SERVICE MANUAL

2001 SOLECTRIA FORCE

Electric 4-Door Sedan With Lead Acid Batteries

Nominal System Voltage: 156V

Charger: BC3KW (3.0kW/240VAC)

First Edition

SOLECTRIA CORPORATION

9 Forbes Road

Woburn, MA 01801

USA

tel 781-932-9009

fax 781-932-9219

ev@solectria.com

www.solectria.com

Foreword

CAUTION

The information provided in this manual is intended for use by persons with appropriate technical skills. Any effort to perform repairs to, or service your unit without the proper tools or knowledge required for the work can result personal injury and product damage.

HOW TO REPORT ERRORS

If, while reading through this manual, you discover an error in the technical information provided, Solectria asks that you notify its Customer Service Department at the phone number provided in your warranty. Please be prepared to provide the following information:

- Your name
- Name and edition of your manual
- Page number(s) where the error(s) appear
- Serial number of your unit

Please feel free to call with any suggestions that you may have regarding the content of your manual. If additional service information is needed or to order replacement parts, please call Monday-Friday 9AM to 5PM USA Eastern Time:

781-932-9009

or fax

781-932-9219

This manual has been prepared as a supplement to the service information contained in the Chevrolet Metro Service Manual. Information contained in this manual is based on the latest product information available at the time of publication. The right is reserved to make changes at any time without notice

Table of Contents

Force Description and Service Guidelines

This section contains a description of the 2001 Solectria Force and its major features. For operating information, refer to the 2001 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.

BATTERY INFORMATION

Solectria vehicles use sealed, starved-electrolyte lead acid batteries. Even if the modules are broken in two, the batteries will not spill significant amounts of electrolyte. However, any clear fluid leaking from a Solectria vehicle should be treated as an electrolyte that can corrode surfaces on contact.

Follow these simple safety guidelines when working on, or near batter spills:

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

BATTERY PACK

Solectria Force batteries are divided between two battery boxes. The first is located under the hood in the motor compartment and the second, in the trunk. The vehicle operates at a nominal battery voltage of 156V DC. The exact voltage level of the vehicle's battery packs depends on their state-of-charge.

High-amperage fuses are located in both the front and rear battery boxes. For safety, the high voltage system is completely isolated from the vehicle chassis and the chassis is not electrically connected to the positive or negative side of the battery. Also for safety, when the vehicle is plugged in for charging, the chassis is grounded via the AC ground.

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.

To prevent a short circuit to the vehicle chassis or other potentially live wires, use caution when handling any high voltage cables.

BATTERY CHARGER

The BC3KW battery charger is located in the trunk, on the driver's side of the vehicle. Using the battery charger, the vehicle battery packs can be recharged from a 208-240V AC 60 Hz outlet. In an emergency, the vehicle can be charged with 110V AC using the "Voltage adapter, 220 to 110VAC".

It is very important that this option is used only for emergencies and not on a routine basis. Using this option frequently will decrease the life span of the battery pack

VEHICLE WIRING CONVENTIONS

Vehicle wiring follows certain conventions. In AC circuitry, the black and white wires are hot, and ground is green. In the DC circuitry, 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.

DRIVE SYSTEM

The electric drive system includes a 3-phase AC induction drive motor, coupled to an automatic transmission.

DRIVE MOTOR CONTROLLER

The drive motor controller is located in the drive motor compartment, on top of the front battery box. The controller converts direct current (DC) electric energy from the battery packs, to 3 phases of alternating current (AC) electric energy, for use by the motor.

AIR CONDITIONING AND DC-DC CONVERTER

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.

HIGH VOLTAGE DC SYSTEMS (NOMINAL 156 V DC)

- (13) 12-Volt gel cell battery modules
- High Voltage Fuse Box
- AHC2 Amp-Hr Meter Circuit Board
- UMOC425T
- AC21 drive motor
- DC-DC Converter 575W, 12 V
- Heater
- Heater Relay
- DC 30 A/C Compressor Motor Controller
- A/C Compressor Motor
- BC3KW Charger

HIGH VOLTAGE WIRING AND CONNECTORS

- 2-pin gray Deutsch connector
- 3-pin gray Deutsch connector
- 2-pin red small Anderson connector
- 2-pin gray large Anderson connector
- 2-pin white Molex

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
- 8-pin Deutsch 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
- BC3KW Battery Charger (input side)
- Preheat computer and harness (optional)

For the safety of the operator and service personnel, the Force contains the following systems:

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

CAUTION

To prevent damage to the vehicle chassis, potentially live wires, or terminals, use caution when handling high voltage cables.

Do not touch two, separate and isolated locations of the high voltage system at different electrical potentials, simultaneously. All exposed electrical cables should be assumed to carry high voltage, regardless of the gauge of wire, and treated with caution.

Preparing the Vehicle for Servicing

CAUTION

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

SECURING THE VEHICLE

Set the parking brake 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.

To prevent the vehicle from being driven, turn the Range-Power Selector, located on the floor console, to the OFF setting.

To shut off the drive motor controller, turn the key off, as you would in a conventional vehicle. This will disconnect the motor and disable most vehicle accessories.

CAUTION

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 accessory (first) position.

DISCONNECTING HIGH VOLTAGE SYSTEMS AND ACCESSORIES

Use the following procedure to disconnect all high voltage electricity from the following auxiliary systems:

- Air conditioning
- Amp-Hour Counter
- Heat
- 12V DC-DC converter

And isolate power to:

- Battery boxes
- Drive Motor Controller and Drive Motor Controller Input Connector
- Charger and Charger Output Connector

Procedure

1. Turn key to the "Off" position,
2. Unplug the vehicle
3. Disconnect the small, red, one-pin Anderson, Service Disconnect, located between the large gray Anderson connector, from the controller and the high voltage fuse box, located near the front strut tower on the passenger's side of the vehicle.

When the Anderson Service Disconnect is unplugged and the drive motor controller is turned off (vehicle key turned to the "off" position), the electrical power of the car is now isolated to the battery boxes, the drive motor controller and drive motor controller input connector, the charger and the charger output connector.

Except for the charger, all high voltage and low voltage power to the vehicle is now disabled and vehicle systems and accessories are shut down.

DISABLING THE CHARGER

WARNING!

Solectria components with capacitors store electricity, even after being disconnected from the battery. Treat all exposed connectors with caution.

To disable the charger, disconnect the small, black, one-pin Anderson connector under the high voltage fuse box, or simply unplug the charger output wires (red, 2-pin Anderson connector).

MANUALLY DISCONNECTING THE DRIVE MOTOR CONTROLLER

To manually disconnect the drive motor controller, disconnect the large, gray, 2-pin connector located on the upper transmission support beam.

ISOLATING BATTERIES

Use the following procedures to manually isolate battery power from the vehicle.

CAUTION

For safety, only trained service personnel should open vehicle battery boxes. Never cut electrical cables. Cutting electrical cables presents additional safety hazards and is not recommended by Solectria.

WARNING!

Failure to follow these guidelines could lead to serious injury.

Procedure

1. Disconnect the red, one-pin Anderson, Service Disconnect before removing any battery interconnect wires.
2. Unplug the input to the drive motor controller
3. Unplug the charger output wires

ADDITIONAL SERVICE INFORMATION

The 2001 Chevrolet Metro Service Manual (not included, but available through a local CHEVROLET dealership) should be consulted for service information for all but the following parts of the Solectria Force:

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

LIFTING THE VEHICLE

WARNING!

NEVER position jack directly under battery box, or attempt to lift vehicle from any point on the battery box!

Procedure

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.

If using a lift, use factory recommended lifting points (i.e. reinforced sections of rocker panel). If using a floor jack at the front of the vehicle, position jack under center of reinforced section of sub-frame just forward of front battery box.

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.

WASHING

Do not wash this vehicle in an automatic car wash. Hand wash only.

SERVICE NOTES

- The diagnostic connector for the Chevrolet Metro is inoperative on the Solectria Force.
- Replacement rear coil springs must be ordered from Solectria Corporation. They are not interchangeable with the standard springs.
- 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**.
- If you attempt any fast charging of the batteries, or if you are using a non-Solectria Battery Charger, **disconnect all Solectria components that are connected to the batteries**. **FAILURE TO DO SO WILL VOID ALL WARRANTIES**.

Safety and Emergency Response Information

- Always wear safety glasses. Remove all jewelry, such as watches, rings, bracelets, and necklaces.

- No tools with exposed metal over 2" long are allowed in work area. Heat shrink metal tools over 2" long.

- 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.

- Use a fender protector pad whenever working on the car.

- 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.

- 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.)

- Unplug the red, 1-pin Anderson Service Disconnect before removing a live device. Always unplug vehicle from wall outlet while servicing.

Continued on Next Page

- Do not use fuses to connect or disconnect accessories. If you are installing an air conditioner controller or fuse, for example, follow these steps:

    1. Turn ignition key off

    2. Disconnect 110VAC or 220VAC charging cord (gas cap) or other charger

    3. Disconnect the red 1-pin Anderson Service Disconnect

    4. Install the controller or fuse

    5. Reattach the red 1-pin Anderson Service Disconnect.

    6. Plug charger cord into wall outlet

    7. 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!!**

    8. 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!**

IN CASE OF VEHICLE FIRE

In case of vehicle fire, spray the vehicle with dry chemical or carbon dioxide foam (ABC or BC extinguishers).

WARNING!

DO NOT USE WATER ON ANY FIRE IN AN ELECTRIC VEHICLE WITH LEAD-ACID BATTERIES!

Do not open the battery boxes. If a battery module is smoldering, or overheating after an accident or fire, disconnect the batteries by following the directions for isolating the battery pack. To disconnect individual batteries, refer to the specific procedure in this manual. Do not cut cables.

If this vehicle is involved in a serious accident, a system of internal fuses is designed to protect passengers and prevent damage to vehicle components.

Servicing the Solectria Drive Motor/Transmission and Vehicle Components

Description

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.

The automatic transmission is a single-speed, gear reduction drive with an integral differential. Check and change the transmission oil level according to the vehicle maintenance schedule.

CHECKING THE TRANSMISSION OIL LEVEL

Procedure

1. The vehicle must be level to get an accurate reading. 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.

2. It is necessary to add transmission oil if the sight glass is not at least half-full. To add transmission oil, remove the filler plug. The 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.

Note

The transmission oil should be replaced after the first 6,000 miles of operation and every 12,000 miles thereafter.

Procedure

1. Drive the vehicle to warm the gearbox.

2. Raise the vehicle following the lifting instructions under **Additional Service Information**.

3. 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.

4. Put a drain pan under the transmission and then remove the drain plug located on the bottom of the transmission to drain the oil.

5. Clean drain plug. Solectria recommends using LOCKTITE Pneumatic Hydraulic Seal 545. Then, re-install the drain plug. Torque to 15ft.-lbs. DO NOT OVERTIGHTEN.

6. Allow sealer to set approximately 15 minutes before adding transmission oil.

7. 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).

8. Reinstall filler plug and check for leaks. Reinstall belly pan with new tie-wraps.

Note

Never lower the vehicle without the drive axles installed. If you must move the vehicle, each of the front wheel bearings must be supported with a 9/16" bolt and nut and two 1¾" washers.

Procedure

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.

Continued on Next Page

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. 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.)

17. 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.

INSTALLING THE MOTOR/TRANSMISSION

Procedure

Installation is the reverse of removal.

Note

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 that holds the drive shaft into the transmission.

REPLACING THE AC INDUCTION MOTOR JUNCTION BOX

The AC Induction Motor Box is not user serviceable. Please contact the Solectria Customer Service Department for more information.

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 their surface, which will damage clothing. Solectria recommends wearing a chemical apron.

A fire or explosion may occur if a wrench or other metal object is placed inside a battery box. Do not place tools in the battery box or in a place where they may fall into the 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****

ACCESSING THE REAR BATTERY BOX

Procedure

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.

If vehicle is equipped with A/C, **the hose connections for the air conditioning unit must not be disconnected for this procedure**.

Procedure

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 drive 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 drive motor controller.

Continued on Next Page

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.

If the range performance of the car has been declining, even after being fully recharged, perform a discharge test.

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

The following tools are needed when either performing a manual discharge test, or using the Solectria battery discharger:

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

Procedure

1. Make sure that the battery pack is completely charged. (See definition of Fully Charged on next page). A new, fully charged 156V vehicle should read "00.00"Ah on the Amp-Hour counter. Battery performance will be expected to decrease gradually over time, but a properly functioning battery pack can be expected to reach 45Ah during a normal drive cycle.

2. Choose a local driving loop near your service facility for the test. If the vehicle is equipped with an optional ammeter, drive the car with the Range-Power selector set to Econ/Max Range. 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. Record the Ah meter's reading. This represents the actual range limit of the vehicle.

3. When the vehicle begins to experience a decline in performance, write down the reading displayed on the Amp-Hour counter

4. When the voltage drops to 135 volts and the maximum current available is less than 50 Amps, bring the car into the work area, set the Range-Power Selector to OFF, set the parking brake, leave the key ON, turn on the vehicle's high beams and set the heat and 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 batteries in one or both boxes feel cold, this could indicate a problem with the battery thermal management system. (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. While keeping the accessories on, check each battery's voltage with a reliable voltmeter. Record these numbers on a chart. **(See Battery Discharge Test Sheet).** 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!

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

1. After locating a bad battery or batteries, mark them with a waterproof marker. Write on each bad 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!

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

3. Once the whole pack has been completely recharged, remove the bad batteries and replace with new and fully charged batteries, of exactly the same type.

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

5. To ensure that all batteries are at the same state of charge when they are used and prevent battery imbalance, verify the battery pack is fully charged before removing or installing new, charged batteries.

Definition: "Fully Charged"

The Solectria Force is equipped with Sonnenschein lead acid batteries that are defined as being at a full state of charge (SOC) 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 approximately -04.30 Ah.

Calculation: 43.00 x(-0.10) = -4.30

Note

Percentages are approximate. The actual overcharge percentage will vary, but should be about 10%.

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

Safety

WARNING!

ALWAYS USE THE ON-BOARD CHARGER TO FULLY RECHARGE THE 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-insulated gloves and wear eye protection when handling battery terminals.
- Always work on one terminal at a time.
- Never allow two people to touch two, different terminals at the same time. Doing so can create a high voltage current through the vehicle body.
- Use hand tools insulated with shrink-wrap or electrical tape.
- Before disconnecting a single battery terminal, the battery pack must be completely isolated from all other components

Procedure

1. Unplug vehicle from wall outlet and 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 red, 1-pin, Anderson Service Disconnect between the fuse box and the large, gray Anderson connector to the drive motor controller.

4. Unplug the black, one-pin Anderson connector hidden underneath the fuse box. This will isolate the charger from the negative side of the battery pack. This will not isolate the charger from the positive side of the battery pack, because it is connected directly to the battery pack on the positive side through an in-line fuse located near the rear battery box.

5. Unplug the charger output wires. The red, 2-pin Anderson Connector. This will disconnect the charger completely from the battery pack.

6. If the controller is still in the vehicle, unplug the large, gray Anderson connector to the drive motor controller.

7. When removing batteries, always disconnect and remove the battery interconnect cable in the rear battery pack between batteries #6 and #7, and in the front battery box, disconnect the two, short interconnect wires between batteries #1 and #2 and between #4 and #5.

Continued on Next Page

8. If a cable needs to be disconnected in order to remove a battery, it must be completely removed. Do not disconnect one end of a cable and leave the other end connected, except if:

   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. To remove battery #1 in the front battery box, 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 is equipped with air conditioning, be careful not to hit the condenser while removing batteries**.)** ***See Appendix B for front battery box diagram*****.**

10. Note The wire length, fuse position, insulation placement and polarity of each module. Also, make a note of any other wires such as temperature sensors, charger wires, etc. You may wish to take a photo to aid in remembering the positions of components and wires.

    Some batteries have been "shaved", to remove case material for a better fit in the battery pack. Please keep track of the position of these batteries.

WARNING!

DO NOT CUT ANY WIRES

When removing any wires that exit the battery box, tape up the wire end and mark it for re-assembly. Please note that one temperature sensor for the Solectria battery charger is usually located in each battery box. It is often embedded in a ring terminal and attached or glued to a central battery terminal. This is not an electrical connection, merely a place to receive an accurate temperature reading. Do not cut this wire. Reinstall this wire in the same location.

11. Remove the batteries and completely vacuum and clean the battery box, using a clean, soft, damp cloth. Inspect, clean, and test the thermal management pad, if so equipped. A white powdery residue indicates battery leakage (**ACID**), and usually means the thermal management pad needs to be replaced. If acid residue is present, clean the area with a paste made from baking soda and water. Re-install the insulating foam, thermal management pad, clear polypropylene plastic and (shaved) batteries in that order. New batteries can be shaved by carefully removing some of the case material at the hold down protrusions with a rasp or SurForm (use old batteries as examples).

12. Compare battery placement and polarity to your wiring diagram. When connecting an entire pack, start with the interconnect wires that exit the battery box, followed by the fusible link, then the other interconnects, in order, from one battery to the next. **ALWAYS use a lock washer under the nut against the interconnect wire.**

Note

Replacement batteries **DO NOT** come with lock washers. Reuse the original washers or supply your own (5/16 split washers - stainless steel). Torque the nut to 80 in. lbs. (6.7 ft. lb., 9 N-m). *ALWAYS use two insulated wrenches when tightening bolts.*

CONFIGURATION OF TERMINALS

Solectria's standard terminal configuration is a "flag type", where the head of the bolt is located over the terminal and the wire, lock washer and nut are located on the other side. You must tighten the nut correctly.

1. Position the head of the bolt with one flat side of the hex, parallel to the battery surface.

2. Place an open-ended wrench on the head of the bolt to relieve the stress on the battery terminal, and a short socket, or closed end wrench on the nut. The two wrenches should be held close together to avoid any twisting of the terminal.

3. After double-checking each terminal, mark each bolt head and terminal with a line of red marker, paint, or fingernail polish to record that all terminals are checked.

WARNING!

Loose terminals can cause a battery fire.

4. Reposition all battery charger wires, battery temperature sensors, thermal management sensors and wires with appropriate loom and tie wraps. Double-check the polarity and proper voltage of the entire pack. If your vehicle has a nominal voltage of 156 volts, minimum voltage is 12.3 to 13.0 volts per battery (160-170 volts). If pack voltage is incorrect, double-check the polarity of each battery.

5. Confirm that all tools have been removed from the battery box. Reposition all top insulating foam. Replace the battery box covers, re-connect the battery charger, controllers, and service disconnect, with the service disconnect being the last connection made.

6. Plug the vehicle in to fully charge all batteries.

7. Cycle the batteries gently *at least twice.* To cycle the batteries, turn on the car's high beams, electric heater (place vent fan on high and open car windows so heat can exit). Leave on until approximately 30.00 amp-hours have registered on the Amp-Hour Meter and then recharge the vehicle.

WARNING!

NEVER allow the battery pack to discharge 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.

Notes

- 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. A 1hour timer controls the heater relay. The heat will need to be turned off, then on again approximately every hour.
- 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.

Procedure

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

Procedure

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 that covers the fan at the center-front of the battery box.
5. Remove the four Phillips machine screws that 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

Procedure

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.***

DRIVE MOTOR CONTROLLER

The drive 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 also regulates the energy flow to the motor based on input received via the accelerator pedal, pot-box, the motor speed sensor and the ignition box.

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

REMOVING THE DRIVE MOTOR CONTROLLER

Procedure

1. Turn ignition key off and apply parking brake.

2. Disconnect the high voltage input to drive motor controller (large gray Anderson connector) and 2-pin, Packard connector (12V ignition for the drive motor controller)

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 (if present) 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 attached to the side of the strut tower is reusable.

6. Remove the 1/4 - 20 nuts and washers that secure the drive motor controller to rubber mounts and lift it off the mounts.

INSTALLING THE DRIVE MOTOR CONTROLLER

Installation is the reverse of removal. Follow all safety precautions and be sure to replace any tie-wraps that were cut off.

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*.**

REMOVING DC-DC CONVERTER

Procedure

1. Turn ignition key off and set parking brake.
2. Disconnect the 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 the vehicle.

INSTALLING THE 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*.

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.

REMOVING THE ABC-1

Procedure

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.

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.

Procedure

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

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 8-pin cable. The Amp-Hour Meter display is integral with the instrument cluster/speedometer assembly. The Amp-Hour circuit board is located inside the high voltage fuse box, under the hood of the vehicle. The circuit board 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.***

Procedure

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.

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.

5. Working from underneath the dashboard, disconnect the 8-pin Deutsch connector to the Amp-Hour display.

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. (Access may be more easily gained from underneath the dash) Pull it straight off. Remove the 3 multi-pin electrical connections also in back of the instrument cluster.

Continued on Next Page

8. Pull the instrument cluster out of the vehicle, complete with wires to the Amp-Hour Meter display, carefully feeding the harness 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 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.

Procedure

1. Turn the ignition key off, set the parking brake and unplug the vehicle from the wall.

2. Unplug the red, 1-pin Anderson Service Disconnect

3. Unplug the following (5) connectors to the high voltage fuse box
   a. The black, 1-pin Anderson Connector (This is Charger Negative)

   b. The (3) 3-pin Deutsch Connectors One each for the DC-DC Converter, Air Conditioning and Heat

   c. 8-pin Amp Hour Counter Connector

4. Carefully cut the zip-ties holding the wires to the vehicle's firewall.

5. Disconnect the large, gray Anderson Connector to the drive motor controller.

6. If equipped, remove the Air Conditioning motor controller from the upper beam.

7. Remove the (2) ¼" nuts from the high voltage fuse box.

8. Remove the high voltage fuse box out from underneath the beam.

9. Unscrew the 4 screws holding down the fuse box cover and remove the cover.

CAUTION

Before removing the circuit board, measure the voltage between one of the flat-head screws on the circuit board and a wire to one of the fuses. If voltage is present, then the red, Anderson Connector has not yet been disconnected. Disconnect the red, Anderson Connector at this time and then measure the voltage between the screw and the chassis of the vehicle.

Watch the voltage reading. Normally, the starting voltage reading will be greater than 50V and quickly decrease to zero. When the voltage has decreased to less than 6V, it is safe to continue.

Continued on Next Page

10. Take note of the position of the black, multi-pin connector on the circuit board.

11. Disconnect the black, multi-pin connector.

12. Take note of the position of the red wire in the gray, wire junction block. (It is in the outer-most pin position)

13. Release this single, red wire from the AMP Hour fuse by pushing the white tab on the wire junction block. (It is the outer most pin position)

14. Unscrew the (2) screws holding the board to the shunt. Be careful to not loose the copper washers underneath the board.

INSTALLING THE AMP-HOUR CIRCUIT BOARD

Procedure

Installation is the reverse of removal. Apply a small amount of silicon sealant, or hot glue, to the 10-pin header. Make sure that the (2) copper washers underneath the circuit board are in position and that as the last step the red, Anderson Disconnect is reconnected.

The 2001 Solectria Force is equipped with a 3.00 kW Battery Charger (model BC3KW), located in the vehicle trunk, on the driver's side.

WARNING!

If you attempt to fast charge the batteries, disconnect all Solectria components connected to the batteries. FAILURE TO DO SO WILL VOID ALL WARRANTIES. Contact Solectria Customer Service Department if you are unsure which components may be affected.

REMOVING THE BATTERY CHARGER

Procedure

1. Turn ignition key off and set parking brake. Unplug vehicle from the wall outlet.
2. Pull rear seat forward.
3. Pull aside the carpet on the driver's side of the trunk and remove the foam from trunk floor.
4. Remove (4) ¼" - 20 nyloc nuts attaching the charger to the charger's rubber mounting brackets, gently pull charger up and out approximately 8" to access the other connectors, found behind the sidewall carpet.
5. Unplug DC output connector (red 2-pin Anderson) and the 220VAC input connector.
6. Unplug the two, 3-pin Packard connectors to the battery temperature sensors
7. Unplug LED interface box connector and leave inside vehicle and remove the charger.

Note

Before installing a new battery charger, check the in-line fuse of positive wire, next to the driver's side strut tower on the trunk floor.Procedure

Installation is the reverse of removal. *Be sure that the vehicle is unplugged from the wall.*

The motor speed sensor is located on the rear of the motor, under the motor end plate. It provides the drive motor controller feedback on the direction and speed of the motor.

Use the following procedures to remove, then reinstall and recalibrate the Motor Speed Sensor assembly.

Tools

(1)-7/16-inch Socket Wrench

(1)-Phillips-head screwdriver

(1)-Non-metallic feeler gauge (.025 inches)

REMOVING THE MOTOR SPEED SENSOR

Procedure

Use the following procedure to remove the Motor Speed Sensor

1. Remove the (4)- sensor cover retaining bolts, using the 7/16-inch socket wrench.
2. Remove the sensor cover.
3. Remove the (2)- Phillips head screws that hold the Motor Speed Sensor to the aluminum bracket.
4. Remove the hex bolt that attaches the strain relief to the motor end-bell.

Use the following procedure to reinstall the Motor Speed Sensor.

Note

During installation, pay attention to the orientation of the Motor Speed Sensor.

Procedure

1. Face the wires of the Motor Speed Sensor towards you. The RED wire must be on your left and the mounting holes must be offset towards the top.

2. Attach the Motor Speed Sensor to the aluminum bracket using (2)- Phillips-head screws.

3. Check the gap between the sensor wheel and the Motor Speed Sensor, with a .025 inches non-metallic feeler gauge.

4. If the gap between the sensor wheel and the Motor Speed Sensor is too large or too small, adjust the gap by loosening the (2), 5/32 hex Allen bolts that attach the sensor bracket to the motor, and slide the sensor bracket towards or away from sensor wheel.

5. When the gap measures .025-inches, tighten bolts.

6. Attach the sensor cover with the (4)- sensor cover retaining bolts, using the 7/16-inch socket wrench.

7. Attach the strain relief for the sensor cable with the hex bolt.

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. When finished checking or replacing fuse, plug in red connector.

REMOVING THE A/C CONTROLLER

Procedure

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 drive motor controller.

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 that hold the controller to the passenger side upper beam bracket and remove it from the vehicle.

INSTALLING THE A/C CONTROLLER

Procedure

Installation is the reverse of removal. Re-connect the red Anderson connector.

The ignition box is an electronic device which gives the drive 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.***

REMOVING THE IGNITION BOX

Procedure

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.

Continued on next page

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 is required for this sub-procedure)

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

INSTALLING THE IGNITION BOX

Procedure

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.

REMOVING THE BRAKE VACUUM PUMP

Procedure

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

INSTALLING THE BRAKE VACUUM PUMP

Procedure

Installation is the reverse of removal.

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

REMOVING THE RANGE-POWER SELECTOR

Procedure

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:
4. 2-pin male mini-Molex (black wires) to Regen relay (reverse lights)
5. 3-pin female international Molex (red, black, and white with red stripe wires) to ignition box (forward/reverse signal)
6. 2-wire, 3-pin male Amp connector (black and orange wires) to ignition box (power saver signal)
7. 2-pin male international Molex (purple wires) to ignition box (neutral interlock)
8. Unplug the 2-wire connector from the regen disable switch (yellow wires).
9. 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 connector behind glove box
10. Remove unit from vehicle.

Procedure

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 SYSYTEM(OPTIONAL)

The Preheat system consists 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***.

REMOVING THE CABIN PREHEAT SYSTEM

Procedure

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 the upper left corner of the panel only and 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)

INSTALLING THE CABIN PREHEAT

Procedure

Installation is the reverse of removal.

APPENDIX A

Troubleshooting Guide 2001 Solectria Force

- **Nominal System Voltage: 156V**
- **Batteries: Lead Acid**
- **Battery Charger: Solectria BC3KW**

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.*
	Ignition key is not in "ON" position.	Turn ignition key on (2 clicks).

SYMPTOM	CHECK FOR	PROCEDURE
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 drive motor controller. If lower than 100V, turn the key off, open the rear 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 front 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.*
	Drive motor controller. Does drive 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.	Set the Range-Power selector to "NORMAL" and push the accelerator pedal all the way down. 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.*.

SYMPTOM	CHECK FOR	PROCEDURE
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 are not operating.	**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.*
	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.

SYMPTOM	CHECK FOR	PROCEDURE
Air Conditioning (A/C) not working	**No 12V signal to A/C controller.**	**WARNING! STAY CLEAR OF AIR CONDITIONING 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 21-22 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.

SYMPTOM	CHECK FOR	PROCEDURE
Air Conditioning (A/C) not working (Continued)	**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.
Brakes not working properly	**Vacuum pump not working or vacuum switch not working.**	To check if pump is working, turn key on and listen for pump after applying brakes several times. If pump doesn't run, check if +12V DC is present at pump terminal and at switch. Also, check switch ground.
	Vacuum leak or vacuum low.	Let the pump stop running, apply brakes three times and note the feel of the pedal. If you get less than three pumps on the brake pedal before it feels stiff or if the vacuum pump doesn't stop running within 60 seconds, you may have a vacuum leak. Check for leak or low vacuum with vacuum gauge. Vacuum switch should shut off at 19" of Hg.

SYMPTOM	CHECK FOR	PROCEDURE
Vehicle trips GFI (Ground Fault Interrupt) Circuit	**Water and salt in AC plug or extension cord**	**With charging cord unplugged** at both ends, wash the two ends in hot soapy water. Rinse and dry. Wash off AC plug at charge port (gas cap) on vehicle with distilled water and an old tooth brush.
	Charger faulty.	Bypass the charge port by plugging the extension cord directly into the charger. If the GFI still trips, then call Solectria
	GFI Circuit faulty.	Have GFI circuit checked by licensed electrician. Alternate models or makes may work more reliably with Solectria chargers. Call Solectria for more details.
	Short in battery thermal management system.	Locate AC junction box in trunk. One at a time, unplug the two (2) wire connectors marked front and rear (black and clear wires). If GFI trips with "front" or "rear" connected, then open the corresponding battery box and inspect the integrity of the circuit. *See "Checking Thermal Management" in Section II.* **NOTE**: The batteries must be below 60°F or the thermal sensors will be "open" and this test will be invalid.

SYMPTOM	CHECK FOR	PROCEDURE
BC3KW equipped vehicle is not charging. Numbers at the Ah Counter are not counting down	**No power from wall outlet.**	Check that extension cord has 110/220V at the vehicle end. Reset circuit breaker or GFI.
	LED light is not on at trunk-mounted charger interface box. No AC voltage input to charger.	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 does not operate, contact Solectria Corporation. The charger may have to be replaced.

SYMPTOM	CHECK FOR	PROCEDURE
BC3KW 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.**	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.
	Charger is in fault mode: Bad signal from temperature sensor.	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.

SYMPTOM	CHECK FOR	PROCEDURE
BC3KW equipped vehicle is not charging - Yellow LED is lit on trunk-mounted charger interface box (cont'd)	**Charger is in fault mode: Batteries are too hot (over 130°F)**	Unplug vehicle. Disconnect the temperature sensors from the interface box. Check for resistance on both front and back temperature sensor connectors. If resistance is lower than 10k ohms, plug the temperature sensors back in and park the car in shade to let batteries cool. Reset the charger by unplugging the vehicle, wait five (5) seconds, and plug it back in again.
	Batteries are too cold (under 32°F)	With vehicle unplugged and temperature sensors unplugged from the interface box, measure resistance at temperature sensor harness. If the batteries are cold the resistance will be higher than 50k ohms. If car is equipped with automatic battery thermal management system, leave the vehicle plugged in for at least eight (8) hours. If the batteries are still below 32°F the following day, then move vehicle indoors and check thermal management system operation. See "*Checking Thermal Management" in Section II.*

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 for details). If okay, replace the ignition box.

PROCEDURE	STEPS
Checking Motor and Controller	Make sure the vehicle is unplugged and the parking brake is securely set. Make sure that the ignition circuit is working by listening for ignition relay 'click' under dash. *Refer to "Checking Ignition Circuit" in previous section*. Turn the ignition switch off and on with the Range-Power selector in the "OFF" setting. Listen and/or feel for the controller to 'clunk' when the key is turned on. If the controller does not clunk, check battery pack voltage at gray Anderson connector. If approximately 156V is present, check the integrity of the 25-pin cable both at the controller and at the ignition box. If it appears okay, then call Solectria for further testing of the 25 pin cable or a replacement controller. If the controller 'clunks', but the motor does not turn, check the 9-pin cable from the motor speed sensor. It may also be necessary to perform a pot-box resistance test (call Solectria for details), or a motor speed sensor adjustment/replacement. IF INSTALLING A NEW CONTROLLER: Sometimes the new controller is out of phase with the motor. Swap the red and white cables coming from the motor at the red, white, and blue connector.

PROCEDURE	STEPS
Checking Thermal Management	The function of thermal management is to maintain the batteries at a temperature of at least 68°F during most conditions and at a temperature not less than 30°F 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°F. 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°F. 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°F, 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°F, call Solectria for a replacement temperature sensor box.

Appendix C

- **Tools and Test Equipment Available Through Solectria**
- **Scheduled Maintenance**

Essential Tools available only from Solectria	Price
Solectria Diagnostic Test Box (ignition/potbox bypass)	$400.00
Probe set for Deutsch connectors	$80.00
Probe set for Packard connectors	$80.00
TOTAL	**$560.00**

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

All prices subject to change without notice.

Solectria Electric Vehicle
Scheduled Maintenance

Item	Odometer (miles) 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

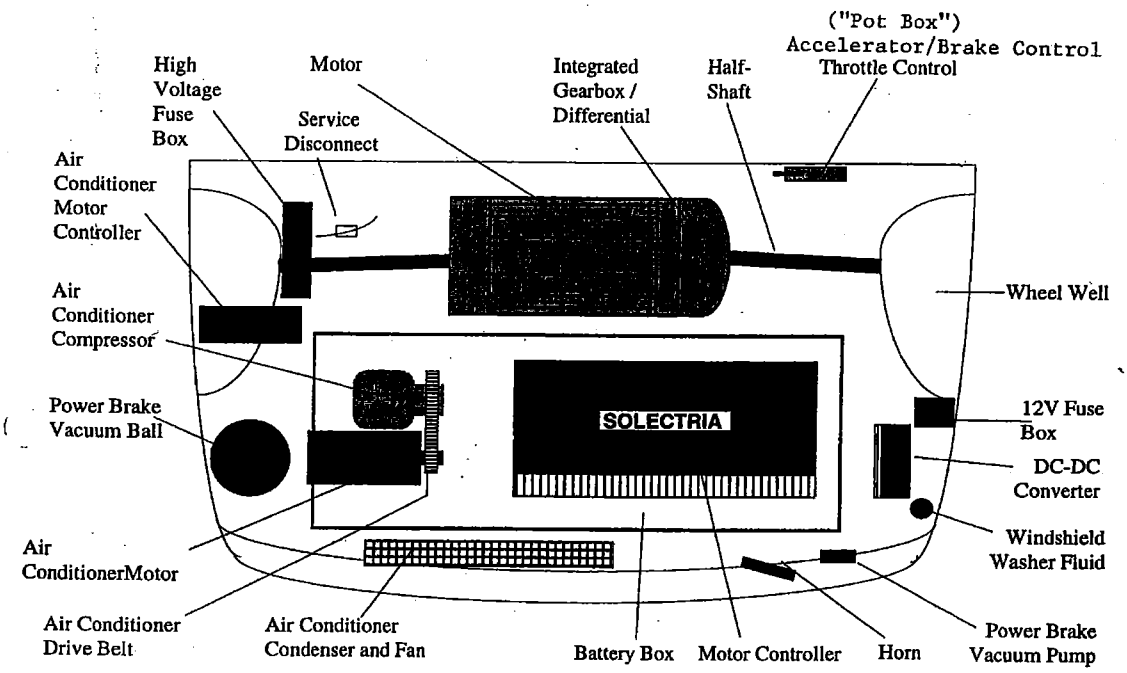
Appendix D

DIAGRAMS

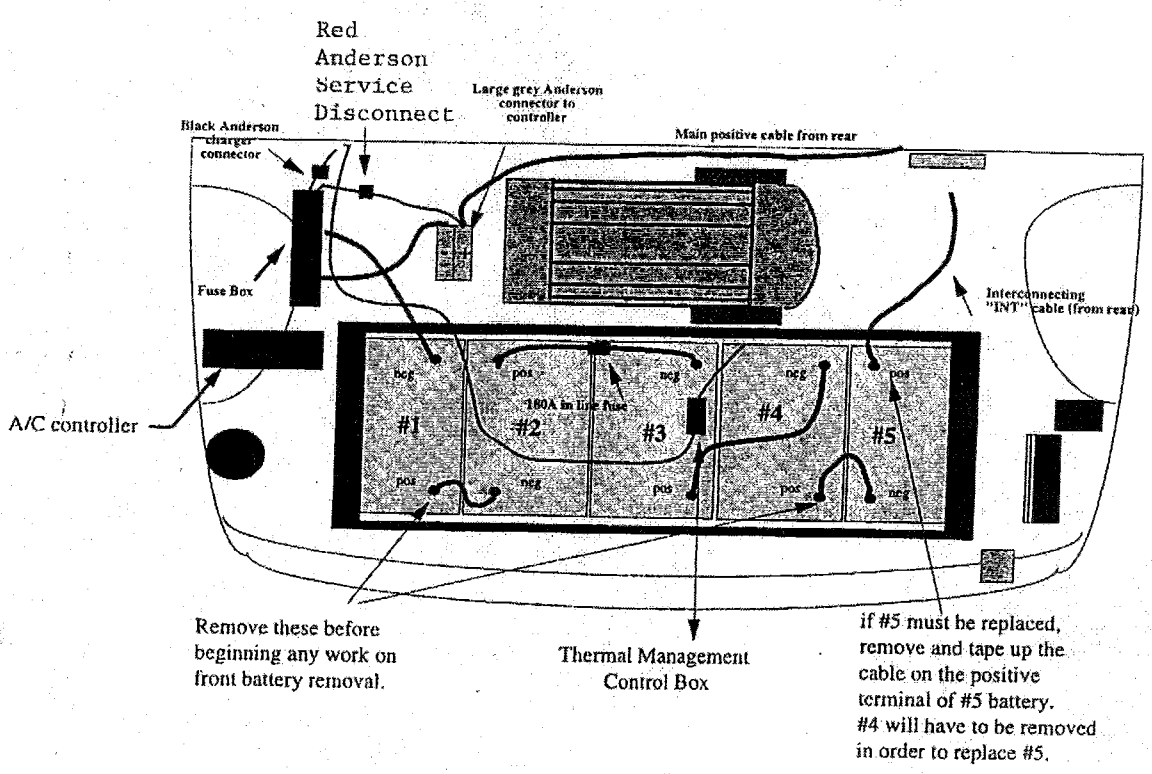
- **Layout and Wiring**
- **Connectors**
- **Towing**
- **Battery Discharge Test Form**

2001 FORCE

DIAGRAM OF EQUIPMENT UNDER THE HOOD

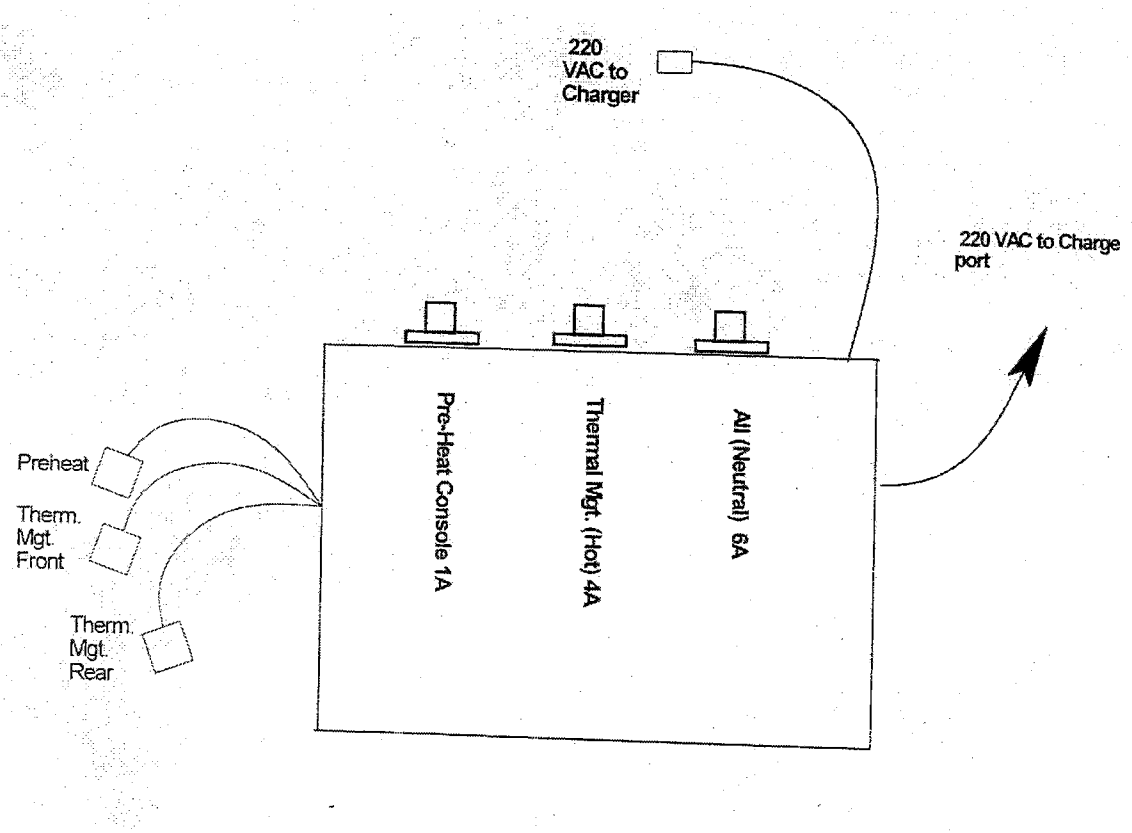


2001 LEAD ACID FORCE FRONT BATTERY BOX

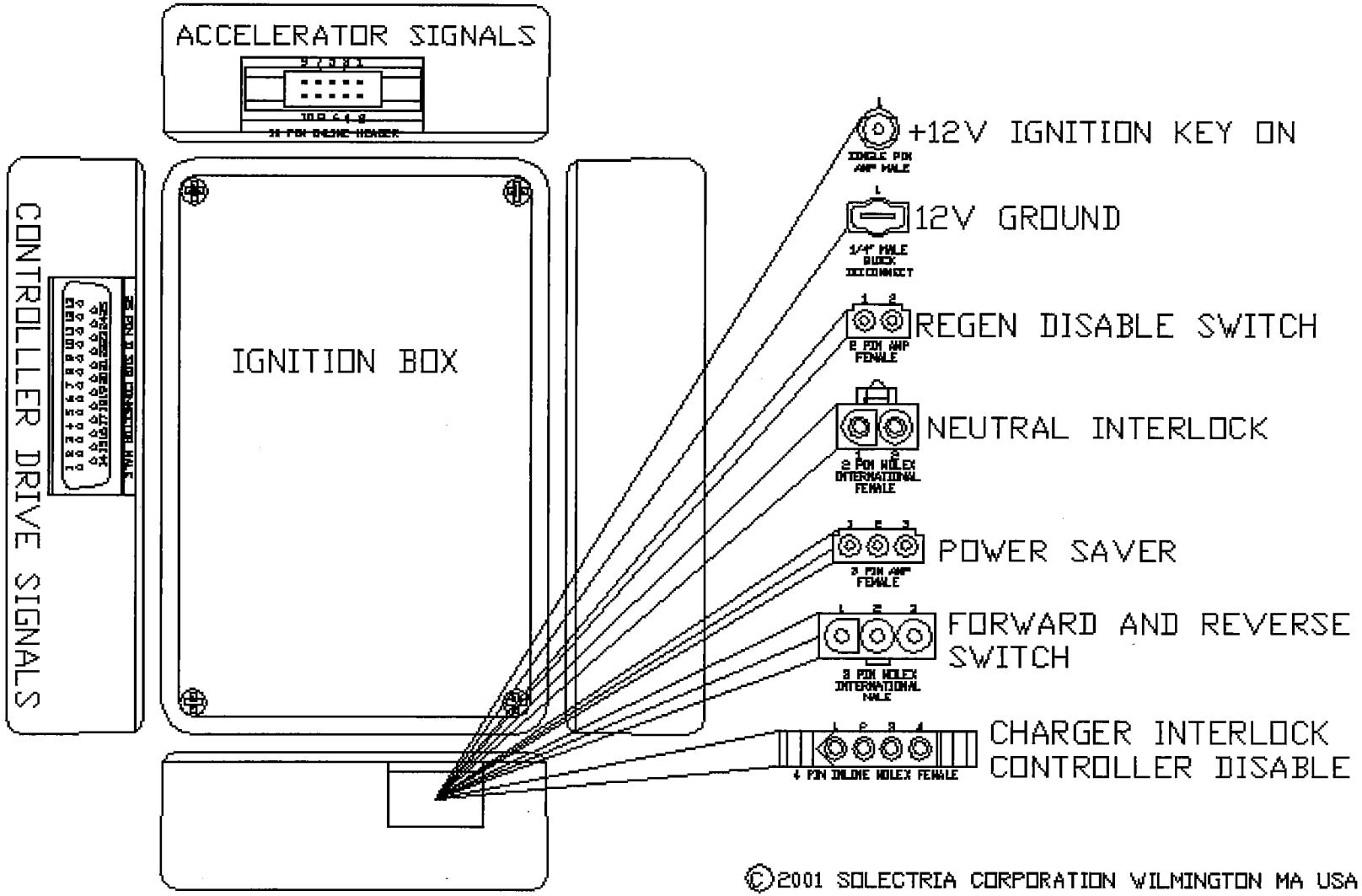


WARNING: ALWAYS UNPLUG THE VEHICLE FROM 110-220VAC CHARGING SUPPLY-(GAS CAP). DISCONNECT THE RED ANDERSON ACCESSORY CONNECTOR, BLACK ANDERSON CHARGER CONNECTOR, AND THE GREY ANDERSON CONNECTOR TO CONTROLLER BEFORE REPLACING ANY BATTERY!

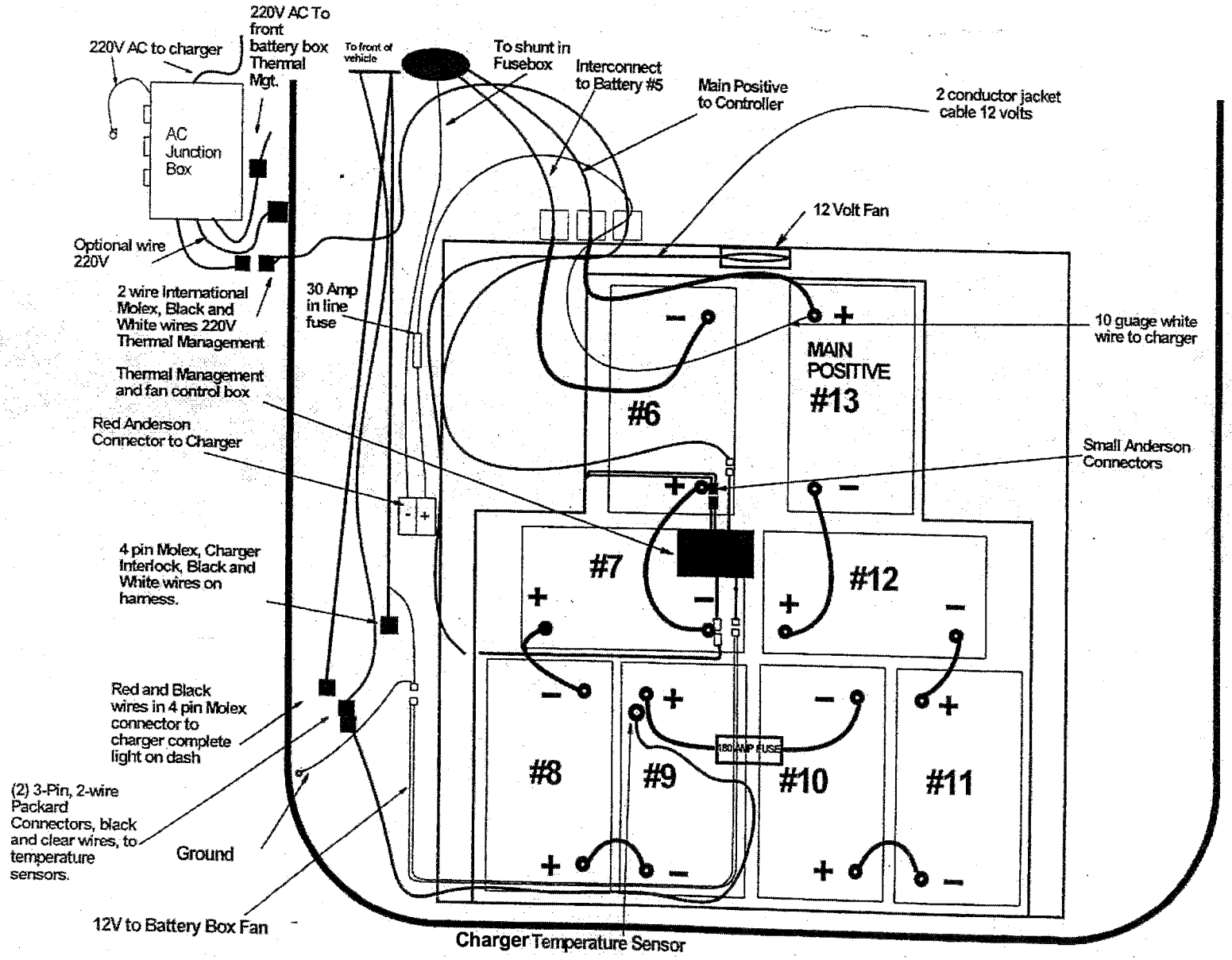
2001 SOLECTRIA FORCE AC JUCTION BOX (FOR VEHICLES with BC3KW)



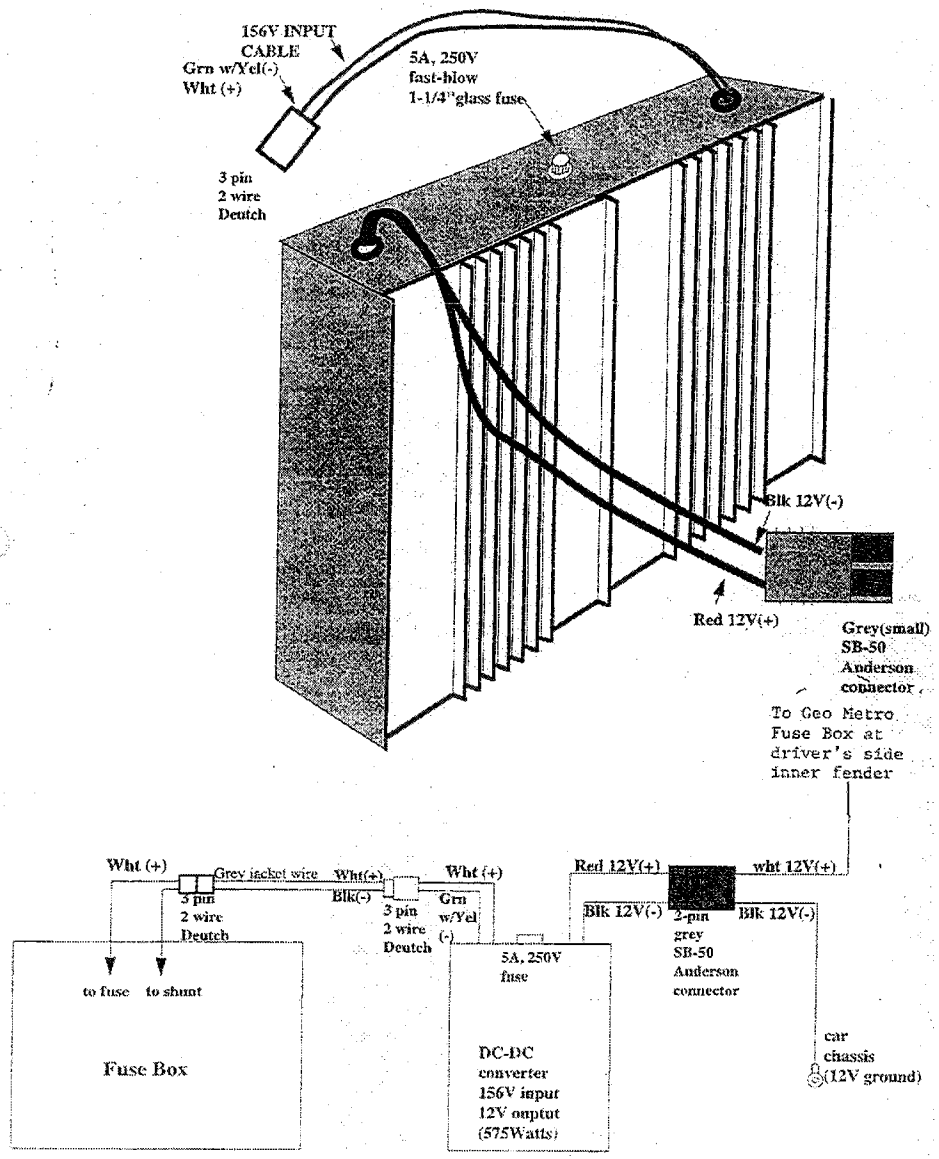
ACTUAL SIZE DRAWING OF IGNITION BOX



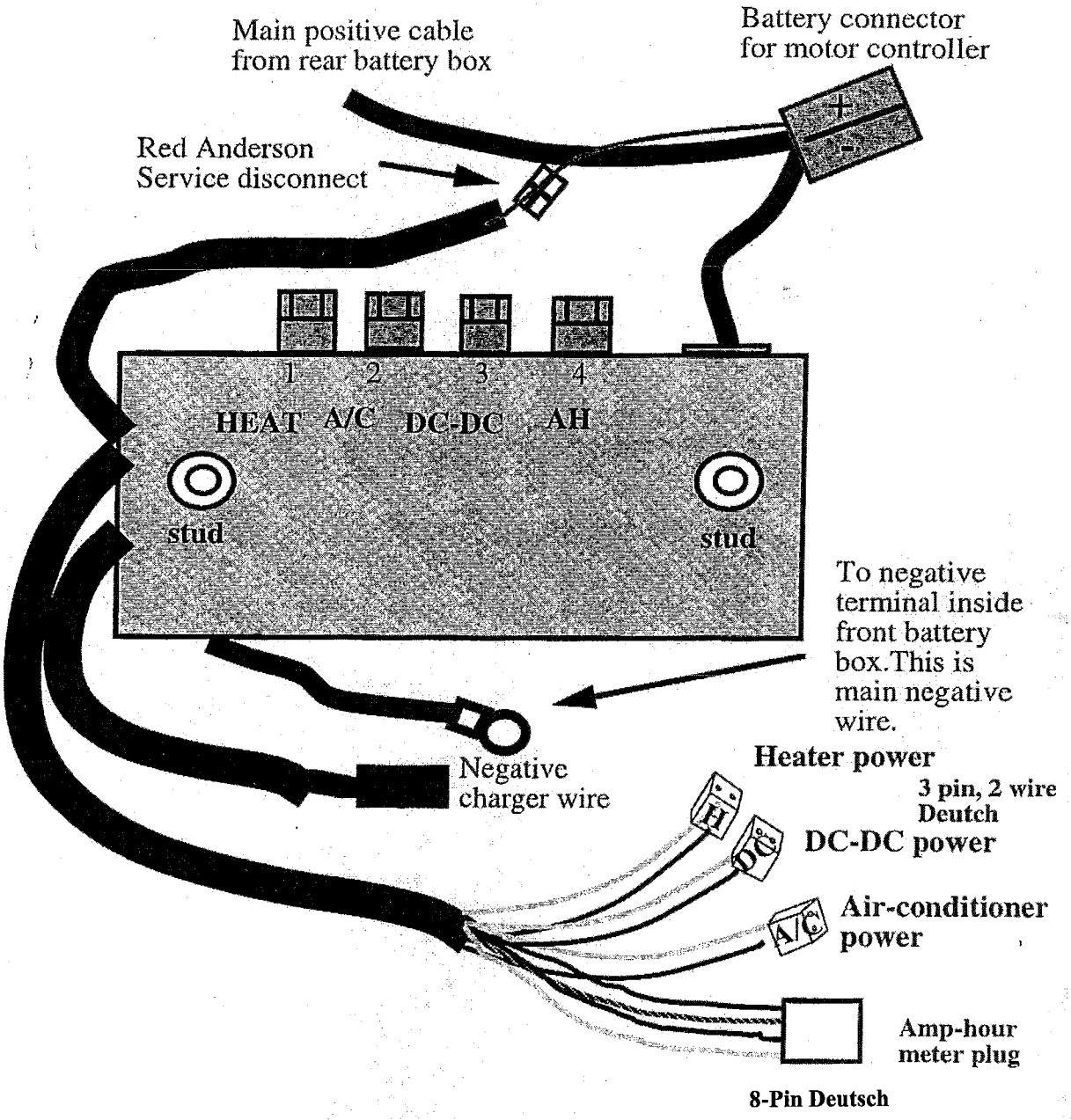
2001 REAR BATTERY BOX WITH BC3KW CHARGER



2001 LEAD ACID FORCE DC-DC WIRING

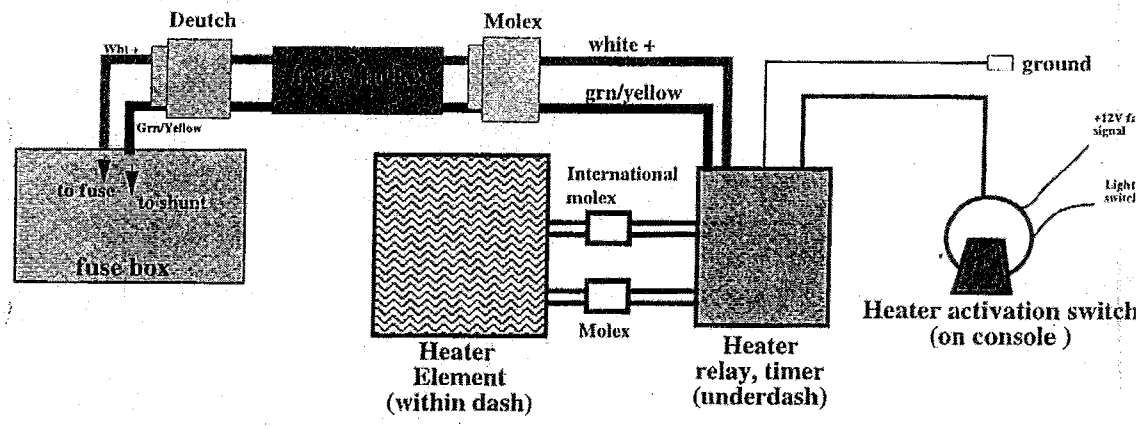


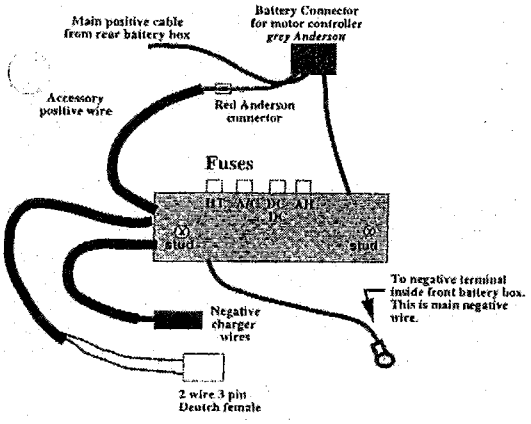
2001 LEAD ACID FORCE FUSE BOX



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)

2001 LEAD ACID FORCE HEATER WIRING





2001 FORCE AUTOMATIC IGNITION WIRING

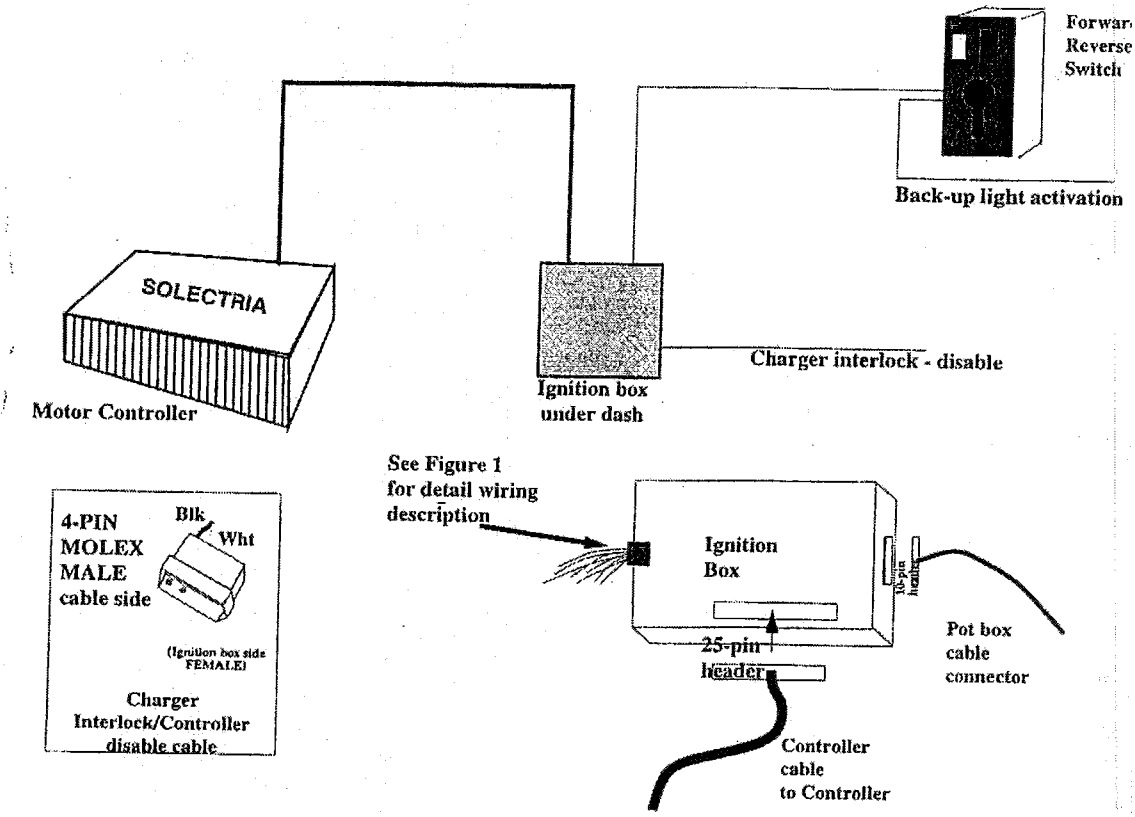
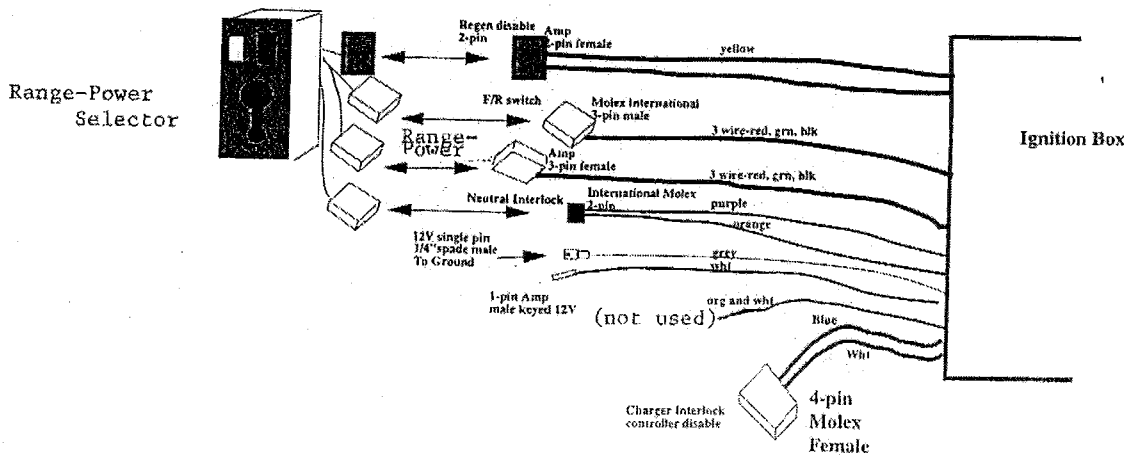
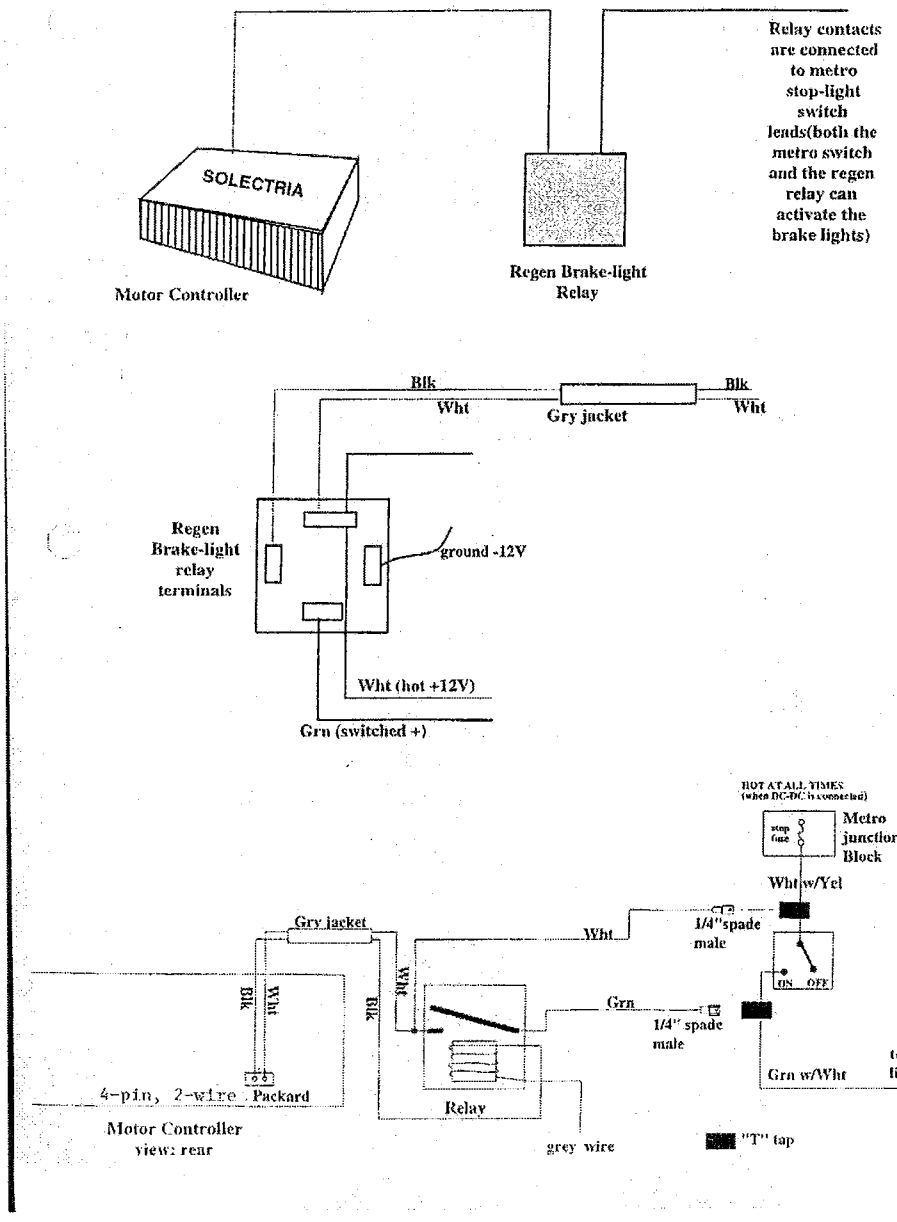


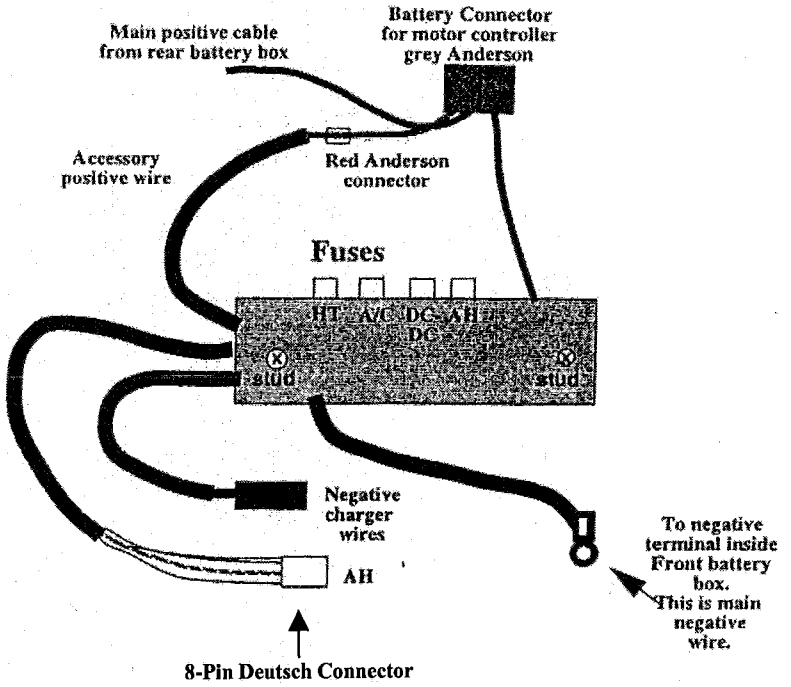
Figure 1

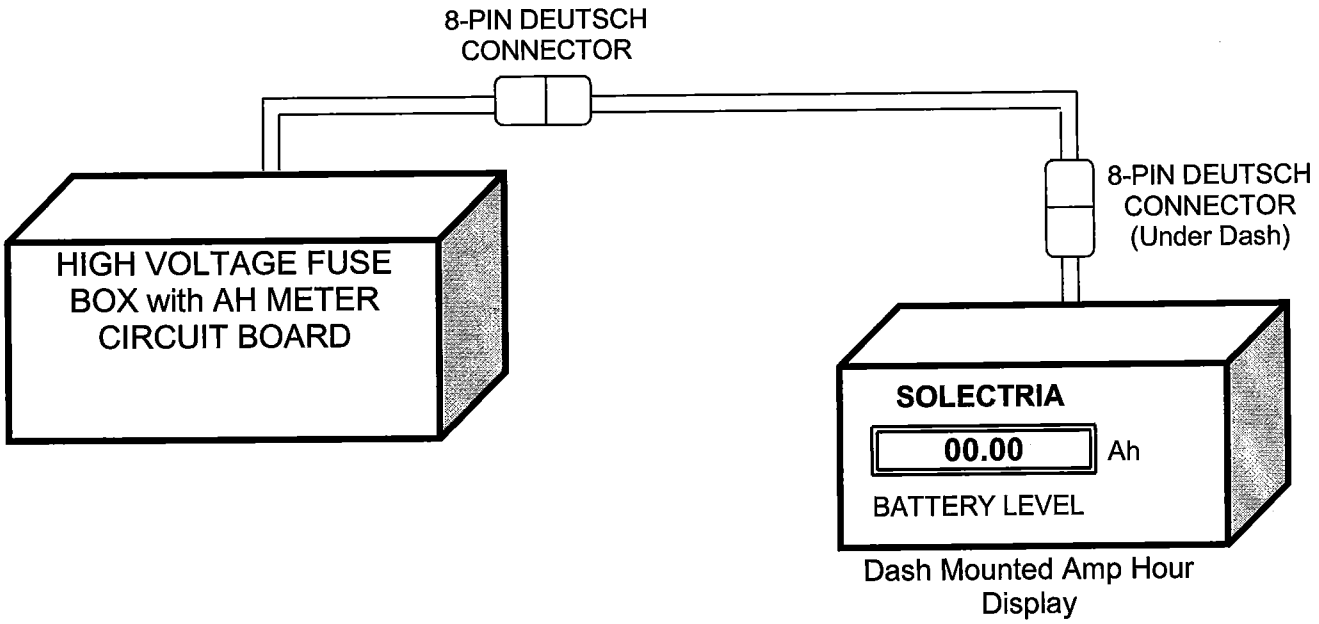


2001 FORCE REGEN BRAKE LIGHT WIRING

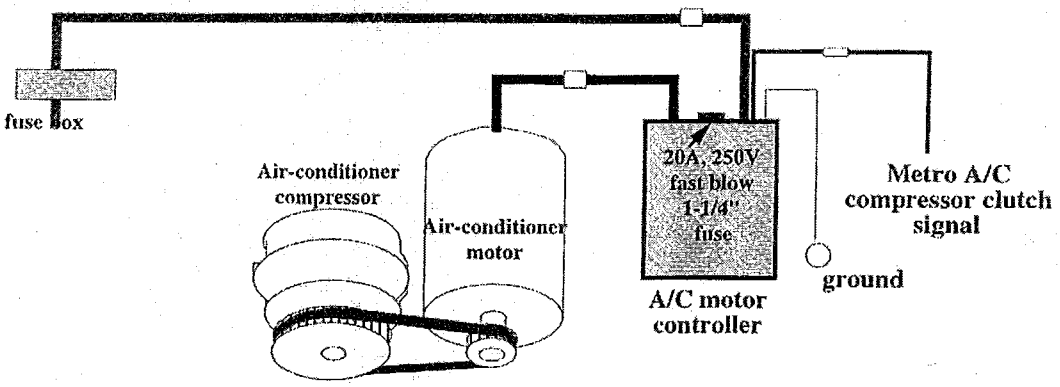


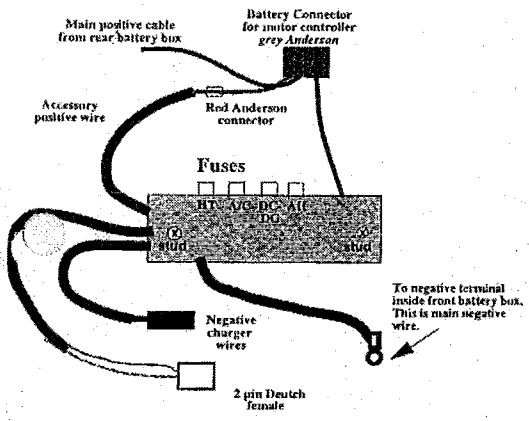
2001 FORCE AMP-HOUR METER WIRING

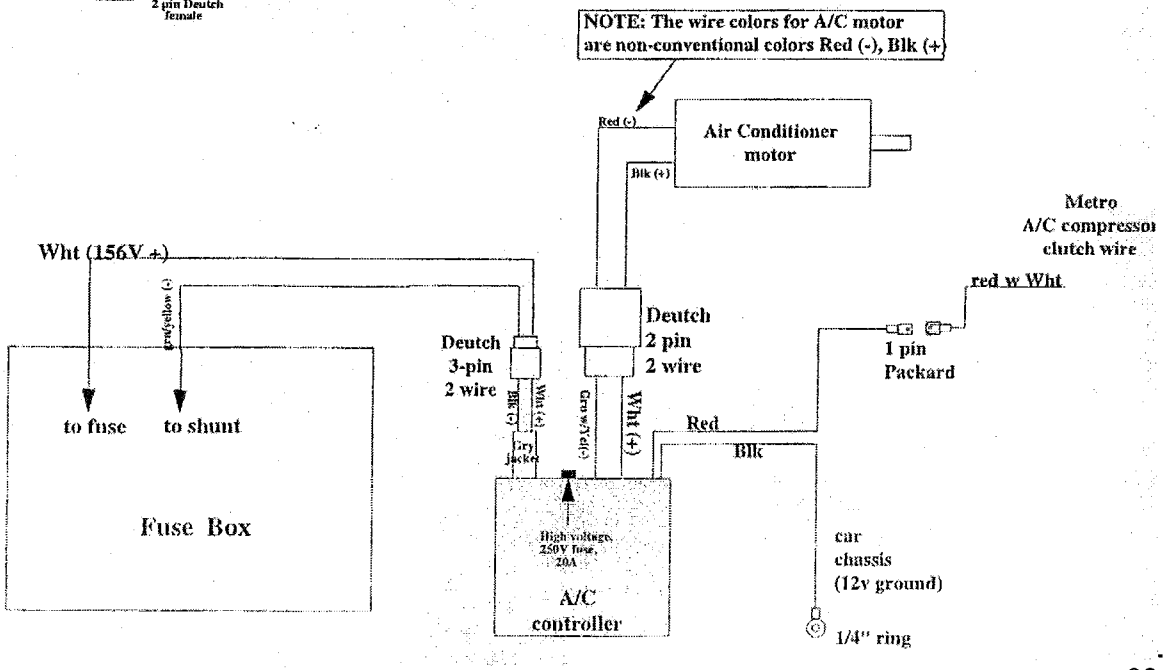




2001 LEAD ACID FORCE AIR-CONDITIONING WIRING

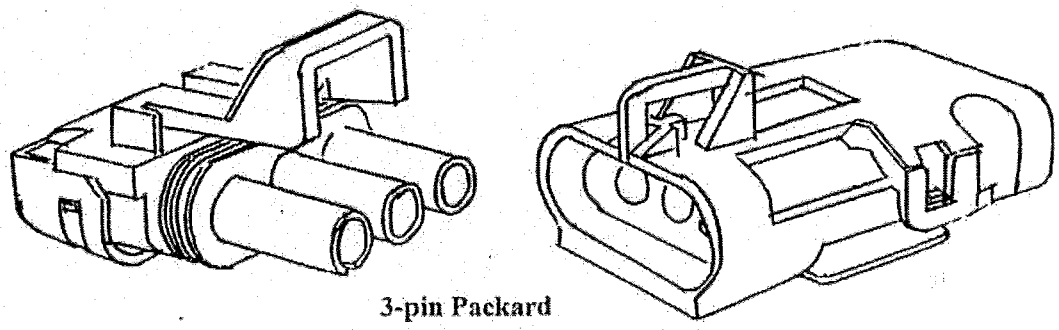






Solectria Connectors

(3-pin model depicted)



3-pin Packard

- *Battery Temperature Sensors*

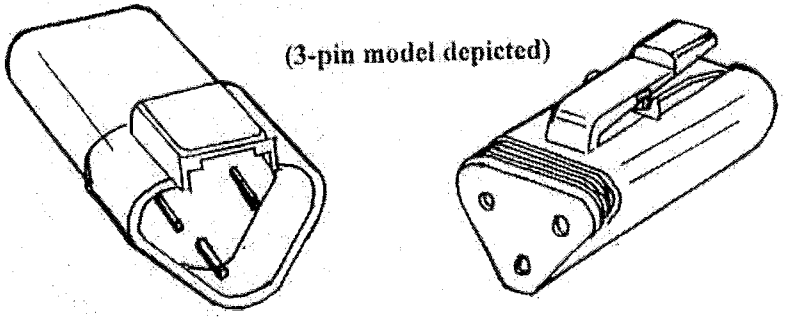
4-pin Packard

- *Regen Brake Light Activation*

2-pin Packard

- ***12V Ignition Signal to Motor Controller***

(3-pin model depicted)



2-pin Deutsch

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

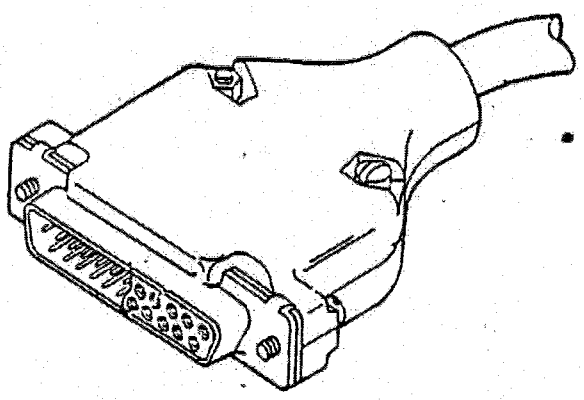
3-pin Deutsch

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

8-Pin Deutsch

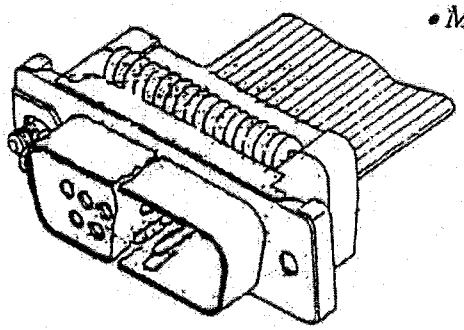
- *Amp-hour meter harness under hood* ***and under dash***

Solectria Connectors



25-pin D sub

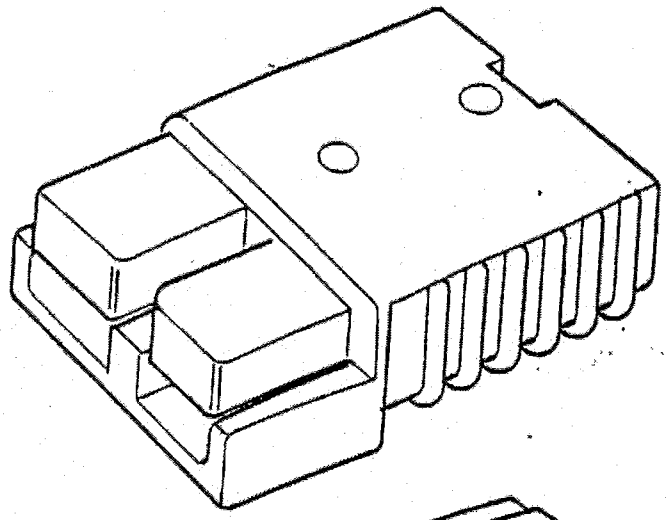
- *Ignition Box to Motor Controller*



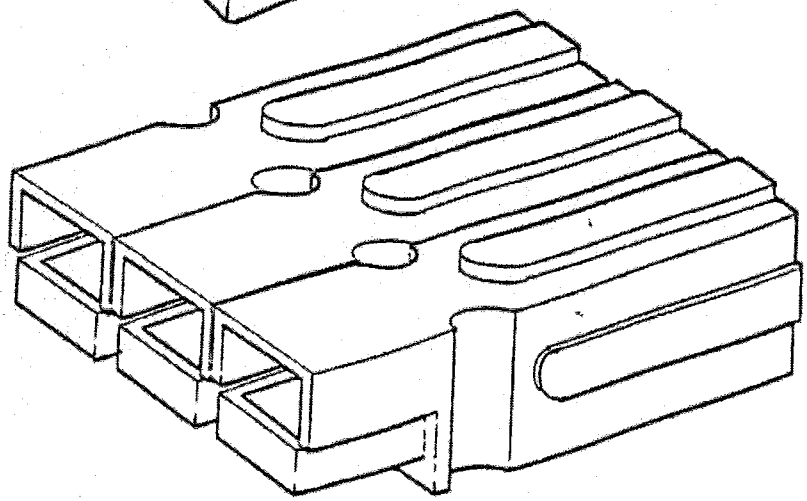
9-pin D sub

- *Motor Speed Sensor to Motor Controller*

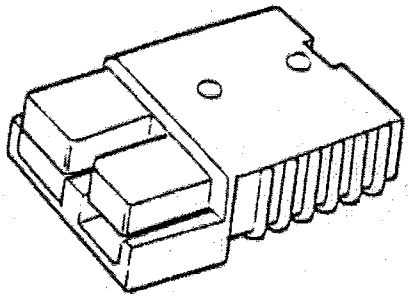
Solectria Connectors



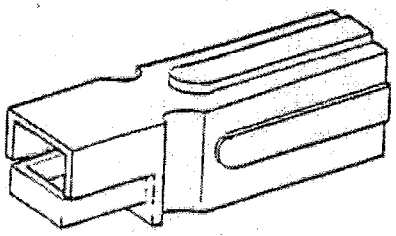
SB175 Large Grey Anderson
- *Battery to Motor Controller*



Power Pole 120
- *Red, White and Blue Motor Power Leads*



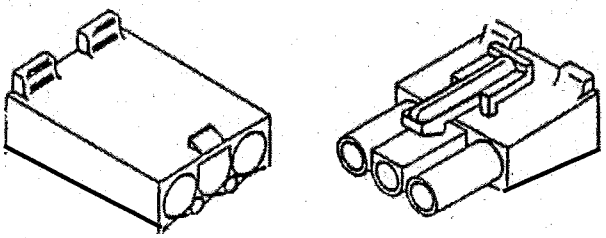
SB50 Anderson
- *Red- BC3kW Charger output to Batteries*
- *Grey- DC-DC 12V Output*



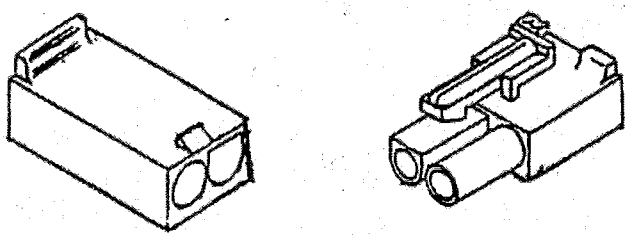
Power Pole 50
- *Red- Accessory Positive-Service Disconnect*
- *Black - Charger Negative Disconnect*

Solectria Connectors

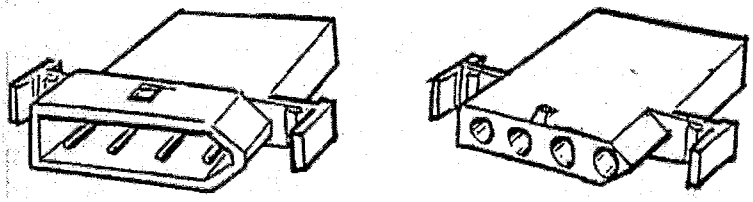
Male **Female**



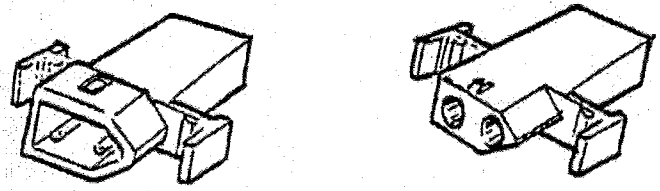
3-pin International Molex
- *Range-Power (Forward-Reverse) Selector*



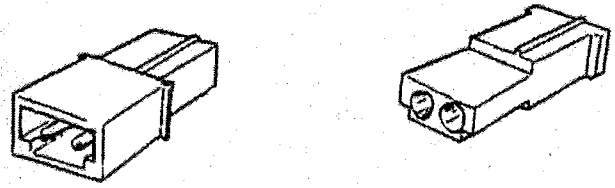
2-pin International Molex
- *Neutral Interlock*
- *110VAC or 220VAC to Battery Thermal Management*



4-pin Molex
- *Charger Interlock*



2-pin Molex
- *High-Voltage Heater under dash*



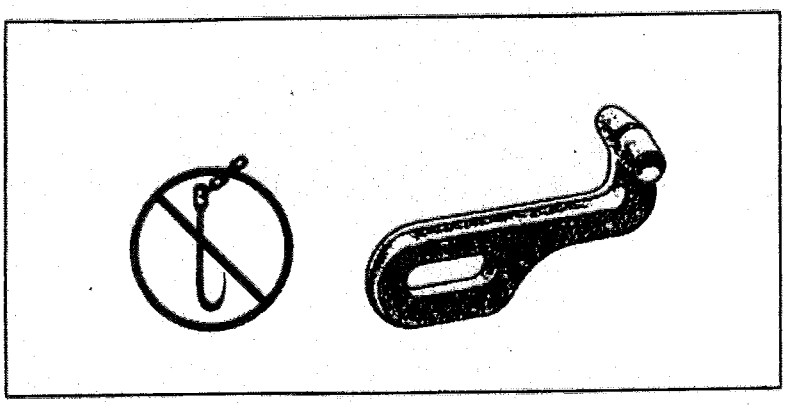
2-pin Amp
- *Regen Disable*

4-pin Amp
- *Charge Complete LED*

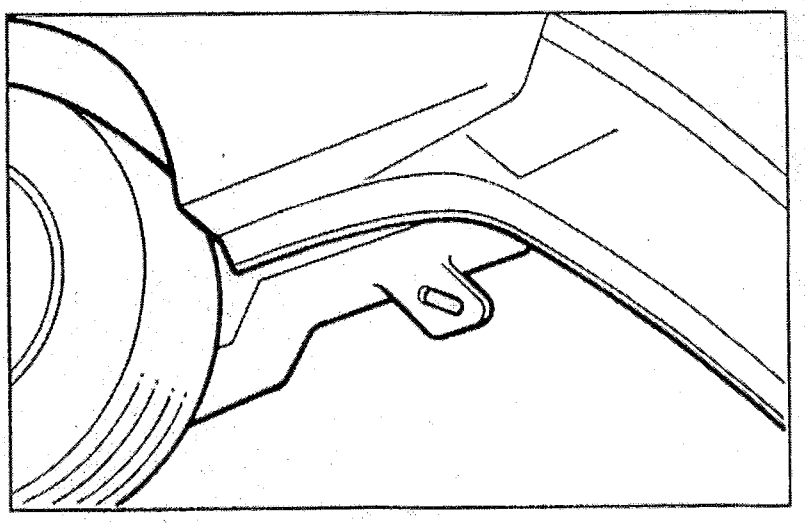
*Note: Connector nomenclature is defined by Solectria. Connector gender may not be consistent with other industries. Please note whether the pins are exposed or set into the connector.

Towing Instructions for 1998 Solectria Force

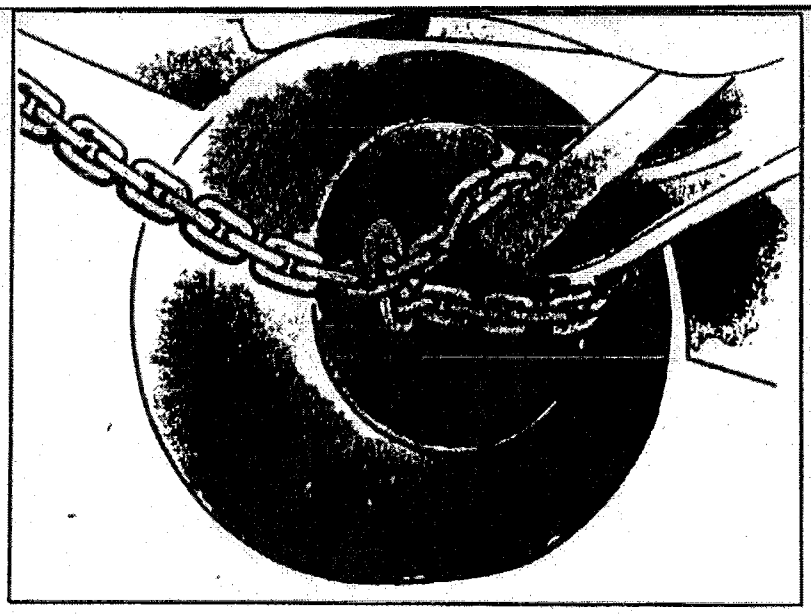
Do not attach winch cables or "J"-hooks to suspension components when towing.



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

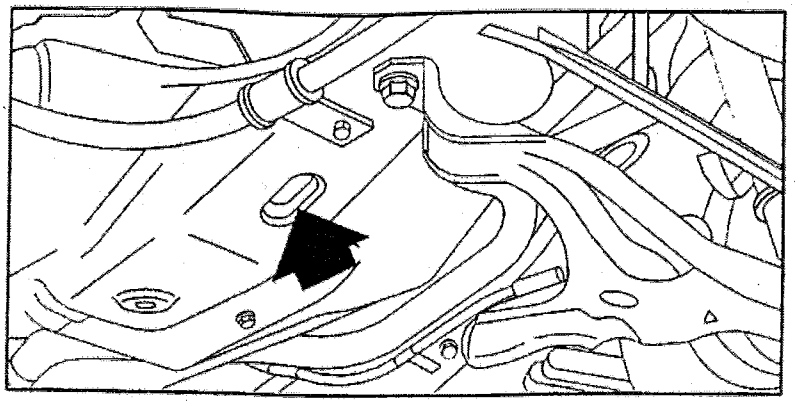


Attach T-hook chains on both sides, in the slotted holes in the brackets, just ahead of the front wheels.



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.

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

WARRANTY

Vehicle Warranty

For applicable warranty information and guidelines, please contact Solectria Corporation at the address and phone numbers on the cover of this manual.