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 on page 22-10).**

SPEED CONTROLLER 24-PIN CONNECTOR WIRE	TEST PROCEDURE
Pin 1 – Tan (18-gauge)	Test Procedure 16 – Pin 1 on page 22-26
Pin 2 – Light Blue (18-gauge)	Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 22-11
Pin 3 – Orange (18-gauge)	Test Procedure 18 – Pin 3 on page 22-28
Pin 4 – Grey (18-gauge)	Test Continuity of wire
Pin 5 – Open (no wire)	Test Procedure 12 – Pin 2 on page 22-21
Pin 6 – Open (no wire)	Test Procedure 13 – Pin 8 on page 22-23
Pin 7 – Open (no wire)	Test Procedure 14 – Pin 19 on page 22-24
Pin 8 – Green (18-gauge)	Test Procedure 13 – Pin 8 on page 22-23
Pin 9 – Pink (18-gauge)	Test continuity of wire
Pin 10 – Brown (18-gauge)	Test Procedure 15 – Pins 10 and 11 on page 22-25
Pin 11 – Blue (18-gauge)	
Pin 12 – Open (no wire)	Test Procedure 17 – Pin 17 on page 22-27
Pin 13 – White (18-gauge)	Test continuity of each wire and perform Test Procedure 11 – Pins 13, 14, and 15 on page 22-20
Pin 14 – Purple/White (18-gauge)	
Pin 15 – Yellow (18-gauge)	
Pin 16 – Open (no wire)	
Pin 17 – Blue/White (18-gauge)	Test Procedure 17 – Pin 17 on page 22-27
Pin 18 – Open (no wire)	
Pin 19 – Orange/White (18-gauge)	Test Procedure 14 – Pin 19 on page 22-24
Pin 20 – Purple (18-gauge)	Test Procedure 19 – Pin 20 (Smart-Key Switch Only) on page 22-28
Pin 21 – Open (no wire)	
Pin 22 – Open (no wire)	
Pin 23 – Green/White (18-gauge)	Test Procedure 20 – Pin 23 on page 22-28
Pin 24 – Open (no wire)	

TEST PROCEDURE 11 – Pins 13, 14, and 15

See General Warning on page 1-1.

Pins 13, 14, and 15 in the 24-pin connector provide a connection point from the MCOR potentiometer to the speed controller.

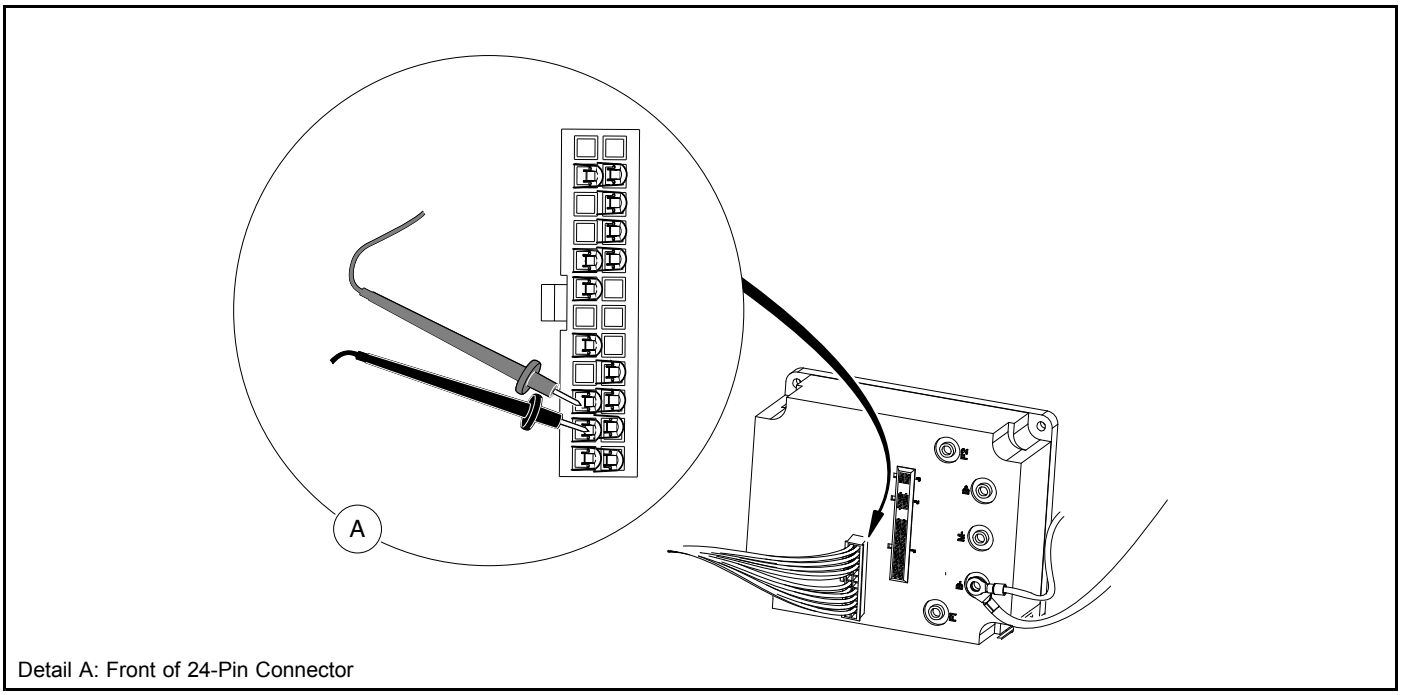
1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame crossmember between the spring mount and side stringer, just forward of each rear wheel. **See WARNING "Lift only one end..." in General Warning on page 1-1.**
3. Disconnect the 24-pin connector at the speed controller.

4. Set a multimeter to 20k ohms. Insert the red (+) probe of the multimeter into pin 15 (yellow wire) of the 24-pin connector. **See following CAUTION.** Insert the black (–) probe into pin 14 (purple/white wire) of the 24-pin connector **(Figure 22-12, Page 22-21)**.

CAUTION

- **Do not fully insert probes into the 24-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.
7. Set a multimeter to 20k ohms. Insert the red (+) probe of the multimeter into pin 15 (yellow wire) at the 24-pin connector. Connect the black (–) probe into pin 13 (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.
11. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**



Detail A: Front of 24-Pin Connector

Figure 22-12 Test: Pins 14 and 15 (Purple/White and Yellow wires)

TEST PROCEDURE 12 – Pin 2

See General Warning on page 1-1.

Pin 2 in the 24-pin connector provides a connection point for the solenoid lockout circuit from the onboard computer to the speed controller.

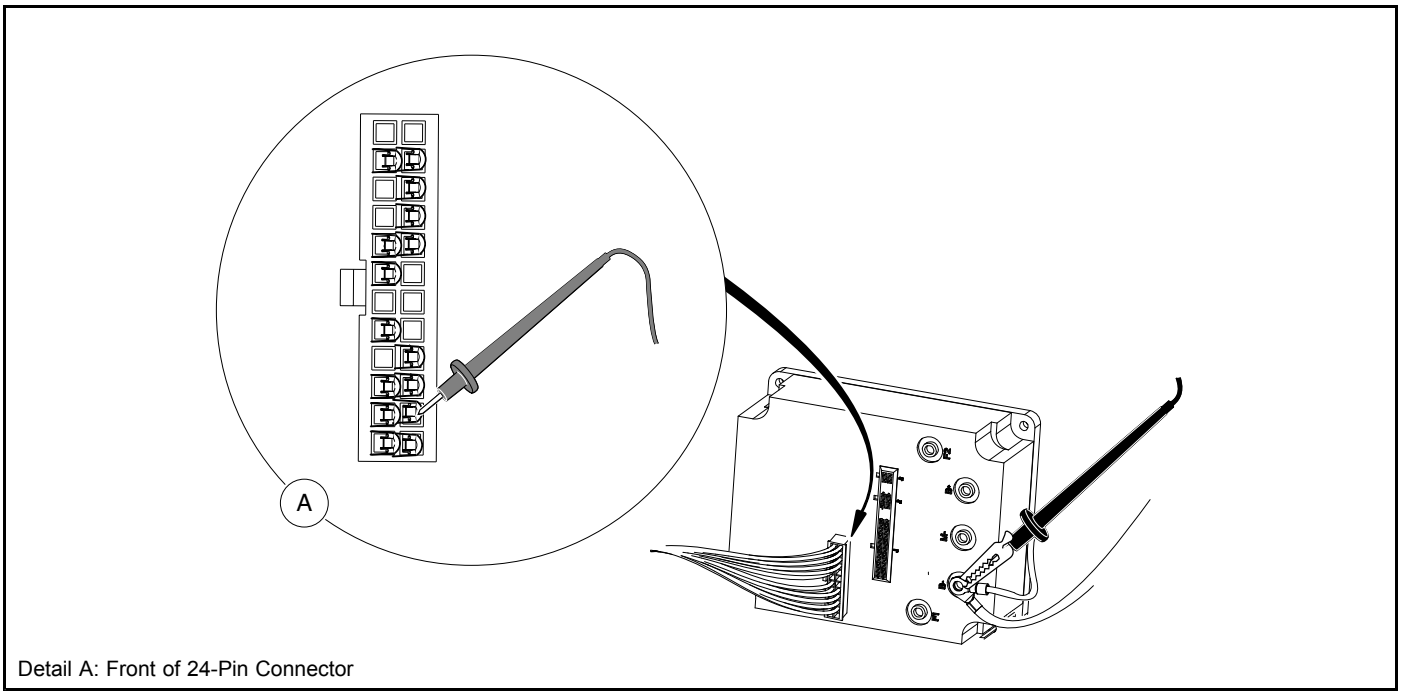
1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

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 Warning on page 1-1.**
3. Disconnect the 24-pin connector at the speed controller.
4. Set a multimeter to 200 volts DC. Insert the red (+) probe of the multimeter into pin 2 (light blue wire) of the 24-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 22-13, Page 22-22)**.

CAUTION

- **Do not fully insert probes into the 24-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the battery cables, positive (+) cable first. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
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 Onboard Computer Gray Wire and Fuse on page 22-29.**
    – Tow/Run switch for proper operation. **See Tow/Run Switch on page 22-16.**



Detail A: Front of 24-Pin Connector

Figure 22-13 Test: Pin 2 (Light Blue Wire)

TEST PROCEDURE 13 – Pin 8

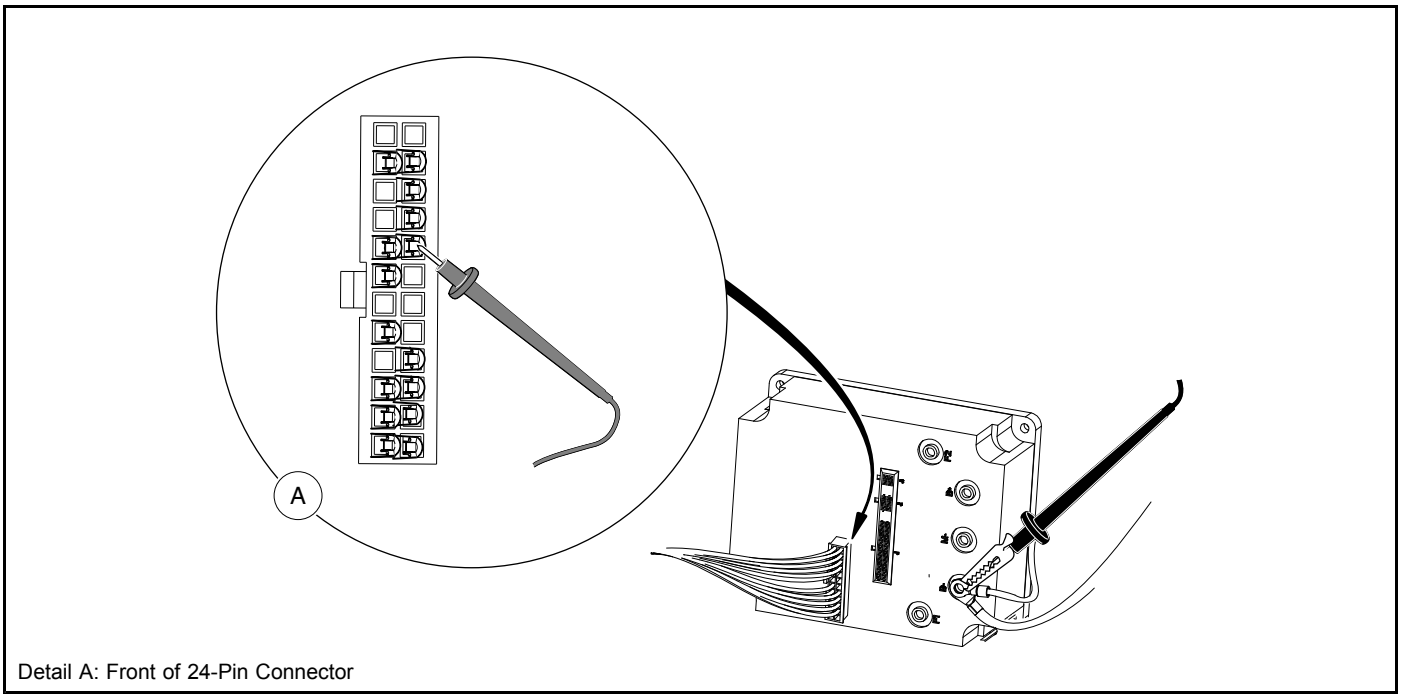
See General Warning on page 1-1.

Pin 8 in the 24-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, Section 1, Page 1-4.**
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 Warning on page 1-1.**
3. Disconnect the 24-pin connector at the speed controller.
4. Set a multimeter to 200 volts DC, insert the red (+) probe of the multimeter into pin 8 (green wire) of the 24-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 22-14, Page 22-23)**.

CAUTION

- **Do not fully insert probes into the 24-pin plug. Doing so can result in a poor connection.**



Detail A: Front of 24-Pin Connector

Figure 22-14 Test: Pin 8 (Green Wire)

5. Place the Tow/Run switch in the TOW position and connect the battery cables, positive (+) cable first. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
6. Place the Tow/Run switch in the RUN position, key switch in the ON position, and Forward/Reverse switch in the FORWARD or NEUTRAL 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 Onboard Computer Gray Wire and Fuse on page 22-29.**
    – Tow/Run switch for proper operation. **See Tow/Run Switch on page 22-16.**
    – Key switch and MCOR limit switch for proper operation. **See Key Switch and MCOR Limit Switch Circuit on page 22-18.**
    – Ensure that the pedal group is adjusted correctly. **See Accelerator and Brake Pedal Group Section.**

TEST PROCEDURE 14 – Pin 19

See General Warning on page 1-1.

Pin 19 in the 24-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, Section 1, Page 1-4.**
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 Warning on page 1-1.**
3. Disconnect the 24-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 19 (orange/white wire) of the 24-pin connector **(Figure 22-15, Page 22-25)**. **See following CAUTION.**

CAUTION

- **Do not fully insert probes into the 24-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the battery cables, positive (+) cable first. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
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 Reverse Buzzer on page 22-34.**
    – Tow/Run switch for proper operation. **See Tow/Run Switch on page 22-16.**

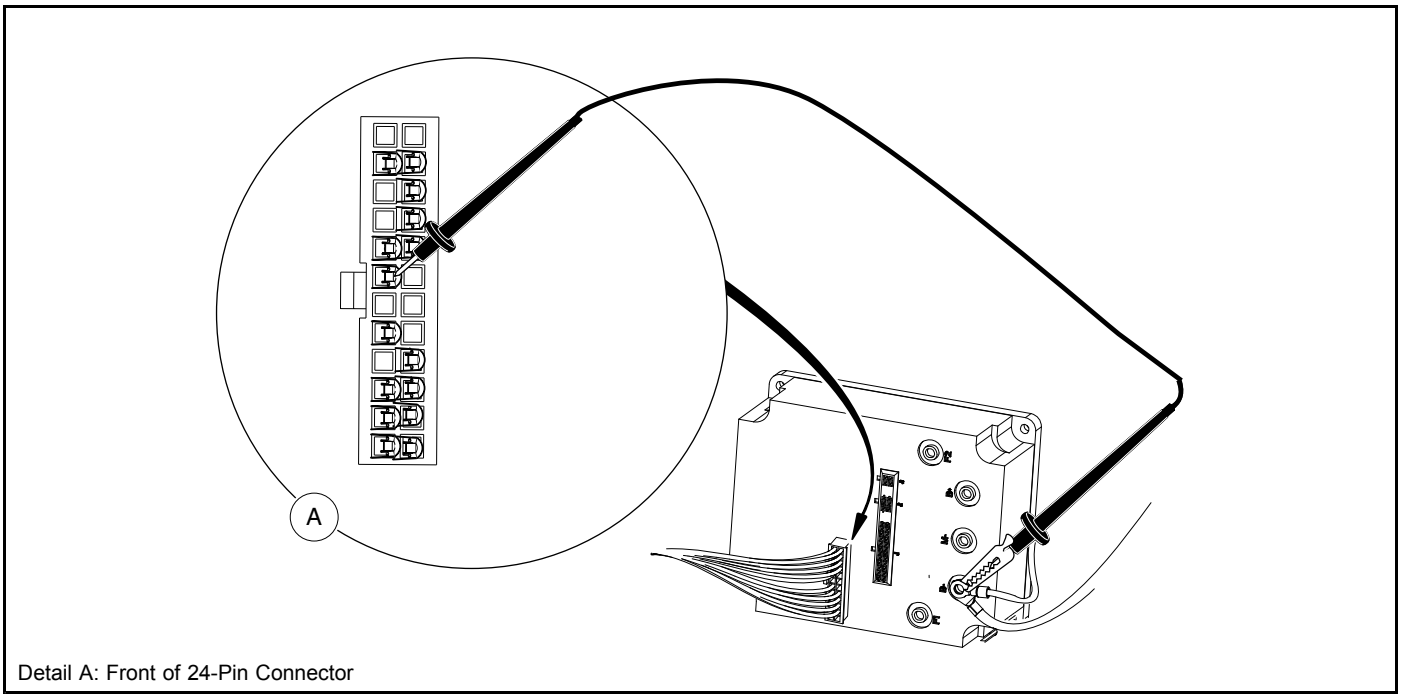


Figure 22-15 Test: Pin 19 (Orange/White Wire)

TEST PROCEDURE 15 – Pins 10 and 11

See General Warning on page 1-1.

Pins 10 and 11 in the 24-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 10 when the Forward/Reverse switch is in the FORWARD position and provides a +48 volt signal on pin 11 when the Forward/Reverse switch is in the REVERSE position.

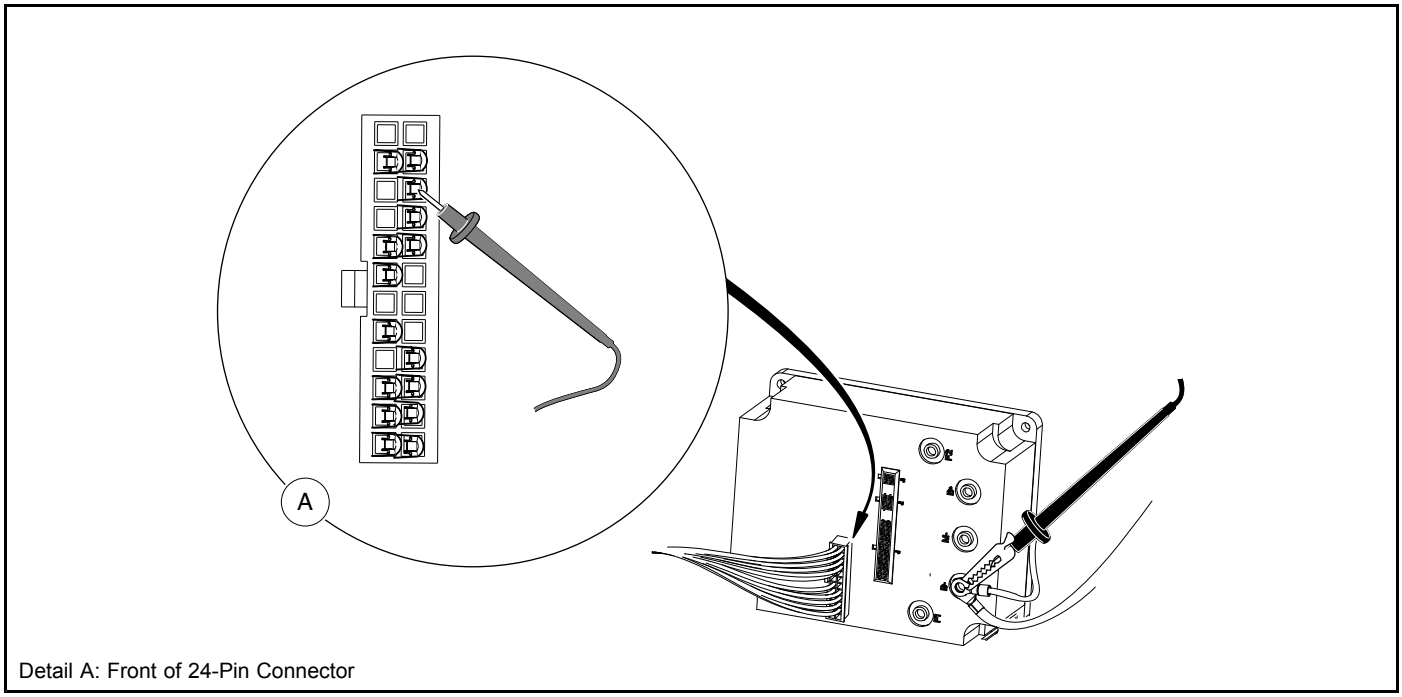
1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame crossmember between the spring mount and side stringer, just forward of each rear wheel. **See WARNING "Lift only one end..." in General Warning on page 1-1.**
3. Disconnect the 24-pin connector at the speed controller.
4. Set a multimeter to 200 volts DC, insert the red (+) probe of the multimeter into pin 10 (brown wire) of the 24-pin connector. **See following CAUTION.** Using an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 22-16, Page 22-26)**.

CAUTION

- **Do not fully insert probes into the 24-pin plug. Doing so can result in a poor connection.**

5. Place the Tow/Run switch in the TOW position and connect the battery cables, positive (+) cable first. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
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 11 (blue wire) of the 24-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 Forward/Reverse Rocker Switch on page 22-33.**
    – Tow/Run switch for proper operation. **See Tow/Run Switch on page 22-16.**



Detail A: Front of 24-Pin Connector

Figure 22-16 Test: Pin 10 (Black Wires)

TEST PROCEDURE 16 – Pin 1

See General Warning on page 1-1.

Pin 1 in the 24-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 1 (tan wire) when the key switch is in the ON position.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
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 Warning on page 1-1.**
3. Disconnect the 24-pin connector at the speed controller.

4. With a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 1 (tan wire) of the 24-pin connector. **See following CAUTION.** With an alligator clip, connect the black (–) probe to the B– terminal of the speed controller **(Figure 22-17, Page 22-27)**.

CAUTION

- **Do not fully insert probes into the 24-pin plug. Doing so can result in a poor connection.**

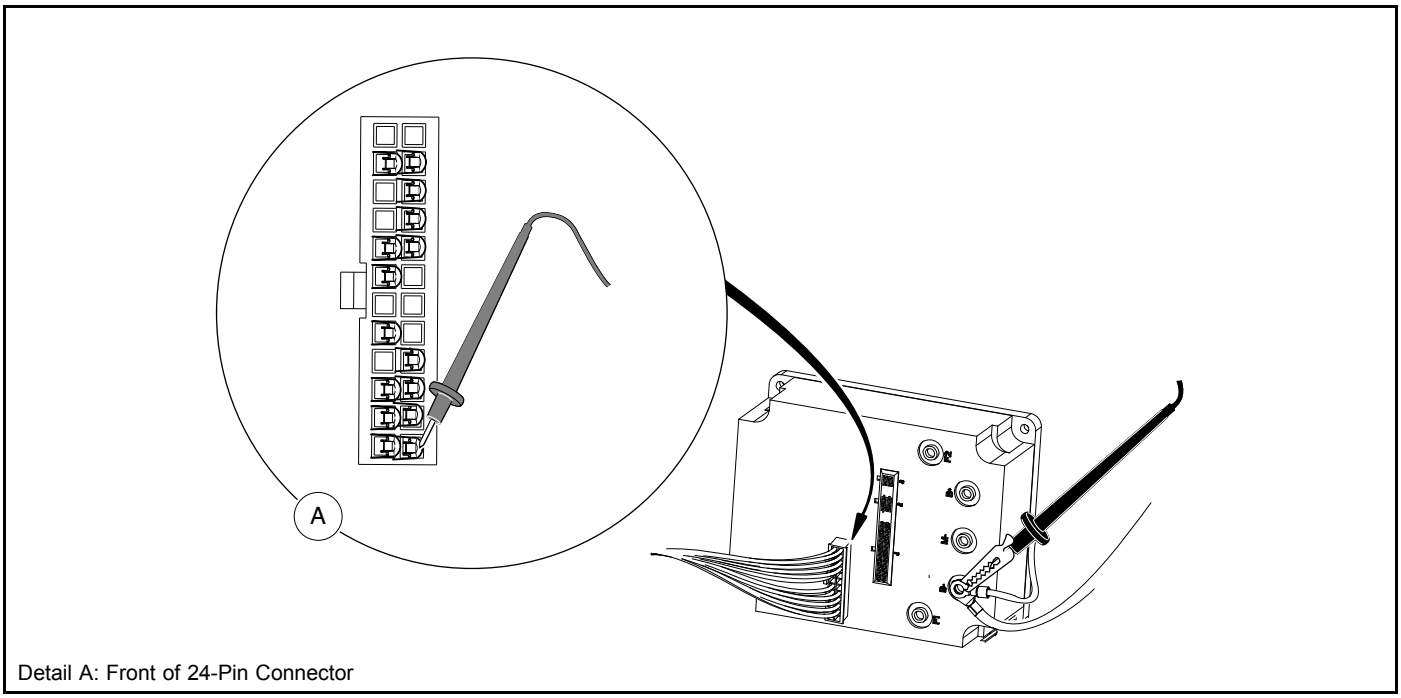


Figure 22-17 Test: Pin 1 (Tan Wire)

5. Place the Tow/Run switch in the TOW position and connect the battery cables, positive (+) cable first. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
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 Tow/Run Switch on page 22-16.**
   – Key switch for proper operation. **See Key Switch and MCOR Limit Switch Circuit on page 22-18.**

TEST PROCEDURE 17 – Pin 17

See General Warning on page 1-1.

Pin 17 in the 24-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. 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 Warning on page 1-1.**

2. Set a multimeter to 200 volts DC. Use an alligator clip to connect the red (+) probe to the positive terminal on battery no. 1. With an insulation-piercing probe, connect the black (–) probe to the blue/white wire attached to pin 17 of the 24-pin connector.
3. Place the Tow/Run switch in the RUN position, the Forward/Reverse swith in the FORWARD position, and the key switch in the ON position.
4. With the accelerator pedal pressed, the multimeter should read 48 volts DC. With the pedal up, the multimeter should read 0 volts DC.
5. If the voltage reading is less than 40 with the accelerator pedal pressed, replace the controller.
6. If any other activity is observed, check the following items:
   – Continuity of the wires in the wire harness.
   – Reverse buzzer for proper operation. **See Reverse Buzzer on page 22-34.**
   – Tow/Run switch for proper operation. **See Tow/Run Switch on page 22-16.**
   – Key switch for proper operation. **See Key Switch and MCOR Limit Switch Circuit on page 22-18.**
   – Solenoid for proper operation. **See Solenoid Contacts on page 22-33.**

TEST PROCEDURE 18 – Pin 3

Voltage is supplied to Pin 3 through the walk away braking circuit breaker:

1. Disconnect the 24-pin connector at the speed controller.
2. With a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 3 (orange wire) of the 24-pin connector. **See following CAUTION.** With an alligator clip, connect the black (–) probe to the negative terminal of battery # 8.

CAUTION

- **Do not fully insert probes into the 24-pin plug. Doing so can result in a poor connection.**

3. The reading should be 48 volts. If the reading is zero volts, replace the circuit breaker.

TEST PROCEDURE 19 – Pin 20 (Smart-Key Switch Only)

Voltage is supplied to Pin 20 when it is in the Mode position.

1. With a multimeter set for 200 volts DC, insert the red (+) probe of the multimeter into pin 20 (purple wire) of the 24-pin connector. **See following CAUTION.** With an alligator clip, connect the black (–) probe to the negative terminal of battery # 8.
2. The reading should be 48 volts. If the reading is zero volts, check the purple wire continuity from the key switch to the 24 pin connector. If there is no continuity, replace the keyswitch.

TEST PROCEDURE 20 – Pin 23

1. Place the Tow/Run switch in the RUN position, the Forward/Reverse swith in the NEUTRAL position, and the key switch in the OFF position.
2. Set the multimeter for 200 volts DC. With an alligator clip, connect the red (+) probe of the multimeter to the positive terminal of battery # 1. With an insulation-piercing probe, connect the black (–) probe to the green/white wire at Pin 23.
3. Push the car to activate walk away braking. When braking activates and reverse buzzer sounds, the reading should be 48 volts.

4. If the reading is zero volts, check the continuity of the green/white wire. if the continuity is good, replace the speed controller.

TEST PROCEDURE 21 – Onboard Computer Silicon-Controlled Rectifier (SCR) Circuit

See General Warning 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 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 fuse terminal that has the black 10-gauge OBC wire (1) attached to it. The reading should be approximately 36-42 volts.
2. If the reading is zero volts, check the black 10-gauge wire connections at the controller and receptacle. Check the continuity of the black 10-gauge wires. If the wires and connections are okay, the SCR has failed. Replace the OBC. If the reading is correct, proceed to 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:
   – Charger receptacle fuse and black wire terminal socket in the charger receptacle.
   – Onboard computer gray wire and fuse. **See Onboard Computer Gray Wire and Fuse on page 22-29.**
   – Red wire at the charger receptacle. **See Voltage at Charger Receptacle Red Wire Socket on page 22-30.**

TEST PROCEDURE 22 – Onboard Computer Gray Wire and Fuse

See General Warning on page 1-1.

1. With batteries connected and a multimeter set to 200 volts DC, connect the red (+) probe to the positive post of battery no. 1 and black (–) probe (with insulation-piercing probe) to gray 16-gauge wire (2) at a point between fuse and receptacle (1). Reading should be approximately 40-45 volts. If reading is zero volts, check gray wire fuse and fuse holder for continuity.
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 less than 5 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 less than 5 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.

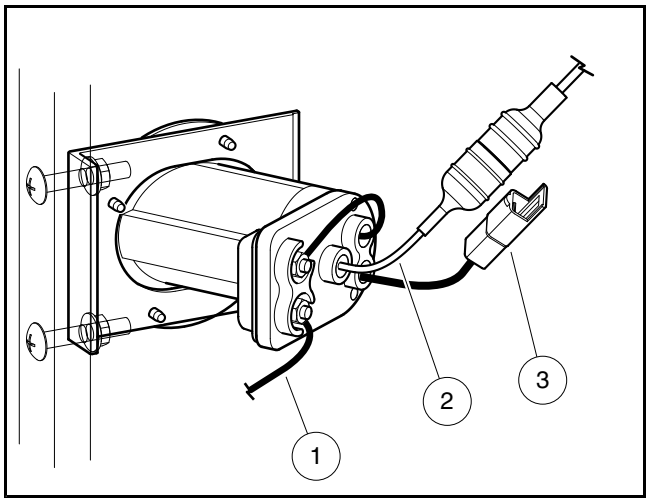


Figure 22-18 Charger Receptacle Tests

TEST PROCEDURE 23 – Voltage at Charger Receptacle Red Wire Socket

See General Warning on page 1-1.

(This procedure will determine if the 10-guage red wire used to charge the batteries has continuity.)

1. With batteries connected and a multimeter set to 200 volts DC, place the black (–) probe on the negative post of battery no. 8 and place the red (+) probe on the charger receptacle socket connected to the red 10-gauge wire (3). 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 24 – Motor Speed Sensor

See General Warning 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. **See Plugging the Handset into the Vehicle, Section 23, Page 23-1.**
3. Access the Monitor 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

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. Set a multimeter 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 24-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.

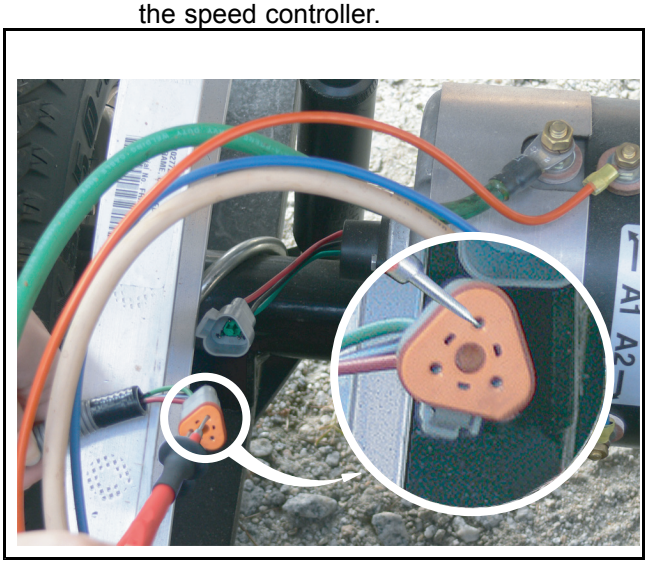


Figure 22-19 Test 13: Speed Sensor Black/White Wire

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. 8 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 24-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.

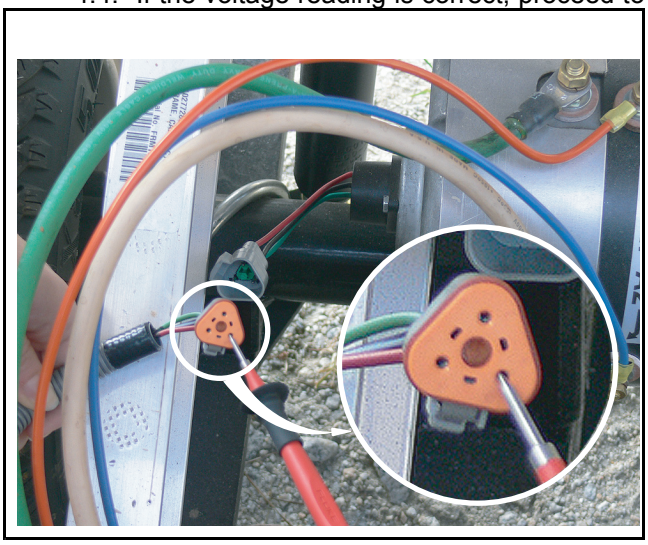


Figure 22-20 Test 13: Speed Sensor Red Wire

5. Check voltage at the light green wire:

5.1. Set a multimeter to 20 volts DC. Place the black (–) probe on the battery no. 8 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 5.00 volts.

5.2. If the voltage is zero volts, check the continuity of the light green wire from the 24-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.

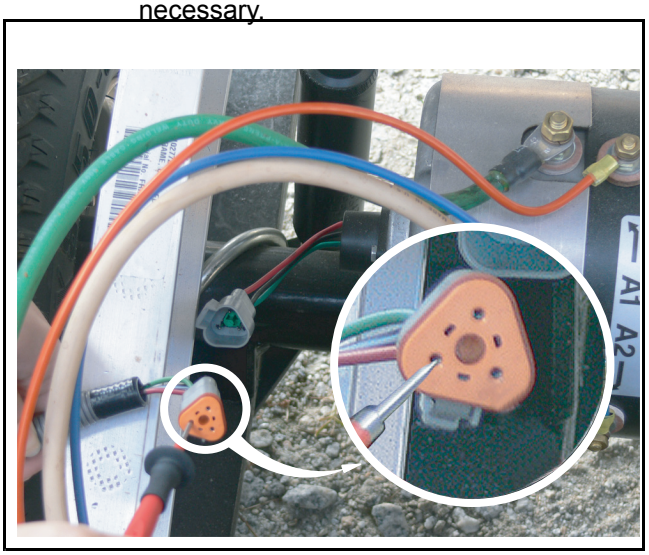


Figure 22-21 Test 13: Speed Sensor Light Green Wire

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. 8 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.

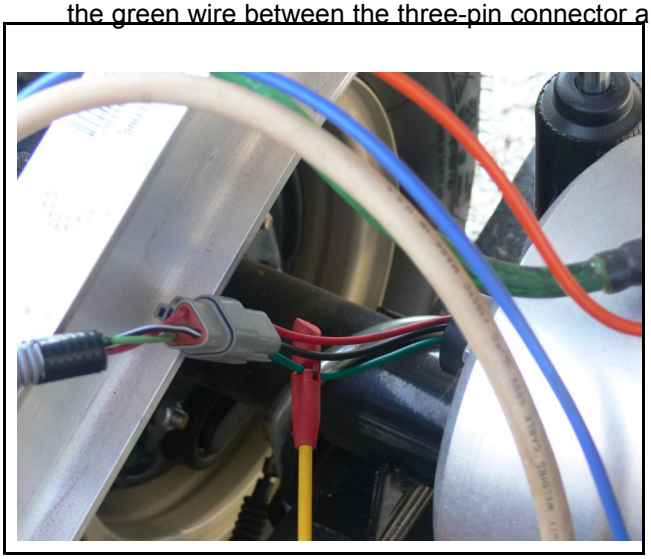


Figure 22-22 Test 13: Speed Sensor Green Wire

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. **See following NOTE.**

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 25 – Solenoid Contacts

See General Warning 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 crossmember between the spring mount and side stringer, just forward of each rear wheel. **See WARNING "Lift only one end..." in General Warning on page 1-1.**
2. Turn the key switch to the ON position and place the Forward/Reverse switch in the FORWARD position.
3. Set a multimeter to 200 volts. Place the black (–) probe on the battery no. 8 negative post and place the red (+) probe on the large post with the 6-gauge yellow wire.
4. With the pedal up, the reading should be 9.5 to 10.5 volts. If the voltage is higher, let the car sit for 5-10 minutes to allow the capacitors to discharge to 9.5 to 10.5 volts.
5. Press the accelerator pedal. The voltage should read 48-50 volts with the pedal pressed. If the voltage does not increase or goes to 0 volts with the pedal pressed, replace the solenoid.

TEST PROCEDURE 26 – Forward/Reverse Rocker Switch

See General Warning 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. **See Plugging the Handset into the Vehicle, Section 23, Page 23-1.**
3. Test FORWARD INPUT.
   3.1. Access the Monitor 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 beginning on page 22-2**. Also check the 24-pin connector at the speed controller. **See 24-Pin Connector on page 22-19.**
4. Test REVERSE INPUT.
   4.1. Access the Monitor 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 22-2.**. Also check the 24-pin connector at the speed controller. **See 24-Pin Connector on page 22-19.**
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

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the center dash panel.
   2.1. Remove the plastic cap covering the mounting screw on each side of the center dash panel.
   2.2. Loosen, but do not remove, the screw on each side of the center dash panel.

2.3. Insert screwdriver at the top center of the dash between dash and cowl brace. Gently pry center dash out slightly from under edge of cowl brace.

2.4. Pull center dash out from the frame and disconnect the wires from the electrical components mounted on the dash panel. Do not allow wires to touch. **See following NOTE.**

NOTE: *Take care to prevent key switch terminals and wires from touching the metal frame around the dash.*

2.5. Slide the dash panel up the steering column by snapping the top out and then rotating the panel out and up.

3. Disconnect the three wires from the rocker switch. Set multimeter 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.
4. 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.
5. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

TEST PROCEDURE 27 – Reverse Buzzer

See General Warning on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the center dash panel.
   2.1. Remove the plastic cap covering the mounting screw on each side of the center dash panel.
   2.2. Loosen, but do not remove, the screw on each side of the center dash panel.
   2.3. Insert screwdriver at the top center of the dash between dash and cowl brace. Gently pry center dash out slightly from under edge of cowl brace.
   2.4. Pull center dash out from the frame and disconnect the wires from the electrical components mounted on the dash panel. Do not allow wires to touch. **See following NOTE.**

NOTE: *Take care to prevent key switch terminals and wires from touching the metal frame around the dash.*

   2.5. Slide the dash panel up the steering column by snapping the top out and then rotating the panel out and up.
   2.6. Disconnect the orange/white and red wires from the reverse buzzer. Make sure the wire terminals on the key switch do not touch vehicle frame.
3. Place the Tow/Run switch in the TOW position and connect the battery cables, positive (+) cable first. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
4. Place the Tow/Run switch in the RUN position.
5. Set a multimeter to 200 volts DC. Place the black (–) probe on battery no. 8 negative post and place the red (+) probe on the red wire terminal end that was disconnected from the reverse buzzer. The reading should be approximately 48 volts (full battery voltage).
   5.1. If the voltage reading is correct, proceed to step 6.
   5.2. If reading is zero volts, check red wire continuity and Tow/Run switch. **See Onboard Computer Solenoid Lockout Circuit on page 22-11. See also** Test Procedure 6 – Tow/Run Switch on page 22-16.
   5.3. If the continuity readings are not correct, repair or replace the red wire.
   5.4. If the continuity readings are correct, proceed to step 6.
6. 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).
   6.1. If the voltage reading is correct, replace the reverse buzzer.

6.2. If reading is zero volts, check orange/white wire continuity and connection at Pin 19 in 24-Pin connector.

6.3. If there is no continuity in the orange/white wire, or the Pin 19 terminal in the 24-Pin connector is not properly seated, repair or replace as required.

6.4. If the orange/white wire continuity and 24-Pin connector are correct and there is no voltage at the orange wire, replace the controller.

TEST PROCEDURE 28 – Rebooting the Onboard Computer

See General Warning 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, Section 1, Page 1-4. See following NOTE.**
2. With the Tow/Run switch in the TOW position, connect the battery cables, positive (+) cable first. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
3. Place Tow/Run switch in the RUN position.
4. Test drive the vehicle. If the problem has been fixed, the vehicle will function normally. If the problem still exists, refer to Wiring Diagrams beginning on page 22-2.

TEST PROCEDURE 29 – Battery Warning Light

See General Warning 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 2-3 seconds. **See Rebooting the Onboard Computer on page 22-35.** 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. Use a jumper wire with an alligator clip at each end and connect one alligator clip to the negative post of battery no. 2 and the other alligator clip to the brown/white wire terminal socket that was removed from the six-pin connector plug.
6. Install the wedge lock 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.

TEST PROCEDURE 30 – Walk Away Braking Relay

See General Warning on page 1-1.

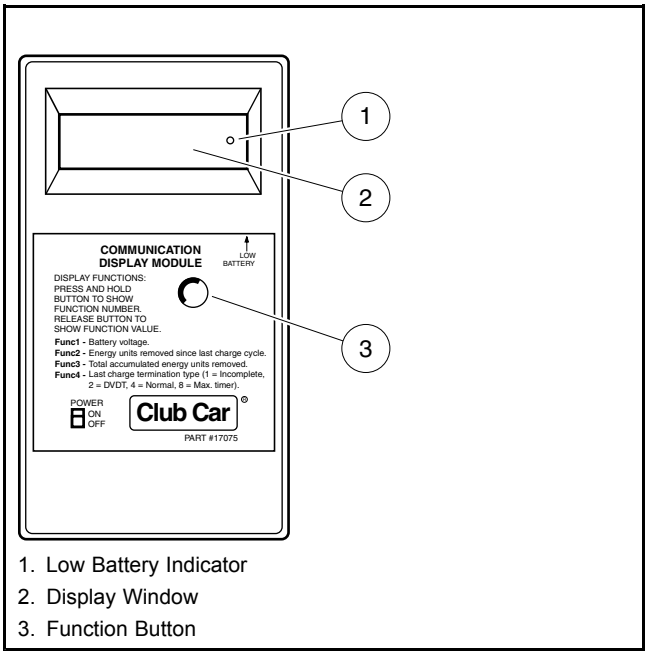
Walk Away Braking Relay Test with the IQDM Handset

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. **See Plugging the Handset into the Vehicle, Section 23, Page 23-1.**
3. Check the FAULTS Menu.
4. If a 15 RELAY DNC or 30 RELAY COIL FAULT is shown in the list, a walk away braking fault has occurred.

Walk Away Braking Relay 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. Slowly push the vehicle a short distance (about 3 feet (1 meter)).
3. You should feel resistance as motor braking is applied. The reverse buzzer will also begin pulsing. If neither of these conditions are present, test the Motor Speed Sensor. **See Motor Speed Sensor on page 22-30.** If the Motor Speed Sensor is operational, replace the walk away braking relay.

COMMUNICATION DISPLAY MODULE (CDM)



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

Figure 22-23 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 Plus vehicle. To access one of these items, the item's corresponding Function Code must be selected on the CDM. This is done by pressing the Function Button until the desired function code is displayed in the window. **See Figure 22-23, Page 22-36** 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 (0 = no charge history, 1 = incomplete, 2 = DVDT, 4 = normal, 8 = max. timer):**

A 0, 1, **2**, **4**, or **8** will be displayed.

0 -- Indicates that no charge history has been recorded by the OBC.

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

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

4 – Indicates the last charge cycle was normal.

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

The CDM also has a low battery 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 22-38.

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). **See following NOTE.**
- 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.

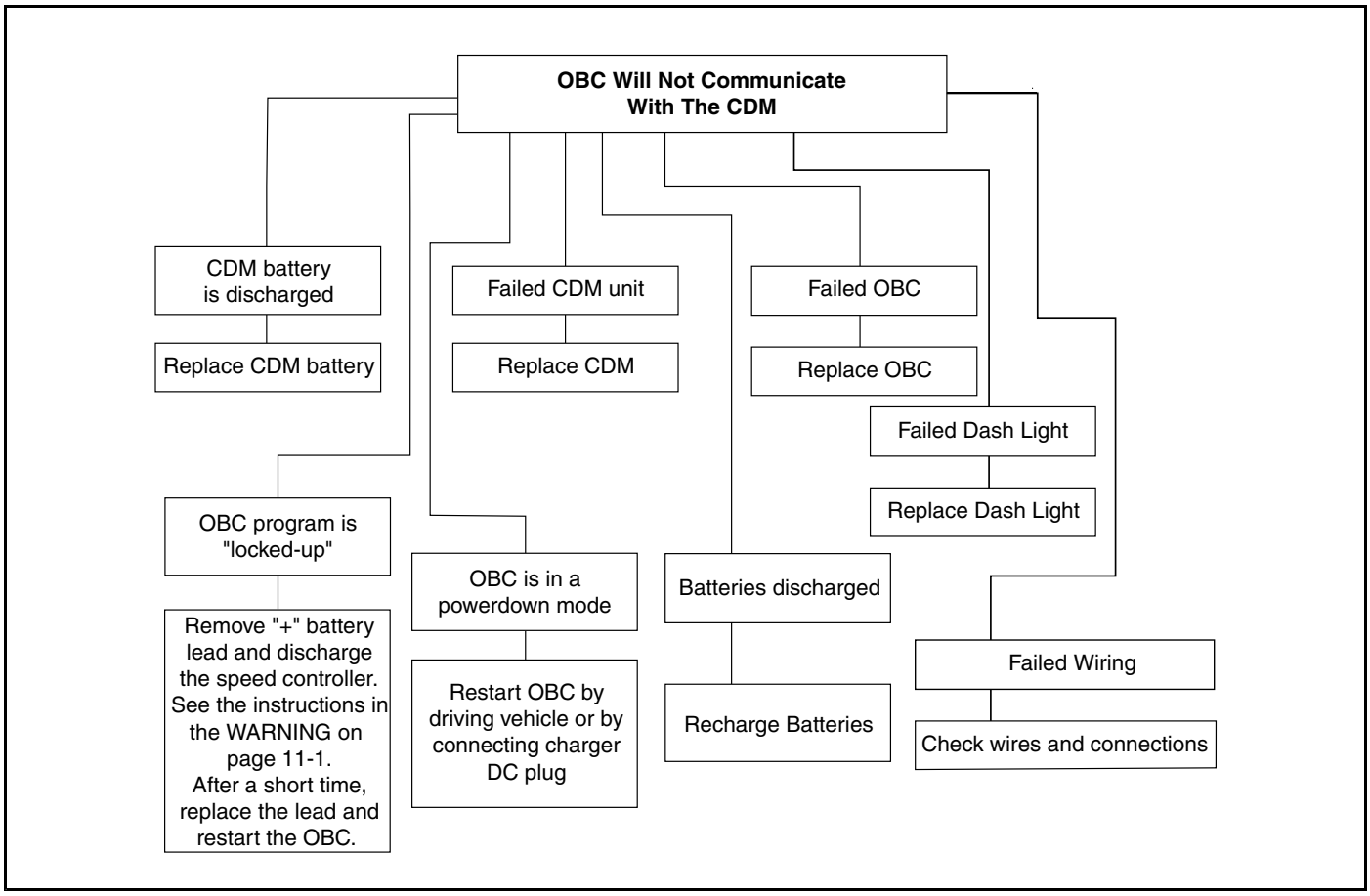


Figure 22-24 Flow Chart – CDM Troubleshooting Guide

SECTION 23 – IQ DISPLAY MODULE (IQDM) SERIES 2 AND IQDM-P DIAGNOSTICS

⚠ DANGER

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

⚠ WARNING

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

NOTE: *For information secific to the IQDM-P handset programming features, see* ***See Section 29 – IQ Display Module (IQDM-P) Series 2 Programming.*** .

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 located on the vehicle.
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.

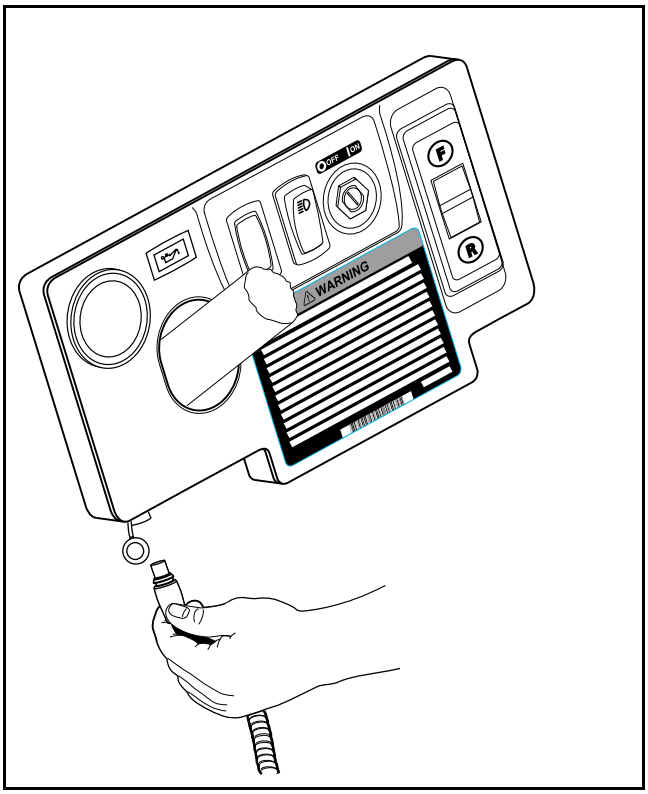


Figure 23-1 IQDM Jack Under Instrument Panel

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)
- 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 Series 2 troubleshooting procedures. **See IQDM and IQDM-P Handset Troubleshooting on page 23-19.**

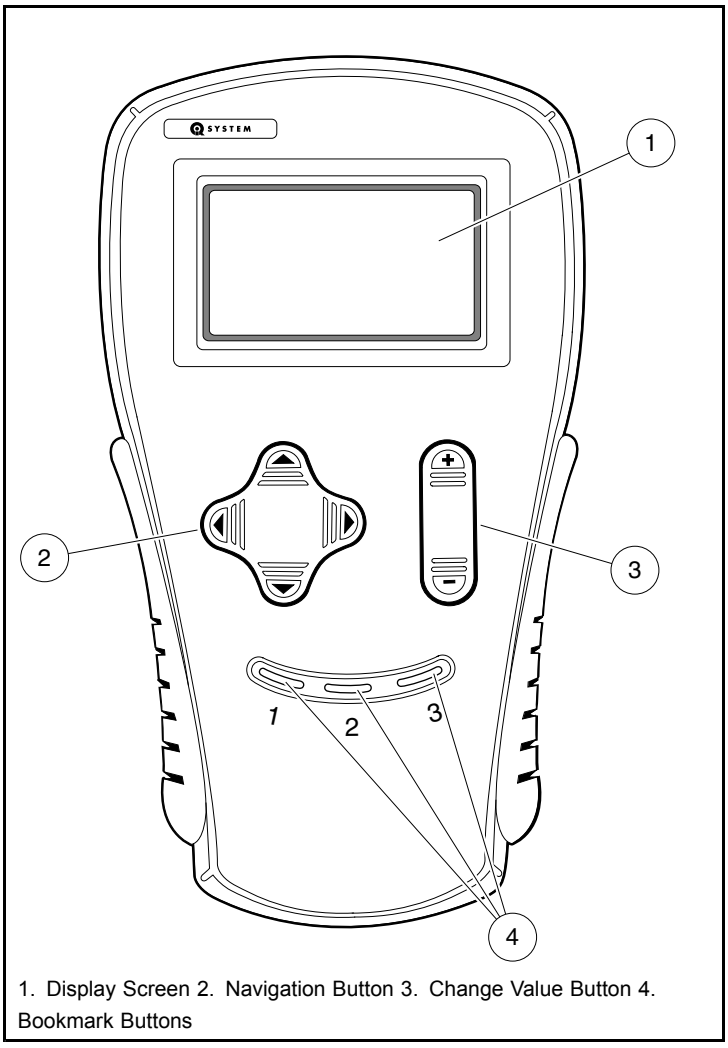
MENU NAVIGATION

The NAVIGATION BUTTON is the four-arrow button located on the left side of the handset **(Figure 23-2, Page 23-3)**. 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.

The CHANGE VALUE BUTTON is the button located on the right side of the handset **(Figure 23-2, Page 23-3)**. This button allows the user to change values by pressing + or –.

The three yellow buttons labeled 1, 2 and 3 are BOOKMARK BUTTONS **(Figure 23-2, Page 23-3)**. 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.*



1. Display Screen 2. Navigation Button 3. Change Value Button 4. Bookmark Buttons

Figure 23-2 Handset Controls

The following menus are accessible on the IQDM Series 2 handset:

PROGRAM (IQDM-P ONLY)

The *program* menu allows the user to view and change custom speed controller settings. **See Program Menu, Section 29, Page 29-2.**

Monitor

The *monitor* menu displays values for certain parameters to facilitate speed controller troubleshooting. **See Monitor Menu on page 23-4.**

Faults

The *faults* menu displays all faults recorded by the speed controller since the history was last cleared. Each fault is listed only once in the fault history menu, even if the fault has occurred multiple times. **See Faults Menu on page 23-9.** The number of fault occurrences can be viewed in the fault counter located in the lower section of the monitor menu.

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 23-14.**

Information

The *information* menu displays the model number, serial number, manufacturer date and software version of the speed controller. **See Information on page 23-18.**

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 23-18.**

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.

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 IN

Indicates the approximate ground speed of the vehicle in miles per hour (MPH).

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 TEMP

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.*

MODE

Indicates what mode the vehicle is being operated in (Mode 1 or Mode 2).

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.

FOOT INPUT

Indicates the status of the 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.

MODE SWITCH

Indicates what position the Mode Switch is in (On or Off).

WK AWAY RELAY

Displays the state of the Walk Away Relay (On or Off). If the speed controller detects that the throttle is at 0% and the vehicle is moving, the relay will activate, reversing the direction of the field current until no motion of the vehicle is detected.

MAIN CONT

Displays the state of the solenoid (main contactor). 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.

PASSWORD TRIES (IQDM-P ONLY)

A password is required to activate Mode 2.The speed controller will log unsuccessful and unauthorized attempts to activate Mode 2. If repeated attempts are unsuccessful, the speed controller will permanently lock out access to Mode 2. In the event that Mode 2 is locked out, the controller must be removed and shipped to Club Car before Mode 2 can be activated.

NOTE: *The lower portion of the monitor menu contains the fault counter information. Each fault is listed in the left hand column and the number of occurances will be listed in the right hand column.*

CIR BRKR OPEN

Displays the number of times the CIR BRKR OPEN fault has been detected. **See Fault Descriptions on page 23-12.**

THRTL FAULT

Displays the number of times the THRTL fault has been detected. **See Fault Descriptions on page 23-12.**

UNDERVOLTAGE

Displays the number of times the UNDERVOLTAGE fault has been detected. **See Fault Descriptions on page 23-12.**

OVERVOLTAGE

Displays the number of times the OVERVOLTAGE fault has been detected. **See Fault Descriptions on page 23-12.**

TEMP CUTBACK

Displays the number of times the TEMP CUTBACK fault has been detected. **See Fault Descriptions on page 23-12.**

HPD

Displays the number of times the HPD fault has been detected. **See Fault Descriptions on page 23-12.**

MAIN WELDED

Displays the number of times the MAIN WELDED fault has been detected. **See Fault Descriptions on page 23-12.**

RELAY WELDED

Displays the number of times the RELAY WELDED fault has been detected. **See Fault Descriptions on page 23-12.**

SPD SENSOR

Displays the number of times the SPD SENSOR fault has been detected. **See Fault Descriptions on page 23-12.**

MAIN DRV ON

Displays the number of times the MAIN DRV ON fault has been detected. **See Fault Descriptions on page 23-12.**

MAIN COIL OPN

Displays the number of times the MAIN COIL OPN fault has been detected. **See Fault Descriptions on page 23-12.**

MAIN DROPOUT

Displays the number of times the MAIN DROPOUT fault has been detected. **See Fault Descriptions on page 23-12.**

MOTOR STALL

Displays the number of times the MOTOR STALL fault has been detected. **See Fault Descriptions on page 23-12.**

MAIN DRVR OFF#

Displays the number of times the MAIN DRVR OFF fault has been detected. **See Fault Descriptions on page 23-12.**

RELAY DNC

Displays the number of times the RELAY DNC fault has been detected (Did not close). **See Fault Descriptions on page 23-12.**

CURRENT SENSE

Displays the number of times the CURRENT SENSE fault has been detected. **See Fault Descriptions on page 23-12.**

M-SHORTED

Displays the number of times the M-SHORTED fault has been detected. **See Fault Descriptions on page 23-12.**

RELAY COIL

Displays the number of times the RELAY COIL fault has been detected. **See Fault Descriptions on page 23-12.**

PRECHARGE

Displays the number of times the PRECHARGE fault has been detected. **See Fault Descriptions on page 23-12.**

FLD MISSING

Displays the number of times the FLD MISSING fault has been detected. **See Fault Descriptions on page 23-12.**

HW FAILSAFE

Displays the number of times the HW FAILSAFE fault has been detected. **See Fault Descriptions on page 23-12.**

DRVR OVERCUR

Displays the number of times the DRVR OVERCUR fault has been detected. **See Fault Descriptions on page 23-12.**

RLY DRVR ON

Displays the number of times the RLY DRVR ON fault has been detected. **See Fault Descriptions on page 23-12.**

RLY DRVR OFF

Displays the number of times the RLY DRVR OFF fault has been detected. **See Fault Descriptions on page 23-12.**

MILES X 1000

Displays the number of miles the vehicle has been driven in units of 1000 miles.

MILES X 100

Displays the number of miles the vehicle has been driven in units of 100 miles.

MILES X 10

Displays the number of miles the vehicle has been driven in units of 10 miles.

MILES X 1

Displays the number of miles the vehicle has been driven in units of single miles.

MILES X 0.1

Displays the number of miles the vehicle has been driven measured in tenths of a mile.

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

NOTE: *The system faults menu displays all of the present faults detected by the speed controller. The faults displayed in this menu are 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 in the fault history menu, the number of fault occurrances are located in the fault counter section of the monitor menu, 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 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:

1. Reduce vehicle speed to zero by reducing armature current to zero
2. Reduce vehicle speed to zero by reducing field current to zero
3. Turn off Main Contactor
4. "Limp-Home:" Cause the vehicle to run at half speed

5. Gradually reduce the armature current limit
6. Quickly reduce the armature current until speed sensor pulses occur
7. Gradually reduce Regen Current Limit
8. SmartKey functions NOT enabled
9. PASSWORD TRIES count incremented
10. Set Internal Scaled Throttle Signal to Zero
11. Turn off Walk Away Relay
12. Activate Walk Away function
13. Activate Walk Away beeping immediately

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	TEST WHEN	CONTROLLER RESPONSE	RECOVER WHEN
01 THROTTLE FAULT 1	Continuous	10	Condition clears
02 UNDER VOLTAGE	Continuous	5	Condition clears
03 OVERVOLTAGE	Continuous	7	Condition clears
04 THERMAL CUTBACK	Continuous	5	Condition clears
06 HPD	KSI Off/On, F or R on	10	Throttle < 25%
07 MAIN WELDED	Contactor commanded open	4	Main or relay successfully opened
08 RELAY WELDED	After Walk Away sequenced	4	Main or relay successfully opened
09 SPEED SENSOR FAULT	Throttle Applied, Arm PWM > 50%	4	Speed pulses appear
10 MAIN DRIVER ON	Continuous while KSI is ON	4	Condition clears
11 MAIN COIL OPEN	Continuous while KSI is ON	3	Condition clears
12 MAIN DROPOUT	Throttle applied	3,12	Throttle applied
13 MOTOR STALL	Throttle applied	6	Speed pulses appear
14 MAIN DRIVER OFF	Throttle applied	3,10	Condition clears
15 RELAY DNC	WalkAway	2,13	Throttle applied
16 KEY SWITCH SRO	At controller power up	3	Cycle KSI
17 CURRENT SENSE FAULT	KSI Off/On, Continuous	1,2,3	KSI Off/On when condition cleared
18 M-SHORTED	Throttle Applied	1,2	Throttle Cycled

TABLE CONTINUED ON NEXT PAGE

CONTROLLER FAULT	TEST WHEN	CONTROLLER RESPONSE	RECOVER WHEN
20 DRIVER OVERCURRENT	Continuous	1,2,3,11	Throttle Reapplied
21 PRECHARGE FAULT	Throttle Applied	1,2,3,11	Cycle KSI or Throttle reapplied
22 FIELD MISSING	Throttle Applied	2,10,11	Cycle KSI
23 RELAY DRIVER ON	Continuous	4	Condition clears
24 HW FAILSAFE	Throttle Applied	1,2,3,11	Cycle KSI
25 INCORRECT PASSWORD	At power up, after SmartKey codes entered	8,9	Cycle Tow/Run
26 CIRCUIT BRKR OPEN	Continuous	4	Condition Clears
27 MAX PASSWORD TRIES	At power up, after SmartKey codes entered	8	Not Field Repairable
29 RELAY DRVR OFF	WalkAway	2,13	Condition clears in WalkAway
30 RELAY COIL FAULT	Continuous	4	Condition clears

FAULT DESCRIPTIONS

The following faults can be detected by the IQ Plus controller:

01 Throttle Fault 1

If the MCOR (Motor Controller Output Regulator) voltage is less than 0.20 volts or greater than 4.80 volts, the controller detects a *throttle fault*.

02 Low Battery Voltage

If the battery voltage falls below 34 volts ±5%, the *low battery voltage* fault is detected by the speed controller.

03 Overvoltage

If the speed controller detects that the battery voltage is too high (72 volts ±5%), the *overvoltage* fault is detected.

04 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.

06 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, when not caused by the operator, can indicate that the pedal limit switch has failed closed.

07 Main Welded

If the speed controller detects that the solenoid contacts are welded closed, a *main welded* fault is detected.

08 Relay Welded

If the speed controller detects that the external Walk Away relay contacts are welded closed, a *relay welded* fault is detected.

09 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.

10 Main Driver On

If the FET that controls the activation of the solenoid coil is found to be energized when it should not be, a *main driver on* fault is detected by the speed controller.

11 Main Coil Open

If the Main Contactor Coil develops an open circuit or is disconnected from the controller , a *main coil open* fault is detected. Walk Away is not affected by this fault.

12 Main Dropout

If the controller detects that the solenoid contacts have opened while the vehicle is in operation, a *main dropout* fault is detected.

13 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.

14 Main Driver Off

If the FET that controls the activation of the solenoid coil is **not** energized when it should be, a *main driver off* fault is detected by the speed controller.

15 Relay DNC

If the external Walk Away Relay contacts do not close, a *relay dnc* is detected.

16 Keyswitch SRO

If the key switch is in the ON position when the controller is powered up, a *key switch sro* fault is detected. This fault detection feature may be turned on or off with an IQDM. Factory default setting is off.

17 Current Sense

If there are problems with the armature current sensor circuitry, a *current sense* fault is detected.

18 M- Shorted

If an uncontrolled current path is detected from the motor to B- (bypassing the MOSFETs), an *M- shorted* fault is detected.

20 Driver Overcurrent

If the current on the relay driver exceeds 120 mA, or the current on the solenoid driver exceeds 6A, a *driver overcurrent* fault is detected.

21 Precharge Fault

If the internal precharge circuit fails, or there is a short between the B+ and B- controller terminals, a *precharge* fault is detected.

22 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.

23 Relay Driver On

If the relay driver has been commanded to turn OFF, but remains on, a *relay driver on* fault is detected.

24 HW Failsafe

If the speed controller detects a failure of the armature drive FETs or circuitry, an *hw failsafe* fault is detected.

25 Incorrect Password

If an incorrect attempt is made to activate Mode 2 by entering Code A, Code B, Code C, an *incorrect password* fault is detected.

26 Circuit BRKR Open

If the circuit breaker element in the Walk Away circuit is blown, or not wired to the controller, a *circuit brkr open* fault is detected.

27 Max Password Tries

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 Mode 2. **See also** Password Tries (IQDM-P only) on page 23-6.

29 Relay DRVR Off

If the Walk Away relay driver FET remains in the OFF state when commanded to switch on, a *relay drvr off* fault is detected.

30 Relay Coil Fault

If the Walk Away relay develops an open circuit or is disconnected from the controller, a *relay coil fault* is detected.

Main CONT DNC

The *main cont dnc* (main contactor (solenoid) did not close) fault is detected when the speed controller has sent voltage to the solenoid activating coil but the solenoid contacts are not closed.

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.

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.

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 activate Mode 2. If a set of codes has been entered incorrectly, the *incorrect password* fault is declared. **See also** Password Tries (IQDM-P only) on page 23-6.

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. If the fault history is not cleared after a repair, a technician may mistakenly replace a new component due to an old fault code. For example, if the MCOR device 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 23-19.**

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 jack 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 jack.
   3.4. Align the keyed portion of the plug with the IQDM jack and connect the plug to the jack **(Figure 23-1, Page 23-1)**.
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 23-3, Page 23-15)**.
9. When the handset is finished recording the speed controller settings, a confirmation message is displayed **(Figure 23-4, Page 23-15)**.
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 IQ Plus vehicle or group of IQ Plus vehicles. **See Speed Controller Cloning – Transferring Settings from the Handset to the Vehicle on page 23-16.**

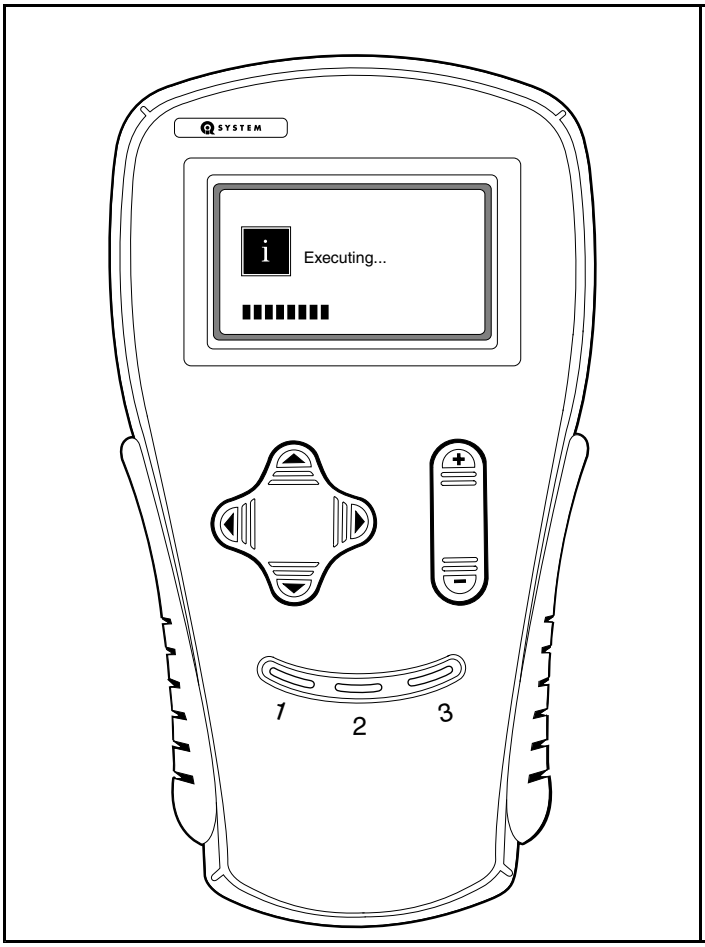


Figure 23-3 Handset Executing

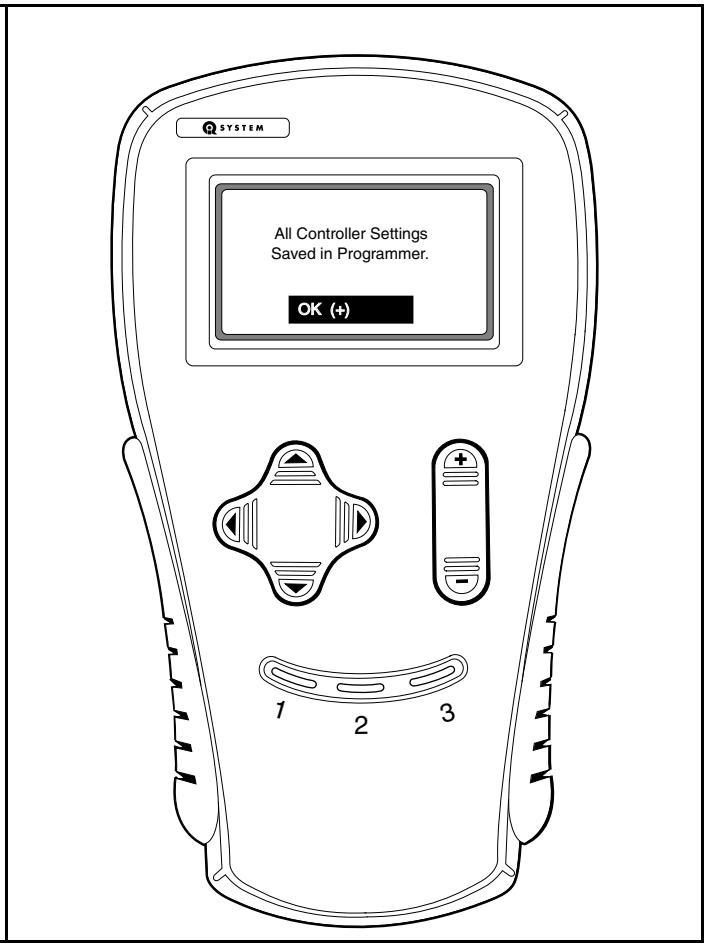


Figure 23-4 Confirmation Message

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 23-14.**
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 jack 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 jack.
   - 4.4. Align the keyed portion of the plug with the IQDM jack and connect the plug to the jack **(Figure 23-1, Page 23-1)**.
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 23-3, Page 23-15)**.
10. When the handset is finished transferring the speed controller settings, a confirmation message is displayed **(Figure 23-5, Page 23-17)**.
11. Repeat this procedure for additional vehicles that need to be programmed with the same handset settings.

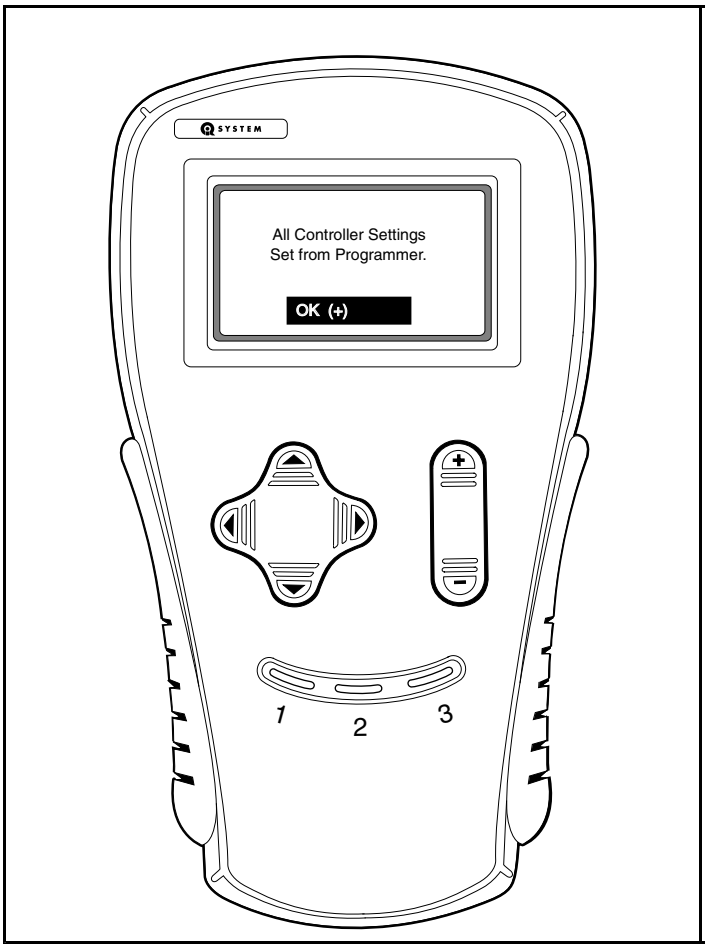


Figure 23-5 Confirmation Message

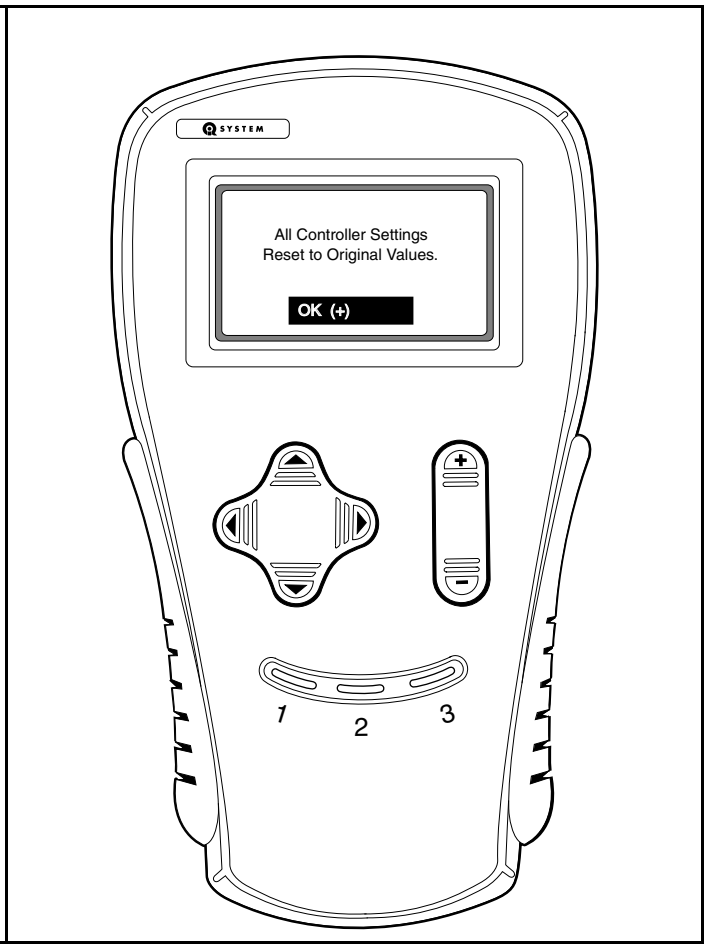


Figure 23-6 Confirmation Message

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 23-3, Page 23-15)**.
6. When the handset is finished resetting the speed controller settings, a confirmation message is displayed **(Figure 23-6, Page 23-17)**.

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 the following items:

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	Time Out 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 handset 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 IQDM and IQDM-P Series 2 handsets.

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 23-1.**
	Vehicle batteries – loose terminals or corrosion	See Section 25 – Batteries: Electric Vehicles.
	Vehicle batteries – improperly wired	See Section 25 – Batteries: Electric Vehicles.
	Vehicle batteries – batteries failed	See Section 25 – Batteries: Electric Vehicles.
	Vehicle batteries – batteries not fully charged	See Section 25 – Batteries: Electric Vehicles.
	Handset cord has failed	Test Procedure 1 – Handset Cord on page 23-21
	Handset cord adaptor has failed	Test Procedure 2 – Handset Cord Adaptor on page 23-21
	IQDM jack (on vehicle) has failed	Test Procedure 3 – IQDM Jacks on page 23-21
	Contrast Setting is too light	**See Program on page 23-18.**
	Onboard computer is in power-down mode	Drive the vehicle for a short distance and reconnect the handset to the vehicle.

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
	Onboard computer malfunction	See Section 22 – Electrical System and Testing: Electric Vehicles.
	Loose vehicle wire harness connections	Test Procedure 3 – IQDM Jacks on page 23-21
	Speed controller malfunction	See Section 22 – Electrical System and Testing: Electric Vehicles.
	Handset has failed	Replace handset
Display screen shows jumbled or undecipherable characters	Speed controller malfunction	See Section 22 – Electrical System and Testing: Electric Vehicles.
	Handset malfunction	Disconnect the IQDM cord from the vehicle. Wait a few seconds and reconnect the handset to the vehicle
	Loose connection at IQDM jack	Test Procedure 3 – IQDM Jacks on page 23-21
	Intermittent handset cord failure	Test Procedure 1 – Handset Cord on page 23-21
	Intermittent handset cord adaptor failure	Test Procedure 2 – Handset Cord Adaptor on page 23-21
	Loose vehicle wire harness connections	Test Procedure 4 – IQDM Jack (Located Under the Instrument Panel) on page 23-21
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 25 – Batteries: Electric Vehicles.
	Vehicle batteries – improperly wired	See Section 25 – Batteries: Electric Vehicles.
	Vehicle batteries – batteries failed	See Section 25 – Batteries: Electric Vehicles.
	Vehicle batteries – batteries not fully charged	See Section 25 – Batteries: Electric Vehicles.
	Speed controller malfunction	See Section 22 – Electrical System and Testing: Electric Vehicles.

TEST PROCEDURES

The following test procedures enable the technician to test the IQDM and IQDM-P Series 2 handsets and the components of the IQ Plus vehicle that are related to the proper operation of the handset. This diagnostics section does not contain detailed information for troubleshooting the vehicle. Refer to See Section 22 – Electrical System and Testing: Electric Vehicles. for detailed vehicle troubleshooting and service procedures.

⚠ 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

2 – Handset Cord Adaptor
3 – IQDM Jacks
4 – IQDM Jack (Located Under the Instrument Panel)
5 – IQDM Jack (Speed Controller)

TEST PROCEDURE 1 – Handset Cord

See General Warning 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 Warning 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 Jacks

See General Warning on page 1-1.

NOTE: *The locations of the IQDM Jacks and speed controller vary based on model, year model, and options. If the IQDM Jack is located under the instrument panel,* ***see Test Procedure 4 – IQDM Jack (Located Under the Instrument Panel) on page 23-21****. To test directly at the speed controller,* ***see Test Procedure 5 – IQDM Jack (Speed Controller) on page 23-22****.*

TEST PROCEDURE 4 – IQDM Jack (Located Under the Instrument Panel)

See General Warning on page 1-1.

1. Turn the key switch to the OFF position, place the Forward/Reverse switch in the NEUTRAL position, and lock the park brake.
2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
3. Check the IQDM jack mounted under the instrument panel.
   3.1. Remove the center dash panel **(Figure 23-7, Page 23-22)**.

3.1.1. Remove the plastic cap (1) covering the mounting screw (2) on each side of the center dash panel (3) **(Figure 23-7, Page 23-22)**.

3.1.2. Loosen, but do not remove, the screw (2) on each side of the center dash panel (3).

3.1.3. Insert screwdriver at the top center of the dash between dash and cowl brace. Gently pry center dash out slightly from under edge of cowl brace.

3.1.4. Pull center dash out from the frame carefully and expose the wiring of the electrical components mounted on the dash panel. Do not allow wires to touch. **See following NOTE.**

NOTE: *Take care to prevent key switch terminals and wires from touching the metal frame around the dash.*

3.2. Disconnect the IQDM jack four-pin connectors (4 and 5) and visually inspect the contacts for damage and corrosion. Inspect the IQDM jack mounted to the bottom of the dash panel. Repair and replace parts as necessary.

3.3. If no problem is found, connect the multi-pin connectors and install the center dash panel.

3.4. Install the three self-tapping screws that hold the F&R rocker switch case (2) to the body. Tighten to 20 in-lb (2.2 N·m).

3.5. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

3.6. Align the keyed portion of the plug with the IQDM jack and connect the plug to the jack. If the handset fails to function, **See IQDM and IQDM-P Handset Troubleshooting on page 23-19.**

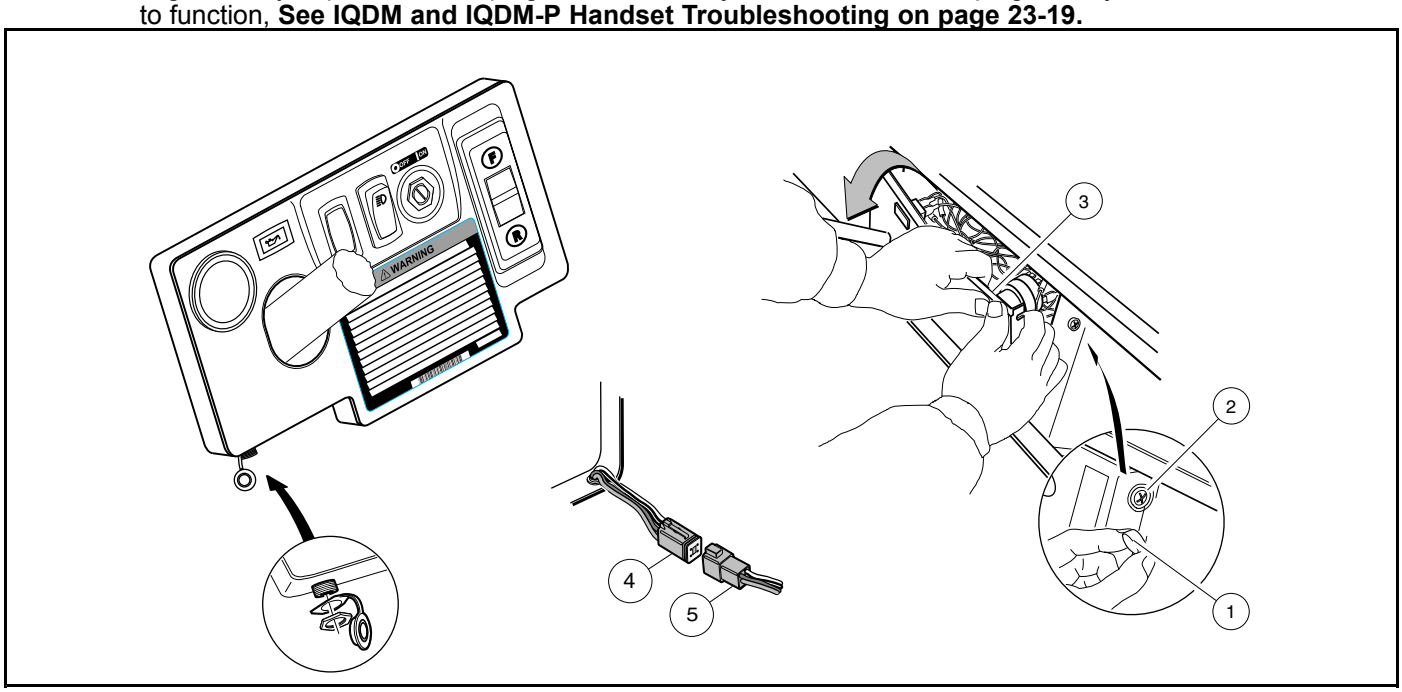


Figure 23-7 Testing IQDM Jack

TEST PROCEDURE 5 – IQDM Jack (Speed Controller)

See General Warning on page 1-1.

1. Check the IQDM jack on the speed controller.
   1.1. Remove the three bolts securing the speed controller access panel and remove the access panel.
   1.2. Disconnect the square four-pin connector (1) from the speed controller.
   1.3. Connect the handset cord to the handset.
   1.4. Connect the other end of the handset cord (without the adapter) to the four-pin connector of the speed controller.
   1.5. Connect the vehicle batteries, positive (+) cable first.

If the handset does not function during Test Procedure 3A, but does function when connected directly to the speed controller, the handset cord adapter and vehicle wire harness should be thoroughly tested. **See Test Procedure 2 – Handset Cord Adaptor on page 23-21.** The IQDM jacks and connections should also be thoroughly checked. **See See Section 22 – Electrical System and Testing: Electric Vehicles. .**

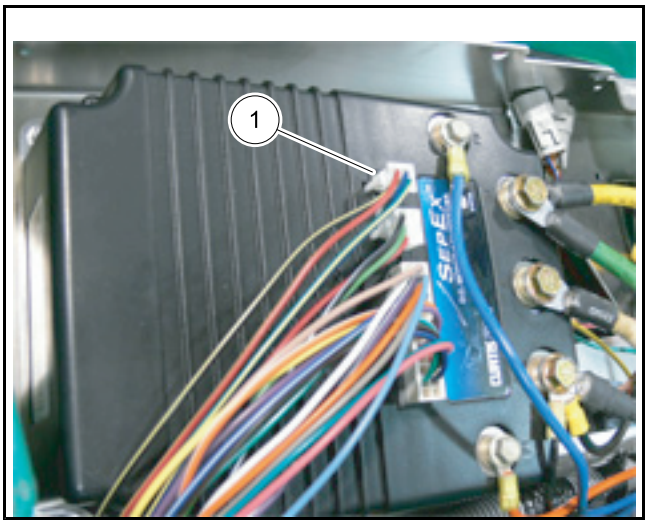


Figure 23-8 Disconnect Four-pin Connector.

⚠ DANGER

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

⚠ WARNING

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

KEY SWITCH

See General Warning on page 1-1.

TESTING THE KEY SWITCH

See Test Procedure 9 – Key Switch and MCOR Limit Switch Circuit on page 22-18.

KEY SWITCH REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the center dash panel **(Figure 24-1, Page 24-2)**.
   - 2.1. Remove the plastic cap (1) covering the mounting screw (2) on each side of the center dash panel (3) **(Figure 24-1, Page 24-2)**.
   - 2.2. Loosen, but do not remove, the screw (2) on each side of the center dash panel (3).
   - 2.3. Insert screwdriver at the top center of the dash between dash and cowl brace. Gently pry center dash out slightly from under edge of cowl brace.
   - 2.4. Pull center dash out from the frame and disconnect the wires from the electrical components mounted on the dash panel. Do not allow wires to touch. **See following NOTE.**

NOTE: *Take care to prevent key switch terminals and wires from touching the metal frame around the dash.*

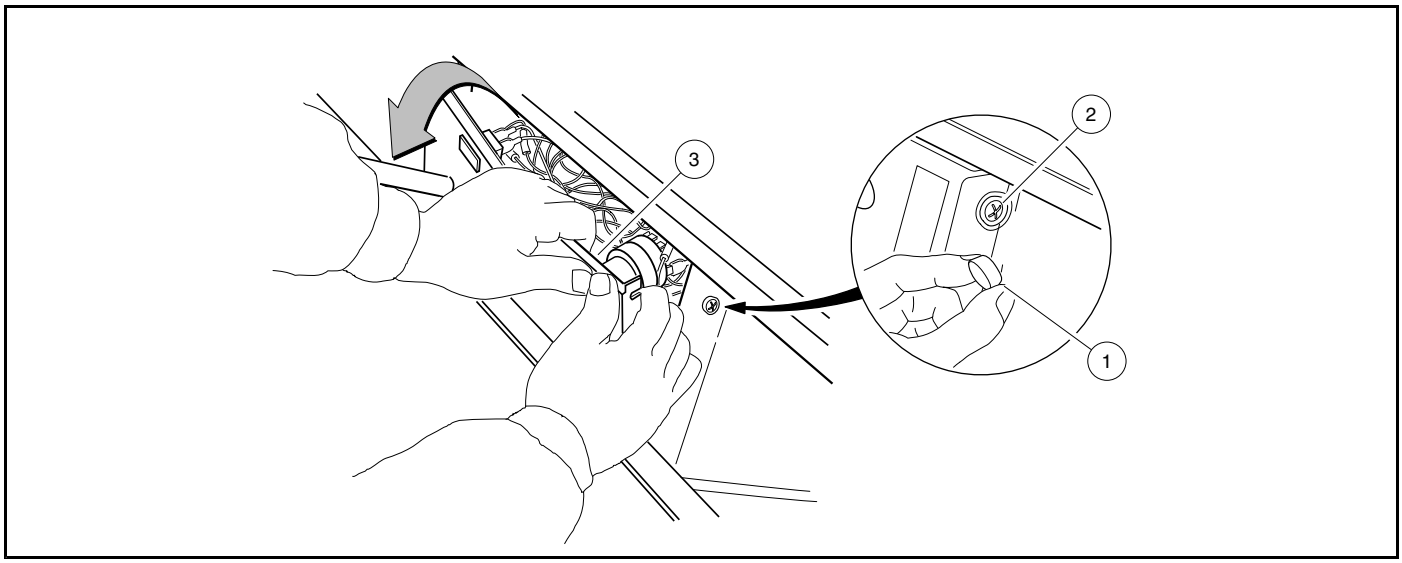


Figure 24-1 Dash Removal

3. Slide center dash panel up steering column by snapping top out and then rotating the panel out and up.
4. Disconnect the wires from the key switch. Do not allow wires to touch.
5. From the back of the dash panel, push down on the retaining tabs surrounding the key switch (4) and remove the key switch cap (8). Hold the key switch and remove the switch retaining nut (6) from the outside of the dash panel **(Figure 24-2, Page 24-2)**.

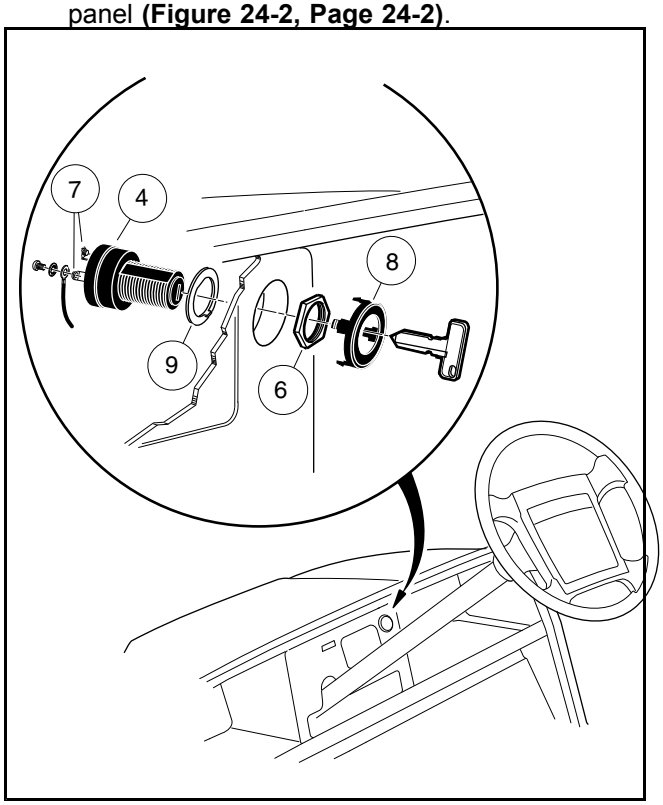


Figure 24-2 Key Switch

KEY SWITCH INSTALLATION

1. Position the key switch and flat washer (9) in the center dash, 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 24-2, Page 24-2)**.

2. Refer to the wiring diagram to connect the wires to the key switch terminals and tighten the terminal screws to 7 in-lb (0.8 N·m). **See Wiring Diagrams, Section 22, Page 22-2.** Coat the terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
3. Install center dash by reversing removal procedure. Make sure key switch terminals (7) do not touch frame and that the center dash panel is properly seated and snapped into place **(Figure 24-2, Page 24-2)**.
4. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

FORWARD/REVERSE ROCKER SWITCH

See General Warning on page 1-1.

TESTING THE FORWARD/REVERSE ROCKER SWITCH

See Test Procedure 26 – Forward/Reverse Rocker Switch on page 22-33.

FORWARD/REVERSE ROCKER SWITCH REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the center dash panel **(Figure 24-1, Page 24-2)**.
3. Remove the 18-gauge brown, orange, and blue wires from the rocker switch.
4. Press the locking tabs on each end of switch (11) and push switch out of dash panel.

FORWARD/REVERSE ROCKER SWITCH INSTALLATION

1. Press the locking tabs on each end of the rocker switch (11) and push switch into dash panel **(Figure 24-3, Page 24-4)**.
2. Connect the 18-gauge brown, orange, and blue wires to the rocker switch exactly as shown in the wiring diagram. **See Wiring Diagrams, Section 22, Page 22-2.**
3. Install center dash by reversing removal procedure. Make sure key switch terminals do not touch frame and that the center dash panel is properly seated and snapped into place.
4. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
5. Place the Tow/Run switch in the RUN position.
6. Inspect the vehicle for proper operation:
   – 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.

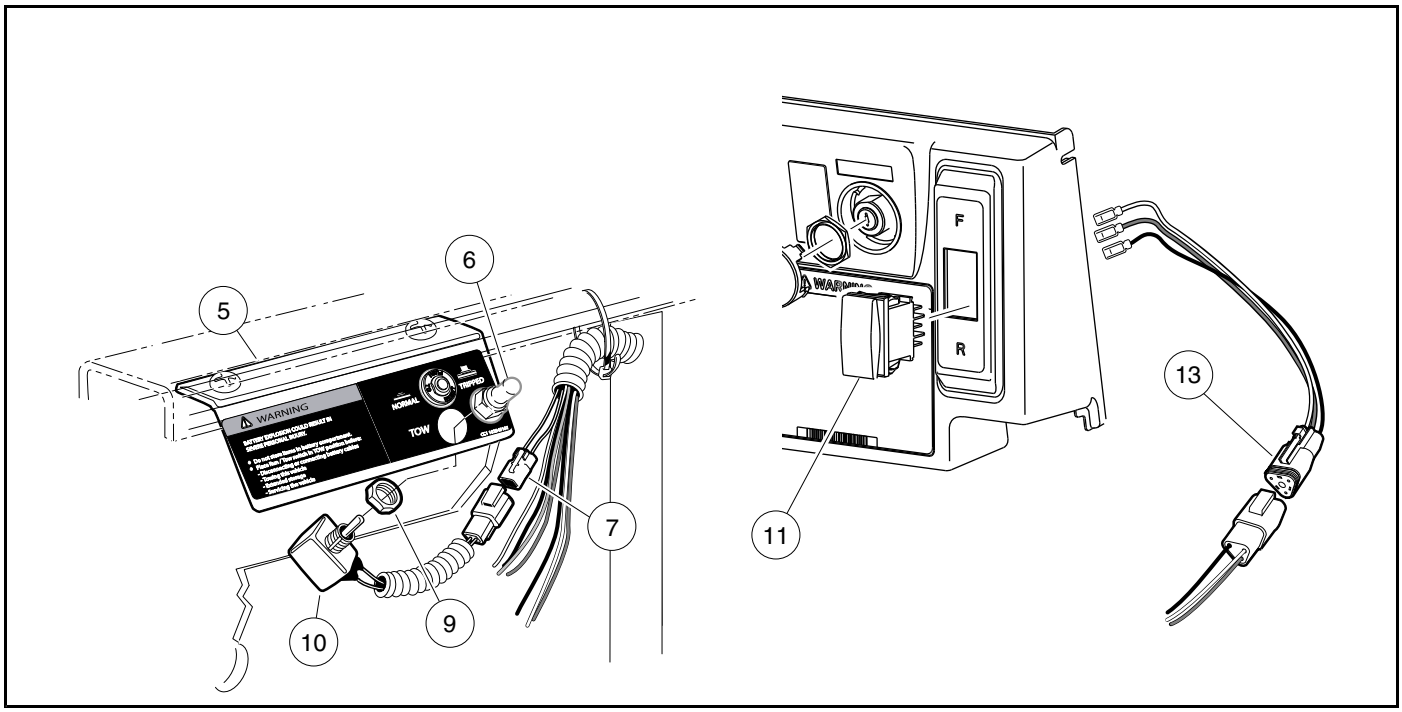


Figure 24-3 Tow/Run Switch and Forward/Reverse Rocker Switch

TOW/RUN SWITCH

See General Warning on page 1-1.

TESTING THE TOW/RUN SWITCH

See Test Procedure 6 – Tow/Run Switch on page 22-16.

TOW/RUN SWITCH REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove Tow/Run switch boot/hex nut (6) **(Figure 24-3, Page 24-4)**.
3. Remove Tow/Run switch (10) and nut (9) from bracket (5).
4. Disconnect the two-pin connector (7) and remove switch.

TOW/RUN SWITCH INSTALLATION

1. Installation is reverse of removal. Make sure groove on switch is aligned with tang on bracket. Tighten Tow/Run switch boot/hex nut (6) to 16 in-lb (1.8 N·m) **(Figure 24-3, Page 24-4)**.
2. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

CIRCUIT BREAKER

See General Warning on page 1-1.

TESTING THE CIRCUIT BREAKER

See Test Procedure 7 – Circuit Breaker on page 22-17

CIRCUIT BREAKER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the plastic nut (1) from the circuit breaker **(Figure 24-4, Page 24-5)**.
3. Remove circuit breaker and metal nut (2) from bracket (3).
4. Disconnect tan and green wires from the spade connectors (4) on the back of the circuit breaker.

CIRCUIT BREAKER INSTALLATION

1. Installation is reverse of removal. Connect tan and green wires to the spade connectors (4) on the back of the circuit breaker. **See following NOTE.**

NOTE: *The spade connectors are not polarity-sensitive. It does not matter what color wire goes to either of the spade connectors.*

2. Insert the circuit breaker and metal nut (2) into the bracket (3).
3. Replace the plactic nut (1) on the circuit breaker.
4. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

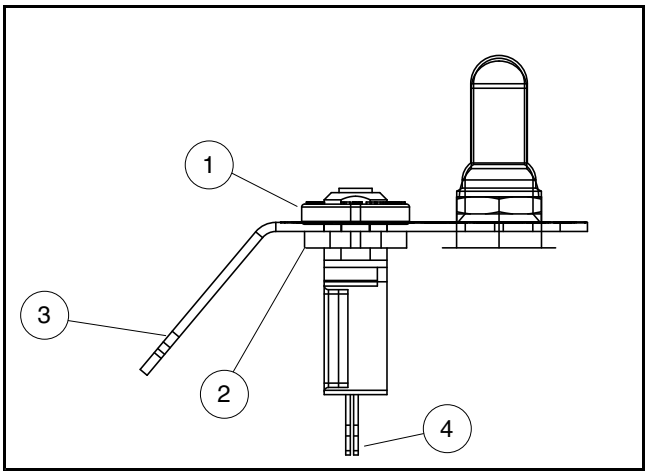


Figure 24-4 Circuit Breaker

MOTOR CONTROLLER OUTPUT REGULATOR (MCOR)

See General Warning on page 1-1.

TESTING THE MCOR

See Test Procedure 4 – MCOR Voltage on page 22-13 and Test Procedure 9 – Key Switch and MCOR Limit Switch Circuit on page 22-18.

MCOR REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Place chocks at rear wheels and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the round tube crossmember of the frame to support vehicle. **See WARNING "Lift only one end..." in General Warning on page 1-1.**
3. Disconnect the two-pin and three-pin connectors (1) from the MCOR (2) **(Figure 24-5, Page 24-7)**.
4. Remove the hex-head screws (3) connecting the MCOR to the frame I-beam.
5. Remove the MCOR from vehicle.
6. Push the drive bar (4) into the hole in the I-beam to disengage it from the accelerator pivot rod (5).

MCOR INSTALLATION

1. Insert the splined end of the drive bar (4) through the hole in the passenger-side frame I-beam as shown **(Figure 24-5, Page 24-7)**.
2. Position the opposite end of the drive bar so that the accelerator pedal sits between the two pins.
3. Place the MCOR (2) onto the splined end of the drive bar **(Figure 24-5, Page 24-7)**. **See following NOTE.**

NOTE: *The MCOR is keyed to ensure correct positioning on the drive bar.*

4. Insert the alignment pins on the MCOR into the holes in the I-beam as shown.
5. Secure the MCOR to the frame I-beam with two hex-head screws (3). Tighten screws to 23 in-lb (2.6 N·m).
6. Connect the two-pin and three-pin connectors (1) from the wire harness to the MCOR.
7. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

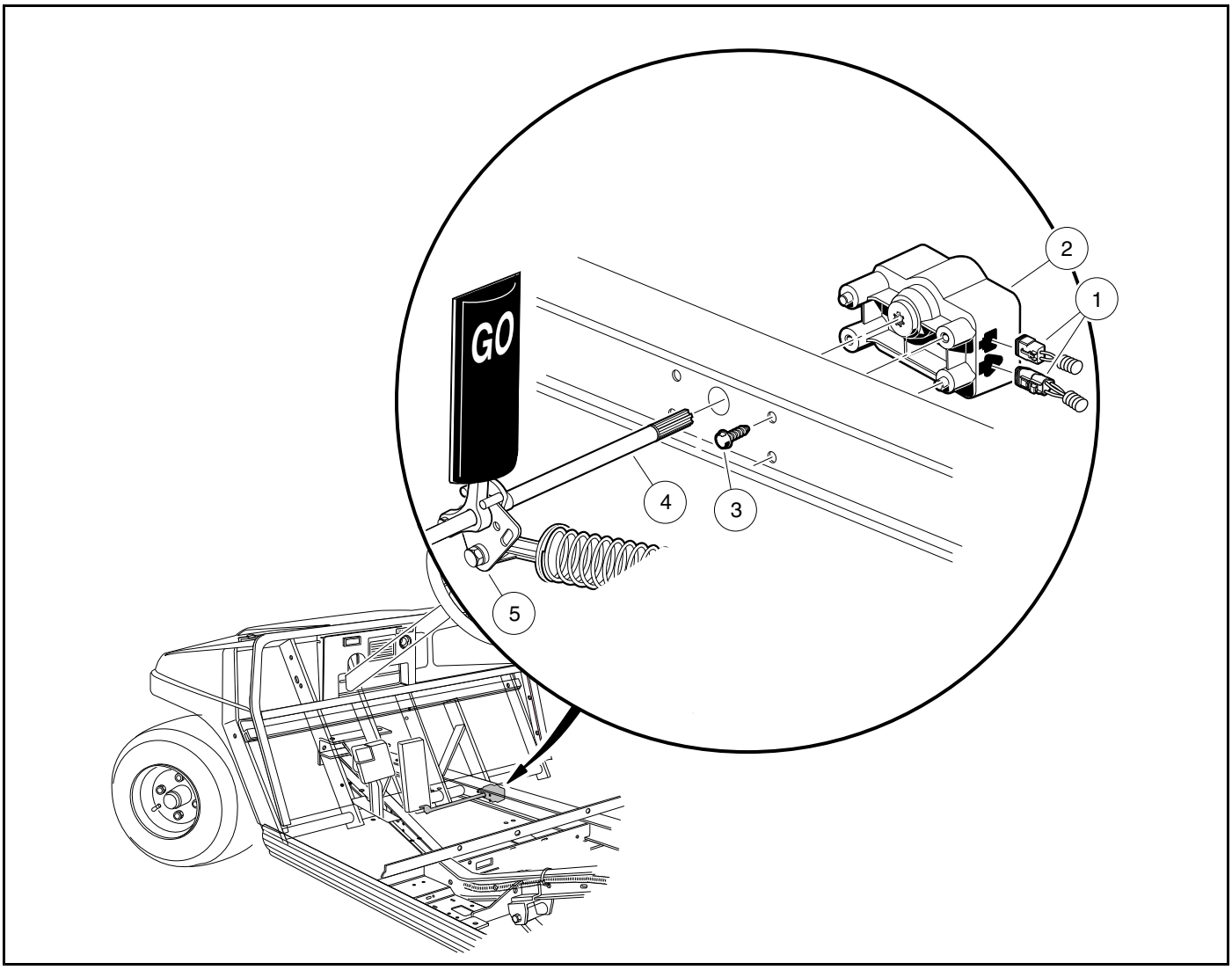


Figure 24-5 Motor Controller Output Regulator (MCOR) Mounting

REVERSE BUZZER

See General Warning on page 1-1.

TESTING THE REVERSE BUZZER

See Test Procedure 27 – Reverse Buzzer on page 22-34.

REVERSE BUZZER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove center dash. **See Key Switch Removal on page 24-1.**
3. Disconnect the 18-gauge red and orange/white wires from reverse buzzer.

4. Remove the two screws from the reverse buzzer. Remove the reverse buzzer from the center dash panel.

REVERSE BUZZER INSTALLATION

1. Install the reverse buzzer in the reverse order of removal. Tighten screws to 4 in-lb (0.45 N·m).
2. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

SPEED CONTROLLER COVER

REMOVING THE SPEED CONTROLLER COVER

1. Use a flathead screwdriver to pry up the center pieces of the 3 push rivets (1) and remove the rivets **(Figure 24-6, Page 24-9)**.
2. Pull the speed controller cover (2) down and away from the component mounting plate.
3. Lift the curved edges of the speed controller cover out of the slots in the component mounting plate.

INSTALLING THE SPEED CONTROLLER COVER

1. Place the curved edges on the bottom of the speed controller cover (2) into the slots on the component mounting plate.
2. Press the speed controller cover onto the component mounting plate over the speed controller and other electrical components.
3. Install the three push rivets (1) **(Figure 24-6, Page 24-9)**.

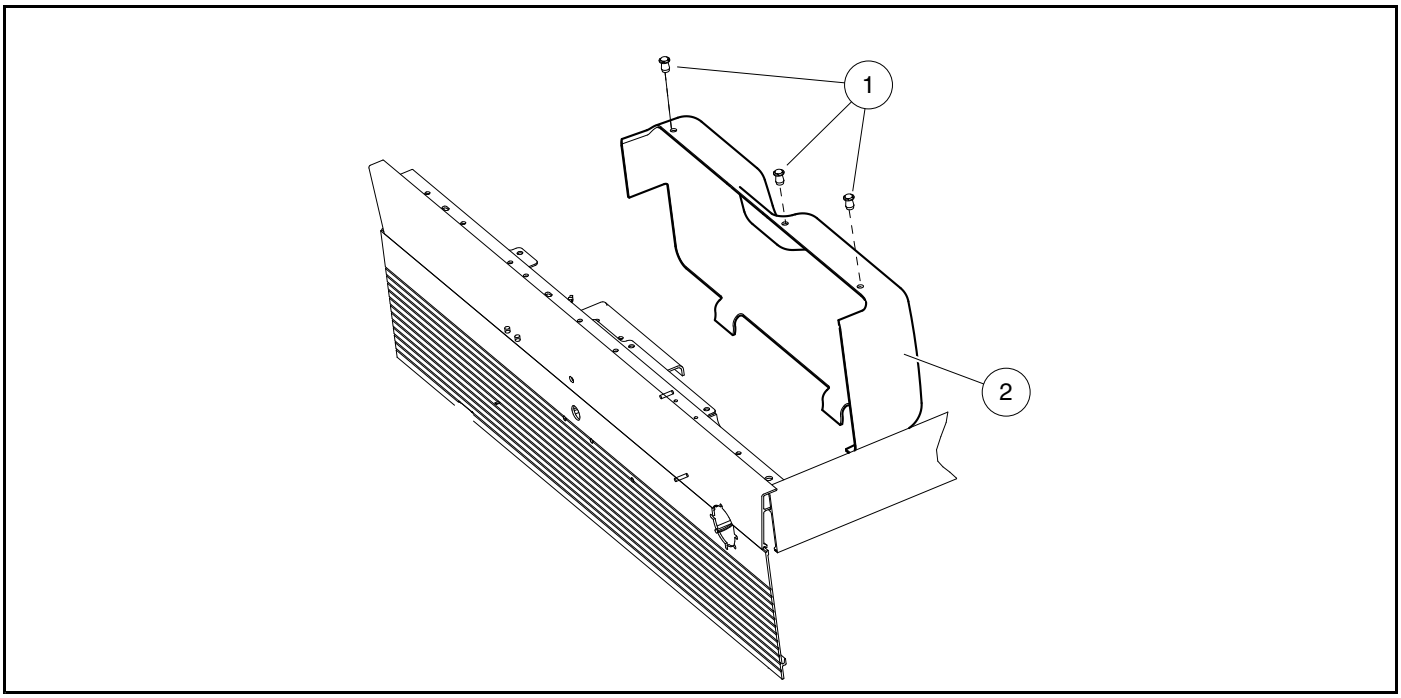


Figure 24-6 Speed Controller Cover

SOLENOID

See General Warning on page 1-1.

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

TESTING THE SOLENOID

See Test Procedure 3 – Solenoid Activating Coil on page 22-12 and Test Procedure 25 – Solenoid Contacts on page 22-33.

SOLENOID REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the speed controller cover. **See Removing the Speed Controller Cover on page 24-8.**
3. Disconnect all wires from the solenoid **(Figure 24-7, Page 24-10)**.
4. Loosen, but do not remove, the two screws (1) that hold the solenoid (2) to the component mounting plate.
5. Lift the solenoid (2) up and off of the component mounting plate.

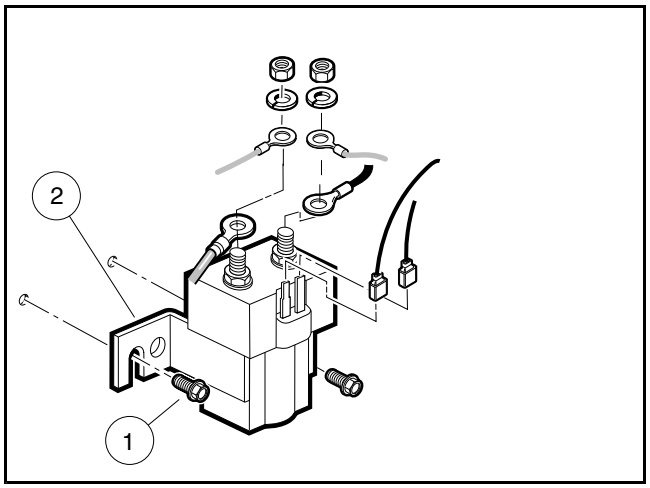


Figure 24-7 Solenoid

SOLENOID INSTALLATION

1. Mount solenoid (2) onto component mounting plate with screws (1) **(Figure 24-7, Page 24-10)**.
2. Tighten screws (1) to 60 in-lb (6.8 N·m).
3. Using the wiring diagram, install the wires, washers, and nuts onto the large mounting posts. Tighten nuts to 77 in-lb (8.7 N·m). **See Wiring Diagrams, Section 22, Page 22-2.**
4. Install the blue/white and light blue wires onto the small terminals of the solenoid **(Figure 24-7, Page 24-10)**.
5. Install speed controller cover. **See See Installing the Speed Controller Cover on page 24-8.**
6. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

ONBOARD COMPUTER (OBC)

See General Warning on page 1-1.

TESTING THE ONBOARD COMPUTER

See Test Procedure 2 – Onboard Computer Solenoid Lockout Circuit on page 22-11, Test Procedure 21 – Onboard Computer Silicon-Controlled Rectifier (SCR) Circuit on page 22-29 and Test Procedure 22 – Onboard Computer Gray Wire and Fuse on page 22-29.

ONBOARD COMPUTER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove speed controller cover. **See Removing the Speed Controller Cover on page 24-8.**
3. Unplug the six-pin connector (1) at the OBC **(Figure 24-8, Page 24-11)**.

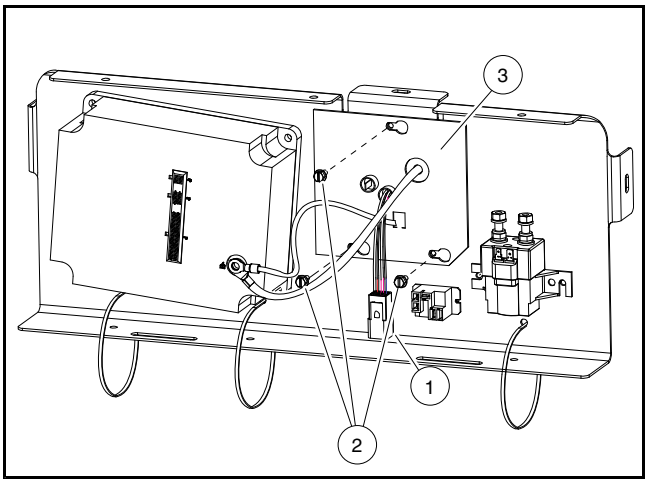


Figure 24-8 Onboard Computer

4. Remove the wire tie securing the speed controller wires to the mounting plate.
5. Remove black 6-gauge wire and black 10-gauge wire from the speed controller B– terminal .
6. Disconnect the 24-pin connector from the speed controller.
7. Disconnect the 6-pin connector from the OBC to the main wiring harness.
8. Disconnect the gray wire from the OBC.
9. Loosen, but do not remove, the three self-tapping screws (2) holding OBC to component mounting plate.
10. Slide OBC (3) towards outside of vehicle and align heads of self-tapping screws (2) with the three holes in the OBC face plate. Pull OBC (3) away from the component mounting plate and remove from component mounting plate.

ONBOARD COMPUTER INSTALLATION

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the speed controller cover. **See Removing the Speed Controller Cover on page 24-8.**
3. Install the OBC (3) onto the component mounting plate by aligning the three holes on the OBC face plate with three holes on component mounting plate. Slide OBC (3) towards inside of vehicle and align heads of self-tapping screws (2) with smaller part of three holes in OBC face plate **(Figure 24-8, Page 24-11)**. Tighten screws to 60 in-lb (6.7 N·m). **See following NOTE.**

NOTE: *The aluminum plate on the OBC should face toward the rear of the vehicle.*

4. Connect the 6-pin connector from the OBC to the wiring harness.
5. Connect the gray wire to the OBC.
6. Connect the black 6-gauge wire and black 10-gauge wire to the speed controller B– terminal with the washer and bolt and tighten to 9 ft-lb (12.2 N·m) **(Figure 24-8, Page 24-11)**.
7. Plug the 6-pin connector from the OBC into the speed controller.
8. Connect the 24-pin connector to the speed controller.
9. Install a wire tie to tightly secure the speed controller wires to the component mounting plate **(Figure 24-6, Page 24-9)**.
10. Install the speed controller cover. **See See Installing the Speed Controller Cover on page 24-8.**
11. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

SOLID STATE SPEED CONTROLLER

See General Warning on page 1-1.

TESTING THE SOLID STATE SPEED CONTROLLER

See Test Procedure 5 – A1 and A2 Motor Voltage on page 22-15.

SPEED CONTROLLER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the speed controller cover. **See Removing the Speed Controller Cover on page 24-8.**
3. Disconnect all wires and multi-pin connectors from the speed controller.
4. Remove the four bolts (1) that hold the speed controller (2) to the component mounting plate and remove the controller from the vehicle.

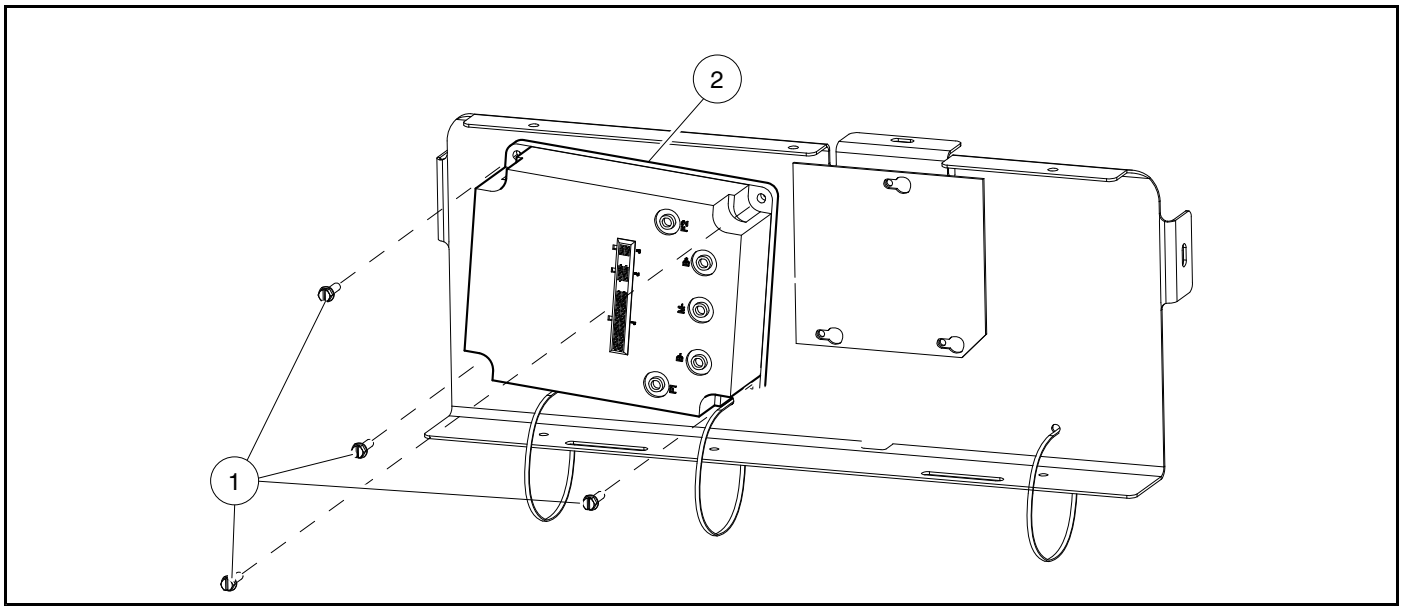


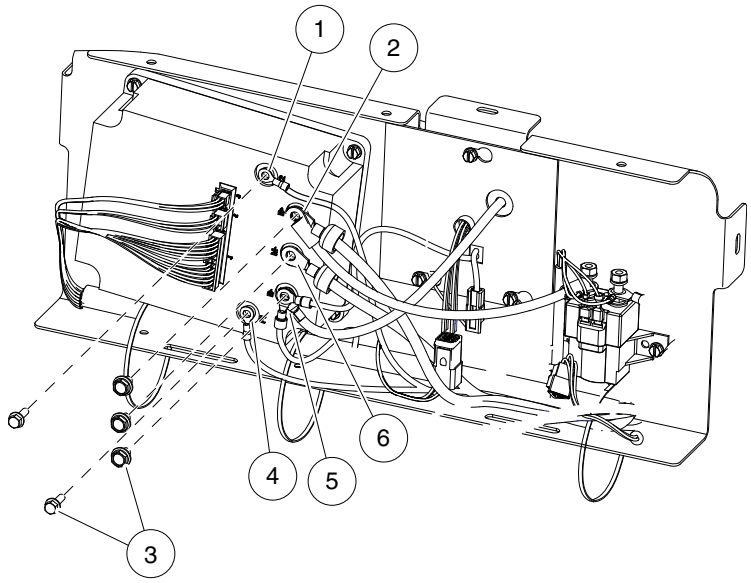
Figure 24-9 Speed Controller

SPEED CONTROLLER INSTALLATION

1. Install the four bolts (1) that hold the speed controller (2) to the component mounting plate and tighten to 60 in-lb (6.8 N·m) **(Figure 24-9, Page 24-12)**.
2. Using the wiring diagram, install the multi-pin connectors and all wires as illustrated. **See Wiring Diagrams, Section 22, Page 22-2.** Tighten bolts (3) to 9 ft-lb (12.2 N·m) **(Figure 24-9, Page 24-12)**.
3. Install the speed controller cover. **See Installing the Speed Controller Cover on page 24-8.**
4. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
5. Place the Tow/Run switch in the RUN position.
6. Inspect the vehicle for proper operation:
   – 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.



1. 10 Ga. Blue
2. 4 Ga. Yellow and 4 Ga. Green
3. Bolts
4. 10 GA. Orange
5. One 4 Ga. Black and Two 10 Ga. Black
6. 10 GA. White

Figure 24-10 Speed Controller Wiring

CHARGER RECEPTACLE

See General Warning 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 23 – Voltage at Charger Receptacle Red Wire Socket on page 22-30.

See also the appropriate battery charger maintenance and service manual.

CHARGER RECEPTACLE INSPECTION

Inspect the receptacle for cracks, loose connections and frayed wiring. **See following NOTE.**

NOTE: *Disassembly of the charger receptacle, for the purpose of removal or installation, is not recommended.*

CHARGER RECEPTACLE REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the 10-gauge red wire from the connector plug (10) **(Figure 24-11, Page 24-15)**.
3. Remove black 10-gauge OBC wire from charger receptacle.
4. Disconnect the gray wire from the receptacle at the yellow fuse holder (9).
5. Remove the four screws (2) that secure the charger receptacle bevel to the receptacle backing plate (1) and to the vehicle body.
6. Move the receptacle assembly toward the front of the vehicle and tilt receptacle upwards in order for the receptacle to pass through the hole in the vehicle body.

CHARGER RECEPTACLE INSTALLATION

1. Insert the 10-gauge red wire and the 18-gauge gray wire through the hole in the vehicle body and the receptacle backing plate **(Figure 24-11, Page 24-15)**.
2. Insert receptacle into vehicle body.
3. Install the four screws (2) that secure the receptacle to the vehicle body and receptacle backing plate (1). Tighten screws to 16 in-lb (1.8 N·m).
4. Connect 18-gauge gray wire to yellow fuse holder (9). Make sure fuse (8) is installed in fuse holder.
5. Connect the 10-gauge black wire to the receptacle fuse link on the charger receptacle**.** Tighten to 23 in-lb (2.6 N·m).
6. Connect the 10-gauge red wire (10) to the connector plug.
7. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

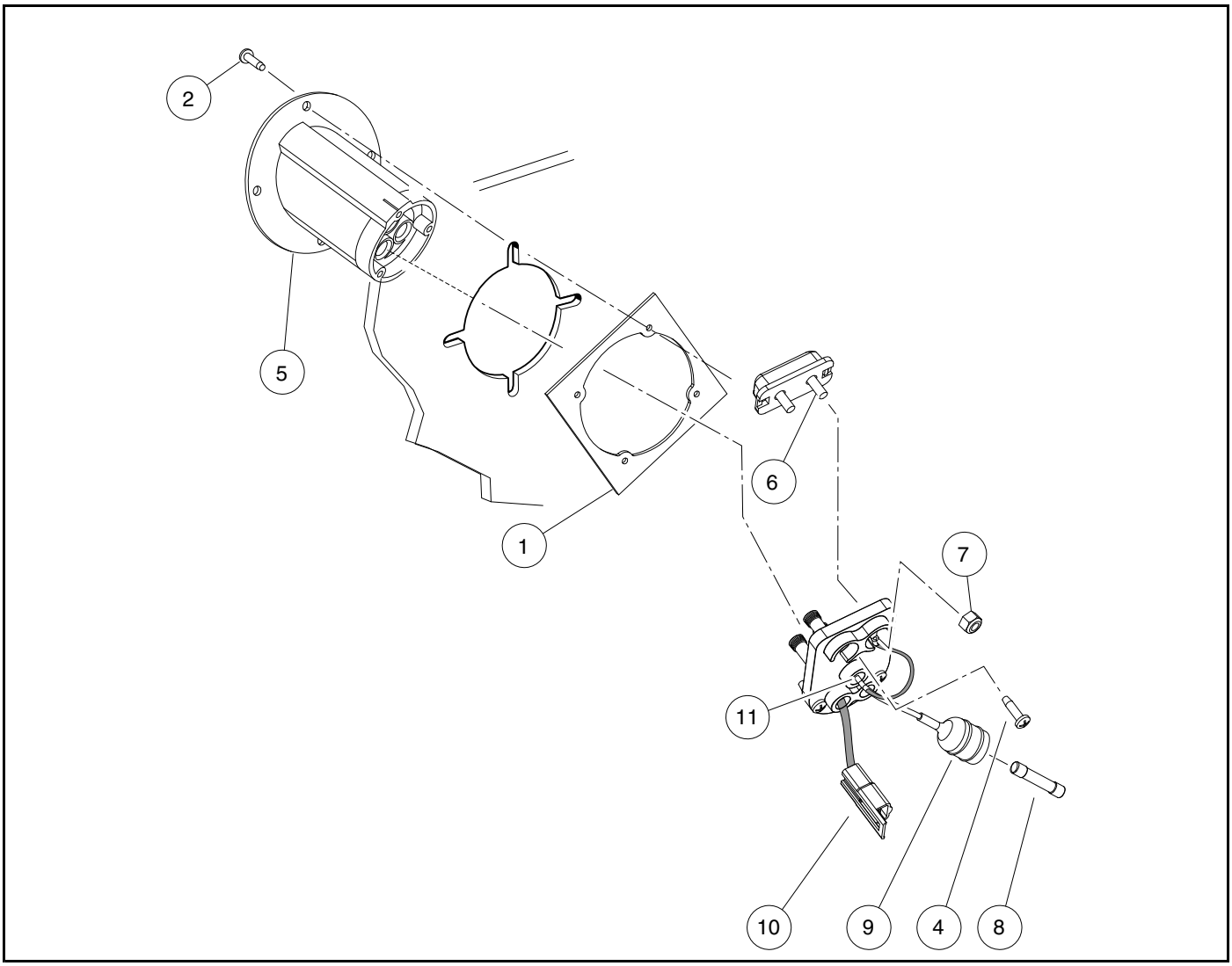


Figure 24-11 Charger Receptacle

RECEPTACLE FUSE LINK

The fuse link on the 48-volt Club Car electric vehicle should not blow under normal operating conditions; however, if the fuse link has blown, the vehicle will not charge and the fuse must be replaced. The fuse link (6) is mounted on top of the charger receptacle in the battery compartment **(Figure 24-11, Page 24-15)**.

RECEPTACLE FUSE LINK REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove the fuse link (6) from the charger receptacle (5) by removing the two nuts and washers used to secure the 10-gauge black wire (11) from the computer and the 10-gauge black wire to the receptacle **(Figure 24-11, Page 24-15)**.
3. Remove the fuse link (6) from the charger receptacle.

RECEPTACLE FUSE LINK INSTALLATION

1. Insert the two fuse link mounting posts into the mounting holes in the charger receptacle.
2. Place the two 10-gauge black wires in their original positions on the fuse link mounting posts.
3. Install nuts (7) on fuse link mounting posts and tighten to 23 in-lb (2.6 N·m) **(Figure 24-11, Page 24-15)**.
4. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

BATTERY WARNING LIGHT

See General Warning on page 1-1.

TESTING THE BATTERY WARNING LIGHT

See Test Procedure 29 – Battery Warning Light on page 22-35.

BATTERY WARNING LIGHT REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Remove center dash. **See Key Switch Removal on page 24-1.**
3. Disconnect the brown wire at the quick disconnect terminal and remove the orange/white wire from the key switch.
4. Press the two retaining tabs (11) and remove the light from the center dash **(Figure 24-12, Page 24-17)**.

BATTERY WARNING LIGHT INSTALLATION

1. Install in reverse order of removal.
2. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

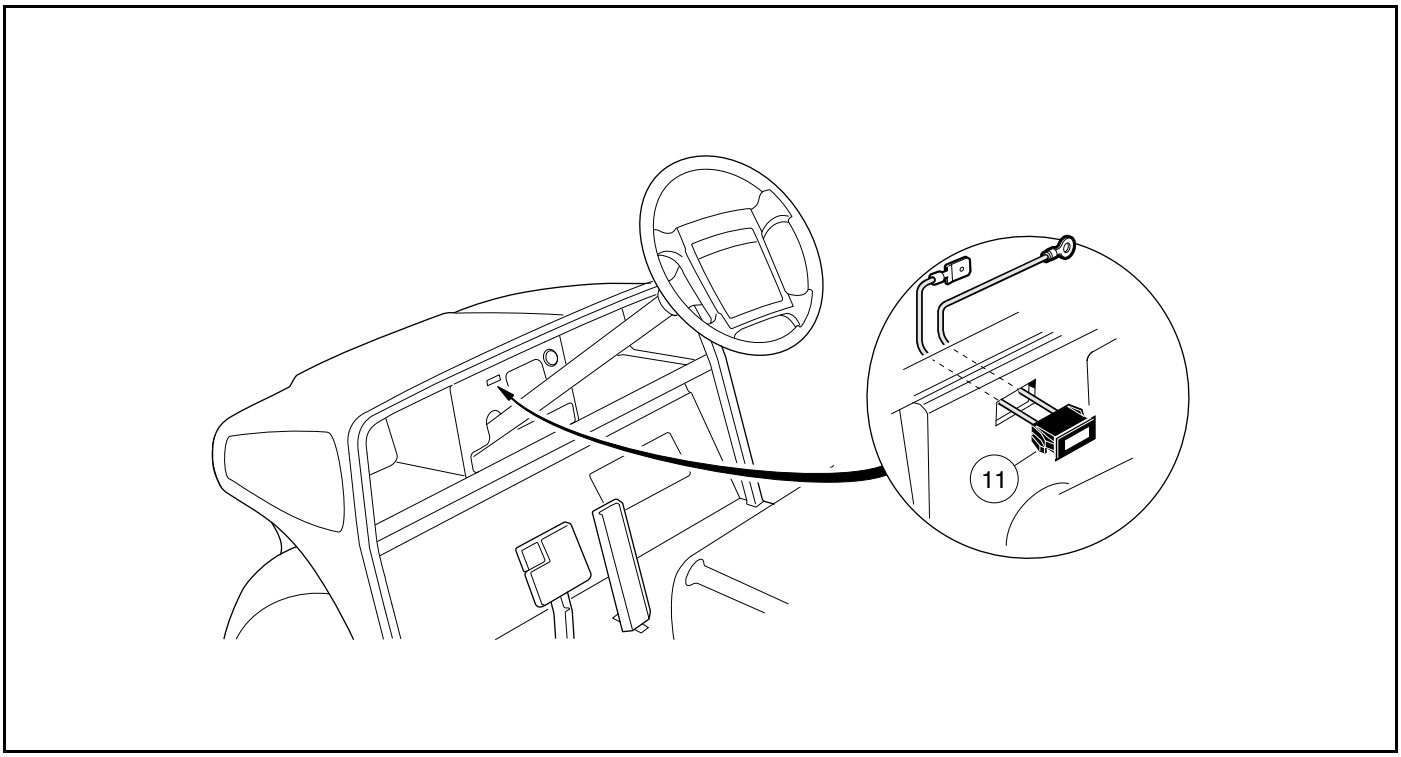


Figure 24-12 Battery Warning Light

⚠ DANGER

- **See General Warning 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 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:**
  - **Exernal: Flush with water. Call a physician immediately.**
  - **Internal: Drink large quantities of milk or water followed by milk of magnesia or vegetable oil. Call a physician immediately.**
  - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

⚠ WARNING

- **See General Warning on page 1-1.**
- **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 25-3.**
- **Use only 4-gauge (AWG) wires with low-resistance terminals to replace battery wires on IQ Plus models.**

GENERAL INFORMATION

The batteries supplied with an electric Club Car 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 Club Car 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.

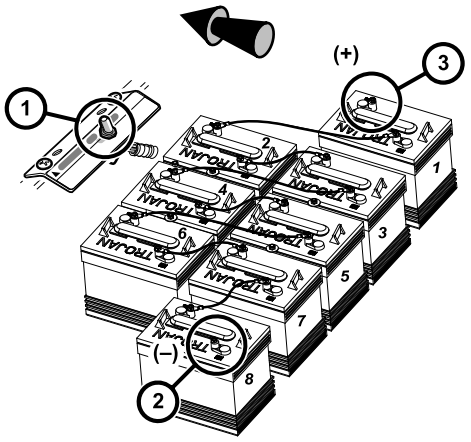
BATTERY REPLACEMENT

See General Warning 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.**

1. Before removing batteries, note the orientation of the batteries and the connecting wires. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.** Remove remaining wires and batteries. **See Wiring Diagrams on page 22-2.**
2. Visually inspect the new batteries for any damage that may have occurred in transit.
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.



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 25-1 Battery Configuration

4. Check and clean the battery rack and hold-downs. The nuts and bolts on the hold-downs may corrode. It is therefore advised they be cleaned periodically and replaced as necessary.
5. Install batteries in the proper orientation **(Figure 25-1, Page 25-2)**. Install battery hold-downs. The hold-downs should be tight enough so batteries do not move while vehicle is in motion, but not so tight as to crack or buckle battery case. Tighten to 40 in-lb (4.5 N·m), alternating between hold-down bolts.
6. Install wires in proper sequence **(Figure 25-1, Page 25-2)**. Install black wire to negative post of battery no. 8 last. Make sure all connections are tight. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
7. Give the battery set a full charge prior to operation to ensure all the batteries are fully charged and the cells are equalized prior to use.

BATTERY CARE

See General Warning on page 1-1.

⚠ WARNING

- **Ensure battery connections are clean and properly tightened.**
- **Use only 4-gauge (AWG) wires with low-resistance terminals to replace battery wires on IQ Plus models.**
- **If battery wire terminals are damaged or corroded, they should be replaced or cleaned as necessary. Failure to do so may cause them to overheat during operation and could result in a fire, property damage, or personal injury.**

PREVENTIVE MAINTENANCE

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

1. Any corrosion build-up on or around batteries should be removed immediately. Terminal connections should be clean and tight. Any frayed or worn wires should be replaced. After all cables have been connected, coat all terminals with Battery Terminal Protector Spray (CCI P/N 1014305) to help prevent future corrosion.
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 (CCI P/N 1014305). **See Self-Discharge on page 25-3.**
3. Maintain proper electrolyte level. **See Electrolyte Level on page 25-3.**
4. Batteries should be properly charged every day they are used. Check the batteries periodically to see that they are in a full state of charge. **See Battery Charging on page 25-5.**
5. Keep hold-downs tight. **See Vibration Damage on page 25-5.**

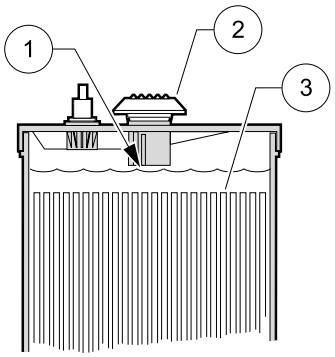
SELF-DISCHARGE

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 25-12.**

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.**



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 25-2 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 25-2, Page 25-4)**. 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.

MINERAL CONTENT

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

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)	EFFECTS OF IMPURITY
Suspended matter	Trace	—
Total solids	100.0	—
Calcium	40.0	Increase of positive shedding
Magnesium	40.0	Reduced life
Iron	3.0	Increased self-discharge at both plates, lower on-charge voltage
Ammonia	8.0	Slight self-discharge of both plates
Organic matter	50.0	Corrosion of positive plate

TABLE CONTINUED ON NEXT PAGE

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)	EFFECTS OF IMPURITY
Nitrates	10.0	Increased sulfation at negative
Nitrites	5.0	Corrosion at both plates, loss of capacity, reduced life
Chloride	5.0	Loss of capacity in both plates, greater loss in positive
Color	Clear and “White”	—
Antimony	5.0	Self-discharge by local action, reduces life, lower on-charge voltage
Arsenic	0.5	Self-discharge, can form poisonous gas at negative
Copper	5.0	Increased self-discharge, lower oncharge voltage
Nickel	None Allowed	Intense lowering of on-charge voltage
Platinum	None Allowed	Violent self-discharge, lower on-charge voltage
Selenium	2.0	Positive shedding
Zinc	4.0	Slight self-discharge at negative

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. Battery hold-downs should be tightened to 40 in-lb (4.5 N·m). Excessive vibration causes the plates to shed prematurely and shortens the life of the battery. It may also cause acid to leak out of the vent caps and corrosion to build up on surrounding metal parts. The acid which is lost reduces the capacity of the battery and cannot be replaced. Battery hold-downs should NOT be so tight as to crack or buckle the battery case. This may cause leaks which would dry out a cell or cause internal short circuits.
See Battery Replacement on page 25-2.

BATTERY CHARGING

See General Warning on page 1-1.

CAUTION

- **Only IQ Plus chargers should be used with IQ Plus vehicles. Long-term use of a PowerDrive battery charger with IQ Plus vehicles will damage the batteries.**

The charger supplied with the Club Car electric vehicle resolves the most common problems associated with battery charging. Undercharging and overcharging are prevented provided the charger is allowed to shut off by itself. Also, all cells are automatically given an equalization charge at low current, which prolongs battery life. Batteries should never be left in a discharged state, as this too affects the internal components and can reduce the capacity of the battery. The batteries should be charged every day they are used. However, the batteries should not be charged if they have not been used.

CHARGER SHUTS OFF AFTER 16 HOURS

This may be due to 1) new batteries, 2) hard use, or 3) cold temperatures. A catch-up charge may be necessary when these conditions are present. On those days when all or some of the vehicles do not get used, check the batteries

for state of charge. Any battery with a specific gravity lower than 1.250 will need a catch-up charge. If the problem continues after a catch-up charge has been performed, check the battery charger. **See See Section 26 – 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 Club Car 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. **See See Section 26 – 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 Club Car CDM (Communication Display Module) can be a very helpful service tool. Monitoring the value of function 3 with the CDM simplifies vehicle usage scheduling.* ***See Communication Display Module (CDM), Section 22, Page 22-36.***

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.

BATTERY TROUBLESHOOTING CHART

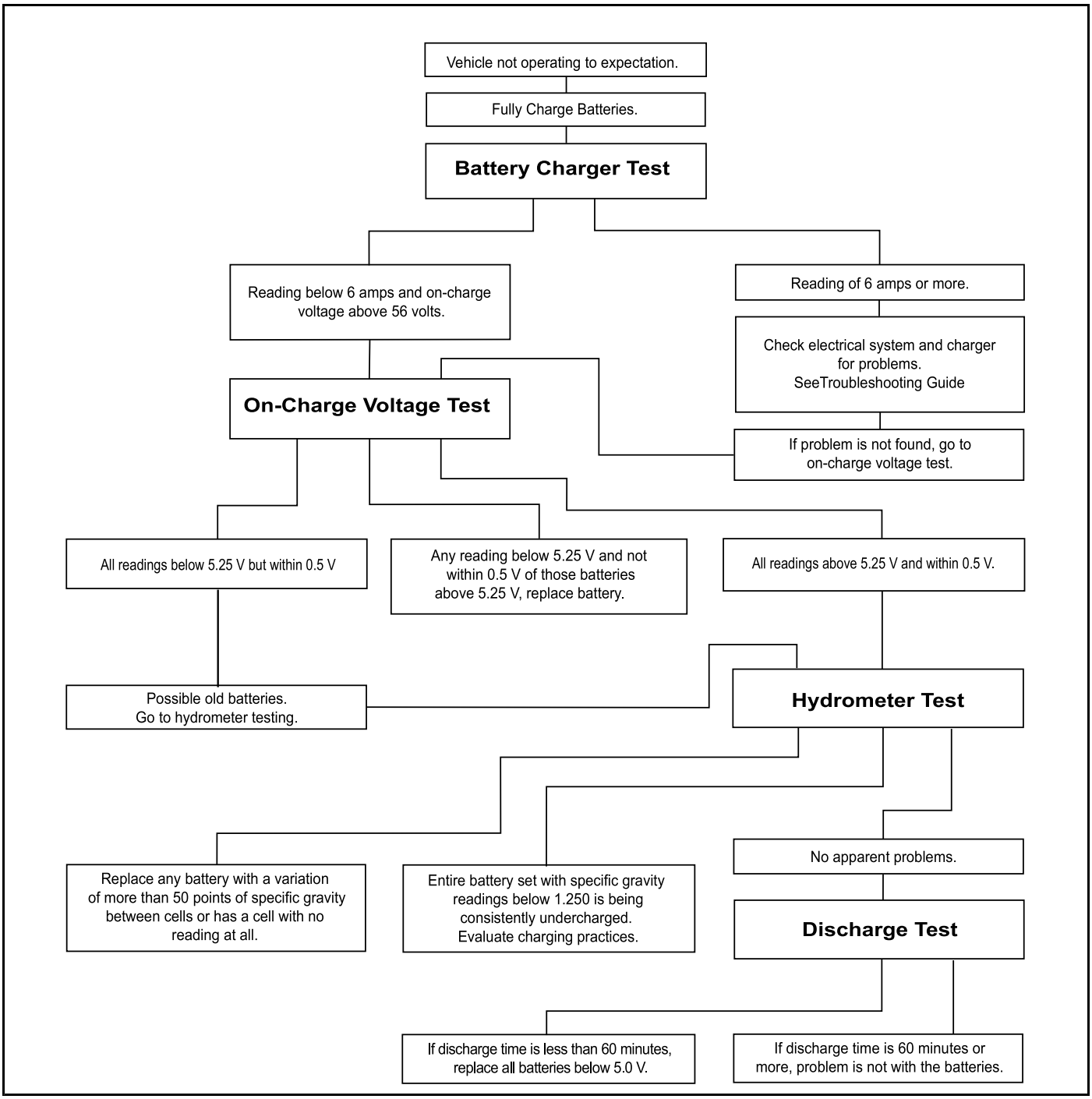

Figure 25-3 Battery Troubleshooting Chart

BATTERY TESTING

See General Warning 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 25-3, Page 25-7)**.

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. 8. 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 25-7** 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.
2. Remove the vent cap. Using a battery thermometer (CCI 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 25-4, Page 25-9)**.
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.

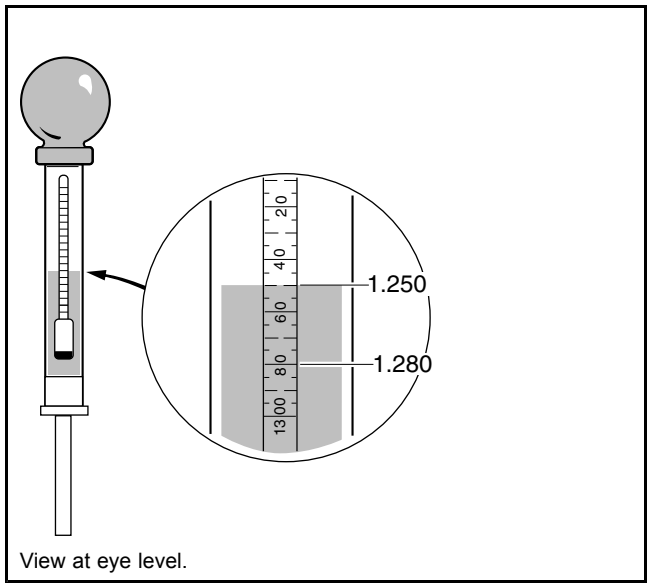

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Figure 25-4 Hydrometer

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 (CCI 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. 8.
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.*

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 5.0 volts.

BATTERY VOLTAGES								BATTERY CONDITION
1	2	3	4	5	6	7	8	
5.25 V	5.25 V	5.25 V	5.25 V	5.25 V	5.25 V	5.25 V	5.25 V	Excellent
5.30 V	5.30 V	5.45 V	4.70 V	5.30 V	5.30 V	5.30 V	5.30 V	Battery no. 4 is near end of useful life
5.40 V	5.40 V	5.00 V	5.40 V	4.60 V	5.40 V	5.40 V	5.40 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	7	8
On-Charge Voltage	7.40 V	7.60 V	7.10* V	7.40 V	7.70 V	7.80 V	7.80 V	7.80 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	7	8
Cell 1 (Positive Post)	1.200*	1.265	1.300	1.250	1.280	1.260	1.260	1.260
Cell 2	1.285	1.275	1.290	1.270	1.295	1.265	1.265	1.265
Cell 3 (Negative Post)	1.265	1.270	1.275	1.265	1.280	1.275	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	7	8
Discharge Voltage	3.80* V	5.25 V	5.65 V	5.25 V	5.50 V	5.60 V	5.70 V	5.30 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	7	8
On-Charge Voltage	7.40 V	7.10* V	7.45 V	7.6 V	7.65 V	7.50 V	7.55 V	7.65 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 STORAGE

See General Warning 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 25-3.**
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 Club Car 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. **See Storage – Electric Vehicle, Section 3, Page 3-5.**

CHARGING A BATTERY PACK THAT HAS LOW VOLTAGE

See the appropriate battery charger maintenance and service manual.

SECTION 26 – BATTERY CHARGER

26

Refer to the appropriate battery charger maintenance and service manual.

⚠ DANGER

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

⚠ WARNING

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

GENERAL INFORMATION

The IQ Plus vehicle is equipped with a 48-volt DC, shunt-wound, reversible traction motor. This 3.7 horsepower motor is designed for use on IQ Plus 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.

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.*

Index of Test Procedures

TEST PROCEDURE 1 – Internal Short Circuits

See General Warning on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
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, F1, and F2 terminals respectively. Multimeter should indicate no continuity. If readings are incorrect, motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal on page 27-2.**
   3.1. An incorrect reading from the A1 or A2 terminal indicates three possible problems: a grounded A1 or A2 terminal, a grounded wire in the brush area, or a grounded armature/commutator. An incorrect reading for the F1 or F2 terminal indicates a possible grounded F1 or F2 terminal or field coil.
4. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

TEST PROCEDURE 2 – Armature Circuit Open

See General Warning on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
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 27-2.**
3. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

TEST PROCEDURE 3 – Field Circuit Open

See General Warning on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Disconnect wires from the F1 and F2 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 F1 terminal and the black (–) probe on the F2 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 27-2.**
3. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

MOTOR

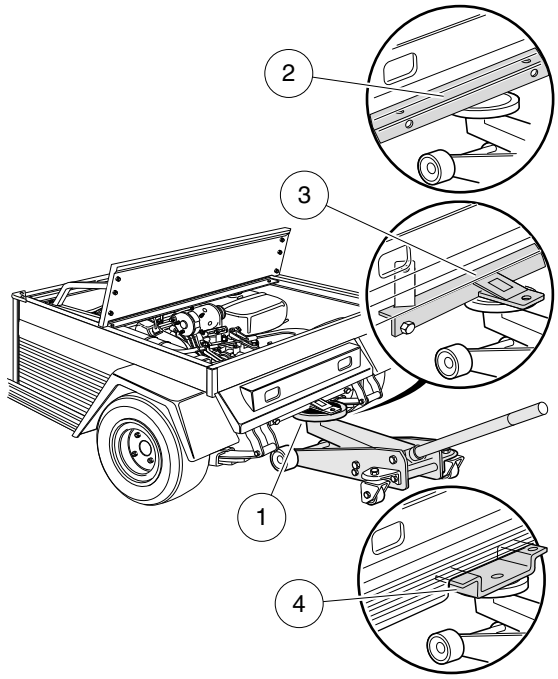
See General Warning on page 1-1.

MOTOR REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
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 27-1, Page 27-3)** 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 27-2, Page 27-3)**. **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.**



1. Position floor jack under hitch bracket or frame.
2. Lifting Position For Standard Turf 1 and Carryall 1
3. Lifting Position For Turf 2 and 252, Carryall 2 and 252, Carryall 2 Plus and XRT 900
4. Lifting Position For Turf 6 And Carryall 6

Figure 27-1 Lift Vehicle with Floor Jack

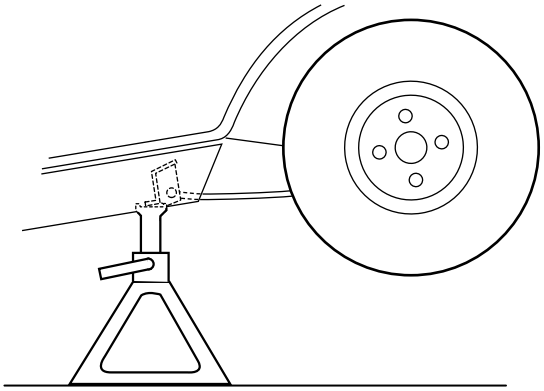


Figure 27-2 Vehicle Supported on Jack Stands

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 27-3, Page 27-3)**.
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 27-3, Page 27-3)**.

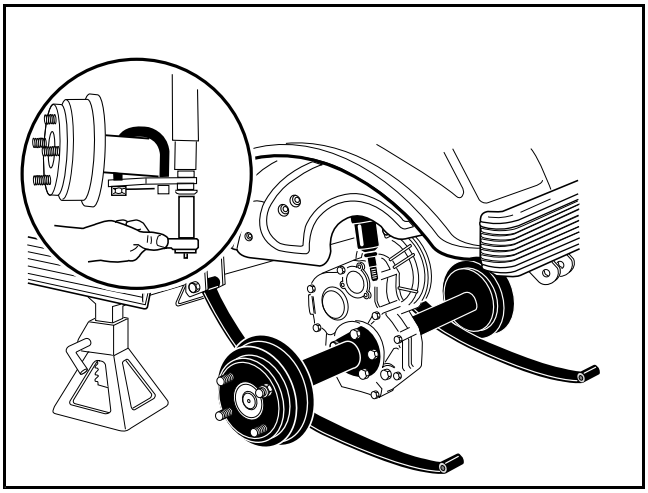


Figure 27-3 Lower Axle

9. Remove the four bolts that mount the motor to the transaxle **(Figure 27-20, Page 27-15)**. **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.

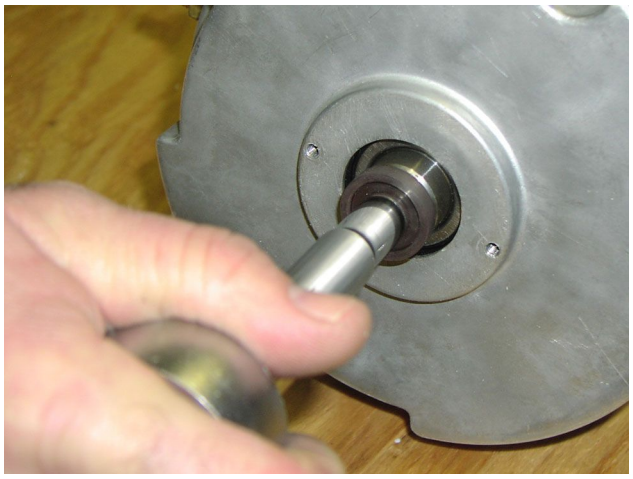


Figure 27-4 Speed Sensor Magnet

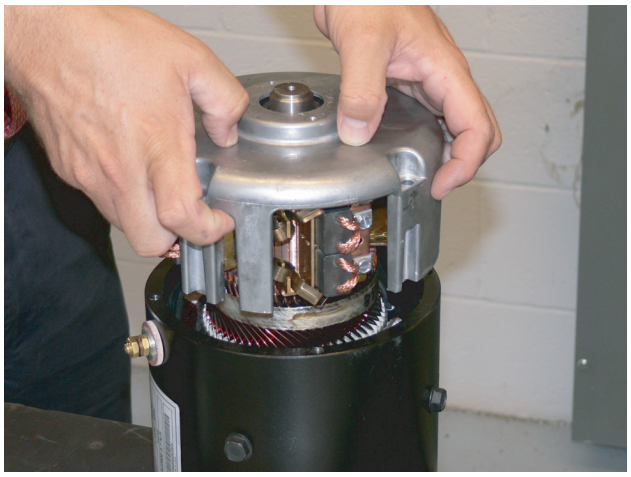


Figure 27-5 End Cap Removal

MOTOR DISASSEMBLY

1. Release the clasp and remove the headband assembly (21) from the motor. Visually inspect brushes and springs. **(Figure 27-13, Page 27-10)**.
2. Before continuing disassembly, place match marks on the motor end cap (20) and motor frame (14).
3. Remove speed sensor (10) and magnet (12).
   3.1. Remove the two screws (11) that secure the speed sensor (10) to the end cap (20).
   3.2. Remove the bolt (13) securing the magnet (12) to the armature shaft (15). Hold the back of the armature assembly to keep it from turning as you remove the bolt.
   3.3. Inspect the speed sensor magnet. **See Speed Sensor Magnet Inspection on page 27-9.**

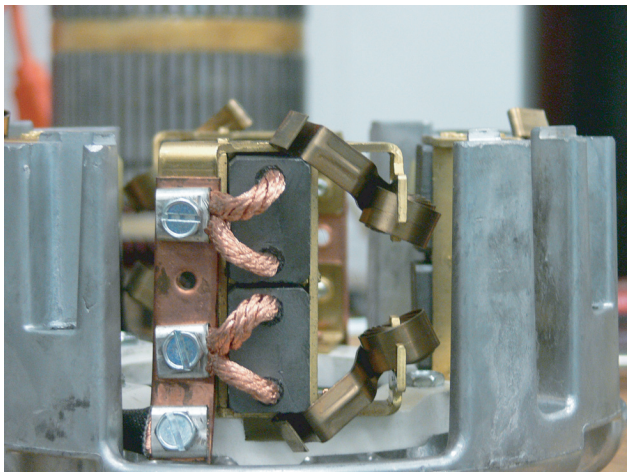


Figure 27-6 Brush Springs Positioning

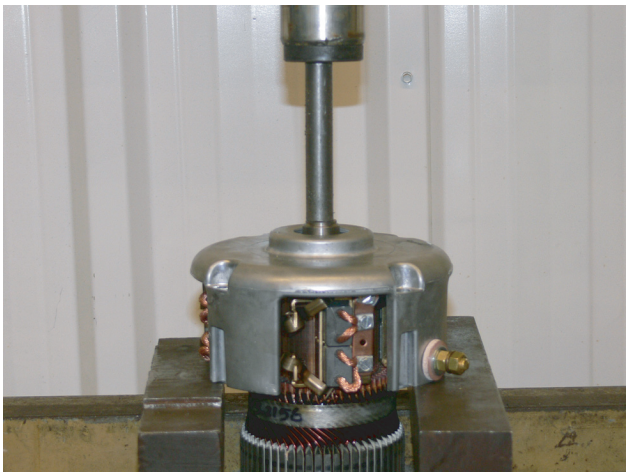


Figure 27-7 Armature Removal

4. Orient the motor so that the splined end of the armature is facing down.
5. Remove the four end cap bolts. The weight of the motor housing will cause it to drop when the bolts are removed. See following Caution.

⚠ CAUTION

- **The motor housing will drop when the bolts are removed. Do not put fingers under the motor housing when removing bolts.**

6. Remove the end cap and armature from the motor frame **(Figure 27-5, Page 27-4)**.
7. Inspect the brush springs for proper tension. **See Motor Brush, Spring, and Terminal Insulator Inspection on page 27-8.**
8. 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.*

8.1. Position the brush springs to reduce tension during removal of the armature. **(Figure 27-6, Page 27-5)**.
8.2. Place the end cap in a press with the armature facing down.
8.3. 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 27-7, Page 27-5)**.
8.4. Have an assistant support the armature while the press is activated.

9. Inspect the armature for wear and damage. **See Armature Inspection and Testing on page 27-7.**
10. Inspect the motor frame and field windings. **See Motor Frame and Field Windings Inspection on page 27-8.**
11. Remove the brush rigging.
11.1. Mark the brush terminal posts (A1 and A2).

11.2. Remove the two nuts securing the brush terminals (A1 and A2) to the end cap.
11.3. Remove the four bolts and the brush rigging from the end cap **(Figure 27-8, Page 27-6)**.
12. Inspect the terminal insulators. **See Terminal Insulator Inspection on page 27-9.**
13. Remove the bearing from the end cap.
13.1. Remove the retaining ring that secures the bearing in the end cap **(Figure 27-9, Page 27-6)**.
13.2. Use an arbor press to remove the bearing from the end cap.
14. Inspect the bearing for wear and damage. **See Bearing Inspection on page 27-9.**

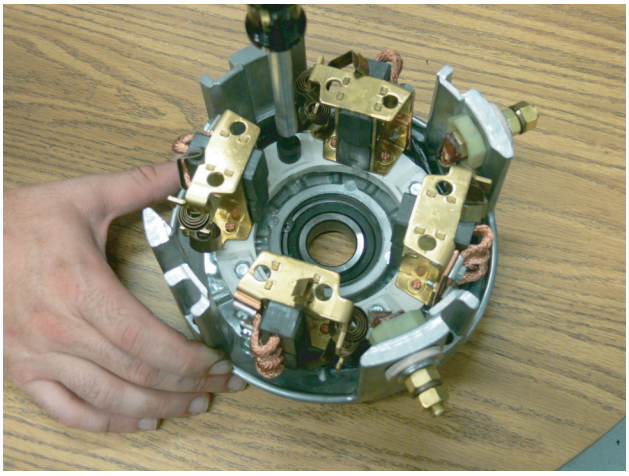


Figure 27-8 Brush Rigging Removal

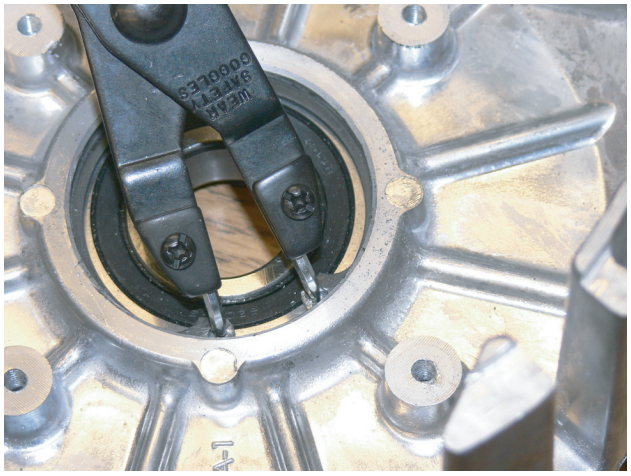


Figure 27-9 Retaining Ring Removal

MOTOR COMPONENT TESTING AND INSPECTION

See General Warning on page 1-1.

ARMATURE INSPECTION AND TESTING

1. Remove the motor from the vehicle. **See Motor Removal, Section 27, Page 27-2.**
2. Remove the end cap and armature by performing steps 1 through 6 of Motor Disassembly on page 27-4.

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 27-10, Page 27-8)***. If the reading is incorrect, replace the armature.

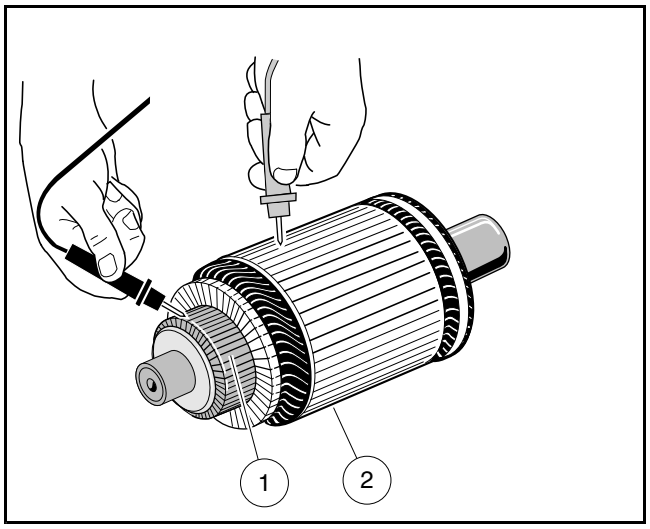


Figure 27-10 Armature Test

MOTOR FRAME AND FIELD WINDINGS INSPECTION

1. Remove the motor from the vehicle. **See Motor Removal, Section 27, Page 27-2.**
2. Remove the end cap and armature by performing steps 1 through 6 of Motor Disassembly on page 27-4.
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, Section 27, Page 27-2.**
2. Release the clasp and remove the headband from the motor.
3. Inspect the brush springs (18) **(Figure 27-13, Page 27-10)**. 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 (1) on a scale (2).
   - 4.2. Place the end of the C-shaped plate (1) so that it is between the spring and the brush.
   - 4.3. Gently pull the scale (2) 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 27-11, Page 27-9)**. **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 27-11*** *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, Section 27, Page 27-2.**
2. Release the clasp and remove the headband from the motor.
3. Inspect the brushes (16) for damage or excessive wear **(Figure 27-13, Page 27-10)**. 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, Section 27, Page 27-2.**
2. Remove the terminal insulators by performing steps 1 through 11 of Motor Disassembly on page 27-4.
3. Inspect the insulators for cracks or other damage. 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, Section 27, Page 27-2.**
2. Remove the bearing by performing steps 1 through 13 of Motor Disassembly on page 27-4.
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 27-12, Page 27-9)**.
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.

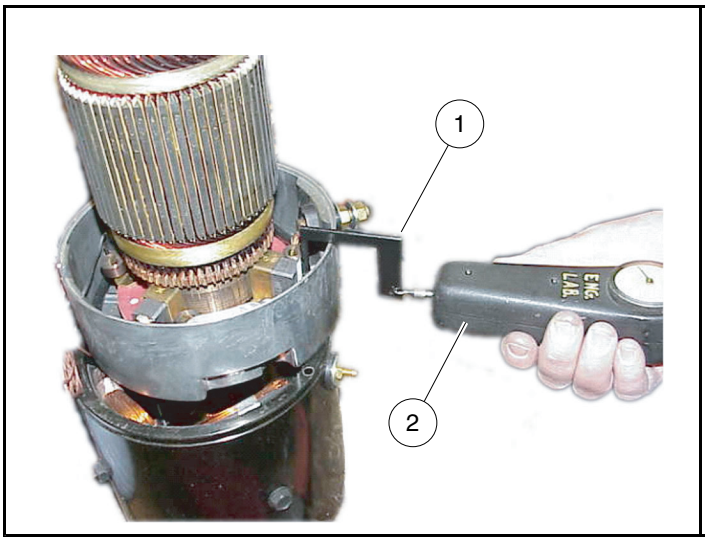


Figure 27-11 Brush Spring Tension Test

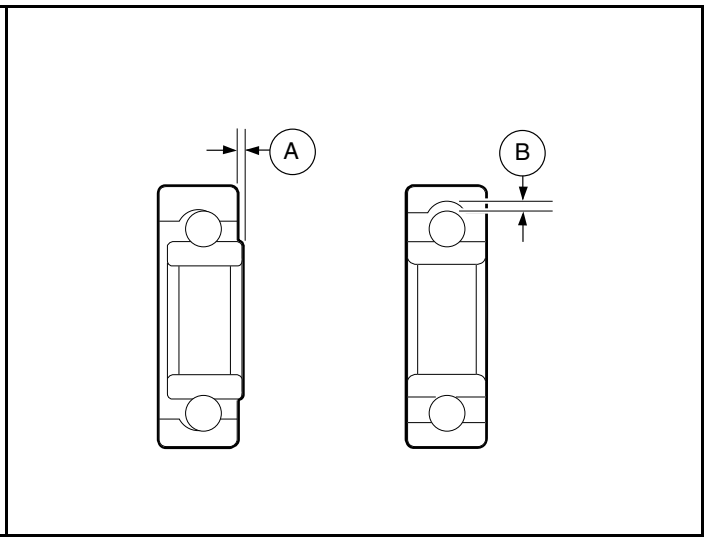


Figure 27-12 Bearing Inspection

Speed Sensor Magnet Inspection

Inspect the speed sensor magnet (12) for rust, wear, and cracks **(Figure 27-13, Page 27-10)**. Replace the magnet if necessary.

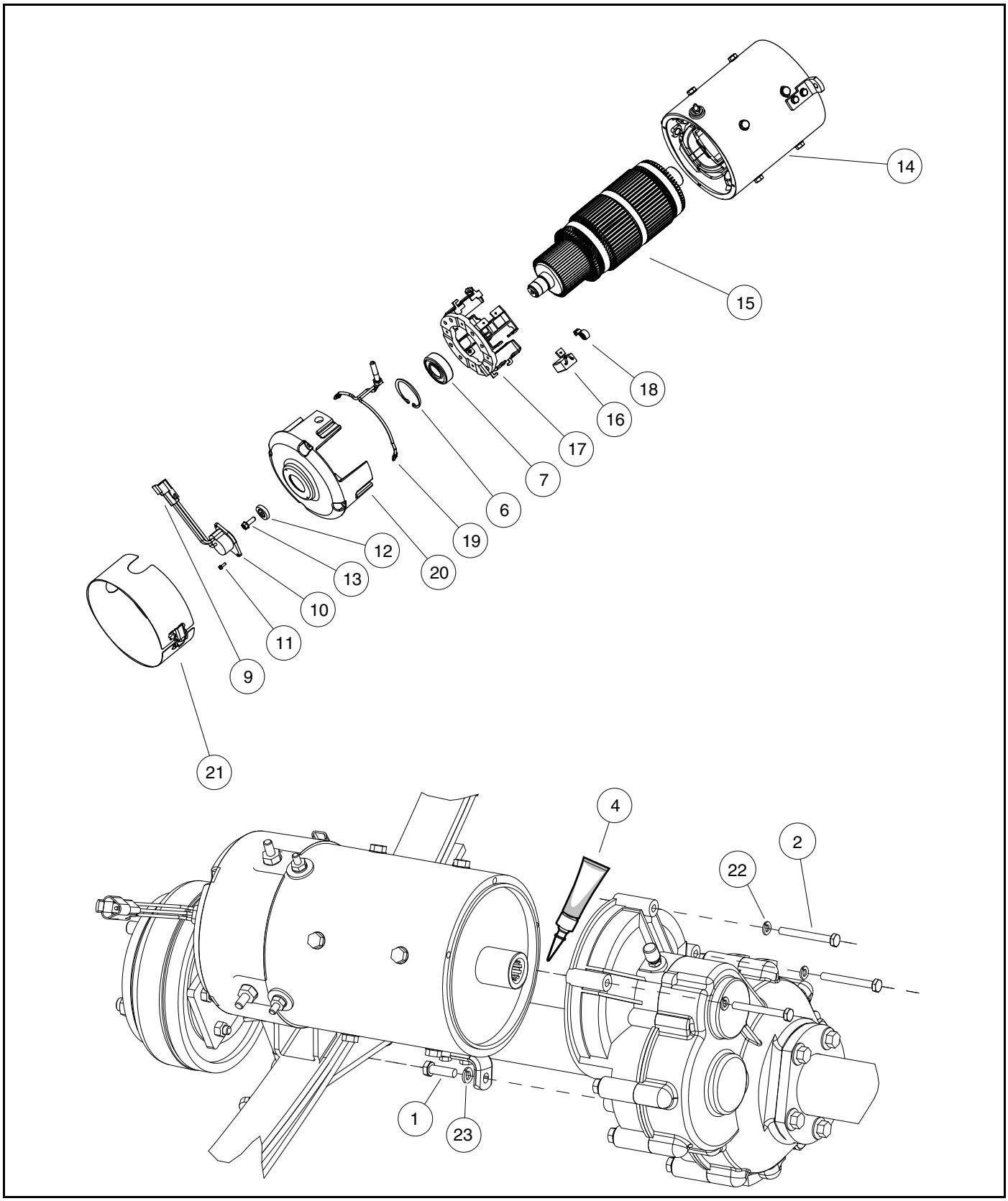


Figure 27-13 Motor

RECONDITIONING THE MOTOR

See General Warning 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)	0.014 ohms between bars 1 and 15
Field resistance at 75 °F (24 °C)	0.55 ohms

MOTOR ASSEMBLY

See General Warning 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.
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 eight brushes.

Install the brushes in the same rigging 180° apart from each other.

   2.1. Insert the brushes into the brush rigging as shown.
   2.2. Insert the two terminal posts through insulators in the end cap (20) wall at the A1 and A2 positions **(Figure 27-13, Page 27-10)**.
   2.3. Place external insulators and washers on each terminal post, and secure terminal with nuts. Tighten nuts to 100 in-lb (11.3 N·m). Ensure that the terminal posts do not rotate when tightening the nuts.
   2.4. Secure the brush rigging to the end cap with four bolts. Tighten the bolts to 25 in-lb (2.8 N·m).
   2.5. One at a time, push the brushes back until they are completely retracted into their mounting slots **(Figure 27-14, Page 27-12)**.

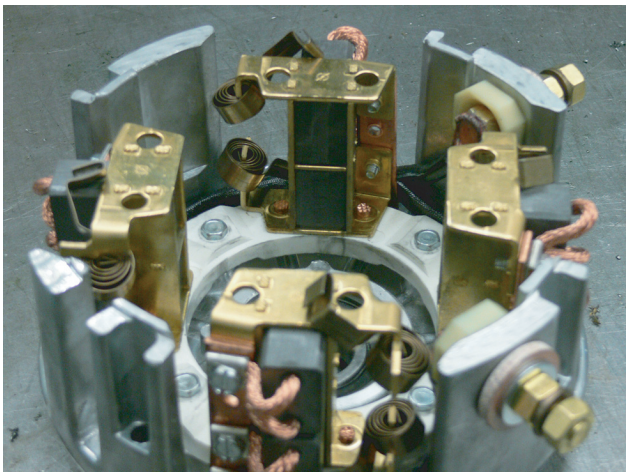


Figure 27-14 Retracted Brushes

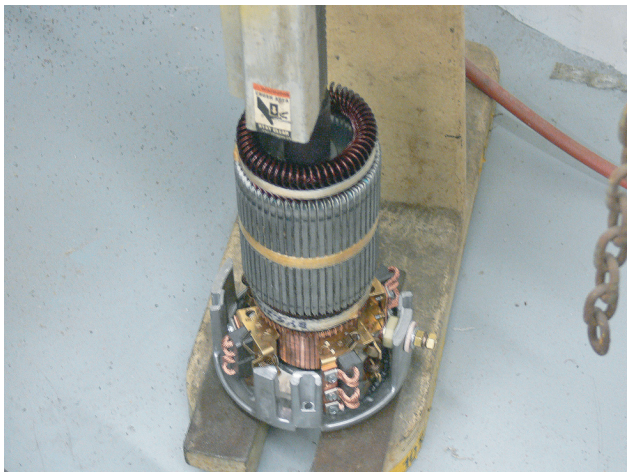


Figure 27-15 Armature Installation

3. With the brushes retracted, use an arbor press to press the armature shaft into the end cap bearing **(Figure 27-15, Page 27-12)**. **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. Move the springs back to their original position. Ensure that the spring rests on the end of each brush.
5. Align the match marks on the end cap (20) and the motor frame (14) and secure with four bolts **(Figure 27-13, Page 27-10)**. Tighten bolts to 130 in-lb (14.7 N·m).
6. Install the speed sensor magnet (12) with bolt (13). Tighten to 65 in-lb (7.3 N·m).
7. Install the speed sensor (10) with two screws (11). Tighten to 25 in-lb (2.8 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 Warning 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 (CCI P/N 102243403) from tube onto a putty knife as shown **(Figure 27-16, Page 27-13)**.
   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 27-17, Page 27-13)**.
   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.

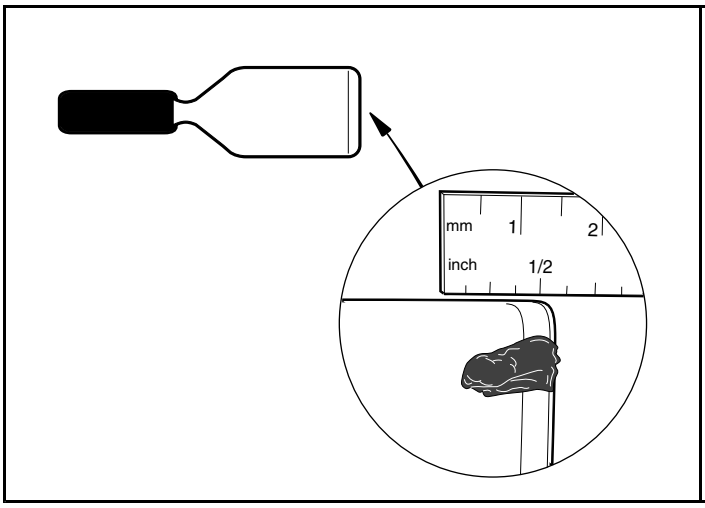


Figure 27-16 Grease on Putty Knife

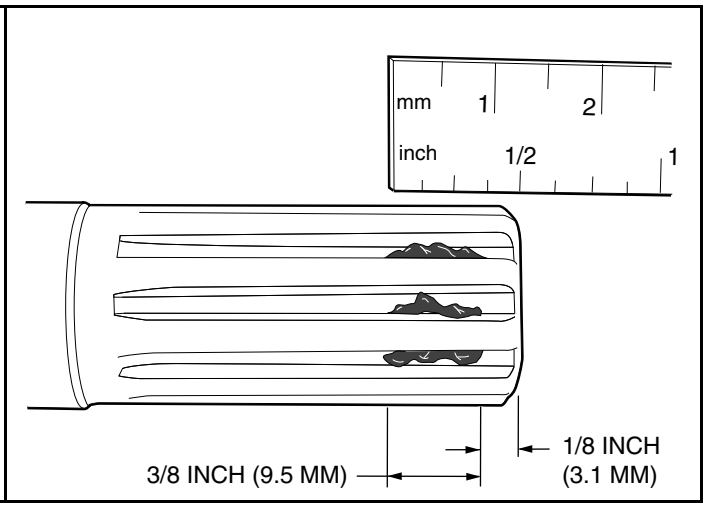


Figure 27-17 Application of grease to Input Shaft Grooves

   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 27-18, Page 27-14)**.
3. Install motor on transaxle.
   3.1. 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. There will be approximately 1/16 inch (1.6 mm) gap between the motor adapter ring and transaxle housing as shown ***(Figure 27-19, Page 27-14)****.*

   3.2. Loosely install the four bolts that secure the motor to the transaxle. Do not tighten.
   3.3. Begin finger-tightening the bolts (1 and 2) in the sequence indicated **(Figure 27-20, Page 27-15)**. 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.*

3.4. Tighten the right bolt (1) to 65 in-lb (7.3 N·m) **(Figure 27-20, Page 27-15)**.

3.5. Tighten the left bolt (2) to 65 in-lb (7.3 N·m) **(Figure 27-20, Page 27-15)**.

3.6. Tighten the center bolt (3) to 65 in-lb (7.3 N·m).

3.7. Tighten the bolt (4) inserted through the tab to 155 in-lb (17.5 N·m).

3.8. 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 22-2.** Tighten the terminal retaining nuts to 65 in-lb (7.3 N·m).Use a wrench on the bottom nuts to keep the terminals from moving.

3.9. 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.

3.10. Connect the three-pin speed sensor plug to the vehicle wire harness.

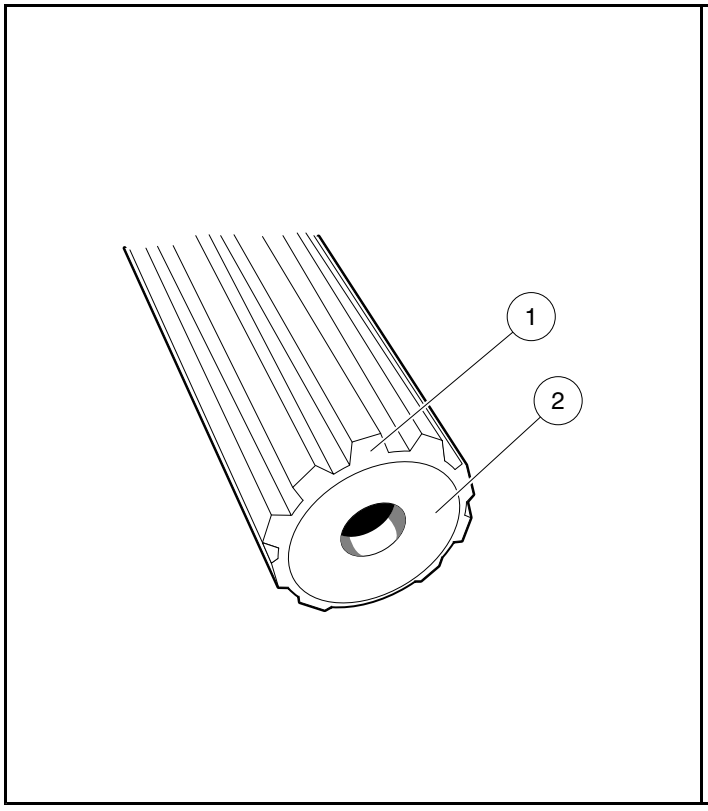


Figure 27-18 Clean Chamfer and Input Shaft End

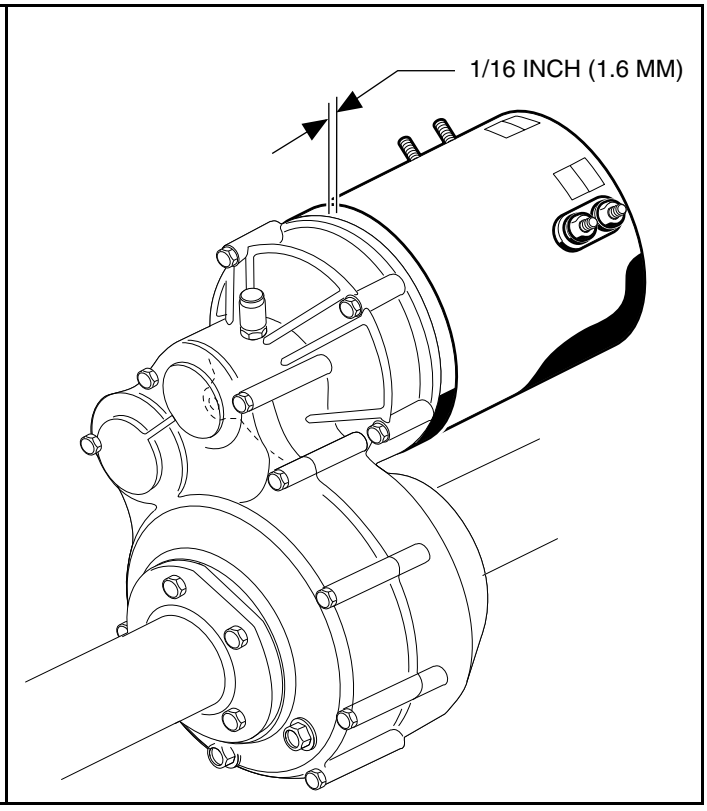


Figure 27-19 Gap at Motor and Transaxle

4. 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.
5. Insert the mounting bolts through the spring shackles and the bushings in the leaf spring eyes and install locknuts. Tighten the bolts to 23 ft-lb (31 N·m). **See Rear Suspension Section.**
6. Install the shock absorbers. Tighten nut until rubber bushing expands to the diameter of the cup washer.
7. If removed, install wheels and finger tighten the lug nuts.
8. Lift vehicle and remove jack stands. Lower vehicle to the floor and tighten lug nuts, using a crisscross pattern. **See Wheel Installation, Section 8, Page 8-1.**

9. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
10. Place the Tow/Run switch in the RUN position.
11. 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.**

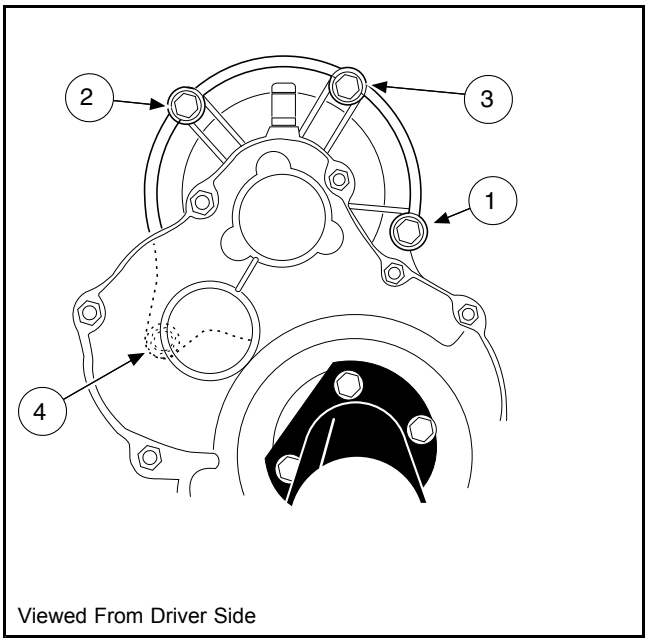


Figure 27-20 Motor Tightening Sequence

⚠ DANGER

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

⚠ WARNING

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

LUBRICATION

See General Warning 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 28-5, Page 28-3)**. 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 Warning 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, Section 1, Page 1-4.**
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 Warning on page 1-1.**
3. Remove the rear wheel and brake drum. **See Wheel Brake Assemblies Section and Wheels and Tires Section.**
4. Use 90° internal snap ring pliers to remove the internal retaining ring (1) from the axle tube **(Figure 28-1, Page 28-2)**.
5. Remove the axle (2), 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 (CCI P/N 1016417) to remove the axle seal and adapter ring from the axle tube **(Figure 28-2, Page 28-2)**. **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.*

6.2. Use a press to separate the axle oil seal (15) from the adapter ring (39) **(Figure 28-3, Page 28-2)**. 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 28-5, Page 28-3)**. If the bearing in a Type G transaxle is worn or damaged, the entire axle shaft assembly (1 or 2) must be replaced.

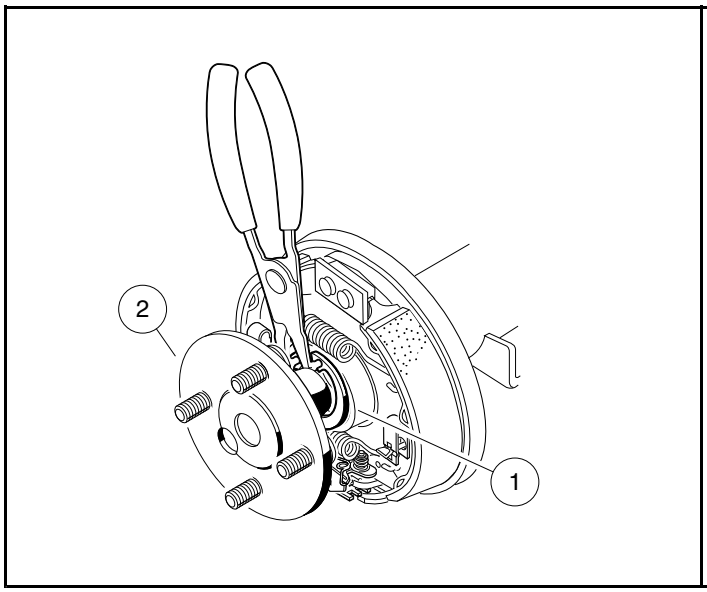


Figure 28-1 Remove Internal Retaining Ring

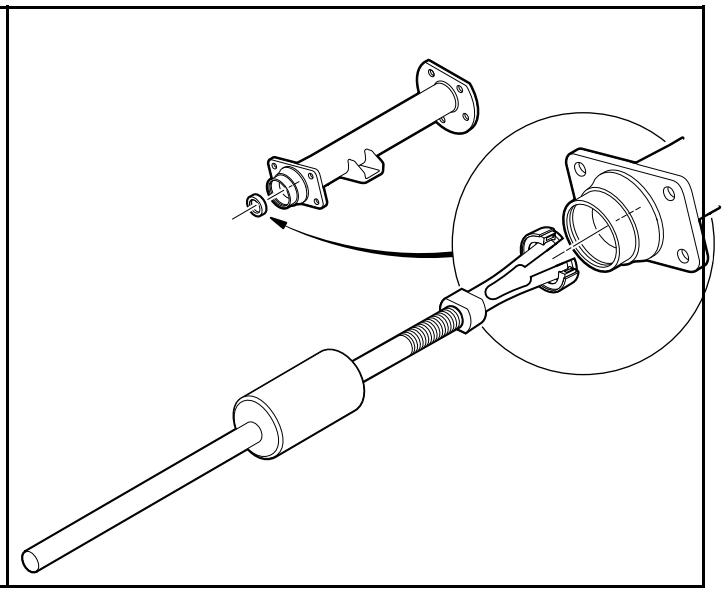
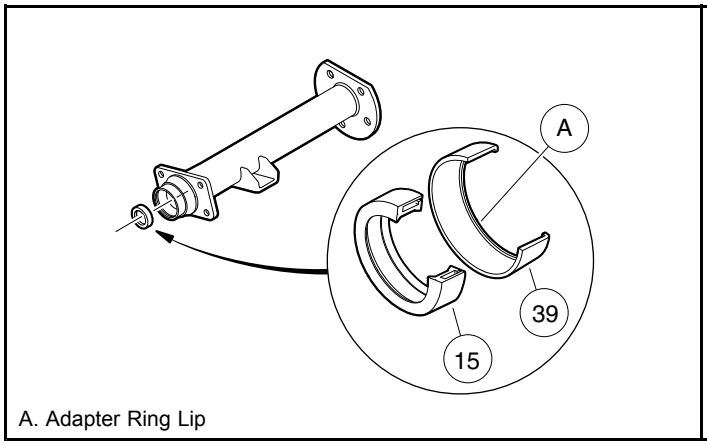


Figure 28-2 Axle Seal and Adapter Ring Removal



A. Adapter Ring Lip

Figure 28-3 Axle Seal and Adapter Ring

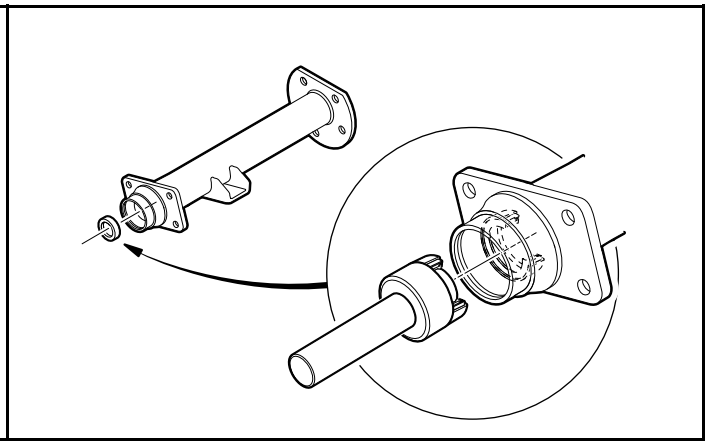


Figure 28-4 Axle Seal and Adapter Ring Installation

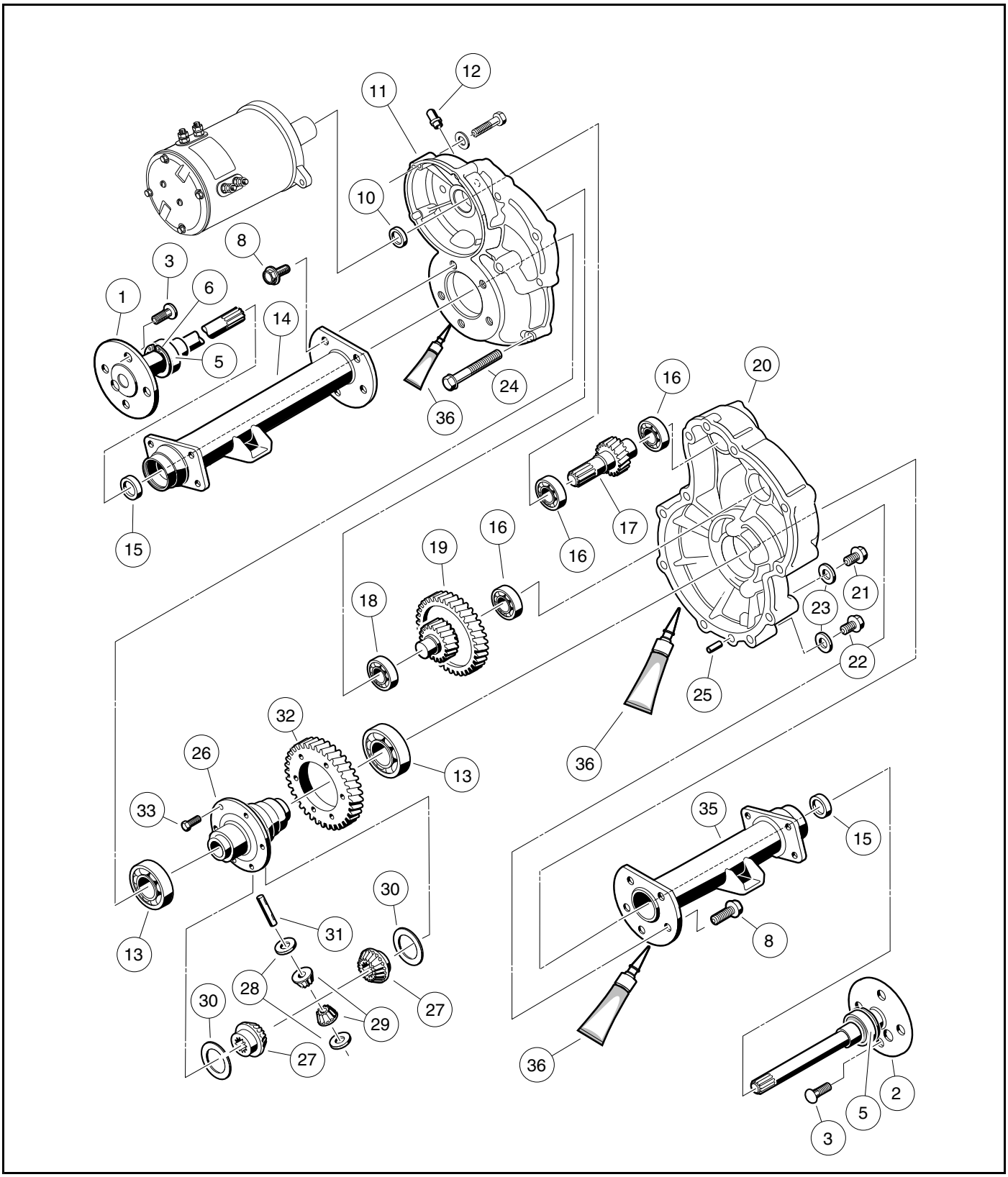


Figure 28-5 Transaxle – Type G

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 28-3, Page 28-2)**.
   1.2. Place a new seal (15) in the adapter ring with the seal lip facing toward the adapter ring lip **(Figure 28-3, Page 28-2)**. Use an axle seal tool (CCI P/N 1014162) and mallet to tap it in until it seats firmly in position **(Figure 28-3, Page 28-2)**. 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 28-5, Page 28-3)**.
   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 28-4, Page 28-2)**. Use an axle seal tool (CCI 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 28-5, Page 28-3)**. 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 28-5, Page 28-3)**. **See following NOTE.**

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 28-5, Page 28-3)****.*

   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.
4. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

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 28-5, Page 28-3)**.

TRANSAXLE

See General Warning on page 1-1.

TRANSAXLE REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Place chocks at the front wheels and slightly loosen lug nuts on both rear wheels.
3. Place a floor jack under the transaxle and raise the rear of the vehicle. Position jack stands under the 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 28-6, Page 28-5)**. **See WARNING "Lift only one end of the vehicle..." in General Warning 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), brake cable clevis pins (2), and cable retaining E-clips (3). Disconnect the brake cables (4) **(Figure 28-7, Page 28-5)**.

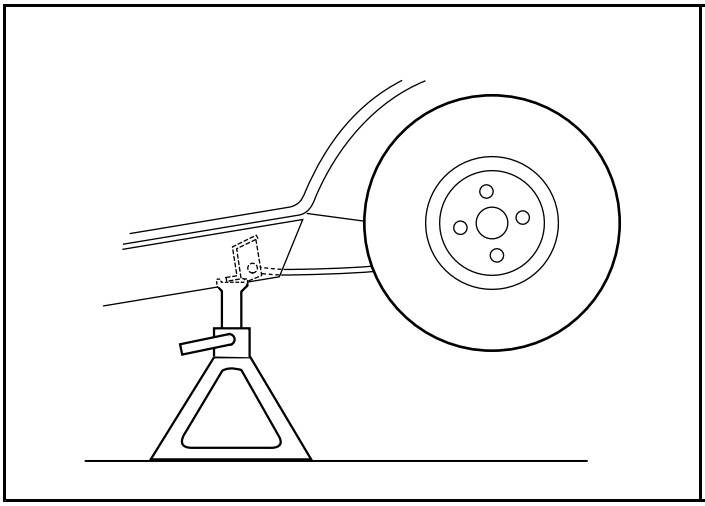


Figure 28-6 Vehicle Supported on Jack Stands

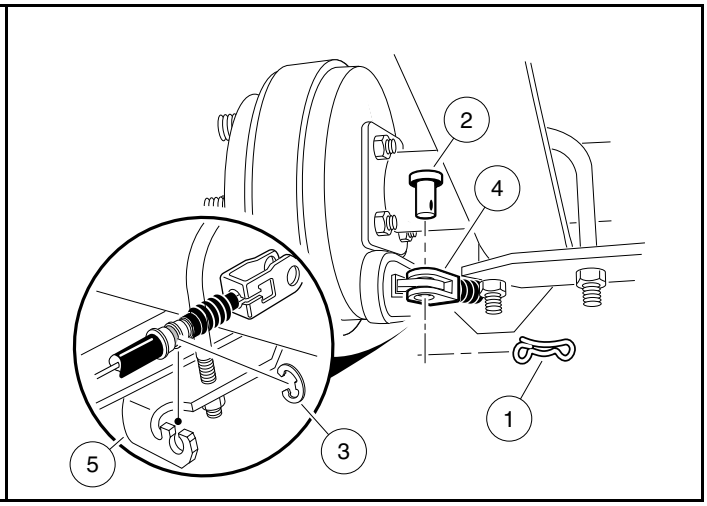


Figure 28-7 Brake Cables

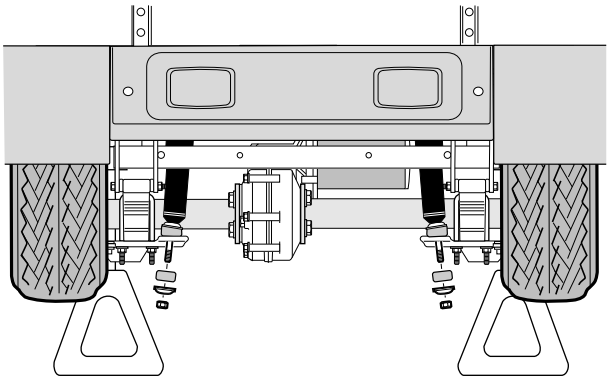


Figure 28-8 Disconnect Shocks

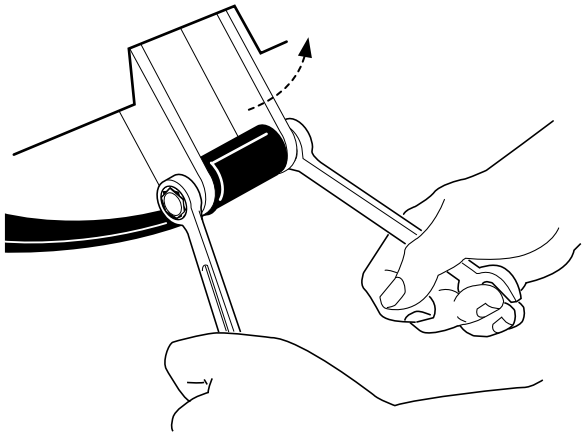


Figure 28-9 Detach Spring From Shackles

6. Disconnect the shock absorbers from their lower mounts **(Figure 28-8, Page 28-6)**.
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. Rotate shackles up and away from springs **(Figure 28-9, Page 28-6)**.
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 **(Figure 28-11, Page 28-6)** and the motor positioning bolt **(Figure 28-12, Page 28-7)** mounting 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.**

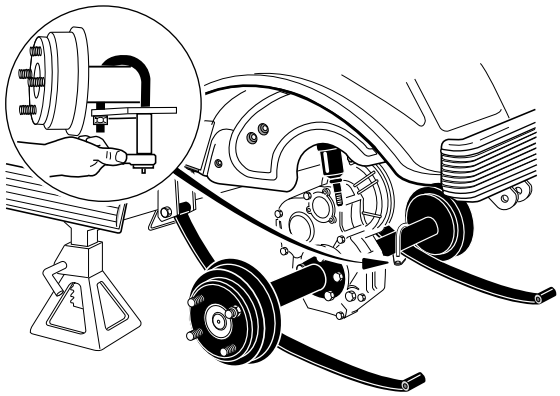
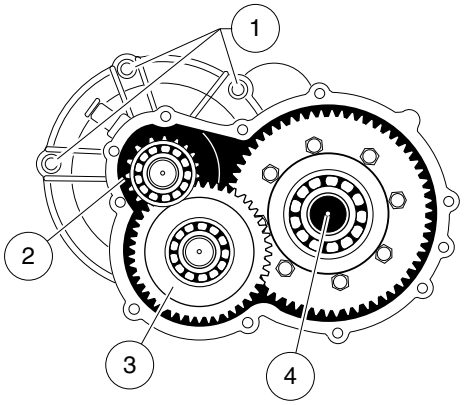


Figure 28-10 Detach Axle From Leaf Springs



1. Motor Mounting Bolts
2. Input Pinion Gear
3. Intermediate Gear Assembly
4. Differential Gear Case

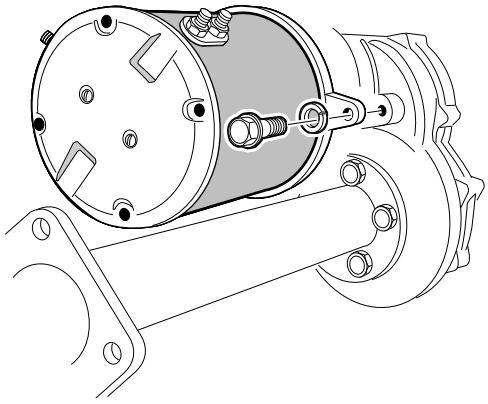
Figure 28-11 Motor Mounting Bolts

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 28-10, Page 28-6)**.
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 28-1. 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 Wheel Brake Assemblies Section.**



Appearance of motor may be different from the motor shown above.

Figure 28-12 Motor Positioning Bolt

TRANSAXLE DISASSEMBLY, INSPECTION, AND ASSEMBLY

See General Warning 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 28-5, Page 28-3)**.
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 28-5, Page 28-3)**. **See following CAUTION.**

CAUTION

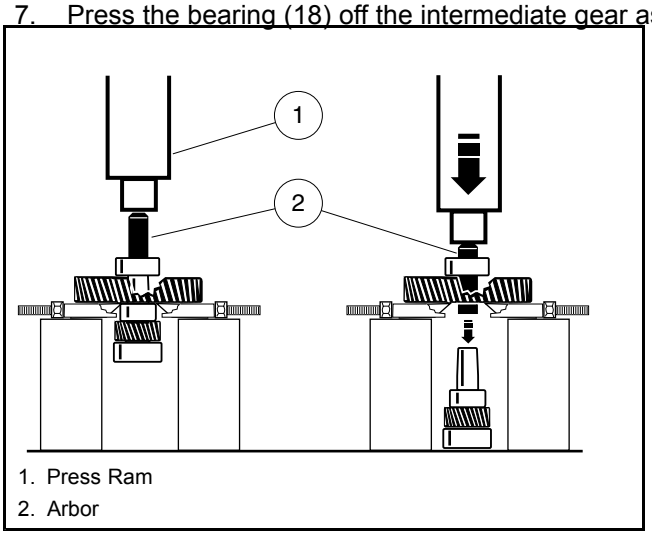
- **Do not damage gears. Use extreme care when handling them.**

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 28-5, Page 28-3)**. **See also Figure 28-13, Page 28-8. 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 28-5, Page 28-3)**. **See also Figure 28-13, Page 28-8.**
7. Press the bearing (18) off the intermediate gear assembly **(Figure 28-5, Page 28-3)**.



1. Press Ram
2. Arbor

Figure 28-13 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 28-5, Page 28-3)**.
   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 28-14, Page 28-8)**. Remove the two bolts.

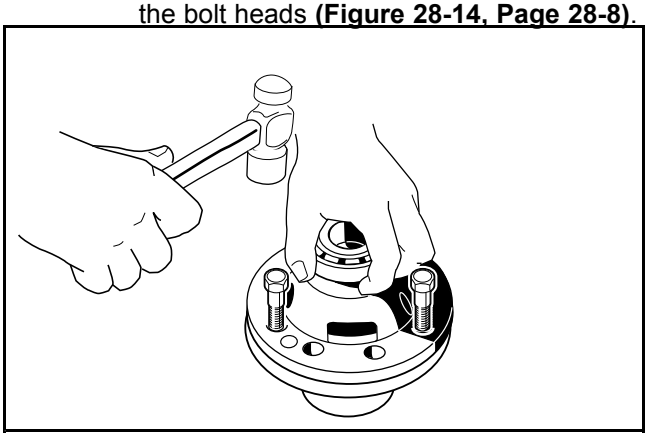


Figure 28-14 Separate Housing

   8.4. Remove the differential pin (31) by pushing pin through differential gear case from one side **(Figure 28-5, Page 28-3)**. **See also Figure 28-15, Page 28-9.**

8.5. Remove the idler gears (1 and 2) and thrust plates (3 and 4) **(Figure 28-16, Page 28-9)**.

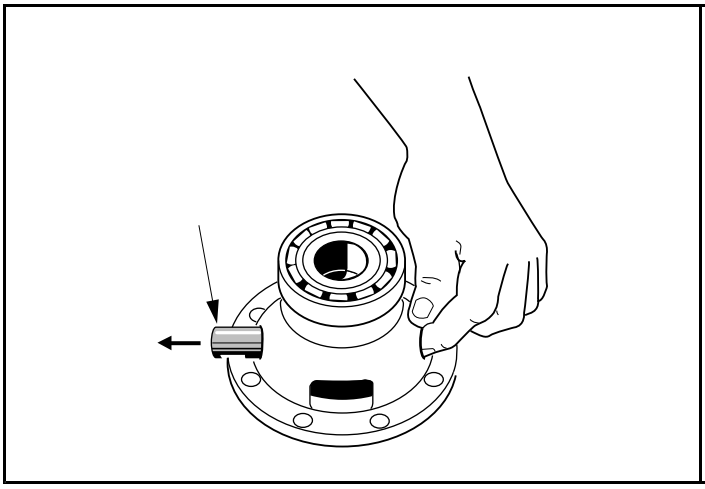


Figure 28-15 Differential Pin

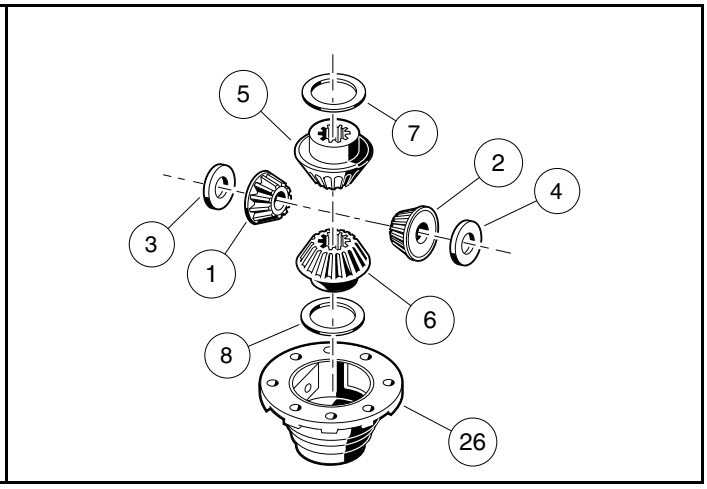


Figure 28-16 Left Differential

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 28-5, Page 28-3)**. 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 28-5, Page 28-3)**.
2. Assemble the differential gear case.
   2.1. Install the pin (31) **(Figure 28-5, Page 28-3)**. 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 28-5, Page 28-3)**.
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 (CCI 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, the intermediate gear assembly, and the input pinion gear simultaneously. Be sure all bearings are seated properly in the housing. Rotate the input shaft to check for smooth gear operation **(Figure 28-11, Page 28-6)**.

7. Install both dowel pins (25) in the transaxle housing (20) **(Figure 28-5, Page 28-3)**.
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 28-5, Page 28-3)**.
   8.3. Install eleven 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 28-5, Page 28-3)**. Tighten the bolts to 37 ft-lb (50.2 N·m).
9. Install the brake assemblies as instructed. **See Wheel Brake Assemblies Section.**
10. Apply a small amount of grease to the lip of the oil seal (15) **(Figure 28-5, Page 28-3)**. **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) (CCI 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 28-5, Page 28-3)**.
    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 Warning 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, lockwashers, and nuts. Tighten the nuts to 25 ft-lb (34 N·m). Tighten the U-bolt nuts so an equal amount of thread is visible on each leg of the bolt.
4. Install the motor. **See Motor Installation on page 27-13 or Motor Installation on page 27-13.**
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 four motor wires. Tighten the retaining nuts to 65 in-lb (7.3 N·m). Use two wrenches to prevent the posts from turning. **See following NOTE.**

NOTE: *If the motor wires were not tagged when disconnected, refer to the wiring diagram for proper connection.* ***See Wiring Diagrams, Section 22, Page 22-2.***

7. Insert bolts through the spring shackles and bushings in the leaf spring eyes. Secure bolts with locknuts. Tighten to 15 ft-lb (20.3 N·m).
8. Connect the brake cables using new bow tie pins (1) **(Figure 28-7, Page 28-5)**.
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. **See Wheel Installation, Section 8, Page 8-1.**
13. Connect the batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
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.**
- **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 29 – IQ DISPLAY MODULE (IQDM-P) SERIES 2 PROGRAMMING

29

⚠ DANGER

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

⚠ WARNING

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

NOTE: *For information pertaining to the introductory display, menu navigation, and monitor, faults and funtion menus, see* ***See Section 23 – IQ Display Module (IQDM) Series 2 And IQDM-P Diagnostics.*** .

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 mounted under the dash panel.
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.

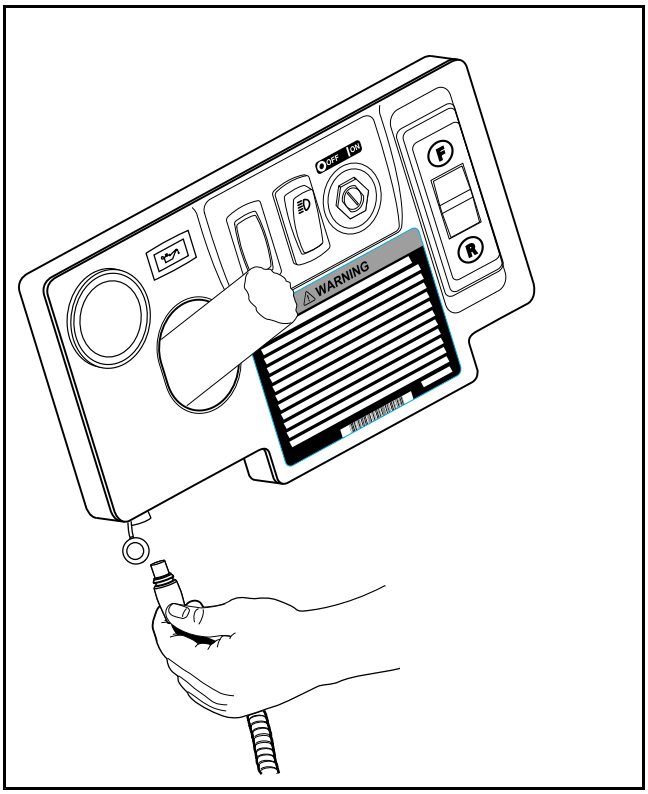


Figure 29-1 IQDM Jack Under Dash Panel

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 29-2, Page 29-3)**. 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 by pressing + or -.

The following parameters can be programmed with the handset from the *program* menu:

NOTE: *M1 refers to "Mode 1" and M2 refers to "Mode 2." To activate Mode 2 in the IQDM-P Series 2, Code A, Code B and Code C must be entered.* ***See Code A, Code B, and Code C on page 29-4.*** *All settings in Mode 2 are programmed with the same procedues as Mode 1.*

M1/M2 SPEED

The vehicle's top speed can be changed by selecting values 1 through 4. **See chart below.**

SPEED SETTING	VEHICLE SPEED
1	8.0 mph (12.9 km/h)
2	12 mph (19.3 km/h)
3	15 mph (24.1 km/h)
4	17 mph (27.4 km/h)

A vehicle programmed for 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.

M1/M2 FAST ACCEL

M1/M2 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.

M1/M2 PEDAL UP

Three options exist for *M1/M2 pedal up* (motor braking). On a level surface, when the accelerator pedal is released, motor braking will slow the vehicle to a stop 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.
When the vehicle is going down an incline, and the accelerator pedal is released motor braking will slow the vehicle to a controlled speed directly proportional to the slope of the incline when pedal up motor braking is enabled (option 1 or 2). If pedal up motor braking is disabled (option 0), the vehicle will coast up to the programmed top speed when the pedal is released.
Change the settings of the M1/M2 Pedal Up by pressing + or – on the change value button.

M1/M2 PEDAL UP 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

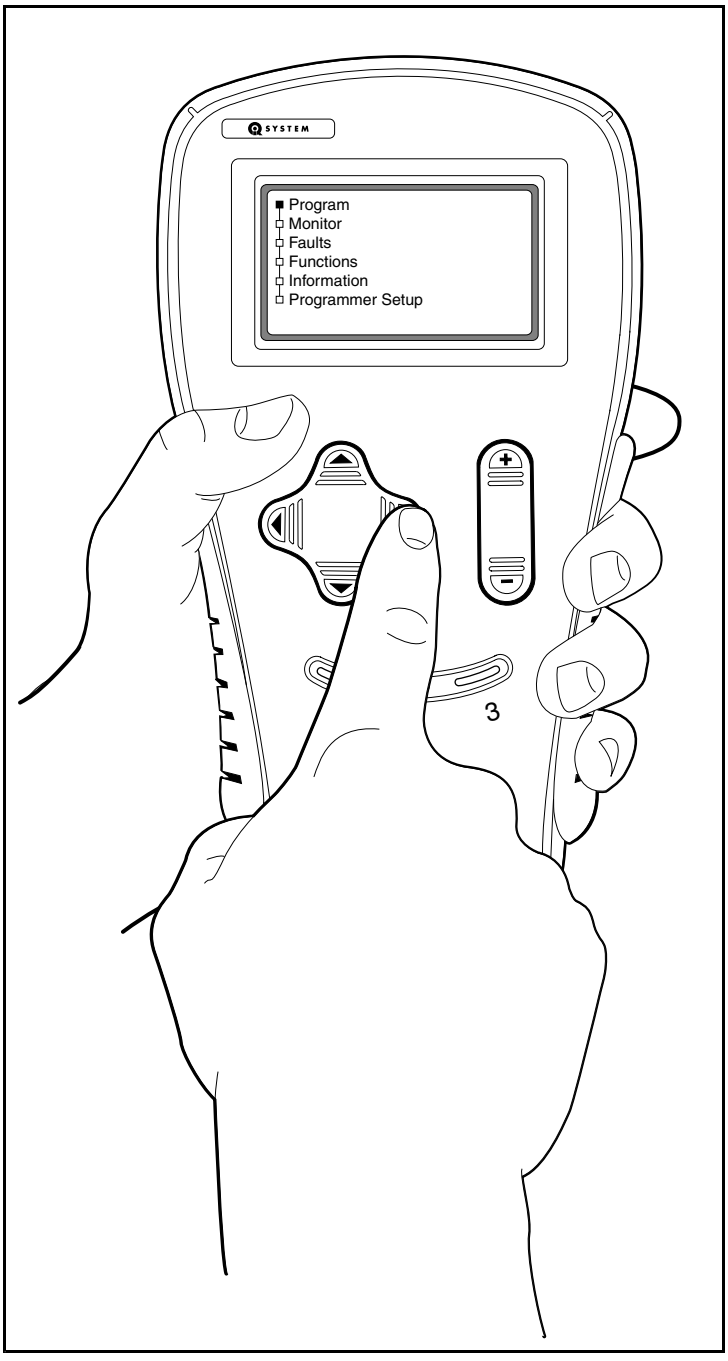


Figure 29-2 Access Program Menu

M1/M2 SPEED CAL

The *M1/M2 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 approximately 0.1 mph (0.2 km/h). The top vehicle speed will be determined by the *M1/M2 speed* menu item and the speed calibration setting. For example, if the speed setting is set for a value of 3 (15.0 mph (24.1 km/h), and the speed calibration is set for 5, the total top speed of the vehicle should be approximately 14.5 mph (23.3 km/h). See the table below for a list of possible approximate speed calibrations.

TABLE CONTINUED ON NEXT PAGE

M1/M2 Speed Cal	Speed Setting			
	1	2	3	4
0	8.0 mph (12.9 km/h)	12.0 mph (19.3 km/h)	15.0 mph (24.1 km/h)	17.0 mph (27.4 km/h)
1	7.9 mph (12.7 km/h)	11.9 mph (19.2 km/h)	14.9 mph (24.0)	16.9 mph (27.2)
2	7.8 mph (12.6 km/h)	11.8 mph (19.0 km/h)	14.8 mph (23.8 km/h)	16.8 mph (27.0 km/h)
3	7.7 mph (12.4 km/h)	11.7 mph (18.8 km/h)	14.7 mph (23.7 km/h)	16.7 mph (26.9 km/h)
4	7.6 mph (12.2 km/h)	11.6 mph (18.7 km/h)	14.6 mph (23.5 km/h)	16.6 mph (26.7 km/h)
5	7.5 mph (12.1 km/h)	11.5 mph (18.5 km/h)	14.5 mph (23.3 km/h)	16.5 mph (26.6 km/h)
6	7.4 mph (11.9 km/h)	11.4 mph (18.3 km/h)	14.4 mph (23.2 km/h)	16.4 mph (26.4 km/h)
7	7.3 mph (11.7 km/h)	11.3 mph (18.2 km/h)	14.3 mph (23.0 km/h)	16.3 mph (26.2 km/h)
8	7.2 mph (11.6 km/h)	11.2 mph (18.0 km/h)	14.2 mph (22.9 km/h)	16.2 mph (26.1 km/h)
9	7.1 mph (11.4 km/h)	11.1 mph (17.9 km/h)	14.1 mph (22.7 km/h)	16.1 mph (26.0 km/h)
10	7.0 mph (11.3 km/h)	11.0 mph (17.7 km/h)	14.0 mph (22.5 km/h)	16.0 mph (25.7 km/h)
11	6.9 mph (11.1 km/h)	10.9 mph (17.5 km/h)	13.9 mph (22.4 km/h)	15.9 mph (25.6 km/h)
12	6.8 mph (10.9 km/h)	10.8 mph (17.4 km/h)	13.8 mph (22.2 km/h)	15.8 mph (25.4 km/h)
13	6.7 mph (10.8 km/h)	10.7 mph (17.2 km/h)	13.7 mph (22.0 km/h)	15.7 mph (25.3 km/h)
14	6.6 mph (10.6 km/h)	10.6 mph (17.1 km/h)	13.6 mph (21.9 km/h)	15.6 mph (25.1 km/h)
15	6.5 mph (10.5 km/h)	10.5 mph (16.9 km/h)	13.5 mph (21.7 km/h)	15.5 mph (25.0 km/h)
16	6.4 mph (10.3 km/h)	10.4 mph (16.7 km/h)	13.4 mph (21.6 km/h)	15.4 mph (24.8 km/h)
17	6.3 mph (10.1 km/h)	10.3 mph (16.6 km/h)	13.3 mph (21.4 km/h)	15.3 mph (24.6 km/h)
18	6.2 mph (10.0 km/h)	10.2 mph (16.4 km/h)	13.2 mph (21.2 km/h)	15.2 mph (24.5 km/h)
19	6.1 mph (9.8 km/h)	10.1 mph (16.3 km/h)	13.1 mph (21.0 km/h)	15.1 mph (24.3 km/h)
20	6.0 mph (9.7 km/h)	10.0 mph (16.1 km/h)	13.0 mph (20.9 km/h)	15.0 mph (24.1 km/h)
21	5.9 mph (9.5 km/h)	9.9 mph (15.9 km/h)	12.9 mph (20.8 km/h)	14.9 mph (24.0 km/h)
22	5.8 mph (9.3 km/h)	9.8 mph (15.8 km/h)	12.8 mph (20.6 km/h)	14.8 mph (23.8 km/h)
23	5.7 mph (9.2 km/h)	9.7 mph (15.6 km/h)	12.7 mph (20.4 km/h)	14.7 mph (23.7 km/h)
24	5.6 mph (9.0 km/h)	9.6 mph (15.4 km/h)	12.6 mph (20.3 km/h)	14.6 mph (23.5 km/h)
25	5.5 mph (8.9 km/h)	9.5 mph (15.3 km/h)	12.5 mph (20.1 km/h)	14.5 mph (23.3 km/h)
26	5.4 mph (8.7 km/h)	9.4 mph (15.1 km/h)	12.4 mph (20.0 km/h)	14.4 mph (23.2 km/h)
27	5.3 mph (8.5 km/h)	9.3 mph (15.0 km/h)	12.3 mph (19.8 km/h)	14.3 mph (23.0 km/h)
28	5.2 mph (8.4 km/h)	9.2 mph (14.8 km/h)	12.2 mph (19.6 km/h)	14.2 mph (22.9 km/h)
29	5.1 mph (8.2 km/h)	9.1 mph (14.6 km/h)	12.1 mph (19.5 km/h)	14.1 mph (22.7 km/h)
30	5.0 mph (8.0 km/h)	9.0 mph (14.5 km/h)	12.0 mph (19.3 km/h)	14.0 mph (22.5 km/h)

CODE A, CODE B, AND CODE C

NOTE: *Smartkey: Mode 2 and Code A, Code B, and Code C are available as part of the Smartkey option. The Smartkey feature is available as a factory option, or as a field kit (102962602 Kit, Field, Smartkey) and can be ordered from Service Parts.*

The code entries are used to activate Mode 2 (M2) functions in the Program Menu. Each vehicle has a unique code for placing the vehicle in this mode.

Once activated, Mode 2 settings can be programmed using the same procedures as Mode 1 settings. This allows the vehicle to be customized to perform according to which mode it is operated in. For more information on this feature, contact your local Club Car distributor or dealer.

To activate Mode 2:

1. Enter Code A, Code B, and Code C.
2. Turn the Tow/Run switch to Tow.
3. Wait 30 seconds.
4. Turn the Tow/Run switch to Run.
5. M2 options will now appear in the Program Menu. **See Program Menu on page 29-2.**

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

U

V

W

Your Comments Are Appreciated

Contact Information (Optional):

Name: _____
Title/Company: _____
Address: _____
_____
City: _____ State: _____ Zip: _____
Phone: _____ Fax: _____
E-mail: _____

I am:

- ☐ Distributor/Dealer
- ☐ Individual Owner
- ☐ Club Car Associate/Representative
- ☐ Technician
- ☐ Golf Course Superintendent
- ☐ Other: _____

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

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