



Audi A3 1997 ➤

Simos Injection and Ignition System (4-cylinder)

Engine ID	AEH	AKL							
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Edition 09.1996

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List of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups

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Simos Injection and Ignition System (4-cylinder)

Repair Group

01 - Self-diagnosis

24 - Mixture preparation, Injection

28 - Ignition system

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Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

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Contents

01 - Self-diagnosis	1
1 Self-odiagnosis	1
1.1 Self-odiagnosis	1
1.2 Function	1
1.3 Technical data of self-diagnosis	1
1.4 Connecting fault reader V.A.G 1551 and selecting engine electronics control unit	2
1.5 Interrogating and erasing fault memory	4
1.6 Fault table	5
1.7 Final control diagnosis	18
1.8 Performing basic setting of engine	20
1.9 Coding Simos control unit	20
1.10 Reading measured value block	21
1.11 Display Group overview with test table	22
1.12 Reading measured value block: Display Groups 00 (block of ten) to 10	25
1.13 Reading measured value block: Display Groups 11 to 99	32
24 - Mixture preparation, Injection	39
1 Servicing Simos injection system	39
1.1 Servicing Simos injection system	39
1.2 Safety precautions	39
1.3 Rules for cleanliness	39
1.4 Technical data	39
1.5 Fitting locations overview	40
1.6 Wiring and component check with test box V.A.G 1598/22	43
1.7 Replacing engine control unit	43
1.8 Testing idling speed	45
1.9 Testing fuel pressure regulator and holding pressure	46
1.10 Testing injectors	48
1.11 Testing injection quantity, leak tightness and spray pattern of injectors	50
1.12 Testing fuel pump relay and activation	52
1.13 Testing air mass meter (vehicles up to model year 1998)	54
1.14 Testing air mass meter (vehicles as of model year 1998)	56
1.15 Testing intake air system for leaks (unmetered air)	58
2 Testing lambda control	59
2.1 Testing lambda control	59
2.2 Poor performance after cold start	60
2.3 Testing operation	61
2.4 Testing lambda probe heating	63
2.5 Testing lambda probe signal wiring and activation	64
2.6 Removing and installing lambda probe	65
3 Testing fuel tank breather system	66
3.1 Testing fuel tank breather system	66
3.2 Testing solenoid valve 1 for activated carbon filter	66
4 Testing throttle valve control unit	68
4.1 Testing throttle valve control unit	68
4.2 Vehicles up to model year 1998	68
4.3 Adaptation of throttle valve control unit	68
4.4 Testing idling switch	70
4.5 Testing throttle valve positioner sender and throttle valve potentiometer	71
4.6 Testing throttle valve control unit (vehicles as of model year 1998)	73
5 Testing intake manifold changeover function	80
5.1 Testing intake manifold changeover function	80
5.2 Testing operation	80



5.3	Testing vacuum system	80
5.4	Testing intake manifold changeover valve	81
5.5	Testing activation of intake manifold changeover valve	82
6	Testing auxiliary signals	83
6.1	Testing auxiliary signals	83
6.2	Testing air conditioner compressor shut-off	83
6.3	Testing engine speed adaptation when air conditioner cuts in	85
6.4	Checking selector lever position on automatic gearbox	86
6.5	Testing starter signal	87
6.6	Testing engine speed signal	88
6.7	Testing throttle valve position	88
6.8	Testing road speed signal	89
6.9	Testing gearshift signal when changing gear	90
6.10	Testing signal from clutch pedal switch	91
6.11	Testing signal from power steering pressure switch	92
6.12	Testing data exchange between engine/ABS/gearbox control unit	94
28	- Ignition system	95
1	Testing ignition system	95
1.1	Testing ignition system	95
1.2	Safety precautions	95
1.3	Technical data for ignition system	95
1.4	Identification of ignition connections on ignition coil	96
1.5	Testing twin-spark ignition system with two ignition coils	96
1.6	Testing intake air temperature sender (vehicles up to model year 1998)	98
1.7	Testing intake air temperature sender (vehicles as of model year 1998)	100
1.8	Testing engine speed sender	102
1.9	Testing coolant temperature sender	103
1.10	Testing control unit voltage supply	105
1.11	Testing knock sensor	107
1.12	Testing Hall sender	109

01 - Self-diagnosis

1 - Self-odiagnosis

1.1 - Self-odiagnosis

1.2 - Function

The control unit for the fuel injection and ignition system is equipped with a fault memory.

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

Stored faults are displayed by calling up the fault display => Page 4 .

This fault memory must be erased once the faults have been eliminated => Page 4 .

A fault relating to the function of the Lambda control system can only be checked after a test drive of at least 10 minutes duration.

The fault memory also stores faults caused by temporary open circuits or loose contacts. These are displayed as sporadic faults (SP), and if they do not re occur after 40 more engine starts they are automatically erased.

1.3 - Technical data of self-diagnosis

Equipped with

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- ◆ Fault memory: Non-volatile memory and volatile memory1).
- ◆ Rapid data transfer

- 1) Will be erased after 40th engine start if fault has not occurred again.

Control unit identification

=> Page 2 ; connecting fault reader V.A.G 1551 and selecting engine electronics control unit

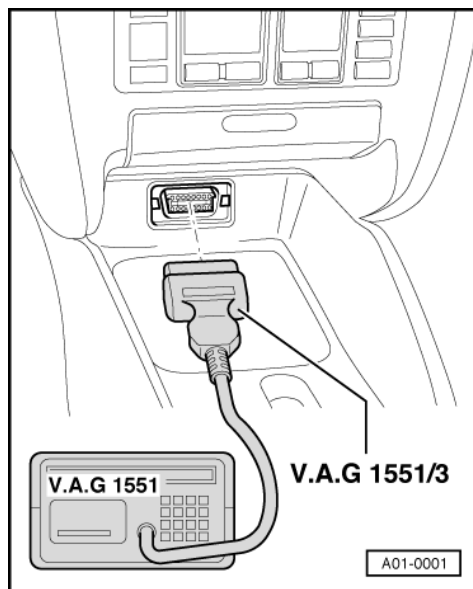
Available functions

Function	Requirement	
	Engine not running, ignition on	Engine idling
01 Check control unit version	yes	yes
02 Interrogate fault memory	yes	yes
03 Final control diagnosis	yes	no
04 Introduction of basic setting	yes	no
05 Erase fault memory	yes	yes



06 End output	yes	yes
07 Encode control unit	yes	no
08 Read block of measured values	yes	yes

1.4 - Connecting fault reader V.A.G 1551 and selecting engine electronics control unit



Note:

Vehicle system tester V.A.G 1552 can be used instead of fault reader V.A.G 1551. However, printouts cannot be made.

Test conditions

- Battery voltage at least 11 V.
- Earth connections on engine and gearbox OK.
- Fuse OK.
- -> Unclip cover for diagnostic connections.
- Connect fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 with cable V.A.G 1551/3.

-> Display readout:

V.A.G - SELF-DIAGNOSIS	HELP
1 - Rapid data transfer	
2 - Flash code output	

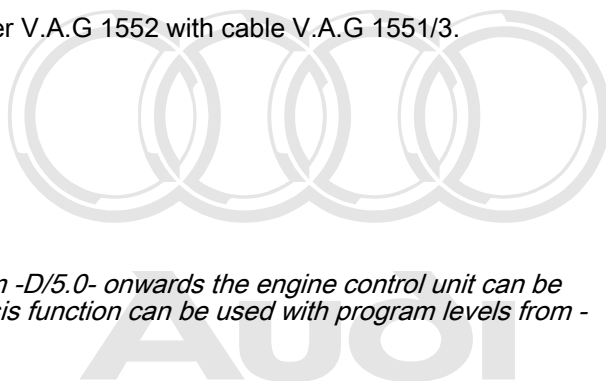
Note:

If using V.A.G 1551 and test cards with program levels from -D/5.0- onwards the engine control unit can be selected directly via "Rapid data transfer". The self-diagnosis function can be used with program levels from -D/5.4- onwards.

Note:

If the display remains blank:

=> Fault reader operating instructions



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Depending on the function required:

- Switch the ignition on.
- or
Start the engine => Page 1, table "Available Functions".

- Switch on printer with the Print button (warning lamp in button lights up).
- Press key 1 for "Rapid data transfer".

-> Display readout:

Rapid data transfer	HELP
Enter address word	XX

Rapid data transfer	Q
01 - Engine electronics	

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-> Press keys 0 and 1 for address word "Engine electronics" and confirm entry by pressing the Q key.

-> If the display shows one of the messages reproduced here, run through the fault finding procedure as described in the Fault Finding Programme for diagnosis wiring.

Rapid data transfer	HELP
Control unit does not answer	

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

Rapid data transfer	HELP
Fault in communication build up	

Rapid data transfer	HELP
K wire not switching to earth	

Rapid data transfer	HELP
K wire not switching to positive	

-> The display on fault reader V.A.G 1551 will show one of the two possible control unit identification codes. For example:

06A906019D	SIMOS 2	HSXXXX
Coding 0000	WSC XXXXX	

- ◆ 06A 906 019 D = Part No. of the control unit (for latest control unit version, see Parts List)
- ◆ SIMOS 2 = system designation and version
- ◆ HSXXXX = programme level number for manual gearbox
- ◆ ATXXXX = programme level number for automatic gearbox
- ◆ Coding 00000 = coding variant
- ◆ WSC = workshop code

-> Or:

06A906019D	1.6l R4/2V SIMOS HS D01
Coding 00000	WSC XXXXX

- ◆ 06A 906 019 D = Part No. of the control unit (for latest control unit version, see Parts List)
- ◆ 1.6 ltr. = engine capacity
- ◆ R4/2V = engine type (in-line engine, 4-cyl., 2 valves per cylinder)
- ◆ SIMOS = designation of injection and ignition system
- ◆ HS = manual gearbox (hand shift)
- ◆ AT = automatic gearbox
- ◆ D = data level (hardware and software versions) of control unit
- ◆ Coding = coding variant of control unit
- ◆ WSC = workshop code



If the coding differs from the vehicle version, then:

- Check control unit coding => Page 20 .
Coding Simos control unit
- Press the ➡key.

-> Display readout:

Rapid data transfer Select function XX	HELP
---	------

Note:

Press the HELP key to obtain a printout of the available functions.

1.5 - Interrogating and erasing fault memory

Note:

Vehicle system tester V.A.G 1552 can be used instead of fault reader V.A.G 1551. However, printouts cannot be made.

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select the engine electronics control unit with the "Address word" 01. When doing this, the engine should be idling.
(Connecting fault reader and selecting engine electronics control unit => Page 2 .)

Only if engine does not start:

- Interrogate fault memory with ignition switched on.
- Switch on printer with the Print button
(warning lamp in button lights up).

-> Display readout:

Rapid data transfer Select function XX	HELP
---	------

- Operate fault reader, taking into account the information on the display:
- Press keys 0 and 2 for function "Interrogate fault memory" and confirm entry with Q key.

-> The display will show either the number of faults stored or the message "No fault recognised!".

X faults recognised

If no fault is stored:

- Press the ➡key.

If one or more faults are stored:

The stored faults are displayed and printed out one after another.

Then the display will show:

- Locate and eliminate faults listed on printout as per fault table => Page 5 .
- Press keys 0 and 5 for the function "Erase fault memory" and confirm entry with Q key.

-> Display readout:

Rapid data transfer Fault memory is erased!
--

Note:

If the ignition is switched off between interrogating the fault memory and erasing the fault memory, then the fault memory will not be erased. It is therefore important to follow the procedure exactly, i.e. first interrogate the fault memory and then erase it.

- Press the =>key.

-> Display readout:

Rapid data transfer Select function XX	HELP
---	------

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

For the function "End output" codes can be entered with the Q key. This is permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.

1.6 - Fault table

Note:

- ♦ The following table (arranged by fault code number) lists all the faults which the engine control unit can recognise and which can appear on the V.A.G 1551 printer display.
- ♦ The fault table is listed according to the 5 digit fault code on the left.
- ♦ If a fault occurs only occasionally or if the fault memory is not erased after the repair has been carried out, the fault will appear on the display as a "sporadically occurring fault" (SP).
- ♦ Explanation of the fault types (e.g. "open circuit/short circuit to earth"):

=> Fault reader operating instructions

- ♦ Before renewing components indicated as being faulty, check the wiring and connectors to these components as well as the earth connections using the current flow diagrams. This is particularly relevant for faults recorded as "occurring sporadically" (SP).

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00282 Throttle valve positioner - V60-1)			
Short circuit	- Open circuit or short to earth or positive, or short between wires	- Cold start problems	- Rectify open circuit or short using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations
Blocked or without voltage	- V60 defective/sticking	- Cold idling problems - Harsh load changes	- Test throttle valve control unit =>Page 68 .
Connector	- Cables interchanged	- Mechanical emergency running (J338) recognised	
Upper stop value	- Engine control unit defective		- Replace engine control unit =>Page 43 .
Signal outside tolerance			
Regulating difference			

- 1) The throttle valve positioner -V60 is a component of throttle valve control unit J338.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
------------------------------	-------------------------	------------------	---------------------



00305 Fuel consumption indicator signal Short to positive	- Short to positive in wiring between engine control unit and on board computer	Test signal for fuel consumption indicator => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations
---	---	--

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00513 Engine speed sender -G28 No signal	- Open circuit or short to earth or positive in signal wire - Open circuit or short to positive in earth wire - Open circuit in screening for -G28 - -G28 defective - Faulty signal input in engine control unit (control unit defective)	- Engine no longer runs up to cut off speed (engine speed governed to approx. 5100 rpm) - Loss of power - Engine starts reluctantly or not at all when cold (cold start problems) - Engine starts reluctantly or not at all when warm (hot start problems)	- Test -G28 =>Page 102 . - Read measured value block, Display Group 01 =>Page 29 . - Replace engine control unit =>Page 43 .

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00513 Engine speed sender -G28 Implausible signal	- Metal particles on engine speed sender -G28 - Gap between -G28 and sender wheel too large	- Engine no longer runs up to cut off speed (engine speed governed to approx. 5100 rpm) - Loss of power - Engine starts reluctantly or not at all when cold (cold start problems) - Engine starts reluctantly or not at all when warm (hot start problems)	- Test -G28 =>Page 102 . - Read measured value block, Display Group 01 =>Page 29 .

Notes on fault code 00513:

- ♦ The presence of metal particles can result in additional signals.
- ♦ If the gap between the sender and the sender wheel is too large or if the sender wheel is damaged, the signals may not be sent or may be too small to be picked up.
- ♦ A loose sender wheel (or loose sender) may result in uneven signal transmission.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00515 Hall sender -G40			

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
No signal	- Fault in power supply or earth connection for - G40	- Engine no longer runs up to cut off speed (engine speed governed to approx. 5100 rpm)	- Test -G40 =>Page 109 .
Implausible signal	- Faulty signal input in engine control unit (control unit defective) - Open circuit or short to positive or earth in signal wire between -G40 and engine control unit	- Engine starts reluctantly or not at all when cold (cold start problems) - Engine starts reluctantly or not at all when warm (hot start problems)	- Rectify open circuit or short using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations
Continued on next Page			

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00515 (cont.) Hall sender -G40 - Fault type - see previous Page	- -G40 defective - Toothed belt has slipped (signal not being sent at the expected time) - Loose contact - Rotor ring defective (bent or cracked)	- Poor performance - See previous Page for other possible effects	- Check valve timing => Mechanics; Repair Group 13; Dismantling and assembling engine Dismantling and assembling engine Removing Installing and tensioning toothed belt

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00516 Idling switch -F601) Open/short circuit to positive	- Open circuit or short to positive or earth in signal wire between -F60 and engine control unit	- Engine running problems when pulling away	- Test throttle valve control unit =>Page 68 . Rectify open circuit or short using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations
Short-circuit to earth	- -F60 defective - Throttle valve sticking - Floor mat pressing down on accelerator - Throttle cable setting	- Engine running problems in transition from idling/overrun to part throttle - Idling speed outside specified range	- Check accelerator cable setting => Mechanics; Repair Group 20; Removing and installing Removing and installing Parts of fuel supply system Adjust throttle cable
Continued on next Page			



Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00516 Idling switch -F601) Fault type - see previous Page	- Moisture in plug connector for throttle valve control unit - Faulty signal input in engine control unit (control unit defective)	- See previous Page	- Replace engine control unit =>Page 43 .

1) The idling switch -F60 is a component of throttle valve control unit J338.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00518 Throttle valve potentiometer - G691) Short to positive	- Open circuit in earth wire - Short to positive in wiring - -G69 defective	- Harsh load changes	- Test -G69 =>Page 68 , Testing throttle valve control unit.
Short-circuit to earth	- -G69 defective - Open circuit in wiring - Short to earth in signal wire between -G69 and engine control unit	- Poor throttle response	- Rectify short or open circuit using current flow diagram
Implausible signal	- Loose contact		
Continued on next Page			

1) The throttle valve potentiometer -G69 is a component of throttle valve control unit J338.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00518 Throttle valve potentiometer - G691) Implausible signal (cont.)	- -G69 defective - Moisture or corrosion on plug connector for potentiometer - Faulty signal input in engine control unit (control unit defective)	- See previous Page	- See previous Page - Replace engine control unit =>Page 43 .

1) The throttle valve potentiometer -G69 is a component of throttle valve control unit J338.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00520 Air mass/air flow meter - G70/-G19			

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
Short to positive	- Open circuit or short to positive or earth in signal wire between -G70 and engine control unit	- Engine running problems - Engine starts reluctantly or not at all when cold (cold start problems)	- Test G70 => Page 54 .
Open/short circuit to earth	- Fault in power supply to -G70 - -G70 defective - Faulty signal input in engine control unit (control unit defective)	- Engine starts reluctantly or not at all when warm (hot start problems) - Engine idles unevenly or not at all when cold and during warm up - Idling speed outside tolerance range	- Read measured value block, Display Group 00 =>Page 25 . - Replace -G70 - Replace engine control unit =>Page 43 .

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00522 Coolant temperature sender -G62			
Open/short circuit to positive	- Open circuit or short to positive or earth in wiring between -G62 and engine control unit	- Cold start problems at very low temperatures - Engine running problems when warm	- Read measured value block, Display Group 00, =>Page 25 .
Short-circuit to earth	- -G62 defective		
Implausible signal	- Faulty earth connection for -G62 - Faulty signal input in engine control unit (control unit defective) - Loose contact or corrosion due to moisture in connector plug	- Increased fuel consumption - Increased emissions - Unsatisfactory performance	- Test -G62 =>Page 103 . - Replace engine control unit =>Page 43 .

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00523 Intake air temperature sender -G42			
Short-circuit to earth	- Open circuit or short to positive or earth in wiring between -G42 and engine control unit	- Hot start problems	- Read measured value block, Display Group 00 =>Page 25 .
Open/short circuit to positive	- -G42 defective - Faulty earth connection for -G42 - Faulty signal input in engine control unit (control unit defective)	- Poor throttle response when cold or during warm-up; pick up problems when throttle opened - Engine idles unevenly or not at all when cold and during warm up	- Check -G42 =>Page 98 . - Replace engine control unit =>Page 43 .

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00524 Knock sensor 1 -G61			



Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
Defective	- -G61 defective		- -Test -G61 =>Page 107 .
Implausible signal	- Knock sensor loose or corrosion on connector - Open circuit or short to positive/earth or to screening for signal wire between knock sensor and engine control unit - Faulty signal input in engine control unit (control unit defective) - Loose ancillaries causing knock sensor to receive additional signals (from vibrations)	- Loss of power - High fuel consumption	- Rectify short or open circuit using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations - Replace engine control unit =>Page 43 .

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00525 Lambda probe -G39 Output open	- Open circuit or short to earth or positive in signal wire between -G39 and engine control unit	- No lambda control	- Rectify short or open circuit using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations
Short-circuit to earth	- Faulty earth connection for -G39	- Rough idling	- Test lambda control =>Page 59 .
Implausible signal	- Corrosion due to moisture in plug connector for lambda probe heating Z19 or lambda probe -G39	- Increased fuel consumption	- Read measured value block, Display Group 01 or 99.
Signal outside tolerance	- Lambda probe heating not functioning - -G39 defective - Faulty signal input in engine control unit (control unit defective)	- Soot on spark plugs - Emissions not OK	- Replace engine control unit =>Page 43 .

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00530 Throttle valve positioner/potentiometer -G881)			
Open/short circuit to positive	- Open circuit or short to earth or positive in signal wire between -G88 and engine control unit	- Idling speed positioner deactivated; engine idles with a mechanically regulated air flow through the emergency running slot - Different idling speed	- Perform adaptation of throttle valve control unit =>Page 68 .
Open/short circuit to earth	- Open circuit in earth wire between -G88 and engine control unit	- Cold start problems - Cold idling problems	- Test throttle valve control unit =>Page 68 .

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
Implausible signal	- -G88 defective or loose contact in connector for throttle valve control unit -J338	- Harsh load changes	
Continued on next Page			

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00530 (cont.) Throttle valve positioner/potentiometer -G881) Fault type - see previous Page	- Faulty signal input in engine control unit (control unit defective) - Contact resistance due to moisture in connector for throttle valve control unit - J338 - Connector incorrectly wired	- Loss of power - Rough idling	- Replace engine control unit =>Page 43 .

1) The throttle valve positioner/potentiometer -G88 is a component of throttle valve control unit -J338.

The throttle valve positioner/potentiometer (variable resistance; activated by the throttle valve positioner) informs the engine control unit of the status of the throttle valve positioner.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00533 Idling speed regulation Upper stop value	- Throttle valve positioner V60 sticking - Air cleaner blocked	- Engine running problems - High fuel consumption	- Test throttle valve control unit =>Page 68 . - Test for leaks (unmetered air) in intake air system =>Page 58 .
Lower stop value	- Unmetered air downstream of throttle valve - Injector defective - Fuel pressure regulator defective	- Fuel odours	- Test injectors =>Page 48 . - Fit a new fuel pressure regulator

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00537 Lambda control Upper stop value	- Short to earth in signal wire between lambda probe and engine control unit - Injector(s) defective (blocked) - Fuel pressure regulator defective	- No lambda control - Engine running problems	- Test lambda probe and lambda control =>Page 59 . - Test injectors =>Page 48 . - Test fuel pressure regulator and holding pressure =>Page 46 .



Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
	- Fuel pump defective		- Test fuel pump => Mechanics; Repair Group 20; Removing and installing parts of fuel system; Testing fuel pump
	- Fuel tank empty		- Removing and installing parts of fuel system; Testing fuel pump
Lower stop value	- See next Page		- Fill up fuel tank

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00537 (cont.) Lambda control Lower stop value	- Solenoid valve 1 for activated charcoal filter (N80) leaking/sticking - Injector(s) defective (not closing fully) - Fuel pressure regulator defective	- No lambda control - Engine running problems	- -Test N80 =>Page 18 . - Test injectors =>Page 48 . - Test fuel pressure regulator and holding pressure =>Page 46 .

Note:

- ♦ If the fault "Lambda control upper stop value" is recorded, this means that the lambda control has reached the "mixture enrichment" regulating limit. However, the lambda probe is still detecting a "lean" mixture.
- ♦ If the fault "Lambda control lower stop value" is recorded, this means that the lambda control has reached the "mixture leaning down" regulating limit. However, the lambda probe is still detecting a "rich" mixture.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00545 Engine/gearbox electrical connection Short to positive	- Open circuit or short to positive or earth in wiring between engine control unit and gearbox control unit	- See Workshop Manual for automatic gearbox => Automatic gearbox 01M; Repair Group 01; Fault table Fault table	- Rectify short or open circuit using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations
Short-circuit to earth	- Faulty signal output from engine control unit (control unit defective)		- Replace engine control unit =>Page 43 .
Undefined switch position	- Fault in automatic gearbox or in control unit for automatic gearbox		- Interrogate fault memory of control unit for automatic gearbox => Automatic gearbox 01M; Repair Group 01; Function of self diagnosis Function of self diagnosis

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00609 Ignition output 1			

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
Short to positive	- Open circuit or short to positive in wiring between engine control unit and output stage of ignition coil - Faulty earth connection for output stage of ignition coil - Ignition coil output stage defective - Engine control unit defective	- Starting problems - Very rough running in all engine load ranges - Severe loss of power	- Rectify short or open circuit using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations - Test twin-spark injection system with two ignition coils =>Page 96 . - Replace engine control unit =>Page 43 .
00610 Ignition output 2 Short to positive	- See fault code 00609	- See fault code 00609	- See fault code 00609

Note:

Ignition outputs 1 and 2 are the outputs on the engine control unit via which the engine control unit activates the output stage of the ignition coils.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00625 Speed signal Implausible signal	- Open circuit or short in signal wire between dash panel insert and engine control unit - Short circuit in signal wire between speedometer and another control unit which uses the road speed signal - Faulty signal input in engine control unit		- Rectify open circuit or short using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations - Replace engine control unit =>Page 43 .

Note:

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If fault code 00625 is recorded the engine control unit assumes a fixed substitute value of 5 km/h.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00635 Lambda probe heating before Cat. Defective	- Open circuit or short to positive or earth in wiring between engine control unit and lambda probe - Output stage in engine control unit defective (engine control unit defective)	- Rough idling - Emission problems	- Test lambda control =>Page 59 . - Rectify short or open circuit using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations - Replace engine control unit =>Page 43 .



Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
	- Lambda probe defective - Fuel pump relay or fuel pump relay activation defective		- Fit a new lambda probe - Test fuel pump relay and activation =>Page 52 .

Notes:

- ♦ The positive power supply to the lambda probe heating comes via the fuel pump relay.
- ♦ The earth connection for the lambda probe heating is provided by the engine control unit, i.e. the entire current supply for the lambda probe heating comes via the engine control unit.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
00650 Clutch pedal switch -F36 Defective	- Open circuit or short circuit	- No cruise control	- Test signal from clutch pedal switch =>Page 91 .
00671 CCS Switch -E45 Implausible signal	- E45 defective - Open circuit or short circuit	- No cruise control	- Test cruise control system => Electrical System; Repair Group 96

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01087 Basic setting not carried out Implausible signal	Conditions for basic setting (adaptation of throttle valve control unit) not fulfilled: - Ignition not switched on - Engine running - Idling speed switch not closed - Implausible voltage signals from throttle valve potentiometer and throttle valve positioner potentiometer (control unit not receiving clear voltage signal; throttle valve not fully closed) - Throttle valve positioner sticking or mechanically damaged	- Engine control unit cannot learn stop values for throttle valve control unit because conditions have not been fulfilled (see "Possible causes of fault")	- Read measured value block, Display Group 01 or 98 =>Page 68 .
Continued on next Page			

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01087 Basic setting not carried out Implausible signal (cont.)	- Battery voltage too low (less than 8V) - Fault in fault memory - Throttle valve control unit defective	See previous Page	- Read measured value block, Display Group 5 - Interrogate fault memory - Fit a new throttle valve control unit

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Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
	- Engine control unit defective		- Replace engine control unit =>Page 43 .

Important note:

Before fitting new parts, always test the old parts and check the wiring.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01123 Engine control unit blocked	- Attempted tampering - Open circuit or short to positive or earth in signal wiring between engine control unit and immobilizer control unit - Control electronics for immobilizer defective/missing - Faulty signal input in engine control unit (control unit defective) - Attempt made to start vehicle with unauthorised key - Engine control unit not adapted to control electronics for immobilizer	- Engine starts but cuts out again immediately	- Rectify short or open circuit using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations - Fit a new immobilizer control unit - Replace engine control unit =>Page 43 . - See Workshop Manual => Electrical System; Repair Group 96; Servicing immobilizer - Perform adaptation of engine control unit to control electronics for immobilizer. =>Page 43 .

Note on fault code 01123:

The control electronics for the immobilizer are located inside the dash panel insert and cannot be replaced separately.

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01126 Engine speed signal Defective	- Open circuit or short to positive or earth in signal wire between engine control unit and dash panel insert - Faulty signal input in dash panel insert - Faulty signal output from engine control unit (control unit defective)	- Rev counter not functioning	- Rectify short or open circuit using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations - Fit a new dash panel insert - Replace engine control unit =>Page 43 .

**Note on fault code 01126:**

In this case the "engine speed signal" is not the signal from the engine speed sender (located on the crankshaft) to the engine control unit, but rather the signal from the engine control unit to the dash panel insert. This signal is also used for various other systems (e.g. rev counter, air conditioner etc.).

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01177 Engine control unit Defective	- Engine control unit defective	- Engine will not start	- Replace engine control unit =>Page 43 .
01242 Output stages in control unit Defective	- Output stages in control unit overheating	- Engine will not start	- Replace engine control unit =>Page 43 .

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01243 Intake manifold changeover valve - N156 Output open	- Open circuit or short to positive or earth in wiring between intake manifold changeover valve -N156 and engine control unit	- Poor performance	- Rectify short or open circuit using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations
Short to positive	- Fault in power supply to -N156		- -Test -N156 =>Page 80 .
Short-circuit to earth	- -N156 defective - Faulty signal output from engine control unit (control unit defective)		- Replace engine control unit =>Page 43 .

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Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01247 Solenoid valve 1 for activated charcoal filter -N80 Short to positive	- Open circuit or short to positive or earth in wiring between -N80 and engine control unit	- Rough idling	- Rectify short or open circuit using current flow diagram => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations
Short-circuit to earth	- Fault in power supply to -N80	- Car may run jerkily at part throttle	- -Test -N80 =>Page 66 .
Output open	- -N80 defective - Faulty signal output from engine control unit (control unit defective)	- Vehicle possibly smells of fuel	- Replace engine control unit =>Page 43 .

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01249 Injector, cylinder 1 -N30 Short to positive	- Open circuit or short to positive or earth in wiring between engine control unit and injector - Injector defective - Fault in power supply to injector - Faulty signal output from engine control unit (control unit defective)	- Engine idles roughly or cuts out	- Test injectors =>Page 48 . - Replace engine control unit =>Page 43 .
Short-circuit to earth			
Output open			

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01250 Injector, cylinder 2 -N31	=>Cyl.1 fault code 01249	=>Cyl.1 fault code 01249	=>Cyl.1 fault code 01249
Short to positive			
Short-circuit to earth			
Output open			

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01251 Injector, cylinder 3 -N32 Short to positive Short-circuit to earth Output open	=>Cyl.1 fault code 01249	=>Cyl.1 fault code 01249	=>Cyl.1 fault code 01249
01252 Injector, cylinder 4 -N33 Short to positive Short-circuit to earth Output open	=>Cyl.1 fault code 01249	=>Cyl.1 fault code 01249	=>Cyl.1 fault code 01249

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01259 Fuel pump relay -J17 Defective	- Open circuit or short to positive in wiring between engine control unit and fuel pump relay - Fuel pump relay defective - Faulty signal output from engine control unit (control unit defective)	- If the wiring has an open circuit or short to positive, the engine will not run.	- Rectify short or open circuit using current flow diagram - => Current Flow Diagrams, Electrical Fault Finding and Fitting Locations - Test fuel pump relay => Page 52 . - Replace engine control unit =>Page 43 .

**Note:**

If fault code 01259 is recorded, components which are supplied with power via the fuel pump relay may also register as faulty.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

Output on V.A.G 1551 printer	Possible cause of fault	Possible effects	Fault rectification
01312 Databus drive faulty	- Fault in signal wires	- Engine running problems (juddering gear changes, load change jolts) - No electronic stability program	- Test data exchange between engine/gearbox/ABS =>Page 94 .
01315 Gearbox control unit without communications	- Fault in signal wires leading to gearbox control unit	- Engine running problems (juddering gear changes, load change jolts)	- Test data exchange between engine/gearbox/ABS =>Page 94 .
01316 Brake control unit without communications	- Fault in signal wires leading to ABS control unit	- No electronic stability program	- Test data exchange between engine/gearbox/ABS =>Page 94 . Check coding of brake control unit => Running gear self-diagnosis; Repair Group 01; Self-diagnosis Electrical Test Self-diagnosis Electrical Test

1.7 - Final control diagnosis

Notes:

- ♦ The final control diagnosis can only be performed with the ignition switched on and the engine not running.
- ♦ The final control diagnosis is terminated if the engine is started or if an engine speed pulse is detected.
- ♦ During the final control diagnosis the individual control elements are actuated in turn for about 50 seconds each unless the programme is deliberately advanced to the next control element by pressing the =>key.
- ♦ The control elements can be tested either by listening or by touching.
- ♦ If the final control diagnosis is to be repeated without first running the engine briefly, switch off the ignition for about 2 seconds.
- ♦ Once the final control diagnosis is complete, the engine cannot be re started until the ignition has been switched off and on again.
- ♦ The ignition and injection systems are blocked during the final control diagnosis.

The final control diagnosis activates the following components in the stated sequence:

1. Fuel pump relay (J17)
2. Activated charcoal filter solenoid valve 1 (N80)

3. Exhaust gas recirculation valve (N18), (two-way valve)1)

- 1) Ignore display

4. Intake manifold changeover valve (N156)

Test conditions

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select the engine electronics control unit with the "Address word" 01. When doing this the ignition must be switched on.
 (Connecting fault reader and selecting engine electronics control unit => Page 2.)

-> Display readout:

Rapid data transfer HELP
 Select function XX

- Operate fault reader, taking into account the information on the display:
- Press keys 0 and 3 for the function "Final control diagnosis".

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-> Display readout:

Rapid data transfer Q
 03-Final control diagnosis

Activating fuel pump relay (J17):

- Confirm input with Q key.

-> Display readout:

Final control diagnosis
 Fuel pump relay-J17

The fuel pump relay will click (i.e. switch on and off) continuously for about 50 seconds unless the programme is deliberately advanced to the next control element by pressing the =>key.

Note:

During the activation of the fuel pump relay the fuel pump must be heard to run at intervals.

If the relay does not click:

- Test fuel pump relay and activation
 =>Page 52.
- Press the =>key.

-> Display readout:

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

Solenoid valve 1 for activated charcoal filter -N80 will click (i.e. switch on and off) continuously for about 50 seconds unless the programme is deliberately advanced to the next control element by pressing the =>key.

- If the valve is not activated (i.e. does not click), test solenoid valve for activated charcoal filter -N80
 =>Page 66.
- Press the =>key.

-> Display readout:

Final control diagnosis
 Exhaust gas recirculation valve-N18



Note:

This display can be ignored.

- Press the ➡key.

-> Display readout:

Final control diagnosis
Intake manifold changeover valve-N156

This valve will click (i.e. switch on and off) continuously for about 50 seconds unless the programme is deliberately advanced to the next control element by pressing the ➡ key.

- If the valve is not activated (i.e. does not click), test intake manifold changeover valve -N156 => Page 80 .
- Press the ➡key.

-> Display readout:

Function is unknown or
cannot be carried out at the moment.

The final control diagnosis is complete.

- Press the ➡key.

Note:

Before selecting function 03 "Final control diagnosis" again, switch the ignition off for about 2 seconds.

1.8 - Performing basic setting of engine

Note:

As part of the basic setting of the engine, the engine control unit is adapted to the throttle valve control unit with the ignition on and the engine not running.

Adaptation of the engine control unit to the throttle valve control unit (under function 04, "Basic setting") must be performed each time either the engine control unit or the throttle valve control unit or both are removed or renewed.

Performing adaptation of throttle valve control unit =>Page 68.

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1.9 - Coding Simos control unit

If the appropriate code for the vehicle is not displayed or if the control unit has been renewed, the control unit must be coded as follows:

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select the engine electronics control unit with the "Address word" 01. When doing this the ignition must be switched on.
(Connecting fault reader and selecting engine electronics control unit => Page 2 .)

-> Display readout:

Rapid data transfer HELP
Select function XX

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

-> Display readout:

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

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

Note:

See next Page for a list of the possible coding variants that can be selected.

List of possible coding variants that can be selected:

Code number	For vehicles with
04000	Manual gearbox
04030	Automatic gearbox

-> The display on fault reader V.A.G 1551 will show the control unit identification.

□
 Coding 00000 WSC XXXXX

Note:

If an unauthorised code number is entered:

-> Display readout:

Function is unknown or
 cannot be carried out at the moment

- Repeat procedure, entering correct code number.
- Press the →key.

-> Display readout:

Rapid data transfer HELP
 Select function XX

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

Note:

An incorrect coding results in:

- ◆ Engine running problems
- ◆ Increased fuel consumption
- ◆ Increased emissions
- ◆ Faults stored in fault memory which are not actually present
- ◆ Reduced gearbox life

1.10 - Reading measured value block

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select the engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
 (Connecting fault reader and selecting engine electronics control unit => Page 2.)

-> Display readout:

Rapid data transfer HELP
 Select function XX

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

-> Display readout:



Read measured value block **HELP**
Enter display group number XXX

- Enter relevant Display Group number (3 figures) and confirm entry by pressing Q.

Example: To select Display Group 5, press keys 0, 0 and 5.

Note:

To change to another display group, proceed as follows:

Display group	V.A.G 1551	V.A.G 1552
Higher	Press key 3	Press ↑ key
Lower	Press key 1	Press ↓ key

Test conditions

- No fault stored in fault memory
=> Page 4, Interrogating fault memory.
- Vehicle stationary, engine idling, throttle valve closed.
- Coolant temperature at least 80 °C.
- Electrical consumers switched off (radiator fan must not run during the check) .
- Air conditioner switched off.
- On vehicles with automatic gearboxes the selector lever must be in either P or N position.

1.11 - Display Group overview with test table

Display Group 00 (block of ten)

Display zone	Designation
1	Intake air temperature
2	Engine control unit power supply voltage
3	Coolant temperature
4	Intake air mass
5	Lambda probe voltage
6	Injection period; additive learned value
7	Condition of lambda control
8	Throttle valve angle
9	Injection period
10	Engine speed

Display Group No.	Display readout:	Designation
01 Basic values	Read measured value block 1 1 2 3 4	1 = Engine speed 2 = Coolant temperature 3 = Lambda probe voltage 4 = Throttle valve adaptation requirements
02 Basic values	Read measured value block 2 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Road speed 4 = Operating status of engine
03 Basic values	Read measured value block 3 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Throttle valve angle

Display Group No.	Display readout:	Designation
		4 = Signal ratio of throttle valve positioner

Display Group No.	Display readout:	Designation
04 Basic values	Read measured value block 4 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Injection period 4 = Air mass
05 Basic values	Read measured value block 5 1 2 3 4	1 = Engine speed 2 = Engine control unit power supply voltage 3 = Coolant temperature 4 = Intake air temperature
06 Altitude-adaptation	Read measured value block 6 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Throttle valve angle 4 = Altitude correction factor

Display Group No.	Display readout:	Designation
07 Idling speed setting	Read measured value block 7 1 2 3 4	1 = Throttle valve angle 2 = Idling speed learned value (without gear engaged) 3 = Idling speed learned value (with gear engaged) 4 = Operating status of engine
08 Idling speed stabilisation	Read measured value block 8 1 2 3 4	1 = Engine speed 2 = Specified idling speed when vehicle is stationary 3 = Idling speed control 4 = Intake air mass
09 Idling speed air requirement	Read measured value block 9 1 2 3 4	1 = Idling speed control 2 = Throttle valve control unit adaptation status 3 = Coolant temperature 4 = Engine speed
10 Lambda control and ACF-system	Read measured value block 10 1 2 3 4	1 = Lambda control 2 = Lambda probe voltage 3 = Signal ratio of solenoid valve 1 for activated charcoal filter -N80 4 = Lambda correction factor with active fuel tank breather system

Display Group No.	Display readout:	Designation
11 Lambda learned values	Read measured value block 11 1 2 3 4	1 = Injection period 2 = Lambda learned value for idling 3 = Lambda learned value for part throttle 4 = Status of fuel tank breather valve (TBV)
12 Lambda learned values	Read measured value block 12 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Lambda control 4 = Lambda probe voltage



Display Group No.	Display readout:	Designation
13 Fuel consumption	Read measured value block 13 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Road speed 4 = Fuel consumption
14 Knock control	Read measured value block 14 1 2 3 4	1 = Ignition timing retardation by knock control, cylinder 1 2 = Ignition timing retardation by knock control, cylinder 2 3 = Ignition timing retardation by knock control, cylinder 3 4 = Ignition timing retardation by knock control, cylinder 4

Display Group No.	Display readout:	Designation
15 Knock control	Read measured value block 15 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Ignition timing retardation by knock control, cylinder 1 4 = Ignition timing retardation by knock control, cylinder 2
16 Knock control	Read measured value block 16 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Ignition timing retardation by knock control, cylinder 3 4 = Ignition timing retardation by knock control, cylinder 4
17 Knock control	Read measured value block 17 1 2 3 4	1 = Knock sensor voltage signal, cylinder 1 2 = Knock sensor voltage signal, cylinder 2 3 = Knock sensor voltage signal, cylinder 3 4 = Knock sensor voltage signal, cylinder 4
18 Torque reduction	Read measured value block 18 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Ignition timing retardation during gearshift 4 = Ignition timing

Display Group No.	Display readout:	Designation
19 Operating status	Read measured value block 19 1 2 3 4	1 = Engine speed 2 = Selector lever position 3 = Air conditioner 4 = Air conditioner compressor/operating status (model year 1998)
20 Operating status of lambda control	Read measured value block 20 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Coolant temperature 4 = Operating status of lambda control
21 Adaptation status of	Read measured value block 21 1 2 3 4	1 = Throttle valve control unit adaptation status 2 = Min. stop of throttle valve

Display Group No.	Display read-out:	Designation
throttle valve control unit		3 = Emergency running position of throttle valve 4 = Max. stop of throttle valve
22 Position of camshaft in relation to crankshaft	Read measured value block 22 1 2 3 4	1 = Engine speed 2 = Intake air mass 3 = Number of teeth on crankshaft mounted sender wheel when Hall sender switches from - to + 4 = Number of teeth on crankshaft mounted sender wheel when Hall sender switches from + to -

Display Group No.	Display read-out:	Designation
23...96		Not allocated
97	Read measured value block 97	For factory use only
98 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 = Throttle valve control unit adaptation status 4 = Adaptation status (e.g. adaptation in progress, fault during adaptation)
99 Lambda control status	Read measured value block 99 1 2 3 4	1 = Engine speed Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG. 2 = Coolant temperature 3 = Lambda control 4 = Lambda control status

1.12 - Reading measured value block: Display Groups 00 (block of ten) to 10

Display group 00 (decimal displayed value)									
▪ Engine running at idling speed									
1	2	3	4	5	6	7	8	9	10
Display zones									
						Engine speed (idling speed)			
						Injection period			
						Throttle valve angle			
						Operating status of lambda control			
						Injection period (additive learned value) for lambda control			
						Lambda probe voltage			
						Intake air mass			
						Coolant temperature			
						Engine control unit power supply voltage			
						Specification		Corresponds to	
						23...27		760...880 rpm ¹⁾	
						2...4		2...4.1 ms	
						4...12		2...6 <°	
						see measured value block 99 2)			
						0...100		-0.8...+0.8 ms	
						0...50		0.0...1.0 V	
						14...30		76...164 mg/stroke	
						170...211		80...110 °C	
						98...147		10...15 V	



Display group 00 (decimal displayed value)		
Intake air temperature	84...158	15...71 °C

1) Up-to-date specifications:

=> Exhaust emissions test binder

2) Display zone 7 gives a decimal figure indicating the operating status of the lambda control. The operating status of the lambda control is represented by an 8 digit bit sequence in Display Group 99, display zone 4
=>Page 38 .

Interpreting display group 00

Display zone: 1 Intake air temperature		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
lower than 84 1)	- Intake air temperature sender - Wiring for intake air temperature sender	- Check intake air temperature sender => Page 98 .
higher than 158 1)		
Display zone: 2 Engine control unit power supply voltage		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
lower than 98	- Alternator defective, battery heavily discharged - High load on electrical system shortly after starting engine due to high charge current and load from 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 for several minutes and switch off ancillaries Test power supply to engine control unit=> Page 105 . Eliminate current drain
higher than 147	- Voltage control on alternator defective - Excess voltage from assisted start or high speed charging	- Test voltage; if necessary, fit a new voltage regulator. Interrogate fault memory =>Page 4 .

1) Depends upon ambient temperature and length of time vehicle is parked.

Display zone: 3 Coolant temperature		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
lower than 170	- Engine too cold - Coolant temperature sender or wiring to engine control unit	- Test drive if necessary. Test coolant temperature sender -G62=> Page 103 .
higher than 211	- Radiator dirty - Radiator fan not working - Coolant thermostat defective - Coolant temperature sender or wiring to engine control unit	- Clean radiator Check operation of radiator fan Test thermostat Test coolant temperature sender -G62=> Page 103 .
Display zone: 4 Intake air mass		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
lower than 14	- Large quantity of unmetered air between intake manifold and air mass meter - Air mass meter or wiring to engine control unit	- Eliminate air leak Test air mass meter =>Page 54 .

Display zone: 3 Coolant temperature		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
higher than 30	- Drive position engaged (automatic gear-box) - Engine load from ancillaries - Air mass meter or wiring to engine control unit	- Move selector lever to P or N - Remove load (power assisted steering) or switch off ancillaries (e.g. air conditioner) - Test air mass meter =>Page 54 .

Display zone: 5 Lambda probe voltage		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
Readout not alternating (lambda control at rich or lean stop limit; see Display Group 99)	- Large quantity of unmetered air - Defective spark plug - Fuel system pressure too high or too low - Injector defective - Coolant temperature sender -G62 - Solenoid valve 1 for activated charcoal filter -N80 - Lambda probe heating not functioning - Lambda probe defective or dirty	- Eliminate source of air leak - Test spark plugs - Test fuel pressure regulator and holding pressure =>Page 59 . - Read measured value block, Display Group 99

Display zone: 5 Lambda probe voltage		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
constant 255	- Short to positive through: - Lambda probe -G39 or - Signal wire or - Engine control unit	- Test lambda probe =>Page 59 .
constant 80	- Open circuit through: - Lambda probe -G39 or - Signal wire or - Engine control unit	- Test lambda probe =>Page 59 .
constant 0	- Short to earth through: - Lambda probe -G39 or - Signal wire - Engine control unit	- Test lambda probe =>Page 59 .

Display zone: 6 Injection period (additive learned value) for lambda control (see also Display Group 11)		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
Low lambda learned values	- Lambda learned values low for idling and normal for part throttle: oil may be diluted (high petrol content in oil) - Injector(s) leaking - Fuel pressure too high - Solenoid valve 1 for activated charcoal filter -N80 is constantly open - Air mass meter -G70 defective - Lambda probe heating defective or lambda probe dirty	- Problem eliminated after motorway drive or oil change - See Display Group 11, display zones 2 and 3 - Test injectors =>Page 63 .



Display zone: 6 Injection period (additive learned value) for lambda control		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
High lambda learned values	- Lambda learned values high for idling and less high for part throttle: unmetered air possible around intake manifold - Injector blocked - Fuel pressure too low - Unmetered air between -G70 and throttle valve - Unmetered air at manifold gasket - Lambda probe heating defective or lambda probe dirty	- Eliminate fault See Display Group 11, display zones 2 and 3 Test injection quantity =>Page 63 .
Display zone: 7 Operating status of lambda control		
- The operating status of the lambda control is represented by a bit sequence (8 digit number block) in Display Group 99, display zone 4.		

Display zone: 8 Throttle valve angle		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
lower than 4	- Throttle valve potentiometer in throttle valve control unit -J338 defective or incorrectly adjusted - Unmetered air between intake manifold and air mass meter (resulting in increased idling speed; the throttle valve control unit will try to regulate the idling speed back to the specified level)	- Test throttle valve control unit -J338 =>Page 68 . - Eliminate sources of air leak
higher than 12	- Adaptation of throttle valve control unit -J338 not performed - Throttle valve potentiometer in throttle valve control unit -J338 defective or incorrectly adjusted - Throttle cable incorrectly adjusted - Throttle valve sticking	- Perform adaptation of throttle valve control unit -J338 =>Page 68 . - Adjust throttle cable => Mechanics; Repair Group 20; Removing and installing parts of fuel supply system; Adjusting throttle cable

Display zone: 9 Injection period		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
lower than 2	- Large quantity of fuel from the ACF system - Wrong injectors installed (delivery rate too high) - Fuel pressure regulator defective	- Test solenoid valve for activated charcoal filter =>Page 46 .
higher than 4	- Increased engine load due to electrical consumers, air conditioner switched on, gear engaged, power assisted steering on full lock	- Remove load
Display zone: 10 Engine speed (idling speed)		
V.A.G 1551 readout	Possible cause of fault	Fault rectification
lower than 23	- Throttle valve control unit -J338 jamming or defective	- Test throttle valve control unit =>Page 68 .
higher than 27	- Throttle valve control unit -J338 jamming or defective - Large quantity of unmetered air (idling speed stabilisation can no longer compensate)	- Test throttle valve control unit =>Page 68 . - Eliminate air leak

Display Group 01: Basic values

Read measured value block 1 ⇒				◀ Display readout
760...880 rpm	80...110 °C	0.00...1.00 V	00000X10	
Throttle valve adaptation requirements (see next Page) 1)				
Lambda probe voltage - see Display Group 00				
Coolant temperature - see Display Group 00				
Engine speed (idling speed) - see Display Group 00				

1) The space marked with an "X" may contain either a 0 or a 1.

Note on display zone 4:

Relevance of figures in 8 digit number block for throttle valve adaptation requirements:

x	x	x	x	x	x	x	x	"1" signifies:
1								Fault identified by self-diagnosis 2)
	1							Signal from automatic gearbox
		1						A/C compressor switched on
			1					Idling switch open 1)
				1				Fault in lambda control
					1			Throttle valve open (angle check) 1)
						1		Engine running 1)
							1	Coolant temperature less than 80 °C

1) A figure "1" in this position means it will not be possible to perform an adaptation of the throttle valve control unit.

2) The self diagnosis has identified a fault which may not yet have been recorded in the fault memory. If the self diagnosis has identified a fault relating to the throttle valve control unit it will not be possible to perform an adaptation of the throttle valve control unit using the "Basic setting" function.

Display Group 02: Basic values

Read measured value block 2 ⇒				◀ Display readout
760...880 rpm	76...164 mg/stroke	0 km/h	0100	
Operating status of engine				
Road speed				
Intake air mass - see Display Group 00				
Engine speed (idling speed) - see Display Group 00				

Note on display zone 4:

Significance of figures in 4 digit number block for operating status of engine:

"1" signifies:				
x	x	x	x	Operating status of engine



"1" signifies:				
1				Overrun
	1			Idling
		1		Part throttle
			1	Full throttle

Display Group 03: Basic values

Read measured value block 3				⇒	◀ Display readout
760...880 rpm	76...164 mg/stroke	2...6 <°	-100...+100 %		
					Signal ratio of throttle valve positioner
					Throttle valve angle - see Display Group 00
					Intake air mass - see Display Group 00
					Engine speed (idling speed) - see Display Group 00

Display Group 04: Basic values

Read measured value block 4				⇒	◀ Display readout
760...880 rpm	76...164 mg/stroke	2...5 ms	1.8...4.2 g/s		
					Intake air mass
					Injection period - see Display Group 00
					Intake air mass - see Display Group 00
					Engine speed (idling speed) - see Display Group 00

Display Group 05: Basic values

Read measured value block 5				⇒	◀ Display readout
760...880 rpm	10...15 V	80...110 °C	15...71 °C		
					Intake air temperature - see Display Group 00
					Coolant temperature - see Display Group 00
					Engine control unit power supply voltage - see Display Group 00
					Engine speed (idling speed)

Display Group 06: Altitude adaptation

Read measured value block 6				⇒	◀ Display readout
760...880 rpm	76...164 mg/stroke	2...6 <°	0.7...1.3		
					Altitude correction factor
					Throttle valve angle
					Intake air mass - see Display Group 00
					Engine speed (idling speed) - see Display Group 00

Display Group 07: Idling speed setting

Read measured value block 07				⇒	◀ Display readout
2...6	x.xx	x.xx		0100	
≤°					
			Operating status of engine		
			Idling speed learned value (with gear engaged)		
			Idling speed learned value (without gear engaged)		
			Throttle valve angle		

Note on display zone 4:

Significance of figures in 4 digit number block for operating status of engine:

"1" signifies:				
x	x	x	x	Operating status of engine
1				Overrun
	1			Idling
		1		Part throttle
			1	Full throttle

Note:

Measured value block 7 is for information only and has no relevance for fault finding in the workshop.

Display Group 08: Idling speed stabilisation

Read measured value block 08				⇒	◀ Display readout
760...880	800...840	-10...+15		1.8...4.2	
rpm	rpm	%		g/s	
			Intake air mass		
			Idling speed control		
			Specified idling speed when vehicle is stationary		
			Engine speed (idling speed) - see Display Group 00		

Display Group 09: Idling speed air requirement

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Read measured value block 9				⇒	◀ Display readout
-10...+15	0000	80...110		760...880	
%		°C		rpm	
			Engine speed		
			Coolant temperature		
			Throttle valve control unit adaptation status		
			Idling speed control		

**Note on display zone 2:**

Relevance of figures in 4 digit number block for adaptation status of throttle valve control unit:

"1" signifies:				
x	x	x	x	Adaptation status
1				A fault has occurred during the adaptation of the throttle valve (interrogate fault memory =>Page 4 .
	1			No current in throttle valve control unit (signal ratio = 0)
		1		Adaptation interrupted due to the battery voltage being too low (below 8V).
			1	Idling switch open (switch position check)

Display Group 10: Lambda control and ACF system

Read measured value block 10			⇒	◀ Display readout
-25...25 %	0.00...1.00 V	xxx %	xxx %	
			Lambda correction factor with active fuel tank breather system	
			Signal ratio of solenoid valve 1 for activated charcoal filter -N80	
		Lambda probe voltage		
Lambda control				

Note:

Measured value block 10 is for information only and has no relevance for fault finding in the workshop.

1.13 - Reading measured value block: Display Groups 11 to 99**Display Group 11: Lambda learned values**

Read measured value block 11			⇒	◀ Display readout
2...5 ms	-1.0...+1.0 ms	0.9...1.15	xxxxxxxx	
			Status of fuel tank breather valve (TBV)	
		Lambda learned value for part throttle		
		Lambda learned value for idling		
Injection period				

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1) The space marked with an "X" may contain either a 0 or a 1.

Note on display zone 4:

Significance of figures in 8 digit number block for status of fuel tank breather valve:

x	x	x	x	x	x	x	x	"1" signifies:
0								Not allocated
	1							Transition to fuel tank breather valve charging check
		1						Transition to fuel tank breather valve minimum operating level

			1				Transition to fuel tank breather valve closure
				1			Fuel tank breather valve charging check
					1		Fuel tank breather valve operating normally
						1	Fuel tank breather valve minimum operating level
						1	Fuel tank breather valve closed

Display Group 12: Lambda learned values

Read measured value block 12				⇒	• Display readout
760...880 rpm	76...164 mg/stroke	-25...25 %	0.0...1.0 V		
				Lambda probe voltage	
				Lambda control	
				Intake air mass - see Display Group 00	
				Engine speed (idling speed)	

Display Group 13: Fuel consumption

Read measured value block 13				⇒	• Display readout
760...880 rpm	76...164 mg/stroke	0 km/h	xxx ltr/h		
				Fuel consumption	
				Road speed	
				Intake air mass - see Display Group 00	
				Engine speed (idling speed)	

Note:

Measured value block 13 is for information only and has no relevance for fault finding in the workshop.

Display Group 14: Knock control

Read measured value block 14				⇒	• Display readout
0.0 °cr/shaft	0.0 °cr/shaft	0.0 °cr/shaft	0.0 °cr/shaft		
				Ignition timing retardation by knock control, cylinder 4	
				Ignition timing retardation by knock control, cylinder 3	
				Ignition timing retardation by knock control, cylinder 2	
				Ignition timing retardation by knock control, cylinder 1	

Display Group 15: Knock control

Read measured value block 15				⇒	• Display readout
760...880 rpm	76...164 mg/stroke	0.0 °cr/shaft	0.0 °cr/shaft		
				Ignition timing retardation by knock control, cylinder 2	
				Ignition timing retardation by knock control, cylinder 1	
				Intake air mass - see Display Group 00	



Engine speed

Display Group 16: Knock control

Read measured value block 16				⇒	◀ Display readout
760...880 rpm	76...164 mg/stroke	0.0 °cr/shaft	0.0 °cr/shaft		
					Ignition timing retardation by knock control, cylinder 4
					Ignition timing retardation by knock control, cylinder 3
					Intake air mass - see Display Group 00
					Engine speed

Note:

- ♦ The knock control must retard the ignition timing as soon as knocking is detected in order to prevent damage to the engine.

Display Group 17: Knock control

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Read measured value block 17				⇒	◀ Display readout
0.4...1.3 V	0.4...1.3 V	0.4...1.3 V	0.4...1.3 V		
					Knock sensor voltage signal, cylinder 4
					Knock sensor voltage signal, cylinder 3
					Knock sensor voltage signal, cylinder 2
					Knock sensor voltage signal, cylinder 1

Display Group 18: Torque reduction on automatics

Read measured value block 18				⇒	◀ Display readout
760...880 rpm	76...164 mg/stroke	0.0 °cr/shaft	xx.x °before TDC		
					Ignition timing
					Ignition timing retardation during gearshift
					Intake air mass - see Display Group 00
					Engine speed (idling speed) - see Display Group 00

Note on display zones 3 and 4:

The ignition timing retardation during a gearshift occurs so rapidly that it cannot always be detected by the V.A.G 1551/1552. The ignition timing value shown in display zone 4 is for information only and has no relevance for fault-finding in the workshop.

Display Group 19: Operating status for vehicles up to model year 1998

Read measured value block 19				"	◀ Display readout
760...880 rpm	0	0	0		
					A/C compressor (0 = off; 1 = on)
					Air conditioner (0 = off; 1 = on)

	Selector lever position (0 = neutral; 1 = gear engaged)
	Engine speed (idling speed) - see Display Group 00

Note on display zones 2, 3 and 4:

On vehicles with manual gearbox and no air conditioner these display zones may show either 0 or 1.

Display Group 19: Operating status for vehicles from model year 1998

Read measured value block 19	"	• Display readout
760...880 rpm	0 0 XXXXX000	
		Meaning of readout: See next Page.
		Air conditioner (0 = off; 1 = on)
		Selector lever position (0 = neutral; 1 = gear engaged)
		Engine speed (idling speed) - see Display Group 00

Note on display zone 4:

Relevance of figures in 8 digit number block for operating condition:

x	x	x	x	x	x	x	x	"1" signifies:
0								Not allocated
	0							Not allocated
		0						Not allocated
			0					Not allocated
				0				Not allocated
					1			Clutch pedal switch operated; Test clutch pedal switch =>Page 91 .
						1		Power steering pressure switch activated Test power steering pressure switch =>Page 92 .
							1	A/C compressor switched on

Display Group 20: Operating status of lambda control (see also Display Group 99)

Read measured value block 20	⇒	• Display readout
760...880 rpm	76...164 mg/stroke 80...110 °C 0XX1011X	
		Operating status of lambda control 1)
		Coolant temperature - see Display Group 00
		Intake air mass - see Display Group 00
		Engine speed - see Display Group 00

1) The space marked with an "X" may contain either a 0 or a 1.

Note on display zone 4:

Relevance of figures in 8 digit number block for operating status of lambda control:

x x x x x x x x	"1" signifies:
-----------------	----------------



1							Fault recorded in memory during diagnosis; interrogate fault memory =>Page 4 .
	0						Not allocated
		0					Not allocated
			1				Restricted operation mode
				1			Lambda control at stop limit
					1		Lambda control switched on
						1	Lambda probe functioning
						1	Mixture status 1 = rich mixture 0 = lean mixture

Note:

For a more detailed explanation of the 8-digit number block, see Display Group 99 =>Page 38 .

Display Group 21: Adaptation status of throttle valve control unit (see Display Group 98)

Read measured value block 21				⇒	• Display readout
0000	xx %	xx %	xx %		
				Max. stop of throttle valve	
				Emergency running position of throttle valve	
				Min. stop of throttle valve	
Throttle valve control unit adaptation status					

Note on display zone 1:

Relevance of figures in 4 digit number block for adaptation status of throttle valve control unit:

"1" signifies:				
x	x	x	x	Throttle valve control unit adaptation status
1				A fault has occurred during the adaptation of the throttle valve (interrogate fault memory =>Page 4 .
	1			No current in throttle valve control unit (no signal ratio)
		1		Adaptation terminated because battery voltage is too low (less than 8V)
			1	Idling switch open (switch position check)

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Note:

Measured value block 21 is for information only and has no relevance for fault finding in the workshop.

Display Group 22: Position of camshaft in relation to crankshaft

Read measured value block 22 ⇒				• Display readout
760...880	76...164	26...30	86...90	
rpm	mg/stroke			
			Number of teeth on crankshaft mounted sender wheel when Hall sender switches from + to -	
			Number of teeth on crankshaft mounted sender wheel when Hall sender switches from - to +	
			Intake air mass - see Display Group 00	

Engine speed - see Display Group 00

Notes on display zones 3 and 4:

- ♦ The engine speed sender on the crankshaft transmits both an engine speed signal and a reference mark signal. The reference mark signal is generated by a gap in the sender wheel.
- ♦ The Hall sender rotor ring on the camshaft has a 180° division so that for one half of each camshaft revolution it covers the window on the Hall sender and for the other half revolution the window is exposed.
- ♦ To synchronise the components when starting, the engine control unit records the instant when the rotor ring begins to cover the window (signal change from - to +) and the instant when it begins to expose the window (signal change from + to -).
- ♦ When the reference mark signal on the crankshaft is detected, the engine control unit counts the number of teeth on the crankshaft mounted sender wheel. As soon as it has counted between 26 and 30 teeth after the gap, the signal sent by the Hall sender on the camshaft should change from - to + (rotor ring begins to cover window). After between 86 and 90 teeth, with the crankshaft already making its second revolution, the Hall sender signal should change from + to - (rotor ring begins to expose window).
- ♦ If the signal does not change within the tooth ranges specified above, this may mean that the toothed belt has slipped.

Display Group 97

This Display Group is for factory use only.

The values shown have no relevance for fault finding in the workshop.

Display Group 98: Adaptation of throttle valve control unit

Basic setting 98		⇒		◀ Display readout
3.70...4.75 V	2.28...4.75 V	0000	00	
Adaptation status				
Throttle valve control unit adaptation status				
Voltage of throttle valve positioner/potentiometer -G88				
Voltage of throttle valve potentiometer -G69				

Note on display zone 3:

Relevance of figures in 4 digit number block for adaptation status of throttle valve control unit:

"1" signifies:				
x	x	x	x	Throttle valve control unit adaptation status
1				A fault has occurred during the adaptation of the throttle valve (interrogate fault memory =>Page 4 .
	1			No current in throttle valve control unit (signal ratio = 0)
		1		Adaptation terminated because battery voltage is too low (less than 8V)
			1	Idling switch open (switch position check)

Note on display zone 4:

Relevance of figures in 2 digit number block for adaptation status:

"1" signifies:		
x	x	Adaptation status
1		A fault has occurred during adaptation of the throttle valve control unit, interrogate fault memory => Page 4 .

**"1" signifies:**

1 Adaptation of throttle valve control unit in progress

Display Group 99: Operating status of lambda control

Read measured value block 99				⇒	Display readout
760...880	80...110	-25...+25	0XX1011X		
rpm	°C	%			
				Operating status of lambda control 1)	
				Coolant temperature	
				Engine speed	

1) The space marked with an "X" may contain either a 0 or a 1.

Note on display zone 4:

Significance of figures in 8 digit number block for operating status of Lambda control:

x	x	x	x	x	x	x	x	"1" signifies:
1								Fault recorded in memory during diagnosis; interrogate fault memory =>Page 4 .
	0							Not allocated
		0						Not allocated
			1					Restricted operation mode
				1				Lambda control at stop limit
					1			Lambda control switched on
						1		Lambda probe functioning
							1	Mixture status 1 = rich mixture 0 = lean mixture

Notes on 8 digit number block:

- The 8 digit number block is composed of eight separate elements known as "bits".
- A sequence of bits (e.g. the sequence of eight in the 8 digit number block) is read from right to left. In the above example, the first bit indicates the mixture status, and the eighth bit indicates whether a fault has been recorded in the fault memory.
- If the fifth bit is a "1" (Restricted operation mode), this means that the lambda control is currently operating within a constant engine load range (e.g. idling or driving at a constant engine speed).
- Continued on next Page

Notes on 8 digit number block in Display Group 99, display zone 4 (cont.):

- Normally the first bit (Mixture status) should fluctuate constantly between "0" and "1".
- If the fourth bit is a "1" (Lambda control at stop limit), the first bit (Mixture status) will indicate which stop limit the lambda control is working at, i.e. rich or lean.
- If the first bit remains constantly at "1", this means that the lambda control is at the "lean" stop limit but that the lambda probe is still registering a "rich" mixture.
- If the first bit remains constantly at "0", this means that the lambda control is at the "rich" stop limit but that the lambda probe is still registering a "lean" mixture.
- The functions of the lambda probe and the lambda control are counterposed, i.e. when the lambda probe is registering "rich" the lambda control must lean down the mixture. If the lambda probe is registering "lean" the lambda control must enrich the mixture.
- The lambda control cannot be switched off manually.

24 - Mixture preparation, Injection

1 - Servicing Simos injection system

1.1 - Servicing Simos injection system

1.2 - Safety precautions

Important!

The fuel system is pressurised. Before loosening hose connections or opening the test connection (to measure fuel pressure), place a cloth around the connection. Then release pressure by carefully pulling off the hose or cap.

To prevent injuries to persons and/or damage to the fuel injection and ignition system, the following must be noted:

- ◆ Do not touch or disconnect ignition wiring when the engine is running or being turned at starter speed.
- ◆ Always switch off the ignition before connecting or disconnecting injection or ignition system wiring or tester cables.
- ◆ To run the engine at starting speed without actually starting it (for example, in order to test compression), unplug the connector from the output stage of the ignition coils and also the connectors on the injectors. After completing the work, interrogate the fault memory and erase it.
- ◆ Always switch off the ignition before cleaning the engine.
- ◆ Always switch off the ignition before connecting or disconnecting the battery, otherwise the engine control unit may be damaged.

1.3 - Rules for cleanliness

When working on the fuel supply/injection system, pay careful attention to the following "5 rules of cleanliness":

- ◆ Thoroughly clean all unions and the adjacent areas before disconnecting.
- ◆ Place removed parts on a clean surface and cover. Only use lint-free cloths!
- ◆ Carefully cover or seal open components if repairs cannot be carried out immediately.
- ◆ Only install clean components:
Only remove replacement parts from packaging immediately prior to installation.
Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- ◆ When the system is open:
Do not work with compressed air if this can be avoided.
Do not move vehicle unless absolutely necessary.

1.4 - Technical data

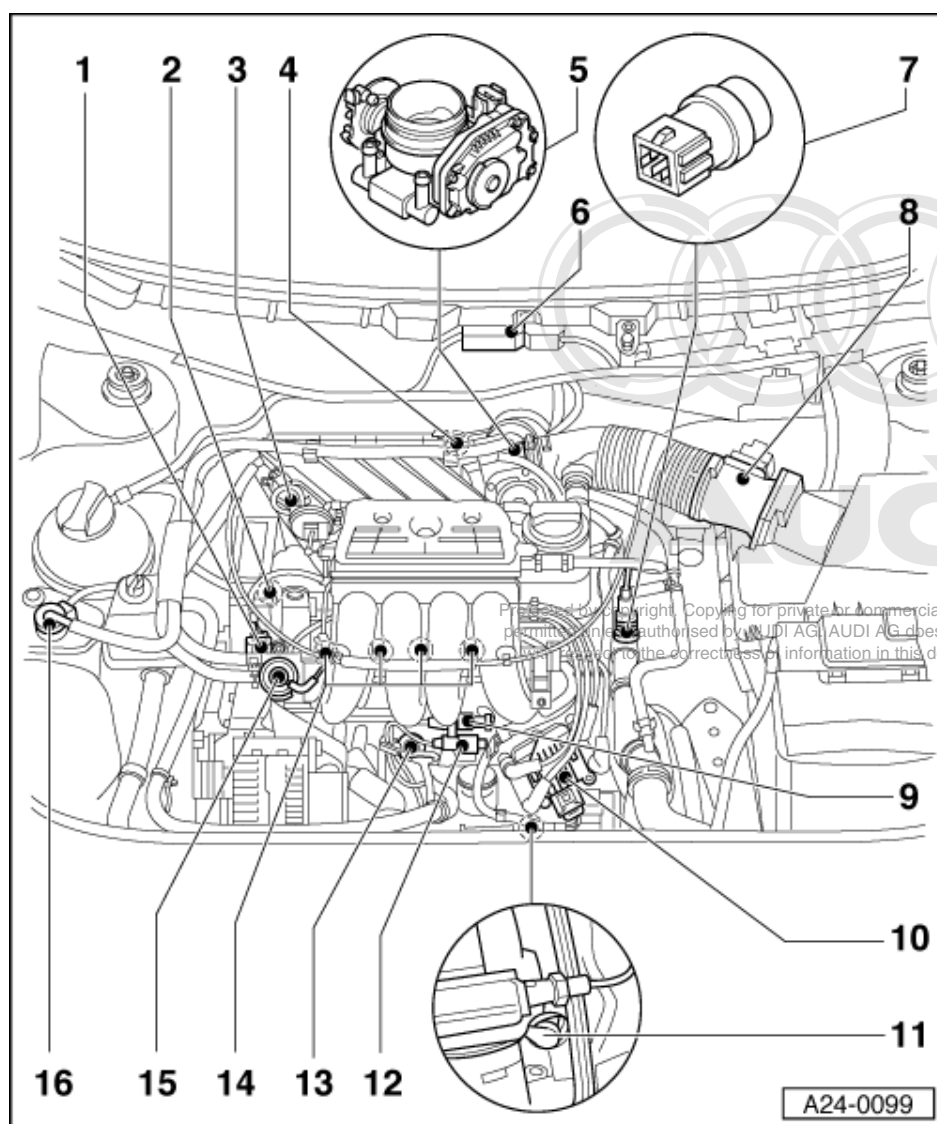
Engine code letters	AEH, AKL
Idling speed Not adjustable - controlled by the idling speed stabilisation	760...880 rpm



Engine speed limiter - shuts off injectors	approx. 6350 rpm	
Fuel pressure at idling speed	Vacuum hose connected	approx. 2.5 bar
	Vacuum hose disconnected	approx. 3 bar
Holding pressure after 10 minutes	at least 1.5 bar	
Injectors	Spray pattern	Same for all injectors
	Resistance (room temperature) 1)	approx. 14.5 ω

1) When the engine is at operating temperature the resistance of the injectors is increased by approx. 4...6 ω .

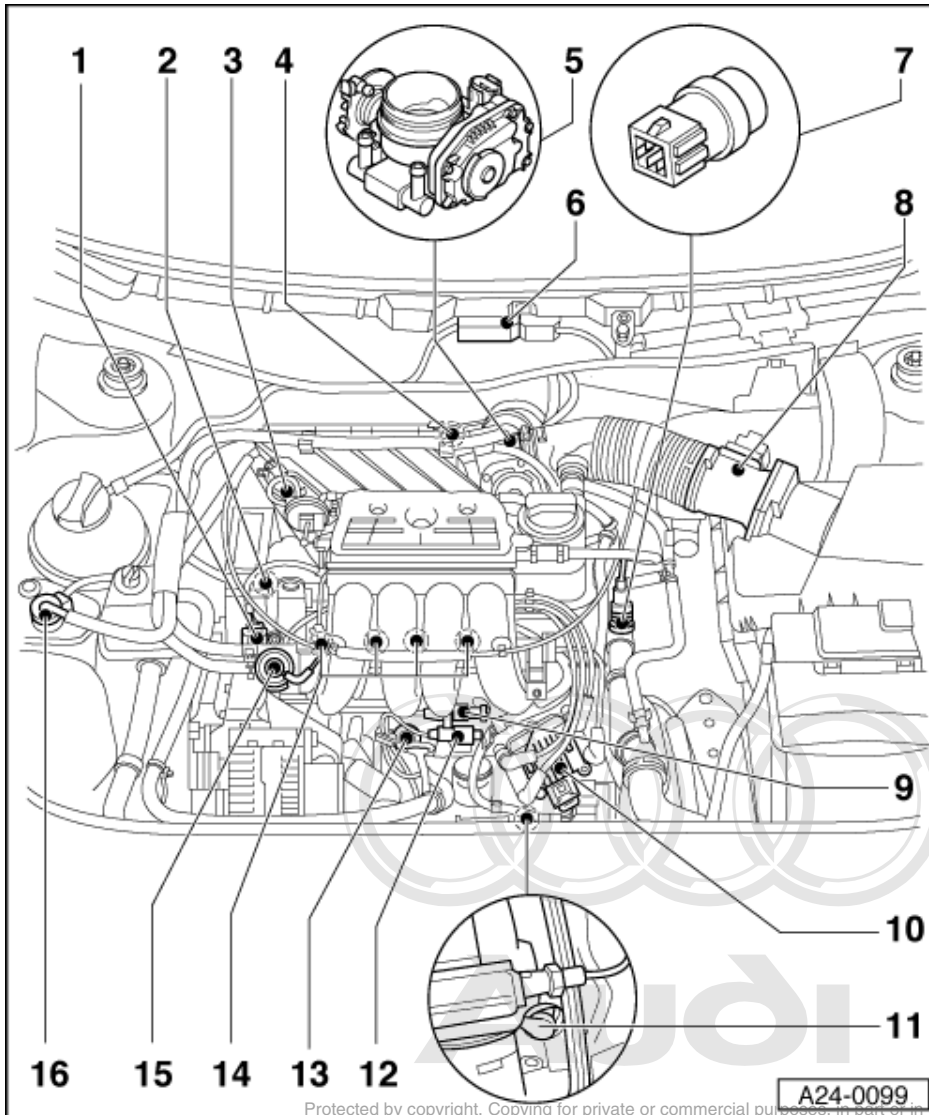
1.5 - Fitting locations overview



- ◆ Lambda probe -G39 with lambda probe heating -Z19
- Directly in front of catalytic converter
- ◆ 4-pin connector
- For Lambda probe and Lambda probe heating

- Located on underside of vehicle on right hand side (facing in direction of travel), beneath a plastic cover

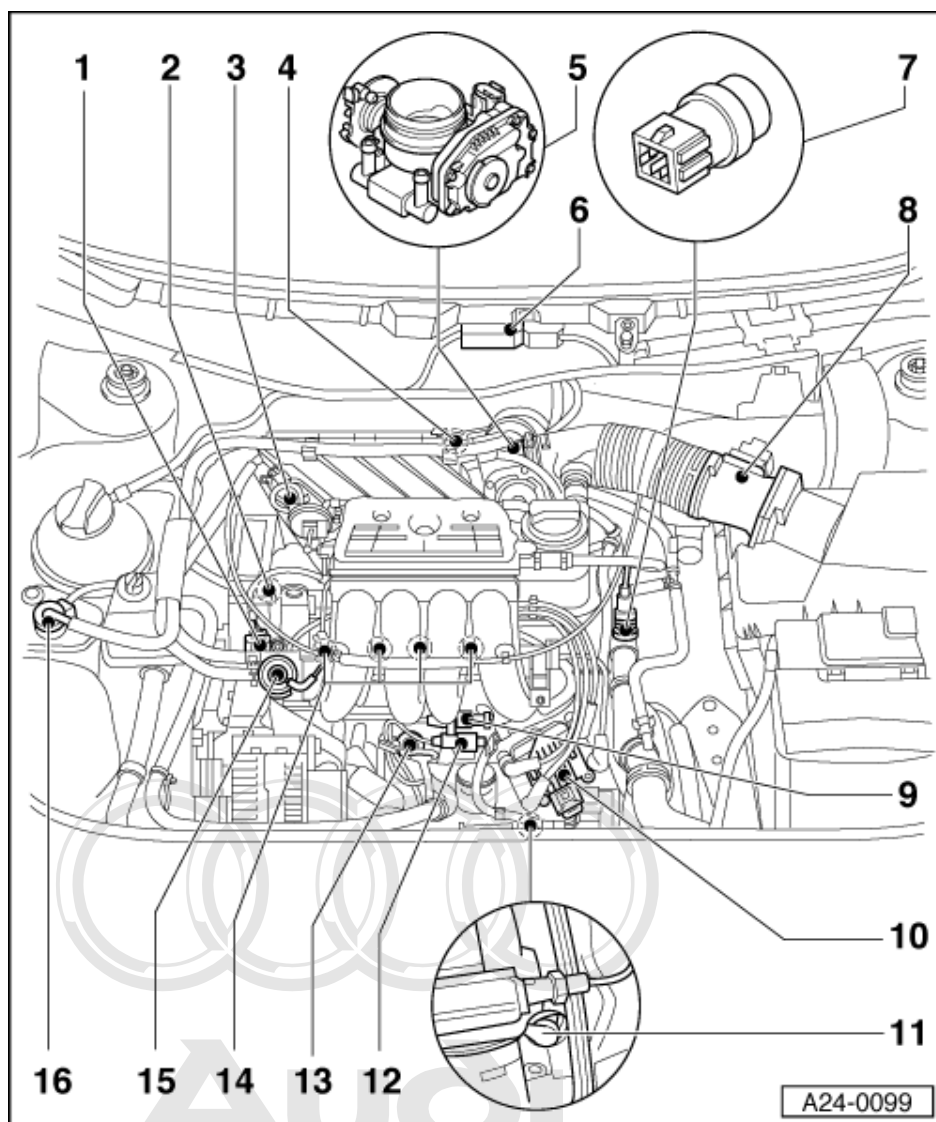
- 1 3-pin connector
 - ♦ For phase sensor (Hall sender) -G40
 - ♦ Black
- 2 Phase sensor (Hall sender) -G40
 - ♦ Beneath camshaft sprocket
- 3 Intake manifold changeover valve (N156)



- 4 Intake air temperature sender (G42)
- 5 Throttle valve control unit (J338)
- 6 Simos injection and ignition system control unit (J361)
- 7 Coolant temperature sender (G62)
- 8 Air mass meter (G70)
- 9 3-pin connector
 - ♦ For knock sensor 1 (G61)
- 10 Ignition coils (N and N128) with output stage (N122)
- 11 Engine speed sender (G28)

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A24-0099



12 3-pin connector

◆ For engine speed sender

◆ Grey

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13 Knock sensor 1 (G61)

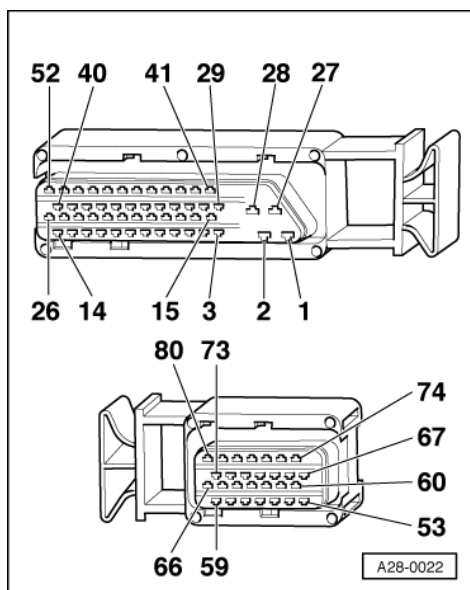
14 Injectors (N30...N33)

15 Fuel pressure regulator

16 Activated charcoal filter solenoid valve 1 (N80)

1.6 - Wiring and component check with test box V.A.G 1598/22

Notes:



- ◆ Use the hand multimeter V.A.G 1526 or the multimeter V.A.G 1715 and the diode test lamp V.A.G 1527 for the checks.
- ◆ To connect the testers to the test box use auxiliary cables from adapter set V.A.G 1594.
- ◆ The contact numbers of the plugs correspond to the socket numbers in the test box.
- With ignition switched off, unplug connectors from control unit.
- Connect test box to wiring harness connector.
- Carry out test as described in the repair instructions.

Important!

To prevent damage to the electronic components, switch to the respective measuring range before connecting the measuring cable and observe the test requirements.

Note:

After re-connecting the engine control unit, perform adaptation of engine control unit to throttle valve control unit

=> Page 68.

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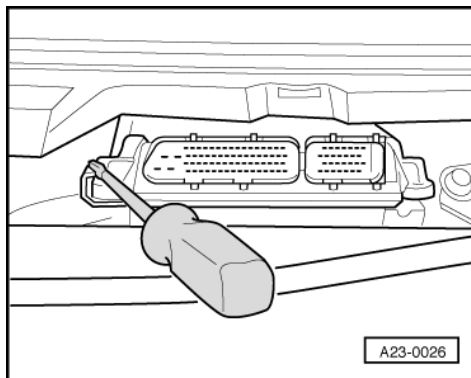
1.7 - Replacing engine control unit

Removing

- Switch off ignition.
- Remove the windscreen wiper arms (screw connections) and take off the plenum chamber cover.

Note:

When removing the cover disconnect the hoses and plugs for the spray nozzles.



- -> Use a screwdriver to press lug on bracket to one side, then pull engine control unit towards the front of the vehicle.
- Release the plug holders and disconnect the control unit plugs.

Installing

Installation is performed in the reverse sequence.

Important note:

After installing the engine control unit the following operations must be performed:

- Coding the new engine control unit => Page 20 .
- Adapting throttle valve control unit (J338) =>Page 68 .
- Adapting engine control unit to immobilizer control unit => Page 44 .

Adapting engine electronics control unit to electronic immobilizer

Test conditions

- Authorised vehicle key required
- Connect fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 with cable V.A.G 1551/3.
- Switch the ignition on.
- Press key 1 for "Rapid data transfer".
- Press keys 1 and 7 for address word "Dash panel insert" and confirm entry by pressing Q.

-> Display readout:

8L0919860.	AB-KOMBIINSTR.
VDO ...	
Coding XXXXX	WSC 12345

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- Press the ⇒ key.

-> Display readout:

IMMO-IDENTNR: AUZXXXXXXXXXX

- Press the ⇒key.

-> Display readout:

Rapid data transfer	HELP
Select function XX	

- Press keys 1 and 0 for function "Adaptation" and confirm entry with Q key.

-> Display readout:

Adaptation
Enter channel number XX

- Press key 0 twice for "Channel number 0" and confirm entry with Q key.

-> Display readout:

Adaptation Q
Erase learned values?

- Confirm input with Q key.

-> Display readout:

Adaptation
Learnt values have been erased

- Conclude adaptation by pressing => key.

Note:

The identity of the engine control unit is read into the immobilizer control unit the next time the ignition is switched on.

1.8 - Testing idling speed

Test conditions

- No leaks in exhaust system
- Coolant temperature at least 80 °C
- Throttle valve in idling position

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=> 4-cylinder Engine, Mechanics; Repair group 20; Fuel supply system; Servicing throttle mechanism Fuel supply system Servicing throttle mechanism

- Electrical consumers switched off (radiator fan must not run during the check)
- Air conditioner switched off
- Pressure gauge not connected
- Selector lever in position P or N

Testing idling speed

Notes:

- ◆ The idling speed cannot be adjusted.
- ◆ The idling speed is regulated by the engine control unit via the throttle valve control unit.
- Interrogate fault memory =>Page 4 . The fault memory must be clear. If necessary, rectify any faults and erase the fault memory. Switch off the engine, then start up again. Take vehicle for a test drive and interrogate the fault memory again to make sure it is clear.
- Leave engine idling.
- Switch off air conditioner.
- Switch off rear window heating.
- Place selector lever in P or N position (automatic gearboxes).
- Read measured value block (select function 08, Display Group 01 =>Page 29).

-> Display readout:

Read measured value block 1
1 2 3 4

- Read off idling speed from display zone 1.

Specification: 760...880 rpm

- Press the ➡key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- If the value does not match the specification, interrogate the fault memory again =>Page 4 .

If the idling speed is too high or too low and there are no faults recorded in the fault memory, carry out the following tests:

- Test idling switch =>Page 70 .
- Large quantity of unmetered air => see "Read measured value block", Display Group 03, 08 or 99.
- Test throttle valve control unit =>Page 68 .

1.9 - Testing fuel pressure regulator and holding pressure

Test conditions

- Fuel pump relay OK, testing =>Page 52
- Fuel pump OK
- Fuel filter OK
- Battery voltage OK

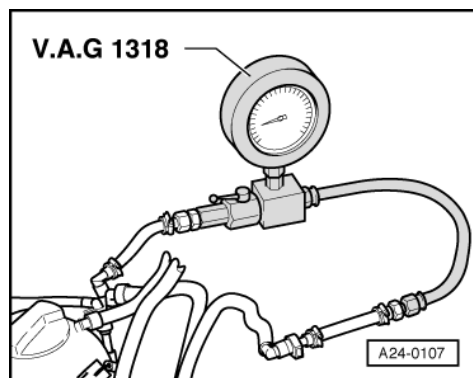
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Note:

The fuel pressure regulator regulates the fuel pressure according to the intake manifold pressure at the throttle valve unit.

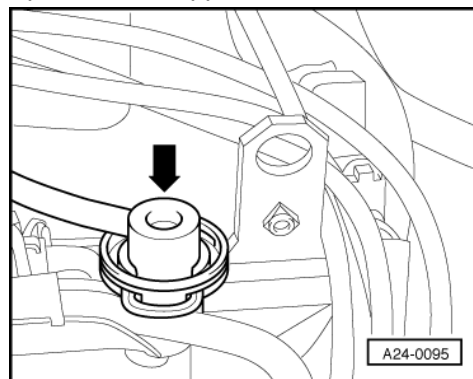
Important!

Fuel system is pressurised. Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.



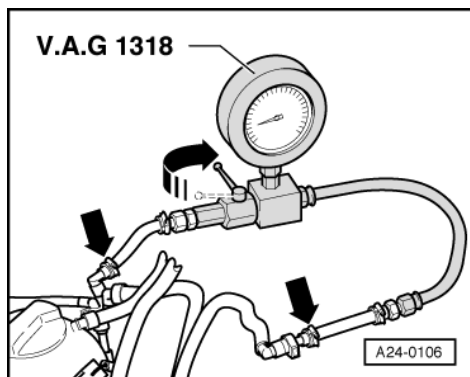
- Pull fuel supply hose (white marking) off fuel supply pipe.
- Connect pressure gauge V.A.G 1318 to fuel supply pipe using adapters 1318/8, 1318/9 and 1318/17.
- -> Open cut-off valve on pressure gauge. The lever points in the direction of flow.
- Start the engine and run at idling speed.
- Measure fuel pressure.

Specification: approx. 2.5 bar



- -> Pull vacuum hose off fuel pressure regulator. The fuel pressure should rise to approx. 3.0 bar.
- Switch off ignition.
- Check leak tightness and holding pressure by watching the gauge indicator fall. After 10 minutes the remaining pressure should be at least 1.5 bar.

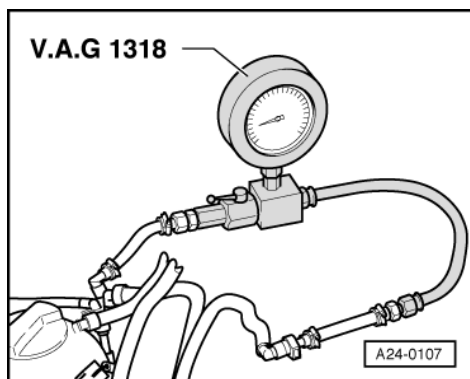
If the holding pressure drops below 1.5 bar:



- Start the engine and run at idling speed.
- -> Allow the pressure to build up, then switch off the ignition. At the same time close the cut off valve on the pressure gauge V.A.G 1318 (valve lever at right angles to direction of flow).
- Observe pressure drop on gauge.

If the pressure does not drop:

- Check fuel pump non return valve.



If the pressure drops again:

- -> Open cut off valve on pressure gauge V.A.G 1318 (valve lever points in direction of flow).
- Start the engine and run at idling speed.
- Allow the pressure to build up, then switch off the ignition. At the same time pinch the return hose (with blue marking) firmly together.

If the pressure does not drop:

- Renew the fuel pressure regulator.

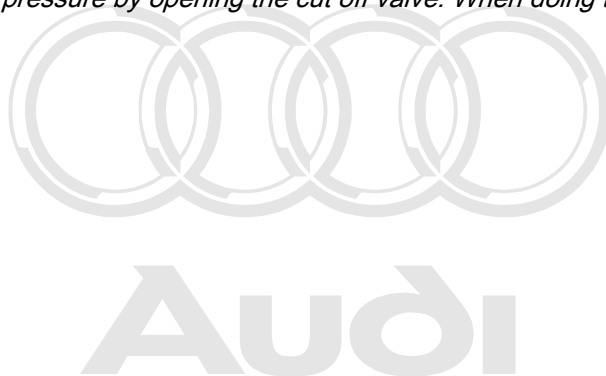
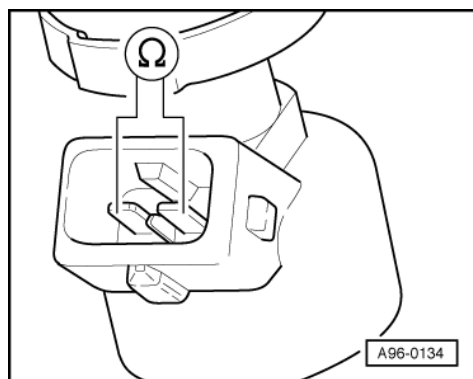
If the pressure drops again:

- Check pipe connections, O-rings on fuel manifold and injectors for leaks.
- Check pressure gauge for leaks.

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Note:

Before removing the pressure gauge, release the fuel pressure by opening the cut off valve. When doing this hold a container over the connection.

1.10 - Testing injectors

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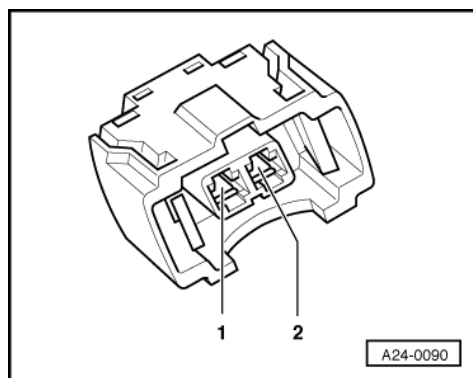
A - Electrical testing of injectors

- Remove the fuel manifold =>Page 50 .
- Remove plug connector from the injector which is to be tested.
- -> Measure resistance between the injector contacts using V.A.G 1526.

Specification: approx. 14.5 ω .

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

- If the measured value is not as specified, renew the injector.

B - Testing power supply**Test conditions**

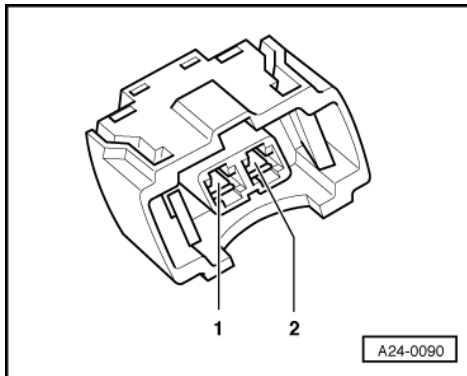
- Fuel pump relay OK, testing =>Page 52 .
- Fuse for injectors OK.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- Remove plug connector from the injector which is to be tested.
- -> Connect diode test lamp V.A.G 1527 between engine earth and contact 1 on the connector.
- Operate starter for a few seconds (the engine can be allowed to start). The diode test lamp should light up.

- If the diode test lamp does not light up, test for open circuits in the wiring between contact 1 and the fuse for the injectors - if necessary rectify open circuit.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations



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- If the diode test lamp lights up, test activation of injectors.

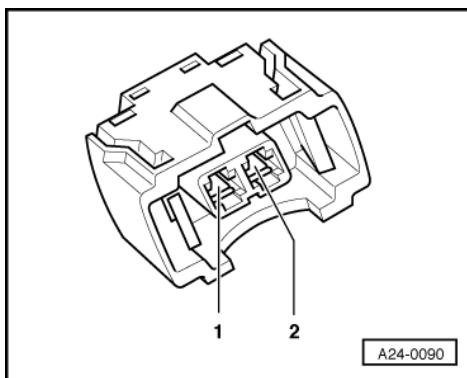
C - Testing activation of injectors

- Remove plug connector from the injector which is to be tested.
- -> Connect diode test lamp V.A.G 1527 between the battery positive terminal (+) and contact 2 on the connector.
- Operate starter for a few seconds (the engine can be allowed to start).

Specification: The diode test lamp should flash.

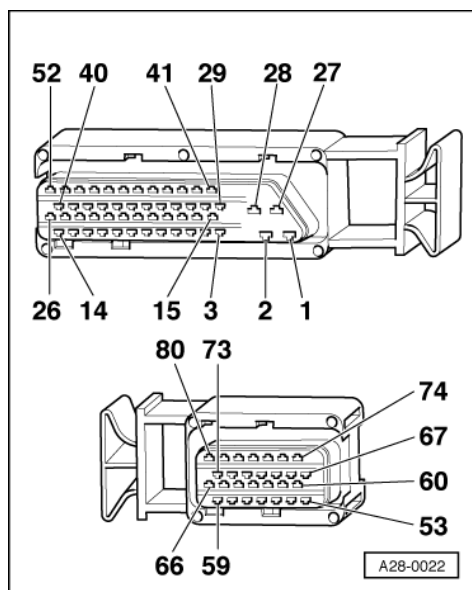
Note:

Diode test lamps with a low current draw continue to glow faintly between impulses from the engine control unit (rather than going out completely) and become much brighter when receiving an impulse.



If the diode test lamp does not flash:

- Connect test box V.A.G 1598/22 to wiring harness for engine control unit =>Page 43 .
- -> Test for open circuit or short to positive in the wiring between the engine control unit and contact 2 on the plug connector for the injector being tested.



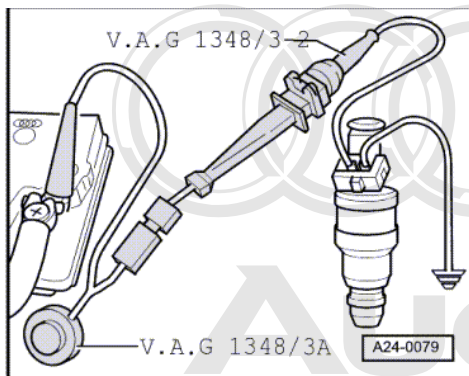
Contact 2 on plug connector for injector	Test box V.A.G 1598/22 or control unit connector
1	73
2	80
3	58
4	65

- Rectify short circuit or open circuit if necessary.
- If the wiring is OK, fit a new engine control unit => Page 43 .

1.11 - Testing injection quantity, leak tightness and spray pattern of injectors

Test conditions

- Fuel pressure OK, testing =>Page 46 .
- Disconnect vacuum hose from fuel pressure regulator.
- Undo quick releases for fuel supply and return hoses. Important! The fuel system is pressurised.
- Disconnect both ends of hose which joins ACF valve to throttle valve control unit and disengage hose from intake manifold.
- Unplug connectors for intake manifold changeover valve and Hall sender (phase sensor).
- Unplug spark plug connectors for cylinders 2 and 3.
- Unbolt fuel manifold from intake manifold and remove carefully from intake manifold together with injectors.
- Disconnect plugs from injectors.
- Unclip wiring harness from cable guide and remove.
- Carefully pull fuel manifold to the right (away from ACF filter) together with injectors, fuel supply hose, fuel return hose and ACF hose. Take out from under intake manifold, then re-connect the fuel supply and return hoses (blue markings).
- Place the injector which is to be tested into a measuring glass from injection quantity tester V.A.G 1602.



- -> Connect one of the injector contacts to engine earth using test cable and crocodile clamp from V.A.G 1594.
- Connect second injector contact 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 and select solenoid valve 1 for activated charcoal filter -N80.
=>Page 18 . The fuel pump will run for approx. 50 seconds.
- Check injectors for leaks (visual check). When the fuel pump is running, only 1 or 2 drops of fuel should escape from each injector during the 50 second running period.
- If the fuel loss is greater, switch off the fuel pump (terminate final control diagnosis) and renew the faulty injector.
- Start final control diagnosis again and select solenoid valve 1 for activated charcoal filter -N80.

Note:

The final control diagnosis cannot be re-started until the ignition has been switched off briefly.

- Immediately after selecting the ACF solenoid valve (fuel pump will run for approx. 50 seconds), activate remote control V.A.G 1348/3 A for 30 seconds.
- Repeat test (i.e. start final control diagnosis) for all injectors.
- Once all four injectors have been actuated, place measuring glasses on a level surface.

Specification: 85...105 ml.

- If the measured value for one or more of the injectors is outside the tolerance range, switch off the fuel pump (terminate final control diagnosis) and renew the defective injector.
- If the measured values for all the injectors are outside the tolerance range, check the fuel pressure => Page 46 .

Note:

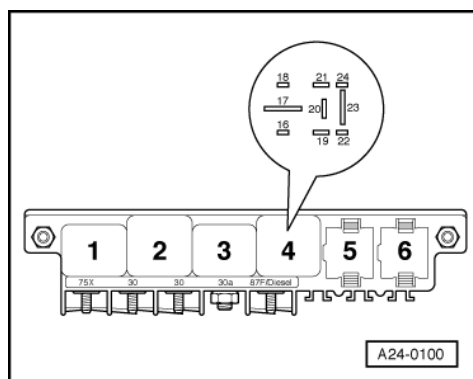
When checking the injection quantity, also check the spray pattern. The spray pattern should be the same for all the injectors.

Installation of the fuel manifold together with injectors is performed in the reverse sequence. The following points should be noted when installing:

- Renew the O-rings at all opened connections. (When renewing the front O-ring, make sure not to remove the plastic cap from the injector head. The O-ring must be pulled off over the plastic cap.)
- Moisten the O-rings with clean engine oil.
- Make sure that the injectors are installed in the correct positions.
- Check to make sure that the retainer clamps are properly seated.



1.12 - Testing fuel pump relay and activation

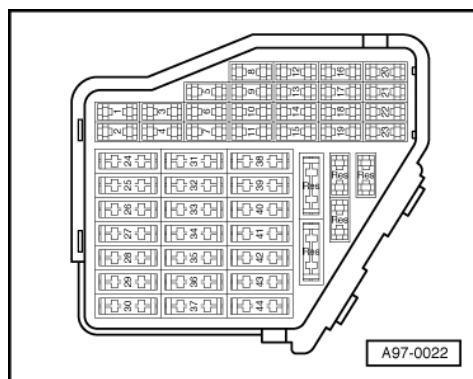


Note:

-> The fuel pump relay is located in the central electrics in the left hand footwell, relay position 4.

A - Testing fuel pump relay -J17

- Remove storage bin in front left hand footwell.



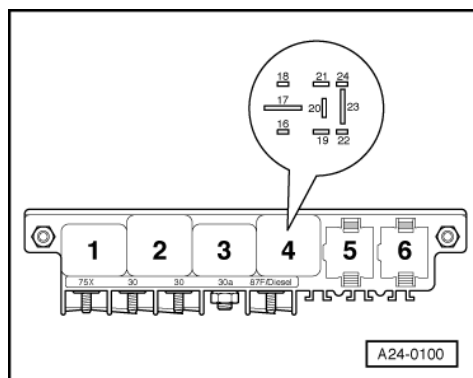
- -> Remove fuel pump fuse from fuse holder and connect diode test lamp V.A.G 1527 between earth and one of the two contacts for the fuel pump fuse.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- Operate the starter briefly.

The fuel pump relay should pick up (can be felt and heard) and the diode test lamp should light up.

- If the fuel pump relay does not pick up, test activation => Page 53 .
- If the fuel pump relay picks up but the diode test lamp does not light up, repeat the test on the other contact.



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- -> If the diode test lamp still does not light up, test for open circuit in wiring between fuel pump fuse and contact 23 in relay position 4. If necessary, rectify open circuit.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- If the power supply, activation and wiring for the fuel pump relay are OK, fit a new fuel pump relay.

B - Testing power supply and activation of fuel pump relay

Note:

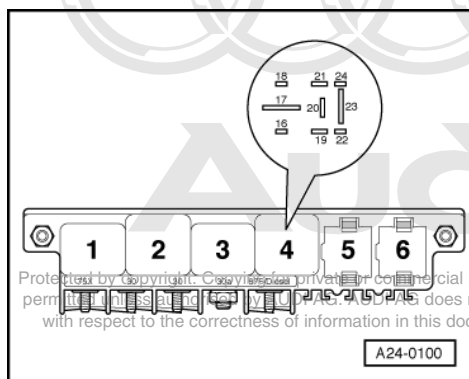
Activation of the fuel pump relay can also be tested using the final control diagnosis.

=>Page 18.

- Remove fuel pump relay J17 from central electrics, relay position 4.

Testing power supply

- Switch the ignition on.

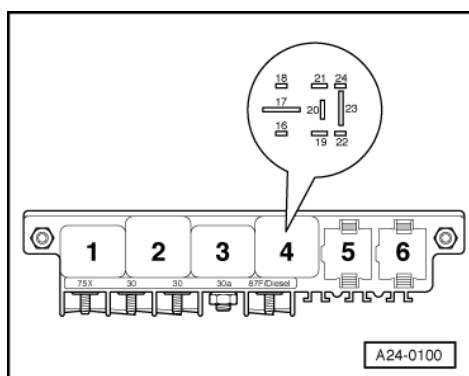


- -> Connect hand-held multimeter V.A.G 1526 between earth and relay panel contact 19 (positive; terminal 15 from ignition switch). Disconnect, then re connect between earth and relay panel contact 17 (permanent positive; terminal 30 from battery).

Specification: approx. battery voltage in each case

- If the values are not as specified, rectify the open circuit.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations



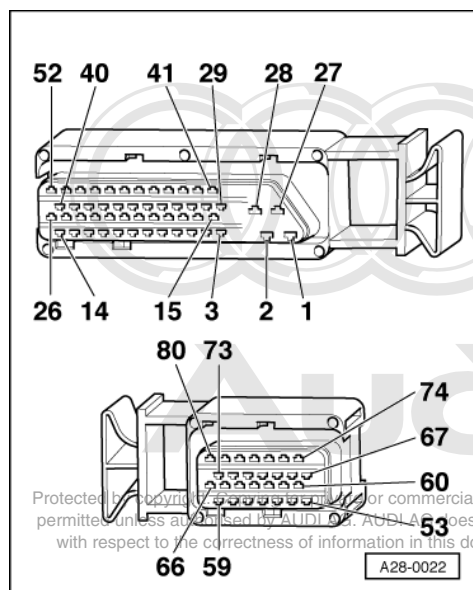
Testing activation

- -> Connect diode test lamp V.A.G 1527 between positive and contact 16 on relay panel (earth connection via engine control unit).
- Operate the starter briefly.



- The diode test lamp should light up and remain lit when the starter is operated.

Note:



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

- If the activation, wiring and power supply for the fuel pump relay are OK but the fuel pump relay still does not pick up, fit a new fuel pump relay.

If the diode test lamp does not light up, test the wiring as follows:

- -> Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=>Page 43 .
- Connect hand-held multimeter between contact 16 on relay panel and socket 4 on the test box, then test wiring for open circuits.
- Rectify open circuit if necessary

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- If there is no open circuit and the diode test lamp still does not light up, fit a new engine control unit
=>Page 43 .
- Refit the fuel pump fuse.

1.13 - Testing air mass meter (vehicles up to model year 1998)

Testing operation

Test conditions

- Vehicle stationary, engine idling.
 - Select Read measured value block (function 08) and Display Group 02 =>Page 29).
- > Display readout:

Read measured value block 2
 1 2 3 4

Display zone 2 shows the intake air mass (milligrams per stroke).

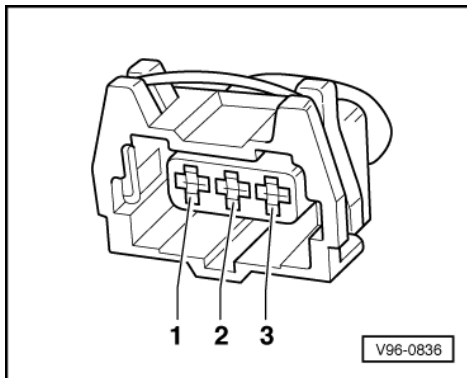
Specification: 76...164 mg/stroke

- If the values are not as specified or if the fault memory has recorded a fault relating to the air mass meter, test the power supply to the air mass meter => Page 55 .

Testing power supply to air mass meter

- Test fuse for air mass meter.

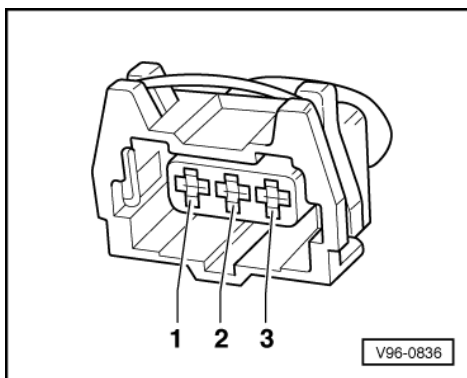
=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations



- -> If the fuse is OK, unplug the connector from -G70 and connect diode test lamp V.A.G 1527 between engine earth and contact 3 on the connector.
- Operate the starter briefly (the engine can be allowed to start briefly). The diode test lamp should light up.
- -> If the diode test lamp does not light up, test for open circuits or shorts to earth in wiring from contact 3 on plug connector to fuse - if necessary repair the wiring.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

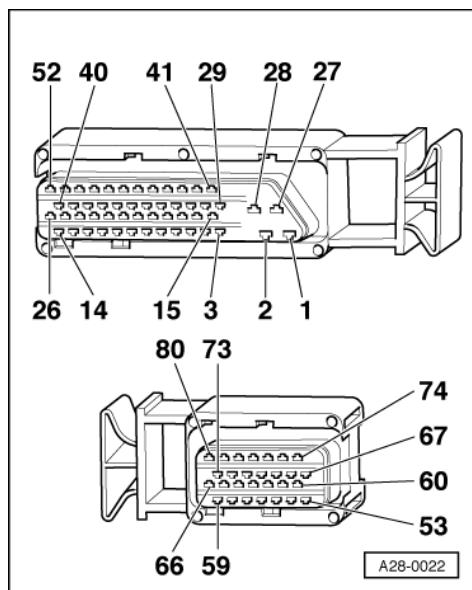
- If the fuse and the wiring are OK but the diode test lamp still does not light up, test the fuel pump relay => Page 52 .
- If the power supply is OK, test the signal wire => Page 55 .



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Testing signal wiring for air mass meter

- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
 =>Page 43 .
- -> Test wiring from plug connector on air mass meter...



- -> to engine control unit for open circuit and short to positive or earth. Rectify if necessary.

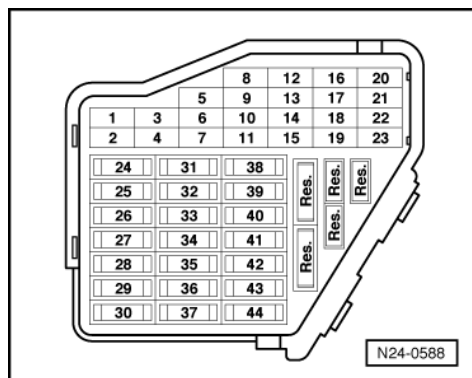
Plug connector for air mass meter G70	Test box V.A.G 1598/22 or control unit connector
1	13
2	12

- If the wiring is OK, fit a new air mass meter (G70).

1.14 - Testing air mass meter (vehicles as of model year 1998)

Note:

From model year 1998 onwards the intake air temperature sender (G42) is integrated in the air mass meter. The sender is therefore no longer fitted as a separate engine component.



Test conditions

- -> Fuse for air mass meter OK.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- Coolant temperature at least 80 °C.
- All electrical consumers, e.g. lights and rear window heating, must be switched off.
- If the vehicle is equipped with an air conditioner, this must be switched off.



- On vehicles with automatic gearbox selector lever in "P" or "N" position.
- Connect the fault reader V.A.G 1551 (V.A.G 1552). Start the engine and select the engine control unit with "Address word" 01.
(Connecting fault reader and selecting engine control unit => Page 2.)

-> Display readout:

Rapid data transfer	HELP
Select function XX	

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

-> Display readout:

Read measured value block	HELP
Enter display group number XXX	

- Press keys 0, 0 and 1 for "Display Group 1" and confirm entry by pressing Q.

-> Display readout:

(1...4 = display zones)

Read measured value block 1
1 2 3 4

- Check whether the coolant temperature is above 80 °C in display zone 2.
- Change to display group 2 as follows:
V.A.G 1551: Press key 3
V.A.G 1552: Press ↑ key

-> Display readout:

(1...4 = display zones)

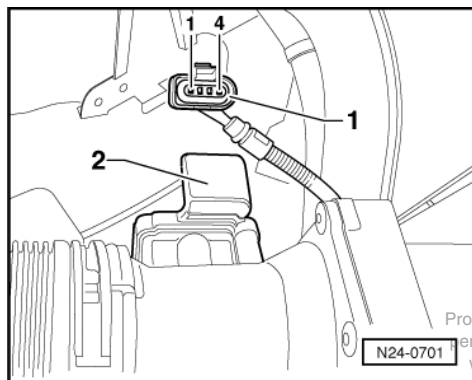
Read measured value block 2
1 2 3 4

Display zone 2 shows the intake air mass (milligrams per stroke).

Specification: 76...164 mg/stroke

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

If the specifications are not attained or there is a fault in fault memory relating to the air mass meter:



- -> Disconnect the 4-pin connector -1- from the air mass meter -2-.
- Connect multimeter (voltage test range) between engine earth and contact 3 on the connector.
- Start engine and run at idling speed.

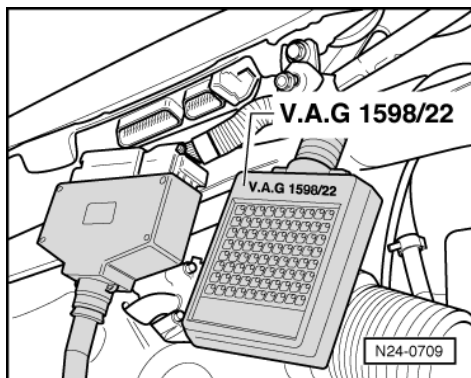
Specification: 11...15 V

- Switch off ignition.
- If the power supply is OK, test the signal wire and the earth connection => Page 55 .

If no voltage is present:

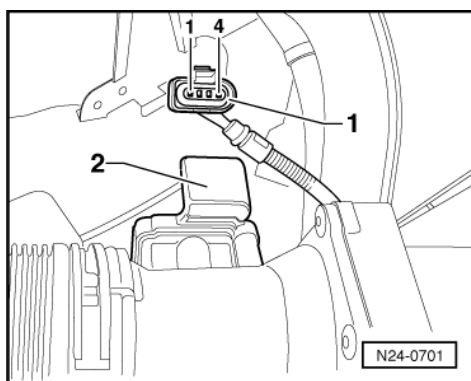
- Check wiring from contact 3 to fuel pump relay (J17) according to current flow diagram.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations



Testing signal and earth wiring for air mass meter

- -> Connect test box V.A.G 1598/22 to wiring harness for control unit.



- -> Check wiring between test box and 4 pin connector for open circuit using current flow diagram.
Contact 1+socket 13
Contact 2+socket 12
Wire resistance: max. 1.5 ω
- Additionally check all wires for short to one another.
Specification: infinite resistance (the wires must not be connected to each other)

If no wiring fault is detected:

- Replace the air mass meter (G70) and the intake air temperature sender (G42).

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1.15 - Testing intake air system for leaks (unmetered air)

Checking with engine leak detector spray G 001 800 A1

Notes:

- ♦ The vacuum in the intake system will cause the leak detector spray to be drawn in with the unmetered air. The leak detector spray reduces the ignitability of the mixture. This leads to a drop in engine speed and to a significant increase of the CO content.

- ♦ The safety precautions listed on the container must be adhered to.
- Connect fault reader V.A.G 1551 (V.A.G 1552) and select the engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
(Connecting fault reader and selecting engine electronics control unit => Page 2.)

-> Display readout:

Rapid data transfer	HELP
Select function XX	

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

-> Display readout:

Read block of measured values
Enter display group number XXX

- Press keys 0, 0 and 1 for "Display Group 01" and confirm entry by pressing Q.

-> Display readout:

(1...4 = display zones)

Read measured value block 1
1234

- Note engine speed in display zone 1.
- Note Lambda probe voltage in display zone 3 and the range within which it fluctuates.
- Systematically spray parts of the intake system with engine leak detector spray.

Engine speed or Lambda probe voltage does not change:

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

If the engine speed drops or the Lambda probe voltage changes:

- Press the =>key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Check sprayed areas of intake system for leaks and rectify if necessary.

2 - Testing lambda control

2.1 - Testing lambda control

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

The voltage signal for "Mixture too rich" (low residual oxygen) is between about 0.7 and 1.0 V.

The voltage signal for "Mixture too lean" (high residual oxygen) is between about 0.0 and +0.3 V.

The transition from "rich" to "lean" is accompanied by a voltage jump from between 0.7 and 1.0 V to between 0.0 and +0.3 V, and vice versa ($\lambda = 1.0$).

Because of the sharp voltage jump the lambda control cannot maintain a constant ideal mixture composition of $\lambda = 1.0$. The system fluctuates continuously between "slightly too lean" and "slightly too rich".

If the voltage does not change or only changes slowly the following faults are possible:

- ♦ Slots or holes in probe head are blocked.
- ♦ Lambda probe has been subjected to excessive thermal stress.
- ♦ Contact resistance in signal wire or earth wire.
- ♦ Lambda probe too cold; lambda probe heating not working.



- ♦ Lambda control switched off (control unit has registered a fault in the injection system => interrogate fault memory and read measured value block, Display Group 99).
- ♦ Lambda probe damaged by contact spray or similar product. (The contact spray is drawn into the probe through the fine cavities in the electrical wiring as a result of thermal fluctuations and capillary effects.)
- ♦ Lambda probe damaged by silicone vapours. (The engine draws in traces of any silicone based sealants that may have been used. The silicone does not burn and damages the lambda probe.)

2.2 - Poor performance after cold start

Test conditions

- No faults relating to lambda control function recorded in fault memory. If faults are recorded, rectify them and erase the fault memory.

The time it takes for the lambda control to cut in (lambda probe temperature must be approx. 300°C) is mainly determined by the following factors.

- ♦ Ambient temperature (summer or winter)
- ♦ Operating conditions after starting
- ♦ Functioning of lambda probe heating

If faults occur after a cold start, check whether the problem arises before or after the lambda control cuts in.

Testing vehicle under cold start conditions:

- Select function 08 "Read measured value block" and Display Group 99
=>Page **38**.

-> Display readout:

Read measured value block 99			
1	2	3	4

Display zone 4 will show the status of the Lambda control.

Relevance of figures in 8 digit number block in display zone 4 (see also Page **38**):

Display zone 4	Meaning of readout
1XXXXXXX	Fault recorded in memory during diagnosis
X1XXXXXX	Not allocated
XX1XXXXX	Not allocated
XXX1XXXX	Restricted operation mode
XXXX1XXX	Lambda control at stop limit
XXXXX1XX	Lambda control switched on
XXXXXX1X	Lambda probe functioning
XXXXXXX1	Mixture status 1 = rich mixture 0 = lean mixture

After cold start:

-> Display readout:

Read measured value block 99			
1	2	3	XXXXX00X

Notes:

- ♦ The lambda probe will not start functioning immediately after a cold start (lambda probe too cold).

- ♦ The lambda control is activated once the lambda probe is functioning.

Important!
The V.A.G 1551 must be operated by a second person.

- Take the vehicle for a test drive and watch display zone 4.

-> The lambda control cannot cut in unless it is switched on and the lambda probe is functioning.

Read measured value block 99

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The readout for the mixture status (on the far right of the 8 digit number block) should fluctuate continuously between "0" and "1".

A "1" in the space for "Mixture status" indicates that the air/fuel mixture is too rich (too little residual oxygen in the exhaust gas).

A "0" in the space for "Mixture status" indicates that the air/fuel mixture is too lean (too much residual oxygen in the exhaust gas).

- If the engine performance is poor before the lambda control cuts in, the lambda control is not the cause of the problem.
- If the performance only becomes poor after the lambda control has cut in, test the operation of the lambda control
=>Page 61 .

Notes:

- ♦ If the performance improves once the lambda control has cut in, this means that the lambda control is counteracting the problem (e.g. unmetered air or defective injector, etc.). Check the lambda learned values to confirm this.
- Select "Read measured value block" (function 08) and Display Group 11.
- Compare the actual values (displayed on the test apparatus) with the specifications.

2.3 - Testing operation

- Select the function "Read measured value block" (function 08) and Display Group 01
=>Page 29 .

-> Display readout:

Read measured value block 1
1 2 3 4

Do not proceed with the test until the coolant temperature shown in display zone 2 has reached at least 80 °C.

Display zone 3 will show the voltage of the lambda probe signal.

- If the lambda probe voltage fluctuates very slowly, test the lambda probe heating => Page 63 .
- Press the =>key.
- Select the function "Read measured value block" (function 08) and Display Group 99
=>Page 38 .

-> Display readout:

Read measured value block 99
1 2 3 4

Display zone 4 will show the status of the Lambda control.



Relevance of figures in 8 digit number block in display zone 4 (see also Page 38):

Display zone 4	Meaning of readout
1XXXXXXX	Fault recorded in memory during diagnosis
X1XXXXXX	Not allocated
XX1XXXXX	Not allocated
XXX1XXXX	Restricted operation mode
XXXX1XXX	Lambda control at stop limit
XXXXX1XX	Lambda control switched on
XXXXXX1X	Lambda probe functioning
XXXXXXX1	Mixture status 1 = rich mixture 0 = lean mixture

-> Display readout:

Read measured value block 99			
1	2	3	XXXX111X

If the lambda control has reached one of its stop limits (i.e. if the "Lambda control at stop limit" space contains a "1"), the "Mixture status" space will indicate which of the stops the lambda control is at.

-> Display readout:

Read measured value block 99			
1	2	3	XXXX1111

If the Lambda control has reached a stop limit and the "Mixture status" space is showing a "1" continuously, this means that the Lambda control is at the maximum leaning down limit but the Lambda probe is still registering "Mixture too rich".

-> Display readout:

Read measured value block 99			
1	2	3	XXXX1110

If the Lambda control has reached a stop limit and the "Mixture status" space is showing a "0" continuously, this means that the Lambda control is at the maximum enrichment limit but the Lambda probe is still registering "Mixture too lean".

Note:

If the Lambda control remains at either of the stop limits ("too rich" or "too lean") for a certain period of time a fault will be recorded in the fault memory.

- If the Lambda control is functioning properly, check the Lambda learned values.
- Press C key.
- Press keys 0,1 and 1 for "Display Group 11" and confirm entry by pressing Q.

The mixture adaptation system has learning ability, i.e. the lambda control can recognise differences between various engines (injector nozzle delivery, compression, fuel pressure etc.) and compensates by adjusting the pre programmed basic injection periods in the map in the control unit. The injection periods are extended or reduced until a " $\lambda = 1$ " mixture composition is achieved.

-> Display readout:

Read measured value block 11			
1	2	3	4

Display zone 2 shows the Lambda learned value for idling.

- ♦ Positive learned value (+...ms): Pre programmed basic injection period is too short, actual injection period ...ms longer in order to achieve a " $\lambda = 1$ " mixture composition.

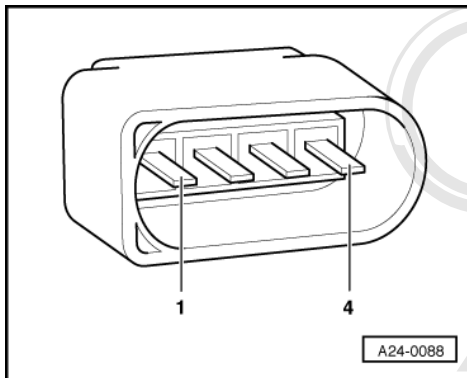
- ♦ Negative learned value (-...ms): Pre programmed basic injection period is too long, actual injection period ...ms shorter in order to achieve a " $\lambda = 1$ " mixture composition.

Display zone 3 shows the Lambda learned value for part throttle.

- ♦ Values greater than 1: Pre programmed basic injection period is too short, actual injection period longer in order to achieve a " $\lambda = 1$ " mixture composition.
- ♦ Values less than 1: Pre programmed basic injection period is too long, actual injection period shorter in order to achieve a " $\lambda = 1$ " mixture composition.

Specifications: => Page 32 .

2.4 - Testing lambda probe heating

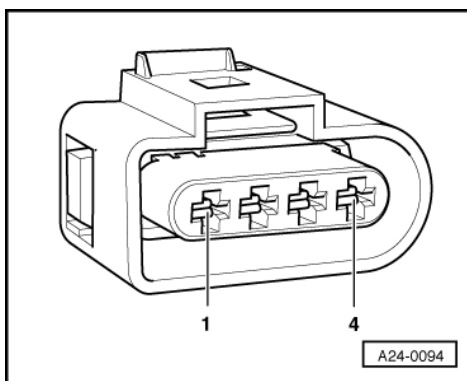


- The lambda probe heating circuit is monitored by the self-diagnosis system.
- Interrogate fault memory => Page 4
- Unplug 4 pin connector for lambda probe (located beneath cover on underside of car on right hand side when facing in direction of travel).
- -> Use V.A.G 1526 to measure resistance between contacts 1 and 2 on lambda probe connector.

Note:

The resistance of the heating element at room temperature is approx. 1...5 Ω . With even a small temperature rise this value will increase sharply.

- If an open circuit is detected, fit a new lambda probe.



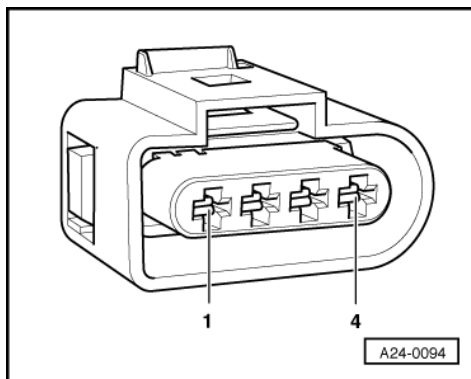
If the heating element has continuity, test the power supply for the lambda probe heating as follows:

- Test fuse for lambda probe heating.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- -> If the fuse is OK, connect diode test lamp V.A.G 1527 between engine earth and contact 1 of plug on wiring harness.

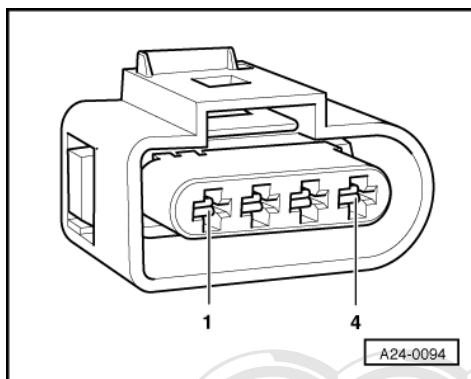
- Operate the starter briefly (the engine can be allowed to start briefly). The diode test lamp should light up.



- -> If the diode test lamp does not light up, test for open circuits or shorts to earth in wiring from contact 1 of plug on wiring harness to fuse - if necessary repair the wiring.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- Switch off ignition.
- Connect test box V.A.G 1598/22 to wiring harness for control unit =>Page 43 .



- -> Test for open circuit in wiring between contact 2 on wiring harness plug (earth connection via engine control unit) and contact 27 on engine control unit - if necessary rectify open circuit.
- If the fuse and the wiring are OK but the diode test lamp still does not light up, test the fuel pump relay => Page 52 .
- If all the test results obtained so far have been OK, fit a new engine control unit =>Page 43 .

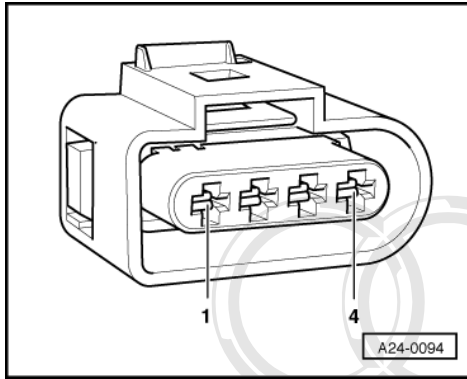
2.5 - Testing lambda probe signal wiring and activation

Note:

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

- Interrogate fault memory =>Page 4 .
- If a fault in the lambda probe has been registered and the lambda probe heating is OK, unplug the lambda probe connector.

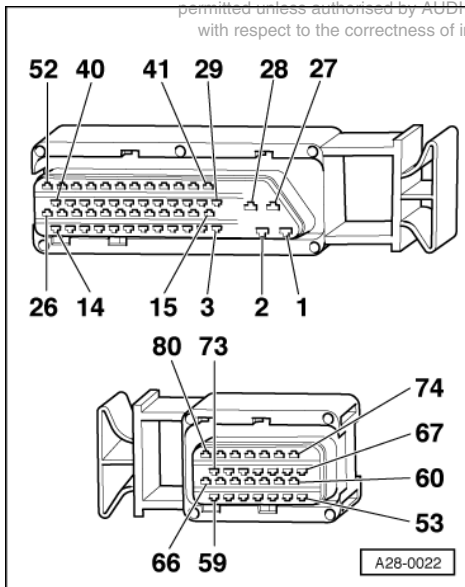


- Switch the ignition on.
- -> Test voltage by connecting hand held multimeter V.A.G 1526 (measuring range 2 V) between contacts 3 and 4 of plug on wiring harness.

Specification: approx. 1.56 V.

- If the reading is not as specified, connect test box 1598/22 to the wiring harness for the engine control unit =>Page 43 .

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- -> Test the following wiring connections for open circuits and shorts to positive or earth; if necessary, rectify the fault.

Lambda probe Bank 1 -G39

Connector on wiring harness, contact	Test box V.A.G 1598/22 or control unit connector
3	25
4	26

- If the wiring is OK, fit a new engine control unit => Page 43 .

2.6 - Removing and installing lambda probe

Removing

- Unplug the lambda probe connector.

- Unscrew the lambda probe using V.A.G 3337/9.

When installing, note the following points:

Notes:

- ♦ When installing, the lambda probe wire must be secured in exactly the same position as before in order to avoid contact between the wire and the exhaust pipe.
- ♦ Tightening torque 50 Nm.
- ♦ The screw thread on the lambda probe is coated with assembly paste. This paste must not be allowed to penetrate the openings on the probe.

3 - Testing fuel tank breather system

3.1 - Testing fuel tank breather system

3.2 - Testing solenoid valve 1 for activated carbon filter.

Testing for leaks

When there is no electrical signal the solenoid valve remains closed.

- Disconnect hose from the solenoid valve for the activated carbon filter (N80).
- Start final control diagnosis and select solenoid valve for activated carbon filter (N80)
=>Page 18 .
- While final control diagnosis is running, blow into solenoid valve to check whether it opens and closes properly. If necessary, fit a new solenoid valve.

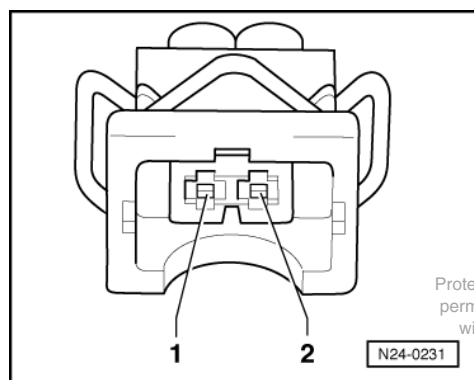
Electrical test of -N80 (ACF valve)

- Unplug connector on ACF valve.
- Measure resistance between contacts on valve using hand held multimeter V.A.G 1526.

Specification: 22...30 Ω .

- If the value is not as specified, fit a new ACF valve.

Testing power supply to ACF valve



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Note:

The ACF valve receives its power supply via the fuel pump relay.

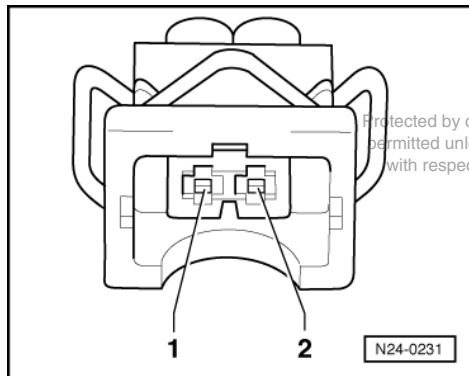
Test conditions

- Fuse for ACF valve OK.
- Unplug connector on ACF valve.
- -> Connect diode test lamp V.A.G 1527 between engine earth and contact 1 on the connector.
- Operate starter.

Specification: The diode test lamp should light up.

- If diode test lamp does not light up, test for open circuit between contact 1 and fuse. Rectify open circuit if necessary.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations



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- If wiring is OK, test fuel pump relay => Page 52 .

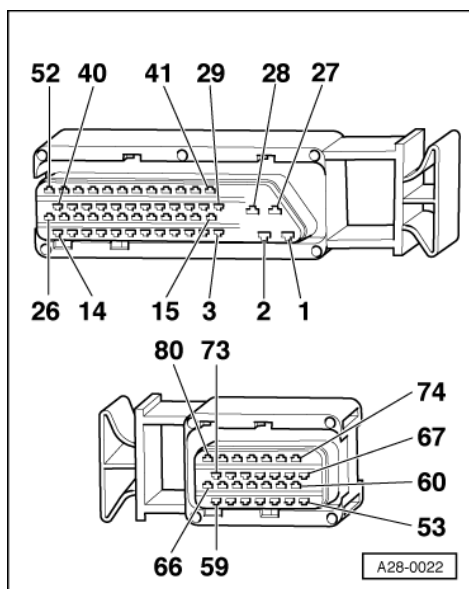
Testing ACF valve activation

- -> Connect diode test lamp V.A.G 1527 between contact 2 (earth connection via engine control unit) and contact 1 (positive, from fuel pump relay) on the connector.
- Start final control diagnosis and select solenoid valve for activated charcoal filter (N80)
 =>Page 18 .

Specification: diode test lamp should start flashing.

If the diode test lamp does not flash or lights up continuously:

- Switch off ignition.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
 =>Page 43 .





- -> If the diode test lamp lights up continuously, test for short circuit to earth in wiring between contact 2 on ACF valve connector and socket 15 on test box.
- If the diode test lamp does not flash, test for open circuits and short circuits to positive in the wiring between contact 2 on ACF valve connector and socket 15 on test box.
- If necessary, rectify short circuit to earth or open circuit.
- If no short circuit or open circuit is found, fit a new engine control unit
=>Page 43 .

4 - Testing throttle valve control unit

4.1 - Testing throttle valve control unit

4.2 - Vehicles up to model year 1998

Note:

Vehicles from model year 1998 =>Page 73 .

Testing operation

The idling speed stabilisation is integrated in the throttle valve control unit.

The throttle valve potentiometer, idling speed switch, throttle valve positioner and potentiometer for throttle valve positioner are located inside the housing opposite the cable pulley.

The housing must not be opened. This means that the two potentiometers, the idling speed switch and the throttle valve positioner cannot be adjusted mechanically or replaced.

All adjustments are made via the "Basic setting" function on the V.A.G 1551.

When there is no electrical signal the throttle valve is moved mechanically to a pre determined position, which causes the engine to idle at a higher speed when warm.

The throttle valve positioner is responsible for damping the action of the throttle valve as it closes.

The angle to which the throttle valve positioner can open the throttle valve is limited, i.e. it cannot open it to full throttle (for example).

4.3 - Adaptation of throttle valve control unit

The adaptation process enables the engine control unit to learn the stop positions of the throttle valve control unit with the ignition switched on and the engine not running.

An adaptation must always be performed if the throttle valve control unit (J338) or the engine control unit is removed and refitted or replaced, or if the power supply to the engine control unit is interrupted.

Test conditions

- No fault stored in fault memory
=> Page 4 , Interrogating fault memory.
- Idling speed switch closed, Testing
=>Page 70 .
- Throttle valve closed (throttle valve angle check by engine control unit), throttle cable correctly adjusted, Testing.

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=> Mechanics; Repair Group 20; Removing and installing parts of fuel supply system; Adjusting throttle cable
 Removing and installing parts of fuel supply system Adjusting throttle cable

- Engine not running
- Power supply to engine control unit more than 8 V, Testing => Page 105 .
- Connect fault reader V.A.G 1551 (V.A.G 1552) and select the engine electronics control unit with the "Address word" 01. When doing this the ignition must be switched on.
 (Connecting fault reader and selecting engine electronics control unit => Page 2 .)

-> Display readout:

Rapid data transfer HELP
Select function XX

- Press keys 0 and 4 for the function "Introduction of basic setting" and confirm entry with Q key.

-> Display readout:

Basic setting HELP
Enter display group number XXX

- Press keys 0, 9 and 8 for "Display Group 98" and confirm entry by pressing Q.

-> Display readout:

System in basic setting 98			
x.xx V	x.xx V	0000	01

When Q is pressed the throttle valve positioner will move to the minimum stop limit (throttle valve closed) and to the maximum stop limit (throttle valve open).

The control unit records the voltage reading for each position in its non-volatile memory.

This process takes no more than 10 seconds. The throttle valve then remains still without receiving any electrical signals (voltage 0).

-> Display readout:

System in basic setting 98			
x.xx V	x.xx V	0100	00

The adaptation of the engine control unit to the throttle valve control unit is now complete.

Note:

If one of the following readouts appears on the display, this means that the adaptation has not been completed successfully:

-> Display readout:

System in basic setting 98			
x.xx V	x.xx V	1100	10

Note:

Relevance of figures in display zone 3:

Display zone 3	Meaning of readout
1XXX	Fault recorded in memory during diagnosis; interrogate fault memory =>Page 4 .
X1XX	No current in throttle valve control unit (signal ratio = 0)
XX1X	Adaptation terminated because battery voltage is too low



Display zone 3	Meaning of readout
1XXX	Fault recorded in memory during diagnosis; interrogate fault memory =>Page 4 .
XXX1	Idling switch open (position check), Testing=>Page 70 .

Relevance of figures in display zone 4: see next Page

Relevance of figures in display zone 4:

Display zone 4	Meaning of readout
1X	Fault recorded in memory during diagnosis; interrogate fault memory =>Page 4 .
X1	Adaptation of throttle valve control unit in progress

-> Display readout:

Basic setting not carried out Implausible signal

Notes:

- ♦ See Fault Table, fault code 01087
- ♦ If the adaptation process for the throttle valve control unit is unsuccessful, the reason can be determined by checking Display Group 1 ("Read measured value block" with ignition switched on)
=>Page 29 .
- ♦ If the adaptation process is unsuccessful, check the test requirements.
=> 68 .
- ♦ After each test requirement has been met try to perform another adaptation of the engine control unit to the throttle valve control unit =>Page 68 .

Note:

If the adaptation is interrupted by the control unit, the reason could be one of the following:

- ♦ The requirements for the adaptation of the engine control unit to the throttle valve control unit have not been met. For a list of the requirements => see Fault Table, fault code 01087.
- ♦ The throttle valve cannot reach the mechanical idling stop because of a build up of dirt (e.g. oil carbon deposits) or an incorrectly adjusted throttle cable.
- ♦ Throttle valve control unit or wiring is defective.

After an interruption the fault Basic setting not completed; "Implausible signal" is recorded in fault memory.

The next time the ignition is switched on the engine control unit will try to perform the adaptation again.

- End the engine basic setting by pressing the ➡ key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.

4.4 - Testing idling switch

- Run engine at idling speed.
- Select Read measured value block (function 08) and Display Group 02 =>Page 29).

-> Display readout:

Read measured value block 2
1 2 3 0100

Check readout in display zone 4.

Note:

Relevance of figures in display zone 4:

Display zone 4	Meaning of readout
1XXX	Overrun
X1XX	Idling
XX1X	Part throttle
XXX1	Full throttle

The readout for idling should be "1".

- Open throttle slowly.

-> Display readout:

Read measured value block 2
1 2 3 0010

The readout for idling should be "0" and the readout for part throttle should be "1". (When the throttle valve is opened the idling speed switch is also opened.)

- If the display is not as specified, switch off ignition and connect test box V.A.G 1598/22 to wiring harness for engine control unit.
- Measure resistance between sockets 67 and 69 using hand held multimeter V.A.G 1526.

Specification: Continuity (throttle valve closed)

- Open throttle slightly.

Specification: idling speed switch should open (no continuity)

- If the value is not as specified, test wiring and contacts for open circuit, damage and dirt using current flow diagram. Remove dirt and replace damaged parts as necessary.

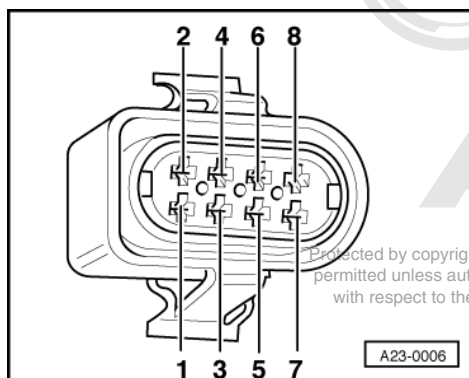
=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- Perform adaptation of engine control unit to throttle valve control unit => Page 68 .
- If the value is still not as specified, check the throttle valve for dirt or stiffness and clean if necessary.
- Repeat adaptation of throttle valve control unit =>Page 68 .
- If it is not possible to start the adaptation or if the adaptation cannot be completed, fit a new throttle valve control unit.
- Perform adaptation of throttle valve control unit =>Page 68 .

4.5 - Testing throttle valve positioner sender and throttle valve potentiometer

Testing sender voltage readings

- Disconnect the 8-pin plug on the throttle valve control unit.



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- Switch the ignition on.
- -> Measure voltage between contacts 4 and 7 on the 8-pin plug using hand held multimeter V.A.G 1526.

Specification: at least. 4.8 V.

If the value is as specified, reconnect the 8-pin plug.

- Start the engine.
- Select Read measured value block (function 08) and Display Group 98 =>Page **37**).

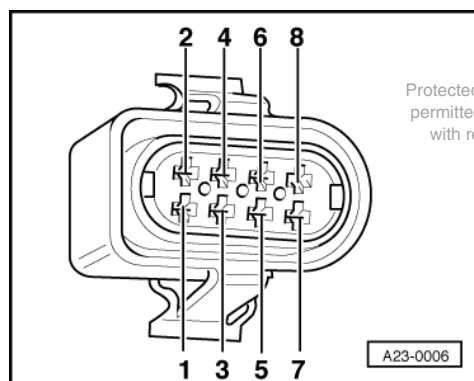
-> Display readout:

Read measured value block 98			
1	2	3	4

The values in display zone 1 (throttle valve potentiometer voltages) should be between 3.70 and 4.75 volts.

The values in display zone 2 (throttle valve positioner potentiometer voltages) should be between 2.28 and 4.75 volts.

- If the values are not as specified, switch off the ignition.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=>Page **43** .



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- Disconnect the 8-pin connector on the throttle valve control unit.
- -> Test for continuity between the test box and the 8-pin connector using multimeter V.A.G 1526.
- Use the multimeter to test the wires for short circuits with each other.

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

- Rectify any open circuits and remove any dirt that may be on the contacts. Erase fault memory and perform adaptation of throttle valve control unit => Page **68** .
- If the value is still not as specified, check the throttle valve for dirt or stiffness and clean if necessary.
- Repeat adaptation of throttle valve control unit =>Page **68** .
- If it is not possible to start the adaptation or if the adaptation cannot be completed, fit a new throttle valve control unit.
- Perform adaptation of throttle valve control unit =>Page **68** .
- If it is not possible to start the adaptation or if the adaptation cannot be completed, fit a new engine control unit => Page **43** .
- If it is not possible to complete the adaptation with the new engine control unit, try performing the adaptation again with the old throttle valve control unit that was removed => Page **68** .

4.6 - Testing throttle valve control unit (vehicles as of model year 1998)

Perform the adaptation as before.

=>Page **68**.

Components of the throttle valve control unit (J338):

Throttle valve positioner (V60), throttle valve positioner potentiometer (G88), throttle valve potentiometer (G69) and idling switch (F60)

Note:

If the throttle valve control unit is replaced, the following must be carried out:

- ◆ adapt the engine control unit to the throttle valve control unit => Page **68**.
- ◆ On vehicles with an automatic gearbox: Adapt the gearbox control unit

=> Automatic gearbox 01M 4-speed, Self-diagnosis; Repair Group 01; Carry out self-diagnosis; Start basic setting Carry out self-diagnosis Start basic setting

Contact pin assignment of throttle valve control unit differs on vehicles with or without a cruise control system (CCS).

Identification: Steering column switch with controls for CCS.

Note:

On vehicles equipped with cruise control (CCS) the throttle valve positioner can open the throttle valve throughout the entire engine speed range.

Test conditions

- Earth connection between throttle valve control unit and cylinder head OK.
- Throttle valve not damaged or dirty.

Testing idling switch

- Connect the fault reader V.A.G 1551 (V.A.G 1552). Then switch ignition on and select engine control unit with the "Address word" 01.
(Connecting fault reader and selecting engine control unit => Page **2**.)

-> Display readout:

Rapid data transfer HELP
Select function XX

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

-> Display readout:

Read measured value block HELP
Enter display group number XXX

- Press keys 0, 9 and 8 for "Display Group 98" and confirm entry by pressing Q key.

-> Display readout:

(1...4 = display zones)

Read measured value block 98
1 2 3 4

- Check idling switch at idling stop in display zone 3.

1st position from right must display 0

Display: 00000000

- Gradually open throttle valve.

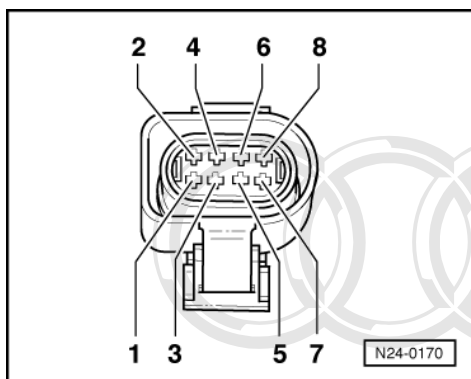
1st position from right must display 1

Display: 00000001

If the specifications are not obtained:

Display	Cause	Continuation of test
Always 1	Open circuit or short to positive	=>Page 74 .
Always 0	Short circuit to earth	=>Page 75 .

Continuation of test if display constantly shows 1



- -> Pull 8-pin connector off throttle valve control unit.
- Bridge the following contacts:
Vehicles with CCS1): Contacts 2 + 6
Vehicles without CCS1): Contacts 3 + 7
using auxiliary cables from V.A.G 1594 and observe display.

1) **CCS = cruise control system**
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Display 0:

- Press the =>key.
- Press keys 0 and 6 for the function "End data transfer" and confirm entry with the Q key.
- Switch off ignition.
- Fit a new throttle valve control unit
- Perform adaptation => Page 68 .

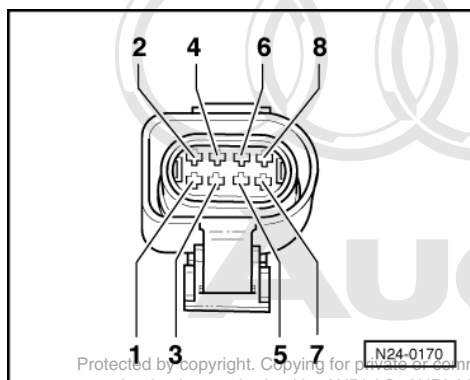
Display 1:

- Press the =>key.
- Press keys 0 and 6 for the function "End data transfer" and confirm entry with the Q key.
- Switch off ignition.
- Check voltage supply of throttle valve control unit and wiring to control unit => Page 78 .

If the voltage supply and wiring is OK:

- Fit a new engine control unit => Page 43 .

Continuation of test if display constantly shows 0



- -> Pull 8-pin connector off throttle valve control unit.

Display 1:

- Press the =>key.
- Press keys 0 and 6 for the function "End data transfer" and confirm entry with the Q key.
- Switch off ignition.
- Fit a new throttle valve control unit
- Perform adaptation => Page 68 .

Display 0:

- Press the =>key.
- Press keys 0 and 6 for the function "End data transfer" and confirm entry with the Q key.
- Switch off ignition.
- Check voltage supply of throttle valve control unit and wiring to control unit => Page 78 .

If the voltage supply and wiring is OK:

- Fit a new engine control unit => Page 43 .

Checking operating condition

- Connect the fault reader V.A.G 1551 (V.A.G 1552). Start the engine and select the engine control unit with "Address word" 01.
(Connecting fault reader and selecting engine control unit => Page 2 .)

-> Display readout:

Rapid data transfer	HELP
Select function XX	

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

-> Display readout:

Read measured value block	HELP
Enter display group number XXX	

- Press keys 0, 9 and 8 for "Display Group 98" and confirm entry by pressing Q key.

-> Display readout:

(1...4 = display zones)

Read measured value block 98			
1	2	3	4

- Check throttle valve control unit operating condition in display zone 3.
Specification: 00000000



Relevance of figures in 8 digit number block for throttle valve control unit operating status:

x	x	x	x	x	x	x	x	"1" signifies:
0								Not allocated
	0							Not allocated
		0						Not allocated
			0					Not allocated
				1				A fault has occurred during the adaptation of the throttle valve (interrogate fault memory =>Page 4)
					1			No current supply to throttle valve control unit (signal ratio = 0)
						1		Adaptation interrupted due to the battery voltage being too low (below 8V).
							1	Idling switch open (switch position check)

If the specifications are not obtained:

- Adapt the engine control unit to the throttle valve control unit => Page 68 .
- Repeat check.

If the specifications are still not attained:

- Check voltage supply of throttle valve control unit and wiring to control unit => Page 78 .

Checking throttle valve potentiometer

Test conditions

- Coolant temperature at least 80 °C
- Connect the fault reader V.A.G 1551 (V.A.G 1552). Then switch ignition on and select engine control unit with the "Address word" 01.
(Connecting fault reader and selecting engine control unit => Page 2 .)

-> Display readout:

Rapid data transfer HELP
Select function XX

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

-> Display readout:

Read measured value block HELP
Enter display group number XXX

- Press keys 0, 0 and 1 for "Display Group 1" and confirm entry by pressing Q. key.

-> Display readout:

(1...4 = display zones)

Read measured value block 1
1 2 3 4

- Check whether the coolant temperature is above 80 °C in display zone 2.
- Change to display group 3 as follows:
- Press C key.

-> Display readout:

Read measured value block HELP
Enter display group number XXX

- Press keys 0, 0 and 3 for "Display Group 3" and confirm entry by pressing Q.

-> Display readout:
(1...4 = display zones)

Read measured value block 3
1 2 3 4

- Read off throttle valve angle in display zone 3.
Specification: 1,9...5,7 <°
- Slowly open throttle valve and watch angle display in display zone 3.
The figure must increase uniformly over the complete range.
- Press the =>key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Switch off ignition.

If the figure does not increase uniformly:

- Fit a new throttle valve control unit
- Perform adaptation => Page 68 .

If the display remains constant:

- Check voltage supply of throttle valve control unit and wiring to control unit => Page 78 .

Checking throttle valve positioner and throttle valve positioner potentiometer

Test conditions

- Coolant temperature at least 80 °C.
- Connect the fault reader V.A.G 1551 (V.A.G 1552). Start the engine and select the engine control unit with "Address word" 01.
(Connecting fault reader and selecting engine control unit => Page 2 .)

-> Display readout:

Rapid data transfer HELP
Select function XX

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

-> Display readout:

Read measured value block HELP
Enter display group number XXX

- Press keys 0, 0 and 1 for "Display Group 1" and confirm entry by pressing Q.

-> Display readout:
(1...4 = display zones)

Read measured value block 1
1 2 3 4

- Check whether the coolant temperature is above 80 °C in display zone 2.
- Change to display group 98 as follows:
- Press C key.

-> Display readout:

Read measured value block HELP
Enter display group number XXX

- Press keys 0, 9 and 8 for "Display Group 98" and confirm entry by pressing Q.

-> Display readout:

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(1...4 = display zones)

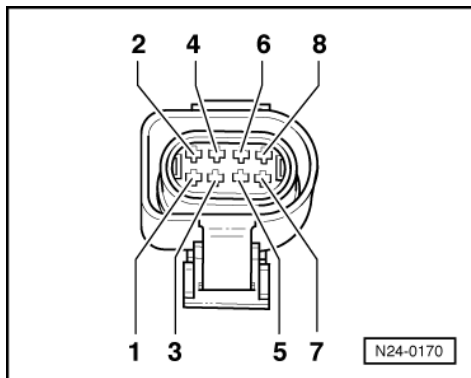
Read measured value block 98
1 2 3 4

- Check the voltage value of the throttle valve positioner potentiometer in display zone 2.
Specification: 2.28...4.75 V

If the specification is not attained:

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

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- Remove the intake hose.
- ➔ Pull 8-pin connector off throttle valve control unit.
- Measure resistance of throttle valve positioner between following contacts:
Vehicles with CCS1): Contacts 7 + 8
Vehicles without CCS1): Contacts 1 + 2
Specification: 3...200 ω

1) CCS = cruise control system

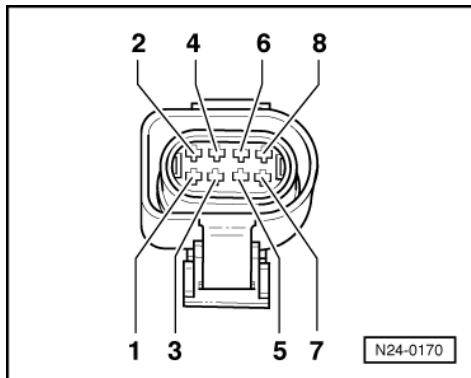
If the specification is not attained:

- Fit a new throttle valve control unit
- Perform adaptation => Page 68 .

If the specification is attained:

- Check voltage supply of throttle valve control unit and wiring to control unit => Page 78 .

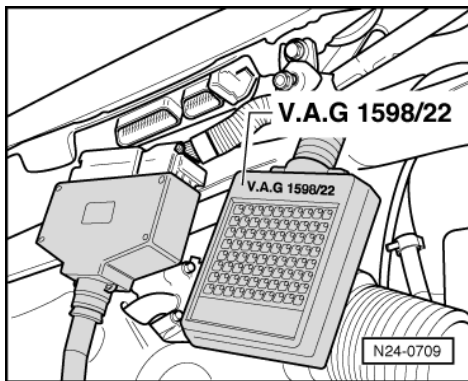
Checking voltage supply and wiring to control unit



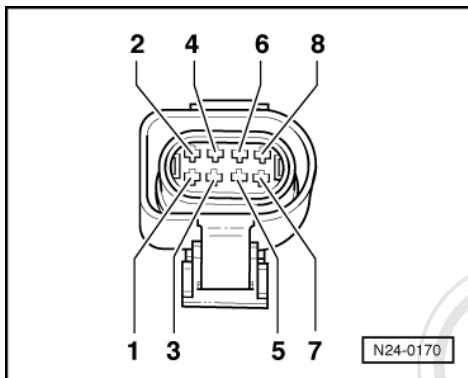
- ➔ Pull 8-pin connector off throttle valve control unit.
- Connect multimeter to measure voltage at following connector contacts:
Vehicles with CCS1): Contacts 2 + 5

Vehicles without CCS1): Contacts 4 + 7

- 1) CCS = cruise control system
- Switch the ignition on.
Specification: at least 4.5 V
 - Switch off ignition.
 - Connect multimeter to measure voltage at following connector contacts:
Vehicles with CCS1): Contacts 2 + 6
Vehicles without CCS1): Contacts 3 + 7
-
- 1) CCS = cruise control system
- Switch the ignition on.
Specification: at least 9 V
 - Switch off ignition.



- -> Connect test box V.A.G 1598/22 to wiring harness for control unit.



- -> Check wiring between test box and connector for open circuit using current flow diagram.

Vehicles fitted with cruise control system:

Contact 1+socket 74
 Contact 2+socket 70
 Contact 4+socket 75
 Contact 5+socket 62
 Contact 6+socket 69
 Contact 7+socket 59
 Contact 8+socket 66

Wire resistance: max. 1.5 ω

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Vehicles without cruise control system:

Contact 1+socket 66
 Contact 2+socket 59
 Contact 3+socket 69

Contact 4+socket 62
Contact 5+socket 75
Contact 7+socket 70
Contact 8+socket 74
Wire resistance: max. 1.5 ω

- Additionally check wires for short to one another.
Specification: infinite resistance.

If no wiring fault is detected:

- Test the power supply to the engine control unit => Page 105 .

5 - Testing intake manifold changeover function

5.1 - Testing intake manifold changeover function

This test should only be carried out if the engine is losing power.

The operation of the intake manifold changeover valve is dependent on the engine load and engine speed.

5.2 - Testing operation

- Run engine at idling speed for 2 or 3 minutes (to build up a vacuum).
- With car stationary and ignition switched on, start final control diagnosis and select intake manifold changeover valve -N156 =>Page 18 .

The vacuum unit for the intake manifold changeover valve should pull and release alternately.

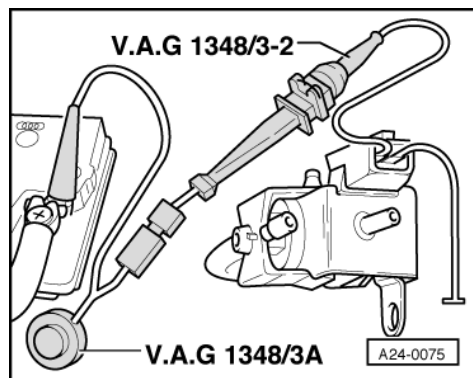
If the changeover is not taking place, carry out the following tests:

- Test intake manifold changeover valve -N156 (perform final control diagnosis => Page 82).
- Make sure that vacuum hoses are properly connected and free of blockages and leaks.
- Make sure that the changeover mechanism can move freely (actuate linkage by hand).

5.3 - Testing vacuum system

- Run engine at idling speed for 2 or 3 minutes (to build up a vacuum).

Note:



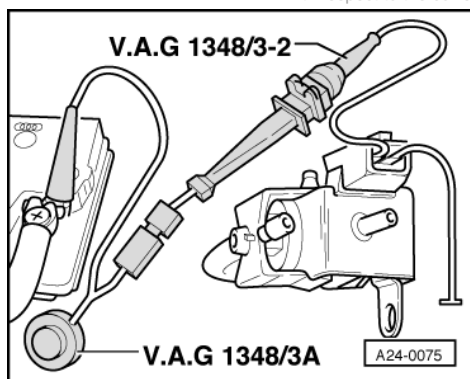
The vacuum reservoir is part of the intake manifold and cannot be renewed separately.

- Switch off ignition.
- Unplug 2-pin connector from intake manifold changeover valve.
- -> Connect one of the contacts on solenoid valve to engine earth using test cable and crocodile clamp from V.A.G 1594.
- Connect second contact on solenoid valve to positive via remote control V.A.G 1348/3A using adapter lead V.A.G 1348/3-2 and auxiliary cable.
- Operate remote control V.A.G 1348/3A approx. 2 to 3 minutes, during this time the vacuum unit should remain in the pulled in position.

If the vacuum unit returns to rest position, test the vacuum unit as follows:

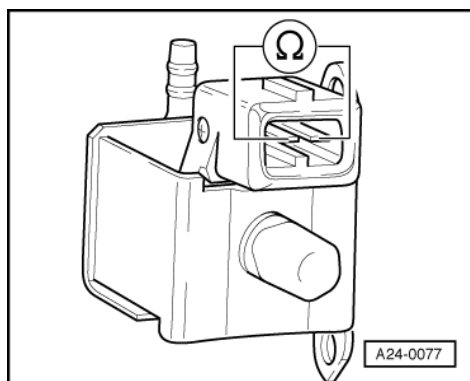
- Disconnect vacuum hoses from vacuum unit for intake manifold changeover valve.
- Connect hand pump V.A.G 1390 to vacuum unit.
- Operate hand pump and observe changeover action.
- Test vacuum unit for leaks. (The vacuum unit should not return to rest position until the hand pump is vented to atmosphere.)
- If necessary, fit a new vacuum unit.

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- If the vacuum unit does not pull, check to ensure clear passage through -N156 as follows:
- -> Connect one of the contacts on -N156 to engine earth using test cables and crocodile clip from V.A.G 1594.
- Connect second contact on -N156 to positive via remote control V.A.G 1348/3A using adapter lead V.A.G 1348/3-2 and auxiliary cable.
- Operate remote control V.A.G 1348/3A.
- Check to ensure clear passage through valve (disconnect vacuum hoses and blow through).
- If necessary, fit a new intake manifold changeover valve.

5.4 - Testing intake manifold changeover valve

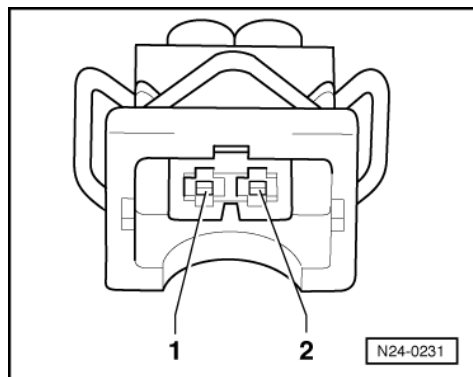


Electrical test of intake manifold changeover valve -N156

Fitting location =>Page 40 .

- Unplug connector on intake manifold changeover valve.
- -> Measure resistance at intake manifold changeover valve.
- Specification: 25 ... 35 ohm.

If the value is not as specified, fit a new valve.

**Testing power supply to intake manifold changeover valve -N156**

- -> Unplug connector on intake manifold changeover valve.
- Connect diode test lamp V.A.G 1527 between engine earth and contact 1 (positive) on connector using cables from adapter set V.A.G 1594.
- Operate starter briefly (the engine can be allowed to start).

Specification: The diode test lamp should light up.

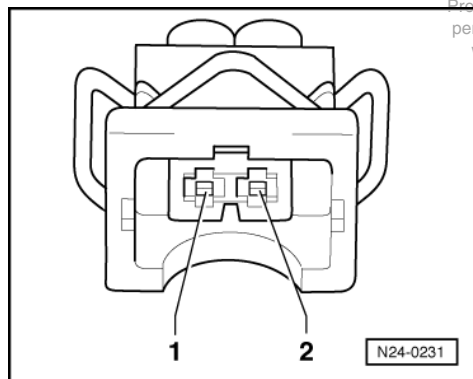
If the diode test lamp does not light up, carry out the following tests:

- Test fuse for -N156.
- Test for open circuit in wiring between fuse and contact 1 on connector for intake manifold changeover valve using current flow diagram.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

Specification: max. 1 ohm

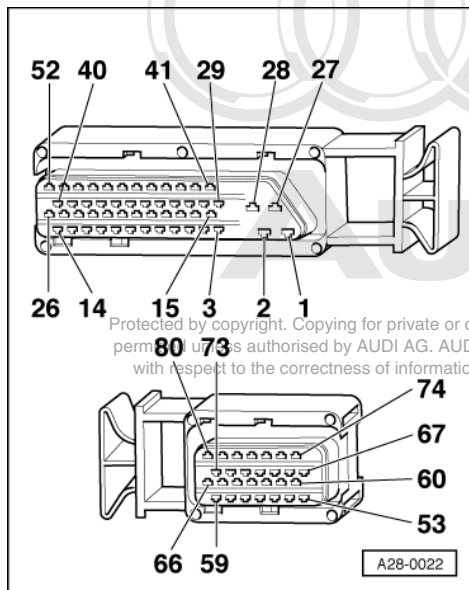
- Test fuel pump relay and activation
- =>Page 52 .

5.5 - Testing activation of intake manifold changeover valve

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- -> Connect diode test lamp V.A.G 1527 between contacts 1 (positive) and 2 (activation signal from engine control unit) on connector for intake manifold changeover valve using cables from adapter set V.A.G 1594.
- Start final control diagnosis =>Page 18 . The diode test lamp should flash when the intake manifold changeover valve is being activated.
- If the diode test lamp does not flash or lights up continuously, connect test box V.A.G 1598/22 to wiring harness for engine control unit
=>Page 43 .
- If the diode test lamp lights up continuously, test for short to earth in wiring between contact 2 on connector for intake manifold changeover valve and socket 64 on test box.
- If the diode test lamp does not flash, test for open circuit or short to positive in wiring between contact 2 on connector for intake manifold changeover valve and socket 64 on test box.

Specification: max. 1 ohm.



- -> If necessary, rectify short circuit to earth or open circuit.
- If no short circuit or open circuit is found, fit a new engine control unit.
=>Page 43 .

6 - Testing auxiliary signals

6.1 - Testing auxiliary signals

6.2 - Testing air conditioner compressor shut-off

Notes:

- ◆ The air conditioner compressor signal from the operating and display unit informs the engine control unit that the compressor is due to cut in shortly.
- ◆ The engine control unit can send a signal via the same wire to shut off the air conditioner compressor.
- ◆ On vehicles with manual gearbox the air conditioner compressor is shut off at full throttle in first gear.
- ◆ On vehicles with automatic gearbox there is no air conditioner compressor shut-off.

Test conditions

- Air conditioner functioning properly
- No faults recorded in fault memory of engine control unit



- Interior temperature of more than +15 °C
- Connect fault reader V.A.G 1551 => Page **2**.
- Start the engine.
- Select "Read measured value block" (function 08) and Display Group 19.
- Switch off air conditioner.

-> Display readout:

Read measured value block 19			
X	X	0	0

Display zone 3 should read "0" (air conditioner operating status).

Display zone 4 should read "0" (air conditioner compressor).

- Switch on air conditioner by pressing "Auto" key and selecting the lowest temperature. The air conditioner compressor should run.

-> Display readout:

Read measured value block 19			
X	X	1	1

Display zone 3 should read "1" (air conditioner operating status).

Display zone 4 should read "1" (air conditioner compressor).

- Take vehicle for a test drive in first gear (press down sharply on accelerator at low engine speed).

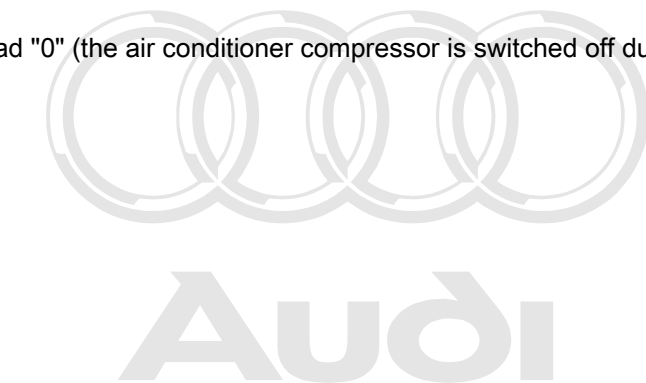
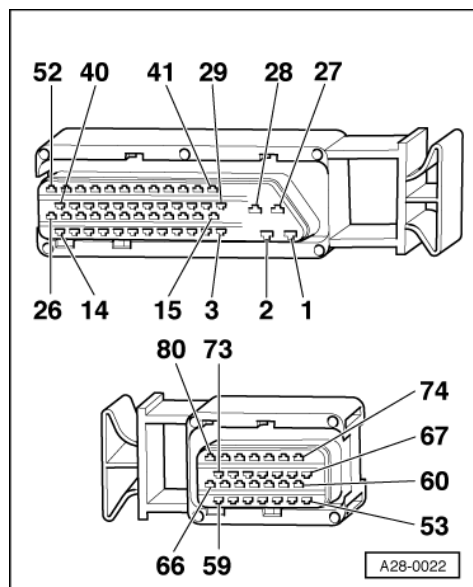
Important!

The V.A.G 1551 must be operated by a second person.

-> Display readout:

Read measured value block 19			
X	X	1	0

When accelerating, display zone 4 should read "0" (the air conditioner compressor is switched off during acceleration).



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- -> If the readouts are not as specified, switch off the engine and connect test box V.A.G 1598/22 to wiring harness for engine control unit => Page **43**.

- Using current flow diagram, test for open circuit and short to earth or positive in wiring between air conditioner operating and display unit (E87) and contact 8 on engine control unit.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- If there are no faults in the wiring, test operation of air conditioner operating and display unit (-E87).

=> Air conditioner; Repair Group 01; Self-diagnosis for air conditioner Self-diagnosis for air conditioner

6.3 - Testing engine speed adaptation when air conditioner cuts in

Notes:

- ♦ When the air conditioner is switched on a positive signal is sent to contact 10 on the engine control unit.
- ♦ The signal causes the engine control unit to maintain a constant idling speed despite the varying power requirement of the air conditioner.

Test conditions

- Air conditioner functioning properly
- No faults recorded in air conditioner fault memory
- Interior temperature of more than +15 °C
- Connect fault reader V.A.G 1551 => Page 2.
- Start the engine (operating temperature).
- Switch off rear window heating.
- Select "Read measured value block" (function 08) and Display Group 19.

-> Display readout:

Read measured value block 19			
1	2	3	4

Display zone 1: Idling speed

Display zone 3: Signal from air conditioner

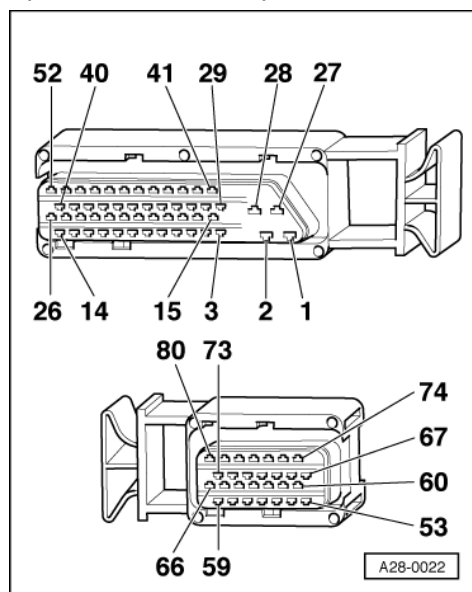
Display zone 4: Air conditioner compressor operating status

- Switch on air conditioner by pressing "Auto" key and selecting the lowest temperature. The air conditioner compressor should run.

Display zone 3 should read "1".

Display zone 4 should read "1" (air conditioner compressor on).

Apart from a brief drop in revs, the idling speed should remain constant.





- -> If the readouts are not as specified, switch off the engine and connect test box V.A.G 1598/22 to wiring harness for engine control unit => Page 43 .
- Test for short or open circuit in wiring between contact 10 on engine control unit and air conditioner operating and display unit E87 using current flow diagram.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- If there are no wiring faults, test the operation of the air conditioner operating and display unit.

=> Air conditioner; Repair Group 01; Self-diagnosis for air conditioner Self-diagnosis for air conditioner

6.4 - Checking selector lever position on automatic gearbox

Notes:

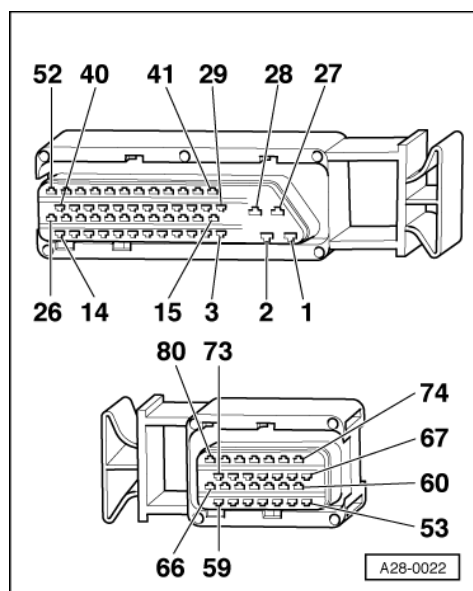
- ♦ The relay for the starter inhibitor and reversing lights -J226 informs the engine control unit whether a gear is engaged (selector lever in position 1, 2, 3, R or D) or not (selector lever in position P or N).
- ♦ When the selector lever is in position P or N the relay for the starter inhibitor and reversing lights -J226 makes an earth connection to contact 22 on the engine control unit.
- Connect fault reader V.A.G 1551 => Page 2 .
- Switch the ignition on.
- Select "Read measured value block" (function 08) and Display Group 19.

-> Display readout:

Read measured value block 19			
1	2	3	4

Display zone 2 should read "0" (selector lever in position P or N).

- Operate the footbrake and engage a gear.



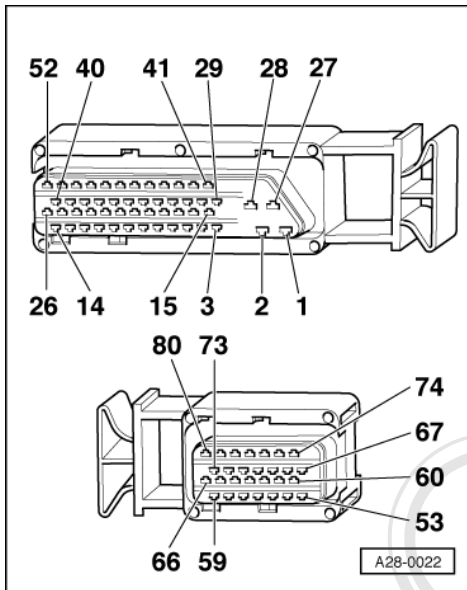
Display zone 2 should read "1".

- -> If the readouts are not as specified, connect test box V.A.G 1598/22 to wiring harness for engine control unit => Page 43 .
- Connect diode test lamp between socket 3 (terminal 30) and socket 22.



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- The diode test lamp should go out when a gear is engaged.



- -> If the diode test lamp lights up continuously or does not light up at all, test for open circuit or short to positive or earth in wiring between contact 22 on engine control unit and relay for starter inhibitor and reversing lights -J226.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

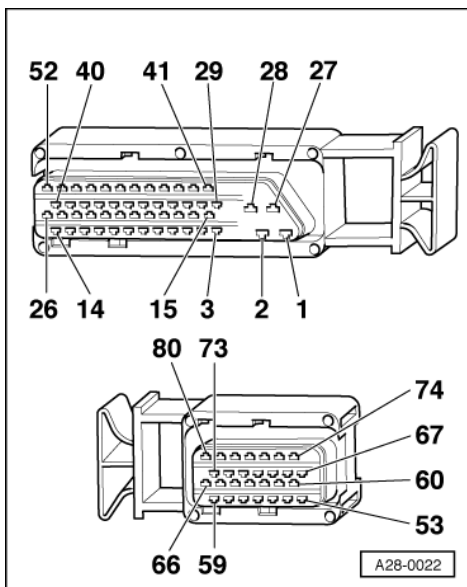
- If there are no faults in the wiring, test the multi-function switch.

=> Automatic gearbox 01M; Repair Group 01; Gearbox: Electrical test Gearbox: Electrical test

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6.5 - Testing starter signal

Notes:



- ♦ The starter signal (terminal 50, from ignition switch) goes to the same input on the engine control unit as the P/N signal.

- ♦ As soon as the engine control unit detects the starter signal the fuel pump relay is switched on.
- On vehicles with an automatic gearbox: unplug relay for starter inhibitor and reversing lights -J226.
- -> Connect test box V.A.G 1598/22 to wiring harness for control unit.
- Connect multimeter V.A.G 1526 (voltage range) between sockets 2 (earth) and 22 (terminal 50).
- Operate starter. Multimeter should read at least. 8 V

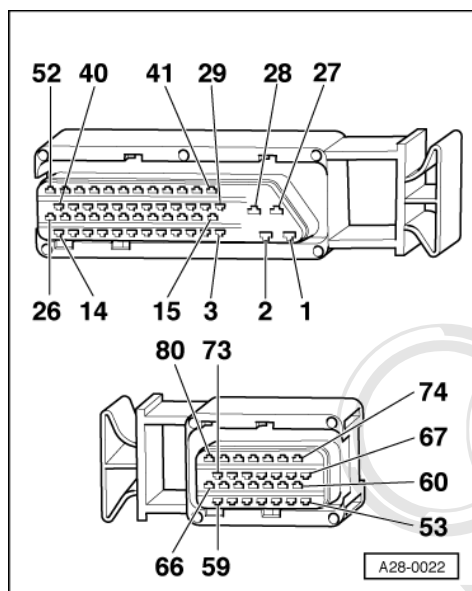
If the specification is not attained:

- Test wiring to ignition switch (terminal 50) using current flow diagram.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

6.6 - Testing engine speed signal

Note:



The engine speed signal is taken from contact 6 on the engine control unit. The signal is used by the automatic gearbox control unit to calculate the gearshift intervals and is also required for other functions, including the rev counter display on the dash panel insert.

- -> Connect test box V.A.G 1598/22 to wiring harness for engine control unit
- =>Page 43 .
- Test for open circuit in wiring between dash panel insert and contact 6 on the test box, using current flow diagram.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

6.7 - Testing throttle valve position

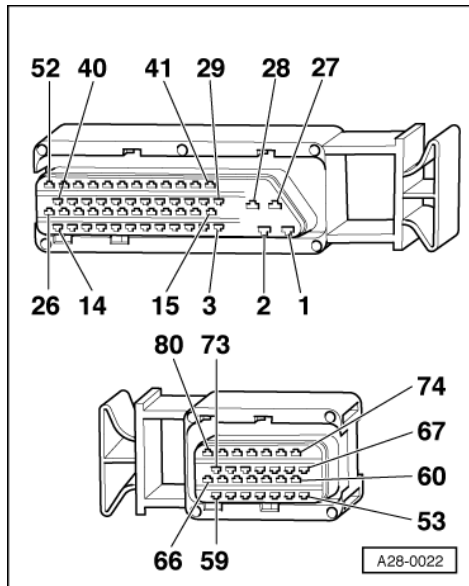
Notes:

- ♦ In conjunction with the engine speed signal this signal enables the automatic gearbox control unit to calculate the gearshift intervals.

- ♦ The signal is a square wave signal and is taken from contact 7 on the engine control unit.
- Connect fault reader V.A.G 1551 => Page 2.
- Start self-diagnosis on gearbox control unit.

=> Automatic gearbox 01M; Repair Group 01; Self-diagnosis Self-diagnosis

- If the gearbox control unit displays fault 00638 "Engine/gearbox electrical connection 2", interrogate fault memory of engine control unit => Page 4.
- If the engine control unit has recorded a fault relating to the throttle valve potentiometer, rectify this fault first. (In this case the fault in the gearbox is a result of the fault in the potentiometer.)



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- -> If no fault relating to the throttle valve potentiometer is displayed, connect test box V.A.G 1598/22 to wiring harness for engine control unit => Page 43.
- Test for short or open circuit in wiring between gearbox control unit and contact 7 on engine control unit connector.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

6.8 - Testing road speed signal

Notes:

- ♦ The road speed signal is generated by the road speed sender -G68 (on the gearbox) and is processed in the dash panel insert.
- ♦ The processed signal goes to contact 20 on the engine control unit and is used for idling speed stabilisation and for the damping of load change jolts when changing gear.
- Connect fault reader V.A.G 1551 => Page 2.
- Switch the ignition on.
- Select "Read measured value block" (function 08) and Display Group 2.

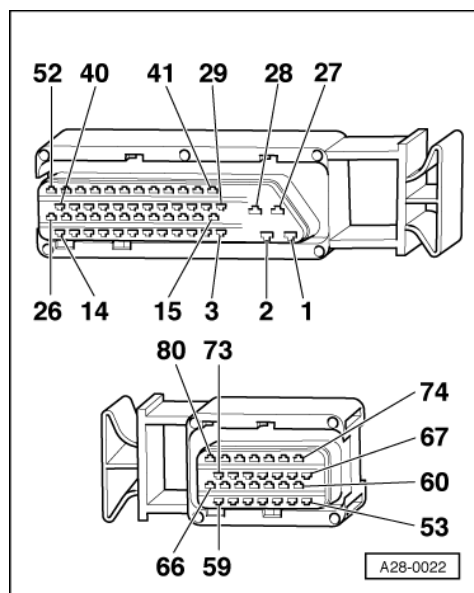
-> Display readout:

Read measured value block 2			
1	2	3	4

- Take vehicle for a test drive and check whether the road speed appears in display zone 3.



- If the road speed does not appear, raise the vehicle (preferably using a lifting platform) until the front left wheel is clear of the ground.



- -> Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=>Page 43 .
- Connect diode test lamp between socket 3 (positive) and socket 20 (road speed signal).
- Switch on the ignition and turn the front left wheel by hand.
- The diode test lamp should flash (very brief flashes).

Note:

If necessary, hold the front right wheel to prevent it from turning.

- If the diode test lamp does not flash, test for open circuit and short circuit in wiring between dash panel insert and contact 20 on connector for engine control unit.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

6.9 - Testing gearshift signal when changing gear

Notes:

- ♦ This signal is produced by the automatic gearbox control unit during a gearshift. The signal enables the ignition timing to be briefly retarded by varying amounts (torque reduction) depending on the road speed and engine speed. This smoothes out the slight jerk as the gear engages.
 - ♦ The signal is a square wave signal which is fed to contact 23 on the engine control unit.
 - ♦ Because the signal is very brief the V.A.G. 1551 does not always recognise the command to retard the ignition timing.
- Connect fault reader V.A.G 1551 => Page 2 .
 - Take the vehicle for a test drive and select "Read measured value block" (function 08) and Display Group 1=> Page 29 .

Important!

The V.A.G 1551 must be operated by a second person.

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-> Display readout:

Read measured value block 1			
1	2	3	X1XXXXX

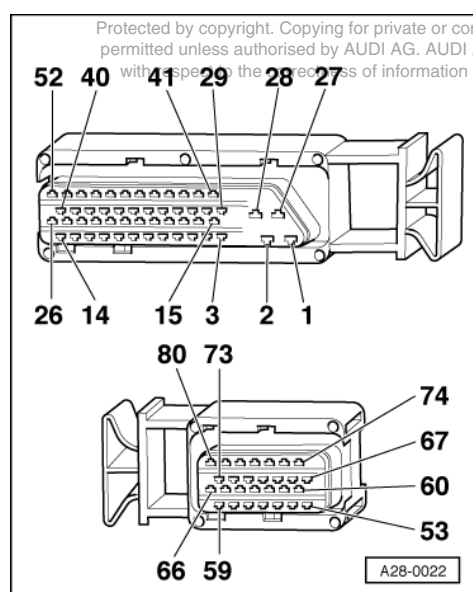
Specification: X 0 X X X X X = no gearshift

Specification: X 1 X X X X X = gearshift

Value: X = no meaning

Note:

When the gearbox control unit gives the command for the ignition timing to be retarded the readout will change briefly from "0" to "1".



- The wiring connection to the gearbox control unit is monitored by the gearbox self-diagnosis (fault code 00545).
- -> If no torque reduction is displayed on the measured value block during a gearshift, or if fault code 00545 appears (on the gearbox control unit), connect test box V.A.G 1598/22 to the wiring harness for the engine control unit => Page 43 .
- Test for open circuits or short circuits in the wiring between the gearbox control unit and contact 23 on the engine control unit.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

6.10 - Testing signal from clutch pedal switch

Note:

The signal from the clutch pedal switch (F36) is used to prevent excessive revs and load change jolts when operating the clutch. This signal is also required for the operation of the cruise control system.

- Connect the fault reader V.A.G 1551 (V.A.G 1552). Start the engine and select the engine control unit with "Address word" 01.
(Connecting fault reader and selecting engine control unit => Page 2 .)

-> Display readout:

Rapid data transfer HELP
Select function XX

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

-> Display readout:

Read measured value block HELP
Enter display group number XXX

- Press keys 0, 1 and 9 for "Display Group 19" and confirm entry by pressing Q.

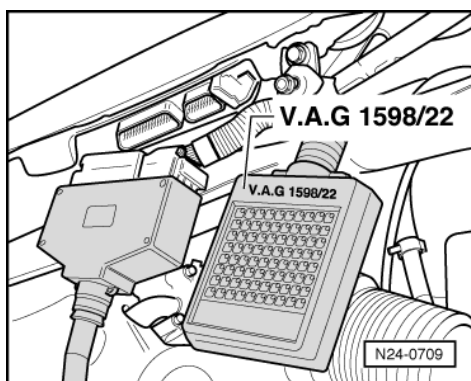
-> Display readout:

Read measured value block 19
1 2 3 4

- Observe display in display zone 4. (3rd position from right)
Specification: x x x x 0 x x
- Fully depress clutch pedal and observe the display in display zone 4.
Specification: x x x x 1 x x
- Press the ➡-key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Switch off ignition.

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If the specification is not attained:



- -> Connect test box V.A.G 1598/22 to wiring harness for control unit.
- Check wiring between test box and 2-pin connector for open circuit using current flow diagram.
Contact 2+socket 21
Wire resistance: max. 1.5 ω .

If the specification is attained:

- Check wiring between contact 1 of 2-pin connector and fuse for open circuit using current flow diagram.
Wire resistance: max. 1.5 ω .

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- If the wiring and the fuse are both OK, test the setting of or renew the clutch pedal switch (F36).

6.11 - Testing signal from power steering pressure switch

Note:

The signal from the power steering pressure switch (F88) is used to stabilise the idling speed of the engine when the steering wheel is turned to full lock (left or right).

- Connect the fault reader V.A.G 1551 (V.A.G 1552). Start the engine and select the engine control unit with "Address word" 01.
(Connecting fault reader and selecting engine control unit => Page 2.)

-> Display readout:

Rapid data transfer HELP
Select function XX

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

-> Display readout:

Read measured value block HELP
Enter display group number XXX

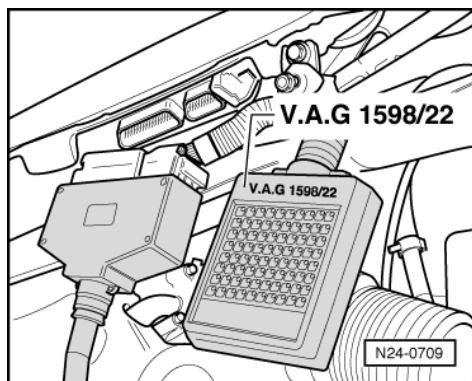
- Press keys 0,1 and 9 for "Display Group 19" and confirm entry by pressing Q.

-> Display readout:

Read measured value block 19
1 2 3 4

- Observe figure displayed in display zone 4:
Specification: x x x x x 0 x
- Turn the steering wheel to full lock and observe the display in display zone 4 (2nd position from right) .
Specification: x x x x x 1 x
- Press the ➡-key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Switch off ignition.

If the specification is not attained:



- -> Connect test box V.A.G 1598/22 to wiring harness for control unit.
- Check wiring between test box and 2-pin connector for open circuit using current flow diagram.
Contact 1+socket 24
Contact 2+socket 14
Wire resistance: max. 1.5 ω .
- Additionally check all wires for short to one another.
Specification: infinite resistance.

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If no wiring fault is detected:

- Connect multimeter V.A.G 1526 (resistance measurement range) to the contacts of the pressure switch:
- Start the engine and run at idling speed.

The multimeter should display infinite resistance (pressure switch is open).

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

The multimeter should display a resistance value of less than 1.5 ohm.

If the specifications are not attained:

- Renew power steering pressure switch:

=> Running gear, Axles, Steering; Repair Group 48; Vane pump, Reservoir, Hydraulic pipes Vane pump, Reservoir, Hydraulic pipes

6.12 - Testing data exchange between engine/ABS/gearbox control unit

Notes:

Data is exchanged between individual control units by means of a bus system.

"Bus" is used to describe a system that transports and distributes data.

The wires between the control units that are used to transfer the data are known as signal wires.

These signal wires are used for serial transmission of data, i.e. data is sent to each of the connected control units in turn.

Testing the bus system

The fault table includes instructions to test the data exchange between engine control unit, gearbox control unit and ABS control unit.

- Interrogate the fault memory of the gearbox control unit.

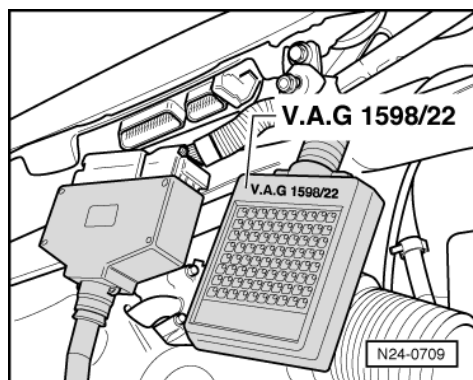
=> Automatic Gearbox; Repair Group 01; Performing self-diagnosis Performing self-diagnosis

- Interrogate the fault memory of the ABS control unit.

=> Running gear FWD and 4WD; Repair Group 01; Self-diagnosis; Electrical tests Self-diagnosis Electrical tests

If a fault is displayed relating to "Databus..." or "...communication":

- Switch off ignition.



- -> Connect test box V.A.G 1598/22 to wiring harness for control unit.
- Check the signal wires between pin 29 and pin 31 of the engine control unit and the gearbox control unit (if fitted) and the ABS control unit for short or open circuit using the current flow diagram .

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- If the wiring is OK, try installing a new engine/gearbox/ABS control unit in turn.

28 - Ignition system

1 - Testing ignition system

1.1 - Testing ignition system

1.2 - Safety precautions

Important!

Fuel system is pressurised. Before loosening hose connections or opening the test connection, place a cloth around the connection. Then release pressure by carefully pulling off the hose or cap.

To prevent injuries to persons and/or damage to the fuel injection and ignition system, the following must be noted:

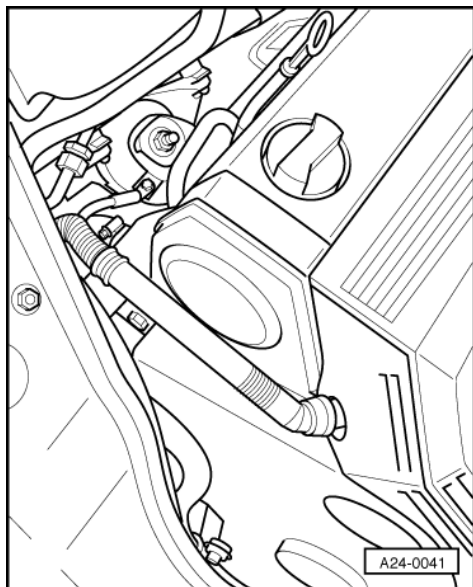
- ◆ Do not touch or disconnect ignition wiring when the engine is running or being turned at starter speed.
- ◆ Always switch off the ignition before connecting or disconnecting injection or ignition system wiring or tester cables.
- ◆ In order to run the engine at starting speed without actually starting it (e.g. to test compression pressure), unplug the connectors from the output stage of the ignition coils and from all the injectors. After completing the work, interrogate the fault memory and erase it.
- ◆ Always switch off the ignition before cleaning the engine.
- ◆ Always switch off the ignition before connecting or disconnecting the battery, otherwise the engine control unit may be damaged.

1.3 - Technical data for ignition system

Engine code letters	AEH, AKL
Idling speed Not adjustable - controlled by the idling speed stabilisation	760...880 rpm
Engine speed limiter - shuts off injectors	approx. 6350 rpm
Ignition timing is determined by the control unit. Ignition timing cannot be adjusted.	
Ignition system	Twin spark ignition system with two ignition coils
Spark plugs	Manufacturer's code ¹⁾ : BKUR 6 ET-10 (NGK) Part No. 1): 101 000 033 AA (NGK) Tightening torque 30 Nm
Spark plug connectors	Resistance approx. 5 kw
Firing order	1-3-4-2

1) For current values see Exhaust Emissions Test Binder

1.4 - Identification of ignition connections on ignition coil



- -> The illustration shows the ignition coil with the HT connections. You can use it to check whether the ignition cables are connected to the ignition coil in the correct sequence. It is also designed to prevent new ignition cables being incorrectly connected if old ones need to be replaced.

Ignition output "A" on ignition coil => cylinder 1

Ignition output "B" on ignition coil => cylinder 2

Ignition output "C" on ignition coil => cylinder 3

Ignition output "D" on ignition coil => cylinder 4

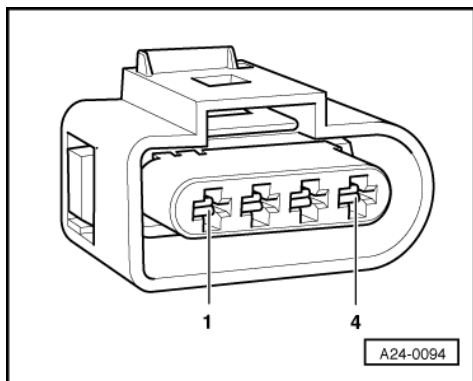
1.5 - Testing twin-spark ignition system with two ignition coils

Fitting location => Page 40 .

Note:

The ignition coils and output stage are combined as a single component and cannot be renewed separately.

- Unplug 4-pin connector from ignition coils.



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Testing earth connection to output stage

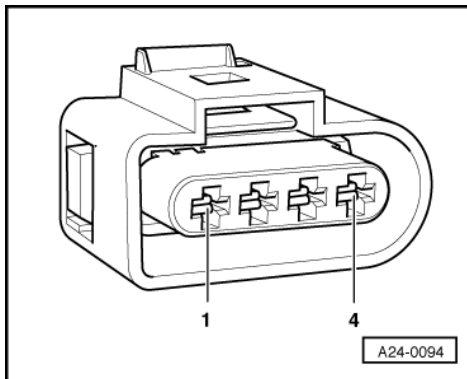
- -> Connect diode test lamp V.A.G 1527 between battery positive terminal and contact 4 (earth) of the connector. The diode test lamp should light up.
- If the diode test lamp does not light up, test wiring using current flow diagram and rectify any open circuits.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

Testing power supply to ignition coils

Test requirements:

- Fuse for ignition coils OK.
- **Unplug 4-pin connector from ignition coils.**
- **Switch the ignition on.**



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

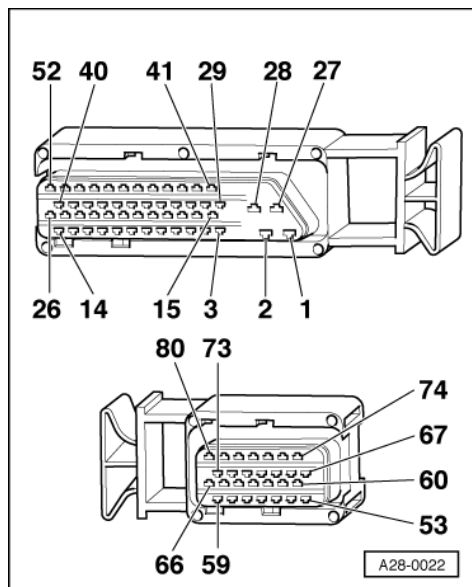
Specification: The diode test lamp should light up.

- If the result is not as specified, test wiring using current flow diagram. Rectify any faults and if necessary replace the fuse.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

Testing activation

- Unplug the connectors from all four injectors (to prevent injection from occurring without ignition).
- Switch the ignition on.
- Connect diode test lamp V.A.G 1527 between engine earth and contact 1 of the 4-pin connector for the ignition coil.
- Operate the starter for a few seconds. The diode test lamp should flash.
- Connect diode test lamp V.A.G 1527 between engine earth and contact 3 of the 4-pin connector for the ignition coil.



- Operate the starter for a few seconds. The diode test lamp should flash.
- -> If the diode test lamp does not flash, test for open circuit or short to positive or earth in wiring between engine control unit and 4 pin connector for ignition coil using current flow diagram. (Connect test box V.A.G 1598/22 to wiring harness for engine control unit.)
- Rectify short circuit or open circuit if necessary.

Contact on 4-pin connector for output stage	Contact on control unit connector
1	71
3	78

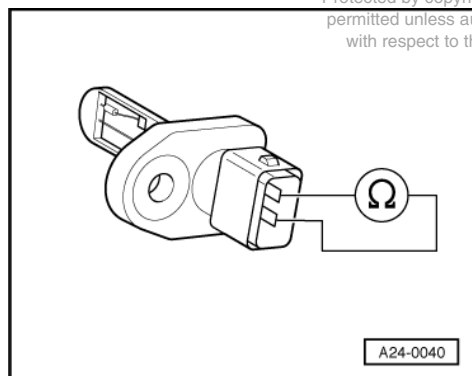
- If no open circuits or short circuits are found, fit a new engine control unit
=>Page 43 .
- If the ignition cables, the power supply to the ignition coils and the output stage activation are OK but there is still no ignition spark, fit new ignition coils with output stage.

1.6 - Testing intake air temperature sender (vehicles up to model year 1998)

Notes:

- ♦ For testing operation of intake air temperature sender, see also "Reading measured value block" Display Group 05, display zone 4.

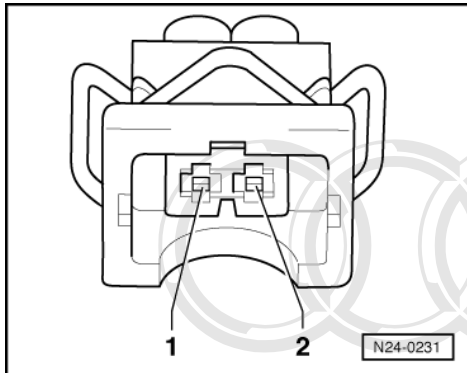
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- ♦ Fitting location of intake air temperature sender => Page 40 .

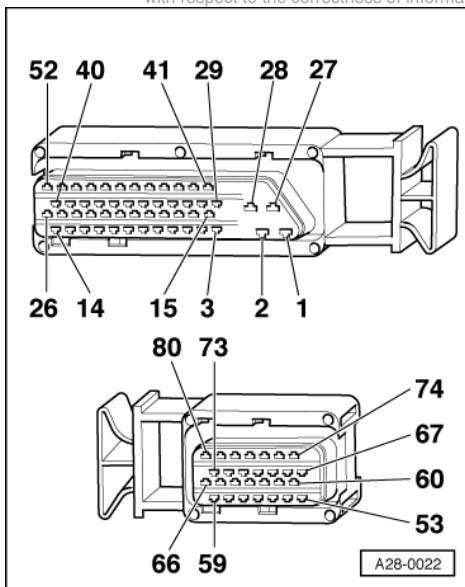
- ♦ Engine cooled to room temperature (approx. 20 °C).
- Unplug connector from intake air temperature sender.
- -> Connect ohmmeter to intake air temperature sender.

Temperature °C	Resistance kw
-20	approx. 13.8
0	approx. 5.5
20	approx. 2.4
40	approx. 1.1
60	approx. 0.6



- If the value does not match the specification, fit a new intake air temperature sender.
- If the value does match the specification, test the wiring between the sender connector and the engine control unit as follows:
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
 =>Page 43 .
- -> Test wiring between 2-pin connector for sender ...

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- -> ... and engine control unit for open circuit and short to positive or earth using current flow diagram.

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



- If no faults have been found in any of the above tests, fit a new engine control unit.
=>Page 43 .

1.7 - Testing intake air temperature sender (vehicles as of model year 1998)

Note:

From model year 1998 onwards the intake air temperature sender (G42) is integrated in the air mass meter. The sender is therefore no longer fitted as a separate engine component.

- Connect the fault reader V.A.G 1551 (V.A.G 1552). Then switch ignition on and select engine control unit with the "Address word" 01.
(Connecting fault reader and selecting engine control unit => Page 2 .)

-> Display readout:

Rapid data transfer HELP
Select function XX

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

-> Display readout:

Read measured value block HELP
Enter display group number XXX

- Press keys 0, 0 and 5 for "Display Group 5" and confirm entry by pressing Q.

-> Display readout:

(1...4 = display zones)

Read measured value block 5
1 2 3 4

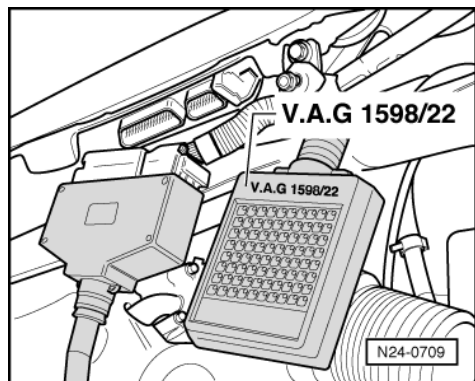
Functional check of sender

- Note intake air temperature figure in display zone 4.

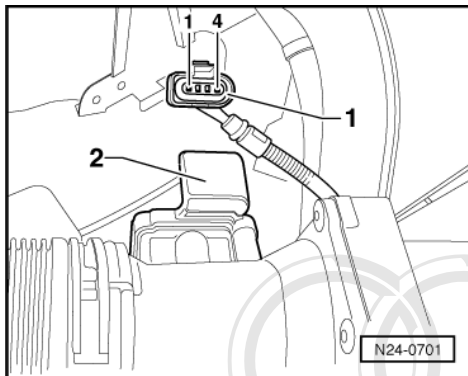
Display	Cause	Continuation of test
60°C	Open circuit or short to positive	=>Page 100 .
	Short circuit to earth	
approx. ambient temperature1)	---	=>Page 102 .

1) If a temperature is displayed which deviates greatly from the ambient temperature of the sender, check sender wiring for contact resistances.

Continuation of check:

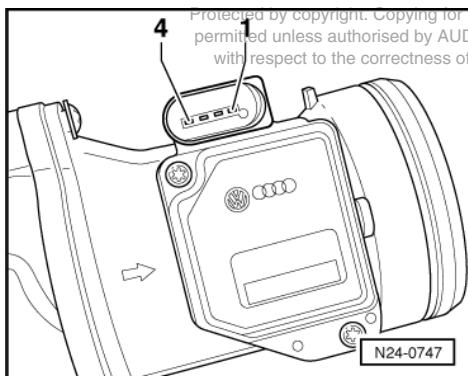


- Switch off ignition.
- -> Connect test box V.A.G 1598/22 to wiring harness for control unit.

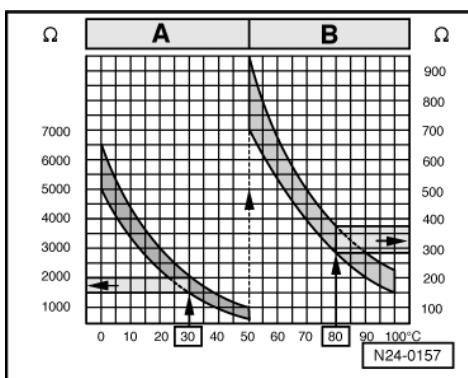


- -> Disconnect the 4-pin connector -1- from the air mass meter -2-.
- Check wiring between test box and 4 pin connector for open circuit using current flow diagram.
 Contact 2+socket 12
 Contact 4+socket 9
 Wire resistance: max. 1.5 ω
- Additionally check wires for short to one another.
 Specification: infinite resistance.

If no fault in wire is detected:



- -> Test resistance between contacts 2 and 4 of sender.



-> Scale A shows resistance values for temperature range 0...50 °C and scale B the values for temperature range 50...100 °C.

Examples:



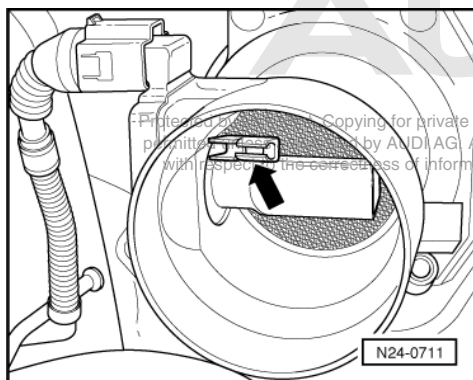
- ♦ 30 °C corresponds to a resistance of 1500...2000 Ω
- ♦ 80 °C corresponds to a resistance of 275...375 Ω

If the specification is not attained:

- Replace the air mass meter (G70) and the intake air temperature sender (G42).

Continuation of check if display = ambient temperature:

- Remove the intake hose between air mass meter and throttle valve control unit.
- Note intake air temperature value in display zone 4.



- -> Spray sender -arrow- with commercial chilling agent whilst observing the temperature value. The temperature value should decrease.
- Press the ➡-key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.

1.8 - Testing engine speed sender

Note:

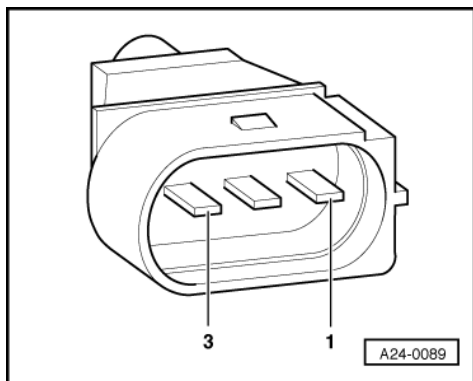
- ♦ The engine speed sender is a combined speed sender and reference mark sender.
- ♦ The engine can run without a signal from the -G28. It is also possible (with considerable difficulty) to start the engine without a signal from the -G28 (emergency running function).
- ♦ For testing the operation of the engine speed sender, see also "Reading measured value block", Display Group 03, display zone 1.

Testing engine speed sender

Fitting location of sender and connector

=> Page 40 .

- Before carrying out the test, make sure that the sender is correctly installed and firmly seated.
- Unplug connector for engine speed sender (grey connector).



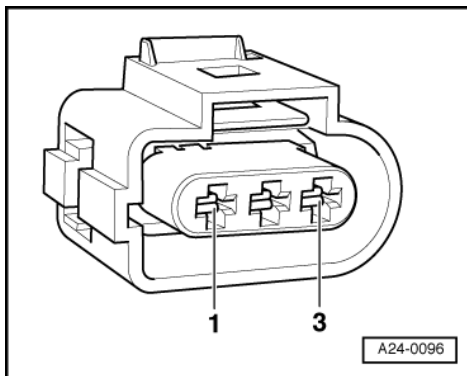
- -> Connect hand held multimeter V.A.G 1526 (resistance test range) to contacts 2 and 3 on connector for engine speed sender using test lead from V.A.G 1594.

Specification: approx. 450...1000 ω .

- If the value does not match the specification, fit a new engine speed sender.
- If the value does match the specification, connect hand held multimeter to contacts 2 and 1 (earth) and to contacts 3 and 1 (earth).

Specification: infinite resistance (open circuit) in each test.

- If the value does not match the specification, fit a new engine speed sender.
- If the value does match the specification, test the wiring between the sender connector and the engine control unit as follows:



- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=>Page 43 .
- -> Test continuity of screening from contact 1 on sender connector to socket 67 on test box.

Specification: max. 1 ω .

- Test continuity of earth wire from contact 2 on sender connector to socket 63 on test box.

Specification: max. 1 ω .

- Test continuity of signal wire from contact 3 on sender connector to socket 56 on test box.

Specification: max. 1 ω .

- If the values are not as specified, rectify short or open circuit in wiring between sender connector and control unit connector.

Contact on sender connector	Contact on control unit connector
1	67
2	63
3	56

- If no open circuits or short circuits are found, fit a new engine control unit =>Page 43 .

1.9 - Testing coolant temperature sender

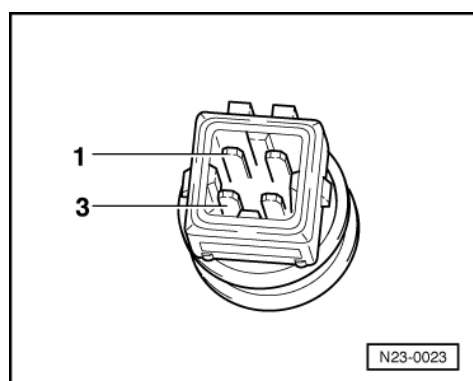
Notes:

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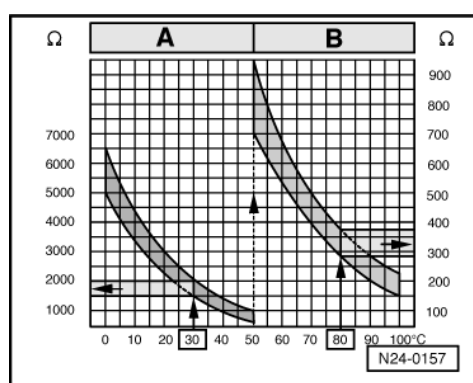
- ♦ For testing the operation of the coolant temperature sender, see also "Reading measured value block", Display Group 01, display zone 2.



- ♦ Fitting location of coolant temperature sender => Page 40 .



- Unplug connector on coolant temperature sender.
- -> Test resistance between contact 1 (earth) and contact 3 (signal) on sender.

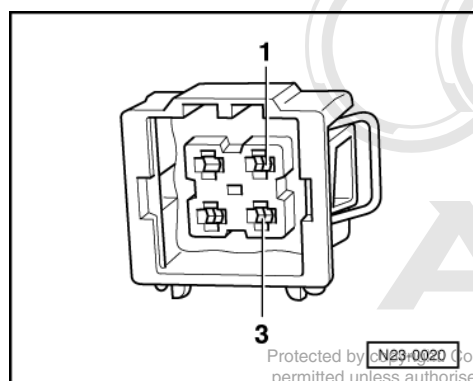


Scale A shows resistance values for temperature range 0...50 °C and scale B the values for temperature range 50...100°C.

Examples:

- ♦ 30 °C corresponds to a resistance of 1500...2000 ω
- ♦ 80 °C corresponds to a resistance of 275...375 ω
- If the value does not match the specification, fit a new sender.

If the value does match the specification, test the wiring between the sender and the engine control unit as follows:



- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=>Page 43 .

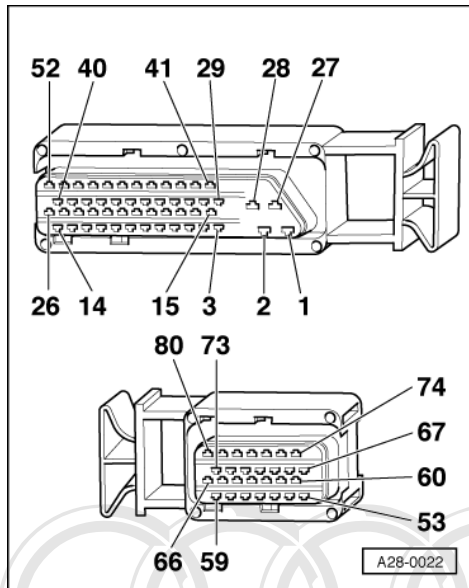
- -> Test for open circuit in earth wire between contact 1 on coolant temperature sender connector and socket 67 on test box.

Specification: max. 1 ω .

- Test for open circuits in signal wire between contact 3 on coolant temperature sender connector and socket 53 on test box.

Specification: max. 1 ω .

- Test for short circuits between the two wires.



- -> If values do not match specifications, rectify short circuits or open circuits in wiring between coolant temperature sender connector and control unit connector.

Contact on sender connector	Contact on control unit connector or test box
1	67
3	53

- If there are no short circuits or open circuits and the coolant temperature sender is OK, fit a new engine control unit. => Page 43.

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1.10 - Testing control unit voltage supply

Note:

For testing the power supply to the engine control unit, see also "Reading measured value block", Display Group 05, display zone 2.

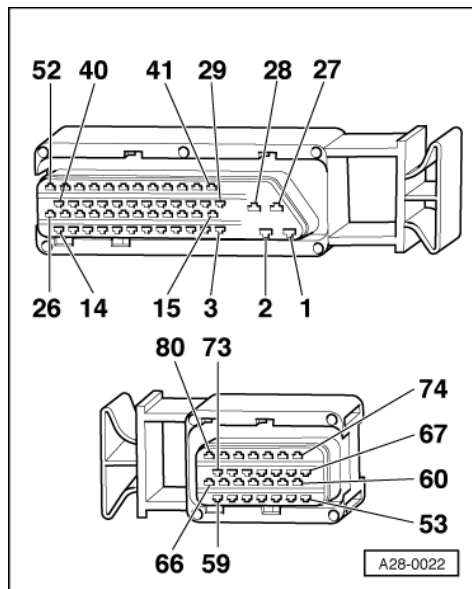
Test requirements:

- Fuse for engine control unit OK
- Battery voltage at least 11 V
- Alternator OK
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=>Page 43.



- Switch the ignition on.
- Connect diode test lamp V.A.G 1527 to socket 1 (positive supply via ignition switch) and earth.

The diode test lamp should light up.



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- -> If the diode test lamp does not light up, test for open circuit in wiring between fuse and contact 1 on control unit connector using current flow diagram. If necessary, rectify open circuit.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- If diode test lamp V.A.G 1527 does light up, connect diode test lamp between socket 1 on control unit connector (positive supply via ignition switch) and socket 2 on control unit connector (earth connection for engine control unit).

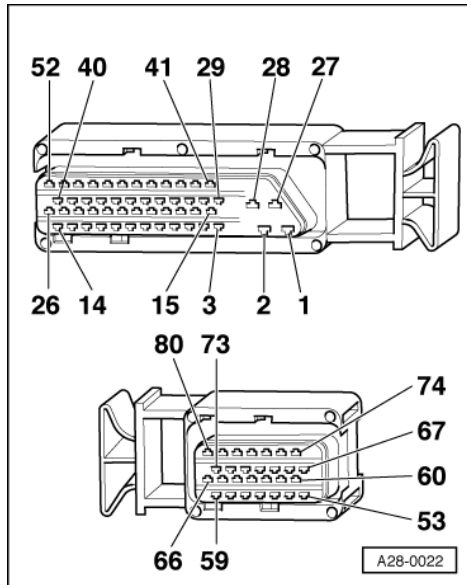
The diode test lamp should light up.

- -> If the diode test lamp does not light up, test for open circuit in wiring between earth and contact 2 on control unit connector. If necessary, rectify open circuit.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

- Connect diode test lamp V.A.G 1527 to socket 3 (permanent live) and earth.

The diode test lamp should light up.



- -> If the diode test lamp does not light up, test for open circuit in wiring between central electrics and contact 3 on control unit connector using current flow diagram. If necessary, rectify open circuit.

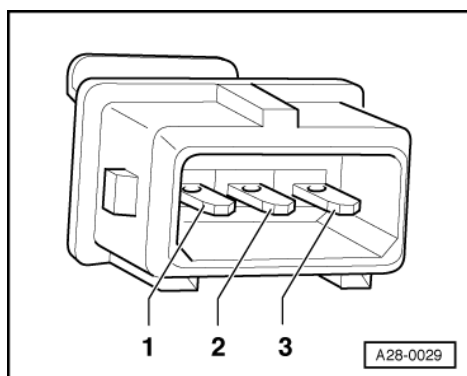
=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations

1.11 - Testing knock sensor

Notes:

- ◆ For testing the operation of the knock sensors, see "Reading measured value block", Display Groups 14, 15, 16 and 17.
- ◆ Fitting locations of plug connectors and knock sensors => Page 40.
- ◆ It is not possible to carry out an electrical test of the knock sensors themselves; (interrogate fault memory =>Page 4).
- ◆ To ensure that the knock sensors function properly it is important to keep exactly to the specified tightening torque of 20 Nm.
- ◆ Check connectors for corrosion.
- ◆ Use only gold plated contacts when repairing the contacts in the plug connectors for the knock sensors.

Testing knock sensor wiring



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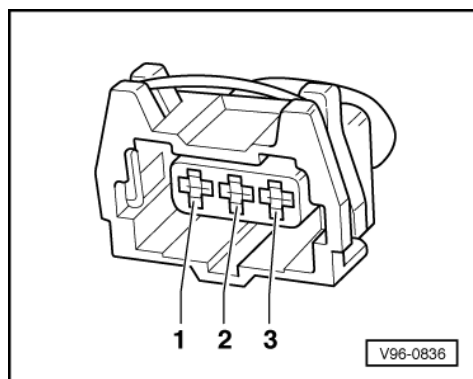
- Unplug knock sensor connector in engine compartment.
- -> Test for short circuits between all three contacts in the knock sensor connector. There must be no connection between any of the wires.
- If there is a connection between the contacts, fit a new knock sensor.



Testing wiring from knock sensors to engine control unit

- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=>Page 43 .
- Test for open circuit and for short to positive/earth or between wires in the wiring between the knock sensor and engine control unit using the current flow diagram.

=> Current Flow Diagrams, Electrical Fault Finding and Fitting Locations



-> Identification of contacts in plug connector:

Signal wire	Earth wire	Screening
1	2	3

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

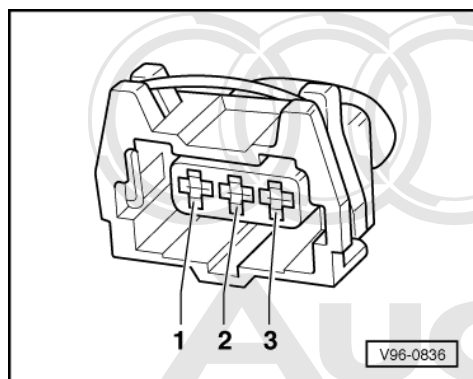
Specification: max. 1 ω .

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

Specification: max. 1 ω .

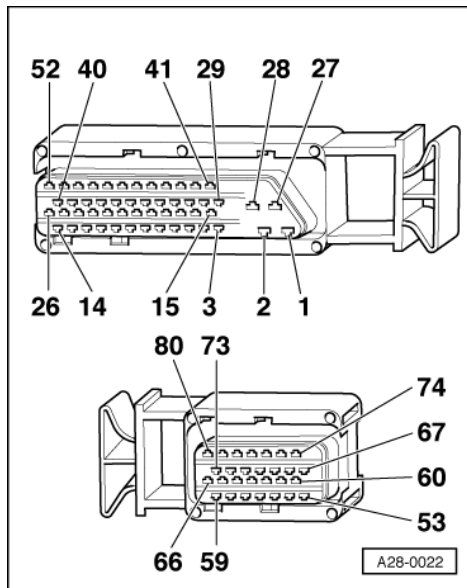
- Test continuity of screening on wiring for knock sensor 1 -G61 from contact 3 on connector in engine compartment to socket 67 on test box.

Specification: max. 1 ω .



- -> If the values do not match the specifications, rectify the short circuits or open circuits.

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- -> Knock sensor 1

Contact on connector for sensor	Contact on control unit connector
1 (signal)	68
2 (earth)	67
3 (screening)	67

1.12 - Testing Hall sender

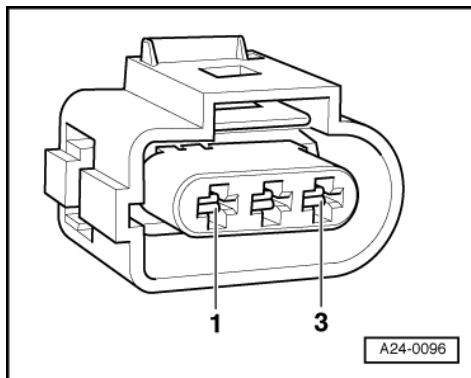
Fitting location of Hall sender => Page 40.

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- ◆ The Hall sender is located beneath the camshaft sprocket.
 - ◆ If no Hall sender signal is received, the knock sensor signals can no longer be assigned to the cylinders. If this happens, the knock control system is deactivated and the ignition timing is slightly retarded in order to prevent knocking.
 - ◆ Even if no Hall sender signal is received, the engine will continue to run and can also be re started. The reason for this is as follows:
 - The fact that the control unit is out of phase by one engine revolution does not have any noticeable effect on the injection system.
 - The fuel is injected upstream of the closed inlet valve instead of while the inlet valve is open. This has only a minor influence on the quality of the air/fuel mixture.
 - With the twin spark ignition system an ignition spark is produced for each cylinder after every engine revolution, and not after alternate revolutions as is normally the case.
 - Unplug connector from Hall sender.
 - Switch the ignition on.

Note:

The connector contacts are numbered on the back of the connector.



- -> Connect hand held multimeter V.A.G 1526 (voltage test range) between contact 1 (positive) and contact 3 (earth) on Hall sender connector. Make sure not to bend the contacts.

Specification: 4.5 ... 5.5 V.

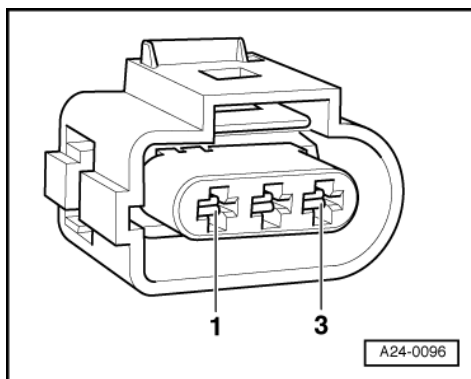
- -> Connect hand held multimeter V.A.G 1526 between contacts 2 and 3 (earth) on Hall sender connector. Make sure not to bend the contacts.

Specification: 4.5 ... 5.5 V.

- If the values are as specified, fit a new Hall sender.

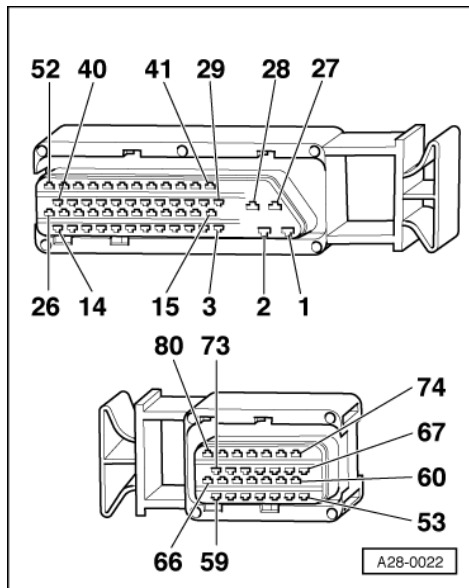
Note:

The Hall sender receives its power supply from the engine control unit.



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- If the values are not as specified, test wiring between the Hall sender and engine control unit as follows:
- Switch off ignition.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
- =>Page 43 .
- -> Test wiring from Hall sender...



- -> ...to engine control unit for open circuit and short to positive or earth.

Contact on 3-pin connector for Hall sender	Contact on control unit connector
1 (positive)	62
2 (signal)	76
3 (earth)	67

- If the wiring is OK but the voltage readings are not as specified, fit a new engine control unit =>Page 43 .



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