

Workshop Manual OCTAVIA

**1.8 ltr./92 kW Engine - Motronic Fuel
Injection and Ignition System**

List of Supplements to **OCTAVIA** Workshop Manual

Edition: 10.99

1.8-ltr./92 kW Engine, Motronic Fuel Injection and Ignition System

Replaces List of Supplements - Edition: 03.98

Supplement	Edition	Subject	Article Number
	08.96	Basic Edition of Workshop Manual	S00.5107.50.20
1	11.96	Supplement to Repair Groups 01, 24 and 28	S00.5107.51.20
2	03.98	Modifications to Engine from 08.97	S00.5107.52.20
3	10.99	Modifications for Model Year 1999	S00.5107.53.20
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Self-diagnosis

Note:

The self-diagnosis monitors only a part of the fuel injection and ignition system.

Features of self-diagnosis

The Motronic control unit (J220) for the fuel injection and ignition system is equipped with a fault memory. The fault memory is designed as a permanent memory and a volatile memory.

If faults occur in the monitored sensors or components, these are stored in the fault memory with an indication of the fault type.

The engine control unit analyses the information and distinguishes 67 different faults ⇒ page 01-9, Fault Table, and stores these until the contents of the fault memory are erased.

Faults which occur only for a short time (sporadically), are displayed as „sporadically occurring fault“ with the addition „/SP“. The cause of a sporadic fault may be, for example, a loose contact or a temporary open circuit in the wiring. If a sporadic fault no longer occurs within 50 engine starts, it is erased from the fault memory.

The faults stored can be read with the vehicle system tester V.A.G 1552 or with the fault reader V.A.G 1551 ⇒ page 01-5.

After the fault or faults have been rectified, the fault memory must be erased ⇒ page 01-5.

Notes:

- ◆ *The description which follows relates only to the vehicle system tester V.A.G 1552 using the programme card version 5.0.*
- ◆ *If „see literature“ appears in the display, refer to the text relating to the fault code in the fault table.*
- ◆ *Use of the fault reader V.A.G 1551 (with programme card version 8.0) with integrated printer is similar although slight differences in the readouts in the display are possible.*

Technical data of self-diagnosis

Interrogating control unit version

The control unit version is displayed when you connect the vehicle system tester V.A.G 1552 and select engine electronics control unit
⇒ page 01-3.

Functions available when using the vehicle system tester V.A.G 1552

Refer to the table below for the requirements which must be met for selecting the desired functions.

Function	Requirement	
	Engine off, ignition on	Engine idling
01 Interrogating control unit version	yes	yes
02 Interrogating fault memory	yes ¹⁾	yes
03 Final control diagnosis	yes	no
04 Basic setting	yes ²⁾	yes ³⁾
05 Erasing fault memory	yes	yes
06 Ending output	yes	yes
07 Coding control unit	yes	no
08 Reading measured value block	yes	yes
10 Adaptation	yes	no

1) Perform only if ignition is switched on and engine does not start (operate starter first of all for at least 6 seconds).

2) Must be performed after the following operations:
Replacing engine control unit (J220), throttle valve control unit (J338) or engine, or when battery is re-connected.

3) Only possible once coolant temperature is more than 80 °C. Before this, this function is inhibited.

Connecting vehicle system tester V.A.G 1552 and selecting engine electronics control unit

Special tools, testers and aids required

- ♦ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3

Test conditions

- Battery voltage at least 11.5 V
- Fuses 10, 12, 29 and 32 o.k.
- Earth connections at gearbox and on left below battery o.k.

Procedure

- ◀ - Connect the vehicle system tester V.A.G 1552 with the cable V.A.G 1551/3.

After the vehicle system tester has been connected:

- Depending on the desired function, you have to:
Switch on ignition
or
Start the engine ⇒ page 01-2, table of „Available Functions“.

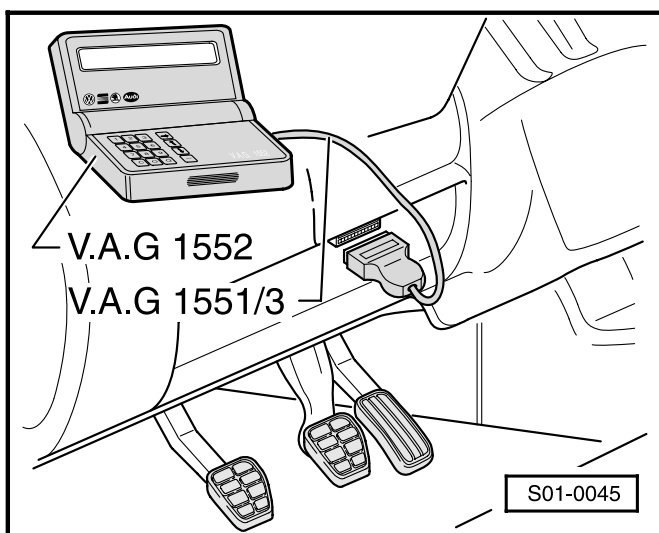
If the readouts which appear in the display are not the same as in the description below, please refer to the following points:

Notes:

- ♦ If „Fault in data transfer!“ is displayed because of an incorrect entry, disconnect cable at fault reader, plug in again and repeat these steps.
- ◀ ♦ If one of the following messages appears in the display, carry out fault finding according to the Fault Finding Programme for Diagnosis Cable.

⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder, or

⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder or



Test of vehicle systems
Control unit does not answer!

HELP

Test of vehicle systems
Fault in communication build-up

HELP

Test of vehicle systems
K wire not switching to earth

HELP

Test of vehicle systems
K wire not switching to positive

HELP

⇒ Operating instructions of vehicle system tester

Note:

Operate the vehicle system tester according to the readout which appears on the display.

Test of vehicle systems
Enter address word XX

HELP

◀ Readout in display:

- Press the keys 0 and 1 for the address word „Engine electronics“ and confirm the entry with the key Q.

06A906018.. 1.8l R4/5V MOTR HS V.. →
Coding 04000 WSC 06388

◀ The control unit identification appears in the display, e.g.:

- ◆ 06A906018.. = Part No. of control unit¹⁾
- ◆ 1.8l = Displacement of engine
- ◆ R4/5V = Type of engine (4-cyl. inline engine/ 5 valves)
- ◆ MOTR = System designation (Motronic)
- ◆ HS = Manual gearbox
AT = Automatic gearbox
- ◆ V.. = Data status (software version) of control unit
- ◆ Coding 04000 = Coding version of control unit
- ◆ WSC = Workshop code from the V.A.G 1552 with which the last coding was performed

Overview of engine control unit

Part No. ¹⁾	Software version	Production
06A90618H	V04, V05	► 07.97
06A90618AM	V02	08.97 ► 06.98
06A90618DJ	V01	06.98 ►

¹⁾ For up-to-date control unit version ⇒ Parts List.

Notes:

- ◆ *If the control unit version displayed does not match the vehicle, replace control unit ⇒ page 24-48.*
- ◆ *Incorrect coding of the engine control unit results in:*
 - *poor driving characteristics (jerky gearshifts, load change jolts, etc.)*

- increased fuel consumption
- increased emission levels
- storage of non-existent faults in the fault memory
- ◆ Functions not being performed (lambda control, actuation of activated charcoal filter system, etc.)
- ◆ Reduction in gearbox life

If the coding does not match the corresponding version in the vehicle:

- Check coding of control unit ⇒ page 24-49.
- Press the → key.

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- For the further procedure ⇒ Repair descriptions

Interrogating and erasing fault memory

Interrogating fault memory

Special tools, testers and aids required

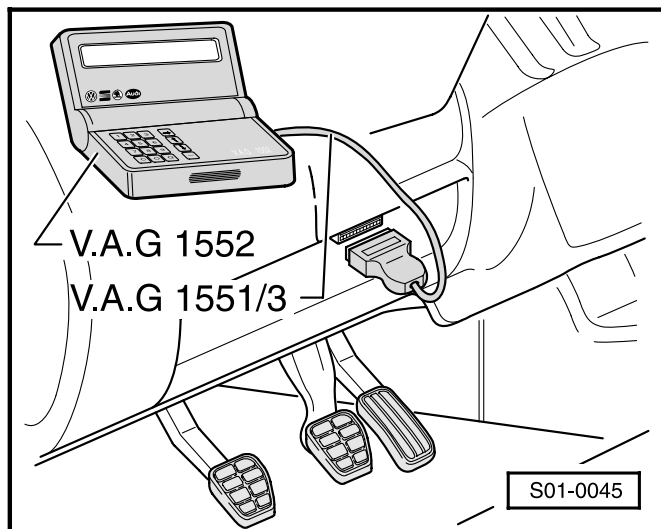
- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3

Test procedure

- ◀ - Connect vehicle system tester V.A.G 1552 and select the engine electronics control unit with the "address word" 01. The engine should be idling for this step. (Connecting vehicle system tester and selecting engine electronics control unit ⇒ page 01-3.)

Only if the engine does not start:

- Switch the ignition on.



Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press 02 for the function "Interrogate fault memory" and confirm the entry with the key Q.

X faults recognized!

- ◀ The number of stored faults or "No fault recognized!" appears in the display.

If no fault is stored:

- Press the → key.

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press 06 to select the function „End data transfer“ and confirm the entry with the key Q.

If one or several faults are stored:

Fault number: 00515

→

◀ Readout of fault number in display, e.g.:

- Press → key.

Hall sender -G40-
Short to earth

→

◀ Readout of source of fault with type of fault in display, e.g.:

- Press → key.

Test of vehicle systems
Fault memory is erased

HELP

◀ Readout in display:

- Press 06 for the function „End data transfer“ and confirm entry with the key Q.
- Rectify the faults displayed by referring to the fault table ⇒ page 01-9.

Note:

When carrying out test and removal and installation work, our control modules may also detect faults such as connectors unplugged. For this reason, it is necessary to interrogate and erase the fault memories of all the control units after concluding the work. Follow the procedure below:

- Press the key 0 twice for the address word 00 „Automatic test sequence“ and confirm the entry with the key Q. V.A.G 1552 transmits all the known address words one after the other.
- Erase fault memory ⇒ page 01-7.

Erasing fault memory

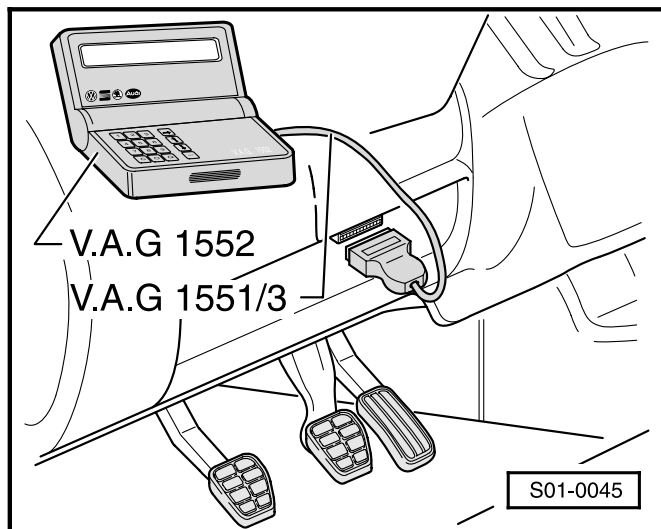
Special tools, testers and aids required

- ♦ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3

Test condition

- Repairs carried out
- After rectifying all the faults, you then have to carry out a road test.

The following operating conditions should be met during this road test:



Test of vehicle systems
Select function XX

HELP

- ◆ Coolant temperature should rise to more than 80 °C.
- ◆ Once this temperature is reached, the operating states of
 - idling
 - part throttle
 - full throttle
 - overrun
 should be achieved several times.
- ◆ Engine speed should be increased to more than 3500 rpm at full throttle.

Procedure

- ◀ - Connect vehicle system tester V.A.G 1552 with cable V.A.G 1551/3 ⇒ page 01-3.
- Once again interrogate the fault memory of the control unit (function 02) ⇒ page 01-5.

◀ Readout in display:

- If only test and removal and installation work has been carried out on the engine electronics, press the keys 0 and 2 for the function „Interrogate fault memory“ and confirm entry with the key Q.

If test and removal and installation work which also affects other control units, was carried out, you have to conclude the work by interrogating and erasing the fault memories of all the control units. Adopt the following procedure:

- Press the key 0 twice for the address word 00 „Automatic test sequence“ and confirm the entry with the key Q. V.A.G 1552 transmits all the known address words one after the other.

No faults recognised!

- ◀ The number of faults stored appears in the display.

If one or several faults are stored:

The stored faults are displayed one after the other.

Test of vehicle systems
Select function XX

HELP

- ◀ After the stored faults have been displayed, the following readout appears:

Test of vehicle systems
Fault memory is erased!

→

◀ Readout in display:

Note:

If you switched off the ignition between „Interrogating fault memory“ and „Erasing fault memory“, the fault memory is then not erased.

- Press the keys 0 and 5 for the function „Erase fault memory“ and confirm the entry with the key Q.
- Press the → key.
- Press the keys 0 and 6 for the function „End data transfer“ and confirm the entry with the key Q.

Fault table

Notes:

- ◆ If "see literature" appears in the display, refer to the fault table for the text belonging to the fault code.
- ◆ The fault table is arranged according to the 5-digit fault code shown on the left.
 Fault code 00515...01165 from page 01-9,
 fault code 01182... 16502 from page 01-15,
 fault code 16504... 17736 from page 01-22,
 fault code 17913... 18262 from page 01-27.1.
- ◆ Explanations on fault types (e.g. "open/short circuit to earth"):
 ⇒ Operating instructions of the vehicle system tester
- ◆ If components are shown as follows:
 First of all, test the cables and plug connections to these components and also the earth cables of the system according to current flow diagram. Only if no fault is found in this case, replace component. This applies in particular if faults are shown as "sporadically occurring" (SP).

Fault table from fault code 00515 to 01165

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
00515 Hall sender -G40 Short circuit to earth	◆ Short circuit to earth in cable connection between Hall sender -G40 and engine control unit ◆ -G40 faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Engine has no power at full throttle ◆ Emission levels not o.k. ◆ High fuel consumption	- Rectify short circuit ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test -G40 ⇒ page 28-8. - Replace engine control unit ⇒ page 24-48.
Open/short circuit to positive	◆ Open circuit in wiring or short to positive in signal cable between Hall sender -G40 and engine control unit ◆ -G40 faulty ◆ Signal input in engine control unit faulty (control unit faulty)		

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
00532 Supply voltage Signal too large	◆ Supply voltage greater than 16 V ◆ Overvoltage caused by jump-starting ◆ Alternator faulty	◆ Engine control unit destroyed	- Test voltage. - Read measured value block, display group 003, display block 2 ⇒ page 01-46.
Signal too small	◆ Supply voltage less than 10 V ◆ Fuse faulty ◆ Poor earth connection to engine control unit ◆ Battery discharged ◆ Current drain with ignition off	◆ Idling speed not within specified range	- Test voltage supply of engine control unit ⇒ page 24-25. - Test fuse. - Read measured value block, display group 003, display block 2 ⇒ page 01-46. - Test charge state of battery.
00543 Maximum engine speed exceeded	◆ Engine overrevs (e.g. wrong gear)	◆ Possible engine damage	- Rectify mechanical damage.

Notes on fault code 00532:

- ◆ If the fault is displayed as sporadic fault, ignore fault readout! This fault may be stored if the engine runs at idling speed for a lengthy period with a large number of electrical components switched on, and the battery is severely discharged.
- ◆ The fault type "Signal too small" is set as soon as the supply voltage is below 10 V for more than 1 second (the control unit does not operate at a voltage of less than 6.5 V).
- ◆ No test is made of "Signal too small" during starting (as the voltage may drop below 10 V when the engine is started).

Note on fault code 00543:

The fault is set if an engine speed of 7100 rpm is exceeded.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
00561 Mixture adaptation Adaptation limit (add) exceeded Adaptation limit (mul) exceeded	◆ Fuel system pressure too low ◆ Incorrect signal from air mass meter ◆ Leaks in exhaust system to catalytic converter ◆ Unmetered air downstream of air mass meter ◆ Injectors have carbon deposits	◆ Vehicle may jerk ◆ Increased fuel consumption ◆ Engine idling may be poor	- Refuel vehicle, test fuel pressure regulator and holding pressure ⇒ page 24-27. - Test air mass meter ⇒ page 24-38. - Rectify leaks. - Test injected quantity ⇒ page 24-29.
Adaptation limit (add) not reached Adaptation limit (mul) not reached	◆ Fuel system pressure too high ◆ Incorrect signal from air mass meter ◆ Fuel in engine oil (possibly from driving short distances) ◆ Injectors leaking	◆ Vehicle may jerk ◆ Increased fuel consumption ◆ Engine idling may be poor ◆ Black exhaust, carbon deposits on spark plugs	- Refuel vehicle, test fuel pressure regulator and holding pressure ⇒ page 24-27. - Test air mass meter ⇒ page 24-38. - Drive on motorway for 15 minutes or change oil. - Read measured value block, display group 008 ⇒ page 01-53. - Test injected quantity ⇒ page 24-29.
Models 08.97 ►			
00557 Power steering pressure switch -F88¹⁾ Short circuit to earth Short circuit to positive	◆ Short circuit to earth ◆ -F88 faulty ◆ Short circuit to positive ◆ -F88 faulty	◆ Engine cuts out at full steering lock	- Test signal from power steering pressure switch ⇒ page 24-69.

Notes on fault code 00561:

- ♦ *add = additive, means that the fault is active only in the idling speed range.*
- ♦ *mul = multiplicative, means that the fault is active over the entire engine speed load range.*

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
00670 Throttle valve positioner sender -G127¹⁾ Signal too small	◆ Short circuit to earth in signal cable from throttle valve positioner sender -G127 to engine control unit ◆ Voltage supply for throttle valve positioner faulty ◆ Throttle valve positioner faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Idling speed positioner is switched off - engine runs in idling speed with mechanically defined air quantity through emergency gap (slightly fast idling speed) ◆ Load change jolt when accelerator released ◆ AC compressor does not cut in until higher rpm	- Adapt engine control unit to throttle valve control unit ⇒ page 24-51. - Test throttle valve control unit ⇒ page 24-16. - Replace engine control unit ⇒ page 24-48.
Signal too large	◆ Open circuit or short circuit to positive in signal cable between throttle valve positioner sender -G127 to engine control unit ◆ Earth supply for throttle valve positioner faulty ◆ Throttle valve positioner faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Idling speed positioner is switched off - engine runs in idling speed with mechanically defined air quantity through emergency gap (slightly fast idling speed) ◆ Load change jolt when accelerator released ◆ AC compressor does not cut in until higher rpm	- Adapt engine control unit to throttle valve control unit ⇒ page 24-51. - Test throttle valve control unit ⇒ page 24-16. - Replace engine control unit ⇒ page 24-48.
Implausible signal	◆ Throttle valve jamming ◆ Fault in cable connection for throttle valve positioner ◆ Basic setting for throttle valve control unit not performed	◆ Idling speed positioner is switched off - engine runs in idling speed with mechanically defined air quantity through emergency gap (slightly fast idling speed) ◆ Load change jolt when accelerator released ◆ AC compressor does not cut in until higher rpm	- Adapt engine control unit to throttle valve control unit ⇒ page 24-51. - Test throttle valve control unit ⇒ page 24-16. - Rectify open circuit in wiring or short circuit according to CFD ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Adapt engine control unit to throttle valve control unit ⇒ page 24-51.

¹⁾ Component of throttle valve control unit -J338.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
01119 Gear recognition signal Open/short circuit to positive	◆ Open circuit or short circuit to positive in signal cable between engine control unit and multifunction switch -F125 ◆ -F125 faulty ◆ Signal output in engine control unit faulty (control unit faulty)	◆ Slightly greater, brief variations in engine speed when gearbox shifted into or out of gear	- Test cable connection to multifunction switch -F125 ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Interrogate fault memory of gearbox ⇒ Automatic Gearbox; Repair Group 01; Performing self-diagnosis - Replace engine control unit ⇒ page 24-48.
Short circuit to earth	◆ Short circuit to earth in signal cable between engine control unit and multifunction switch -F125 ◆ -F125 faulty (short to earth not cancelled when gear engaged)	◆ Slightly greater, brief variations in engine speed when gearbox shifted into or out of gear	- Test cable connection to multifunction switch -F125 ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Interrogate fault memory of gearbox ⇒ Automatic Gearbox; Repair Group 01; Performing self-diagnosis
01120 Camshaft adjustment 1 Mechanical fault	◆ Voltage supply for camshaft adjustment valve -N205 faulty ◆ Open/short circuit to earth or positive in cable connection between camshaft adjustment valve and engine control unit ◆ Camshaft adjustment valve -N205 faulty ◆ Mechanical camshaft adjustment faulty	◆ Loss of torque in lower engine speed range 1300...3600 rpm	- Test camshaft adjustment valve -N205 ⇒ page 28-12. - Read measured value block, display group 025 ⇒ page 01-66 or 026 ⇒ page 01-67. - Replace camshaft adjuster.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
01165 Throttle valve control unit -J338 Control limit not reached Control limit exceeded Control difference	◆ Throttle valve jamming ◆ Positioner mechanism jamming ◆ Fault (open/short circuit to positive or to earth) in cable connection for throttle valve positioner -V60 ◆ Throttle valve positioner sender -G127 faulty ◆ -V60 faulty ◆ Signal output in engine control unit faulty (control unit faulty)	◆ Increased idling speed ◆ Load change jolt when accelerator released	- Read measured value block, display group 23 ⇒ page 01-63. - Test throttle valve control unit -J338 ⇒ page 24-16. - Replace engine control unit ⇒ page 24-48.

Note:

If fault "01165" is stored in the fault memory, fault "17953" is also stored the next time the engine is started.

Fault table from fault code 01182 to 16502

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
01182 Altitude adaptation Signal not to tolerance	♦ Throttle valve potentiometer -G69 faulty ♦ Incorrect throttle valve part fitted ♦ Unmetered air ♦ Air filter blocked	♦ Start problems ♦ Poor throttle response ♦ Starting-off problems	- Test throttle valve potentiometer -G69 ⇒ page 24-18. - Check part number. - Rectify unmetered air. - Replace air filter.
01247 Solenoid valve 1 for activated charcoal filter -N80 Short circuit to earth	♦ Short circuit to earth between activated charcoal filter solenoid valve -N80 and engine control unit ♦ -N80 faulty	♦ Possible jerking in part load range	- Test solenoid valve 1 for activated charcoal filter (-N80) ⇒ page 24-13.
Short circuit to positive	♦ Short circuit to positive between -N80 and engine control unit ♦ -N80 faulty	♦ Vehicle may smell of fuel	- Read measured value block, display group 10 ⇒ page 01-55.
Outlet open	♦ Open circuit in wiring between -N80 and fuse ♦ Open circuit in wiring between -N80 and engine control unit		- Rectify open circuit in wiring or short circuit according to CFD ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
	♦ Fuse faulty ♦ -N80 faulty		- Test fuse.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
01249 Injector cylinder 1 -N30 Short circuit to earth Short circuit to positive Outlet open	 ♦ Short circuit to earth in cable connection from injector to engine control unit ♦ Injector faulty ♦ Short circuit to positive in cable connection from injector to engine control unit ♦ Injector faulty ♦ Open circuit in cable connection between injector and engine control unit ♦ Fuse faulty ♦ Open circuit in wiring between injector and fuse ♦ Injector faulty	 ♦ Irregular engine running, engine may cut out	 - Test injectors ⇒ page 24-29. - Test fuse. - Rectify short circuit or open circuit in wiring ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
01250 Injector cylinder 2 -N31 Short circuit to earth Short circuit to positive Outlet open	⇒ Cyl. 1 fault code 01249	⇒ Cyl. 1 fault code 01249	⇒ Cyl. 1 fault code 01249
01251 Injector cylinder 3 -N32 Short circuit to earth Short circuit to positive Outlet open	⇒ Cyl. 1 fault code 01249	⇒ Cyl. 1 fault code 01249	⇒ Cyl. 1 fault code 01249
01252 Injector cylinder 4 -N33 Short circuit to earth Short circuit to positive Outlet open	⇒ Cyl. 1 fault code 01249	⇒ Cyl. 1 fault code 01249	⇒ Cyl. 1 fault code 01249

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
01259 Fuel pump relay -J17 Open/short circuit to earth	◆ Open circuit in wiring or short circuit to earth between fuel pump relay -J17 and engine control unit ◆ Voltage supply for -J17 faulty ◆ Fuel pump relay -J17 faulty	◆ If open circuit: engine does not run ◆ If short circuit to earth: engine continues running normally; when ignition on, however, high power consumption as relay constantly operated and fuel pump constantly running even if engine not running	- Rectify open circuit in wiring or short circuit ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test fuel pump relay -J17 ⇒ page 24-36.
Short circuit to positive	◆ Short circuit to positive in cable connection between fuel pump relay -J17 and engine control unit		
01314 Engine control unit	◆ Components or functions for cruise control system in engine control unit (J220) faulty	◆ Cruise control system not operating	- Replace engine control unit (J220) ⇒ page 24-48.
16485 Air mass meter -G70 Implausible signal	◆ Battery weak ◆ -G70 faulty ◆ Air filter blocked ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Poor performance ◆ Air mass displayed in measured value block constant ◆ Emergency running (substitute value from throttle valve angle and engine speed), consequently no perceptible effect on driving characteristics	- Test battery. - Test air mass meter (-G70) ⇒ page 24-38. - Replace filter element. - Replace engine control unit ⇒ page 24-48.

Note:

If fault "01259" is stored, the faults "01247/01249/01250/01251/01252/17935" may also be stored as these components are supplied with voltage through the fuel pump relay.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
16486 Air mass meter -G70 Signal too small	◆ Unmetered air between air mass meter -G70 and engine ◆ Voltage supply to -G70 faulty ◆ Air filter blocked ◆ Open circuit or short circuit to earth in signal cable between -G70 and engine control unit ◆ -G70 faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Emergency running (substitute value from throttle valve angle and engine speed), consequently no perceptible effect on driving characteristics	- Determine leakage and rectify. - Read measured value block, display group 02 ⇒ page 01-45. - Replace filter element. - Rectify short circuit or open circuit in wiring ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test air mass meter (-G70) ⇒ page 24-38. - Replace engine control unit ⇒ page 24-48.
16487 Air mass meter -G70 Signal too large	◆ Short circuit to positive in signal cable between air mass meter -G70 and engine control unit ◆ Earth supply for -G70 faulty ◆ -G70 faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Emergency running (substitute value from throttle valve angle and engine speed), consequently no perceptible effect on driving characteristics	- Read measured value block, display group 002 ⇒ page 01-45. - Test air mass meter -G70 ⇒ page 24-38. - Replace engine control unit ⇒ page 24-48.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
16496 Intake air temperature sender -G42 Signal too small	◆ Short circuit to earth in cable connection between intake air temperature sender -G42 and engine control unit ◆ -G42 faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Emergency running; a substitute value computed by the engine control unit is constantly displayed, approx. 19.5 °C	- Read measured value block, display group 003, display block 4 ⇒ page 01-46. - Test intake air temperature sender -G42 ⇒ page 24-20. - Replace engine control unit ⇒ page 24-48.
16497 Intake air temperature sender -G42 Signal too large	◆ Open circuit or short circuit to positive in cable connection between intake air temperature sender -G42 and engine control unit ◆ -G42 faulty ◆ Earth supply to -G42 faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Emergency running; a substitute value computed by the engine control unit is constantly displayed, approx. 19.5 °C	- Read measured value block, display group 003, display block 4 ⇒ page 01-46. - Test intake air temperature sender -G42 ⇒ page 24-20. - Replace engine control unit ⇒ page 24-48.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
16500 Coolant temperature sender -G62 Implausible signal	◆ Coolant temperature sender -G62 supplies implausible signal because of loose contact or corrosion caused by moisture in connector ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Cold start problems at very low temperatures ◆ Poor driving characteristics in warming-up phase ◆ Increased fuel consumption ◆ Increased emission levels	- Read measured value block, display group 003 ⇒ page 01-46. - Test -G62 ⇒ page 24-23. - Replace engine control unit ⇒ page 24-48.
16501 Coolant temperature sender -G62 Signal too small	◆ Short circuit to earth in cable connection between coolant temperature sender -G62 and engine control unit ◆ -G62 faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Cold start problems at very low temperatures ◆ Poor driving characteristics in warming-up phase ◆ Increased fuel consumption ◆ Increased emission levels	- Read measured value block, display group 003 ⇒ page 01-46. - Test -G62 ⇒ page 24-23. - Replace engine control unit ⇒ page 24-48.

Note on fault code 16500:

The temperature pattern in the range from 20 °C up to 60 °C is compared with a model pattern stored in the control unit. The model temperature pattern rises more slowly than the real temperature. If the real temperatures rise less slowly because of a fault, there comes a point at which they are aligned with the model temperatures. The engine control unit detects this fault as implausible.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
16502 Coolant temperature sender -G62 Signal too large	◆ Open circuit or short circuit to positive in cable connection between -G62 and engine control unit ◆ -G62 faulty ◆ Earth supply to -G62 faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Cold start problems at very low temperatures ◆ Poor driving characteristics in warming-up phase ◆ Increased fuel consumption ◆ Increased emission levels	- Read measured value block, display group 003 ⇒ page 01-46. - Test -G62 ⇒ page 24-23. - Replace engine control unit ⇒ page 24-48.

Note on fault code 16500, 16501 and 16502:

As soon as one of the faults is detected, the control unit uses a substitute value from the model temperature pattern stored in the control unit.

Fault table from fault code 16504 to 17736

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
16504 Throttle valve potentiometer -G69 ¹⁾ Electric fault in circuit	◆ Open circuit in wiring or short circuit to positive ◆ Short circuit to earth ◆ -G69 faulty	◆ Jerky acceleration ◆ Load change jolts when accelerator released ◆ Irregular idling speed control characteristics	- Rectify short circuit or open circuit in wiring. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test throttle valve potentiometer -G69 ⇒ page 24-18.
16505 Throttle valve potentiometer -G69 ¹⁾ Implausible signal	◆ Moisture or corrosion in plug connection at throttle valve potentiometer -G69 ◆ -G69 faulty	◆ Jerky acceleration ◆ Irregular idling speed control characteristics ◆ Load change jolts when accelerator released	- Test throttle valve potentiometer -G69 ⇒ page 24-18.
16506 Throttle valve potentiometer -G69 ¹⁾ Signal too small	◆ Open circuit or short circuit to earth in signal cable between -G69 and engine control unit ◆ Voltage supply for -G69 faulty ◆ -G69 faulty	◆ Jerky acceleration ◆ Irregular idling speed control characteristics ◆ Load change jolts when accelerator released	- Test throttle valve potentiometer -G69 ⇒ page 24-18. - Rectify short circuit or open circuit in wiring. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
16507 Throttle valve potentiometer -G69 ¹⁾ Signal too large	◆ Short circuit to positive in signal cable between -G69 and engine control unit ◆ Earth supply for -G69 faulty ◆ -G69 faulty	◆ Jerky acceleration ◆ Load change jolts when accelerator released	- Rectify short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test throttle valve potentiometer -G69 ⇒ page 24-18.

Note on fault code 16505:

What is compared is the air flow (air mass) at the particular engine speed with the throttle valve angle.

Notes on fault codes 16504, 16505, 16506 and 16507:

- ◆ As soon as one of the faults is recognized, the control unit uses a substitute value formed from the engine speed.
- ◆ If a fault occurs simultaneously at the throttle valve potentiometer and at the air mass meter, no emergency running function is possible. Consequence: the engine cuts out.

¹⁾ Component of throttle valve control unit -J338.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
16514 Bank 1, probe 1 Electrical fault in circuit	◆ Corrosion caused by moisture in plug connection of probe heater -Z19 or lambda probe -G39 ◆ Short circuit between lambda probe signal cable and lambda probe reference earth cable ◆ Amplitude of signal cable too small (lambda probe - G39 faulty or probe slots blocked or dirty)	◆ Lambda closed-loop control switches to open-loop ◆ Poor idling ◆ Emission levels not o.k. ◆ Increased fuel consumption	- Rectify short circuit or open circuit in wiring. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test function of lambda control ⇒ page 24-42.3. - Read measured value block, display group 007 ⇒ page 01-51. - Read measured value block, display group 021 ⇒ page 01-62.
16515 Bank 1, probe 1 Voltage too small	◆ Short circuit of lambda probe signal cable to earth or to screening ◆ Short circuit of lambda probe reference earth cable to earth or to screening ◆ Lambda probe faulty	◆ Lambda closed-loop control switches to open-loop ◆ Poor idling ◆ Emission levels not o.k. ◆ Increased fuel consumption	- Rectify short circuit or open circuit in wiring. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test operation of lambda control ⇒ page 24-42.3. - Read measured value block, display group 007 ⇒ page 01-51. - Read measured value block, display group 021 ⇒ page 01-62.
16516 Bank 1, probe 1 Voltage too large	◆ Short circuit of signal cable to positive ◆ Lambda probe faulty	◆ Lambda closed-loop control switches to open-loop ◆ Poor idling	- Rectify short circuit or open circuit in wiring. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test lambda control ⇒ page 24-42.3.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
16518 Bank 1, probe 1 No activity	◆ Lambda probe faulty (dirty) ◆ Open circuit in wiring between probe heater and engine control unit ◆ Probe heater not operating	◆ Increased fuel consumption ◆ Emission levels not o.k. ◆ Carbon deposits on spark plugs	- Read measured value block, display group 021 ⇒ page 01-62. - Test probe heater ⇒ page 24-45.
16519 Bank 1, probe 1 Heating circuit electrical fault	◆ Open circuit in wiring or short circuit to positive	◆ Probe heater not operating	- Test probe heater ⇒ page 24-45.
16705 Engine speed sender -G28 Implausible signal	◆ Engine speed sender - G28 loose ◆ Sender rotor loose	◆ Engine misfiring	- Test engine speed sender -G28 ⇒ page 24-21.4.
16706 Engine speed sender -G28 No signal	◆ Signal cable has open circuit or short circuit to earth or to positive ◆ Earth cable has open circuit or short circuit to positive ◆ -G28 loose or faulty ◆ Open circuit in wiring to screening of -G28 ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Engine does not start ◆ Engine cuts out	- Rectify open circuit in wiring or short circuit ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test -G28 ⇒ page 24-21. - Replace engine control unit ⇒ page 24-48.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
16710 Knock sensor 1 -G61 Signal too small	◆ -G61 loose or faulty ◆ Open circuit or short circuit to earth or to screening of signal cable between knock sensor and engine control unit ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Reduced output ◆ High fuel consumption	- Test knock sensor ⇒ page 28-6. - Rectify open circuit in wiring or short circuit ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Replace engine control unit ⇒ page 24-48.
16711 Knock sensor 1 -G61 Signal too small	◆ -G61 loose or faulty ◆ Short circuit to earth in wiring	◆ High fuel consumption ◆ Reduced output	- Test knock sensor ⇒ page 28-6.
16712 Knock sensor 1 -G61 Signal too large	◆ -G61 loose or faulty ◆ Short circuit to positive in wiring	◆ High fuel consumption ◆ Reduced output	- Test knock sensor ⇒ page 28-6.
16716 Knock sensor 2 -G66 Signal too small	◆ -G66 loose or faulty ◆ Short circuit to earth in wiring	◆ High fuel consumption ◆ Reduced output	- Test knock sensor ⇒ page 28-6.
16717 Knock sensor 2 -G66 Signal too large	◆ -G66 loose or faulty ◆ Short circuit to positive in wiring	◆ High fuel consumption ◆ Reduced output	- Test knock sensor ⇒ page 28-6.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
16885 Vehicle speed signal Implausible signal	◆ Vehicle speed sender faulty ◆ Open circuit in wiring or short circuit between vehicle speed sender and speedometer ◆ Open circuit in wiring or short circuit between dash panel insert and engine control unit ◆ Speedometer faulty	◆ AC compressor does not cut out at full throttle ◆ Brief variation in idling speed from specified speed ◆ Poor load change characteristics ◆ Malfunction in systems which use vehicle speed signal	- Test vehicle speed signal. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Read measured value block, display group 011, display block 3 ⇒ page 01-57. - Rectify open circuit in wiring or short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test vehicle speed signal ⇒ page 24-61.
16989 Control unit faulty	◆ Engine control unit faulty	◆ Engine does not start	- Replace engine control unit ⇒ page 24-48.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
17733 Knock control cyl. 1 Control limit not reached	♦ Poor fuel quality (less than 95 RON) ♦ Abnormal engine running noises (ancillaries loose) ♦ Open circuit in screening of knock sensor 1 or 2 ♦ Loose contact at plug connections ♦ Knock sensor tightened to incorrect torque	♦ High fuel consumption ♦ Poor performance ♦ Irregular engine running ♦ Top speed is not reached	- Refuel with fuel of at least 95 RON. - Rectify cause for abnormal engine running noises. - Test knock sensor ⇒ page 28-6. - Rectify short circuit or open circuit in wiring. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Read measured value block, display group 014 and 015 ⇒ page 01-58. - Slacken knock sensor and tighten again to 20 Nm.
17734 Knock control cyl. 2 Control limit reached			
17735 Knock control cyl. 3 Control limit reached			
17736 Knock control cyl. 4 Control limit reached			

Fault table from fault code 17913 to 18262

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
17913 Idling speed switch -F60 ¹⁾ Does not close/open circuit	◆ Throttle valve sticking ◆ -F60 faulty ◆ Setting of throttle cable ◆ Footmat pressing on accelerator pedal ◆ Open circuit in wiring or short circuit to positive between -F60 and engine control unit ◆ Signal cable in engine control unit faulty (engine control unit faulty)	◆ Load change jolt when accelerator released ◆ Idling speed not within specified range ◆ AC compressor does not cut in until higher rpm	- Test -F60 ⇒ page 24-16. - Set accelerator cable. ⇒ 1.8-ltr./92 kW Engine, Mechanical Components; Repair Group 20; Setting throttle cable - Rectify open circuit in wiring or short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Replace engine control unit ⇒ page 24-48.
17914 Idling switch -F60 ¹⁾ Does not open/short circuit to earth	◆ Moisture in connector of throttle valve control unit ◆ -F60 faulty ◆ Short circuit to earth between -F60 and engine control unit ◆ Signal cable in engine control unit faulty (engine control unit faulty)	◆ Idling speed control switches to open-loop control ◆ Idling speed not within specified range ◆ Load change jolts when accelerator released ◆ AC compressor does not cut in until higher rpm	- Test idling speed switch -F60 ⇒ page 24-16. - Rectify open circuit in wiring or short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Replace engine control unit ⇒ page 24-48.

¹⁾ Component of throttle valve control unit -J338.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
17915 Idling system learned value Lower limit reached	♦ Unmetered air upstream of throttle valve control unit	♦ High idling speed	- Eliminate unmetered air.
17916 Idling system learned value Upper limit reached	♦ Intake system blocked (air cleaner or intake port)	♦ No power	- Inspect intake system.
Models 08.97 ► 17920 Intake manifold changeover valve -N156 Short circuit to positive	♦ Short circuit to positive in cable connection between intake manifold changeover valve -N156 and engine control unit ♦ -N156 faulty ♦ Signal input in engine control unit faulty (control unit faulty)	♦ Poor acceleration	- Test -N156 ⇒ page 24-66. - Replace engine control unit ⇒ page 24-48.
Models 08.97 ► 17923 Intake manifold changeover valve -N156 Short circuit to earth	♦ Short circuit to earth in cable connection between intake manifold changeover valve -N156 and engine control unit ♦ -N156 faulty ♦ Signal input in engine control unit faulty (control unit faulty)	♦ Poor acceleration	- Test -N156 ⇒ page 24-66. - Replace engine control unit ⇒ page 24-48.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
Models 08.97 ► 17924 Intake manifold changeover valve -N156 Open circuit	◆ Open circuit in cable connection between intake manifold changeover valve -N156 and engine control unit ◆ Voltage supply for -N156 faulty ◆ -N156 faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Poor acceleration	- Test -N156 ⇒ page 24-66. - Replace engine control unit ⇒ page 24-48.
17934 Bank 1, camshaft adjustment -N205 Short circuit to positive	◆ Short circuit to positive between camshaft adjustment valve -N205 and engine control unit ◆ Valve -N205 faulty ◆ Fuse faulty ◆ Signal input in engine control unit faulty (control unit faulty)	◆ Poor torque in lower engine speed range of 1300...3600 rpm	- Rectify open circuit in wiring or short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test camshaft adjustment valve -N205 ⇒ page 28-12. - Test fuse. - Replace engine control unit ⇒ page 24-48.
17935 Bank 1, camshaft adjustment -N205 Short circuit to earth	◆ Short circuit to earth between camshaft adjustment valve -N205 and engine control unit ◆ Valve -N205 faulty ◆ Fuse faulty	◆ Poor torque in lower engine speed range of 1300...3600 rpm	- Rectify open circuit in wiring or short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test camshaft adjustment valve -N205 ⇒ page 28-12. - Test fuse.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
17936 Bank 1, camshaft adjustment -N205 Open circuit	◆ Open circuit in wiring between camshaft adjustment valve -N205 and engine control unit ◆ Fuse faulty	◆ Poor torque in lower engine speed range of 1300...3600 rpm	- Rectify open circuit in wiring or short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test -N205 ⇒ page 28-12. - Test fuse.
17953 Throttle valve control Malfunction	◆ Voltage or earth supply for throttle valve potentiometer -G69 and throttle valve positioner sender -G127 faulty ◆ Open circuit in signal cable for -G69 and -G127 ◆ -G69 and -G127 faulty ◆ Throttle valve stiff or dirty	◆ Increased idling speed ◆ Load change jolt when accelerator released	- Read measured value block, display group 023 ⇒ page 01-63. - Test throttle valve control unit -J338 ⇒ page 24-16. ◆ Clean throttle valve.
17967 Throttle valve control unit -J338 Fault in basic setting	◆ Idling switch open ◆ Min. stop not reached (jamming)	◆ Engine running in emergency mode	- Test idling switch ⇒ page 24-16. - Read measured value block, display group 004, display block 4 ⇒ page 01-48.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
17972 Throttle valve control unit -J338 Undervoltage in basic setting	♦ Voltage below 10 V during basic setting		- Test voltage, read measured value block, display group 003, display block 2 ⇒ page 01-46.
17973 Throttle valve control unit -J338 Lower stop is not reached	♦ Throttle valve jamming ♦ Throttle valve positioner jamming/mechanical damage	♦ Start problems ♦ Poor throttle response ♦ Starting-off problems	- Inspect throttle valve for damage or dirt. - Test throttle valve control unit ⇒ page 24-16.
17978 Engine control unit inhibited	♦ Attempt at starting with unauthorized key ♦ Attempt at manipulation ♦ Short circuit in communication cable ♦ Incorrect coding ♦ Fault in immobiliser system ♦ No immobiliser control unit or faulty ♦ Engine control unit replaced and not adapted to immobiliser	♦ Engine starts and cuts out again immediately	- Adapt engine control unit to electronic immobiliser ⇒ page 24-50. - Test electronic immobiliser: ⇒ Repair Group 96; Servicing electronic immobiliser

Notes on fault code 17978:

- ♦ The electronics for controlling the immobiliser are located in the instrument cluster and cannot be replaced separately.
- ♦ If an attempt is made to start the engine with a non-adapted key, a static fault is stored. If the engine is subsequently started with an adapted key, the fault is converted into a sporadic fault.

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
18010 Voltage supply tml. 30 Voltage too small	◆ Battery was disconnected ◆ Permanent voltage supply at control unit was disconnected or open circuit in wiring ◆ Fuse 10 or 29 faulty	◆ Learned values in engine control unit are lost	- Test voltage supply for engine control unit ⇒ page 24-25. - Test fuse.
18020 Engine control unit incorrectly coded	◆ Engine control unit incorrectly coded	◆ Poor driving characteristics ◆ Increased emission levels ◆ Various faults in fault memory	- Code engine control unit ⇒ page 24-49.
Models 08.97 ► 18034 Drive databus No message from gearbox ECU	◆ Fault in data cables to gearbox control unit ◆ Fault in system: automatic gearbox	◆ Poor driving characteristics (jerky gear changes, load change jolts)	- Test data cable to engine control unit pins 29+41 for open circuit or short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder - Test automatic gearbox control unit. ⇒ Automatic Gearbox binder

Readout on V.A.G 1552	Possible cause of fault	Possible effects	Rectifying fault
Models 08.97 ➤ 18259 Drive databus No message from ABS ECU	♦ Fault in data cables to ABS control unit	♦ No stability control	- Test data cable to engine control unit pins 29+41 for open circuit or short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
	♦ Fault in system: ABS		- Test ABS control unit. ⇒ Running Gear binder; Anti-lock brake system
Models 08.97 ➤ 18262 Drive databus Hardware faulty	♦ Fault in data cables to gearbox or ABS control unit	♦ Poor driving characteristics (jerky gearshifts, load change jolts) ♦ No stability control	- Test data cable to engine control unit pins 29+41 for open circuit or short circuit. ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
	♦ Fault in system: automatic gearbox or ABS		- Test ABS control unit. ⇒ Running Gear binder; Anti-lock brake system - Test automatic gearbox control unit. ⇒ Automatic Gearbox binder

Final control diagnosis

With final control diagnosis the following components are actuated in the order stated:

1. Injector cyl. 1 -N30
2. Injector cyl. 2 -N31
3. Injector cyl. 3 -N32
4. Injector cyl. 4 -N33
5. Solenoid valve 1 for activated charcoal filter -N80

Models ► 07.97

6. Camshaft adjustment 1 (valve 1 for camshaft adjustment -N205)

Models 08.97 ►

6. Variable intake manifold changeover valve -N156
7. Camshaft adjustment 1 (valve 1 for camshaft adjustment -N205)

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Hand-held multimeter V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Diode test lamp, e.g. V.A.G 1527
- ◆ Current flow diagram

Notes:

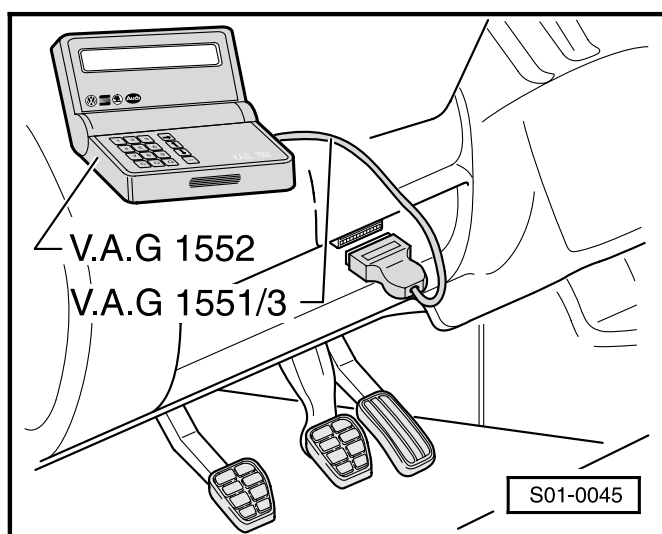
- ◆ *Final control diagnosis can only be carried out when the engine is not running and the ignition is switched on.*
- ◆ *Final control diagnosis is aborted if the engine is started or if an engine speed pulse is detected.*
- ◆ *During final control diagnosis the individual actuator is operated until the diagnosis is switched on to the next actuator by pressing the → key.*
- ◆ *The actuators are checked by listening or by touching.*
- ◆ *Before repeating final control diagnosis without briefly running the engine, switch off the ignition for about 20 seconds.*
- ◆ *The electric fuel pump runs during the entire final control diagnosis.*
- ◆ *Final control diagnosis is ended after 10 minutes.*
- ◆ *Idling switch should be in proper order.*

Test condition

- Fuses 10, 28, 29, 32, 34 and 43 should be in proper order.

Procedure

- ◀ - Connect V.A.G 1552 and select the engine electronics control unit by entering the „address word“ 01.



Test of vehicle systems
Select function XX

HELP

The ignition should be switched on when carrying out this step (⇒ page 01-3, Connecting vehicle system tester and selecting control unit for engine electronics).

◀ Readout in display:

- Press the keys 0 and 3 for the function „Final control diagnosis“.

Test of vehicle systems
03 - Final control diagnosis

Q

◀ Readout in display:

- Confirm the entry with the key Q.

Final control diagnosis
Injector cyl. 1 -N30

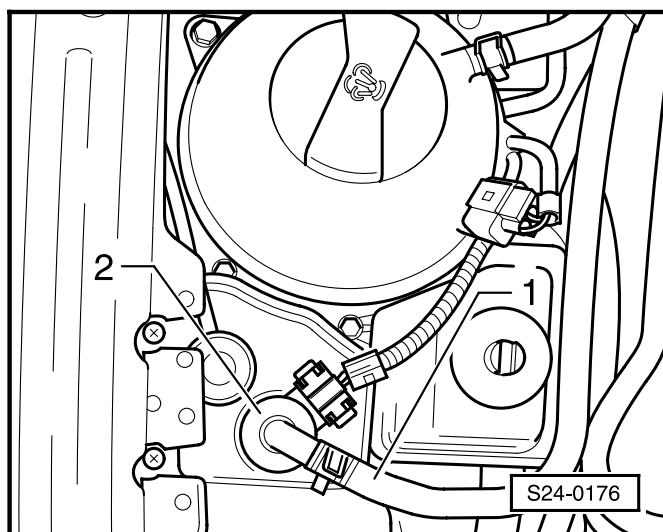
→

◀ Readout in display:

- Rotate throttle control at the throttle valve control unit. The injector for cylinder 1 clicks five times as soon as idling switch opens.
- To move forward to the next injector, press the → key each time (it is also possible to move forward in the test routine without testing the particular injector).
- Test all the injectors one after the other in this way.
- If one of the injectors is not actuated (does not click), test injectors ⇒ page 24-34.
- Press the → key.

Final control diagnosis of solenoid valve 1 for activated charcoal filter:

◀ Installation position of solenoid valve 2



Final control diagnosis
Solenoid valve 1 for activated charcoal filter -N80

→

◀ Readout in display:

This solenoid valve (positioned on right in front of coolant reservoir) **should click**.

- If the valve is not actuated (does not click), test solenoid valve for activated charcoal filter -N80 ⇒ page 24-13.

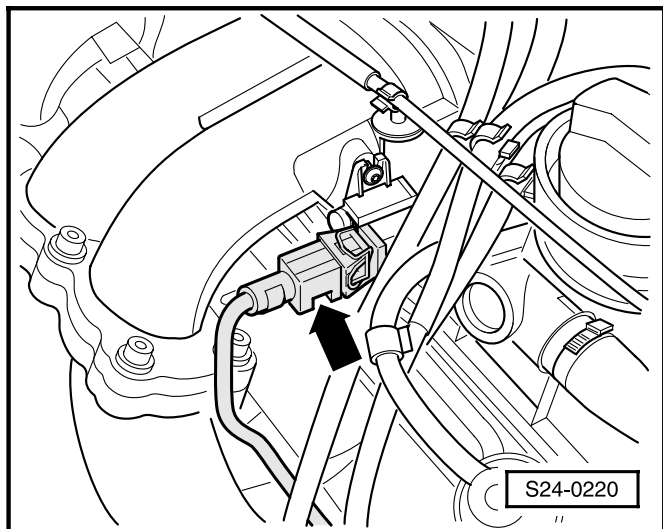
If the solenoid valve clicks, opens and closes:

- Press the → key.

Models 08.97 ►**Final control diagnosis of variable intake manifold changeover:**

Final control diagnosis
Intake manifold changeover valve -N156 →

◀ Readout in display:



◀ Installation position of intake manifold changeover valve -N156

The intake manifold changeover valve **should click**.

- If the valve is not actuated (does not click), test intake manifold changeover valve -N156 ⇒ page 24-66.

If the valve clicks, opens and closes:

- Press the → key.
- Switch off the ignition.

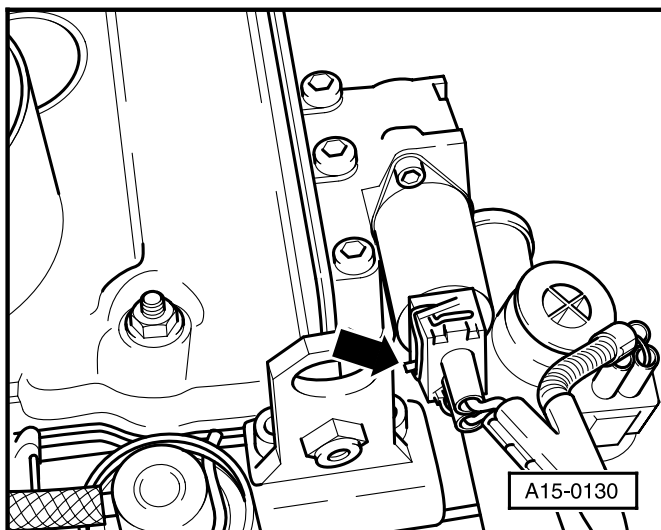
All models

Final control diagnosis of camshaft adjustment:

Final control diagnosis
Camshaft adjustment 1

→

◀ Readout in display:



This valve continues to be actuated (clicks) until final control diagnosis is ended by pressing the → key.

- If the valve is not actuated (does not click), test camshaft adjustment valve ⇒ page 28-12.
- Press the → key.

◀ Installation position of solenoid valve 1

Note:

Before again selecting function 03 „Final control diagnosis“, switch off ignition for about 20 seconds.

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press the keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.
- Switch off the ignition.

Measured value blocks

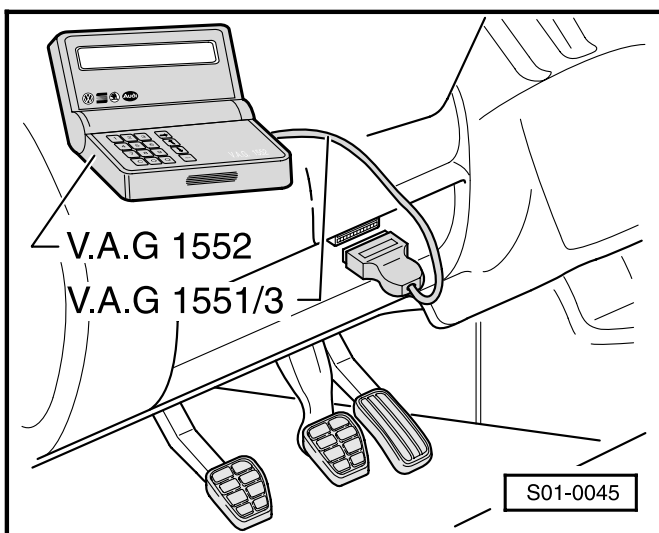
Reading measured value block

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3

Test conditions

- Coolant temperature at least 80 °C
- Electrical components switched off (radiator fan must not cut in during the test)
- Air conditioning switched off
- No fault stored in the fault memory



Procedure

- ◀ - Connect the vehicle system tester V.A.G 1552 and select the engine electronics control unit by entering the „address word“ 01. The engine should be idling during this step. (Connecting vehicle system tester and selecting engine electronics control unit ⇒ page 01-3).

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press the keys 0 and 8 for the function „Read measured value block“ and confirm the entry with the key Q.

Read measured value block
Enter display group number XXX

HELP

◀ Readout in display:

Note:

Display group number 001 is an example in order to present the sequence.

- Press the keys 0, 0 and 1 for „Display group number 1“ and confirm the entry with the key Q.

Read measured value block 1
1 2 3

→
4

◀ Readout in display,
e.g.: (1...4 = display blocks)

- Press the → key.

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.

The readouts in the functions of Reading measured value block and Basic setting are described in the individual component tests. This list is intended only as a summary.

Note:

Proceed as follows to switch into another display group:

Display group	V.A.G 1552	V.A.G 1551
higher	Press ↑ key	Press key 3
lower	Press ↓ key	Press key 1
skip	Press key C	Press key C

List of display groups

Display group	Designation	Designation
000 Basic function	Read measured value block 00 1 2 3 4 5 6 7 8 9 10	1 = Coolant temperature 2 = Engine load 3 = Engine speed 4 = Battery voltage 5 = Throttle valve angle 6 = Idling air mass controlled value 7 = Idling air mass learned value 8 = Controlled value of mixture formation (lambda control value) 9 = Learned value of mixture formation (lambda learned value) 1 = Learned value of mixture formation (lambda learned value) 0
001 Basic function	Read measured value block 1 1 2 3 4	1 = Engine speed 2 = Engine load (injection time for each crankshaft revolution) 3 = Throttle valve angle 4 = Ignition angle
002 Basic function	Read measured value block 2 1 2 3 4	1 = Engine speed 2 = Engine load (injection time for each crankshaft revolution) 3 = Corrected injection time for each power stroke 4 = Inducted air mass
003 Basic function	Read measured value block 3 1 2 3 4	1 = Engine speed 2 = Battery voltage 3 = Coolant temperature 4 = Intake air temperature

Display group number	Readout in display	Designation
004 Idling speed stabilisation	Read measured value block 4 1 2 3 4	1 = Throttle valve angle 2 = Idling air mass learned (automatic gearbox not in gear) 3 = Idling air mass learned (gear of automatic gearbox engaged) 4 = Operating state: Idling speed Part load Full load Deceleration Enrichment
005 Idling speed stabilisation	Read measured value block 5 1 2 3 4	1 = Idling speed (actual) 2 = Idling speed (specified) 3 = Idling speed controller 4 = Air mass
006 Idling speed stabilisation	Read measured value block 6 1 2 3 4	1 = Idling speed 2 = Idling speed controller 3 = Lambda controller 4 = Ignition angle
007 Lambda control and ACF system	Read measured value block 7 1 2 3 4	1 = Lambda controller 2 = Lambda probe voltage 3 = On/off ratio of solenoid valve 1 for activated charcoal filter -N80 4 = Lambda correction factor if fuel tank ventilation active
008 Lambda learned values	Read measured value block 8 1 2 3 4	1 = Injection time 2 = Lambda learned value at idling speed (additive) 3 = Lambda learned value at part load (multiplicative) 4 = Tank breather system: TB active (tank breather active) TB n. active (tank breather not active)
009 Lambda learned values	Read measured value block 9 1 2 3 4	1 = Engine speed (actual) 2 = Lambda controller 3 = Lambda probe voltage 4 = Lambda learned values at idling speed (additive)

Display group	Readout in display	Designation
010 Tank breather	Read measured value block 10 1 2 3 4	1 = On/off ratio of solenoid valve 1 for activated charcoal filter -N80 2 = Lambda correction factor with active tank breather 3 = Filling level of activated charcoal filter -N80 4 = ACF purging rate
011 Fuel consumption	Read measured value block 11 1 2 3 4	1 = Engine speed 2 = Engine load (injection time for each crankshaft revolution) 3 = Vehicle speed 4 = Fuel consumption
012 Fuel consumption	Read measured value block 12 1 2 3 4	1 = Engine speed 2 = Battery voltage 3 = Fuel consumption 4 = Ignition angle
013 Knock control	Read measured value block 13 1 2 3 4	1 = Ignition angle of cylinder 1 retarded by knock control 2 = Ignition angle of cylinder 2 retarded by knock control 3 = Ignition angle of cylinder 3 retarded by knock control 4 = Ignition angle of cylinder 4 retarded by knock control
014 Knock control	Read measured value block 14 1 2 3 4	1 = Engine speed 2 = Engine load 3 = Ignition angle of cylinder 1 retarded by knock control 4 = Ignition angle of cylinder 2 retarded by knock control
015 Knock control	Read measured value block 15 1 2 3 4	1 = Engine speed 2 = Engine load (injection time for each crankshaft revolution) 3 = Ignition angle of cylinder 3 retarded by knock control 4 = Ignition angle of cylinder 4 retarded by knock control
016 Knock control	Read measured value block 16 1 2 3 4	1 = Knock sensor signal cylinder 1 2 = Knock sensor signal cylinder 2 3 = Knock sensor signal cylinder 3 4 = Knock sensor signal cylinder 4

Display group	Readout in display	Designation
017 Catalytic converter heating	Read measured value block 17 1 2 3 4	1 = Engine speed 2 = Engine load 3 = Energy balance for Cat heating 4 = Ignition angle
018 Altitude adaptation	Read measured value block 18 1 2 3 4	1 = Engine speed 2 = Engine load (without altitude correction) from air mass meter 3 = Engine speed (after altitude correction) from throttle valve angle 4 = Altitude correction factor
019 Torque reduction	Read measured value block 19 1 2 3 4	1 = Engine speed 2 = Engine load (injection time for each crankshaft revolution) 3 = Gearbox control (signal) 4 = Ignition angle
020 Operating states	Read measured value block 20 1 2 3 4	1 = Engine speed 2 = Selector lever position 3 = Air conditioning 4 = AC compressor
021 Operating states lambda control	Read measured value block 21 1 2 3 4	1 = Engine speed 2 = Engine load (injection time for each crankshaft revolution) 3 = Coolant temperature 4 = Lambda control OFF/ON
022		Ignore
023 Adaptation throttle valve positioner	Read measured value block 23 1 2 3 4	1 = Learning demand display 2 = Bottom stop of throttle valve positioner 3 = Emergency running stop of throttle valve positioner 4 = Upper stop of throttle valve positioner
024 Knock control	Read measured value block 24 1 2 3 4	1 = Engine speed (actual) 2 = Engine load (injection time for each crankshaft revolution) 3 = Ignition angle 4 = Total of ignition angle retardation cylinders 1 to 4

Display group number	Readout in display	Designation
Models ► 07.97		
025	Read measured value block 25	1 = Operating state:
Camshaft adjustment control	1 2 3 4	Idling
		Part throttle
		Full throttle
		Overrun
		Enrichment
		2 = Hall sender -G40 (°CRA)
		3 = Control:
		Camshaft adjustment
		4 = Active camshaft adjustment angle in °CRA
Models 08.97 ►		
025	Read measured value block 25	1 = Operating state:
Camshaft adjustment control, intake manifold changeover	1 2 3 4	Idling
		Part throttle
		Full throttle
		Overrun
		Enrichment
		2 = Setting variation Hall sender -G40 (°CRA)
		3 = Operating state:
		Camshaft adjustment
		Intake manifold changeover
		4 = Active camshaft adjustment angle in °CRA

Display group number	Readout in display	Designation
Models ► 07.97		
026	Read measured value block 26	1 = Engine speed (rpm)
Camshaft adjustment control	1 2 3 4	2 = Engine load (injection time for each crankshaft revolution in ms) 3 = Control: Camshaft adjustment 4 = Active camshaft adjustment angle in °CRA
Models 08.97 ►		
026	Read measured value block 26	1 = Engine speed (rpm)
Camshaft adjustment control, intake manifold changeover	1 2 3 4	2 = Engine load (injection time for each crankshaft revolution in ms) 3 = Operating state: Camshaft adjustment Intake manifold changeover 4 = Active camshaft adjustment angle in °CRA
027...094		Ignore
095	Read measured value block 95	1 = Engine speed (idling speed) (rpm)
Basic functions	1 2 3 4	2 = Engine load (in ms) 3 = Ignition angle in °CRA 4 = Coolant temperature in °C
096...097		Ignore

Display group number	Readout in display	Designation
098 Adaptation of throttle valve control unit	Read measured value block 98 1 2 3 4	1 = Throttle valve potentiometer voltage 2 = Throttle valve positioner potentiometer voltage 3 = Operating state: idling/part throttle 4 = Adaptation status: Adaptation in progress Adaptation o.k. Adaptation ERROR
099 Lambda control	Read measured value block 99 1 2 3 4	1 = Engine speed rpm 2 = Coolant temperature 3 = Lambda controller 4 = Lambda control ON/OFF

Display group 000 to 007

Display group 000 at idling speed (engine warm, coolant temperature not below +80 °C)

Display block	Specified readout	Corresponds to measured value	Designation
1	170...204	80...105 °C	Coolant temperature (requirement for basic setting)
2	20...50	1.0...2.5 ms	Engine load (without ancillaries)
3	76...84 ¹⁾ 76...88 ²⁾	760...840 rpm ¹⁾ 760...880 rpm ²⁾	Engine speed (without ancillaries)
4	146...212	10...14.5	Battery voltage
5	0...12	0...5°	Throttle valve angle
6	118...138	-2.5...+2.5 kg/h	Idling air mass control value (idling controller)
7	112...144	-4...+4 kg/h	Idling air mass learned value
8	78...178	-10...+10 %	Controlled value of mixture formation (lambda control value) additive (conduct road test if not within tolerance)
9	243...255 or 0...+13 ¹⁾ 0...+12 ²⁾	-0.64...+0.64 ms	Learned value of mixture formation (lambda learned value) additive (conduct road test if not to tolerance)
10	118...138	-8...+8 %	Learned value of mixture formation (lambda learned value) multiplicative (conduct road test if not to tolerance)

Notes on display blocks 9 and 10:

- ◆ In the case of the additive learned value the injection time is altered by a fixed amount which does not depend on the basic injection time.
- ◆ In the case of the multiplicative learned value this is a percentage change to the injection time which is dependent on the basic injection time.

1) ➤ 07.97

2) 08.97 ➤

Test table display group 000

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
1	greater than 204	◆ Coolant temperature sender -G62 ◆ Cable connection to engine control unit	- Test -G62 ⇒ page 24-23
	less than 170	◆ Coolant temperature sender -G62 ◆ Cable connection to engine control unit ◆ Coolant thermostat constantly open	- Test -G62 ⇒ page 24-23 - Test thermostat
2	greater than 50	◆ Air conditioning switched on ◆ Electrical components on ◆ Lambda control at rich or lean stop ◆ AC compressor also runs although AC switched off	- Switch off AC - Switch off components - Test operation of lambda control ⇒ page 24-44 - Test AC compressor control ⇒ page 24-55
	less than 20	◆ Unmetered air downstream of air mass meter ◆ Unmetered air downstream of throttle flap ◆ Vacuum hose off ◆ Fuel pressure regulator	- Rectify cause
3	less than 76	◆ Gear engaged (automatic gearbox) ◆ Engine load because of ancillaries ◆ Throttle valve control unit -J338 jamming or faulty	- Move selector lever into P or N - Eliminate load (AC, power steering etc.) - Test throttle valve control unit -J338 ⇒ page 24-16
	greater than 84 ¹⁾ greater than 88 ²⁾	◆ Idling switch -F60 not closed or faulty ◆ Large quantity of unmetered air (cannot be compensated by idling stabilising control) ◆ Throttle valve control unit -J338 jamming or faulty	- Interrogate fault memory, test/set idling switch - Eliminate unmetered air - Test throttle valve control unit -J338 ⇒ page 24-16

1) ➤ 07.97

2) 08.97 ➤

Display field	Readout on V.A.G 1552	Cause of fault	Rectifying fault
4	less than 146	◆ Alternator faulty, battery severely discharged ◆ Severe load on the electrical system shortly after starting because of high charge current and ancillaries ◆ Contact resistance in positive supply or earth connection for engine control unit ◆ Current drain with the ignition off	- Test voltage, charge battery - Increase engine speed slightly for a few minutes and switch off ancillaries - Test voltage supply of engine control unit ⇒ page 24-25 - Eliminate current drain
	greater than 212	◆ Voltage regulator at alternator faulty ◆ Excess voltage caused by jump-starting or quick-charger	- Test voltage, replace regulator if necessary - Interrogate fault memory ⇒ page 01-5
5	less than 0	◆ Not possible	
	greater than 12	◆ Basic setting of throttle valve control unit not carried out ◆ Setting of throttle cable not o.k. ◆ Throttle valve potentiometer in throttle valve control unit faulty ◆ Throttle valve mechanism jamming	- Adapt engine control unit to throttle valve control unit ⇒ page 24-51 - Interrogate fault memory ⇒ page 01-5 - Set throttle cable ⇒ 4-Cylinder Engine, Mechanical Components; Repair Group 20; Removing and installing parts of fuel supply system; Servicing throttle mechanism - Eliminate cause of fault, replace if necessary
6	less than 118	◆ Unmetered air downstream of throttle valve	- Eliminate unmetered air
	greater than 138	◆ Increased engine load resulting from ancillaries	- Eliminate load, switch off ancillaries
7	less than 112	◆ Unmetered air downstream of throttle valve	- Eliminate unmetered air
	greater than 144	◆ Increased engine load resulting from ancillaries	- Eliminate load, switch off ancillaries

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
8	less than 78	◆ Mixture too rich, lambda control produces leaner mixture ◆ Large amount of fuel from ACF system (not in the case of basic setting) ◆ Leak in vacuum hose for fuel pressure regulator ◆ Lambda learned values at stop	- Operate accelerator at intervals of 20 seconds until learning is completed - Replace vacuum hose - Check lambda learned values, display group 008 ⇒ page 01-53
	greater than 178	◆ Mixture too lean, lambda control produces richer mixture ◆ Unmetered air ◆ Injection nozzles faulty ◆ Lambda learned values at stop	- Test quantity injected ⇒ page 24-29 - Eliminate unmetered air - Check lambda learned values, display group 008 ⇒ page 01-53
	Readout jumps or is at a constant 128	◆ Fuel level too low ◆ Lambda closed-loop control switches to open-loop	- At least 10 litres of fuel in tank
9	less than 243 or greater than 13 ¹⁾ greater than 12 ²⁾		- Display group 008, display block 2 and 3 ⇒ page 01-53
10	less than 118 or greater than 138		- Display group 008, display block 2 and 3 ⇒ page 01-53

1) ➤ 07.97

2) 08.97 ➤

Display group 001 Basic function:

Read measured value block 1				→	◀ Readout in display
XXX rpm	1.0...2.5 ms	0...5 ∠°	XX.X° BTDC		
1	2	3	4	◀ Display blocks	
					▶ 07.97 : 3...12° BTDC Ignition angle 08.97 ▶ : 6...12° BTDC
					Throttle valve angle Readout when accelerator fully depressed is 80...90 ∠° As soon as a fault is detected at the throttle valve potentiometer, a fixed substitute value of 35 ∠° is displayed
					Engine load (injection time for each crankshaft revolution)
					▶ 07.97 : 760...840 rpm Idling speed 08.97 ▶ : 760...880 rpm

Test table display group 001

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
1	less than 760 rpm	♦ Gear engaged (automatic gearbox) ♦ Engine load because of ancillaries ♦ Throttle valve control unit - J338 jamming or faulty	- Move selector lever into P or N - Switch off unnecessary components (AC off, wheels straightahead, etc.) - Test throttle valve control unit -J338 ⇒ page 24-16
	greater than 840 rpm ¹⁾ greater than 880 rpm ²⁾	♦ Idling switch -F60 not closed/faulty ♦ Large quantity of unmetered air (cannot be compensated by idling stabilisation control) ♦ Throttle valve control unit -J338 jamming or faulty ♦ Air conditioning not switched off	- Interrogate fault memory ⇒ page 01-5 - Eliminate unmetered air - Test throttle valve control unit -J338 ⇒ page 24-16 - Switch off AC

1) ▶ 07.97

2) 08.97 ▶

Test table display group 001

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
2	less than 1.0	♦ Smaller readouts can only occur when driving on overrun	
	greater than 2.5	♦ Poor idling (not running on all cylinders) ♦ Air mass meter -G70 faulty ♦ Throttle valve control unit -J338 faulty ♦ Electrical components on ♦ Steering wheel at full lock ♦ Gear engaged (automatic gearbox)	- Injector or spark plugs faulty/replace - Interrogate fault memory ⇒ page 01-5 - Test throttle valve control unit -J338 ⇒ page 24-16 - Switch off components - Move steering wheel into centre position - Move selector lever into P or N
3	greater than 5 ∠°	♦ Basic setting of throttle valve control unit -J338 not carried out ♦ Throttle valve potentiometer in throttle valve control unit -J338 faulty or incorrectly set ♦ Setting of throttle cable ♦ Throttle valve jamming	- Carry out basic setting of throttle valve control unit -J338 - Interrogate fault memory ⇒ page 01-5 - Test throttle valve control unit -J338 ⇒ page 24-16 - Set throttle cable ⇒ 1.8 ltr./92 kW Engine, Mechanical Components; Repair Group 20; Servicing throttle mechanism - Rectify cause
4	less than 3° BTDC ¹⁾ less than 6° BTDC ²⁾	♦ Electrical components on ♦ Steering wheel at full lock ♦ Gear engaged (automatic gearbox)	- Switch off components - Move steering wheel into centre position - Move selector lever into P or N
	greater than 12° BTDC	♦ Unmetered air	- Eliminate unmetered air

1) ➤ 07.97

2) 08.97 ➤

Note on display block 3:

The readout is 75...95 ∠° when accelerator pedal is fully depressed.

Display group 002, Basic function:

Read measured value block 2				→	◀ Readout in display
XXX rpm	1.0...2.5 ms	2.0 ..5.0 ms	2.0...4.0 g/s		
1	2	3	4		◀ Display blocks
					Inducted air mass
					Corrected injection time per power stroke
					Engine load (theoretical injection time per crankshaft revolution)
					Idling speed
					► 07.97 : 760...840 rpm
					08.97 ► : 760...880 rpm

Test table display group 002

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
1		♦ ⇒ display group 001, display block 1, page 01-43	
2		♦ ⇒ display group 001, display block 2, page 01-43	
3	less than 2.0	♦ High fuel quantity out of activated charcoal filter system (ACF) ♦ Incorrect injectors with larger flow installed	- Test activated charcoal filter solenoid valve ⇒ page 24-13. - Test injected quantity ⇒ page 24-29.
	greater than 5.0	♦ Increased engine load, caused by electrical components, air conditioning, gear engaged or power steering at full lock	- Eliminate load.

Test table display group 002

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
4	less than 2.0	♦ Large quantity of unmetered air between intake manifold and air mass meter	- Eliminate unmetered air
	greater than 4.0	♦ Gear engaged (automatic gearbox) ♦ Engine load because of ancillaries	- Move selector lever into P or N - Eliminate load (AC, power steering etc.)

Notes on display group 002:

- ♦ What is displayed in display block 2 is the injection time which corresponds to the inducted air mass and the engine load at idling speed. This readout is a computed, theoretical value which, for processor-related reasons, relates only to one crankshaft revolution. Engine load at idling refers to the natural friction of the engine and the drive of the ancillaries which have to be overcome. The inducted air mass is shown in display block 4.
- ♦ In contrast, what is shown in display block 3 is the injection time which results from a complete power stroke, in other words two revolutions of the crankshaft.
- ♦ Nevertheless, what is shown in display block 3 is not approximately twice the readout of display block 2 but is a corrected, actual injection time. It is corrected by variable parameters such as:
 - Lambda control
 - Fuel supply from activated charcoal filter
 - Air density, air temperature
 - System voltage (more rapid / slower opening of injectors)
- ♦ If, for example, the engine inducts unmetered air, only the computed value in display block 2 (injection time for each crankshaft revolution) should change. The actual injection time for each power stroke is maintained at the specified value by the lambda control.

Display group 003, basic function:

Read measured value block 3 →				◀ Readout in display
XXX rpm	10.0...14.5 V	80...105 °C	... °C	
1	2	3	4	◀ Display blocks
				Intake air temperature
				Coolant temperature
				Battery voltage
				Idling speed
				► 07.97 : 760...840 rpm
				08.97 ► : 760...880 rpm

Note on display block 4:

It is not possible to state specified values as the readout is greatly dependent on the ambient temperature.

Test table display group 003

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
1		♦ see also display group 001, display block 1 ⇒ page 01-43	
2	less than 10 V	♦ Alternator faulty, battery severely discharged ♦ Electrical system subject to severe load after starting because of high charge current and ancillaries ♦ Contact resistance in power supply or earth connection for engine control unit ♦ Current drain with ignition off	- Test voltage, charge battery - Increase engine speed slightly for a few minutes and switch off ancillary components - Test voltage supply to engine control unit ⇒ page 24-25 - Eliminate current drain
	greater than 14.5 V	♦ Voltage regulator at alternator faulty ♦ Overvoltage caused by jump-starting or quick-charger	- Test voltage, replace regulator if necessary - Interrogate fault memory ⇒ page 01-5
3	less than 80 °C	♦ Engine too cold ♦ Coolant temperature sender or cable connection to engine control unit	- Carry out road test, if necessary - Test coolant temperature sender -G62 ⇒ page 24-23
	greater than 105 °C	♦ Radiator dirty ♦ Radiator fan not operating ♦ Thermostat faulty ♦ Coolant temperature sender or cable connection to engine control unit	- Clean radiator - Test operation - Test thermostat - Test coolant temperature sender -G62 ⇒ page 24-23
4	constant 19.5 °C	♦ Fault detected at intake air temperature sender -G42 detected	- Interrogate fault memory ⇒ page 01-5
		♦ Intake air temperature sender -G42	- Test -G42 ⇒ page 24-20

Note on display block 3:

In combination with fault code „16500“ what is compared in display block 3 is the temperature curve in the range from 20 °C up to 60 °C with a model curve stored in the control unit. The model curve rises more slowly than the real temperature. If the real temperatures become slower because of a fault, they are aligned at some point with the model values. This fault is detected by the engine control unit as being implausible.

Display group 004, idle speed setting:

Read measured value block 4 →				◀ Readout in display
0...5 °	-1.7...+1.7 g/s	-1.7...+1.7 g/s	Idling speed	
1	2	3	4	◀ Display blocks
Operating state (idling, part throttle, full throttle, enrichment, overrun)				
Idling air mass learned, with gear engaged (models with automatic gearbox) The readout „0“ is always displayed in the case of models with manual gearbox				
Idling air mass learned (no gear engaged on models with automatic gearbox)				
Throttle valve angle				

Test table display group 004

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
1		♦ see display group 001, display block 3 ⇒ page 01-44	
2	less than -1.7 g/s	♦ Unmetered air downstream of throttle flap	- Eliminate unmetered air
	higher than +1.7 g/s	♦ High load because of ancillaries ♦ Constriction or foreign bodies in intake area	- Switch off AC and electrical components - Eliminate constriction or foreign bodies

Notes on display block 2 and 3:

- ♦ What is displayed is the extent to which the idling stabilisation has „drifted away“ from the mean value given as a result of the design. In the case of a new engine, the readout is in the positive range because of the higher friction and, in the case of a run-in engine, it is in the negative range. Readouts of -1.7 g/s in combination with a too low readout in display group 005, display block 3, indicate unmetered air.
- ♦ The readout displayed is not measured by the air mass meter but is computed from the information supplied by the throttle valve potentiometer.

Display group 005, idling stabilisation: (idling speed)

Read measured value block 5 →				◀ Readout in display
XXX rpm	800 / 860 rpm	-10.0...+10.0 %	2.0...4.0 g/s	
1	2	3	4	◀ Display blocks
				Air mass
				Idling controller
				Engine speed (specified) is displayed in steps of 10 Manual gearbox: 800 rpm (AC off) Manual gearbox: 860 rpm (AC on) Automatic gearbox: 800 rpm (AC off) Automatic gearbox: 860 rpm (AC on)
				Idling speed ➤ 07.97 : 760...840 rpm 08.97 ➤ : 760...880 rpm
				Max. readout: 2550 rpm

Notes on display block 3:

- ◆ As a result of a change in the load conditions at idling speed, the required idling air mass at a constant engine speed also changes.
- ◆ What is displayed is the change in the idling air mass in %. As soon as this change has been compensated for by the learning process of the idling stabilisation, the mean value is again reached. The extent of the variation from the mean value depends on the extent of the load change (e.g. by switching electrical components on or off).
- ◆ The learning process is carried out in small steps each time the idling switch closes. Several steps are required in the case of major differences. This necessitates briefly blipping the accelerator pedal at intervals of about 20 seconds. Each time this is done, a further step of the learning process is carried out.
- ◆ The difference as a result of „drift“ then appears in display group 004, display block 2. The readouts of the idling controller remain outside of the tolerance range if the learned values in display group 04, display block 2 have moved against stop.
- ◆ Stop values: -1.7 and +1.7 g/s, respectively

Notes on display block 4:

- ◆ In the case of fault (00670) throttle valve positioner: constant speed 840 rpm and air flow of 2.8 g/s.
- ◆ In the case of fault (00670/16505/16506/16507) throttle valve positioner and throttle valve potentiometer, the digital idling stabilisation (DIS) is switched off and a constant speed of approx. 1000 rpm and an air mass of 2.8 g/s are output.

Display group 006, idling stabilisation:

Read measured value block 6				→	◀ Readout in display	
XXX	-10.0...+10.0	-10.0...+10.0	XX.X°			
rpm	%	%	BTDC			
1	2	3	4	◀ Display blocks		
				Ignition angle	➤ 07.97	: 3...12° BTDC
					08.97 ➤	: 6...12° BTDC
				Lambda controller		
				Idling controller		
				Idling speed	➤ 07.97	: 760...840 rpm
					08.97 ➤	: 760...880 rpm

Test table display group 006

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
1	not within tolerance range	♦ see display group 001, display block 1 ⇒ page 01-43	
2		♦ see display group 005, display block 3 ⇒ page 01-49	
3		♦ Negative readout, engine too rich. Effect: lambda control produces leaner mixture ♦ Positive readout („+“ is not displayed), engine too lean. Effect: lambda control produces richer mixture ♦ Unmetered air ♦ Injector faulty ♦ Lambda learned values at stop	- Wait 30 seconds until the readout has stabilised - Eliminate unmetered air - Test quantity injected ⇒ page 24-29 - Check lambda learned values, display group 008 ⇒ page 01-53
4		♦ see display group 001, display block 4 ⇒ page 01-43	

Notes on display block 3:

- ♦ The readout varies around the zero setting. If a constant 0 is displayed, the lambda control has switched from closed-loop to open-loop because there is a fault in the lambda control. Interrogate fault memory ⇒ page 01-5.
- ♦ Operating state of lambda control: check display group 021, display block 4 ⇒ page 01-62.

Display group 007, lambda control and ACF system:

Read measured value block 7 →				◀ Readout in display
-10.0...+10.0 %	0.0...1.0 V	0...99%	0.3...1.25	
1	2	3	4	◀ Display blocks
				Lambda correction factor if fuel tank breather system active
				On/off ratio of solenoid valve 1 for activated charcoal filter -N80 On/off ratio 0 % means -N80 closed On/off ratio 99 % means -N80 fully open
				Lambda probe voltage
				Lambda controller

Test table display group 007

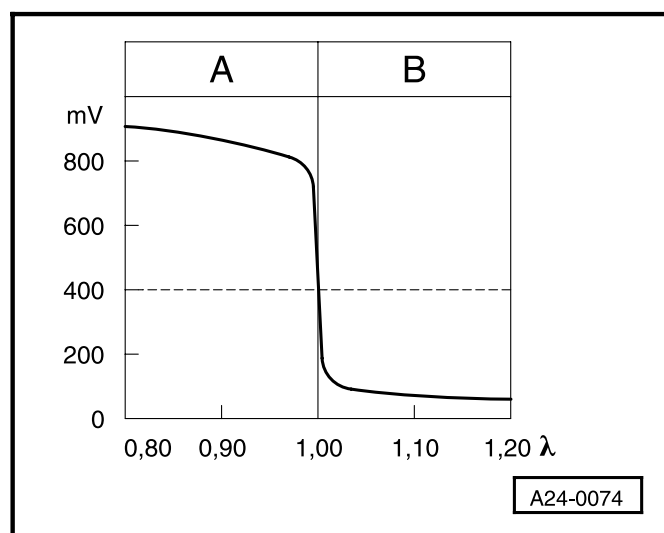
Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
2	readout does not vary (constant 0.00 ... 0.30 V or constant 0.70 ... 1.00 V)	♦ Large quantity of unmetered air ♦ Spark plug faulty ♦ Fuel pressure too high/low ♦ Injector faulty ♦ Coolant temperature sender -G62 faulty ♦ Activated charcoal filter solenoid valve ♦ Lambda probe heater not operating ♦ Lambda probe faulty/dirty	- Check intake system for leaks (unmetered air) ⇒ page 24-42.2 - Test spark plugs - Test fuel pressure regulator and holding pressure ⇒ page 24-27 - Test injectors ⇒ page 24-34 - Test coolant temperature sender ⇒ page 24-23 - Test fuel tank breather ⇒ page 24-13 - Test lambda probe heater ⇒ page 24-45 - Test operation of lambda probe ⇒ page 24-44
	constant 1.00 V	♦ Short circuit to positive in: lambda probe, lambda probe cable, earth cable, engine control unit	- Test lambda probe heater ⇒ page 24-45 - Test lambda probe signal wire and actuation ⇒ page 24-46.1
	constant between 0.40 ... 0.50 V	♦ Open circuit in: lambda probe, lambda probe cable, earth cable, engine control unit	
	constant 0.00 V	♦ Short circuit to earth in: lambda probe, lambda probe cable, earth cable, engine control unit	

Notes on display block 2:

- ♦ The voltage signal „rich mixture (low level of residual oxygen)“ is at approx. 0.7...1.0 V (related to reference earth).
- ♦ The voltage signal „lean mixture (large level of residual oxygen)“ is at approx. 0.0...0.3 V (related to reference earth).
- ♦ A voltage jump from 0.7...1.0 V to 0.0...0.3 V and vice versa takes place at transition from „rich“ to „lean“ and vice versa ($\lambda = 1.0$).
- ♦ In view of the steep voltage jump, the lambda control is not able to maintain constant the ideal mixture composition which corresponds to $\lambda = 1.0$. The control constantly fluctuates back and forward between the „slightly too lean“ and „slightly too rich“ states.

Notes on display block 4:

- ♦ In the case of a readout of 0.3, the engine is supplied with a very rich mixture from the ACF system. The lambda control therefore has to reduce the quantity injected to 30 %.
- ♦ In the case of a readout of 1.0 either an ideal mixture is supplied from the ACF system (not necessary to produce leaner or richer mixture) or the ACF valve is closed (adaptation: display group 008, display block 4).
- ♦ In the case of a readout of 1.01 ... 1.2 the mixture from the ACF system is too lean. The lambda control therefore has to produce a richer mixture.

◀ **Lambda probe voltage U_λ in mV**

A: Lambda probe voltage high

- ♦ rich mixture (fuel excess or air deficiency)
- ♦ high CO level

B: Lambda probe voltage low

- ♦ lean mixture (fuel deficiency or air excess)
- ♦ low CO level

Display groups 008 to 099

Display group 008, lambda learned values

Read measured value block 8				→	◀ Readout in display
2.0...5.0 ms	-10.0...+10.0 %	-8.0...+8.0 %	TB active or TB n. active or λ adaptation		
1	2	3	4	◀ Display blocks	
				„TB active“ means that solenoid valve 1 for the activated charcoal filter is pulsed (6 to 16 min) „TB n. active“ means that solenoid valve 1 for the activated charcoal filter is constantly closed (1 min) „λ adaptation“ means the correction of the voltage curve shift caused by ageing of the lambda probe	
				Lambda learned value at part throttle (multiplicative)	
				Lambda learned value at idling (additive)	
Injection time					

Test table display group 008

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
1		♦ see display group 002, display block 3 ⇒ page 01-45	
2 and 3	low lambda learned values	♦ Low lambda idling learned values with normal lambda part throttle learned values: oil dilution (high level of fuel in oil) possible ♦ Injector leaking ♦ Fuel pressure too high ♦ Solenoid valve 1 for activated charcoal filter -N80 constantly open ♦ Air mass meter -G70 faulty ♦ Lambda probe heater faulty or lambda probe dirty	- Disappears after driving on motorway or changing oil - Display group 007, display block 2 ⇒ page 01-51 - Test injector ⇒ page 24-34 - Test fuel pressure ⇒ page 24-27 - Test -N80 ⇒ page 24-13 - Test -G70 ⇒ page 24-38 - Test lambda probe heater ⇒ page 24-45

Notes on display blocks 2 and 3:

- ♦ Low values indicate that the engine is running too rich and for this reason the lambda control produces a leaner mixture.
- ♦ add = additive - The fault (e.g. unmetered air) always has a far less pronounced effect as engine speed rises. In the case of the additive learned value the injection time is altered by a fixed amount. The amount is not dependent on the basic injection time.
- ♦ mul = multiplicative - The fault (e.g. faulty injector) has an increasingly pronounced effect as engine speed rises. In the case of the multiplicative learned value this is a percentage change in the injection time. This change is dependent on the basic injection time.

Test table display group 008

Display block	Readout on V.A.G 1552	Cause of fault	Rectifying fault
2 and 3	high lambda learned values	♦ High lambda idling learned values with less high lambda part throttle learned values: unmetered air possible in intake manifold area ♦ Injector blocked ♦ Air mass meter -G70 faulty ♦ Fuel pressure too low ♦ Unmetered air between -G70 and throttle valve ♦ Unmetered air at the manifold gasket ♦ Lambda probe heater faulty or lambda probe dirty	- Inspect intake system for leaks (unmetered air) ⇒ page 24-42.2 - Test injectors ⇒ page 24-34 - Test air mass meter -G70 ⇒ page 24-38 - Test fuel pressure regulator and holding pressure ⇒ page 24-27 - Rectify cause - Test lambda probe heater ⇒ page 24-45

Notes on display blocks 2 and 3:

- ♦ High values mean that the engine is running too lean and the lambda control therefore produces a richer mixture.
- ♦ All the learned values are reset if the control unit is de-energized.

Display group 009, lambda learned values:

Read measured value block 9				→	◀ Readout in display
XXX rpm	-10...+10 %	0...1.0 V	-10...+10 %		
1	2	3	4		◀ Display blocks
					Lambda learned value at idling speed (additive)
					Lambda probe voltage
					Lambda controller
Idling speed					➤ 07.97 : 760...840 rpm 08.97 ➤ : 760...880 rpm

Display group 010, fuel tank breather:

Read measured value block 10				→	◀ Readout in display
0...99 %	0.3...1.25	-3...+32 ¹⁾ -5...45 ²⁾	0.00...0.30		
1	2	3	4		◀ Display blocks
					Activated charcoal filter (ACF) purging rate: If readout „0.00“ no supply from the ACF system. If readout „0.30“ 30 % of the inducted air mass comes from the ACF system.
					Filling level of activated charcoal filter: If -3 or -5 there are no petrol vapours in the activated charcoal filter. If 32 or 45 the activated charcoal filter is completely filled with petrol vapours.
					Lambda correction factor with active fuel tank breather
					On/off ratio of solenoid valve 1 for activated charcoal filter (ACF)

1) ➤ 07.97

2) 08.97 ➤

Notes on display group 10:

- ◆ *The engine control unit determines by means of solenoid valve 1 for activated charcoal filter (N80) how much fuel is supplied to the engine from the activated charcoal filter system. If solenoid valve 1 is closed further (lower on/off ratio) in order to maintain the set purging rate with a high filling level in the activated charcoal filter, the lambda control reacts to this by a change in the lambda correction factor. If this reaction is lower than expected because, in the meantime, fuel vapours from the fuel tank have increased the filling level, the control unit calculates from this a higher filling level.*
- ◆ *Testing fuel tank breather: ⇒ Repair Group 24; Testing fuel tank breather.*
- ◆ *At idling speed, the engine is able to process only a certain maximum fuel vapour quantity from the activated charcoal filter system. That is why, when the engine is idling, the opening of solenoid valve 1 for the activated charcoal filter is limited. At part and full throttle, the on/off ratio may rise to as much as 99 %.*
- ◆ *The influence of the activated charcoal filter system can be assessed by comparing the readout during the „Basic setting“ (solenoid valve 1 closed) and during „Reading measured value block“ (solenoid valve 1 open for approx. 220...900 seconds / closed for approx. 70 seconds).*
- ◆ *It is possible to switch over between the function 04 „Basic setting“ and function 08 „Reading measured value block“ by pressing keys 4 and 8 on V.A.G 1552 or V.A.G 1551.*

Notes on display block 1:

- ◆ *When the lambda control operates, solenoid valve 1 for the activated charcoal filter (N80) is pulsed at intervals of approx. 220...900 seconds (tank breather is carried out) and switched off for approx. 70 seconds (no tank breather). During the approximately 70 seconds the lambda control learns the operating conditions without any variation as a result of fuel vapours from the activated charcoal filter.*
- ◆ *On/off ratio of 0 % means solenoid valve 1 for activated charcoal filter is closed. On/off ratio of 99 % means solenoid valve 1 is fully open.*

Notes on display block 2:

- ◆ *If a very rich mixture flows out of the activated charcoal filter system, the lambda control has to produce a leaner mixture. This leaner mixture may be as much as 0.6. In this case, this means that the lambda control has to reduce the quantity of fuel injected by 40 %.*
- ◆ *In the case of a readout of 1.0 (lambda control in neutral range, in other words without any correction factor) either an ideal mixture flows out of the activated charcoal filter system (not necessary to produce leaner or richer mixture), or solenoid valve 1 is closed ⇒ display block 1.*
- ◆ *In the case of a readout of 1.01...1.25 the mixture from the activated charcoal filter system is too lean. The lambda control therefore has to produce a richer mixture.*

Display group 011, fuel consumption:

Read measured value block 11				→	◀ Readout in display
XXX rpm	1.0...2.5 ms	0 km/h	0.5...1.5 l/h		
1	2	3	4		◀ Display blocks
					Fuel consumption: The specified readout applies only to idling without any load as a result of ancillaries (automatic gearbox, AC, alternator, power-steering pump)
				Road speed	
				Engine load	
Idling speed				► 07.97 : 760...840 rpm 08.97 ► : 760...880 rpm	

Notes on display block 2:

- ◆ The maximum engine load is reduced by approx. 10 % for each 1000 m above mean sea level (MSL).
- ◆ The maximum engine load is likewise reduced by as much as 10 % at very high ambient temperatures.
- ◆ When driving at full throttle, the following minimum values should be achieved:
 - At 4000 rpm approx. 7.5 ms
 - At 6000 rpm approx. 6.5 ms

Display group 012, fuel consumption:

Read measured value block 12				→	◀ Readout in display
XXX rpm	10...14.5 V	0.5...1.5 l/h	XX.X° BTDC		
1	2	3	4		◀ Display blocks
				Ignition angle	► 07.97 : 3...12° BTDC 08.97 ► : 6...12° BTDC
				Fuel consumption - see display group 011, display block 4 ⇒ page 01-57	
				Battery voltage - see display group 003, display block 2 ⇒ page 01-46	
Idling speed				► 07.97 : 760...840 rpm 08.97 ► : 760...880 rpm	

Display group 013, knock control:

Read measured value block 13				→	◀ Readout in display
0...15° CRA	0...15° CRA	0...15° CRA	0...15° CRA		
1	2	3	4		◀ Display blocks
					Retardation of ignition angle cylinder 4 by knock control
					Retardation of ignition angle cylinder 3 by knock control
					Retardation of ignition angle cylinder 2 by knock control
					Retardation of ignition angle cylinder 1 by knock control

Notes on display group 013:

- ♦ The knock control is active from an engine load of more than 40 %.
- ♦ If the engine load rises above 40 %, the current ignition angle retardation values are displayed; if engine load drops below this level, the values last used remain constant.
- ♦ If knocking is audible without any detectable retardation of ignition angle, increase engine speed for 5 seconds to more than 3500 rpm to initiate knock sensor fault detection (diagnosis).
- ♦ If one ignition angle retardation value of a cylinder differs significantly from the others, the following faults are possible:
 - loose ancillaries
 - corrosion at the plug connection
 - engine damage (e.g. oil combustion because of faulty piston)
- ♦ If all the cylinders have large ignition timing retardation values, the following faults are possible:
 - corrosion at the plug connection
 - tightening torque (20 Nm) not o.k.
 - open circuit in wiring
 - knock sensor faulty
 - loose ancillaries
 - poor quality fuel (less than 95 RON)

Display group 014, knock control:

Read measured value block 14				→	◀ Readout in display
0...6800 rpm	0...10.0 ms	0...15° CRA	0...15° CRA		
1	2	3	4		◀ Display blocks
					Retardation of ignition angle cylinder 2 by knock control
					Retardation of ignition angle cylinder 1 by knock control
					Engine load (injection time for each revolution)
					Engine speed

Notes on display group 014:

- ♦ With this display group it is possible to check the ignition angle retardation of cylinders 1 and 2 at certain engine speed and load conditions.
- ♦ Causes for retardation of ignition angle: display group 013 ⇒ page 01-58.

Display group 015, knock control:

Read measured value block 15				→	◀ Readout in display
0...6800 rpm	0...10.0 ms	0...15° CRA	0...15° CRA		
1	2	3	4		◀ Display blocks
					Retardation of ignition angle cylinder 4 by knock control
					Retardation of ignition angle cylinder 3 by knock control
					Engine load (injection time for each revolution)
					Engine speed

Notes on display group 015:

- ♦ With this display group it is possible to check the ignition angle retardation of cylinders 3 and 4 at certain engine speed and load conditions.
- ♦ Causes for retardation of ignition angle: display group 013 ⇒ page 01-58.

Display group 016, knock control: (idling speed)

Read measured value block 16				→	◀ Readout in display
0.4...2.0 V	0.4...2.0 V	0.4...2.0 V	0.4...2.0 V		
1	2	3	4		◀ Display blocks
					Knock sensor signal cylinder 4
					Knock sensor signal cylinder 3
					Knock sensor signal cylinder 2
					Knock sensor signal cylinder 1

Notes:

- ♦ If the difference between the smallest and largest knock sensor signal is more than 50 %, the cause may be corrosion at the plug connection.
- ♦ The signal voltage of the knock sensors displayed at higher engine speeds and loads may reach levels as much as 5.1 volts.
- ♦ If the electrical test of the knock sensor, of the wiring and the plug connection does not reveal any faults, inspect the engine for loose ancillaries or engine damage: Display group 013 ⇒ page 01-58.

Display group 017, catalytic converter heating:

Read measured value block 17				→	◀ Readout in display
0...6800 rpm	1.0...2.5 ms	0...100 %	XX.X° BTDC		
1	2	3	4	◀ Display blocks	
					Ignition angle
					Energy balance for catalytic converter heater
					Engine load (injection time per revolution)
					Engine speed

Notes on display group 017:

- ♦ In order to warm up the catalytic converter as rapidly as possible to its operating temperature after a cold start, engine speed is increased in the idling speed range and the ignition angle is retarded. Only the retardation of the ignition angle is active in the part load range.
- ♦ This function for rapidly heating up the catalytic converter is active at start temperatures from -9 up to +39 °C.
- ♦ The function is cancelled if one of the following states exists:
 - Engine speed more than 4000 rpm
 - Engine load greater than 7.0 ms
 - Fault stored in fault memory of air mass meter and coolant temperature sender
 - Energy balance greater than 1.0
 - Vehicle speed more than 55 km/h
 - Altitude correction factor less than -20 % (display group 018)
- ♦ As soon as the function is cancelled, the display for the energy balance is frozen and is reset when the engine is next started.

Display group 018, altitude adaptation:

Read measured value block 18				→	◀ Readout in display
XXX rpm	1.0...2.5 ms	0.5...3 ms	-50...+15 %		
1	2	3	4	◀ Display blocks	
					Altitude correction factor
					Engine load from throttle valve angle
					Engine load from air mass meter, display group 001, display block 2 ⇒ page 01-43
					Idling speed
					07.97 ▶ : 760...840 rpm
					08.97 ▶ : 760...880 rpm

Notes on display group 018:

- ♦ The engine control unit compares the load signal from the air mass meter with a load value which is computed from the throttle valve angle and engine speed. The difference of the two values results in the altitude correction factor.
- ♦ -30 % equals an atmospheric pressure of approx. 70 kPa (30 % below 100 kPa)
- ♦ At an altitude of approx. 400 m above MSL and standard atmospheric conditions, no altitude correction is necessary.
- At sea level the correction factor is about 0 %.
- At an altitude of 2000 m the correction factor is about -20 %.
- ♦ The altitude adaptation influences the following factors:
 - determining start fuel quantity
 - intake manifold pulsation compensation

Display group 019, torque reduction: (automatic gearbox) ► 07.97

Read measured value block 19 →				◀ Readout in display
0...6800 rpm	ms	X 1 X	° CRA	
1	2	3	4	◀ Display blocks
				Ignition angle
				Operating state: X 1 X = no gearbox control signal X 0 X = gearbox control signal X = ignore readout
				Engine load
				Engine speed

Notes on display group 019:

- ◆ This display group can be used to assess whether the gearbox control signal from the gearbox control unit is received in the engine control unit.
- ◆ In view of the short signal, ignition angle retardation is not always detected by V.A.G 1552 and is therefore also not always displayed.

Display group 019, additional signals: power steering pressure switch, ignition angle retardation and clutch pedal switch 08.97 ►

Read measured value block 19 →				◀ Readout in display
0...6800 rpm	0...10.00 ms	xxxx__x	° CRA	
1	2	3	4	◀ Display blocks
				Ignition angle
				Additional signals 0xxx__x = power steering pressure switch active xx0x__x = ignition angle retardation active xxx0__x = clutch pedal switch active
				Engine load
				Engine speed

Notes on display group 019:

This display group can be used to assess the different additional signals.

- ◆ Power steering pressure switch
- ◆ Clutch pedal switch
- ◆ Ignition angle retardation during gearshift

Display group 020, operating states:

Read measured value block 20 →				◀ Readout in display
XXX rpm	Neutral Gear ENG	A/C high A/C low	Compr. ON Compr. OFF	
1	2	3	4	◀ Display blocks
				AC compressor ON/OFF „Compr. OFF“ is always displayed for models without air conditioning
				Air conditioning High = high heating or cooling capacity Low = low heating or cooling capacity „A/C LOW“ is always displayed on models without air conditioning
				Selector lever position, Neutral or Gear ENG „Neutral“ is always displayed on models with manual gearbox
Idling speed				➤ 07.97 : 760...840 rpm 08.97 ➤ : 760...880 rpm

Display group 021, lambda control operating state:

Read measured value block 21 →				◀ Readout in display
XXX rpm	1.0...2.5 ms	XXX °C	λ Reg. OFF λ Reg. ON	
1	2	3	4	◀ Display blocks
				Lambda control OFF/ON
				Coolant temperature
				Engine load, see display group 001, display block 2 ⇒ page 01-43
Idling speed				➤ 07.97 : 760...840 rpm 08.97 ➤ : 760...880 rpm

Notes on display group 021:

- ♦ The lambda control is switched on by the engine control unit as a function of the engine temperature and intake air temperature.
- ♦ At a start temperature above 15 °C (intake air temperature) the lambda control is switched on as soon as probe readiness is detected.
- ♦ At a start temperature below 15 °C (intake air temperature) the lambda control is not switched on by the engine control unit until the coolant temperature is 55 °C.
- ♦ If the lambda control is switched off, the engine runs map-controlled.

Display group 023, adaptation of throttle valve control unit: ► 07.97

Read measured value block 23 →				◀ Readout in display
01000000	73...97 %	54...85 %	6...43 %	◀ Display blocks
1	2	3	4	
				Max. stop of throttle valve positioner -V60
				Emergency running stop of throttle valve positioner -V60
				Min. stop of throttle valve positioner -V60
				Learning demand display

Note on display block 1:

If the specified readout is not achieved, adapt engine control unit to the throttle valve control unit -J338 ⇒ page 24-51.

Note on display blocks 2, 3 and 4:

What is displayed are the stop values learned during the last basic setting.

Note on display blocks 1, 2, 3 and 4:

If the specified readout is again not achieved after carrying out the basic setting, inspect the cable connection for open circuit and short circuit and also the plug connections for dirt or corrosion before replacing the throttle valve control unit.

X	X	X	X	X	X	X	X	Meaning of the 8-digit readout
								1 = Ignore
								2 = Learning process Min. stop of throttle valve positioner sender -G127 Readout „0“ = learning process completed, learning process o.k. Readout „1“ = learning process not completed, learning process not o.k.
								3 = Learning process Max. stop of throttle valve positioner sender -G127 Readout „0“ = learning process completed, learning process o.k. Readout „1“ = learning process not completed, learning process not o.k.
								4 = Learning process Min. stop of throttle valve potentiometer -G69 Readout „0“ = learning process completed, learning process o.k. Readout „1“ = learning process not completed, learning process not o.k.
								5 = Learning process Max. stop of throttle valve potentiometer -G69 Readout „0“ = learning process completed, learning process o.k. Readout „1“ = learning process not completed, learning process not o.k.
								6 = Ignore
								7 = Compensation of throttle valve potentiometer -G69 to throttle valve positioner sender -G127 Readout „0“ = compensation has to be carried out Readout „1“ = compensation completed, compensation o.k.
								8 = Ignore

Display group 023, adaptation of throttle valve control unit: 08.97 ➤

Read measured value block 23 →				◀ Readout in display
100000	73...97 %	54...83 %	6...43 %	
1	2	3	4	◀ Display blocks
				Max. stop of throttle valve positioner -V60
				Emergency running stop of throttle valve positioner -V60
				Min. stop of throttle valve positioner -V60
				Learning demand display

Note on display block 1:

If the specified readout is not achieved, adapt engine control unit to the throttle valve control unit -J338 ⇒ page 24-51.

Note on display blocks 2, 3 and 4:

What is displayed are the stop values learned during the last basic setting.

Note on display blocks 1, 2, 3 and 4:

If the specified readout is again not achieved after carrying out the basic setting, inspect the cable connection for open circuit and short circuit and also the plug connections for dirt or corrosion before replacing the throttle valve control unit.

X	X	X	X	X	X	Meaning of the 6-digit readout
						1 = Learning process Min. stop of throttle valve positioner sender -G127 Readout „0“ = learning process completed, learning process o.k. Readout „1“ = learning process not completed, learning process not o.k.
						2 = Learning process Max. stop of throttle valve positioner sender -G127 Readout „0“ = learning process completed, learning process o.k. Readout „1“ = learning process not completed, learning process not o.k.
						3 = Learning process Min. stop of throttle valve potentiometer -G69 Readout „0“ = learning process completed, learning process o.k. Readout „1“ = learning process not completed, learning process not o.k.
						4 = Learning process Max. stop of throttle valve potentiometer -G69 Readout „0“ = learning process completed, learning process o.k. Readout „1“ = learning process not completed, learning process not o.k.
						5 = Ignore
						6 = Compensation of throttle valve potentiometer -G69 to throttle valve positioner sender -G127 Readout „0“ = compensation has to be carried out Readout „1“ = compensation completed, compensation o.k.

Display group 024, knock control:

Read measured value block 24				→	◀ Readout in display
0...6800 rpm	0...10.0 ms	20° ATDC 42° BTDC	0...36.0 °CRA		
1	2	3	4	◀ Display blocks	
				Total of ignition angle retardation cylinders 1 to 4	
				Ignition angle	
				Engine load	
				Engine speed	

Notes on display group 024:

- ♦ As soon as any signs of knocking are detected, the ignition angle has to be retarded by the knock control in order to prevent engine damage.
- ♦ As a result of the ignition angle being retarded, however, the exhaust temperature is increased. There is a risk of the catalytic converter overheating.
- ♦ An ignition angle retardation of e.g. 3° CRA at all cylinders has exactly the same effect as an ignition angle retardation of 12° CRA at only one cylinder.
- ♦ In order to prevent this risk of overheating, the mixture is enriched at full throttle from a total ignition angle retardation of approx. 10° CRA in order to reduce the exhaust temperature.

Display group 025, camshaft adjustment control: ➤ 07.97

Read measured value block 25				→	◀ Readout in display
Idling	-30...+30 ° CRA	X XX	-3...+22 ° CRA		
1	2	3	4	◀ Display blocks	
				Active camshaft adjustment angle Camshaft in normal position = -3.0 ... 3.0° CRA Camshaft in switched position = 15.0 ... 22.0° CRA	
				Operating state: Camshaft adjustment	
				Setting variation of phase sender (Hall sender)	
				Operating state	

Meaning of digits in the 3-digit readout, display block 3 - operating state

X					X	X	Meaning
							Readout „0“ = condition not met, actuation not active Readout „1“ = condition met, actuation active
							Camshaft adjustment (1 = advanced, power position)
							Ignore
							Not assigned
							Ignore

Note on display block 4:

There are only two positions for the variable camshaft, the normal position and the switched position. In order to activate the switched position of the camshaft, the car should be accelerated in second gear when driving slowly (about 1000 rpm) with the accelerator pedal depressed. If the actuation of the camshaft adjustment is active - see display block 3 - it is possible to detect in display block 4 whether an adjustment of the camshaft has in fact taken place (feedback). If the adjustment is not active, check whether full throttle is detected (the camshaft adjustment is only active at full throttle!).

Display group 025, camshaft adjustment control, variable intake manifold changeover: 08.97 ➤

Read measured value block 25 →				◀ Readout in display
Idling	-30...+30 ° CRA	X XX	-3...+22 ° CRA	
1	2	3	4	◀ Display blocks
				Active camshaft adjustment angle Camshaft in normal position = -3.0 ... 3.0° CRA Camshaft in switched position = 15.0 ... 22.0° CRA
				Operating state: Camshaft adjustment Variable intake manifold changeover
				Setting variation of phase sender (Hall sender)
				Operating state

Notes on display blocks 3 and 4:

- There are only two positions for the variable camshaft, the normal position and the switched position. In order to activate the switched position of the camshaft, the car should be accelerated in first gear from a standing start.
Display block 4 shows the actual position of the variable camshaft. If the actuation of the camshaft adjustment is active - see display block 3 - it is possible to detect in display block 4 whether an adjustment of the camshaft has in fact taken place (feedback).
- Camshaft in normal position = -3.0...+3.0° CRA
- Camshaft in switched position = 15.0...22.0° CRA
- If a readout between 4.0° CRA and 14.0° CRA appears in display block 4 during the road test, the camshaft adjustment solenoid valve switches the oil pressure correctly to the mechanical camshaft adjuster but the adjuster is not able to reach its end position (e.g. because it is stiff).
- Check camshaft adjustment: ⇒ Repair Group 15; Removing and installing camshafts and camshaft adjuster.

Meaning of digits in the 3-digit readout, display block 3 - operating state

X						X	X	Meaning
								Readout „0“ = condition not met, actuation not active Readout „1“ = condition met, actuation active
								Camshaft adjustment (1 = advanced, power position)
								Intake manifold changeover (1 = long intake tract, torque position)
								Not assigned
								Ignore

Display group 026, camshaft adjustment control: ► 07.97

Read measured value block 26				→	◀ Readout in display
0...4500 rpm	0...10.0 ms	X XX	-3...+22 ° CRA		
1	2	3	4	◀ Display blocks	
				Active camshaft adjustment angle Camshaft in normal position = -3.0 ... 3.0° CRA Camshaft in switched position = 15.0 ... 22.0° CRA	
				Operating state: Camshaft adjustment	
				Engine load see display group 001, display block 2 ⇒ page 01-43	
Engine speed					

Note on display block 4:

There are only two positions for the variable camshaft, the normal position and the switched position. In order to activate the switched position of the camshaft, the car should be accelerated in second gear when driving slowly (about 1000 rpm) with the accelerator pedal depressed. If the actuation of the camshaft adjustment is active - see display block 3 - it is possible to detect in display block 4 whether an adjustment of the camshaft has in fact taken place (feedback). If the adjustment is not active, check whether full throttle is detected (the camshaft adjustment is only active at full throttle!).

Meaning of digits in the 3-digit readout, display block 3 - operating state

X						X X		Meaning
								Readout „0“ = condition not met, actuation not active Readout „1“ = condition met, actuation active
								Camshaft adjustment (1 = advanced, power position)
								Ignore
								Not assigned
								Ignore

Display group 026, camshaft adjustment control, variable intake manifold changeover: 08.97 ➤

Read measured value block 26				→	◀ Readout in display
0...4500 rpm	0...10.00 ms	X XX	-3...+22 ° CRA		
1	2	3	4	◀ Display blocks	
					Active camshaft adjustment angle Camshaft in normal position = -3.0 ... 3.0° CRA Camshaft in switched position = 15.0 ... 22.0° CRA
					Operating state: Camshaft adjustment Variable intake manifold changeover
					Engine load see display group 001, display block 2 ⇒ page 01-43
					Engine speed

Meaning of digits in the 3-digit readout, display block 3 - operating state

X						X	X	Meaning
								Readout „0“ = condition not met, actuation not active Readout „1“ = condition met, actuation active
								Camshaft adjustment (1 = advanced, power position)
								Intake manifold changeover (1 = long intake tract, torque position)
								Not assigned
								Ignore

Note on display block 4:

There are only two positions for the variable camshaft, camshaft adjustment not active or camshaft adjustment active. If the camshaft adjustment is active - see display block 3 - it is possible to detect in display block 4 whether an adjustment has in fact taken place (feedback).

Display group 095 basic functions: 08.97 ➤

Read measured value block 95				→	◀ Readout in display
XXX rpm	1.00...2.5 ms	9.0° BTDC	80...105 °C		
1	2	3	4	◀ Display blocks	
					Coolant temperature
					Ignition angle ¹⁾
					Engine load
					Idling speed ➤ 07.97 : 760...840 rpm 08.97 ➤ : 760...880 rpm

¹⁾ When display group 095 is selected in function 04 „Basic setting“, the engine control unit sets a fixed ignition timing of approx. 9.0° before TDC when engine is idling.

Display group 098, adaptation of throttle valve control unit:

When display group 098 is selected in function 04 „Basic setting“, the throttle valve control unit -J338 is adapted to the engine control unit.

Basic setting 98 0...5 V 0...5 V Idling Part throttle → ADP. runs ADP. o.k. ADP ERROR				◀ Readout in display
1	2	3	4	◀ Display blocks
				Adaptation status ADP. = Adaptation of throttle valve control unit
				Operating state
				Voltage of throttle valve positioner sender -G127
				Voltage of throttle valve positioner -G69

Note on display block 4:

ADP. = Adaptation; Checking adaptation of throttle valve control unit ⇒ page 24-51.

Display group 099, lambda control:

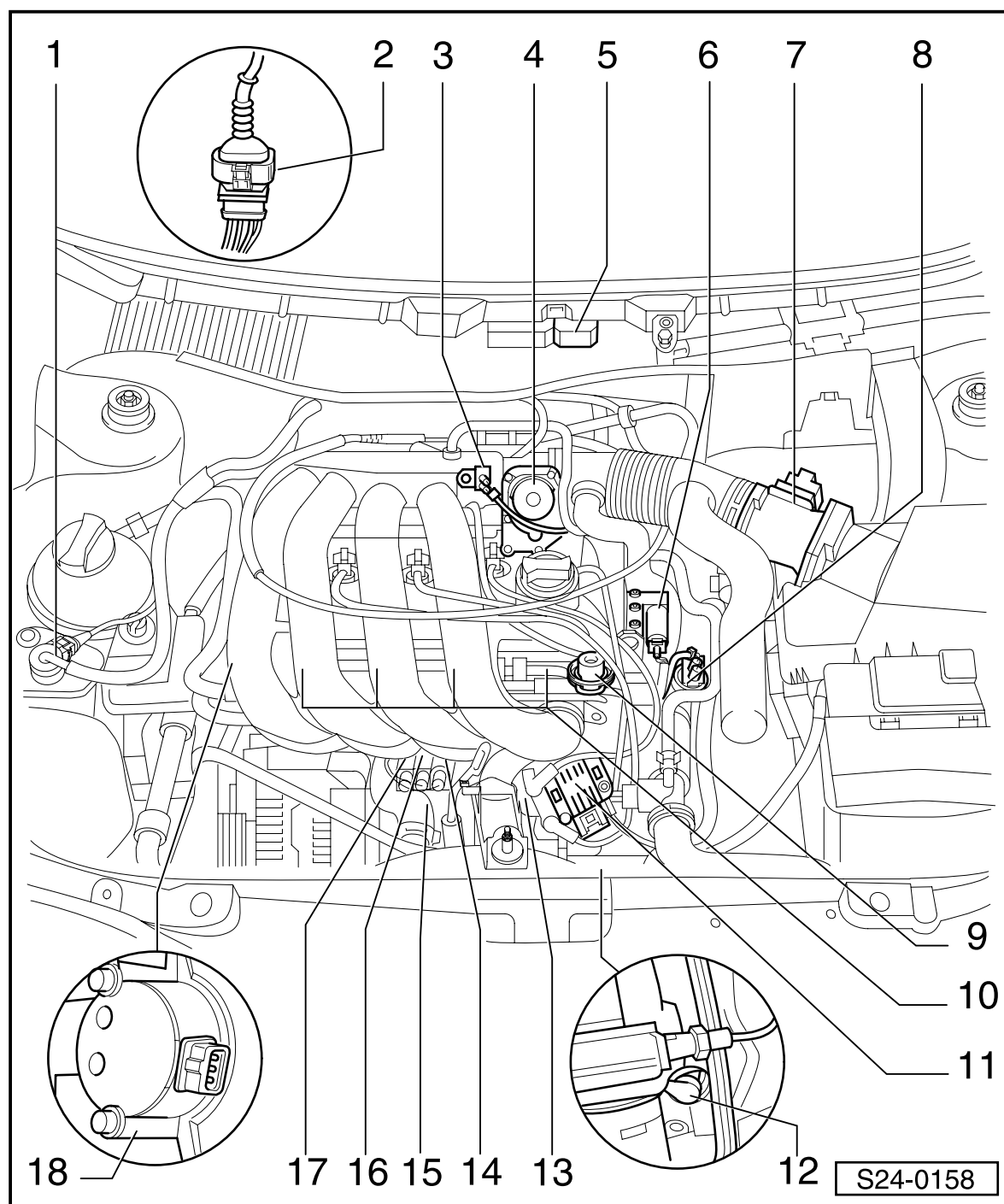
Read measured value block 99 0...6800 rpm -40...125 °C -10.0...+10.0 % → λ Reg. OFF λ Reg. ON				◀ Readout in display
1	2	3	4	◀ Display blocks
				Lambda control OFF/ON Basic setting 04: λ Reg. OFF Read measured value block 08: λ Reg. ON
				Lambda controller
				Coolant temperature
				Engine speed

Notes on display group 099:

- ♦ For defined fault finding, the lambda control is switched off when display group 099 is selected in „Basic setting 04“ or is switched off when „Read measured value block 08“ is selected.
- ♦ The lambda control is automatically reactivated when you quit function 04 „Basic setting“.
- ♦ It is possible to switch back and forward between function 04 „Basic setting“ and function 08 „Reading measured value block“ by pressing keys 4 and 8 on V.A.G 1552.

Servicing fuel injection system - valid ► 07.97

Summary of fitting locations



1 - Solenoid valve 1 for activated charcoal filter -N80

- ◆ Activated charcoal filter system

⇒ Engine, Mechanical Components; Repair Group 20; Removing and installing parts of the fuel supply system; Removing and installing parts of the activated charcoal filter system

2 - 4-pin plug connection

- ◆ For lambda probe (G39) and lambda probe heater (Z19)

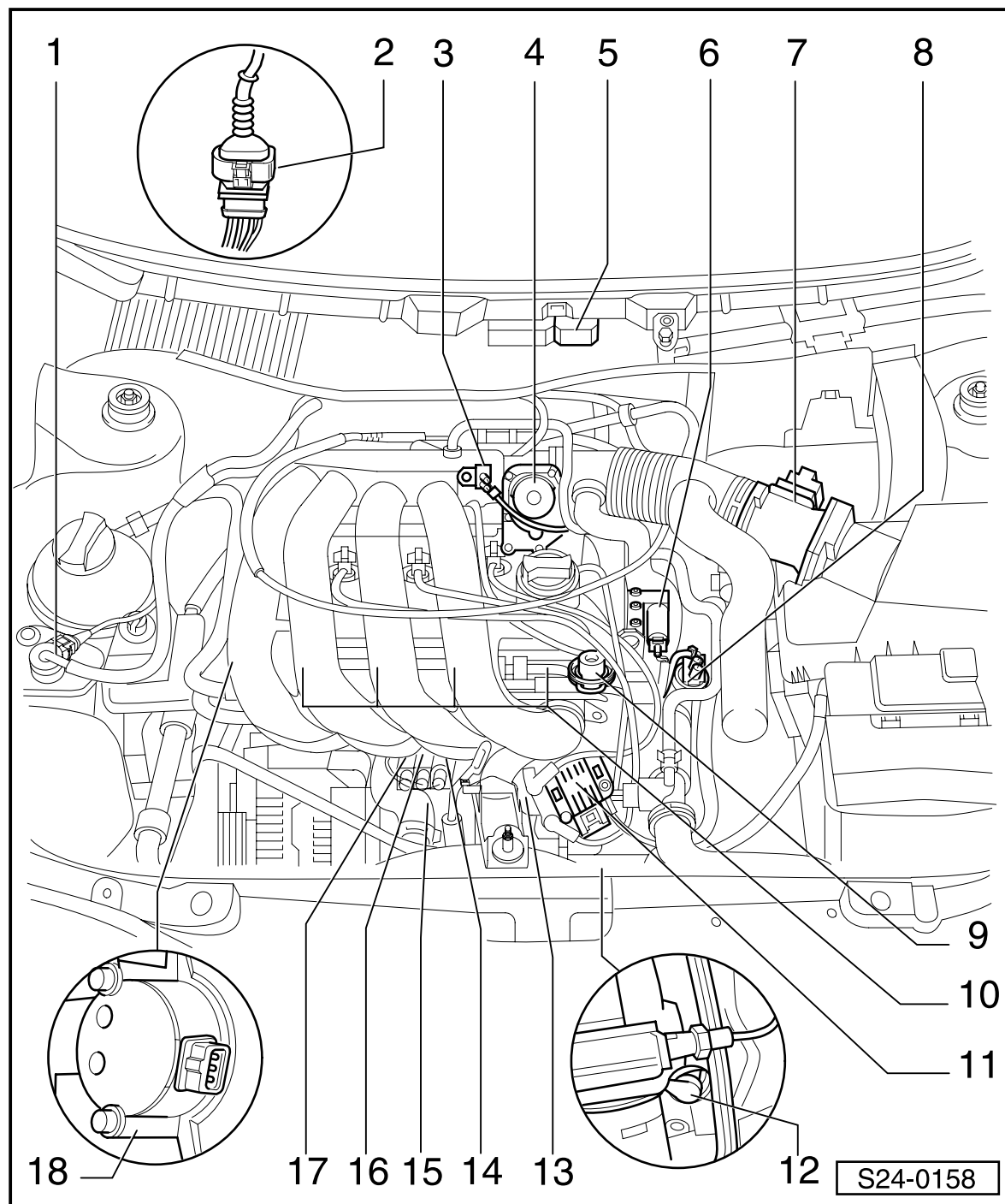
- ◆ On right on underside of vehicle below a cover

3 - Intake air temperature sender (G42)

4 - Throttle valve control unit (J338)

5 - Engine control unit (J220)

6 - Camshaft adjustment valve (N208)



7 - Air mass meter (G70)

8 - Coolant temperature sender (G62)

9 - Fuel pressure regulator

10 - Injector (N30...N33)

11 - Ignition coils (N and N128) with power output stage (N122)

12 - Engine speed sender (G28)

13 - Knock sensor 2 (G66)

14 - 3-pin connector

◆ For engine speed sender

15 - Knock sensor 1 (G61)

16 - 3-pin connector

◆ For knock sensor 2

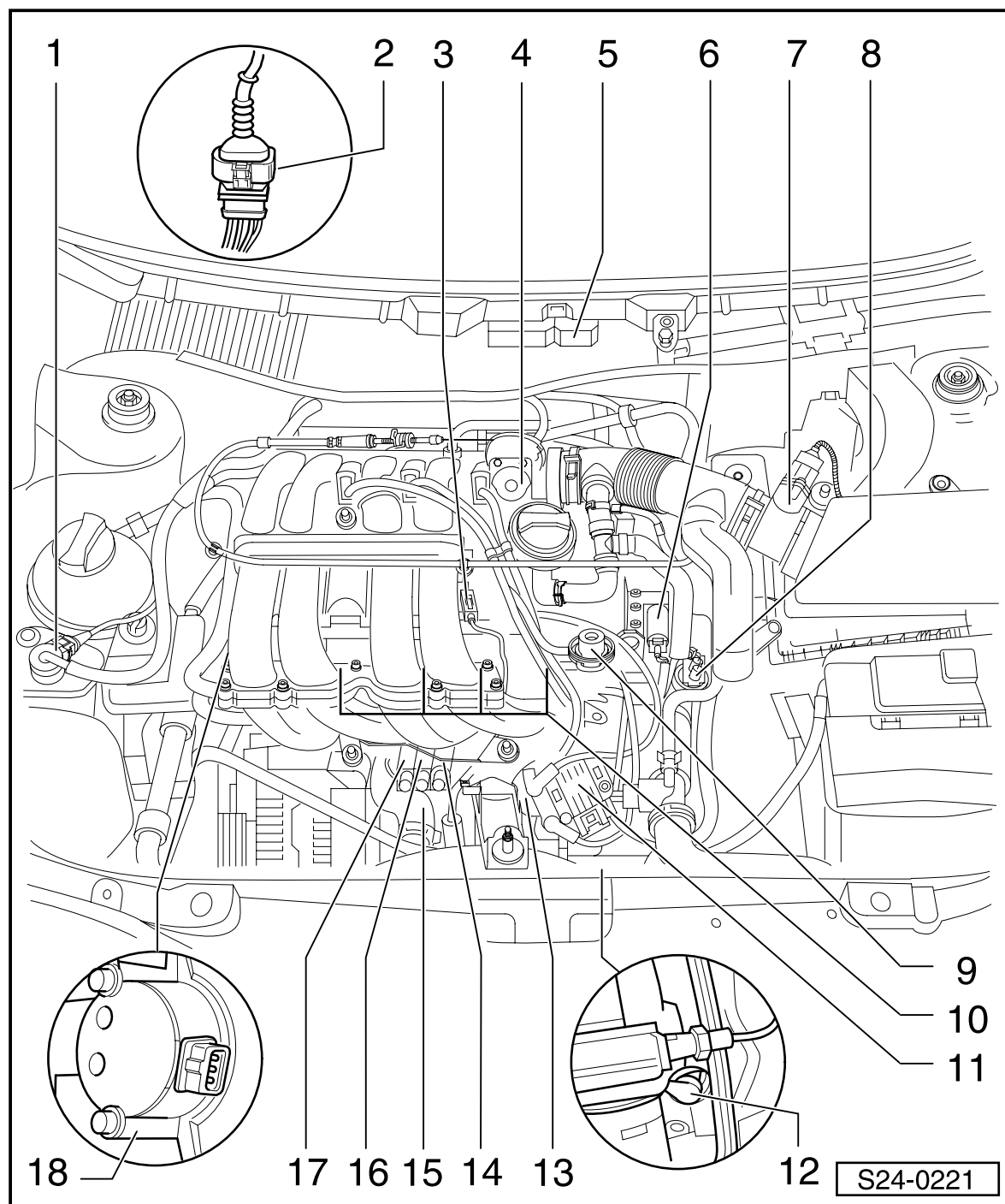
17 - 3-pin connector

◆ For knock sensor 1

18 - Hall sender (G40)

Servicing fuel injection system - valid 08.97 ➤

Summary of fitting locations



1 - Solenoid valve 1 for activated charcoal filter -N80

- ◆ Activated charcoal filter system

⇒ Engine, Mechanical Components; Repair Group 20; Removing and installing parts of the fuel supply system; Removing and installing parts of the activated charcoal filter system

2 - 4-pin plug connection

- ◆ For lambda probe (G39) and lambda probe heater (Z19)

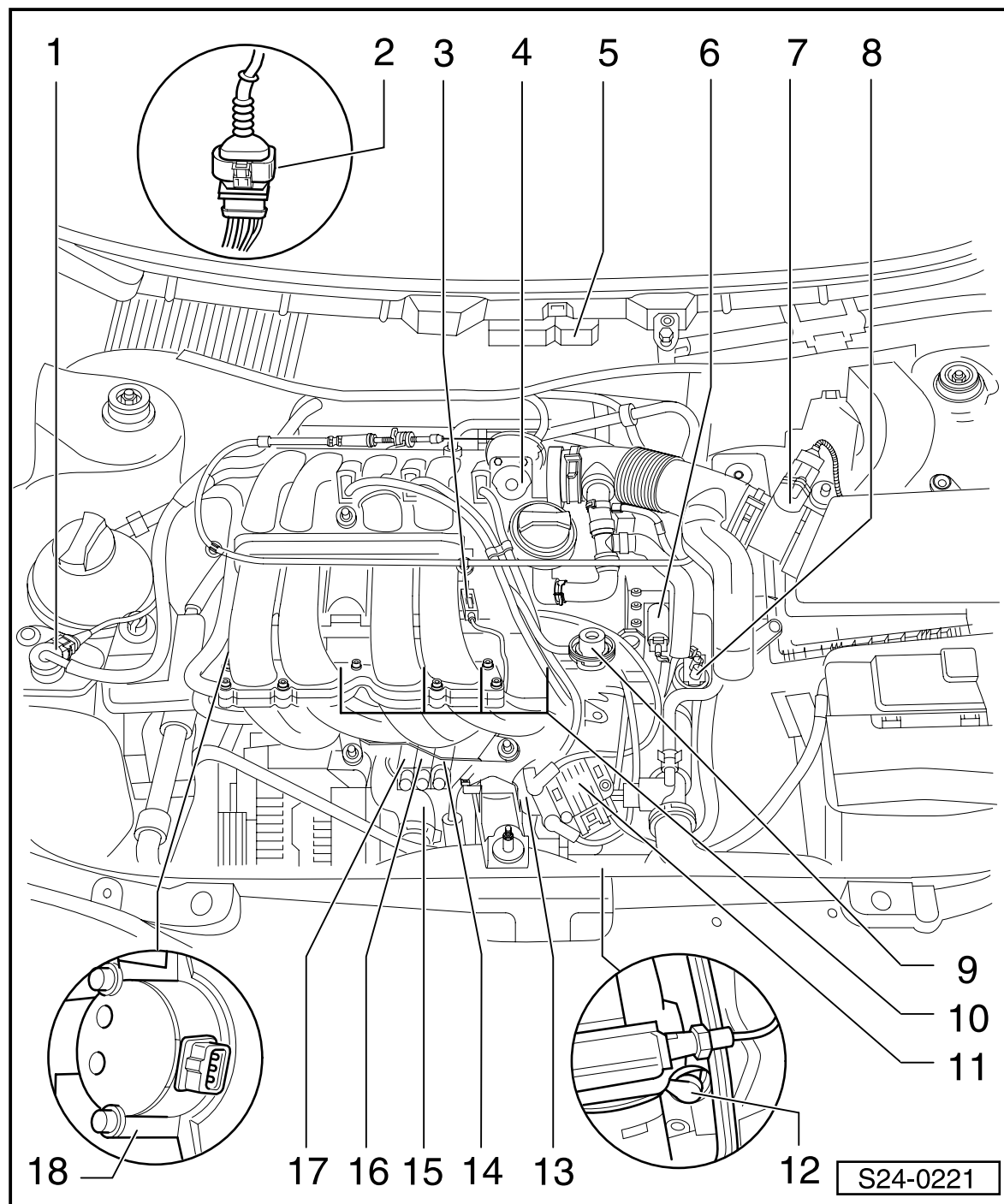
- ◆ On right on underside of vehicle below a cover

3 - Variable intake manifold changeover valve (N156)

4 - Throttle valve control unit (J338)

5 - Engine control unit (J220)

6 - Camshaft adjustment valve (N208)



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7 - Air mass meter (G70) and intake air temperature sender (G42)

8 - Coolant temperature sender (G62)

9 - Fuel pressure regulator

10 - Injector (N30...N33)

11 - Ignition coils (N and N128) with power output stage (N122)

12 - Engine speed sender (G28)

13 - Knock sensor 2 (G66)

14 - 3-pin connector
♦ For engine speed sender

15 - Knock sensor 1 (G61)

16 - 3-pin connector
♦ For knock sensor 2

17 - 3-pin connector
♦ For knock sensor 1

18 - Hall sender (G40)

Servicing fuel injection system

Servicing ignition system ⇒ Repair Group 28

Notes:

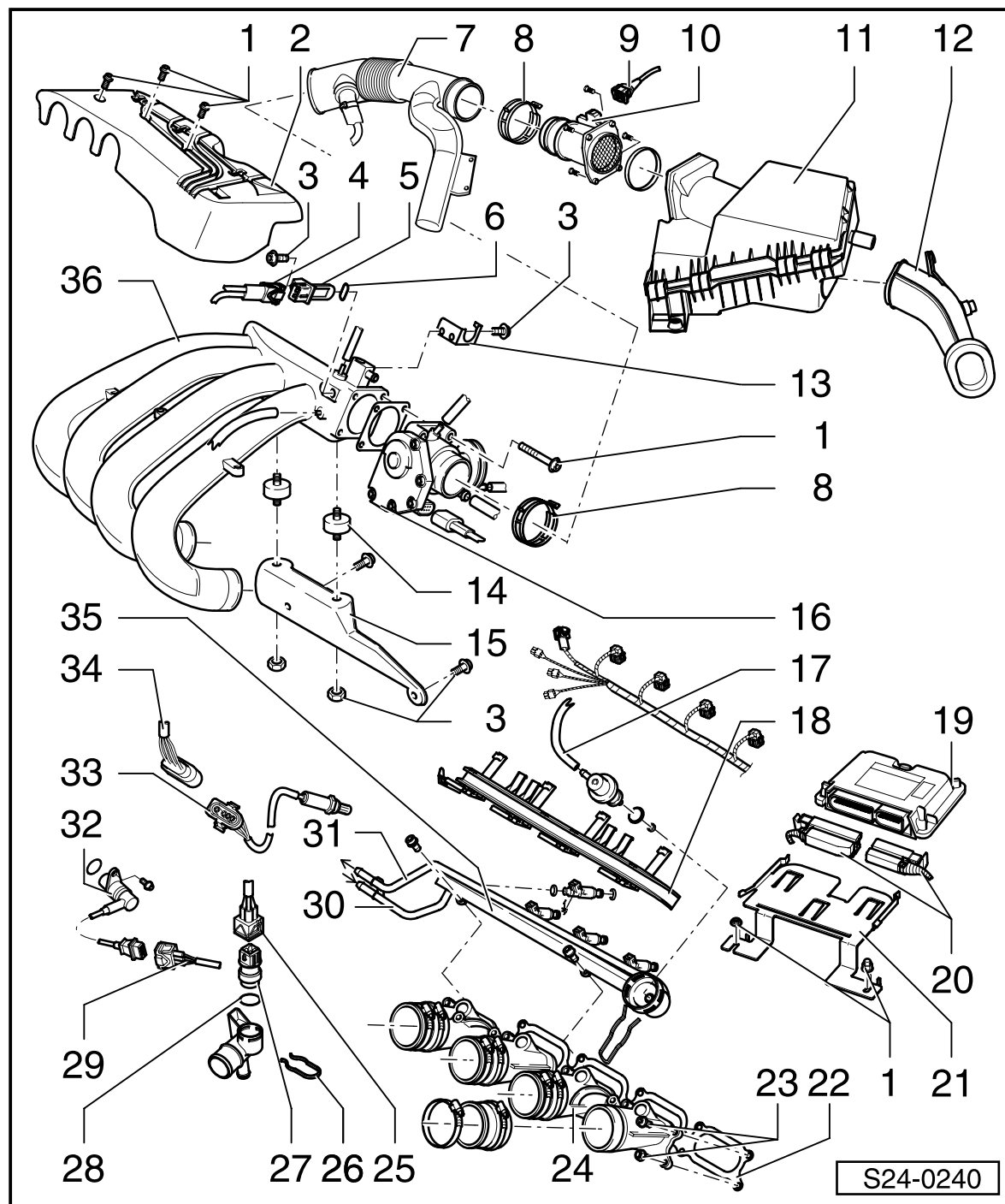
- ◆ *The control unit for the fuel injection and ignition system is equipped with a fault memory. The fault memory should be interrogated and the vacuum connections inspected (for unmetered air) before carrying out repair and setting operations and also fault finding.*
- ◆ *Do not use any sealants which contain silicone. Traces of silicone elements inducted by the engine are not combusted in the engine and damage the lambda probe.*
- ◆ *Components marked with * are tested by self-diagnosis ⇒ page 01-5, Interrogating fault memory.*
- ◆ *Components marked with ** can be tested with final control diagnosis ⇒ page 01-30.*
- ◆ *A voltage of at least 11.5 V is required for proper operation of the electrical components.*
- ◆ *If the engine runs only briefly and then cuts out again after fault finding, repairs or tests of components, the cause for this may be that the immobiliser has blocked the engine control unit. In this case, it is necessary to interrogate the fault memory and to adapt the control unit, as appropriate ⇒ page 24-50.*
- ◆ *When conducting certain tests it is possible that a fault is detected and stored by the control unit. After completing all tests and repair work, it is therefore necessary to interrogate the fault memory and to erase the memory, if necessary.
⇒ page 01-5, Interrogating fault memory,
⇒ page 01-6, Erasing fault memory.*
- ◆ *Always replace clamp-type clips by screw-type clips.*

Safety precautions ⇒ page 24-10

Rules for cleanliness ⇒ page 24-10

Technical data ⇒ page 24-11

Testing intake system for leaks (unmetered air)
⇒ page 24-40



Valid ► 07.97

1 - M6 = 10 Nm
M8 = 20 Nm

2 - Ignition cable guide

3 - 25 Nm

4 - Connector

- ◆ black, 2-pin
- ◆ for intake air temperature sender (G42)

5 - Intake air temperature sender (G42)*

6 - O-ring

- ◆ Replace if damaged

7 - Intake hose

8 - Clamp

9 - Connector

- ◆ 3-pin
- ◆ For air mass meter (G70)

10 - Air mass meter (G70)*

11 - Air filter

- ♦ Disassembling and assembling
⇒ page 24-9

12 - Inlet connection**13 - Support**

- ♦ For throttle cable

14 - Rubber support bearing**15 - Bracket**

- ♦ For intake manifold, bolted to cylinder head

16 - Throttle valve control unit (J338)***17 - Vacuum hose**

- ♦ To top part of intake manifold

18 - Cable guide

- ♦ Clipped onto fuel rail

19 - Motronic control unit (J220)*

- ♦ For fuel injection system, lambda control, camshaft adjustment valve, activated charcoal filter solenoid valve, knock control system, engine speed limit, ignition and also self-diagnosis
- ♦ Fitting location: in middle of plenum chamber
- ♦ Testing voltage supply ⇒ page 24-25
- ♦ After replacing, adapt throttle valve control unit ⇒ page 24-51
- ♦ After replacing, adapt electronic immobiliser ⇒ page 24-50

20 - Connector

- ♦ Do not unplug or plug in connector unless the ignition is switched off
- ♦ Release for unplugging

21 - Mounting plate**22 - Gasket**

- ♦ Replace

23 - 10 Nm**24 - Bottom part of intake manifold**

- ♦ Disassembling and assembling
⇒ page 24-8

25 - Connector

- ♦ 4-pin
- ♦ Cable contact 1 and cable contact 3 for (G62)

26 - Retaining clamp**27 - Coolant temperature sender (G62)***

- ♦ With coolant temperature gauge sender (G2)
- ♦ Marking: yellow ring
- ♦ Release pressure in cooling system, if necessary, before removing
- ♦ Testing ⇒ page 24-23

28 - O-ring

- ♦ Replace if damaged

29 - 3-pin plug connection

- ♦ For engine speed sender (G28)

30 - Feed line

- ♦ Secure hose at fuel rail with spring strap clamp
- ♦ Hose with white marking

31 - Return-flow line

- ♦ Secure hose at fuel rail with spring strap clamp
- ♦ Hose with blue marking

32 - Engine speed sender (G28)*

- ♦ Fitting location: on inlet side of cylinder block
- ♦ Testing ⇒ page 24-21.4

33 - Lambda probe (G39)*, 55 Nm

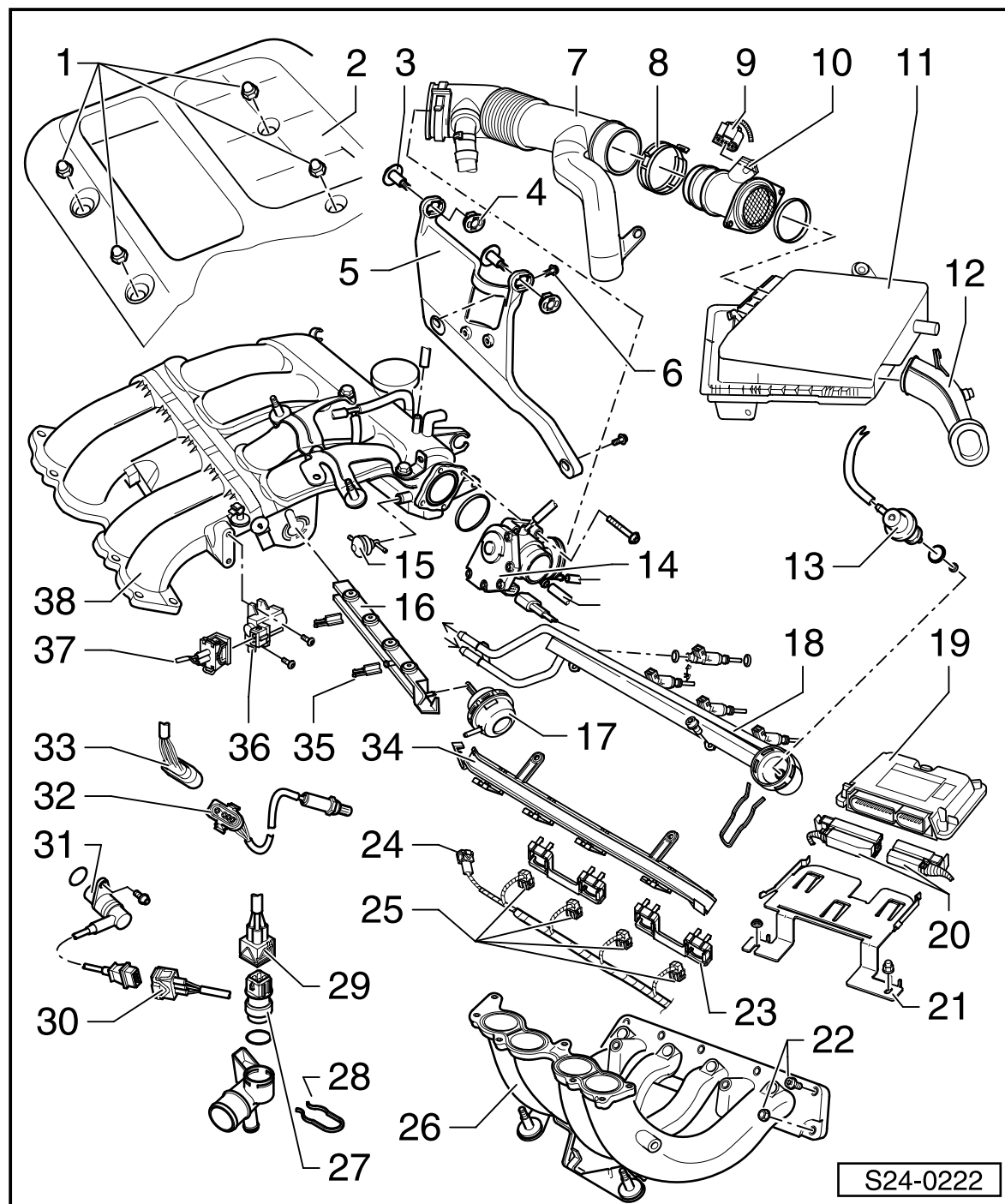
- ♦ Fitting location: in front exhaust pipe
- ♦ Grease only thread with „G5“; „G5“ must not get into the slots of the probe body
- ♦ Testing lambda probe and lambda control ⇒ page 24-42.3
- ♦ Voltage of probe heater supplied through fuel pump relay (J17)
- ♦ Testing lambda probe heater
⇒ page 24-45

34 - 4-pin plug connection

- ♦ For lambda probe (G39) and lambda probe heater (Z19)
- ♦ On right next to lambda probe below cover at floor panel

35 - Fuel rail with injectors */****36 - Top part of intake manifold**

- ♦ Disassembling and assembling
⇒ page 24-6



Valid 08.97 ►

1 - 10 Nm

2 - Intake manifold trim panel

3 - 20 Nm

4 - Rubber supporting bush

5 - Bracket

- ◆ For intake manifold, bolted to cylinder head

6 - 25 Nm

7 - Intake hose

8 - Clamp

9 - Connector

- ◆ 5-pin
- ◆ For air mass meter (G70) and intake air temperature sender (G42)

10 - Air mass meter (G70)* and intake air temperature sender (G42)*

11 - Air filter

- ◆ Disassembling and assembling
⇒ page 24-9.2

12 - Inlet connection**13 - Fuel pressure regulator****14 - Throttle valve control unit (J338)*****15 - Non-return valve**

- ◆ For vacuum reservoir, integrated in intake manifold
- ◆ Ensure correctly installed; if incorrectly installed, valve does not operate and acceleration is thus reduced

16 - Shift linkage

- ◆ For variable intake manifold change-over

17 - Vacuum unit

- ◆ For variable intake manifold change-over

18 - Fuel rail with injectors */****19 - Motronic control unit (J220)***

- ◆ For fuel injection system, lambda control, camshaft adjustment valve, activated charcoal filter solenoid valve, knock control system, engine speed limit, ignition as well as self-diagnosis
- ◆ Fitting location: in middle of plenum chamber
- ◆ Testing voltage supply ⇒ page 24-25
- ◆ After replacing, adapt throttle valve control unit ⇒ page 24-51
- ◆ After replacing, adapt electronic immobiliser ⇒ page 24-50

20 - Connector

- ◆ Do not unplug or plug in connector unless the ignition is switched off
- ◆ Release for unplugging

21 - Mounting plate**22 - 10 Nm****23 - Connector lock**

- ◆ For connector of injectors

24 - Connector

- ◆ For Hall sender (G40)

25 - Connector

- ◆ For injectors (N30...N33)

26 - Bottom part of intake manifold

- ◆ Disassembling and assembling
⇒ page 24-9.1

27 - Coolant temperature sender (G62)*

- ◆ With coolant temperature gauge sender (G2)
- ◆ Marking: yellow ring
- ◆ Release pressure from cooling system, if necessary, before removing
- ◆ Testing ⇒ page 24-23

28 - Retaining clamp**29 - Connector**

- ◆ 4-pin
- ◆ Cable for G62 in sockets 1 and 3

30 - 3-pin plug connection

- ◆ For engine speed sender (G28)

31 - Engine speed sender (G28)*

- ◆ Fitting location: on inlet side of cylinder block
- ◆ Testing ⇒ page 24-21.4

32 - Lambda probe (G39)*, 55 Nm

- ◆ Fitting location: in front exhaust pipe
- ◆ Grease only thread with „G5“; „G5“ must not get onto the slots of the probe body
- ◆ Testing lambda probe and lambda control ⇒ page 24-42.3
- ◆ Voltage for probe heater supplied through fuel pump relay (J17)
- ◆ Testing lambda probe heater ⇒ page 24-45

33 - 4-pin plug connection

- ◆ For lambda probe (G39) and lambda probe heater (Z19)
- ◆ On right next to lambda probe below cover at floor panel

34 - Cable guide

- ◆ With fuel rail bolted to intake manifold

35 - Locking catches

- ◆ For shift linkage of variable intake manifold changeover

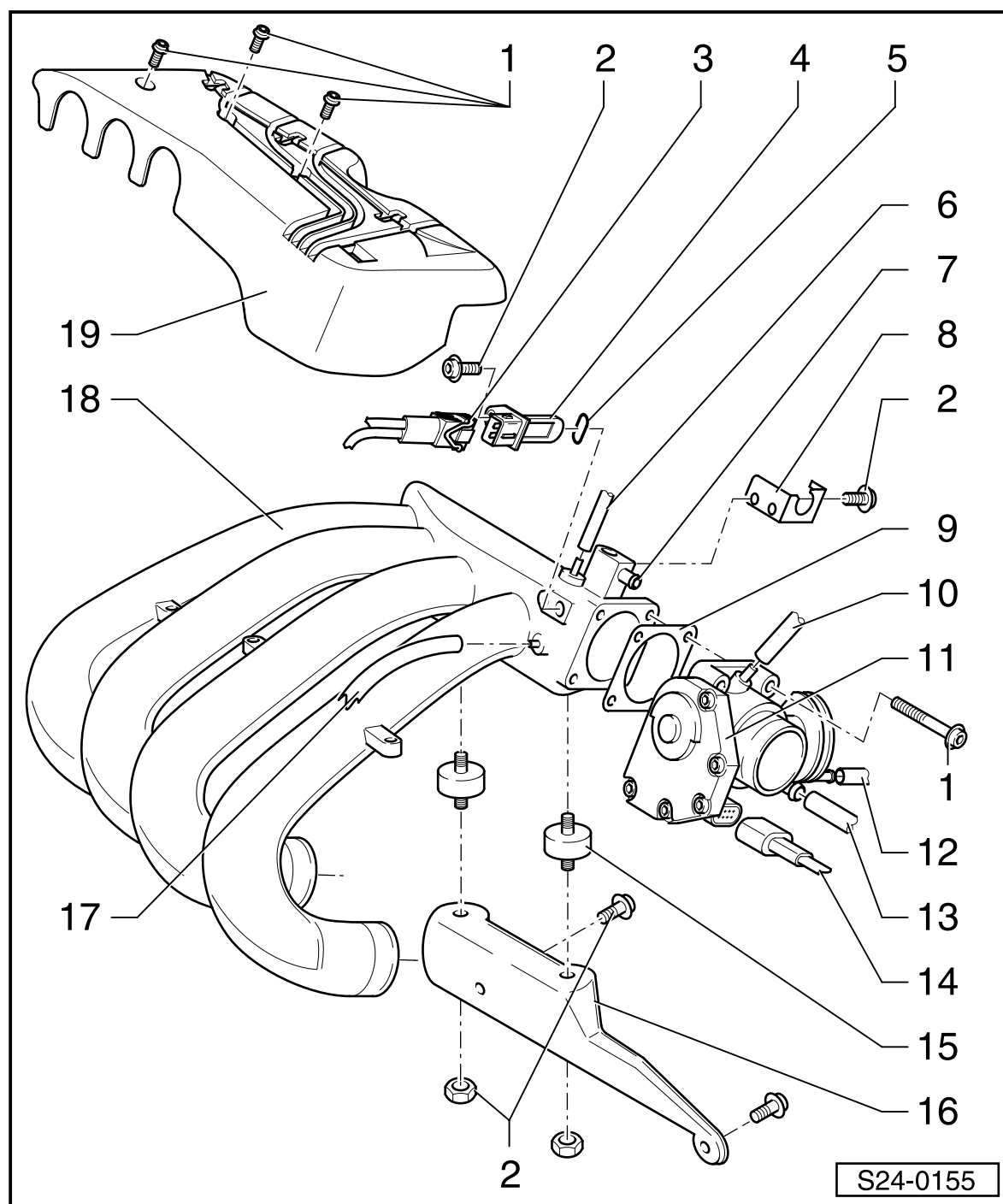
36 - Variable intake manifold changeover valve (N156)**37 - Connector**

- ◆ For variable intake manifold changeover valve (N156)

38 - Top part of intake manifold

- ◆ Disassembling and assembling
⇒ page 24-7.1

Disassembling and assembling top part of intake manifold - valid ► 07.97



1 - M6 = 10 Nm
M8 = 20 Nm

2 - 25 Nm

3 - Connector

- ◆ black, 2-pin
- ◆ for intake air temperature sender (G42)

4 - Intake air temperature sender (G42)*

- ◆ Testing ⇒ page 24-20

5 - Seal

- ◆ Replace

6 - Vacuum hose

- ◆ To intake hose

7 - Vacuum connection

- ◆ To brake servo unit

8 - Support

- ◆ For throttle cable
- ◆ Adjusting throttle cable:

⇒ 1.8-ltr./92 kW Engine Mechanical Components; Repair Group 20; Adjusting throttle cable

9 - Gasket

- ◆ Replace

10 - Vent hose

- ◆ From solenoid valve 1 for activated charcoal filter (N80) */**
- ◆ Activated charcoal filter system

⇒ 1.8-ltr./92 kW Engine Mechanical Components; Repair Group 20; Removing and installing parts of activated charcoal filter system

11 - Throttle valve control unit (J338)*

- ◆ Testing ⇒ page 24-16
- ◆ Components of throttle valve control unit (J338):
 - throttle valve positioner (V60),
 - throttle valve positioner sender (G127),
 - throttle valve potentiometer (G69),
 - idling speed switch (F60)
- ◆ After replacing, adapt engine control unit ⇒ page 24-51

12 - Coolant hose

- ◆ To heat exchanger

13 - Coolant hose

- ◆ To branch connector

14 - Connector

- ◆ black, 8-pin
- ◆ For throttle valve control unit (J338)
- ◆ Do not unplug or plug in connector unless the ignition is switched off

15 - Rubber support bearing**16 - Bracket**

- ◆ For intake manifold, bolted to cylinder head

17 - Vacuum hose

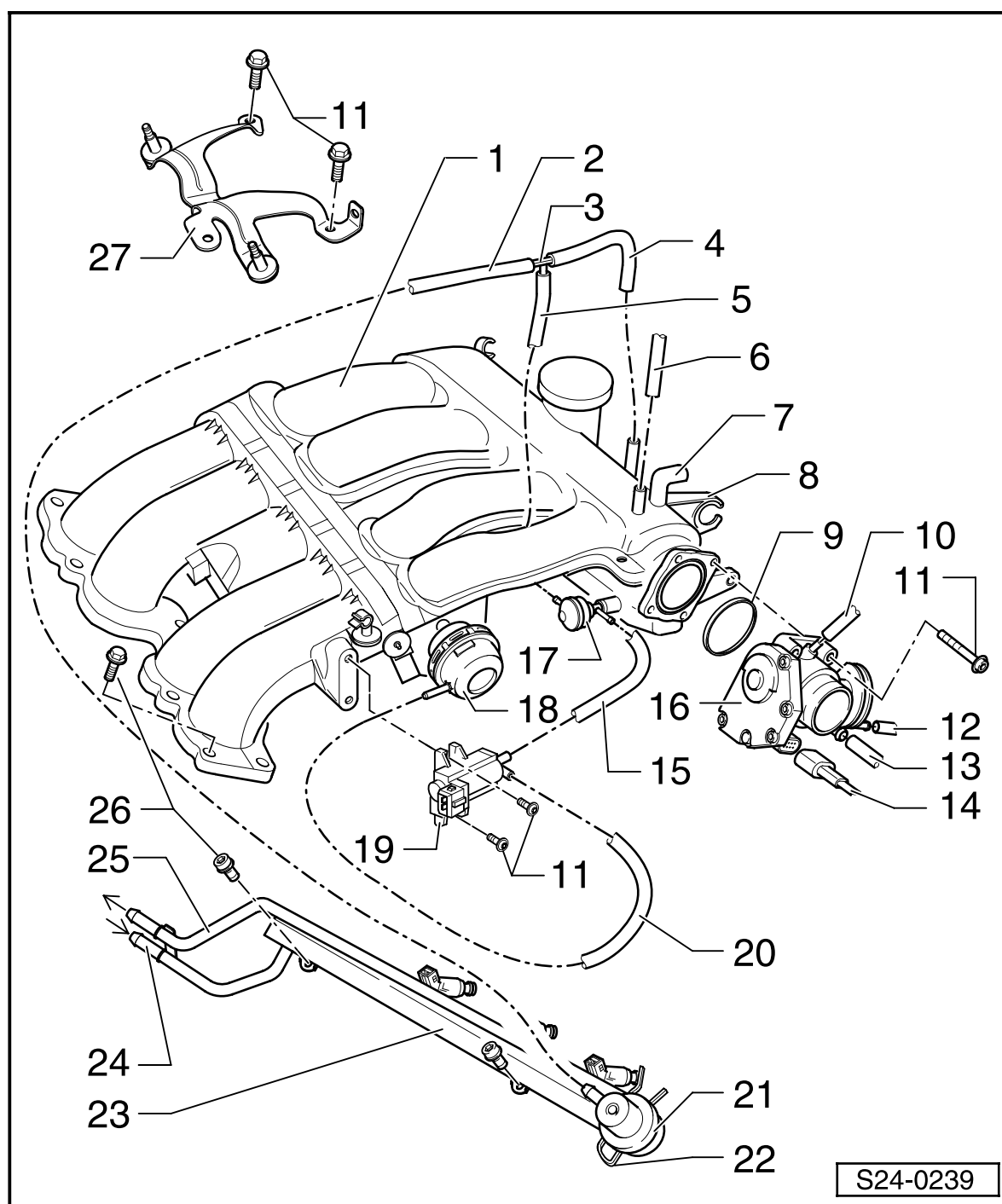
- ◆ To fuel pressure regulator

18 - Top part of intake manifold

- ◆ Removing and installing
- ⇒ 1.8-ltr./92 kW Engine Mechanical Components; Repair Group 15; Removing and installing cylinder head cover

19 - Ignition cable guide

Disassembling and assembling top part of intake manifold - valid 08.97 ➤



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1 - Top part of intake manifold

- ◆ Removing and installing

⇒ Engine Mechanical Components; Repair Group 15; Removing and installing cylinder head cover

2 - Vacuum hose

- ◆ To fuel pressure regulator

3 - Branch connector

4 - Vacuum hose

- ◆ To top part of intake manifold

5 - Vacuum hose

- ◆ To non-return valve for vacuum reservoir (item 17)

6 - Vacuum hose

- ◆ To intake hose

7 - Vacuum hose

- ◆ To brake servo unit

8 - Support

- ◆ For throttle cable
- ◆ Adjusting throttle cable:

⇒ 1.8-ltr./92 kW Engine Mechanical Components; Repair Group 20; Adjusting throttle cable

9 - Shaped rubber seal

- ◆ Replace

10 - Vent hose

- ◆ From solenoid valve 1 for activated charcoal filter (N80) */**
- ◆ Activated charcoal filter system

⇒ 1.8-ltr./92 kW Engine Mechanical Components; Repair Group 20; Removing and installing parts of activated charcoal filter system

11 - 10 Nm**12 - Coolant hose**

- ◆ To heat exchanger

13 - Coolant hose

- ◆ To branch connector

14 - Connector

- ◆ black, 8-pin
- ◆ For throttle valve control unit (J338)
- ◆ Do not unplug or plug in connector unless the ignition is switched off

15 - Vacuum hose**16 - Throttle valve control unit (J338)***

- ◆ Testing ⇒ page 24-16
- ◆ Components of throttle valve control unit (J338):
 - throttle valve positioner (V60),
 - throttle valve positioner sender (G127),
 - throttle valve potentiometer (G69),
 - idling speed switch (F60)
- ◆ After replacing, adapt engine control unit ⇒ page 24-51

17 - Non-return valve

- ◆ For vacuum reservoir, integrated in intake manifold
- ◆ Ensure correctly installed; if incorrectly installed, valve does not operate; acceleration reduced as a result

18 - Vacuum unit

- ◆ For variable intake manifold change-over

19 - Variable intake manifold changeover valve (N156)**20 - Vacuum hose****21 - Fuel pressure regulator****22 - Retaining clamp****23 - Fuel rail with injectors****24 - Feed line**

- ◆ Secure hose with spring strap clamp
 - ◆ From fuel filter:
- ⇒ 1.8-ltr./92 kW Engine Mechanical Components; Repair Group 20; Removing and installing fuel tank with attached parts and fuel filter

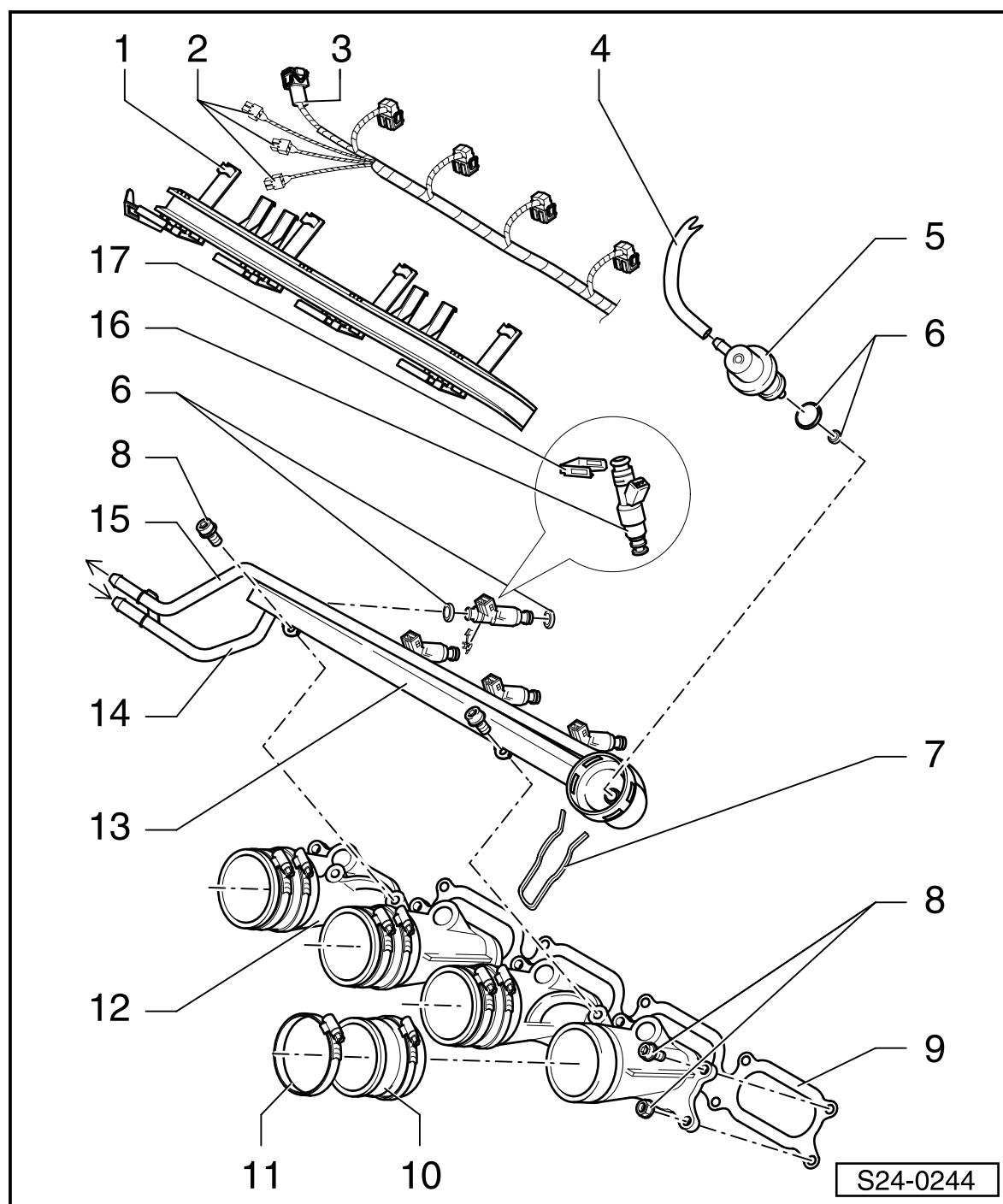
25 - Return-flow line

- ◆ Secure hose with spring strap clamp
 - ◆ Ensure tightly fitted
 - ◆ To fuel delivery unit in the fuel tank:
- ⇒ 1.8-ltr./92 kW Engine Mechanical Components; Repair Group 20; Removing and installing fuel tank with attached parts and fuel filter

26 - 20 Nm**27 - Bracket**

- ◆ For intake manifold cover

Disassembling and assembling bottom part of intake manifold - valid ► 07.97



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1 - Cable guide

- ◆ Clipped onto fuel rail

2 - Connectors

- ◆ For knock sensor 1 (G61), black connector
- ◆ For knock sensor 2 (G66), brown connector
- ◆ For engine speed sender (G28), grey connector

3 - Connector

- ◆ For Hall sender (G40)

4 - Vacuum hose

- ◆ To top part of intake manifold

5 - Fuel pressure regulator

- ◆ Testing pressure regulator and holding pressure ⇒ page 24-27

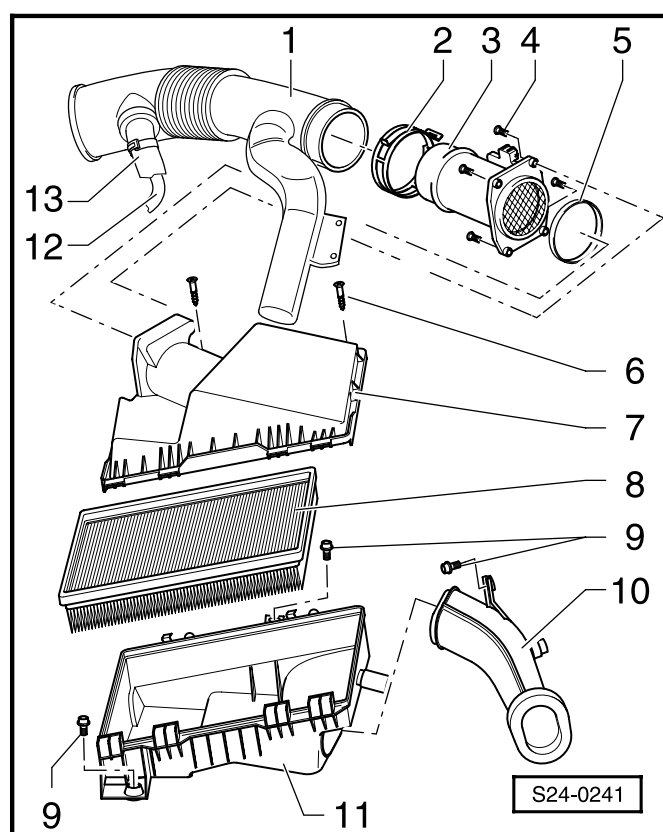
6 - O-ring

- ◆ Replace if damaged

7 - Retaining clip

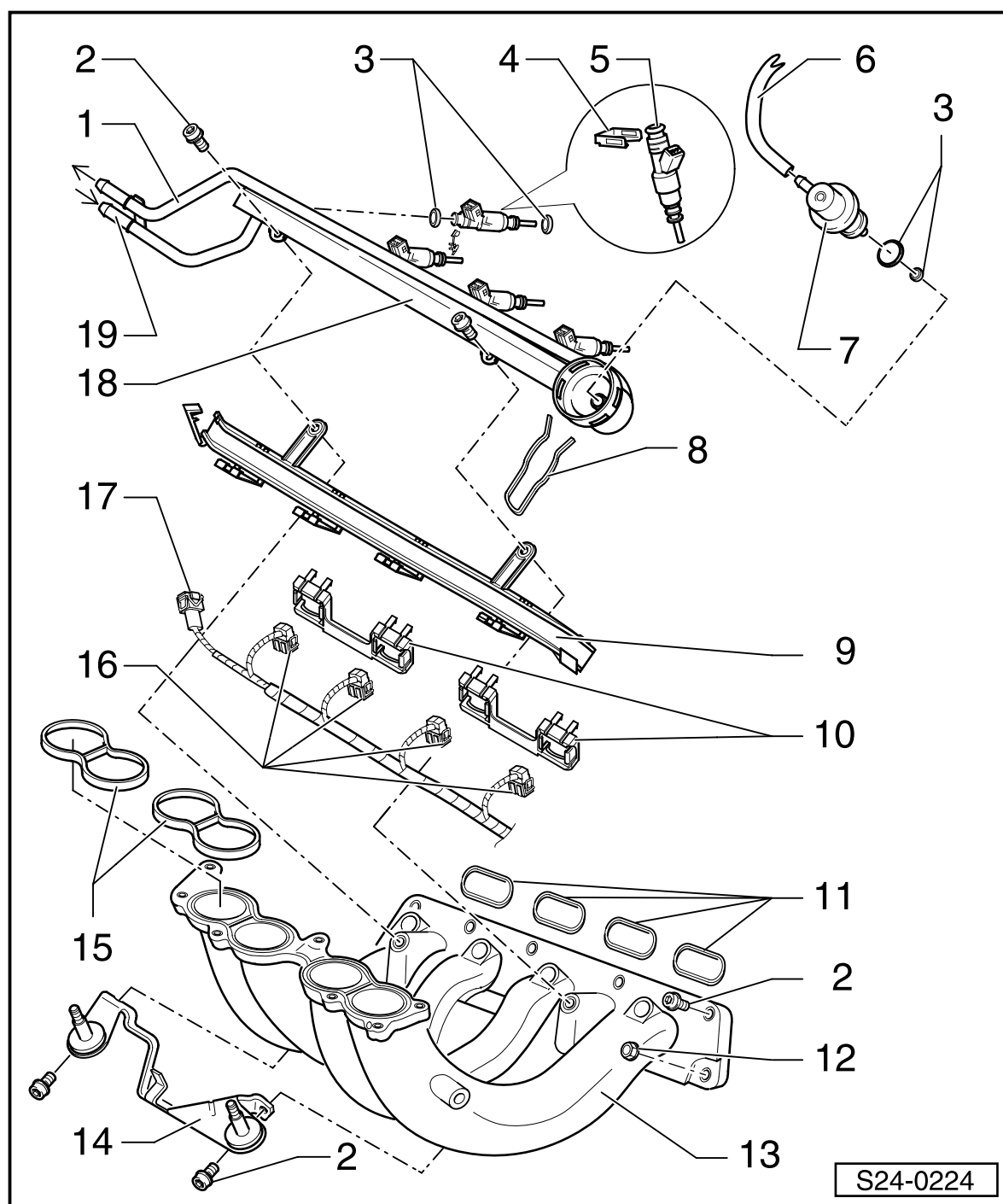
- 8 - 10 Nm**
- 9 - Gasket**
 - ◆ Replace
- 10 - Intermediate flange**
 - ◆ Inspect for cracks
- 11 - Clamp**
 - ◆ Replace by screw-type clamp
- 12 - Bottom part of intake manifold**
- 13 - Fuel rail**
- 14 - Feed line**
 - ◆ Secure hose at fuel rail with spring strap clip
 - ◆ Hose with white marking
- 15 - Return-flow hose**
 - ◆ Secure hose at fuel rail with spring strap clip
 - ◆ Hose with blue marking
- 16 - Injector (N30...N33)*/****
 - ◆ Testing ⇒ page 24-34
- 17 - Retaining clip**
 - ◆ Ensure correctly fitted onto injector and fuel rail

Removing and installing air filter, air mass meter



- 1 - Intake hose**
 - ◆ Ensure tightly connected
- 2 - Clamp**
- 3 - Air mass meter (G70)***
 - ◆ Testing ⇒ page 24-38
- 4 - 10 Nm**
- 5 - O-ring**
 - ◆ Replace if damaged
- 6 - 10 Nm**
 - ◆ For top part of air filter
- 7 - Top part of air filter**
- 8 - Filter element**
- 9 - 25 Nm**
- 10 - Intake fitting**
- 11 - Bottom part of air filter**
- 12 - Vacuum connection**
 - ◆ From top part of intake manifold
- 13 - Air admission**
 - ◆ From crankcase

Disassembling and assembling bottom part of intake manifold - valid 08.97 ➤



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1 - Return-flow line

- ◆ Secure hose at fuel rail with spring strap clip
- ◆ Hose with blue marking

2 - 10 Nm

3 - O-ring

- ◆ Replace if damaged

4 - Retaining clip

- ◆ Ensure correctly fitted on at injector and fuel rail

5 - Injector (N30...N33)*/**

- ◆ Testing ⇒ page 24-35.2

6 - Vacuum hose

- ◆ From top part of intake manifold to fuel pressure regulator

7 - Fuel pressure regulator

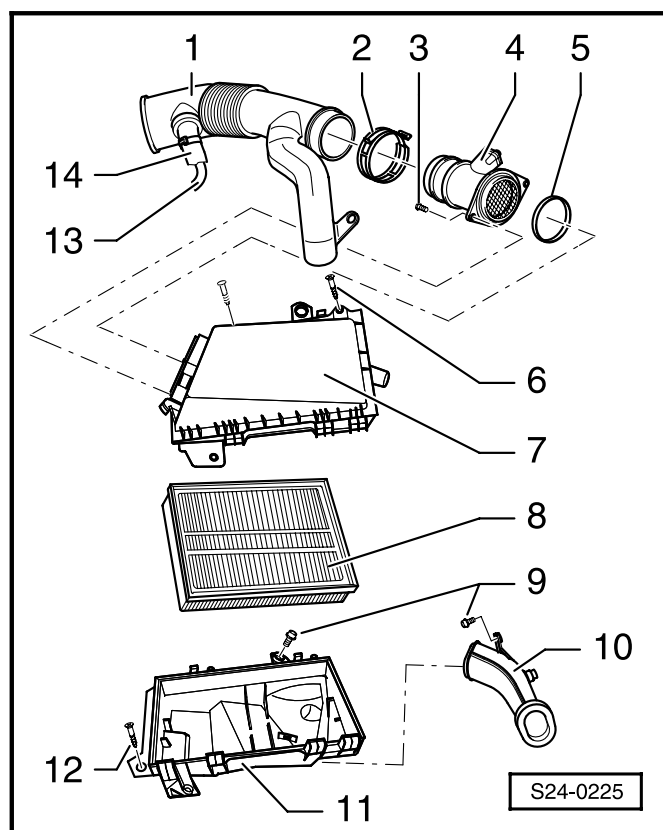
- ◆ Testing pressure regulator and holding pressure ⇒ page 24-27

8 - Retaining clip

- ◆ For fuel pressure regulator

- 9 - Cable guide**
 - ◆ Attached with fuel rail to bottom part of intake manifold
- 10 - Connector locking element**
- 11 - Shaped seal**
 - ◆ Replace if damaged
- 12 - 10 Nm**
- 13 - Bottom part of intake manifold**
- 14 - Front bracket**
 - ◆ For intake manifold cover
- 15 - Shaped seal**
 - ◆ Replace if damaged
- 16 - Connectors**
 - ◆ For injectors (N30...N33)
- 17 - Connector**
 - ◆ For Hall sender (G40)
- 18 - Fuel rail**
- 19 - Feed line**
 - ◆ Secure hose at fuel rail with spring strap clip
 - ◆ Hose with white marking

Removing and installing air filter, air mass meter and intake air temperature sender



- 1 - Intake hose**
 - ◆ Ensure correctly fitted on
- 2 - Clamp**
- 3 - 10 Nm**

4 - Air mass meter (G70)* and intake air temperature sender (G42)

- ◆ Testing air mass meter (G70) ⇒ page 24-41
- ◆ Testing intake air temperature sender (G42) ⇒ page 24-21.1

5 - O-ring

- ◆ Replace if damaged

6 - 10 Nm

- ◆ For top part of air filter

7 - Top part of air filter

8 - Filter element

9 - 25 Nm

10 - Intake fitting

11 - Bottom part of air filter

12 - 20 Nm

13 - Vacuum connection

- ◆ From top part of intake manifold

14 - Air admission

- ◆ From crankcase

Safety precautions

Important!

The fuel system is pressurised! Place cleaning rags around the connection point before opening the system. Then, release the pressure by carefully detaching the connection point.

Pay attention to the following points in order to avoid injuries to persons and/or damage to the fuel injection and ignition system:

- ◆ Do not touch or disconnect ignition cables when the engine is running or operating at starting speed.
- ◆ Do not disconnect or connect cables of the fuel injection and ignition system - also not cables of test equipment - unless the ignition is switched off.
- ◆ To operate the engine at starting speed without the engine starting (e.g. for testing compression pressure), unplug the connector from the power output stage of the ignition coils and the connectors at the injectors. Interrogate the fault memory after completing the work.
- ◆ Do not wash an engine unless the ignition is switched off.
- ◆ Do not disconnect or re-connect the battery unless the ignition is switched off otherwise the engine control unit may be damaged.

Rules for cleanliness

Pay careful attention to the following „5 rules“ for cleanliness when carrying out work on the fuel supply/fuel injection system:

- ◆ Thoroughly clean connection points and the surrounding area before disconnecting.
- ◆ Place removed parts down on a clean surface and cover over. Do not use fluffing cloths!
- ◆ Carefully cover over or seal opened components if repairs are not carried out immediately.

- ◆ Install only clean parts:
Do not remove replacement parts from their wrapping until just before installing.
Do not use parts which have been stored unwrapped (e.g. in tool boxes etc.).
- ◆ If the system is opened:
Avoid working with compressed air, if possible.
Avoid moving the vehicle, if possible.

Technical data

Engine code		AGN ► 07.97	AGN 08.97 ►
Idling speed Speed cannot be adjusted; is controlled by idling speed stabilisation	Manual gearbox (AC off) (AC on)	800 ± 50 rpm 860 ± 50 rpm	800 +80/-40 rpm 800 ± 100 rpm
	Automatic gearbox (AC off) (AC on)	800 ± 50 rpm 860 ± 50 rpm	800 +80/-40 rpm 860 ± 100 rpm
Engine speed governed by shutting off the injectors	6800 rpm		
Motronic control unit ¹⁾ Part number	⇒ Parts List		
Fuel pressure at idling speed	Vacuum hose fitted on	approx. 0.25 MPa (2.5 bar)	
	Vacuum hose disconnected	approx. 0.30 MPa (3.0 bar)	
Holding pressure after 10 minutes	at least 0.15 MPa (1.5 bar)		
Injectors	Ejected spray	Two-hole nozzle	
	Injected quantity (30 s)	85...105 ml	
	Resistance (room temperature) ²⁾	13...18 Ω	

¹⁾ After replacing engine control unit, adapt throttle valve control unit ⇒ page 24-51 and adapt electronic immobiliser ⇒ page 24-50.

²⁾ When engine is at operating temperature, the resistance of the injectors is increased by about 4...6 Ω.

Testing components and operation

Testing idling speed

Notes:

- ◆ *Idling speed, ignition timing and CO content cannot be adjusted.*
- ◆ *Idling speed is tested during the basic setting of the engine.*
- ◆ *The CO content is maintained at the specified value by the lambda control. Faults at the lambda control are detected by the self-diagnosis and stored in the fault memory.*

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3

Test conditions

- No leak in exhaust system.
- Coolant temperature at least 80 °C.
- Throttle valve in idling position.
⇒ 1.8-ltr./92 kW Engine, Mechanical Components; Repair Group 20; Fuel supply system; Servicing throttle mechanism
- Electrical components switched off (radiator fan must not cut in during the test).
- Air conditioning switched off.
- Pressure measuring device not connected.
- Selector lever in P or N.

Test procedure

- Start engine and run at idling speed.
- Interrogate fault memory ⇒ page 01-5. No fault should be stored; rectify any faults stored and erase fault memory ⇒ page 01-7, switch off engine and start again, carry out a road test and once again interrogate fault memory as a check.
- After this:
 - ◆ Leave V.A.G 1552 connected.

Test of vehicle systems
Enter address word XX

HELP

Read measured value block 5 →
810 rpm 800 rpm 0.0 % 2.8 g/s

- ◆ Continue running engine at idling speed.

◀ Readout in display:

- Read measured value block (function 08) and select display group 005 ⇒ page 01-49.

◀ Readout in display:

- Read off idling speed in display block 1.

Models	Specification
➤ 07.98	760...840 rpm
08.97 ➤	760...880 rpm

- Press the → key.
- Press keys 0 and 6 for the function "End output" and confirm the entry with the key Q.
- If the specification is not achieved, once again interrogate fault memory ⇒ page 01-5.

If idling speed is too high or too low and no fault is stored in the fault memory, carry out the following tests marked with a dot:

- Test idling speed switch ⇒ page 24-16.
- Large quantity of unmetered air ⇒ page 24-53, Performing basic setting of engine control unit, and also read measured value block display group 001, 005 and 008, respectively.
- Test throttle valve control unit ⇒ page 24-16.

Testing fuel tank breather

Testing activated charcoal filter solenoid valve

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)

- ◆ Diode test lamp (e.g. V.A.G 1527 B)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Test box V.A.G 1598/22

Testing for leaks

The solenoid valve is closed in the de-energized state.

- Detach the hose from the activated charcoal filter solenoid valve (N80).
- Connect a suitable pressure gauge and a compressed air device (air pump) to the solenoid valve.
- Produce an air pressure which can be indicated with this.
- Initiate final control diagnosis and select the activated charcoal filter solenoid valve (N80) ⇒ page 01-30.1.
- When the solenoid valve opens, the air pressure indicated must clearly drop and, when the valve is closed, it must clearly increase again; replace solenoid valve if necessary.

Electrical test of ACF valve -N80-

- Unplug the connector at the ACF valve.
- Use the hand-held multimeter to conduct a resistance measurement between the contacts of the valve.

Specification: 22...30 Ω .

- If the specification is not achieved, replace ACF valve.

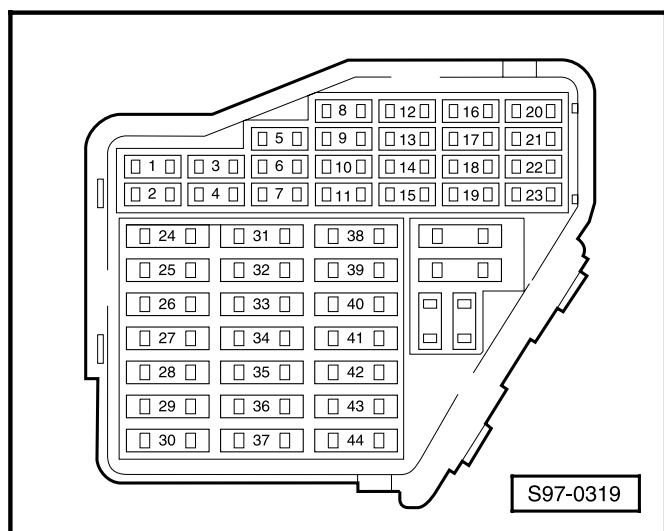
Testing voltage supply of ACF valve

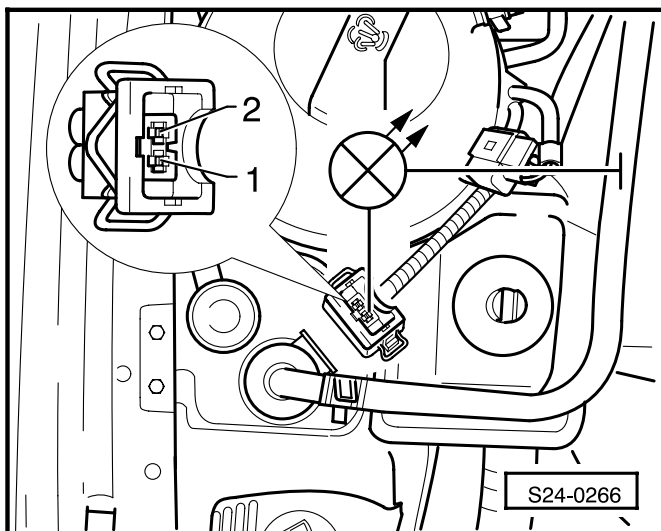
Note:

The voltage for the ACF valve is supplied through the fuel pump relay.

Test condition

- Fuse 43 o.k.





Test procedure

- Unplug the connector at the ACF valve.
- ◀ - Connect diode test lamp between contact 1 of the connector and engine earth.

- Operate the starter.

Specification: The diode test lamp must come on.

- If the diode test lamp does not come on, test the cable connection from contact 1 to fuse 43 for continuity, and repair if necessary.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

- If the cable connection is o.k., test fuel pump relay ⇒ page 24-36.

Testing actuation of ACF valve

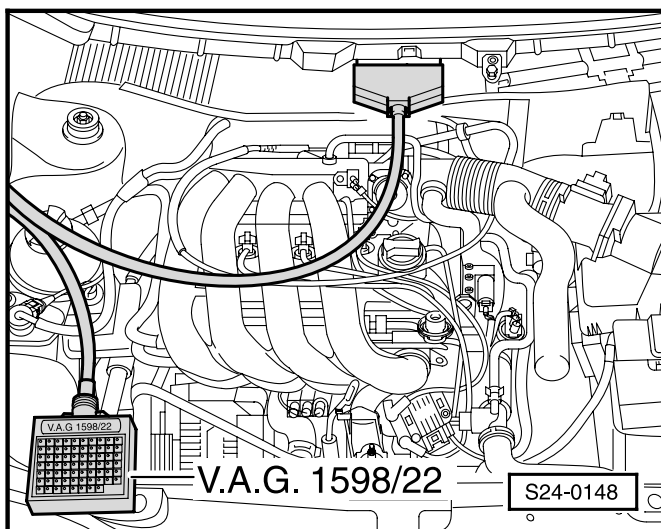
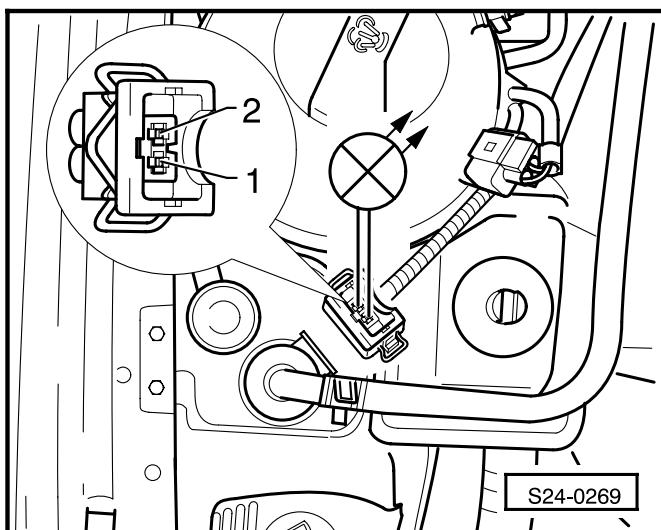
- ◀ - Connect the diode test lamp between contact 2 (earth actuation of engine control unit) and positive terminal of the battery.

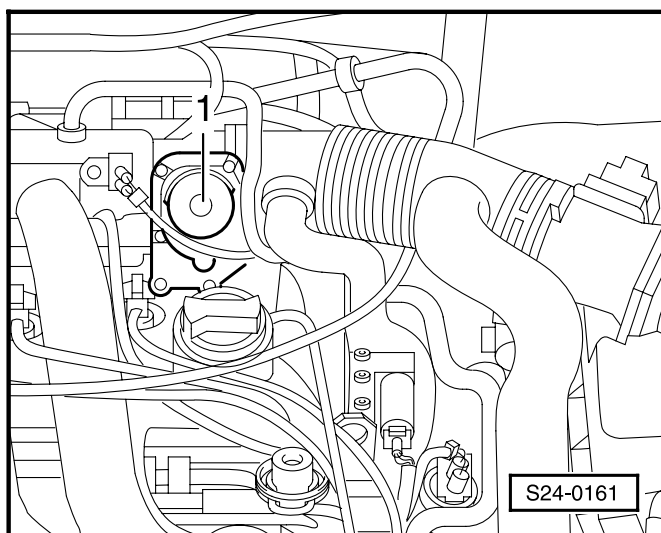
- Initiate final control diagnosis and select the activated charcoal filter solenoid valve (N80) ⇒ page 01-30.1.

Specification: The diode test lamp must flash.

If the diode test lamp does not flash, or if it comes on and remains on:

- Switch off the ignition.
- ◀ - Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48.
- If the diode test lamp came on and remained on, test the cable from contact 2 of the connector at the ACF valve to socket 61 of the test box for short to earth.
- If the diode test lamp did not flash, test the cable from contact 2 of the connector at the ACF valve to socket 61 of the test box for continuity and also for short circuit to positive.
- If there is neither an open circuit in the wiring nor a short circuit, replace engine control unit ⇒ page 24-48.





Testing throttle valve control unit

Testing operation

◀ The idling speed stabilisation is integrated in the throttle valve control unit. Throttle valve potentiometer (G69), idling speed switch (F60), throttle valve positioner (V60) and throttle valve positioner potentiometer (G127) are enclosed in the housing opposite the cable pulley -1-. The housing must not be opened. All settings are performed as part of the basic setting with V.A.G 1552. When de-energized, the throttle valve moves into a particular, mechanically defined position. The throttle valve positioner performs the closing damping function of the throttle valve.

Note:

If the control unit is replaced, it is necessary to:

- ◆ adapt the engine control unit to the throttle valve control unit ⇒ page 24-51
- ◆ on models fitted with automatic gearbox, adapt the gearbox control unit
⇒ Automatic Gearbox; Repair Group 01; Self-Diagnosis/Electrical Test; Performing self-diagnosis; Initiating basic setting

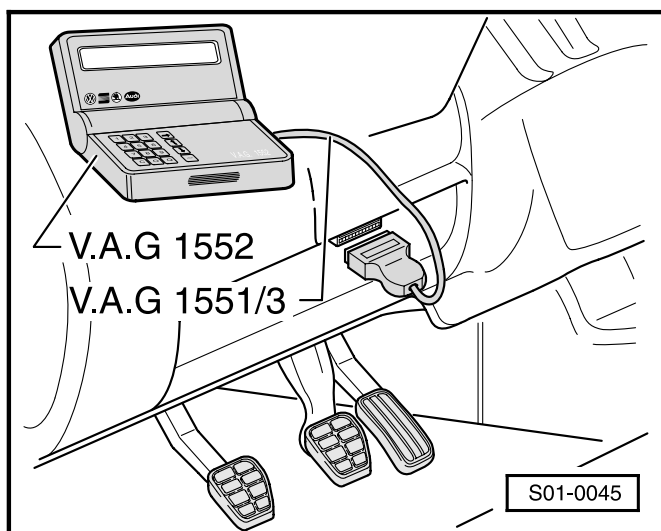
Testing idling speed switch

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Current flow diagram

Procedure

- ◀ - Connect the vehicle system tester V.A.G 1552 with cable V.A.G 1551/3 ⇒ page 01-3.
- Read measured value block (function 08) and select display group 098 ⇒ page 01-69.



Read measured value block 98
X.XXX V X.XXX V Idling



The ignition should be switched on when carrying out this step.

◀ Readout in display:

Display field 3 should indicate „Idling“.

- Open throttle valve slowly.

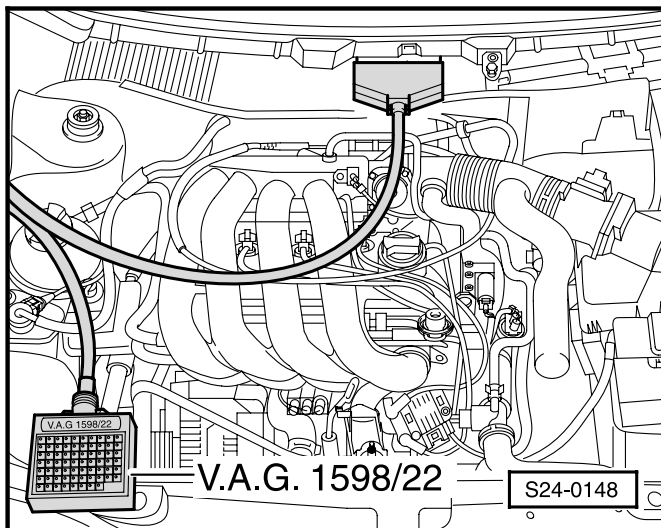
Read measured value block 98
X.XXX V X.XXX V Part throttle



◀ Readout in display:

Display field 3 should indicate „Part throttle“.

- If the specification is not achieved, switch off the ignition and connect test box V.A.G 1598/22 to the wiring loom to the engine control unit.



Important!

Switch on the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.

- Use hand-held multimeter V.A.G 1526 to carry out a resistance measurement between sockets 67 and 69.

Specification: continuity (throttle valve closed)

- Open throttle valve slightly.

Specification: idling switch should open (no continuity)

- If the specification is not achieved, inspect the cable connections and contacts for open circuit or dirt, clean if necessary and carry out basic setting of engine control unit.
- If the specification is again not achieved, inspect throttle valve for dirt or sticking movement and clean, if necessary.
- Repeat basic setting of engine control unit ⇒ page 24-53.
- If it is not possible to start the basic setting or complete it successfully, replace the throttle valve control unit.
- Carry out basic setting of engine control unit ⇒ page 24-53.

Testing senders for throttle valve positioner and throttle valve potentiometer

Special tools, testers and aids required

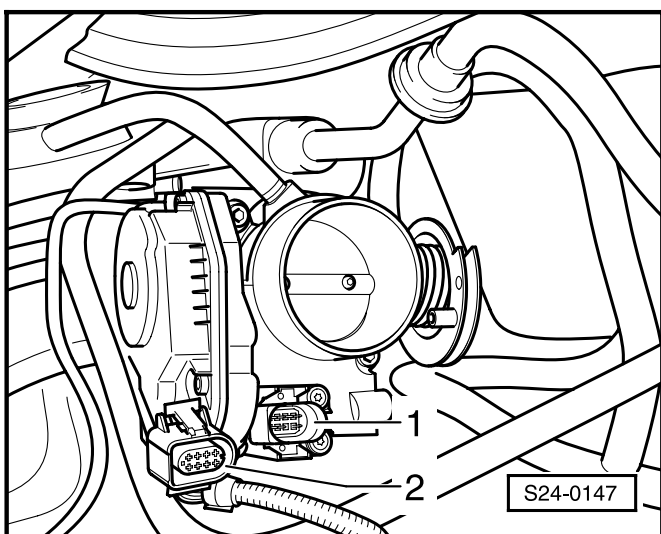
- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter, e.g. V.A.G 1526 or multimeter V.A.G 1715
- ◆ Adapter cable set V.A.G 1594
- ◆ Current flow diagram

Procedure

- Detach the intake hose from the throttle valve control unit ⇒ page 24-9.

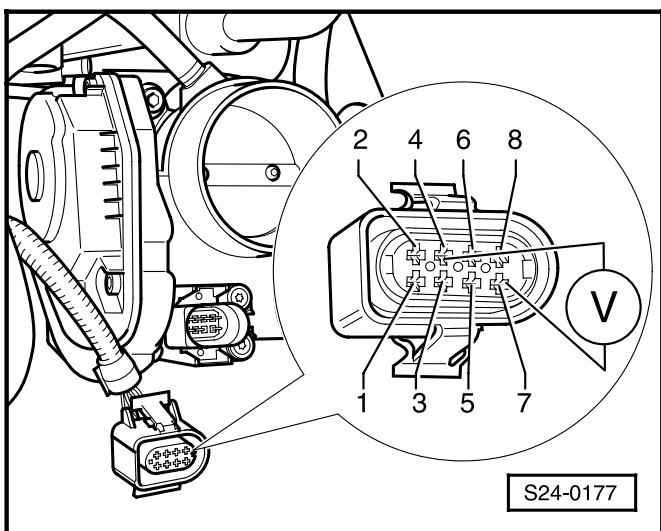
Testing voltages of the senders

- ◀ - Unplug the 8-pin connector -2- at the throttle valve control unit -1-.



Important!

Switch on the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.



- Switch on the ignition.
- ◀ - Use hand-held multimeter V.A.G 1526 to measure between contact 4 and contact 7 at the 8-pin connector.

Specification: min. 4.8 V

If the specification is not achieved, plug in the 8-pin connector again.

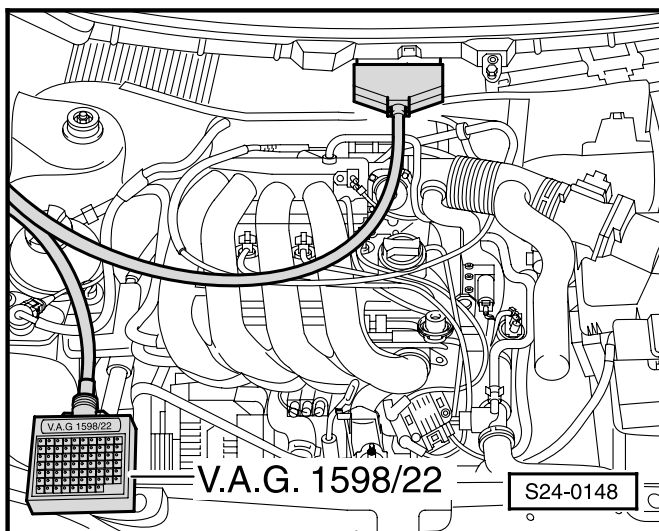
- Start the engine.
- Select Reading measured value block (function 08) and display group 098 ⇒ page 01-61.

Read measured value block 98
4.420 V 3.080 V Idling

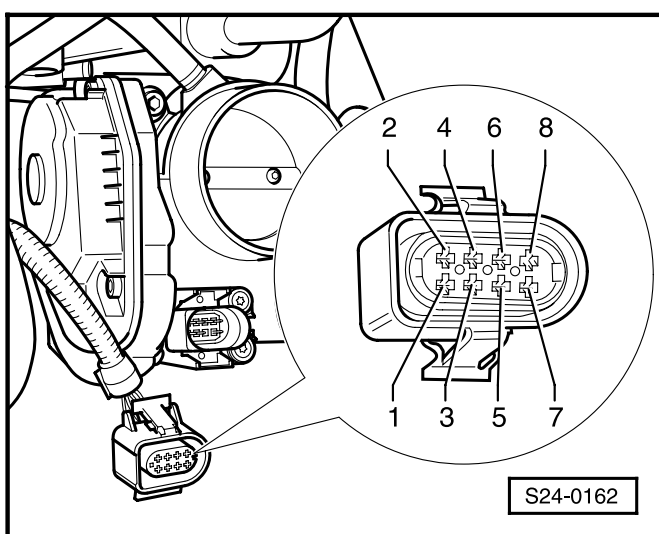


- ◀ Readout in display:

The readouts of display fields 1 and 2 should be between 0.5 V and 4.9 V.



- If the specifications are not achieved, switch off the ignition.
- ◀ - Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48, Replacing engine control unit.
- Unplug the 8-pin connector at the throttle valve control unit.



- ◀ - Use multimeter V.A.G 1526 to test the wiring between test box and 8-pin connector for continuity.

Contact at 8-pin connector	Contact at test box
1	66
2	59
3	69
4	62
5	75
7	67
8	74

- Use multimeter to test the wiring for short circuit to each other.
- Rectify any open circuits in the wiring and dirt at the contacts, erase fault memory (function 05) ⇒ page 01-6 and carry out basic setting of engine control unit ⇒ page 24-53.
- If the specification is again not achieved, inspect throttle valve for dirt or sticking movement and clean, if necessary.
- Repeat basic setting of the throttle valve control unit ⇒ page 24-53.
- If it is not possible to start the basic setting or complete it successfully, replace throttle valve control unit.

- Carry out basic setting of the throttle valve control unit ⇒ page 24-53.
- If it is not possible to start or successfully complete the basic setting, replace engine control unit ⇒ page 24-48.

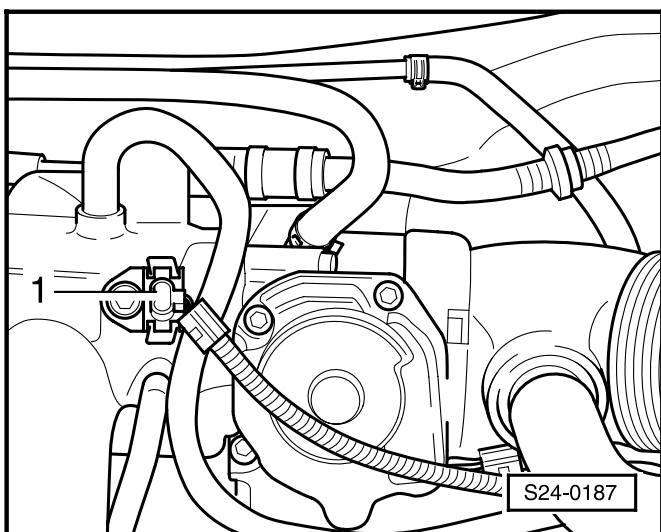
Testing intake air temperature sender - valid ► 07.97

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter, e.g. V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Current flow diagram

Notes:

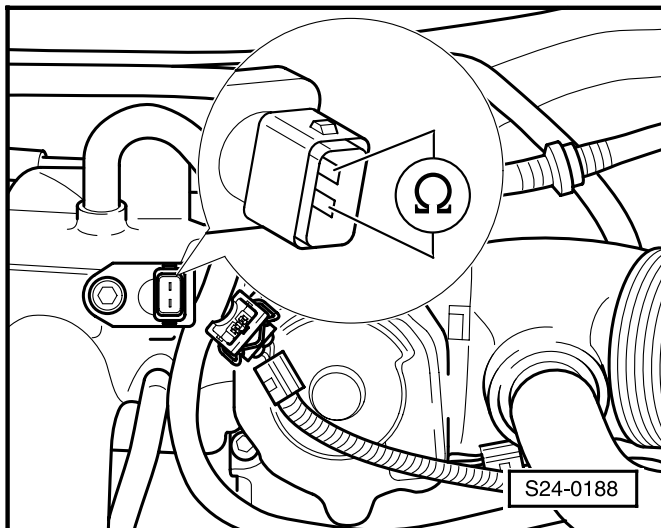
- ◆ *If a fault exists at the sender or in the cable connections, the control unit operates with a substitute temperature of 19.5 °C.*
- ◆ *Refer also to Reading measured value block, display group 003, display block 4 for the operational test of the intake air temperature sender (G42).*
- ◆ *Engine cooled down to room temperature (approx. 20 °C).*



Warning!

Select the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.

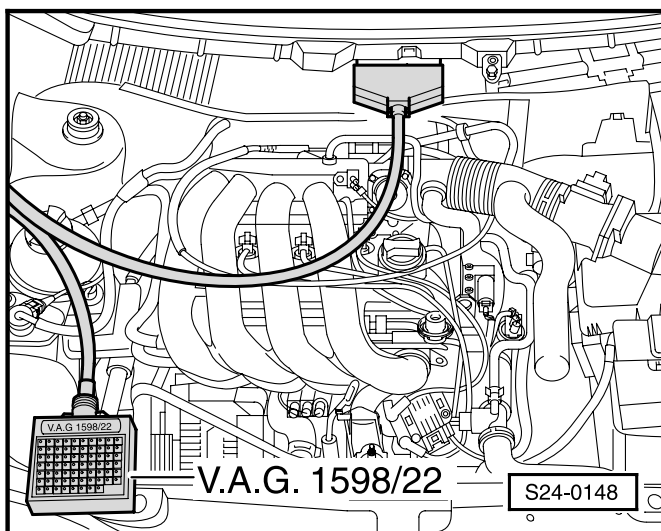
- ◀ - Unplug the connector -1- from the intake air temperature sender.



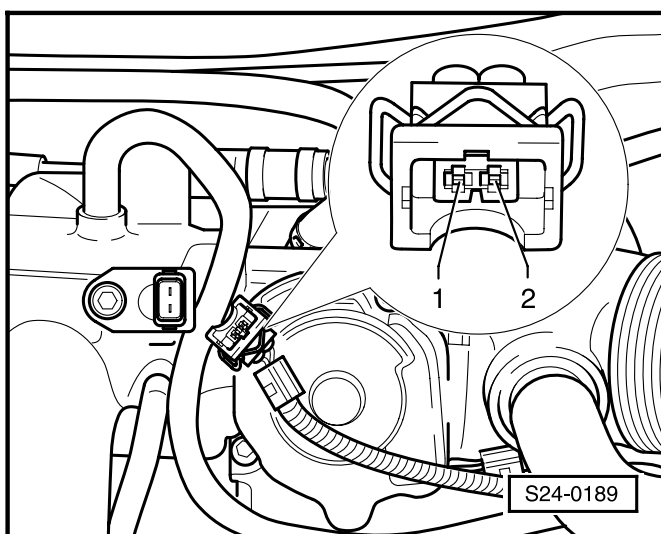
- ◀ - Connect the hand-held multimeter V.A.G 1526 A or multimeter V.A.G 1715 to the intake air temperature sender.

Specification: 2.0 ... 4.0 k Ω .

- If the specification is not achieved, replace intake air temperature sender.
- If the specification is achieved, test the wiring between sender connector and engine control unit as follows:



- ◀ - Connect test box V.A.G 1598/22 to the engine control unit wiring loom.



- ◀ - Test the cable connection from the 2-pin connector for the sender to the engine control unit for open circuit as well as for short circuit to positive and to earth on the basis of the current flow diagram.

Contact to 2-pin connector	Contact at control unit connector or test box
1	54
2	67

- If the tests carried out so far do not reveal any fault, replace the engine control unit
⇒ page 24-48.

Testing intake air temperature sender - valid 08.97 ➤

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Adapter cable set (e.g. V.A.G 1594)
- ◆ Current flow diagram
- ◆ Refrigerating spray

Notes:

- ◆ *If a fault exists at the sender or at the cable connections, the control unit operates with a substitute temperature of 19.5 °C.*
- ◆ *From 08.97 the intake air temperature sender (G42) is an integral part of the air mass meter (G70) and cannot be replaced separately.*

Test procedure

- Connect vehicle system tester V.A.G 1552. Then, switch the ignition on and select the engine control unit with the "address word" 01.
(Connecting vehicle system tester V.A.G 1552 and selecting engine control unit ⇒ page 01-3.)

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press keys 0 and 8 for the function „Read measured value block“ and confirm the entry with the key Q.

Read measured value block
Enter display group number XXX

HELP

◀ Readout in display:

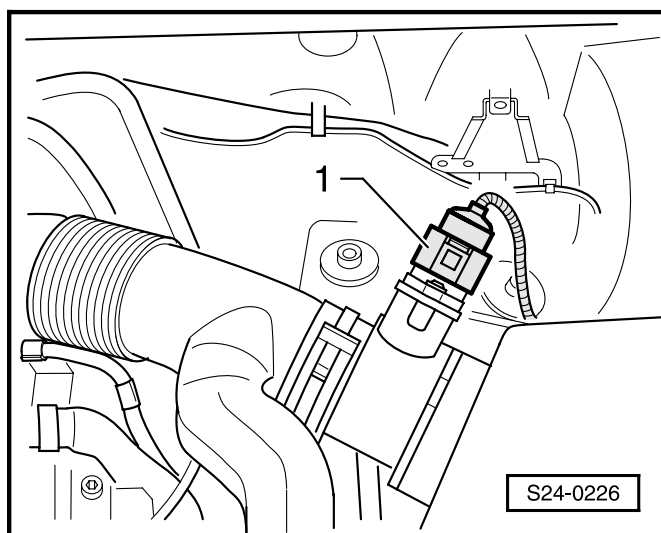
- Press keys 0, 0 and 3 for „Display group number 3“ and confirm the entry with the key Q.

Read measured value block	3	→
800 rpm	13.580 V	96.0 °C 45.0 °C

◀ Readout in display:
(1...4 = display blocks)

- Read off the intake air temperature in display block 4.

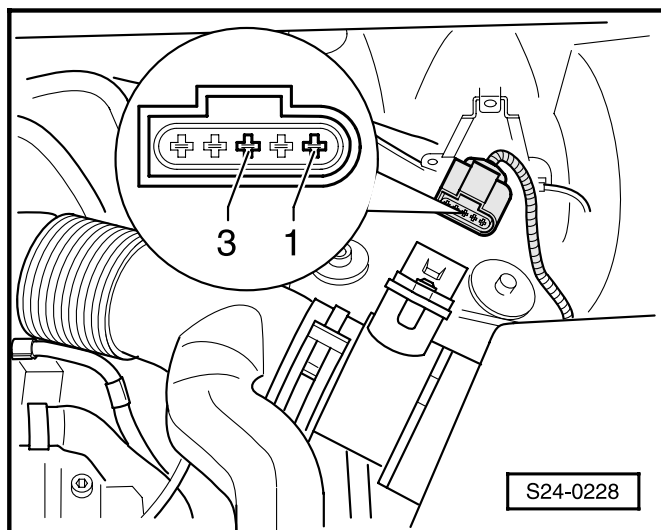
Readout	Cause	Continue test
approx. -46 °C	Open circuit or short circuit to positive	⇒ page 24-21.2
approx. 141 °C	Short circuit to earth	⇒ page 24-21.3
approx. ambient temperature ¹⁾	-	⇒ page 24-21.4



- ¹⁾ If the temperature displayed is below the ambient temperature of the sender, first of all test the sender cables for contact resistance. When doing this, note that the sender may be heated up by heat radiated from the engine when the car is stationary.

Continuation of test if readout approx. -46 °C:

- ◀ - Unplug the 5-pin connector -1- from the air mass meter with intake air temperature sender.



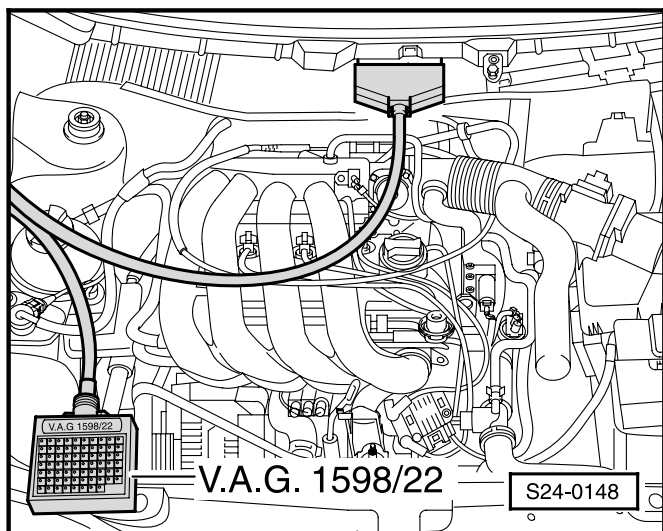
- ◀ - Bridge contacts 1 + 3 of the connector with auxiliary cables from V.A.G 1594 A and at the same time check the readout in the display.

If the readout jumps to approx. 141 °C:

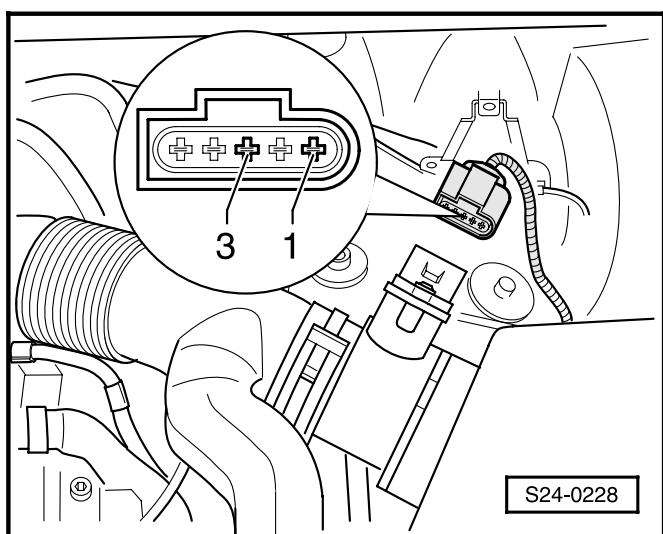
- Press the → key.
- Press keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.
- Switch off the ignition.
- Replace the air mass meter (G70) with the intake air temperature sender (G42).

If the readout remains at approx. -46 °C:

- Press the → key.
- Press keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.
- Switch off the ignition.



- ◀ - Connect test box V.A.G 1598/22 to the engine control unit wiring loom.

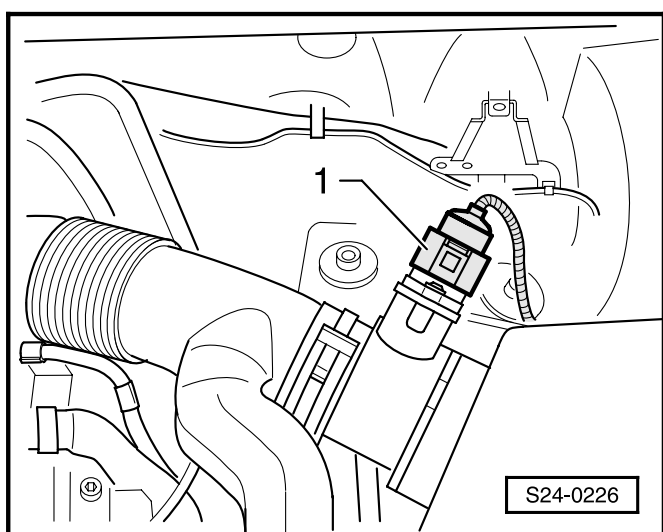


- ◀ - Test the cable connection from the 5-pin connector for the engine control unit sender for open circuit in wiring and also short circuit to positive or to earth on the basis of the current flow diagram.

Contact at 5-pin connector	Contact at control unit connector or test box
1	40
3	12

If no fault is found in the wiring:

- Replace the engine control unit
⇒ page 24-48.



Continuation of test if readout approx. 141 °C:

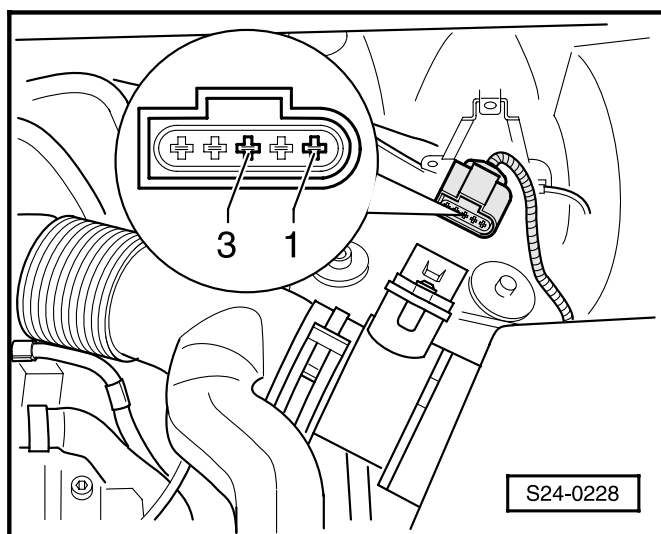
- ◀ - Unplug the 5-pin connector -1- from the air mass meter.

If the readout jumps to approx. -46 °C:

- Press the → key.
- Press keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.
- Switch off the ignition.
- Replace the air mass meter (G70) with the intake air temperature sender (G42).

If the readout remains at approx. 141 °C:

- Press the → key.



- Press keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.
- Switch off the ignition.
- Unplug the connector from the engine control unit.
- ◀ - Test the wiring to the control unit connector at the 5-pin connector contact 1 for short circuit to cable contact 3 and also to chassis earth.

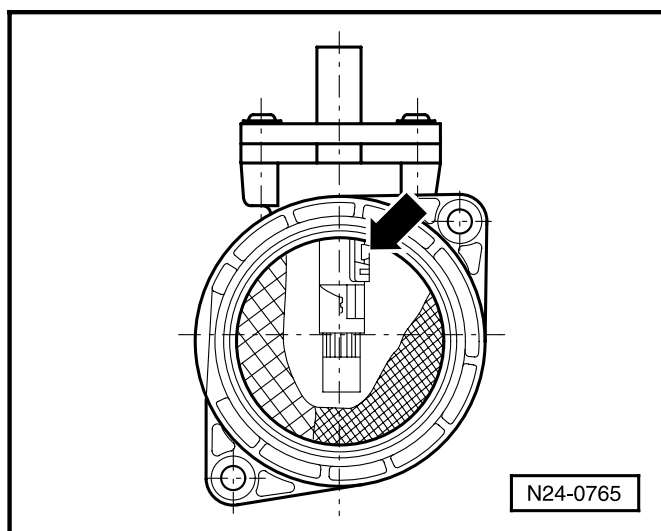
Specification: $\infty \Omega$

If no fault is found in the wiring:

- Replace the engine control unit
⇒ page 24-48.

Continuation of test if readout is ambient temperature:

- Remove the intake hose between air mass meter and throttle valve control unit.
- Note the intake air temperature shown in display block 4.
- ◀ - Spray the sender -arrow- with a commercially available refrigeration spray and check the temperature indicated. The temperature readout should drop.
- Press the → key.
- Press keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.



Testing engine speed sender

Special tools, testers and aids required

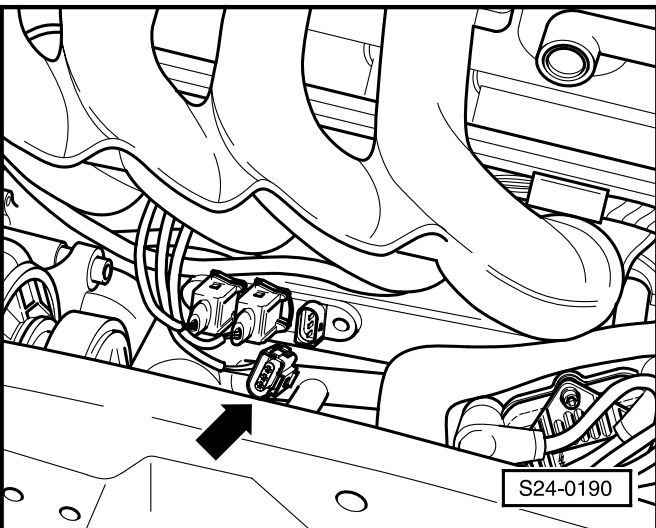
- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter, e.g. V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Current flow diagram

Notes:

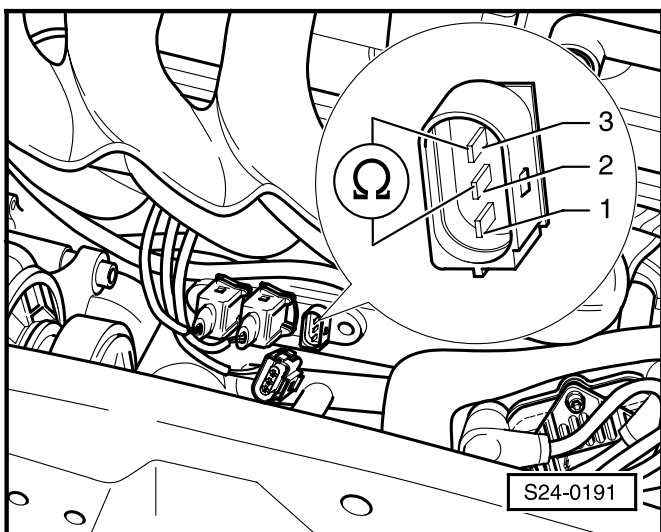
- ♦ The engine speed sender is an rpm and reference mark sender. If no signal is supplied by -G28, it is not possible to start the engine. If the signal from -G28 fails when the engine is running, the engine will then stop immediately.
- ♦ ⇒ Reading measured value block, display group 003, display field 1 for the operational test of the engine speed sender.

Testing engine speed sender

- Before carrying out the test, check to ensure sender is correctly installed and tight.
- ◀ - Unplug the connector of the engine speed sender (identification: grey plug connection).

**Important!**

Switch on the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.



- ◀ - Connect the hand-held multimeter V.A.G 1526 (resistance measurement) to contacts 2 and 3 of the connector in the connector holder using the test cable from V.A.G 1594.

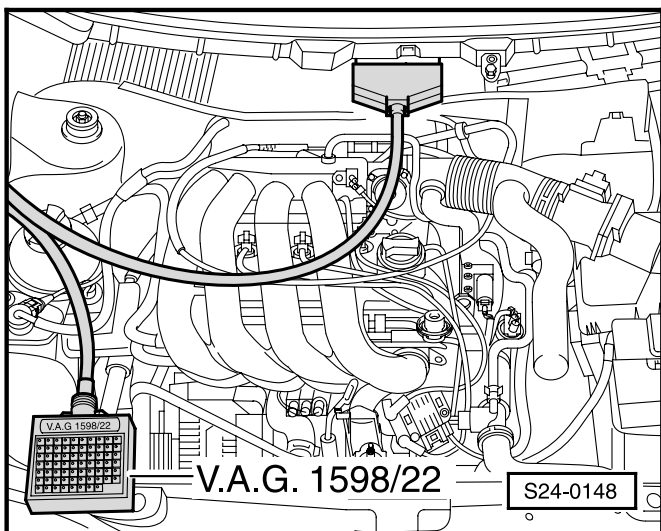
Specification: about 450...1000 Ω

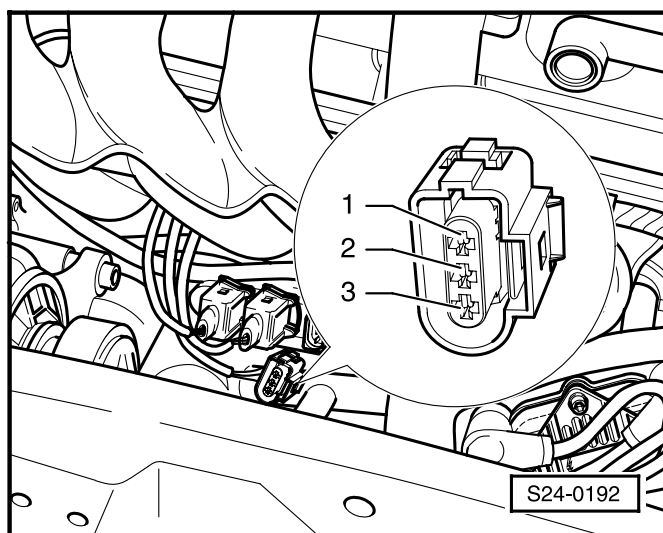
- If the specification is not achieved, replace engine speed sender.
- If the specification is achieved, connect the hand-held multimeter to contacts 2 and 1 (earth) and also to contacts 3 and 1 (earth).

Specification in each case: $\infty \Omega$ (no continuity).

- If the specification is not achieved, replace the engine speed sender.
- If the specification is achieved, test the wiring between sender connector and engine control unit as follows:

- ◀ - Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48, Replacing engine control unit.





- ◀ - Test screening from contact 1 of the connectors to socket 67 of the test box for continuity.

Specification: max. 1 Ω .

- Test earth cable from contact 2 of the connectors to socket 63 of the test box for continuity.

Specification: max. 1 Ω .

- Test signal cable from contact 3 of the connectors to socket 56 of the test box for continuity.

Specification: max. 1 Ω .

- If the specifications are not achieved, rectify short circuit or open circuit in wiring.
- If there is neither an open circuit in the wiring nor a short circuit, replace the engine control unit $\Rightarrow$ page 24-48.

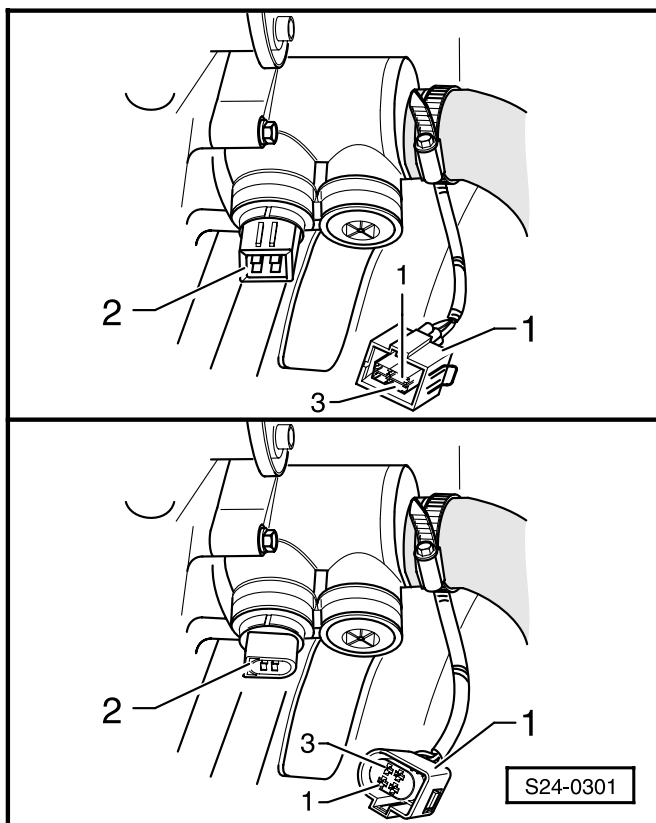
Testing coolant temperature sender (G62)

Special tools, testers and aids required

- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Test box V.A.G 1598/22

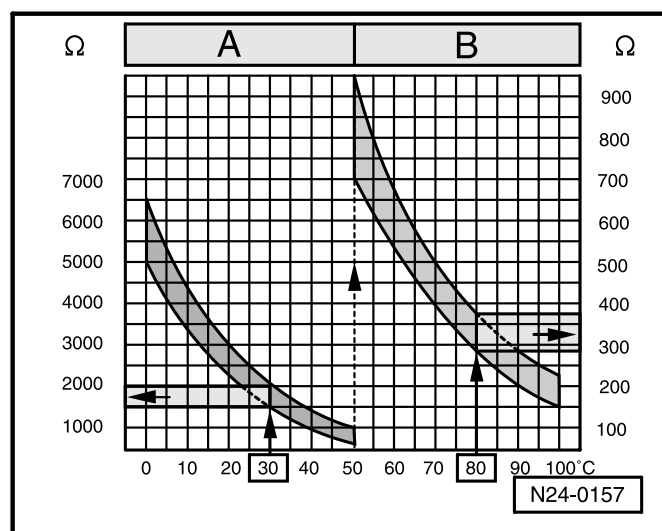
Notes:

- ◆ *For the operational test of the coolant temperature sender, refer also to Reading measured value block, display group 003, display block 3 $\Rightarrow$ page 01-46.*



- Unplug the connector at the coolant temperature sender.

- ◀ - Test the resistance between contact 1 (earth) and contact 3 (signal) of the sender.



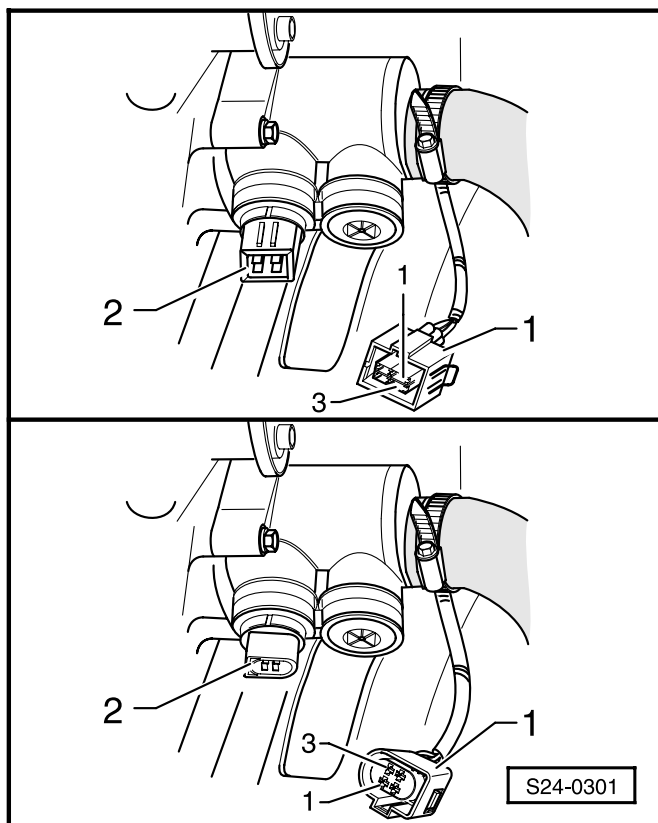
- ◀ The range A indicates the resistances for the temperature range 0...50 °C, range B the resistances for the temperature range 50...100 °C.

Examples of reading chart:

- ◆ 30 °C equals a resistance of 1500...2000 Ω
- ◆ 80 °C equals a resistance of 275...375 Ω
- If the specification is not achieved, replace the sender.

If the specification is achieved, test the wiring from the sender to the engine control unit as follows:

- Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit
⇒ page 24-48.



- Test the earth cable from contact 1 of the connector for coolant temperature sender to socket 67 of the test box for continuity.

Specification: max. 1 Ω .

- Test the signal cable from contact 3 of the connector for coolant temperature sender to socket 53 of the test box for continuity.

Specification: max. 1 Ω .

- Test both cables for short circuit to each other.
- If the specifications are not achieved, rectify the short circuit or the open circuit in the wiring between the connector for coolant temperature sender and connector of control unit.

Connector at coolant temperature sender	Test box V.A.G 1598/22
1	67
3	53

- If there is neither a short circuit nor an open circuit in the wiring, and the coolant temperature sender is o.k., replace the engine control unit $\Rightarrow$ page 24-48.

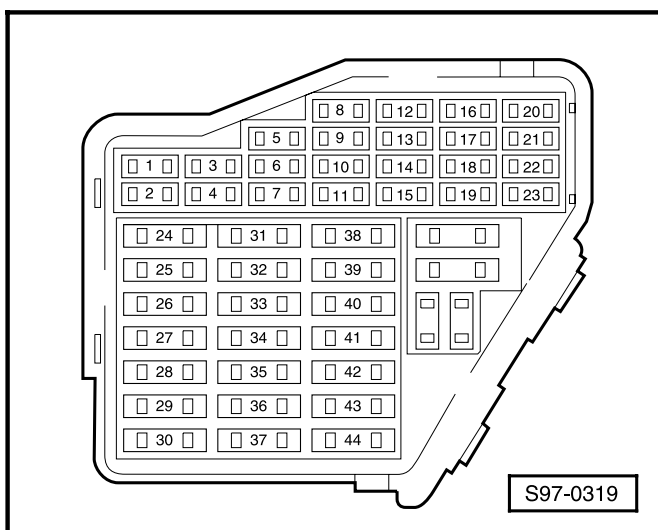
Testing voltage supply for control unit

Special tools, testers and aids required

- Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- Test box V.A.G 1598/22
- Hand-held multimeter (e.g. V.A.G 1526 A)
- Adapter cable set (e.g. V.A.G 1594 A)
- Current flow diagram

Test conditions:

- Battery voltage at least 11 V
- Generator o.k.
- Fuses 10, 29, 32 for engine control unit o.k.



Test procedure

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm the entry with the key Q.

Read measured value block
Enter display group number XXX

HELP

◀ Readout in display:

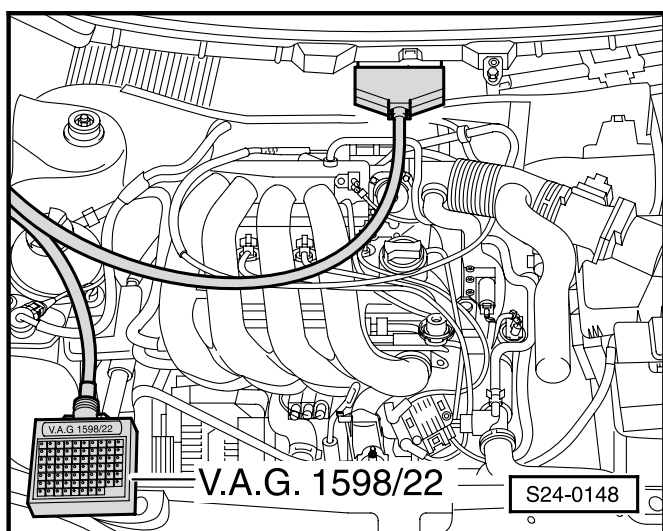
- Press the keys 0, 0 and 3 for "Display group number 003" and confirm the entry with the key Q.

Read measured value block 3 →
800 rpm **13.580 V** 96.0 °C 45.0 °C

◀ Readout in display (example):
1...4 = display blocks

- Check the readout in display block 2.
Specification: approx. battery voltage
- Press the → key.
- Press keys 0 and 6 for the function "End output" and confirm the entry with the key Q.
- Switch off the ignition.

If the specification is not achieved:

**Testing voltage supply of terminal 30**

- ◀ Connect test box V.A.G 1598/22 to the wiring loom of the control unit.
- Use the multimeter to measure the supply voltage between sockets 2+3 of the test box:
Specification: at least 11 V

Testing voltage supply of terminal 15

- Switch the ignition on.
- Use the multimeter to measure the supply voltage between sockets 2+1 of the test box:
Specification: at least 11 V

If the specifications are not achieved:

- Test the cable connections to the relay plate according to the current flow diagram.

Testing fuel pressure regulator and holding pressure

Special tools, testers and aids required

- ◆ Pressure measuring device e.g. V.A.G 1318
- ◆ Pressure hose with connections e.g. V.A.G 1318/8
- ◆ Adapter e.g. V.A.G 1318/9
- ◆ Adapter e.g. V.A.G 1318/7

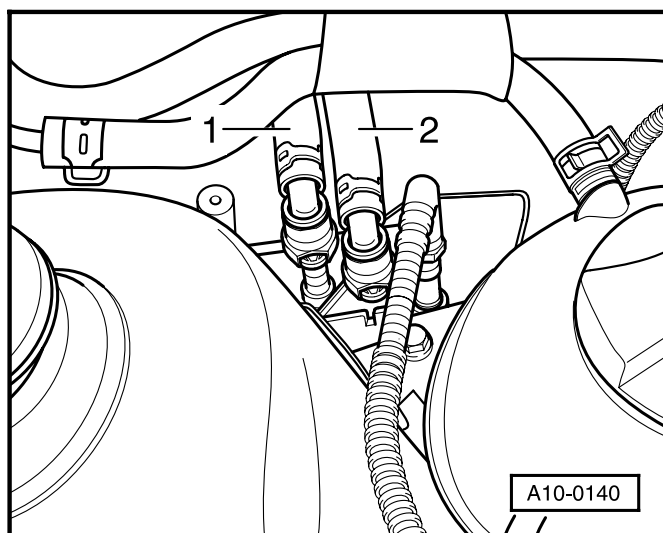
Test conditions

- Delivery and fuel pump o.k.; testing:
⇒ Engine, Mechanical Components; Repair Group 20; Removing and installing parts of the fuel supply system; Testing fuel pump
- Fuel pump relay o.k.; testing ⇒ page 24-36.
- Fuel filter o.k.
- Battery voltage o.k.

Test procedure

Note:

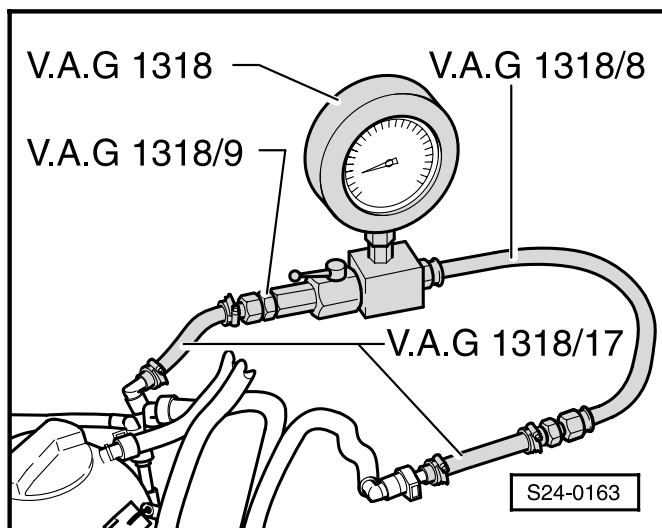
The fuel pressure regulator controls the fuel pressure as a function of the intake manifold pressure at the throttle valve body.



Important!

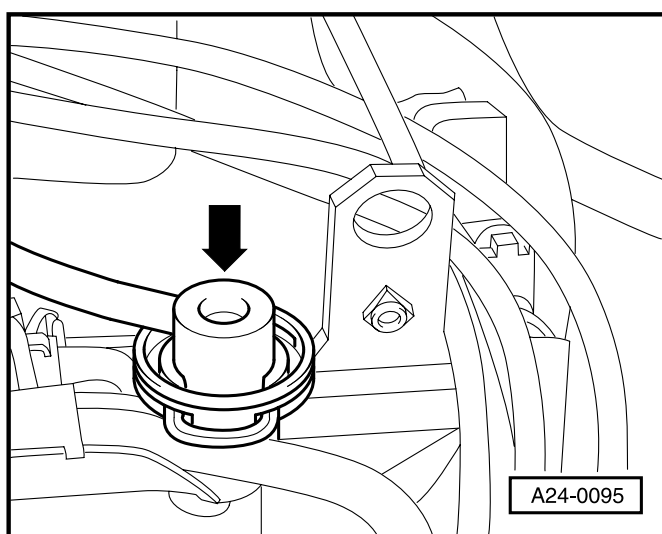
The fuel system is pressurized! Place cleaning rags around the connection point before opening the system. Then, release the pressure by carefully detaching the connection point.

- ◀ - Disconnect the fuel feed hose -1- (with white marking) from the feed pipe.



- ◀ - Connect the pressure measuring device V.A.G 1318 to the feed pipe with the adapters 1318/8, 1318/9 and 1318/17.
- Open the shut-off cock of the pressure measuring device. The lever points in direction of flow.
- Start the engine and run at idling speed.
- Measure the fuel pressure.

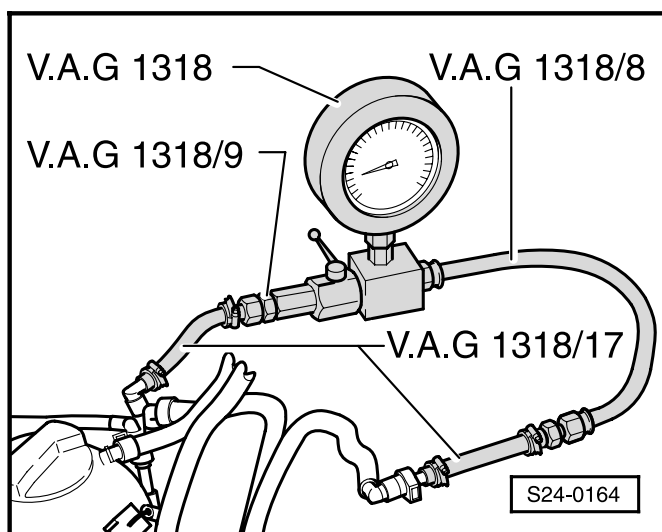
Specification: about 0.25 MPa.



- ◀ - Detach the vacuum hose from the fuel pressure regulator. The fuel pressure should rise to about 0.3 MPa.
- Switch off the ignition.
- Inspect for leaks and test the holding pressure by observing the pressure drop at the pressure gauge. At least 0.15 MPa pressure should still exist after 10 minutes.

If the holding pressure drops below 0.15 MPa:

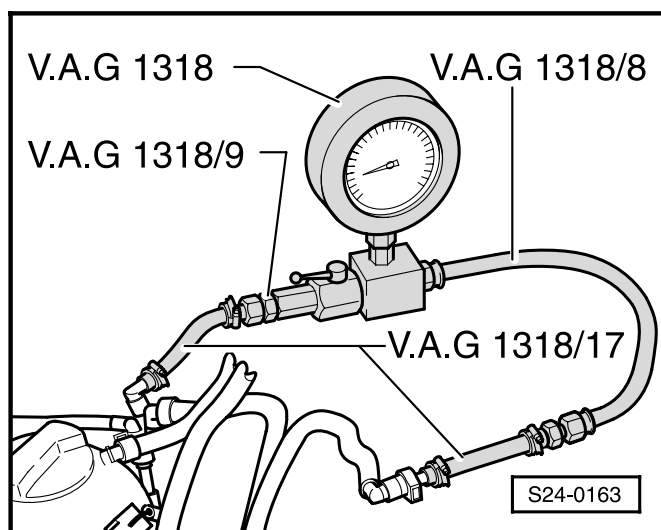
- Start the engine and run at idling speed.



- ◀ - After building up pressure, switch off the ignition. At the same time close the shut-off cock of the pressure measuring device V.A.G 1318 (lever at right angles to direction of flow).
- Observe the pressure drop on the pressure gauge.

If the pressure does not drop:

- Test the non-return valve of the fuel pump.



If the pressure again drops:

- ◀ - Open the shut-off cock of the pressure measuring device V.A.G 1318 (lever in direction of flow).
- Start the engine and run at idling speed.
- After the pressure has built up, switch off the ignition. At the same time pinch off the return-flow hose (blue marking) tight.

If the pressure does not drop:

- Replace the fuel pressure regulator.

If the pressure again drops:

- Inspect the pipe connections, O-rings at fuel rail and injectors for leaks.
- Inspect the pressure measuring device for leaks.

Note:

Release fuel pressure by opening the shut-off cock before disconnecting the pressure measuring device. Hold vessel in front of connection for this step.

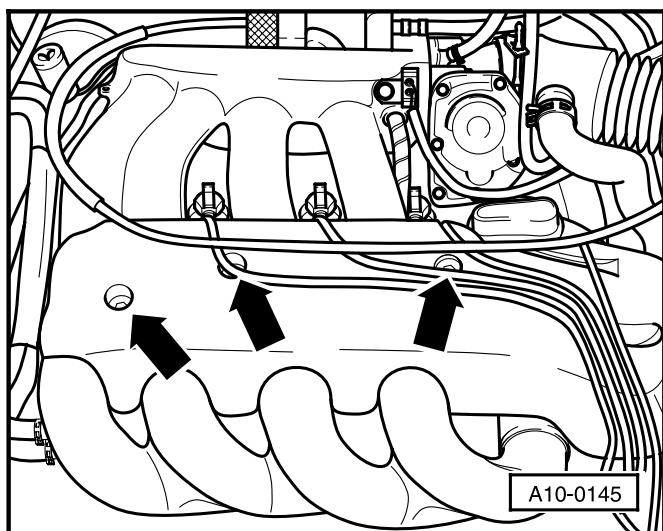
Testing quantity injected, leaktightness and spray pattern of injectors

Special tools, testers and aids required

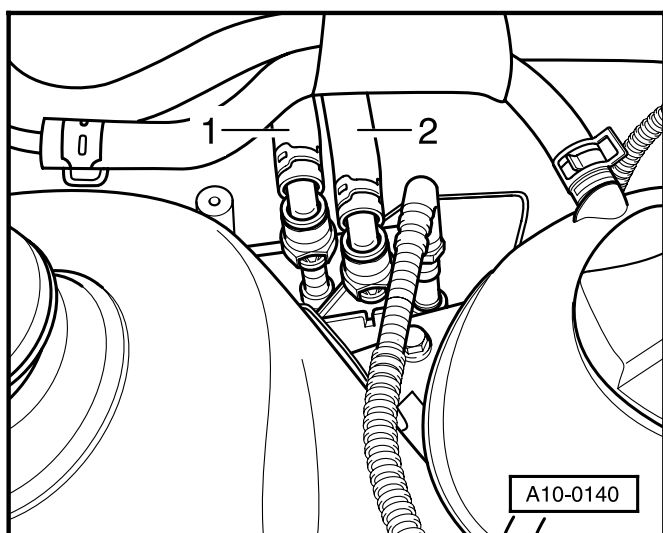
- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Remote control V.A.G 1348/3A with adapter cable V.A.G 1348/3-2
- ◆ Tester for quantity injected, e.g. V.A.G 1602

Test condition

- Fuel pressure o.k.; Testing ⇒ page 24-27.


Test procedure - valid ► 07.97:

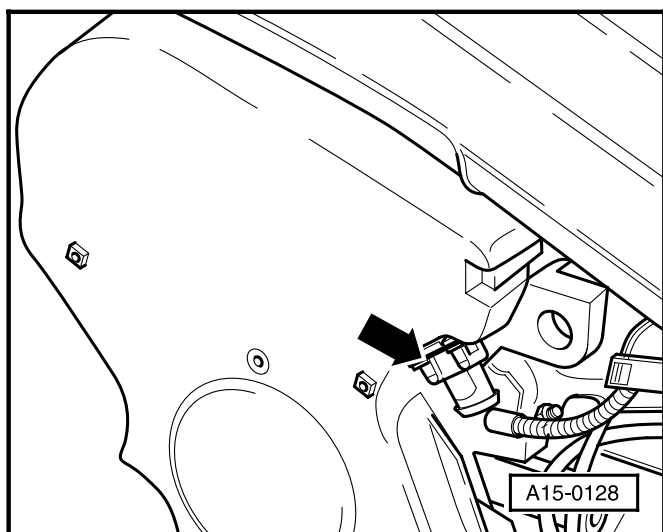
- Unclip throttle cable and ignition cables from the ignition cable guide.
- ◀ - Remove ignition cable guide -arrows-.
- Detach vacuum hose from the fuel pressure regulator.



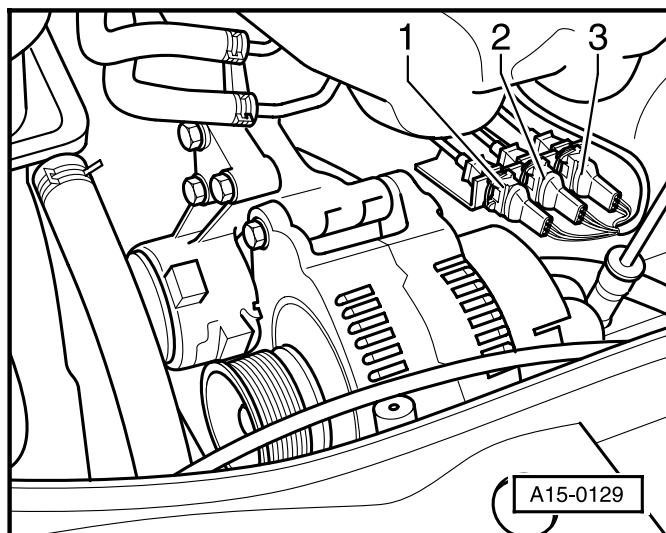
- ◀ - Detach fuel feed pipe -1- and fuel return-flow line -2- (press release catches).

Warning!

Fuel feed line is pressurized! Place cleaning rags around the connection point before detaching the hose connections. Then, release pressure by carefully detaching the hose.



- ◀ - Unplug connector from the Hall sender (G40) -arrow-.

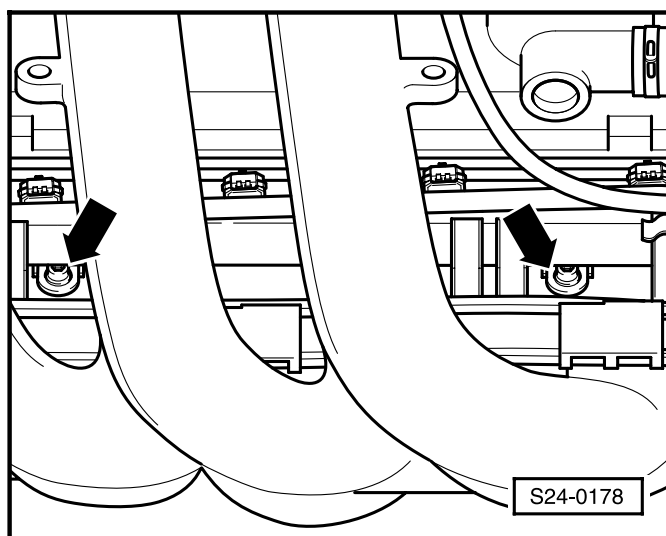


◀ - Unplug the following electrical connections:

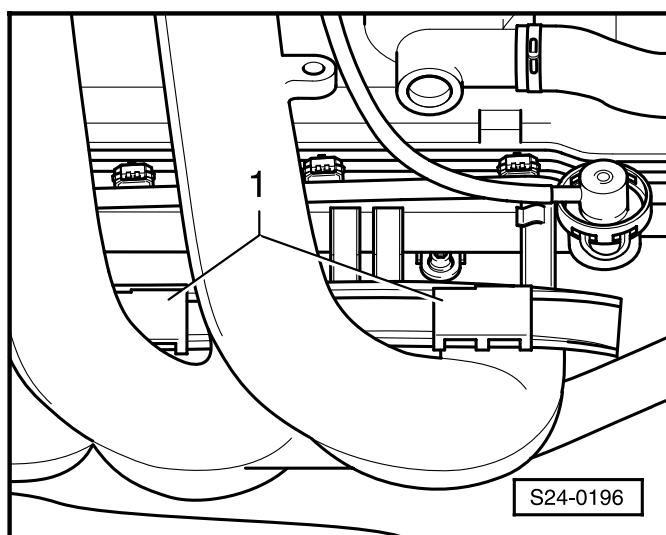
- ◆ Knock sensor I (G61) -1- black connector
- ◆ Knock sensor II (G66) -2- brown connector
- ◆ Engine speed sender (G28) -3- grey connector

- Unplug connectors from the injectors, knock sensors and engine speed sender.

- Unclip wiring loom from the cable guide and remove.



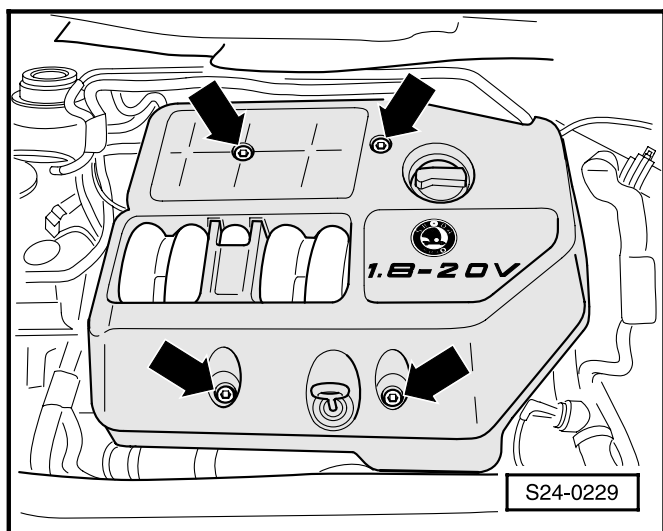
◀ - Unbolt fuel rail from the intake manifold by removing the two securing screws -arrows-.



◀ - Unclip cable guide -1- toward the front of the vehicle and remove toward the gearbox side.

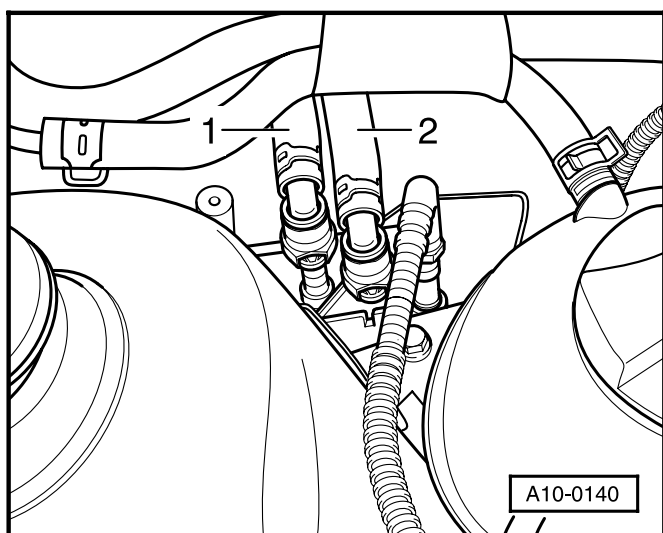
Note:

The activated charcoal filter, power steering reservoir and windshield washer fluid reservoir have to be slackened and placed to the side, as described below, to facilitate removing the fuel rail.



Test procedure - valid 08.97 ►

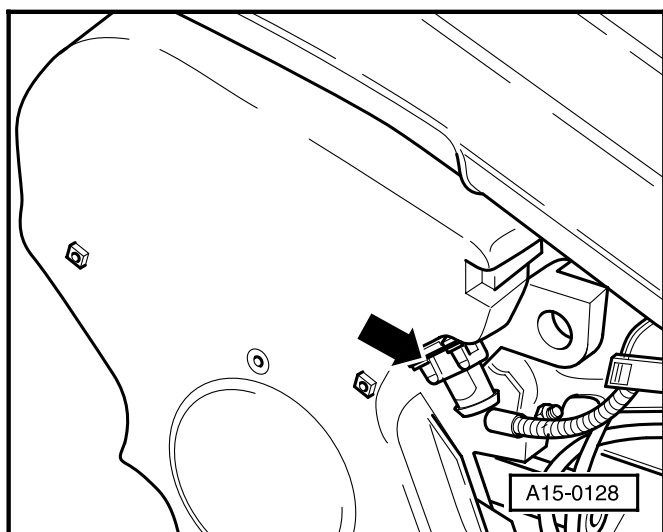
- ◄ - Remove intake manifold trim panel -arrows-.
- Unclip throttle cable from the cable guide.
- Detach vacuum hose from the fuel pressure regulator.
- Remove top part of intake manifold.



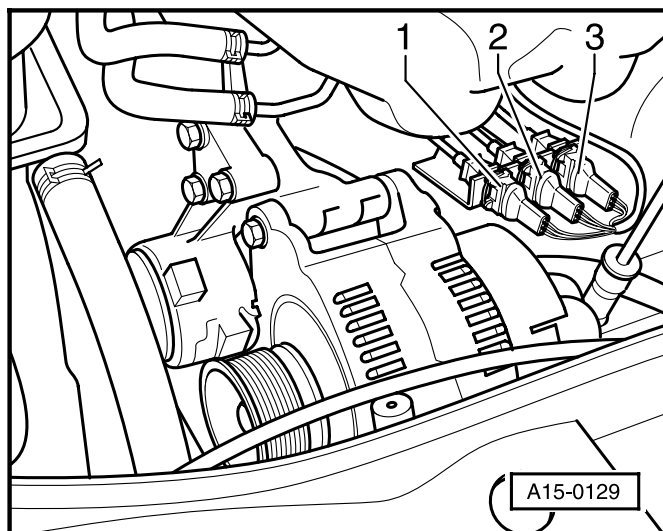
- ◄ - Detach fuel feed pipe -1- and fuel return-flow line -2- (press release catches).

Warning!

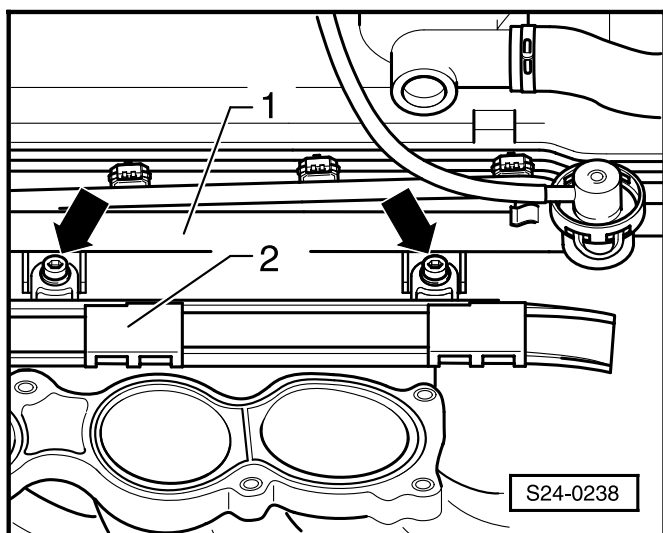
Fuel feed line is pressurized! Place cleaning rags around the connection point before detaching the hose connections. Then, release pressure by carefully detaching the hose.



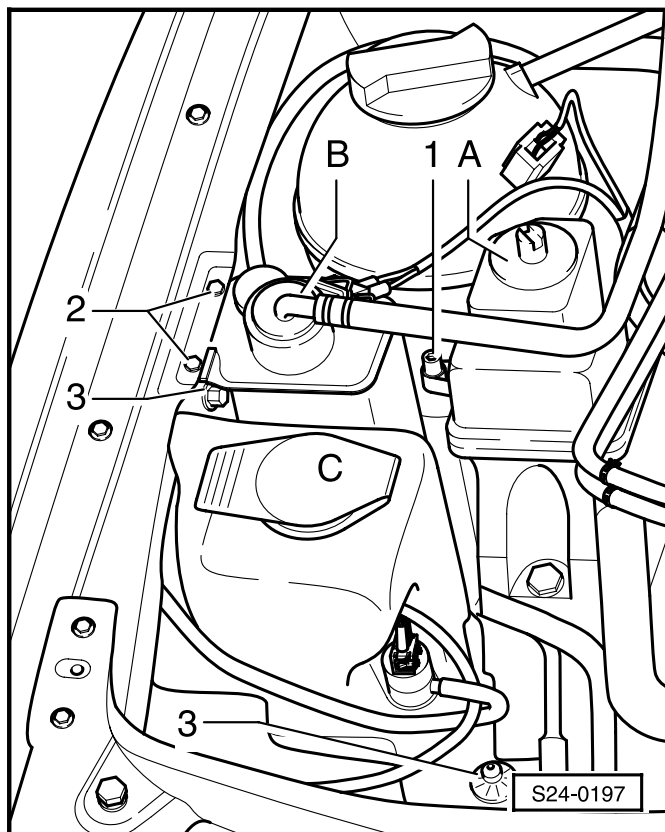
- ◄ - Unplug connector from the Hall sender (G40) -arrow-.

**Valid for all models**

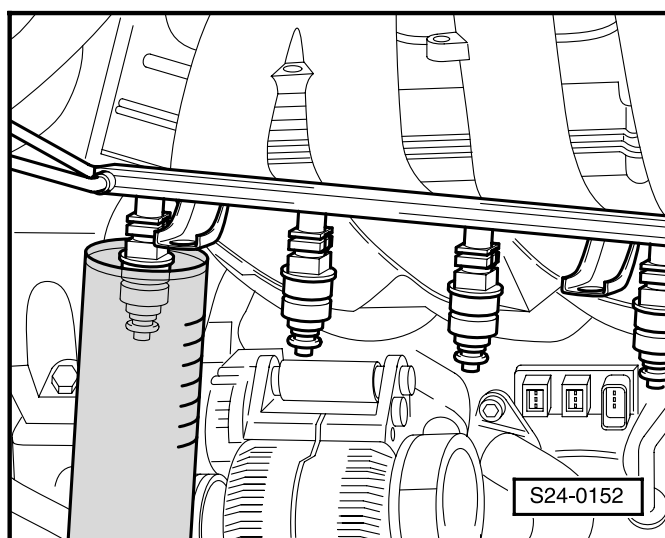
- ◀ - Separate the following electrical connections:
 - ♦ Knock sensor I (G61) -1-, black connector
 - ♦ Knock sensor II (G66) -2-, brown connector
 - ♦ Engine speed sender (G28) -3-, grey connector
- Unplug the connectors from the injectors, knock sensors and engine speed sender.
- Unclip wiring harness from the cable guide and remove.



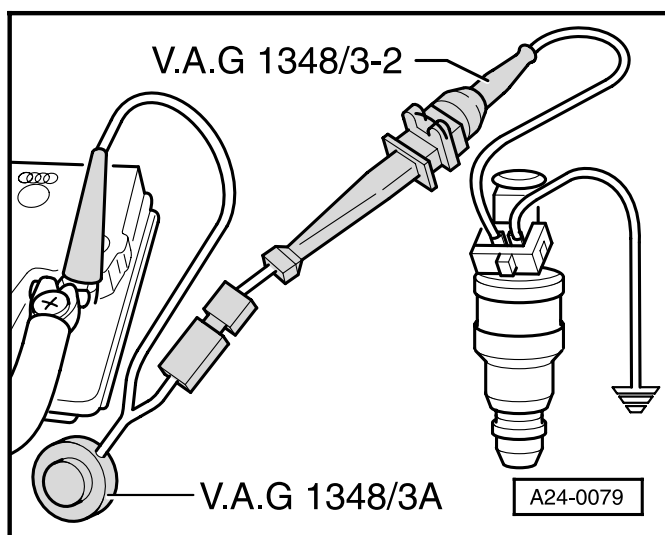
- ◀ - Unbolt fuel rail -1- and cable guide -2- from the intake manifold; remove the two securing screws -arrows- for this step.



- ◀ - Unscrew bolt -1- of the power steering reservoir -A-, bolts -2- of activated charcoal filter -B- and nuts -3- of the windshield washer reservoir -C-.
- Place reservoirs to the side with pipes/cables connected.
- Lift fuel rail up and out of the holes of the bottom part of the intake manifold together with the injectors.
- Turn fuel rail together with the injectors so that the undersides of the injectors are facing up.
- Carefully pull out fuel rail together with the injectors to the left.



- Fit on fuel feed and fuel return-flow pipes again.
- ◀ - Insert the injector to be tested in a measuring glass of the tester for quantity injected, e.g. V.A.G 1602.



- ◀ - Connect one contact of the injector to engine earth using test cable and crocodile clamp from V.A.G 1594.
- Connect second contact of the injector to positive using remote control V.A.G 1348/3 A, adapter cable V.A.G 1348/3-2 and auxiliary cable.
- Start final control diagnosis (function 03) ⇒ page 01-30. The fuel pump should run.

- Inspect the injectors for leaks (visual inspection). When fuel pump is running, only 1...2 drops a minute should flow out of each injector.
- If the fuel loss is greater, switch off fuel pump (end final control diagnosis) and replace the faulty injector.
- Once again start final control diagnosis, if necessary.

Note:

The ignition has first of all to be switched off briefly before it is possible to again start final control diagnosis.

- Operate remote control V.A.G 1348/3 A for 30 seconds.
- Carry out measurement at all the injectors.
- After all four injectors have been actuated, position the measuring glasses on a flat surface.

Specification: 85...105 ml

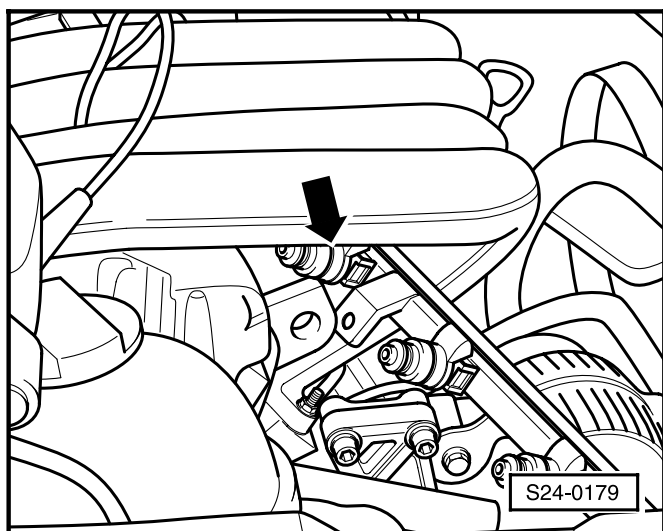
- If the measurement obtained for one or several injectors is not within the tolerance, switch off fuel pump (end final control diagnosis) and replace the faulty injector.
- If the measurements obtained for all the injectors are not within the tolerance, test fuel pressure ⇒ page 24-27.

Note:

When testing the quantity of fuel injected, also inspect the spray pattern. The spray ejected should be identical at all injectors.

Before installing the injectors, pay attention to the following points:

- Replace O-rings at all opened connection points. (The plastic cap on the injector head must on no account be removed for replacing the front O-ring - lift the O-ring over the plastic cap).
- Moisten O-rings with clean engine oil.
- Check to ensure the injectors are correctly installed.
- Check to ensure the retaining clips are correctly fitted on.



► 07.97

- ◄ - Carefully insert fuel rail with injectors between top part of intake manifold and lifting eye of the cylinder head.
- Press fuel rail with injection nozzles into the holes of the bottom part of the intake manifold.
- Re-install cable guide.
- Insert bolts for attaching fuel rail and tighten.
- Installation of the remaining parts is carried out in the reverse order to removing.

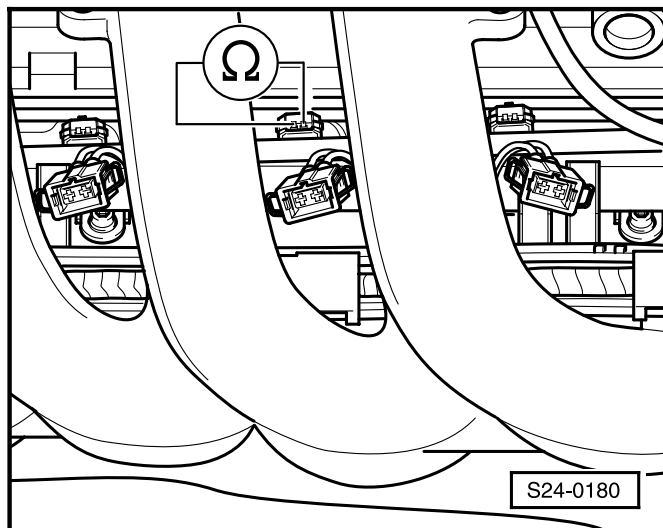
08.97 ►

- Press fuel rail with injection nozzles into the holes of the bottom part of the intake manifold.
- Re-install cable guide.
- Screw in bolts for attaching fuel rail and cable guide and tighten.
- Install top part of intake manifold.
- Installation of the remaining parts is carried out in the reverse order to removing.

Testing injectors - valid ► 07.97

Special tools, testers and aids required

- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter, e.g. V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Diode test lamp, e.g. V.A.G 1527
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Current flow diagram



Test conditions

- Engine speed sender o.k.
- Fuel pump relay o.k.

Test procedure

- Remove the ignition cable guide.

A - Electrical test of injectors

- Unplug the connector at the injector to be tested.
- ◀ - Use V.A.G 1526 A to carry out a resistance measurement between the contacts of the injector.
Specification: 13...18 Ω.

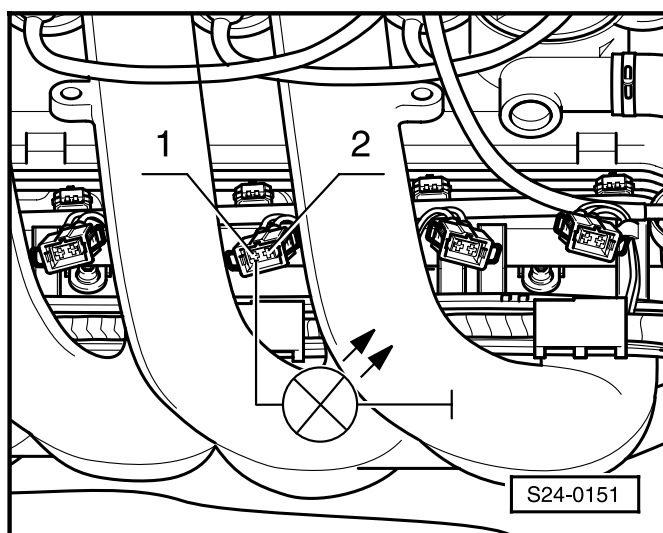
When engine is at operating temperature, the resistance is increased by approx. 4...6 Ω.

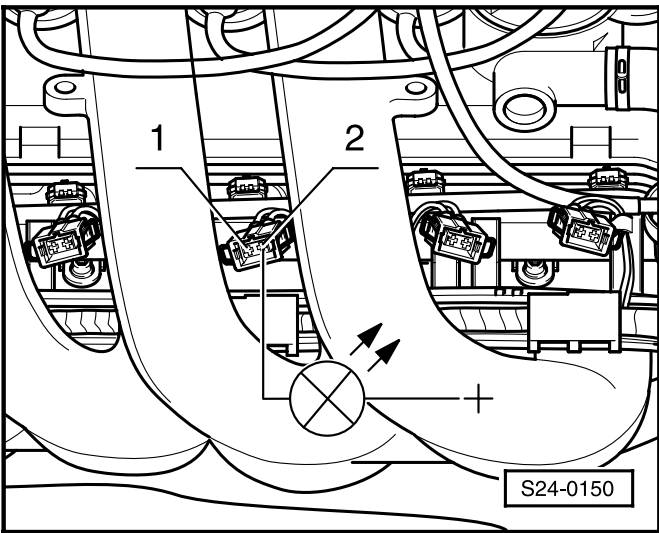
- If the specification is not achieved, replace injector.

B - Testing voltage supply

Test condition

- Fuse 32 for injectors o.k.
- Unplug connector at the injector to be tested.
- ◀ - Connect diode test lamp V.A.G 1527 between contact 1 and engine earth.
- Operate starter for a few seconds; the diode test lamp should come on.
- If the diode test lamp does not come on, test cable connection from contact 1 to fuse for injectors for continuity and rectify any open circuit.
- ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
- If the diode test lamp comes on, test actuation of the injectors.





C - Testing actuation of the injectors

- Unplug the connector at the injector to be tested.
- Connect diode test lamp V.A.G 1527 between contact 2 and battery positive.
- Operate starter for a few seconds (the engine may also start when this is done).

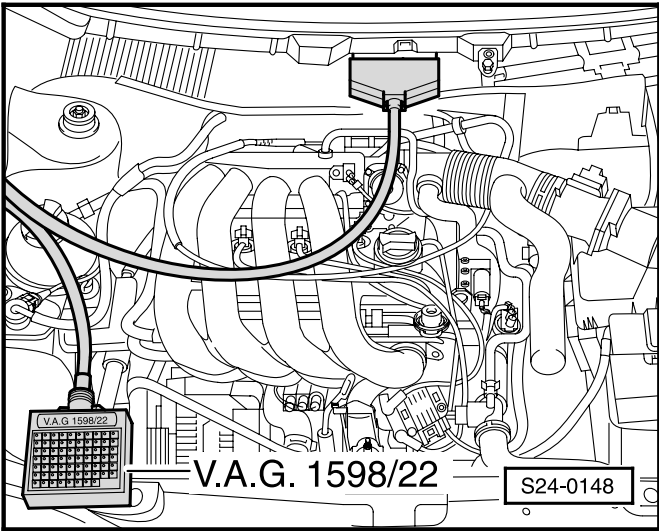
Specification: Diode test lamp should flash.

Note:

Diode test lamps with a low current consumption do not go out completely between the flash pulses, but continue to glow slightly and become significantly brighter during the flash pulse.

If the diode test lamp does not flash:

- Connect test box V.A.G 1598/22 to the engine control unit wiring loom.



Warning!

Set the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.

- Test the cable connection between contact 2 of the connector of the relevant injector and the engine control unit for continuity and for short circuit to positive.

Contact 2 at connector of injector	Test box V.A.G 1598/22 or -J220
1	73
2	80
3	58
4	65

- Rectify any open circuit in the wiring or short circuit.
- If the cable connection is o.k., replace engine control unit ⇒ page 24-48.

Testing injectors - valid 08.97 ➤**Special tools, testers and aids required**

- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter, e.g. V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Diode test lamp, e.g. V.A.G 1527
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Current flow diagram

Test conditions

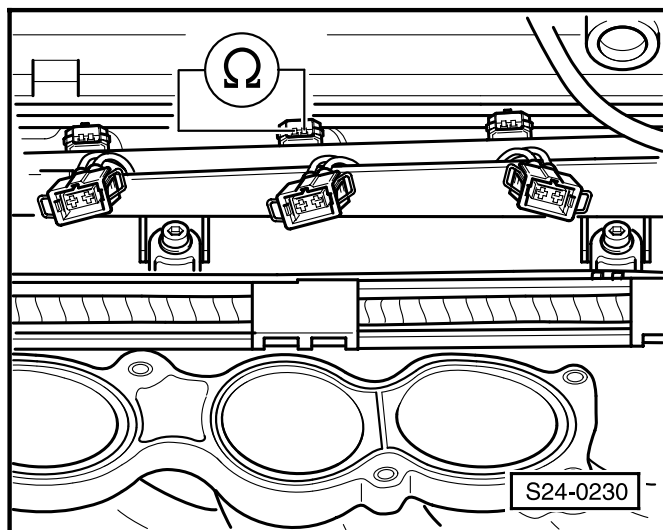
- Engine speed sender o.k.
- Fuel pump relay o.k.

Test procedure

- Remove the ignition cable guide.
- Remove the top part of the intake manifold.

A - Electrical test of injectors

- Unplug the connector at the injector to be tested.



- ◀ - Use V.A.G 1526 A to carry out a resistance measurement between the contacts of the injector.

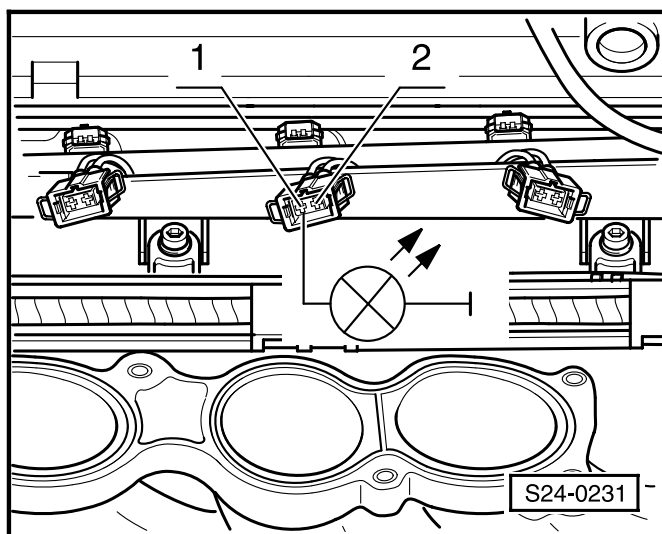
Specification: 13...18 Ω.

When engine is at operating temperature, the resistance is increased by approx. 4...6 Ω.

- If the specification is not achieved, replace injector.

B - Testing voltage supply**Test condition**

- Fuse 32 for injectors o.k.
- Unplug connector at the injector to be tested.
- ◀ - Connect diode test lamp V.A.G 1527 between contact 1 and engine earth.
- Operate starter for a few seconds; the diode test lamp should come on.
- If the diode test lamp does not come on, test cable connection from contact 1 to fuse for injectors for continuity and rectify any open circuit.
- ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
- If the diode test lamp comes on, test actuation of the injectors.

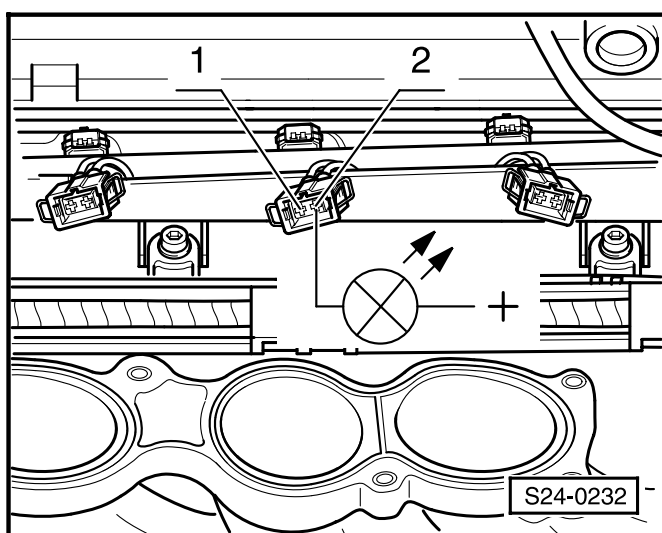
**C - Testing actuation of the injectors**

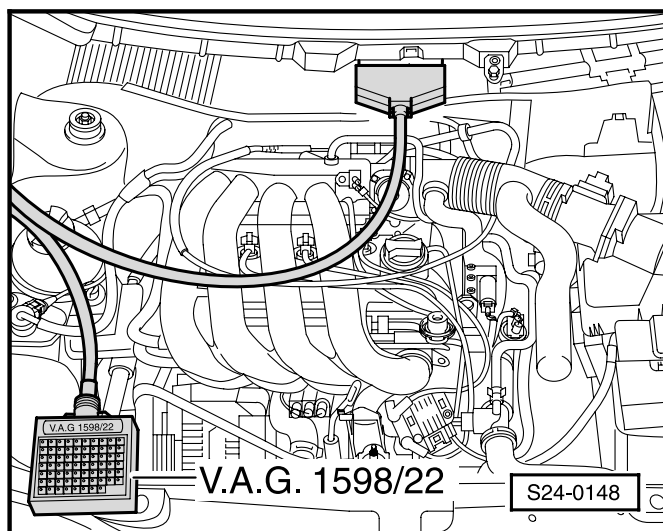
- Unplug the connector at the injector to be tested.
- ◀ - Connect diode test lamp V.A.G 1527 between contact 2 and battery positive.
- Operate starter for a few seconds (the engine may also start when this is done).

Specification: Diode test lamp should flash.

Note:

Diode test lamps with a low current consumption do not go out completely between the flash pulses, but continue to glow slightly and become significantly brighter during the flash pulse.





If the diode test lamp does not flash:

- Connect test box V.A.G 1598/22 to the engine control unit wiring loom.

Warning!

Set the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.

- Test the cable connection between contact 2 of the connector of the relevant injector and the engine control unit for continuity and for short circuit to positive.

Contact 2 at connector of injector	Test box V.A.G 1598/22 or -J220
1	73
2	80
3	58
4	65

- Rectify any open circuit in the wiring or short circuit.
- If the cable connection is o.k., replace engine control unit ⇒ page 24-48.

Testing fuel pump relay and actuation

Special tools, testers and aids required

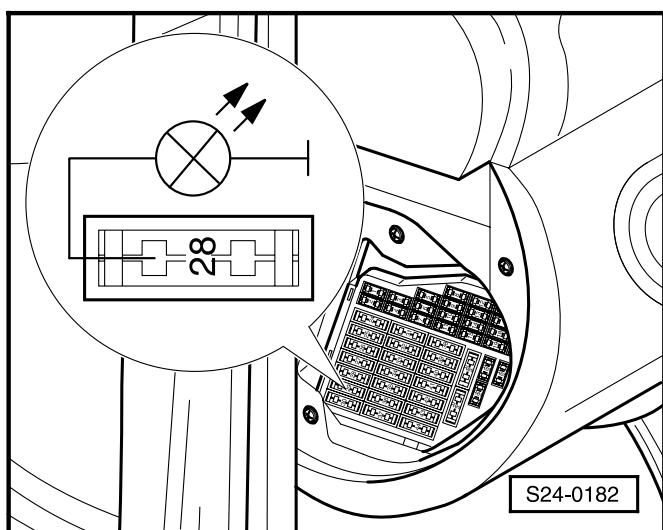
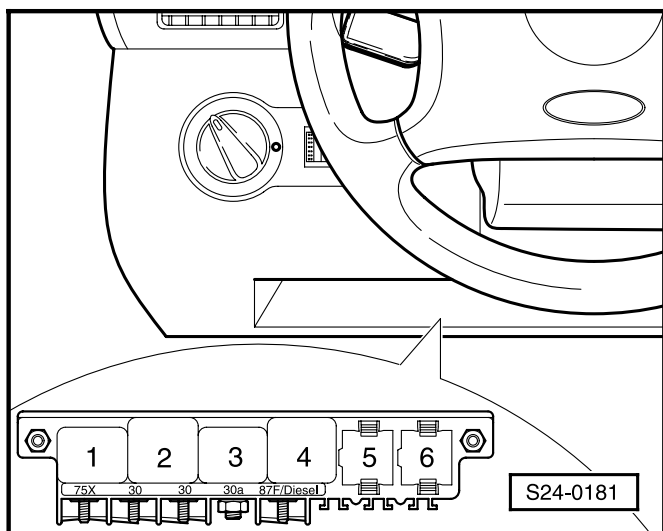
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Diode test lamp (e.g. V.A.G 1527)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Current flow diagram

Test condition

- Fuse 132 at the fuse holder at the battery must be o.k.

Note:

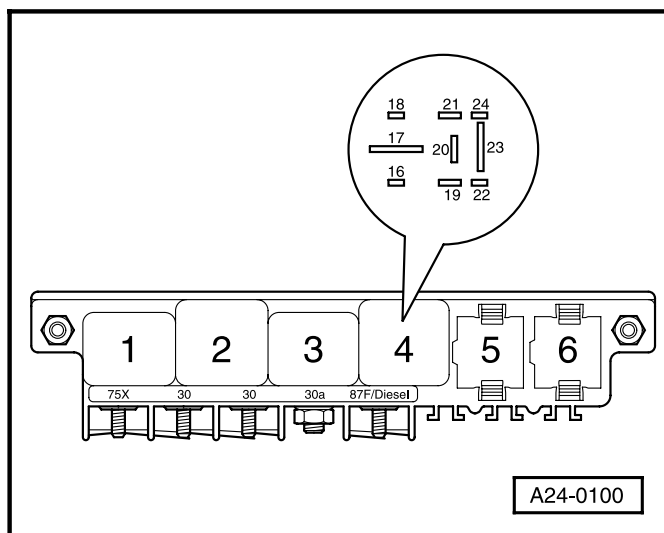
- ◀ The fuel pump relay is located in the electrical centre in the interior of the vehicle behind the storage compartment in the driver footwell, relay position 4.



A - Testing fuel pump relay -J17

- Remove the storage compartment in the front left footwell.
- ◀ - Pull out fuse 28 at the fuse holder and connect diode test lamp V.A.G 1527 between earth and one of the two contacts of fuse 28.
- Briefly operate the starter.

Fuel pump relay must operate (can be felt and heard), diode test lamp must come on.



- If the diode test lamp does not come on although the fuel pump relay operates, repeat the test at the other contact.
- ◀ - If the diode test lamp again does not come on, test cable connection between contact 23 and relay position 4 and fuse 28 for continuity and rectify any open circuit.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
- If no open circuit can be found, replace fuel pump relay.
- If the fuel pump relay does not operate, test actuation ⇒ page 24-37.
- If the voltage supply and the actuation are o.k., replace fuel pump relay.

B - Testing voltage supply and actuation of fuel pump relay

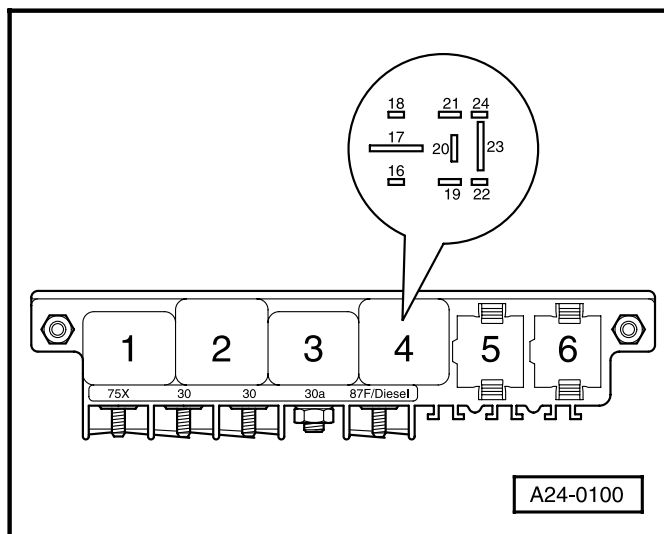
- Remove fuel pump relay -J17 from the central electric's, relay position 4.

Testing voltage supply

- Switch on the ignition.

Important!

Switch on the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.



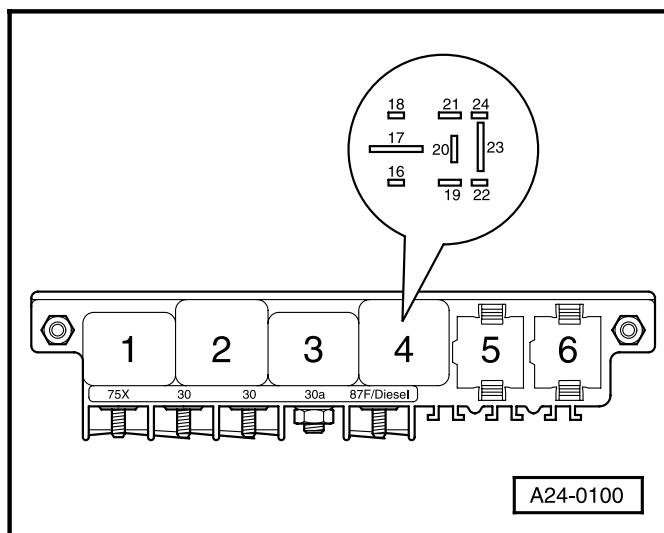
- ◀ - Connect hand-held multimeter V.A.G 1526 in turn to contact 19 (positive) and earth and also to contact 17 (positive) and earth of the relay base.

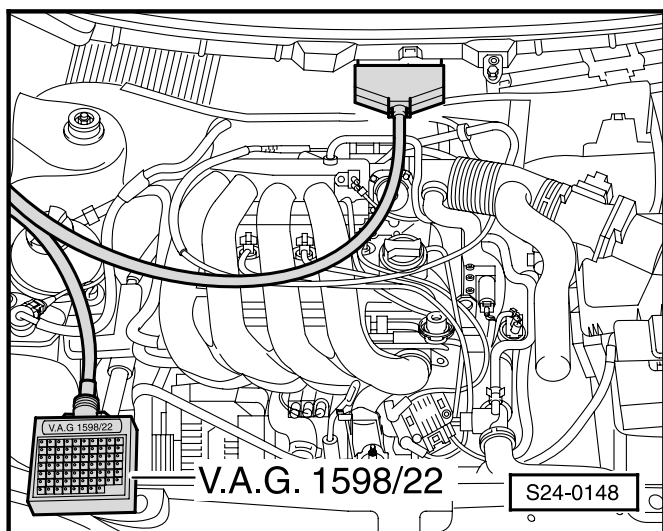
Specification in each case: about battery voltage

- If the specifications are not achieved, rectify open circuit in wiring.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

Testing actuation

- ◀ - Connect diode test lamp V.A.G 1527 to contact 16 (earth) and positive.
- The diode test lamp should come on and remain on when the starter is operated.



**Note:**

Diode test lamps with a low current consumption do not go out completely, but continue to glow until the starter is operated.

If the diode test lamp does not come on, test the cable as follows:

- ◀ - Connect test box V.A.G 1598/22 to the engine control unit wiring loom.
- Connect the hand-held multimeter between contact 16 of the relay base and socket 4 of the test box and test the cable connection for continuity.
- Rectify any open circuit in the wiring.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
- If no open circuit is present and the diode test lamp does not come on, replace engine control unit ⇒ page 24-48.
- If actuation of the fuel pump relay and the cable connection are o.k., replace fuel pump relay.
- Re-insert fuse 28.

Testing air mass meter - valid**➤ 07.97****Special tools, testers and aids required**

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter, e.g. V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Current flow diagram

Test conditions

- Fuse 43 should be o.k.
- The coolant temperature should be at least 85 °C.
- All electrical components switched off.
- Air conditioning of car switched off, if fitted.
- On vehicles with automatic gearbox, selector lever should be in position „P“ or „N“.

Testing operation

- Connect the vehicle system tester V.A.G 1552 and select the engine electronics control unit ⇒ page 01-3.
- Select Reading measured value block (function 08) and display group 002 ⇒ page 01-45.

Read measured value block 2				→
1	2	3	4	

◀ Readout in display:

The inducted air mass is shown in display block 4 (grams per second).

Specification: 2.0...4.0 g/s

- Press the → key.
- Press keys 0 and 6 for function „End output“ and confirm the engine with the key Q.
- Switch off the ignition.

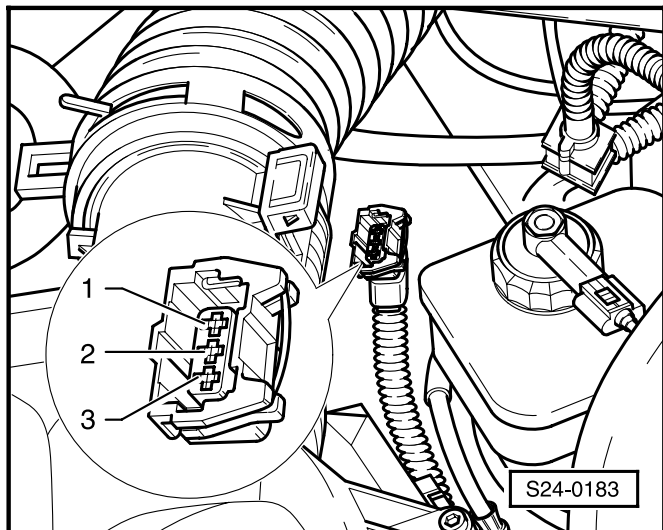
If the specifications are not achieved or if there is a fault regarding the air mass meter in the fault memory:

- Test the voltage supply of the air mass meter (G70) ⇒ page 24-40.

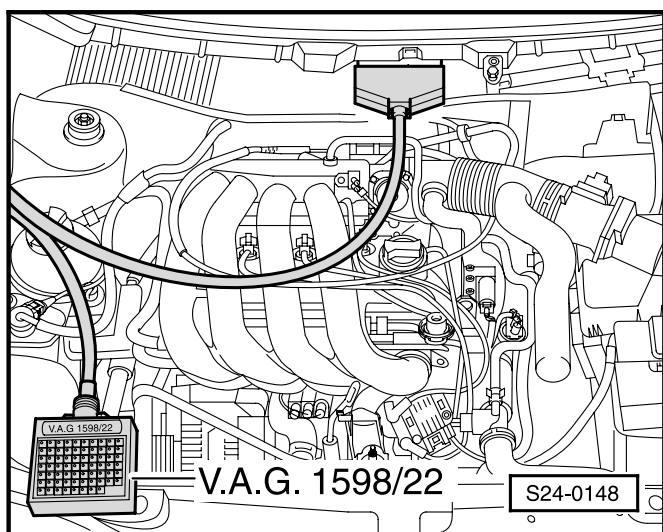
Testing voltage supply of air mass meter (G70)

Warning!

Switch on the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.

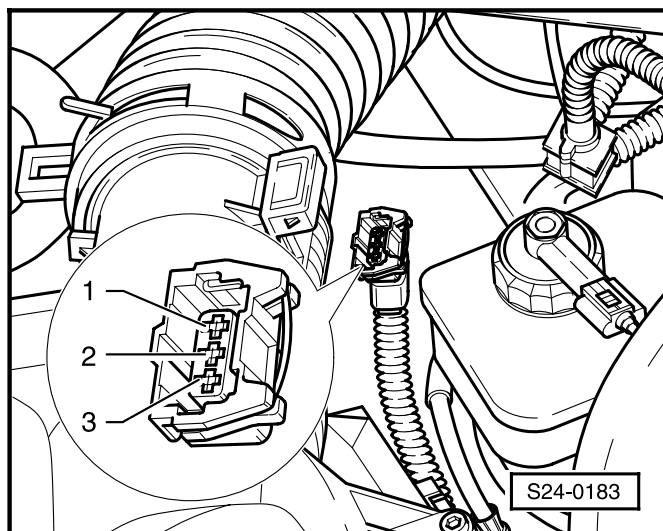


- Unplug the 3-pin connector from the air mass meter.
- ◀ - Connect hand-held multimeter, e.g. V.A.G 1526 A, to contact 3 of the connector and to engine earth for measuring the voltage.
- Start the engine and run at idling speed.
Specification: approx. battery voltage
- Switch off the ignition.
- If the specification is not achieved, test the cable between contact 3 of the connector to the fuse for open circuit, and for short circuit to earth or to positive, and rectify any fault.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
- If fuse and cable are o.k. and if the specification is nevertheless not achieved, test the fuel pump relay (J17) ⇒ page 24-36.
- If the voltage supply is o.k., check the signal wires ⇒ page 24-40.



Testing signal and earth wire for air mass meter

- ◀ - Connect test box V.A.G 1598/22 to the engine control unit wiring loom.



- Test cable connection from the connector at air mass meter to the engine control unit for open circuit and for short circuit to positive and to earth, and repair if necessary.

Connector for air mass meter G70	Test box V.A.G 1598/22 or -J220
1	13
2	12

- If the cable connection is o.k., replace air mass meter (G70).

Testing air mass meter

- valid 08.97 ➤

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter, e.g. V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Current flow diagram

Test conditions

- Fuse 43 should be o.k.
- The coolant temperature should be at least 85 °C.
- All electrical components switched off.
- Air conditioning of car switched off, if fitted.
- On vehicles with automatic gearbox, selector lever should be in position „P“ or „N“.

Testing operation

- Connect the vehicle system tester V.A.G 1552 with cable V.A.G 1551/3 ⇒ page 01-3, engine idling.
- Select Reading measured value block (function 08) and display group 002 ⇒ page 01-45.

Read measured value block 2				→
1	2	3	4	

◀ Readout in display:

The inducted air mass is shown in display block 4 (grams per second).

Specification: 2.0...4.0 g/s

- Press the → key.
- Press keys 0 and 6 for function „End output“ and confirm the engine with the key Q.
- Switch off the ignition.

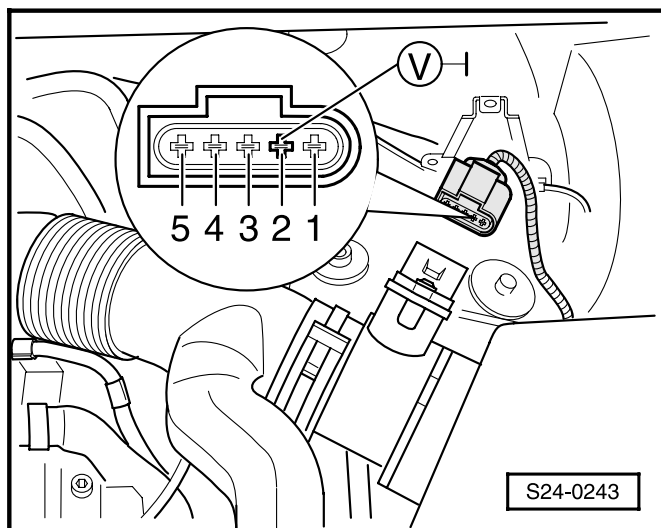
If the specifications are not achieved or if there is a fault regarding the air mass meter in the fault memory:

- Test the voltage supply of the air mass meter (G70) ⇒ page 24-42.1.

Testing voltage supply of air mass meter (G70)

Warning!

Switch on the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.

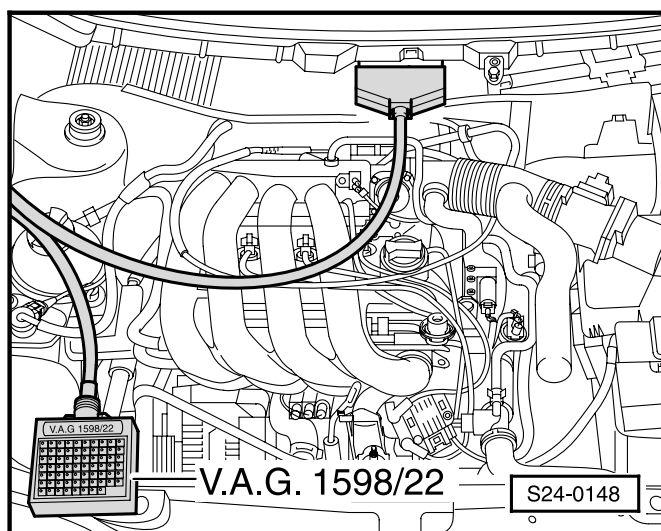


- Unplug the 5-pin connector from the air mass meter.
- ◀ - Connect hand-held multimeter, e.g. V.A.G 1526 A, to contact 2 of the connector and to engine earth for measuring the voltage.

- Start the engine and run at idling speed.

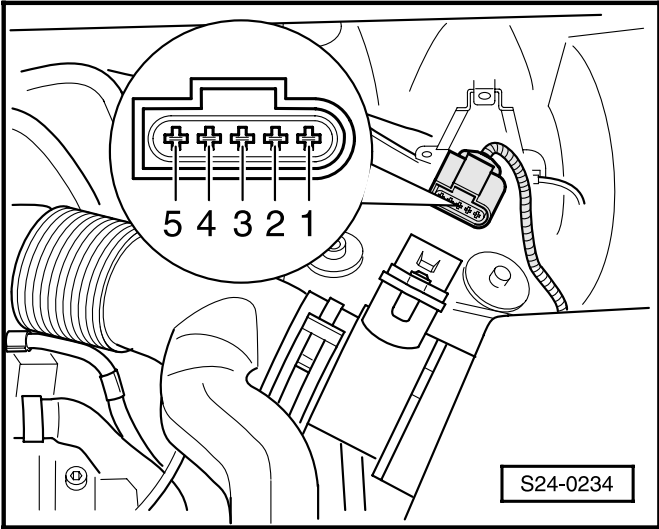
Specification: approx. battery voltage

- Switch off the ignition.
- If the specification is not achieved, test the cable between contact 2 of the connector to the fuse for open circuit, and for short circuit to earth or to positive, and rectify any fault.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
- If fuse and cable are o.k. and if the specification is nevertheless not achieved, test the fuel pump relay (J17) ⇒ page 24-36.
- If the voltage supply is o.k., check the signal wires ⇒ page 24-42.1.



Testing signal and earth wire for air mass meter

- ◀ - Connect test box V.A.G 1598/22 to the engine control unit wiring loom.



- ◀ - Test cable connection from the connector at air mass meter to the engine control unit for open circuit and for short circuit to positive and to earth, and repair if necessary.

Connector for air mass meter G70	Test box V.A.G 1598/22 or -J220
3	12
4	11
5	13

- If the cable connection is o.k., replace air mass meter (G70) with intake air temperature sender (G40).

**Testing intake system for leaks
(unmetered air)**

Special tools, testers and aids required

- ♦ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ♦ Engine leak detection spray G 001 800 A1

Test procedure

Notes:

- ♦ *The vacuum in the intake system draws in the leak detection spray with the unmetered air. The leak detection spray reduces the ignition performance of the mixture. This results in a drop in engine speed and in a change in the lambda probe readout.*
- ♦ *It is essential to pay attention to the safety precautions stated on the can.*
- Connect vehicle system tester V.A.G 1552 and select the engine control unit with the address word „01“ ⇒ page 01-3. Engine should be idling for this step.

Test of vehicle systems
Select function XX

HELP

- ◀ Readout in display:
- Press the keys 0 and 8 for the function „Reading measured value block“ and confirm the entry with the key Q.

Read measured value block
Enter display group number XX

HELP

- ◀ Readout in display:
- Press keys 0, 0 and 9 for „Display group number 9“ and confirm the entry with the key Q.

Read measured value block 9				→
1	2	3		4

◀ Readout in display:
(1...4 = display blocks)

- Note the engine speed shown in display block 1.
- Note the lambda probe voltage shown in display block 3 and the range within which it varies.
- Spray the parts of the intake system systematically with engine leak detection spray.

If there is no change to the engine speed or to the lambda probe voltage:

- Press the → key.
- Press keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.

If the engine speed drops or if there is a change to the lambda probe voltage:

- Press the → key.
- Press keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.
- Inspect the sprayed part of the intake system for leaks and rectify the fault.

Testing lambda control

The lambda probe compares the oxygen content of the air with the residual oxygen in the exhaust gas and supplies a voltage signal to the engine control unit.

The voltage signal „rich mixture“ (low level of residual oxygen) is at approx. 0.7...1.0 V (related to reference earth).

The voltage signal „lean mixture“ (large level of residual oxygen) is at approx. 0.0...0.3 V (related to reference earth).

A voltage jump from 0.7...1.0 V to 0.0...0.3 V and vice versa takes place at the transition from „rich mixture“ to „lean mixture“ and vice versa.

In view of the steep voltage jump, the lambda control is not able to maintain constant the ideal mixture composition which corresponds to $\lambda = 1.0$.

A so-called reference voltage of approx. 0.4...0.5 V is programmed in the engine control unit for analysing the signal from the lambda probe. The control constantly fluctuates back and forward between the „slightly too lean“ and „slightly too rich“ states.

The control cycle should be performed at least 30 times a minute when the engine is idling at normal operating temperature.

If there is no change to the voltage, or only a sluggish change, the following faults may exist:

- ◆ *Slots or holes in probe head blocked.*
- ◆ *The ventilation hole at the probe -area of connection cable- is sealed off.*
- ◆ *Probe has been subjected to excessive thermal stresses.*
- ◆ *The probe has been damaged by fuel containing lead.*
- ◆ *Contact resistance in the signal wire.*
- ◆ *Probe too cold, probe heater not operating.*
- ◆ *Lambda control switched off (engine control unit has detected fault at fuel injection system $\Rightarrow$ Interrogating fault memory and also Reading measured value block, display group 021).*
- ◆ *Probe damaged by contact spray or similar products. (Because of the thermal fluctuations and capillary effect, the contact spray is drawn in through the fine cavities in the electric cables into the probe).*
- ◆ *Probe damaged by silicone vapours. (Use of sealants containing silicone has resulted in traces of silicone elements being inducted by the engine. These silicone elements are not combusted and damage the lambda probe).*
- ◆ *The probe has been damaged by oil elements escaping at the crankcase ventilation or by leaks in the engine.*

Poor performance after cold start

Test condition

- No fault in respect of lambda control stored; rectify any faults and erase fault memory.

The time which elapses until the lambda control is activated (probe temperature required about 300 °C) is determined primarily by the following factors:

- ◆ Ambient temperature (summer/winter)
- ◆ Operating conditions after start
- ◆ Operation of probe heater

If faults occur after a cold start, it is then necessary to check whether the problem occurs before or only after the lambda control is activated.

Test vehicle under cold start conditions:

- Connect vehicle system tester V.A.G 1552 with cable V.A.G 1551/3 ⇒ page 01-3.
- Select the function Reading measured value block (function 08) and display group 007 ⇒ page 01-51.

Read measured value block 7				→
1	2	3	4	

◀ Readout in display:

The signal voltage of the lambda probe appears in display field 2.

If the vehicle is cold or lambda control not operating: 0.45...0.50 V.

Important!

Have a second person operate V.A.G 1552.

- Carry out a road test and observe the readout in display field 2.

Read measured value block 7				→
1	0.780V	3	4	

◀ When the lambda control is activated, the voltage signal should fluctuate between the ranges 0.0...+0.3 and +0.7...+1.0 V.

Voltage readouts greater than +0.7 V indicate a rich mixture composition (low level of oxygen in exhaust).

Voltage readouts of less than +0.3 V indicate a lean mixture composition (large level of oxygen in exhaust).

- If the handling problem occurs before the lambda control is activated, the lambda control is then not the cause of the problem.
- If the handling problem does not occur until after the lambda control is activated, test operation of lambda control ⇒ page 24-44.

Notes:

- ♦ *If the problem is not so severe after the lambda control is activated, the cause of the fault (e.g. unmetered air, faulty injector, etc.) is counteracted by the lambda control being activated. This can be recognised from reading the lambda learned values.*
- *Select Reading measured value block (function 08) and display group 008. If the specifications are not achieved, rectify fault.*
- *In addition, read the measured value blocks in function 04 (basic setting). If this function is selected, the activated charcoal filter solenoid valve -N80 is closed.*
- ♦ *With display group 099 it is possible to specifically switch the lambda control off and on. Press the keys 4 and 8 to switch back and forward between „Basic setting“ (lambda control off) and „Read measured value block“ (lambda control on).*

Testing operation

- Select the function Reading measured value block (function 08) and display group 003
⇒ page 01-46.

Read measured value block 3				→
1	2	3	4	

◀ Readout in display:

Do not continue with the test until the coolant temperature in display field 3 is at least 80 °C.

- Press the key C.
- Press the keys 00 and 7 for „Display group number 007“ and confirm the entry with the key Q.

Read measured value block 7				→
1	2	3	4	

◀ Readout in display:

The signal voltage of the lambda probe appears in display field 2.

- If the probe voltage changes very slowly, test lambda probe heater ⇒ page 24-45.
- If a constant probe voltage of 0.45...0.50 V is displayed, there is an open circuit in the signal wire; test cable connection
⇒ page 24-46.
- If a constant voltage of 0.0...+0.3 V (mixture too lean) is displayed, the mixture control has moved against the control stop in the „richer mixture“ direction but the lambda probe still recognises „mixture too lean“.
- If a constant voltage of 0.7...1.0 V (mixture too rich) is displayed, the mixture control has moved against the control stop in the „leaner mixture“ direction but the lambda probe still recognises „mixture too rich“.
- Press the key C.
- If the lambda probe is operating properly, check the lambda learned values.
- Select the function Reading measured value block (function 08) and display group 008 and confirm the entry with the key Q.

Read measured value block 8				→
2ms	-0.7 %	-0.5 %	TB active	

◀ Readout in display:

The mixture adaptation is adaptive, in other words differences between engines (nozzle flow, compression, fuel pressure, etc.) are detected by means of the lambda control and compensated for by adapting the basic injection times programmed in the map. These injection times are extended or shortened until a mixture of $\lambda = 1$ is achieved. The difference of the actual injection time from the basic injection time programmed in the map is stated in %.

- ◆ Positive learned value (+...%): Programmed basic injection time too short, actual injection time extended by ...% so that $\lambda = 1$ is achieved.
- ◆ Negative learned value (-...%): Programmed basic injection time too long, actual injection time shortened by ...% so that $\lambda = 1$ is achieved.

Specifications: $\Rightarrow$ page 01-53.

Testing lambda probe heater

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter, e.g. V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Current flow diagram

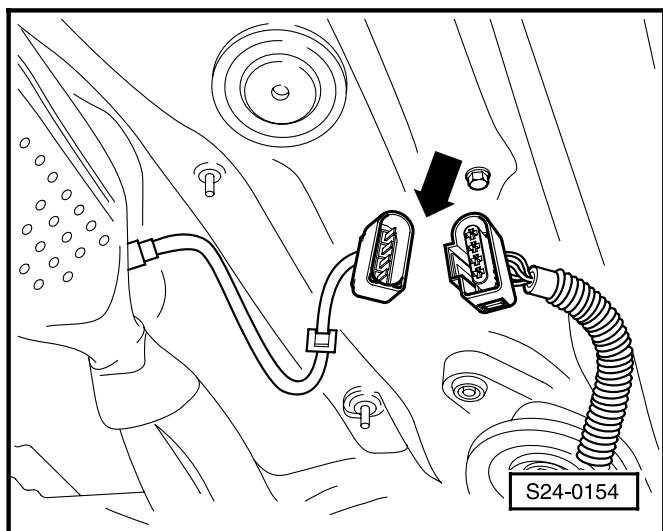
Test condition

- Fuse 43 should be o.k.

Test procedure

The heating circuit of the lambda probe is monitored by the self-diagnosis.

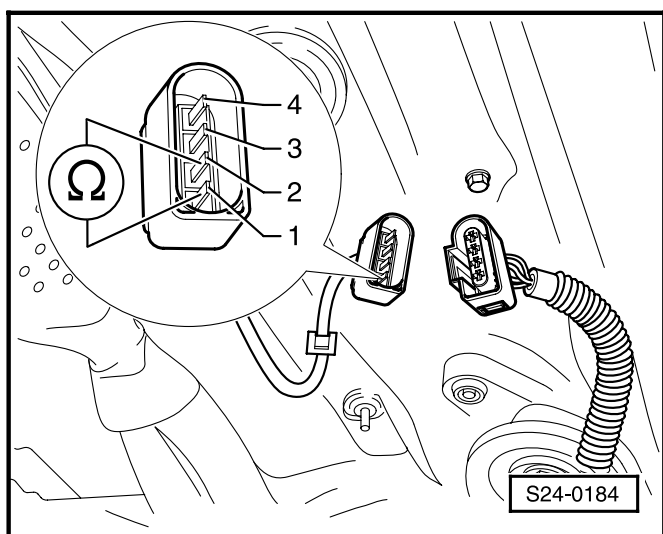
- Interrogate fault memory $\Rightarrow$ page 01-5.



- ◀ - Unplug the 4-pin connector at the underside of the car on the right next to the lambda probe (G39).

Warning!

Switch on the relevant measuring range before connecting the test cables and pay attention to the test conditions in order to avoid damaging the electronic components.



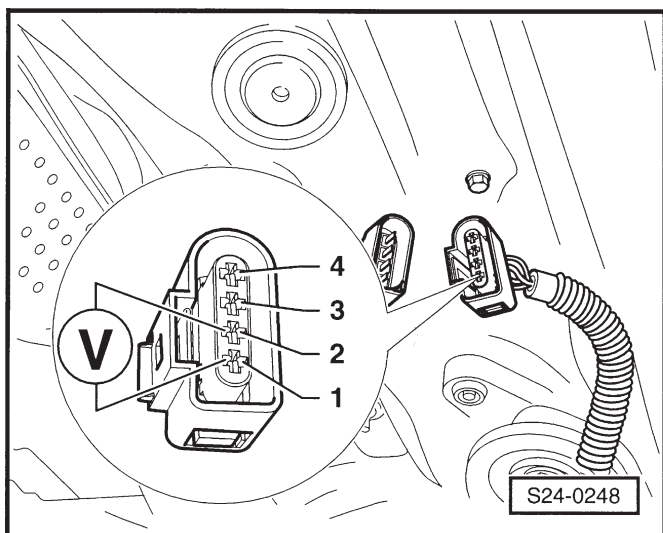
- ◀ - Use V.A.G 1526 A to carry out a continuity test (measurement resistance) between contacts 1 and 2 of the probe connector.

Note:

At room temperature the resistance of the heating element is approx. 1...5 Ω . The resistance rises sharply even if there is only a slight increase in temperature.

- If an open circuit is detected, replace lambda probe (G39).

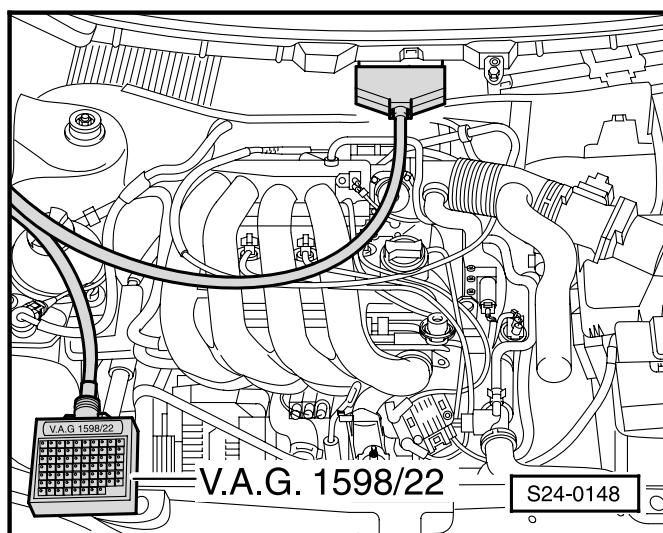
If the heating element has continuity, test voltage supply for lambda probe heater (Z19) as follows:



- ◀ - Connect hand-held multimeter V.A.G 1526 A or V.A.G 1527 between contact 1 of the connector at the wiring harness and contact 2.
- Briefly operate the starter (engine may also briefly start).

Specification: approx. battery voltage

- If the specification is not achieved, test the cable connection from contact 1 of the connector at the wiring harness to the fuse for open circuit or for short circuit to earth and repair if necessary.



- ◀ - Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit
⇒ page 24-48.
- Test the cable connection from contact 2 of the connector at the wiring loom to contact 27 of the test box for continuity; rectify any open circuit in the wiring.

If the fuses and the cable connections are o.k. and the specification is nevertheless not achieved, test the engine control unit as follows:

- Connect hand-held multimeter between the positive terminal of the battery and contact 2 of the connector of the lambda probe heater at the wiring loom.
- Briefly operate the starter (engine may also start for a short time).

Specification: approx. battery voltage

- If the specification is not achieved, replace engine control unit ⇒ page 24-48.
- If the specification is achieved, test fuel pump relay ⇒ page 24-36.

Testing lambda probe signal cable and actuation

Note:

The lambda probe signal is monitored by the self-diagnosis.

- Interrogate fault memory ⇒ page 01-5.
- If a lambda probe fault is displayed and if the probe heater is o.k., separate plug connection for lambda probe.
- Switch the ignition on.
- ◀ Use the hand-held multimeter to conduct a voltage measurement between contacts 3 and 4 of the connector at the wiring loom.

Specification: 450 ± 50 mV

- If the specification is achieved:
- Replace lambda probe -G39.
- If the specification is not achieved:
- Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48, Replacing engine control unit.
- ◀ Test the following cable connections for open circuit, short circuit to positive and to earth, and repair if necessary:

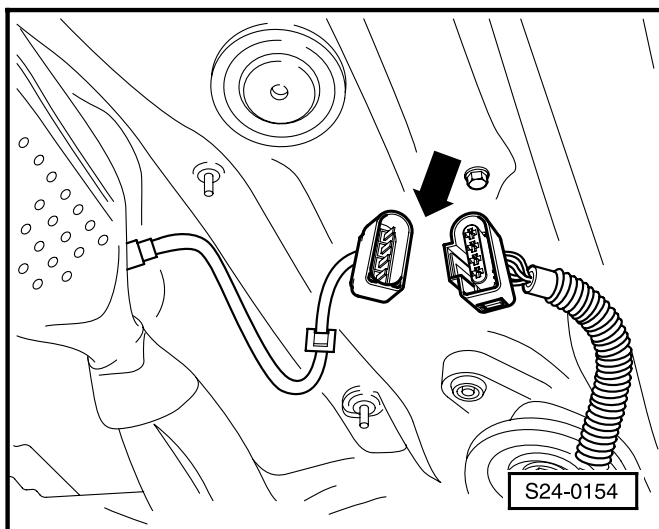
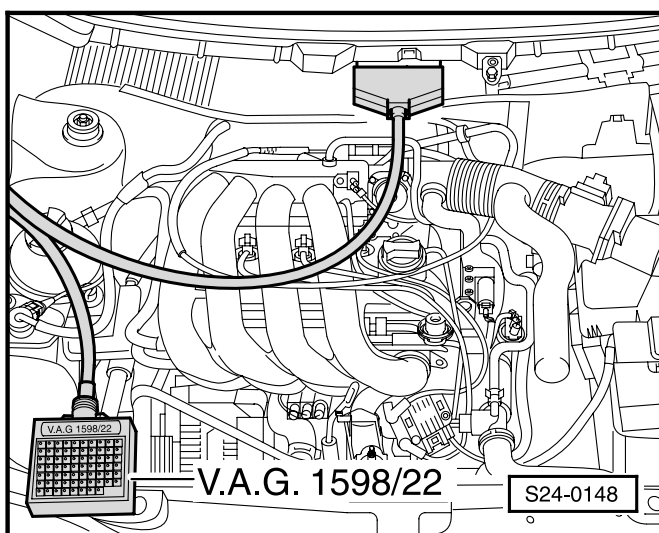
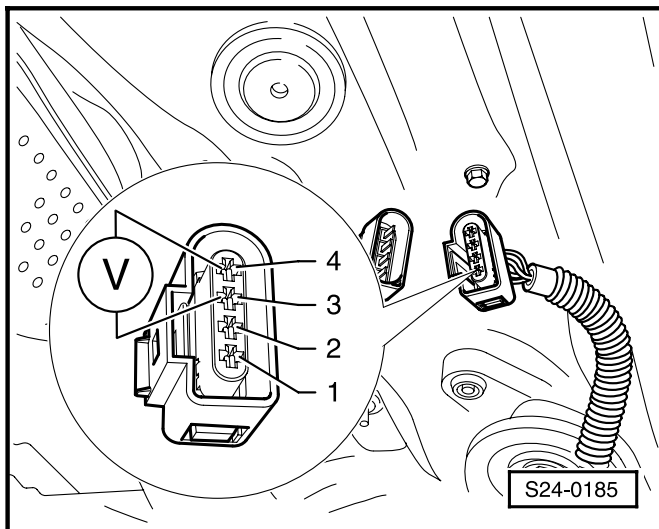
Connector at wiring loom, contact	Test box V.A.G 1598/22
3	25
4	26

- If the cable connection is o.k., replace engine control unit ⇒ page 24-48.

Removing and installing lambda probe

Removing

- ◀ Separate the 4-pin plug connection at the underside of the vehicle on the right to the lambda probe (G39).



- Unbolt the lambda probe.

When installing, pay attention to the following points:

Notes:

- ♦ Tightening torque 50 Nm.
- ♦ The thread of the lambda probe is coated with an assembly paste. This paste must not get onto the openings of the probe.

Replacing, coding and adapting engine control unit

Replacing engine control unit

Note:

When the connectors are unplugged from the engine control unit, the learned values are erased, although the contents of the fault memory are retained.

Removing

- Switch the ignition off.
- Detach the windscreen wiper arms and remove the cover of the plenum chamber.

Notes:

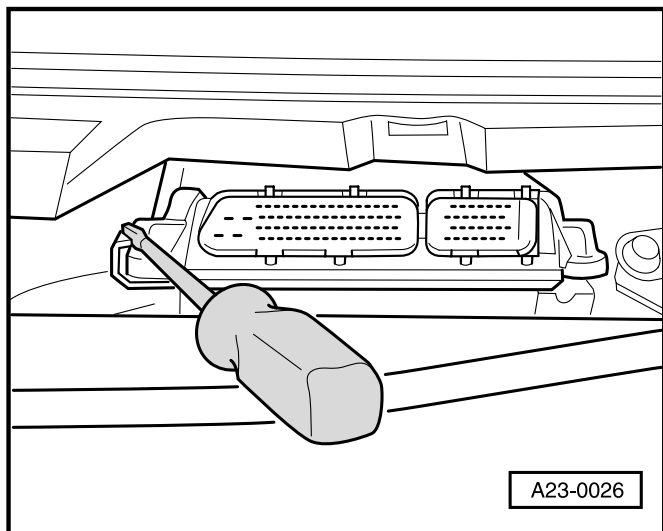
- ♦ When taking off the cover, disconnect the hose and connector for the spray nozzles.
- ♦ It is not necessary to take out the control unit in order to connect the test box V.A.G 1598/22 for the component test.
- Release the connector catches and unplug the control unit connectors.
- ◀ - Use a screwdriver to press the catch of the fixture to the side and pull the engine control unit forward.

Installing

Installation is carried out in the reverse order to removing.

Notes:

- ♦ In the initial learning phase during engine basic setting, slightly irregular idling as well as slight jerking during driving are possible.
- ♦ After installing the engine control unit, it is necessary to carry out the following steps:



- Perform coding of the new engine control unit
⇒ page 24-49.
- Adapt engine control unit to the throttle valve control unit (J338) ⇒ page 24-51.
- Adapt engine control unit to the electronic immobiliser ⇒ page 24-50.

Coding engine control unit

If the coding displayed does not match the vehicle, or if the control unit has been replaced, it is then necessary to code the control unit as follows:

- Connect vehicle system tester V.A.G 1552 and select the engine electronics control unit with the "address word" 01. The ignition must be switched on for this step.
(Connecting vehicle system tester and selecting engine electronics control unit ⇒ page 01-3.)

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press keys 0 and 7 for the function "Code control unit" and confirm the entry with the key Q.

Code control unit
Enter code number xxxxx (0-32000)

Q

◀ Readout in display:

- Enter the relevant code number for this vehicle and confirm the entry with the key Q.

Code number	for models fitted with
04030	Automatic gearbox
04000	Manual gearbox

06A906018..1.8l R4/5V MOTR HS V.. →
Coding 04000 WSC 06388

◀ The control unit identification appears in the display of the vehicle system tester V.A.G 1552 (example):

- Switch the ignition off and on again.

Note:

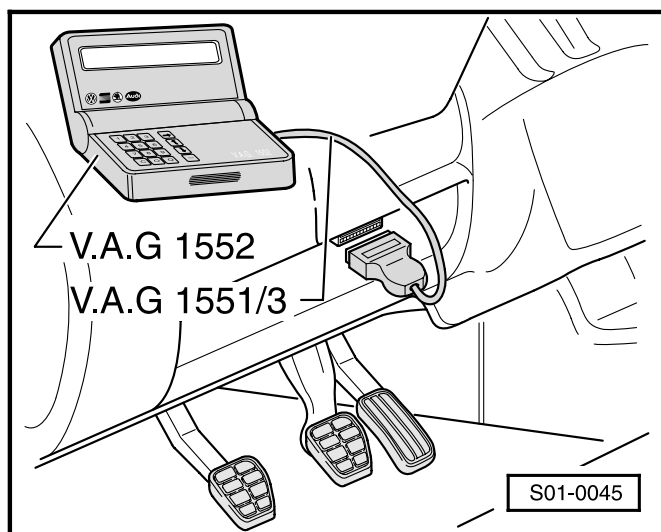
The coding entered is activated when the ignition is switched on the next time.

- Press the → key.

Test of vehicle systems HELP
Select function XX

◀ Readout in display:

- Press keys 0 and 6 for the function "End output" and confirm the entry with the key Q.



Adapting engine control unit to electronic immobiliser

Test condition

- Authorised car key available

Procedure

- ◀ - Connect vehicle system tester V.A.G 1552 with cable V.A.G 1551/3 ⇒ page 01-3.
- Switch on the ignition.
- Press key 1 for „Rapid data transfer“.
- Press the keys 1 and 7 for the address word „Dash panel insert“ and confirm the entry with the key Q.
- Press the → key.

◀ Readout in display:

- Press the → key.

◀ Readout in display:

- Press the → key.

◀ Readout in display:

- Press the keys 1 and 0 for the function „Adaptation“ and confirm the entry with the key Q.

◀ Readout in display:

- Press the key 0 twice for „Channel number 0“ and confirm the entry with the key Q.

◀ Readout in display:

- Confirm the entry with the key Q.

◀ Readout in display:

- Complete adaptation by pressing the → key.

Note:

When the ignition is next switched on, the identification of the engine control unit is entered in the immobiliser control unit.

8L0919860. AB-COMBIINSTR. VDO ... →
Coding XXXXX WSC 12345

IMMO-IDENTNR: AUZXXXXXXXXXXXX →

Test of vehicle systems HELP
Select function XX

Adaptation
Enter channel number XX

Adaptation Q
Erase learned values?

Adaptation →
Learned values are erased

Adapting engine control unit to throttle valve control unit

When the basic setting is carried out, the engine control unit learns the stop positions of the throttle valve control unit with the ignition switched on and the engine not running.

Note:

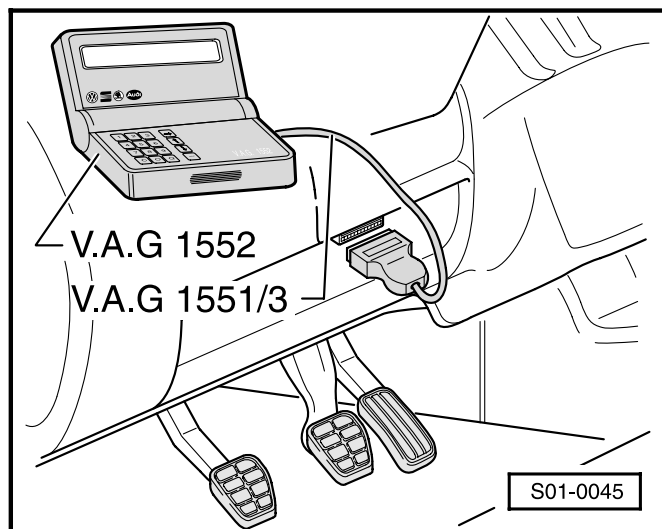
If the throttle valve control unit (J338) is removed and installed or replaced, or if the voltage supply of the engine control unit is interrupted, it is then always necessary to carry out a basic setting.

Test condition

- No fault in fault memory ⇒ page 01-5, Interrogating fault memory

Procedure

- ◀ - Connect vehicle system tester V.A.G 1552 and select the control unit for engine electronics with the „address word 01“. The engine should be switched on for this step. (Connecting vehicle system tester and selecting control unit for engine electronics ⇒ page 01-3.)



Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press the keys 0 and 4 for the function „Initiate basic setting“ and confirm the entry with the key Q.

Basic setting
Enter display group number XXX

HELP

◀ Readout in display:

- Press the keys 0, 9 and 8 for „Display group number 98“ and confirm the entry with the key Q.

System in basic setting 98
x.xxx V x.xxx V Idling ADP. runs

→

◀ Readout in display:

After pressing the key Q, the throttle valve positioner is moved into the Min., Max. and five intermediate positions and the control unit stores the relevant throttle valve angles in the permanent memory. This procedure takes not more than 10 seconds. After this, the throttle valve remains in the start position for a short time and then closes.

System in basic setting 98
x.xxx V x.xxx V Idling ADP. o.k.

→

◀ Readout in display:

Basic setting 98 X.XXX V X.XXX V Idling ADP, n.o.k. →	◀ If one of the following messages appears in the display, adaptation has been aborted.
Basic setting 98 X.XXX V X.XXX V Idling ADP, runs →	- End adaptation by pressing the → key.
Grundeinstellung 98 X.XXX V X.XXX V Idling ERROR →	
Function is unknown or cannot be carried out at the moment!	
No fault recognised →	- Interrogate fault memory (function 02) ⇒ page 01-5.
Idling switch does not open Short to earth →	◀ - If no fault is recognised, check whether idling switch opens and closes when the accelerator is depressed ⇒ page 24-16, Testing idling switch.
Idling switch does not close Open circuit →	◀ - If one of these faults is displayed, check whether idling switch opens and closes when accelerator is depressed ⇒ page 24-16, Testing idling switch.
Supply voltage Signal too small →	◀ - If this fault is displayed, test voltage supply for engine control unit (voltage at terminal 30 of engine control unit has dropped below 10 V).
Throttle valve positioner sender -G127 Signal too small or large →	◀ - If one of the following faults is displayed, test throttle valve positioner sender -G127 and throttle valve potentiometer -G69 ⇒ page 24-18.
Throttle valve potentiometer -G69 Signal too small or large →	
Throttle valve positioner sender -G127 Implausible signal →	

Note:

If basic setting is aborted by the control unit, the reason for this may be the following:

- ◆ *The throttle valve does not reach the mechanical idling stop because of dirt, e.g. oil carbon deposits or throttle cable not correctly set.*
- ◆ *The battery voltage is too low.*

- ◆ *The throttle valve control unit or the cable connection is faulty.*

After basic setting is aborted the fault „Basic setting not carried out, fault in the basic setting“ is entered in the fault memory. When the ignition is next switched on, basic setting is once again carried out automatically.

- End basic setting of the engine by pressing the → key.
- Press the keys 0 and 6 for the function „End data transfer“ and confirm the entry with the key Q.

Carrying out basic setting of engine control unit

When the engine is not running, it is possible to carry out the following operations with the basic setting:

- ◆ Adaptation of throttle valve control unit to engine control unit ⇒ page 01-61, display group 098.

When the engine is running, it is possible to carry out the following operations with the basic setting:

- ◆ Learning of lambda control ⇒ any display group.
- ◆ Fault finding by specifically switching lambda control on and off ⇒ page 01-62, display group 099.

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3

Test conditions for operations when engine running

- Coolant temperature at least 80 °C
- Electrical components switched off (radiator fan must not cut in during the test)
- Air conditioning switched off
- Selector lever in position P or N
- No fault stored in fault memory

- Connect the vehicle system tester V.A.G 1552 and select the control unit for engine electronics with the „address word 01“. The ignition should be switched on for this step. (Connecting vehicle system tester and selecting control unit for engine electronics ⇒ page 01-3.)

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press the keys 0 and 4 for the function „Basic setting“ and confirm the entry with the key Q.

Basic setting
Enter display group number XXX

HELP

◀ Readout in display:

- Select the desired display group number according to the list of display groups from „Reading measured value block“.

Note:

Display group number 001 is an example in order to present the sequence.

- Enter 001 for the function „Display group number 01“.

Basic setting
Enter display group number 001

Q

◀ Readout in display:

- Confirm entry with the key Q.

System in basic setting 1
1 2 3

→

◀ Readout in display:

Notes:

- ♦ *In the case of display group number 000 the readouts appear as decimals.*
- ♦ *Each time the PRINT key (of V.A.G 1551) is pressed, the current readout in the display is printed out.*
- ♦ *Press key C before selecting other display groups.*
- If the specifications are achieved in all the display fields, press the → key.

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press the keys 0 and 6 for the function „End output“ and confirm the entry with the key Q.

Testing additional signals

Testing A/C compressor cut-off

Notes:

- ◆ *The A/C compressor signal supplies the engine control unit with the information that the compressor is switched on within 140 ms.*
- ◆ *The engine control unit has the possibility of switching off the A/C compressor using the same cable connection.*
- ◆ *The A/C compressor is switched off by the engine control unit:*
 - *during sharp acceleration (full throttle)*
 - *in the emergency programme (emergency running mode)*
 - *if the coolant temperature is greater than 120 °C*

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter, e.g. V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Diode test lamp, e.g. V.A.G 1527
- ◆ Adapter cable set V.A.G 1594 A
- ◆ Current flow diagram

Test conditions

- Operation of A/C o.k.
- No fault stored in fault memory of engine control unit
- Interior temperature warmer than +15 °C
- Connect the vehicle system tester V.A.G 1552 with the cable V.A.G 1551/3 ⇒ page 01-3.
- Start the engine.
- Select Reading measured value block (function 08) and display group 020 ⇒ page 01-62.

Read measured value block 20				→
1	2	3	4	

◀ Readout in display:

- Switch off the air conditioning.

Specified readout in display block 4: Compr. OFF

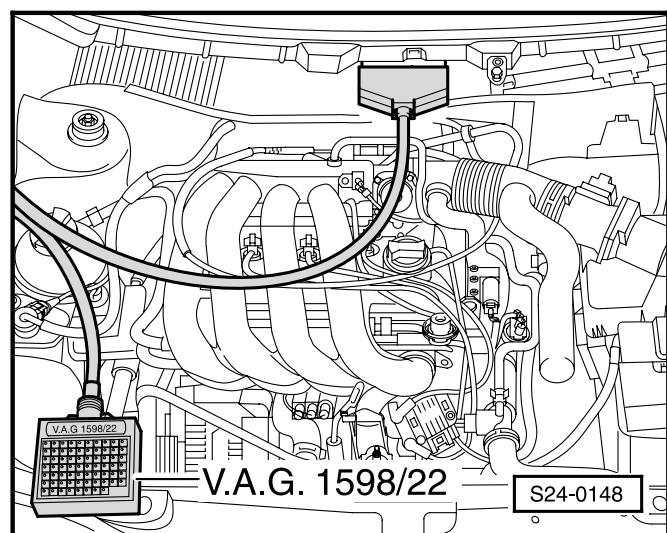
- Switch on the air conditioning with the „Auto“ button. Compressor should run.

Specified readout in display block 3: A/C-High

Specified readout in display block 4: Compr. ON

- Depress the accelerator suddenly and release it again (short blip of throttle).

When the accelerator pedal is depressed rapidly, the readout in display block 4 should switch for a few seconds from „ON“ to „OFF“ (A/C compressor cut-off when car accelerated).



◀ If the readout does not change as described, switch off the engine and connect test box V.A.G 1598/22 to the wiring loom to the engine control unit.

- Test the cable connection from contact 8 of the engine control unit to contact 3 at the radiator fan control unit (J293) for short circuit to earth and to positive and for open circuit on the basis of the current flow diagram.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

- If no fault exists in the cable connection, replace the radiator fan control unit (J293).
⇒ Heating and Air Conditioning; Repair Group 87

Testing engine speed adaptation by switching on the air conditioning

Notes:

- ♦ When the air conditioning is switched on, a positive signal is supplied to contact 10 at the engine control unit.
- ♦ The effect of this signal is that the engine control unit maintains idling speed constant even if the power demand of the air conditioning system varies.

Special tools, testers and aids required

- ♦ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3

- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Diode test lamp (e.g. V.A.G 1527)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Current flow diagram

Test conditions

- Air conditioning operating properly
- No fault stored in fault memory of air conditioning system
- Interior temperature warmer than +15 °C
- Connect vehicle system tester V.A.G 1552 with cable V.A.G 1551/3 ⇒ page 01-3.
- Start the engine (normal operating temperature).
- Switch the rear window heater off.
- Read measured value block (function 08) and select display group 020.

Read measured value block 20	→
800 rpm neutral A/C low Compr. OFF	

◀ Readout in display:

Display block 1: idling speed

Display block 3: signal from AC

Display block 4: signal from AC compressor

- Switch the air conditioning on with the "Auto" button. Compressor must run.

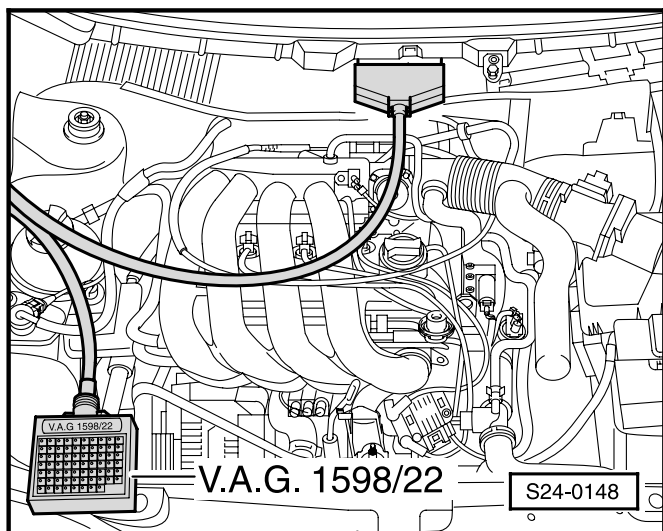
Specification in display block 4: "Compr. ON"

Apart from a brief drop in speed (less than one second), idling speed must remain constant.

If the engine speed does not remain constant, test whether the signal from the air conditioning is received at the engine control unit.

Specification in display block 3: "A/C high"

Specification in display block 4: "Compr. ON"



- ◀ - If the signal is not received, switch off the engine and connect test box V.A.G 1598/22 to the wiring loom to the engine control unit.
- Test the cable connection from contact 8 of the engine control unit to contact 3 of the radiator fan control unit (J293) for short circuit to earth and to positive and for open circuit according to the current flow diagram.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
- If there is no fault in the cable connection, replace radiator fan control unit (J293).
⇒ Heating and Air Conditioning; Repair Group 87

Testing selector lever position of automatic gearbox

Note:

Earth is connected to contact 22 at the engine control unit by the starter lockout and reversing light relay -J226 when the selector lever is moved into position P or N.

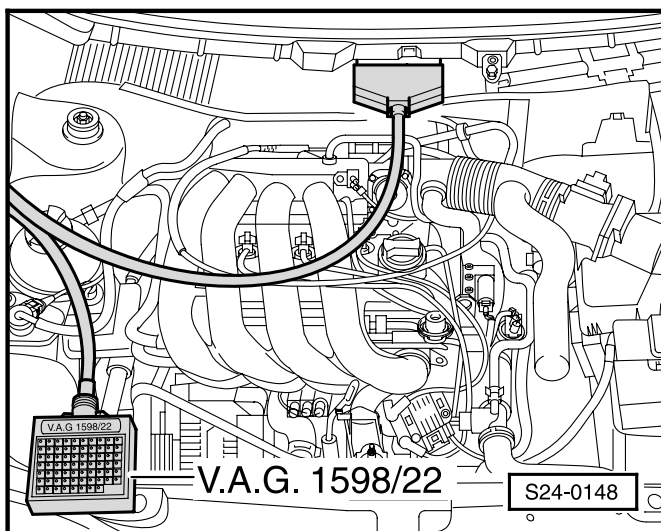
Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Diode test lamp (e.g. V.A.G 1527)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Current flow diagram
- Connect vehicle system tester V.A.G 1552 with cable V.A.G 1551/3 ⇒ page 01-3.
- Start the ignition.
- Read measured value block (function 08) and select display group 020.

Read measured value block 20 →
800 rpm **neutral** A/C low Compr. OFF

◀ Readout in display:

Specification in display block 2: „Neutral“ (selector lever in P or N)



- Depress the footbrake and move selector lever into a gear.

Specification: "Gear ENG"

- If the readout does not appear as described, connect test box V.A.G 1598/22 to the wiring loom to the engine control unit
 ⇒ page 24-48.
- Connect the diode test lamp between socket 3 (terminal 30) and socket 22.
- When a gear is engaged, the diode test lamp must go out.
- Move selector lever into P or N, diode test lamp must come on.
- If the specifications are not achieved, test the cable connection from contact 22 at the engine control unit to the gearbox control unit for short circuit to positive and to earth, and also for open circuit.
 ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
- If there is no fault in the cable connection, test the multifunction switch.
 ⇒ Automatic Gearbox; Repair Group 01; Gearbox: Electrical test

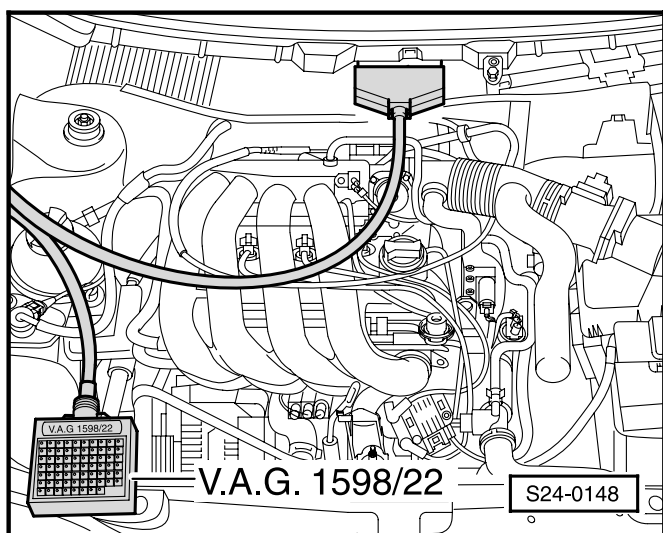
Testing engine speed signal

Note:

The engine speed signal is available at contact 6 of the engine control unit. The signal is required for various purposes, including the rev counter in the dash panel insert and the operation of other control units.

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Diode test lamp (e.g. V.A.G 1527)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Current flow diagram



- ◀ - Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48, Replacing engine control unit.
- Test cable connection from contact 6 of the test box to the dash panel insert for open circuit according to the CFD.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

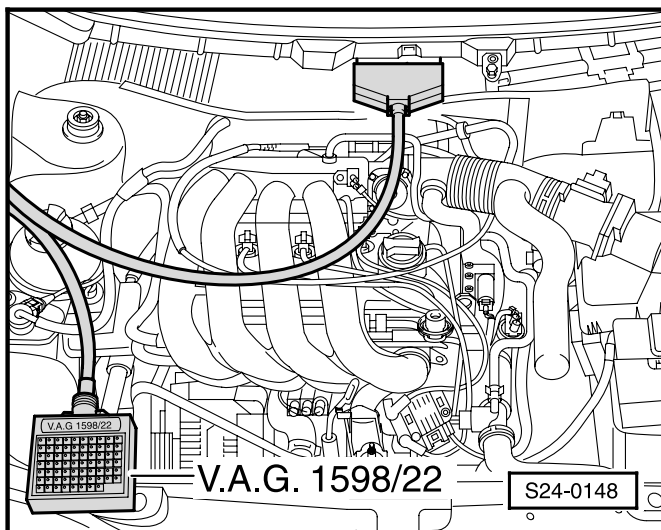
Testing throttle valve position

Notes:

- ◆ *This signal is used by the automatic gearbox control unit in conjunction with the engine speed signal for various purposes, including calculating the engine torque which is output.*
- ◆ *The signal is a pulse width modulated square-wave signal (on/off ratio), which is output by the engine control unit at contact 7.*

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Diode test lamp (e.g. V.A.G 1527)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Current flow diagram
- Connect vehicle system tester V.A.G 1552 with cable V.A.G 1551/3 ⇒ page 01-3.
- Initiate self-diagnosis of the gearbox control unit.
⇒ Automatic Gearbox; Repair Group 01; Performing self-diagnosis.
- If fault 00638 "Engine/gearbox electrical connection 2" is displayed by the gearbox control unit, interrogate the fault memory of the engine control unit ⇒ page 01-5.
- If a fault relating to the throttle valve potentiometer is stored in the engine control unit, then first of all rectify this fault (the fault in the gearbox control unit is then only a consequential fault).



- ◀ - If no fault relating to the throttle valve potentiometer is displayed, connect test box V.A.G. 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48.
- Test the cable connection from contact 7 to gearbox control unit for open circuit and for short circuit.
- ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

If the specifications are not achieved:

- Replace the engine control unit
⇒ page 24-48.

Testing vehicle speed signal

Notes:

- ◆ The vehicle speed signal is generated by the vehicle speed sender -G68 and processed in the dash panel insert.
- ◆ The processed signal is received at contact 20 of the engine control unit and is used for idling speed stabilisation and for minimizing load change jolts during gearshifts.

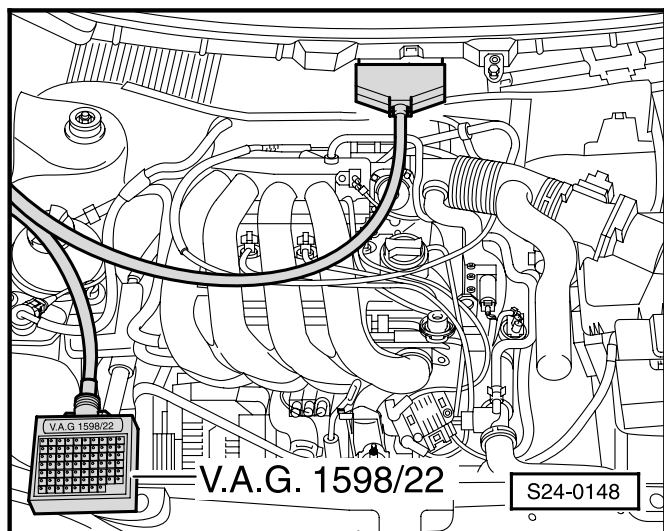
Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G. 1552 with cable V.A.G. 1551/3
- ◆ Test box V.A.G. 1598/22
- ◆ Hand-held multimeter (e.g. V.A.G. 1526 A)
- ◆ Diode test lamp (e.g. V.A.G. 1527)
- ◆ Adapter cable set (e.g. V.A.G. 1594 A)
- ◆ Current flow diagram
- Connect vehicle system tester V.A.G. 1552 with cable V.A.G. 1551/3 ⇒ page 01-3.
- Start engine.
- Read measured value block (function 08) and select display group 011.

Read measured value block 11 →			
800 rpm	1.40 ms	0 km/h	0.84 l/h

◀ Readout in display:

- Conduct a road test to determine whether the vehicle speed is shown in display block 3.
- If the vehicle speed is not displayed, raise the vehicle at the front left until the wheel is clear.



- ◀ - Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48, Replacing engine control unit.
- Connect the diode test lamp between socket 3 (positive) and socket 20 (signal).
- Switch on ignition and rotate the front left wheel by hand.
- Diode test lamp should flash (very brief flash signal).

Note:

The right front wheel must not rotate when this is done; hold tight if necessary.

- If the diode test lamp does not flash, test the cable connection from contact 20 at the connector of the engine control unit to the dash panel insert for open circuit and short circuit.
⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

Testing gearbox control signal during gearshift

Notes:

- ◆ As a result of this signal from the gearbox control unit, the ignition angle is briefly retarded to a varying extent during a gearshift of the automatic gearbox, depending on vehicle speed and engine speed (torque reduction) in order to minimise gearshift jolts.
- ◆ The signal in question is a square-wave signal which is received at contact 23 of the engine control unit.
- ◆ In view of the very short signal, the request to retard the ignition angle is not always detected by V.A.G 1552.

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Diode test lamp V.A.G 1527

- ◆ Adapter cable set V.A.G 1594 A
- ◆ Current flow diagram
- Connect V.A.G 1552 ⇒ page 01-3.
- Carry out a road test and select Reading measured value block (function 08) and display group 019 ⇒ page 01-57.

Important!**Have a second person operate V.A.G 1552.**

Read measured value block 19				→
1	2	3	4	

◀ Readout in display:

- Display field 3 shows the gearbox control signal supplied by the gearbox for the gear-shift.

Specification: X 1 X = no gearbox control

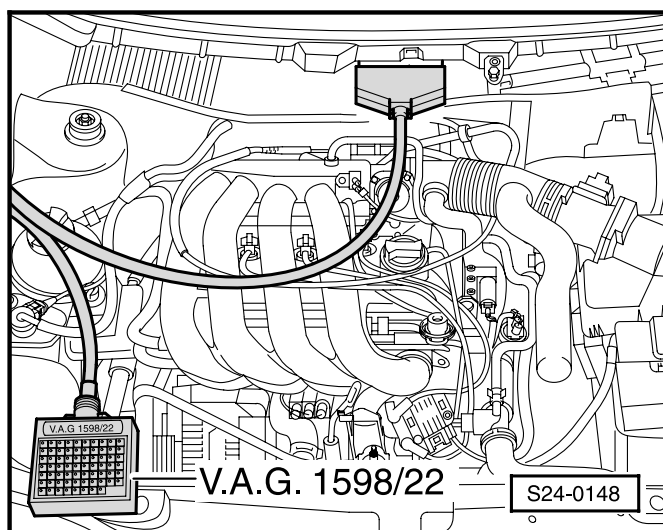
Specification: X 0 X = gearbox control

Readout: X = ignore

- Display field 4 shows the effective ignition angle (actual value).
- The cable connection to the gearbox control unit is monitored by the self-diagnosis of the gearbox (fault code 00545).

- ◀ - If no readout for the torque reduction appears in the measured value block during a gear-shift or if fault code 00545 is displayed (in gearbox control unit), connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48, Replacing engine control unit.

- Test the cable connection from contact 23 of the engine control unit to the gearbox control unit for open circuit and short circuit.
- ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder



Testing variable intake manifold changeover - valid 08.97 ➤

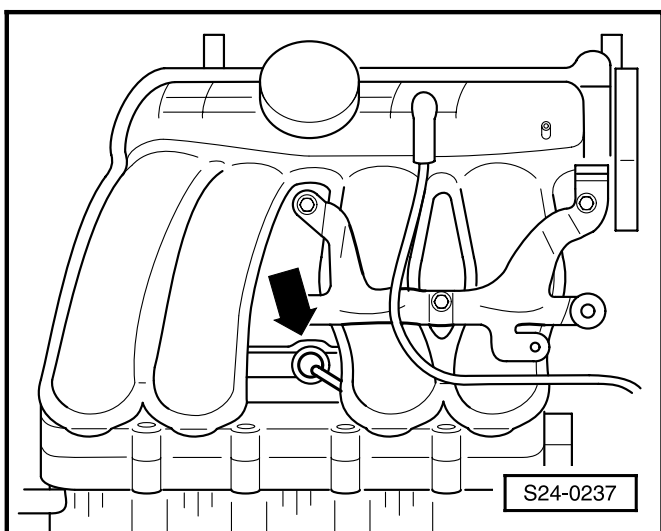
The test should only be carried out if engine performance is poor.

Test condition

- Engine should be at normal operating temperature.

Testing operation

- Start engine and run at idling speed.
- Connect vehicle system tester V.A.G 1552 and select engine electronics ⇒ page 01-3.
- Press keys 0 and 8 for the function „Read measured value block“, display group 001 ⇒ page 01-43.
- Increase speed of engine suddenly (to at least 2500 rpm) and release accelerator again.



- ◀ When this is done, the intake manifold changeover vacuum unit should operate, the shift linkage should move back again into its initial position -arrow-.

If the changeover does not occur, carry out the following tests and inspections:

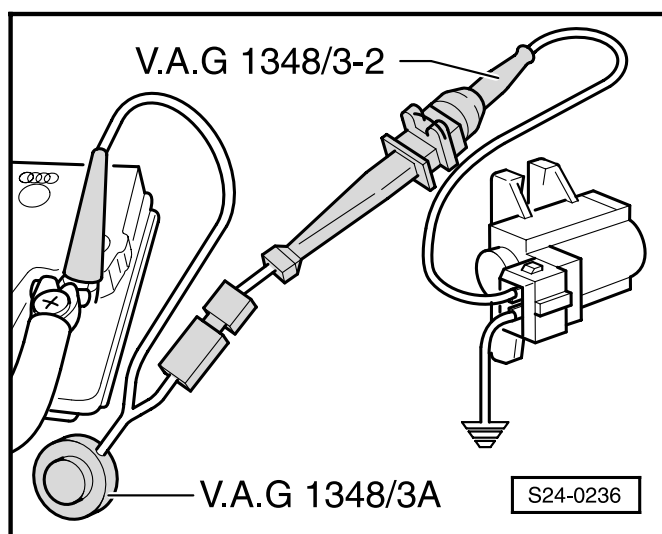
- Test variable intake manifold changeover valve -N156 (Final control diagnosis ⇒ page 01-32, if necessary, test variable intake manifold changeover valve ⇒ page 24-66 and test actuation of variable intake manifold changeover valve ⇒ page 24-68).
- Inspect vacuum lines for leaks ⇒ page 24-65.
- Inspect vacuum lines for blockage and correct connection ⇒ page 24-7.1, illustration.
- Inspect ease of operation of linkage for intake manifold changeover (move linkage manually).

Testing vacuum system

Special tools, testers and aids required

- ◆ Remote control V.A.G 1348/3A with adapter cable V.A.G 1348/3-2
- ◆ Manually-operated vacuum pump V.A.G 1390
- ◆ Adapter cable set V.A.G 1594 A

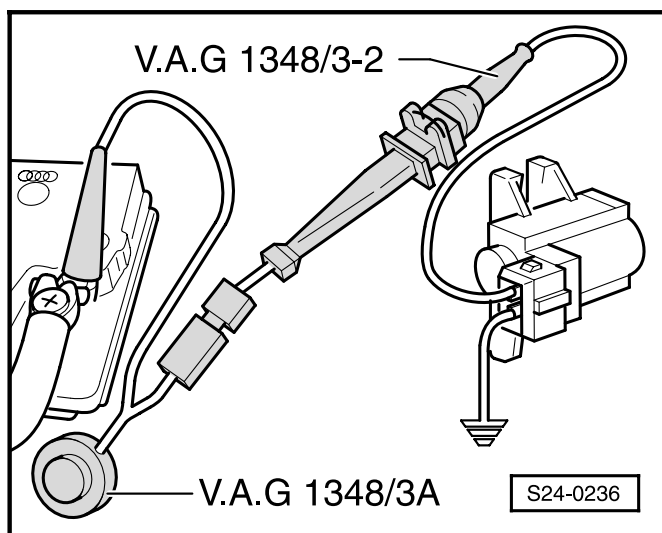
- Run the engine at idling speed for 2 to 3 minutes (to build up vacuum).
- Switch off the ignition.
- Unplug connector from the variable intake manifold changeover valve.
- ◀ - Connect one contact of the solenoid valve -N156 to engine earth using a test cable and crocodile clamp from V.A.G 1594.
- Connect second contact of the solenoid valve -N156 to positive using remote control V.A.G 1348/3A, adapter cable V.A.G 1348/3-2 and auxiliary cable.
- Operate remote control V.A.G 1348/3A for about 2 to 3 minutes; the vacuum unit should remain operated during this time.



If the vacuum unit moves back into its original position, test vacuum unit as follows:

- Detach vacuum lines from the vacuum unit for the variable intake manifold changeover at the T connector.
- Connect manually operated pump V.A.G 1390 to the vacuum unit.
- Operate pump and observe the changeover operation.
- Inspect vacuum unit for leaks. (The vacuum unit must not move back into its original position so long as air has not been admitted at the manually operated pump.
- Replace vacuum unit, if necessary.

If the vacuum unit does not operate, test solenoid valve -N156 for continuity as follows:



- Use a test cable and crocodile clamp from V.A.G 1594 to connect one contact of solenoid valve -N156 to engine earth.
- ◀ - Use the remote control V.A.G 1348/3A, adapter cable V.A.G 1348/3-2 and auxiliary cable to connect the second contact of the solenoid valve -N156 to positive.
- Operate remote control V.A.G 1348/3A.
- Check valve for blockage (detach vacuum lines and blow through).
- Replace variable intake manifold changeover valve, if necessary.
- If none of the faults or checks so far has revealed any fault, inspect the vacuum system for leaks.

Testing variable intake manifold changeover valve

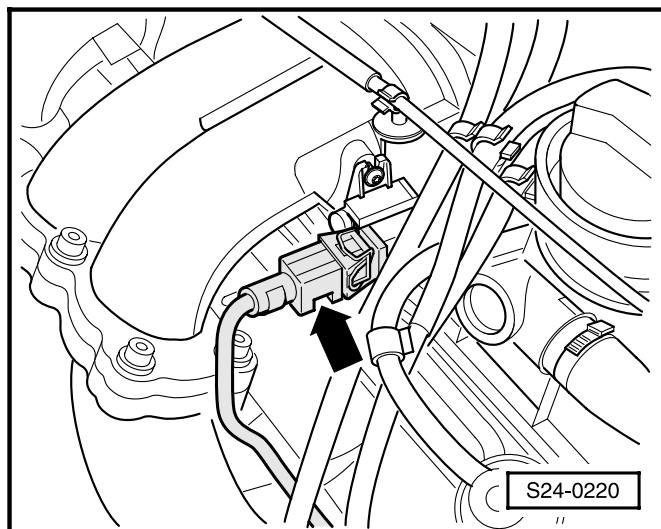
Fitting location ⇒ page 24-2.1, item 3.

Special tools, testers and aids required

- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Diode test lamp (e.g. V.A.G 1527)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Test box V.A.G 1598/22

Test condition

- Fuse 34 must be o.k.

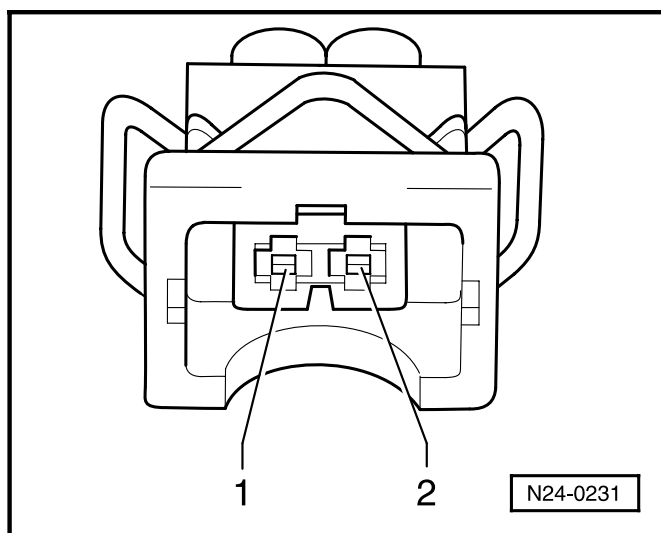


Electrical test of variable intake manifold changeover valve -N156

- ◀ - Unplug connector -arrow- from the variable intake manifold changeover valve -N156.
- Use V.A.G 1526 A to carry out resistance measurement between the contacts of the valve.

Specification: 25 ... 35 Ω

If the specification is not achieved, replace variable intake manifold changeover valve -N156.



Testing voltage supply of variable intake manifold changeover valve -N156

- Unplug connector at the variable intake manifold changeover valve -N156.
- ◀ - Use cables from adapter cable set V.A.G 1594 A to connect diode test lamp V.A.G 1527 to contact 1 of the connector and to engine earth.
- Briefly operate starter (engine may also start).

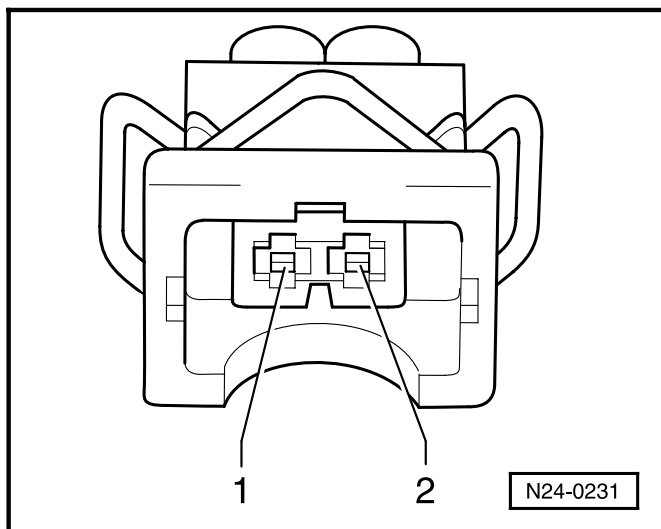
Specification: Diode test lamp should come on.

If the diode test lamp does not come on, carry out the following tests:

- Test cable from contact 1 of the connector at the variable intake manifold changeover valve to the fuse for continuity on the basis of the current flow diagram.
- ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

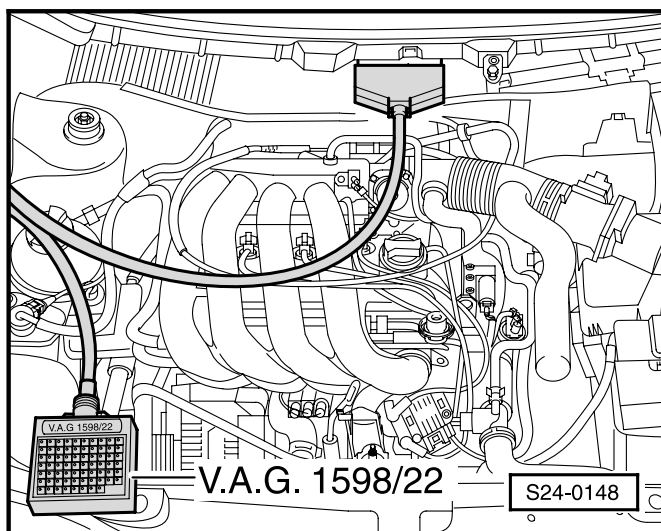
Specification: max. 1 Ω .

- Test fuel pump relay and actuation ⇒ page 24-36.



Testing actuation of the variable intake manifold changeover valve

- ◀ - Use cables from adapter cable set V.A.G 1594 A to connect diode test lamp V.A.G 1527 to contact 1 (positive) and contact 2 (actuation of engine control unit) of the connector for the variable intake manifold changeover valve.
- Initiate final control diagnosis ⇒ page 01-30.1. When the variable intake manifold changeover valve is actuated, the diode test lamp should flash.



- ◀ - If the diode test lamp does not flash or comes on and remains on, connect test box V.A.G 1598/22 to the wiring loom to the engine control unit.
- If the diode test lamp comes on and remains on, test cable from contact 2 of the connector for variable intake manifold changeover valve to socket 64 of the test box for short to earth.
- If the diode test lamp does not flash, test cable from contact 2 of the connector for variable intake manifold changeover valve to socket 64 of the test box for continuity and also for short circuit to positive.

Specification: max. 1 Ω

- Rectify any fault.
- If there is neither an open circuit in the wiring nor a short circuit, replace engine control unit ⇒ page 24-48.

Testing signal from power steering pressure switch

(Models from Model Year 1998)

Special tools, testers and aids required

- ♦ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3

Test procedure

- Connect vehicle system tester V.A.G 1552 and select the engine electronics control unit with the "address word" 01. Engine must be idling for this step.
(Connecting vehicle system tester and selecting engine electronics control unit ⇒ page 01-3.)

Test of vehicle systems
Select function XX

HELP

◀ Readout in display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm the entry with the key Q.

Read measured value block
Enter display group number XXX

◀ Readout in display:

- Press keys 0, 1 and 9 for "Display group number 19" and confirm the entry with the key Q.

Read measured value block 19 →
800 rpm 1.45 ms 1011 0 9.0° BTDC

◀ Readout in display:

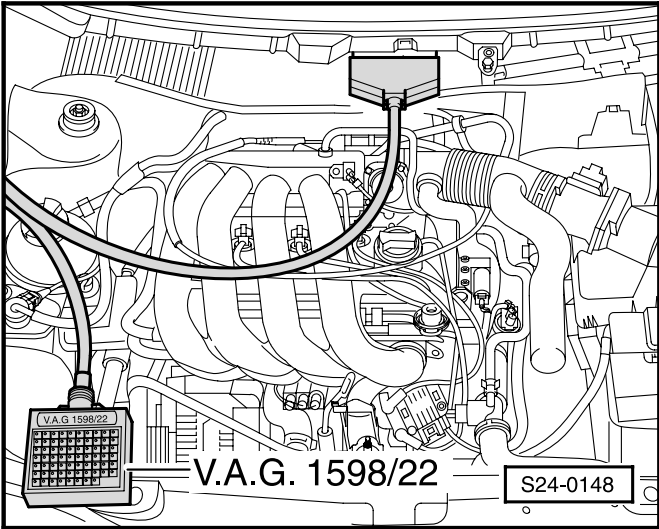
- Observe the readout in display block 3.

Specification: 1xxx x

- Turn the steering wheel to full lock and observe the readout in display block 3 (1. digit from left).

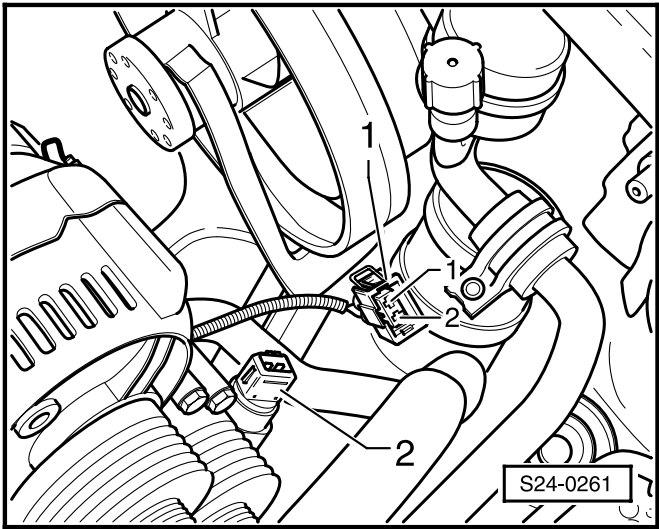
Specification: 0xxx x

- Press the → key.
- Press keys 0 and 6 for the function "End output" and confirm the entry with the key Q.
- Switch the ignition off.



If the specification is not achieved:

- Connect test box V.A.G 1598/22 to the wiring loom to the control unit.



- Unplug the 2-pin connector -1- from the power steering pressure switch (F88) -2-.
- Test the cables between test box and 2-pin connector for continuity according to current flow diagram.
Cable resistance: max. 1.5 Ω

Contact at 2-pin connector	Test box V.A.G 1598/22
1	49
2	14

- In addition, test all cables for short circuit to each other.

Specification: $\infty \Omega$

If no fault is found in the wiring:

- Connect the multimeter to the contacts of the pressure switch.
- Start the engine and run it at idling speed. Test the pressure switch for continuity.

Specification: $\infty \Omega$

- Turn the steering wheel to full lock. The pressure switch must switch to continuity.

Specification: 1.5 Ω

If the specifications are not achieved:

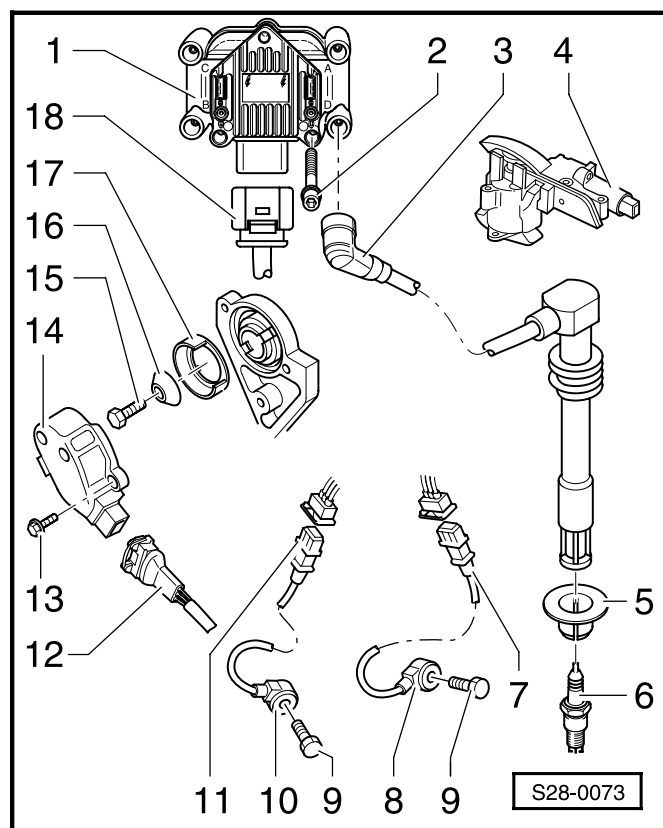
- Replace the power steering pressure switch:
⇒ Running Gear; Repair Group 48; Steering

If the specifications are achieved:

- Replace the engine control unit
⇒ page 24-48.

Servicing ignition system

List of components



Note:

Motronic control unit (J220)* with connector
⇒ page 24-1, item 5.

1 - Ignition coils (N and N128)

- ◆ With identification for ignition cables:
A = Cylinder 1
B = Cylinder 3
C = Cylinder 2
D = Cylinder 4
- ◆ With power output stages (N122 and N192)
- ◆ Testing ⇒ page 28-3

2 - 10 Nm

3 - Ignition cable

- ◆ With interference suppression connector and spark plug connector
- ◆ Test for continuity

4 - Camshaft adjustment valve (N205)*/**

- ◆ Testing ⇒ page 28-11

5 - Cover

6 - Spark plug, 30 Nm

- ◆ Use special spark plug wrench for removing and installing
- ◆ Type and electrode gap ⇒ page 28-3, Technical data of ignition system

7 - Connector

- ◆ brown, 2-pin

8 - Knock sensor 2 (G66)*

- ◆ On left in direction of travel
- ◆ Contacts of sensor and of connector gold-plated

9 - 20 Nm

- ◆ Tightening torque is important for proper operation of knock sensor

10 - Knock sensor 1 (G61)*

- ◆ On right in direction of travel
- ◆ Contacts of sensor and of connector gold-plated

11 - Connector

- ◆ black, 2-pin

12 - Connector

- ◆ black, 3-pin

13 - 10 Nm

14 - Hall sender (G40)*

- ◆ Testing ⇒ page 28-8

15 - 25 Nm

16 - Washer

- ◆ dished

17 - Orifice plate for Hall sender

- ◆ Can be installed only in one position
- ◆ Pay attention to fitting location: insert notch into camshaft

18 - Connector

- ◆ 4-pin

Safety precautions

Pay attention to the following points in order to avoid injuries to persons and/or damage to the fuel injection and ignition system:

- ◆ Do not touch or disconnect ignition cables when the engine is running or operating at starting speed.
- ◆ Do not disconnect or connect cables of the fuel injection and ignition system - also not test equipment cables - unless the ignition is switched off.
- ◆ To operate the engine at starting speed without it starting (e.g. compression test), unplug the connector from the power output stage for the ignition coils and the connectors from the injectors. After completing the work, interrogate fault memory.
- ◆ Do not wash an engine unless the ignition is switched off.
- ◆ Do not disconnect and connect the battery unless the ignition is switched off otherwise the engine control unit may be damaged.

Notes:

- ◆ *This section deals only with components relating specifically to the ignition system. Other components of the fuel injection and ignition system ⇒ Repair Group 24.*
- ◆ *The control unit for the fuel injection and ignition system is equipped with self-diagnosis.*
- ◆ *Components marked with * are tested by self-diagnosis ⇒ page 01-5, Interrogating fault memory.*
- ◆ *Components marked with ** can be tested with final control diagnosis ⇒ page 01-30.*
- ◆ *A voltage of at least 11.5 V is required for proper operation of the electrical components.*
- ◆ *When conducting certain tests it is possible that the fault will be recognised and stored by the control unit. For this reason, always interrogate the fault memory and erase it, if necessary, after completing all the tests and repair work.*
⇒ page 01-5, Interrogating fault memory
⇒ page 01-6, Erasing fault memory

Technical data of ignition system

Engine code letters	AGN
Engine speed sender	Resistance approx. 450...1000 Ω
Ignition system	Twin-spark ignition system with two ignition coils
Spark plugs	Tightening torque 30 Nm
Part No.	101 000 033 AA
Manufacturer's designation	NGK BKUR 6ET - 10
Electrode gap	1 mm ¹⁾
Spark plug connector	Resistance approx. 5 k Ω
Firing order	1-3-4-2
Engine speed governed by Motronic control unit: Governed speed	6800 $\pm$ 40 rpm

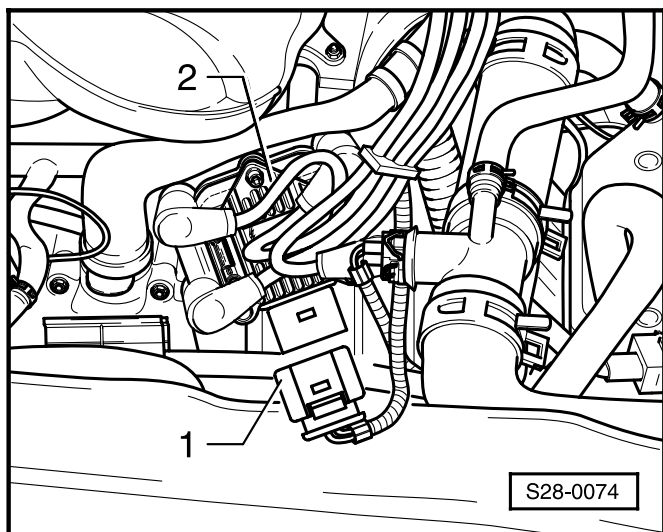
¹⁾ Distance between centre electrode and earth electrode.

Testing components and functions

Testing twin-spark ignition system with two ignition coils

Special tools, testers and aids required

- ◆ Diode test lamp (e.g. V.A.G 1527)
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter (e.g. V.A.G 1526 A)
- ◆ Adapter cable set (e.g. V.A.G 1594 A)
- ◆ Current flow diagram



Test conditions

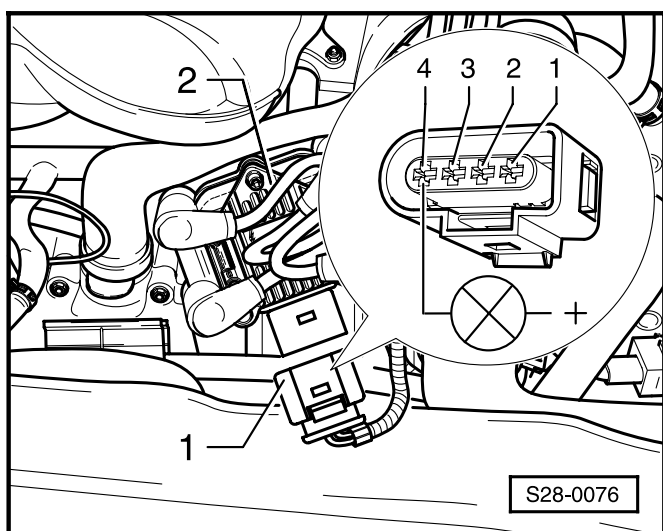
- Battery voltage at least 11.5 V
- Engine speed sender o.k.; Testing ⇒ page 24-21
- Hall sender o.k.; Testing ⇒ page 28-8

Testing earth supply of power output stage

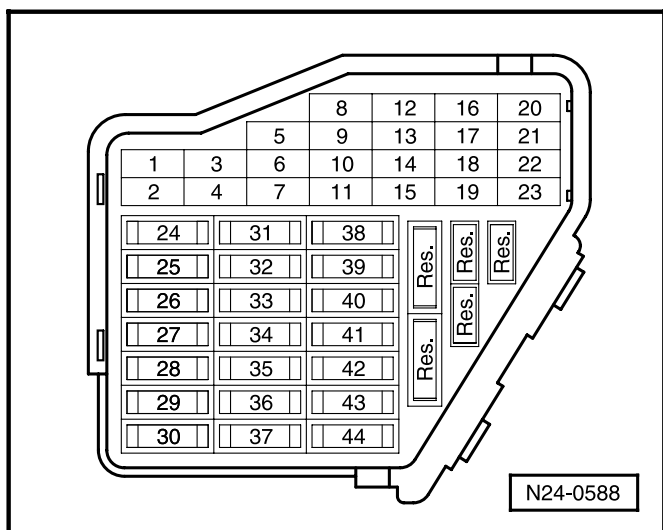
Note:

Ignition coils and power output stage are a single component and cannot be replaced separately.

- ◀ - Unplug the 4-pin connector -1- at the ignition coils -2-.



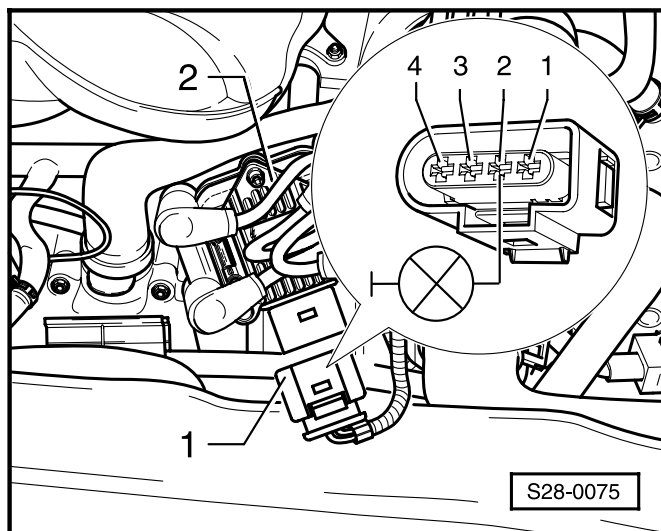
- ◀ - Connect diode test lamp V.A.G 1527 between battery positive and contact 4 of the connector (earth); diode test lamp should come on.
- If the diode test lamp does not come on, test cable connection for continuity according to current flow diagram and rectify any open circuit.
- ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder



Testing voltage supply of ignition coils

Test requirement:

- ◀ ● Fuse 29 for ignition coils o.k.
- Unplug the 4-pin connector at the ignition coils.
- Switch on the ignition.



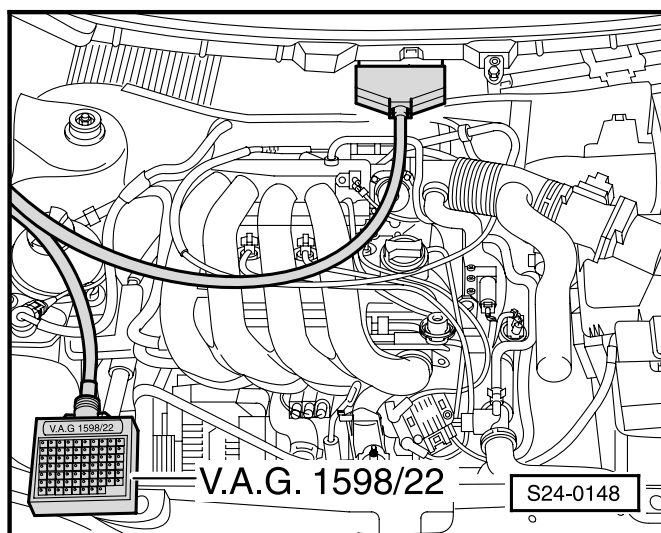
- Connect diode test lamp V.A.G 1527 between engine earth and contact 2 of connector (positive supply).

Specification: Diode test lamp should come on.

- If the specifications are not achieved, test for open circuit in wiring according to current flow diagram and rectify any open circuit or test the fuse.
- ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

Testing actuation

- Unplug the connectors at all four injectors.
- Switch on ignition.
- Connect diode test lamp V.A.G 1527 between engine earth and contacts 1 and 3 one after the other.
- Operate the starter for a few seconds each time. The diode test lamp should flash each time.
- Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48, Replacing engine control unit.



- If the diode test lamp does not flash, test the cable connection from the connector to the engine control unit for open circuit and short circuit on the basis of current flow diagram (connect test box V.A.G 1598/22 to wiring loom to engine control unit).
- Rectify any open circuit in wiring or short circuit.

Contact at 4-pin connector of power output stage	Contact at control unit connector
1	71
3	78

- If no open circuit or short to earth is found, replace engine control unit ⇒ page 24-48.

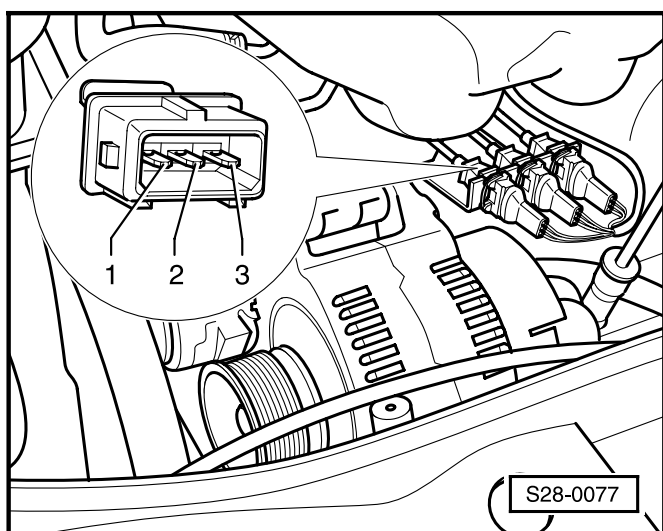
Testing knock sensors

Special tools, testers and aids required

- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter V.A.G 1526 or multimeter V.A.G 1715
- ◆ Adapter cable set V.A.G 1594
- ◆ Current flow diagram

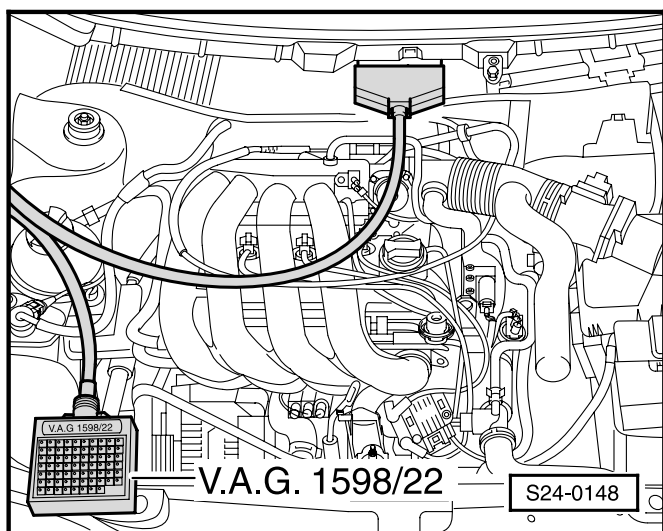
Notes:

- ◆ *Reading measured value block, display groups 012, 013, 014 and 015 for testing operation of the knock sensors.*
- ◆ *The knock sensors themselves cannot be tested electrically (interrogate fault memory ⇒ page 01-5).*
- ◆ *It is essential to adhere exactly to the tightening torque of 20 Nm if the knock sensors are to operate properly.*
- ◆ *Inspect plug connection for corrosion.*
- ◆ *Only gold-plated contacts may be used for repairing contacts in the plug connection of the knock sensors.*



Testing knock sensor wiring

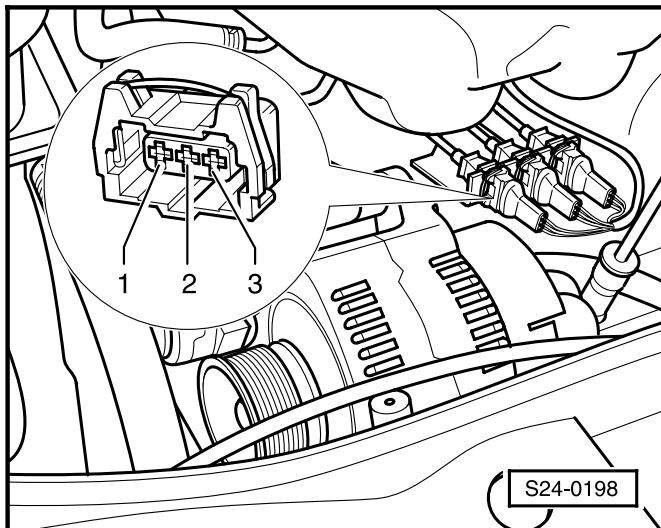
- Separate the plug connection of the relevant knock sensor in the engine compartment.
- ◀ - Test all three contacts at the connector of the knock sensor for short circuit to each other. There must not be any connection between the cables.



- If a connection exists, replace knock sensor.

Testing wiring from knock sensors to engine control unit

- ◀ - Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48, Replacing engine control unit.
- Test the wiring between sender and engine control unit for open circuit and short circuit according to the current flow diagram.



⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

◀ Contact assignment of plug connection:

Signal wire	Earth wire	Screening
1	2	3

- Test signal wire of knock sensor 1 -G61 from contact 1 of connector in engine compartment to socket 68 of test box for continuity.

Specification: max. 1 Ω .

- Test earth wire of knock sensor 1 -G61 from contact 2 of connector in engine compartment to socket 67 of test box for continuity.

Specification: max. 1 Ω .

- Test screening of cable for knock sensor 1 -G61 from contact 3 of connector in engine compartment to socket 67 of test box for continuity.

Specification: max. 1 Ω .

- Test signal wire of knock sensor 2 -G66 from contact 2 of connector in engine compartment to socket 60 of test box for continuity.

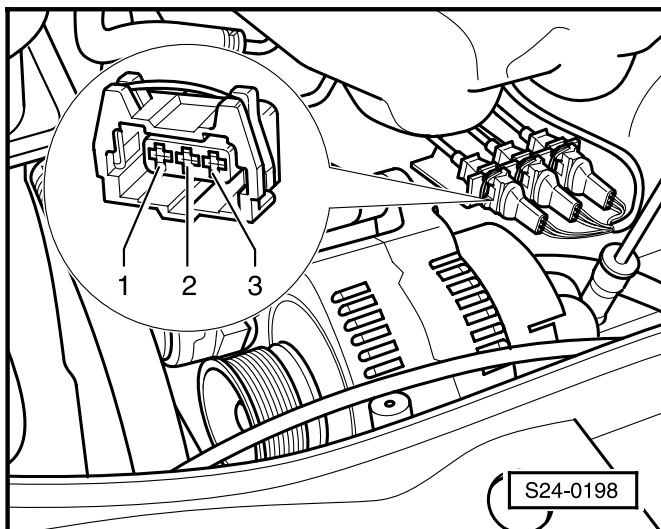
Specification: max. 1 Ω .

- Test earth wire of knock sensor 2 -G66 from contact 2 of connector in engine compartment to socket 67 of test box for continuity.

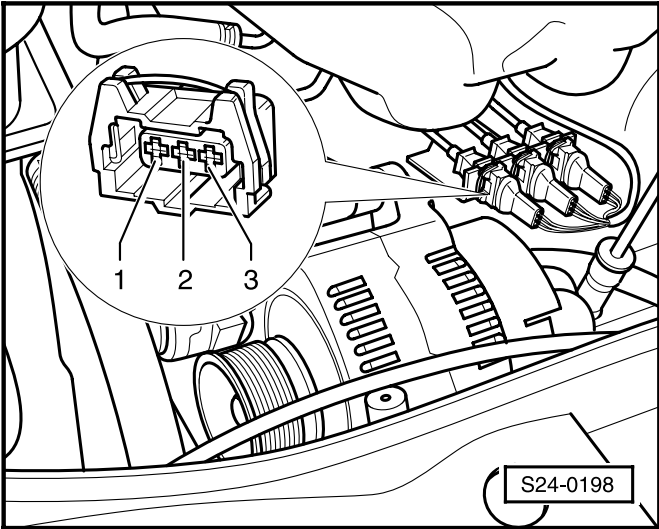
Specification: max. 1 Ω .

- Test screening of cable for knock sensor 2 -G66 from contact 3 of connector in engine compartment to socket 67 of test box for continuity.

Specification: max. 1 Ω .



◀ If the specifications are not achieved, rectify any open circuit in the wiring or short circuit.



● Knock sensor 1

Sensor connector contact	Contact at control unit connector
1 (Signal)	68
2 (Earth)	67
3 (Screening)	67

● Knock sensor 2

Sensor connector contact	Contact at control unit connector
1 (Signal)	60
2 (Earth)	67
3 (Screening)	67

Testing Hall sender

Special tools, testers and aids required

- ◆ Test box V.A.G 1598/22
- ◆ Diode test lamp, e.g. V.A.G 1527
- ◆ Hand-held multimeter, e.g. V.A.G 1526 or multimeter V.A.G 1715
- ◆ Adapter cable set V.A.G 1594
- ◆ Current flow diagram

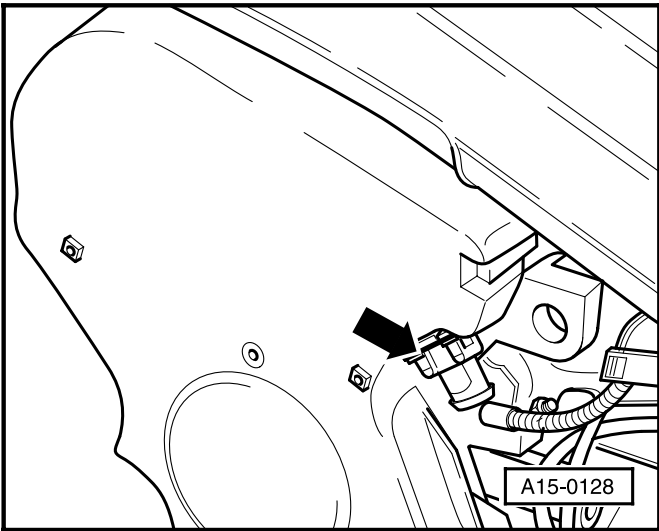
Test condition

- Fault at sender recognised by self-diagnosis

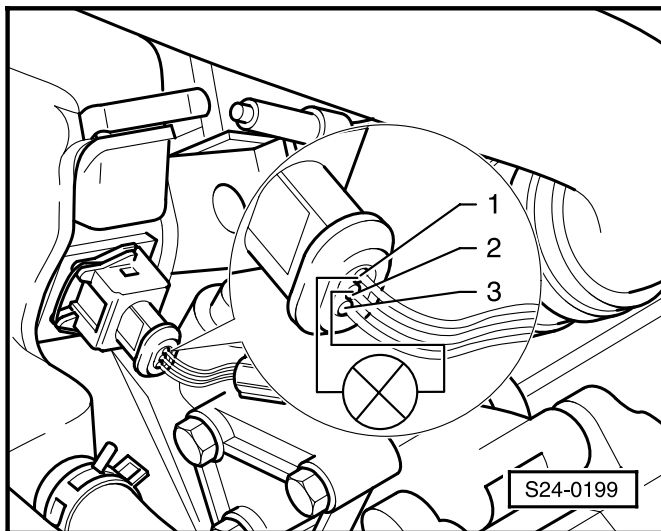
◀ Installation position of Hall sender.

Notes:

- ◆ In normal operation the engine control unit recognises the ignition position for cylinder 1 from the Hall sender signal.
- ◆ Because it is no longer possible to assign the cylinders to the knock sensor signals if no signal is received from the Hall sender, the knock control is switched off and the ignition angle is retarded slightly in order to reliably avoid any knocking.
- ◆ If the Hall sender signal is not received, the engine continues running and can also be started again for the following reasons:



- ◆ The offset by one revolution does not have any perceptible effects on fuel injection. Fuel injection then does not take place with the inlet valve opened but „advanced“ (upstream of the closed inlet valve). Consequently the quality of the mixture formation is only slightly affected.
- ◆ With the twin-spark ignition system, an ignition spark is generated for each cylinder during each engine revolution in contrast to the normal system in which a spark is generated during each second engine revolution.



- ◀ - Connect diode test lamp V.A.G 1527 from the rear to contacts 1 and 2 at the connector of the Hall sender (the connector remains plugged in at Hall sender).

Note:

The connector contacts are numbered accordingly on the rear of the connector.

- Operate the starter for a few seconds.
- The diode test lamp should flash briefly during each second engine revolution.
- Unplug the connector at the Hall sender.
- Switch on the ignition.
- Connect hand-held multimeter V.A.G 1526 to contact 1 (positive) and contact 3 (earth) of the connector of the Hall sender.

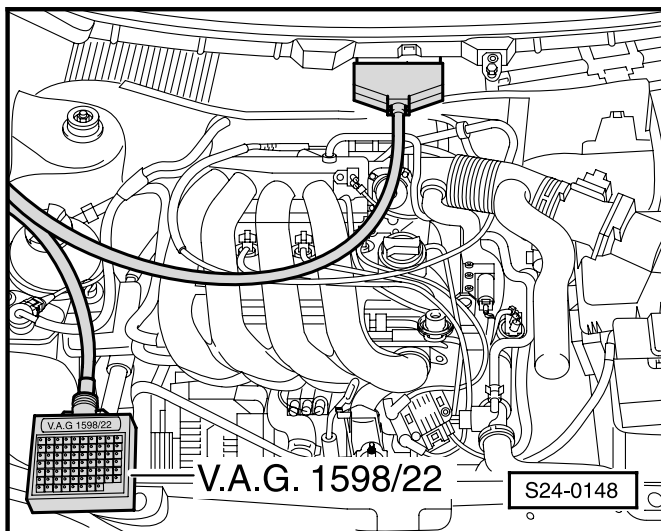
Specification: 4.5 ... 5.5 V

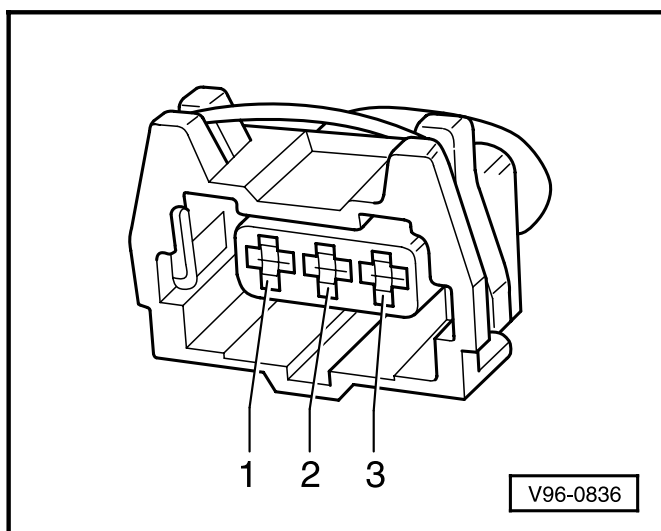
- Connect hand-held multimeter V.A.G 1526 to contacts 2 and 3 of the connector of the Hall sender.

Specification: about battery voltage

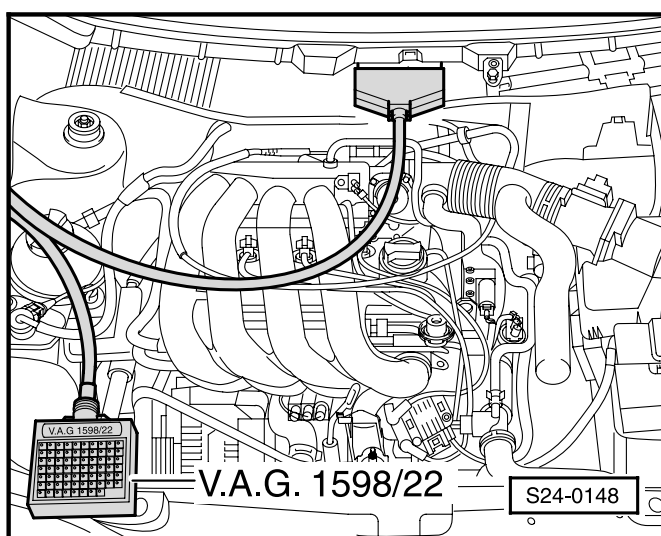
- If the specifications are achieved and the diode test lamp does not flash, replace Hall sender.
- If the specifications are not achieved, test the wiring as follows:

- ◀ - Connect test box V.A.G 1598/22 to the wiring loom to the engine control unit
⇒ page 24-48, Replacing engine control unit.





- ◀ - Test the cable connection from the Hall sender ...



- ◀ - ... to the engine control unit for open circuit in wiring and also for short circuit to positive and to earth.

Contact at 3-pin connector of Hall sender	Contact at connector of control unit
1 (positive)	62
2 (signal)	76
3 (earth)	67

- If an open circuit or short circuit exists, replace engine control unit ⇒ page 24-48.
 - If a fault relating to the camshaft sensor (Hall sender) is again displayed after erasing the fault memory as a check although all the tests up until now were o.k., the following fault is possible:
 - Rotor orifice of Hall sender turned wrong way round.
 - Unbolt Hall sender and check whether the rotor orifice at the camshaft is correctly installed (incorrectly installed, the detent lug is flattened when tightening the bolt).
 - If the rotor orifice is correctly installed, check assignment of crankshaft to camshaft.
- ⇒ 1.8-ltr./92 kW Engine, Mechanical Components; Repair Group 15; Cylinder Head, Valve Gear; Removing and installing camshafts and camshaft adjuster

Note regarding signal test with oscilloscope:

The middle of the Hall window must be positioned on the third descending slope of the engine speed signal after the reference mark gap.

Testing camshaft adjustment

Special tools, testers and aids required

- ♦ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3

Test condition

- Operating temperature of at least 80 °C.

◀ Installation position of solenoid valve.

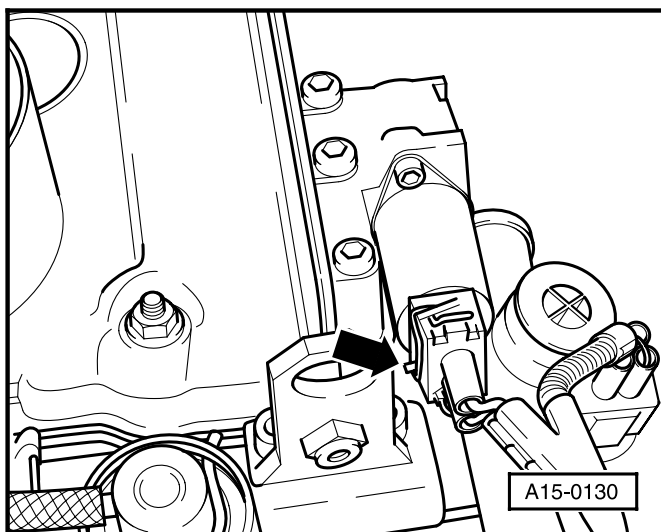
Testing operation

The inlet camshaft is adjusted in line with engine load and speed. The electric camshaft adjuster valve directs oil pressure to the camshaft adjuster (mechanical adjusting device).

- Start engine and run at idling speed.

Camshaft adjustment is only active 2 seconds after starting engine.

- Select Reading measured value block (function 08) and display group 025
⇒ page 01-61.



Read measured value block 25				→
1	2	3	4	

◀ Readout in display:

- Check readout in display field 3.

Specification: X X 0

Actuation of the camshaft adjustment is not active.

- Carry out a road test.
- Accelerate car from a slow speed (1000 rpm) in 2nd gear with accelerator depressed fully.

Important!

Have a second person operate V.A.G 1552.

- Check the readout in display field 3.

Read measured value block 25				→
1	2	3	4	

◀ Readout in display:

Specification: X X 1

Value: X = ignore

Actuation of the camshaft adjustment is active.

Notes:

- ◆ Display field 4 indicates whether an adjustment of the camshaft has in fact taken place.
- ◆ The camshaft adjustment takes place only at full throttle; for this reason check the readout in display field 1.

Specification without adjustment: -3.0 to 3.0 ° CA

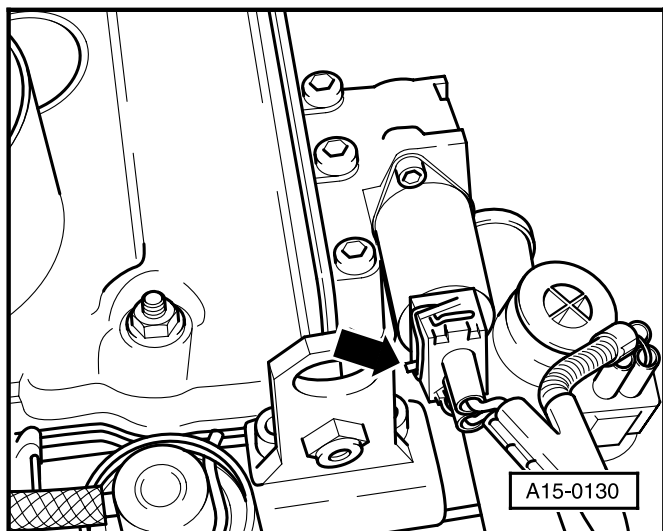
Specification with adjustment: 15.0 to 22.0 ° CA

- If the specifications are not achieved, test camshaft adjustment solenoid valve
⇒ page 28-12.

Testing camshaft adjustment solenoid valve

Special tools, testers and aids required

- ◆ Vehicle system tester V.A.G 1552 with cable V.A.G 1551/3
- ◆ Test box V.A.G 1598/22
- ◆ Hand-held multimeter V.A.G 1526 A or multimeter V.A.G 1715
- ◆ Adapter cable set V.A.G 1594 A



◀ Installation position of solenoid valve.

Test procedure

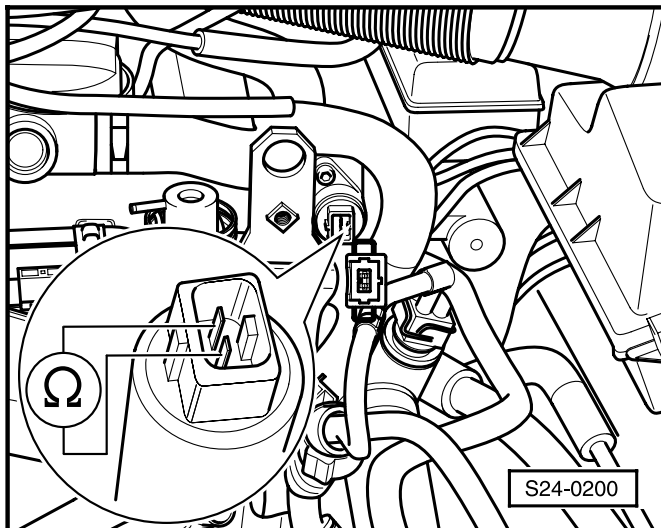
- Switch on the ignition.
- Start final control diagnosis (function 03) and select camshaft adjustment ⇒ page 01-30.

Final control diagnosis
Camshaft adjustment 1



◀ Readout in display:

The valve should be heard to clearly click during actuation of the camshaft adjustment.



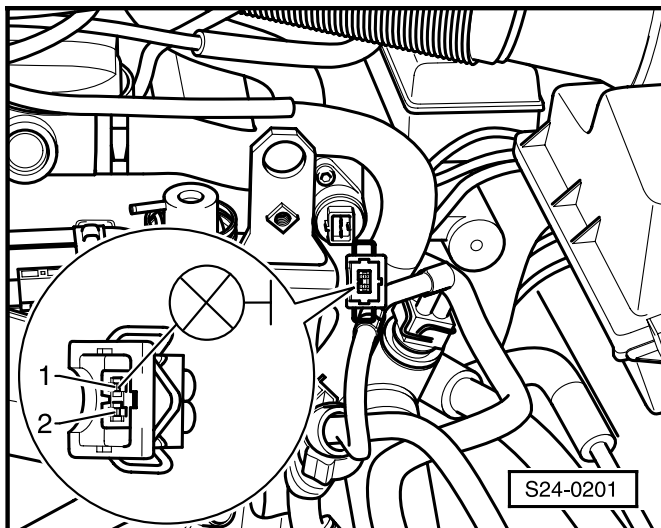
If the valve does not click, switch off the ignition.

- ◀ - Unplug the connector from the solenoid valve -N205.
- Use V.A.G 1526 A to carry out a resistance measurement between the contacts of the valve.

Specification: 10 ... 18 Ω

- If the specification is not achieved, replace valve.

Testing voltage supply of camshaft adjustment valve -N205



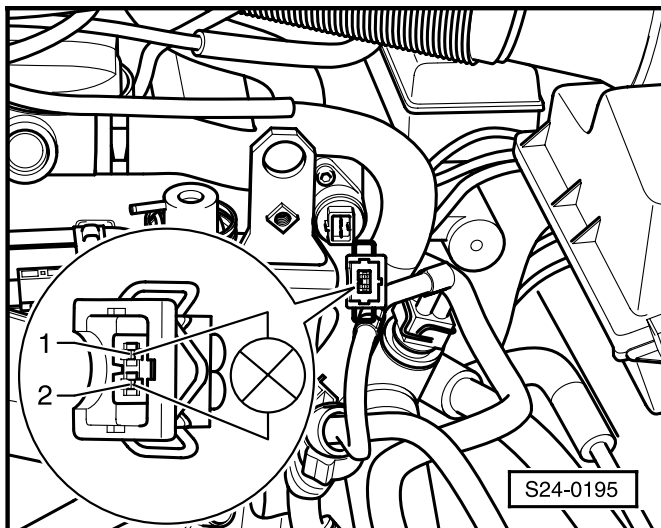
- Unplug the connector at the solenoid valve -N205.
- ◀ - Connect diode test lamp V.A.G 1527 with cables from adapter cable set V.A.G 1594 A to contact 1 of the connector and to engine earth.
- Operate the starter for a few seconds. The engine may also start when this is done.

Diode test lamp should come on.

If the diode test lamp does not come on, carry out the following tests:

- Test the fuse for the camshaft adjustment valve.
- Test cable from contact 1 of connector for camshaft adjustment to the fuse for open circuit.
- ⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder
- Test fuel pump relay and actuation ⇒ page 24-36.

Testing actuation of camshaft adjustment



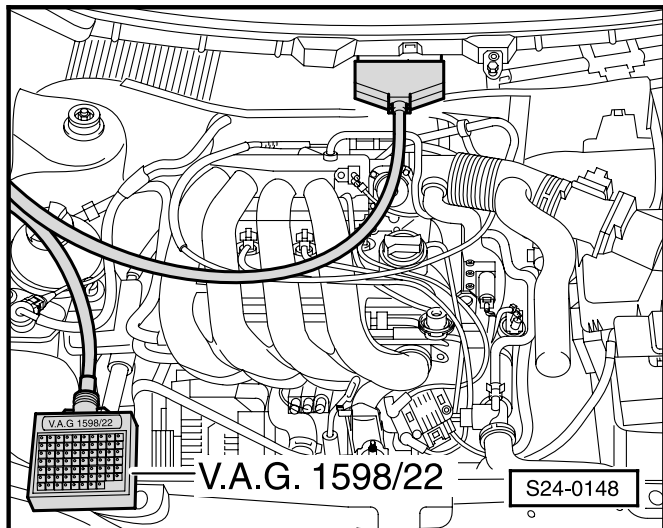
- ◀ - Use cables from adapter cable set V.A.G 1594 A to connect the diode test lamp V.A.G 1527 to contact 1 (positive) and to contact 2 of the connector of the valve.

Final control diagnosis
Camshaft adjustment 1



◀ Readout in display:

The diode camshaft should flash when the camshaft adjustment is actuated.



◀ - If the diode test lamp does not flash or if it comes on and remains on, connect test box V.A.G 1598/22 to the wiring loom to the engine control unit ⇒ page 24-48, Replacing engine control unit.

- If the diode test lamp comes on and remains on, test the cable connection between contact 2 of the connector to contact 55 of the test box for short circuit to earth.

⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

- If the diode test lamp does not flash, test the cable from contact 2 of the connector to contact 55 of the test box for open circuit or short circuit to positive.

⇒ Current Flow Diagrams, Electrical Fault Finding and Fitting Locations binder

- Rectify any short to earth or open circuit in the wiring.

- If there is neither an open circuit in the wiring nor a short circuit, replace the engine control unit ⇒ page 24-48.

- If the cable connections are o.k., replace the mechanical camshaft adjuster.

⇒ 1.8-ltr./92 kW Engine Mechanical Components; Repair Group 15; Cylinder Head, Valve Assembly; Removing and installing camshafts and camshaft adjuster