

# SERVICE MANUAL

<sup>1998</sup>  
~~1997~~ SOLECTRIA FORCE

Nominal System Voltage: 156V  
Batteries: Lead Acid  
Charger: BC3300 (3.3kW/240VAC)

## SOLECTRIA CORPORATION

33 Industrial Way  
Wilmington, MA 01887  
USA

tel 508-658-2231

fax 508-658-3224

<http://www.solectria.com>

Copyright 1997 Solectria Corporation. All rights reserved.  
No part of this publication may be reproduced, stored in any retrieval system or transmitted in any form or by any means, including but not limited to electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of Solectria Corporation.

## FORWARD

This manual has been prepared as a supplement to the service information contained in the Geo 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

	Page
<b>Introduction</b>	
Description/Service Guidelines .....	4
Additional Service Information .....	8
Standard Safety Precautions .....	9
<b>Drive Motor/Automatic Transmission</b>	
Description/location .....	10
Checking oil level .....	10
Changing transmission oil .....	10
Replacement of motor/transmission .....	11
Installation of motor/transmission .....	12
Motor junction block replacement .....	12
<b>Battery Pack</b>	
Description/location .....	13
Rear Battery Box .....	13
Front Battery Box .....	13
Checking Battery condition (discharge testing) .....	14
Battery removal .....	16
Battery Box Fan .....	18
<b>Electronic Components</b>	
Motor Controller .....	19
DC-DC Converter .....	19
Accelerator/Brake Controller .....	20
Amp Hour Counter .....	21
Battery Charger .....	23
Motor Speed Sensor .....	23
A/C Controller .....	25
Ignition Box .....	26
<b>Accessories</b>	
Cabin Preheating System .....	27
Vacuum Pump and Reservoir .....	27
Range-Power Selector .....	27
<b>Appendix A - Parts List, Tools &amp; Test Equipment</b>	
<b>Appendix B - Layout and Wiring Diagrams, Connector Drawings</b>	
<b>Appendix C - Troubleshooting Guide, Battery Discharge Test Form, Towing Instructions</b>	

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

## FORCE DESCRIPTION AND SERVICE GUIDELINES

This section contains a description of the 1997 Solectria Force and its major features. For operating information, refer to the 1997 Solectria Force Owner's Manual.

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

**All major components are electrically connected to the battery pack and have high voltage labels. Use due caution when servicing.**

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

### Basic Vehicle Layout

The 1997 Solectria Force operates on a 156V nominal DC system. The exact voltage level of the battery in any Force 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 in the motor compartment and under the floor of the trunk.

The Force drive system uses a 3-phase AC induction drive motor. The motor controller, located on top of the front battery box under the hood in the motor compartment, receives high current, high voltage (156V) direct current (DC) electricity from the battery and delivers variable frequency alternating current (AC) to the motor, located behind the front battery box.

***NOTE:** Each of the following three electronic components has high voltage cables which supply them with power.*

#### 1. DC-DC Converter

The DC-DC converter (which supplies 12V DC to power the vehicle accessories), power brake system, and air conditioning components are also located under the hood. The electric heater is located under the dash board.

#### 2. Battery Charger

The Battery Charger is located on the driver's side of the trunk and may be one of two models, the standard BC1600 or the optional BC3300.

##### **Battery Charger - BC1600**

The vehicle's battery pack is recharged from any 20A, 120VAC, 60Hz outlet (NEMA 5-20R). This outlet should be on a dedicated GFI-protected circuit.

##### **Battery Charger - BC3300 Optional**

If your car is equipped with an optional BC3300 charger, it is designed to be charged using a standard 20A, 240VAC, 60Hz outlet (NEMA 6-20R). This outlet

should be on a dedicated GFI-protected circuit. In an emergency or if 240VAC is not available, a BC3300 equipped car may also be charged with 120VAC using the custom adapter cord provided.

### **3. Amp-Hour Meter**

The digital Amp-Hour meter display is located in the instrument cluster, while the Amp-Hour meter box is found under the dash near the steering column.

### **Safety**

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

The car will not drive if it is plugged in.

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

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

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

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

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

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

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

### **Battery Information**

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

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

### **Disabling the Vehicle**

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

### **Servicing the Car - Emergency Procedures**

*To secure the car*, set the parking brake firmly by lifting the standard hand-operated brake lever between the front seats. Turn the Range-Power Selector, located on the floor console, to the OFF setting to prevent the vehicle from being driven.

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

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

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

All high voltage and low voltage power to the vehicle is thus disabled and no systems or accessories on the vehicle will operate except the charger. **The charger can be disabled by disconnecting the small black one-pin Anderson connector under the fuse box, or simply unplugging the charger output wires (2-pin red Anderson connector).**

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

### WARNING!

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

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

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

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

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

