SERVICE MANUAL

First Edition

1998 SOLECTRIA FORCE

Electric 4-Door Sedan With Lead Acid Batteries

Nominal System Voltage: 156V

Charger: BC3300 (3.3kW/240VAC)

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FORCE DESCRIPTION AND SERVICE GUIDELINES

This section contains a description of the 1998 Solectria Force and its major features. For operating information, refer to the 1998 Solectria Force Owner's Manual.

Please read the section entitled **Standard Practices For Working On or Near High Voltage Systems** before servicing any vehicle.

For complete servicing description, see specific procedures in the text.

Vehicle Layout

The Solectria Force operates at a nominal battery voltage of 156V DC. The exact voltage level of the battery in any Force depends on the vehicle's state-of-charge. The battery modules are split between a front and a rear battery box, located under the hood in the motor compartment and in the trunk.

A high-amperage fuse is located in both front and rear battery boxes. The high voltage system is completely isolated from the vehicle chassis. The chassis is not electrically connected to the positive or negative side of the battery. The chassis is grounded to the AC ground whenever the vehicle is plugged in to be charged. In spite of these safety features, there is a remote possibility that a closed circuit could be formed as a result of a short circuit to the vehicle chassis.

Therefore, extreme care must be taken when handling any high voltage cables so as not to form a short circuit to the vehicle chassis or other potentially live wires.

The Solectria electric drive system includes a 3-phase AC induction drive motor that is coupled to an automatic transmission. An associated motor controller receives electric power from the self-contained battery pack. The motor controller is located in the motor compartment on top of the front battery box. The controller converts direct current (DC) electric energy to 3 phases of alternating current (AC) electric energy to operate the motor. The motor compartment also contains the air conditioning system (if provided) and the DC/DC converter which supplies 12V DC to the vehicle's accessories.

The battery pack is recharged from any 208-240V AC 60 Hz outlet with the BC3300 battery charger. The charger is located in the trunk on the driver's side of the vehicle. Using the "Emergency Charging Adaptor" your Force can be charged with 110V AC in an emergency. It is very important that this option is used only for emergencies and not on a routine basis. If this option is used frequently, the life span of the battery pack will decrease. **All major components are electrically connected to the battery pack and have high voltage labels. Use due caution when servicing.**

The Force wiring follows certain conventions. In all DC circuit wiring, the red wire is always positive. If neither wire is red, the lighter colored wire is positive. In AC

circuitry, the black wire is hot, and ground is green. Packard and small gray Anderson connectors are low voltage (12-V DC); Deutsch, red Anderson and large gray Anderson connectors are high voltage. Molex connectors can have both low and high voltage. Familiarize yourself with these connectors and their uses, as shown in the connector diagrams at the end of this manual.

High Voltage DC Systems (nominal 156 V DC)

- (13) 12-Volt gel cell battery modules
- High Voltage Fuse Box
- Amp-Hr Shunt
- AH100 Amp-Hr Meter & Control Box
- AMC 325 42kW motor controller
- AC GTX20 drive motor
- DC-DC Converter 575W, 12 V
- Heater
- Heater Relay
- DC 30 A/C Compressor Motor Controller
- A/C Compressor Motor
- BC3300 Charger
- High voltage wiring and connectors
    - 2-pin gray Deutsch connector
    - 3-pin gray Deutsch connector
    - 4-pin gray Deutsch connector
    - 2-pin red small Anderson connector
    - 2-pin gray large Anderson connector
    - 2-pin white Molex
    - 4-pin white Mini-Molex connector
    - 6-pin white International Molex connector

Low Voltage DC Systems (12 V DC)

- Low Voltage Fuse Box
- Vacuum Pump
- Vacuum Switch
- IB Ignition Box
- Amp-Hr Meter Display
- Regenerative Braking Wiring
- Reverse Light Wiring
- Drive Motor Cooling Fan
- Drive Motor Temperature Sensor
- Rear Battery Box Cooling Fan
- Low Voltage Connectors

- 1-pin black Packard
- 2-pin black Packard connector
- 3-pin black Packard connector
- 4-pin black straight Packard connector
- 4-pin black square Packard connector
- slide terminal connector

High Voltage AC Systems (240 V AC)
(These AC systems are "live" only when the vehicle is plugged in.)

- Charging Outlet
- AC junction box
- Battery Thermal Management System
- BC3300 Battery Charger (input side)
- Preheat computer and harness (optional)

Safety

The Force contains various systems for operator and service personnel safety:

The car will not drive if it is plugged in.

The car will not drive if the Range-Power Selector is set to Forward or Reverse when the ignition key is turned on (for safety, Range-Power Selector must be set to OFF position when ignition key is turned on).

All high voltage DC components except the controller and the charger are fused at the main DC fuse box. Chargers are fused in-line in the trunk.

Battery thermal management and the optional cabin preheat system, which operate on AC, are fused at the AC junction box in the trunk (Note: Cars equipped with a BC1600 charger do not use an AC junction box as they are internally fused in the charger.)

Each battery box is independently fused to open and disable the high voltage circuit during overcurrent conditions. These high-amperage fuses are located inside each of the battery boxes.

The batteries in the Force are completely isolated from the car chassis to prevent the possibility of electrical shock or current leakage to the car. However, there is still a remote possibility that a closed circuit could be formed by a subset of battery modules as a result of short circuiting to the car chassis or other conductors during a severe accident.

Extreme care must be taken when handling any high voltage cables so as not to short circuit the battery to the vehicle chassis or other potentially live wires or terminals.

Unless two separate and isolated locations of the high voltage system at different electrical potentials are touched simultaneously, there is no hazard for shock. Nevertheless, exposed electrical cables should be treated with caution, and assumed to carry high voltage regardless of the gauge of wire.

Battery Information

The lead acid batteries used in Solectria vehicles are sealed, starved-electrolyte lead acid. The starved-electrolyte batteries will not spill significant amounts of electrolyte, even if the modules are broken in two. However, any clear fluid leaking from a Solectria vehicle should be treated as electrolyte with the potential for corrosion.

Avoid contact with the skin or inhaling fumes. Wear acid/base resistant rubber gloves, rubber boots, and protective clothing and stay up-wind. Dilute the spill with large amounts of water. Sodium bicarbonate (baking soda) may also be used cautiously to neutralize any electrolyte spills.

Disabling the Vehicle

The Force is virtually silent when turned on. The absence of noise or motor "running" sounds does not indicate that the vehicle is disabled.

Servicing the Car - Emergency Procedures

To secure the car, set the parking brake firmly by lifting the standard hand-operated brake lever between the front seats. An alarm will sound if the parking brake is not set when the key is turned off. Turn the Range-Power Selector, located on the floor console, to the OFF setting to prevent the vehicle from being driven.

Turn the key off, as you would in a conventional vehicle, to shut off the motor controller, thereby disconnecting the motor, and disabling most vehicle accessories. (Note: When the key is turned off and removed, the steering wheel will lock. To unlock the steering wheel, the key must be inserted and turned to the first *accessory* position).

To isolate accessories: To disconnect all high voltage electricity from all auxiliary systems (such as air conditioning, Amp-Hour Meter, heat, and the 12-volt DC-DC converter), disconnect the small, red one-pin Anderson Service Disconnect located between the large gray Anderson connector to the controller and the high voltage fuse box on the passenger side, front strut tower.

With this connector unplugged and the motor controller turned off (key off), the electrical power of the car is isolated to the battery boxes, the controller, the charger and the connector.

All high voltage and low voltage power to the vehicle is thus disabled and no systems or accessories on the vehicle will operate except the charger. **The charger can be disabled by disconnecting the small black one-pin Anderson connector under the high**

voltage fuse box, or simply unplugging the charger output wires (2-pin red Anderson connector).

Although turning the key to the off position will disable the motor controller, the controller can also be disconnected manually, if necessary, by disconnecting the large gray 2-pin connector located on the upper transmission support beam.

WARNING!

Note that each Solectria component under the hood and in the trunk may store electricity in capacitors for some time even after being disconnected from the battery. Therefore, exposed conductors should always be treated with caution.

To isolate batteries: **Before removing any battery interconnect wires, the red one-pin Anderson Service Disconnect must be unplugged, the input to the controller must be unplugged, and the charger output wires must also be unplugged.**

Once these operations are completed, all high voltage and low voltage power to the vehicle will be disabled. Note that each electronic box under the hood and bed may hold a charge for some time in capacitors even after being disconnected from the battery. Exposed conductors from these units should be treated with caution.

Following the procedure above for disabling the vehicle should make the vehicle "safe" while servicing it. For operator safety, battery boxes should be opened only by trained service personnel. Also, electrical cables should never be cut. Cutting cables presents additional safety problems, and is not recommended by Solectria. Failure to follow these guidelines could lead to serious injury.

Vehicle fires: Spray vehicle fires with dry chemical or carbon dioxide foam (ABC or BC extinguishers). In general, battery boxes should not be opened. However, if there are indications that a battery module is smoldering or heating up after an accident or fire, disconnecting the smoldering battery pack should eliminate the problem. **Follow the directions in the previous paragraph for isolating the battery pack.** To disconnect individual batteries, refer to the specific procedure in the text. As stated above, cutting cables and opening battery boxes create additional hazards that are best avoided if possible.

ADDITIONAL SERVICE INFORMATION

The 1998 Chevrolet Metro Service Manual (not included with this manual but available through a local CHEVROLET dealership) should be consulted for service information on all parts of the Solectria Force, except for the following parts:

- Electric Drive System (motor, controller, transmission)
- Batteries
- Solectria Electronic Components
- Heating and Air Conditioning system
- Solectria - installed wiring

SERVICE NOTES

1. The diagnostic connector for the Chevrolet Metro is inoperative on the Solectria Force.
2. Replacement rear coil springs must be ordered from Solectria Corporation. They are not interchangeable with the standard springs.
3. For safety, always remove the ignition key from the steering column before performing service work on the car. Unplug the vehicle from the wall outlet when changing out electronic components. **Solectria electronic components are not user serviceable. Any attempt to service components will void all warranties.**
4. Disconnect all Solectria components which are connected to the batteries if you attempt any fast charging of the batteries or if using a non-Solectria Battery Charger unless installed by Solectria. **FAILURE TO DO SO WILL VOID ALL WARRANTIES.**
5. **Lifting vehicle:** If using a lift, use factory recommended lifting points (i.e. reinforced sections of rocker panel). If using a floor jack, position jack under center of reinforced section of sub-frame just forward of front battery box.

WARNING!
Do NOT position jack directly under battery box, or attempt to lift vehicle from any point on the battery box!

Using a floor jack at the rear, position floor jack under center reinforced section of sub-frame between lower control arms. Position jack stands safely under vehicle at reinforced sections of sub-frame and apply parking brake, or chock wheels.

6. **Towing:** Solectria recommends towing the vehicle with the front wheels on a dolly or carrying it on a flat bed vehicle. If you must tow with the front wheels (i.e., drive wheels) on the ground, never leave the key in the ON position and the regen disable switch in the DRY position. **Regenerative breaking is enabled with the key ON and this could cause a high towing load and the batteries to be severely overcharged.** If you must tow in this manner, the regen disable switch must be set to the SLIPPERY position and the key turned OFF. **SEE "TOWING INSTRUCTIONS" IN APPENDIX C.**
7. **Washing**: Solectria does not recommend washing this vehicle in an automatic carwash.

STANDARD PRACTICES FOR WORKING ON OR NEAR HIGH VOLTAGE SYSTEMS

1. Always use safety glasses. Remove all jewelry, such as watches, rings, bracelets, and necklaces.
2. No tools with exposed metal over 2" long are allowed in work area. Heat shrink metal tools over 2" long.
3. Keep all tools away from or below high voltage areas. Keep tools in a tool caddy, toolbox, pants pocket, or floor, not on vehicle surfaces.
4. Use a fender protector pad whenever working on the car.
5. Use only your right hand when working with high voltage. Put your left hand in your pocket. Never use jumper clips or touch anything to live plugs/batteries except when using a voltmeter.
6. Use a voltmeter to check voltages and polarity before making any connection of components. (Make sure voltmeter is not set to measure current, and leads are connected to correct positive and negative jacks on meter.)
7. Unplug the red, 1-pin Anderson Service Disconnect before removing a live device. (If the vehicle is not fully charged when you begin working on it, leave a note on the Amp-Hour counter with the reading before disconnecting it.) Always unplug vehicle from wall outlet while servicing.
8. Do not use fuses to connect or disconnect accessories. If you are installing an air conditioner controller or fuse, for example, follow these steps:
   - •turn ignition key off
   - •check the Amp-Hour counter and put a post-it note on the meter with the reading
   - •disconnect 110VAC or 220VAC charging cord (gas cap) or other charger
   - •disconnect the red 1-pin Anderson Service Disconnect
   - •verify that the Amp-Hour counter has no power (no display should be visible)
   - •install the controller or fuse
   - •reattach the red connector and check that the Amp-Hour meter reads 00.00
   - •plug charger cord into wall outlet
9. When servicing batteries, <u>always</u> isolate the battery pack from other components before removing any battery interconnects. <u>Always</u> work on only one battery terminal at a time. <u>Never</u> allow another person to touch any other part of the battery pack while you are working on it. **ONE PERSON ONLY!!**
10. Do not use any piece of test equipment unless you have been trained and you fully understand and accept its operation. **UNDER NO CIRCUMSTANCES SHOULD TESTING RIGS OR USE OF THEM DISOBEY ANY OF THE ABOVE RULES!**

DRIVE MOTOR TRANSMISSION ASSEMBLY

MOTOR AND TRANSMISSION

The drive motor is a 3-phase AC induction motor, located in the rear of the motor compartment behind the battery box, and coupled to the transmission. The motor and transmission are removed from the vehicle as a unit. There are no user serviceable parts in the motor; however the bearings should be checked every 50,000 miles. Please notify Solectria when this mileage is reached.

The automatic transmission is a single-speed gear reduction drive with an integral differential. The transmission oil level should be checked at every periodic maintenance.

Checking Transmission Oil Level

1. Turn ignition key off and set parking brake. To check oil level, look at the sight glass located on the driver's side of the transmission forward of the half shaft. The oil level should be visible in the glass. The vehicle must be level to get an accurate reading.
2. If the sight glass is not half full, it is necessary to add transmission oil. To add transmission oil, remove filler plug. Filler plug is located at the top of the transmission just below the vent.
3. Using a **clean** funnel add oil until fluid level fills half the sight glass. Use Dextron III ATF oil. Reinstall filler plug.

Changing Transmission Oil

After the first 6,000 miles of operation and every 12,000 miles thereafter, the transmission oil should be replaced.
It is preferable to drive the vehicle first to warm the gearbox. Raise the vehicle following the lifting instructions under **Additional Service Information.**

1. Turn ignition key off and set parking brake. The belly pan must be removed in order to access the transmission drain plug. Remove the two 5/16 bolts at the belly pan bracket. Snip the two tie-wraps at each forward corner. Remove the Phillips screw at the center bottom bracket on the front bumper. Slide the belly pan backward and out while pulling down on the lower bumper lip.
2. Put a drain pan under the transmission, then remove the drain plug located on the bottom of the transmission to drain the oil.
3. Clean drain plug. Solectria recommends using LOCKTITE Pneumatic Hydraulic Seal 545. Then, re-install the drain plug. Torque to 15ft.-lbs. DO NOT OVERTIGHTEN.
4. Allow sealer to set approximately 15 minutes before adding transmission oil.
5. To add transmission oil, remove filler plug. Filler plug is located at the top of the transmission just below the vent. Using a clean funnel, add approximately 1 quart of Dextron III ATF (Automatic Transmission Fluid).
6. Reinstall filler plug and check for leaks. Reinstall belly pan with new tie-wraps.

Replacement of Motor/Transmission Assembly

Note: Do NOT lower vehicle without drive axles installed. If you must move the vehicle, each of the front wheel bearings may be supported with a 9/16" bolt and nut and two 1¾" washers.

1. Turn ignition key off and apply parking brake.
2. Loosen the axle nuts at the front wheels. Raise the front of vehicle and support on stands so that the front suspension hangs free.
3. Remove the belly pan.
4. Drain the transmission oil. See **Changing Transmission Oil**.
5. Remove the front wheels and remove ball joint-pinch bolts.
6. Loosen sway bar link retaining nuts from lower control arms.
7. Pull lower ball joints from steering knuckles.
8. Pry drive axles out of transmission using a large screw driver taking care to avoid damaging the seals.
9. Pull steering knuckles away from axles, and remove the axles from the vehicle.
10. Pull back the boot from the speedometer cable end where it enters the transmission: it is above the lower support beam at the bottom of the firewall. Remove the clip and pull the cable straight out.
11. Remove the vent tube from the hole in the frame rail under the master cylinder.
12. Remove the controller from the vehicle as outlined in the motor controller removal procedure.
13. Remove the gray motor speed sensor cable from the firewall by detaching the harness clamps located along firewall. Coil the wire harness and lay it on top of motor to keep it out of the way- it will be removed with the motor. A tie-wrap or rubber band can help make this procedure easier.
14. Unplug the two 12V wire harness connectors at the firewall from the motor cooling fan and the motor temperature sensor.
15. To remove the upper support beam, remove the two 1/4 - 20 bolts holding the remaining half of the large gray Anderson connector. Remove the center through bolt at the rubber motor mount. Remove two 3/8 bolts from each end of the beam. Remove the beam and the motor mount as a unit. The motor/transmission can lean on the front battery box.
16. Remove the two Phillips screws attaching the motor cooling fan housing to the motor and carefully tilt it up and off the motor. The drivetrain will not clear the fuse box with the fan on.
17. Re-insert the through bolt at the upper motor mount bracket and attach a suitable lifting device to it. Put slight tension on it. (Lifting fixture may be made or purchased from Solectria.)
18. Underneath, remove the two ½" x 3¾" bolts connecting the lower support beam to the transmission "bat wings." Now carefully lift the drive train out of the vehicle.

Motor/Transmission Installation

Installation is the reverse of removal. The spacers on each lower through bolt are 3/4 inch thick. These spacers may be a stack of 6 washers or ¾" round aluminum spacers. Be sure to clean, seal and tighten the transmission drain plug before adding fluid (1 quart capacity).

When inserting the speedometer cable, align the tab on the speedometer cable end with slot in the speedometer drive gear. Push the speedometer cable in and insert the securing clip in the slot of the cable end. Do not secure the clip over the edge of the cable end. If this occurs it will bind and break the cable.

Be sure to clean and grease drive shaft splines and seal surfaces before installing. Carefully inspect shafts for damage to CV boots, spindle threads, or internal spring clips on the inner joint spline which holds the drive shaft into the transmission.

AC Induction Motor Junction Block Replacement

1. Remove the motor junction box cover and gasket.
2. Mark the wires at each terminal and note their position. Remove the stud nuts, washers, and wires.
3. Remove the two M-6 screws holding the junction block to the motor plate and lift out the block along with the two spacer nuts between the block and the plate.
4. Install new block and spacer nuts.
5. Install one flat washer on each stud, then the appropriate two motor wires on each stud, making sure the wire lugs seat properly (they should be at a 45° angle to each other). Install another flat washer and the thin nut and torque to 90 in.-lbs. Do NOT apply ANY side force to the nut or stud; use a 13 mm deep socket and support it with your hand. All washers and nuts must be brass for proper electrical conductivity.
6. Install the controller wires, a flat washer, and apply a small amount of 242 Locktite© to the nut only. Install the nut and torque it to 120 in.-lbs., again being careful to support it.
7. Install the gasket and cover.

BATTERY PACK

The battery pack consists of thirteen (13) 12-volt deep-cycle starved electrolyte lead acid batteries. The batteries are located in two boxes. There are five batteries located in the front battery box, and eight batteries located in the rear battery box. ***See Appendix B for front and rear battery box diagrams.***

WARNING!

The battery electrolyte is a sulfuric acid paste. Even though the vehicle is equipped with sealed batteries, you should always wear safety goggles or a face shield and rubber gloves when servicing a battery. The batteries may carry acid on the surface of the battery which will damage clothing. Solectria recommends wearing a chemical apron.

Do not place tools in the battery box or in a place where they may fall into the battery box. A fire or explosion hazard may occur if a wrench or other metal object is placed inside a battery box. Wear safety glasses or face shield to protect eyes from flaming bits of molten metal. Maintain a set of insulated tools for battery work.

Keep casual observers and extra helping hands away from the battery terminals. If not wearing safety glasses, keep observers away from the vehicle.

Refer to front of manual for additional safety precautions.

To Gain Access to the Rear Battery Box

To gain access to the batteries, lower rear seat back and pull carpet and foam from the trunk floor. Remove ¼"-20 bolts from the rear battery box cover and lift it off. Make a sketch showing the arrangement of the insulation pieces, and set these pieces aside.

To Gain Access to the Front Battery Box

If vehicle is equipped with A/C **the hose connections for the air conditioning unit must not be disconnected for this procedure**. The removal procedure is as follows:

1. Turn ignition key off and set parking brake. Unplug the air conditioning drive motor.
2. Remove three ¼"-20 cap nuts from the air conditioning drive unit mounting plate.
3. Lay the A/C drive unit assembly upside down on the front bumper. Be sure to use a thick foam block to support the compressor assembly on the bumper, so as not to stress the hoses or damage the vehicle.
4. Disconnect the main battery plug (large gray 2-wire Anderson connector) from the motor controller. Disconnect the 4-pin, 2-wire black Packard connector for re-regen brake light activation that runs along the Anderson connector.
5. If the vehicle is equipped with metal mesh over the red, white and blue motor power cable, remove it by cutting the two tie-wraps and unzipping the black zipper.
6. Disconnect the motor connector (large red, white and blue 3-wire connector) from the controller.

7. Remove the four 1/4 - 20 nuts at each corner at the motor controller.
8. Undo the tie-wraps at the harness junction near the driver's side strut tower and disconnect the 25-pin (ignition box) and 9-pin (motor speed sensor) connectors located behind the DC-DC converter. The tie-wrap on the strut tower is releasable and reusable.
9. Remove the controller and set it in a safe place. It should not be dropped or allowed to tip over.
10. Remove the ¼"-20 bolts (and the 4 rubber A/C mounts, if so equipped) on the perimeter of the battery box cover and lift it off. To remove, bend along the long dimension, then "roll" out from under hood by holding cover while it is slightly bent. The battery box cover is fairly flexible.
11. Make a sketch showing the arrangement of the insulation pieces, and set these pieces aside.

Checking Battery Condition

If the range performance of the car following a full re-charge has been declining, perform a discharge test.

An automatic battery discharger unit is available from Solectria Corporation (please contact us for pricing and availability). This unit greatly simplifies performing a battery discharge test, however, the test can also be performed manually (see Field Discharge Test instructions below).

In either case, the following tools are needed:

- Voltmeter
- Pair of wire cutters
- Small slotted screw driver
- 7/16 " socket
- Medium extension
- Ratchet
- Tie wraps

FIELD DISCHARGE TEST

1. Completely recharge the battery pack. See definition of Fully Charged on next page.
2. Get from the driver the Amp-Hour reading at which the vehicle begins to experience a decline in performance. This will allow you to plan ahead and not run out of energy during the test. Choose a local driving loop near your service facility for this test. When new and fully charged, the 156V car should be able to achieve at least 45Ah on the Amp-Hour Meter. The battery performance can be expected to decrease gradually over time.
3. If the vehicle is equipped with an optional ammeter, drive the car keeping the Range-Power selector set to Econ/MaxRange throughout this procedure. Using the optional onboard voltmeter as a guide, continue to drive the car until the voltage drops to 135

volts and the maximum current available is less than 50 Amps, or until the car will not maintain 30 mph on a level road.

4. When the above conditions are met, bring the car into the work area, set the Range-Power Selector to OFF, set the parking brake, leave the key ON, and turn on the vehicle's high beams and turn on the heat with the fan on high.
5. Quickly open both the front and rear battery boxes.
6. Feel the batteries in each box. **They should be at room temperature or slightly above room temperature.** If the vehicle has been parked outside in cold weather and properly charged, yet the batteries in one or both boxes feel cold, the vehicle may have low range. The battery thermal management system must be evaluated at this point. See "Checking Thermal Management" in Section II of the Troubleshooting Guide at the end of this manual.
7. Number each battery according to the Front Battery and Rear Battery diagrams.
8. Check each battery's voltage with a reliable voltmeter while keeping the accessories on. Record these numbers on a chart. **(See Battery Discharge Test Sheet).** You should stop the test when 4 of the batteries are below 10.5 volts. Any battery that tests less than 10.5 volts before reaching 45 amp-hours should be replaced.

WARNING!

FAILURE TO OBSERVE THE FOLLOWING INSTRUCTIONS MAY DAMAGE NEW BATTERIES

After locating the bad battery or batteries, mark these with a waterproof marker (to identify the bad ones you can write on the battery the mileage, date and reading on the Amp-Hour Meter when the voltage dropped below 10.5 Volts). **DO NOT REMOVE THE BATTERIES AT THIS TIME!**

Place the insulating foam and covers back on the battery boxes to maintain a temperature that the charger will recognize as valid. Completely recharge the entire battery pack first, before removing the bad batteries.

Once the whole pack has been completely recharged, you can remove the bad batteries and replace with new FULLY CHARGED one(s).

If you are not replacing the entire pack of batteries, trickle charge the new batteries separately overnight (in parallel, positive to positive, negative to negative) using a power supply set at 13.8-14.2V.

It is very important to make sure the battery pack is fully charged before removing or installing new charged batteries. This ensures that all batteries are at the same level of charge when they are used and prevents battery imbalance.

PLEASE BE SURE THAT ALL SERVICE PERSONNEL RECEIVE THIS NOTICE BEFORE BEGINNING WORK ON BATTERIES!

Definition of "Fully charged"

The Solectria Force is equipped with Sonnenschein lead acid batteries which are defined as being at a full state of charge (S.O.C.) once the Battery Charger has supplied the batteries with a 10% overcharge. This means that when the batteries are finished re-charging, the Amp-Hour Meter should read a negative value corresponding to 10% of the Amp-Hours obtained in the discharge test.
For example, if the discharge test Amp-Hour Meter reading is about 43.00Ah, following a full recharge, the Amp-Hour Meter should reading should be about -04.30 Ah *Calculation: 43.00 x(-0.10) = -4.30*

Note: These numbers are approximate. The actual overcharge percentage will vary, but should be about 10%.

The time needed to achieve a fully charged condition is dependent on the type of Battery Charger and the age of the battery pack.

Battery Removal

WARNING!

ALWAYS USE ON-BOARD CHARGER TO FULLY RECHARGE ENTIRE BATTERY PACK BEFORE REMOVING ANY BATTERIES!

- Batteries are connected in series for a total pack voltage of 156V DC, a potentially lethal source of electricity.
- To avoid shock, use rubber insulating gloves and wear eye protection when handling battery terminals.
- Always work on only one terminal at a time.
- Never allow another person to touch a terminal at the same time as you. This will create a high voltage current through the body of the vehicle on which you are leaning.
- Use insulated hand tools. These can be made inexpensively using shrink wrap or electrical tape.
- The battery pack must be completely isolated from all other components BEFORE disconnecting any one battery terminal.

1. Unplug vehicle from wall outlet. Disconnect 110VAC or 220VAC charging cord from gas cap plug.
2. Document the reading on the Amp-Hour Meter (should be zero or a negative number).
3. Unplug the 1-pin red Anderson Service Disconnect between the fuse box and the large gray Anderson connector to the motor controller. This will cause the Amp-Hour Meter to go blank and will also isolate all the auxiliary electrical components **except the charger**.
4. Unplug the black one-pin Anderson connector hidden underneath the fuse box. This will isolate the charger on the negative side as it is connected directly to the battery pack on the positive side through an in-line fuse near the rear battery box. Or, you can unplug the charger output wires: 2-pin red Anderson Connector.
5. Unplug the large gray Anderson connector to the motor controller (if the controller is still in the vehicle).
6. For safety sake on all battery removal jobs, disconnect and remove a battery interconnect cable in rear battery pack (preferably the wires between batteries #6 and #7).
7. For protection in front battery box, first disconnect two short interconnect wires (between batteries #1 and #2 and between #4 and #5).

8. If any cable needs to be disconnected in order to remove any battery, it must be completely removed. Do not disconnect one end of a cable and leave the other end connected, except in the case of:
   a. the interconnect cable coming from the rear battery box to battery #5 in the front.
   b. the main cable from the fuse box to battery #1 in the front.
   c. the main positive cable to battery #13 in the rear.
   d. the cable from the negative terminal of battery #6 in the rear.

   For these wires, once they have been removed from the battery terminal, tape up the live ends carefully with electrical insulation tape.
9. In the front battery box, to remove battery #1, battery #2 must be removed and the 'bad' battery must be slid to the position of #2 to be removed. If battery #5 is bad, battery #4 should be removed first. (Note: If the car has air conditioning, be careful not to hit the condenser while removing batteries.) ***See Appendix B for front battery box diagram.***
10. Be sure to write down the location of the insulation pieces inside the battery boxes before removing batteries. Vacuum the floor of the battery box, making sure it is free of all debris before installing batteries.
11. Before connecting any terminals confirm the physical placement of the positive and negative terminals agree with the battery layout diagram and the polarity of each battery is correct. Once the defective batteries have been replaced, properly torque all terminals to approximately 10 ft-lb. **Proper torque is achieved by using two wrenches close together so as not to twist or apply any load to battery terminals.** Check the total pack voltage at the gray Anderson connector to the controller. Minimum voltage is 160-170 volts. Check also that the polarity is correct (the connector is stamped + and -). Make sure all tools have been removed from the battery compartment. Secure the battery box covers and reconnect the controller, charger (black Anderson connector), and accessories (red Anderson Service Disconnect) in that order. If the amp-hour counter reads "100.00" instead of "00.00", disconnect the red Anderson connector. Wait 10 to 20 seconds and try again.
12. Plug the vehicle in to top off all batteries. Cycle the batteries gently at least twice by turning on the car's high beams and its electric heater (fan on high), and leaving these on until approximately 30.00 amp-hours have registered on the Amp-Hour Meter (open car windows so heat can exit). Then recharge the vehicle completely.

CAUTION: Do NOT allow pack to discharge appreciably more than 30 amp-hours during its first few cycles. Discharging the batteries more than 30 amp-hours when they are new could cause permanent harm to the pack.

NOTE

- For long life and optimal performance, new batteries must be cycled gently at first for proper conditioning.
- Running the heat to discharge 30.00 Amp-Hours from the pack will take approximately 3 hours.

- It is not necessary to monitor the vehicle continuously during the battery discharge procedure, but remember to check back after 2 or 2 ½ hours to see how the batteries are doing.
- Service personnel should cycle the pack twice to assure proper initial conditioning of the pack. However, the vehicle operator can complete the battery conditioning process while driving. Please advise the vehicle operator as follows.

INSTRUCTIONS TO VEHICLE OPERATOR

How to Condition a New Battery Pack

1. Referring to the optional dash-mounted ammeter or combination voltmeter/ammeter as a guide, drive the car gently, ideally drawing no more than 150 Amps at any one time and consuming less than 20 Amp-Hours total. (If your car does not have an ammeter or voltmeter/ammeter, or to avoid taking your eyes off the road, the same effect is achieved by driving the vehicle with the power selector switch in "ECON/MAXRANGE" or "NORMAL" at all times with few exceptions.)
2. Plug the vehicle in to complete a full charging cycle.
3. Repeat this cycle 10 times. Pack is now conditioned but you may notice an additional improvement in performance as time goes on.

Solectria recommends that new batteries be fully cycled once each 24 hour period, if possible.

Battery Box Fan Replacement

A battery box fan is located only in the rear battery box. It operates automatically on 12V whenever the battery temperature is high enough to warrant its use. Use the following procedure to remove and replace the battery box fan.

1. Turn ignition key off and set parking brake. Unplug vehicle from wall outlet.
2. Fold down the car rear seat. Pull up the carpet and foam from the trunk floor.
3. Remove rear battery box cover.
4. Remove the foil tape which covers the fan at the center front of the battery box.
5. Remove the four Phillips machine screws which hold the fan in place. You can access these between battery #6 and #13.
6. Lift the fan out of the hole, snip the small harness tie, and unplug the connector.

Battery Box Fan Installation

Installation is the reserve of removal. Be sure to zip tie the harness to the fan body. Wiring of this fan is described in the rear battery box diagram. ***See Appendix B for rear battery box diagram.***

ELECTRONIC COMPONENTS

MOTOR CONTROLLER

The motor controller serves as the interface between the battery pack and the drive motor in your vehicle. It does this by changing the DC power coming from the battery pack to AC power to run the motor, and it regulates the energy flow to the motor based on input received via the accelerator pedal and pot-box, the motor speed sensor, and the ignition box.

The motor controller is located in the motor compartment on top of the front battery box. There are no user serviceable parts in the motor controller. The motor controller is air cooled, so the cooling fans should be kept free of debris. ***See Appendix B for diagram.***

Removing Motor Controller

1. Turn ignition key off and apply parking brake.
2. Disconnect the high voltage input to motor controller (large gray Anderson connector).
3. Disconnect regenerative braking signal connector (4-pin, 2-wire black Packard connector).
4. Snip the two tie-wraps on metal mesh over motor power connector (red, white and blue) and unzip mesh. Remove the tie-wraps at the three-phase output connector to motor and disconnect multi-colored connectors.
5. Disconnect the 25-pin (ignition box) and 9-pin (motor speed sensor) connectors located behind the DC-DC Converter. The tie-wrap fixed to the side of the strut tower is reusable.
6. Remove the 1/4 - 20 nuts and washers that secure controller to rubber mounts and lift it off the mounts.

Installing Motor Controller

Installation is the reverse of removal. Be sure to replace any tie-wraps that were cut off. **Be sure the ignition key is still off and park brake is set.**

DC-DC CONVERTER

The DC-DC converter converts 156VDC to 12VDC for the vehicle's 12V accessories. It is located in the motor compartment on the drivers side behind the headlight assembly. Other than the external fuse there are no user serviceable parts. ***See Appendix B for diagram.***

DC-DC Converter Removal

1. Turn ignition key off and set parking brake.
2. Disconnect 2-pin gray Anderson connector (12 volt).
3. Disconnect 3-pin, 2-wire Deutsch connector from the high voltage DC input.
4. Remove the 3/8" nut holding the end attached to the top cross member bolt and the 6mm bolt attaching the bracket to the front condenser support panel.
5. Remove component from vehicle.

DC-DC Converter Installation is the reverse of removal. Be sure replacement unit is correct voltage for vehicle. **Note:** To avoid spark connect high voltage 2-pin Deutsch before the 12V gray Anderson connector. Be sure headlights and other 12V accessories are turned *Off*, and ignition key is *Off*.

ACCELERATOR/BRAKE CONTROLLER (a.k.a. "Pot-Box" or "ABC-1")
Located under the hood on the driver's side firewall, the accelerator/brake controller is actuated by the accelerator cable and feeds a signal to the ignition box (under the dashboard) via a 10-pin cable.

ABC-1 Removal

1. Turn ignition key OFF and set emergency brake.
2. Remove three Phillips screws from the driver's side lower dash panel. Pull out on the upper left corner of the panel only, then slide it left to clear the small tab on the right top corner.
3. Pull the white foam absorber straight out from the knee bolster plate (there are two push clips holding it). Undo the four Phillips screws and remove the plate. The ignition box is now visible to the right of the steering column (the Amp-Hour box is on the left).
4. Release the ignition box from its position (it is attached with Velcro) and pull it out just enough to unplug the 10-pin cable.
5. If the cable has been routed through the firewall on the driver's side, then carefully ease it through the grommet. If it has been routed through the passenger side of the firewall, then do not bother to remove it.
6. Remove the small circlip, plastic washer, and cable end from the ABC arm. Remove the second plastic washer. There is no need to loosen the cable housing from the bracket. Unscrew the 2 cable bracket screws, remove the secondary return spring, and set the bracket and cable assembly aside. Remove the 4 retaining screws from the firewall and remove unit from vehicle.
7. If the cable runs through the firewall on the passenger side, and access is difficult because of installed options, then cut the cable. If removal of the cable is difficult, it does no harm to simply leave this old cable installed in the vehicle.

ABC-1 Installation

1. Apply a small amount of silicone sealer to the firewall around the 4 retaining screw holes and attach the ABC to the firewall.
2. Install the cable bracket, cable, and secondary return spring.
3. Install one washer the ABC arm pin, then the cable end, another washer and the circlip. DO NOT CHANGE THE ADJUSTMENT OF THE ARM ON THE SHAFT.
4. If the cable was routed through the driver's side firewall, then ease it back through the same grommet. If the cable went through the passenger side firewall and was cut for removal, then locate the hole in the firewall on the driver's side where the clutch slave cylinder once mounted and pass the 10-pin cable through this hole.

5. Connect cable to the ignition box. Be sure to route and secure the cable in such a way that it does not interfere with the accelerator or brake pedal controls, or the drive shaft.

AMP-HOUR COUNTER REMOVAL AND INSTALLATION

The Amp-Hour Meter measures and integrates the current and time when discharging and charging the battery pack. It consists of two separate components connected by a 20-pin cable. The Amp-Hour Meter display is integral with the instrument cluster/speedometer assembly. The Amp-Hour control box is located just left of the steering column over the lower dash panel. The control box and display may be removed from the vehicle individually. The Amp-Hour control box and display are not user serviceable. ***See diagrams at end of manual.***

IMPORTANT WARNING!

Disconnect the red one-pin Anderson accessory connector (which is located between the fuse box and the large grey Anderson connector to the controller) before unplugging the amp-hr counter or the harness. This will cause the Amp-Hour counter to go blank. Doing so will also protect the Amp-Hour counter from a power surge when the Amp-Hour counter is plugged back in. Make a note of the Amp-Hour counter reading before disconnecting so that when counter is re-connected the vehicle operator will know the battery state of charge (i.e., meter will reset to 0.00, so without a note, the operator has no way of knowing the true battery state of charge - see below for more details). All electrical components will not operate now except for the battery charger. (220V AC charging connection should be disconnected from the vehicle.)

Upon reconnecting the 1-pin red Anderson accessory connector, the Amp-hour counter will reset to zero. Please note that this does not indicate the actual state-of-charge. When charging vehicle, the Amp-Hour counter may read negative numbers in excess of actual overcharge. The Amp-Hour counter will reset itself as soon as it senses a current draw after charging.

If the Amp-hr counter reads 100.00 or 99.99 (instead of 00.00) after re-connecting the 1-pin red Anderson accessory connector, disconnect and wait at least 10 seconds before reconnecting.

Amp-Hour Meter display removal

1. Turn the ignition key off and unplug the vehicle from the wall.
2. Disconnect the red one-pin Anderson Service Disconnect under the hood. **See "WARNING!" immediately above.**

3. Remove three Phillips screws from the driver's side lower dash panel. Pull out on the upper left corner of the panel only, then slide it left to clear the small tab on the right.
4. Pull the white foam absorber straight out from the knee bolster plate (there are two push clips holding it). Undo the four Phillips screws and remove the plate. The Amp-Hour control box is now visible to the left of the steering column (the ignition box is on the right).
5. Working from underneath the dashboard, disconnect the flat ribbon 20-pin connector from the Amp-Hour box. Also disconnect the 6-pin international Molex "Y" connectors from the vehicle harness and the Amp-Hour box.
6. Remove the (2) Torx T-40 bolts holding up the steering column. Allow the steering column to hang free but do not force it down. Remove the small left and right lower instrument panel covers, just on either side of the steering column (one screw each). Remove the 4 medium length screws holding the instrument cluster trim panel.
7. Remove the 4 screws securing the instrument cluster assembly. (The (2) top shorter screws are holding the white tabs on each side.) Reach behind and squeeze the tab holding the speedometer cable to the speedometer head. Pull it straight off. Remove the 3 multi-pin electrical connections also in back of the instrument cluster.
8. Pull the instrument cluster out of the vehicle complete with wires to the Amp-Hour Meter display and Ammeter/voltmeter, carefully feeding both harnesses through the instrument cluster opening.
9. Squeeze the 7 black tabs holding the cover on to the cluster assembly and pull the cover straight off. Undo the (2) small and (2) large Phillips screws holding the speedometer head assembly at the back of the cluster. Transfer the speedometer head and the ammeter/voltmeter assembly to the new cluster assembly.
10. Installation is the reverse of removal. Please take extreme care not to pull on the voltmeter/ammeter and Amp-Hour harness. Be sure the red-Anderson connector under the hood is still unplugged, the key is off, and the vehicle is unplugged from the wall.

Amp-Hour box removal

1. Turn the ignition key off and set parking brake. Unplug vehicle from the wall. **Unplug the 1-pin red Anderson Service Disconnect**. ***See Warning above.***
2. Remove three Phillips screws from the driver's side lower dash panel. Pull out on the upper left corner of the panel only, then slide it left to clear the small tab on the right.
3. Pull the white foam absorber straight out from the knee bolster plate (there are two push clips holding it). Undo the four Phillips screws and remove the plate. The Amp-Hour control box is now visible to the left of the steering column (the ignition box is on the right).
4. Release the Amp-Hour box from its position (it is attached with Velcro) and pull it out just enough to carefully unplug the 20-pin connector which goes to the Amp-Hour Meter display and the 6-pin Molex connector which goes to the fuse box and the voltmeter/ammeter gauge.

Installation of Amp-Hour Counter Box
Installation is the reverse of removal. Be sure the red Anderson Service Disconnect connector under the hood is still unplugged, the key is off, and the vehicle is unplugged from the wall. **It is very important that the red Service Disconnect is connected last.**

BATTERY CHARGER
The 1998 Solectria Force is equipped with a 3.3 kW Battery Charger (model BC3300), located in the trunk, on the driver's side of the car.

> **WARNING!**
>
> **Disconnect all Solectria components which are connected to the batteries if you attempt any fast charging of the batteries. FAILURE TO DO SO WILL VOID ALL WARRANTIES. Contact Solectria if you are unsure which components may be affected.**

3.3 kW Battery Charger Removal
1. Turn ignition key off and set parking brake. Unplug vehicle from the wall outlet.
2. Pull back of rear seat forward.
3. Pull drivers side carpet aside and remove foam from trunk floor.
4. Unscrew (at the charger end) the 18-pin cable from the charger to the LED box.
5. Remove (4) ¼" - 20 nylocks, gently pull charger up and out approximately 8" to access the other two connectors found behind the sidewall carpet.
6. Unplug DC output connector (red 2-pin Anderson) and the 220VAC input connector.
7. Remove charger. Leave LED interface box as is inside vehicle.

Installation of 3.3 kW Battery Charger
Note: Before installing new charger, check in-line fuse on positive wire next to driver's side strut tower on trunk floor.

Installation is the reverse of removal. Be sure the vehicle is unplugged from the wall during this procedure.

Motor Speed Sensor
The motor speed sensor is located on the rear of the motor under the motor end plate. It provides the motor controller feedback on the direction and speed of the motor. To access the sensor, the motor cooling fan and shroud must be removed.

Testing Motor Sensor

1. Turn the key off and set the parking brake.
2. Jack front of the vehicle and place it on jack stands.
3. Turn vehicle on, select the normal driving setting, and accelerate slowly up to maximum speed. Listen for motor vibrations or shudders: if a motor sensor is malfunctioning, it can shudder sharply at a particular speed (usually a high speed). DO NOT CONFUSE THIS WITH OUT-OF-BALANCE TIRES. The motor may also turn very slowly or "growl" as well. Do not confuse this symptom with an out-of-phase controller.
4. If the sensor is functioning properly, turn off the key, lower the vehicle, and test drive for the same symptoms. If adjustment or replacement is required proceed as follows:

Motor Speed Sensor Adjustment/Replacement

1. Turn the ignition key off and set the parking brake.
2. Disconnect the 9-pin connector between the controller and speed sensor . It is located behind the DC-DC Converter.
3. Disconnect the DC input to controller (large gray Anderson Connector). Loosen the remaining half to the connector from the upper cross beam and place out of the way.
4. Remove the A/C motor/compressor assembly. Do not undo compressor lines. Simply lift motor/compressor plate out of motor compartment and lay it upside down on a pad on the front bumper. Disconnect the A/C motor wires first.
5. Separate the motor cooling fan harness from the motor temperature sensor harness at the firewall.
6. Remove the (2) Philips machine screws (SAE #8-32) securing the fan housing to the motor and remove the fan and housing by disengaging from lower stud, then tilting it up as you slide and lift it off the motor.
7. Remove the (3) small M4 (metric) screws from the motor cover plate. Carefully cut the seal between the plate and the motor with a razor blade while gently prying the plate with a small slotted screwdriver. Be extra careful near the sensor cable exit point from motor.
8. Inspect encoder wheel for dirt and sensor wear marks. Replace if damaged.
9. **To adjust:** Carefully remove silicone from inner slotted screw-head at circuit board and adjust as outlined below.
10. **To replace:** Cut the small zip tie securing the gray harness to the holder and remove the small Phillips screw (metric M-3) securing the holder and ground wire to the motor.
11. Remove the silicone from the slotted screws at the circuit board. Loosen the outer screw almost all the way- there is a spacer between the board and the motor under this screw. Loosen the inner screw (metric) all the way while reaching behind the board to catch the small spring. Now, remove the outer screw all the way being careful to catch the spacer/washer behind it. Please do not lose any hardware.
12. Snip the two black temperature sensor wires close to the board (1/8 - 1/4 inch), then undo the harness clamps at the firewall and remove the sensor from the vehicle.

Motor Speed Sensor Installation

1. Install a lock washer and a flat washer on outer shorter screw (metric M-3) and insert through circuit board and 0.025 spacer/washer under board. Hold spacer on back of board while starting screw into motor two turns. Place spring behind board and hold it while inserting inner longer screw (metric M-3) and flat washer through board and spring and into motor. Tighten down outer shorter screw all the way.
2. **To adjust**: Line up the speed sensor plate retaining screws parallel to the inner edge of the circuit board by turning the drive wheels slightly. Using a plastic non-abrasive feeler gauge to avoid damaging the sensor wheel, adjust inner screw so that the gap between the center inner edge of the board itself and the sensor plate is 0.125-0.130 inches. Insert gauge only 1/8 inch from edge of board. Do not lift board with gauge.
3. Put a 1/8 inch dab of silicone sealant on each screw head and along outer edge of board to prevent movement.
4. Re-solder the temperature sensor wires if they were cut upon removal (they are not polarized). Be careful not to overheat the terminals or they may unsolder from the board. Install small harness holder and ground wire against the motor and tie-wrap harness to holder.
5. Run test procedure again before installing cover. (Temporarily plug in gray Anderson connector at motor controller and 9-pin connector.)
6. Apply a narrow bead of silicone sealant around the motor cover plate rim and install the cover plate. Be sure harness is seated in its notch.
7. The rest of the procedure is the reverse of removal. Be sure to install (2) tie-wraps at the red, white and blue connector before reinstalling metal zip-on mesh. Road test the vehicle to verify that the repair is complete.

AIR CONDITIONING CONTROLLER

The Air Conditioner (A/C) Controller is both a switching device and a voltage converter for the A/C compressor motor. It is located on the passenger side of the motor compartment near the fuse box. Other than the external fuse, there are no user serviceable parts. Before checking fuse, disconnect red one-pin Service Disconnect Anderson connector near high voltage fuse box. Write down Amp-Hour Meter number before disconnecting. When finished checking or replacing fuse, plug in red connector.

A/C Controller removal

1. Turn ignition key off and set parking brake. Disconnect the red Anderson Service Disconnect between the fuse box and large gray Anderson connector to the motor controller. Make a note of the Amp-Hour Meter reading before disconnecting (the Amp-Hour Meter will go blank).
2. Disconnect the high voltage input wire (3-pin, 2-wire Deutsch connector with black and white wires), the output wire (2-pin Deutsch to A/C motor with green and white wires), the signal wire (red wire with 1-pin Packard), and black ground wire with eyelet.
3. Remove the two Phillips machine screws which hold the controller to the passenger side upper beam bracket and remove it from the vehicle.

A/C Controller installation
Installation is the reverse of removal. Re-connect the red Anderson connector. If Amp-Hour Meter reads 99.00 or 100.00, disconnect the red Service Disconnect Anderson connector, wait 10 seconds and try again.

IGNITION BOX

The ignition box is an electronic device which gives the motor controller input signals from the vehicle operator and provides other safety interlocks such as neutral interlock and charging interlock (i.e., vehicle cannot be driven if key is turned "on" with Range-Power Selector set to a forward or reverse setting, or if vehicle is charging). The ignition box is located just right of the steering column over the lower dash panel. ***See Appendix B for diagram.***

Ignition Box removal

1. Turn ignition key off and set parking brake. Unplug vehicle from the wall. Be sure parking brake is set.
2. Remove three Phillips screws from the driver's side lower dash panel. Pull out on the upper left corner of the panel only, then slide it left to clear the small tab on the right top corner.
3. Pull the white foam absorber straight out from the knee bolster plate (there are two push clips holding it). Undo the four Phillips screws and remove the plate. The ignition box is now visible to the right of the steering column (the Amp-Hour box is on the left).
4. Release the ignition box from its position (it is attached with Velcro) and pull it out just enough to unplug the following connections:

No particular order required

a. Regenerative Brake Disable: 2-pin female Amp connector (2 yellow wires)
b. Charge Interlock: 4-pin female Molex connector (2 wires, white and blue)
c. Range-Power Selector Signal: 3-pin female Amp connector (3 wires, red, green and black)
d. Forward-Reverse signal from Power-Range Selector: 3-pin male International Molex connector (3 wires, red, green and black)
e. Neutral Interlock Signal from Range-Power Selector: 2-pin female international Molex (orange and purple wires)
f. +12V ignition signal: round single-pin male connector (white wire)
g. Ground wire: male spade connector (gray wire)
h. Controller cable: 25-pin male D-sub connector
i. Pot box signal: 10-pin male header connector

Ignition Box Installation
Installation is the reverse of removal.

BRAKE VACUUM PUMP ASSEMBLY

Because there is no vacuum created by the electric motor, a 12V vacuum pump is utilized to supply vacuum to the brake booster. It is located under the hood on the upper motor support beam.

Vacuum Pump Removal

The vacuum pump is removed complete with the bracket. To remove the vacuum pump assembly, remove the (3) ¼-20 nylock nuts on top of the assembly. Unplug the 12V wires and the vacuum hose, and rotate it out from under the beam.

Vacuum Pump Installation

Installation is the reverse of removal.

RANGE-POWER SELECTOR

The Range-Power Selector, used to select forward or reverse motion or OFF, is located on the center console.

Range-Power Selector Removal

1. Turn key off and set parking brake.
2. Unscrew the 6 screws securing the console. Lift out the console.
3. Remove the four 1/4" nuts holding the Range-Power Selector bracket to the floor and move it out in order to give yourself space to disconnect the following:
    a. 2-pin male mini-Molex (black wires) to Regen. relay (reverse lights)
    b. 3-pin female international Molex (red, black, and white with red stripe wires) to ignition box (forward/reverse signal)
    c. 2-wire, 3-pin male Amp connector (black and orange wires) to ignition box (power saver signal)
    d. 2-pin male international Molex (purple wires) to ignition box (neutral interlock)
4. Unplug the 2-wire connector from the regen disable switch (yellow wires).
5. Follow the wires from the heat switch and disconnect;
    a. orange wire to heater relay
    b. gray ground wire
    c. red wire to heater fan "T" tap behind glove box
6. Remove unit from vehicle.

Range-Power Selector Installation

Installation is the reverse of removal. Be sure the key is off. Also be sure to include all the wires that were under the same ground screw as the heater switch.

ACCESSORIES

CABIN PREHEAT (Optional)

The Preheat system conists of a computer that can be set programmed to heat the cabin before the driver starts a trip. The Preheat system uses power from the battery pack, however it only works when the vehicle is plugged into wall outlet. The charger is typically able to replenish or supply enough energy used by the preheat system to keep the batteries fully charged during the preheat cycle. ***See Owners manual for operation and programming.***

Cabin Preheat removal

1. Turn ignition key off and set parking brake. Unplug vehicle from wall outlet. Remove three Phillips screws from the driver's side lower dash panel. Pull out on the upper left corner of the panel only, then slide it left to clear the small tab on the right.
2. Pull the white foam absorber straight out from the knee bolster plate (there are two push clips holding it). Undo the four Phillips screws and remove the plate.
3. Reach up and unscrew the (2) plastic thumb screws from the back of the cabin preheat computer.
4. Pull out the computer just enough to unplug the two connectors:

a. 110VAC or 220VAC supply: 2-pin male international Molex (black and white wires).
b. Signal to heater relay: 2-pin male amp connector (purple and red/white wires).

Cabin Preheat installation

Installation is the reverse of removal.

APPENDIX A - INSTRUCTIONS FOR MONITORING A SOLECTRIA BC3300

(Note: The software necessary to perform this operation is available from Solectria for a nominal fee. It is provided free of charge to customers who choose an optional Technical Training Session.)

These instructions assume that you have the monitoring program (mon.exe) installed in a directory called BC3300 in the c drive of a your computer. Make sure that the charger is plugged in. If the any of the five lights located in the charger interface box are not lit check that the plug has voltage in the range of 200 to 240 VAC. If none of the lights turn on after checking for the input voltage, the charger has to be sent to Solectria to be diagnosed; the monitoring program will not work in this case. To run the monitoring program follow these steps:

1. With the charger plugged in, connect a 9 pin cable from COM 1 in the computer to the 9 pin connector on the charger.
2. Turn the computer on, it should display the c prompt (c:\)
3. Type cd bc3300 *enter*. This will change the directory to the BC 3300 directory.
4. Type mon *enter*. This will run the program. At this point you should see a screen like this one:

```
+-------------------------------------------------------------------------------------------------+
| NLG  - monitor program on COM1:  Version 1.61, Solectria Corp.  (C) 1996                        |
+-------------------------------------------------------------------------------------------------+
|status NLG4: |     0      |Um_pk[V]: 299.4 |Tpstg[°C]: 35.71 |power [%]: 100.00                  |
|             |            |                |                 |                                   |
|Imains[Amp]:   0.000      |Umeff[V]: 206.13 |Tbat1[°C]: 26.61 |Pprim [W]:     0                   |
|                          |                 |Tbat2[°C]: 26.25 |F_out[Hz]:     0                   |
|Ibatt [Amp]:   0.000      |Ubatt[V]: 219.26 |Tbatt[°C]: 26.61 |Psec  [W]:     0                   |
+-------------------------------------------------------------------------------------------------+
| section: 5|  sect.1    |sect.2   | sect.3   | sect.4 | sect.5  | sum 1-5|  total   |  calc._  |
+-----------+------------+---------+----------+--------+---------+--------+----------+----------+
|time  [min] |  235.7  |  30.0    |  60.0    |  65.8  |  20.0   |  411.5 |   504.5|   0.0    |
+-----------+-------+--------------+----------+--------+---------+--------+----------+----------+
|charge [Ah ]|  44.7   |   5.0    |   5.0    |   5.5  |   0.0   |  60.2  |   85.0   |   0.0    |
+-----------+------------+---------+----------+--------+---------+--------+----------+----------+
|energy [Wh]|  10640  |  1219    |  1212    |  1335  |    0    |  14406 |  19191 |             |
+-----------+------------+---------+----------+--------+---------+--------+----------+----------+--------+
|UB min. [V]| 198.82  |  221.17 | 220.60   | 221.10 |  219.24 |  198.82 |    1.71  |                  |
+-----------+------------+---------+----------+--------+---------+--------+----------+------------------| press
|UB max. [V]| 221.59  |  222.24 | 221.43   | 222.84 | 222.19  |  222.84 |   222.84 |                  | <F1>
+--------------+---------+----------+---------+--------+---------+--------+----------+------------------|for help
|TB min.[°C]|  17.97  |  27.96   |  29.80   |  27.68 |  26.61  |  17.97  |  175.00  |                  |
+------------+----------+----------+----------+-------+----------+---------+----------+------------------| press
|TB max.[°C]|  28.03  |  31.32   |  34.96   |  33.35 |  27.75  |  34.96  |   48.31  |                  |<F10>
+-------------------------------------------------------------------------------------------------+to quit
```

The parameter the you need the most to pin-point a problem with a BC3300 is Status displayed on the top left of the screen. Common values and their meaning are listed below:

3- Overvoltage from AC (220 VAC)
5- Overvoltage (fuse blown or missing connection)
9- Fault on temp sensor #1 (white & black wires on box), FRONT BATTERY BOX
17- Fault on temp sensor #2 (gray & black wires on box), REAR BATTERY BOX
33- Battery over temperature
65- Maximum DC Kw-h limit exceeded
129- Maximum Amp-limit exceeded
257- Maximum time limit exceeded

APPENDIX B

Troubleshooting Guide

1998 Solectria Force

Nominal System Voltage: 156V

Batteries: Lead Acid

Battery Charger: Solectria BC3300

Section I: Problem Solving

Section II: Systems Diagnosis

Section I: Problem Solving

SYMPTOM	CHECK FOR	PROCEDURE
Vehicle does not drive.	Vehicle is plugged in.	Unplug it.
	Range-Power selector is set to one of the forward or reverse settings when the ignition key is turned on.	Set the Range-Power selector to the "OFF" setting and turn the ignition key off then on again (2 clicks). Now set the Range-Power selector to one of the forward settings, or to the reverse setting, and try driving the vehicle again. Be sure to push accelerator pedal down at least half way before car will start to move. (When the ignition key is turned on, the vehicle will power up only if the Range-Power selector is at the OFF setting.)
	12V system is not working. Are lights out? Horn not working?	*See "12V accessories don't work" below.*
If the vehicle does not move or stops abruptly while driving	Main fuse in front or rear battery box may have blown or one or more battery modules are open.	Leaving the key on, check main battery voltage at the gray Anderson connector to the motor controller. If lower than 156V, turn the key off, open the <u>rear</u> battery box and check the main interconnect fuse (voltage across the fuse indicates a blown fuse). If fuse is okay, check the fuse in the <u>front</u> battery box. (Call Solectria for replacement fuses) Also, check for open modules and faulty interconnects. If a module is open or partially open, follow the procedure in the text for battery replacement.
	Ignition circuit. Does ignition circuit under dash "click" when key is turned? (Click sound is normal.)	*See "Checking ignition circuit" in Section II.*
	Motor Controller. Does motor controller "clunk" on? (Clunk sound is normal.)	*See "Checking Motor and Controller" in Section II..*
	Motor speed sensor out of adjustment or failed.	*See "Checking Motor and Controller" in Section II first, then see "Motor Speed Sensor Adjustment" in text.*

SYMPTOM	CHECK FOR	PROCEDURE
Vehicle is sluggish	Is Amp-hour meter reading over 40.00-50.00 Ah? If so, batteries are running low on energy and need to be recharged.	The car may not drive if amp-hour meter reads over 40.00-50.00 Ah. The battery pack should be fully recharged at this time (until the "Charge Complete" LED on the dash comes on). If necessary, the vehicle may be driven following a partial recharge, but it should be fully recharged at the earliest opportunity for maximum battery performance and life.
	Is Range-Power selector is set to ECON/MAXRANGE?	Select to NORMAL or POWER setting for more power (and less range).
	Is vehicle in 'limp home'mode due to low, weak, or damaged battery pack, or faulty battery interconnects.	Set the Range-Power selector to "NORMAL" and push the accelerator pedal all the way down. Using the optional dash mounted voltmeter (or a separate voltmeter – *See "How to Measure Voltage" section in text*), check to see that the voltage does not drop under 140V at any time when the amp-hour meter is between 00.00 and 35.00 amp-hours. If it does fall under 140V, perform a battery discharge test. *See "Battery Discharge Test" section in text.* It is necessary to fully charge the battery pack at this time.
	Batteries are cold.	If vehicle has been left unplugged in the cold for some time, then plug it in until the batteries have reached 60°F before driving. If the vehicle has been plugged in, then check that the thermal management system is functioning properly. *See "Checking Thermal Management" in Section II..*
Vehicle is jerking on acceleration	Faulty controller or faulty 25-pin cable.	*See "Checking Motor and Controller" in Section II..*
	Motor speed sensor out of adjustment.	See *"Motor Speed Sensor" in text.*
	Faulty pot-box signal.	If hesitation occurs at a particular point in the accelerator pedal travel, or seems to be affected by bumps, then the problem may be in the pot-box. Call Solectria for details on checking pot box resistance.

SYMPTOM	CHECK FOR	PROCEDURE
12-volt accessories don't work	Ignition key is not in "ON" position.	Turn ignition key on (2 clicks).
	DC-DC Converter is in brown-out mode.	Turn off ignition key and disconnect input wires to the DC-DC Converter (small gray Deutsch connector with green and white wires), then reconnect input wires to DC-DC; check output on 2-pin gray Anderson connector for 12V (red and black wires), or turn key on and turn on the headlights.
	Blown fuse at DC fuse box or at DC-DC converter.	Check fuses at DC fuse box and at the DC-DC converter as follows. 1. Turn ignition key to off position. 2. Disconnect the small gray Deutsch connector with green and white wires. 3. Take out the fuse from on top of the DC-DC Converter, and test it with a continuity meter. 4. Replace the fuse if it is blown with the same value and type of fuse, or re-install the original if it is not blown. 5. Take out the DC-DC Converter fuse from the High-Voltage DC fuse box and test it with a continuity meter. 6. Same as step 4. 7. Re-connect the small gray Deutsch connector. 8. Try turning headlights on. 9. See *"Checking DC -DC Converter" in Section II.*
	Main fuse in front or rear battery box is blown or battery module is open.	Check for approximately 156V at controller. See *"Vehicle does not drive" in Section I of this Troubleshooting Guide.*

SYMPTOM	CHECK FOR	PROCEDURE
Air Conditioning (A/C) not working	No 12V signal to A/C controller.	**WARNING! STAY CLEAR OF AIR CONDITION ING MOTOR WHEN DIAGNOSING.** 1. Unplug single red wire from A/C controller. Turn on ignition, fan, and A/C, and check for +12V between harness wire and chassis ground. 2. If no +12V is present, reconnect the wire and unplug the molded connector at the pressure switch mounted on the receiver/drier. Connect the wires with a jumper or pliers to momentarily bypass the switch and if the A/C motor starts, then the system refrigerant is low. Have it tested, evacuated and recharged with 24 oz. R134a refrigerant. 3. If the compressor does not run with the pressure switch bypassed, then check the relay at the 12V fuse box located under the hood, and check the other relay behind the glovebox on the evaporator.
	Blown fuses and/or blown A/C controller	1. Turn ignition key off and unplug 156V input to A/C controller. Check for 156V (between the white and green wires). If no 156V, check A/C fuse at main DC fuse box. 2. If there is 156V, turn ignition key off, re-connect 156V input, and disconnect the connector connecting the A/C motor controller to the A/C motor. Turn ignition key on and check controller output to A/C motor for minimum of 40-50V DC. 3. If there is no voltage present at the controller output, unplug the 156V input wire again and check the fuse in the controller. If this fuse is fine, the A/C controller must be replaced. **Note**: Do not plug in 156V supply or the motor unless the red +12V wire is disconnected or the ignition key is off. Doing so will cause sparks that will damage the connectors.
	Burnt brushes and/or A/C motor.	Turn ignition key off and disconnect A/C motor to controller wires. Turn ignition key

		back on and check for minimum 48V DC at output of A/C controller to motor. If voltage is present, turn key off. Remove motor brushes and inspect commutator for wear and discoloration. Clean commutator with cotton swab and alcohol, and replace. Replace brush if carbon section is less than ¼" in length. Otherwise, replace motor.

SYMPTOM	CHECK FOR	PROCEDURE
BC3300 equipped vehicle is not charging - Green LED at amp-hour meter is not flashing and numbers are not counting down *** Note: If your vehicle is equipped with a BC1600 charger, please call Solectria for more details.*	No power from wall outlet. No LED light come on at trunk-mounted charger interface box. No AC voltage input to charger.	Check that extension cord has 110/220V at the vehicle end. Reset circuit breaker or GFI. With vehicle plugged in: check for the AC voltage at the end of the charger input extension cord inside the trunk. If no voltage present: check for voltage at the AC junction box. If voltage is present to the charger and the charger doesn't operate, contact Solectria Corporation. The charger may have to be replaced.
BC3300 equipped vehicle is not charging - Yellow LED is lit on trunk-mounted charger interface box (signifying "Fault Mode")	Charger is in fault mode: Problem with battery pack voltage to charger. Charger is in fault mode: Bad signal from temperature sensor. Charger is in fault mode: Batteries are too hot (over	With vehicle unplugged, disconnect two-pin red Anderson charger output connector and check for DC voltage at vehicle harness. If no voltage or very low voltage is present, check the inline fuse between the Anderson connector and the positive terminal of #13 battery. (This fuse is located outside the rear battery box near the left rear strut tower.) Sometimes the fuse can be blown in such a way that full pack voltage can be measured at the output. In this case, leave the charger output hooked up to the car harness. Carefully back probe the connector. Make sure the car is unplugged from the wall. If no or low voltage is present, then disconnect the 2-pin red Anderson connector and replace the fuse. Unplug vehicle. Disconnect temperature sensors from charger interface box and measure the resistance at the vehicle side of the harness (black Packard 3-pin, 2-wire connectors with clear and black wires). Resistance should measure anywhere from 15k to 45k depending on battery temperature. If no resistance is measured or if out of specification, call Solectria for a chart which shows correct resistance values at various temperatures. (It's possible the batteries may be too hot or too cold.) Otherwise, call Solectria for a replacement sensor. Unplug vehicle. Disconnect the temperature sensors from the interface box. Check for

Section II: Systems Diagnosis

PROCEDURE	STEPS
Checking DC-DC Converter	With key off and car unplugged from wall, use a voltmeter to back probe the low voltage side of the DC-DC converter (gray Anderson connector with red and black wires). • **If full 12V is present**, disconnect one-by-one each of the main fuses located next to the DC-DC Converter and measuring the voltage at the gray Anderson connector to find what circuit of the car is shorted. • **If voltage is considerably lower than 12V**, check car harness for a short. • **If no voltage is present**, unplug the 156V input to the DC-DC converter (gray Deutsch connector with green and white wires) and check the fuse in the DC-DC converter. If the fuse is blown try replacing it with the same current rating (5A). Re-install good fuse, re-connect 156V input (be certain the key is off or 12V output is disconnected) and check for 12V at gray Anderson connector. If there still is no 12V, unplug the 156V input and check the car harness for 156V input to the DC-DC Converter. If full voltage is present and the fuse in the DC-DC is good and there still is no 12V output, then the DC-DC converter must be replaced. If there is no voltage or very low voltage present at the DC-DC input, check the DC-DC fuse in the main DC fuse box with the DC-DC input still unplugged. If the DC-DC fuse in the main fuse box has continuity, check the main battery pack voltage at the gray Anderson connector to the controller. See "Vehicle does not drive" section.

PROCEDURE	STEPS
Checking Ignition Circuit	Sit in the vehicle with the windows rolled up (it must be quiet to hear the ignition relay). Set the Range-Power selector to any forward setting. Make sure the car is unplugged from wall outlet and the Parking Brake is set. Turn the ignition key ON. Wait until the reminder chime stops. Put seat belt on. Slowly turn the Range-Power selector back towards the OFF setting. (Don't let the spring detent in the Range-Power selector affect turning the handle). Listen for the relay in the ignition box to 'click' (the relay is located under the steering column) being careful not to confuse the ignition relay click with the mechanical detent in the Range-Power selector that 'clicks' first. The ignition click indicates that the ignition circuit, the Range-Power selector, and the neutral interlock circuit are all working properly. If no 'click' is heard, check for keyed +12V DC to the ignition box (white wire). *See "Ignition Box" section in text to access*. Unplug the single pin white wire to the ignition box and plug it back in with key on to check if the relay inside 'clicks'. Make sure it is also grounded (gray wire). If 12V is present and ground is in good condition, check the Range-Power selector for continuity in Forward or Reverse (call Solectria at 508-658-2231 for details). If okay, replace the ignition box.

PROCEDURE	STEPS
Checking Thermal Management	The function of thermal management is to maintain the batteries at a temperature of at least 68 ℉ during most conditions and at a temperature not less than 30 ℉ above ambient at extremely low temperatures. To test the operation of the thermal management system, fully charge the vehicle and then leave it plugged in outside at least eight (8) hours (preferably overnight) when the ambient temperature is less than 60 ℉. Using a non-conductive temperature probe, check temperature of both the front and rear boxes by inserting the probe into them. The rear box can be probed through the vent holes on the sides of the box cover. The front box can be probed through the grommet for the main interconnect located at the top rear of the driver's side. Both boxes should be approximately 68 ℉. If the temperature readings do not match this, the rear AC junction box wires must be accessed. First ensure that proper AC current is reaching the plug of the car. If so, gently pull the three (3) gray jacketed wires out from behind the carpet on the driver's side of the trunk. If you have not already done so, plug in the car and back probe the 2-pin International Molex pins, one set for the front and one set for the rear. If no voltage is present, unplug car from the wall and check fuses in AC junction box, replace as necessary. If still no voltage is found, replace rear AC junction box. If voltage is present at 2-pin Molex connector, unplug it and check resistance of Thermal Management circuits. The resistance should be approximately 320 ohms each. If circuit is open and the batteries are below 60 ℉, or differ significantly (more than 20%) in resistance, the battery box must be opened and another resistance check made at the mini red and black Anderson connector. If there is no continuity here, the thermal pad must be replaced. If there is continuity here, but none through to the temperature sensor, and batteries are definitely below 60 ℉, call Solectria for a replacement temperature sensor box.

Solectria
Battery Discharge Test

Vehicle: _____ **Date:** _____ **Meters used:** **Time:** _____

Battery: _____ **Mileage:** _____ **Voltage:** _____

Procedure: _____ **Battery Temp:** _____ **Amperage:** _____

_____ **Charged to:** _____

Terminal Voltage

Time																Time
Amps _____																Amps
Amp hr counter																Amp hr
Battery #1 _____																#1
Battery #2 _____																#2
Battery #3 _____																#3
Battery #4 _____																#4
Battery #5 _____																#5
Battery #6 _____																#6
Battery #7 _____																#7
Battery #8 _____																#8
Battery #9 _____																#9
Battery #10 _____																#10
Battery #11 _____																#11
Battery #12 _____																#12
Battery #13 _____																#13
Total Voltage _____																Total

Appendix C

Lists:

Tools & Test Equipment

Scheduled Maintenance

Tools & Test Equipment

Essential Tools available only from Solectria	Price
Solectria Diagnostic Test Box (ignition/potbox bypass)	$380.00
Probe set for Deutsch connectors	$40.00
Probe set for Packard connectors	$40.00
TOTAL	**$460.00**

Other Essential Tools	Price (approximate)	Available from	Recommended Model
Deutsch Connector Crimping Tool	$160.00	Ladd Industries (800) 223-1236	Deutsch HDT48-00
Molex Standard Pin Crimper	$125.00	Sterling Electronics (800) 745-5500, Richey Electronics (973) 575-7960, Hamilton Electronics (800) 354-1616	Molex 11-01-0008
Molex pin removal tool	$12.00	Sterling Electronics (800) 745-5500, Richey Electronics (973) 575-7960, Hamilton Electronics (800) 354-1616	Molex 11-03-0044
Packard Weatherpack Crimping Tool	$128.00	Waytek (800) 328-2724	Waytek 402
Regular crimper & wire stripping tool (10 AWG to 22 AWG)	$14.00	Waytek (800) 328-2724	Waytek 403
Soldering iron with pin-point tip, 60 Watts	$69.00	Contact East (978) 682-2000	Weller W60P-3
Digital multi-meter (volt-ohm meter)	$99.00	Contact East (978) 682-2000	Fluke Model 70
Standard automotive tools	$500.00 (estimated)	Automotive tool supplier	n/a

Optional (available only from Solectria)	Price
Battery Discharger	$4,500.00

Revised June 1998. All prices subject to change without notice.

Solectria Electric Vehicle

Scheduled Maintenance

	Odometer (miles)															
Item	**6,000**	**12,000**	**18,000**	**24,000**	**30,000**	**36,000**	**42,000**	**48,000**	**54,000**	**60,000**	**66,000**	**72,000**	**78,000**	**84,000**	**90,000**	**96,000**
Rotate/inspect tires	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Change gearbox oil	x	x		x		x		x		x		x		x		x
Inspect gearbox oil level			x		x		x		x		x		x		x	
Inspect steering & suspension		x		x		x		x		x		x		x		x
Inspect brake system		x		x		x		x		x		x		x		x
Change brake fluid										x						

Owner/Operator Inspections

Weekly
Check windshield washer fluid level
Check hood latch operation

Monthly
Check tire pressure

Every 6 months
Check restraint system
Check wiper blades

Once a year
Lubricate key lock
Lubricate body
Check steering column Lock
Check parking brake performance

Appendix D

Diagrams:

Layout and Wiring

Connectors

Towing

Wiring Diagrams for 1998 Solectria Force

Under Hood Layout

AC Junction Box

Air Conditioning

Amp-Hour Meter

Battery - Front Battery Box

Battery - Rear Battery Box

DC-DC Converter

Fuse Box

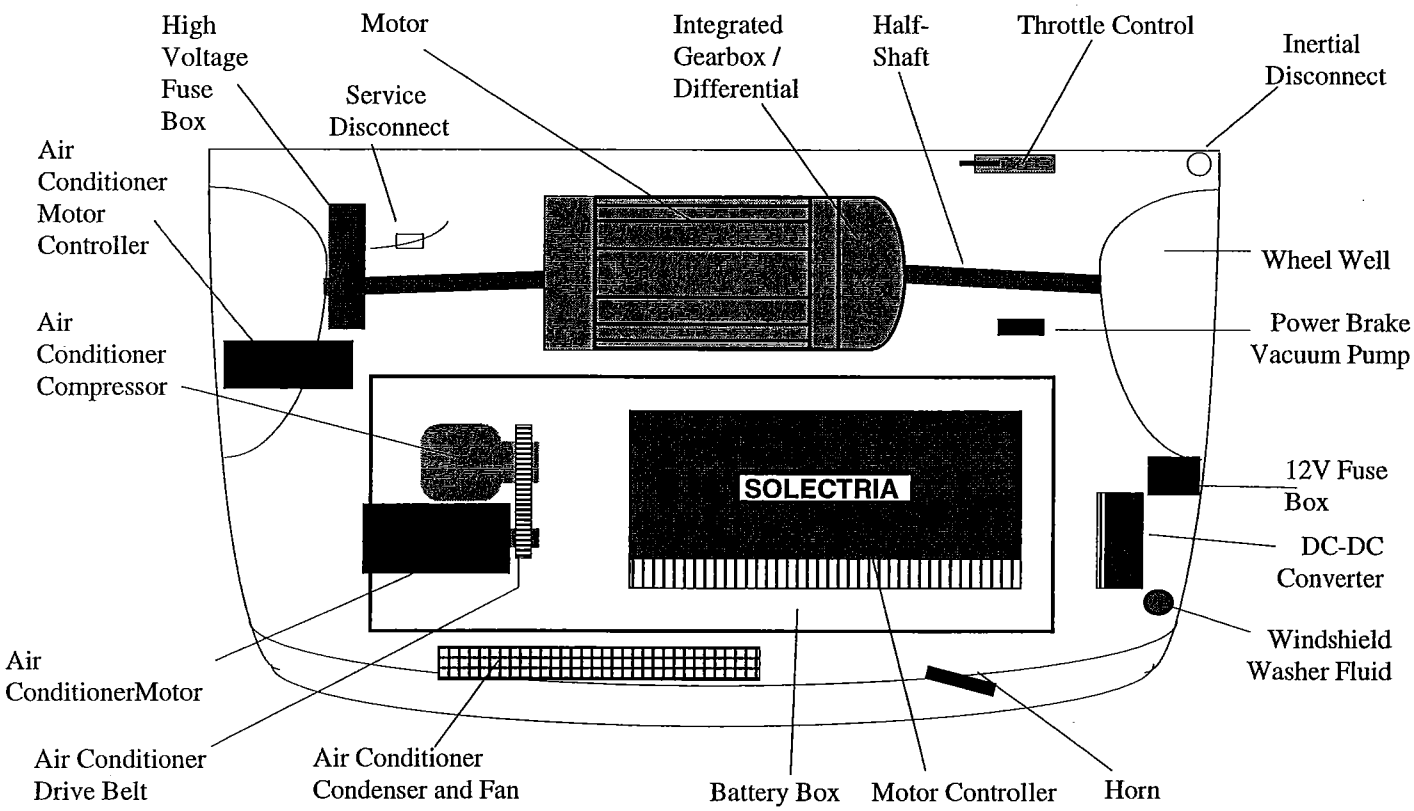
Heater

Ignition

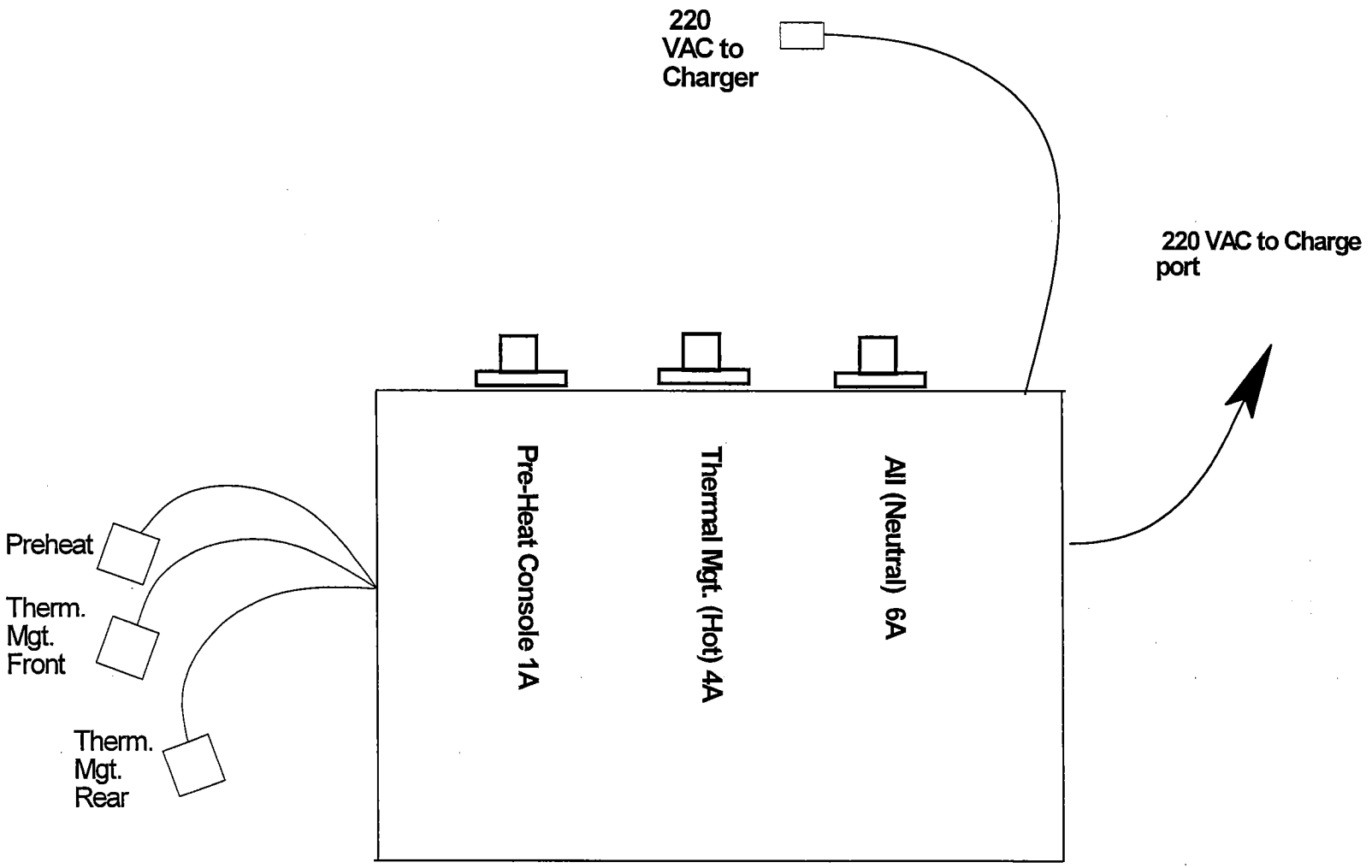
Regen Brake Light

1998 SOLECTRIA FORCE

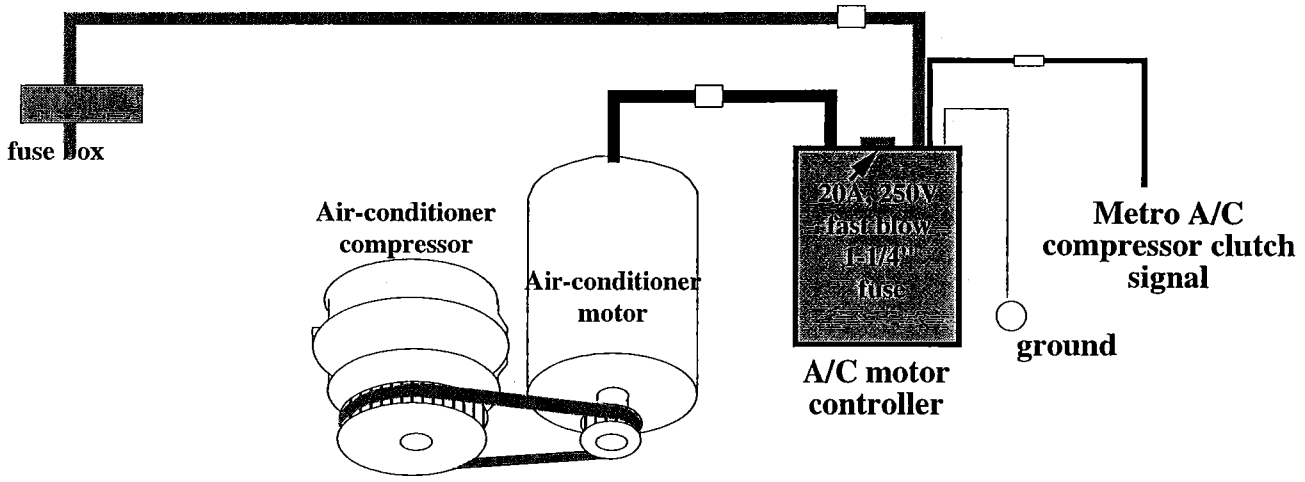
DIAGRAM OF EQUIPMENT UNDER THE HOOD

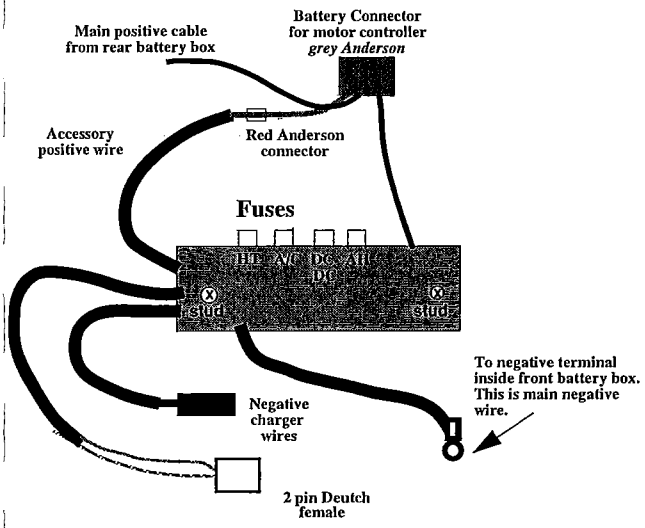


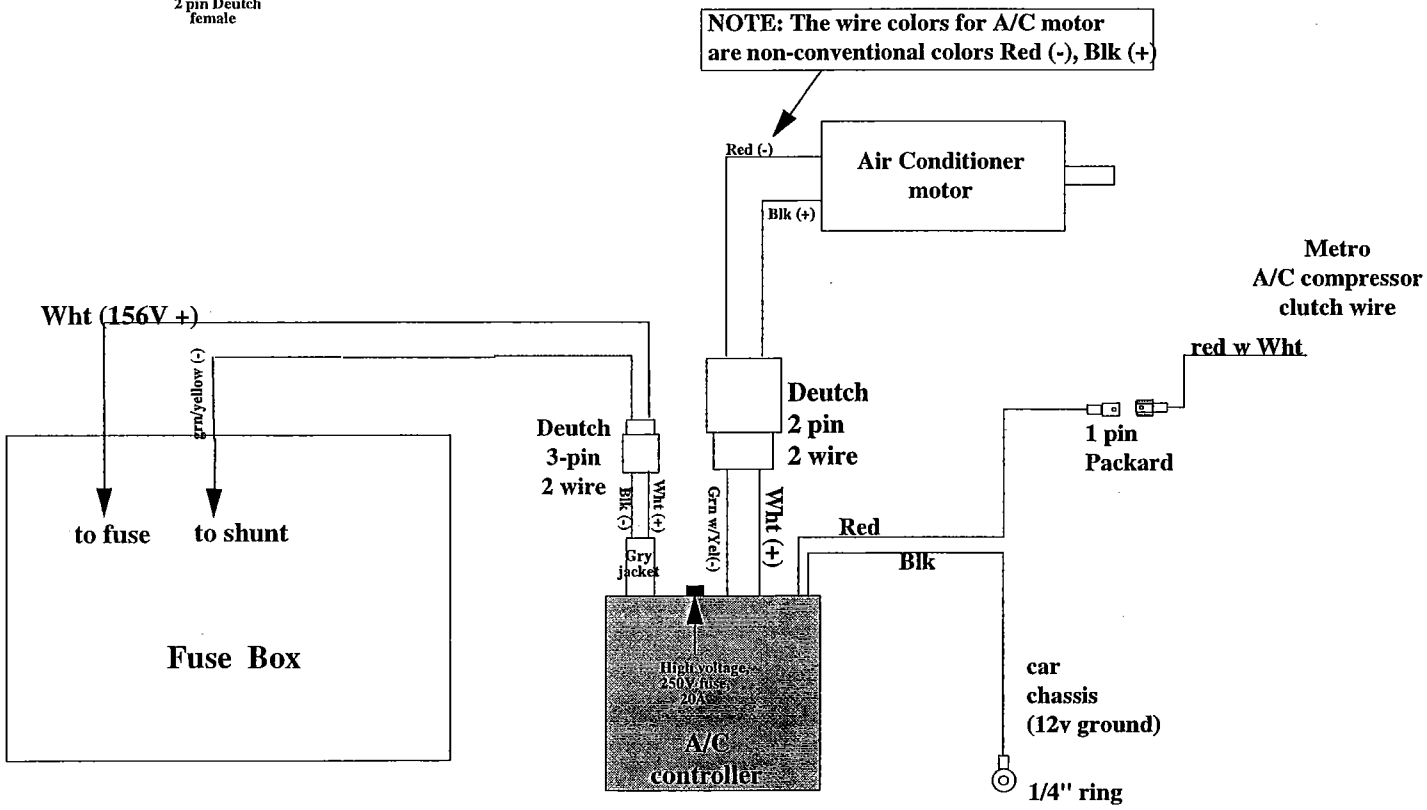
1998 SOLECTRIA FORCE AC JUNCTION BOX (for Vehicles with BC3300 Charger)



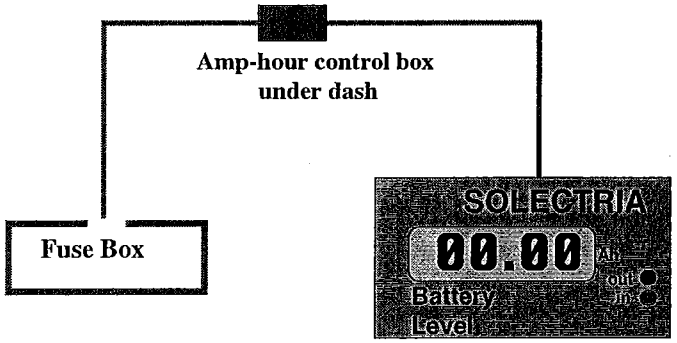
1998 LEAD ACID FORCE AIR-CONDITIONING WIRING



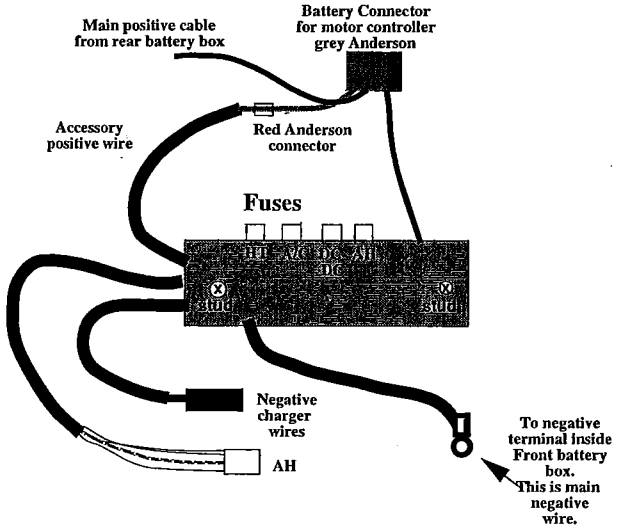


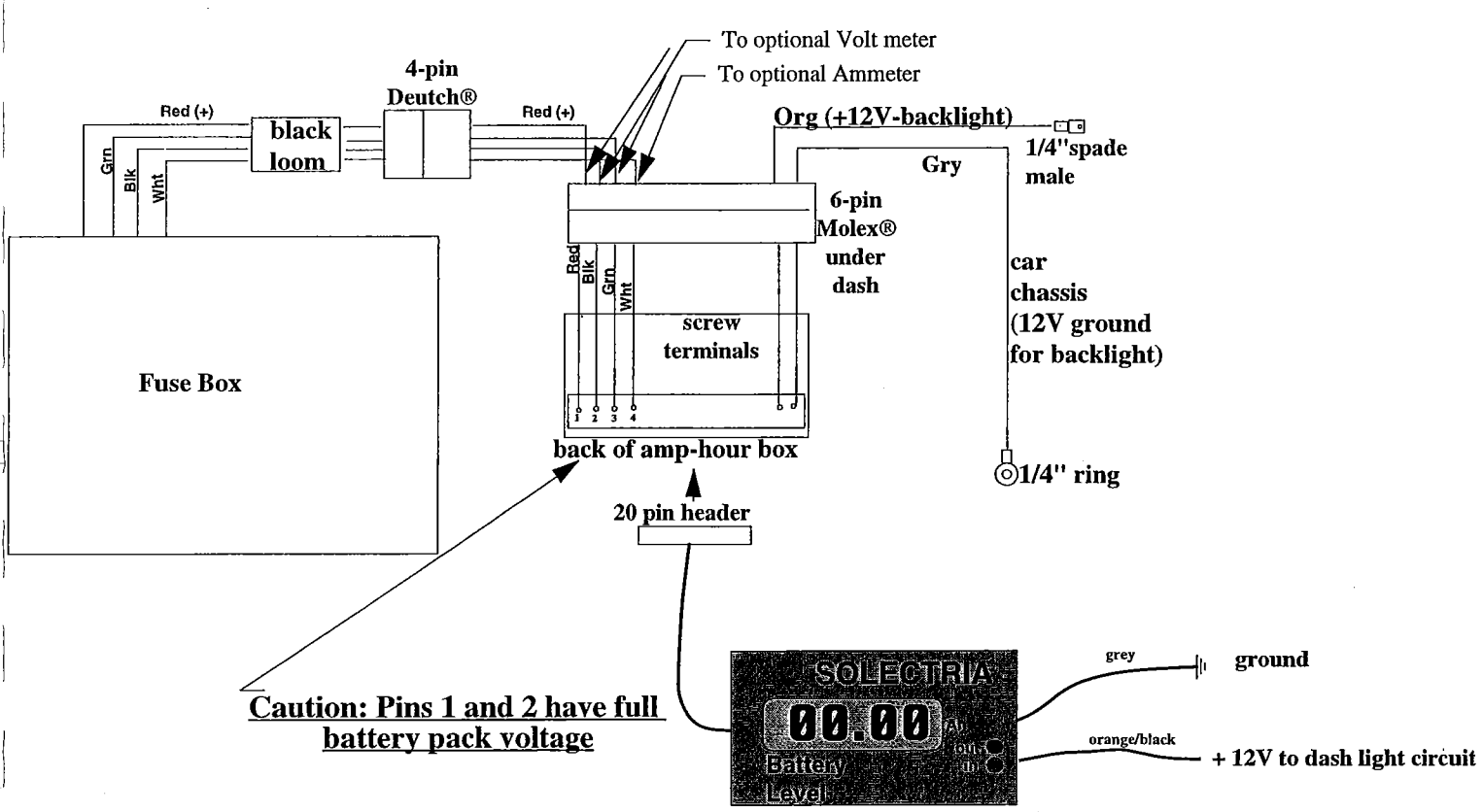


1998 FORCE AMP-HOUR METER WIRING

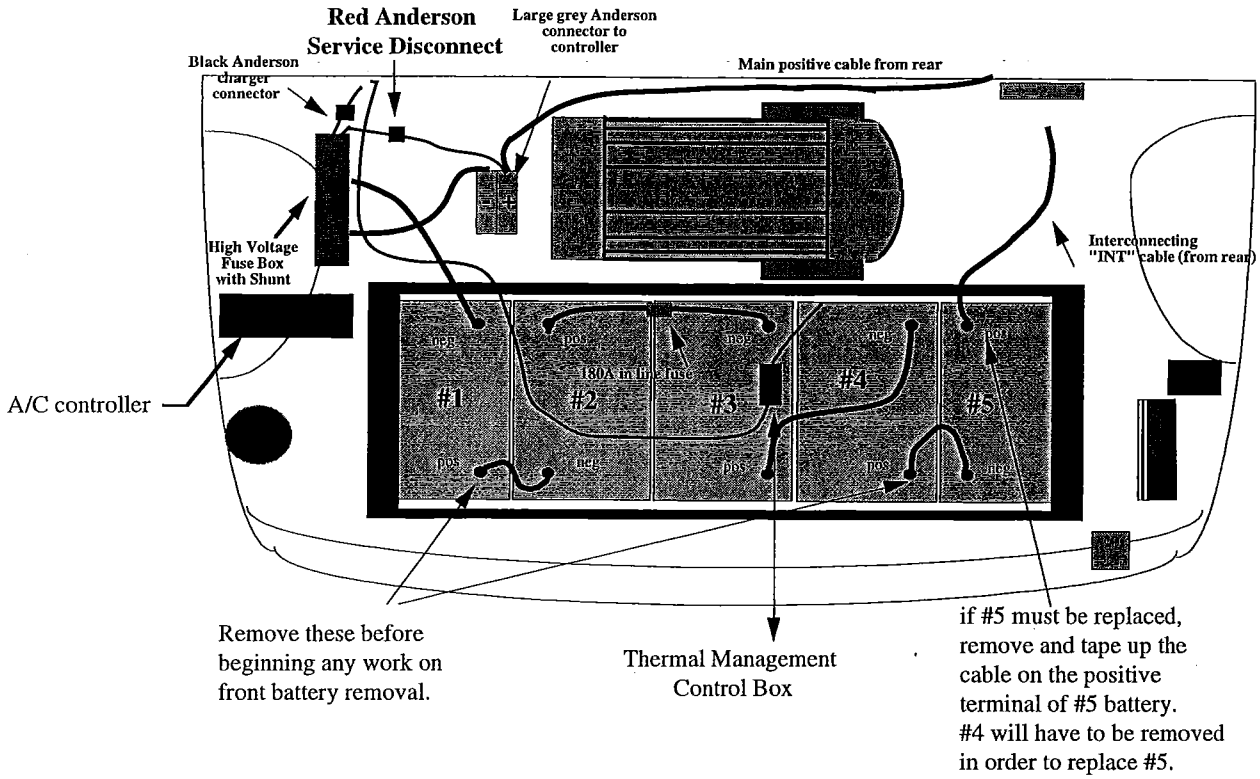


Amp-hour
display
on dashboard



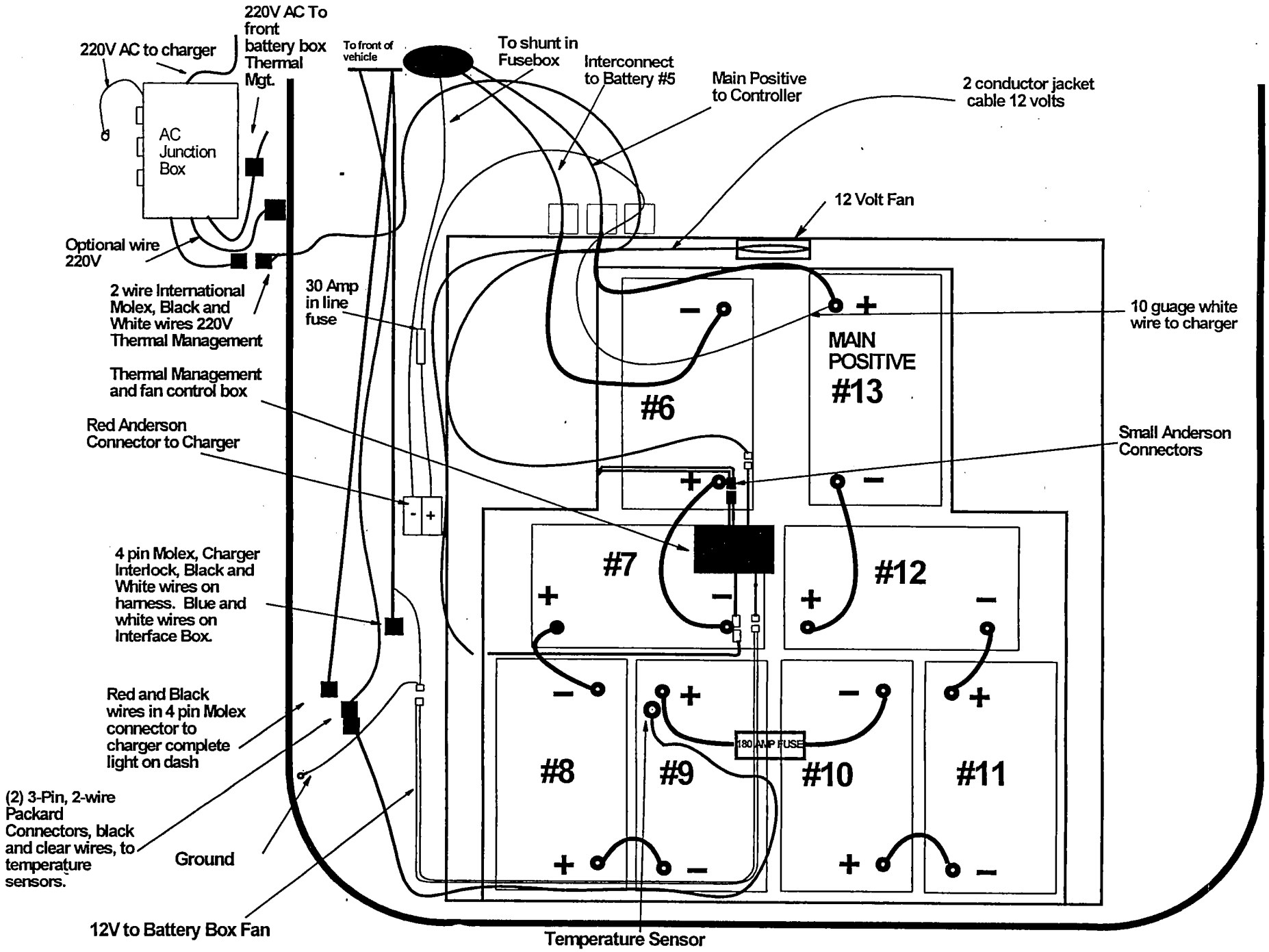


1998 LEAD ACID FORCE FRONT BATTERY BOX

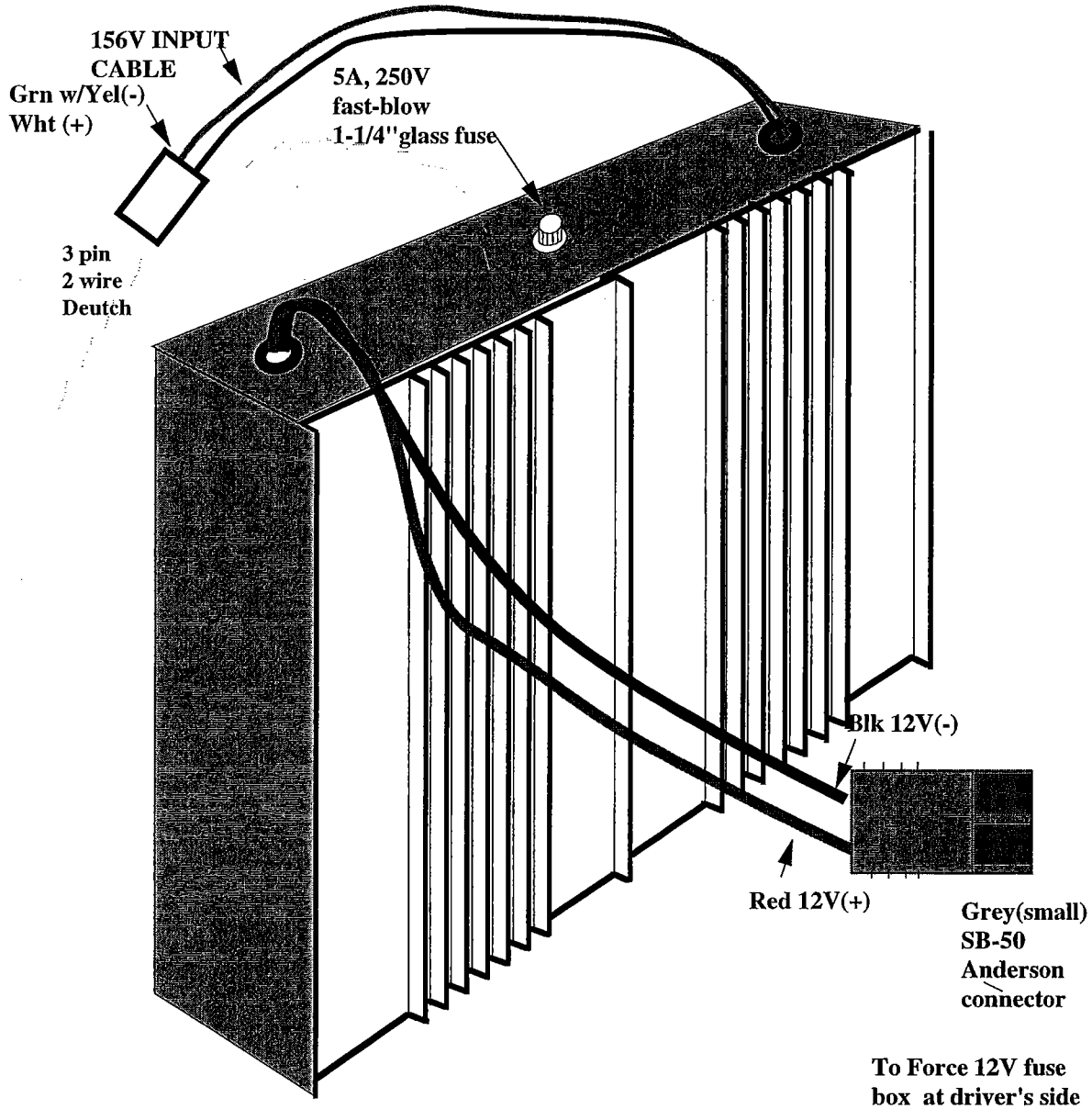


WARNING: ALWAYS UNPLUG THE VEHICLE FROM 110-220VAC CHARGING SUPPLY-(GAS CAP). DISCONNECT THE RED ANDERSON ACCESSORY CONNECTOR, BLACK ANDERSON CHARGER CONNECTOR, AND THE GREY ANDERSON CONNECTOR TO CONTROLLER BEFORE REPLACING ANY BATTERY!

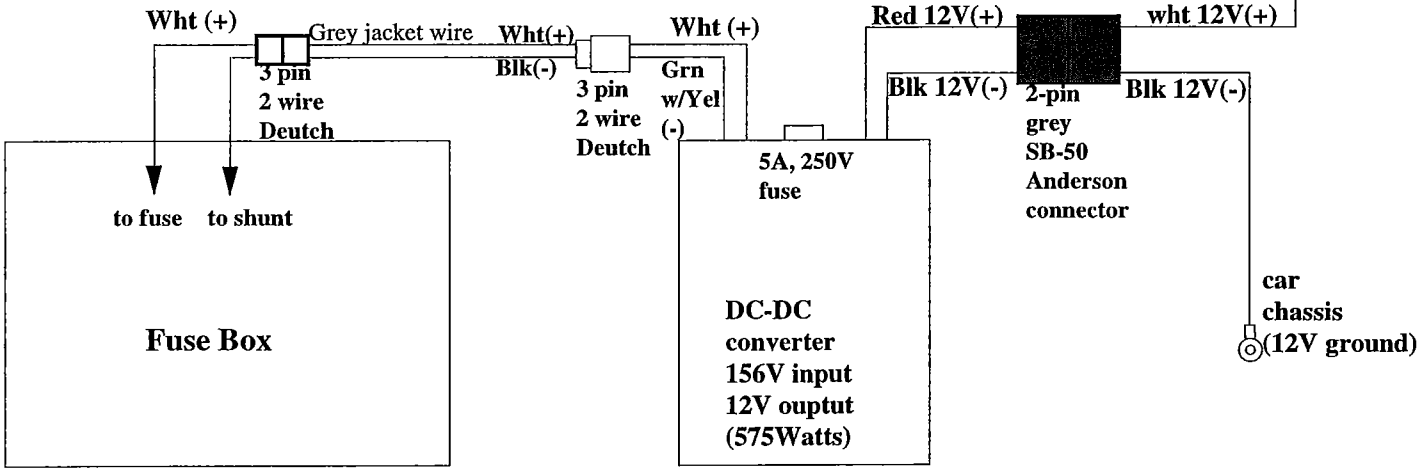
1998 REAR BATTERY BOX WITH BC3300 CHARGER



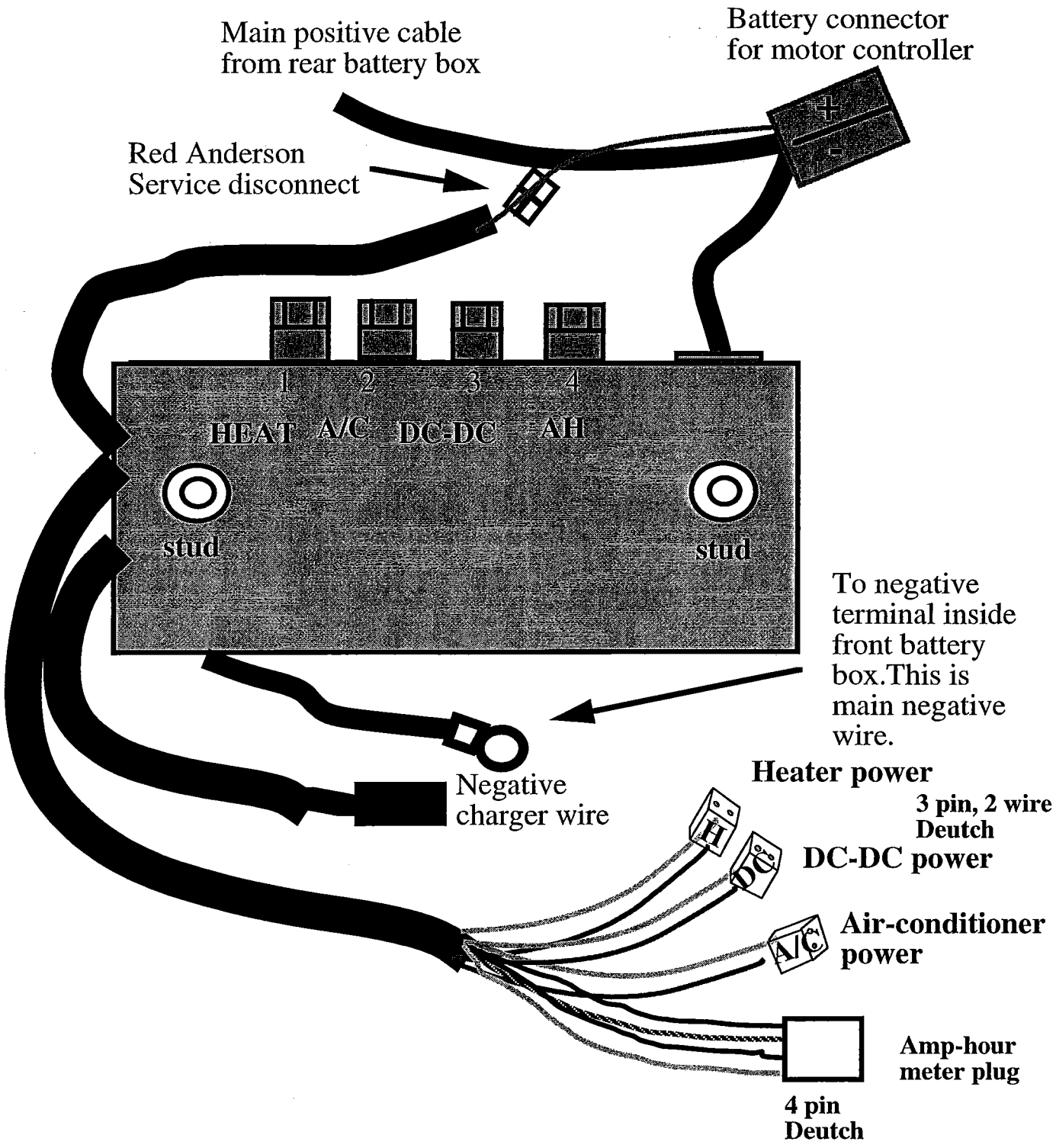
1998 LEAD ACID FORCE DC-DC WIRING



To Force 12V fuse box at driver's side inner fender

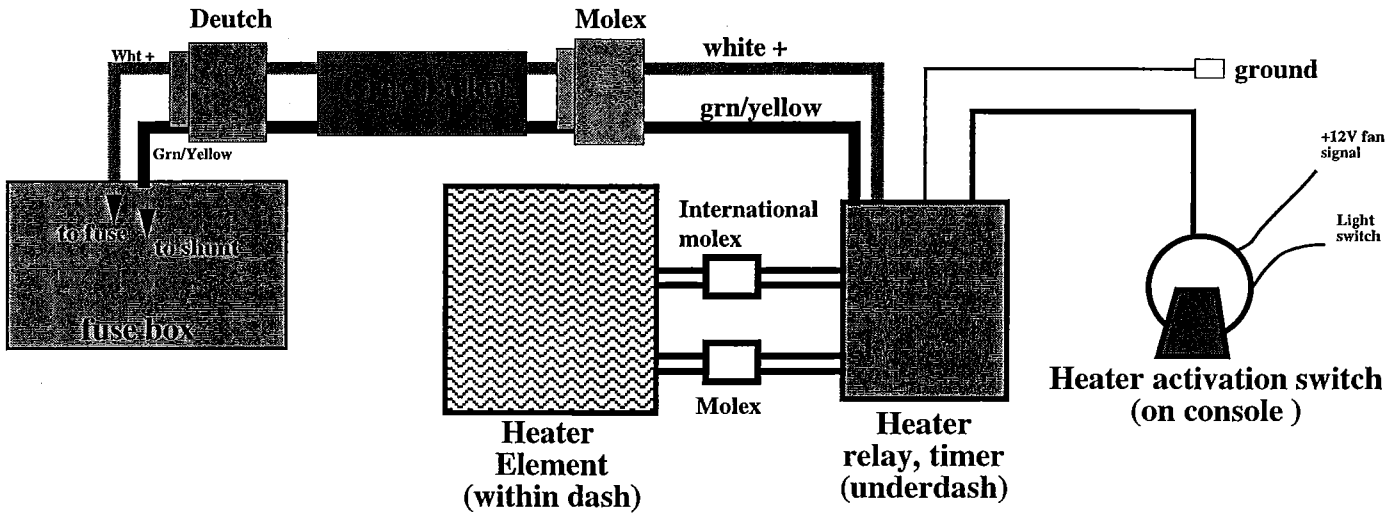


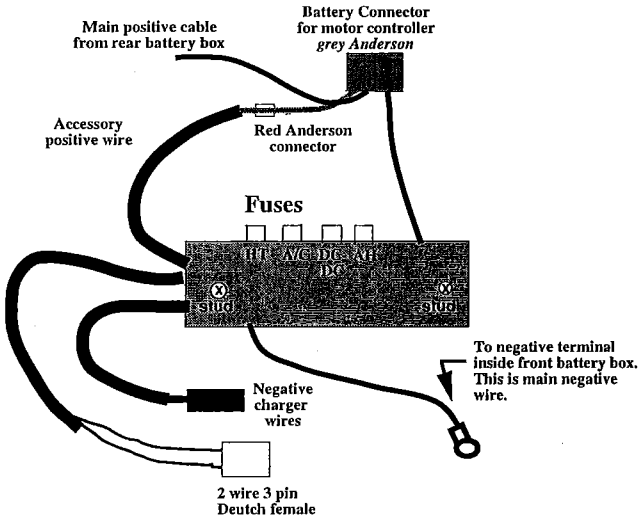
1998 LEAD ACID FORCE FUSE BOX



1.) DC-DC converter fuse (6A, 250V)
2.) Heater fuse (20A slow blow, 250V)
3.) Air conditioning fuse (20A, 250V)
4.) Amp hour counter fuse (2A, 250V)

1998 LEAD ACID FORCE HEATER WIRING





1998 FORCE AUTOMATIC IGNITION WIRING

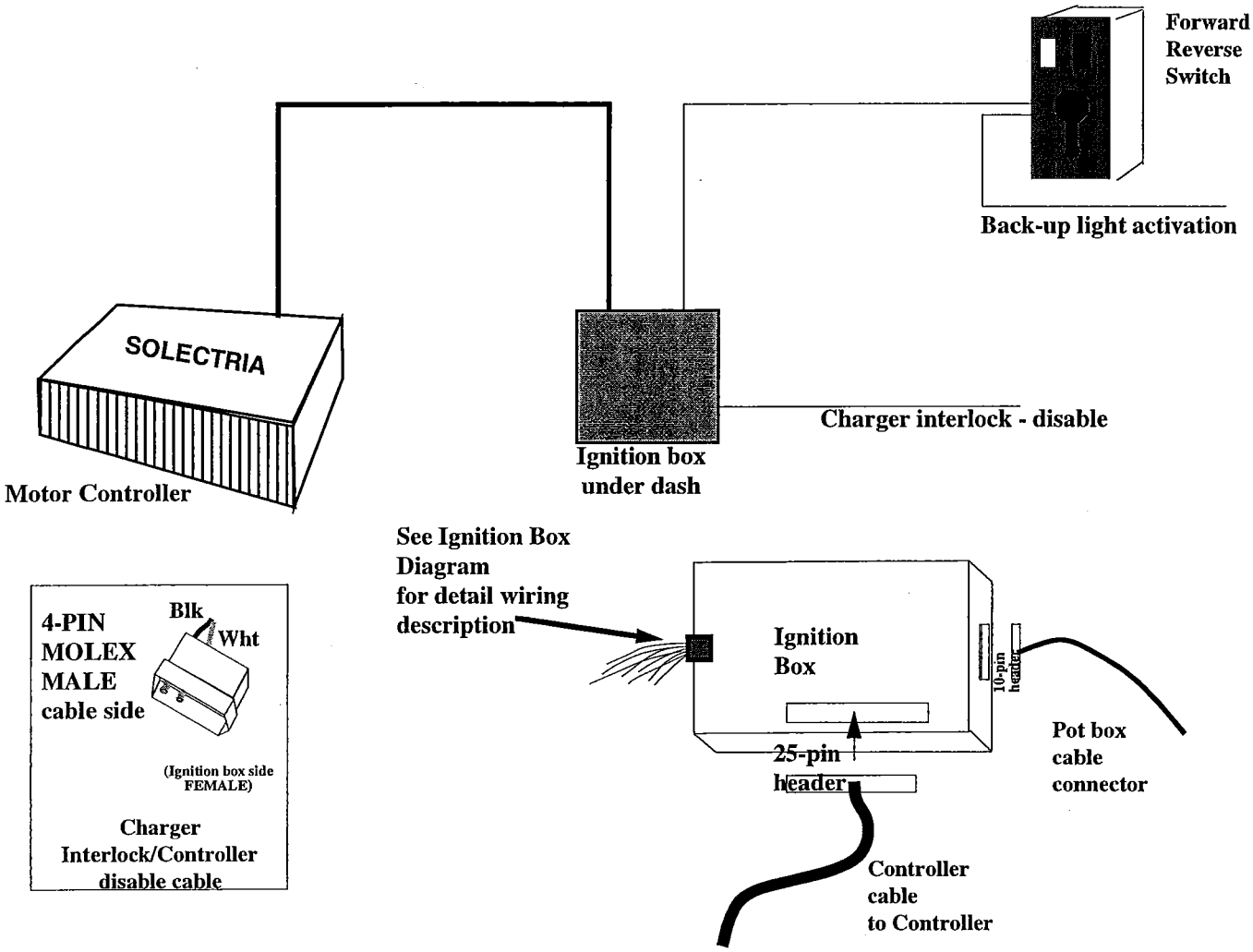
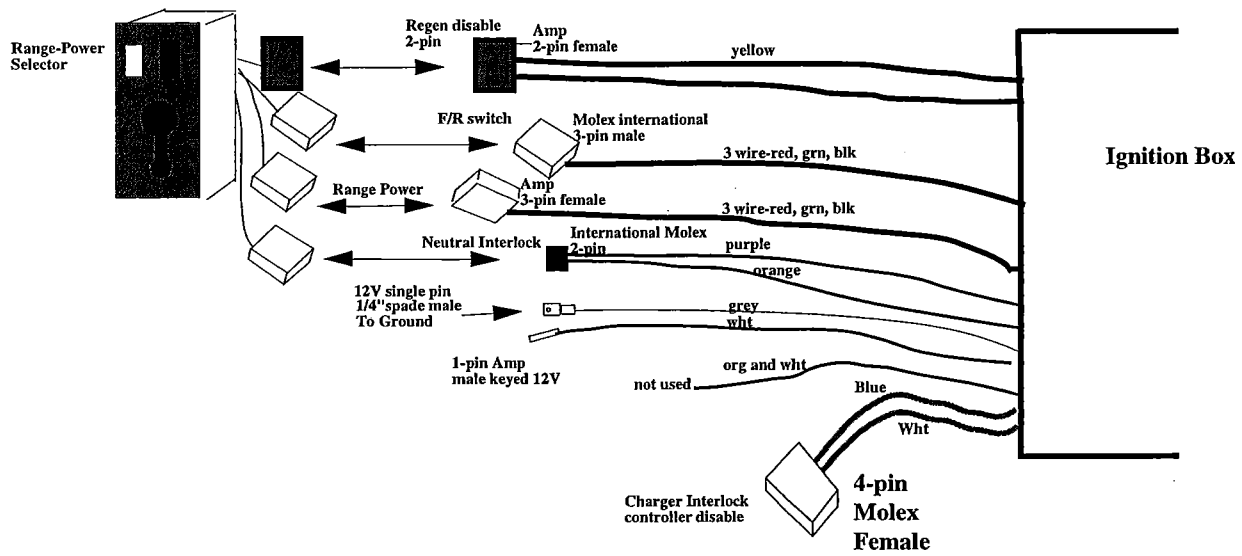
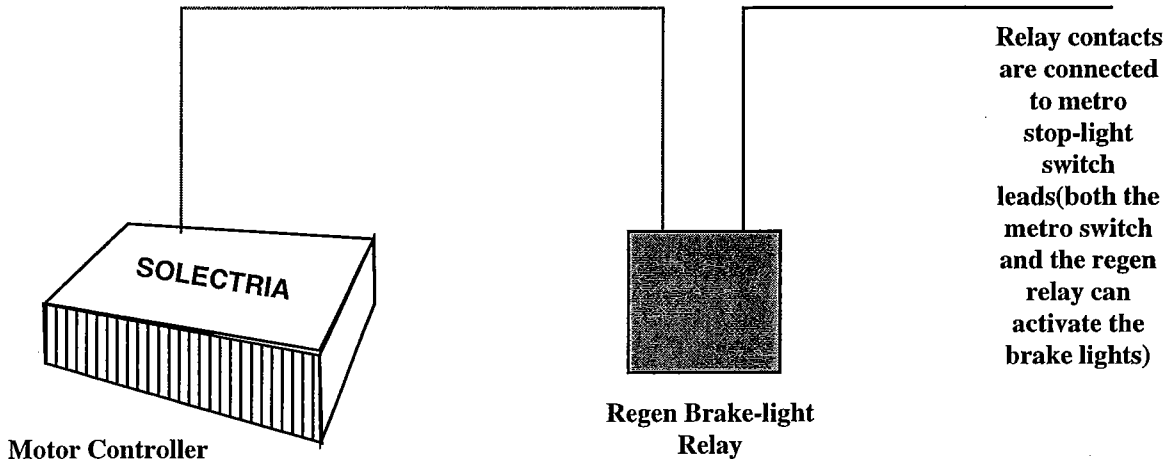
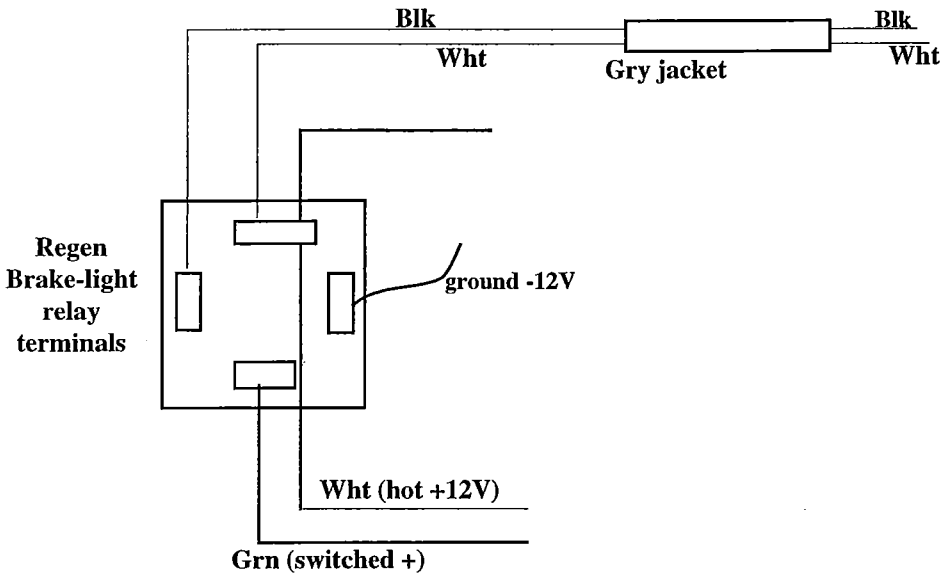


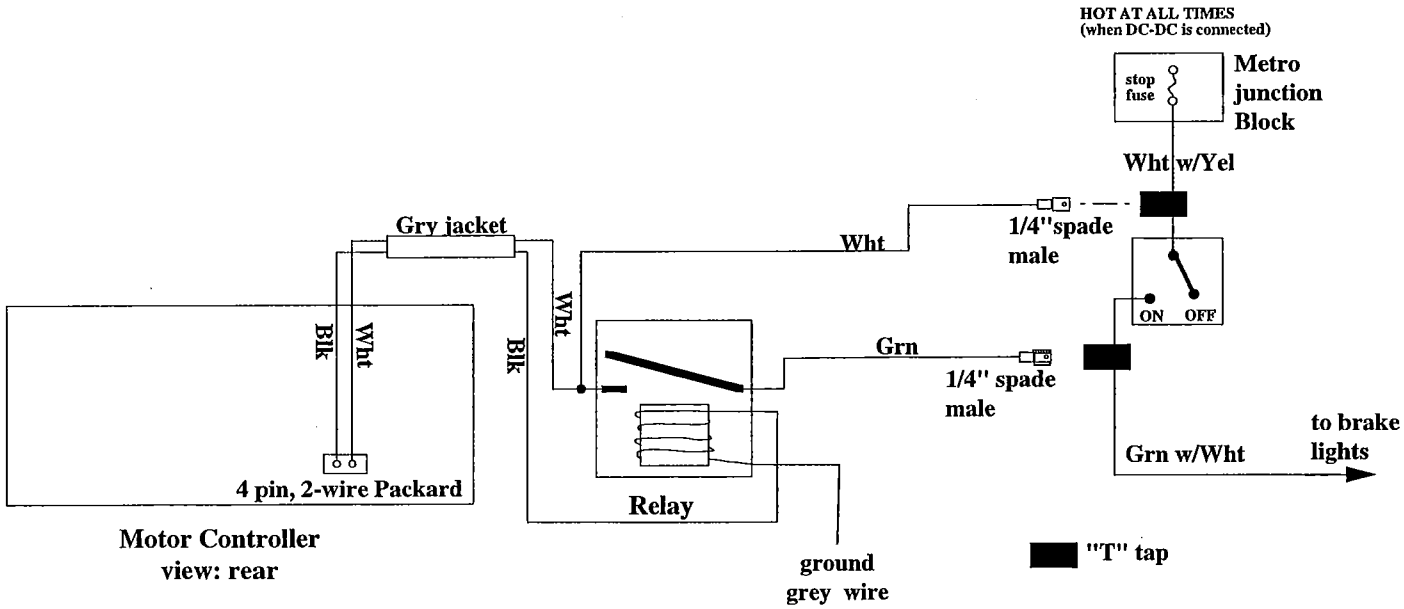
Figure 1



1998 FORCE REGEN BRAKE LIGHT WIRING

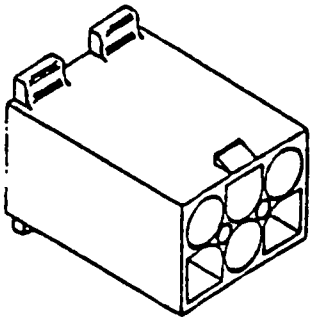


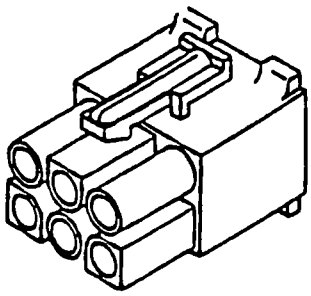




Solectria Connectors

Male **Female**



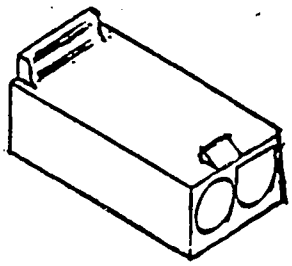


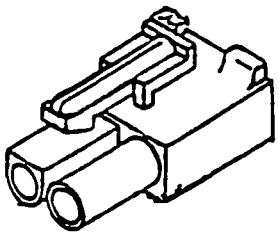
6-pin International Molex

- *Amp-Hour Counter Harness under dash*

3-pin International Molex

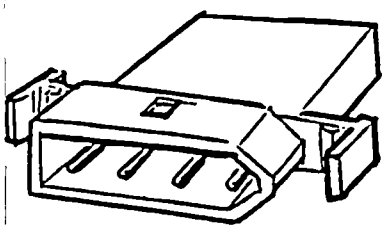
- *Range-Power (Forward-Reverse) Selector*

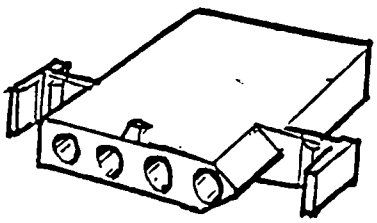




2-pin International Molex

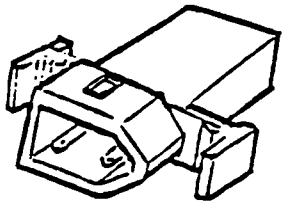
- *Neutral Interlock*
- *110VAC or 220VAC to Battery Thermal Management*

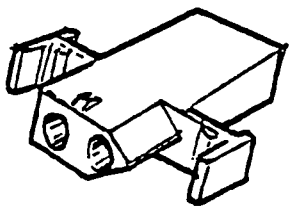




4-pin Molex

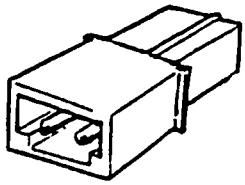
- *Charger Interlock*

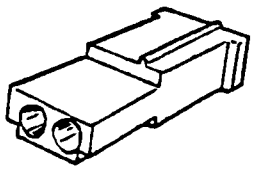




2-pin Molex

- *High-Voltage Heater under dash*





2-pin Amp

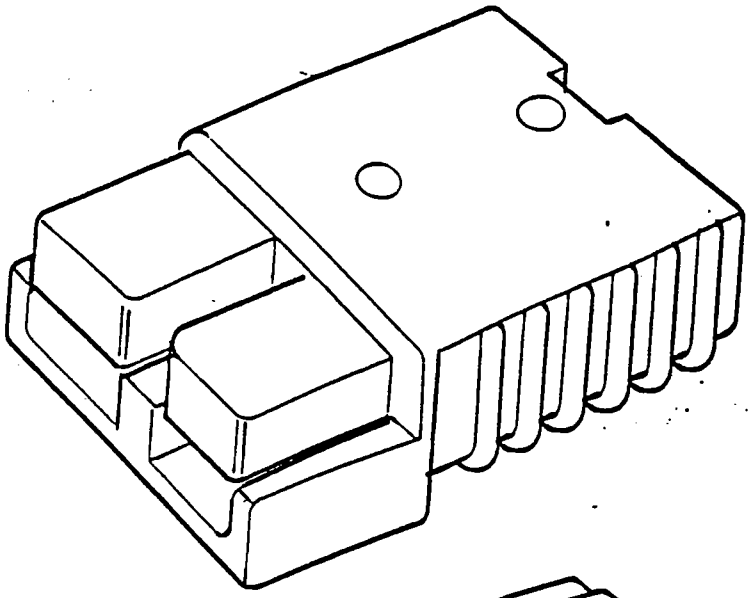
- *Regen Disable*

4-pin Amp

- *Charge Complete LED*

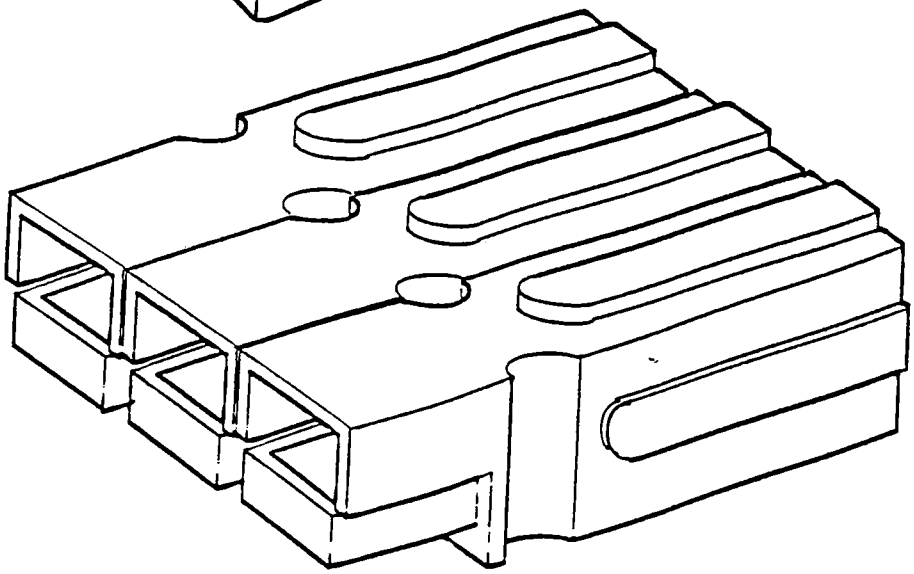
*Note: Connector nomenclature is defined by Solectria. Connector gender may not be consistent with other industries. Please note whether the pins are exposed or set into the connector.

Solectria Connectors



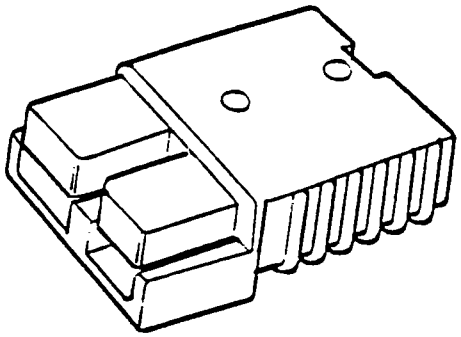
SB175 Large Grey Anderson

- *Battery to Motor Controller*



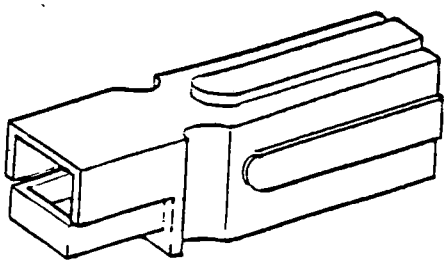
Power Pole 120

- *Red, White and Blue Motor Power Leads*



SB50 Anderson

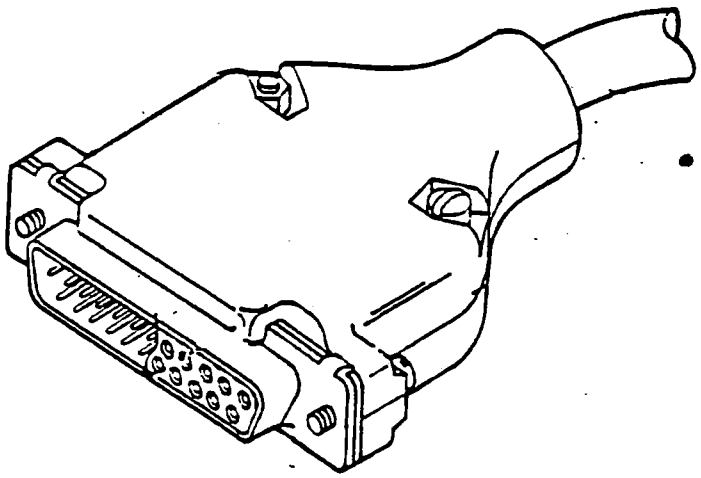
- *Red-BC3300 Charger output to Batteries*
- *Grey- DC-DC 12V Output*



Power Pole 50

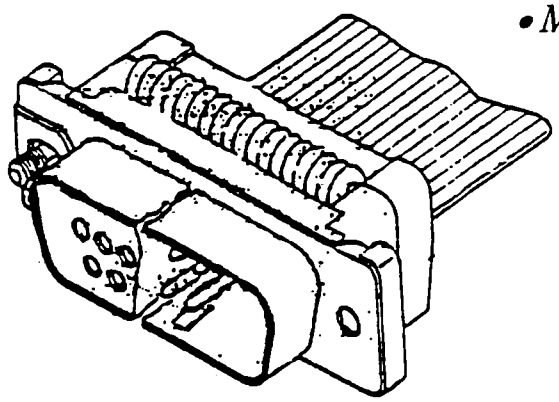
- *Red- Accessory Positive-Service Disconnect*
- *Black - Charger Negative Disconnect*

Solectria Connectors



25-pin D sub

- *Ignition Box to Motor Controller*

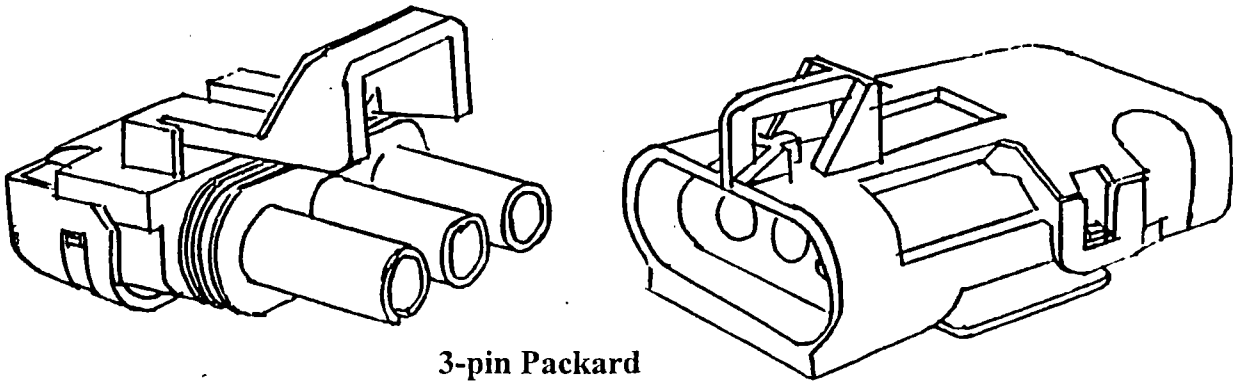


9-pin D sub

- *Motor Speed Sensor to Motor Controller*

Solectria Connectors

(3-pin model depicted)



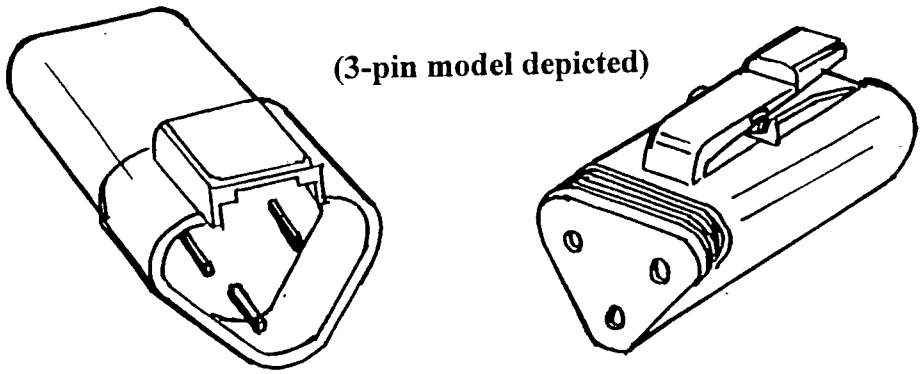
3-pin Packard

- *Battery Temperature Sensors*

4-pin Packard

- *Regen Brake Light Activation*

(3-pin model depicted)



2-pin Deutsch

- *A/C Controller to A/C motor*

3-pin Deutsch

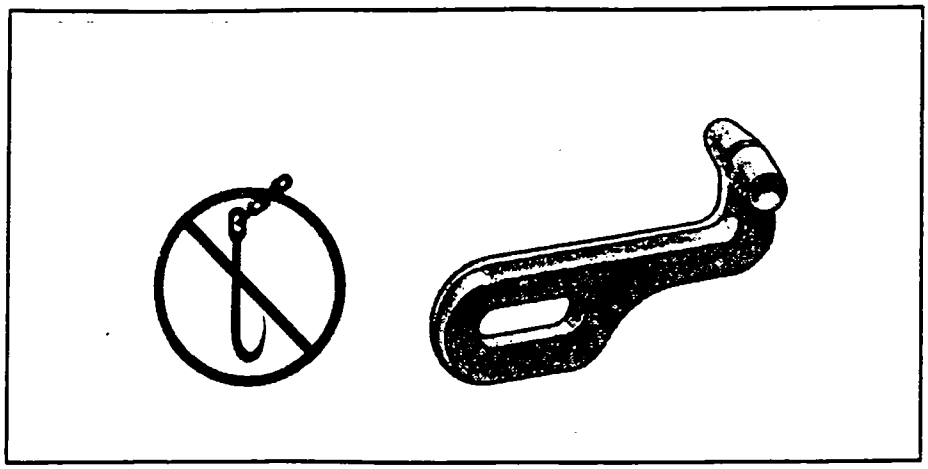
- *DC-DC, Heat and A/C out of fuse box*

4-pin Deutsch

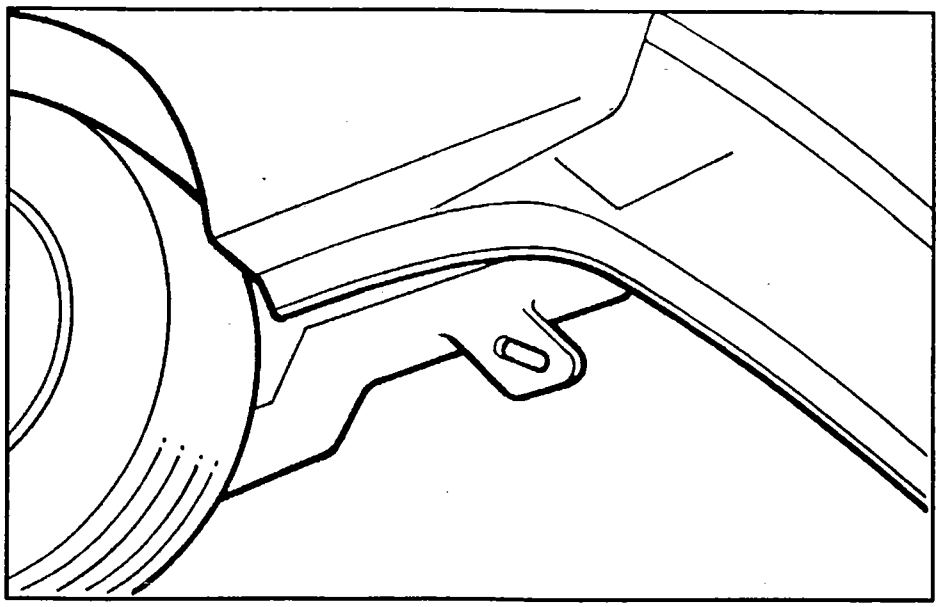
- *Amp-hour meter harness under hood*

Towing Instructions for 1998 Solectria Force

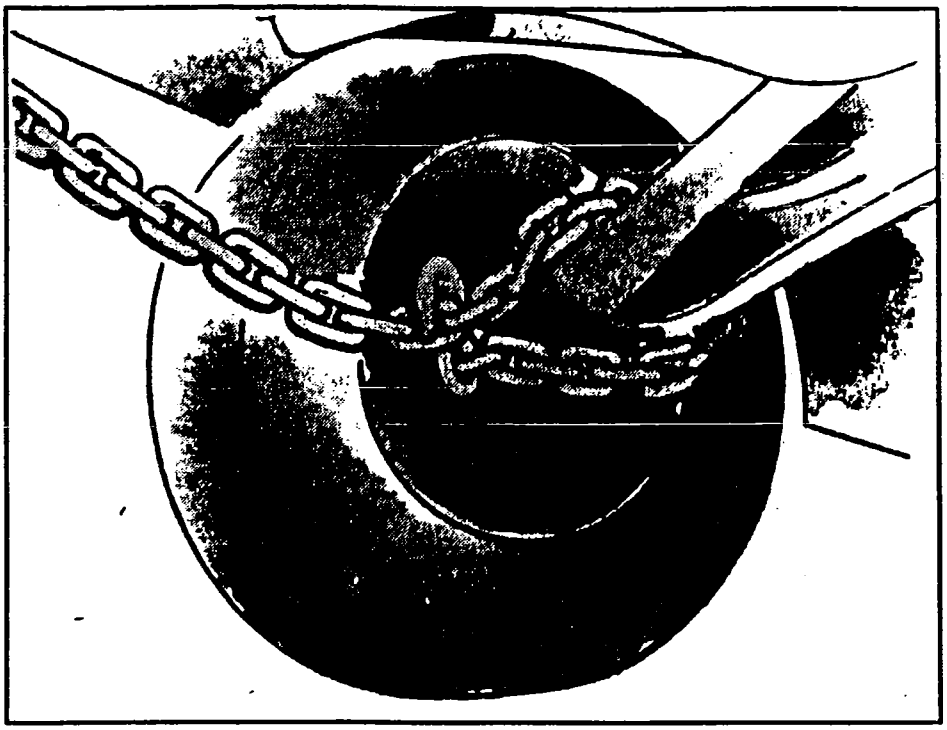
Do not attach winch cables or "J"-hooks to suspension components when towing.



Always use "T"-hooks inserted into the "T"-hook slots. See diagrams.

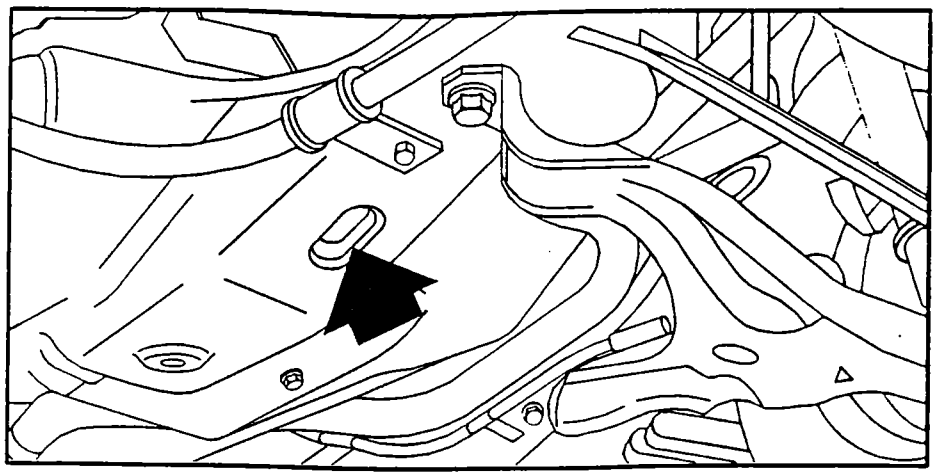


Attach T-hook chains on both sides, in the slotted holes in the brackets, just ahead of the front wheels.



Attach a separate safety chain around the outboard end of each lower control arm.

Do not wrap chain around track rods, sway bars, tie rods, or brake lines.



Attach T-hook chains to the T-hook slots in the bottom of the floor pan just ahead of the rear wheels on both sides.