300 Electrical System - General

GENERAL

A brief description of the principal parts of the electrical system is presented here. Also covered here are general electrical system troubleshooting tips as well as instructions on using the Saab wiring diagrams.

Fuse rating and color

Red .	. 10 amp
Blue. .	. 15 amp
Yellow .	. 20 amp
Green .	. 30 amp

Voltage and Polarity

Saab electrical systems are 12-volt direct current (DC) negative-ground systems. A voltage regulator controls the system voltage at approximately the 12-volt rating of the battery. All circuits are grounded by direct or indirect connection to the negative (-} terminal of the battery. A number of ground connections throughout the car connect the wiring harness to chassis ground. These circuits are completed by the battery cable or ground strap between the body and the battery negative (-) terminal.

Wiring, Fuses, and Relays

Nearly all parts of the wiring harness connect to components of the electrical system with keyed, push-on connectors that lock into place. Notable exceptions are the heavy battery cables and the alternator wiring. The wiring is color-coded for circuit identification.

With the exception of the battery charging system, all electrical power is routed from the ignition switch or the battery through the fuse/relay panel, located in the right side of the engine compartment. Fuses prevent excessive current from damaging components and wiring. Fuses are color coded to indicate their different current capacities.

The relays are electromagnetic switches that operate on low current to switch a high-current circuit on and off. Many of the relays are mounted on the fuse/relay panel in the engine compartment, although later models are equipped with additional auxiliary relay panels. For information on relay and fuse locations, see 371 Wiring Diagrams, Fuses and Relays.

Electrical System Safety Precautions

Please read the following warnings and cautions before doing any work on your electrical system.

WARNING

• Some of the cars covered by this manual are equipped with a Supplemental Restraint System (SRS} that automatically deploys an airbag. The airbag unit uses an explosive device to electrically ignite a powerful gas. On cars so equipped, any work involving the steering wheel and SRS system should only be performed by an authorized Saab dealer. Performing repairs without disarming the SRS may cause serious personal injury.

* On cars equipped with SRS (airbag) the ignition switch must be in the lock position before replacing fuses. If fuse no. 7 is removed with the ignition switch on, an SRS fault will be detected. !f the SRS warning light comes on, see an authorized Saab dealer.

WARNING

• The ignition system of the car operates at lethal voltages. People with pacemakers or weak hearts should not expose themselves to the ignition system. Extra caution must be taken when working on the ignition system orwhen servicing the engine while it is running or the key is on. See 340 Ignition System for additional ignition system warnings and cautions.
• Before operating the starter without starting the engine (as when making a compression test), disable the ignition system as described in 340 Ignition System.
• Keep hands, clothing and other objects clear of the radiator cooling fan when working on a warm engine. The fan may start at any time, even when the ignition is switched off.

Electrical Test Equipment

Many of the electrical tests described in this manual call for measuring voltage, current or resistance using a digital multimeter (DMM). Digital meters are preferred for precise measurements and for electronics work because they are generally more accurate than analog meters. The numerical display is also less likely to be misread, since there is no needle position to be misinterpreted by reading at an angle.

An LED test light is a safe, inexpensive tool that can be used to perform many simple electrical tests that would otherwise require a multimeter. The LED indicates when voltage is present between any two test-points in a circuit.

CAUTION

• Always turn off the engine and remove the negative (-) battery cable before removing any electrical components.
• Connect and disconnect ignition system wires, multiple connectors, and ignition test equipment leads only while the ignition is off.
• Do not disconnect the battery while the engine is running.
• Do not quick-charge the batlery {for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.
• Do not use a test lamp that has a normal incandescent bulb to test circuits containing electronic components. The high electrical consumption of these test lamps may damage the components.
• Many of the solid-state modules are static sensitive. Static discharge will permanently damage them. Always handle the modules using proper static prevention equipment and techniques.
• To avoid damaging harness connectors or relay panel sockets, use jumper wires with flat-blade connectors that are the same size as the connector or relay terminals.
• Always switch a test meter to the appropriate function and range before making test connections.
• Do not try to start the engine of a car which has been heated above 176°F(80°C), (for example, in a paint drying booth) until allowing it to cool to normal temperature.
• Disconnect the battery before doing any electric welding on the car.
• Do not tow a car suspected of having a defective ignition system without first disconnecting the ignition control unit.
• Do not wash the engine while it is running, or anytime the ignition is switched on.

CAUTION

• Choose test equipment carefully. Use a meter with at least 10 megohm input impedance, or an LED test light. An analog meter (swing-needle) or a test light with a normal incandescent bulb may draw enough current to damage sensitive electronic components.
• An ohmmeter must not be used to measure resistance on solid state components such as control units ortime delay relays.
• Always disconnect the battery before making resistance (ohm) measurements on the circuit.

WIRING DIAGRAMS

The wiring diagrams shown in 371 Wiring Diagrams, Fuses and Relays have been specially designed to enable quick and efficient diagnosis and troubleshooting of electrical malfunctions.

Each electrical sub-system, such as the ignition system, the hazard warning lights, etc., is described individually and a separate wiring diagram is shown for each sub-system on the car. Each wiring sub-system consists of a spread that includes a brief description of the circuit operation, fault tracing, a list of all the components used in the circuit along with their location in the car, and the wiring diagram(s) applicable to that circuit.

Wiring Codes and Abbreviations

A tremendous amount of information is included in each wiring diagram if you know how to read them. For example, you will notice that all electrical components, connectors, fuses, and ground locations are identified using a unique number. Each of these numbers corresponds to a particular part in the circuit. A complete listing of these component numbers, their identifications and locations is given in 371 Wiring Diagrams, **Fuses and Relays.**

All wire colors in the diagrams are abbreviated. Combined color codes indicate a multi-colored wire. For example the code BL/RD indicates a Blue wire with a Red stripe. Wire color abbreviation are listed below. Immediately following the wire color is the nominal cross-sectional area of the wire given in mm^2.

NOTE

Sometimes the color of an installed wire may be different than the one on the wiring diagram. Don't be concerned, just be sure to confirm that the wire connects to the proper terminals.

Wire color codes

BL or BU. .	. Blue
BR or BN. .	. Brown
GL or YE. .	. Yellow
GN .	. Green
GR or GY .	. Gray
OG .	. Orange
RA or PK.	. .Pink
RD. .	. Red
SV or BK. .	Black
VL .	. .Violet
VT or WH .	. White

Most terminals are identified by numbers on the components and harness connectors. The terminal numbersfor major electrical connections are shown in the diagrams. Though many terminal numbers appear only once, several other numbers appear in numerous places throughout the electrical system and identify certain types of circuits. Several of the most common circuit numbers are listed below in **Table a.**

Table a. Terminal and Circuit Numbers

Number	Circuit description
1	Low voltage switched (1) terminal of coil
4	High voltage center terminal of coil
+X	Originates at ignition switch. Supplies power when the ignition switch is in the PARK, RUN, or START position
S	Originates at ignition switch. Supplies power whenever the key is in the ignition switch, (power in LOCK, PARK, RUN, or START position)
15or +15	Originates at ignition switch. Supplies power when ignition switch is in RUN or START position
30 or +30	Battery positive (+) voltage. Supplies power whenever battery is connected. (Not dependent on ignition switch position, unfused)
31	Ground, battery negative (-) terminal

continued

Table a. Terminal and Circuit Numbers (continued)

Number	Circuit description
50 or +50	Supplies power from battery to starter solenoid when ignition switch is in START position only
+54	Originates at ignition switch. Supplies power when ignition switch is in the RUN position only
85	Ground side (-) of relay coil
86	Power-in side (+) of relay coil
87	Relay change-over contact
D	Alternator warning light and field energizing circuit

Additional abbreviations shown in the wiring diagrams are given below

Abbreviation

ABS.	. antilock brakes
AC .	. air conditioning
AIC .	. automatic idle control
ARC.	. automatic performance control (turbo models)
AUT .	. .automatic transmission
CAB. .	. cabriolet (convertible)
cc .	. cruise control
CONV .	. convertible
ECU .	. electronic control unit
EZK .	. electronic ignition with knock control
I .	. fuel injection engine
LH .	. fuel injection system
LHD.	. left hand drive
LHF.	. .left hand, front
LHR.	. left hand, rear
LHS .	. left hand, side
M .	. designation for model year, i.e. M89for 1989 model
MAN .	. .manual transmission
P .	. .passenger
RHD. .	. .right hand drive
RHF.	. right hand, front
RHR. . .	. right hand, rear
RHS.	. .right hand, side
SRS .	. supplemental restraint system Airbag (see warnings in text)
T .	. turbo
TSI .	timing service instrument (test
2-D .	. 2-door sedan
3-D .	. 3-door hatchback
4-D .	. 4-door sedan
US .	. . . Cars for sale in the United
CA.	. Cars for sale in Canada
UC .	. Cars for sale in California

CAUTION
Many of the wiring diagrams are applicable to cars delivered to other world markets served by Saab. At times, there may be certain parts of the diagram that are applicable only to these markets. This manual covers only Saab cars delivered to the United States (US), California (UC), and Canada (CA). Abbreviations other than US, UC, and CA found on a particular diagram should be ignored. For example the abbreviation "ME" is for cars sold in the Middle East. Table b is a complete list of the market codes.

Table b. Market Codes

Market codes	Market	Market codes	Market
AT	Austria	FR	France
AU	Australia	GB	Great Britain
BE	Belgium	GR	Greece
CA	Canada	IS	Iceland
CH	Switzerland	IT	Italy
DE	Germany	JP	Japan
DK	Denmark	ME	Middle East
ES	Spain	NL	Netherlands
EU	Europe	NO	Norway
FE	Far East	SE	Sweden
FI	Finland	US	USA

Using the Wiring Diagrams

An example of a wiring diagram is shown below together with an explanation of the symbols used in the diagram. See Fig.1.

NOTE
• Unless specified otherwise, switches and relays are shown in the rest or de-energized position.
• Throughout the wiring diagrams, a fuse is shown together with the designation 22A. This 22A code is the component number for the fuse holder in the fuse/relay panel and should not be confused with the fuse rating or the fuse position.
• Designations such as +30, +15. +54 are positive voltage supplies, usually found at the top of each circuit. Each number represents when voltage is present in the circuit. For example, +30 is live at all times (unfused) and +15 is live when the key is in the run or start position. See above for a listing of the common terminal and circuit numbers.

ELECTRICAL TROUBLESHOOTING

ELECTRICAL TROUBLESHOOTING

Four things are required for current to flow in any electrical circuit: a voltage source, wires or connections to transport the voltage, a consumer or device that uses the electricity, and a connection to ground. Most problems can be found using only a digital multimeter (volt/ohm/amp meter) to check for voltage supply, for breaks in the wiring (infinite resistance/no continuity), or for a path to ground that completes the circuit.

Electric current is logical in its flow, always moving from the voltage source toward ground. Keeping this in mind, electrical faults can be located through a process of elimination. When troubleshooting a complex circuit, separate the circuit into smaller parts. The general tests outlined below may be helpful in finding electrical problems. The information is most helpful when used with the wiring diagrams.

Be sure to analyze the problem. Use the wiring diagrams to determine the most likely cause of the problem. Get an understanding of how the circuit works by following the circuit from ground back to the power source.

You will find the problem if you follow a simple and logical step-by-step procedure. Test portions of the circuit at one time, starting with the area or component most likely to be at fault. Test first at points that you can reach most easily. When you find the cause of the problem, make the repair. Use appropriate tools and procedures. As a final check, test the functions of the circuit that you worked on.

When making test connections at connectors and components, use care to avoid spreading or damaging the connectors or terminals. Some electrical tests may require jumper wires to temporarily bypass components or connections in the wiring harness. When connecting jumper wires, use blade connectors at the wire ends that match the size of the terminal being tested. The delicate internal contacts are easily spread apart, and this can cause intermittent or faulty connections that can lead to more problems.

Checking for Voltage and Ground
Checking for the presence of voltage or ground is usually the first step in troubleshooting a problem circuit. When checking for voltage, a digital voltmeter or LED test light should be used, for example, if a parking light does not work, check for voltage at the bulb socket will quickly determine if the circuit is functioning properly or if the bulb itself is faulty. If voltage and ground are found at the socket, then the bulb is most likely faulty.

Another valuable troubleshooting technique is a voltage drop test. This is a good test to make if current is flowing through the circuit, but the circuit is not operating correctly. Sluggish wipers or dim headlights are examples of this. A voltage drop test will help to pinpoint a corroded ground strap or a faulty switch. Normally, there should be less than 1 volt drop across most wires or closed switches. A voltage drop across a connector or short cable should not exceed 0.5 volts.

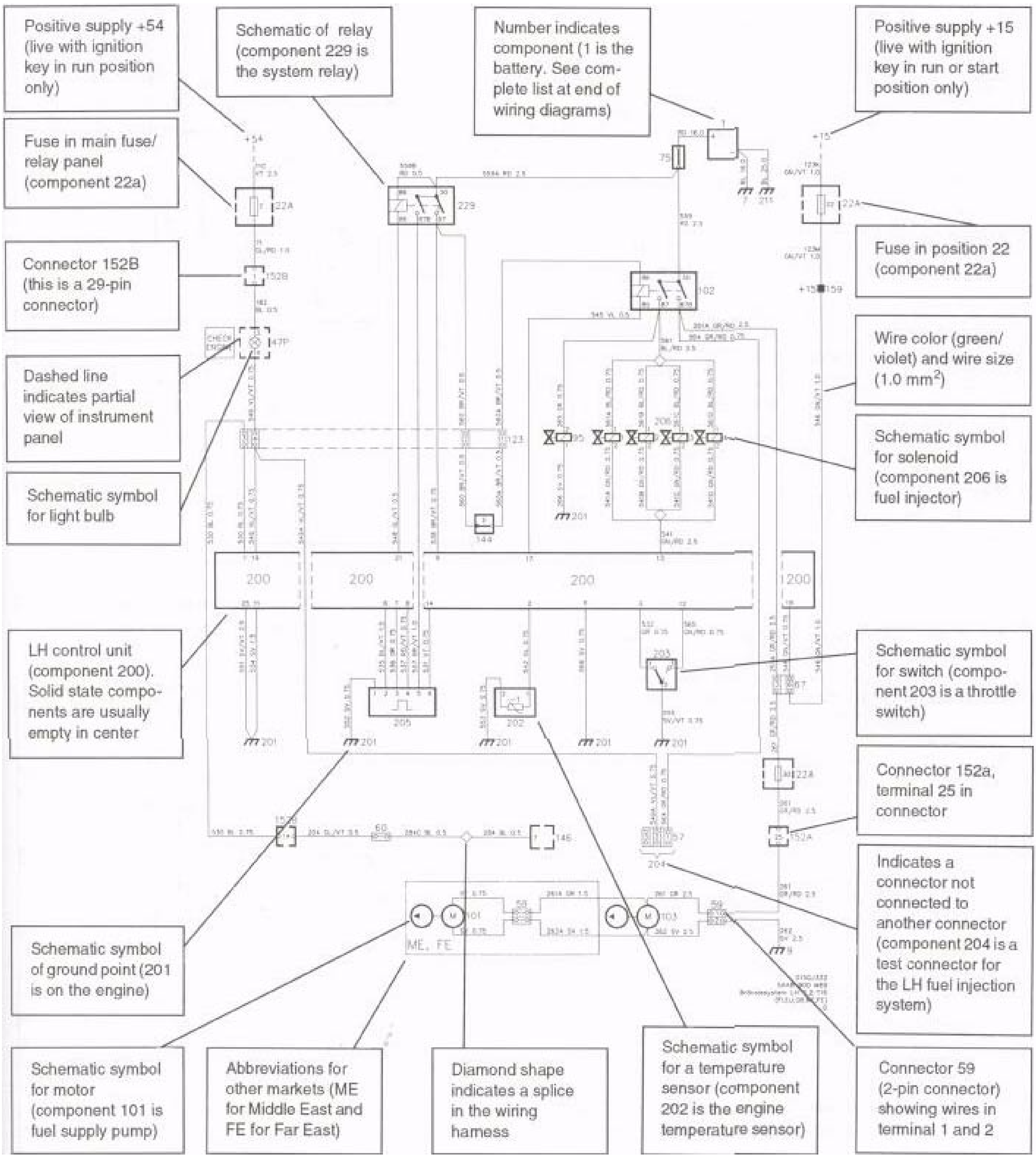


Fig. 1. Example of how to read Saab wiring diagrams.

The wires, connectors, and switches that carry current are designed with very low resistance so that current flows with a minimum loss of voltage. A voltage drop is caused by higher than normal resistance in a circuit. This additional resistance actually decreases or stops the flow of current. A voltage drop can be noticed by problems ranging from dim headlights to sluggish wipers. Some common sources of voltage drops are faulty wires or switches, dirty or corroded connections or contacts, and loose or corroded ground wires and ground connections.

Voltage drop can only be checked when current is running through the circuit, such as by operating the starter motor or turning on the headlights. Making a voltage drop test requires measuring the voltage in the circuit and comparing it to what the voltage should be. Since these measurements are usually small, a digital voltmeter should be used to ensure accurate readings. If a voltage drop is suspected, turn the circuit on and measure the voltage at the circuit's load.

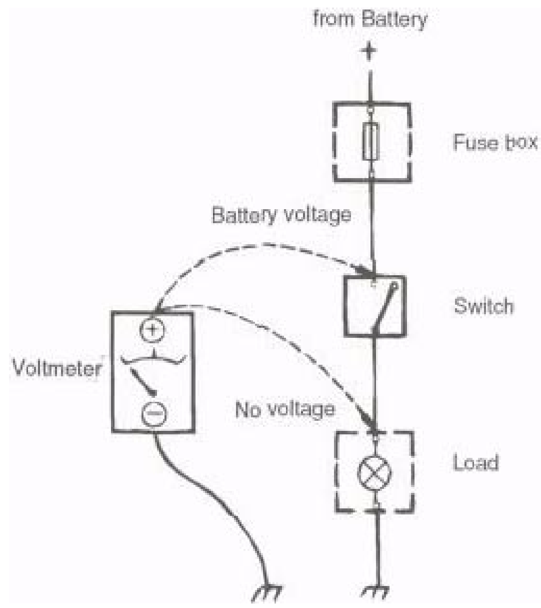


Fig. 2. Voltmeter being used to check for voltage,

NOTE

• A voltage drop test is generally more accurate than a simple resistance check because the resistances involved are often too small to measure with most ohmmeters. For example, a resistance as small as 0.02 ohms would results in a 3 Volt drop in a typical 150 amp starter circuit. (150 amps x 0.02 ohms =3 volts).
• Keep in mind that voltage with the key on and voltage with the engine running are not the same. With the ignition on and the engine off (battery voltage), voltage should be approximately 12.6 volts. With the engine running (charging voltage), voltage should be approximately 14.0 volts. Measure voltage at the battery with the ignition on and then with the engine running to get exact measurements.

To measure voltage

1. Connect the voltmeter negative lead to a reliable ground point on the car. The negative (-) battery terminal is always a good a ground point.
2. Connect the voltmeter positive lead to the point in the circuit you wish to measure. See Fig. 2. If a reading is obtained, current is flowing through the circuit.

NOTE

The voltage reading should not deviate more than 1 volt less than the voltage at the battery. If the voltage is less than this, there is probably a fault in the circuit, such as a corroded connector or a loose ground wire.

To check for a voltage drop

1. Connect the voltmeter positive lead to the positive (+) battery terminal or a positive power supply close to the battery source.
2. Connect the voltmeter negative lead to the other end of the cable or switch being tested. See Fig. 3.

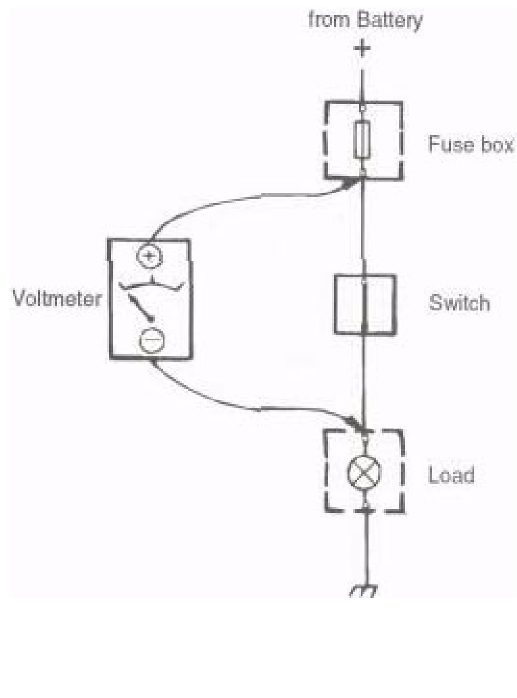


Fig. 3. Voltmeter being used to check for voltage drop.

3. With the power on and the circuit working, the meter shows the voltage drop (the difference between the two points). This value should not exceed 1 volt.

NOTE

The maximum voltage drop in an automotive circuit, as recommended by the Society of Automotive Engineers (SAE), is as follows: 0 Volts for small wire connections; 0.1 Volts for high current connections; 0.2 Volts for high current cables; and 0.3 Volts for switch or solenoid contacts. On longer wires or cables, the drop may be slightly higher. In any case, a voltage drop of more than 1.0 Volt usually indicates a problem.

Checking for Continuity

The continuity lest can be used to check a circuit or switch. Because most automotive circuits are designed to have little or no resistance, a circuit or part of a circuit can be easily checked for faults using an ohmmeter. An open circuit or a circuit with high resistance will not allow current to flow. A circuit with little or no resistance allows current to flow easily.

CAUTION

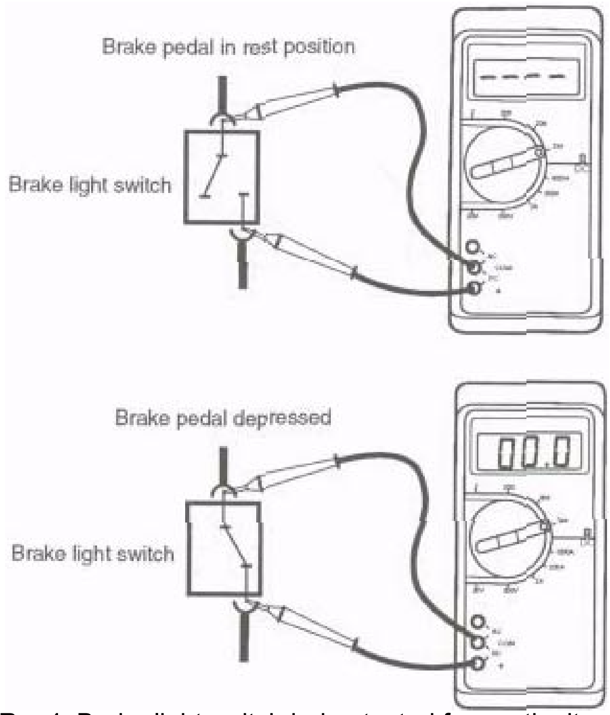
Do not use an analog (swing-needle) ohmmeter to check circuit resistance or continuity on any electronic (solid-state) components. The internal power source used in most analog meters can damage solid state components. Use only a high quality digital ohmmeter having high input impedance when checking electronic components.

When checking continuity, the ignition should be off. On circuits that are powered at all times, the battery should be disconnected. Using the appropriate wiring diagram, a circuit can be easily tested for faulty connections, wires, switches, relays, and engine sensors by checking for continuity. Fig. 4 shows continuity lest being made on a brake light switch.

Checking for Short Circuits

A short circuit is exactly what the name implies. The circuit takes a shorter path than it was designed to take. The most common short that causes problems is a short to ground where the insulation on a positive (+} wire wears away and the metal wire is exposed. When the wire rubs against a metal part of the car or other ground source, the circuit is shorted to ground. If the exposed wire is live (positive battery voltage), a fuse will blow and the circuit may possibly be damaged.

Shorts to ground can be located with an ohmmeter or a voltmeter. Short circuits are often difficult to locale and may vary in nature. Short circuits can be found using a logical approach based on the current path.



Rg. 4. Brake light switch being tested for continuity.

With brake pedal in rest position (switch open) there is no continuity (infinite ohms), With the pedal depressed (switch closed) there is continuity (zero ohms).

CAUTION

• On circuits protected with large fuses (25 amp and greater), the wires or circuit components may be damaged before the fuse blows. Always check for damage before replacing fuses of this rating.
• When replacing blown fuses, use only fuses having the correct rating. Always confirm the correct fuse rating printed on the fuse/relay panel cover.

To check for a short circuit using an ohmmeter

1. Remove the blown fuse from the circuit and disconnect the cables from the battery.
2. Disconnect the harness connector from the circuit's load or consumer.
3. Using an ohmmeter, connect one test lead to the load side of the fuse terminal (terminal leading to the circuit) and the other test lead to ground. See Fig. 5.
4. If there is continuity to ground, there is a short to ground.

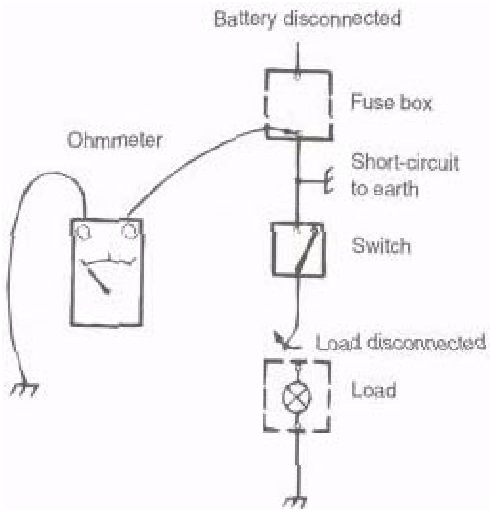


Fig. 5. Ohmmeter being used to find short circuit.

5. If there is no continuity, work from the wire harness nearest to the fuse/relay panel and move or wiggle the wires while observing the meter. Continue to move down the harness until the meter displays a reading. This is the location of the short to ground.

Visually inspect the wire harness at this point for any faults. If no faults are visible, carefully slice open the harness cover or the wire insulation for further inspection. Repair any faults found.

To check for a short circuit using a voltmeter

1. Remove the blown fuse from the circuit.
2. Disconnect the harness connector from the circuit's load or consumer.
3. Using a voltmeter, connect the test leads across the fuse terminals. See Fig. 6. Make sure power is present in the circuit, if necessary turn the key on.

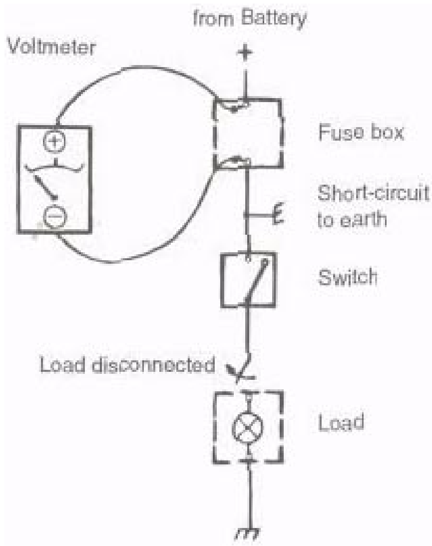


Fig. 6. Voltmeter being used to find short circuit.

4. If voltage is present at the voltmeter, there is a short to ground.
5. If voltage is not present, work from the wire harness nearest to the fuse/relay panel and move or wiggle the wires while observing the meter. Continue to move down the harness until the meter displays a reading. This is the location of the short to ground.

Visually inspect the wire harness at this point for any faults. If no faults are visible, carefully slice open the harness cover or the wire insulation for further inspection. Repair any faults found.

311 Battery

GENERAL

The six-cell, 12-volt lead-acid battery capacity is rated by ampere/hours (Ah) and cold cranking amps (CCA). The Ah rating is determined by the average amount of current the battery can deliver over time without dropping below a specified voltage. The CCA rating is determined by the battery's ability to deliver starting current at 0° (-18°C). The original battery installed is rated at 62 Ah and is located in the engine compartment, behind the right headlight assembly.

Maintenance consists of keeping the battery and terminals clean and keeping the connections tight. After cleaning, alight coating of petroleum jelly should be spread on the terminals. Inspect the battery cables for chafing and deterioration of the insulation due to high heat.

For general information on troubleshooting electrical systems see 300 Electrical System—General. For information on battery wiring see 371 Wiring Diagrams, Fuses and Relays.

WARNING

- Wear goggles, rubber gloves, and a rubber apron when working with battery electrolyte. Electrolyte contains sulfuric acid and can cause skin irritation and burning. If electrolyte is spilled on your skin or clothing, flush the area at once with large quantities of water. If electrolyte gets into your eyes, bathe them with large quantities of clean water for several minutes and call a physician.
- Batteries that are being charged or are fully charged give off explosive hydrogen gas. Keep sparks and open flames away. Do not smoke.

CAUTION

- Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.
- Always disconnect the negative (-) battery cable first and reconnect it last. Cover the battery post with an insulating material whenever the terminal is removed.
- When boost starting the car using jumper cables, be careful not to reverse the battery connections. Even a momentary connection will damage the alternator.

BATTERY TESTING

Battery testing determines the state of battery charge. The most common methods are open-circuit and load voltage testing. Batteries that have filler caps can also be tested by checking the specific gravity of the electrolyte. The specific gravity test checks the amount of acid in the electrolyte as an indication of battery charge. Inexpensive specific gravity testers are available at most auto supply stores.

OPEN-CIRCUIT VOLTAGE TEST

An open-circuit voltage test checks battery voltage by connecting an accurate digital voltmeter to the battery posts after disconnecting the battery ground cable. Before making an open-circuit voltage test on a battery, first load the battery with 15 amps for one minute, for example by turning on the headlights without the engine running. Open-circuit voltage levels and their corresponding percentages of charge are in Table a.

CAUTION

- Do not disconnect the battery when the engine is running. The alternator will be damaged.
- Replace batteries if the case is cracked or leaking. Electrolyte can damage the car. If electrolyte is spilled, clean the area with a solution of baking soda and water.
- Always allow a frozen battery to thaw before attempting (o recharge it.
- Always disconnect the battery terminals during battery recharging. This will prevent damage to solid-state components.

Table a. Open-Circuit Voltage and Battery Charge

Open -circuit voltage	State of charge
12.6 V or more	Fully charged
12.4V	75% charged
12.2V	50% charged
12.0V	25% charged
11.7V or less	Fully discharged

The battery is in satisfactory condition if the open-circuit voltage is at least 12.4 volts. If the open-circuit voltage is at this level or above, but the battery still lacks power for starting, make a load voltage test to determine the battery's service condition. If the open-circuit voltage is below 12.4 volts, recharge the battery. If the battery cannot be recharged to at least 75%, it should be replaced.

Load Voltage Testing

A load voltage battery test is made by connecting a specific resistive load to the battery terminals and then measuring voltage. The test requires a special tester and can generally be performed quickly and inexpensively by an authorized Saab dealer or qualified repair facility. The battery should be fully charged for the most accurate results. If the equipment is available, disconnect the negative (-) battery cable. Then apply a 200 Amp load for 15 seconds and measure the battery's voltage. If the voltage is below that listed, the battery should be replaced.

Battery charging

Discharged batteries can be recharged using a battery charger, but a battery can never be charged to a voltage in excess of that which it is capable of producing electro-chemical-ly. Prolonged charging causes gassing that will evaporate the electrolyte to a level that can damage the battery.

Always read and follow the instructions provided by the battery charger's manufacturer. Do not use a charger if the instructions are not available. Table b lists charging rates and times that should be followed when charging batteries.

WARNING

The gasses given off by the battery during charging are explosive. Do not smoke. Keep open flames away from the top of the battery, and prevent electrical sparks by turning off the battery charger before connecting or disconnecting it.

WARNING

Always wear protective goggles and clothing when performing a load test.

CAUTION

Always disconnect a battery cable when using a battery charger. This will prevent damage to solid-state components.

Battery load test minimum
* (200 amp load for 15 seconds)
9.6V at 80°F(27°C)
9.5 V at 60°F(16°C)
9.3V at 40°F(4°C)
8.9V at 20°F(-7°C)
8.5V at O°F(-18°C)

If the battery quickly becomes discharged, there may be a fault in the charging system or in the electrical system. See 321 Alternator and Charging System for charging system tests. On all models, be certain that the appropriate heat shields are securely attached to the battery.

Table b. Battery Charging Specifications

Charging rate (low-maintenance batteries)	Specific gravity	Approximate charging time
Fast charge (at 80% to 90% of battery's capacity, example: 44 to 50 amperes for a 55-ampere hour battery)	1.150 or less	1 hour
	1.150 to 1.175	3/4 hour
	1.175 to 1.200	1/2 hour
	1.200 to 1.225	1/4 hour
Slow charge (at 10% of battery's capacity, example: 5.5 amperes for a 55-ampere hour battery)	Above 1.225	Slow charge only, to a specific gravity of 1.250 to 1.265

NOTE

If the key is left in the ignition switch, a battery draw of about 40 milliamps will discharge the battery over a period of time.

321 Alternator and Charging System

GENERAL

The charging system consists of a belt-driven 14-volt alternator and a voltage regulator. The voltage regulator, which is mounted on the alternator, also serves as the alternator brush holder. The charging system provides the current necessary to keep the battery charged and to operate the car electrical accessories.

To prevent damage to the alternator or regulator when making tests or repairs, make all connections with negative (-) to negative, and positive (+) to positive. Even momentary contact with a conductor of the wrong polarity can damage the alternator's diodes.

Please read the following cautions before doing any work on the charging system or alternator.

CAUTION

- Never operate the engine with the battery disconnected. Never operate the alternator with its output terminal (B+ or 30) disconnected and the other terminals connected. Never short, bridge, or ground any terminals of the charging system.
- Always disconnect the negative (-} battery cable before removing the alternator. This will prevent an accidental short from one of the alternator terminals.
- Do not reverse the polarity of the battery. Damage to the alternator will result.
- Always disconnect both battery cables before doing any electric (arc) welding to the car.

CHARGING SYSTEM TROUBLESHOOTING

Charging system trouble is indicated by an illuminated alternator warning light on the instrument panel, or by an under-or overcharged battery.

The alternator generates electrical current by electrical induction. When the engine is running, part of the current it produces energizes its electromagnetic field. When starting, some other current must be provided to initially energize the field and begin the current generating process. This current is provided by the battery through the alternator warning light in the instrument cluster. If the lamp burns out, the alternator will not charge the battery properly.

CHARGING SYSTEM QUICK-CHECK

As a quick-check, measure the voltage across the battery terminal with the key off and then again with the engine running. The battery voltage should be approximately 12.6 with key off and 14.0 with the engine running. If the voltage does not increase when the engine is running, there is fault in the charging system.

TO TEST CHARGING SYSTEM

1. Inspect the V-belts and make sure they are tight. Make sure the battery is fully charged, as described in 311 Battery.
2. Check the charge warning lamp. On 1987 and later cars, check that the ignition switch relay closes when the key is turned on. See 371 Wiring Diagrams, Fuses and Relays for a complete listing of fuse and relay locations.

NOTE

* The charging system warning light should come on when the key is on and go out when the car is started. Turning the key on is a test that checks the warning light circuit to the alternator. If the light does not come on when the key is turned on, check the light bulb and the wiring to the bulb using the appropriate wiring diagram before making any more tests. Wiring diagrams can be found in 371 Wiring Diagrams, Fuses and Relays.

- When replacing the charging system warning bulb, be sure to use the correct 2.0 watt replacement bulb. A similar 1.2 watt bulb (with black socket base) will also fit in this location. If the smaller bulb is installed, the battery will not charge correctly at idle. The light will also go out at a higher rpm. See an authorized Saab parts department for additional information.

3. Check for battery voltage between ground and terminal B+ at the back of the alternator. Then check for battery voltage between terminal D+ and ground with the ignition key on.

NOTE

If the voltage is not present at either terminal, check the alternator wiring and electrical circuit using the appropriate wiring diagram.

4. With the engine running, carefully measure the voltage between terminal D+ and ground and then between B+ and ground. The difference should not exceed 0.7 volts.

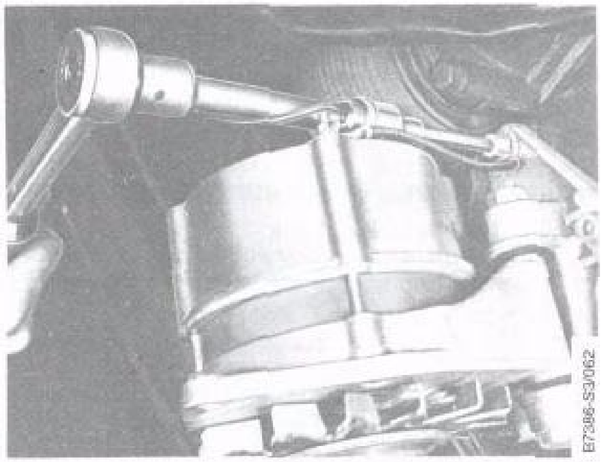


Fig. 1. Alternator mounting bolt being removed,

NOTE

If battery voltage was present at terminal D+ and B+ as described in step 3, but the voltage difference in step 4 is not as specified, the alternator is faulty and should be replaced.

5. If no faults are found up to this point, the alternator should be tested using special test equipment, such as the Sun VAT40. Alternator test specifications are shown below.

Alternator output specifications
• Bosch 80 Amp . .54 Amps @ 1900 rpm

NOTE
If a load tester is not available, an output test can be done by running the engine at 1900 rpm and turning on all electrical loads such as fans, lights and heated window. Voltage at the battery should be approximately 12 volts or higher.

To remove and install alternator

1. Disconnect the negative (-) battery cable.
2. Loosen the alternator mounting bolts, pivot the alternator and remove the alternator V-belts.
3. Disconnect the wires from the rear of the alternator.
4. Remove the alternator mounting bolts and the alternator. See Fig. 1
5. Install the new alternator, leaving the mounting bolts slightly loose. Install the V-belt and tension it as described in 1 LUBRICATION AND MAINTENANCE.

CAUTION

V-belt tension is critical to the life of alternator and proper alternator operation. A loose belt will cause undercharging (and often a loud screeching sound). A tight belt will quickly destroy the alternator bearings and the bearings of other component driven off the same belt

6. Tighten all mounting bolts. Install the wiring to the alternator. Reconnect the battery terminal and check the operation ot the charging system warning lamp.

NOTE

Be sure to reinstall the insulating boots to the wire terminals on the back of the alternator.

Regulator/Brush Assembly

The voltage regulator is easily removed from the back of the alternator by removing the two mounting screws. See Fig. 2. The regulator is available as replacement part. In addition, the carbon brushes can also be separately replaced.

With the regulator removed measure the brush length. See Fig. 3. If the brush length is less than the minimum length specified in the figure, they should be replaced. Replacing the brushes requires a soldering iron and electric/electronic solder.

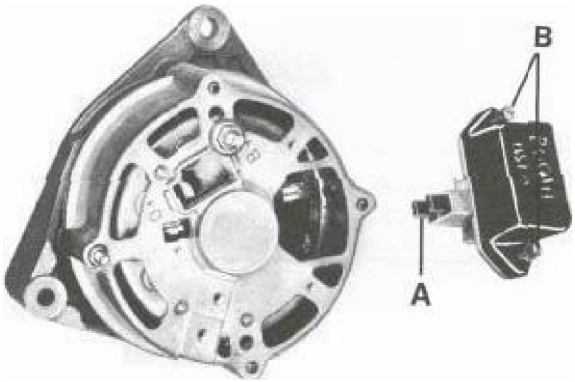


Fig. 2. Voltage regulator and brush holder removed from back of alternator. The brushes are at A. Remove the holder screws at B.

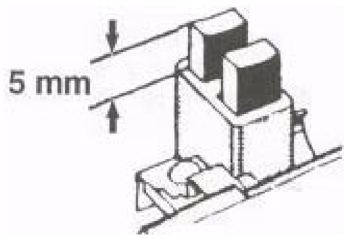


Fig. 3. Minimum regulator brush length. If brushes are shorter than 5 mm (0.2 in.), they should be replaced.

To replace regulator brushes

1. Remove the voltage regulator from the alternator.
2. Carefully unsolder the brush lead from the brush holder terminal, withdrawing the brush from the holder at the same time.

CAUTION

Work quickly to prevent overheating the solid state regulator.

3. Remove any traces of solder from the brush holder terminal.
4. Fit the new brush into the holder, insert the brush lead into the terminal, and solder it into place.
5. Reinstall the regulator.

Alternator and Charging System

Operation

The alternator supplies the electrical components and recharges the battery. The alternator is not fused. Voltage regulation is controlled internally by a regulator. The alternator circuit includes a warning lamp in the instrument cluster. If the lamp burns out, the alternator will not charge the battery properly. See 853 Dashboard and Consoles and 351 Lighting for information on changing the lamp.

See 321 Alternator and Charging System for alternator and charging system repair information and additional fault tracing.

CAUTION

- Do not disconnect the battery or any wire when the engine is running. Do not reverse the polarity of the battery. Do not ground any alternator terminals. This will damage the alternator.
- Always disconnect the negative (-) battery cable before removing the alternator. Unfused battery voltage is always present at the rear of the alternator.
- Always disconnect the negative {-} battery cable and all wires to the alternator before doing any electric (arc) welding to the car.

Fault Tracing

1. Inspect the V-belts and make sure they are tight. Test for a fully charged battery as described in 311 Battery.
2. Check for faulty connections and broken wires.
3. If no visible faults can be found, test the alternator output using an alternator load tester.

Alternator output specification

- Bosch type 80 A . 54 Amps @ 1900 rpm

NOTE

If A load tester is not available, an output test can be done by running the engine at 2000 rpm and turning on all electrical loads such as fans, lights and heated window. Voltage at the battery should be approximately 12 volts or higher.

Component Locations

1 battery
2 alternator in back ot engine compartment
4 starter motor under intake manifold
21 ignition switch relay in main fuse/relay panel
22A main fuse/relay panel in left wheel housing
47E charging lamp in instrument cluster
75 distribution block in right wheel housing
159 +15 distribution in main fuse/relay panel

Connector Locations

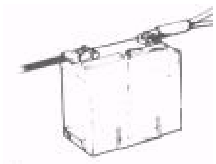
1985-1990
59 2-pin connector in main fuse/relay panel
152A 29-pin bulkhead connector behind main fuse/relay panel
152B 29-pin bulkhead connector behind main fuse/relay panel
152C 29-pin bulkhead connector behind main fuse/relay panel

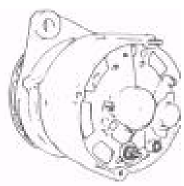
1991 and later
H29-1 29-pin bulkhead connector behind main fuse/relay pane l (1991-1991 1/2) H29-2 29-pin bulkhead connector behind main fuse/relay panel (1991-1991 1/2) H29-3 29-pin bulkhead connector behind main fuse/relay panel (1991-1991 1/2) H33-1 30-pin bulkhead connector behind main fuse/relay panel
(1991 1/2 and later) H33-2 33-pin bulkhead connector behind main fuse/relay panel
(1991 1/2 and later) H33-3 33-pin bulkhead connector behind main fuse/relay panel
(1991 1/2 and later)

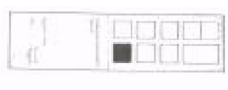
Ground Locations

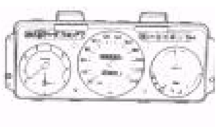
1985-1990
7 ground point at radiator cross member
158 ground distribution in main fuse/relay panel
211 ground point on gearbox

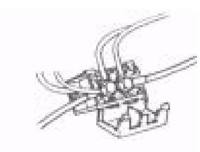
1991 and later
G1 ground point at radiator cross member
G6 ground distribution in main fuse/relay panel
G25 ground point on gearbox


1


2

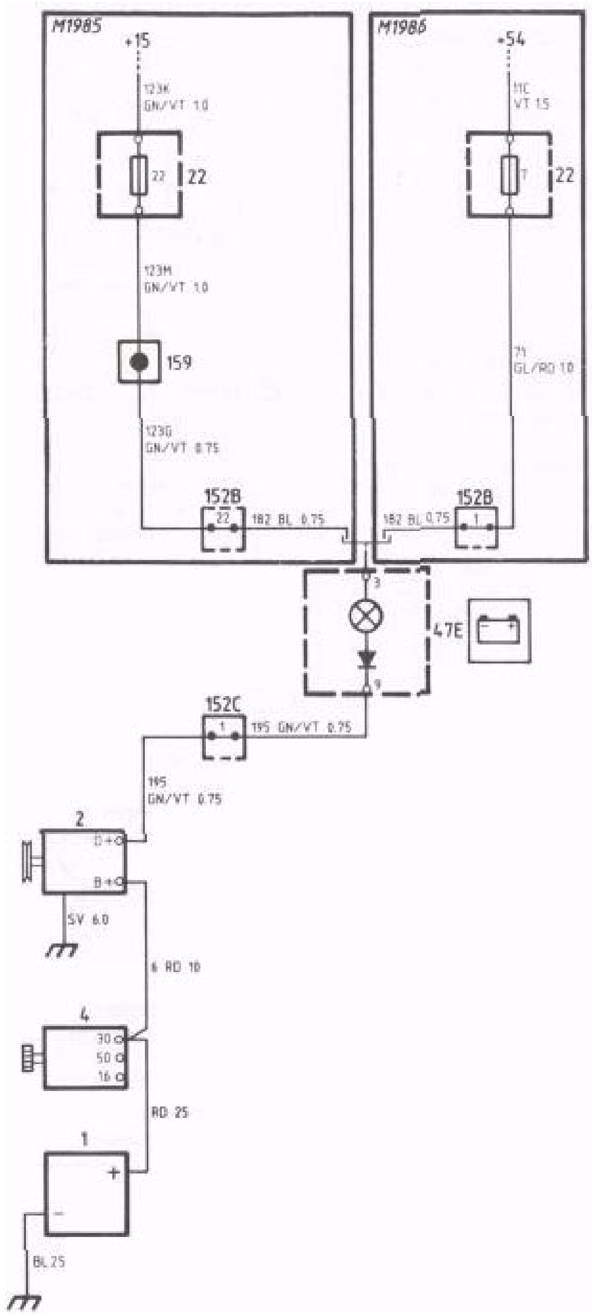

21, 22a


47E, 110


75

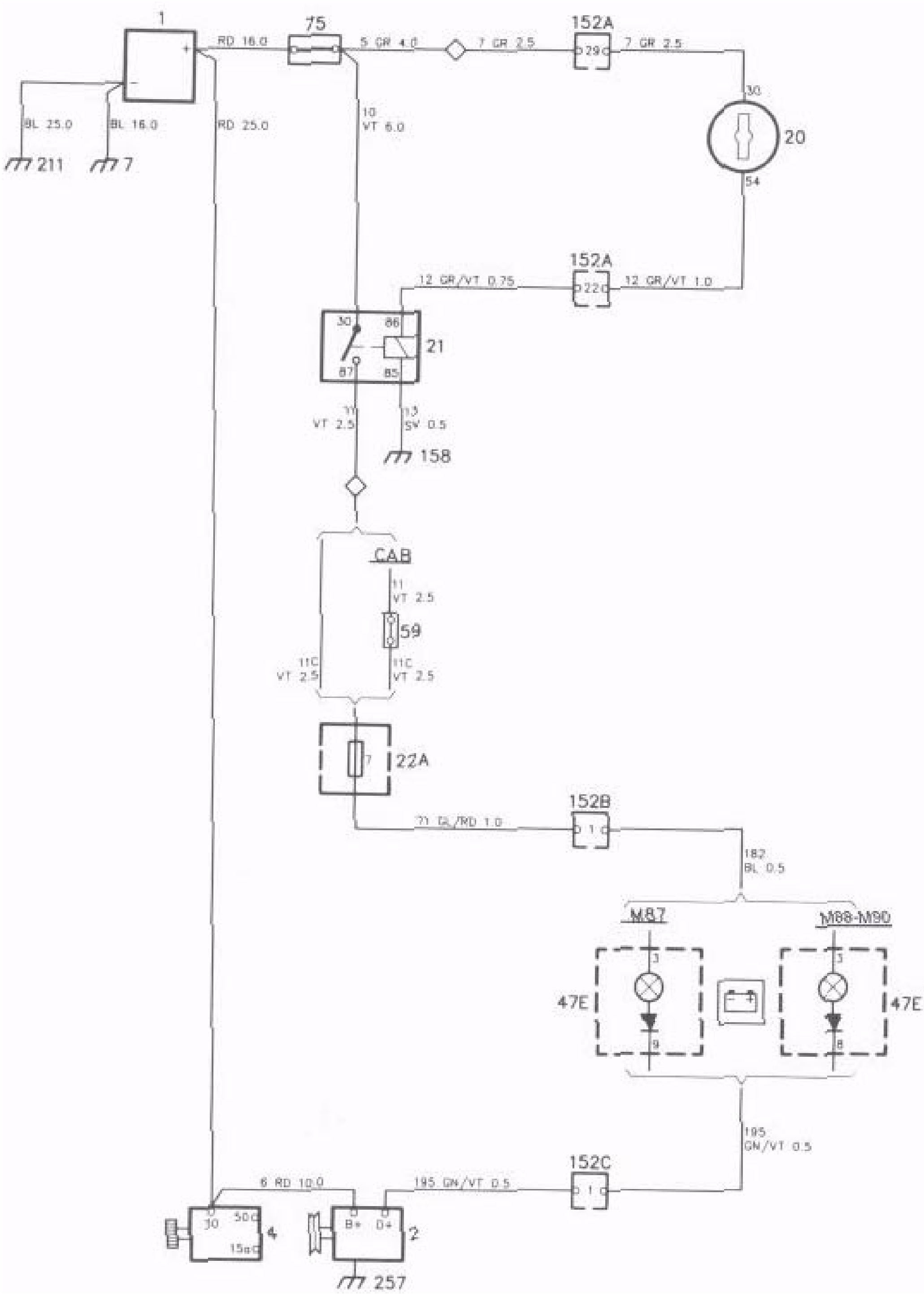
Alternator and Charging System

1985-1986



Alternator and Charging System

1987-1990



Alternator and Charging System

1991-1993