Saab 9000

SERVICE MANUAL

SAAB

$ 1445 3-6 HP

Saab 9000

SERVICE MANUAL

0 News
M 1991

Foreword
This manual contains brief descriptions of the most important new features of the 1991 Saab 9000.
This information is not binding. We reserve the right to introduce modifications without notice.

Saab Automobile AB

Units

The basic and derived units used throughout the Service Manual are in accordance with the SI system. (Systéme International d'Unités)

For users not familiar with the SI units, some non-Continental units are given in brackets after the respective SI unit.

The following symbols and abbreviations are used:

SI unit	Equivalent unit and symbol
Millimters (mm)	inch (in)
Kilograme (kg)	pound (lb)
Newton (N)	pound-force (lbf)
Newtonmeter (Nm)	foot pound (ft lb)
Atmosphere (bar)	pound-force per square inch (lbf/in^2) (Also abbreviated: psi)
Liter (l)	US liquid quart (liq qt) (Also abbreviated: qts)
	US gallon (USgal)
°Celcius (°C)	°Fahrenheit (°F)

Conversion factors

1 in = 25.4 mm	1 kg = 2.20 lb
1 lb = 0.45 kg	1 N = 0.23 lbf
1 lbf = 4.45 N	1 Nm = 0.74 lbf ft
1 lbf ft = 1.36 Nm	1 bar = 14.5 lbf/in^2
1 psi = 0.07 bar	1 l = 1.05 liq qt
1 US liq qt = 0.83 UKqt	1 USgal = 0.83 UKgal
°F = °C x 9/5 + 32	°C = (°F - 32) x 5/9
1 mm = 0.039 in	

Market codes

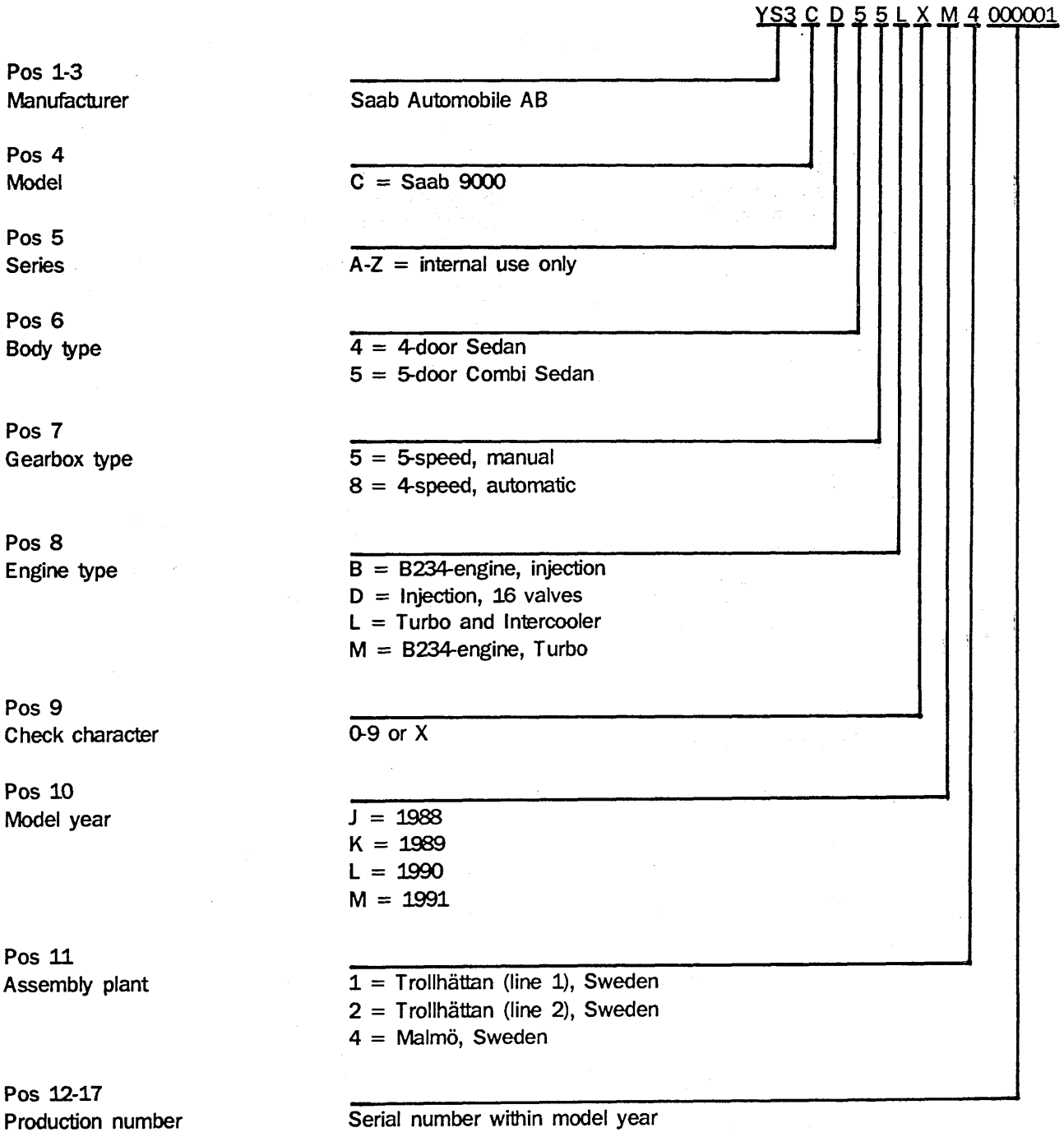
The codes refer to market specifications

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		

Production: Saab Automobile AB, Trollhättan, Sweden

Technical data

Chassis number (Vehicle Identification Number = VIN)



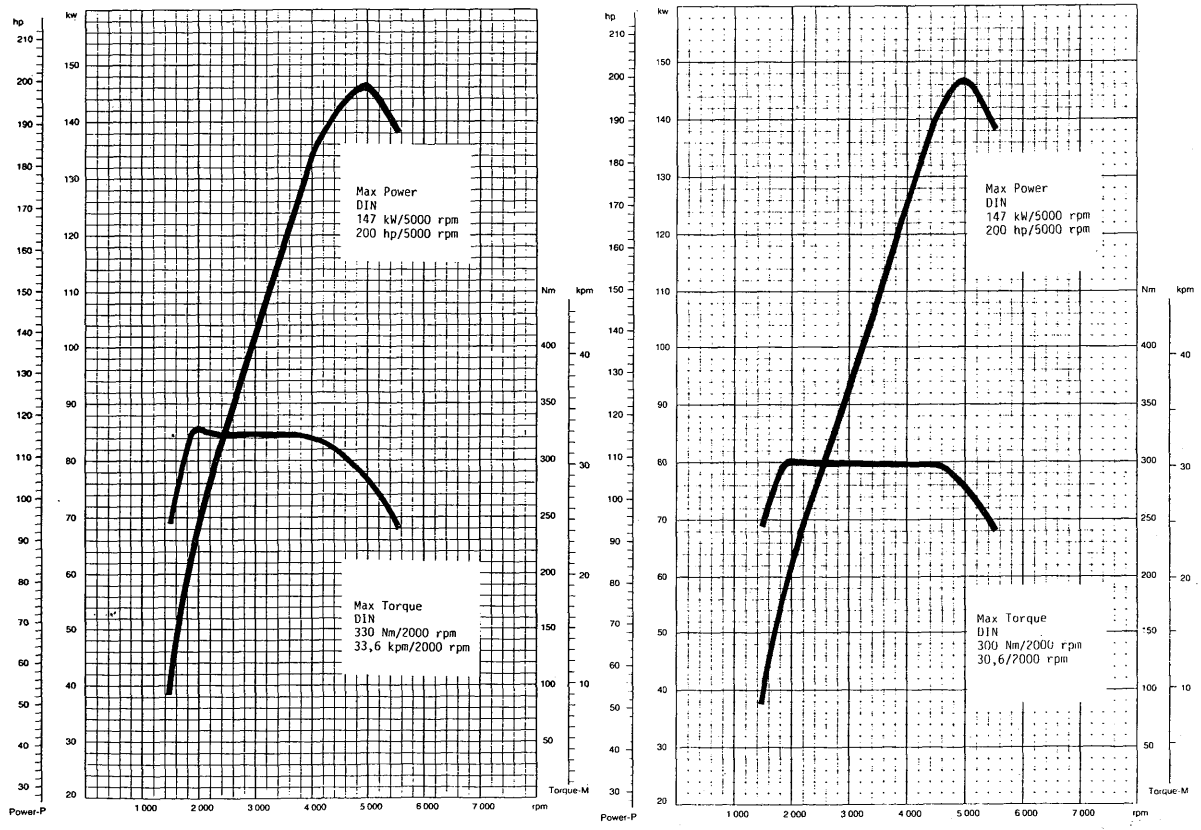
Pre-delivery inspection and Warranty service

To get information about news and changes in section 1:1, see book 1:1 Pre-delivery inspection and Break-in service.

Service

To get information about news and changes in section 1:2, see book 1:2 Service.

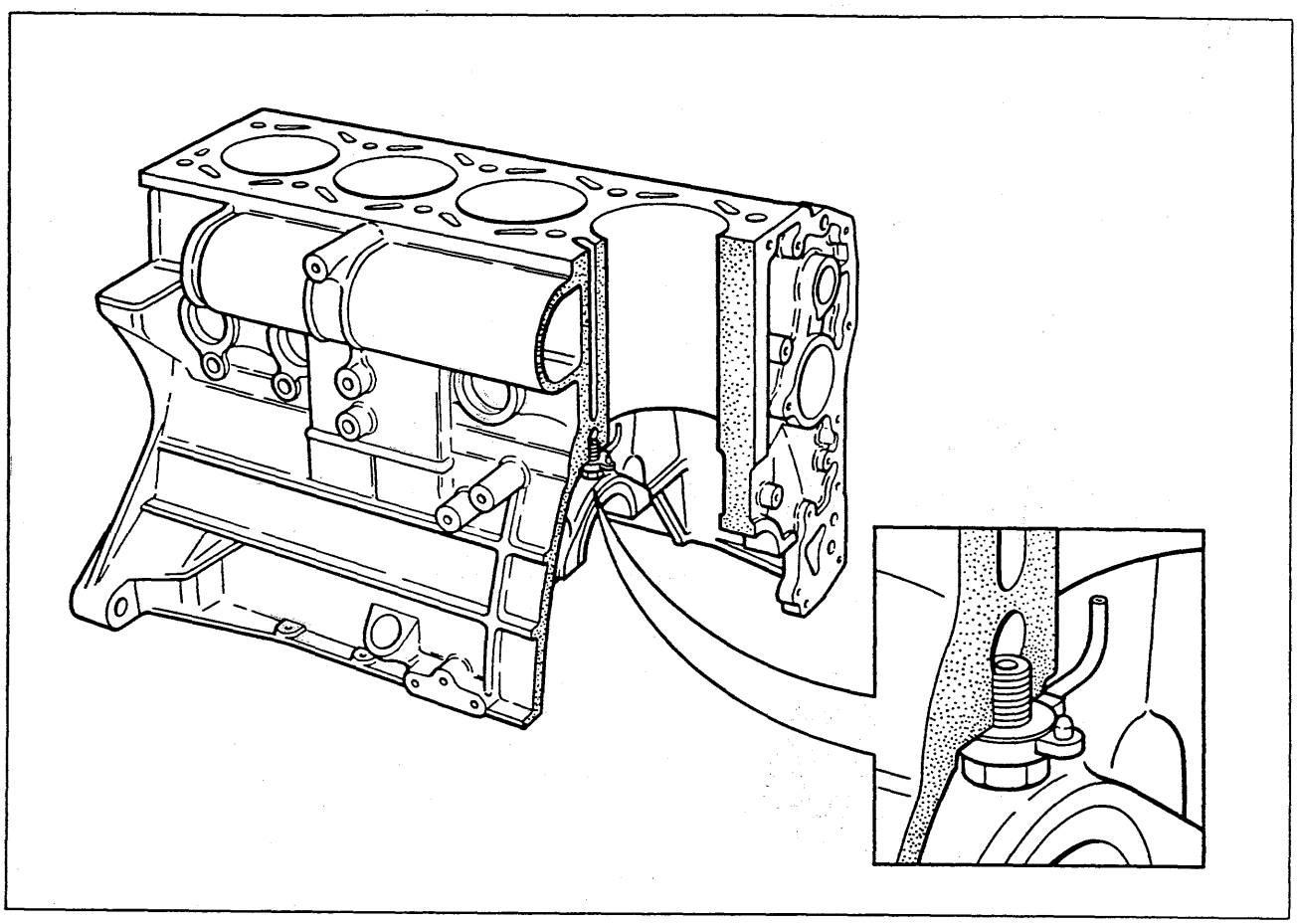
Engine



New engine variant—B234 Turbo

A Turbo version of the B234 is available for all markets as from M91.

The new engine develops 200 hp at 5,000 rpm and a torque of no less than 330 Nm (Manuals) or 300 Nm (Automatics) at 2,000 rpm.



The cooling-oil valves are located at the bottom of each cylinder bore.

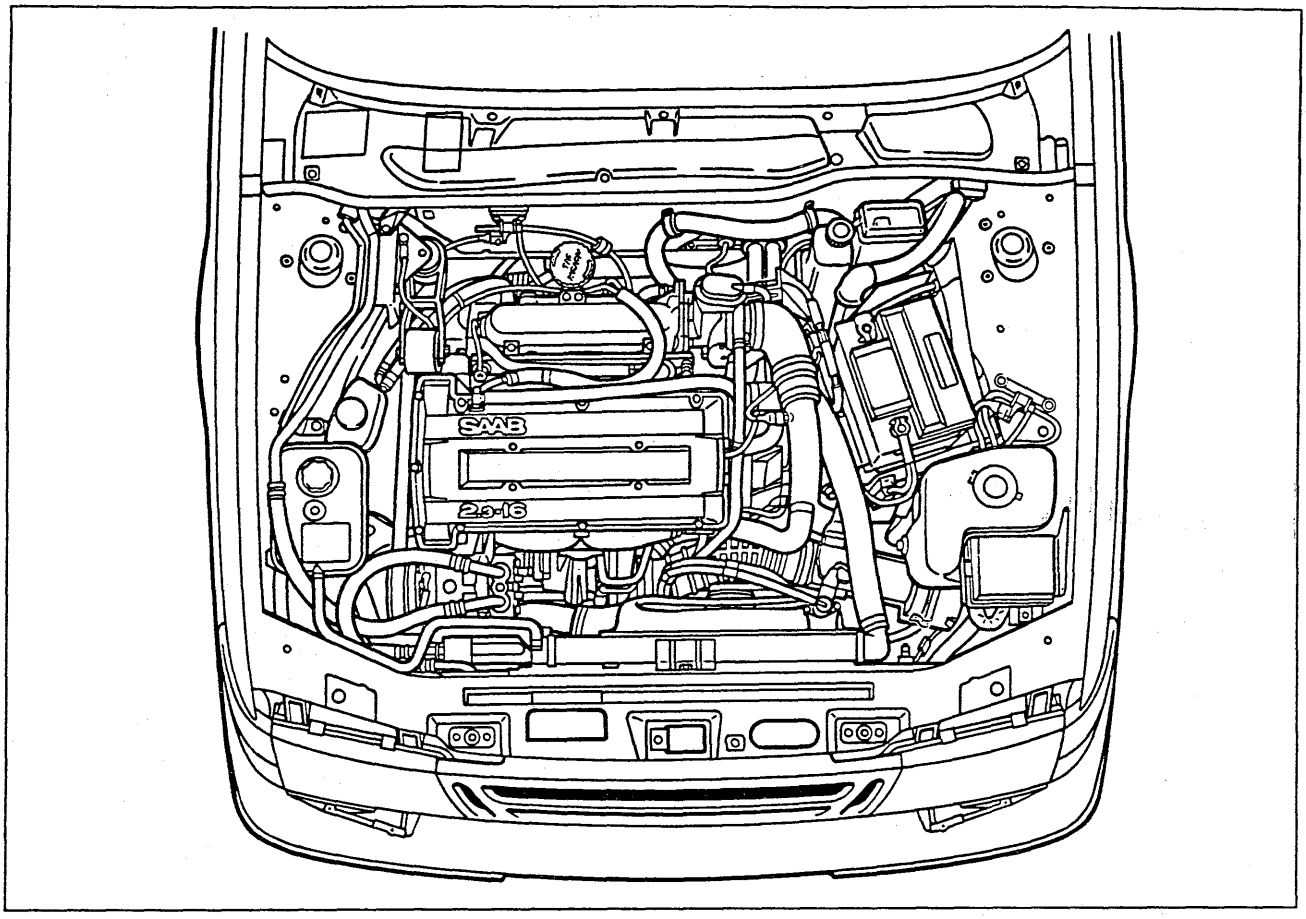
Oil-cooled pistons

In view of the greater power delivered by the turbo-charged variant of the B234 engine, effective control of the engine temperature is necessary.

This is achieved partly by a larger engine-oil cooler and partly by oil-cooling of the pistons.

Oil is supplied via oilways in the block to a valve at the bottom of each cylinder bore. The valves spray the oil into the pistons, with the return flow of oil transporting heat away from the engine for dissipation in the oil cooler.

The valves open at an oil pressure of 1.7 bar and close at a pressure of 1.0 bar.



Induction system

The following induction-system components have either been modified or redesigned for the B234 Turbo:

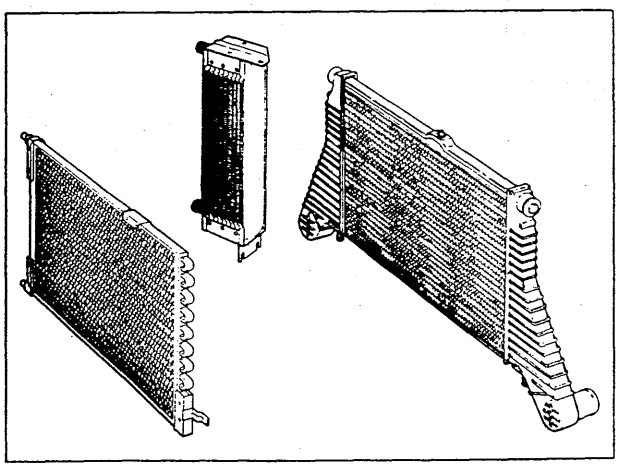
- New cover for the air-cleaner housing to accommodate a new, larger air mass meter with larger-bore connections.
- New hoses between turbo unit and air mass meter and intercooler.
- New alloy duct with new rubber connectors for connection to intercooler and throttle housing.
- Modified air intake and APC hose.

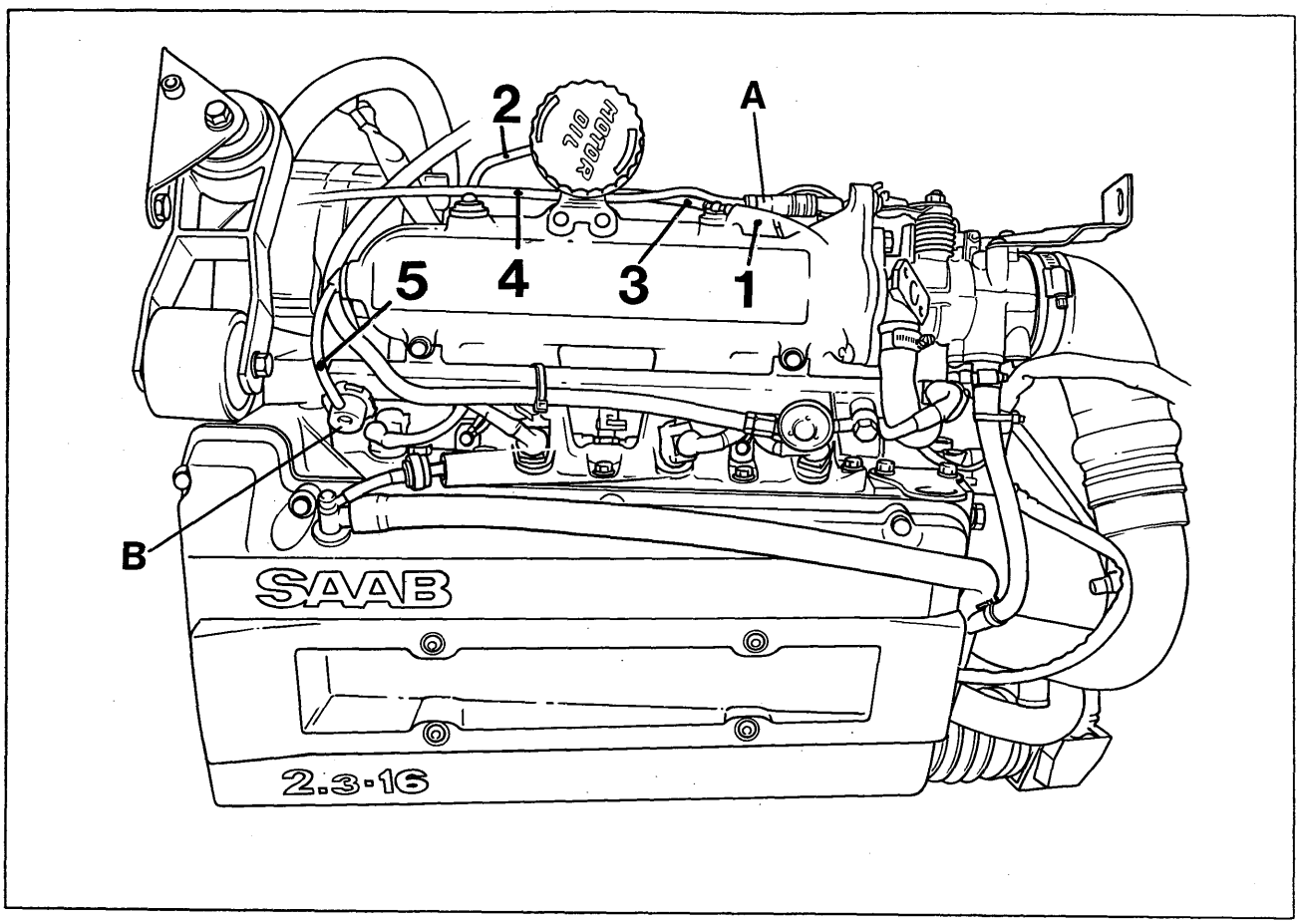
New intercooler

The B234 Turbo is equipped with a new intercooler, which has a higher cooling effect and lower pressure drop.

Cars with AC/ACC have a new AC condenser, also necessitating a new bracket for cars with AC and a 20-dm^2 radiator.

The new cooler assembly for the B234 Turbo, which also includes a larger engine-oil cooler, is also fitted to B202 Turbo cars.





Inlet manifold vacuum ports
1. *To crankcase ventilation*
2. *To bypass valve*
3. *To modulating valve, electronic EGR*
4. *To ELCD canister*
5. *To fuel-pressure regulator*

New inlet manifold, injection rail & fuel-pressure regulator

The B234 Turbo is equipped with a new inlet manifold with shorter pipes and reconfigured ports for the vacuum hoses.

The vacuum hoses have been rerouted, which means that their lengths have also been changed.

There is a new port on the inlet manifold, immediately downstream of the throttle housing, for the purging hose (A) from the valve on the ELCD canister.

The new fuel-injection rail has a rectangular cross-section, and the pressure and return ends have been reversed compared with the rail on the B234i.

The fuel-pressure regulator (B) is of a completely new design and, because of its compactness, is now fitted direct to the fuel-injection rail.

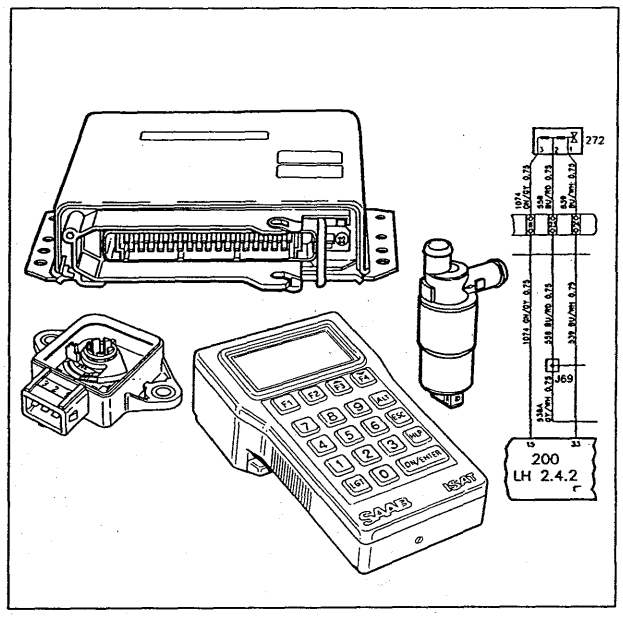
The pressure regulator maintains a constant fuel pressure, 3.0 bar above the pressure in the inlet manifold.

The fuel lines have been adapted to the new fuel-injection rail.

LH 2.4.2 fuel-injection system

The LH 2.4.2 system is fitted to all B234 Turbo engines, as well as to all B234i engines to North-American specifications.

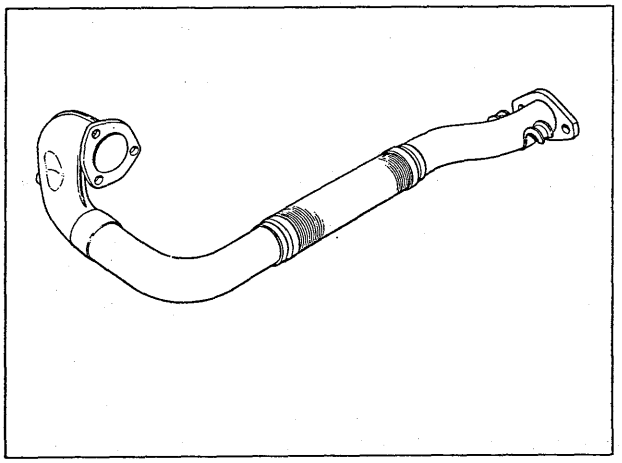
Details of the LH 2.4.2 system are given in the section starting on page 20.



Exhaust system

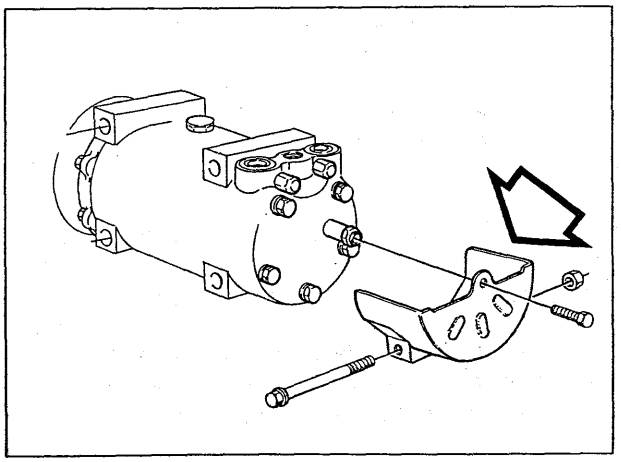
A new exhaust-pipe front section is fitted to B234 Turbo engines to match the new exhaust manifold and T25 turbo unit.

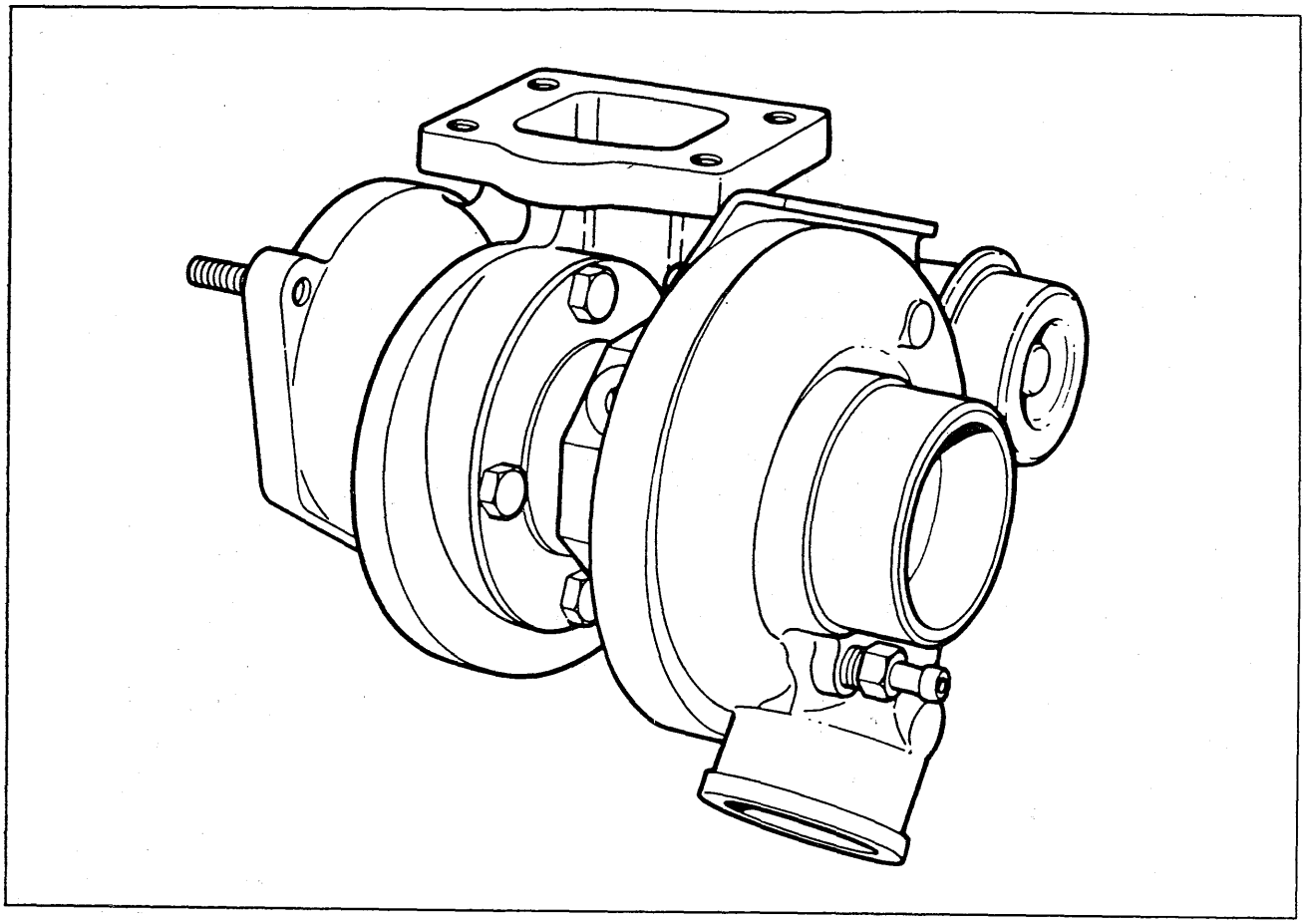
For details of removal/fitting of the new exhaust, see page 18.



Heat shield between turbo unit and AC compressor

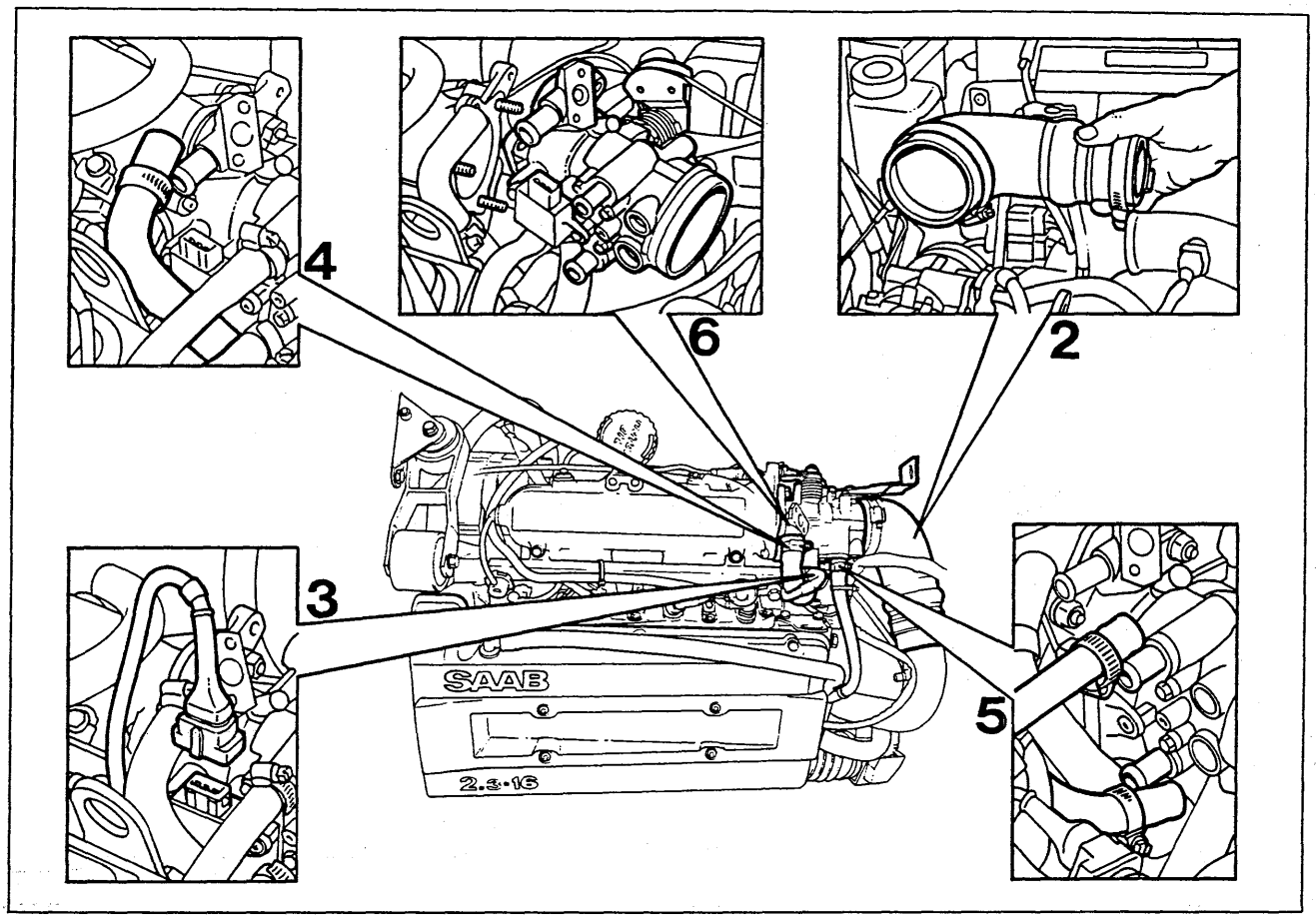
A heat shield is now fitted to protect the AC compressor from the heat emitted by the turbo unit.





Turbocharger

The B234 Turbo engine is equipped with a new T25 monoblock turbocharger, which has the waste-gate integrated in the casting.



Replacing B234 components

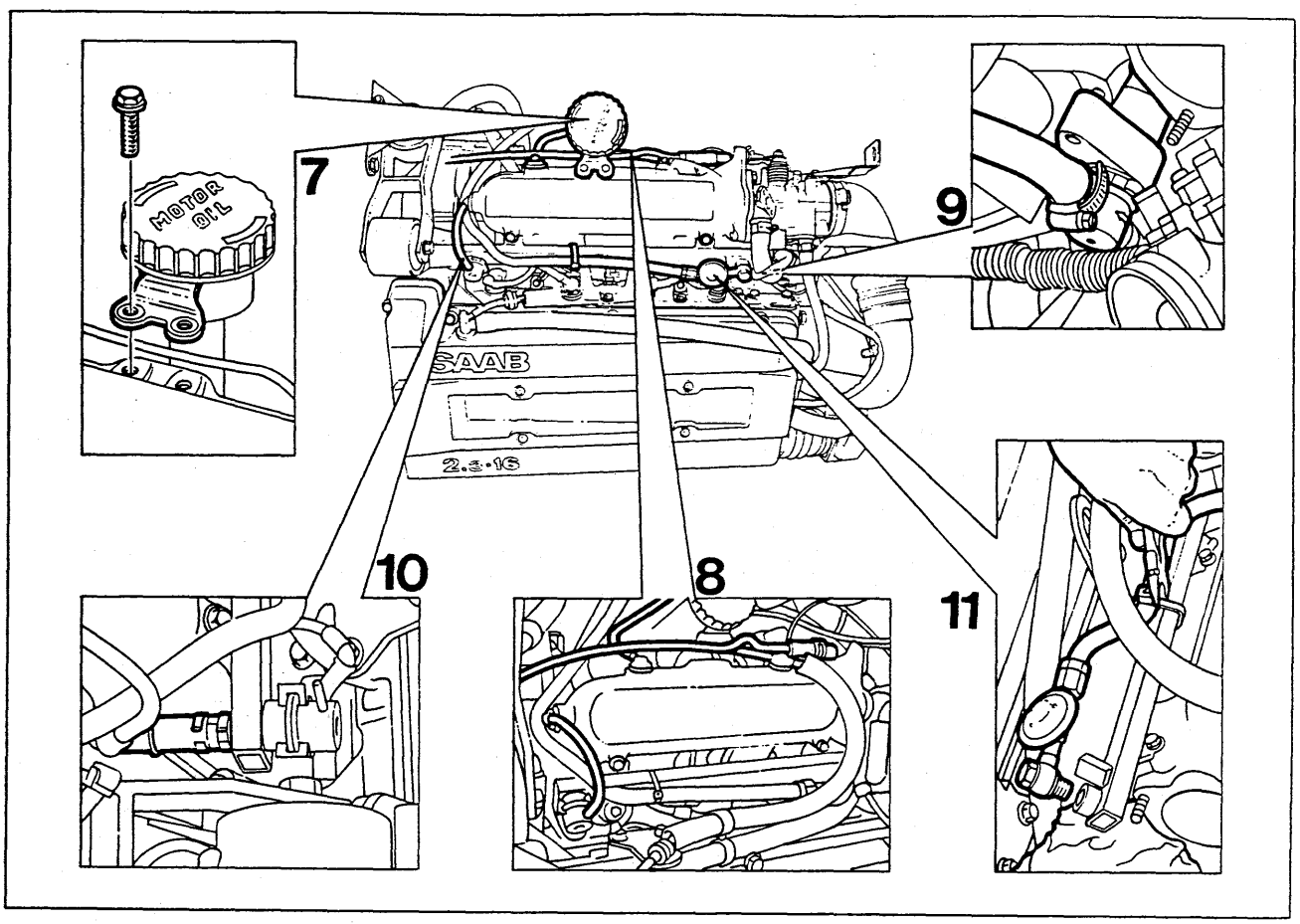
Note
The following method applies to a B234 Turbo engine with electronic EGR. Owing to a late decision to discontinue the EGR system on the B234 Turbo on M91, disregard any pictures or items relating to electronic EGR.

For further information, see page 19.

Inlet manifold

To remove

1. Drain the coolant and refit the drain plug.
2. Remove the rubber elbow from between the throttle housing and turbo discharge pipe.
3. Unplug the connector from the throttle-position sensor (or throttle potentiometer).
4. Disconnect the AIC hose from the throttle housing.
5. Disconnect the coolant hoses from the throttle housing.
6. Unbolt the throttle housing (3 nuts) and swivel the housing out of the way.



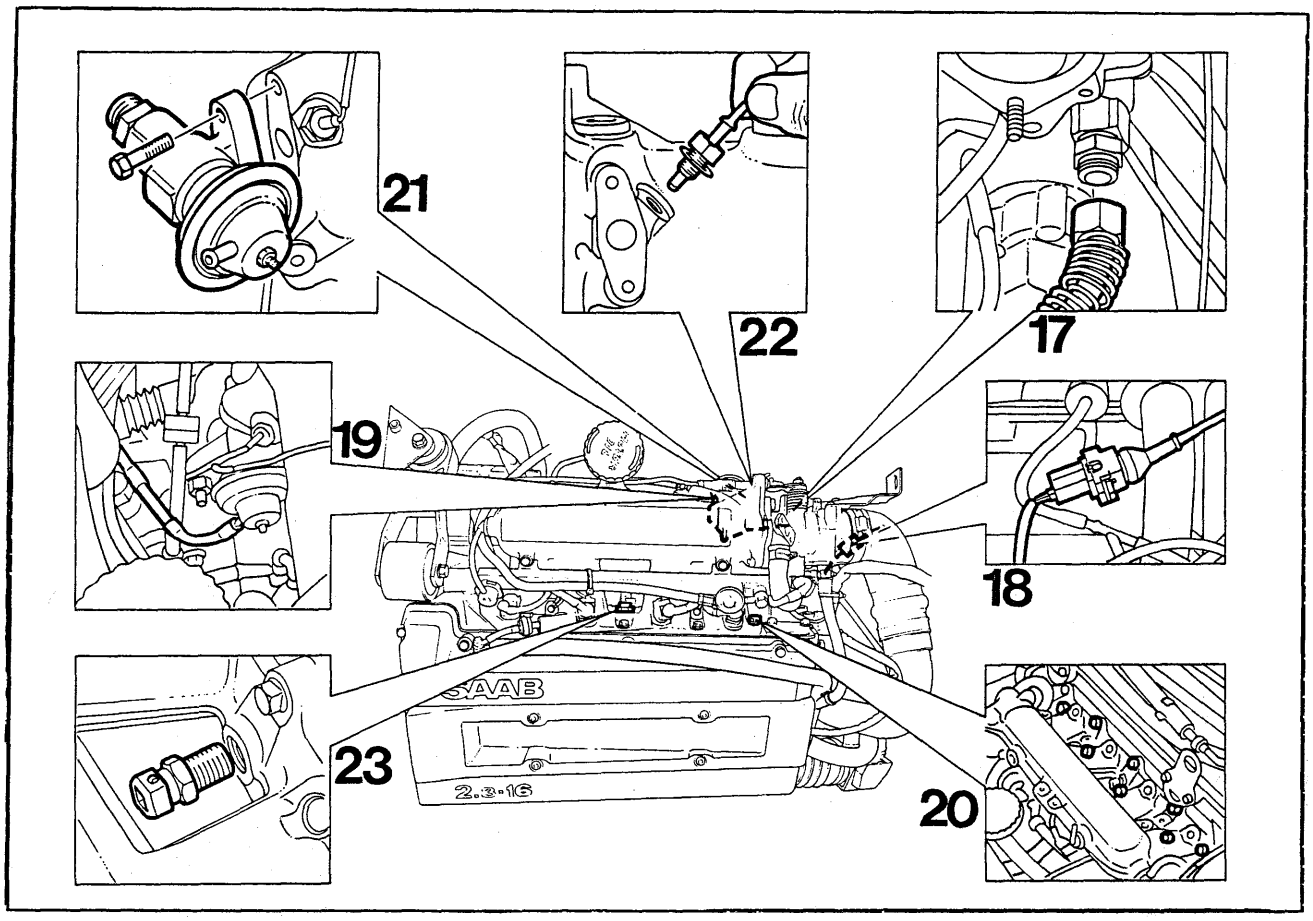
7. Undo the bracket securing the oil filler pipe to the inlet manifold.

8. Disconnect all vacuum hoses from the inlet manifold. Note the configuration of the hoses and, if necessary, mark them to ensure that they are reconnected to the correct ports.

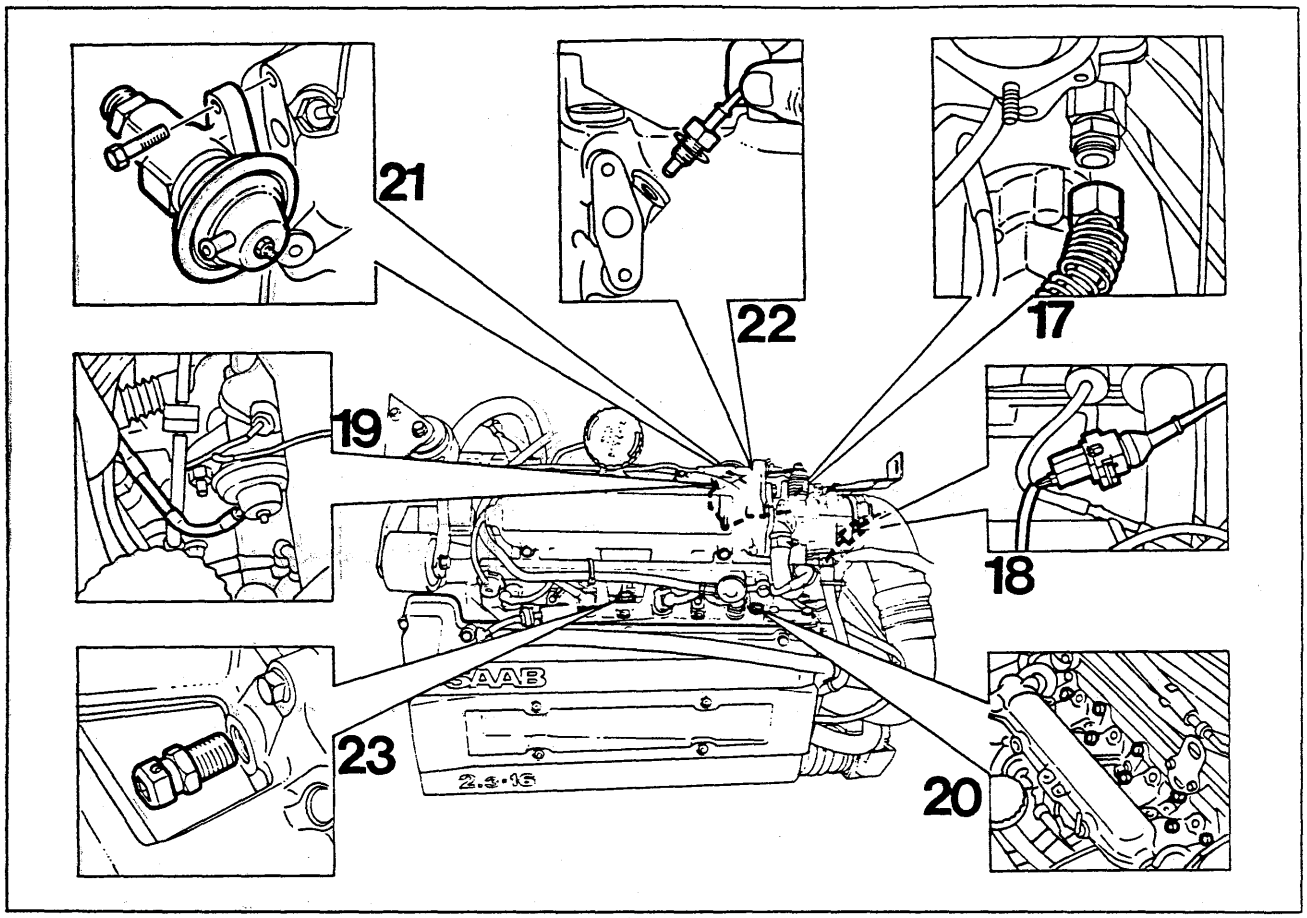
9. Undo and move aside the AIC valve from the mounting on the inlet manifold.

10. Disconnect the fuel hose from the fuel-pressure regulator. Catch any escaping fuel in kitchen paper or a rag.

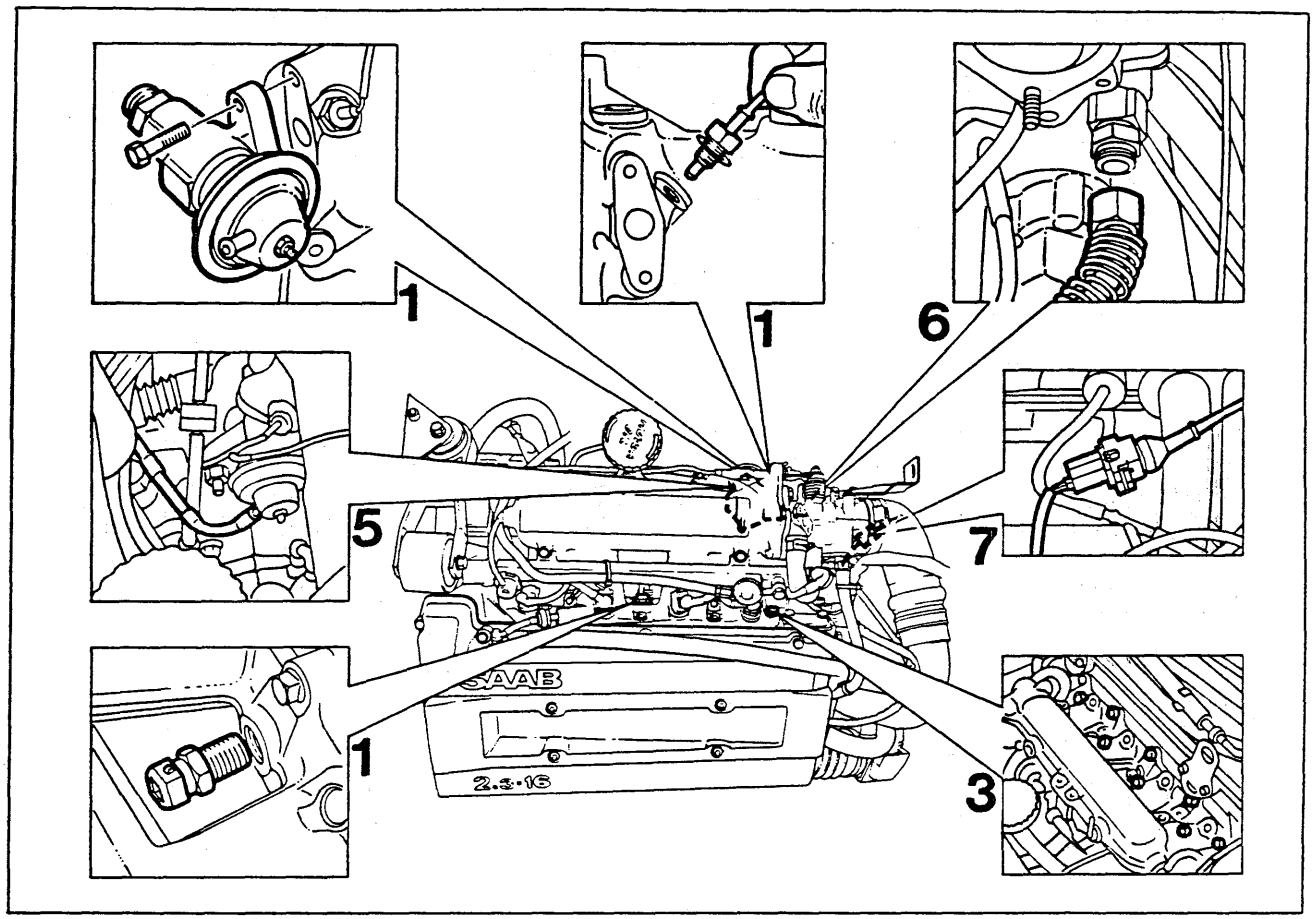
11. Undo the banjo fitting connecting the fuel hose and pulsator to the fuel-injection rail. Catch any escaping fuel in kitchen paper or a rag. Take care not to lose the seals. Snip through the tie and tuck the fuel hose and pulsator up against the false bulkhead panel.



12. Unplug the connectors from the injectors.
13. Undo the securing bolts and lift off the fuel-injection rail complete with injectors.
14. Unplug the connector from the temperature sensor.
15. Disconnect the leads from the earthing point on the inlet manifold.
16. Undo the cable clip underneath the inlet manifold (2 screws) and move the leads and connectors away from the inlet manifold.



17. Disconnect the EGR pipe.
18. Unplug the connector for the EGR-system temperature sensor.
19. Disconnect the red-marked hose from the EGR valve.
20. Undo the eight securing bolts and lift off the inlet manifold.
21. Remove the EGR valve from the inlet manifold.
22. Remove the EGR-system temperature sensor.
23. Remove the coolant-temperature sensor.
24. Remove the rubber bushes (if necessary) and the spigots from the vacuum ports.



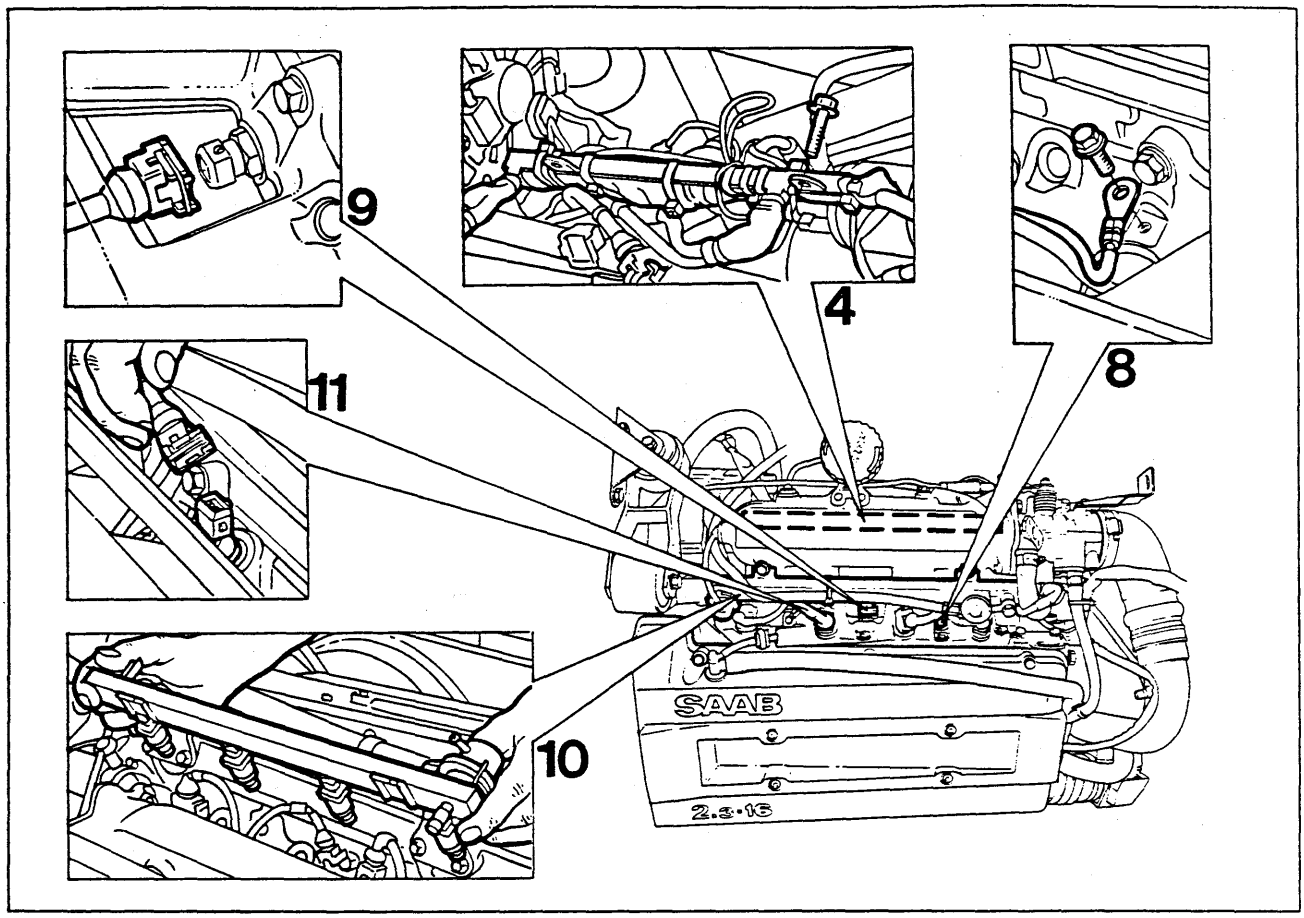
To fit

Make sure the flanges are clean before fitting the inlet manifold.

1. As applicable, fit the rubber bushes and spigots for the vacuum hoses, the temperature sensors (coolant & EGR) and the EGR valve complete with new gasket.
2. Fit a new cylinder-head gasket.
3. Fit the inlet manifold and tighten the head bolts.

Tightening torque:
22 Nm (16 lbf ft)

4. Secure the wiring loom with connectors and tighten the clip on the underside of the inlet manifold.
5. Reconnect the red-marked hose to the EGR valve.
6. Reconnect the EGR pipe.
7. Plug on the connector for the EGR-system temperature sensor.



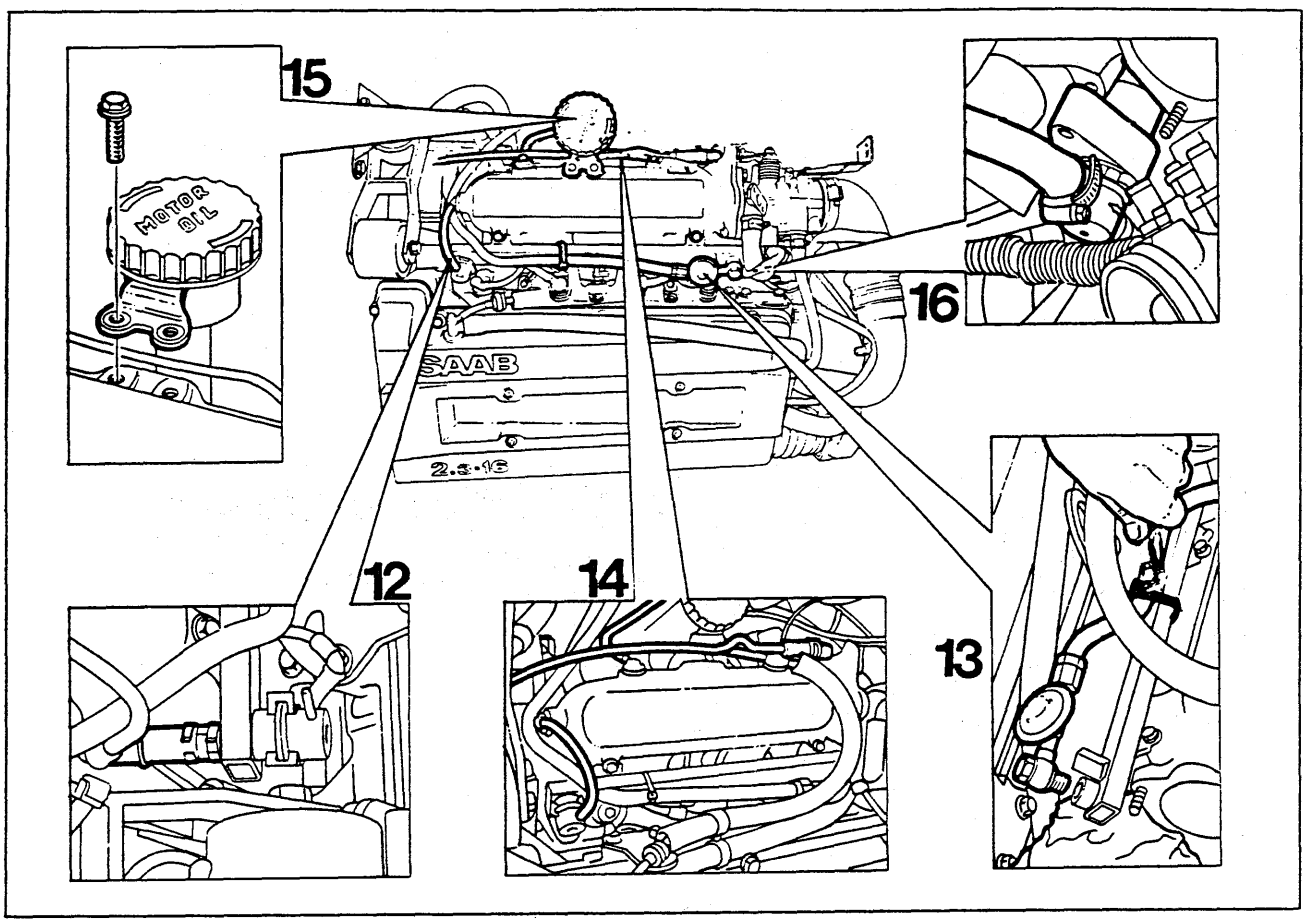
8. Reconnect the leads to the earthing point.

9. Plug the connector onto the temperature sensor.

10. Apply a dab of Vaseline onto the O rings for the injectors. Fit the fuel-injection rail complete with injectors onto the inlet manifold.

    Tighten the bolts.

11. Plug the connectors onto the injectors.



12. Connect the fuel hose to the pressure regulator.

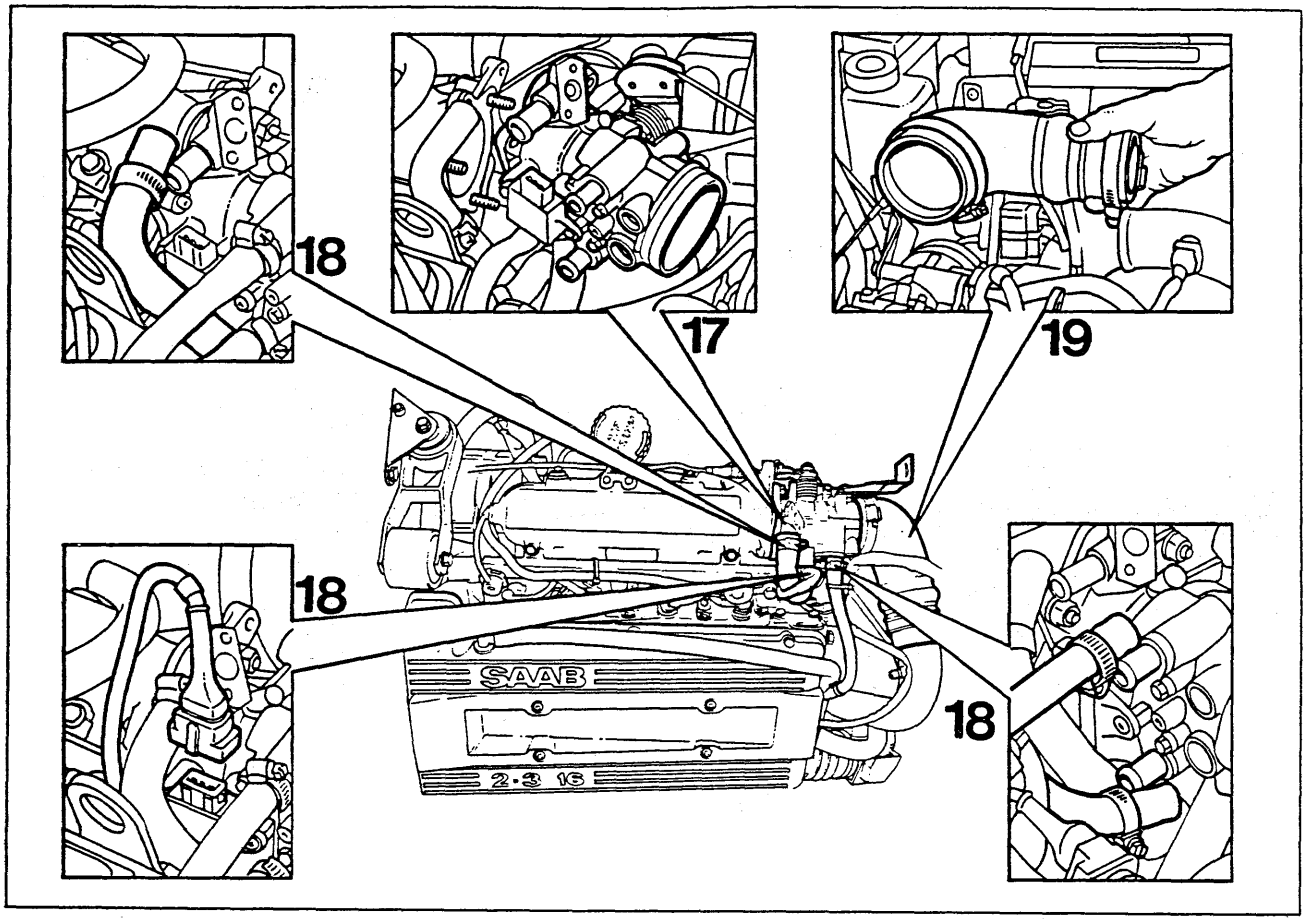
13. Connect the fuel hose with pulsator to the fuel-injection rail.

    Use a tie to secure the fuel hose to the fuel-injection rail.

14. Reconnect the vacuum hoses to the inlet manifold.

15. Refit the oil filler-pipe bracket to the inlet manifold.

16. Position the AIC valve correctly on the locating pin in the inlet manifold.



17. Check that the seal for the throttle housing is in good condition and correctly positioned. Refit the throttle housing.

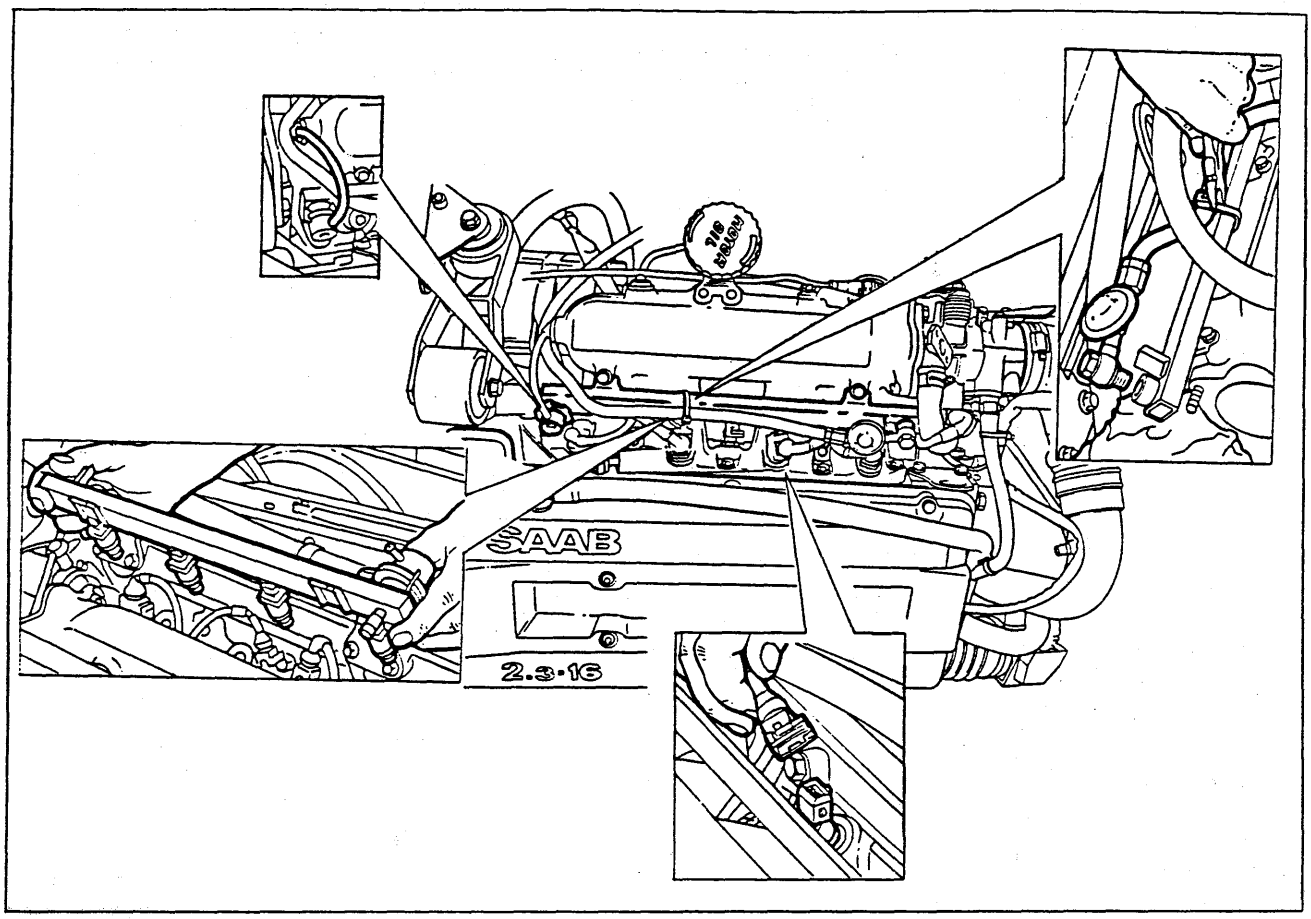
18. Reconnect the following to the throttle housing:

    - AIC hose
    - Coolant hoses
    - Connector for throttle-position sensor (throttle potentiometer)

19. Fit the rubber elbow between the throttle housing and turbo delivery pipe.

20. Refill the cooling system to the correct level.

21. Check that the engine is running properly and inspect all connections for leaks.



Fuel-injection rail

To remove

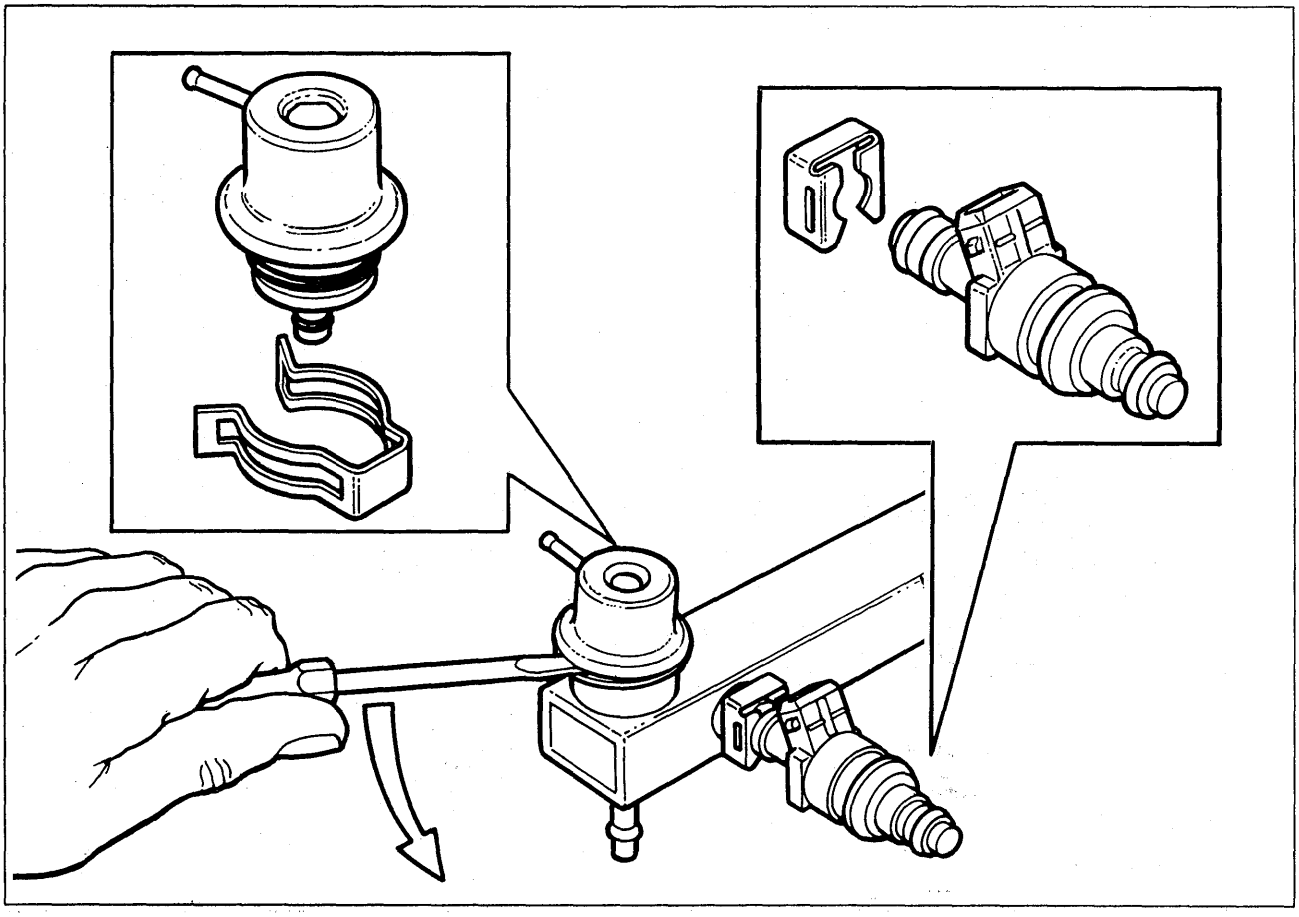
1. Disconnect the fuel-return line from the fuel-injection rail.
   Soak up any escaping fuel by means of a rag or kitchen paper.
2. Disconnect the pulsator from the fuel-injection rail, snip through the tie and tuck the fuel line and pulsator out of the way.
3. Disconnect the vacuum hose from the fuel-pressure regulator.
4. Unplug the connectors from the injectors.
5. Undo the bolts and lift off the fuel-injection rail complete with injectors.

To fit

1. Apply a dab of Vaseline onto the O rings for the injectors. Fit the fuel-injection rail complete with injectors onto the inlet manifold.

   Tighten the bolts.
2. Plug the connectors onto the injectors.
3. Connect the vacuum hose to the pressure regulator.
4. Connect the fuel hose with pulsator to the fuel-injection rail.

   Use a tie to secure the fuel hose to the fuel-injection rail.
5. Connect the fuel-return line to the fuel-injection rail.
6. Check that the system is working properly and inspect all connections for leaks.



Fuel-pressure regulator

To remove

1. Clean the area around the regulator and disconnect the vacuum hose.
2. Remove the clip.
3. Ease off the regulator using a screwdriver.

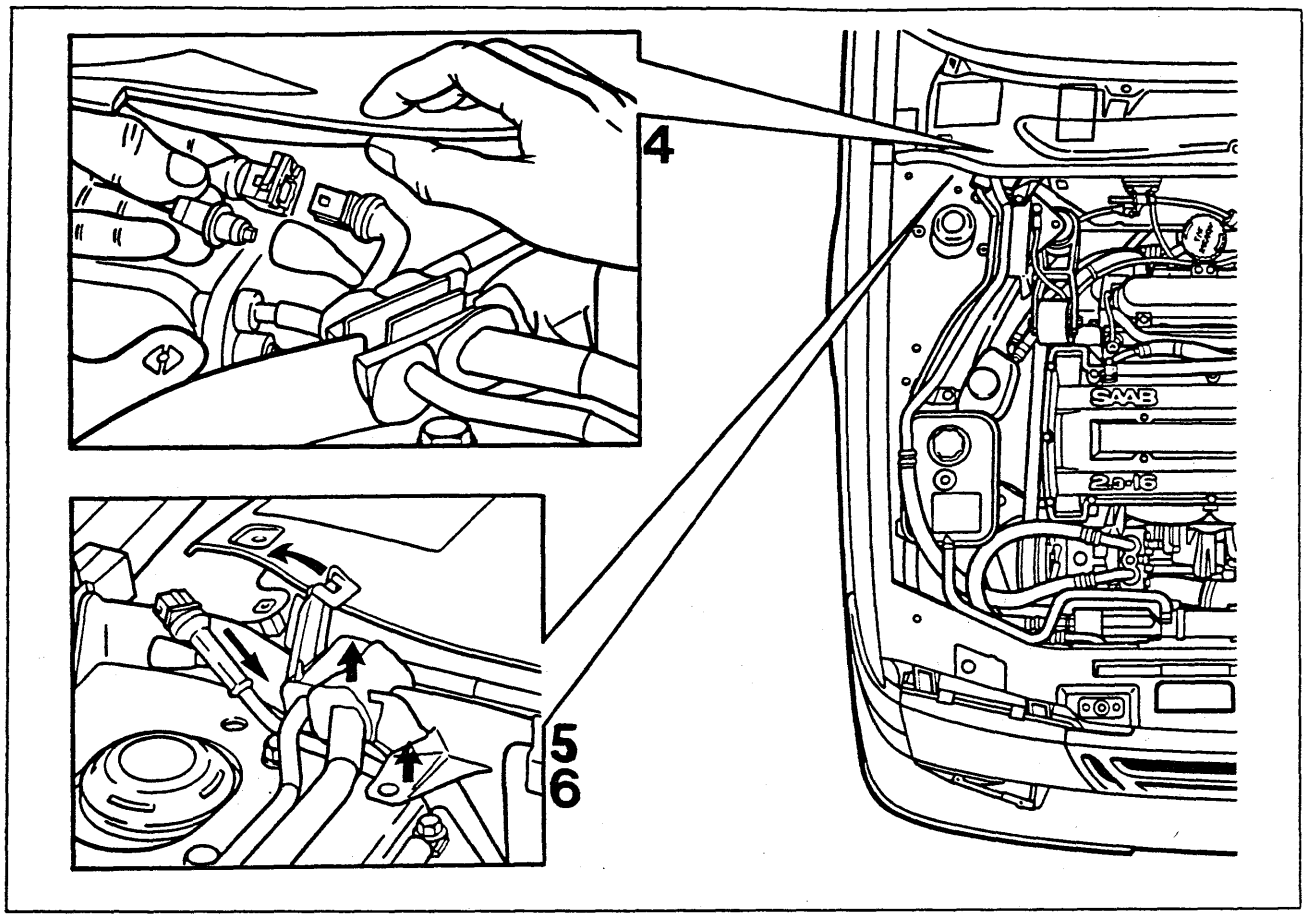
To fit

1. Inspect the O rings and replace any that are damaged. Lubricate them lightly with Vaseline and refit the regulator.
2. Fit the clip.
3. Reconnect the vacuum hose.
4. Check that the system is working properly and inspect all connections for leaks.

Injectors

To replace the injectors, follow the procedure on page 15.

Remove the clips and injectors as shown.



Lambda sensor

Note
The procedure described below may seem to be more involved than necessary, since it is possible to unscrew and screw in the sensor without disconnecting the wiring.

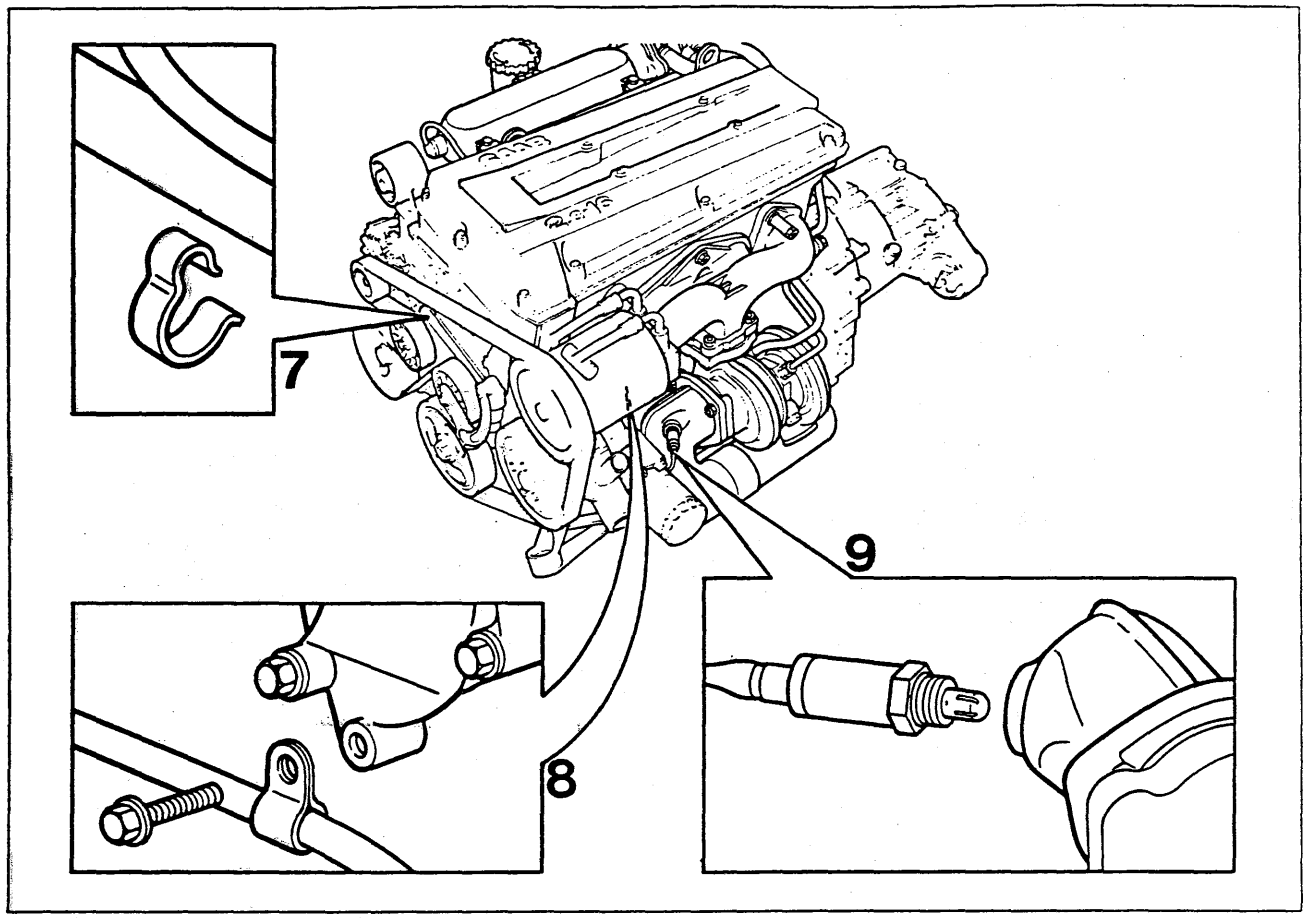
Doing so, however, is very likely to damage the system.

To remove

1. Unscrew (four or five screws) the cover on the RH side over the false bulkhead panel.
2. Undo the bolt securing the AC pipe and steering servo reservoir.
3. Undo the securing bolts for the false bulkhead panel.
4. Raise the cover and unplug the connectors.
5. Raise the plastic clip and AC pipes, and withdraw the lead complete with connector.
6. Raise the bulkhead panel slightly and continue withdrawing the lead.
7. Undo the two clips securing the lead to the coolant pipe.
8. Undo the cable clip at the lower fixing bolt for the AC bracket.
9. Remove the Lambda sensor.

To fit

Refit in reverse order.



Exhaust pipe front section

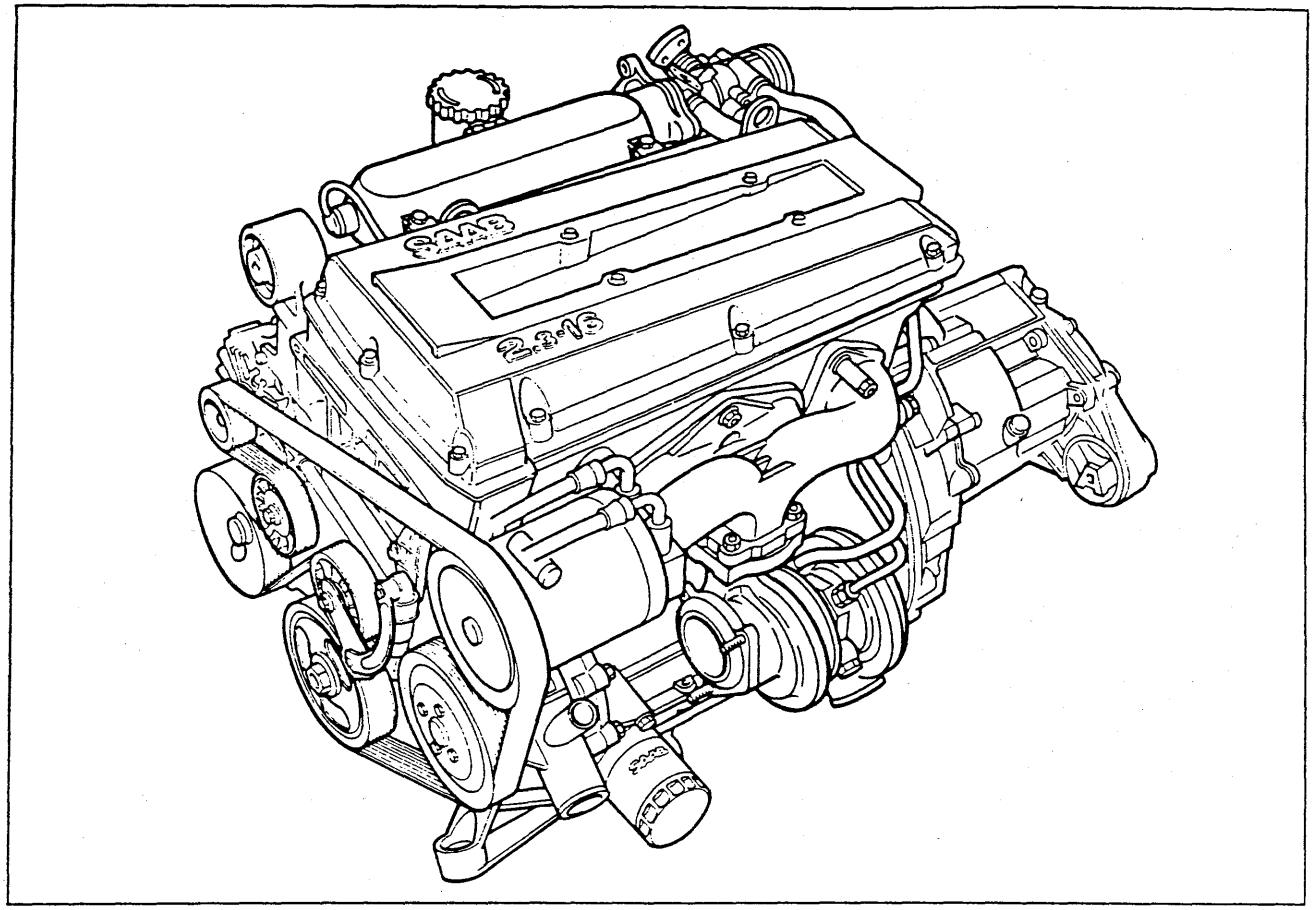
To remove

1. Remove the Lambda sensor (see page 17).
2. Apply penetrating oil to the stud threads and remove the nuts securing the pipe to the turbo unit.
3. Undo the nuts securing the exhaust pipe to the silencer.
4. Release the pipe from the rubber hanger and remove the pipe.

To fit

1. Lift the exhaust pipe into position, secure it to the silencer and hook on the rubber hanger.
2. Connect the pipe to the turbo unit and tighten the nuts.
3. Refit the Lambda sensor.
4. Check for leaks.

B234 engine in all US-spec. 9000



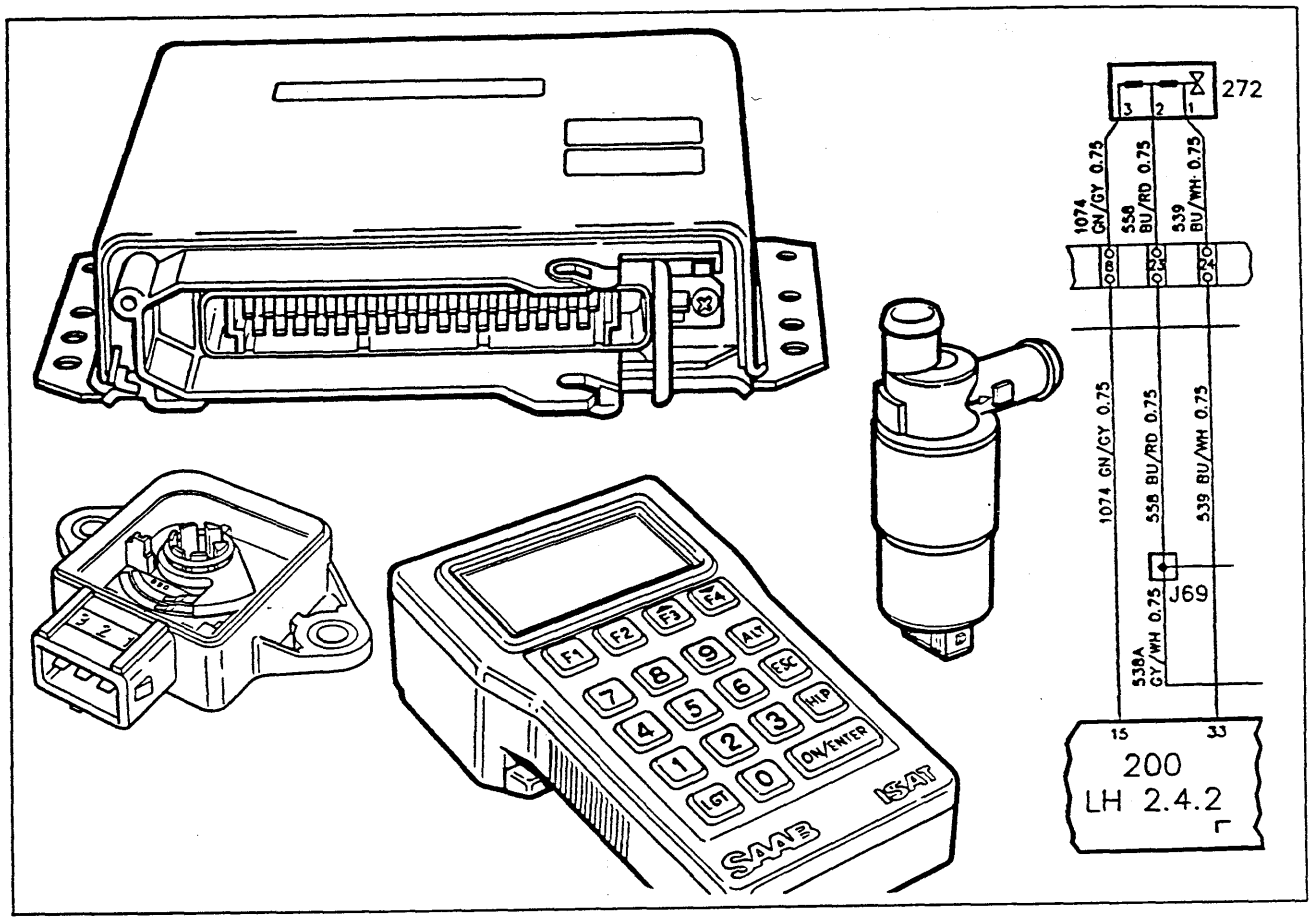
As from M91, all 9000-series cars for the US are equipped with the B234 engine, in either the normally aspirated or turbo variant.

Electronic EGR discontinued on B234 Turbo (UC)

To meet the strict exhaust-emission regulations in California, an electronic EGR system was introduced on certain M90 US-spec. cars with, e.g. B202 Turbo engines.

However, it has now been established that the basic engine comfortably meets the relevant emission criterion (0.40 g/mile NO) without EGR, which is why the EGR system has been discontinued on B234 Turbo engines as from M91.

LH 2.4.2 Fuel-injection system



LH 2.4.2 is fitted to all B234 engines.

The most important changes to the new LH 2.4.2 system are the expanded ISAT diagnostics function, made possible by a new ECU, and the replacement of the throttle-position sensor by a throttle potentiometer.

A new AIC valve has also been introduced.

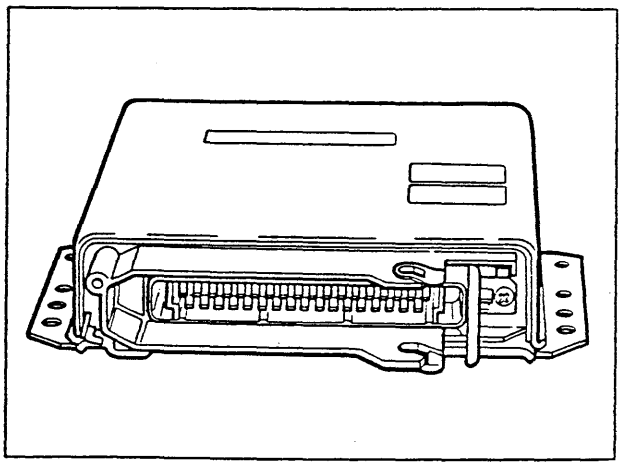
LH-system ECU

The ECU for the LH 2.4.2 has been upgraded for system changes in the form of modified components, and has also been reprogrammed to modify the control of a number of other functions.

Activation of the Lambda sensor on cold-starting is now controlled by time rather than temperature as before. This means that the theoretical limit at which control can be initiated has been lowered from 16°C to 0°C.

Cut-in of the AC is now controlled by the LH-system ECU.

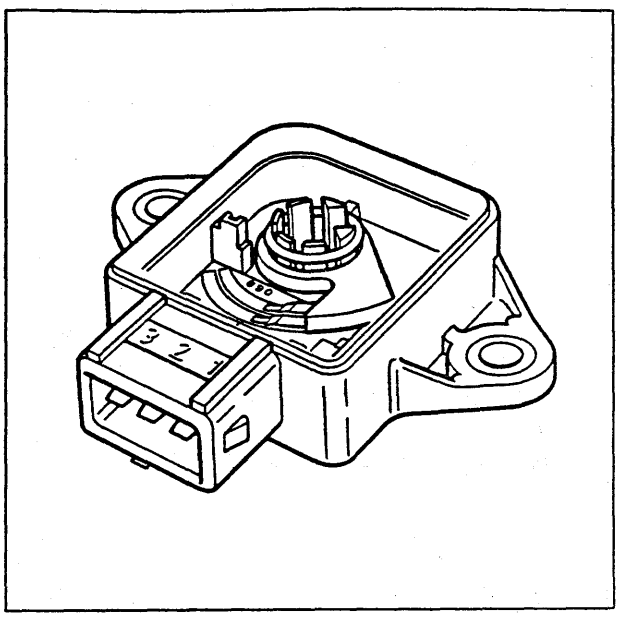
The AC relay has been discontinued.



Throttle potentiometer

The earlier throttle-position sensor has been replaced by a throttle potentiometer that sends a steplessly variable signal to the ECU, to provide information on the position of the throttle butterfly. This information is then used for a variety of functions, such as fuel shut-off.

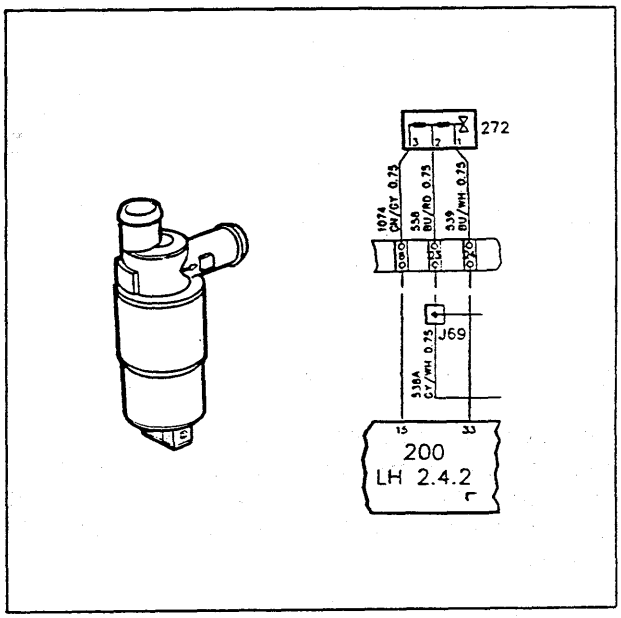
The throttle function is adaptive, which means that the ECU remembers which throttle signal corresponds to idling and which signal to full throttle. No manual adjustment is therefore necessary.



AIC valve

In contrast to earlier variants, the AIC valve now has two windings that work in opposition on a voltage drop, e.g. on cut-in of the AC, to allow the valve to be set partially open.

The valve is spring-loaded, so that in the event of a fault it will be put in the limp-home mode, to set an idling speed of about 850 rpm when there is no load on the engine.



ECU-pin nominal values (LH 2.4.2)

Pin no.	Cable colour [1]	Circuit	In	Out	Voltage, V	Remarks
1	BU	RPM signal from ignition system	x		6.5 >8	When starter operating On idling
2	GY	Throttle potentiometer	x		0.2 4.0	Idling Full throttle
3	GN/RD	Throttle-position signal to DI/APC (PWM)		x	1.0 10	Idling Full throttle
4	RD	+30 supply	x		Battery voltage	
5	BK	Signal earth			0	As distinct from chassis earth
6	BU/WH	Air mass meter earth signal	x		0	
7	OG	Air mass meter signal	x		2 5	Idling with engine running Full throttle with engine running
8	RD/WH	Air mass meter burn-off function		x	4 0	During burn-off All other times
9	GY/WH	Feed from system relay	x		Battery voltage	
10	GN/RD	Throttle potentiometer, nominal		x	5	
11	GN/RD	AC relay control circuit		x	Battery 0	AC off AC on
12	BU/WH	Diagnostics lead K (PWM)	x	x		
13	YE	Temperature sensor, engine	x		4–0.5	-20°C to +80°C
14	GN/WH	AC/ACC load signal	x		12 0	AUTO*) ECON OFF
15	GN/GY	AIC opening control signal		x	7–11	Load-free idling; normal engine temp
16	GY/RD	Diagnostics lead L	x	x		PWM signal
17	BK/WH	Chassis earth			0	
18	GN/RD	Injectors		x		Use ISAT pulse function to check that frequency increases as throttle opens
19	YE/WH	EGR valve		x	Battery <Battery	De-energized Energized
20	VT	Fuel pump relay control circuit		x	1 Battery	Energized Ignition on
21	YE/WH	System relay control circuit		x	1 Battery	Ignition on Ignition off
22	VT/WH	*CHECK ENGINE* light		x	Battery 1	Off On
23	YE	EGR temperature sensor		x	4.5 <4.5	EGR closed EGR open
24	GN	Lambda sensor signal	x		0.6–1.0 0–0.4	Rich Lean

Pin no	Cable colour [1]	Circuit	In	Out	Voltage, V	Remarks
25	BU/RD	*Tq* load signal		x		**)
26	WH	Shift-up light (US Manual)		x	Battery 0	De-energized Energized
27	YE/RD	Tank breather valve		x	Battery 1	Valve open Valve closed
28	WH	PRE-IGNition signal	x		0 6.5 12	Fuel boosting on PRE-IGN No boosting Fuel boosting on knocking
29	GY/WH	Coding	x			Not used
30	OG	DRIVE signal	x		Battery 0	R, D, 1, 2 & 3 P, N & manual gearbox
31	GN/RD	Fuel-consumption signal to EDU3		x		***)
32		Cold-start valve (where applicable)		x	Battery 0	De-energized Energized (<-15°C)
33	BU/WH	AIC closing control signal		x	5–11	Idling, load-free
34	GN	Signal from speed sensor	x		6 0 or 12	Wheels turning Wheels stationary
35	GN/WH	+15 feed	x		Battery	Ignition on

*) *Only if anti-frost thermostat closed*

**) *Use ISAT pulse function to check that pulse width and frequency change with throttle setting*

***) *Use ISAT pulse function to check that frequency of fuel-consumption signal changes as throttle-setting changes.*

1) *New cable-colour codes have been introduced as from M91. See the table on page 24.*

New cable-colour codes

New cable-colour coding has been introduced on M91.

Code	Colour
BK	Black
BN	Brown
BU	Blue
GN	Green
GY	Grey
OG	Orange
PK	Pink
RD	Red
VT	Violet
WH	White
YE	Yellow

Fault diagnosis on LH 2.4.2

Additional fault and command codes

There are a number of new fault codes for the LH 2.4.2 system on M91 that can be read off using ISAT.

The number of command codes has also been increased, bringing the total to more than 20.

The fault-code and command-code tables on the following pages show all the available codes.

Note that all fault codes that start with a 4 or a 5 indicate permanent faults, and those starting with a 2 or a 3 faults of a transient or intermittent nature.

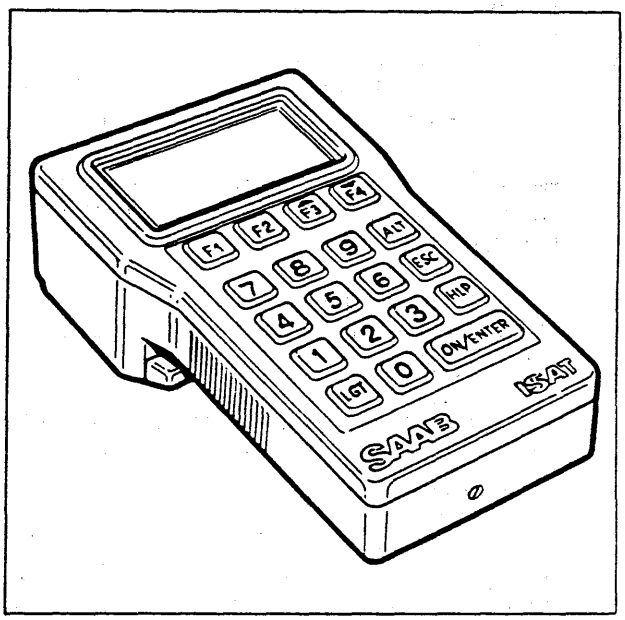
Fault diagnosis using ISAT

Before starting fault-diagnosis work

Successful fault diagnosis on the LH system requires not only in-depth knowledge of the system on the part of the technician but also access to ISAT.

Thanks to the self-diagnostics incorporated in the LH system, which continuously monitors and records the majority of conceivable faults, be they permanent or intermittent, it is easy using ISAT to pinpoint a fault, rectify it and then check that the system is functioning properly again.

This integrated self-diagnostics function in the system not only makes for quicker fault-diagnosis work but, above all, much more reliable diagnosis. It is therefore far less likely that a sound component will be replaced, having mistakenly been adjudged faulty, and service costs should benefit considerably as a result.



ISAT is a valuable aid to efficient, reliable diagnosis.

Is the fault in the LH system?

Many so-called fuel-injection faults can often be traced to other unrelated engine or electrical faults. Before starting any fault-diagnosis work on the LH system, therefore, always check the following first:

- Battery condition
- Engine condition
- Charging system
- Auxiliary systems
- Electrical connections
- Earthing points
- Ignition system

Points to note

1. When fault-diagnosis work is being done on microprocessor-based systems, some elements of the memory can become corrupted and hence generate abnormal symptoms. To clear all such systems, switch the ignition off for at least 35 seconds.

2. Always read off and note down all stored fault codes before disconnecting the battery or ECU. Never disconnect the ECU with the ignition on, as this can damage the ECU circuitry.

3. Before tracing faults on a vehicle's electronic systems, always start by checking that the earthing circuits for the ECU concerned are good and that all nominal voltage levels are correct.

4. Check all plugs and connections before fault-finding elsewhere in a system. Unplug connectors and plugs to check that the pins are undamaged and not loose. After checking, plug in all connectors and clear all fault codes. Start the engine or drive the car again to check whether the fault or faults persist.

5. When first detected, a fault will be assigned a permanent-fault code. If the fault later disappears, the fault will be classified as intermittent.

6. All signals around the 12-volt level are proportional to battery voltage. These levels must therefore be taken only as a rough guide.

7. Zero-voltage signal levels indicate earth, although a sensitive multimeter may indicate a value slightly above 0 V.

8. Voltage measurements on inputs or outputs must only be made with the ignition on or the engine running.

9. The diagnostics socket (black) is located underneath the RH front seat. The socket is protected by a plastic cover held in place by means of a bayonet-type screw fastener.

10. During fault diagnosis, the ignition switch must always be in the Drive position.

11. The ISAT system number for the LH system is #1.

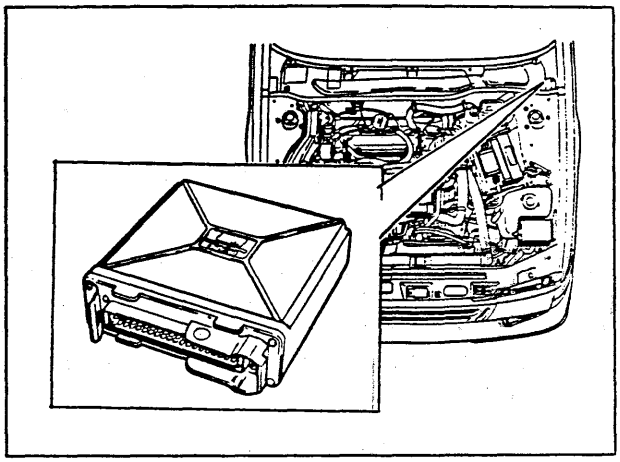
12. If communication cannot be established between ISAT and the ECU, start by checking the leads from ECU pins 12 & 16 and the diagnostics socket (347). Check also that the power feed and earth circuits to the diagnostics socket are good and that the connector pins are not damaged.

13. Once the fault codes stored in the system's ECU have been transferred to ISAT, the diagnosis function is finished. The faults are displayed in the form of five-figure codes; subsequent fault-diagnosis work should follow the recommended test procedure detailed in the fault-diagnosis chart.

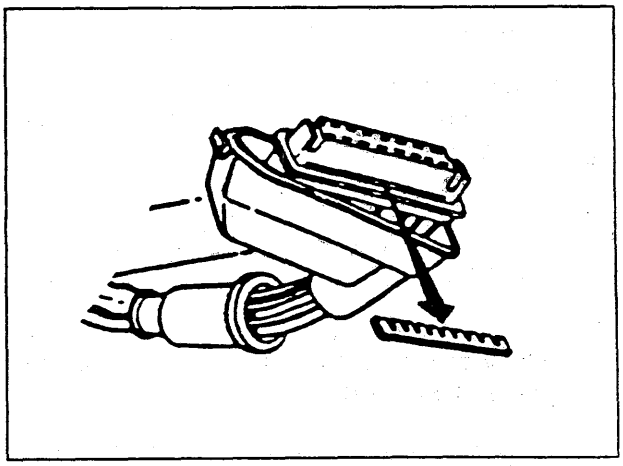
Connecting test probes to the ECU connector

Before starting any fault-diagnosis work on the LH system, you must first gain access to the ECU connector block. Test probes and the like must be connected to the back of the wiring-loom half of the connector.

1. Remove the ECU, located behind the false bulkhead panel.



2. Unplug the connector.
3. Undo the cover and peel back the rubber gaiter.
4. Pull out the rubber seal and remove the connector block.



5. Plug in the connector.

Checking the wiring

The words, 'Check the wiring between xx and yy', are used frequently in the fault-diagnosis charts. Sometimes the wiring may be run through different types of connector and, by implication, these must also be checked for circuit continuity and short circuiting.

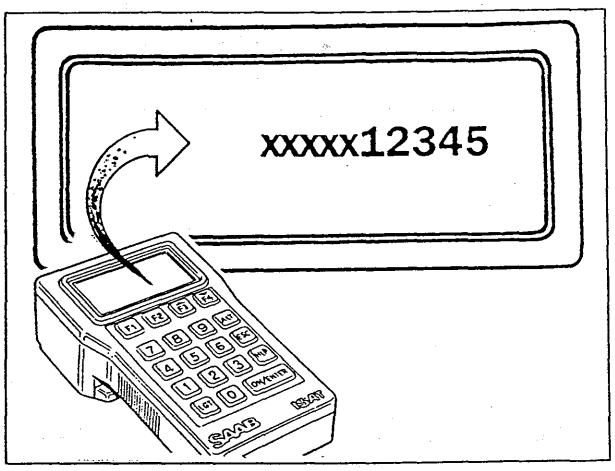
Also make a visual check to ensure that there is no damage to wiring or connectors.

Be alert to the possibility of crosstalk or interference from other components.

ISAT command codes

When ISAT command codes are being used to simulate signals or functions, the resulting readings on the display are in the form of an alphanumeric code.

The code has five character positions.



Reading on ISAT display in form of five-character alphanumeric code.

Example 1:

To check the position of the throttle butterfly, we enter command code 201 on the ISAT keypad.

With the engine idling, the last five characters on the ISAT display should be 8B101.

Example 2:

Sometimes we want to know if a signal is high or low. To check the DRIVE signal, we enter command code 203 via the ISAT keypad.

If the signal is not activated, code 8B000 will be displayed, indicating that the signal level is low. If the signal is activated, 8B103 should be displayed, indicating a high signal level.

Fau lt codes for LH 2.4.2

Permanent fault	Intermittent fault	Malfunction indicated	Action, see page:
42 241	22241	M91 onwards: voltage high, over 16 V	32
42 251	22251	ECU pin 4, signal low (below 1 V)	32
42 252	22252	M91 onwards: signal low, below 10 V	32
42 291	22291	Battery voltage below 10 V or over 16 V	32
42 440	22440	Mixture rich: no control by Lambda sensor	33
42 441	22441	M91 onwards: mixture rich on idling	33
42 442	22442	M91 onwards: mixture rich on driving	33
42 450	22450	Mixture lean: no control from Lambda sensor	33
42 451	22451	M91 onwards: mixture lean on idling	33
42 452	22452	M91 onwards: mixture lean on driving	33
424 60*	22460*	Lambda-sensor signal faulty	33
42491	22491	Mixture incorrect on idling	33
42492	22492	Mixture incorrect on driving	33
44221	24221	M91 onwards: speed signal absent	35
44261	24261	M91 onwards: road-speed sensor signal faulty	36
44671	24671	M91 onwards: PRE-IGNition signal longer than 20 s	37
45641*	25641*	M91 onwards: air mass meter signal high	38
45651*	25651*	M91 onwards: air mass meter signal low	38
45691*	25691*	Air mass meter signal faulty (too high or too low)	38
45723	25723	DRIVE signal, function faulty	40
45771*	25771	Throttle potentiometer indicating idling during driving (constantly earthed)	41
45772*	25772	Throttle potentiometer indicating full throttle and idling simultaneously	41
46221*	26221	Temperature sensor indicating temperature below -90°C during driving (broken circuit)	43
46271*	26271	Temperature sensor indicating temperature above 160°C (constantly earthed)	43
46391	26391	EGR system function faulty (temp. low)	45
58121	38121	Air mass meter burn-off function absent	47
58321	38321	AIC valve function faulty	48
58322*	38322	ELCD valve function faulty	51
58371*	38371	Injector faulty	49
58372*	38372	M91 onwards: ELCD valve: broken circuit or shorting to earth	51
58382*	38382	M91 onwards: ELCD valve shorting to positive	51
67192*		ROM fault (ECU)	

*) *When this fault occurs, the CHECK ENGINE light will also come on.*

Command codes for LH 2.4.2

Code	Function/signal	Display text (example)
22A	Air mass meter signal	803.6 = 3.6 V 804.7 = 4.7 V
22B	Battery voltage	8010.6 = 10.6 V 8007.3 = 7.3 V
23A	EGR pulse ratio	80000 = 0% (valve closed) 80012 = 12% 80027 = 27%
100	All fault codes transferred	
200	Check status of AC	8B100 = activated 8B000 = not activated
201	Throttle-butterfly position	8B101 (= idling position) 8B001 (= normal position) 8B301 (= full-throttle position) 8B103 (= idling + full throttle)
202	ELCD valve status	8B002 (= open) 8B102 (= closed)
203	DRIVE signal status	8B103 (activated) 8B003 (not activated)
204	Gear indicator	8B104 = light on 8B004 = light off
205	Lambda sensor status	8B105 (lean) 8B305 (rich) 8B005 (de-energized)
206	PRE-IGNition signal*	8B106 = fuel boost on pre-ign 8B006 = fuel boost on knocking
207	Ignition pulses	8B007 (= pulses absent) 8B107 (= pulses present)
239	AIC pulse ratio	80035 = 35% 80043 = 43%
249	RPM	801000 = 1000 rpm 805500 = 5500 rpm
250	Coolant temperature	800-30 = -30°C 80+130 = +130°C
279	Throttle-butterfly angle (degrees)	e.g. 80030 = 30°
382	ECU code	(Four last figures of Bosch part no.)
550	Activate AC function	8A550 = activated
552	Activate injectors	8A552 (opening duration of 15 Hz or 1.5 ms)

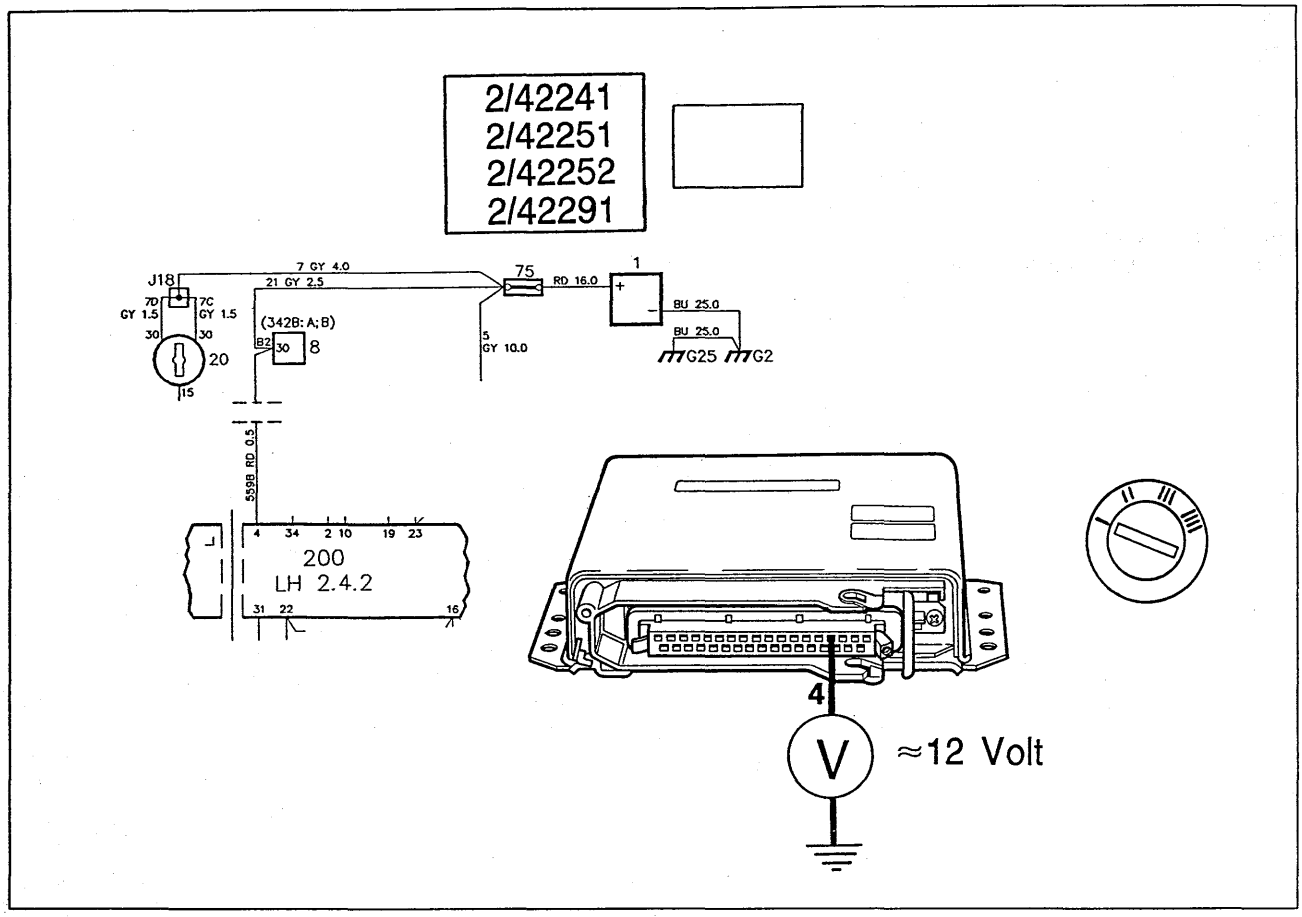
* *During normal operation, ISAT reading should alternate between 8B006 and 8B106*

Command codes for LH 2.4.2

553	Activate AIC (1 Hz)	8A553
554	Activate ELCD (1 Hz)	8A554 from ECU to ISAT
555	Activate EGR (1 Hz)	8A555 = activated (US–West only)
800	Terminate communications	
900	Clear all fault codes and reset all adaptive values to initial level	11111
930	Reset all adaptive values to initial setting	11011

Fault-diagnosis chart for LH 2.4.2

Fault codes 2/42241, 2/42251, 2/42252 & 2/42291



Malfunction indicated

Incorrect voltage level (below 10 V or above 16 V) at ECU pin 4.

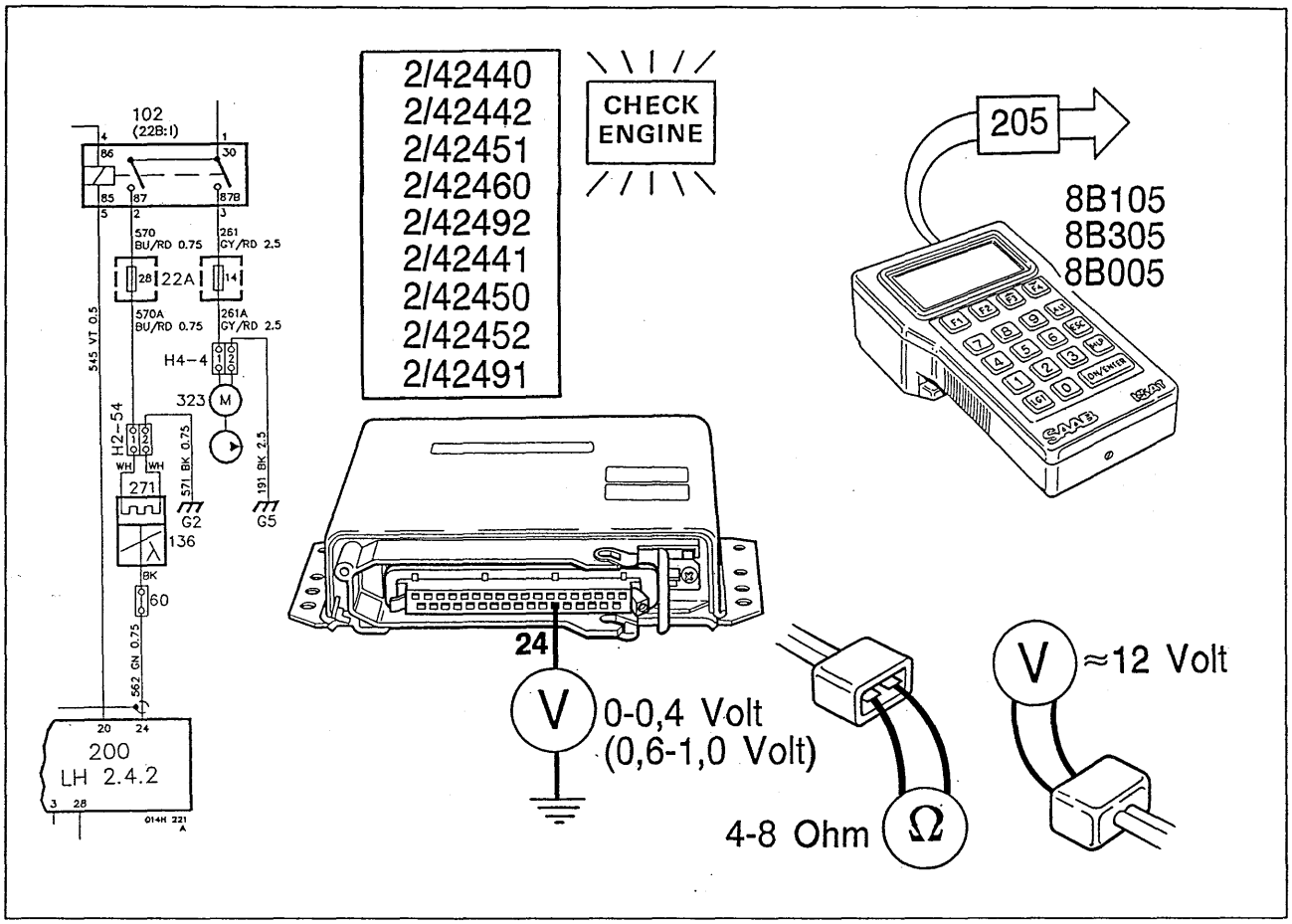
Fault symptom

Engine erratic of fails to start

Test procedure

1. Check the battery, starter motor and charging system.
2. With the ignition off, check that battery voltage is available at ECU pin 4. If not, check the RD lead and GY lead to terminal block 75 on the battery shelf.
3. Clean the following earthing points and check that they are tightened down:
   - Battery
   - Earthing point G2 behind the battery
   - Earthing point G25 on gearbox
   - Earthing point G7 on engine

Fault codes 2/42440, 2/42441, 2/42442, 2/42450, 2/42451, 2/42452, 2/42460, 2/42491 & 2/42492



Note
During the running-in period (up to 500 km) some of these fault codes may be generated even though no fault exists.
Double-check, therefore, after clearing the fault code, to see if it is generated again.

Malfunction indicated

Incorrect fuel-air mixture

Fault symptom

Engine lumpy due to rich or lean mixture.

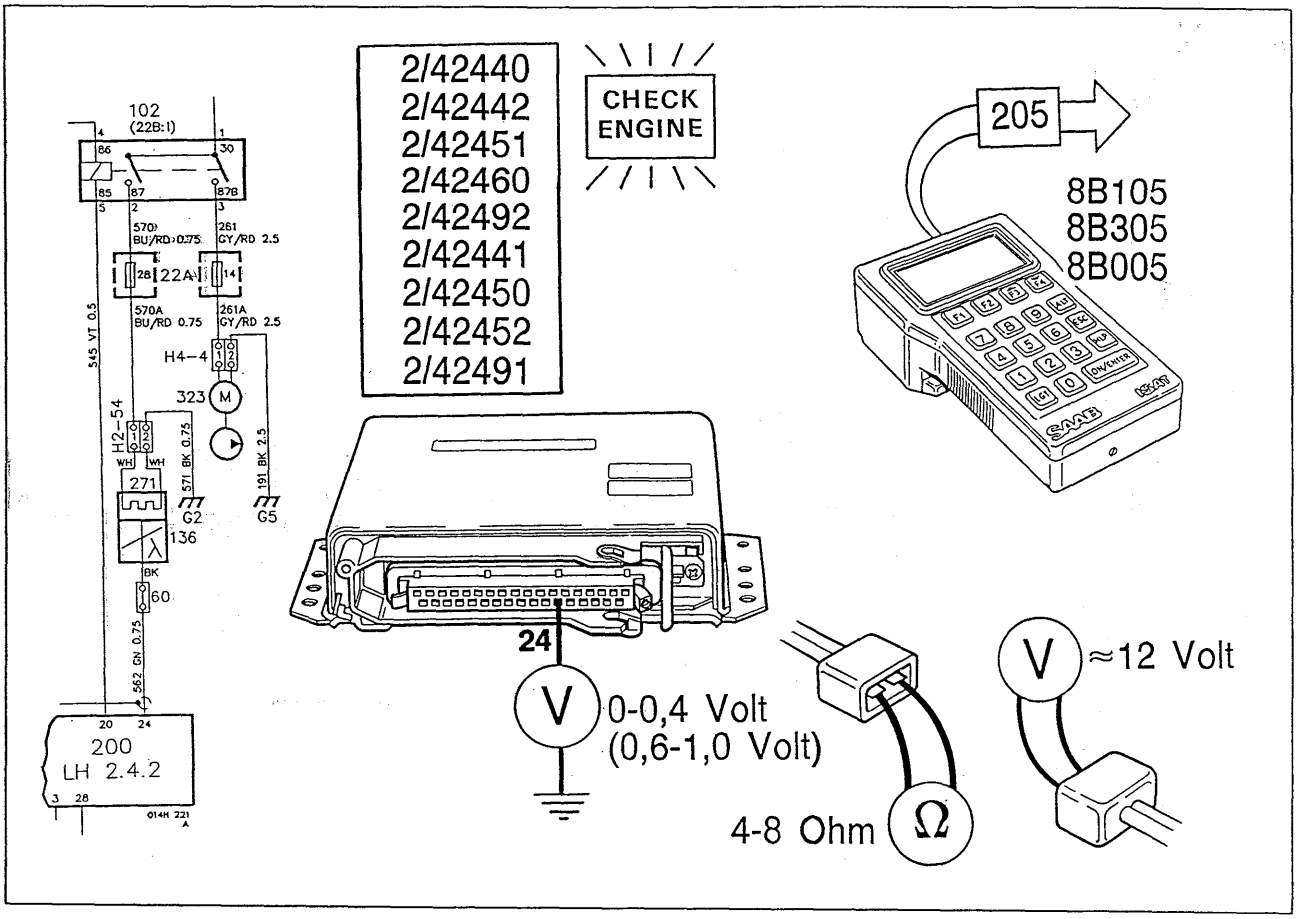
CHECK ENGINE light on.

Test procedure

1. With the engine at normal temperature, enter ISAT command code 205. The following codes should alternate on the display:
   - 8B105 (lean)
   - 8B305 (rich)
   - 8B005 (not activated)

   If any of these codes are displayed continuously, the Lambda sensor is faulty.

2. Check that battery voltage is available across the pins in the Lambda-sensor connector.
   If voltage available, go on to step 3.
   If not, check the following:
   - Lambda sensor fuse #28
   - The BU/RD lead between pin 1 of the Lambda-sensor connector and fuse #28 for broken or short circuit.
   - The BK lead between pin 2 of the Lambda-sensor connector and earth for broken or short circuit.



3. With the ignition off, unplug the connector for the Lambda-sensor preheating and measure the resistance across the sensor terminals (WH–WH).

   The resistance should be 4–8 ohm.

   If the circuit is broken or the resistance high, fit a new Lambda sensor.

4. Check for leaks in the induction system by listening.

5. Check the fuel pressure and operation of the fuel-pressure regulator.

   Relative to the depression in the inlet manifold, the fuel pressure should be:

   - 3.0 bar (all LH 2.4.2)

   If the fuel pressure is incorrect, fit a new regulator.

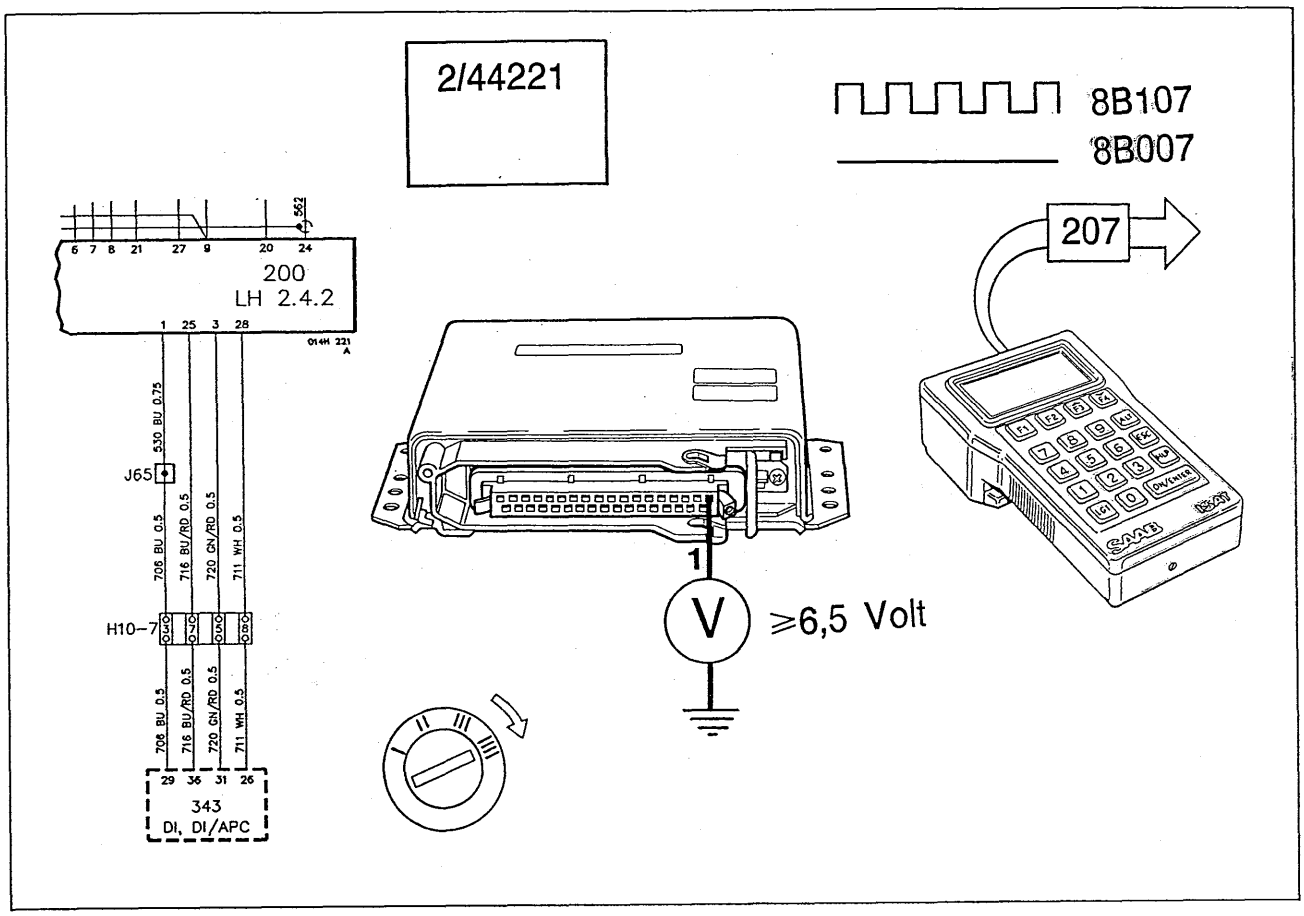
6. With the engine idling, measure the Lambda-sensor signal between ECU pin 24 and a reliable earthing point. The signal should alternate between 0 and 0.4 V (lean) or 0.6 and 1.0 V (rich) with the engine at normal temperature.

   If not, check the GN and the BK leads between ECU pin 24 and the Lambda sensor for a broken or short circuit.

7. If fault persists, fit a new Lambda sensor and check the function again by entering ISAT command code 205.

8. Try a known good ECU.

Fault code 2/44221



Malfunction indicated

No RPM signal from ignition system to ECU.

Fault symptom

Engine fails to start.

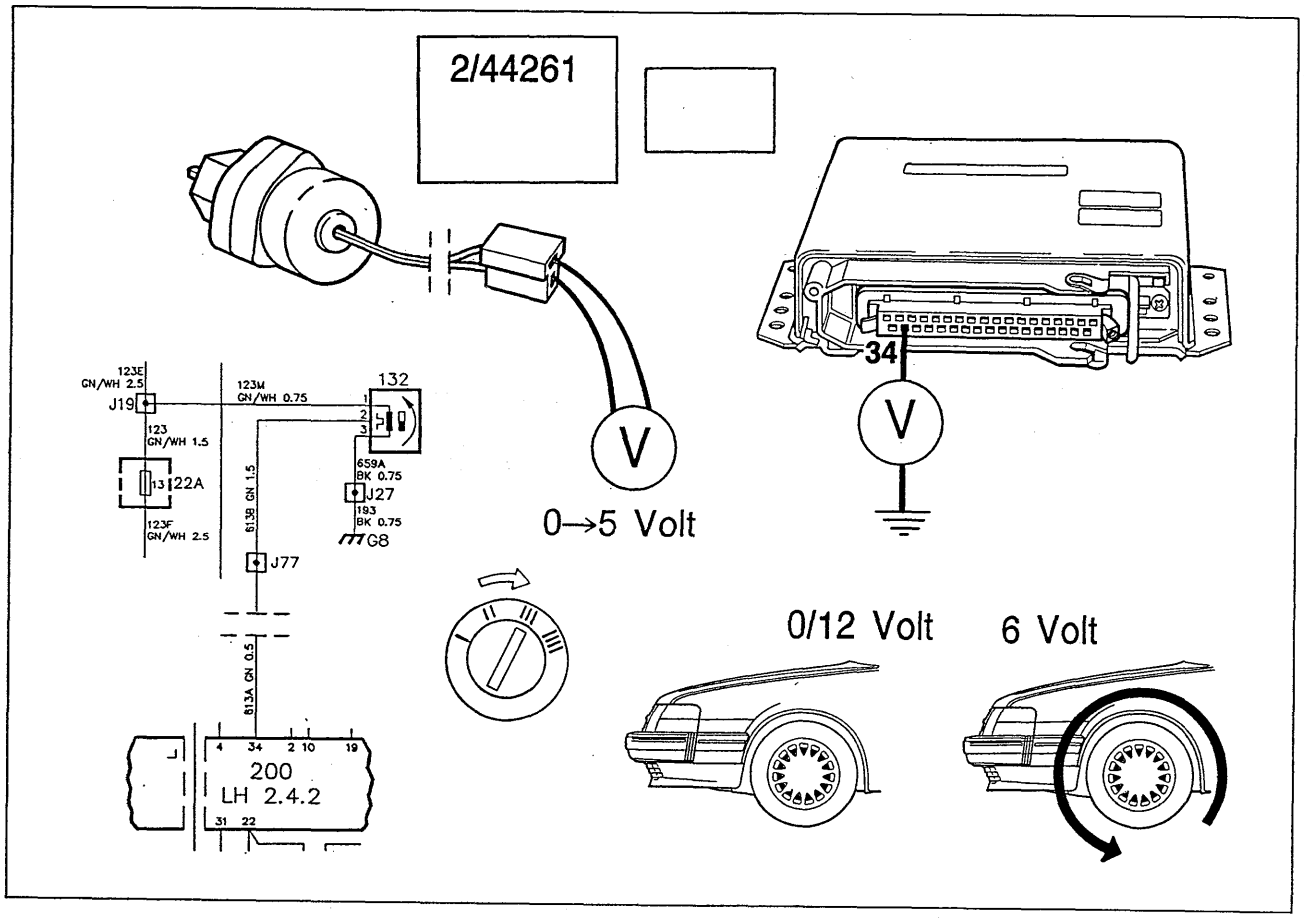
Test procedure

1. Check that the voltage reading at ECU pin 1 is above 6.5 V whilst the starter motor is running.

   If not, check the BU lead between LH-system ECU pin 1 and DI/APC-system ECU pin 29 for broken or short circuit.

2. If necessary, follow the test procedure detailed in the section on the DI/APC system.

Fault code 2/44261



Malfunction indicated

Signal from road-speed sensor incorrect or absent.

Fault symptom

Rough idling.

Test procedure

1. Check that the speedometer is working.

   If not, unplug the two-pin connector for the speedometer and measure the signal voltage from the speed sensor on the gearbox. The multimeter must be set to measure alternating current (a.c.).

   The signal level should rise as the speed increases, and should be between 0 and 5 V.

2. Check that the EDU, which also receives a road-speed signal, is working properly.

   If not, check that pin 1 of the speedometer is live and that pin 3 is earthed.

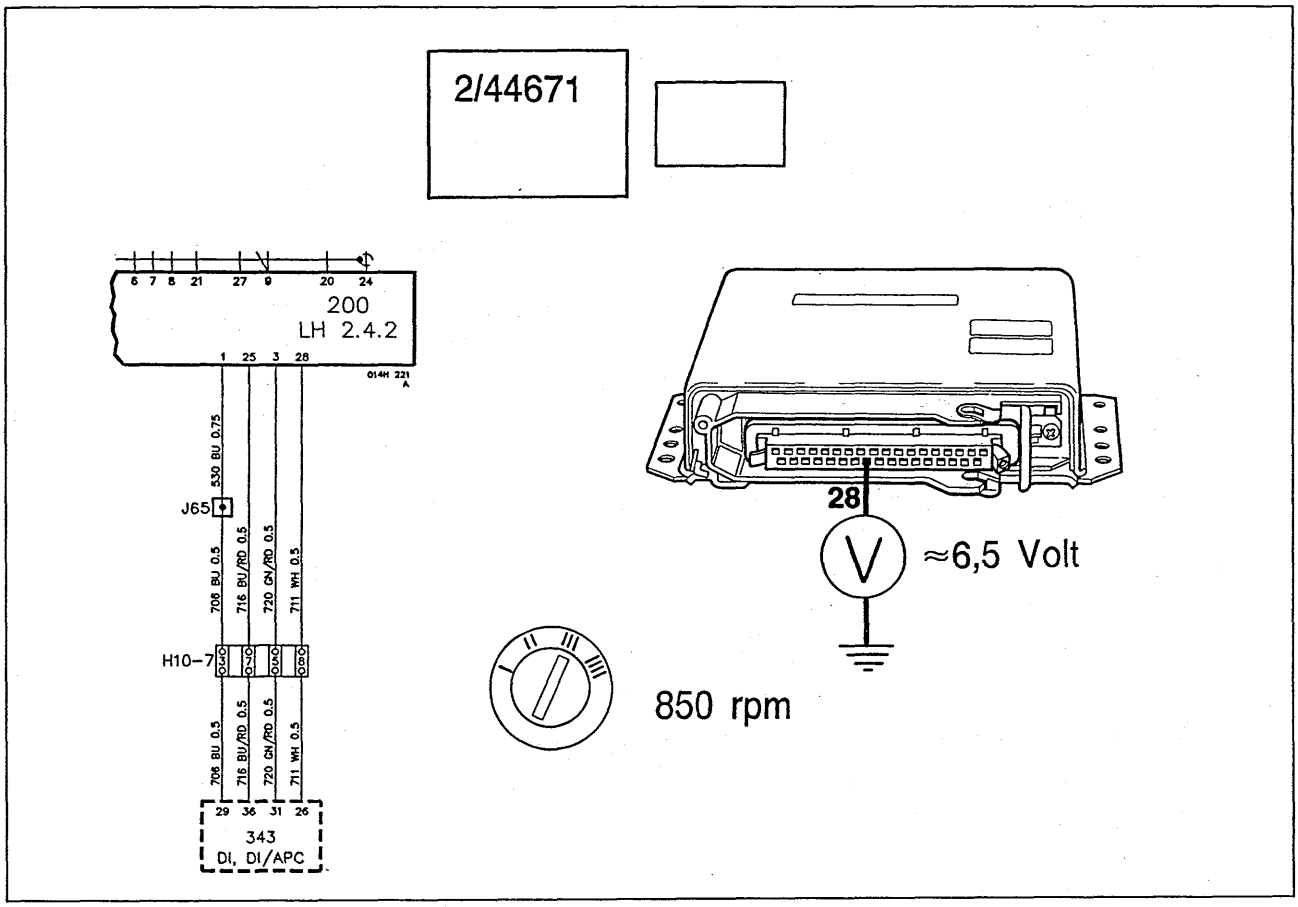
3. Check the GN lead between the speed sensor (132) and pin 34 of the LH-system ECU for broken circuit or circuit shorting to earth.

4. Check the speed pulses to ECU pin 34 with the wheels alternately rotating and static.

   With the wheel stationary, the signal level should be 0 or 12 V (depending on the position). The level for a rotating wheel should be approximately 6 V.

5. Try a known good LH-system ECU.

Fault code 2/44671



Malfunction indicated

Duration of PRE-IGNition signal longer than 20 seconds.

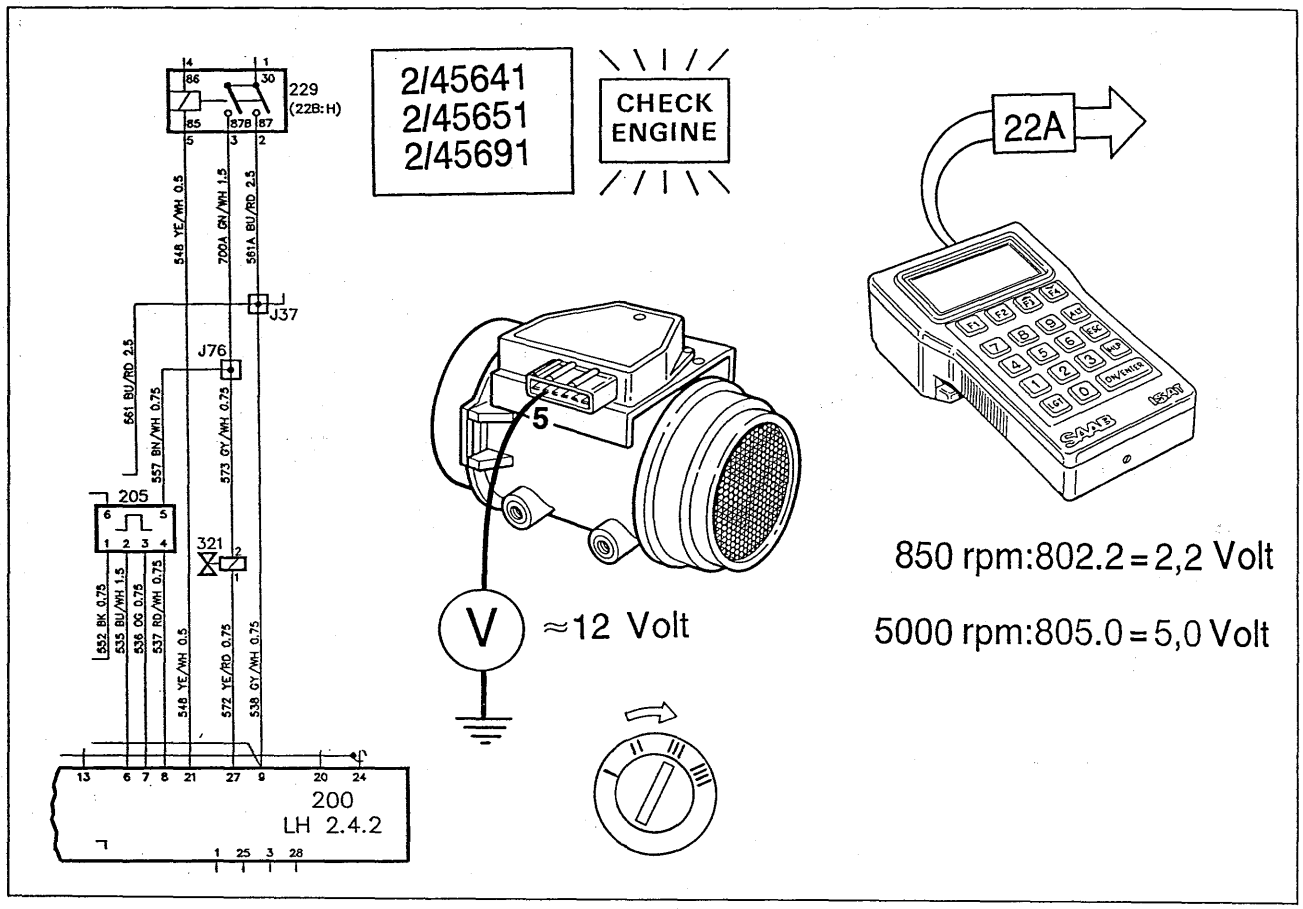
Test procedure

1. With the engine idling, check that approximately 6.5 V is present across ECU pin 28 and earth.

   If not, check the WH lead between LH-system ECU pin 28 and DI/APC-system ECU pin 26 for broken or short circuit.

2. If necessary, follow the test procedure detailed in the section on the DI/APC system.

Fault codes 2/45641, 2/45651 & 2/45691



Malfunction indicated

Signal from air mass meter incorrect or absent.

Fault symptom

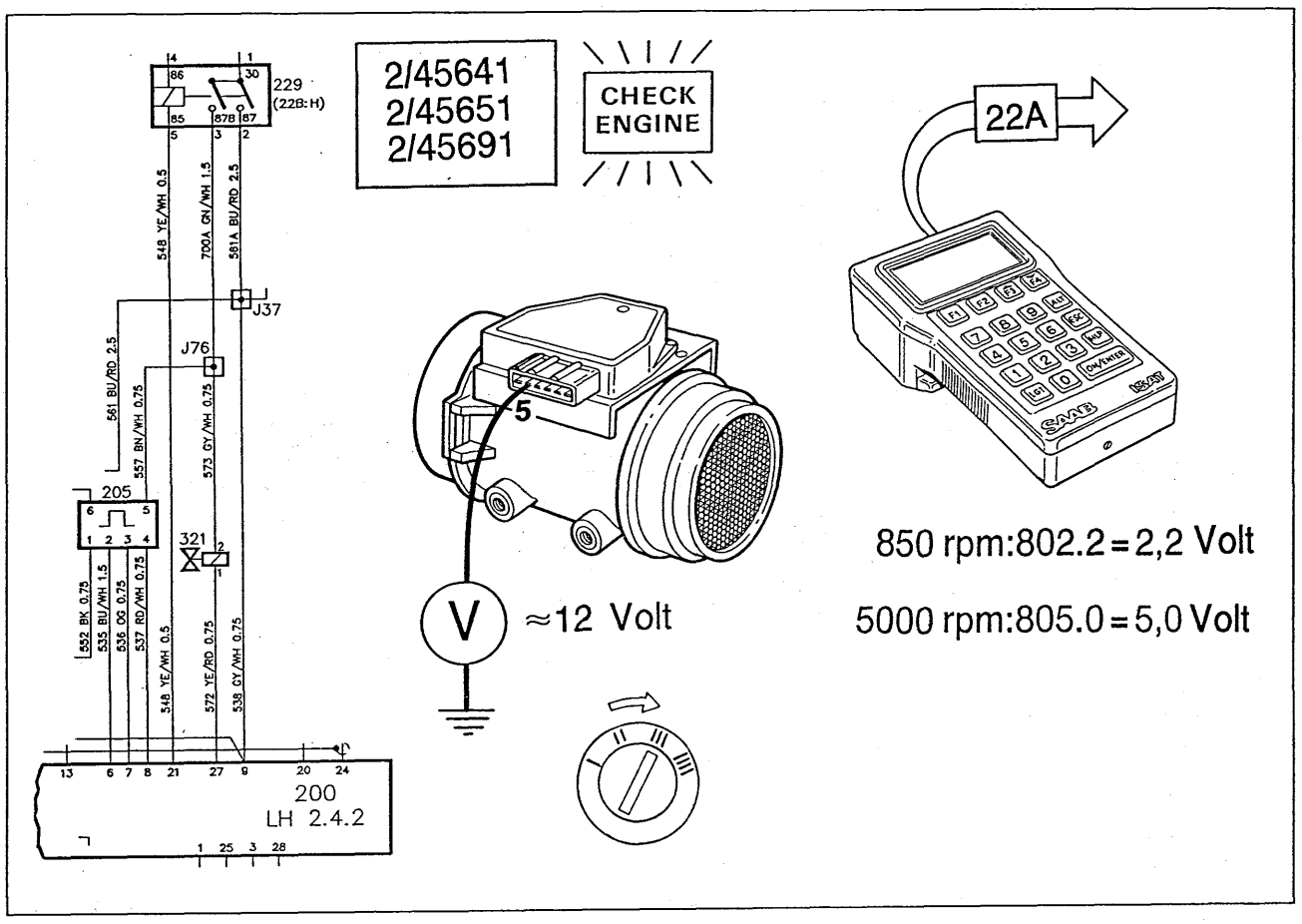
Poor drivability, difficult starting and high fuel consumption. This code often occurs with other codes.

CHECK ENGINE light on.

Test procedure

1. Enter ISAT command code 22A and check that the following values are displayed:
   - 802.0 = 2.0 V on idling
   - 805.0 = 5.0 V on full throttle
2. Check for leaks in the induction system by listening.
3. Check that pin 1 on the air mass meter has a good earth connection.
   If not, check the BK lead between pin 1 of the air mass meter and earth for a broken or short circuit.
4. With the ignition in the Drive position, check that battery voltage is present at air mass meter pin 5.

   If not, check the BN/WH lead between pin 5 of the air mass meter and pin 87 of the system relay for broken or short circuit.



5. Enter ISAT command code 22A and check that the signal varies between 2 and 5 V depending on the load (reading should be 802.0–805.0). If not, check the OG lead between ECU pin 7 and air mass meter pin 3 for a broken or short circuit.

6. Check for correct earthing at air mass meter pin 2.

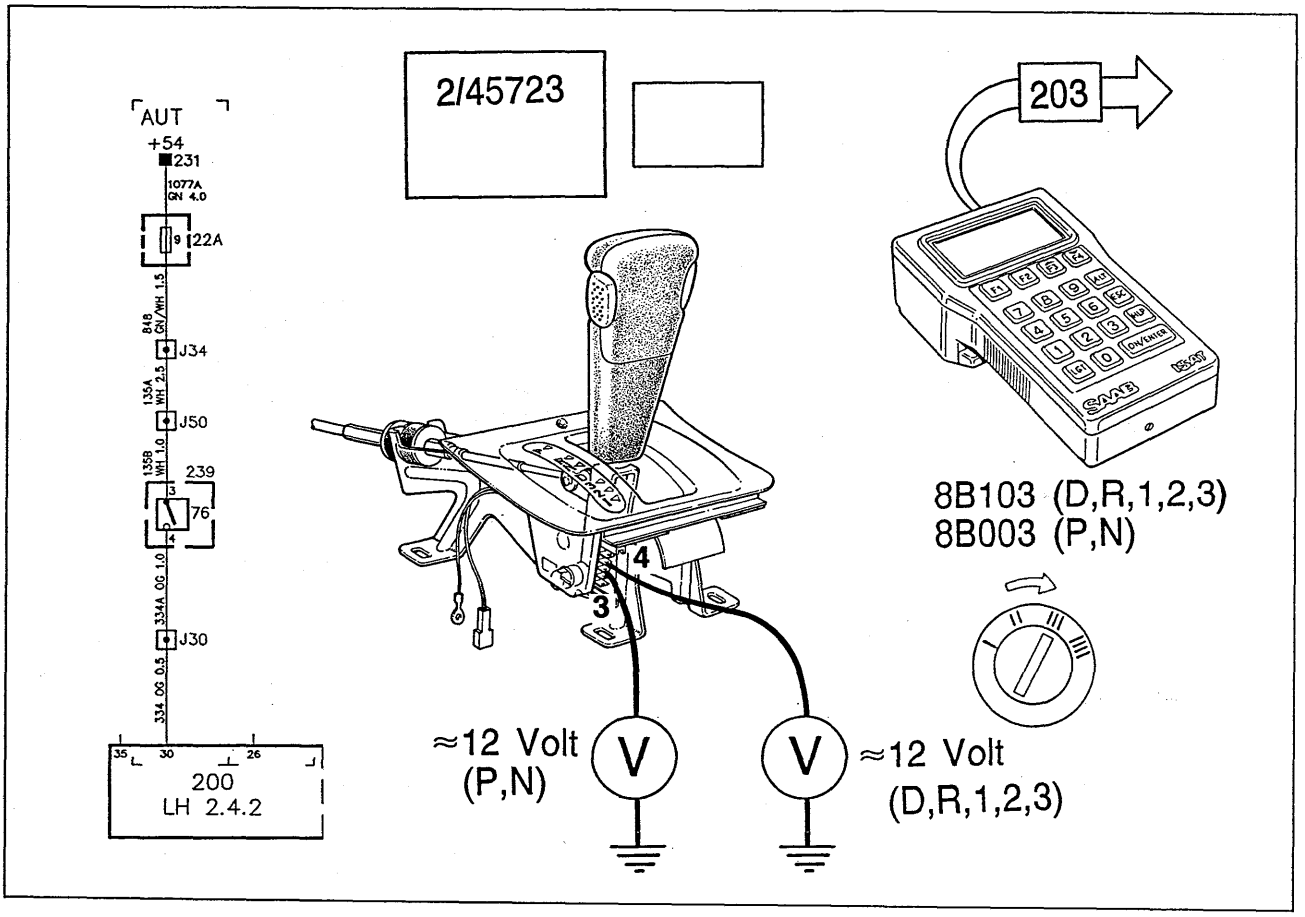
   If not, check the BU/WH lead from the pin to ECU pin 6 for a broken or short circuit.

7. If the fault has still not been found, clear the fault codes and test drive the car. Check to see whether the fault code has been generated again.

8. Fit a new air mass meter and repeat step 6.

9. Try a known good LH–system ECU.

Fault code 2/45723



Malfunction indicated

DRIVE signal absent or incorrect

Fault symptom

No increase in rpm when a drive position (D, R, 1, 2 or 3) is selected on the automatic transmission.

Test procedure

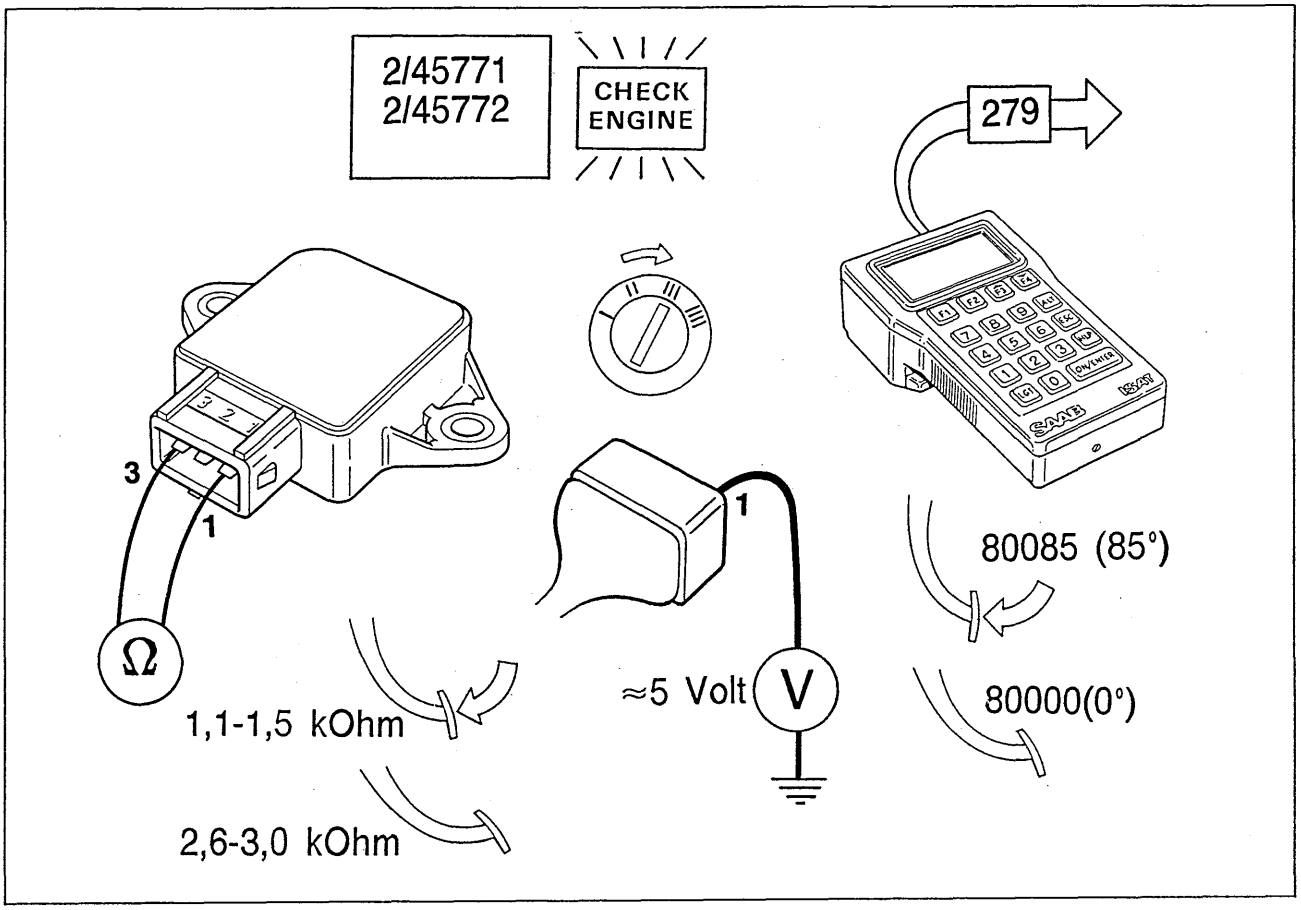
1. Enter ISAT command code 203 and check that the following is as shown on the display:
   - With gear selector in a drive position: 8B103 (activated)
   - With gear selector at P or N: 8B003 (not activated)
2. Check fuse #9.
3. Check that battery voltage is present at pin 3 of the gear-selector switch (239).

   If not, check the WH and GN/WH leads between the switch and the fuse, and the GN lead between the fuse and the +54 terminal block.
4. With the gear selector in a drive position, check that battery voltage is present at pin 4 of the gear-selector switch.

   If not, but pin 3 is live, fit a new gear-selector switch.
5. With the gear selector in a drive position, check that battery voltage is present at ECU pin 30.

   If not, check the OG lead between ECU pin 30 and the gear-selector switch for a broken or short circuit.

Fault codes 2/45771 & 2/45772



Malfunction indicated

Signal from throttle potentiometer absent or incorrect.

Fault symptom

Idling control not functioning properly.

CHECK ENGINE light on

Test procedure

1. With the ignition in the Drive position, enter ISAT command code 279.

   The following throttle-butterfly position should now be indicated on the display:

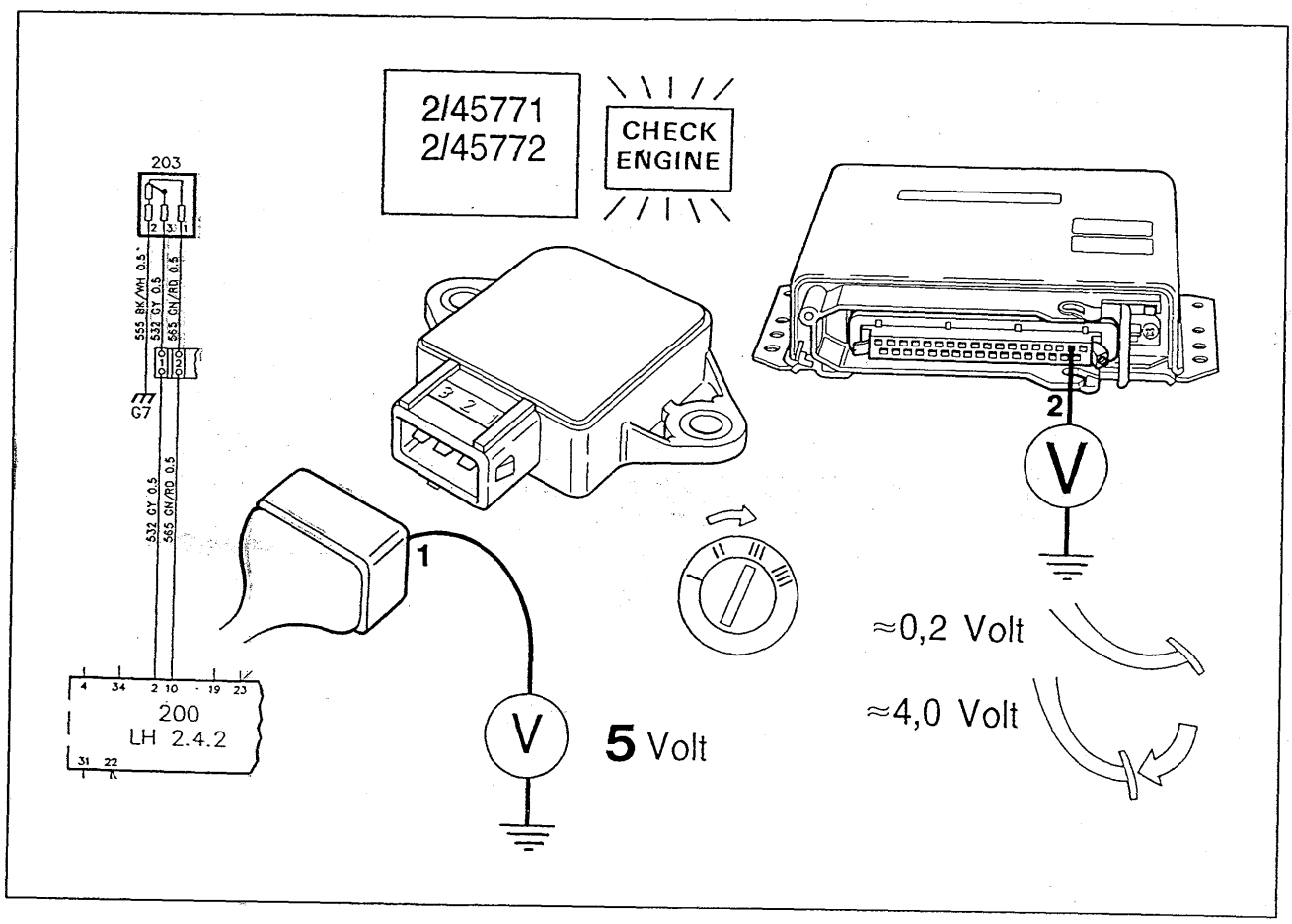
   - With accelerator depressed:
     80085 = approx. 85° (open)
   - Foot off accelerator:
     80000 = approx. 0° (closed)

2. Measure the resistance across pins 1 & 3 of the throttle potentiometer.

   The correct readings are as follows:

   - With accelerator depressed: 1.1–1.5 kohm
   - Foot off accelerator: 2.6–3.0 kohm

   If the resistance is incorrect, fit a new throttle potentiometer.



3. With the ignition in the Drive position, measure the voltage at pin 1 of the throttle-potentiometer connector. The reading should be 5 V.

   If not, check the GN/RD lead between pin 1 of the throttle-potentiometer connector and ECU pin 10 for a broken or short circuit.

4. With the ignition off, check that the earthing circuit is good from pin 2 of the throttle-potentiometer connector.

   If not, check the BK/WH lead between the pin and earth for a broken or short circuit.

5. With the ECU connector plugged in and the ignition in the Drive position, check the voltage across ECU pin 2 and earth.

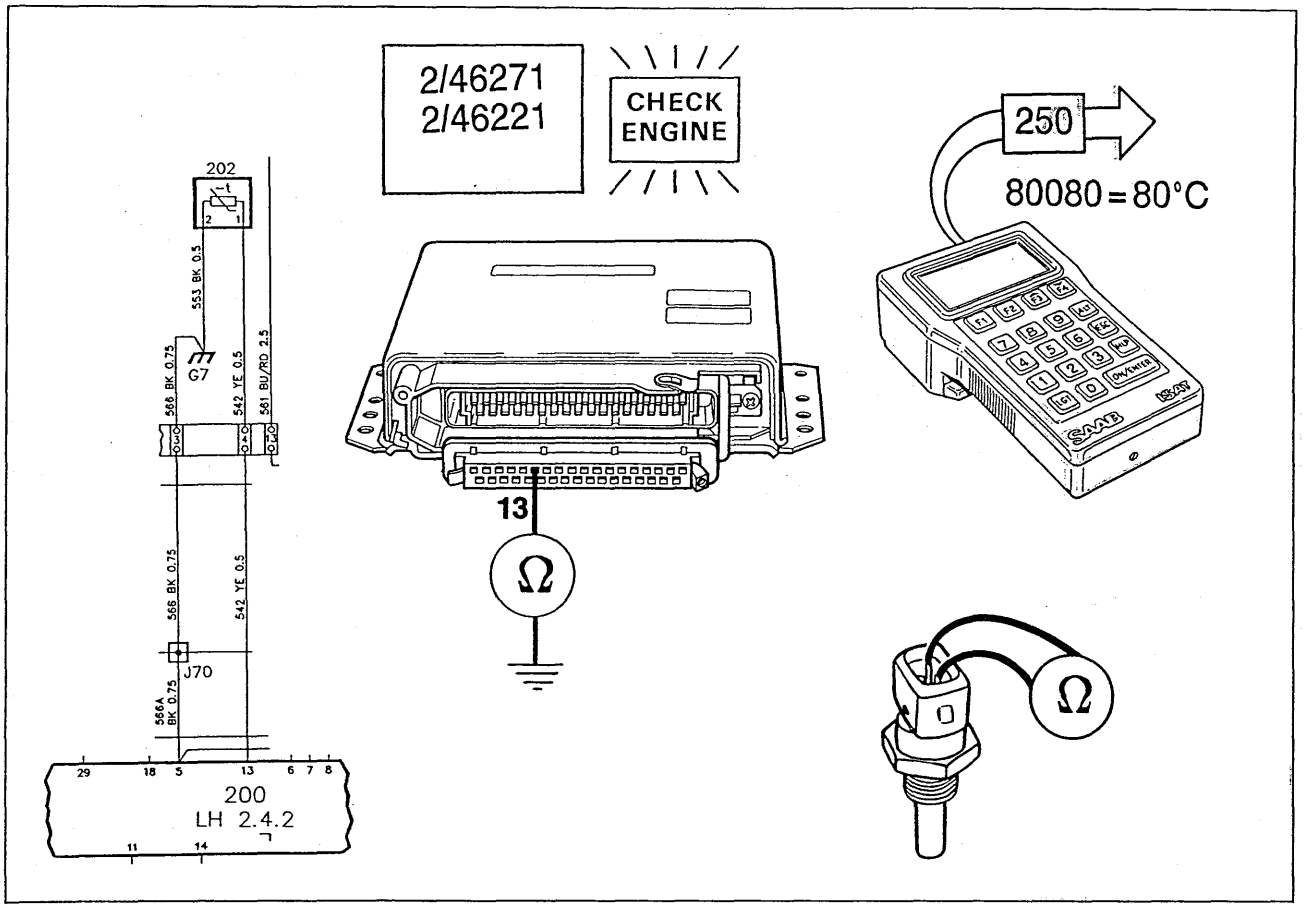
   Correct readings are as follows:

   - Foot off accelerator (idling): approx. 0.2 V
   - With accelerator depressed: approx. 4 V

   If correct readings are not obtained, check the GY lead between pin 3 of the throttle-potentiometer connector and ECU pin 2 for a broken or short circuit.

6. Try a known good ECU.

Fault codes 2/46271 & 2/46221



Malfunction indicated

Temperature-sensor incorrect or absent

Fault symptom

Poor drivability.
CHECK ENGINE light on.

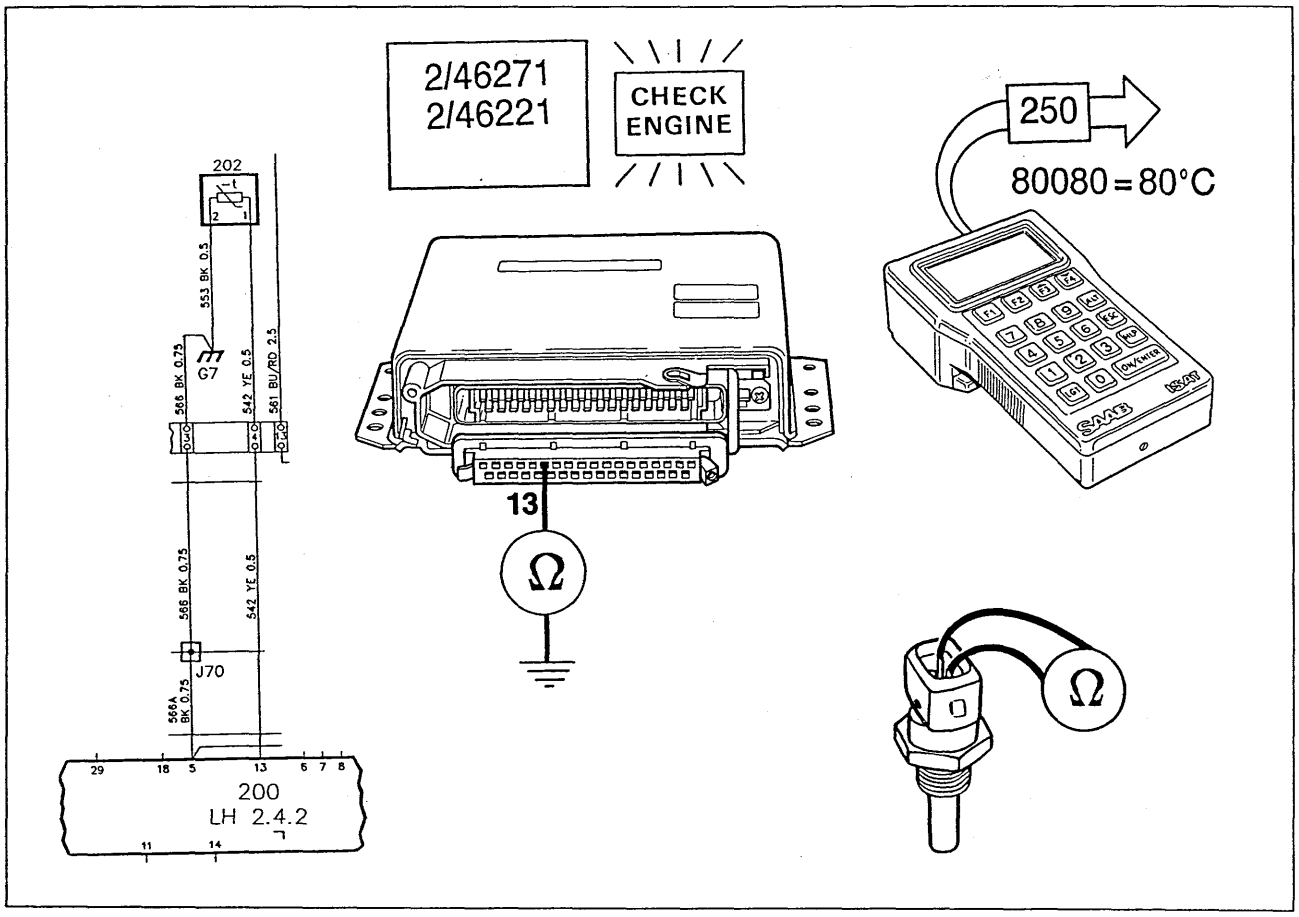
Test procedure

1. Enter ISAT command code 250.

   The engine temperature should now be shown on the display, e.g. 80+080 if the temperature is 80°C.

2. With the temperature-sensor connector unplugged, measure the resistance of the sensor.
   If the reading is incorrect, fit a new temperature sensor.

3. If the resistance is correct, plug in the temperature-sensor connector and unplug the ECU connector. From the back of the ECU connector, measure the resistance across pin 13 (YE) and a reliable earth.



The value should be consistent with that shown in the table (a reading a few ohms higher is acceptable).

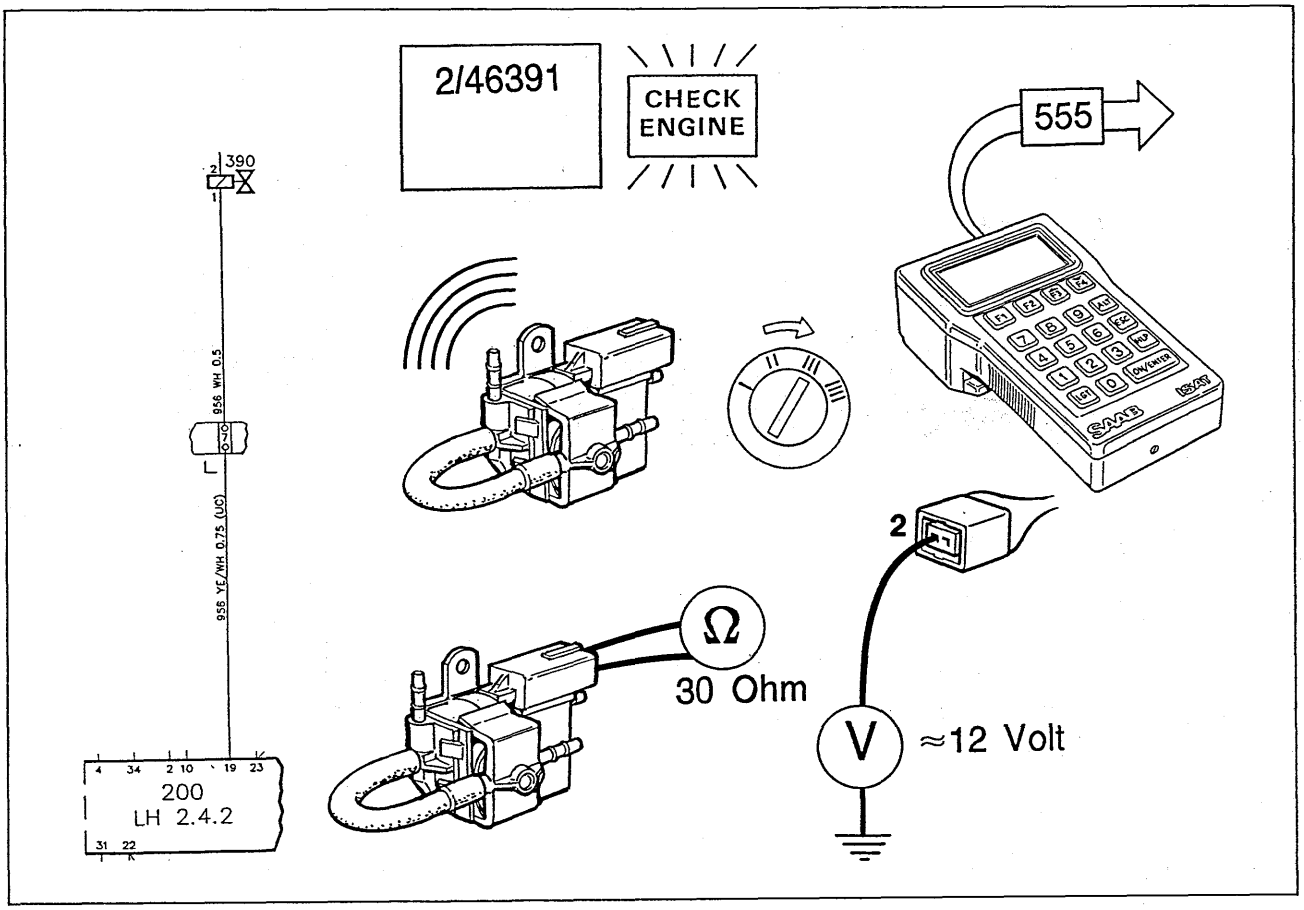
If the resistance is incorrect, check the YE lead between connector pin 13 and temperature-sensor connector pin 1 for a broken or short circuit.

- Check the BK lead between temperature-sensor connector pin 2 and the earthing point on the engine for a broken or short circuit.
- Try a known good ECU.

Table

°C	°F	Ohm (±10%)
-20	-4	14000
-10	14	9000
0	32	5800
10	50	3800
15	58	3000
20	68	2600
25	76	2000
30	86	1700
80	176	320

Fault code 2/46391



Malfunction indicated

EGR temperature-sensor signal incorrect or absent

Fault symptom

CHECK ENGINE light on.

Test procedure

1. With the ignition in the Drive position, enter ISAT command code 555.

   Listen and check whether the modulating valve is working. If it is, go to step 6.

2. If the modulating valve is not working, unplug the valve connector and measure the resistance across the pins.

   Correct reading: approx. 30 ohm.

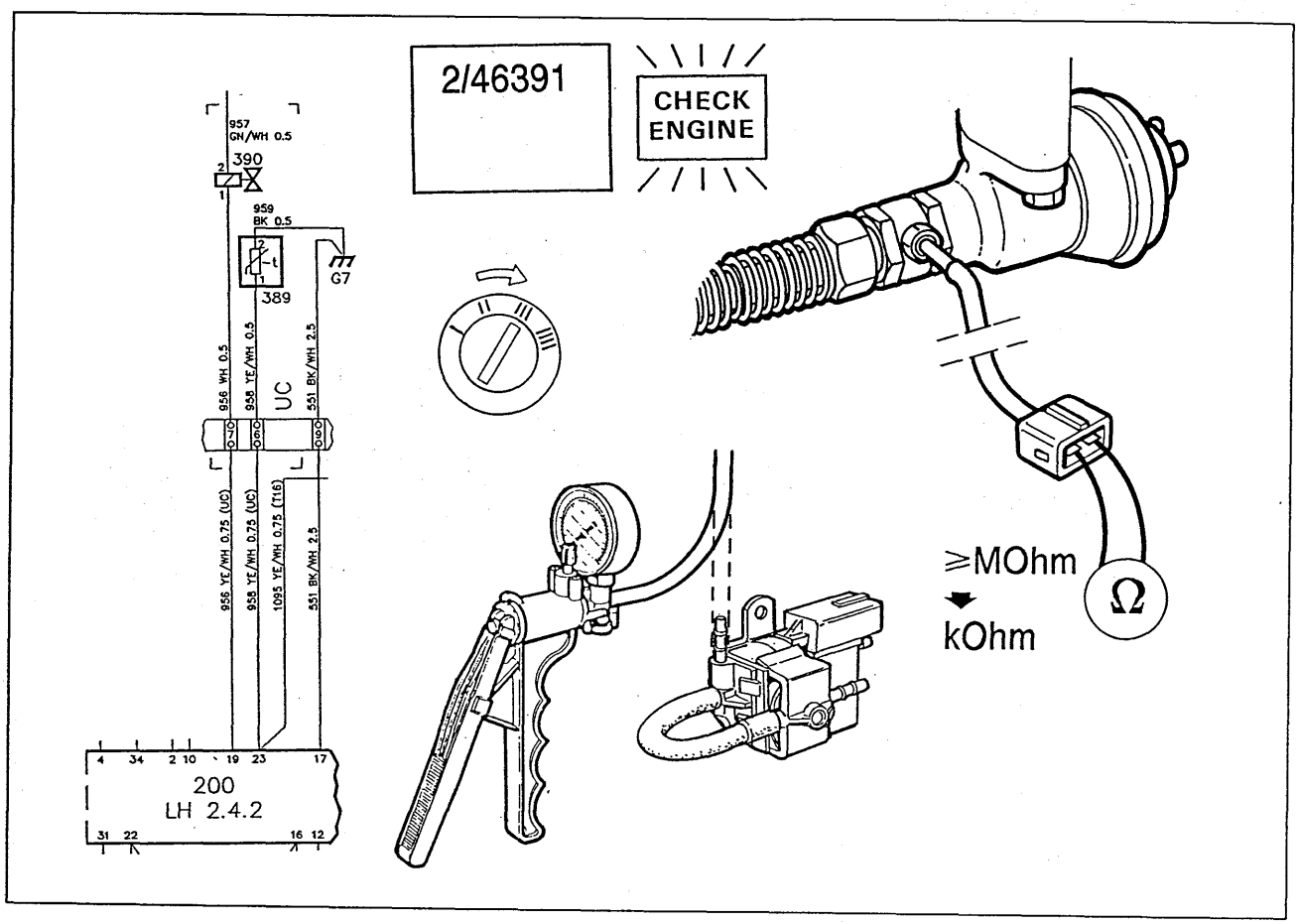
   If resistance incorrect, fit a new modulating valve.

3. With the ignition in the Drive position, check that battery voltage is reaching pin 2 (GN/WH) of the modulating valve.

   If not, check the GN/WH lead and BU/RD lead between the modulating valve and pin 87 on the system relay for a broken or short circuit.

4. Check the WH and YE/WH leads between pin 1 of the modulating-valve connector and ECU connector pin 19 for a broken or short circuit.

5. Try a known good ECU.



6. Plug in the connectors for the modulating valve and ECU and unplug the connector for the EGR-sensor temperature sensor.

   With the engine idling, check that the resistance of the temperature sensor is several Mohm.

   Raise a vacuum in the valve by connecting a vacuum pump or sucking on the end of the red-marked hose and check that the resistance of the temperature sensor falls to within the kohm range.

   If not, fit a new EGR valve (the temperature sensor is integral with the EGR valve).

7. With the ECU connector unplugged, check the YE/WH lead between the EGR temperature sensor and ECU connector pin 23 for a broken or short circuit.

   Check the BK lead from the temperature sensor to earth for a broken or short circuit.

8. If the fault persists, continue by checking the vacuum hoses, as follows:

   a. With the engine idling, disconnect the red-marked hose from the modulating valve.

   b. Raise a vacuum in the hose.

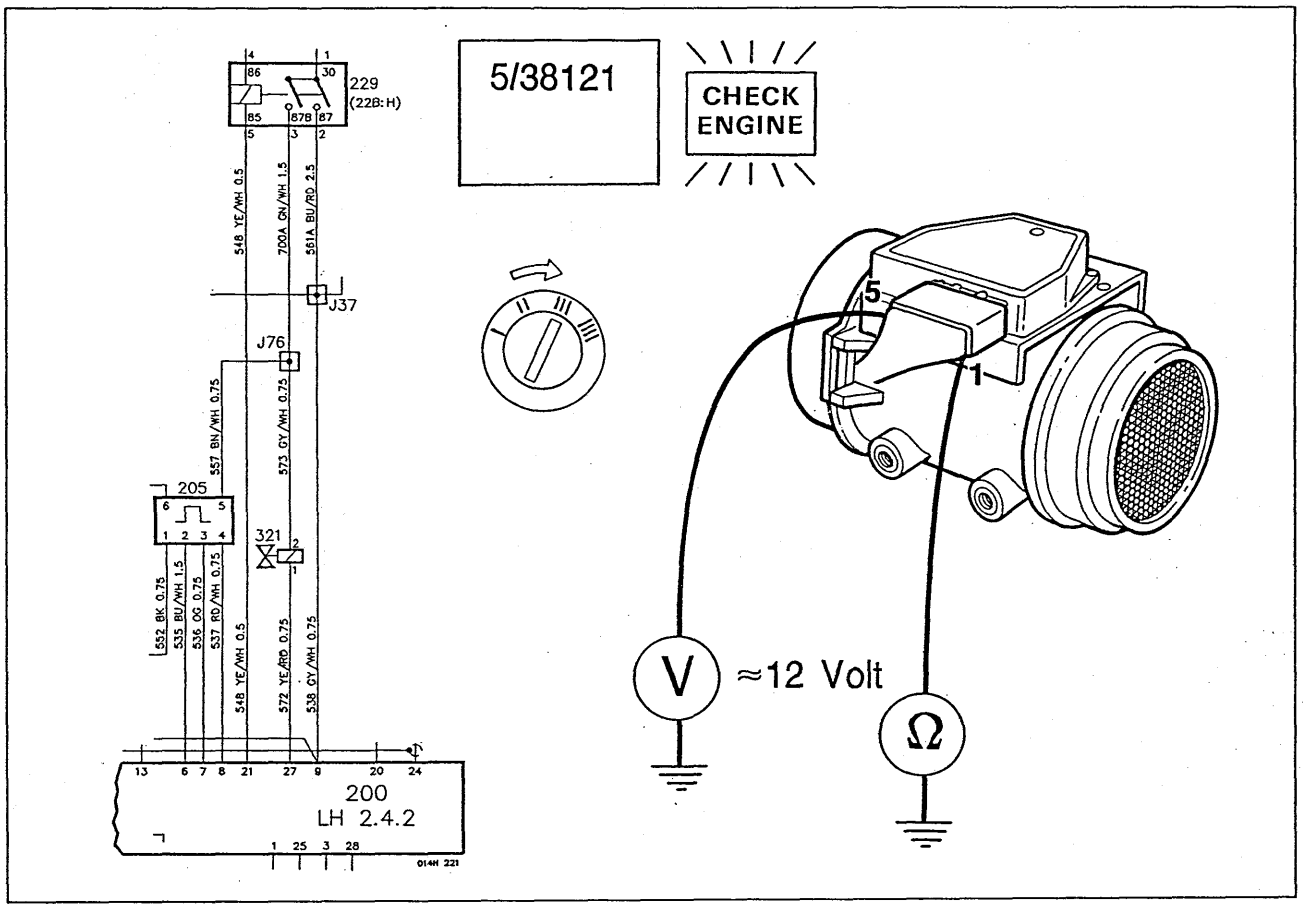
      If the engine rpm falls, the EGR valve is working properly.

      If not, check the hose, connections and vacuum tank.

   c. Check that a vacuum is present in the white-marked hose to the modulating valve.

      If not, check the hose, connections and vacuum tank.

Fault code 5/38121



Malfunction indicated

Air mass meter burn-off function faulty

Fault symptom

Starting difficulties, poor drivability and high fuel consumption

CHECK ENGINE light on.

Test procedure

If fault code 2/45691 occurs at the same time, investigate that fault first.

1. With the ECU and air-mass-meter connectors unplugged, check the RD/WH lead between ECU pin 8 and air mass meter pin 4.

2. With the connectors plugged in and the ignition in the Drive position, check that battery voltage is reaching air mass meter pin 5 and that pin 1 is correctly earthed.

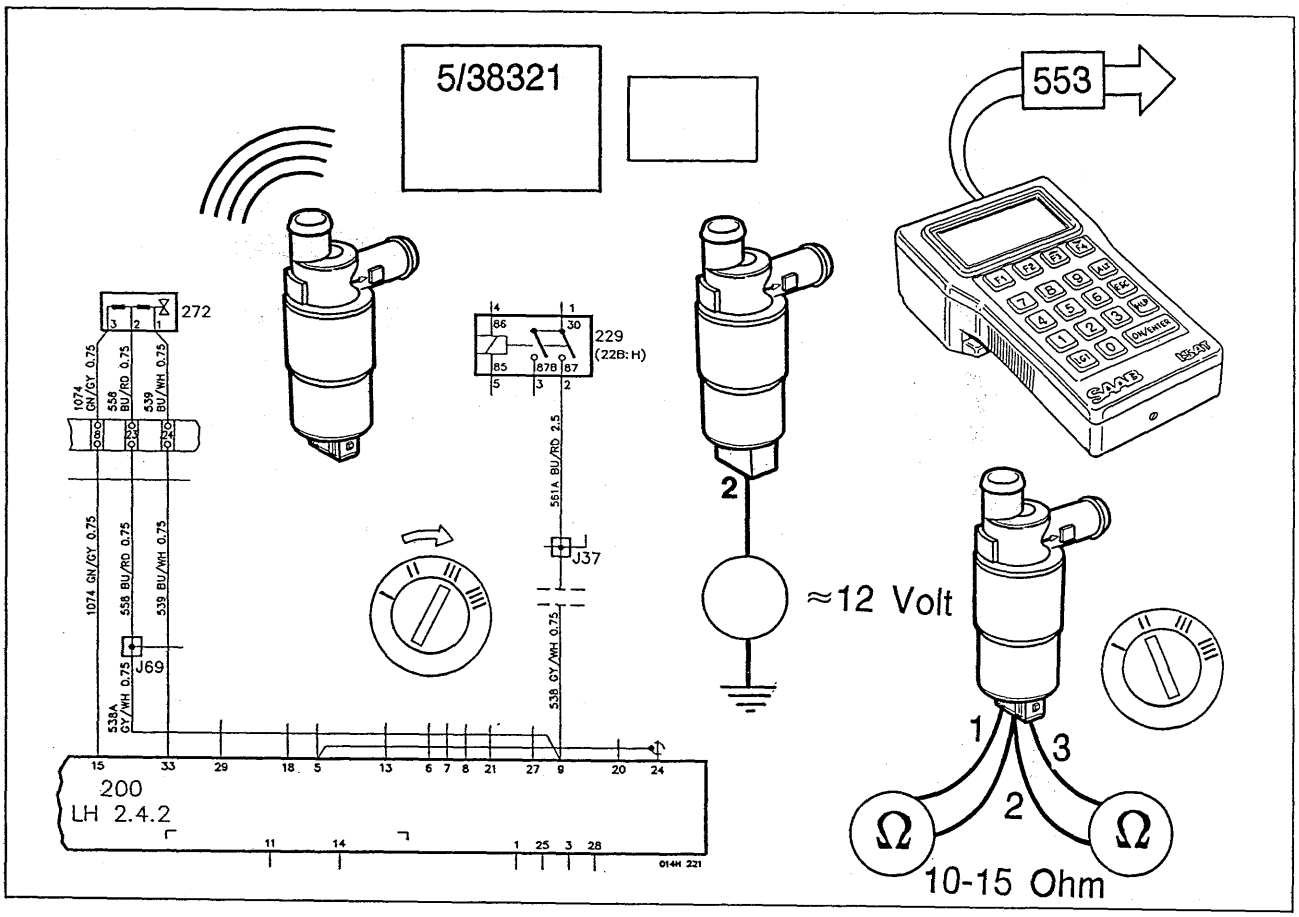
   If no voltage is reaching the pin, check the BN/WH and GN/WH leads between pin 5 of the air mass meter and pin 87B of the system relay.

   If there is no earth, check the BK lead between air mass meter pin 1 and earthing point G7 on the inlet manifold.

3. If the fault persists, fit a new air mass meter, clear the codes and test drive the car. Check to see if the fault code has been generated again.

4. If the fault code appears again, refit the old air mass meter and try a known good LH-system ECU.

Fault code 5/38321



Malfunction indicated

AIC valve faulty

Fault symptom

Rough idling

Test procedure for LH 2.4.2

1. With the ignition in the Drive position, enter ISAT command code 553.

   Listen to check that the AIC valve is working (1 Hz).

2. With the ignition in the Drive position, check that battery voltage is available across pin 2 of the AIC-valve connector and a reliable earth.

   If not, check the BU/RD lead and GY/WH lead between pin 2 of the AIC valve and pin 87 of the system relay for broken or short circuit.

3. With the ignition off and the AIC-valve connector unplugged, measure the resistance across the valve's two windings, i.e. across pins 1 and 2 and across pins 2 and 3.

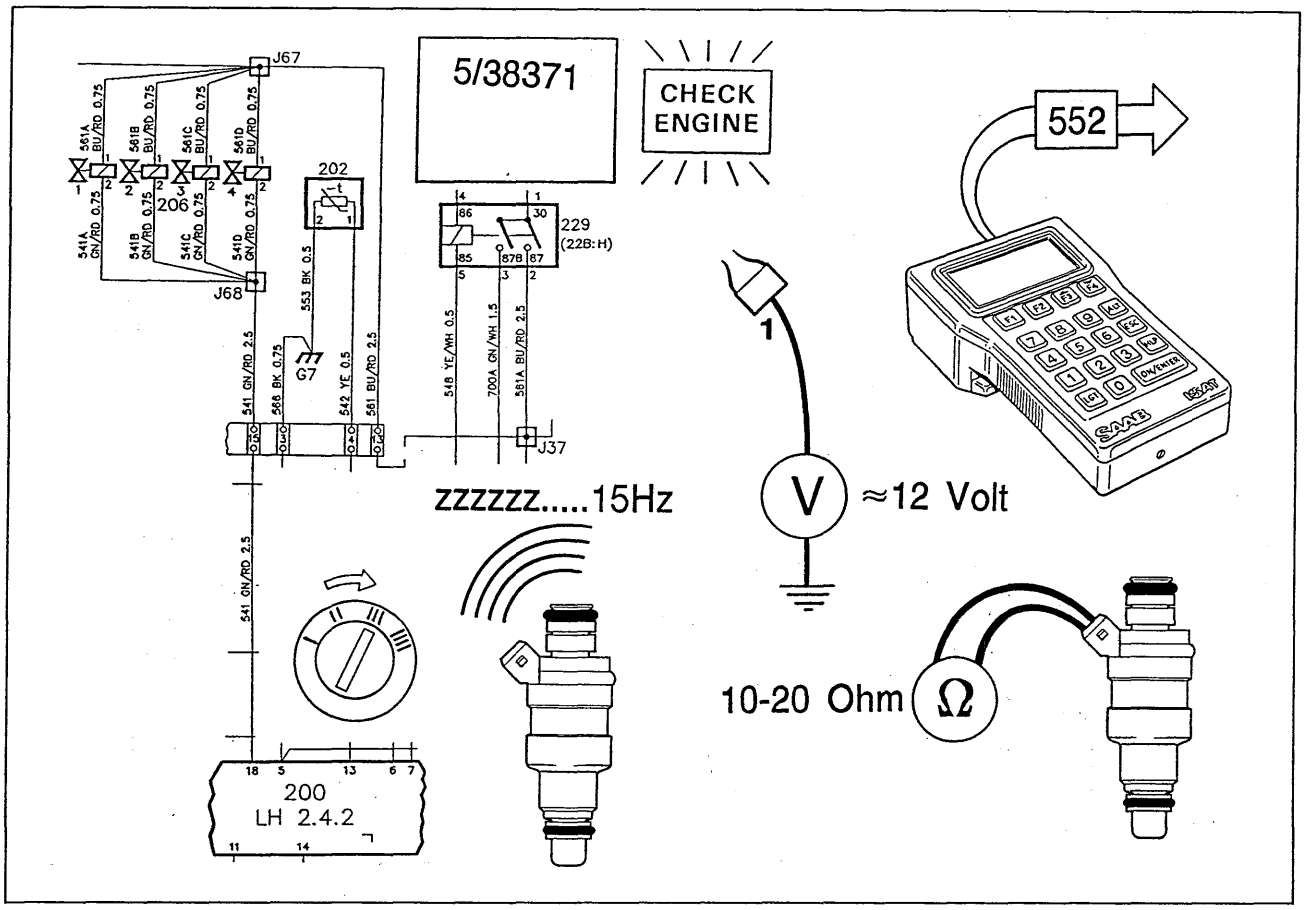
   Resistance for each winding: 10–15 ohm.

   If not, fit a new AIC valve.

4. Check the BU/WH lead between ECU pin 33 and AIC valve pin 1, and the GN/GY lead between ECU pin 15 and AIC valve pin 3 for a broken or short circuit.

5. Try a known good ECU.

Fault code 5/38371



Malfunction indicated

Injector-function faulty

Fault symptom

Poor drivability; engine misfiring

CHECK ENGINE light on.

Test procedure

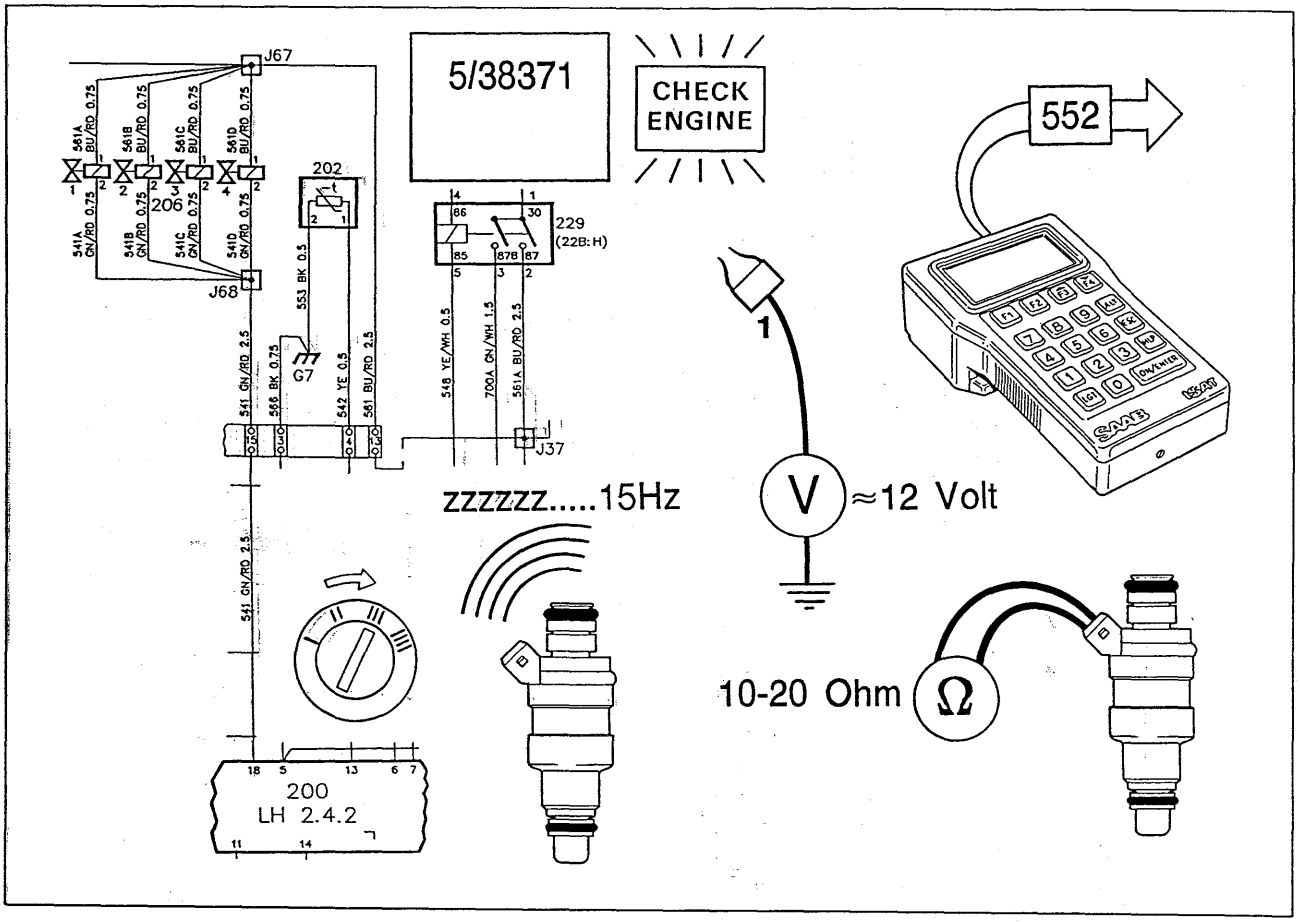
Note
The fault could also be due to faulty ignition in one of the cylinders. For details of fault-diagnosis on the ignition system, see the appropriate section of the Workshop Manual.

1. With the ignition in the Drive position, enter ISAT command code 552.

   Listen to check that all injectors are operating (15 Hz).
   If the injectors are working, continue with the test procedure, but remember that faults can be intermittent.

2. With the ignition in the Drive position, check that battery voltage is reaching pin 1 of the connector for each injector.

   If not, check the BU/RD lead between pin 1 and pin 87 of the system relay for a broken or short circuit.

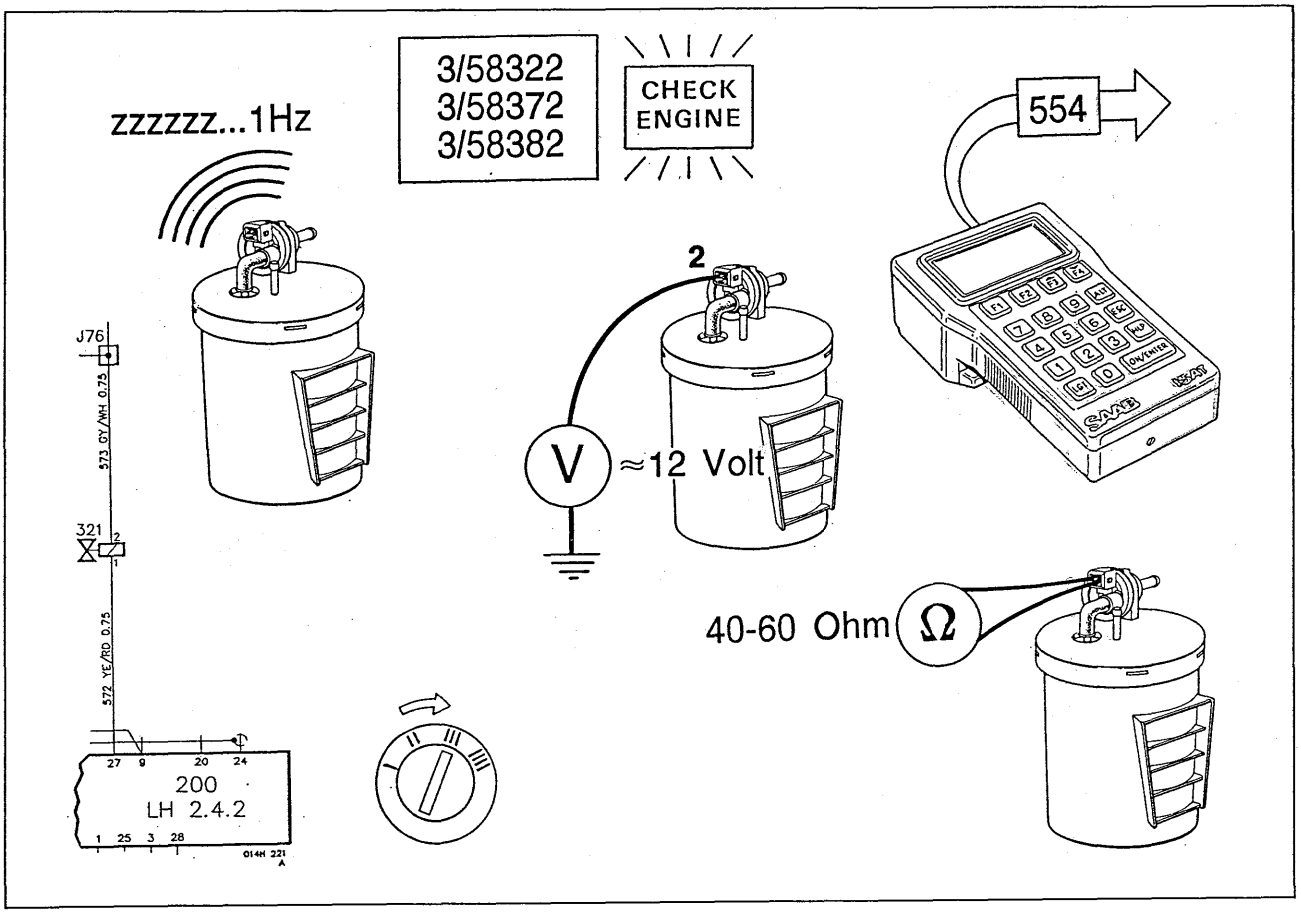


3. With the connectors unplugged, measure the resistance across the injector connector pins. Correct resistance: 10–20 ohm. If incorrect, replace the faulty injector.

4. With the ignition off and ECU connector unplugged, check the GN/RD lead between pin 2 at each injector and pin 18 of the ECU connector for a broken or short circuit.

5. If the fault has still not been traced, try a known good ECU.

Fault codes 3/58322, 3/58372 & 3/58382



Malfunction indicated

Purging valve on ELCD canister not working properly.

Fault symptom

Poor drivability and idling control.

CHECK ENGINE light on.

Test procedure

1. With the ignition in the Drive position, enter ISAT command code 554.

   Check by listening to see whether the valve is working (1 Hz).

2. Check that battery voltage is available across valve pin 2 and a reliable earth.

   If not, check the GY/WH lead between pin 2 of the valve connector and pin 87 of the system relay for a broken or short circuit.

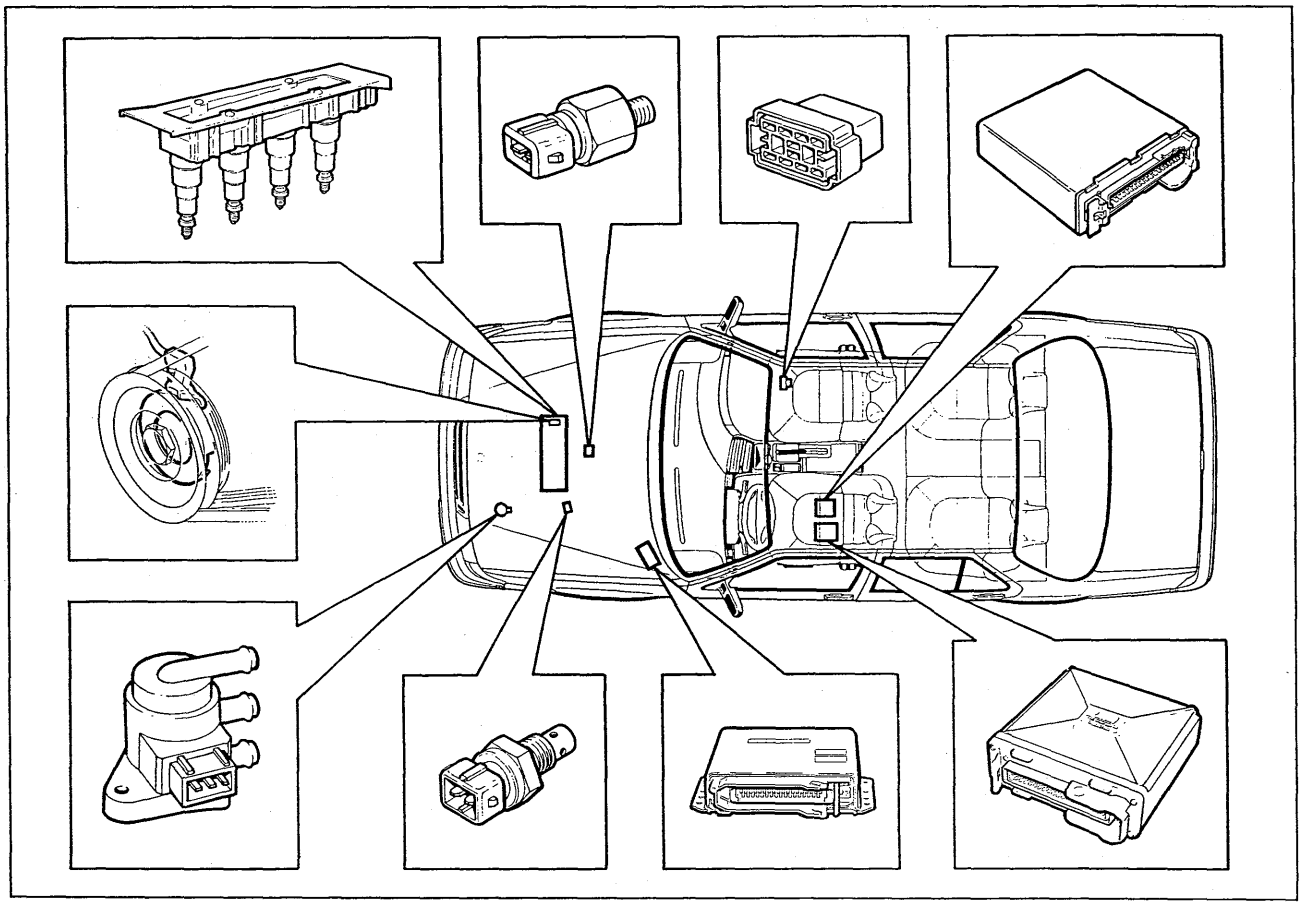
3. Measure the resistance of the valves across pins 1 & 2.
   Correct value: 40–60 ohm.

   If resistance incorrect, fit a new valve.

4. With the ignition off and the ECU connector and valve connector both unplugged, check the YE/RD lead between pin 1 on the valve connector and pin 27 on the ECU connector for a broken or short circuit.

5. Try a known good ECU.

DI/APC system M91



A number of important changes have been made to the DI/APC system on M91

The ISAT diagnostics function has been greatly expanded, with many more fault codes and command codes than before.

A new DI/APC-system ECU is now fitted, together with a new temperature sensor upstream of the throttle housing.

The adjustments made by the DI/APC-system ECU to counter knocking in the engine also give better emission values and lower fuel consumption than before.

The boost pressure is governed by the position (angle) of the throttle butterfly, subject to temperature compensation based on information supplied by the temperature sensor upstream of the throttle housing. The drivability of the vehicle is therefore greatly improved on acceleration, as the acceleration provided corresponds more exactly to that called for by the driver's foot on the accelerator.

The separate pressure sensor has been discontinued, with the pressure-sensing function now being regulated by the *Tq* load signal from the LH-system ECU, and the signal from the sensor providing information on the temperature of the induction air.

A number of other functions have also been added:

- Torque limitation in low gears (engine variants with automatic transmission)
- Spark-plug burn-off function when engine switched off (irrespective of position of ignition key)
- Fuel enrichment on knocking (Turbo—LH 2.4.2)
- ECU mapped firing point on idling (which means that TDC checking is no longer possible).

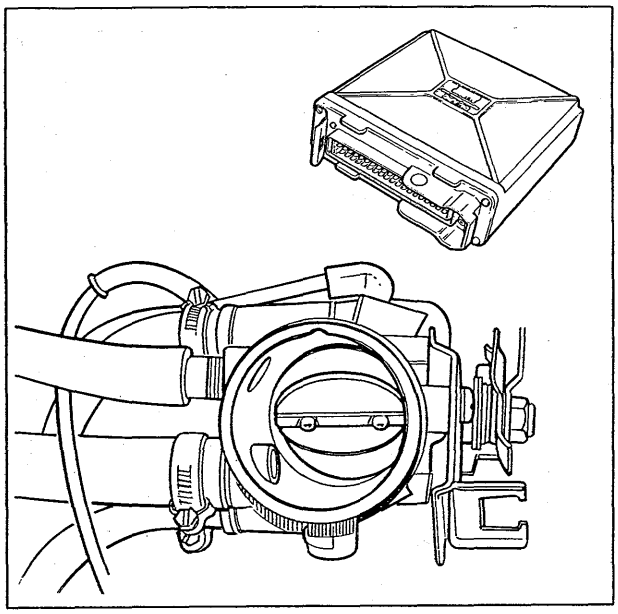
Modified boost-pressure values
B234 Turbo

- Basic boost pressure: 0.4 ± 0.03 bar at 3000 rpm
- Maximum boost pressure (Manuals): approx. 1.0 bar at 3000–3500 rpm
- Maximum boost pressure (Automatics): 0.77 bar at 2700 rpm.

Boost pressure controlled by throttle position

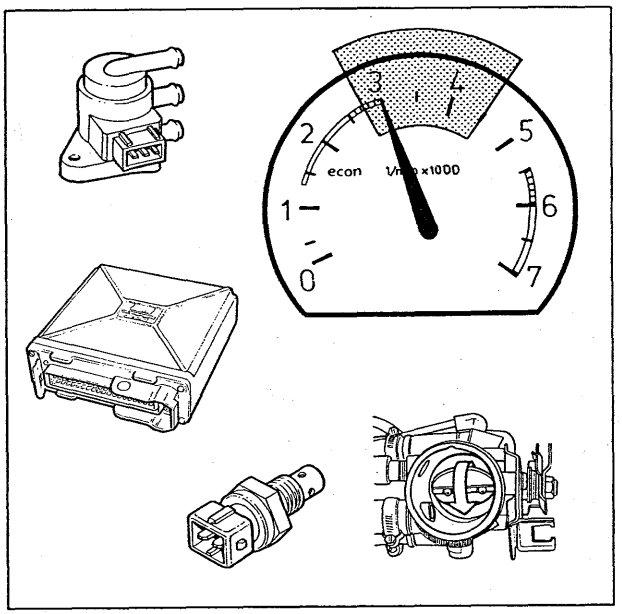
On cars equipped with a throttle potentiometer (variants with LH 2.4.2), the boost pressure is controlled by the throttle position at any given moment.

This means that the maximum boost pressure is mapped individually for each given throttle position, thus improving driving characteristics. For instance, if the throttle butterfly is open 45°, the engine will not be at full boost.



Increased range for adaption

The operating range of the adaptive function has been extended to a range of 2750–4500 rpm, as against 2750–3250 rpm before. The practical effect of this is that adaption is now simpler. A lower gear can be selected and road and traffic conditions are less important.



Adapted boost pressure during cruise control

Engines on which the boost pressure is regulated by the position of the throttle butterfly do not require the boost pressure to be limited to the base-line setting when the cruise-control system is activated, since the boost pressure is proportional to the throttle opening.

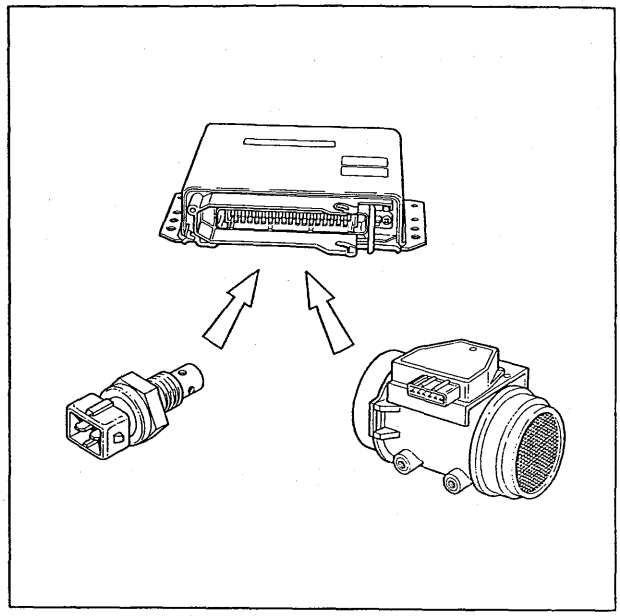
On cars where the boost pressure is not governed by the position of the throttle butterfly, limiting the boost pressure to the basic setting is achieved by means of a vacuum switch operated by the vacuum in the cruise-control system.

The vacuum switch is wired such that it sends an earth signal to the DI-system ECU when it is closed.

Load signal *(Tq)*

Information on the load on the engine (the mass of the induction air) is provided by the LH-system ECU in the form of a signal having a modulated pulse width.

The boost pressure is computed on the basis of this load signal and the value received from the temperature sensor upstream of the throttle housing.

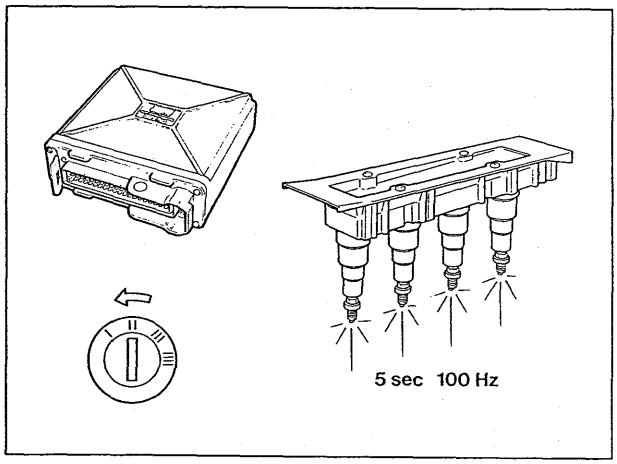


Spark-plug burn-off

Automatic burn-off of the spark plugs takes place each time the engine is switched off by means of the ignition switch.

The burn-off function, which operates in all cylinders simultaneously, lasts for five seconds at a frequency corresponding to 6000 rpm.

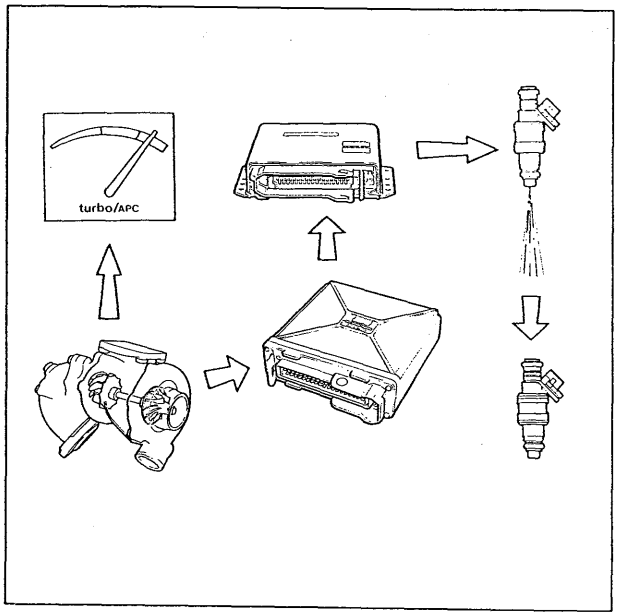
Note
Power is supplied to the DI-system ECU and ignition cartridge by the LH-system relay, which operates for five seconds after the engine has been switched off by means of the ignition key.



Integral pressure-switch function

A pressure-switch function has been mapped into the DI-system ECU (to cut off fuel injection if boost pressure is too high).

The fuel-injection function is shut off by eight speed pulses being suppressed by the DI-system ECU. When generation of the pulses is renewed, a new check is made. If the boost pressure is still high, a further eight pulses will be suppressed. This cycle continues until the boost pressure has fallen below the preset limit.

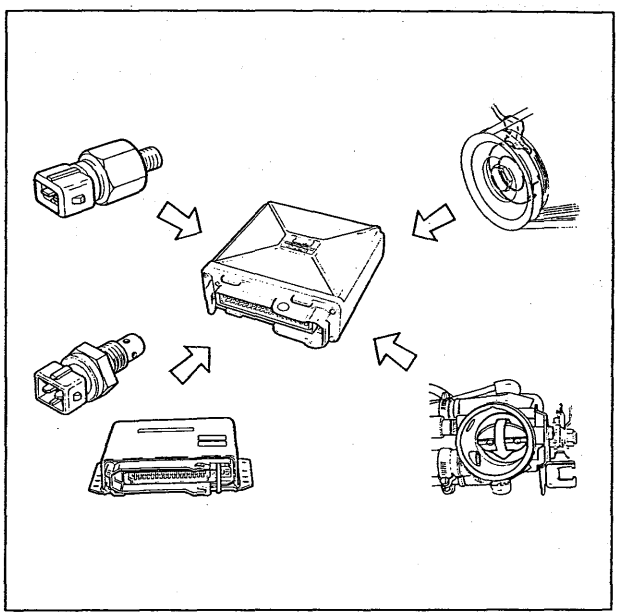


Function modifications on M91

APC control of boost pressure

For monitoring and control of the boost pressure, the ECU receives information on:

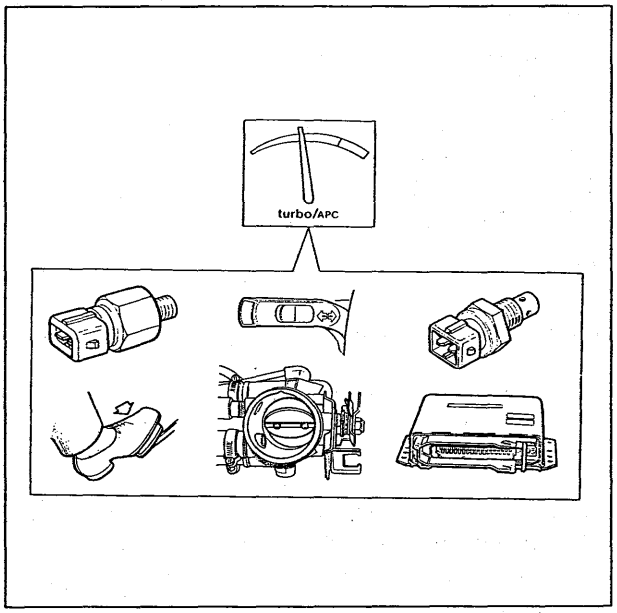
- The induction-air mass (load signal from LH; air-temperature signal from temperature sensor upstream of throttle housing).
- Engine rpm (crankshaft sensor)
- Knocking (knock sensor)
- Throttle position (LH 2.4.2—from throttle potentiometer)



For reasons of safety and good drivability, limiting of the boost pressure or retarding the timing is governed by a variety of factors.

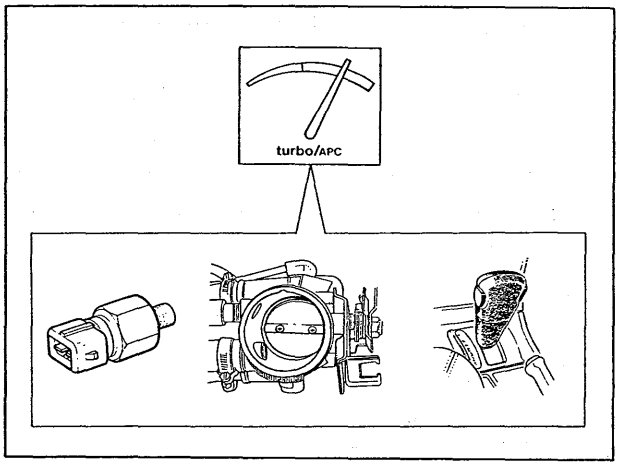
Base-line charging pressure is selected:

- if the signal from the throttle potentiometer is absent
- if the load signal is absent or at a constant level for more than 45 seconds
- if the signal from the knock sensor is absent or weak
- if the brake pedal is depressed
- if the temperature sensor is faulty



Limited boost pressure is obtained:

- if a low gear is selected (Automatics)
- if the throttle is only partially open
- if knocking is detected

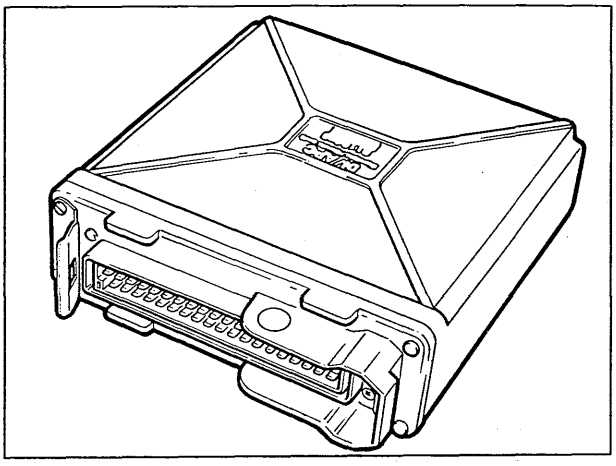


Retarded timing is selected:

- if the brake pedal is depressed when the boost pressure is above 105 kPa and the engine speed below 3000 rpm (Automatics)
- if knocking is detected
- if fuel shut-off is operative (engine braking with throttle closed)

DI/APC-system ECU

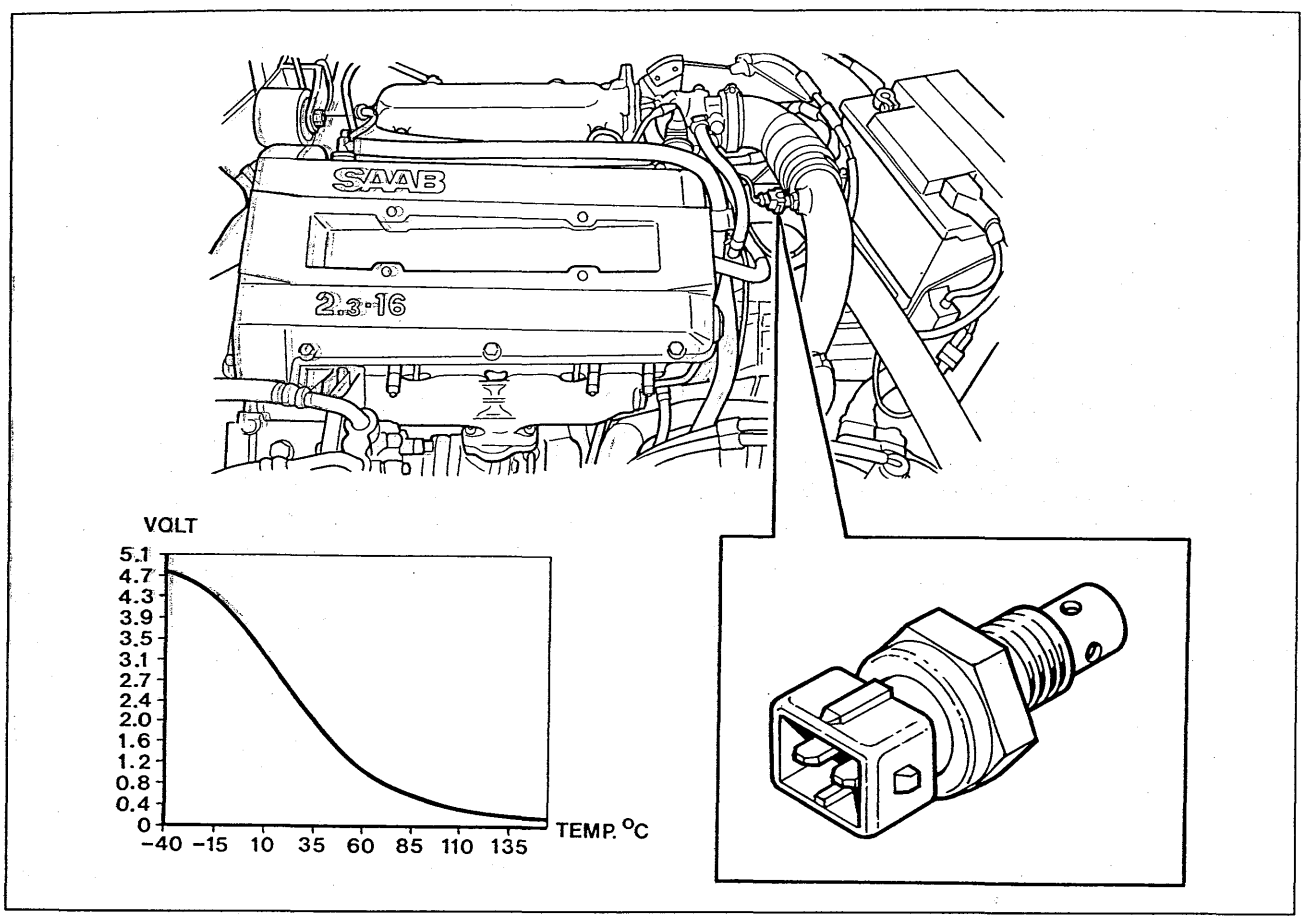
The following table provides an overview of the ECU input and output signals on different engine variants, following the modifications made to the DI/APC system for M91.



DI/APC-system ECU input and output signals, M91

Engine type	B234 Turbo	B234i
Input signals:		
Throttle-position signal (from LH)	x	x
Tq signal from LH	x	x
Temperature of intake air	x	
Crankshaft-sensor signal	x	x
Knock-sensor signal	x	x
Combustion signal	x	x
Brake signal	x	
Road-speed signal	x	
Output signals:		
Ignition-trigger pulses	x	x
Solenoid valve	x	
Fuel boosting	x	(x)
Engine rpm	x	x

(x) = Provision made



Temperature sensor

This temperature sensor, located in the turbo delivery pipe upstream of the throttle housing, informs the system of the temperature of the induction air.

The signal level from the sensor varies between 0 and 5 V depending on the temperature (see Table). At 20°C, the signal is 2.7 V.

Table

°C	°F	Voltage (V)
-20	-4	4.5
-10	14	4.1
0	23	3.7
10	50	3.3
15	58	2.9
20	68	2.7
25	76	2.5
30	86	2.3
80	176	0.7

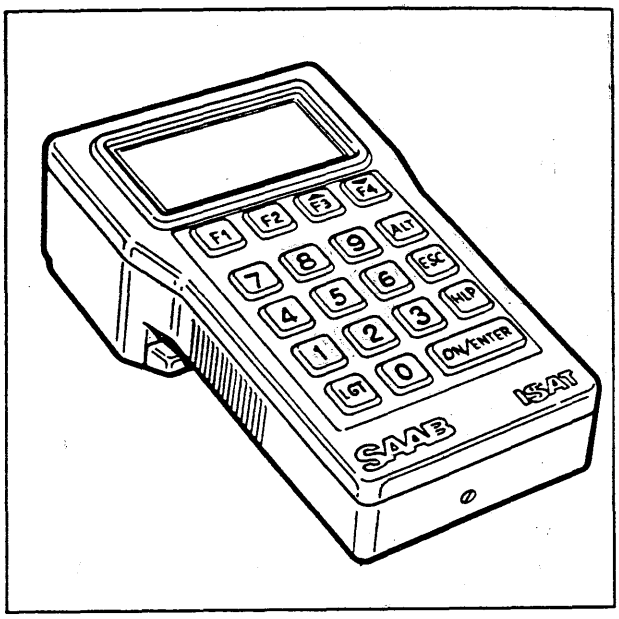
Fault diagnosis using ISAT

Before starting fault-diagnosis work

Successful fault diagnosis on the DI/APC system requires not only in-depth knowledge of the system on the part of the technician but also access to ISAT.

Thanks to the self-diagnostics incorporated in the DI/APC system, which continuously monitors and records the majority of conceivable faults, be they permanent or intermittent, it is easy using ISAT to pinpoint a fault, rectify it and then check that the system is functioning properly again.

This integrated self-diagnostics function in the system not only makes for quicker fault-diagnosis work but, above all, much more reliable diagnosis. It is therefore far less likely that a sound component will be replaced, having mistakenly been adjudged faulty, and service costs should benefit considerably as a result.



ISAT is a valuable aid to efficient, reliable diagnosis.

Is the fault in the DI/APC system?

Many so-called DI/APC-system faults can often be traced to other unrelated engine or electrical faults. Before starting any fault-diagnosis work on the DI/APC system, therefore, always check the following first:

- Battery condition
- Engine condition
- Charging system
- Auxiliary systems
- Electrical connections
- Earthing points

Points to note

1. Always read off and note down all stored fault codes before disconnecting the battery or ECU.

2. Before tracing faults on a vehicle's electronic systems, always start by checking that the earthing circuits for the ECU concerned are good and that all nominal voltage levels are correct.

3. Check all plugs and connections before fault-finding elsewhere in a system. Unplug connectors and plugs to check that the pins are undamaged and not loose. After checking, plug in all connectors and clear all fault codes. Start the engine or drive the car again to see if the fault or faults are still there.

4. When first detected, a fault will be assigned a permanent-fault code. If the fault later disappears, the fault will be classified as intermittent.

5. All signals around the 12-volt level are proportional to battery voltage. These levels must therefore be taken only as a rough guide.

6. Zero-voltage signal levels indicate earth, although a sensitive multimeter may indicate a value slightly above 0 V.

7. Voltage measurements on inputs or outputs must only be made with the ignition on or the engine running.

8. The diagnostics socket (black) is located underneath the RH front seat. The socket is protected by a plastic cover held in place by means of a bayonet-action fastener.

9. During fault diagnosis, the ignition switch must always be in the Drive position.

10. The ISAT system number for the DI/APC system is #2.

11. If communication cannot be established between ISAT and the ECU, start by checking the leads from ECU pins 4 & 24 and the diagnostics socket (347).

12. Check also that the power feed and earth circuits to the diagnostics socket are good and that the connector pins are not damaged.

13. Once the fault codes stored in the system's ECU have been transferred to ISAT, the self-diagnostics function is finished. The faults are displayed in the form of five-figure codes; subsequent fault-diagnosis work should follow the recommended test procedure detailed in the fault-diagnosis chart.

Note
If the fault code disappears when a new ECU is being tried, always test the old ECU again before deciding that it is faulty. There is always the possibility that a fault is merely the result of a loose contact or corroded pin.

Connecting test probes to the ECU connector

Before starting any fault-diagnosis work on the DI/APC system, you must first gain access to the ECU connector block. Test probes and the like must be connected to the back of the wiring-loom half of the connector.

1. Remove the ECU, located under the driver's seat.

Note
The ignition must be off when the connector is being unplugged or plugged in.

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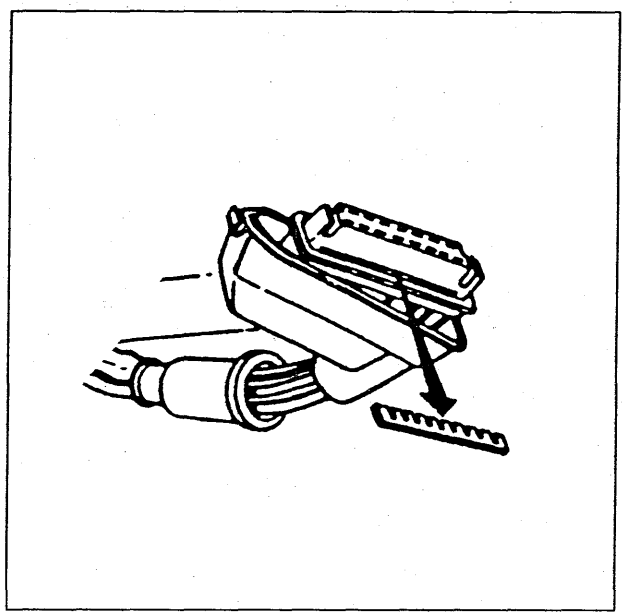
2. Unplug the connector.
3. Undo the cover and peel back the rubber gaiter.
4. Pull out the rubber seal and lift up the connector block.



Note
To prevent the connector being reversed, mark both the ECU and the connector before removing the cover.

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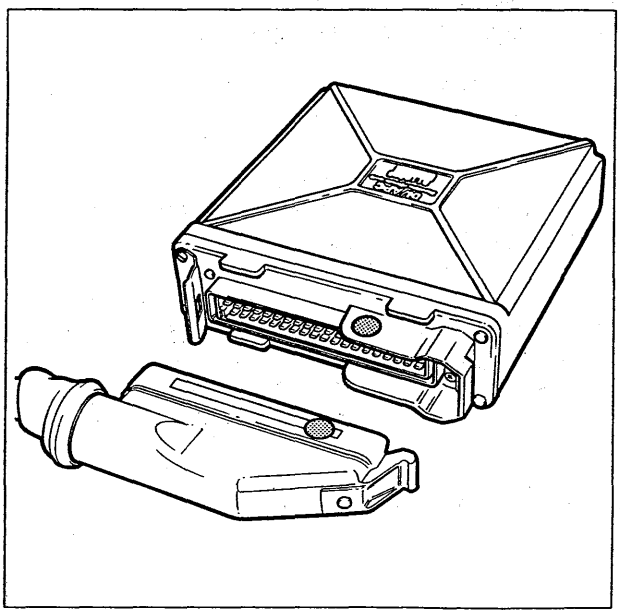
5. Plug in the connector.

Checking the wiring

The words, 'Check the wiring between xx and yy', are used frequently in the fault-diagnosis charts. Sometimes the wiring may be run through different types of connector and, by implication, these must also be checked for circuit continuity and short circuiting.

Also make a visual check to ensure that there is no damage to wiring or connectors.

Be alert to the possibility of crosstalk or interference from other components.



Mark both the ECU and connector

Using ISAT command codes

When ISAT command codes are being used to simulate signals or functions, the resulting readings on the display are in the form of an alphanumeric code.

The code has five character positions.

Example 1:

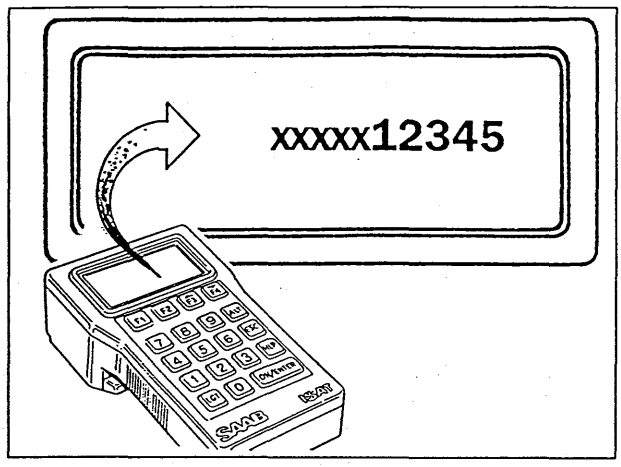
To check the position of the timing advance, enter command code 27A on the ISAT keypad.

With the engine idling, the last five characters on the ISAT display should be 80+20, indicating that the timing is 20° BTDC.

Example 2:

Sometimes we want to know if a signal is high or low. To check the brake signal, we enter command code 200 via the ISAT keypad.

If the signal is not activated, code 8B000 will be displayed, indicating that the signal level is low. If the signal is activated, 8B100 will be displayed, indicating a high signal level.



Reading on ISAT display in form of five-character alphanumeric code.

Command codes

Code	Component/signal	Code displayed; Voltage (V)
200	Brake signal	8B000 = not activated; 0 V 8B100 = activated; battery voltage
202	Crankshaft sensor	8B000 = unscreened; 0 V 8B100 = screened; 5 V
203	Ignition synchronization (all cylinders)	8B300 (combustion signal high); 5 V 8B000 (combustion signal low); ≤1 V
204	Throttle potentiometer, full throttle (LH 2.4.2)	80000 = idling (engine running); *) 80100 = full throttle (engine running); *)

*) *New reading introduced on M91*

Code	Component/signal	Code displayed; Voltage (V)
229	Knock-sensor signal level	80004 (e.g.) 0.4 V
27A	Current position of throttle butterfly	80+15 = 15° BTDC (M91 onwards) 80-05 = 5° ATDC
280	Engine variant: cat/non-cat	e.g. B202L.KAT-165E (M91 onwards)
282	EPROM part number	e.g. PGM.NR 912614
283	Number of times knocking detected (Turbo only)	8B0x3 = where *x* is the number of times knocking detected (M91 onwards)
285	ECU part number	e.g. ECU.NR7859721 (M91 onwards)
286	Coding—linked terminals on connector 406 (Turbo only)	8E300 = ECU pin 1 to 12 V 8E200 = ECU pin 1 to earth 8E100 = ECU pin 1 not linked 8E000 = other (invalid combination)
287	Load signal *Tq* (*µs*)	80015 = 15 *µs* pulse width
450	Activate ignition sparks	11111
451	Activate solenoid valve (Turbo only)	11111
452	Activate *CHECK ENGINE* light (blinking)	11111
453	Activate fuel-boosting function (Turbo only)	11111; 12–0 V
454	Activate RPM signal	11111 *) (crankshaft position must be 10–45° BTDC: enter 202 and move car until 8B100 changes to 8B000)

*) *Remove fuel-pump fuse before entering this code*

Note
Command codes 450–454 inclusive activate the relevant function for about one minute.

Fault codes for the DI/APC system

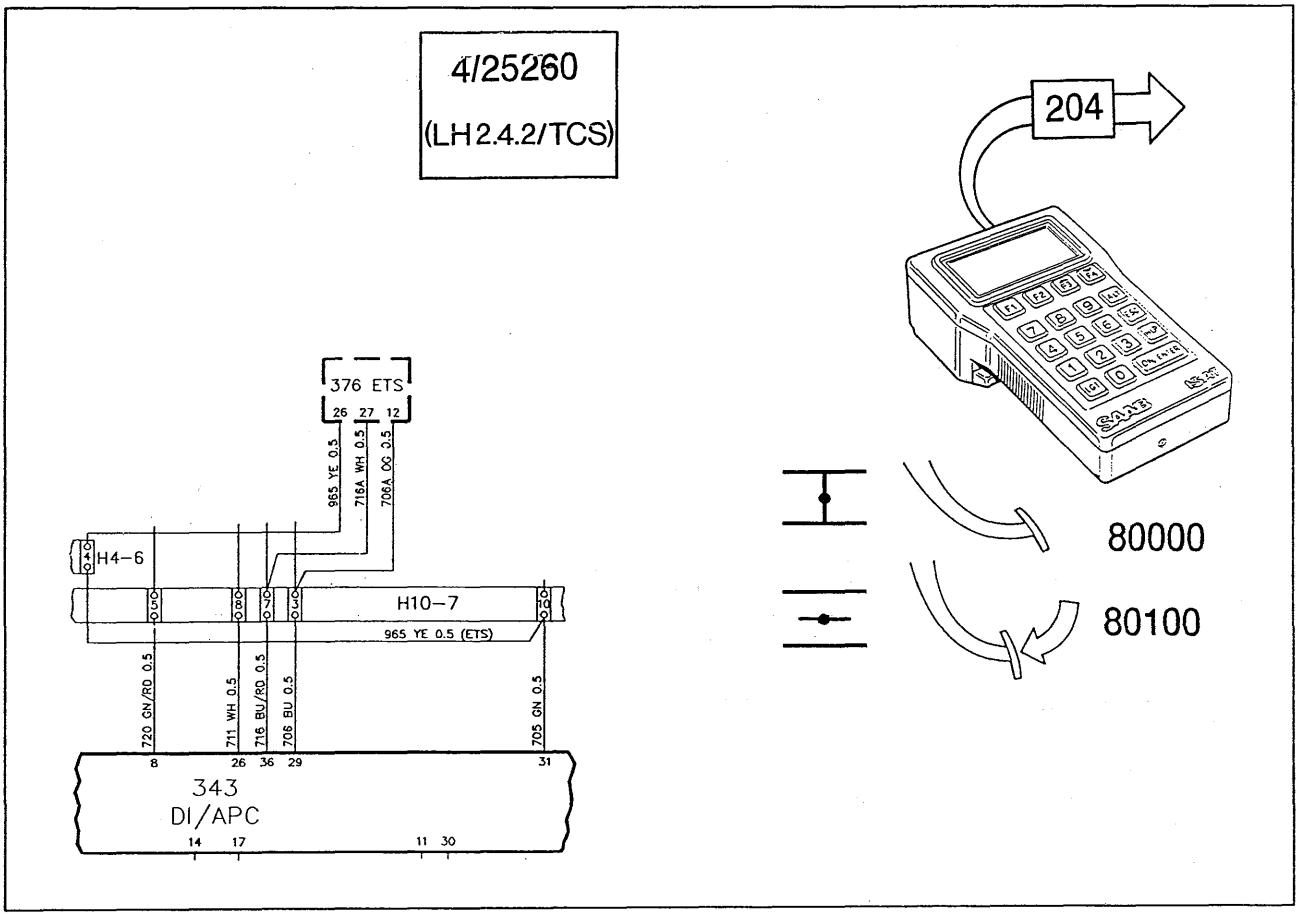
Permanent fault	Intermittent fault	Malfunction indicated	Action, see page:
429B0	229B0	M91: coding fault. Engine starts but only base-line charging pressure available	72
44261	24261	M91: road-speed signal absent (Turbo)	71
44360	24360	Crankshaft-sensor signal faulty	WM 2:6
44460	24460	Load signal, *Tq*, faulty	74
44461	24461	Adaption fault—outside limits	WM 2:6
44660	24660	PRE-IGNition fault	WM 2:6
44661	24661	Knock-sensor signal faulty	WM 2:6
44662	24662	Pre-ignition synchronization fault	WM 2:6
46660	26660	Pressure-sensor function faulty (pre-M91 only)	WM 2:6
45260	25260	M91: throttle-potentiometer signal faulty (LH 2.4.2)	65
45360	25360	Brake signal faulty	WM 2:6
46391	26391	M91: signal from temp sensor upstream of throttle housing faulty	67
60000	-	Watchdog (internal monitoring)	WM 2:6
60001	-	ECU (ROM) fault	WM 2:6
60002	-	ECU (RAM) fault	WM 2:6
11111	-	Acknowledgement = OK	WM 2:6

Fault-diagnosis chart for DI/APC

The fault-diagnosis procedures that follow only concern functions affected by M91 modifications.

For all other fault-diagnosis work, refer to section 2:6 of the Workshop Manual.

Fault code 4/25260



Fault symptom

Engine runs on base-line charging pressure only.

Malfunction indicated

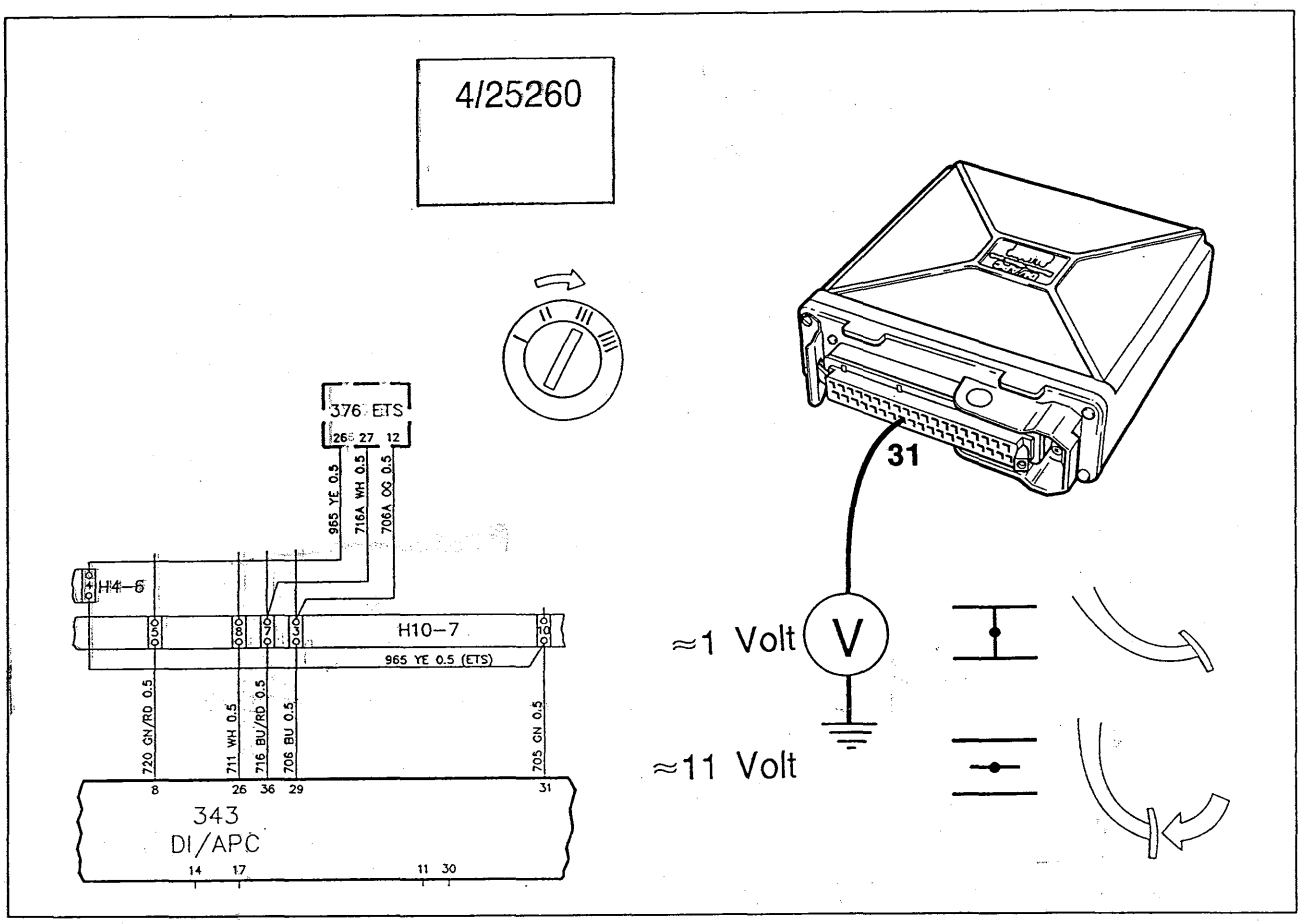
Throttle-potentiometer signal faulty or missing.

Test procedure

1. With the engine idling, enter ISAT command code 204 to check the input throttle signal to pin 31.

   At full throttle, display = 80000; halfway or idling position = 80100.

   If the values are incorrect or are not displayed, use ISAT to check whether any fault codes have been recorded for the LH system.



2. With the ignition in the Drive position, check the signal at pin 31:

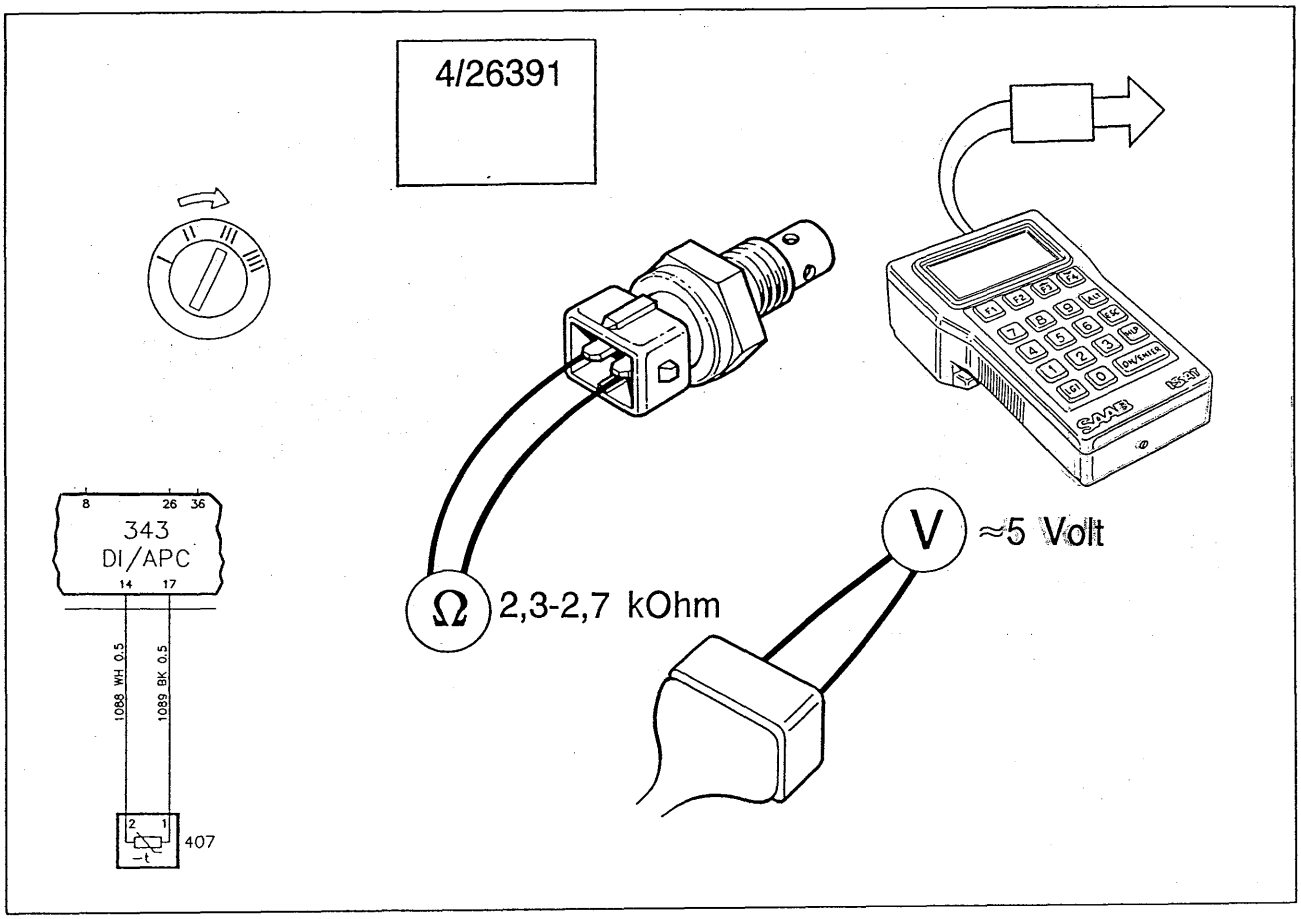
   - Correct value for idling position: approx. 1 V
   - Correct value for full throttle: approx. 11 V

   If the signal is correct, clear the fault code and test drive the car. If the fault code is generated again, try a known good DI/APC-system ECU.

3. If there is no signal at pin 31, check the GN/RD lead between pin 3 of the LH-system ECU and pin 31 on the DI/APC-system ECU.

4. If the wiring is sound, try fitting a known good LH-system ECU.

Fault code 4/26391



Malfunction indicated

Temperature-sensor signal (induction air) faulty or absent

Fault symptom

Only base-line charging pressure available

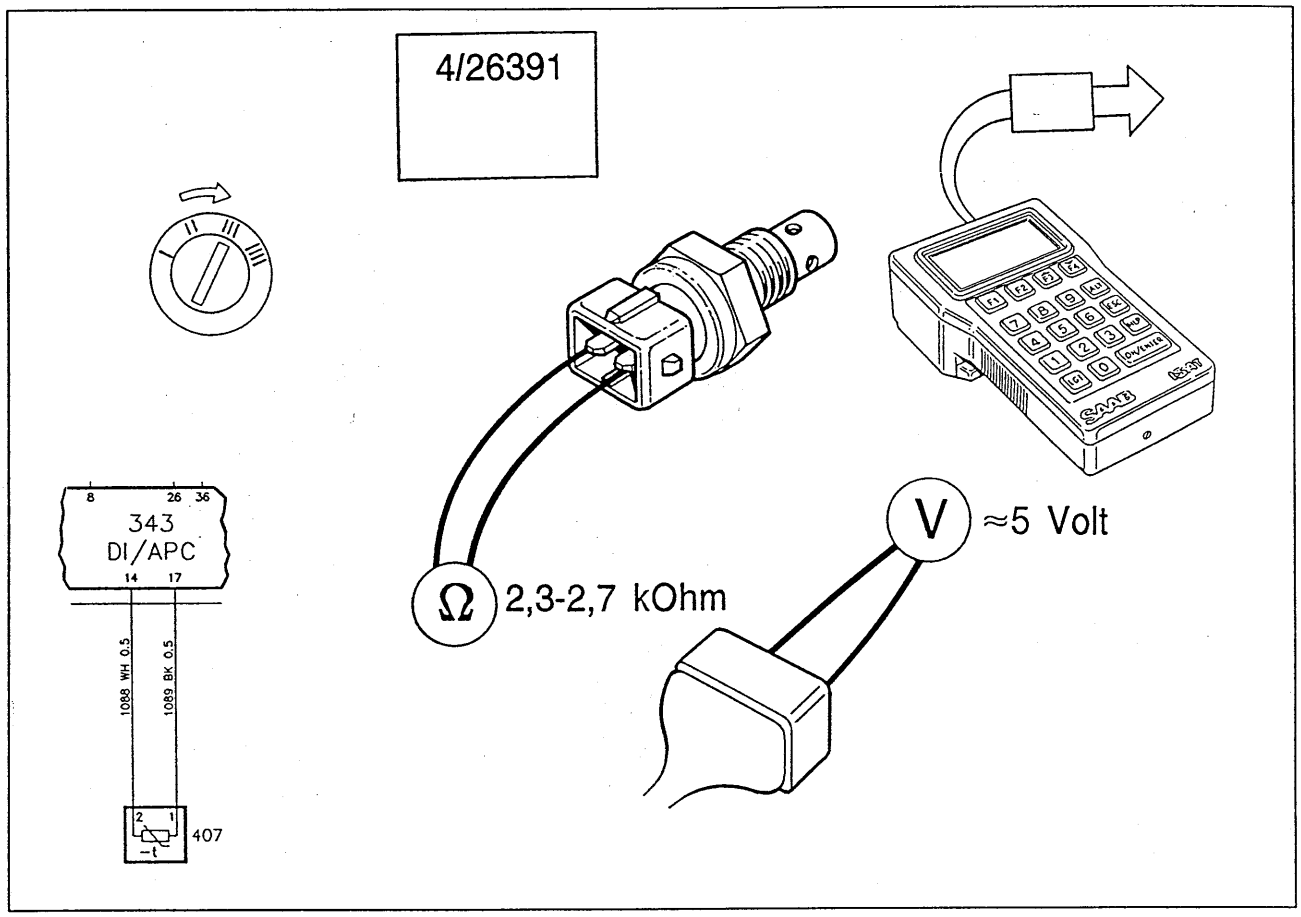
Test procedure

1. Measure the resistance of the temperature sensor (upstream of throttle housing).
   At 20°C, the resistance should be between 2.3 & 2.7 kohm (see table).

   If the resistance is incorrect, fit a new temperature sensor.

Resistance values

°C	°F	Ohm (±10%)
-20	-4	14000
-10	14	9000
0	32	5800
10	50	3800
15	58	3000
20	68	2600
25	76	2000
30	86	1700
80	176	320



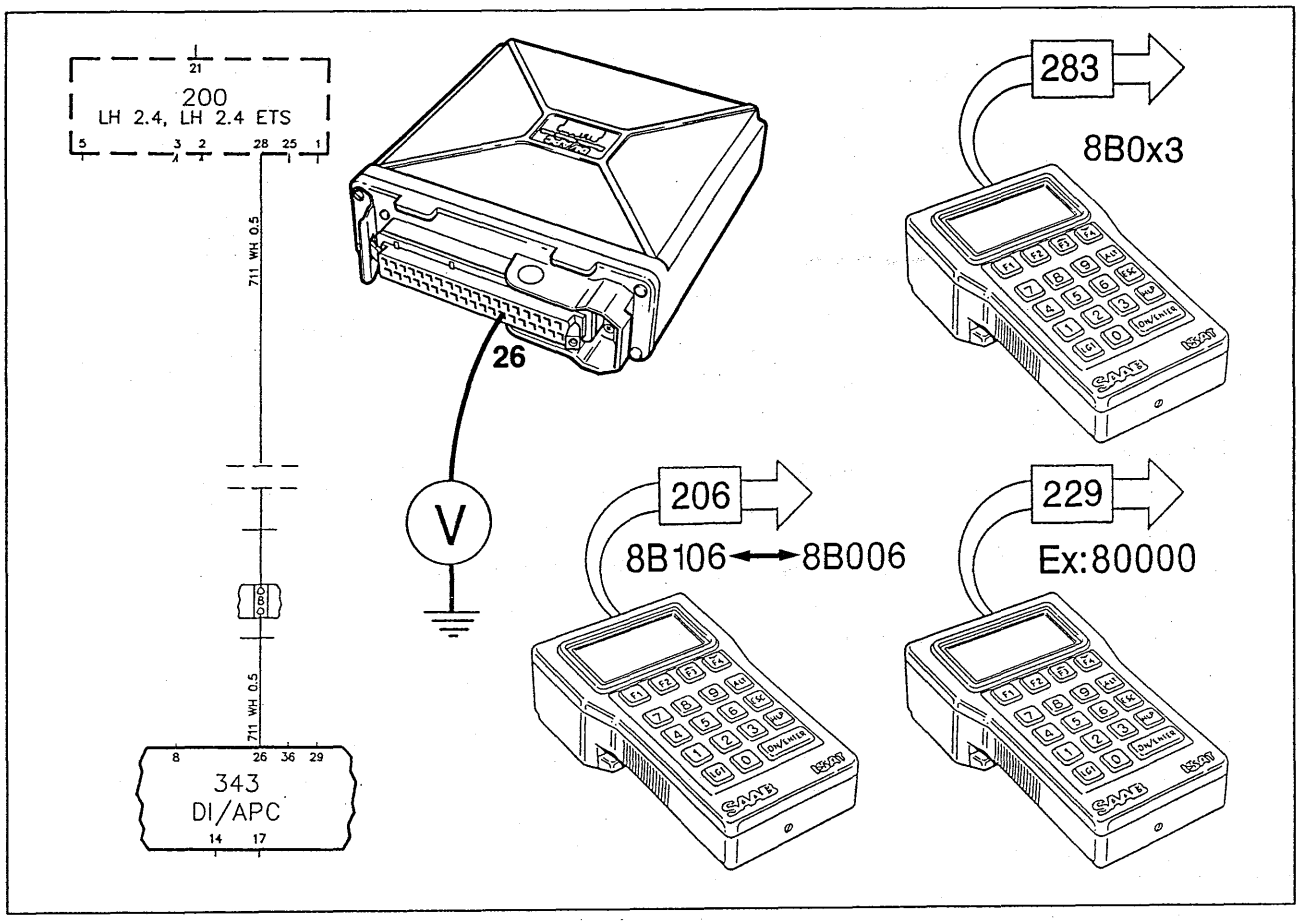
2. If the resistance is correct, with the ignition on check the voltage across the temperature-sensor connector pins.

   Correct voltage: approx. 5 V

   If the correct value is not obtained, check the WH lead between the temperature-sensor connector and ECU connector pin 14, and also the BK lead between the sensor connector and ECU pin 17 for a broken or short circuit.

   If the wiring is sound, try a known good DI/APC system ECU.

Boost pressure low



Fault symptom

Duration of knocking longer than normal

Test procedure

1. With the engine running, enter ISAT command code 283 and check for knocking/pinking while driving. The number of times knocking is detected will be shown on the display in the form of 8B0x3, where *x* = the number of times.

2. Command code 229 can also be used to check the signal level from the knock sensor.

3. If knocking is occurring, establish contact with the LH system, system #1.

   Enter command code 206 and watch the ISAT display for the following readings (LH 2.4.2 Turbo only):

   - 8B106 fuel boosting on knocking
   - 8B006 fuel boosting on pre-ignition
   - When the engine is running normally, without knocking or pre-ignition, the signal will alternate between 8B106 and 8B006.

4. If there is no fuel boosting on knocking/pinking, enter command code 453 (with the ignition in the Drive position).

   The display should now show 11111, and the voltage at ECU connector pin 26 should switch from 12 to 0 V.

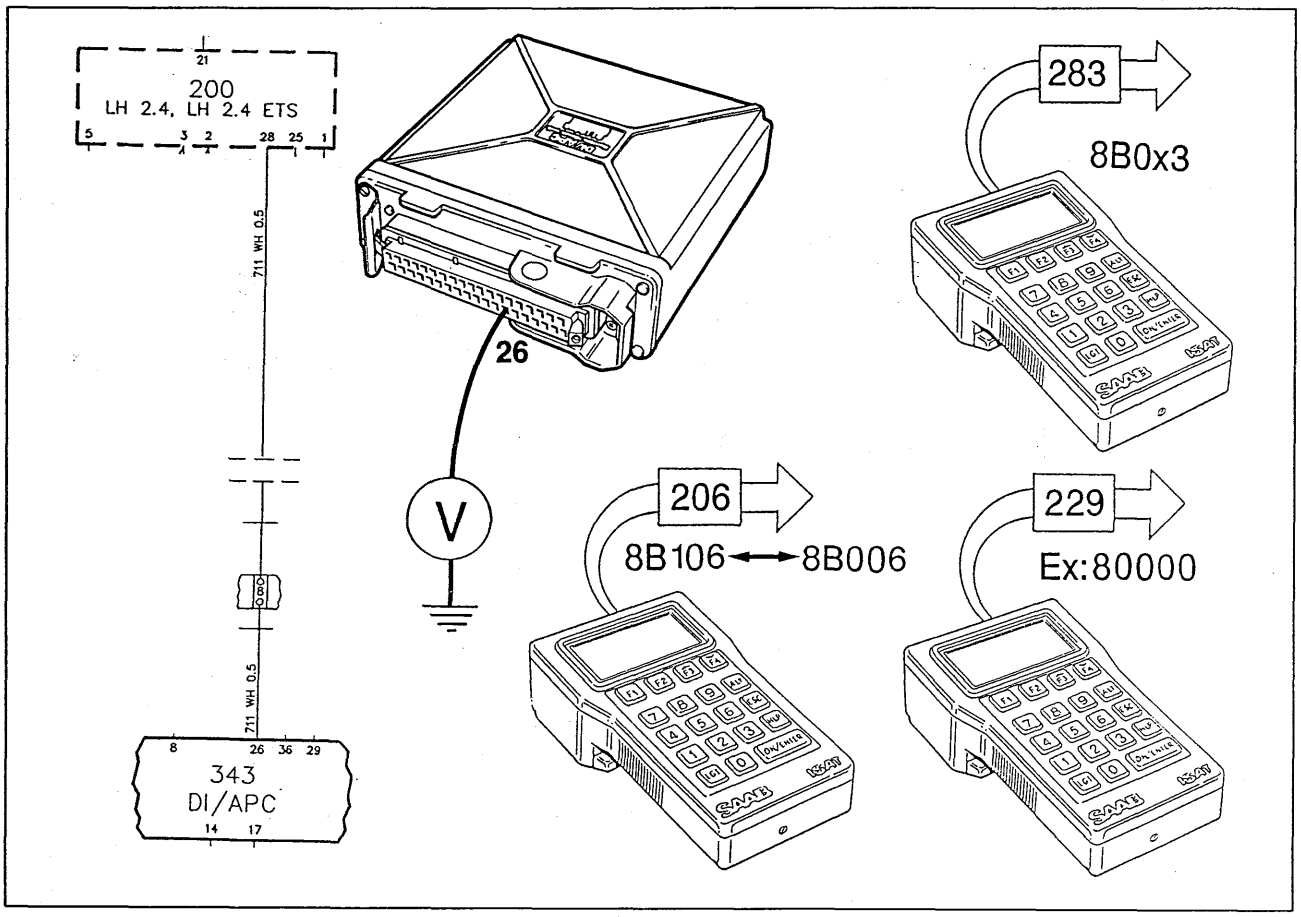
5. If not, check the 12-V feed from LH-system ECU pin 20 to pin 26 of the DI/APC-system ECU.

   If the circuit is dead, check the lead between the ECUs.

   If the wiring is sound, try a known good LH-system ECU.

6. If 12 V is reaching pin 26 but the voltage is not alternating between 12 and 0 V when command code 453 has been entered, try a known good DI/APC-system ECU.

High fuel consumption



Fault symptom

High fuel consumption; engine rough

Test procedure

1. While driving the car, enter ISAT command code 206 (for the LH system). Check if fuel-boosting is constant (8B006 or 8B106 showing all the time).

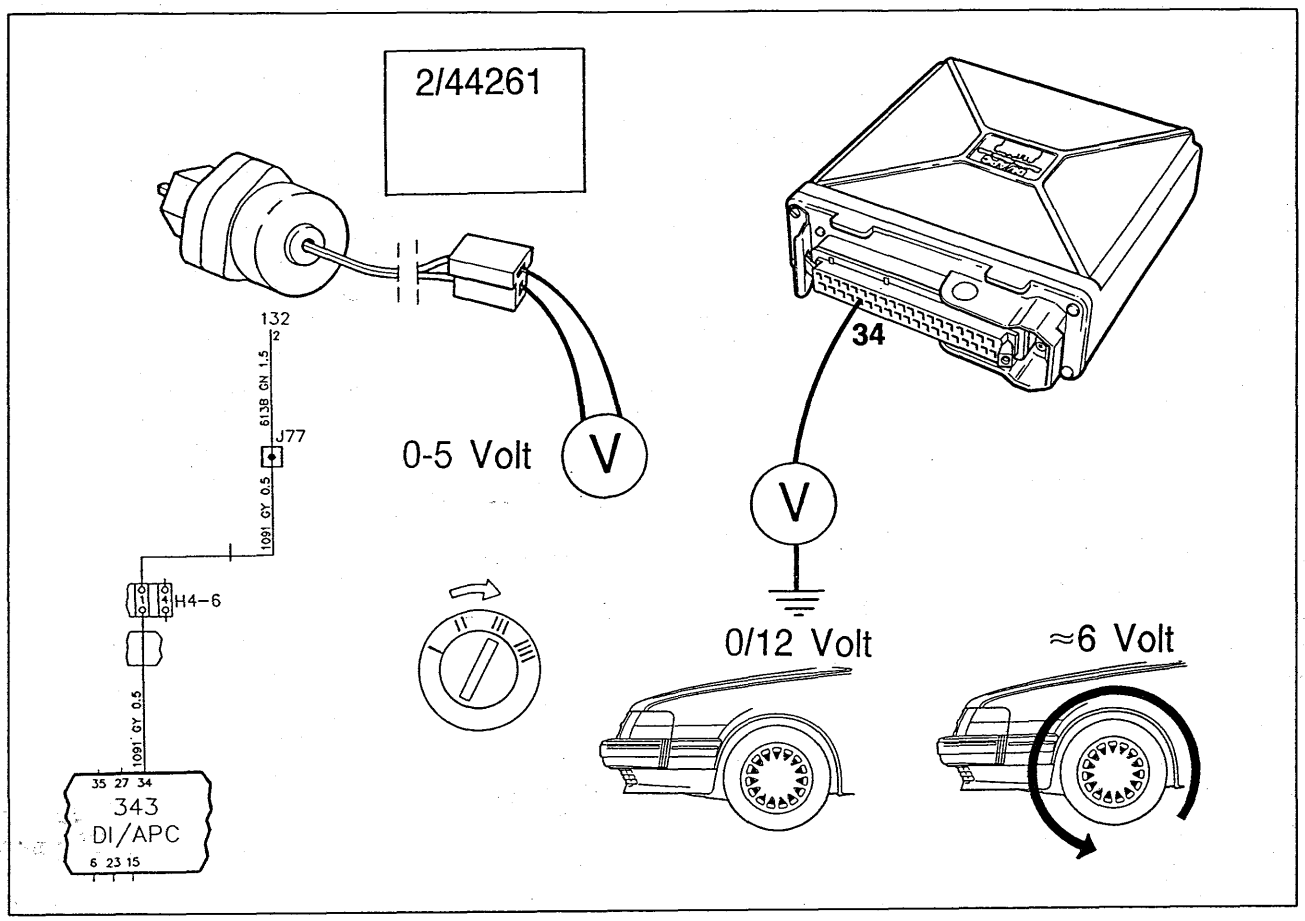
2. If constant fuel-boosting is indicated but pinking/knocking does not occur, check if the signal level from the knock sensor is high, by using command code 229 for the DI/APC system.

   Command code 283 can also be used.

   If the signal is high, follow the test procedure for the knock sensor.

3. If the signal is correct, continue fault diagnosis on the LH system.

Fault code 2/44261



Malfunction indicated

Road-speed signal faulty or absent (DI/APC cars only)

Test procedure

1. Check that the speedometer is working.

   If not, unplug the two-pin connector from the speedometer and measure the signal voltage from the speed sensor on the gearbox. The multimeter must be set for measuring a.c..

   As the speed increases, the signal voltage should increase within the range 0–5 V.

2. Check that the EDU is working as this also uses the speed signal.

   If not, check that voltage is present at pin 1 of the speedometer and that pin 3 is correctly earthed. If these are both correct, fit a new speed sensor on the instrument.

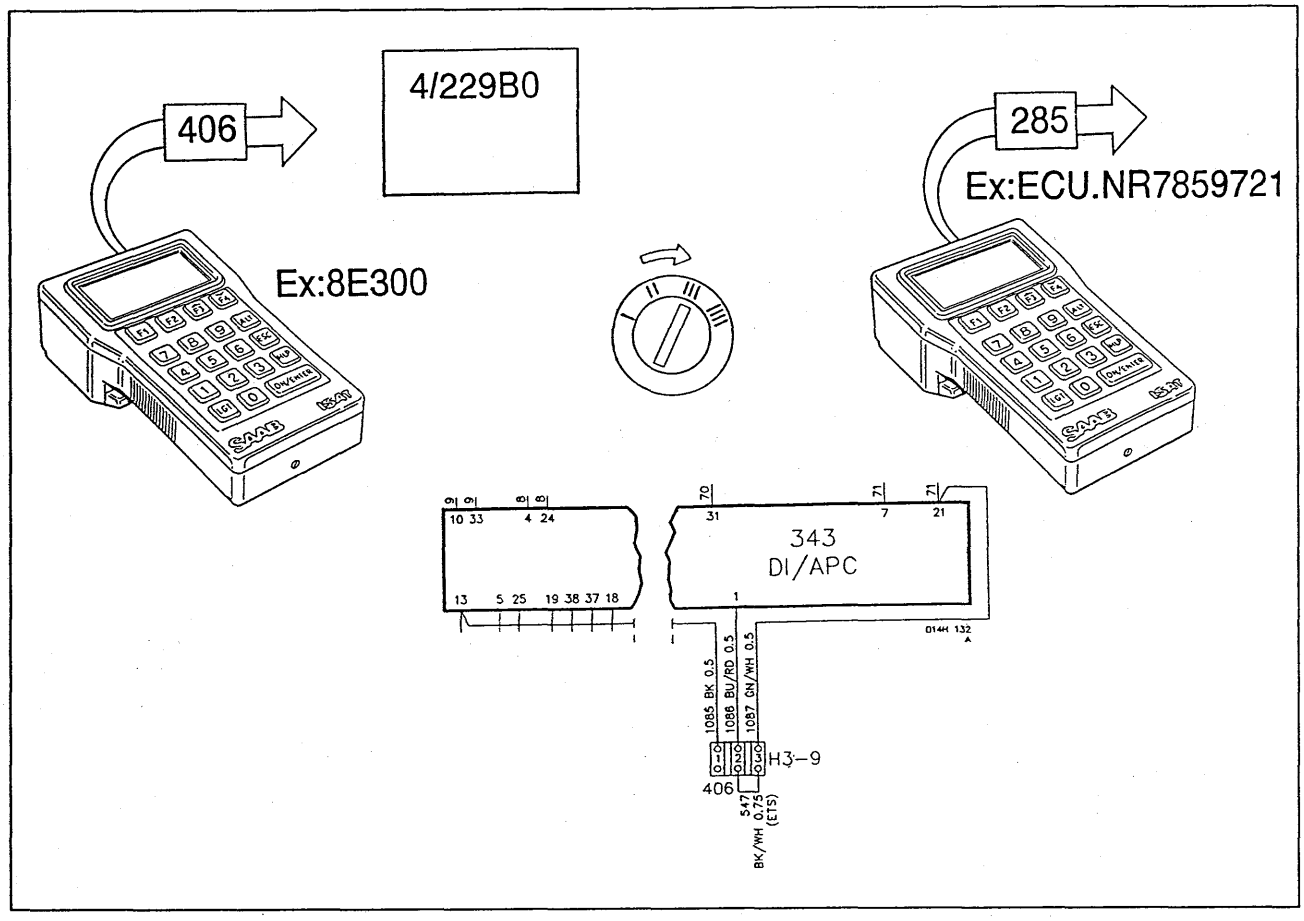
3. Check the speed pulses to ECU pin 34 with the wheels alternately rotating and stationary. Use the engine to rotate the wheels.

   With the wheels stationary, the signal level should be 0 or 12 V d.c. (depending on the position of the wheel) and, with the wheels rotating, approx. 6 V d.c..

   If the signal is correct, try a known good DI/APC-system ECU.

   If the signal is incorrect or absent, check the GN lead between the speed sensor (132) and pin 34 of the DI/APC-system ECU for a broken or short circuit.

Fault code 4/229B0



Malfunction indicated

Coding fault

Fault symptom

Only base-line charging pressure available

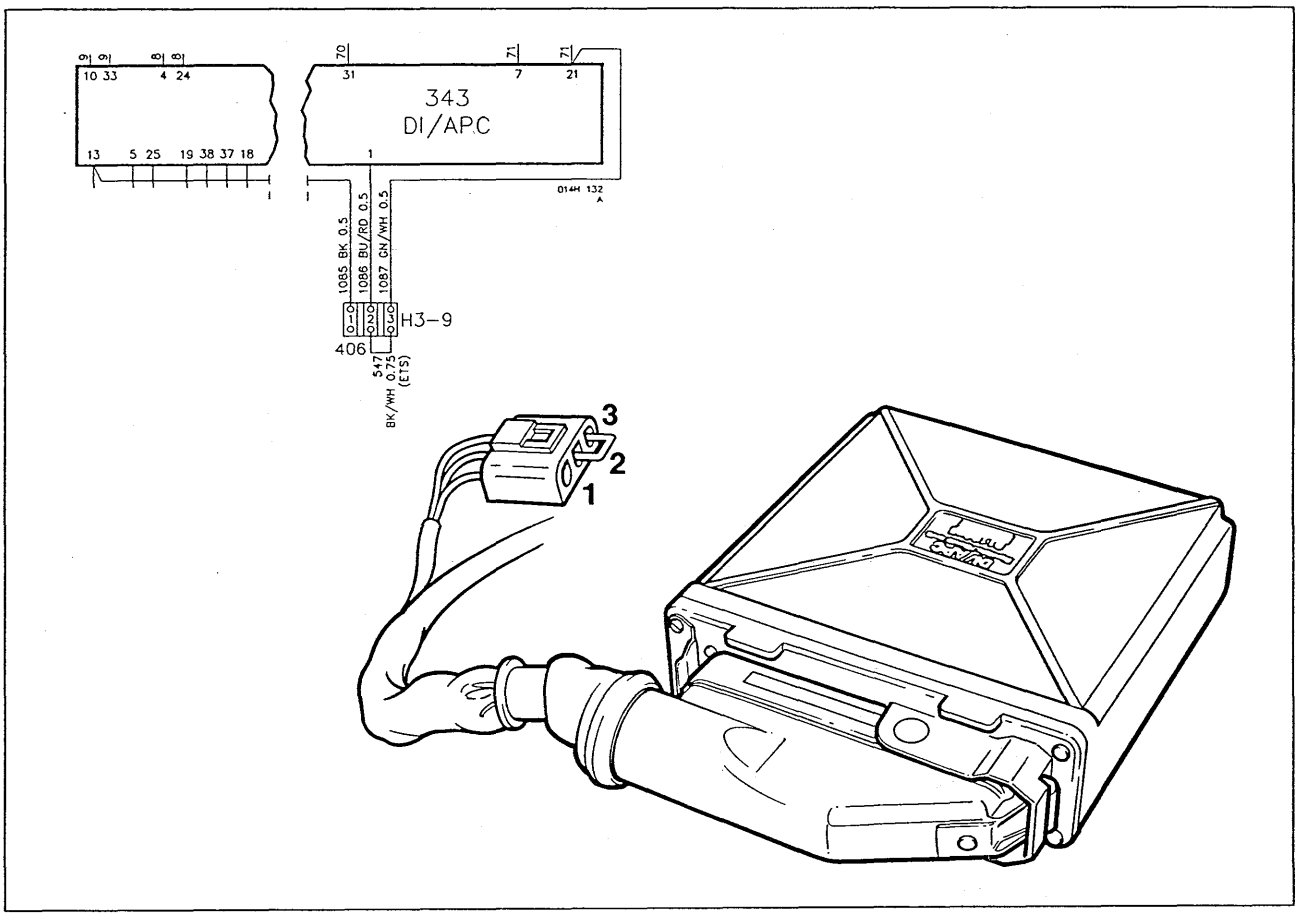
Test procedure

1. With the ignition in the Drive position, enter ISAT command code 406 to display the current coding for the ECU.

   The following display options are available:

   - 8E000 = invalid combination
   - 8E100 = ECU pin 1 (pin 2 on connector 286) not connected
   - 8E200 = ECU pin 1 earthed(pin 13 on ECU/pin 1 on connector)
   - 8E300 = Pin 1 connected to battery voltage (ECU pin 21/connector pin 3)

2. Check the coding of the 3-pin connector (406).
3. Check the wiring between the connector and the ECU for a broken or short circuit and to see that the wiring is connected correctly.
4. Check that the correct ECU is fitted by entering command code 285.



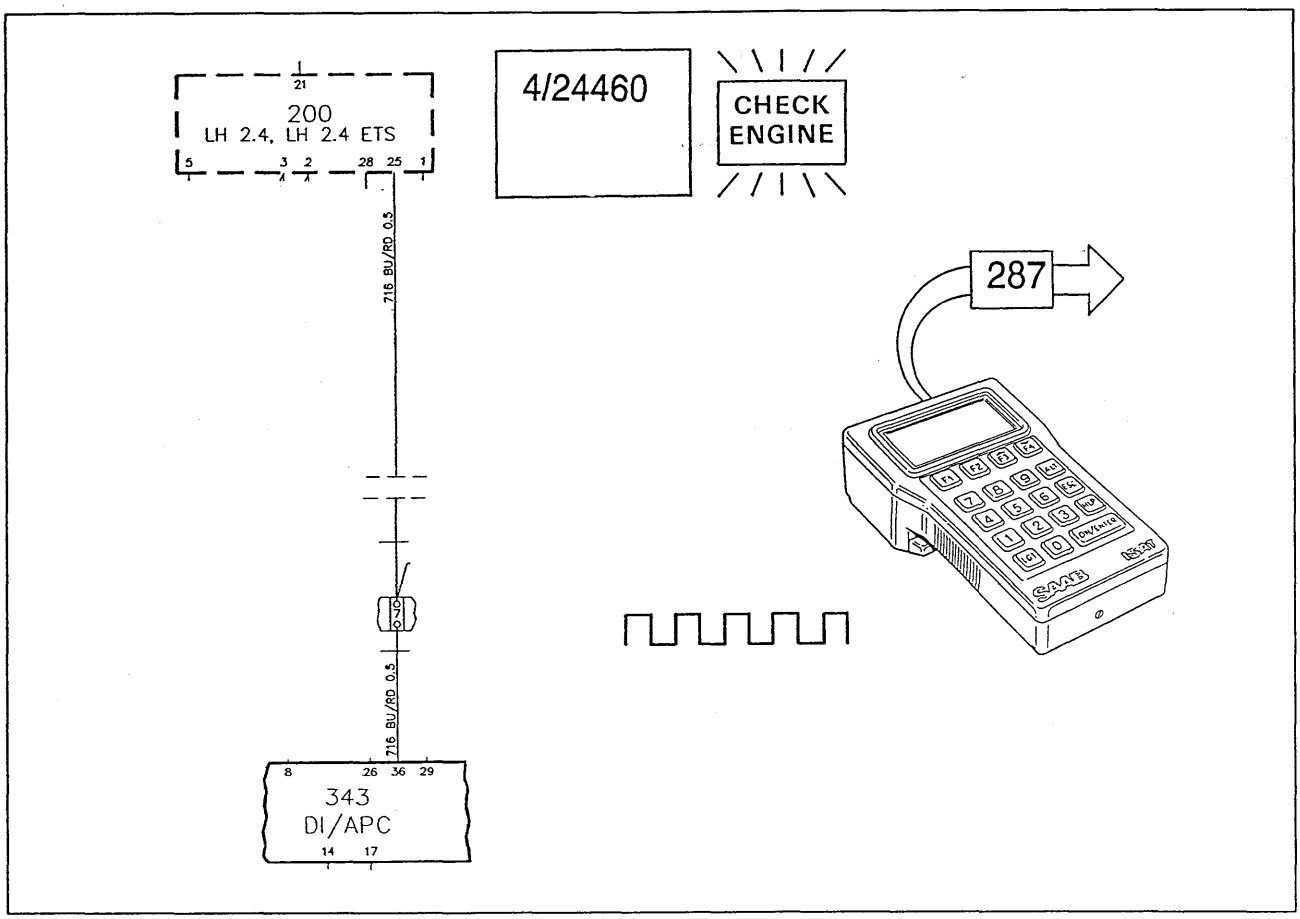
ECU coding

To limit the number of ECU variants, the leads from ECU pins 1, 13 & 21 have been run to a connector in the wiring loom adjacent to the ECU.

The way in which the ECU is configured for a given engine variant is done by different linking of the RD/BU lead from pin 1. There are three wiring options for the lead from ECU pin 1: the lead can be unconnected, linked to earth or linked to battery voltage.

On M91 vehicles, however, there are no US engine variants on which the same ECU is used with alternative codings.

Fault code 4/24460



Malfunction indicated

Load signal, *Tq*, faulty

Fault symptom

Only base-line charging pressure available (Turbo)
CHECK ENGINE light on

Test procedure

1. With the engine running, enter ISAT command code 287 and check the pulse width (*µs*) of the load signal, which should vary with variations in load and RPM.

   The frequency and pulse width of the signal can also be checked using the ISAT PULS function.

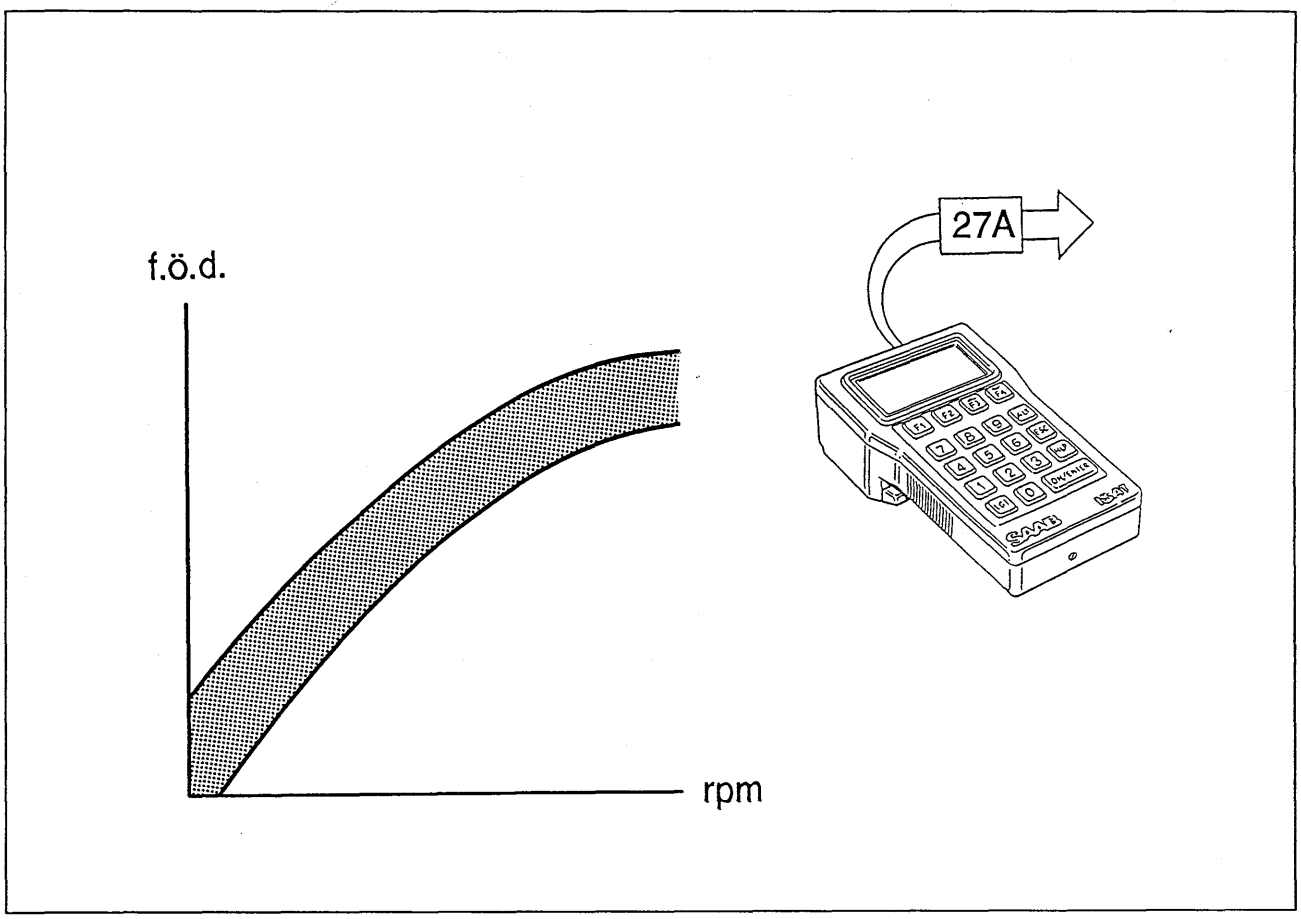
   The normal pulse width for the *Tq* signal on idling is 10–30 *µs*.

   If the reading is high (over 50 *µs*), follow the test procedure for the throttle signal.

2. If the signal is incorrect or absent, check the BU/RD lead between pin 36 of the DI/APC-system ECU and pin 25 of the LH-system ECU for a broken or short circuit.

   If the wiring is sound, try fitting a known good LH-system ECU.

3. Test drive the car and check whether the fault code is generated again. If so, try fitting a known good DI/APC-system ECU, at the same time refitting the old LH-system ECU.



Use command code 27A to check the timing at different rpm values.

Ignition–timing check

As from M91, at engine speeds between 800 & 900 rpm, there is no set timing on any variants. The ignition advance varies between 10° and 20° depending on the actual engine speed within the range 800–900 rpm.

However, ISAT command code 27A can be used to monitor the timing change within this speed range.

If the ignition advance is a constant 20° or more at engine speeds of 800–900 rpm, follow the test procedure for the *Tq* signal.

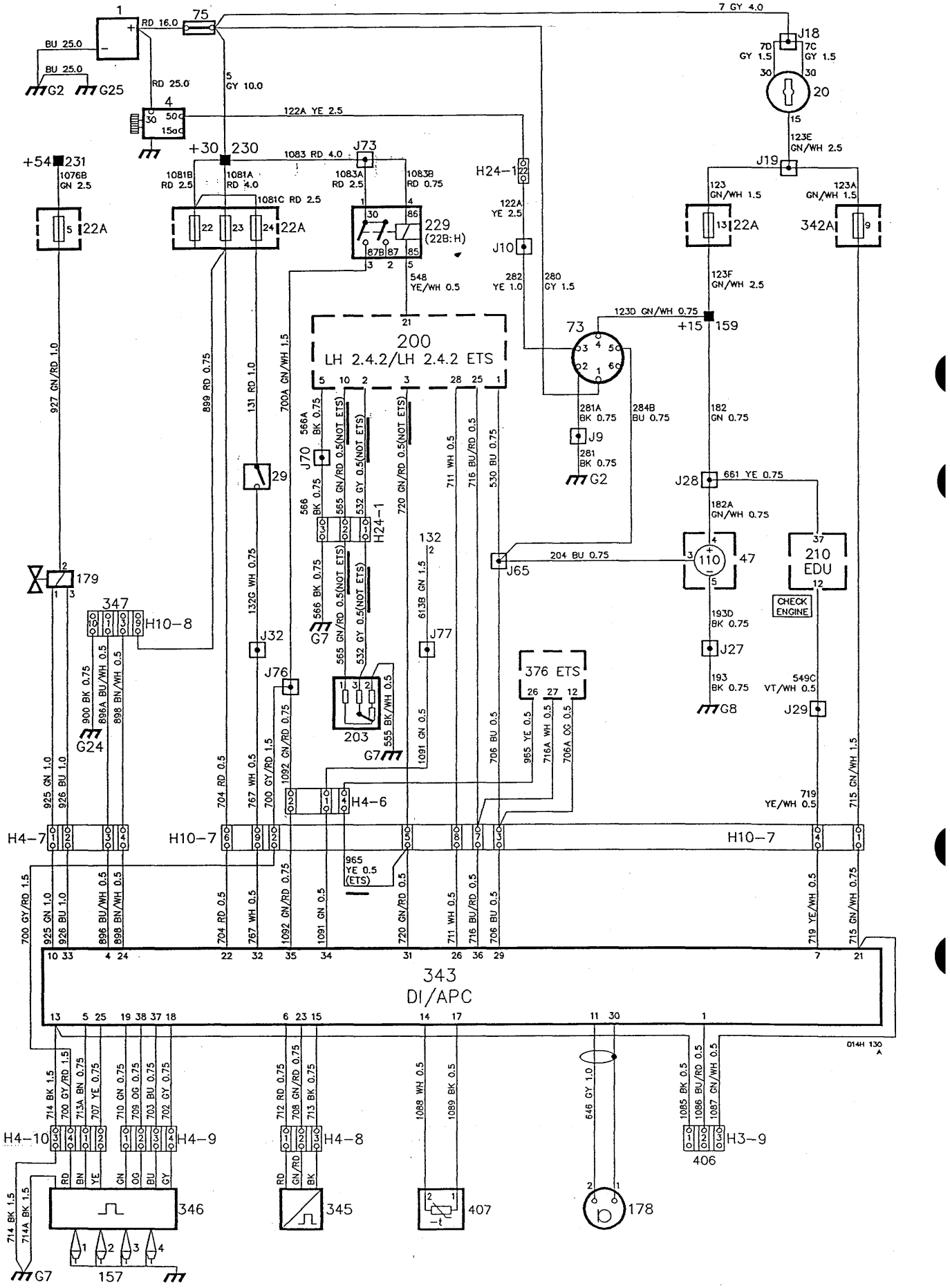
ECU-pin configuration for DI/APC, M91

Pin no.	Cable colour *)	Circuit	In	Out	Voltage, V	Remarks
1	RD/BU	Variant-coding lead			0 6–7 Battery	Linked to earth Not connected Linked to battery voltage
2						Not connected
3						Not connected
4	BU/WH	Diagnostics lead K (347; pin 3)				
5	BN	Combustion signal, cylinders 3 + 4			0	
6	RD	Feed to crankshaft sensor			Approx. 12	
7	YE/WH	*CHECK ENGINE* light, EDU 3			0 11–12	On Off
8	GN/RD	Throttle signal from 203 (LH 2.4 non-TCS only)			0 10–12	Full throttle Idling
9						Not connected
10	GN	Solenoid valve 179, pin 1 (Turbo only)			Battery	De-energized
11	GY	Knock-sensor signal			0	
12						Not connected
13	BK	Earth connection				
14	WH	Temperature sensor 407—sensor upstream of throttle housing (n/a DI non-Turbo)			0–5	Temperature dependent
15	BK	Earth for crankshaft sensor				
16						Not connected
17	BK	Earth for temperature sensor 407				
18	GY	Trigger signal for no. 4 cylinder			Battery	
19	GN	Trigger signal for no. 2 cylinder			Battery	
20						Not connected
21	GN/WH	+15 feed (342A)			Battery	
22	RD	+30 feed			Battery	
23	GN/RD	Signal from crankshaft sensor			0 5	Unscreened Screened
24	BN/WH	L diagnostics lead (347, pin 3)			10–12	
25	YE	Combustion signal for cylinders 1 + 2			0 5	Low High
26	WH	Enrichment on PRE-IGN/knocking (Engine running & normal operation)			12 6–7 12	Ignition on LH 2.4.2 LH 2.4
27						Not connected
28						Not connected
29	BU	RPM signal			Approx. 6.5 10–12	On starting Engine running

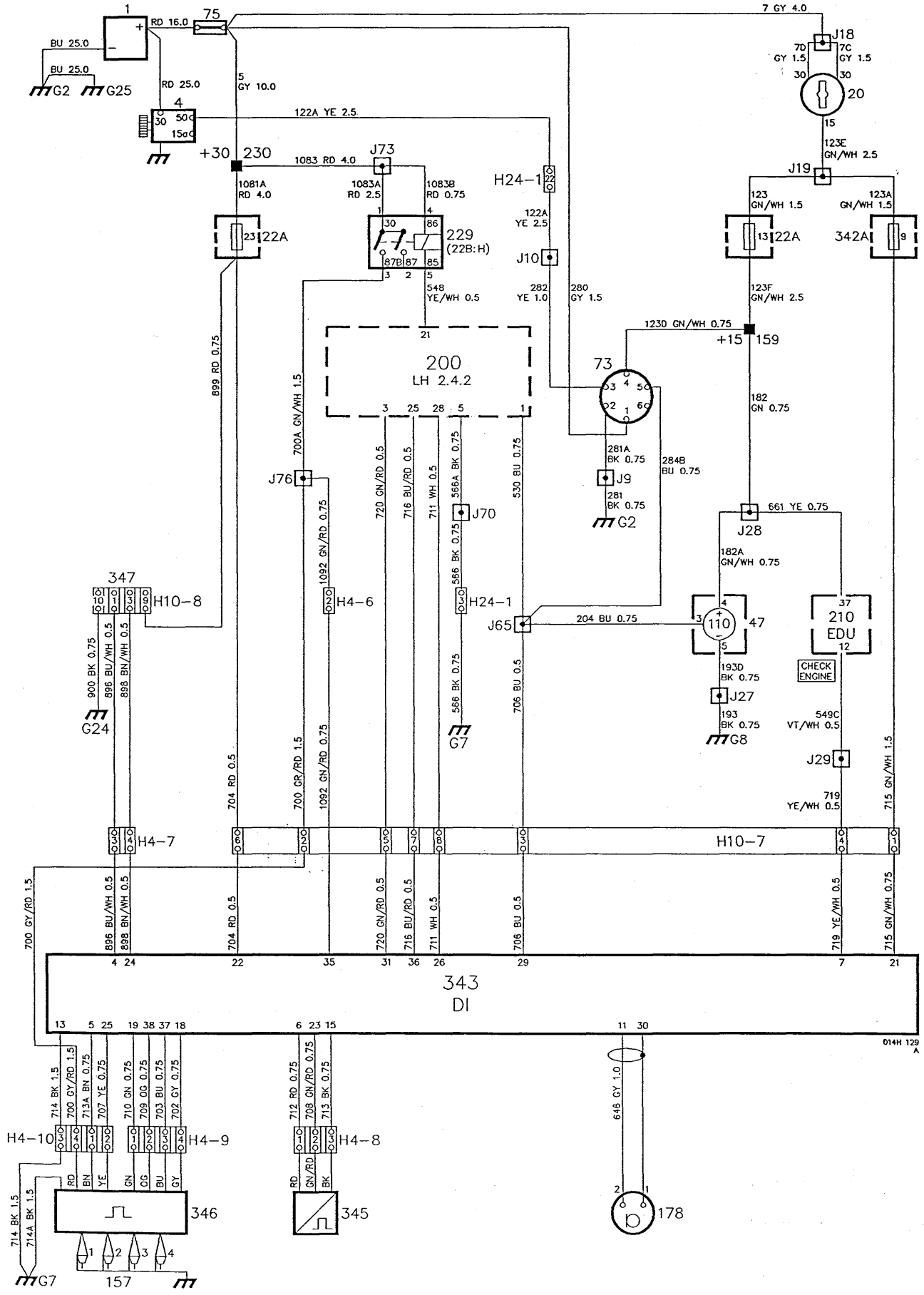
Pin no.	Cable colour *)	Circuit	In	Out	Voltage, V	Remarks
30						Earth (screen) for knock detector 178
31	GN/RD	Throttle-position signal			1 Approx. 11	Idling Full throttle
32	WH	Brake signal (Turbo only)			0 Battery	Not activated Activated
33	BU	Solenoid valve 176, pin 3 (Turbo only)			Battery	De-energized
34	GN/GY	Speed-sensor signal (n/a DI non-Turbo)			0 or 12 0–5	Car stationary Car moving
35	GN/RD	Feed from system relay (+30)			Battery	
36	BU/RD	Load signal, *Tq*			<1	Use ISAT PULS function or command code 287
37	BU	Trigger signal for no. 3 cylinder			Battery	
38	OG	Trigger signal for no. 1 cylinder			Battery	

*) *New cable-colour codes have been introduced as from M91. See the table on page 24.*

Wiring diagram for DI/APC, LH 2.4.2



Wiring diagram for DI, LH 2.4.2



List of DI/APC-system components

22A	Fuse panel in glove compartment
47	Main instrument panel
73	TSI socket
132	Road-speed sensor
157	Spark plugs
178	Knock sensor, APC/EZK
179	Solenoid valve, APC
187	Cruise-control vacuum pump
210	EDU trip computer (voltmeter & fuel consumption)
342A	Fuse box in engine bay
343	ECU for DI or DI/APC
345	Crankshaft sensor, DI/APC
346	Ignition cartridge for DI or DI/APC
347	Diagnostics socket for DI, DI/APC & LH
406	Coding for DI/APC
407	Engine-temperature sensor, DI/APC

Electrical system

New colour codes

A new standard for designating the cable colours on circuit diagrams and in fault- tracing schedules is being introduced as from the 1991 models.

Kod	English
BK	Black
BN	Brown
BU	Blue
GN	Green
GY	Grey
OG	Orange
RD	Red
VT	Violet
WH	White
YE	Yellow
PK	Pink

Daylight driving lights (option)

To get day light driving lights you have to install relay 174 in relay panel behind the glove compartment, whereby the headlamp dipped beams and parking lights will light up when the ignition is switched on, provided that the light switch is in the 0 position.

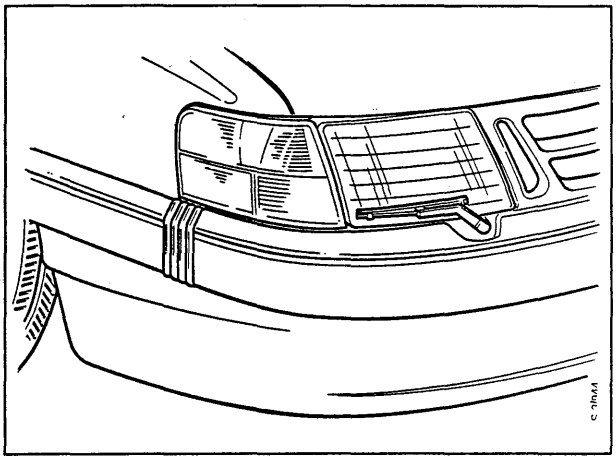
If the switch is in the parking light position, only the parking lights will be switched on, regardless of whether the ignition is switched on or off.

If the switch is in the headlamp position, the headlamp dipped beams or full beams and the parking lights will light up when the ignition is switched on.

The daylight driving lights can be disconnected by removing fuse No. 31.

Headlamp wipers

Due to the stricter cleaning requirements on the headlamp wipers, the sweep of the wiper motors has been increased from 110 degrees to 120 degrees, and the wiper blades are now 10 mm longer.



Headlamp wipers (US)

Five-door 1991 models for the US market will be equipped with headlamp wipers. For removing and fitting, see Group 0, News, 1990 model.

Radiator fan relay

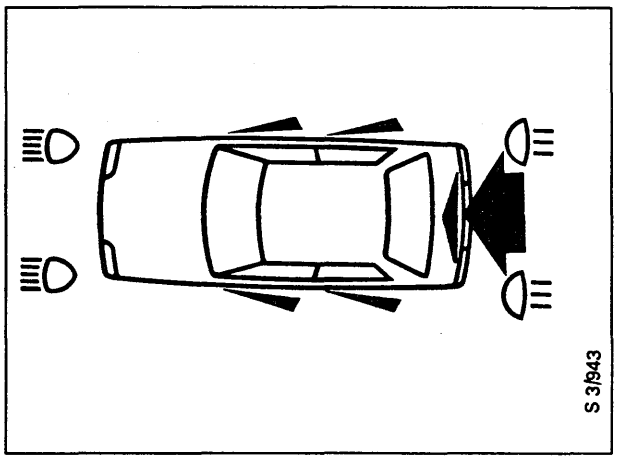
A new, uprated relay (70A) is being introduced on the 1991 models with two-speed radiator fan.

Earthing point

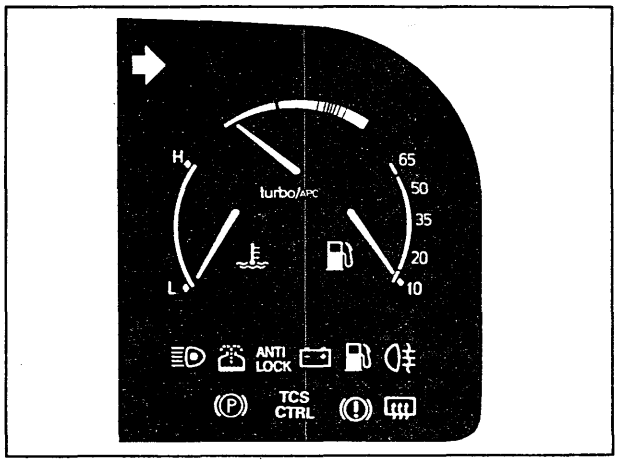
A new earthing point (G29) at the right-hand rear light cluster has been added on the 1991 model.

Instruments

A warning that the luggage compartment lid is not properly closed has been introduced in the pictogram.



A floating transition between the red and yellow fields has been introduced on the turbocharger boost pressure gauge.



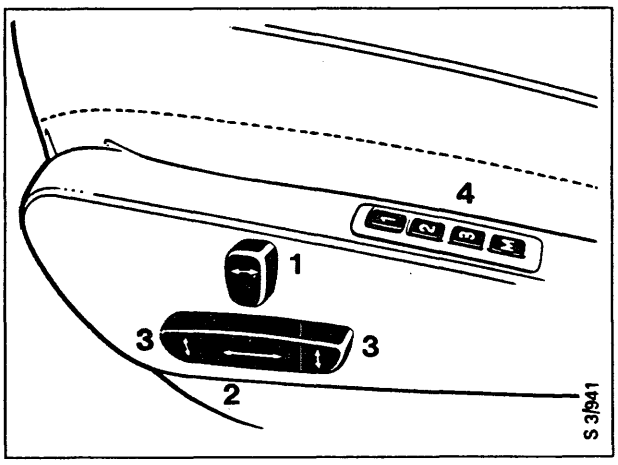
Electrically adjustable front seats with memory function

A memory function is introduced as an option for the electrically operated front seats.

For particulars of the operation, and the removal and refitting of the seat, see the section entitled Body.

The electrical operation is also described in this section (see the system diagram).

The setting is adjustable by means of the buttons on the control panel. After the seat has been adjusted, the setting can be stored by pressing the memory store button marked M and one of the memory recall buttons 1, 2 or 3. The memory function is then activated by keeping the appropriate memory recall button depressed until the seat has assumed its stored setting.



1 Backrest rake adjustment
2 Fore-and-aft adjustment
3 Seat cushion height adjustment
4 Buttons for memory function

System diagrams

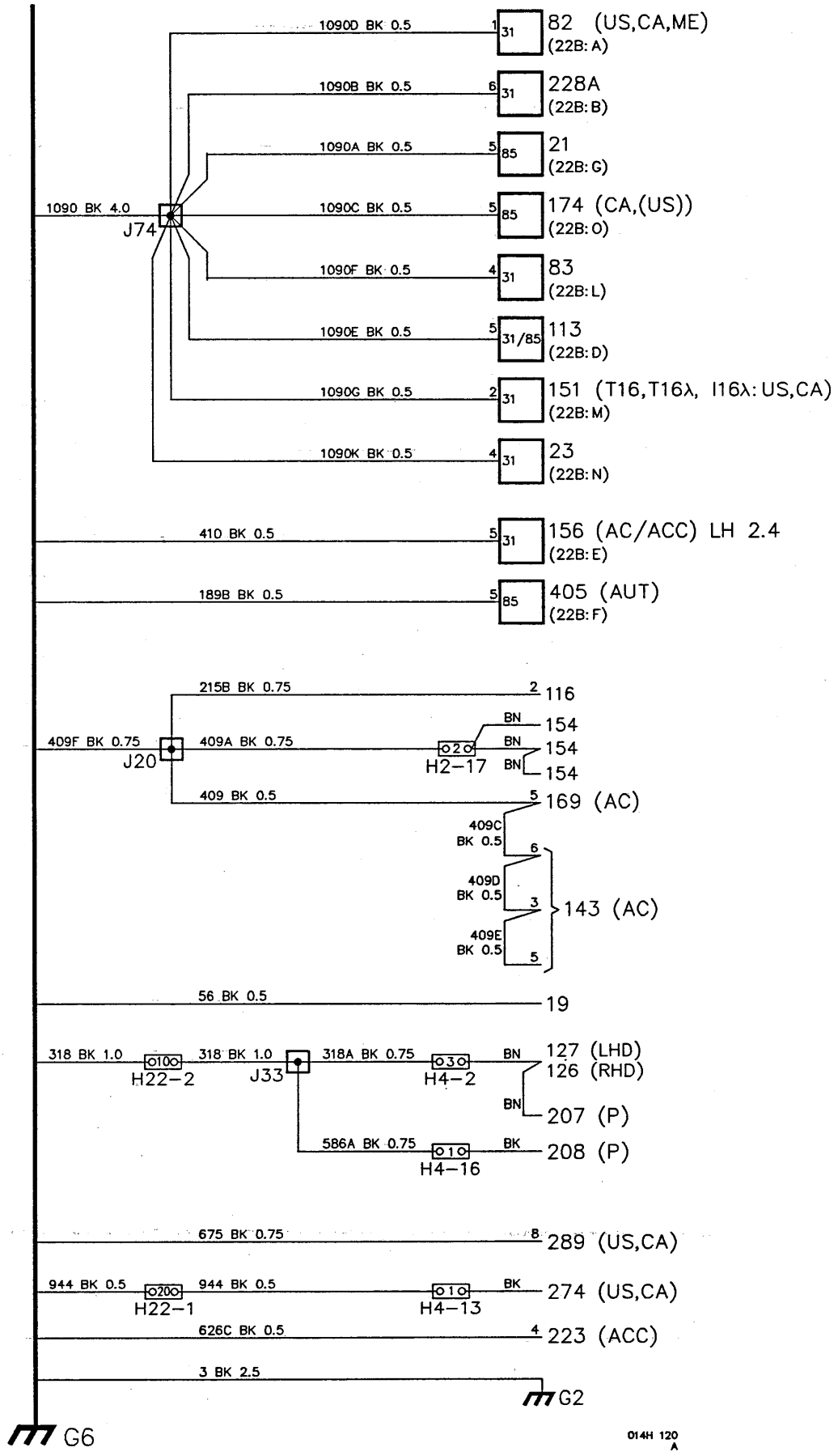
As from the 1991 models, connectors, earthing points and crimped connectors have been given new designations, and each component has been given a unique number.

Examples: Connector H10-8
H = Housing
10 = 10-pole
8 = Serial number

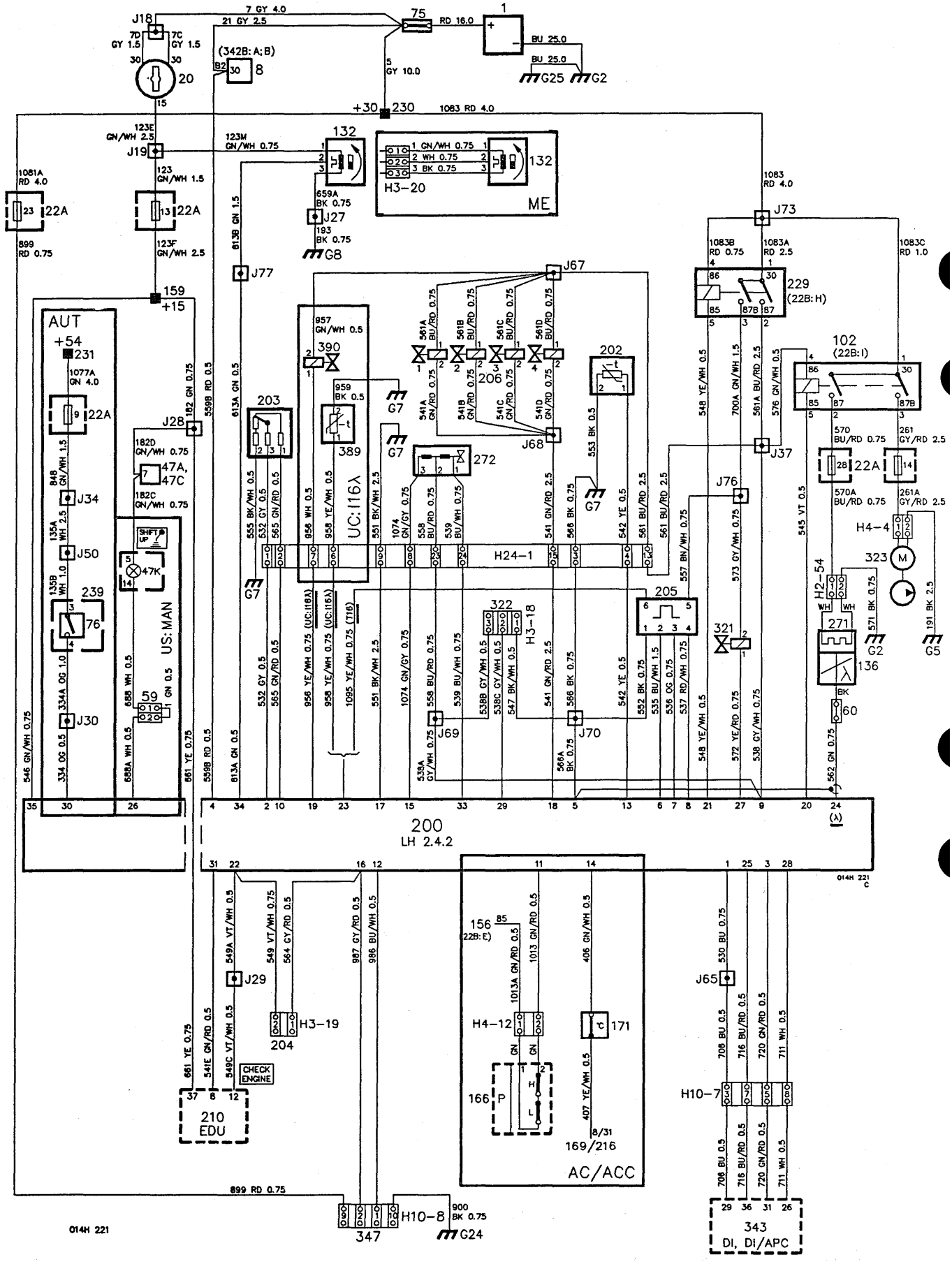
Earthing point G 29
G = Ground
29 = Serial number

Crimped connector J 77
J = Junction
77 = Serial number

Negative distribution terminal (G6)



LH 2.4.2 fuel system for I16, I16 lambda, T16 and T16 lambda



Operation

The LH 2.4.2 fuel system is an update of the LH 2.4. The fuel injection system is controlled and monitored by control unit 200, and a number of features have been modified as compared to the LH 2.4 system:

- The filament temperature of the air mass meter is LH 2.4.2 = 155°C above the outdoor temperature LH 2.4 = 120°C above the outdoor temperature Turbo engines are equipped with a larger air mass meter, rated for a maximum flow of 640 kg/h (that of the LH 2.4 is 470 kh/h)
- The LH 2.4.2 system has a throttle potentiometer, whereas the LH 2.4 system has a throttle switch.
- The injection valves are of a new type and have a higher capacity than the valves of the LH 2.4 system.
- The pressure controller for both the injection engine and the Turbo engine is designed for 3.0 bar.
- The programme is more comprehensive, which ensures better control.
- Sensor 132 for the speed transmitter supplies the speed signal to pin 34 of control unit 200. (LH 2.4 only on cars with shift-up function.)
- The AC is actuated via control unit 200. (LH 2.4 via a time-delay relay.)
- Delayed AC-cycling at road speeds below 15 km/h.
- Delayed actuation of lambda control, which improves the driveability during the warm-up stage.
- The Automatic Idling Control (AIC) valve has a 2-coil rotor and a "Limp home" function.

The idling control system is adaptive (self-instructive) and compensates automatically for normal changes. The idling speed is controlled by means of valve 272.

The built-in deceleration function interrupts the fuel supply during overrun braking within a certain engine speed range.

Electrically-operated vent valve 321 for the charcoal canister is controlled by signals from the control unit. The charcoal in the canister absorbs fuel fumes in the vent line from the tank.

The built-in fault diagnosis system gives fault codes via the CHECK ENGINE lamp or enables readings to be obtained by means of the ISAT.

The system receives its positive supply from fuse 13 when the ignition switch is in the start or drive position, and a constant supply from terminal +30 to relays 229 and 102.

The system calculates and controls the opening times of electrically controlled fuel injection valves 206, on the basis of the data stored in the control unit and information received from various transmitters.

Control unit 200 receives information on the engine speed by sensing the ignition pulses the ignition system.

Throttle angle transmitter 203 provides the control unit with information on the throttle angle.

Temperature transmitter 202 is of Negative Temperature Coefficient (NTC) type and continuously supplies the control unit with information on the engine temperature. If the signal is lost, the control unit will simulate an engine temperature of +45°C.

Air mass meter 205 is built into a plastic housing, and has no CO/lambda screw. In the event of a loss or signal from the air mass meter, e.g. if the filament should fail, an emergency system known as the "Limp-home" function in the control unit will come into operation. The car can then be driven, although its driveability will be limited. When the "Limp home" function is operative or if a serious fault should occur in the fuel system, warning lamp 47P CHECK ENGINE will light up. This lamp is located in the combined instrument and is supplied from fuse 13.

Fuel is supplied to the engine by an electrically driven fuel pump 323 which draws fuel from the fuel tank and pressurises the fuel in the system.

Air Conditioning (AC)/ Automatic Climate Control (ACC)

Thye control unit is connected to the air conditioning system via pin 14 "AC 171".

When the AC compressor is running, the control unit will compensate for the increased load caused by the compressor at engine idling speed, while at full throttle, the compressor will be disconnected.

Test connector 204 should be used for fault tracing. When pin 1 in the socket is earthed, flashing codes will be obtained on the CHECK ENGINE lamp.

Control unit 200 is connected to EDU1/EDU2 trip computer 210.

Lambda exhaust emission control

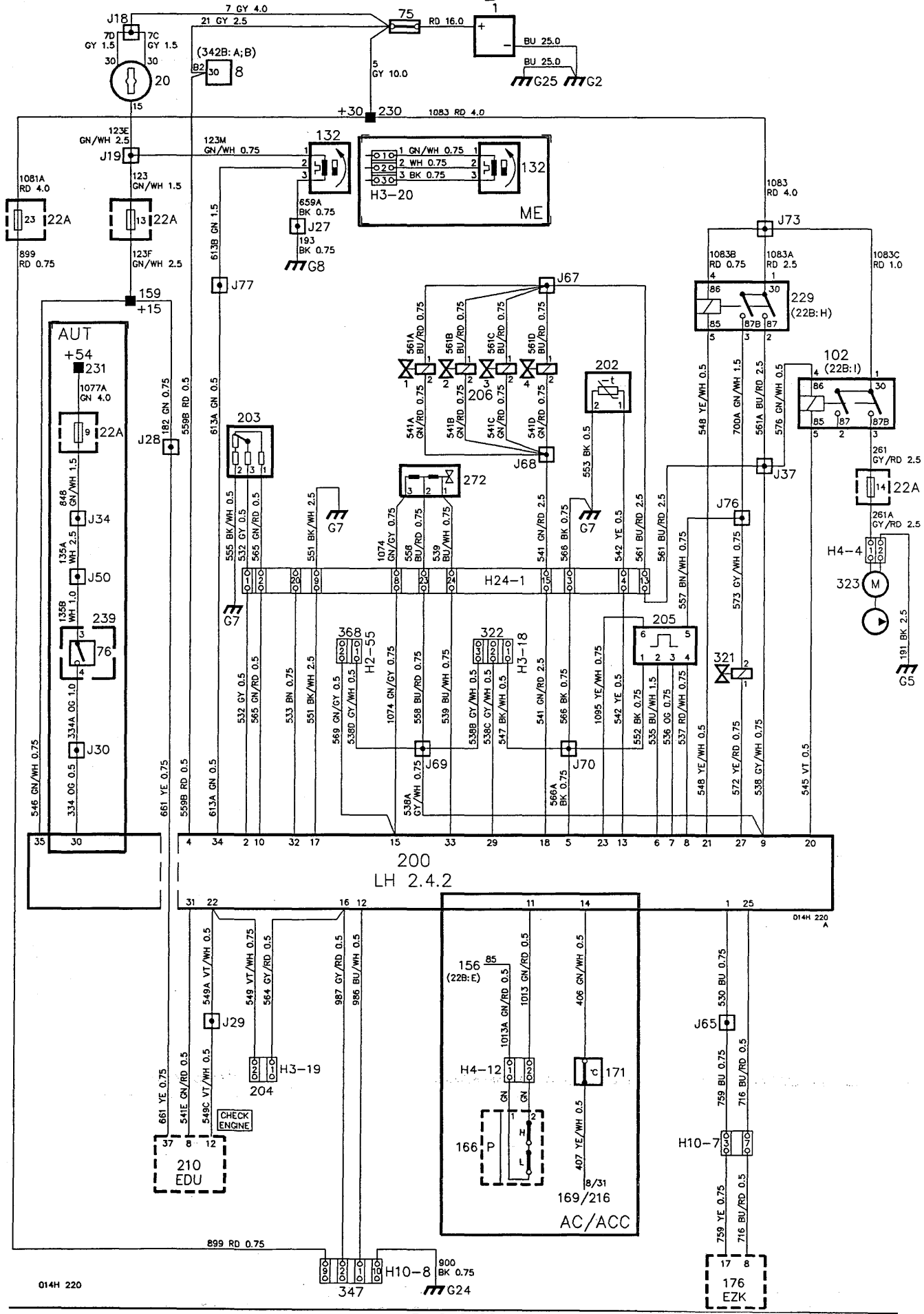
The car is equipped with an adaptive (self-instructive) Lambda system which compensates for variations in the fuel/air mixture caused by changes in the fuel system.

Lambda sensor 136 continually measures the oxygen content of the exhaust gases, thus enabling the control unit to adjust the mixture to as close as possible to Lambda = 1. The sensor is heated by preheater 271 (protected by fuse 28).

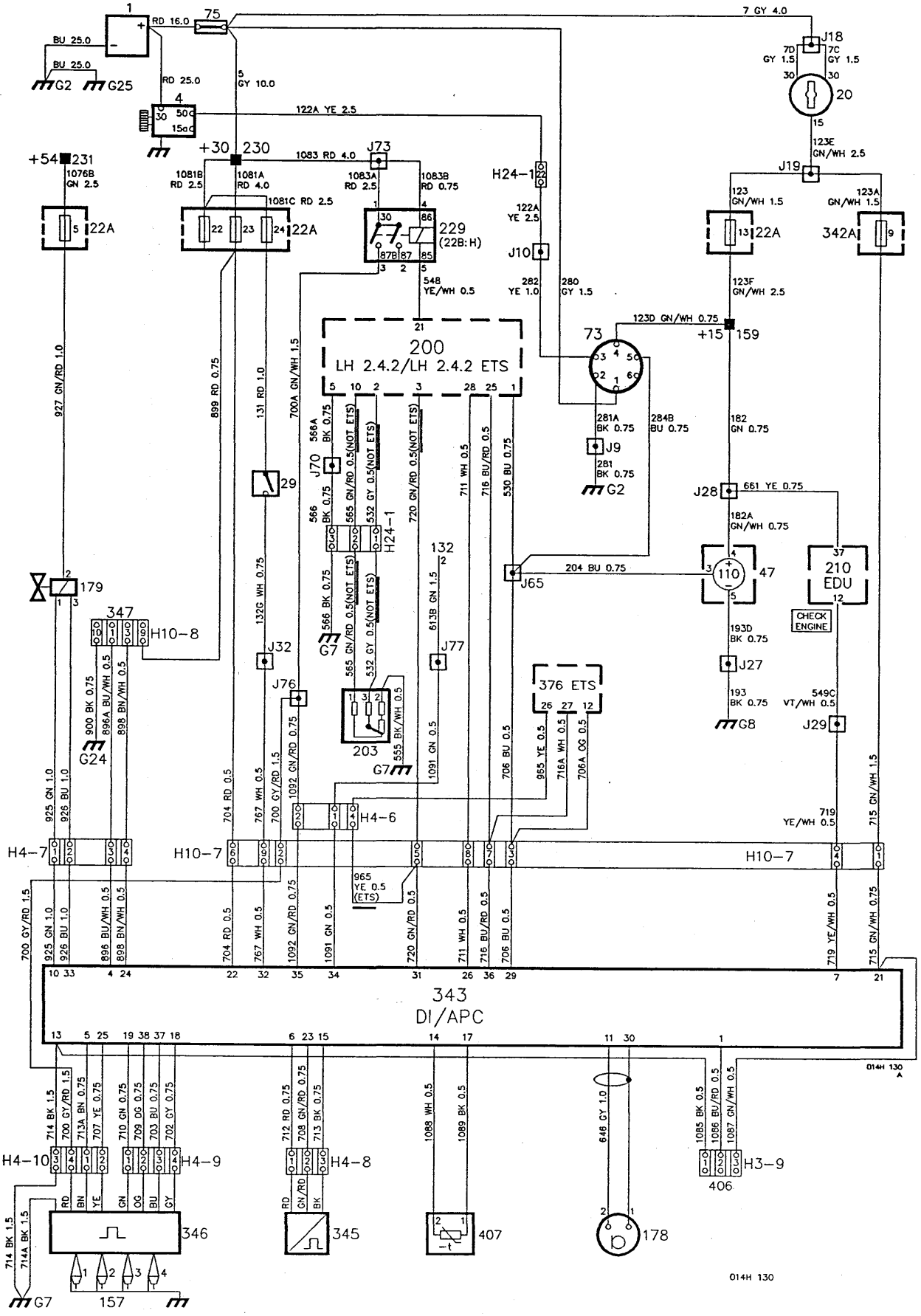
Automatic transmission

Cars with automatic transmission are also equipped with switch 76 which will close when the selector lever is set to "Drive" and the control unit will then compensate for the increased load applied by the automatic transmission when the engine is running at idling speed. Three-pole connector (coding) 322 has a plug which enables a car with automatic transmission to be distinguised from a car with manual gearbox.

LH 2.4.2 fuel system for I16



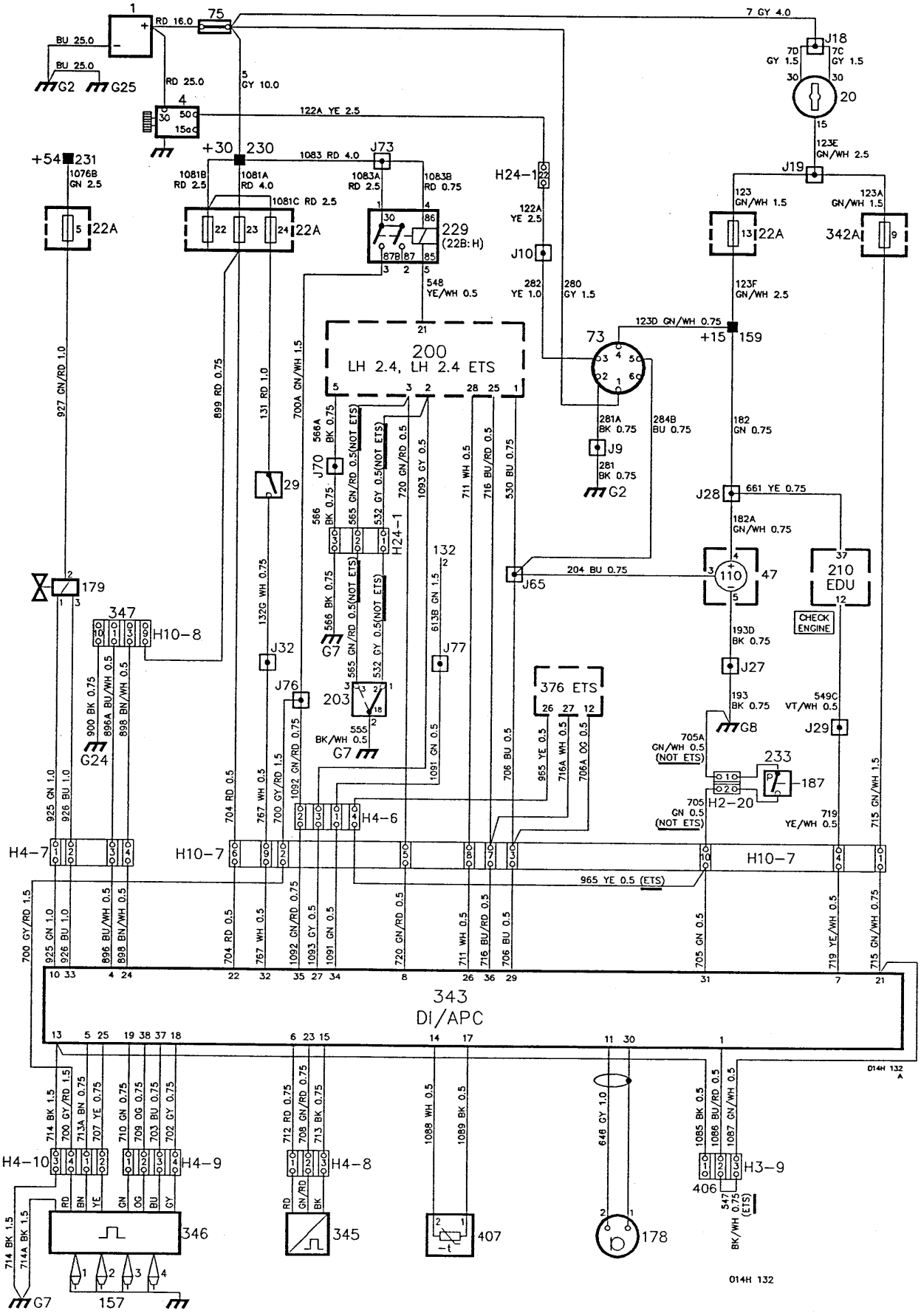
DI-APC ignition system for T16, T16 lambda with 2.4.2



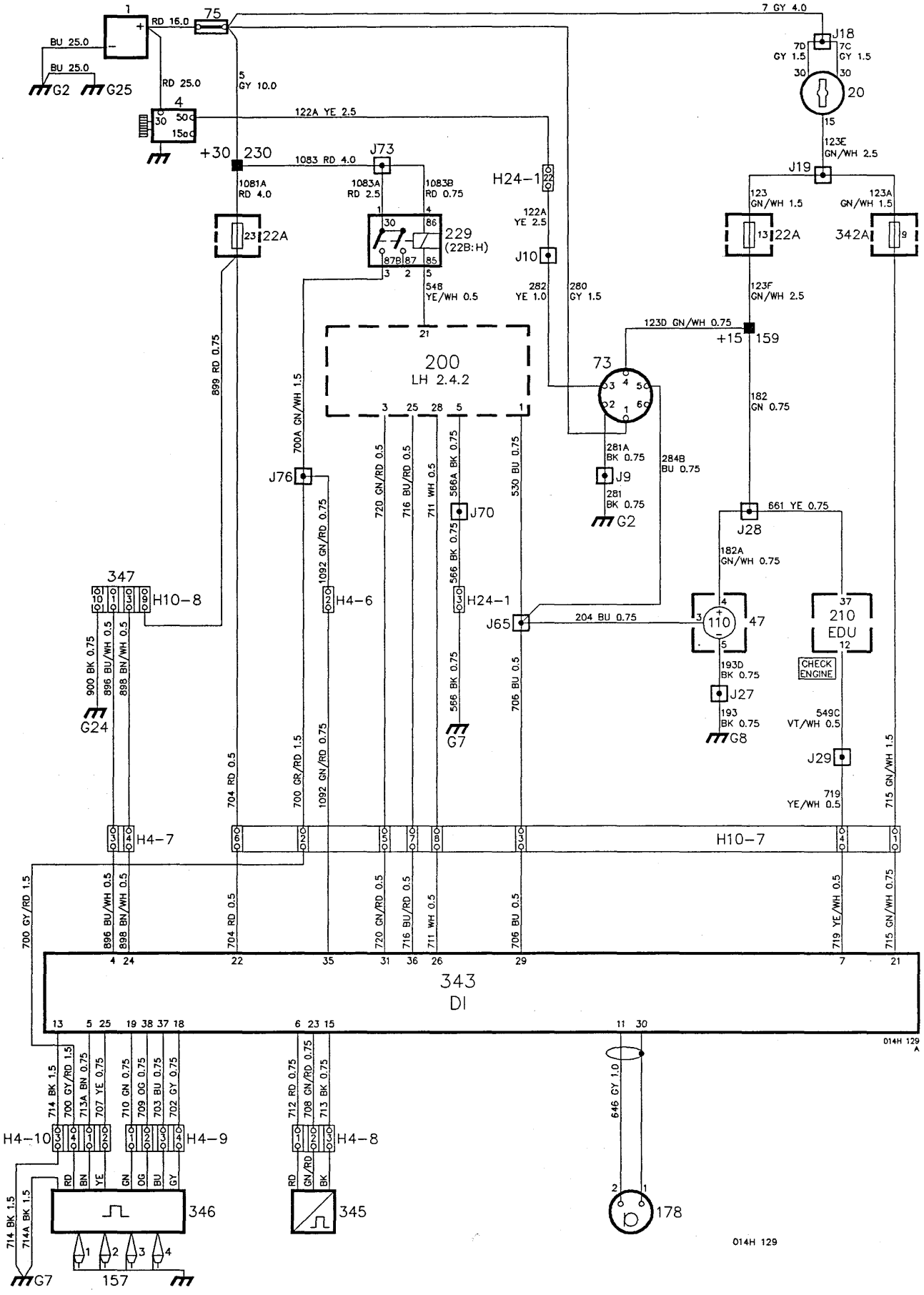
Operation

A detailed description of the DI-APC system is presented in the section entitled Engine in this manual

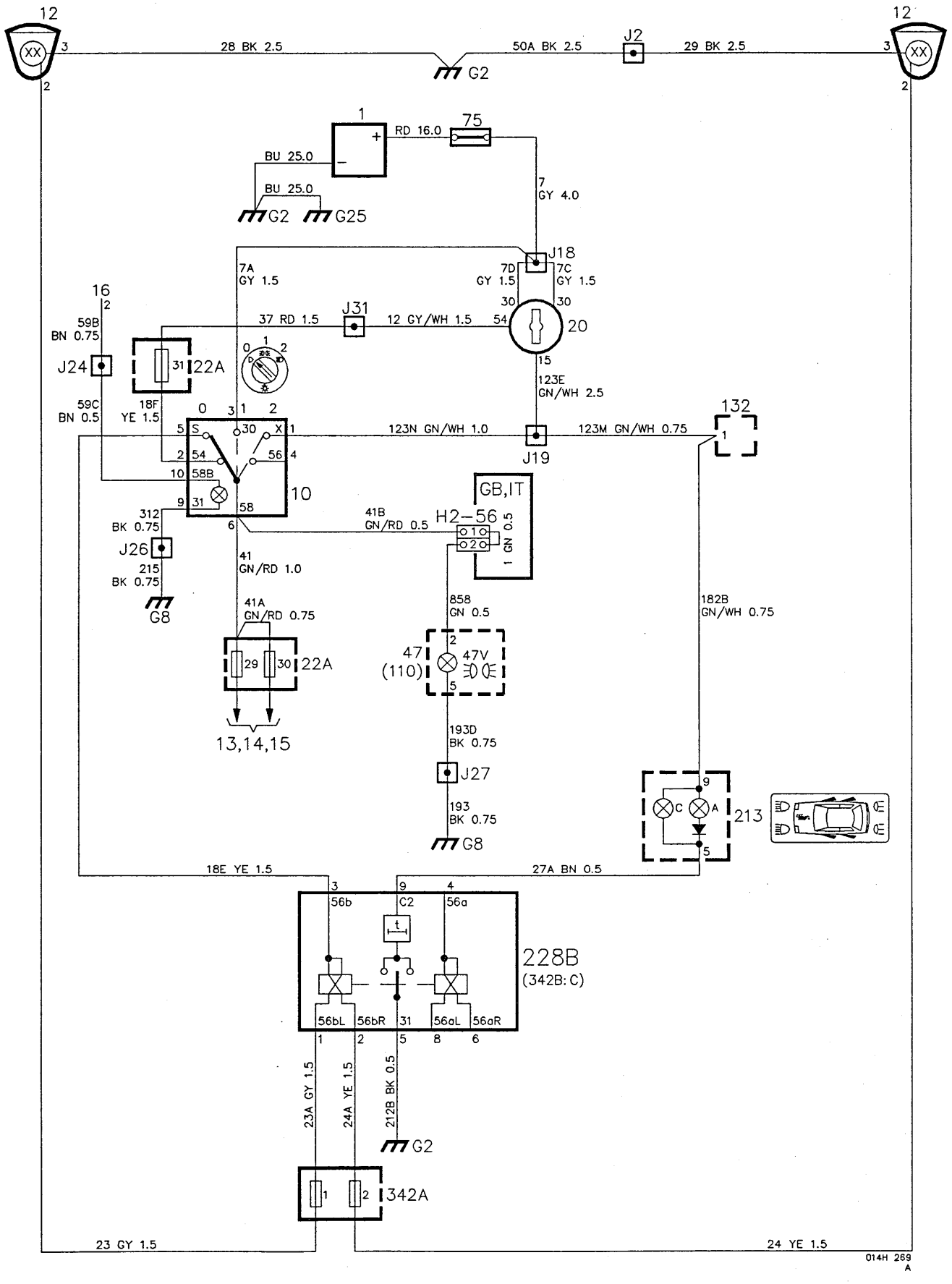
DI-APC ignition system for T16 lambda with 2.4



DI ignition system for I16, I16 lambda



Daylight driving lights (option)



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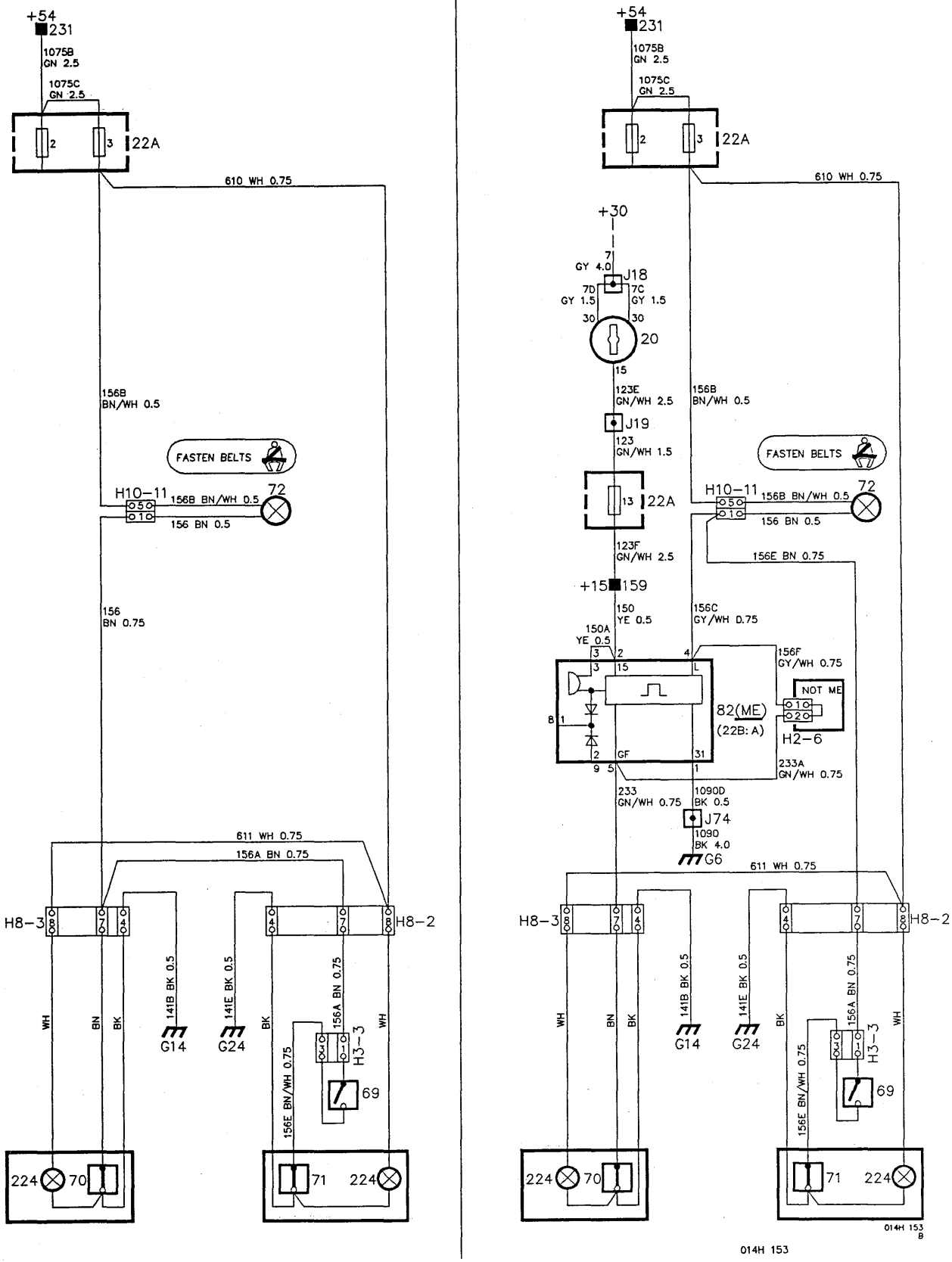
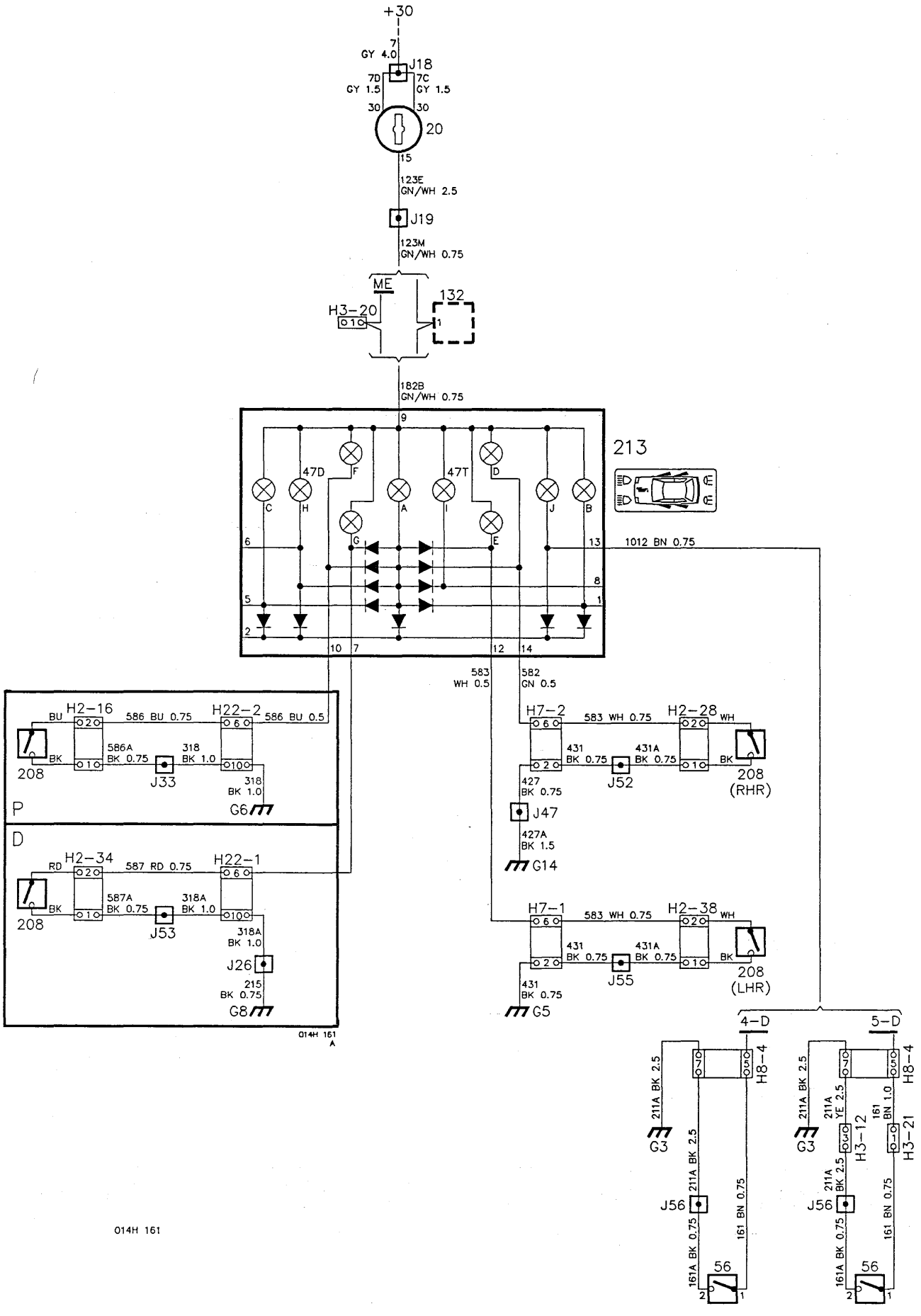
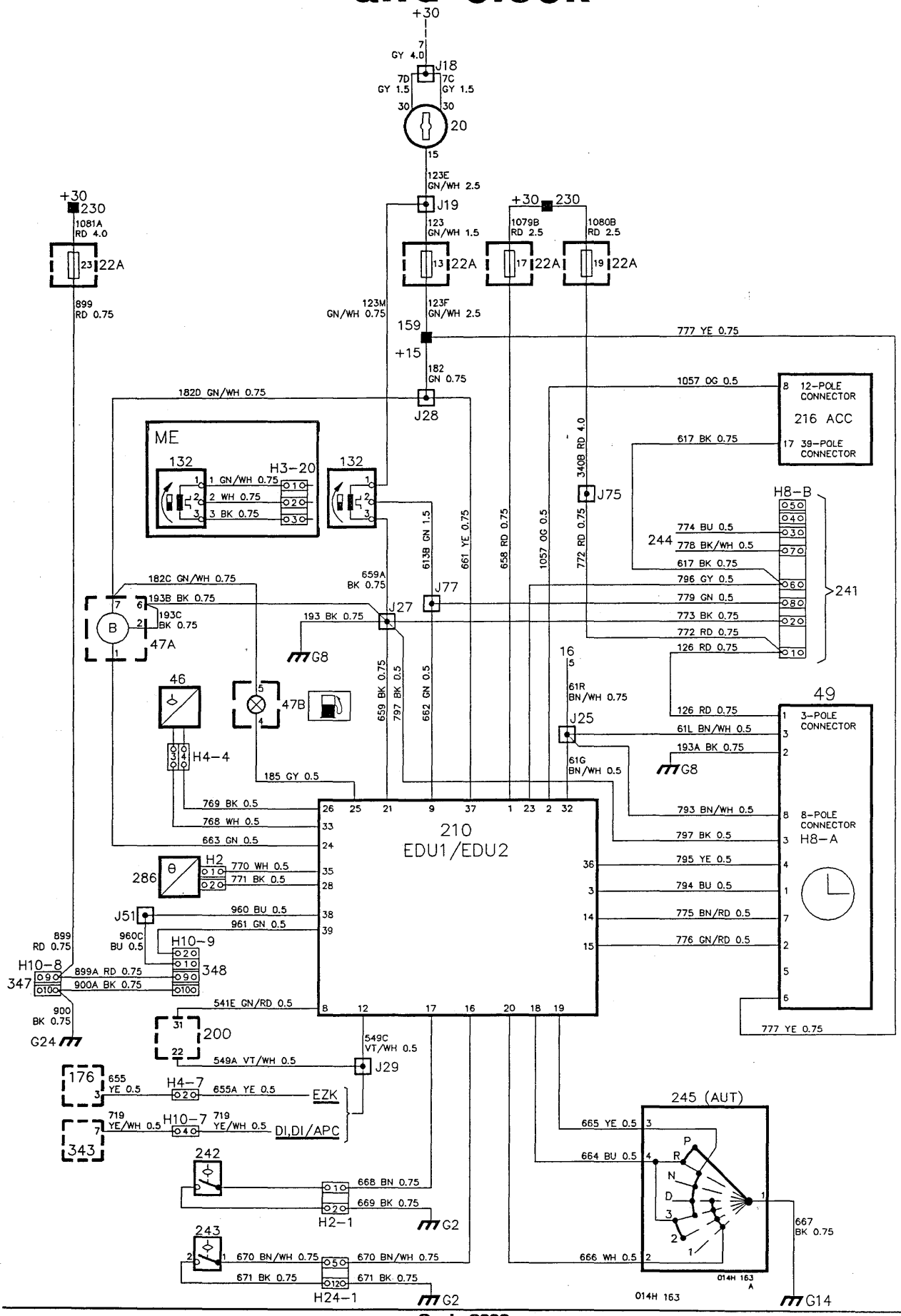
Seat-belt warning



Pictogram – Door indications



EDU1/EDU2 trip computer and clock

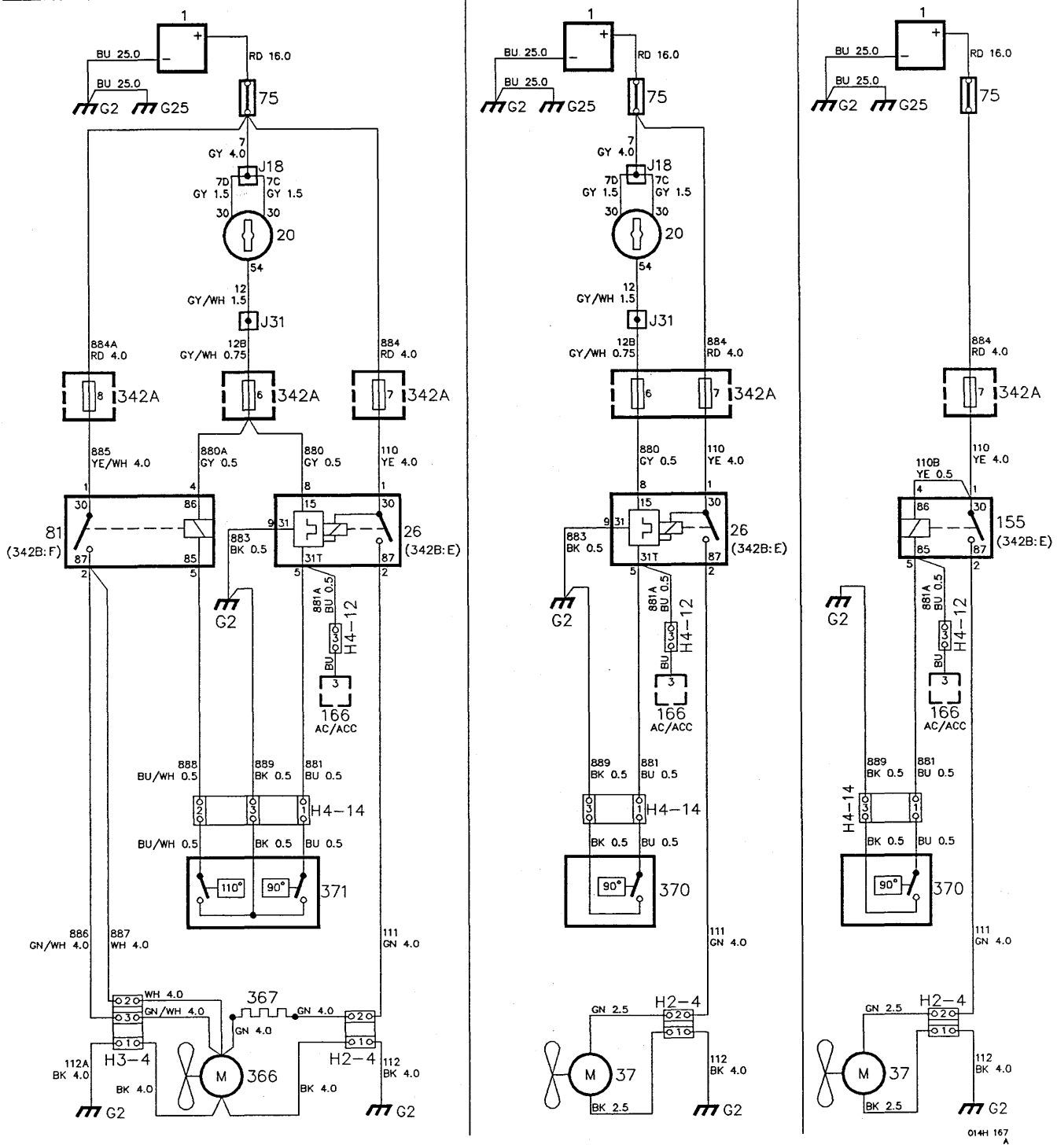


Radiator fan

AUT (AC/ACC T16,T16λ)
AUT: US,JP,ME,FE,AU
MAN (2.3 T16,T16λ): US,JP,ME,FE,AU

CA
MAN: US,JP,ME,FE,AU

SE,FI,EU,GB



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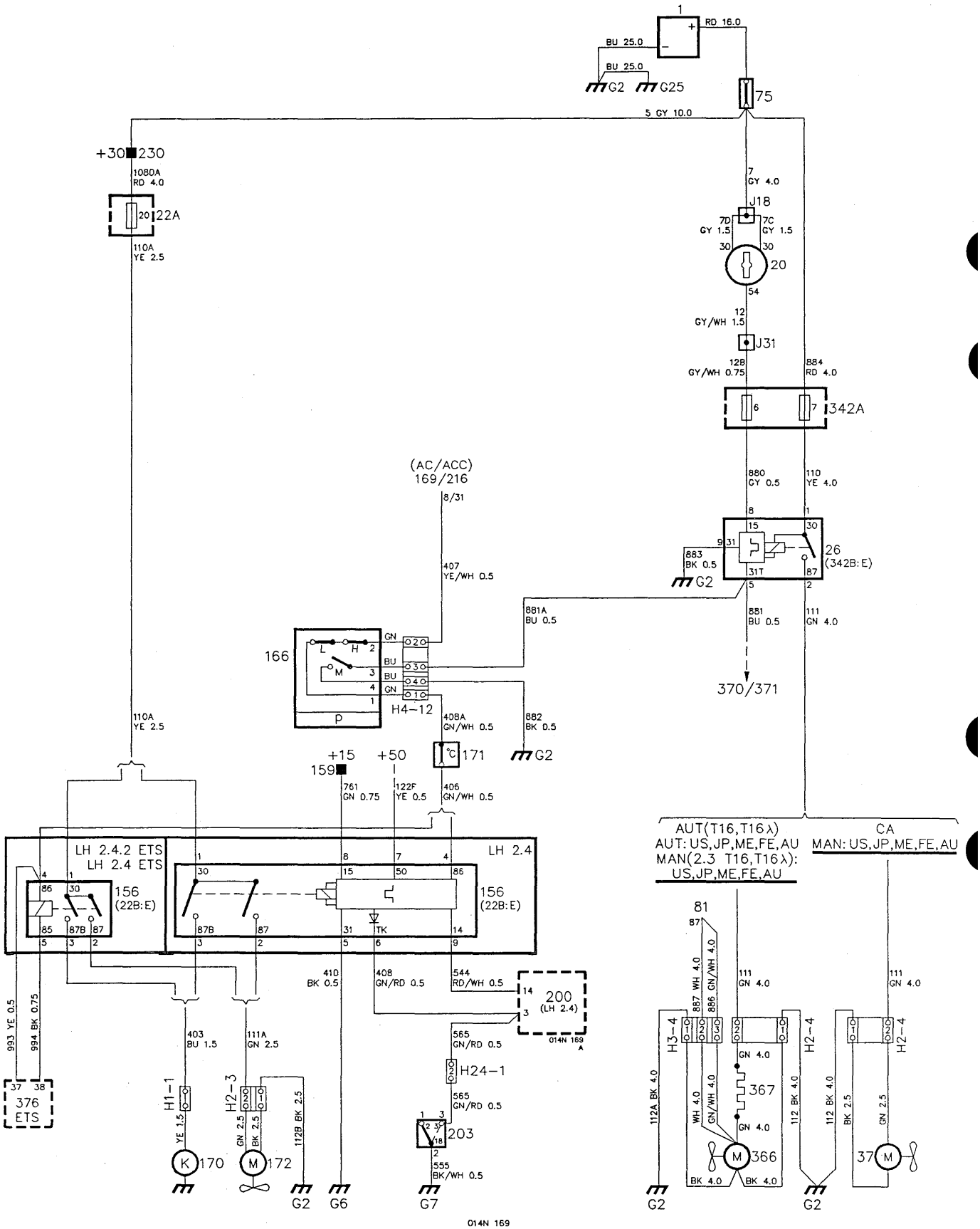
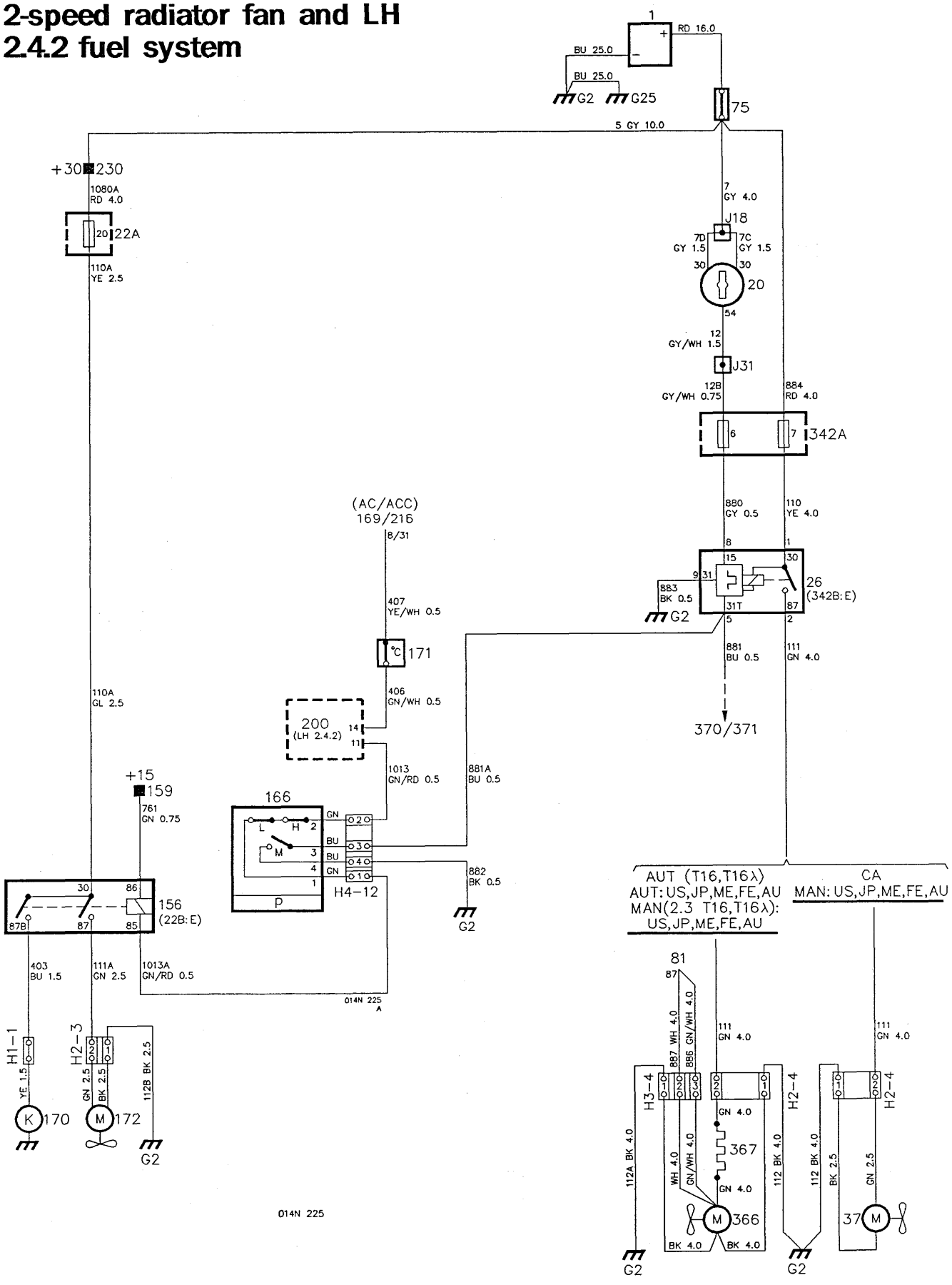
AC compressor and AC/ACC radiator fans

2-speed fan and LH 2.4

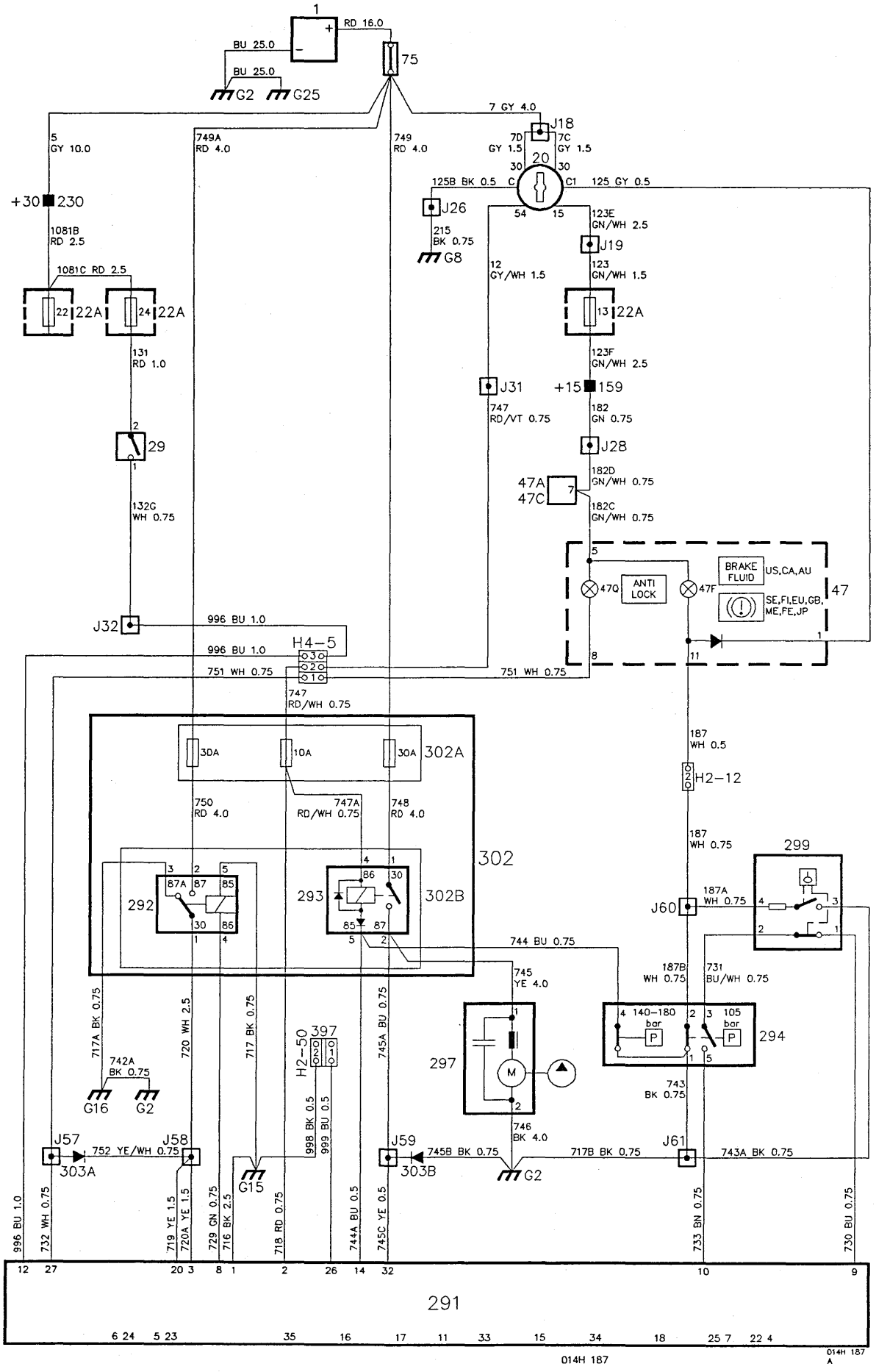


AC compressor and AC/ACC radiator fans

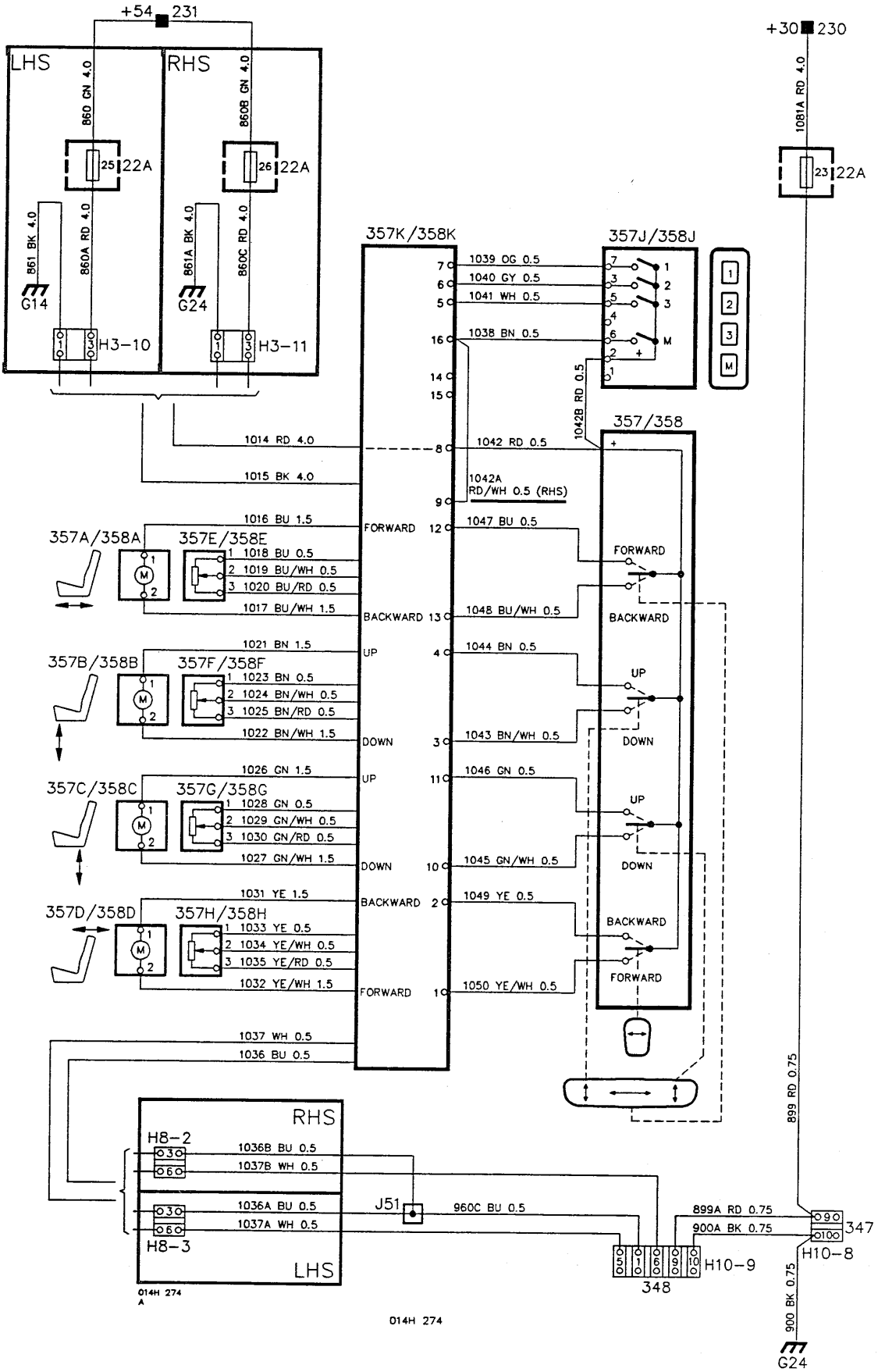
2-speed radiator fan and LH 2.4.2 fuel system



Anti-lock brakes



Electrically adjustable seats with memory function



Operation

Each electrically adjustable front seat with memory function consists of:

- Two control units with switches, one of which is for manual adjustment of the seat, and the other for storing the settings in the memory and recalling them from the memory.
- Electronic control unit
- 4 electric motors with position sensors.

Switches

The switch units consist of a number of switches. One pole of each switch is supplied with battery voltage from pin 8 of the electronic control unit. When the switch is operated, the battery voltage will be supplied back to the corresponding switch input of the electronic control unit.

Electronic control unit

The +54 supply is taken across fuse 25 or 26 to the electronic control unit via cable 860A/1014RD for the left-hand seat and 860C/1014RD for the right-hand seat.

The supplies to the motors, potentiometers and switches are taken from the electronic control unit.

The electronic control unit continuously monitors the switches, and when a valid combination of switches has been activated, it will carry out the appropriate operation. When one of the motors is running, the electronic control unit monitors its current consumption and the position of the seat via the position sensors (potentiometers).

The memory of the electronic control unit can store three different seat settings and five fault codes. The memory will retain the information even after the power supply has been switched off.

Motors

The supply to the motors is taken from the electronic control unit. The voltage is the battery voltage, and the polarity changes depending on the direction in which the motors are run.

Position sensors

The position sensors consist of potentiometers, one of which is fitted to each motor shaft.

The potentiometers are supplied from the electronic control unit with a voltage of approximately 5V between pins 1 and 3. When the motor shaft is rotating, the voltage at the centre tapping of the potentiometer (pin 2) varies between 0.4 and 4.6V. The electronic control unit determines the position of the seat by measuring this voltage.

Manual adjustment of seat setting

The electronic control unit can only run two motors at a time, and will therefore stop all motors if more than two switches in the manual control unit 357 (358) have been activated simultaneously.

The fore-and-aft travel of the seat and the seat cushion slope are restricted by mechanical stops. The electronic control unit will keep these motors energised as long as the corresponding switch in the manual control unit 357 (358) is actuated (although no longer than one minute).

The backrest has no mechanical stop to limit its rake in either direction. The limitation is therefore set by the electronic control unit which reads the backrest position sensor. The electronic control unit will then inhibit operation of the backrest rake motor if the position sensor is faulty.

Storing the seat setting in the memory

- Use the manual control unit 357 (358) to adjust the seat to the required position.
- Press the memory store button M in memory switch panel 357J (358J) and keep the button depressed.
- Press the memory recall button of your choice (1, 2 or 3) briefly, and the electronic control unit will then read all position sensors and will store their values in the selected memory. Then release button M.

If one of the position sensors is defective, a new seat setting will not be stored in the memory, and any earlier seat setting will then be retained even after a new setting has been programmed.

Resetting the seat from the memory

Press the memory recall button of your choice (1, 2 or 3) in the memory control unit 357J (358J) and keep it depressed.

The electronic control unit will then read all position sensors and will run the motors until the seat setting corresponds to the setting stored in the memory, or until the memory recall button has been released.

Fault tracing

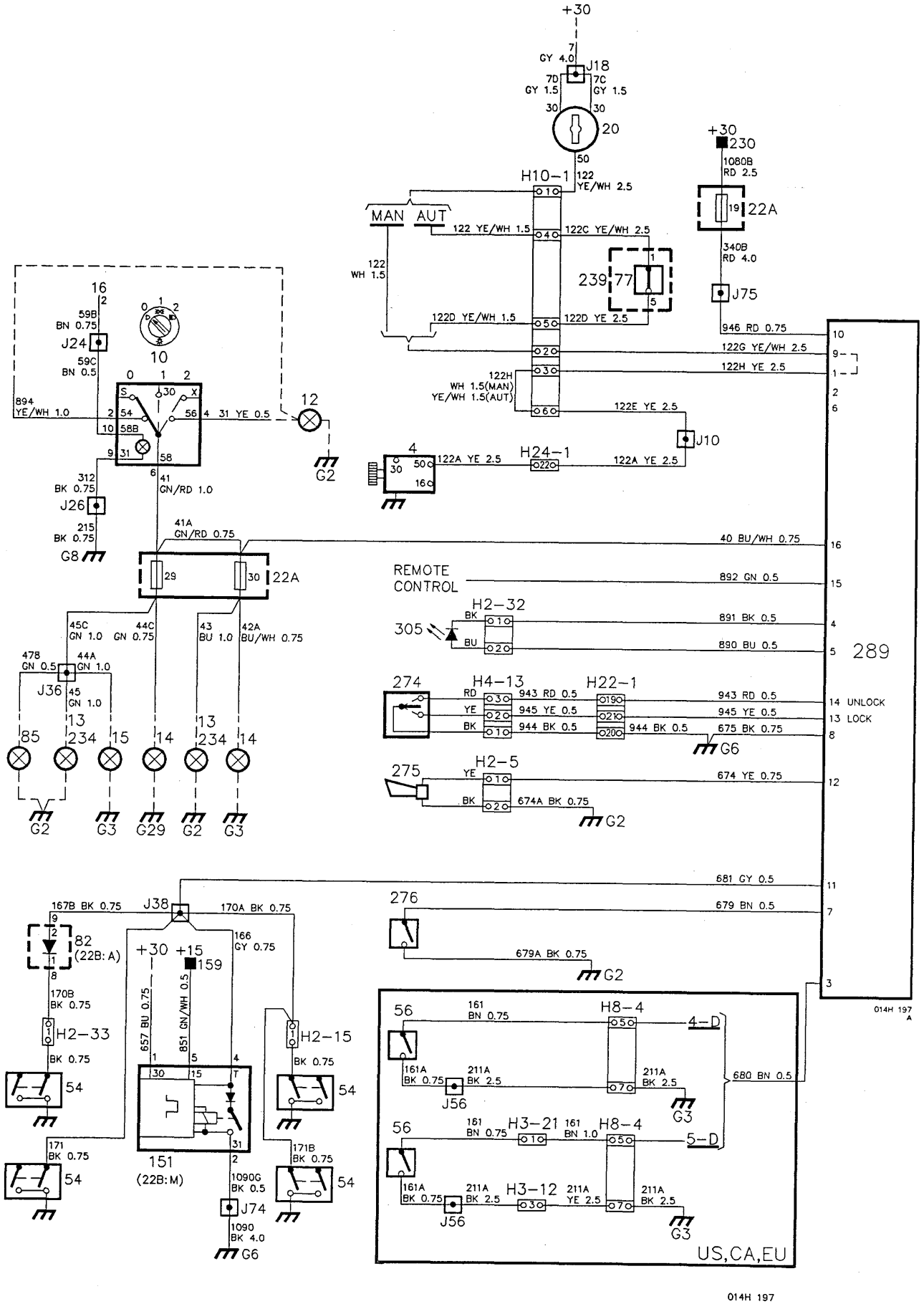
Faults detected by the electronic control unit are stored in the memory as fault codes. The fault codes can be read by means of the ISAT.

If the electronic control unit detects a fault on one of the position sensors or motors, or if a motor moves too slowly, the corresponding motor will be stopped.

The ISAT can also be used for reading each individual switch and the values of all position sensors.

For a more detailed description of fault tracing, see the section entitled Body.

Burglar alarm for US, CA (EU)



List of components

Numerical index

1 Battery
2 Alternator
4 Starter motor
5 Ignition coil
6 Ignition distributor
8 Lighting relay
10 Light switch
11 Full beam filament
12 Dipped beam filament
13 Parking lights
14 Rear lights
15 Number plate illumination
16 Instrument lighting rheostat
18 Combined instrument lighting
19 Glove compartment lamp
20 Ignition switch
21 Ignition switch relay
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22B Relay board, glove compartment
23 Flasher relay
24 Direction indicator stalk switch
25 Switch for hazard warning lights
26 Time-delay relay for the radiator fan
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28 Direction indicator lamps, right-hand side
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30 Brake lamps
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32 Reversing lights
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41 Horn switch
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45 Coolant temperature transmitter
46 Fuel level transmitter
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47C Coolant temperature gauge
47D Oil pressure warning lamp
47E Charging warning lamp
47F Brake fluid level warning lamp
47G Full-beam warning lamp
47H Direction indicator warning lamp, left-hand
47I Direction indicator warning lamp, right-hand
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47K Lamp for shift-up indication
47M Handbrake warning lamp
47N Warning lamp for the rear fog lights
47Q Warning lamp, ABS
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47U Cruise Control indicating lamp
47V "Headlamp on" warning lamp
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49 Clock
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56 Luggage compartment light switch
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66 Headlamp wiper motor
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70 Seat-belt switch for the driver
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74 Resistor for radiator fan
75 Distribution block, positive battery supply
76 Switch for raising the engine idling speed, auto
77 Starting interlock contacts, automatic transmission
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111 Electronic speedometer
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132 Sensor for the speed transmitter
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161 Switch for the rear fog lights 1
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169 Switch for the AC
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171 Anti-freeze thermostat (cycling clutch switch), AC and ACC
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176 Control unit for the EZK ignition system
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184 Motor for central locking system, co-driver's door
185 Motor for the central locking system, right-hand rear door
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187 Vacuum pump for Cruise Control
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191A Switch for right-hand rear electric window regulator
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195 Level switch for windscreen washer fluid
198 Recirculation damper motor - ACC
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200 Control unit for the LH fuel injection system
202 Engine temperature transmitter for the LH fuel injection system
203 Throttle angle transmitter for the LH fuel injection system
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206 Fuel injection valves for LH fuel injection system
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217 Air mixture temperature transmitter - ACC
218 Interior temperature transmitter - ACC
219 Suction fan for the interior temperature transmitter - ACC

220 Speed control for the ventilation fan - ACC
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222 Temperature control damper motor - ACC
223 Sun transmitter - ACC
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272 Engine idling speed adjustment, LH fuel injection system
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276 Bonnet switch for burglar alarm
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289 Burglar alarm control unit
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294 Pressure switch, ABS
295 Main valve, ABS
296 Valve block, ABS
297 Hydraulic pump motor, ABS
298A Left-hand front wheel sensor, ABS
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298D Right-hand rear wheel sensor, ABS
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303B Diode, ABS
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318A Bass amplifier, 4-D
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331 Electronic unit for the airbag
332A Sensor for airbag, left-hand
332B Sensor for airbag, right-hand
333 Airbag
335 2-pole connector for the airbag
336 Slip-ring contact for the airbag
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342A Fuse board in the engine compartment
342B Relay board in the engine compartment
343 Control unit for the DI, DI-APC system
345 Crankshaft sensor for the DI-APC system
346 Ignition cartridge for the DI, DI-APC system
347 Test socket for diagnostic testing of DI, DI/APC and LH systems
348 Test socket for diagnostic testing of EDU and ACC
349 Radio contact box with amplifier
350 Contact box for CD player/equalizer
352 Slip-ring contacts, horn
353 Radio/cassette player
354 Amplifier
356 Control unit for speed warning
357 Switch for left-hand electrically operated front seat
357A Fore-and-aft adjustment motor for electrically operated front seat, left-hand

357B Front height adjustment motor for electrically operated front seat, left-hand
357C Rear height adjustment motor for electrically operated front seat, left-hand
357D Backrest rake adjustment motor for electrically operated front seat, left-hand
357E Fore-and-aft adjustment sensor for electrically operated front seat with memory, left-hand
357F Front height adjustment sensor for electrically operated front seat with memory, left-hand
357G Rear height adjustment sensor for electrically operated front seat with memory, left-hand
357H Backrest rake adjustment sensor for electrically operated front seat with memory, left-hand
357J Switch for left-hand electrically operated front seat with memory
357K Control unit for left-hand electrically operated front seat with memory
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358B Front height adjustment motor for electrically operated front seat, right-hand
358C Rear height adjustment motor for electrically operated front seat, right-hand
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358F Front height adjustment sensor for electrically operated front seat with memory, right-hand
358G Rear height adjustment sensor for electrically operated front seat with memory, right-hand
358H Backrest rake adjustment sensor for electrically operated front seat with memory, right-hand
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370 Temperature switch, one-position for radiator fan
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388 Switch for boot lid lock, 4-door
389 NTC resistor for LH 2.4
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394 24-pole connector
397 Test connector for ABS diagnostics
405 Reversing light relay, auto
406 Coding connector, DI-APC
407 Engine temperature sensor, DI-APC
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G3 Earthing point in the luggage compartment
G5 Earthing point, under the back seat
G6 Negative distribution terminal
G7 Earthing point on the engine
G8 Earthing point on the fascia
G14 Earthing point on the left-hand front seat member
G15 Earthing point for electronic control unit for ABS at the TSI connector
G16 Earthing point for the brake unit, ABS
G20 Earthing point for electronic control unit for airbag
G24 Earthing point on right-hand front seat member
G25 Earthing point, gearbox
G26 Earthing point at right-hand C pillar
G27 Earthing point for the electric aerial
G28 Earthing point, redundant, for the airbag
G29 Earthing point at the right-hand rear lamp cluster

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Transmission

For particulars of the drive shaft bearing bracket, see the manual gearbox
For particulars of the reinforced drivers, see the manual gearbox

Manual gearbox

To remove and refit the gearbox

Object code 47100

To remove

On cars equipped with the B234 Turbo engine, the method is somewhat altered and certain operations are new. All new operations are headed New in the text. For additional illustrations and more detailed descriptions, see Service Manual O, News, for the 1990 model, under the heading To remove and refit the gearbox, and section 431 of Service Manual 4:1.

1 Remove the battery.

2 Remove the washer fluid container.

3 Remove the holder with the connectors, the terminal blocks and the positive cable from the battery tray. If the car is equipped with ABS brakes, release the stay for the hydraulic unit.

4 Remove the battery tray.

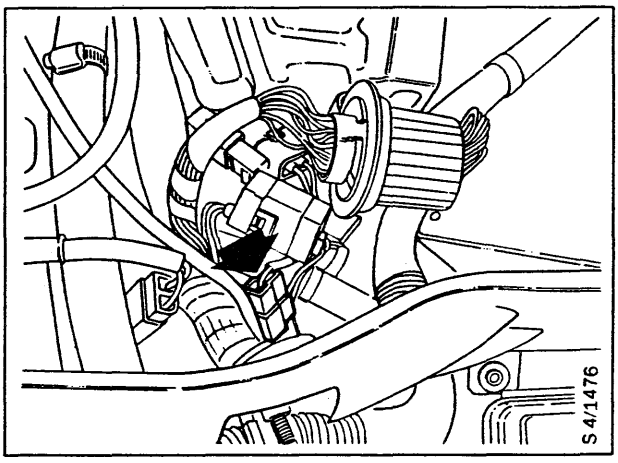
5 Remove the 8 bolts for the cover over the bulkhead.

New

6 Remove the rubber strip. Lift the cover and disconnect the washer hoses from the nozzle. Remove the cover.

New

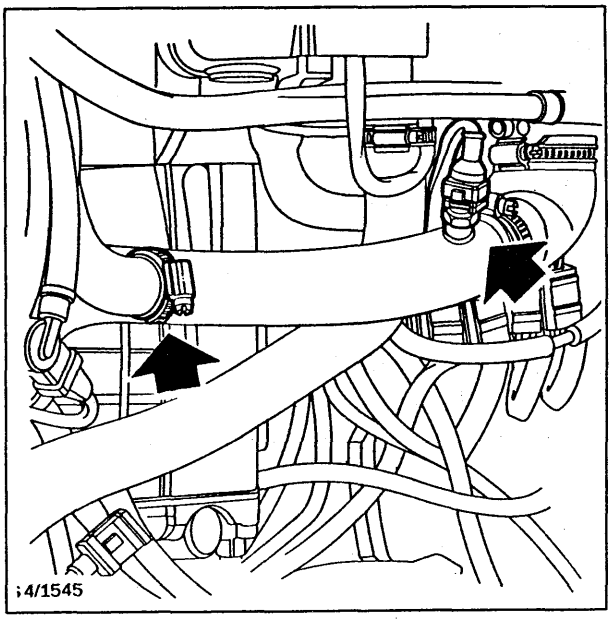
7 Separate the speedometer cable connector. First withdraw the washer hose and then the speedometer cable through the rubber grommet.



8 Disconnect the electrical connector from the air mass meter.

New

9 Disconnect the connector for the intake air temperature sensor and disconnect the hose on the delivery pipe from the by-pass valve.



New

10 Remove the delivery pipe between the throttle housing and the intercooler.

New

11 Remove the nuts retaining the starter motor. Remove the starter motor and place it on the steering gear.

12 Separate the selector rod universal joint and separate the selector rod.

13 Pinch the slave cylinder pressure hose with clamping tongs and separate the pressure line.

14 Remove the upper bolts for the stay at the wheel housing.

15 Release the left-hand engine mounting.

16 Sling the engine from the engine lifting beam (tool 83 93 977).
Lift the car

17 Remove the left-hand front wheel and the wheel housing liners.

18 Disconnect the negative cable from the battery and the reversing light switch connector from the gearbox.

19 Separate the suspension arm from the ball joint.

20 Remove the anti-roll bar.

21 Remove the lower bolt for the stay at the wheel housing.

22 Remove the three bottom bolts from the joint between the engine and gearbox.

23 Remove the centre and left-hand skirts under the spoiler.

24 Separate the sub-frame at the front and rear. Lower the sub-frame.

Note

Observe cleanliness when carrying out work on the universal joints. Even very small quantities of sand or dirt will shorten appreciably the useful life of the universal joints.

25 Remove the universal joint.

Lower the car

26 Sling the gearbox from the workshop hoist and remove the top nut and bolt from the joint face.

27 Withdraw the gearbox and lower it onto the floor.

To fit

Before starting the fitting work, make sure that the drive shaft is in position in the right-hand driver and that the aluminium tube is pressed into the seal.

Note

Check that the aluminium tube seals against the gearcase.

1 Slide the gearbox into place, guiding the driver shaft and gearbox input shaft.

2 Fit the top bolt and nut into the joint face.

3 Release the gearbox from the hoist and remove the hoist.
Raise the car

4 Fit the three bottom bolts into the joint face and tighten all bolts.
Tightening torque: 54 - 100 Nm (40 - 74 lbf ft).

Note

Observe cleanliness when carrying out work on the universal joints. Even very small quantities of sand or dirt will shorten appreciably the useful life of the universal joints.

5 Fit the universal joint

6 Raise the sub-frame and secure it in position.

7 Fit the anti-roll bar.

8 Fit the suspension arm into the ball joint.

9 Fit the bottom bracket for the wheel housing stay but do not tighten it.
Lower the car.

10 Remove the lifting beam (tool 83 93 977).

New

11 Fit the starter motor into place and fit the nuts.

12 Fit the top mounting of the wheel housing stay and tighten the bolts.

13 Tighten the left-hand engine mounting.
Raise the car.

14 Tighten the bottom mounting of the wheel housing stay.

15 Connect the battery negative cable to the gearcase and connect the reversing light switch.

16 Fit the wheel housing liners and the left-hand front wheel.

17 Fit the left-hand and centre skirts under the spoiler. Lower the car.

18 Fit the selector rod universal joint.

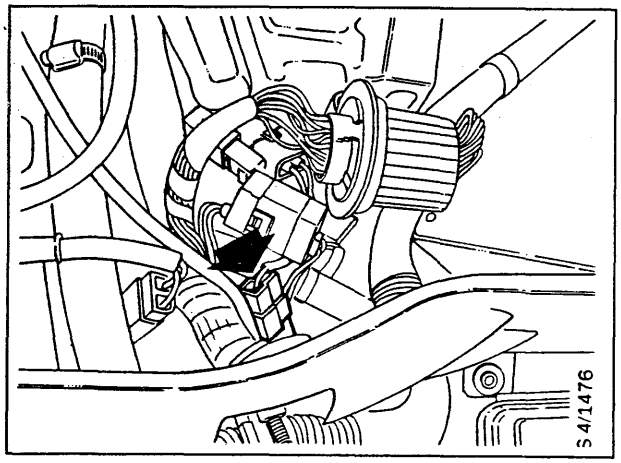
19 Fit the slave cylinder pressure pipe and remove the clamping tongs.

New

20 First run the speedometer cable through the rubber grommet and then run the washer hose.

New

21 Connect the connector and fit the washer hose to the nozzle.



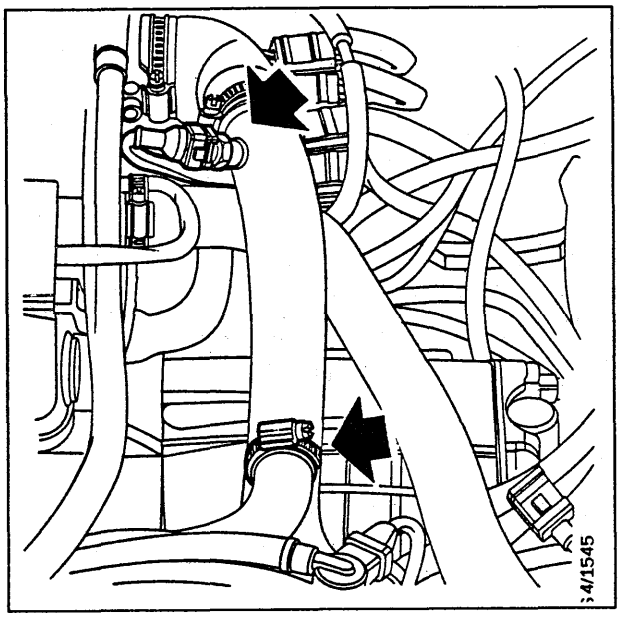
22 Fit the rubber strip and cover over the bulkhead.

New

23 Fit the delivery pipe between the intercooler and the throttle housing.

New

24 Fit the hose from the by-pass valve to the pipe and connect the temperature sensor.



25 Connect the air mass meter connector.

26 Fit the battery tray.

27 Connect the positive cable, fit the terminal block and the holder for the connectors. On cars with ABS brakes, bolt the stay for the hydraulic unit to the battery tray.

28 Fit the battery.

29 Fit the washer fluid container.

30 If necessary, bleed the slave cylinder.

31 Check the oil level and test the car on the road.

Drive shaft bearing bracket

To remove

Object code 47541

On cars equipped with the B234 turbocharged engine, the procedure for removing the drive shaft bearing bracket is largely the same as on the B234 normally aspirated engine, with the exception of a few operations. All new operations are headed **New** in the text, and other illustrations are included in the Service Manual O, News for the 1990 model, under the heading Drive shaft bearing bracket.

1 Disconnect the negative cable from the battery.

2 Remove the right-hand front wheel and the wheel housing liners.

3 Release the rubber gaiter clip from the inner universal joint.

4 Release the brake hose from the McPherson strut.

5 Release the two bolts securing the McPherson strut to the steering swivel member. On cars equipped with ABS brakes, remove the bracket for the ABS cable.

Note

Observe cleanliness when carrying out work on the universal joints. Even very small quantities of sand or dirt will shorten appreciably the useful life of the universal joints.

6 Swing out the drive shaft so that it separates from the driver, and protect the rubber gaiter and driver from dirt.

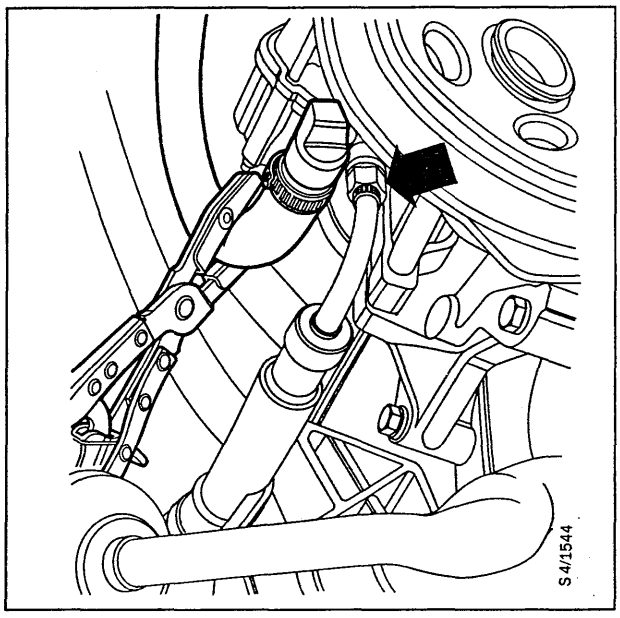
7 Remove the stay between the sub-frame and wheel housing.

8 Remove the bolts from the front and rear engine mountings on the right-hand side.

9 Remove the servo pressure hose bracket from the drive shaft bearing bracket.

New

10 Pinch the servo hose running between the pump and the reservoir with clamping tongs. Disconnect the hose from the pump and move the hose out of the way.



11 Lower the car. Cut off the strap around the engine stay and remove the stay.

12 Fit the lifting beam (tool 83 93 977) and raise the engine so that it is clear of the engine mountings.

13 Raise the car and remove the three bolts securing the bearing bracket.

14 Swing out the bearing bracket and remove it.

To fit

New

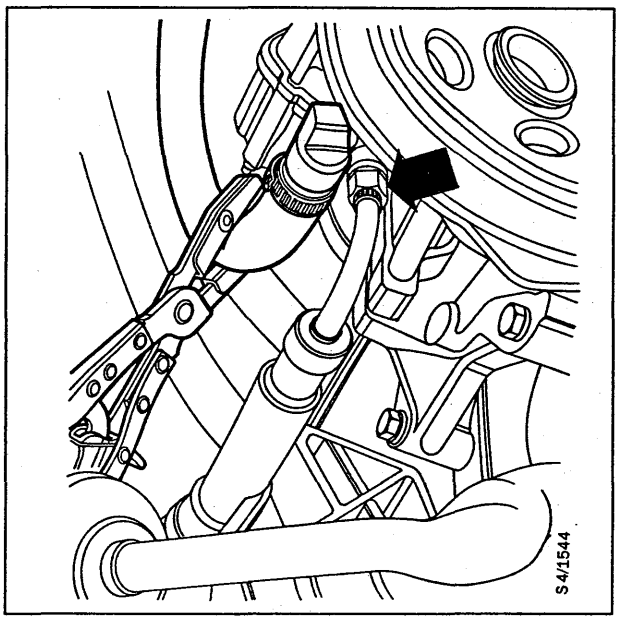
1 Fit the bearing bracket with the aluminium tube to the gearcase.

2 Fit the bearing bracket onto the two dowels in the engine block, making sure that the pipe seals against the gearcase.

3 Fit the bearing bracket retaining bolts.

New

4 Fit the hose between the pump and the steering gear. Remove the clamping tongs.



5 Fit the servo hose bracket.

6 Lower the car and lower the engine so that it rests on the engine mountings. Remove the lifting beam (tool 83 93 977.

7 Raise the car and tighten the bolts for the two engine mountings.

8 Fit the stay between the wheel housing and sub-frame.

Note

Observe cleanliness when carrying out work on the universal joints. Even very small quantities of sand or dirt will shorten appreciably the useful life of the universal joints.

9 Remove the protection from the rubber gaiter and driver, and assemble the universal joint.

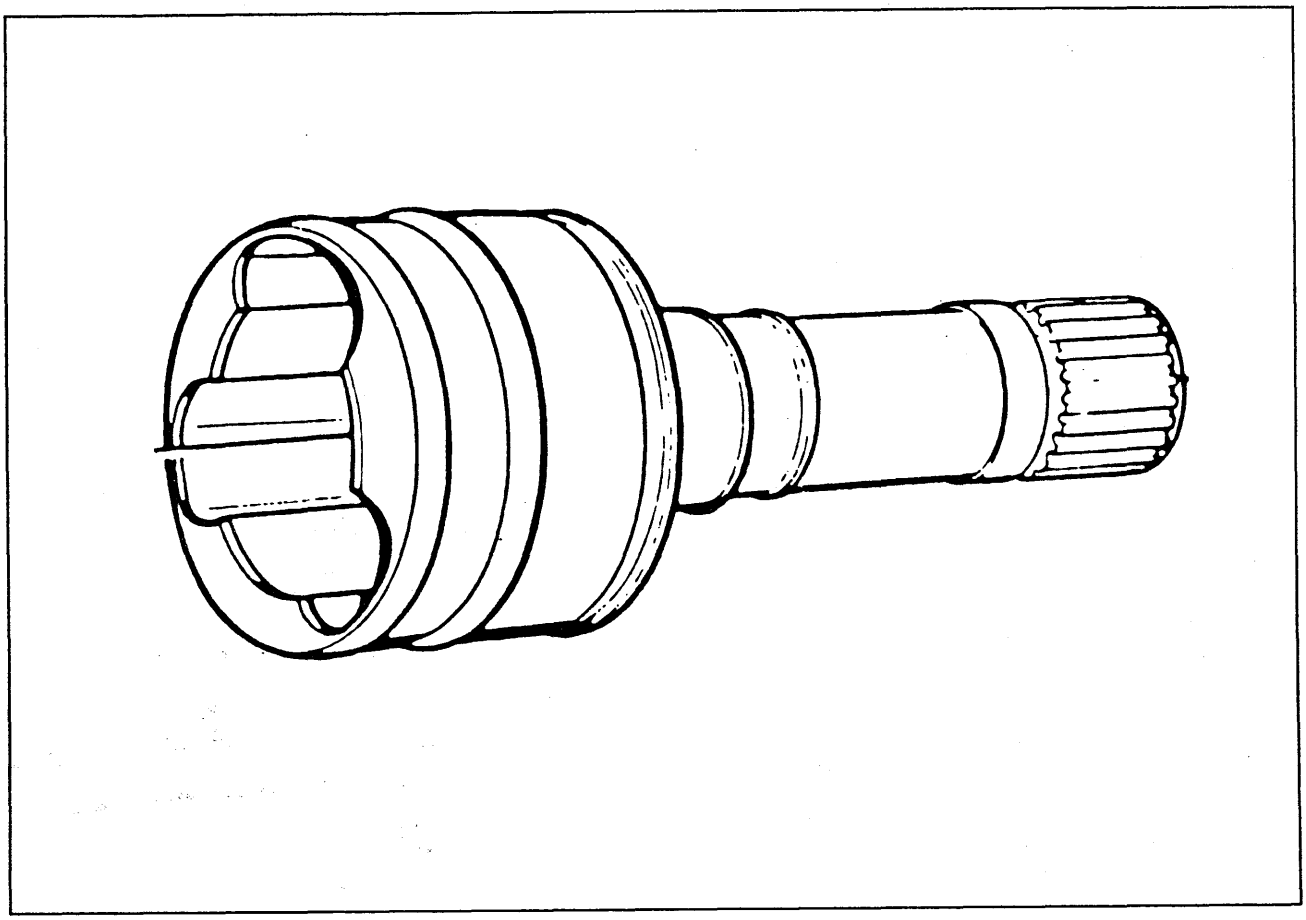
10 Fit the McPherson strut to the steering swivel member and secure the brake hose to the McPherson strut. If the car is equipped with ABS brakes, fit the holder with the ABS cable. Tighten the McPherson strut bolts.
Tightening torque: 78 - 105 Nm (57.5 - 77.4 lbf ft)

11 Secure the clip retaining the universal joint rubber gaiter.

12 Fit the wheel housing liners and the wheel.

13 Lower the car. Fit the engine stay and fit the strap around the cables.

14 Connect the negative cable to the battery.



Reinforced drivers

Cars with the B234 Turbo engine are equipped with reinforced inner drivers capable of transmitting the higher torque of 330 Nm delivered by the engine on cars with manual gearbox and 300 Nm on cars with automatic transmission. As a result, the procedure for dismantling the drive shaft bearing bracket is somewhat altered.

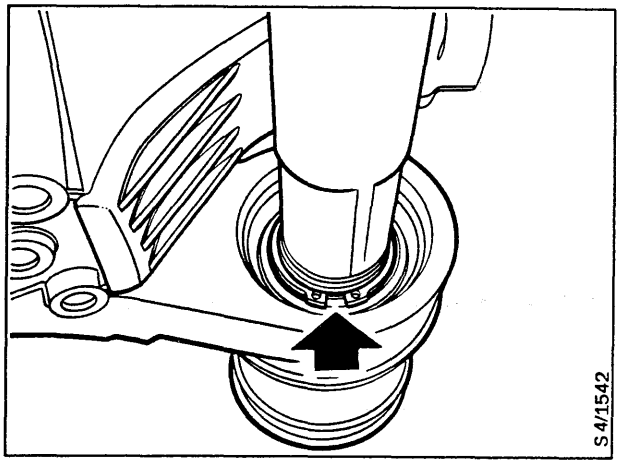
Drive shaft bearing bracket

Object code 47541

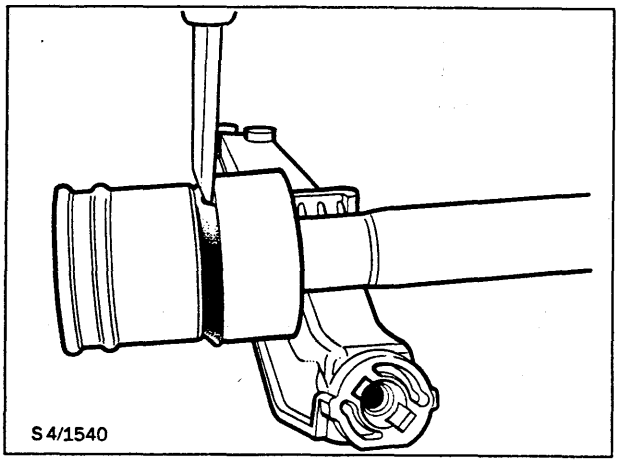
To dismantle

1 Remove the aluminium tube and the tube seal.

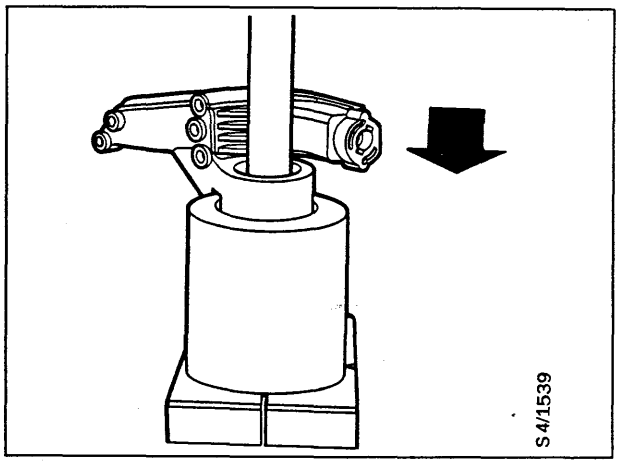
2 Remove the circlip from the driver shaft.



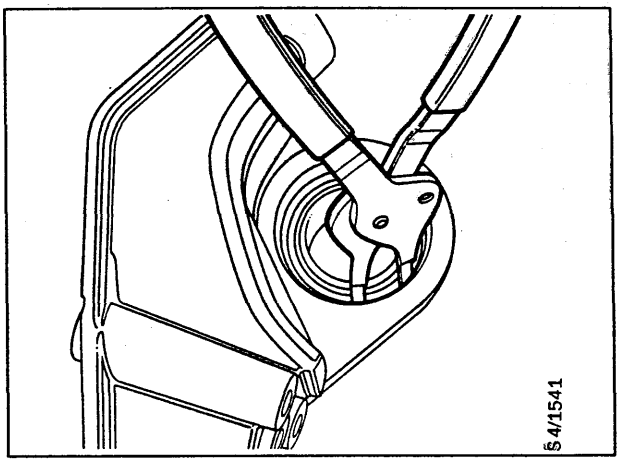
3 Cut away the dust cover from the driver.



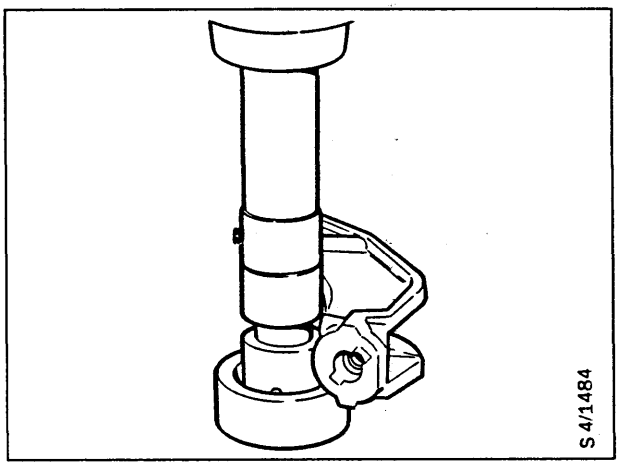
4 Place the bearing bracket in a press fitted with tools 89 96 449 and 89 91 402 and press the driver out of the bearing bracket.



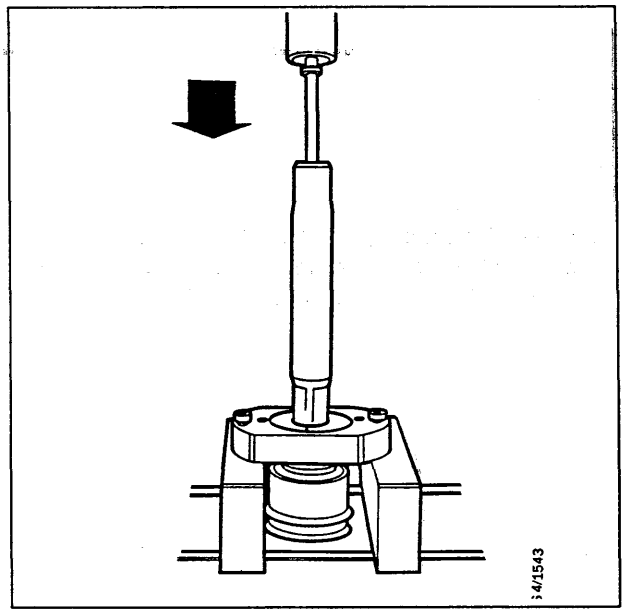
5 Remove the circlip from each end of the bearing bracket.



6 Use tool 87 90 487 to press out the bearing.



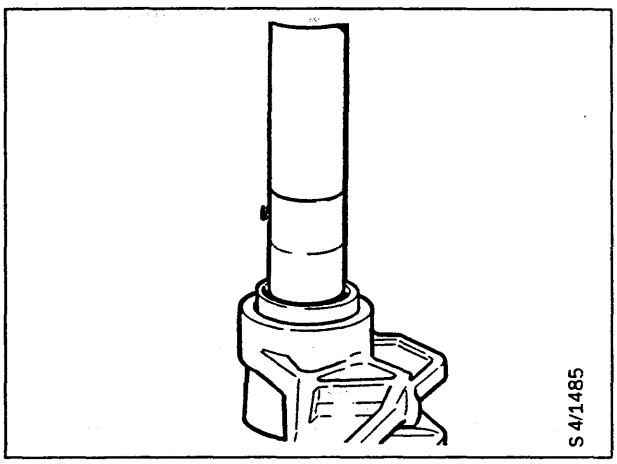
7 Use tools 87 90 636 and 87 91 212 and a long drift to press the intermediate shaft out of the driver shaft.



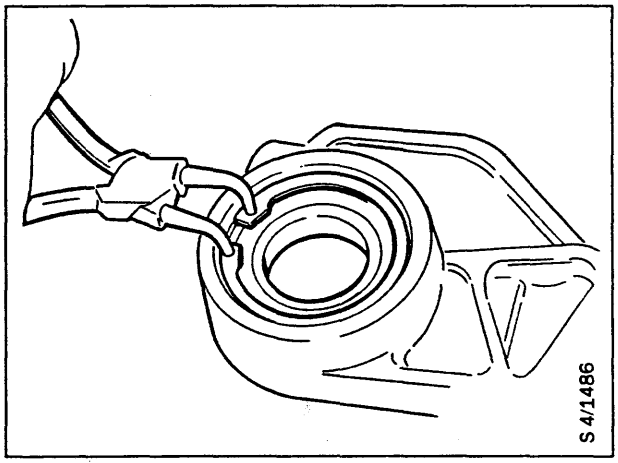
To assemble

1 Fit the inner circlip into the bearing bracket.

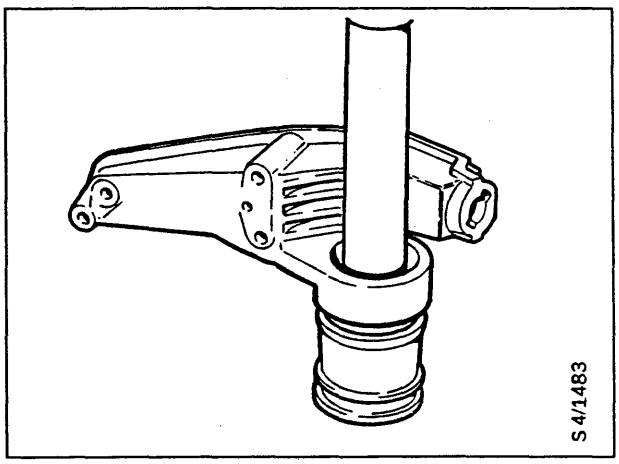
2 Use tool 87 90 461 to press the bearing into the bearing bracket. Use tool 83 90 114 as support.



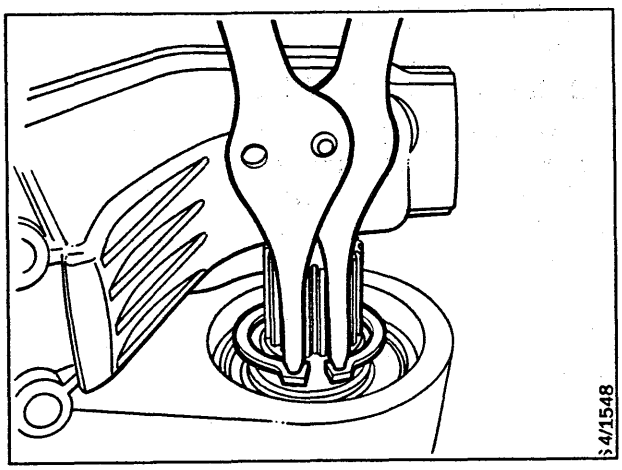
3 Fit the other circlip into the bearing bracket and a new dust cover to the driver. At the same time, check the O-ring.



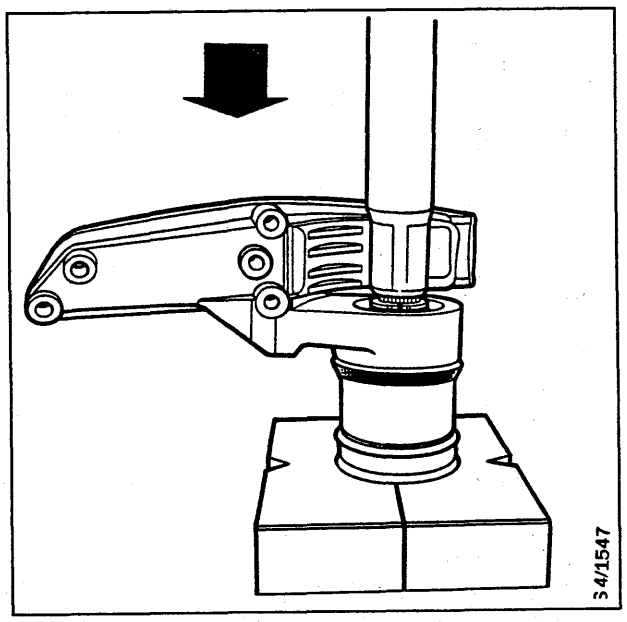
4 Use tool 87 91 204 to press the driver into the bearing bracket. Press the bearing inner race into place.



5 Fit the circlip to the driver shaft.



6 Fit the intermediate shaft to the driver shaft, possibly using a press.



7 Fit the rubber seal and the aluminium tube to the bearing bracket.

Automatic transmission

Shifting speeds US/CA

A new centrifugal governor has been introduced on cars with the B234 normally aspirated engine, and the shifting speeds have therefore changed. The reduction ratios are the same as on cars with the B202 Turbo engine.

Shifting speeds on the 9000S 2.3 US/CA
Least possible throttle, and accelerator pedal held stationary.

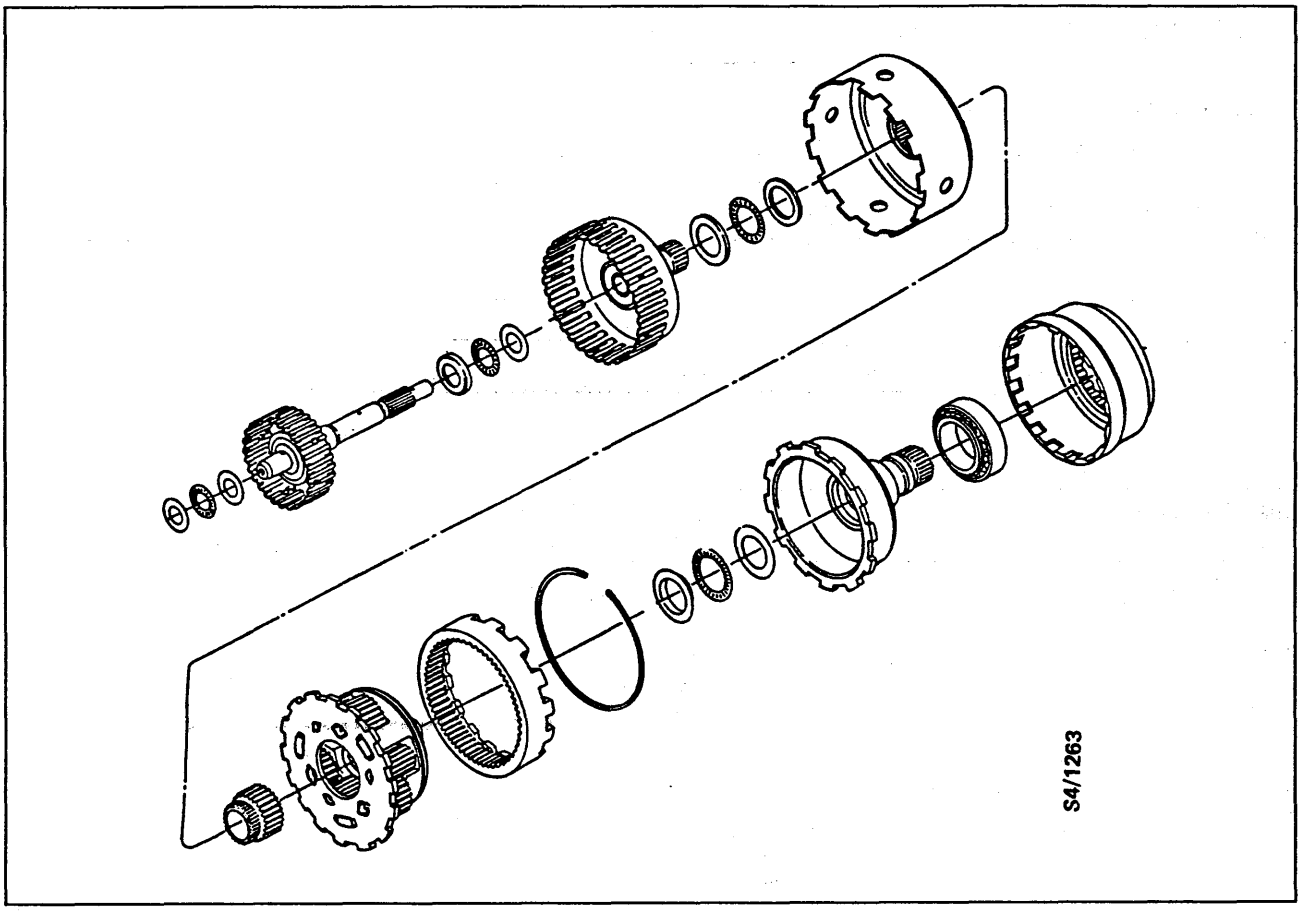
		3-stage governor
Upshift to 2nd	km/h (mph)	19-25 (12-15)
Upshift to 3rd	km/h (mph)	40-50 (25-31)
Upshift to 4th	km/h (mph)	58-75 (36-46)

Accelerator pedal pressed down to the kick-down position and held there.

		3-stage governor
Upshift to 2nd	km/h (mph)	56-66 (34-41)
Upshift to 3rd	km/h (mph)	108-120 (67-74)
Upshift to 4th	km/h (mph)	161-173 (100 107)

Dynamic rolling radius of 306 mm with 195/65 T 15" wheels. Speed at 1000 r/min

1	11.6 km/h	(7.2 mph)
2	21.3 km/h	(13.2 mph)
3	30.0 km/h	(18.6 mph)
4	40.5 km/h	(25.2 mph)

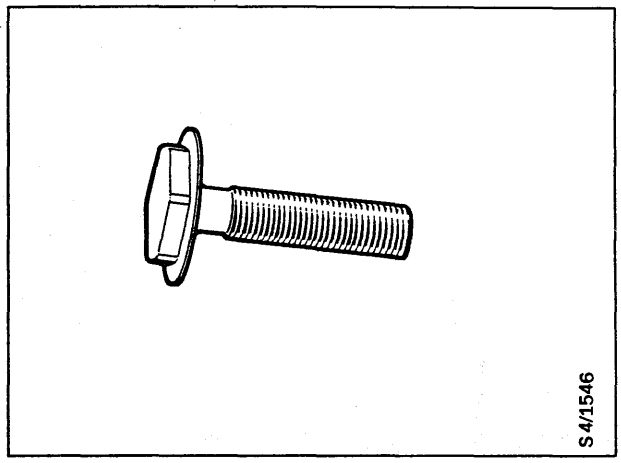


Intermediate shaft - Planet gear

Cars powered by the B234 Turbo engine are equipped with a new, reinforced intermediate shaft and planet gear to withstand the higher torque delivered by the engine.

Output shaft

To withstand the higher torque delivered by the B234 Turbo engine, the output shaft is equipped with a longer bolt.



To remove and refit the transmission

Object code 44000

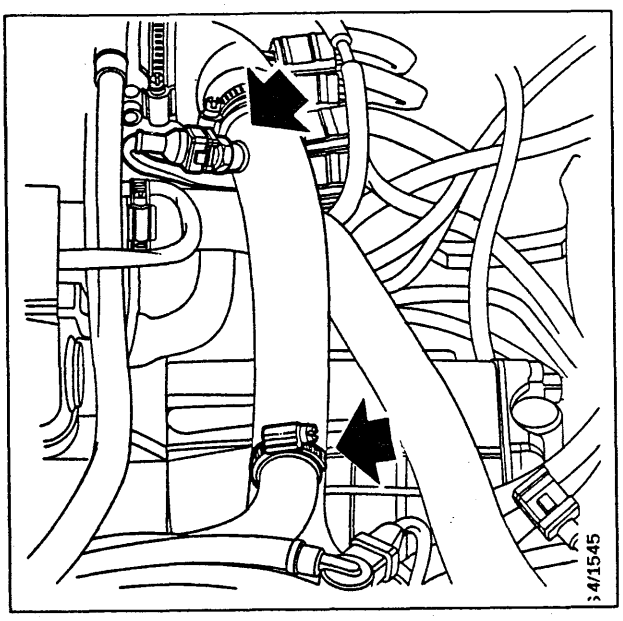
To remove

On cars equipped with the B234 Turbo engine, the operations are somewhat different and certain operations are new. All new operations are headed **New** in the text. For additional illustrations and more detailed descriptions, see the Service Manual O, News for the 1990 model under the heading Automatic transmission, To remove and refit the transmission, and section 442 of Service Manual 4:3.

1 Remove the battery.
2 Remove the washer fluid container.
3 Remove the holder with the connectors, the terminal block and the positive cable from the battery tray. On cars equipped with ABS brakes, release the stay for the hydraulic unit.
4 Remove the battery tray.
5 Disconnect the connector from the air mass meter.

New

6 Disconnect the connector for the intake air temperature sensor on the delivery pipe between the throttle housing and the intercooler. Remove the hose on the delivery pipe from the by-pass valve, and remove the hose between the transmission and delivery pipe.



New

7 Remove the delivery pipe between the throttle housing and the intercooler.

New

8 Remove the nuts securing the starter motor. Remove the starter motor and place it on the steering gear.

9 Remove the throttle cable

10 Remove the oil cooler hoses for the transmission.

11 Disconnect the selector cable.

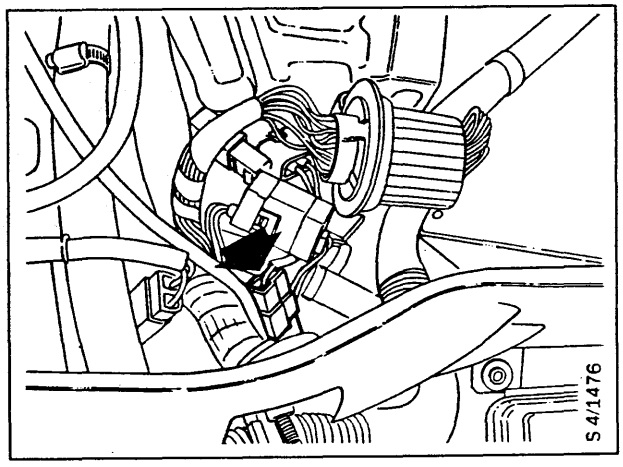
12 Remove the 8 bolts retaining the bulkhead cover.

New

13 Remove the rubber strip. Lift the cover and disconnect the hoses from the nozzle. Remove the cover.

New

14 Disconnect the speedometer cable connector. First withdraw the washer hose and then the speedometer cable through the rubber grommet.



15 Disconnect the negative cable from the gearcase.

16 Remove the bolt securing the top end of the stay to the wheel housing.

17 Sling the engine from the lifting beam (tool 83 93 977).
Lift the car.

18 Remove the left-hand front wheel and remove the wheel housing liners.

19 Remove the bolts securing the torque converter to the drive plate. Remove the bolts through the starter motor opening.

20 Separate the suspension arm from the ball joint.

21 Remove the anti-roll bar.

22 Release the left-hand engine mounting.

23 Remove the lower bolt securing the stay to the wheel housing.

24 Remove the centre and left-hand skirts under the spoiler.

25 Split the sub-frame at the front and rear and lower it.

Note

Observe cleanliness when carrying out work on the universal joints. Even very small quantities of sand or dirt will shorten appreciably the useful life of the universal joints.

---

26 Separate the universal joint.

27 Remove the three bolts at the bottom of the gearcase joint face. Lower the car.

28 Use tool 87 91 816 to keep the torque converter in place.

29 Remove the vent on the gearcase cover and plug the hole.

30 Fit tool 87 91 451 and hook the tool hoist into the tool.

Note

It is easier to lower the transmission if the lifting beam (tool 83 92 977) is removed.

---

31 Remove the remaining bolts from the joint face and lower the transmission.

To fit

Do not fit the vent yet. Before starting the fitting work, make sure that the drive shaft is in position in the right-hand driver and that the aluminium tube is pressed into the seal.

Note

Check that the aluminium tube seals against the gearcase.

1 Lift the transmission into place.

2 Slide the transmission towards the engine and fit one bolt loosely into the joint face.

3 If the lifting beam (tool 83 93 977) has been removed, refit it and use it to support the engine. Remove the tool hoist and tools 87 91 451 and 87 91 816. Lift the car.

4 Bolt the drive plate to the torque converter, and lock with Loctite 242. Fit the bolts through the opening for the starter motor. Take care not to drop any of the bolts, since the transmission would then have to be removed again.

5 Tighten all bolts in the joint face.

Note

Observe cleanliness when carrying out work on the universal joints. Even very small quantities of sand or dirt will shorten appreciably the useful life of the universal joints.

6 Fit the universal joint.

7 Raise the sub-frame and secure it in position.

8 Fit the left-hand and centre skirts under the spoiler.

9 Fit the anti-roll bar.

10 Fit the suspension arm to the ball joint.

11 Fit the bottom bracket for the wheel housing. Lower the car

12 Remove the lifting beam (tool 83 93 977).

13 Tighten the left-hand engine mounting.

New

14 Fit the starter motor into place and fit the nuts.

15 Fit the vent.

16 Tighten the stay at the wheel housing.

17 Connect the negative cable.

18 Connect the selector cable.

19 Connect the throttle cable and adjust it (see the News Service Manual for 1990 under the heading Throttle cable)

New

20 First run the speedometer cable through the rubber grommet and then the washer hose.

New

21 Connect the connector and fit the washer hose to the nozzle.

22 Fit the rubber strip and cover to the bulkhead.

23 Fit the oil cooler hoses.

New

24 Fit the delivery pipe between the intercooler and the throttle housing.

New

25 Fit the by-pass valve hose to the delivery pipe and connect the temperature sensor for the intake air. Connect the hose between the delivery pipe and the gearcase.

26 Connect the connector for the air mass meter.

27 Fit the battery tray.

28 Connect the positive cable and fit the terminal block and the holder for the connectors to the battery tray. On cars with ABS brakes, secure the stay for the hydraulic unit.

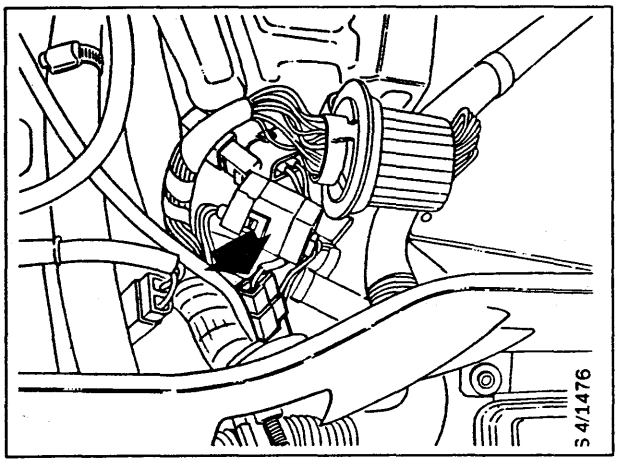
29 Fit the washer fluid container.

30 Fit the battery.

31 Fit the wheel housing liners and the wheel.

32 Check the fluid level in the transmission.

33 Test the car on the road and check the fluid level again.



Suspension and wheels

General

A new model variant—the CD Sport—equipped with a sports chassis has been introduced. The sports chassis enhances the road behaviour of the car.

Variants equipped with a sports chassis also have ABS brakes as standard.

Dampers

The MacPherson struts on the new variant have sports-rated dampers.

Springs

Harder coil springs matched to the weight of the car are fitted both front and rear.

Anti-roll bar

A sports-version anti-roll bar, having a diameter of 19 mm, is fitted at the front.

The rear anti-roll bar has a diameter of 18 mm.

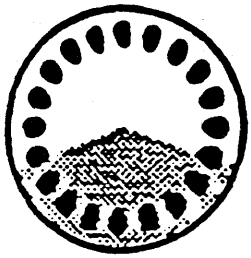
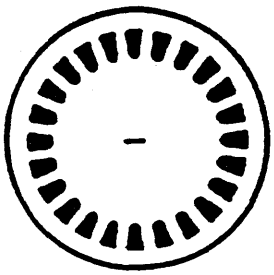
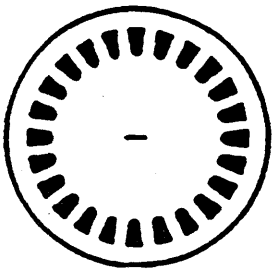
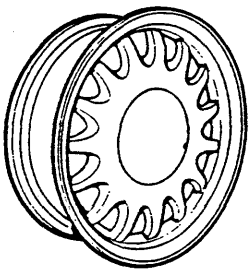
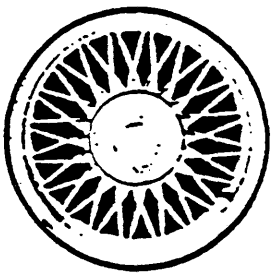
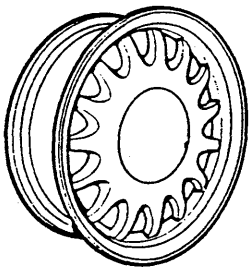
Wheels

A new light-alloy wheel with 15 spokes has been introduced. This wheel, which replaces the earlier Turbo wheel, is made of hardened alloy and is therefore more resistant to impact. The new wheel is also 0.8 kg lighter, having an unsprung weight of 6.6 kg.

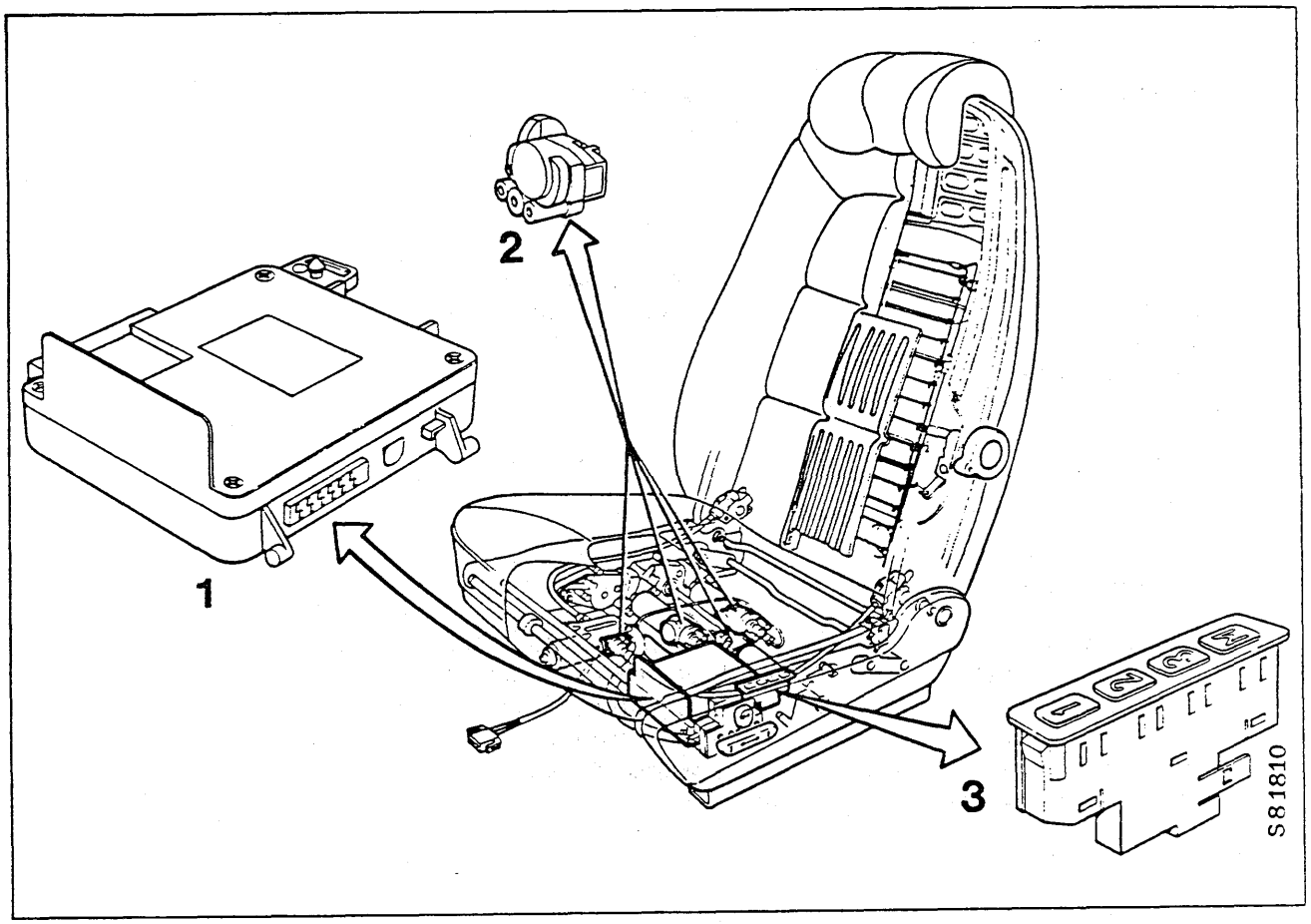
Wheel and tyre programme

Table of wheels, tyres, hubcaps and wheel covers

Model	Wheel 15 x 6"	Hubcap or wheel cover	Tyre size	Option or market specification
9000i CS	Light alloy, 15 spokes	Hubcap	195/65 HR	
9000T CS	Light alloy, 15 spokes	Hubcap	205/50 ZR	
9000T CD	Light alloy, 15 spokes	Hubcap	195/65 VR	
9000i CD	Light alloy, 15 spokes	Hubcap	195/65 HR	

	Standard		Option	
9000i 16		15 x 6" Steel + plastic wheel cover		
9000i 16 CD		15 x 6" Steel + plastic wheel cover		
9000T 16		15 x 6" Lightweight alloy, 15 spokes		
9000T 16 CD		15 x 6" Lightweight alloy, 15 spokes		15 x 6" Light alloy cross-spoke
9000T 16 Sport		16 x 6.5" Light alloy Aero design		

Body



1 ECU
2 Position sensors (potentiometers)
3 Memory control panel

Memory function for electrically adjusted front seats

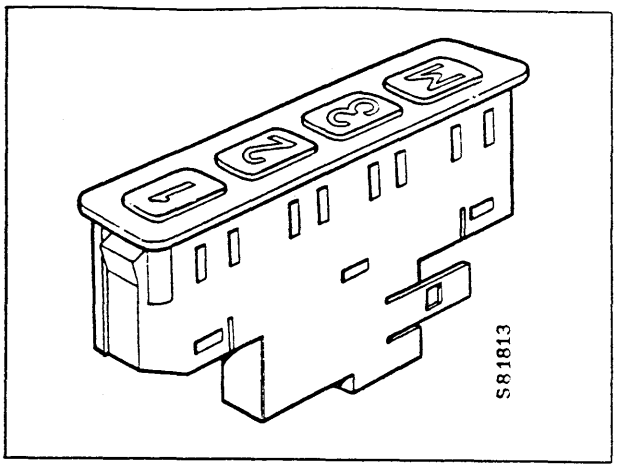
A memory function for the electrically adjustable front seats is now being offered as a factory-fitted option. The function can store the settings for the three different seat adjustments, which are then selected automatically when the appropriate control button is depressed.

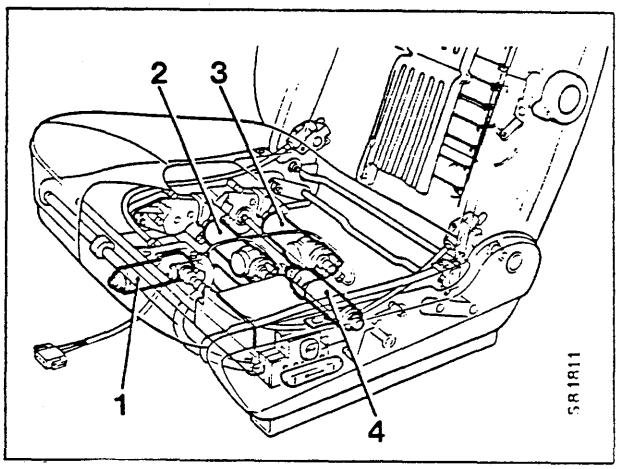
The memory function has been made possible by the addition of an ECU, a position sensor for each servo motor and a control panel containing four buttons for storing and selecting the settings.

The memory control panel houses four buttons, three of which ***(1,2 & 3)*** are for selecting the settings and the fourth, ***M***, for adding the desired setting to the memory. The procedure for storing the seat settings is as follows:

- Using the normal buttons, adjust the seat to the desired position.
- Store the setting in memory by pressing the ***M*** button together with the desired selection button ***(1,2 or 3)***.

To recall a stored setting, hold down the appropriate selection button ***(1,2 or 3)*** until the seat has adopted the selected position.





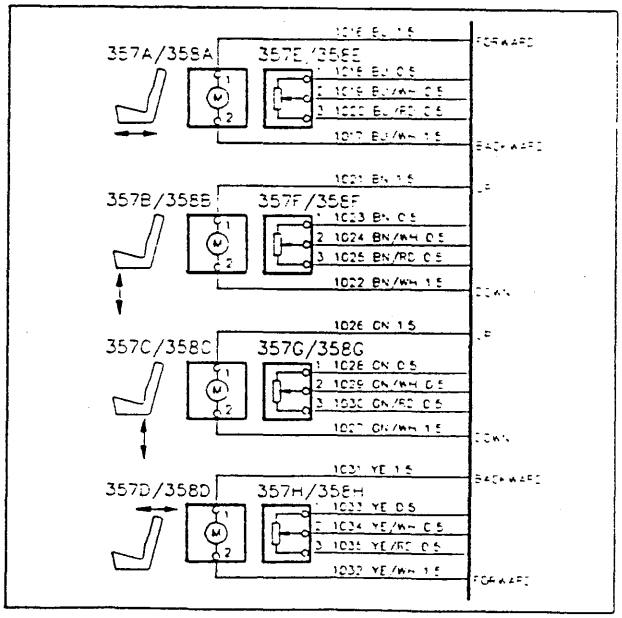
1 Backrest adjustment
2 Thigh-support adjustment
3 Fore-aft adjustment
4 Seat-height adjustment

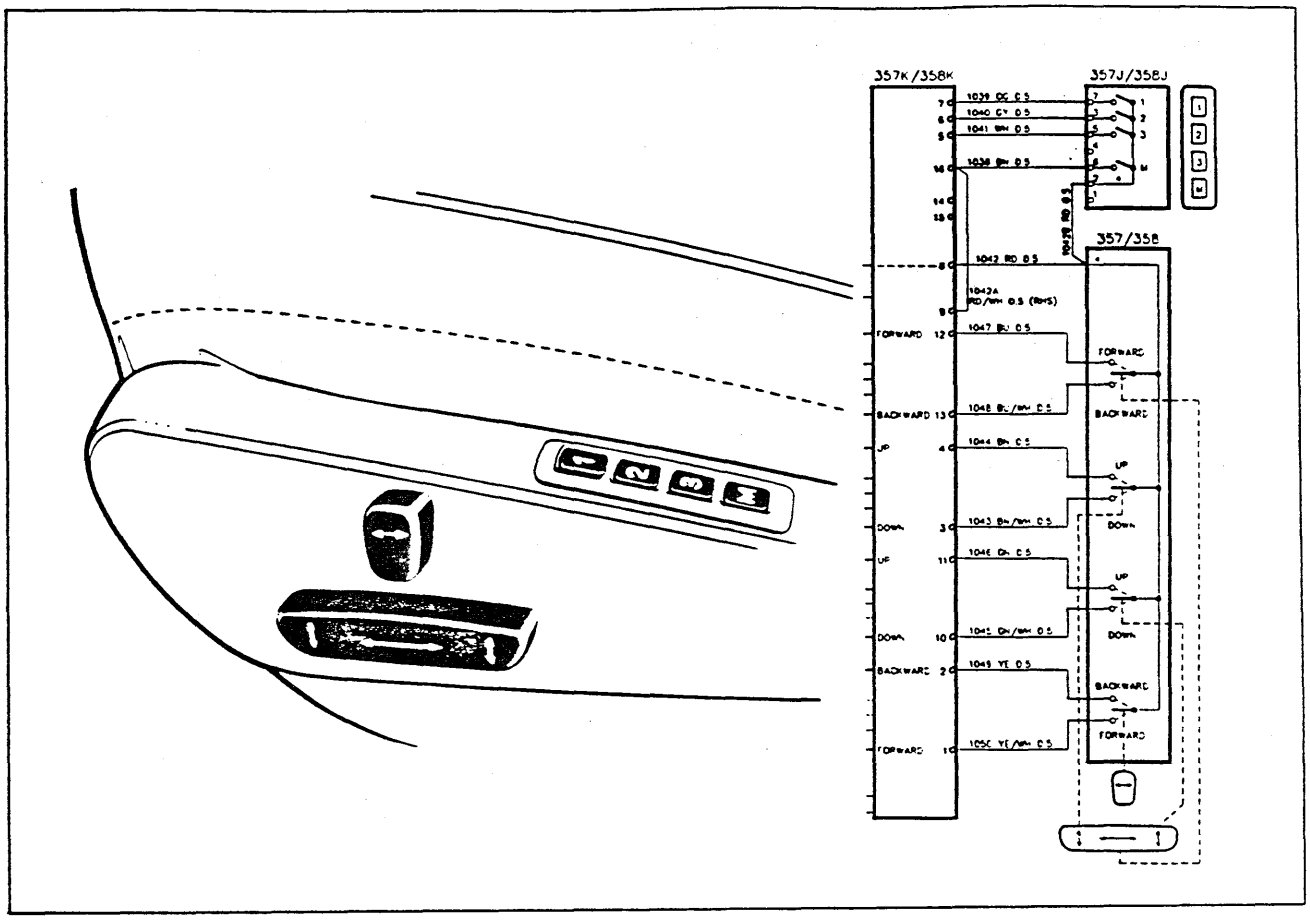
Technical description

The live feed to the ECU is taken from the +54 terminal block via a 25 A fuse. The ECU supplies the feed to the motors, position sensors (potentiometers) and switches. The switches are monitored continuously by the ECU, and when a valid combination of switches are activated, the ECU selects the relevant function. The ECU also monitors the power used by the individual motors when they are operating, and also the position of the seat settings from the data received from the position sensors.

The system includes a self-diagnostics function, which stores codes for any faults detected, which can then be transferred to ISAT.

The position sensors incorporate potentiometers fitted to the individual motor spindles. The live feed of approx. 5 V is supplied to pins 1 and 3 of the potentiometers from the ECU. As the spindle turns, the voltage at pin 2 of the potentiometer varies—usually between 0.4 and 4.6 V. By measuring this voltage, the ECU is able to determine the seat setting.

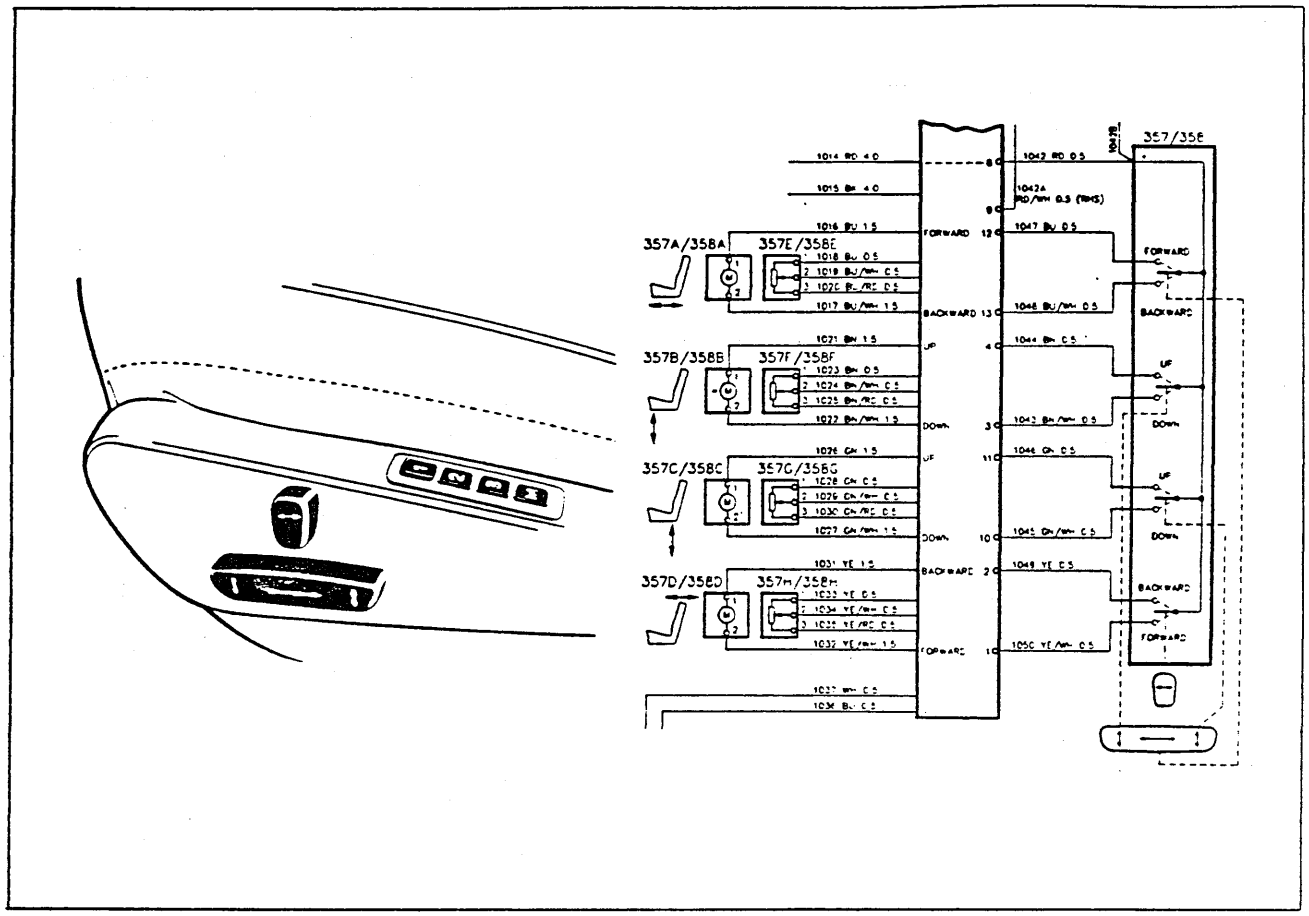




The pushbutton controls consist of a number of switches, each of which receives battery voltage (12 V) to one of its terminals from the ECU. When a control is operated, a circuit is made, connecting the 12 V back to the switch input on the ECU, changing the voltage at the input from 0 to 12 V.

The ECU monitors the switches in the two panels continuously and as soon as a valid command signal is detected, it initiates the corresponding function, i.e. operates the motors for manual adjustment of the seat or to adjust the seat to one of the settings stored in the memory, or saves the current setting in the memory.

If the command is not a valid one, e.g. if two memory buttons or manual control buttons are pressed simultaneously, the ECU will not initiate any of the functions. If a command to select a preset setting or to save a setting in memory is detected at the same time as a manual command is given, the ECU will respond to the manual command.

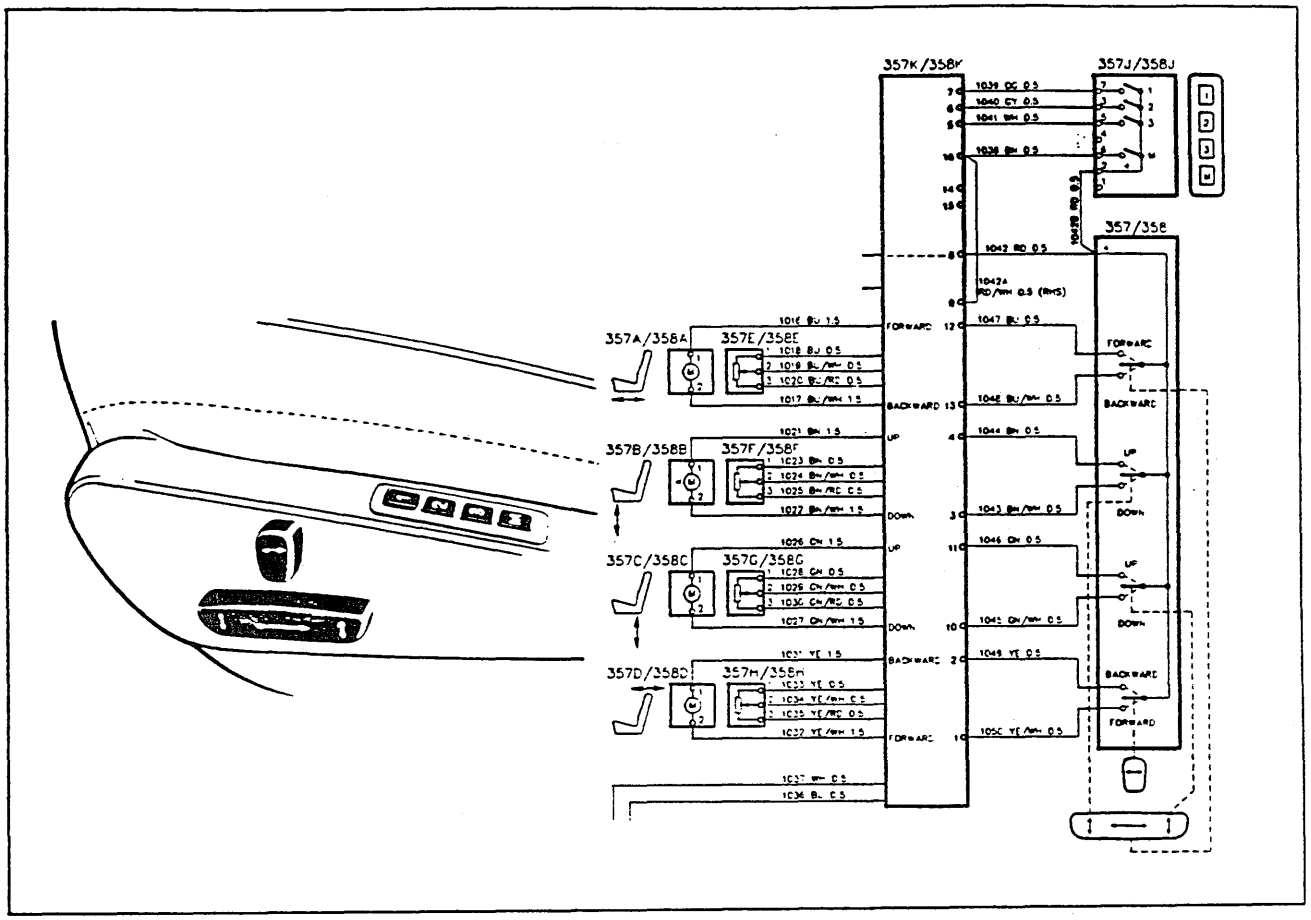


When the seat is being adjusted manually

The ECU notes which of the manual controls is being operated and applies the appropriate current to the motors to move the seat in the desired direction.

The ECU permits only two motors to run simultaneously, which means if more than two of the manual controls are pressed at the same time, the ECU will switch off all the motors. Mechanical stops are provided for fore-aft adjustment of the seat and for adjustment of the seat height. The ECU will apply power to the relevant motors for the settings for as long as the manual control is being operated (up to a maximum duration of one minute).

No mechanical stops are provided for the backrest, with the limits of travel being determined by the ECU on the information received from the position sensors. For this reason, the ECU will not allow the backrest motor to be operated if a position sensor is faulty.



Saving the seat settings

When a seat setting is to be saved, the ECU notes the values of all the position sensors and stores them in memory. The memories in which the settings are saved retain the information even if the power supply to the ECU is interrupted.

If any of the position sensors is faulty, it will not be possible to store any new settings in the memory, although any previously stored settings will still remain.

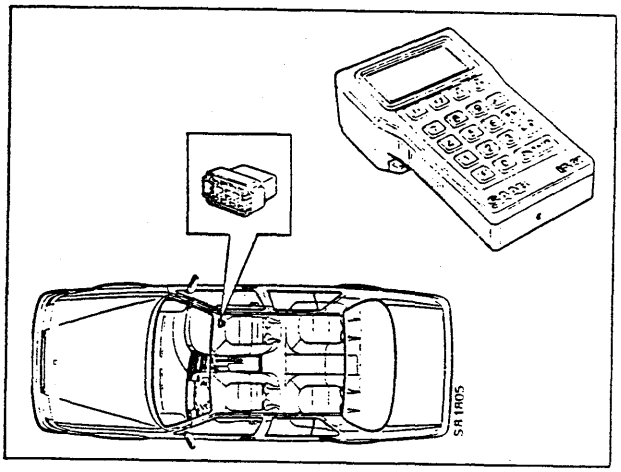
Selecting a setting from memory

To adjust the seat to a preselected setting, the ECU monitors all the position sensors and operates the motors until the seat is in the preselected position or until the control button is released.

If the ECU detects a fault in one of the position sensors, or if adjustment of one of the seat settings is abnormally slow, it will switch off the relevant motor.

Diagnostics

Faults detected by the ECU are stored in the form of fault codes. These can then be transferred to ISAT by connecting the instrument to the diagnostics socket underneath the RH front seat. ISAT command codes can be used to monitor the status of the individual switches and the values from each position sensor.



Internal testing of ECU circuitry

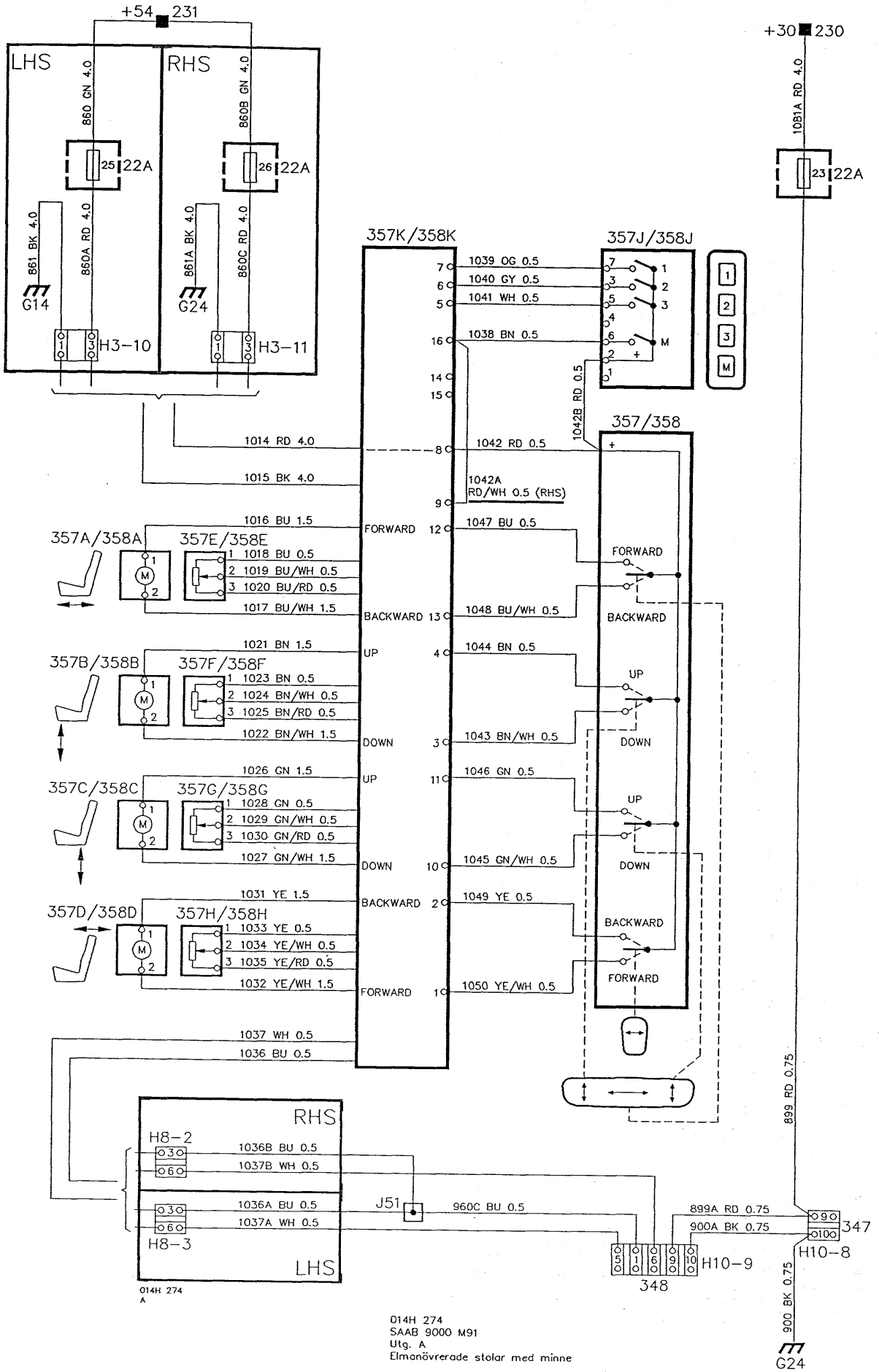
The ECU carries out automatic testing of some of its internal components. If a fault is detected, a fault code indicating an ECU fault is generated.

Testing of external components

Testing of all the position sensors is carried out automatically when a setting is being saved or recalled. The position sensor for the backrest is also tested when the backrest is adjusted manually. If testing reveals a faulty position sensor, it will only be possible to operate the corresponding motor manually (this does not apply to the backrest motor, which cannot be operated at all if its position sensor is faulty). In addition, it will not be possible to save any new settings.

Whenever a motor is operated in response to one of the manual controls or a preselected setting being recalled, it is tested for excessive power consumption. If this is detected, the motor is switched off. If the ECU finds that the power consumption of a motor is high on four successive occurrences, it will inhibit further operation of the motor. It will then not be possible to run the motor again until fault diagnosis has been carried out and the relevant fault code cleared.

Wiring diagram



014H 274
SAAB 9000 M91
Utg. A
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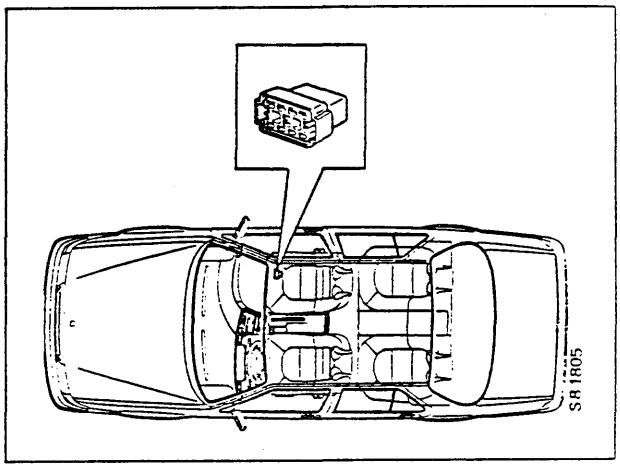
Fault diagnosis

Before starting work

Test run all the motors in both directions before starting any fault-diagnosis work. If the fuse for the seat blows when any of the motors is running, the probable cause is one of the motor connections shorting to earth. Rectify the fault, fit a new fuse and then proceed with the fault-diagnosis work.

Fault diagnosis using ISAT

Connect ISAT to the diagnostics socket underneath the RH front seat. Switch on the ignition and establish contact with the ECU: the LH front seat has system number 4, and the RH front seat system number 5.



Once contact has been established, ISAT will display the message *SEAT MEMORY L* (LH seat) or *SEAT MEMORY R* (RH seat), depending on the system number selected. All the fault codes detected by the ECU will also be displayed.

Note that the seat cannot be adjusted while ISAT is connected.

If ISAT should fail to make contact with the ECU, follow the test procedure on page 20.

Note down any fault codes displayed. Before going any further, check that the input signals to the ECU from the memory buttons and from the manual controls are correct (see page 16). This is necessary to eliminate any duplicated faults, which make fault diagnosis more difficult.

Fault codes

P = Permanent fault
I = Intermittent fault

LH potentiometer and motor = 357 + letter
RH potentiometer and motor = 358 + letter

P	I	Malfunction indicated	See page:
11111		No fault detected	–
45221	25221	Potentiometer 357F/358F (thigh-support adjustment) Potentiometer voltage high	11
45222	25222	Potentiometer 357E/358E (fore-aft adjustment) Potentiometer voltage high	11

P	I	Malfunction indicated	See page:
45223	25223	Potentiometer 357G/358G (height adjustment) Potentiometer voltage high	11
45224	25224	Potentiometer 357H/358H (backrest adjustment) Potentiometer voltage high	11
45231	25231	Potentiometer 357F/358F (thigh-support adjustment) Potentiometer voltage low	11
45232	25232	Potentiometer 357E/358E (fore-aft adjustment) Potentiometer voltage low	11
45233	25233	Potentiometer 357G/358G (height adjustment) Potentiometer voltage low	11
45234	25234	Potentiometer 357H/358H (backrest adjustment) Potentiometer voltage low	11
45291	25291	Potentiometer 357F/358F (thigh-support adjustment) Adjustment from memory setting too slow	14
45292	25292	Potentiometer 357E/358E (fore-aft adjustment) Adjustment from memory setting too slow	14
45293	25293	Potentiometer 357G/358G (height adjustment) Adjustment from memory setting too slow	14
45294	25294	Potentiometer 357H/358H (backrest adjustment) Adjustment from memory setting too slow	14
53640	33640	Power consumption by a motor >50 A	-
53641	33641	Motor 357B/358B (thigh-support adjustment) Power consumption >50 A	13
53642	33642	Motor 357A/358A (fore-aft adjustment) Power consumption >50 A	13
53643	33643	Motor 357C/358C (height adjustment) Power consumption >50 A	13
53644	33644	Motor 357D/358D (backrest adjustment) Power consumption >50 A	13
67590	77590	ECU fault (fit a new ECU)	-

ISAT command codes

Transferring fault codes from ECU

Command code	Description
100	Send all stored fault codes to ISAT
800	Terminate communications
900	Clear all stored fault codes

Codes for monitoring status of manual-control and memory-control switches

8B000 = Closed circuit detected by ECU
8B100 = Open circuit detected by ECU

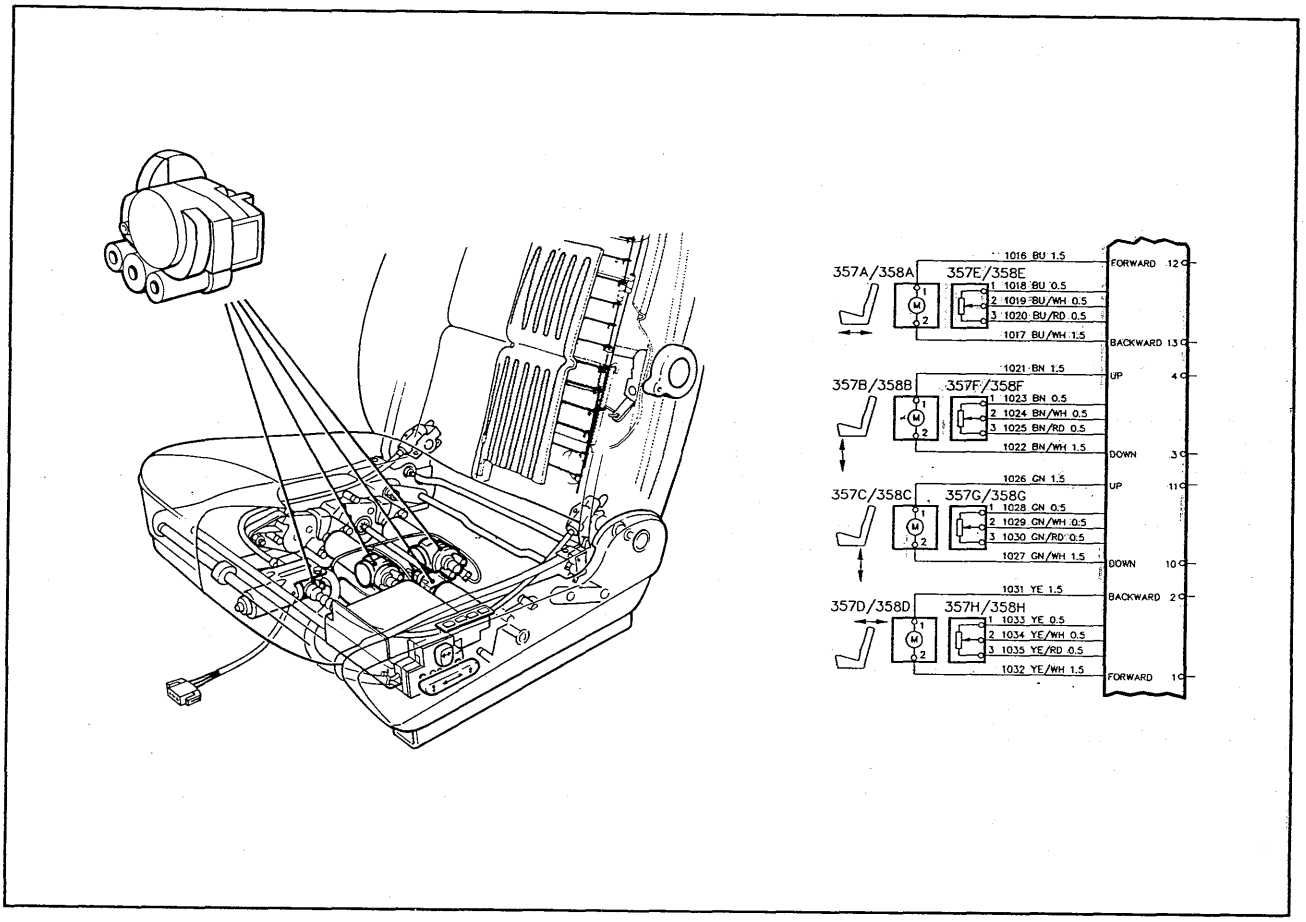
Command code	Description
200	Seat at front stop
201	Seat at rear stop
202	Backrest at forward limit
203	Backrest at rear limit
204	Thigh support at max. height
205	Thigh support at min. height
206	Seat at max. height
207	Seat at min. height
20A	Memory button *3*
20B	Memory button *2*
20C	Memory button *1*
20D	Memory button *M*

Codes for monitoring potentiometer values

The potentiometer value is given in the form of a number between 0 and 255. For instance, if the reading on the ISAT display is 80123, this indicates a potentiometer value of 123.

Command code	Description
279	Potentiometer 357F/358F (thigh-support adjustment)
280	Potentiometer 357E/358E (fore-aft adjustment)
281	Potentiometer 357G/358G (height adjustment)
282	Potentiometer 357H/358H (backrest adjustment)

Potentiometer faults



Fault codes: 45221/25221
45222/25222
45223/25223
45224/25224

Voltage from potentiometer high.

Fault codes: 45231/25231
45232/25232
45233/25233
45234/25234

Voltage from potentiometer low.

Fault symptom

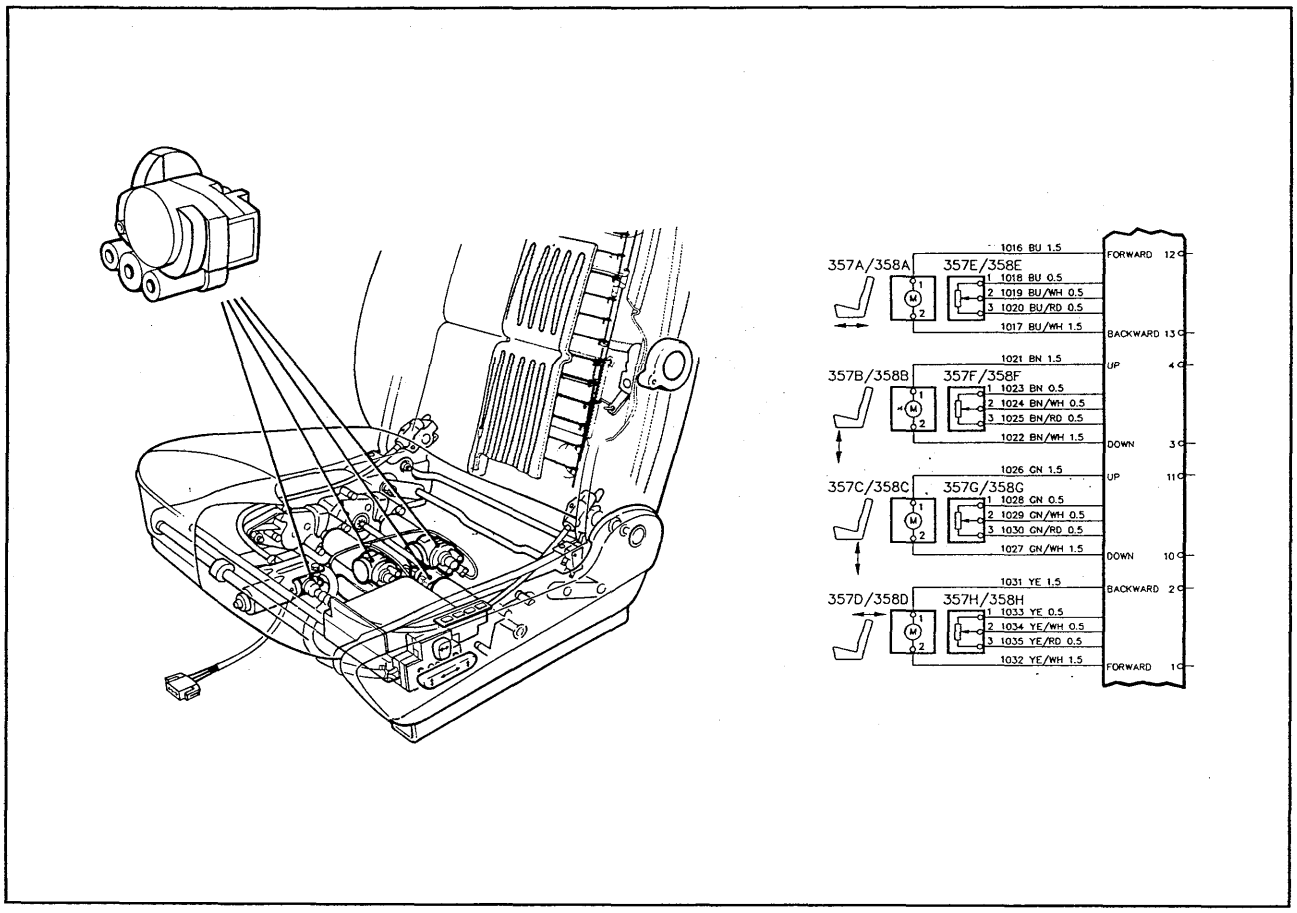
- New setting for seat cannot be saved.
- One or more motors fail to operate when saved setting being recalled.
- No manual adjustment of backrest possible (only if backrest potentiometer faulty).
- Another sign that a potentiometer is faulty is that the relevant motor will only run for a few seconds at a time on manual operation (n/a backrest motor).

  Note that this symptom will only occur if an attempt to save or recall a setting has been made before the manual-adjustment attempt. The symptom will disappear when the power supply to the ECU is broken.

Malfunction indicated

Fault codes: 45221/25221
45222/25222
45223/25223
45224/25224

- Break in circuit between ECU and pin 3 or pin 2 of potentiometer.
- Short circuit between leads to pins 1 & 2 of potentiometer.
- Potentiometer faulty.



Fault codes: 45231/25231
45232/25232
45233/25233
45234/25234

- Break in circuit between ECU and potentiometer pin 1.
- Short circuit between leads connected to potentiometer pins 1 & 3 or pins 2 & 3.
- Potentiometer faulty.

Test procedures

Note
After a potentiometer has been disconnected, it must be recalibrated before any adjustment can be made to the seat. Do this by running the motor to both end stops.

Unplug the connector from the potentiometer. Check the live feed to the potentiometer from the ECU by measuring the voltage across pins 1 & 3 of the connector with the ignition on.

Correct voltage: approx 5 V.

If voltage reading incorrect: Check the wiring between pin 1 and the ECU and between pin 3 and the ECU. If the wiring and connector are sound, fit a new ECU.

If voltage reading correct: Check the wiring between pin 2 and the ECU.

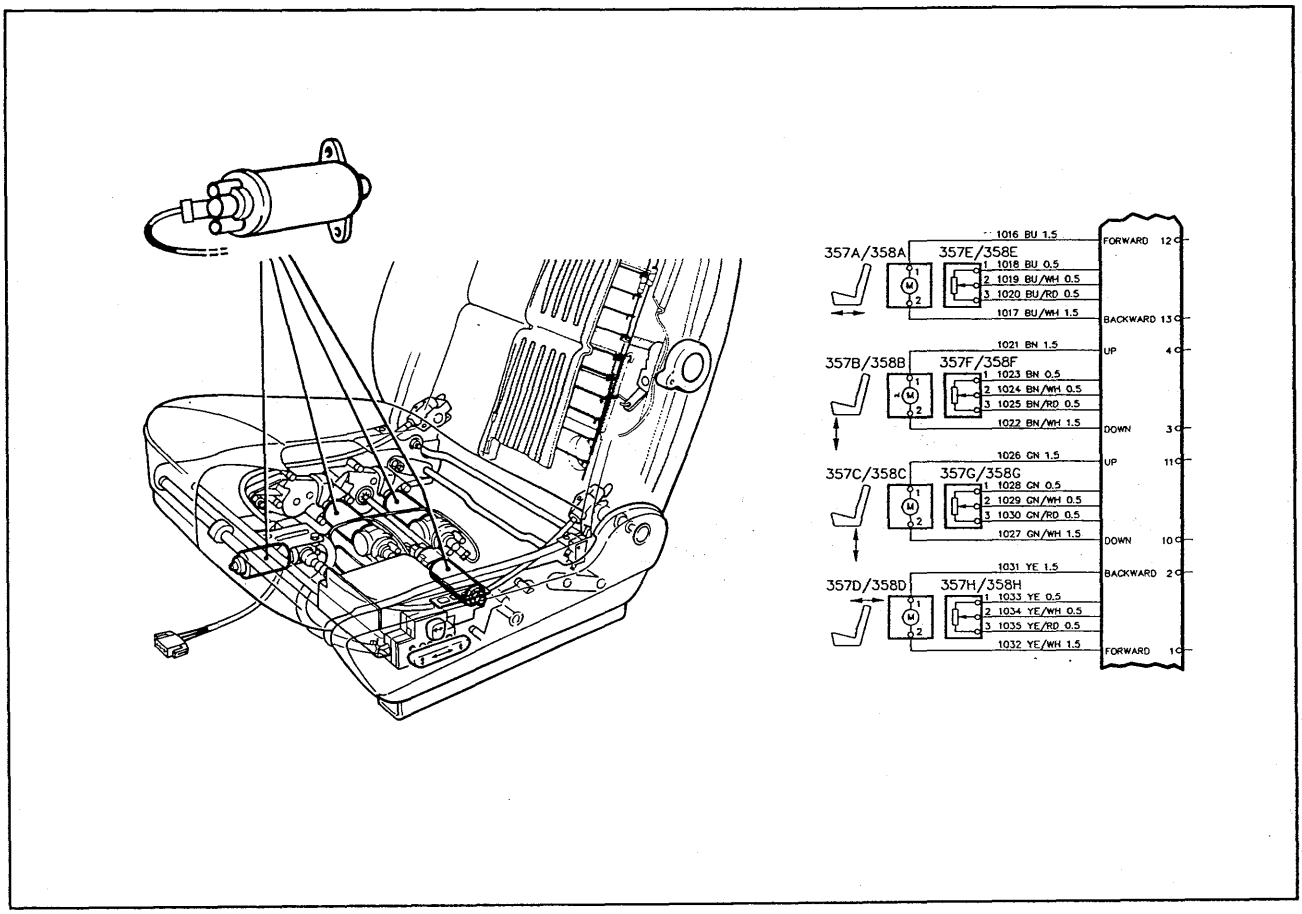
To check that the potentiometer is sound, using an ohmmeter measure the resistance across the potentiometer pins. Correct values are as follows:

Across pins 1 & 3: approx. 2200 ohm
Across pins 2 & 3: 200–2200 ohm*
Across pins 2 & 1: 200–2200 ohm*

* Depending on position of seat.

If the readings vary widely from the specified values, the potentiometer is faulty.

Motor faults



Fault codes: 53641/33641
53642/33642
53643/33643
53644/33644

The ECU monitors the power used by the motors and if the value for a motor exceeds the preset limit assumes that there is a short circuit. The ECU switches off the motor and generates a fault code. If this occurs four times in succession for the same motor, the ECU will not allow the motor to be started again.

Fault symptom

Motor will not run on either manual control or memory control.

Malfunction indicated

- Motor defective
- Shorting between motor terminals

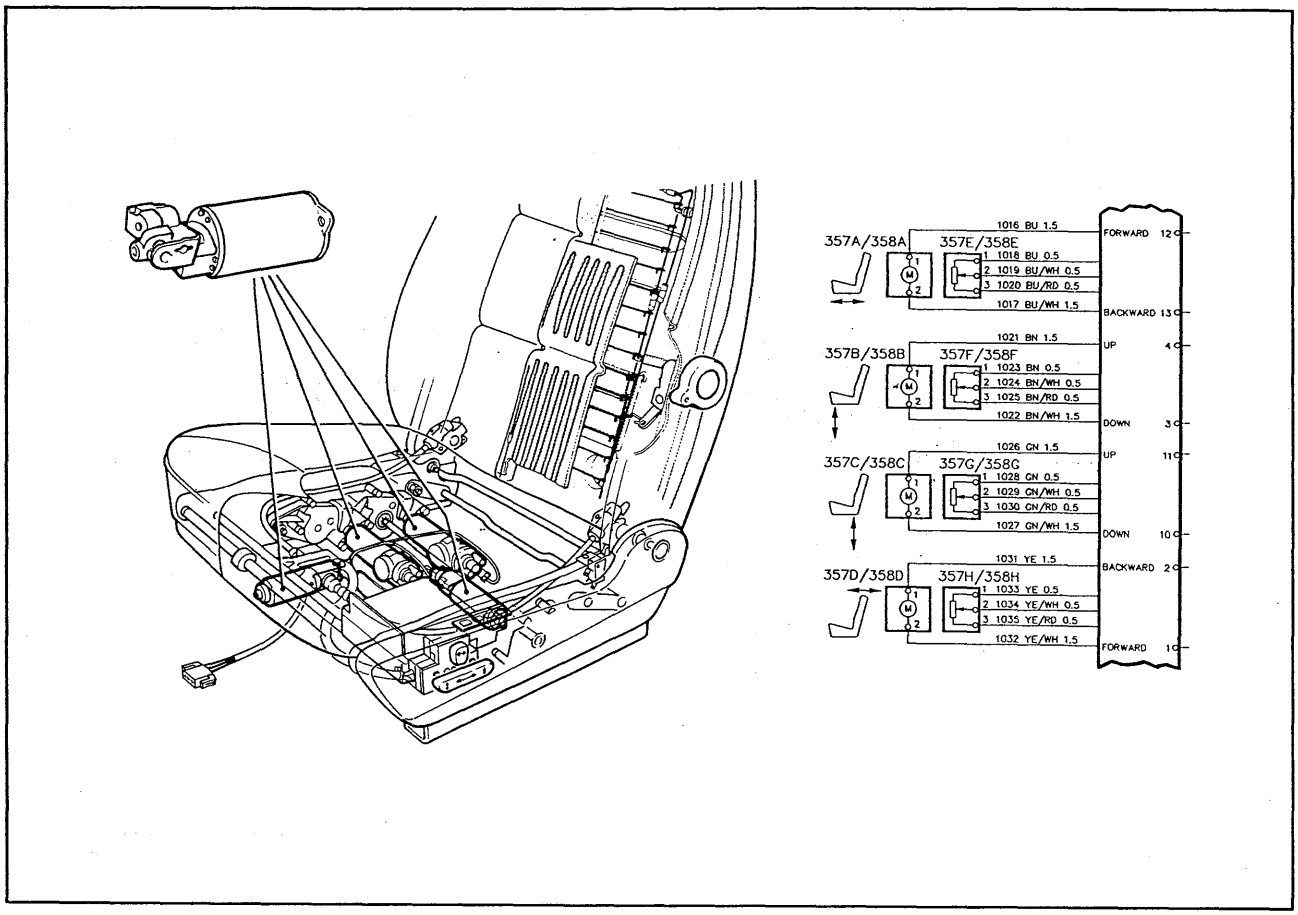
Test procedure

Clear the fault codes and terminate communication between ISAT and the ECU.
Unplug the connector from the motor and connect a voltmeter across pins 1 & 2 of the connector. Enter the command code to run the motor in both directions by means of the manual control. The voltage across pins 1 & 2 should alternate between +12 V and −12 V (battery voltage) depending on the command given by the manual control.

If the voltage is correct, try a new motor.

Note
The motor for the backrest must not be test run on a power supply other than that from the ECU. If connected to another power supply, the motor could be run beyond one of the potentiometer end stops. This would alter the position of the potentiometer on the spindle, putting it out of calibration (the backrest end limits would be incorrect).

Slow change in potentiometer value on recalling a setting



Fault codes: 45291/25291
45292/25292
45293/25293
45294/25294

When a seat setting is being recalled, the ECU monitors the speed at which the seat adjustments are altered. If the speed is too slow or the seat fails to move at all when the ECU has excited a motor, the motor concerned will be switched off and a fault code generated.

Fault symptom (1)

Motor fails to respond to manual control.

Malfunction indicated (1)

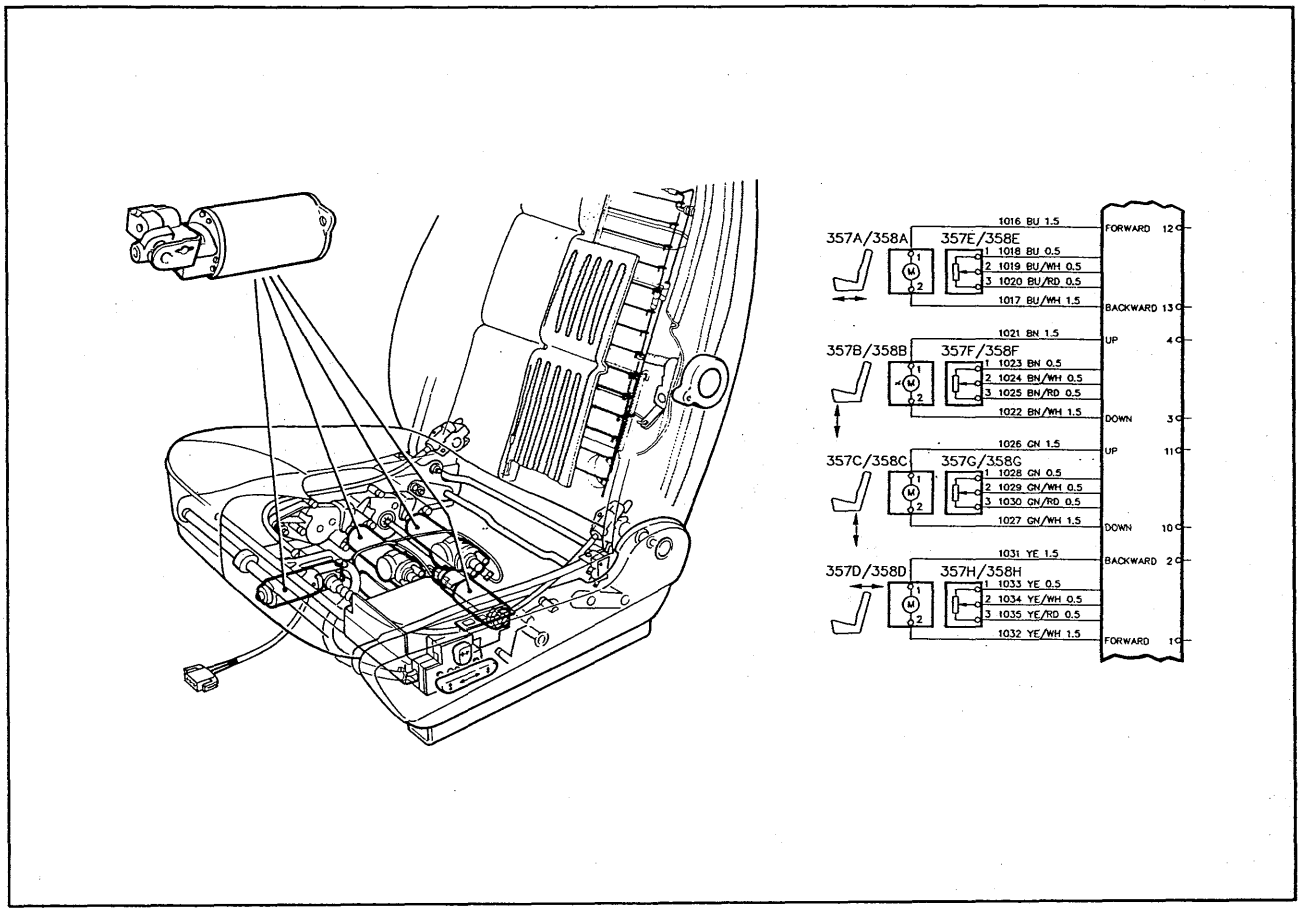
- Break in circuit between motor and ECU.
- Motor faulty.

Test procedure (1)

Clear the fault codes and terminate communication between ISAT and the ECU.
Unplug the connector from the motor and connect a voltmeter across pins 1 & 2 of the connector. Enter the command code to run the motor in both directions by means of the manual control. The voltage across pins 1 & 2 should alternate between +12 V and −12 V (battery voltage) depending on the command given by the manual control.

If the voltage is correct, try a known good motor.

If no voltage is present, check for a break in the wiring between the ECU and the motor.



Fault symptom (2)

The motor operates at normal speed on manual control but not at all on memory control.

Malfunction indicated (2)

Potentiometer fault—the potentiometer does not change position as it is loose on the spindle or because of some other mechanical fault.

Test procedure (2)

Check the input signal from the potentiometer (see page 19).

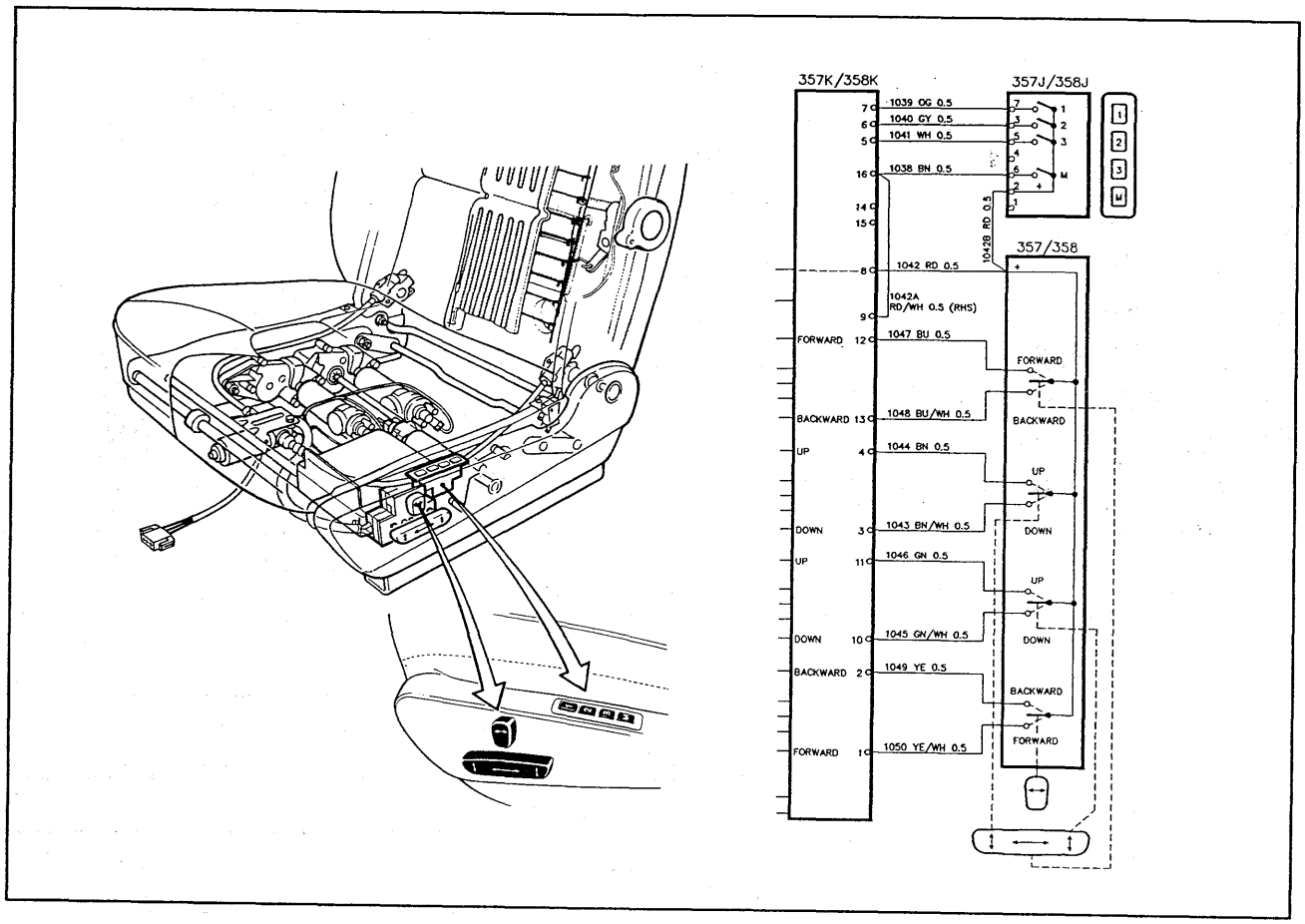
Fault symptom (3)

The motor operates only slowly on manual control and not at all on memory control.

Malfunction indicated (3)

Mechanical fault preventing movement of the seat.

Checking the input signals from the manual and memory controls



Connect ISAT and establish contact with the ECU. Enter the command codes for monitoring each switch individually (codes 200–207, 20A–20D). The display should now show 8B000, indicating an open switch circuit.

Actuate the manual control or press one of the memory buttons to cause the switch to make the circuit. The display should now show 8B100, indicating a closed circuit.

One of the switches faulty

Fault symptom (1)

ECU indicates that all switches are open (8B000 on ISAT).

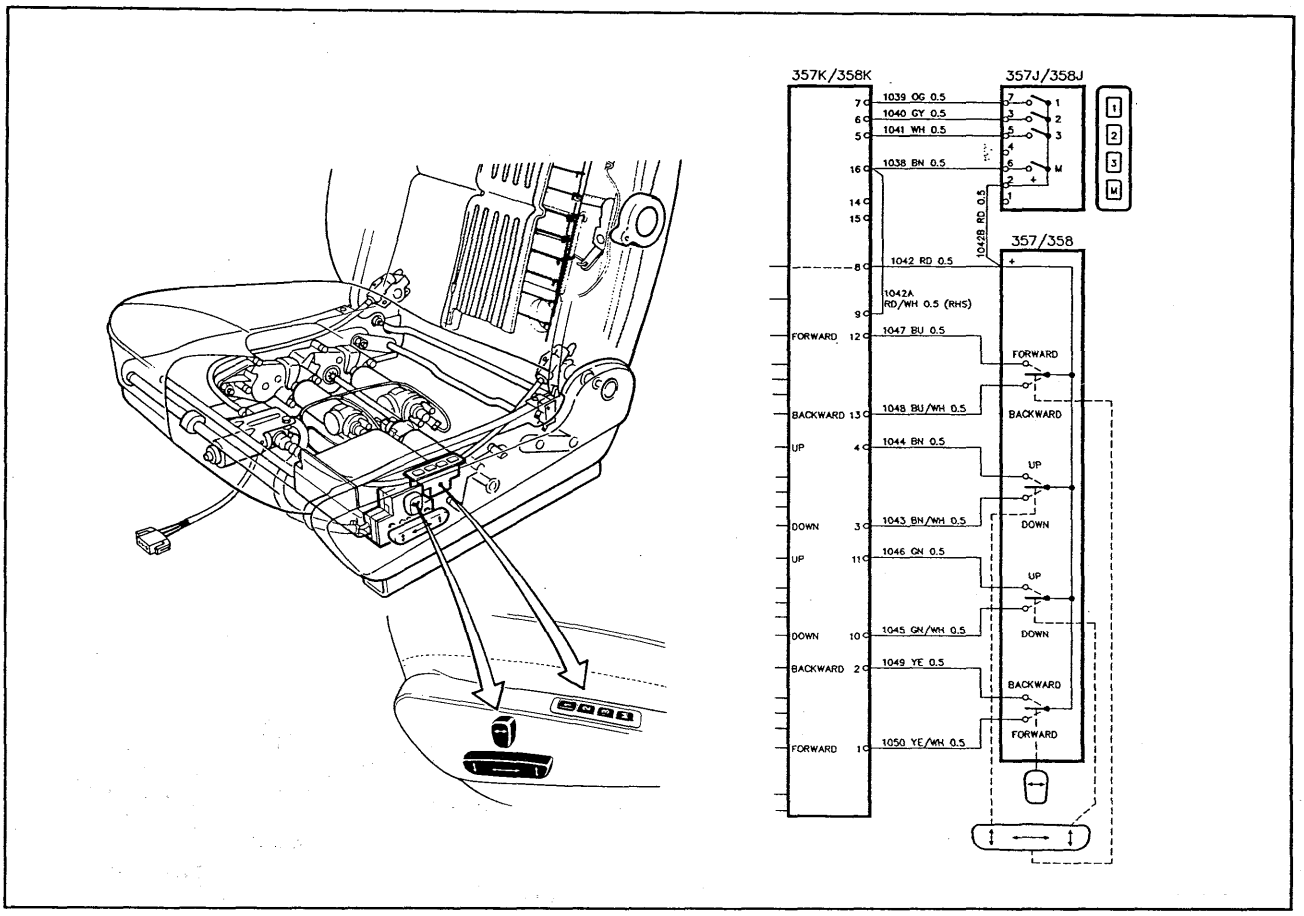
Malfunction indicated (1)

No live feed from ECU to manual control and memory buttons.

Test procedure (1)

Disconnect the manual control and memory switch panel from the ECU. Check that battery voltage is reaching ECU pin 8 by connecting a voltmeter across pin 8 and chassis earth. If no voltage is reaching pin 8, fit a new ECU. Note that the power supply to the ECU must be connected during this test.

If battery voltage is reaching pin 8, check the wiring between the controls and pin 8 on the connector (1042 & 1042B) for a broken circuit or shorting to earth.



Fault symptom (2)

ECU indicates that all switches are open (8B000 on ISAT), even though manual control working properly.

Malfunction indicated (2)

No live feed from ECU to memory panel.

Test procedure (2)

Check the wiring between the manual control (1042B) and the memory panel.

Fault symptom (3)

Only one of the switches for the manual or memory controls is identified as open by the ECU (8B000 on ISAT).

Malfunction indicated (3)

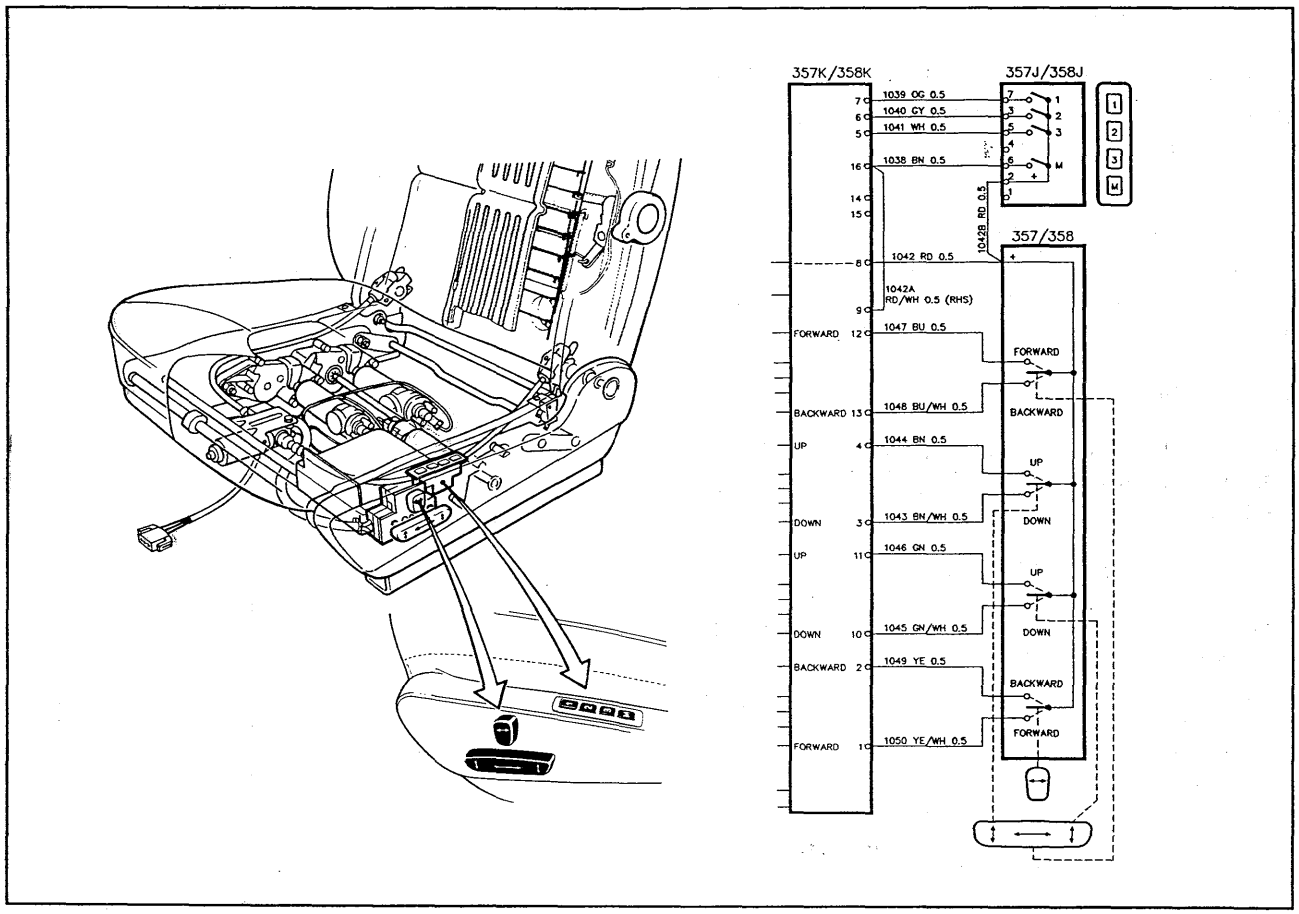
- Break in circuit between the switch concerned and the ECU.
- Internal fault in control panel preventing switch from making circuit.
- Fault in ECU.

Test procedure (3)

Unplug the connector on the control panel for the wiring from the ECU. Connect an ohmmeter across pin 8 in the 16-pin connector and the pin for the switch concerned. Check that there is circuit continuity when the switch makes the circuit and that the circuit is open when the switch breaks the circuit. If not, find out whether the fault is in the wiring or in the switch panel.

If function correct, check if the fault is in the ECU. With the connector for the panel unplugged, enter the command code for monitoring the status of the switch. ISAT should now display 8B000. Simulate a closed switch by connecting pin 8 direct to the input pin on the ECU connector for the relevant switch. ISAT should now display 8B100.

If the readings are incorrect, fit a new ECU.



Fault symptom (4)

One of switches identified as being constantly open (8B100 on ISAT).

Malfunction indicated (4)

- Switch sticking in closed position.
- Shorting in wiring or connectors causing battery voltage to reach the input pin for the switch at the ECU even though switch not closed.
- Fault in ECU.

Test procedure (4)

Unplug the connector (on leads from ECU) from the switch panel and enter the command code for monitoring the status of the switch. If the ECU still indicates that the switch is closed (8B100 on ISAT), fit a new ECU.

If not, check the connector and wiring, and also check to see if the switch is sticking in the closed position.

Checking input signals from potentiometers

Using the manual control, operate the motor for the potentiometer concerned until the adjustment limit is reached. (If a motor cannot be run manually, its potentiometer cannot be tested in this way.)

Connect ISAT and establish contact with the ECU. Enter the command code for monitoring the potentiometer (codes 279–282). The potentiometer value will then be shown, e.g. as 80123, with 123 being the value. Note this value and terminate communications between ISAT and the ECU.

Next run the motor to move the seat to the opposite adjustment limit. Read off the potentiometer value as before.

Assessing the readings

The difference between the two potentiometer readings for each motor should be 100–200 units when the seat has been moved from one adjustment limit to the other. If the motors have been run for a shorter period, the difference will be smaller.

Example:

The potentiometer value for the seat at the forward stop is 235, and for the rear stop 53.

This gives a difference of 235 – 53 = 182, indicating that the potentiometer is working properly.

Fault symptom

The potentiometer value does not alter, or alters only slightly, between one end limit and the other.

Malfunction indicated

Potentiometer slipping on spindle.

Test procedure

Fit a new potentiometer.

Full function check

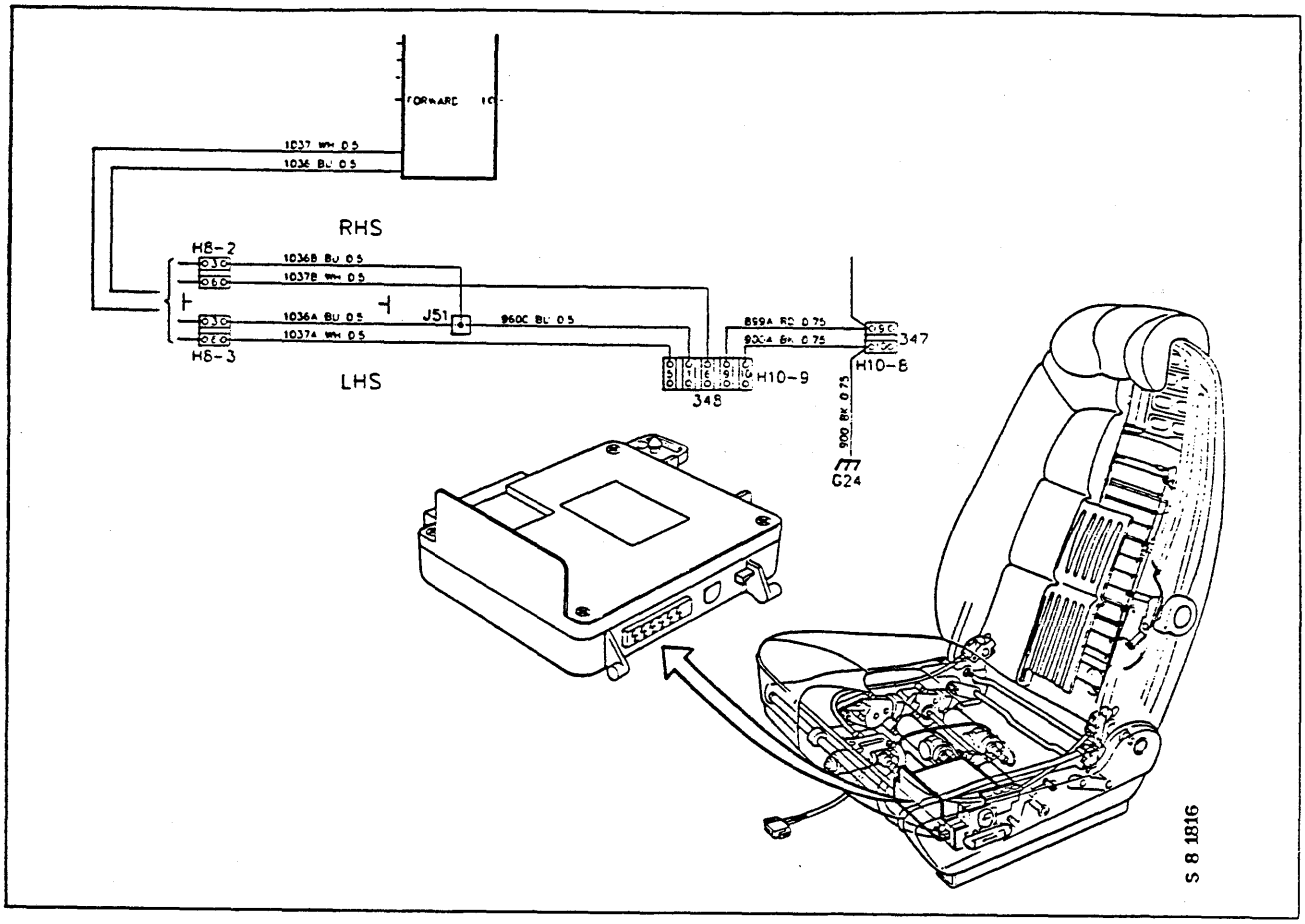
Clear all fault codes.

Check that all motors can be operated manually.

Save three different seat settings in the three memories. Make sure that the seat adjustments in the settings saved all differ.

Check that the seat adopts the setting saved when the setting is recalled.

Connect ISAT and check that no fault codes have been generated.



No contact between ISAT and ECU

Check the following:

- That the ignition is on and that live feed is reaching the ECU.
- That battery voltage is available across pins 9 & 10 of the diagnostics socket (the ISAT display should come on when the tester is connected to the socket).
- The wiring between the diagnostics socket and the ECU (1036 & 1037).

If ISAT still fails to make contact with the ECU:

Fault symptom (1)

Manual seat adjustment is available but when the control is released the seat resumes its original settings.

Malfunction indicated (1)

Fault in memory-control panel. Memory controls constantly activated.

Test procedure (1)

Unplug the connector on the loom between the control panel and the ECU. Call up the ECU using ISAT. Once contact has been established, reconnect the memory panel and follow the test procedure detailed on page 16.

Fault symptom (2)

The ECU is completely dead and fails to respond to any command signals, be they from the memory-control panel or from the manual controls.

Malfunction indicated (2)

The ECU has detected an internal fault resulting in all functions being inhibited.

Test procedure (2)

Fit a new ECU.

Removal and installation procedures

Follow the procedures for electrically adjustable front seats (without memory function) given in the News Supplement to Workshop Manual section 0 for M89.

With the introduction of seats with a memory function, some steps have been added or modified, and these are detailed in the following pages.

The page reference for each step refers to the page number in the M89 News Supplement.

If a procedure has been completely revised, it is described in its entirety in the following pages.

Front seats

Object code: 85210

To remove

Step 1 on page 179:

Also remove the memory-panel switches (see section on electrical system elsewhere in this book).

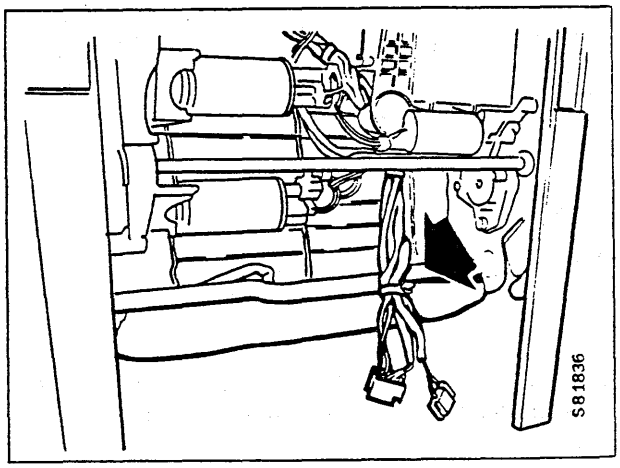
To fit

Step 8 on page 181:

Note that the leads must be run as shown in the picture.

Step 11 on page 182:

Also refit the switches in the memory-control panel (refer to the section on the electrical system elsewhere in this book).



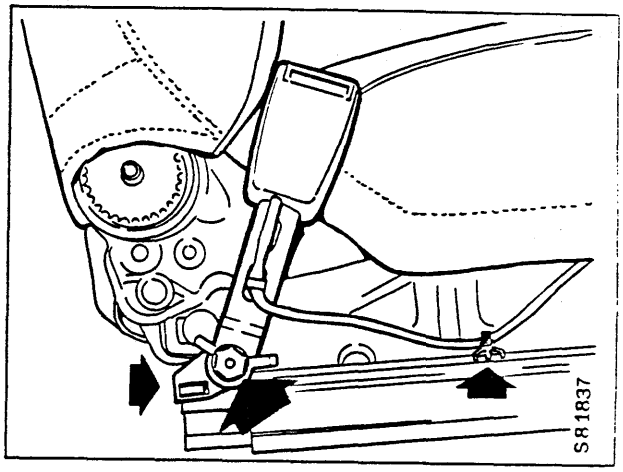
Seat chassis

A description of the entire procedure follows.

Object code 85211

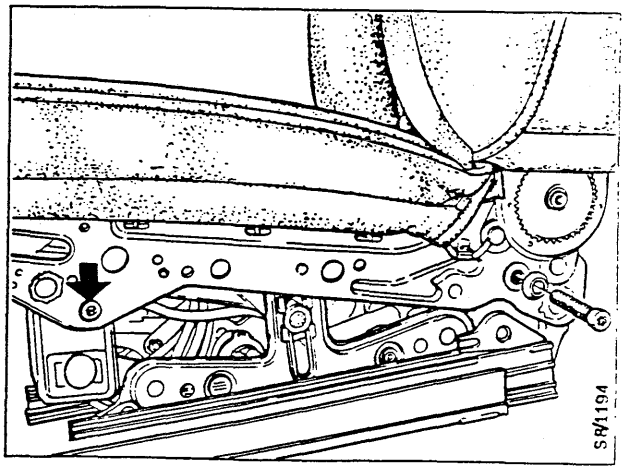
To remove

1. Position the seat at the forward end of its travel.
2. Remove the seat from the car (see preceding page).
3. Remove the switch panel (see page 30).
4. Remove the ECU (see page 32).
5. Unbolt the seat-belt anchorage, save the spacer and snip through the tie securing the lead to the seat runner.



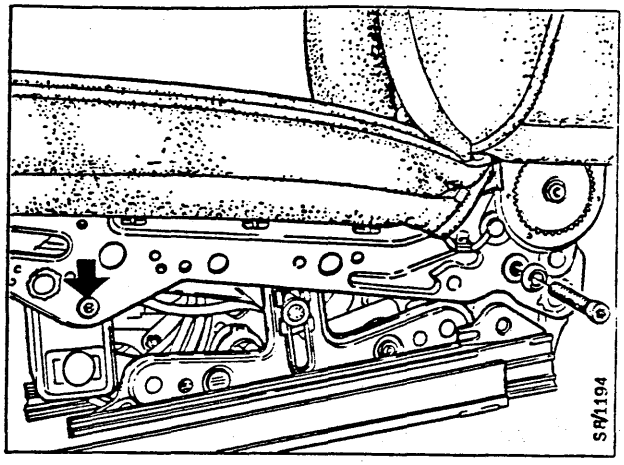
6. Release the cover stiffener from the mounting on the inside of the seat.

7. Remove the four screws (two on either side) securing the seat frame to the chassis. Save the cup washers behind the rear screws.



To fit

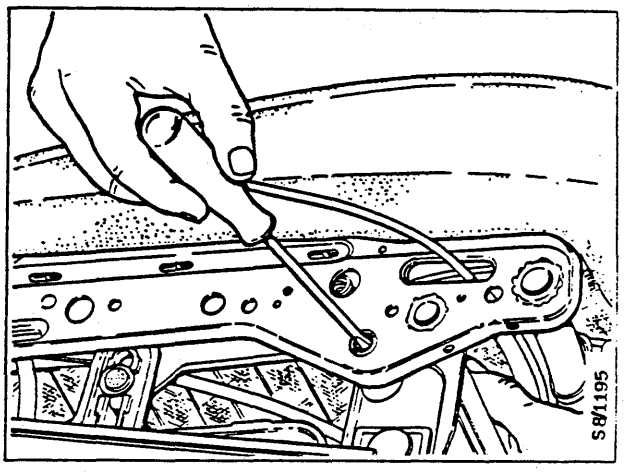
1. Place the seat chassis in position and tighten the two screws securing it to the seat frame on the LH side.



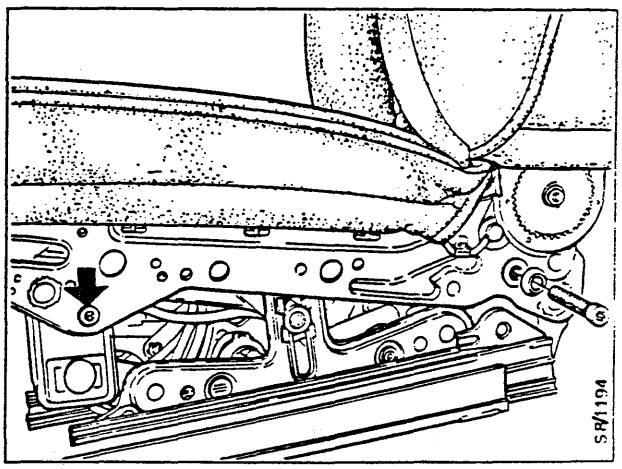
Note
Remember to fit the cup washer under the rear screw.

Tightening torque:
14–26 Nm (10.5–19.0 lbf ft)

2. Screw down the set screws on the RH side of the seat until they butt against the seat chassis.



3. Fit and tighten the two screws securing the seat frame to the chassis on the RH side.

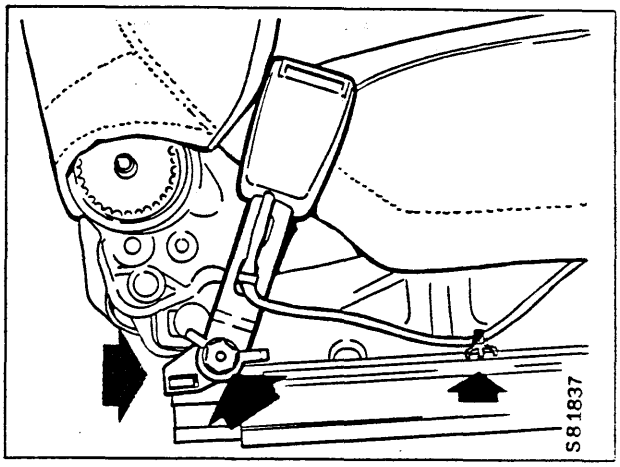


Note
Remember to fit the cup washer under the rear screw.

Tightening torque:
14–26 Nm (10.5–19.0 lbf ft)

4. Secure the cover stiffener to the seat frame.

5. Fit the spacer and tighten the seat-belt anchorage. Fit a new cable tie to secure the lead to the seat runner.



Caution
Do not overtighten the belt anchorage (see specified tightening torque below) as this will damage the seat runner, which will then have to be replaced.

Tightening torque:
40 Nm (29.5 lbf ft)

6. Fit the ECU (see page 33).

7. Refit the switch panel (see page 31).

8. Instal the seat in the car (see page 21).

Height-adjustment drive assembly (incl. motor)

Object code: 85204

To remove

Start by carrying out steps 1 & 2 below. Next turn to page 196 in the M89 News Supplement and carry out the procedure starting from step 3 on that page.

Note that the seat chassis does not need to be removed.

1. Remove the seat from the car (see page 21 in this section).

2. Remove the ECU (see page 32).

To fit

Turn to page 198 in the M89 News Supplement and carry out steps 5 & 6. After step 6, proceed as follows:

1. Refit the ECU (see page 33).
2. Install the seat in the car (see page 21).

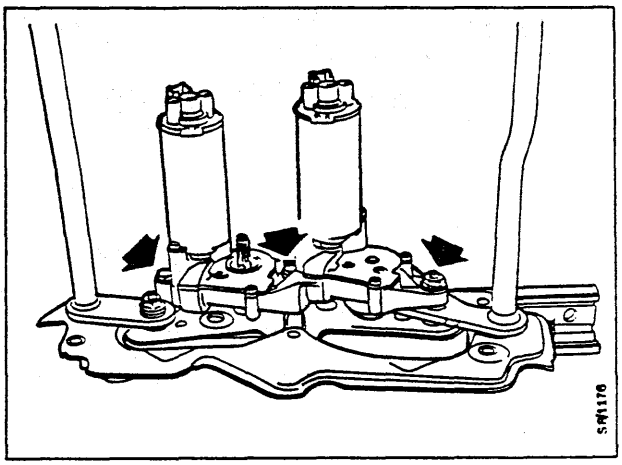
Fore-aft & thigh-support adjustment drive assembly (incl. motor)

The entire procedure follows.

Object code: 85204

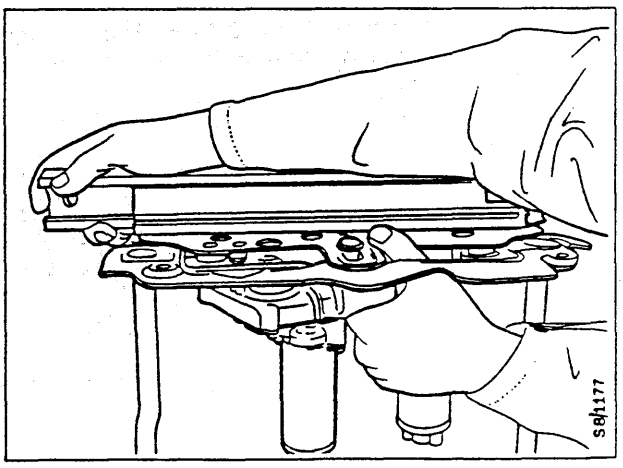
To remove

1. Remove the height-adjustment unit (as detailed on preceding page).
2. Undo the two securing bolts and the nut for the fore-aft & thigh-support adjustment assembly.

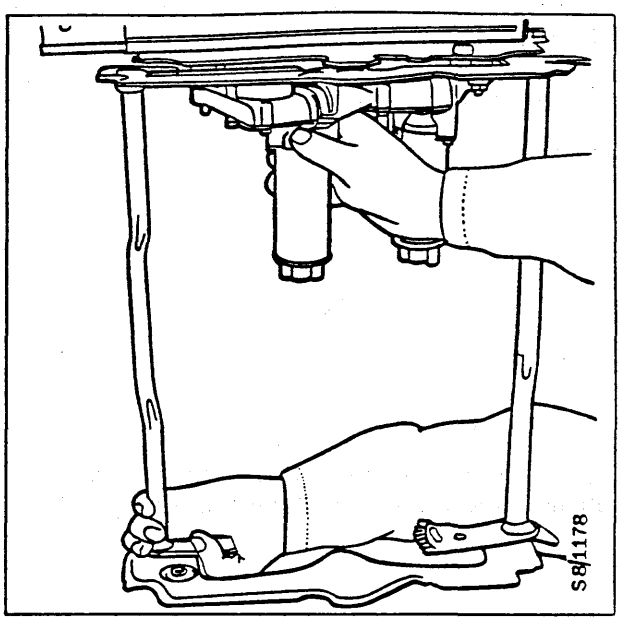


To fit

1. Engage the fore-aft adjustment pinion in the teeth in the seat runner.

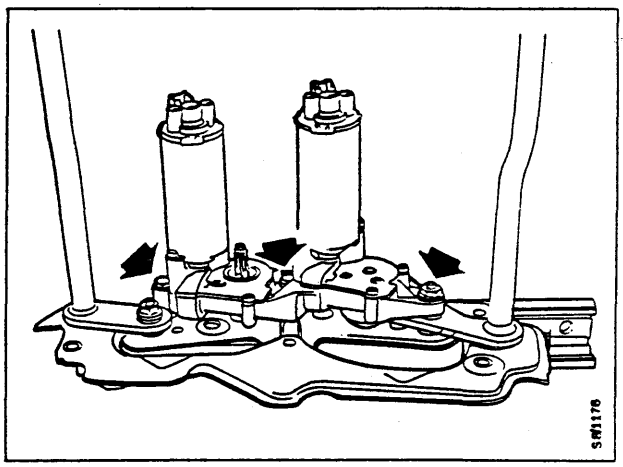


2. Engage the height-adjustment pinion in the teeth in the chassis cam.



3. Tighten the nut and the two bolts securing the unit to the chassis.

Tightening torque:
Bolts: 8–12 Nm (6.0–8.5 lbf ft)
Nut: 17–21 Nm (12.5–15.5 lbf ft)



4. Fit the height-adjustment assembly (see page 25).

Seat frame & backrest-adjustment assembly

Object code: 85211/85212

To remove

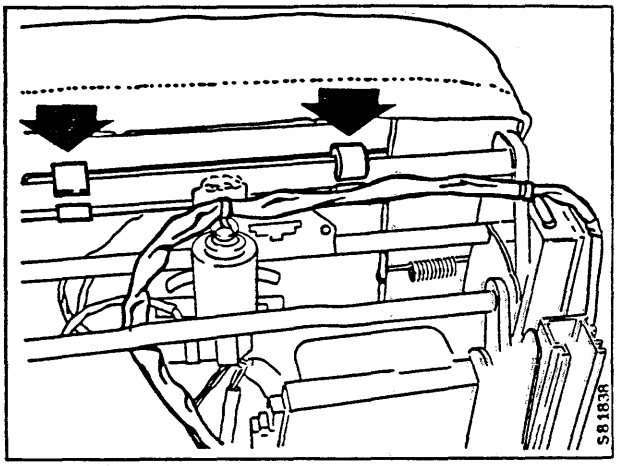
Step 14 on page 214:

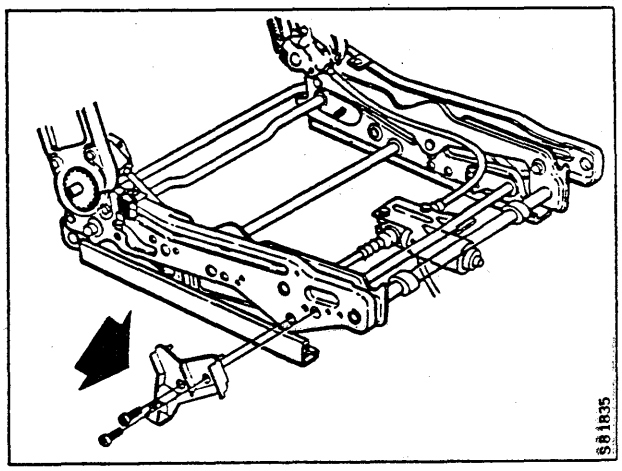
Also remove the rubber stops from the front of the seat frame and the fixings for the cover stiffener.

To fit

Step 15 on page 215:

Secure the fixings for the cover stiffener and fit the rubber stops at the front of the seat frame.





Outboard seat runner

Object code: 85229

To remove

Step 4 on page 184:

First remove the ECU (see page 32).

To fit

Step 6 on page 185:

Refit the ECU (see page 33).

Seat side panel

Object code: 85218

Removal & refitting

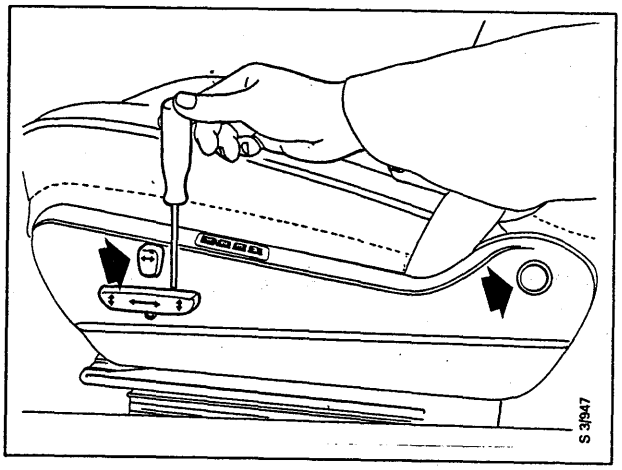
Refer to the procedure for removing the switch panel (see page 31).

To change the switch unit for the memory function

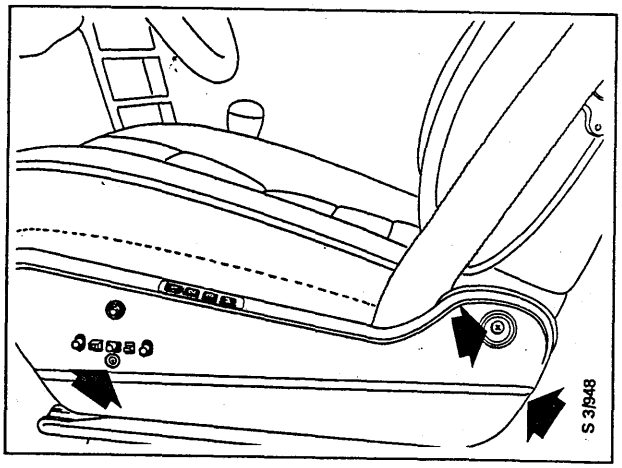
Object code 36450

To remove

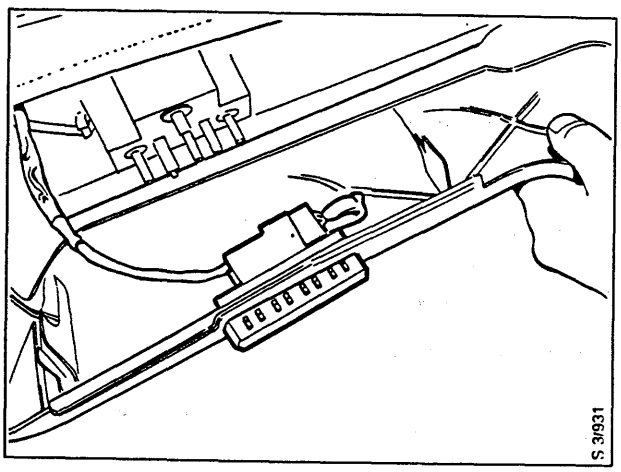
1 Remove the control buttons and remove the cover.



2 Remove the three screws for the seat side cover.

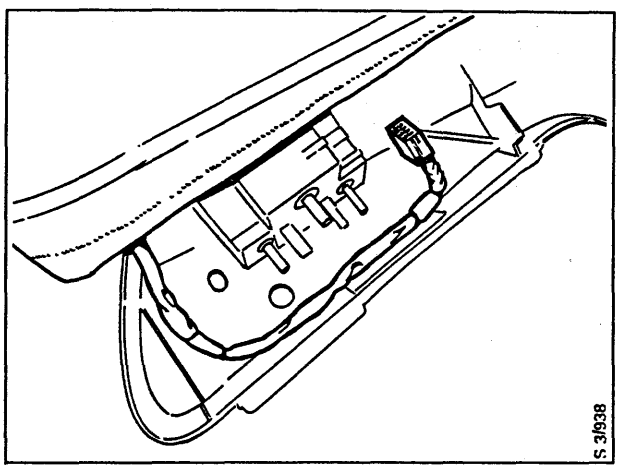


3 Remove the switch unit from the cover and disconnect the connector.

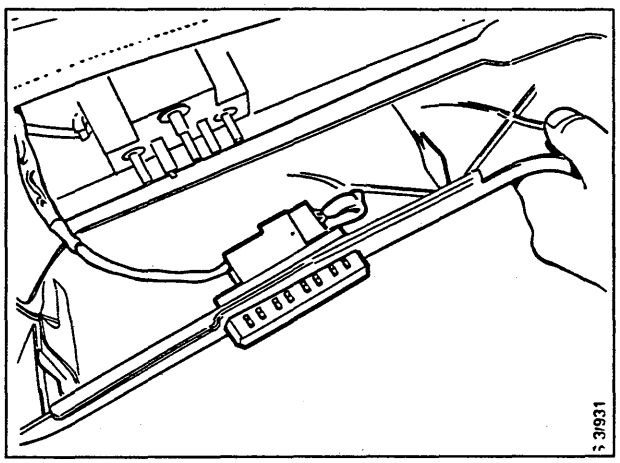


To fit

1 Place the electric cable in the mountings of the cover.

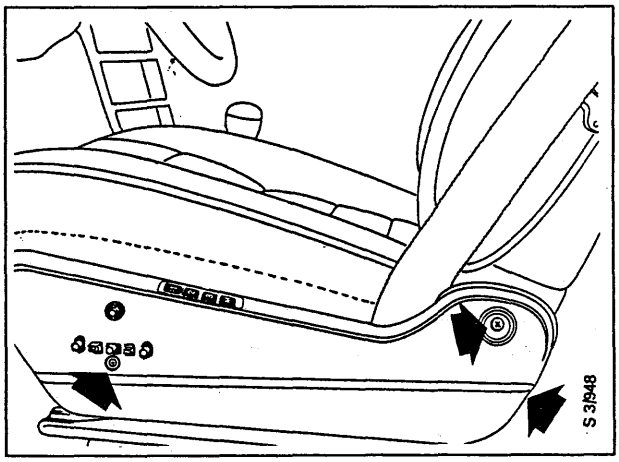


2 Connect the connector to the switch unit and press the unit into the cover.

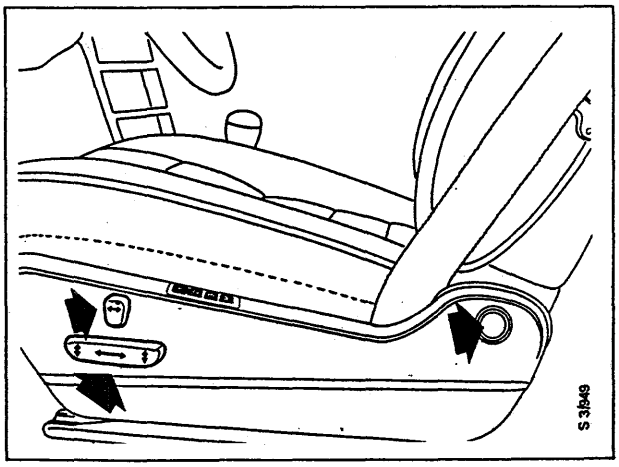


3 Fit the three screws retaining the cover.

CAUTION
Don't tighten the front screw harder than to a torque of 1.5 Nm (1.1 lbf ft), since the switch unit may otherwise be damaged.



4 Fit the control buttons and the seat side cover.



To change the switch unit for the electrically operated seat

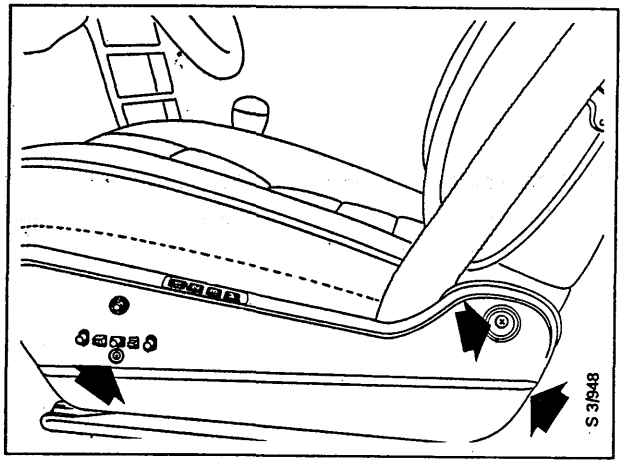
Object code 36450

To remove

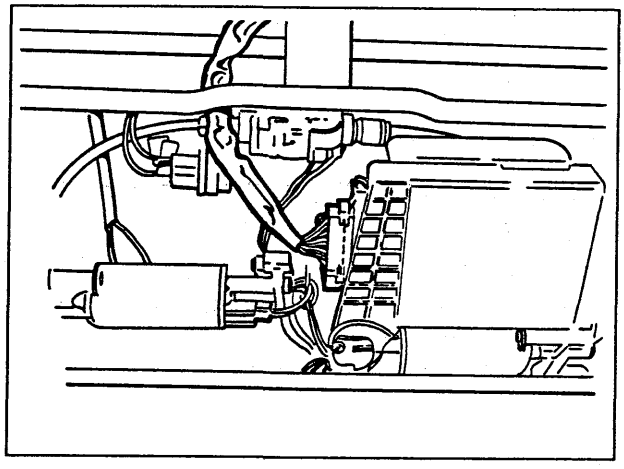
1 Set the seat cushion to its highest position.

2 Remove the control buttons and remove the cover.

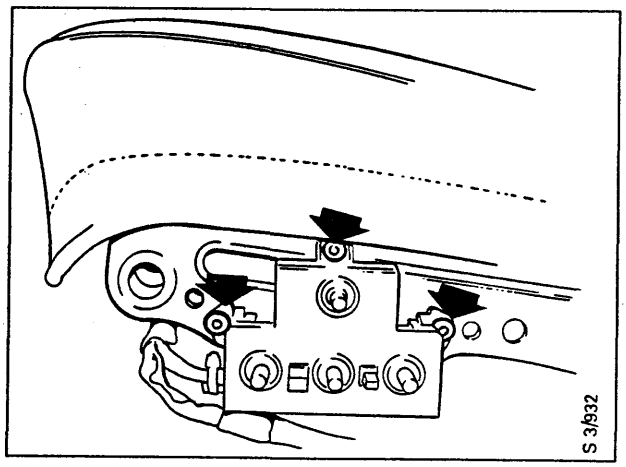
3 Remove the three screws retaining the seat side cover.



4 Disconnect the connector from the electronic control unit and cut off the two straps from the seat frame.

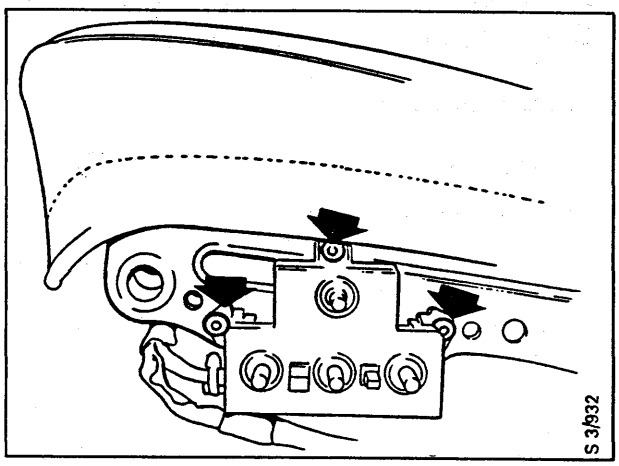


5 Remove the three retaining screws and remove the complete switch unit together with the cable harness.

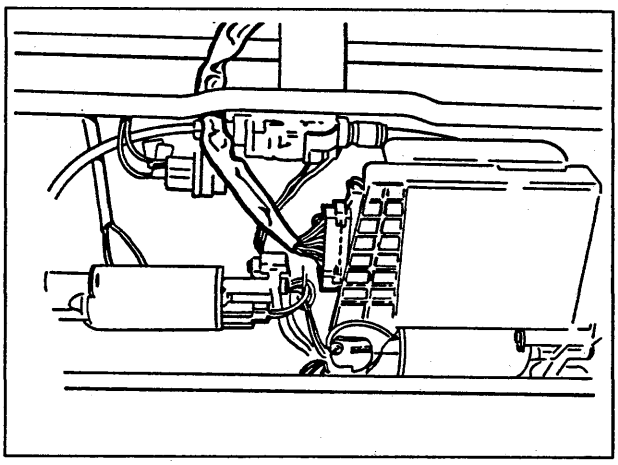


To fit

1 Fit the switch unit.



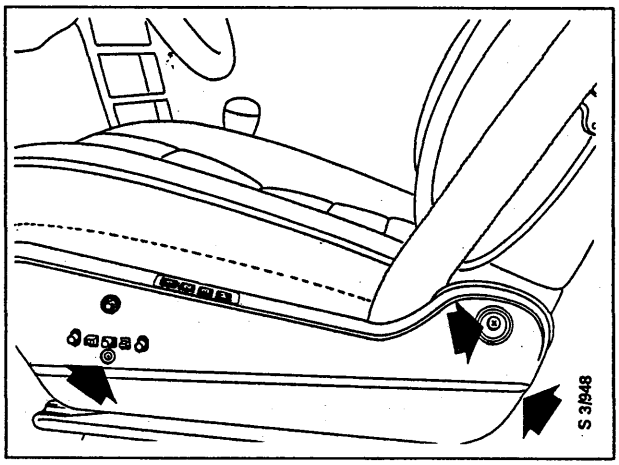
2 Connect the connector to the electronic control unit, and use straps to secure the cable harness to the seat frame.



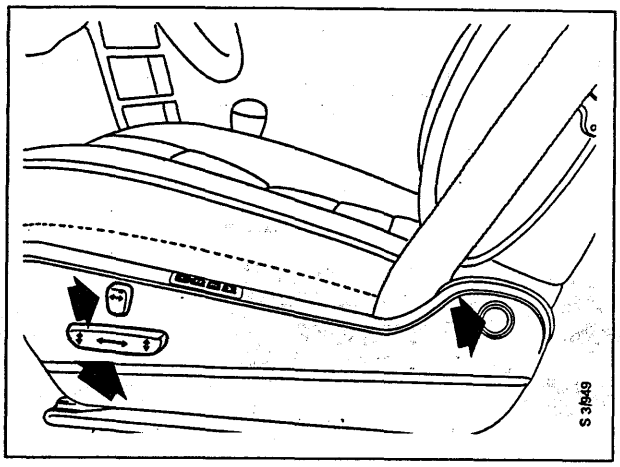
3 Fit the three screws retaining the side cover.

CAUTION

Don't tighten the front screw harder than to a torque of 1.5 Nm (1.1 lbf ft), since the switch unit may otherwise be damaged.



4 Fit the control buttons and the cover.

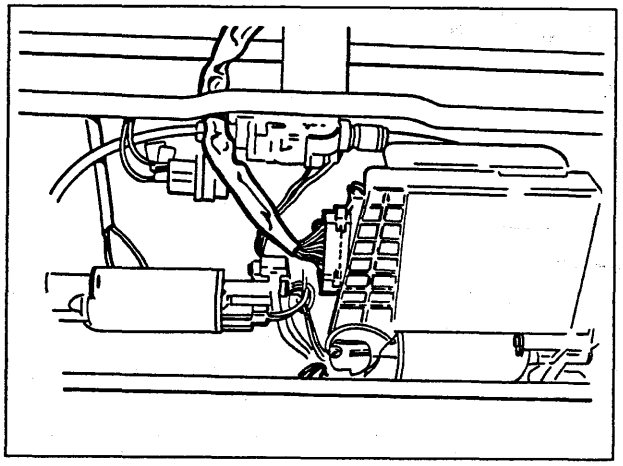


To change the electronic control unit

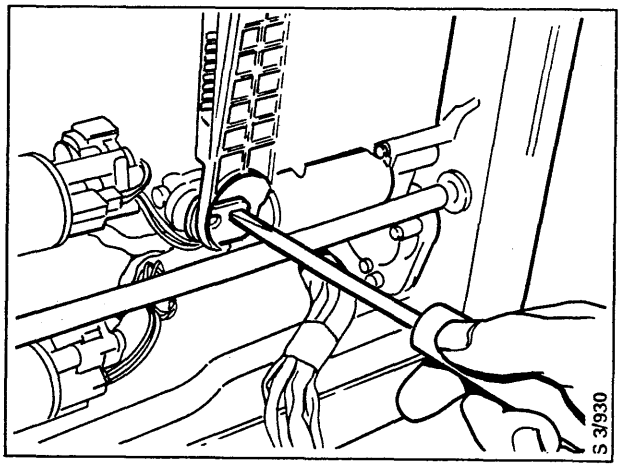
Object code 36455

To remove

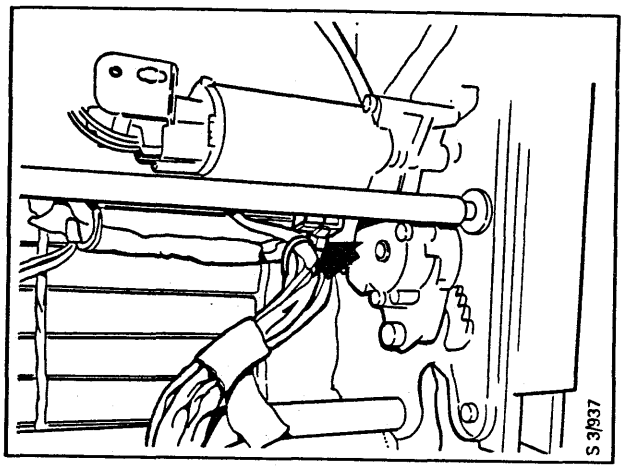
1 Set the seat cushion to its highest position.
2 Remove the seat from the car as described in the section entitled Body.
3 Disconnect the connector from the electronic control unit.



4 Remove the locking screw and use a screwdriver to release the electronic control unit mounting.

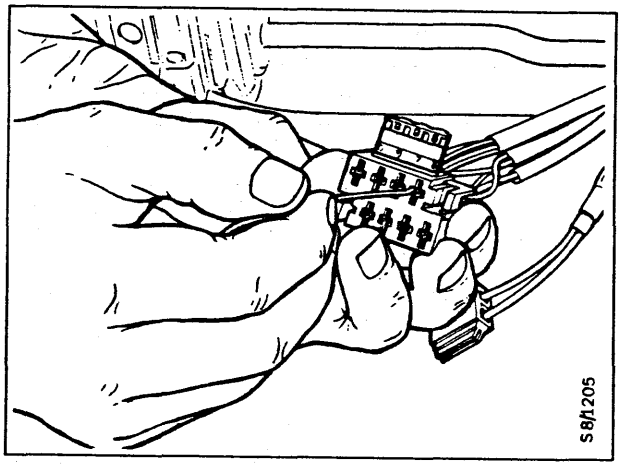


5 Release the cable harness straps from the motor mountings and cut off the straps holding together the connector cables.



6 Mark the colour of each cable to the motors and disconnect the connectors.

7 Mark the white and blue cable and disconnect it from the 8-pole connector.



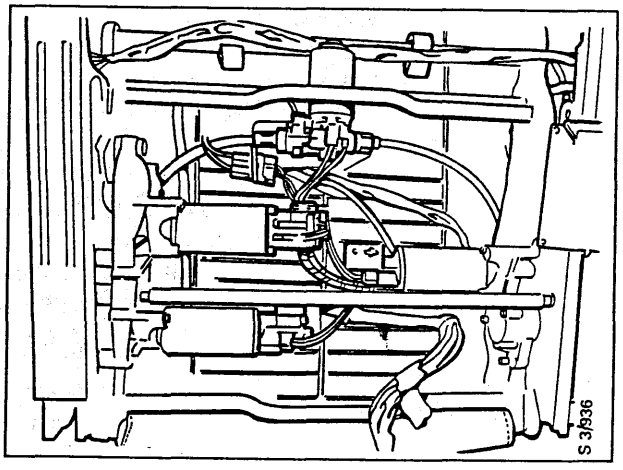
8 Release the electronic control unit from the mounting bracket and remove it.

To fit

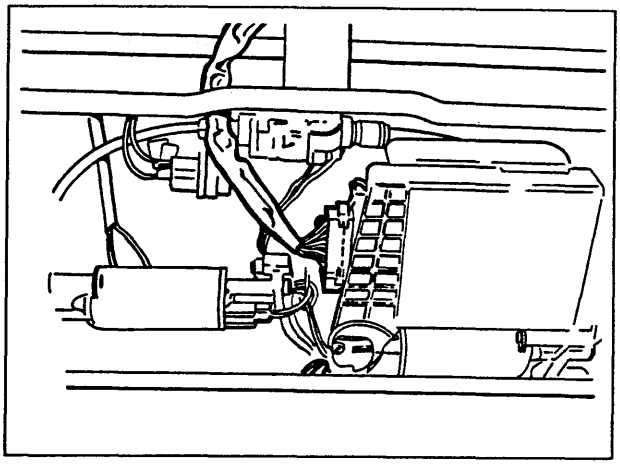
1 Press the electronic control unit onto its mounting bracket.

2 Connect the white and blue cable in accordance with the marking to the 8-pole connector.

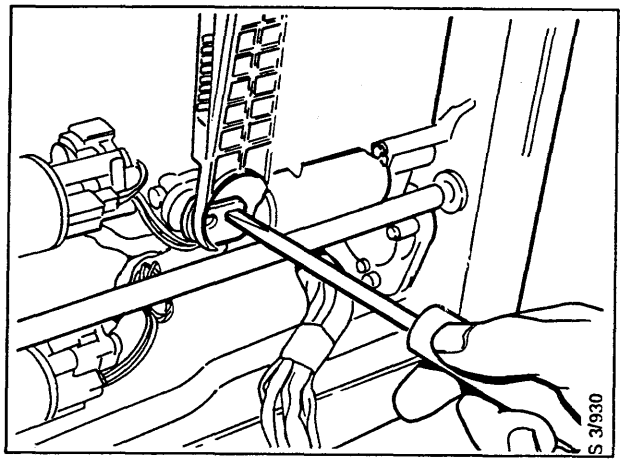
3 Fit the connectors to the motors. Fit the straps to the electric cables and press them onto the motor mountings.



4 Fit the connector to the electronic control unit.



5 Fit the bracket retaining the electronic control unit and fit the locking screw.



6 Fit the seat into the car. See the section entitled Body.

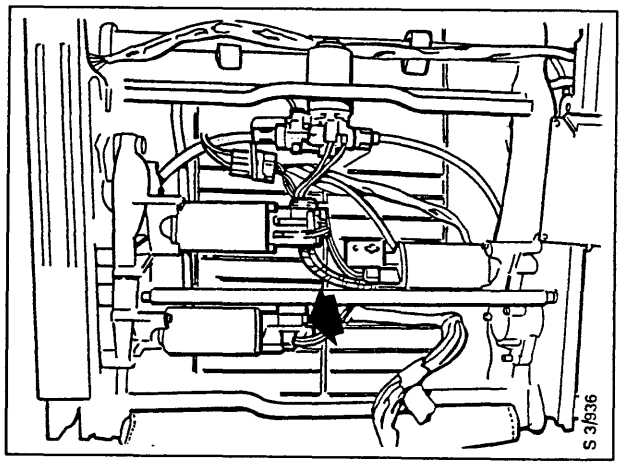
To change the potentiometer for the fore-and-aft adjustment motor

Object code 36456

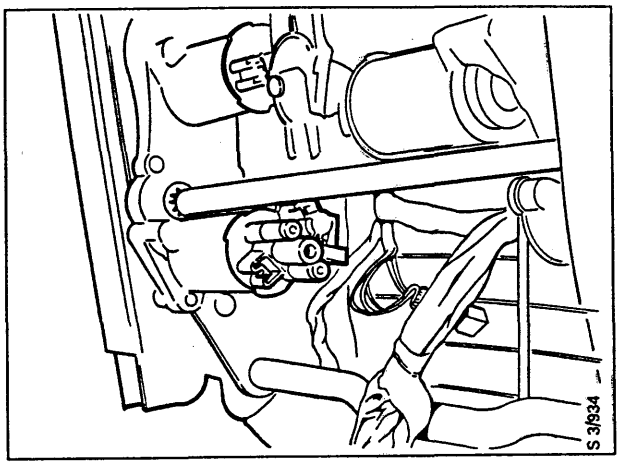
To remove

1 Remove the seat from the car. See the section entitled Body.

2 Disconnect the connector from the motor.

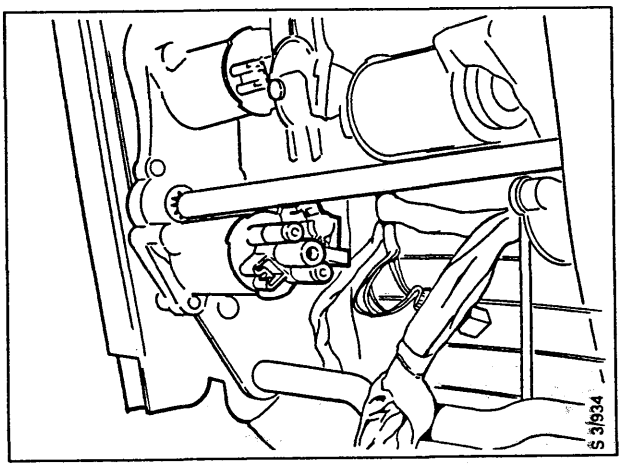


3 Release the potentiometer and remove it from the shaft.



To fit

1 Secure the potentiometer to the motor.



2 Connect the connector to the motor and fit the seat into the car. See the section entitled Body.

3 Run the seat to the front and rear limits of travel. The potentiometer will then be adjusted automatically.

To change the potentiometer for the front height adjustment motor

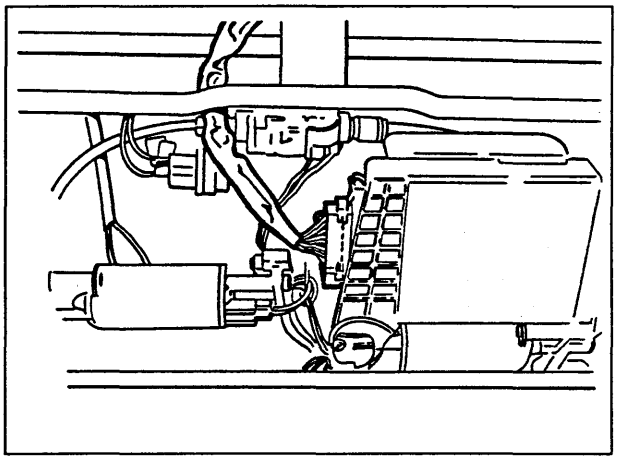
Object code 36454

To remove

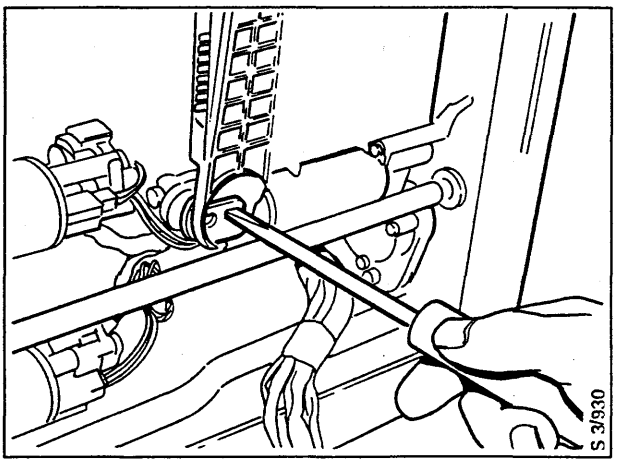
1 Set the seat cushion to its highest position.

2 Remove the seat from the car. See the section entitled Body.

3 Disconnect the connector from the electronic control unit.

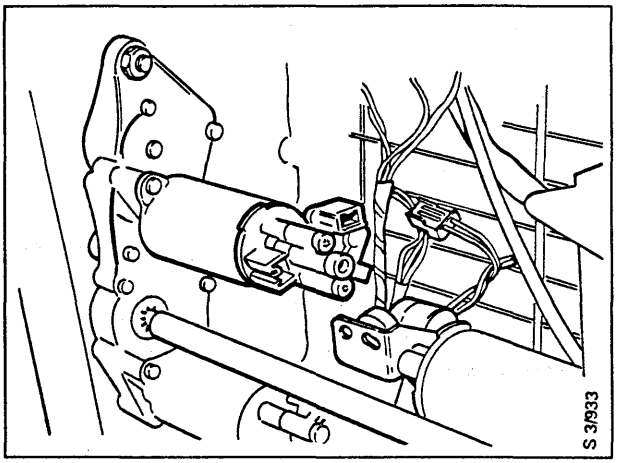


4 Remove the locking screw and use a screwdriver to turn the electronic control unit bracket. Turn the electronic control unit to one side.



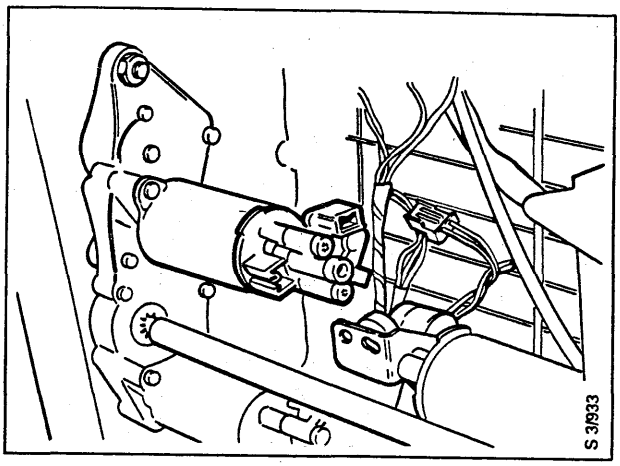
5 Disconnect the connectors from the motor.

6 Release the potentiometer and remove it from the shaft.



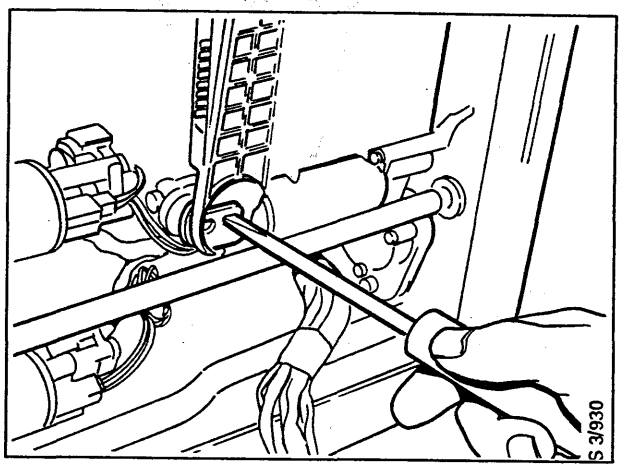
To fit

1 Secure the potentiometer to the motor.

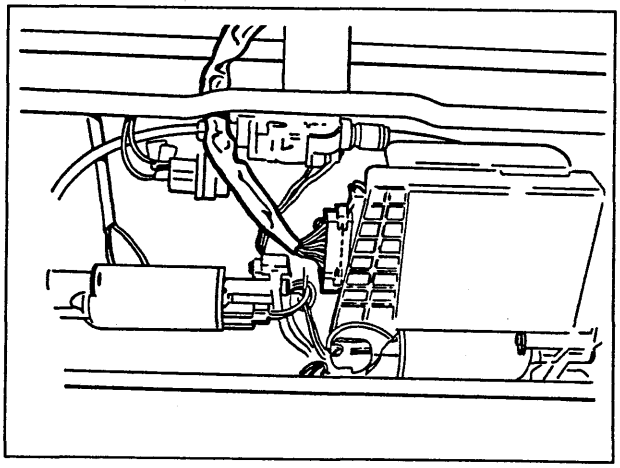


2 Connect the connectors to the motor.

3 Fit the electronic control unit to its mounting bracket and tighten the locking screw.



4 Connect the connector to the electronic control unit.



5 Fit the seat into the car. See the section entitled Body.

6 Run the seat cushion to the top and bottom limits of its travel. The potentiometer will then be adjusted automatically.

To change the potentiometer for the rear height adjustment motor

Object code 36454

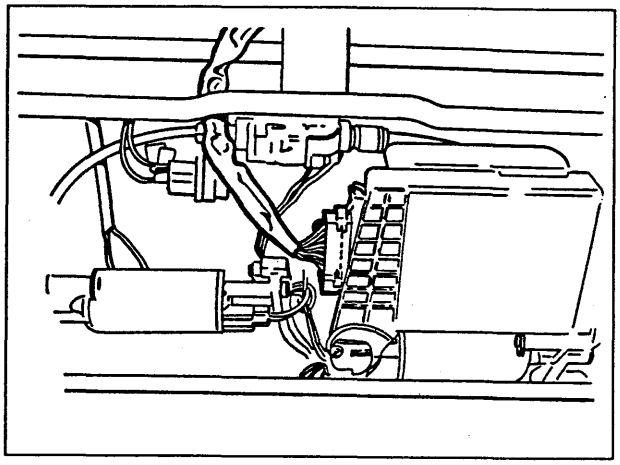
To remove

1 Move the seat cushion to its highest position.

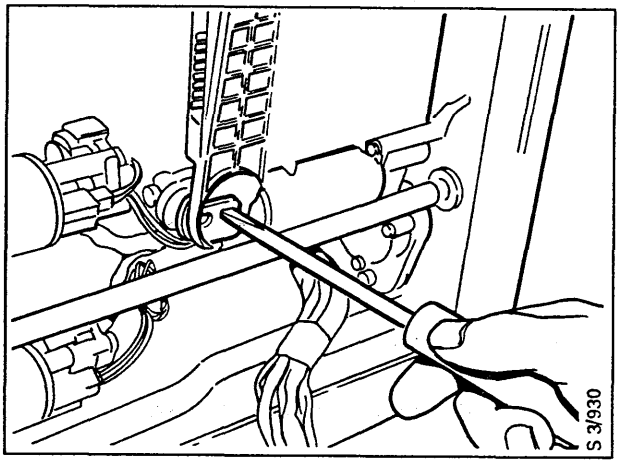
2 Remove the seat from the car. See the section entitled Body.

3 Disconnect the connector from the electronic control unit.

4 Remove the locking screw and use a screwdriver

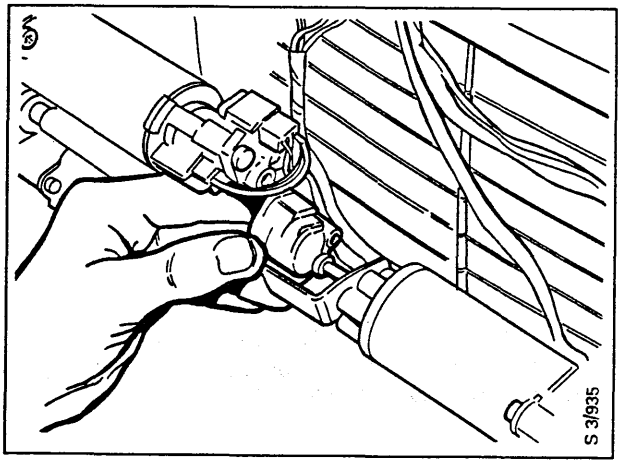


to turn the electronic control unit out of its mounting bracket.



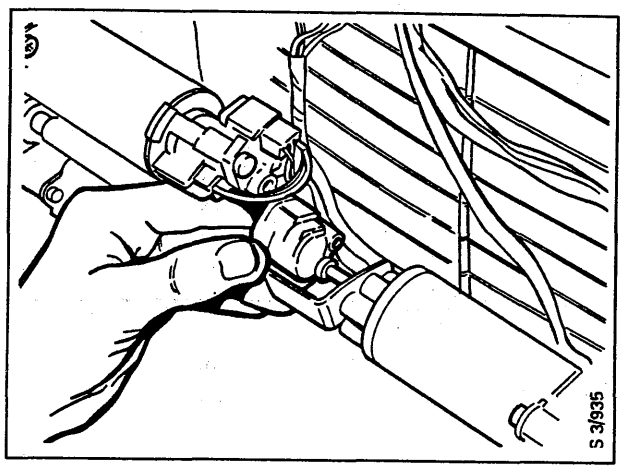
5 Disconnect the connectors from the motor.

6 Release the potentiometer and remove it from the shaft. Save the mounting bracket for the electronic control unit.



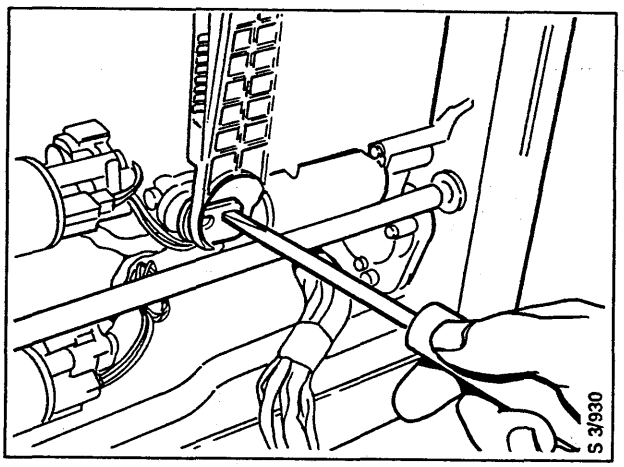
To fit

1 Secure the potentiometer with the mounting bracket for the electronic control unit to the motor.



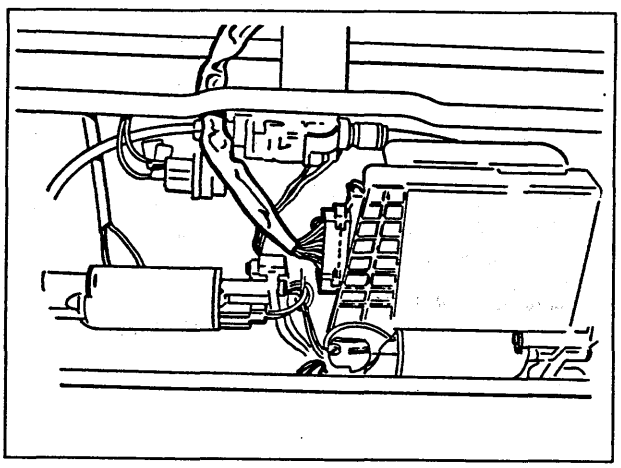
2 Connect the connectors to the motor.

3 Fit the electronic control unit to its mounting bracket and tighten the locking screw.



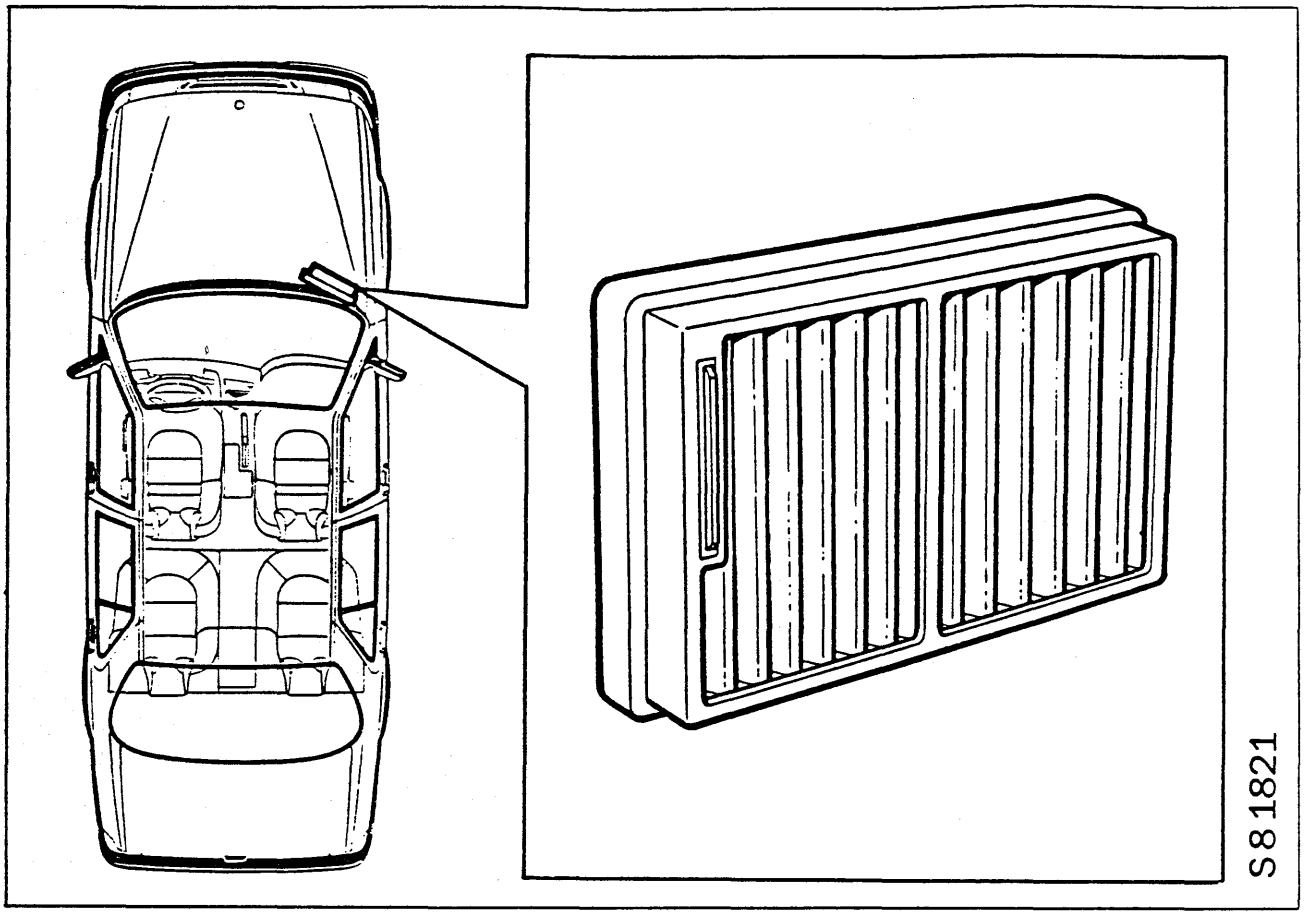
4 Connect the connector to the electronic control unit.

5 Fit the seat into the car. See the section entitled Body.



6 Run the rear height adjustment to the top and bottom of its travel. The potentiometer will then be adjusted automatically.

Fresh-air filter



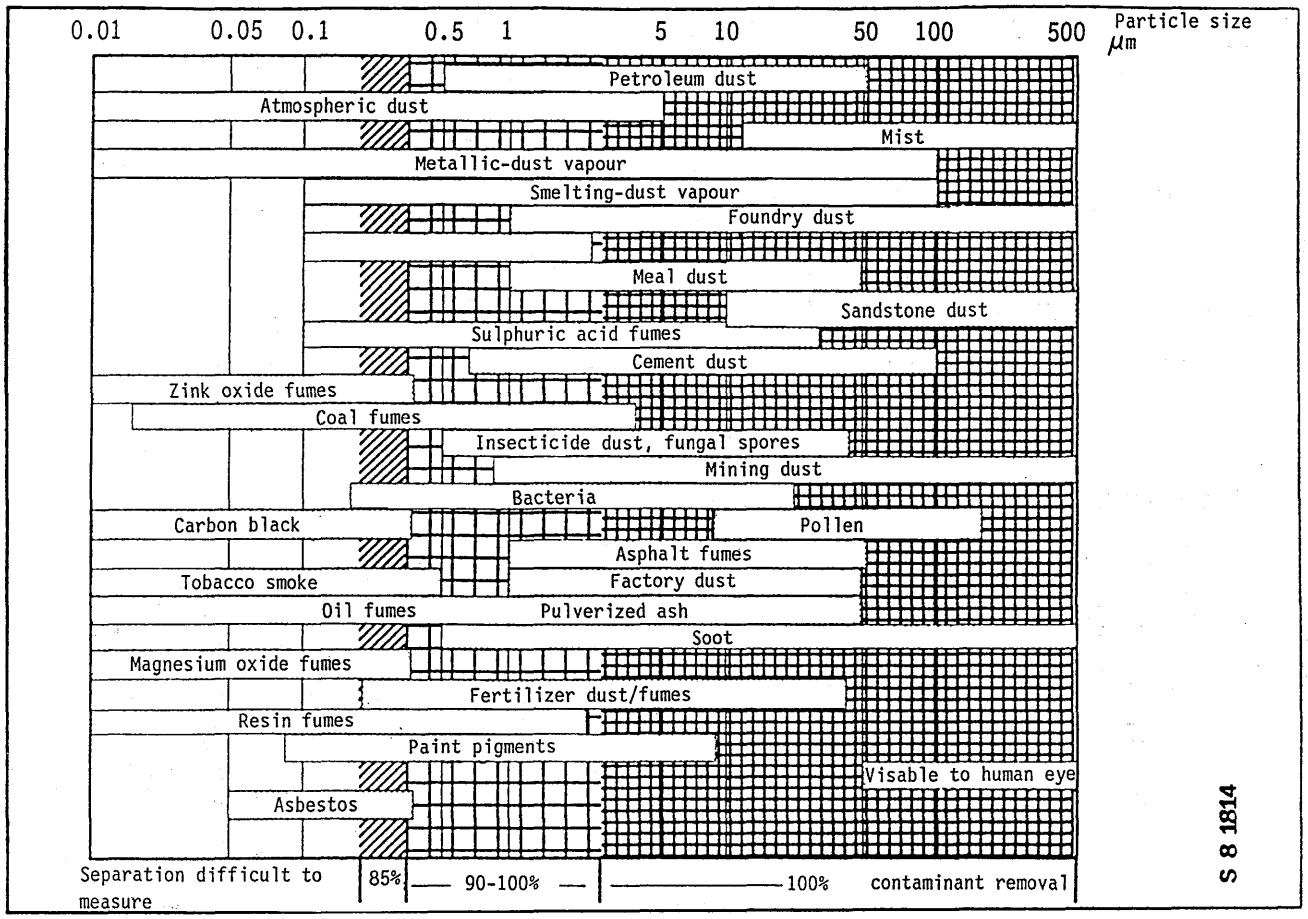
A new fresh-air filter for the cabin has been developed. The new filter provides extremely effective filtration of the air supplied to the cabin, and makes Saab a market-leader in this area.

In existing filters, the filter material consists of oil-impregnated glass fibre, with filtration being effected by the larger particles in the air being trapped by the fibres, and the smaller ones by the oil. However, some of the tiniest particles have been able to pass through the filter, entrained in the air.

The new filter, however, consists of electrostatically charged polypropylene fibres. In this filter, the larger particles are still trapped by the fibres but, instead of oil, an electrostatic charge is used to prevent the tiniest particles passing through. So the air is cleaned not only by particles becoming separated out by the fibres but also by the electrostatic charge, which has the same sort of effect as a magnet on iron filings.

Besides removing visible dust particles from the air, the new filter also traps pollen, fungal spores, fine dust particles, asphalt vapour and many other undesirable constituents in the air.

For instance, most bacteria are also trapped in the filter. But the nutrients on which the bacteria live are trapped at the same time, which means that the occasional musty smell given off by air conditioning systems, reminiscent of a damp cellar and caused by bacteria, is now effectively eliminated.

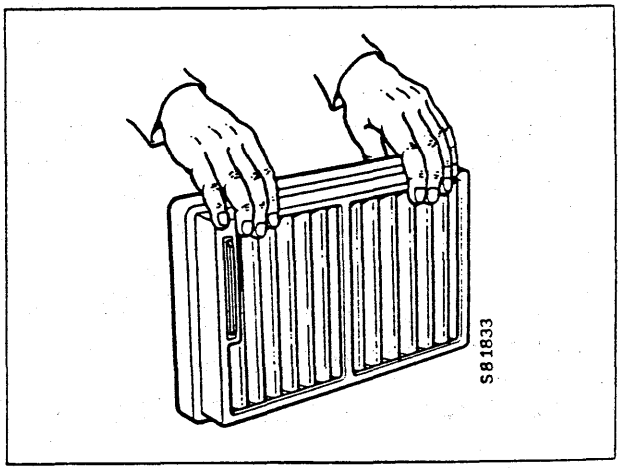


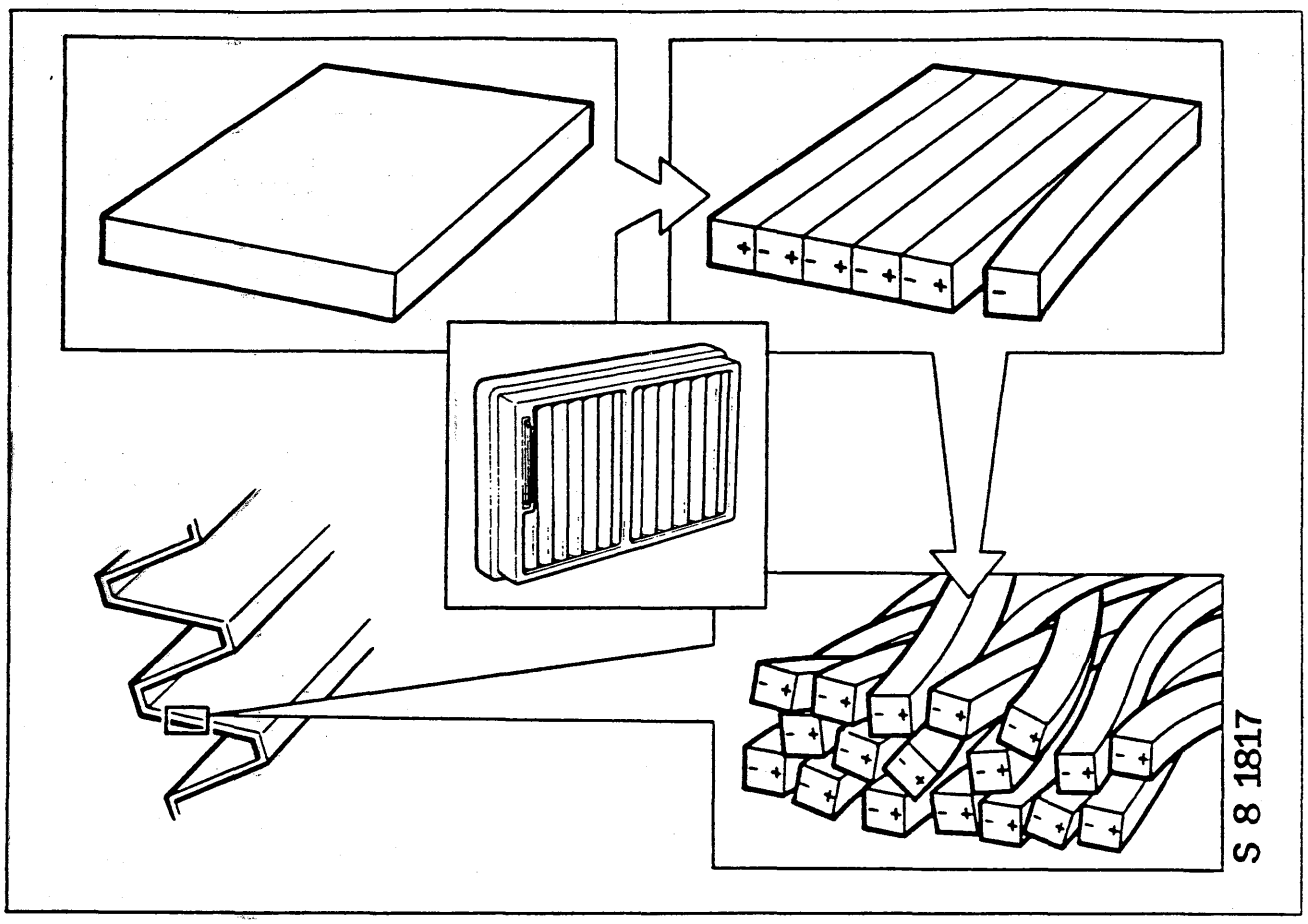
This diagram provides a better illustration of the effectiveness of the new filter.

The new fresh-air filter for the cabin is of the cartridge type, and should be replaced in just the same way and at the same intervals as earlier filters.

Because the new filter does not contain glass fibres, gloves no longer have to be worn when handling it. However, bear in mind that a filter being replaced at the recommended service interval will contain contaminants collected from 24,000 miles of driving. So always hold the filter by the plastic frame and make sure you wash your hands thoroughly with soap and water afterwards.

Filters that have been replaced should not be incinerated.





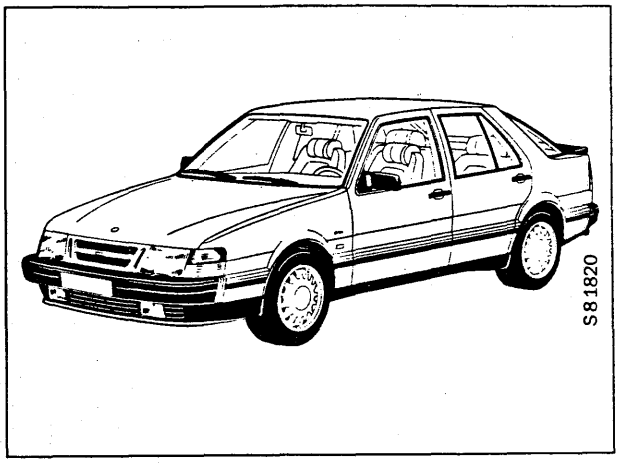
The fibres are charged electrostatically during manufacture and need no subsequent recharging. Thin layers of polypropylene are spun into fine threads, with a positive charge being applied on one side and a negative charge on the other—roughly the same way as a comb creates a static charge in your hair. The polypropylene threads then become interwoven to form a fabric, 2–3 mm thick, which constitutes the actual filter material.

At the beginning of the model year, the new fresh-air filter will be fitted to cars equipped with manual heating and ventilation. Later on during the year, the filter will also be fitted to cars with AC and ACC.

Restyled front for the 9000 5D

The 9000 5D now has the same styling at the front as the 9000 4D. The only difference is that the bumper on the 9000 CD has bright-metal trim that is not fitted on 5-door cars.

All M91 5-door cars have chromium-plated grilles.

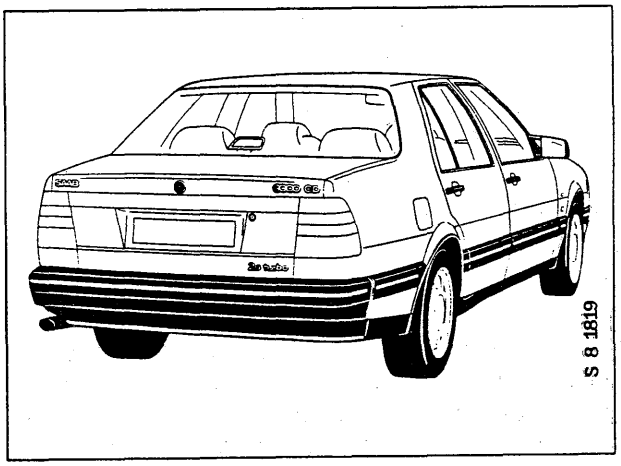


Décor strip on luggage-compartment lid, 9000 4D

A colour-coded alloy décor panel now replaces the anthracite-grey plastic panel on the luggage-compartment lid of the 9000 4D.

The décor panel is the same type as that fitted to 5-door cars, and will be fitted to all 9000 4D vehicles with the exception of the sports variant.

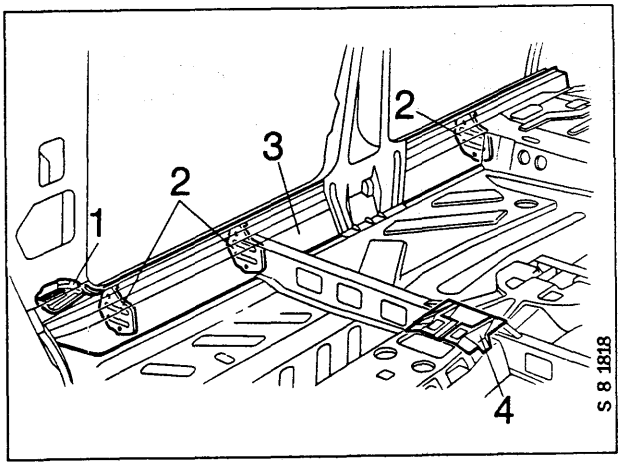
As the old plastic panel has been discontinued, the lock cylinder has been shortened to fit the new panel.



Enhanced occupant safety

To further improve the safety of occupants in the event of a side-on collision, the body has been strengthened in a number of places:

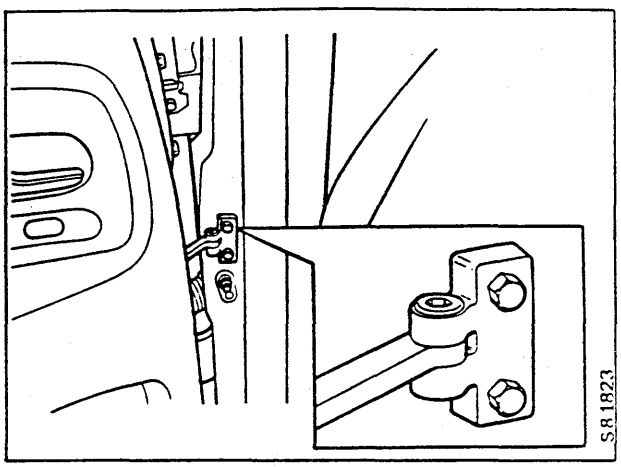
1. One steel plate at the bottom of the A pillar
2. Three steel plates in the door frame
3. Stronger sills
4. Reinforced seat pressing/tunnel



Door-check mechanism

A new door-check mechanism has been introduced on all variants. The new design allows the door to be restrained in three optional positions and is now less likely to be noisy in operation.

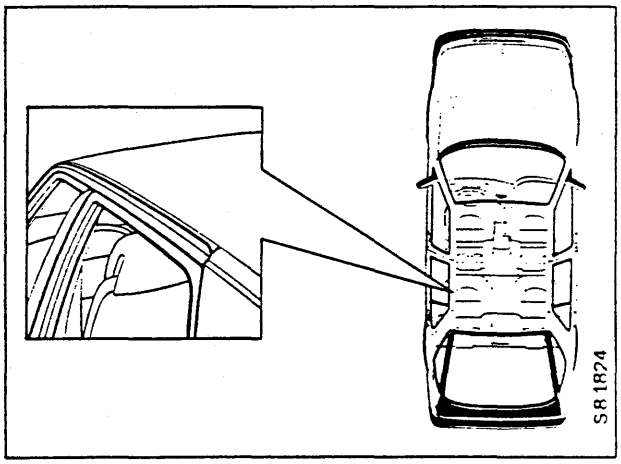
The door-check mechanism is bolted to the body. The hinged arm can be separated by removal of the pivot pin. A rubber seal at the attachment point to the door prevents dirt getting into the mechanism.



Door seal

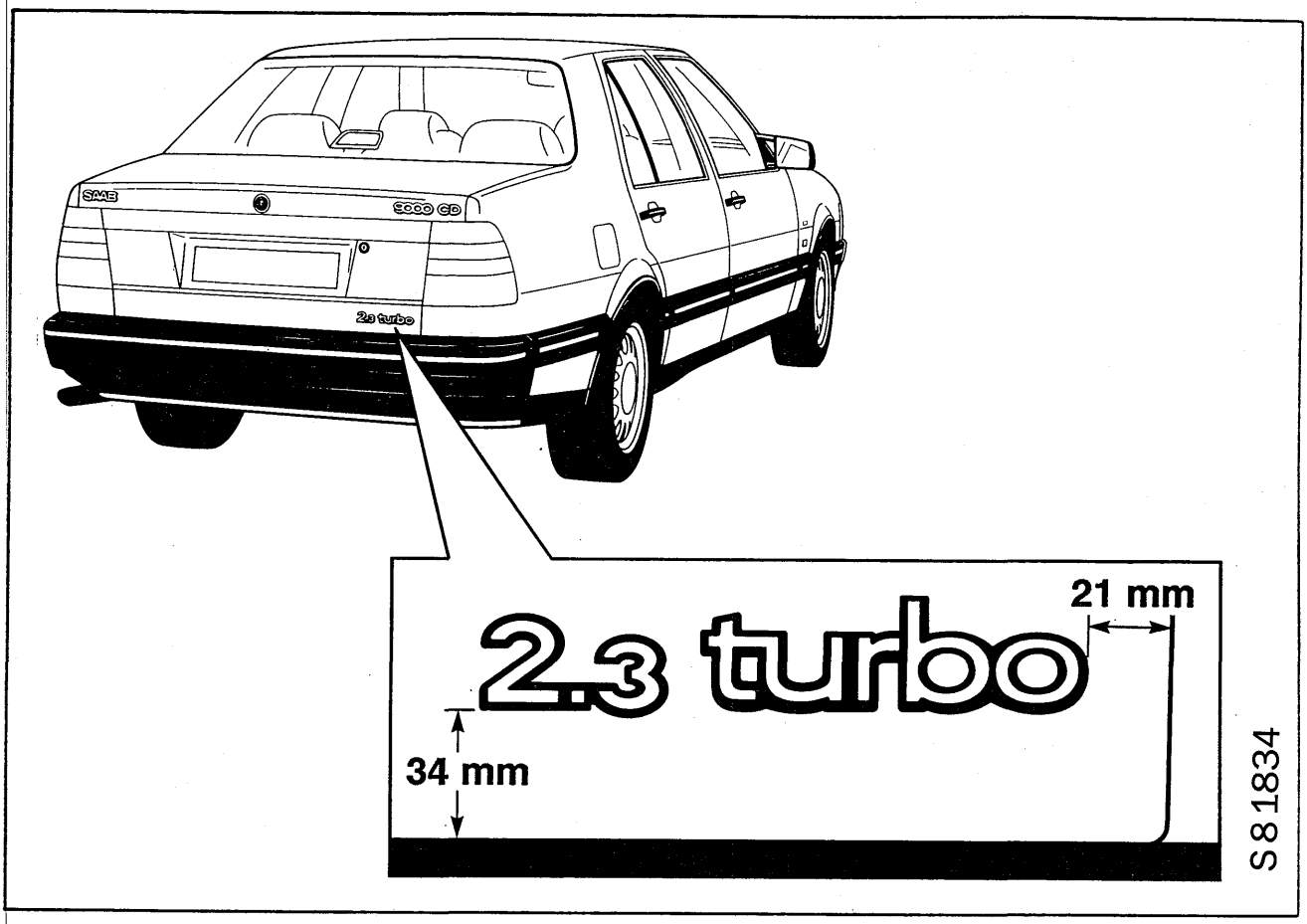
A new door seal that reduces wind noise inside the car is now fitted to all variants. The new seal also reduces the likelihood of water from the roof dripping onto the seat when a door is open.

The trailing ends of the seal are injection moulded, to make them more hard wearing and resistant to wear caused by the action of the rear doors.



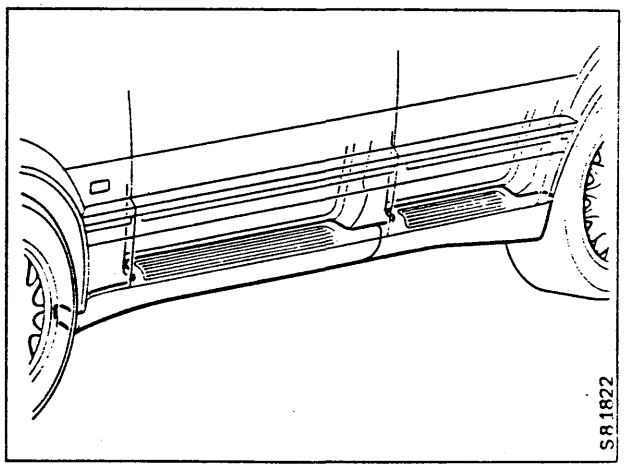
New badging

The appearance and location of the new badging is shown below.



Sill scuff plates

The wraparound sill scuff plates introduced on the 9000 T16S last year are now being fitted as standard on all variants.



Body colours

Two colours have been discontinued and three have been replaced by new finishes of a similar hue.

Colour code	Colour	Type	Remarks
200	Silver	Base colour	Superseded by 228
201	Bronze	Base colour	Superseded by 227
202	Rose quartz	Base colour	Discontinued
205	Malachite	Base colour	Superseded by 230
212	Magenta	Base colour	Discontinued
217	Ascot grey	Solid	Discontinued
227	Citrine beige (Silver-beige metallic)	Base colour	Replaces 201 bronze
228	Platan grey (Mid-grey metallic)	Base colour	Replaces 200 silver
230	Scarab green (Dark green metallic)	Base colour	Replaces 205 malachite

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From

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Comments/suggestions

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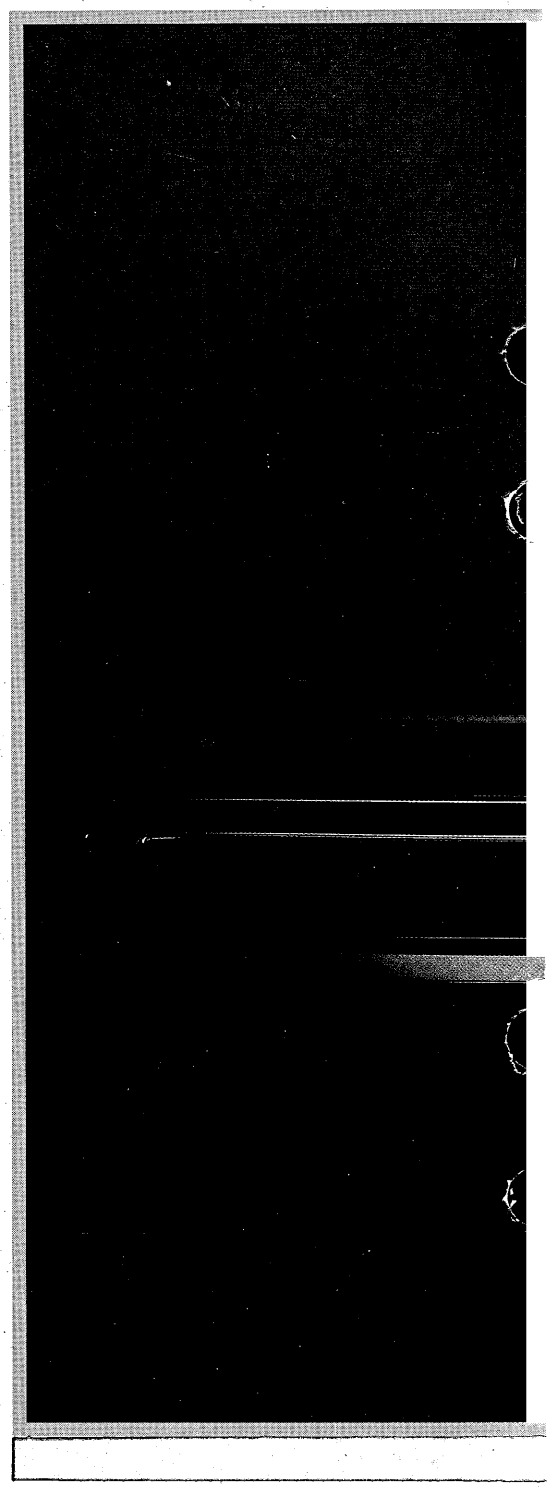
Manual concerned: .....

It is important that Saab technicians in the field regard the Workshop Service Manual as their bible, and we therefore strive to make the manual easy to use and to provide accurate information.

By letting us have your views on this manual you will be helping us to maintain a high standard in our literature.

Note down any comments or suggestions you may have on a sheet of paper or take a copy of this page and send us your views at the above address. For greater convenience, you are also welcome to send your comments by fax, using the telephone number shown.



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