

Saab 9000

Service Manual



M 1985-95

ENG

I:5 Diagnosis and fault tracing

Warning, Important and Note

The headings "Warning", "Important" and "Note" occur from time to time in the Service Manual. They are used to draw the attention of the reader to information of special interest and seriousness. The importance of the information is indicated by the three different headings and the difference between them is explained below.

WARNING

Warns of the risk of material damage and grave injury to mechanics and the driver, as well as serious damage to the car.

Important

Points out the risk of minor damage to the car and also warns the mechanic of difficulties and time-wasting mistakes.

Note

Hints and tips on how the work can be done in a way that saves time and labour. This information is not supplied for reasons of safety.

Market codes

The codes refer to market specifications

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

Diagnostic methods

Fault diagnosis	1	Cruise control system test unit	19
Diagnostic methods	1	Fault diagnosis using self test	20
General test methods	2	Fault diagnosis using ISAT scan tool	24
LH MFI system test unit	8	Scan tool menu structures	28
ABS system test unit	11	Scan tool multimeter features	35
EZK system test unit	15	Breakout box (BOB).	40
Airbag system test unit	16	Location of control modules	41

Fault diagnosis

Before starting fault diagnosis

Electronic systems are sometimes suspected of being faulty when, in fact, the fault is in the engine itself or in other auxiliary systems. Remember to check the following points before starting fault diagnosis on the systems:

- battery condition
- engine condition
- charging system
- other auxiliary systems
- cable connections
- grounding points

Successful fault tracing on the systems requires both thorough knowledge of the system and access to diagnostic instruments.

As the systems' inbuilt self diagnosis continuously monitors and registers most of the faults, both permanent and intermittent, that may arise, it is very easy to pinpoint a fault with the diagnostic instruments, attend to it and then check that the system is free of faults.

Diagnostic methods

Fault diagnosis can be carried out using various methods. The same system can be analyzed using one or more diagnostic methods.

- Special test units
- Lamp flash codes
- ISAT scan tool

To make it easier to take readings on the various systems, the measuring points can be "moved out" using a so called breakout box (BOB). The breakout box is connected to the system's control module.

In connection with fault diagnosis

In the fault diagnosis routine, which is found in the service manual for each system, "Check lead from ... to ..." appears frequently.

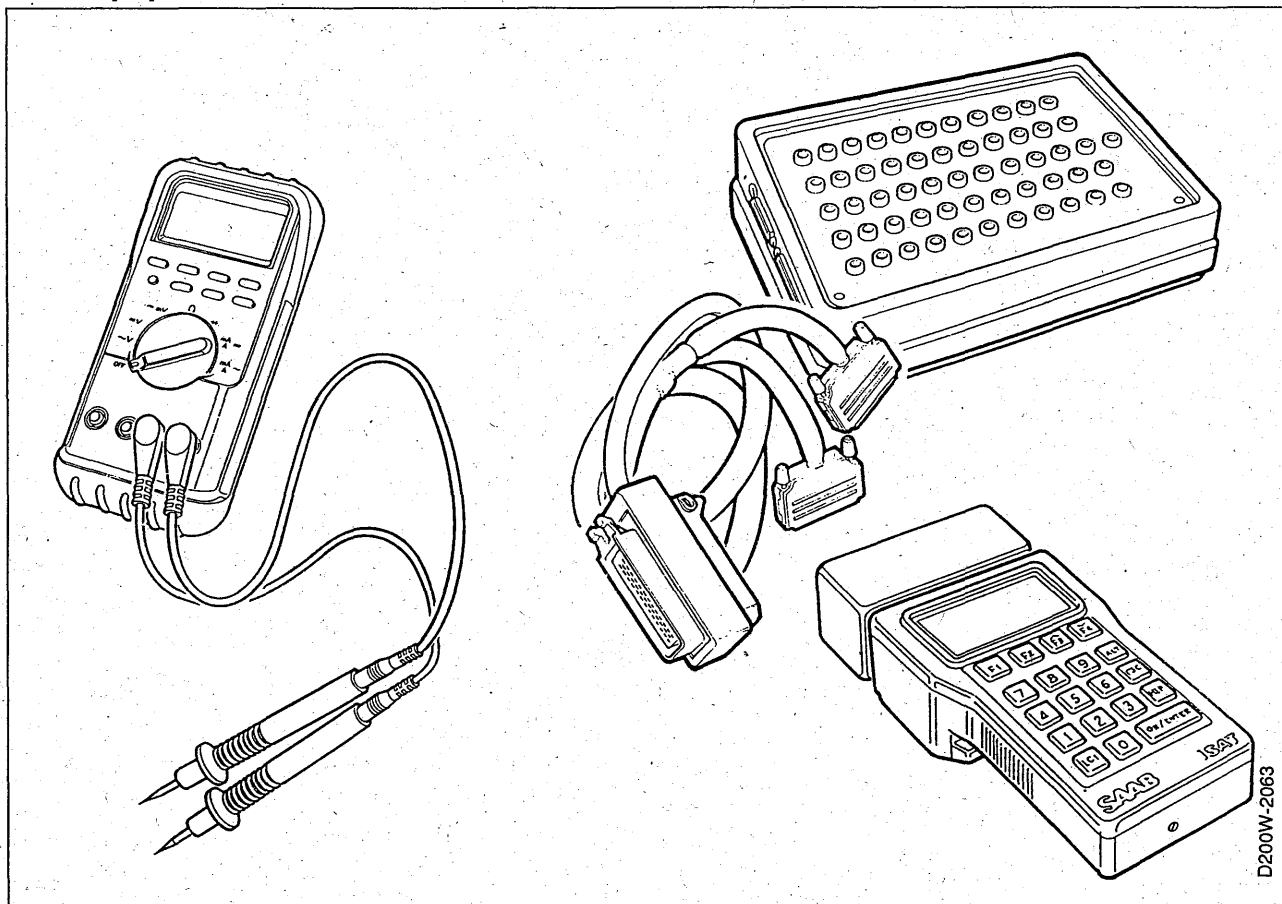
In certain cases, the leads are routed through jointing boxes or distribution points, and these should then be checked for breaks/short circuits.

Note possible risks of interference from components connected to the lead in question.

Also check that leads are not damaged/give a faulty ground signal. Always check that you use the correct wiring diagram for the car, year and type of system.

General test methods

Test equipment



Suitable instruments for fault diagnosis on the car's electrical system are ISAT scan tool, voltmeter and ohmmeter.

Use a voltmeter or scan tool to measure the voltage in a circuit.

Ohmmeter or scan tool are used to check for shorts or breaks in wiring harnesses, connectors, switches and contacts.

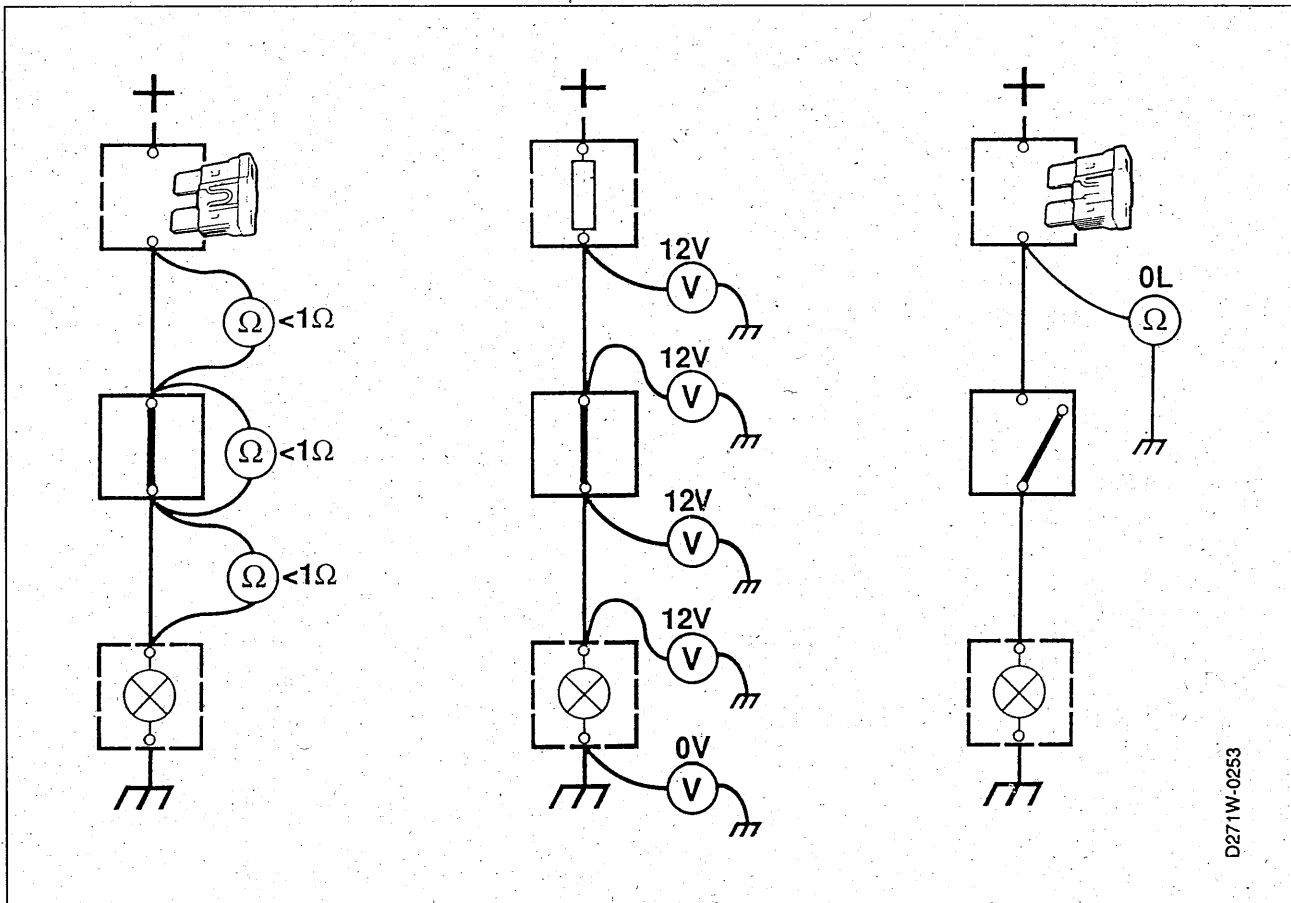
Important

Be extremely careful when measuring resistance if the car battery is connected. Normal loads that are not switched off destroy or damage the reading and can easily cause incorrect information.

Disconnection of the battery is **not** recommended as many sub-systems store information in their memories that is erased when power is lost.

General test methods (contd.)

Checking break/short circuit



Break (resistance measurement)

- 1 Make sure that the component or lead that is to be checked is not live.
- 2 With the instrument set for measuring resistance, connect the probes to each side of the component or lead to be checked.

For wiring harnesses, the resistance should normally be less than 1 Ohm. There is a specified value that applies to individual components.

Break (voltage measurement)

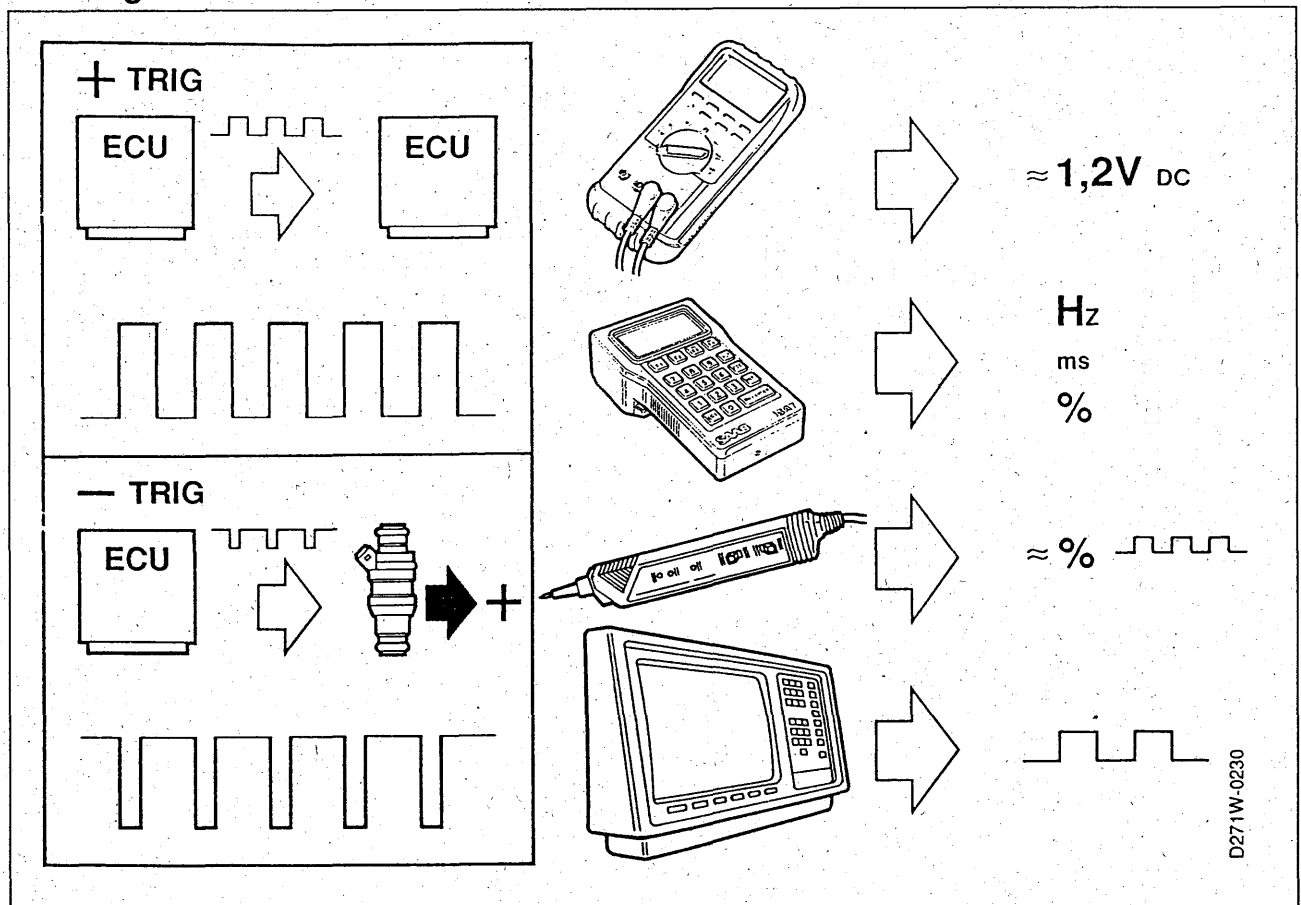
- 1 Connect any load.
- 2 With the instrument set for voltage measurement, connect the black probe to a safe grounding point and the red probe to the lead side.
- 3 Start at the output on the control module/switch, measuring away from it and continue on towards the load. When the voltage disappears, you have just passed the break.
- 4 Start at the input to the control module/consumer, measuring away from the power source and move gradually in towards the control module/switch. When the voltage disappears, the break has been passed.

Short circuit to ground (resistance measurement)

- 1 Make sure that the lead to be checked is not live and that any load is disconnected.
- 2 With the instrument set for measuring resistance, connect one of the probes to the load side of the wiring harness and the other probe to a safe grounding point in the car.
- 3 Carefully touch the wiring and check at the same time that the instrument continues to show infinite resistance (OL).

General test methods (contd.)

PWM signals



Measuring PWM

PWM signals, i.e. communication between control modules, are always positive-triggered, i.e. the pulse is a battery positive voltage (BPV) pulse. Other PWM outputs (inputs) are generally negative-triggered, for example the injectors which are constantly positive powered and pulsed with ground from the control module.

Measuring with voltmeter

If you measure PWM with a voltmeter, the voltmeter will show the average voltage on the cable. This means that the average voltage increases as the pulse ratio increases.

Using the voltmeter, it is possible to get a rough estimate of the pulse ratio. At 9% pulse ratio, 1.2 volt is usually achieved ($0.09 \times 13 \text{ V} = 1.17 \text{ volt}$).

In the case of positive-triggered PWM, connect the red test lead to the cable and the black test lead to a safe grounding point.

In the case of negative-triggered PWM, connect the black test lead to the cable and the red test lead the BPV.

If the voltmeter is equipped with a Smooth feature, use this.

Measuring with scan tool or multimeter with pulse measuring feature

Connect the red test lead to the cable and the black test lead to a safe grounding point. Select positive or negative trigger. Frequency, pulse time and pulse ratio can then be measured.

Measuring with Logic Probe

Connect BPV supply voltage and a safe ground and then place the probe on the cable. The Logic Probe shows if there are any pulses and gives a rough estimate of the pulse ratio.

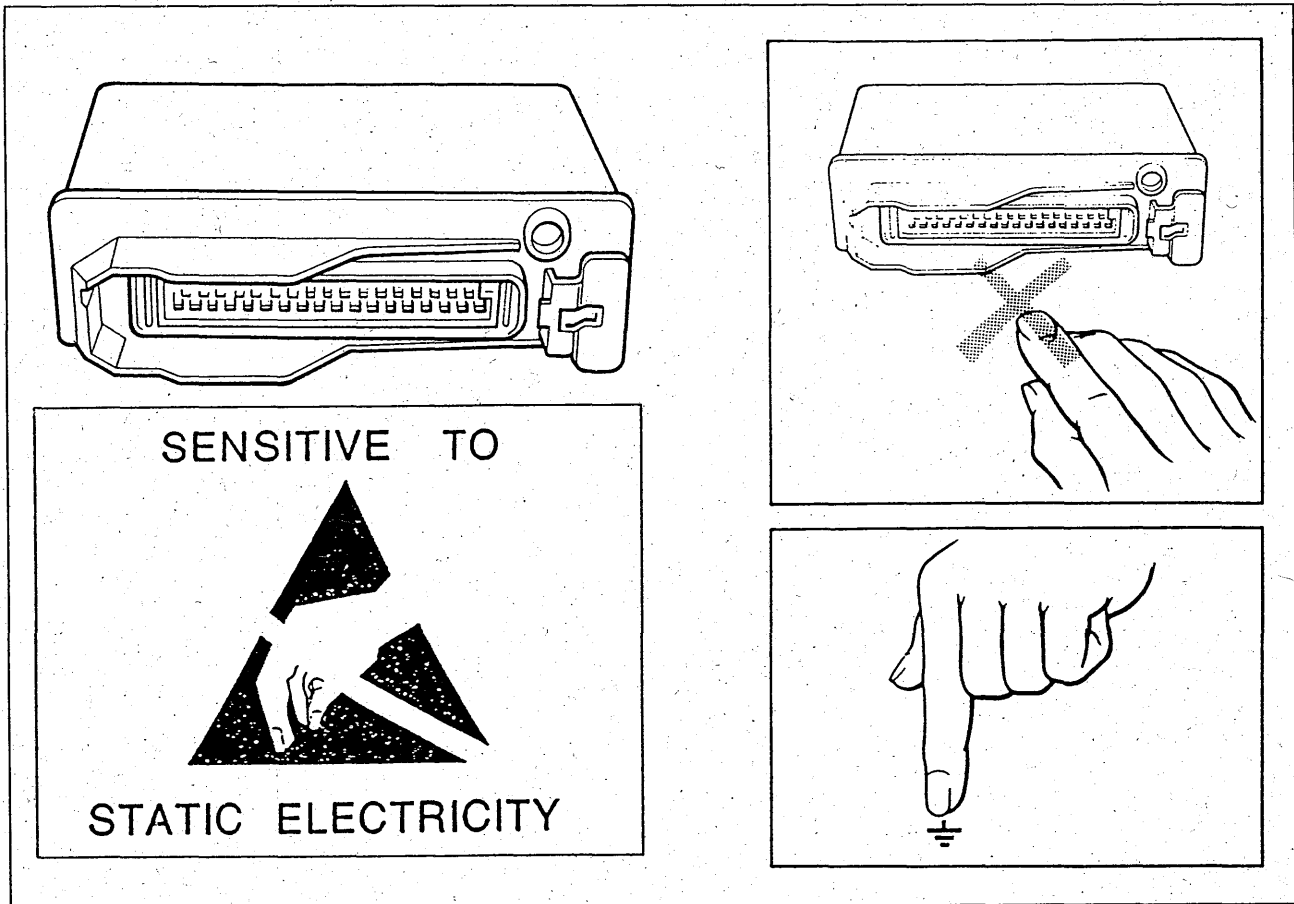
Measuring with oscilloscope

Frequency and pulse time can be read at the same time to obtain a picture of the pulses. This shows how pulse width changes when the value of the information changes.

For more information on PWM signals, see Service Manual 3:2 "Electrical system, Wiring diagrams".

General test methods (contd.)

Handling control modules



All control modules are more or less sensitive to static electricity and, if handled carelessly, may be damaged so seriously that they no longer work properly. For this reason, it is important that the following rules are followed at all times when a control module is removed or replaced for any reason.

- Avoid unplugging or removing the control module unless absolutely necessary.
- Never touch the connector pins and never place the control module in such a way that the connector pins touch anything else.
- Before unpacking a new control module, ground the packaging to the car's bodywork. Open the packaging as short a time as possible before fitting the module.
- Avoid wearing clothes made of synthetic materials and shoes with insulating soles.
- When working with the control module, it is important to ground yourself regularly. This is especially important when you have been sitting in the car, when you have changed position or moved around the car and when working in climates with very dry air (e.g. winter in cold markets).
- Furthermore, always handle control modules which are suspected of being defective in the same way. This will greatly improve the chances of determining the cause of the fault.

General test methods (contd.)

Remember when fault tracing

- 1 SDA Mk II must always be connected to the scan tool.
- 2 The data link connector(s) are located under the right-hand front seat. In cars -M1994, there are two connectors (one green and one black) and in cars M1995-, there is one connector (green).
- 3 Read and note diagnostic trouble codes stored in all systems before the battery and the control module are disconnected.
- 4 If no communication can be achieved between the ISAT and the control module, first check that the fuses are intact and that there is supply voltage to the fuses.

Then check the leads between the control module and the data link connector.

- 5 Also check that the voltage supply and the ground to the data link connector are correct and that the connector pins are not damaged and are secure.
- 6 There are lists of diagnostic trouble codes in each section.

Important

Diagnostic trouble codes should be used only for purposes of diagnosing faults. It is not absolutely certain that they indicate a faulty component.

-
- 7 To avoid damage to control modules and components, the ignition key must be OFF when the BOB is connected or connectors unplugged.
 - 8 Check that the control module grounding connections and supply voltages are correct.
 - 9 It could sometimes be necessary to unplug connectors to check that contacts and pins are not damaged and are correctly fitted. Reconnect all connectors and erase all diagnostic trouble codes. If possible, start/drive the car and check if the fault(s) remain.

If a faulty contact is suspected, use contact spray KONTAKT 61 (part No. 45-30 04 520) on the female pins and connector.

Important

Contact spray of grease must not be used on the oxygen sensor connectors.

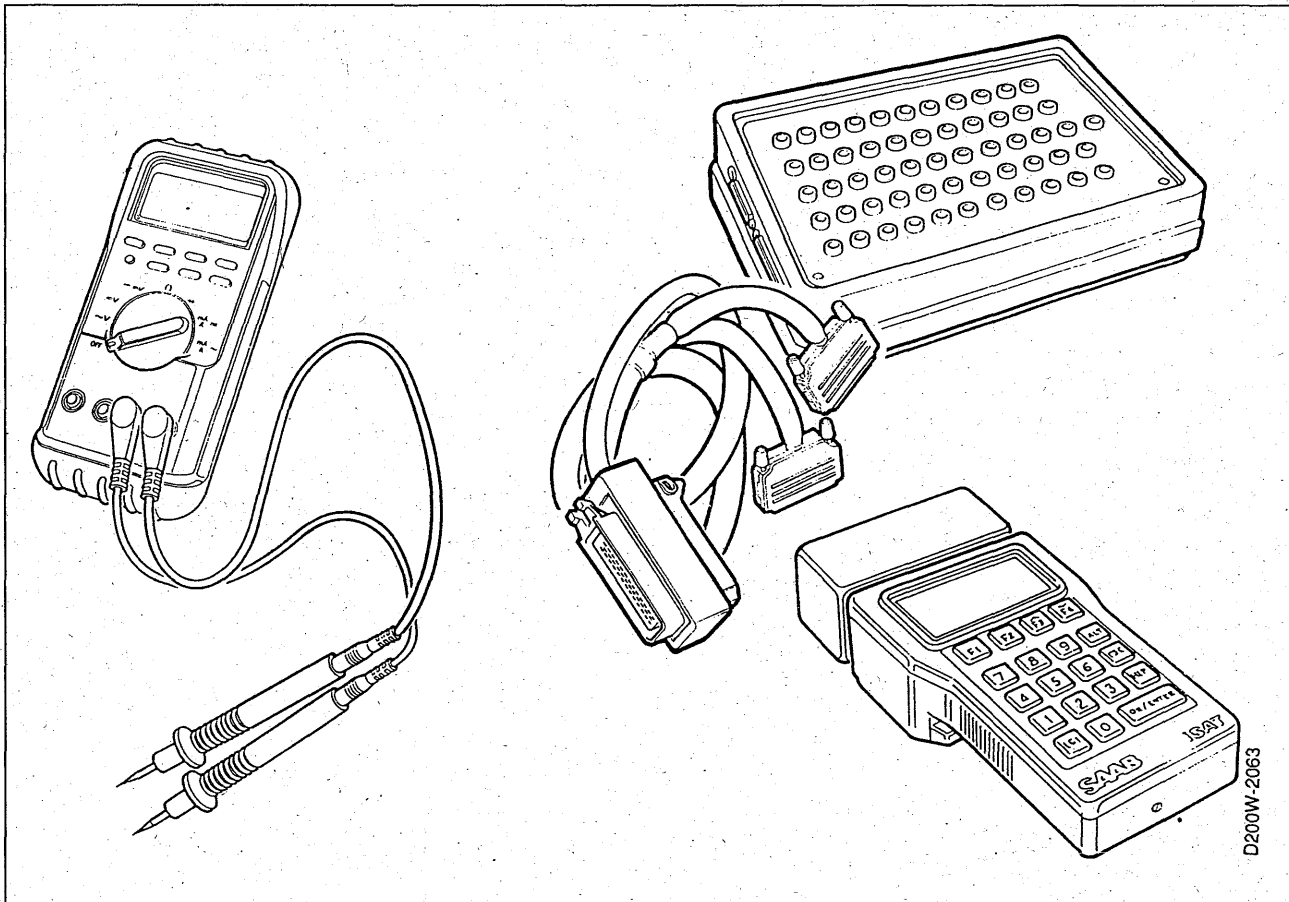
- 10 The voltage level of 12 V should be regarded as approximate and not an absolute value. The reading may be directly proportional to BPV, but 0.5 - 1.5 volts may be lost due to voltage drop across the internal control module drive step.
- 11 The voltage level of 0 volt should be regarded as approximate and not as an absolute value. Due to internal voltage drop in the control module drive step, the feed between the control module pins and ground can show around 0.5 - 1.5 volts, but this is given under Readings, control module connections to 0 volt.
- 12 Never switch from one unit to another (for example from volts, via amps to ohms) on the meter, without first having unplugged the instrument test leads.
- 13 Resistance readings should always be taken with the ignition at OFF.

Important

After carrying out an operational test, always erase the fault memory with the command "CLEAR FAULT CODES". All systems are erased with the command "CLEAR".

General test methods (contd.)

Readings, control module connections



Readings and instructions for reading voltage levels on the control module are listed under each heading.

Points to remember:

- Unless otherwise stated, all voltage measurements are taken with all components connected and with the ignition key at ON.
 - Readings are taken using the breakout box (BOB) connected between the control module and the control module connector.
 - Some of the readings should be taken with the engine idling.
 - Several voltage levels must be regarded as guiding values. Your common sense should tell you whether a reading is correct or not.
 - If any reading is incorrect, use the wiring diagram to fine out which cables, connectors or components should be checked.
 - All readings are under normal working conditions (i.e. warm engine).
 - Specified test readings are for a calibrated FLUKE 88/97.
- The readings %(+), ms(+) show the pulse ratio and pulse width of the signal. Test instrument with pulse ratio and pulse width measurement should be used. The symbol (+) designates positive trigger pulses, TRIG+.

LH MFI system test unit

Test equipment consists of an instrument, a cable for voltage supply, a test lead with double connectors and a pressure sensor with magnetic clip. There are two designs of test lead:

- 25 pole, for cars with LH 2.2
- 35 pole for cars with LH 2.4

Voltage supply

Voltage supply +12V is connected to the battery with battery clamps.

Pressure sensor

The pressure sensor is connected to the LH MFI system to measure fuel pressure.

Measuring range: 0-10 bar

Pressure class: 1%

Connection to car

The connection is made between the control module and the car's wiring harness with a double connector (male-female type) and a 2 metre long replaceable cable.

- 1 Uncover the control module by removing the coverplate over the false bulkhead space on the left-hand side.

If the car is equipped with ABS brakes, loosen the ABS control module and its bracket.

Remove the control module retaining screws.

- 2 Connect the instrument by connecting the cable with the double connector between the control module and the car's wiring harness.

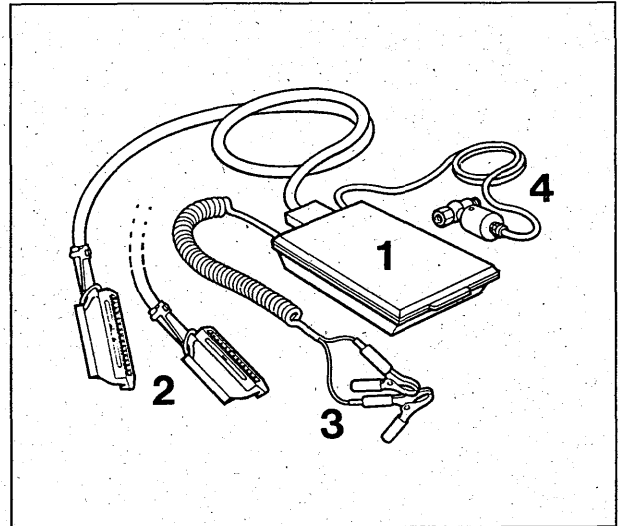
For cars with LH 2.2, a 25 pin connector is used and for cars with LH 2.4, a 35 pin connector is used.

- 3 In order to avoid damage caused by crushing, lay the cables between the door and the chassis where the sealing strip divides and then in under the rear edge of the bonnet on the left-hand side.

Connect the clamps to the battery, first (-) and then (+).

Important

Check that the battery terminals are clean so that the connection is good. Always make sure that the power cable is connected to the instrument before the connection is made to the battery.



- 1 LH MFI system test unit
- 2 Signal cable, control module test units
- 3 Cable with battery clamps
- 4 Pressure sensor for measuring fuel pressure

LH MFI system test unit (contd.)

Before starting work

Before starting fault diagnosis with the LH MFI tester, it is advisable to check first, via the built-in fault diagnosis system in LH 2.4 cars, that there are no intermittent faults stored in the LH control module.

When connecting the LH MFI tester to the system, the power supply to the control module is interrupted, resulting in the control module's fault memory being erased and the direct possibility of detecting intermittent faults disappearing.

This is also the case when one of the battery leads is disconnected.

In a computer based fault tracing system such as the LH MFI system tester, programmed values are used as references for certain parameters that are to be checked.

The reference level in the software must be balanced to a level where any faults are detected within, what is in certain cases a very narrow range. This means that in these cases, a fault might sometimes be detected without there being any fault.

This can only happen under operating conditions that are significantly different from normal driving conditions.

The following are examples of faults that can be detected under these circumstances:

LH 2.2	LH 2.4	
E0020	E013	Warming up too slow, i.e. thermostat fault or long idling in extremely cold conditions.
E020	E020	Engine braking during long period, signal level from oxygen sensor faulty.
E207	E207	Wide open throttle acceleration for long period; mass air flow sensor voltage abnormally high.
E113	E118	Engine speed too high, over-revving protector released, charge air pressure too high.

It is often the case that the fuel injection system is suspected of being faulty, when the fault is actually in the engine itself or in the electrical system.

Check the following before testing the injection system:

- Battery condition
- Charging system
- Ignition system (setting, spark plugs, cables, distributor cap, rotor etc.)
- Battery connections and grounding point
- Engine condition (compression; vacuum in intake pipe etc.)
- Air leakage in turbo/intake system

In certain cases, it may be an advantage to quickly check the main relay and the pump relay as follows:

- 1 Unplug the connectors from the LH MFI control module and the mass air flow sensor.
- 2 Connect a breakout box (BOB).
- 3 **LH 2.2**
Ground pins 17 and 21 to pin 25.
LH 2.4
Ground pins 20 and 21 to pin 17.
- 4 Check that there is voltage to:
 - LH 2.2 on:**
pins 9 and 13 (LH MFI control module)
pin 2 or pin 5 (mass air flow sensor)
pin 2 (IAC valve)
fuse 14 (fuel pump relay)
 - LH 2.4 on:**
pins 9 and 18 (LH MFI control module)
pin 5 (mass air flow sensor)
fuse 14 (fuel pump relay)

LH MFI system test unit (contd.)**Accessories**

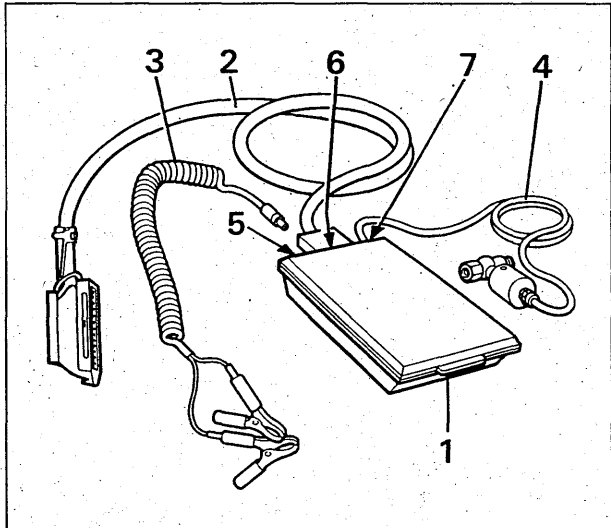
Item	Designation/Part number	Remarks
1.	Grounding lead, part No. 83 93 894	
2.	Signal lead, 25 pole, 35 pole, part No. 83 94 231, 83 94 348	
3.	Test wiring harness for connecting scan tool, part No. 86 10 784	
4.	Test equipment for fuel pressure, part No. 83 93 852	
5.	Pulse relation gauge, part No. 83 93 597	Replaced by scan tool
6.	Electric lead, forced operation of fuel pump, part No. 83 93 886	

ABS system test unit

Saab's ABS system test unit has been developed to ensure that it is possible to carry out servicing and fault diagnosis on Saab's antilock brake system in a rational and safe way.

The test equipment consists of the following components:

- 1 Test instrument
- 2 Signal cable with double 35 pin connector
- 3 Cable for power supply
- 4 Pressure sensor with connecting hose
- 5 Socket for connection of power cable
- 6 Socket for connection of signal cable
- 7 Fitting for connection of hose to pressure sensor.



Three different tests can be carried out with the test equipment:

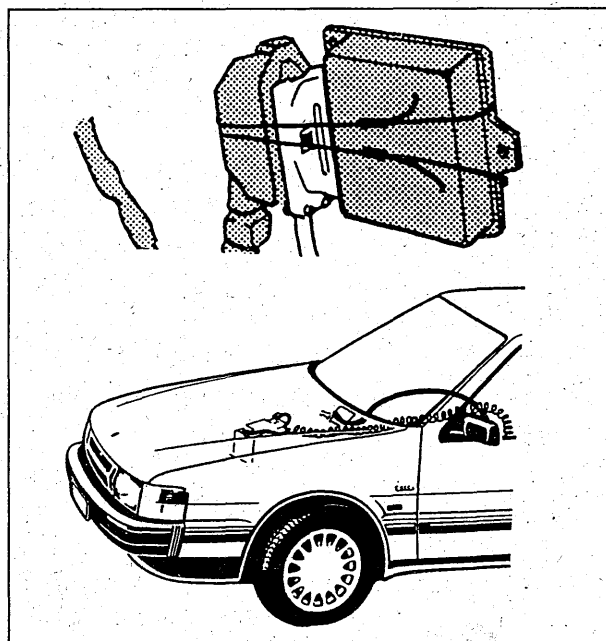
- a. Automatic operational test of each wheel sensor with signal cable and pressure in brake system accumulator.
- b. Manual valve test.
- c. Manual operational test on each wheel sensor with signal cable and pressure in brake system accumulator.

ABS system test unit (contd.)

Connecting the test instrument

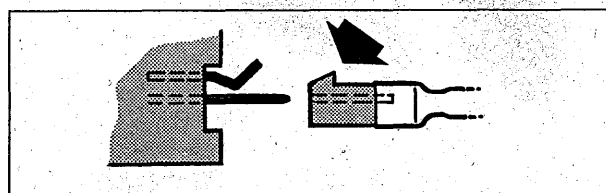
- 1 Turn the ignition key to OFF.
- 2 Remove the cover plate from over the false bulkhead on the left-hand side.
Remove the control module securing clip.
Remove the electronic control module.
- 3 Connect the signal cable with the 35 pole connector between the control module and the connector in the car's wiring harness.
Secure the connector with a cable tie around the control module and its connector.
Pass the cable in through the front side window.
Connect it to the socket on the test instrument.
- 4 Connect the power supply cable clamps to the battery (negative terminal first).
Run the power cable in through the front side window and connect it to the socket on the test instrument.

The program then automatically selects "ABS type I"



Important

When the 35 pin connector is connected to the ABS system tester, the power supply cable must also be connected, or the electronics in the ABS tester can be destroyed. This applies if the ABS tester is connected for a long period without testing taking place. In order to avoid damage to the test instrument when it is connected to the power supply cable, make sure that the connector is plugged into the right socket.



⚠ WARNING

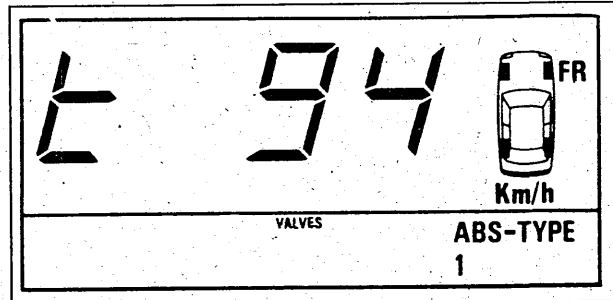
The ignition key must be turned to the OFF position before the signal cable connector is unplugged from the control module. Otherwise, there is a danger of destroying the control module.

ABS system test unit (contd.)

Selecting ABS system type

When the test instrument is powered, the test program automatically selects "ABS type 1". This is equivalent to a toothed gear with 94 teeth, which was fitted in all Saab models up until M 1989.

The letter "t" (stands for teeth) is shown on the display as well as the value "94" which gives the number of teeth. The text "ABS type 1" is also given, which is the automatically selected system.



In cars from model year 1990, the number of teeth is changed to 46, which means that "ABS type 2" must be selected for these cars.

Selection of ABS type should be made within 4 seconds after connecting the power supply, by simultaneously pressing the two function keys. The text "t 46" and "ABS type 2" is then displayed.

After selection of the ABS system, the program automatically goes over to "Manual test sequence" after a couple of seconds.

Diagnostic trouble code 009

When using the ABS system tester on cars from model year 1990, the tester always registers diagnostic trouble code 009. The reason for 009 is that the voltage level between pins 9 and 10 on the electronics unit in cars from 1990 is significantly lower than on electronics units in older year models and the ABS tester registers this as a fault. If this diagnostic trouble code is displayed in combination with other diagnostic trouble codes, 009 should be rectified last. If the ABS warning lamp is lit and only fault code 009 is displayed, follow the recommended action for this diagnostic trouble code.

ABS system test unit (contd.)

Connecting pressure sensor

⚠ WARNING

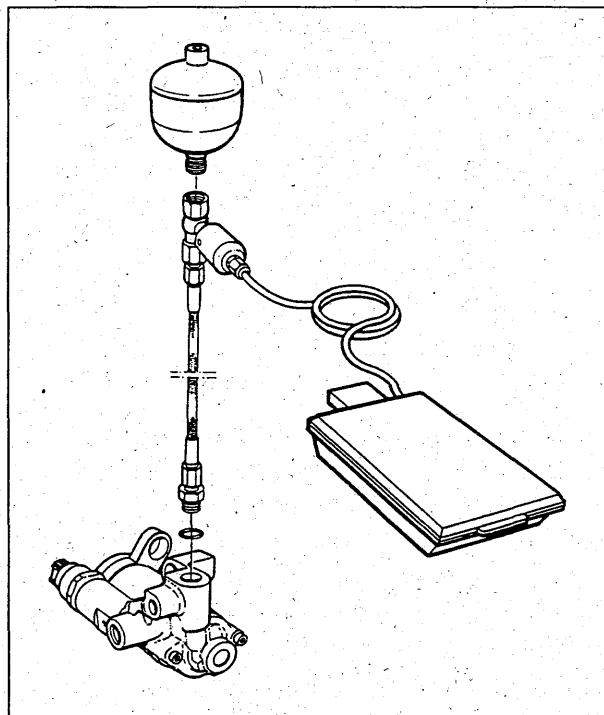
Before starting work, the brake system must be depressurized. Press the brake pedal about 20 times or until there is a noticeable resistance in the pedal.

- 1 Remove the fuse holder from 1990 and later model year cars.
- 2 Remove the pressure accumulator using a 8 mm hex key.
- 3 Fit the connecting hose to the brake unit.
- 4 Fit the pressure sensor to the hose.
- 5 Fit the pressure accumulator to the pressure sensor.

Place the pressure accumulator so that the hood can be closed.

- 6 Refit the fuse holder temporarily.

Before removing the pressure sensor, the brake system should again be depressurized.



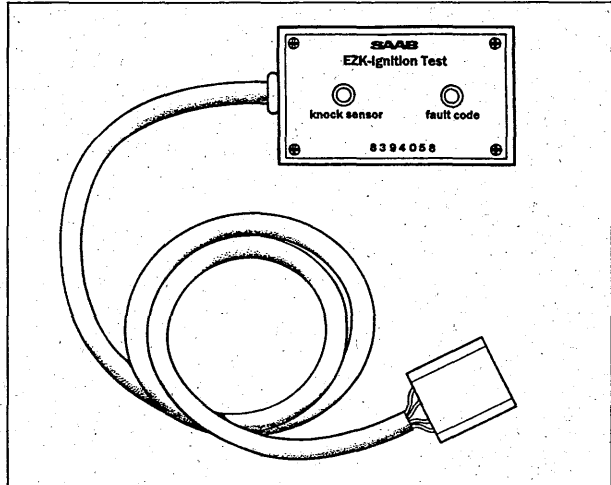
Accessories

Item	Designation/Part number
------	-------------------------

- | | |
|----|--|
| 1. | Extension cable between control module and ABS system tester, part No. 89 96 589 |
| 2. | ABS system tester, part No. 89 96 514 |

EZK system test unit

In Saab's EZK ignition system, there is an automatic fault tracing system. When carrying out an operational test after fault tracing, stored diagnostic trouble codes can be read using a test instrument. The test instrument LEDs (one green and one red) give the reason for any fault with flashing codes. The flashes on the green LED correspond to the flashes of the malfunction indicator (**CHECK ENGINE**) lamp and the diagnostic trouble code is read from the fault diagnosis schedule. The red diode flashing indicates knocking.

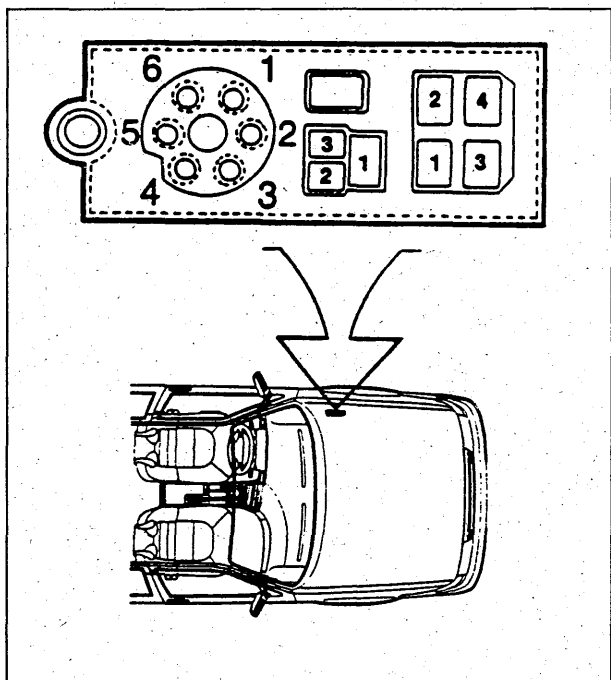


Connection and reading of diagnostic trouble codes

- 1 Connect the system tester to the 4 pin socket.

NOTE: The ignition must be off

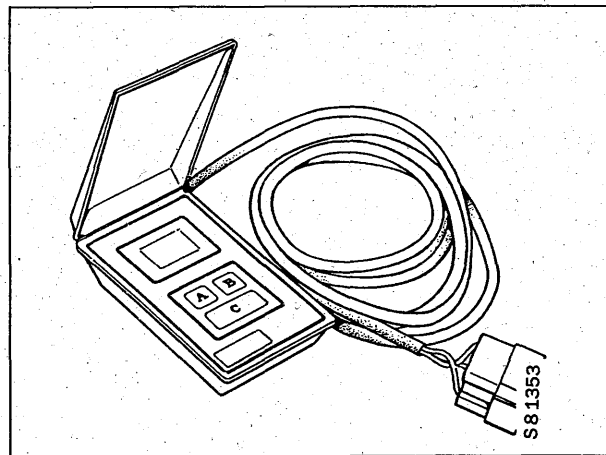
- 2 Switch on the ignition and start the engine. Check that the LED for fault indication (green) is lit for 2 seconds while the starter motor is working.
- 3 Let the engine run until it reaches its normal working temperature. At some stage during the warm-up process, engine speed must momentarily go over 2300 rpm.
- 4 Allow the engine idle and note the number of flashes from the LEDs. Read the cause of the fault.



Airbag system test unit

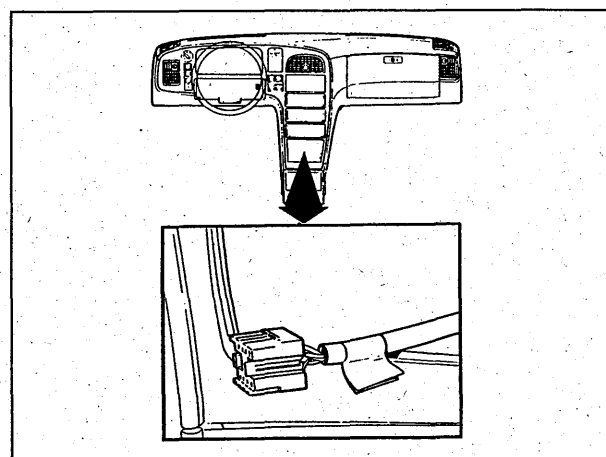
Saab's SRS system tester consists of an instrument with connecting cable and connector.

All faults that arise in the system, permanent or intermittent, are stored in the control module and can be read using the tester.



Connection to car

The tester is connected to the special SRS data link connector, located under the radio compartment. Connection is via a connector and a 1 metre long cable.

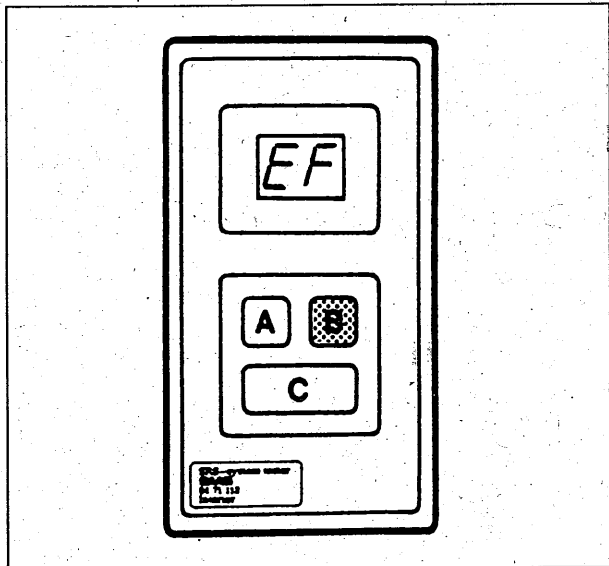


Airbag system test unit (contd.)

Checking external faults (in e.g. wiring harness or sensors)

- 1 Press "B". "EF" shows on the display.
- 2 Press "C".

When "C" is pressed for the first time, the SRS code (system designation) is displayed. When it is pressed for the second time, program version etc. is displayed as per table.



Ex-ample	Explanation
41	SRS system designation
03	Program version
01	Number of hours of fault* (first fault)
15	Number of minutes of fault* (first fault) (Displayed in intervals of 5 minutes)
2d	Diagnostic trouble code (2 digits/characters)

* If time exceeds 99 hours and 55 minutes, 99 hours and 99 minutes is shown.

If there are several faults stored, the tester proceeds (when "C" is next pressed) directly to the next diagnostic trouble code followed by type of fault. When all faults have been gone through, "EF" is shown on the display. If "C" is then pressed, the tester starts again from the beginning and shows the code for SRS (system designation) and so on.

Airbag system test unit (contd.)

Checking internal faults (in the control module)

- 1 Press "A". "IF" is shown on the display.
- 2 Press "C".

Procedure and code sequence are the same as for external faults.

Erasing stored faults

- 1 Press "A" and "C" at the same time. The display shows "Er".
- 2 Press "C".

When "C" is pressed for the first time the code for SRS (system designation) is shown. When it is depressed for the second time, the software version is shown, and the third press erases all faults. If erasure is correctly carried out, "01" is displayed. If not, "02" is displayed. If "02" is displayed, erasure must be repeated.

If the airbag has been activated, the diagnostic trouble codes cannot be erased.

Control module number

Every control module has its own number which is read by pressing "A" and "B" at the same time. The display shows "tn". Press "C" repeatedly to read the entire number. The number consists of 10 digits which are shown 2 by 2.

Fault diagnosis

Important

Before working on the system, the following must be done:

- Disconnect the negative lead from the battery.
- Unscrew the steering wheel airbag and unplug the connector on the reverse.
- Connect reference resistor 84 71 153 to the connector.

This action means that it is not necessary to wait 20 minutes after disconnecting the battery.

Also note the following:

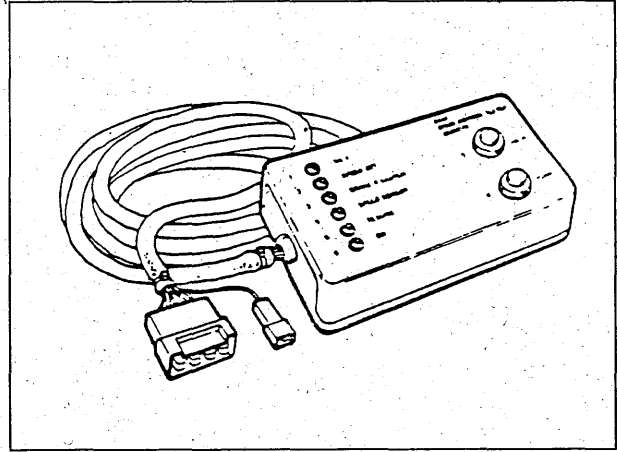
- Splicing of SRS cables is not permitted. Splicing can cause malfunction, making the system unserviceable and even cause personal injury.
- If a connector is unplugged when the ignition is on, this is registered as a fault in the system. The fault does not disappear until it has been erased.
- Permanent fault = a fault registered by the control module that is still present the moment the ignition key is turned to OFF.
- Intermittent fault = a fault that is registered by the control module which is **not** present at the moment the ignition key is turned to OFF.

Accessories

Item	Designation/Part number	Remarks
1.	SRS system test unit, part No. 84 71 112	
2.	Test lead, part No. 84 71 146	
3.	Reference resistor, part No. 84 71 153	

Cruise control system test unit

This tester has been developed to facilitate fault diagnosis and to avoid unnecessary replacement of fault-free components in the cruise control system in year models up to M1991.



Connecting the test instrument

- 1 Unplug the connectors from the electronics unit (one 8 pin and one 1 pin) and connect them the test box wiring harness.
- 2 Set the cruise control switch to OFF and switch on the ignition. Check that the diodes marked 1, 3 and 5 light.

IMPORTANT: LED 5 is most likely to light when the car is moving.

Fault diagnosis using self test

There are two main possibilities for using the fault diagnosis system:

- Fault diagnosis, stored faults
- Component and signal testing (LH MFI)

Stored faults

Faults that arise intermittently are often difficult to locate. Certain electronic systems have an inbuilt memory that makes it possible to localize and rectify this type of fault after it has occurred.

By following the instructions below, which describe how the system's memory feature is activated, the malfunction indicator (CHECK ENGINE) lamp in the car's instrument panel will provide information on stored faults in the form of flashing codes.

A certain combination of short flashes, e.g. 1+2+3+2+2 represents a particular fault. Using a list of diagnostic trouble codes, the significance of 12322 can be looked up and the fault be rectified. In the same way, you can activate diagnostic trouble codes for faults Nos 2 and 3 and via flashes on the malfunction indicator lamp check the code in the list of diagnostic trouble codes.

Up to three faults can be stored in the control module memory, and these can be activated during fault diagnosis and give information on the type of fault. Serious faults are given priority, which in practice means that these must be attended to before the control module stores any non-"A" faults.

Component and signal testing

It is advisable to carry out this test in conjunction with diagnosis of stored faults.

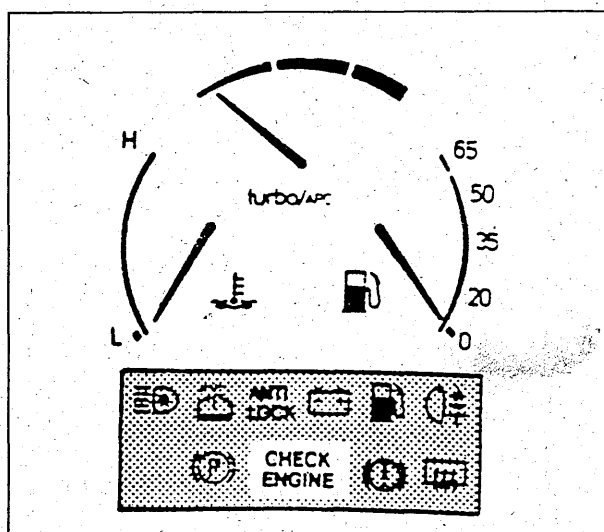
The test consists partly of an operational check of certain key components in the LH MFI system and partly a signal test of important control module signals.

In this test as well, the malfunction indicator lamp will flash codes of the same type as for stored faults. In this case however, the code is not a diagnostic trouble code, but an identification code which shows which component or which signal is being tested.

Important

All reading and testing is interrupted when the ignition key is turned to OFF.

If a serious fault is repeated, this is recorded in the memory each time the fault arises and the malfunction indicator lamp lights. When the fault is rectified, the memory may therefore need emptying for the diagnostic trouble code to "disappear". When in doubt, test drive the car.



Fault diagnosis with self-diagnosis (contd.)

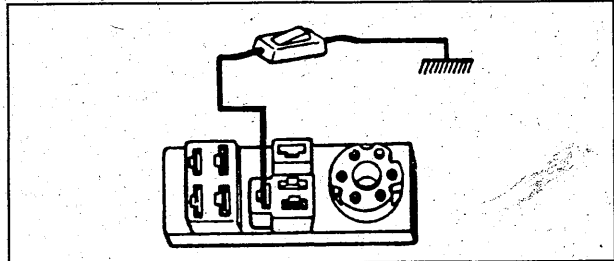
Reading stored faults

Important

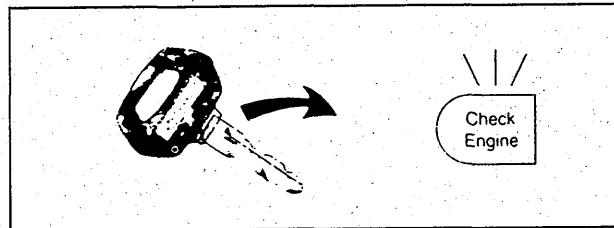
Read the entire starting sequence before the ignition key is turned to ON.

- 1 Ground pin 3 in the 3 pin test socket in the engine compartment on the left-hand side. Use cable with switch, part No. 83 93 886.

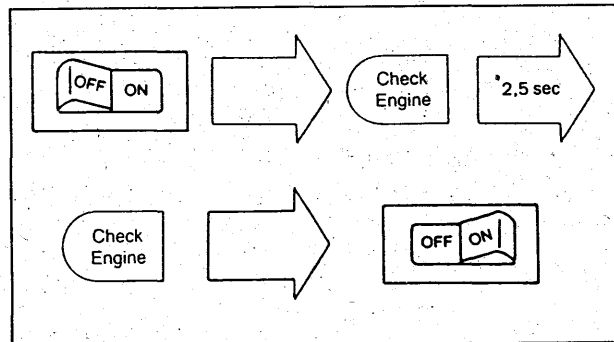
IMPORTANT: Make sure that the switch is OFF.



- 2 Use the malfunction indicator (CHECK ENGINE) lamp to read diagnostic trouble codes.
- 3 Turn the ignition key to ON. Malfunction indicator (CHECK ENGINE) lights.



- 4 Set the switch to ON (pin 16 in the control module is grounded). Malfunction indicator lamp goes out.
- 5 Watch the malfunction indicator lamp carefully. After about 2.5 seconds, it gives a short flash, which means that the first diagnostic trouble code is activated. Switch the switch to OFF directly after the flash.
- 6 The first diagnostic trouble code (of a possible 3) is activated and will be displayed in the form of short flashes of the malfunction signal directly after the activation signal.



Important

The diagnostic trouble code starts and ends with a long flash of the malfunction indicator lamp. These long flashes are not part of the actual fault code, but serve as start and stop signals.

If the engine is off during fault diagnosis, the diagnostic trouble code "12231" is generated as there is no engine speed signal. Turn the starter motor for about 5 seconds — if the diagnostic trouble code disappears, the ignition signal is OK and the fault is something else.

As soon as confirmation is received, the key is released to the drive position and testing continues.

Fault diagnosis with self-diagnosis (contd.)

Next diagnostic trouble code

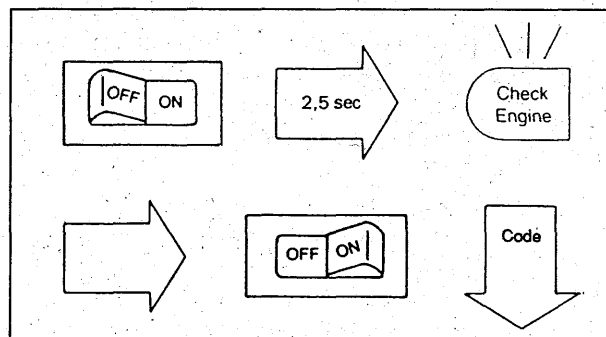
With the switch to OFF, the next diagnostic trouble code (if any) is not activated in the control module memory, but diagnostic trouble code "12112" is repeated again and again.

To check if there are two or more faults in the system, proceed as below.

7 Set the switch to ON.

8 After a **short flash**, set the switch to OFF.

Diagnostic trouble code No.2 will then be displayed in the same way as diagnostic trouble code No.1.



If there are more faults stored, this will be shown in the same way as the first fault, but with a separate diagnostic trouble code.

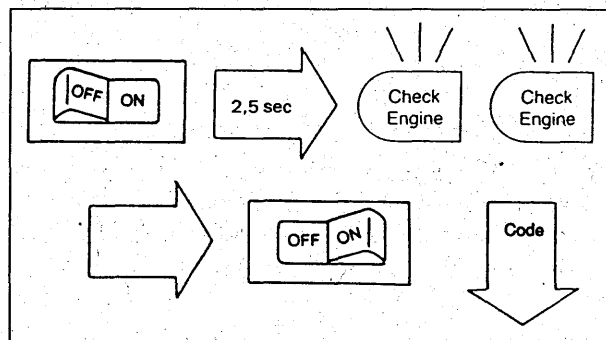
9 Any third code is also read in the same way. If there is no third fault stored or all faults have been rectified, this is designated with a series of long flashes.

Start from the beginning

If for any reason, you want to repeat the diagnostic trouble codes from the start, this is done as follows:

1 Set the switch to ON.

2 After **two short flashes**, set the switch to OFF and diagnostic trouble code No. 1 will be repeated.



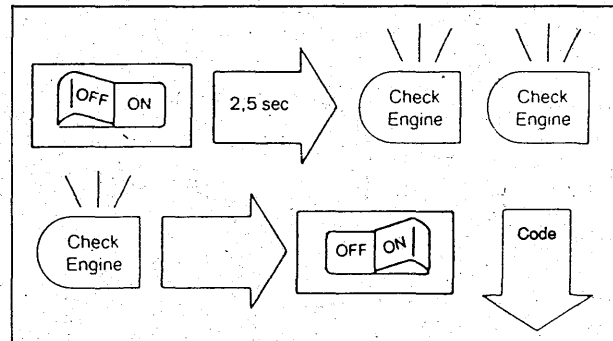
Fault diagnosis with self-diagnosis (contd.)

Erasing the memory

- 1 Set the switch to ON.
- 2 After **three short flashes**, set the switch to OFF.
The memory is now erased.

Important

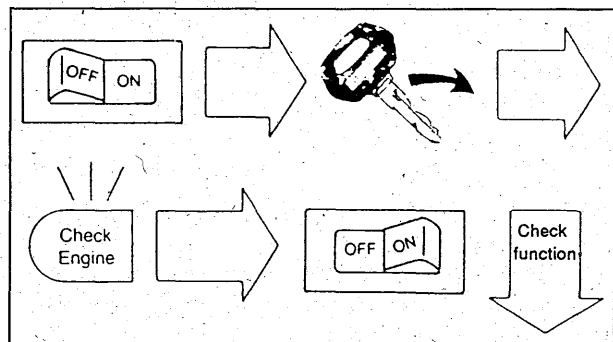
The memory can only be erased after the code "00000" has been displayed (end of diagnostic trouble codes).



Component and signal testing

The test is carried out starting from point 1 and covers all points up to point 7, see table. The connection is the same as for "Fault diagnosis, stored faults".

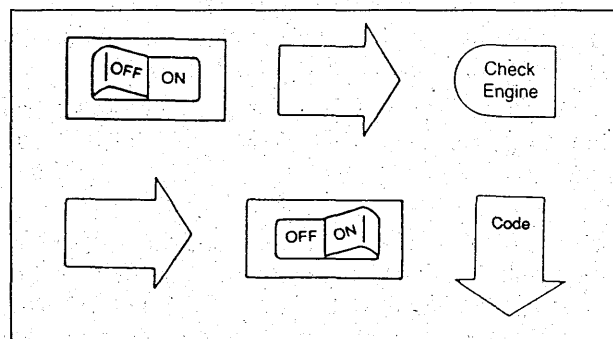
- 1 Set the switch to ON.
- 2 Switch on the ignition and wait for **one short flash** of the malfunction indicator (CHECK ENGINE) lamp, after which the switch is immediately set to OFF.
At the same time as the lamp flashes, the fuel pump should start. If not, the pump is faulty. Listen and check fuel pressure if necessary.



Important

The fuel pump only runs for 1 second. No ID code is given during this test.

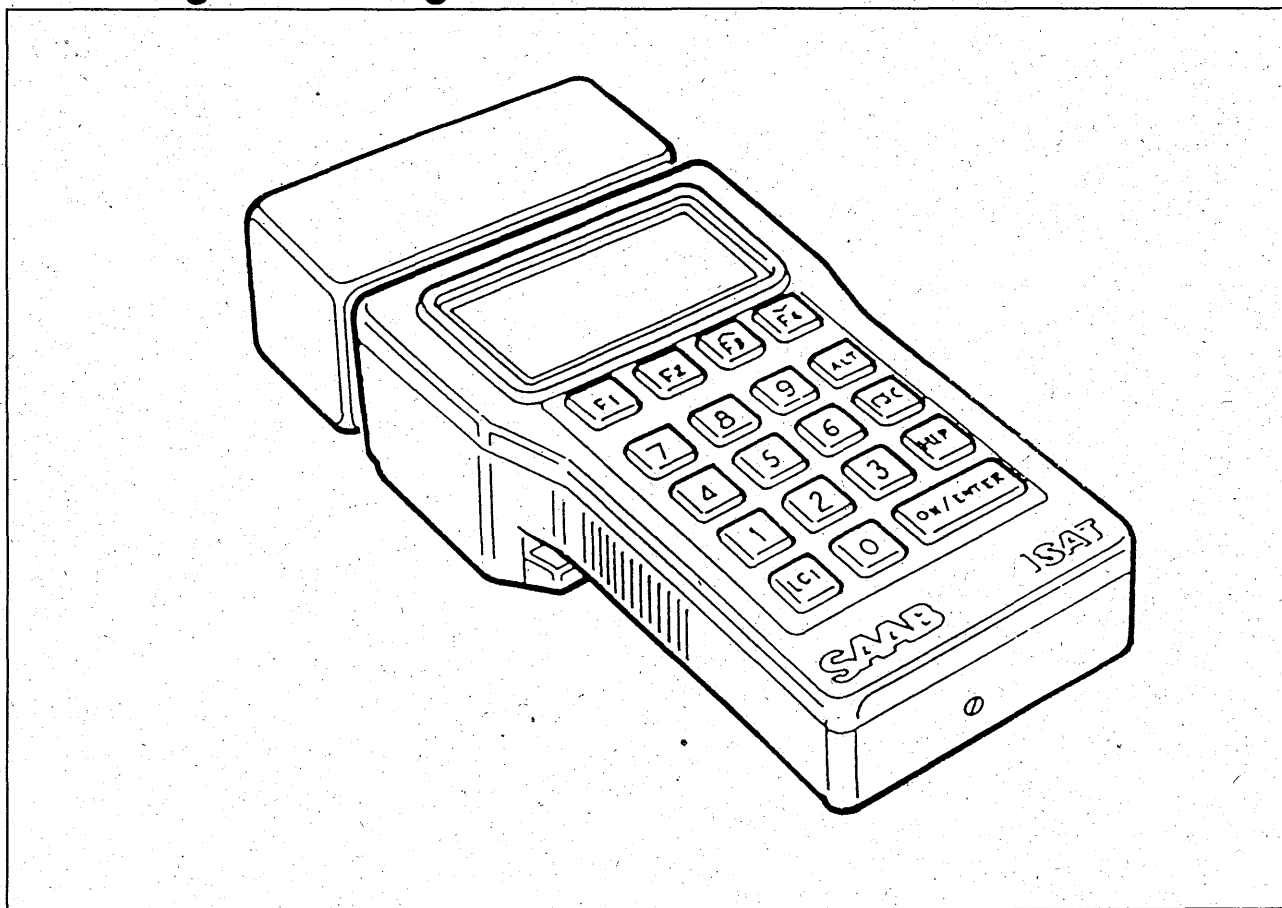
- 3 To proceed to test No. 2, i.e. injectors, set the switch to ON.
- 4 After **one short flash**, switch to OFF.
A code is now displayed in the same way as during "Fault diagnosis, stored faults", i.e. one long flash starts and ends the actual code, which consists only of short flashes.



Check by listening that the injectors are working.

- 5 Run through the remaining points in the table in the same way. Set the switch to ON — wait for a short flash — switch to OFF.

Fault diagnosis using ISAT scan tool

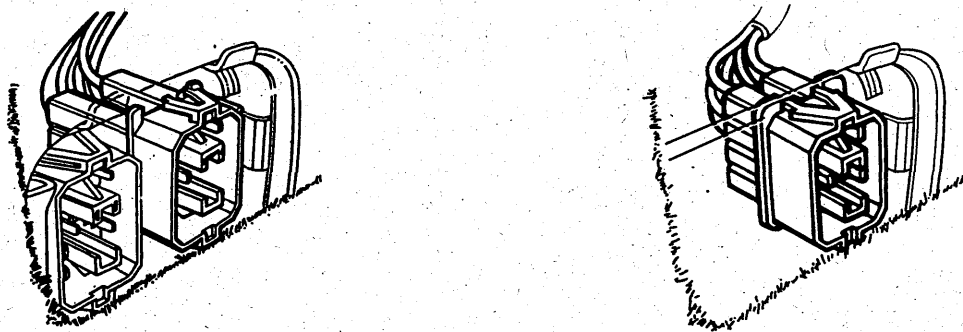


The ISAT (Intelligent SAab Tester) scan tool is primarily intended for fault diagnosis on electronics systems designed with self-diagnosis, such as Saab Electronic Ignition, LH MFI, TCS, EDU, ACC 2 etc. In this type of system, any faults that arise, including intermittent faults, are diagnosed and stored in the system's control module (ECU). Using the ISAT scan tool, the fault information stored in the system is copied and the fault is presented in the form of a five digit code on the scan tool display.

For information on how the instrument works and how to operate it, see Service Manual 1:4 ISAT scan tool.

In order to increase understanding and user-friendliness, a new menu structure is being introduced in EPROM M1995 with POINTER MENU, where the group being sought is displayed in plain text. This means that all commands, responses to commands and diagnostic trouble codes will be presented in plain text for certain electronics systems such as Motronic 2.8.1, Saab Trionic, TCS (6 Cyl), Theft alarm (M1995), Airbag and Seat with memory. For other electronics systems such as LH MFI, DI/APC Electronic Ignition, ACC, EDU, ABS and ETS, reading is the same as with the old code structure. In addition, a new test feature is being introduced, PWM, which is used for measuring pulse width modulated signals.

Fault diagnosis with ISAT scan tool (contd.)



Data link connector -M1994

The car has two data link connectors

- Black (347)
- Green (348)

Pin	System (Black)	System (Green)
1	K line	K line
2	LH/EZK/LUCAS (L line)	EDU (L line)
3	DI/APC Electronic Ignition (L link)	ACC (L line)
4	ETS (L line)	ABS (L line)
5	No connection	Left-hand seat with memory (L line)
6	No connection	Right-hand seat with memory (L line)
7	No connection	No connection
8	No connection	Airbag (L line)
9	BPV	BPV
10	Ground	Ground

Data link connector M1995-

The car has one data link connector

- Green (348)

Pin	System
1	K line
2	Motronic 2.8.1 (L line)
3	ETS (L line)
4	ABS (L line)
5	Seat with memory (L line)
6	No connection
7	No connection
8	No connection
9	BPV
10	Ground

Fault diagnosis with ISAT scan tool (contd.)

ISAT scan tool to remember

Communication with Trionic

Communication between the scan tool and the Trionic control module is normally possible

- With the ignition key ON
- When idling

Fault diagnosis that requires communication at engine speeds higher than 2500 rpm is difficult to accomplish.

At high engine speeds, Trionic gives priority to its basic functions and the diagnostic function can be switched off. The result of this is that Trionic is not able to achieve communication with the scan tool. The scan tool shows "CONTACT NOT MADE".

Communication with ACC -M1994

Communication between the scan tool and ACC -M1994 can cause general communications problems with all electronics systems in the car (green connector). The reason is that the ACC system does not meet certain specifications for communication. Unfortunately, this also affects other electronics systems in the car.

If problems are a nuisance, disconnect the ACC system in the following way:

- Turn the ignition key to OFF
- Remove fuses 1 and 17 for the ACC system
- Turn the ignition key to ON

Diagnosis of other electronics systems in the car can now be carried out.

Static electricity, ESD

See the text on page 5 This applies especially to the scan tool. Electrostatic discharge on the scan tool display can destroy it.

Connection

Connecting and disconnecting the scan tool to the data link connector **must be done with the ignition key OFF**.

Ending communication

After completed diagnosis, when communication between the selected system and the scan tool is to be ended, the command "END" is recommended.

Scan tool software freeze

When using the scan tool, the software can freeze, where the screen either freezes or goes blank.

The cause is internal software faults in the scan tool. It does not help to press keys, and the only way to reset the scan tool program is to disconnect the internal scan tool batteries and short the two terminals.

Important

A faulty battery can jeopardize communication between the car and the scan tool.

Fault diagnosis with ISAT scan tool (contd.)

Basic design

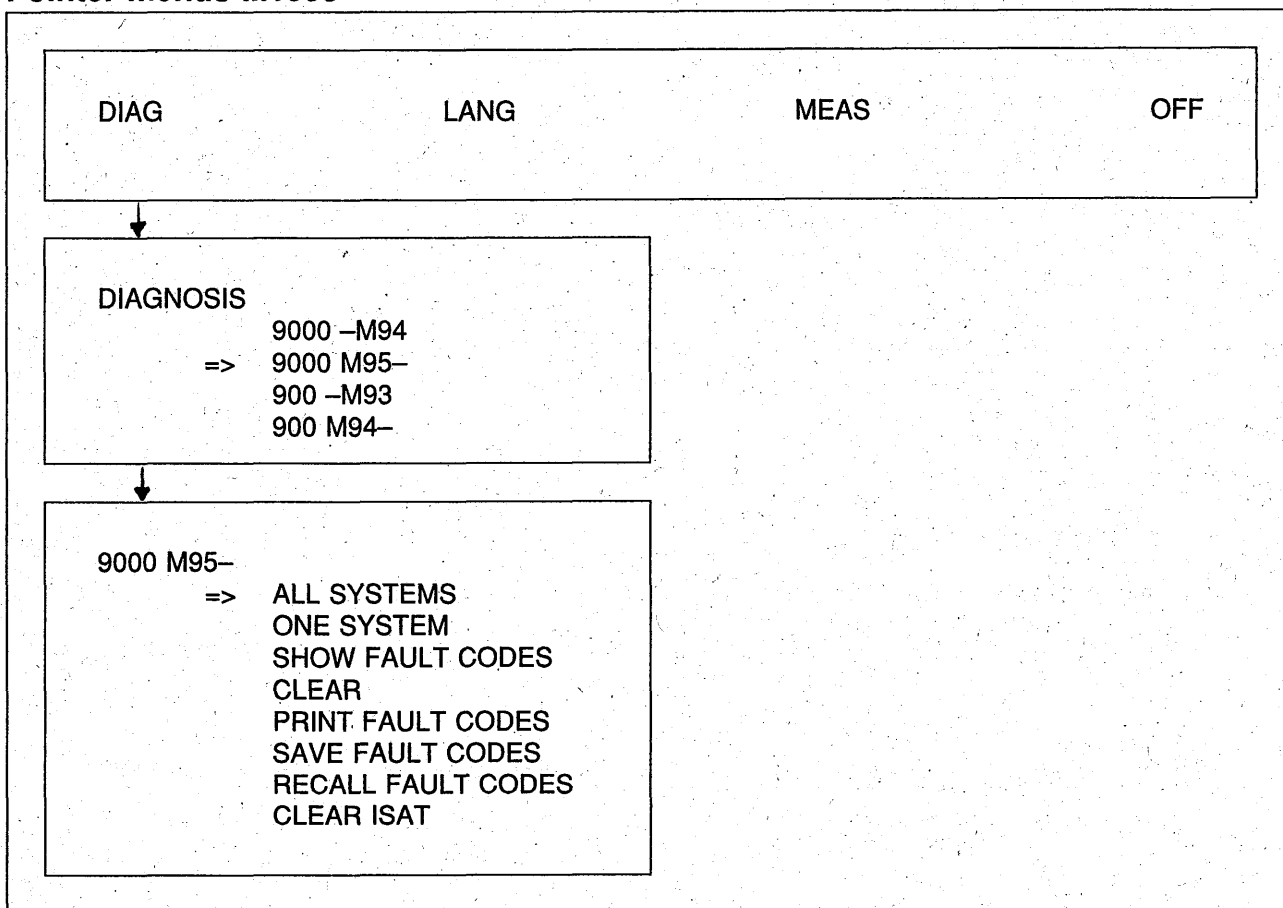
Item	Designation/Part number	Remarks
1.	Storage/transport case, part No. 86 10 826	
2.	Instrument, part No. 86 10 651	
3.	Diagnostic cable — 10 pole, part No. 86 10 701	
4.	Diagnostic cable — 4 pole, part No. 86 10 693	Saab Electronic Ignition (M1988 1/2)
5.	Test leads, part No. 86 10 719	Multimeter functions (DMM)

Accessories

Item	Designation/Part number	Remarks
1.	Program module	
2.	TSI module assembly, part No. 86 10 925	Including items 3-7
3.	TSI module, part No. 86 10 941	Including connectors and clips. Clips are also available separately (part No. 86 10 933)
4.	Wiring, part No. 86 10 727	For connection to car's TSI socket
5.	Inductive sensor, part No. 86 10 735	Including wiring and connectors for TDC sensor as well
6.	TDC sensor, part No. 86 10 005	
7.	Stroboscope light, part No. 86 10 958	
8.	Temperature sensor cable, part No. 86 10 750	
9.	Pressure sensor module, part No. 86 10 990	Use in conjunction with ABS and LH MFI system pressure sensors.
10.	Inductive current probe, part No. 86 10 743	For measuring currents up to 600 A
11.	Connection cable, part No. 86 10 776	CI fuel injection with oxygen sensing
12.	Connection cable, part No. 86 10 784	LH MFI with oxygen sensing
13.	Adapter cable, part No. 86 10 982	For compression tests
14.	Pressure gauge, part No. 86 10 974	Pressure sensor

Scan tool menu structures

Pointer menus M1995-



The scan tool is switched on with the ON/ENTER button and then shows the main menu DIAG, LANG, MEAS, OFF.

If F1 is selected, the sub-menu (pointer menu) to DIAG (DIAGNOSIS) is displayed. In this menu, the desired car is selected from 9000-M94, 9000 M95-, 900-M93 or 900 M94-. Selection is made using a cursor that can be moved up or down the display with the F3 and F4 keys.

9000 M95- is selected using the F4 key and activated using ON/ENTER. The sub-menu to DIAGNOSIS, 9000 M95- is now displayed. The following commands and associated functions are found in this menu:

- ALL SYSTEMS
- ONE SYSTEM
- SHOW FAULT CODES
- CLEAR
- PRINT FAULT CODES
- SAVE FAULT CODES
- RECALL FAULT CODES
- CLEAR ISAT

ISAT scan tool menu structure (contd.)

Pointer menus M1995 (contd.)

ALL SYSTEMS	
=> ACC	0 FAULT
AIRBAG	0 FAULT
EDU	1 FAULT
MOTRONIC 2.8.1	1 FAULT
LH MEMORY SEAT	1 FAULT
M95 THEFT ALARM	0 FAULT
TRIONIC	1 FAULT
TCS V6	2 FAULT
ABS	2 FAULT
ETS	0 FAULT

ALL SYSTEMS

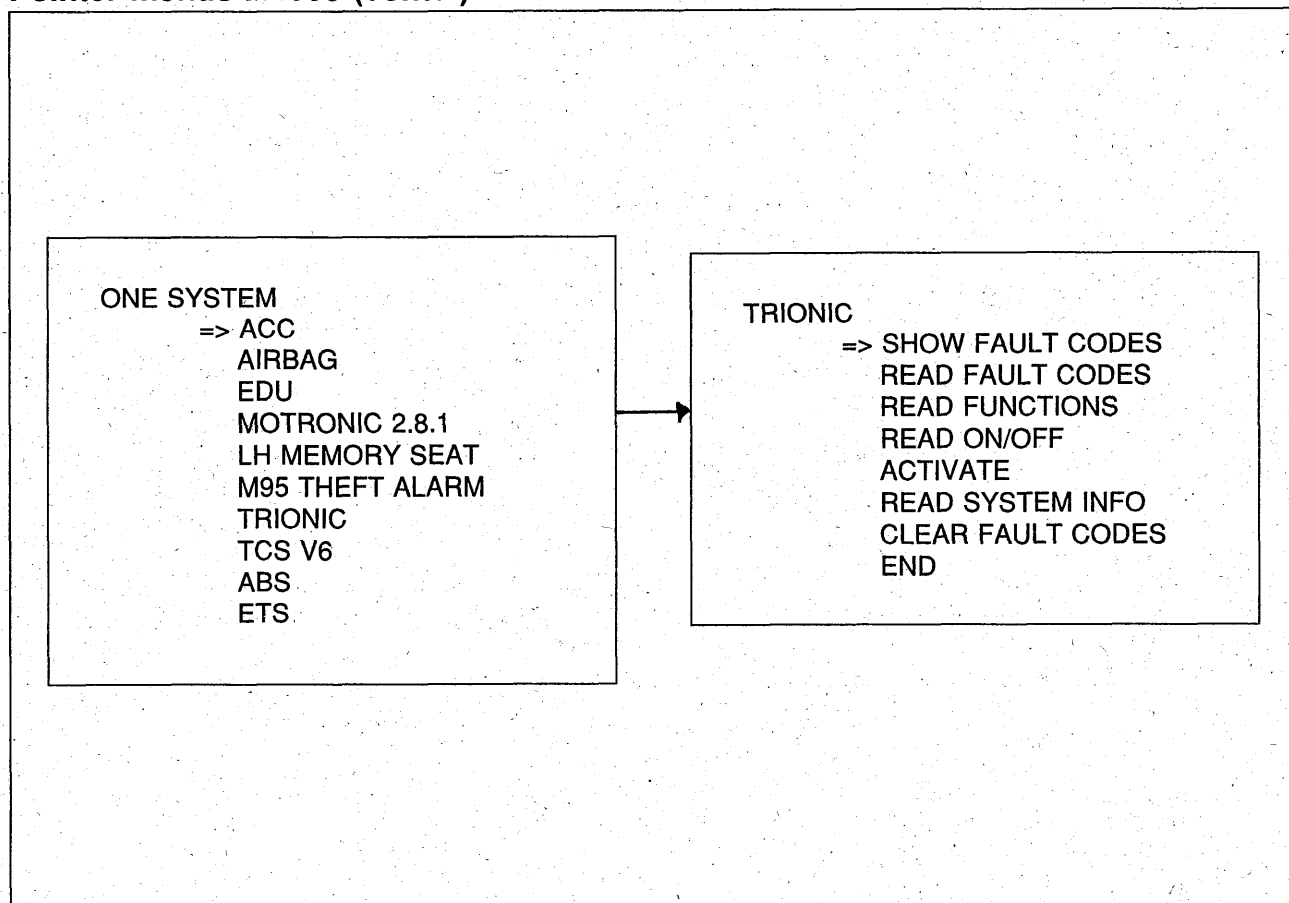
The scan tool establishes contact with all electrical subsystems with ISAT diagnostics which are specified for 9000 M95-. Relevant subsystems are presented under ONE SYSTEM. The actual subsystems in the car respond with system name and number of faults. Subsystems that are not fitted in that particular car do not, of course, respond. The result is a list of those systems that are fitted to the particular car, together with the number of diagnostic trouble codes in each system.

E.g.

ALL SYSTEMS	
=> ACC	0 FAULT
AIRBAG	0 FAULT
EDU	1 FAULT
MOTRONIC 2.8.1	1 FAULT
LH MEMORY SEAT	1 FAULT
M95 THEFT ALARM	0 FAULT
TRIONIC	1 FAULT
TCS V6	2 FAULT
ABS	2 FAULT
ETS	0 FAULT

ISAT scan tool menu structure (contd.)

Pointer menus M1995 (contd.)



ONE SYSTEM

In this pointer menu, all subsystems in production are presented. Any subsystem can be selected using the cursor, by moving up and down the display with the F3 and F4 buttons. The selected subsystem is activated using ON/ENTER, but only those systems fitted in the actual car respond. The sub-menu for ONE SYSTEM is now displayed. A typical example, AUT TRANSMISSION is illustrated. In this sub-menu, it is possible to use the cursor to diagnose the selected subsystem by reading and zeroing diagnostic trouble codes, reading inputs and outputs, input and output signals, internal control module functions and system information. Further breakdown of the menu structure is described in the appropriate Service Manual.

SHOW FAULT CODES

Diagnostic trouble codes that were registered when ALL SYSTEMS was activated can be displayed. One fault is shown per display and these are selected using the F3 and F4 keys.

CLEAR

All diagnostic trouble codes that were registered when ALL SYSTEMS was activated are zeroed.

PRINT FAULT CODES

The diagnostic trouble codes that were displayed under SHOW FAULT CODES can be printed out.

SAVE FAULT CODES

Diagnostic trouble codes presented under SHOW FAULT CODES can be stored in the scan tool's internal memory.

RECALL FAULT CODES

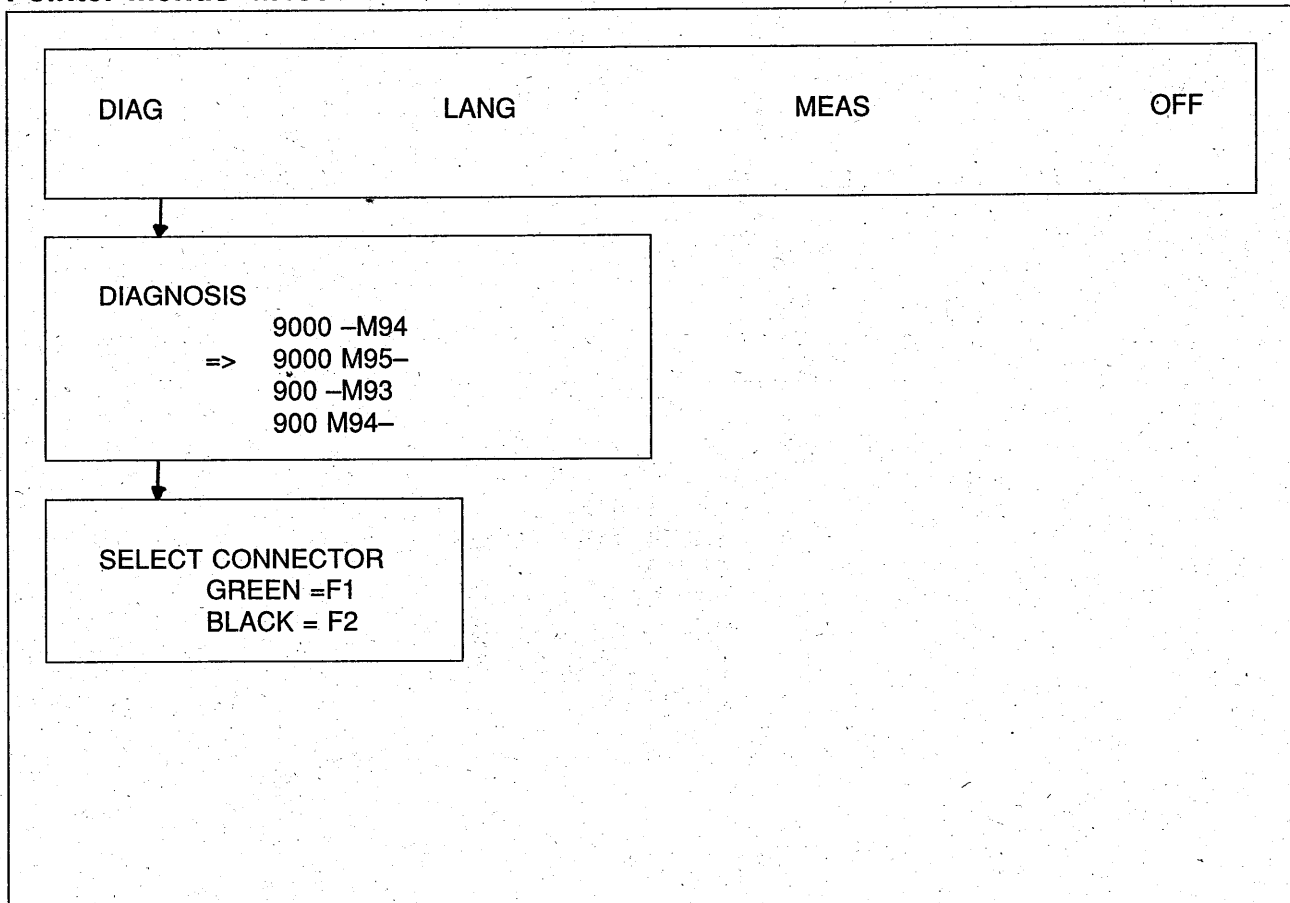
Diagnostic trouble codes stored in the scan tool's internal memory are displayed again.

CLEAR ISAT

Scan tool internal memory is zeroed.

ISAT scan tool menu structure (contd.)

Pointer menus -M1994



The scan tool is switched on with the ON/ENTER button and then shows the main menu DIAG, LANG, MEAS, OFF.

If F1 is selected, the sub-menu (pointer menu) to DIAG (DIAGNOSIS) is displayed. In this menu, the desired car is selected from 9000-M94, 9000 M95-, 900-M93 or 900 M94-. Selection is made using a cursor that can be moved up or down the display with the F3 and F4 keys.

Using the F4 key, 9000 -M94 is selected and activated with ON/ENTER. The sub-menu to DIAGNOSIS, 9000-M94 is now displayed. This menu is used to select data link connector, green or black. The menus displayed are

```

SELECT CONNECTOR
GREEN = F1
BLACK = F2
  
```

F1 or F2 is selected, depending on whether the engine or car electronics are to be contacted.

Selection of F2 allows communication with

- TRIONIC
- LH MFI
- DI-APC
- ETS

Selection of F1 allows communication with

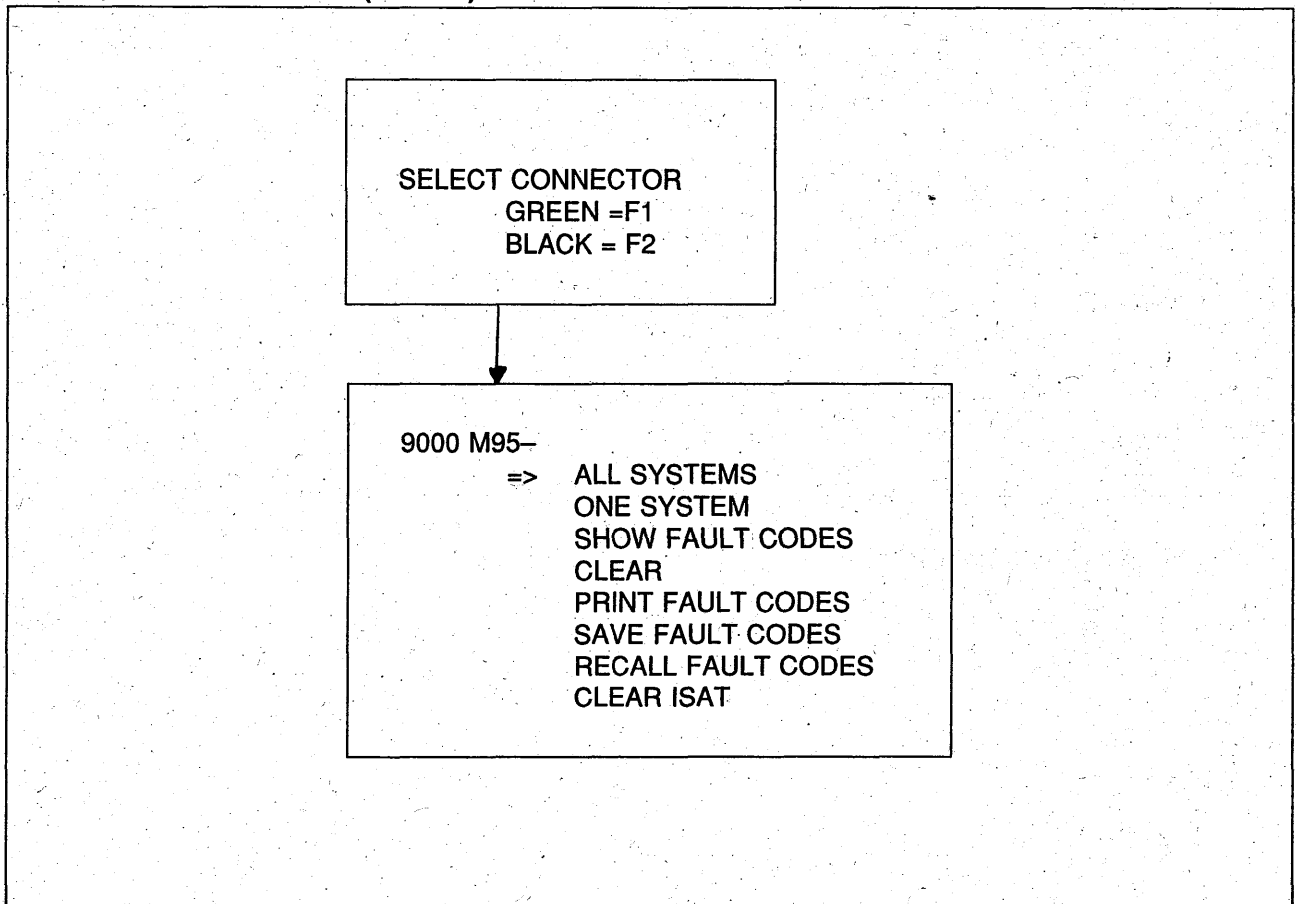
- AIRBAG
- EDU
- ACC
- ABS
- LH MEMORY SEAT
- RH MEMORY SEAT

Important

The diagnosis cable must be connected to the selected data link connector.

ISAT scan tool menu structure (contd.)

Pointer menus -M1994 (contd.)

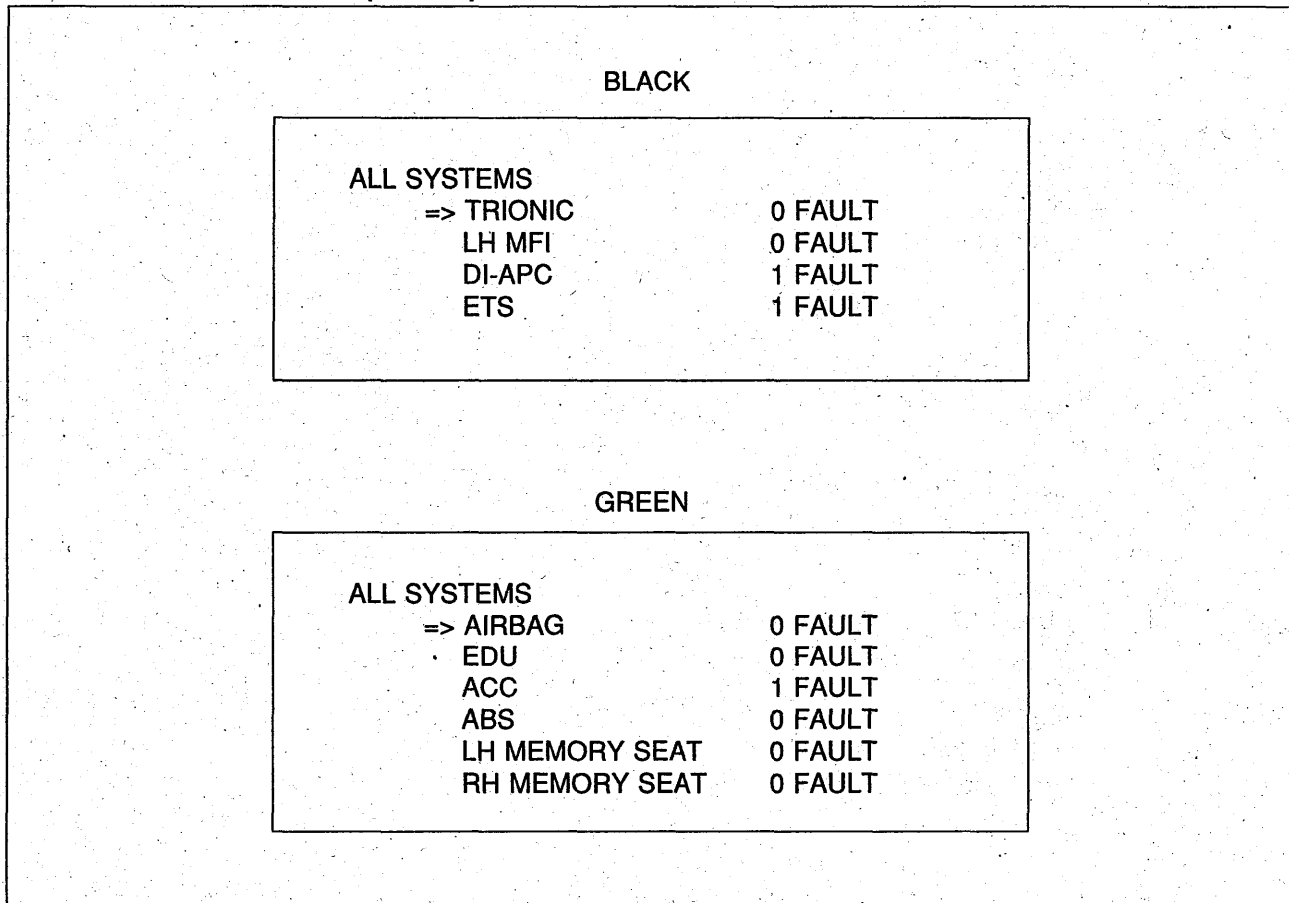


After selection with F1 or F2 and activation with ON/ENTER, the actual sub-menu to DIAGNOSIS is displayed. The following commands and associated functions are to be found in this menu:

- ALL SYSTEMS
- ONE SYSTEM
- SHOW FAULT CODES
- CLEAR
- PRINT FAULT CODES
- SAVE FAULT CODES
- RECALL FAULT CODES
- CLEAR ISAT

ISAT scan tool menu structure (contd.)

Pointer menus -M1994 (contd.)



ALL SYSTEMS

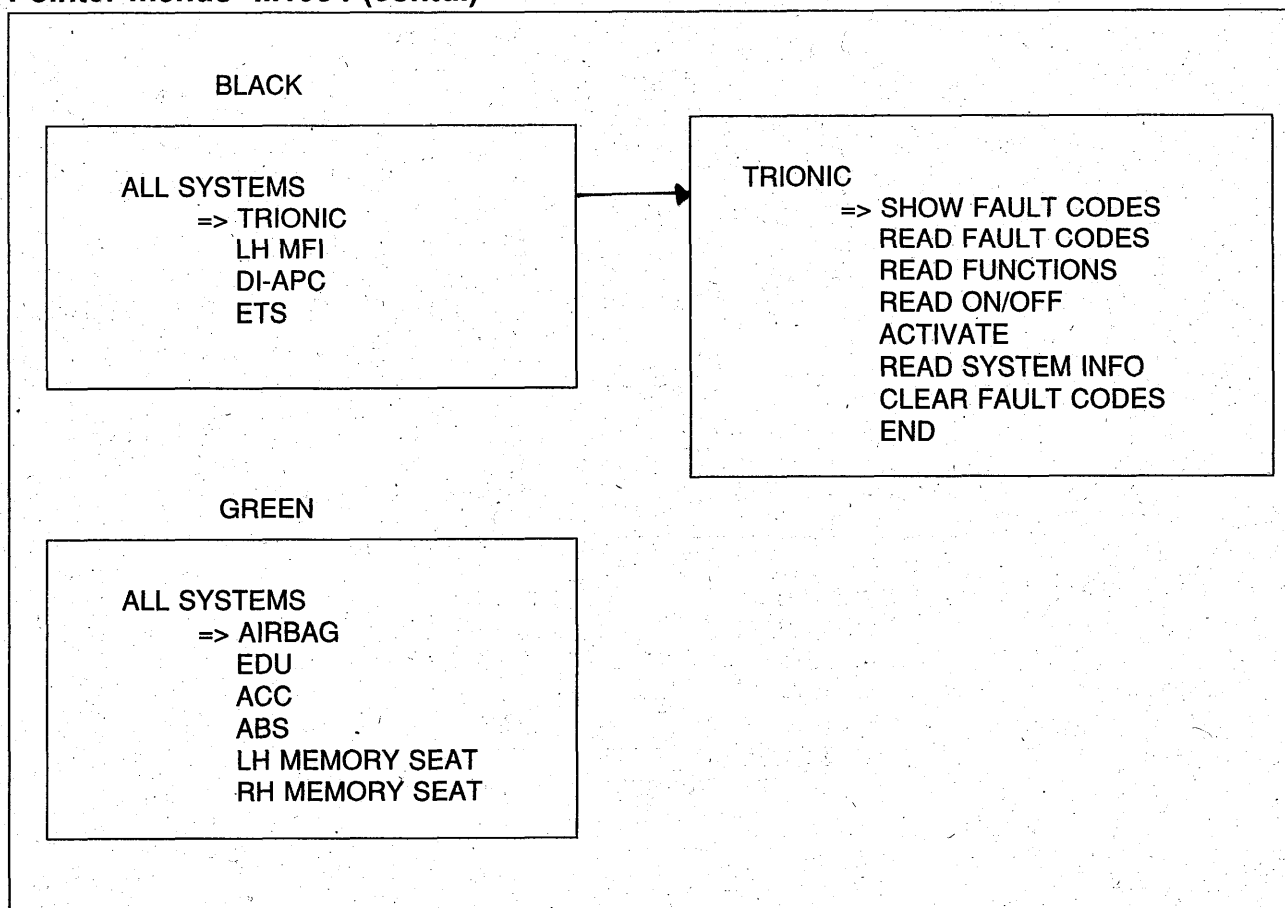
The scan tool makes contact with all electrical sub-systems with ISAT diagnosis specified for 9000 -M94 in the activated data link connector, green or black. The actual subsystems in the car respond with system name and number of faults. Sub-systems that are not fitted in the car in question do not, of course, respond. The result is a list of systems fitted in the particular car, together with the number of faults in each system.

E.g.

BLACK	GREEN
ALL SYSTEMS	ALL SYSTEMS
=> TRIONIC	=> AIRBAG
LH MFI	EDU
DI-APC	ACC
ETS	ABS
0 FAULT	0 FAULT
0 FAULT	0 FAULT
1 FAULT	1 FAULT
1 FAULT	LH MEMORY SEAT
	RH MEMORY SEAT
	0 FAULT
	0 FAULT

ISAT scan tool menu structure (contd.)

Pointer menus -M1994 (contd.)



ONE SYSTEM

In this pointer menu, all subsystems in production within the selected data link connector (green or black) are presented. Any subsystem can be selected using the cursor, by moving up and down the display with the F3 and F4 keys. The selected subsystem is activated using ON/ENTER, but only those systems fitted in the actual car respond. The sub-menu for ONE SYSTEM is now displayed. A typical example, TRIONIC is illustrated. In this sub-menu, it is possible to use the cursor to diagnose the selected subsystem by reading an zeroing diagnostic trouble codes, reading inputs and outputs, input and output signals, internal control module functions and system information. Moreover, output signals and outputs can be activated. Further breakdown of the menu structure is described in the appropriate Service Manual.

SHOW FAULT CODES

Diagnostic trouble codes that were registered when ALL SYSTEMS was activated can be displayed. One fault is shown per display and these are selected using the F3 and F4 keys.

CLEAR

All diagnostic trouble codes that were registered when ALL SYSTEMS was activated are zeroed.

PRINT FAULT CODES

The diagnostic trouble codes that were displayed under SHOW FAULT CODES can be printed out.

SAVE FAULT CODES

Diagnostic trouble codes presented under SHOW FAULT CODES can be stored in the scan tool's internal memory.

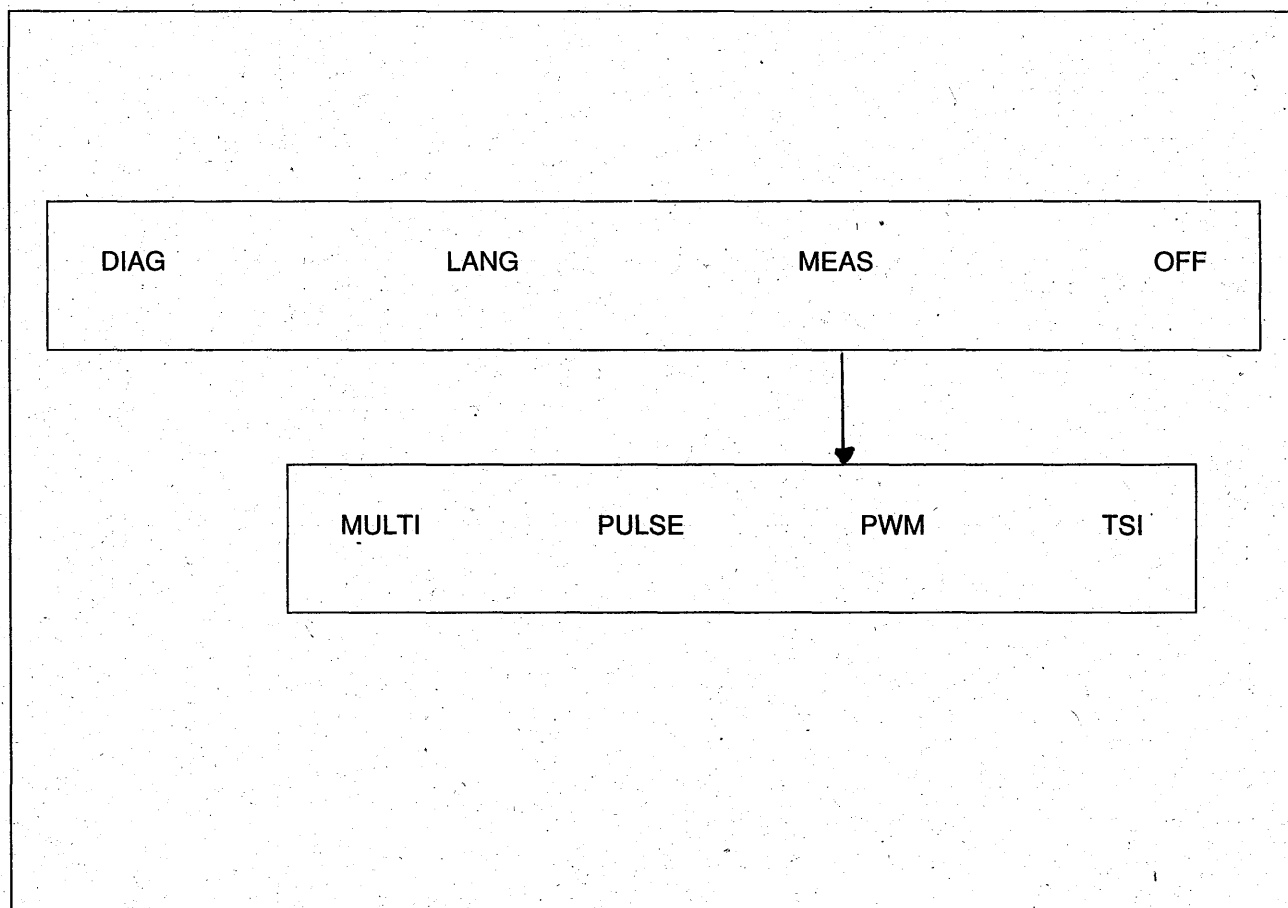
RECALL FAULT CODES

Diagnostic trouble codes stored in the scan tool's internal memory are displayed again.

CLEAR ISAT

Scan tool internal memory is zeroed.

Scan tool multimeter features

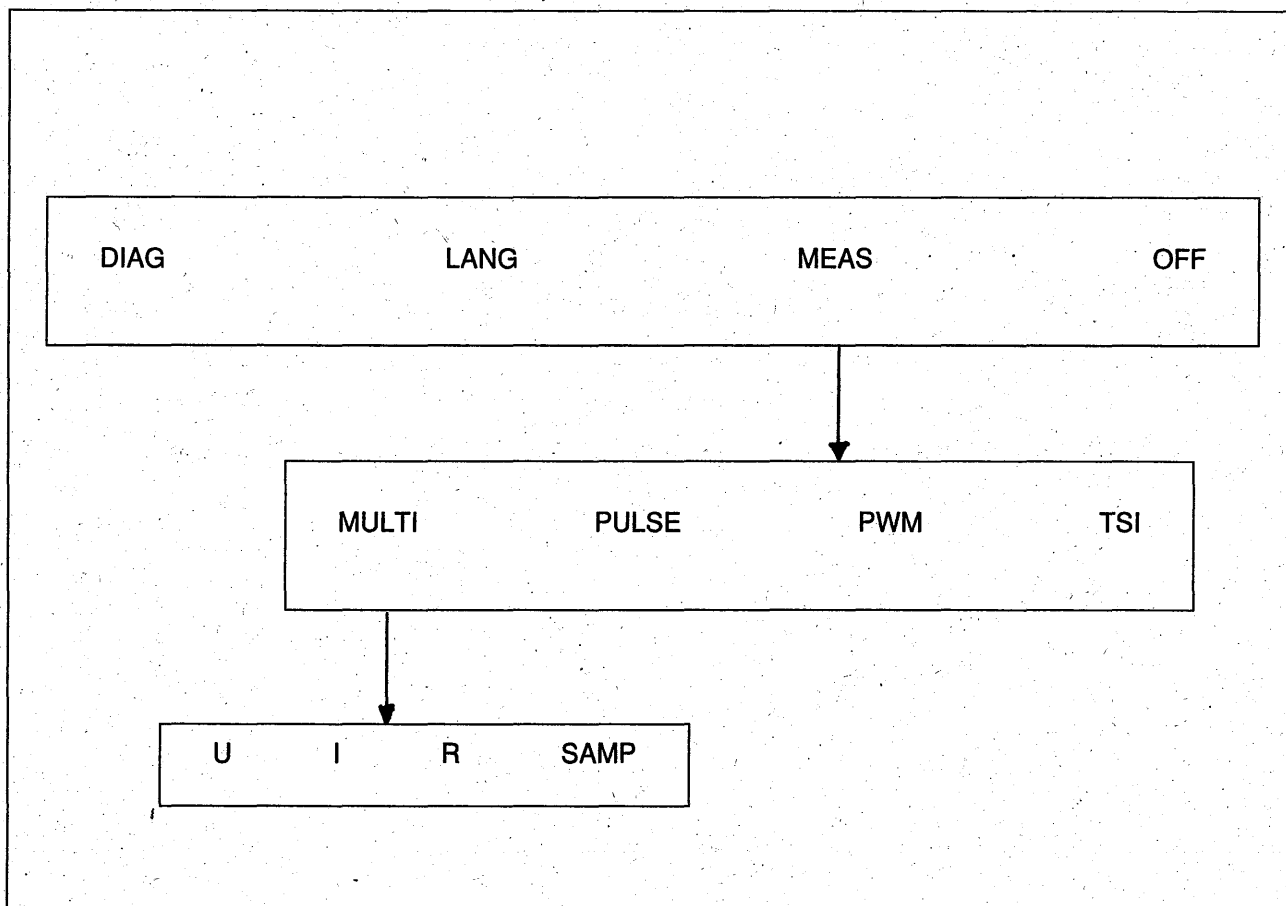


The following measuring features are available under the scan tool menu MEAS

- MULTI - multimeter functions (voltage, current, resistance including sampling)
- PULSE - pulse/frequency measurement
- PWM - pulse/pulse ratio measurement
- TSI - measurement of timing, camshaft angle, rpm, pulse ratio and closed loop function. The TSI module must be connected and SDA II must be unplugged. Function is described in Service Manual 1:4 "ISAT scan tool".

Scan tool multimeter functions (contd.)

MULTI



Test feature MULTI makes it possible to measure voltage, current and resistance.

Test connection for voltage and resistance measurement is made on the multimeter input black and red sockets (on SDA II) and for current measurement to the multimeter's black and white outputs (on SDA II). The instrument automatically selects the correct test range (auto-ranging) irrespective of the size of the measurement.

Available ranges are

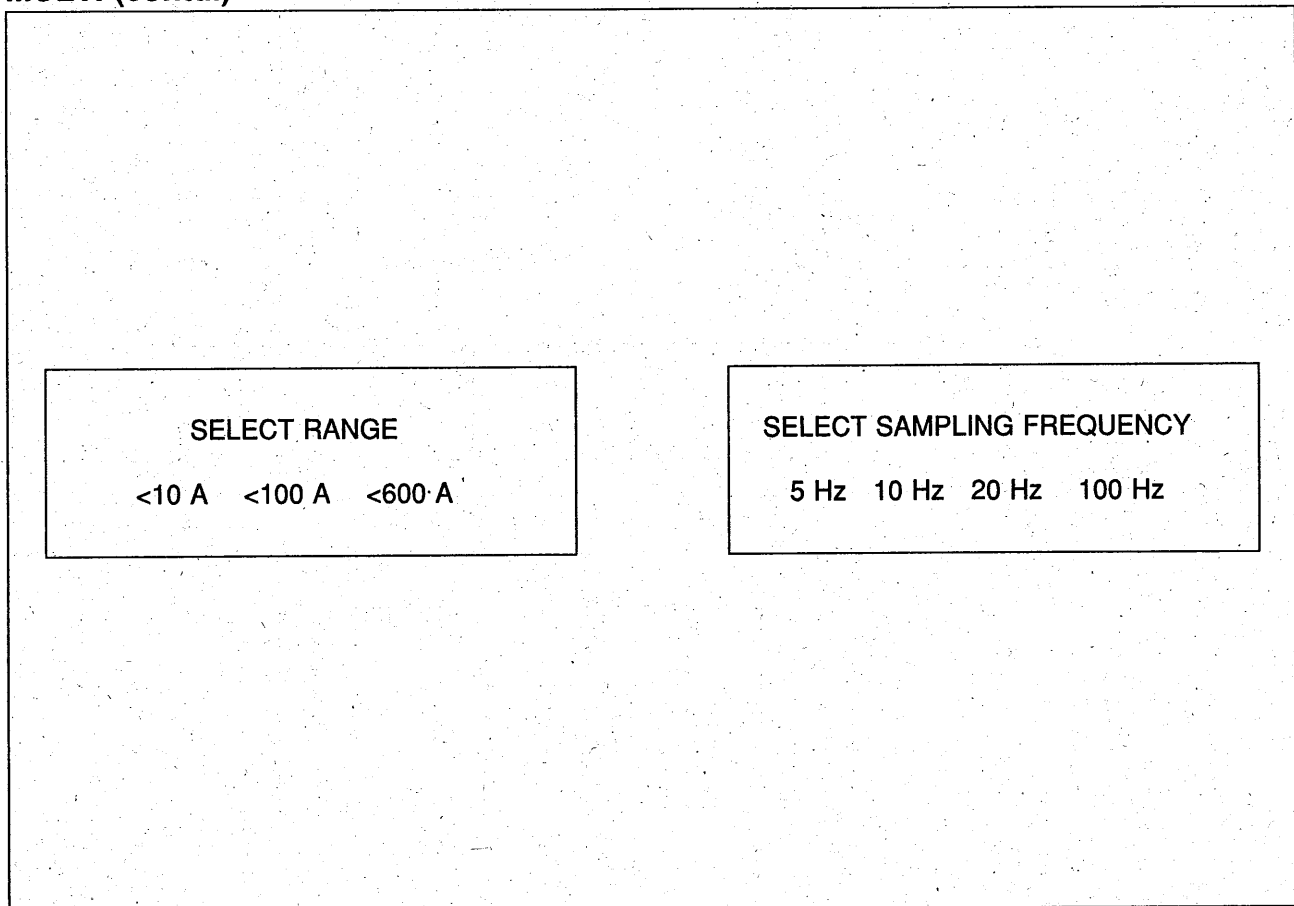
- Voltage 0 ± 126 V DC
- Current 0 ± 10 A (with inductive current probe, up to 600 A)
- Resistance 0 - 256 kOhm

Important

When the scan tool is used as a multimeter and is not connected to the car's data link connector, the integrated battery is used as the power source. Measuring low resistances means high power consumption and a corresponding drain on the battery. For this reason, avoid this type of measurement if the scan tool is not connected to the car's data link connector. The scan tool display requires a great deal of power that will eventually drain the battery. Avoid leaving the scan tool switched on as this reduces the quality of the multimeter feature. However, there is an inbuilt switch-off feature that automatically switches off the scan tool about 8 minutes after a key was last pressed.

Scan tool multimeter functions (contd.)

MULTI (contd.)



The following sub-menu is used when measuring current

SELECT RANGE
<10 A <100 A <600 A

Depending on the magnitude of the current, the following ranges are selected

F1 = 0-10 A
F2 = 10-100 A
F3 = 100-600 A

When measuring current strengths greater than 10 A, use inductive current probe 86 10 743. Test connection of the probe is made to the multimeter inputs black and red sockets (on SDA II). The required range is selected on the inductive current probe.

Important

Measurement of currents over 10 A may not last for more than 30 seconds.

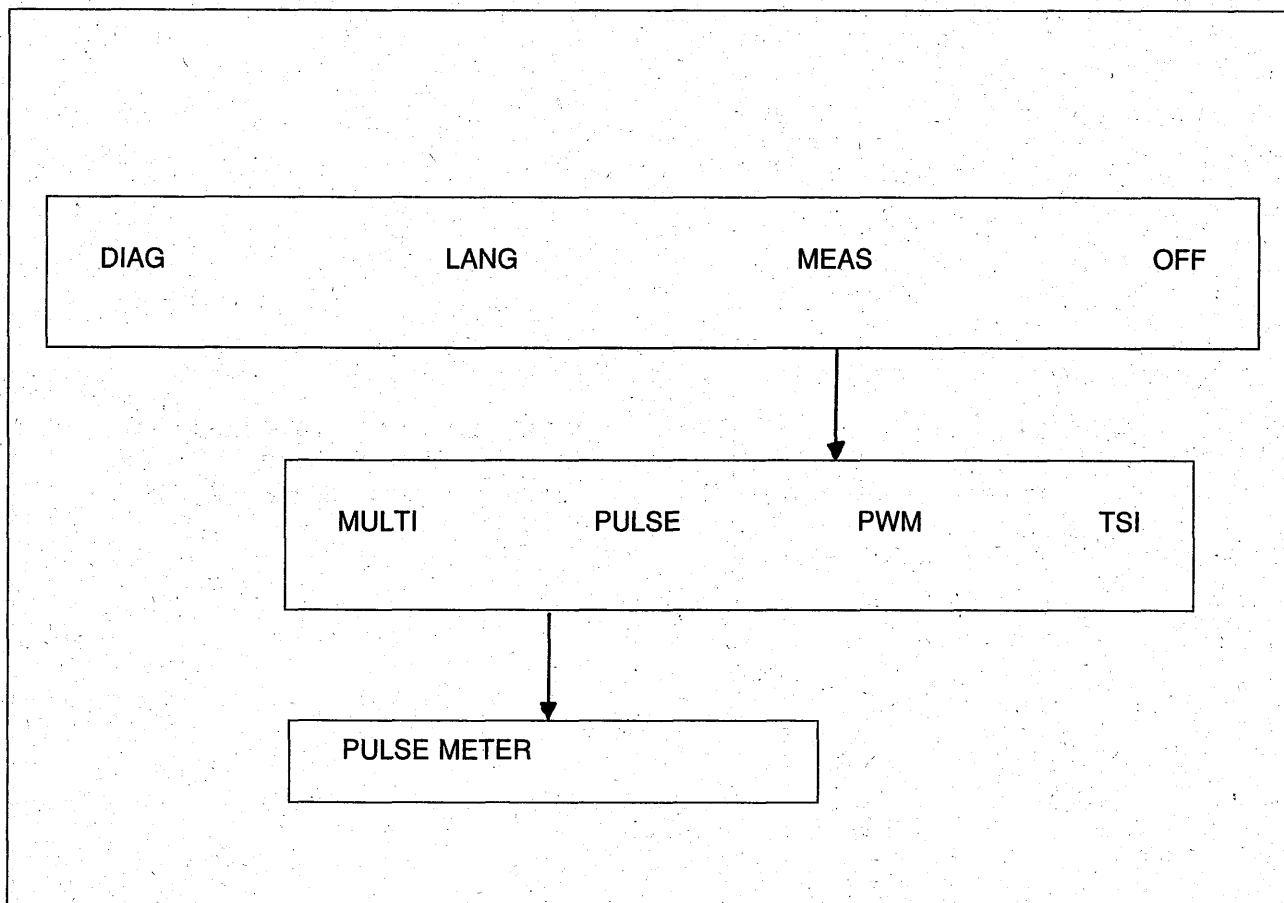
The multimeter feature also has the command SAMP. If this is selected, the selected range is sampled. This means that the scan tool regularly measures the instantaneous value 1000 times. The result is presented as minimum, average and maximum values. SAMP has the sub-menu

SAELECT SAMPLING FREQUENCY
5 Hz 10 Hz 20 Hz 100 Hz

Press function key F1 to F4 to select sampling frequency.

Scan tool multimeter functions (contd.)

PULSE



The PULSE test feature makes it possible to measure the pulse width and frequency of a signal. Test connection is made to the multimeter input on the black and red sockets (on SDA II). As an example, the scan tool display may show for injector pulses for MOTRONIC/ TRIONIC when idling

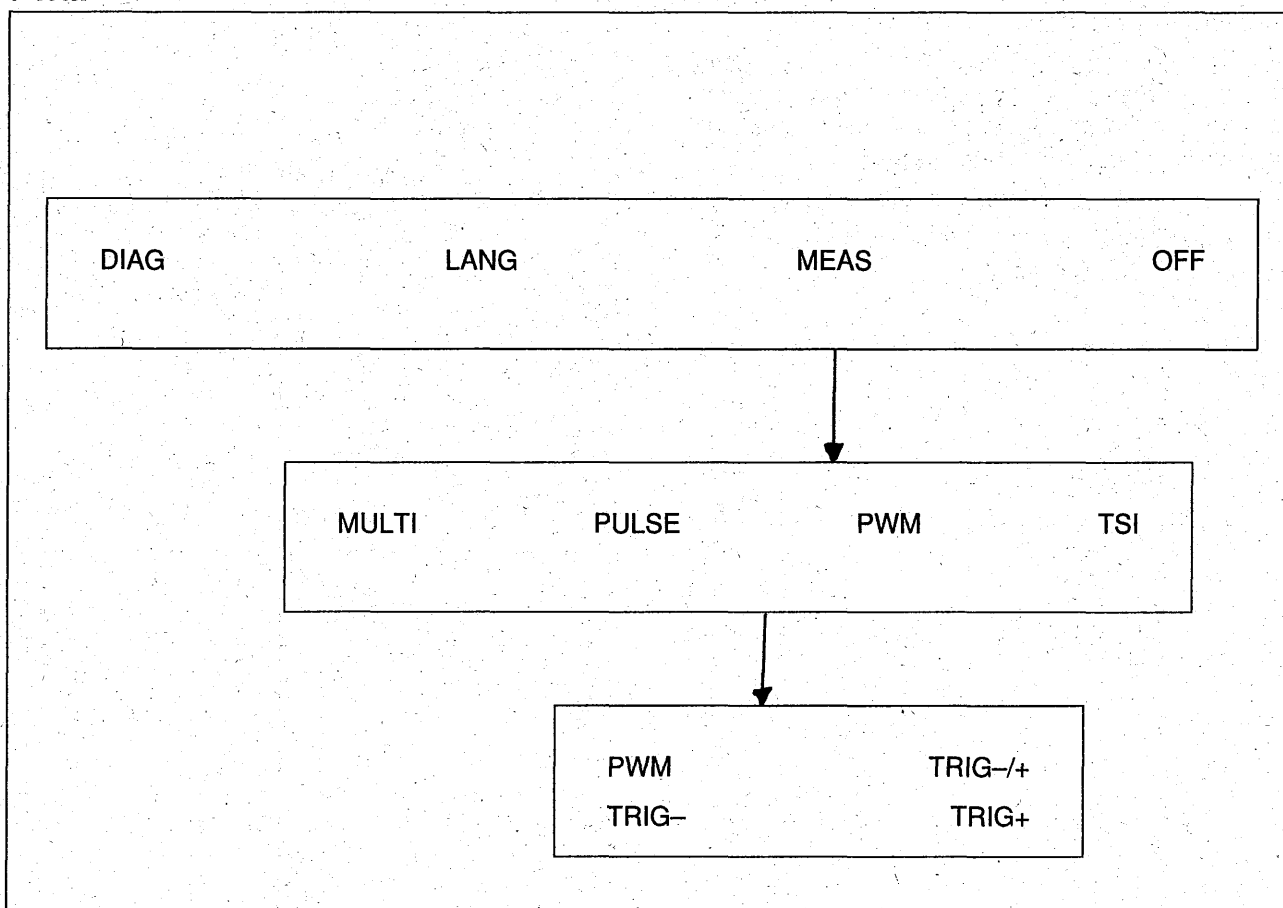
PULSE METER
 WIDTH 21 ms
 FREQ. 7.1 Hz

The display shows for example for throttle position from MOTRONIC at idling

PULSE METER
 WIDTH 0.9 ms
 FREQ. 100 Hz

Scan tool multimeter functions (contd.)

PWM



The PWM (Pulse Width Modulation) makes it possible to measure the characteristic data of an information-carrying signal. This information is contained in the signal's pulse ratio (duty cycle) or pulse width rather than its frequency.

Test connection is made to the multimeter's black and red sockets (on SDA II).

If PWM is selected, TRIG- is automatic. Using the F2 and F1 keys, TRIG+ and TRIG- can be selected.

TRIG- is used for negative signals.

When unactivated, the signal is equal to BPV, and when it is activated, it drops to 0 volts for a certain time (pulse width) and at a certain frequency. The display may for example show for injector pulses for MOTRONIC/TRIONIC at idling

```

PWM TRIG -
DUTY CYCLE 6%
WIDTH 2.1ms
TRIG- TRIG+
  
```

TRIG+ is used for positive signals.

When unactivated, the signal is equivalent to 0 volts, and when activated, it rises to BPV for a certain time (pulse width) and at a certain frequency. The display shows, for example, for throttle position from MOTRONIC at idling

```

PWM TRIG +
DUTY CYCLE 9%
WIDTH 0.9ms
TRIG- TRIG+
  
```

If signal frequency is also required, the PULSE feature is used.

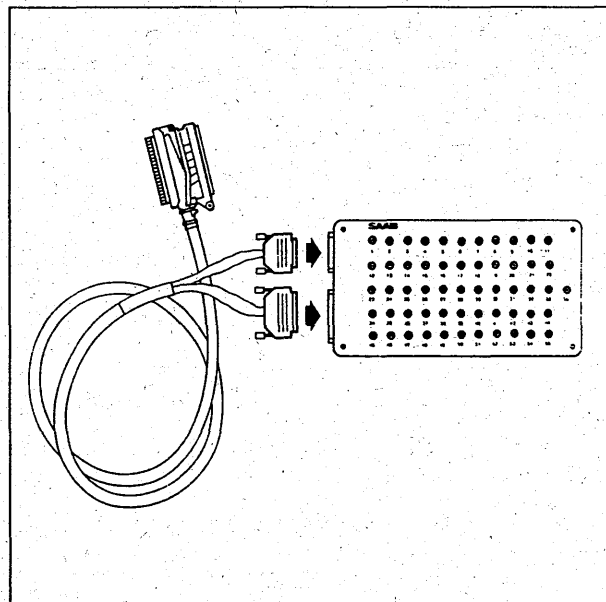
Breakout box (BOB)

The breakout box (BOB), part No. 86 11 006, is used in certain systems to facilitate control module test when diagnosing faults.

The breakout box is connected between connector and control module using a special test lead which switches the test points out to numbered sockets on the breakout box to facilitate reading.

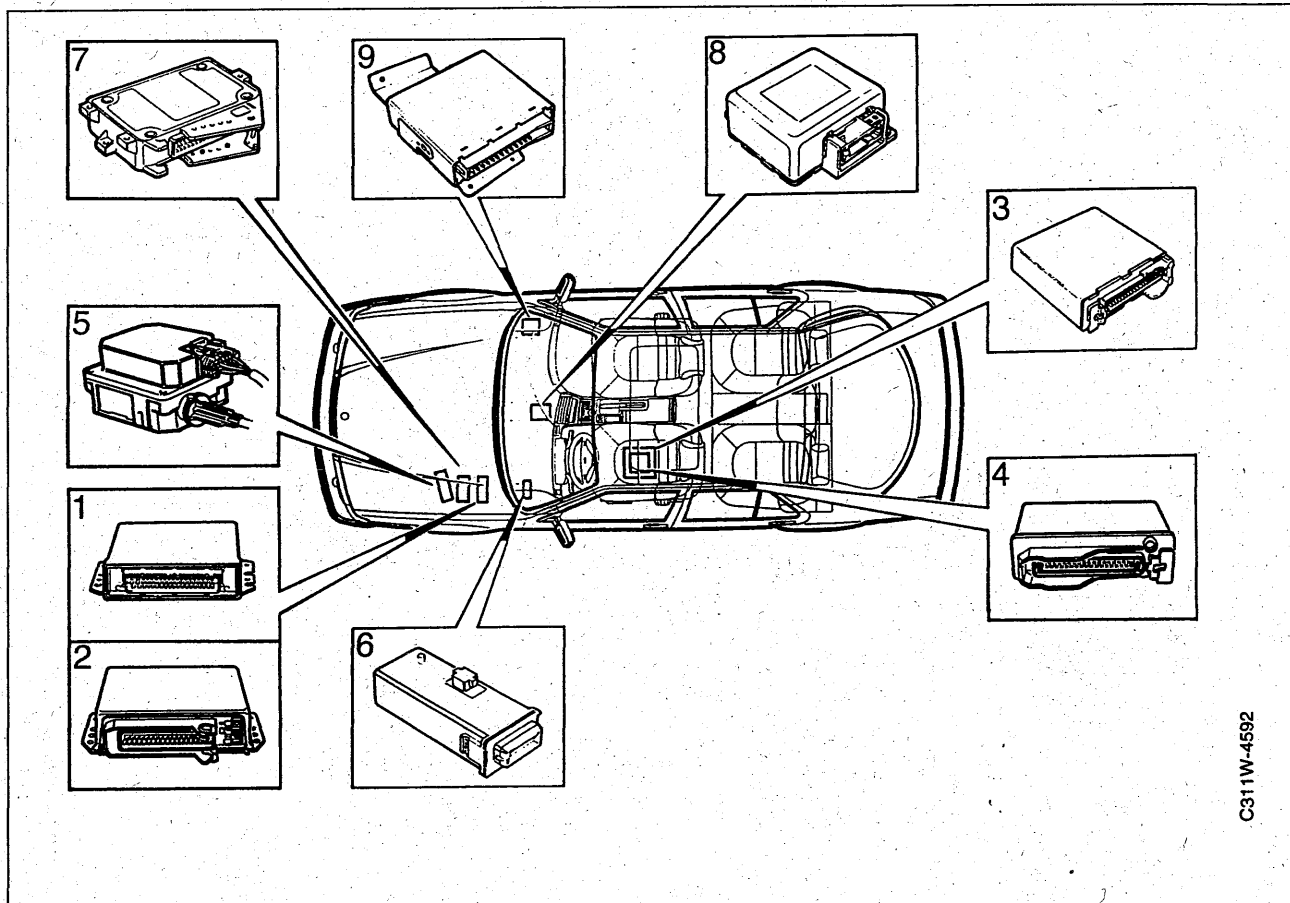
Each individual system has a special test lead.

For further information about test leads, see Service Manual 1:3 "Special tools".



Location of control modules

M1995



C311W-4592

Engine management system

- 1 **TRIONIC**
- 2 **MOTRONIC**
The control modules are located on a bracket in the false bulkhead. The bracket is mounted on the left-hand side of the front upper bulkhead partition.
- 3 **ETS**
- 4 **TTS**
The control modules are located on a bracket under the left-hand front seat.

Comfort systems

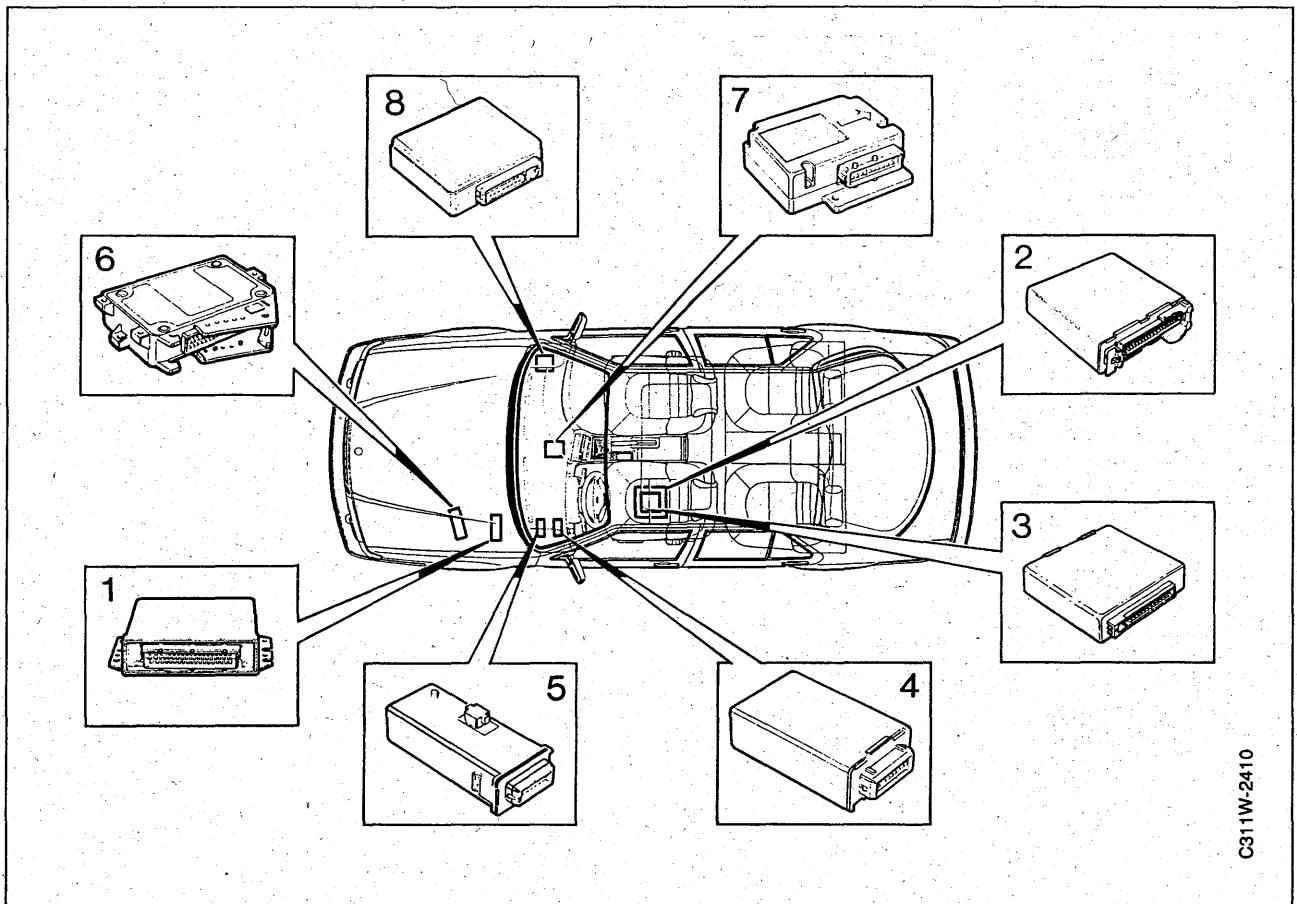
- 5 **Cruise control**
The control module is located beside the battery tray.
- 6 **Central locking system**
The control module is located on a bracket on the far left-hand side under the fascia.

Safety systems

- 7 **ABS or TC/ABS**
The ABS or TC/ABS control module is fitted on the battery tray.
- 8 **SRS (Airbag)**
The SRS control module (airbag and belt tensioner) are located on a bracket in the front part of the center console under the fascia.
- 9 **Theft Alarm**
The control module is located behind the glove compartment and knee shield on the right-hand side behind the fascia.

Location of control modules (contd.)

M1994



C311W-2410

Engine management system

1 TRIONIC

The control module is located on a bracket in the bulkhead partition space. The bracket is fitted to the left-hand side of the upper front bulkhead partition.

2 ETS

3 ASR

The ETS throttle control module is located on a bracket under the left-hand front seat. On cars with traction control for cars with automatic transmission, there is also an ASR control module fitted on top of the ETS throttle control module.

Comfort systems

4 Cruise control

5 Central locking system

The control modules are located on a bracket to the left-hand side under the fascia.

Safety systems

6 ABS or TC/ABS

The ABS or TC/ABS control module is fitted on the battery tray.

7 Airbag

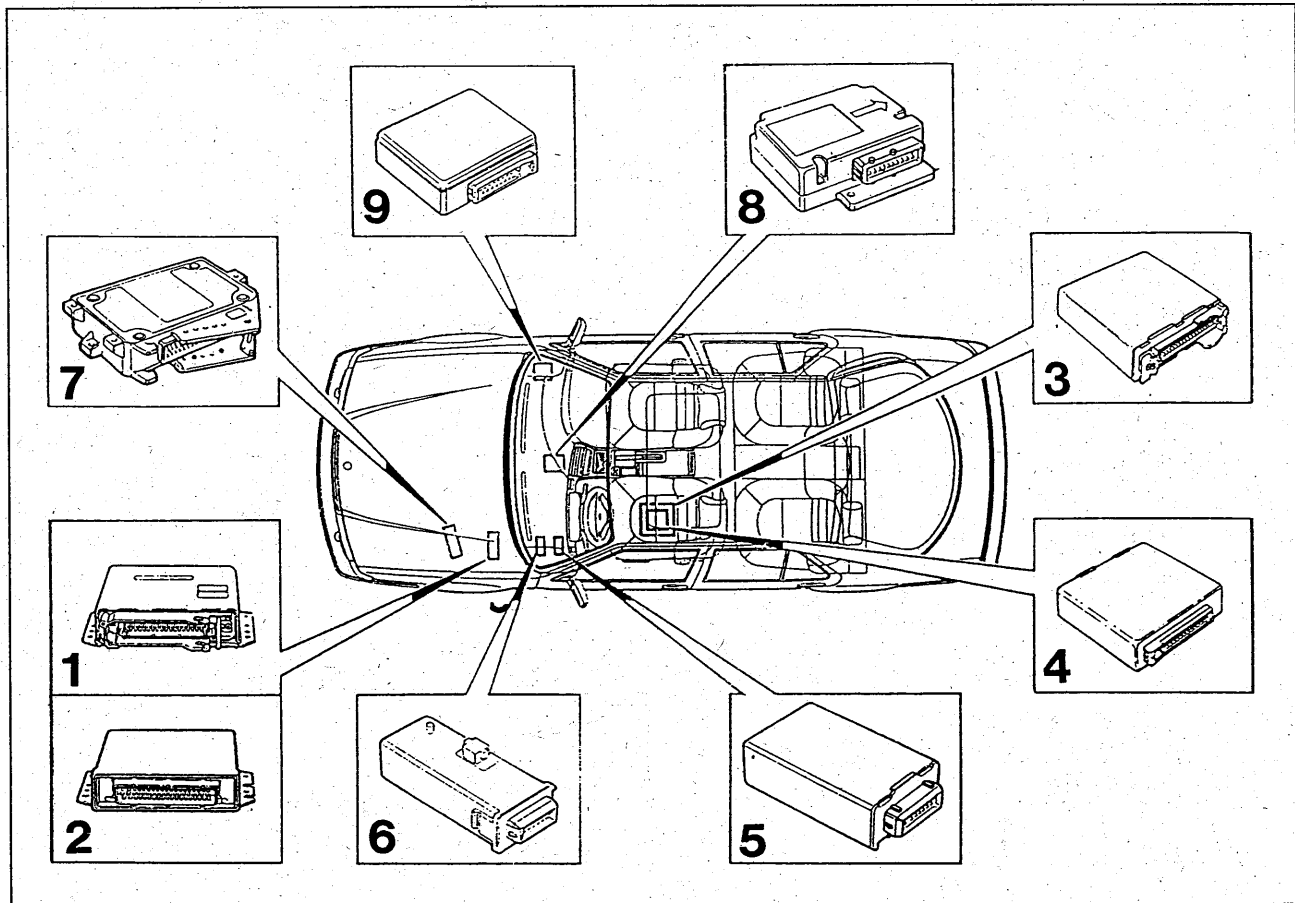
The airbag control module is located on a bracket in the front part of the center console under the fascia and also controls the belt tensioners.

8 Theft Alarm

The theft alarm control module is located behind the glove compartment and knee shield on the right-hand side behind the fascia.

Location of control modules (contd.)

M1993



Engine management system

- 1 **LH MFI and Electronic Ignition (EZK)**
- 2 **TRIONIC**
The LH MFI and Electronic Ignition or TRIONIC control modules (or EZK) are located on a bracket in the bulkhead partition space. The bracket is located on the left-hand side of the upper front bulkhead partition.
- 3 **ETS**
- 4 **ASR**
The ETS throttle control module is located on a bracket under the left-hand front seat. On cars with traction control for cars with automatic transmission, there is also an ASR control module fitted on top of the ETS throttle control module.

Comfort systems

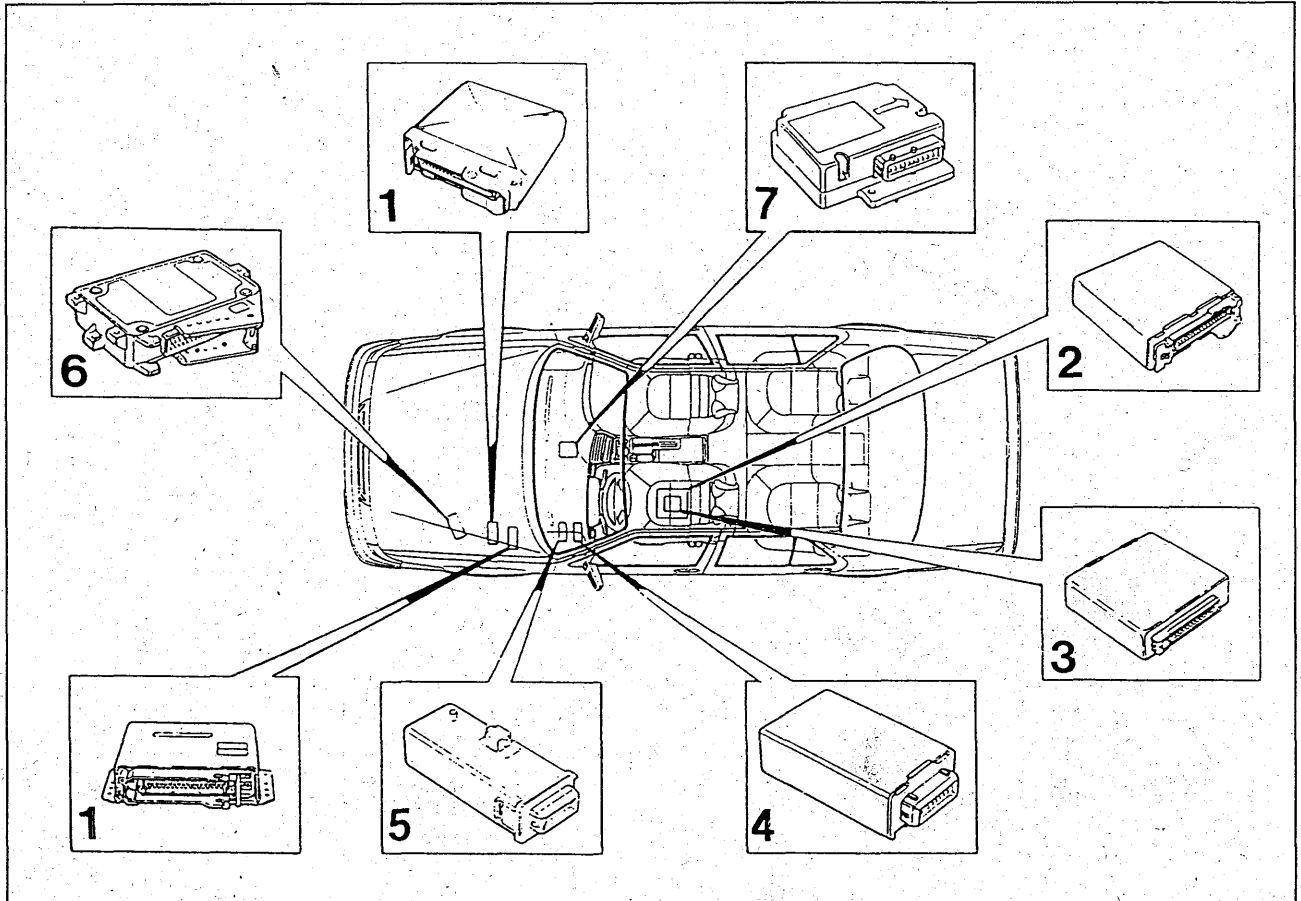
- 5 **Cruise control**
- 6 **Central locking system**
Cruise control and central locking control modules are mounted on a bracket on the far left under the fascia.

Safety systems

- 7 **ABS or TC/ABS**
The ABS or TC/ABS control module is mounted on the battery tray.
- 8 **Airbag and belt tensioner**
The airbag and belt tensioner control modules are located on a bracket in the front part of the center console under the fascia.
- 9 **Theft Alarm**
The theft alarm control module is placed behind the glove compartment and knee shield on the right-hand side in the cabin.

Location of control modules (contd.)

M1992



Engine management system

1 LH MFI, DI and DI/APC Electronic Ignition (EZK)

The control modules for LH MFI, DI and DI/APC Electronic Ignition (or alternatively EZK) are located on a bracket in the bulkhead partition space. The bracket is mounted on the left-hand side of the upper front bulkhead partition.

2 ETS

3 ASR

The ETS throttle control module is located on a bracket under the left-hand front seat. On cars with traction control for cars with automatic transmission, there is also an ASR control module fitted on top of the ETS throttle control module.

Comfort systems

4 Cruise control

5 Central locking system

Cruise control and central locking control modules are mounted on a bracket on the far left under the fascia.

Safety systems

6 ABS or TC/ABS

The ABS or TC/ABS control module is mounted on the battery tray.

7 Airbag and belt tensioner

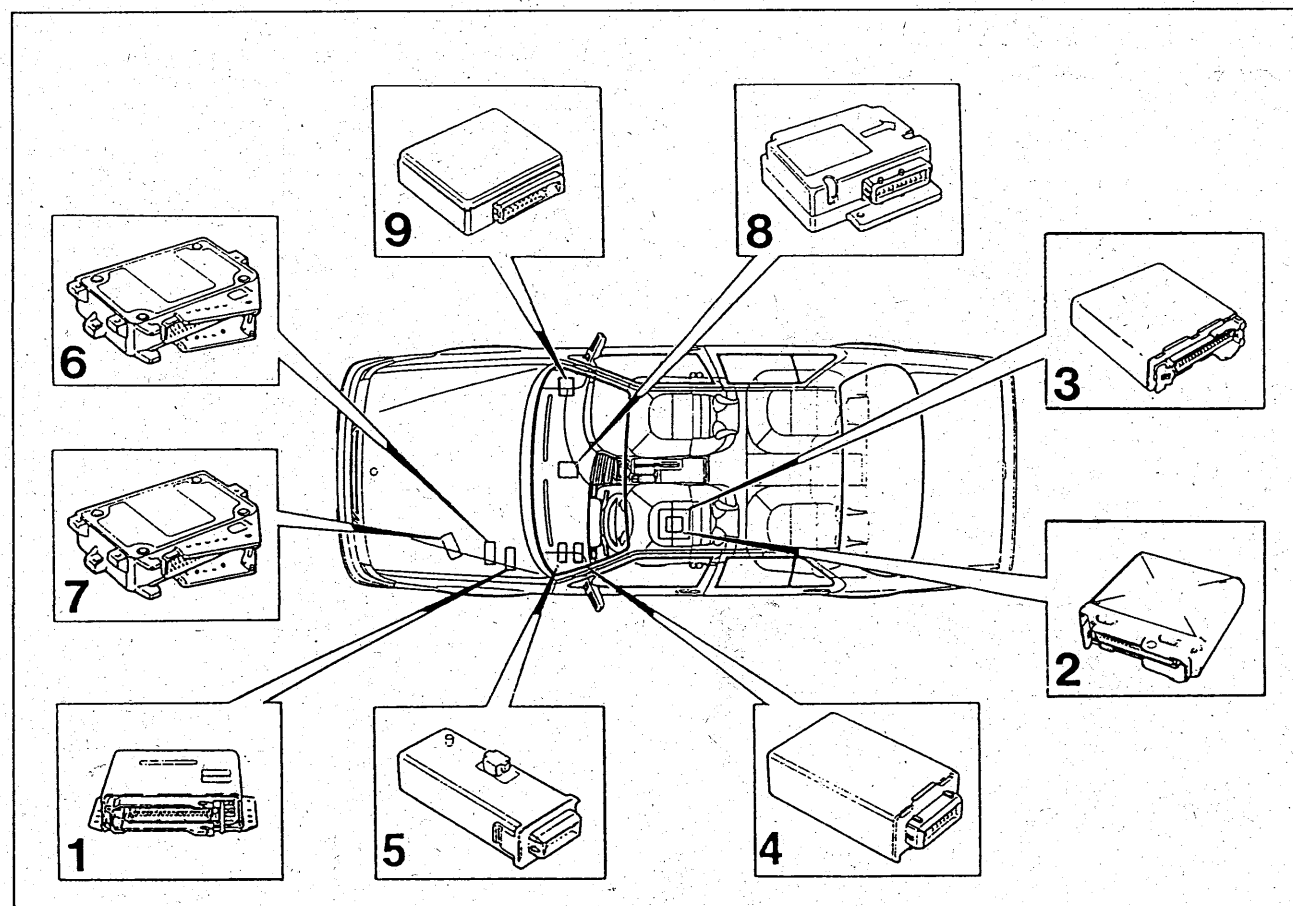
The airbag and belt tensioner control modules are located on a bracket in the front part of the center console under the fascia.

8 Theft Alarm

The theft alarm control module is placed behind the glove compartment and knee shield on the right-hand side in the cabin.

Location of control modules (contd.)

M1991



Engine management system

1 LH MFI

The LH MFI control module is located on a bracket in the bulkhead partition space. The bracket is mounted on the left-hand side of the upper front bulkhead partition.

2 DI-DI/APC Electronic Ignition (EZK)

The DI-DI/APC Electronic Ignition (or EZK) control module is located under the left-hand front seat next to the Throttle control module.

3 ETS

The ETS throttle control module is located on a bracket under the left-hand front seat.

Comfort systems

4 Cruise control

5 Central locking system

Cruise control and central locking control modules are mounted on a bracket on the far left under the facia.

Safety systems

6 ABS

The ABS control module is located on a bracket in the bulkhead partition space.

7 TC/ABS

The TC/ABS control module is mounted on the battery tray.

8 Airbag and belt tensioner

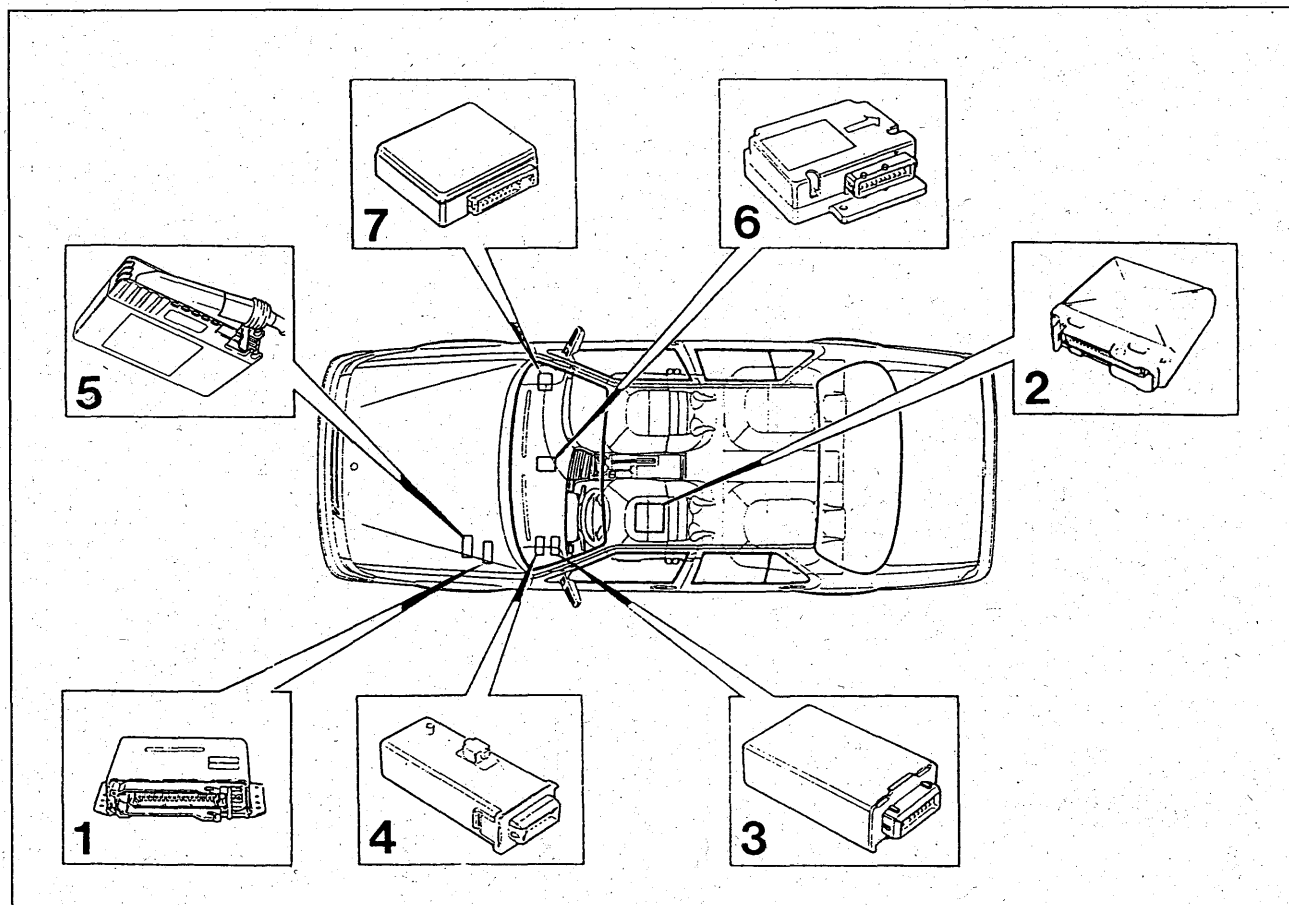
The airbag and belt tensioner control modules are located on a bracket in the front part of the center console under the facia.

9 Theft Alarm

The theft alarm control module is placed behind the glove compartment and knee shield on the right-hand side in the cabin.

Location of control modules (contd.)

M1990



Engine management system

1 LH MFI

The control module is located on a bracket in the bulkhead partition space. The bracket is fitted to the left-hand side of the upper front bulkhead partition.

2 DI-DI/APC ELECTRONIC IGNITION (EZK)

The DI-DI/APC Electronic Ignition (or EZK) control module is located on a bracket under the left-hand front seat.

Comfort systems

3 Cruise control

4 Central locking system

Cruise control and central locking control modules are mounted on a bracket on the far left under the dash.

Safety systems

5 ABS

The ABS control module is located on a bracket in the bulkhead partition space.

6 Airbag and belt tensioner

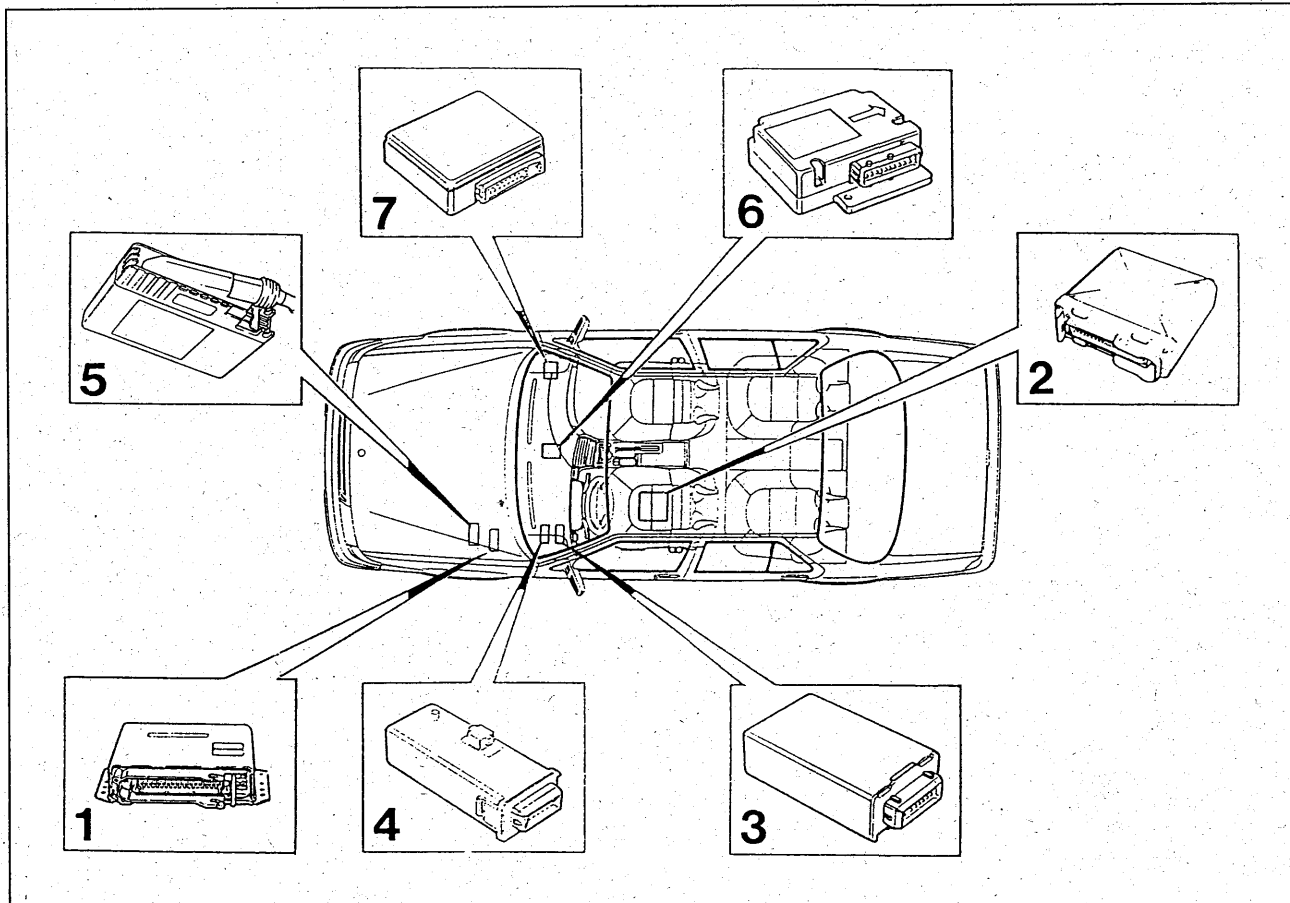
The airbag and belt tensioner control modules are located on a bracket in the front part of the center console under the dash.

7 Theft Alarm

The theft alarm control module is placed behind the glove compartment and knee shield on the right-hand side in the cabin.

Location of control modules (contd.)

M1989



Engine management system

1 LH MFI

The control module is located on a bracket in the bulkhead partition space. The bracket is fitted to the left-hand side of the upper front bulkhead partition.

2 DI/APC Electronic Ignition (EZK)

The DI/APC Electronic Ignition (or EZK) control module is located on a bracket under the left-hand front seat.

Comfort systems

3 Cruise control

4 Central locking system

Cruise control and central locking control modules are mounted on a bracket on the far left under the facia.

Safety systems

5 ABS

The ABS control module is located on a bracket in the bulkhead partition space.

6 Airbag and belt tensioner

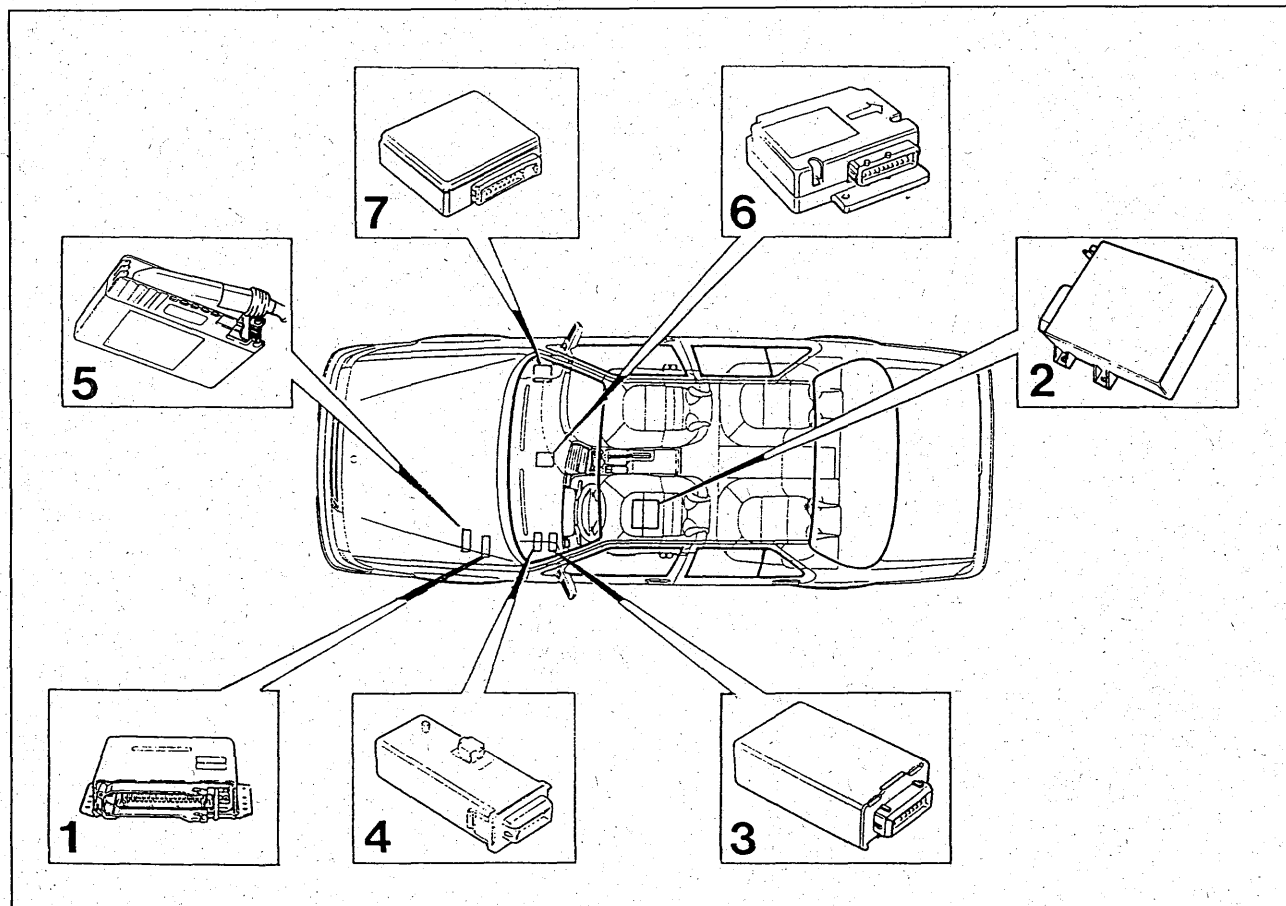
The airbag and belt tensioner control modules are located on a bracket in the front part of the center console under the facia.

7 Theft Alarm

The theft alarm control module is placed behind the glove compartment and knee shield on the right-hand side in the cabin.

Location of control modules (contd.)

M1988



Engine management system

1 LH MFI

The control module is located on a bracket in the bulkhead partition space. The bracket is fitted to the left-hand side of the upper front bulkhead partition.

2 Electronic Ignition (EZK), APC

The APC and Electronic Ignition (or EZK) control modules are located on a bracket under the left-hand front seat.

Comfort systems

3 Cruise control

4 Central locking system

Cruise control and central locking control modules are mounted on a bracket on the far left under the fascia.

Safety systems

5 ABS

The ABS control module is located on a bracket in the bulkhead partition space.

6 Belt tensioners

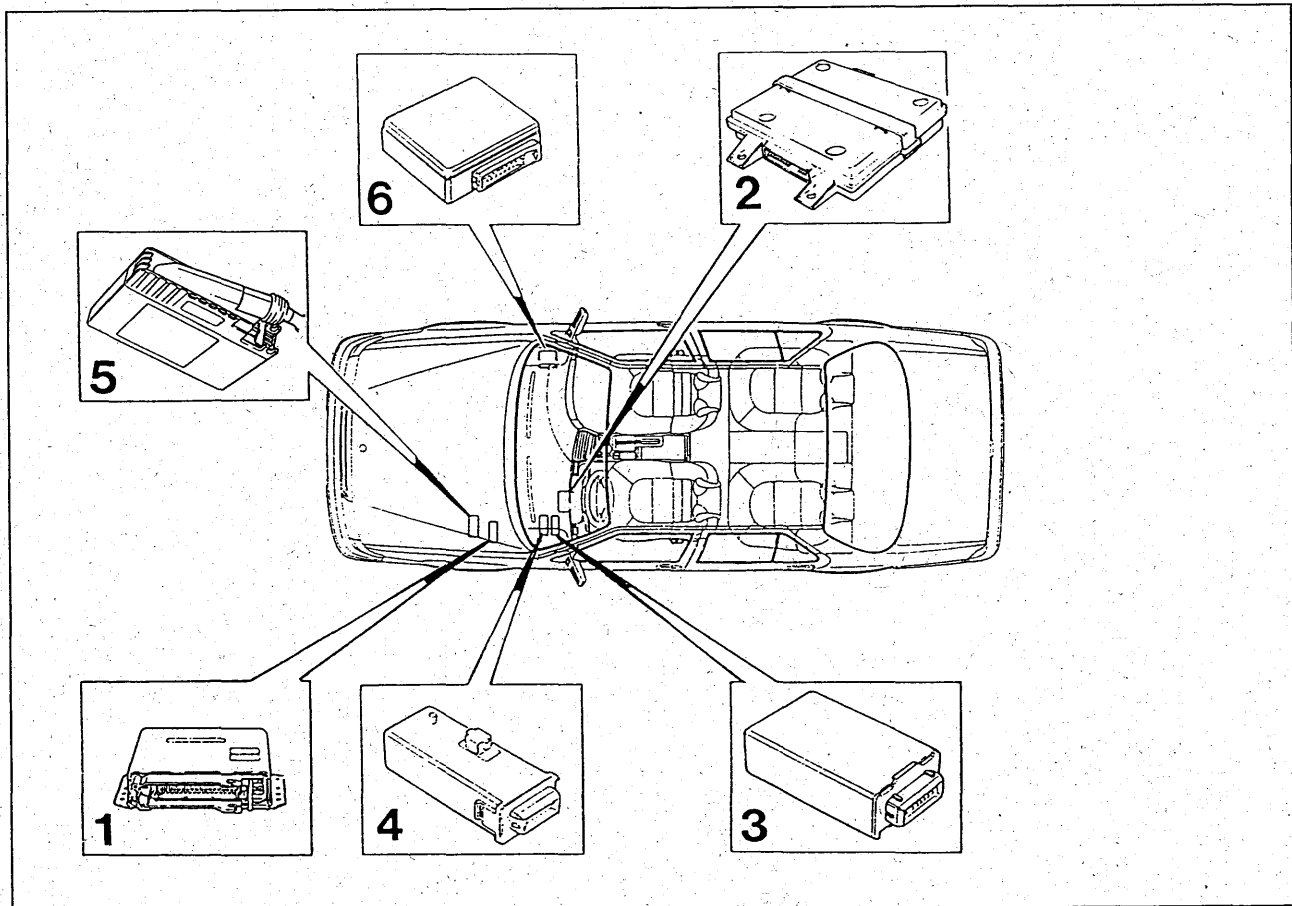
The belt tensioner control module is located on a bracket in the front part of the center console under the fascia.

7 Theft Alarm

The theft alarm control module is placed behind the glove compartment and knee shield on the right-hand side in the cabin.

Location of control modules (contd.)

M1987



Engine management system

1 LH MFI

The LH MFI control module is located on a bracket in the bulkhead partition space. The bracket is mounted on the left-hand side of the upper front bulkhead partition.

2 APC (EZK)

The APC (or EZK) control module is located on a bracket on the far left under the facia.

Comfort systems

3 Cruise control

4 Central locking system

Cruise control and central locking control modules are mounted on a bracket on the far left under the facia.

Safety systems

5 ABS

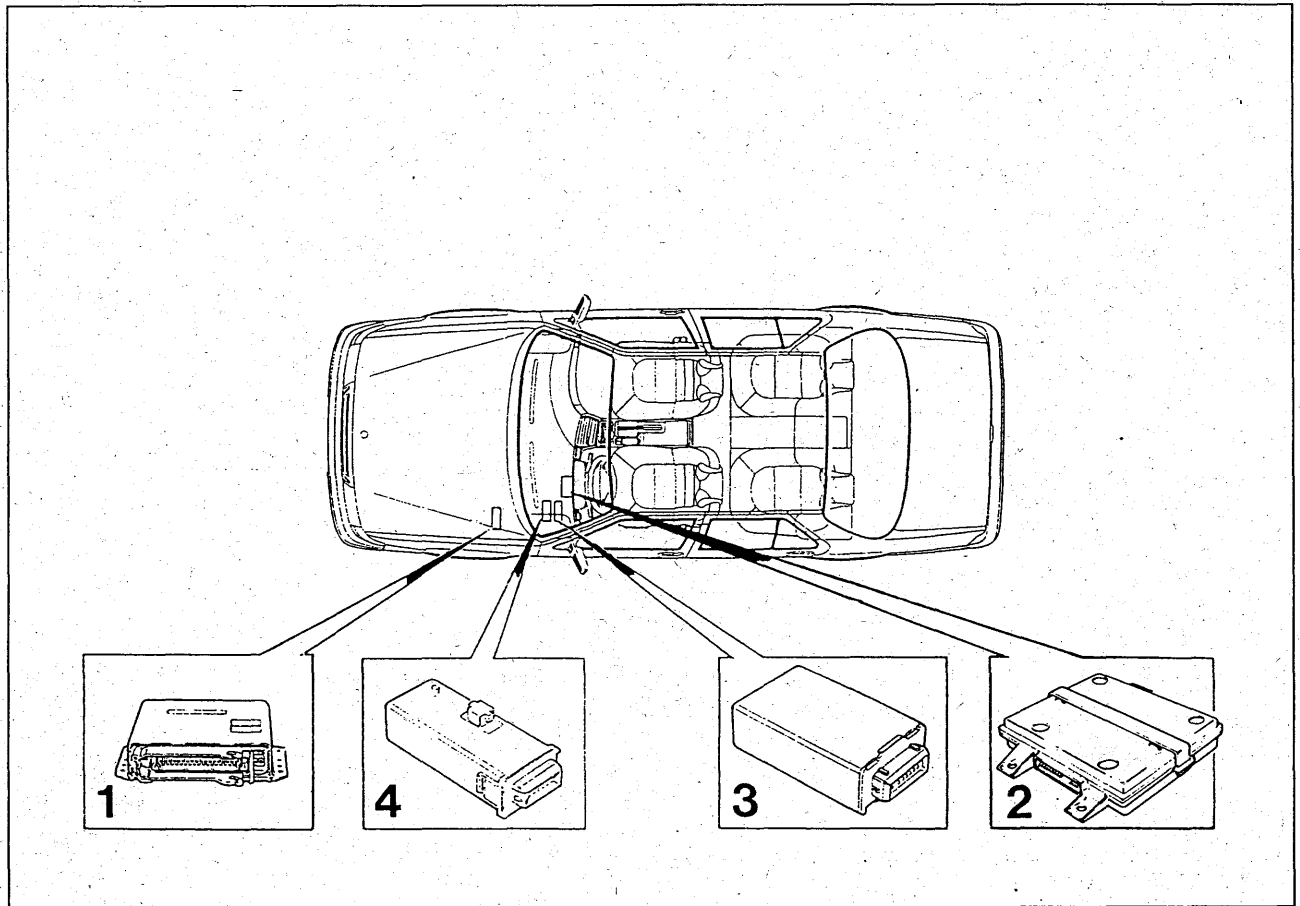
The ABS control module is located on a bracket in the bulkhead partition space.

6 Theft Alarm

The theft alarm control module is placed behind the glove compartment and knee shield on the right-hand side in the cabin.

Location of control modules (contd.)

-M1986



Engine management system

1 LH MFI

The LH MFI control module is located on a bracket in the bulkhead partition space. The bracket is mounted on the left-hand side of the upper front bulkhead partition.

2 APC (EZK)

The APC (or EZK) control module is located on a bracket on the far left under the fascia.

Comfort systems

3 Cruise control

4 Central locking system

Cruise control and central locking control modules are mounted on a bracket on the far left under the fascia.

Engine

Traction Control System, TCS (4 Cyl)	51	MOTRONIC 2.8.1 Engine Management System	110
Traction Control System, TCS (6 Cyl)	71	Saab Trionic Engine Management System .	128
LH Multiport Fuel Injection System	80	Turbo System	145
DI-DI/APC Electronic Ignition Systems	100		
EZK Ignition System	109		

TCS (4 Cyl)

Fault tracing hints M1991 and early M1992

Components in these cars before a certain date of manufacture have sometimes not met quality requirements. These problems, sometimes in combination with faulty contacts or incorrect settings can cause the system to switch to limp-home mode where the customer complains or that the car comes into the workshop for repair.

Two types of limp-home can arise:

- The system goes out of limp-home when restarted
- The system must be corrected/reset using the ISAT scan tool

Fault diagnosis and localization of the faults can sometimes be difficult to carry out, which is why we have provided the following summary of causes and recommended action.

Causes of fault

Faults can of course arise due to other faults than those given below. However we would like to point out special factors that have proved to be difficult in most cases of problems with drivability. This applies to the following:

- **24 pin connector** in the main wiring harness (front bulkhead partition). faulty contact due to oxidation caused by water leakage.
- **Grounding points G7 and G15** . Resistance too high due to poor contact.
- **Throttle cable** . Cable position incorrectly set.
- **Actuating valve** . Component fault (leakage) can arise up to date of manufacture 0391.
- **Non-return valve** (leakage)
- **Pedal position sensors** . Component fault can arise up to date of manufacture 101 (=W10 year 91).
- **Throttle body (throttle position sensor)**. Component fault can arise up to serial number 117885.

Action

In the case of fault in the TCS system (limp-home mode), start fault diagnosis as follows:

- 1 Read and note the diagnostic trouble codes registered using the scan tool.
- 2 Check the throttle cable and adjust it if necessary so that there is maximum play in the cable. The play should be at least 1 mm (see page 173 in Service Manual 2:5).
- 3 Unplug the 24 pin connector in the main wiring harness and check it for damp. If it is damp, change the rubber seal, part No. 43 52 936.

Wipe the connector dry and use contact spray Kontakt 61, part No. 45-30 04 520 on the female terminals. Then plug in and unplug the connector several times to remove any oxide deposits.
- 4 Check grounding points G7 (engine, 2) and G15 (beside the TSI socket).
- 5 Check that the non-return valve is correctly located.

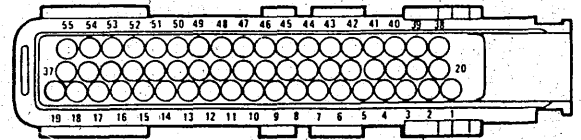
After this first check and correction measures, erase all diagnostic trouble codes and test drive the car to see if it returns the limp-home mode or if any warning lamps light.

If the fault(s) remain, conduct fault diagnosis under each diagnostic trouble code.

TCS (4 Cyl) (contd.)

Checking voltage TC/ABS

Checks should be done with the breakout box (BOB) connected, all components connected and the ignition key to ON. All readings are taken on the BOB.



M) TCS manual only

A) TCS Automatic trans only

Pin	Circuit/function	Color	Check	See 2:5, page
1	Ground	BK	Check that the voltage drop to ground (G15) is less than 0.1 V	-
2	FL outlet valve (valve activated when control module connects it to ground)	YE/RD	See "Checking resistance" on page 153 in Service Manual 2:5	122
3	Measuring voltage from main relay (ABS)	GN/RD or YE/WH	With relay activated = 12 V Relay not activated (fault in system) = less than 2 V	104
4 ^M	Communication between TC/ABS and ETS (digital signal to pin 32 on ETS throttle control module)	BK/WH	With engine running = approx. 5 V (values nearer 0 or 10 V show a fault in the circuit)	133
5	No connection			
6	No connection			
7 ^M	TCS indicator lamp (control module grounds lamp when the system is activated)	BN/RD	Lamp out = approx. 12 V Lamp on = approx. 0 V	146
8	Pressure and level warning circuit (goes to pin 51)	BU	Switch closed = approx. 5-10 V (pressure/level = Ok) Switch open = 0 V (pressure/level = low)	107
9 ^A	RR speed signal (digital signal to ASR control module)	GN	Check with logic probe: continuous "PULSE" without rotating wheel (test pulse). Frequency increases with increased wheel speed.	119
10 ^A	FL Wheel speed signal (digital signal to ASR control module)	YE	Check with logic probe: continuous "PULSE" without wheel rotating (test pulse). Frequency increases with increased wheel speed	113
11 ^A	FR Wheel speed signal (digital signal to ASR control module)	BU	Check with logic probe: continuous "PULSE" without rotating wheel (test pulse). Frequency increases with increased wheel speed.	115
12 ^A	RL Wheel speed signal (digital signal to ASR control module)	GY	Check with logic probe: continuous "PULSE" without rotating wheel (test pulse). Frequency increases with increased wheel speed.	117
13 ^M	TC block pressure switch (signal voltage to switch)	BN/WH	Brake off = approx. 8 V (switch closed) Brake on = approx. 10 V (switch open)	139
14	To pump relay, pin 87 (detects position of relay contacts)	YE	Pump relay operated = 12 V Pump relay released = 0 V	110
15	No connection			
16	No connection			
17	No connection			
18	No connection			
19	Ground	BK	Check voltage drop to ground is less than 0.1 V.	-

Pin	Circuit/function	Color	Check	See 2:5, page
20	FL inlet valve (valve activated when circuit grounded via control module)	GN/WH	See "Checking resistance" on page 154 in Service Manual 2:5	121
21	FR Outlet valve (valve activated when circuit grounded via control module)	BU/RD	See "Checking resistance" on page 154 in Service Manual 2:5	124
22	No connection			
23	Data link L (commands from ISAT scan tool to control module)	YE		99 p.5
24 ^M	TC/ABS-ETS communication (digital signal to ETS, pin 29)	GN/WH	With engine running - approx. 5 V (readings close to 0 or 10 volts show a problem in the circuit) When using logic probe, continuous "PULSE" should be displayed.	133
25	No connection			
26 ^M	TC block pressure switch (voltage signal from switch)	BK/WH	Brake off = approx. 8 V (switch closed) Brake on = 0 V (switch open)	139
27	Ground, RR wheel speed sensor	BK/GN	Measure voltage (AC) between pins 27 and 45. When wheel rotated 1 turn/second, the voltage should be about 0.1 - 0.5 V.	119
28	Ground, RL wheel speed sensor	YE/GN	Measure voltage (AC) between pins 28 and 46. When wheel rotated 1 turn/second, the voltage should be about 0.1 - 0.5 V.	117
29	Ground, FR wheel speed sensor	BU/GN	Measure voltage (AC) between pins 29 and 47. When wheel rotated 1 turn/second, the voltage should be about 0.1 - 0.5 V.	115
30	Ground, FL wheel speed sensor	GY/GN	Measure voltage (AC) between pins 30 and 48. When wheel rotated 1 turn/second, the voltage should be about 0.1 - 0.5 V.	113
31	No connection			
32	Brake light signal (from brake light switch)	BU	Brake off = 0 V Brake on = 12 V	137
33	Voltage from main relay (ABS)	YE	Relay activated (system working) = 12 V Relay not activated (fault in system) = <2 V	104
34	Actuating signal for relay (control module activates relay by grounding circuit)	GN	Relay not activated = 12 V Relay activated = approx. 1 v or less	104
35 ^M	+30 voltage	RD	12 V	104
36	Rear outlet valve (control module activates the valve by grounding the circuit)	BU/WH	See "Checking resistance" on page 154 in Service Manual 2:5	126
37 ^M	TC block NO valve (control module activates the valve by grounding the circuit)	YE	See "Checking resistance" on page 155 in Service Manual 2:5	128
38	FR Inlet valve (control module activates valve by grounding circuit)	RD/WH	See "Checking resistance" on page 155 in Service Manual 2:5	123
39	Main valve (control module activates valve by grounding the circuit)	BK	See "Checking resistance" on page 155 in Service Manual 2:5	127

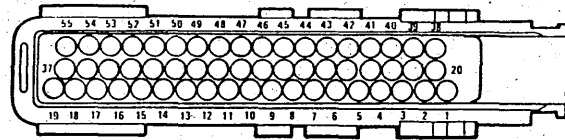
Pin	Circuit/function	Color	Check	See 2:5, page
40 ^M	TC block NC valve (control module activates valve by grounding the circuit)	BU/GY	See "Checking resistance" on page 155 in Service Manual 2:5	129
41	No connection			
42	Data link K (data from control module to ISAT scan tool)	BU		99 p.5
43	No connection			
44 ^M	TCS CTRL lamp	BU	Lamp off = 12 V Lamp on = <2 V	142
45	RR wheel speed sensor signal	GN	Check the voltage (AC) between pins 45 and 27. When the wheel rotates 1 turn/second, the sensor signal should be approx. 0.1-0.5 V.	119
46	RL Wheel speed sensor signal	GN	Check the voltage (AC) between pins 46 and 28. When the wheel rotates 1 turn/second, the sensor signal should be approx. 0.1-0.5 V.	117
47	FR Wheel speed sensor signal	GN	Check the voltage (AC) between pins 47 and 29. When the wheel rotates 1 turn/second, the sensor signal should be approx. 0.1-0.5 V.	115
48	FL Wheel speed sensor signal	GN	Check the voltage (AC) between pins 48 and 30. When the wheel rotates 1 turn/second, the sensor signal should be approx. 0.1-0.5 V.	113
49	No connection			
50	Pump relay, pin 85 (detects relay status)	BK	Operating circuit not activated (pressure switch open) = 12 V Operating circuit activated (pressure switch closed) = <1 V	111
51	Pressure and level warning circuit (goes to pin 8)	BN	System OK (switches closed) = 5-10 V System fault (a switch open) = approx. 1.5 V	107
52	ANTI LOCK lamp	WH	Lamp off = 12 V Lamp on = <2 V	140
53	+54 voltage	RD	12 V when ignition key is ON	104
54	Rear intake valve (control module activated the valve by grounding the circuit)	BN/WH	See "Checking resistance" on page 155 in Service Manual 2:5	125
55	No connection			

TCS (4 Cyl) (contd.)

Checking resistance TC/ABS

The resistance readings listed below should be checked with the breakout box (BOB) connected, the control module **disconnected** and with the ignition **off**.

All readings are taken on the breakout box.



- M) TCS manual only
A) TCS auto trans only

Pin	Circuit/function	Color	Check	See 2:5, page
1	Ground	BK	Less than 1 Ohm to battery ground	-
2	FL Outlet valve (control module activates the valve by grounding the circuit)	YE/RD	Resistance between pins 2 and 3 should be about 3-4 Ohms	122
3	Voltage supply from relay (ABS)	GN/RD or YE/WH	Check lead to relay pin 30	104
4 ^M	Communication between TC/ABS and ETS (digital signal to ETS, pin 32)	BK/WH	Check the lead to ETS pin 32 Check that there is no short to ground	133
5	No connection			
6	No connection			
7 ^M	TCS lamp (control module grounds the circuit when the system is activated)	BN/RD	See "Checking voltage" on page 148 of Service Manual 2:5	146
8	Pressure and level warning circuit (to pin 51)	BU	Check that the circuit is whole between pins 8 and 51 when the pressure accumulator is charged.	107
9 ^A	RR speed signal (digital signal to ASR control module)	GN	See "Checking voltage" on page 148 in Service Manual 2:5	119
10 ^A	FL Wheel speed sensor signal (digital signal to ASR control module)	YE	See "Checking voltage" on page 148 in Service Manual 2:5	113
11 ^A	FR Wheel speed signal (digital signal to ASR control module)	BU	See "Checking voltage" on page 148 in Service Manual 2:5	115
12 ^A	RL Wheel speed signal (digital signal to ASR control module)	GY	See "Checking voltage" on page 148 in Service Manual 2:5	117
13 ^M	TC block pressure switch (voltage signal to switch)	BN/WH	Check that the circuit is whole between pins 13 and 26 (brake pedal not depressed)	139
14	From pump relay pin 87 (gives position of relay contacts)	YE	Check the lead to pump relay, pin 87.	110
15	No connection			
16	No connection			
17	No connection			
18	No connection			
19	Ground	BK	Less than 1 Ohm to battery ground	-
20	FL Inlet valve (control module activates the valve by grounding the circuit)	GN/WH	Resistance between pins 20 and 3 should be 6-7 Ohms.	121

Pin	Circuit/function	Color	Check	See 2:5, page
21	FR Inlet valve (control module activates the valve by grounding the circuit)	BU/RD	Resistance between pins 21 and 3 should be 3-4 Ohms.	124
22	No connection			
23	Data link L (data from ISAT scan tool to the control module)	YE		99 p.5
24 ^M	Communication between TC/ABS and ETS (digital signal to ETS, pin 29)	GN/WH	Check the lead to ETS pin 29 Check that there is no short to ground	133
25	No connection			
26 ^M	TC block pressure switch (voltage signal from the switch)	BK/WH	Check that the circuit is whole between pins 26 and 13 (brake pedal not applied)	139
27	Ground, RR wheel speed sensor	BK/GN	Resistance between pins 27 and 45 should be about 1100 Ohms	119
28	Ground, RL wheel speed sensor	YE/GN	Resistance between pins 28 and 46 should be about 1100 Ohms	117
29	Ground, FR wheel speed sensor	BU/GN	Resistance between pins 29 and 47 should be about 1100 Ohms	115
30	Ground, FL wheel speed sensor	GY/GN	Resistance between pins 30 and 48 should be about 1100 Ohms	113
31	No connection			
32	Brake light signal (from brake light switch)	BU	See "Checking voltages" on page 150 in Service Manual 2:5	137
33	Voltage from main relay (ABS)	YE	Check the lead to the main relay, pin 30	104
34	Operating signal for main relay (control module activates the relay by grounding the circuit)	GN	Check the lead to the main relay, pin 86	104
35 ^M	+ 30 Voltage supply	RD	See "Checking voltages" on page 150 in Service Manual 2:5	104
36	Rear outlet valve (control module activates the valve by grounding the circuit)	BU/WH	The resistance between pins 36 and 3 should be about 3-4 Ohms	126
37 ^M	Tc block NO valve (the control module activates the valve by grounding the circuit)	YE	The resistance between pins 37 and 3 should be 6-8 Ohms.	128
38	FR Inlet valve (control module activates valve by grounding circuit)	RD/WH	The resistance between pins 38 and 3 should be 6-7 Ohms.	123
39 ^M	Main valve (control module activates valve by grounding the circuit)	BK	The resistance between pins 39 and 3 should be 4-5 Ohms.	127
40 ^M	TC block NC valve (control module activates valve by grounding the circuit)	BU/GY	The resistance between pins 40 and 3 should be 6-8 Ohms.	129
41	No connection			
42	Data link K (data from the control module to the ISAT scan tool)	BU		99 p.5
43	No connection			
44 ^M	TCS CTRL lamp	BU	See "Checking voltages" on page 151 in Service Manual 2:5	142

Pin	Circuit/function	Color	Check	See 2:5, page
45	Output signal from RR wheel speed sensor	GN	The resistance between pins 45 and 27 should be around 1100 Ohms.	119
46	Output signal from RL wheel speed sensor	GN	The resistance between pins 46 and 28 should be about 1100 Ohms.	117
47	Output signal from FR wheel speed sensor	GN	The resistance between pins 47 and 29 should be about 1100 Ohms.	115
48	Output signal from FL wheel speed sensor	GN	The resistance between pins 48 and 30 should be about 1100 Ohms.	113
49	No connection			
50	Pump relay, pin 85 (monitors relay status)	BK	Check the line to pump relay pin 85 and check that the circuit is grounded when the pressure switch is closed (accumulator not pressurized).	111
51	Pressure and level warning circuit (to pin 8)	BN	Check the continuity of the circuit between pins 51 and 8 when the accumulator is pressurized.	107
52	ANTI LOCK lamp	WH	See "Checking voltages" on page 151 in Service Manual 2:5	140
53	+54 Voltage supply	RD	See "Checking voltages" on page 151 in Service Manual 2:5	104
54	Rear Inlet valve (the valve is activated by the control module grounding the circuit)	BN/WH	The resistance between pins 54 and 3 should be 6-7 Ohms.	125
55	No connection			

TCS (4 Cyl) (contd.)**Diagnostic trouble codes TC/ABS**

Permanent	Intermittent	Component/Signal	See 2:5, page
32251	22251	Main relay not working properly	104
35321	25321	Brake light switch not working properly	137
36521	26521	Pressure switch not working properly	139
36522	26522	Safety circuit pins 8-51, short to +12 volts	107
44221	24221	FL wheel speed sensor, no signal	113
44222	24222	FR wheel speed sensor, no signal	115
44223	24223	RL wheel speed sensor, no signal	117
44224	24224	RR wheel speed sensor, no signal	119
44251	24251	FL wheel speed sensor, faulty signal (compare wheel speed)	113
44252	24252	FR wheel speed sensor, faulty signal (compare wheel speed)	115
44253	24253	RL wheel speed sensor, faulty signal (compare wheel speed)	117
44254	24254	RR wheel speed sensor, faulty signal (compare wheel speed)	119
44291	24291	FL wheel speed sensor, faulty signal (<40 km/h)	113
44292	24292	FR wheel speed sensor, faulty signal (<40 km/h)	115
44293	24293	RL wheel speed sensor, faulty signal (<40 km/h)	117
44294	24294	RR wheel speed sensor, faulty signal (<40 km/h)	119
4422A	2422A	FL wheel speed sensor, faulty signal (<40 km/h)	113
4422B	2422B	FR wheel speed sensor, faulty signal (<40 km/h)	115
4422C	2422C	RL wheel speed sensor, faulty signal (<40 km/h)	117
4422D	2422D	RR wheel speed sensor, faulty signal (<40 km/h)	119
53421	33421	FL Inlet valve, not working	121
53422	33422	FL outlet valve, not working	122
53423	33423	FR Inlet valve, not working	123
53424	33424	FR outlet valve, not working	124
53425	33425	Rear inlet valve, not working	125
53426	33426	Rear outlet valve, not working	126
53427	33427	Main valve, not working	127
53428	33428	NO Traction valve, not working	128
53429	33429	NC Traction valve, not working	129
-----	234B1	FL Outlet valve, hydraulic fault	130
-----	234B2	FR Outlet valve, hydraulic fault	130
-----	234B3	Rear outlet valve, hydraulic fault	130
-----	234B4	Rear outlet valve, hydraulic fault	130
-----	775B1	Control module fault	131
-----	775B2	Control module fault, RAM	132
E7061	F7061	No communication with ETS	133

TCS (4 Cyl) (contd.)**TC/ABS Command codes**

Code	Function/component	Display text
259	Reads speed signal from FL wheel speed sensor	E.g. 80020 = 20 km/h
25A	Reads speed signal from FR wheel speed sensor	E.g. 80020 = 20 km/h
25B	Reads speed signal from RL wheel speed sensor	E.g. 80020 = 20 km/h
25C	Reads speed signal from RR wheel speed sensor	E.g. 80020 = 20 km/h
200	Gives status of TC block pressure switch	8B100 = closed (brake not applied) 8B000 = open (brake applied)
201	Gives status of pressure and level warning switch (safety circuit)	8B100 = closed (pressure and level = OK) 8B000 = open (pressure and level = low)
202	Gives status of brake light switch	8B100 = closed (brake applied) 8B000 = open (brake not applied)
800	Communication over	
900	Erase all diagnostic trouble codes	

TCS (4 Cyl) (contd.)

Voltage reading, TCS manual

- All readings should be taken with all components connected and with the ignition to drive.
- Readings can be taken on the back of the control module connector or, preferably, using the break-out box (BOB) connected between the control module and the control module connector.
- Some of the readings should be taken with the engine idling.
- Be careful not to connect the ETS throttle control module connector the wrong way around.
- A large number of voltage levels are only approximate. Use common sense when assessing whether a reading is correct or not.
- If a reading is incorrect, use the wiring diagram to see which cables, connectors or components should be further investigated.

Pin	Circuit/function	Color	Check	See 2:5 page
1	Ground	BK	Check the voltage drop to ground. This should be less than approx. 0.1 V.	180
2	Accelerator pedal position sensor, reference voltage	YE/RD	Approx. 5 V	210
3	Throttle position sensor, reference voltage	YE/WH	Approx. 5 V	210
4	Accelerator pedal position sensor, ground	YE	0.1-0.2 V	206
5	Throttle position sensor, ground	WH	0.1-0.2 V	204
6	Charge air bypass valve, control signal	GY	Not activated = 12 V Activated = approx. 0 V	256
7	No connection			
8	No connection			
9	Data link L from ISAT scan tool to control module	YE/WH	12 V	161 p.5
10	Input signal from wheel speed sensor	GN/RD	Should alternate between 0 and 12 V when both front wheels are rotated by hand at the same time (or the car is pushed forward)	189
11	No connection			
12	Rpm signal	OG	At least 2 V when running starter motor Approx. 3 V when idling (can increase slightly with increased rpm)	187
13	Main relay operating circuit (the control module grounds the circuit when it receives +15 voltage provided that there is no fault in the ETS system)	BU	Not activated = 12 V Activated = <1.5 volts	229

Pin	Circuit/function	Color	Check	See 2:5 page
14	Accelerator pedal, safety switch	GY/WH	Pedal not depressed = approx. 1 V Pedal depressed half way = approx. 7-9 V	217
15	Brake light switch	WH	Brake pedal not depressed = 0 V Brake pedal depressed = 12 V	224
16	Throttle position sensor, position signal	BU/WH	Approx. 4 V when idling which decreases to approx. 0.1 V at wide open throttle. The throttle butterfly must be opened by hand, see 2:5, page 233 for information.	204
17	Accelerator pedal position sensor, position signal	GN/YE	Approx. 0.1 V when idling increasing to approx. 4 V at wide open throttle.	206
18	Cruise control "RESUME"	YE	"RESUME" activated = 12 V "RESUME" not activated = 0 V	257
19	Cruise control "SET"	RD/WH	"SET" activated = 12 V "SET" not activated = 0 V	257
20	Throttle motor	GN		233
21	Throttle motor	GN/WH		233
22	Voltage supply from main relay	BU/RD	Relay activated = 12 V Relay not activated = approx. 0 V	229
23	TCS CTRL lamp	VT/WH	Lamp on = <2 V Lamp off = 12 V	142
24	No connection			
25	+15 voltage	GN/WH	Ignition on = 12 V Ignition off = approx. 0 V	183
26	Throttle angle, output signal to LH MFI and Electronic Ignition	YE	Signal pulse width should increase as the throttle opens. Use the ISAT scan tool PULSE feature.	-
27	Engine load signal Tq	WH	Signal frequency should increase with engine load. Use the scan tool PULSE feature.	200
28	Throttle body safety switch	BK/WH	Throttle butterfly closed = approx. 1 V Throttle butterfly open at least half way = 7-10 V	215
29	Communications signal To TC/ABS pin 24 on cars with manual gearbox To ASR pin 14 on cars with automatic transmission	GN/WH	With car stationary and engine idling = approx. 5 V Readings near 0 or 10 V show that there is a fault in the circuit.	185
30	No connection			
31	Cruise control, "ON"/"OFF"	RD	At "ON" = 12 V At "OFF" = 0 V	257
32	Communications signal To TC/ABS pin 4 on cars with manual gearbox To ASR pin 2 on cars with automatic transmission	BK/WH	With car stationary and engine idling = approx. 5 V Readings near 0 or 10 V show that there is a fault in the circuit.	185
33	Temperature sensor	YE	Voltage varies with temperature: Approx. 4.0 V -20°C (-4°F) Approx. 2.3 V +20°C (68°F) Approx. 0.5 V +80°C (176°F)	227

Pin	Circuit/function	Color	Check	See 2:5 page
34	Data link K, data from control module to ISAT scan tool	BU/WH		161 p.5
35	Control signal to safety valve	BN/WH	Valve activated (system working) = approx. 1.0 V Valve not activated (system disconnected) = 0 V (may be battery positive voltage if the main relay is still activated)	231
36	Brake and clutch switches	WH	No pedal depressed = 12 V Pedal(s) depressed = <1 V	221
37	A/C connection	YE	A/C connected (or ACC in A/C mode) = approx. 10-12 V A/C not connected (or ACC in ECON mode) = 0 V	259
38	A/C relay operating circuit	BK	A/C relay activated = approx. 1 V A/C relay not activated (connection made) = approx. 10-12 V A/C relay not activated (no connection made) = 0 V	259

TCS (4 Cyl) (contd.)

Measuring voltages, TCS automatic transmission

- All readings should be taken with all components connected and with the ignition to drive.
- Readings can be taken on the back of the control module connector or, preferably, using the breakout box (BOB) connected between the control module and the control module connector.
- Some of the readings should be taken with the engine idling.
- Be careful to connect the ETS throttle control module correctly.
- A large number of voltage levels are only approximate. Use common sense when assessing whether a reading is correct or not.
- If a reading is incorrect, use the wiring diagram to see which cables, connectors or components should be further investigated.

Pin	Circuit/function	Color	Check	See 2:5, page
1	Accelerator pedal position sensor connected to ETS pin 17	GY/GN	Approx 0.1 V when idling, increasing to approx 4 V at wide open throttle	206
2*)	Communication with ETS, connected to ETS pin 32	BK/WH	With stationary car and engine idling = approx. 5 V Readings close to 0 or 10 V show a fault in the circuit	253
3	Throttle position sensor, position signal connected to ETC pin 16	BU/WH	Approx. 4 V when idling, decreasing to approx. 0.1 V at wide open throttle	204
4	No connection			
5	No connection			
6	No connection			
7	Accelerator pedal position sensor, reference voltage connected to ETS pin 2	YE/RD	Approx. 5 V	206
8*)	RL Wheel speed signal digital signal in from ABS pin 12	GY	With a logic probe, a stable "PULSE" should be shown If the wheel is turned, the "PULSE" frequency should increase the faster the wheel is turned.	196
9*)	FR wheel speed signal digital signal in from ABS pin 11	BU	With a logic probe, a stable "PULSE" should be shown If the wheel is turned, the "PULSE" frequency should increase the faster the wheel is turned.	194
10*)	FL wheel speed signal digital signal in from ABS pin 10	YE	With a logic probe, a stable "PULSE" should be shown If the wheel is turned, the "PULSE" frequency should increase the faster the wheel is turned.	192

Pin	Circuit/function	Color	Check	See 2:5, page
11	KDW position sensor, reference voltage	YE/RD	Approx. 5 V	208
12	+15 voltage connected to ETS pin 25	GN/WH	Ignition on = 12 V Ignition off = 0 V	183
13	Ground	BK	Check voltage drop to ground. Should be less than 0.1 V	229
14*)	Communication with ETS connected to ETS pin 29	YE	With car stationary and engine idling = approx. 5 V Readings near 0 or 10 V show that there is a fault in the circuit.	253
15	KDW position sensor, ground	RD	Approx. 0.1 - 0.2 V	208
16	DRIVE signal	OG	Selector lever to R, D, 3, 2 or 1 = 12 V Selector lever to N or P = approx. 0 V	212
17	No connection			
18	Engine speed	OG	At least 2 V when starter motor running Approx. 3 when idling and may be higher at higher rpm	187
19	TCS lamp the control module grounds the circuit when the TCS is connected	BN/WH	Lamp off = 12 V Lamp on = 0 V	146
20	Throttle position sensor, reference voltage connected to ETS pin 3	YE/WH	Approx. 5 V	204
21*)	RR Wheel speed signal digital signal in from ABS pin 9	GN	With a logic probe, a stable "PULSE" should be shown If the wheel is turned, the "PULSE" frequency should increase the faster the wheel is turned.	198
22	KDW position sensor, position signal	BU/RD	With KDW motor in fixed position about "half way" = approx. 2.5 V	208
23*)	KDW motor	BU/WH		184
24*)	KDW motor	WH		184
25	Supply voltage from main relay	BU/RD	Relay activated = 12 V Relay not activated = approx. 0 V	178

*) Digital signals (PWM). Checked with pulse meter, logic probe or oscilloscope.

TCS (4 Cyl) (contd.)

Diagnostic trouble codes TCS

^{M)} TCS manual only

^{A)} TCS Automatic trans only

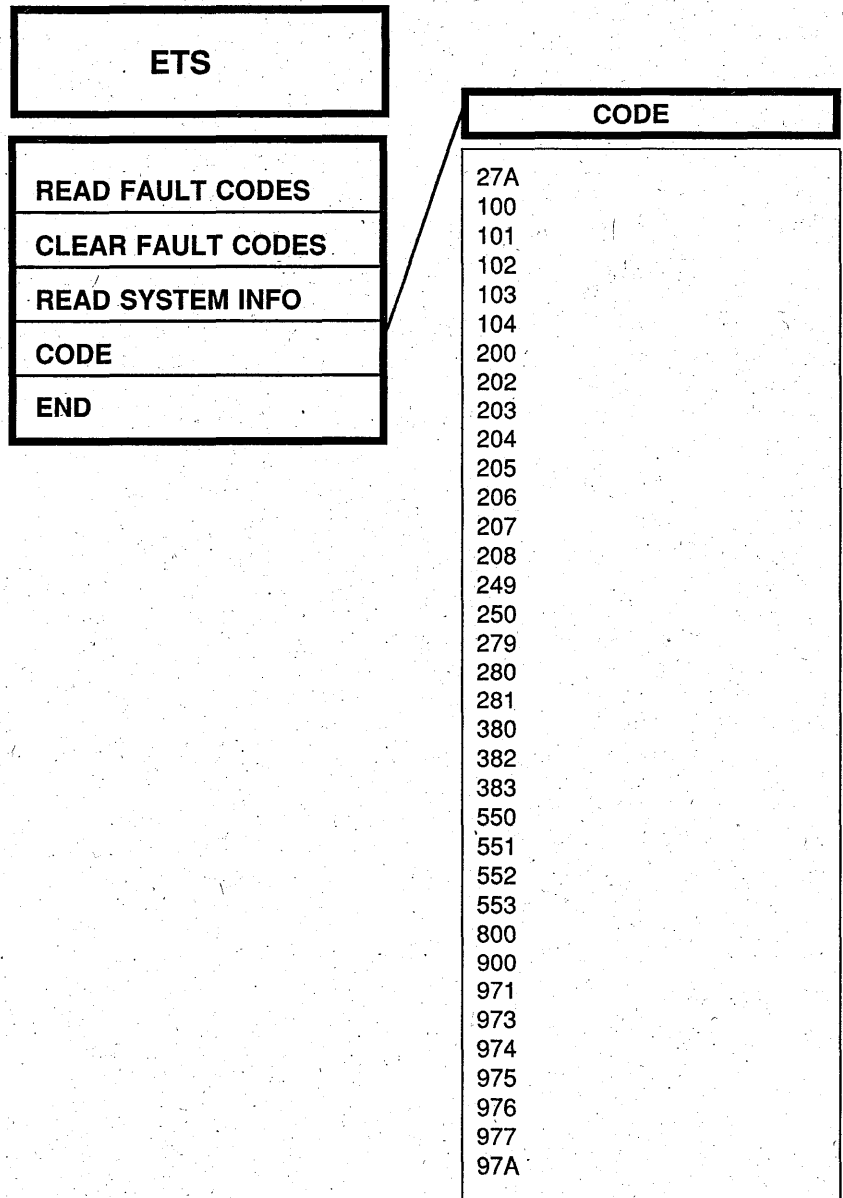
Permanent	Intermittent	Faulty function/component	Action, see 2:5, page
42220	22220	no +30 voltage on pin 22	178
42241	22241	Battery positive voltage (BPV) too high, >18 V	181
42252	22252	BPV too low, <6 V	182
42320	22320	No +15 signal on pin 25 despite rpm pulses being detected	183
43691 ^{A)}	23691	KDW Actuator motor, cable control not working (function against idling)	184
43692 ^{A)}	23692	KDW actuator motor, cable control not working (function against wide open throttle)	184
44020 ^{M)}	24020	Communication with TC/ABS interrupted	185
44021 ^{M)}	24021	No communication with TC/ABS	185
44090 ^{M)}	24090	Faulty signal from TC/ABS	185
44221	24221	No rpm signal	200
44260	24260	Signals from TC/ABS and the output shaft speed sensor do not tally	189
44261	24261	Signals from TC/ABS and the output shaft speed sensor do not tally	189
44262 ^{A)}	24262	No signal from wheel speed sensors/ABS control module	191
44290	24290	Speed signal disrupted	189
44291	24291	Signals from TC/ABS and the output shaft speed sensor do not tally	189
44295 ^{A)}	24295	No signal from FL wheel speed sensor	192
44296 ^{A)}	24296	No signal from FR wheel speed sensor	194
44297 ^{A)}	24297	No signal from RL wheel speed sensor	196
44298 ^{A)}	24298	No signal from RR wheel speed sensor	198
44390	24390	Rpm signal indicates speed >7000rpm	187
44391	24391	Rpm signal increasing too quickly	187
44420	24420	No Tq engine load signal	200
44490	24490	Tq engine load signal disrupted/high during deceleration	187
44690	24690	Incorrect rpm/Tq engine load ratio	202
44691 ^{A)}	24691	No rpm signal to ASR	203
45240	25240	Throttle position sensor, signal too high	204
45241	25241	Accelerator pedal position sensor, signal too high	206
45242	25242	Throttle position sensor, signal ground too high	204
45243	25243	Accelerator pedal position sensor, signal ground too high	206
45244 ^{A)}	25244	KDW position sensor, signal ground too high	208
45245 ^{A)}	25245	KDW position sensor, signal voltage too high	208
45250	25250	Throttle position sensor, signal too low	204
45251	25251	Accelerator pedal position sensor, signal too low	206
45252	25252	Throttle position sensor, signal ground too low	204
45253	25253	Accelerator pedal position sensor, signal ground too low	206

Permanent	Intermittent	Faulty function/component	Action, see 2:5, page
45254 ^{A)}	25254	KDW position sensor, signal ground too low	208
45255 ^{A)}	25255	KDW position sensor, signal voltage too low	208
45290	25290	Throttle position sensor, faulty signal	204
45291	25291	Accelerator pedal position sensor, faulty signal	206
45292 ^{A)}	25292	Deviations in signals from ETS to throttle and pedal position sensors	210
45360	25360	Pedal switch, constant over idling	217
45391 ^{A)}	25391	N /P modes not detected after starting	212
45720	25720	Throttle switch, constantly off	215
45721	25721	Accelerator pedal switch, constantly off	219
45722	25722	Brake switch and, in cars with manual gearbox, clutch switch faulty	221
45723	25723	Brake signal from brake light switch, but not from TC/ABS	223
45724	25724	Brake signal from TC/ABS, but not from brake light switch	224
45770	25770	Throttle switch, constantly on	215
45771	25771	Accelerator switch, constantly on	219
45780	25780	Throttle switch, voltage too high	213
45781	25781	Pedal switch, voltage too high	217
45791 ^{A)}	25791	Kd point not detected	226
457B1 ^{A)}	257B1	KDW not connected	226
457B2 ^{A)}	257B2	KDW not set	226
46221	26221	Temp sensor, temperature too low	227
46271	26271	Temp sensor, temperature too high	227
53240	33240	Main relay, current too high	229
53250	33250	Main relay, current too low	229
53270	33270	Main relay, constantly activated	229
53440	33440	Safety valve, current too high	231
53450	33450	Safety valve, current too low	231
53630	33630	Throttle motor, incorrect function	233
55780	35780	Throttle switch, voltage too low	213
55781	35781	Pedal switch, voltage too low	217
58341	38341	Idling too low	235
58351	38351	Idling too high	235
62490	72490	Control module fault, PID regulator	255
67190	77190	Control module, RAM fault	255
67191	77191	Control module, ROM fault	255
67192	77192	Control module, EEPROM fault	255
67193	77193	Control module, EEPROM fault	255
67196	77196	Control module fault, time function	255
67290	77290	Control module fault, D/A converter	255
672B1 ^{A)}	772B1	Control module fault, D/A converter for KDW motor	237
67390	77390	Control module fault, speed control <20 km/h	255
67391	77391	Control module fault, speed control <48 km/h	255
67590	77590	Internal monitoring (Watchdog 1)	255
67591	77591	Control module fault, reset function	255

Permanent	Intermittent	Faulty function/component	Action, see 2:5, page
67592	77592	Internal monitoring (Watchdog 2)	255
67593	77593	Control module fault, safety switch 30	255
67594	77594	Control module fault, safety switch 31	255
67595	77595	Control module fault, safety switch 32	255
675B0	-----	Control module, calibration interrupted/not carried out	238
675B1	-----	Control module, calibration not possible	239
675B2	-----	Control module, engine version not specified	240
675B3 ^{A)}	775B3	Control module, EEPROM fault	241
675B4 ^{A)}	775B4	Control module fault, monitoring (Watchdog)	242
675B5 ^{A)}	775B5	Control module, ROM fault	241
68170	78170	Control module fault, software fault (system relay)	255
68331 ^{A)}	78331	Short circuit in KDW motor final step	243
68340	78340	Control module fault, transistor for system relay	255
68341	78 341	Control module fault, safety valve	255
68342	78342	Control module fault, TCS CTRL lamp	255
68390	78390	Throttle control faulty	245
68391	78391	Control module fault, GR flip-flop	255
683B0	783B0	Throttle control faulty (oscillation in throttle butterfly)	248
683B1 ^{A)}	783B1	KDW motor not in rest position when power off	249
E7590	D7590	Safety system, incorrect function	250
E75B1 ^{A)}	D75B1	Communication fault, series interface	253
E75B2 ^{A)}	D75B2	Communications fault, break/short circuit to ground	253
E75B3 ^{A)}	D75B3	Communications fault, cannot be re-established	253

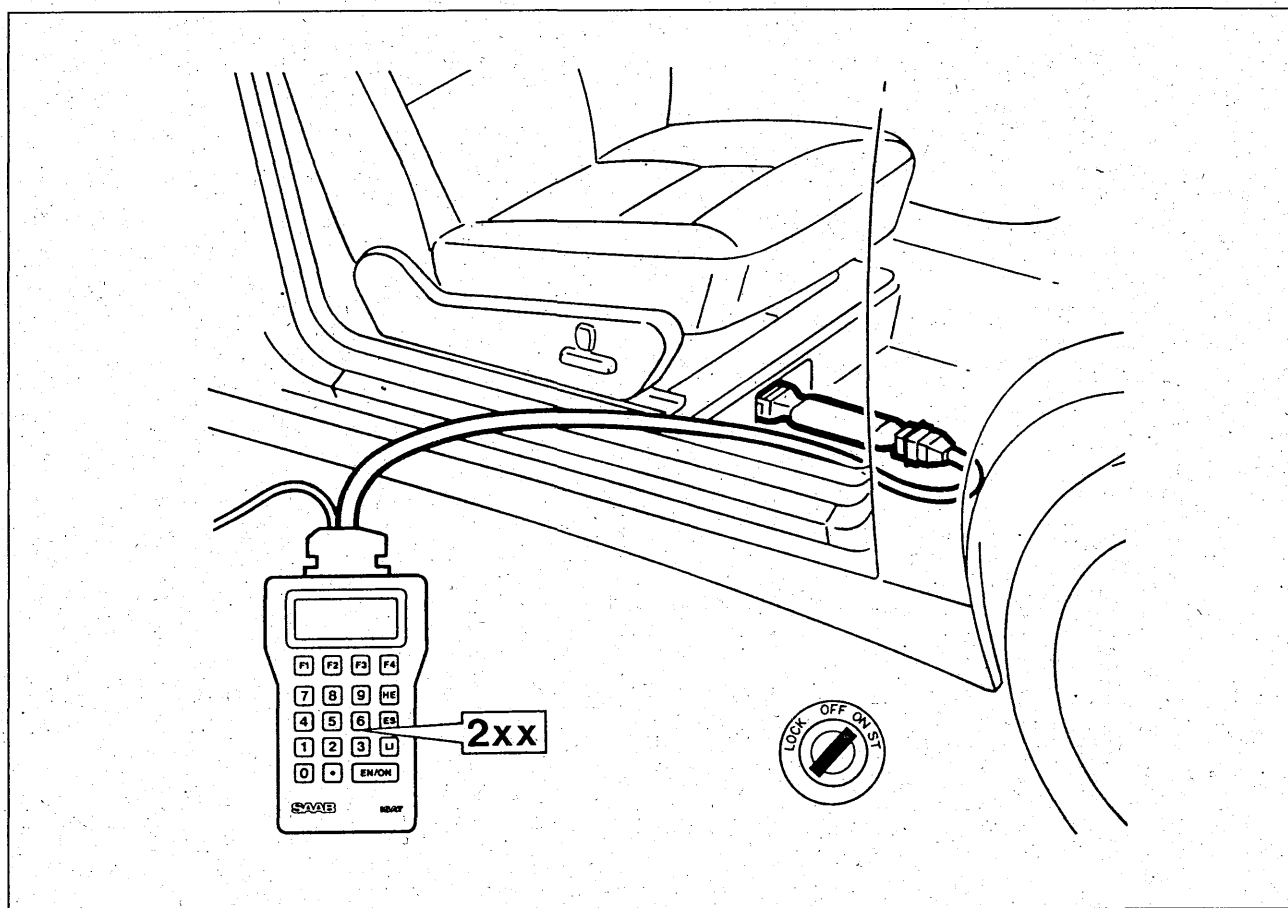
TCS (4 Cyl) (contd.)

Menu structure for command codes



TCS (4 Cyl) (contd.)

ETS command codes



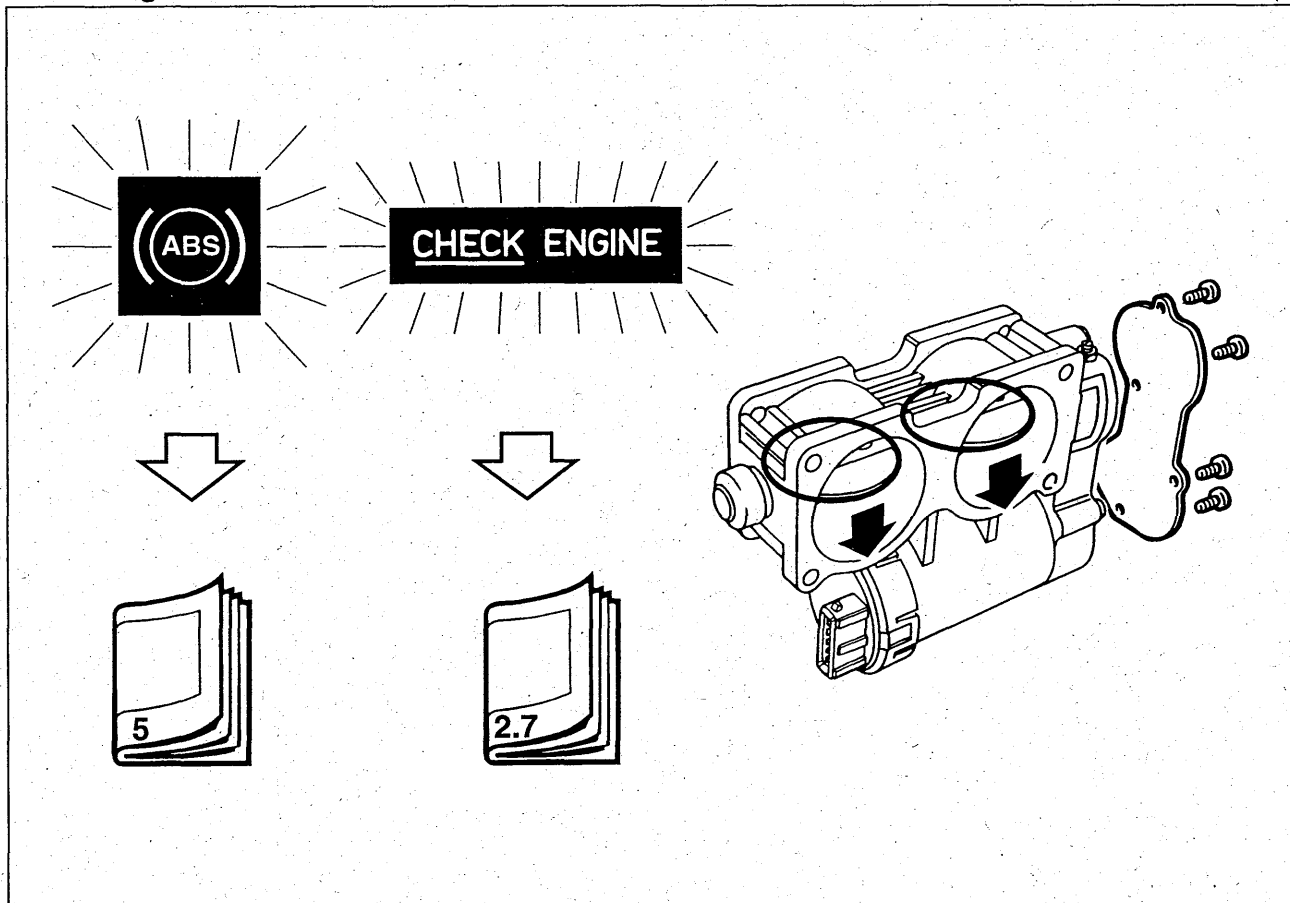
Code	Command function	Text on scan tool
27A	Accelerator pedal travel in %	E.g. 80033=33%
100	Transfer all diagnostic trouble codes to the scan tool	----
101	Transfer 1st diagnostic trouble code + counter	E.g. 58351 80255 = diagnostic trouble code 58351 registered 255 times
102	Transfer 2nd diagnostic trouble code + counter	
103	Transfer 3rd diagnostic trouble code + counter	
104	Transfer 4th diagnostic trouble code + counter	
200	A/C relay, reads current status	8B100=activated 8B000=not activated
202	Cruise control, ON/OFF status	8B102=ON 8B002=OFF
203	Cruise control, SET status	8B103=ON 8B003=OFF
204	Cruise control, RESUME status	8B104=ON 8B004=OFF

Code	Command function	Text on scan tool
205	Brake and clutch switches, status	8B105=ON 8B005=OFF
206	Brake light switch status	8B106=ON 8B006=OFF
207	Safety switch, accelerator pedal	8B107=ON 8B007=OFF
208	Safety switch, throttle body	8B108=ON 8B008=OFF
249	Engine speed	803500=3500rpm
250	Engine coolant temperature in °C	E.g. 800-15=-15°C 800+35=+35°C 80 <-20= <-20°C 80>+50=>+50°C
279	Throttle butterfly opening angle in %	E.g. 80030=30%
280	Speed	80110=110 km/h
281	Engine load signal Tq (pulse width in µs)	idling = approx. 25µs Full load = approx. 500µs
380	Gives EPROM manufacturing number	80 XX RELYY HH:MM DD.MM.YYYY
382	Gives ETS throttle control module part number	80YYYYYY
383	Gives ETS throttle control module serial number	80ZZZZZZ
550	A/C relay activated, 0.2 Hz	8A550
551	Activates safety valve (1 Hz)	8A551
552	Activates charge air bypass valve (1 Hz)	8A552
553	Activates TCS CTRL lamp 1(Hz)	8A553
800	Ends communication	----
900	Erases diagnostic trouble codes	11111
971 *	Basic setting	8A971=in progress 8D971=completed
973 *	Calibration, warm engine	8A973
974 *	Basic setting for idling	8A974
975	Shows actual engine version	see 976-977
976	Stores data on B202 Turbo	802.0T
977	Stores data on B234 Turbo, manual	802.3TS
97A	Stores data on B234 Turbo, automatic	802.3TA

^{*)} For a more detailed description of the calibration procedure, see Service Manual 2:5, pages 171-176.

TCS (6 Cyl)

Fault diagnosis schedule



- 1 If the ANTI LOCK lamp is lit, always begin fault diagnosis in the ABS system.
- 2 If the malfunction indicator (CHECK ENGINE) lamp is lit, always start fault diagnosis in the Motronic system.
- 3 With the ignition switched off, check that the throttle butterfly can freely be moved to the closed position and that it is easily returned to the open position with spring force.

Important

In order to establish communication between the ISAT and the TCS control module, the following must be observed:

- the ignition must be in the drive position
- rpm must be <1500 rpm (if the engine is running)
- the TCS system must be connected

The ISAT cannot make contact with the system if:

- the circuit to pin 9 on the control module is faulty
- pins 13/30 are not correctly grounded
- pins 28/32 do not have the correct voltage supply
- the circuit to pin 3 is shorted to battery+

TCS (6 Cyl) (contd.)

Readings, control module connections

Unless otherwise stated, the ignition must be in the ON position. All values are approximate.

Pin	Color	Component/Function	In/Out	Measuring conditions	Reading	Between X-Y	See 2:5, page
1	BK/WH	TCS OFF/ON	In	TCS switch ON (pushed in)	BPV	32 — 1	18
				TCS switch OFF (not pushed in)	0 V		
2		No connection					
3	YE/WH	Position sensor, TCS throttle, reference voltage	Out		approx. 5 V	3 — 13	20
4		No connection					
5	RD/WH	Disengaging cruise control	Out	Activate with ISAT scan tool: ON	BPV	5 — 13	25
				Activate with ISAT scan tool: OFF	0 V		
6	OG	Engine speed	In	Idling	40 Hz (LP LO HI)	6 — 13	23
7	BU	Wheel speed FR	In		14.25 Hz (LP HI LOp)	7 — 13	22
				Rotate FR wheel approx. 1/2 turn/s	46 Hz (LP HI LOp)		
8	GN	Wheel speed RR	In		14.25 Hz (LP HI LOp)	8 — 13	22
				Rotate RR wheel approx. 1/2 turn/s	46 Hz (LP HI LOp)		
9	BU/WH	Data link K	In/Out	ISAT scan tool connected	BPV	9 — 13	15
				ISAT scan tool not connected	0 V		
10		No connection					
11	YE	Position signal, main butterfly (from MOTRONIC). Engine temp. signal (from MOTRONIC)	In	Idling	1.2 volt 100 Hz 9% (+) 0.9 ms (+) (LP LO HI)	11 — 13	21
				Ignition ON, starter motor running.	0.25-1.0 V 100 Hz 2-8.2% (+) 0.2-0.82ms (+) (LP LO HI)		
12	BN/WH	TCS lamp	Out	Activate with ISAT scan tool: ON	BPV	32 — 12	16
				Activate with ISAT scan tool: OFF	0 V		
13	BK	Ground	In		< 0.1 V	13 — B-	14
14		No connection					
15		No connection					
16		No connection					

Pin	Color	Component/Function	In/Out	Measuring conditions	Reading	Between X-Y	See 2:5, page
17		No connection					
18	GN/WH	Throttle motor Important Erase any trouble codes after this test.	Out	Activate with ISAT: BUTTERFLY CLOSING ON	3.5 volts 500 Hz 35% (+) 0.7 ms (+) (LP LO HI)	18 — 35	19
				As above + open throttle by hand (max. 5 s)	8-11 volts		
				As above + close butterfly additionally by hand (max 5 secs)	minus 8 to minus 11 V		
19		No connection					
20	WH	Position sensor, butterfly TCS, ground	Out		BPV	32 — 20	20
21	GY	Disengaging full-load enrichment system	Out		6 volts 31 Hz 50% (+) 16 ms (+) (LP HI LO)	21 — 13	26
				TCS function activated	6 volts 62 Hz 50% (+) 8 ms (+) (LP HI LO)		
22		No connection					
23	WH	Brake light switch	In	Brakes applied	BPV	23 — 13	24
				Brakes not applied	0 V		
24	GY	RL Wheel speed	In		14.25 Hz (LP HI LO)	24 — 13	22
				Rotate RL wheel approx. 1/2 turn/s	46 Hz (LP HI LO)		
25	YE	FL wheel speed	In		14.25 Hz (LP HI LO)	25 — 13	22
				Rotate wheel FL approx. 1/2 turn/s	46 Hz (LP HI LO)		
26	VT/WH	TCS OFF lamp	Out	Turn off the TCS system using switch: lamp LIT	BPV	32 — 26	17
				Activate TCS system using switch: lamp OFF	0 V		
27	BU/WH	Position sensor, butterfly TCS, outlet	In	Activate with ISAT: BUTTERFLY CLOSING ON	approx. 1.2 V	27 — 13	20
				Activate using ISAT: BUTTERFLY CLOSING OFF	approx. 4.4 V		

74 Engine

Pin	Color	Component/Function	In/ Out	Measuring conditions	Reading	Between X-Y	See 2:5, page
28	GN/ WH	+15 voltage	In		< 0.5 V	BPV — 28	13
				Ignition OFF	BPV		
29		No connection					
30	BK	Ground	In		< 0.1 V	30 — BPV-	14
31		No connection					
32	RD	Voltage supply	In		< 0.5 V	BPV — 32	13
33		No connection					
34		No connection					
35	GN	Throttle motor	Out	See pin 18		18 — 35	19

TCS (6 Cyl) (contd.)

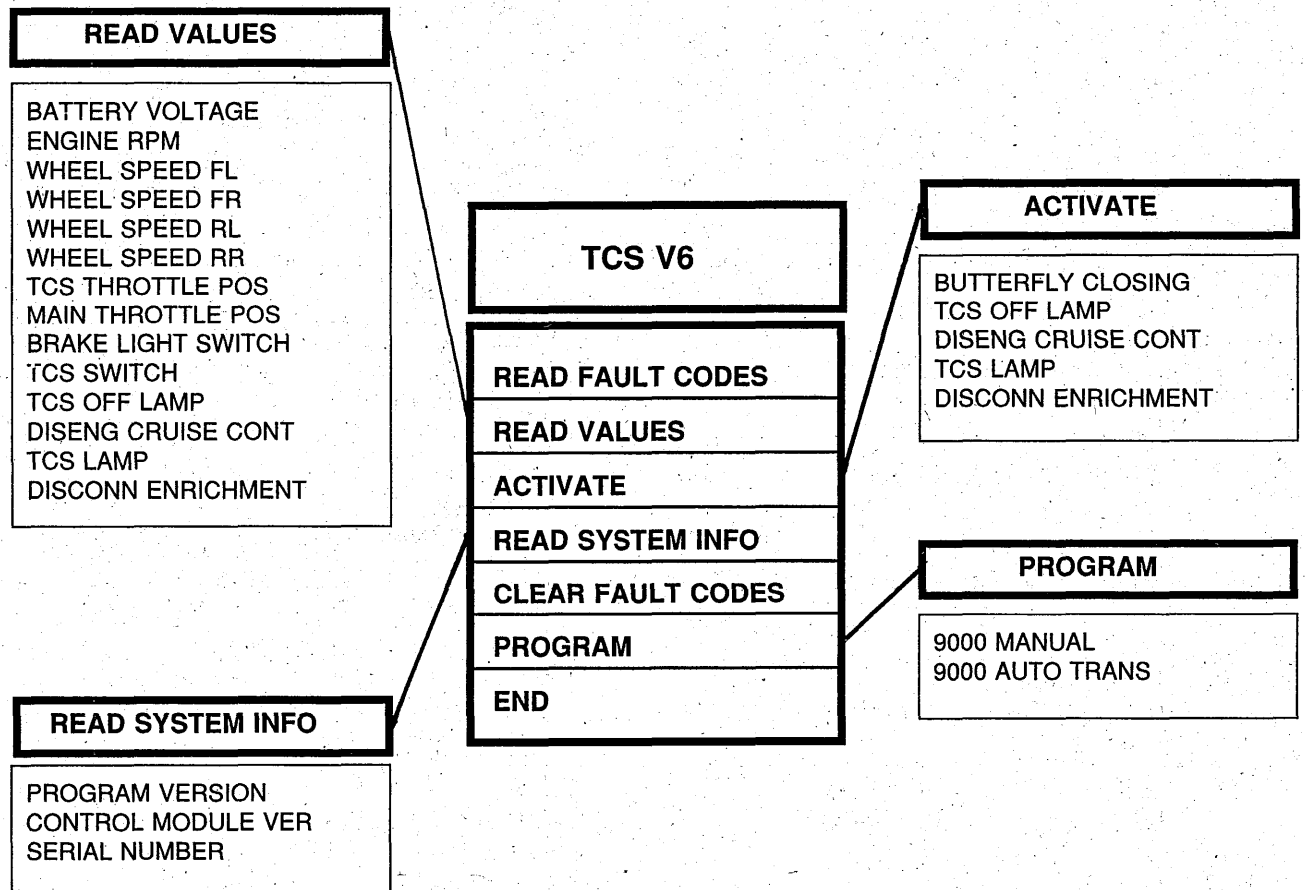
Diagnostic trouble codes

Engine running or ignition key in ON position

Diagnostic trouble code	Faulty function/component	TCS-OFF	Text on ISAT display	See 2:5, page
B1192	TCS switch, shorting to ground	ON	FAULT XX P/I B1192 TCS SWITCH SHORTING TO GROUND	45 (18)
B1302	Position sensor TCS butterfly, shorting to ground/interruption	ON	FAULT XX P/I B1302 TCS THROTTLE SENSOR SHORT TO GND/OPEN	39 (19)
B1303	TCS throttle position sensor, shorted to BPV/open circuit	ON	FAULT XX P/I B1303 TCS THROTTLE SENSOR SHORT BATT+/OPEN	39 (19)
B1371	Wheel speed FL, no signal	ON	FAULT XX P/I B1371 WHEEL SPEED FL FAULTY SIG/NO SIG	42 (22)
B1376	Wheel speed FR, no signal	ON	FAULT XX P/I B1376 WHEEL SPEED FR FAULTY SIG/NO SIG	42 (22)
B1381	Wheel speed RL, no signal	ON	FAULT XX P/I B1381 WHEEL SPEED RL FAULTY SIG/NO SIG	42 (22)
B1386	Wheel speed RR, no signal	ON	FAULT XX P/I B1386 WHEEL SPEED RR FAULTY SIG/NO SIG	42 (22)
B1406	Position signal, main throttle butterfly, faulty	ON	FAULT XX P/I B1406 MAIN THROTTLE POS SIGNAL INCORRECT	46 (21)
B1407	Position signal, main throttle butterfly, short circuit to ground	ON	FAULT XX P/I B1407 MAIN THROTTLE POS SHORT TO GROUND	46 (21)
B1408	Position signal, main throttle butterfly, short circuit to BPV/break	ON	FAULT XX P/I B1408 MAIN THROTTLE POS SHORT BATT+/OPEN	46 (21)
B1605	TCS control module, control module fault	ON	FAULT XX P/I B1605 CONTROL MODULE INTERNAL FAULT	38 (12)
B1610	Control module not programmed	ON	FAULT XX P/I B1610 CONTROL MODULE NOT PROGRAMMED	50 (35)
B1710	Engine speed, no signal	ON	FAULT XX P/I B1710 ENGINE RPM SIGNAL FAULTY SIG/NO SIG	41 (23)
B2433	TCS throttle body, short-circuit to bpv or ground	ON	FAULT XX P/I B2433 THROTTLE MOTOR SHORT BATT+/GROUND	47 (19)
B2434	TCS throttle body, break/mechanical fault	ON	FAULT XX P/I B2434 THROTT HOUSING/MOTOR OPEN/MECH FAULT	48 (19)

TCS (6 Cyl) (contd.)

Menu structure for command codes



TCS (6 Cyl) (contd.)

READ VALUES

	ISAT scan tool display	Function
1	BATTERY VOLTAGE XX.X V	Shows control module supply voltage
2	ENGINE RPM XXXX rpm	Engine speed (shows 450 rpm as lowest value)
3	WHEEL SPEED FL XXX km/h	Wheel speed FL (shows 3 km/h as lowest speed)
4	WHEEL SPEED FR XXX km/h	Wheel speed FR (shows 3 km/h as lowest speed)
5	WHEEL SPEED RL km/h	Wheel speed RL (shows 3 km/h as lowest speed)
6	WHEEL SPEED RR XXX km/h	Wheel speed RR (shows 3 km/h as lowest speed)
7	TCS THROTTLE POS XX %	This figure is the pulse ratio of the TCS throttle position signal from the TCS control module (9-92%)
8	MAIN THROTTLE POS XX %	This figure is the pulse ratio of the main throttle position signal from the MOTRONIC control module to the TCS control module (9-92%)
9	BRAKE LIGHT SWITCH ON/OFF	Shows status of brake light switch
10	TCS SWITCH ACTIVE/NOT ACTIVE	Shows status of TCS switch ("ACTIVE" only when the switch is held pressed)
11	TCS OFF LAMP ON/OFF	Shows whether the TCS control module turns on the TCS OFF lamp
12	DISENG CRUISE CONTROL ON/OFF	Shows whether the TCS control module disengages the cruise control system
13	TCS LAMP ON/OUT	Shows whether the TCS control module turns on the TCS lamp and whether the TCS control module activates the TCS function in the TCM control module
14	DISCONN ENRICHMENT ON/OFF	Shows whether the TCS control module sends the "disconnect full-load enrichment" signal to the MOTRONIC control module (the ISAT display alternates between ON and OFF when the function is activated)

TCS (6 Cyl) (contd.)

ACTIVATE

Important

When a system feature is activated with the scan tool, this means that the TCS control module is doing something which is not functionally normal, which means that diagnostic trouble codes can be generated in other systems that are dependent on the TCS system.

Important

The activate functions should always be used with discretion.

When activating throttle closure, engine torque greatly decreases.

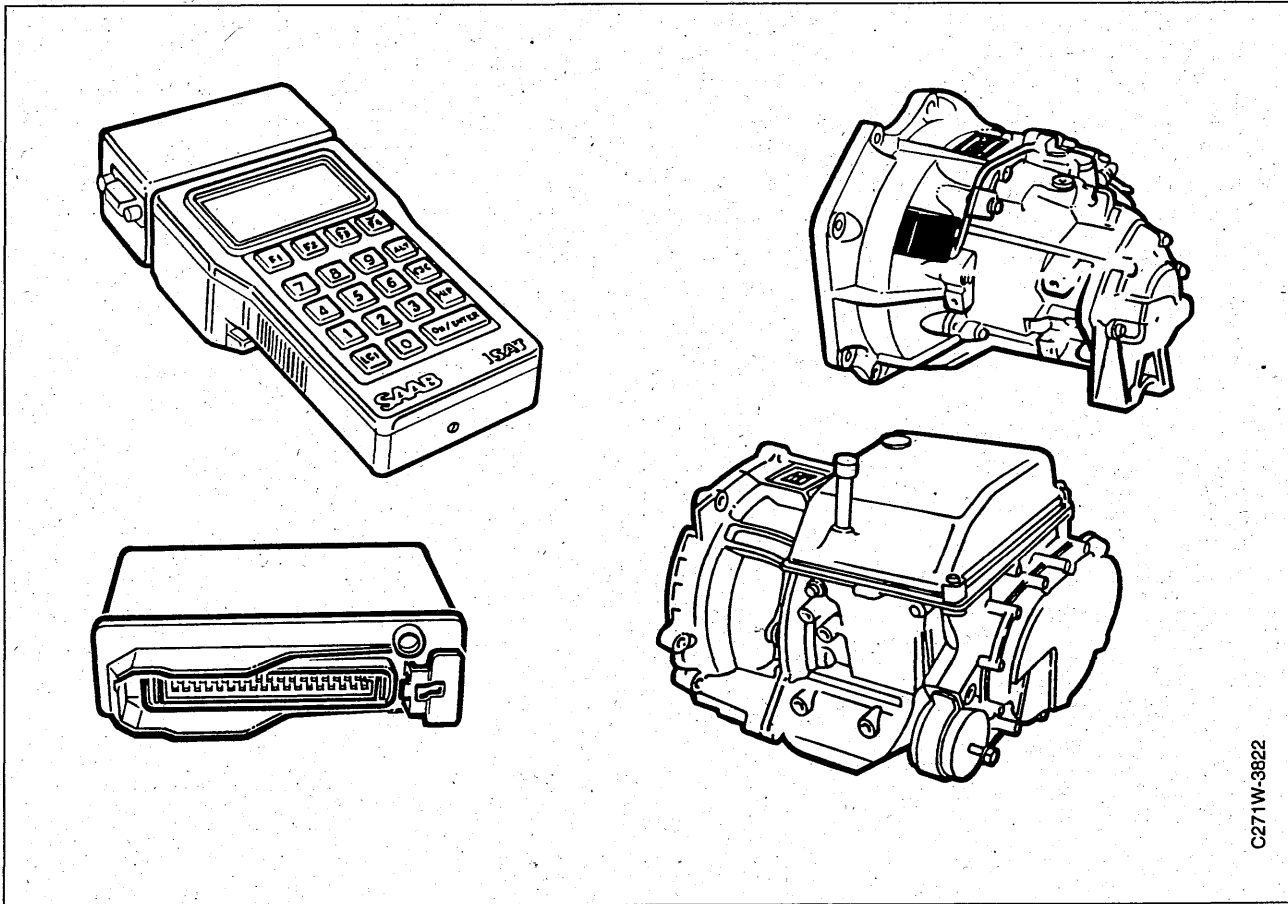
When activating "disconnect full-load enrichment", the engine stops.

- Always deactivate an activated function before proceeding in the scan tool menu.
- Always erase any diagnostic trouble codes that have been registered in the Motronic or TCM system after finishing work.

	ISAT scan tool display	Function
1	BUTTERFLY CLOSING ON/OFF	The TCS control module closes the TCS throttle almost completely
2	TCS OFF LAMP FUNCTION ON/OFF	The TCS control module activates the TCS OFF lamp
3	DISENG CRUISE CON- TROL FUNCTION ON/OFF	The TCS control module disengages the cruise control system
4	TCS LAMP FUNCTION ON/OFF	The TCS control module activates the TCS lamp and the TCS program in the TCM control module
5	DISCONN ENRICHMENT FUNCTION ON/OFF	The TCS control module sends battery+ via the lead to the MOTRONIC control module for disconnection of full-load enrichment. The MOTRONIC control module interprets this as fuel shut-off and the engine stops (used only as a wiring check).

TCS (6 Cyl) (contd.)

READ SYSTEM INFO and PROGRAM



READ SYSTEM INFO

	ISAT scan tool display	Function
1	PROGRAM VERSION	Shows current program in the TCS control module
2	CONTROL MODULE VER	Shows the control module version number
3	SERIAL NUMBER	Shows the serial number of the control module

PROGRAM

	ISAT scan tool display	Function
1	PROGRAMMED FOR 900 MANUAL 900 AUTO TRANS 9000 MANUAL 9000 AUTO TRANS CHANGE OK	Shows the gearbox variant for which the TCS control module is programmed
2	TYPE OF GEARBOX 900 MANUAL 9000 AUTO TRANS	Enables the control module to be programmed for the type of gearbox concerned

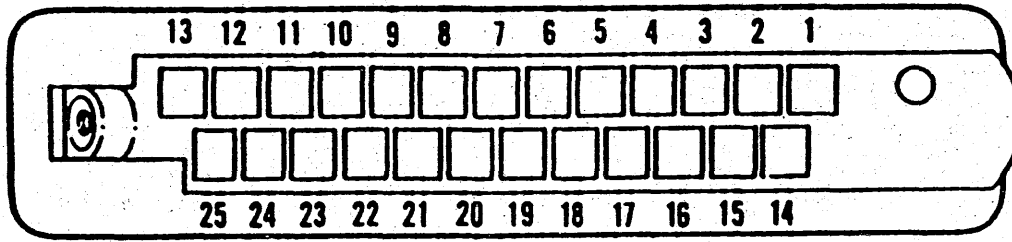
LH MFI

Safety instructions

- 1 Never start the engine if the battery is not properly connected to the engine's electrical systems.
- 2 The car must not be started using an external power source of batteries linked in series (24 volt) or quick charger (16 volt) when the battery is connected to the car's electrical systems.
- 3 If a quick charger is used, make sure that the battery's connection terminals are disconnected.
- 4 Never disconnect the battery when the engine is running.
- 5 Make sure that all leads make good contact.
- 6 Never plug in or unplug the control module connector when the ignition is on.
- 7 Disconnect the connection to the ignition system's final step when compression testing.
- 8 At temperatures over 80 °C (176 °F) (oven enameling/drying), the control module must be removed from the car.
- 9 The control module must be removed before starting arc welding.
- 10 Never mix the fuel pump connections.

LH MFI (contd.)

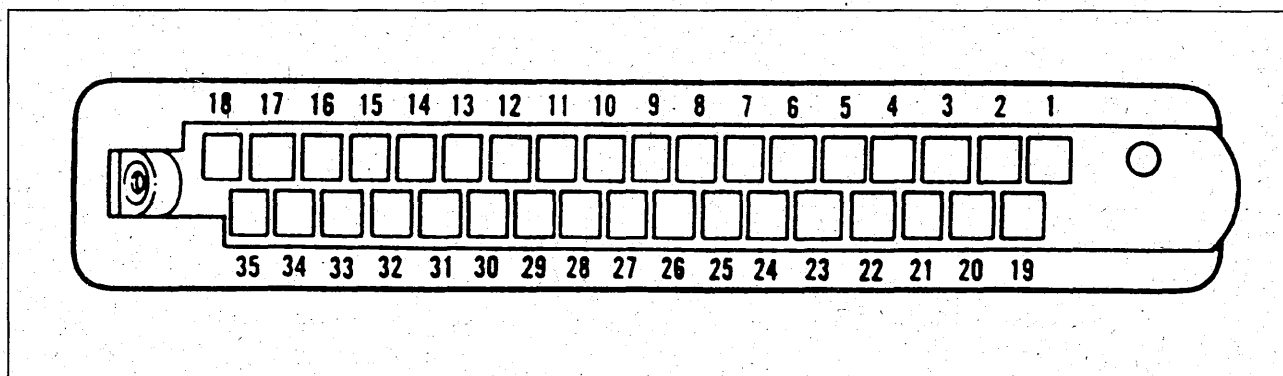
Control module connections LH MFI 2.2



Pin	Color	Component/Function
1	BU	Ignition pulse amplifier (engine speed)
2	YE	Temperature sensor
3	GY	Throttle position switch
4	OG	Signal, "Drive" position (Aut)
5	BK	Grounding point
6	BU/WH	Mass air flow sensor
7	OG	Mass air flow sensor
8	RD/WH	Mass air flow sensor
9	GY/WH	Main relay
10	BU/WH	IAC valve
11	BK	Grounding point
12	GN/RD	Throttle position switch
13	GN/RD	Injectors, control signal
14	WH	Mass air flow sensor
15	BK	Grounding point (LH 2.2 with oxygen sensor)
16	RD/WH	Raised idling (A/C compressor)
17	VT	Pump relay
18	GN/WH	Distribution box, positive terminal (+15)
19	VT/WH	Data link connector
20	WH	M88: Oxygen sensor/M89 : DI/APC Electronic Ignition control module
21	YE/WH	Main relay
22	GN	Data link connector (CHECK ENGINE)
23	YE/RD	IAC valve
24	BU/RD	Engine load signal, Tq (9000 Turbo with Electronic Ignition and 9000 i/S with EZK)
25	BK/WH	Grounding point

LH MFI (contd.)

Readings, control module connections LH MFI 2.4 and 2.4.1



Pin	Color	Component/Function	In/ Out	Voltage	Remarks
1	BU	Rpm signal from ignition system	In	6.5 V >8 V	with starter motor running when idling
2	GY	Throttle position sensor, idling switch		0 V 12 V	idling above idling
3	GN/RD	Throttle position sensor, wide open throttle switch		12 V 0 V	idling wide open throttle
4	RD	Voltage supply +30	In	12 V	
5	BK	Signal ground		0 V	separated from chassis ground
6	BU/WH	Mass air flow sensor, ground signal	In	0 V	
7	OG	Mass air flow sensor, signal	In	2 V 5 V	idling full load
8	RD/WH	Mass air flow sensor, free burning	Out	4 V 0 V	during free burning in other cases
9	GY/WH	Voltage supply from main relay	In	12 V	
10		No connection			
11		No connection			
12	BU/WH	Data link K	In/ Out		(PWM signal)
13	YE	Engine temperature sensor	In	4-0.5 V	-20°C-+80°C
14	GN/WH	A/C / ACC, load signal (not ETS)	In	12 V 0 V	AUTO *) ECON, OFF
15	GN/GY	Coding for cold start injector (not ETS)		12 V 0 V	valve fitted valve not fitted
16	GY/RD	Data link L	In/ Out		PWM signal
17	BK/WH	Chassis ground		0 V	
18	GN/RD	Injectors	Out		***)
19	YE/WH	EGR valve	Out	12 V <12 V	not activated activated
20	VT	Fuel pump relay, operating circuit	Out	1 V 12 V	activated ignition on
21	YE/WH	Main relay, operating circuit	Out	1 V 12 V	ignition on ignition off
22	VT/WH	Malfunction indicator (CHECK EN- GINE) lamp	Out	12 V 1 V	off on

Pin	Color	Component/Function	In/ Out	Voltage	Remarks
23	YE	EGR temperature sensor	In	4.5 V <4.5 V	EGR closed EGR open
24	GN	Signal from oxygen sensor	In	0.6-1 V 0-0.4 V	rich lean
25	BU/RD	Engine load signal, Tq	Out		**)
26	WH	SHIFT UP lamp (US manual)	Out	12 V 0 V	not activated activated
27	YE/RD	EVAP canister purge valve	Out	12 V 1 V	open valve closed valve
28	WH	PRE IGNition signal	In	0 V 6.5 V 12 V	enriching pre-ignition no enriching enriching knocking
29	GY/WH	Coding	In		not used
30	OG	DRIVE signal	In	12 V 0 V	R,D,1,2 and 3 P,N and manual gearbox
31	GN/RD	Consumption signal to EDU 3	Out		***)
32	-	Cold start injector (certain versions, not ETS)	Out	12 V 0 V	not activated activated (<-15°C)
33	BU/WH	Idle air control valve, control signal (not ETS)		5-12 V	
34		No connection			
35	GN/WH	+15 Voltage	In	12 V	ignition on

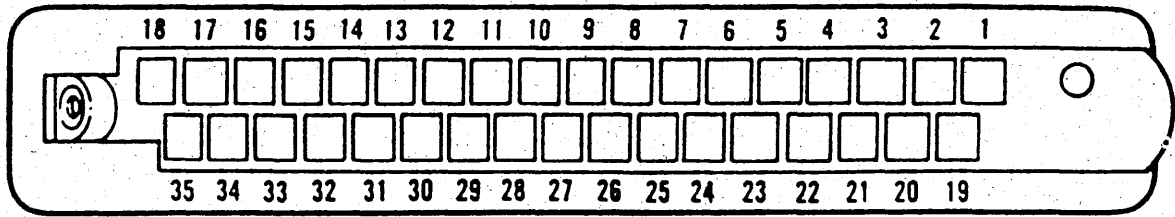
*) On condition that the frost protection thermostat is closed.

***) Use the ISAT scan tool pulse measuring feature and check that pulse width and frequency change with throttle position.

***) The ISAT scan tool pulse measuring feature and check that frequency changes with throttle position.

LH MFI (contd.)

Readings, control module connections MFI LH 2.4.2



Pin	Color	Component/Function	In/ Out	Voltage	Remarks
1	BU	Rpm signal from ignition system	In	6.5 V >8 V	with starter motor running when idling
2	GY	Throttle position sensor (not ETS)	In	0.2 V 4 V	idling full load
3	GN/RD	Not ETS: Throttle angle signal to DI/APC Electronic Ignition (PWM)	Out	1 V 10 V	idling full load
		With ETS: Throttle angle signal from ETS		0.5 V 10 V	idling full load
4	RD	Voltage supply +30	In	12 V	
5	BK	Signal ground		0 V	separated from chassis ground
6	BU/WH	Mass air flow sensor, ground signal	In	0 V	
7	OG	Mass air flow sensor, signal	In	2 V 5 V	idling full load
8	RD/WH	Mass air flow sensor, free burning	Out	4 V 0 V	during free burning in other cases
9	GY/WH	Voltage supply from main relay	In	12 V	
10	GN/RD	Throttle position sensor, reference voltage (not ETS)	Out	5 V	
11	GN/RD	A/C relay, operating circuit	Out	12 V 0 V	A/C not connected A/C connected
12	BU/WH	Data link K	In/ Out		(PWM signal)
13	YE	Engine temperature sensor	In	4-0.5 V	-20°C-+80°C
14	GN/WH	A/C / ACC, load signal (not ETS)	In	12 V 0 V	AUTO *) ECON, OFF
15	GN/GY	Idle air control valve, opening control signal (not ETS)	Out	7-11 V	unloaded, idling and with warm engine
16	GY/RD	Data link L	In/ Out		PWM signal
17	BK/WH	Chassis ground		0 V	
18	GN/RD	Injectors	Out		***)
19	YE/WH	EGR valve	Out	12 V <12 V	not activated activated
20	VT	Fuel pump relay, operating circuit	Out	1 V 12 V	activated ignition on

Pin	Color	Component/Function	In/ Out	Voltage	Remarks
21	YE/WH	Main relay, operating circuit	Out	1 V 12 V	ignition on ignition off
22	VT/WH	Malfunction indicator (CHECK ENGINE) lamp	Out	12 V 1 V	off on
23	YE	EGR temperature sensor	In	4.5 V <4.5 V	EGR closed EGR open
24	GN	Signal from oxygen sensor	In	0.6-1 V 0-0.4 V	rich lean
25	BU/RD	Engine load signal, Tq	Out		**)
26	WH	SHIFT UP lamp (US manual)	Out	12 V 0 V	not activated activated
27	YE/RD	EVAP canister purge valve	Out	12 V 1 V	open valve closed valve
28	WH	PRE IGNition signal	In	0 V 6.5 V 12 V	enriching pre-ignition no enriching enriching knocking
29	GY/WH	Coding	In		not used
30	OG	DRIVE signal	In	12 V 0 V	R,D,1,2 and 3 P,N and manual gearbox
31	GN/RD	Consumption signal to EDU 3	Out		***)
32	-	Cold start injector (certain versions)	Out	12 V 0 V	not activated activated (<-15°C)
33	BU/WH	IAC valve, closing signal (not ETS)	Out	5-11 V	unloaded idling
34	GN	Signal from vehicle speed sensor	In	6 V 0 or 12 V	rotating wheels stationary wheels
35	GN/WH	+15 Voltage	In	12 V	ignition on

*) On condition that the frost protection thermostat is closed.

**) Use the ISAT scan tool pulse measuring feature and check that pulse width and frequency change with throttle position.

***) The ISAT scan tool pulse measuring feature and check that frequency changes with throttle position.

LH MFI (contd.)**Diagnostic trouble codes MFI LH 2.2, system test unit**

(25 pin connector)

Diagnostic trouble code	Pin No.	Malfunction	See 2:3 on page
E001	1	No ignition pulse	240-7
E101	1	Starter motor, rpm too slow	240-7
E002	2	Temperature sensor, no signal	240-7
E102	2	Temperature sensor, circuit shorted	240-7
E003	3	Throttle position switch, idle switch not closing in closed throttle position	240-8
E103	3	Throttle position switch, idle switch not opening when engine speed is increased from idling to 2500 rpm.	240-8
E005	5	ECM pin 5, no ground contact	240-8
E006	6	Mass air flow sensor, no ground contact	240-9
E007	7	Mass air flow sensor, no signal	240-9
E107	7	Mass air flow sensor, signal too low	240-9
E207	7	Mass air flow sensor, signal too high	240-9
E008	8	Mass air flow sensor, no filament burn-off function	240-10
E108	8	Mass air flow sensor, filament burn-off function constantly activated	240-10
E009	9	Main relay, no voltage supply (diagnostic trouble codes always occur when MFI LH3 software is used)	240-10
E109	9	Main relay, voltage supply too low	240-10
E010	10	IAC valve, no signal from ECM, pin 10	240-11
E011	11	ECM, pin 11, no ground connection	240-11
E012	12	Throttle position switch, wide open throttle switch does not close	240-11
E112	12	Throttle position switch, wide open throttle switch continuously closed	240-12
E213	13	Injectors, injection pulses continuously activated	240-12
E014	14	MAF sensor, break in circuit for CO adjustment	240-12
E017	17	Pump relay, faulty operating circuit	240-13
E018	18	Distribution terminal +15, no voltage supply	240-13
E020	20	Oxygen sensor, incorrect signal	240-13
E320	20	DI/APC Electronic Ignition, PRE —IGN signal constantly activated	240-14
E021	21	Main relay, operating circuit faulty	240-14
E023	23	IAC valve, no signal	240-14
E025	25	ECM pin 25, no ground contact	240-14

The page references apply to Service Manual 2:3 "Fuel injection system" M1985-1989-

This book will be replaced by Service Manual 2:3 "LH Multiport fuel injection system" M1985-1993, which means that the page references will no longer apply. When the new book comes out, you are instead referred to "Fault diagnosis".

LH MFI (contd.)

Possible faults caused by:

E002:	E025
E006:	E007
E009:	E017,E102,E213,E001
E013:	E213,E001,E101
E014:	E025
E017:	E010,E001,E101
E018:	E001
E021:	E009,E007,E001,E213
E023:	E001
E025:	E001

In addition, the following may be displayed:

"GLOU"	Filament burn-off in mass air flow sensor
"C 1"	LH 2.2
"C 2"	LH 2.2 with IAC
"C 3"	LH 2.2 with IAC and closed loop system
"F PU"	Fuel pump activated
"FUEL"	Fuel mode
"OFF"	Starting position for testing of injectors
"F in"	Injectors in open position
"Mon"	Monitor mode

LH MFI (contd.)**Diagnostic trouble codes, MFI LH 2.4, System test unit**

(35 pin connector)

Diagnostic trouble code	Pin No.	Malfunction	See 2:3 on page
E001	1	No ignition pulse	240-15
E101	1	Starter motor, rpm too slow	240-15
E002	2	Throttle position switch, idle switch not closing in closed throttle position	240-15
E102	2	Throttle position switch, idle switch not opening when engine speed is increased from idling to 2500 rpm.	240-16
E003	3	Throttle position switch, wide open throttle switch constantly open	240-16
E103	3	Throttle position switch, wide open throttle switch continuously closed	240-16
E004	4	No BPV to ECM memory function	240-16
E005	5	ECM pin 5, no ground contact	240-17
E006	6	Mass air flow sensor, no ground contact	240-17
E007	7	Mass air flow sensor, no signal	240-17
E107	7	Mass air flow sensor, signal too low	240-17
E207	7	Mass air flow sensor, signal too high	240-17
E008	8	Mass air flow sensor, no filament burn-off function	240-18
E108	8	Mass air flow sensor, filament burn-off function constantly activated	240-18
E009	9	Main relay, no voltage supply (diagnostic trouble codes always occur when MFI LH3 software is used)	240-18
E109	9	Main relay, voltage supply too low	240-18
E013	13	Temperature sensor, no signal	240-19
E013	13	Temperature sensor, circuit shorted	240-19
E017	17	No ground connection	240-19
E218	18	Injectors, injection pulses continuously activated	240-19
E020	20	Pump relay, faulty operating circuit	240-19
E021	21	Main relay, operating circuit faulty	240-20
E024	24	Oxygen sensor, incorrect signal	240-20
E328	28	PRE IGN signal, constantly grounded	240-20
E033	33	Idle air control valve, no signal from pin 33	240-21
E035	35	No voltage supply from distribution terminal +15	240-21

The page references apply to Service Manual 2:3 "Fuel injection system" M1985-1989-.

This book will be replaced by Service Manual 2:3 "LH Multiport fuel injection system" M1985-1993, which means that the page references will no longer apply. When the new book comes out, you are instead referred to "Fault diagnosis".

LH MFI (contd.)

Possible faults caused by:

E001:	E107,E020,E017,E113
E005:	E107,E001
E006:	E107
E009:	E020,E109,E001,E107,E113
E017:	E107,E001
E018:	E107,E001
E020:	E107,E001
E021:	E013,E029,E009,E107,E001
E024:	E017

In addition, the following may be displayed:

"GLOU"	Filament burn-off in mass air flow sensor
"C 6"	LH 2.4
"F PU"	Fuel pump activated
"FUEL"	Fuel mode
"OFF"	Starting position for testing of injectors
"F in"	Injectors in open position
"Mon"	Monitor mode

LH MFI (contd.)

LH MFI diagnostic trouble codes, Self diagnosis

Important

The suggested action in the table below should be regarded as a starting point for continued fault diagnosis.

If the engine will not start, always check if there is an ignition signal as per self diagnosis code 12231.

Temporary faults of a serious nature make the malfunction indicator (CHECK ENGINE) lamp light while the fault is present. When the fault temporarily disappears, the MIL (CHECK ENGINE) lamp goes out, but the fault code is always stored.

Diagnostic trouble code	CHECK	LH MFI system			Possible cause of fault	See 2:3 page
	ENGINE	2.4	2.4.1	2.4.2		
12111	Off	x	x	x	Adaptation fault, closed loop. (fuel/air mixture at closed throttle)	240-30
12112	Off	x	x	x	Adaptation fault, closed loop. (fuel/air mixture when driving)	240-30
12113	Off	x	x		Adaptation fault, idle speed control, pulse ratio too low	240-30
12114	Off	x	x		Adaptation fault, idle speed control, pulse ration too high.	240-30
12211	Off	x	x	x	BPV incorrect (under 10 V or over 16 V with engine running).	240-29
12212	Off	x	x		Throttle position switch closed throttle contact faulty, shorted to ground while driving.	240-30
12213	Off	x	x		Throttle position switch wide open throttle contact faulty, shorted to ground at low load (closed throttle).	240-30
12214	On	x	x	x	Temperature sensor, faulty signal (temp under -90°C or over +160°C).	240-29
12221	On	x	x	x	MAF sensor, no signal. Car goes to limp-home mode.	240-29
12222	Off	x	x	x	Idle speed control faulty	240-30
12223	On	x	x	x	Fuel/air mixture too lean	240-29
12224	On	x	x	x	Fuel/air mixture too rich	240-29
12225	On	x	x	x	Oxygen sensor, faulty signal/preheating not operating (engine temperature must be over +70°C, for M88 over +80°C)	240-29
12231	Off	x	x	x	No ignition signal. Always comes as the first diagnostic trouble codes if the engine is switched off. Run the starter motor for 5 secs. If the code disappears, the ignition signal is OK and the fault lies elsewhere.	240-29
12232	Off	x	x	x	Voltage for memory > 1 V	240-29
12233	On	x	x	x	Change made in EPROM, (=ROM fault)	*)
12241	On	x	x	x	Injector, malfunction	*)

Diagnostic trouble code	CHECK	LH MFI system			Possible cause of fault	See 2:3 page
	ENGINE	2.4	2.4.1	2.4.2		
12242	Off	x	x	x	MAF sensor, no filament burn-off	*)
12243	Off	x	x		Vehicle speed sensor, no signal	*)
12244	Off	x	x	x	No drive signal to pin 30 (Aut.)	*)
12245	On	x	x	x	EGR function faulty, USA West	*)
12251	On			x	Throttle position sensor faulty	*)
12252	Off			x	EVAP canister purge valve not working	*)
12253	On			x	PRE IGNition signal more than 20 secs.	*)
12254	Off			x	No rpm signal, engine stationary	*)
00000	Off	x	x	x	No more faults/ no faults detected	240-30

*) For action, see fault diagnosis routines in Service Manual 0 "News 1990" on page 47

The page references apply to Service Manual 2:3 "Fuel injection system" M1985-1989-

This book will be replaced by Service Manual 2:3 "LH Multiport fuel injection system" M1985-1993, which means that the page references will be incorrect. When the new book comes out, you are instead referred to the "Fault diagnosis" section.

This also applies to the News book.

When faults occur in the LH 2.4 MFI system which can be classified as "adaptation faults", the car must be driven for approximately 10 minutes to avoid the corresponding diagnostic trouble codes reappearing, despite the fault having been corrected. The reason for this is that the system tries to compensate for changes that affect the function in one direction or another.

When the system compensates for values outside the fault limit, a diagnostic trouble code is registered.

When the diagnostic trouble codes are cleared, the learned fault compensation remains. Before the diagnostic trouble codes are cleared, the system must learn a new compensation.

This compensation takes a certain time for the system to implement. The time varies depending on the fault, but 10 minutes of driving with a warm engine is sufficient for the system to "learn" and adapt to the new conditions.

This applies to the following diagnostic trouble codes:

- 12223, 12224 and 12225
(oxygen sensor signal/preheating)
- 12111 and 12112
(adaptation fault, closed loop)
- 12113 and 12114
(adaptation fault, idle speed control)

LH MFI (contd.)**Table for component and signal testing**

ID code	CHECK ENGINE	Component/Signal	Remarks
— —	-	Fuel signal	Listen (pump runs for about 1 sec)
12411	-	Injectors	Listen
12412	-	IAC valve	The valve alternates between open and closed once every second. Listen
12413	-	EVAP canister purge valve	The valve alternates between open and closed once every second. Listen
12414	-	EGR valve	Listen
12415	-	A/C	Listen
12421	-	Drive signal, aut.	Lamp stops flashing when changing from "N" to "D"
12424	-	Throttle position switch, closed throttle signal	Lamp stops flashing when the accelerator pedal is depressed.
12431	-	Throttle position sensor, wide open throttle signal	The lamp stops flashing when the accelerator pedal is fully depressed
12432	-	Fuel pump	Listen

LH MFI (contd.)

Diagnostic trouble codes LH 2.4 and LH 2.4.1 M1990, ISAT ST

Permanent	Temporary	Faulty component/signal	Action
67192	-	ROM fault	*)
45771	25771	Throttle position switch, closed throttle contact does not open when engine speed and load increase (constantly grounded)	*)
45772	25772	Throttle position switch, wide open throttle switch continuously closed	*)
46261	26261	Temperature sensor, signal constant	*)
46271	26271	Temperature sensor, temp over +160°C (constant ground)	*)
46221	26221	Temperature sensor, temp under -90°C (break)	*)
42291	22291	ECM pin 4, voltage < 10 V or > 16 V	*)
42251	22251	ECM pin 4, voltage too low (< 10 V)	*)
58121	38121	MAF sensor, no filament burn-off function.	*)
45691	25691	MAF sensor, faulty signal (too high or too low)	*)
42491	22491	Fuel/air mixture faulty for long period (idling additive)	*)
42492	22492	Fuel/air mixture faulty for long period	*)
42450	22450	Fuel/air mixture too lean	*)
42440	22440	Fuel/air mixture too rich	*)
42460	22460	Oxygen sensor, incorrect signal	*)
58321	38321	IAC valve, malfunction	*)
44261	24261	Vehicle speed sensor, faulty signal	*)
45723	25723	DRIVE signal, malfunction	*)
46391	26391	EGR system, malfunction (temp too high or too low)	*)
58371	38371	Injectors, injection pulses malfunction	*)

*) For action, see fault diagnosis schedule in Service Manual 0: News M1990, page 47 Engine.

This section will be replaced by Service Manual 2:3 "LH Multiport fuel injection system" M1985-1993, which means that the page references will be incorrect. When the new book comes out, you are instead referred to "fault diagnosis".

LH MFI (contd.)

Diagnostic trouble codes LH 2.4 and LH 2.4.2 M1991-, ISAT scan tool

Permanent	Temporary	Flash code	MIL (CHECK ENGINE)	Faulty component/signal	Action
42241	22241	12211		Voltage too high (>16 V) (M1991-)	*)
42251	22251	12232		ECM pin 4, voltage too low (<1 V)	*)
42252	22252	12211		Voltage too low (<10 V) (M1991-)	*)
42291	22291	12211		BPV too low or too high (<10 V >16 V)	*)
42440	22440	12224	On	Fuel-air mixture too rich, oxygen sensor cannot regulate	*)
42441	22441	12112		Fuel-air mixture too rich when idling (M1991-)	*)
42442	22442	12111		Fuel-air mixture too rich when driving (M1991-)	*)
42450	22450	12223	On	Fuel-air mixture too lean, oxygen sensor cannot regulate	*)
42451	22451	12112		Fuel-air mixture too lean when idling (M1991-)	*)
42452	22452	12111		Fuel-air mixture too lean when driving (M1991-)	*)
42460	22460	12225	On	Oxygen sensor, incorrect signal	*)
42491	22491	12112		Fuel-air mixture too lean when idling	*)
42492	22492	12111		Fuel-air mixture too lean when driving	*)
44221	24221	12231		No rpm signal (engine not turning)	*)
		12254		No rpm signal (engine not turning) (2.4.2 only)	
44261	24261	12243		ECM pin 34, no speed signal	*)
44671	24671	12253	On	PRE IGNition, signal >20 sec (M1991-) (2.4.2 only)	*)
45641	25641	(12221)	On	MAF sensor, signal too high (M1991-) (2.4.2 only)	*)
45651	25651	(12221)	On	MAF sensor, signal too low (M1991-) (2.4.2 only)	*)
45691	25691	12221	On	MAF sensor, signal too high or too low	*)
45723	25723	12244		ECM pin 30, no DRIVE signal (Aut.)	*)
45771	25771	12212		Throttle position switch/sensor, closed throttle constantly grounded (2.4 only)	*)
		12213		Throttle position switch/sensor, wide open throttle position constantly grounded (2.4 only)	
		12251	On	Throttle position sensor faulty (2.4.2 only)	
46221	26221	12214	On	Temperature sensor, temp too low (break)	*)
46261	26261	12214	ON	Temperature sensor, signal constant	*)
46271	26271	12214	ON	Temperature sensor, temp too high (short to ground)	*)
46391	26391	12245	On	EGR system, malfunction (temp too low)	*)
58121	38121	12242	On	Mass air flow sensor, no filament burn-off function	*)

Permanent	Temporary	Flash code	MIL (CHECK ENGINE)	Faulty component/signal	Action
58321	38321	12222		IAC valve, malfunction	*)
58322	38322	12252		EVAP canister purge valve, malfunction (2.4.2 only)	*)
58371	38371	12241	On	Injector, malfunction	*)
58372	38372	12251	On	EVAP canister purge valve break/short to ground (M1991-) (2.4.2 only)	*)
58382	38382	12251	On	EVAP canister purge valve short to BPV (M1991) (2.4.2 only)	*)
67192		12233	On	ROM fault	*)
		12411		Operation, injectors (2.4.2 only)	
		12412		Operation, IAC valve (2.4.2 only)	
		12413		Operation, EVAP canister purge valve (2.4.2 only)	
		12414		Operation, EGR valve (2.4.2 only)	
		12415		Operation, A/C (2.4.2 only)	
		12421		Operation, DRIVE signal (2.4.2 only)	
		12424		Operation, throttle position sensor, closed throttle (2.4.2 only)	
		12431		Operation, throttle position sensor, wide open throttle (2.4.2 only)	
		12432		Operation, fuel pump (2.4.2 only)	
		12511		Load signal to EZK (drop) (2.4.2 only)	
		12512	On	Knock sensor fault, EZK (2.4.2 only)	
		12513	On	Knock control signal from EZK (2.4.2 only)	

*) For action, see Fault diagnosis schedule in Service Manual 0 "News" M1991, page 31 Engine.

This section will be replaced by Service Manual 2:3 "LH Multiport fuel injection system" M1985-1993, which means that the page references will be incorrect. When the new book comes out, you are instead referred to "fault diagnosis".

LH MFI (contd.)

Menu structure for command codes

LH MFI
READ FAULT CODES
CLEAR FAULT CODES
READ SYSTEM INFO
CODE
END

LH MFI (contd.)**Command codes LH 2.4 and 2.4.1 M1990, ISAT scan tool**

Code	Function/signal	Display text/example
100	All diagnostic trouble codes are transferred from the ECM memory to the scan tool	
200	Checks A/C status (not TCS)	8B100 (=activated) 8B000 (=not activated)
201	Checks throttle position	8B101 (=closed throttle) 8B001 (=normal position) 8B301 (=wide open throttle) 8B102 (=closed throttle+open throttle)
202	Checks position of EVAP canister purge valve	8B002 (=open) 8B102 (=closed)
203	Checks DRIVE signal status	8B103 (=activated) 8B003 (=not activated)
205	Checks oxygen sensor status	8B105 (=rich) 8B305 (=lean) 8B005 (=inactive)
207	Ignition pulses	8B107 (=pulses present) 8B007 (=no pulses)
382	ECM, identification code	Last 4 digits in Bosch spare part number
550	Activates A/C function	8A550
552	Activates injectors (15 Hz and 1.5 ms opening time) Fuel pump disconnected	8A552
553	Activated IAC valve (1Hz)	8A553
554	Activates EVAP canister purge valve (1Hz)	8A554
555	Activates EGR valve (1 Hz) (only where fitted)	8A555
800	Ends communication	
900	Erases all diagnostic trouble codes and resets learned values to the basic level	11111 (System No. 1 is zeroed)
930	Resets all learned values to basic level	11011

LH MFI (contd.)

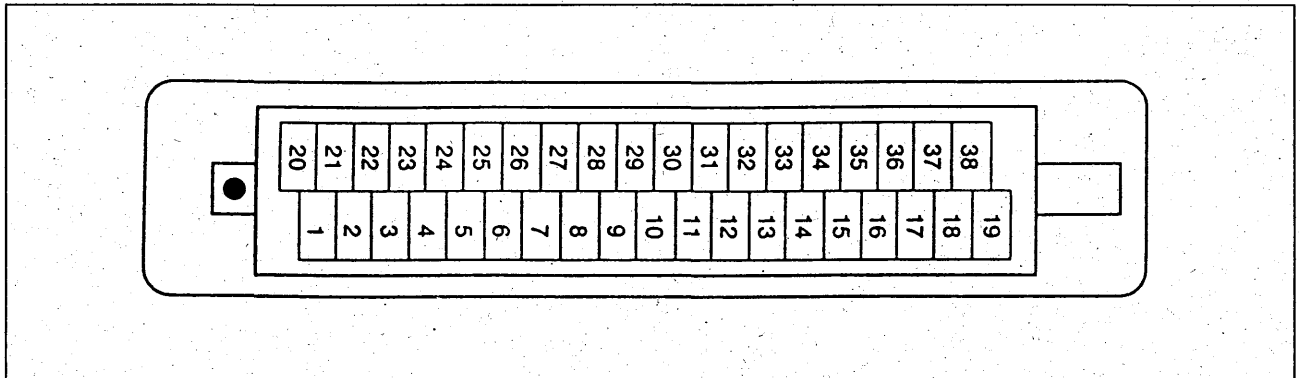
Command codes LH 2.4 and LH 2.4.2 M1991-, ISAT scan tool

Code	Function/signal	Display text/example
22A **)	Mass air flow sensor	803.6=3.6 V 804.7=4.7 V
22B **)	BPV	8010.6=10.6 V 8007.3=7.3 V
23A **)	EGR, pulse ratio	80000=0%(injector closed) 80012=12% 80027=27%
100	All diagnostic trouble codes are transferred from the ECM memory to the scan tool	
200	Check A/C status	8B100=activated 8B000=not activated (not ETS cars)
201	Throttle position	8B101 (=closed throttle) 8 B001 (=normal position) 8B301 (=wide open throttle) 8B103 (=closed throttle-wide open throttle)
202	Position of EVAP canister purge valve	8B002 (=open) 8B102 (=closed)
203	DRIVE signal status	8B103=active 8B003=not active
204	Shift indication (SHIFT UP)	8B104=lamp on 8B004=lamp off
205	Oxygen sensor status	8B105 (=lean) 8B305 (=rich) 8B005 (=inactive)
206	PRE IGNition signal ³	8B106=pre ignition enrichment 8B006=knocking enrichment
207	Ignition pulses	8B007 (=no pulses present) 8B107 (=pulses present)
239 **)	IAC valve pulse ratio	80035=35% 80043=43% (not ETS cars)
249 **)	Rpm	801000=1000rpm 805500=5500rpm
250 **)	Coolant temperature	800-30=-30°C 80+130=+130°C
279 **)	Throttle angle in degrees (°)	E.g. 80030=30° (not ETS cars)
382	ECM code	(The last 4 digits in Bosch spare part number)
550	Activates A/C function	8A550=activated
552	Activates injectors	8A552 (15 Hz and 1.5 ms opening time)
553	Activated IAC valve (1Hz)	8A553 (not ETS cars)

Code	Function/signal	Display text/example
554	Activates EVAP canister purge valve (1Hz)	8A554 from ECM memory to scan tool
555	Activates EGR (1 Hz)	8A555=activated (only where fitted)
800	Ends communication	
900	Erases all diagnostic trouble codes and resets all learned values to base level	11111
930	Resets all learned values to base level	11011

*) When working normally, the scan tool should show 8B006 and 8B106 alternately.

**) When these command codes are used in combination with ISAT with EPROM M93 (version 3.12), communication can be broken. This is because the command codes are not programmed in all LH ECM software. When communication is broken, new contact must be made between the scan tool and the ECM.

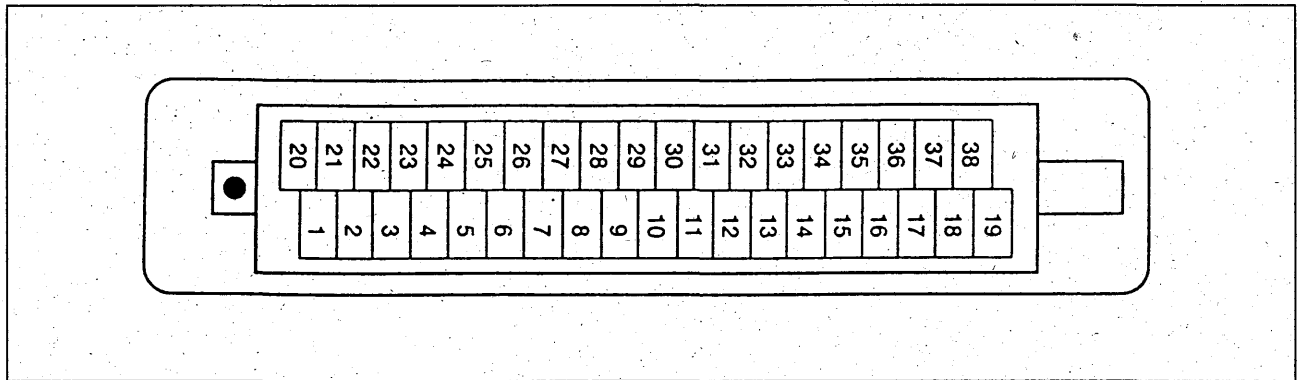
DI-DI/APC Electronic Ignition**Electronic Control Module (ECM) connections -M1990**

Pin	Color	Component/Function	Remarks
1-3		No connection	
4	BU/WH	Data link connector, pin 1	
5	BN	Combustion signal, cyl 3+4	
6	RD	Voltage to crankshaft position sensor	
7	YE/WH	Ground connection for MIL (CHECK ENGINE)	
8	GN/RD	Wide open throttle signal, throttle position switch	
9		No connection	
10	GN	Boost pressure control valve, pin 1	
11	GY	Knock sensor signal	
12		No connection	
13	BK	Ground connection at intake manifold	
14	WH	Signal from pressure sensor, pin 1	
15	BK	Ground connection for crankshaft position sensor	
16		No connection	
17	BK	Ground connection for pressure sensor, pin 2	
18	GY	Trigg signal, cyl 4	
19	GN	Trigg signal, cyl 2	
20	RD	Voltage supply to pressure sensor connection 3	
21	GN/WH	Ignition voltage +15	
22	RD	Voltage +30 via fuse 23	
23	GN/RD	Signal from crankshaft sensor	
24	BN/WH	Data link connector, pin 3	
25	YE	Combustion signal, cyl 1+2	
26	WH	Enriching, PRE IGN/knocking connection 28	
27-28		No connection	
29	BU	Ignition pulse	
30		Shield. Ground to knock sensor.	
31		No connection	
32	WH	Signal when brake activated	
33	BU	Boost pressure control valve, pin 3	
34		No connection	
35	GN	Signal when cruise control disconnected	
36	BU/RD	Engine load signal Tq to connection 25	

Pin	Color	Component/Function	Remarks
37	BU	Trigg signal cyl 3	
38	OG	Trigg signal cyl 1	

DI-DI/APC Electronic Ignition (contd.)

Readings, ECM connections M1991-



Pin	Color	Component/Function	Voltage	Remarks
1	RD/BU	Coding cable	0 V 6-7 V 12 V	connected to ground not connected connected to BPV
2,3		No connection		
4	BU/WH	Data link K, pin 3		
5	BN	Combustion signal, cyl 3+4	0 V	
6	RD	Voltage to crankshaft position sensor	approx. 12 V	
7	YE/WH	MIL (CHECK ENGINE) in EDU 3	0 V 11-12 V	on off
8	GN/RD	Throttle position signal (LH 2.4 without TCS only)	0 V 10-12 V	wide open throttle closed throttle
9		No connection		
10	GN	Boost pressure control valve, pin 1, turbo only	12 V	not activated
11	GY	Knock sensor signal	0 V	
12		No connection		
13	BK	Ground connection		
14	WH	Intake air temperature sensor (turbo only)	0-5 V	
15	BK	Ground connection for crankshaft position sensor		
16		No connection		
17	BK	Ground connection for temperature sensor		
18	GY	Trigg signal, cyl 4	12 V	
19	GN	Trigg signal, cyl 2	12 V	
20		No connection		
21	GN/WH	+15 Voltage	12 V	
22	RD	+ 30 Voltage	12 V	
23	GN/RD	Signal from crankshaft sensor	0 V 5 V	opening shield
24	BN/WH	Data link L, pin 3	10-12 V	
25	YE	Combustion signal, cyl 1+2	0 V 5 V	low high
26	WH	Enrichment, PRE IGN/knocking (engine running, normal function)	12 V 6-7 V 12 V	ignition on LH 2.4.2 LH 2.4

Pin	Color	Component/Function	Voltage	Remarks
27	GY	Throttle position switch, closed throttle (LH 2.4 without TCS)	0 V 10-12 V	closed throttle position normal position
28		No connection		
29	BU	Rpm signal	approx. 6.5 V 10-12 V	when starting when running
30		Ground (shield) for knock sensor		
31	GN/RD	Throttle angle signal (LH 2.4.2 and LH 2.4 with TCS) Vacuum switch cruise control (LH without TCS)	1 V approx. 11 V 12 V 0 V	closed throttle wide open throttle not active active (closed vacuum switch)
32	WH	Brake signal (turbo only)	0 V 12 V	not applied applied
33	BU	Boost pressure control valve, pin 3 (turbo only)	12 V	not activated
34	GN/GY	Speed sensor signal (turbo only)	0 or 12 V 0-5 V	stationary when driving
35	GN/RD	Feed from main relay	12 V	
36	BU/RD	Engine load signal Tq	< 1 V	Use the scan tool PULSE feature or command code
37	BU	Trigg signal cyl 3	12 V	
38	OG	Trigg signal cyl 1	12 V	

DI-DI/APC Electronic Ignition (contd.)**Diagnostic trouble codes, scan tool**

Permanent	Temporary	Faulty component/function	See 2:6, page	See 0 News M1991, page
429B0	229B0	M1991-:Coding fault. Car can start, but runs only at basic charge pressure		81
44261	24261	M1991-: No speed signal (turbo)		80
44360	24360	Crankshaft position sensor, signal faulty	36	
44460	24460	Engine load signal (Tq), faulty		83
44461	24461	Adaptation fault, outside limits	50	
44660	24660	PRE IGNition fault	46	
44661	24661	Knock sensor, faulty signal	38	
44662	24662	Combustion, synchronization fault	48	
46660	26660	Pressure sensor, malfunction (up to M1991 only)	40	
45260	25260	M1991-:Throttle position sensor, faulty signal (LH 2.4.2 or TCS)		71
45360	25360	Brake signal faulty	42	
46391	26391	M1991-:Intake air temperature sensor, faulty signal		76
60000		Internal monitoring	54	
60001		ROM fault	54	
60002		RAM fault	54	
11111		Reply code for OK		

DI-DI/APC Electronic Ignition (contd.)

Menu structure for command codes

DI-APC
READ FAULT CODES
CLEAR FAULT CODES
READ SYSTEM INFO
CODE
END

DI-DI/APC Electronic Ignition (contd.)**Command codes -M1990, scan tool**

Code	Component/Function	Display text/Voltage (V)
300	Brake signal	8B000=not activated/0 V 8B100=activated/BPV
301	Cruise control (LH 2.4 cat. without TCS)	8B100=activated/0 V *) 8B000=not activated/11 V *)
302	Crankshaft position sensor	8B000=shield open/0 V 8B100=shield closed/5 V
303	Combustion signal, synchronization	8B000 = 1+2 high and 3+4 low 8B200 = 1+2 low and 3+4 high 8B300 = 1+2 high and 3+4 high
304	Throttle position switch, wide open throttle contact	8B100 = wide open throttle contact open 8B000 = wide open throttle contact closed
320	Pressure sensor status	E.g. 8B036 = 3.6 V
329	Knock sensor, signal level	E.g. 8B001 = 0.1 V
450	Activates ignition sparks	-
451	Activates boost pressure control valve	-
452	Activates MIL (CHECK ENGINE) (flashes)	-
453	Activates enrichment (turbo only)	11111 = correct function
454	Activates rpm signal	

DI-DI/APC Electronic Ignition (contd.)

Command codes M1991-, scan tool

Code	Component/Function	Display text/Voltage (V)
200	Brake signal	8B000=not activated/0 V 8B100=activated/BPV
201	Cruise control (LH 2.4 cat. without TCS)	8B100=activated/0 V *) 8B000=not activated/11 V *)
202	Crankshaft position sensor	8B000=shield open/0 V 8B100=shield closed/5 V
203	Ignition synchronization (all cyl)	8B300 5 V (combustion signal high) 8B000 1 V (combustion signal low)
204	Throttle position switch, wide open throttle contact (LH 2.4/LH 2.4.2)	80000=closed throttle (engine running) **) 80100=wide open throttle (engine running) **)
220	Pressure sensor status	80022 (E.g.) 2.2 V (M1991-)
229	Knock sensor, signal level	80004 (Ex.) 0.4 V
27A	Current ignition dwell angle	89+15=15° before TDC (M1991-) 80-05=5° after TDC
280	Engine type, cat/no cat	E.g. B202L.cat 165E (1991-)
282	Part No. of EPROM	E.g. PGM.NR 912614
283	Number of recorded spikes (turbo only)	8B0x3=where x is the number of recorded spikes (M1991-)
285	Part No. of ECM	E.g. ECU.NR 7859721 (M1991-)
286	Coding (jumpering of switch piece) (turbo only)	8E300:ECM pin 1 to 12 V 8E200:ECM pin 1 to ground 8E100:ECM pin 1 not connected (no jumpering) 8E000:other=illegal combinations
287	Engine load signal Tq	80015= 15 µs pulse width
450	Activates ignition sparks	11111
451	Activates boost pressure control valve (turbo only)	11111
452	Activates MIL (CHECK ENGINE) (flashes)	11111
453	Activates enrichment (turbo only)	11111/12-0 V
454	Activates rpm signal	11111 ***) (Crankshaft must stand at 10-45° before TDC; punch in 202 and adjust the position of the car until the scan tool display changes from 8B100 to 8B000
456	Activate wide open throttle signal 0-12 V (1 Hz)	(B202.L with LH 2.4 cat) ****)

Code	Component/Function	Display text/Voltage (V)
457	Activates closed throttle position 0-12 V (1 Hz)	(B202.L with LH 2.4 cat) ****)

**) This is the opposite from earlier year models.*

***) New reading from 1991.*

****) Remove the fuel pump fuse before using the command*

*****) The throttle must not be fully open/closed when checking each signal. Hint: Place the throttle butterfly half open using a screwdriver.*

Important

Command codes 450 to 457 activate each function for about 1 minute.

EZK

The EZK ignition system has an automatic fault diagnosis feature which uses diagnostic trouble codes to pinpoint the fault. These diagnostic trouble codes can be read using an EZK system tester connected to the data link connector.

The diagnostic trouble codes are given with flashes on either the green or the red LED on the EZK system tester.

These diagnostic trouble codes can then be interpreted using the table of diagnostic trouble codes below. The figures in the table correspond to the number of flashes on each diode.

Diagnostic trouble codes, self diagnosis

The table gives the number of flashes for the **Green** and **Red** LEDs.

Green	Red	Cause of fault	Action
1		Does not apply	-
2		Does not apply	-
3		ECM fault (M1989-)	
4		A: Knock sensor and lead B: Inside the control module	Use an ohmmeter to check the shielded cable between the knock sensor and the ECM. Connect the ohmmeter test leads to connections 12 and 13 on the ECM connector, seen from the cable side. Change the cable if the circuit is intact. Otherwise, connect a lead over the connections on the knock sensor. Important Push back the rubber protector and connect the lead on the cable side. Measure between connections 12 and 13 on the control module connector. Change the cable if there is a break or short in the circuit. Change the control module
5		Incorrect input signal from the LH MFI system	Check the BU/RD lead between connection 24 in the connector and connection 8 on the ECM in the ignition system. Use a BOB. If there is no fault in the lead, the LH MFI system ECM must be changed.
	Sporadic	Indicates knocking	Normal position
	Continuous	Maximum downward adjustment	Check if there is extreme engine vibration (loose panels, broken engine brackets etc.). Correct the reason for this vibration.

MOTRONIC 2.8.1**Readings, control module connections**

> = greater than; < = less than; ≈ = approximately equal to; ~ = alternating voltage

Pin	Color	Component/Function	In Out	Measuring conditions	Reading	Across	See 2:7, page
1	BU	Ignition coil, cyl. 1+4	Out		BPV	1 — 19	39/150
				750 ± 50 rpm	≈ 7 % (-) (HI LOp)		
2	BK	Ground, ignition	In	750 ± 50 rpm	<0,1V	2 — Batt-	26/139
3	VT	Fuel pump relay	Out		0 V	3 — 18	25/156
				750 ± 50 rpm	BPV		
4	BN/ WH	Idle air control (IAC) valve	Out	750 ± 50 rpm ⁾	3.5-5.5 V	4 — 18	48/129
					100 Hz 25-45% (-) 2.5-4.5 ms (-) (HI LO)	4 — 19	
5	YE/ RD	EVAP canister purge valve	Out	750 ± 50 rpm check that valve is acti- vated using scan tool	≈ 0.1 V	5 — 18	49/113
					15 Hz 5% (-) 3.0 ms (-) (HI LOp)	5 — 19	
6		No connection					
7	OG	Mass air flow sensor	In	750 ± 50 rpm ⁾	≈ 0.8 V	7 — 30	31/78
				2500 ± 50 rpm ⁾	≈ 1.5 V		
				Wide open throttle, max rpm ⁾	≈ 4.6 V		
8	BK	Camshaft position sen- sor	In	750 ± 50 rpm	≈ 4.5 V~ ≈ 6.2 Hz 11% (-) (LOp)	8 — 14	30/110
9	GN	Vehicle speed	In	Raise one front wheel and ro- tate it	≈ 6 V ≈ 50% (-) (HI LOp)	9 — 14	37/167
10	BK	Oxygen sensor, refer- ence ground	In	750 ± 50 rpm	< 0.05 V	10 — Batt-	26/139
11	GN	Rear knock sensor	In	4000 rpm	>20 mV~	11 — 30	35/104
12	GN/ RD	Throttle position sensor (voltage measurement)	Out	Ignition ON	5 V	12 — 19	32/86

Pin	Color	Component/Function	In Out	Measuring conditions	Reading	Across	See 2:7, page
13	GY/ RD	Data link (L)	In/Out	scan Tool not connected	≈ 5 V	13 — 19	56
				scan Tool con- nected	≈ 8.5 V		
14	BK	Ground, injectors	In	750 ± 50 rpm	< 0.1 V	14 — Batt-	26/139
15	GN	Injector, cyl. 5	Out		BPV	15 — 19	41/123
				750 ± 50 rpm	6.2 Hz 3.0 ms (-) (HI LOp)		
16	BU	Injector, cyl. 2	Out		BPV	16 — 19	41/117
				750 ± 50 rpm	6.2 Hz 3.0 ms (HI LOp)		
17	GY	Injector, cyl. 1	Out		BPV	17 — 19	41/115
				750 ± 50 rpm	6.2 Hz 3.0 ms (HI LOp)	17 — 37	
18	RD	Battery positive voltage +30 (memory)	In	750 ± 50 rpm	< 0.5 V	18 — Batt+	24
19	BK	Ground, control module electronics	In	750 ± 50 rpm	< 0.1 V	19 — Batt+	26
20	BU/ WH	Ignition coil, cyl. 2+5	Out		BPV	20 — 19	39/150
				750 ± 50 rpm	≈ 7 % (-) (HI LOp)		
21	BU/ RD	Ignition coil, cyl. 3+6	Out		BPV	21 — 19	39/150
				750 ± 50 rpm	≈ 7 % (-) (HI LOp)		
22	WH	MIL (CHECK ENGINE)	Out	Ignition ON, MIL (CHECK ENGINE) lit	BPV	22 — 18	55/135
				750 ± 50 rpm, MIL (CHECK ENGINE) off	≈ 0 V		
23		No connection					
24	BK	Ground, other output stages	In	750 ± 50 rpm	< 0.1 V	24 — Batt+	26/139

Pin	Color	Component/Function	In Out	Measuring conditions	Reading	Across	See 2:7, page
25	GN/ RD	A/C relay	Out	750 ± 50 rpm, A/C ON	BPV	18 — 25	53/137
				750 ± 50 rpm, A/C OFF	0 V		
				activate with ISAT, select "ACTIVATE", select "A/C RE- LAY"	BPV/0 V	12 — 25	
26	YE	Secondary air injection pump relay	Out	Activate with scan tool, se- lect "ACTI- VATE", select "SECOND. AIR RELAY"	BPV/0 V	18 — 26	52/127
27	YE/ GY	BPV +15	In		< 0.5 V	27 — Batt+	24/139
28	GN/ WH	Rear oxygen sensor	In	750 ± 50 rpm, oxygen sensing active	0.1-0.9 V	28 — 10	44/88
29	GN	Front knock sensor	In	4000 rpm	>30 mV~	29 — 30	35/107
30	BK	Sensor ground	Out	750 ± 50 rpm	< 0.1 V	30 — BPV-	26
31		No connection					
32		No connection					
33	VT	Injector, cyl. 6	Out		BPV	19 — 33	41/125
				750 ± 50 rpm	6.2 Hz 3.0 ms (HI LOp)		
34	WH	Injector, cyl. 4	Out		BPV	19 — 34	41/121
				750 ± 50 rpm	6.2 Hz 3.0 ms. (HI LOp)		
35	YE	Injector, cyl. 3	Out		BPV	19 — 35	41/119
				750 ± 50 rpm	6.2 Hz 3.0 ms (HI LOp)		
36		No connection					
37	BU/ RD	Voltage supply via main relay	In		< 0.5 V	37 — BPV	24/139
38	GY	TCS active	In		31 Hz 50%	38 — 19	54/143
39		No connection					

Pin	Color	Component/Function	In Out	Measuring conditions	Reading	Across	See 2:7, page
40	GN/ WH	A/C in	In	A/C ON	BPV	40 — 19	53/137
				A/C OFF	0 V		
41		No connection					
42	OG	D/R input	In	P, N, manual	0 V	42 — 19	38/164
				R, D, 3, 2, 1	BPV		
43	BU	Output, engine speed	Out	750 ± 50 rpm	≈ 6.5 V ≈ 37 Hz 50% (HI LO)	43 — 19	28/102
				2500 rpm	≈ 6.5 V ≈ 125 Hz 50%		
44	OG	Intake air temperature sensor	In	Air temp. about 25°C (77°F)	≈ 3.4 V also see Technical Data	44 — 30	34/81
45	YE/ WH	Engine coolant temperature sensor	In	Engine temp. about 90°C (194°F)	≈ 1.0 V also see Technical Data	45 — 30	33/83
46	YE/ WH	Main relay	Out		BPV	46 — 18	25/153
				Ignition OFF	0 V		
47	GN	Front oxygen sensor	In	750 ± 50 rpm, oxygen sensing active	0.1-0.9 V	47 — 10	44/92
48	BK	Crankshaft position sensor, reference ground	In		BPV	48 — 18	28/102
49	YE	Crankshaft position sensor, signal input	In	Starter motor running	≈ 2-5 V~ 150-250 Hz	49 — 48	28/102
				750 ± 50 rpm	≈ 5-10 V~ ≈ 725 Hz		
50		No connection					
51							
52		No connection					
53	BU	Throttle position sensor	In	Closed throttle	≈ 0.5 V	53 — 30	32/86
				Wide open throttle position	≈ 4.5 V		

Pin	Color	Component/Function	In Out	Measuring conditions	Reading	Across	See 2:7, page
54	YE	Throttle position signal	Out		≈ 0.25-1 V 100 Hz	54 — 19	54/169
				750 ± 50 rpm	≈ 1.2 V 100 Hz 9% (+) 0.9 ms (+) (Hlp LO)		
				2500 rpm	≈ 2.0 V 100 Hz 15% (+) 1.5 (+) (Hlp LO)		
55	BU/ WH	Data link (K)	In/ Out	ISAT scan tool not connected	0 V	55 — 19	56
				ISAT scan tool connected	BPV		

*¹) A/C and all electrical loads switched off.

MOTRONIC 2.8.1 (contd.)**Diagnostic trouble codes**

Diagnostic trouble code (SAE)	Faulty function/component	MIL (CHECK ENGINE)	Text displayed on Scan Tool	See 2:7, page
P0102	Mass air flow (MAF) sensor, input to ECM low, break or short to ground	on	FAULT XX P/I P0102 INDUCTION AIR MASS INPUT LOW/OPEN SHORTING TO GROUND	78
P0103	MAF sensor, input to ECM high or short to BPV	on	FAULT XX P/I P0103 INDUCTION AIR MASS INPUT HIGH/ SHORTING TO BATT+	78
P0112	Intake air temperature sensor, input low or shorted to ground	on	FAULT XX P/I P0112 INTAKE AIR TEMP INPUT LOW/ SHORTING TO GROUND	81
P0113	Intake air temperature sensor, input high, break or short to BPV	on	FAULT XX P/I P0113 INTAKE AIR TEMP INPUT HIGH/OPEN SHORTING TO BATT+	81
P0117	Engine coolant temperature sensor, input to ECM low or shorted to ground	on	FAULT XX P/I P0117 COOLANT TEMPERATURE INPUT LOW/ SHORTING TO GROUND	83
P0118	Engine coolant temperature sensor, input to ECM high, break or short to BPV	on	FAULT XX P/I P0118 COOLANT TEMPERATURE INPUT HIGH/OPEN SHORTING TO BATT+	83
P0122	Throttle position sensor, input low or shorted to ground	on	FAULT XX P/I P0122 THROTTLE POSITION INPUT LOW/ SHORTING TO GROUND	86
P0123	Throttle position sensor, input high, break or short to BPV	on	FAULT XX P/I P0123 THROTTLE POSITION INPUT HIGH/OPEN SHORTING TO BATT+	86
P0131	Rear oxygen sensor, input to control module low or shorted to ground	on	FAULT XX P/I P0131 OXYGEN SENSOR 1-3-5 INPUT LOW/ SHORTING TO GROUND	88
P0132	Rear oxygen sensor, input to ECM high or shorted to BPV	on	FAULT XX P/I P0132 OXYGEN SENSOR 1-3-5 INPUT HIGH/ SHORTING TO BATT+	88
P0134	Rear oxygen sensor, no control module input or open circuit.	on	FAULT XX P/I P0134 OXYGEN SENSOR 1-3-5 NO INPUT/ OPEN	88
P0151	Front oxygen sensor, input to ECM low or shorted to ground	on	FAULT XX P/I P0151 OXYGEN SENSOR 2-4-6 INPUT LOW/ SHORTING TO GROUND	92
P0152	Front oxygen sensor, input to ECM high or shorted to BPV	on	FAULT XX P/I P0152 OXYGEN SENSOR 2-4-6 INPUT HIGH/ SHORTING TO BATT+	92
P0154	Front oxygen sensor, no control module input or open circuit	on	FAULT XX P/I P0154 OXYGEN SENSOR 2-4-6 NO INPUT/ OPEN	92

116 Engine

Diagnostic trouble code (SAE)	Faulty function/component	MIL (CHECK ENGINE)	Text displayed on Scan Tool	See 2:7, page
P0171	Adaptation too lean, rear cylinder bank (cylinders 1-3-5).	on	FAULT XX P/I P0171 ADAPTATION 1-3-5 LEAN	96
P0172	Adaptation too rich, rear cylinder bank (cylinders 1-3-5).	on	FAULT XX P/I P0172 ADAPTATION 1-3-5 RICH	96
P0174	Adaptation too lean, front cylinder bank (cylinders 2-4-6).	on	FAULT XX P/I P0174 ADAPTATION 2-4-6 LEAN	99
P0175	Adaptation too rich, front cylinder bank (cylinders 2-4-6).	on	FAULT XX P/I P0175 ADAPTATION 2-4-6 RICH	99
P0322	Crankshaft position sensor, no control module input		FAULT XX P/I P0322 CRANKSHAFT POSITION NO INPUT	102
P0326	Rear knock sensor, no input to ECM/open or short circuit		FAULT XX P/I P0326 KNOCK SENSOR 1-3-5 NO INPUT/ OPEN/SHORTING	104
P0331	Front knock sensor, no input to ECM/open or short circuit		FAULT XX P/I P0331 KNOCK SENSOR 2-4-6 NO INPUT OPEN/SHORTING	107
P0336	Crankshaft position sensor, control module input wrong		FAULT XX P/I P0336 CRANKSHAFT POSITION INPUT WRONG	102
P0342	Camshaft position sensor, input to ECM low, break or short to ground	on	FAULT XX P/I P0342 CAMSHAFT POSITION INPUT LOW/OPEN SHORTING TO GROUND	110
P0343	Camshaft position sensor, input to ECM high or shorted to BPV	on	FAULT XX P/I P0343 CAMSHAFT POSITION INPUT HIGH SHORTING TO BATT+	110
P0605	Control module fault	oN	FAULT XX P/I P0605 CONTROL MODULE INTERNAL FAULT	112
P1001	EVAP canister purge valve, output from ECM low, open circuit or short to ground	on	FAULT XX P/I P1001 EVAP VALVE OUTPUT LOW/OPEN SHORTING TO GROUND	113
P1002	EVAP canister purge valve, output from ECM high or shorted to BPV	on	FAULT XX P/I P1002 EVAP VALVE OUTPUT HIGH/ SHORTING TO BATT+	113
P1011	Injector, cylinder 1		FAULT XX P/I P1011 INJECTOR 1 OUTPUT LOW/OPEN SHORTING TO GROUND	115
P1012	Injector, cylinder 1		FAULT XX P/I P1012 INJECTOR 1 OUTPUT HIGH/ SHORTING TO BATT+	115
P1021	Injector, cylinder 2		FAULT XX P/I P1021 INJECTOR 2 OUTPUT LOW/OPEN SHORTING TO GROUND	117

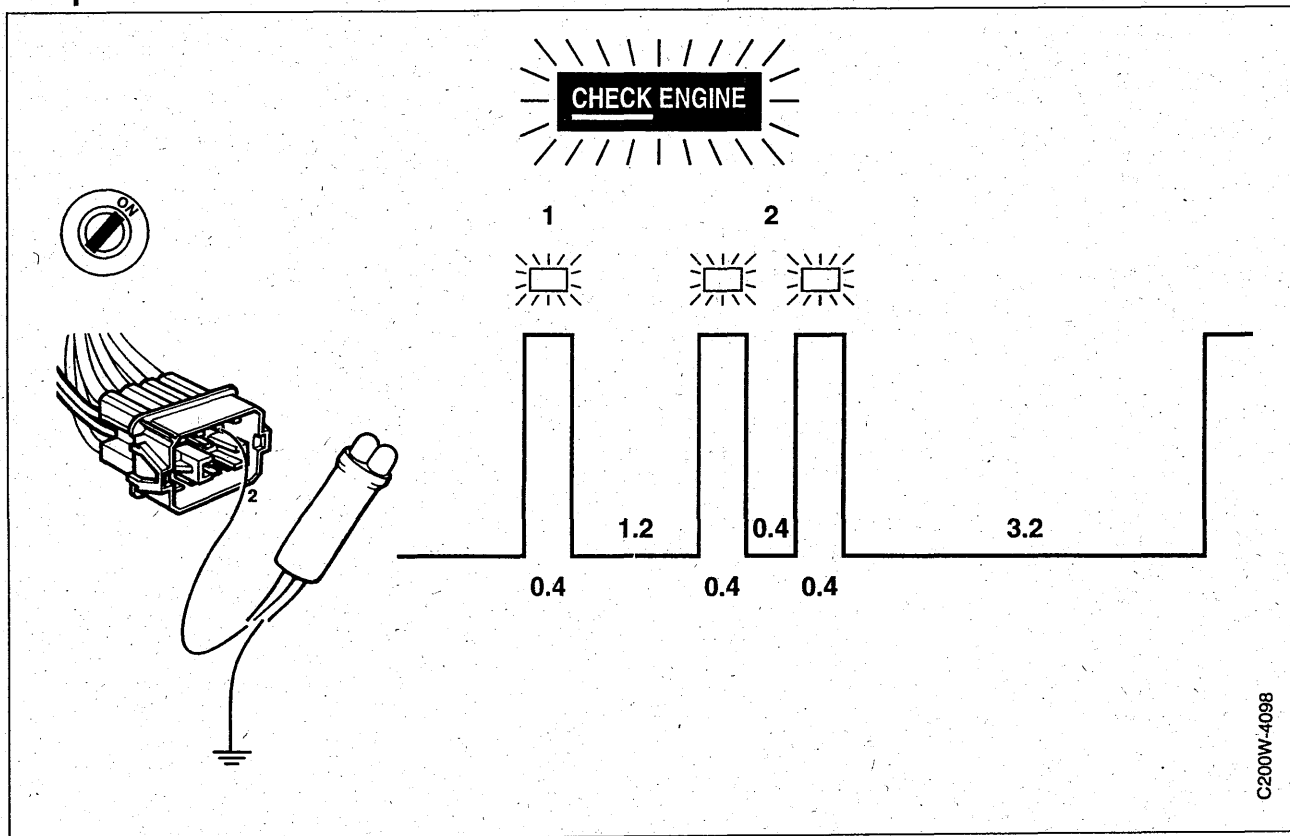
Diagnostic trouble code (SAE)	Faulty function/component	MIL (CHECK ENGINE)	Text displayed on Scan Tool	See 2:7, page
P1022	Injector, cylinder 2		FAULT XX P/I P1022 INJECTOR 2 OUTPUT HIGH/ SHORTING TO BATT+	117
P1031	Injector, cylinder 3		FAULT XX P/I P1031 INJECTOR 3 OUTPUT LOW/OPEN SHORTING TO GROUND	119
P1032	Injector, cylinder 3		FAULT XX P/I P1032 INJECTOR 3 OUTPUT HIGH/ SHORTING TO BATT+	119
P1041	Injector, cylinder 4		FAULT XX P/I P1041 INJECTOR 4 OUTPUT LOW/OPEN SHORTING TO GROUND	121
P1042	Injector, cylinder 4		FAULT XX P/I P1042 INJECTOR 4 OUTPUT HIGH/ SHORTING TO BATT+	121
P1051	Injector, cylinder 5		FAULT XX P/I P1051 INJECTOR 5 OUTPUT LOW/OPEN SHORTING TO GROUND	123
P1052	Injector, cylinder 5		FAULT XX P/I P1052 INJECTOR 5 OUTPUT HIGH/ SHORTING TO BATT+	123
P1061	Injector, cylinder 6		FAULT XX P/I P1061 INJECTOR 6 OUTPUT LOW/OPEN SHORTING TO GROUND	125
P1062	Injector, cylinder 6		FAULT XX P/I P1062 INJECTOR 6 OUTPUT HIGH/ SHORTING TO BATT+	125
P1206	Relay for secondary air injection pump, output from ECM low, open circuit or short to ground	on	FAULT XX P/I P1206 SECONDARY AIR RELAY OUTPUT LOW/OPEN SHORTING TO GROUND	127
P1207	Relay for secondary air injection pump, output from ECM too high or short to BPV	on	FAULT XX P/I P1207 SECONDARY AIR RELAY OUTPUT HIGH/ SHORTING TO BATT+	127
P1211	Idle air control valve, output from ECM low, open circuit or short to ground		FAULT XX P/I P1211 IAC VALVE OUTPUT LOW/OPEN SHORTING TO GROUND	129
P1212	IAC valve, output from ECM high or short to BPV		FAULT XX P/I P1212 IAC VALVE OUTPUT HIGH/ SHORTING TO BATT+	129
P1236	Valve for switching intake manifold, output from ECM low, open circuit or short to ground		FAULT XX P/I P1236 INTAKE OUTER FLAP BREAK/ SHORT GROUND	131
P1237	Valve for switching intake manifold, output from ECM high or short to BPV		FAULT XX P/I P1237 INTAKE OUTER FLAP SHORTING TO BATT+	131

118 Engine

Diagnostic trouble code (SAE)	Faulty function/component	MIL (CHECK ENGINE)	Text displayed on Scan Tool	See 2:7, page
P1246	Valve for switching intake manifold, output from ECM low, open circuit or short to ground		FAULT XX P/I P1246 INTAKE INNER FLAP BREAK/ SHORT GROUND	133
P1247	Valve for switching intake manifold, output from ECM high or short to BPV		FAULT XX P/I P1247 INTAKE INNER FLAP SHORTING TO BATT+	133
P1251	MIL (CHECK ENGINE), output from ECM low or shorted to ground		FAULT XX P/I P1251 CHECK-ENGINE LAMP OUTPUT LOW/ SHORTING TO GROUND	135
P1252	MIL (CHECK ENGINE), output from ECM high or shorted to BPV		FAULT XX P/I P1252 CHECK-ENGINE LAMP OUTPUT HIGH/ SHORTING TO BATT+	135
P1450	A/C Relay, output from ECM low, open circuit or short to ground		FAULT XX P/I P1450 AC RELAY OUTPUT LOW/OPEN SHORTING TO GROUND	137
P1451	A/C Relay, output from ECM high or shorted to BPV		FAULT XX P/I P1451 AC RELAY OUTPUT HIGH/ SHORTING TO BATT+	137
P1500	Battery positive voltage lower than 10 V or higher than 16 V.		FAULT XX P/I P1500 BATTERY VOLTAGE VOLTAGE WRONG	139
P1601	Fuel pump relay, output from ECM high or shorted to BPV		FAULT XX P/I P1601 FUEL PUMP RELAY OUTPUT HIGH/ SHORTING TO BATT+	141
P1602	Fuel pump relay, output from ECM low, break or short to ground		FAULT XX P/I P1602 FUEL PUMP RELAY OUTPUT LOW/OPEN SHORTING TO GROUND	141
P1630	TCS Active (test signal), signal low, open circuit or shorted to ground		FAULT XX P/I P1630 TCS FULL LOAD SIGNAL LOW/OPEN SHORTING TO GROUND	143
P1631	TCS Active (test signal), signal high or shorted to BPV		FAULT XX P/I P1631 TCS TEST SIGNAL SIGNAL HIGH/ SHORTING TO BATT+	143

MOTRONIC 2.8.1 (contd.)

Lamp flash codes

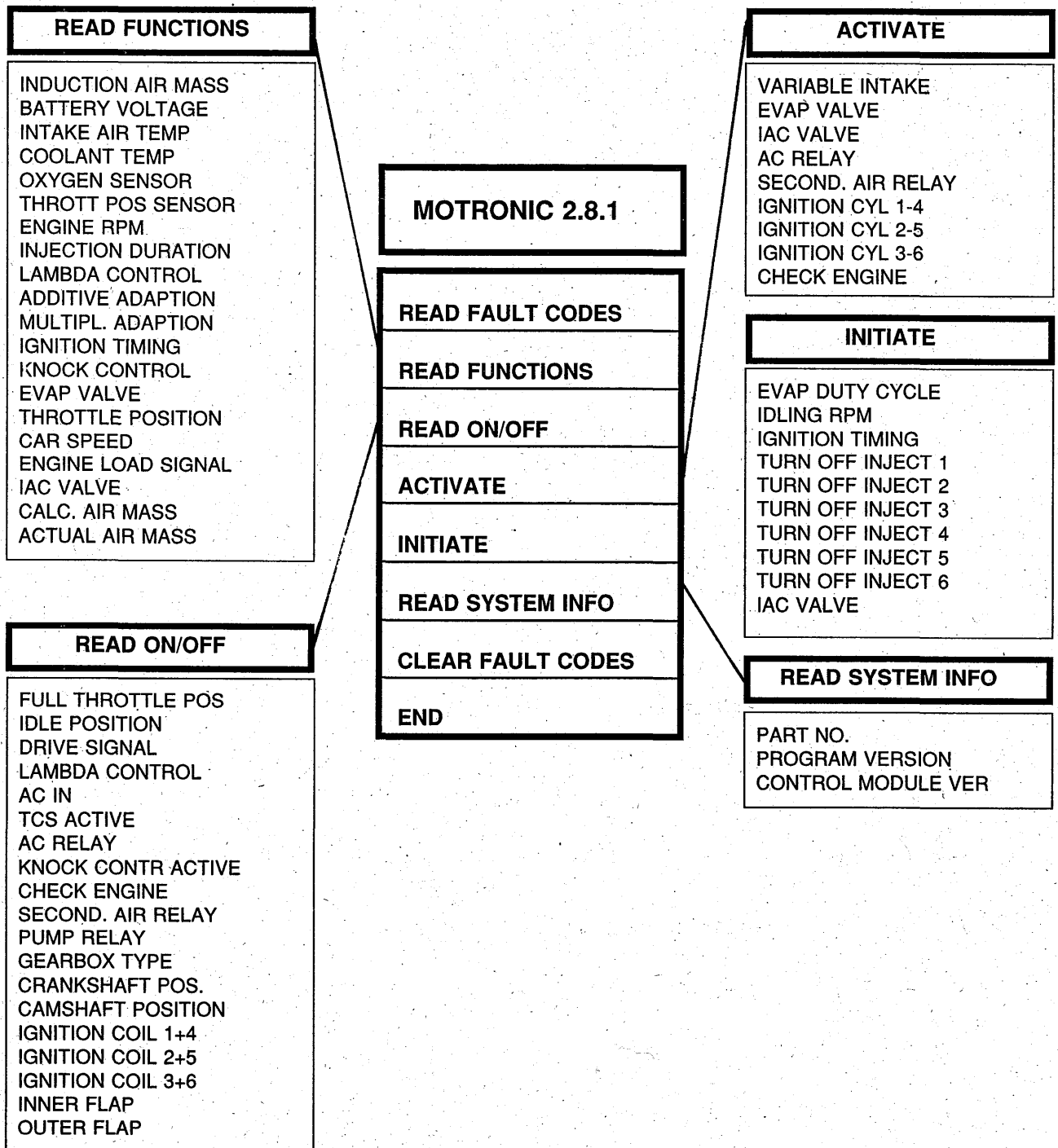


Turn the ignition key to ON and ground pin 2 in the 10 pin data link connector under the right-hand front seat. Use test lamp 86 11 857. The flashing codes can be read as long as pin 2 is grounded.

Flash code	Function	Diagnostic trouble code	Fault diagnosis, see 2:7 on page
11	Relay, secondary air injection	P1206, P1207	127
12	No fault		
21	Mass air flow sensor	P0102, P0103	78
31	Intake air temperature sensor	P0112, P0113	81
41	Engine coolant temperature sensor	P0117, P0118	83
51	Throttle position sensor	P0122, P0123	86
61	Rear oxygen sensor	P0131, P0132, P0134	88
62	Front oxygen sensor	P0151, P0152, P0154	92
71	Adaptation, rear cylinder bank (cyl 1-3-5)	P0171, P0172	96
72	Adaptation, front cylinder bank (cyl 2-4-6)	P0174, P0175	99
81	EVAP canister purge valve	P1001, P1002	113
91	Control module fault (internal memory)	P0605	112

MOTRONIC 2.8.1 (contd.)

Menu structure for command codes



MOTRONIC 2.8.1 (contd.)

READ FUNCTIONS

No.	ISAT scan tool display	Function
1	INDUCTION AIR MASS X.X V / X.XX g/s	Shows the MASS AIR FLOW SENSOR's input voltage (control module, pin 7) and the associated intake air flow in grammes per second (g/s). Conversion is carried out according to the characteristics of the mass air flow sensor: $g/s = f(V)$. See "Technical data". Operating range: 0.0-5.5 V.
2	BATTERY VOLTAGE XX.X V	Shows the control module's power supply, +15. Operating range: 0.0-17.4 V.
3	INTAKE AIR TEMP X.X V / XXX °C	Shows the input voltage (control module, pin 44) from the intake air temperature sensor in the intake manifold in V and associated temperature in °C. Conversion is carried out according to the characteristics of the intake air temperature sensor: $°C = f(V)$. Operating range: 0.0-5.0 V.
4	COOLANT TEMP X.X V / XXX °C	Shows the input voltage (control module, pin 45) from the coolant temperature sensor and associated temperature in °C. Conversion is carried out according to the characteristics of the coolant temperature sensor: $°C = f(V)$. Operating range: 0.0-5.0 V.
5	OXY SENSOR REAR X.XX V	Shows the input voltage (control module, pin 28) from the rear oxygen sensor, cylinder bank 1-3-5. Operating range: 0.00-1.25 V.
	OXY SENSOR FRONT X.XX V	Shows the input voltage (control module, pin 47) from the front oxygen sensor, cylinder bank 2-4-6. Operating range: 0.00-1.25 V.
6	THROTT POS SENSOR X.X V	Shows the throttle position sensor's input voltage (control module, pin 53). Operating range: 0.0-5.0 V.
7	ENGINE RPM XXXX RPM	Shows engine speed in rpm. Operating range: 0-10240 rpm.
8	INJECTION DURATION XX.X ms	Shows the injection duration for cylinder 1 in ms. Operating range: 0.0-98.7 ms.
9	LAMBDA CONT. REAR ±XX %	Shows the working range of closed loop control. At outer values, the diagnostic trouble codes "Adaptation lean" and "Adaptation rich" are registered. Operating range: ±25 %.
	LAMBDA CONT. FRONT ±XX %	Shows the working range of closed loop control. At outer values, the diagnostic trouble codes "Adaptation lean" and "Adaptation rich" are registered. Operating range: ±25 %.

No.	ISAT scan tool display	Function
10	ADDITIVE REAR X.XXX ms	Shows the additive injection duration correction. Adaptation takes place at idling speed. Operating range: 0.0-0.384 ms.
	ADDITIVE FRONT X.XXX ms	Shows the additive injection duration correction. Adaptation takes place at idling speed. Operating range: 0.0-0.384 ms.
11	MULTIPL. FRONT ±XX %	Shows the multiplicative injection duration correction. Adaptation takes place while the car is being driven. Operating range: ±25 %.
	MULTIPL. REAR ±XX %	Shows the multiplicative injection duration correction. Adaptation takes place while the car is being driven. Operating range: ±25 %.
12	IGNITION TIMING XXX DEGREES	Shows the current ignition timing for cylinder 1 in degrees before top dead centre (BTDC). Operating range: 78-(-144) degrees.
13	KNOCK CONTROL XXX DEGREES	Shows the ignition retard in degrees when knocking occurs in cylinder 1. Operating range: 0-128 degrees.
14	EVAP VALVE XXX.X%	Shows the EVAP canister purge valve's opening relationship expressed in %. Operating range: 0-100 %.
15	THROTTLE POSITION XXX.X %	Shows the degree of throttle opening expressed in %. Operating range: 9-100 %.
16	CAR SPEED XXX KM/H	Shows vehicle speed in km/h. Operating range: 0-255 km/h.
17	ENGINE LOAD SIGNAL XX.XX ms	Shows internal control module quantity, which is proportional to the current engine load. Operating range: 0-12.25 ms.
18	IAC VALVE XXX.X % OPEN	Shows the opening angle of the IAC valve in %. Operating range: 0-100%.
19	CALC. AIR MASS XXX.X g/s	Shows the air flow calculated by the control module that has to pass the IAC valve for attainment of the correct idling speed. Operating range: 0-17 g/s.
20	ACTUAL AIR MASS XXX.X g/s	Shows the air flow through the IAC valve (mass air flow sensor value less adapted leakage flow across the throttle butterfly) as measured by the control module. Operating range: 0-17 g/s.

MOTRONIC 2.8.1 (contd.)**READ ON/OFF**

No.	ISAT scan tool display	Function
1	FULL THROTTLE POS YES/NO	Shows the input from the throttle position sensor. YES at wide open throttle, otherwise NO
2	IDLE POSITION YES/NO	Shows the input from the throttle position sensor. YES at closed throttle, otherwise NO
3	DRIVE SIGNAL YES/NO	Shows the position of the automatic transmission selector lever. YES for R, D, 3, 2 or 1. NO for P and N.
4	CRANKSHAFT POS. ACTIVE/INACTIVE	Shows the input from the crankshaft position sensor. ACTIVE if the sensor is working, NOT ACTIVE if the sensor is faulty
5	LAMBDA CONT. REAR YES/NO	Shows whether the lambda control function is engaged for the rear cylinder bank.
	LAMBDA CONT. FRONT YES/NO	Shows whether the lambda control function is engaged for the front cylinder bank.
6	AC IN ON/OFF	Shows whether the ICE signal requesting A/C engagement is activated.
7	IGNITION COIL 1+4 ACTIVE/NOT ACTIVE	Shows whether the control module sends pulses to ignition coil 1+4.
8	IGNITION COIL 2+5 ACTIVE/NOT ACTIVE	Shows whether the control module sends pulses to ignition coil 2+5.
9	IGNITION COIL 3+6 ACTIVE/NOT ACTIVE	Shows whether the control module sends pulses to ignition coil 3+6
10	TCS ACTIVE YES/NO	Shows whether the TCS is activated (working). The Scan Tool shows "YES" and "NO" alternately when the TCS is activated.
11	AC RELAY ON/OFF	Shows the current status of the A/C relay.
12	CAMSHAFT POSITION ACTIVE/INACTIVE	Shows the input from the camshaft position sensor. ACTIVE if the sensor is working, INACTIVE if it is faulty
13	KNOCK CONTR ACTIVE YES/NO	Shows whether the control module's knock control calculation routines are functional.
14	CHECK ENGINE ON OFF	Shows MIL (CHECK ENGINE) status.
15	OUTER FLAP ACTIVE/INACTIVE	Shows whether the intake manifold's outer flap is activated or not.
16	INNER FLAP ACTIVE/INACTIVE	Shows whether the intake manifold's inner flap is activated or not.
17	SECOND. AIR RELAY ON/OFF	Shows the status of the secondary air injection pump relay
18	PUMP RELAY ON/OFF	Shows the status of the fuel pump relay.

124 Engine

No.	ISAT scan tool display	Function
19	GEARBOX TYPE MAN/AUT	Shows the type of gearbox.

MOTRONIC 2.8.1 (contd.)

ACTIVATE

Important

When a system function is activated with the Scan Tool, the Motronic control module is made to do something that it would not otherwise do in the course of its normal operation. This may cause diagnostic trouble codes to be generated in other systems which are dependent on the Motronic system.

Activation should only be done with the ignition in the drive position and in Neutral gear. If initiation is done in any other gear, the scan tool should show SELECT NEUTRAL.

Important

The activate functions should always be used with discretion.

- Always deactivate an activated function before proceeding further in the Scan Tool menu.
- Always clear any trouble codes generated in the Motronic system, or in any other system, when you are through with fault diagnosis.

No.	ISAT scan tool display	Function
1	INNER/OUTER FLAP FUNCTION ON/OFF ACTIVE 0.5 Hz/30s	The menu "VARIABLE INTAKE" has a sub-menu consisting of two commands, "INNER FLAP" and "OUTER FLAP". "VARIABLE INTAKE" —"OUTER FLAP" —"INNER FLAP" The Motronic ECM activates one of the flaps, depending on the command selected
2	EVAP VALVE ACTIVE 0.5Hz/30s	The Motronic control module activates the EVAP canister purge valve.
3	IAC VALVE ACTIVE 0.5Hz/30s	The Motronic control module activates the idle air control (IAC) valve.
4	AC RELAY FUNCTION ON/OFF ACTIVE 0.5 Hz/30 s	The Motronic control module activates the A/C relay.
5	SECOND. AIR RELAY FUNCTION ON/OFF ACTIVE 0.5 Hz/30 s	The Motronic control module activates the secondary air injection pump relay and the pump starts
6	IGNITION CYL 1-4 FUNCTION ON/OFF ACTIVE 0.5Hz/30s	The Motronic control module activates the ignition coil for cylinders 1+4
7	IGNITION CYL 2-5 ON/OFF ACTIVE 0.5Hz/30s	The Motronic control module activates the ignition coil for cylinders 2+5
8	IGNITION CYL 3-6 ON/OFF ACTIVE 0.5Hz/30s	The Motronic control module activates the ignition coil for cylinders 3+6
9	CHECK ENGINE FUNCTION ON/OFF ON OFF	The Motronic control module activates the CHECK ENGINE function.

MOTRONIC 2.8.1 (contd.)

INITIATE

Important

When a system function is activated with the Scan Tool, the Motronic control module is made to do something that it would not otherwise do in the course of its normal operation. This may cause diagnostic trouble codes to be generated in other systems which are dependent on the Motronic system. Initiation is only done with the engine idling. When activating with a gear selected, the scan tool should show ENGINE IDLING.

Important

The initiate functions should always be used with discretion.

- Always reset an activated function to its original value before proceeding in the scan tool menu.
- Always clear any trouble codes generated in the Motronic system, or in any other system, when you are through with fault diagnosis.
- The operating range of the various commands is wide and unlimited. Exercise care and vary the entered command only round the normal idling speed parameters. See further in "Technical description".

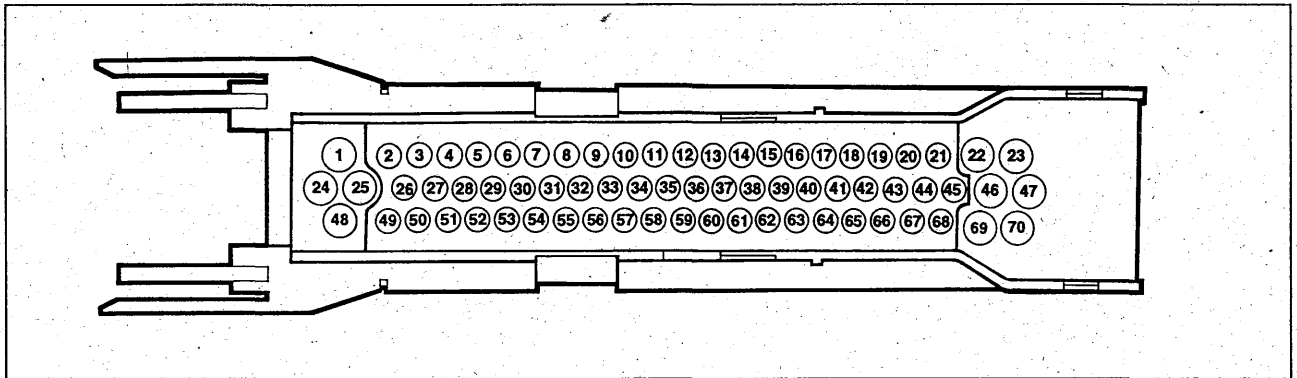
No.	ISAT scan tool display	Function
1	EVAP DUTY CYCLE --.% + -	Shows the duty cycle of the EVAP canister purge valve in %. A reading of 50% is obtained on engagement, which can be adjusted in steps of ± 0.4 %. Operating range: 0-100 %.
2	IDLING RPM —RPM + -	Shows idling speed in rpm. A reading of 1000 rpm is obtained on engagement, which can be adjusted in steps of ± 10 rpm. Operating range: 0-2300 rpm.
3	IGNITION TIMING -- DEGREES + -	Shows the ignition timing in degrees at idling speed. A reading of 10.5 degrees is obtained on engagement, which can be adjusted in steps of ± 0.75 degrees. Operating range: $106(-84)^{\circ}$ BTDC.
4	TURN OFF INJECT 1	Enables injector 1 to be turned off.
5	TURN OFF INJECT 2	Enables injector 2 to be turned off.
6	TURN OFF INJECT 3	Enables injector 3 to be turned off.
7	TURN OFF INJECT 4	Enables injector 4 to be turned off.
8	TURN OFF INJECT 5	Enables injector 5 to be turned off.
9	TURN OFF INJECT 6	Enables injector 6 to be turned off.
10	IAC VALVE -- % CLOSED + -	Shows the opening angle of the IAC valve in %. A reading of 50% is obtained on engagement, which can be regulated in steps of ± 0.4 %. Operating range: 0-100 %.

MOTRONIC 2.8.1 (contd.)**READ SYSTEM INFO**

No.	ISAT scan tool display	Function
1	PART NO. XX XX XXX	Shows Saab's 7 digit part number for the control module.
2	PROGRAM VERSION XXXXXXXXXX	Shows Bosch's 10-digit part number for the software.
3	CONTROL MODULE VER XXXXXXXXXX	Shows Bosch's 10-digit part number for the control module.

Saab Trionic

Readings, control module connections (M1993)



Unless otherwise stated, all readings should be taken via a breakout box (BOB) with the ignition in Drive and all components and connectors plugged in.

Pin	Color	Component/Function	In/ Out	Voltage	Remarks
1	RD	Voltage supply +30	In	12 V	
2	GN	Boost pressure control valve	Out	*)	Pin 3
3	GN/RD	Injector, cylinder 1	Out	12 V	When idling
4	GN/RD	Injector, cylinder 2	Out	12 V	When idling
5	GN/RD	Injector, cylinder 3	Out	12 V	When idling
6	GN/RD	Injector, cylinder 4	Out	12 V	When idling
7		No connection			
8		No connection			
9	BN/WH	Trigg/ignition signal cyl 1	Out	*)	When idling
10	GN	Trigg/ignition signal cyl 2	Out	*)	When idling
11	BU	Trigg/ignition signal cyl 3	Out	*)	When idling
12	GY	Trigg/ignition signal cyl 4	Out	*)	When idling
13	WH	Torque limiting boost pressure	In	*) 0 V	Selector lever to R Other positions
14	OG	Selector lever position N/D	In	0 V 12 V	Selector lever P,N Selector lever R,D,1,2,3
15	WH	Brake signal	In	12 V 0 V	On Off
16		No connection			
17	YE	Detecting cylinders 1 and 2	In	approx. 1 V	When idling
18	BN	Detecting cylinders 3 and 4	In	approx. 1 V	When idling
19		No connection			
20		No connection			
21	YE/RD	Signal from EVAP canister purge valve	In	0 V 12 V	Closed Open
22	GY	Manifold absolute pressure sensor	In	0.4-4.75 V	Barometric pressure=approx. 1.9 V
23	GY	Oxygen sensor	In	0-1.5 V	Pin 4
24	BK/WH	Power ground	In		G7 (Intake manifold)

Pin	Color	Component/Function	In/ Out	Voltage	Remarks
25	BK/WH	Power ground	In		G7 (Intake manifold)
26	GN	Boost pressure control valve	Out	12 V	Pin 1
27	YE/RD	Signal to EVAP canister purge valve	Out	0 V 12 V	Closed Open
28		No connection			
29		No connection			
30		No connection			
31	YE/WH	Main relay	Out		Grounds main relay, pin 85
32	GN	MIL (CHECK ENGINE)	Out		Grounds lamp (=on)
33	BU/WH	Diagnostic	Out		Data link connector, scan tool, pin 1
34	GN/RD	Fuel consumption	Out	5-15 mV	When idling
35	YE/RD	Engine load signal Tq	Out	PWM	With TCS only
36	RD	Cruise control (not TCS)	In		
37		No connection			
38	BU	2-Speed radiator fan	In	0 V 12 V	On (position 1 only) Off
39	GN	Vehicle speed	In	0-12 V	From speedometer
40	GN/RD	Crankshaft position sensor	In	0-12 V	
41		No connection			
42	GN/RD	Throttle position sensor (not TCS)	Out	approx. 5 V	
43	BU/WH	Manifold absolute pressure sensor	Out	approx. 5 V	Pin 3
44	OG	Knock sensing, ignition discharge module	In	10-30 mV	When idling
45	GY	Throttle position sensor	In	0.2-4.5 V	Pin 3 (not TCS)
46	BK	Intake air temperature sensor	In	0.2-4.0 V	90°C = approx. 1 V (pin 2)
47	BK	Reference ground	In		G7 (Intake manifold)
48	RD	Voltage supply +30	In	12 V	
49	BU/RD	Idle air control (IAC) valve	Out	approx. 5 V	When idling (not TCS)
50	BK	Oxygen sensor, heating	Out	12 V	When sensor cold
51		No connection			
52		No connection			
53		No connection			
54	GN/RD	A/C relay	Out		Grounds A/C relay, pin 85
55	BN	SHIFT UP	Out		
56	VT	Fuel pump relay	Out		Grounds relay, pin 85
57		Throttle position	In	0.7-12 V	With TCS
58	BU	Engine speed	Out	approx. 1 V	At 2000 rpm on tachometer
59	GN/WH	Idling speed compensation A/C and ACC	In	0 V 12 V 12 V 0 V	On (TCS) Off On (not TCS) Off
60	GN/WH	Ignition lock +15	In	12 V	
61		No connection			
62	GY	Data link connector 444			Production only
63	RD	Data link connector 444			Production only

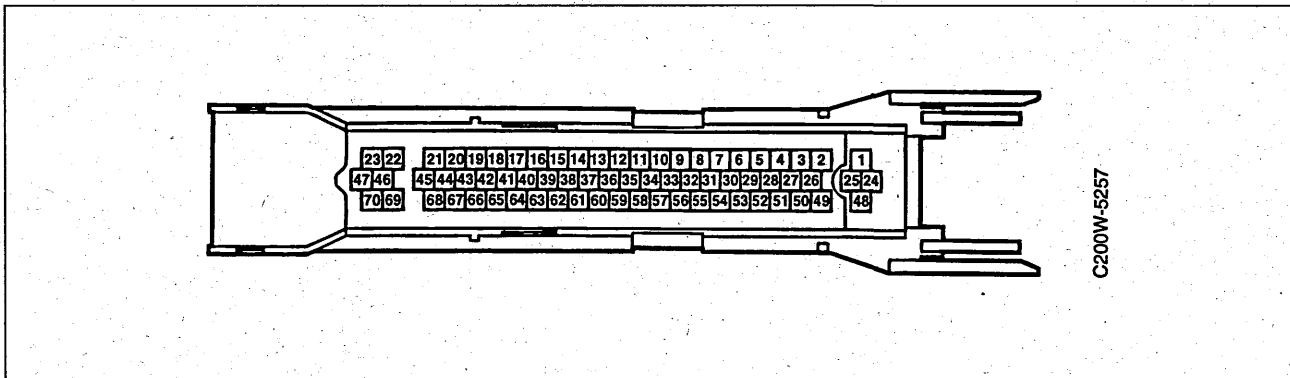
130 Engine

Pin	Color	Component/Function	In/ Out	Voltage	Remarks
64	RD	Crankshaft position sensor	Out	12 V	Pin 1
65	RD/WH	Data link connector 444			Production only
66	BK	Signal ground (not TCS) Reference ground (TCS)	In		
67	BK/WH	Signal ground	In		
68	YE	Engine coolant temperature sensor	In		Pin 1
69		No connection			
70		No connection			

) This reading is 1 v less than BPV, i.e. BPV 12 V minus 1 V = 11 V.

Saab Trionic (contd.)

Test readings, control module connections (M1994-)



> = greater than; < = less than; ≈ = approximately equal to; ~ = alternating current
 Pins without additional comments are not connected.
 (LP = Logic probe, P = select pulse, p = visible pulses)

Pin	Color	Component/Function	In/Out	Measuring conditions	Across	Reading	Function/fault diagnosis, see 2:7, page
1	PK/WH	+30	In	Idling	BPV - 1	< 0.5 V	33/28
2	GN/BK	Boost pressure control valve	Out		1 - 2	1.2 V	51/146
					2 - 25	90 Hz 17.5% (-) 1.9 ms (-) (LP HI LO)	
3	GN/WH	Injector 1	Out	850 ± 50 rpm	1 - 3	0.2 V	46/114
					3 - 25	7.1 Hz 2.5-4.5 ms (-) (HI LOp)	
4	BU/WH	Injector 2	Out	850 ± 50 rpm	1 - 4	0.2 V	46/114
					4 - 25	7.15 Hz 2.5-4.5 ms (-) (HI LOp)	
5	VT/WH	Injector 3	Out	850 ± 50 rpm	1 - 5	0.2 V	46/114
					5 - 25	7.15 Hz 2.5-4.5 ms (-) (HI LOp)	
6	GY/WH	Injector 4	Out	850 ± 50 rpm	1 - 6	0.2 V	46/114
					6 - 25	7.15 Hz 2.5-4.5 ms (-) (HI LOp)	
7-8		No connection					
9	OG/BK	Trigg 1	Out	850 ± 50 rpm	1 - 9	1.2 V	41/119
					9 - 25	7.1 Hz 8.3% (-) 11 ms (-) (HI LOp)	

132 Engine

Pin	Color	Component/Function	In/Out	Measuring conditions	Across	Reading	Function/fault diagnosis, see 2:7, page
10	GN/ YE	Trigg 2	Out	850 ± 50 rpm	1 - 10	1.2 V	41/119
					10 - 25	7.1 Hz 8.3% (-) 11 ms (-) (HI LOp)	41/119
11	BU/ RD	Trigg 3	Out	850 ± 50 rpm	1 - 11	1.2 V	41/119
					11 - 25	7.1 Hz 8.3% (-) 11 ms (-) (HI LOp)	41/119
12	GY/ RD	Trigg 4	Out	850 ± 50 rpm	1 - 12	1.2 V	41/119
					12 - 25	7.1 Hz 8.3% (-) 11 ms (-) (HI LOp)	41/119
13	WH	Reversing light switch, manual	In		13 - 25	0 V	
				Gear R	13 - 25	BPV	
14		DRIVE	In	P, N	14 - 25	0 V	62/136
				R, D, 1, 2, 3	14 - 25	BPV	62/136
15	VT	Brake light switch	In	Brake pedal not depressed	15 - 25	0 V	52/138
				Brake pedal depressed	15 - 25	BPV	52/138
16		No connection					
17	YE/ BN	Combustion cyl 1+2	In	850 ± 50 rpm	17 - 25	≈1.5 V 15-30 Hz (LO Hlp)	170/117
18	BN/ RD	Combustion cyl 3+4	In	850 ± 50 rpm	18 - 25	≈1.5 V 15-30 Hz (LO Hlp)	170/117
19-20		No connection					
21	YE/ GY	EVAP canister purge valve Diagnostics	In	Scan tool activates EVAP canister purge valve in Trionic	21 - 25	6-7 V 8 Hz 50% (-) 60 ms (-) (Hlp LOp)	54/101
22	BU/ BN	Pressure sensor	In		22 - 67	100 kPa = 1.9 V also see Technical Data	36/75
23	GN	Oxygen sensor	In	850 ± 50 rpm and engine warm	23 - 47	0.1-0.9 V	40/87
24	BK	Main ground	In	850 ± 50 rpm	24 - Batt-	< 0.1 V	34
25	BK	Main ground	In	850 ± 50 rpm	25 - Batt-	< 0.1 V	34

Pin	Color	Component/Function	In/ Out	Measuring conditions	Across	Reading	Function/ fault diagnosis, see 2:7, page
26	BU	Boost pressure control valve	Out		1 - 26	0 V	51/146
				Scan tool activates boost pressure control valve in Trionic	26 - 25	90 Hz 17.5% (-) 1.9 ms (-) (LP P HI LO)	51/146
27	YE/ GY	EVAP canister purge valve	Out	Scan tool activates EVAP canister purge valve in Trionic	27 - 25	6-7 V 8 Hz 50% (-) 60 ms (-) (LP HI LO)	54/101
28-30		No connection					
31	BU/ GY	Main relay	Out		31 - 25	BPV	55/124
				Scan tool activates IAC valve	31 - 25	0 V	55/124
32	YE/ GN	MIL (CHECK ENGINE)	Out	Turn the ignition key from OFF to ON.	32 - 25	< 0.5 V	60/139
				After 3 s	32 - 25	BPV	60/139
33	GY/ BK	Diagnostic	In/ Out	ISAT scan tool not connected	33 - 25	≈ 6.5 V	59
				ISAT scan tool connected	33 - 25	BPV	59
34	GN/ RD	Fuel consumption signal	Out	850 ± 50 rpm	34 - 25	7.1 Hz 2.5-4.5 ms (-)	
35	YE/ BK	Cars without ETS Engine load signal (A/C and all current consumers switched off)	Out	850 ± 50 rpm	35 - 67	28 Hz ≈ 25 μs (+)	36/75
				2500 rpm	35 - 67	85 Hz ≈ 40 μs (+) (LP P HI LO)	36/75
		Cars with ETS	Out	850 ± 50 rpm	35 - 67	28 Hz ≈ 60 μs (+)	36/75
				2500 ± 50 rpm	35 - 67	85 Hz ≈ 170 μs (+) (LP P HI LO)	36/75
36	BU/ GN	Cruise control	In		36 - 25	BPV	52
				Activate CC diagnostic mode, press SET/RES	36 - 25	0 V	52
37		Secondary air injection, diagnostics	In	Scan tool activates secondary air injector	37 - 25	BPV 0 V	
38		No connection					
39	PK/ BK	Speed signal	In	Raise one front wheel and rotate it	39 - 25	≈ 6 V 50 Hz (HI LO)	58/104
40		No connection					

Pin	Color	Component/Function	In/ Out	Measuring conditions	Across	Reading	Function/ fault diagnosis, see 2:7, page
41	YE	Crankshaft position sensor	In	850 ± 50 rpm	41 - 67	5-10 V~ ≈ 825 Hz (LP HI LO)	35/98
42	BN/ WH	Throttle position sensor	Out		42 - 67	5 V	39/84
43	GY	Pressure sensor	Out		43 - 67	5 V	36/75
44	OG	Knock signal	In	850 ± 50 rpm	44 - 67	50-100 mV~ (LP P LO)	43/96
45	GN/ BN	Throttle position sensor	In		45 - 67	Idling ≈ 0.5 V also see Technical data	39/84
46	WH/ BK	Intake air temperature sensor	In		46 - 67	40°C = 1.5 V also see Technical Data	37/78
47	BK	Oxygen sensor, reference ground	In	850 ± 50 rpm	25 - 47	< 0.05 V	34
48	PK/ WH	+30		850 ± 50 rpm	BPV 48	< 0.5 V	33
49	BU/ VT	Idle air control (IAC) valve	Out	850 ± 50 rpm	1 - 49	3.5-6.0 V	28/107
				A/C and all electrical loads switched off	49 - 25	500 Hz 30-50% 0.5-0.9 ms (LP HI LO)	28/107
50	BK/ WH	Oxygen sensor, heating	Out	850 ± 50 rpm	50 - 25	≈ 0.3 V	40/91
				Remove fuse No. 28	50 - 25	0 V	40/91
51		No connection					
52	YE	Relay, secondary air injection	Out	Scan tool activates secondary air injector	52 - 25	BPV	
					32 - 25	0 V	
53		No connection					
54	RD/ WH	A/C, out	Out	Scan tool activates A/C in Trionic	54 - 25	BPV+/<0.5 V	57/141
55	BU/ YE/	SHIFT UP	Out	Turn the ignition key from OFF to ON	55 - 25	< 0.5 V	61/139
				After 3 s	55 - 25	BPV	61/139
56	WH	Fuel pump relay	Out		56 - 25	BPV	56/128
				Scan tool activates oxygen sensor preheating in Trionic	56 - 25	0 V	56/128

Pin	Color	Component/Function	In/ Out	Measuring conditions	Across	Reading	Function/ fault diagnosis, see 2:7, page
57	GN/ OG	Throttle position signal (cars without ETS)	Out	850 ± 50 rpm	57 - 25	≈1 V 100 Hz 9% (+) 0.9 ms (+) (LP HI LO)	39/84
	YE	Throttle position signal (cars with ETS)	In	850 ± 50 rpm	57 - 67	≈0.7 V 200 Hz 5% (+) 0.26 ms (+)	39/84
58	GN/ RD	Rpm signal	Out	850 ± 50 rpm	58 - 25	≈ 0.5 V 28 Hz (LP HI LO)	35/98
59	GN/ GY	A/C in	In	M1995: ISAT scan tool activates A/C in EDU M1994: A/C button ON/OFF	59 - 25	BPV	57/141
						59 - 25	0 V
60	YE/ GY	+15	In		BPV - 60	< 0.5 V	33
61		No connection					
62-63		For production only					
64		No connection					
65		For production only					
66	BK	Reference ground, en- gine coolant temperature sensor	In		66 - 25	< 0.05 V	34/81
67	BK	Sensor ground	Out		67 - 25	< 0.05 V	34
68	YE/ WH	Engine coolant tempera- ture sensor	In		68 - 66	90°C = 0.41 V also see Technical Data	38/81
69-70		No connection					

Saab Trionic (contd.)

Diagnostic trouble codes

Diagnostic trouble code (SAE)	Faulty function/component	MIL (CHECK ENGINE)	Text displayed on Scan Tool	See 2:7, page
P0105	Manifold absolute pressure (MAP) sensor. General diagnostic trouble code for pressure sensor function.	On	FAULT XX P0105 INTAKE PRESSURE FUNCTION INCORRECT	82
P0106	Manifold absolute pressure (MAP) sensor. Vacuum hose leakage. Faulty sensor.	On	FAULT XX P0106 INTAKE PRESSURE INPUT INCORRECT	82
P0107	Manifold absolute pressure (MAP) sensor. Control module input shorting to ground.	On	FAULT XX P0107 INTAKE PRESSURE SHORT TO GROUND	82
P0108	Manifold absolute pressure (MAP) sensor. Control module input shorting to BPV or open circuit.	On	FAULT XX P0108 INTAKE PRESSURE OPEN CIRCUIT SHORT TO BATT+	82
P0110	Intake air temperature sensor. General diagnostic trouble code for temperature sensor operation.	On	FAULT XX P0110 INDUCTION AIR TEMP FUNCTION INCORRECT	85
P0112	Intake air temperature sensor. Control module input shorting to ground.	On	FAULT XX P0112 INDUCTION AIR TEMP SHORT TO GROUND	85
P0113	Intake air temperature sensor Control module input shorting to BPV or open circuit.	On	FAULT XX P0113 INDUCTION AIR TEMP OPEN CIRCUIT SHORT TO BATT+	85
P0115	Engine coolant temperature sensor. General diagnostic trouble code for temperature sensor operation.	On	FAULT XX P0115 COOLANT TEMPERATURE FUNCTION INCORRECT	Without ETS, p. 88 With ETS, p. 91
P0117	Engine coolant temperature sensor. Control module input shorting to ground.	On	FAULT XX P0117 COOLANT TEMPERATURE SHORT TO GROUND	Without ETS, p. 88 With ETS, p. 91
P0118	Engine coolant temperature sensor. Control module input shorting to BPV or open circuit.	On	FAULT XX P0118 COOLANT TEMPERATURE OPEN CIRCUIT SHORT TO BATT+	Without ETS, p. 88 With ETS, p. 91
P0120	Throttle position sensor. General diagnostic trouble code for throttle position sensor operation.	On	FAULT XX P0120 THROTTLE POSITION FUNCTION INCORRECT	Without ETS, p. 94 With ETS, p. 98
P0121	Throttle position sensor. Sensor malfunction.	On	FAULT XX P0121 THROTTLE POSITION INPUT FAULTY	94

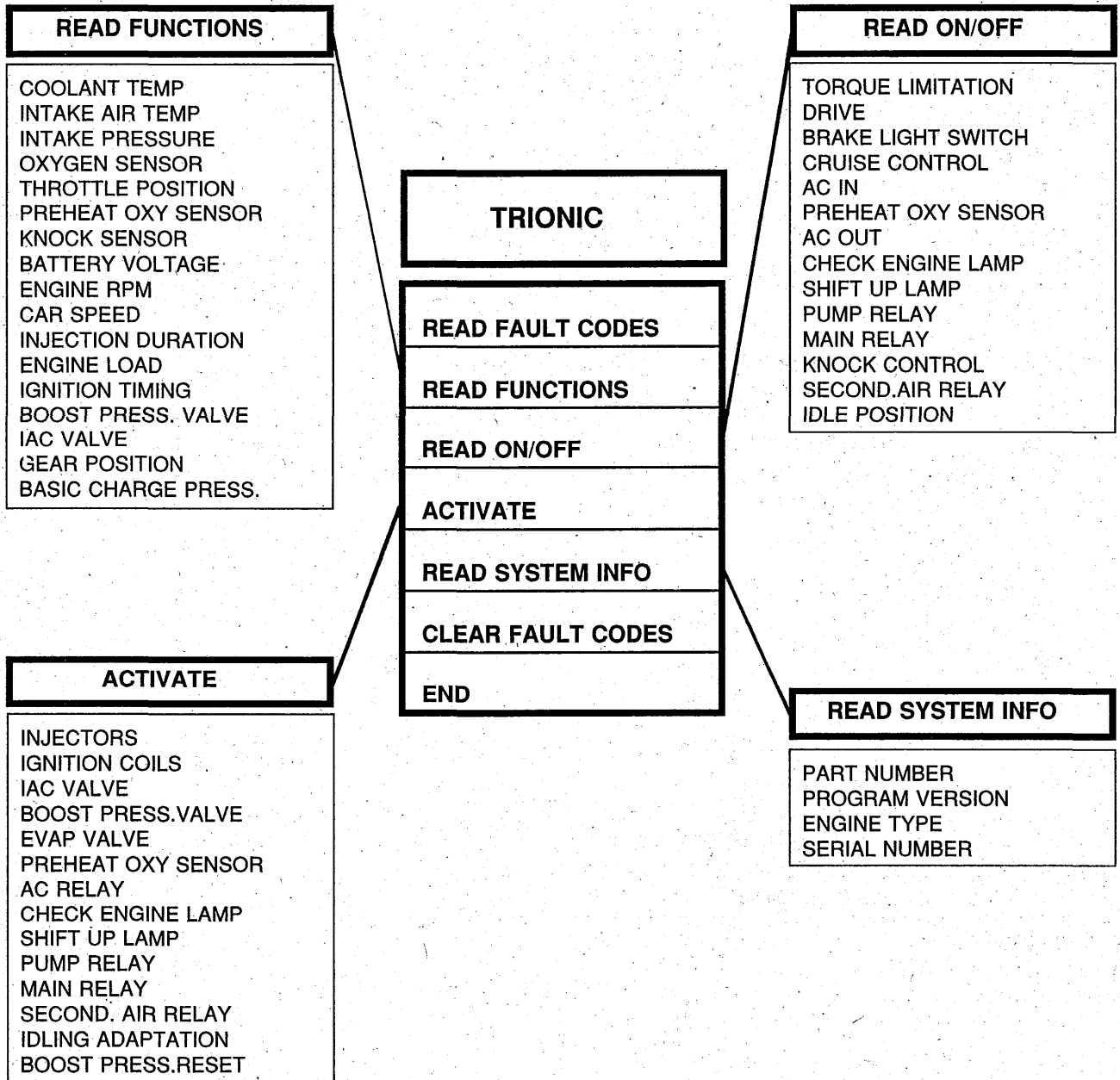
Diagnostic trouble code (SAE)	Faulty function/component	MIL (CHECK ENGINE)	Text displayed on Scan Tool	See 2:7, page
P0122	Throttle position sensor. Control module input shorting to ground.	On	FAULT XX P0122 THROTTLE POSITION SHORT TO GROUND	Without ETS, p. 94 With ETS, p. 98
P0123	Throttle position sensor. Control module input shorting to BPV or open circuit.	On	FAULT XX P0123 THROTTLE POSITION OPEN CIRCUIT SHORT TO BATT+	94
P0130	Oxygen sensor. General diagnostic trouble code for oxygen sensor operation.	On	FAULT XX P0130 OXYGEN SENSOR FUNCTION INCORRECT	101
P0131	Oxygen sensor. Max. leaner mixture.	On	FAULT XX P0131 OXYGEN SENSOR LEAN	101
P0132	Oxygen sensor. Max. enrichment.	On	FAULT XX P0132 OXYGEN SENSOR RICH	101
P0135	Preheating, oxygen sensor. Current outside limits.	On	FAULT XX P0135 OXYGEN SENSOR NO PREHEATING	107
P0170	Adaptation. General diagnostic trouble code for adaptation operation.	On	FAULT XX P0170 ADAPTATION FUNCTION INCORRECT	110
P0171	Adaptation. Lean mixture.	On	FAULT XX P0171 ADAPTATION LEAN	110
P0172	Adaptation. Rich mixture.	On	FAULT XX P0172 ADAPTATION RICH	110
P0325	Knock signal from the ignition discharge module (NOTE: no knock sensor).	-	FAULT XX P0325 KNOCK SENSOR OPEN CIRCUIT	112
P0335	Crankshaft position sensor. Malfunction.	-	FAULT XX P0335 CRANKSHAFT POS SENS FUNCTION INCORRECT	115
P0410	Relay, secondary air injection control. Malfunction.	On	FAULT XX P0410 SECOND.AIR RELAY FAULTY FUNCTION	118
P0413	Relay, secondary air injection control. Voltage too high, open circuit	On	FAULT XX P0413 SECOND. AIR RELAY BREAK	118
P0414	Relay, secondary air injection. Voltage too low, short circuit.	On	FAULT XX P0414 SECOND. AIR RELAY SHORTING TO GROUND	118
P0443	EVAP canister purge valve. General diagnostic trouble code for EVAP canister purge valve operation.	On	FAULT XX P0443 EVAP VALVE FUNCTION INCORRECT	121
P0444	EVAP canister purge valve. Control module output, open circuit.	On	FAULT XX P0444 EVAP VALVE OPEN CIRCUIT	121

138 Engine

Diagnostic trouble code (SAE)	Faulty function/component	MIL (CHECK ENGINE)	Text displayed on Scan Tool	See 2:7, page
P0445	EVAP canister purge valve. Control module output, shorting to ground.	On	FAULT XX P0445 EVAP VALVE SHORT TO GROUND	121
P0500	Car speed. Input signal from speedometer. General diagnostic trouble code for speed. -	-	FAULT XX P0500 WHEEL SPEED FR FUNCTION INCORRECT	124
P0501	Car speed. Input signal out of limits.	-	FAULT XX P0501 WHEEL SPEED FR SIGNAL INCORRECT	124
P0502	Car speed. No input signal.	-	FAULT XX P0502 WHEEL SPEED FR OPEN CIRCUIT	124
P0505	Idle air control (IAC) valve. Malfunction.	-	FAULT XX P0505 IAC VALVE FUNCTION INCORRECT	126
P0605	Electronic control module. Internal fault.	-	FAULT XX P0605 CONTROL MODULE INTERNAL FAULT	130
P1322	Malfunction in ETS. Engine switched off (safety feature).	-	FAULT XX P1322 ENGINE RPM SIGNAL WRONG	131
P1500	Battery positive voltage. Outside limits.	-	FAULT XX P1500 BATTERY VOLTAGE VOLTAGE INCORRECT	133

Saab Trionic (contd.)

Menu structure for command codes



Saab Trionic (contd.)

READ FUNCTIONS

ISAT scan tool display	Function
COOLANT TEMP XXX °C	General engine coolant temperature. See "Test readings, control module connections", pin 68.
INTAKE AIR TEMP XXX °C	Current intake air temperature. See "Test readings, control module connections", pin 46.
INTAKE PRESSURE XXX kPa	Current intake air pressure. See "Test readings, control module connections", pin 22.
OXYGEN SENSOR X.XX V	Current voltage from oxygen sensor. See "Test readings, control module connections", pin 23.
THROTTLE POSITION XX.X%	Current throttle position in % of 5 V. See "Test readings, control module connections", pin 45.
PREHEAT OXY SENSOR XXXX mA	Internal Trionic status indicating prevailing current consumption in oxygen sensor preheating circuit.
KNOCK SENSOR X.XX V	Internal Trionic status indicating current knock level.
BATTERY VOLTAGE XX.X V	Current battery voltage. See "Test readings, control module connections", pin 60.
ENGINE RPM XXXX RPM	Current engine speed. See "Test readings, control module connections", pin 58.
CAR SPEED XXX KM/H	Current car speed. See "Test readings, control module connections", pin 39.
INJECTION DURATION XXX ms	Internal Trionic status indicating opening time of relevant injector.
ENGINE LOAD XX.XX µs	Internal Trionic status indicating current engine load.
IGNITION TIMING XX.X DEGREES	Internal Trionic status indicating current ignition timing.
BOOST PRESS. VALVE XX.X % OPEN	Internal Trionic status indicating BPC valve opening angle. The higher the reading, the higher the boost pressure.
IAC VALVE XX.X % OPEN	Internal Trionic status indicating opening angle of idle air control valve.
GEAR POSITION U,R,1,2,3,4,5	Gear position engaged. The gear position is calculated in the Trionic system, based on current input data (engine speed, car speed). U stands for "Undefined".
BASIC CHARGE PRESS	In the boost pressure function in the Trionic works: The scan tool displays "BOOST PRESSURE" If the boost pressure function in the Trionic is not working: The cause of the fault is shown on the scan tool display (KNOCK CONTROL/ BRAKE ACTIVE/ PRESSURE SENSOR FAULT/ CRUISE CONTROL ON/ GEAR R/ BATTERY VOLTAGE)

Saab Trionic (contd.)

READ ON/OFF

ISAT scan tool display	Function
TORQUE LIMITATION ON 12 V/ OFF 0 V	Input from reversing light switch. See "Test readings, control module connections", pin 13.
DRIVE ON 12 V/ OFF 0 V	Input signal from gear selector position sensor in cars with automatic transmission. See "Test readings, control module connections", pin 14.
BRAKE LIGHT SWITCH ON 12 V/ OFF 0 V	Input from brake light switch. See "Test readings, control module connections", pin 15.
CRUISE CONTROL ON 0 V/ OFF 12 V	Input signal from cruise control module. See "Test readings, control module connections", pin 36.
AC IN ON 12 V/ OFF 0 V	M1995 Input signal from EDU via antifrost thermostat. See "Test readings, control module connections", pin 59. M1994 Input signal from antifrost thermostat.
PREHEAT OXY SENSOR ON/OFF	Internal Trionic status indicating if the oxygen sensor preheating circuit is activated (=ON).
AC OUT ON 0 V/ OFF 12 V	Output to A/C relay/compressor. See "Test readings, control module connections", pin 54.
CHECK ENGINE LAMP ON 0 V/ OFF 12 V	Output to main instrument. See "Test readings, control module connections", pin 32.
SHIFT UP LAMP ON 0 V/ OFF 12 V	Output to main instrument. See "Test readings, control module connections", pin 55.
PUMP RELAY ON 0 V/ OFF 12 V	Output to fuel pump relay. See "Test readings, control module connections", pin 56.
MAIN RELAY ON 0 V/ OFF 12 V	Output to main relay. See "Test readings, control module connections", pin 31.
KNOCK CONTROL YES/NO	Internal Trionic status indicating whether ignition is retarded as a result of knock control.
SECOND. AIR RELAY ON 0 V/ OFF 12 V	Output to secondary air injection relay. See "Test readings, control module connections", pin 52.
IDLE POSITION YES/NO	Internal Trionic status indicating whether engine is idling or not.

Saab Trionic (contd.)

ACTIVATE

ISAT scan tool display	Function
INJECTORS	<p>This command has a submenu as follows:</p> <ul style="list-style-type: none"> • INJECTOR CYL 1 • INJECTOR CYL 2 • INJECTOR CYL 3 • INJECTOR CYL 4 <p>Each injector is activated for 10 seconds at a frequency of 10 Hz.</p>
IGNITION COILS	<p>This command has a submenu as follows:</p> <ul style="list-style-type: none"> • IGNITION CYL 1 • IGNITION CYL 2 • IGNITION CYL 3 • IGNITION CYL 4 <p>each ignition coil is active for 10 seconds with a frequency of 200 Hz.</p>
BOOST PRESS.VALVE	The boost pressure control valve is activated for 10 seconds at a frequency of 90 Hz.
IAC VALVE	The idle air control valve is activated for 10 seconds with a current of 0.6 A.
EVAP VALVE	The EVAP canister purge valve is activated for 10 seconds with frequency of 8 Hz.
PREHEAT OXY SENSOR	Oxygen sensor preheating is activated for 10 seconds.
AC RELAY	The A/C relay/compressor is activated for 10 seconds at a frequency of 1 Hz.
CHECK ENGINE LAMP (MIL)	The MIL is activated for 10 seconds at a frequency of 1 Hz.
SHIFT UP LAMP	The SHIFT UP lamp is activated for 10 seconds at a frequency of 1 Hz.
FUEL PUMP RELAY	The fuel pump relay is activated for 10 seconds at a frequency of 1 Hz.
MAIN RELAY	The main relay is activated for 10 seconds at a frequency of 1 Hz.
SECOND. AIR RELAY	The secondary air injection relay is activated for 10 seconds at a frequency of 1 Hz.
IDLING ADAPTATION	This command is used for forced adaptation of the throttle position when idling.
BOOST PRESS.RESET	This command is used for resetting boost pressure adaptation.

Saab Trionic (contd.)**READ SYSTEM INFO**

ISAT scan tool display	Function
PART NUMBER XXX XXXX	The Trionic control module part number.
PROGRAM VERSION XXX XXXX	Trionic control module program version.
ENGINE TYPE XX XXX XXXX X	The engine version programmed in the Trionic control module.
SERIAL NUMBER XXX XXXX	The serial number of the Trionic control module.

Turbo System

Components included

Symptom	Cause of fault	See 2:4, page
The boost pressure control (BPC) valve works at idling speed (irregular clapping sound).	Idling speed too low.	291-5
	Break in the electrical line between the pressure sensor and the control module.	291-5
	Faulty pressure sensor.	291-5
	Poor contact/break in the wiring between the knock sensor and the control module.	291-5
	Knock sensor loose.	291-5
	Faulty knock sensor.	291-5
	Faulty control module.	291-5
	Electrical interference.	291-5
The boost pressure control valve does not work when the APC system is checked in the car.	There is no voltage to the control module between terminals 14 (+) and 6 (-). Important The wiring harness connector should be connected to the control module when taking readings.	291-6
	Poor contact in knock sensor connector. Break in the wiring between the knock sensor and control module.	291-6
	Knock sensor loose.	291-6
	Faulty knock sensor.	291-6
	Boost pressure control valve not working despite receiving <5 V. Important The BPC valve connector should be plugged in.	291-6
	Faulty pressure sensor.	291-6
	Faulty control module.	291-6

Fault diagnosis schedule, basic charge pressure

Symptom	Cause of fault	See 2:4, page
Basic charge pressure cannot be adjusted as described.	Faulty wastegate.	291-1
	The bearing between the membrane housing and the push rod is seizing.	291-1
	Blocked restriction in BPC valve hose nipple to turbocharger (connection marked "C").	291-1

Fault diagnosis schedule, maximum charging pressure

Symptom	Cause of fault	See 2:4, page
Maximum charging pressure too low (low engine output).	Charge pressure incorrectly set (-M1989).	291-2
	Poor contact in the wiring between pressure sensor and control module or between pressure sensor and ground or in the knock sensor connector, Break in the wiring between knock sensor and control module and between pressure sensor and control module.	291-2
	Faulty knock sensor.	291-2
	Faulty pressure sensor.	291-2
	BPC valve not opening.	291-2
	Faulty control module.	291-2
	Knock sensor registering abnormal engine vibration.	291-2
	Faulty spring or push rod seizing in membrane housing.	291-2
	Faulty turbocharger.	291-2
Boost pressure too high (includes large overrun of boost pressure during acceleration) pressure switch opens.	Hose leaking between turbocharger and BPC valve.	291-3
	Hose leaking between BPC valve and diaphragm housing.	291-3
	Diaphragm housing leaking.	291-3
	Hose to pressure sensor leaking.	291-3
	Faulty pressure sensor.	291-3
	BPC valve not closing due to piston seizing.	291-3
	Blocked restriction in BPC valve hose nipple to turbocharger (connection marked "C").	291-3
	Basic charge pressure incorrect.	291-3
	Short in pressure sensor signal lead.	291-3
	Faulty control module.	291-3
	Bearing seizing wastegate housing and flap valve.	291-3
Bearing seizing between push rod and diaphragm housing.	291-3	
Boost pressure normal, but no reduction of boost pressure despite constant knocking.	APC system not working.	291-4
	Poor contact in knock sensor cable.	291-4
	Knock sensor loose.	291-4
	Faulty knock sensor.	291-4
	Faulty control module.	291-4
	Bearing seizing between wastegate housing and flap valve.	291-4
	Bearing seizing between push rod and diaphragm housing.	291-4

Electrical system

Trip computer, EDU	147	Theft Alarm.	165
Trip computer, DCC	160	Audio system	177
Cruise control	161		

EDU

Diagnostic trouble codes -M1989, self tests

Code	Explanation
F1	Fault in transmission range switch or wiring (automatic only)
F2	Short circuit in outside air temperature sensor
F3	Short circuit in fuel level sensor.
F4	Uncertain function in trip computer

If outside temperature is not shown despite F2 not being shown, this could mean that the sensor signal has been lost or that trip computer DCC has not been installed.

Important

In the event of the EDU malfunctioning, check the 8 pin connector behind the combined instrument, before changing the EDU. If one half or the entire EDU is not lit, start by checking if the lamps are intact.

EDU (contd.)**Test readings, control module connections (M1990-1994)**

Readings should be taken with the ignition key ON.

Pin	Color	Component/Function	In/ Out	Measuring conditions	Reading	Across	Function/ fault diagno- sis, see 3:5, page
1	RD	+30	In			1 - 21	29
2	OG	ACC	Out				
3	BU	DCC	Out				
4-7		No connection					
8	GN/ RD	Fuel pulses	In	Idling	0.2-0.6 V 14-1100 Hz	8 - 21	31
9	WH	Wheel speed signal (M1990)	In	Rotate front wheels 1 revolution/s 20 km/h	Alternates be- tween 0 and 11 V 14 Hz	9 - 21	31
	GN	Wheel speed signal (M1991-1994)					
10-11		No connection					
12	VT/ WH	MIL (CHECK ENGINE) (M1990-1993)	In	On Off	0 V 12 V	12 - 21	42
	YE/ WH	MIL (CHECK ENGINE) (M1994)					
13		No connection					
14	BN/ WH	INFO button (M1990)	In	Pressed Released	0 V 12 V	14 - 21	43
	BN/ RD	INFO button (M1991- 1994)					
15	GN/ RD	R button	In	Pressed Released	0 V 12 V	15 - 21	43
16	BN/ WH	Engine oil level sensor	In	On Off	0 V 12 V	16 - 21	42
17	BN	Engine coolant level sen- sor	In	On Off	0 V 12 V	17 - 21	42
18	BU	Selector lever position sensor	In	Position P,R,3,2 Position N,D,1 and man.	0 V 12 V	18 - 21	41
19	YE	Selector lever position sensor	In	Position R,N,D,3 Position P,2,1 and man.	0 V 12 V	19 - 21	41
20	WH	Selector lever position sensor	In	Position D,3,2,1 Position P,R,N and man.	0 V 12 V	20 - 21	41
21	BK	Ground	In		< 0.1 V	21 - Batt-	
22		No connection					
23	GY	Temperature signal	In	Normal	12 V 950-1000 Hz	23 - 21	39

Pin	Color	Component/Function	In/ Out	Measuring conditions	Reading	Across	Function/ fault diagno- sis, see 3:5, page
24	GN	Fuel level gauge	In	Full tank Empty tank	0 V 12 V	24 - 21	35
25	GY	Fuel level warning lamp	In	On Off	0 V 12 V	25 - 21	35
26	BK	Ground					
27		No connection					
28	BK	Outside temperature sensor	In		1.5-5 V	28 - 35	39
29-31		No connection					
32	BN/ WH	Rheostat, instrument illu- mination	In	Zero position Max. illumina- tion	0 V 12 V	32 - 21	29
33	WH	Fuel level sensor	In	Empty tank Full tank Read with the connector plugged into the control module	0.4 V 0.3 V	33 - 26	35
34		No connection					
35	WH	Outside temperature sensor	Out	Read with the connector plugged into the control module	1.5-5 V	35 - 28	39
36	YE	Light sensor	In	Min. light inten- sity Max. light in- tensity	0 V 12 V	36 - 21	30
37	YE	+15	In		12 V	37 - 21	29
38	BU	Diagnostic					
39	GN	Diagnostic					

EDU (contd.)**Diagnostic trouble codes M1990-1994,
ISAT scan tool**

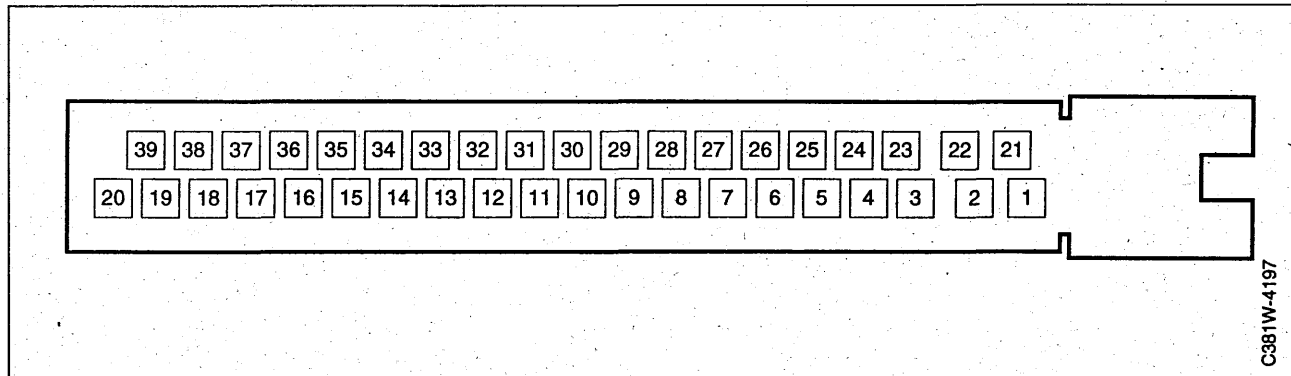
Permanent	Temporary	Type of fault	See 3:5, page
11111		System without faults	
45362	25362	Fault in selector lever position sensor (automatic transmission)	41
45522	25522	Fuel level sensor, open circuit	35
45532	25532	Fuel level sensor, short circuit	35
46222	26222	Can displayed if the EDU has not been programmed for the car after being changed	
46322	26322	Outside air temperature sensor, break	39
46391	26391	Diagnostic trouble codes in ACC unit No outside air temperature signal from EDU control module	39
96692	69992	Internal fault in EDU control module	
F2		Diagnostic trouble code in DCC unit (shown on display) No outside air temperature signal from EDU control module	39

Command codes EDU, scan tool

For command codes for EDU trip computer, see Service Manual 3:5 "Programmable trip computer EDU" M1990-1994, page 55.

EDU (contd.)

Test readings, control module connections (M1995)



> = greater than ; < = less than.

Pins with no further comment are not connected.

Pin	Color	Component/Function	In/ Out	Measuring conditions	Reading	Across	Function/ fault diagno- sis, see 3:5, page
1	RD	Battery positive voltage +30	In		< 0.5 V	1- BPV	24
2		No connection					
3	OG	ACC wake up	In	Command from ACC No command	12 V 0 V	3 - 21	40
4	YE/ WH	A/C	Out	Scan tool acti- vates A/C ON OFF	12 V 0 V	4 - 21	39
5	BU	Radiator fan, step 1	Out	Scan tool acti- vates A/C ON OFF	0 V 12 V	5 - 21	37/84
6	BU/ WH	Radiator fan, step 2	Out	Scan tool acti- vates A/C ON OFF	0 V 12 V	6 - 21	37/854
7		No connection					
8	GN/ RD	Fuel pulses	In	Idle, warm en- gine Motronic Saab Trionic	6.25 Hz 3 ms 7.5 Hz 2.5 ms	8 - 21	329
9	GN	Wheel speed signal	In	Rotate front wheels 1 revolution/s 20 km/h	Alternates be- tween 0 and 11 V 12 Hz	9 - 21	28
10	YE	A/C	Out	Scan tool acti- vates A/C or ACC ON OFF	12 V 0 V	10 - 21	38/79
	YE/ WH	ACC					

Pin	Color	Component/Function	In/ Out	Measuring conditions	Reading	Across	Function/ fault diagno- sis, see 3:5, page
11		No connection					
12	YE/ WH	MIL (CHECK ENGINE)	In	On Off	0 V 12 V	12 - 21	34/80
13		No connection					
14	BN/ RD	INFO button	In	Pressed Released	0 V 12 V	14 - 21	26/70
15	GN/ RD	R button	In	Pressed Released	0 V 12 V	15 - 21	26/70
16		No connection					
17	BN	Engine coolant level sensor	In	On Off	0 V 12 V	17 - 21	35
18	BU	Gear selector position sensor A	In	Position P,R,3,2 Position N,D,1 and man.	0 V 12 V	18 - 21	33/66
19	YE	Gear position sensor B	In	Position R,N,D,3 Position P,2,1 and man.	0 V 12 V	19 - 21	33/66
20	WH	Gear position sensor C	In	Position D,3,2,1 Position P,R,N and man.	0 V 12 V	20 - 21	41
21	BK	Ground	In		< 0.1 V	21 - Batt-	24
22	GN/ WH	Voltage supply to fuel/temp. gauge	Out		1 V lower than BPV	22 - 21	42
23	BK	Outside air temperature sensor	Out		Varies be- tween 7 and 13 V	23 - 21	41
24	GN	Fuel level gauge	Out	Full tank Empty tank	approx. 9 V approx. 1 V	24 - 21	42
25	GY	Lamp, low fuel level	Out	Activate with Scan Tool, Lamp ON Lamp OFF	0 V 12 V	25 - 21	31
26	BK	Ground, fuel level sensor	In		< 0.1 V	26 - 21	30
27	OG	Ground, engine coolant temperature sensor	In		< 0.1 V	27 - 21	36
28	BK	Ground, outside temperature sensor	In		< 0.1 V	28 - 21 V	32
29		No connection					
30	YE	Engine temperature instrument	Out		1-9 V depending on coolant tem- perature	30 - 21	42
31		No connection					

Pin	Color	Component/Function	In/ Out	Measuring conditions	Reading	Across	Function/ fault diagno- sis, see 3:5, page
32	BN/ WH	Rheostat, instrument illu- mination	In	Zero position Max. illumina- tion	13 - 100% PWM approx. 2 V 12 V	32 - 21	27
33	WH	Fuel level sensor	In	Empty tank Full tank	approx. 0.4 V approx. 3 V	33 - 21	30
34	YE	Coolant temperature	In		0-1 V depending on engine cool- ant tempera- ture	34 - 21	36
35	WH	Outside temperature sensor	In		1.5-5 V depending on temperature	35 - 21	32
36	YE	Light sensor	In	Min. light inten- sity Max. light in- tensity	0 V 10 V	36 - 21	27
37	YE	+15	In		< 0.5 V	37 - BPV	24
38	BU	Diagnostic	In/ Out	ISAT scan tool connected Scan tool not connected	12 V 5 V	38 - 21	25

EDU (contd.)**Diagnostic trouble codes (M1995)**

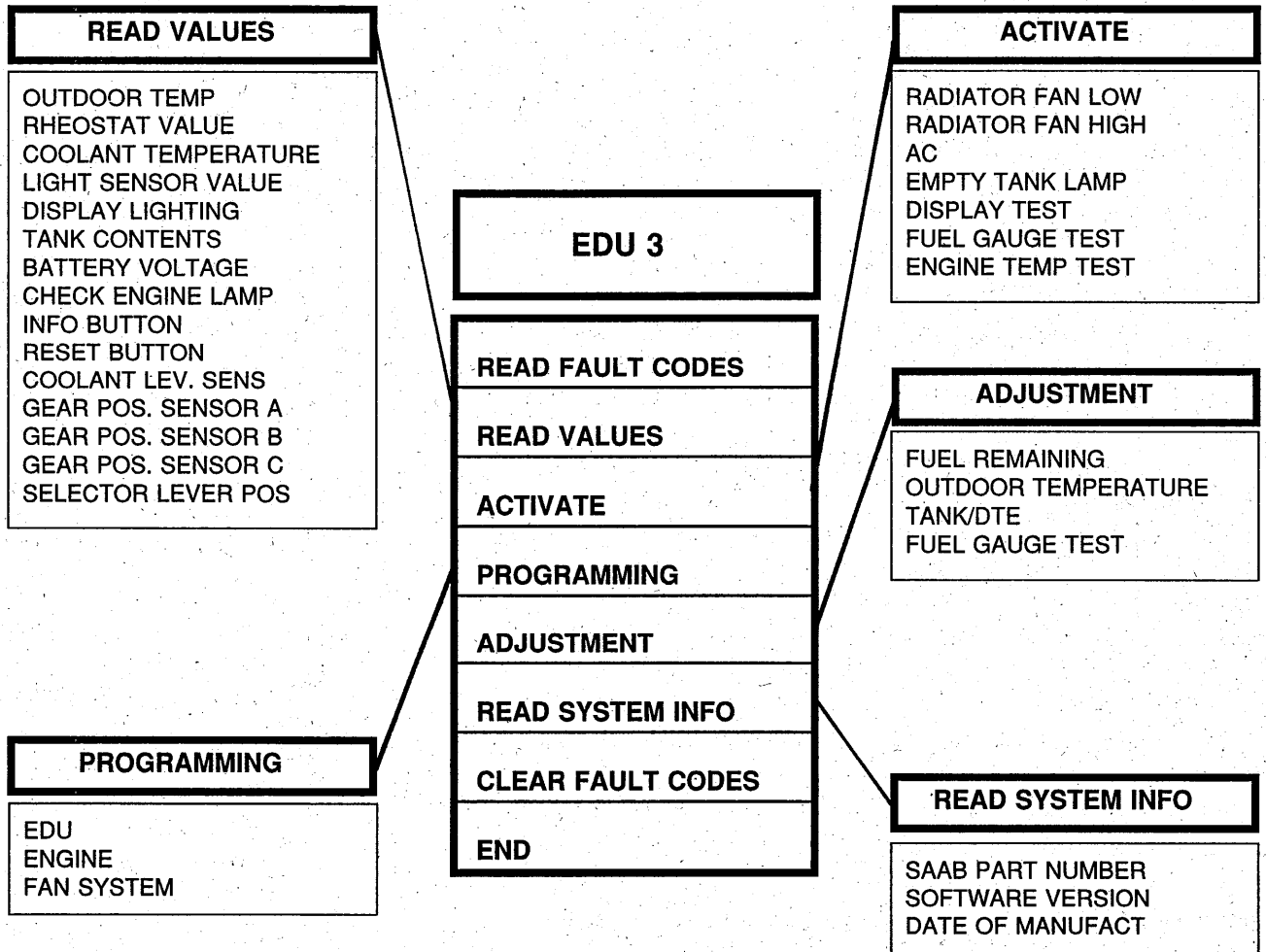
Diagnostic trouble code (SAE)	Faulty function/component	Text on ISAT display	See 3:5, page
B1102	Radiator fan, step 2 - relay shorted to BPV	FAULT X P/I B1102 RAD FAN HIGH SPEED RELAY SHORT TO BATTERY +	59
B1103	Radiator fan, step 2 - relay break	FAULT X P/I B1103 RAD FAN HIGH RELAY OPEN CIRCUIT	60
B1104	Radiator fan, step 1 - relay shorted to BPV	FAULT X P/I B1104 RAD FAN LOW SPEED RELAY SHORT TO BATTERY +	61
B1312	Coolant temperature sensor, shorted to ground	FAULT X P/I B1312 COOLANT TEMPERATURE INPUT LOW/ SHORTING TO GROUND	62
B1313	Engine coolant temperature sensor - shorting the BPV	FAULT X P/I B1313 COOLANT TEMPERATURE INPUT HIGH/OPEN SHORTING TO BATT+	63
B1605	Control module, internal fault	FAULT X P/I B1605 INTERNAL FAULT	92
B1722	Fuel level sensor, shorted to ground	FAULT X P/I B1722 FUEL LEVEL SENSOR SHORTING TO GROUND	64
B1723	Fuel level sensor, open circuit	FAULT X P/I B1723 FUEL LEVEL SENSOR OPEN CIRCUIT	64
B1745	Outside temperature, no signal	FAULT X P/I B1745 OUTDOOR TEMPERATURE NO SIGNAL	65
B1775	Gear selector position sensor faulty	FAULT X P/I B1775 TRANS.RANGE SWITCH INPUT WRONG	66

EDU (contd.)**Faults without diagnostic trouble codes (M1995)**

Fault symptom	Component/Function	See 3:5, page
Display blank.	Voltage supply	67
Dim display in strong sunlight	Light sensor	69
EDU control module does not respond when buttons are pressed	INFO and R buttons	70
Parts of the display dark	Lamps	95
L/km: Instantaneous fuel consumption shows maximum when driving	Fuel consumption	72
L/km: Instantaneous fuel consumption shows minimum	Fuel consumption	73
MPG: Instantaneous fuel consumption shows minimum when driving	Fuel consumption	72
MPG: Instantaneous fuel consumption shows maximum	Fuel consumption	73
The fuel warning lamp does not light or lights continuously, but the fuel gauge shows normal readings	Fuel level and range counter	74
The fuel gauge shows zero or maximum, but the range indicator and tank gauge show normal readings	Fuel level and range counter	75
The fuel gauge shows zero and with the rheostat to minimum, the right-hand direction indicator lamp glows dimly or lights brightly with the rheostat to max.	Fuel level and range counter	75
Fuel gauge and D.T.E. are faulty	Fuel gauge float arm	77
Permanently high outside temperature reading	Outside temperature sensor	78
A/C not working and fault traced to circuit in EDU.	A/C	79
CHECK (MIL) functions do not light when the ignition key is turned to ON or do not go out when the engine is started	CHECK (MIL) functions	80,82
Radiator fan not working (1st step in 2 speed fan)	Radiator fan	84
Radiator fan, step 2 not working	Radiator fan	85
Engine temperature display not working.	Engine temperature display	86

EDU (contd.)

Menu structure for command codes (M1995)



EDU (contd.)**READ VALUES (M1995)**

ISAT scan tool display	Function
OUTDOOR TEMP XX °C YY °F	Shows outside temperature in °C and °F
RHEOSTAT VALUE XXX %	Shows the rheostat value in % (0 - 100%) Light on gives a value between 13 and 100% Light off gives the value 100%.
COOLANT TEMP XXX °C YYY °F	Shows the coolant temperature in °C and °F
LIGHT SENSOR VALUE XX.X %	Shows cabin light value in V (0-10 V)
DISPLAY LIGHTING XXX %	Shows the display lighting in % (0 - 100%)
TANK CONTENTS XX Litres YY US GALLONS ZZ IMP GALLONS	Shows the contents of the tank in liters, US gallons or Imp. gallons
BATTERY VOLTAGE XX.X V	Shows battery positive voltage in V
CHECK ENGINE LAMP ON 0 V OFF 12 V	Shows the status of the malfunction indicator (CHECK ENGINE) lamp
INFO BUTTON ON 0 V OFF 12 V	Shows the status of the INFO button
RESET BUTTON ON 0 V OFF 12 V	Shows the status of the R button
COOLANT LEV. SENS ON 12 V OFF 12 V	Shows the status of the coolant level sensor
GEAR POS. SENSOR A ON 0 V OFF 12 V	Status of transmission range sensor A
GEAR POS. SENSOR B ON 0 V OFF 12 V	Status of transmission range sensor B
GEAR POS. SENSOR C ON 0 V OFF 12 V	Status of transmission range sensor C
SELECTOR LEVER POS.	Shows the position of the gear selector lever P, R, N, D, 3, 2, 1

EDU (contd.)**ACTIVATE (M1995)**

ISAT scan tool display	Function
RADIATOR FAN LOW ON OFF	Radiator fan, low speed activated
RADIATOR FAN HIGH ON OFF	Radiator fan, high speed activated
AC ON OFF	The A/C compressor is activated (the signal is sent to the engine management system)
EMPTY TANK LAMP ON OFF	Warning lamp for empty tank ON/OFF
DISPLAY TEST IN PROGRESS....	All EDU functions on the display go to full light strength
FUEL GAUGE TEST (0-70) LITERS	Select the number of liters on the scan tool. The gauge reading should correspond to the number of liters programmed
ENGINE TEMP TEST (0-147°C)	Select temperature on the scan tool. The gauge reading should correspond to selected temperature

EDU (contd.)

READ SYSTEM INFO (M1995)

ISAT scan tool display	Function
SAAB PART NUMBER XX XX XXX	Part number of the EDU control module
SOFTWARE VERSION XXXXXXXXXX	Program version of the EDU control module
DATE OF MANUFACT XXXXXXXXXX	Date of manufacture of the EDU control module

PROGRAMMING/ADJUSTING (M1995)

When changing an EDU 3 unit, it must be programmed using the scan tool. Select "PROGRAMMING" in the EDU menu and respond to the questions asked by the scan tool.

Important

The scan tool normally verifies the values last programmed when programming/adjusting. When EDU programming, **this is not done**. This means that it is not possible to program once and then once more and check what was programmed.

Important

When programming, the display can flash and the temperature/fuel gauges fluctuate up and down. This is caused by the programming voltage and is perfectly normal.

For programming/adjusting, see Service Manual 3:5 "Programmable EDU trip computer", pages 52 to 58.

DCC

Diagnostic trouble codes, self test

Code	Cause of fault
------	----------------

F1	Internal fault in DCC
----	-----------------------

F2	No temperature signal from EDU. (M1990: If there is a fault in the outside air temperature sensor, this can also be indicated on the EDU.)
----	---

Cruise control

Fault diagnosis (M1985-1994)

The instrument described can no longer be ordered. Instead, a BOB should be used.

- 1 Connect the test instrument.
- 2 Set the cruise control switch to OFF and turn the ignition key to ON.

Check that LEDs 1, 3 and 5 light.

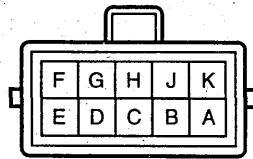
IMPORTANT: LED 5 is most likely to light when the car is moving.

- If diode 1 does not light, check the voltage supply to the control module.
 - If diode 3 does not light, check the pedal switches and wiring harnesses for these.
 - If diode 5 does not light, drive the car and check the vehicle speed sensor at the speedometer and the wiring harness.
- 3 Press the brake pedal and check that diode 3 goes out. Release the pedal (diode lights).
Manual gearbox: Press the brake pedal and check that diode 3 goes out again.
 - If there is a fault, check the pedal switch is working and correctly set and check the wiring harness (short to ground).
 - 4 Set the cruise control switch to ON and check that LED 9 lights.
 - If the LED does not light, check the switch and wiring harness.
 - 5 Press the "SET" button and check that LED 2 lights when the button is held pressed.
 - If LED 2 does not light, check the switch and wiring harness.
 - 6 Press the switch to position "RES" and check that LED 6 lights when the button is held pressed.
 - If LED 6 does not light, check the switch and wiring harness.
 - 7 Press the "VALVE" button on the test box and listen for whether the cruise control pump is activated.
 - If the pump does not work, check the valve and the wiring harness.
 - 8 Press the "PUMP" button on the test box and listen for whether the pump is working.
 - If the pump does not work, check the pump and the wiring harness.
 - 9 Pump and valve can also be checked while driving. If the "PUMP" button is pressed, throttle increases. When "VALVE" is pressed (or the clutch/brake pedal is pressed) throttle ceases.
 - If this does not happen, check the vacuum system.

If the tests in points 1 to 9 give the correct result, the fault lies in the control module.

Cruise control (contd.)

Test readings, control module connections (M1995)



C368W-4224

Pin	Color	Component/ Function	In/ Out	Measuring conditions	Reading	Across
1 (A)	GN	Switch	In	Switch set to ON position Ignition switched ON	12 V	1 - 5
2 (B)	GY/GN	Switch	In	Switch held in SET position Ignition switched on	12 V	2 - 5
3 (C)	GY	Switch	In	Switch held in RES position Ignition switched ON	12 V	3 - 5
4 (D)	YE/GN	Brake pedal switch	In	Automatic transmission D, 1, 2, 3 Pedal not depressed Pedal depressed	12 V 0 V	4 - 5
				Manual Pedal not depressed Pedal depressed	12 V 0 V	
		Clutch pedal switch	In	Manual Pedal not depressed Pedal depressed	12 V 0 V	4 - 5
5 (E)	BK	Power ground	In		12 V	5 - BPV
6 (F)	BN/WH	Ignition +54	In	Ignition key to ON	12 V	6 - 5
7 (G)	VT or BU/GN	Brake light switch	In	Brake pedal depressed Brake pedal not depressed	12 V 0 V	7 - 5
8 (H)	BN/YE or YE/WH	CRUISE indicator lamp	Out	Lamp out Lamp on	0 V 12 V	8 - 5
9 (J)	BU/GN	Communication with Saab Trionic	Out	In diagnostics mode ON/OFF SET RESUME	12 V	9 - 6
10 (K)	BK/GN	Speed signal	In	Car driven slowly forward	approx. 6 V	10 - 5

Cruise control (contd.)

Diagnostics mode (M1995)

Fault diagnosis is carried out without the scan tool.
Begin fault diagnosis by checking:

- 1 Fuses, see 3:5, page 16.
- 2 Ignition, see 3:5, page 17
- 3 Grounding, see 3:5, page 18.
- 4 The pins of the male control module connector for possible slide-out.

Fault diagnosis is carried out in the diagnostics mode. To enter the diagnostics mode, see the table below.

To leave diagnostics mode, increase speed to over 32 km/h (20 mph) or turn the ignition key to OFF.

If you happen to make a mistake in the diagnostics mode, you will automatically be returned to point 5 and will have to continue from there.

	Action	CRUISE lamp	Item checked	See 3:5, page
1	Engine switched off and handbrake applied.			
2	Automatic transmission: selector lever in position N (P, R). Manual gearbox: clutch pedal depressed.			
3	Press SET and RES at the same time and hold them pressed while the engine is starting.			
	The CRUISE lamp should light up to confirm that you are in diagnostics mode.	Lights up Remains out	ON function SET function RESUME function CRUISE lamp	27 21 24 44
4	First release the SET button and then the RES button.	Goes out Remains on	SET function RESUME function	21 24
5	Press the SET button.	Lights up Remains out	SET function	21
6	Release the SET button.	Goes out Remains on	SET function	21
7	Move the switch to RES/— position	Lights up Remains out	RESUME function	24
8	Release RES/—	Goes out Remains on	RESUME function	24
9	Move the switch to the TIP/OFF position.	Lights up Remains out	TIP/OFF function	19
10	Release TIP/OFF.	Goes out Remains on	TIP/OFF function	19
11	Automatic transmission: shift to D (3, 2, 1) Manual gearbox: release the clutch pedal	Lights up Remains out	Automatic transmission: Selector lever position sensor Manual gearbox: Clutch pedal switch	30 33
12	Depress the brake pedal.	Goes out Remains on	Brake pedal switch Automatic transmission Manual gearbox	32 35

	Action	CRUISE lamp	Item checked	See 3:5, page
13	Release the brake pedal.	Lights up Remains out	Brake pedal switch Automatic transmission Manual gearbox	32 35
14	Automatic transmission: shift to N (P, R) Manual gearbox: depress the clutch pedal	Goes out Remains on	Automatic transmission: Selector lever position sensor Manual gearbox: Clutch pedal switch	30 33
15	Depress the brake pedal and keep it depressed for about five seconds After about five seconds	Lights up Remains out Goes out Remains on	Brake light switch Electronic control module	36 48
16	Release the brake pedal	Slight increase in engine idling speed No increase in engine idling speed	Stepping motor/cable	41
17	Drive off slowly	Lamp flashes in time with the speed Lamp does not flash	Speed signal	42

Theft Alarm

Test readings, control module connections (-M1994)

Pin	Color	Function	In/ Out	Measuring conditions	Reading	Across
1	RD	+30	In	Service switch turned clockwise Service switch turned anticlockwise	12 V 0 V	1 - 2
2	BK	Ground	In		12 V	2 - BPV
3	GN/WH	+15	In	Ignition ON	12 V	3 - 2
4	GY	Door switches	In	Reading taken when delay period for interior lighting has expired (about 20 s after doors are closed). All doors closed Door open	12 V 0 V	4 - 2
5	WH	Main switch	In	Bonnet closed Bonnet open	12 V 0 V	5 - 2
6	BK	Switch, interior lighting	In	Trunk closed Trunk open	12 V 0 V	6 - 2
7		No connection				
8	BU/BK	Level alarm trigger signal	In/ Out	Deactivated alarm Activated alarm Triggering alarm	12 V 12 V 0 V for about 1 s	8 - 2
9	VT	Switch for disengaging ultrasound and level alarm Position 1 = open Position 0 = closed	In	Ultrasound not fitted Ultrasound fitted with: Switch to position 1 Switch to position 0	12 V 12 V 0 V	9 - 2
10		Signal for disengaging ultrasound unit when using cabin heater	In	Cabin heater ON	12 V	10 - 2
11	BK/WH	Radio/accessory		Lead grounded Lead not grounded	0 V approx. 10 V	11 - 2
12	BU	Siren with battery back-up		Alarm not triggered Alarm triggered	12 V approx. 0.5 V	12 - 2
13	RD	Voltage supply to level sensor	Out	Alarm deactivated Alarm activated	0 V 12 V	13 - 2
14	BN	Horn	Out	Alarm triggered	12 V (pulses)	14 - 2
15	YE/WH	+50	In	Ignition key to START	12 V	15 - 2
16	YE	Starter motor interlock	Out	Ignition key to START Alarm deactivated Alarm activated	12 V 0 V	16 - 2
17	RD	+30	In	Service switch turned clockwise Service switch turned anticlockwise	12 V 0 V	17 - 2
18	BU/WH	Left-hand direction indicators	Out	Alarm activated	12 V (pulses)	18 - 2

Pin	Color	Function	In/ Out	Measuring conditions	Reading	Across
19	RD/WH	Right-hand direction indicators	Out	Alarm activated	12 V (pulses)	19 - 2
20	BK	Ground	In		12 V	20 - BPV
21	GN	Central locking control, locking	Out	Central locking not activated Central locking locked	12 V 0 V for 1 to 6 s	21 - 2
22		No connection				
23	BK	Ground	In		12 V	23 - BPV
24	RD	Central locking control, unlocking	Out	Central locking not activated Central locking, unlocking	12 V 0 V for 1 to 6 s	24 - 2
25		No connection				

3 pin connector for connecting ultrasound alarm

Pin	Color	Function	In/ Out	Measuring conditions	Reading	Across
1	GN/BK	Triggering alarm	In	Alarm deactivated Alarm activated Triggering	12 V 12 V 0 V for about 2 s	1 - Ground
2	BN	Ground	Out		12 V	2 - BPV
3	RD	Voltage supply	Out	Alarm deactivated Alarm activated	0 V 12 V	3 - Ground

Theft alarm (contd.)

Test readings, control module connections (M1995)

Pin	Component/ function	In/Out	Measuring conditions	Reading	Across	Function/ fault diagnosis, see 3:5, page.
1	Antenna remote transmitter, signal	In				24/64
2	LED	Out	Activate with Scan Tool, Select "LED" "OFF" "ON"	<0.5 V 2 V	2 - 13	22/58
3	Trunk switch	In	Trunk closed Trunk open	12 V 0 V	3 - 13	15/70
4	Door switches	In	Door closed Door open Delay approx. 18 s	12 V 0 V	4 - 13	15/60
5	Glass breakage sensor, ground	In	Ignition "OFF"	<5 Ohms	5 - 13	16/65
6	Central locking system unlocking	In	Deactivate alarm with key, front door - normal position - key position, unlock	12 V 0 V for 0.75 s	6 - 13	27/60
7	Glass breakage sensor, input	In	Central locking, unlocking (car key)	0.3 V	7 - 5	16/65
8	Starter relay, +50 supply	Out	Starter motor running Ignition "ON" (+15)	12 V 0 V	13 - 8	21/51
9	Fuel pump relay	Out	Ignition "ON" (+15) Alarm armed (when idling)	12 V 0 V	13 - 9	21/56
10	+15	Out	Ignition "ON" (+15)	12 V	10 - 13	18/68
11	Horn	Out	Activate with Scan Tool, Select "HORN" "OFF" "ON"	12 V 0 V	11 - 13	19/69
12	Direction indicators	Out	Activate with Scan Tool, Select "FLASHERS" "OFF" "ON"	0 V 12 V	12 - 13	20/67
13	Power ground	In		< 0.1 V	13 - Batt -	12/-
14	Antenna ground	In	Ignition "OFF"	<5 Ohms	14 - 13	24/64
15	Key, trunk	In	Arm alarm Locked position Unlocked position Key in trunk lock	12 V	15 - 13	27/75
16	Switch; hood	In	Hood open Hood closed	0 V 12 V	16 - 13	15/62
17	Central locking system, locking	In	Arm alarm from driver door normal position locking key position	12 V 0 V for 0.75 s	17 - 13	27/60

Pin	Component/function	In/Out	Measuring conditions	Reading	Across	Function/fault diagnosis, see 3:5, page.
18	Door indication, driver door	In	Open door Closed door	0 V 12 V	18 - 13	-/78
19	Data link, K	In/Out	ISAT scan tool connected Scan tool not connected	12 V 0 V	19 - 13	32/49
20	+50	In	Starter motor running Ignition "ON" (+15)	12 V 0 V	20 - 13	21/51
21	+15 (4-cyl) +30 (6-cyl)	In	Ignition "ON" (+15)	< 0.5 V	21 - BPV	18/56
22	+15 (4-cyl) +30 (6-cyl) Voltage supply Trionic/Motronic	Out	Ignition "ON" (+15)	< 0.5 V	22 - BPV	21/56
23	Unlocking trunk using remote control	In	Activate with Scan Tool, Select "TAILGATE" "ON" "OFF" or remote control	12 V 0 V	23 - 13	26/72
24	Direction indicators	Out	Activate with Scan Tool, Select "FLASHERS" "OFF" "ON"	0 V 12 V	24 - 13	20/67
25	+30	In		< 0.5 V	25 - BPV	12/-

Theft alarm (contd.)

Diagnostic trouble codes (M1995)

Diagnostic trouble code (SAE)	Faulty function/component	Text on ISAT display	See 3:5, page
B1193	Horn - break/open circuit	FAULT XX B1193 HORN OPEN	45
B1605	Control module, internal fault	FAULT XX B1605 INTERNAL FAULT	47

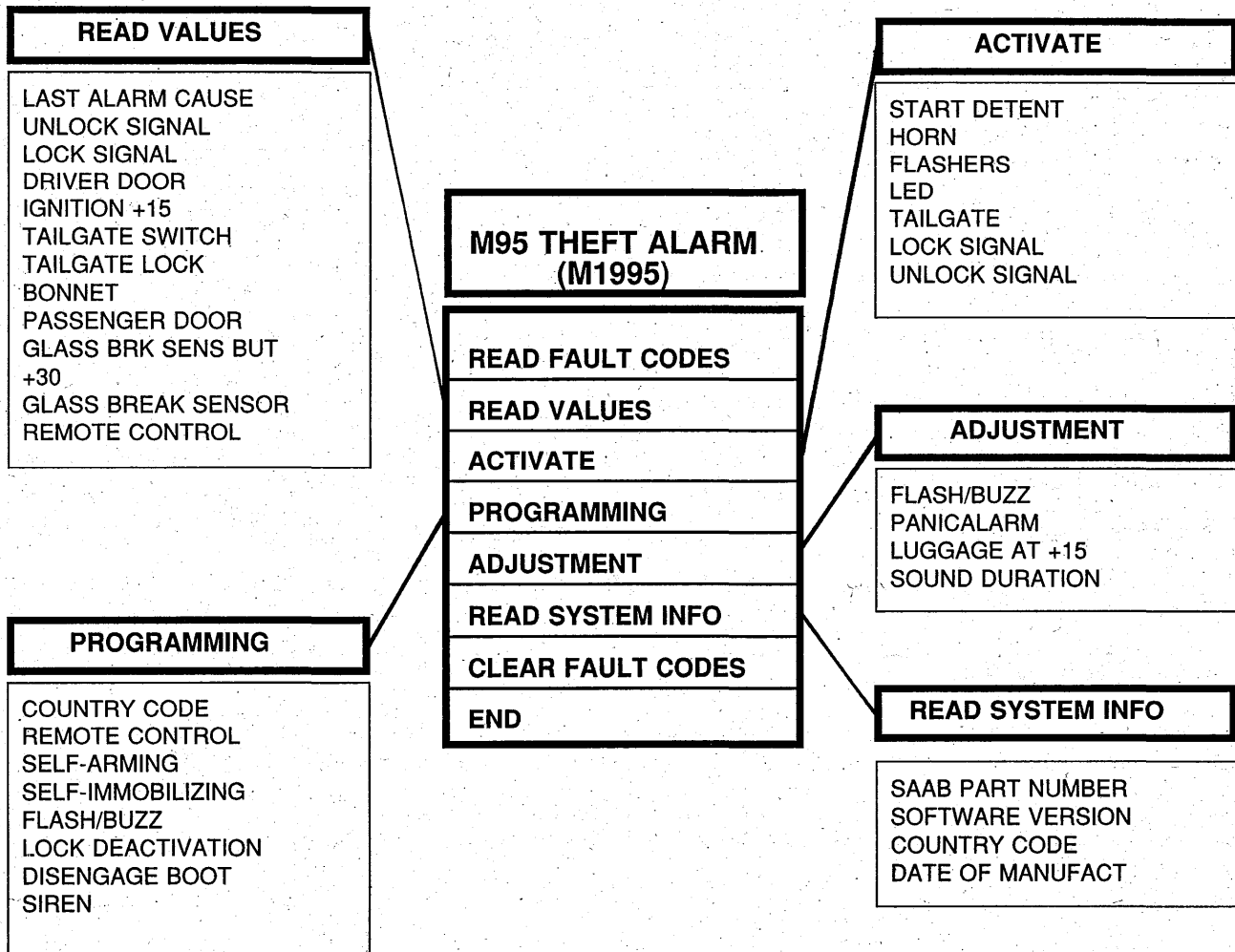
Theft alarm (contd.)

Faults without diagnostic trouble codes (M1995)

Fault symptom	Component/Function	See 3:5, page
Scan tool cannot make contact with control module	Fault diagnosis, data link connector	49
Starter motor not working Alarm not triggered when armed. Starter motor runs at different ignition positions	Fault diagnosis, starter motor interlock +50	51
The alarm is not set off when the ignition is switched on	Fault diagnosis, +15 supply	54
Fuel pump relay not working	Fault diagnosis, +15/+30 supply to fuel pump relay	56
LED not lighting	Fault diagnosis, LED	58
Doors disconnected from alarm	Fault diagnosis, door switches in central locking system	60
Alarm is not triggered when hood is opened and alarm is armed	Engine, hood switch	62
The remote control does not work	Fault diagnosis, remote control	64
Glass breakage sensor not working	Fault diagnosis, glass breakage sensor	65
Direction indicators lit continuously/do not light	Fault diagnosis, direction indicators	67
The horn sounds continuously	Fault diagnosis, horn	69
Trunk disconnected from alarm, LED flashes during delay period	Fault diagnosis, luggage compartment illumination switch	70
Trunk/driver door cannot be disarmed with key	Fault diagnosis, remote control, trunk opening	72
Central locking system, trunk	Fault diagnosis, microswitch in trunk, opening with key	75
Door indication not working when driver door opened	Fault diagnosis, door indication, driver door	78
The alarm is not armed after the interior lighting with time delay	Fault diagnosis, delayed arming due to delayed interior lighting	81
Alarm sounds falsely	Fault diagnosis, false alarm	82

Theft alarm (contd.)

Menu structure for command codes (M1995)



Theft alarm (contd.)**READ VALUES (M1995)**

ISAT scan tool command	Function	ISAT display
LAST ALARM CAUSE	Displays the last 10 alarm causes There are 6 possible alarm causes 1. TAILGATE 2. BONNET 3. DRIVER DOOR 4. PASSENGER DOOR 5. GLASS BREAK SENSOR 6. IGNITION +15	1. TAILGATE 2. BONNET 3. --- : : : : 10. ---
UNLOCK SIGNAL	Displays "ON" when the door receives un- lock signal, otherwise "OFF" is displayed.	ON OFF
LOCK SIGNAL	Displays "ON" when the door receives locking signal, otherwise displays "OFF".	ON OFF
DRIVER DOOR	Shows if the door is open or closed.	OPEN CLOSED
IGNITION +15	Shows if the ignition is on or off.	ON OFF
TAILGATE SWITCH	Shows if the trunk is open or closed.	OPEN CLOSED
TAILGATE LOCK	Shows if the tailgate is locked or unlocked.	OPEN CLOSED
BONNET	Shows if the hood is open or closed.	OPEN CLOSED
PASSENGER DOOR	Shows if any of the passenger doors is open or closed.	OPEN CLOSED
GLASS BRK SENS BUT	Shows if the glass breakage sensor has been disconnected with the button.	ON OFF
+30		ON OFF
GLASS BREAK SENSOR	Shows the value from the glass break sen- sor.	0-255
REMOTE CONTROL	Shows which button has been pressed on the remote control. Also functions on a re- mote control that has not been pro- grammed.	NO BUTTON LH BUTTON RH BUTTON

Theft alarm (contd.)**ACTIVATE (M1995)**

ISAT scan tool command	Function	ISAT display
START DETENT	"ON" activates the starter motor interlock. Otherwise, it shows if the theft alarm control module output is active or not.	ON OFF
HORN	"ON" activates the horn. It otherwise shows if the theft alarm control module output is active or not.	ON OFF
FLASHERS	"ON" activates the direction indicator circuit. Otherwise, it shows if the theft alarm control module output is active or not.	ON OFF
LED	"ON" activates the LED. Otherwise, it shows if the theft alarm control module output is active or not.	ON OFF
TAILGATE	"ON" activates unlocking of trunk. Otherwise, it shows whether the theft alarm control module output is active or not.	ON OFF
LOCK SIGNAL	"ON" activates door locking via the central locking system. Otherwise, it shows whether the theft alarm control module output is active or not.	ON OFF
UNLOCK SIGNAL	"ON" activates unlocking of doors via the central locking system. Otherwise, it shows whether the theft alarm control module output is active or not.	ON OFF

Theft alarm (contd.)**PROGRAMMING (M1995)**

ISAT scan tool command	Function	ISAT display
COUNTRY CODE	To select a country-adapted or customized alternative for the alarm and to select siren with battery back-up.	GERMANY GREAT BRITAIN SWITZERLAND HOLLAND OWN ALTERNATIVE SIREN
REMOTE CONTROL	To program and deprogram one or more (max. 4) remote controls for the car. "PROGRAMMING" to program a remote control "DEPROGRAMMING" to deprogram a remote control "DEPROGRAM ALL" to simultaneously deprogram all remote controls.	PROGRAMMING DEPROGRAMMING DEPROGRAM ALL
SELF-ARMING	To select the self-arming function. "OFF" to deselect the function. "AT +15 OFF" the moment when the function is connected. "+15 OFF, DOOR CLOSED" the moment when the function is connected. "TIME BEFORE ACTIV." to select the delay before self-arming. "ACTIVATION TIME" to select the time the function is to be activated.	OFF AT +15 OFF +15 OFF, DOOR CLOSED TIME BEFORE ACTIV. ACTIVATION TIME
SELF-IMMOBILIZING	To select the self-immobilizing function (3 circuit breaking). "ON" to select the function. "OFF" to deselect the function. "TIME BEFORE ACTIV." to select the delay before self-immobilization. "ACTIVATION TIME" to select the time the function is to be activated.	ON OFF TIME BEFORE ACTIV. ACTIVATION TIME
FLASH/BUZZ	To select the characteristics of the flashing/sound confirmation when one of the buttons on the remote control is pressed. "ORIGINAL VALUE" gives the same configuration as at delivery. "ADJUSTMENT" allows the option of changing the configuration of the confirmation.	ORIGINAL VALUE ADJUSTMENT
LOCK DEACTIVATION	Allows the alarm to be armed/disarmed with the key. "OFF" if only the remote control is to be used. "ON" if the car key and the remote control should be able to be used.	OFF ON

ISAT scan tool command	Function	ISAT display
DISENGAGE BOOT	Allows the option of opening the trunk using the key when the alarm is armed. "OFF" if only the remote control is to be used. "ON" if the car key and the remote control should be able to be used.	OFF ON
SIREN	Programming for siren with battery back-up "ON" if the siren is to be included. "OFF" to deselect the siren.	ON OFF

Theft alarm (contd.)**ADJUSTMENT (M1995)**

ISAT scan tool command	Function	ISAT display
FLASH/BUZZ	To adjust the configuration of the flash/sound confirmation if "ADJUSTMENT" is selected when programming "FLASH/BUZZ". "LOCK" allows adjustment of the confirmation when locking. "UNLOCK" allows adjustment of the confirmation when unlocking. "SEL FLASH TIME" to adjust the flash confirmation. "SEL SOUND TIME" to adjust to sound confirmation.	LOCK UNLOCK SEL FLASH TIME SEL SOUND TIME
PANICALARM	The panic alarm feature quickly sets off the alarm when the left-hand button on the remote control is pressed for 2.25 seconds. "OFF" to deselect the function. "ON" to select the function.	PANICALARM OFF ON
LUGGAGE AT +15	Allows opening of the trunk with the ignition key to "ON". "OFF" to deselect the function. "ON" to select the function.	LUGGAGE AT +15 OFF ON
SOUND DURATION	Allows the possibility of changing the character of the sound by selecting different sound times. "5 - 10 - 15 - 20 - 25 - 30 ms"	SOUND DURATION 10 ms

READ SYSTEM INFO (M1995)

ISAT scan tool command	Function	ISAT display
SAAB PART NUMBER	Shows the Saab part number for the theft alarm.	SAAB PART NUMBER XX XXX XXX
SOFTWARE VERSION	Shows which software version the theft alarm is equipped with.	SOFTWARE VERSION: XX XXX XXX
COUNTRY CODE	Shows the selected country code and the option to select another country code.	VALUE IS GERMANY
DATE OF MANUFACT	Shows the date of manufacture of the control module.	DATE OF MANUFACT: XX XX XX

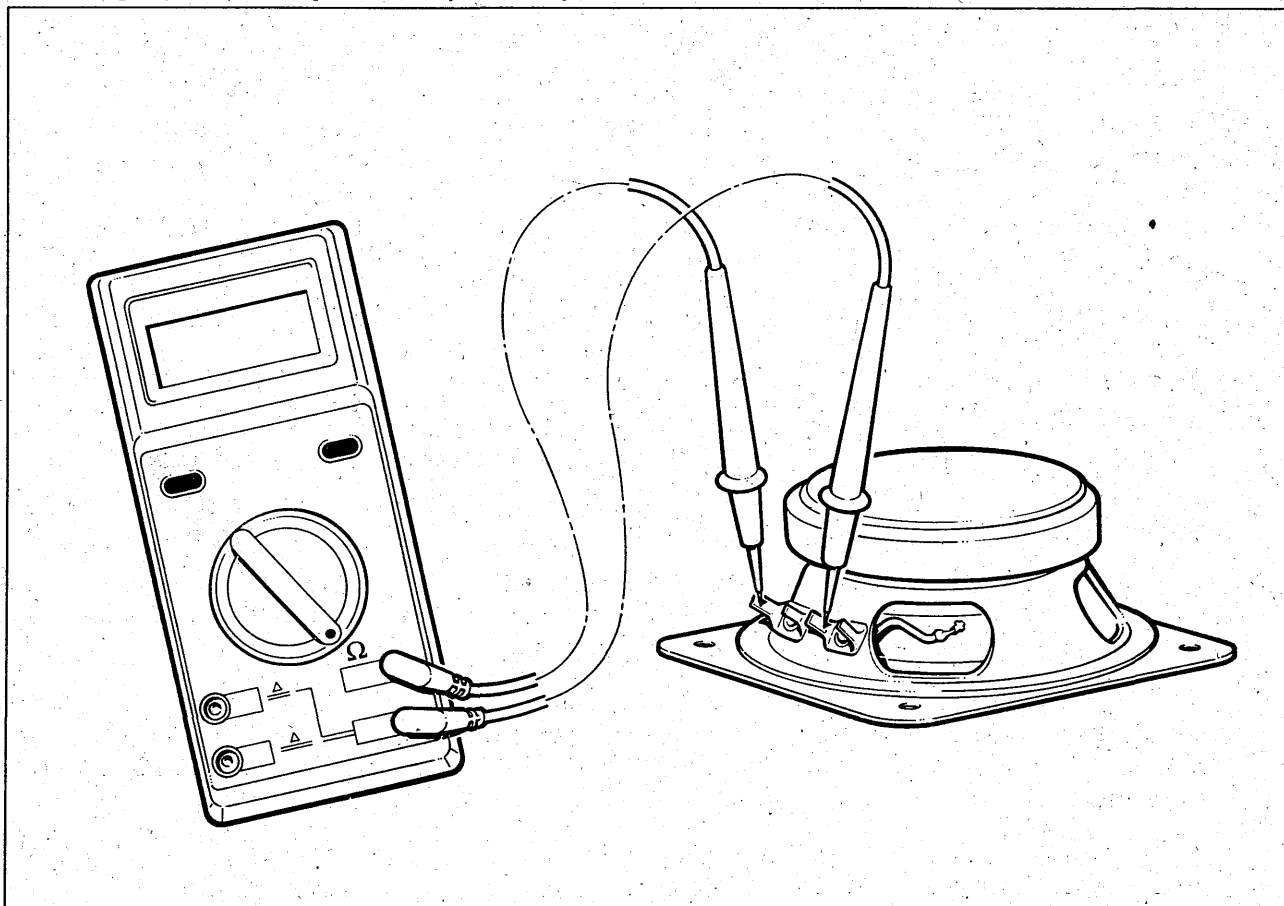
Audio system

Fault diagnosis (-M1994)

Fault symptom	Probable cause	See 3:5, page
No sound at all. Radio display does not light. The LED in the front amplifier does not light (this amplifier is only available for CC -M1991 and CD -M1992)	Faulty fuse	Action 1, page 22
CC -M1991 and CD -M1992: No sound at all Radio display lights LED in front amplifier lights	Break in ground connection G27	Action 2, page 23
CC/CS M1992- and CD M1993-: No sound at all Radio display lights	DIN connector not plugged in No voltage supply to amplifier	Action 8, page 29
CC -M1991 and CD -M1992: No bass sound Weak sound in upper loudspeaker	The DIN cable is not connected No power supply to amplifier	CC -M1991: Action 3, page 24 CD -M1992: Action 4, page 25
CC -M1991 and CD -M1992: No bass sound Normal sound in other speaker	Fuse in bass amplifier blown	CC -M1991: Action 5, page 26 CD -M1992: Action 6, page 27
CC -M1991 and CD -M1992: Bass sound OK, but no sound from one of the four speakers, FL, FR, RL, RR	Break in speaker circuit	Action 7, page 28
CC/CS M1992- and CD M1993-: No sound from one of the speakers, FL, FR, RL, RR	Break in speaker circuit	Action 7, page 28
Crackling or scraping noise, loud and sometimes pulsating popping	DIN connector poorly connected	CC -M1991: Action 3, page 24 CD -M1992: Action 4, page 25 CC/CS M1992- and CD M1993-: Action 8, page 29
CC -M1991 and CD -M1992: Loud low frequency noise	Poor contact in ground connection G27	Action 2, page 23

Audio system (contd.)

Readings accross speakers (-M1994)

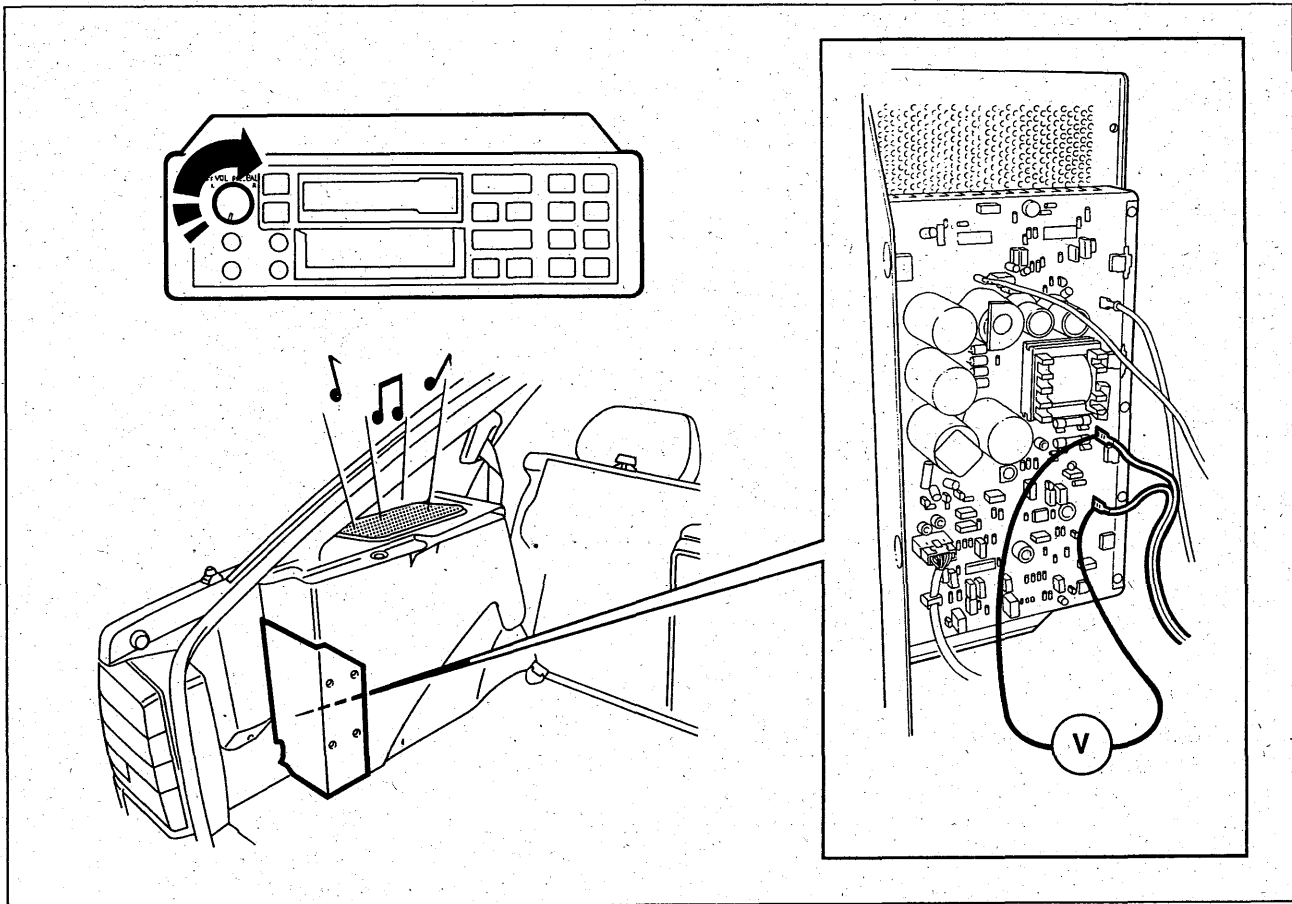


Speaker coil resistance is measured between the speaker connecting pins with connectors, filters and capacitors disconnected.

Loudspeakers	Reading
Front bass treble	3.0-4.0 Ohms 7.0-8.0 Ohms
CC -M1991 and CD -M1992: Rear bass Rear mid-range Rear tweeter	6.0-7.0 Ohms 3.0-4.0 Ohms 2.5-3.5 Ohms
CC/CS M1992- and CD M1993-: Rear bass Rear tweeter	3.0-4.0 Ohms 3.0-4.0 Ohms

Audio system (contd.)

Readings across speaker outputs (-M1994)



	Reading
The speaker outputs on the amplifiers are read with the speakers connected and with speech or music as the source.	0-Between 5 and 10 V ~ depending on speaker type, programme material and volume setting.

This reading can only be used to check that the amplifier gives an output signal.
Voltage level cannot be used as a measure of how good or how bad the amplifier is.

Audio system (contd.)

Diagnostic trouble codes (M1995)

If there are any diagnostic trouble codes in the system, these will be shown as diagnostic trouble codes on the display.

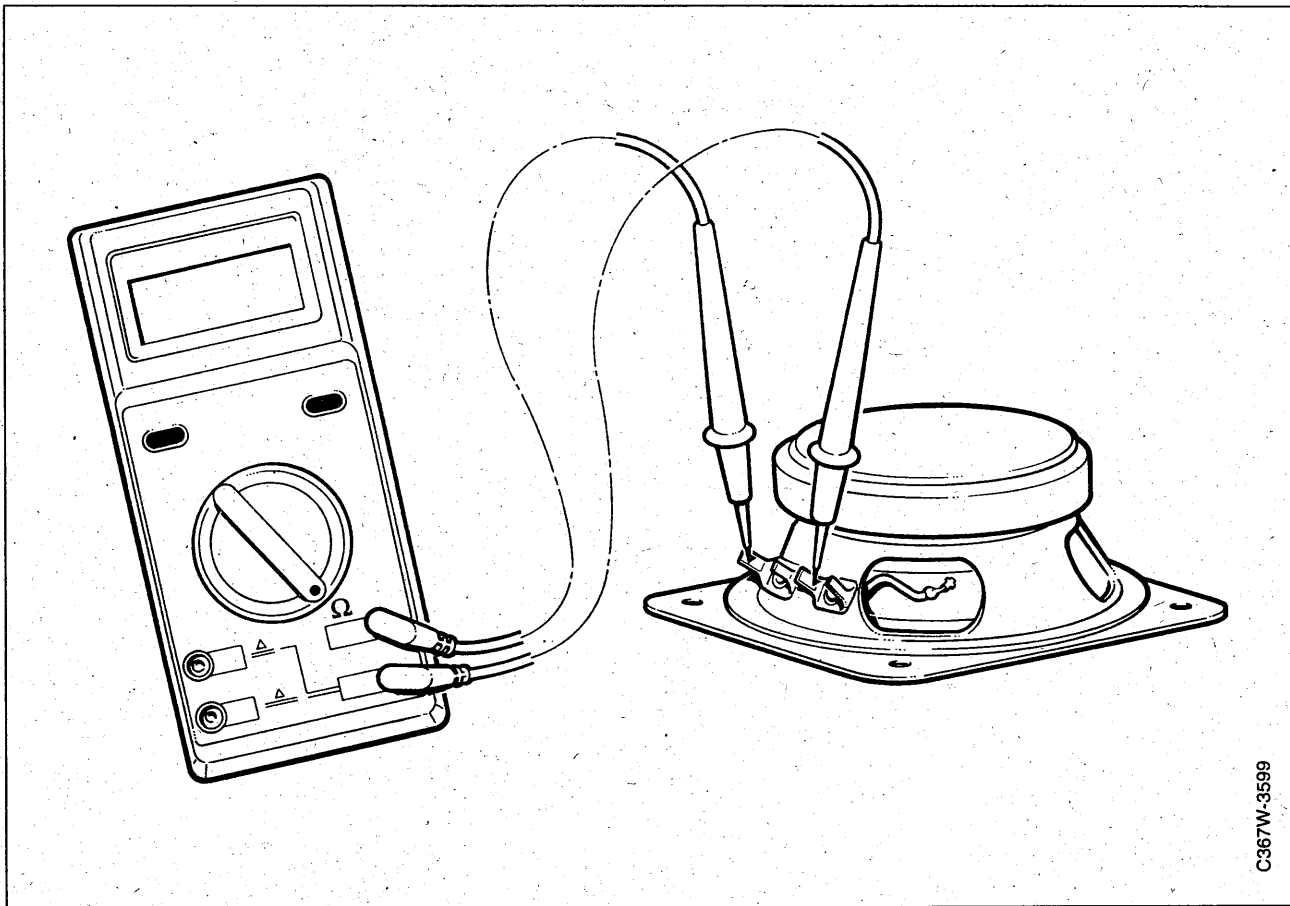
Diagnostic trouble code	Fault symptom	see 3:5, page
TAPE ER8	Cassette cannot be removed	18
TUN ER99	Fault in radio. RDS function (not US)	18
CDAC ER1	The internal battery in the CD changer is dead	19
CDAC ER2	Mechanical fault in CD changer.	19
CDAC ER3	Disc fault.	20
CDAC ER5	Wrong type of disc in the CD changer.	20
CDAC ER6	Disc wrong way up.	21

Fault diagnosis without diagnostic trouble codes

Action No.	Fault symptom	see 3:5, page
1	No sound at all. Radio display does not light. No power.	22
2	No sound at all. Radio display does not light. No ground.	23
3	No sound at all. Radio display does not light.	24
4	No sound from one of the speakers.	25
5	Poor sound from radio. Cassette player working normally. Antenna not going up.	26
6	Crackling or scraping sound, loud popping.	27
7	Nothing happens when one of the CD buttons on the radio unit is activated.	28

Audio system (contd.)

Readings across speakers (M1995)



C367W-3599

Speaker coil resistance is measured between the speaker connecting pins with connectors, filters and capacitors disconnected.

Audio System Premium

Loudspeakers	Reading
Front mid-range treble	3.0-4.5 Ohms 5.0-7.0 Ohms
Rear bass treble	3.0-4.5 Ohms 3.0-4.5 Ohms

Audio System Prestige

Loudspeakers	Reading
Front mid-range treble	3.0-4.5 Ohms 3.0-4.5 Ohms
Rear bass mid-range treble	2.0-3.0 Ohms 3.0-4.5 Ohms 3.0-4.5 Ohms

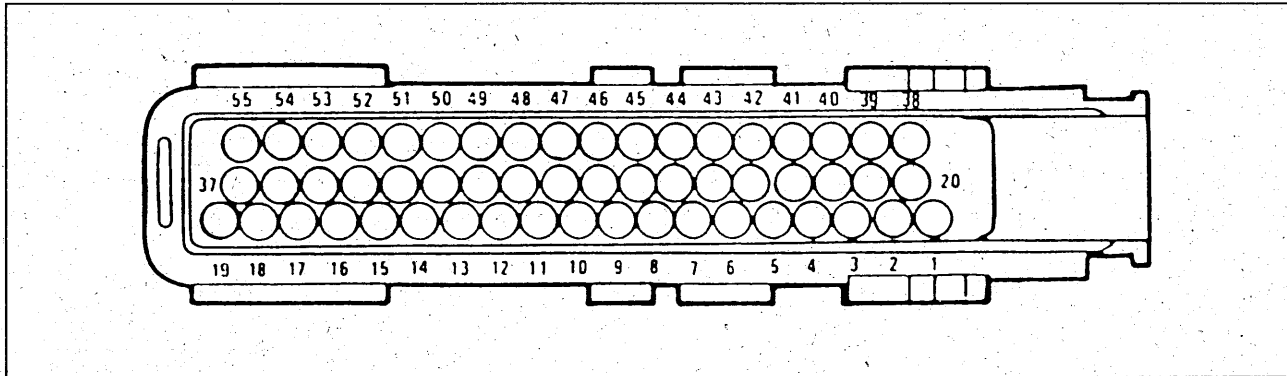
Brakes

ABS Mk II Antilock brakes 183

ABS Mk IV Antilock brakes 191

ABS Mk II

Test readings, control module connections (via breakout box)



Pin	Color	Component/Function	In/Out	Voltage	Remarks
1	BK	Power ground	In	0 V	
2	YE/RD	Rear intake valve	Out	12 V 0 V	not active active
3	YE/WH	Voltage supply via main relay	In	12 V	
4-7		No connection			
8	BU	Safety circuit (to 51)	In	5-6 V 0 V	closed open
9-13		No connection			
14	YE	Pump relay, pin 87	In	12 V 0 V	relay contact closed relay contact open
15-18		No connection			
19	BK	Signal ground	In	0 V	
20	GN/WH	Outlet valve FR	Out	12 V 0 V	not activated activated
21	BU/RD	Inlet valve, FL	Out	12 V 0 V	
22		No connection			
23	YE	Data link L	In	12 V	not activated
24-26		No connection			
27	BK/GN	Ground, RR wheel sensor	In	0 V	
28	YE/GN	Ground, RL wheel sensor	In	0 V	
29	BU/GN	Ground, FR wheel sensor	In	0 V	
30	GY/GN	Ground, FL wheel sensor	In	0 V	
31		No connection			
32	BU	Brake light signal	In	12 V 0 V	Brake applied Brake not applied
33	YE	Voltage supply via main relay	In	12 V	

Pin	Color	Component/Function	In/ Out	Voltage	Remarks
34	GN	Operating current, main relay	Out	approx. 1 V 12 V	activated not activated
35		No connection			
36	BU/WH	Rear outlet valve	Out	12 V 0 V	not activated activated
37		No connection			
38	RD/WH	FR inlet valve	Out	12 V 0 V	not activated activated
39	BK	Main valve	Out	12 V 0 V	not activated activated
40-41		No connection			
42	BU	Data link K	Out	approx. 10 V	
43-44		No connection			
45	—	RR Wheel sensor	In	0-2.5 V	output signal (AC) *)
46	—	RL wheel sensor	In	0-2.5 V	output signal (AC) *)
47	—	FR Wheel sensor	In	0-2.5 V	output signal (AC) *)
48	—	FL Wheel sensor	In	0-2.5 V	output signal (AC) *)
49		No connection			
50	BK	Pump relay, pin 85	Out	approx. 1 V 12 V	activated not activated
51	BN	Safety circuit (to 8)	Out	5-6 V approx. 1.5 V	closed open
52	WH	ANTI LOCK warning lamp	Out	12 V approx. 1.7 V	off on
53	RD	Voltage supply +54	In	12 V	
54	BN/WH	FL outlet valve	Out	12 V 0 V	not activated activated
55		No connection			

*) Voltage varies according to wheel speed

ABS Mk II (contd.)

Diagnostic trouble codes, system tester

Diagnostic trouble code	Pin No.	Malfunction	See 5:2, page
E001	1	No ground connection	590-27
E002	2	No battery positive voltage or voltage too low	590-28
E320	3,20	Main relay, function	590-29
E422	4,22	No signal from RR wheel speed sensor	590-30
E523	5,23	No signal from FL wheel speed sensor	590-30
E624	6,24	No signal from RL wheel speed sensor	590-30
E725	7,25	No signal from RF wheel speed sensor	590-30
E008	8	Main relay, no control	590-31
E009	9	Brake fluid level low, brake fluid pressure low	590-32
E010	10	Control module fault	590-32
E011	11	No ground connection	590-33
E014	14	Fault, pump relay/pressure switch	590-34
E015	15	Inlet valve, FR	590-35
E016	16	Outlet valve, rear	590-35
E017	17	Inlet valve, rear	590-35
E018	18	Main valve	590-35
EE22	sensor	Distance between wheel sensor and cog wheel not constant, RR	590-36
EE23	sensor	Distance between wheel sensor and cog wheel not constant, FL	590-36
EE24	sensor	Distance between wheel sensor and cog wheel not constant, RL	590-36
EE25	sensor	Distance between wheel sensor and cog wheel not constant, FR	590-36
E032	32	Fault, pump relay	590-37
E132	1,32	Hydraulic pump constantly activated	590-38
E033	33	Outlet valve, FL	590-35
E034	34	Outlet valve, FR	590-35
E035	35	Inlet valve, FL	590-35
PRES	ext	Accumulator pressure too low	590-39

If several diagnostic trouble codes are displayed in combination, they should be investigated and rectified in the following order:

E002	EE24	E001	E033
E442	EE25	E009	E034
E523	E011	E010	E035
E624	E008	E015	E132
E725	E320	E016	PRES
EE22	E014	E017	
EE23 ▼	E032 ▼	E018 ▼	

ABS Mk II (contd.)

Diagnostic trouble codes, self diagnosis (-M1989)

The control module has no inbuilt self diagnostics, but by temporarily changing to a control module with part number 40 02 176, diagnostic trouble codes can be read using the ANTI LOCK lamp.

- 1 Remove the ABS control module.
- 2 Remove the casing from the connector and connect an extra cable to pin 26 (with terminal 91 20 957). Run the cable out of the casing.
- 3 Press the control pin out of the new control module, connect and fit.
- 4 Drive the car until the ANTI LOCK lamp lights and stays lit.
- 5 Turn the ignition key to OFF and ground the cable.
- 6 Turn the ignition key to ON, disconnect the cable from ground and read the diagnostic trouble codes using the ANTI LOCK lamp, see page 188.
- 7 After reading the diagnostic trouble codes, the original control module should be refitted.

ABS Mk II (contd.)

Diagnostic trouble codes, self diagnostics (M1990-)

Fault tracing on the ABS using flashing codes is not a replacement for fault diagnosis with the ABS system tester, but may be a good complement.

Reading flashing codes

- 1 With the car stationary and the ignition key to OFF, short the data link connector with a suitable conductor where the ends are not insulated.
- 2 Turn the ignition key to ON. Remove the conductor from the data link connector and keep an eye on the ANTI LOCK warning lamp, which now starts flashing.

Reading diagnostic trouble codes can be interrupted at any time by reshorting the data link connector or by turning the ignition key to OFF.
- 3 If there is a valve fault, the diagnostic trouble code is displayed only once and the ANTI LOCK lamp then lights continuously. In order to repeat the reading, repeat points 1 and 2 above.

Important

If several valve diagnostic trouble codes are stored, the first fault read must be rectified before the next fault can be read.

In the case of a wheel sensor fault, the diagnostic trouble code will be displayed repeatedly.

Important

If several sensor diagnostic trouble codes are stored, the data link connector must be shorted after each diagnostic trouble code is read in order to proceed to the next.

If there are both valve and sensor faults stored in the control module memory, the valve faults are always read first.

When the data link connector is shorted after the last stored diagnostic trouble code, the ANTI LOCK lamp gives long flashes. If the data link connector is shorted once more, the ANTI LOCK lamp goes over to continuously lit, which means that the fault must be rectified before the diagnostic trouble code is erased.

If there are no diagnostic trouble codes stored in the ABS control module memory, the code 4444 is displayed.

- 4 The control module memory is erased by driving the car at a speed of >30 km/h after repair.

Important

In order to be erased, the diagnostic trouble codes must have been read.

If the ANTI LOCK lamp lights constantly, despite action being taken and the diagnostic trouble code being erased, there is still some fault remaining in the system.

ABS Mk II (contd.)**Diagnostic trouble codes, self diagnosis (contd.)**

Diagnostic trouble code	Electronic control module Pin No.	Valve block Pin No.	Faulty function/component	Action
1111	—	—	Control module fault	*)
1112	35	2	Inlet valve, FL (IFL)	*)
1114	15	7	Inlet valve, FR (IFL)	*)
1122	17	5	Inlet valve, rear (IR)	*)
1132	16	3	Outlet valve, FL (OFL)	*)
1134	34	6	Outlet valve, FR (OFR)	*)
1142	33	4	Outlet valve, rear (OR)	*)
1222	18	Main valve (MV) connector, pin 1		*)
1233	5, 23	—	Wheel sensor, FL, no signal	*)
1241	7, 25	—	Wheel sensor, FR, no signal	*)
1243	4, 22	—	Wheel sensor, RR, no signal	*)
1311	6, 24	—	Wheel sensor, RL, no signal	*)
1312	9, 10	—	Safety circuit for pressure and level sensor, shorting to +12 V	*)
4444	—	—	System OK, no diagnostic trouble codes in control module memory	*)

*) Action, see SI 590-1131

ABS Mk II (contd.)

Diagnostic trouble codes, scan tool

All readings on the system are taken with breakout box (BOB) connected.

Important

If no diagnostic trouble codes can be read from the system despite warning lamps being lit, start by checking the safety circuit (pins 8-51)

WARNING

The breakout box must not be used when driving. Remember that the brake system is a safety system.

Permanent	Intermittent	Component/Signal	See 0 News M1992 on page
	775B1	Control module fault	33
	775B2	Control module fault, RAM*)	34
32251	22251	Main relay not working properly	8
	36522	Safety circuit pins 8-51, shorting to +12 V	12
44221	24221	FL wheel speed sensor, no signal	17
44222	24222	FR wheel speed sensor, no signal	19
44223	24223	RL wheel speed sensor, no signal	21
44224	24224	RR wheel speed sensor, no signal	23
	2422A	FL wheel speed sensor, faulty signal (<40 km/h)	17
	2422B	FR wheel speed sensor, faulty signal (<40 km/h)	19
	2422C	RL wheel speed sensor, faulty signal (<40 km/h)	21
	2422D	RR wheel speed sensor, faulty signal (<40 km/h)	23
	24291	FL wheel speed sensor, faulty signal (<40 km/h)	17
	24292	FR wheel speed sensor, faulty signal (<40 km/h)	19
	24293	RL wheel speed sensor, faulty signal (<40 km/h)	21
	24294	RR wheel speed sensor, faulty signal (<40 km/h)	23
	24251	FL wheel speed sensor, faulty signal (compare wheel speed)	17
	24252	FR wheel speed sensor, faulty signal (compare wheel speed)	19
	24253	RL wheel speed sensor, faulty signal (compare wheel speed)	21
	24254	RR wheel speed sensor, faulty signal (compare wheel speed)	23
53427	33427	Main valve, not working	31
53421	33421	FL Inlet valve, not working	25
53422	33422	FL outlet valve, not working	26
53423	33423	FR Inlet valve, not working	27
53424	33424	FR outlet valve, not working	28
53425	33425	Rear inlet valve, not working	29
53426	33426	Rear outlet valve, not working	30
	234B1	FL Outlet valve, hydraulic fault	32
	234B2	FR Outlet valve, hydraulic fault	32
	234B3	Rear outlet valve, hydraulic fault	32
	234B4	Rear outlet valve, hydraulic fault	32

ABS Mk II (contd.)

Command codes, scan tool

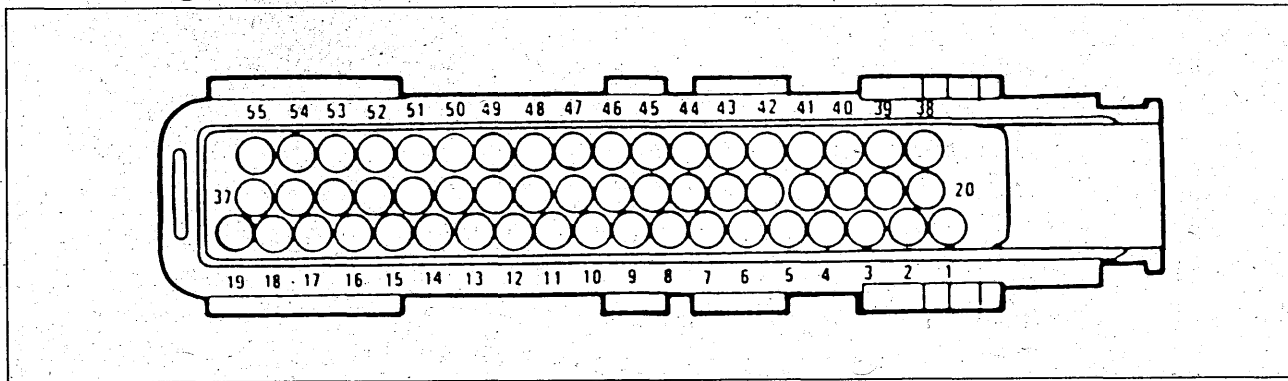
Important

In cases where command codes are used for tests while the car is being driven, remember that contact between the scan tool and the control module is broken when speed exceeds 20 km/h.

Code	Function/component	Display text
259	Reads speed signal from FL wheel speed sensor	E.g. 80020 = 20 km/h
25A	Reads speed signal from FR wheel speed sensor	E.g. 80020 = 20 km/h
25B	Reads speed signal from RL wheel speed sensor	E.g. 80020 = 20 km/h
25C	Reads speed signal from RR wheel speed sensor	E.g. 80020 = 20 km/h
201	Gives status of pressure and level warning switch (safety circuit)	8B100 = closed 8B000 = open
202	Gives status of brake light switch	8B100 = closed 8B000 = open
800	Communication over	
900	Erase all diagnostic trouble codes	

ABS Mk IV

Test readings, control module connections



Pin	Color	Component/Function	In/ Out	Voltage	Remarks
1	BK	Ground 1	In	0 V	G 15
2	YE/RD	FL outlet valve	Out	PWM neg.	Ref 12 V
3	GN/RD	Voltage supply +30	In	12 V	
4-8		No connection			
9	GN	Wheel speed signal RR	Out		To ASR (PWM signal)
10	YE	Wheel speed signal FL	Out		To ASR (PWM signal)
11	BU	Wheel speed signal FR	Out		To ASR (PWM signal)
12	GY	Wheel speed signal RL	Out		To ASR (PWM signal)
13-14		No connection			
15	BU	Pump relay, pin 85	Out	0 V	Relay ground ref. 12 V (off)
16	BU	Pedal position sensor	In	1-10 V	Depending on position
17		No connection			
18	BN/RD	Outlet valve RR	Out	PWM neg.	Ref 12 V
19	BK	Ground 2	In	0 V	G 15
20	GN/WH	Inlet valve, FL	Out	PWM neg.	Ref 12 V
21	BU/RD	Outlet valve FR	Out	PWM neg.	Ref 12 V
22		No connection			
23	YE	Data link L	In		Pin 4
24-26		No connection			
27	BK/GN	RR Wheel sensor	Out	0 V	Ref. ground
28	YE/GN	RL wheel sensor	Out	0 V	Ref. ground
29	BU/GN	FR Wheel sensor	Out	0 V	Ref. ground
30	GN/GY	FL Wheel sensor	Out	0 V	Ref. ground
31	BK	Pump sensor	Out	approx. 0.7 V AC	Active
32	BU	Brake light switch	In	12 V	0 V off
33	YE	Voltage supply +30	In	12 V	Over main relay
34	GN	Main relay ground	Out	0 V	Ref 12 V pin 85
35		No connection			
36	BU/WH	Outlet valve FR	Out	PWM neg.	Ref 12 V
37		No connection			
38	RD/WH	FR inlet valve	Out	PWM neg.	Ref 12 V

192 Brakes

Pin	Color	Component/Function	In/ Out	Voltage	Remarks
39		No connection			
40		No connection			
41	GN	Pedal position sensor	Out	0 V	Ground
42	BU	Data link K	Out		Pin 1
43-44		No connection			
45	GN	RR Wheel sensor	In	0.15-0.70 V	AC Signal, sine wave
46	GN	RL wheel sensor	In	0.15-0.70 V	AC Signal, sine wave
47	GN	FR Wheel sensor	In	0.15-0.70 V	AC Signal, sine wave
48	GN	FL Wheel sensor	In	0.15-0.70 V	AC Signal, sine wave
49	WH	Pump sensor	In	approx. 0-0.8 V	AC signal
50-51		No connection			
52	WH	ABS warning lamp ground	Out	0 V	Ref 12 V off
53	RD	Voltage supply +54	In	12 V	+54
54	BN/WH	Inlet valve RL	Out	PWM neg.	Ref 12 V
55	GY/RD	Inlet valve RR	Out	PWM neg.	Ref 12 V

ABS Mk IV (contd.)**Diagnostic trouble codes, scan tool**

Permanent	Intermittent	Component/Signal	See 5:2, page
	775B1	Control module fault	590-26
	775B2	Control module fault, RAM	590-27
42251	22251	Main relay not working properly	590-8
44221	24221	FL wheel speed sensor, no signal	590-10
44222	24222	FR wheel speed sensor, no signal	590-12
44223	24223	RL wheel speed sensor, no signal	590-14
44224	24224	RR wheel speed sensor, no signal	590-16
	2422A	Wheel sensor FL, no signal (>40 km/h)	590-10
	2422B	Wheel sensor FR, no signal (>40 km/h)	590-12
	2422C	Wheel sensor RL, no signal (>40 km/h)	590-14
	2422D	Wheel sensor RR, no signal (>40 km/h)	590-16
	24291	Wheel sensor FL, no signal (<40 km/h)	590-10
	24292	Wheel sensor FR, no signal (<40 km/h)	590-12
	24293	Wheel sensor RL, no signal (<40 km/h)	590-14
	24294	Wheel sensor RR, no signal (<40 km/h)	590-16
	24251	FL wheel speed sensor, faulty signal (compare wheel speed)	590-10
	24252	FR wheel speed sensor, faulty signal (compare wheel speed)	590-12
	24253	RL wheel speed sensor, faulty signal (compare wheel speed)	590-14
	24254	RR wheel speed sensor, faulty signal (compare wheel speed)	590-16
53421	33421	FL Inlet valve, not working	590-18
53422	33422	FL outlet valve, not working	590-19
53423	33423	FR Inlet valve, not working	590-20
53424	33424	FR outlet valve, not working	590-21
53425	33425	Inlet valve RL, not working	590-22
53426	33426	Outlet valve RL, not working	590-23
53427	33427	Inlet valve RR, not working	590-24
53428	33428	Outlet valve RR, not working	590-25
	334B1	FL Outlet valve, hydraulic fault	590-19
	334B2	FR Outlet valve, hydraulic fault	590-21
	334B3	Outlet valve RL, hydraulic fault	590-23
	334B4	Outlet valve RR, hydraulic fault	590-25
45721	25721	Pedal position sensor	590-31
	24791	Pump fault, not working despite control signal	590-32
44792	24792	Pump fault, working without control signal	590-33
E75B1		Hydraulic fault	590-34

ABS Mk IV (contd.)

Command codes, scan tool

Important

In cases where command codes are used for testing while the car is being driven, remember that contact between the scan tool and the control module is broken when speed exceeds 20 km/h.

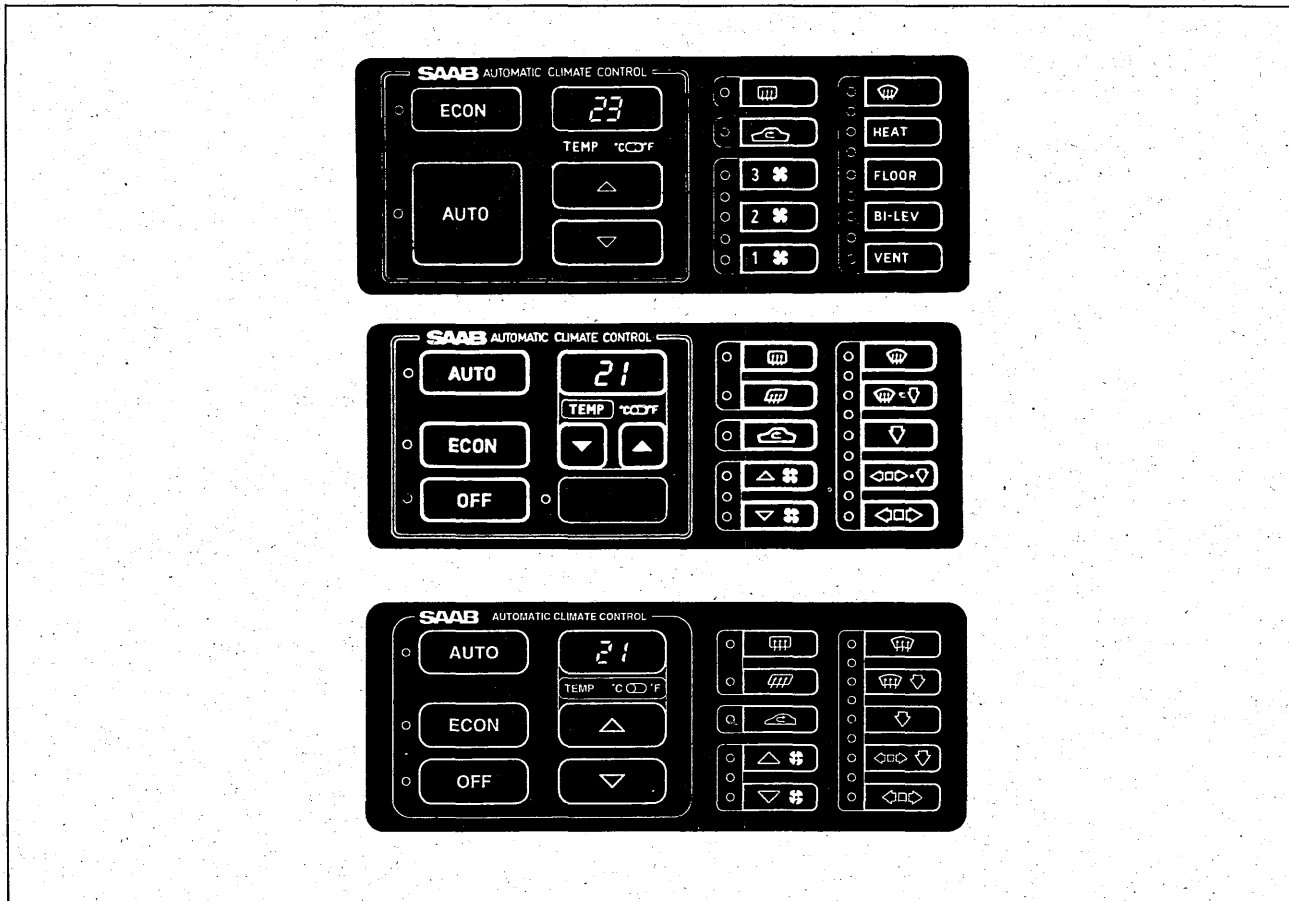
Code	Function/component	Display text
100	Reads all stored diagnostic trouble codes	
201	Pedal position sensor	8B X00 (X=1-7, where 1=pedal in rest position 6=pedal fully depressed 7 means hydraulic fault)
202	Brake light switch	8B 000/8B 100 (100=closed, 000=open)
259	FL wheel speed	8B 0XX (XX=km/h)
25A	Wheel speed FR	8B 0XX
25B	RL Wheel speed	8B 0XX
25C	Wheel speed RR	8B 0XX
800	Communication over	
900	Erase all diagnostic trouble codes	11111

Body

Automatic Climate Control, ACC 195
 Airbag 207

Electrically operated seats with memory. . 218

ACC



ACC (-M1989)

In order to avoid damage to the electronics in the temperature control module, take the following action:

- Whenever working on the ACC unit, always detach the negative battery lead.
- When arc welding, detach the negative battery lead, regulator connector and the 25 pin connector to the climate control module.
- When taking readings and diagnosing faults, the 25 pin connector for the climate control module should be detached.
- M1988 and later:

The heat sink on the cabin fan speed control is live (+12V) when the ignition is on. If the heat sink is grounded, the speed control is destroyed.

When conducting fault diagnosis (AUTO and VENT pressed simultaneously), the climate control module runs a program. The display then shows the number of faults and gives a diagnostic trouble code for each one.

ACC II (M1990-)

When taking readings and conducting fault diagnosis, both the connectors (one 39 pin and one 12 pin) should be unplugged. All readings should be taken on the connectors and not on the climate control module.

Stored diagnostic trouble codes in the self test program can be read using the scan tool. The number of faults stored is shown on the display for 6 s when the ignition is switched on.

ACC (contd.)

Diagnostic trouble codes (-M1989), self diagnostics

Press AUTO and VENT at the same time and then release them. The ACC control module runs through a diagnostic program (takes about 40 s), which is indicated with 88 flashing on the display. After fault tracing, the number of faults is shown on the display. Press VENT to read the diagnostic trouble codes. You leave diagnostics mode by pressing AUTO.

Code	Component/Function	Cause of fault
1C	Cabin temperature sensor	Short circuit
1U	Cabin temperature sensor	Break in circuit
2C	Outside temperature sensor	Short circuit
2U	Outside temperature sensor	Break in circuit
3C	Air mixture sensor	Short circuit
3U	Air mixture sensor	Break in circuit
5C	Motor for air - air mixture damper	Wrong direction of rotation
5U	Motor for air - air mixture damper	Other fault
6C	Motor for air - air distribution damper	Wrong direction of rotation
6U	Motor for air - air distribution damper	Other fault
7C	Motor for recirculation damper	Internal short circuit or blockage
7U	Motor for recirculation damper	Break or short to ground.
A/C	Control signal	Break or short to ground/BPV
AU	Cabin fan motor/speed control	Break in main circuit. Motor blocked. Fault in speed control
EU	Climate control module	

ACC (contd.)**Diagnostic trouble codes M1990, scan tool**

Permanent	Temporary	Faulty component/signal
41021	21021	Outside temperature, no signal from EDU
41321	21321	Hot air damper motor, current consumption too high
41421	21421	Distribution damper motor, current consumption too high
41621	21621	Solar sensor, communications fault with ACC (no signals)
41631	21631	Solar sensor, component fault.
41D21	21D21	Mixed air sensor and cabin air sensor, break in sensor ground or short to BPV
41E21	21E21	Mixed air sensor, break to ACC or short to BPV
41F21	21F21	Cabin air sensor, break to ACC or short to BPV

ACC (contd.)**Diagnostic trouble codes M1990-1994,
ISAT scan tool**

ACC unit version is shown on the scan tool display.

VERSION 2.00

VERSION 2.01

VERSION 2.02

Version	Permanent	Temporary	Faulty component/signal	See 8:3, page
2.00 2.01	42521	22521	Mixed air sensor and cabin temperature sensor: Short circuit to BPV or lower (pin 2 or 22)	854-10
2.00 2.01	46322	26322	Mixed air temperature sensor: Break (pin 21 or 22) or short circuit to BPV (pin 21)	854-12
2.00 2.01	46323	26323	Cabin temperature sensor: Break (pin 1 or 2) or short circuit to BPV (pin 1)	854-14
2.00 2.01	46391	26391 *)	Outside temperature signal from EDU: Communications fault, no temperature pulses. Break or short circuit to ground or BPV	854-16
2.01	53221	33221	Electrically heated rear window: Break, short to BPV, electrically heated rear window disconnected	854-17
2.01	53222	33222	A/C relay or injection system control module: Short to BPV (in ECON mode)	854-17
2.01	53271	33271	Electrically heated rear window: Short to ground, window connected	854-17
2.01	53272	33272	A/C relay or injection system control module: Short to ground (in AUTO mode)	854-17
2.01	53621	33621	Recirculation damper, motor: Short to BPV	854-18
2.00 2.01	53623	33623	Air distribution damper, motor: Short to BPV, break, bridge or internal short in ACC unit	854-19
2.01	53623 53673	33623 33673	Air distribution damper, motor: Short to BPV, break, bridge or internal short in ACC unit	854-19
2.00 2.01	53624	33624	Air mixture damper, motor: Short to BPV, break, bridge or internal short in ACC unit	854-21
2.01	53624 53674	33624 33674	Air mixture damper, motor: Short to BPV, break, bridge or internal short in ACC unit	854-21
2.01	53671	33671	Recirculation damper, motor: Short to ground	854-18
2.01	53672 *)	33672 *)	Cabin temperature sensor, fan: Short to ground	854-23
2.01	53673	33673	Air distribution damper, motor: Short to ground	854-19
2.01	53674	33674	Air mixture damper, motor: Short to ground	854-21
2.00 2.01	66891	-	Solar sensor: Component fault	854-24
2.00 2.01	E6891 *)	D6891 *)	Solar sensor: Communications fault, no pulses. Break, short to ground or BPV	854-24

Version	Permanent	Tempo- rary	Faulty component/signal	See 8:3, page
2.02	53421 *)	33421 *)	Rear A/C valve and rear fan control unit power supply. Pins 32 and 34. Break or short to BPV	
2.02	53471	33471	Rear A/C valve and rear fan control unit power supply. Pins 32 and 34 shorted to ground	

*) Diagnostic trouble code can be registered in the ACC II without any fault occurring and may be rectified as follows:

- 1 Erase DTCs using the scan tool.
- 2 Start the car and check if the DTCs come back.
 - If the DTCs do not come back, no further action is required.
 - If the DTC comes back, conduct fault diagnosis using Service Manual 8:3, "Automatic Climate Control ACC II".

ACC (contd.)**Command codes M1990-1994, ISAT scan tool**

Code	Description
100	Send all stored diagnostic trouble codes
229	Battery positive voltage to ACC unit, voltage range 0-26.5 V
22A	Fan speed control, signal, 0-5 V
250	Inside temperature, +10°C - +40°C
251	Outside temperature via EDU, -44°C - +50°C
252	Mixed air temperature, 0°C - +80°C
270	Control of LED intensity via photo transistor, 0% (dark) - 100% (light)
279	Desired position of recirculation damper motor, Fresh air or Recirculation
27A	Desired position of air mixture damper motor, 0% (LO) - 100% (HI)
27B	Desired position of air distribution damper motor, 45° (ventilation) - 135° (defrost)
380	Type of solar sensor: Standard or Australia
800	End of communication
900	Erase all stored diagnostic trouble codes. Start self test of ACC system and calibration of damper motors. All previously stored faults cleared.

Important

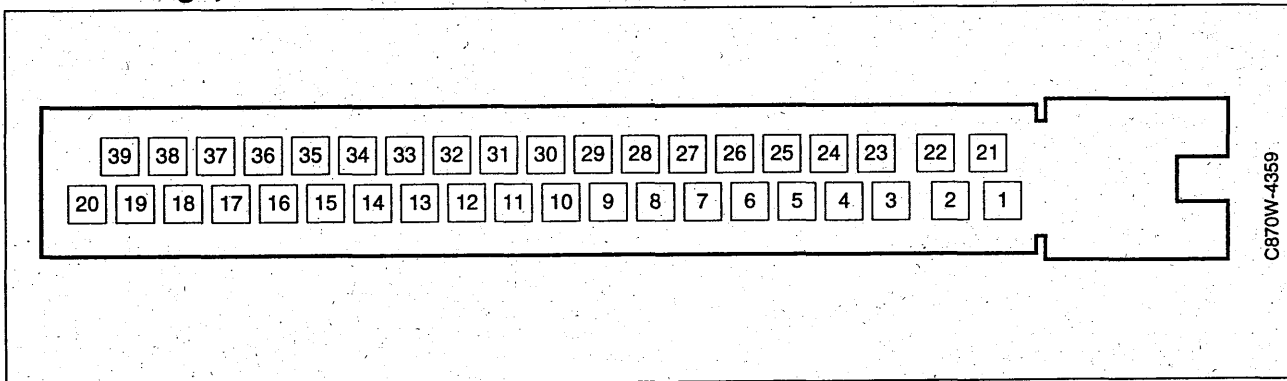
Commands 27A, 27B and 279 refer to desired position of damper motors. This means that it is never possible to know if the motor really has moved the damper to the desired position. This can only be checked visually.

The rear A/C system means that fault diagnosis on the ACC M1992-, is expanded with a command code.

Code	Description
22B	Show control signal for rear fan speed control, 0-5 V

ACC (contd.)

Test readings, control module connections (M1995)



Unless otherwise stated, the ignition key should be turned to ON. All readings are approximate.

Pin	Component/Function	In/ Out	Measuring conditions	Reading	Across	See 8:3, page
1	Ground	In		< 0.4 V	1 - Batt-	12
2	Recirculation motor (F)	Out	Recirculation ON OFF	1 V lower than BPV 0 V	2 - 1	24
3	No connection (prepared for parking heater)	In				20
4	Parking heater	Out	Parking heater off on	0 V 12 V	4 - 1	20
5	Supply voltage to solar sensor	Out		12 V	5 - 1	16
6	Solar sensor	In		2-8 Hz	6 -1	16
7	+15	In		< 0.5 V	7 - BPV	12
8	No connection					
9	Supply voltage to LH door fan	Out	Rear door fans, Not activated Low speed Full speed	0 V approx 5 V approx 10 V	9 - 1	18
10	Supply voltage to RH door fan	Out	Rear door fans, Not activated Low speed Full speed	0 V approx 5 V approx 10 V	10 - 1	18
11	No connection					
12	Diagnostic	In/ Out	ISAT scan tool con- nected Scan tool not con- nected	12 V 4.5-5.0 V	12 - 1	
13	No connection					
14	Mixed air temperature sensor, ground	Out		< 0.1 V	14 - 1	14

Pin	Component/Function	In/ Out	Measuring conditions	Reading	Across	See 8:3, page
15	Cabin temperature sensor, ground	Out		< 0.1 V	15 - 1	13
16	Supply voltage to cabin temperature sensor fan	Out		12 V	16 - 1	13
17	Supply voltage to fan control unit	Out		12 V	17 - 1	17
18	Outside temperature signal from EDU	In		7-13 V (alternating)	18 - 1	15
19	No connection					
20	Test voltage, cabin fan	Out	FanNot activated Full speed	0 V 5 V	20 - 1	17
21	Recirculation motor (R)	Out	Recirculation ON OFF	0 V 1 V lower than BPV	21 - 1	24
22	+30	In		< 0.5 V	22 - BPV	12
23	Motor, air distributor	Out	Motor not activated	1 V lower than BPV	23 - 1	23
24	Motor, air distributor	Out	Motor not activated	approx. 1 V	24 - 1	23
25	Motor, air distributor	Out	Motor not activated	1 V lower than BPV	25 - 1	23
26	Motor, air distributor	Out	Motor not activated	approx. 1 V	26 - 1	23
27	Motor, mixed air damper	Out	Motor not activated	1 V lower than BPV	27 - 1	22
28	Motor, mixed air damper	Out	Motor not activated	approx. 1 V	28 - 1	22
29	Motor, mixed air damper	Out	Motor not activated	1 V lower than BPV	29 - 1	22
30	Motor, mixed air damper	Out	Motor not activated	approx. 1 V	30 - 1	22
31	Rheostat	In	Min. light intensity Max. light intensity	approx. 2 V 12 V	31 - 1	21
32	Mixed air temperature sensor	In	At approx. +20°C	approx. 6.6 V	32 - 1	14
33	Cabin temperature sensor	In	At approx. +20°C	approx. 6.4 V	33 - 1	13
34	No connection					
35	Solar sensor, ground	Out		< 0.1 V	35 - 1	16
36	No connection					
37	No connection					
38	A/C (to EDU)	Out	AUTO MODE ECON MODE	12 V 0 V	38 - 1	
39	Electrically heated rear windscreen	Out	Electrically heated rear windscreen ON OFF	12 V 0 V	39 - 1	19

ACC (contd.)

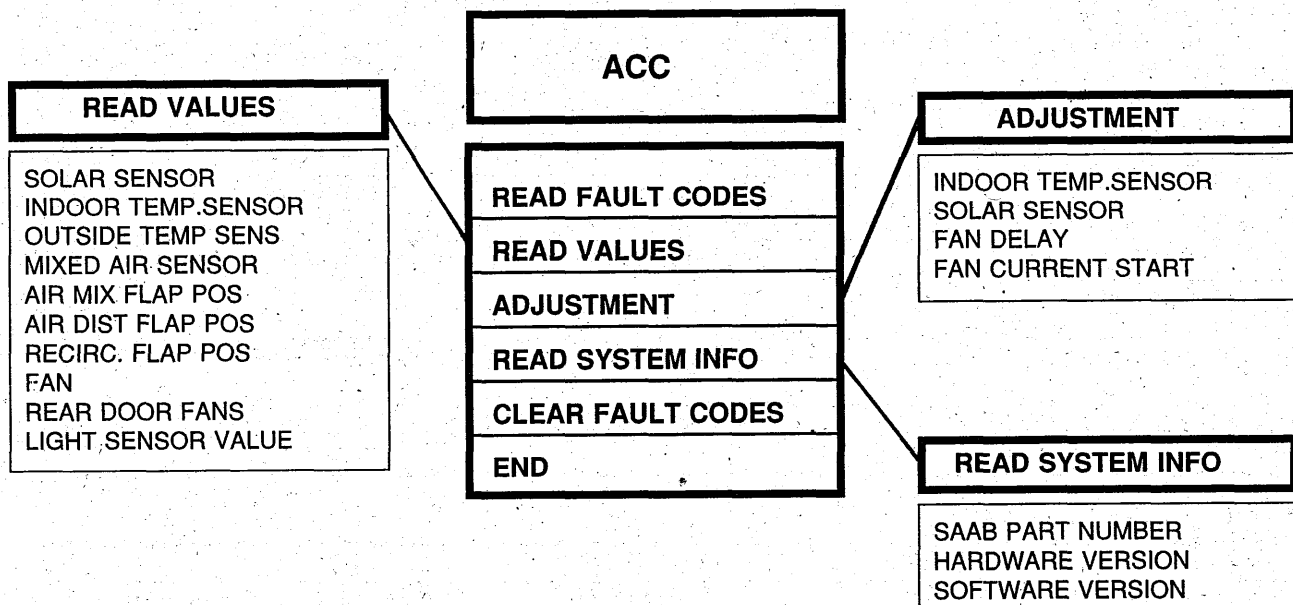
Diagnostic trouble codes (M1995)

Diagnostic trouble code	Faulty function/component	Text on ISAT display	Action, see 8:3, page
B1341	Solar sensor, component fault.	FAULT X P/I B1341 SOLAR SENSOR COMPONENT FAULT	48
B1343	Solar sensor, open circuit/short circuit.	FAULT X P/I B1343 SOLAR SENSOR OPEN/SHORT CIRCUIT	49
B1348	Blended air temperature sensor, break/short to BPV	FAULT X P/I B1348 MIXED AIR SENSOR BREAK/SHORT BATT+	50
B1353	Cabin temperature sensor, break/short circuit to BPV	FAULT X P/I B1353 INDOOR TEMP.SENSOR BREAK/SHORT BATT+	52
B1354	Suction fan, cabin temperature sensor, break/short circuit to BPV	FAULT X P/I B1354 CABIN TEMP SENSOR FAN BREAK/SHORT BATT+	54
B1355	Suction fan, cabin temperature sensor, short circuit to ground	FAULT X P/I B1355 CABIN TEMP SENSOR FAN SHORTING TO GROUND	55
B1492	A/C, shorting to BPV	FAULT X P/I B1492 AC RELAY SHORT TO BATT+	56
B1493	A/C, short to ground	FAULT X P/I B1493 AC RELAY SHORTING TO GROUND	56
B1497	Electrically heated rear window, break	FAULT X P/I B1497 HEATED REAR WINDOW OPEN CIRCUIT	57
B1498	Electrically heated rear window, short to ground	FAULT X P/I B1498 HEATED REAR WINDOW SHORTING TO GROUND	57
B1515	Common sensor ground, Shorting to BPV	FAULT X P/I B1515 SENSOR GROUND DEFECTIVE	58
B1605	Control module fault	FAULT X P/I B1605 INTERNAL FAULT	59
B1746	Outside temperature sensor, break/short circuit	FAULT X P/I B1746 OUTSIDE TEMP SENS OPEN/SHORT CIRCUIT	60
B2352	Voltage supply to the cabin fan, short circuit to ground.	FAULT X P/I B2352 FAN POWER SUPPLY SHORTING TO GROUND	61
B2402	Air distributor stepping motor, short circuit to ground	FAULT X P/I B2402 AIR DIST FLAP MOTOR SHORTING TO GROUND	62
B2403	Air distributor stepping motor, break (when calibrating)	FAULT X P/I B2403 AIR DIST FLAP MOTOR OPEN CIRCUIT	62
B2412	Recirculation flap motor, shorting to ground	FAULT X P/I B2412 RECIRC. FLAP MOTOR SHORTING TO GROUND	63

Diagnostic trouble code	Faulty function/component	Text on ISAT display	Action, see 8:3, page
B2413	Recirculation flap motor, shorting to BPV	FAULT X P/I B2413 RECIRC. FLAP MOTOR SHORT TO BATT+	63
B2437	Rear door fans, shorting to ground	FAULT X P/I B2437 REAR DOOR FAN SHORTING TO GROUND	64
B2438	Rear door fans, break	FAULT X P/I B2438 REAR DOOR FAN OPEN CIRCUIT	64
B2492	Mixed air flap stepping motor, shorting to ground	FAULT X P/I B2492 AIR MIX FLAP MOTOR SHORTING TO GROUND	67
B2493	Mixed air flap stepping motor, break (during calibration)	FAULT X P/I B2493 AIR MIX FLAP MOTOR OPEN CIRCUIT	67
Fault with no diagnostic trouble code	Cabin fan motor, not working/faulty control	-	68

ACC (contd.)

Menu structure for command codes (M1995)



ACC (contd.)**READ VALUES (M1995)**

ISAT scan tool text/commands	Function
SOLAR SENSOR XXXX W/m ²	Shows solar intensity (0-1390 W/m ²).
INDOOR TEMP.SENSOR XX °C XX °F	Shows the number of degrees in Celsius and Fahrenheit for the cabin temperature sensor.
OUTSIDE TEMP SENS XX °C XX °F	Shows the number of degrees in Celsius and Fahrenheit for the outside temperature sensor.
MIXED AIR SENSOR XX °C XX °F	Shows number of degrees in Celsius and Fahrenheit for mixed air temperature sensor.
AIR MIX FLAP POS XXX %	Shows the position of the blended air flap (0 - 100 %, where 0 % is max. cold and 100 % is max. heat).
AIR DIST FLAP POS XXX °	Shows the position of the air distributor (45-135°).
RECIRC. FLAP POS FRESH AIR MODE / RECIRC. MODE	Shows if the air recirculation flap is in the fresh air position or in the air recirculation position.
FAN CONTROL VOLTAGE X.X V	Shows the ACC control module control voltage to the fan.
REAR DOOR FANS XX.X V	Shows the voltage value of the rear door fans.
LIGHT SENSOR VALUE XXX %	Shows the current light intensity in the cabin (0 - 100 %).

ADJUSTMENT (M1995)

ISAT scan tool text/commands	Function
INDOOR TEMP.SENSOR	Adjustment ($\pm 2.5^{\circ}\text{C}$) of how the ACC control module interprets the reading from the cabin temperature sensor. See 8:3, page 38.
SOLAR SENSOR	Adjustment of the solar sensor's influence on the ACC control module control program. See 8:3, page 39.
FAN DELAY	To deactivate the cabin fan start delay. See 8:3, page 40.
FAN CURRENT START	Adjustment of cabin fan start current. See 8:3, page 41.

READ SYSTEM INFO (M1995)

ISAT scan tool text/commands	Function
SAAB PART NUMBER	Shows Saab part number.
HARDWARE VERSION	Shows the hardware version.
SOFTWARE VERSION	Shows the software version.

Airbag (contd.)

Diagnostic trouble codes -M1991, system tests

FS 1 = Front sensor, LH

FS 2 = Front sensor, RH

Electric detonator 1 = Electric detonator for airbag

Electric detonator 2 = Electric detonator for belt tensioners

SS = Safety sensor

If several diagnostic trouble codes are registered when reading, external faults (wiring harness and external components) should be rectified first. Then check if there are any diagnostic trouble codes for internal faults (control module) remaining.

Important

Before changing the control module, try erasing the diagnostic trouble code, turning the ignition key to ON and waiting for at least 40 seconds. Then check if the diagnostic trouble code has returned. If it has, change the control module.

External faults

Diagnostic trouble code	Explanation	Action, see 8:6, page
01	FS 1, closed 1-5 times	Change FS 1 (page 26)
02	FS 1, closed more than 5 times	Change FS 1 (page 26)
03	FS 2, closed 1-5 times	Change FS 2 (page 26)
04	FS 2, closed more than 5 times	Change FS 2 (page 26)
05	FS 1, closed more than 2 s	Change FS 1 (page 26)
06	FS 2, closed more than 2 s	Change FS 2 (page 26)
07	FS 1, short to BPV	11
08	FS 2, short to BPV	11
09	FS 1, short to ground	13
0A	FS 2, short to ground	13
0b	FS 1, short to BPV	15
0C	FS 2, short to BPV	15
0d	Diagnostic trouble code 2d has been present more than 10 minutes (Diagnostic trouble code 0d exists only in cars with control module part number 91 24 074)	47 *)
0E	System ground too high	17 *)
0F	FS 1, resistance to ground \geq 3 Ohms	19 *)
10	FS 2, resistance to ground \geq 3 Ohms	19 *)
11	FS 1, break in wiring	21 *)
12	FS 2, break in wiring	21 *)
13	FS 1, wiring resistance too high	23 *)
14	FS 2, wiring resistance too high	23 *)
17	4700 μ F Capacitor, capacity too low	Change control module (page 23)

Diagnostic trouble code	Explanation	Action, see 8:6, page
19	Resistance across capacitor 4700 μ F too high	Change control module (page 23)
1b	Electric detonator 1, short to BPV	25
1C	Electric detonator 2, short to BPV	27
1E	Electric detonator 1, short to BPV	28
1F	Electric detonator 2, short to BPV	30
21	Electric detonator 1, short to ground	31
22	Electric detonator 2, short to ground	34
24	Electric detonator 1, short to ground	36
25	Electric detonator 2, short to ground	39
27	Electric detonator 1, break	47 ^{*)}
28	Electric detonator 2, break	41 ^{*)}
2A	Electric detonator 1, resistance too low	43
2b	Electric detonator 2, resistance too low	46
2d	Electric detonator 1, resistance too high. For cars with control module part number 91 24 074, the fault must have been continuous for at least 35 s before the SRS lamp lights.	47 ^{*)}
2E	Electric detonator 2, resistance too high	50 ^{*)}
30	SRS Lamp, short to BPV or ground	52
31	SRS Lamp, broken	53
32	Diagnostics unit defective	Change control module (page 23)
33,34	Crash registration, indicates correct detonation. Code arises after a crash where airbag and belt tensioners have detonated correctly.	
35	FS 1, break	21
36	FS 2, break	21
37	Detonation voltage has passed through Electric detonator 2 without detonation.	Change control module (page 23)
43	Diode 7, shorted or break	Change control module (page 23)
44	Diode 8, shorted or break	Change control module (page 23)

After codes 1-44 have been investigated and action taken, proceed to "Internal faults".

^{*)} If these codes are repeatedly registered as intermittent diagnostic trouble codes, and changing components only helps temporarily, see Service Information 853-1532.

Airbag (contd.)

Diagnostic trouble codes -M1991, system testers Internal faults

Diagnostic trouble code	Explanation	Action, see 8:6, page
20	This diagnostic trouble code does not indicate any particular fault and should therefore be erased and left with no action	Try using a new control module and see if the diagnostic trouble code returns after erasure
39	Capacitor 4700 μ F, voltage too low	Change control module (page 23)
3A	Capacitor 4700 μ F, voltage too high	Change control module (page 23)
3E	Diode D5, shorted or break	Change control module (page 23)
40	Electric detonator 1, defective power source	Change control module (page 23)
41	Electric detonator 2, defective power source	Change control module (page 23)
47	FS 1, defective power source	Change control module (page 23)
48	FS 2, defective power source	Change control module (page 23)
49	SS, wiring break	Change control module (page 23)
4b	SS, closed more than 2 s	Change control module (page 23)
52	IC supply circuit defective	Change control module (page 23)
53	5 V voltage control defective	Change control module (page 23)
54	EEPROM defective	Change control module (page 23)
55	This diagnostic trouble code does not indicate any particular fault and should therefore be erased and left with no action	Try using a new control module and see if the diagnostic trouble code returns after erasure
56	IC supply circuit, temperature too high	Change control module (page 23)
57	Microprocessor defective	Change control module (page 23)
58	Multiplexer defective	Change control module (page 23)
59	Power source for leakage current reading defective	Change control module (page 23)
5A	A/D converter defective	Change control module (page 23)
5b	Mono-stable flip-flop FS 1, outside range	Change control module (page 23)
5C	Mono-stable flip-flop FS 2, outside range	Change control module (page 23)
5d	Mono-stable flip-flop SS, outside range	Change control module (page 23)
5E	Start of collision recording defective	Change control module (page 23)
5F	Start of sensor recording defective	Change control module (page 23)

Airbag (contd.)

Diagnostic trouble codes M1992-1994

FS 1 = Front sensor LH

FS 2 = Front sensor RH

Electric detonator 1 = Electric detonator for steering wheel airbag

Electric detonator 2 = Electric detonator for LH belt tensioner

Electric detonator 3 = Electric detonator for RH belt tensioner

Electric detonator 4 = Electric detonator for passenger airbag

Permanent	Temporary	Explanation	Action, see 8:6 , page
43A21	23A21	Electric detonator 1, break	64
43A22	23A22	Electric detonator 4, break	66,68
43A24	23A24	Electric detonator 2, break	75 ^{*)}
43A25	23A25	Electric detonator 3, break	75 ^{*)}
43A31	23A31	Electric detonator 1, short	73
43A32	23A32	Electric detonator 4, short	69,71
42450	22450	Secondary voltage, break	91
42482	22482	Lamp 2, SRS symbol, short to BPV	84
45321	25321	FS 1, break	77 ^{*)}
45322	25322	FS 2, break	78 ^{*)}
45341	25341	FS 1, resistance to ground too high	80 ^{*)}
45342	25342	FS 2, resistance to ground too high	80 ^{*)}
47421	27421	Lamp 1, SRS symbol, broken or open circuit	81
47471	27471	Lamp 1, SRS symbol, short circuit to ground	82
47481	27481	Lamp 1, SRS symbol, short circuit to BPV	83
67570	77570	Electric detonator 1, short to ground	85
		Electric detonator 2, short to ground	85
		Electric detonator 3, short to ground	85
		Electric detonator 4, short to ground	85
		FS 1, short to ground	85
		FS 2, short to ground	85
67580	77580	Electric detonator 1, short to BPV	88
		Electric detonator 2, short to BPV	88
		Electric detonator 3, short to BPV	88
		Electric detonator 4, short to BPV	88
		FS 1, short to BPV	88
		FS 2, short to BPV	88
67590	-	Control module defective	-
-	77590	Control module defective	92
67592	-	Collision registration	-
E2991	-	System incorrectly programmed	92

^{*)} If these codes are repeatedly registered as intermittent diagnostic trouble codes, and changing components only helps temporarily, see Service Information 853-1532.

Airbag (contd.)

Menu structure for command codes (-M1994)

AIRBAG
READ FAULT CODES
CLEAR FAULT CODES
READ SYSTEM INFO
CODE
END

Airbag (contd.)

Command codes M1992-1994

Important

If there are no diagnostic trouble codes stored when command codes 101-105 are used, communication is ended.

Command code	Description
100	Shows all diagnostic trouble codes
101	Shows diagnostic trouble code 1 with time and diagnostic trouble code counter. In addition to the diagnostic trouble code, the scan tool also shows e.g. "802419 15" (24=24 hours 19=19 mins 15=15 times), which means that the diagnostic trouble code arose 24 hours and 19 minutes ago, the fault is intermittent and has arisen 15 times.
102	Shows diagnostic trouble code 2 with time and fault counter
103	Shows diagnostic trouble code 3 with time and fault counter
104	Shows diagnostic trouble code 4 with time and fault counter
105	Shows diagnostic trouble code 5 with time and fault counter
380	Shows control module serial number. The scan tool then shows something like "8B12345678" where 12345678 is the serial number.
381	This command code exists only on M1992-1993 and certain M1994 which have control module with part number 41 76 368. These control modules are programmed at the manufacturer. Shows programming. If the scan tool shows "8B203", the control module is incorrectly programmed. If the scan tool shows "8B204", the control module is correctly programmed.
550	Lights lamp 2 in the SRS symbol and allows it to be on for about 5 seconds.
551	Lights lamp 1 in the SRS symbol and allows it to flash for about 5 seconds.
800	End communication.
900	Erases all diagnostic trouble codes, resets all fault counters and ends communication.
B24	This command code exists only on M1992-1993 and certain M1994 which have control module with part number 41 76 368. These control modules are programmed at the manufacturer. Shows programming. If the scan tool shows "80100", programming is correct. If the scan tool shows "80000", programming is incorrect.

Airbag (contd.)**Test readings, control module connections (M1995)**

Pin	Color	Component Function	Measuring conditions	Reading	Between X-Y	Func./Diag, page
1	BN	Driver belt tensioner	Connect reference resistor. Connect a BOB. Ignition off.	approx. 2.5 Ohms	1 - 2	24/ as DTC table
2	BU	Driver belt tensioner	Connect reference resistor. Connect a BOB. Ignition off.	approx. 2.5 Ohms	2 - 1	24/ as DTC table
3	BU/ WH	Passenger belt tensioner	Connect reference resistor. Connect a BOB. Ignition off.	approx. 2.5 Ohms	3 - 4	24/ as DTC table
4	YE/ WH	Passenger belt tensioner	Connect reference resistor. Connect a BOB. Ignition off.	approx. 2.5 Ohms	4 - 3	24/ as DTC table
5	GN/ WH	Battery positive voltage +15	Connect a BOB. Ignition on.	approx. 12 V	5 - 6	20/ as DTC table
6	BK	Ground	Connect a BOB. Ignition off.	0 Ohm	6 - Ground	21/ as DTC table
7	BU	SRS lamp	Connect the Scan Tool. Ignition on. Activate SRS lamp.	SRS Lamp should light.	-	25/ as DTC table
9	GN	Data link connector	Connect a BOB. Ignition off.	approx. 0.5 Ohm	9 - 1 (data link connector)	20/ as DTC table
10	OG	Driver airbag	Connect reference resistor. Connect a BOB. Ignition off.	3 - 4 Ohm	10 - 11	22/ as DTC table
11	RD	Driver airbag	Connect reference resistor. Connect a BOB. Ignition off.	3 - 4 Ohm	11 - 10	22/ as DTC table
13	VT	Passenger airbag	Connect reference resistor. Connect a BOB. Ignition off.	approx. 2.5 Ohms	13 - 14	23/ as DTC table
14	GY	Passenger airbag	Connect reference resistor. Connect a BOB. Ignition off.	approx. 2.5 Ohms	14 - 13	23/ as DTC table

Airbag (contd.)

Diagnostic trouble codes (M1995)

Diagnostic trouble code	Faulty function/component	Fault	Text on scan tool display	See 8:6, page
B1227	SRS Warning lamp	Short to BPV	FAULT X Y B 1227 SRS LAMP SHORT TO BATT+ xxxC xxH xxM	36
B1228	SRS Warning lamp	Short circuit to ground, break or faulty lamp	FAULT X Y B 1228 SRS LAMP BREAK, SHORTING TO GROUND xxxC xxH xxM	38
B1332	Driver airbag	Break	FAULT X Y B1332 DRIVER AIRBAG OPEN CIRCUIT xxxC xxH xxM	42
B1333	Driver airbag	Short between wires to airbag	FAULT X Y B 1333 DRIVER AIRBAG RESISTANCE TOO LOW xxxC xxH xxM	47
B1337	Passenger airbag	Break	FAULT X Y B1337 PASSENGER AIRBAG OPEN CIRCUIT xxxC xxH xxM	50
B1338	Passenger airbag	Short between wires to airbag	FAULT X Y B1338 PASSENGER AIRBAG RESISTANCE TOO LOW xxxC xxH xxM	54
B1605	Electronic control module	Internal fault	FAULT X Y B 1605 INTERNAL FAULT xxxC xxH xxM	57
B1610	Electronic control module	Control module is programmed with wrong configuration	FAULT X Y B1610 CONTROL MODULE WRONGLY PROGRAMMED xxxC xxH xxM	57
B1615	Electronic control module	Control module used	FAULT X Y B1615 IGNITION CIRCUIT ACTIVATED CRASH xxxC xxH xxM	57
B2332	Driver airbag	Short to ground	FAULT X Y B2332 DRIVER AIRBAG SHORTING TO GROUND xxxC xxH xxM	58
B2333	Driver airbag	Short to BPV	FAULT X Y B2333 DRIVER AIRBAG SHORT TO BATT+ xxxC xxH xxM	63
B2337	Passenger airbag	Short to ground	FAULT X Y B2337 PASSENGER AIRBAG SHORTING TO GROUND xxxC xxH xxM	58

Diagnostic trouble code	Faulty function/component	Fault	Text on scan tool display	See 8:6, page
B2338	Passenger airbag	Short to BPV	FAULT X Y B2338 PASSENGER AIRBAG SHORT TO BATT+ xxxC xxH xxM	63
B2441	Driver belt tensioner	Break	FAULT X Y B2441 DRIVER BELT TENS. OPEN CIRCUIT xxxC xxH xxM	68
B2442	Driver belt tensioner	Short to ground	FAULT X Y B2442 DRIVER BELT TENS. SHORTING TO GROUND xxxC xxH xxM	72
B2443	Driver belt tensioner	Short to BPV	FAULT X Y B2443 DRIVER BELT TENS. SHORT TO BATT+ xxxC xxH xxM	76
B2444	Driver belt tensioner	Short between wires to belt tensioner	FAULT X Y B2444 DRIVER BELT TENS. RESISTANCE TOO LOW xxxC xxH xxM	80
B2446	Passenger belt tensioner	Break	FAULT X Y B2446 PASS. BELT TENS. OPEN CIRCUIT xxxC xxH xxM	83
B2447	Passenger belt tensioner	Short to ground	FAULT X Y B2447 PASS. BELT TENS. SHORTING TO GROUND xxxC xxH xxM	72
B2448	Passenger belt tensioner	Short to BPV	FAULT X Y B2448 PASS. BELT TENS. SHORT TO BATT+ xxxC xxH xxM	76
B2449	Passenger belt tensioner	Short between wires to belt tensioner	FAULT X Y B2449 PASS. BELT TENS. RESISTANCE TOO LOW xxxC xxH xxM	87
No diagnostic trouble code displayed	Electronic control module	No voltage supply		90

FAULT X = diagnostic trouble code ordinal number

Y = Type of fault: P = permanent, I = intermittent

xxxC = number of times each fault has been registered (0-255)

xxH = number of hours passed since the diagnostic trouble code was first registered (max 40 hours)

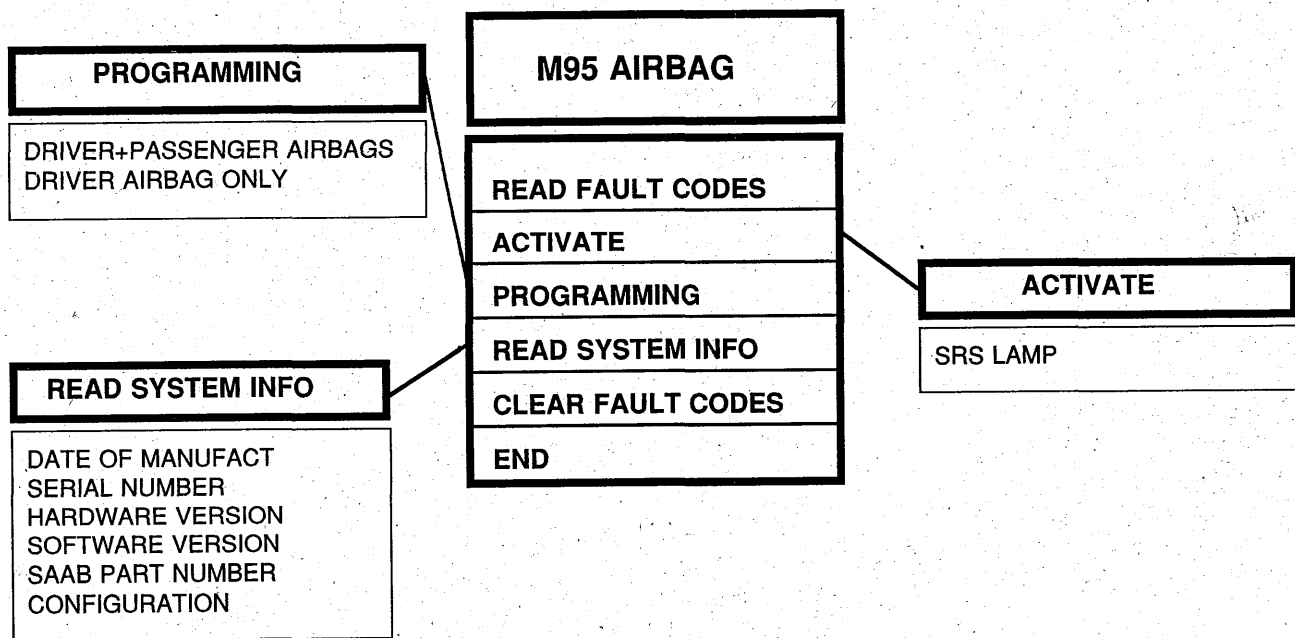
xxM = number of minutes passed since the diagnostic trouble code was registered for the first time

BATT+ = Battery positive voltage (BPV)

SHORT = Short circuit

Airbag (contd.)

Menu structure for command codes (M1995)



Electrically operated front seats with memory

Before starting fault diagnosis

Try running all motors in both directions. If the electric seat fuse blows when one of the motors is run, this motor is probably shorted to ground. Rectify the fault and change the fuse.

Fault diagnosis

Connect the scan tool to the data link connector located under the RH front seat. Turn the ignition key to ON and call up the control module.

LH front seat has system number 4 and the RH front seat has system number 5.

When contact has been established with the control module, the display shows "SEAT MEMORY L" (LH seat) or "SEAT MEMORY R" (RH seat) depending on which system number is selected. At the same time, all diagnostic trouble codes found by the control module are displayed.

If the scan tool cannot make contact with the control module, check that:

- the ignition key has been turned to ON and that there is voltage to the control module.
- that there is battery positive voltage between pins 9 and 10 in the data link connector. The scan tool indicates the voltage is correct by the display lighting up when it is connected to the data link connector.
- the connection between the data link connector and the control module is good.

If the scan tool still cannot make contact with the control module, the cause may be as follows:

Symptom 1

Seat can be controlled manually, but when the manual control is released, the seat returns to its original position.

Cause of fault 1

Fault in memory buttons. The memory buttons are constantly activated.

Action 1

See Service Manual 0 "News" M1991- Body, page 20.

Symptom 2

The control module does not react to any commands, either from the memory buttons or from the manual control.

Cause of fault 2

The control module has detected an internal fault and all functions are blocked.

Action 2

Change the control module.

Note the diagnostic trouble codes displayed. Before continuing fault diagnosis, check that the control module is receiving the correct input signals from the memory buttons and from the manual control. See Service Manual 0 "News" M1991- Body work, page 16. This should be done to avoid double faults that can make fault diagnosis more difficult.

Electrically operated front seats with memory (contd.)

Diagnostic trouble codes

Diagnostic trouble code	Faulty function/ component	Fault	Text on ISAT display	Action
25221	Seat front edge Potentiometer	Voltage from potentiometer too high (intermittent)	FAULT 1 I 25221 SEAT FRONT POT OPEN/SHORT BATT+	*)
45221	Seat front edge Potentiometer	Voltage from potentiometer too high (permanent)	FAULT 1 P 45221 SEAT FRONT POT OPEN/SHORT BATT+	*)
25222	Legroom adjustment Potentiometer	Voltage from potentiometer too high (intermittent)	FAULT 1 I 25222 LEGROOM ADJUST POT OPEN/SHORT BATT+	*)
45222	Legroom adjustment Potentiometer	Voltage from potentiometer too high (permanent)	FAULT 1 P 45222 LEGROOM ADJUST POT OPEN/SHORT BATT+	*)
25223	Seat rear edge Potentiometer	Voltage from potentiometer too high (intermittent)	FAULT 1 I 25223 SEAT REAR POT OPEN/SHORT BATT+	*)
45223	Seat rear edge Potentiometer	Voltage from potentiometer too high (permanent)	FAULT 1 P 45223 SEAT REAR POT OPEN/SHORT BATT+	*)
25224	Backrest Potentiometer	Voltage from potentiometer too high (intermittent)	FAULT 1 I 25224 BACKREST POT OPEN/SHORT BATT+	*)
45224	Backrest Potentiometer	Voltage from potentiometer too high (permanent)	FAULT 1 P 45224 BACKREST POT OPEN/SHORT BATT+	*)
25231	Seat front edge Potentiometer	Voltage from potentiometer too low (intermittent)	FAULT 1 I 25231 SEAT FRONT POT OPEN/SHORT GROUND	*)
45231	Seat front edge Potentiometer	Voltage from potentiometer too low (permanent)	FAULT 1 P 45231 SEAT FRONT POT OPEN/SHORT GROUND	*)
25232	Legroom adjustment Potentiometer	Voltage from potentiometer too low (intermittent)	FAULT 1 I 25232 LEGROOM ADJUST POT OPEN/SHORT GROUND	*)
45232	Legroom adjustment Potentiometer	Voltage from potentiometer too low (permanent)	FAULT 1 P 45232 LEGROOM ADJUST POT OPEN/SHORT GROUND	*)
25233	Seat rear edge Potentiometer	Voltage from potentiometer too low (intermittent)	FAULT 1 I 25233 SEAT REAR POT OPEN/SHORT GROUND	*)
45233	Seat rear edge Potentiometer	Voltage from potentiometer too low (permanent)	FAULT 1 P 45233 SEAT REAR POT OPEN/SHORT GROUND	*)
25234	Backrest Potentiometer	Voltage from potentiometer too low (intermittent)	FAULT 1 I 25234 BACKREST POT OPEN/SHORT GROUND	*)
45234	Backrest Potentiometer	Voltage from potentiometer too low (permanent)	FAULT 1 P 45234 BACKREST POT OPEN/SHORT GROUND	*)

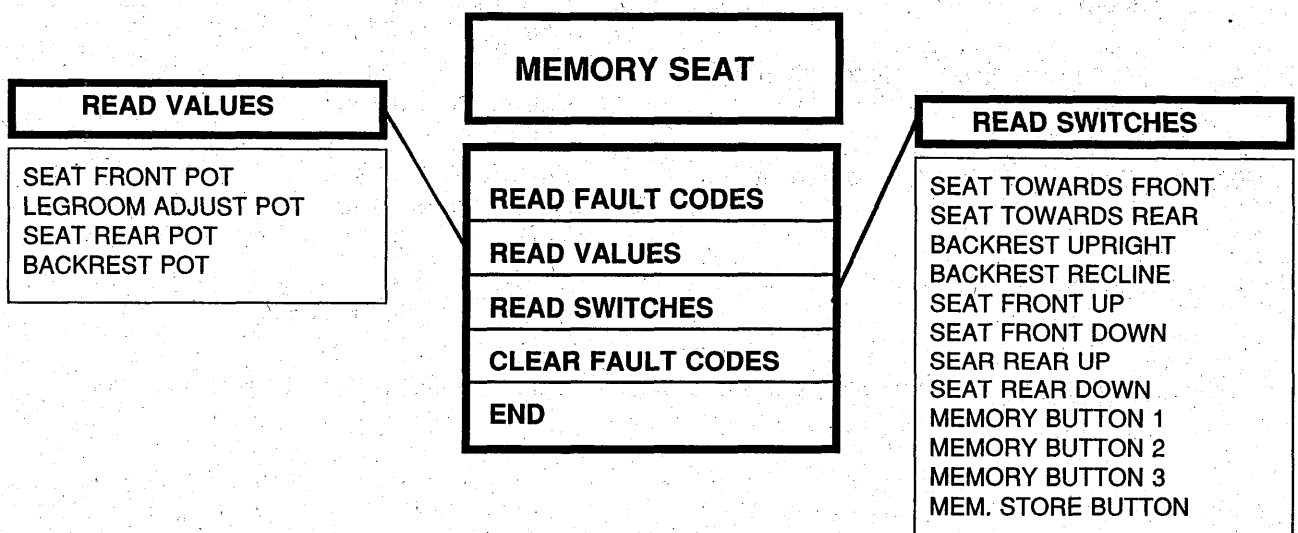
Diagnostic trouble code	Faulty function/ component	Fault	Text on ISAT display	Action
25291	Seat front edge Potentiometer	Adjustment too slow when setting with memory (intermittent)	FAULT 1 I 25291 SEAT FRONT POT CHANGES TO STORED SETTINGS TOO SLOW	*)
45291	Seat front edge Potentiometer	Adjustment too slow when setting with memory (permanent)	FAULT 1 P 45291 SEAT FRONT POT CHANGES TO STORED SETTINGS TOO SLOW	*)
25292	Legroom adjustment Potentiometer	Adjustment too slow when setting with memory (intermittent)	FAULT 1 I 25292 LEGROOM ADJUST POT CHANGES TO STORED SETTINGS TOO SLOW	*)
45292	Legroom adjustment Potentiometer	Adjustment too slow when setting with memory (permanent)	FAULT 1 P 45292 LEGROOM ADJUST POT CHANGES TO STORED SETTINGS TOO SLOW	*)
25293	Seat rear edge Potentiometer	Adjustment too slow when setting with memory (intermittent)	FAULT 1 I 25291 SEAT REAR POT CHANGES TO STORED SETTINGS TOO SLOW	*)
45293	Seat rear edge Potentiometer	Adjustment too slow when setting with memory (permanent)	FAULT 1 P 45291 SEAT REAR POT CHANGES TO STORED SETTINGS TOO SLOW	*)
25294	Backrest Potentiometer	Adjustment too slow when setting with memory (intermittent)	FAULT 1 I 25292 BACKREST POT CHANGES TO STORED SETTINGS TOO SLOW	*)
45294	Backrest Potentiometer	Adjustment too slow when setting with memory (permanent)	FAULT 1 P 45292 BACKREST POT CHANGES TO STORED SETTINGS TOO SLOW	*)
33640	All motors	Power consumption >50 A in one of the motors (intermittent)	FAULT 1 I 33640 MOTOR FAULT POWER CONSUMPTION 50 A	*)
53640	All motors	Power consumption in one of the motors >50 A (permanent)	FAULT 1 P 53640 MOTOR FAULT POWER CONSUMPTION 50 A	*)
33641	Seat front Motor	Power consumption >50 A (intermittent)	FAULT 1 I 33641 SEAT FRONT MOTOR CONSUMING 50 A	*)
53641	Seat front Motor	Power consumption >50 A (permanent)	FAULT 1 P 53641 SEAT FRONT MOTOR CONSUMING 50 A	*)
33642	Legroom adjustment Motor	Power consumption >50 A (intermittent)	FAULT 1 I 33642 LEGROOM ADJUST MOTOR CONSUMING 50 A	*)
53642	Legroom adjustment Motor	Power consumption >50 A (permanent)	FAULT 1 P 53642 LEGROOM ADJUST MOTOR CONSUMING 50 A	*)

Diagnostic trouble code	Faulty function/ component	Fault	Text on ISAT display	Action
33643	Seat rear Motor	Power consumption >50 A (intermittent)	FAULT 1 I 33643 SEAT REAR MOTOR CONSUMING 50 A	*)
53643	Seat rear Motor	Power consumption >50 A (permanent)	FAULT 1 P 53643 SEAT REAR MOTOR CONSUMING 50 A	*)
33644	Backrest Motor	Power consumption >50 A (intermittent)	FAULT 1 I 33644 BACKREST MOTOR CONSUMING 50 A	*)
53644	Backrest Motor	Power consumption >50 A (permanent)	FAULT 1 P 53644 BACKREST MOTOR CONSUMING 50 A	*)
77590	Control module fault	(intermittent)	FAULT 1 I 77590 CONTROL MODULE FAULT	*)
67590	Control module fault	(permanent)	FAULT 1 P 67590 CONTROL MODULE FAULT	*)
1111	No faults		MEMORY SEAT NO FAULTS DETECTED	*)

*) For action, see the fault diagnosis schedule in Service Manual 0 "News" M1991, page 8 Body work.

Electrically operated front seats with memory (contd.)

Command codes, scan tool





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