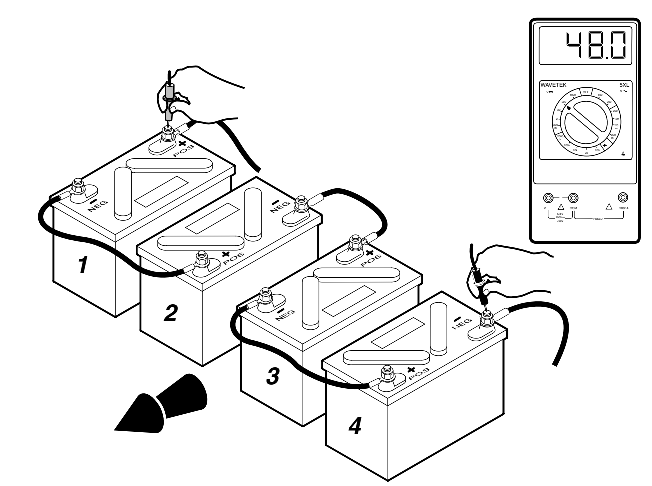
The battery voltage can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **Batteries / Voltage Check without the IQDM Handset**.

Batteries / Voltage Check with the IQDM Handset

1. Connect the IQDM to the vehicle.
2. Access the Test menu and select BATT VOLTAGE by using the SCROLL DISPLAY buttons. The IQDM should indicate at least 48 volts with the batteries fully charged. If not, check for loose battery connections or a battery installed in reverse polarity. **Refer to Batteries on page 18-1 for further details on battery testing.**

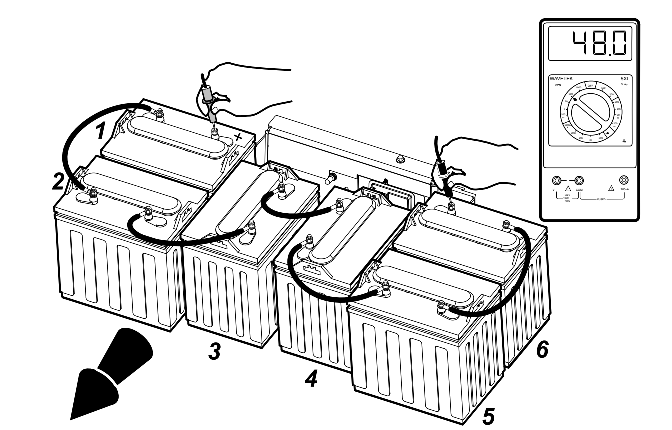
Batteries / Voltage Check without the IQDM Handset

1. With batteries connected and using a multimeter set to 200 volts DC, place red (+) probe on the positive (+) post of battery no. 1 and the black (–) probe on the negative (–) post of battery no. 4 **(Figure 13-6, Page 13-14)** or battery no. 6 **(Figure 13-7, Page 13-14)**.
2. The multimeter should indicate at least 48 volts with the batteries fully charged. If not, check for loose battery connections or a battery installed in reverse polarity. **Refer to Batteries on page 18-1 for further details on battery testing.**



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

Figure 13-6 Battery Voltage Test – 4 x 12 Volt Battery Configuration



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

Figure 13-7 Battery Voltage Test – 6 x 8 Volt Battery Configuration

TEST PROCEDURE 2 – Onboard Computer Solenoid Lockout Circuit

See General Warnings on page 1-1.

The solenoid lockout circuit disables the vehicle when the battery charger is plugged into the vehicle. Use the following procedure to test the solenoid lockout circuit:

1. With batteries connected, place the Tow/Run switch in the RUN position.
2. Using a multimeter set to 200 volts DC, place black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and red (+) probe (with insulation-piercing probe) on the light blue onboard computer wire (at a point between the OBC and the six-pin connector). The reading should be approximately 38-42 volts (full battery voltage). If the reading is not 38-42 volts, proceed to step 3. If the reading is 38-42 volts, proceed to Test Procedure 3 – Solenoid Activating Coil on page 13-15.
3. Place insulation-piercing probe on the light blue 18-gauge wire at a point between OBC six-pin connector and main wire harness. If reading is 38-42 volts, check the wire terminal connectors inside six-pin connector at OBC six-pin connector. Make sure pins are properly aligned inside housing. Make sure wire colors match and are connected to the correct terminals.
4. If reading is zero volts, plug the charger DC cord into the vehicle charger receptacle. If the dash light illuminates for 10 seconds, the OBC is now powered-up. Unplug the DC cord; the reading at the OBC light blue wire should be approximately 38-42 volts. If the vehicle now operates normally, the DC cord has powered up the electrical system. The electrical system should also power-up when the accelerator pedal is pressed. To check the accelerator pedal function, see Test Procedure 4 – Throttle Position Sensor Voltage on page 13-16.
5. If the dash light illuminates for 10 seconds and the vehicle does not operate:
   - 5.1. Using a multimeter set to 200 volts DC, place black (–) probe on battery number 4 and place red (+) probe (with insulation-piercing probe) on light blue 18-gauge wire at OBC six-pin connector.
   - 5.2. With Tow/Run switch in the RUN position, the voltage reading should be approximately 48 volts.
6. If the dash light does not illuminate and the vehicle does not operate, check the OBC activation circuit.
   - 6.1. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the red 18-gauge wire located on the OBC side of the six-pin connector. The reading should be approximately 48 volts. If the reading is incorrect, test the Tow/Run switch and connecting wires. **See Test Procedure 6 – Tow/Run Switch on page 13-18.**
   - 6.2. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the red 18-gauge wire (harness side of six-pin connector). Multimeter should indicate 48 volts. If voltage is correct, check connections in the six-pin connector. If connections are correct, OBC activation circuit has failed. Replace OBC.

TEST PROCEDURE 3 – Solenoid Activating Coil

See General Warnings on page 1-1.

NOTE: *Be aware that one of two different solenoids may be found on the vehicle. Visually, the production solenoid is smaller than the service replacement. On the labels, the larger service replacement solenoid has SOL0605 and the smaller production solenoid has SOL5006. Internally, specifications and test results differ between the two.*

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Access the solenoid by removing the electronics module cover. **See Electronics Module Cover on page 17-5.**
3. Remove the two small wire terminals from the solenoid.
4. Place red (+) probe of the multimeter on the positive (+) solenoid terminal. Place the black (–) probe on the other small solenoid terminal.

– A reading of 200 to 250 ohms should be obtained for factory-installed solenoids **(Figure 13-8, Page 13-16)**. If not, replace the solenoid.

– A reading of 180 to 190 ohms should be obtained for service replacement solenoids **(Figure 13-9, Page 13-16)**. If not, replace the solenoid.

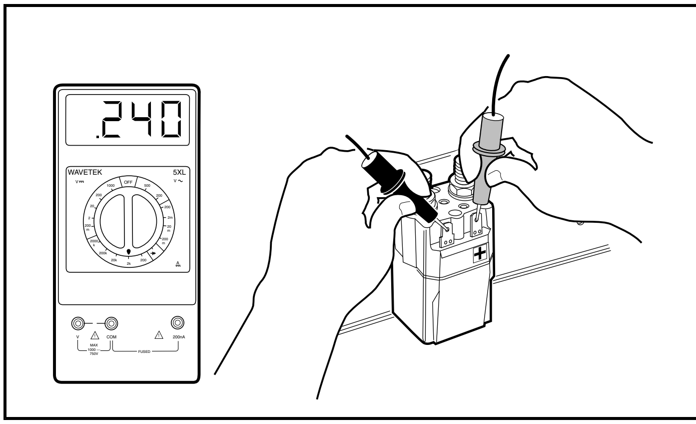


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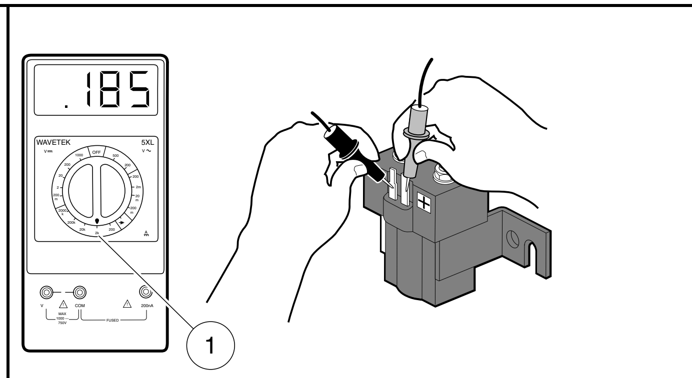
Figure 13-8 Activating Coil Test – Factory-installed Solenoid



1. 2k Ohm Setting

2500-20000-10283
Figure 13-9 Activating Coil Test – Service Replacement Solenoid

TEST PROCEDURE 4 – Throttle Position Sensor Voltage

See General Warnings on page 1-1.

The accelerator position, which is proportional to the sensor voltage, can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **Throttle Position Sensor Voltage Test without the IQDM Handset**.

Throttle Position Sensor Voltage Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. Connect the IQDM to the vehicle.
3. Access the Test menu and select THROTTLE % by using the SCROLL DISPLAY buttons.
4. The IQDM should indicate 0 % with the pedal not pressed. While monitoring the IQDM display screen, slowly press the accelerator pedal. As the pedal is pressed, the IQDM should indicate a rise from 0 % (pedal not pressed) to 100 % (pedal fully pressed).
5. If the throttle position sensor does not operate as described in previous step, proceed to **Throttle Position Sensor Voltage Test without the IQDM Handset**.

Throttle Position Sensor Voltage Test without the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
2. With key switch OFF and batteries connected, place Tow/Run switch in RUN. Using a multimeter set to 200 volts DC, place red (+) probe on battery no. 1 positive post and place black (–) probe (with insulation-piercing probe)

on the purple/white wire at a point close to the six-pin connector at the throttle position sensor. The reading should be approximately 48-50 volts (full battery voltage).

3. If reading is zero volts, check the purple/white wire continuity from the six-pin connector at the sensor to the 16-pin connector at the speed controller. Check terminal positions in six-pin connector at the sensor and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.
4. With multimeter set to 20 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the white wire at a point close to the six-pin connector at the sensor. The reading should be 5 volts.
5. If reading is zero volts, check the white wire continuity from the six-pin connector at the sensor to the 16-pin connector at the speed controller. Check terminal positions in six-pin connector at the sensor and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.
6. Turn key switch ON and, with multimeter set to 20 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the yellow wire at a point close to six-pin connector at the sensor. The reading should be approximately 0.30 volts with the pedal up. Slowly press the accelerator pedal and note the readings on the multimeter. As the pedal is pressed, the reading should increase until it reaches 4.15 to 4.45 volts when the pedal is fully pressed.
7. If reading does not increase as the pedal is pressed, replace the accelerator pedal assembly. **See Accelerator Pedal Removal on page 5-6.**
8. If the reading is not between 4.15 and 4.45 volts with the pedal fully pressed, the vehicle will not operate at rated top speed. Replace the accelerator pedal assembly. **See Accelerator Pedal Removal on page 5-6.**

TEST PROCEDURE 5 – A1 and A2 Motor Voltage

See General Warnings on page 1-1.

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

2. With the batteries connected and using a multimeter set to 200 volts DC, place the black (–) probe on the A2 motor terminal (white wire) and connect the red (+) probe to the A1 (green wire) motor terminal.
3. With Tow/Run switch in the RUN position, place the Forward/Reverse switch in the FORWARD position, turn key switch to the ON position and slowly press accelerator pedal.
4. As the accelerator pedal is pressed, the voltage reading should increase from approximately 5 volts RMS when the throttle position sensor limit switch closes, to approximately 48 volts RMS with the accelerator pedal fully pressed. **See following NOTE.**

NOTE: *Voltage can vary depending on controller speed setting as well as which zone a Guardian equipped vehicle is located.*

Example: *Speed setting 1 may only read 30 volts.*

4.1. If there is no voltage reading, check the throttle position sensor. **See Throttle Position Sensor Voltage on page 13-16.** Also check the continuity of the large posts of the solenoid. **See Solenoid Continuity on page 13-32.**

4.2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

4.3. Check continuity on A1 and A2 motor terminal posts and continuity of the F1 and F2 motor terminal posts. Also, check continuity of all motor wires. See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).

TEST PROCEDURE 6 – Tow/Run Switch

See General Warnings on page 1-1.

Tow/Run Switch Test with the IQDM Handset

1. With the Tow/Run switch in the RUN position, connect the IQDM to the vehicle.
2. Immediately after the IQDM is connected to the vehicle, the screen should display a copyright notice and the IQDM model number.
3. If the IQDM display screen is blank, drive the vehicle a short distance to activate the onboard computer.
4. If the IQDM display screen begins to work after the vehicle has been driven, turn the key switch to the OFF position and proceed to step 5; otherwise, perform the following procedure, **Tow/Run Switch Test without the IQDM Handset**.
5. With the IQDM still connected to vehicle, place Tow/Run Switch in TOW position and wait 90 seconds.
6. If the IQDM display screen goes blank after 90 seconds, the Tow/Run switch and connecting wires are operating correctly.
7. If the IQDM display screen is still active after 90 seconds, the switch has failed closed. Replace the Tow/Run switch. **See Tow/Run Switch Removal on page 17-6.**

Tow/Run Switch Test without the IQDM Handset

1. Remove the bolt that secures the electronics module to the battery bucket and pull module forward to access Tow/Run switch wires.
2. With the batteries connected and using a multimeter set on 200 volts DC, connect the black (–) probe to the negative post of battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) and connect red (+) probe (with insulation-piercing probe) on the pink wire close to the connector on the Tow/Run switch.

⚠ WARNING

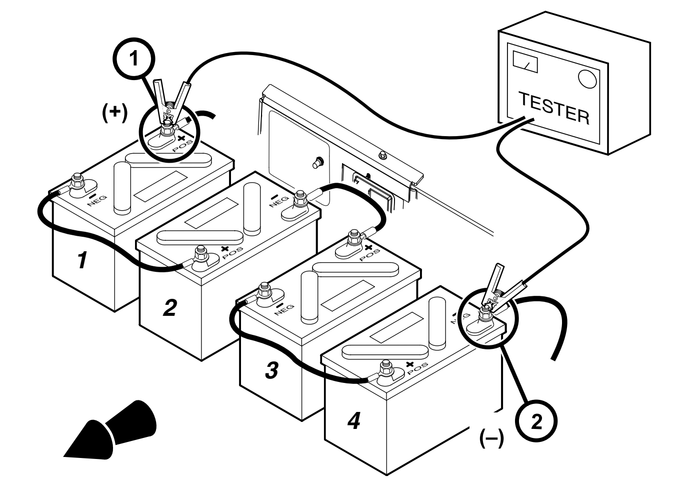
- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

3. With the Tow/Run switch in the RUN position, the reading should be approximately 48-50 volts. With the switch in the TOW position, the reading should be below approximately 5 volts.
4. If the reading is above 5 volts with the switch in the TOW position, replace the switch.
5. If the reading is below 5 volts with switch in the RUN position, check continuity of the pink 16-gauge wire from the large post of the solenoid to the connector at the Tow/Run switch.
6. If the continuity readings are correct, replace the Tow/Run switch.

TEST PROCEDURE 7 – Battery Pack Voltage (Under Load)

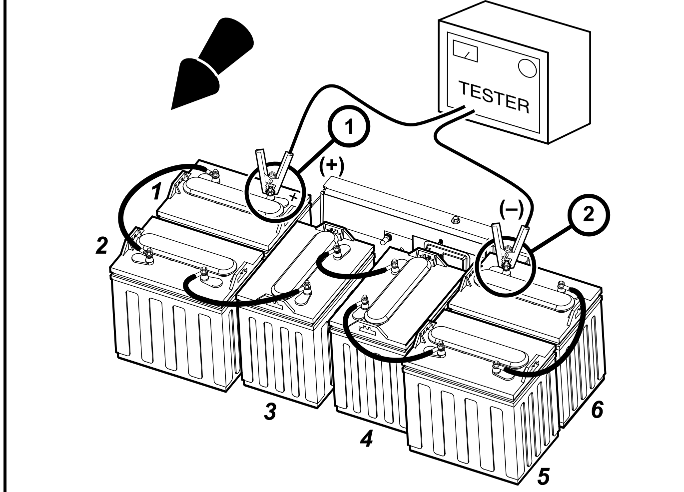
See General Warnings on page 1-1.

1. Be sure the batteries are fully charged and that the electrolyte level is correct in all cells.
2. Connect the tester leads to the positive (+) post of battery no.1 and negative (–) post of battery no. 4 **(Figure 13-10, Page 13-19)** or battery no. 6 **(Figure 13-11, Page 13-19)**.



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

Figure 13-10 Battery Discharge Test – 4 x 12 Volt Battery Configuration



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

Figure 13-11 Battery Discharge Test – 6 x 8 Volt Battery Configuration

3. Turn the discharge machine on and record the voltage reading of battery pack while under load.
4. A fully charged set of batteries in good condition should read between 46-49 volts while under load.
5. A reading of 32-46 volts indicates discharged or failed batteries. Each battery should be checked with a multimeter while under load.
6. A reading of 32 volts or less will not activate discharge machine. If the voltage of the batteries is below 32 volts, the batteries are deeply discharged or have failed.
7. Recording the battery pack voltage reading while under load provides a more accurate diagnosis of the condition of the batteries. When the discharge machine is ON, it places the battery pack under load and many times can help determine if one or more batteries in the set have failed. Testing battery voltage while the batteries are not under load will not always indicate the true condition of the batteries. For more information about the batteries, refer to Batteries on page 18-1.

TEST PROCEDURE 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit

See General Warnings on page 1-1.

Key Switch and Throttle Position Sensor Limit Switch Circuit Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
2. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
3. Connect the IQDM to the vehicle.
4. Test the key switch.
   4.1. Access the Test menu and select KEY INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the key switch is in the OFF position.
   4.2. While monitoring the IQDM display screen, turn the key switch to the ON position. The IQDM should indicate ON.
   4.3. If the IQDM does not indicate that KEY INPUT is ON when the key switch is in the ON position, proceed to the following procedure, **Key Switch and Throttle Position Sensor Limit Switch Circuit Test without the IQDM Handset**. If the key switch functions as described, proceed to the following step. **See following NOTE.**

NOTE: *The key switch MUST function properly in order to test the throttle position sensor limit switch with the IQDM handset.*

5. Test the throttle position sensor limit switch.
   5.1. Select FOOT INPUT on the Test menu by using the SCROLL DISPLAY buttons on the IQDM.
   5.2. The IQDM should indicate that FOOT INPUT is OFF when the accelerator pedal is not pressed, regardless of the key switch position.
   5.3. With the key switch in the ON position, press the accelerator pedal. The IQDM should indicate that FOOT INPUT is ON when the accelerator pedal is pressed.
6. If any reading is obtained that is not described in steps 4 and 5, perform the following steps:
   6.1. Check the wiring of the key switch and throttle position sensor. **See Wiring Diagrams on page 13-3.**
   6.2. Check the continuity of the key switch wires and the throttle position sensor limit switch wires.
7. If the problem was not found, proceed to the following procedure, **Key Switch and Throttle Position Sensor Limit Switch Circuit Test without the IQDM Handset**.

Key Switch and Throttle Position Sensor Limit Switch Circuit Test without the IQDM Handset

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
4. Test the key switch.
   4.1. Remove the instrument panel. **See Key Switch Removal, Section 17, Page 17-1.**
   4.2. Using a multimeter set to 200 ohms, place the red (+) probe on the key switch terminal with the blue wire. Place the black (–) probe on the other key switch terminal.
   4.3. With the key switch in the OFF position, the multimeter should indicate that continuity is not present.
   4.4. With the key switch in the ON position, the multimeter should indicate that continuity is present.

4.5. If any other reading is obtained, replace the key switch. **See Key Switch Removal on page 17-1.**

4.6. If the key switch operates as described in the previous steps, install the instrument panel in the reverse order of removal and proceed to the following step.

5. Test the throttle position sensor limit switch. **See following NOTE.**

NOTE: *Make sure that the key switch is operating correctly and that the key switch and instrument panel are properly installed before proceeding.*

5.1. With batteries connected and using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire close to the six-pin connector on the throttle position sensor.

⚠ WARNING

- **The Forward/Reverse switch must be in the neutral position to avoid personal injury due to contact with rotating wheels.**

5.2. With Tow/Run switch in the RUN position, key switch in the ON position, and Forward/Reverse rocker switch in the NEUTRAL position, the voltage reading should be zero volts. When the accelerator pedal is pressed, the voltage reading should be approximately 48 volts (full battery voltage).

5.3. If the voltage reading is 48 volts when the accelerator pedal is not pressed, replace the accelerator pedal assembly. **See Accelerator Pedal Removal on page 5-6.**

5.4. If the voltage reading is zero volts when the accelerator pedal is pressed, check for voltage to the limit switch using the following test procedure.

5.4.1. Using a multimeter set to 200 volts DC, place black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the place red (+) probe (with insulation-piercing probe) on the blue wire where it connects to the throttle position sensor. With the key switch ON, the reading should be approximately 48 volts (full battery voltage).

5.4.2. If the reading is zero volts, check the continuity of the blue wire that goes from the key switch to the throttle position sensor.

5.4.3. If the reading is approximately 48 volts, replace the accelerator pedal assembly. **See Accelerator Pedal Removal on page 5-6.**

TEST PROCEDURE 9 – 16-Pin Connector

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Disconnect the 16-pin connector from the speed controller. Inspect terminal ends inside plug to ensure they are in position and seated in plug housing. If any terminals look like they are not pushed all the way into the connector, gently push the terminals until they are firmly seated in the 16-pin connector. After each terminal has been pushed into the housing, gently pull on the wire to ensure it is locked into place.
3. Check wires in the plug to make sure none are broken at the terminal pin crimp. Repair or replace as required.
4. Check the wire colors of each wire and make sure that the colors for each pin position match the wire colors in the wiring diagram. **See Wiring Diagrams on page 13-3.**
5. When connecting the 16-pin connector to the controller, push plug into controller receptacle with enough force to lock plug into place. An audible click will be heard when plug is properly seated to the controller.

A procedure is provided for testing each of the wires in the 16-pin connector. Refer to the following chart for the appropriate procedure for each pin in the 16-pin connector.

If the results of any of the referenced procedures are different from those described in the procedure, check the continuity of the wires in the wire harness and test the connected components with the appropriate test procedures. **See Index of Test Procedures.**

SPEED CONTROLLER 16-PIN CONNECTOR WIRE	FUNCTION	TEST PROCEDURE
Pin 1 – White (18-gauge)	+5V to throttle position sensor	Test Procedure 10 – Pins 1, 2, and 3 on page 13-22 Also for Pin 3 Test continuity of wire and perform Test Procedure 21 – Motor Speed Sensor on page 13-31
Pin 2 – Yellow (18-gauge)	Pedal position signal from throttle position sensor	
Pin 3 – Purple/White (18-gauge)	Ground for throttle position sensor	
Pin 4 – Open (No wire)		
Pin 5 – Light Blue (18-gauge)	Charger interlock	Test Procedure 11 – Pin 5 on page 13-22
Pin 6 – Green (18-gauge)	To throttle position sensor limit switch for accelerator pedal input	Test Procedure 12 – Pin 6 on page 13-24
Pin 7 – Orange/White (18-gauge)	Reverse buzzer ground	Test Procedure 13 – Pin 7 on page 13-24
Pin 8 – Brown (18-gauge)	Forward signal from FNR	Test Procedure 14 – Pins 8 and 16 on page 13-25
Pin 9 – Gray (18-gauge)	To Tow switch sonic weld	Test Procedure 15 – Pin 9 on page 13-26
Pin 10 – Tan (18-gauge)	To key switch sonic weld	Test Procedure 16 – Pin 10 on page 13-27
Pin 11 – Open (no wire)		
Pin 12 – Blue/White (18-gauge)	Solenoid coil ground	Test Procedure 17 – Pin 12 on page 13-28
Pin 13 – Black/White (18-gauge)	Negative (-) side of motor speed sensor	Test continuity of each wire and perform Test Procedure 21 – Motor Speed Sensor on page 13-31
Pin 14 – Light Green (18-gauge)	To motor speed sensor output	
Pin 15 – Red (18-gauge)	Positive (+) side of motor speed sensor	
Pin 16 – Blue (18-gauge)	Reverse signal from FNR	Test Procedure 14 – Pins 8 and 16 on page 13-25

TEST PROCEDURE 10 – Pins 1, 2, and 3

See General Warnings on page 1-1.

Pins 1, 2, and 3 in the 16-pin connector provide a connection point from the throttle position sensor to the speed controller. Two wires simply supply 5 volts to the sensor. The sensor varies the voltage according to pedal position and sends that voltage signal to the controller through the third wire. See chart above. To test these wires, **see Test Procedure 4 – Throttle Position Sensor Voltage on page 13-16**.

TEST PROCEDURE 11 – Pin 5

See General Warnings on page 1-1.

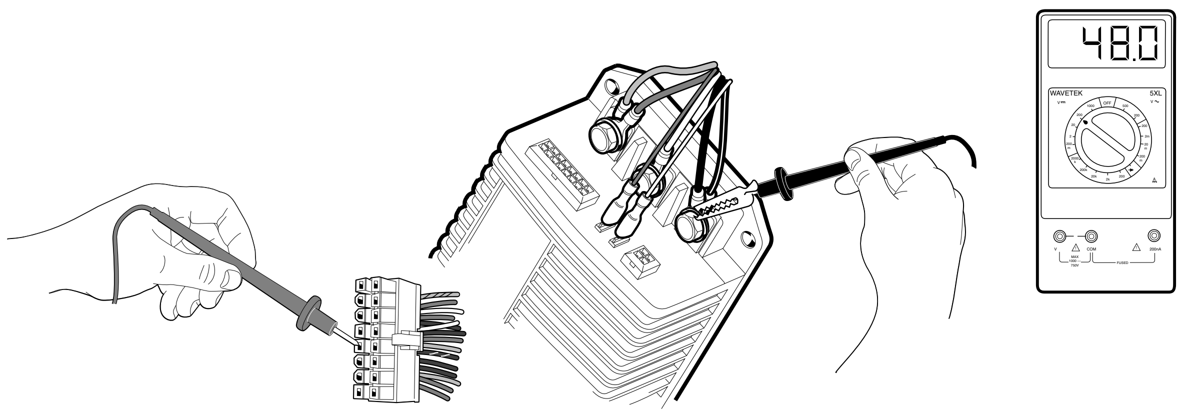
Pin 5 in the 16-pin connector provides a connection point for the solenoid lockout circuit from the onboard computer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**

3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 5 (light blue wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 13-12, Page 13-23)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**



200 DCV Setting (reading with OBC powered-up and battery charger disconnected)

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Figure 13-12 Pin 5 Test

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position.
7. The multimeter should indicate zero volts DC at this time.
8. While monitoring the multimeter, plug the battery charger into the vehicle charger receptacle.
9. After a short delay, the onboard computer should power-up (come out of sleep mode), charger relay should click, and the ammeter on the charger should indicate that the vehicle batteries are being charged.
10. The multimeter should indicate zero volts DC while the charger is connected to the vehicle.
11. While observing the multimeter, disconnect the DC plug from the vehicle charger receptacle.
12. The multimeter should indicate full battery voltage when the charger is not connected to the vehicle.
13. If any other reading is obtained, check the following items:
    – Continuity of the wires in the wire harness

    – Onboard computer for proper operation. **See Test Procedure 19 – Onboard Computer Gray Wire on page 13-30.**

    – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 13-18.**

TEST PROCEDURE 12 – Pin 6

See General Warnings on page 1-1.

Pin 6 in the 16-pin connector provides a connection point for the throttle position sensor limit switch to the speed controller. A 48 volt signal is sent through this wire when the accelerator pedal is pressed, completing the circuit inside the throttle position sensor. To test this wire, **see Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 13-20**.

TEST PROCEDURE 13 – Pin 7

See General Warnings on page 1-1.

Pin 7 in the 16-pin connector provides a connection point for the reverse buzzer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Place a jumper wire with an alligator clip between the B– terminal of the speed controller (use alligator clip for this connection) and pin 7 (orange/white wire) of the 16-pin connector **(Figure 13-13, Page 13-25)**. **See following CAUTION.**

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position.
7. The reverse buzzer should sound when the Tow/Run switch is in the RUN position.
8. If any other activity is observed, check the following items:
   – Continuity of the wires in the wire harness

   – Reverse buzzer for proper operation. **See Test Procedure 24 – Reverse Buzzer on page 13-33.**

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 13-18.**

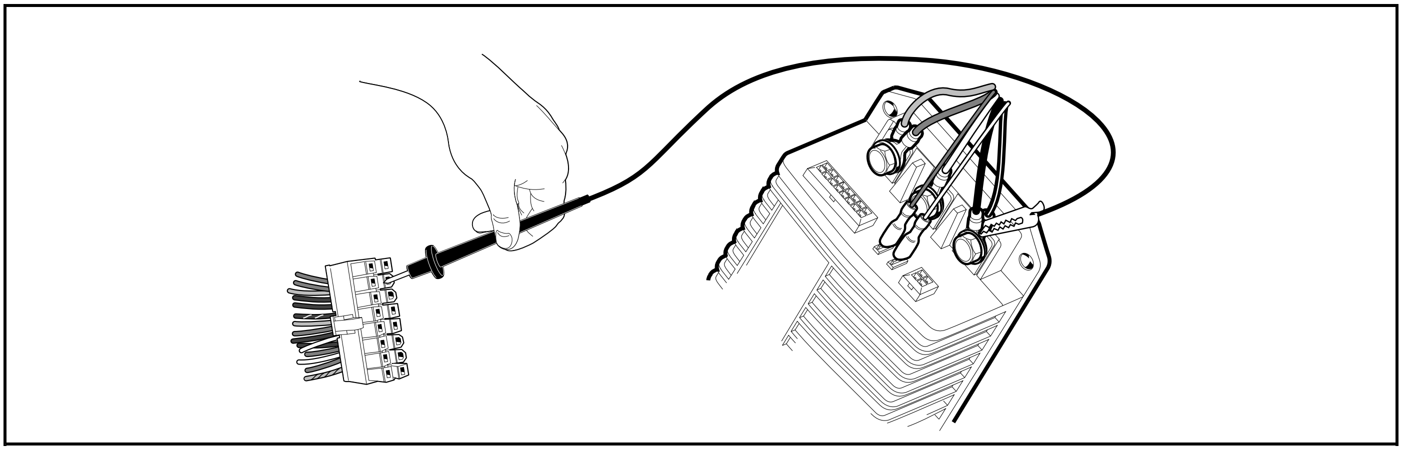

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Figure 13-13 Pin 7 Test

TEST PROCEDURE 14 – Pins 8 and 16

See General Warnings on page 1-1.

Pins 8 and 16 in the 16-pin connector provide a connection point for the Forward/Reverse rocker switch to the speed controller. The switch provides a +48 volt signal to the speed controller through pin 8 when the Forward/Reverse switch is in the FORWARD position and provides a +48 volt signal on pin 16 when the Forward/Reverse switch is in the REVERSE position.

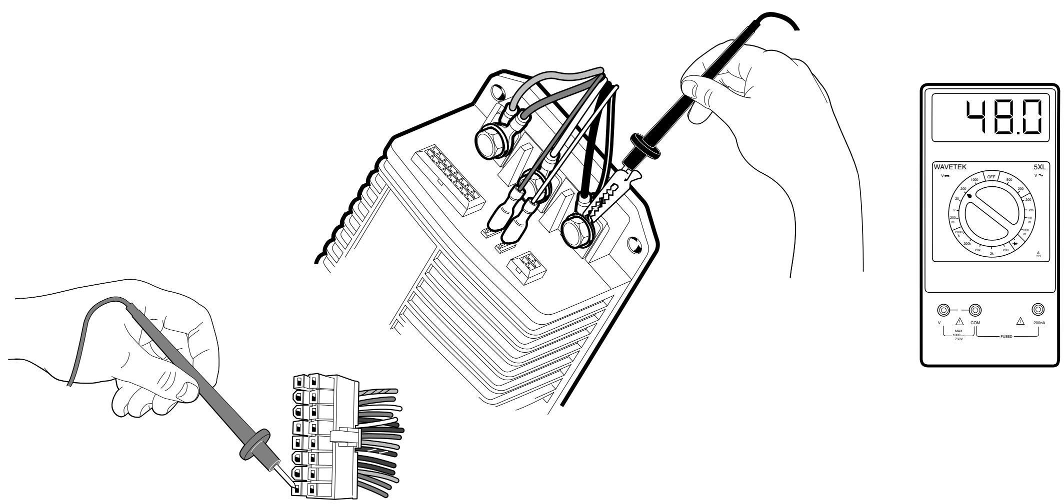
1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame crossmember between the spring mount and side stringer, just forward of each rear wheel. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 8 (brown wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 13-14, Page 13-26)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position and the Forward/Reverse switch in the NEUTRAL position. The multimeter should indicate zero volts DC at this time.
7. While monitoring the multimeter, place the Forward/Reverse switch in the REVERSE position. The multimeter should still indicate zero volts.
8. Place the Forward/Reverse switch in the FORWARD position. The multimeter should indicate full battery voltage (approximately 48 volts).
9. Insert the red (+) probe of the multimeter into pin 16 (blue wire) of the 16-pin connector. Leave the black (–) probe (alligator clip) connected to the B– terminal of the speed controller. **See previous CAUTION.**
10. Place the Forward/Reverse switch in the NEUTRAL position. The multimeter should indicate zero volts DC at this time.
11. While monitoring the multimeter, place the Forward/Reverse switch in the FORWARD position. The multimeter should still indicate zero volts.

12. Place the Forward/Reverse switch in the REVERSE position. The multimeter should indicate full battery voltage (approximately 48 volts).
13. If any other reading is obtained, check the following items:
    - Continuity of the wires in the wire harness
    - Forward/Reverse switch for proper operation. **See Test Procedure 23 – Forward/Reverse Rocker Switch on page 13-32.**
    - Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 13-18.**



200 DCV Setting (reading with Tow/Run switch in RUN and Forward/Reverse switch in FORWARD)

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Figure 13-14 Pins 8 and 16 Test

TEST PROCEDURE 15 – Pin 9

See General Warnings on page 1-1.

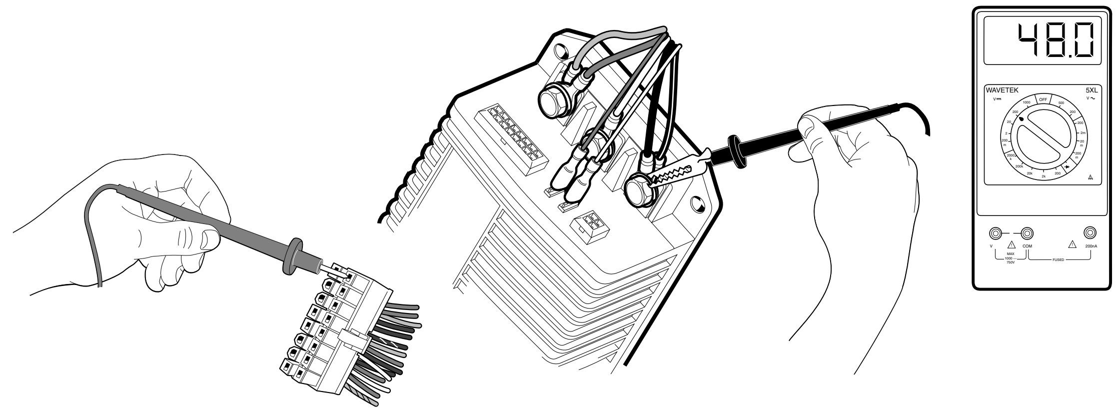
Pin 9 in the 16-pin connector provides a connection point for the Tow/Run switch to the speed controller. The switch provides a +48 volt signal to the speed controller through pin 9 when the Tow/Run switch is in the RUN position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 9 (gray wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 13-15, Page 13-27)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. With the Tow/Run switch in the TOW position, the multimeter should indicate zero volts.
7. Place the Tow/Run switch in the RUN position.



200 DCV Setting (reading with Tow/Run switch in RUN position)

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Figure 13-15 Pin 9 Test

8. With the Tow/Run switch in the RUN position, the multimeter should indicate full battery voltage (approximately 48 volts).
9. If any other reading is obtained, check the following items:
   – Continuity of the wires in the wire harness

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 13-18.**

TEST PROCEDURE 16 – Pin 10

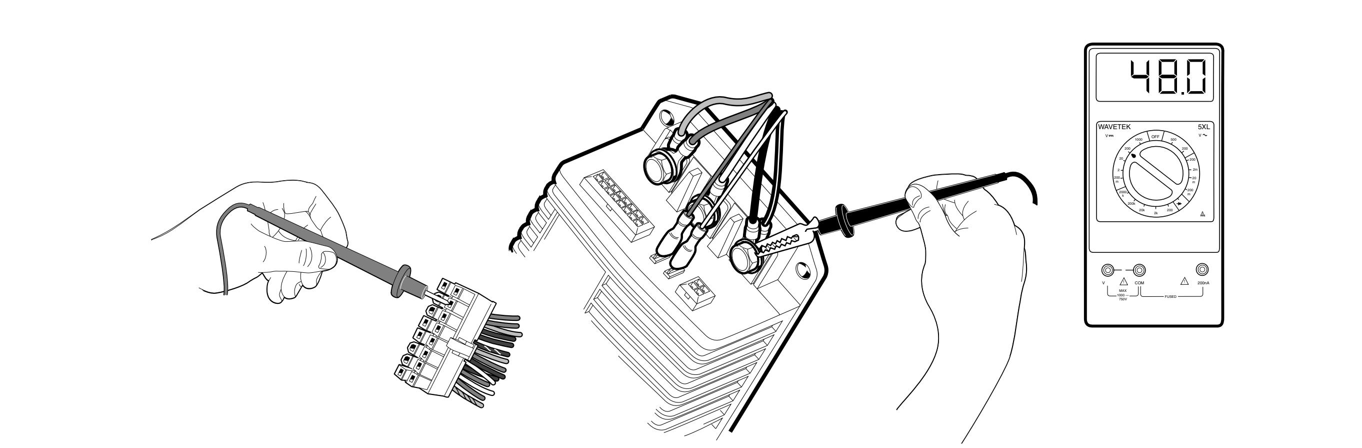
See General Warnings on page 1-1.

Pin 10 in the 16-pin connector provides a connection point for the key switch to the speed controller. The key switch provides a +48 volt signal to the speed controller through pin 10 when the key switch is in the ON position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 10 (tan wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 13-16, Page 13-28)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**



200 DCV Setting (reading with Tow/Run switch in RUN and key switch in the ON position)

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Figure 13-16 Pin 10 Test

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. With the Tow/Run switch in the TOW position, the multimeter should indicate zero volts.
7. Place the Tow/Run switch in the RUN position and the key switch in the ON position.
8. With the key switch in the ON position, the multimeter should indicate full battery voltage (approximately 48 volts). With the key switch in the OFF position, the reading should be zero volts.
9. If any other reading is obtained, check the following items:
   – Continuity of the wires in the wire harness
   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 13-18.**
   – Key switch for proper operation. **See Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 13-20.**

TEST PROCEDURE 17 – Pin 12

See General Warnings on page 1-1.

Pin 12 in the 16-pin connector provides a connection point for the solenoid coil to the speed controller. The speed controller activates the solenoid coil by providing a ground to the solenoid coil at the appropriate time.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Place a jumper wire with an alligator clip between the B– terminal of the speed controller (use alligator clip for this connection) and pin 12 (blue/white wire) of the 16-pin connector **(Figure 13-17, Page 13-29)**. **See following CAUTION.**

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

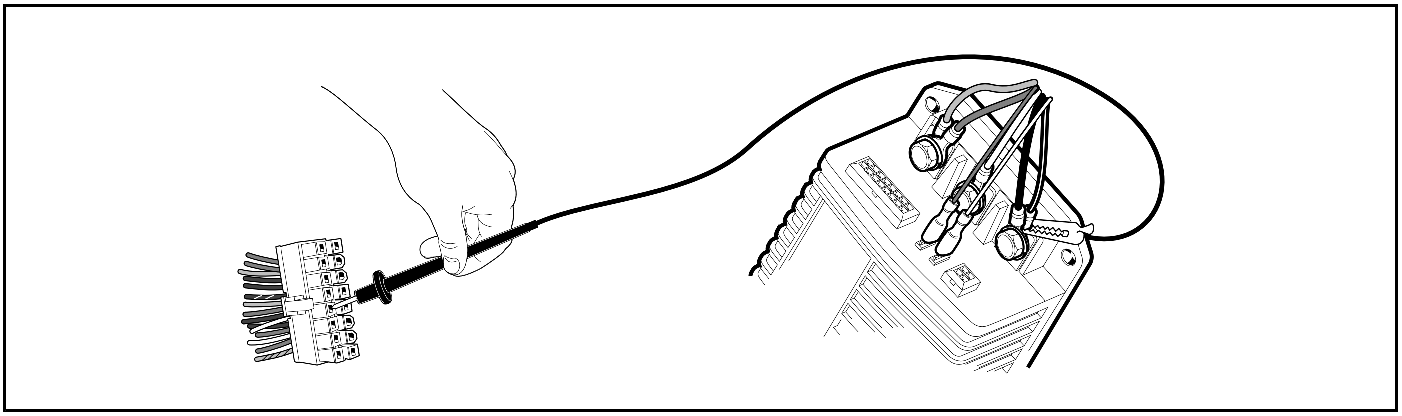

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Figure 13-17 Pin 12 Test

6. Place the Tow/Run switch in the RUN position and the key switch in the ON position.
7. The solenoid should click when the key switch is placed in the ON position.
8. If any other activity is observed, check the following items:
   – Continuity of the wires in the wire harness

   – Reverse buzzer for proper operation. **See Test Procedure 24 – Reverse Buzzer on page 13-33.**

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 13-18.**

   – Key switch for proper operation. **See Test Procedure 8 – Key Switch and Throttle Position Sensor Limit Switch Circuit on page 13-20.**

   – Solenoid for proper operation. **See Test Procedure 22 – Solenoid Continuity on page 13-32.**

TEST PROCEDURE 18 – Onboard Computer Silicon-Controlled Rectifier (SCR) Circuit

See General Warnings on page 1-1.

The silicon controlled rectifier (SCR), located inside the onboard computer, acts as a switch on the negative side of the circuit.

This allows the onboard computer (OBC) to control the battery charging current.

Use the following procedure to test the SCR:

1. With batteries connected and using a multimeter set to 200 volts DC, place the red (+) probe on the positive post of battery no. 1 and place the black (–) probe on the charger receptacle socket that has the black 10-gauge wire attached to it. The reading should be approximately 36-42 volts.
2. If the reading is zero volts, check the black 10-gauge wire connection to the OBC connector. Check the continuity of the black 10-gauge wires. If the wires and connections are okay, the SCR has failed. Replace the OBC. If the reading is correct, proceed to the following step.
3. Plug in AC and DC cords. When the battery charger relay clicks on, reading should be approximately 48 volts (full battery voltage). If the reading does not rise from approximately 40 volts to full battery voltage when the DC cord is plugged in and the relay clicks on, check the following items:

– Black wire terminal socket in the charger receptacle.

– Onboard computer gray wire. **See Test Procedure 19 – Onboard Computer Gray Wire on page 13-30.**

– Red wire at the charger receptacle. **See Test Procedure 20 – Voltage at Charger Receptacle Red Wire Socket on page 13-30.**

TEST PROCEDURE 19 – Onboard Computer Gray Wire

See General Warnings on page 1-1.

1. With batteries connected and the DC cord disconnected, pull back on the boot (1) on the gray wire (2) connection at the OBC (3) **(Figure 13-18, Page 13-30)**. Using a multimeter set to 200 volts DC, connect the red (+) probe to the positive post of battery no. 1 and black (–) probe to gray 16-gauge wire at the OBC connection (4). Reading should be approximately 48 volts. If reading is zero volts, replace the OBC.

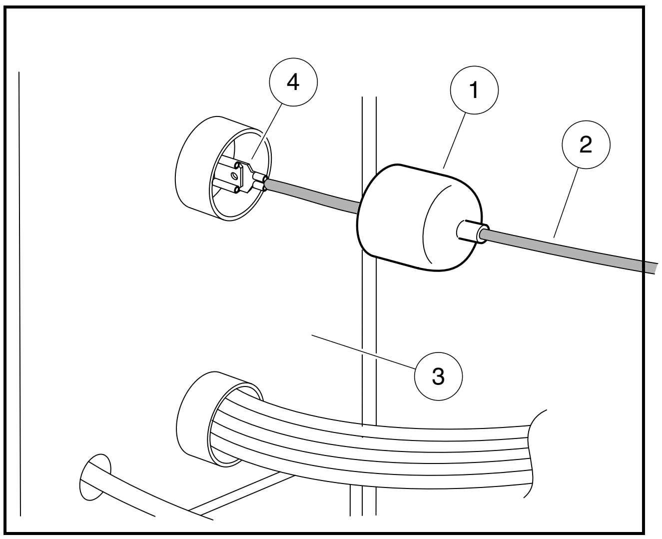

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Figure 13-18 OBC Connections

2. If the reading in step 1 is 48 volts, plug the DC cord into the vehicle's charger receptacle. The voltage reading should drop to approximately 4.0 volts before the charger relay clicks on.
3. When the charger relay is activated, the reading should rise to approximately 48 volts.
4. If voltage does not drop to approximately 4.0 volts when the DC cord is plugged in and then rise to approximately 48 volts when the charger relay clicks on, the gray wire circuit in the OBC has failed. Replace the OBC.

TEST PROCEDURE 20 – Voltage at Charger Receptacle Red Wire Socket

See General Warnings on page 1-1.

1. With batteries connected, DC cord disconnected, and using a multimeter set to 200 volts DC, place the black (–) probe on the negative post of battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) and place the red (+) probe on the charger receptacle socket connected to the red 10-gauge wire. The reading should be 48-50 volts (full battery voltage).
2. If the reading is zero volts, check the continuity of the 10-gauge red wire from the positive post of battery no. 1 to the receptacle socket.

TEST PROCEDURE 21 – Motor Speed Sensor

See General Warnings on page 1-1.

Motor Speed Sensor Test with the IQDM Handset

⚠ CAUTION

- **Perform the following procedure only on a level surface. To avoid injury or property damage, ensure that the path of the vehicle is clear before pushing vehicle.**

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Access the Test menu and select SPEED PULSES by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the vehicle is at rest.
4. While monitoring the IQDM display screen, slowly push the vehicle a short distance (about 3 feet (1 meter)). The IQDM should indicate ON for speed sensor pulses while the wheels are in motion.
5. If the IQDM does not indicate ON while the wheels are in motion, proceed to the following procedure, Motor Speed Sensor Test without the IQDM Handset.

Motor Speed Sensor Test without the IQDM Handset

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. With batteries connected, disconnect the three-pin connector at the motor speed sensor.
3. Check voltage at purple/white wire:
   - 3.1. Using a multimeter set to 200 volts DC, place the red (+) probe on the battery no. 1 positive post and place the black (–) probe on the purple/white wire terminal socket in the three-pin connector. The voltage reading should be 48 to 50 volts (full battery voltage).
   - 3.2. If the reading is zero volts, check the continuity of the purple/white wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.
4. Check voltage at red wire:
   - 4.1. With Tow/Run switch in the RUN position and using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place red (+) probe on red wire terminal socket in three-pin connector. The voltage reading should be approximately 15-16 volts.
   - 4.2. If the voltage reading is zero volts, check the continuity of the red wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the wire continuity is correct, replace the speed controller.
   - 4.3. If the reading is below 14 volts, replace the speed controller.
   - 4.4. If the voltage reading is correct, proceed to the following step.
5. Check voltage at light green wire:
   - 5.1. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the light green wire female terminal in the three-pin connector at the motor speed sensor. The voltage reading should be from 4.60 to 4.90 volts.
   - 5.2. If the voltage is zero volts, check the continuity of the light green wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.
   - 5.3. If reading is below 3.50 volts, check the continuity of the wires and plug and replace the speed controller if necessary.

6. Reconnect the three-pin connector at the motor speed sensor. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire between the three-pin connector and the motor speed sensor.
   6.1. Raise one rear wheel off ground. Slowly turn the rear wheel to rotate the motor armature. As the armature rotates, the voltage reading should alternate from zero to approximately 4.85 volts. The voltage reading will fluctuate from zero to 4.85 volts and back to zero four times for each revolution of the motor armature.

NOTE: *The voltage reading of 4.85 is an approximate reading. The actual reading may vary from 4.50 to 5.00 volts.*

   6.2. Replace the speed sensor if:
   – There is no voltage reading.
   – The voltage reading is not above 3.50.
   – The voltage reading does not fluctuate as the motor is turned.

TEST PROCEDURE 22 – Solenoid Continuity

See General Warnings on page 1-1.

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
3. Disconnect the three wires that are crimped together from the forward large post of the solenoid.
4. Using a multimeter set to 200k ohms, place the black (–) probe on one solenoid large post and place the red (+) probe on the other large post. The reading should be no continuity.
5. Connect the three wires crimped together to the forward large solenoid post. Install washer and nut on large solenoid post and tighten to 77 in-lb (8.7 N·m).
6. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

7. Place the Tow/Run switch in the RUN position, turn the key switch to the ON position, place the Forward/Reverse rocker switch in the FORWARD position, and press the accelerator pedal. The solenoid should click and the multimeter should indicate continuity. If the reading is no continuity, replace the solenoid.

TEST PROCEDURE 23 – Forward/Reverse Rocker Switch

See General Warnings on page 1-1.

Forward/Reverse Rocker Switch Test with the IQDM Handset

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Test FORWARD INPUT.

3.1. Access the Test menu and select FORWARD INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or REVERSE position.

3.2. Place the Forward/Reverse switch in the FORWARD position. The IQDM should indicate that FORWARD INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on page 13-3.** Also check the 16-pin connector at the speed controller. **See Test Procedure 9 – 16-Pin Connector on page 13-21.**

4. Test REVERSE INPUT.

4.1. Access the Test menu and select REVERSE INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or FORWARD position.

4.2. Place the Forward/Reverse switch in the REVERSE position. The IQDM should indicate that REVERSE INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on page 13-3.** Also check the 16-pin connector at the speed controller. **See Test Procedure 9 – 16-Pin Connector on page 13-21.**

5. If the IQDM displays readings other than those described above and the wiring is found to be correct, proceed to the following procedure, **Forward/Reverse Rocker Switch Test without the IQDM Handset**.

Forward/Reverse Rocker Switch Test without the IQDM Handset

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the two screws securing the rocker switch case to the vehicle body.
3. Remove switch from car. **See Forward/Reverse Rocker Switch Removal on page 17-3.**
4. Disconnect the three wires from the rocker switch. Using a multimeter set to 200 ohms, place the black (–) probe on the brown wire terminal 3 position on the rocker switch, and place the red (+) probe on the orange wire terminal 2 position. With the switch in NEUTRAL or REVERSE, there should be no continuity. With the switch in FORWARD, there should be continuity. If the readings are incorrect, replace the switch.
5. Place the black (–) probe on the blue wire terminal 1 position on the rocker switch and place the red (+) probe on the orange wire terminal. With the switch in REVERSE, there should be continuity. If the readings are incorrect, replace the switch.

TEST PROCEDURE 24 – Reverse Buzzer

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the instrument panel. **See Key Switch Removal, Section 17, Page 17-1.**
3. Disconnect the orange/white and pink wires from the reverse buzzer.
4. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
5. Place the key switch in the OFF position and the Tow/Run switch in the RUN position.
6. Using a multimeter set to 200 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the pink wire terminal end that was disconnected from the reverse buzzer. The reading should be approximately 48 volts (full battery voltage).

6.1. If the voltage reading is correct, proceed to step 7.

6.2. If reading is zero volts, check pink wire continuity and Tow/Run switch. **See Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 13-15. See also Test Procedure 6 – Tow/Run Switch on page 13-18.**

6.3. If the continuity readings are not correct, repair or replace the pink wire.

6.4. If the continuity readings are correct, proceed to step 7.

7. Place the Forward/Reverse switch in REVERSE. Using a multimeter set to 200 volts DC, place the black (–) probe on the orange/white wire terminal end (that was disconnected from the reverse buzzer) and place the red (+) probe on battery no. 1 positive post. The reading should be approximately 48 volts (full battery voltage).
   7.1. If the voltage reading is correct, replace the reverse buzzer.
   7.2. If reading is zero volts, check orange/white wire continuity and connection at Pin 7 in 16-Pin connector.
   7.3. If there is no continuity in the orange/white wire, or the Pin 7 terminal in the 16-Pin connector is not properly seated, repair or replace as required.
   7.4. If the orange/white wire continuity and 16-Pin connector are correct and there is no voltage at the orange wire, replace the controller.

TEST PROCEDURE 25 – Rebooting the Onboard Computer

See General Warnings on page 1-1.

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

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

NOTE: *Wait at least 90 seconds for the capacitors in the speed controller to discharge. The capacitors in the speed controller must be fully discharged in order to reboot the OBC.*

2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
3. Place Tow/Run switch in the RUN position.
4. Test drive the vehicle. If the vehicle functions normally the problem is corrected. If the problem still exists, refer to Wiring Diagrams on page 13-3.

TEST PROCEDURE 26 – Battery Warning Light

See General Warnings on page 1-1.

1. Reboot the OBC and drive the vehicle a short distance. When vehicle is first driven, the battery warning light should illuminate for 10 seconds. **See Test Procedure 25 – Rebooting the Onboard Computer on page 13-34.** If the battery warning light does not illuminate when rebooting the OBC, proceed to step 2.
2. Turn key switch OFF, place Tow/Run switch in TOW and place Forward/Reverse rocker switch in NEUTRAL.
3. Disconnect the six-pin connector at the OBC.
4. Remove the wedge lock from the six-pin connector housing that is connected to the vehicle wire harness. Remove the brown/white wire from the connector plug.
5. Using a jumper wire with an alligator clip at each end, connect one alligator clip to the negative post of battery no. 1 and the other alligator clip to the brown/white wire terminal socket that was removed from the six-pin connector plug.
6. Install the wedgelock in the six-pin connector housing and reconnect the six-pin connector plug. Place the Tow/Run switch in the RUN position and the battery light should illuminate. If the light does not illuminate, replace the battery warning light assembly.

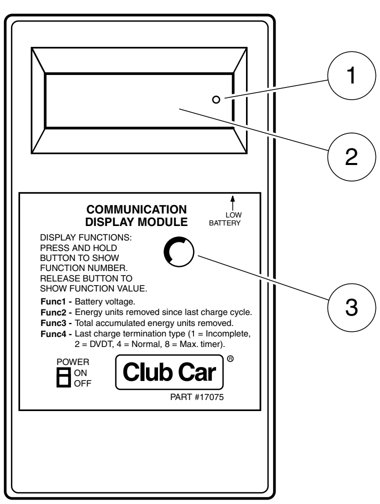
BATTERY WARNING LIGHT

IQ System and Excel 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 if the charge is less than 90% complete but the vehicle has enough power for 60 minutes of operation. This will alert the fleet operator that the vehicle may be used, but that it must be charged to completion as soon as possible.
- The 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 battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals, 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 battery warning light will flash quickly, after inserting the DC plug, indicating the charger’s voltage suppressor has failed closed.

COMMUNICATION DISPLAY MODULE (CDM)



1. Low Battery 2. Display Window 3. Function Button

Figure 13-19 CDM

The CDM can be used to retrieve from the onboard computer four important items of information that can be useful in troubleshooting the Excel System vehicle. To access one of these items, the item’s corresponding Function Code must be selected on the CDM. This is done by pressing the Function Button until the desired function code is displayed in the window. **See Figure 13-19, Page 13-35 for CDM features.** Releasing the button when the desired code is displayed will display the data. Function codes and corresponding data are as follows:

- **F1 – Battery voltage:**
- This displays the battery pack's current state of charge. A reading of less than 48 volts indicates that the batteries need to be charged. If a reading of less than 48 volts is obtained immediately after a charge cycle, there may be a problem in the charge circuit.
- **F2 – Energy units removed since last charge cycle:**
- If the display reads over 75 (the vehicle battery warning light should be illuminated), the vehicle batteries need to be recharged before being used again. This data can be used to make sure all vehicles in a fleet receive equal usage on a short-term basis.
- **F3 – Total accumulated energy units removed since initial vehicle start-up:**
- This information is most useful in making sure that all vehicles in a fleet receive equal usage over long periods of time.
- **F4 – Last charge termination type (1 = incomplete, 2 = DVDT, 4 = normal, 8 = max. timer):**
- A **1**, **2**, **4**, or **8** will be displayed.
- **1** – Indicates the last charge cycle was incomplete and the batteries were not fully charged. Batteries should be charged again at the earliest opportunity.
- **2** – Indicates a back-up charge program was employed by the OBC to complete the charge cycle if a normal charge (4) is not possible. DVDT refers to an increase in voltage within a time period. The OBC monitors battery voltage during charging and will terminate the charge when the voltage does not increase within the time period. A DVDT charge may be displayed the first few times a new set of batteries is charged, and the first time a set of batteries is charged after the batteries have been disconnected and reconnected. A problem may exist if persistent DVDT readings are obtained.
- **4** – Indicates the last charge cycle was normal.
- **8** – Indicates the charger ran for sixteen hours and shut itself off without completing the charge cycle. This means there may be a problem in the charge circuit.

The CDM also has a low battery indicator, which illuminates when CDM batteries are weak and need to be replaced. Weak batteries in the CDM may cause the CDM to register inaccurate information or no information.

USING THE CDM TO RETRIEVE DATA FROM THE ONBOARD COMPUTER

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

NOTE: *If, by positioning CDM on seat bottom, the CDM is unable to collect the data stream from the onboard computer, hold CDM approximately 6 inches (15.2 cm) from battery warning light.*

3. Wait approximately 30 seconds for a value to appear in the display window.
4. If a value does not appear in the display window after 30 seconds, try adjusting the aim of the CDM and repeating step 3 until a value appears. If there is still no reading, check for weak batteries in the CDM.
   - 4.1. Adjust aim of CDM.
   - 4.2. Drive vehicle a short distance to ensure OBC is not in powerdown mode.
   - 4.3. Check for weak batteries in CDM.

4.4. If reading is still not obtained, go to the CDM Troubleshooting Guide on page 13-38.

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

- The value currently displayed will be F1 (battery voltage).
- To view F2, press and hold the button on the CDM. When “Func 2” appears in the display window, release the button. The value for F2 will then be displayed.
- To view F3, press and hold the button on the CDM until “Func 3” appears in the display window. Release the button. The value for F3 will be displayed.
- To view F4, press and hold the button on the CDM until “Func 4” appears in the display window. Release the button. The value for F4 will be displayed.

***NOTE:** The values of all four functions can be recalled by pressing and releasing the CDM button.*

CDM TROUBLESHOOTING GUIDE

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

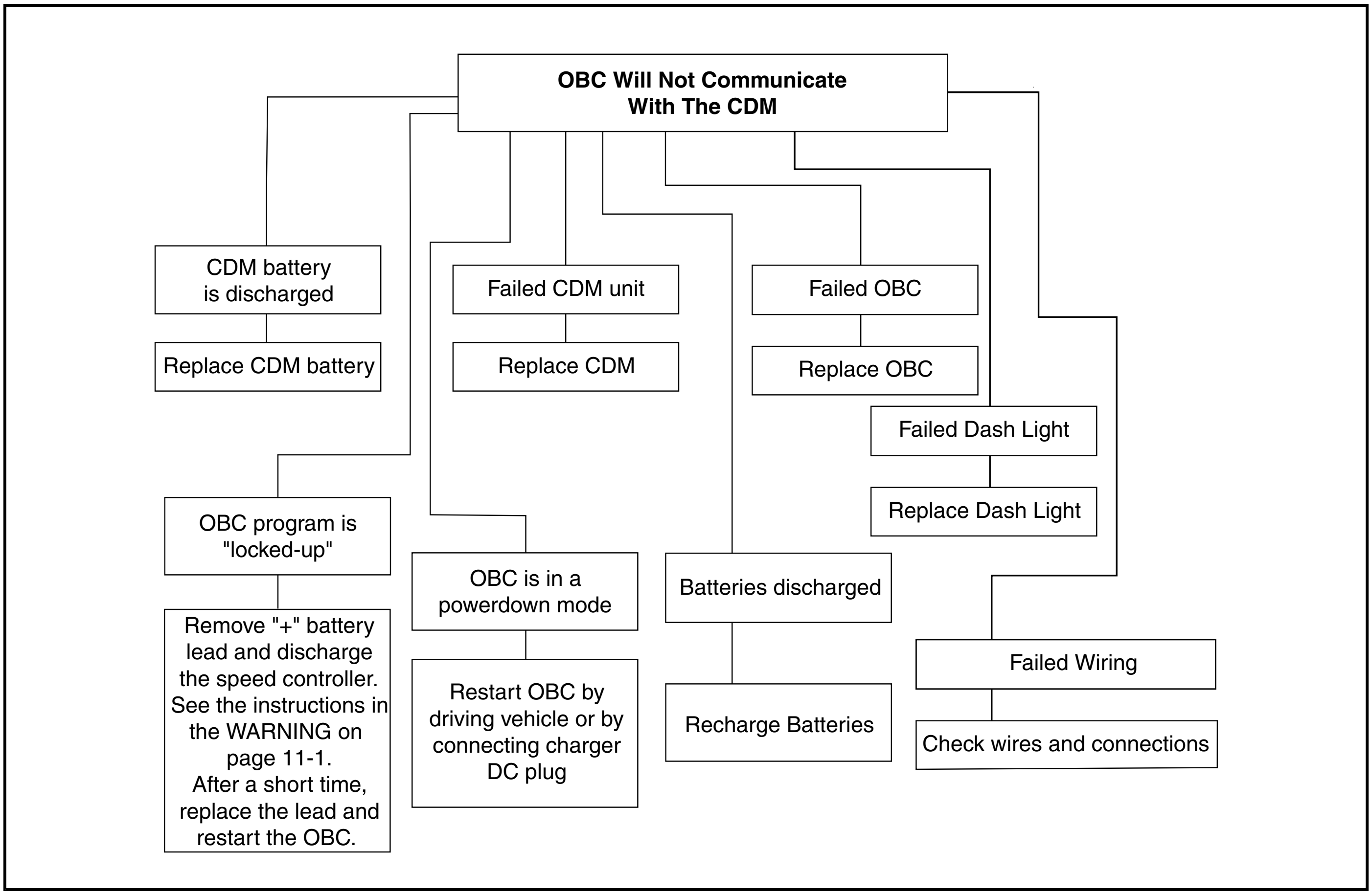


Figure 13-20 Flow Chart – CDM Troubleshooting Guide

SECTION 14 – EXCEL SYSTEM TROUBLESHOOTING – MCOR

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**
- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

GENERAL INFORMATION

NOTE: *Many 2009 model year Precedent vehicles have had the pedal group reworked to use an MCOR in place of the throttle position sensor. Use this troubleshooting section for system diagnosis. For a vehicle that still uses the throttle position sensor, see* ***Excel System Troubleshooting – TPS on page 13-1*** *or* ***IQ System Troubleshooting – TPS on page 11-1****.*

Starting early 2010 model year with Serial Number PQ1009-082079, all electric Precedent vehicles were factory-equipped with an MCOR sensor in the Gen II pedal group. The pedal group has its own serial number with a prefix that also changed as follows:

Gen II pedal group equipped with throttle position sensor (before reverting to MCOR):	either PGE1 or PBE1(with brake light switch)
Gen II pedal group equipped with MCOR:	either PGE2 or PBE2(with brake light switch)

The Excel System vehicle uses a 48-volt electrical system that is powered by four 12-volt lead-acid batteries or six 8-volt lead-acid batteries and includes an onboard computer. The Excel System vehicle uses a shunt-wound 3.2 hp motor and includes several additional features.

DIFFERENCES BETWEEN THE EXCEL AND IQ SYSTEMS

- Excel is used in Precedent models only.
- Excel utilizes the 1515 controller instead of the 1510A.
- The Excel 1515 controller uses half-bridge technology allowing cooler operating temperatures and increased motor braking.
- The Excel minimum motor braking speed has been lowered to almost zero.
- Excel has higher energy output during regenerative braking due to the lowered minimum motor braking speed.
- The Excel accelerator pedal has more control of downhill speed.
- When parked on a hill, the Excel vehicle resists sudden acceleration after the park brake is released.

- The programmed speed of the Excel vehicle can now range from 5 to 19.2 mph with fine adjustments in 0.1 mph increments.
- Excel provides mileage readings.
- Excel has more diagnostics available.
- Excel offers the ability to change software. See Section 16 – IQ Display Module (IQDM) and IQDM-P Diagnostics: Excel System.

FEATURES

- **Shunt-Wound Motor:** The shunt-wound motor, unlike a series motor, is designed so that the speed controller is able to vary the amount of current passing through the field coils independently from the current passing through the armature.
- **Motor Braking:** Under certain conditions a shunt-wound motor also has the ability to act as an electrical brake to slow the vehicle. There are two features of the Excel electrical system that will activate the motor braking function: Walk Away Braking and Motor Braking (adjustable with the IQDM-P handset).
- **Walk Away Braking:** This prevents the vehicle from rolling away uncontrolled should the driver park on a slope and leave the vehicle without locking the park brake. The vehicle will roll at about 1 mph (1.6 km/h). If the walk away braking function remains engaged for two seconds or more, a warning buzzer will sound to alert the driver that motor braking has been activated.

⚠ WARNING

- **Walk Away Braking will not limit vehicle speed to 1 mph (1.6 km/h) on very steep grades. Do not operate vehicle on slopes exceeding 20% grades.**

- **Motor Braking:** When going down an incline with the accelerator pedal partially pressed, the motor braking function will activate to assist the operator in maintaining a speed less than the speed setting. For example, if the vehicle is going down an incline with the accelerator pedal pressed half way, the motor braking function will activate to assist the operator in maintaining a speed approximately half of the speed setting defined in the Program Menu.
- **Regenerative Braking**: When motor braking is activated, the vehicle motor acts as a generator, slowing the vehicle as it creates energy that is used to charge the batteries.
- **Tow/Run Switch:** When the Tow/Run switch is in the RUN position, the vehicle will function normally. When the switch is in the TOW position, power to the OBC and controller is shut off, disabling the vehicle operating circuit and walk away braking, allowing the vehicle to be towed.
- **Motor Protection Circuit:** The operator should never attempt to hold the vehicle on an incline by pressing the accelerator pedal instead of the brake pedal, as motor overheating could result. By reducing the current to the motor during such an occurrence, the motor protection circuit reduces the possibility of motor damage. When this situation arises, a *motor stall fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See Motor Stall on page 16-13.**
- **High Pedal Detect:** This function prevents unexpected vehicle movement if the key switch is turned ON after the accelerator is pressed. The vehicle will not move until the accelerator is released and pressed again. When this situation arises, a *HPD fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See HPD on page 16-12.**
- **Onboard Computer (OBC):** The OBC, 1) monitors battery condition, 2) monitors the number of energy units used by the vehicle, 3) determines the number of energy units required to recharge the batteries and shuts the charger off when this number is reached, 4) determines when to activate regenerative motor braking, 5) locks out vehicle movement while the charger is plugged into the vehicle charger receptacle, 6) stores operating data, which can be read by the Communication Display Module (CDM). **See Communication Display Module (CDM) on page 14-38.**

WIRING DIAGRAMS

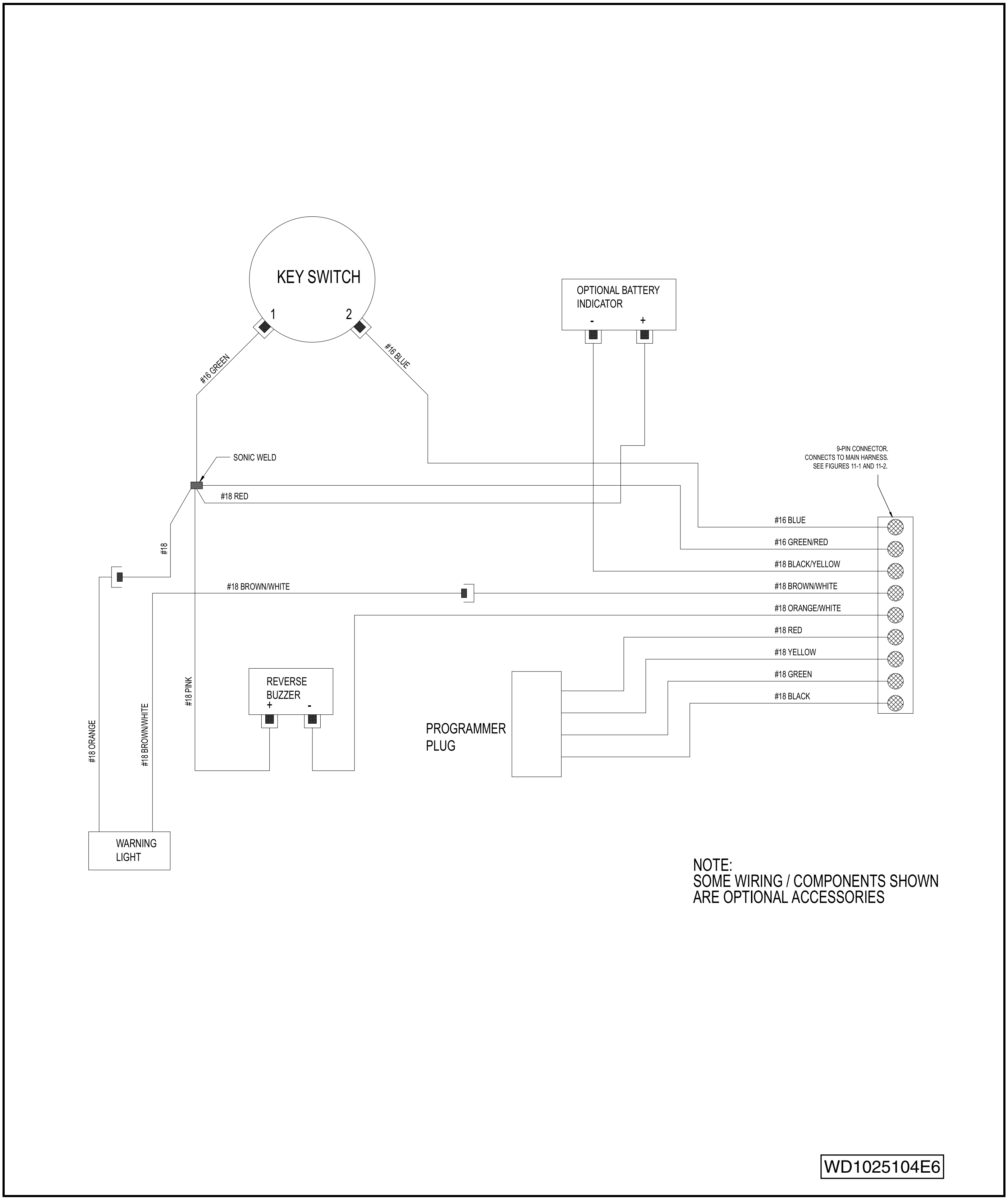


Figure 14-1 Precedent Electric Vehicle Instrument Panel Wiring Diagram

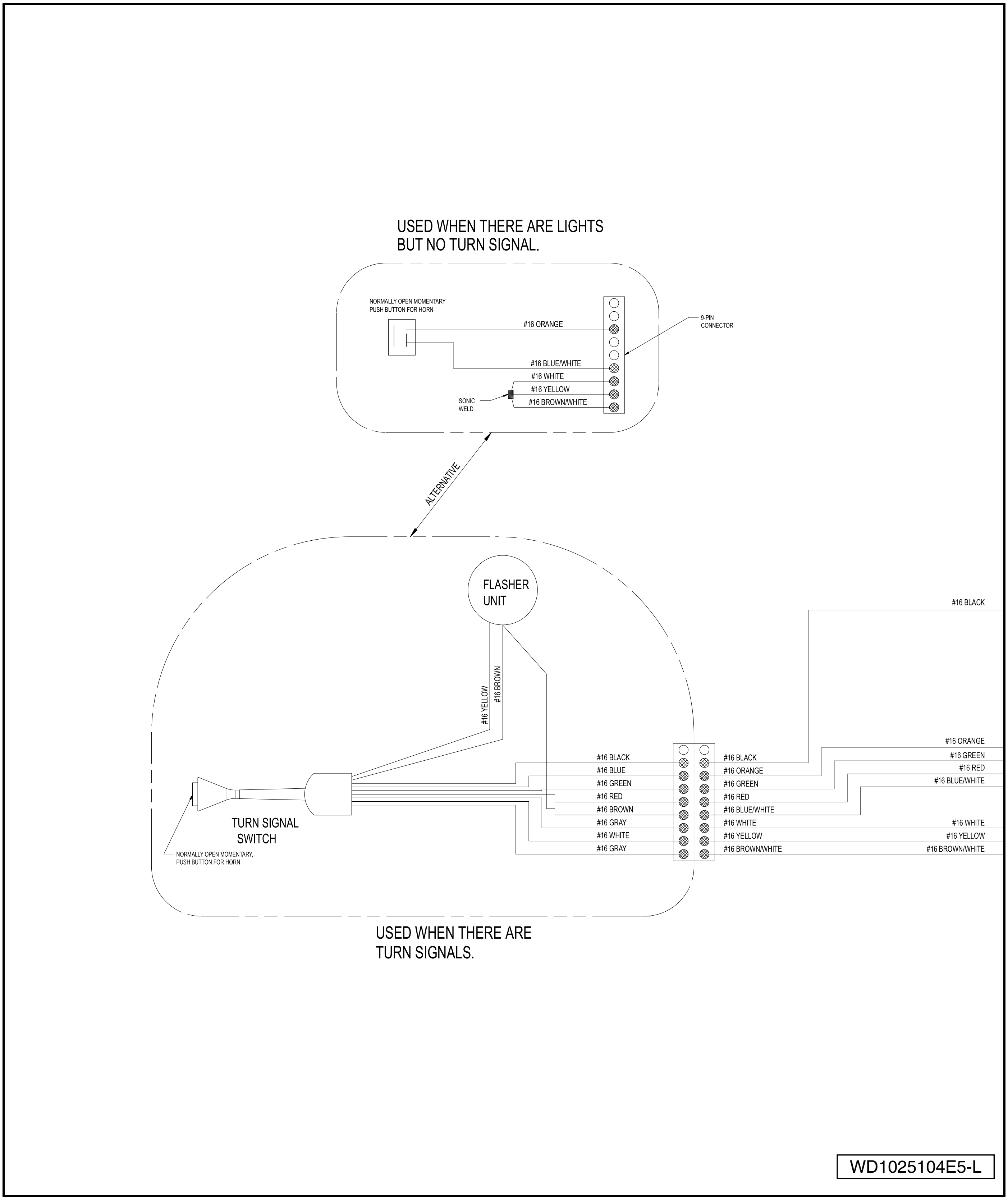


Figure 14-2 Precedent Electric Vehicle Accessory Wiring Diagram

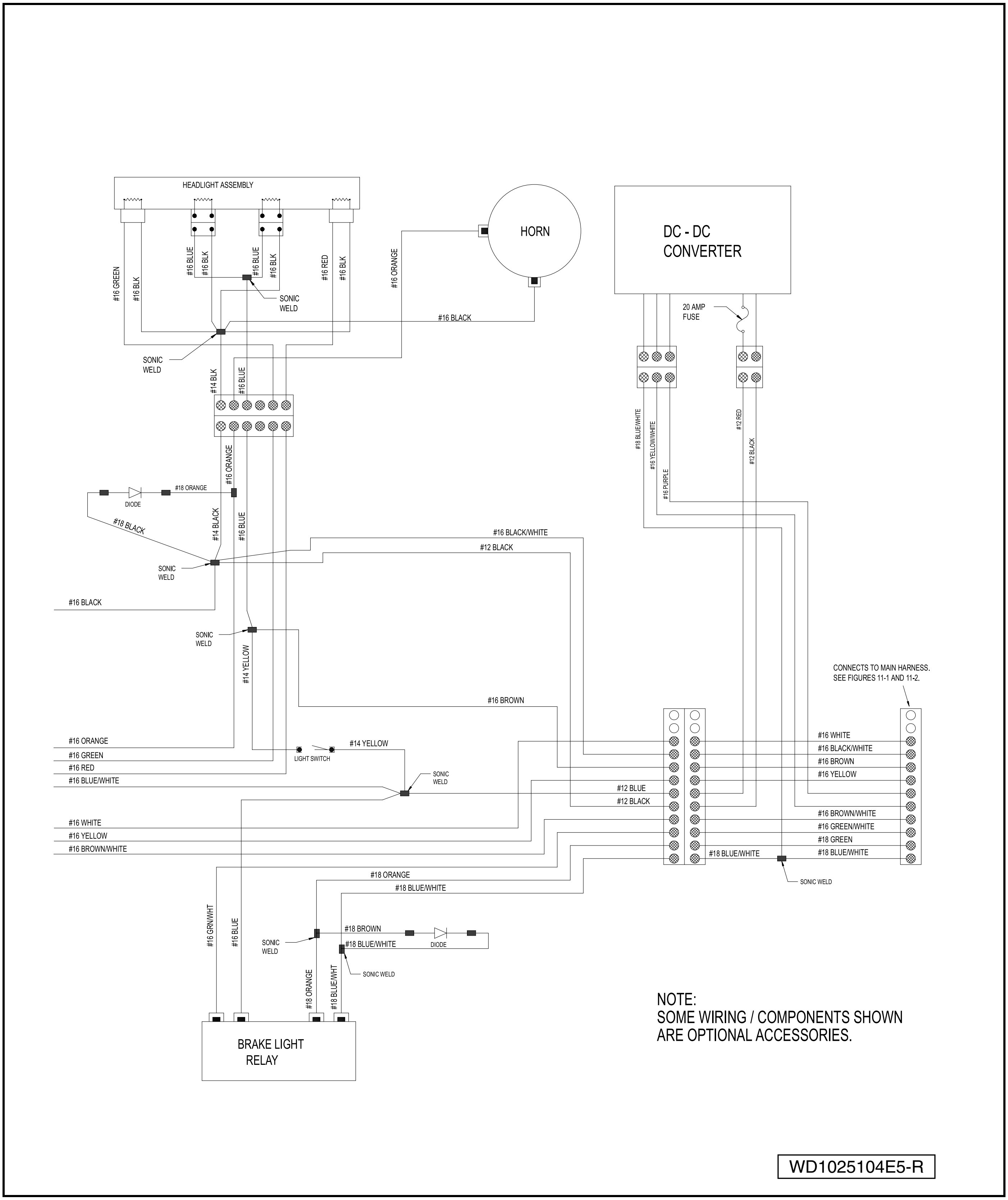


Figure 14-3 Precedent Electric Vehicle Accessory Wiring Diagram (Continued)

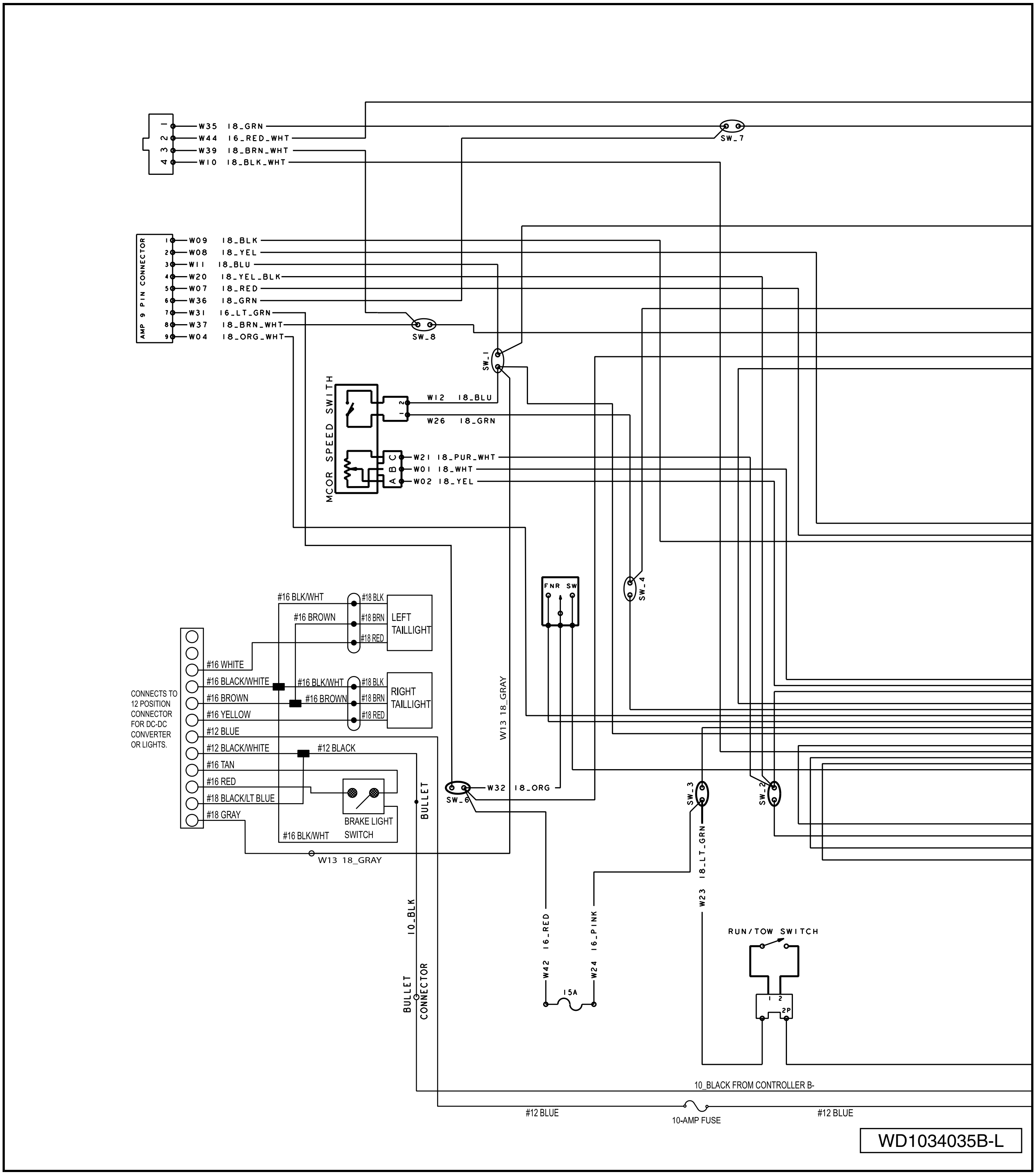


Figure 14-4 Wiring Diagram – Excel System with MCOR

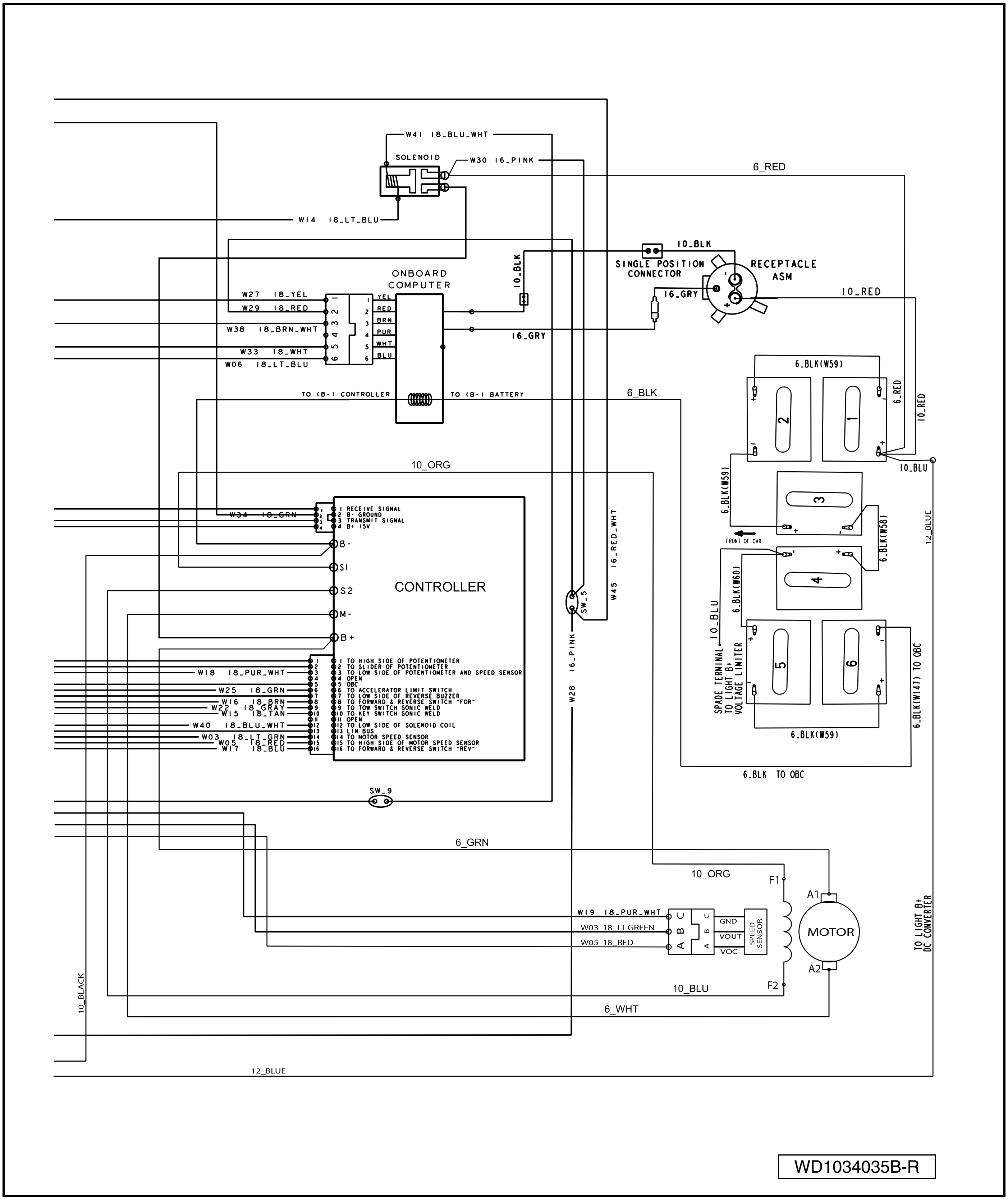


Figure 14-5 Wiring Diagram – Excel System with MCOR (Continued)

TROUBLESHOOTING

The following troubleshooting guides will be helpful in identifying operating difficulties should they occur. The guides include the symptom, probable cause(s) and suggested checks. The procedures used in making these checks can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING THE VEHICLE WITH THE IQDM

Club Car recommends the use of the IQDM handset for troubleshooting vehicles equipped with the Excel electrical system. Troubleshooting Guide 1 is to be used in conjunction with the IQDM handset. **See IQ Display Module (IQDM) and IQDM-P Diagnostics: Excel System on page 16-1** for operating instructions. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the IQDM while the vehicle is in motion. A technician can monitor the IQDM while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

In the event that the vehicle is not functioning properly after completing Troubleshooting Guide 1, the technician should proceed to Troubleshooting Guide 2.
If an IQDM handset is unavailable, the technician should proceed to Troubleshooting Guide 2.

TROUBLESHOOTING GUIDE 1

The following troubleshooting guide is intended for use with an IQDM handset. **See following NOTE.**

NOTE: *Before troubleshooting the vehicle, check the diagnostic history from the Special Diagnostics Menu. Note any fault codes.*

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Test Menu – THROTTLE % value does not increase as the accelerator pedal is pressed or Diagnostic Menu – THROTTLE FAULT fault code	Loose or disconnected three-pin connector at the MCOR or broken wire	Repair and/or connect the three-pin connector to the MCOR
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed MCOR	Test Procedure 4 – MCOR Voltage on page 14-16
Test Menu – HEATSINK °C indicates that temperature is above 85 °C (145 °F) or Diagnostic Menu – THERMAL CUTBACK fault code	Over-adjusted brakes	Section 6 – Wheel Brake Assemblies
	Vehicle is over-loaded	Ensure that vehicle is not over-loaded before returning to operation
Test Menu – ARM PWM value does not reach 100% when vehicle is at full speed	Failed MCOR	Test Procedure 4 – MCOR Voltage on page 14-16

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Test Menu – SPEED PULSES menu item indicates that speed pulses are OFF when the vehicle is in motion or Diagnostic Menu – SPEED SENSOR fault code	Loose or disconnected motor speed sensor or broken wire	Repair and/or connect the three-pin connector to the motor speed sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed motor speed sensor	Test Procedure 21 – Motor Speed Sensor on page 14-34
Test Menu – FOOT INPUT menu item indicates that the MCOR internal limit switch is always ON or always OFF.	Loose or disconnected two-pin connector at the MCOR or broken wire	Repair and/or connect the two-pin connector to the MCOR
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed MCOR	Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 14-20
Test Menu – FORWARD INPUT and/or REVERSE INPUT does not indicate the correct reading	Loose or disconnected Forward/Reverse rocker switch (quick disconnect terminals) or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected Forward/Reverse rocker switch (three-pin connector) or broken wire	Repair and/or connect the three-pin connector from the Forward/Reverse switch to the wire harness
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed Forward/Reverse rocker switch	Test Procedure 23 – Forward/Reverse Rocker Switch on page 14-35
Test Menu – MAIN CONT DRIVER (solenoid) does not indicate ON when the solenoid should be activated. or Diagnostic Menu – MAIN CONT DNC (main contactor (solenoid) did not close) fault code	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
	Loose, broken, or disconnected wire(s) at solenoid or B+ speed controller terminal	Repair and/or connect the loose or disconnected wire(s)
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed solenoid	Replace solenoid. **See Solenoid Removal on page 17-13.**
Test Menu – KEY INPUT does not indicate ON when key switch is in the ON position	Loose or disconnected wires at key switch terminals or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed key switch	Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 14-20

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Diagnostic Menu – THROTTLE FAULT fault code	Loose or disconnected three-pin connector at the MCOR or broken wire	Repair and/or connect the three-pin connector to the MCOR
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed MCOR	Test Procedure 4 – MCOR Voltage on page 14-16
Diagnostic Menu – HW FAILSAFE (Hardware Failsafe) fault code	Armature drive FET's (field-effect transistors) inside speed controller have failed	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
Diagnostic Menu – MAIN WELDED (main solenoid contacts welded) fault code	solenoid contacts have failed closed	Replace solenoid. **See Solenoid Removal on page 17-13.**
Diagnostic Menu – MAIN DRIVER ON or MAIN DRIVER OFF fault code	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-1.** Reconnect the batteries and see if the symptom returns.
	Failure of the FET that controls the solenoid coil	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
Diagnostic Menu – MAIN COIL FAULT fault code or Diagnostic Menu – MAIN DROPOUT (1 or 2) fault code	Solenoid coil has failed in an open condition	Replace solenoid. **See Solenoid Removal on page 17-13.**
Diagnostic Menu – FIELD MISSING fault code	Loose or disconnected motor field coil wires at motor or speed controller or broken wire	Repair and/or connect the field coil wires
	Failure of the motor field windings	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Failure of the FET's that control field current	Replace the speed controller. **See Speed Controller Removal on page 17-12.**
Diagnostic Menu – HPD (high pedal detect) fault code	Operator error	Train operators to fully remove foot from accelerator pedal before turning key switch to the ON position or changing the selected direction with the Forward/Reverse switch
Diagnostic Menu – LOW BATTERY fault code	Batteries require charging	Place batteries on battery charger and allow them to fully charge
	Improperly maintained or failed batteries	See Section 18 – Batteries.
Diagnostic Menu – MOTOR STALL fault code	Operator error	Train operators to use the brake to hold the vehicle on a hill, rather than holding the vehicle on a hill using the accelerator pedal

TROUBLESHOOTING GUIDE 2

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle does not operate	Batteries – Batteries discharged	Charge batteries
	Batteries – Battery connections	Check vehicle wiring. **See Wiring Diagrams on page 14-3.**
	Battery charger is connected to the vehicle – Solenoid lockout feature has disabled the vehicle	Disconnect the battery charger from the vehicle
	Onboard computer failure	Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 14-15
	Key switch and MCOR limit switch circuit	Check for loose or disconnected wires at key switch and MCOR
	Failed key switch	Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 14-20
	Failed MCOR	Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 14-20. See also Test Procedure 4 – MCOR Voltage on page 14-16.
	Forward/Reverse rocker switch	Test Procedure 23 – Forward/Reverse Rocker Switch on page 14-35
	Solenoid – loose wires	Test Procedure 3 – Solenoid Activating Coil on page 14-15
	Solenoid – failed coil	Test Procedure 3 – Solenoid Activating Coil on page 14-15
	Speed controller thermal cutback	Allow controller to cool and ensure that vehicle is not over-loaded before returning to operation
	16-pin connector at speed controller	Check for loose or disconnected wires at the 16-pin connector. **See also Test Procedure 9 – 16-Pin Connector on page 14-22.**
	High pedal detect	Cycle accelerator pedal
	Motor stall	Cycle accelerator pedal
	Motor Failure	See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 17-12.**
	Motor – Motor connections	Check for loose or disconnected wires
	Speed controller – Motor and power connections	Check for loose or disconnected wires

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle runs slowly	Speed sensor disconnected or failed	Test Procedure 21 – Motor Speed Sensor on page 14-34
	Incorrect speed setting	To change the programmed top speed of the vehicle, an IQDM-P handset must be used
	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 14-3.**
	Batteries – Batteries discharged	Charge batteries
	MCOR malfunction	Test Procedure 4 – MCOR Voltage on page 14-16
	Motor – loose wires	Inspect and tighten all wire connections at the motor.
	Failed motor	Replace motor. **See Motor Removal on page 20-3.**
	Vehicle is over-loaded	Ensure that vehicle is not over-loaded before returning to operation.
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 17-12.**
	Brakes – improperly adjusted	See Section 6 – Wheel Brake Assemblies.
	Tires – under-inflated or flat tires	See Section 8 – Wheels and Tires.
Vehicle operates, but motor braking function does not	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 14-3.**
	Speed sensor disconnected or failed	Test Procedure 21 – Motor Speed Sensor on page 14-34
Vehicle will run in forward, but not in reverse or will run in reverse but not forward	Forward/Reverse rocker switch – improperly wired	Test Procedure 23 – Forward/Reverse Rocker Switch on page 14-35
	Motor – improperly wired	Check motor wiring. **See Wiring Diagrams on page 14-3.**
	Speed controller – improperly wired or failed speed controller FET	Check vehicle wiring. **See Wiring Diagrams on page 14-3.**
Vehicle operates, but battery charger does not charge batteries	Onboard computer – gray wire	Test Procedure 19 – Onboard Computer Gray Wire on page 14-33
	Battery charger connections – loose wires at receptacle or batteries	Check wire connections and tighten if necessary.
	Battery charger	Refer to the appropriate battery charger maintenance and service manual.

TEST PROCEDURES

Using the following procedures, the entire electrical system can be tested without major disassembly of the vehicle.

WARNING

- **If wires are removed or replaced, make sure wiring and wire harness is properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.**

For many tests the electronics module cover must be removed to gain access to the various components that are mounted on the component mounting plate. **See Electronics Module Cover on page 17-5.** **See following WARNING.**

WARNING

- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

After test procedures are completed, be sure to replace the cover. **See Electronics Module Cover on page 17-5.** **See following CAUTION.**

CAUTION

- **Exposure to water may damage electronic components.**
  - **Do not operate vehicle without the cover properly installed.**
  - **Do not direct a water stream in area of the cover.**

Index of Test Procedures

1 – Batteries / Voltage Check
2 – Onboard Computer Solenoid Lockout Circuit
3 – Solenoid Activating Coil
4 – MCOR Voltage
5 – A1 and A2 Motor Voltage
6 – Tow/Run Switch
7 – Battery Pack Voltage (Under Load)
8 – Key Switch and MCOR Limit Switch Circuit
9 – 16-Pin Connector
10 – Pins 1, 2, and 3
11 – Pin 5
12 – Pin 6
13 – Pin 7
14 – Pins 8 and 16
15 – Pin 9
16 – Pin 10
17 – Pin 12
18 – Onboard Computer Silicon-Controlled Rectifier (SCR) Circuit
19 – Onboard Computer Gray Wire
20 – Voltage at Charger Receptacle Red Wire Socket

TEST PROCEDURE 1 – Batteries / Voltage Check

See General Warnings on page 1-1.

NOTE: *The batteries must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in the Battery section of this manual.* ***See Battery Care on page 18-16.***

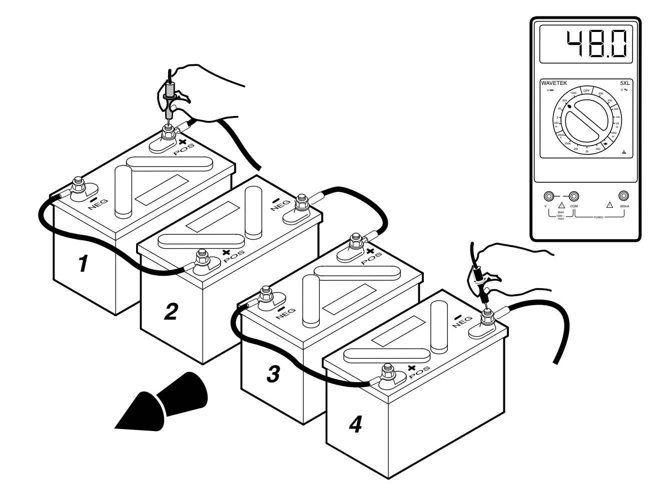
The battery voltage can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **Batteries / Voltage Check without the IQDM Handset**.

Batteries / Voltage Check with the IQDM Handset

1. Connect the IQDM to the vehicle.
2. Access the Test menu and select BATT VOLTAGE by using the SCROLL DISPLAY buttons. The IQDM should indicate at least 48 volts with the batteries fully charged. If not, check for loose battery connections or a battery installed in reverse polarity. **Refer to Batteries on page 18-1 for further details on battery testing.**

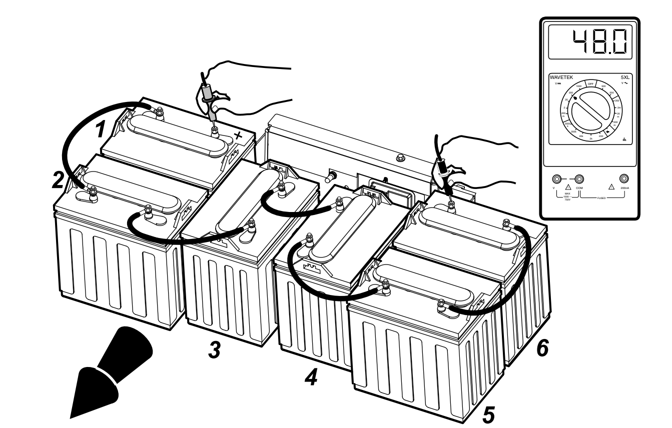
Batteries / Voltage Check without the IQDM Handset

1. With batteries connected and using a multimeter set to 200 volts DC, place red (+) probe on the positive (+) post of battery no. 1 and the black (–) probe on the negative (–) post of battery no. 4 **(Figure 14-6, Page 14-14)** or battery no. 6 **(Figure 14-7, Page 14-14)**.
2. The multimeter should indicate at least 48 volts with the batteries fully charged. If not, check for loose battery connections or a battery installed in reverse polarity. **Refer to Batteries on page 18-1 for further details on battery testing.**



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

Figure 14-6 Battery Voltage Test – Style B Battery Configuration



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

Figure 14-7 Battery Voltage Test – Style C Battery Configuration

TEST PROCEDURE 2 – Onboard Computer Solenoid Lockout Circuit

See General Warnings on page 1-1.

The solenoid lockout circuit disables the vehicle when the battery charger is plugged into the vehicle. Use the following procedure to test the solenoid lockout circuit:

1. With batteries connected, place the Tow/Run switch in the RUN position.
2. Using a multimeter set to 200 volts DC, place black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and red (+) probe (with insulation-piercing probe) on the light blue onboard computer wire (at a point between the OBC and the six-pin connector). The reading should be approximately 38-42 volts (full battery voltage). If the reading is not 38-42 volts, proceed to step 3. If the reading is 38-42 volts, proceed to Test Procedure 3 – Solenoid Activating Coil on page 14-15.
3. Place insulation-piercing probe on the light blue 18-gauge wire at a point between OBC six-pin connector and main wire harness. If reading is 38-42 volts, check the wire terminal connectors inside six-pin connector at OBC six-pin connector. Make sure pins are properly aligned inside housing. Make sure wire colors match and are connected to the correct terminals.
4. If reading is zero volts, plug the charger DC cord into the vehicle charger receptacle. If the dash light illuminates for 10 seconds, the OBC is now powered-up. Unplug the DC cord; the reading at the OBC light blue wire should be approximately 38-42 volts. If the vehicle now operates normally, the DC cord has powered up the electrical system. The electrical system should also power-up when the accelerator pedal is pressed. To check the accelerator pedal function, see Test Procedure 4 – MCOR Voltage on page 14-16.
5. If the dash light illuminates for 10 seconds and the vehicle does not operate:
   - 5.1. Using a multimeter set to 200 volts DC, place black (–) probe on battery number 4 and place red (+) probe (with insulation-piercing probe) on light blue 18-gauge wire at OBC six-pin connector.
   - 5.2. With Tow/Run switch in the RUN position, the voltage reading should be approximately 48 volts.
6. If the dash light does not illuminate and the vehicle does not operate, check the OBC activation circuit.
   - 6.1. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the red 18-gauge wire located on the OBC side of the six-pin connector. The reading should be approximately 48 volts. If the reading is incorrect, test the Tow/Run switch and connecting wires. **See Test Procedure 6 – Tow/Run Switch on page 14-19.**
   - 6.2. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the red 18-gauge wire (harness side of six-pin connector). Multimeter should indicate 48 volts. If voltage is correct, check connections in the six-pin connector. If connections are correct, OBC activation circuit has failed. Replace OBC.

TEST PROCEDURE 3 – Solenoid Activating Coil

See General Warnings on page 1-1.

NOTE: *Be aware that one of two different solenoids may be found on the vehicle. Visually, the production solenoid is smaller than the service replacement. On the labels, the larger service replacement solenoid has SOL0605 and the smaller production solenoid has SOL5006. Internally, specifications and test results differ between the two.*

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Access the solenoid by removing the electronics module cover. **See Electronics Module Cover on page 17-5.**
3. Remove the two small wire terminals from the solenoid.
4. Place red (+) probe of the multimeter on the positive (+) solenoid terminal. Place the black (–) probe on the other small solenoid terminal.

– A reading of 200 to 250 ohms should be obtained for factory-installed solenoids **(Figure 14-8, Page 14-16)**. If not, replace the solenoid.

– A reading of 180 to 190 ohms should be obtained for service replacement solenoids **(Figure 14-9, Page 14-16)**. If not, replace the solenoid.

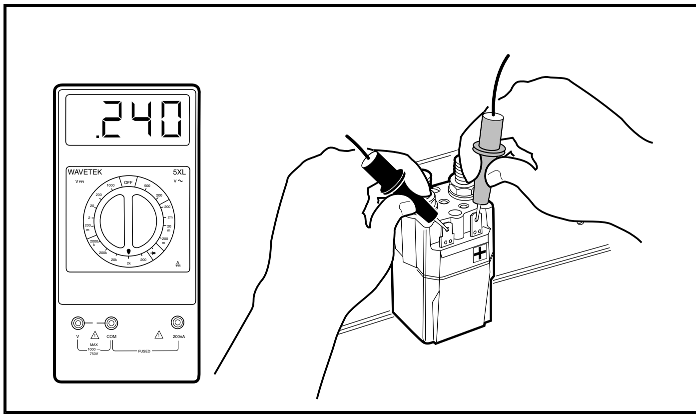
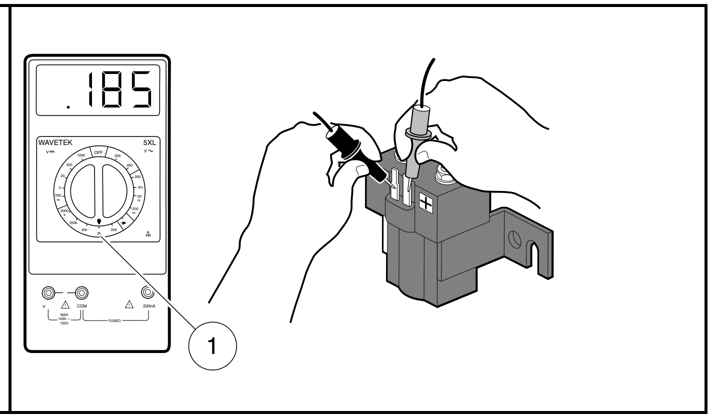


Figure 14-8 Activating Coil Test – Factory-installed Solenoid



2500-20000-10283

Figure 14-9 Activating Coil Test – Service Replacement Solenoid

TEST PROCEDURE 4 – MCOR Voltage

See General Warnings on page 1-1.

The accelerator position, which is proportional to the MCOR voltage, can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **MCOR Voltage Test without the IQDM Handset**.

MCOR Voltage Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. Connect the IQDM to the vehicle.
3. Access the Test menu and select THROTTLE % by using the SCROLL DISPLAY buttons.
4. The IQDM should indicate 0 % with the pedal not pressed. While monitoring the IQDM display screen, slowly press the accelerator pedal. As the pedal is pressed, the IQDM should indicate a rise from 0 % (pedal not pressed) to 100 % (pedal fully pressed).
5. If the MCOR does not operate as described in step 4, proceed to **MCOR Voltage Test without the IQDM Handset**.

MCOR Voltage Test without the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. With the batteries connected, place Tow/Run switch in RUN. Using a multimeter set to 200 volts DC, place red (+) probe on battery no. 1 positive post and place black (–) probe (with insulation-piercing probe) on the purple/white wire at a point close to the three-pin connector at the MCOR. The reading should be approximately 48-50 volts (full battery voltage).
3. If reading is zero volts, check the purple/white wire continuity from the three-pin connector at the MCOR to the 16-pin connector at the speed controller. Check terminal positions in three-pin connector at the MCOR and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.
4. With multimeter set to 20 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the white wire at a point close to the three-pin connector at the MCOR. The reading should be approximately 4.65 volts.
5. If reading is zero volts, check the white wire continuity from the three-pin connector at the MCOR to the 16-pin connector at the speed controller. Check terminal positions in three-pin connector at the MCOR and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.
6. With multimeter set to 20 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the no. 18 yellow wire at a point close to three-pin connector at the MCOR. The reading should be approximately 0.32 volts with the pedal up. Slowly press the accelerator pedal and note the readings on the multimeter. As the pedal is pressed, the reading should increase until it reaches 4.65 volts when the pedal is fully pressed.
7. If reading does not increase as the pedal is pressed, replace the MCOR.
8. If the reading is not approximately 4.60 volts with the pedal fully pressed, the vehicle will not operate at rated top speed. Check the MCOR resistance.
   - 8.1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
   - 8.2. Disconnect the 16-pin connector at the speed controller.
   - 8.3. Using a multimeter set for 20k ohms, connect the red (+) probe of the multimeter to the yellow wire at the MCOR three-pin connector with an insulation piercing probe. Connect black (–) probe to the purple/white wire with an insulation-piercing probe.
   - 8.4. With the accelerator pedal fully up (not pressed), the multimeter should read approximately 1k ohms.
   - 8.5. Slowly press the accelerator pedal while monitoring the multimeter. The resistance should rise as the pedal is pressed. When the pedal is all the way to the floor, the multimeter should indicate between 5.67k ohms and 7.43k ohms.
   - 8.6. Using a multimeter set for 20k ohms, connect the red (+) probe of the multimeter to the yellow wire at the MCOR three-pin connector with an insulation piercing probe. Connect black (–) probe to the white wire with an insulation-piercing probe.
   - 8.7. With the accelerator pedal fully up (not pressed), the multimeter should indicate between 5.67k ohms and 7.43k ohms.
   - 8.8. Slowly press the accelerator pedal while monitoring the multimeter. The resistance should drop as the pedal is pressed. When the pedal is all the way to the floor, the multimeter should indicate approximately 1k ohms.
   - 8.9. If the MCOR does not operate as described, replace the MCOR. **See MCOR Removal on page 17-8.**

TEST PROCEDURE 5 – A1 and A2 Motor Voltage

See General Warnings on page 1-1.

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1. See also following WARNING.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

2. With the batteries connected and using a multimeter set to 200 volts DC, place the black (–) probe on the A2 motor terminal (white wire) and connect the red (+) probe to the A1 (green wire) motor terminal.
3. With Tow/Run switch in the RUN position, place the Forward/Reverse switch in the FORWARD position, turn key switch to the ON position and slowly press accelerator pedal.
4. As the accelerator pedal is pressed, the voltage reading should increase from approximately 5 volts RMS when the MCOR limit switch closes, to approximately 48 volts RMS with the accelerator pedal fully pressed. **See following NOTE.**

NOTE: *Voltage can vary depending on controller speed setting as well as which zone a Guardian equipped vehicle is located.*

Example: *Speed setting 1 may only read 30 volts.*

4.1. If there is no voltage reading, check the MCOR. **See MCOR Voltage on page 14-16.** Also check the continuity of the large posts of the solenoid. **See Solenoid Continuity on page 14-35.**

4.2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

4.3. Check continuity on A1 and A2 motor terminal posts and continuity of the F1 and F2 motor terminal posts. Also, check continuity of all motor wires. See Section 20 – Motor (Model EJ4-4001 and EJ8-4001A).

TEST PROCEDURE 6 – Tow/Run Switch

See General Warnings on page 1-1.

Tow/Run Switch Test with the IQDM Handset

1. With the Tow/Run switch in the RUN position, connect the IQDM to the vehicle.
2. Immediately after the IQDM is connected to the vehicle, the screen should display a copyright notice and the IQDM model number.
3. If the IQDM display screen is blank, drive the vehicle a short distance to activate the onboard computer.
4. If the IQDM display screen begins to work after the vehicle has been driven, turn the key switch to the OFF position and proceed to step 5; otherwise, perform the following procedure, **Tow/Run Switch Test without the IQDM Handset**.
5. With the IQDM still connected to vehicle, place Tow/Run Switch in TOW position and wait 90 seconds.
6. If the IQDM display screen goes blank after 90 seconds, the Tow/Run switch and connecting wires are operating correctly.
7. If the IQDM display screen is still active after 90 seconds, the switch has failed closed. Replace the Tow/Run switch. **See Tow/Run Switch Removal on page 17-6.**

Tow/Run Switch Test without the IQDM Handset

1. Remove the bolt that secures the electronics module to the battery bucket and pull module forward to access Tow/Run switch wires.
2. With the batteries connected and using a multimeter set on 200 volts DC, connect the black (–) probe to the negative post of battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) and connect red (+) probe (with insulation-piercing probe) on the pink wire close to the connector on the Tow/Run switch.

⚠ WARNING

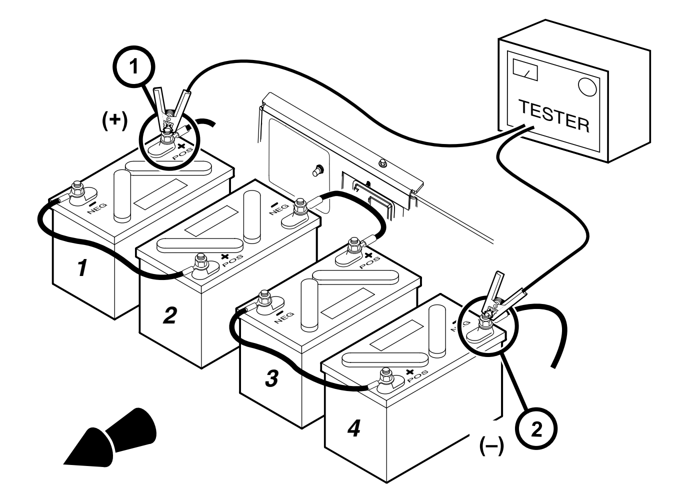
- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

3. With the Tow/Run switch in the RUN position, the reading should be approximately 48-50 volts. With the switch in the TOW position, the reading should be below approximately 5 volts.
4. If the reading is above 5 volts with the switch in the TOW position, replace the switch.
5. If the reading is below 5 volts with switch in the RUN position, check continuity of the pink 16-gauge wire from the large post of the solenoid to the connector at the Tow/Run switch.
6. If the continuity readings are correct, replace the Tow/Run switch.

TEST PROCEDURE 7 – Battery Pack Voltage (Under Load)

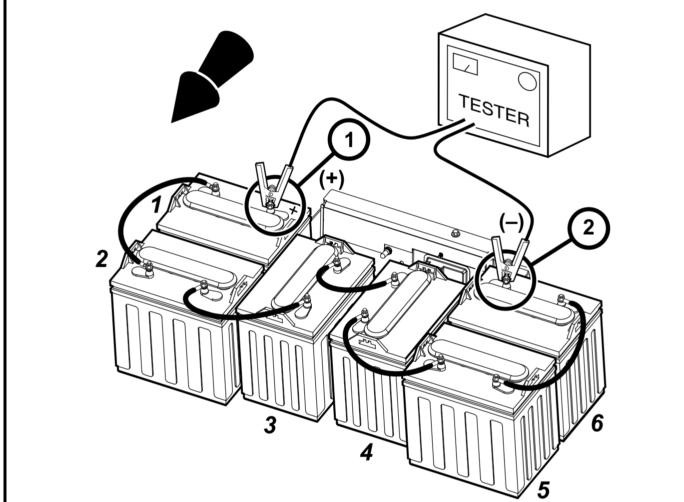
See General Warnings on page 1-1.

1. Be sure the batteries are fully charged and that the electrolyte level is correct in all cells.
2. Connect the tester leads to the positive (+) post of battery no.1 and negative (–) post of battery no. 4 **(Figure 14-10, Page 14-20)** or battery no. 6 **(Figure 14-11, Page 14-20)**.



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

Figure 14-10 Battery Discharge Test – Style B Battery Configuration



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

Figure 14-11 Battery Discharge Test – Style C Battery Configuration

3. Turn the discharge machine on and record the voltage reading of battery pack while under load.
4. A fully charged set of batteries in good condition should read between 46-49 volts while under load.
5. A reading of 32-46 volts indicates discharged or failed batteries. Each battery should be checked with a multimeter while under load.
6. A reading of 32 volts or less will not activate discharge machine. If the voltage of the batteries is below 32 volts, the batteries are deeply discharged or have failed.
7. Recording the battery pack voltage reading while under load provides a more accurate diagnosis of the condition of the batteries. When the discharge machine is ON, it places the battery pack under load and many times can help determine if one or more batteries in the set have failed. Testing battery voltage while the batteries are not under load will not always indicate the true condition of the batteries. For more information about the batteries, refer to See Section 18 – Batteries. .

TEST PROCEDURE 8 – Key Switch and MCOR Limit Switch Circuit

See General Warnings on page 1-1.

Key Switch and MCOR Limit Switch Circuit Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
2. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
3. Connect the IQDM to the vehicle.

4. Test the key switch.
   4.1. Access the Test menu and select KEY INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the key switch is in the OFF position.
   4.2. While monitoring the IQDM display screen, turn the key switch to the ON position. The IQDM should indicate ON.
   4.3. If the IQDM does not indicate that KEY INPUT is ON when the key switch is in the ON position, proceed to the following procedure, **Key Switch and MCOR Limit Switch Circuit Test without the IQDM Handset**. If the key switch functions as described, proceed to the following step. **See following NOTE.**

NOTE: *The key switch MUST function properly in order to test the MCOR limit switch with the IQDM handset.*

5. Test the MCOR limit switch.
   5.1. Select FOOT INPUT on the Test menu by using the SCROLL DISPLAY buttons on the IQDM.
   5.2. The IQDM should indicate that FOOT INPUT is OFF when the accelerator pedal is not pressed, regardless of the key switch position.
   5.3. With the key switch in the ON position, press the accelerator pedal. The IQDM should indicate that FOOT INPUT is ON when the accelerator pedal is pressed.
6. If any reading is obtained that is not described in steps 4 and 5, perform the following steps:
   6.1. Check the wiring of the key switch and MCOR. **See Wiring Diagrams on page 14-3.**
   6.2. Check the continuity of the key switch wires and the MCOR limit switch wires.
7. If the problem was not found, proceed to the following procedure, **Key Switch and MCOR Limit Switch Circuit Test without the IQDM Handset**.

Key Switch and MCOR Limit Switch Circuit Test without the IQDM Handset

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
3. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
4. Test the key switch.
   4.1. Remove the instrument panel. **See Key Switch Removal, Section 17, Page 17-1.**
   4.2. Using a multimeter set to 200 ohms, place the red (+) probe on the key switch terminal with the blue wire. Place the black (–) probe on the other key switch terminal.
   4.3. With the key switch in the OFF position, the multimeter should indicate that continuity is not present.
   4.4. With the key switch in the ON position, the multimeter should indicate that continuity is present.
   4.5. If any other reading is obtained, replace the key switch. **See Key Switch Removal on page 17-1.**
   4.6. If the key switch operates as described in the previous steps, install the instrument panel in the reverse order of removal and proceed to the following step.
5. Test the MCOR limit switch. **See following NOTE.**

NOTE: *Make sure that the key switch is operating correctly and that the key switch and instrument panel are properly installed before proceeding.*

   5.1. With batteries connected and using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire close to the two-pin connector on the MCOR.

⚠ WARNING

- **The Forward/Reverse switch must be in the neutral position to avoid personal injury due to contact with rotating wheels.**

5.2. With Tow/Run switch in the RUN position, key switch in the ON position, and Forward/Reverse rocker switch in the NEUTRAL position, the voltage reading should be zero volts. When the accelerator pedal is pressed, the voltage reading should be approximately 48 volts (full battery voltage).

5.3. If the voltage reading is 48 volts when the accelerator pedal is not pressed, replace the MCOR. **See MCOR Removal on page 17-8.**

5.4. If the voltage reading is zero volts when the accelerator pedal is pressed, check the limit switch circuit using the following test procedures.

5.4.1. Using a multimeter set to 200 volts DC, place black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and the place red (+) probe (with insulation-piercing probe) on the blue wire where it connects to the MCOR. With the key switch ON, the reading should be approximately 48 volts (full battery voltage).

5.4.2. If the reading is zero volts, check the continuity of the blue wire that goes from the key switch to the MCOR.

5.4.3. If the reading is approximately 48 volts, proceed to the following step.

5.4.4. Using a multimeter set to 200 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire where it connects to the MCOR. With the Tow/Run switch in the RUN position, the key switch ON, the Forward/Reverse rocker switch in NEUTRAL and the accelerator pedal pressed, the reading should be approximately 48 volts (full battery voltage).

5.4.5. If the reading is zero volts, test the continuity of the MCOR limit switch and the green wire. If the limit switch does not pass the continuity test, replace the MCOR. **See MCOR Removal on page 17-8.**

TEST PROCEDURE 9 – 16-Pin Connector

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Disconnect the 16-pin connector from the speed controller. Inspect terminal ends inside plug to ensure they are in position and seated in plug housing. If any terminals look like they are not pushed all the way into the connector, gently push the terminals until they are firmly seated in the 16-pin connector. After each terminal has been pushed into the housing, gently pull on the wire to ensure it is locked into place.
3. Check wires in the plug to make sure none are broken at the terminal pin crimp. Repair or replace as required.
4. Check the wire colors of each wire and make sure that the colors for each pin position match the wire colors in the wiring diagram. **See Wiring Diagrams on page 14-3.**
5. When connecting the 16-pin connector to the controller, push plug into controller receptacle with enough force to lock plug into place. An audible click will be heard when plug is properly seated to the controller.

A procedure is provided for testing each of the wires in the 16-pin connector. Refer to the following chart for the appropriate procedure for each pin in the 16-pin connector.

If the results of any of the referenced procedures are different from those described in the procedure, check the continuity of the wires in the wire harness and test the connected components with the appropriate test procedures. **See Index of Test Procedures.**

TABLE CONTINUED ON NEXT PAGE

SPEED CONTROLLER 16-PIN CONNECTOR WIRE	TEST PROCEDURE
Pin 1 – White (18-gauge)	Test Procedure 10 – Pins 1, 2, and 3 on page 14-23 Also for Pin 3 Test continuity of wire and perform Test Procedure 21 – Motor Speed Sensor on page 14-34
Pin 2 – Yellow (18-gauge)	
Pin 3 – Purple/White (18-gauge)	
Pin 4 – Open (No wire)	
Pin 5 – Light Blue (18-gauge)	Test Procedure 11 – Pin 5 on page 14-24
Pin 6 – Green (18-gauge)	Test Procedure 12 – Pin 6 on page 14-25
Pin 7 – Orange/White (18-gauge)	Test Procedure 13 – Pin 7 on page 14-27
Pin 8 – Brown (18-gauge)	Test Procedure 14 – Pins 8 and 16 on page 14-28
Pin 9 – Gray (18-gauge)	Test Procedure 15 – Pin 9 on page 14-29
Pin 10 – Tan (18-gauge)	Test Procedure 16 – Pin 10 on page 14-30
Pin 11 – Open (no wire)	
Pin 12 – Blue/White (18-gauge)	Test Procedure 17 – Pin 12 on page 14-31
Pin 13 – Black/White (18-gauge)	
Pin 14 – Light Green (18-gauge)	Test continuity of each wire and perform Test Procedure 21 – Motor Speed Sensor on page 14-34
Pin 15 – Red (18-gauge)	
Pin 16 – Blue (18-gauge)	Test Procedure 14 – Pins 8 and 16 on page 14-28

TEST PROCEDURE 10 – Pins 1, 2, and 3

See General Warnings on page 1-1.

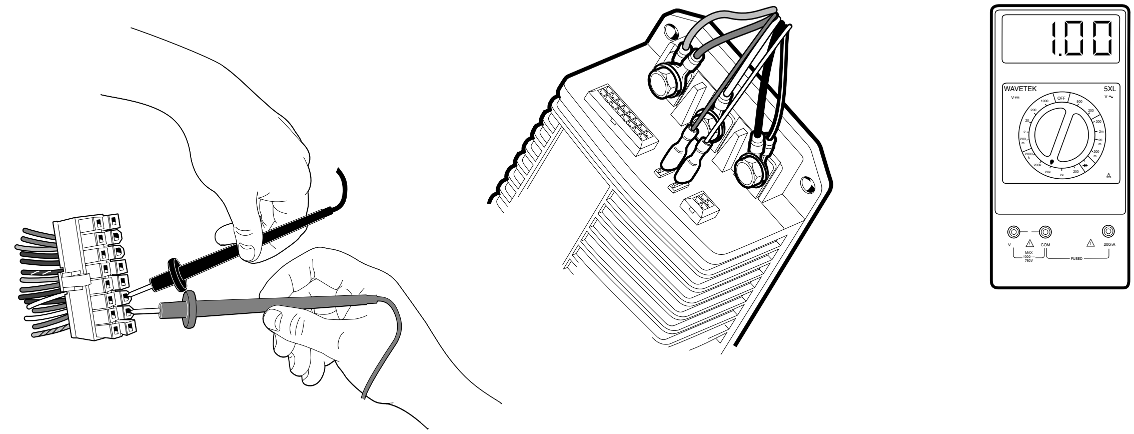
Pins 1, 2, and 3 in the 16-pin connector provide a connection point from the MCOR potentiometer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 20k ohms, insert the red (+) probe of the multimeter into pin 2 (yellow wire) of the 16-pin connector. **See following CAUTION.** Insert the black (–) probe into pin 3 (purple/white wire) of the 16-pin connector **(Figure 14-12, Page 14-24)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. With the accelerator pedal fully up (not pressed), the multimeter should read approximately 1k ohms.
6. Slowly press the accelerator pedal while monitoring the multimeter. The resistance should rise as the pedal is pressed. When the pedal is all the way to the floor, the multimeter should indicate between 5.67k ohms and 7.43k ohms.



20k Ohm Setting (reading with pedal not pressed)

685

Figure 14-12 Pins 1, 2, and 3 Test

7. Using a multimeter set for 20k ohms, insert the red (+) probe of the multimeter into pin 2 (yellow wire) at the 16-pin connector. Connect the black (–) probe into pin 1 (white wire). **See previous CAUTION.**
8. With the accelerator pedal fully up (not pressed), the multimeter should indicate between 5.67k ohms and 7.43k ohms.
9. Slowly press the accelerator pedal while monitoring the multimeter. The resistance should drop as the pedal is pressed. When the pedal is all the way to the floor, the multimeter should indicate approximately 1k ohms.
10. If any other reading is observed, check the continuity of the wires in the wire harness.

TEST PROCEDURE 11 – Pin 5

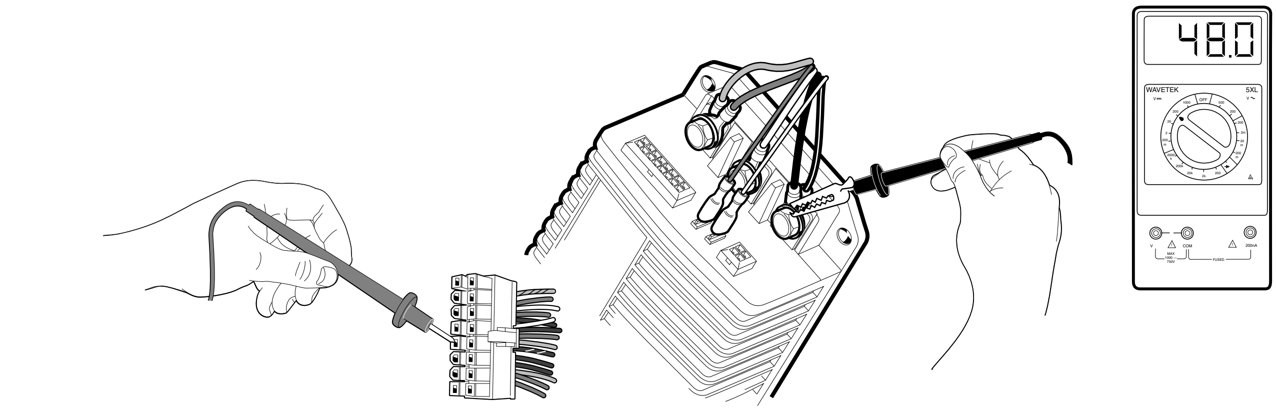
See General Warnings on page 1-1.

Pin 5 in the 16-pin connector provides a connection point for the solenoid lockout circuit from the onboard computer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 5 (light blue wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 14-13, Page 14-25)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**



200 DCV Setting (reading with OBC powered-up and battery charger disconnected)

686

Figure 14-13 Pin 5 Test

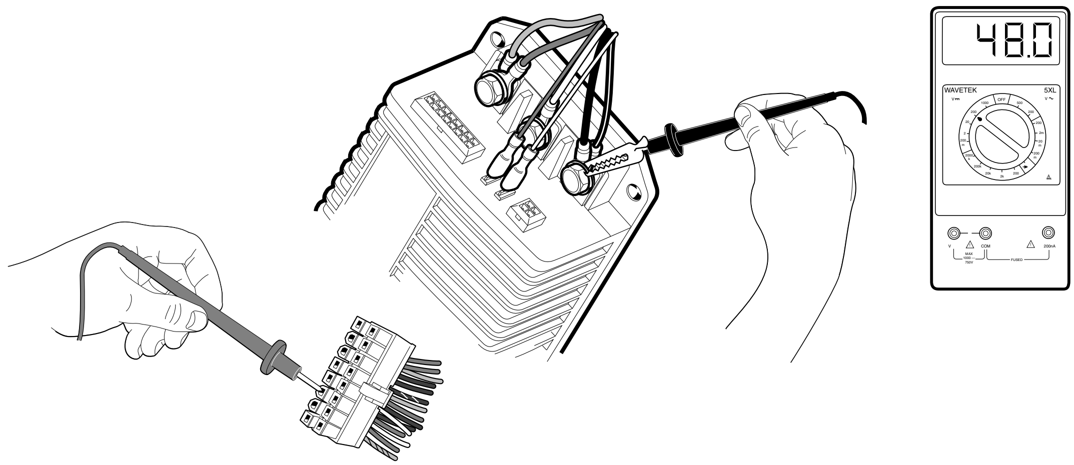
5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position.
7. The multimeter should indicate zero volts DC at this time.
8. While monitoring the multimeter, plug the battery charger into the vehicle charger receptacle.
9. After a short delay, the onboard computer should power-up (come out of sleep mode), charger relay should click, and the ammeter on the charger should indicate that the vehicle batteries are being charged.
10. The multimeter should indicate zero volts DC while the charger is connected to the vehicle.
11. While observing the multimeter, disconnect the DC plug from the vehicle charger receptacle.
12. The multimeter should indicate full battery voltage when the charger is not connected to the vehicle.
13. If any other reading is obtained, check the following items:
    – Continuity of the wires in the wire harness
    – Onboard computer for proper operation. **See Test Procedure 19 – Onboard Computer Gray Wire on page 14-33.**
    – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 14-19.**

TEST PROCEDURE 12 – Pin 6

See General Warnings on page 1-1.

Pin 6 in the 16-pin connector provides a connection point for the MCOR limit switch to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.



200 DCV Setting (reading with OBC powered-up and accelerator pedal pressed)

687

Figure 14-14 Pin 6 Test

4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 6 (green wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 14-14, Page 14-26)**.

⚠ CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position, key switch in the ON position, and Forward/Reverse switch in the FORWARD position.
7. The multimeter should indicate zero volts DC at this time.
8. While monitoring the multimeter, slowly press the accelerator pedal and hold the pedal at approximately 20% of full travel.
9. After a short delay, the onboard computer should power-up (come out of sleep mode).
10. The multimeter should indicate full battery voltage (approximately 48 volts) when the accelerator pedal is pressed.
11. While observing the multimeter, release the accelerator pedal.
12. The multimeter should indicate zero volts when the accelerator pedal is not pressed.
13. If any other reading is obtained, check the following items:
    – Continuity of the wires in the wire harness
    – Onboard computer for proper operation. **See Test Procedure 19 – Onboard Computer Gray Wire on page 14-33.**
    – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 14-19.**
    – Key switch and MCOR limit switch for proper operation. **See Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 14-20.**

TEST PROCEDURE 13 – Pin 7

See General Warnings on page 1-1.

Pin 7 in the 16-pin connector provides a connection point for the reverse buzzer to the speed controller.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Place a jumper wire with an alligator clip between the B– terminal of the speed controller (use alligator clip for this connection) and pin 7 (orange/white wire) of the 16-pin connector **(Figure 14-15, Page 14-27)**. **See following CAUTION.**

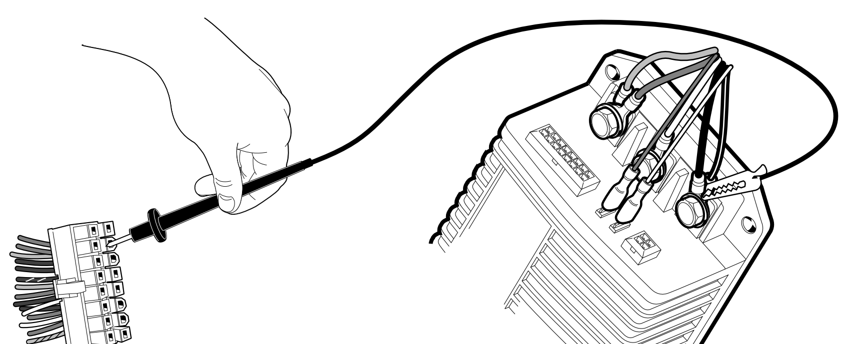
CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. Place the Tow/Run switch in the RUN position.
7. The reverse buzzer should sound when the Tow/Run switch is in the RUN position.
8. If any other activity is observed, check the following items:
   – Continuity of the wires in the wire harness

   – Reverse buzzer for proper operation. **See Test Procedure 24 – Reverse Buzzer on page 14-36.**

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 14-19.**



688

Figure 14-15 Pin 7 Test

TEST PROCEDURE 14 – Pins 8 and 16

See General Warnings on page 1-1.

Pins 8 and 16 in the 16-pin connector provide a connection point for the Forward/Reverse rocker switch to the speed controller. The switch provides a +48 volt signal to the speed controller through pin 8 when the Forward/Reverse switch is in the FORWARD position and provides a +48 volt signal on pin 16 when the Forward/Reverse switch is in the REVERSE position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame crossmember between the spring mount and side stringer, just forward of each rear wheel. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 8 (brown wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 14-16, Page 14-29)**.

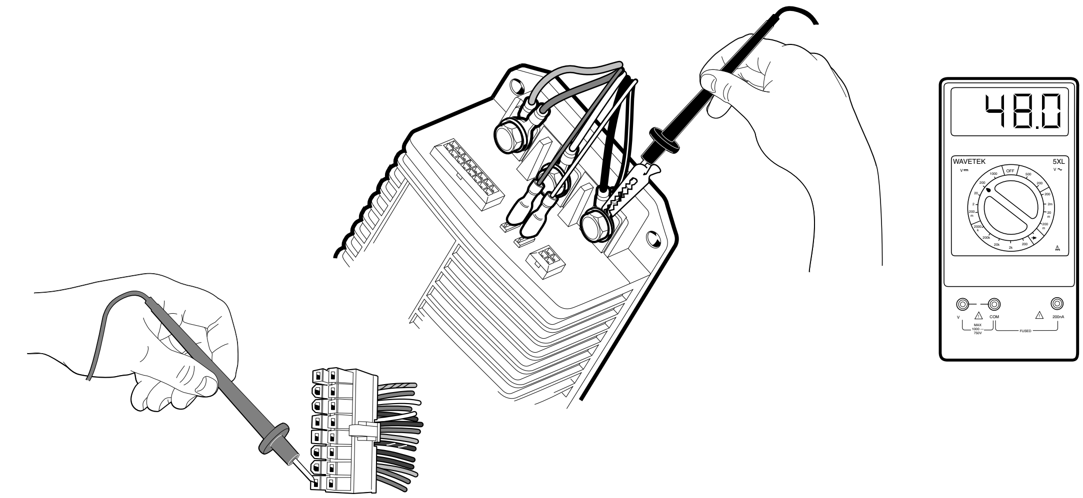
CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

1. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
2. Place the Tow/Run switch in the RUN position and the Forward/Reverse switch in the NEUTRAL position. The multimeter should indicate zero volts DC at this time.
3. While monitoring the multimeter, place the Forward/Reverse switch in the REVERSE position. The multimeter should still indicate zero volts.
4. Place the Forward/Reverse switch in the FORWARD position. The multimeter should indicate full battery voltage (approximately 48 volts).
5. Insert the red (+) probe of the multimeter into pin 16 (blue wire) of the 16-pin connector. Leave the black (–) probe (alligator clip) connected to the B– terminal of the speed controller. **See previous CAUTION.**
6. Place the Forward/Reverse switch in the NEUTRAL position. The multimeter should indicate zero volts DC at this time.
7. While monitoring the multimeter, place the Forward/Reverse switch in the FORWARD position. The multimeter should still indicate zero volts.
8. Place the Forward/Reverse switch in the REVERSE position. The multimeter should indicate full battery voltage (approximately 48 volts).
9. If any other reading is obtained, check the following items:
   – Continuity of the wires in the wire harness

   – Forward/Reverse switch for proper operation. **See Test Procedure 23 – Forward/Reverse Rocker Switch on page 14-35.**

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 14-19.**



200 DCV Setting (reading with Tow/Run switch in RUN and Forward/Reverse switch in FORWARD)

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Figure 14-16 Pins 8 and 16 Test

TEST PROCEDURE 15 – Pin 9

See General Warnings on page 1-1.

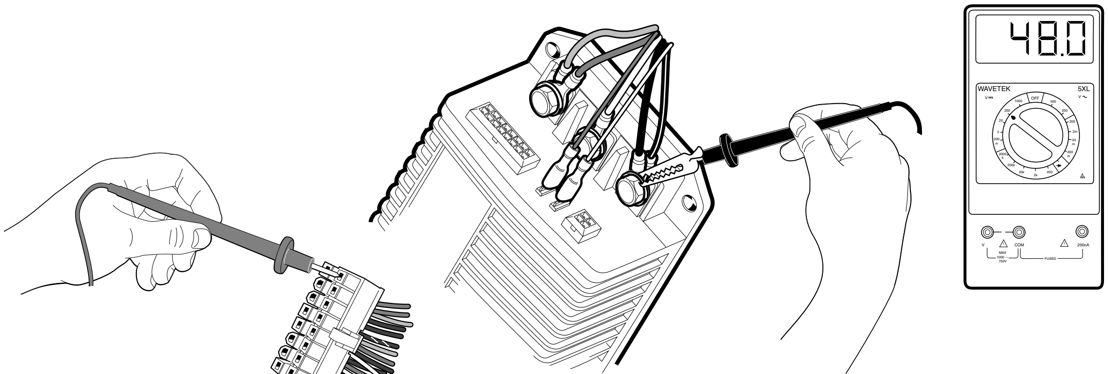
Pin 9 in the 16-pin connector provides a connection point for the Tow/Run switch to the speed controller. The switch provides a +48 volt signal to the speed controller through pin 9 when the Tow/Run switch is in the RUN position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 9 (gray wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 14-17, Page 14-30)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. With the Tow/Run switch in the TOW position, the multimeter should indicate zero volts.
7. Place the Tow/Run switch in the RUN position.



200 DCV Setting (reading with Tow/Run switch in RUN position)

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Figure 14-17 Pin 9 Test

8. With the Tow/Run switch in the RUN position, the multimeter should indicate full battery voltage (approximately 48 volts).
9. If any other reading is obtained, check the following items:
   – Continuity of the wires in the wire harness
   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 14-19.**

TEST PROCEDURE 16 – Pin 10

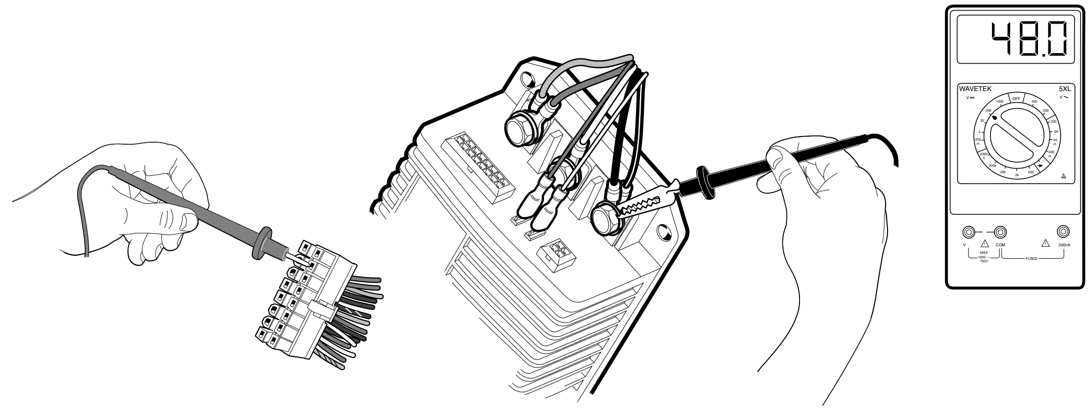
See General Warnings on page 1-1.

Pin 10 in the 16-pin connector provides a connection point for the key switch to the speed controller. The key switch provides a +48 volt signal to the speed controller through pin 10 when the key switch is in the ON position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Using a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 10 (tan wire) of the 16-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 14-18, Page 14-31)**.

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**



200 DCV Setting (reading with Tow/Run switch in RUN and key switch in the ON position)

691

Figure 14-18 Pin 10 Test

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
6. With the Tow/Run switch in the TOW position, the multimeter should indicate zero volts.
7. Place the Tow/Run switch in the RUN position and the key switch in the ON position.
8. With the key switch in the ON position, the multimeter should indicate full battery voltage (approximately 48 volts). With the key switch in the OFF position, the reading should be zero volts.
9. If any other reading is obtained, check the following items:
   – Continuity of the wires in the wire harness

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 14-19.**

   – Key switch for proper operation. **See Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 14-20.**

TEST PROCEDURE 17 – Pin 12

See General Warnings on page 1-1.

Pin 12 in the 16-pin connector provides a connection point for the solenoid coil to the speed controller. The speed controller activates the solenoid coil by providing a ground to the solenoid coil at the appropriate time.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Disconnect the 16-pin connector at the speed controller.
4. Place a jumper wire with an alligator clip between the B– terminal of the speed controller (use alligator clip for this connection) and pin 12 (blue/white wire) of the 16-pin connector **(Figure 14-19, Page 14-32)**. **See following CAUTION.**

CAUTION

- **Do not fully insert probes into the 16-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

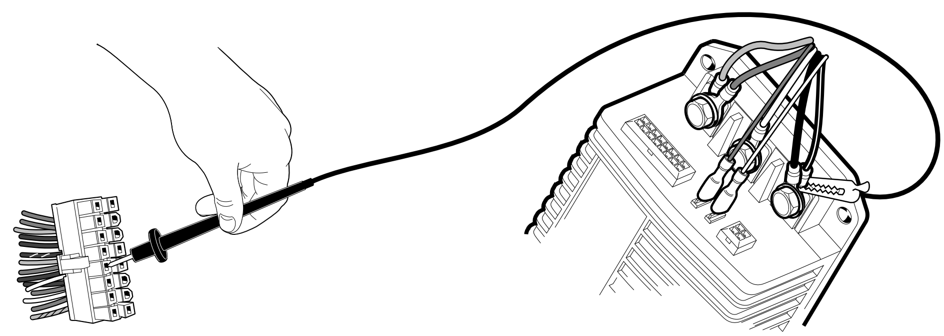


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Figure 14-19 Pin 12 Test

6. Place the Tow/Run switch in the RUN position and the key switch in the ON position.
7. The solenoid should click when the key switch is placed in the ON position.
8. If any other activity is observed, check the following items:
   – Continuity of the wires in the wire harness

   – Reverse buzzer for proper operation. **See Test Procedure 24 – Reverse Buzzer on page 14-36.**

   – Tow/Run switch for proper operation. **See Test Procedure 6 – Tow/Run Switch on page 14-19.**

   – Key switch for proper operation. **See Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 14-20.**

   – Solenoid for proper operation. **See Test Procedure 22 – Solenoid Continuity on page 14-35.**

TEST PROCEDURE 18 – Onboard Computer Silicon-Controlled Rectifier (SCR) Circuit

See General Warnings on page 1-1.

The silicon controlled rectifier (SCR), located inside the onboard computer, acts as a switch on the negative side of the circuit.

This allows the onboard computer (OBC) to control the battery charging current.

Use the following procedure to test the SCR:

1. With batteries connected and using a multimeter set to 200 volts DC, place the red (+) probe on the positive post of battery no. 1 and place the black (–) probe on the charger receptacle socket that has the black 10-gauge wire attached to it. The reading should be approximately 36-42 volts.
2. If the reading is zero volts, check the black 10-gauge wire connection to the OBC connector. Check the continuity of the black 10-gauge wires. If the wires and connections are okay, the SCR has failed. Replace the OBC. If the reading is correct, proceed to the following step.
3. Plug in AC and DC cords. When the battery charger relay clicks on, reading should be approximately 48 volts (full battery voltage). If the reading does not rise from approximately 40 volts to full battery voltage when the DC cord is plugged in and the relay clicks on, check the following items:

– Black wire terminal socket in the charger receptacle.

– Onboard computer gray wire. **See Test Procedure 19 – Onboard Computer Gray Wire on page 14-33.**

– Red wire at the charger receptacle. **See Test Procedure 20 – Voltage at Charger Receptacle Red Wire Socket on page 14-33.**

TEST PROCEDURE 19 – Onboard Computer Gray Wire

See General Warnings on page 1-1.

1. With batteries connected and the DC cord disconnected, pull back on the boot (1) on the gray wire (2) connection at the OBC (3) **(Figure 14-20, Page 14-33)**. Using a multimeter set to 200 volts DC, connect the red (+) probe to the positive post of battery no. 1 and black (–) probe to gray 16-gauge wire at the OBC connection (4). Reading should be approximately 48 volts. If reading is zero volts, replace the OBC.

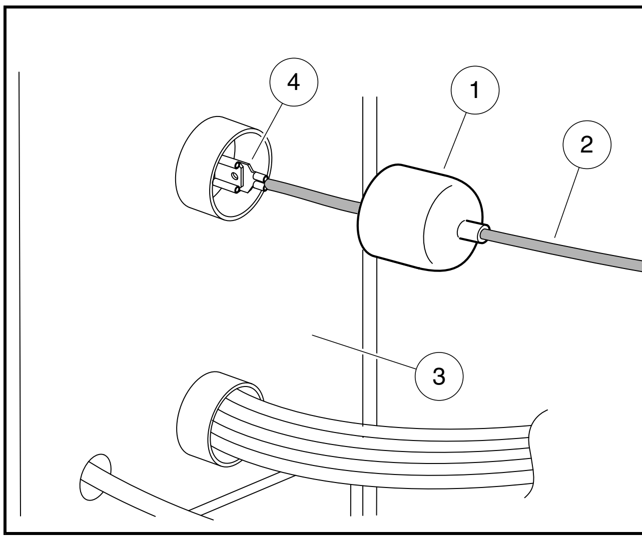

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Figure 14-20 OBC Connections

2. If the reading in step 1 is 48 volts, plug the DC cord into the vehicle's charger receptacle. The voltage reading should drop to approximately 4.0 volts before the charger relay clicks on.
3. When the charger relay is activated, the reading should rise to approximately 48 volts.
4. If voltage does not drop to approximately 4.0 volts when the DC cord is plugged in and then rise to approximately 48 volts when the charger relay clicks on, the gray wire circuit in the OBC has failed. Replace the OBC.

TEST PROCEDURE 20 – Voltage at Charger Receptacle Red Wire Socket

See General Warnings on page 1-1.

1. With batteries connected, DC cord disconnected, and using a multimeter set to 200 volts DC, place the black (–) probe on the negative post of battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) and place the red (+) probe on the charger receptacle socket connected to the red 10-gauge wire. The reading should be 48-50 volts (full battery voltage).
2. If the reading is zero volts, check the continuity of the 10-gauge red wire from the positive post of battery no. 1 to the receptacle socket.

TEST PROCEDURE 21 – Motor Speed Sensor

See General Warnings on page 1-1.

Motor Speed Sensor Test with the IQDM Handset

⚠ CAUTION

- **Perform the following procedure only on a level surface. To avoid injury or property damage, ensure that the path of the vehicle is clear before pushing vehicle.**

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Access the Test menu and select SPEED PULSES by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the vehicle is at rest.
4. While monitoring the IQDM display screen, slowly push the vehicle a short distance (about 3 feet (1 meter)). The IQDM should indicate ON for speed sensor pulses while the wheels are in motion.
5. If the IQDM does not indicate ON while the wheels are in motion, proceed to the following procedure, Motor Speed Sensor Test without the IQDM Handset.

Motor Speed Sensor Test without the IQDM Handset

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. With batteries connected, disconnect the three-pin connector at the motor speed sensor.
3. Check voltage at purple/white wire:
   - 3.1. Using a multimeter set to 200 volts DC, place the red (+) probe on the battery no. 1 positive post and place the black (–) probe on the purple/white wire terminal socket in the three-pin connector. The voltage reading should be 48 to 50 volts (full battery voltage).
   - 3.2. If the reading is zero volts, check the continuity of the purple/white wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.
4. Check voltage at the red motor speed sensor wire:
   - 4.1. With Tow/Run switch in the RUN position and using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place red (+) probe on red wire terminal socket in three-pin connector. The voltage reading should be approximately 15-16 volts.
   - 4.2. If the voltage reading is zero volts, check the continuity of the red wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the wire continuity is correct, replace the speed controller.
   - 4.3. If the reading is below 14 volts, replace the speed controller.
   - 4.4. If the voltage reading is correct, proceed to the following step.
5. Check voltage at the light green wire:
   - 5.1. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the light green wire female terminal in the three-pin connector at the motor speed sensor. The voltage reading should be from 4.60 to 4.90 volts.
   - 5.2. If the voltage is zero volts, check the continuity of the light green wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.
   - 5.3. If reading is below 3.50 volts, check the continuity of the wires and plug and replace the speed controller if necessary.

6. Reconnect the three-pin connector at the motor speed sensor. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire between the three-pin connector and the motor speed sensor.
   6.1. Raise one rear wheel off ground. Slowly turn the rear wheel to rotate the motor armature. As the armature rotates, the voltage reading should alternate from zero to approximately 4.85 volts. The voltage reading will fluctuate from zero to 4.85 volts and back to zero four times for each revolution of the motor armature.

NOTE: *The voltage reading of 4.85 is an approximate reading. The actual reading may vary from 4.50 to 5.00 volts.*

   6.2. Replace the speed sensor if:
   – There is no voltage reading.
   – The voltage reading is not above 3.50.
   – The voltage reading does not fluctuate as the motor is turned.

TEST PROCEDURE 22 – Solenoid Continuity

See General Warnings on page 1-1.

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-1.**
2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
3. Disconnect the three wires that are crimped together from the forward large post of the solenoid.
4. Using a multimeter set to 200k ohms, place the black (–) probe on one solenoid large post and place the red (+) probe on the other large post. The reading should be no continuity.
5. Connect the three wires crimped together to the forward large solenoid post. Install washer and nut on large solenoid post and tighten to 77 in-lb (8.7 N·m).
6. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

7. Place the Tow/Run switch in the RUN position, turn the key switch to the ON position, place the Forward/Reverse rocker switch in the FORWARD position, and press the accelerator pedal. The solenoid should click and the multimeter should indicate continuity. If the reading is no continuity, replace the solenoid.

TEST PROCEDURE 23 – Forward/Reverse Rocker Switch

See General Warnings on page 1-1.

Forward/Reverse Rocker Switch Test with the IQDM Handset

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Test FORWARD INPUT.

3.1. Access the Test menu and select FORWARD INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or REVERSE position.

3.2. Place the Forward/Reverse switch in the FORWARD position. The IQDM should indicate that FORWARD INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on page 14-3.** Also check the 16-pin connector at the speed controller. **See Test Procedure 9 – 16-Pin Connector on page 14-22.**

4. Test REVERSE INPUT.

4.1. Access the Test menu and select REVERSE INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or FORWARD position.

4.2. Place the Forward/Reverse switch in the REVERSE position. The IQDM should indicate that REVERSE INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on page 14-3.** Also check the 16-pin connector at the speed controller. **See Test Procedure 9 – 16-Pin Connector on page 14-22.**

5. If the IQDM displays readings other than those described above and the wiring is found to be correct, proceed to the following procedure, **Forward/Reverse Rocker Switch Test without the IQDM Handset**.

Forward/Reverse Rocker Switch Test without the IQDM Handset

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the two screws securing the rocker switch case to the vehicle body.
3. Remove switch from car. **See Forward/Reverse Rocker Switch Removal on page 17-3.**
4. Disconnect the three wires from the rocker switch. Using a multimeter set to 200 ohms, place the black (–) probe on the brown wire terminal 3 position on the rocker switch, and place the red (+) probe on the orange wire terminal 2 position. With the switch in NEUTRAL or REVERSE, there should be no continuity. With the switch in FORWARD, there should be continuity. If the readings are incorrect, replace the switch.
5. Place the black (–) probe on the blue wire terminal 1 position on the rocker switch and place the red (+) probe on the orange wire terminal. With the switch in REVERSE, there should be continuity. If the readings are incorrect, replace the switch.

TEST PROCEDURE 24 – Reverse Buzzer

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the instrument panel. **See Key Switch Removal, Section 17, Page 17-1.**
3. Disconnect the orange/white and pink wires from the reverse buzzer.
4. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
5. Place the key switch in the OFF position and the Tow/Run switch in the RUN position.
6. Using a multimeter set to 200 volts DC, place the black (–) probe on battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the pink wire terminal end that was disconnected from the reverse buzzer. The reading should be approximately 48 volts (full battery voltage).

6.1. If the voltage reading is correct, proceed to step 7.

6.2. If reading is zero volts, check pink wire continuity and Tow/Run switch. **See Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 14-15. See also Test Procedure 6 – Tow/Run Switch on page 14-19.**

6.3. If the continuity readings are not correct, repair or replace the pink wire.

6.4. If the continuity readings are correct, proceed to step 7.

7. Place the Forward/Reverse switch in REVERSE. Using a multimeter set to 200 volts DC, place the black (–) probe on the orange/white wire terminal end (that was disconnected from the reverse buzzer) and place the red (+) probe on battery no. 1 positive post. The reading should be approximately 48 volts (full battery voltage).
   - 7.1. If the voltage reading is correct, replace the reverse buzzer.
   - 7.2. If reading is zero volts, check orange/white wire continuity and connection at Pin 7 in 16-Pin connector.
   - 7.3. If there is no continuity in the orange/white wire, or the Pin 7 terminal in the 16-Pin connector is not properly seated, repair or replace as required.
   - 7.4. If the orange/white wire continuity and 16-Pin connector are correct and there is no voltage at the orange wire, replace the controller.

TEST PROCEDURE 25 – Rebooting the Onboard Computer

See General Warnings on page 1-1.

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

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

NOTE: *Wait at least 90 seconds for the capacitors in the speed controller to discharge. The capacitors in the speed controller must be fully discharged in order to reboot the OBC.*

2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
3. Place Tow/Run switch in the RUN position.
4. Test drive the vehicle. If the vehicle functions normally the problem is corrected. If the problem still exists, refer to Wiring Diagrams on page 14-3.

TEST PROCEDURE 26 – Battery Warning Light

See General Warnings on page 1-1.

1. Reboot the OBC and drive the vehicle a short distance. When vehicle is first driven, the battery warning light should illuminate for 10 seconds. **See Test Procedure 25 – Rebooting the Onboard Computer on page 14-37.** If the battery warning light does not illuminate when rebooting the OBC, proceed to step 2.
2. Turn key switch OFF, place Tow/Run switch in TOW and place Forward/Reverse rocker switch in NEUTRAL.
3. Disconnect the six-pin connector at the OBC.
4. Remove the wedge lock from the six-pin connector housing that is connected to the vehicle wire harness. Remove the brown/white wire from the connector plug.
5. Using a jumper wire with an alligator clip at each end, connect one alligator clip to the negative post of battery no. 1 and the other alligator clip to the brown/white wire terminal socket that was removed from the six-pin connector plug.
6. Install the wedgelock in the six-pin connector housing and reconnect the six-pin connector plug. Place the Tow/Run switch in the RUN position and the battery light should illuminate. If the light does not illuminate, replace the battery warning light assembly.

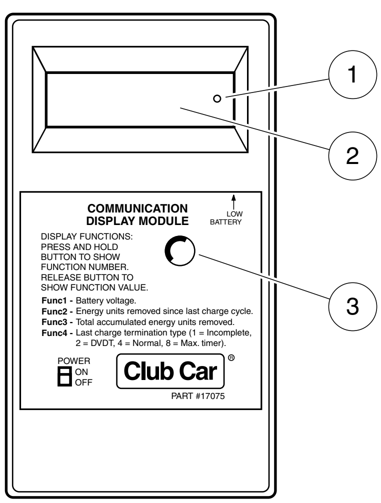
BATTERY WARNING LIGHT

IQ System and Excel 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 if the charge is less than 90% complete but the vehicle has enough power for 60 minutes of operation. This will alert the fleet operator that the vehicle may be used, but that it must be charged to completion as soon as possible.
- The 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 battery warning light will repeatedly illuminate for 10 seconds, at 4 second intervals, 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 battery warning light will flash quickly, after inserting the DC plug, indicating the charger’s voltage suppressor has failed closed.

COMMUNICATION DISPLAY MODULE (CDM)



1. Low Battery 2. Display Window 3. Function Button

Figure 14-21 CDM

The CDM can be used to retrieve from the onboard computer four important items of information that can be useful in troubleshooting the Excel System vehicle. To access one of these items, the item’s corresponding Function Code must be selected on the CDM. This is done by pressing the Function Button until the desired function code is displayed in the window. **See Figure 14-21, Page 14-38 for CDM features.** Releasing the button when the desired code is displayed will display the data. Function codes and corresponding data are as follows:

- **F1 – Battery voltage:**
- This displays the battery pack's current state of charge. A reading of less than 48 volts indicates that the batteries need to be charged. If a reading of less than 48 volts is obtained immediately after a charge cycle, there may be a problem in the charge circuit.
- **F2 – Energy units removed since last charge cycle:**
- If the display reads over 75 (the vehicle battery warning light should be illuminated), the vehicle batteries need to be recharged before being used again. This data can be used to make sure all vehicles in a fleet receive equal usage on a short-term basis.
- **F3 – Total accumulated energy units removed since initial vehicle start-up:**
- This information is most useful in making sure that all vehicles in a fleet receive equal usage over long periods of time.
- **F4 – Last charge termination type (1 = incomplete, 2 = DVDT, 4 = normal, 8 = max. timer):**
- A **1**, **2**, **4**, or **8** will be displayed.
- **1** – Indicates the last charge cycle was incomplete and the batteries were not fully charged. Batteries should be charged again at the earliest opportunity.
- **2** – Indicates a back-up charge program was employed by the OBC to complete the charge cycle if a normal charge (4) is not possible. DVDT refers to an increase in voltage within a time period. The OBC monitors battery voltage during charging and will terminate the charge when the voltage does not increase within the time period. A DVDT charge may be displayed the first few times a new set of batteries is charged, and the first time a set of batteries is charged after the batteries have been disconnected and reconnected. A problem may exist if persistent DVDT readings are obtained.
- **4** – Indicates the last charge cycle was normal.
- **8** – Indicates the charger ran for sixteen hours and shut itself off without completing the charge cycle. This means there may be a problem in the charge circuit.

The CDM also has a low battery indicator, which illuminates when CDM batteries are weak and need to be replaced. Weak batteries in the CDM may cause the CDM to register inaccurate information or no information.

USING THE CDM TO RETRIEVE DATA FROM THE ONBOARD COMPUTER

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

NOTE: *If, by positioning CDM on seat bottom, the CDM is unable to collect the data stream from the onboard computer, hold CDM approximately 6 inches (15.2 cm) from battery warning light.*

3. Wait approximately 30 seconds for a value to appear in the display window.
4. If a value does not appear in the display window after 30 seconds, try adjusting the aim of the CDM and repeating step 3 until a value appears. If there is still no reading, check for weak batteries in the CDM.
   - 4.1. Adjust aim of CDM.
   - 4.2. Drive vehicle a short distance to ensure OBC is not in powerdown mode.
   - 4.3. Check for weak batteries in CDM.

4.4. If reading is still not obtained, go to the CDM Troubleshooting Guide on page 14-40.

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

- The value currently displayed will be F1 (battery voltage).
- To view F2, press and hold the button on the CDM. When “Func 2” appears in the display window, release the button. The value for F2 will then be displayed.
- To view F3, press and hold the button on the CDM until “Func 3” appears in the display window. Release the button. The value for F3 will be displayed.
- To view F4, press and hold the button on the CDM until “Func 4” appears in the display window. Release the button. The value for F4 will be displayed.

NOTE: *The values of all four functions can be recalled by pressing and releasing the CDM button.*

CDM TROUBLESHOOTING GUIDE

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

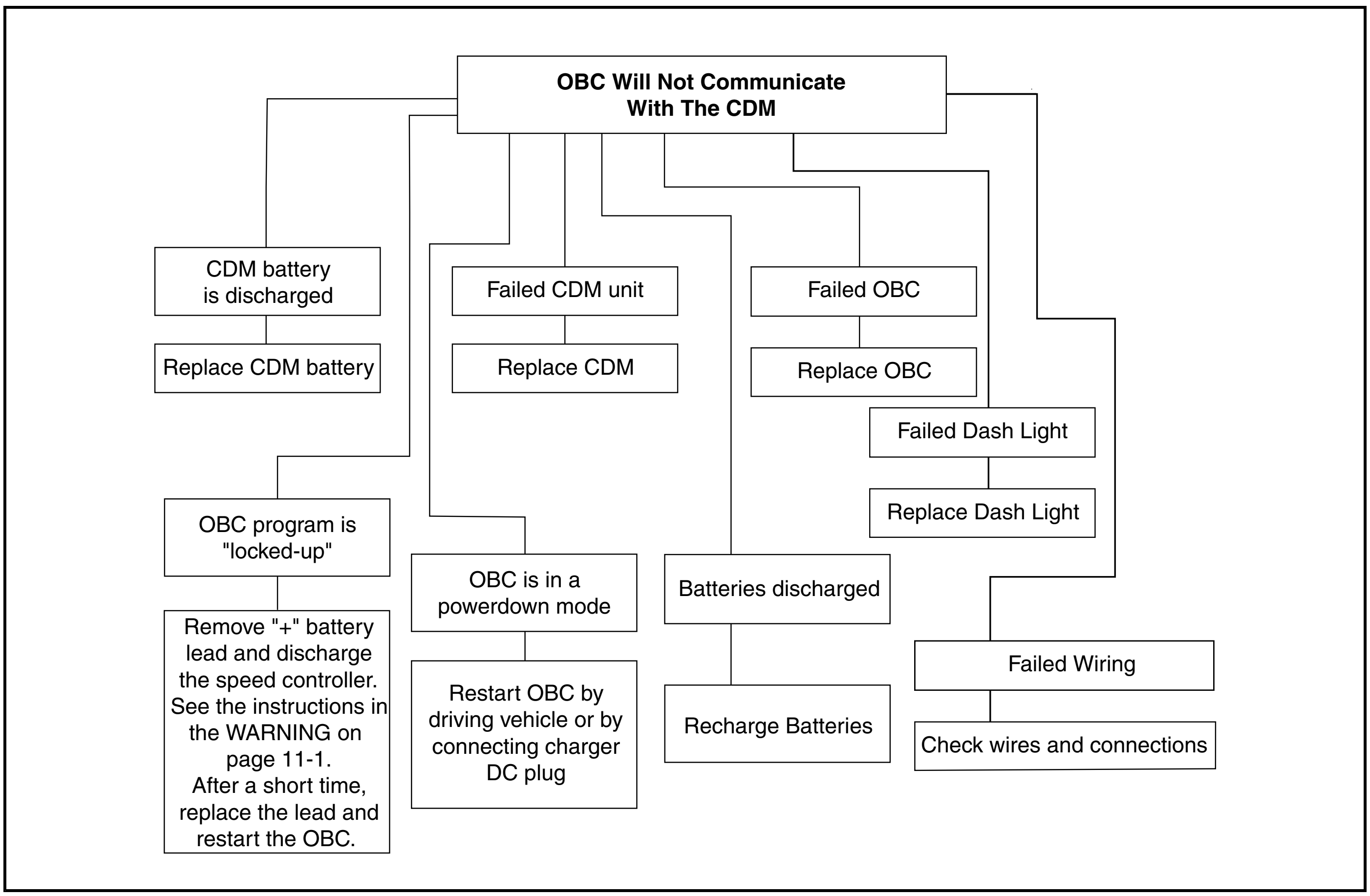


Figure 14-22 Flow Chart – CDM Troubleshooting Guide

SECTION 15 – IQ DISPLAY MODULE (IQDM) AND IQDM-P DIAGNOSTICS: IQ SYSTEM

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

NOTE: *For information specific to the IQDM-P handset programming features,* ***see IQ Display Module Programmer (IQDM-P): IQ System on page 22-1.***

The information presented in this section addresses the Series 2 versions of the IQDM-P and IQDM handsets.

2009 Precedent IQ electric vehicles equipped with the Gen II Pedal Assembly will produce a reoccurring Throttle Fault 1 fault code registered in the vehicle's controller fault history when taking readings with the IQDM diagnostic module. This occurs due to the Gen II Pedal Assembly having a modular electric throttle with a throttle position sensor instead of an MCOR. The 1510 series controller that is used with IQ System cars requires a constant low voltage signal from the MCOR to signal there are no broken wires, loose connector plugs, etc. between the controller and MCOR. The throttle position sensor loses this connection when the key switch is turned off, prompting the controller to instantly register the appropriate Throttle Fault 1 code in fault history. The code can be cleared but will return every time the key switch is turned OFF. It has no ill effect on the operation of the vehicle and should not be interpreted as a fault that necessitates replacement of the vehicle's accelerator pedal assembly that contains the throttle position sensor.

There are circumstances in which a legitimate Throttle Fault 1 fault code will register. If the vehicle does have an issue with the throttle position sensor or its wiring, the fault code will be present in the Current Faults menu with the key switch in the ON position. This fault code will also most likely be accompanied by a non-operational vehicle.

The Excel system uses a 1515 series controller that has software preventing this fault code from registering when the key is switched off. Future IQ system controllers will have software to prevent this as well.

PLUGGING THE HANDSET INTO THE VEHICLE

1. Connect one end of the cable to the port located on the bottom of the handset.
2. Connect the cable adaptor to the IQDM cable.
3. Find the IQDM port on the vehicle **(Figure 15-1, Page 15-2)**.
4. Remove the dust cap from the IQDM port.
5. Align the keyed portion of the plug with the IQDM port and connect the plug to the port.

INTRODUCTORY DISPLAY

Immediately after the handset is connected to the vehicle, it begins loading the vehicle speed controller information. After a few seconds, the screen displays the following menu items:

- Program (IQDM-P only)
- Monitor

- Faults
- Functions
- Information
- Programmer Setup

In the event that the handset does not display any information, or the screen is difficult to read, refer to the IQDM troubleshooting procedures. **See IQDM and IQDM-P Handset Troubleshooting on page 15-18.**

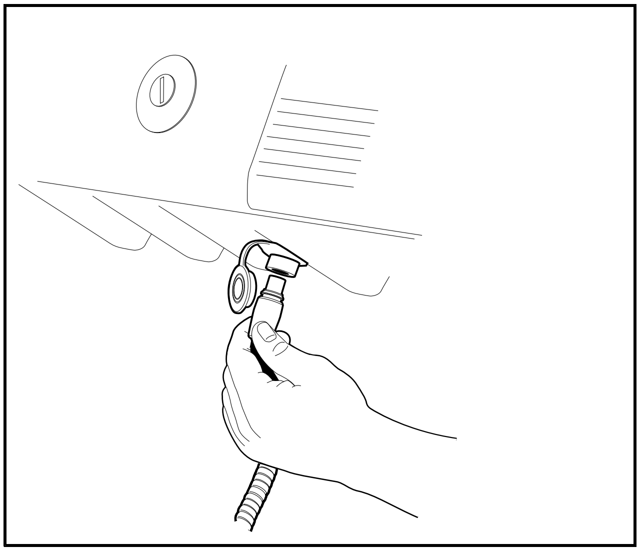


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Figure 15-1 IQDM Port Under Instrument Panel

MENU NAVIGATION

The NAVIGATION BUTTON (1) is the four-arrow button located on the left side of the handset **(Figure 15-2, Page 15-3)**. This button is used to navigate through and select menus. Pressing the up or down arrows allows the user to scroll through the menu items. When the box beside the desired menu is blinking, pressing the right arrow selects that menu item. Pressing the left arrow allows the user to go back one screen (2).

The CHANGE VALUE BUTTON (3) is the button located on the right side of the handset **(Figure 15-2, Page 15-3)**. This button allows the user to change values by pressing + or –.

The three yellow buttons labeled 1, 2 and 3 are BOOKMARK BUTTONS (4) **(Figure 15-2, Page 15-3)**. These buttons allow the user to bookmark up to three specific screens for rapid return to those screens. To bookmark a specific display screen, have the desired screen displayed and simply press and hold a bookmark button until the statement “bookmark set” is displayed. When it is necessary to go back to the bookmarked screen, rapidly press and release the appropriate bookmark button. **See following NOTE.**

NOTE: *When going to a bookmarked display screen, be sure to rapidly press and release the button. If the button is pressed and held for too long, the bookmark will be overridden with the current screen.*

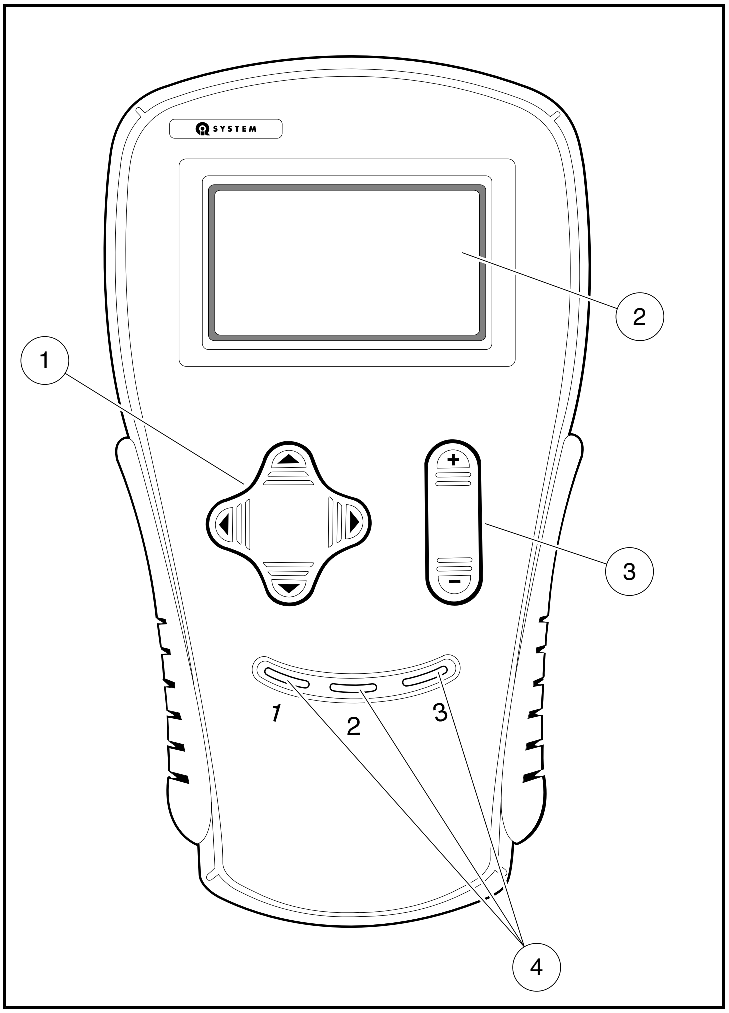

Figure 15-2 Handset Controls

The following menus are accessible on the IQDM handset:

PROGRAM (IQDM-P ONLY)

The *program* menu allows the user to view and change custom speed controller settings. **See Program Menu on page 22-2.**

MONITOR

The *monitor* menu displays values for certain parameters to facilitate speed controller troubleshooting. **See Monitor Menu on page 15-4.**

FAULTS

The *faults* menu displays all faults recorded by the speed controller since the history was last cleared. Each fault is listed only once, even if the fault has occurred multiple times. **See Faults Menu on page 15-7.**

FUNCTIONS

The *functions* menu allows the user to transfer all current settings from the speed controller to the handset and from the handset to the speed controller. **See Functions Menu on page 15-13.**

INFORMATION

The *information* menu displays the model number, serial number, manufacturer date and software version of the speed controller. **See Information on page 15-16.**

PROGRAMMER SETUP

The *programmer setup* menu allows the user to set the LCD contrast, display the fault history of the programmer as well as various other information pertaining to the handset such as model number, serial number, OEM information, etc. **See Programmer Setup on page 15-17.**

MONITOR MENU

The *monitor* menu is accessed by using the up or down arrow to scroll to *monitor* and pressing the right arrow key to activate the menu. All information in the *monitor* menu is updated in real time, allowing the trained technician to troubleshoot the vehicle by monitoring the handset as the key switch is cycled, Forward/Reverse switch is activated, etc.

Since the *monitor* menu is updated while the vehicle is in operation, the trained technician has the ability to monitor the status of several components in conditions or locations where a problem with vehicle performance has been reported. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the handset while the vehicle is in motion. A technician can monitor the handset while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

The following parameters can be monitored in real time with the handset from the *monitor* menu:

THROTTLE

Indicates the position of the accelerator pedal from 0% (pedal not pressed) to 95 - 100% (pedal fully pressed). This item can be monitored when the key switch is in the ON or OFF position.

BATT VOLTAGE

Displays the current battery voltage at the speed controller.

HEATSINK

Displays the temperature (in degrees Celsius) of the speed controller heatsink. During normal operating conditions, the heatsink temperature should be below 85 °C ±5 °C (185 °F ±9 °F). **See following NOTE.**

NOTE: *Improper brake adjustment can sometimes cause the operating current to be higher than normal. This higher current increases the temperature of the speed controller heatsink.*

ARM CURRENT

Displays the motor armature current (in amperes).

FIELD CURRENT

Displays the motor field current (in amperes).

ARM PWM

Displays motor armature PWM (pulse width modulation). The range of pulse width modulation is 0% to 100%. When the vehicle is operating at full speed, the pulse width modulation should be at 100%.

FIELD PWM

Displays motor field PWM (pulse width modulation). The range of pulse width modulation is 0% to 100%. When the vehicle is in operation, the pulse width modulation will fluctuate in response to the terrain and throttle input.

SPEED PULSES

The *speed pulses* menu item displays the activity of the motor speed sensor. With the key switch in the OFF position, the Forward/Reverse switch in the NEUTRAL position, and the vehicle at rest, the handset should should indicate that speed pulses are off. When the vehicle is gently pushed a short distance, the handset should indicate that speed pulses are on.

FOOT INPUT

Indicates the status of the throttle position sensor or MCOR(motor controller output regulator) internal limit switch: on or off. When the accelerator pedal is unpressed, the handset should indicate that the limit switch is off. When the accelerator pedal is pressed and the key switch is in the ON position, the display should indicate that the limit switch is on.

FORWARD INPUT

With the Forward/Reverse switch in the NEUTRAL or REVERSE position, the handset should indicate that the forward input is off. When the Forward/Reverse switch is placed in the FORWARD position, the handset should indicate that the forward input is on.

REVERSE INPUT

With the Forward/Reverse switch in the NEUTRAL or FORWARD position, the handset should indicate that the reverse input is off. When the Forward/Reverse switch is placed in the REVERSE position, the handset should indicate that the reverse input is on.

MAIN CONT

Displays the current solenoid (main contactor) state. When the contactor is activated, the handset indicates that the solenoid is on. When the contactor is not activated, the handset indicates that the solenoid is off.

KEY INPUT

Displays the position of the key switch: OFF or ON.

PASSWORD TRIES (IQDM-P ONLY)

A password is required to place the vehicle in “private speed mode” (speed setting 4). The speed controller will log unsuccessful and unauthorized attempts to place the speed controller in “private speed mode”. If repeated attempts are unsuccessful, the speed controller will permanently lock out access to “private speed mode”. In the event that “private speed mode” is locked out, the controller must be removed and shipped to Club Car before it can ever be placed in “private speed mode”. **See Code A, Code B, and Code C on page 22-3.**

10.3 TRANSAXLE

This menu is reserved for possible future use and has no application at this time.

20+ SPEED

This menu is reserved for possible future use and has no application at this time.

The remaining items that display under the Monitor menu are fault condition occurrences. The display indicates the fault name and the number of fault occurrences. **See following Faults Menu section.**

FAULTS MENU

The *faults* menu is accessed by using the up or down arrow to scroll to *faults* and pressing the right arrow key to activate the menu.

Faults displayed in the *faults* menu will aid the trained technician in troubleshooting the vehicle. Faults displayed often indicate which components in the electrical system need to be tested.

Since the *faults* menu is updated while the vehicle is in operation, the trained technician has the ability to monitor the occurrence of faults in conditions or locations where a problem with vehicle performance has been reported. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the handset while the vehicle is in motion. A technician can monitor the handset while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

SYSTEM FAULTS

The *system faults* menu displays all of the faults detected by the speed controller since the last time the fault history has been cleared. The faults displayed in this menu may or may not be currently active. Once a fault has been detected, it is stored in the memory of the speed controller for display on the *fault history* menu. Each detected fault is listed only once, even if the fault has occurred multiple times.

Causes of Faults

Some common causes of faults are:

- Loose, broken, or disconnected wires or connectors
- Failed components
- Improper adjustment or installation of electrical or mechanical components (examples: brake adjustment, improper throttle position sensor or MCOR installation)
- Improper wiring of electrical components

As shown above, there are many possible causes for faults to occur, and the speed controller has a programmed reaction to each fault that is based on the fault currently detected. The technician should be familiar with the detected faults and the controller's reactions to faults to ensure a proper diagnosis.

An example of a possible mis-diagnosis of a vehicle due to a fault: If the three-pin speed sensor wire has been disconnected, the speed controller will detect a *speed sensor* fault. When a *speed sensor* fault is detected, the controller responds to the fault by limiting the vehicle speed to 1/2 of its normal top speed. If the technician reaches the conclusion that the vehicle is running slowly because batteries are heavily discharged, he has made an improper diagnosis of the problem.

The vehicle speed controller should be checked for fault codes before any service is performed.

The speed controller, after detecting a fault, will respond in one or more of the following ways:

- A. Reduce vehicle speed to zero by reducing armature current
- B. Reduce vehicle speed to zero by reducing field current to zero
- C. Turn off the solenoid
- D. Cause the vehicle to run at half speed
- E. Gradually reduce the armature current limit
- F. Quickly reduce the armature current until speed sensor pulses occur
- G. Reduce field current and beep reverse buzzer at a fast rate

CONTROLLER FAULT	CONTROLLER RESPONSE
HW FAILSAFE	A, B, C
KEY SWITCH SRO	C
THROTTLE FAULT 1	A
SPEED SENSOR	D
MAIN WELDED	D
MAIN DRIVER ON	D
MAIN DRIVER OFF	A, C
HIGH SPEED WALKAWAY	D
MAIN COIL FAULT	A
FIELD MISSING	A, B, C
HPD	A
PROC/WIRING	A
OVERVOLTAGE	A, B, G
LOW BATTERY	E
THERMAL CUTBACK	E
MOTOR STALL	F
MAIN DROPOUT	A, C
OPEN ARMATURE	A
MAX PASSWORD TRIES	(no action taken)
INCORRECT PASSWORD	(no action taken)

Fault Recovery

When a fault is detected by the speed controller, the speed controller will attempt to recover from the fault and resume normal operation. In the case of an intermittent problem such as a loose wiring connection, the controller **may** be able to recover and operate normally for a while, but the problem should be repaired before placing the vehicle in service.

Depending on the type of fault, the controller will attempt to recover immediately after the condition clears or after the accelerator pedal has been cycled (released and pressed again).

CONTROLLER FAULT	CONTROLLER FAULT CODE	CONTROLLER ATTEMPTS TO RECOVER
HW FAILSAFE	24	When key switch is cycled
KEY SWITCH SRO	3	When key switch is cycled
THROTTLE FAULT 1	28	When condition clears
SPEED SENSOR	18	When condition clears
MAIN WELDED	8	When condition clears
MAIN DRIVER ON	15	When condition clears
MAIN DRIVER OFF	14	When accel. pedal is cycled
HIGH SPEED WALKAWAY	5	When Tow/Run switch is cycled or a charge cycle is completed
MAIN COIL FAULT	13	When accel. pedal is cycled
FIELD MISSING	26	When accel. pedal is cycled
HPD	4	When accel. pedal is cycled
PROC/WIRING	30	When condition clears
OVERVOLTAGE	9	When condition clears
LOW BATTERY VOLTAGE	25	When condition clears
THERMAL CUTBACK	2	When condition clears
MOTOR STALL	20	When condition clears
MAIN DROPOUT	11	When accel. pedal is cycled
OPEN ARMATURE	23	When condition clears and accel. pedal is cycled
MAX PASSWORD TRIES	7	When Tow/Run switch is cycled
INCORRECT PASSWORD	6	When Tow/Run switch is cycled

The following faults can be detected by the IQ System controller:

HW FAILSAFE

The armature drive FET's (field effect transistors) regulate the armature current. If the speed controller detects a failure of the armature drive FET's or circuitry, a *hardware failsafe* fault is detected.

KEY SWITCH SRO (STATIC RETURN TO OFF)

The controller detects a *key switch sro fault* and the vehicle will be disabled when the controller is powered up with the key switch on and after any of the following events have occured: 1. the run/tow switch had been placed in the tow position, 2. the DC plug of the charger had been plugged into the vehicle, 3. the battery set had been disconnected or 4.

if the vehicle had gone into sleep mode and the accelerator was pressed while the key switch was switched on. The *key switch sro fault detect is by default disabled but can be enabled via the program menu KSI SRO ENABLE parameter.*

THROTTLE FAULT 1

If the throttle position sensor or MCOR (Motor Controller Output Regulator) voltage is less than 0.20 volts or greater than 4.80 volts, the controller detects a *throttle fault 1 fault*.

SPEED SENSOR

If the speed controller does not detect pulses from the speed sensor while the controller outputs power (greater than 75% armature PWM) to the motor, a *speed sensor* fault is detected.

MAIN WELDED

If the speed controller detects that the solenoid contacts are welded closed, a *main welded* fault is detected.

MAIN DRIVER ON

If the FET that controls the closing of the solenoid contacts is found to be energized when it should not be, a *main driver on* fault is detected by the speed controller.

MAIN DRIVER OFF

If the FET that controls the closing of the solenoid is **not** energized when it should be, a *main driver off* fault is detected by the speed controller.

HIGH SPEED WALKAWAY

If the key switch is turned off or the Forward/Reverse (F&R) switch is placed in neutral while the vehicle is being driven downhill at full speed for more than 8 seconds, the controller detects a *high speed walkaway fault*.

MAIN COIL FAULT

If the speed controller determines that the solenoid is not closing as a result of a solenoid coil failure, a *main coil fault* is detected.

FIELD MISSING

If the speed controller is operating at a duty cycle of greater than 90% (almost full speed) and the field current is less than 3 amps, a *field missing* fault is detected by the speed controller.

HPD

The *HPD* (High Pedal Detect) fault is detected if the accelerator pedal is already depressed when the key switch is turned to the ON position. This fault is also detected if the accelerator pedal is pressed when the selected direction is changed by pressing the Forward/Reverse switch. This fault, when not caused by the operator, can indicate that the pedal limit switch has failed closed.

PROC/WIRING

This fault is detected if the Forward/Reverse switch is giving a signal to place the controller in forward and reverse at the same time. This rare fault can be caused by a failed Forward/Reverse switch or improper vehicle wiring.

OVERVOLTAGE

If the speed controller detects that the battery voltage is too high (68.4 to 75.6 volts DC), the *overvoltage* fault is detected.

LOW BATTERY VOLTAGE

If the battery voltage falls below 34 volts ±5%, the *low battery voltage* fault is detected by the speed controller.

THERMAL CUTBACK

If the controller heatsink temperature is found to be in excess of 85 °C ±5 °C (185 °F ±9 °F) or below –25 °C ±5 °C (–13 °F ±9 °F), the *thermal cutback* fault is detected.

MOTOR STALL

If the motor current is high and there is no movement of the vehicle wheels for a short period of time, a *motor stall* is detected by the speed controller. This fault can be caused by an operator holding the vehicle on a hill by depressing the accelerator pedal instead of the brake pedal.

MAIN DROPOUT

If the controller detects that the solenoid contacts have opened while the vehicle is in operation, a *main dropout* fault is detected.

OPEN ARMATURE

If the accelerator pedal is pressed 2/3 to the floor, the armature current is less than 20 amps, and there are no speed sensor pulses, an *open armature* fault is detected.

INCORRECT PASSWORD (IQDM-P ONLY)

Each vehicle has a password in the form of a unique set of codes used to place the vehicle in “private speed mode”. If a set of codes has been entered incorrectly, the *incorrect password* fault is declared. For additional information on codes, refer to Code A, Code B, and Code C. **See Code A, Code B, and Code C on page 22-3. See also Password Tries (IQDM-P only) on page 15-6.**

MAX PASSWORD TRIES (IQDM-P ONLY)

The *max password tries* fault is declared when the incorrect password fault has been declared several times. In the event that the *max password tries* fault is indicated, the speed controller must be removed and shipped to Club Car before it can ever be placed in “private speed mode”. **See Code A, Code B, and Code C on page 22-3. See also Password Tries (IQDM-P only) on page 15-6.**

FAULT HISTORY

The *fault history* menu can be useful in determining the cause of a vehicle problem; however, the fault history alone should not be the factor that determines when a component is replaced. Some faults detected by the speed controller are not the result of a failed component, and are instead the result of vehicle operator error. If a fault appears in the *fault history* menu, the trained technician should attempt to determine when and where the fault has occurred. For example, if the *motor stall* fault is present in the fault history, the trained technician may be able to determine the location on the course where an operator has held the vehicle on a hill by using the accelerator pedal.

CLEARING FAULT HISTORY

After a repair has been made, the fault history should be cleared. This will enable the trained technician to properly troubleshoot the vehicle in the future, in the event that another problem occurs. It is recommended that the fault history be cleared in order to avoid the replacement of a component that caused a fault in the past, but has been replaced and is now functioning correctly. For example, if the throttle position sensor or MCOR (Motor Controller Output Regulator) was disconnected and the speed controller detected a fault code associated with the throttle, the fault history should be cleared so that any future problem is not diagnosed incorrectly as a throttle problem. **See Clear Fault History on page 15-17.**

FUNCTIONS MENU

The *functions* menu is accessed by using the up or down arrow to scroll to *functions* and pressing the right arrow key to activate the menu.

GET SETTINGS FROM CONTROLLER

This function transfers all of the speed controller settings (except for “private speed mode”) from the vehicle speed controller to the handset. This enables the trained technician to “clone” a speed controller. Once the speed controller settings have been transferred to the handset, the technician can then connect the handset to another vehicle and transfer the stored settings into the speed controller.

Speed Controller Cloning – Transferring Settings from the Vehicle to the Handset

1. Locate a vehicle that has the desired speed controller settings.
2. Turn the key switch to the OFF position, place the Forward/Reverse handle in the NEUTRAL position, and lock the park brake.
3. Plug the handset into the vehicle.
   3.1. onnect one end of the cable to the port located on the bottom of the handset.
   3.2. Connect the cable adaptor to the IQDM cable.
   3.3. Remove the dust cap from the IQDM port.
   3.4. Align the keyed portion of the plug with the IQDM port and connect the plug to the port **(Figure 15-1, Page 15-2)**.
4. Scroll to the *functions* menu and select.
5. Select *settings*.
6. Select *get settings from controller*.
7. Press + on the change value button to confirm the operation.
8. The handset will display an “executing...” message for the next few seconds while the controller settings are being stored in the handset’s memory **(Figure 15-3, Page 15-14)**.
9. When the handset is finished recording the speed controller settings, a confirmation message is displayed **(Figure 15-4, Page 15-14)**.
10. With the controller settings stored in the memory of the handset, the handset can be used to transfer all of the desired speed controller settings to any IQ System vehicle or group of IQ System vehicles. **See Speed Controller Cloning – Transferring Settings from the Handset to the Vehicle on page 15-14.**

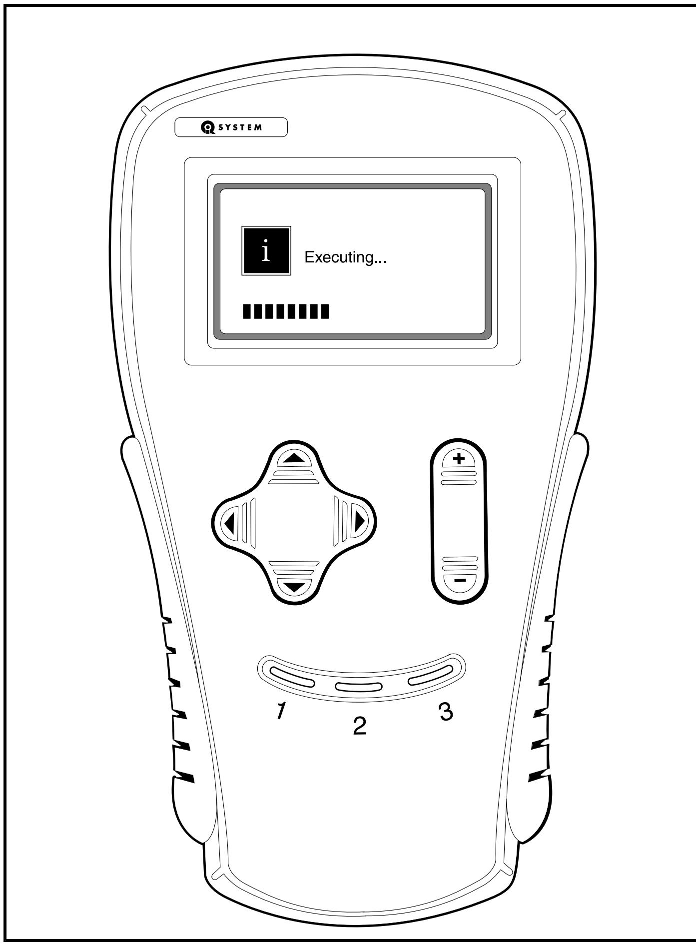

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Figure 15-3 Handset Executing

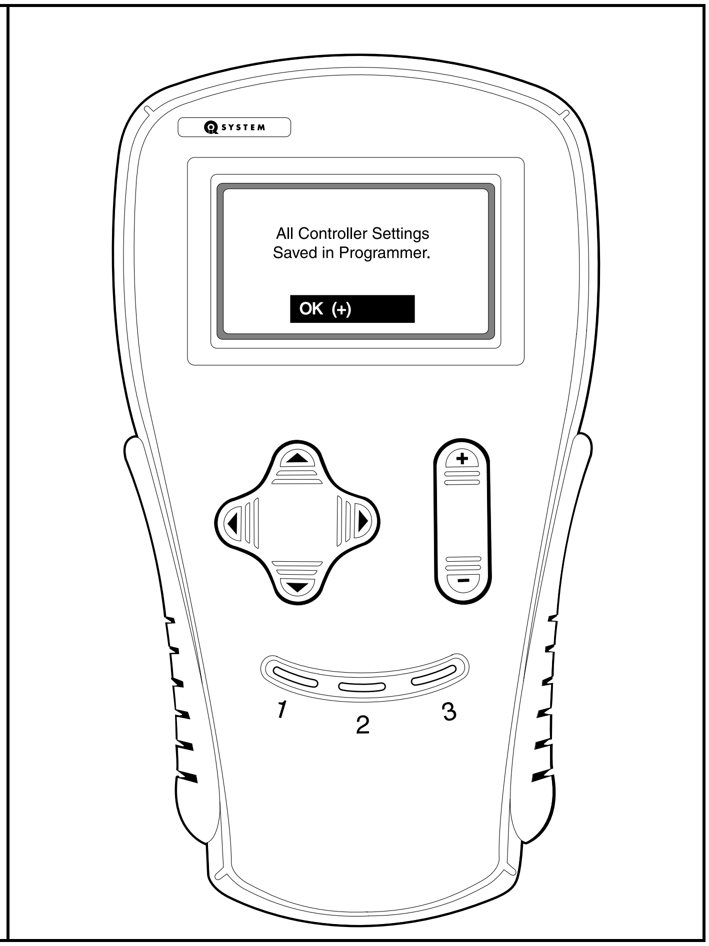

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Figure 15-4 Confirmation Message

WRITE SETTINGS TO CONTROLLER

This function transfers all of the speed controller settings (except for “private speed mode”) from the handset to the vehicle speed controller. This enables the trained technician to “clone” a speed controller. Once the speed controller settings have been transferred to the handset, the technician can then connect the handset to another vehicle and transfer the stored settings into the speed controller.

Speed Controller Cloning – Transferring Settings from the Handset to the Vehicle

1. Perform this procedure with a handset that has the desired speed controller settings. **See Speed Controller Cloning – Transferring Settings from the Vehicle to the Handset on page 15-13.**
2. Locate a vehicle that does **not** have the desired speed controller settings.
3. Turn the key switch to the OFF position, place the Forward/Reverse handle in the NEUTRAL position, and lock the park brake.
4. Plug the handset into the vehicle.
    - 4.1. Connect one end of the cable to the port located on the bottom of the handset.
    - 4.2. Connect the cable adaptor to the IQDM cable.
    - 4.3. Remove the dust cap from the IQDM port.
    - 4.4. Align the keyed portion of the plug with the IQDM port and connect the plug to the port **(Figure 15-1, Page 15-2)**.
5. Scroll to the *functions* menu and select.
6. Select *settings*.

7. Select *write settings to controller*.
8. Press + on the change value button to confirm the operation.
9. The handset will display an “executing...” message for the next few seconds while the controller settings are being stored in the handset’s memory **(Figure 15-3, Page 15-14)**.
10. When the handset is finished transferring the speed controller settings, a confirmation message is displayed **(Figure 15-5, Page 15-15)**.
11. Repeat this procedure for additional vehicles that need to be programmed with the same handset settings.

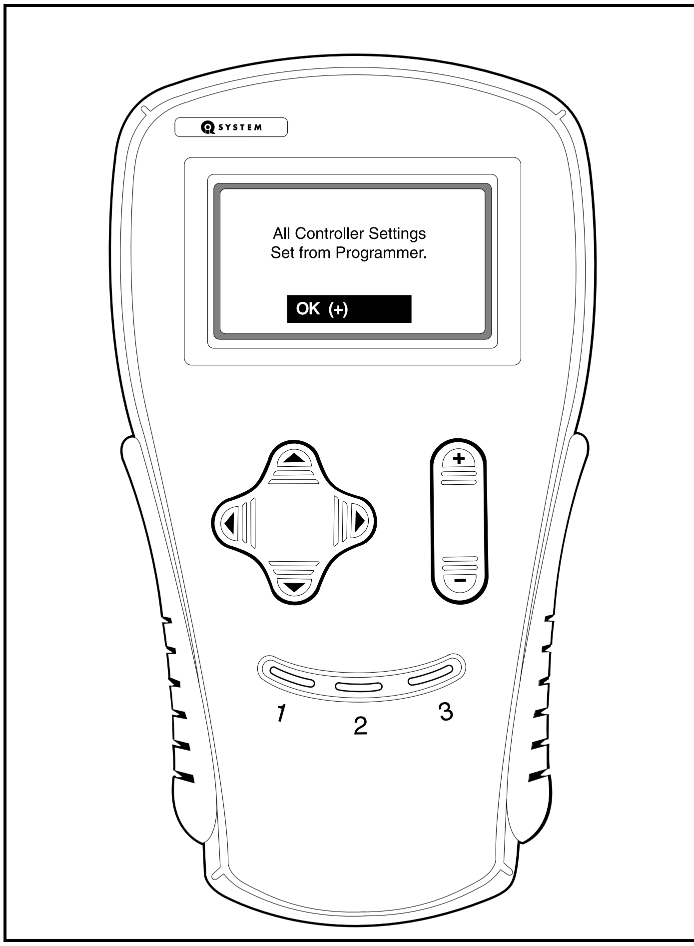

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Figure 15-5 Confirmation Message

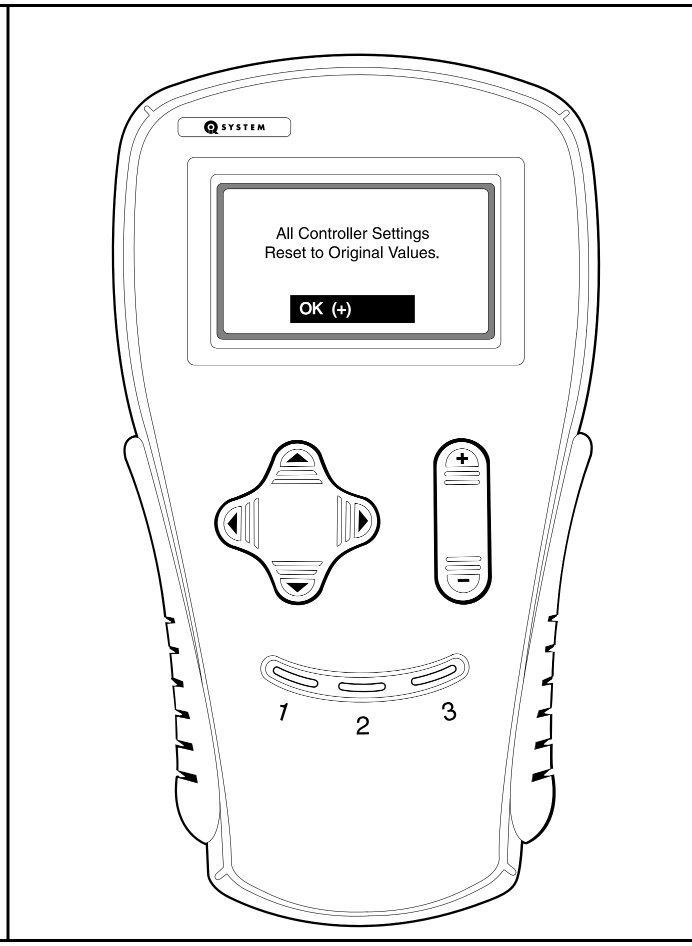

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Figure 15-6 Confirmation Message

RESET ALL SETTINGS

In the event that a mistake was made and one or more changes should not have been made with the handset, the speed controller settings can be reverted to the original settings from the beginning of the session (when the handset was plugged into the vehicle). This function is similar to the “undo” command on a PC and will work correctly only when the handset has **not** been unplugged and power to the speed controller has **not** been interrupted.

Resetting All Settings

1. During an active session when the settings need to be returned to the original values (the values that were active at the beginning of the session), scroll to the *functions* menu and select.
2. Select *settings*.
3. Select *reset all settings*.
4. Press + on the change value button to confirm the operation.

5. The handset will display an “executing...” message for the next few seconds while the controller settings are being stored in the handset’s memory **(Figure 15-3, Page 15-14)**.
6. When the handset is finished resetting the speed controller settings, a confirmation message is displayed **(Figure 15-6, Page 15-15)**.

INFORMATION

The *information* menu is accessed by using the up or down arrow to scroll to *information* and pressing the right arrow key to activate the menu.

This menu selection displays information pertaining to the speed controller. The information provided from this menu selection includes:

MODEL NUMBER

Displays the model number of the speed controller.

SERIAL NUMBER

Displays the serial number of the speed controller.

MFG DATE

Displays the date the speed controller was manufactured.

SOFTWARE VERSION

Displays the speed controller software version.

PROGRAMMER SETUP

The *programmer setup* menu selection allows the user to set the LCD display contrast, records the fault history of the handset, and displays information pertaining to the handset.

PROGRAM

This menu allows the user to adjust the contrast on the display screen. After selecting the *LCD–Contrast* menu, use the change value buttons to adjust the contrast for the best readability.

FAULTS

This menu selection displays faults that have been detected within the handset. This *faults* menu does not pertain to any faults detected in the speed controller.
The following faults can be detected within the handset:

CODE NUMBER	TEXT DISPLAYED
9	Timeout error detect-no response from controller
14	Communication error with controller
15	Error in handset
16	Handset does not support this function
17	Serial port overrun error
18	Security lockout on program menu

Fault History

This menu displays any faults that have been detected within the handset itself.

Clear Fault History

The *clear fault history* function will erase the history of faults that are stored in the handset.

INFORMATION

This menu selection displays information pertaining to the handset. The information provided in this menu selection includes model number, serial number, the date the handset was manufactured, the handset software version, etc.

IQDM AND IQDM-P HANDSET TROUBLESHOOTING

In the event that the handset does not function as described in this manual, the following troubleshooting guide should be studied and the referenced test procedures should be performed to troubleshoot the handset.

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Handset display screen is blank	Handset cord and/or adaptor is disconnected	**See Plugging the Handset into the Vehicle on page 15-1.**
	Vehicle batteries – loose terminals or corrosion	See Section 18 – Batteries. .
	Vehicle batteries – improperly wired	See Section 18 – Batteries. .
	Vehicle batteries – batteries failed	See Section 18 – Batteries. .
	Vehicle batteries – batteries not fully charged	See Section 18 – Batteries. .
	Handset cord has failed	Test Procedure 1 – Handset Cord on page 15-19
	Handset cord adaptor has failed	Test Procedure 2 – Handset Cord Adaptor on page 15-19
	IQDM port (mounted under instrument panel assembly) has failed	Test Procedure 3 – IQDM Ports on page 15-20
	Contrast Setting is too light	**See Program on page 15-17.**.
	Onboard computer is in power-down mode	Drive the vehicle for a short distance and reconnect the handset to the vehicle.
	Onboard computer malfunction	See Section 11 – IQ System Troubleshooting – TPS. .
	Loose vehicle wire harness connections	Test Procedure 3 – IQDM Ports on page 15-20
	Speed controller malfunction	See Section 11 – IQ System Troubleshooting – TPS. .
	Handset has failed	Replace handset
Display screen shows jumbled or undecipherable characters	Speed controller malfunction	See Section 11 – IQ System Troubleshooting – TPS. .
	Handset malfunction	Disconnect the IQDM cord from the vehicle. Wait a few seconds and reconnect the handset to the vehicle
	Loose connection at IQDM port	Test Procedure 3 – IQDM Ports on page 15-20
	Intermittent handset cord failure	Test Procedure 1 – Handset Cord on page 15-19
	Intermittent handset cord adaptor failure	Test Procedure 2 – Handset Cord Adaptor on page 15-19
	Loose vehicle wire harness connections	Test Procedure 3 – IQDM Ports on page 15-20

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Handset is “locked-up” – buttons do not respond	Handset malfunction	Disconnect the IQDM cord from the vehicle. Wait a few seconds and reconnect the handset to the vehicle
	Vehicle batteries – loose terminals or corrosion	See Section 18 – Batteries. .
	Vehicle batteries – improperly wired	See Section 18 – Batteries. .
	Vehicle batteries – batteries failed	See Section 18 – Batteries. .
	Vehicle batteries – batteries not fully charged	See Section 18 – Batteries. .
	Speed controller malfunction	See Section 11 – IQ System Troubleshooting – TPS. .

TEST PROCEDURES

The following test procedures enable the technician to test the IQDM and IQDM-P handsets and the components of the IQ System vehicle that are related to the proper operation of the handset.

⚠ WARNING

- **If wires are removed or replaced, make sure wiring and wire harness is properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.**

Index of Test Procedures

1 – Handset Cord
2 – Handset Cord Adaptor
3 – IQDM Ports

TEST PROCEDURE 1 – Handset Cord

See General Warnings on page 1-1.

1. Using a multimeter set for 200 ohms, place the red (+) probe into one of the terminals on the end of the cord with the square plug.
2. Place the black (–) probe on each of the pins, one at a time, on the plug on the other end of the cord.
3. The multimeter should indicate continuity on only one pin. If any other reading is obtained, the cord must be replaced.
4. Repeat the procedure three more times, each time with the red (+) probe inserted into a different terminal on the end of the cord with the square plug.

TEST PROCEDURE 2 – Handset Cord Adaptor

See General Warnings on page 1-1.

The procedure for testing the handset cord adaptor is similar to the cord test.

1. Using a multimeter set for 200 ohms, place the red (+) probe into one of the terminals on the end of the adapter with the square plug.

2. Place the black (–) probe on each of the pins, one at a time, on the other plug of the adaptor.
3. The multimeter should indicate continuity on only one pin. If any other reading is obtained, the adaptor must be replaced.
4. Repeat the procedure three more times, each time with the red (+) probe inserted into a different terminal on the end of the adaptor with the square plug.

TEST PROCEDURE 3 – IQDM Ports

Inspect the IQDM ports for damage or corrosion.

IQDM PORT (LOCATED UNDER INSTRUMENT PANEL)

See General Warnings on page 1-1.

1. Turn the key switch to the OFF position, place the Forward/Reverse rocker switch in the NEUTRAL position, and lock the park brake.
2. Place the Tow/Run switch in the TOW position, disconnect the batteries, negative (–) cable first, and wait 90 seconds for the speed controller capacitors to discharge. **See General Warnings on page 1-1.**
3. Check the IQDM port mounted under the instrument panel.
   3.1. Remove the three screws (1) that secure the instrument panel assembly (2) to the dash assembly (3) **(Figure 15-7, Page 15-20)**.

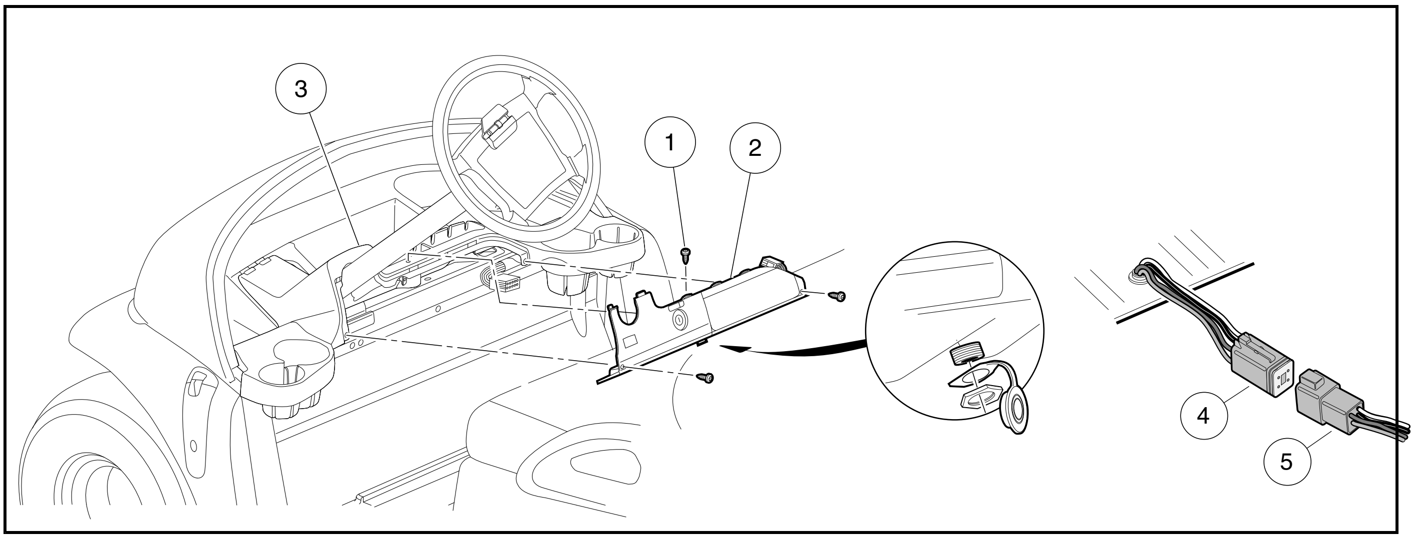

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Figure 15-7 Instrument Panel Assembly Removal and IQDM Port Connection

   3.2. Disconnect the four-pin connectors (4 and 5) and visually inspect the contacts for damage and corrosion. Inspect the IQDM port, mounted under the instrument panel assembly (2). Repair and replace parts as necessary.
   3.3. If no problem is found, connect the four-pin connectors and install the instrument panel assembly.
   3.4. Install the three screws (1) that secure the instrument panel assembly (2) to the dash assembly (3) **(Figure 15-7, Page 15-20)**.
4. Check the IQDM port on the speed controller.
   4.1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
   4.2. Remove electronics module cover. **See Electronics Module Cover on page 17-5.**.
   4.3. Connect IQDM to controller

4.3.1. Disconnect the square four-pin connector (3) from the speed controller.

4.3.2. Connect the handset cord to the handset.

4.3.3. Connect the other end of the handset cord (without the adapter) (4) to the four-pin connector of the speed controller (2) **(Figure 15-8, Page 15-21)**.

4.3.4. Connect the vehicle batteries, positive (+) cable first.

4.3.5. If the handset functions when connected directly to the speed controller, the adapter plug or vehicle wire harness should be thoroughly tested. **See Test Procedure 2 – Handset Cord Adaptor on page 15-19.** See Section 11 – IQ System Troubleshooting – TPS.

4.4. Replace electronics module cover. **See Electronics Module Cover Installation on page 17-5.**

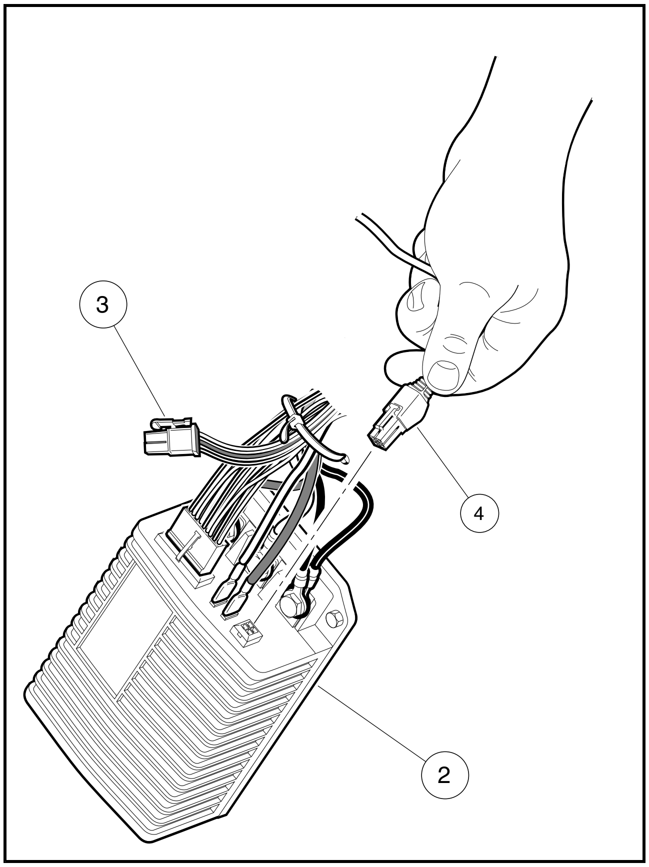

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Figure 15-8 IQDM Connector On Speed Controller

SECTION 16 – IQ DISPLAY MODULE (IQDM) AND IQDM-P DIAGNOSTICS: EXCEL SYSTEM

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

NOTE: *For information specific to the IQDM-P handset programming features,* ***see IQ Display Module Programmer (IQDM-P): Excel System on page 23-1.***

The information presented in this section addresses the series 2 versions of the IQDM-P and IQDM handsets. IQDM series 1 and IQDM-P series 1 handsets are not compatible with the Excel System. ***See Figure 16-2, Page 16-1.***

This manual spans several model years and software releases ranging from version 10 to version 14 (as of early 2011 model year). The software version can be viewed in the Information menu of the IQDM. ***See Information on page 16-17.***

PLUGGING THE HANDSET INTO THE VEHICLE

1. Connect one end of the cable to the port located on the bottom of the handset.
2. Connect the cable adaptor to the IQDM cable.
3. Find the IQDM port on the vehicle **(Figure 16-1, Page 16-1)**.
4. Remove the dust cap from the IQDM port.
5. Align the keyed portion of the plug with the IQDM port and connect the plug to the port.

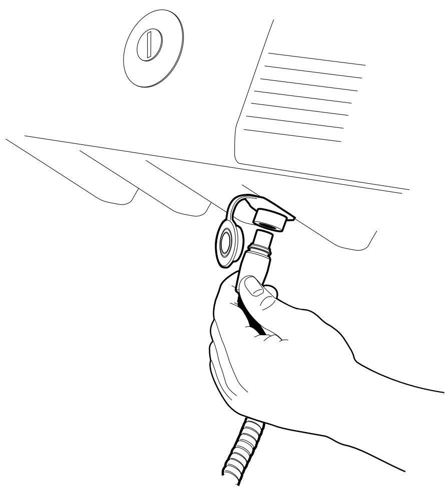

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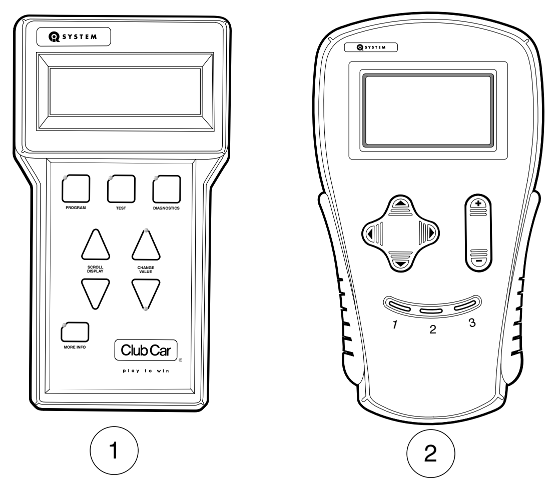
Figure 16-1   IQDM Port Under Instrument Panel



1. IQDM Series 1 (can not be used with Excel System)
2. IQDM Series 2

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Figure 16-2   IQDM Versions

INTRODUCTORY DISPLAY

Immediately after the handset is connected to the vehicle, it begins loading the vehicle speed controller information. After a few seconds, the screen displays the following menu items:

- Program (IQDM-P only)
- Monitor
- Faults
- Functions
- Information
- Programmer Setup

In the event that the handset does not display any information, or the screen is difficult to read, refer to the IQDM troubleshooting procedures. **See IQDM and IQDM-P Handset Troubleshooting on page 16-19.**

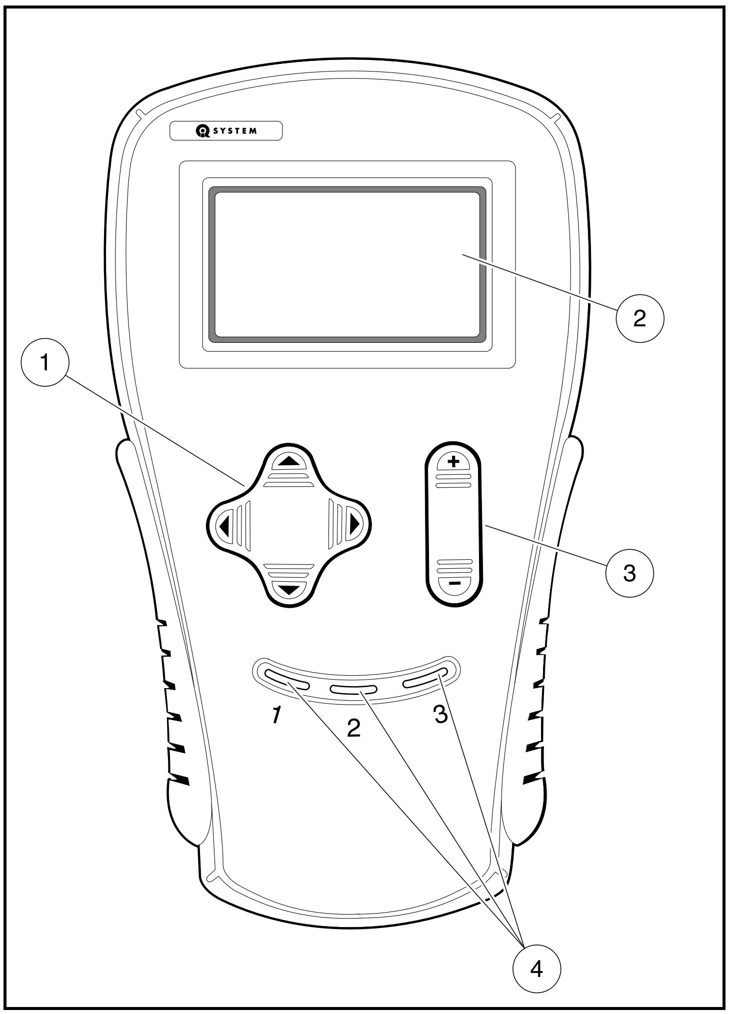

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Figure 16-3 Handset Controls

MENU NAVIGATION

The NAVIGATION BUTTON (1) is the four-arrow button located on the left side of the handset **(Figure 16-3, Page 16-2)**. This button is used to navigate through and select menus. Pressing the up or down arrows allows the user to scroll through the menu items. When the box beside the desired menu is blinking, pressing the right arrow selects that menu item. Pressing the left arrow allows the user to go back one screen (2).

The CHANGE VALUE BUTTON (3) is the button located on the right side of the handset **(Figure 16-3, Page 16-2)**. This button allows the user to change values by pressing + or –.

The three yellow buttons labeled 1, 2 and 3 are BOOKMARK BUTTONS (4) **(Figure 16-3, Page 16-2)**. These buttons allow the user to bookmark up to three specific screens for rapid return to those screens. To bookmark a specific display screen, have the desired screen displayed and simply press and hold a bookmark button until the statement “bookmark set” is displayed. When it is necessary to go back to the bookmarked screen, rapidly press and release the appropriate bookmark button. **See following NOTE.**

NOTE: *When going to a bookmarked display screen, be sure to rapidly press and release the button. If the button is pressed and held for too long, the bookmark will be overridden with the current screen.*

The three yellow buttons also allow for quicker input of serial number and car decal number. Press and hold “+” or “-” while holding buttons 1, 2 or 3 to accelerate a number search.

The following menus are accessible on the IQDM handset:

PROGRAM (IQDM-P ONLY)

The *program* menu allows the user to view and change custom speed controller settings. **See Program Menu on page 23-2.**

MONITOR

The *monitor* menu displays values for certain parameters to facilitate speed controller troubleshooting. **See Monitor Menu on page 16-4.**

FAULTS

The *faults* menu displays all faults recorded by the speed controller since the history was last cleared. Each fault is listed only once, even if the fault has occurred multiple times. **See Faults Menu on page 16-8.**

FUNCTIONS

The *functions* menu allows the user to transfer all current settings from the speed controller to the handset and from the handset to the speed controller. **See Functions Menu on page 16-14.**

INFORMATION

The *information* menu displays the model number, serial number, manufacturer date and software version of the speed controller. **See Information on page 16-17.**

PROGRAMMER SETUP

The *programmer setup* menu allows the user to set the LCD contrast, display the fault history of the programmer as well as various other information pertaining to the handset such as model number, serial number, OEM information, etc. **See Programmer Setup on page 16-18.**

MONITOR MENU

The *monitor* menu is accessed by using the up or down arrow to scroll to *monitor* and pressing the right arrow key to activate the menu. All information in the *monitor* menu is updated in real time, allowing the trained technician to troubleshoot the vehicle by monitoring the handset as the key switch is cycled, Forward/Reverse switch is activated, etc. **See following NOTE.**

NOTE: *Values appearing in these menus represent approximate measurements made by the controller and may differ from measurements made by external instruments.*

Since the *monitor* menu is updated while the vehicle is in operation, the trained technician has the ability to monitor the status of several components in conditions or locations where a problem with vehicle performance has been reported. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the handset while the vehicle is in motion. A technician can monitor the handset while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

The following parameters can be monitored in real time with the handset from the *monitor* menu:

SPEED

Vehicle speed in mph. Only visible with the IQDM-P.

THROTTLE

Indicates the position of the accelerator pedal from 0% (pedal not pressed) to 95 - 100% (pedal fully pressed). This item can be monitored when the key switch is in the ON or OFF position.

BATT AUX VOLTAGE

Displays the current battery voltage at the speed controller.

TEMPERATURE (SAME AS HEATSINK IN IQ SYSTEM)

Displays the temperature (in degrees Celsius) of the speed controller heatsink. During normal operating conditions, the heatsink temperature should be below 85 °C ±5 °C (185 °F ±9 °F). **See following NOTE.**

NOTE: *Anything that adds resistance (i.e. improper brake adjustment, low air pressure in tires, low battery voltage, etc.) can cause the operating current to be higher than normal. This higher current increases the temperature of the speed controller heatsink.*

ARM CURRENT

Displays the motor armature current (in amperes).

FIELD CURRENT

Displays the motor field current (in amperes).

ARMATURE PWM

Displays motor armature PWM (pulse width modulation). The range of pulse width modulation is 0% to 100%. When the vehicle is operating at full speed, the pulse width modulation should be at 100%.

FIELD PWM

Displays motor field PWM (pulse width modulation). The range of pulse width modulation is 0% to 100%. When the vehicle is in operation, the pulse width modulation will fluctuate in response to the terrain and throttle input.

BRAKE VOLTS IN

This menu is reserved for possible future use and has no application at this time.

SPEED PULSES

The *speed pulses* menu item displays the activity of the motor speed sensor. With the key switch in the OFF position, the Forward/Reverse switch in the NEUTRAL position, and the vehicle at rest, the handset should indicate that speed pulses are off. When the vehicle is gently pushed a short distance, the handset should indicate that speed pulses are on.

FOOT INPUT

Indicates the status of the throttle position sensor or MCOR (Motor Controller Output Regulator) internal limit switch: on or off. When the accelerator pedal is unpressed, the handset should indicate that the limit switch is off. When the accelerator pedal is pressed and the key switch is in the ON position, the display should indicate that the limit switch is on.

KEY INPUT

Displays the position of the key switch: OFF or ON.

FORWARD INPUT

With the Forward/Reverse switch in the NEUTRAL or REVERSE position, the handset should indicate that the forward input is off. When the Forward/Reverse switch is placed in the FORWARD position, the handset should indicate that the forward input is on.

REVERSE INPUT

With the Forward/Reverse switch in the NEUTRAL or FORWARD position, the handset should indicate that the reverse input is off. When the Forward/Reverse switch is placed in the REVERSE position, the handset should indicate that the reverse input is on.

CHARGER INHIBIT

Displays charger connection. When the controller energizes the solenoid coil, the handset indicates ON. When the controller de-energizes the solenoid coil, the handset indicates OFF.

MAIN CONT DRIVER

Displays the present solenoid (main contactor) state. When the charger is connected and the controller does not drive (inhibited), the handset indicates ON. When the charger is not connected and the controller is allowed to drive, the handset indicates OFF.

PASSWORD TRIES (IQDM-P ONLY)

A password is required to place the vehicle in “private speed mode” (speed setting 4). The speed controller will log unsuccessful and unauthorized attempts to place the speed controller in “private speed mode”. If repeated attempts are unsuccessful, the speed controller will permanently lock out access to “private speed mode”. In the event that “private speed mode” is locked out, the controller must be removed and shipped to Club Car before it can ever be placed in “private speed mode”. **See Code A, Code B, and Code C on page 23-4.**

ODOMETER

Displays approximate distance travelled in miles.

VEHICLE SPEEDS (IQDM-P ONLY)

Press right arrow to display programmed speeds for each speed setting. **See Code A, Code B, and Code C on page 23-4.**

PEDAL COUNTERS

Accumulates accelerator pedal usage.

FAULT COUNTERS

The Fault Counters indicate how many times each fault type has been recorded since the last clearing of fault history. **See following Faults Menu section.**

FAULT COUNT ODOMETERS

The Fault Count Odometers indicate the odometer reading associated with the last occurrence of each fault type. Will indicate 0.0 (miles) if the fault occurred before the last clearing of fault history.

NEG IA 250

Displays how many, or the last time, the armature current reached 250 amps during regenerative braking (version 13 or newer software).

NEG IA 300

Displays how many, or the last time, the armature current reached 300 amps during regenerative braking (version 13 or newer software).

FAULTS MENU

CAUTION

- **A failed motor will damage the controller. Always inspect the motor before replacing the controller.**

NOTE: *The software is subject to frequent updates, and this manual spans many versions. Be aware that some faults listed in this manual may not display in the IQDM, indicating older software.*

The *faults* menu is accessed by using the up or down arrow to scroll to *faults* and pressing the right arrow key to activate the menu.

Faults displayed in the *faults* menu will aid the trained technician in troubleshooting the vehicle. Faults displayed often indicate which components in the electrical system need to be tested.

Since the *faults* menu is updated while the vehicle is in operation, the trained technician has the ability to monitor the occurrence of faults in conditions or locations where a problem with vehicle performance has been reported. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the handset while the vehicle is in motion. A technician can monitor the handset while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

SYSTEM FAULTS

The *system faults* menu displays all of the faults detected by the speed controller since the last time the fault history has been cleared. The faults displayed in this menu may or may not be currently active. Once a fault has been detected, it is stored in the memory of the speed controller for display on the *fault history* menu. Each detected fault is listed only once, even if the fault has occurred multiple times.

Causes of Faults

Some common causes of faults are:

- Loose, broken, or disconnected wires or connectors
- Failed components
- Improper adjustment or installation of electrical or mechanical components (examples: brake adjustment, improper throttle position sensor or MCOR installation)
- Improper wiring of electrical components

As shown above, there are many possible causes for faults to occur, and the speed controller has a programmed reaction to each fault that is based on the fault currently detected. The technician should be familiar with the detected faults and the controller’s reactions to faults to ensure a proper diagnosis.

An example of a possible mis-diagnosis of a vehicle due to a fault: If the three-pin speed sensor wire has been disconnected, the speed controller will detect a *speed sensor* fault. When a *speed sensor* fault is detected, the controller responds to the fault by limiting the vehicle speed to 1/2 of its normal top speed. If the technician reaches the conclusion that the vehicle is running slowly because batteries are heavily discharged, he has made an improper diagnosis of the problem.

The vehicle speed controller should be checked for fault codes before any service is performed.

The speed controller, after detecting a fault, will respond in one or more of the following ways:

- A. Reduce vehicle speed to zero by reducing armature current
- B. Reduce vehicle speed to zero by reducing field current to zero
- C. Turn off the solenoid
- D. Cause the vehicle to run at half speed
- E. Gradually reduce the armature current limit
- F. Quickly reduce the armature current until speed sensor pulses occur
- G. Reduce field current and beep reverse buzzer at a fast rate

CONTROLLER FAULT	CONTROLLER RESPONSE
HW FAILSAFE	A, B, C
THROTTLE FAULT	A
SPEED SENSOR	D
MAIN WELDED	D
MAIN DRIVER ON	D
MAIN DRIVER OFF	A, C
MAIN COIL OPEN	A
FIELD MISSING	A, B, C
HPD	A
OVERVOLTAGE	A, B, G
LOW BATTERY	E
THERMAL CUTBACK	E
MOTOR STALL	F
MAIN DROPOUT (1 and 2)	A, C
MAX PASSWORD TRIES	(no action taken)
INCORRECT PASSWORD	(no action taken)
BLD OVERCURRENT	Not Applicable At This Time
MAIN DRIVER OVERCURRENT	A, B
CURRENT SENSE FAULT	A, B
M– SHORTED	A, B, C

Fault Recovery

When a fault is detected by the speed controller, the speed controller will attempt to recover from the fault and resume normal operation. In the case of an intermittent problem such as a loose wiring connection, the controller **may** be able to recover and operate normally for a while, but the problem should be repaired before placing the vehicle in service.

Depending on the type of fault, the controller will attempt to recover immediately after the condition clears or after the accelerator pedal has been cycled (released and pressed again).

CONTROLLER FAULT	CONTROLLER ATTEMPTS TO RECOVER
HW FAILSAFE	When key switch is cycled
THROTTLE FAULT	When condition clears
SPEED SENSOR	When condition clears
MAIN WELDED	When condition clears
MAIN DRIVER ON	When condition clears
MAIN DRIVER OFF	When accel. pedal is cycled
MAIN COIL OPEN	When accel. pedal is cycled
FIELD MISSING	When accel. pedal is cycled
HPD	When accel. pedal is cycled
OVERVOLTAGE	When condition clears
LOW BATTERY VOLTAGE	When condition clears
THERMAL CUTBACK	When condition clears
MOTOR STALL	When condition clears
MAIN DROPOUT (1 and 2)	When accel. pedal is cycled
MAX PASSWORD TRIES	When Tow/Run switch is cycled
INCORRECT PASSWORD	When Tow/Run switch is cycled
BLD OVERCURRENT	Not applicable at this time
MAIN DRIVER OVERCURRENT	When condition clears
CURRENT SENSE FAULT	Within controller
M– SHORTED	When key switch is cycled

The following faults can be detected by the Excel System controller:

HW FAILSAFE

The armature drive FET's (field effect transistors) regulate the armature current. If the speed controller detects a failure of the armature drive FET's or circuitry, a *hardware failsafe* fault is detected.
What it means: A catastrophic failure internal to the controller on either the power board or the logic board.
What to do: Replace controller.

THROTTLE FAULT

If the throttle position sensor or MCOR (Motor Controller Output Regulator) voltage is less than 0.20 volts or greater than 4.80 volts, the controller detects a *throttle fault*.

What it means: If the voltage seen by the controller coming out of the MCOR is not within specified limits, this fault occurs.
What to do: Replace MCOR.

NOTE: *Newer controllers may, infrequently, read voltages above or below limits and give a false fault.*

SPEED SENSOR

If the speed controller does not detect pulses from the speed sensor while the controller outputs power (greater than 75% armature PWM) to the motor, a *speed sensor* fault is detected.
What it means: Speed sensor is not working.
What to do: Replace speed sensor.

MAIN WELDED

If the speed controller detects that the solenoid contacts are welded closed, a *main welded* fault is detected.
What it means: The solenoid contact is welded closed and will not dropout when pedal is released, or key switch is turned to OFF, or FNR is switched to N.
What to do: Replace solenoid.

MAIN DRIVER ON

If the FET that controls the closing of the solenoid contacts is found to be energized when it should not be, a *main driver on* fault is detected by the speed controller.
What it means: The controller FET controlling the energizing of the solenoid is on (or energized) when it should not be. This causes main contactors to stay engaged.
What to do: Replace controller.

MAIN DRIVER OFF

If the FET that controls the closing of the solenoid is **not** energized when it should be, a *main driver off* fault is detected by the speed controller.
What it means: The controller FET controlling the energizing of the solenoid is off (or not energized) when it should be.
What to do: Replace controller.

MAIN COIL OPEN

If the speed controller determines that the solenoid is not closing as a result of a solenoid coil failure, a *main coil open fault* is detected.
What it means: An open circuit in the solenoid coil. It could be in either the ground side or B+ side of the circuit.
What to do: Check for a broken or disconnected blue wire on the B+ side of the solenoid coil, a broken or disconnected blue/white wire on the B- side of the solenoid coil, a broken coil wire inside the solenoid which would result in zero ohms resistance reading, a defective coil which could result in very low coil resistance (usually less than 40 ohms; large solenoids should read 180 - 190 ohms; small solenoids 200 - 250 ohms), a broken blue/white wire at the 16-pin controller plug or its terminal is loose in the 16-pin plug.

FLD (FIELD) MISSING

If the speed controller is operating at a duty cycle of greater than 90% (almost full speed) and the field current is less than 3 amps, a *field missing* fault is detected by the speed controller.

CAUTION

- **A failed motor will ruin a controller. If a new controller is installed in a vehicle with a bad motor, the bad motor will blow the field FET in the new controller. Always check the motor before replacing a controller when a FLD Missing fault is shown.**

What it means: Not necessarily a controller issue.
What to do: Check in this order: continuity of orange and blue motor field wires, short in motor, and then controller.

HPD

The *HPD* (High Pedal Detect) fault is detected if the accelerator pedal is already depressed when the key switch is turned to the ON position. This fault is also detected if the accelerator pedal is pressed when the selected direction is changed by pressing the Forward/Reverse switch. This fault, when not caused by the operator, can indicate that the pedal limit switch has failed closed.
What it means: The pedal is depressed before the key switch and/or the FNR is switched on. This is a safety control and the controller must see the pedal engaged last in the following sequence: key switch first, FNR second, and then pedal last.
What to do: Check throttle percentage and, if at 0, issue is driver error.

OVERVOLTAGE

If the speed controller detects that the battery voltage is too high (68.4 to 75.6 volts DC), the *overvoltage* fault is detected.
What it means: Occurs when the controller sees 72 or more volts. Reverse Buzzer beeps when fault occurs and the car will freewheel.
What to do: Check to see if car has been towed without being put into “Tow” mode. Check charger relay because, in Excel vehicles, bypassing the relay in the charger could cause the controller to read an overvoltage fault. Note too that Excel vehicles, on hilly courses, may see this fault if the driver turns the key switch off while the vehicle is in motor braking mode.

LOW BATTERY VOLTAGE (UNDERVOLTAGE)

If the battery voltage falls below 34 volts ±5%, the *low battery voltage* fault is detected by the speed controller.
What it means: Voltage coming into the controller is at, or less than, 34 volts.
What to do: Check battery voltage under a load.

THERMAL CUTBACK

If the controller heatsink temperature is found to be in excess of 85 °C ±5 °C (185 °F ±9 °F) or below –25 °C ±5 °C (–13 °F ±9 °F), the *thermal cutback* fault is detected.
What it means: Heatsink temperature rises above 85°C. (185°F).

What to do: Monitor Heatsink Temp, battery voltage, brakes dragging, car under extreme loads, low or no air pressure in tire(s).

MOTOR STALL

If the motor current is high and there is no movement of the vehicle wheels for a short period of time, a *motor stall* is detected by the speed controller. This fault can be caused by an operator holding the vehicle on a hill by depressing the accelerator pedal instead of the brake pedal.
What it means: This fault appears anytime current is running to the motor and no movement of the armature is registered.
What to do: In most cases this is an operator issue holding the vehicle on an incline with the accelerator pedal, not the brake pedal.

MAIN DROPOUT (1 OR 2)

If the controller detects that the solenoid contacts have opened while the vehicle is in operation, a *main dropout* fault is detected.
What it means: Occurs when the solenoid coil losses ground causing the main contact to lose connection. With Main Dropout 2, the solenoid drops out while the vehicle is in regen/motor braking.
What to do: Check the following components: key switch, MCOR, batteries, battery cables, FNR, solenoid coil, solenoid contacts, and controller 16-pin connector.

CURRENT SENSE FAULT

If there are problems with the armature current sensor circuitry, a *current sense* fault is detected.

INCORRECT PASSWORD (IQDM-P ONLY)

Each vehicle has a password in the form of a unique set of codes used to place the vehicle in “private speed mode”. If a set of codes has been entered incorrectly, the *incorrect password* fault is declared. For additional information on codes, refer to Code A, Code B, and Code C. **See Code A, Code B, and Code C on page 23-4.See also Password Tries (IQDM-P Only) on page 16-6.**

MAX PASSWORD TRIES (IQDM-P ONLY)

The *max password tries* fault is declared when the incorrect password fault has been declared several times. In the event that the *max password tries* fault is indicated, the speed controller must be removed and shipped to Club Car before it can ever be placed in “private speed mode”. **See Code A, Code B, and Code C on page 23-4. See also Password Tries (IQDM-P Only) on page 16-6.**

FAULT HISTORY

The *fault history* menu can be useful in determining the cause of a vehicle problem; however, the fault history alone should not be the factor that determines when a component is replaced. Some faults detected by the speed controller are not the result of a failed component, and are instead the result of vehicle operator error. If a fault appears in the *fault history* menu, the trained technician should attempt to determine when and where the fault has occurred. For example, if the *motor stall* fault is present in the fault history, the trained technician may be able to determine the location on the course where an operator has held the vehicle on a hill by using the accelerator pedal.

CLEARING FAULT HISTORY

After a repair has been made, the fault history should be cleared. This will enable the trained technician to properly troubleshoot the vehicle in the future, in the event that another problem occurs. It is recommended that the fault history be cleared in order to avoid the replacement of a component that caused a fault in the past, but has been replaced and is now functioning correctly. For example, if the throttle position sensor or MCOR (Motor Controller Output Regulator) was disconnected and the speed controller detected a fault code associated with the throttle, the fault history should be cleared so that any future problem is not diagnosed incorrectly as a throttle problem. **See Clear Fault History on page 16-18.**

FUNCTIONS MENU

The *functions* menu is accessed by using the up or down arrow to scroll to *functions* and pressing the right arrow key to activate the menu.

GET SETTINGS FROM CONTROLLER

This function transfers all of the speed controller settings (except for “private speed mode”) from the vehicle speed controller to the handset. This enables the trained technician to “clone” a speed controller. Once the speed controller settings have been transferred to the handset, the technician can then connect the handset to another vehicle and transfer the stored settings into the speed controller.

Speed Controller Cloning – Transferring Settings from the Vehicle to the Handset

1. Locate a vehicle that has the desired speed controller settings.
2. Turn the key switch to the OFF position, place the Forward/Reverse handle in the NEUTRAL position, and lock the park brake.
3. Plug the handset into the vehicle.
   3.1. Connect one end of the cable to the port located on the bottom of the handset.
   3.2. Connect the cable adaptor to the IQDM cable.
   3.3. Remove the dust cap from the IQDM port.
   3.4. Align the keyed portion of the plug with the IQDM port and connect the plug to the port **(Figure 16-1, Page 16-1)**.
4. Scroll to the *functions* menu and select.
5. Select *settings*.
6. Select *get settings from controller*.
7. Press + on the change value button to confirm the operation.
8. The handset will display an “executing...” message for the next few seconds while the controller settings are being stored in the handset’s memory **(Figure 16-4, Page 16-15)**.
9. When the handset is finished recording the speed controller settings, a confirmation message is displayed **(Figure 16-5, Page 16-15)**.

10. With the controller settings stored in the memory of the handset, the handset can be used to transfer all of the desired speed controller settings to any Excel System vehicle or group of Excel System vehicles. **See Speed Controller Cloning – Transferring Settings from the Handset to the Vehicle on page 16-15.**

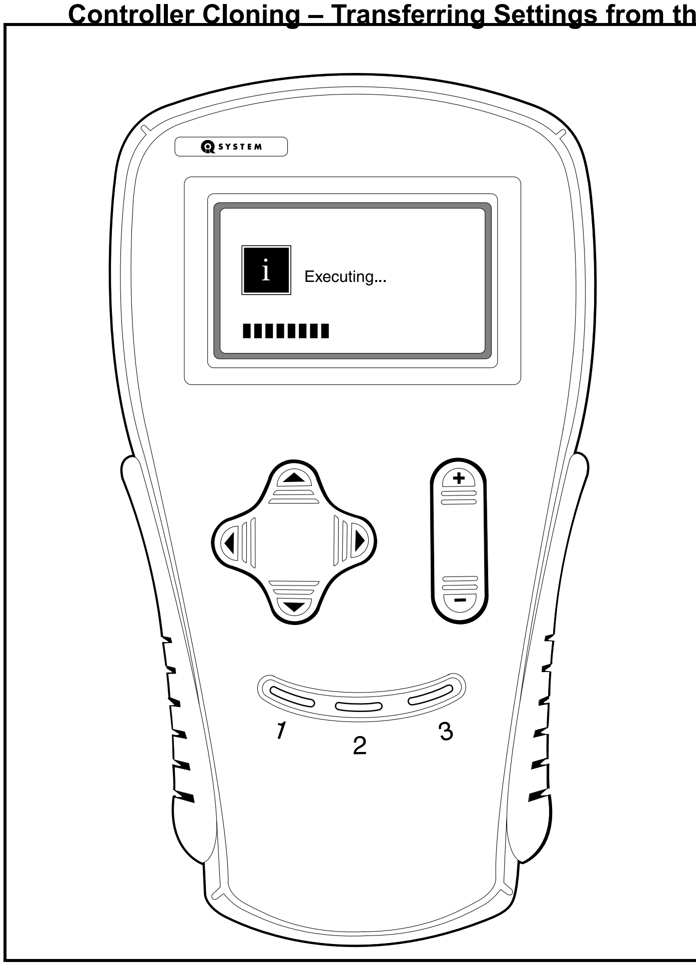

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Figure 16-4 Handset Executing

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Figure 16-5 Confirmation Message

WRITE SETTINGS TO CONTROLLER

This function transfers all of the speed controller settings (except for “private speed mode”) from the handset to the vehicle speed controller. This enables the trained technician to “clone” a speed controller. Once the speed controller settings have been transferred to the handset, the technician can then connect the handset to another vehicle and transfer the stored settings into the speed controller.

Speed Controller Cloning – Transferring Settings from the Handset to the Vehicle

1. Perform this procedure with a handset that has the desired speed controller settings. **See Speed Controller Cloning – Transferring Settings from the Vehicle to the Handset on page 16-14.**
2. Locate a vehicle that does **not** have the desired speed controller settings.
3. Turn the key switch to the OFF position, place the Forward/Reverse handle in the NEUTRAL position, and lock the park brake.
4. Plug the handset into the vehicle.
   4.1. Connect one end of the cable to the port located on the bottom of the handset.
   4.2. Connect the cable adaptor to the IQDM cable.
   4.3. Remove the dust cap from the IQDM port.
   4.4. Align the keyed portion of the plug with the IQDM port and connect the plug to the port **(Figure 16-1, Page 16-1)**.

5. Scroll to the *functions* menu and select.
6. Select *settings*.
7. Select *write settings to controller*.
8. Press + on the change value button to confirm the operation.
9. The handset will display an “executing...” message for the next few seconds while the controller settings are being stored in the handset’s memory **(Figure 16-4, Page 16-15)**.
10. When the handset is finished transferring the speed controller settings, a confirmation message is displayed **(Figure 16-6, Page 16-16)**.
11. Repeat this procedure for additional vehicles that need to be programmed with the same handset settings.

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Figure 16-6 Confirmation Message

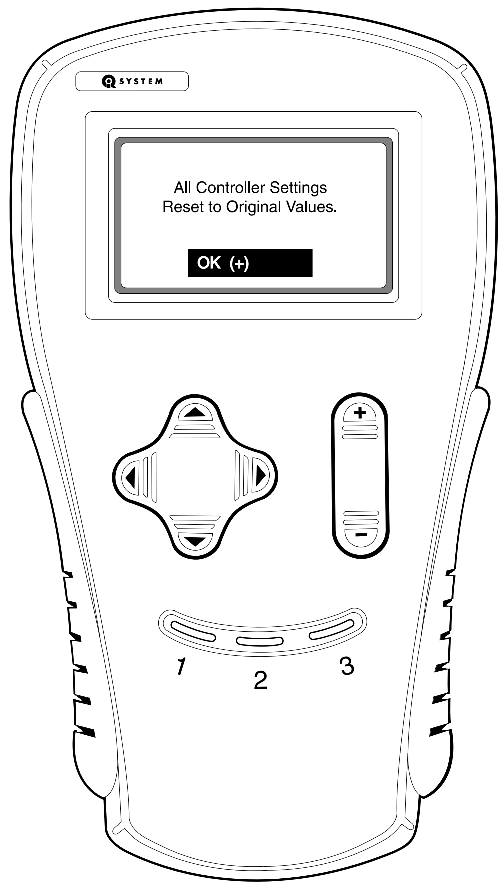

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Figure 16-7 Confirmation Message

RESET ALL SETTINGS

In the event that a mistake was made and one or more changes should not have been made with the handset, the speed controller settings can be reverted to the original settings from the beginning of the session (when the handset was plugged into the vehicle). This function is similar to the “undo” command on a PC and will work correctly only when the handset has **not** been unplugged and power to the speed controller has **not** been interrupted.

Resetting All Settings

1. During an active session when the settings need to be returned to the original values (the values that were active at the beginning of the session), scroll to the *functions* menu and select.
2. Select *settings*.
3. Select *reset all settings*.

4. Press + on the change value button to confirm the operation.
5. The handset will display an “executing...” message for the next few seconds while the controller settings are being stored in the handset’s memory **(Figure 16-4, Page 16-15)**.
6. When the handset is finished resetting the speed controller settings, a confirmation message is displayed **(Figure 16-7, Page 16-16)**.

INFORMATION

The *information* menu is accessed by using the up or down arrow to scroll to *information* and pressing the right arrow key to activate the menu.

This menu selection displays information pertaining to the speed controller. The information provided from this menu selection includes:

MODEL NUMBER

Displays the model number of the speed controller.

SERIAL NUMBER

Displays the serial number of the speed controller.

MFG DATE

Displays the date the speed controller was manufactured.

SOFTWARE VERSION

Displays the speed controller software version. **See following NOTE.**

NOTE: *This manual spans several model years, and the software version displayed can range from version 10 to version 14 (as of early 2011 model year).*

PROGRAMMER SETUP

The *programmer setup* menu selection allows the user to set the LCD display contrast, records the fault history of the handset, and displays information pertaining to the handset.

PROGRAM

This menu allows the user to adjust the contrast on the display screen. After selecting the *LCD–Contrast* menu, use the change value buttons to adjust the contrast for the best readability.

FAULTS

This menu selection displays faults that have been detected within the handset. This *faults* menu does not pertain to any faults detected in the speed controller.
The following faults can be detected within the handset:

CODE NUMBER	TEXT DISPLAYED
14	Communication error with controller
15	Error in handset
16	Handset does not support this function
17	Serial port overrun error
18	Security lockout on program menu

Fault History

This menu displays any faults that have been detected within the handset itself.

Clear Fault History

The *clear fault history* function will erase the history of faults that are stored in the handset.

INFORMATION

This menu selection displays information pertaining to the handset. The information provided in this menu selection includes model number, serial number, the date the handset was manufactured, the handset software version, etc.

IQDM AND IQDM-P HANDSET TROUBLESHOOTING

In the event that the handset does not function as described in this manual, the following troubleshooting guide should be studied and the referenced test procedures should be performed to troubleshoot the handset.

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Handset display screen is blank	Handset cord and/or adaptor is disconnected	**See Plugging the Handset into the Vehicle on page 16-1.**
	Vehicle batteries – loose terminals or corrosion	See Section 18 – Batteries.
	Vehicle batteries – improperly wired	See Section 18 – Batteries.
	Vehicle batteries – batteries failed	See Section 18 – Batteries.
	Vehicle batteries – batteries not fully charged	See Section 18 – Batteries.
	Handset cord has failed	Test Procedure 1 – Handset Cord on page 16-20
	Handset cord adaptor has failed	Test Procedure 2 – Handset Cord Adaptor on page 16-20
	IQDM port (mounted under instrument panel assembly) has failed	Test Procedure 3 – IQDM Ports on page 16-21
	Contrast Setting is too light	**See Program on page 16-18.**
	Onboard computer is in power-down mode	Drive the vehicle for a short distance and reconnect the handset to the vehicle
	Onboard computer malfunction	See Section 13 – Excel System Troubleshooting – TPS.
	Loose vehicle wire harness connections	Test Procedure 3 – IQDM Ports on page 16-21
	Speed controller malfunction	See Section 13 – Excel System Troubleshooting – TPS.
	Handset has failed	Replace handset
Display screen shows jumbled or undecipherable characters	Speed controller malfunction	See Section 13 – Excel System Troubleshooting – TPS.
	Handset malfunction	Disconnect the IQDM cord from the vehicle. Wait a few seconds and reconnect the handset to the vehicle
	Loose connection at IQDM port	Test Procedure 3 – IQDM Ports on page 16-21
	Intermittent handset cord failure	Test Procedure 1 – Handset Cord on page 16-20
	Intermittent handset cord adaptor failure	Test Procedure 2 – Handset Cord Adaptor on page 16-20
	Loose vehicle wire harness connections	Test Procedure 3 – IQDM Ports on page 16-21

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Handset is “locked-up” – buttons do not respond	Handset malfunction	Disconnect the IQDM cord from the vehicle. Wait a few seconds and reconnect the handset to the vehicle
	Vehicle batteries – loose terminals or corrosion	See Section 18 – Batteries.
	Vehicle batteries – improperly wired	See Section 18 – Batteries.
	Vehicle batteries – batteries failed	See Section 18 – Batteries.
	Vehicle batteries – batteries not fully charged	See Section 18 – Batteries.
	Speed controller malfunction	See Section 13 – Excel System Troubleshooting – TPS.

TEST PROCEDURES

The following test procedures enable the technician to test the IQDM and IQDM-P handsets and the components of the Excel System vehicle that are related to the proper operation of the handset.

⚠ WARNING

- **If wires are removed or replaced, make sure wiring and wire harness is properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.**

Index of Test Procedures

1 – Handset Cord
2 – Handset Cord Adaptor
3 – IQDM Ports

TEST PROCEDURE 1 – Handset Cord

See General Warnings on page 1-1.

1. Using a multimeter set for 200 ohms, place the red (+) probe into one of the terminals on the end of the cord with the square plug.
2. Place the black (–) probe on each of the pins, one at a time, on the plug on the other end of the cord.
3. The multimeter should indicate continuity on only one pin. If any other reading is obtained, the cord must be replaced.
4. Repeat the procedure three more times, each time with the red (+) probe inserted into a different terminal on the end of the cord with the square plug.

TEST PROCEDURE 2 – Handset Cord Adaptor

See General Warnings on page 1-1.

The procedure for testing the handset cord adaptor is similar to the cord test.

1. Using a multimeter set for 200 ohms, place the red (+) probe into one of the terminals on the end of the adapter with the square plug.

2. Place the black (–) probe on each of the pins, one at a time, on the other plug of the adaptor.
3. The multimeter should indicate continuity on only one pin. If any other reading is obtained, the adaptor must be replaced.
4. Repeat the procedure three more times, each time with the red (+) probe inserted into a different terminal on the end of the adaptor with the square plug.

TEST PROCEDURE 3 – IQDM Ports

Inspect the IQDM ports for damage or corrosion.

IQDM PORT (LOCATED UNDER INSTRUMENT PANEL)

See General Warnings on page 1-1.

1. Turn the key switch to the OFF position, place the Forward/Reverse rocker switch in the NEUTRAL position, and lock the park brake.
2. Place the Tow/Run switch in the TOW position, disconnect the batteries, negative (–) cable first, and wait 90 seconds for the speed controller capacitors to discharge. **See General Warnings on page 1-1.**
3. Check the IQDM port mounted under the instrument panel.
   3.1. Remove the three screws (1) that secure the instrument panel assembly (2) to the dash assembly (3) **(Figure 16-8, Page 16-21)**.

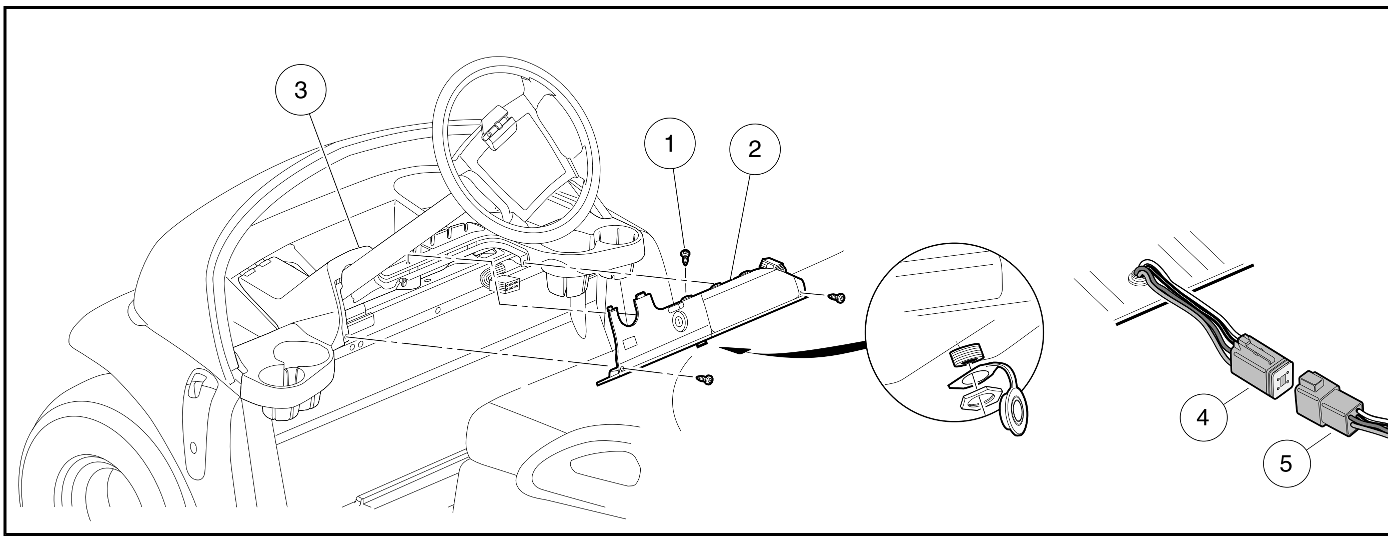

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Figure 16-8 Instrument Panel Assembly Removal and IQDM Port Connection

   3.2. Disconnect the four-pin connectors (4 and 5) and visually inspect the contacts for damage and corrosion. Inspect the IQDM port, mounted under the instrument panel assembly (2). Repair and replace parts as necessary.
   3.3. If no problem is found, connect the four-pin connectors and install the instrument panel assembly.
   3.4. Install the three screws (1) that secure the instrument panel assembly (2) to the dash assembly (3) **(Figure 16-8, Page 16-21)**.
4. Check the IQDM port on the speed controller.
   4.1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
   4.2. Remove electronics module cover. **See Electronics Module Cover on page 17-5.**
   4.3. Connect IQDM to controller.

4.3.1. Disconnect the square four-pin connector (3) from the speed controller.

4.3.2. Connect the handset cord to the handset.

4.3.3. Connect the other end of the handset cord (without the adapter) (4) to the four-pin connector of the speed controller (2) **(Figure 16-9, Page 16-22)**.

4.3.4. Connect the vehicle batteries, positive (+) cable first.

4.3.5. If the handset functions when connected directly to the speed controller, the adapter plug or vehicle wire harness should be thoroughly tested. **See Test Procedure 2 – Handset Cord Adaptor on page 16-20.** See Section 13 – Excel System Troubleshooting – TPS.

4.4. Replace electronics module cover. **See Electronics Module Cover on page 17-5.**

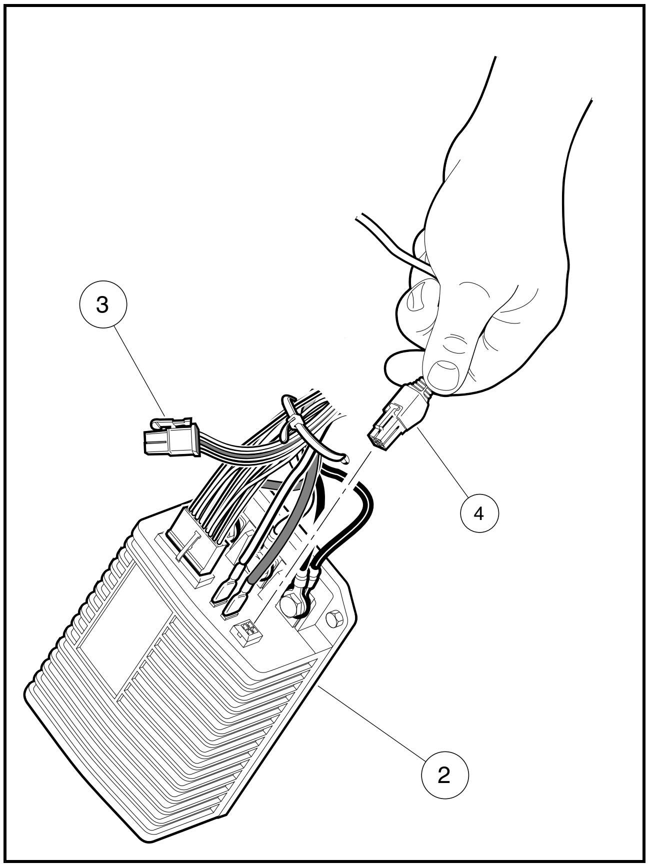

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Figure 16-9 IQDM Connector On Speed Controller

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

KEY SWITCH

See General Warnings on page 1-1.

TESTING THE KEY SWITCH

See the appropriate troubleshooting section for the type of electrical system used in the vehicle.
See IQ System Troubleshooting – TPS on page 11-1 or IQ System Troubleshooting – MCOR on page 12-1 or Excel System Troubleshooting – TPS on page 13-1 or Excel System Troubleshooting – MCOR on page 14-1.

KEY SWITCH REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the instrument panel **(Figure 17-1, Page 17-2)**.
   - 2.1. Remove three screws (1) from the instrument panel (2).
   - 2.2. Rotate the instrument panel up and away from the dash to disengage the tabs at the top of the panel.
   - 2.3. Disconnect the electrical connector (3) to the instrument panel.
3. Disconnect the wires from the key switch.
4. From the back of the instrument panel, push down on the retaining tabs surrounding the key switch (4) and remove the key switch cap (8). Hold the key switch and remove the switch retaining nut (6) from the outside of the instrument panel **(Figure 17-2, Page 17-2)**.

KEY SWITCH INSTALLATION

1. Position the key switch and flat washer (9) in the instrument panel, then install and tighten the switch retaining nut (6) to 40 in-lb (4.5 N·m). Install key switch cap (8) in center dash **(Figure 17-2, Page 17-2)**.
2. Connect the blue and green wires to the key switch terminals. Either orientation is correct. **See Wiring Diagrams on page 12-2 or 14-3.**
3. Install the instrument panel.
   - 3.1. Connect the electrical connector (3) **(Figure 17-1, Page 17-2)**.

3.2. Position the instrument panel (2) on the dash assembly. Make sure tabs on upper edge properly engage with the corresponding slots on the dash assembly. Ensure that there are no wires exposed or pinched during positioning.

3.3. Secure instrument panel to the dash assembly with three screws (1). Tighten screws to 1.8 ft-lb (2.5 N·m).

4. Connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

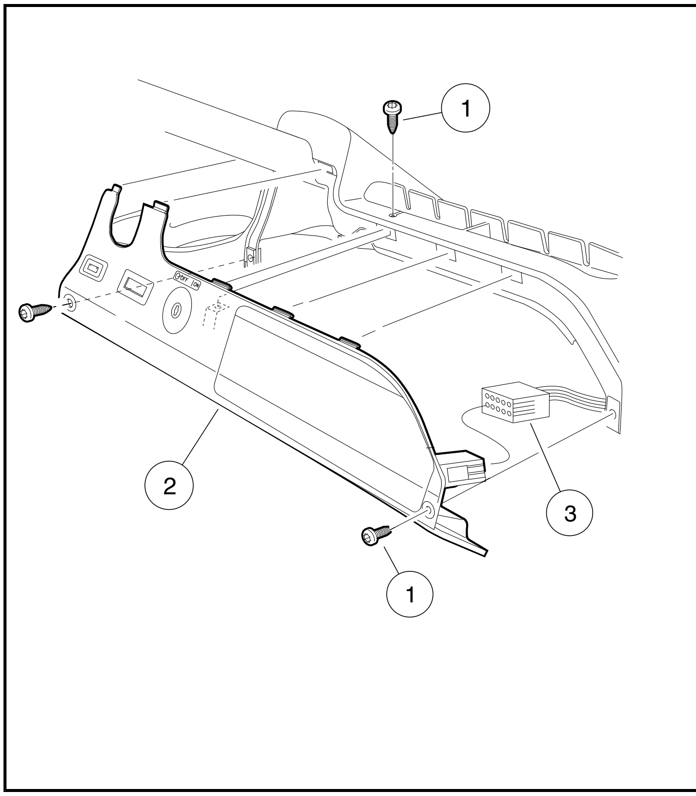

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Figure 17-1 Instrument Panel Removal

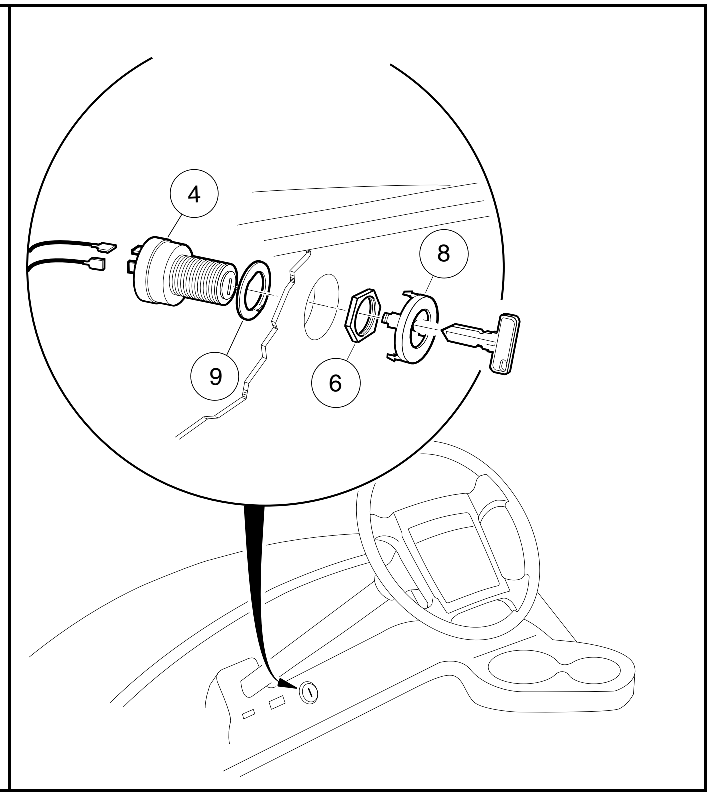

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Figure 17-2 Key Switch

BATTERY WARNING LIGHT

See General Warnings on page 1-1.

TESTING THE BATTERY WARNING LIGHT

See Test Procedure 26 – Battery Warning Light on page 12-38 or 14-37.

BATTERY WARNING LIGHT REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove instrument panel. **See Key Switch Removal on page 17-1.**
3. Disconnect the wires at the warning light.
4. Press the two retaining tabs (11) and remove the light from the center dash **(Figure 17-3, Page 17-3)**.

BATTERY WARNING LIGHT INSTALLATION

1. Install in reverse order of removal.
2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

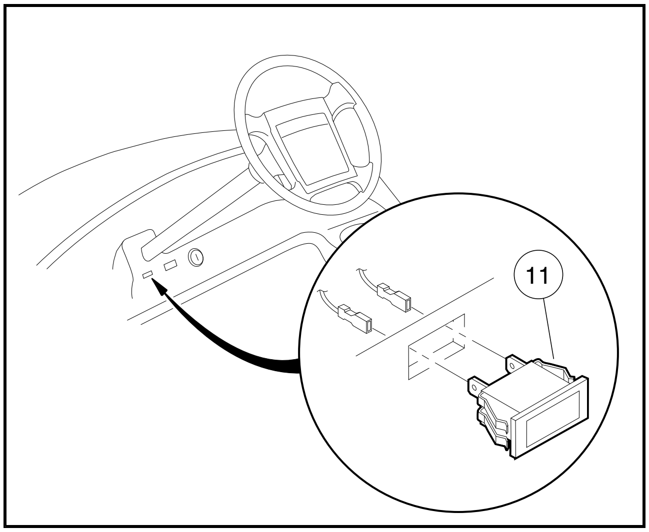

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Figure 17-3 Battery Warning Light

FORWARD/REVERSE ROCKER SWITCH

See General Warnings on page 1-1.

TESTING THE FORWARD/REVERSE ROCKER SWITCH

See Test Procedure 23 – Forward/Reverse Rocker Switch on page 12-35 or 14-35.

FORWARD/REVERSE ROCKER SWITCH REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove two screws (2) that hold Forward/Reverse rocker switch housing (1) to the vehicle **(Figure 17-4, Page 17-4)**.
3. Remove the three wires from the rocker switch.
4. Press in on the locking tabs on each side of switch (3), and push switch out of housing.

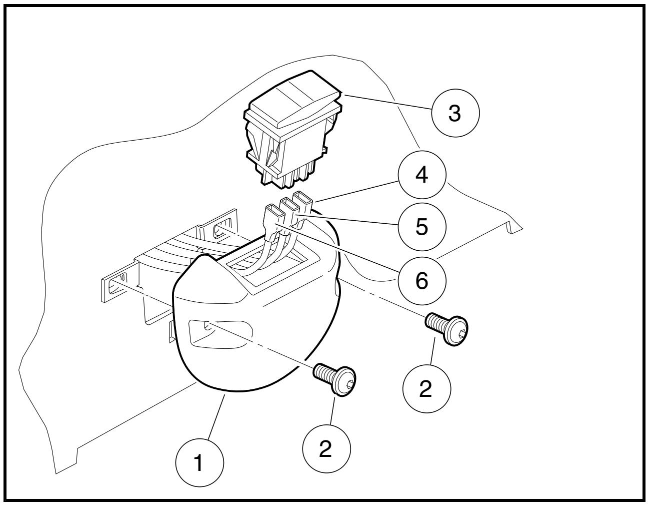

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Figure 17-4 Forward/Reverse Rocker Switch

FORWARD/REVERSE ROCKER SWITCH INSTALLATION

1. Route the three wires through bezel. Connect the blue (4), orange (5) and brown (6) wires to the rocker switch (3), exactly as shown in **(Figure 17-4, Page 17-4)**.
2. Orient the rocker switch (3) so the terminals are towards the front of the housing (1). Push rocker switch (3) into housing (1).
3. Place the housing in position on the body and install the two screws (2). Tighten to 20 in-lb (2.3 N·m).
4. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
5. Place the Tow/Run switch in the RUN position.
6. Inspect the vehicle for proper operation.

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**
- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

ELECTRONICS MODULE COVER

See General Warnings on page 1-1.

The electronics module cover needs to be removed to gain access to the speed controller, Tow/Run switch, and onboard computer.

ELECTRONICS MODULE COVER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the two plastic rivets (1) that secure the access panel (2) to the vehicle **(Figure 17-5, Page 17-6)**.
3. Remove cover (5) by first releasing the two hooks (4) that secure the cover to the battery bucket. Then, maneuver the cover to release the four tabs (3) from the matching holes in the hood of the battery bucket.

CAUTION

- **Be careful not to break the two hooks (4) on the bottom of the cover. Push the bottom of the cover up to release the hooks before pulling cover away from battery bucket.**

ELECTRONICS MODULE COVER INSTALLATION

1. Install cover (5) by first hooking the four tabs (3) into the matching holes in the hood of the battery bucket **(Figure 17-5, Page 17-6)**. Then, use the two hooks (4) to secure the cover to the battery bucket.
2. Place access panel (2) on vehicle and secure with the two plastic rivets (1). **See following CAUTION.**

CAUTION

- **Exposure to water may damage electronic components.**
  - **Do not operate vehicle without this cover properly installed.**
  - **Do not direct water stream in the area of the cover.**

3. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

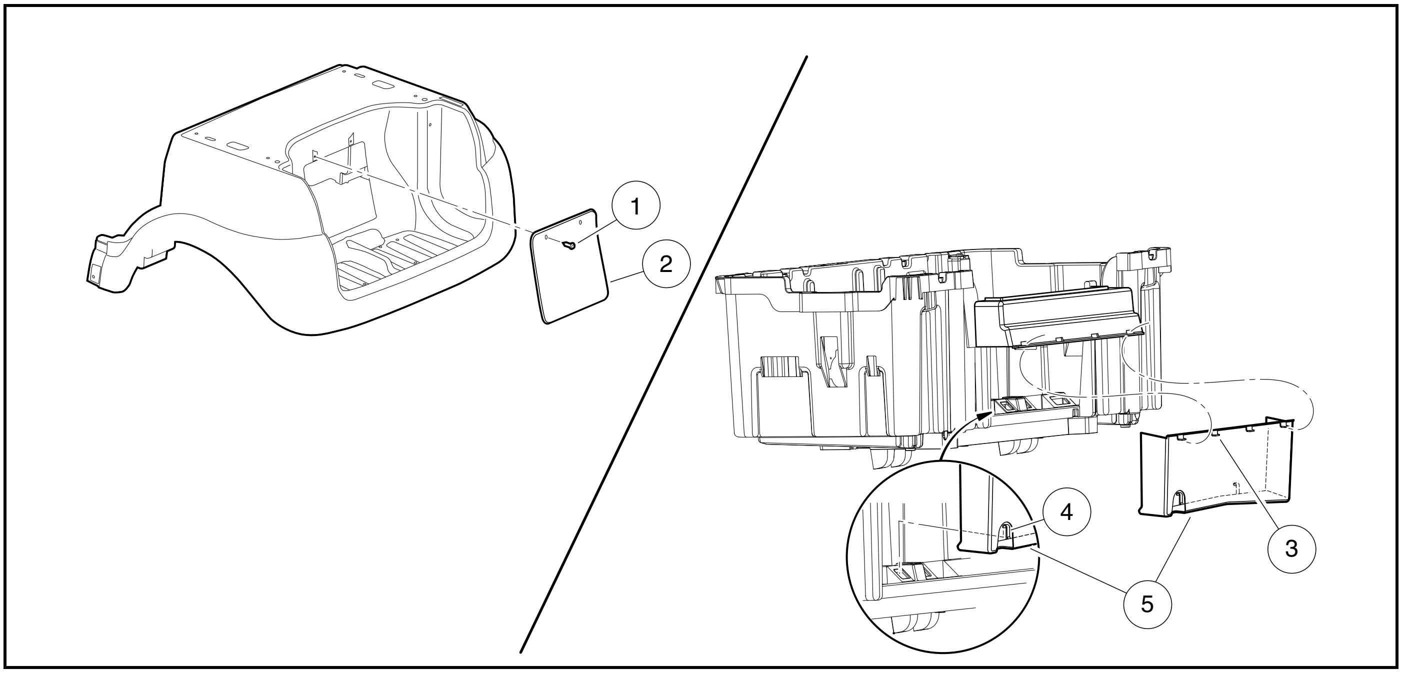

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Figure 17-5 Access and Remove Electronics Module Cover

TOW/RUN SWITCH

See General Warnings on page 1-1.

TESTING THE TOW/RUN SWITCH

See Test Procedure 6 – Tow/Run Switch on page 14-19.

TOW/RUN SWITCH REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the bolt (11) that secures the electronics module to the battery bucket **(Figure 17-8, Page 17-11)**.
3. Pull electronics module forward and disconnect the pink wire (3) and light green wire (4) from switch.
4. Remove Tow/Run switch boot/hex nut (1) **(Figure 17-6, Page 17-7)**.
5. Remove Tow/Run switch (2) from electronics module.

TOW/RUN SWITCH INSTALLATION

1. Installation is reverse of removal. Make sure flat on switch is aligned with flat part of D-shaped hole in electronics module **(Figure 17-6, Page 17-7)**. Tighten Tow/Run switch boot/hex nut (1) to 16 in-lb (1.8 N·m).
2. Connect the wires to the switch.

3. Return electronics module to its original location and secure with bolt (11) **(Figure 17-8, Page 17-11)**. Tighten bolt to 40 in-lb (4.5 N·m).
4. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

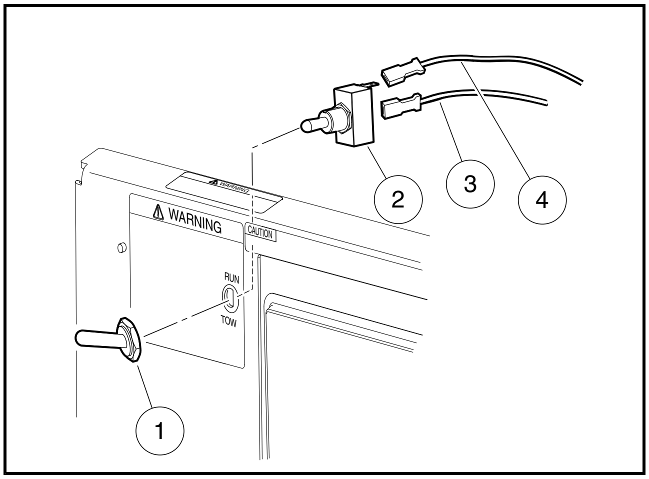

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Figure 17-6 Tow/Run Switch

THROTTLE POSITION SENSOR (TPS)

See General Warnings on page 1-1.

TESTING THE THROTTLE POSITION SENSOR

See Test Procedure 4 – MCOR Voltage on page 12-16 and Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 12-21.
See Test Procedure 4 – MCOR Voltage on page 14-16 and Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 14-20.

THROTTLE POSITION SENSOR REPLACEMENT

The throttle position sensor itself is not intended to be replaced. If sensor is determined to need replacing through test procedures listed above, the accelerator pedal assembly must be replaced. **See Accelerator Pedal Removal on page 5-6.**

MOTOR CONTROLLER OUTPUT REGULATOR (MCOR)

See General Warnings on page 1-1.

TESTING THE MCOR

For IQ System see Test Procedure 4 – MCOR Voltage on page 12-16 and Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 12-21.
For Excel System see Test Procedure 4 – MCOR Voltage on page 14-16 and Test Procedure 8 – Key Switch and MCOR Limit Switch Circuit on page 14-20.

MCOR REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove pedal group. **See Pedal Group Removal on page 5-3.**
3. Disconnect the two-pin and three-pin connectors from the MCOR.
4. Remove the hex-head screw securing the MCOR to the pedal group.

MCOR INSTALLATION

1. Secure the MCOR to the pedal group with hex-head screw. Tighten screw to 19 in-lb (2.1 N·m).
2. Connect the two-pin and three-pin connectors from the wire harness to the MCOR.
3. Install the pedal group. **See Pedal Group Installation on page 5-4.**
4. Connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

REVERSE BUZZER

See General Warnings on page 1-1.

TESTING THE REVERSE BUZZER

See Test Procedure 24 – Reverse Buzzer on page 12-36 or 14-36.

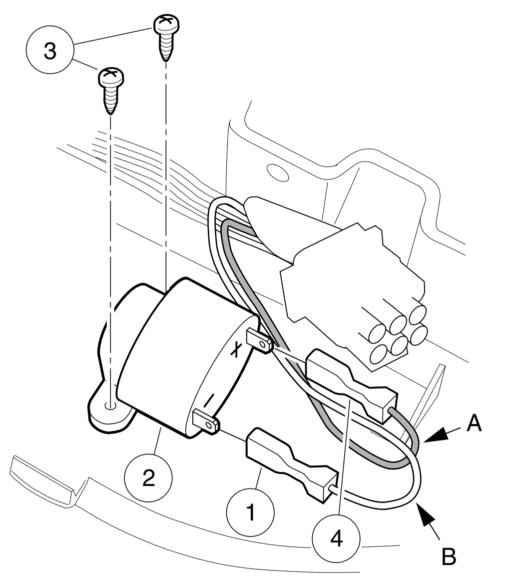
REVERSE BUZZER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove instrument panel. **See Key Switch Removal on page 17-1.**

3. Disconnect the 18-gauge pink and orange/white wires from reverse buzzer.
4. Remove the two screws from the reverse buzzer. Remove the reverse buzzer from the dash panel.

REVERSE BUZZER INSTALLATION

1. Install the reverse buzzer in the reverse order of removal. Pink wire must be connected to the positive terminal. Tighten screws to 4 in-lb (0.45 N·m).
2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**



(Viewed from underside of instrument panel)
A. Pink B. Orange/White

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Figure 17-7 Reverse Buzzer

ELECTRONICS MODULE

See General Warnings on page 1-1.

While it is not necessary to remove the electronics module from the vehicle, access to individual components may be easier with the module removed.

ELECTRONICS MODULE REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the batteries from the vehicle to provide enough room to access the controller (8) **(Figure 17-8, Page 17-11)**. **See Battery Replacement on page 18-15.**
3. Remove the bolt (11) that secures the electronics module to the battery bucket.
4. Pull electronics module forward and disconnect the heavy gauge wires from the controller by removing the three screws (9).

5. Disconnect the 16-pin connector, 4-pin connector, and spade connectors from the controller.
6. Remove the three self-tapping screws (10) that hold the controller to the component mounting plate (14) and remove the controller from the vehicle.
7. Remove two nuts (3) on top of the solenoid (5) posts and remove the wires from the posts.
8. Disconnect the spade connectors on the front of the solenoid.
9. Disconnect the 6-pin connector and all other leads from the onboard computer (OBC) (15) and the two wires from Tow/Run switch.
10. Lift the electronics module from the vehicle. **See following WARNING.**

⚠ WARNING

- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

ELECTRONICS MODULE INSTALLATION

1. Return electronics module to its location in vehicle but leave it tilted forward.
2. Complete connections to the computer, the controller, the Tow/Run switch and the solenoid per the electrical schematics. **See Wiring Diagrams on page 14-3.**
3. Tighten bolts on the controller to 9 ft-lb (12.2 N·m).
4. Tighten nuts on the solenoid to 6.4 ft-lb (8.7 N·m).
5. Set electronics module in place and secure with bolt (11) **(Figure 17-8, Page 17-11)**. Tighten bolt to 40 in-lb (4.5 N·m).
6. Install the batteries and battery cables in their original locations. **See Battery Replacement on page 18-15.**
7. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
8. Place the Tow/Run switch in the RUN position.
9. Inspect the vehicle for proper operation. **See following WARNINGS.**

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**
- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

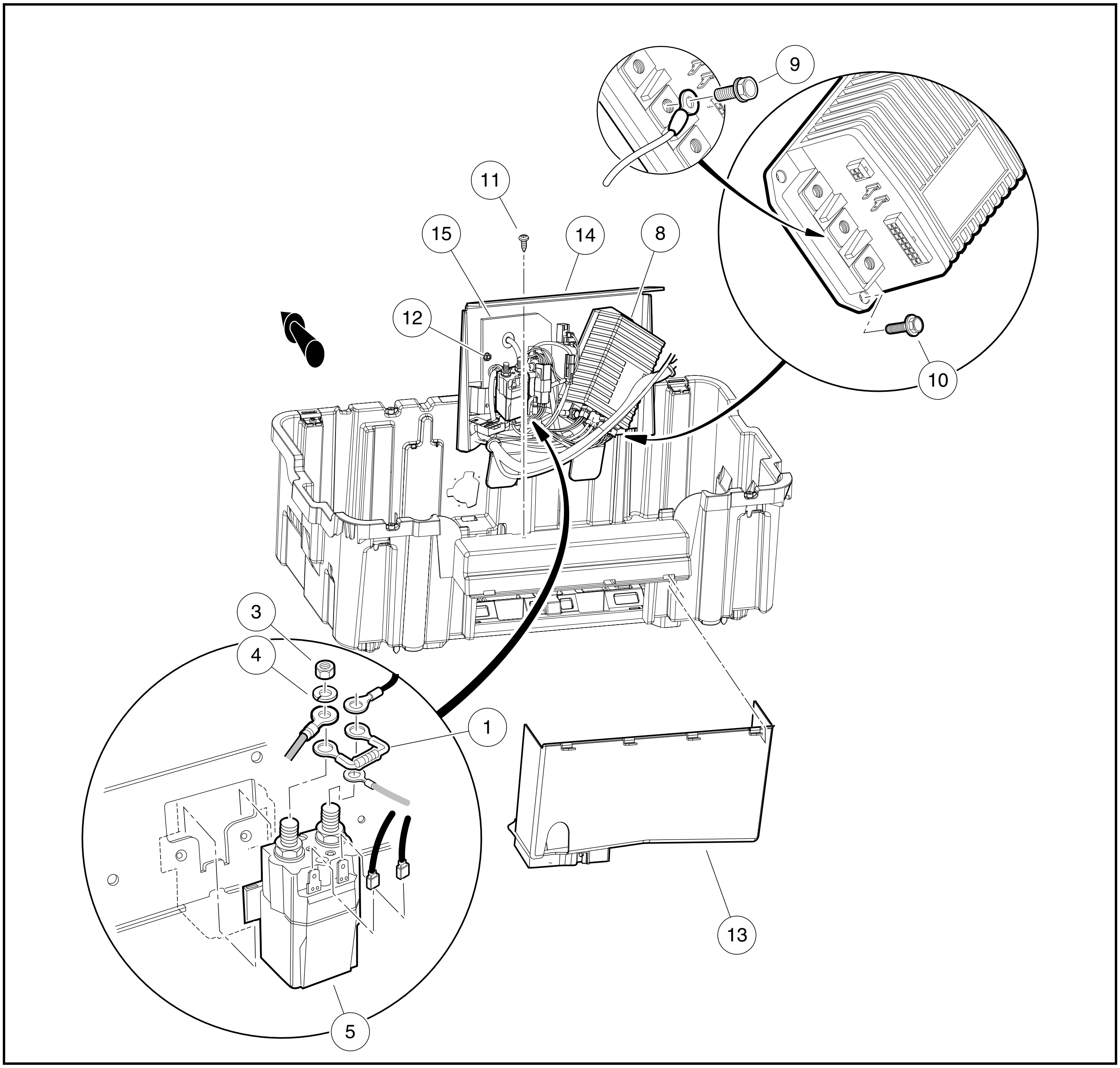

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Figure 17-8 Electronics Module Removal

SPEED CONTROLLER

See General Warnings on page 1-1.

TESTING THE SOLID STATE SPEED CONTROLLER

See Test Procedure 5 – A1 and A2 Motor Voltage on page 14-18.

SPEED CONTROLLER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the batteries from the vehicle to provide enough room to access the controller (8) **(Figure 17-8, Page 17-11)**. **See Battery Replacement on page 18-15.**
3. Remove the bolt (11) that secures the electronics module to the battery bucket.
4. Pull electronics module forward and disconnect the heavy gauge wires from the controller by removing the three screws (9).
5. Disconnect the 16-pin connector, 4-pin connector, and spade connectors from the controller.
6. Remove the three self-tapping screws (10) that hold the controller to the component mounting plate (14) and remove the controller from the vehicle.

SPEED CONTROLLER INSTALLATION

1. Locate the controller (8) on the component mounting plate (14) and secure with three self-tapping screws (10). Tighten screws to 5.5 ft-lb (7.5 N·m) **(Figure 17-8, Page 17-11)**.
2. Connect the 16-pin connector, 4-pin connector, and spade connectors to the controller.
3. Connect the the heavy gauge wires to the controller per the electrical schematics. **See Wiring Diagrams on page 14-3.** Tighten screws (9) on the controller to 9 ft-lb (12.2 N·m).
4. Return electronics module to its original location and secure with bolt (11). Tighten bolt to 40 in-lb (4.5 N·m).
5. Install the batteries and battery cables in their original locations. **See Battery Replacement on page 18-15.**
6. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
7. Place the Tow/Run switch in the RUN position.
8. If vehicle is equipped with the Guardian SVC system, perform the following additional steps for proper setup.
    8.1. Connect an IQDM to the IQDM port on the vehicle.
    8.2. Select *Program, Settings, Control Mode* and set the value to 1.
    8.3. Select *Program, Settings, Anti Tamper* and set the value to 0.
    8.4. Select *Program, Vehicle ID, Vehicle S/N* and enter the last six digits of the vehicle serial number.

NOTE: *The speed for scrolling values may be increased by utilizing the bookmark keys (yellow buttons) in combination with the data inc/dec key (+/-).*

    8.5. Select *Program, Vehicle ID, Vehicle Decal* and enter the number on the Vehicle Number Decal.

8.6. Select *Information, Software Version* and verify the value is 13 or higher. If not, contact a Club Car Technical Representative.

8.7. Place the Tow/Run switch in the TOW position for 30 seconds. Then return it to RUN.

9. Inspect the vehicle for proper operation.

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**
- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

SOLENOID

See General Warnings on page 1-1.

The solenoid is located on the rear side of the electronics module.

TESTING THE SOLENOID

See Test Procedure 3 – Solenoid Activating Coil on page 14-15 and Test Procedure 22 – Solenoid Continuity on page 14-35.

SOLENOID REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the batteries from the vehicle to provide enough room to access the solenoid (5) **(Figure 17-8, Page 17-11)**. **See Battery Replacement on page 18-15.**
3. Remove the bolt (11) that secures the electronics module to the battery bucket.
4. Pull electronics module forward and remove the four wires from solenoid.
5. Slide solenoid up to disengage the mounting tabs and remove from component mounting plate (14).

SOLENOID INSTALLATION

1. Mount solenoid (5) onto component mounting plate (14) **(Figure 17-8, Page 17-11)**.
2. Connect the four wires to the appropriate solenoid terminals. **See Wiring Diagrams on page 14-3 or 12-2.** Tighten the nuts that secure the yellow (4) and red (5) wires to 72 - 84 in-lb (8 - 9.5 N·m).
3. Return electronics module to its original location and secure with bolt (11). Tighten bolt to 40 in-lb (4.5 N·m).
4. Install the batteries and battery cables in their original locations. **See Battery Replacement on page 18-15.**

5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

ONBOARD COMPUTER (OBC)

See General Warnings on page 1-1.

TESTING THE ONBOARD COMPUTER

See Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 14-15, Test Procedure 18 – Onboard Computer Silicon-Controlled Rectifier (SCR) Circuit on page 14-32, and Test Procedure 19 – Onboard Computer Gray Wire on page 14-33.

ONBOARD COMPUTER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove the batteries from the vehicle to provide enough room to access the OBC (15) **(Figure 17-8, Page 17-11)**. **See Battery Replacement on page 18-15.**
3. Remove the bolt (11) that secures the electronics module to the battery bucket.
4. Pull electronics module forward and disconnect the wires from OBC.
5. Disconnect the 6 gauge black wire, that passes through the OBC, from the B- terminal on the controller.
6. Loosen, but do not remove, the two self-tapping screws (12) holding OBC to component mounting plate(14).
7. Slide OBC upwards to align heads of self-tapping screws (12) with the two key holes in the OBC face plate and remove OBC.

ONBOARD COMPUTER INSTALLATION

1. Install the OBC onto the component mounting plate by engaging the two key holes on the OBC face plate with the self-tapping screws (12) **(Figure 17-8, Page 17-11)**. Tighten screws to 5.5 ft-lb (7.5 N·m).
2. Connect wires per the electrical schematics. **See Wiring Diagrams on page 14-3 or 12-2.** Make sure all connections are fully seated and boot on gray sense lead is properly seated.
3. Return electronics module to its original location and secure with bolt (11). Tighten bolt to 40 in-lb (4.5 N·m).
4. Install the batteries and battery cables in their original locations. **See Battery Replacement on page 18-15.**
5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

CHARGER RECEPTACLE

See General Warnings on page 1-1.

The charger cord, plug, and receptacle are wear items and should be inspected daily. Visually inspect them for cracks, loose connections, and frayed wiring; they must be replaced when worn or damaged. If charger plug 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 or lightly sprayed with WD-40® brand spray lubricant. The plug should then be inserted and removed several times to ensure ease of insertion, ease of removal, and good electrical contact.

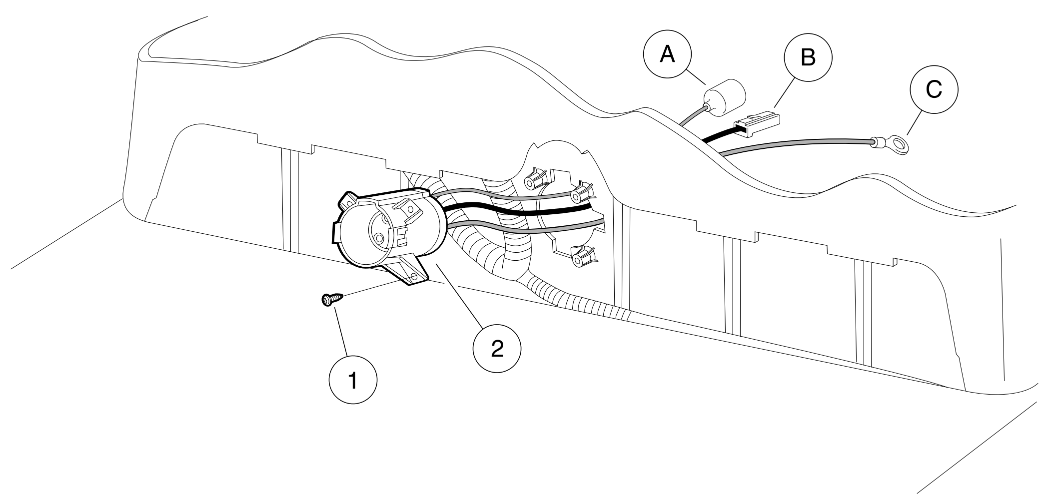
TESTING THE CHARGER RECEPTACLE

See Test Procedure 20 – Voltage at Charger Receptacle Red Wire Socket on page 12-33 or 14-33.
See also the appropriate battery charger maintenance and service manual.

CHARGER RECEPTACLE INSPECTION

Inspect the receptacle for cracks, loose connections and frayed wiring.

NOTE: *Disassembly of the charger receptacle, for the purpose of removal or installation, is not recommended.*



A. Gray to OBC
B. Black to Connector
C. Red to Battery Number 1 Positive (+) Post

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Figure 17-9 Charger Receptacle

CHARGER RECEPTACLE REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Remove kick plate. **See Kick Plate and Charger Receptacle Bezel on page 4-8.**
3. Remove the 10-gauge red wire from the positive post of battery no. 1 **(Figure 17-9, Page 17-15)**.
4. Disconnect the black wire from its connector.

5. Disconnect the gray wire from the OBC.
6. Remove the three screws (1) that secure the charger receptacle (2) to the bucket.

CHARGER RECEPTACLE INSTALLATION

1. Insert the wires through the hole in the bucket **(Figure 17-9, Page 17-15)**.
2. Insert receptacle (2) into bucket.
3. Install the three screws (1) that secure the receptacle to the bucket. Tighten screws to 16 in-lb (1.8 N·m).
4. Connect gray wire to the OBC. Make sure boot is properly seated.
5. Connect the black wire to the mating connector. Make sure connector is fully seated.
6. Connect the red wire to the positive post of battery no. 1.
7. Install kick plate. **See Kick Plate and Charger Receptacle Bezel on page 4-8.**
8. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

HEADLIGHT ADJUSTMENT

Headlights are available as an accessory on this vehicle. To raise or lower the headlight beam, washers can be added to the mounting hardware between the headlight and the bumper assembly.

See General Warnings on page 1-1.

AIMING THE HEADLIGHT BEAM

1. Park the vehicle on a level surface 5 feet away from, and facing a vertical surface such as a garage door or wall.
2. On the vertical surface, mark a 24 inch long, horizontal line 15 1/2 inches above the ground directly in front of the vehicle.
3. Turn on headlight. Take note where the beam strikes the vertical surface in relation to the marked horizontal line. To raise the beam, add washers (size M6) to the lower mounting screw (1). To lower the beam, add washers to both upper screws. Tighten screws to 66 in-lb (7.5 N·m). While it is possible to add washers with the headlight/bumper assembly mounted to the vehicle, these adjustments may be easier if the headlight/front bumper assembly is unbolted first **(Figure 17-10, Page 17-17)**.

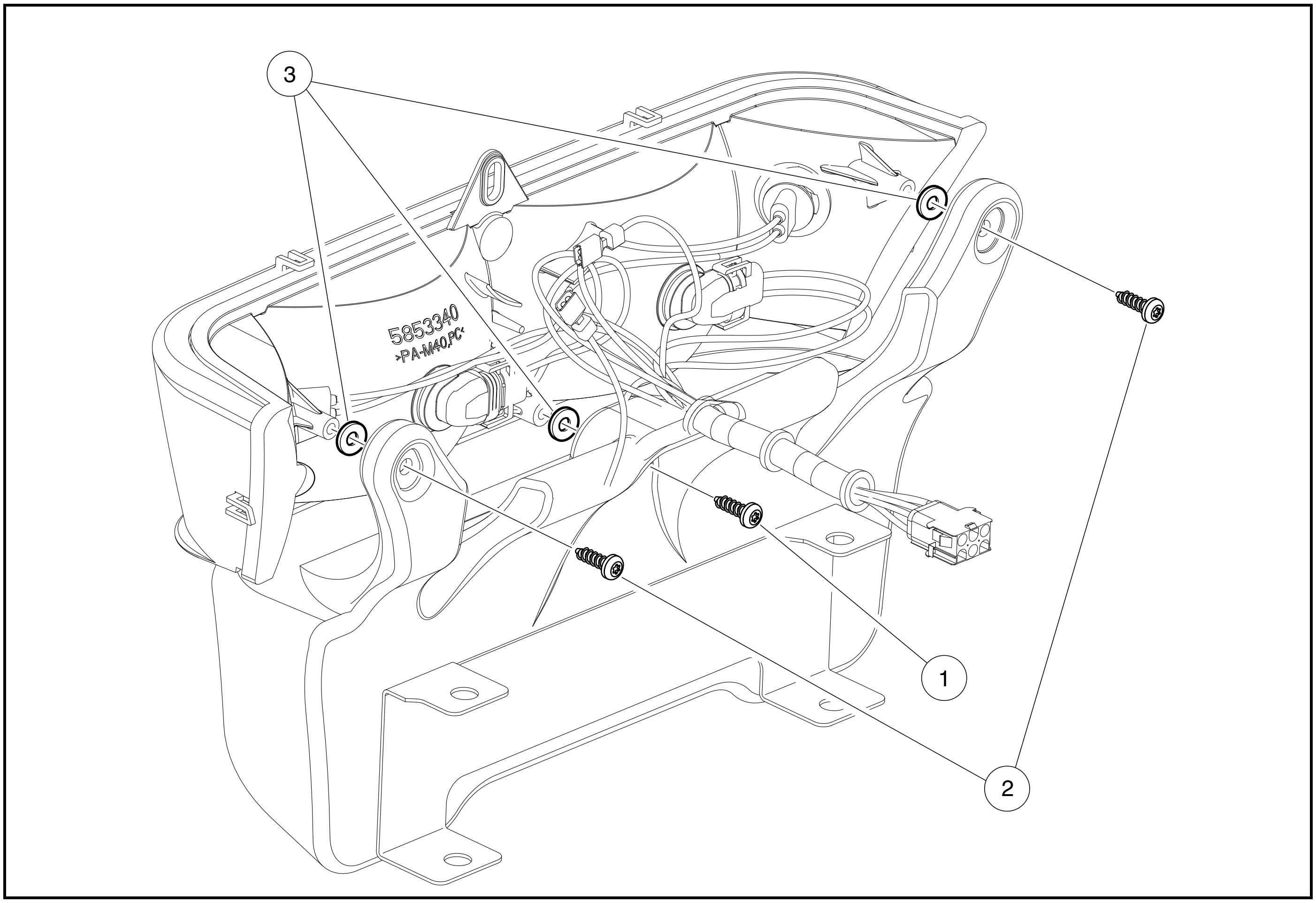

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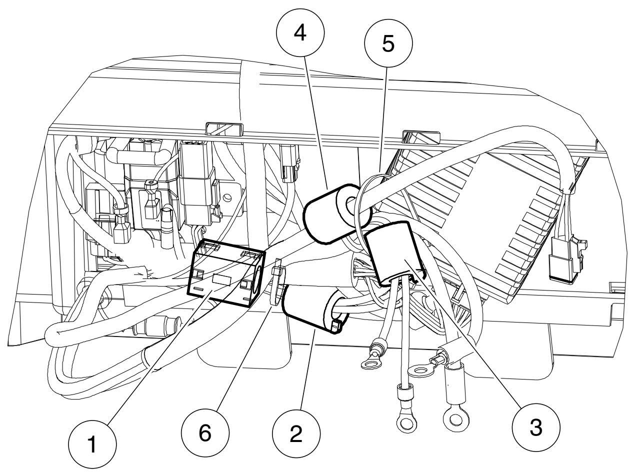
Figure 17-10 Headlight Aiming

FERRITE BEADS – CE MARK VEHICLES

***NOTE:** CE Mark IQ System vehicles are no longer offered starting model year 2011.*

These beads bring the IQ System vehicle into compliance with EMC requirements for use in the European Union.



1. This bead goes around 4 wires (6 Ga. White, 6 Ga. Green, 10 Ga. Orange, 10 Ga. Blue) near the controller.
2. This bead goes around 2 wires (10 Ga. Orange and 10 Ga. Blue) as close as reasonable to the controller.
3. This bead goes around 2 wires (10 Ga. Orange and 10 Ga. Blue) near the motor just before the wires split to terminals F1 and F2.
4. This bead goes around the motor speed sensor harness (black conduit) just before the three-pin connector at the motor.
5. This wire tie goes around the motor speed sensor harness (black conduit) and 2 wires (6 Ga. White and 6 Ga. Green) between the bead (item 4) and three-pin connector.
6. This wire tie goes around 4 wires (6 Ga. White, 6 Ga. Green, 10 Ga. Orange, 10 Ga. Blue) between the bead (item 1) and controller.

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Figure 17-11 Ferrite Bead Placement For Precedent Vehicles

SECTION 18 – BATTERIES

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

⚠ 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 area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Charge batteries in a well-ventilated area only. Batteries emit hydrogen while being charged. Hydrogen is an explosive gas and must never exceed a level of 2% of the air.**
- **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.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**

⚠ WARNING

- **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.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Ensure battery connections are clean and properly tightened. See Battery Care on page 18-16.**

CAUTION

- **On all electric vehicles, turn off all accessories before charging batteries.**

NOTE: *Recycle or dispose of discarded batteries in accordance with local, state, and federal regulations.*

GENERAL INFORMATION

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

BATTERY TROUBLESHOOTING CHART

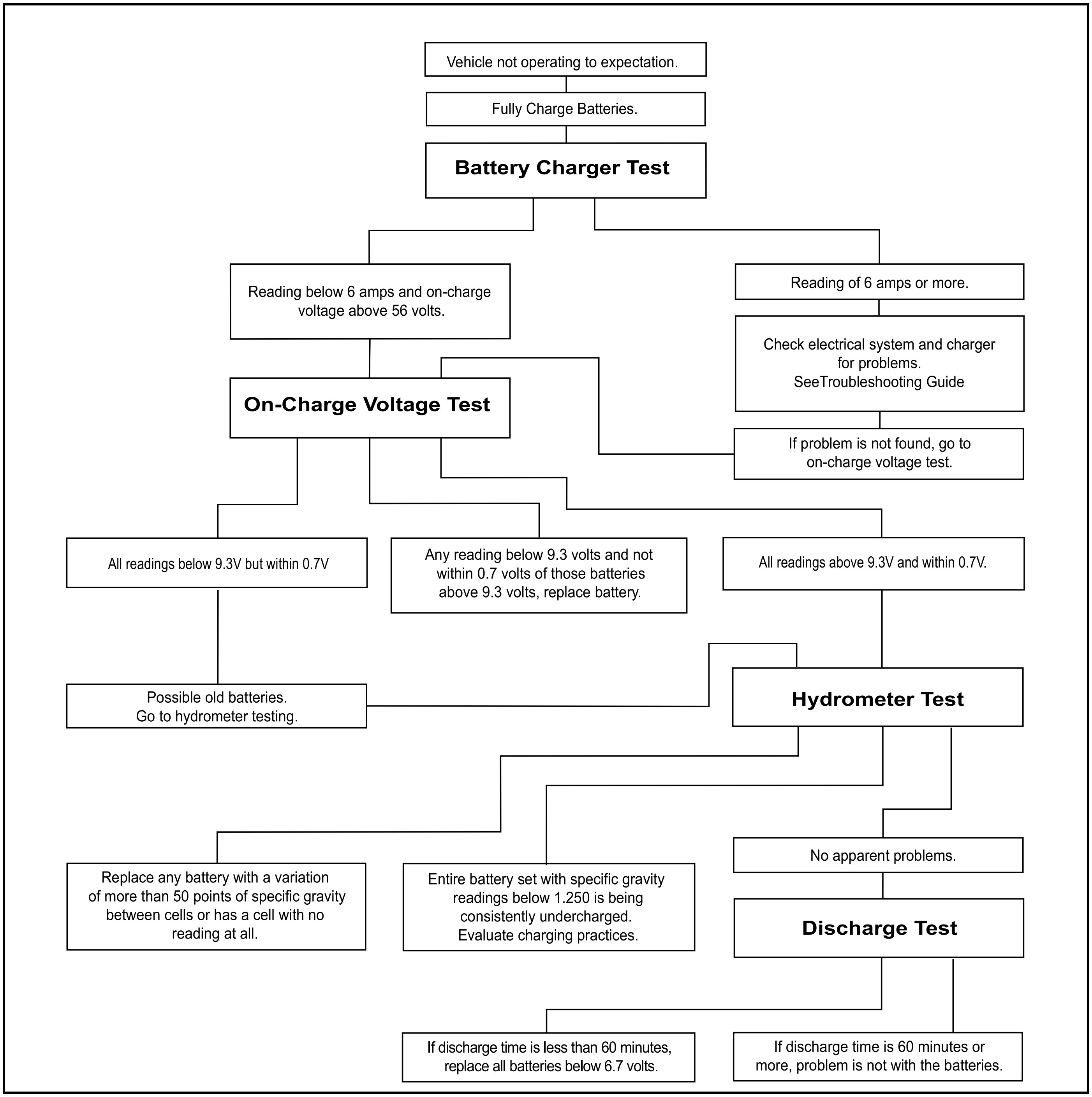

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Figure 18-1 Battery Troubleshooting Chart

BATTERY TESTING – 12 VOLT

See General Warnings on page 1-1.

Four tests have been developed to help diagnose problems with batteries that have not performed as expected. Because each test becomes progressively more detailed and time-consuming, begin with the first test and follow through with the other tests until the problem has been identified as outlined in the Battery Troubleshooting Chart **(Figure 18-1, Page 18-2)**.

BATTERY CHARGER TEST

The easiest way to monitor the condition of a vehicle's batteries is simply to observe the reading on the battery charger ammeter at the end of the charge cycle. After a full charge, disconnect the charger DC plug, wait 20 to 30 seconds and reconnect the charger DC plug. The ammeter needle will jump to 15 amps or more and then taper to below 6 amps within 10 to 20 minutes, indicating sound, fully charged batteries.
Continued poor performance may indicate a problem in the vehicle electrical system, brakes or battery charger. If the problem is not found in the vehicle or charging system, proceed to the on-charge voltage test. Batteries that remain at 8 amps or higher should be tested further using the on-charge voltage test.

ON-CHARGE VOLTAGE TEST

When the batteries are fully charged, disconnect the charger DC plug. Wait 20 to 30 seconds and reconnect the DC plug to restart the charger. After 5 minutes, use a multimeter to check and record the voltage of the battery set as well as the individual batteries. Set the multimeter to 200 volts DC. Place the red (+) probe on the positive (+) post of battery no. 1 and the black (–) probe on the negative (–) post of battery no. 4 **(Figure 18-6, Page 18-16)**. Record reading. Then set multimeter to 20 volts DC and place the red (+) probe on the positive (+) post and the black (–) probe at the negative (–) post of each battery. Record the readings.
The on-charge voltage for the set should be between 56.0 volts and 63.0 volts depending on the age and state of charge of the batteries being tested. If individual batteries read above 14.0 volts and are within 1.0 volts of each other, go to the hydrometer test. If any battery reads below 14.0 volts and not within 1.0 volts of those batteries above 14.0 volts, replace battery. If readings are below 14.0 volts but within 1.0 volts of each other, the batteries are old. Old batteries may have enough capacity left to last several more months. Go to hydrometer test. **See Battery Troubleshooting Chart on page 18-2** and the examples on the following pages.

HYDROMETER TEST

A hydrometer measures the specific gravity of the battery's electrolyte. The higher the specific gravity, the higher the state of charge of the batteries. A fully charged battery should read between 1.250 and 1.280 at 80 °F (26.7 °C). Never add acid to batteries to obtain a higher specific gravity.

Performing the Hydrometer Test

1. Be sure batteries have sufficient electrolyte to cover plates by approximately 1/2 inch (13 mm) and are fully charged prior to beginning test. If water must be added, recharge the batteries before performing the hydrometer test. **See following CAUTION.**

CAUTION

- **Do not allow battery acid from battery caps or hydrometer to drip onto the front or rear body of the vehicle. Battery acid will cause permanent damage. Wash immediately.**

2. Remove the vent cap. Using a battery thermometer (CC P/N 1011767), record electrolyte temperature of the no. 1 cell.
3. Squeeze the rubber bulb of the hydrometer and insert into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
4. When the float rises off the bottom, adjust the electrolyte level so that the float rides free of the bottom but does not strike the top of the glass tube. Remove the hydrometer from the cell and release the pressure from the bulb.
5. Hold the hydrometer vertically, ensuring that the float is not touching the sides of the barrel. Hold the hydrometer at eye level and read the scale at the level of electrolyte **(Figure 18-2, Page 18-4)**.
6. Record the reading and return the electrolyte to the cell from which it was taken. Replace vent cap.
7. Repeat steps 2 through 6 on all cells.

Hydrometer Calibration

Most hydrometers are calibrated to read correctly at 80 °F (26.7 °C). The readings obtained as described above must be corrected for temperature. For each 10 °F (5.6 °C) above 80 °F (26.7 °C), add 0.004 to the reading. For each 10 °F (5.6 °C) below 80 °F (26.7 °C), subtract 0.004 from the reading.

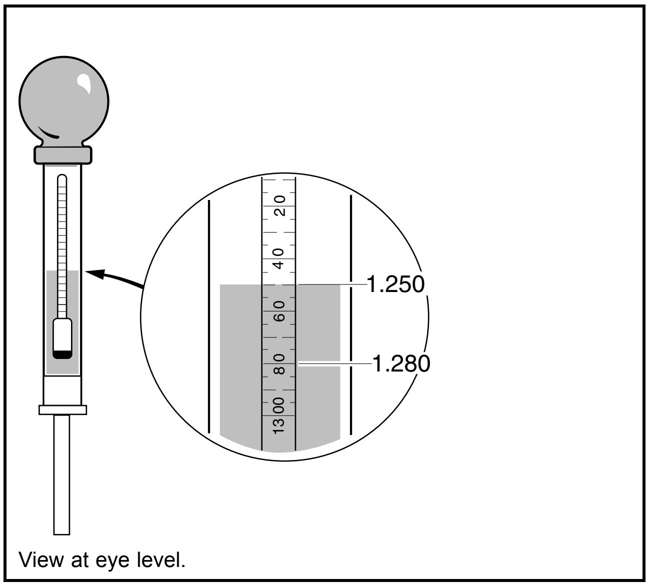


Figure 18-2 Hydrometer Test

Interpreting the Results of the Hydrometer Test

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

SPECIFIC GRAVITY (TEMPERATURE CORRECTED)	APPROXIMATE STATE OF CHARGE
1.250-1.280	100%
1.220-1.240	75%
1.190-1.210	50%
1.160-1.180	25%

If the difference between the cells is 0.020 or more, the low cell should be suspected. It may require a catch-up charge or it may be a weak cell. When the variations between cells reach 0.050 or more, the battery with the low cell should be replaced.

VEHICLE NO.	BATTERY NO.	ELECTROLYTE TEMPERATURE	CORRECTION FACTOR	CORRECTED SPECIFIC GRAVITY						REQUIRED ACTION
				CELL 1	CELL 2	CELL 3	CELL 4	CELL 5	CELL 6	
12	1	20 °F (–6.6 °C)	–0.024	1.275 –0.024 = 1.251	1.280 –0.024 = 1.256	1.280 –0.024 = 1.256	1.275 –0.024 = 1.251	1.280 –0.024 = 1.256	1.280 –0.024 = 1.256	Sound Battery – Fully Charged
54	3	50 °F (10 °C)	–0.012	1.260 –0.012 = 1.248	1.200 –0.012 = 1.188	1.270 –0.012 = 1.258	1.265 –0.012 = 1.253	1.270 –0.012 = 1.258	1.260 –0.012 = 1.248	Bad no. 2 Cell
38	2	100 °F (37.8 °C)	+.008	1.200 + 0.008 = 1.208	1.180 + 0.008 = 1.188	1.170 + 0.008 = 1.178	1.200 + 0.008 = 1.208	1.180 + 0.008 = 1.188	1.198 + 0.008 = 1.198	Discharged Battery – Recharge and Recheck
22	4	80 °F (26.7 °C)	.000	1.240 – 0 = 1.240	1.245 – 0 = 1.245	Float does not rise	1.235 – 0 = 1.235	1.250 – 0 = 1.250	1.240 – 0 = 1.240	no.3 Cell Dead – Replace Battery

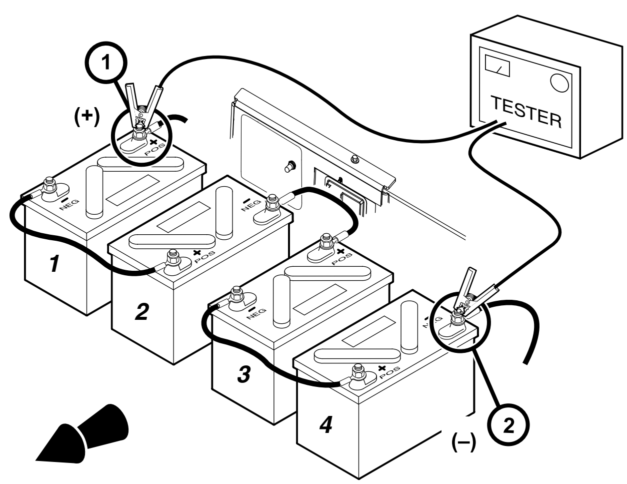
DISCHARGE TEST

If the previous tests have failed to identify the problem, conduct a discharge test. The discharge test comes closest to simulating actual vehicle operating conditions by continuously drawing current from the batteries until voltage drops to 42.0 volts.
The discharge test is the hardest test on the batteries and the most time-consuming to perform. Use the battery discharge tester (P/N 101831901).

Performing the Discharge Test

1. Be sure the batteries are fully charged and that the electrolyte level is correct in all cells.
2. Connect the tester leads to the positive (+) post of battery no.1 and negative (–) post of battery no. 4 **(Figure 18-3, Page 18-6)**.
3. Check and record the electrolyte temperature of the battery packs. Check cell no. 2 (second cell from positive post) in each battery.
4. Reset discharge machine and turn the tester ON.
5. When the batteries have been discharging for approximately 60 minutes, set the discharge machine to function 3 and check battery set voltage. Check voltage every 10 minutes throughout the rest of the test. As soon as the battery set voltage reaches 0.5 volts above the shut-off point (42.0 volts), use a multimeter to measure individual battery voltages. Measure and record the voltage of each battery to the nearest 0.01 volt. **See following NOTE.**

NOTE: *The tester will shut off automatically when shut-off voltage is reached.*



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 4 (-).

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Figure 18-3 Battery Discharge Test – 4 x 12 Volt Battery Configuration

Interpreting Discharge Test Results

1. If discharge time is 60 minutes or higher, the problem is not with the batteries.
2. If discharge times are low (less than 60 minutes), replace batteries below 10.05 volts.

BATTERY VOLTAGES				BATTERY CONDITION
1	2	3	4	
10.50 V	10.50 V	10.50 V	10.50 V	Excellent
10.60 V	10.60 V	10.83 V	9.75 V	Battery no. 4 is near end of useful life
10.8 V	10.8 V	10.01 V	9.41 V	Battery nos. 3 and 4 are near end of useful life

3. In general, battery sets that discharge in less than 60 minutes at 78 °F (25.6 °C) on the discharge test will typically not hold a charge for an entire work shift. However, discharge time is dependent on the electrolyte temperature. The table shown gives the discharge times, at various temperatures, of a set of batteries that delivers 62 minutes at 80 °F (26.7 °C).

ELECTROLYTE TEMPERATURE	DISCHARGE TIME TO SHUT-OFF POINT	ELECTROLYTE TEMPERATURE	DISCHARGE TIME TO SHUT-OFF POINT
40-49 °F (4-9 °C)	40 Minutes	85-89 °F (29-32 °C)	64 Minutes
50-59 °F (10-15 °C)	45 Minutes	89-99 °F (32-37 °C)	66 Minutes
60-64 °F (16-18 °C)	50 Minutes	100-109 °F (38-43 °C)	68 Minutes
65-69 °F (18-21 °C)	54 Minutes	110-119 °F (43-48 °C)	70 Minutes
70-74 °F (21-23 °C)	57 Minutes	120-129 °F (49-54 °C)	72 Minutes
75-79 °F (24-26 °C)	60 Minutes	130-150 °F (54-66 °C)	74 Minutes
80-84 °F (27-29 °C)	62 Minutes	*****	*****

BATTERY TROUBLESHOOTING EXAMPLES

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

Example 1
Vehicle no. 68 was suspected of having a bad battery due to its performance. As a result, the battery charger test was performed. After a full charge, the battery charger ammeter read 8.0 amps. Next, the on-charge voltage test was performed and the following results were recorded:

BATTERY NO.	1	2	3	4
On-Charge Voltage	15.22 V	15.90 V	14.70* V	15.24 V

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

Hydrometer test results:

CELL NUMBER	BATTERY NUMBER			
	1	2	3	4
Cell 1 (Positive Post)	1.200*	1.265	1.300	1.250
Cell 2	1.285	1.275	1.290	1.270
Cell 3	1.265	1.270	1.275	1.265
Cell 4 (Negative Post)	1.275	1.270	1.285	1.265
Cell 5	1.270	1.265	1.280	1.270
Cell6	1.275	1.280	1.280	1.260

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

Discharge test results:

BATTERY NO.	1	2	3	4
Discharge Voltage	8.16* V	10.99 V	11.60 V	10.72 V

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

Example 2
Vehicle no. 70 was also suspected of having a bad battery due to its performance. The battery charger test showed 7.0 amps after a full charge. After confirming there were no problems with the electrical system, charger or brakes, the on-charge voltage was recorded as follows:

BATTERY NO.	1	2	3	4
On-Charge Voltage	15.72 V	14.66* V	15.80 V	15.85 V

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

BATTERY TESTING – 8 VOLT

See General Warnings on page 1-1.

Four tests have been developed to help diagnose problems with batteries that have not performed as expected. Because each test becomes progressively more detailed and time-consuming, begin with the first test and follow through with the other tests until the problem has been identified as outlined in the Battery Troubleshooting Chart **(Figure 18-1, Page 18-2)**.

BATTERY CHARGER TEST

The easiest way to monitor the condition of a vehicle's batteries is simply to observe the reading on the battery charger ammeter at the end of the charge cycle. After a full charge, disconnect the charger DC plug, wait 20 to 30 seconds and reconnect the charger DC plug. The ammeter needle will jump to 15 amps or more and then taper to below 6 amps within 10 to 20 minutes, indicating sound, fully charged batteries.

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

ON-CHARGE VOLTAGE TEST

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

The on-charge voltage for the set should be between 56.0 volts and 63.0 volts depending on the age and state of charge of the batteries being tested. If individual batteries read above 7.0 volts and are within 0.5 volts of each other, go to the hydrometer test. If any battery reads below 7.0 volts and not within 0.5 volts of those batteries above 7.0 volts, replace battery. If readings are below 7.0 volts but within 0.5 volts of each other, the batteries are old. Old batteries may have enough capacity left to last several more months. Go to hydrometer test. **See Battery Troubleshooting Chart on page 18-2** and the examples on the following pages.

HYDROMETER TEST

A hydrometer measures the specific gravity of the battery's electrolyte. The higher the specific gravity, the higher the state of charge of the batteries. A fully charged battery should read between 1.250 and 1.280 at 80 °F (26.7 °C). Never add acid to batteries to obtain a higher specific gravity.

Performing the Hydrometer Test

1. Be sure batteries have sufficient electrolyte to cover plates by approximately 1/2 inch (13 mm) and are fully charged prior to beginning test. If water must be added, recharge the batteries before performing the hydrometer test. **See following CAUTION.**

CAUTION

- **Do not allow battery acid from battery caps or hydrometer to drip onto the front or rear body of the vehicle. Battery acid will cause permanent damage. Wash immediately.**

2. Remove the vent cap. Using a battery thermometer (P/N 1011767), record electrolyte temperature of the no. 2 cell.
3. Squeeze the rubber bulb of the hydrometer and insert into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
4. When the float rises off the bottom, adjust the electrolyte level so that the float rides free of the bottom but does not strike the top of the glass tube. Remove the hydrometer from the cell and release the pressure from the bulb.
5. Hold the hydrometer vertically, ensuring that the float is not touching the sides of the barrel. Hold the hydrometer at eye level and read the scale at the level of electrolyte **(Figure 18-4, Page 18-10)**.
6. Record the reading and return the electrolyte to the cell from which it was taken. Replace vent cap.
7. Repeat steps 2 through 6 on all cells.

Hydrometer Calibration

Most hydrometers are calibrated to read correctly at 80 °F (26.7 °C). The readings obtained as described above must be corrected for temperature. For each 10 °F (5.6 °C) above 80 °F (26.7 °C), add 0.004 to the reading. For each 10 °F (5.6 °C) below 80 °F (26.7 °C), subtract 0.004 from the reading.

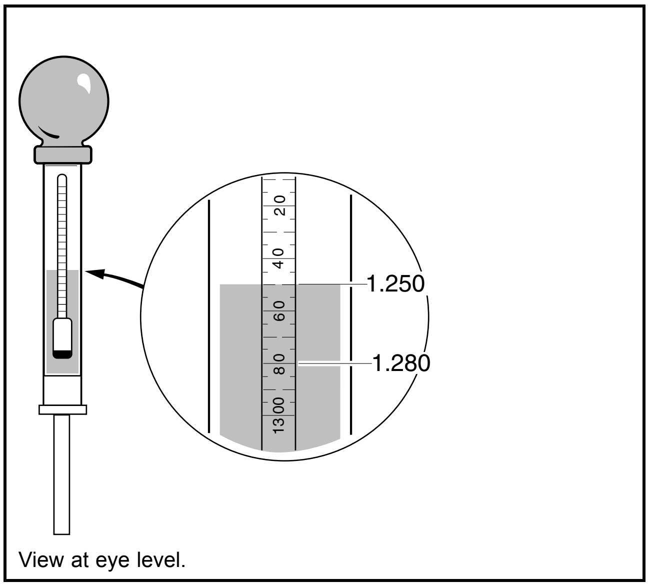

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Figure 18-4 Hydrometer Test

Interpreting the Results of the Hydrometer Test

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

SPECIFIC GRAVITY (TEMPERATURE CORRECTED)	APPROXIMATE STATE OF CHARGE
1.250-1.280	100%
1.220-1.240	75%
1.190-1.210	50%
1.160-1.180	25%

If the difference between the cells is 0.020 or more, the low cell should be suspected. It may require a catch-up charge or it may be a weak cell. When the variations between cells reach 0.050 or more, the battery with the low cell should be replaced.

VEHICLE NO.	BATTERY NO.	ELECTROLYTE TEMPERATURE	CORRECTION FACTOR	CORRECTED SPECIFIC GRAVITY			REQUIRED ACTION
				CELL 1	CELL 2	CELL 3	
12	1	20 °F (-6.6 °C)	– 0.024	1.275 –0.024 = 1.251	1.280 – 0.024 = 1.256	1.280 – 0.024 = 1.256	Sound Battery – Fully Charged
35	6	90 °F (32.2 °C)	+ 0.004	1.155 + 0.004 = 1.159	1.165 + 0.004 = 1.169	1.160 + 0.004 = 1.164	Discharged Battery – Recharge
54	3	50 °F (10 °C)	– 0.012	1.260 –0.012 = 1.248	1.200 – 0.012 = 1.188	1.270 – 0.012 = 1.258	Bad no. 2 Cell
69	5	80 °F (26.7 °C)	0.000	1.250 – 0 = 1.250	1.255 – 0 = 1.255	1.230 – 0 = 1.230	Weak no. 3 Cell – Catch-up Charge
38	2	100 °F (37.8 °C)	+ 0.008	1.200 + 0.008 = 1.208	1.180 + 0.008 = 1.188	1.170 + 0.008 = 1.178	Discharged Battery – Recharge and Recheck
22	4	80 °F (26.7 °C)	0.000	1.240 – 0 = 1.240	1.245 – 0 = 1.245	Float does not rise	no.3 Cell Dead – Replace Battery

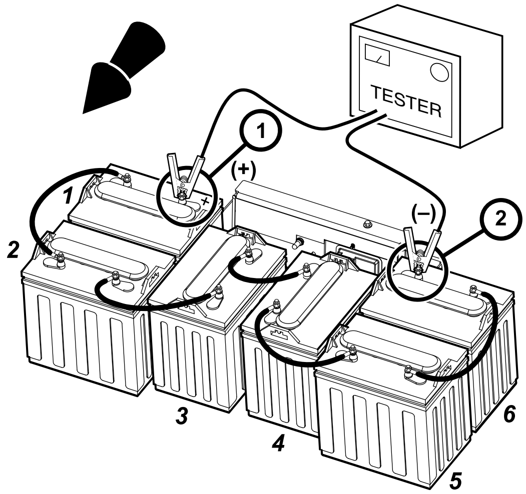
DISCHARGE TEST

If the previous tests have failed to identify the problem, conduct a discharge test. The discharge test comes closest to simulating actual vehicle operating conditions by continuously drawing current from the batteries until voltage drops to 42.0 volts.
The discharge test is the hardest test on the batteries and the most time-consuming to perform. Use the battery discharge tester (P/N 101831901).

Performing the Discharge Test

1. Be sure the batteries are fully charged and that the electrolyte level is correct in all cells.
2. Connect the tester leads to the positive (+) post of battery no.1 and negative (–) post of battery no. 6 **(Figure 18-5, Page 18-12)**.
3. Check and record the electrolyte temperature of the battery packs. Check cell no. 2 (second cell from positive post) in each battery.
4. Reset discharge machine and turn the tester ON.
5. When the batteries have been discharging for approximately 60 minutes, set the discharge machine to function 3 and check battery set voltage. Check voltage every 10 minutes throughout the rest of the test. As soon as the battery set voltage reaches 0.5 volts above the shut-off point (42.0 volts), use a multimeter to measure individual battery voltages. Measure and record the voltage of each battery to the nearest 0.01 volt. **See following NOTE.**

NOTE: *The tester will shut off automatically when shut-off voltage is reached.*



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

720
Figure 18-5 Battery Discharge Test – 6 x 8 Volt Battery Configuration

Interpreting Discharge Test Results

1. If discharge time is 60 minutes or higher, the problem is not with the batteries.
2. If discharge times are low (less than 60 minutes), replace batteries below 6.7 volts.

BATTERY VOLTAGES						BATTERY CONDITION
1	2	3	4	5	6	
7.00 V	7.00 V	7.00 V	7.00 V	7.00 V	7.00 V	Excellent
7.07 V	7.07 V	7.22 V	6.50 V	7.07 V	7.07 V	Battery no. 4 is near end of useful life.
7.20 V	7.20 V	6.67 V	7.33 V	6.27 V	7.33 V	Battery nos. 3 and 5 are near end of useful life.

3. In general, battery sets that discharge in less than 60 minutes at 78 °F (25.6 °C) on the discharge test will typically not hold a charge for an entire work shift. However, discharge time is dependent on the electrolyte temperature. The table shown gives the discharge times, at various temperatures, of a set of batteries that delivers 62 minutes at 80 °F (26.7 °C).

ELECTROLYTE TEMPERATURE	DISCHARGE TIME TO SHUT-OFF POINT	ELECTROLYTE TEMPERATURE	DISCHARGE TIME TO SHUT-OFF POINT
40-49 °F (4-9 °C)	40 Minutes	85-89 °F (29-32 °C)	64 Minutes
50-59 °F (10-15 °C)	45 Minutes	89-99 °F (32-37 °C)	66 Minutes
60-64 °F (16-18 °C)	50 Minutes	100-109 °F (38-43 °C)	68 Minutes
65-69 °F (18-21 °C)	54 Minutes	110-119 °F (43-48 °C)	70 Minutes
70-74 °F (21-23 °C)	57 Minutes	120-129 °F (49-54 °C)	72 Minutes
75-79 °F (24-26 °C)	60 Minutes	130-150 °F (54-66 °C)	74 Minutes
80-84 °F (27-29 °C)	62 Minutes	*****	*****

BATTERY TROUBLESHOOTING EXAMPLES

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

Example 1

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

BATTERY NO.	1	2	3	4	5	6
On-Charge Voltage	10.15 V	10.60 V	9.80* V	10.16 V	10.56 V	10.61 V

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

Hydrometer test results:

CELL NUMBER	BATTERY NUMBER					
	1	2	3	4	5	6
Cell 1 (Positive Post)	1.200*	1.265	1.300	1.250	1.280	1.260
Cell 2	1.285	1.275	1.290	1.270	1.295	1.265
Cell 3	1.265	1.270	1.275	1.265	1.280	1.275
Cell 4 (Negative Post)	1.275	1.270	1.285	1.265	1.275	1.275

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

Discharge test results:

BATTERY NO.	1	2	3	4	5	6
Discharge Voltage	5.44* V	7.33 V	7.73 V	7.15 V	7.43 V	7.41 V

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

Example 2

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

BATTERY NO.	1	2	3	4	5	6
On-Charge Voltage	10.48 V	9.77* V	10.53 V	10.57 V	10.55 V	10.33 V

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

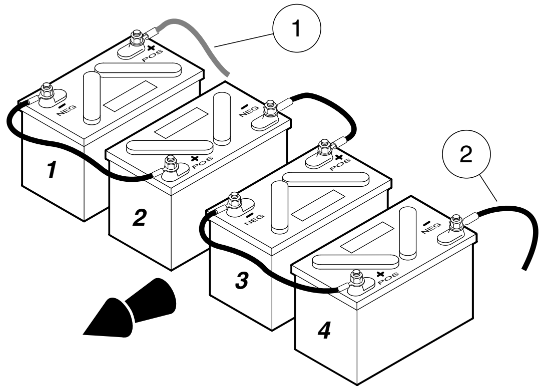
BATTERY REPLACEMENT

See General Warnings on page 1-1.

⚠ WARNING

- **To prevent electrolyte leakage from the battery vents, batteries must be kept in an upright position. Tipping a battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out the vent hole. Do not exceed this 45° angle when lifting, carrying, or installing batteries. Battery acid can cause severe personal injury to skin or eyes, and can damage clothing.**
- **When replacing batteries in the Single Point Watering System, place the battery cap from the new replacement battery onto the used battery being removed from the car. Important safety warnings on the battery cap must remain with the battery after it has been removed from the car**

1. Before removing batteries, note the orientation of the batteries and the connecting wires. Disconnect the battery cables and discharge the controller as instructed. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.** Remove remaining wires and batteries **(Figure 18-6, Page 18-16) (Figure 18-7, Page 18-16)**.
2. Visually inspect the new batteries for any damage that may have occurred in transit. New batteries will not deliver their full capabilities until they have been discharged and recharged 20 to 50 times. To obtain the maximum service life from new batteries, restrict vehicles with new batteries to one hour of operation between charges for the first two months vehicle is in service. Batteries should be fully charged before first use of new vehicle, before first use of a vehicle after storage, and before use each day.
3. If the battery cables are to be reused, inspect them for broken or frayed wires, damaged terminals, or worn insulation. Remove any corrosion on the connectors. A solution of baking soda and water (1 cup (237 mL) baking soda per 1 gallon (3.8 L) of water) does an excellent job of neutralizing and removing the corrosion. Be careful not to allow the baking soda solution to enter the battery.
4. Check and clean the battery rack and hold-downs. The nuts and bolts on the hold-downs may corrode. It is therefore advised they be cleaned periodically and replaced as necessary.
5. Install batteries in the proper orientation **(Figure 18-6, Page 18-16) (Figure 18-7, Page 18-16)**. Install battery hold-downs. The hold-downs should be tight enough so batteries do not move while vehicle is in motion, but not so tight as to crack or buckle battery case. Tighten hold-down retaining nuts to 72 in-lb (8.1 N·m), alternating between hold-down bolts.
6. Install wires in proper sequence. Install black wire to negative post of battery no. 4 (4 x 12-Volt battery set) or battery no. 6 (6 x 8-Volt battery set) last. Tighten all connections to 110 in-lb (12.4 N·m). Coat all terminals with Battery Terminal Protector Spray (P/N 1014305) to minimize future corrosion.
7. Give the batteries a full charge prior to operation. This ensures all the batteries are fully charged and the cells are equalized prior to use.



(Viewed from driver side of vehicle)
1. RED wire to battery no. 1 (+).
2. BLACK wire to battery no. 4 (-).

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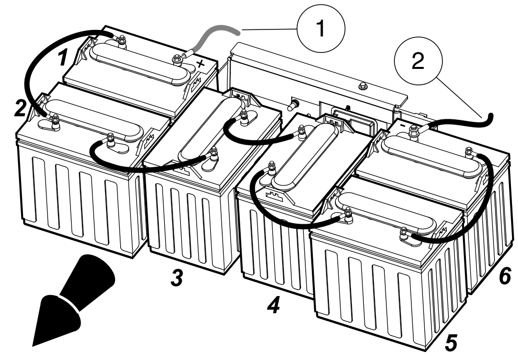
Figure 18-6 Battery Configuration – 4 x 12 Volt



(Viewed from driver side of vehicle)
1. RED wire to battery no. 1 (+).
2. BLACK wire to battery no. 6 (-).

723
Figure 18-7 Battery Configuration – 6 x 8 Volt

BATTERY CARE

See General Warnings on page 1-1.

WATER QUALITY

To keep batteries in good working condition, the purity of water used is very important. Distilled water is quite pure and is the most common type of water used in batteries. Other acceptable types are deionized water and water from reverse osmosis. Ordinary tap water should not be used because it contains an excessive amount of impurities that will degrade battery performance.

Distilled water is produced by distillation, a process in which water is boiled, the steam is collected and then condensed back into water. This process creates a finished product free of minerals, having left all the impurities in the original water sample. Club Car, along with our battery manufacturers, highly recommends that distilled water be used in electric vehicle batteries.

Deionized water is the purest form of water, but it is also the most expensive. Deionization removes all ionizable particles (organic and inorganic) from water through ion exchange. Positively and negatively charged ions are removed from the water and replaced with H+ and OH- ions. When these two ions are combined, they form H2O, or purified water.

Reverse osmosis is a method of removing solids from water by forcing it through a membrane. The membrane rejects all solids while allowing purified water to pass through. The choice of membrane determines the amount of impurities that the water may contain.

Water from municipal supplies, ponds and wells usually contain detrimental levels of dissolved minerals and chemicals. If using tap water, it is important to use an in-line deionizer to remove impurities that can damage batteries and significantly reduce battery life. If tap water is used without a deionizer, regular water analyses must be conducted to check for impurities because water companies commonly revise their additives on a periodic basis. The following chart lists the maximum allowable minerals, solids, and contaminates in parts per million and their impact on battery performance. Your local water company should be able to perform testing and compare their results to the chart.

If using tap water, Club Car's Service Parts Department offers two different deionizer systems: one for vehicles equipped with the Single Point Water System (SPWS) P/N AM1240701 and the other for vehicles without SPWS, P/N AM10974.

TABLE CONTINUED ON NEXT PAGE

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)	EFFECTS OF IMPURITY
Suspended matter	Trace	-
Total solids	100.0	-
Organic and volatile matter	50.0	Corrosion of positive plates
Ammonia	8.0	Slight self-discharge of both plates
Antimony	5.0	Self-discharge, reduces life, lower on-charge voltage
Arsenic	0.5	Self-discharge, can form poisonous gas
Calcium	40.0	Increase of positive plate shedding
Chloride	5.0	Loss of capacity in plates, greater loss in positive plates
Copper	5.0	Increased self-discharge, lower on-charge voltage
Iron	3.0	Increased self-discharge, lower on-charge voltage
Magnesium	40.0	Reduced life
Nickel	None allowed	Intense lowering of on-charge voltage
Nitrates	10.0	Increased sulfation of negative plate
Nitrates	5.0	Plate corrosion, loss of capacity, reduced life
Platinum	None allowed	Violent self-discharge, lower on-charge voltage
Selenium	2.0	Positive plate shedding
Zinc	4.0	Slight self-discharge of negative plates

BATTERY CARE – VEHICLES EQUIPPED WITH THE SINGLE-POINT WATERING SYSTEM

⚠ WARNING

- **When replacing batteries in the Single Point Watering System, place the battery cap from the new replacement battery onto the used battery being removed from the car. Important safety warnings on the battery cap must remain with the battery after it has been removed from the car.**

To keep batteries in good working condition, follow this maintenance program on a regular basis:

1. Keep the batteries clean and free of corrosion. Wash tops and terminals of batteries with a solution of baking soda and water (1 cup (237 mL) baking soda per gallon (3.8 L) of water). Rinse solution off of the batteries. Do not allow this solution to enter the battery. Be sure terminals are tight. Let the terminals dry and then coat with Battery Terminal Protector Spray (P/N 1014305). **See following NOTE.**

NOTE: *Dispose of waste water properly.*

2. The battery hold-downs should be tight enough so that the batteries do not move while the vehicle is in motion, but not so tight as to crack or buckle the battery case. Tighten hold-down retaining nuts to the proper torque. **See step 5 of Battery Replacement on page 18-15.** The terminal connections should be clean and tight, and any worn insulation or frayed wires should be replaced. Tighten battery terminals to proper torque. **See Connecting the Batteries – Electric Vehicles on page 1-3. See following WARNING.**

⚠ WARNING

- **If battery wire terminals are damaged or corroded, replace or clean them as necessary. Failure to do so may cause them to overheat during operation and could result in fire, property damage, or personal injury.**

3. After use, charge the batteries. The batteries should never be left discharged any longer than absolutely necessary (do not leave discharged overnight).
4. Water the batteries monthly or according to the watering interval. **See Establishing the Watering Interval for New Vehicles on page 18-18. See Watering Batteries with the SPWS on page 18-26.**

CAUTION

- **The watering interval must adequately maintain the electrolyte level above the top of the plates. See Figure 18-8, Page 18-20.**

- **Water the batteries only AFTER charging.**

Establishing the Watering Interval for New Vehicles

If you do not already have a battery watering interval for your vehicles, manually check the battery water level weekly to establish the correct watering interval. Thereafter, water batteries according to the established interval. During periods of heavy use, add additional watering as required.

Single-Point Watering System Maintenance

1. For vehicles newly equipped with the Single-Point Watering System, the initial electrolyte level check on all battery cells verifies that all the valves in the SPWS are functioning correctly. **See Periodic Service Schedule on page 10-3.** If a valve is fails to open, the cell will eventually dry out. The initial one-time inspection of all cells will identify any occurrence of a valve that fails to open. If a valve fails to close, it will become evident due to the cell overflowing during routine watering. Either failure scenario is rare, but should be monitored in the initial inspection and during routine watering sessions. Replace malfunctioning valves to ensure maximum battery life. **See following CAUTION.**

CAUTION

- **After checking the electrolyte, fully tighten the battery caps to prevent electrolyte leakage.**

2. After the initial six-week inspection, manually check the electrolyte level at least once per year, particularly after long-term storage or any other period of vehicle inactivity. **See preceding CAUTION.**

BATTERY CARE – VEHICLES WITHOUT THE SINGLE-POINT WATERING SYSTEM

To keep batteries in good working condition, follow this maintenance program on a regular basis:

1. Keep the batteries clean and free of corrosion. Wash tops and terminals of batteries with a solution of baking soda and water (1 cup (237 mL) baking soda per gallon (3.8 L) of water). Rinse solution off of the batteries. Do not allow this solution to enter the battery. Be sure terminals are tight. Let the terminals dry and then coat with Battery Terminal Protector Spray (P/N 1014305). **See following NOTE.**

NOTE: *Dispose of waste water properly.*

2. Check the electrolyte level weekly **(Figure 18-8, Page 18-20)**. Add water only **after** charging unless the electrolyte level is below the top of the plates. In this case, add just enough water to cover the plates, charge, and then check the level again. Never charge batteries if plates are exposed above electrolyte level. For best battery life, add only distilled water. **See following CAUTION and NOTE.**

CAUTION

- **Do not overfill the batteries.**

NOTE: *A battery watering gun or bottle is available at many auto parts dealers.*

3. The battery hold-downs should be tight enough so that the batteries do not move while the vehicle is in motion, but not so tight as to crack or buckle the battery case. Tighten hold-down retaining nuts to the proper torque. **See step 8 of Battery Replacement on page 18-15.** The terminal connections should be clean and tight, and any worn insulation or frayed wires should be replaced. Tighten battery terminals to proper torque. **See Connecting the Batteries – Electric Vehicles on page 1-3. See following WARNING.**

⚠ WARNING

- **If battery wire terminals are damaged or corroded, replace or clean them as necessary. Failure to do so may cause them to overheat during operation and could result in fire, property damage, or personal injury.**

4. After use, charge the batteries. The batteries should never be left discharged any longer than absolutely necessary (do not leave discharged overnight).

SELF-DISCHARGE

Contaminants on dirty batteries can provide a path for a small current draw that can slowly discharge batteries, thus wasting valuable energy. To prevent self-discharge, batteries should always be kept clean.
Hot weather also has an effect on a battery's self-discharge rate. The higher the temperature, the quicker a set of batteries will discharge. In hotter climates, batteries should be checked more often. When storing batteries, keep in a cool place. **See Battery Storage on page 18-28.**

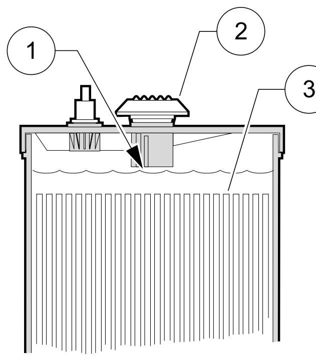
ELECTROLYTE LEVEL

⚠ CAUTION

- **Do not allow battery acid from battery caps or hydrometer to drip onto the front or rear body of the vehicle. Battery acid will cause permanent damage. Wash immediately.**

CAUTION CONTINUED ON NEXT PAGE

⚠ CAUTION



1. Level Indicator 2. Cap 3. Plates
Electrolyte level at least 1/2 inch (13 MM) above plates or to level indicator.

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Figure 18-8 Battery Electrolyte Level

Add water only after charging unless the electrolyte is below the level of the plates. If the electrolyte level is below the level of the plates, add just enough water to cover the plates and then charge the batteries. After charging, fill with water to the level indicator. Filling a battery to the level indicator before charging will result in overfilling because the electrolyte level will rise during charging and some of the electrolyte may bubble out of the cap. This reduces the battery's capacity and corrodes the metal parts around it.
The electrolyte level should be checked weekly to be sure electrolyte is at its proper level **(Figure 18-8, Page 18-20)**. Never allow the electrolyte level to fall below the tops of the plates because this will cause the exposed part of the plate to become permanently inactive. For best results, use a battery watering gun to add water to batteries. Check the electrolyte level more frequently in hot weather or when batteries are old.

VIBRATION DAMAGE

The battery hold-downs should always be tight enough to keep the battery from bouncing. Battery life may be severely shortened if the battery hold-downs are too loose. **See step 8 of Battery Replacement on page 18-15.** Excessive vibration causes the plates to shed prematurely and shortens the life of the battery. It may also cause acid to leak out of the vent caps and corrosion to build up on surrounding metal parts. The acid which is lost reduces the capacity of the battery and cannot be replaced. Battery hold-downs should NOT be so tight as to crack or buckle the battery case. This may cause leaks which would dry out a cell or cause internal short circuits. **See Battery Replacement on page 18-15.**

BATTERY CHARGER – HIGH FREQUENCY

Some vehicles have been equipped with onboard, high frequency battery chargers. Refer to the appropriate high frequency battery charger owner's manual, owner's manual supplement or maintenance and service manual.

BATTERY CHARGER – FERRORESONANT

See General Warnings on 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

- **Only trained technicians should repair or service the charger. Contact your nearest Club Car distributor/dealer.**
- **Each charger should have its own dedicated 15 or 20 ampere separately protected (circuit breaker or fuse) single phase branch circuit, in accordance with all applicable electrical codes for the location.**
- **Connect the charger AC supply cord to a properly grounded, three-wire outlet of the proper voltage and frequency as shown on the charger.**
- **Do not use an adapter to plug the charger with a three-prong plug into a two-prong outlet. Improper connection of the equipment-grounding conductor can result in a fire or an electrical shock.**
- **An extension cord or electrical outlet must accept a three-prong plug. Extension cord should be a three-wire No. 12 AWG (American Wire Gauge) or no. 14 (British Standard Wire Gauge), and be as short as possible (no more than 12 feet (3.7 m)). The use of improper extension cord could result in fire or an electrical shock.**
- **Do not operate the charger if it has received a sharp blow, was dropped, or otherwise damaged in any way.**
- **Have worn, cut, or damaged power cords or wires replaced immediately.**
- **Do not use near fuels, grain dust, solvents, thinners, or other flammables. Chargers can ignite flammable materials and vapors.**
- **Do not expose to rain or any liquid. Keep the charger dry.**
- **Never push objects of any kind into the charger through cabinet slots. They may touch dangerous voltage points or cause an electrical short circuit that could result in fire or electrical shock.**
- **Do not connect a stationary charger to the receptacle if the charger cord, plug, or the vehicle receptacle is broken, damaged, or does not make a good electrical connection. Fire or personal injury can result. Have a qualified technician replace the parts.**
- **When the charger is on, the charger DC cord may be disconnected from the vehicle receptacle slowly. 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.**
- **Do not block or cover the charger ventilation slots. The slots provide ventilation and protect the charger from overheating.**

WARNING CONTINUED ON NEXT PAGE

⚠ WARNING

- **Do not allow clothing, blankets, or other material 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.**

NOTE: *Because the vehicle's onboard computer (OBC) has a storage charge feature that automatically checks and recharges the batteries as necessary every 15 days, the charger can remain plugged to the vehicle throughout the storage period.*

At one hour and at two hours into the charge cycle, the charger will shut off in order to run a selt-diagnostic program (ammeter will drop to zero). Charging will resume in a few moments (ammeter returns to previous rate of charge).

The charger supplied with the electric vehicle resolves the most common problems associated with battery charging. Undercharging and overcharging are prevented provided the charger is allowed to shut off by itself. Also, all cells are automatically given an equalization charge at low current, which prolongs battery life. Batteries should never be left in a discharged state, as this too affects the internal components and can reduce the capacity of the battery. The batteries should be charged every day they are used. However, the batteries should not be charged if they have not been used.

Each electric vehicle is supplied with a fully automatic battery charger as standard equipment. The AC cord to each charger is to be connected to a source capable of supplying 15 amperes minimum per charger.

To reduce the risk of electric shock, the battery charger must be grounded. The charger is equipped with an AC electric cord having 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 Electrical Code and all local codes and ordinances. See the owner's manual supplied with the charger for specific operating instructions before using the charger.

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

- **Be sure all wire connections at the receptacle and the fuse link 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 18-9, Page 18-23).**
- **Do not pull on the DC cord (Figure 18-10, Page 18-23). 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.**

WARNING CONTINUED ON NEXT PAGE

⚠ WARNING

- **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 pins 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.**

NOTE: *When temperatures fall below 18.3 °C (65 °F), batteries charged in unheated areas should be placed on charge as soon as possible after use. Batteries are warmest immediately after use, and cold batteries require more time to fully charge.*

Insert the charger DC plug into the vehicle receptacle. The charger will turn on two to ten seconds later **(Figure 18-9, Page 18-23)**.

When inserting the DC plug, align the raised guide on the plug with the guide slot in the receptacle and push straight in slowly.

Club Car battery chargers interact with the vehicle's onboard computer. The computer records the amount of energy consumed during vehicle use. While the charger is plugged in, the vehicle's control circuit is locked out, preventing operation of the vehicle as well as the possibility of consequent damage to the charger and the vehicle.

Once the lockout is actuated, the charger turns on. The onboard computer then records the amount of energy being returned to the batteries. When the optimum amount of energy needed to replenish the batteries is returned, the charger will shut off. The control circuit lockout remains activated until the charger plug is disconnected from the vehicle.

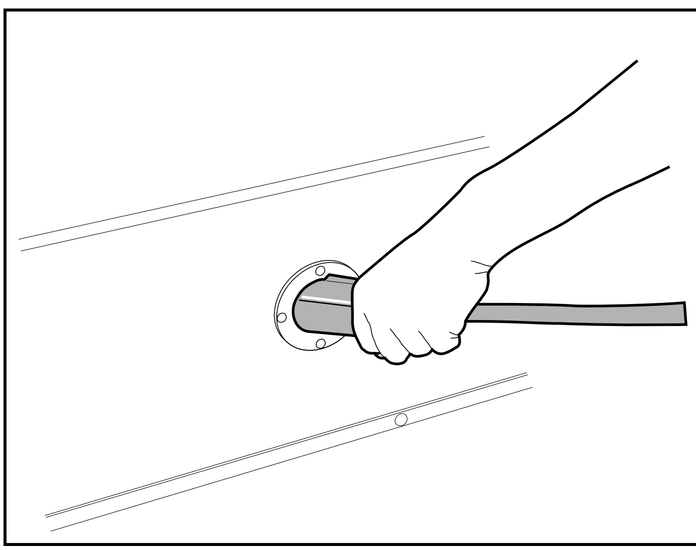

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Figure 18-9 Correct Insertion of Charger DC Plug

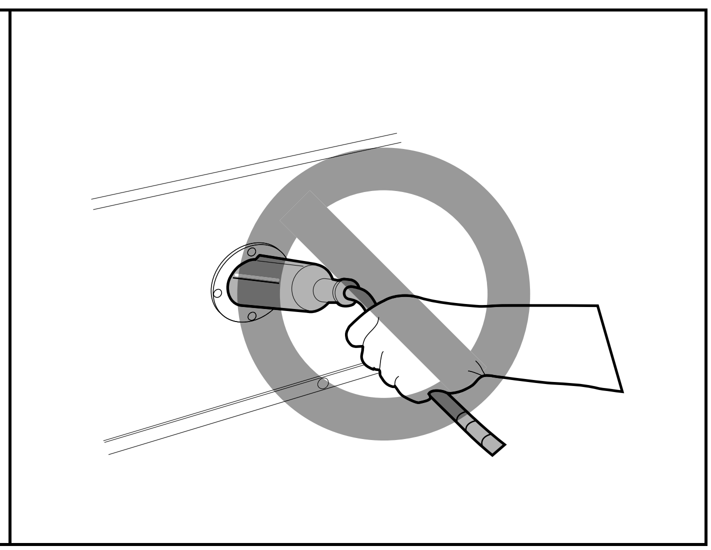

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Figure 18-10 Incorrect Insertion of Charger DC Plug

Electric vehicles are supplied with a PowerDrive or PowerDrive 3 battery charger. Use only the PowerDrive family of chargers with this electric vehicle.

As long as the charger is allowed to shut off by itself, the batteries will be fully charged. Overcharging and undercharging will normally be prevented.
Batteries should be put on charge even if they have been used for only a short period (10 minutes). The charger is automatic and will turn off when batteries are fully charged. If the charger does not seem to be operating properly, or if the batteries seem weak, contact your local Club Car distributor/dealer.

PLUG AND RECEPTACLE

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 or lightly sprayed with WD-40® brand spray lubricant. The plug should then be inserted and removed several times to ensure ease of insertion, ease of removal, and good electrical contact. **See following NOTE.**

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

CHARGER SHUTS OFF AFTER 16 HOURS

This may be due to 1) new batteries, 2) hard use, or 3) cold temperatures. A catch-up charge may be necessary when these conditions are present. On those days when all or some of the vehicles do not get used, check the batteries for state of charge. Any battery with a specific gravity lower than 1.250 will need a catch-up charge. If the problem continues after a catch-up charge has been performed, check the battery charger. Refer to the appropriate battery charger maintenance and service manual. See Section 19 – Battery Charger.

DEEP-DISCHARGE

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

EARLY EXCESSIVE DISCHARGING

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

INCOMING AC SERVICE

Make sure the incoming AC line service is sufficient. If circuit breakers are tripping, fuses blow during the night or the charger does not give the required starting rate when sound batteries are put on charge, an AC line problem exists. The electrical service to the vehicle storage facility should be sufficient to deliver adequate voltage and current to each charger with all the chargers turned on. If not, consult your local power company or electrical contractor. Refer to the appropriate battery charger maintenance and service manual. See Section 19 – Battery Charger.

FLEET ROTATION

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

NOTE: *When vehicles are being rotated, the CDM (Communication Display Module) can be a very helpful service tool. Monitoring the value of function 3 with the CDM simplifies vehicle usage scheduling.* ***See Communication Display Module (CDM) on page 12-39 or Communication Display Module (CDM) on page 14-38.***

NUMBERING VEHICLES AND CHARGERS

Return the vehicles to the same charger each night if possible. If the vehicles are put in a storage facility at random and a vehicle dies while in use and testing shows the batteries are sound, then the problem is most likely with the charger. However, finding the problem charger may prove to be quite time consuming. Numbering the vehicles and the chargers and returning each vehicle to its designated charger each night can significantly reduce the amount of time spent troubleshooting a problem.

SINGLE POINT WATERING SYSTEM (SPWS)

⚠ WARNING

- **When replacing batteries in the Single Point Watering System, place the battery cap from the new replacement battery onto the used battery being removed from the car. Important safety warnings on the battery cap must remain with the battery after it has been removed from the car**

CAUTION

- **Water the batteries only AFTER charging.**
- **Use only the water deionizer equipment (P/N AM1240701) to water batteries with the SPWS.**

INITIAL MAINTENANCE OF THE SPWS

After six-weeks of operation, remove the valves from the batteries and manually check the battery water level to ensure that the SPWS is not leaving any cells dry. This initial electrolyte level check on all the battery cells verifies that all the valves in the SPWS are functioning correctly. If a valve fails to open, the cell will eventually dry out. The initial one-time inspection of all cells will identify any occurrence of a valve that fails to open. If a valve fails to close, it will become evident due to the cell overflowing during routine watering. Either failure scenario is rare, but should be monitored in the initial inspection and during routine watering sessions. Replace malfunctioning valves to ensure maximum battery life. After the initial six-week inspection, manually check the battery water levels at least once per year, particularly after winter storage or any other period of vehicle inactivity. **See following NOTE.**

NOTE: *For the longest battery life, be sure the mineral contents of the water meet the minimum requirements as stated in the vehicle's appropriate maintenance and service manual.* ***See Water Quality on page 18-16.***

WATERING BATTERIES WITH THE SPWS

Checking the Water Flow Rate

1. Connect the water hose with the built-in screen filter (2) to the water faucet (1) **(Figure 18-11, Page 18-26)**. **See following CAUTION.**

CAUTION

- **Make sure the screen filter is clean.**
- **Do not use a longer garden hose than provided with the System (20 feet), as a decrease in water pressure could overfill the batteries and damage the refill system.**

2. Before screwing the hose-end assembly (3) onto the opposite end of the water hose, check the screen filter (4) inside the end of the assembly to make sure it is clean **(Figure 18-11, Page 18-26)**.
3. Connect the purger (5) to the female coupler (8) on the hose-end assembly **(Figure 18-12, Page 18-26)**.

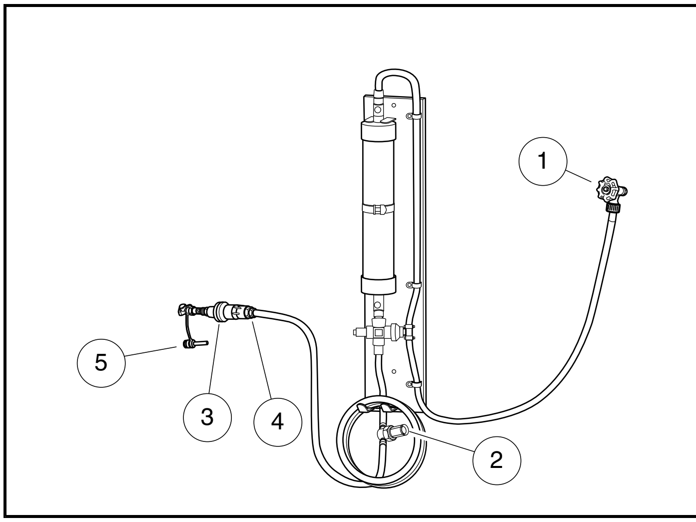

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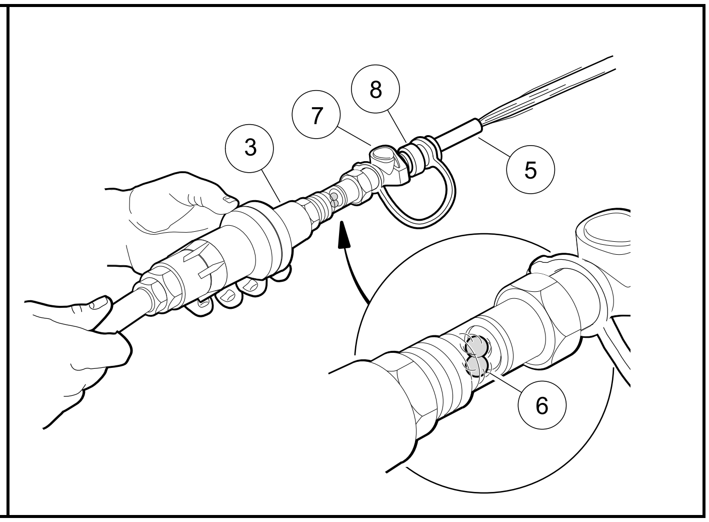
Figure 18-11 Connecting Hose with Filter to Water Source



725
Figure 18-12 Checking the Water Flow Rate

4. Completely open the water faucet until the water flows out of the hose-end assembly (3), and note the movement of the red flow indicator balls (6). **See following NOTE.**

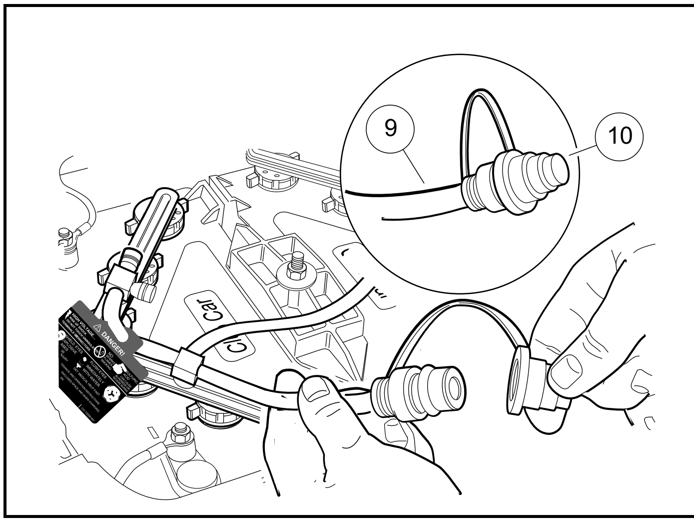
NOTE: *The water flow rate must be at least two gallons-per-minute for the SPWS to function properly.*

This step also eliminates any trapped air from the water hose.

5. Check the water quality light on the deionizer to make sure the light is green in color, indicating acceptable water quality. If the light indicates unacceptable water quality, the cartridge must be replaced.
6. After ensuring adequate water flow rate, press the grey button (7) on the end of the female coupler (8) to disconnect the purger from the pressure regulator.

Refilling the Batteries

1. Locate the battery fill coupling (9) on the driver side of the battery compartment, remove the dust cover (10) from the male connector **(Figure 18-13)**, and connect the hose-end assembly (3) **(Figure 18-14)**. The water flow will begin immediately.



70
Figure 18-13 Dust Cap

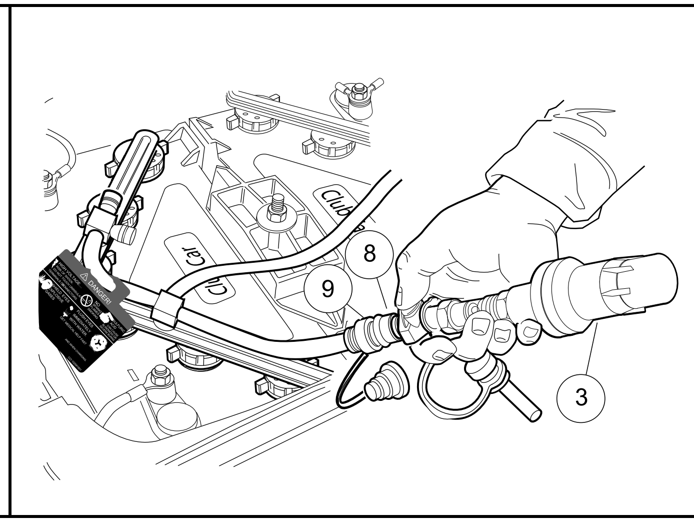


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Figure 18-14 Connecting Hose-end Assembly to Battery Fill Connector

2. The red flow indicator balls should swirl, indicating that the batteries are being filled. **See following CAUTION.**

CAUTION

- **If at any time water overflows from the batteries, immediately stop the refill process, disconnect the pressure regulator from the battery fill coupling, and call for service.**

3. When the red flow indicator balls stop moving, immediately press the grey button to disconnect the hose-end assembly from the battery fill coupling (9), and squeeze the dust cover (10) to lightly secure it to the male connector of the battery fill coupling **(Figure 18-13, Page 18-27)**.
4. Place the battery fill coupling into the space between the battery bucket and the car body. Leaving the fill coupling on top of the battery bank or tucked between the batteries and the battery bucket can result in coupling damage.

Turn the water faucet off when finished filling the vehicle(s).

BATTERY STORAGE

See General Warnings on page 1-1.

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

1. Keep the batteries clean and free of corrosion. **See Battery Care on page 18-16.**
2. Batteries that are in vehicles for winter storage should be left disconnected in the vehicles if the batteries are not going to be connected to a charger.
3. Fully charge the batteries prior to storage.
4. Store in a cool area. The colder the area in which the batteries are stored, the less the batteries will self-discharge. Batteries stored at 0 °F (–17.8 °C) will discharge very little over a four-month period. Batteries stored at 80 °F (26.7 °C) will have to be recharged every few weeks.
5. 48-volt electric vehicles and compatible battery chargers are designed to be left connected, with AC power to the charger ON, during off-season storage. The storage charge feature will automatically charge the batteries as needed throughout the storage period.

CHARGING A BATTERY PACK THAT HAS LOW VOLTAGE

See the appropriate battery charger maintenance and service manual.

SECTION 19 – BATTERY CHARGER

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Refer to the appropriate battery charger maintenance and service manual.

SECTION 20 – MOTOR (MODEL EJ4-4001 AND EJ8-4001A)

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⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

GENERAL INFORMATION

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

MOTOR IDENTIFICATION

There are three types of motors used in these electric vehicles: Model 5BC59JBS6390 (gray housing), EJ4-4001 (black housing) and EJ8-4001A (black housing). The EJ4-4001 and EJ8-4001A motors are from the same manufacturer, share some internal components but differ in the following aspects:

MOTOR	TERMINAL STUDS	INTERNAL PARTS	MOUNTING BOLTS USED
EJ4-4001	All four studs are 5/16" (8mm) diameter	Brush plate assembly, stoning hole cover, frame & field assembly	4
EJ8-4001A	A1 and A2 studs stay 5/16" (8mm) diameter F1 and F2 studs are 1/4" (6.35mm) diameter	Brush plate assembly, stoning hole cover, frame & field assembly	3

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

EXTERNAL MOTOR TESTING

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

NOTE: *Tag the motor wires for identification before disconnecting.*

Scrape a small amount of paint from motor housing (ground) and use this location when testing motor terminals to electrical ground.

Index of Test Procedures

MOTOR TERMINALS	CONTINUITY TEST RESULT
A1 to A2 F1 to F2	Continuity
A1 to F1 A1 to F2	No Continuity
A2 to F1 A2 to F2	No Continuity
A1 to Ground A2 to Ground	No Continuity
F1 to Ground F2 to Ground	No Continuity

TEST PROCEDURE 1 – Internal Short Circuits

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Disconnect wires from terminals on motor using two wrenches to prevent posts from turning.
3. With a multimeter set to 200 ohms, place black (–) probe on motor housing. Scratch through paint to ensure a good connection. Place red (+) probe on A1, A2, S1, and S2 terminals respectively. Multimeter should indicate no continuity between the motor housing and all individual terminals. If readings are incorrect, motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal on page 20-3.**
   3.1. An incorrect reading from the A1 or A2 terminal indicates three possible problems: a grounded A1 or A2 terminal, a grounded wire in the brush area, or a grounded armature/commutator. An incorrect reading for the S1 or S2 terminal indicates a possible grounded S1 or S2 terminal or field coil.
4. If readings are correct, reconnect the motor wires. **See Motor Installation on page 20-14.**
5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

TEST PROCEDURE 2 – Armature Circuit Open

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**

2. Disconnect wires from the A1 and A2 terminals on the motor using two wrenches to prevent posts from turning. Set a multimeter to 200 ohms and place the red (+) probe on the A1 terminal and black (–) probe on the A2 terminal. The multimeter should indicate continuity. If the reading is incorrect, a possible open or poor contact in a brush assembly and/or open armature windings may be the cause. The motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal on page 20-3.**
3. If reading is correct, reconnect the motor wires. **See Motor Installation on page 20-14.**
4. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

TEST PROCEDURE 3 – Field Circuit Open

See General Warnings on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Disconnect wires from the S1 and S2 terminals on the motor using two wrenches to prevent posts from turning. Set a multimeter to 200 ohms and place the red (+) probe on the S1 terminal and the black (–) probe on the S2 terminal. The multimeter should indicate continuity. If the reading is incorrect, a possible open field coil or bad connections at the terminals may be the cause. The motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal on page 20-3.**
3. If reading is correct, reconnect the motor wires. **See Motor Installation on page 20-14.**
4. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**

MOTOR

See General Warnings on page 1-1.

MOTOR REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Disconnect wires from the terminals on the motor using two wrenches to prevent posts from turning. Label the wires to ensure proper reconnection.
3. Slightly loosen all the lug nuts on both rear wheels.
4. Place floor jack under transaxle and raise rear of vehicle **(Figure 20-1, Page 20-4)** then place jack stands under frame crossmember between the spring mount and the side stringer, just forward of each rear wheel. Lower the vehicle to let the jack stands support the vehicle **(Figure 20-2, Page 20-4)**. **See following WARNING.**

⚠ WARNING

- **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.**

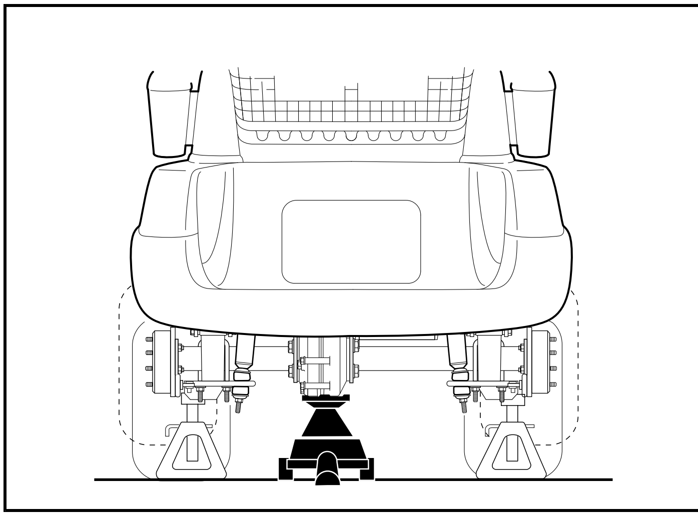

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Figure 20-1 Lift Vehicle with Floor Jack

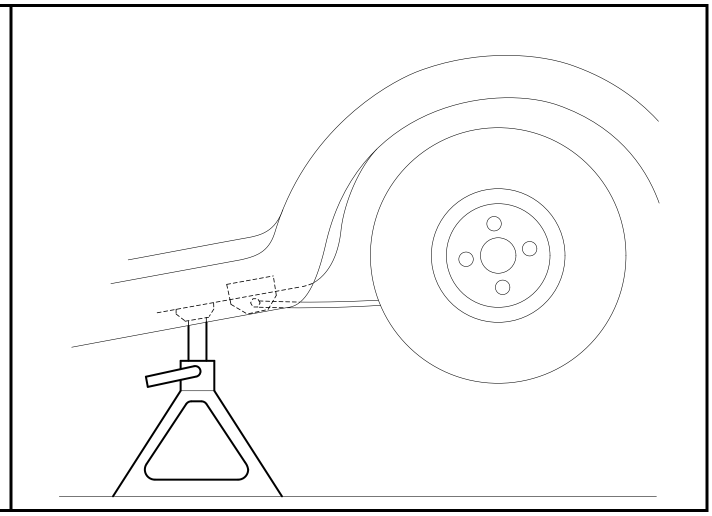

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Figure 20-2 Vehicle Supported on Jack Stands

5. Remove both rear wheels.
6. Remove the nut, cup washer, and bushing from the bottom side of the shock absorber. Compress the shock absorber (pushing upwards) to move it out of the way **(Figure 20-3, Page 20-4)**.
7. Remove the nuts and bolts mounting the rear leaf springs to the shackles.
8. To gain easier access to the motor, lower the transaxle as low as it will go. If more room is needed, remove the jack from beneath the transaxle and allow the springs to rest on the floor **(Figure 20-3, Page 20-4)**.

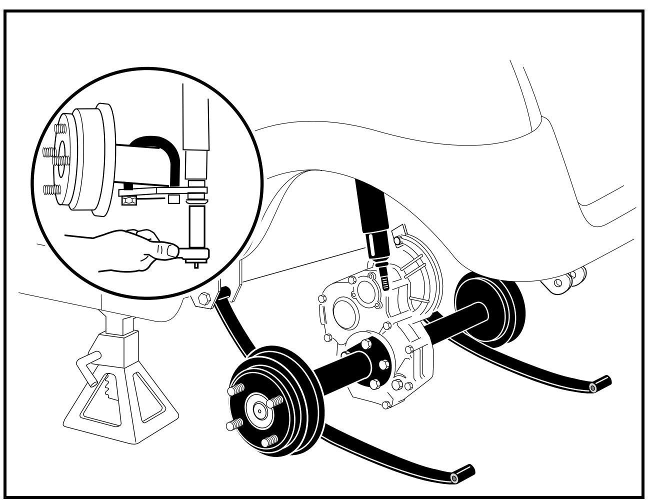

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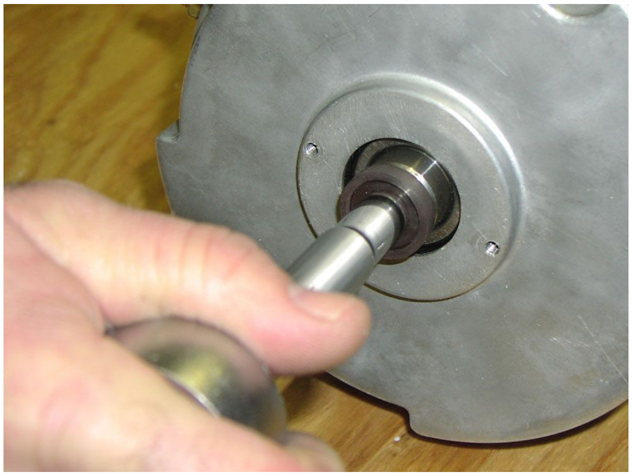
Figure 20-3 Lower Axle

9. Remove the bolts and lock washers that secure the motor to the transaxle **(Figure 20-24, Page 20-16)**. **See following CAUTION.**

⚠ CAUTION

- **Do not position fingers under motor when sliding motor off of the input shaft in step 9. Fingers may get pinched when motor disengages.**

10. Carefully slide the motor away from the transaxle until the motor spline disengages the input shaft and remove the motor from the vehicle.



748
Figure 20-4 Speed Sensor Magnet

749
Figure 20-5 End Cap

MOTOR DISASSEMBLY

1. Before beginning disassembly, place match marks on the motor end cap and motor frame.
2. Remove speed sensor and magnet.
   2.1. Remove the two screws (25) that secure the speed sensor (10) to the end cap (11) **(Figure 20-15, Page 20-11)**.
   2.2. Remove the screw securing the magnet to the armature shaft **(Figure 20-4, Page 20-5)**.
   2.3. Inspect the speed sensor magnet. **See Speed Sensor Magnet Inspection on page 20-10.**
3. Loosen, but do not remove, the two screws securing the end cap to the motor frame **(Figure 20-5, Page 20-5)**.

750
Figure 20-6 End Cap Disengagement

751
Figure 20-7 End Cap Removal

4. Orient the motor so that the splined end of the armature is facing down.
5. Inspect the area where the end cap mates with the motor frame. If the end cap appears to be loose where it connects to the motor frame, proceed to step 6; otherwise, disengage the end cap from the motor frame using the following procedure:
   5.1. With the end cap bolts loose (about 1/4 inch between the end cap and the head of the bolt), place a socket on the head of the bolt. **See following CAUTION.**

CAUTION

- **Ensure that there is sufficient thread engagement of the end cap bolts before proceeding. Performing the procedure without having adequate thread engagement could damage the motor frame, end cap, or end cap bolts.**

5.2. Gently tap each bolt, alternating between blows, until the end cap and motor frame become disengaged **(Figure 20-6, Page 20-5)**.

6. Remove the two end cap bolts.
7. Remove the end cap and armature from the motor frame **(Figure 20-7, Page 20-5)**.
8. Inspect the brush springs for proper tension. **See Motor Brush, Spring, and Terminal Insulator Inspection on page 20-9.**
9. Remove the armature from the end cap bearing. **See following CAUTION and NOTE.**

⚠ CAUTION

- **Removing the armature from the end cap requires two people: one to operate the press, and another to hold the armature. Failure to heed this CAUTION could result in personal injury and/or damage to the armature resulting from an unsupported armature falling after it becomes disengaged from the end cap bearing.**

NOTE: *Replacement of the end cap bearing is recommended if the armature is removed.*

9.1. Place the end cap in a press with the armature facing down.

9.2. Place a bearing press tool with an outer diameter smaller than that of the armature shaft between the press ram and the armature shaft **(Figure 20-8, Page 20-7)**.

9.3. Have an assistant support the armature while the press is activated.

10. Inspect the armature for wear and damage. **See Armature Inspection and Testing on page 20-7.**
11. Inspect the motor frame and field windings. **See Motor Frame and Field Windings Inspection on page 20-9.**
12. Remove the brush rigging.

12.1. Mark the brush terminal posts (A1 and A2).

12.2. Remove the two nuts securing the brush terminals (A1 and A2) to the end cap **(Figure 20-9, Page 20-7)**.

12.3. Remove the two screws and the brush rigging to the end cap **(Figure 20-10, Page 20-7)**.

13. Inspect the terminal insulators. **See Terminal Insulator Inspection on page 20-9.**
14. Remove the bearing from the end cap.

14.1. Remove the retaining ring that secures the bearing in the end cap **(Figure 20-11, Page 20-7)**.

14.2. Use an arbor press to remove the bearing from the end cap.

15. Inspect the bearing for wear and damage. **See Bearing Inspection on page 20-10.**

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Figure 20-8 Armature Removal

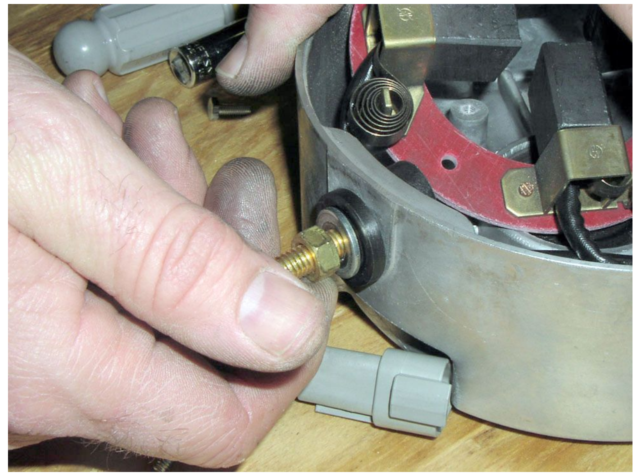

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Figure 20-9 A1 and A2 Terminals

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Figure 20-10 Brush Rigging

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Figure 20-11 Bearing Retaining Ring

MOTOR COMPONENT TESTING AND INSPECTION

See General Warnings on page 1-1.

ARMATURE INSPECTION AND TESTING

1. Remove the motor from the vehicle. **See Motor Removal on page 20-3.**
2. Remove the end cap and armature by performing steps 1 through 7 of Motor Disassembly on page 20-5.

Visual Inspection

- Burned, charred or cracked insulation
- Improperly cured varnish
- Thrown solder

- Flared armature windings
- Damaged armature core laminations
- Worn, burned or glazed commutators
- Dirty or oily commutators
- Raised commutator bars
- Worn armature bearing or shaft

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

CAUTION

- **Do not use emery cloth to polish the commutator. Particles of emery are conductive and may short-circuit the commutator bars. Do not use oil or lubricants on the commutator or brushes.**

NOTE: *Oil on the commutator may indicate a faulty transaxle input shaft oil seal.*

Armature Ground Test

CAUTION

- **Do not submerge the armature in solvent.**

NOTE: *Before testing the armature, wipe it clean with a clean cloth. Remove any carbon dust and metal particles from between the commutator bars.*

1. With a multimeter set to 200 ohms, place one probe on the commutator (1) and the other on the armature core (2). The multimeter should indicate no continuity **(Figure 20-12, Page 20-8)**. If the reading is incorrect, replace the armature.

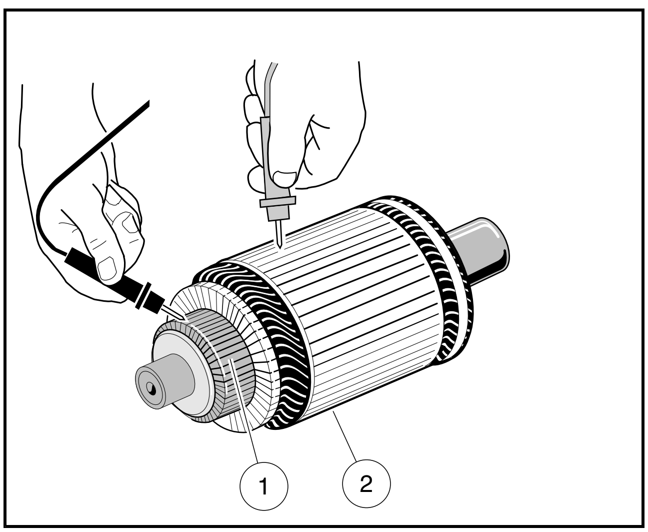

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Figure 20-12 Armature Test

MOTOR FRAME AND FIELD WINDINGS INSPECTION

1. Remove the motor from the vehicle. **See Motor Removal on page 20-3.**
2. Remove the and cap and armature by performing steps 1 through 7 of Motor Disassembly on page 20-5.
3. Burned or scorched insulation on the field windings indicates the motor has overheated due to overloads or grounded or shorted coil windings. If the insulation on the field windings is scorched, replace the motor or the stator shell assembly.

MOTOR BRUSH, SPRING, AND TERMINAL INSULATOR INSPECTION

Brush Spring Tension Test

1. Remove the motor from the vehicle. **See Motor Removal on page 20-3.**
2. Remove the end cap and armature by performing steps 1 through 7 of Motor Disassembly on page 20-5.
3. Inspect the brush springs (14) **(Figure 20-15, Page 20-11)**. Replace springs that are discolored from heat (light gold or blue tinted).
4. Test the brush springs for proper tension.
   - 4.1. Place a C-shaped steel plate on a scale.
   - 4.2. Place the end of the C-shaped plate so that it is between the spring and the brush as shown **(Figure 20-13, Page 20-10)**.
   - 4.3. Gently pull the scale to obtain the spring tension reading. **See following CAUTION.**

CAUTION

- **When checking brush spring tension, do not over-extend the spring. Using excessive force will damage the spring.**

   - 4.4. Replace springs which require a force of less than 35 oz. (990 grams) **(Figure 20-13, Page 20-10)**. **See following NOTE.**

NOTE: *When installing new brushes, remove and replace brushes one at a time. This method ensures the terminals and brushes will be properly positioned in the rigging. Refer to* ***Motor Assembly on page 20-12*** *for brush installation.*

When replacing brushes, replace all four brushes. Never replace only two.

Install the brushes in the same rigging 180° apart from each other.

Brush Inspection

1. Remove the motor from the vehicle. **See Motor Removal on page 20-3.**
2. Remove the end cap and armature by performing steps 1 through 7 of Motor Disassembly on page 20-5.
3. Inspect the brushes (13) for damage or excessive wear **(Figure 20-15, Page 20-11)**. Replace brushes if required. **See preceding NOTE.**
4. Use dial calipers or a micrometer to measure the brush length. The minimum-allowable brush length is 0.62 inches (16 mm). Replace the set of brushes as required. **See preceding NOTE.**

Terminal Insulator Inspection

1. Remove the motor from the vehicle. **See Motor Removal on page 20-3.**
2. Remove the terminal insulators by performing steps 1 through 12 of Motor Disassembly on page 20-5.
3. Inspect the insulators (4 and 6) for cracks or other damage **(Figure 20-15, Page 20-11)**. Replace insulators as required.

Bearing Inspection

NOTE: *Replacement of the end cap bearing is highly-recommended if the end cap is removed from the motor. The following procedure is provided as a guideline for determining general bearing failure.*

1. Remove the motor from the vehicle. **See Motor Removal on page 20-3.**
2. Remove the bearing by performing steps 1 through 14 of Motor Disassembly on page 20-5.
3. Use a clean cloth to wipe the carbon dust off of the bearing. Inspect the bearing by spinning it by hand and checking for both axial (A) and radial (B) play **(Figure 20-14, Page 20-10)**.
4. Replace the bearing if it is noisy, does not spin smoothly, or has excessive play. Check the bearing and replace if rusted, worn, cracked, or if there is an abnormal color change in the metal of the bearing.

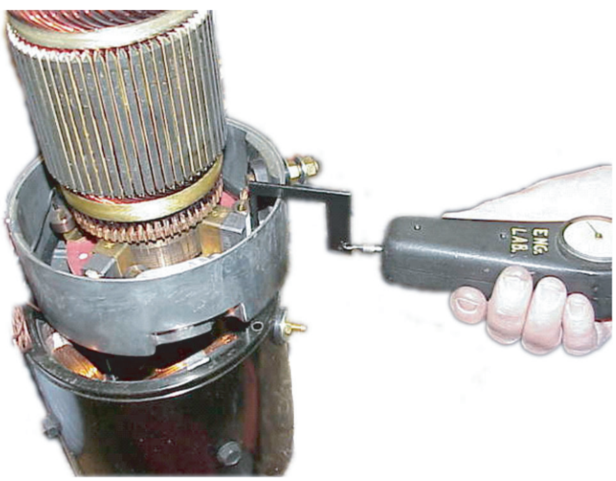

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Figure 20-13 Brush Spring Tension Test

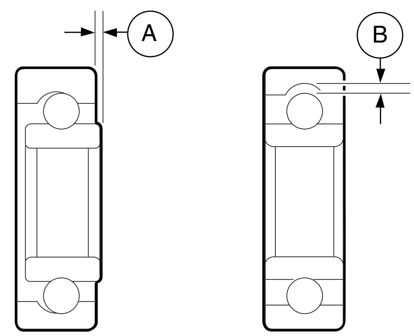

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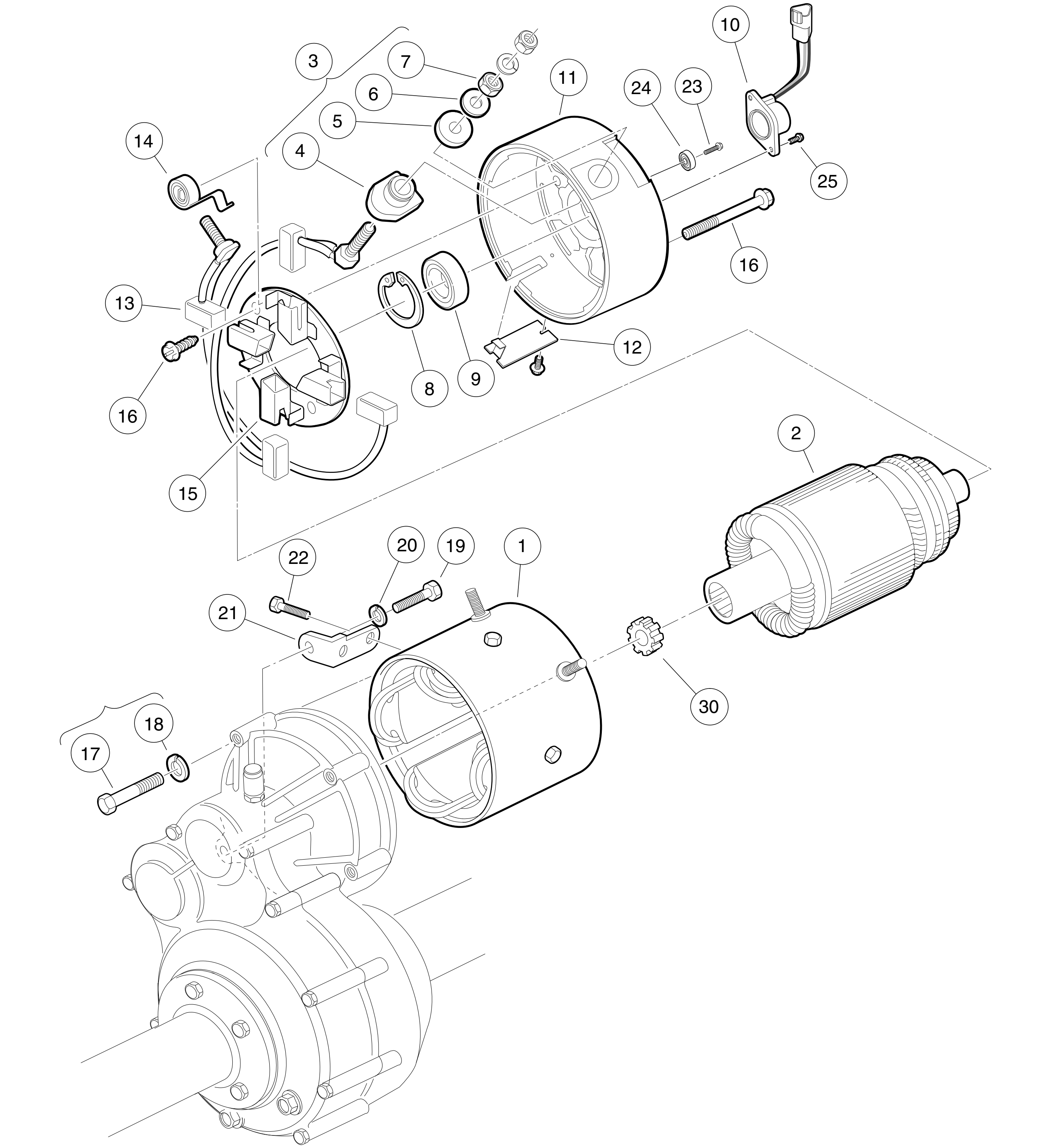
Figure 20-14 Bearing Inspection

Speed Sensor Magnet Inspection

Inspect the speed sensor magnet (24) for rust, wear, and cracks **(Figure 20-15, Page 20-11)**. Replace the magnet if necessary.



Items 19, 20, 21, and 22: Used only on EJ4–4001 motor

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Figure 20-15 Motor

RECONDITIONING THE MOTOR

See General Warnings on page 1-1.

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

MOTOR SPECIFICATIONS

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

ITEM	SERVICE LIMIT
Commutator diameter (minimum)	2.80 in. (71.10 mm)
Commutator concentric with armature shaft within	0.003 in. (0.08 mm)
Bar to bar runout should not exceed	0.005 in. (0.013 mm)
Undercut of segment insulator after machining commutator	0.040 in. (1.0 mm)
Armature resistance at 75 °F (24 °C)	0.012 ohms between bar 1 and bar 15
Field coil resistance at 75 °F (24 °C)	1.75 ohms

MOTOR ASSEMBLY

See General Warnings on page 1-1.

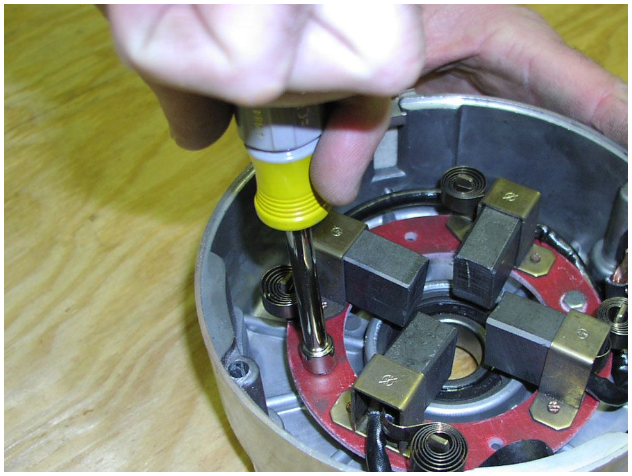
1. Replace the bearing.
   1.1. Use an arbor press to install a new bearing into the end cap. To help avoid damaging the bearing, apply pressure only to the outer race when installing the bearing.
   1.2. Install the retaining ring to secure the bearing **(Figure 20-11, Page 20-7)**.
2. Install the brushes and brush rigging. **See following NOTE.**

NOTE: *When installing new brushes, remove and replace brushes one at a time. This method ensures the terminals and brushes will be properly positioned in the rigging.*

When replacing brushes, replace all four brushes. Never replace only two.

Install the brushes in the same rigging 180° apart from each other.

   2.1. Insert the brushes into the brush rigging as shown **(Figure 20-16, Page 20-13)**.
   2.2. Insert the two terminal posts through insulators (4) in the end cap (11) wall at the A1 and A2 positions **(Figure 20-15, Page 20-11)**.
   2.3. Place external insulators (5) and washers (6) on each terminal post, and secure terminal with nuts (7). Tighten nuts (7) to 100 in-lb (11.3 N·m). Ensure that the terminal posts do not rotate when tightening the nuts **(Figure 20-15, Page 20-11)**.
   2.4. Secure the brush rigging to the end cap with two screws. Tighten the screws to 25 in-lb (2.8 N·m) **(Figure 20-10, Page 20-7)**.
   2.5. One at a time, push the brushes back until they are completely retracted into their mounting slots and the spring pressure holds them in the retracted position as shown **(Figure 20-17, Page 20-13)**.



758
Figure 20-16 Brush Rigging

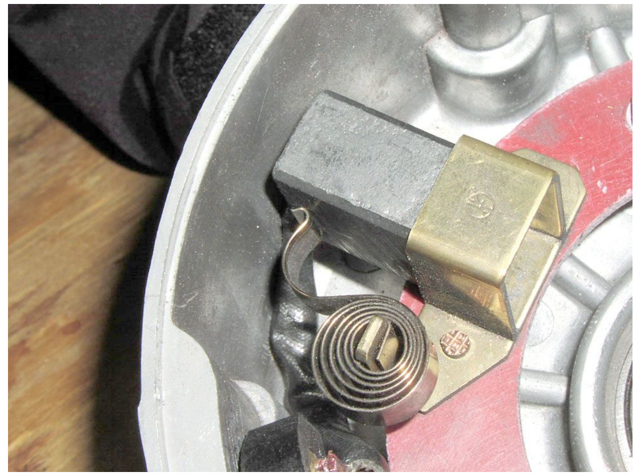


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Figure 20-17 Retracted Brushes

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Figure 20-18 Armature Installation

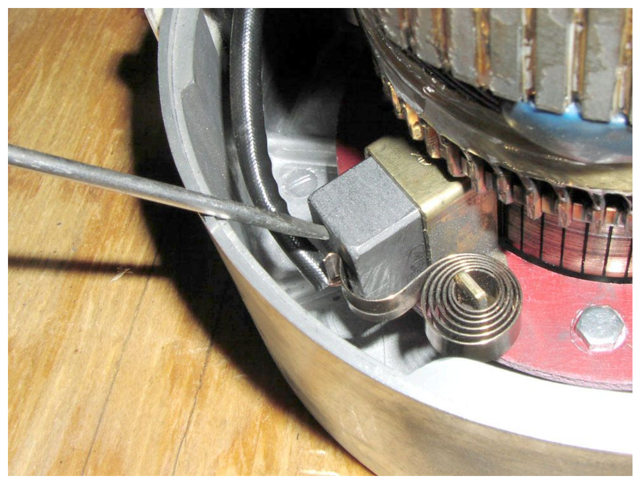

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Figure 20-19 Brush Setting

3. With the brushes retracted, use an arbor press to press the armature shaft into the end cap bearing **(Figure 20-18, Page 20-13)**. **See following CAUTION.**

CAUTION

- **Make sure the brushes are held back. Do not allow the brushes to support the weight of the commutator. The brushes can be easily damaged by this weight.**

4. Gently press each brush with a small screwdriver until the spring rests on the end of each brush as shown **(Figure 20-19, Page 20-13)**.
5. Align the match marks on the end cap and the motor frame (1) and secure with two bolts (16) **(Figure 20-15, Page 20-11)**. Tighten bolts to 130 in-lb (14.7 N·m).
6. Install the speed sensor magnet (24) with screw (23). Tighten to 65 in-lb (7.3 N·m).
7. Install the speed sensor (10) with screws (25). Tighten to 20 in-lb (2.2 N·m).
8. Make sure the armature turns freely. If it does not turn freely, disassemble the motor to find the problem.

MOTOR INSTALLATION

See General Warnings on page 1-1.

1. Clean the transaxle input shaft.
   1.1. Spray the input shaft thoroughly with CRC® Brakleen™ or equivalent brake cleaner degreaser.
   1.2. Wipe input shaft with a clean cloth.
   1.3. Inspect the grooves of the input shaft and remove any remaining debris.
   1.4. Repeat steps 1.1 through 1.3 until input shaft is clean.
2. Lubricate the transaxle input shaft.
   2.1. Squeeze approximately 1/2 inch (1.3 cm) of moly-teflon lubricant (P/N 102243403) from tube onto a putty knife as shown **(Figure 20-20, Page 20-14)**.
   2.2. Rotate wheels to rotate input shaft.
   2.3. Apply motor coupling grease evenly to the rotating input shaft starting at approximately 1/8 inch (3.1 mm) from the end of the shaft and working back toward the transaxle (away from the end of the shaft) **(Figure 20-21, Page 20-14)**.
   2.4. The grease should be evenly distributed in the grooves to a width of approximately 3/8 inch (9.5 mm).
   2.5. Use a flat screwdriver to clean the grease out of one of the grooves and allow air to escape when the motor is pushed onto the input shaft.

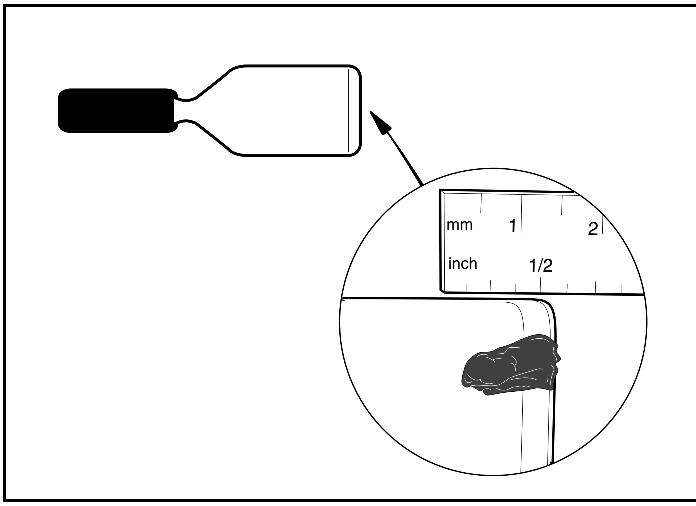

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Figure 20-20 Grease on Putty Knife

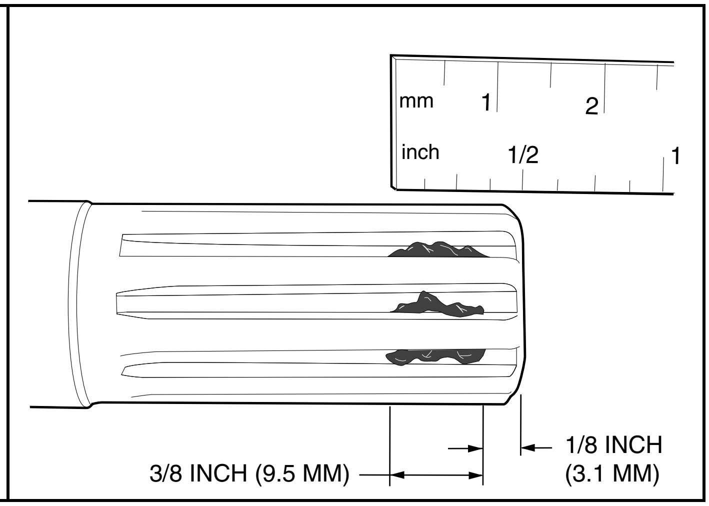

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Figure 20-21 Application of grease to Input Shaft Grooves

   2.6. Check the chamfer (1) and end (2) of the input shaft to ensure these areas are completely clean of grease as shown **(Figure 20-22, Page 20-15)**.
3. Install the molded bumper.
   3.1. With the flat side toward the bottom of the coupling, install the molded bumper (30) into the motor coupling **(Figure 20-15, Page 20-11)**. **See following NOTE.**

NOTE: *The motor coupling and the new molded bumper must be free of grease and debris.*

   3.2. Ensure that the installed bumper is seated at the bottom of the coupling.
4. Install motor on transaxle.
   4.1. Slide the motor coupling onto the transaxle input shaft. **See following NOTE.**

NOTE: *The coupling will push any excess grease on the input shaft along the shaft toward the transaxle.*

When the motor is pushed onto the input shaft, the motor housing will not bottom out against the transaxle housing ***(Figure 20-15, Page 20-11)****. There will be approximately 1/16 inch (1.6 mm) gap between the motor adapter ring and transaxle housing as shown* ***(Figure 20-23, Page 20-15)****.*

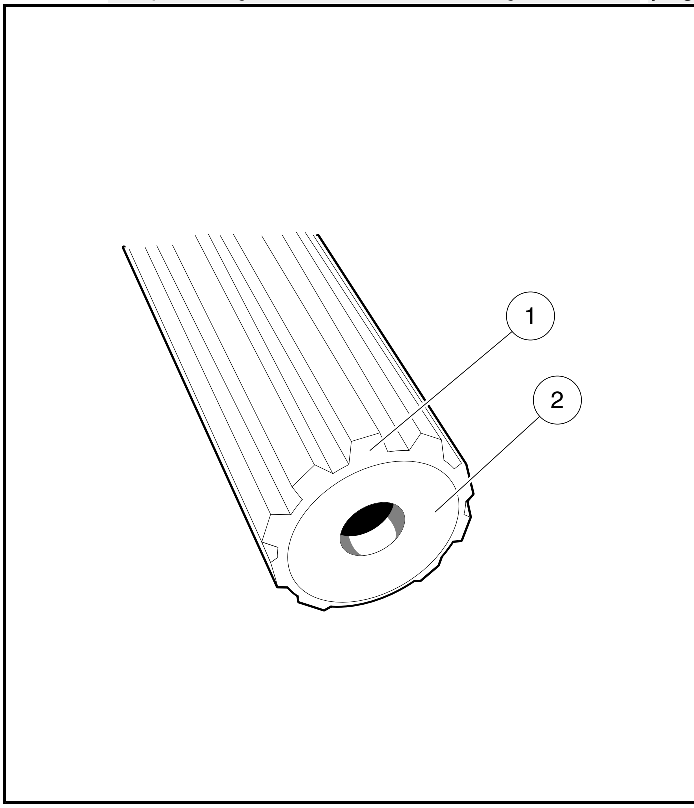

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Figure 20-22 Clean Chamfer and Input Shaft End

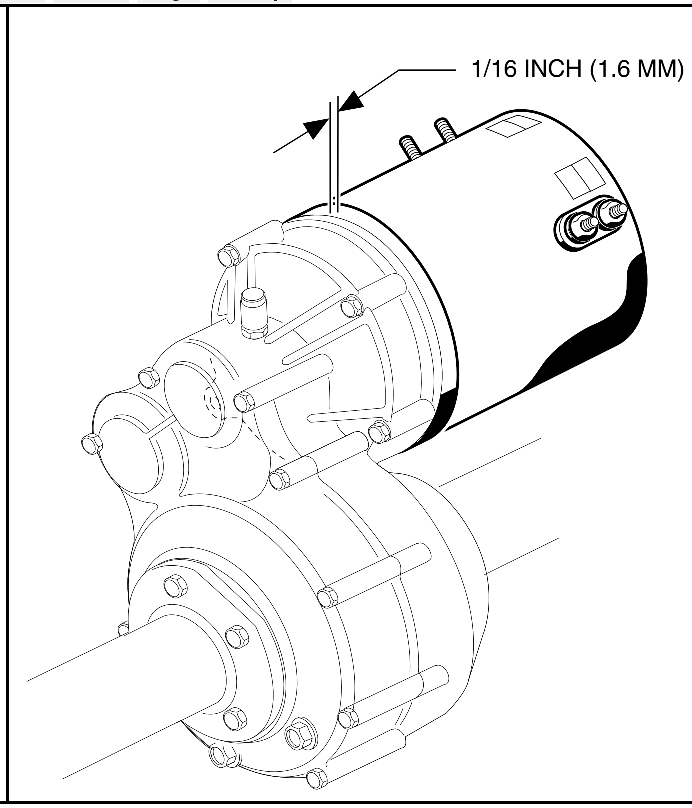

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Figure 20-23 Gap at Motor and Transaxle

4.2. Loosely install the four bolts (EJ4–4001 motor) **(Figure 20-24, Page 20-16)**, or three bolts (EJ8–4001A motor) **(Figure 20-25, Page 20-16)**, and lock washers that secure the motor to the transaxle. Do not tighten.

4.3. Begin finger-tightening the bolts (1 and 2) in the sequence indicated. Continue tightening by hand until the motor is seated in the transaxle housing. **See following CAUTION and NOTE.**

CAUTION

- **Make sure the motor is properly seated in the transaxle housing.**

NOTE: *Failure to install and tighten the motor mounting bolts in the proper sequence and to the proper tightness may result in motor noise during operation.*

4.4. Tighten the right bolt (1) to 65 in-lb (7.3 N·m).

4.5. Tighten the left bolt (2) to 65 in-lb (7.3 N·m).

4.6. Tighten the center bolt (3) to 65 in-lb (7.3 N·m).

4.7. **EJ4–4001 motor only:** Tighten the bolt (4) inserted through the L-bracket to 155 in-lb (17.5 N·m) **(Figure 20-24, Page 20-16)**.

4.8. Install the motor wires, making sure they are connected to the correct motor terminals and that the terminal orientation is correct. **See Wiring Diagrams on page 11-2, or 12-2, or 13-3, or 14-3.** Hold the bottom nut of stud with wrench and tighten the terminal retaining nuts. For 5/16 inch (8mm) diameter studs, tighten the nuts to 100 in-lb (11 N·m). For 1/4 inch (6.3mm) diameter studs, tighten the nuts to 45 in-lb (5.0 N·m).

4.9. Secure the white, orange, green, and blue wires with a wire tie so that none of the motor wires will scrub the motor or transaxle when the vehicle is in operation.

4.10. Connect the three-pin speed sensor wire to the vehicle wire harness.

5. If using a chain hoist, lower the vehicle and guide the leaf springs into the shackles. If using a floor jack, raise the transaxle until the leaf springs can be guided into the shackles.
6. Insert the mounting bolts through the spring shackles and the bushings in the leaf spring eyes and install lock nuts. Tighten the bolts to 23 ft-lb (31 N·m). See Section 9 – Rear Suspension.
7. Install the shock absorbers. Tighten nut until rubber bushing expands to the diameter of the cup washer.
8. If removed, install wheels and finger tighten the lug nuts.
9. Lift vehicle and remove jack stands. Lower vehicle to the floor and tighten lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).
10. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
11. Place the Tow/Run switch in the RUN position.
12. Inspect the vehicle for proper operation. **See following WARNING.**

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**
- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

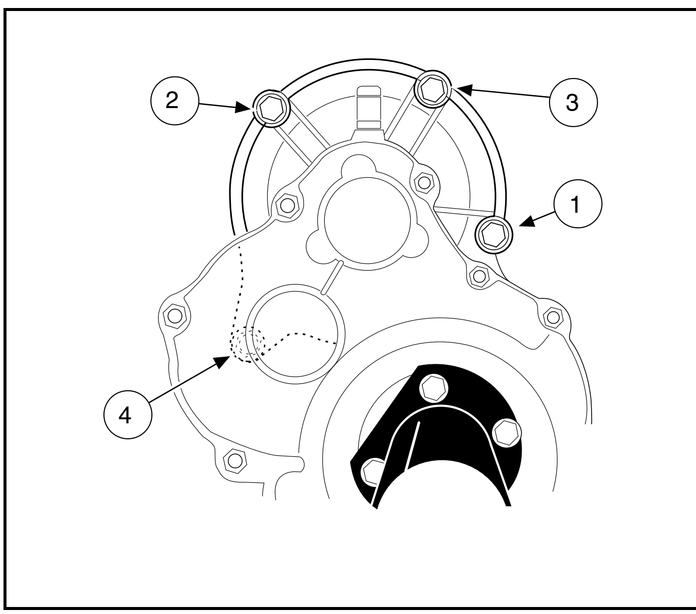

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Figure 20-24 EJ4–4001 Motor Mounting Bolts and Tightening Sequence

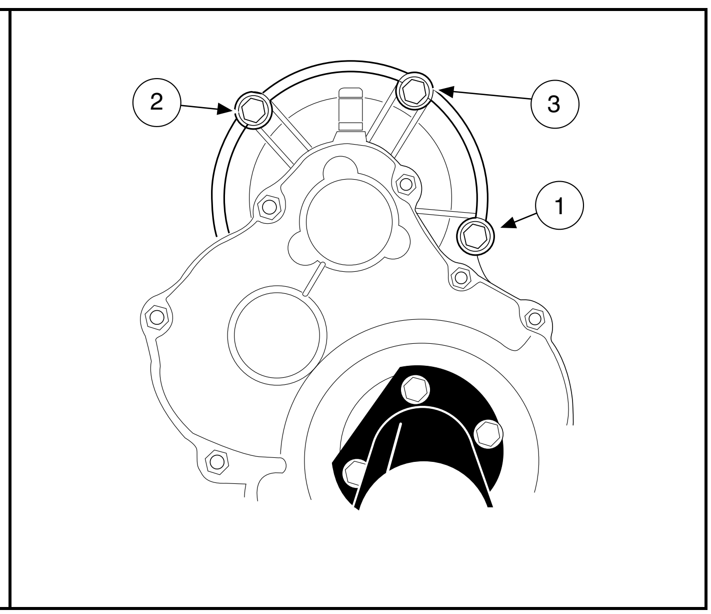

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Figure 20-25 EJ8–4001A Motor Mounting Bolts and Tightening Sequence

SECTION 21 – TRANSAXLE (TYPE G)

21

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

LUBRICATION

See General Warnings on page 1-1.

There are two plugs located on the lower half of the transaxle housing. The upper plug (21) (as viewed when the vehicle is on a level surface) is used as a lubricant level indicator **(Figure 21-5, Page 21-3)**. When the vehicle is parked on a level surface, the lubricant level should be even with the bottom of the hole. The lower plug (22) is for draining the lubricant. When draining the lubricant, the upper plug should be removed so the lubricant will drain faster. Be sure the drain plug is installed before filling. **See following NOTE.**

NOTE: *Recycle or dispose of used oil or lubricant in accordance with local, state, and federal regulations.*

AXLE BEARING AND SHAFT

See General Warnings on page 1-1.

AXLE SHAFT

Axle Shaft and Oil Seal Removal

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels. Loosen lug nuts on rear wheels and lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the axle tubes to support the vehicle. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Remove the rear wheel and brake drum. See Section 6 – Wheel Brake Assemblies. See Section 8 – Wheels and Tires.
4. Use 90° internal snap ring pliers to remove the internal retaining ring (6) from the axle tube **(Figure 21-5, Page 21-3)**. **See also Figure 21-1, Page 21-2.**
5. Remove the axle, retaining ring, and bearing assembly by pulling the axle straight out of the housing.
6. If necessary, remove the axle oil seal and adapter ring.
   6.1. Use a bearing puller (P/N 1016417) to remove the axle seal and adapter ring from the axle tube **(Figure 21-2, Page 21-2)**. **See following CAUTION and NOTE.**

CAUTION

- **Do not scar or damage the inside surfaces of the tube when removing the oil seal and adapter ring. A damaged tube might have to be replaced.**

NOTE: *Do not discard the adapter ring. If the adapter ring is lost or damaged, the axle tube will have to be replaced. Varying rear axle configurations have been installed on vehicles. If replacing axle tubes, take note of individual axle tube lengths to ensure proper fit.*

6.2. Use a press to separate the axle oil seal (15) from the adapter ring (39) **(Figure 21-3, Page 21-2)**. Retain the adapter ring and discard the oil seal.

7. Inspect the axle shaft assembly to be sure the bearing and collar have not slipped and are still seated against the shoulder on the axle shaft.
8. Inspect bearing (5) **(Figure 21-5, Page 21-3)**. If the bearing in a Type G transaxle is worn or damaged, the entire axle shaft assembly (1 or 2) must be replaced.

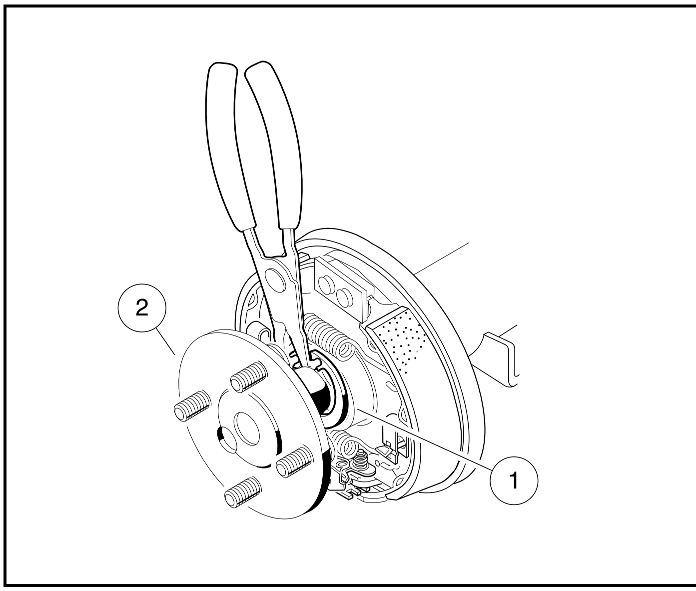

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Figure 21-1 Remove Internal Retaining Ring

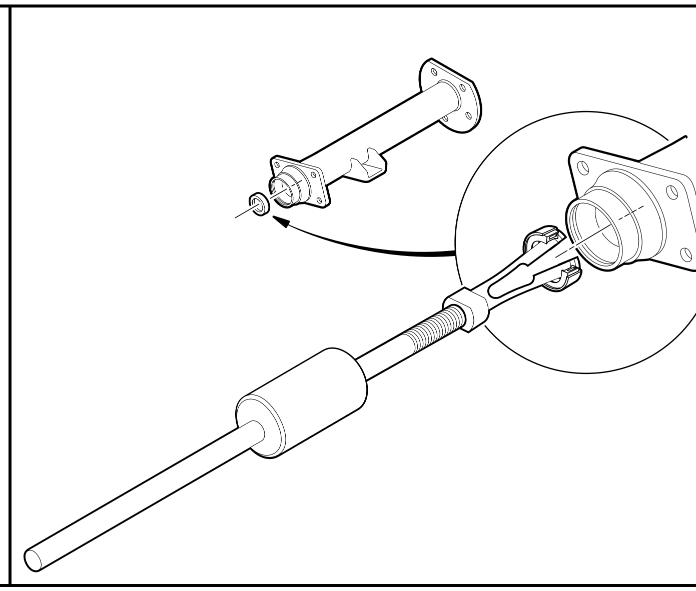

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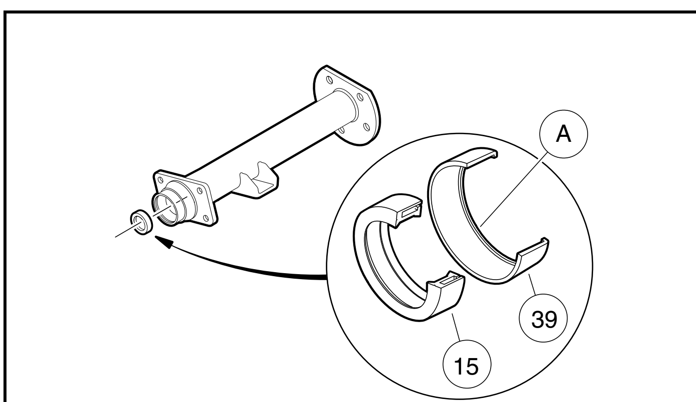
Figure 21-2 Axle Seal and Adapter Ring Removal



A. Adapter Ring Lip

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Figure 21-3 Axle Seal and Adapter Ring

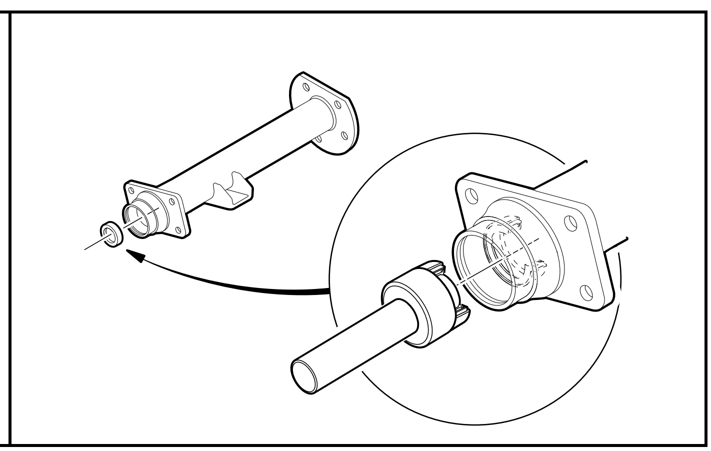

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Figure 21-4 Axle Seal and Adapter Ring Installation

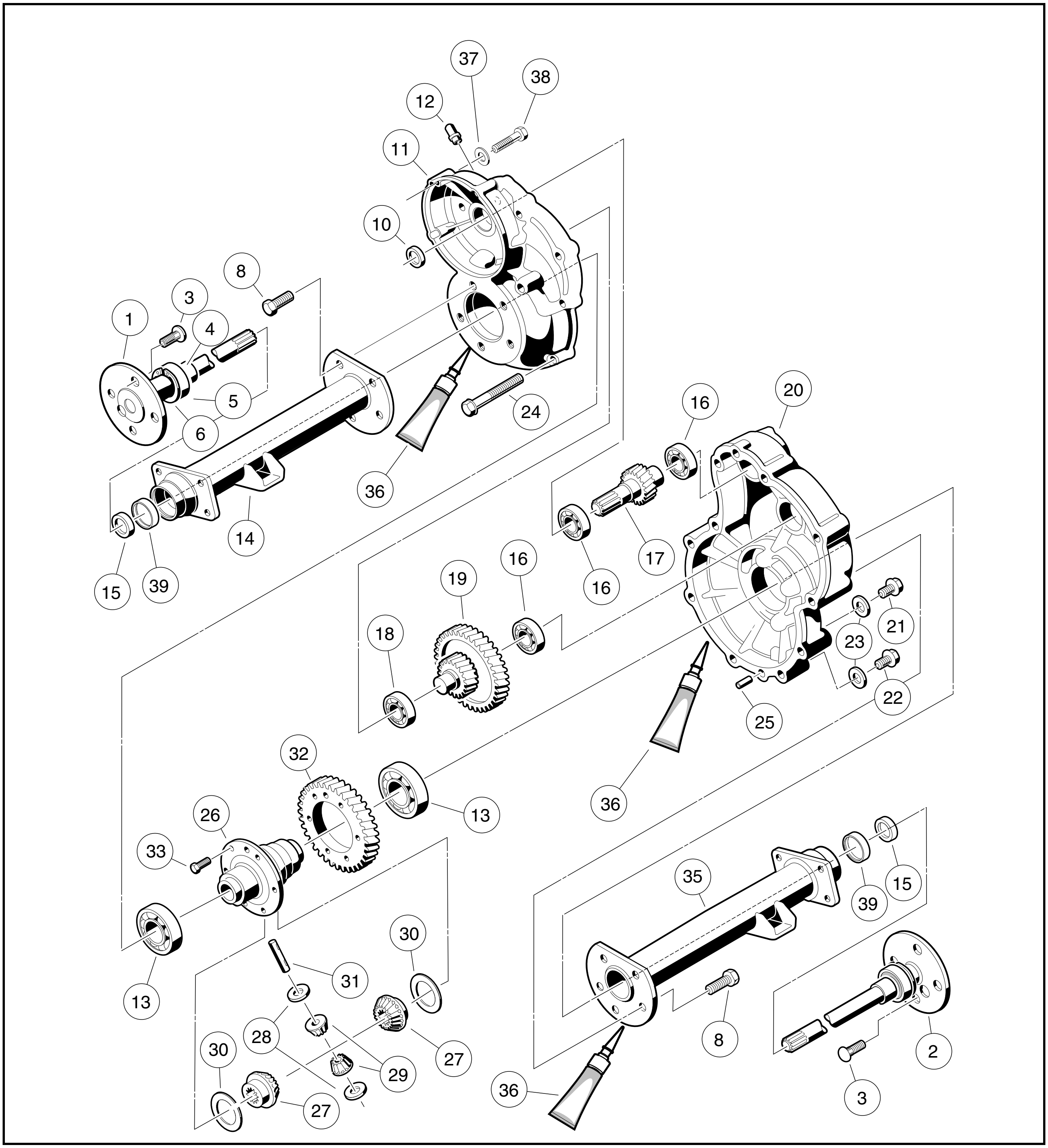

Figure 21-5 Transaxle – Type G

Axle Shaft and Oil Seal Installation

1. If previously removed, install a new oil seal.
   1.1. Clean seal seat in the adapter ring (39) **(Figure 21-3, Page 21-2)**.
   1.2. Place a new seal (15) in the adapter ring with the seal lip facing toward the adapter ring lip **(Figure 21-3, Page 21-2)**. Use an axle seal tool (P/N 1014162) and mallet to tap it in until it seats firmly in position **(Figure 21-3, Page 21-2)**. A hydraulic press may also be used with the axle seal tool.
   1.3. Clean adapter ring seat(s) in the axle tube (14 or 35) **(Figure 21-5, Page 21-3)**.
   1.4. Apply Loctite® 603 to the outer diameter of the adapter ring.
   1.5. Place the oil seal and adapter ring assembly into the axle tube with the seal lip facing away from the bearing **(Figure 21-4, Page 21-2)**. Use an axle seal tool (P/N 1014162) and mallet to tap it in until it seats firmly in position. **See following CAUTION.**

CAUTION

- **Clean any residual oil from the exposed end of the axle shaft and from the oil seal area prior to installing the axle shaft to prevent oil from coming in contact with brakes.**

2. Install the rear axle into the transaxle. **See following NOTE.**
   2.1. Insert the shaft, splined end first, through the seal and into the axle tube. Be careful not to damage the seal on the inside of the axle tube hub. Advance the shaft through to the bearing on the shaft, then rotate it to align the shaft splines with the splined bore of the differential side gear (27) **(Figure 21-5, Page 21-3)**. Continue advancing the shaft until the bearing on the axle is firmly seated within the axle tube hub seat.
   2.2. Use a pair of snap ring pliers to install the retaining ring (6) inside axle tube hub so that it seats against the axle bearing assembly and into the machined slot in the inside wall of the axle tube hub **(Figure 21-5, Page 21-3)**.

NOTE: *If the retaining ring (6), axle bearing (5), or sleeve (4) must be replaced, the entire axle shaft assembly (1 or 2) must be replaced* ***(Figure 21-5, Page 21-3)****.*

   2.3. Place a 1/4 to 3/8-inch (6 to 10 mm) diameter rod against the retaining ring and tap lightly at four to five locations around the retaining ring to ensure it is properly seated. **See following WARNING.**

⚠ WARNING

- **Be sure the retaining ring is properly seated in its groove. If the ring is not properly installed, the axle assembly will separate from the transaxle and damage the axle assembly and other components. Loss of vehicle control could result, causing severe personal injury or death.**

3. If a new oil seal was installed, allow 24 hours before operating the vehicle to allow the Loctite 603 to fully cure.

AXLE BEARING

Do not remove the axle bearing (5) from a Type G transaxle. If bearing is worn or damaged, the entire axle assembly (1 or 2) must be replaced **(Figure 21-5, Page 21-3)**.

TRANSAXLE

See General Warnings on page 1-1.

TRANSAXLE REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles on page 1-3.**
2. Place chocks at the front wheels and slightly loosen lug nuts on both rear wheels. **See WARNING "Lift only one end..." in General Warnings on page 1-1.**
3. Place a floor jack under the transaxle and raise the rear of the vehicle. Position jack stands under the aluminum frame rails forward of the spring mount. Lower the vehicle to let the jack stands support the vehicle **(Figure 21-6, Page 21-5)**. **See WARNING "Lift only one end of the vehicle..." in General Warnings on page 1-1.**
4. Remove the rear wheels, then thread one lug nut onto a stud on each rear hub. This will keep the brake drums on the hubs.
5. Remove the bow tie pins (1) and brake cable clevis pins (3). Use tool (P/N 102555501) to compress tangs on cable end and remove cable end from bracket (4) **(Figure 21-7, Page 21-5)**.

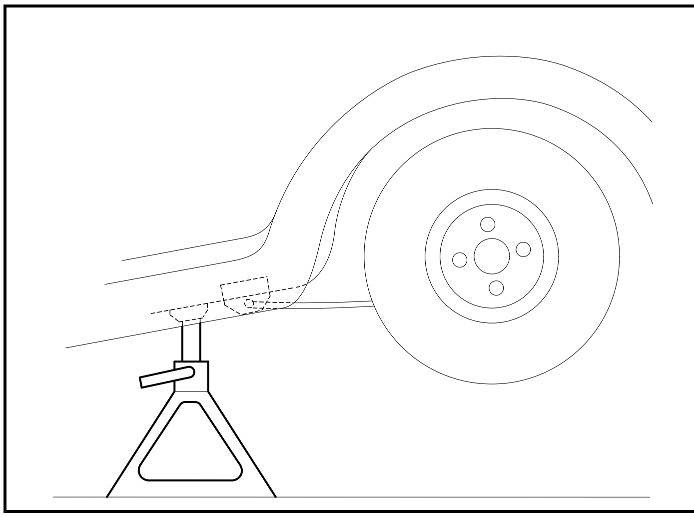

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Figure 21-6 Vehicle Supported on Jack Stands

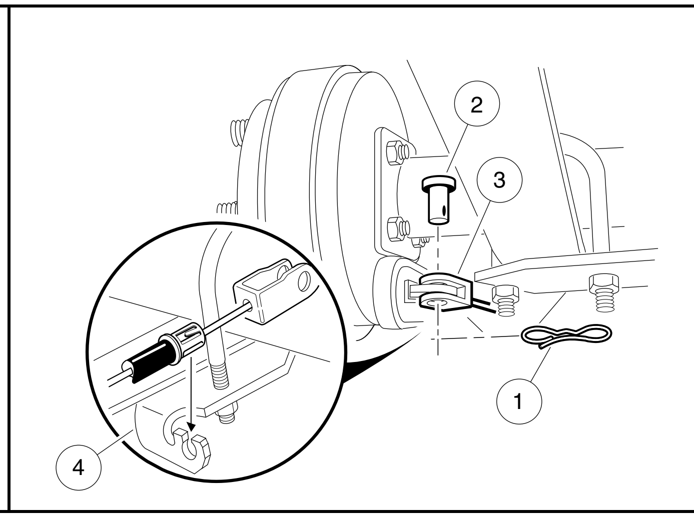

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Figure 21-7 Brake Cable

6. Disconnect the shock absorbers from their lower mounts **(Figure 21-8, Page 21-6)**.
7. Disconnect the four motor wires. Use two wrenches to prevent the post from turning.
8. With a floor jack supporting the transaxle, remove lower spring shackle nuts and bolts. Position shackles so they are clear of springs **(Figure 21-9, Page 21-6)**.
9. If a chain hoist was used to raise the vehicle, lift the vehicle high enough to permit easy access and clearance for removal of the motor. If a floor jack was used to raise the vehicle, lower the transaxle enough to permit easy access and clearance for removal of the motor.
10. Remove the three motor mounting bolts (1) **(Figure 21-11, Page 21-7)** and the motor positioning bolt (EJ4–4001 and 5BC59JBS6390 motors only) **(Figure 21-12, Page 21-7)**, securing the motor to the transaxle. **See following CAUTION.**

⚠ CAUTION

- **Do not position fingers under motor when sliding motor off of the input shaft. Fingers may get pinched when motor disengages.**

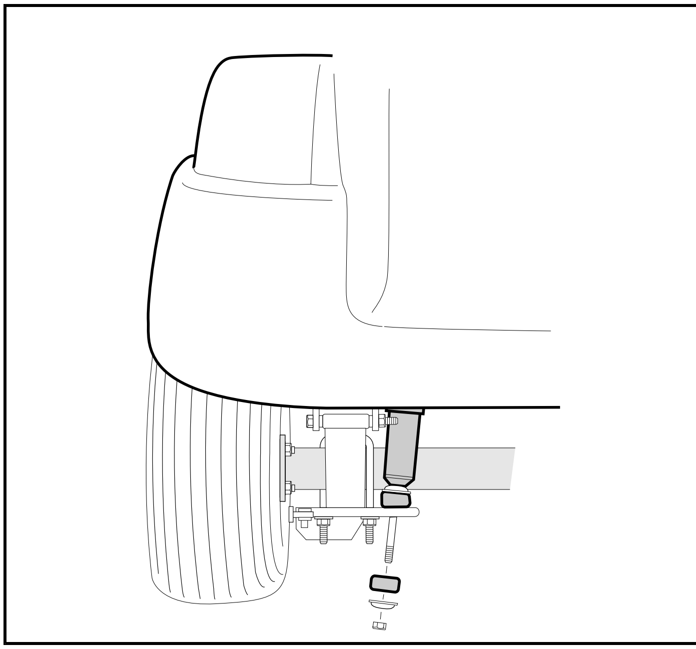

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Figure 21-8 Disconnect Shocks

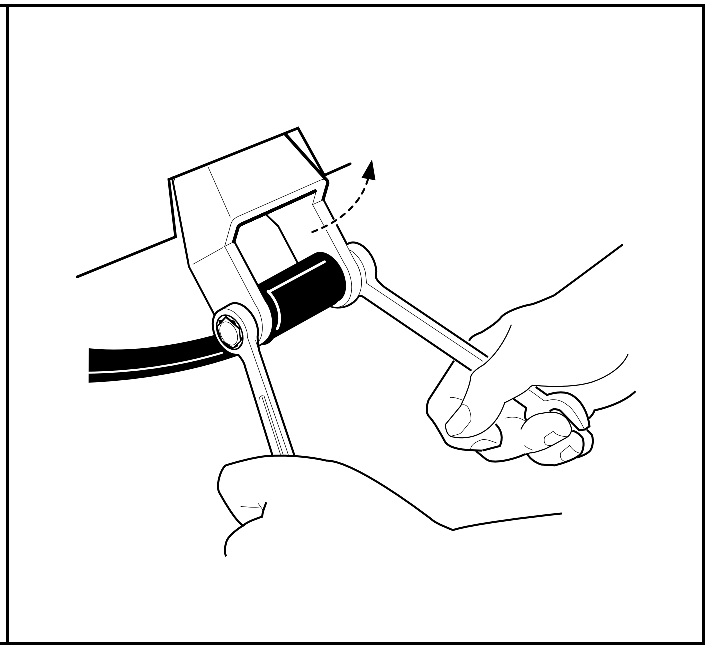

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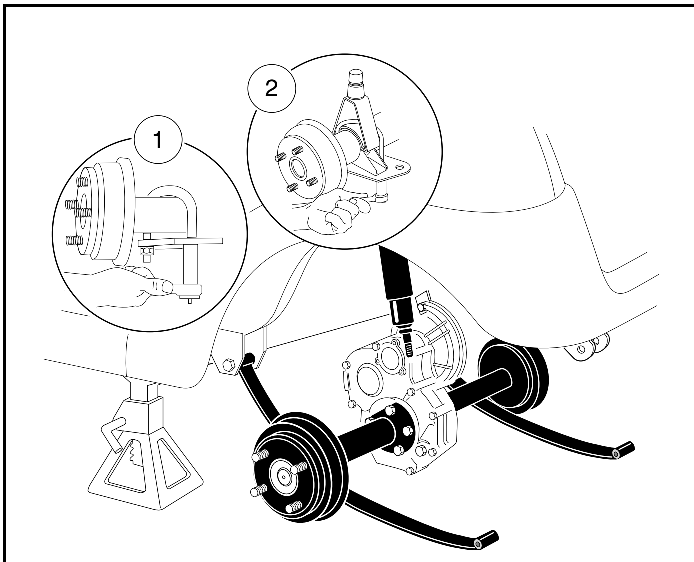
Figure 21-9 Shackles

11. Carefully remove the motor from the transaxle. Slide the motor away from the transaxle until the motor spline becomes disengaged from the input shaft, then lift motor out. **See preceding WARNING.**
12. If a floor jack was used, pull floor jack from beneath the transaxle and allow the springs to rest on the floor.
13. Remove the U-bolts attaching the transaxle to the leaf springs **(Figure 21-10, Page 21-7)**.
14. Carefully lift each end of the transaxle off its positioning pin (on the leaf spring) and slide the transaxle to the rear and out of the vehicle.
15. Drain the lubricant from the transaxle and remove the axle shafts. **See Axle Shaft and Oil Seal Removal on page 21-1.See following NOTE.**

NOTE: *Recycle or dispose of used oil or lubricant in accordance with local, state, and federal regulations.*

16. Remove the brake assemblies if required. **See Brake Cluster Removal on page 6-11.**



1. Precedent 2. Villager 4

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Figure 21-10 Leaf Springs

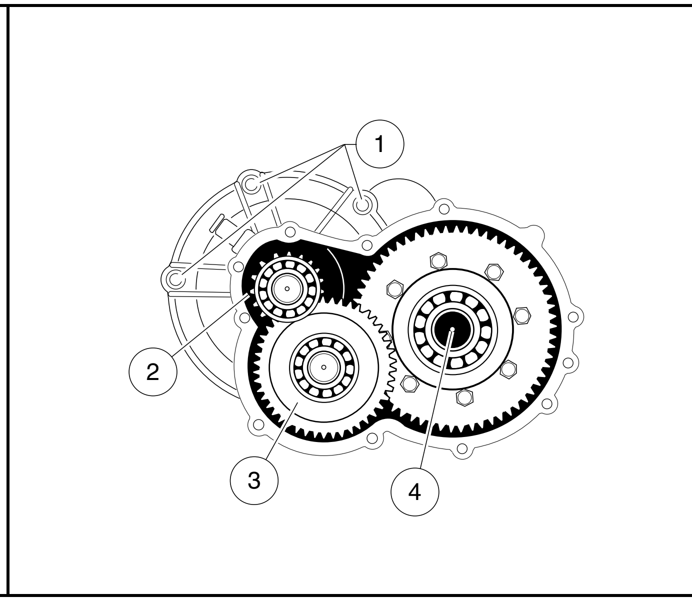

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Figure 21-11 Motor Mounting Bolts

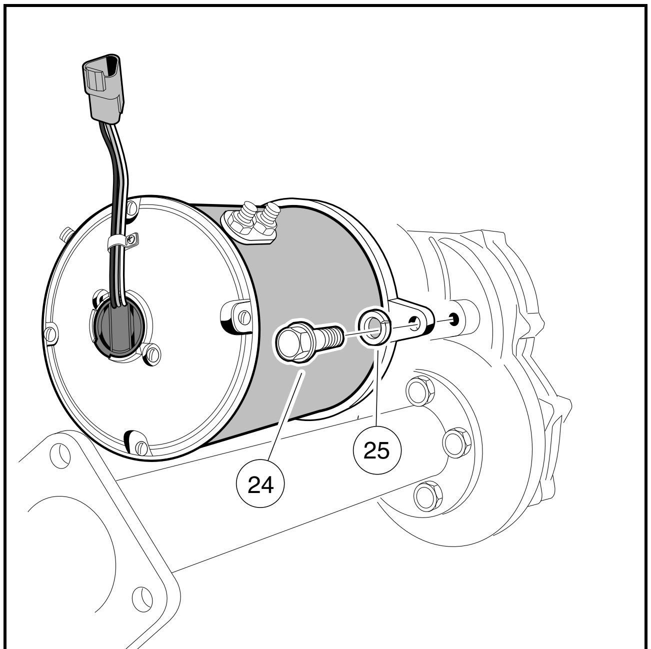

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Figure 21-12 Motor Positioning Bolt – EJ4–4001 and 5BC59JBS6390 Motors Only

TRANSAXLE DISASSEMBLY, INSPECTION, AND ASSEMBLY

See General Warnings on page 1-1.

TRANSAXLE DISASSEMBLY AND INSPECTION

1. To detach axle tubes (14 and 35) from the transaxle housing, remove the bolts (8) **(Figure 21-5, Page 21-3)**.
2. Remove 11 bolts (24) that hold housing together.
3. Pull the halves of the housing (11 and 20) apart. If necessary, tap lightly on the spline of the input pinion (17). **See following CAUTION.**

CAUTION

- **To prevent damage to the housing mating seal surfaces, use caution when separating halves.**

4. Remove input pinion gear (17) by pulling gear out while rocking intermediate gear assembly (19). Lift intermediate gear assembly and differential gear case unit out simultaneously **(Figure 21-5, Page 21-3)**. **See following CAUTION.**

CAUTION

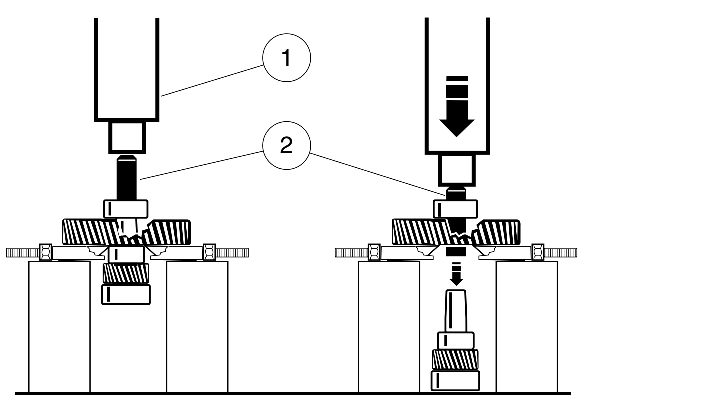
- **Do not damage gears. Use extreme care when handling them.**

5. Use a bearing puller or arbor press to remove bearings (16) from the input pinion gear. If the oil seal (10) is damaged, replace it **(Figure 21-5, Page 21-3)**. **See also Figure 21-13, Page 21-8. See following CAUTION.**

CAUTION

- **Do not reuse bearings after removing them. Replace bearings with new ones.**

6. To disassemble the intermediate gear assembly, press off together the bearing (16) and the gear (19) **(Figure 21-5, Page 21-3)**. **See also Figure 21-13, Page 21-8.**
7. Press the bearing (18) off the intermediate gear assembly **(Figure 21-5, Page 21-3)**.



1. Press Ram 2. Arbor

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Figure 21-13 Intermediate Gear Assembly

8. Disassemble the differential gear case:
   8.1. Remove the hex bolts (33) and the ring gear (32) from the differential case **(Figure 21-5, Page 21-3)**.
   8.2. Remove the ring gear.
   8.3. Separate the differential gear case housing. If necessary, install two of the hex bolts (removed previously in step 8.1.) into the differential gear unit and, while holding the unit slightly above the work area, lightly tap the bolt heads **(Figure 21-14, Page 21-9)**. Remove the two bolts.

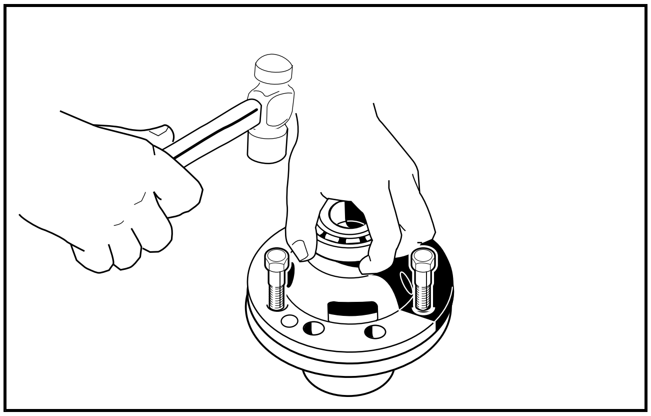

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Figure 21-14 Separate Housing

   8.4. Remove the differential pin (31) by pushing pin through differential gear case from one side **(Figure 21-5, Page 21-3)**. **See also Figure 21-15, Page 21-9.**
   8.5. Remove the idler gears (1 and 2) and thrust plates (3 and 4) **(Figure 21-16, Page 21-9)**.

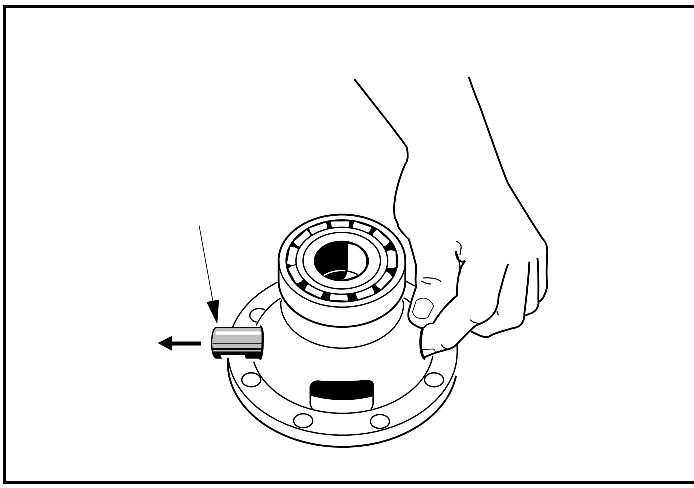

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Figure 21-15 Differential Pin

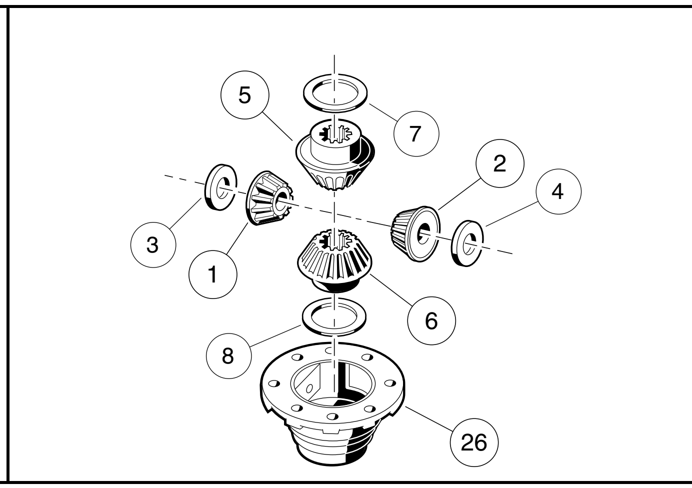

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Figure 21-16 Left Differential

   8.6. Remove the differential gears (5 and 6) and thrust plates (7 and 8).
   8.7. Inspect the bearings (13) of the differential case (26) and replace them if they are damaged **(Figure 21-5, Page 21-3)**. To remove them, press them off. **See following CAUTION.**

CAUTION

- **Do not reuse bearings after removing them. Replace bearings with new ones.**

9. Inspect parts for wear or damage. Any worn or damaged parts should be replaced. **See following NOTE.**

NOTE: *Damaged or worn gears should be replaced as sets.*

TRANSAXLE ASSEMBLY

CAUTION

- **Do not press against the bearing outer race.**
- **The housing and all parts must be wiped clean and dry before reassembly.**

1. If bearings (13) were removed during disassembly, install new bearings using an arbor press **(Figure 21-5, Page 21-3)**.
2. Assemble the differential gear case.
   - 2.1. Install the pin (31) **(Figure 21-5, Page 21-3)**. Apply a small amount of oil to all thrust plates and to both ends of the pin.
   - 2.2. Install the hex bolts (33) and output gear (32). Tighten bolts to 58 ft-lb (78.6 N·m).
3. Press a new bearing (18) onto the intermediate gear assembly **(Figure 21-5, Page 21-3)**.
4. Press new bearing (16) onto input pinion gear (17).
5. Apply grease to the lip of the new oil seal (10) and install the seal using a transaxle pinion seal tool (P/N 1014161). The lip of the oil seal should face the inside of the transaxle housing. Make sure the seal is firmly seated.
6. Install the differential assembly (4), the intermediate gear assembly (3), and the input pinion gear (2) simultaneously. Be sure all bearings are seated properly in the housing. Rotate the input shaft to check for smooth gear operation **(Figure 21-11, Page 21-7)**.
7. Install dowel pin(s) (25) (if originally installed) in the transaxle housing (20) **(Figure 21-5, Page 21-3)**.
8. Install left half of transaxle housing:
   - 8.1. Place a 1/8-inch (3 mm) bead of Three Bond liquid gasket on mating surface of housing.
   - 8.2. Install left half of transaxle housing (20) **(Figure 21-5, Page 21-3)**.
   - 8.3. Install bolts (24) in the case housing and tighten to 19 ft-lb (25.7 N·m). Type G transaxles have no shims or gasket.
   - 8.4. Install axle tube (14 and 35) with bolts (8) **(Figure 21-5, Page 21-3)**. Tighten the bolts to 37 ft-lb (50.2 N·m).
9. Install the brake assemblies as instructed. **See Brake Cluster Installation on page 6-11.**
10. Apply a small amount of grease to the lip of the oil seal (15) **(Figure 21-5, Page 21-3)**. **See following CAUTION.**

⚠ CAUTION

- **Clean any residual oil from the exposed end of the axle shaft and from the oil seal area prior to installing the axle shaft to prevent oil from coming in contact with brakes.**

11. Install the rear axle onto the transaxle.
    - 11.1. Insert the splined end of the axle shaft into the axle tube. Be careful not to damage the seal on the inside of the axle tube hub. Advance the shaft through to the bearing on the shaft, and rotate it to align the shaft splines with the splined bore of the differential gear. Continue advancing the shaft until the bearing on the axle is firmly seated within the axle tube hub seat.
    - 11.2. Using 90° internal snap ring pliers (0.090 tip) (P/N 1012560), attach the internal retaining ring into the axle tube hub so that it seats against the axle bearing assembly and into the machined slot in the inside wall of the axle tube hub **(Figure 21-5, Page 21-3)**.
    - 11.3. Place a 1/4 to 3/8-inch (6 to 10 mm) diameter rod against the retaining ring and tap lightly at four or five locations to ensure it is properly seated. **See following WARNING.**

⚠ WARNING

- **Be sure retaining ring is properly seated in its groove. If ring is not properly installed, the axle assembly will separate from the transaxle and damage the axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.**

12. Make sure the drain plug (22) is installed in the transaxle and tightened to 23 ft-lb (31 N·m). Fill the transaxle, through the level indicator hole, with 22 ounces of SAE 30 API Class SE, SF, or SG oil (a higher grade may also be used). Install and tighten the level indicator plug (21) to 23 ft-lb (31 N·m).

TRANSAXLE INSTALLATION

See General Warnings on page 1-1.

1. If using a chain hoist, raise the vehicle and place transaxle in position on the jack stands. If using a floor jack, lower the jack stands to their lowest settings and place the transaxle in position on the jack stands.
2. Align the center hole in the saddle of the transaxle with the pilot bolt in the leaf spring assembly.
3. Install the two U-bolts, jounce bumper mount (if required), and spacers, lock washers, and nuts. Tighten the nuts to 25 ft-lb (34 N·m). Tighten the U-bolt nuts so an equal amount of thread is visible on each leg of the bolt.
4. Install the motor. **See Motor Installation on page 20-14.**
5. If using a chain hoist, lower the vehicle while guiding the leaf springs into the rear spring shackles. If using a floor jack, raise the differential while guiding the leaf springs into the rear spring shackles. Then raise the jack stands to support the transaxle.
6. Connect the motor wires, making sure they are connected to the correct motor terminals and that the terminal orientation is correct. Hold the bottom nut of stud with wrench and tighten the terminal retaining nuts. For 5/16 inch (8mm) diameter studs, tighten the nuts to 100 in-lb (11 N·m). For 1/4 inch (6.3mm) diameter studs, tighten the nuts to 45 in-lb (5.0 N·m). **See following NOTE.**

NOTE: *If the motor wires were not tagged when disconnected, refer to the wiring diagram for proper connection.* ***See Wiring Diagrams on page 12-2 or Wiring Diagrams on page 14-3.***

7. Insert bolts through the spring shackles and bushings in the leaf spring eyes. Secure bolts with lock nuts. Tighten to 15 ft-lb (20.3 N·m).
8. Connect the brake cables using new bow tie pins (1) **(Figure 21-7, Page 21-5)**.
9. Install the shock absorbers. Tighten shock absorber retaining nuts until the rubber bushings expand to the same size as the cup washers.
10. Install the rear wheels and finger-tighten the lug nuts.
11. Lift the vehicle and remove the jack stands.
12. Lower vehicle and tighten the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m).
13. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries – Electric Vehicles on page 1-3.**
14. Inspect the vehicle to check for proper operation. **See following WARNING.**

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**

WARNING CONTINUED ON NEXT PAGE

⚠ WARNING

- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

SECTION 22 – IQ DISPLAY MODULE PROGRAMMER (IQDM-P): IQ SYSTEM

22

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

NOTE: *For information pertaining to the introductory display, menu navigation, and monitor, faults and function menus,* ***see IQ Display Module (IQDM) and IQDM-P Diagnostics: IQ System on page 15-1.***

The information presented in this section addresses the series 2 versions of the IQDM-P and IQDM handsets.

PLUGGING THE HANDSET INTO THE VEHICLE

1. Connect one end of the cable to the jack located on the bottom of the handset.
2. Connect the cable adaptor to the IQDM cable.
3. Find the IQDM jack on the vehicle **(Figure 22-1, Page 22-1)**.
4. Remove the dust cap from the IQDM jack.
5. Align the keyed portion of the plug with the IQDM jack and connect the plug to the jack.

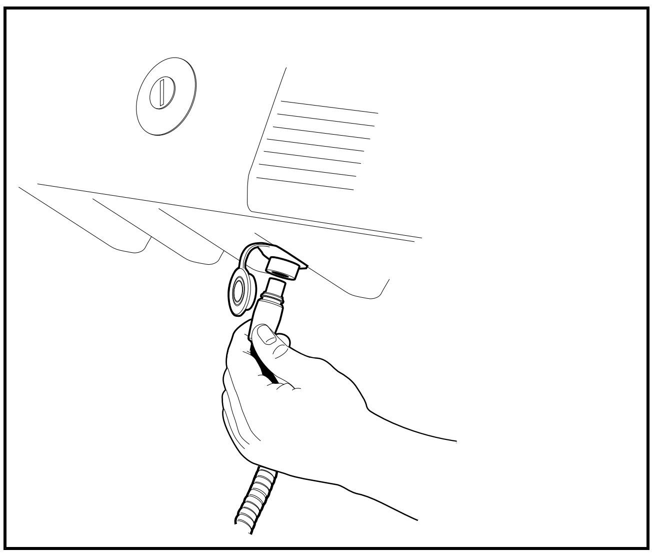

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Figure 22-1 IQDM Port Under Instrument Panel

PROGRAM MENU

The *program* menu can be accessed by pressing the right arrow on the navigation button when the square beside *program* is blinking **(Figure 22-2, Page 22-2)**. When the *program* menu is active, use the up or down arrows on the navigation button to go to the desired item in the *program* menu. Again, press the right arrow to select the menu item. Use the change value button to change the values of the selected item as necessary.

The following parameters can be programmed with the handset from the *program* menu:

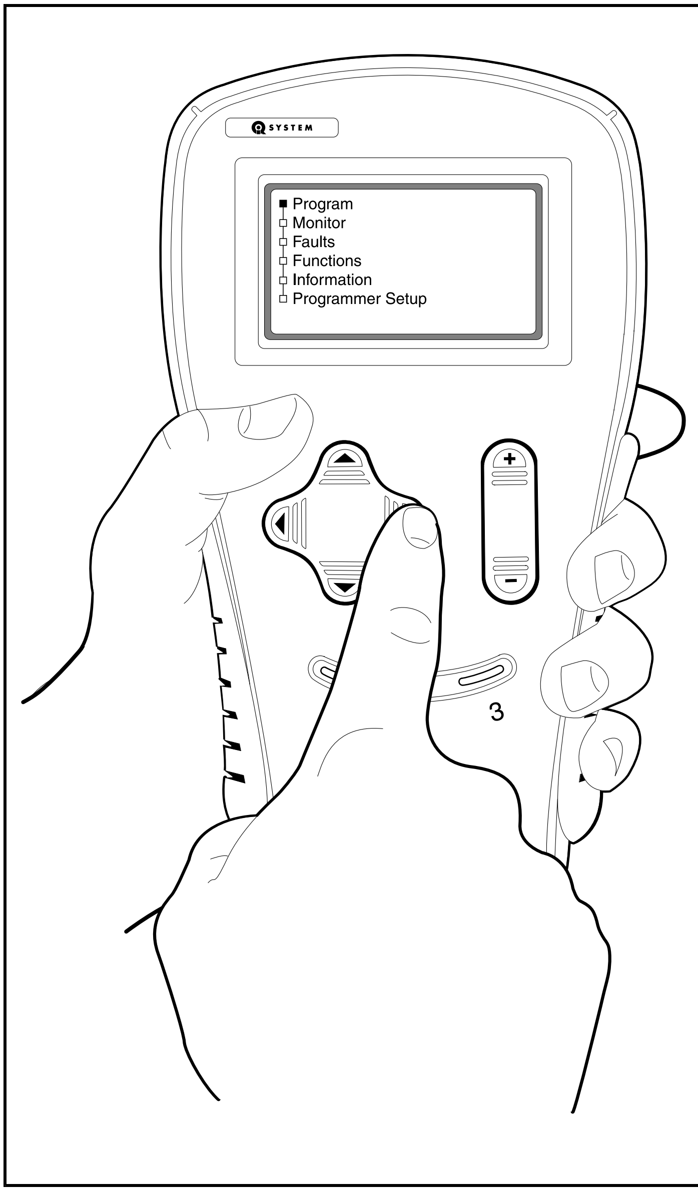

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Figure 22-2 Access Program Menu

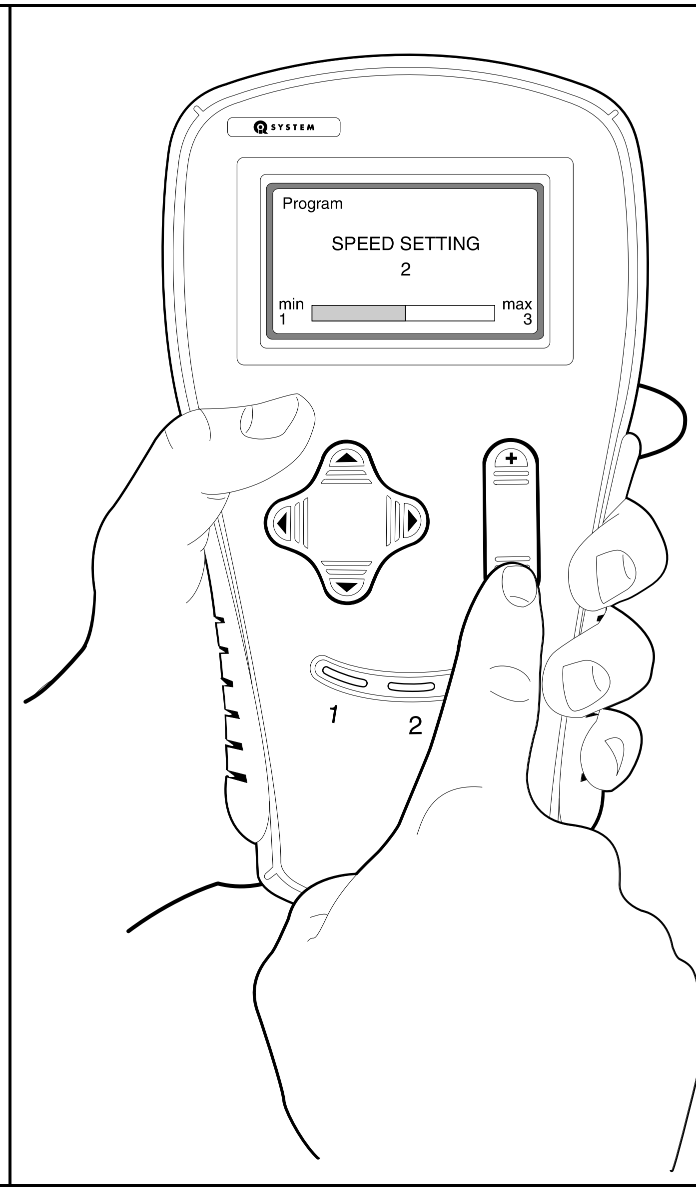

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Figure 22-3 Change Speed Setting

SPEED SETTING

The vehicle's top speed can be changed by selecting values 1 through 3 **(Figure 22-3, Page 22-2)**. If a value of 4 is displayed for the speed setting, a special access code has been entered to place the vehicle in "private speed mode." A speed setting of 4 cannot be selected with the *speed setting* menu item. For additional information on speed setting 4, refer to *Code A, Code B, and Code C*. **See Code A, Code B, and Code C on page 22-3.**

SPEED SETTING	DESCRIPTION	VEHICLE SPEED
1	Commercial speed	8.0 mph (12.9 km/h)
2	Slow golf speed	13.2 mph (21.3 km/h)
3	Normal golf speed	14.8 mph (23.8 km/h)
4	Private speed mode	19.6 mph (31.5 km/h)

FAST ACCEL

Fast accel (fast acceleration) is an option that can be enabled or disabled. With *fast accel* turned on, the vehicle will accelerate at a noticeably faster rate. With this feature turned off, the vehicle speed will gradually increase, even if the accelerator is quickly pressed to the floor. Turn the feature on or off by pressing + or – on the change value button.

PEDAL UP MODE

Three options exist for *pedal up mode* (motor braking). When the accelerator pedal is released, motor braking will slow the vehicle to a speed of approximately 11 mph (17.7 km/h) when pedal up motor braking is enabled (option 1 or 2). If pedal up motor braking is disabled (option 0), the vehicle will coast to a stop when the pedal is released. **See following NOTE.**
Change the settings of the Pedal Up Mode by pressing + or – on the change value button.

NOTE: *Pedal up mode does not affect top vehicle speed. If the accelerator pedal is released when the vehicle is going down an incline, the motor braking function will activate, slowing the vehicle to the speed setting defined in the Program menu.* ***See Speed Setting on page 22-3.***

PEDAL UP MODE SETTING	MODE	OPERATION DESCRIPTION
0	Off	Pedal up motor braking is disabled
1	Mild pedal up	Mild pedal up motor braking
2	Aggressive pedal up	Aggressive pedal up motor braking

SPEED CAL

The *speed cal* (speed calibration) menu item allows the user to fine tune the vehicle speed. This feature cannot be used to increase the vehicle speed. The range for speed calibration is 0 to 10. Each time the number is increased, the top speed will be decreased by 0.12 mph (0.2 km/h). The top vehicle speed will be determined by the *speed setting* menu item and the speed calibration setting. For example, if the speed setting is set for a value of 3 (14.8 mph (23.8 km/h)), and the speed calibration is set for 5, the total top speed of the vehicle should be approximately 14.2 mph (22.9 km/h).

CODE A, CODE B, AND CODE C

The code entries are used to place the vehicle in "private speed mode", speed setting code 4. Each vehicle has a unique code for placing the vehicle in this mode. A vehicle programmed for "private speed mode", speed setting 4, does not conform to ANSI Z130.1 – American National Standard for Golf Cars – Safety and Performance Specifications because it is capable of speeds in excess of 15 mph (24.1 km/h). For more information on this feature, contact your local Club Car distributor or dealer.

SLOW PEDAL UP

slow pedal up is an option that toggles either on or off. With the *slow pedal up* parameter turned off, downhill speed with the pedal up will be maintained at 11.3 mph (18.2 kph). Turned on, this parameter maintains pedal up, downhill speed at 10.4 mph (16.8 kph).

KSI SRO ENABLE

The *ksi sro enable* (key switch static return to off) option toggles either on or off. With this menu item enabled, the vehicle will not operate if the key switch is on after the car is charged or the run/tow switch is cycled. The vehicle will be disabled when the controller is powered up with the key switch on and after any of the following events have occured: 1. the run/tow switch had been placed in the tow position, 2. the DC plug of the charger had been plugged into the vehicle, 3. the battery set had been disconnected or 4. if the vehicle had gone into sleep mode and the accelerator was pressed while the key switch was switched on. The KEY SWITCH SRO fault detect that is controlled by the *ksi sro enable* parameter is disabled (off) by default.

M2 MAX SPEED

The *m2 max speed* option allows for adjustability of the SPEED 2 speed setting. From the factory, the vehicle can be set to one of four standard SPEED 2 speed settings. The four speed settings are 11.4, 12.4, 13.2 and 14.0 mph (18.4, 20.0, 21.3 and 22.6 km/h, respectively). The default SPEED 2 speed setting is 13.2 mph (21.3 km/h). The top speed of the vehicle can be set between 11.2 to 14.8 mph in 0.2 mph (18.1 to 23.9 km/h in 0.3 km/h) increments. (The IQDM displays mph as “%”).

SECTION 23 – IQ DISPLAY MODULE PROGRAMMER (IQDM-P): EXCEL SYSTEM

23

⚠ DANGER

- **See General Warnings on page 1-1.**

⚠ WARNING

- **See General Warnings on page 1-1.**

NOTE: *For information pertaining to the introductory display, menu navigation, and monitor, faults and function menus,* ***see IQ Display Module (IQDM) and IQDM-P Diagnostics: Excel System on page 16-1.***

The information presented in this section addresses the series 2 versions of the IQDM-P and IQDM handsets. IQDM series 1 and IQDM-P series 1 handsets are not compatible with the Excel System. ***See Figure 23-2, Page 23-1.***

PLUGGING THE HANDSET INTO THE VEHICLE

1. Connect one end of the cable to the jack located on the bottom of the handset.
2. Connect the cable adaptor to the IQDM cable.
3. Find the IQDM jack on the vehicle **(Figure 23-1, Page 23-1)**.
4. Remove the dust cap from the IQDM jack.
5. Align the keyed portion of the plug with the IQDM jack and connect the plug to the jack.

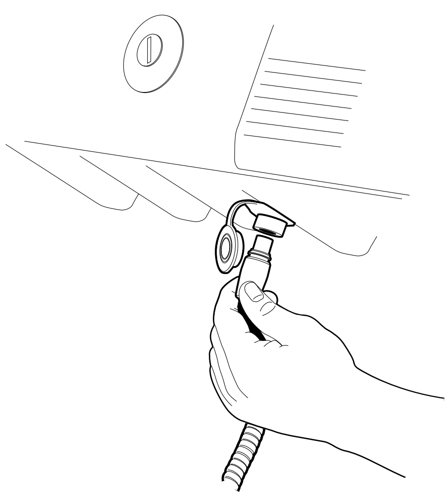

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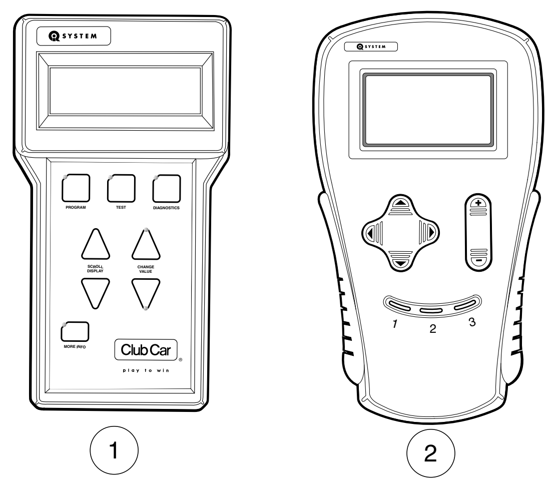
Figure 23-1 IQDM Port Under Instrument Panel



1. IQDM–P Series 1 (can not be used with Excel System)
2. IQDM–P Series 2

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Figure 23-2 IQDM–P Versions

PROGRAM MENU

The *program* menu can be accessed by pressing the right arrow on the navigation button when the square beside *program* is blinking **(Figure 23-3, Page 23-2)**. When the *program* menu is active, use the up or down arrows on the navigation button to go to the desired item in the *program* menu. Again, press the right arrow to select the menu item. Use the change value button to change the values of the selected item as necessary.

The following parameters can be programmed with the handset from the *program* menu:

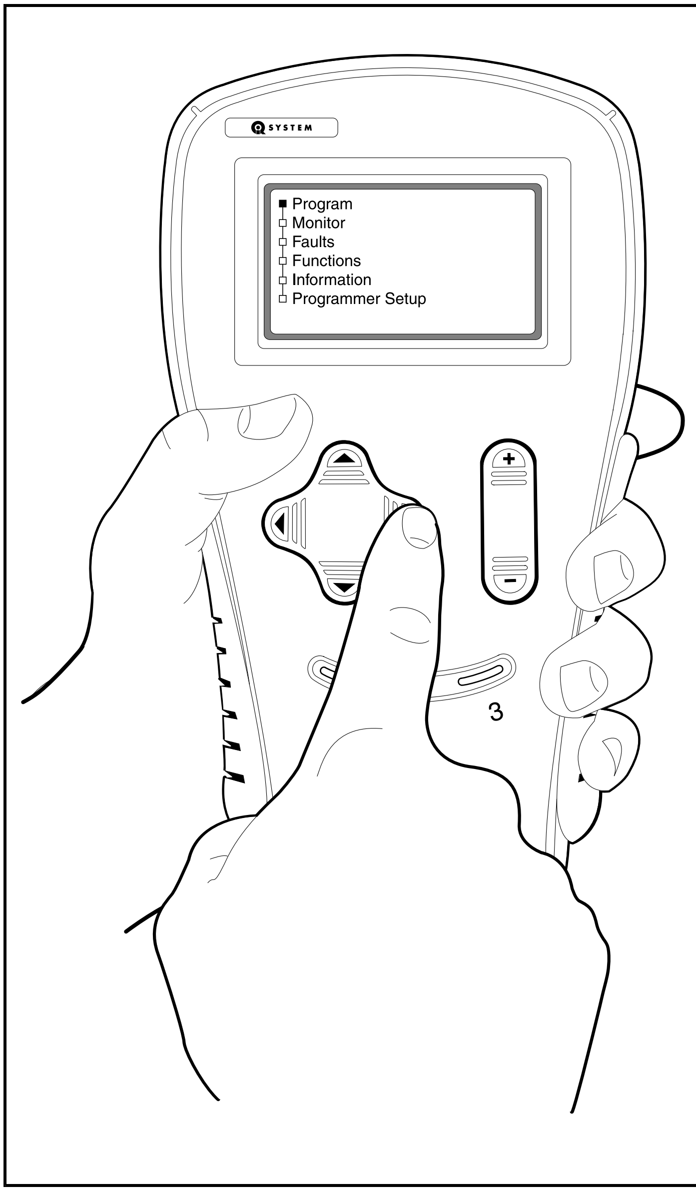

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Figure 23-3 Access Program Menu

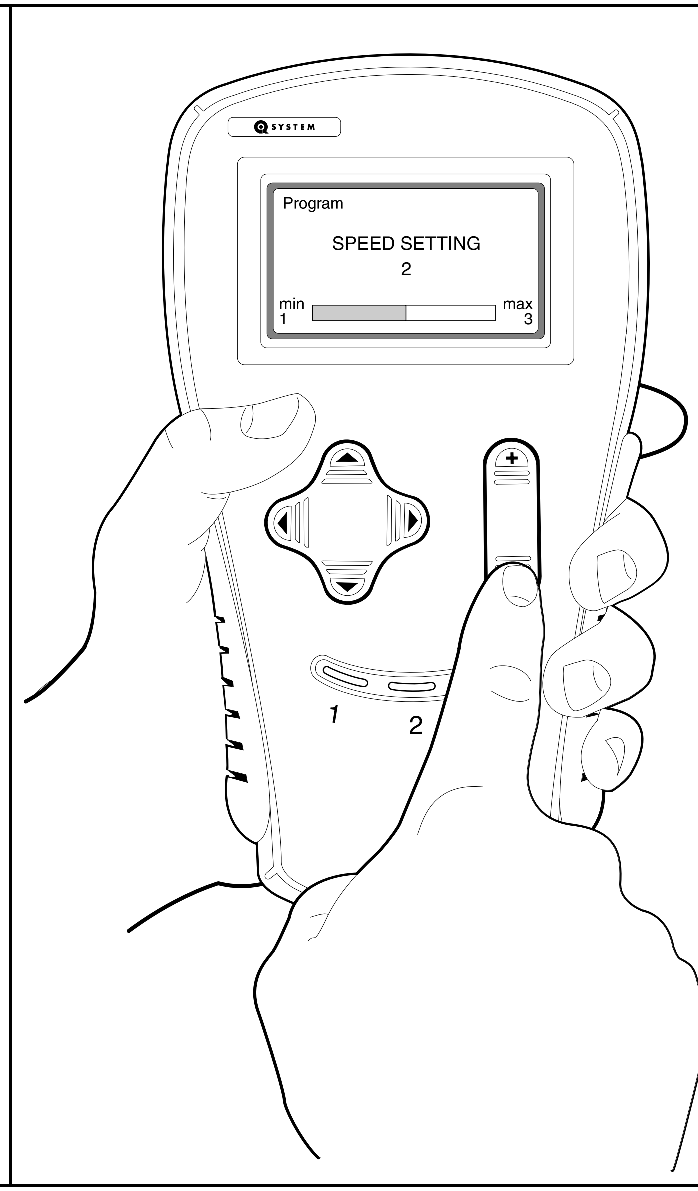

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Figure 23-4 Change Speed Setting

SPEED SETTING

The vehicle's top speed can be changed by selecting values 1 through 3 **(Figure 23-4, Page 23-2)**. If a value of 4 is displayed for the speed setting, a special access code has been entered to place the vehicle in "private speed mode." A speed setting of 4 cannot be selected with the *speed setting* menu item. For additional information on speed setting 4, refer to *Code A, Code B, and Code C*. **See Code A, Code B, and Code C on page 23-4.**

SPEED SETTING	DESCRIPTION	VEHICLE SPEED
1	Commercial speed	8.0 mph (12.9 km/h)
2	Slow golf speed	11.4 mph (18.3 km/h)
3	Normal golf speed	Typical 14.8 mph (23.8 km/h). **See S3 FWD Speed on page 23-4.**
4	Private speed mode	19.2 mph (30.9 km/h)

NOTE: *Present speed values for each speed setting may be observed in the monitor menu.* ***See Vehicle Speeds (IQDM-P Only) on page 16-7.***

FAST ACCEL

Fast accel (fast acceleration) is an option that can be enabled or disabled. With *fast accel* turned on, the vehicle will accelerate at a noticeably faster rate. With this feature turned off, the vehicle speed will gradually increase, even if the accelerator is quickly pressed to the floor. Turn the feature on or off by pressing + or – on the change value button.

PEDAL UP MODE

Three options exist for *pedal up mode* (motor braking). When the accelerator pedal is released, motor braking will slow the vehicle to "near zero speed" when pedal up motor braking is enabled (option 1 or 2). If pedal up motor braking is disabled (option 0), the vehicle will coast to a stop when the accelerator pedal is released. **See following NOTE.** Change the settings of the Pedal Up Mode by pressing + or – on the change value button.

NOTE: *Pedal Up Mode does not affect top vehicle speed. When the vehicle is going down an incline, the motor braking function will activate to prevent the vehicle from exceeding the speed setting defined in the Program menu, regardless of Pedal Up Mode setting (0,1,2).* ***See Speed Setting on page 23-3.***

When going down an incline with the accelerator pedal partially pressed, the motor braking function will activate to assist the operator in maintaining a speed less than the top speed setting. For example, if the vehicle is going down an incline with the accelerator pedal pressed half way, the motor braking function will activate to assist the operator in maintaining a speed approximately half of the speed setting defined in the Program Menu.

PEDAL UP MODE SETTING	MODE	OPERATION DESCRIPTION
0	Off	Pedal up motor braking is disabled
1	Mild pedal up	Mild pedal up motor braking
2	Aggressive pedal up	Aggressive pedal up motor braking

SPEED CAL

The *speed cal* (speed calibration) menu item allows the user to fine tune the vehicle speed. This feature cannot be used to increase the vehicle speed. The range for speed calibration is 0 to 30. Each time the number is increased, the top speed will be decreased by 0.1 mph (0.16 km/h). The top vehicle speed will be determined by the *speed setting* menu item and the speed calibration setting. For example, if the speed setting is set for a value of 2 (11.4 mph (18.3 km/h)), and the speed calibration is set for 5, the total top speed of the vehicle should be approximately 10.9 mph (17.5 km/h).

NOTE: *The SPEED CAL function will not be necessary in most golf applications since the speed setting 3 is finely adjustable with S3 FWD SPEED.* ***See S3 FWD Speed on page 23-4.***

S3 FWD SPEED

The *s3 fwd speed* option allows for adjustability of the SPEED 3 speed setting. From the factory, *s3 fwd speed* will be set to one of 4 options: 12.4, 13.2, 14.0 and 14.8 mph (20.0, 21.3, 22.6 and 23.8 km/h, respectively). The default *s3 fwd speed* is be 14.8mph (23.8 km/h). The *s3 fwd speed* may be adjusted with the handset from 11.4 to 14.8 mph (18.3 to 23.8 km/h) in 0.1 mph (0.16 km/h) increments. The speed value chosen for *s3 fwd speed* may also be observed in the monitor menu. **See Vehicle Speeds (IQDM-P Only) on page 16-7.**
To fine tune vehicle top speed in normal golf speed range (12.4 to 14.8mph (20.0 to 23.8 km/h)):

1. Access the *program* menu, then the *speed setting* menu with the navigation keys.
2. Select Speed Setting 3 with the change value buttons.
3. Access the *program* menu and the *s3 fwd speed* menu with the navigation keys.
4. Use the change value buttons to select desired speed.

CODE A, CODE B, AND CODE C

The code entries are used to place the vehicle in “private speed mode”, speed setting code 4. Each vehicle has a unique code for placing the vehicle in this mode. A vehicle programmed for “private speed mode”, speed setting 4, does not conform to ANSI Z130.1 – American National Standard for Golf Cars – Safety and Performance Specifications because it is capable of speeds in excess of 15 mph (24.1 km/h). For more information on this feature, contact your local Club Car distributor or dealer.

VEHICLE S/N

Six digit number programmed by vehicle manufacturer.

VEHICLE DECAL

Decal number ranging from 0 - 999 and programmed by vehicle manufacturer.

A

B

C

D

E

F

H

I

K

L

M

O

P

T

U

W

Your Comments Are Appreciated

Contact Information (Optional):

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Title/Company: ____________________
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Phone: __________ Fax: __________
E-mail: ____________________

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- ☐ Club Car Associate/Representative
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- ☐ Golf Course Superintendent
- ☐ Other: __________

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