



Audi A4 1995 ➤

Motronic injection and ignition system (6-cylinder)						
Engine ID	ACK	ALG				

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List of Workshop Manual Repair GroupsList of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups Audi A4 1995 ➤

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Repair Group

01 - Self diagnosis

24 - Mixture preparation, Injection

28 - Ignition system

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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01 - Self diagnosis

1 - Self-diagnosis of Motronic system

1.1 - Self-diagnosis of Motronic system

1.2 - Technical data of self-diagnosis

Equipped with

- ♦ The data transfer between control unit and fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 is carried out in the operating mode "Rapid data transfer".
- ♦ The fault memory is equipped with a non-volatile memory and therefore does not depend on the power supply.

Control unit identification

The control unit version is displayed when fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 is connected and the engine control unit is selected => Page **2**.

Selectable functions when using the fault reader V.A.G 1551 or V.A.G 1552

The prerequisites for selecting the desired functions can be taken from the following table.

Fault reader V.A.G 1551 or V.A.G 1552	Ignition on, engine not running	Engine idling	Vehicle being driven	Page
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Address words				
01 Engine electronics	Yes	Yes	Yes	
00 Automatic test sequence	Yes	Yes	Yes	
Functions				
01 Interrogate control unit version	Yes	Yes	Yes	2
02 Interrogate fault memory	No	Yes	Yes	4
03 Final control diagnosis	No	Yes	No	27
04 Basic setting	No	Yes	Yes	30
05 Erase fault memory	Yes	Yes	Yes	4
06 End output	Yes	Yes	Yes	4
07 Code control unit	Yes	No	No	32
08 Read measured value block	Yes	Yes	Yes	33



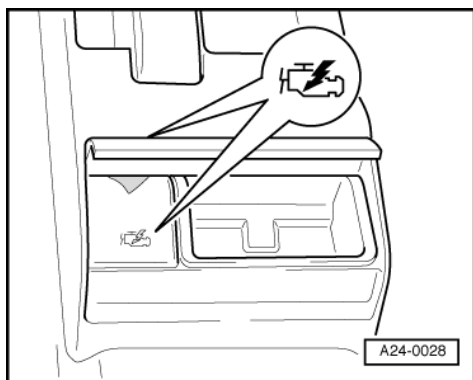
1.3 - Connecting fault reader V.A.G 1551 and selecting engine electronics control unit

Note:

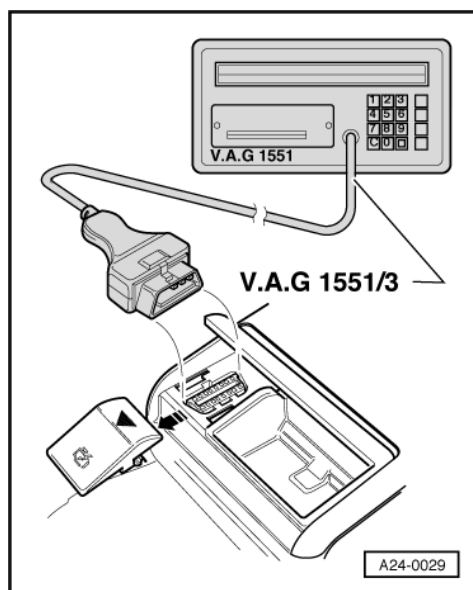
The vehicle system tester V.A.G 1552 can be used instead of the fault reader V.A.G 1551, however a print-out is not possible.

Test conditions

- Battery voltage at least 11 V.
- Earth connections on engine and gearbox OK.
- Fuses OK.
- Fuel pump relay OK.



- -> Open rear ashtray (in centre console) and remove cover for diagnostic connector.



- -> Connect fault reader V.A.G 1551 to diagnostic connector using test lead V.A.G 1551/3.

-> Indicated in display

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

- 1) appears alternately

Note:

If the display remains blank:

=> Fault reader operating instructions

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

-> Indicated on display:

Rapid data transfer HELP
Enter address word XX

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Rapid data transfer Q
01 - Engine electronics

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

Note:

-> 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
K wire not switching to earth

Rapid data transfer HELP
K wire not switching to positive

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

4D0907551 2.8l V6/5V MOTR HS D08
□ Coding 04002 WSC XXXXX

- ◆ 4D0 907 557 = Part No. of the control unit (for latest control unit version see parts catalogue)
- ◆ 2.8 ltr. = Engine displacement
- ◆ V6/V5 = Engine configuration (V-engine, 5 valve)
- ◆ MOTR = System designation (Motronic)
- ◆ HS = Manual gearbox (hand change)
AT = Automatic gearbox
- ◆ D08 = Programme level number
- ◆ Coding xxxxx = Control unit coding
Coding table => Page 32
- ◆ WSC xxxxx = Workshop code from V.A.G 1551, of the workshops who carried out the last coding. (If the factory coding has not been changed, WSC 00000 appears)

- Press =>key.

-> Indicated on display:

Rapid data transfer HELP
Select function XX



2 - Interrogating and erasing fault memory

2.1 - Interrogating and erasing fault memory

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select 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.)

Note:

Only when engine does not start:

- Interrogate fault memory with ignition switched on.

-> Indicated on display:

Rapid data transfer HELP
Select function XX

- Press keys 0 and 2 for function "Interrogate fault memory" and confirm entry with Q key.

-> Indicated on display:

No fault recognised

- Press =>key.

or

-> Indicated on display:

X faults recognised

If the printer on the fault reader is switched on the stored faults will be displayed and printed out in sequence.

- Locate and eliminate faults printed out as per fault table
=> Page 4.
- Press keys 0 and 5 for the function "Erase fault memory" and confirm entry with Q key.

-> Indicated on display:

Rapid data transfer HELP
Fault memory is erased!

Note:

If the ignition is switched off between interrogating fault memory and erasing fault memory, the fault memory will not be erased.

- Press =>key.

-> Indicated on display:

Rapid data transfer HELP
Select function XX

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

2.2 - Fault table

Notes:

- ♦ The fault table is listed according to the 5 digit fault code on the left.

- ♦ Before renewing components indicated as being faulty, check the wiring and connectors to these components as well as the earth connections using current flow diagram. This is particularly relevant if faults are output as "occurring sporadically" (SP).
- ♦ Sporadic faults are faults that only occur from time to time. (The word "sporadic" means "intermittent" or "occurring at irregular intervals".)

2.3 - Fault codes 00282 - 16507

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00282 Throttle valve positioner -V60 Short circuit to positive	- Short to positive in wiring for throttle valve positioner -V60 - -V60 defective - Output for -V60 in engine control unit defective (control unit defective)	- Increased idling speed - Load change jolt when easing off accelerator - Idling speed positioner switched off - engine idles with mechanically regulated air flow through the emergency running slot (slightly higher idling speed)	- Read measured value block, Display Group 023 => Page 52 - Test throttle valve control part -J338 => Page 108 - Renew engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00282 Throttle valve positioner -V60 Short circuit to earth	- Short to earth in wiring for throttle valve positioner - -V60 - -V60 defective - Faulty output for -V60 in engine control unit (control unit defective)	- Increased idling speed - Load change jolt when easing off accelerator - Idling speed positioner switched off - engine idles with mechanically regulated air flow through the emergency running slot (slightly higher idling speed)	- Read measured value block, Display Group 023 => Page 52 - Test throttle valve control part -J338 => Page 108 - Renew engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00532 Supply voltage Signal too great	- Supply voltage greater than 16 V - Excess voltage from assisted start - Defective alternator	- Damage to engine control unit	- Check voltage - Read measured value block, Display Group 003, display zone 2 => Page 40
Signal too small	- Supply voltage less than 10 V - Defective fuse	- Idling speed not within tolerances	- Check voltage supply to engine control unit => Page 138 - Check fuse



	- Poor earth connection to engine control unit - Battery discharged - Current drain when ignition is off		- Read measured value block, Display Group 003, display zone 2 => Page 40 - Check battery charge level
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Notes on fault code 00532:

- ♦ If the fault is shown as a sporadic fault, ignore the fault message on the display. This fault is often stored when the engine is left idling for a long period with a number of electrical consumers switched on and causing heavy discharging of the battery.
- ♦ The fault message "Signal too low" is stored if the supply voltage falls below 10.00 V for more than 1 second. (The control unit will not function at less than 6.5 V.)
- ♦ The unit does not check for low signals when the engine is being started since the voltage may fall below 10.00 V during starting.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00543 Maximum revs exceeded	- Speed was above 7100 rpm (e.g. missed gear)	- Possible damage to valves and pistons (contact)	- Check engine for damage and erase fault memory

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00561 Mixture adaptation Adaption limit (add) exceeded	- Fuel system pressure too low	- Car may run jerkily	- Fill car up with petrol and check fuel system pressure => Page 80
Adaption limit (mul) exceeded	- Incorrect signal from air mass meter - Leaks in exhaust system before catalytic converter - Unmetered air downstream of air mass meter - Carbon on injectors	- Increased fuel consumption - Rough idling	- Test air mass meter => Page 90 - Repair leaks - Check injection quantity => Page 85

Notes:

- ♦ (add) = additive, i.e. fault only occurs during idling
- ♦ (mul) = multiplicative, i.e. fault occurs over the entire engine speed range and at all throttle openings.
- ♦ If the fault "00561" and the fault "01088" are stored in fault memory, there must be a fault present which leads to incorrect fuel/air mixtures for both cylinder banks.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00561 Mixture adaptation Adaption limit (add) not reached	- Fuel system pressure too high	- Car may run jerkily	- Fill up with petrol and check fuel system pressure => Page 80
Adaption limit (mul) not reached	- Incorrect signal from air mass meter - Fuel in engine oil (possibly due to short journeys)	- Increased fuel consumption - Rough idling	- Test air mass meter => Page 90 - Take car for 15-minute run on motorway or change oil

	- Injectors leaking	- Black smoke, soot on spark plugs	- Check injection quantity => Page 85
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Notes:

- ♦ (add) = additive, i.e. fault only occurs during idling
- ♦ (mul) = multiplicative, i.e. fault occurs over the entire engine speed range and at all throttle openings.
- ♦ If the fault "00561" and the fault "01088" are stored in fault memory, there must be a fault present which leads to incorrect fuel/air mixtures for both cylinder banks.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00670 Throttle valve positioner sender - G127 Signal too small	- Short to earth in signal wire between throttle valve positioner sender - -G127 and engine control unit - Fault in power supply to throttle valve positioner - Defective throttle valve positioner - Faulty signal input in engine control unit - (control unit defective)	- Idling speed positioner switched off - engine idles with mechanically regulated air flow through the emergency running slot (slightly higher idling speed) - Load change jolt when easing off accelerator - AC compressor not activated at low engine speeds	- Perform adaption of throttle valve control part => Page 113 - Fit a new engine control unit => Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00670 Throttle valve positioner sender - G127 Signal too great	- Open circuit or short to positive in signal wire between throttle valve positioner sender - G127 and engine control unit - Defective earth connection to throttle valve positioner - Defective throttle valve positioner Continued ▼	- Idling speed positioner switched off - engine idles with mechanically regulated air flow through the emergency running slot (slightly higher idling speed) - Load change jolt when easing off accelerator - AC compressor not activated at low engine speeds	- Perform adaption of throttle valve control part => Page 113

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00670 Throttle valve positioner sender - G127 Signal too great	(Fault code 00670 continued)		



	- Faulty signal input in engine control unit - (control unit defective)		- Fit a new engine control unit =>Page 78
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Notes on fault code 00670:

- ♦ The throttle valve positioner sender is located in the throttle valve control part -J338.
- ♦ The sender is a potentiometer which signals the position of the throttle valve positioner to the control unit.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01088 Mixture adaption 2 Adaption limit (add) exceeded	- Fuel system pressure too low	- Car may run jerkily	- Fill car up with petrol and check fuel system pressure => Page 80
Adaption limit (mul) exceeded	- Incorrect signal from air mass meter -G70 - Unmetered air downstream of -G70 - Leaks in exhaust system upstream of catalytic converter - Solenoid valve 1 for activated charcoal filter - -N80 sticking - Carbon on injectors	- Increased fuel consumption - Rough idling	- Test -G70 => Page 90 - Read measured value block, Display Group 002 => Page 39 - Rectify leaks - Test -N80 => Page 105 - Check injection quantity => Page 85

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01088 Mixture adaption 2 Adaption limit (add) not reached	- Fuel system pressure too high	- Car may run jerkily	- Check fuel system pressure => Page 80
Adaption limit (mul) not reached	- Incorrect signal from air mass meter -G70 - Fuel in engine oil (possibly due to short journeys) - Injectors leaking	- Increased fuel consumption - Rough idling - Black exhaust smoke, soot on spark plugs	- Test -G70 => Page 90 - Take car for 15-minute run on motorway or change oil - Check injection quantity => Page 85

Note on fault code 01088:

- ♦ add = additive - The fault (e.g. unmetered air) has less effect as engine speed increases.
- ♦ mul = multiplicative - The fault (e.g. injector fault) has more effect as the engine speed increases.
- ♦ If the fault "00561" and the fault "01088" are stored in fault memory, there must be a fault present which leads to incorrect fuel/air mixtures for both cylinder banks.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01119 Gear recognition signal			

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
Open/short circuit to positive	- Open circuit or short circuit in signal wire between - engine control unit and multi-function switch - F125 - Fault in earth connection to -F125 - Faulty signal input in engine control unit - (control unit defective)	- Engine running problems (jerky gearshifts, load change jolts)	- Check wiring using current flow diagram => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Test multi-function switch -F125 => Automatic gearbox 01V, Self-diagnosis; Repair group 01; Electrical test - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01119 Gear recognition signal Short circuit to earth	- Short circuit to earth in signal wire between engine control unit and multi-function switch - F125 - Fault in earth connection to -F125 - Faulty signal input in engine control unit - (control unit defective)	- Engine running problems (jerky gearshifts, load change jolts)	- Check wiring using current flow diagram => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Test multi-function switch -F125 => Automatic gearbox 01V, Self-diagnosis; Repair group 01; Electrical test - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01120 Camshaft timing control 1 01121 Camshaft timing control 2 Mechanical fault	- Fault in power supply to camshaft adjustment valve -N205 or -N208 - Open circuit / short to earth or positive in wiring between camshaft adjustment valve (-N205 or -N208) and engine control unit	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. - Lack of power	- Test camshaft adjustment valve - N205 => Page 147 - Read measured value block, Display Group 025, 026 or 027 => Page 53 - Renew mechanical camshaft adjuster

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01120 Camshaft timing control 1	(Fault code 01120 continued)		



01121 Camshaft timing control 2 Mechanical fault	- Camshaft adjustment valve -N205 or -N208 defective - Mechanical camshaft - adjuster defective		
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Note on fault codes 01120 and 01121:

The faults will not be stored until 10 minutes after starting and a coolant temperature of above 60 °C.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01165 Throttle valve control part - J338 Regulating limit not reached	- Throttle valve jamming - Positioner mechanism - jamming	- Increased idling speed	- Read measured value block, Display Group 023 => Page 52
Regulating limit exceeded	- Fault (open circuit / short to positive or earth) in - wiring to throttle valve positioner -V60	- Load change jolt when easing off accelerator	- Test throttle valve control part -J338 => Page 108
Regulating difference	- Throttle valve positioner sender -G127 defective - -V60 defective - Faulty signal output in engine control unit - (control unit defective)		- Fit a new engine control unit=>Page 78

Note:

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

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01247 Activated charcoal filter solenoid valve 1 -N80			
Short circuit to earth	- Short to earth between activated charcoal filter solenoid valve -N80 and engine control unit - -N80 defective	- Car may run jerkily at part throttle	- Test -N80 => Page 105
Short circuit to positive	- Short to positive between -N80 and engine control unit - -N80 defective	- Car may smell of petrol	- Read measured value block, Display Group 010 => Page 47
Output open	- Open circuit in wiring - between -N80 and fuse - Open circuit in wiring - between -N80 and engine control unit		- Rectify open or short circuit (see Current Flow Diagram) => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations

	- Fuse defective - N80 defective		- Test fuse
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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01249 No.1 cyl. injector -N30 Short circuit to earth	- Short to earth in wiring - between injector and - engine control unit - Injector defective	- Engine runs unevenly or cuts out	- Test injectors => Page 82
Short circuit to positive	- Short to positive in wiring between injector and - engine control unit - Injector defective		
Output open	- Open circuit in wiring - between injector and - engine control unit - Fuse defective - Open circuit in wiring - between injector and fuse - Injector defective		
			- Rectify short circuit or open circuit => Current Flow Diagrams, Electrical Fault-Finding & Fit- ting Locations Check fuse

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01250 No. 2 cyl. injector -N31 Short circuit to earth	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249
Short circuit to positive			
Output open			
01251 No. 3 cyl. injector -N32 Short circuit to earth	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249
Short circuit to positive			
Output open			

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01252 No. 4 cyl. injector -N33 Short circuit to earth	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249
Short circuit to positive			
Output open			
01253 No. 5 cyl. injector -N83 Short circuit to earth	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249
Short circuit to positive			



Output open			
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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01254 No. 6 cyl. injector -N84 Short circuit to earth	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249	=> Cylinder 1, fault code 01249
Short circuit to positive			
Output open			

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01259 Fuel pump relay -J17 Open/short circuit to earth	- Open circuit or short to earth between fuel pump relay -J17 and engine control unit - Fault in power supply to -J17 - Fuel pump relay -J17 defective	- Open circuit: engine will not run - Short to earth: engine will continue to run normally but will use more current when ignition is on because relay picks up constantly and fuel pump runs continuously, even when engine is not running	- Rectify open circuit or short circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Test fuel pump relay -J17 => Page 87
Short circuit to positive	- Short to positive in wiring between fuel pump relay -J17 and engine control unit		

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If fault code 01259 has been stored, fault codes 01247, 01249, 01250, 01251, 01252, 1253, 1254, 17923 or 17935 could also be stored, since the components to which they relate receive their power from the fuel pump relay.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16486 Air mass meter -G70 Signal too small	- Unmetered air between air mass meter -G70 and engine - Fault in power supply to -G70 - Open circuit or short to earth in signal wiring between -G70 and engine control unit - -G70 defective - Faulty signal input in engine control unit - (control unit defective)	- Emergency running mode (substitute value based on throttle valve angle and engine speed), so no noticeable effect on performance	- Locate and rectify leak - Rectify short circuit or open circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Test -G70 => Page 90 - Fit a new engine control unit => Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
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16487 Air mass meter -G70 Signal too great	- Short to positive in signal wire between air mass meter -G70 and engine control unit - Defective earth connection to -G70 - -G70 defective - Faulty signal input in engine control unit - (control unit defective)	- Emergency running mode (substitute value based on throttle valve angle and engine speed), so no noticeable effect on performance	- Test -G70 => Page 90 - Fit a new engine control unit =>Page 78
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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16496 Intake air temperature sender - G42 Signal too small	- Short to earth in wiring between intake air temperature sender - G42 and engine control unit - -G42 defective - Faulty signal input in engine control unit - (control unit defective)	- Emergency running mode (display shows constant substitute value of 25.5 ° C)	- Read measured value block, Display Group 003 => Page 40 - Test -G42 => Page 131 - Fit a new engine control unit =>Page 78

Note on fault code 16496:

- ♦ The fault "Signal too small" will be stored at idling approx. 3 minutes after starting.
- ♦ The fault could also be that the intake air temperature sender connector and twin path intake manifold change-over valve connector have been interchanged. The connector for the sender is black, the connector for the valve is blue.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16497 Intake air temperature sender - G42 Signal too great	- Open circuit or short to positive in wiring between intake air temperature sender -G42 and engine control unit - -G42 defective - Defective earth connection to -G42 - Faulty signal input in engine control unit - (control unit defective)	- Emergency running mode (display shows constant substitute value of 25.5 ° C)	- Read measured value block, Display Group 003 => Page 40 - Test -G42 => Page 131 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16500			



Coolant temperature sender - G62 Implausible signal	- Coolant temperature sender -G62 delivering an implausible signal because of a loose contact or - moisture corrosion on connector plug - Faulty signal input in engine control unit - (control unit defective)	- Difficulty with cold starting, especially at very low temperatures - Poor performance in warm-up phase - Increased fuel consumption - Increased emissions	- Read measured value block, Display Group 003 => Page 136 - Fit a new engine control unit =>Page 78
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Note on fault code 16500:

The temperature curve between 20°C and 60°C is compared with a model temperature curve stored in the control unit. The model curve rises less sharply than the actual curve. If there is a fault which causes the actual temperature to rise too slowly, the real values will coincide with those in the model curve at a certain point. The engine control unit recognises the fault as implausible.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16501 Coolant temperature sender - G62 Signal too small	- Short to earth in wiring between coolant temperature sender - G62 and engine control unit - -G62 defective - Faulty signal input in engine control unit - (control unit defective)	- Cold start problems at very low temperatures - Poor performance in warm-up phase - Increased fuel consumption - Increased emissions	- Read measured value block, Display Group 003 => Page 40 - Test -G62 =>Page 136 - Fit a new engine control unit =>Page 78

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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16502 Coolant temperature sender - G62 Signal too great	- Open circuit or short to positive in wiring between coolant temperature sender -G62 and engine control unit - -G62 defective - Defective earth connection to -G62 - Faulty signal input in engine control unit - (control unit defective)	- Difficulty with cold starting, especially at very low temperatures - Poor performance in warm-up phase - Increased fuel consumption - Increased emissions	- Read measured value block, Display Group 003 => Page 40 - Test -G62 =>Page 136 - Fit a new engine control unit =>Page 78

Note on fault codes 16500, 16501 and 16502:

As soon as a fault is stored in the fault memory, the engine control unit uses the intake air temperature as a substitute value for starting the engine (starting temperature substitute value) and calculates the engine tem-

perature according to a predetermined model (an increase of 5.25 °C every 65 seconds). After a certain period a fixed substitute value will be adopted when the engine has reached operating temperature. This fixed substitute value is also dependent on the intake air temperature.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16505 Throttle valve potentiometer -G69 Implausible signal	- Moisture or corrosion in connector on throttle valve potentiometer -G69 - -G69 defective	- Jerky acceleration - Load change jolt when easing off accelerator - Uneven idling speed - control	- Test throttle valve potentiometer -G69 => Page 38

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16506 Throttle valve potentiometer -G69 Signal too small	- Short to earth in signal wire between -G69 and engine control unit - Fault in power supply to -G69 - -G69 defective	- Jerky acceleration - Load change jolt when easing off accelerator	- Test throttle valve potentiometer -G69 => Page 38 Rectify short circuit or open circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16507 Throttle valve potentiometer -G69 Signal too great	- Open circuit or short to positive in signal wire between -G69 and engine control unit - Defective earth connection to -G69 - -G69 defective	- Jerky acceleration - Load change jolt when easing off accelerator	- Test throttle valve potentiometer -G69 => Page 38

Note on fault code 16505:

The air flow rate (air mass) is compared with the throttle valve angle at each different engine speed.

Notes on fault codes 16505, 16506 and 16507:

- ♦ If one of the above faults is detected, the control unit adopts a substitute value derived from the engine speed.
- ♦ If a fault develops with both the throttle valve potentiometer and the air mass meter at the same time, the emergency running function cannot operate and therefore the engine will cut out.

2.4 - Fault codes 16514 - 18259

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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
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16514 Bank1 - Probe1 Electrical fault in circuit	- Corrosion due to moisture in plug connection for lambda probe heating -Z19 or lambda probe -G39 - Short circuit between - signal wire for lambda probe and reference earth wire for lambda probe - Amplitude in signal wire too small (lambda probe - -G39 contaminated or probe slits blocked/dirty)	- Lambda closed-loop control switches to open-loop control - Rough idling - Emission levels not OK - Increased fuel consumption	- Rectify short circuit or open circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Test lambda control =>Page 97 - Read measured value block, Display Group 009 =>Page 51
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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16515 Bank 1 - Probe 1 Voltage too low	- Short to earth or short to screening in lambda probe signal wire - Short to earth or short to screening in lambda probe reference earth wire - Lambda probe defective	- Lambda closed-loop control switches to open-loop control - Rough idling - Emission levels not OK - Increased fuel consumption	- Rectify short circuit or open circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Test lambda control =>Page 45 - Read measured value block, Display Group 021 =>Page 51

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16516 Bank 1 - Probe 1 Voltage too high	- Short to positive in signal wire - Lambda probe defective	- Lambda closed-loop control switches to open-loop control - Increased fuel consumption - Emission values not OK - Spark plugs become covered with soot - Rough idling	- Rectify short circuit or open circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Test lambda control =>Page 97 - Read measured value block, Display Group 021 =>Page 45

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16518 Bank 1 - Probe 1 No activity	- Lambda probe defective (dirty)	- Lambda closed-loop control switches to open-loop control - Increased fuel consumption - Emission levels not OK	- Read measured value block, Display Group 021 =>Page 45

	- Open circuit in wiring between lambda probe heating and engine control unit - Lambda probe heating not functioning	- Spark plugs become covered with soot - Rough idling	- Test lambda probe heating =>Page 100
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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16534 Bank 2 - Probe 1 Electrical fault in circuit	=>Bank 1, Lambda probe 1 fault code 16514	=>Bank 1, Lambda probe 1 fault code 16514	=>Bank 1, Lambda probe 1 fault code 16514
16535 Bank 2 - Probe 1 Voltage too low	=>Bank 1, Lambda probe 1 fault code 16515	=>Bank 1, Lambda probe 1 fault code 16515	=>Bank 1, Lambda probe 1 fault code 16515
16536 Bank 2 - Probe 1 Voltage too high	=>Bank 1, Lambda probe 1 fault code 16516	=>Bank 1, Lambda probe 1 fault code 16516	=>Bank 1, Lambda probe 1 fault code 16516
16538 Bank 2 - Probe 1 No activity	=>Bank 1, Lambda probe 1 fault code 16518	=>Bank 1, Lambda probe 1 fault code 16518	=>Bank 1, Lambda probe 1 fault code 16518

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16705 Engine speed sender -G28 Implausible signal	- Engine speed sender -G28 loose - Sender wheel loose	- Engine misfires	- Test engine speed sender -G28 =>Page 133

Note on fault code 16705:

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- ◆ When the number of signals per crankshaft rotation starting from the reference mark gap is incorrect (60 signals), the fault "Implausible signal" will be set.
 - ◆ To obtain a specific gap between G28 and sender wheel, G28 has a spacer washer. If the speed sender is fitted without the spacer washer the sender wheel will be severely damaged.
 - ◆ Metal particles can cause additional signals to be generated.
 - ◆ Signals may not be generated or be too small and therefore not recognised if the sender gap to sender wheel is too large or the sender wheel is damaged.
 - ◆ The signals can be irregular if the sender wheel is loose.
 - ◆ Interference signals can cause additional signals to be recognised.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16706 Engine speed sender -G28 No signal	- Open circuit or short to positive or earth in signal wiring - Open circuit or short to positive in earth wiring - -G28 loose or defective	- Engine will not start - Engine cuts out	- Rectify open circuit or short circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Read measured value block, Display Group 001 => Page 38 - Test -G28 =>Page 133



	- Open circuit in connection to screening for -G28 - Faulty signal input in engine control unit - (control unit defective)		- Fit a new engine control unit =>Page 78
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V.A.G 1551 print-out 16711 Knock sensor 1 -G61 Signal too small	Possible causes of fault	Possible effects	Fault remedy
	- Knock sensor loose or corrosion on plug - Open circuit in sender earth wiring between knock sensor and engine control unit - Knock sensor defective - Open circuit or short to earth in signal wire (or short circuit to screening for signal wire) between knock sensor and engine control unit - Faulty signal input in engine control unit - (control unit defective)	- High fuel consumption - Poor performance	- Tightening torque for knock sensor: 20 Nm - Test knock sensor => Page 140 - Read measured value block 017 and 018 => Page 50 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out 16712 Knock sensor 1 -G61 Signal too great	Possible causes of fault	Possible effects	Fault remedy
	- Knock sensor loose or corrosion on plug - Knock sensor defective - Possible engine damage	- High fuel consumption - Loss of power	- Tightening torque for knock sensor: 20 Nm - Test knock sensor => Page 140
16716 Knock sensor 2 -G66 Signal too small	=> Knock sensor 1 -G61 fault code 16711	=> Knock sensor 1 -G61 fault code 16711	=> Knock sensor 1 -G61 fault code 16711
16717 Knock sensor 2 -G66 Signal too great	=> Knock sensor 1 -G61 fault code 16712	=> Knock sensor 1 -G61 fault code 16712	=> Knock sensor 1 -G61 fault code 16712

V.A.G 1551 print-out 16885 Vehicle speed signal Implausible signal	Possible causes of fault	Possible effects	Fault remedy
	- Vehicle speed sender defective - Open circuit or short circuit between vehicle speed sender and speedometer	- Air conditioner compressor does not cut out at full throttle in 1st gear - Idling speed deviates briefly from specified value	- Test road speed signal => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Read measured value block, Display Group 011, display zone 3 => Page 48

	- Open circuit or short circuit between dash panel insert and engine control unit - Speedometer defective	- Poor load change performance - Malfunction in systems which use road speed signal	- Rectify open circuit or short circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Test road speed signal => Page 116
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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16989 Control unit defective	- Open circuit in earth connections to control unit - Engine control unit defective	- Engine will not start	- Check earth connections using current flow diagram - Fit a new engine control unit => Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17733 Knock control Cyl. 1 Control limit reached	- Poor-quality fuel (less than RON 91) - Abnormal engine noise (ancillaries loose) - Open circuit in screening for knock sensor 1 or 2 - Loose contact in connector - Wrong tightening torque on knock sensor	- High fuel consumption - Poor performance - Engine runs unevenly - Vehicle will not reach top speed	- Fill up with petrol (at least RON 91) - Test knock sensor => Page 140 - Rectify open circuit or short circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Read measured value block, Display Groups 017 and 018 => Page 50 - Tighten knock sensor (20Nm)

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17734 Knock control Cyl. 2 Control limit reached	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733
17735 Knock control Cyl. 3 Control limit reached	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733
17736 Knock control Cyl. 4 Control limit reached	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733
17737 Knock control Cyl. 5 Control limit reached	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733



V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17738 Knock control Cyl. 6 Control limit reached	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733	=> Knock control Cyl. 1 fault code 17733
17745 Bank 1, Camshaft pos. sensor - G163 Short circuit to earth	- Short to earth in wiring - between Hall sender - G163 and engine - control unit - G163 defective - Faulty signal input in - engine control unit - (engine control unit defective)	- No power at full throttle - Emission values not OK - High fuel consumption (Effects only likely to occur if -G40 and -G163 both fail at the same time)	- Rectify short using current flow diagram - Test -G163 =>Page 78

Note on fault code 17745:

If fault "17799" is also stored in the fault memory with fault "17745", the fault "17799" could be a knock-on fault. In this case begin the fault finding with fault "17745".

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17746 Bank 1, Camshaft pos. sensor - G163 Open/short circuit to positive	- Open circuit or short to positive in signal wire - between Hall sender - G163 and engine - control unit - Fault in power supply or earth connection to -G163 - G163 defective - Faulty signal input in - engine control unit - (control unit defective)	- No power at full throttle - Emission values not OK - High fuel consumption (Effects only likely to occur if -G40 and -G163 both fail at the same time)	- Rectify open circuit or short using current flow diagram - Test -G163 =>Page 142 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17799 Bank 2, Camshaft pos. sensor - G40 Short circuit to earth	- Short to earth in wiring - between Hall sender - G40 and engine control unit - G40 defective - Faulty signal input in - engine control unit - (control unit defective)	- No power at full throttle - Emission values not OK - High fuel consumption (Effects only likely to occur if -G40 and -G163 both fail at the same time)	- Rectify short using current flow diagram - Test -G40 =>Page 78

Note on fault code 17799:

If fault "17745" is also stored in the fault memory with fault "17799", the fault "17799" could be a knock-on fault. In this case begin the fault finding with fault "17745".

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17800 Bank 2, Camshaft pos. sensor -G40 Open/short circuit to positive	- Open circuit or short to positive in signal wire - between Hall sender - G40 and engine control unit - Fault in power supply or earth connection to -G40 - -G40 defective - Faulty signal input in engine control unit - (control unit defective)	- No power at full throttle - Emission values not OK - High fuel consumption (Effects only likely to occur if -G40 and -G163 both fail at the same time)	- Rectify open circuit or short using current flow diagram - Test -G40 =>Page 142 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17829 Secondary air inlet valve -N112 Short circuit to earth (Fault only occurs on vehicles with secondary air system)	- Short to earth in wiring - between secondary air inlet valve -N112 and engine control unit - -N112 defective - Faulty signal input in engine control unit - (control unit defective)		- Test secondary air system => Final control diagnosis, Page 27 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17830 Secondary air inlet valve -N112 Short circuit to positive (Fault only occurs on vehicles with secondary air system)	- Short to positive in wiring between secondary air inlet valve -N112 and engine control unit - -N112 defective - Faulty signal input in engine control unit - (control unit defective)		- Test secondary air system => Final control diagnosis, Page 27 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17840 Secondary air inlet valve -N112 Open circuit (Fault only occurs on vehicles with secondary air system)	- Open circuit in wiring - between secondary air inlet valve -N112 and engine control unit		- Test secondary air system => Final control diagnosis, Page 27



V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
	- Fault in power supply to -N112 - -N112 defective - Faulty signal input in engine control unit - (control unit defective)		- Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17841 Relay for secondary air pump -J299 Open circuit (Fault only occurs on vehicles with secondary air system)	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. - Open circuit in wiring between secondary air pump relay -J299 and engine control unit - Fault in power supply to -J299 - -J299 defective - Faulty signal input in engine control unit - (control unit defective)		- Test secondary air system => Final control diagnosis, Page 27 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17842 Relay for secondary air pump -J299 Short circuit to positive (Fault only occurs on vehicles with secondary air system)	- Short to positive in wiring between secondary air pump relay -J299 and engine control unit - -J299 defective - Faulty signal input in engine control unit - (control unit defective)		- Test secondary air system => Final control diagnosis, Page 27 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17843 Relay for secondary air pump -J299 Short circuit to earth (Fault only occurs on vehicles with secondary air system)	- Short to earth in wiring between secondary air pump relay -J299 and engine control unit - -J299 defective - Faulty signal input in engine control unit - (control unit defective)		- Test secondary air system => Final control diagnosis, Page 27 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17913 Idling speed switch -F60 Does not close/open circuit	- Throttle valve sticking	- Load change jolt when easing off accelerator	- Test idling speed switch => Page 110

	- Throttle cable setting - Floor mat is pressing down on accelerator pedal - Open circuit or short to positive between idling speed switch -F60 and engine control unit - -F60 defective - Faulty signal input in engine control unit - (control unit defective)	- Idling speed is outside the specified range - Air conditioner compressor only cuts in at high engine speed	- Adjust throttle cable => 6-cylinder engine (5-valve), Mechanics; Repair group 20; Removing and installing parts of fuel supply system; Servicing throttle cable Removing and installing parts of fuel supply system; Servicing throttle cable - Rectify short circuit or open circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Fit a new engine control unit =>Page 78
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V.A.G 1551 print-out 17914 Idling speed switch -F60 Does not open / short to earth	Possible causes of fault	Possible effects	Fault remedy
	- Moisture in throttle valve plug - Short to earth between idling speed switch -F60 and engine control unit - -F60 defective - Faulty signal input in engine control unit - (control unit defective)	- Idling speed closed-loop control switches to open-loop control - Idling speed not within the specified range - Load change jolt when easing off accelerator - Air conditioner compressor only cuts in at high engine speed	- Test idling speed switch => Page 110 - Rectify short circuit or open circuit => Current Flow Diagrams, Electrical Fault-Finding & Fitting Locations - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out 17920 Intake manifold change-over valve -N156 Short circuit to positive	Possible causes of fault	Possible effects	Fault remedy
	- Short to positive in wiring between intake manifold change-over valve -N156 and engine control unit - -N156 defective - Faulty signal input in engine control unit - (control unit defective)	- -N156 does not open (loss of power above 4700 rpm)	- Test -N156 => Page 92 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out 17923 Intake manifold change-over valve -N156	Possible causes of fault	Possible effects	Fault remedy
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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
Short circuit to earth	- Short to earth in wiring - between intake manifold change-over valve - N156 and engine control unit - -N156 defective - Faulty signal input in engine control unit - (control unit defective)	- -N156 does not open (loss of power above 4700 rpm)	- Test -N156 => Page 92 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17924 Intake manifold change-over valve - N156 Open circuit	- Open circuit in wiring - between intake manifold change-over valve - N156 and engine control unit - Fault in power supply to -N156 - -N156 defective - Faulty signal input in engine control unit - (control unit defective)	- -N156 does not open (loss of power above 4700 rpm)	- Test -N156 => Page 92 - Fit a new engine control unit =>Page 78

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17953 Throttle valve control Faulty	- Fault in power supply or earth connection for throttle valve potentiometer - G69 and throttle valve positioner sender -G127 - Open circuit in signal wire for -G69 and -G127 - -G69 and -G127 defective - Throttle valve stiff or dirty	- Increased idling speed - Load change jolt when easing off accelerator	- Read measured value block, Display Group 023 => Page 52 - Test throttle valve control part -J338 =>Page 108

Note on fault code 17953:

If other faults are stored in the fault memory which affect the throttle valve control part, e.g. the fault "00670", the fault "17953" could be a knock-on fault. In this case begin fault finding with the other faults.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17967 Throttle valve control part -J338			

Fault in basic setting	- Voltage at engine control unit dropped below 10 V during adaption of throttle valve control part -J338 to engine control unit		- Read measured value block, Display Group 003, display zone 2 => Page 40 Test voltage supply to engine control unit =>Page 28-24 Check battery charge level
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Notes:

- ♦ Important: Before attempting to repair the above fault, check the notes on the next page. On vehicles with control units programmed with software version D08 or higher (Part No. 4D0 907 551) the possible causes of this fault are different.
- ♦ To find out what software version the control unit has, check the control unit identification=>Page 2 .

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17967 Throttle valve control part - J338 Fault in basic setting	- Conditions for basic setting (i.e. adaption of throttle valve control unit) were violated during adaption process: Driver applied throttle during adaption process (idling speed switch opened) Driver started engine during adaption process (engine speed signal detected)	- The engine control unit cannot learn the limit stop positions of the throttle valve control part because the basic setting (adaption) conditions were violated.	- Ensure that conditions for basic setting (adaption of throttle valve control part) have been met; check learning requirement display =>Page 01-145 Repeat adaption of throttle valve control part =>Page 24-91

Notes:

- ♦ Check the control unit identification to find out what software version the control unit has=>Page 2
- ♦ Control units with software versions up to D08 will store the fault "Throttle valve control part J338; Fault in basic setting" if the voltage at the engine control unit falls below 10 V during the adaption of the throttle valve control part. (Further notes=>next page.)

Continued:

- ♦ Control units with software version D08 or higher will store the fault if the conditions for the basic setting (adaption of throttle valve control part) are violated during the adaption process (see previous page).
- ♦ The software has now been updated to include a new fault code which will appear if the voltage falls below 10 V during the adaption process. This makes it easier to identify the exact cause of the problem.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17972 Throttle valve control part - J338 Low voltage at basic setting	- Voltage at engine control unit fell below 10 V during adaption of throttle valve control part -J388	- The engine control unit cannot learn the limit stop positions of the throttle valve control part.	- Test voltage supply to engine control unit =>Page 28-24 Check battery charge level Repeat adaption of throttle valve control part =>Page 24-91



V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17973 Throttle valve control part -J338 Lower stop is not reached	- Throttle cable incorrectly set - Throttle valve dirty or stiff - Floor mat pressing down on accelerator pedal - Throttle valve control part defective	- The engine control unit cannot learn the limit stop positions of the throttle valve control part.	- Check and adjust throttle cable setting => 6-cylinder engine (5-valve), Mechanics; Repair group 20; Removing and installing parts of fuel supply system; Servicing throttle cable Removing and installing parts of fuel supply system; Servicing throttle cable - Clean the throttle valve - Renew throttle valve control part, then perform adaption =>Page 24-91

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17978 Engine control unit blocked	- Attempted tampering - Short circuit in signal wire - Immobilizer control unit defective/missing	- Engine starts but cuts out again immediately	- Check that keys are correctly matched. If necessary, perform matching procedure => Electrical system; Repair group 01; Self-diagnosis of electronic immobilizer; Function 10 - Adaption Self-diagnosis of electronic immobilizer; Function 10 - Adaption - Interrogate fault memory => Electrical system; Repair group 01; Self-diagnosis of electronic immobilizer; Function 02 - Interrogate fault memory Self-diagnosis of electronic immobilizer; Function 02 - Interrogate fault memory

Note on fault code 17978:

If an attempt is made to start the car with an unmatched key the control unit will register a static fault. If the car is then started with a correctly matched key, the fault will be re-classified as a sporadic fault.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
18010 Voltage supply terminal 30 Voltage too low	- Battery was disconnected - Permanent power supply to control unit was disconnected, or open circuit		- Test power supply to engine control unit => Page 138

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
18020 Engine control unit incorrectly coded	- Engine control unit incorrectly coded - Vehicle has front-wheel drive with ASR but control unit is coded for four-wheel drive	- Engine running problems - Increased emissions - Various faults stored in fault memory - ASR not working - ASR warning lamp lights up	- Code control unit => Page 32

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
18034 CAN-Bus Message missing from gearbox CU	- Fault in data transmission wires to gearbox control unit	- Automatic gearbox switches to emergency running mode - Engine running problems (jerky gearshifts, load change jolts)	- Test CAN bus => Page 122
18259 CAN-Bus Message missing from ABS CU	- Fault in data transmission wires to ABS control unit	- Electronic stability program (ESP) not functioning	- Test CAN bus => Page 122

3 - Final control diagnosis

3.1 - 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, individual control elements continue to be actuated until the test programme is 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 starting the engine briefly, switch off the ignition for approx. 20 seconds.
- ◆ The electric fuel pump runs continuously throughout the final control diagnosis.
- ◆ The final control diagnosis is terminated after 10 minutes.

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

1. Injector, cylinder 1 -N30
2. Injector, cylinder 2 -N31
3. Injector, cylinder 3 -N32
4. Injector, cylinder 4 -N33
5. Injector, cylinder 5 -N83
6. Injector, cylinder 6 -N84
5. Solenoid valve 1 for activated charcoal filter -N80
8. Secondary air inlet valve -N112



(only on vehicles with secondary air system)

9. Relay for secondary air pump -J299
(only on vehicles with secondary air system)
10. Intake manifold change-over valve -N156
11. Camshaft timing control 1 (camshaft adjustment valves 1 and 2,
-N205 and -N208)

Test requirements

- Fuses for engine electronics okay
- Idling speed switch -F60 okay
- Fuel pump relay okay

Special tools, testers and auxiliary items

- ♦ Diode test lamp V.A.G 1527
- ♦ Test box V.A.G 1598/22
- Connect fault reader V.A.G 1551 (V.A.G 1552) and select 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.)

-> Indicated on display:

Rapid data transfer	HELP
Select function XX	

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

-> Indicated on display:

Rapid data transfer	Q
03-Final control diagnosis	

Testing injectors

- Confirm input with Q key.

-> Indicated on display:

Final control diagnosis
Injector, cylinder 1 -N30

Note:

The fuel pump relay should pick up and the fuel pump should run. There will be a clearly audible flowing sound from the fuel pressure regulator. If the fuel pump does not run, test activation

=>Page 87.

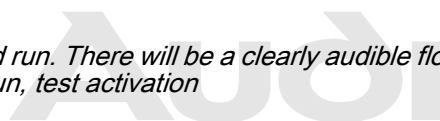
- Turn throttle actuator on throttle valve control part so that the idling speed switch opens.

The injector should click five times.

- Press the ➡ key to advance the programme to the next injector. (It is also possible to advance the programme without testing each injector.)
- Use this procedure to test all the injectors in sequence.

If one of the injectors is not actuated (does not click):

- Test injectors=>Page 82.



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Activating solenoid valve for activated charcoal filter

- Press ⇒key.

-> Indicated on display:

Final control diagnosis
ACF solenoid 1 -N80

The solenoid valve will continue to be actuated (i.e. will click) until the⇒key is pressed to advance the programme to the next control element.

If the valve is not actuated (does not click):

- Test solenoid valve 1 for activated charcoal filter -N80
=> Page 105 .

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Activating secondary air inlet valve

(only on vehicles with secondary air system)

- Press ⇒key.

-> Indicated on display:

Final control diagnosis
Secondary air inlet valve -N112

The valve will continue to be actuated (i.e. will click) until the⇒key is pressed to advance the programme to the next control element.

If the valve is not actuated (does not click):

- Test secondary air inlet valve -N112
=>Page 103 .

Activating secondary air pump relay

(only on vehicles with secondary air system)

- Press ⇒key.

-> Indicated on display:

Final control diagnosis
Secondary air pump relay -J299

Secondary air pump relay -J299 activates secondary air pump motor -V101 which runs at intervals until the final control diagnosis is terminated by pressing the⇒key.

If secondary air pump motor -V101 does not run at intervals:

- Test secondary air pump relay -J299
=>Page 104 .

Activating intake manifold change-over valve

- Press ⇒key.

-> Indicated on display:

Final control diagnosis
Intake manifold press. change valve -
N156

The solenoid valve will continue to be actuated (i.e. will click) until the⇒key is pressed to advance the programme to the next control element.



If the valve is not actuated (does not click):

- Test intake manifold change-over (pressure change) valve -N156
=>Page 92

Activating camshaft adjustment valves

- Press =>key.

-> Indicated on display:

Final control diagnosis
Camshaft timing control 1

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Camshaft adjustment valves 1 and 2 (-N205 and -N208) will continue to be actuated (i.e. will click) until the =>key is pressed to advance the programme to the next control element.

If the valve is not actuated (does not click):

- Test camshaft adjustment valve
=>Page 147 .
- Press =>key.

Note:

Before selecting function 03 "Final control diagnosis" again, switch off the ignition for approx. 20 seconds.

4 - Basic setting

4.1 - Basic setting

With the engine not running, the following operation can be performed in the basic setting mode:

- ♦ Adaption of throttle valve control part to engine control unit
=>Display Group 098

With the engine running, the following operations can be performed in the basic setting mode:

- ♦ Learning process for lambda control
=> relevant Display Group
- ♦ Fault-finding by activating and deactivating the lambda control
=>Page 55 , Display Group 099

Test conditions for operations with engine running

- Coolant temperature at least 80 °C
- Electrical consumers switched off (radiator fan must not run during the check)
- Air conditioner switched off
- Gear selector lever in P or N position
- No faults stored in fault memory
- Connect fault reader V.A.G 1551 (V.A.G 1552) and select 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 .)

-> Indicated on display:

Rapid data transfer HELP
Select function XX

- Press keys 0 and 4 for function "Basic setting" and confirm entry by pressing Q.

-> Indicated on display:

Introduction of basic setting HELP
Input display group number XXX

- Select the required display group number from the Display Group Overview in the "Read measured value block" section.

Note:

Display Group number 000 is used here as an example to demonstrate the procedure.

- Press key 0 three times.

-> Indicated on display:

Basic setting Q
Enter display group number 00

- Confirm entry by pressing Q.

-> Indicated on display:

Basic setting 0 Q
1 2 3 4 5 6 7
8 9 10

Display Group 000

Display group 000 (decimal displayed value) ¹⁾									
Basic setting 0 =>									
1	2	3	4	5	6	7	8	9	10
Indicated on display									
Display zones									
Lambda learnt value Bank 2 (mul.)									
Specification									
Corresponds to									
115...141									
-10...10 %									
Lambda learnt value Bank 1 (mul.)									
115...141									
-10...10 %									
Lambda control value Bank 2									
115...141									
-10...10 %									
Lambda control value Bank 1									
115...141									
-10...10 %									
Idling air mass learnt value									
118...138									
-5...5 kg/h									
Idling air mass control value									
115...141									
-10...10 %									
Throttle valve angle									
0...12									
0...5 <°									
Engine speed									
62...74									
620...740 rpm									
Four-wheel-drive									
74...86									
740...860 rpm									
Front wheel drive									
Engine load									
20...50									
1.0...2.5 ms									
Coolant temperature									
171...204									
80...105 °C									

1) This table is only provided as an overview. The relevance of individual measured values is explained in display groups 001 to 099.

Notes:

- ◆ In Display Group 00 the measured values are shown in decimal form.
- ◆ Press the PRINT key at any time to print out the message currently being displayed.
- ◆ Before selecting more display groups, press C.

- If all the display zones show the specified values, press the => key.

-> Indicated on display:

Rapid data transfer HELP
Select function XX



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

5 - Coding control unit

5.1 - Coding 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 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.)

-> Indicated on display:

```
Rapid data transfer      HELP
Select function XX
```

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

-> Indicated on display:

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

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

Coding variants =>Page 32

-> If the following display is shown:

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

An unauthorised code number has been entered.

-> The control unit identification will be displayed on fault reader V.A.G 1551, as in this example.

```
4D0907551.. 2.8l      V6/5V MOTR HS
D..□
Coding 04002      WSC 06388
```

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- Press =>key.

-> Indicated on display:

```
Rapid data transfer      HELP
Select function XX
```

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

Coding variants for engine control unit

Country/emissions	Drive / extra functions	Gearbox	Vehicle model
00 = ---	0 = Front-wheel drive without traction control system	0 = 5-speed manual gearbox	0 = ---
01 = ---	1 = Front-wheel drive with traction control system	1 = ---	1 = Audi A4
02 = Non-Member State of the European Union (MVEG I)	2 = Four-wheel drive without traction control system	2 = ---	2 = Audi A6

Country/emissions	Drive / extra functions	Gearbox	Vehicle model
03 = ---	3 = Four-wheel drive with electronic stability program (ESP)	3 =	3 = Audi A8
04 = Member State of the European Union (MVEG II)	4 = ---	4 = ---	4 = ---
05 = Engines with secondary air system (MVEG III)	5 = ---	5 = Automatic gearbox 01V	5 = ---
06 = ---	6 = ---	6 = ---	6 = ---
07 = ---	7 = ---	7 = ---	7 = ---
08 = China and Commonwealth of Independent States (CIS)	8 = ---	8 = ---	8 = ---

Compose the code number as per the following example:

Member State of the European Union	04
Front-wheel drive without traction control system	0
5-speed manual gearbox	0
Audi A4	1
Code number	<u>04 0 0 1</u>

Note:

Vehicles with traction control system (ASR) can be identified by the ASR warning lamp located in the dash panel insert, or by means of the ABS/ASR self-diagnosis

=> Running gear, Self-diagnosis; Repair group 01

6 - Reading measured value block

6.1 - Reading measured value block

Test conditions

- Coolant temperature at least 80 °C
- Electrical consumers switched off (radiator fan must not run during the check)
- Air conditioner switched off
- Gear selector lever in P or N position
- No fault stored in fault memory
- Connect fault reader V.A.G 1551 (V.A.G 1552) and select 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.)

-> Indicated on display:

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.

-> Indicated on display:

Read measured value block
Enter display group number XXX

- Enter the required display group number and confirm entry with the Q key.



-> Indicated on display:

Read measured value block										0
1	2	3	4	5	6					
7	8	9	10							

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
Skip	Press key C	Press key C

Display group overview

Display Gr. number	Indicated on display	Meaning
000 Basic function	Read measured val. block 00 1 2 3 4 5 6 7 8 9 10	1 = Coolant temperature 2 = Engine load 3 = Engine speed 4 = Throttle valve angle 5 = Control value for air mass at idling speed (idling speed control) 6 = Learned value for air mass at idling speed 7 = Control value for mixture formation, Bank 1 8 = Control value for mixture formation, Bank 2 9 = Learned value for mixture formation, Bank 1 10 = Learned value for mixture formation, Bank 2

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Display Gr. number	Indicated on display	Meaning
001 Basic function	Read measured val. block 1 1 2 3 4	1 = Engine speed 2 = Engine load (injection period per crankshaft revolution) 3 = Throttle valve angle 4 = Ignition timing
002 Basic function	Read measured val. block 2 1 2 3 4	1 = Engine speed 2 = Engine load (injection period per crankshaft revolution) 3 = Injection period (per engine cycle) 4 = Intake air mass
003 Basic function	Read measured val. block 3 1 2 3 4	1 = Engine speed 2 = Battery voltage 3 = Coolant temperature 4 = Intake air temperature

Display Gr. number	Indicated on display	Meaning
004 Idling speed	Read measured val. block 4 1 2 3 4	1 = Throttle valve angle 2 = Idling air mass, learned (automatics: not in drive position)

Display Gr. number	Indicated on display	Meaning
stabilisation		3 = Idling air mass, learned (automatics: drive engaged) 4 = Operating state: Idling Part throttle Full throttle Overrun Enrichment
005 Idling speed stabilisation	Read measured val. block 5 1 2 3 4	1 = Engine speed (actual) 2 = Engine speed (specified) 3 = Control value for idling speed stabilisation (idling speed control) 4 = Air mass

Display Gr. number	Indicated on display	Meaning
006 Idling speed stabilisation	Read measured val. block 6 1 2 3 4	1 = Idling speed 2 = Control value for air mass at idling speed (idling speed control) 3 = Lambda control, Bank 1 4 = Lambda control, Bank 2
007 Lambda learned values	Read measured val. block 7 1 2 3 4	1 = Lambda learned value, Bank 1 (multiplicative) 2 = Lambda learned value, Bank 2 (multiplicative) 3 = Lambda learned value, Bank 1 (additive) 4 = Lambda learned value, Bank 2 (additive)
008 Lambda learned values	Read measured val. block 8 1 2 3 4	1 = Idling speed 2 = Injection period per engine cycle 3 = Lambda learned value, Bank 1 (additive) 4 = Lambda learned value, Bank 2 (additive)

Display Gr. number	Indicated on display	Meaning
009 Lambda learned values	Read measured val. block 9 1 2 3 4	1 = Lambda probe voltage, Bank 1 2 = Lambda probe voltage, Bank 2 3 = Duty cycle of solenoid valve 1 for activated charcoal filter -N80 4 = Lambda correction factor with active fuel tank breather system
010 Fuel tank breather	Read measured val. block 10 1 2 3 4	1 = Duty cycle of solenoid valve 1 for activated charcoal filter -N80 2 = Lambda correction factor with active fuel tank breather system 3 = Fill level of activated charcoal filter -N80 4 = Purging rate of fuel tank breather system
011 Fuel consumption	Read measured val. block 11 1 2 3 4	1 = Engine speed 2 = Engine load (injection period per crankshaft revolution) 3 = Road speed 4 = Fuel consumption



Display Gr. number	Indicated on display	Meaning
012 Knock control	Read measured val. block 12 1 2 3 4	1 = Engine speed 2 = Ignition timing retardation by knock control, cylinder 1 3 = Ignition timing retardation by knock control, cylinder 2 4 = Ignition timing retardation by knock control, cylinder 3
013 Knock control	Read measured val. block 13 1 2 3 4	1 = Engine load 2 = Ignition timing retardation by knock control, cylinder 1 3 = Ignition timing retardation by knock control, cylinder 2 4 = Ignition timing retardation by knock control, cylinder 3
014 Knock control	Read measured val. block 14 1 2 3 4	1 = Engine speed 2 = Ignition timing retardation by knock control, cylinder 4 3 = Ignition timing retardation by knock control, cylinder 5 4 = Ignition timing retardation by knock control, cylinder 6

Display Gr. number	Indicated on display	Meaning
015 Knock control	Read measured val. block 15 1 2 3 4	1 = Engine speed 2 = Ignition timing retardation by knock control, cylinder 4 3 = Ignition timing retardation by knock control, cylinder 5 4 = Ignition timing retardation by knock control, cylinder 6
016 Knock control	Read measured val. block 16 1 2 3 4	1 = Engine speed 2 = Engine load 3 = Ignition timing 4 = Total ignition timing retardation by knock control
017 Knock sensor	Read measured val. block 17 1 2 3 4	1 = Engine speed 2 = Knock sensor voltage signal, cylinder 1 3 = Knock sensor voltage signal, cylinder 2 4 = Knock sensor voltage signal, cylinder 3

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Display Gr. number	Indicated on display	Meaning
018 Knock sensor	Read measured val. block 18 1 2 3 4	1 = Engine speed 2 = Knock sensor voltage signal, cylinder 4 3 = Knock sensor voltage signal, cylinder 5 4 = Knock sensor voltage signal, cylinder 6
019 Torque reduction	Read measured val. block 19 1 2 3 4	1 = Engine speed 2 = Engine load (injection period per crankshaft revolution) 3 = Required engine torque (specified torque) 4 = Actual engine torque (actual torque)
020 Operating conditions	Read measured val. block 20 1 2 3 4	1 = Engine speed 2 = Gear selector lever position 3 = Operating condition of air conditioner / rear window heating 4 = Air conditioner compressor

Display Gr. number	Indicated on display	Meaning
021 Operating	Read measured val. block 21 1 2 3 4	1 = Engine speed 2 = Engine load (injection period per crankshaft revolution)

Display Gr. number	Indicated on display	Meaning
conditions for lambda control		3 = Coolant temperature 4 = Lambda control OFF/ON
022		Ignore
023 Throttle valve positioner adaption	Read measured val. block 23 1 2 3 4	1 = Learning requirement display 2 = Min. stop of throttle valve positioner 3 = Emergency running stop of throttle valve positioner 4 = Max. stop of throttle valve positioner

Display Gr. number	Indicated on display	Meaning
024 Traction control	Read measured val. block 24 1 2 3 4	1 = Engine speed 2 = Torque reduction stages 3 = Required/specified engine torque (MMS) 4 = Actual engine torque (MMI)
025 System status	Read measured val. block 25 1 2 3 4	1 = Engine speed 2 = Engine load 3 = System status 4 = (Unallocated)

Display Gr. number	Indicated on display	Meaning
026 Camshaft timing control	Read measured block val. 26 1 2 3 4	1 = Engine speed 2 = Engine load 3 = Camshaft timing control, Bank 1 4 = Camshaft timing control, Bank 2
027 Camshaft timing control	Read measured val. block 27 1 2 3 4	1 = System status 2 = (Unallocated) 3 = Camshaft timing control, Bank 1 4 = Camshaft timing control, Bank 2
028...094		Ignore
095 Basic function	Read measured val. block 95 1 2 3 4	1 = Engine speed 2 = Engine load 3 = Ignition timing 4 = Coolant temperature
096...097		For factory use only

Display Gr. number	Indicated on display	Meaning
098 Throttle valve control part adaption	Read measured block val. 98 1 2 3 4	1 = Throttle valve potentiometer voltage 2 = Throttle valve positioner potentiometer voltage 3 = Operating state: idling / part load 4 = Adaption status: Adaption in progress Adaption OK Adaption ERROR
099 Lambda control	Read measured val. block 99 1 2 3 4	1 = Engine speed 2 = Coolant temperature 3 = Lambda mixture control



		4 = Lambda mixture control ON/OFF
--	--	-----------------------------------

6.2 - Reading measured value block: Display Groups 001 to 010

Display Group 001 - Basic function:

Read measured value block 1	⇒	◀ Indicated on display
xxx rpm	1.0....2.5 ms	0...5 <°
		9...15 ° BTDC
		Ignition timing
		Throttle valve angle
		Engine load (injection period per crankshaft revolution)
		Idling speed shown in steps of 40 rpm Four-wheel drive: 620...740 rpm Front-wheel drive: 740...860 rpm

Notes on display zone 2:

The increase in idling speed on vehicles with front-wheel drive occurs when the engine control unit receives a positive signal at contact 10 (from terminal 15).

Notes on display zone 2:

- ♦ The maximum engine load decreases by about 10 % per 1000 m above sea level.
- ♦ The engine load also decreases by up to 10 % if the ambient temperatures are very high.
- ♦ At full throttle the values will be at least:
approx. 7.0 ms at 4000 rpm
approx. 6.5 ms at 6000 rpm

Test table, Display Group 001

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
1	less than 620 rpm or less than 740 rpm	- Throttle valve control part -J338 sticking or defective	- Test throttle valve control part - J338 => Page 108
	more than 740 rpm or more than 860 rpm	- Idling speed switch -F60 not closed (defective) - Large quantity of unmetered air - (idling speed stabilisation cannot compensate) - Throttle valve control part -J338 sticking or defective	- Interrogate fault memory => Page 4 - Rectify leak (unmetered air) - Test throttle valve control part - J338 => Page 108

Test table, Display Group 001

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
2	less than 1.0	- Values of less than 1.0 can only occur when driving on overrun	
	more than 2.5	- Rough idling (engine not running on all cylinders)	- Injector or spark plugs defective

		- Air mass meter -G70 defective - Throttle valve control part -J338 defective - Electrical consumers on - Steering wheel on full lock - Drive position engaged (automatic gearbox) - Lambda control at maximum enrichment or leaning-down limit	- Interrogate fault memory => Page 4 - Test throttle valve control part - J338 => Page 108 - Switch off consumers - Return steering wheel to centre - Move selector lever to P or N - Test lambda control => Display Group 006
--	--	--	--

Test table, Display Group 001

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
3	less than 0 <°	- Not possible	
	more than 5 <°	- Adaption of throttle valve control part -J338 not performed - Throttle valve potentiometer in throttle valve control part -J338 defective or incorrectly set - Throttle cable setting - Throttle valve sticking	- Perform adaption of throttle valve control part -J338 => Page 4 - Test throttle valve control part - J338 => Page 108 - Adjust throttle cable => 6-cyl. Engine (5-valve), 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 - Rectify fault

Note on display zone 3:

- ♦ When the accelerator is fully depressed the display will show a value of between 75 and 95 <°.

Display Group 002 - Basic function:

Read measured value block 2				⇒	◀ Indicated on display
xxx rpm	1.0...2.5 ms	1.0...4.0 ms	3.0...5.0 g/s		
			Intake air mass		
		Injection period per engine cycle			
	Engine load - see Display Group 001				
Idling speed shown in steps of 40 rpm Four-wheel drive: 620...740 rpm Front-wheel drive: 740...860 rpm					

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Test table, Display Group 002

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
1		- See Display Group 001, display zone 1 => Page 38	
2		- See Display Group 001, display zone 2 => Page 38	



Test table, Display Group 002

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
3	less than 1.0	- Large quantity of fuel from activated charcoal filter system (ACF) - Wrong type of injectors fitted - (delivery rate too high)	- Test solenoid valve for activated charcoal filter =>Page 105 - Check injection quantity => Page 85
	more than 2.5	- Increased engine load (electrical consumers on, air conditioner on, drive position engaged or power steering on full lock)	- Remove load
4	less than 3.0	- Large quantity of unmetered air - between intake manifold and air mass meter	- Rectify leak (unmetered air)
	more than 5.0	- Drive position engaged (automatic gearbox) - Increased engine load due to - ancillaries	- Move selector lever to P or N - Remove load (e.g. air conditioner, power steering)

Notes on Display Group 002:

- Display zone 2 shows the injection period corresponding to the intake air mass and the engine load when idling. The value is a calculated (i.e. theoretical) value which for technical reasons only relates to a single crankshaft revolution. The engine load when idling is the load created by the internal friction which the engine has to overcome and the power required to drive the ancillaries. The intake air mass is shown in display zone 4.
- Display zone 3 shows the injection period for a complete engine cycle, i.e. two crankshaft revolutions.
- However, the value shown in display zone 3 is a corrected value corresponding to the actual injection period. It will not be double the value shown in display zone 2. The correction takes into account factors such as the following:

- Lambda mixture control
- Fuel intake from the activated charcoal filter
- Air density, air temperature
- Voltage of electrical system (faster or slower opening of injectors)

- For example, if the engine takes in unmetered air, only the calculated value in display zone 2 (injection period per crankshaft revolution) should change. The lambda mixture control will ensure that the actual injection period per complete engine cycle remains at the specified value.

Notes on display zone 4:

- Displayed is the air mass measured by the air mass meter.
- In emergency running caused by a fault on the throttle valve control part the engine runs without idling stabilisation at an increased idling speed (approx. 1000...1300 rpm) via the emergency running gap. In this case the air throughput is approx. 4.5...5.5 g/s.
- The replacement value in g/s from throttle valve potentiometer will be displayed if the engine control unit detects a fault on the air mass meter.

Display Group 003 - Basic function:

Read measured value block 3			⇒	◀ Indicated on display
xxx rpm	10..14.5 V	80..105 °C	...	°C
				Intake air temperature
				Coolant temperature

	Battery voltage
	Idling speed shown in steps of 40 rpm Four-wheel drive: 620...740 rpm Front-wheel drive: 740...860 rpm

Note on display zone 3:

The engine control unit will use the intake air temperature as a replacement value for an engine start (start temperature - replacement value) as soon as there is a fault stored in the fault memory, which affects the coolant temperature sender (G62). The temperature then rises according to a model stored in the control unit. When the engine has reached normal working temperature a fixed replacement value will be displayed after a certain period. This fixed value is also dependent upon the intake air temperature.

Note on display zone 4:

It is not possible to give specified values as the display readout is heavily affected by the ambient temperature.

Test table, Display Group 003

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
1		- See Display Group 001, display zone 1 => Page 38	
2	less than 10 V	- Alternator defective, battery charge very low - Heavy demand on electrical system shortly after starting due to high charging current and ancillaries - Contact resistance in power supply or earth connection for engine control unit - Current drain when ignition is switched off	- Test voltage and charge battery - Increase revs for a few minutes and switch off ancillaries - Test power supply to engine control unit => Page 138 - Eliminate current drain
	more than 14.5 V	- Voltage regulator in alternator defective - Excess voltage from assisted start or rapid charging	- Test voltage and if necessary fit a new regulator - Interrogate fault memory =>Page 4

Test table, Display Group 003

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
3	less than 80°C	- Engine too cold - Coolant temperature sender or wiring to engine control unit	- Take vehicle for test drive - Test coolant temperature sender -G62 =>Page 136
	more than 105°C	- Radiator dirty - Radiator fan not working - Thermostat defective - Coolant temperature sender or wiring to engine control unit	- Clean radiator - Check operation - Test thermostat - Test coolant temperature sender -G62 => Page 136
4	constant 25.5°C	- Fault detected in intake air temperature sender -G42 - Intake air temperature sender -G42	- Interrogate fault memory =>Page 4 - Test -G42 =>Page 131



Display Group 004 - Idling speed stabilisation:

Read measured value block 4			⇒	◀ Indicated on display
0....5 <°	-0.7...+0.7 g/s	-0.7...+0.7 g/s	Idling	
				Operating state (idling, part/full throttle, enrichment, overrun)
				Idling speed air mass, learned value (manual gearbox in neutral; automatic gearbox with selector lever in position P or N)
				Idling speed air mass, learned value (automatic gearbox with drive position engaged)
Throttle valve angle				

Test table, Display Group 004

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
2	less than -0.7 g/s	- Unmetered air downstream of throttle valve	- Rectify leak (unmetered air)
	more than +0.7 g/s	- Increased load due to ancillaries - Constriction or foreign bodies in intake tract	- Switch off air conditioner and electrical consumers - Eliminate constriction or foreign bodies

Note on display zone 1:

With the accelerator pedal floored the display value is about 75...95 <°.

Notes on display zones 2 and 3:

- Displayed is how far the idling stabilisation has "learned" and moved away from the predetermined design average. If the engine is new the value will be in the positive range due to the high engine friction, and when run-in in the negative range. Values from -0.70 g/s in conjunction with a value which is too low in display group 05, display zone 3 indicates unmetered air.
- The value displayed is calculated on the basis of information from the throttle valve potentiometer. It is not measured by the air mass meter.
- Display zone 3 will always show 0 on vehicles with a manual gearbox.

Note on display zone 4:

The following operating states are shown:

- Idling
- Part throttle
- Full throttle
- Overrun
- Enrichment (full-throttle enrichment)

Display Group 005 - Idling speed stabilisation:

Read measured value block 5			⇒	◀ Indicated on display
xxx rpm	xxx rpm	-10...+10 %	3.0...5.0 g/s	
				Air mass
Idling speed control				

Engine speed (specified) shown in steps of 10 rpm Four-wheel drive: 680 rpm Front-wheel drive with automatic gearbox, selector lever in P or N: 800 rpm Front-wheel drive with automatic gearbox, drive position engaged: 770 rpm Front-wheel drive with manual gearbox: 800 rpm
Engine speed (actual) shown in steps of 10 rpm Display: max. 2550 rpm in steps of 10 rpm Four-wheel drive: 620...740 rpm Front-wheel drive: 740...860 rpm

Note on display zone 2:

The specified engine speed from engine control unit (calculated in control unit) is displayed.

Notes on display zone 3:

- ♦ The change in air mass during idling is shown as a percentage. As soon as the change has been compensated for by the idling speed stabilisation learning process, the mean value is restored. The amount of deviation from the mean value depends on the extent of the load change (e.g. as a result of switching electrical consumers on or off).
- ♦ The air mass requirement varies with changing load conditions during idling, even though the engine speed remains the same.
- ♦ The learning process proceeds in small stages each time the idling speed switch closes. If the deviation is large, several stages are required. In such cases the accelerator must be blipped at intervals of approx. 20 seconds. Each blip activates a further stage in the learning process.
- ♦ The amount by which the learned value has "drifted away" is then shown in Display Group 004, display zone 2. The values from the idling speed control remain outside the tolerance if the learned values in Display Group 004, display zone 2, have reached the limits of adjustment (stop values).
- ♦ Min. values: -1.70 or +1.70 g/s

Display Group 006 - Idling speed stabilisation:

Read measured value block 6	⇒	◀ Indicated on display
xxx rpm	-10...+10 %	-10...+10 %
		Lambda control, Bank 2
		Lambda control, Bank 1
		Idling speed air mass, control value (idling speed control) - see Display Group 005
		Engine speed (actual) shown in steps of 10 rpm Display: max. 2550 rpm in steps of 10 rpm Four-wheel drive: 620...740 rpm Front-wheel drive: 740...860 rpm

Test table, Display Group 006

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
3/4	Outside tolerance range	- Negative value = mixture too rich. - Result: lambda control leans out the mixture - Positive value (+ sign not shown) - = mixture too lean. Result: lambda control enriches the mixture - Unmetered air - Injector defective - Lambda learned values at limit of adjustment	- Wait 30 seconds until display has settled - Rectify leak (unmetered air) - Check injection quantity => Page 85 - Check lambda learned values - see Display Group 007

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**Notes on display zone 3:**

- ♦ The readout should fluctuate around 0. If the display shows a constant 0, this means that the lambda mixture control has switched from closed-loop control to open-loop control because of a fault in the lambda control function. If this happens, interrogate the fault memory=>Page 4 .
- ♦ Lambda control operating status: check Display Group 021, display zone 4=>Page 51 .

Display Group 007 - Lambda learned values:

Read measured value block 7				⇒	Indicated on display
-10...+10 %	-10...+10 %	-10...+10 %	-10...+10 %		
					Lambda learned value for Bank 2 at idling speed (additive)
					Lambda learned value for Bank 1 at idling speed (additive)
					Lambda learned value for Bank 2 at part throttle (multiplicative)
					Lambda learned value for Bank 1 at part throttle (multiplicative)

Notes on all display zones:

Low values indicate that the engine is running too rich and therefore the Lambda regulation is leaning the mixture.

- ♦ High values indicate that the engine is running too lean and therefore the Lambda regulation enriches the mixture.
- ♦ If there is no voltage supply to the control unit all the values learnt will be cancelled.
- ♦ add = additive - The effects of the fault (e.g. unmetered air) will reduce as the engine speed increases. The injection period will be modified by a fixed amount for additive learnt values. This amount is not dependent upon the basic injection period.
- ♦ mul = multiplicative - The effects of the fault (e.g. faulty injector) will increase as the engine speed increases. A multiplicative learnt value is a proportional change to the injection period. This change is dependent on the basic injection period.
- ♦ If differences of more than 15 % are displayed between cylinder bank 1 and cylinder bank 2 for the Lambda learnt values, the following faults are possible:
 - Spark plug defective
 - Injector defective (leaking, blocked)
 - Lambda probe defective, soiled
 - Unmetered air on one bank
 - The engine basic mechanical setting (valve timing) not in order

Test table, Display Group 007

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
1/2/3/4	Low lambda learned values	- Low lambda learned values at idling speed and normal lambda learned values at part throttle; oil may be - diluted with petrol - Injector leaking - Fuel pressure too high - Solenoid valve 1 for activated - charcoal filter -N80 constantly open - Air mass meter -G70 defective - Lambda probe heating defective or lambda probe dirty	- Disappears after motorway run or oil change Display Group 009, display zones 1 and 2 => Page 45 - Test injector =>Page 82 - Check fuel pressure => Page 80 - Test -N80 => Page 105 - Test -G70 => Page 90 - Check lambda probe heating => Page 100

Test table, Display Group 007

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
1/2/3/4	High lambda learned values	- High lambda learned values for - idling and lower lambda learned - values for part throttle; possibility of unmetered air around intake manifold - Injector blocked - High values in display zones 2 and 3; air mass meter -G70 defective - Fuel pressure too low - Unmetered air between -G70 and throttle valve - Unmetered air at manifold gasket - Lambda probe heating defective or lambda probe dirty	- Rectify faults - Display Group 009, display zones 1 and 2 => Page 45 - Check injection quantity =>Page 85 - Test -G70 =>Page 90 - Check fuel pressure =>Page 80 - Rectify fault - Check lambda probe heating =>Page 100

Display Group 008 - Lambda learned values:

Read measured value block 8	⇒	◀ Indicated on display
xxx 1.00...3.00 -10...+10 -10...+10		
rpm ms % %		
		Lambda learned value for Bank 2 at idling speed (additive) - see Display Group 007
		Lambda learned value for Bank 1 at idling speed (additive) - see Display Group 007
		Injection period per engine cycle - see Display Group 002
Idling speed shown in steps of 10 Display: max. 2550 rpm in steps of 10 Four-wheel drive: 620...740 rpm Front-wheel drive: 740...860 rpm		

Display Group 009 - Lambda probe voltage:

Read measured value block 9	⇒	◀ Indicated on display
0.00...1.00 0.00...1.00 0....99 % 0.6...1.1		
V V		
		Lambda correction factor with active fuel tank breather system - see Display Group 010
		Duty cycle of ACF solenoid valve 1 - see Display Group 010
		Lambda probe voltage, Bank 2
		Lambda probe voltage, Bank 1

Notes on display zones 1 and 2:

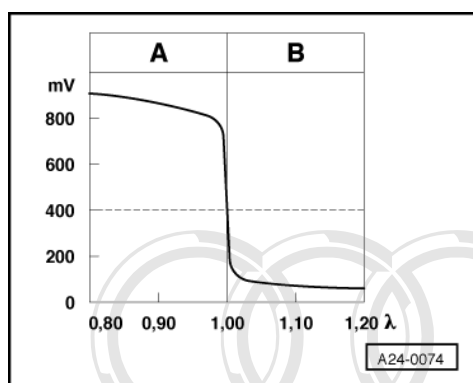
- ♦ The voltage signal "rich mixture (low level of residual oxygen)" is approx. 0.7...1.1 V.
- ♦ The voltage signal "lean mixture (high level of residual oxygen)" is approx. 0.0...0.3 V.



- ♦ When changing from "rich" to "lean" and back again ($\lambda = 1.0$) the voltage jump will change from 0.7...1.1 V to 0.0...0.3 V or back again.

Notes continued:

- ♦ Due to the steep voltage jumps the Lambda control cannot keep the ideal mixture composition $\lambda = 1.0$ constant. The control fluctuates constantly between conditions "slightly too lean" and "slightly too rich".
- ♦ The displayed value must temporarily drop below 0.3 V and exceed 0.6 V. Displayed values below 0.45 V signifies lean, above 0.45 V rich.



-> Lambda probe voltage U_{λ} in mV

A: High Lambda probe voltage

- ♦ Rich mixture (excess of fuel or shortage of air)
- ♦ Higher CO value

B: Low Lambda probe voltage

- ♦ Lean mixture (shortage of fuel or excess air)
- ♦ Lower CO value

Test table, Display Group 009

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
1/2	Display constant (between 0.0 and 0.3 V or between 0.7 and 1.1 V)	- Large quantity of unmetered air - Spark plug defective - Fuel system pressure too low or too high - Injector defective - Coolant temperature sender - G62 - Solenoid valve 1 for activated charcoal filter -N80 - Lambda probe heating not working - Lambda probe defective or dirty	- Rectify fault - Check spark plug - Check fuel pressure regulator and holding pressure => Page 80 - Test injectors => Page 82 - Interrogate fault memory => Page 136 - Perform final control diagnosis =>Page 105 - Check lambda probe heating => Page 100 - Interrogate fault memory => Page 98

Display zone	Readout on V.A.G 1551	Cause of fault	Fault remedy
--------------	-----------------------	----------------	--------------

1/2	Constant 1.105 V	- Short circuit to positive in: - - Lambda probe - - Signal wire - - Earth wire - - Engine control unit	- Test lambda probe => Page 98
	Constant value between 0.400 and 0.500 V	- Open circuit in: - - Lambda probe -G39 - - Signal wire - - Earth wire - - Engine control unit	- Test lambda probe => Page 98
	Constant 0.000 V	- Short circuit to earth in: - - Lambda probe -G39 - - Signal wire - - Earth wire - - Engine control unit	- Test lambda probe => Page 98

Display Group 010 - Fuel tank breather system:

Read measured value block 10 ⇒ ◀ Indicated on display			
0...99 %	0.6...1.1	-5...+95	0.00...1.50
Purging rate of fuel tank breather system			
Fill level of activated charcoal filter			
Lambda correction factor with active fuel tank breather system			
Duty cycle of solenoid valve 1 for activated charcoal filter -N80			

Notes on display group 010:

- ♦ The engine control unit specifies the amount of fuel vapours which are fed into the engine, via the activated charcoal filter solenoid valve 1 (N80). If the activated charcoal filter has a high charge level and the solenoid valve 1 must remain close to maintain prescribed purge rate (low duty cycle), the reaction of the Lambda regulation will be seen by a change in the Lambda correction factor. If this reaction is lower than expected, because in the meantime the charge level has been increased due to the fuel vapours from the fuel tank, the control unit will from this calculate a higher charge level.
- ♦ Testing fuel tank breather system =>Page **105**

Notes continued:

Notes on display zone 1:

- ♦ When the Lambda control starts operating, the activated charcoal filter solenoid valve 1 (N80) is pulsed at intervals of approx. 220...900 seconds (tank breather function) and switched off for approx. 70 seconds (no tank breather function).
During the 70 seconds the Lambda control learns the operating conditions without the influence of fuel vapours from the activated charcoal filter.
- ♦ Duty cycle 0 % indicates that the activated charcoal filter solenoid valve 1 is closed. For a duty cycle of 99 % the solenoid valve 1 is fully open.
- ♦ At idling speed the engine can only accept a certain maximum amount of fuel vapours from the activated charcoal filter system. Therefore the activated charcoal filter solenoid valve 1 opening is limited at idling. The duty cycle can rise to 99 % at part throttle and full throttle.
- ♦ The influence of the activated charcoal filter system can be assessed by comparing the displayed values during the "Basic setting" (solenoid valve 1 closed) and during "Read measured value block" (solenoid valve 1 approx. 220...900 seconds open/approx. 70 seconds closed).
- ♦ It is possible to switch between function 04 "Basic setting" and function 08 "Read measured value block" by pressing keys 4 and 8 on V.A.G 1551/1552.

Notes continued:

Notes on display zone 2:

- ♦ If a very rich mixture is being given off by the activated charcoal filter system, it must be leaned down by the Lambda control. This leaning can be up to 0.6. This means in this case that the Lambda control must reduce the injection rate by 40 %.



- ♦ If the displayed value is 1.0 (Lambda control in neutral range, which means no correction factor) either an ideal mixture is coming from the activated charcoal filter system (it is not necessary to alter the mixture) or the solenoid valve 1 is closed => display zone 1.
- ♦ If the displayed value is between 1.01 and 1.10 the mixture coming from the activated charcoal filter system is too lean. Therefore the Lambda control must enrich the mixture.

Notes on display zone 3:

- ♦ -5 indicates that there are no fuel vapours in activated charcoal filter.
- ♦ +95 indicates that the activated charcoal filter is completely full with fuel vapours.

Notes on display zone 4:

- ♦ The display shows the proportion of the total intake volume that comes from the activated charcoal filter system.
- ♦ 0.00 indicates nothing has been fed in from the activated charcoal filter system (solenoid valve 1 closed).
- ♦ 1.50 indicates that 30 % of the intake air mass comes from the activated charcoal filter system.

6.3 - Read measured value block: Display Groups 011 to 099**Display Group 011 - Fuel consumption:**

Read measured value block 11 ⇒				◀ Indicated on display
xxx rpm	1.0...2.5 ms	0 km/h	0.8...1.8 ltr./h	
				Fuel consumption: The specified value shown on the display relates only to idling without additional load from ancillaries (automatic gearbox, air conditioner, alternator, power steering pump). Not for measuring fuel consumption in litres/100 km
				Road speed
				Engine load
Idling speed shown in steps of 40 rpm Four-wheel drive: 620...740 rpm Front-wheel drive: 740...860 rpm				

Display Group 012 - Knock control:

Read measured value block 12 ⇒				◀ Indicated on display
0...6800 rpm	0...12° cr/shaft	0...12° cr/shaft	0...12° cr/shaft	
				Ignition timing retardation by knock control, cylinder 3
				Ignition timing retardation by knock control, cylinder 2
				Ignition timing retardation by knock control, cylinder 1
Engine speed				

Display Group 013 - Knock control:

Read measured value block 13 ⇒				◀ Indicated on display
0...10 ms	0...12° cr/shaft	0...12° cr/shaft	0...12° cr/shaft	
				Ignition timing retardation by knock control, cylinder 3

		Ignition timing retardation by knock control, cylinder 2
		Ignition timing retardation by knock control, cylinder 1
	Engine load	

Display Group 014 - Knock control:

Read measured value block 14	⇒	◀ Indicated on display
0...6800 rpm	0...12° cr/shaft	0...12° cr/shaft
		Ignition timing retardation by knock control, cylinder 6
		Ignition timing retardation by knock control, cylinder 5
		Ignition timing retardation by knock control, cylinder 4
	Engine speed	

Display Group 015 - Knock control:

Read measured value block 15	⇒	◀ Indicated on display
0...10 ms	0...12° cr/shaft	0...12° cr/shaft
		Ignition timing retardation by knock control, cylinder 6
		Ignition timing retardation by knock control, cylinder 5
		Ignition timing retardation by knock control, cylinder 4
	Engine load	

Notes on display groups 012, 013, 014 and 015:

- ◆ The knock control operates at engine loads of 40% or more.
- ◆ At engine loads of more than 40% the display will show the current (instantaneous) ignition timing retardation values. At engine loads of less than 40% the display will show the last values used (constant readout).
- ◆ If there is audible knocking and no perceptible ignition timing retardation, increase the engine speed to above 3500 rpm for 5 seconds in order to activate the knock sensor fault recognition (diagnosis) function.
- ◆ If there is a significant difference between the ignition timing retardation value for one of the cylinders and the values for the other cylinders, the following faults are possible:

- Loose ancillaries

- Corrosion on plug connector

- Engine damage (e.g. oil burning because of defective piston)

- ◆ If the ignition timing retardation values for all the cylinders are high, the following faults are possible:

- Corrosion on plug connector

- Wrong tightening torque (should be 20 Nm)

- Open circuit in wiring

- Knock sensor defective

- Loose ancillaries

- Poor-quality fuel (less than RON 95)



Display Group 016 - Knock control:

Read measured value block 16				⇒	◀ Indicated on display
0...6800 rpm	0...10 ms	-20...+40° A/BTDC	0.0...72.0° cr/shaft		
Total ignition timing retardation, cylinders 1 to 6					
Ignition timing					
Engine load					
Engine speed					

Notes on display group 016:

- ♦ To prevent engine damage the knock control must retard the ignition timing as soon as pinking is recognised.
- ♦ Retarding the ignition will though increase the exhaust gas temperature. There is a danger that the catalyst will overheat.
- ♦ To prevent this overheating, the mixture is enriched to lower the exhaust gas temperature when the total retardation of approx. 10°cr/shaft is reached at full throttle.

Display Group 017 - Knock sensor:

Read measured value block 17				⇒	◀ Indicated on display
xxx rpm	0.50...1.40 V	0.50...1.40 V	0.50...1.40 V		
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Knock sensor voltage signal, cylinder 3					
Knock sensor voltage signal, cylinder 2					
Knock sensor voltage signal, cylinder 1					
Idling speed shown in steps of 40 rpm					
Four-wheel drive: 620...740 rpm					
Front-wheel drive: 740...860 rpm					

Display Group 018 - Knock sensor:

Read measured value block 18				⇒	◀ Indicated on display
xxx rpm	0.50...1.40 V	0.50...1.40 V	0.50...1.40 V		
			Knock sensor voltage signal, cylinder 6		
			Knock sensor voltage signal, cylinder 5		
			Knock sensor voltage signal, cylinder 4		
Idling speed shown in steps of 40 rpm					
Four-wheel drive: 620...740 rpm					
Front-wheel drive: 740...860 rpm					

Notes on display groups 017 and 018:

- ♦ If no faults are found when testing the knock sensor, the wiring and the connectors, check the engine for loose ancillaries or engine damage (see display groups 012, 013, 014 and 015).
- ♦ At high engine speeds the displayed signal voltage for the knock sensors can reach 5.1 V.
- ♦ If there is more than 50 % difference between the smallest and largest knock sensor signals, the cause could be corrosion on the connector.

Display Group 019 - Torque reduction (automatic gearbox):

Read measured value block 19				⇒	◀ Indicated on display
------------------------------	--	--	--	---	------------------------

0...6800 rpm	0.0...10.0 ms	0...410 Nm	-100...300 Nm	
			Actual engine torque	
			Required (specified) engine torque	
	Engine load			
Engine speed				

Notes on display group 019:

- ◆ This display group is used to check how the retardation of the ignition timing reduces the engine torque and thereby minimises jerky gear shifts.
- ◆ Due to the very short signals the retardation of the ignition timing is not always detected and therefore not displayed on V.A.G. 1551/1552.
- ◆ The engine torque required for the gear shift (specified torque) is shown in display zone 3.
- ◆ The actual engine torque (clutch torque/actual torque) is shown in display zone 4
- ◆ Checking ignition timing retardation during gear shift => Page 121

Display Group 020 - Operating conditions:

Read measured value block 20 ⇒				◀ Indicated on display
rpm	Neutral	A/C-High	Compr.ON	
	Gear engag	A/C-Low	Compr.OFF	
Air conditioner compressor ON/OFF				
On vehicles with no air conditioner the display will always read "Compr.OFF".				
Status of "idling speed increase" function				
Selector lever in Neutral or with gear engaged				
On vehicles with manual gearboxes the display will always read "Neutral".				
Engine speed shown in steps of 10 rpm				

Note on display zone 3:

- ◆ A/C-High = "idling speed increase" function active
- ◆ A/C-Low = "idling speed increase" function not active
- ◆ On vehicles with front-wheel drive the display will always show "A/C-High".
- ◆ On vehicles with four-wheel drive the idling speed is increased when the battery voltage is low.

Display Group 021 - Operating conditions for Lambda control:

Read measured value block 21			⇒	◀ Indicated on display
rpm	ms	° C	λctrl.OFF λctrl.ON	
			Lambda control OFF/ON	
		Coolant temperature		
	Engine load			
Engine load shown in steps of 40 rpm				

Notes on display group 021:

- ◆ At a starting temperature of below 15 °C (intake air temperature) the engine control unit will not switch the Lambda control on until a coolant temperature of 55 °C is reached.
- ◆ For a starting temperature above 15 °C (intake air temperature) the Lambda control will commence functioning when the probes are recognised as being operationally ready.
- ◆ If the Lambda control is switched off the engine runs controlled by the engine map.

**Display Group 022**

This display group is for factory use only.

The display values are not relevant for fault-finding in the workshop.

Display Group 023 - Adaption of throttle valve positioner:

Read measured value block 23				⇒	◀ Indicated on display
01000000	72...95 %	60...92 %	xxx %		
					Max. stop of throttle valve positioner -V60 Vehicles up to model year 1997: 16...51 % Vehicles from model year 1998 onwards Manual gearbox: 18...54 % Automatic gearbox: 34...70 %
					Emergency running stop of throttle valve positioner -V60 Vehicles up to model year 1997: 65...85 % Vehicles from model year 1998 onwards: 60...92 %
					Min. stop of throttle valve positioner -V60
Learning requirement display					

Note on display zone 1:

If the display does not show the specified value, perform adaption of throttle valve control part -J338=>Page 109.

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Note on display zone 2, 3 and 4:

The display will show the stop values learned at the last basic setting.

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

If the display still does not show the specified value even after the basic setting has been performed, check the wiring for open circuits or short circuits and also check the plug connections for dirt or corrosion before fitting a new throttle valve control part.

Significance of figures in 8 digit number block, display zone 1 - Learning requirements display

X X X X X X X X								Relevance
								Not relevant
								Learning process Min. stop from sender for throttle valve positioner (G127) 0 = Learning process carried out, learning process OK. 1 = Learning process not carried out, learning process not OK.
								Learning process Max. stop from sender for throttle valve positioner (G127) 0 = Learning process carried out, learning process OK. 1 = Learning process not carried out, learning process not OK.
								Learning process throttle valve potentiometer (G69) Min. stop 0 = Learning process carried out, learning process OK. 1 = Learning process not carried out, learning process not OK.
								Learning process throttle valve potentiometer (G69) Max. stop 0 = Learning process carried out, learning process OK. 1 = Learning process not carried out, learning process not OK.
								Not relevant
								Balancing throttle valve potentiometer (G69) with sender for throttle valve positioner (G127) 0 = Balance must be carried out 1 = Balance has been carried out, balance OK.

Not relevant

Display Group 024 - Traction control system (ASR):

Read measured value block 24		⇒		Indicated on display
0...6800 rpm	0 ... 12	-100...410 Nm	-100...300 Nm	
		Actual engine torque (MMI)		
		Required/specified engine torque (MMS)		
		Torque reduction stages		
		Engine speed		

Notes on display group 024:

- Display group 024 is only relevant for vehicles with traction control system (TCS).
- Vehicles with traction control system can be recognised by the TCS warning lamp in dash panel insert or ABS/TCS self-diagnosis.

⇒ Running gear, Self-diagnosis; Repair group 01

When loss of traction is recognised, how the engine torque is reduced to prevent wheel spin can be assessed in this display group.

The engine control unit informs the ABS/TCS control unit of the current engine torque (actual torque). If wheel spin is recognised the required specified torque signal is calculated in the ABS/TCS control unit. This specified torque signal is forwarded to the engine control unit to reduce the torque. This torque reduction is broken down into 12 reduction stages. The ABS/TCS control unit receives the return information as to what extent the engine torque has been reduced, via the actual torque signal.

Notes continued:

- When the engine is cold (coolant temperature less than 30 °C) the engine torque reduction is achieved by:
 - Small reduction stages (1...2) by retarding the ignition timing.
 - Large reduction stages (3...12) by briefly switching off individual injectors.
- When the engine is warm (coolant temperature exceeds 45 °C) the engine torque reduction is achieved by briefly switching off individual injectors and by retarding the ignition timing.

Notes on display zones 3 and 4:

- Display zone 3 shows the required engine torque as calculated by the ABS/ASR control unit (specified engine torque).
- Testing specified engine torque signal from ABS/ASR control unit ⇒ Page 119.
- Display zone 4 shows the actual engine torque (torque at clutch).
- Testing signal for actual engine torque ⇒ Page 119.
- A distinctly higher value than the maximum 300 Nm possible from the engine will be shown in display zone 3 when the traction control system is not active, i.e. when no torque reduction is required from the traction control system. This is a purely theoretical value (up to 410 Nm) which is deliberately high in order to ensure that there is a definite "safety margin" compared with the actual torque available. This ensures that the engine control unit will recognise the demand to reduce the torque under all conditions.
- During the period where the traction control system is active the values in display zones 3 and 4 will come into a line with each other.

Display Group 025 - System status:

Read measured value block 25		⇒		Indicated on display
0...6800 rpm	0.0...10.0 ms	X	XX	
		(Unallocated)		
		System status - see Display Group 027		
		Engine load		



Engine speed

Display Group 026 - Camshaft timing control:

Read measured value block 26			⇒	◀ Indicated on display
0...6800 rpm	0.0...10.0 ms	Normal position: -3.0 ... 6.0 ° cr/shaft Adjusted position: 16.0 ... 25.0 ° cr/shaft		
		Camshaft timing control, Bank 2 - see Display Group 027		
		Camshaft timing control, Bank 1 - see Display Group 027		
		Engine load		
		Engine speed		

Display Group 027 - System status and camshaft timing control:

Read measured value block 27			⇒	◀ Indicated on display
X X X	Normal position: -3.0 ... 6.0 ° cr/shaft Adjusted position: 16.0 ... 25.0 ° cr/shaft			
		Camshaft timing control, Bank 2		
		Camshaft timing control, Bank 1		
		(Unallocated)		
		System status		

Note on display zone 1:

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The display shows which systems are being activated by the engine control unit (system status). If the operating conditions (e.g. engine load, engine speed) for a system are right, the control unit will activate the system. However, the fact that a system is being activated does not necessarily mean that it is operating correctly.

Significance of the figures in the 3 digit display, display zone 1 - System mode

X						X	X	Significance
Value "0" = Conditions not fulfilled, activation not active								
Value "1" = Conditions fulfilled, activation active								
Camshaft adjustment								
Intake manifold change-over								
Vacant								
Energy statement for heating-up Cat.								

Notes on display zones 3 and 4:

- There are only two positions for the adjustable camshaft, the normal position and the adjusted position. To bring the camshaft into the adjusted position, accelerate the vehicle in 1st gear from rest. Display zones 3 and 4 show the actual positions of the adjustable camshafts. When the camshaft adjustment function is active (see display zone 1), display zones 3 and 4 will show whether the camshaft positions have in fact been adjusted (feed-back signal).
-Camshaft in normal position = -3.0...+6.0°cr/shaft
-Camshaft in adjusted position = 16.0...25.0°cr/shaft
- If display zones 3 and/or 4 display a value between 6.0°cr/shaft and 16.0°cr/shaft during a road test, this means that the camshaft adjustment solenoid valves are directing the oil pressure to the mechanical camshaft adjusters in the normal way, but that the mechanical camshaft adjusters are unable to reach their end positions (e.g. because they are stiff).

- ♦ Testing camshaft timing control => Page 146 .

Display Group 095 - Basic function:

Basic setting 95			⇒	◀ Indicated on display
xxx rpm	1.00....2.50 ms	12.0° BTDC	-40...125 °C	
			Coolant temperature - see Display Group 003	
			Ignition timing - see Display Group 001	
			Engine load	
			Engine control units up to 4D0 907 551: ... %	
			Engine control units from 4D0 907 551 F onwards: 1,00...2,50 ms	
			Engine speed	
Four-wheel drive: 620...740 rpm				
Front-wheel drive: 740...860 rpm				

Display Groups 096 and 097:

These display groups are for factory use only.

The display values are not relevant for fault-finding in the workshop.

Display Group 098 - Adaption of throttle valve control part:

Basic setting 98			⇒	◀ Indicated on display
0...5 V	0...5 V	Idling Part throt	ADP. runs ADP. O.K. ADP ERROR	
			Adaption state ADP. = adaption of throttle valve control part	
		Operating state		
	Voltage of potentiometer for idling speed positioner			
Voltage of throttle valve potentiometer				

Display Group 099 - Lambda control:

Read measured value block 99			⇒	◀ Indicated on display
rpm	°C	-10...+10 %	λ ctrl. OFF λ ctrl. ON	
			Lambda control OFF/ON Basic setting (04): λ ctrl. OFF Read measured value block (08): λ ctrl. ON	
			Lambda control	
	Coolant temperature			
Engine speed				

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Notes on display zone 4:

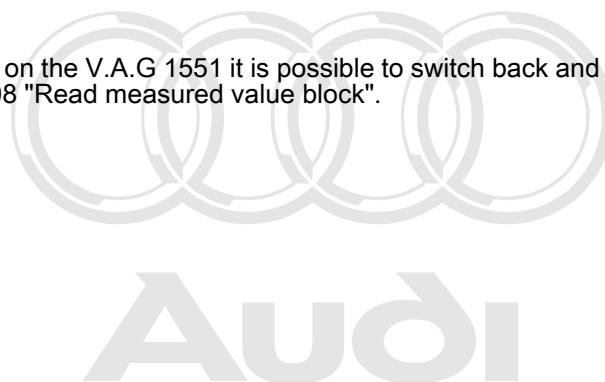
- ♦ To assist fault-finding, the lambda mixture control function is de-activated when Display Group 099 is selected in "Basic setting" mode (function 04) and activated when it is selected in "Read measured value block" mode (function 08).
- ♦ The lambda mixture control function is automatically re-activated by exiting from function 04 "Basic setting".



Audi A4 1995 ➤

Motronic injection and ignition system (6-cylinder) - Edition 09.1997

- ♦ By pressing the keys 4 and 8 on the V.A.G 1551 it is possible to switch back and forth between function 04 "Basic setting" and function 08 "Read measured value block".



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24 - Mixture preparation, Injection

1 - Servicing Motronic injection system

1.1 - Servicing Motronic injection system

1.2 - Safety precautions

Warning!

The fuel system is pressurized! Before loosening hose connections or opening the test connection, place a cloth around the connection. Then carefully pull hose off or remove the plug.

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 operate the engine at starting speed without actually starting it (for example, in order to test compression), unplug the connector from the power output stage for the ignition coils and also the plug connectors on the injectors. After completing the work, interrogate the fault memory.
- ◆ 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.

Observe following if test and measuring instruments are required during a test drive:

Warning

- ◆ Test equipment must always be secured on the rear seat and operated by a second person.
- ◆ If test equipment is operated from the front passenger seat, the occupant could be injured by the passenger's airbag in an accident.

1.3 - Rules for cleanliness

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

- ◆ Thoroughly clean all unions and the adjacent areas before disconnecting.
- ◆ Place parts that have been removed on a clean surface and cover. Do not use fluffy cloths!
- ◆ Carefully cover opened components or seal, if the repair cannot be carried out immediately.
- ◆ Only install clean components:
Only unpack replacement parts 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

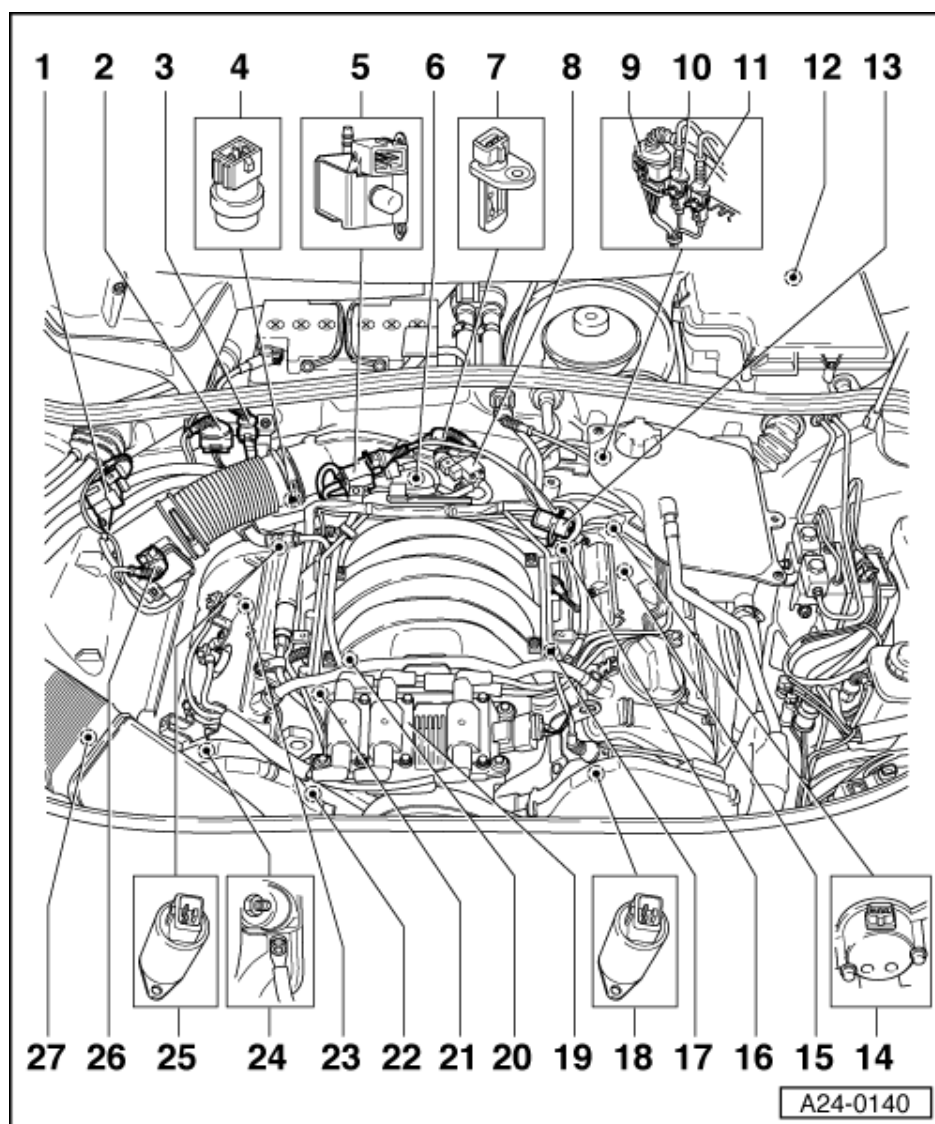
Engine code letters		ACK (2.8 ltr. / 5V / 142 kW engine) ALG (2.8 ltr. / 5V / 142 kW engine with secondary air system)
Idling speed Not adjustable - controlled by idling speed stabilisation	Front-wheel drive	740...860 rpm
On vehicles with four-wheel drive the idling speed may increase to between 740 and 860 rpm when the battery voltage is low.	Four-wheel drive	620...740 rpm
Engine speed limitation by switching off the injectors		6500 rpm
Fuel pressure at idling speed	Vacuum hose connected	approx. 3.2 ... 3.8 bar
	Vacuum hose disconnected	approx. 3.8 ... 4.2 bar
Holding pressure after 10 minutes	Engine cold	approx. 2.2 bar
	Engine warm	approx. 3.0 bar
Injectors	Spray pattern	Two-hole injector
	Injection qty. (30 s)	90 ... 125 ml
	Resistance (room temperature) 1)	13.5 ... 15.5 ω

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



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1.5 - Fitting locations overview



Diagnostic connector

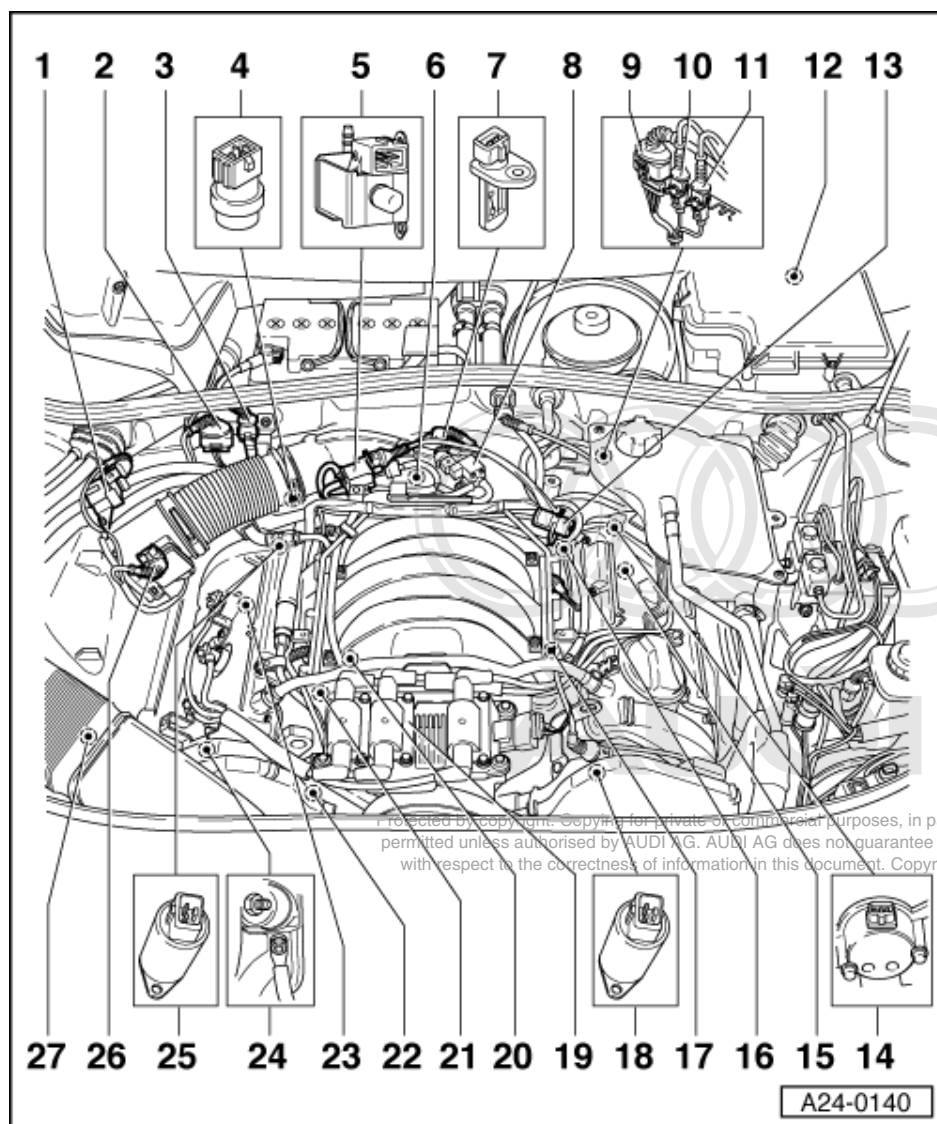
- ◆ Located in rear ashtray in centre console

Fuel pump relay

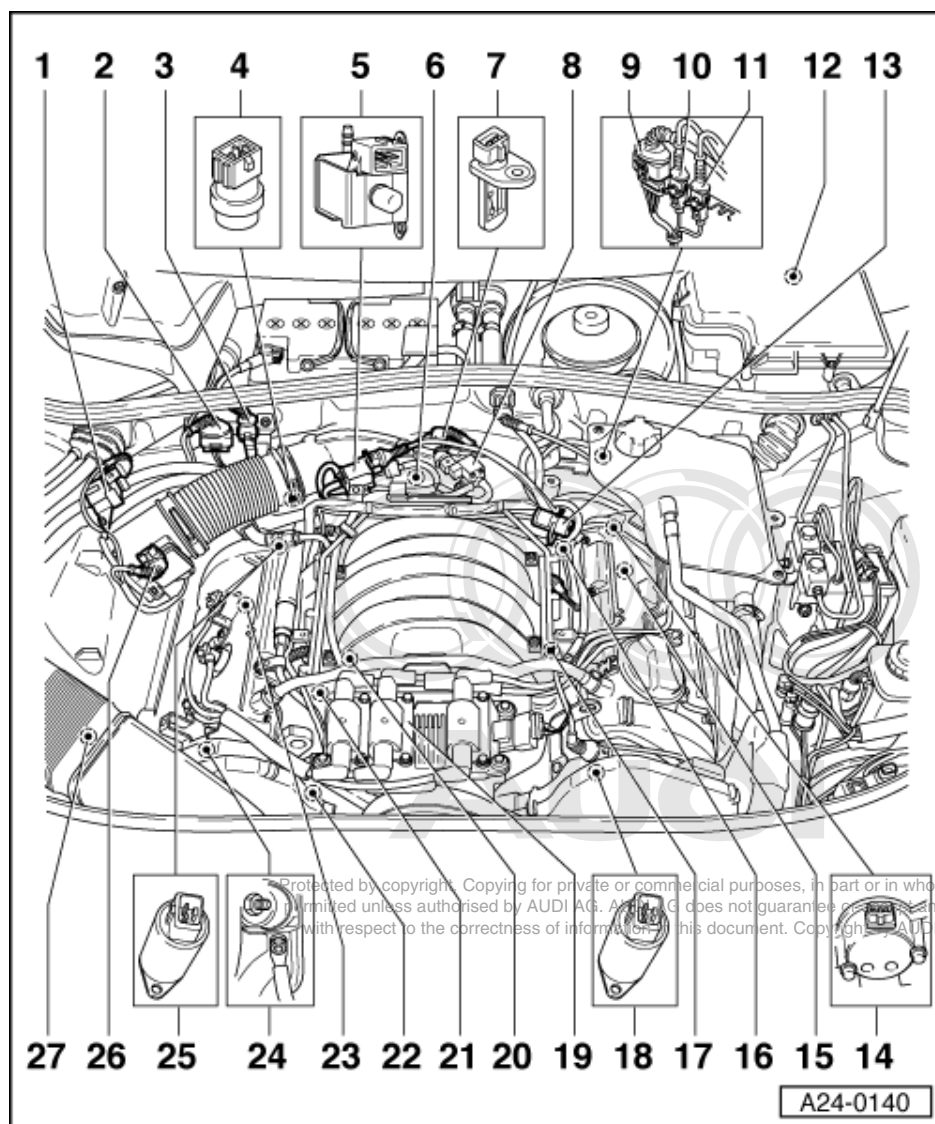
- ◆ In relay position 6 in central electrics below dash panel

- 1 Activated charcoal filter solenoid valve 1 -N80
- 2 4 pin connector
 - ◆ For Lambda probe 1 -G39
- 3 3 pin connector
 - ◆ For knock sensor 1 -G61
- 4 Coolant temperature sender -G62
 - ◆ On coolant pipe behind cylinder head Bank 1

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- 5 Secondary air inlet valve**
-N112
♦ Only on vehicles with secondary air system
- 6 Throttle valve control part -J338**
- 7 Intake air temperature sender -G42**
- 8 Intake manifold change-over valve -N156**
- 9 4 pin connector**
♦ For Lambda probe 2 -G108 and Lambda probe heating -Z28
- 10 3 pin connector**
♦ For engine speed sender -G28
- 11 3 pin connector**
♦ For knock sensor 2 -G66



12 Electronics box in plenum chamber

- ♦ Engine control unit -J220
- ♦ Secondary air pump relay -J299
 (only on vehicles with secondary air system)

13 Fuel pressure regulator

14 Hall sender -G40

- ♦ Cylinder bank 2

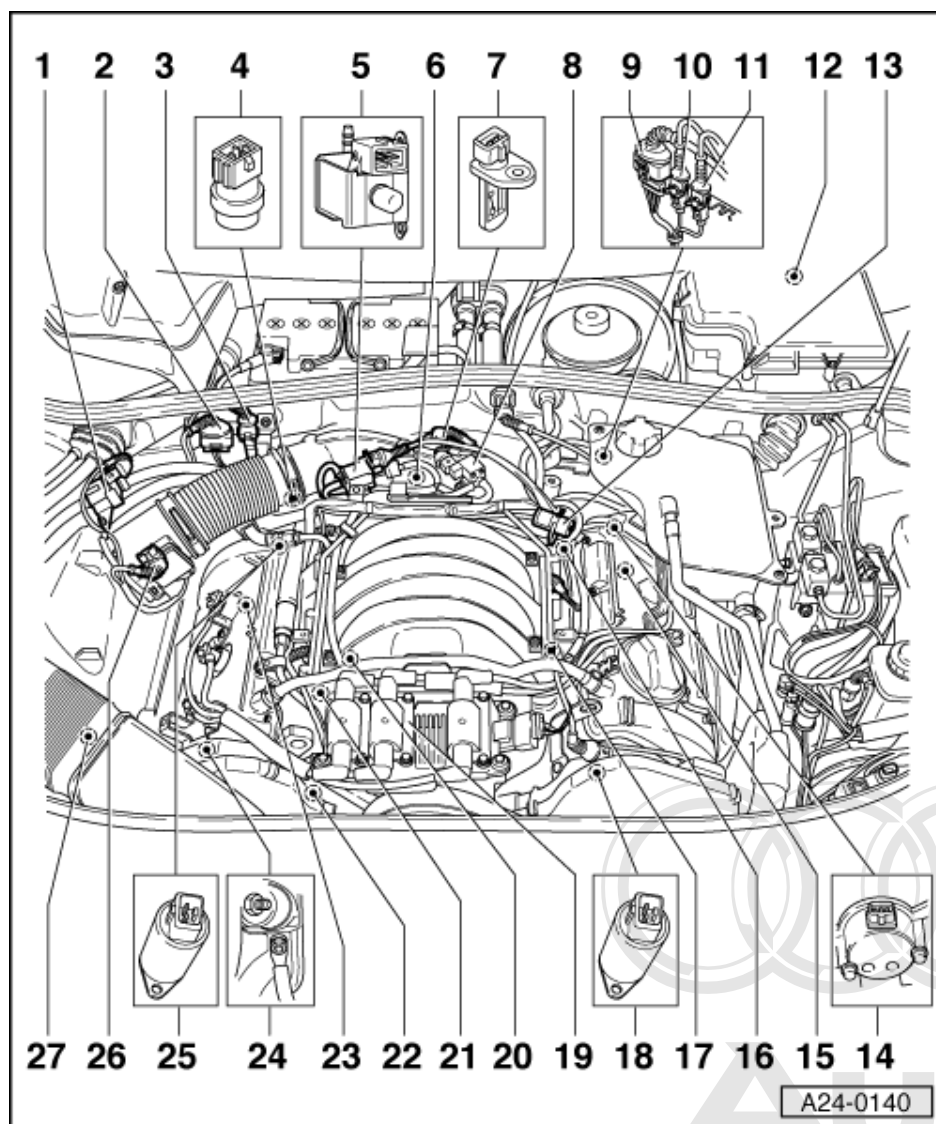
15 Lambda probe 2 -G108

16 Engine speed sender -G28

- ♦ In gearbox housing above starter ring gear

17 Knock sensor 2 -G66

18 Camshaft adjustment valve 2 -N208



19 Ignition coils -N, -N128 and -N158

- ♦ With output stage -N122

20 Knock sensor 1 -G61

21 Injector -N30...-N33, -N83, -N84

22 Hall sender -G163

- ♦ Cylinder bank 1

23 Lambda probe 1 -G39

24 Earth connection

- ♦ On engine support, right

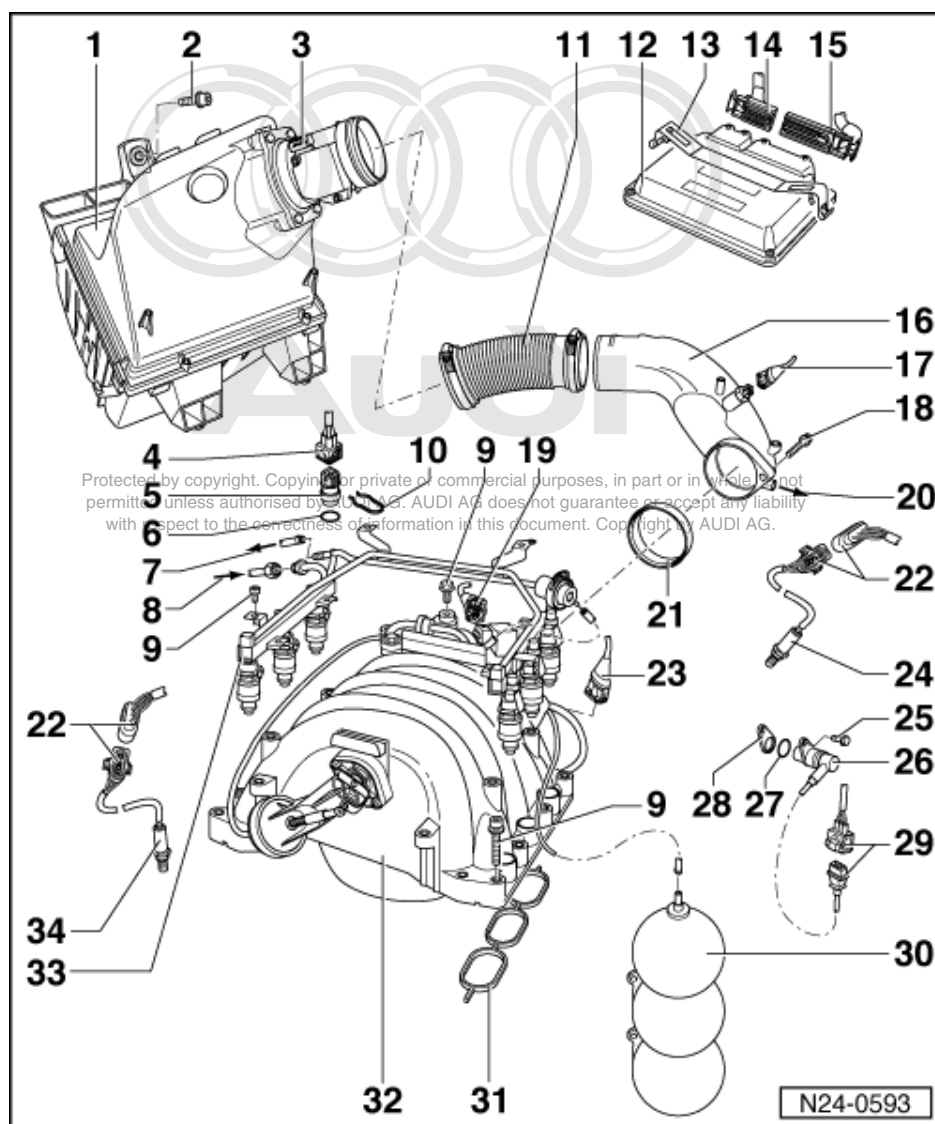
25 Camshaft adjustment valve 1 -N205

26 Air mass meter -G70

27 Secondary air pump motor -V101

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1.6 - Removing and installing parts of the injection system



1 Air cleaner

- ♦ Dismantling and assembling
=> Page 69

2 20 Nm

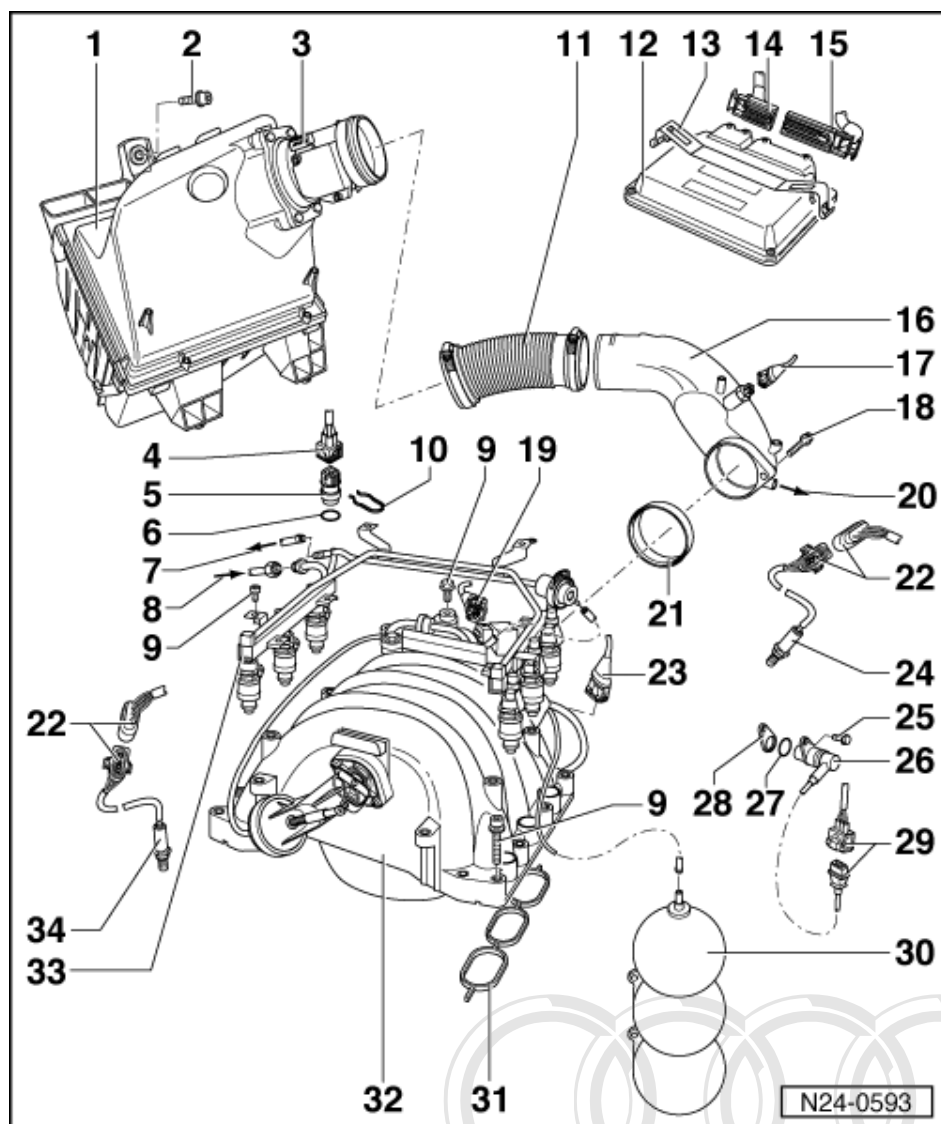
3 Air mass meter -G70

4 Connector

- ♦ Blue, 4 pin
- ♦ For coolant temperature sender -G62

5 Coolant temperature sender -G62

- ♦ Blue
- ♦ For engine control unit
- ♦ With coolant temperature gauge sender -G2
- ♦ Before removing, release pressure from cooling system

**6 O ring**

- ◆ Renew if damaged

7 Return pipe

- ◆ Blue
- ◆ Secure with spring-type clips
- ◆ Check securely seated

8 Supply pipe/hose

- ◆ Black

9 10 Nm**10 Retaining clip**

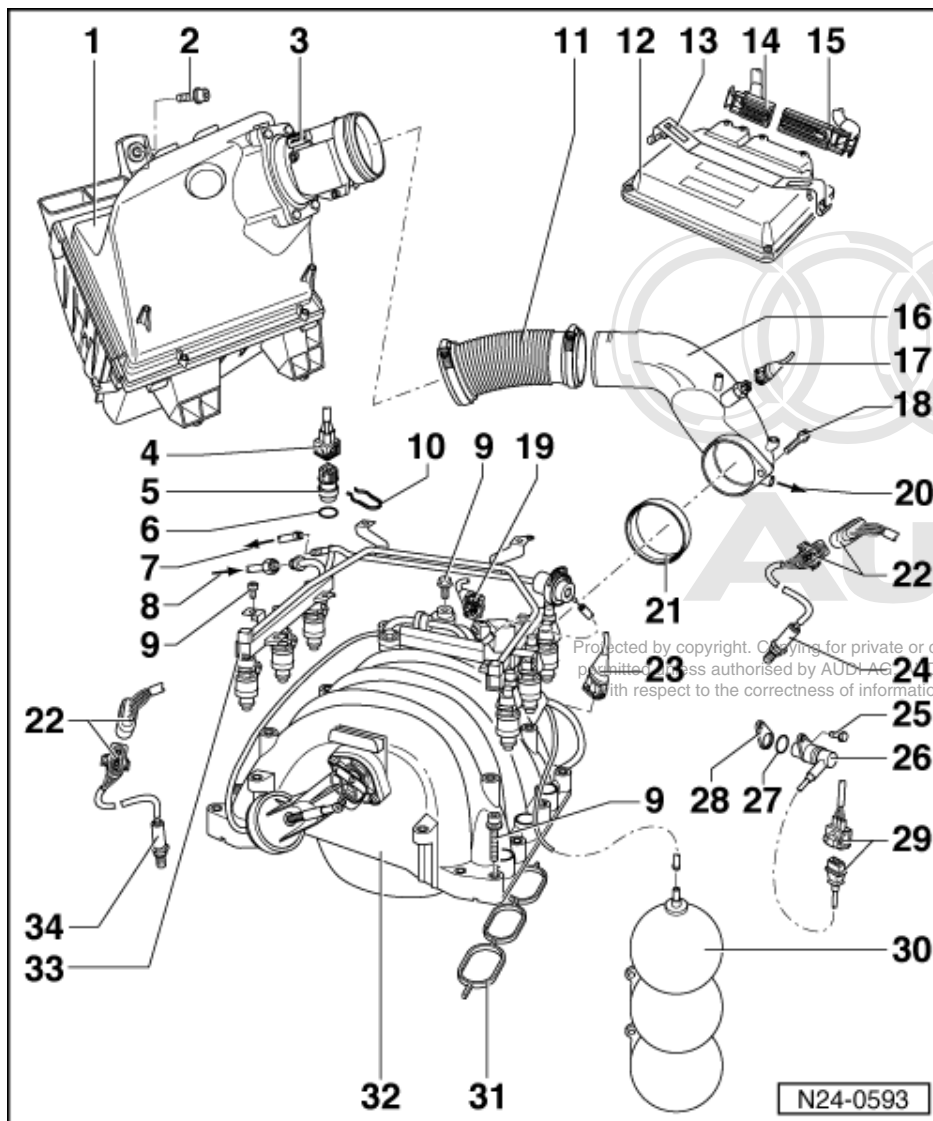
- ◆ Check seated securely

11 Connecting hose**12 Engine control unit**

(Motronic control unit -J220)

- ◆ Located in electronics box in plenum chamber (left-hand side)

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13 Securing plate

14 Connector, 28 pin

- ♦ Only disconnect or connect with ignition switched off
- ♦ Release to disconnect

15 Connector

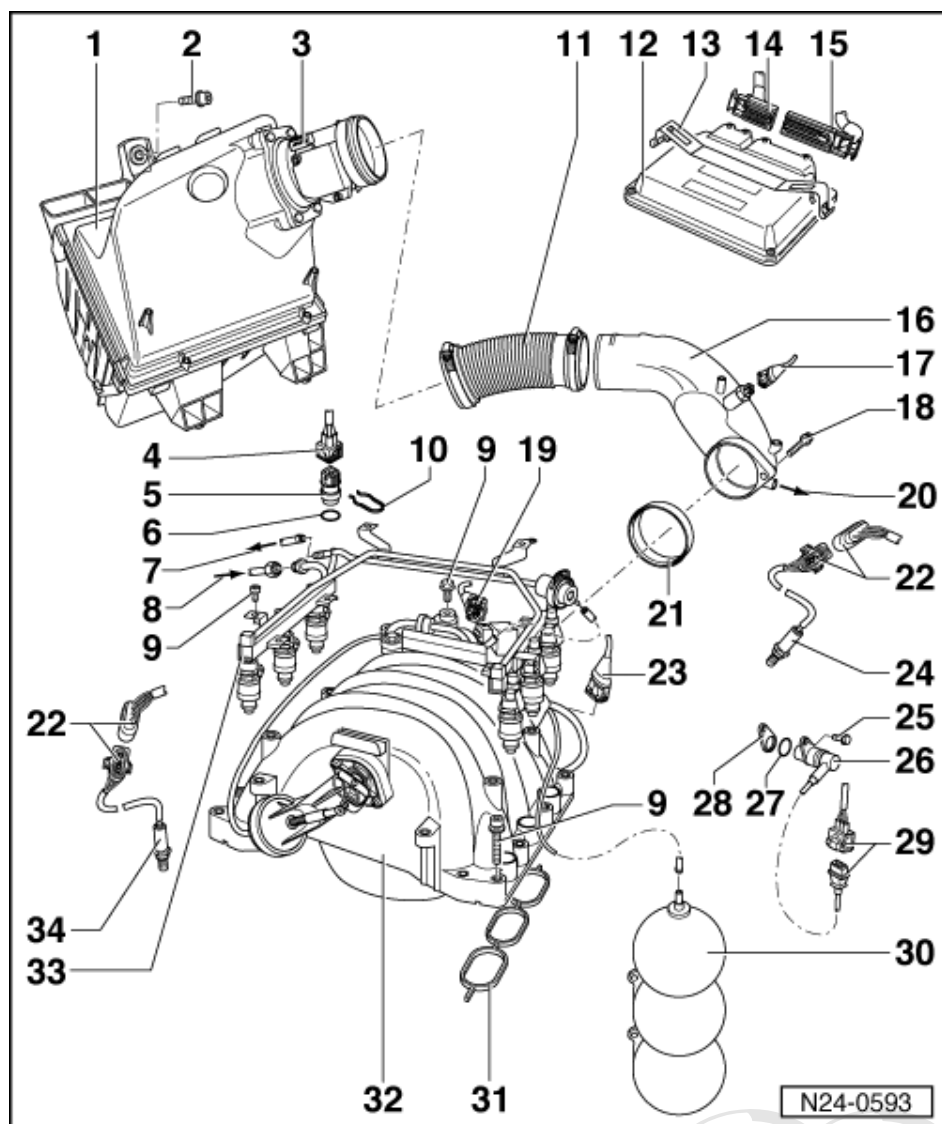
- ♦ Only disconnect or connect with ignition switched off
- ♦ Release to disconnect

16 Air intake elbow

17 Connector

- ♦ Black, 2-pin
- ♦ For intake air temperature sender -G42

18 10 Nm



19 Connector

- ◆ Blue, 2 pin
- ◆ For intake manifold change-over valve -N156

20 To crankcase breather valve

21 Seal

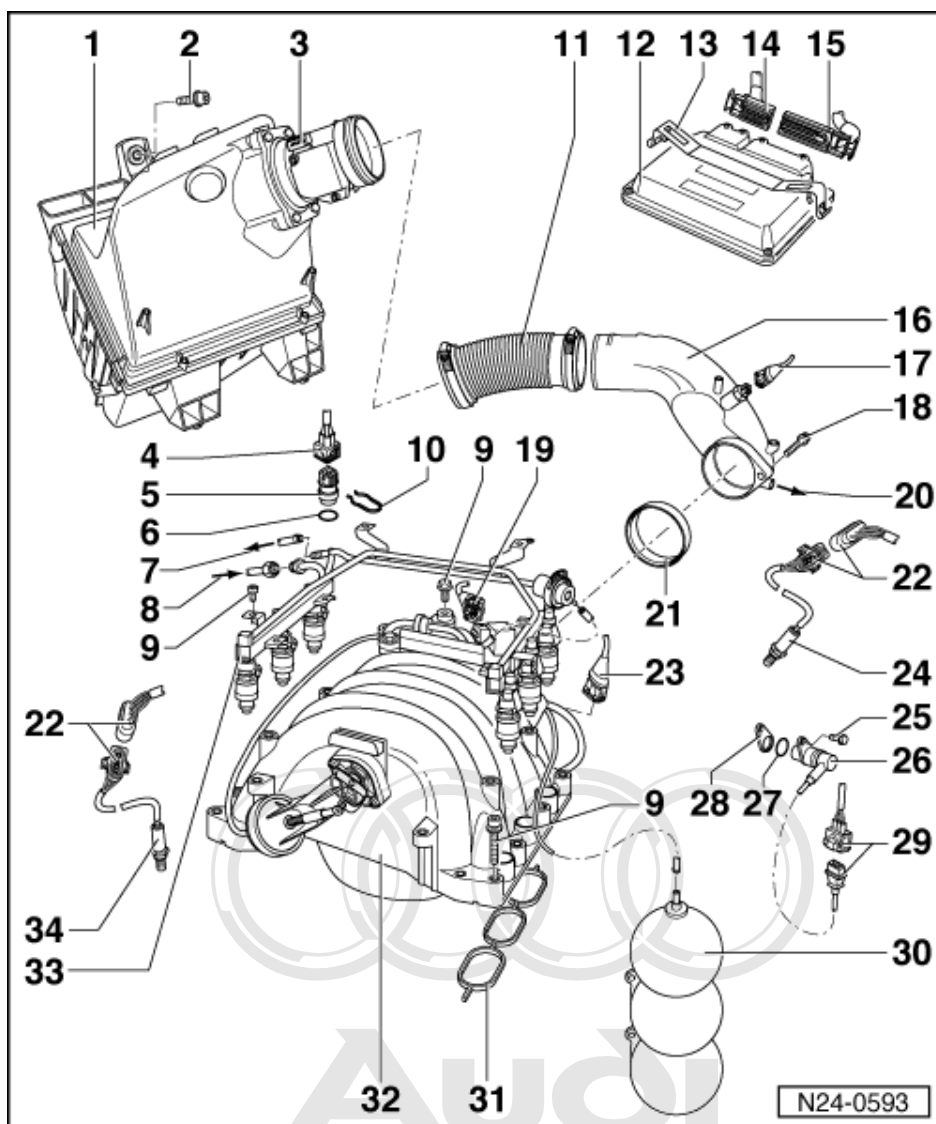
22 4 pin connector

- ◆ Black
- ◆ For Lambda probe and Lambda probe heating

23 Connector

- ◆ Black, 2-pin
- ◆ For injectors -N30...-N33, -N83, -N84

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24 Lambda probe 2 -G108, 50 Nm

- ♦ Cylinder bank 2

25 10 Nm

26 Engine speed sender -G28

- ♦ In gearbox housing above starter ring gear

27 O ring

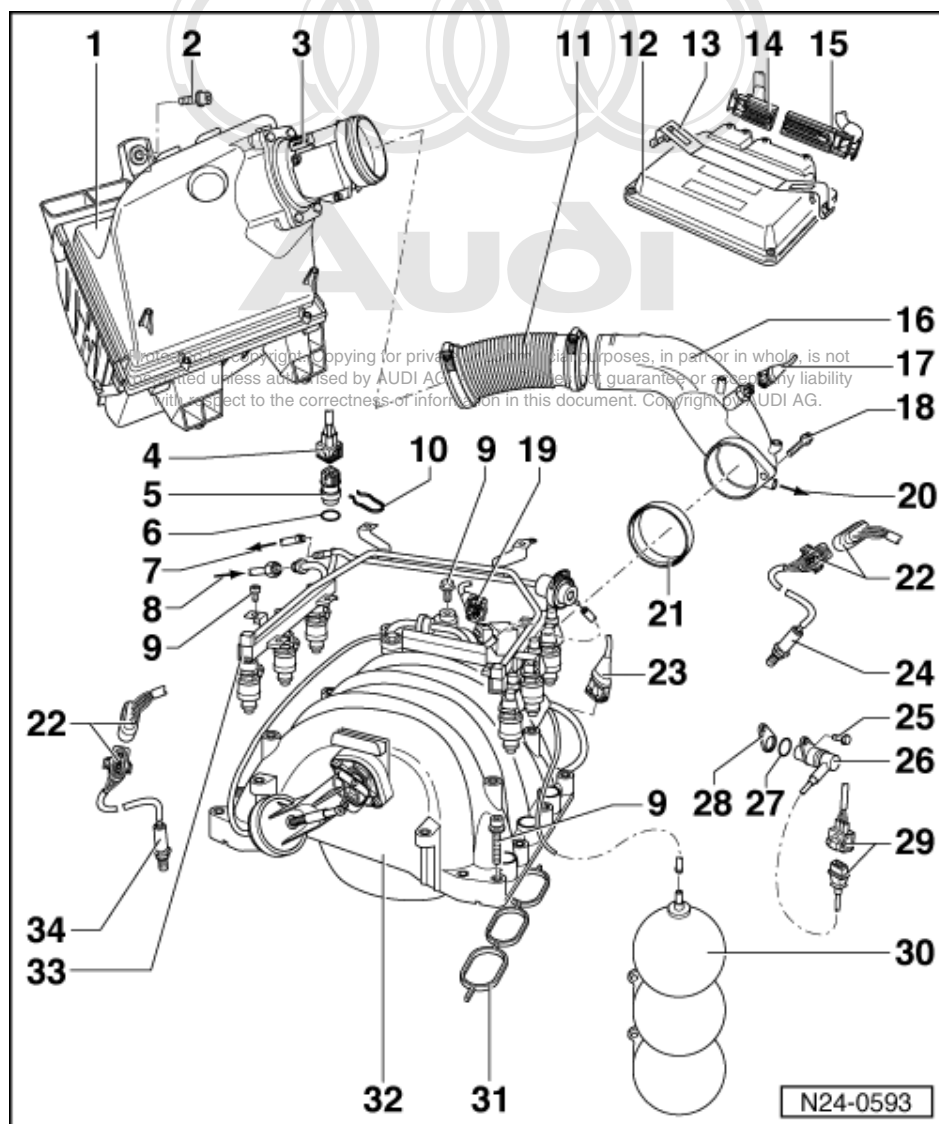
28 Spacer

29 3 pin connector

- ♦ Grey
- ♦ For engine speed sender

30 Vacuum reservoir

- ♦ For intake manifold change-over at full load



31 Gasket

32 Intake manifold

- ♦ Removing and installing parts of intake manifold change-over
=> Page 71
- ♦ Removing and installing throttle valve control part
=> Page 24-19

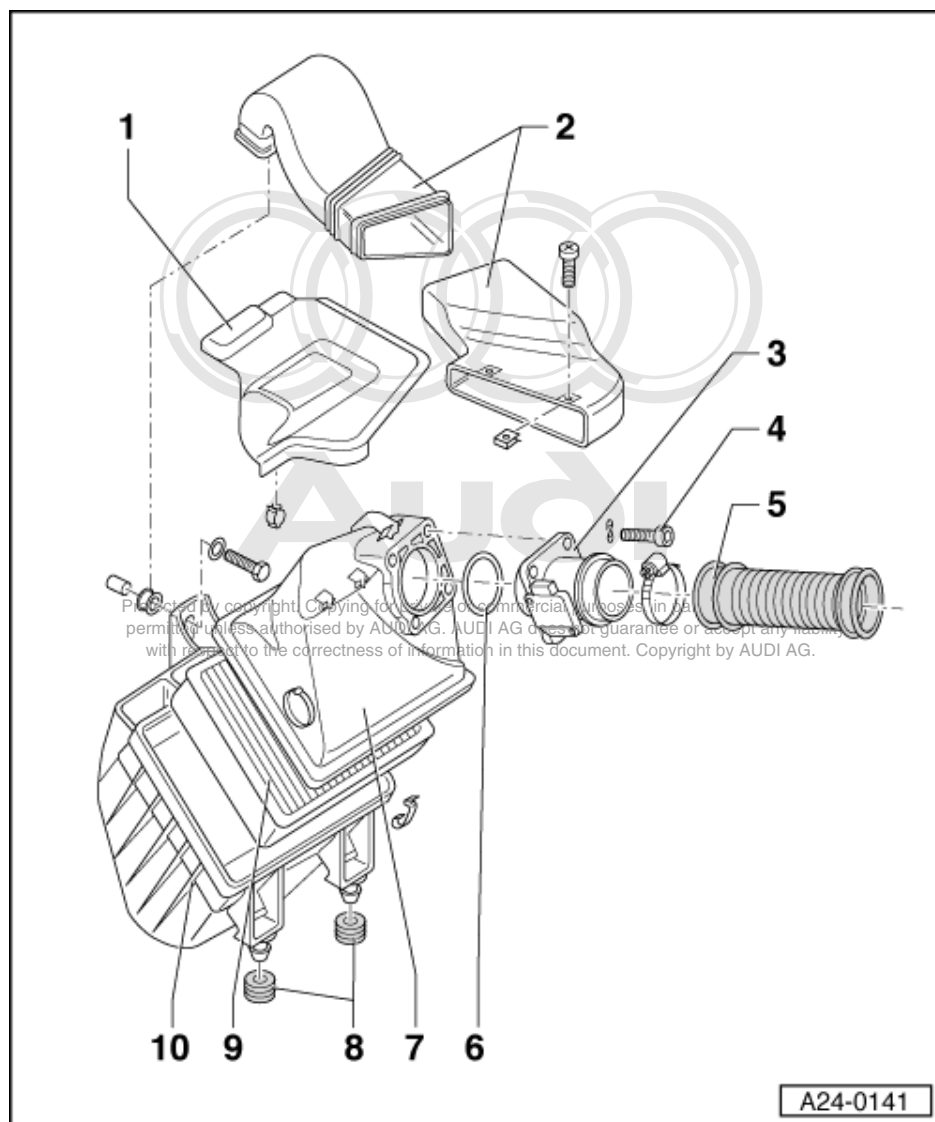
33 Fuel rail with injectors

- ♦ Dismantling and assembling
=> Page 70

34 Lambda probe 1 -G39, 50 Nm

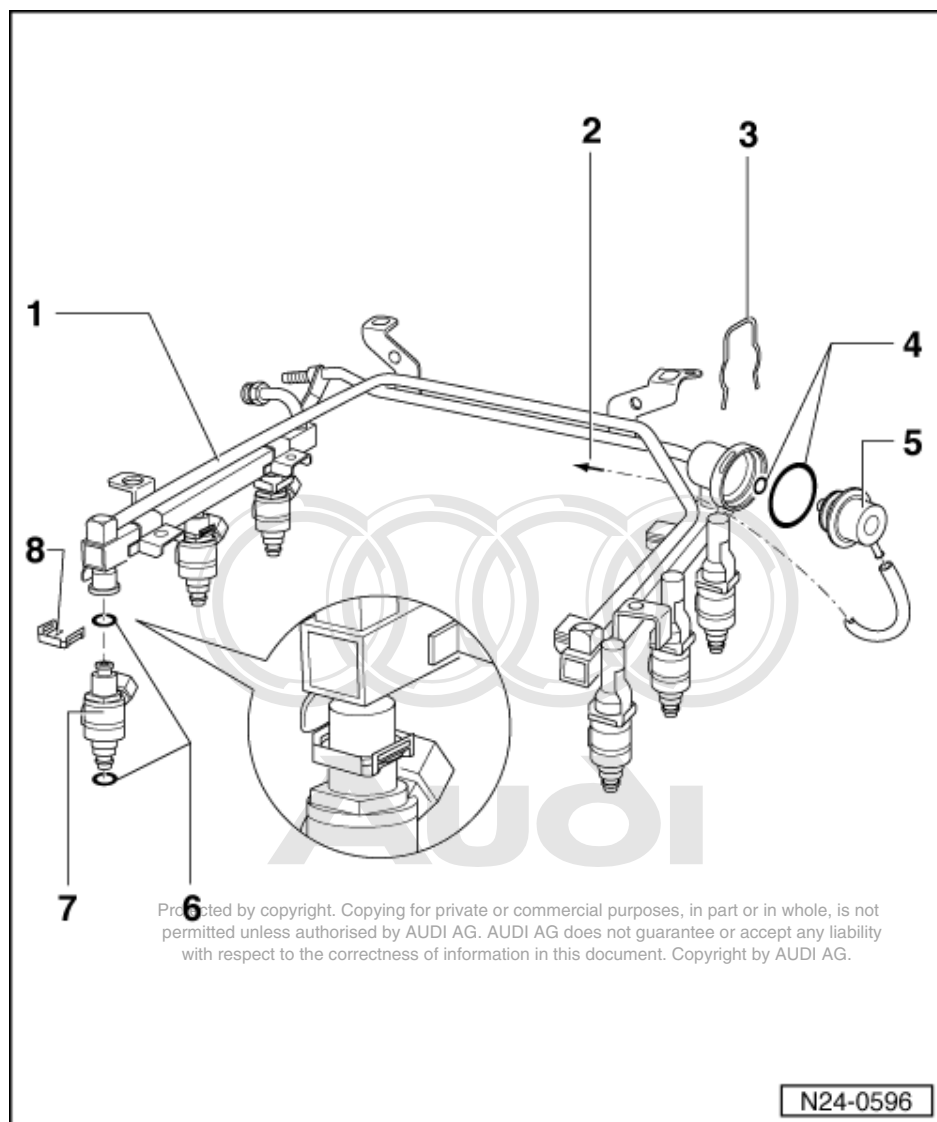
- ♦ Cylinder bank 1
- ♦ Voltage supply for Lambda probe heating via fuel pump relay -J17

1.7 - Dismantling and assembling air cleaner



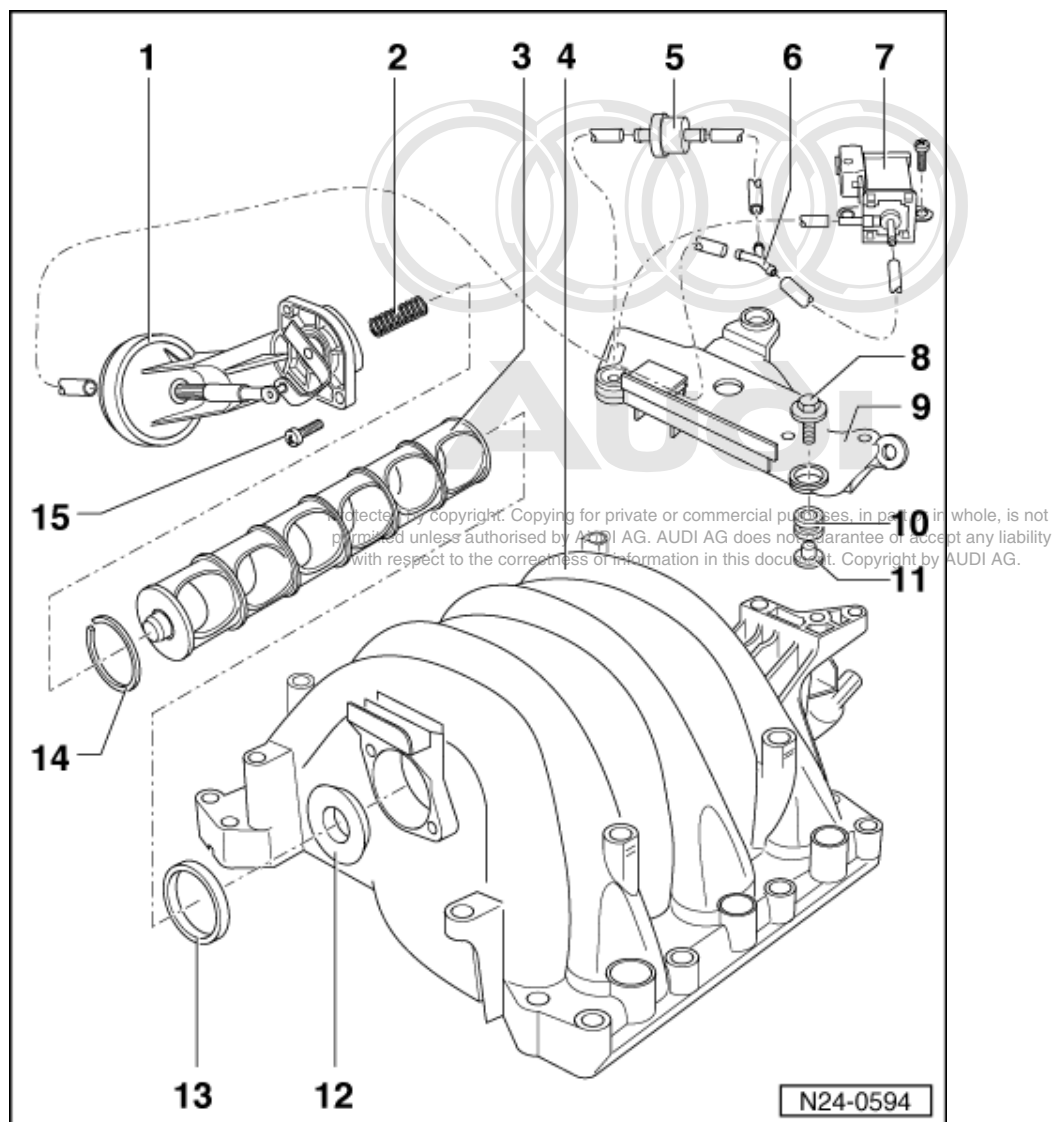
- 1 Cover
- 2 Spacer sleeve
 - ♦ To lock carrier
- 3 Air mass meter -G70
- 4 10 Nm
- 5 Connector hose
- 6 Seal
- 7 Air cleaner (upper section)
- 8 Packing
- 9 Filter element
- 10 Air cleaner (lower section)

1.8 - Dismantling and assembling fuel rail with injectors

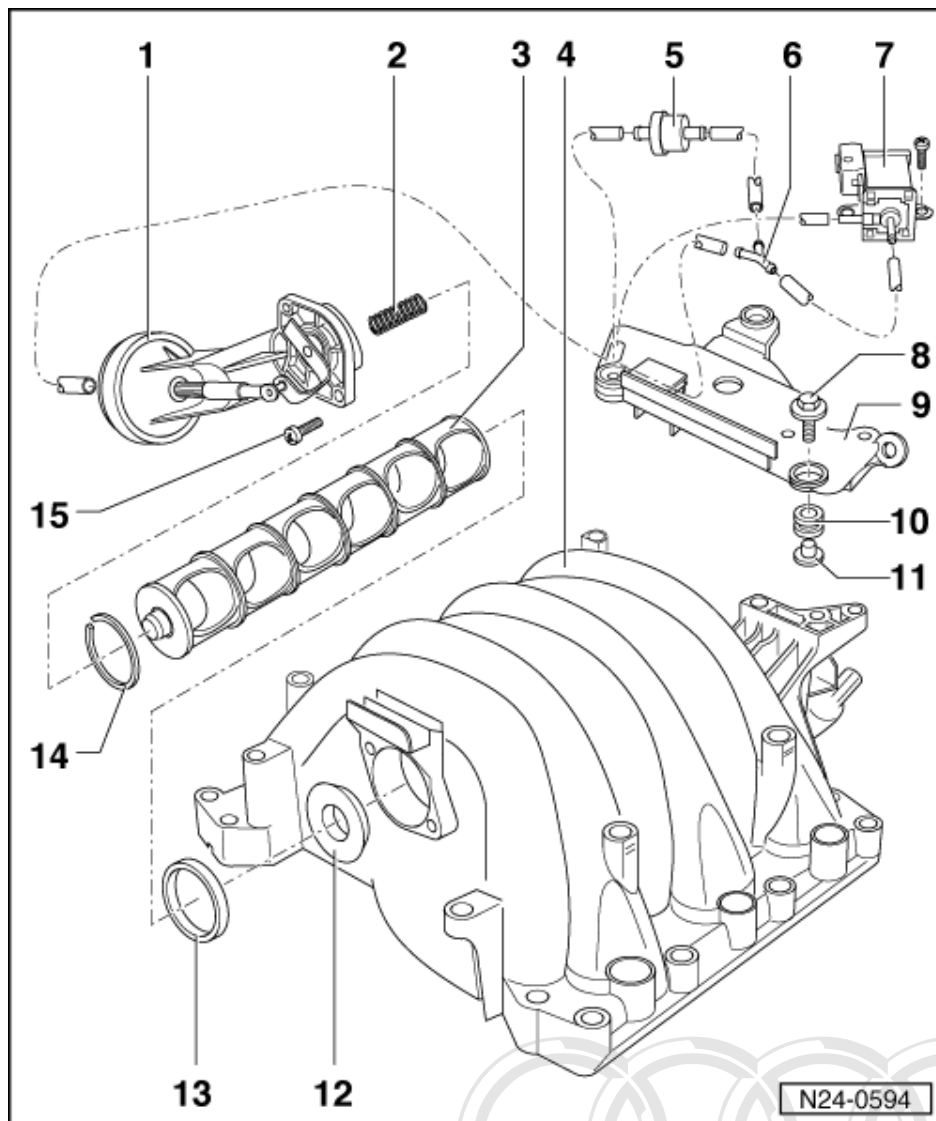


- 1 Fuel rail
- 2 To T piece
 - ♦ => Page 73 , item 4
- 3 Retaining clip
- 4 O ring
 - ♦ Renew
- 5 Fuel pressure regulator
- 6 O ring
 - ♦ Renew
- 7 Injectors -N30...-N33, -N83, -N84
- 8 Retaining clip
 - ♦ Ensure seated correctly at injector and fuel rail

1.9 - Removing and installing parts of intake manifold change-over



- 1 Vacuum unit
- 2 Spring
- 3 Change-over barrel
- 4 Intake manifold
- 5 Non-return valve
 - ♦ Installation position: blue end facing towards Y piece
- 6 Y piece
- 7 Intake manifold change-over valve -N156



8 10 Nm

9 Securing plate

10 Rubber grommet

11 Spacer sleeve

12 Washer

- ♦ Conical side to intake manifold

13 Seal

- ♦ Renew if damaged

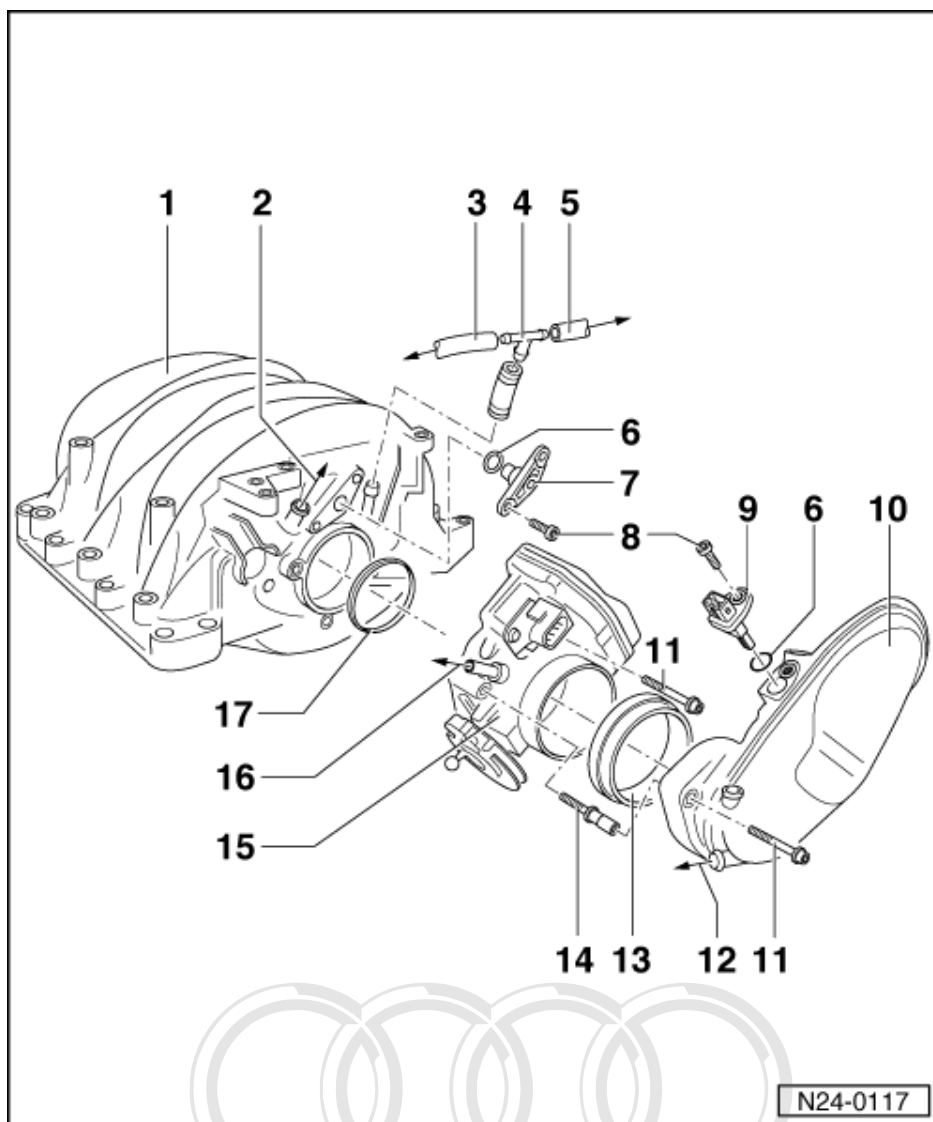
14 Seal

- ♦ For change-over barrel

15 6 Nm

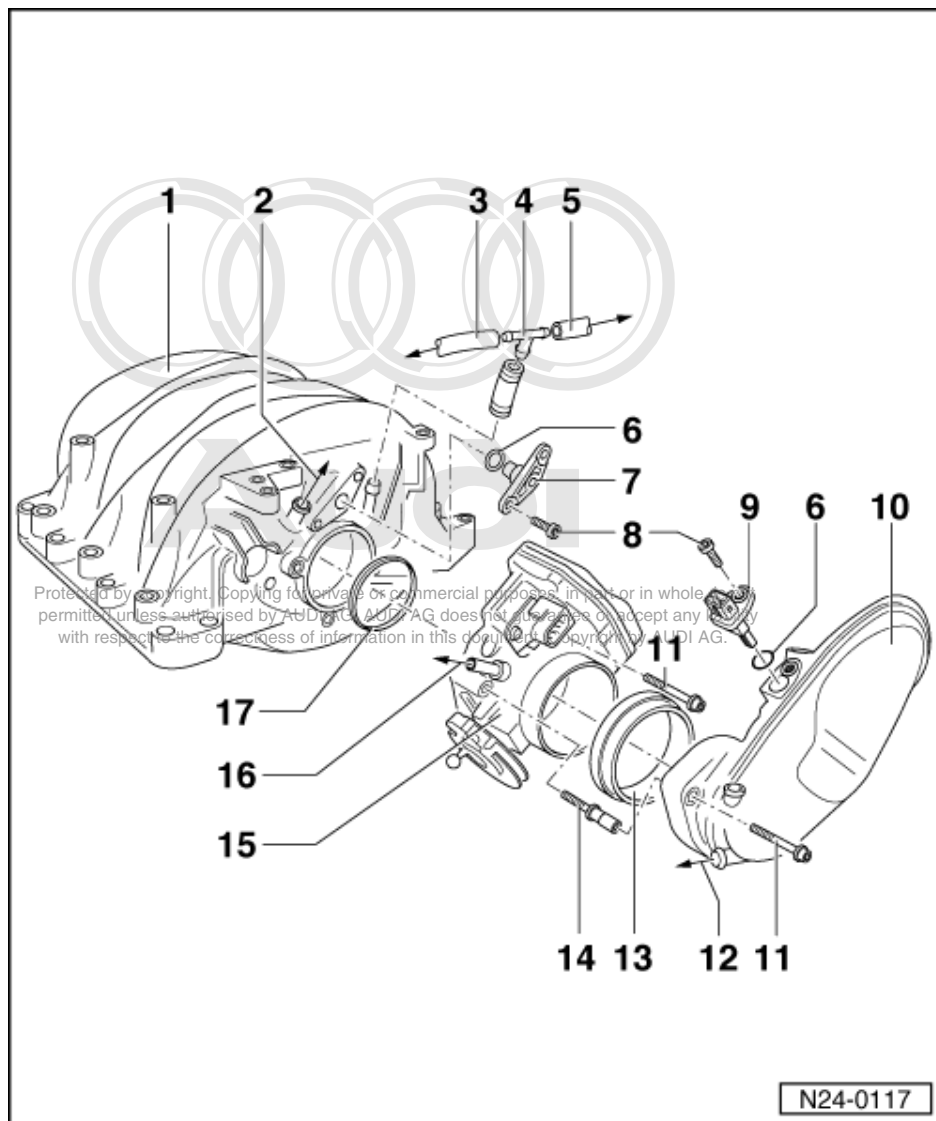
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1.10 - Removing and installing throttle valve control part



- 1 Intake manifold
- 2 To vacuum booster
- 3 To fuel pressure regulator
 - ♦ =>Page 70 , item 5
- 4 T piece
- 5 To non-return valve
 - ♦ =>Page 71 , item 5
- 6 O ring
 - ♦ Renew if damaged
- 7 Support bracket
 - ♦ For change-over barrel
- 8 6 Nm

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9 Intake air temperature sender
-G42

10 Air intake elbow

11 10 Nm

12 To crankcase breather valve

13 Seal

14 10 Nm

- ♦ Insert with locking fluid "D6"

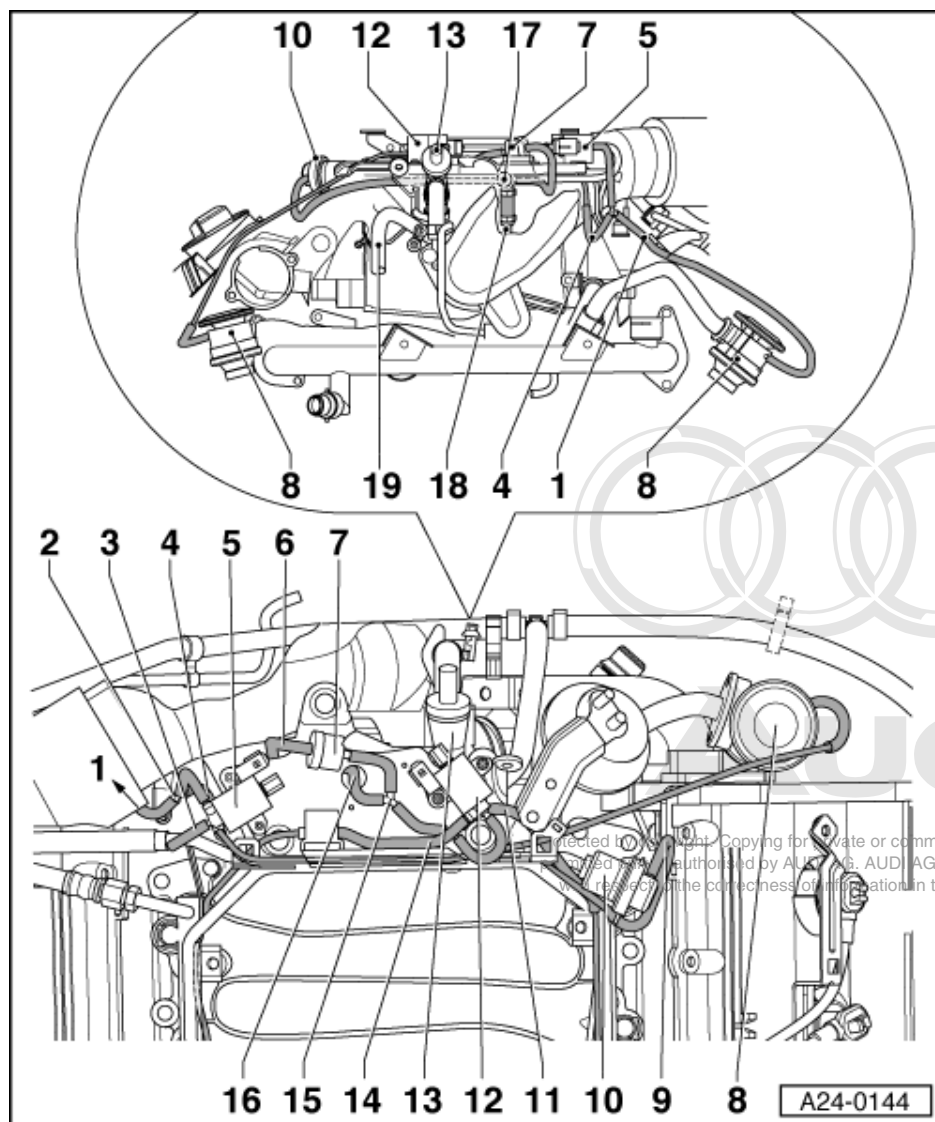
15 Throttle valve control part
-J338

16 To solenoid valve 1 for activated charcoal filter -N80

17 Seal

- ♦ Renew if damaged

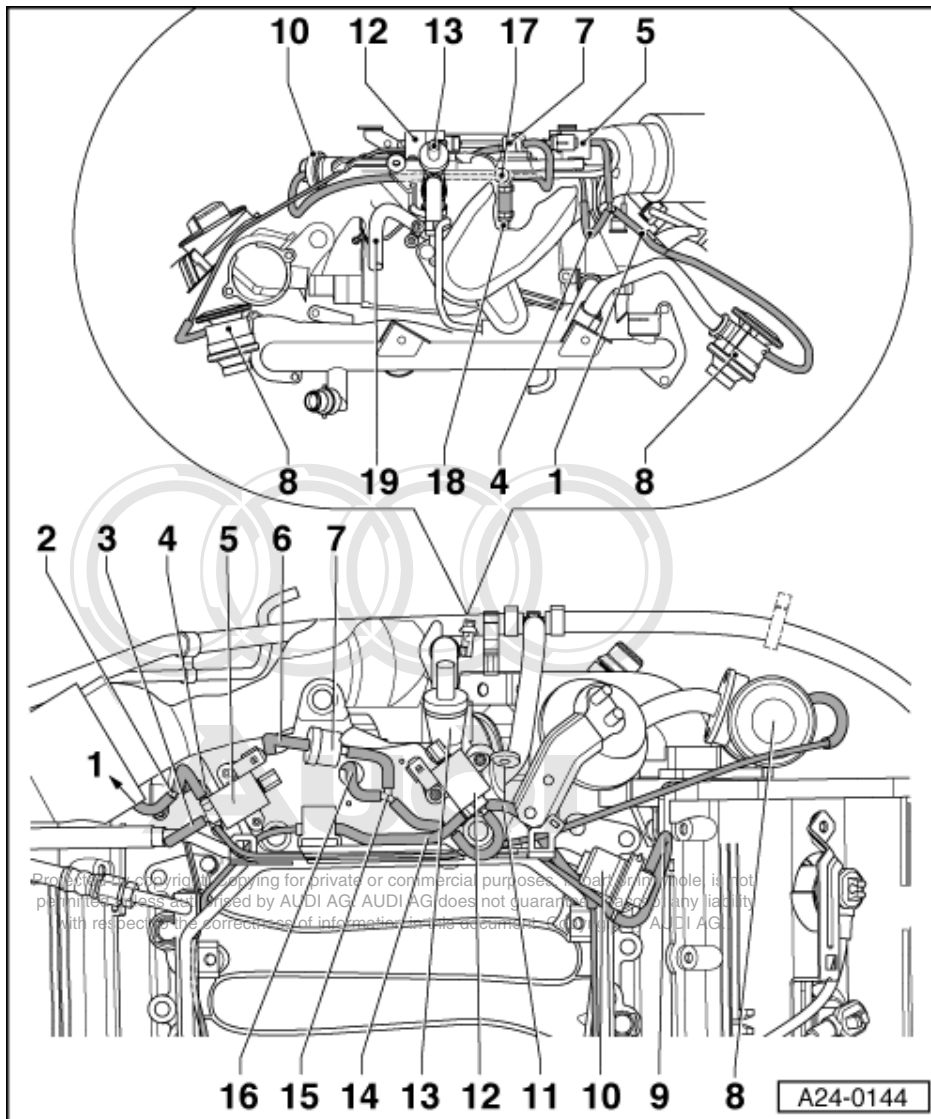
1.11 - Vacuum connections



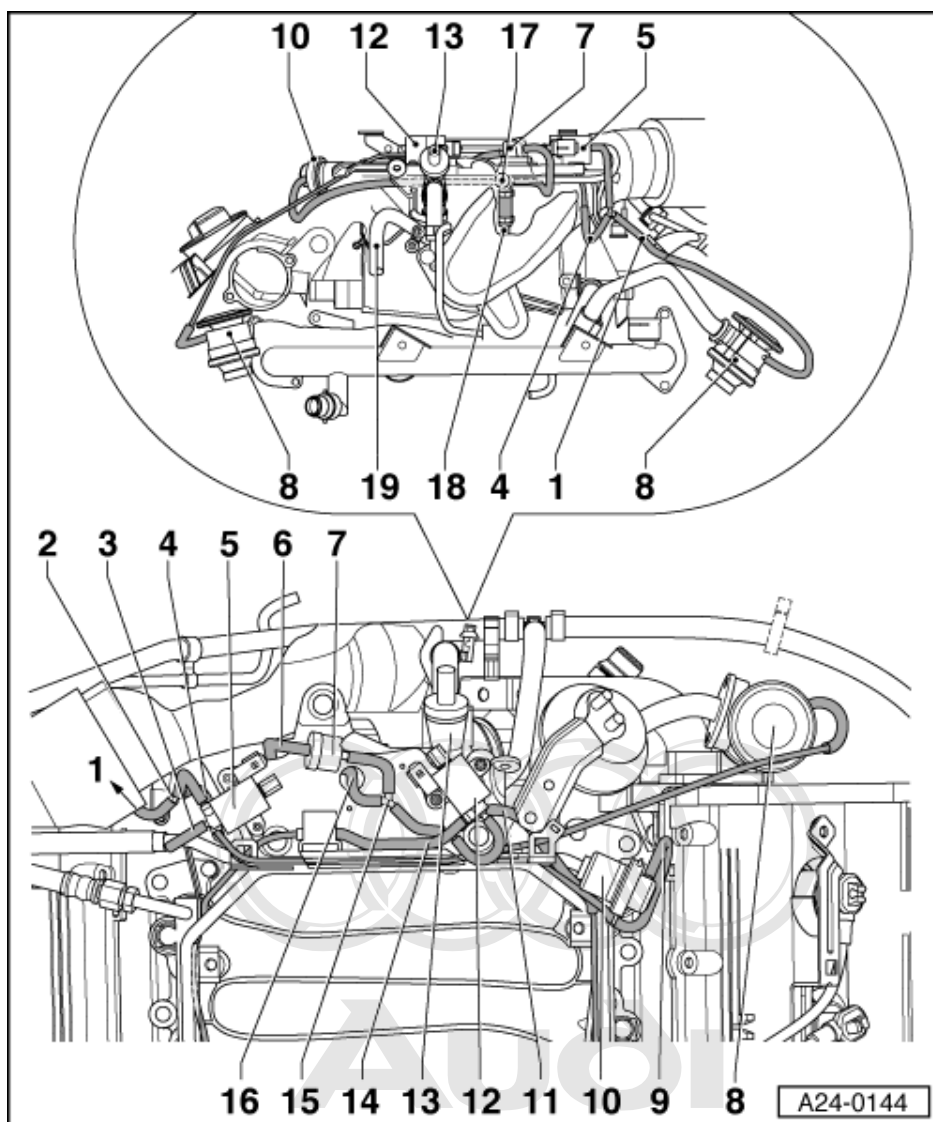
Upper part of illustration: rear of engine

Lower part of illustration: engine seen from above

- 1 Hose to combination valve for secondary air system
- 2 T-piece
- 3 To Y-piece
 - ♦ Item 15
- 4 Hose to combination valve for secondary air system
- 5 Secondary air inlet valve -N112
- 6 To T-piece on variable intake manifold
 - ♦ Item 17



- 7 Non-return valve**
- 8 Combination valve for secondary air system**
 - ♦ Combination valve 1 for Bank 1
 - ♦ Combination valve 2 for Bank 2
- 9 To T-piece on variable intake manifold**
 - ♦ Item **17**
- 10 Fuel pressure regulator**
- 11 Hose to vacuum reservoir in left-hand wheel housing**
- 12 Intake manifold change-over valve -N156**
- 13 Vacuum booster**
- 14 To vacuum unit for intake manifold changeover function**



15 Y piece

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16 Hose to secondary air inlet valve -N112

- ♦ Item 5

17 T-piece on variable intake manifold

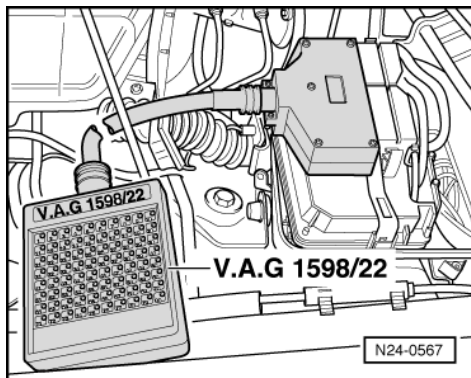
18 Hose to connection for variable intake manifold

19 Hose to activated charcoal filter

1.12 - 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 and the socket numbers in the test box are identical.
- With ignition switched off, pull plug connector off control unit.



- -> Connect test box to wiring harness connector.
- Carry out check according to relevant repair operations.

Warning!

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

Note:

After re-connecting the engine control unit, perform adaptation of throttle valve control part =>Page 109 .

1.13 - Renewing engine control unit

Fitting location => Fitting locations overview, Page 59

Note:

When the engine control unit is disconnected the learned values are erased but the contents of the fault memory remain intact.

Removing engine control unit

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .

-> The control unit identification will appear on the display.

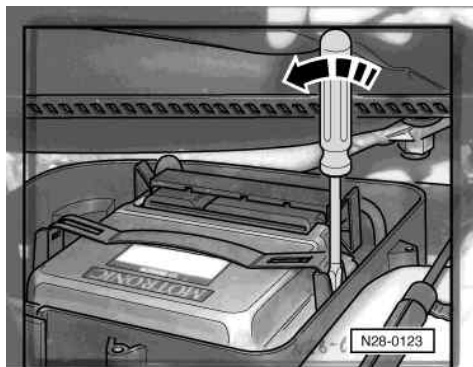
4D0907551B 2.8l V6/5V MOTR HS D01
Coding 04101 WSC 00000

- Always start by calling up the control unit identification on the display and printing it out.
- Check the coding against the list of coding variants=>Page 32 .
- Press the⇒key.

-> Indicated on display:

Rapid data transfer HELP
Select function XX

- Switch off ignition.
- Remove plenum chamber cover.



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- Remove cover on electronics box in plenum chamber.
- -> Carefully lever off the retainer bar with a screwdriver -arrow-.
- Release catches and unplug control unit connectors.

Installing engine control unit

Installation is performed in the reverse sequence.

Note:

During the initial learning phase of the basic setting operation for the engine the idling may be slightly rough and the engine may pull a little unevenly.

- Interrogate and erase fault memory=>Page 4!
- Code control unit => Page 32.
- Perform adaption of throttle valve control part
=> Page 109.
- Perform adaption of engine control unit to immobilizer control unit

=> Electrical System; Repair Group 01; Self-diagnosis of electronic immobilizer; 10 - Adaption Self-diagnosis of electronic immobilizer 10 - Adaption

1.14 - Testing idling speed

Notes:

- ♦ The idling speed cannot be adjusted.
- ♦ The idling speed is tested during the basic setting of the engine.

Test conditions

- No leaks in exhaust system
- Coolant temperature at least 80 °C
- 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

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- Connect fault reader V.A.G 1551
=> Page 2.
- Switch on ignition.
- 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.
- Run the engine at idling speed.
- Switch off air conditioner.
- Switch off rear window heating.
- Place selector lever in P or N position (automatic gearboxes).
- Start basic setting of engine using V.A.G 1551 and continue until "Basic setting 1" appears on the display
=>Page 30.

-> Indicated on display:

System in basic setting 1			
1	2	3	4

- Read off idling speed from display zone 1.



Specifications:

- ♦ Four-wheel drive: 620 ... 740 rpm
- ♦ Front-wheel drive: 740 ... 860 rpm

Note:

The increase in idling speed on vehicles with front-wheel drive occurs when the engine control unit receives a positive signal at contact 10 (from terminal 15).

- Press =>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:

- Testing idling speed switch =>Page 110 .
- Large quantity of unmetered air
=>Basic setting of engine, Display Groups 001, 005, 006 and 009
- Test throttle valve control part =>Page 108 .

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1.15 - Checking system pressure, fuel pressure regulator and holding pressure

Note:

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

Test conditions

- Fuel pump relay OK; testing => Page 87 .
- Fuel pump OK
- Fuel filter OK
- Battery voltage at least 11 V

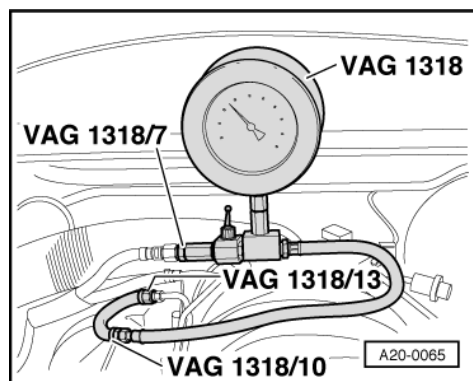
Special tools, testers and auxiliary items

- ♦ Pressure tester V.A.G 1318
- ♦ Adapter V.A.G1318/7
- ♦ Adapter V.A.G 1318/10
- ♦ Adapter V.A.G1318/13

Warning!

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

Testing system pressure and fuel pressure regulator



- -> Connect pressure gauge V.A.G 1318 between fuel supply pipe and fuel rail using adapters 1318/7, 1318/10 and 1318/13. Lever on pressure gauge must be in the "open" position (lever aligned with direction of flow).
- Disconnect vacuum hose between fuel pressure regulator and intake manifold at fuel pressure regulator end; seal off end of hose.

Notes:

- ♦ If fuel leaks out at the connection for the fuel pressure regulator during the following test, fit a new fuel pressure regulator.
- ♦ During the following test, do not allow the engine to run any longer than necessary with the vacuum hose disconnected. When the hose is disconnected, the increased fuel pressure causes enrichment of the air/fuel mixture which may exceed the Lambda control regulation limit and be registered as a fault in the fault memory.
- Start the engine and run at idling speed.
- Switch off the air conditioner.
- Measure fuel pressure.
 - Specification: approx. 3.8 ... 4.2 bar
- If fuel pressure does not match specification, fit a new fuel pressure regulator for test purposes and repeat pressure test.
- If fuel pressure still does not match specification, check fuel pump and supply pipe for damage (e.g. pinching) and renew if necessary.
- If pressure is higher than specification, check return pipe for damage (e.g. pinching) and renew if necessary.
- Re-connect vacuum hose to fuel pressure regulator and observe drop in pressure on pressure gauge.
- When the vacuum hose is re-connected the fuel pressure should drop by around 0.5 bar.

If the pressure does not change as specified, carry out the following tests:

- Check vacuum hose for cracks and other damage.
- Test vacuum hose for blockages at intake manifold.
To do this, disconnect hose at fuel pressure regulator and blow into it.
- If there are no leaks in the hose and no blockages at the vacuum connection, fit a new fuel pressure regulator.

Testing holding pressure

- Holding pressure 10 minutes after switching off engine (minimum pressure)

Specification:

With engine cold: approx. 2.2 bar
With engine hot: approx. 3.0 bar

If the specification is not attained:

Note:

A rise in pressure (due to fuel expansion) when the engine is hot is normal.

- Start the engine and run at idling speed.
- Switch ignition off after the pressure has built-up. At the same time close pressure gauge cut-off tap (lever at 90° to throughflow direction).

If the pressure does not drop, the following faults are possible:

- ♦ Union between pressure gauge and fuel supply pipe leaking
- ♦ Supply pipe leaking at fuel tank
- ♦ Return valve in fuel pump leaking

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=> 6-cylinder engine (5-valve), Mechanics; Repair group 20; Removing and installing fuel delivery unit Re-moving and installing fuel delivery unit

If the pressure drops again, the following faults are possible:



- ♦ Fuel pressure regulator defective
- ♦ Injectors leaking
- ♦ Unions on pressure gauge downstream of cut-off valve leaking

Note:

When disconnecting the pressure gauge, close the cut-off valve, unscrew the union on adapter V.A.G 1318/12, then open the cut-off valve to drain off excess fuel into a suitable container.

1.16 - Checking injectors

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Diode test lamp V.A.G 1527
- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

Electrical testing of injectors

- Connect fault reader V.A.G 1551
=> Page **2**.
- Switch ignition on.
- Start final control diagnosis and select injectors
=> Page **27**.

-> Indicated on display:

Final control diagnosis Injector, Cylinder 1 -N30
--

- Actuate throttle control on throttle valve control part in order to open idling speed switch.

The injector should click five times.

If the injector clicks:

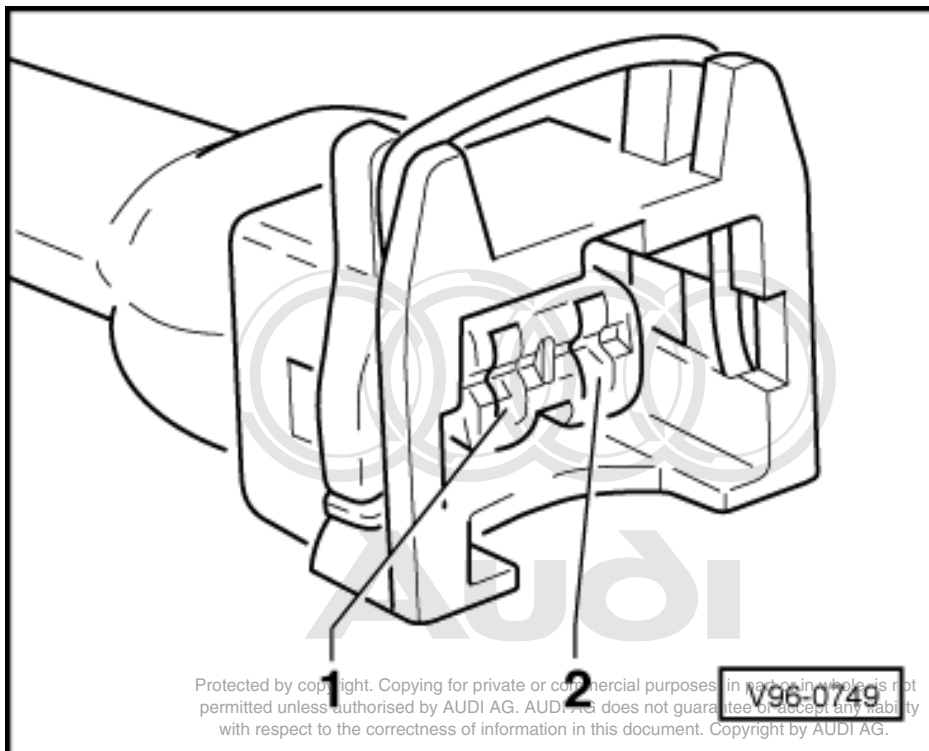
- Select the next injector.

Valve does not click:

- Remove plug connector from the injector which is to be tested.



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- -> Connect diode test lamp V.A.G 1527 to contacts 1 and 2 of the connector.
- Repeat final control diagnosis and select the same injector again.

Note:

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

The diode test lamp should flash five times.

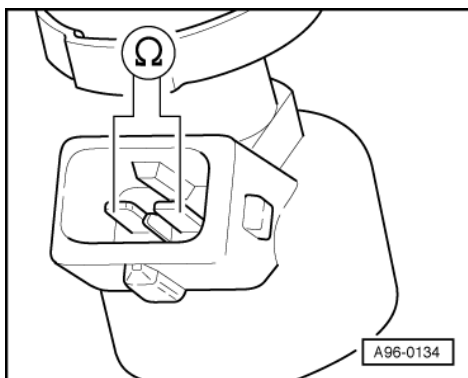
Note:

Diode test lamps with a low current draw continue to glow faintly between flashes (rather than going out completely) and become much brighter during the flashes.

If the diode test lamp does not flash:

- Test voltage supply
=> Page 84 .

If the diode test lamp flashes:



- -> Connect multimeter to valve (resistance measurement range)

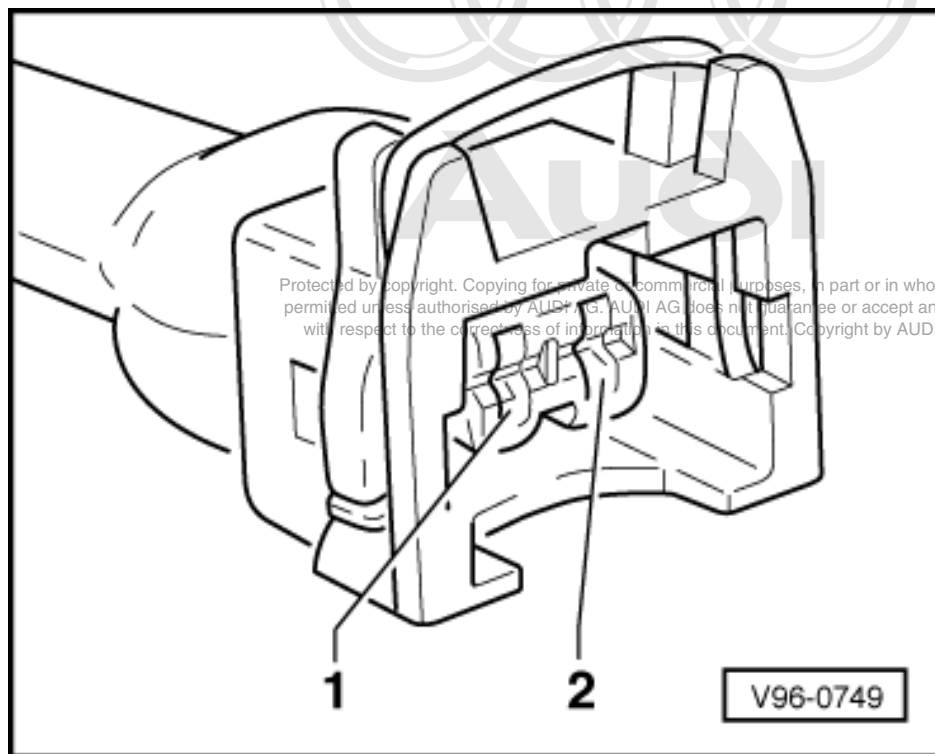
- Specification: 13.5 ... 15.5Ω

If the specification is not attained:

- Fit a new injector.

Testing voltage supply

- Remove plug connector from the injector which is to be tested.



- -> Connect multimeter to contact 1 of connector (voltage measurement range).
- Operate starter for a few seconds (the engine can be allowed to start).

Specification: The diode test lamp should light up.

If the diode test lamp lights up:

- Check wiring connections => Page 84 .

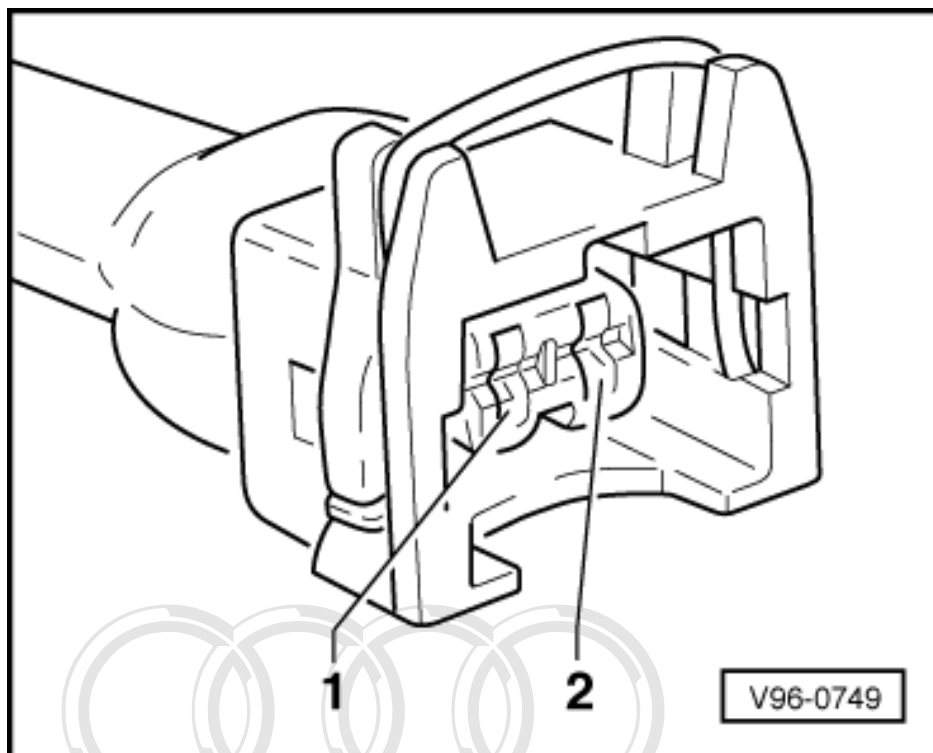
If the diode test lamp does not light up:

- Check wiring connection between contact 1 and fuel pump relay via fuse for injectors.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

Checking wiring connections

- Switch off ignition.
- Remove plug connector from the injector which is to be tested.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=> Page 77 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Cylinder	Contact No. on 2-pin connector on wiring harness	Socket on test box V.A.G 1598/22
1	2	73
2	2	80
3	2	58
4	2	65
5	2	72
6	2	79

- Rectify any open/short circuit as necessary.

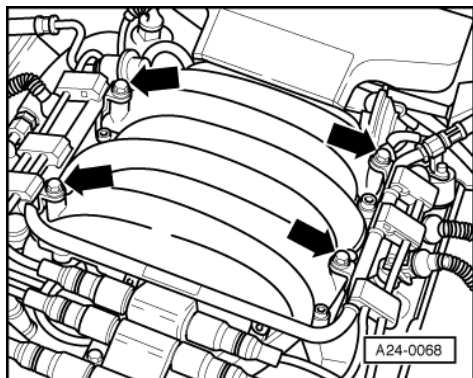
1.17 - Testing injection quantity, leak-tightness and spray pattern of injectors

Test conditions

- Fuel pressure OK; testing => Page 80 .

Special tools, testers and auxiliary items

- ◆ Remote control V.A.G 1348/3A with adapter cable V.A.G 1348/3-2
- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ◆ Adapter set V.A.G 1594
- ◆ Measuring unit V.A.G 1602



- Remove intake hose between air mass meter and intake silencer.
- Unplug connectors from injectors.
- -> Unbolt fuel rail from intake manifold.
- Disconnect vacuum hose from fuel pressure regulator.
- Lift fuel rail off intake manifold together with injectors and support fuel rail.

Testing for leaks

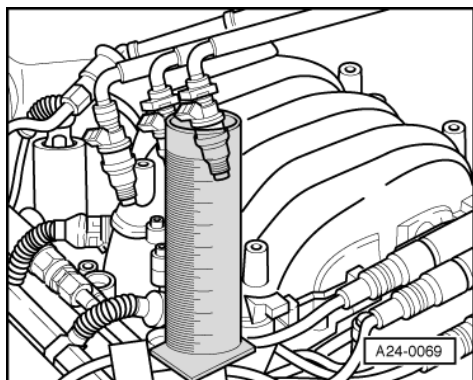
- Connect fault reader V.A.G 1551
=> Page **2**.
- Switch on ignition.
- Start final control diagnosis => Page **27**. The fuel pump must be running.

Note:

This step is performed in order to run the fuel pump without starting the engine. When carrying out this test the idling speed switch must remain closed, otherwise the injector which has been selected will be activated and will spray fuel five times.

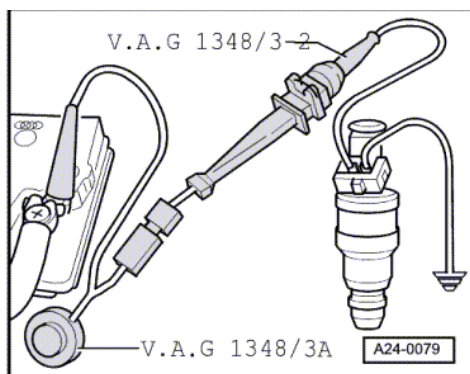
- Check injectors for leaks (visual check). When the fuel pump is running, only 1 or 2 drops should escape per minute from each injector.
- If the fuel loss is greater, switch off the fuel pump (terminate final control diagnosis) and renew the faulty injector.
 - Renew seals.

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Checking injection quantity

- -> 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 => Page 27 . The fuel pump must be running.

Note:

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

- Activate remote control V.A.G 1348/3 A for 30 seconds.
- When all three injectors from the first bank of cylinders have been activated, place the three measuring glasses on a level surface.

Specification for each injector: 90 ... 125 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.
- Repeat test for injectors from second bank of cylinders.
- If the measured values for all the injectors are outside the tolerance range, check the fuel pressure => Page 80 .

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 rail 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 injectors are correctly positioned, insert vertically into fuel rail and secure with retainer clips.
- Position fuel rail together with injectors against intake manifold and press into place evenly all round.

1.18 - Testing fuel pump relay and activation

The fuel pump and some of the injection system components are powered via the fuel pump relay -J17.

The fuel pump relay -J17 will only close if the engine is turning over. In other words, the relay is only earthed (via the engine control unit) when the engine control unit is receiving engine speed impulses.

Test conditions

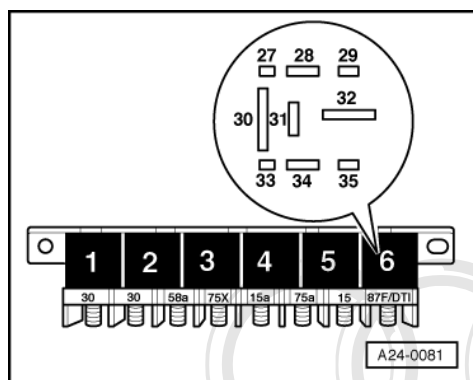
- Battery voltage at least 11 V

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

Testing operation of fuel pump relay

- Connect fault reader V.A.G 1551
=> Page 2 .
- Switch on ignition.
- Start final control diagnosis and select one of the injectors
=> Page 27 .



-> The fuel pump relay (central electrics, relay position 6) should pick up...

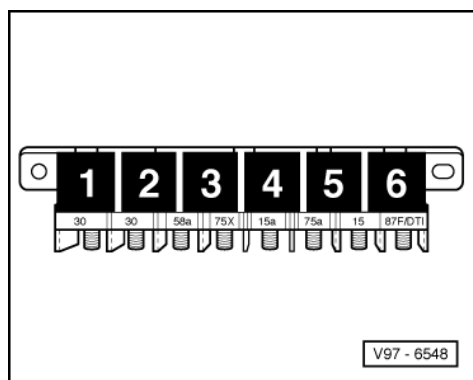
- If the relay does not pick up, test activation of fuel pump relay
=>Page 88 .

...and the fuel pump should run.

- If fuel pump does not run, test activation of fuel pump and other components =>Page 90 .

Testing activation of fuel pump relay

- Switch off ignition.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit => Page 77 .



- Connect sockets 2 and 4 of test box to each other using auxiliary cable from V.A.G 1594.
- Switch ignition on.

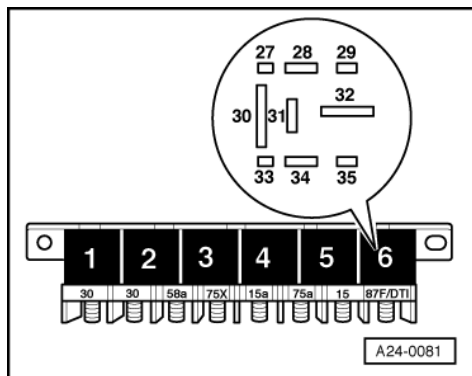
-> Specification: The fuel pump relay (central electrics, relay position 6) should pick up.

If the relay picks up now but not during the final control diagnosis:

- Fit a new engine control unit.

If the relay does not pick up:

- Switch off ignition.



- -> Disconnect fuel pump relay from relay panel (central electrics, relay position 6).
- Connect multimeter (voltage measurement range) between earth and contact 28 on relay panel.
- Switch ignition on.
 - Specification: approx. battery voltage

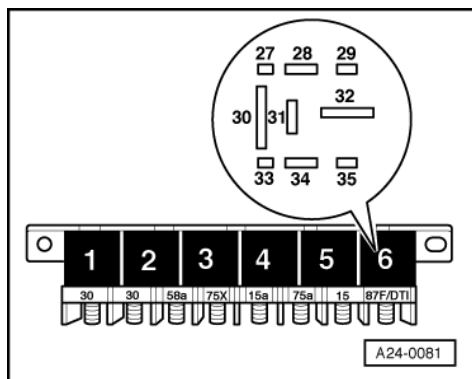
If the specification is not attained:

- Check the wiring.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

If the specification is attained:

- Switch off ignition.



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- -> Test for open circuit and short to positive or earth in the following wiring connections:

Central electrics, relay position 6, contact	Socket on test box V.A.G 1598/22
16	4

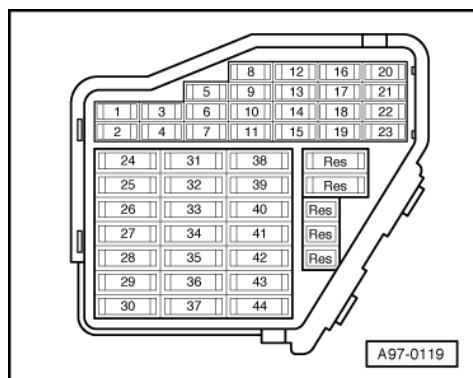
- Rectify any open/short circuit as necessary.

If no fault in wire is detected:

- Fit a new fuel pump relay -J17.



Testing activation for fuel pump and other components



- -> Remove fuses 28, 29 and 34.
- Start final control diagnosis and select one of the injectors
=> Page 27 .
- Connect multimeter (voltage measurement range) between earth and the left-hand or right-hand contact on the following fuses:

Fuse No.	Specification for left-hand or right-hand contact
28	approx. battery voltage
29	approx. battery voltage
34	approx. battery voltage

If the specification is not attained:

- Check wiring

=> Current flow diagrams, Electrical fault-finding and Fitting locations

If no fault in wire is detected:

- Fit a new fuel pump relay -J17.

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1.19 - Checking air mass meter

Special tools, testers and auxiliary items

- ♦ Diode test lamp V.A.G 1527
- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

Testing operation

- Connect fault reader V.A.G 1551
=> Page 2 .
- Start the engine.
- Select "Read measured value block", Display Group 002, engine at idling speed=>Page 39 .

-> Indicated on display:

Read measured value block	2
1 2 3 4	

Display zone 4 will show the intake air mass in grams per second.

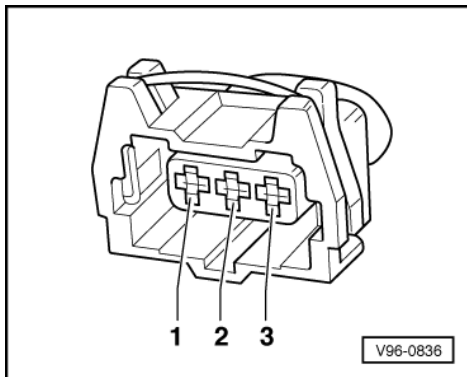
♦ Specification: 3.0 ... 5.0 g/s

- 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.

Testing power supply to air mass meter

- Test fuse for air mass meter.

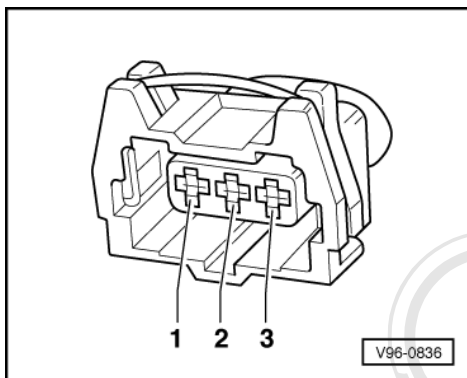
=> Current flow diagrams, Electrical fault-finding and Fitting locations



- -> If the fuse is OK, connect diode test lamp V.A.G 1527 between engine earth and contact 3 on the plug connector.
- Switch on ignition. 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 between fuse and contact 3 on plug connector. Rectify if necessary.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

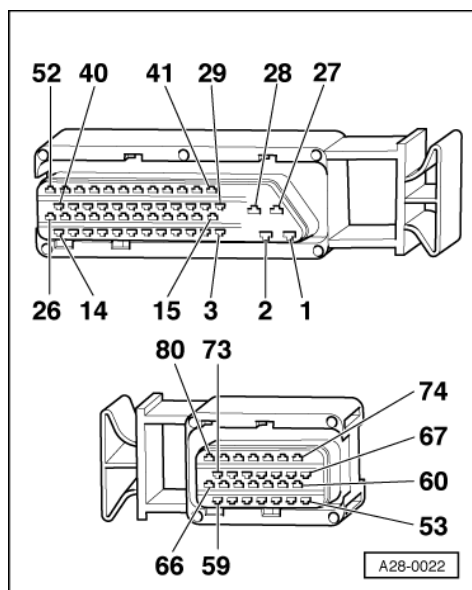
- If the power supply is OK, test the signal wiring
=> Page 91 .



Testing signal wire for air mass meter

- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=> Page 77 .
- -> Test wiring from plug connector on air mass meter...

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- -> ... 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 J220
1	13
2	12

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

2 - Testing intake manifold change-over function

2.1 - Testing intake manifold change-over function

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

The intake manifold change-over function switches over from the long intake tract to the short intake tract at about 4700 rpm.

2.2 - Testing operation

- Increase the engine speed to well above 4700 rpm; the vacuum unit for the intake manifold change-over system should "pull". (The vacuum unit is located on the front of the intake manifold, on the left-hand side below the ignition coils.)

If the intake manifold does not switch over, carry out the following tests:

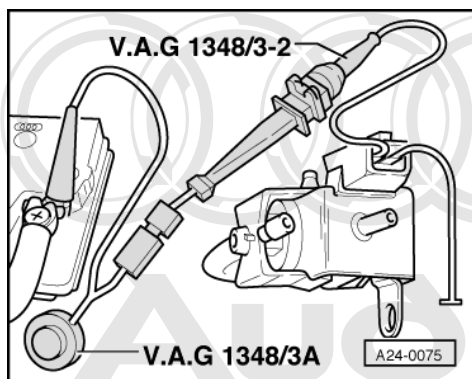
- Test intake manifold change-over valve -N156 (valve and activation=>Pages 96).
- Test vacuum system for leaks=>Page 93 .
- Check that vacuum hoses are properly connected and free of leaks and obstructions.
- Check that change-over mechanism operates freely (move push-rod by hand).

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2.3 - Testing vacuum system for leaks

Special tools, testers and auxiliary items

- ◆ Remote control V.A.G 1348/3A with adapter cable V.A.G 1348/3-2
 - ◆ Hand vacuum pump V.A.G 1390
 - ◆ Adapter set V.A.G 1594
- Run engine at idling speed for 2 or 3 minutes to build up vacuum pressure.
 - Switch off ignition.
 - Unplug connector from intake manifold change-over valve -N156.

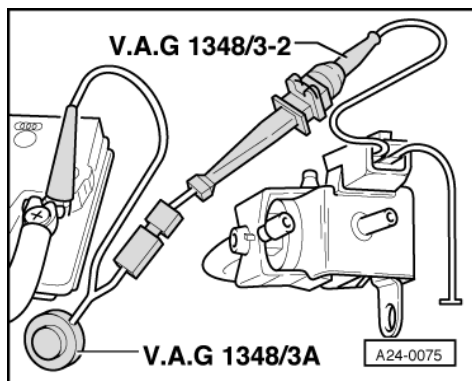


- -> Connect one of the contacts on the solenoid valve to engine earth using test leads and crocodile clamp from V.A.G 1594.
- Connect the second contact on the solenoid valve to positive using remote control V.A.G 1348/3A, adapter lead V.A.G 1348/3-2 and auxiliary cable.

- Operate remote control V.A.G 1348/3A for about 2 or 3 minutes. During this time the vacuum unit should remain in the "pulled-in" position.

If the vacuum unit returns to its original "rest" position, carry out the following test:

- Disconnect vacuum hoses from vacuum unit for intake manifold change-over system.
- Connect hand pump V.A.G 1390 to vacuum unit.
- Operate hand pump and check whether change-over function is working.
- Test vacuum unit for leaks. (The vacuum unit should not return to the "rest" position while a vacuum is being maintained via the hand pump.)



- If necessary, renew vacuum unit.
- If the vacuum unit does not pull, test -N156 for obstructions as follows:
- -> Connect one of the contacts on -N156 to engine earth using test leads and crocodile clamp from V.A.G 1594.
- Connect the other contact on -N156 to positive using remote control V.A.G 1348/3A, adapter lead V.A.G 1348/3-2 and auxiliary cable.
- Operate remote control V.A.G 1348/3A.
- Test valve for obstructions (remove vacuum hoses and blow through).
- If necessary, renew intake manifold change-over valve.



- If no faults have been found in any of the tests so far, test the vacuum system for leaks.

2.4 - Testing intake manifold change-over valve

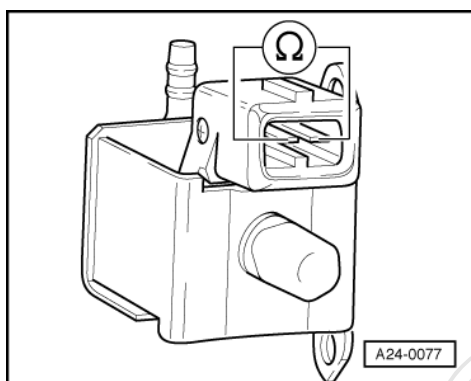
Fitting location => Page **59** .

Special tools, testers and auxiliary items

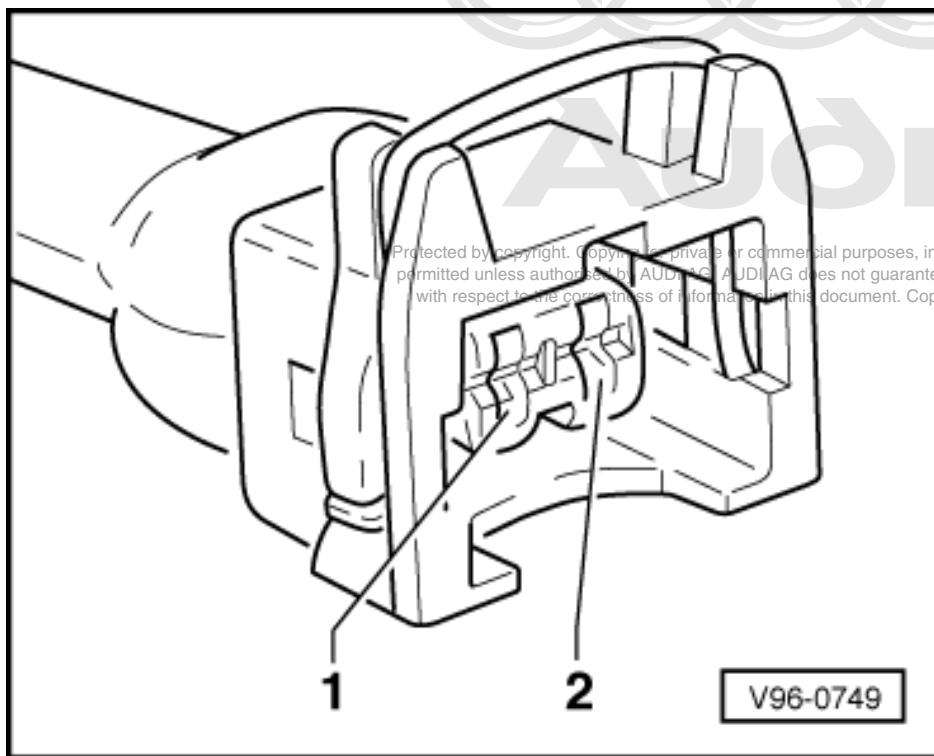
- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Diode test lamp V.A.G 1527
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

Electrical test of intake manifold change-over valve -N156

- Unplug connector from intake manifold change-over valve -N156.



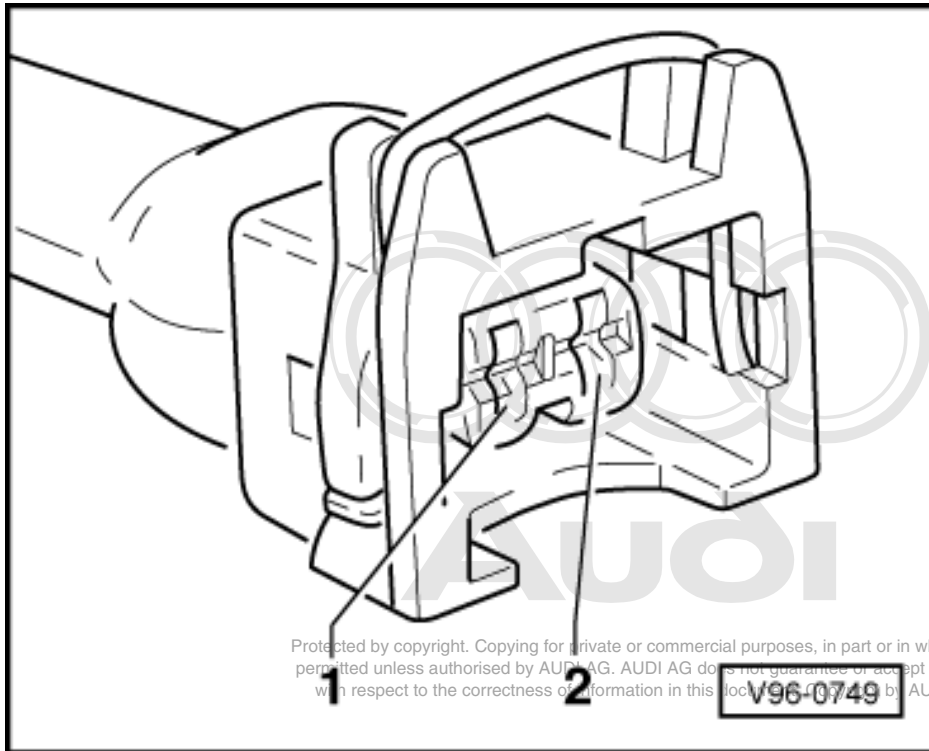
- -> Measure resistance between valve contacts using V.A.G 1526.
- Specification: 25 ... 35Ω
- If the reading does not match the specification, renew intake manifold change-over valve -N156.



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Testing power supply to intake manifold change-over valve -N156

- -> Unplug connector from intake manifold change-over valve -N156.



- -> Connect diode test lamp V.A.G 1527 between engine earth and contact 1 on connector using test leads from auxiliary cable set V.A.G. 1594.
- Operate the starter briefly.

Specification: The diode test lamp should light up.

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

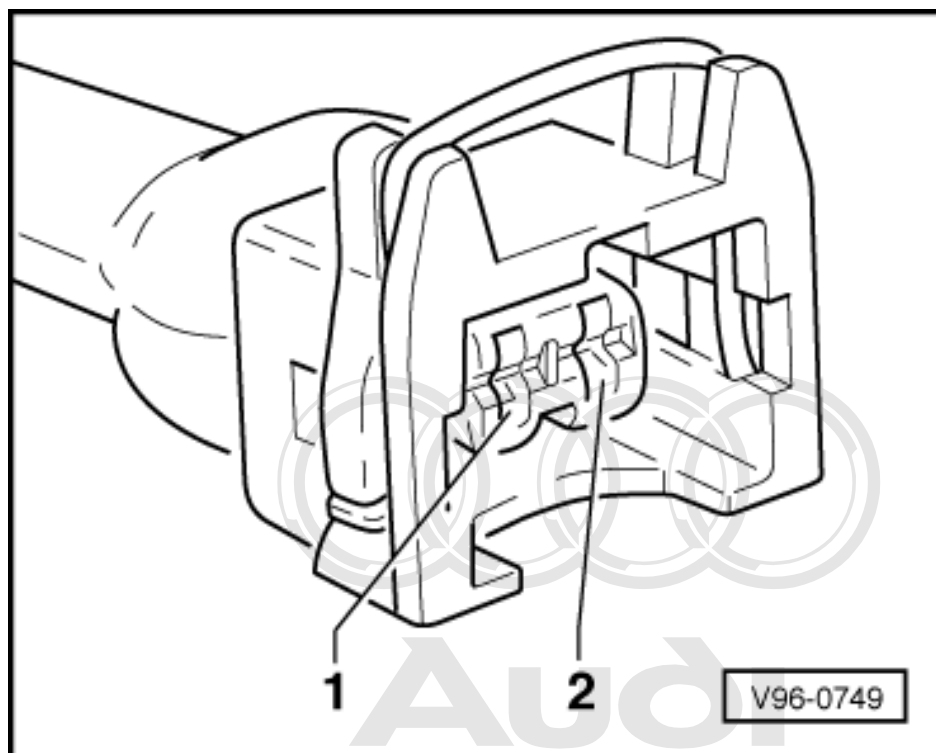
- Test fuse for -N156.
- Test for open circuit in wiring between fuse and contact 1 on connector for intake manifold change-over valve using current flow diagram.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

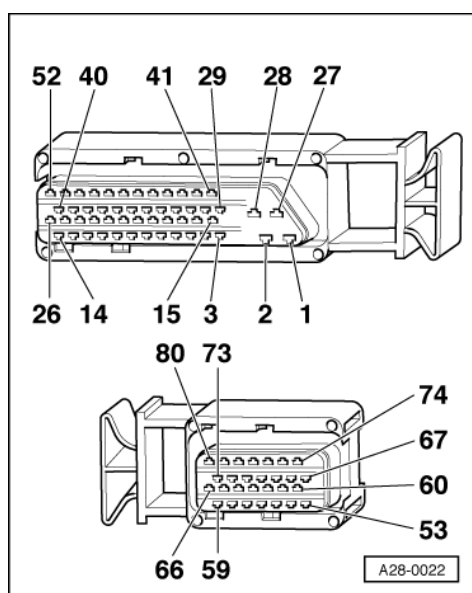
- Specification: maximum 1Ω
- Test fuel pump relay and activation
=> Page 87 .



Testing activation of intake manifold change-over valve



- -> Connect diode test lamp V.A.G 1527 between contacts 1 (positive) and 2 on connector for intake manifold change-over valve using test leads from auxiliary cable set V.A.G 1594.
- Perform final control diagnosis => Page 27. The diode test lamp should flash when the intake manifold change-over valve is 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 77.
- If the diode test lamp lights up continuously, test for short circuit to earth in wiring between socket 64 on test box V.A.G 1598/22 and contact 2 on connector for intake manifold change-over valve.
- If the diode test lamp does not flash, test for open circuit or short to positive in wiring between socket 64 on test box and contact 2 on connector for intake manifold change-over valve.
- Specification: maximum 1 ω



- -> If necessary, rectify short to earth or open circuit.

- If no short circuits or open circuits are found, fit a new engine control unit => Page **78**.

3 - Testing lambda control

3.1 - 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 1.1 V (based on reference earth).

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

The transition from "rich" to "lean" is accompanied by a voltage jump from between 0.7 and 1.1 V to between 0.0 and +0.3 V (based on reference earth) 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 wiring or reference earth wiring.
- ◆ Lambda probe too cold; lambda probe heating not working.
- ◆ Lambda control switched off (control unit has detected a fault in the injection system); see "Interrogating fault memory" and "Reading measured value block", Display Group 021.
- ◆ Lambda probe damaged by contact spray or similar product. (The contact spray is drawn into the probe via the fine cavities in the electrical wiring as a result of temperature fluctuations and capillary effect.)
- ◆ 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.)

3.2 - 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/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.

Special tools, testers and auxiliary items

- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Testing vehicle under cold-start conditions:

- Connect fault reader V.A.G 1551
=> Page **2**.
- Start the engine.



- Select "Read measured value block", Display Group 009, engine at idling speed=>Page **45** .

-> Indicated on display:

Read measured value block 9
1 2 3 4

Display zone 1 will show the signal voltage for lambda probe 1.

Display zone 2 will show the signal voltage for lambda probe 2.

Engine cold or lambda control not running: 0.45...0.50 V.

- Take vehicle for a test drive.

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Important:

Secure fault reader to rear seat and operate from this location. When doing this, always observe the relevant safety precautions => Page **57** .

- Observe display zones 1 and 2 during test drive.

-> When the lambda control cuts in the voltage readings in display zones 1 and 2 should fluctuate with the ranges of 0.0...+0.3 V and +0.7...+1.1 V.

Read measured value block 9
1 2 3 4

Voltages of more than +0.7 V indicate a rich fuel mixture (low oxygen level in exhaust gas).

Voltages of less than +0.3 V indicate a lean fuel mixture (high oxygen level in 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 engine performance only becomes poor after the lambda control has cut in, test operation of lambda probes
=> Page **98** .

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", Display Group 008, engine at idling speed=>Page **45** . If the values are not as specified, rectify the fault.
- Check also the measured value blocks in function 04 (Basic setting). The solenoid valve for the activated charcoal filter -N80 is closed for this function.
- ♦ The lambda control can be switched on and off as required using Display Group 099. Press keys 4 and 8 to switch back and forth between "Basic setting " (lambda control off) and "Read measured value block" (lambda control on).

3.3 - Testing operation of lambda probes

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- Connect fault reader V.A.G 1551
=> Page **2** .
- Start the engine.

- Select "Read measured value block", Display Group 003, engine at idling speed=>Page 40 .

-> Indicated on display:

Read measured value block 3			
1	2	3	4

Do not proceed with the test until the coolant temperature shown in display zone 3 has reached at least 80°C.

- Press C key.
- Press keys 0, 0 and 9 for Display Group 009 and confirm entry with Q key.

-> Indicated on display:

Read measured value block 9			
1	2	3	4

Display zone 1 will show the signal voltage for lambda probe 1.

Display zone 2 will show the signal voltage for lambda probe 2.

- If the lambda probe voltage reading fluctuates very slowly, test the lambda probe heating => Page 100 .
- If the display shows a constant lambda probe voltage reading of 0.000 V, this means there is a short circuit to earth.
Test wiring => Page 100 .
- If the display shows a constant lambda probe voltage reading of between 0.45 and 0.50 V, this means there is an open circuit in the signal wire. Test wiring => Page 101 .
- If the display shows a constant lambda probe voltage reading of 1.105 V, this means there is a short circuit to positive.
Test wiring=>Page 101 .
- If the display shows a constant voltage reading of between 0.0 and +0.3 V (mixture too lean), this means that the lambda control has reached the maximum enrichment limit but the lambda probe is still registering "Mixture too lean".
- If the display shows a constant voltage reading of between +0.7 and 1.0 V (mixture too rich), this means that the lambda control has reached the maximum leaning-down limit but the lambda probe is still registering "Mixture too rich".
- Press C key.

-> Indicated on display:

Read measured value block	
Enter display group number xxx	

- If the lambda probe is functioning properly, select Display Group 008 and check lambda learned values.
=>Page 45 .

-> Indicated on display:

Read measured value block 8			
1	2	3	4

Display zone 3 will show the lambda learned value for cylinder bank 1. Display zone 4 will show the lambda learned value for cylinder bank 2.

The lambda control has learning ability, i.e. is self-adaptable. Faults such as unmetered air or defective injectors have the effect of changing the air/fuel mixture composition. The lambda probes detect this and compensate by adjusting the basic injection periods mapped in the control unit. The injection periods are extended or reduced until a mixture composition of $\lambda = 1$ is achieved. The difference between the actual injection period and the basic period mapped in the control unit is given as a percentage.

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

Specifications: Reading measured value block => Page 45 .



- If the values do not match the specifications, see test table for Display Group 007=>Page 45 .

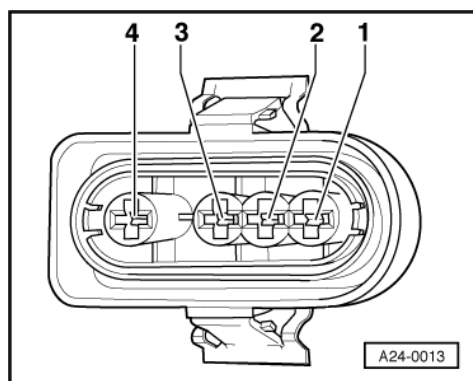
Note:

If necessary, Display Group 007 can also be checked and printed out in the "Basic setting" mode (function 04) for the purposes of fault-finding. In the "Basic setting" mode the influence of systems such as the activated charcoal filter is eliminated=>Page 30 .

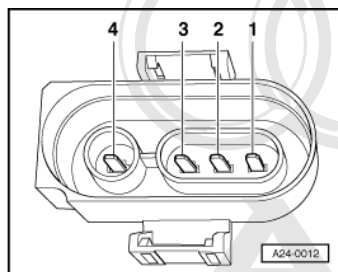
3.4 - Checking Lambda probe heating

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594
- Unplug lambda probe connector for left-hand or right-hand cylinder bank.
(Fitting locations=>Pages 60)



- -> Connect voltmeter between contacts 1 (positive) and 2 (earth).
- Start the engine.
 - Specification: 12 ... 14 V
- If the readings do not match the specifications, carry out the following tests (marked with dots):
 - Test fuse for lambda probe heating
 - Test for open circuit in wiring between contact 1 and fuse in fuse holder using current flow diagram. Specification: max. 1 ω .
(If necessary, check contact assignment.)
 - Test for open circuit in wiring between contact 2 and engine earth. Specification: max. 1 ω
 - Test fuel pump relay => Page 87 .



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- -> If the reading matches the specification, connect hand-held multimeter V.A.G. 1526 between contacts 1 and 2.

Specification at room temperature: approx. 2 ... 5 ω

Note:

The resistance of the heating element at room temperature is about 2...5 ω . With even a small temperature rise this value will increase sharply.

- If the reading does not match the specification, fit a new lambda probe.

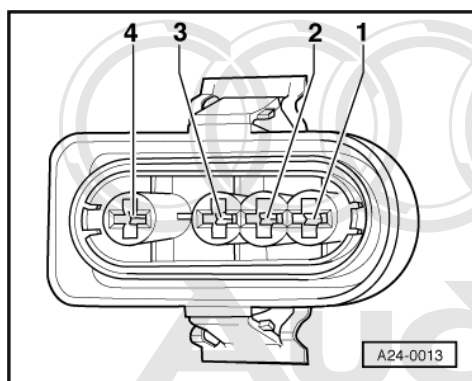
3.5 - Testing lambda probe signal wiring and activation

Note:

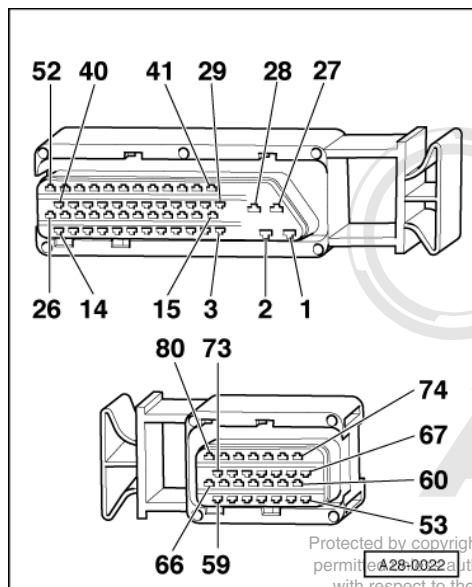
The lambda probe signal is monitored by the self-diagnosis system.

Special tools, testers and auxiliary items

- ◆ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ◆ Adapter set V.A.G 1594
- ◆ Test box V.A.G 1598/22
- Connect fault reader V.A.G 1551
=> Page 2 .
- Switch on ignition.
- Interrogate fault memory=>Page 4 .
- If a fault relating to the lambda probe is indicated on the display and the lambda probe heating is OK, unplug the lambda probe connector for the left-hand or right-hand cylinder bank.
Fitting locations=>Pages 60 .



- -> 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
- Switch ignition on.
- Specification: 450±50 mV
- If the reading matches the specification, fit a new lambda probe.
- If the reading is not as specified, connect test box 1598/22 to the wiring harness for the engine control unit
=>Page 77 .



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- -> Test for open circuit and short to positive or earth in the following wiring connections:

Lambda probe Bank 1 -G39

Contact on wiring harness plug	Test box V.A.G 1598/22 or -J220
3	25
4	26

Lambda probe Bank 2 -G108

Contact on wiring harness plug	Test box V.A.G 1598/22 or -J220
3	39
4	40

- Rectify any open/short circuit as necessary.
- If the wiring is OK, fit a new engine control unit
=>Page 78 .

3.6 - Removing and installing lambda probe

Special tools, testers and auxiliary items

- ♦ Hot paste G 052 112 A3

Removing

- Unplug lambda probe connector for left-hand or right-hand cylinder bank.
(Fitting locations=>Pages 60)
- Release cable ties.
- Unscrew lambda probe.

Installing

When installing, note the following points:

Notes:

- ◆ Tightening torque: 50 Nm.
- ◆ The screw thread on the lambda probe is coated with a special paste. This paste must not be allowed to penetrate the openings on the probe.
- ◆ When installing, the cable ties must be re-fitted at exactly the same points in order to prevent contact between the lambda probe wire and the exhaust pipe.

4 - Testing secondary air system

4.1 - Testing secondary air system

4.2 - Testing secondary air inlet valve

Fitting location => Fitting locations overview, Page **59**

Special tools, testers and auxiliary items

- ◆ Diode test lamp V.A.G 1527
 - ◆ Test leads from adapter set V.A.G 1594
 - ◆ Test box V.A.G 1598/22
- Pull 2-pin connector off valve and connect diode test lamp V.A.G 1527 to disconnected connector using test leads from V.A.G 1594.
The LED should flash.

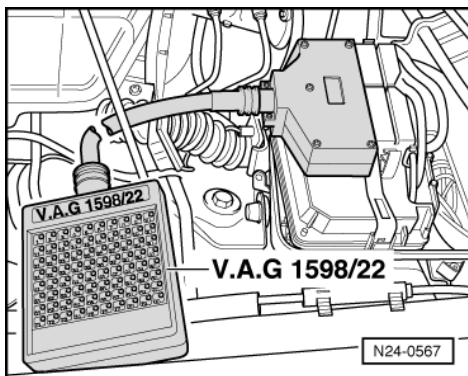
If the LED flashes:

- Replace secondary air inlet valve:

=> 6-cylinder engine (5-valve), Mechanics; Repair group 26; Secondary air system; Removing and installing parts of secondary air system Secondary air system Removing and installing parts of secondary air system

If the LED does not flash:

- Switch off ignition.



- -> Connect test box V.A.G 1598/22 to wiring harness for engine control unit=>Page **77** .
- Test for open circuit in wiring between socket 33 on test box and contact 2 on 2-pin connector using current flow diagram.
Wiring resistance: max. 1.5 ω

If no fault in wire is detected:



- Test voltage supply to valve using current flow diagram.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

4.3 - Testing secondary air pump relay

- Pull 2-pin connector off secondary air pump motor and connect diode test lamp V.A.G 1527 to disconnected connector using test leads from V.A.G 1594.
The LED should flash.

If the LED flashes:

- Renew secondary air pump motor (V101):

=> 6-cylinder engine (5-valve), Mechanics; Repair group 26; Secondary air system; Removing and installing parts of secondary air system
Secondary air system Removing and installing parts of secondary air system

If the LED does not flash but the secondary air pump relay clicks:

- Check fuse for secondary air pump relay -J299.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

If the fuse is not faulty:

- Remove secondary air pump relay from relay carrier.

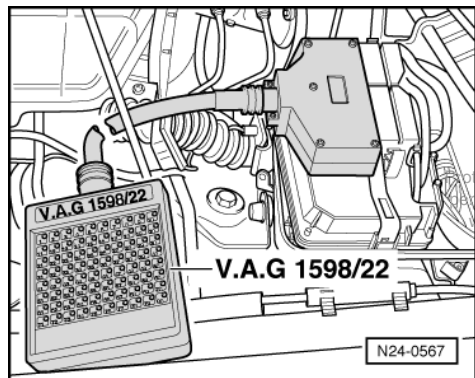
=> Current flow diagrams, Electrical fault-finding and Fitting locations

Notes:

- ♦ If tools are necessary to pull relays or control units out of the relay plate, first disconnect battery earth strap.
- ♦ Before disconnecting battery earth strap obtain code for radios with anti-theft coding.
- Test voltage supply (terminal 30) to relay using current flow diagram. If necessary, renew secondary air pump relay -J299.

If the LED does not flash and the secondary air pump relay does not click:

- Switch off ignition.



- -> Connect test box V.A.G 1598/22 to wiring harness for engine control unit=>Page 77 .
- Test for open circuit in wiring between socket 30 on test box and contact 6 on relay carrier using the current flow diagram.
Wiring resistance: max. 1.5Ω

If no fault in wire is detected:

- Renew engine control unit=>Page 78 .

5 - Testing fuel tank breather system

5.1 - Testing fuel tank breather system

5.2 - Testing operation

Test conditions

- No fault stored in fault memory

Special tools, testers and auxiliary items

- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- Connect fault reader V.A.G 1551
=> Page 2 .
- Start the engine.
- Select "Read measured value block", Display Group 010, engine at idling speed=>Page 47 .

-> Indicated on display

Read measured value block 10			
1	2	3	4

- Observe readout in display zone 1.

The duty cycle of the activated charcoal filter solenoid valve comprises an active period of about 220 to 900 seconds (fuel tank breather system on) followed by an inactive period of about 1 minute (fuel tank breather system off). During the 70 seconds or so of non-activity the lambda control learns the engine operating conditions without the influence of the fuel vapour from the activated charcoal filter.

- If the fuel tank breather system is not active, wait for about 70 seconds until it is re-activated.
- Observe readout in display zone 3.

- ◆ A readout of -5 indicates that the ACF filter is new (contains no fuel vapour).
- ◆ A readout of between 0 and+95 indicates the quantity of fuel vapour in the ACF filter.

5.3 - Testing solenoid valve 1 for activated charcoal filter

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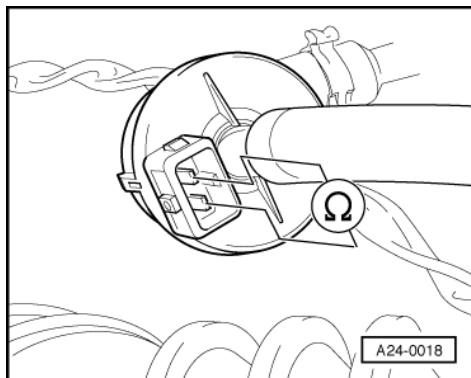
Fitting location => Fitting locations overview, Page 59

Special tools, testers and auxiliary items

- ◆ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ◆ Diode test lamp V.A.G 1527
- ◆ Adapter set V.A.G 1594

Electrical test of solenoid valve 1 for activated charcoal filter -N80

- Unplug connector on ACF valve.



- -> Measure resistance between contacts on valve using hand-held multimeter V.A.G 1526.
- Specification: 20 ... 28Ω
- If the value is not as specified, fit a new ACF valve.

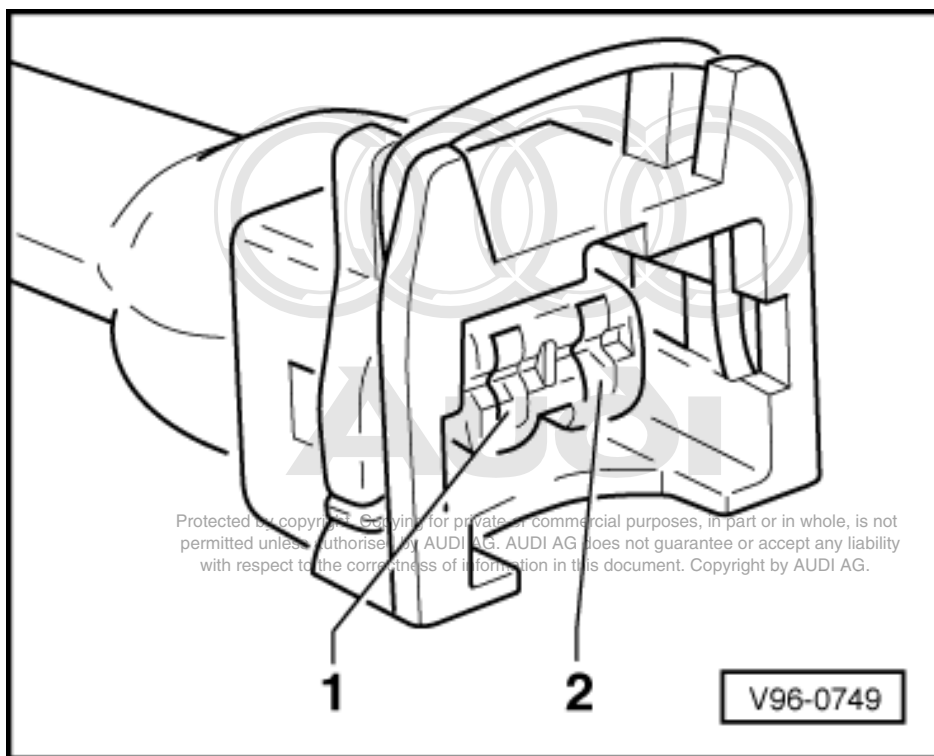
Testing power supply to ACF valve

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.

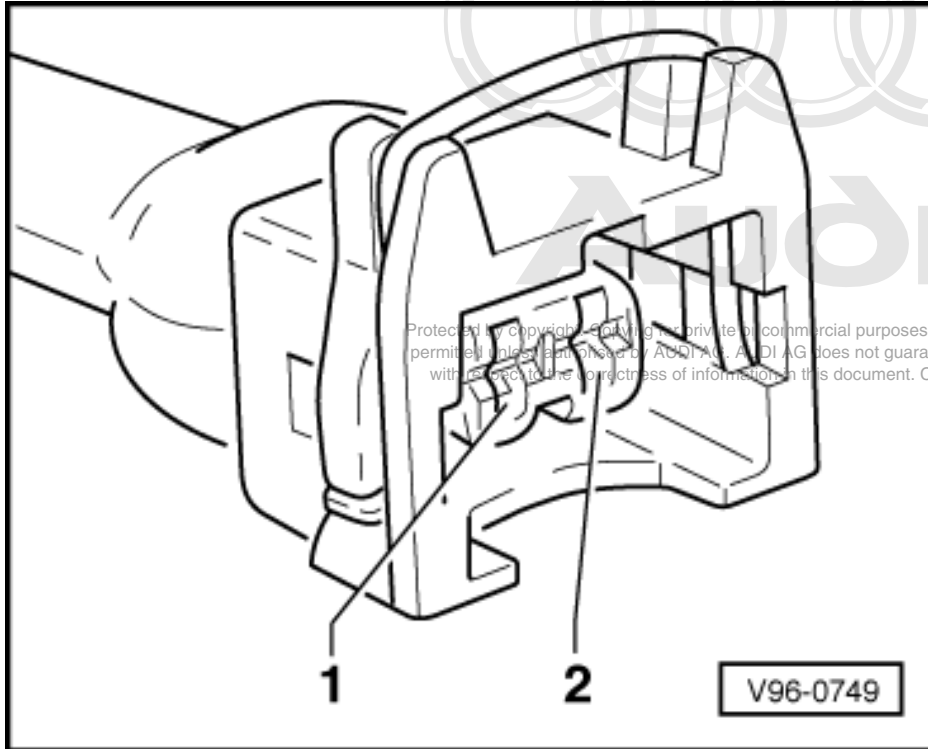
Specification: diode test lamp should light up.

- 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 binder

- Test fuel pump relay and activation
=> Page 87 .

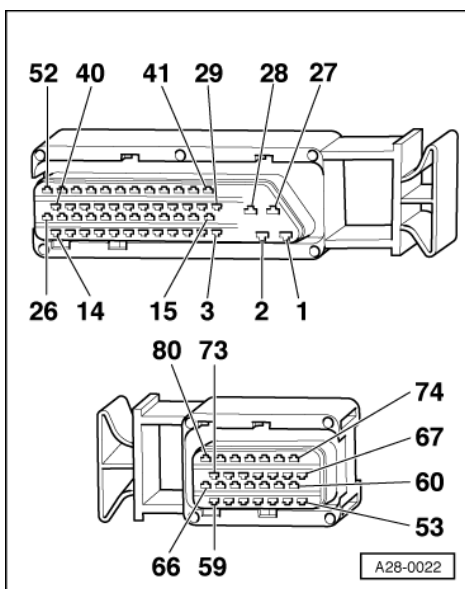
Testing activation of ACF valve



- -> Connect diode test lamp V.A.G 1527 between contacts 2 and 1 (positive) of plug connector.
- Start final control diagnosis and select solenoid valve for activated charcoal filter -N80
=>Page 27 .

Specification: diode test lamp should start flashing.

- 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 77 .





- -> If the diode test lamp lights up continuously, test for short circuit to earth in wiring from contact 2 on ACF valve connector.
- 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.
 - Specification: max. 1Ω
- 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 78 .

6 - Testing throttle valve control part

6.1 - Testing throttle valve control part

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

The box facing the cable pulley contains the following components (this box must not be opened):

- ♦ Throttle valve potentiometer -G69
- ♦ Throttle valve positioner potentiometer -G88
- ♦ Idling speed switch -F60
- ♦ Throttle valve positioner -V60 (electric motor)

The potentiometers and switches cannot be adjusted mechanically. Adjustments are carried out during the basic setting (function 04) with fault reader V.A.G 1551 or 1552.

6.2 - Testing learning requirement

The process of adapting the throttle valve control part -J338 to the engine control unit enables the engine control unit to learn the stop positions of the throttle valve control part -J338. It also provides the engine control unit with a reference curve relating the throttle valve potentiometer -G69 to the throttle valve positioner sender - G127.

Display Group 023 shows the values learnt as a result of the last adaption process, and also the learning requirement.

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- Connect fault reader V.A.G 1551
=> Page 2 .
- Start the engine.
- Select "Read measured value block", Display Group 023, engine at idling speed=>Page 52 .

-> Indicated on display:

Read measured value block 23		
01000000	72...95%	65...85%
16...51%		

- Check the display values=>Page 52 .

If the values do not match the specifications:

- Perform adaption of throttle valve control part to engine control unit
=>Page 109 .
- Repeat the test.

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6.3 - Performing adaption of throttle valve control part

In order for the idling speed stabilisation to function, the engine control unit needs to know the stop positions of the throttle valve positioner (V60) and the potentiometer characteristics of the throttle valve positioner sender (G127) and throttle valve potentiometer (G69).

The learning process (adaption process) must be carried out if:

- ◆ the voltage supply to the engine control unit has been interrupted (e.g. when the battery is disconnected)
- ◆ a new throttle valve control part has been fitted
- ◆ a new engine control unit has been fitted
- ◆ fault code 17967 is recorded in the fault memory

The learning process (adaption process) is carried out:

- ◆ automatically if the ignition is switched on once for at least 6 seconds without operating the starter or the accelerator
- ◆ by selecting Display Group 098 in the "Basic setting" mode with the engine not running

Special tools, testers and auxiliary items

- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- Connect fault reader V.A.G 1551
=> Page 2.
- Switch on ignition.
- Select "Basic setting", Display Group 098, engine not running
=>Page 55.

-> Indicated on display:

Basic setting 98
4.420 V 3.880 V Idling
ADP.runs

When the Q key is pressed the throttle valve positioner moves to Min., Max. and several intermediate positions, and the control unit records the various throttle valve angles in its permanent (non-volatile) memory. This process takes no more than 10 seconds. The throttle valve then remains in the start position for about 20 seconds before returning to the rest position (no current).

-> Indicated on display:

Basic setting 98
4.420 V 3.880 V Idling
ADP.O.K.

The adaption process has been successfully completed.

Note:

-> If one of these messages appears on the display, this means that the adaption process has been aborted.

Basic setting 98
4.420 V 3.880 V Idling
ADP.ERROR

The following faults are possible:

Function is unknown or
cannot be carried out at the moment

- ◆ Engine started while adaption was in progress
- ◆ Battery voltage less than 10 V
- ◆ Throttle cable incorrectly adjusted
- ◆ Fault in wiring between throttle valve control part and engine control unit
- ◆ Throttle valve control part defective



6.4 - Testing idling speed switch

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22
- Connect fault reader V.A.G 1551
=> Page 2 .
- Switch on ignition.
- Select "Read measured value block", Display Group 098, engine not running=>Page 55 .

-> Indicated on display:

Read measured value block 98
4.420 V 3.880 V Idling
ADP.O.K.

- Check display in display zone 3.

Read measured value block 98
4.420 V 3.880 V Idling ADP.O.K.

-> Specification: Idling

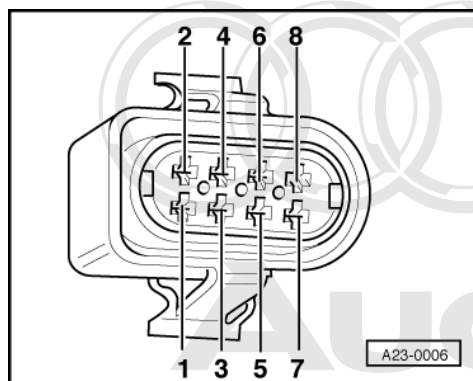
- Operate accelerator pedal.

Read measured value block 98
4.420 V 3.880 V Part throt
ADP.O.K.

-> Specification: Part throttle

If the specification is not attained:

- Switch off ignition.
- Unplug connector from throttle valve control part.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=> Page 77 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Contact on 8-pin connector on wiring harness	Socket on test box V.A.G 1598/22
3	69
7	67

- Rectify any open/short circuit as necessary.

If no wiring fault is detected:

- Fit a new throttle valve control part (J338).

6.5 - Testing throttle valve potentiometer

The throttle valve potentiometer (G69) informs the engine control unit of the position of the throttle valve.

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

- Connect fault reader V.A.G 1551
=> Page 2.
- Switch on ignition.
- Select "Read measured value block", Display Group 001, engine not running=>Page 38.

-> Indicated on display:

Read measured value block 1			
0 rpm	0.00 ms	4 -5	
12.05BTDC			

- Check display in display zone 3.

Read measured value block 1				
0 rpm	0.00 ms	4 -5	12.05BTDC	

-> Specification: 0...5 <°

- Press accelerator pedal down slowly.

Read measured value block 1				
0 rpm	0.00 ms	86 -5	12.05BTDC	

-> Specification: The value in display zone 3 should rise continuously to between 85 and 90 <° (accelerator pedal fully depressed).

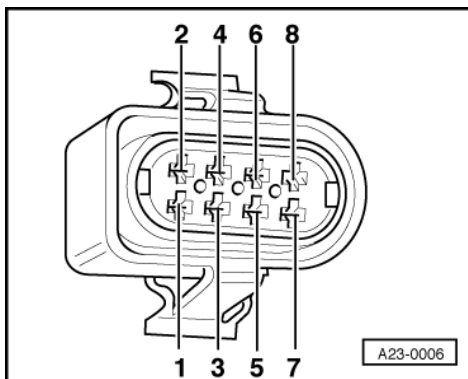
If either the initial or the final specification is not attained:

- Check throttle cable setting

=> 6-cylinder engine (5-valve), Mechanics; Repair group 20; Removing and installing parts of fuel supply system; Servicing throttle mechanism Removing and installing parts of fuel supply system Servicing throttle mechanism

If the readout does not change or only changes irregularly:

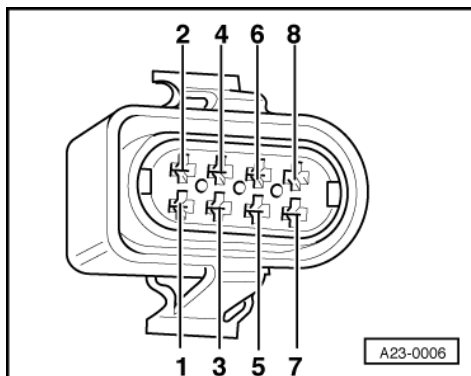
- Switch off ignition.
- Unplug connector from throttle valve control part.



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- -> Connect multimeter (voltage measurement range) between earth and contact 4 of the connector.
- Switch ignition on.
 - Specification: approx. 5 V
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=> Page 77 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Contact on 8-pin connector on wiring harness	Socket on test box V.A.G 1598/22
4	62
5	75
7	67

- Rectify any open/short circuit as necessary.

If no wiring fault is detected:

- Fit a new throttle valve control part (J338).

6.6 - Testing throttle valve positioner sender

The throttle valve positioner sender (G127) informs the engine control unit of the position of the throttle valve positioner (V60).

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

- Connect fault reader V.A.G 1551
=> Page 2 .
- Start the engine.
- Select "Read measured value block", Display Group 098, engine at idling speed=>Page 55 .

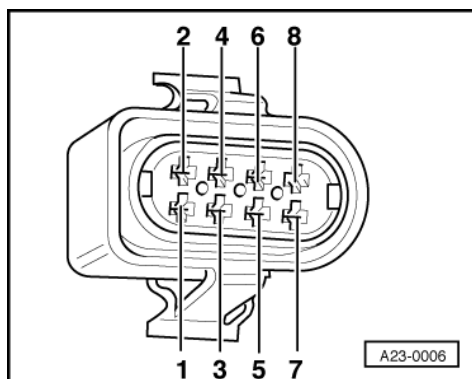
-> Indicated on display:

Read measured value block 98
4.420 V 3.880 V Idling
ADP.O.K.

- Check display in display zone 2.
 - Specification: 0.500 ... 4.900 V

If the specification is not attained:

- Switch off ignition.
- Unplug connector from throttle valve control part.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=> Page 77 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Contact on 8-pin connector on wiring harness	Socket on test box V.A.G 1598/22
4	62
7	67
8	74

- Rectify any open/short circuit as necessary.

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If no wiring fault is detected:

- Fit a new throttle valve control part (J338).

6.7 - Testing throttle valve positioner

The throttle valve positioner (V60) is an electric motor. When the engine is idling the throttle valve positioner actuates the throttle valve via a gear mechanism in order to control the idling speed.

Special tools, testers and auxiliary items

- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ◆ Adapter set V.A.G 1594
- ◆ Test box V.A.G 1598/22

- Connect fault reader V.A.G 1551
=> Page 2 .
- Switch on ignition.
- Select "Basic setting", Display Group 098, engine not running
=>Page 55 .

-> Indicated on display:

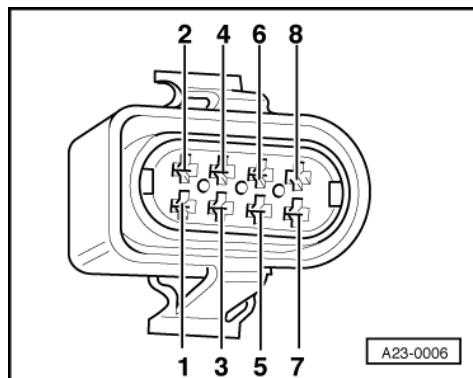
Basic setting 98		
4.420 V	3.880 V	Idling
ADP.runs		

When the Q key is pressed, the throttle valve positioner moves to the Min. and Max. stops. (The action of the throttle valve positioner in the throttle valve control part is both visible and audible.)

If the throttle valve positioner does not move:



- Switch off ignition.
- Unplug connector from throttle valve control part.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit
=> Page 77 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Contact on 8-pin connector on wiring harness	Socket on test box V.A.G 1598/22
1	66
2	59

- Rectify any open/short circuit as necessary.

If no wiring fault is detected:

- Fit a new throttle valve control part (J338).

7 - Testing auxiliary signals

7.1 - Testing auxiliary signals

7.2 - Testing air conditioner compressor shut-off

Notes:

- ♦ The air conditioner compressor signal informs the engine control unit that the compressor will be switched on in 140 ms.
- ♦ The engine control unit can send a signal via the same wire to shut off the air conditioner compressor.
- ♦ The engine control unit will shut off the air conditioner compressor in the following circumstances:
 - Sharp acceleration (full throttle)
 - In emergency running mode (back-up)
 - If the coolant temperature exceeds 120°C

Test conditions

- Air conditioner functioning properly
- No faults recorded in fault memory of engine control unit
- Interior temperature of more than +15°C

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/22

- Connect fault reader V.A.G 1551
=> Page 2.
- Start the engine.
- Select "Read measured value block", Display Group 020, engine at idling speed=>Page 51.

-> Indicated on display:

Read measured value block				20
1	2	3	4	

- Switch off air conditioner.

Display zone 4 should read "Compr.OFF".

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

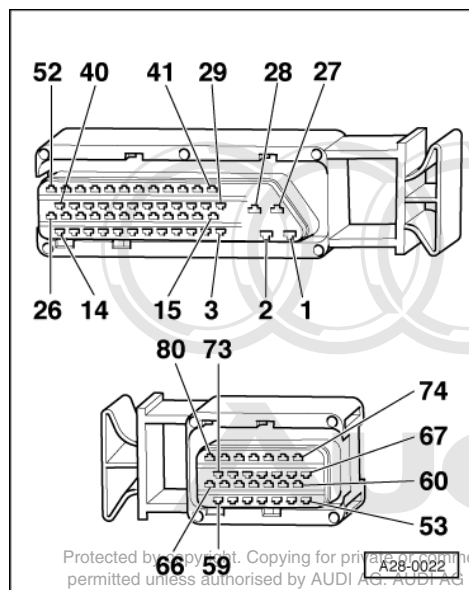
Display zone 3 should read "A/C-High".

Display zone 4 should read "Compr.ON".

- Floor and release the accelerator quickly (short blip).

When the accelerator is floored quickly, the readout in display zone 4 should jump from "ON" to "OFF" for a few seconds (compressor shut-off during acceleration).

- If the display readout is not as specified, switch off the engine and connect test box V.A.G 1598/22 to the wiring harness for the engine control unit=>Page 77.



- -> Test for open circuit and short to earth or positive in wiring between air conditioner and contact 8 on engine control unit using the current flow diagram.

=> Current flow diagrams, Electrical fault finding and Fitting locations binder

- If there are no faults in the wiring, test operation of air conditioner.

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

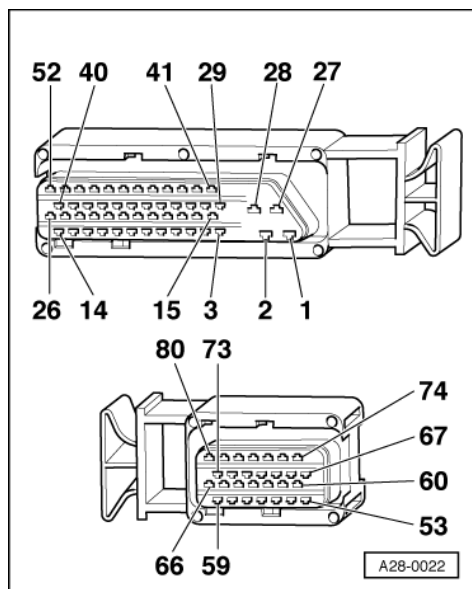


7.3 - Checking engine speed signal

The engine speed signal is taken from contact 6 on the engine control unit. This signal is required for the rev counter on the dash panel insert and for other control units.

Special tools, testers and auxiliary items

- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22



- Connect test box V.A.G 1598/22 to wiring harness for engine control unit.
=>Page 77 .
- -> Test for open circuit in wiring between dash panel insert and contact 6 on the test box using current flow diagram.

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=> Current flow diagrams, Electrical fault-finding and Fitting locations

7.4 - Testing speed signal

Notes:

- ♦ The road speed signal is produced by the road speed sender -G68 and 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.

Special tools, testers and auxiliary items

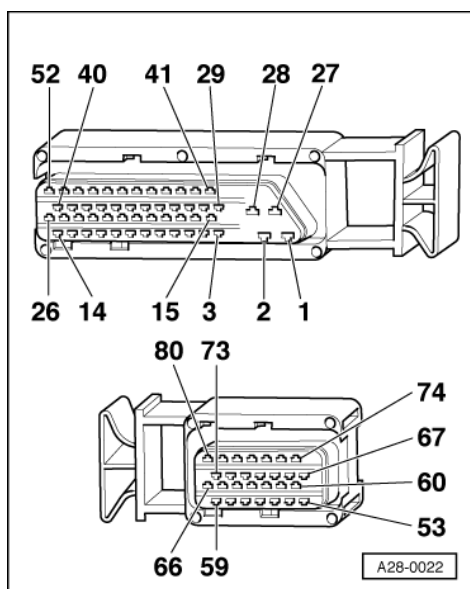
- ♦ Diode test lamp V.A.G 1527
 - ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
 - ♦ Adapter set V.A.G 1594
 - ♦ Test box V.A.G 1598/22
- Connect fault reader V.A.G 1551
=> Page 2 .
 - Start the engine.
 - Select "Read measured value block", Display Group 011, engine at idling speed=>Page 48 .
- > Indicated on display:

Read measured value block 11
1 2 3 4

Important:

Secure fault reader to rear seat and operate from this location. When doing this, always observe the relevant safety precautions => Page 57 .

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



- If the road speed is not displayed, lift vehicle at the front left until the wheel is off the ground.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit.
=>Page 77 .
- -> Connect diode test lamp between socket 3 (positive) and socket 20 (signal).
- Switch on the ignition and turn the front left wheel by hand.

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The diode test lamp should flash (at very rapid intervals).

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

7.5 - Testing fuel consumption signal for on-board computer

Notes:

- ♦ The fuel consumption signal is generated by the engine control unit on the basis of the injection period, and is transmitted to the on-board computer.
- ♦ Testing fuel consumption signal

=> Current flow diagrams, Electrical fault-finding and Fitting locations; Fault-finding programme for on-board computer

7.6 - Testing output signal for throttle valve position

Note:

The automatic gearbox control unit uses this signal together with the engine speed signal to calculate the gearshift points.

Special tools, testers and auxiliary items

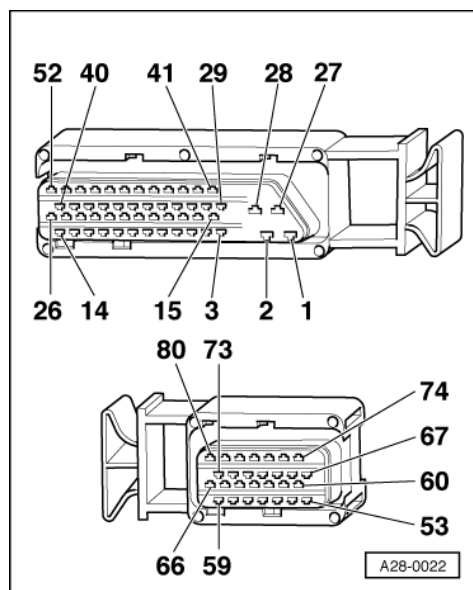
- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

Vehicles with engine control unit numbers

up to 4D0 907 551 F

- Connect fault reader V.A.G 1551
=> Page 2 .
- Start self-diagnosis of gearbox control unit

=> Automatic gearbox 01V, Self-diagnosis; Repair group 01; Performing self-diagnosis Performing self-diagnosis



- If the gearbox control unit indicates fault 00638 ("Engine/gearbox electrical connection 2"), interrogate the fault memory of the engine control unit=>Page 4 .
- If the engine control unit has stored a fault relating to the throttle valve potentiometer, rectify this fault first. (The fault recorded by the gearbox control unit will only have occurred as a result of the earlier fault.)
- If no faults relating to the throttle valve potentiometer are indicated, connect test box V.A.G 1598/22 to the wiring harness for the engine control unit=>Page 77 .
- -> Test for open circuit and short circuit in wiring from contact 7 on gearbox control unit using the current flow diagram.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

Vehicles with engine control unit numbers

from 4D0 907 551 G onwards

The engine control unit and gearbox control unit exchange data via the CAN bus.

=>Testing CAN bus, Page 122 .

7.7 - Testing signal for actual engine torque

Notes:

- ◆ The engine control unit transmits the signal for the actual engine torque (actual torque at clutch) to various electronic systems in the vehicle (e.g. automatic gearbox control unit and ABS/ASR control unit (ASR = traction control system)).
- ◆ On vehicles with engine control unit numbers up to 4D0 907 551 F, the signal for the actual engine torque is transmitted from the engine control unit to the ABS/ASR control unit and the gearbox control unit via a single wire.
- ◆ On vehicles with engine control unit numbers from 4D0 907 551 onwards, the signal for the actual engine torque is transmitted from the engine control unit to the ABS/ASR control unit and the gearbox control unit via the CAN bus data wire.
Testing CAN bus => Page 122 .
- ◆ The actual engine torque signal (MMI) and the signal wire are monitored by the ABS/ASR control unit and the gearbox control unit.

=> Running gear, Self-diagnosis; Repair group 01

=> Automatic gearbox 01V, Self-diagnosis; Repair group 01; Performing self-diagnosis Performing self-diagnosis

7.8 - Testing signal for specified engine torque from ABS/ASR control unit

Notes:

- ◆ On vehicles with engine control unit numbers up to 4D0 907 551 F, the signal for the specified engine torque is transmitted from the engine control unit to the ABS/ASR control unit via a single wire.
- ◆ On vehicles with engine control unit numbers from 4D0 907 551 onwards, the signal for the specified engine torque is transmitted from the engine control unit to the ABS/ASR control unit via the CAN bus data wire.
Testing CAN bus => Page 122 .
- ◆ The specified engine torque signal (MMS / signal indicating rough road surface) and the signal wire are monitored by the ABS/ASR control unit.

=> Running gear, Self-diagnosis; Repair group 01

- ◆ To test whether the specified engine torque signal is being transmitted, see "Read measured value block", Display Group 024.

Test conditions

- Control unit coding OK => Page 32 .

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7.9 - Testing gear selection signal

Note:

Multi-function switch -F125 on the gearbox informs the engine control unit whether a gear has been selected (selector lever in position 2, 3, 4, R or D) or not (selector lever in position P or N).

Special tools, testers and auxiliary items

- ◆ Diode test lamp V.A.G 1527
- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ◆ Adapter set V.A.G 1594



- ♦ Test box V.A.G 1598/22

Vehicles with engine control unit numbers

up to 4D0 907 551 F

- Connect fault reader V.A.G 1551
=> Page 2 .
- Switch ignition on.
- Select "Read measured value block", Display Group 020, engine not running=>Page 51 .

-> Indicated on display:

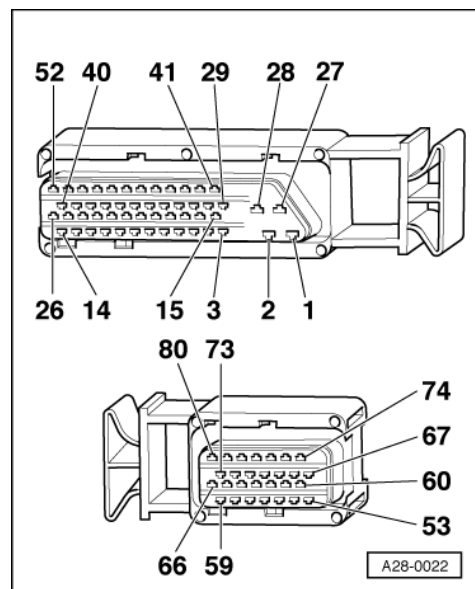
Read measured value block	20
1 2 3 4	

Specification for display zone 2: "Neutral" (selector lever in P or N)

- Depress the brake pedal and engage a gear.

Specification: "Gear engag."

- If the display readout is not as specified, switch off the engine and connect test box V.A.G 1598/22 to the wiring harness for the engine control unit=>Page 77 .



- -> Connect diode test lamp between socket 3 (positive) and socket 22 (signal).

Diode test lamp V.A.G 1527 should light up when the selector lever is in position P or N, and then go out when a gear is engaged (selector lever in position 2, 3, 4 R or D).

- If the diode test lamp does not light up or lights up continuously, test for open circuit and short circuit in wiring between multi-function switch and contact 22 on connector for engine control unit.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

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

=> Automatic gearbox 01V, Self-diagnosis; Repair group 01; Electrical test Electrical test

Vehicles with engine control unit numbers

from 4D0 907 551 G onwards

The engine control unit and gearbox control unit exchange data via the CAN bus.

=>Testing CAN bus, Page 122 .

7.10 - Checking ignition retardation during gear selection

Notes:

- ♦ The engine control unit receives the gearshift signal from the gearbox control unit. (If the control unit has a CAN bus, the signal is transmitted via the CAN bus data wire.) The engine control unit then retards the ignition timing briefly according to the road speed and engine speed. This reduces the torque and thus ensures a smoother gear change.
- ♦ Because the signal is very brief, fault reader V.A.G 1551 does not always register the instruction to reduce the torque, and therefore this may not be shown on the display.

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- Connect fault reader V.A.G 1551
=> Page 2 .
- Start the engine.
- Select "Read measured value block", Display Group 019, engine at idling speed=>Page 50 .

-> Indicated on display:

Read measured value block 19

1	2	3	4
---	---	---	---

- Pull handbrake fully on and additionally depress the foot brake.
- Observe displays in the display zones 3 and 4 when selecting a gear.
 - Display zone 3 displays the required engine torque for gear selection (specified torque).
 - Display zone 4 displays the actual engine torque (clutch torque/actual torque).

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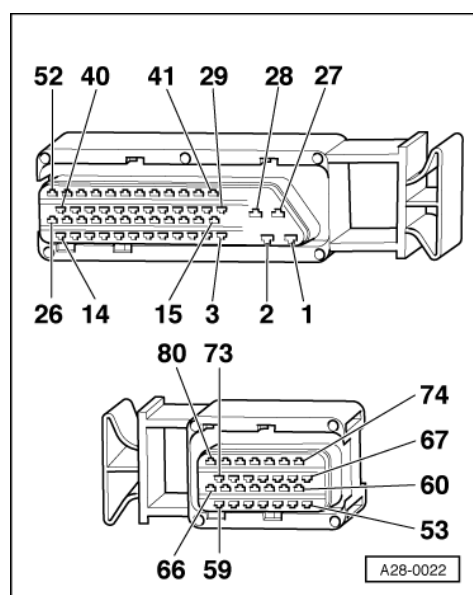
When a gear is engaged the readouts in the two display zones should match. The ignition timing retardation is now activated.

- If the ignition timing retardation is not activated, continue the test as follows:

Vehicles with engine control unit numbers up to 4D0 907 551 F

The gearshift signal and the signal wire are monitored by the gearbox self-diagnosis (fault code 00545).

=> Automatic gearbox 01V - Self-diagnosis; Repair group 01; Performing self-diagnosis Performing self-diagnosis





- -> If the measured value block does not indicate any torque reduction during the gearshift, or if the gearbox control unit has stored fault code 00545, connect test box V.A.G 1598/22 to the wiring harness for the engine control unit=>Page **77** .
- Test for open circuit and short circuit in wiring from engine control unit to gearbox control unit using the current flow diagram.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

Vehicles with engine control unit numbers

from 4D0 907 551 G onwards

The engine control unit and gearbox control unit exchange data via the CAN bus.

=>Testing CAN bus, Page **122** .

7.11 - Testing change-up and change-down signals

Notes:

- ♦ These signals, in conjunction with the gearshift signal (ignition timing retardation during gearshift), inform the engine control unit whether a higher gear or a lower gear has been selected (change-up or change-down).
- ♦ The change-up and change-down signals and the signal wire are monitored by the gearbox control unit.

=> Automatic gearbox 01V, Self-diagnosis; Repair group 01; Performing self-diagnosis Performing self-diagnosis

Test conditions

- Control unit correctly coded=>Page **32**

Vehicles with engine control unit numbers

from 4D0 907 551 G onwards

The engine control unit and gearbox control unit exchange data via the CAN bus.

=>Testing CAN bus, Page **122** .

7.12 - Testing CAN bus

Testing data transfer between engine control unit, gearbox control unit and ABS control unit (CAN bus)

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22
- Connect fault reader V.A.G 1551
=> Page **2** .
- Switch ignition on.
- Interrogate fault memory for gearbox control unit.

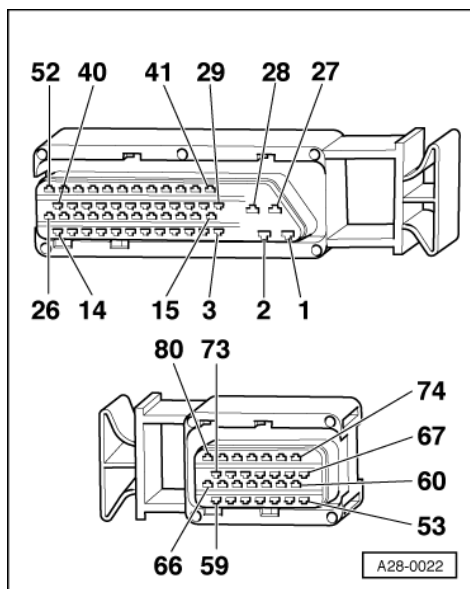
=> Automatic gearbox 01V, Self-diagnosis; Repair group 01; Performing self-diagnosis Performing self-diagnosis

- Interrogate fault memory for ABS control unit.

=> Running gear, Self-diagnosis; Repair group 01

If a fault relating to the CAN bus is displayed:

- Switch off ignition.
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit.
 =>Page 77 .



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- -> Test for open circuit or short circuit in the wiring between the engine control unit (contacts 29 and 41) and the gearbox control unit and ABS control unit.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

- If the wiring is OK, try to locate the fault by replacing first the gearbox control unit, then the ABS control unit (only on vehicles with ESP / electronic stability program) and finally the engine control unit, one after the other.



28 - Ignition system

1 - Testing ignition system

1.1 - Testing ignition system

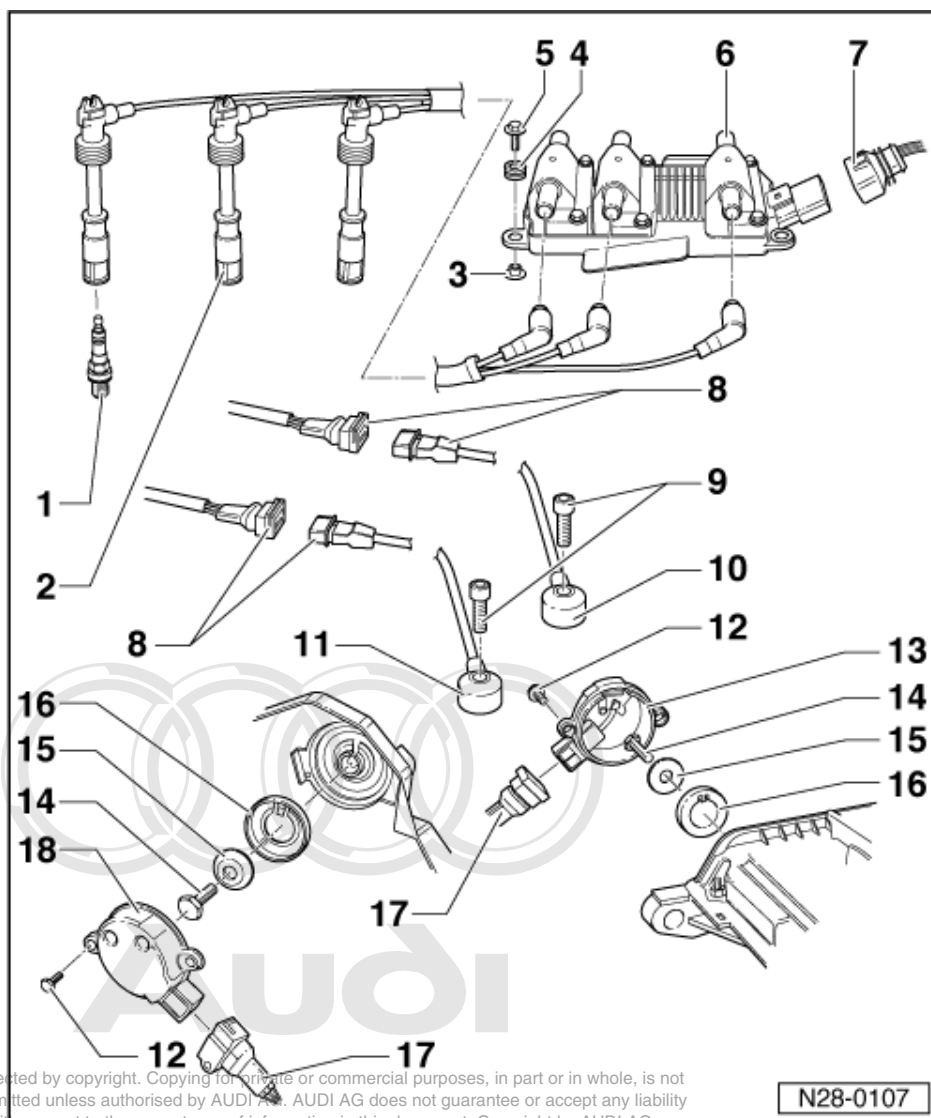
1.2 - Safety precautions

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

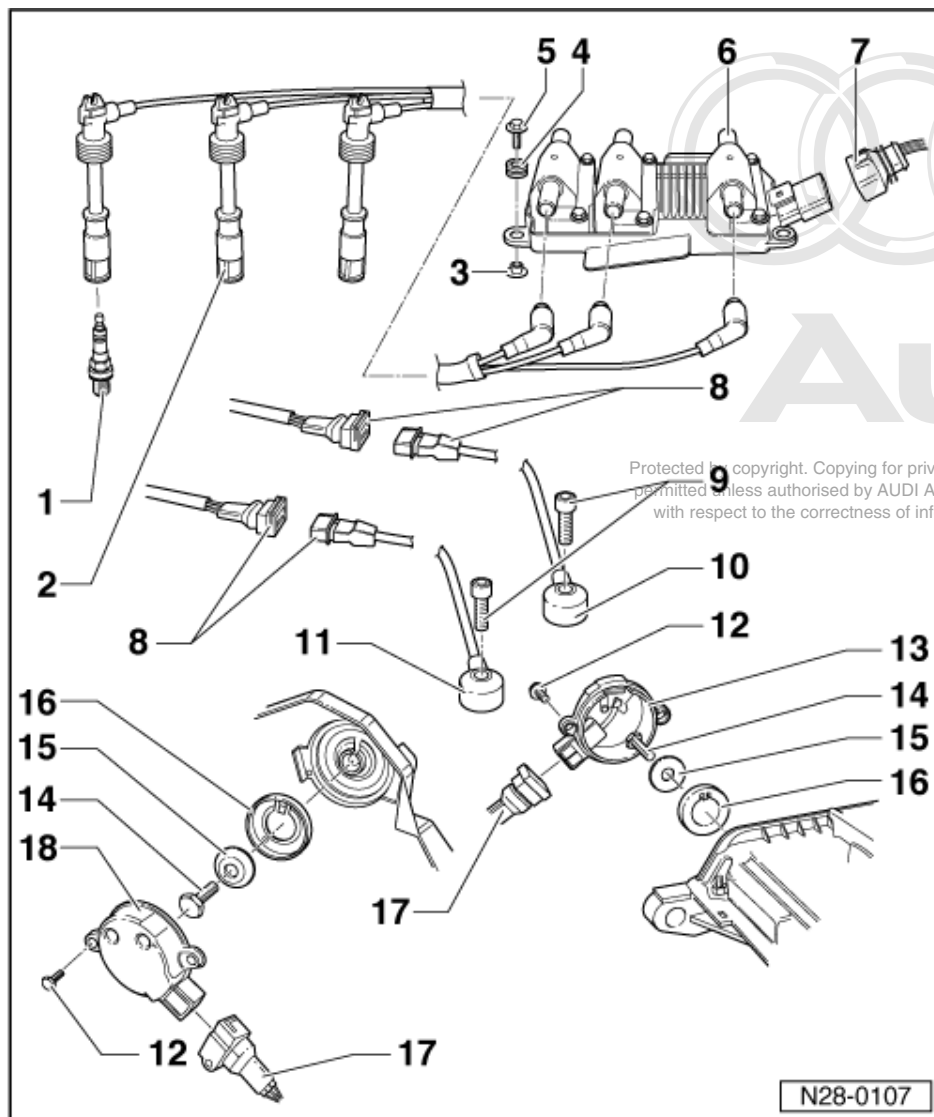
- ♦ Do not touch or disconnect ignition wiring when the engine is running or being turned at starter speed.
- ♦ The ignition must be switched off before connecting or disconnecting injection or ignition system wiring or tester cables.
- ♦ In order to run the engine at starting speed without actually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

1.3 - Removing and installing parts of the ignition system

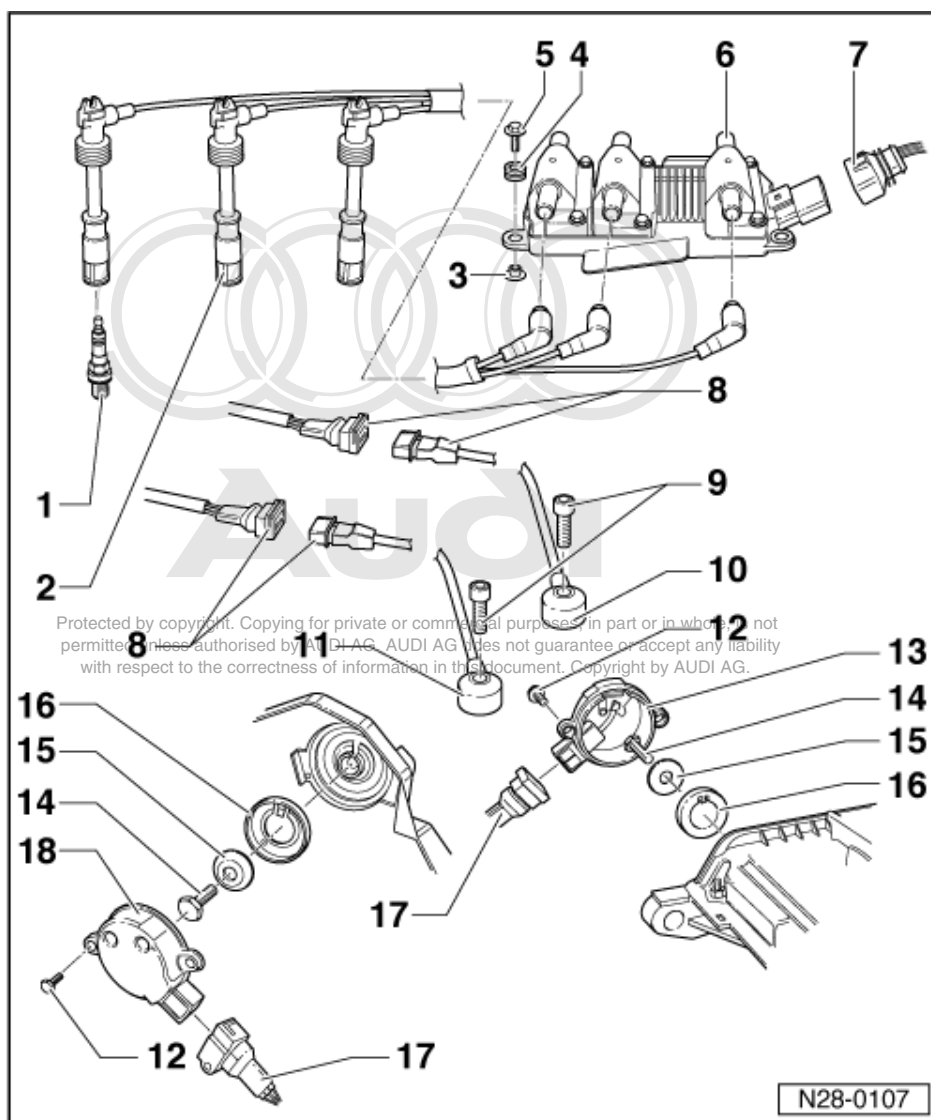


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- 1 Spark plug, 30 Nm
 - ♦ Remove and install with 3122B
- 2 Spark plug connector
- 3 Spacer sleeve
- 4 Rubber grommet
- 5 10 Nm
- 6 Ignition coils -N, -N128 and -N158
 - ♦ With output stage -N122
 - ♦ With ignition cable identification, do not interchange



- 7 Connector**
 - ♦ Black, 5 pin
- 8 3 pin connector**
 - ♦ Contacts gold plated
- 9 20 Nm**
 - ♦ Tightening torque influences the function of the knock sensor
- 10 Knock sensor 2, -G66**
 - ♦ Cylinder bank 2
 - ♦ Sensor and connector contacts are gold-plated
- 11 Knock sensor 1, -G61**
 - ♦ Cylinder bank 1
 - ♦ Sensor and connector contacts are gold-plated
- 12 10 Nm**



13 Hall sender -G40

- ♦ Cylinder bank 2

14 25 Nm

15 Washer

- ♦ Conical

16 Hood

- ♦ For Hall sender
- ♦ When installing note fixing arrangement

17 Connector

- ♦ Black, 3 pin
- ♦ For Hall sender -G40 or -G163

18 Hall sender -G163

- ♦ Cylinder bank 1



1.4 - Technical data

Engine code letters	ACK (2.8 ltr. / 5V / 142 kW engine) ALG (2.8 ltr. / 5V / 142 kW engine with secondary air system)
Ignition timing is determined by the control unit. Ignition timing cannot be adjusted.	
Ignition system	Twin-spark ignition system with three ignition coils
Spark plugs	Tightening torque: 30 Nm
Firing order	1-4-3-6-2-5
Maximum engine speed limited by Motronic system Cut-off speed	approx. 6500 rpm

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1.5 - Testing ignition coils

Notes:

- ♦ The ignition coils and the output stage are combined as a single component.
- ♦ The primary resistance of the ignition coils cannot be measured.
- ♦ The secondary resistance must first be measured between the spark plug connectors for the relevant cylinders, without disconnecting the ignition cables from the ignition coils. This measurement also includes the interference-suppression resistance in the ignition cables.
- ♦ Fitting location => Page 59 .

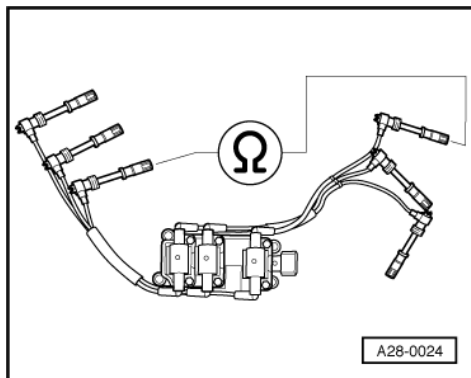
Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Diode test lamp V.A.G 1527
- ♦ Adapter set V.A.G 1594

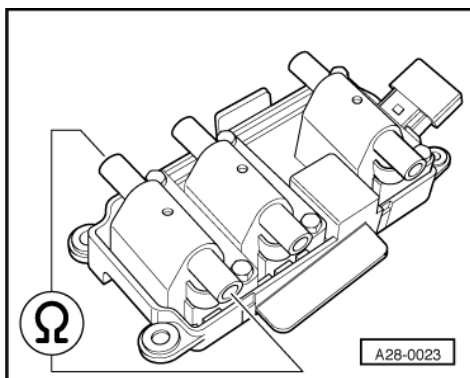
- Unplug 5-pin connector from ignition coils.

Testing ignition coils -N, -N128 and -N158

- Disconnect ignition cables from spark plugs.



- -> Connect hand-held multimeter V.A.G 1526 between the two spark plug connectors for the ignition circuit which is to be tested.
 - Specification: 16 ... 27 kweach
- If the values do not match the specifications, disconnect the ignition cables from the ignition coils and then measure the resistance in the cables and the coils separately.

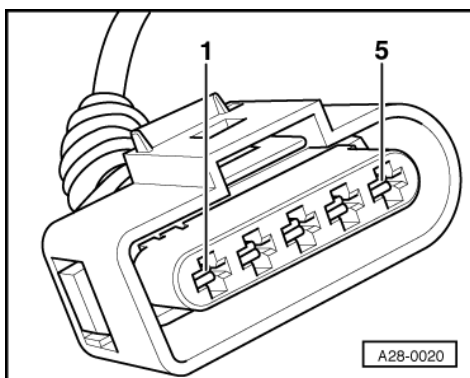


- -> Connect hand-held multimeter V.A.G 1526 between the two ignition cable connections on the ignition coil which is to be tested.
- Connect hand-held multimeter V.A.G 1526 between the two connections on the ignition cable which is to be tested.
- Specifications:

Ignition coils	Ignition cables
8.0 ... 14.0 kΩ	3.0 ... 7.0 kΩ

- If the values do not match the specifications, renew the defective components.

Testing earth connection to output stage



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

Specification: 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.

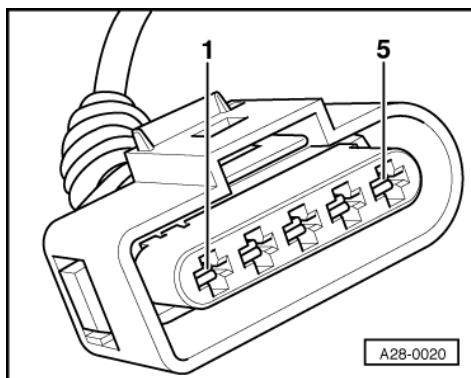
=> Current flow diagrams, Electrical fault-finding and Fitting locations

Testing power supply to ignition coils

Test requirement:

- Fuse for ignition coils OK

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- Switch ignition on.
- -> Connect diode test lamp V.A.G 1527 between engine earth and contact 1 (positive) on the connector.

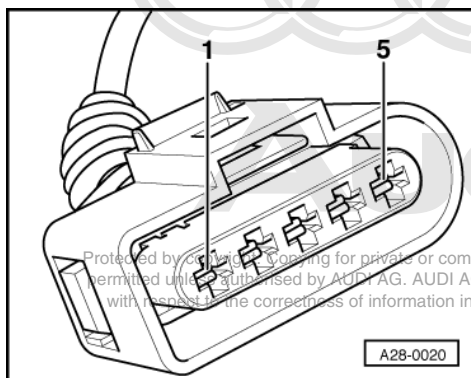
Specification: The diode test lamp should light up.

- If specified results are not obtained, test for open circuit using current flow diagram. Rectify any open circuits and test the fuse.

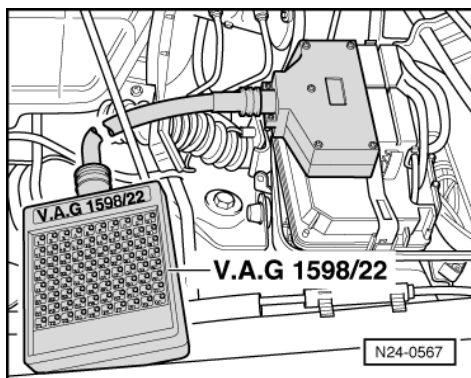
=> Current flow diagrams, Electrical fault-finding and Fitting locations

Testing activation

- Unplug connectors from all six injectors (interrogate fault memory after testing).
- Switch ignition on.



- -> Connect diode test lamp between engine earth and contacts 3, 4 and 5 in turn.
- Operate the starter for a few seconds in each case. The diode test lamp should flash each time.



- -> If the diode test lamp does not flash, test for open circuits or short circuits in wiring between connector and engine control unit using current flow diagram. (Connect test box V.A.G 1598/22 to wiring harness for engine control unit.)

Contact on 5-pin connector for output stage	Contact on control unit connector
3	71
4	78
5	70

- Rectify any open circuits or short circuits.
- If no open circuits or short circuits to earth are found, fit a new engine control unit.
=> Page 78

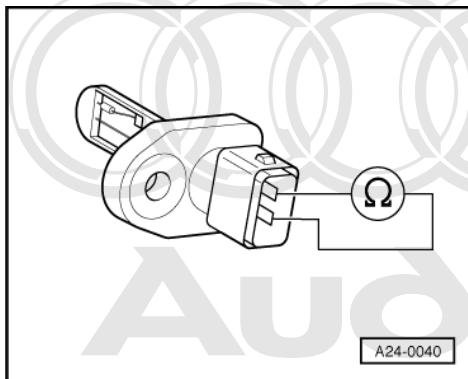
1.6 - Checking intake air temperature sender

Notes:

- ◆ For testing the operation of the intake air temperature sender, see also "Reading measured value block", Display Group 003, display zone 4.
- ◆ Fitting location of intake air temperature sender
=> Page 59.
- ◆ Engine cooled to room temperature (approx. 20 °C).

Special tools, testers and auxiliary items

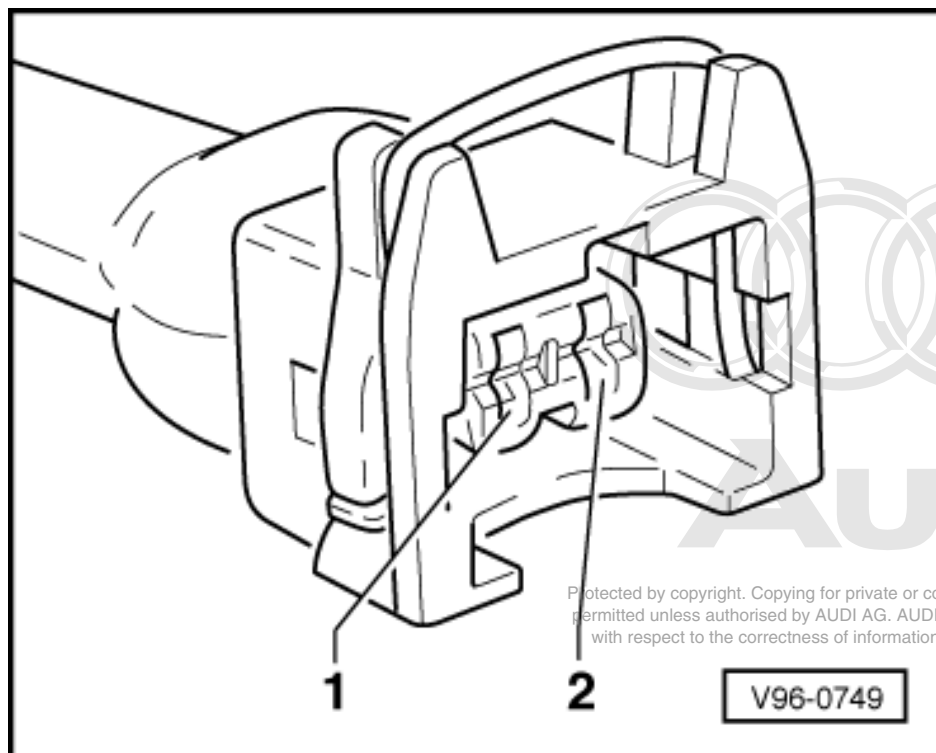
- ◆ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ◆ Adapter set V.A.G 1594



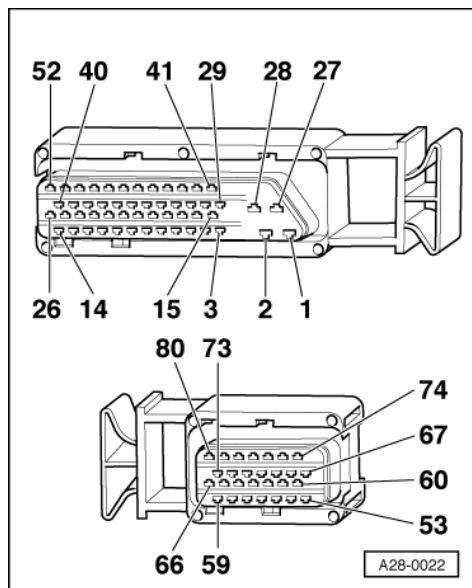
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Unplug connector from intake air temperature sender.
-> Connect ohmmeter to intake air temperature sender.

- Specification: 1.1 ... 5.5 kΩ
- 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 77 .
- -> Test wiring between 2-pin connector for sender ...



- -> ... 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 78 .

1.7 - Checking engine speed sender

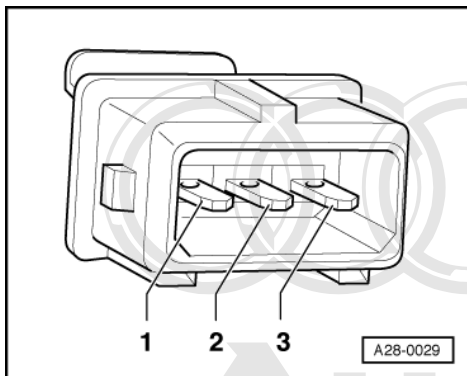
Notes:

- ♦ The engine speed sender is a combined speed sender and reference mark sender. Without a signal from the -G28 the engine cannot be started. If the signal from the -G28 fails while the engine is running, the engine will cut out immediately.
- ♦ The engine speed sender -G28 has a spacer shim beneath it to create a defined gap between it and the sender wheel. If the engine speed sender is installed without this spacer shim it will be damaged by the sender wheel.
- ♦ For testing the operation of the engine speed sender, see also "Reading measured value block", Display Group 003, display zone 1.
- ♦ The test procedure varies depending on the type of engine speed sender fitted. The sender type can be identified by the design of the connector=>Page 133 .

Special tools, testers and auxiliary items

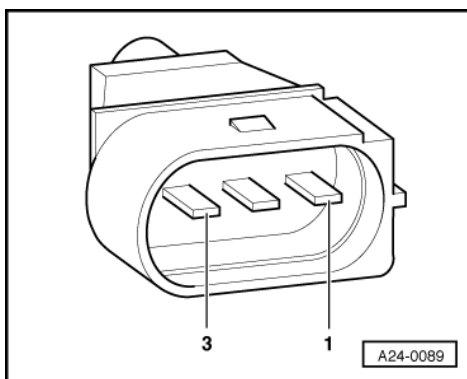
- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

The various types of speed sender which are fitted at the factory can be identified by the design of the connectors and by the order of contacts.



-> Square connector for engine speed sender

- Testing connector for engine speed sender=>Page 134
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- -> Oval connector for engine speed sender



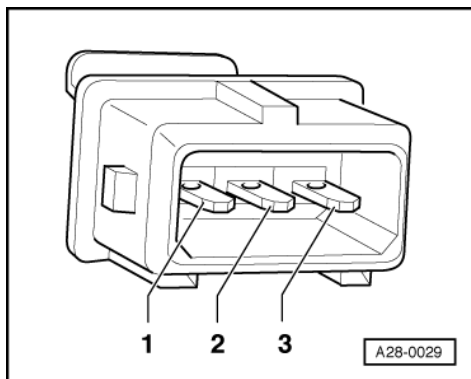
- Testing connector for engine speed sender=>Page **135** .

Testing engine speed sender with square connector

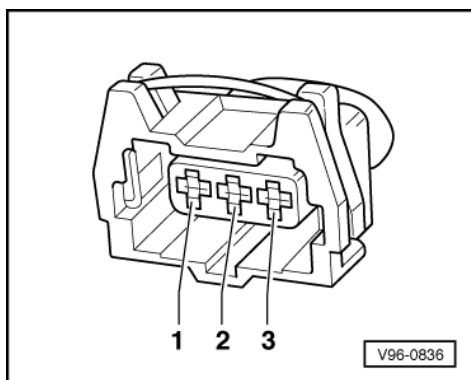
Fitting location of sender and connector

=>Page **61** .

- 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 measurement range) between contacts 1 and 2 of the connector in the connector bracket using test lead from V.A.G 1594.
 - Specification: 730...1000 ω
 - If the value does not match the specification, fit a new engine speed sender.
 - If the value matches the specification, connect hand-held multimeter between contacts 1 and 3 (earth) and between contacts 2 and 3 (earth).
 - Specification: infinity ω (no continuity) in each case
 - 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 **77** .



- -> Test continuity of screening between contact 3 on sender connector and 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 between contact 1 on sender connector and socket 56 on test box.
 - Specification: max. 1 ω
- If the values do not match the specifications, rectify short circuits or open circuits between sender connector and connectors on engine control unit.

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

- If no faults have been detected so far, check that sender wheel is securely mounted on crankshaft.

In order to check the sender wheel the sender must be removed.

- Slowly rotate engine and check that sender wheel has no run-out and is securely mounted.
- If no open circuits or short circuits are found, fit a new engine control unit =>Page 78 .

Note:

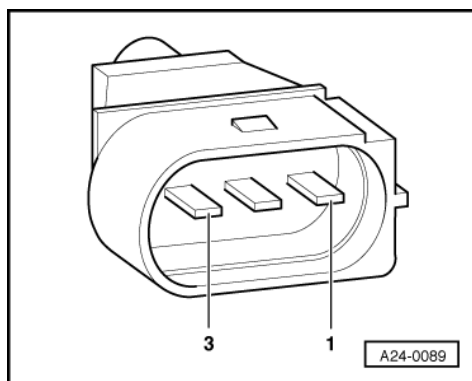
A large gap in the sender wheel is normal. This gap acts as a reference mark.

Testing engine speed sender with oval connector

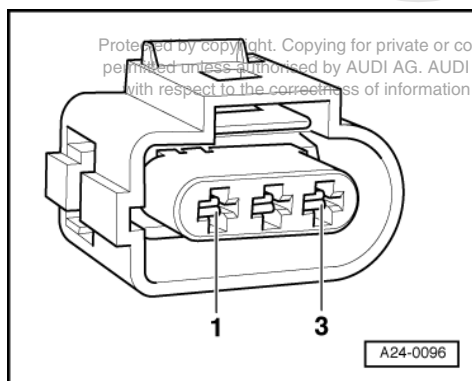
Fitting location of sender and connector

=>Page 61 .

- 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 in connector support bracket using test lead from V.A.G 1594.
 - Specification: 730...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: infinity ω (no continuity) in each case
 - 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 77 .



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- -> Test continuity of screening from contact 1 on sender connector to socket 67 on test box.
 - Specification: max. 1Ω
- Test continuity of earth wire from contact 2 on sender connector to socket 63 on test box.
 - Specification: max. 1Ω
- Test continuity of signal wire from contact 3 on sender connector to socket 56 on test box.
 - Specification: max. 1Ω
- If the values do not match the specifications, rectify short circuits or open circuits between sender connector and connectors on engine control unit.

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

- If no faults have been detected so far, check that sender wheel is securely mounted on crankshaft.

In order to check the sender wheel the sender must be removed.

- Slowly rotate engine and check that sender wheel has no run-out and is securely mounted.
- If no open circuits or short circuits are found, fit a new engine control unit =>Page 78 .

Note:

A large gap in the sender wheel is normal. This gap acts as a reference mark.

1.8 - Testing coolant temperature sender

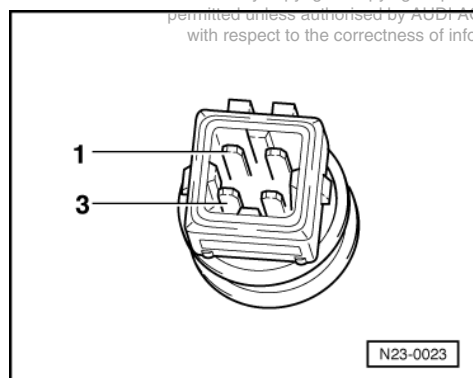
Notes:

- ♦ For testing the operation of the coolant temperature sender, see also "Reading measured value block", Display Group 003, display zone 3.
- ♦ Fitting location of coolant temperature sender
=> Page 59 .

Special tools, testers and auxiliary items

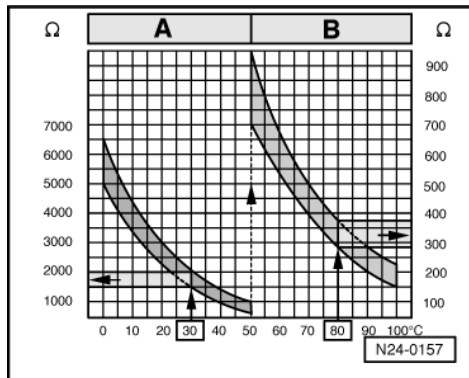
- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

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- Unplug connector on coolant temperature sender.
- -> Test resistance between contacts 1 and 3 on the sender.

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

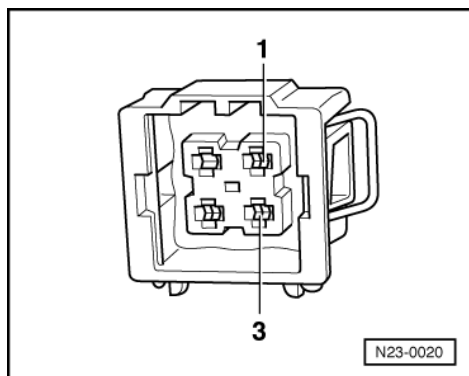


Examples:

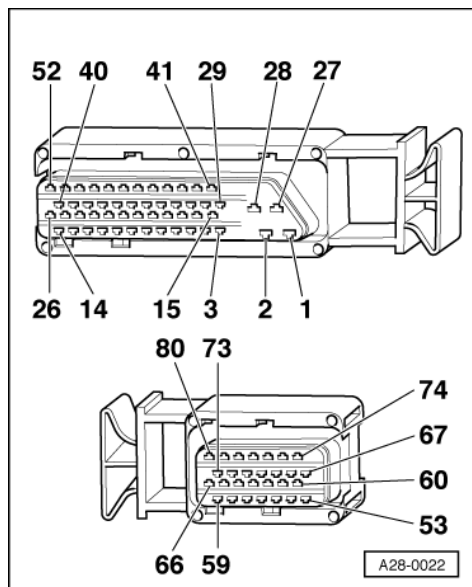
- ◆ 30 °C corresponds to a resistance from 1500...2000 ω
- ◆ 80 °C corresponds to a resistance from 275...375 ω
- If the value does not match the specification, fit a new sender.

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 the wiring harness for the engine control unit.
=> Page 77



- -> Test for open circuit in earth wire between contact 3 on coolant temperature sender connector and socket 67 on test box.
 - Specification: max. 1 ω
- Test for open circuits in signal wire between contact 1 on coolant temperature sender connector and socket 53 on test box.
 - Specification: max. 1 ω
- Test for short circuits between the two wires.



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- -> 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	53
3	67

- If there are no short circuits or open circuits and the coolant temperature sender is OK, fit a new engine control unit.
=> Page **78**

1.9 - Checking control unit voltage supply

Note:

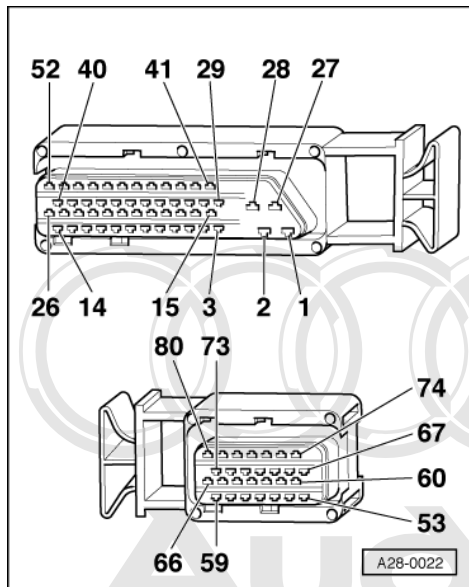
For testing the power supply to the engine control unit, see also "Reading measured value block", Display Group 003, display zone 2.

Test requirements:

- Fuse for engine control unit OK
- Battery voltage at least 11 V
- Alternator OK

Special tools, testers and auxiliary items

- ♦ Diode test lamp V.A.G 1527
- ♦ Test box V.A.G 1598/22
- Connect test box V.A.G 1598/22 to wiring harness for engine control unit.
=> Page **77**
- Switch ignition on.



- -> Connect diode test lamp V.A.G 1527 between socket 1 (positive supply via ignition) and earth.

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Specification: The diode test lamp should light up.

- If the diode test lamp does not light up, test for open circuits using the current flow diagram and rectify if necessary.

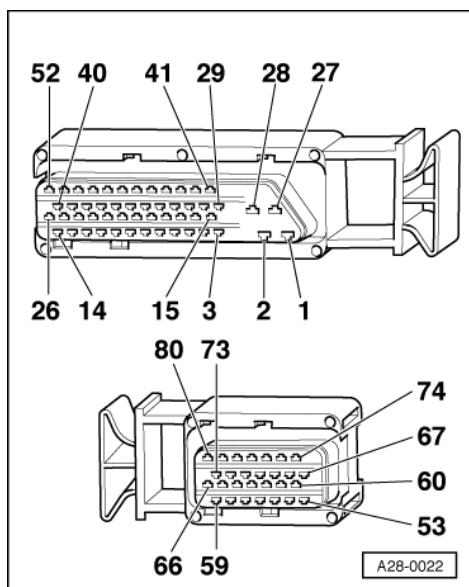
=> Current flow diagrams, Electrical fault-finding and Fitting locations

- If diode test lamp V.A.G 1527 lights up, connect diode test lamp to socket 1 (live positive supply via ignition switch) and socket 2 (earth connection).

Specification: The diode test lamp should light up.

- If the diode test lamp does not light up, test wiring for open circuits using current flow diagram and rectify if necessary.

=> Current flow diagrams, Electrical fault-finding and Fitting locations



- -> Connect diode test lamp V.A.G 1527 between socket 3 (permanent positive) and earth.

Specification: The diode test lamp should light up.

- If the diode test lamp does not light up, test wiring between central electrics and contact 3 on control unit connector using current flow diagram. Rectify any open circuits.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

1.10 - Testing knock sensors

Notes:

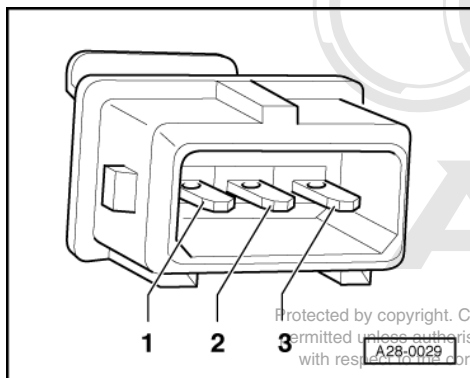
- ♦ To test the operation of the knock sensors, use the function "Read measured value block", Display Groups 012, 013, 014 and 015.
- ♦ Fitting locations of plug connectors and knock sensors
=> Page 59 .
- ♦ It is not possible to carry out an electrical test of the knock sensors themselves. See "Interrogating fault memory", Page 4 .
- ♦ In order to remove and install the knock sensors the intake manifold must be removed.
- ♦ 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.

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

Testing knock sensor wiring

- Unplug the connector for the relevant knock sensor in the engine compartment.

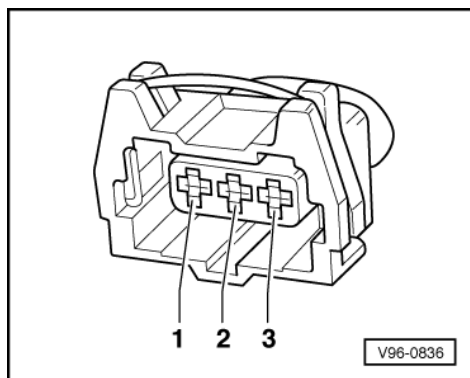


- -> Test for short circuits between all three contacts in the knock sensor connector. There must be no connection between any of the wires.
- If there is a connection between the contacts, fit a new knock sensor.

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 77 .
- Using the current flow diagram, test for continuity and short circuits in the wiring between the sender and engine control unit.

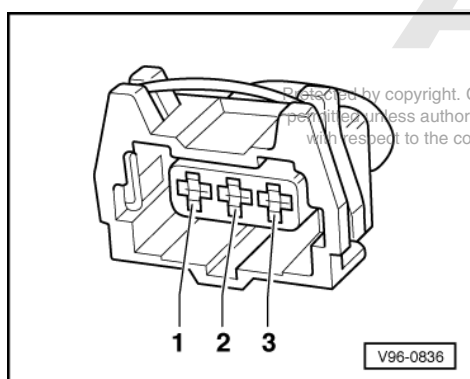
=> Current flow diagrams, Electrical fault-finding and Fitting locations



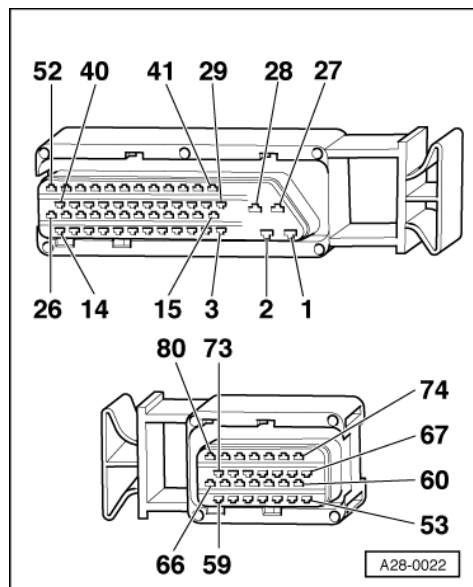
-> Identification of contacts in plug connector:

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. 1Ω
- 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. 1Ω
- 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. 1Ω
- Test continuity of signal wire of knock sensor 2 (-G66) from contact 1 on connector in engine compartment to socket 60 on test box.
 - Specification: max. 1Ω



- Test continuity of earth wire of knock sensor 2 (-G66) from contact 2 on connector in engine compartment to socket 67 on test box.
 - Specification: max. 1Ω
- Test continuity of screening on wiring for knock sensor 2 (-G66) from contact 3 on connector in engine compartment to socket 67 on test box.
 - Specification: max. 1Ω
- 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

- Knock sensor 2

Contact on connector for sensor	Contact on control unit connector
1 (signal)	60
2 (earth)	67
3 (screening)	67

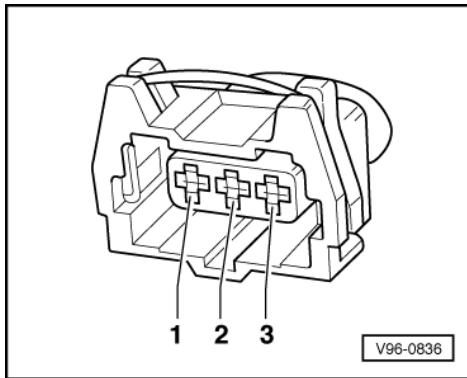
1.11 - Checking Hall sender

Notes:

- ♦ Hall sender -G40 is located at the rear of the left-hand cylinder head (Bank 2).
- ♦ Hall sender -G163 is located at the front of the right-hand cylinder head (Bank 1).
- ♦ Fitting location=>Page 61 .

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Diode test lamp V.A.G 1527
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/22

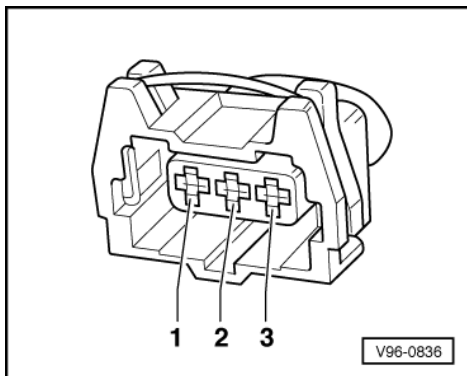


Testing voltage supply

- Unplug 3-pin connector from the Hall sender which is to be tested.
- -> Connect hand-held multimeter V.A.G 1526 to contacts 1 (positive) and 3 (earth) of the connector.
- Switch ignition on.
 - Specification: at least 9 V
- If the value does not match the specification, test for open circuits and short circuits in wiring between Hall senders and engine control unit using current flow diagram.

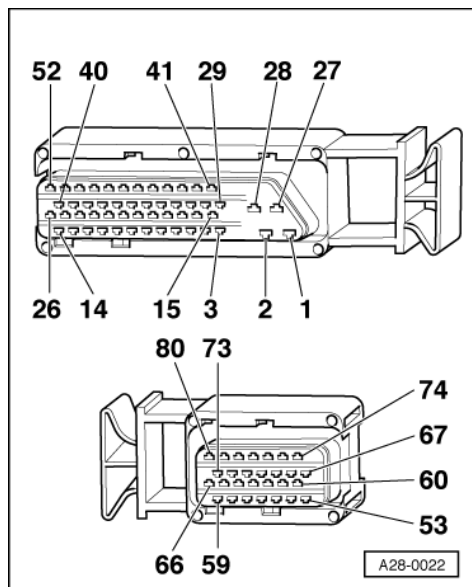
=> Current flow diagrams, Electrical fault-finding and Fitting locations

- Connect test box V.A.G 1598/22 to the wiring harness for the engine control unit.
- => Page 77



- -> Test for open circuit in earth wire between contact 3 on connector for Hall sender -G40 and socket 67 on test box.
 - Specification: max. 1Ω
- Test for open circuit in positive wire between contact 1 on connector for Hall sender -G40 and socket 11 on test box.
 - Specification: max. 1Ω
- Test for short circuits between the two wires.
- Test for open circuit in earth wire between contact 3 on connector for Hall sender -G163 and socket 14 on test box.
 - Specification: max. 1Ω
- Test for open circuit in positive wire between contact 1 on connector for Hall sender -G163 and socket 11 on test box.
 - Specification: max. 1Ω
- Test for short circuits between the two wires.

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- -> If one of the values does not match the specification, test for open circuit or short circuit between sender connectors and engine control unit connectors.

Connector for Hall sender -G40	Contact on control unit connector
1 (positive)	11
3 (earth)	67

Connector for Hall sender -G163	Contact on control unit connector
1 (positive)	11
3 (earth)	14

- If there are no open circuits or short circuits, fit a new engine control unit => Page 78 .

Testing operation

Note:

To test the operation of the Hall senders, unplug the 5-pin connector from the output stage together with the ignition coils (interrogate fault memory after testing).

Test conditions

- Voltage supply to Hall senders OK
Testing => Page 143 .
- Slide back rubber sleeves on connectors for Hall senders but leave connectors plugged in.
- Connect diode test lamp V.A.G 1527 between contact 2 (Hall sender signal) and contact 1 (positive) on each connector in turn.

Note:

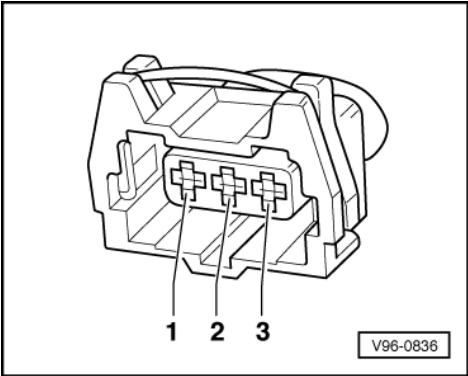
The connector contacts are numbered on the back of the connector.

- Operate starter for a few seconds.

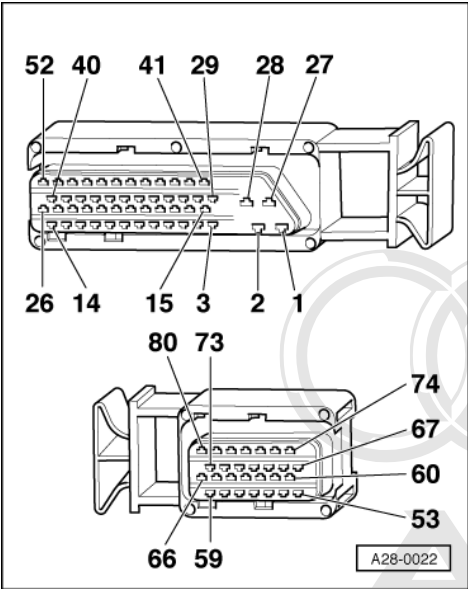
The diode test lamp should flash briefly on alternate engine revolutions (i.e. once every two revolutions).

- If the diode test lamp does not flash, switch off ignition and unplug 3-pin connector on Hall sender.
- Connect test box V.A.G 1598/22 to the wiring harness for the engine control unit.
=> Page 77

- Test for open circuit in signal wire between contact 2 on connector for Hall sender -G40 and socket 76 on test box.
- Test for open circuit in signal wire between contact 2 on connector for Hall sender -G163 and socket 44 on test box.
 - Specification: max. 1Ω



- -> If the value does not match the specification, rectify short circuit or open circuit in wiring between Hall sender connector...



- -> ...and control unit connector.

Contact on connector for Hall sender -G40	Contact on control unit connector
2 (signal)	76

Contact on connector for Hall sender -G163	Contact on control unit connector
2 (signal)	44

- If there are no open circuits or short circuits, reconnect engine control unit to engine wiring harness.
- Connect hand-held multimeter V.A.G 1526 between contacts 2 and 3 of each Hall sender connector in turn.
- Switch ignition on.
 - Specification: at least 9 V
- If the values do not match the specification, fit a new engine control unit => Page 78 .
- If the values match the specifications, fit a new Hall sender.



2 - Testing camshaft timing control

2.1 - Testing camshaft timing control

The timing of the inlet camshaft is controlled according to engine load and engine speed. The electrically operated camshaft adjustment valve transmits oil pressure to the mechanical camshaft adjuster as required.

Note:

The camshaft timing control only becomes active 25 seconds after the engine is started.

2.2 - Testing operation of camshaft timing control

Test conditions

- Coolant temperature at least 80 °C

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3
- Connect fault reader V.A.G 1551
=> Page 2 .
- Start the engine.
- Select "Read measured value block", Display Group 027, engine at idling speed=>Page 54 .

-> Indicated on display:

Read measured value block 27			
1	2	3	4

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- Observe readout in display zones 1, 3 and 4.

Notes:

- ♦ Display zone 1 shows the status of the camshaft timing control.
 - "0" = camshaft timing control not being activated
 - "1" = camshaft timing control activated
("1" will only appear on the fault reader display during a test drive.)
- ♦ The positions marked "X" in display zone 1 are of no relevance when testing the camshaft timing control.
- ♦ Display zones 3 and 4 indicate whether or not the camshaft positions have actually been adjusted (feedback signal):
 - Normal position: -3.0° ... 6.0° crankshaft angle
 - Adjusted position: 16.0° ... 25.0° crankshaft angle

Specifications (with engine idling):

Display zone 1	Display zone 3	Display zone 4
X.....X0	-3.0...6.0°/cr.	-3.0...6.0°/cr.

- Take the vehicle for a test drive.

Important:

Secure fault reader to rear seat and operate from this location. When doing this, always observe the relevant safety precautions => Page 57 .

- Accelerate rapidly from standstill in 1st gear.

Specifications (during test drive):

Display zone 1	Display zone 3	Display zone 4
X.....X1	16.0...25.0°/cr.	16.0...25.0°/cr

Notes:

- ◆ If a value of between 6.0 °/crankshaft and 16.0 °/crankshaft appears in display zone 3 and/or display zone 4 during the test drive, this means that the camshaft adjustment solenoid valves are diverting the oil pressure to the appropriate mechanical camshaft adjuster correctly, but that the mechanical adjuster is not reaching its end stop position (e.g. because it is not moving freely).
- If the values do not match the specifications, test the solenoid valves for camshaft adjustment =>Page **147**.

2.3 - Testing solenoid valves for camshaft adjustment

Note:

Fitting locations of solenoid valves=>Pages **62**.

Special tools, testers and auxiliary items

- ◆ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ◆ Diode test lamp V.A.G 1527
- ◆ Adapter set V.A.G 1594
- ◆ Test box V.A.G 1598/22
- Connect fault reader V.A.G 1551
=> Page **2**.
- Switch ignition on.
- Start final control diagnosis and select camshaft timing control => Page **27**.

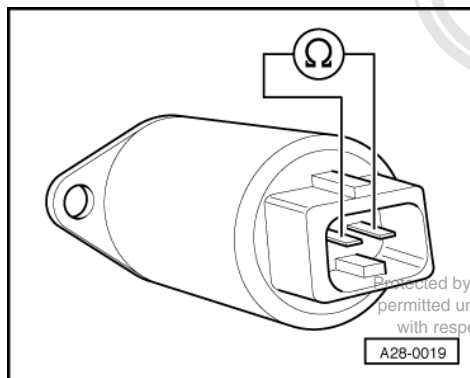
-> Indicated on display:

Final control diagnosis
Camshaft timing control 1

When the camshaft timing control is activated the solenoid valves should click audibly.

If the valve does not click, switch off the ignition.

- Unplug connector from the solenoid valve which is being tested.

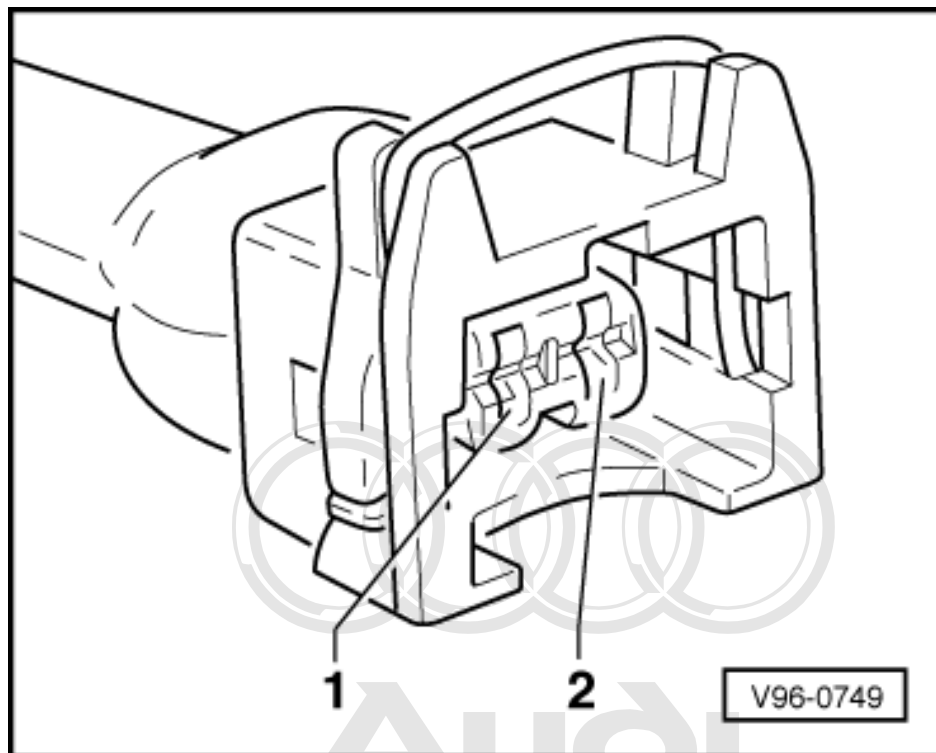


- -> Measure the resistance between the solenoid valve contacts using V.A.G 1526.
- Specification: 10 ... 18Ω
- If the value does not match the specification, fit a new solenoid valve.

Testing voltage supply to camshaft adjustment valves

(-N205 and -N208)

- Unplug connector on the solenoid valve which is being tested.



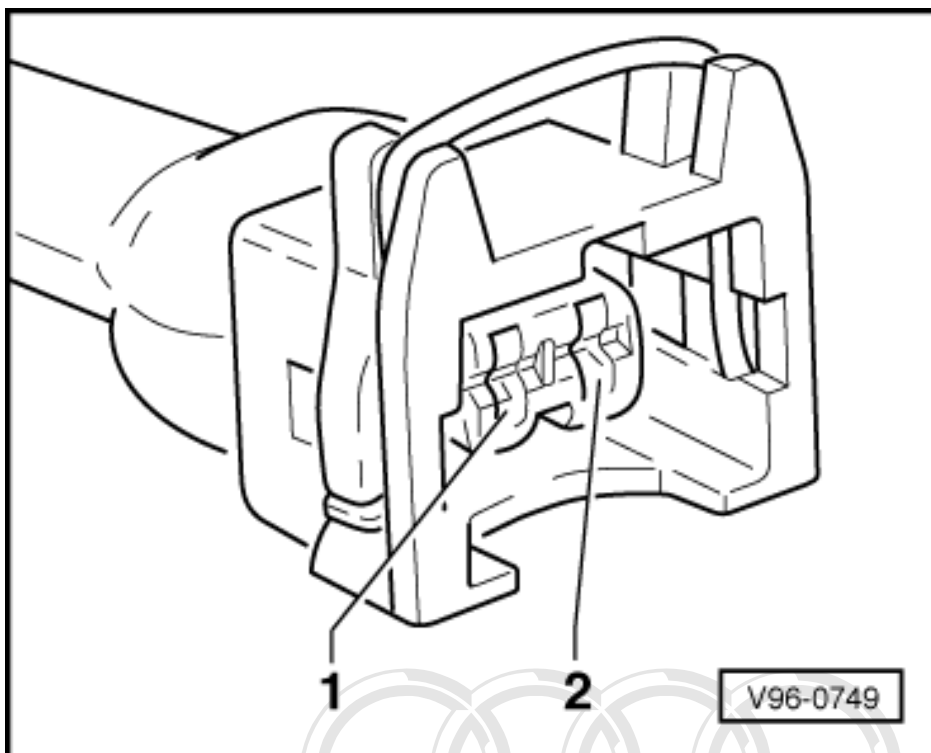
- -> Connect diode test lamp V.A.G 1527 to contact 1 on connector and to engine earth using auxiliary leads from V.A.G 1594.
 - Operate starter for a few seconds. The engine can be allowed to start.
- Specification: The diode test lamp should light up.

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

- Test fuse for camshaft adjustment valve.
- Test for open circuit in wiring between contact 1 of connector for camshaft adjustment valve and fuse.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

- Test fuel pump relay and activation
- => Page 87 .



Testing activation of camshaft timing control

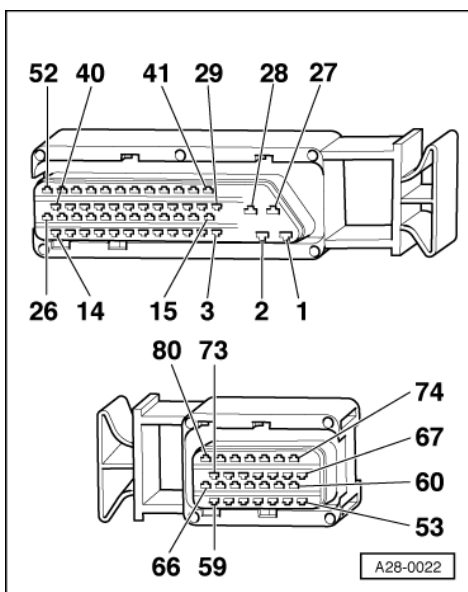
- -> Connect diode test lamp V.A.G 1527 to contact 1 (positive) and contact 2 on valve connector using test leads from auxiliary cable set V.A.G 1594.
- Start final control diagnosis and select camshaft timing control => Page 27 .

-> Indicated on display:

Final control diagnosis
Camshaft timing control 1

When the camshaft timing control is activated the diode test lamp should start flashing.

- If the diode test lamp does not flash or if it lights up continuously, connect test box V.A.G 1598/22 to wiring harness for engine control unit => Page 77 .





- -> If the diode test lamp lights up continuously, test for short to earth in wiring from contact 2.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

- If the diode test lamp does not flash, test for open circuit or short to positive in wiring between contact 2 on connector and contact 55 on test box.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

- Rectify any short circuits to earth or open circuits if found.
- If no short circuits or open circuits are found, fit a new engine control unit => Page 78 .
- If the wiring connections are OK, fit a new mechanical camshaft adjuster

=> 6-cylinder engine (5-valve), Mechanics; Repair group 15; Cylinder head, valve gear; Removing and installing camshafts
Cylinder head, valve gear Removing and installing camshafts



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