

SERVICE MANUAL

1997 SOLECTRIA E-10

ELECTRIC PICKUP TRUCK

Nominal System Voltage: 276V

Batteries: Lead Acid

Battery Charger: BC3300 (3.3kW/240VAC)



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If additional service information is needed or to order replacement parts, please call Vehicle Technical Support at 508-658-2231 or fax 508-658-3224, Monday-Friday 9 AM to 5 PM Eastern Time.

E-10 DESCRIPTION AND SERVICE GUIDELINES

This section contains a description of the Solectria E-10 pickup truck and its major features. For operating information, refer to the Solectria E-10 Owner's Manual.

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

Basic Truck Layout

Your 1997 Solectria E-10 operates on 276V nominal DC power. (A few E-10s produced have a battery pack with a different voltage.) The exact voltage depends on the battery's state of charge and whether power is being taken from, or put back into the batteries. The battery modules are divided between a front and a rear battery box, located under the hood and beneath the truck bed.

Each of the following electronic components have high voltage cables which supply them with power:

- The truck's two motor controllers are located on top of the rear battery box under the bed. The controllers receive direct current (DC) directly from the battery and deliver alternating current (AC) to the motors, located at the rear of the truck under the bed.
- The truck's DC-DC converter (which supplies 12V DC to power the vehicle accessories), the power steering system, and air conditioning components are all located under the hood. The electric heater is located under the dash board.
- The battery chargers are located behind the seat in the cab or under the hood. The digital Ampere-Hour meter is located in the console.

The E-10 contains various systems for operator and service personnel safety. The truck will not drive if it is plugged in or if the Range-Power Selector is not set to OFF before the ignition key is turned on.

All high voltage DC components except the controllers are fused at the main DC fuse box. Chargers are fused in-line either behind the seat and/or under the hood.

All of the accessories (except for the motor controllers) are also fused through the 50A fuse inside the rear battery box. Battery thermal management and the optional cabin pre-heat system, which operate on AC, are fused at the AC junction box behind the seat.

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

The batteries in the E-10 are completely isolated from the truck chassis to prevent the possibility of electrical shock or current leakage to the truck. 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 truck chassis or other conductors during a severe accident.

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

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

Battery Types

All batteries used in Solectria E-10 trucks are sealed starved-electrolyte or gel lead-acid batteries. Starved-electrolyte batteries will not spill significant amounts of electrolyte, even if the modules are broken in two. However, any fluid or paste leaking from a battery should be treated as electrolyte with the potential for causing chemical burns. Avoid contact with the skin or 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) may also be used cautiously to neutralize any electrolyte.

Disabling the Vehicle

The E-10 is virtually silent when turned on. The absence of noise or motor "running" sounds does not indicate that the vehicle is disabled.

Servicing the Truck - Emergency Procedures

To secure the truck, set the parking brake firmly by pushing the foot-operated pedal next to the driver's door. Turn the Range-Power Selector, located on the floor console, to the OFF setting to prevent the vehicle from being driven.

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

To isolate accessories: To disconnect all high voltage electricity from all auxiliary systems (such as power steering, air conditioning, amp-hour meter, heat, the 12V DC-DC converter, and charger), disconnect the small, red one-pin Anderson accessory connector located under the hood along the firewall between the high voltage fuse box and the heater fan housing.

With this connector unplugged and the motor controllers turned off (key off), the electrical power of the truck is isolated to the battery boxes, the controllers and the high voltage connectors.

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

Although turning the key to the off position will disable the motor controller, the controller can also be disconnected manually, if necessary, by disconnecting the large gray 2-pin connector located under the bed. Note that each Solectria component under the hood and in the trunk may store electricity in capacitors for some time even after being disconnected from the battery. Therefore, exposed conductors should always be treated with caution.

In general, battery boxes should not be opened and electrical cables should never be cut in order to make the vehicle "safe". Following the procedure above for disabling the vehicle should make the vehicle "safe" in virtually all circumstances. If there are indications that a battery module is smoldering or heating up after an accident or fire, cutting the interconnecting battery cable may eliminate the problem.

However, cutting cables presents additional safety problems, and is not recommended by Solectria. If you feel you must cut cables, always use electrically insulated cutters, cut only one cable at a time, be careful not touch any other part of the vehicle while making the cut, and always tape up both ends of the free wire after it is cut. Failure to follow these guidelines could lead to additional injuries.

To isolate batteries: Before removing any battery interconnect wires, the red one-pin Anderson accessory connector must be unplugged and the input to the controllers disconnected. To isolate the batteries completely, also disconnect the large black 1-pole Anderson connector under the hood on the firewall below the fan housing. These are the main negative wires from each battery string. Once these operations are completed, all high voltage and low voltage power to the truck will be disabled. Note that each electronic box under the hood and bed may hold a charge for some time in capacitors even after being disconnected from the battery. Exposed conductors from these units should be treated with caution. Following the procedure above for disabling the truck should make the truck "safe" while servicing the vehicle. For operator safety, battery boxes should be opened only by trained service personnel. Also, electrical cables should never be cut. Cutting cables presents additional safety problems, and is not recommended by Solectria. Failure to follow these guidelines could lead to serious injury.

Vehicle fires: Spray vehicle fires with dry chemical or carbon dioxide foam (ABC or BC extinguishers). In general, battery boxes should not be opened. However, if there are indications that a battery module is smoldering or heating up after an accident or fire,

disconnecting the smoldering battery pack should eliminate the problem. **Follow the directions in the previous paragraph for isolating the battery pack.** To disconnect individual batteries, refer to the specific procedure in the text. As stated above, cutting cables and opening battery boxes create additional hazards that are best avoided if possible.

ADDITIONAL SERVICE INFORMATION

The Chevrolet S-10 Service Manual for your truck is not included with this manual, but may be purchased through a local Chevrolet dealership (Item # GMT/96-ST-1 for Model Year 1996 and GMT/97-ST-1 for Model Year 1997 – please check the door jamb label to confirm whether your 1997 Solectria E-10 was built on a 1996 or a 1997 Chevy S-10 chassis). The Chevrolet service manual should be consulted for service information on all parts of the Solectria E-10, except for the following parts:

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

SERVICE NOTES

1. The diagnostic connector for the Chevy S-10 is inoperative on the Solectria E-10.
2. Rear leaf springs must be ordered from Solectria Corporation. They are not interchangeable with the standard springs.
3. For safety, always remove the ignition key from the steering column before performing service work on the car. Unplug the vehicle from the wall outlet when changing out electronic components. **Solectria electronic components are not user serviceable. Any attempt to service components will void all warranties.**
4. Disconnect all Solectria components which are connected to the batteries if you attempt any fast charging of the batteries or if using a non-Solectria battery charger unless installed by Solectria. **FAILURE TO DO SO WILL VOID ALL WARRANTIES.**
5. **Lifting truck bed:** Using a 15mm socket, unscrew the four bed bolts located in pairs on the underside of the bed in front of the rear wheels. With one person on each side, tilt the bed up and back. **ALWAYS USE THE PROP ROD TO SECURE THE RAISED BED.**
6. **Lifting vehicle:** If using a lift, use factory recommended lifting points on the frame rails. If using a floor jack, position jack under front cross-member between control arms. **Do not position jack directly under battery box, or attempt to lift truck from any point on the battery box. Do not use a bumper jack in the rear.** Using a floor jack at the rear, position floor jack under center rear axle. Position jack stands safely under truck and apply parking brake.

7. **Towing** Do not tow truck by the rear bumper. Solectria recommends towing the truck with the rear wheels on a dolly, or carrying it on a flatbed truck. If you must tow with the rear 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.
8. **Washing:** Solectria does not recommend washing this vehicle in an automatic car wash.

STANDARD PRACTICES FOR WORKING ON OR NEAR HIGH VOLTAGE SYSTEMS

1. Always use safety glasses. Remove all metallic jewelry, such as watches, rings, bracelets, and necklaces.
2. No tools with exposed metal over 2" long are allowed in work area. Metal tools over 2" long should be wrapped with heat shrink tubing or tape.
3. Keep all tools away from or below high voltage areas. Keep tools in a tool caddy, toolbox, or on the floor. Do not keep them on truck surfaces or in shirt pockets where they may fall onto or be knocked into a battery box.
4. Use a fender protector pad whenever working on the truck.
5. Always turn the ignition key off and remove the ignition key from the steering column before performing service work on the truck. Unplug the truck from the wall outlet when changing out electronic components or before performing any other service work on the truck.
6. 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 or batteries except when using a voltmeter.
7. Use a voltmeter to check voltages and polarity before making any connection of components. (Make sure voltmeter is not set to measure current or ohms, and the leads are connected to the correct positive and negative jacks on the meter.)
8. Disconnect the red, one-pin Anderson accessory connector before removing any accessories (refer to '*isolate accessories*' in previous section). Leave a note on the amp-hr meter with the reading before disconnecting it if the truck is not fully charged. Check that the display has gone blank.
9. Do not use fuses to connect or disconnect accessories. If you are installing an air conditioner controller or fuse, for example, follow these steps:
 - turn ignition key off
 - check the amp-hr meter and write down the meter reading if the truck is not fully charged.
 - disconnect the 110VAC or 220VAC charging cord (gas cap)
 - disconnect the red one-pin Anderson accessory connector
 - verify that the amp-hr meter has no power (no display)
 - install the controller or fuse
 - reattach the red connector
 - check that the amp-hour meter is reading 00.00
 - plug charging cord into wall outlet
10. When servicing batteries, always work on only one battery terminal at a time. **Never allow another person to touch any other part of the battery pack while you are working on it. ONE PERSON ONLY!!**
11. Do not use any piece of test equipment unless you have been trained and you fully understand and accept its operation. **Do not use any unfused test equipment.**
UNDER NO CIRCUMSTANCES SHOULD TESTING DEVICES OR USE OF THEM DISOBEY ANY OF THE ABOVE RULES!

DRIVE SYSTEM ASSEMBLY

MOTORS AND DRIVE ASSEMBLY

The two drive motors are 3-phase AC induction motors, located in the rear of the truck under the bed, and coupled to the drive pulley via drive belts. The motors and drive assembly can be removed from the truck separately or as a unit. There are no user serviceable parts in the motor except for the sensor; however, the bearings should be checked every 50,000 miles. Please notify the factory when this mileage is reached.

To service the drive assembly, periodically check the tension on the drive belts, and the oil level in the drive hub and the rear differential every 6,000 miles or 6 months.

Checking Drive Hub Oil Level

1. Turn off ignition key and set parking brake.
2. With the truck level, remove the plug on the side of the hub. The oil level should be up to the bottom of the hole.
3. If oil is needed, add oil through the side hole or the vent tube fitting. Use a squirt can or similar device (capacity is only a few ounces). Solectria recommends using 10W-30 synthetic motor oil.

Changing Drive Hub Oil

After the first 1,000 miles of operation and every three years or 24,000 miles thereafter, replace the hub oil.

1. Turn off ignition key and set parking brake.
2. Remove the drain plug and let the oil drain.
3. Clean the drain plug and reinstall it using an appropriate sealer. Solectria recommends using LOCKTITE Pneumatic Hydraulic Sealant 545.
Torque to 10 foot pounds.
4. Remove the plug on the side of the hub and fill with oil up to the bottom of the hole.

Checking Rear Differential Oil Level

A sight glass is located on one side of the Solectria differential housing. The oil level should be at or above the middle of the glass. If the oil level is below the middle of the glass, add oil at the vent tube fitting or the fill plug. Solectria recommends SAE 75-90 GL5 synthetic gear lubricant.

Changing Rear Differential Oil

After the first 1,000 miles of operation and every three years or 24,000 miles thereafter, replace the differential oil.

1. Turn off ignition key and set parking brake.
2. Remove the drain plug and let the oil drain.

3. Clean the drain plug and reinstall it using an appropriate sealer. Solectria recommends using LOCKTIE Pneumatic Hydraulic Sealant 545. Torque to 10-15 foot pounds.
4. Remove the filler plug and add oil up to the middle of the sight glass. Reinstall the filler plug.

Belt Adjustment/Replacement

1. Turn off ignition key and set parking brake.
2. If truck has a roll pan instead of a bumper, unplug the license plate lights and remove the pan.
3. Unbolt the front of the bed. Lift the bed and support with prop rod.
4. Remove eight 1/4" - 20 nuts from the drive box cover just in front of the rear bumper. Remove the cover.
5. Loosen four 1/2" - 13 x 2" motor bolts.
6. Loosen two 3/8" - 16 x 1 1/4" hanger bolts.
7. Slide motor toward hub and remove belt. To adjust: Slide the motor away from hub until belts are tensioned properly (i.e. 1/4" deflection at center span with 5 lb. pressure applied). To move motor, stand between the motor and drive shaft and apply pressure with your knee using a knee pad. Tighten all bolts. Do not use a pry bar or over-tighten the belts.

Motor Removal

1. Turn ignition key off and set the parking brake.
2. If truck has a roll pan instead of a bumper, unplug the license plate lights and remove the pan.
3. Unbolt front of the bed. Lift the bed and support it with the prop rod.
4. Unzip the metal mesh and unplug motor power leads (red, white and blue connector). Detach the motor speed sensor leads at the controller (9-pin connector). Snip the tie-wraps securing the harness to the frame rail.
5. Remove eight 1/4" - 20 nuts from the drive box cover in just in front of the rear bumper. Remove the cover.
6. Loosen the top 1/2" - 13 x 2" motor bolt and remove the remaining 3 motor bolts
7. Remove two 3/8" - 16 x 1 1/4" hanger bolts.
8. Remove the drive belt and support the motor.
9. Remove the last bolt and slide the motor out of the box and down.

Motor Installation

Installation is the reverse of removal. Adjust belts as previously outlined.

Drive System Removal

1. Turn ignition key off and set the parking brake.
2. If truck has a roll pan instead of a bumper, unplug the license plate lights and remove the pan.
3. Remove the four bolts securing the front of the bed.
4. Lift bed and support with prop rod.
5. Remove the driveshaft and vent tubing from the drive hub.

6. Unzip the metal mesh and unplug motor power leads (red, white and blue connector).
7. Detach the motor speed sensor leads at the controllers (9-pin connectors). Snip the tie wraps securing the harness to the frame rail.
8. Disconnect one of the bed cable stays.
9. Make up and install a longer prop rod to support the bed. Secure the original prop rod in its holder.
10. Attach a suitable lifting fixture to the universal yoke at the hub and apply slight tension to it.
11. Remove two 1/2" - 13 x 3 3/4" bolts from each end of the drive box.
12. Remove four 3/8" - 16 x 1 1/4" bolts from motor hangers.
13. Steady the unit and lift it out, guiding carefully out from under the remaining cable stay and prop rod.
14. Lower the bed or engage the original prop rod.

Drive System Installation

Installation is the reverse of removal.

BATTERY PACK

DESCRIPTION AND LOCATION

The truck's battery pack consists of twenty-three (23) 12-volt deep-cycle lead acid batteries. The batteries are wired in series, resulting in an overall nominal battery pack voltage of 276V. *(Note: A few E-10s produced have battery packs with different configurations and voltages.)* The batteries are located in two boxes. There are eight (8) batteries located in the front battery box under the hood, and fifteen (15) batteries in the rear battery box under the bed of the truck.

WARNING!

See Standard Practices For Working With High Voltage Systems.

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

Do not place tools in the battery box or in a place where they may fall into battery box. A fire or explosion hazard may occur if a wrench or other metal object is placed inside a battery box. Wear safety glasses or face shield to protect eyes from flying 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.

Checking Battery Condition

If the range performance of the truck following a full re-charge has been declining, perform a **Field Discharge Test**. The following tools are needed:

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

FIELD DISCHARGE TEST

1. Completely recharge the battery pack. See definition of Fully Charged on page 13.
2. Get the Amp-hour reading from the driver at which they begin to experience a decline in performance. This will allow you to plan ahead and not run out of energy during the test. Choose a local driving loop near your service facility for this test. When new and fully charged, the 276V truck should be able to achieve 45.00Ah on the meter. The battery performance can be expected to decrease gradually over time.
3. Using the onboard ammeter as a guide, drive the truck at a maximum output of 100 Amps. (Set the Range Power selector to MAX RANGE.) Continue to drive the truck until the voltage drops to 241.5 volts and the maximum current available is less than 100 Amps, or until the truck will not maintain 30 mph on a level road.
4. When the above conditions are met, bring the truck into the work area, leave the key ON, turn on all the accessories (heat, headlights, high beams, fan on high) and set the parking brake.
5. Quickly open both the front and rear battery boxes.

To gain access to rear batteries:

- Unscrew the bed bolts. There should be two on either side in front of the rear wheels.
- Lift bed and secure with prop rod.
- Unscrew the eight 1/4" nuts fastening the motor controllers to battery box (4 each).
- Disconnect the large gray Anderson connectors from each controller to the batteries. Remove the metal zip-on mesh, cut the zip-ties holding the red, white and blue Anderson connectors from the controllers to the motors and pull them apart.
- Using a small slotted screw driver, unscrew the two 25 pin and 9 pin connectors at each controller. Separate the connectors.
- Disconnect the 2 wire-4 pin Packard connector from one controller (regen brake light).
- Lift the controllers and put them aside in a safe place.
- Unscrew the 1/4" bolts that fasten the battery cover to the battery box.
- Remove the cover by lifting and sliding it back.
- Make a note of the position of the insulation pieces and set aside.

To gain access to front batteries:

- Unplug the positive 12V supply to the Power Steering controller in order to temporarily deactivate it. It is a single red wire with a spade connector. Remove the power steering guard.
- Remove all the 1/4" bolts around the cover. Do not remove the four end plate bolts. (You can loosen these bolts to aid in installation).
- Lift the cover straight up. Be careful not to damage the A/C condenser if the truck is equipped with air conditioning.
- Make a note of the position of the insulation pieces and set aside.

Note: Feel the batteries in each box. They should be at room temperature or slightly above room temperature. If the vehicle has been parked outside in cold weather and

properly charged, yet the batteries in one or both boxes feel cold, the vehicle may have low range. The battery thermal management system must be evaluated at this point.

6. Number each battery according to the battery box diagrams. *See Appendix C for battery box diagram.*
7. With accessories still on, write down the Amp-hour reading and proceed to note the individual battery voltages. *See Appendix C for Battery Discharge Test Sheet.*
8. Continue to note Amp-hour readings before taking battery voltages every 10 minutes. When one battery reaches 10.7 volts, begin taking reading continuously (every 3 minutes) until seven (7) batteries are below 10.5 volts. At this point shut down all the accessories and turn ignition key off. Any battery that tests lower than 10.5 volts before reaching 45.00 Amp-hours should be replaced. **DO NOT REMOVE ANY BATTERIES AT THIS TIME!**

WARNING!

Failure to observe the following instructions will damage the batteries.

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

Place the insulating foam and covers back on the battery boxes to maintain a temperature that the charger will recognize as valid.

Completely recharge the entire battery pack first, before removing the bad batteries.

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

It is very important to make sure the battery pack and new battery modules are fully charged before removing or installing any batteries.

Trickle charge new batteries separately overnight (in parallel; positive to positive, negative to negative), using a power supply that is set at 13.8V to 14.2V. This ensures that all batteries are at the same level of charge when they are installed and prevents battery imbalance.

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

DEFINITION OF "FULLY CHARGED":

The time needed to achieve a fully charged condition is dependent on the type of battery charger and the age of the battery pack. Most batteries achieve a full charge once the battery charger has supplied them with approximately 10% overcharge. This means that the Amp-hour meter should read a negative value corresponding to about 6-10% of the Amp-hours obtained in the discharge test.

For example:

Discharge test Amp-hour reading: 48.00Ah

Calculation: $48 \times (-0.06 \text{ to } -0.10) = -2.88 \text{ to } -4.8$

The Amp-hour should display: -02.88 to -04.80 Ah

Battery Removal

WARNING!

Always fully recharge the battery pack before removing any batteries using the onboard charger. If not replacing the entire battery pack, individual replacement batteries should be trickle charged overnight at 13.8V to 14.2V before installation.

Batteries are connected in one string of 23 batteries. The total pack voltage is 276V.

To avoid shock, use rubber insulating gloves and wear eye protection when handling battery terminals.

Always work on only one terminal at a time.

Never allow another person to touch a terminal at the same time as you, including terminals in the other battery boxes in the truck!! This could create a current through the body of the truck on which you are leaning.

Use insulated hand tools. These can be made inexpensively using shrink wrap or electrical tape.

The battery pack must be completely isolated from all other components BEFORE disconnecting any one battery terminal.

1. Unplug truck from wall outlet. Disconnect 110V AC or 220V AC charging cord (gas cap).

2. **Unplug the 1-pin red Anderson accessory connector** located on the firewall between the fuse box and the heater fan housing. This will isolate all auxiliary electrical components except the controllers. This will also cause the Amp-hour meter to go blank. Document the reading on the Amp-hour meter. (It should be zero or a negative number.) If not, fully charge the truck before proceeding. Do not unplug the one-pin Anderson, or continue until the truck is fully charged!!
3. **Unplug the large black 1-pole Anderson connector** under the fan housing. These are the main negative leads from each battery string.
4. **Unplug the large gray Anderson connectors** to the motor controllers if they are still in the truck.
5. If any cable needs to be disconnected in order to remove any battery, it must be completely removed. **Never disconnect one end of a cable and leave the other end connected, except in the case of the under truck harness wires.**
6. If the truck has air conditioning, be careful not to hit condenser while removing front batteries.
7. In the rear battery box, to remove any of the front row batteries the corresponding battery in the second row must be removed. This will allow you to slide the "bad" battery back and out from under the cab. DO NOT attempt to disconnect the front terminals of the first row of batteries while they are still in place. There should be plenty of cable to allow you to pull them back for better access once the battery in the second row is removed. The same applies while installing these batteries. *See Appendix C for rear battery box diagram.*
8. Before connecting any terminals confirm the physical placement of the positive and negative terminals agree with the battery layout diagram and the polarity of each battery is correct.
9. Once the defective batteries have been replaced, torque all terminals to 23 ft.-lb. (Sonnenschein-Deka-East Penn Group 27 batteries). When applying torque to the terminals, use a wrench to apply an opposing force or back-up force to avoid over-torquing the battery terminal.
10. **With a voltmeter, check between each pin of the large black Anderson connector and the side of the red one-pin Anderson accessory connector with a single red wire. Check also that the polarity is correct (red wire +, black connector -).**
11. Make sure all tools have been removed from the battery compartments. Secure the insulation pieces and the battery box covers and reconnect the controllers, 1-pole black Anderson connector, and accessories (red Anderson connector) in that order.
12. Check voltage and polarity at gray Anderson connector before plugging in controllers. If the amp-hour meter reads 100 instead of zero disconnect the red Anderson connector. Wait 10 to 20 seconds and try again.
13. Plug the truck in to top off all batteries.

Note

When driving with new batteries they should be cycled gently. Draw no more than 150 Amps for 10 cycles using less than 20 Amp-hours per cycle. This can be achieved by driving the truck with the power selector switch in "NORMAL" or "MAX RANGE" at all times. This will help condition the new batteries in the battery pack. Always leave

the truck plugged in to wall outlet whenever possible. Solectria recommends that new batteries be fully cycled once for each 24 hour period.

ELECTRONIC COMPONENTS

MOTOR CONTROLLER

The motor controllers are located under the bed on top of rear battery box. There are no user serviceable parts in the motor controller. The motor controller is air cooled therefore the cooling fans should be kept free of debris.

Removing Motor Controller

1. Turn ignition key off and apply parking brake.
2. Unbolt the front of the bed (there are two bolts on each side). Tilt the bed up and back. **Support the bed with the prop rod.**
3. Disconnect high voltage input to motor controller (large gray Anderson connector). Disconnect regenerative braking signal connector (2-wire, 4 pin black Packard connector). Only one controller is connected to the regenerative braking signal.
4. Snip the two tie-wraps on metal mesh over motor power connector (red, white and blue) and unzip mesh. Remove the tie-wraps at the 3-phase output connector to motor and disconnect the red, white and blue connectors.
5. Using a small slotted screw driver, disconnect the 25 pin (ignition box) and 9 pin (motor speed sensor) connectors.
6. Remove the 1/4 - 20 nuts and washers that secure controller to rubber mounts and lift it off the mounts.

Installing Motor Controller

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

DC-DC CONVERTER

The DC-DC converter converts 276 volts DC to 12 volts DC for the truck's 12V accessories. It is located in the engine compartment on the driver's side behind the headlight assembly. Other than the external fuse, there are no user serviceable parts. *See Appendix C for diagram.*

DC-DC Converter Removal

1. Turn the ignition key off and set the parking brake.
2. Disconnect 2-pin gray Anderson connector (12 volt output).
3. Disconnect 3-pin Deutsch connector from 276 volts DC input.
4. Slide component straight up and out of bracket.

DC-DC Converter Installation

Installation is the reverse of removal. Be sure replacement unit is correct voltage for truck.

Note

To reduce spark, re-connect 276V 3-pin Deutsch before the 12V gray Anderson connector is re-connected. As a general rule, make sure headlights and other 12V accessories are turned off, and ignition key is off, before completing any service procedures on this vehicle.

AMP-HOUR METER/CONSOLE

The Amp-Hour meter measures and integrates the current and time when the battery pack is charging or discharging. It is located in the console and has no user serviceable parts. *See Appendix C for diagram.*

WARNING!

It is best to fully charge the truck before disconnecting the Amp-hour meter.

Disconnect the red one-pin Anderson accessory connector located between the fuse box and the heater fan housing before unplugging the amp-hr meter or the harness. This will cause the Amp hour meter to go blank. It will also protect it from a power surge when plugging it back in. Make a note of the Amp hour meter reading before disconnecting. (It is best to fully charge truck before disconnecting the Amp hour meter.) All electrical components will not operate now. The truck should be unplugged from the wall outlet.

Upon reconnecting the red Anderson connector the Amp-hr meter will reset to zero. Please note that this does not indicate the actual state-of-charge. When charging truck, the Amp-Hr meter may read negative numbers in excess of actual overcharge. The Amp-hr meter will reset itself to 00.00 as soon as it senses a current draw after charging.

If the Amp-hr meter reads 100.00 or 99.99 after connecting the red Anderson connector, disconnect and wait at least 10 seconds before reconnecting.

Amp-hour Meter Removal

1. Turn the ignition key off and set the parking brake.
2. Unplug truck from wall outlet.
3. Disconnect red one-pin Anderson accessory connector under the hood. *See Warning above.*

4. Remove the bolt from either side of the console and lift it to clear mounting brackets. Turn the console to the side to expose connectors underneath. (It may be necessary to unplug connectors in front of the console.)
5. Unplug and detach the 6-pin International Molex connector from the circuit board and remove the following wires from the back of the Ammeter/Voltmeter.

Do not confuse these wires on installation.

- a) Ammeter: green wire- Pin #1, white wire- Pin #3
 - b) Voltmeter: red wire- pin #4, black wire- Pin #5
6. With a 3/16" slotted screw driver, loosen the retainers on the sides of the Amp-hour meter a few turns. Push down on the retainers to unhook. Push the Amp-hour meter out of the console complete with harness.

Installation of Amp-hour Meter

Installation is the reverse of removal. Be sure the red one-pin Anderson service connector under the hood is still unplugged, the key is off and the truck is unplugged from the wall.

IGNITION BOARD

The ignition board is an electronic device which gives the motor controllers input signals from the driver. It also provides other safety interlocks such as neutral and charger. One circuit board, located under the console, controls both motor controllers. *See Appendix C for diagram.*

Ignition Board Removal

1. Turn the ignition key off and set the parking brake.
2. Unplug truck from wall outlet.
3. Unplug the red one-pin Anderson accessory connector under the hood between the fan housing and the fuse box.
4. Unplug the connectors at the front of the console.
5. Remove the bolt from either side of the console and lift it out to clear the mounting brackets.
6. Remove the connectors attached to the inside of the ignition board. Remove the 6-pin Amp-hour plug from the rectangular hole in the circuit board.
7. Detach the 6 small machine screws securing the board to the console.

Ignition Board Installation

Installation is the reverse of removal. Be sure the red one-pin Anderson connector under the hood is still unplugged. *See important Amp-Hour Meter Warning in previous section.*

BATTERY CHARGER

The truck is equipped with one 3.3 kW battery charger mounted under the hood.

WARNING!

Disconnect all Solectria components which are connected to the batteries if you attempt any fast charging of the batteries. FAILURE TO DO SO WILL VOID ALL WARRANTIES.

Contact Solectria if you are unsure which components may be affected.

Always connect the battery charger output to the DC battery pack before plugging it into the AC power. Running the charger when it is not connected to the batteries may damage the charger.

3.3kW Battery Charger Removal

1. Turn the ignition key off and set the parking brake.
2. Unplug truck from the wall outlet.
3. Detach battery charger interface box (with LEDs) from fan housing (it is attached with Velcro) and lay it aside. If the interface box is attached to the battery charger, do not detach it. Disconnect the two temperature sensors (3-pin Packard, green and black wires at harness), the disable wire and the Charge Complete light wire (4-pin Packard). Leave the large 18-pin cable attached to the charger.
4. Locate and disconnect the remaining two electrical connections in this order:
 - a. AC input: large black or gray 3 prong plug.
 - b. DC output: large red 2-wire Anderson connector.
5. Remove the 1/4" nuts at each corner of the charger. If it is attached with Velcro, wiggle the charger to loosen it. Lift out charger and interface box as a unit.

Installation of 3.3 kW Battery Charger

Installation is the reverse of removal. Be sure the truck is unplugged from the wall. A small spark may occur when connecting the high voltage DC wires (green and white wires - Molex connector). This is normal, but be sure the truck is unplugged from the wall. Temporarily disconnecting the red one-pin Anderson accessory connector under the hood (between the heater fan housing and the main high voltage fuse box) will reduce the spark at the charger plugs, but will reset the Amp-Hour meter to zero.

MOTOR SPEED SENSOR

A motor speed sensor is located on the rear of each motor under the motor's end plate (facing the cab). It provides the motor controller feedback on the direction and speed of the motor.

Testing Motor Sensor

WARNING!

Rear wheels should spin during this procedure. Make sure people and objects are clear. Do not spin at high speeds. With power off (key out of ignition) check both tires for pebbles or debris in tires treads (rotate by hand). Wear safety glasses.

1. Turn the ignition key off and set parking brake.
2. Unplug the truck from wall outlet.
3. Jack the rear of the truck by the axle and place it on the jack stands. Release the parking brake.
4. Unscrew the bed bolts: there are two bolts on each side in front of the rear wheels. Lift the truck bed (it tilts up and back). **ALWAYS USE THE PROP ROD.**
5. Disconnect the speed sensor between the controller and the motor not being tested (9-pin cable).
6. Turn ignition on, select the normal driving setting, and accelerate slowly up to maximum speed. Listen for motor vibrations or shudders: if a motor sensor is malfunctioning, it can shudder sharply and intermittently at a particular speed, usually a high speed. (Do not confuse this with out of balance tires.) The motor may also turn very slowly or 'growl' as well.
7. Re-connect the first speed sensor and disconnect the speed sensor that was just tested. Repeat the test.
8. If both sensors are functioning properly, turn off the key and secure all connections under the bed. Renew zip-ties if any were removed. Bolt down bed and lower truck.
9. If one motor is not operating normally, unplug the 'bad' motor's speed sensor from the controller and plug in the 'good' motor's speed sensor in its place. Repeat the test. If this motor still runs properly, adjust or replace the speed sensor from the bad motor. If this motor now runs poorly, the problem may be related to a controller, ignition box, or 25-pin cable. The drive belts must be in place for this test.

Motor Speed Sensor Adjustment/Replacement

1. Turn the ignition key off.
2. Disconnect the 9 pin connector between the corresponding controller and speed sensor from the motor that is 'bad'.
3. Remove the 3 small M4 (metric) screws from the motor cover plate. **Hold on to all hardware.** Carefully cut the seal between the plate and the motor with a razor blade while gently prying the plate with a small slotted screwdriver. Be extra careful near the sensor cable exit point from motor.
4. Inspect encoder wheel for dirt and sensor wear marks. Replace if damaged.
5. **To adjust:** Carefully remove silicone from inner slotted screw-head at circuit board and adjust as outlined below. **To replace:** Cut the small zip tie securing the gray harness to the holder and remove the small Phillips screw (metric) securing the holder and ground wire to the motor. Remove the silicone from the slotted screws at the circuit board. Loosen the outer screw almost all the way- there is a spacer between

the board and the motor under this screw. Loosen the inner screw (metric) all the way while reaching behind the board to catch the small spring. Now, remove the outer screw all the way being careful to catch the spacer/washer behind it.

6. Snip the two black temperature sensor wires close to the board (1/8" to 1/4"), then snip the zip ties along the frame rail and remove the sensor from the truck.

Motor Speed Sensor Installation

1. Install a lock washer and a flat washer on outer shorter screw (metric) and insert through circuit board and 0.025 spacer/washer under board. Hold spacer on back of board while starting screw into motor two turns. Place spring behind board and hold it while inserting inner longer screw (metric) and flat washer through board and spring and into motor. Tighten down outer shorter screw all the way.
2. **To adjust:** Line up the encoder wheel retaining screws parallel to the inner edge of the circuit board by turning the truck's drive wheels slightly. Using a non-abrasive plastic gauge (to avoid damaging the sensor wheel), adjust inner screw so that the gap between the center inner edge of the board itself and the sensor plate is 0.145 inches. Insert gauge only 1/4 inch from edge of board. Do not lift the board with gauge.
3. Put a 1/8 inch dab of silicone sealant on each screw to prevent movement.
4. Re-solder the temperature sensor wires if they were cut upon removal (they are not polarized). Be careful not to overheat the terminals or they may unsolder from the board. Install small harness holder and ground wire against the motor and tie-wrap harness to holder.
5. Run the test procedure again on jack stands.
6. Apply a narrow bead of silicone RTV sealant around the motor cover plate rim and install the cover plate. Be sure harness is seated in the notch.
7. The rest of the procedure is the reverse of removal. Be sure to install 2 tie-wraps at the red, white and blue connector, before reinstalling metal zipper mesh. Road test the truck to verify that the repair is complete.

AIR CONDITIONING CONTROLLER

The Air Conditioning (A/C) Controller is both a switching device and a voltage converter for the A/C compressor motor. It is located under the hood on the passenger side near the A/C motor. Other than the external fuse, there are no user serviceable parts.

Before checking fuse, unplug truck from wall outlet. Write down amp-hour meter number (because the Amp-hour meter will go blank), then disconnect the red one-pin Anderson accessory connector near high voltage fuse box. When finished checking/replacing fuse, plug in red connector.

A/C Controller removal

1. Turn the ignition key off and set the parking brake. Unplug from wall outlet.
2. The amp-hour meter will go blank, so it is important to make a note of the Amp-hour meter reading. Disconnect the red one-pin Anderson accessory connector located at the firewall between the fuse box and heater fan housing.

3. Disconnect the high voltage input wire (3-pin Deutsch, black and white wires), the output wire (2-pin Deutsch to A/C motor, green and white wires), the signal wire (red wire with male spade), and black ground wire with eyelet.
4. Remove the fasteners which secure the controller and remove it from the truck.

A/C Controller installation

Installation is the reverse of removal. Re-connect the red Anderson connector. If amp-hour meter reads 99.99 or 100.00, disconnect the red Anderson connector, wait 10 seconds and try again.

POWER STEERING CONTROLLER

The power steering (P/S) controller is an electronic box mounted between the power steering motor and the P/S pump. It controls the voltage to the motor. Other than the external fuse, there are no user serviceable parts.

Before checking fuse unplug truck from wall outlet. Write down amp-hour meter number (because the amp-hour meter will go blank), then disconnect the red one-pin Anderson accessory connector near high voltage fuse box. When finished checking/replacing fuse, plug in red connector.

Power Steering Controller removal

1. Turn ignition key off and set parking brake. Unplug truck from wall outlet.
2. Make a note of the Amp-Hour meter reading. Disconnect the red one-pin Anderson accessory connector at the firewall between the heater fan housing and fuse box.
3. Unplug all wires from the P/S controller as follows:
 - 12V supply- single red wire with a spade connector.
 - Ground wire- single black wire bolted to chassis with a grounding screw.
 - High voltage to controller from battery pack - 3-pin Deutsch connector (black and white wires at the controller).
 - Controller to P/S motor - 2-pin Deutsch connector (green and white wires at the controller).
4. Remove the P/S belt guard.
5. Unbolt the two nuts holding the controller to the P/S bracket and remove the controller.

Power Steering controller installation

Installation is the reverse of removal.

Power Steering Motor removal

1. Turn ignition key off and set parking brake.
2. Remove the P/S belt guard. Unplug motor from controller.
3. Loosen 4 Allen head bolts holding motor on mounting plate. Slide motor forward to loosen and remove belt.

4. Remove motor bolts and remove the motor.

Power Steering motor installation

1. Position the new motor and finger tighten Allen bolts. Install the belt and tension it until you can deflect it 1/4 inch with moderate finger pressure (3 ft.-lb.).
2. Tighten the motor bolts.
3. Reinstall the belt guard.

Power Steering Motor Brush Removal

1. Turn ignition key OFF and set parking brake.
2. Unplug the P/S motor from the P/S controller.
3. Unscrew the P/S motor brush retainers. There are two retainers, one on each side of the input wires.
4. Carefully pull out brush assembly; a bit of masking tape may be used to pull out the brush if it is stuck in the holder.
5. Visually inspect the motor commutator for discoloration. Replace the motor if the commutator appears burned.

Power Steering Motor Brush Installation

Installation is the reverse of removal. Do not touch the contact surfaces of the brush.

VACUUM PUMP AND RESERVOIR

Because there is no vacuum created by the electric motor, vacuum pumps are utilized to supply vacuum to the brake booster. They are located under the hood on the passenger side. A cylindrical vacuum reservoir is also used in the system. It is located under the cab on the passenger side.

Vacuum Pump Removal

The single vacuum pump assembly is located under the BC3300 charger. *See Battery Charger removal procedure.* Remove the charger support plate. Unscrew the three 1/4" nuts holding the pump assembly to the frame rail. Remove the ground screw from under the pump. Unplug the positive 12V wire at the switch and remove the vacuum hose from the T junction.

Vacuum Pump Installation

Installation is the reverse of removal. Be sure to include the ground wire from the VAC switch upon installation.

CABIN PRE-HEAT SYSTEM

The cabin pre-heat system is programmed to heat the cabin before the driver starts a trip. This system uses power from the battery pack, however it only works when the truck is plugged into a wall outlet. The charger is typically able to replenish or supply enough energy used by the cabin pre-heat system to keep the batteries fully charged during the pre-heat cycle. *See Owners manual for operation and programming.*

Cabin Pre-heat Removal

The pre-heat computer is located on the console. See Amp-hour meter/console procedure.

Cabin Pre-heat Installation

Installation is the reverse of removal.

1997 Solectria E-10 Parts List
For Service and Repair Use Only
Not for Distribution

| <u>Part</u> | <u>Model Name/Number</u> | <u>Supplier</u> |
|--|-------------------------------|-----------------|
| Drive train | | |
| Motors | ACgtx20 E-10† | Solectria |
| Controllers..... | AC320 or AC325 E-10*,† | Solectria |
| DC-DC Controller | DC-DC380 E-10† | Solectria |
| Heater | | |
| Element Relay | HRelay* | Solectria |
| Vacuum Assist Brakes | | |
| Canister | Vaccumulator* | Solectria |
| Micro-Switch | Vswitch* | Solectria |
| Pump | Vpump* | Solectria |
| Air Conditioner | | |
| A/C Motor | BPM1-276V* | Solectria |
| A/C Controller | DC20- A/C† | Solectria |
| A/C relay | A/C 4100824-26..... | Solectria |
| A/C Belt | A/C Belt | Solectria |
| A/C Pulley, motor side..... | A/C PUL-small | Solectria |
| A/C Pulley, compressor | A/C PUL-large | Solectria |
| Accel/Brake Control | ABC1 E-10..... | Solectria |
| Amp Hour Meter | AH100..... | Solectria |
| Shunt | SH100 | Solectria |
| Rear Exhaust Fan (option) | RBBBoxfan-4” | Solectria |
| Battery Charger | | |
| Main Charger | BC1000u, BC3300† | Solectria |
| Batteries | Group 27† | Solectria |
| Console | | |
| Range-Power Selector..... | Range-Power Selector E-10 ... | Solectria |
| Ignition Box | IB E-10* | Solectria |
| Ignition board..... | CIB E-10* | Solectria |
| A/C Switch..... | A/CSW | Solectria |
| Recirculation Switch..... | RECSW..... | Solectria |
| Regeneration Switch | REGSW..... | Solectria |
| Heater Switch..... | Hswitch | Solectria |
| Voltmeter | VH100† | Solectria |
| Amp-hour meter..... | AH100..... | Solectria |
| Ammeter | AM100 | Solectria |
| Cabin Pre-heat..... | PRE-2..... | Solectria |

Power Steering

| | | |
|------------------|--------------------|-----------|
| Motor..... | BPM0.5 | Solectria |
| Controller | DC20-PS† | Solectria |
| Brushes..... | BPM0.5 Brush | Solectria |
| Belt..... | P/S Belt | Solectria |

This list is for Solectria customer use only. Please do NOT copy or distribute.

*** Must indicate what year your vehicle was delivered (check door jamb label for month and year produced at Solectria).**

† Must indicate if your battery pack has a special pack voltage/special battery type.

Appendix B

Troubleshooting Guide

1997 Solectria E-10

Nominal System Voltage: 276V

Batteries: Lead Acid

Battery Charger: Solectria BC3300 (3.3kW/240VAC)

Section I: Problem Solving

Section II: Systems Diagnosis

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|-------------------------|---|--|
| Vehicle does not drive. | Vehicle is plugged in. | Unplug vehicle. |
| | Vehicle is in 'gear' when key is turned to ON position. | The Range-Power Selector must pass by the NEUTRAL position before the vehicle will operate. |
| | 12V system is not working (lights, horn, etc.) | <i>See Section I E; 12V accessories don't work .</i> |
| | IGN circuit in console not "clicking". | <i>See Section II B; checking IGN circuit.</i> |
| | Motor controller does not "clunk". | <i>See Section II C; checking controllers and motors.</i> |
| | Motor controller or motor speed sensor failure. | <i>See Section II C; checking controller and motors.</i> |
| Vehicle is sluggish | Amp-hour Meter reading is over 40.00 to 50.00Ah. | The truck may not drive if amp-hour meter reads over 40.00 to 50.00 Ah. It is necessary to fully charge the battery pack at this time (until the Amp-hour meter reads 00.00). If necessary, the vehicle may be driven following a partial re-charge, but it should be fully recharged at the earliest opportunity for maximum battery performance. |
| | Range-Power Selector is set to Max Range. | Check position of Range-Power Selector. If set to Max Range, turn the switch to NORMAL or Max Power. |
| | Vehicle is in 'limp home' mode (due to low, weak or damaged battery pack, or bad wiring). | Check battery pack voltage when under load while driving using the voltmeter on the console. If voltage reading is at or under 237V while driving, and Amp-Hour meter reads less than 40.00Ah, check battery pack capacity by performing a battery discharge test. <i>See Battery Discharge Test</i> in text. It is necessary to fully charge the battery pack at this time. |
| | Only one drive system is operating. | If voltage reading is over 259V while driving, make sure that both drive systems are operating. <i>See Section II C; Checking motors and controllers.</i> |

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|---|--|--|
| Vehicle is sluggish (cont'd) | One or more battery strings are open (fuse blown or open module). Low battery voltage or low current output should be an indicator. <i>See "vehicle is in limp home mode" (above).</i> Batteries are very cold. | <ol style="list-style-type: none"> 1. Unplug truck charger from wall outlet 2. Using a clamp-on Amp meter at the large black 1-pole Anderson connector, run accessories and measure current on the one main negative wire 3. If a clamp on Amp-meter is unavailable, record Amp-hour meter reading and unplug small one-pole red Anderson connector 4. Then unplug large black 1-pole Anderson connector 5. Check for nominal 276V between the pole of the black connector and the red connector 6. The fuse box side of the connectors will be dead, so check the battery side. <i>See Section I J step 6.</i> |
| Vehicle jerking on acceleration | Faulty pot-box signal. Faulty motor speed sensor, faulty controller or faulty 25-pin cable. | <p>Try turning the Range-Power Selector to Maximum Power. Push the accelerator pedal all the way to the floor. Drive the truck using the Range-Power Selector to accelerate and decelerate. If vibrations are eliminated, the problem is probably the pot box. Call Solectria for details on checking pot box resistance.</p> <p>Refer to motor speed sensor testing text, and see <i>Section II C, Checking Motors and Controllers.</i></p> |
| Controller growling when truck started. | | Early versions of the E-10 (MY1995) may have symptoms of controller growling on start up, especially when cold. This typically goes away after a few miles. If this noise is unsatisfactory, please call Solectria to arrange to have the controller upgraded. |

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|--------------------------------|--|---|
| 12-volt accessories don't work | DC-DC in brown-out mode. | Turn off key and disconnect input wire to DC - DC (small white Molex connector-green and white wires), then reconnect input wires to DC-DC; don't worry about slight spark; check output on 2-pin gray connector for 12V. |
| | Blown fuse in DC fuse box. | Check fuses at DC fuse box and on the DC-DC converter. <i>See Section II A; checking DC -DC converter.</i> |
| | Accessory fuse in rear battery box is blown (chargers are not working either.) | Check for approximately 276V at DC-DC converter input and work back to main battery pack. <i>See Section II A; checking DC-DC converter.</i> |

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|--|--------------------------------------|---|
| Power steering is squealing, power steering not operating | Loose/slipping belt. | Tighten belt until there is a 1/4" deflection when 1 to 3 ft.-lb. force applied. |
| | Burnt brushes and/or motor. | Turn ignition key off and disconnect P/S motor to controller wires. Turn ignition key back on and check for minimum 48V DC at output of controller to motor. If voltage is present turn key off. Remove motor brushes and inspect commutator for wear and discoloration (replace brush if carbon section is less than 1/4" in length). Otherwise replace motor. |
| | Blown fuses and/or blown controller. | <ol style="list-style-type: none"> 1. Unplug single red wire from power steering controller 2. Turn on ignition and check for +12V between red wire and chassis 3. If no +12V, check harness for trouble 4. If there is +12V, reconnect the red wire and unplug 276V input to P/S controller 5. Check for 276V (between the white and green wires) 6. If no 276V, check DC fuse in fuse box 7. If there is 276V, turn ignition key off, reconnect 276V input, and disconnect controller output to motor 8. Turn ignition key on and check controller output to motor for minimum of 40-50V DC 9. If there is no voltage present at the controller output, unplug the 276V input wire again and check the fuse in the controller (it faces down) 10. If this fuse is fine, the power steering controller must be replaced 11. Note: Do not plug in 276V supply or the motor unless the red +12V wire is disconnected or the ignition key is off 12. This will cause sparks that will damage the connectors. |

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|-----------------|-------------------------------------|--|
| A/C not working | No 12V signal to A/C controller. | <ol style="list-style-type: none"> 1. Unplug single red wire from A/C controller 2. Turn on ignition, and select "max A/C", and check for positive 12V between harness wire and chassis ground 3. If no positive 12V, reconnect the wire and unplug the molded connector at the pressure switch mounted on the fan/evaporator housing 4. Connect the wires with a jumper or pliers to temporarily bypass the switch and if the A/C motor starts, then the system refrigerant is low 5. Have it tested, evacuated & recharged with 24 oz R134A refrigerant 6. If the compressor does not run with the pressure switch bypassed, then check the relay at the firewall above the DC fuse box 7. Also check the 20A blade fuse located near the 12V junction block at the driver's side inner fender. |
| | Blown fuses and/or blown controller | <ol style="list-style-type: none"> 1. Unplug single red wire from A/C controller 2. Turn on ignition and A/C and check for +12V between red wire and chassis 3. If no +12V, check harness for trouble 4. If there is +12V, reconnect the red wire and unplug 276V input to A/C controller 5. Check for 276V (between white & green wires) 6. If no 276V, check DC fuse in fuse box 7. If there is 276V, turn ignition key off, re-connect 276V input, and disconnect controller output to motor 8. Turn ignition key on and check controller output to motor for minimum of 40-50V DC 9. If there is no voltage present at the controller output, unplug the 276V input wire again and check the fuse in the controller 10. If this fuse is fine, the A/C controller must be replaced 11. Note: Do not plug in 276V 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. |

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|-------------------------------|--|--|
| A/C not working (cont'd) | Burnt brushes and/or motor | Turn ignition key off and disconnect P/S motor to controller wires. Turn ignition key back on and check for minimum 48V DC at output of controller to motor. If voltage is present, turn key off. Remove motor brushes and inspect commutator for wear and discoloration (replace brush if carbon section is less than 1/4" in length). Otherwise, replace motor. |
| Brakes not working adequately | <p>Vacuum pump not working or vacuum switch not working.</p> <p>Vacuum leak or vacuum low.</p> | <p>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 is present at pump. If not, check for +12V at switch. Also check grounds.</p> <p>Let the pump stop running, apply brakes three times and make sure the pedal doesn't feel stiff. If you get less than three pumps on the brake pedal or if 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.</p> |

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|-------------------|---|---|
| Vehicle trips GFI | Water and salt in AC plug or extension cord | With extension 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 for a replacement charger. |
| | Short in battery thermal management system. | Locate AC junction box behind seat. One at a time, unplug the 2-wire connectors marked front and rear (black and white wires). If GFI trips with front" or "rear" connected, then open corresponding battery box and inspect the integrity of the circuit. The batteries must be below 60°F or the thermal sensors will be "open" and the test will be invalid. |

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|---|---|---|
| Vehicle not charging - BC3300 equipped (Green LED at Ah meter not flashing and numbers are not counting down) | <p>No power from wall outlet.</p> <p>No LED light come on at interface box. No AC voltage input to charger.</p> | <p>Check that extension cord has 208-240V at the truck end. Reset circuit breaker or GFI.</p> <p>With vehicle plugged in: check for the AC voltage at the end of the charger input extension cord under the hood. (If no voltage present: check for voltage at the charger plug and AC junction box behind the seat.) If voltage is present to the charger and the charger doesn't operate, contact Solectria Corporation. The charger may have to be replaced.</p> |

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|--|---|---|
| Vehicle not charging - BC3300 equipped (Green LED at Ah meter not flashing and numbers are not counting down) (cont'd) | Charger is in fault mode: problem with battery pack voltage to charger. (Yellow light is lit on interface box). | <ol style="list-style-type: none"> 1. <u>With vehicle unplugged:</u> Disconnect two-pin red Anderson charger output connector and check for DC voltage at vehicle harness 2. If no voltage or very low voltage is present, check the inline fuse (or fuses) between the charger and the one-pin red Anderson accessory connector under the hood 3. 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 truck harness 4. Carefully back probe the connector. Make sure the truck is unplugged from the wall. 5. If the fuse is in good condition and no voltage or low voltage is present at the battery side of the Anderson accessory connector, open rear battery box and replace 50 amp charger/accessory fuse 6. If the fuse is blown, all accessories including the DC-DC converter will not work. Note: unplug the one-pin red Anderson connector before replacing this fuse. |
| | Charger is in fault mode: Bad signal from temperature sensor. (Yellow LED is lit on interface box) | Unplug vehicle. Disconnect temperature sensors from charger interface box and measure the resistance at the vehicle side of the harness (Packard connectors with green and black wires). It 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 replacement sensor. |
| | Charger is in fault mode: Batteries are too hot: over 130 °F. (Yellow LED is lit on interface box.) | Unplug truck from wall. 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 truck in shade to let batteries cool. The charger will restart when the batteries have cooled. |

Section I: Problem Solving

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| SYMPTOM | CHECK FOR | PROCEDURE |
|--|-------------------------------------|--|
| Vehicle not charging - BC3300 equipped (Green LED at Ah meter not flashing and numbers are not counting down) (cont'd) | 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. <i>See Section I Vehicle Not Charging BC3300 step 6 for further testing.</i> |
| Speedometer needle with erratic movements | Bad grounds. | Check grounds at controllers to frame. Check ground at 12V side of DC-DC converter on the grill. |
| | Bad connections | Check green wire from the ignition board in the console. It connects to the O.E. speedometer signal wire at the harness over the passenger side lower dash panel. |

Section II: Systems Diagnosis

TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| PROCEDURE | STEPS |
|--------------------------|--|
| Checking DC-DC converter | <ol style="list-style-type: none"> 1. With key off and truck unplugged from wall, back probe the low voltage side of the DC-DC converter with a voltmeter (gray Anderson connector-red and black wires). 2. If full 12V, check truck harness for broken wire or bad fusible link. 3. If considerably lower than 12V, check truck harness for a short. 4. If no voltage is present, unplug the 276V input to the DC-DC converter and check the fuse in the DC-DC converter. 5. If the fuse is blown try replacing it with the same current rating (5A). 6. Re-install good fuse, re-connect 276V input (be certain the key is off or 12V output is disconnected) and check for 12V at gray Anderson connector. 7. If there still is no 12V, unplug the 276V input and check the truck harness for 276V. 8. 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. 9. If there is no voltage or very low voltage present at the DC-DC input, check the fuse in the main DC fuse box with the DC-DC input still unplugged. 10. If fuse is okay, check for +276V DC between the battery side of the one-pin red Anderson accessory connector and any of the green wires with yellow stripe exiting the fuse box. 11. If no voltage or low voltage is present, open the rear battery box and check the 50 Amp charging/accessory fuse. 12. If this fuse is blown, all accessories will not work including chargers. |
| Checking IGN circuit | <ol style="list-style-type: none"> 1. Sit in the vehicle with the windows rolled up (it must be quiet to hear the ignition relays.) Set the Range-Power Selector to any forward setting. Make sure the truck is unplugged from wall outlet. 2. Turn the ignition key ON. Wait until the reminder chime stops. Put seat belt on. 3. Slowly turn the 'gear' switch back towards NEUTRAL or OFF. (Don't let the spring detent in the Range-Power Selector affect turning the handle). Listen for the relays on the ignition circuit to 'click'. Don't confuse the mechanical detent in the switch that 'clicks' first. The click indicates that the ignition circuits and the neutral interlock circuits are working. To verify that both relays are working (there is one for each controller), proceed to the next step. The truck will operate with only one ignition box/controller/motor, but the performance will be reduced by more than half. 4. If no 'click', check for keyed +12V to the ignition board or ignition boxes. MY1996: pin #3 at Molex Minifit connector at front of console- (white wire). MY1995: Turn the console upside down. Check the single pin white wire to each ignition box. Unplug both ignition boxes and plug each in one at a time with key on to check if the relays inside 'click'. Make sure they are also grounded (gray wires). If 12V is present and grounds are in good condition, check the Range-Power Selector for continuity in Forward or Reverse (call Solectria at 508-658-2231 for details). If okay, replace the ignition board or boxes. |

Section II: Systems Diagnosis

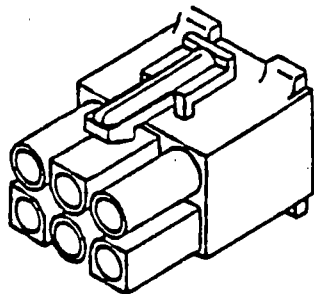
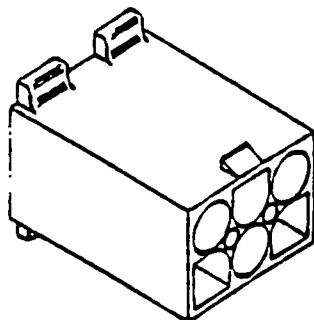
TROUBLE SHOOTING GUIDE FOR SOLECTRIA E-10

| PROCEDURE | STEPS |
|---------------------------------|--|
| Checking Motors and Controllers | <ol style="list-style-type: none"> 1. Insure that the ignition circuits are working: listen for ignition relay 'click' under console. 2. Refer to Checking Ignition Circuit in previous section. 3. Make sure the truck is unplugged. 4. Jack the rear of the truck by the axle and place the axle on jack stands with the wheels free to turn. 5. WARNING: Failure to support the rear axle may cause unintended acceleration resulting in possible injury or death. 6. Raise the bed. WARNING: always use prop rod. Turn the ignition switch off and on with Range-Power Selector in NEUTRAL. Listen and/or feel for each controller to 'clunk'. <ol style="list-style-type: none"> A. If only one controller (e.g. driver's side controller) clunks and the other one does not, check battery pack voltage at gray Anderson connector. If approximately 276V is present, disconnect and swap the 25-pin cables at each controller. If driver's side controller then clunks, this indicate that the ignition box or 25-pin cable to that controller is bad. If it does not clunk, the controller must be replaced. B. If both controllers clunk, disconnect the motor power leads (red, white and blue connectors) and the 9-pin motor speed sensor from one-controller and accelerate slowly. <p style="text-align: center;">WARNING!</p> <p>Rear wheels should spin during this procedure.</p> <ul style="list-style-type: none"> • Make sure people and objects are clear. • Do not spin at high speeds. • With power off (key out of ignition) check both tires for pebbles or debris in tires treads (rotate by hand) • Wear safety glasses. <ol style="list-style-type: none"> 7. If truck accelerates normally, try the other motor/controller combination by itself. 8. If one motor does not work, try swapping the motor leads and speed sensor leads to the other controller. 9. If controller drives one motor but not the other motor, check the motor speed sensor as outlined in the text. 10. If controller does not drive either motor, replace the controller. 11. If both controllers clunk, but neither motor will turn, it may be necessary to perform a pot-box resistance test (call Solectria for details). <p>Note: Before unplugging and re-plugging and swapping things around, be sure to turn off ignition key switch and place Range-Power Selector to NEUTRAL.</p> |

Solectria Connectors

Male

Female

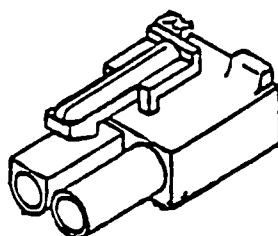
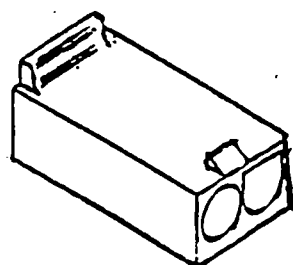


6-pin International Molex

- *Amp-Hour Counter Harness under dash*

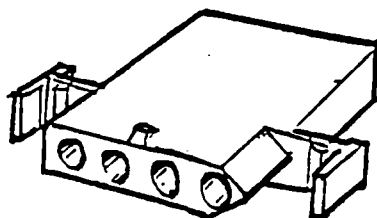
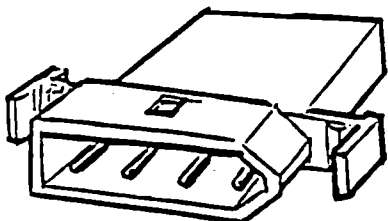
3-pin International Molex

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



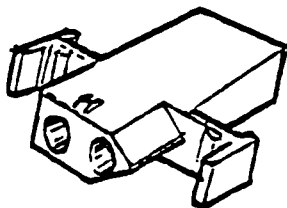
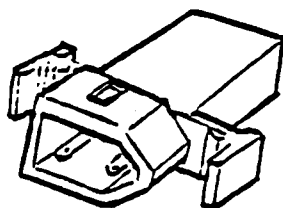
2-pin International Molex

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



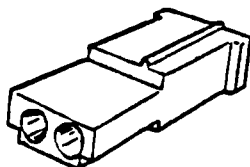
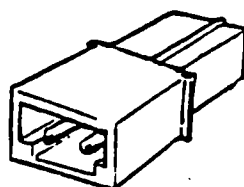
4-pin Molex

- *Charger Interlock*



2-pin Molex

- *High-Voltage Heater under dash*



2-pin Amp

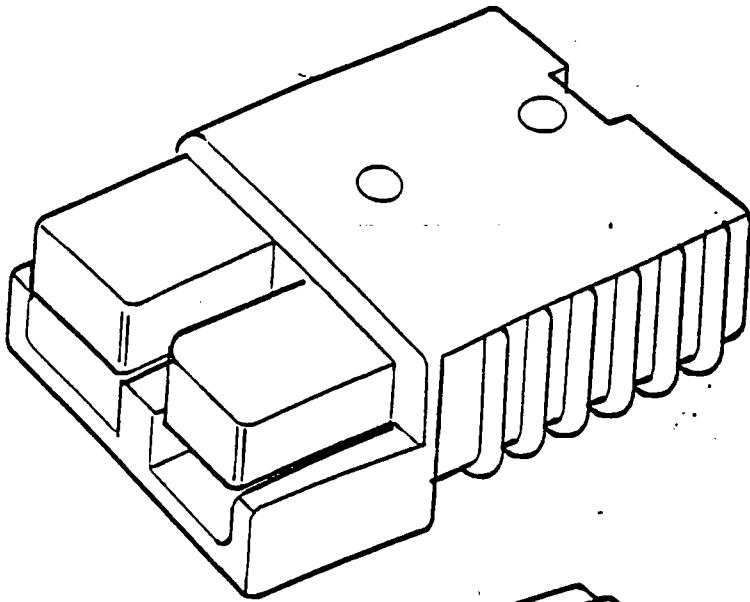
- *Regen Disable*

4-pin Amp

- *Charge Complete LED*

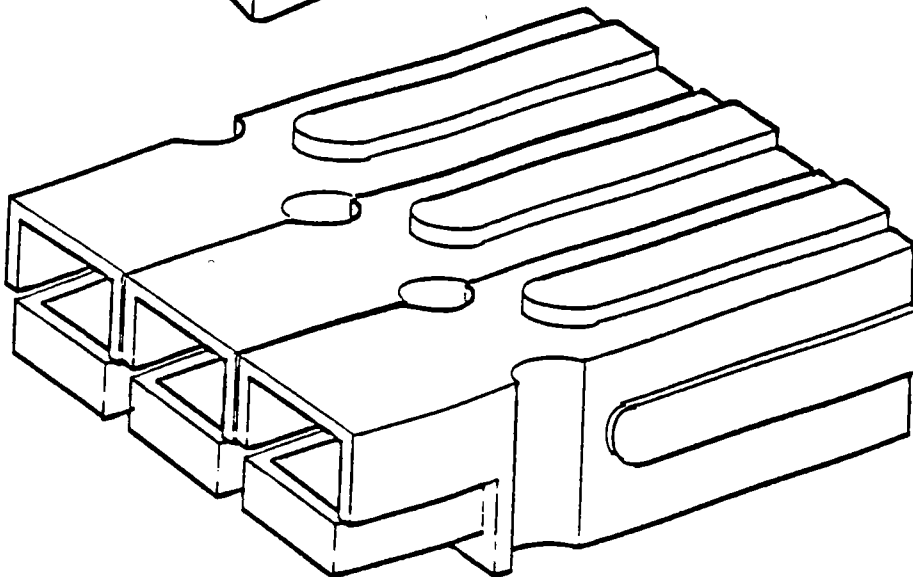
*Note: Connector nomenclature is defined by Solectria. Connector gender may not be consistent with other industries. Please note whether the pins are exposed or set into the connector.

Solectria Connectors



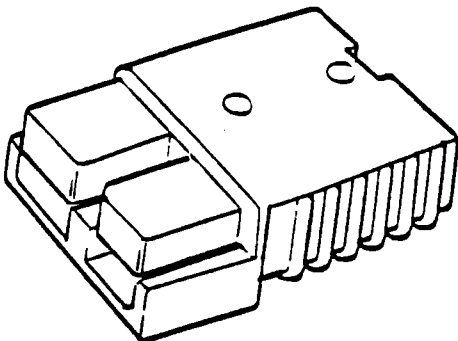
SB175 Large Grey Anderson

- *Battery to Motor Controller*



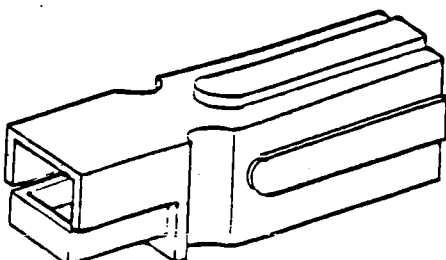
Power Pole 120

- *Red, White and Blue Motor Power Leads*



SB50 Anderson

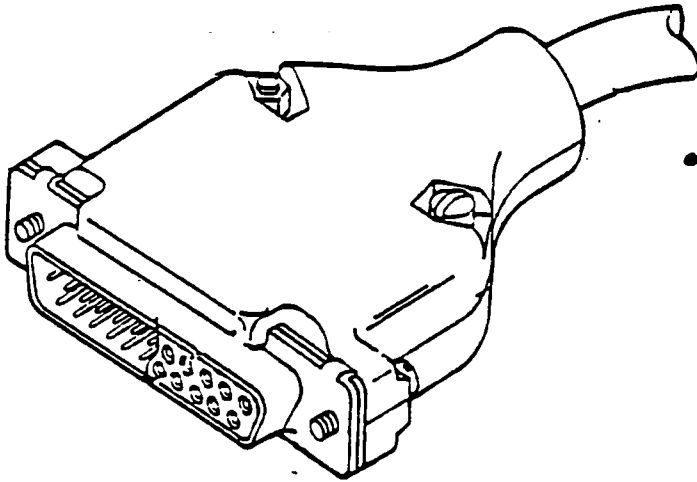
- *Red-BC3300 Charger output to Batteries*
- *Grey- DC-DC 12V Output*



Power Pole 50

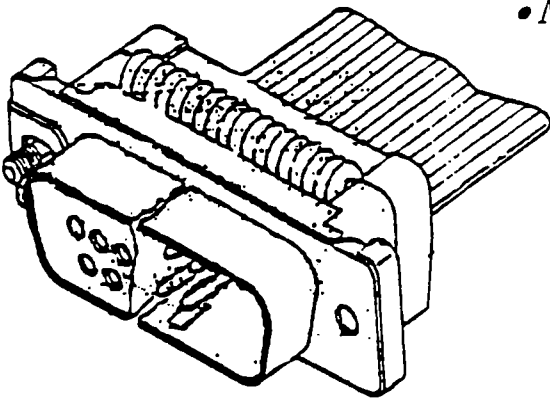
- *Red- Accessory Positive-Service Disconnect*
- *Black - Charger Negative Disconnect*

Solectria Connectors



25-pin D sub

- *Ignition Box to Motor Controller*

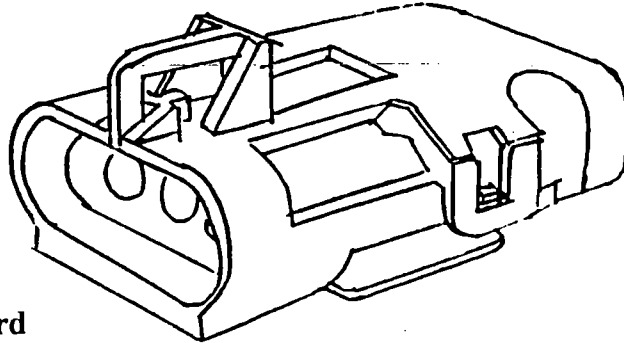
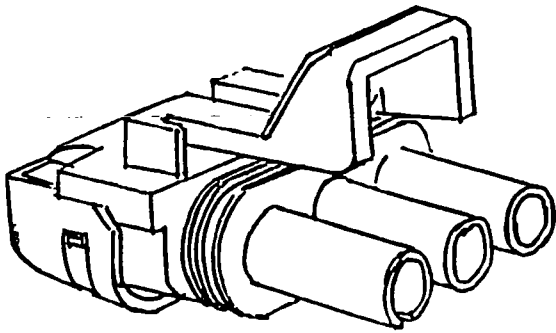


9-pin D sub

- *Motor Speed Sensor to Motor Controller*

Solectria Connectors

(3-pin model depicted)

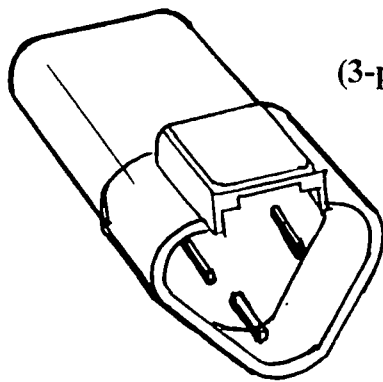


3-pin Packard

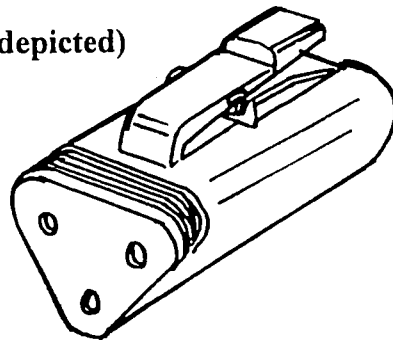
- *Battery Temperature Sensors*

4-pin Packard

- *Regen Brake Light Activation*



(3-pin model depicted)



2-pin Deutsch

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

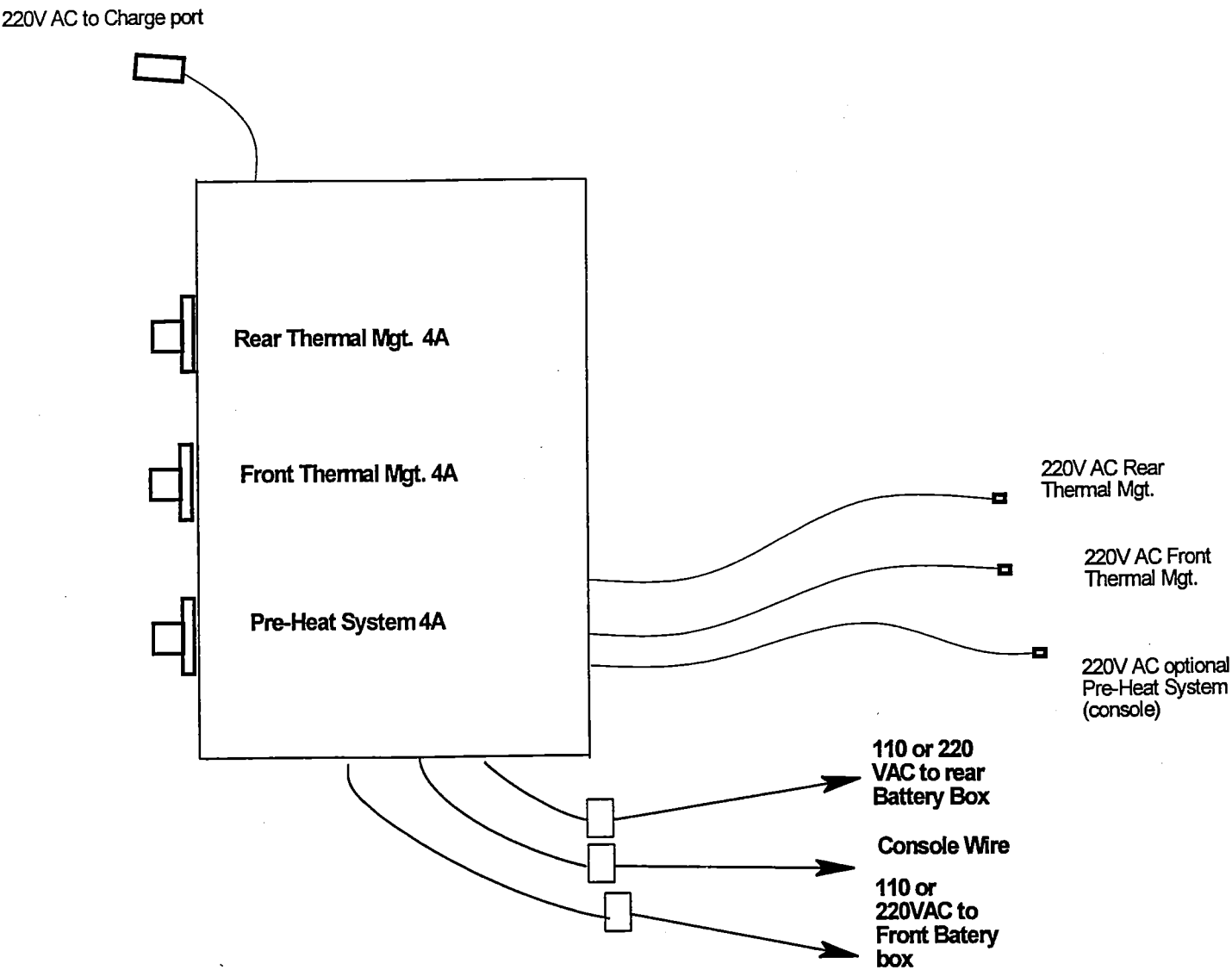
3-pin Deutsch

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

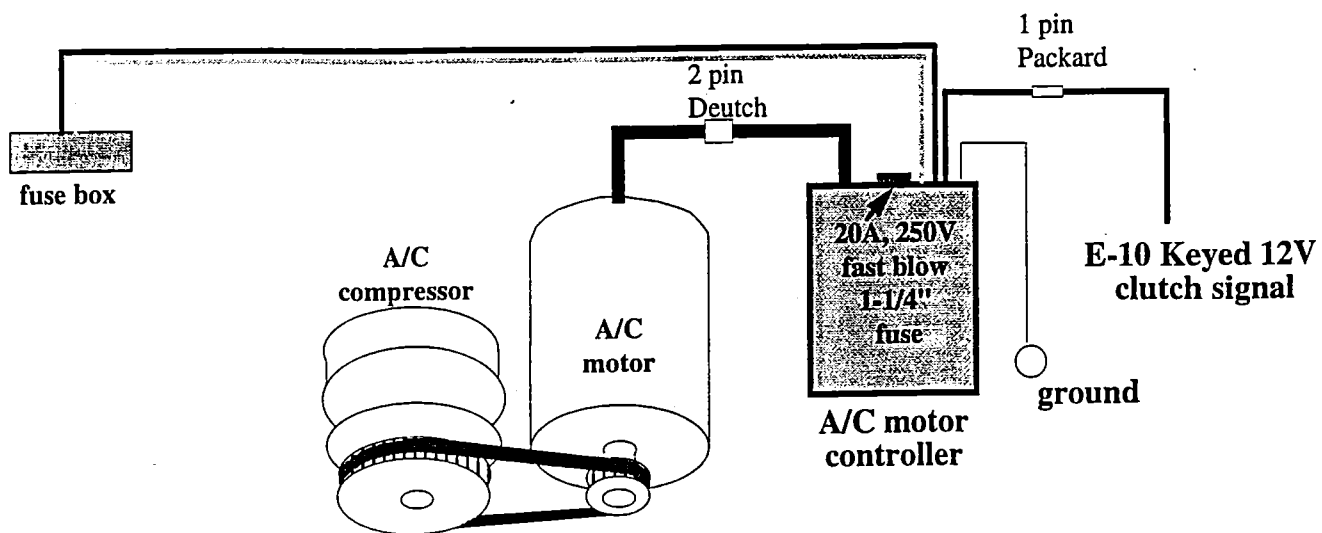
4-pin Deutsch

- *Amp-hour meter harness under hood*

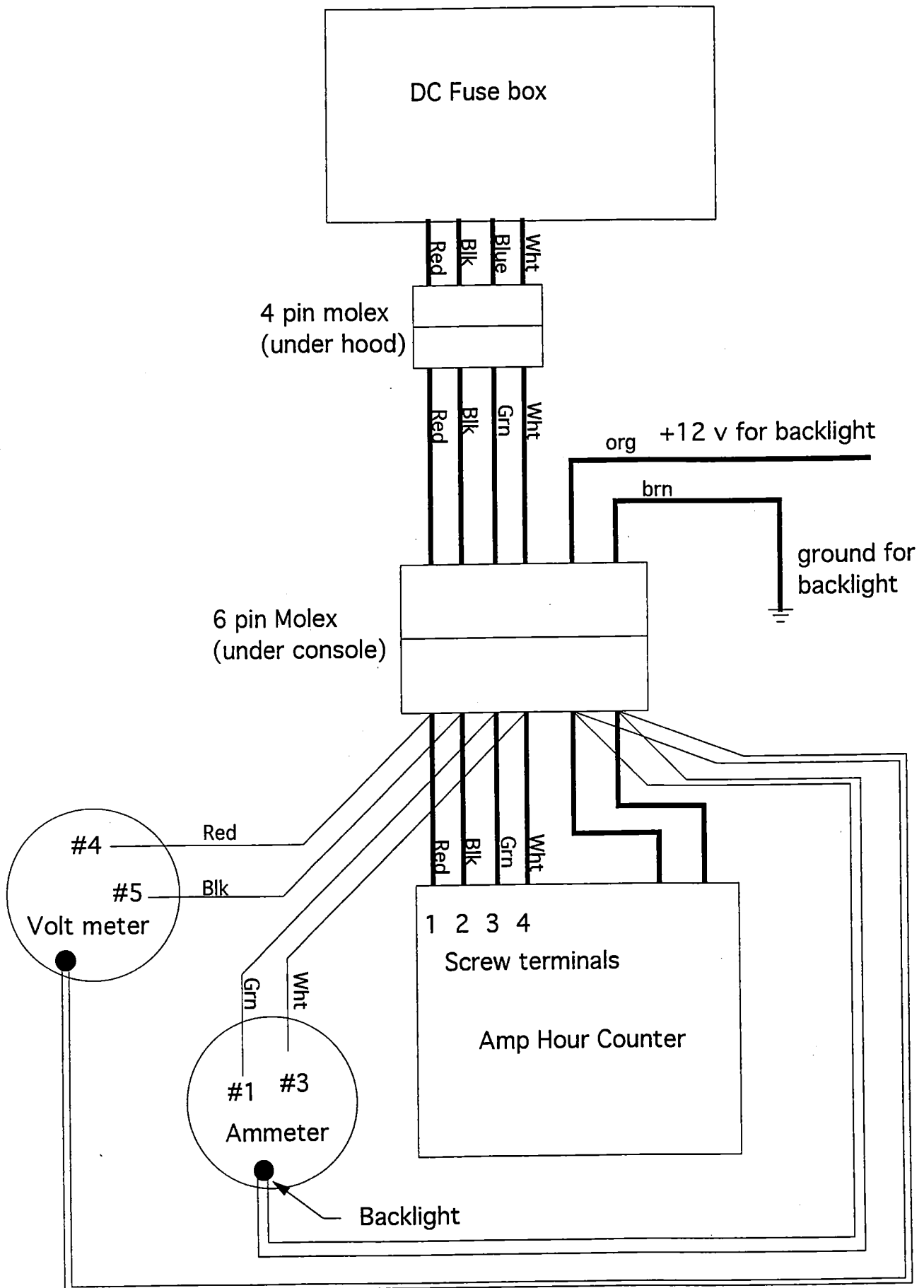
1997 AC JUNCTION BOX



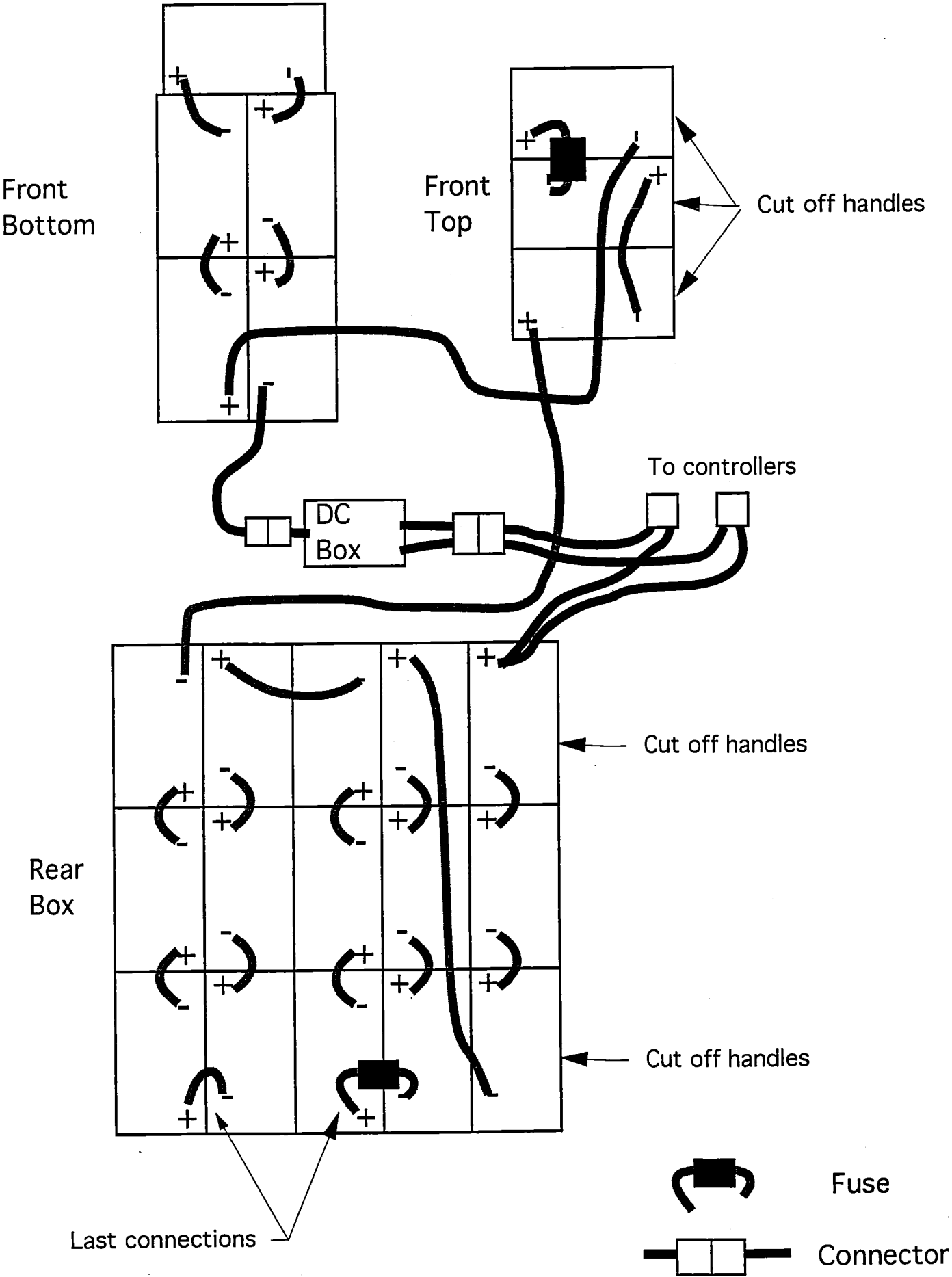
1997 E-10 Air Conditioning (A/C) WIRING



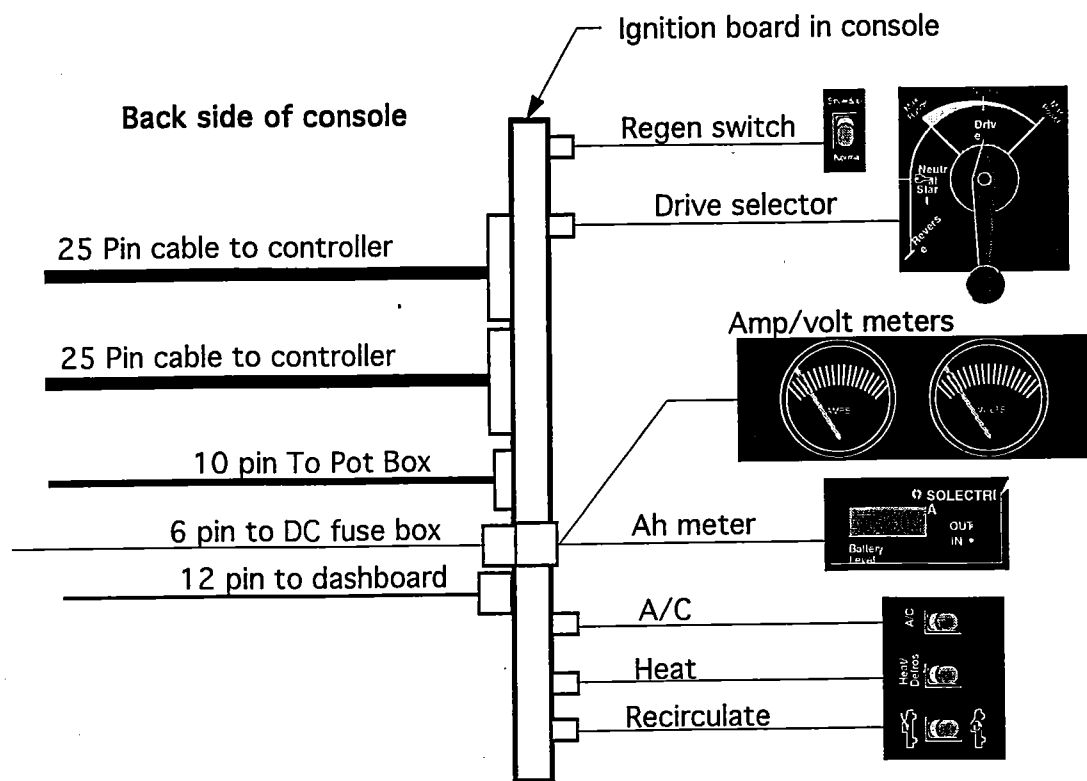
1996-1997 E-10 Amp-Hour Meter Wiring



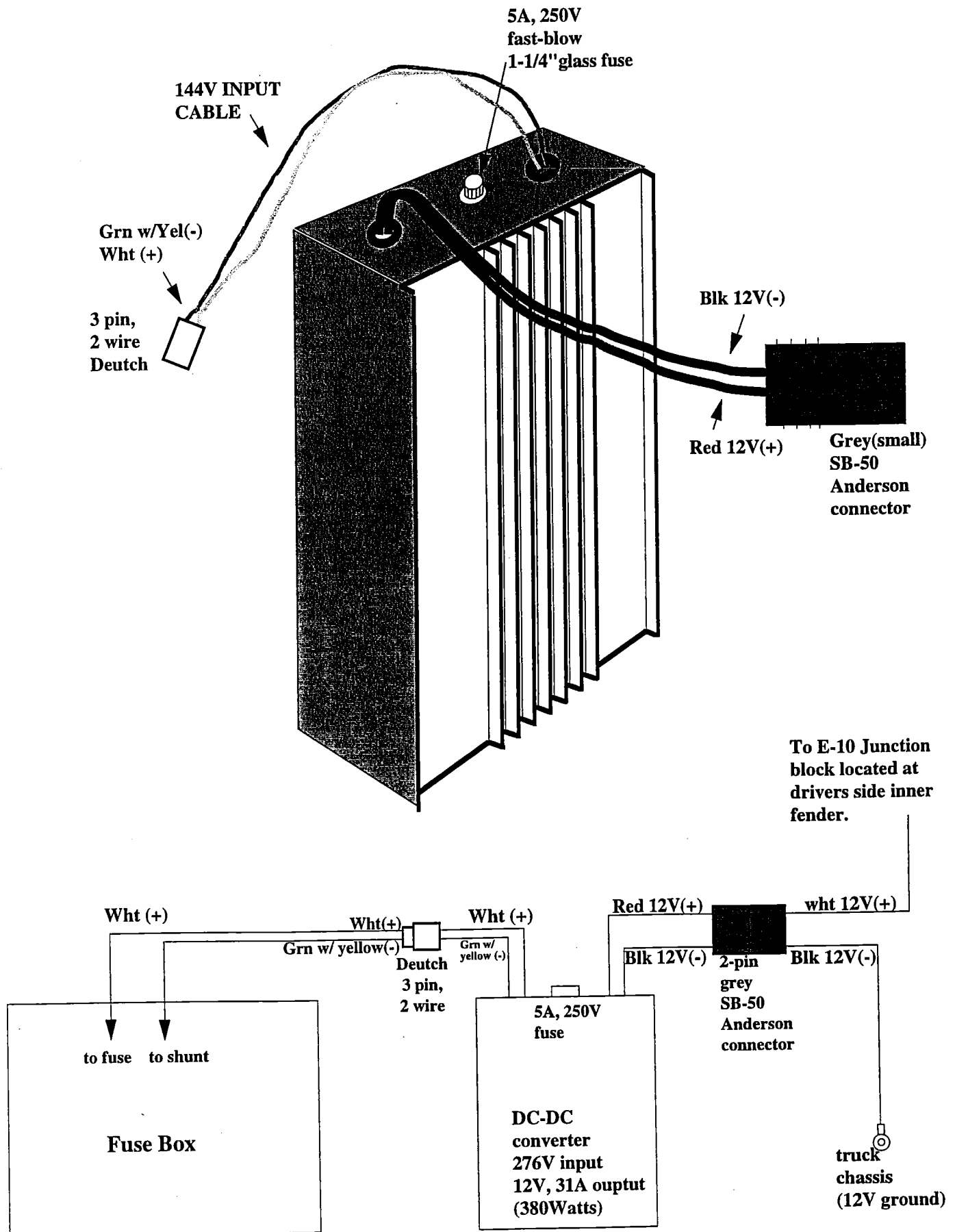
276 Volt E-10 Sonnenschein Battery Layout



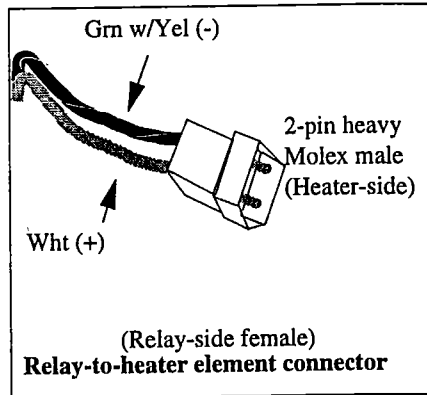
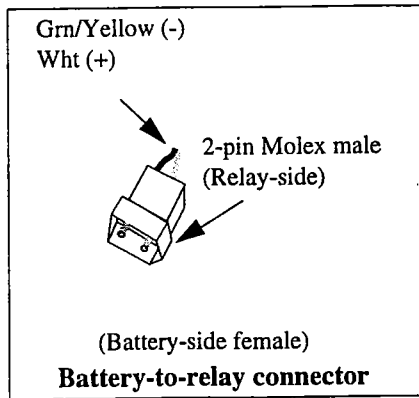
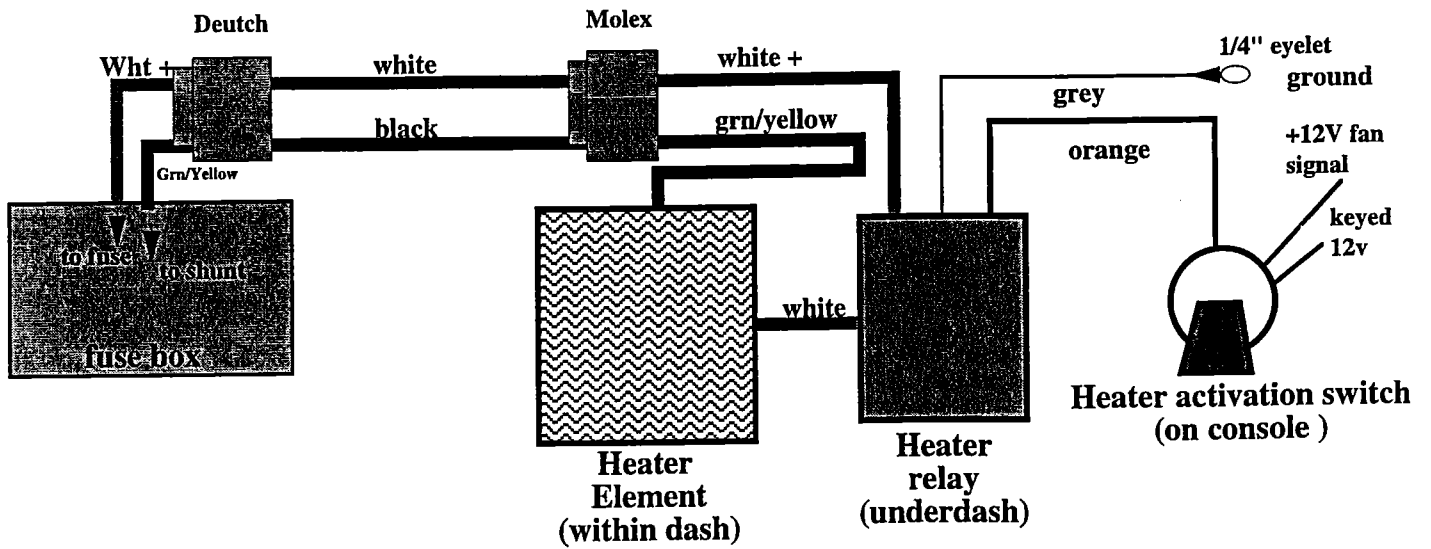
1997 E-10 Console ignition board wiring



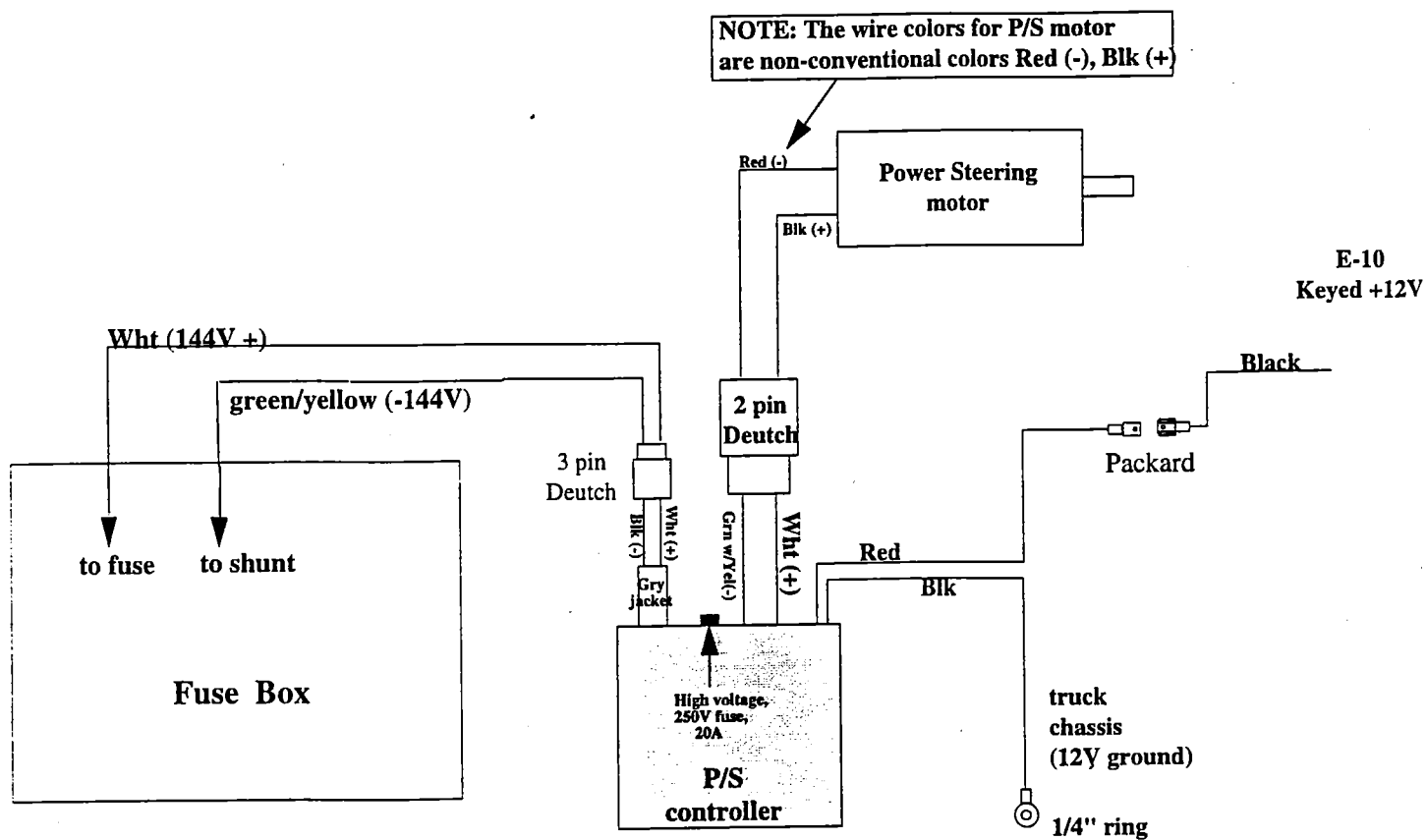
1997 E-10 DC-DC WIRING



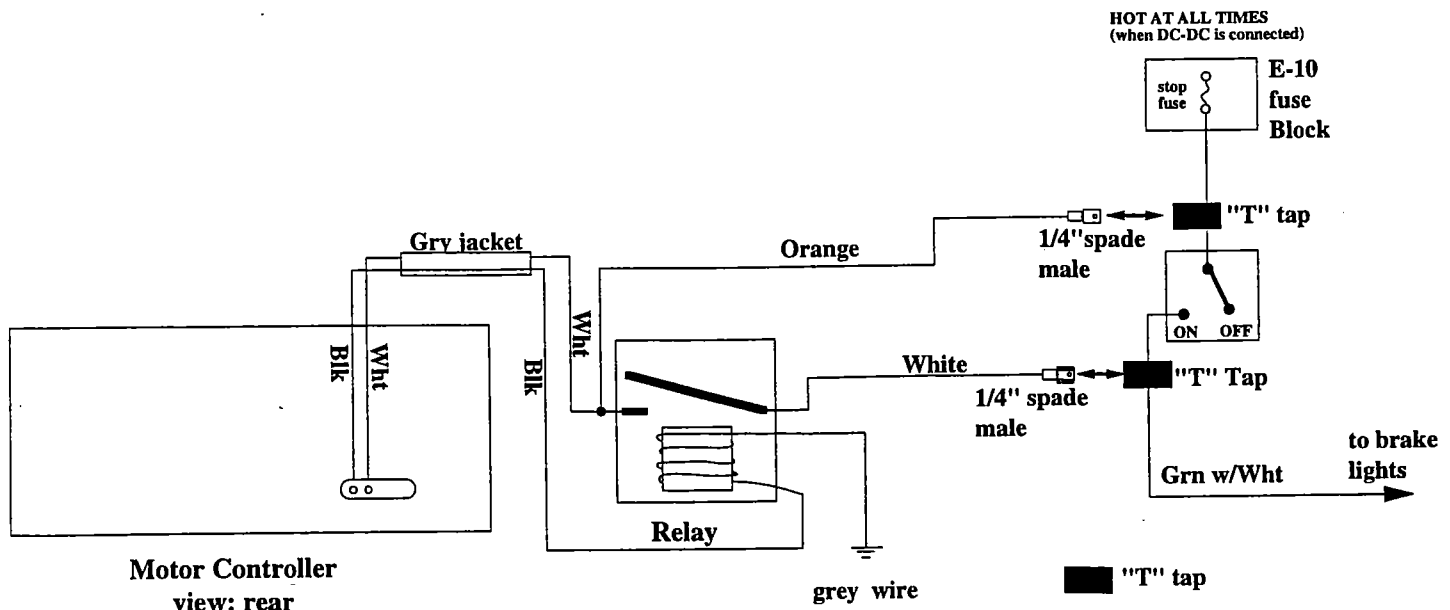
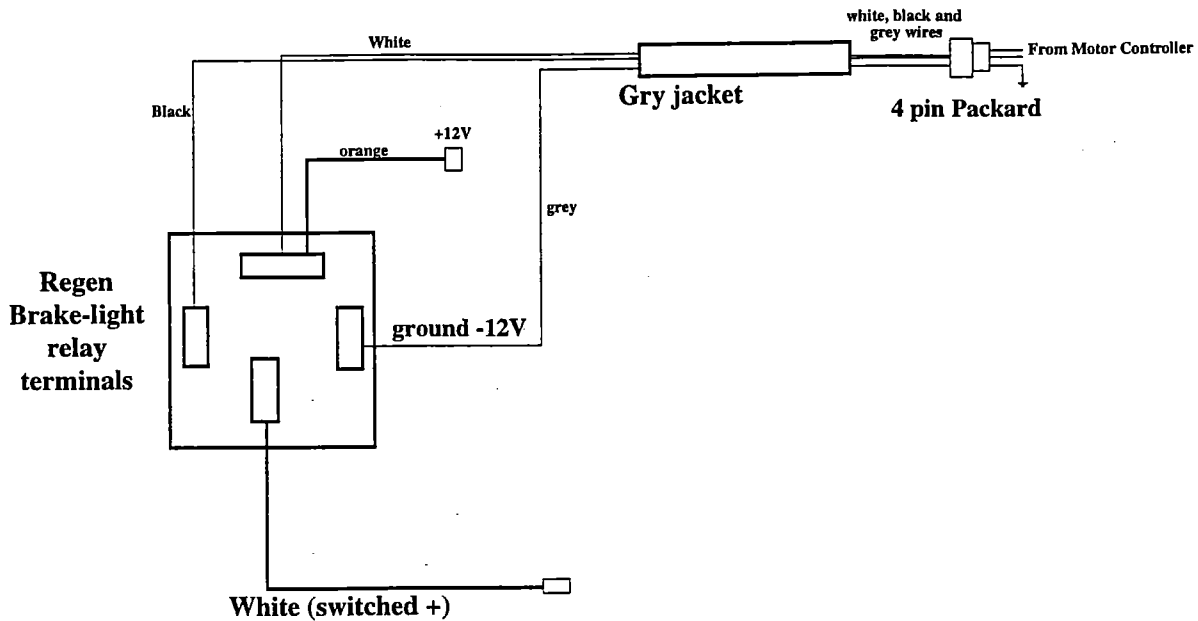
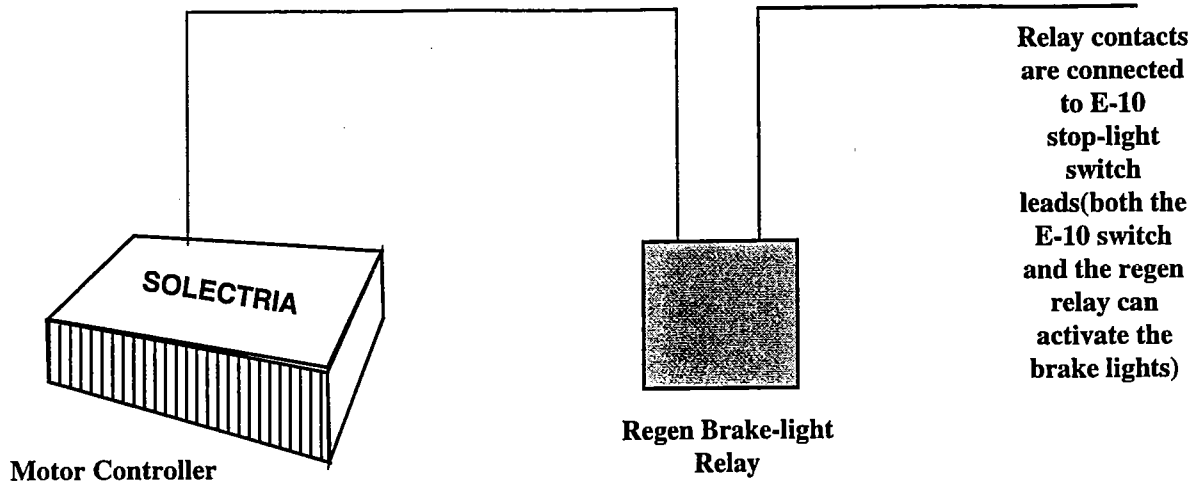
1997 E-10 HEATER WIRING



1997 E-10 POWER STEERING WIRING

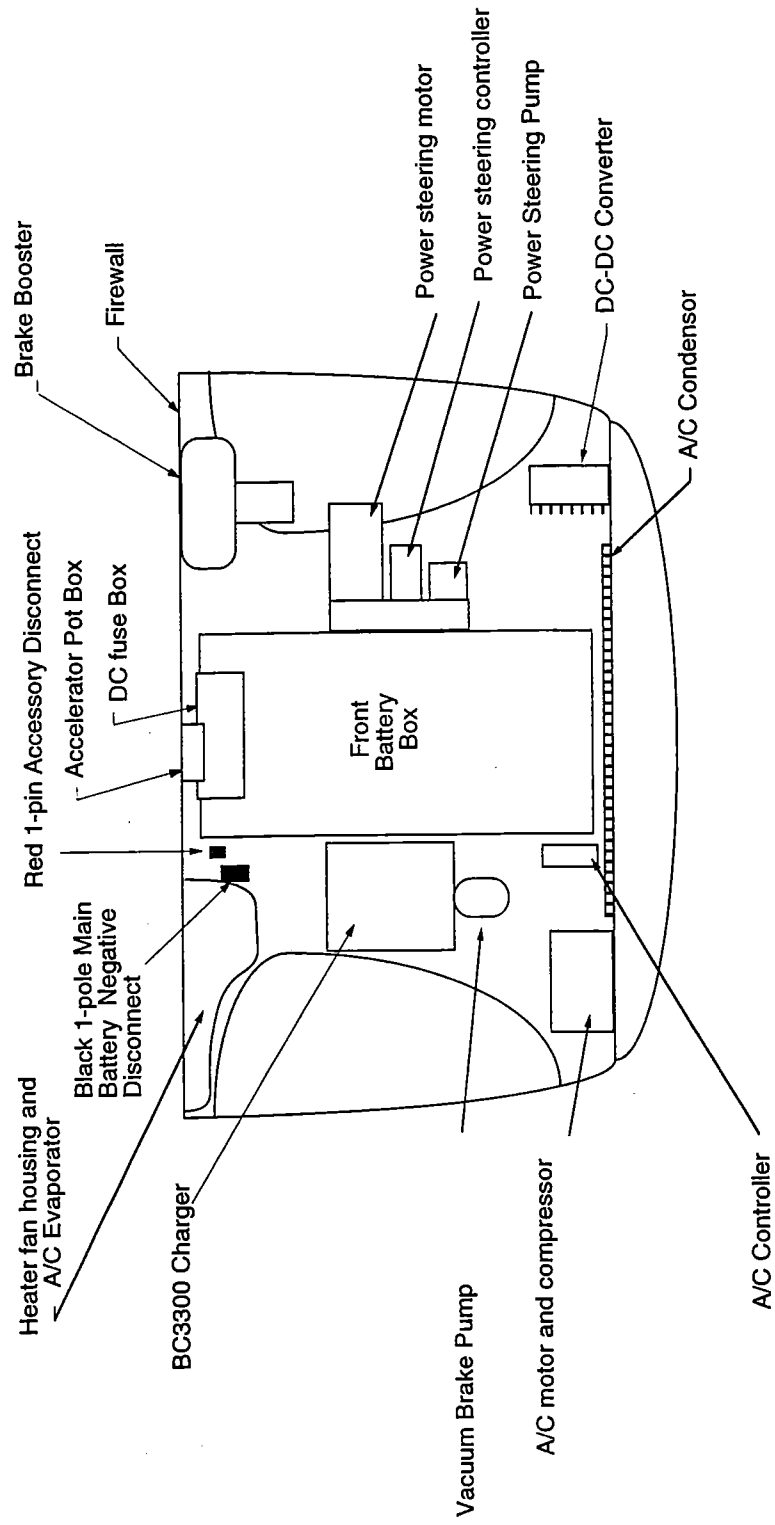


1997 E-10 REGEN BRAKE LIGHT WIRING



1997 SOLECTRIA E-10 TRUCK

Under Hood Layout



1997 Solectria E-10 Vehicle Layout

