Audi A4 1995 ➢

Motronic injection and ignition system (4-cyl.)									
Engine ID	APT	ARG	AVV						

Edition 01.1999

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List of Workshop Manual Repair GroupsList of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups

Audi A4 1995 ➤

Motronic injection and ignition system (4-cyl.)

Repair Group

01 - Self-diagnosis

24 - Mixture preparation, Injection

28 - Ignition system

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

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01 - Self-diagnosis

1 - Self-diagnosis of Motronic system

1.1 - Self-diagnosis of Motronic system

1.2 - Technical data for self-diagnosis

Equipment

The term "self-diagnosis" relates specifically to the electrical and electronic part of the control system.

The control unit is equipped with a fault memory so that the fault can be traced quickly in the event of an electronic/electrical component failure or an open circuit.

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The advantages of self-diagnosis can only be fully exploited by using the vehicle diagnostic, testing and information system VAS 5051 or the fault reader V.A.G. 1551, in operating mode 1 "Rapid data transfer."

Functions which the vehicle diagnostic, testing and information system VAS 5051 and the fault reader V.A.G 1551 can register => Page 1 , List of selectable functions.

The fault memory is equipped with a non-volatile memory and therefore does not depend on the power supply.

Faults relating to the electronic throttle are also indicated by a warning lamp in the dash panel insert.

Selectable functions when using fault reader V.A.G 1551

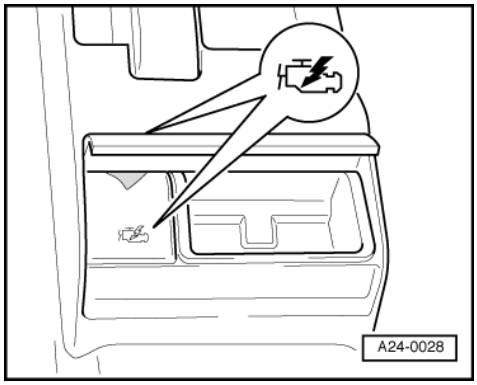
The prerequisites for selecting the desired functions can be taken from the following table.

Address words and functions on fault reader V.A.G 1551		Ignition on, engine not running	Engine running at idling speed	Vehicle being driven
Address words				
00	Automatic test sequence	yes	yes	yes
01	Engine electronics	yes	yes	yes
Functions				
01	Interrogate control unit version	yes	yes	yes
02	Interrogate fault memory	yes	yes	yes
03	Final control diagnosis	yes	no	no
04	Basic setting	yes	yes	yes
05	Erase fault memory	yes	yes	yes
06	End output	yes	yes	yes
07	Code control unit	yes	no	no
08	Read measured value block	yes	yes	yes

1.3 - Connecting and selecting functions for vehicle diagnostic, testing and information system VAS 5051 or fault reader V.A.G 1551

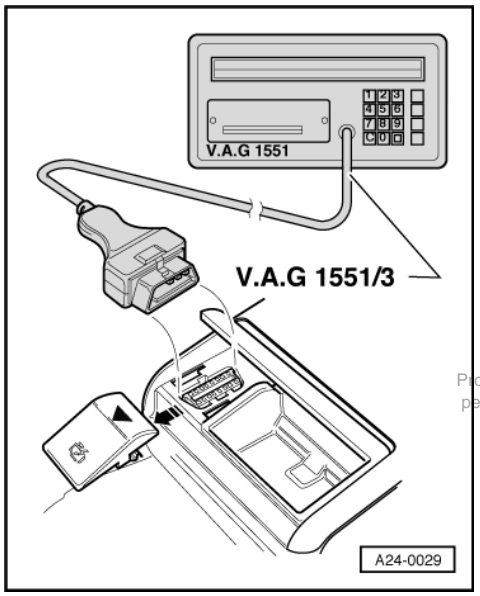
Test conditions

- Fuses for engine electronics OK
- Fuel pump relay OK.



- Battery voltage at least 11 V
- Earth connections on engine and gearbox OK.

- Switch ignition off.
- -> Open rear ashtray and remove cover for diagnostic connector.



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- -> Connect vehicle diagnostic, testing and information system VAS 5051 with diagnosis cable VAS 5051/1. As an alternative, connect fault reader V.A.G 1551 with diagnosis cable V.A.G 1551/3.

Warning!
- **When performing test-drives and checks, the vehicle diagnostic, testing and information system VAS 5051 as well as the fault reader V.A.G. 1551 may be secured only on rear seat, from where it is to be operated.**
- **Please follow safety precautions => Page 35**

Note:

Only the procedure for self-diagnosis using fault reader V.A.G. 1551 is described below. For details of how to use the vehicle diagnostic, testing and information system VAS 5051, please refer to its operating manual.

-> Indicated in display

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

1) appears alternately

- If no display appears, check diagnostic cables:

=> Current Flow Diagrams, Electrical Fault-Finding and Fitting Locations binder; Fault-finding programme: "Diagnostic wiring"

Depending on the function required (=> table of selectable functions Page 1):

- Switch ignition on.

or

- Start the engine.
- Switch on fault-reader printer with the Print key (Warning lamp in key lights up).
- Press key 1 for "Rapid data transfer".

-> Indicated on display:

```
Rapid data transfer     HELP
Enter address word XX
```

```
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
Fault in communication build up
```

```
Rapid data transfer     HELP
K wire not switching to earth
```

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```
Rapid data transfer     HELP
K wire not switching to positive
```

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

```
8B0906018.. 1.8l     R4S/5V MOTR HS
D..
Coding 05001     WSC 06388
```

- 8B0906018..	Control unit number (see Parts List)
- 1.8 ltr.	Engine capacity

- R4S/5V	In-line, normally aspirated engine, 4 cylinders, 5 valves per cylinder
- MOTR	Motronic
- HS AT	HS = manual gearbox AT = automatic transmission
- GRA (or CCS)	Only appears on vehicles with cruise control system
- D..	Software version in control unit
- Coding 05001	Control unit coding
- WSC 06388	Workshop Code of the V.A.G 1551 with which the last coding was performed

Notes:

- Incorrect coding may lead to higher emissions and increased strain on the automatic gearbox resulting from harsh gear-shift jolts.
- Incorrect coding also causes non-existent faults to be stored in the fault memory.

If the coding differs from the vehicle version, then:

- Check control unit coding
  => Coding engine control unit, Page 23
- Press ⇒key.

-> Indicated on display:

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

Note:

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

2 - Interrogating and erasing fault memory

2.1 - Interrogating and erasing fault memory

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

Note:

If the engine does not start, turn over the engine with the starter motor for at least 5 seconds, then leave the ignition switched on.

- Switch on printer with the Print button
  (Warning lamp in button lights up).

-> Indicated on display:

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

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- Operate fault reader taking into account the information on the display:

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

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

```
X Faults recognised!
```

If no fault is stored:

- Press ⇒key.

If one or more faults are stored:

The faults stored will be displayed and printed out one after the other.

-> Indicated on display:

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

- Locate and eliminate faults printed out as per fault table
  => Page 6 .
- Press keys 0 and 5 for the function "Erase fault memory" and confirm entry with Q key.

-> Indicated on display:

```
Rapid data transfer
Fault memory is erased!
```

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Note:

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

- Press ⇒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.

Automatic test sequence

During test and assembly work faults can be recognised from other control units like e.g. plug disconnected. Therefore on completion the fault memories of all control units must be interrogated and erased. To do this:

- Press 0 key twice for address word "Automatic test sequence" and confirm entry with Q key. The fault reader V.A.G 1551 will then transmit all known address words one after the other.

When a control unit answers with its identification the number of stored faults appears on the display or "No fault recognised".

Any system faults that are stored will be displayed one after the other and printed out. The V.A.G 1551 will then transmit the next address word.

-> The automatic test sequence has ended when the following appears on the display:

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

- Erase all fault memories and then carry out a road test.
- Interrogate the fault memories of all control units again using the "automatic test sequence". No faults must be stored in fault memory.

If no fault is stored:

- Press the ⇒key.

-> Indicated on display:

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

- Press keys 0 and 6 for the "End data transfer" function and confirm input with the Q key.

2.2 - Fault table

Notes:

- If faults occur in the sensors and components being monitored, they will be stored in the fault memory together with an indication of the type of fault.
- Faults relating to the electronic throttle are also indicated by the EPC (Electronic Power Control) warning lamp in the dash panel insert.
- If the connector for the engine control unit is disconnected, or if the battery is disconnected, all the "learned values" in the control unit will be erased. The contents of the fault memory will remain intact. When the engine is then started, it may not idle smoothly for the first few seconds.
  Adaption procedures must also be performed for certain functions=>Page 41 .
- The fault table is arranged according to the 5-digit fault codes in the left-hand column.
- If a fault is stored in the fault memory and then does not occur again during the next 40 engine warm-up phases, the fault code will be automatically erased.
- Sporadically occurring faults (temporary faults) will be indicated on the V.A.G 1551 display as "SP".
- Components that are indicated as being faulty by the V.A.G 1551 should not be renewed immediately. Always start by checking the wiring, connectors and earth connections for the component using the current flow diagram. This is particularly important in the case of sporadic faults (indicated by the letters "SP"on the fault reader display).

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Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P0101	16485	Air mass meter -G70 Implausible signal	Test air mass meter => Page 57
P0102	16486	Air mass meter -G70 Signal too small	
P0103	16487	Air mass meter -G70 Signal too large	
P0112	16496	Intake air temp. sender -G42 Signal too small	Test intake air temperature sender => Page 61
P0113	16497	Intake air temp. sender -G42 Signal too large	
P0116	16500	Coolant temp. sender -G62 Implausible signal	Test coolant temperature sender => Page 63
P0117	16501	Coolant temp. sender -G62 Signal too small	
P0118	16502	Coolant temp. sender -G62 Signal too large	

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P0130	16514	Bank 1, Probe 1 Electrical fault in current circuit	Test lambda control => Page 69
P0131	16515	Bank 1, Probe 1 Voltage too low	Test lambda probe signal wire and activation => Page 72
P0132	16516	Bank 1, Probe 1 Voltage too high	

Fault code		Readout on fault reader display	Fault rectification
P0133	16517	Bank 1, Probe 1 Signal too slow	Test lambda control => Page 65
P0134	16518	Bank 1, Probe 1 No activity	Test lambda probe heating => Page 69
P0135	16519	Bank 1, Probe 1 Heating element circuit; electrical fault	Test lambda control => Page 65
P0136	16520	Bank 1, Probe 2 Electrical fault in current circuit	Test lambda control => Page 86
P0137	16521	Bank 1, Probe 2 Voltage too low	Test lambda control => Page 65
P0138	16522	Bank 1, Probe 2 Voltage too high	

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P0139	16523	Bank 1, Probe 2 Signal too slow	Test lambda control => Page 86
P0140	16524	Bank 1, Probe 2 No activity	
P0161	16545	Bank 2, Probe 2 Heating element circuit; electrical fault	
P0300	16684	Misfiring recognised	Test injectors=>Page 49 Test spark plugs, ignition cables and connectors Test ignition coils and output stages => Page 135
P0301	16685	Cyl.1 Misfiring recognised	
P0302	16686	Cyl.2 Misfiring recognised	
P0303	16687	Cyl.3 Misfiring recognised	
P0304	16688	Cyl.4 Misfiring recognised	

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P0321	16705	Engine speed sender -G28 Implausible signal	Test engine speed sender => Page 138
P0322	16706	Engine speed sender -G28 No signal	
P0327	16711	Knock sensor 1 -G61 Signal too small	Test knock sensor => Page 140
P0328	16712	Knock sensor 1 -G61 Signal too large	

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P0332	16716	Knock sensor 2 -G66 Signal too small	
P0333	16717	Knock sensor 2 -G66 Signal too large	

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P0341	16725	Camshaft pos.-sensor => -G40 Implausible signal	Test Hall sender => Page 141
P0342	16726	Camshaft pos.-sensor => -G40 Signal too small	
P0343	16727	Camshaft pos.-sensor => -G40 Signal too large	
P0411	16795	Secondary air system Through-flow defective	Check hoses and connections Check secondary air system => 4-Cylinder engine (5-valve), Mechanics; Repair group 26
P0420	16804	Bank 1, Catalyst system Efficiency too low	Generate readiness code => Page 26 or Renew catalytic converter
P0441	16825	Tank breathing system Flow rate faulty	- Carry out work steps 1 to 4 => Readiness code, Page 26

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P0501	16885	Vehicle speed signal Implausible signal	Test vehicle speed signal => Page 128
P0560	16944	Voltage supply Implausible signal	Test voltage supply for engine control unit => Page 136
P0562	16946	Voltage supply Voltage too low	
P0563	16947	Voltage supply Voltage too high	

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P0571	16955	Brake light switch -F Implausible signal	Test brake light switch and brake pedal switch => Page 121
P0601	16985	Control unit defective	Renew engine control unit => Page 42
P0604	16988	Control unit defective	
P0605	16989	Control unit defective	
P0606	16990	Control unit defective	
P0685	17069	Main relay => -J271 Open circuit	Test Motronic current supply relay => Page 55
P0686	17070	Main relay => -J271 Short circuit to Earth	
P0687	17071	Main relay => -J271 Short circuit to Positive	
P0688	17072	Main relay, load circuit => -J271 Open circuit	

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P1102	17510	Bank 1 - Probe 1, Heating element circuit Short to Positive	Test lambda probe heating => Page 69

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1105	17513	Bank 1 - Probe 2, Heating element circuit Short to Positive	Test lambda probe heating => Page 92
P1111	17519	Lambda control (Bank 1) System too lean	Test lambda probe and lambda control => Page 65
P1112	17520	Lambda control (Bank 1) System too rich	
P1113	17521	Bank 1 - Probe 1 Internal resistance too great	Test lambda probe heating => Page 69
P1114	17522	Bank 1 - Probe 2 Internal resistance too great	Test lambda probe heating => Page 92
P1115	17523	Bank 1 - Probe 1, Heating element circuit Short to Earth	Test lambda probe heating => Page 69
P1116	17524	Bank 1 - Probe 1, Heating element circuit Open circuit	
P1117	17525	Bank 1 - Probe 2, Heating element circuit Short to Earth	Test lambda probe heating => Page 92
P1118	17526	Bank 1 - Probe 2, Heating element circuit Open circuit	

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Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1127	17535	Bank 1, Mixture adaption (mult.) System too rich	Take car for test drive (fuel in oil) Check fuel system pressure => Page 44
P1128	17536	Bank 1, Mixture adaption (mult.) System too lean	Test air mass meter => Page 49 Rectify air leaks (unmetered air)
P1136	17544	Bank 1, Mixture adaption (add.) System too lean	Take car for test drive (fuel in oil)
P1137	17545	Bank 1, Mixture adaption (add.) System too rich	Test fuel system pressure => Page 101

Note:

- mult. = multiplicative, i.e. the fault occurs across the whole range of engine speeds and engine loads.
- add. = additive, i.e. the fault only occurs at idling speed.

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1149	17557	Lambda control, Bank 1 Implausible control value	Test lambda probe and lambda control => Page 65
P1176	17584	Bank 1, Lambda correction after cat Control limit reached	Check lambda probe before and after catalytic converter => Current flow diagrams, Electrical fault finding and Fitting locations
P1171	17579	Angle sens. 2 for throt. valve drive -G188 Implausible signal 1)	Test angle sender for throttle valve drive

P1172	17580	Angle sens. 2 for throt. valve drive -G188 Signal too small 1)	=> Page 114
P1173	17581	Angle sens. 2 for throt. valve drive -G188 Signal too large 1)	
P1201	17609	Injector Cyl. 1 -N30 Electrical fault in current circuit	Test injectors =>Page 49
P1202	17610	Injector Cyl. 2 -N31 Electrical fault in current circuit	
P1203	17611	Injector Cyl. 3 -N32 Electrical fault in current circuit	
P1204	17612	Injector Cyl. 4 -N33 Electrical fault in current circuit	

1) If this fault occurs the engine control unit activates the EPC warning lamp in the dash panel insert.

Notes on EPC warning lamp =>Page 115 .

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1213	17621	Injector Cyl. 1 -N30 Short to Positive	Test injectors =>Page 49
P1214	17622	Injector Cyl. 2 -N31 Short to Positive	
P1215	17623	Injector Cyl. 3 -N32 Short to Positive	
P1216	17624	Injector Cyl. 4 -N33 Short to Positive	
P1225	17633	Injector Cyl. 1 -N30 Short to Earth	Test injectors =>Page 49
P1226	17634	Injector Cyl. 2 -N31 Short to Earth	
P1227	17635	Injector Cyl. 3 -N32 Short to Earth	
P1228	17636	Injector Cyl. 4 -N33 Short to Earth	

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Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1237	17645	Injector Cyl. 1 -N30 Open circuit	Test injectors =>Page 49
P1238	17646	Injector Cyl. 2 -N31 Open circuit	
P1239	17647	Injector Cyl. 3 -N32 Open circuit	
P1240	17648	Injector Cyl. 4 -N33 Open circuit	
P1250	17658	Fuel status too low	Put fuel in tank, erase fault memory Interrogate fault memory of dash panel insert => Electrical system; Repair group 01; Self-diagnosis of dash panel insert Self-diagnosis of dash panel insert

Fault code	Readout on fault reader display	Fault rectification

SAE	V.A.G		
P1325	17733	Knock control Cyl. 1 Control limit reached	Test knock control => Page 140
P1326	17734	Knock control Cyl. 2 Control limit reached	
P1327	17735	Knock control Cyl. 3 Control limit reached	
P1328	17736	Knock control Cyl. 4 Control limit reached	

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1335	17743	Engine torque monitoring 2 Control limit surpassed 1)	Test throttle valve control part => Page 42
P1336	17744	Engine torque monitoring Control limit surpassed	Renew engine control unit Page 42
P1337	17745	Bank 1, Camshaft pos. sensor => -G163 Short to Earth	Test Hall sender => Page 141
P1338	17746	Bank 1, Camshaft pos. sensor => -G163 Open circuit / Short to Positive	
P1340	17748	Camshaft pos.-Crankshaft pos.-sens Wrong allocation	Test phase position of Hall sender => Page 144

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1) If this fault occurs the engine control unit activates the EPC warning lamp in the dash panel insert.

Notes on EPC warning lamp =>Page 115 .

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1355	17763	Ignition activation Cyl. 1 Open circuit	Test activation of output stages => Page 135
P1356	17764	Ignition activation Cyl. 1 Short to Positive	
P1357	17765	Ignition activation Cyl. 1 Short to Earth	
P1358	17766	Ignition activation Cyl. 2 Open circuit	
P1359	17767	Ignition activation Cyl. 2 Short to Positive	
P1360	17768	Ignition activation Cyl. 2 Short to Earth	

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		

P1361	17769	Ignition activation Cyl. 3 Open circuit	Test activation of output stages => Page 135
P1362	17770	Ignition activation Cyl. 3 Short to Positive	
P1363	17771	Ignition activation Cyl. 3 Short to Earth	
P1364	17772	Ignition activation Cyl. 4 Open circuit	
P1365	17773	Ignition activation Cyl. 4 Short to Positive	
P1366	17774	Ignition activation Cyl. 4 Short to Earth	

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Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1386	17794	Control unit defective	Renew engine control unit => Page 42
P1387	17795	Control unit defective	
P1388	17796	Control unit defective 1)	
P1409	17817	Tank breathing valve -N80 Electrical fault in current circuit	Test solenoid valve 1 for activated charcoal filter => Page 101
P1410	17818	Tank breathing valve -N80 Short to Positive	
P1420	17828	Secondary air inlet valve -N112 Fault in electrical circuit	Test secondary air inlet valve => Page 105
P1421	17829	Secondary air inlet valve -N112 Short to Earth	
P1422	17830	Secondary air inlet valve -N112 Short to positive	
P1424	17832	Bank 1, Secondary air system Leak recognised	Check hoses and components of secondary air system => 4-Cylinder engine (5-valve), Mechanics; Repair group 26; Secondary air system Secondary air system

1) If this fault occurs the engine control unit activates the EPC warning lamp in the dash panel insert.

Notes on EPC warning lamp =>Page 115 .

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1425	17833	Tank breathing valve -N80 Short to Earth	Test solenoid valve 1 for activated charcoal filter =>Page 101
P1426	17834	Tank breathing valve -N80 Open circuit	
P1427	17835	Activation: vacuum pump for brakes Short to Positive	Test activation of vacuum pump for brakes => Brake system; Repair group 47; Electrical vacuum pump Electrical vacuum pump
P1428	17836	Activation: vacuum pump for brakes Short to Earth	

P1429	17837	Activation: vacuum pump for brakes Open circuit	

Notes:

- Vehicles with automatic gearbox or CVT employ an electrical vacuum pump to boost the vacuum delivered by the engine to the brake servo.
- This vacuum pump is activated as required by the engine control unit via a relay.

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1432	17840	Secondary air inlet valve - N112 Open circuit	Test secondary air inlet valve => Page 105
P1433	17841	Relay for secondary air pump -J299 Open circuit	Test relay for secondary air system => Page 107
P1434	17842	Relay for secondary air pump -J299 Short to positive	
P1435	17843	Relay for secondary air pump -J299 Short to Earth	
P1436	17844	Relay for secondary air pump -J299 Fault in electrical circuit	
P1479	17887	Vacuum system for brakes Mechanical fault	Carry out "short trip" in engine control unit (Basic setting: Display group 8 with ignition on and selector lever in "P" or "N"). Check hoses and connections to pump and from pump to brake servo. Carry out Final control diagnosis in engine control unit to check whether vacuum pump runs or is activated.

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1500	17908	Fuel pump relay -J17 Electrical fault in current circuit	Test fuel pump relay

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P1501	17909	Fuel pump relay -J17 Short to Earth	=> Page 52
P1502	17910	Fuel pump relay -J17 Short to Positive	
P1511	17919	Intake manif. change-over valve -N156 Electrical fault in current circuit	Test intake manifold change-over function
P1512	17920	Intake manif. change-over valve -N156 Short to Positive	=> Page 96
P1515	17923	Intake manif. change-over valve -N156 Short to Earth	
P1516	17924	Intake manif. change-over valve -N156 Open circuit	
P1517	17925	Main relay =>-J271 Fault in electrical circuit	Test Motronic current supply relay => Page 55

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1519	17927	Bank 1, Variable valve timing Faulty	Test camshaft timing control => Page 145
P1523	17931	Crash signal from airbag control unit Implausible signal	Test crash signal => Page 127
P1529	17937	Variable valve timing => -N205 Short to Positive	Test camshaft timing control => Page 145
P1530	17938	Variable valve timing => -N205 Short to Earth	
P1531	17939	Variable valve timing => -N205 Open circuit	
P1539	17947	Clutch pedal switch -F36 Implausible signal	Test clutch pedal switch => Page 124

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Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1541	17949	Fuel pump relay -J17 Open circuit	Test fuel pump relay => Page 52
P1542	17950	Angle sender for throt. val. drive -G187 Implausible signal 1)	Test angle sender for throttle valve drive => Page 114
P1543	17951	Angle sender for throt. val. drive -G187 Signal too small 1)	
P1544	17952	Angle sender for throt. val. drive -G187 Signal too large 1)	

P1545	17953	Throttle valve control Faulty 1)	Test throttle valve control part => Page 111
P1558	17966	Throttle valve drive -G186 Fault in electrical circuit	
P1559	17967	Throttle valve control part -J338 Fault in basic setting 1)	Perform adaption => Page 112
P1560	17968	Maximum engine revs surpassed	Repair mechanical damage

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1564	17972	Throttle valve control part -J338 Low voltage at base setting 1)	Test throttle valve control part => Page 111
P1565	17973	Throttle valve control part -J338 Lower stop is not reached 1)	
P1568	17976	Throttle valve control part -J338 Mechanical fault 1)	

1) If this fault occurs the engine control unit activates the EPC warning lamp in the dash panel insert.

Notes on EPC warning lamp =>Page 115 .

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1569	17977	Cruise control system switch -E45 Implausible signal	Test cruise control system switch => Electrical system; Repair group 01; Self-diagnosis for cruise control system (CCS) Self-diagnosis for cruise control system (CCS)
P1570	17978	Engine control unit blocked	Perform adaption of electronic immobilizer to engine control unit => Electrical system; Repair group 01; Self-diagnosis for immobilizer Self-diagnosis for immobilizer
P1579	17987	Throttle valve control unit -J338 Adaption not started	Test throttle valve control part => Page 111
P1593	18001	Altitude adaption Signal not within tolerance range	Test for air leaks in intake system (hoses, hose clamps, etc.) Test air mass meter => Page 111

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1602	18010	Voltage supply Kl. 30 Voltage too low	Test voltage supply (terminal 30) for engine control unit => Page 136 .
P1603	18011	Control unit defective	Renew engine control unit => Page 42
P1604	18012	Control unit defective 1)	
P1606	18014	Poor road info/eng.sp.mom from ABS CU (specified engine torque from ABS control unit) Electrical fault in current circuit	- Test wiring between engine control unit and ABS control unit => Current flow diagrams, Electrical fault finding and Fitting locations

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P1609	18017	Crash switch-off triggered	Accident has occurred with airbag triggered or final control diagnosis was performed on airbag control unit, leading to a fault reading in the engine control unit (erase fault memory)

1) If this fault occurs the engine control unit activates the EPC warning lamp in the dash panel insert.

Notes on EPC warning lamp =>Page 115 .

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1610	18018	Control unit defective	Renew engine control unit =>Page 42
P1612	18020	Engine control unit Wrong coding	Code engine control unit =>Page 23
P1624	18032	Request warning lamp be switched on Active	Fault affecting emissions originating from gearbox control unit Interrogate fault memory of gearbox control unit
P1626	18034	Data bus drive - No message from gearbox CU	Test CAN data bus => Page 131
P1630	18038	Accelerator position sender -G79 Signal too small 1)	Test accelerator position sender =>Page 117
P1631	18039	Accelerator position sender -G79 Signal too large 1)	
P1633	18041	Accelerator position sender 2 - G185 Signal too small 1)	
P1634	18042	Accelerator position sender 2 - G185 Signal too large 1)	

1) If this fault occurs the engine control unit activates the EPC warning lamp in the dash panel insert.

Notes on EPC warning lamp =>Page 115 .

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1635	18043	Data bus drive No message from air cond. CU	Test CAN data bus =>Page 131
P1639	18047	Accelerator position sender 1/2 (G79 + G185) Implausible signal 1)	Test accelerator position sender =>Page 117
P1640	18048	Control unit defective	Renew engine control unit => Page 42
P1648	18056	Data bus drive Defective	Test CAN data bus =>Page 131
P1649	18057	Data bus drive No message from ABS CU	Test CAN data bus =>Page 131
P1650	18058	Data bus drive Message from combi-instrument (dash panel insert) missing	Test CAN data bus =>Page 131
P1676	18084	Electr. throttle control fault lamp -K132 Electrical fault in current circuit 1)	Notes on EPC warning lamp => Page 115

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P1677	18085	Electr. throttle control fault lamp -K132 Short to Positive 1)	

1) If this fault occurs the engine control unit activates the EPC warning lamp in the dash panel insert.

Notes on EPC warning lamp =>Page 115 .

Note:

Electronic throttle control fault lamp -K132 is also known as the EPC (Electronic Power Control) warning lamp.

Fault code		Readout on fault reader display	Fault rectification
SAE	V.A.G		
P1682	18090	Data bus drive Implausible info from ABS CU	Test CAN data bus =>Page 131
P1853	18261	CAN bus Implausible info from ABS CU	Interrogate fault memory of ABS control unit => Running gear, Self-diagnosis for ABS, ESP; Repair group 01; Interrogating fault memory 131
P1912	18320	Pressure sensor for brake servo -G294 Open circuit / Short to Positive	Test wiring from pressure sensor for brake servo -G294 => Current flow diagrams, Electrical fault finding and Fitting locations
P1913	18321	Pressure sensor for brake servo -G294 Short to Earth	

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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 will be activated for approx. 1 minute, or 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.
- The electric fuel pump runs continuously throughout the final control diagnosis.
- If the final control diagnosis is to be repeated, the engine must be started. The engine control unit needs to detect an engine speed of more than 300 rpm.

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

1. Solenoid valve 1 for activated charcoal filter -N80 (fuel tank breather valve)

2. Secondary air inlet valve -N112
(only on vehicles with secondary air system)

3. Secondary air pump relay -J299
(only on vehicles with secondary air system)

4. Intake manifold change-over valve -N156

5. Camshaft timing control 1 (camshaft adjustment valve 1 -N205)

6. Brake vacuum pump -V192

7. Injector, cylinder 1 -N30

8. Injector, cylinder 3 -N32

9. Injector, cylinder 4 -N33

10. Injector, cylinder 2 -N31

Test requirements

- Fuses for engine electronics okay.
- Fuel pump relay okay.

- Connect vehicle diagnostic, testing and information system VAS 5051 or fault reader V.A.G 1551 and select engine electronics control unit by entering "address word" 01 => Page 2 .
  When doing this the ignition must be switched on.

-> 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
```

- Confirm input with Q key.

Activating solenoid valve for activated charcoal filter -N80 (fuel tank breather valve)

-> Indicated on display:

```
Final control diagnosis
Fuel tank breather valve -N80
```

This solenoid valve will continue to be actuated (i.e. will click) for about 1 minute or until the ⇒ key is pressed to advance the programme to the next control element.

If solenoid valve is not actuated (does not click).

- Test solenoid valve 1 for activated charcoal filter -N80 => Page 101 .

Activating secondary air inlet valve -N112

(only on vehicles with secondary air system)

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- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Secondary air inlet valve -N112
```

This solenoid valve will continue to be actuated (i.e. will click) for about 1 minute or until the ⇒ key is pressed to advance the programme to the next control element.

If secondary air inlet valve is not actuated (i.e. does not click):

Test secondary air inlet valve
=>Page 105 .

Activating secondary air pump relay -J299

(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 switches secondary air pump motor -V101 on and off continuously for about 1 minute or until the ⇒ key is pressed to advance the programme to the next control element.

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

Test secondary air pump relay
=>Page 107 .

Activating intake manifold change-over valve -N156

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Intake manifold change-over valve -N156
```

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

If the valve is not activated (does not click).

- Test intake manifold change-over valve -N156 => Page 96 .

Activating camshaft adjustment valve

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Camshaft timing control 1
```

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- Camshaft adjustment valve 1 (-N205) will continue to be activated (i.e. will click) for about 1 minute or until the ⇒key is pressed to advance the programme to the next control element.
- This solenoid valve will continue to be activated (i.e. will click) for about 1 minute or until the ⇒key is pressed to advance the programme to the next control element.

If the solenoid valve is not actuated (i.e. does not click), test solenoid valve for camshaft adjustment
=> Page 146

Brake servo pressure system

activating brake servo relay -J569:

Notes:

- Vehicles with automatic gearbox or CVT employ an electrical vacuum pump to boost the vacuum delivered by the engine to the brake servo.
- The brake servo relay -J569 is only activated for approx. 10 seconds. It may therefore be necessary to start the final control diagnosis several times.

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Brake servo pressure system
```

The brake vacuum pump -V192 is activated by the brake servo relay -J569 and will run for approx. 10 seconds, or until the ⇒key is pressed to advance the programme to the next control element.

If the brake vacuum pump -V192 does not start:

- Proceed with final control diagnosis until completed.
- Switch off ignition.
- Renew brake vacuum pump.

=> Brake systems; Repair group 47; Assembly overview Assembly overview

If no fault is detected:

- Check voltage supply and wiring connection from brake vacuum pump (V192) for open/short circuit.

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

Activating injectors

(not on all vehicles)

Note:

The injectors are actuated according to the firing order (i. e. Cylinder 1, Cylinder 3, Cylinder 4, Cylinder 2)

- Press ⇒key.

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-> Indicated on display:

```
Final control diagnosis
Injector Cyl. 1 -N30
```

- Press ⇒key.

After pressing key ⇒, the injector should click five times.

-> Indicated on display:

```
Final control diagnosis
Injector Cyl. 1 -N30
```

If the injector does not click:

- Test injectors => Page 49 .
- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Injector Cyl. 3 -N32
```

- Press ⇒key.

After pressing key ⇒, the injector should click five times.

-> Indicated on display:

```
Final control diagnosis
Injector Cyl. 3 -N32
```

If the injector does not click:

- Test injectors => Page 49 .

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Injector Cyl. 4 -N33
```

- Press ⇒key.

After pressing key ⇒, the injector should click five times.

-> Indicated on display:

```
Final control diagnosis
Injector Cyl. 4 -N33
```

If the injector does not click:

- Test injectors => Page 49 .
- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Injector Cyl. 2 -N31
```

- Press ⇒key.

After pressing key ⇒, the injector should click five times.

-> Indicated on display:

```
Final control diagnosis
Injector Cyl. 2 -N31
```

If the injector does not click:

- Test injectors => Page 49 .
- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
END
```

- Press ⇒key.

-> Indicated on display (ready to select function)

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

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Note:

Before the function "Final control diagnosis" can be repeated, it is necessary to first start the engine, then switch the ignition off and back on again.

4 - Basic setting

4.1 - Basic setting

With the ignition on and engine not running, the following operation can be performed in the "Basic setting" mode ("Function 04"):

- Adaption of throttle valve control part to engine control unit

=>Page 112

With the engine running, the following operations can be performed in the basic setting mode "Function 04":

- Learning process for lambda control
  => Page 67
- Fault-finding by switching lambda control on and off
  => Page 65

Test conditions for operations with engine running

- No fault stored in fault memory
- Coolant temperature at least 85 °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
- Wheels in straightaway position

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.
- Interrogate and erase fault memory
  => Page 4 .
  There should be no faults stored in the fault memory. (If necessary rectify faults, erase fault memory and switch off engine. Start engine again, take vehicle for a road test and interrogate fault memory again to check.)
- Leave engine idling.

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-> 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:

```
Basic setting
Enter 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 000 is used here as an example to illustrate the procedure.

- Press key 0 three times.

(000 is to select Display Group 000)

Note:

When the display group is selected the ACF valve is closed and the air conditioner compressor is switched off.

-> Indicated on display:

```
Basic setting     Q
Enter display group number     000
```

- Confirm entry by pressing Q.

-> Indicated on display:

```
System in basic setting 0
1     2     3     4     5     6     7
8     9     10
```

Display Group 000 (decimal readouts)			
▪ Engine idling (coolant temperature not below 85 °C)			
Display zones		Specification	Corresponds to
1 2 3 4 5 6 7 8 9 10	Lambda learned value at part throttle	102...153	-10...10 %
	Lambda learned value with engine idling	76...178	-10...10 %
	Lambda control value	115...140	-10...10 %
	Learned value of idling speed control	102...153	-5...5 %
	Idling speed control	102...153	-5...5 %
	Throttle valve angle	1...8	0.4...2.75 %
	Battery voltage	142...207	10...14.5
	Engine rpm (idling speed) 1)	81...91	810...910 rpm
	Engine load (without electrical consumers)	20...34	15...26 %
	Coolant temperature (requirement for basic setting)	185...205	85...105 °C

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1) Up-to-date specifications:

=> Exhaust emissions test binder

- Allow engine to idle for a few minutes: coolant temperature at least 85 °C (at least 185 in display zone 1).

Notes:

- When the PRINT key is pressed the current display will be printed out.
- Press C before selecting further display groups.

- If the readouts in all the display zones match the specifications, 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.

-> Indicated on display:

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

5 - Coding engine control unit

5.1 - Coding engine control unit

Notes:

- If the correct coding for the vehicle is not displayed, or if the control unit has been replaced, the control unit must be coded.
- Coding is checked via fault reader V.A.G 1551.
- During control unit identification a 5-digit code must always be displayed.
- Incorrect coding may lead to higher emissions and increased strain on the automatic transmission resulting from harsh gearshift jolts.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.

-> 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.

Compose the code number according to the following example:

MVEG 3 (exhaust emission standard)	05
Front-wheel drive without ASR/ESP	0
Manual gearbox	0
Audi A4	1
Code number	05 0 0 1

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

```
8B0906018.. 1.8l     R4S/5V MOTR HS
D..□
Coding 05001     WSC 06388
```

- 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.
- Switch ignition off and then on again.

Note:

The next time the ignition is switched on the newly entered coding will be activated.

Coding variants for engine control unit

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Country/emission standard	Drive train/additional functions	Gearbox	Model
00 = ----------	0 = FWDwithout ASR ---------- FWD without ESP	0 = 5-speed manual	0 = ----------
01 = ----------	1 = ----------	1 = ----------	1 = Audi A4
02 = ----------	2 = 4WD without ESP	2 = ----------	2 = ----------
03 = ----------	3 = ----------	3 = Automatic	3 = ----------
04 = MVEG II	4 = ----------	4 = ----------	4 = ----------
05 = MVEG III (EU D-3)	5 = FWD with ASR ---------- FWD with ESP	5 = ----------	5 = ----------
06 = ----------	6 = ----------	6 = ----------	6 = ----------
07 = ----------	7 = 4WD with ESP	7 = ----------	7 = ----------
08 = ----------	8 = ----------	8 = ----------	8 = ----------
09 = ----------	9 = ----------	9 = ----------	9 = ----------

Country/emission standard	Drive train/additional functions	Gearbox	Model
10 = EU III	10 = ----------	10 = ----------	10 = ----------

Note:

ASR stands for Traction Control System

ESP stands for Electronic Stability Program

Vehicles with "ASR" or "ESP" have a switch in the centre console marked "ASR" or "ESP".

6 - Reading measured value block

6.1 - Reading measured value block

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Test conditions

- Coolant temperature at least 85 °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 vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

-> 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 relevant display group number and confirm entry with Q key.

Note:

The display group number required is indicated in the instructions for testing functions and components given in the relevant sections of this Manual.

-> Indicated on display (example)

```
Read measured value block     1
     1     2     3     4
```

Note:

To change to another display group proceed as follows:

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

7 - Readiness code

7.1 - Readiness code

The readiness code appears as an 8-digit display in measured value block 086, Display zone 1. Each of the 8 digits represents a specific part of the emission control system.

When the operation of these components is tested via self-diagnosis (provided that the test is fully completed) the corresponding digit on the 8-digitdisplay will change from "1" to "0". This happens regardless of whether or not the component is found to be OK, but, as already stated, only if the test is run to the end.

If the test is completed, but the component is found to be "not okay", the relevant fault will be stored in the fault memory. Interrogate fault memory.

When the readiness code is generated after completion of the tests, it will therefore appear as "0 0 0 0 0 0 0 0" (Measured value block 086, display zone 1).

The readiness code will revert back to "11111111" if:

- the fault memory has been erased,
- or if a new engine control unit is installed.

7.2 - Reading off readiness code

Test sequence

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.

-> Indicated on display:

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

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

-> Indicated on display:

```
Read measured value block     Q
Enter display group number XXX
```

- Press keys 0, 8 and 6 for "Display group No. 86" and confirm entry with Q key.

-> Indicated on display:

```
Read measured value block 86
     1     2     3     4
```

- Check readiness code in display zone 1.
  - Specification:0 0 00 0 0 00

	Display zones			
	1	2	3	4
Display group 086: Readiness code				
Display	**0 0 0 0 0 0 0 0**	X X X X X X X X	X X X X X X X X	**X X X X X X X X**
Indicates	**Ready bits completed tests**	Cycle flags completed cycles	Cycle flags completed cycles	Cycle flags completed cycles

	Display zones			
Range	1 = not completed 0 = completed	1 = not completed 0 = completed	1 = not completed 0 = completed	1 = not completed 0 = completed
Specification	0 0 0 0 0 0 0 0	X X X X X X X X	X X X X X X X X	X X X X X X X X
Note	Significance of readiness code is explained on the following pages.			

Note on Display zone 1:

This display indicates which components have been tested via self-diagnosis since the last time the fault memory was erased or a new control unit was installed. After erasing the fault memory, all test values (except the values which cannot be tested) are set to 1. After performing the test procedure successfully all values are set to 0.

Note on Display zone 2, 3 and 4:

This display indicates which components have been tested via self-diagnosis since the last engine start. The diagnosis status of all components is set back to1when the engine is switched off. All testable values are set to0after the diagnosis is completed.

X	X	X	X	X	X	X	X	Notes on Display group 86, Display zone 1 (ready bits)
								1 = Diagnosis of catalytic converter - Display 0 = ready - Display 1 = not ready (generating readiness code => Page 28)
								2 = Heating for catalytic converter (not applicable): display constantly 0
								3 = Activated charcoal filter system (0 = ready) - Display 0 = ready - Display 1 = not ready (generating readiness code => Page 28)
								4 = Secondary air system - Display 0 = ready - Display 1 = not ready (generating readiness code => Page 28)
								5 = Air conditioner (not applicable): display constantly 0
								6 = Lambda probes (0 = ready) - Display 0 = ready - Display 1 = not ready (generating readiness code => Page 28)
								7 = Heating for lambda probes (0 = ready); no "short trip" required - Display 0 = ready - Display 1 = not ready
								8 = Exhaust gas recirculation (not applicable): display constantly 0

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Note:

The readiness code will be generated only when all display digits are "0".

If the specification"0 0 0 0 0 0 00"is attained:

- Press ⇒key.

-> Indicated on display (function selection):

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

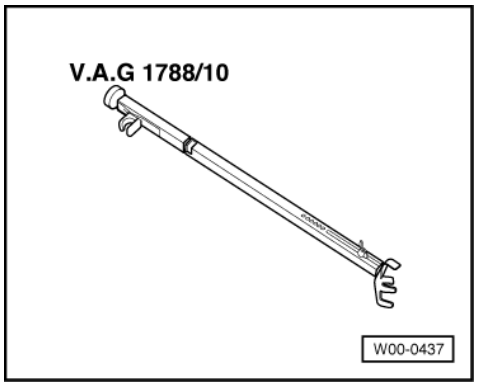
- As an additional check, interrogate fault memory (no faults should be stored).

If the specification is not attained:

- Generate readiness code => Page 28

7.3 - Generating readiness code

Special tools and workshop equipment required



- Speed regulator V.A.G 1788/10

Test requirements

- Engine not running
- Electrical consumers switched off (radiator fan must not run during the test)
- Coolant temperature at least 80°C

Work step 1: interrogate fault memory

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.

-> Indicated on display:

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

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

-> The number of faults stored or "No fault recognised!" will be shown on the display.

```
X Faults recognised!
```

If a fault is stored:

- Rectify fault and erase fault memory. Then take vehicle for a road test and interrogate fault memory once again to check for faults.

If no faults are stored:

- Press ⇒key.

Work step 2: erase fault memory

- Ignition switched on.

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-> Indicated on display:

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

- Press keys 0 and 5 for the function "Erase fault memory" and confirm entry with Q key.

Note:

If the fault memory is erased, the readiness code is set back and therefore has to be regenerated.

-> Indicated on display:

```
Rapid data transfer
Fault memory is erased!
```

- Press ⇒key.

The readiness code can be generated in two ways:

- When the vehicle is driven under varying engine load conditions, the control unit carries out tests on the relevant parts of the emission control system, and in this way the readiness code is generated automatically.

or

- Generate the readiness code as follows:

Work step 3: diagnosis of fuel tank breather valve

Test conditions

- Engine idling
- Coolant temperature above 85°C (Display group 4, display zone 3)

-> 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     Q
Enter display group number XXX
```

- Enter "070" for Display Group 070 and confirm entry with Q key.

-> Indicated on display:

```
System in basic setting 70
     1     2     3     4
```

- Check the readout in display zone 4:

	Display zones			
	1	2	3	4
Display Group 070: Diagnosis of fuel tank breather valve				
Display	xx %	xx.x %		---
Indicates	Fuel tank breather valve: degree of opening	Lambda control variation	Relative mass flow through tank breather valve	**Diagnosis status**
Range	min.: 0 % max.: 100 %	min.: -25.0 % max.: 25.0 %		**Test OFF** **Test ON** **TBV OK** **TBV n. OK** **Abort**
Specification	xx %	-2.5...2.5 %	xx...xx %	**TBV OK**

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	Display zones			
Note				If "TBV n. OK" appears on display, interrogate fault memory (=> Page 101 .

If the specification "TBV O.K." is attained:

- Press C key.

Work step 4: diagnosis of fuel supply system

- Engine idling
- Lambda control function active

-> Indicated on display:

```
Introduction of basic setting      Q
Enter display group number XXX
```

- Enter "107" for "Display group number 107" and confirm with Q key.

-> Indicated on display

```
System in basic setting      107
     1     2     3     4
```

- Check the readout in display zone 4:

	Display zones			
	1	2	3	4
Display Group 107: Diagnosis of fuel supply system				
Display	xxx rpm	x.x %		**Test ON**
Indicates	rpm (actual)	Lambda control mean value (bank 1)		**Diagnosis status**
Range	min.: 550 rpm max.: 7200rpm	-25.0 ... 25.0 %		**Test OFF** **Test ON** **Syst. OK** **Syst. n. OK**
Specification	600 ... 900 rpm	-23 %...23 %		Syst. OK
Note				**If the display shows "Syst. n. OK", interrogate fault memory => Page 4 .**

If the specification "Syst. OK" is obtained in display zone 4:

- Press C key.

Work step 5: diagnosis of lambda probe heating

-> Indicated on display:

```
Introduction of basic setting      Q
Enter display group number XXX
```

- Enter "041" for "Display group number 041" and confirm with Q key.

-> Indicated on display

```
System in basic setting 41
     1     2     3     4
```

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- Check readouts in display zones 1 and 3:

Note:

The readouts can be obtained more quickly by increasing engine speed.

	Display zones			
	1	2	3	4
Display Group 41: Lambda probe heating (at idling speed)				
Display	**xxx kOhm**	**Htg.bC.ON**	**xxx kOhm**	**Htg.aC.ON**
Indicates	**Bank 1, Probe 1**	**Status of heating**	**Bank 1, Probe 2**	**Status of heating**
Range		**Htg.bC.ON Htg.bC.OFF**		**Htg.aC.ON Htg.aC.OFF**
Specification	**less than 2 kOhm**	**Htg.bC.ON**	**less than 2 kOhm**	**Htg.aC.ON**
Note				

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Important notes on Display group 41: display zones 1 and 3:

- Display zones 1 and 3 remain blank until the lambda probes reach operating temperature (increase engine speed to obtain the readouts).
- A resistance value below 0.9 kOhm should appear in display zones 1 and 3 when both lambda probes have reached operating temperature.
- Do not continue the test until display zones 1 and 3 show a resistance value below 0.9 kOhm.

- Press C key.

Work step 6: diagnose of ageing of lambda probe before catalytic converter

Test conditions

- Increase engine speed until the exhaust temperature in display zone 2 reaches 200°C.

-> Indicated on display:

```
Introduction of basic setting     Q
Enter display group number XXX
```

- Enter "034" for "Display group number 034" and confirm with Q key.

-> Indicated on display

```
System in basic setting     34
     1     2     3     4
```

- Check the readout in display zone 4:

	Display zones			
	1	2	3	4
Display group 034: Ageing of lambda probe before catalytic converter				
Display	xxxx rpm	xxx °C	x.x s	**Test ON**
Indicates	Engine speed	Exhaust temperature	Cycle duration of lambda probe (before catalytic converter)	Status of diagnosis
Range	min.: 550 rpm max.: 7200rpm	70...850 °C	0.0...3.0 sec.	Test OFF Test ON B1-P1 OK B1-P1 n. OK
Specification	600...900 rpm	above 200 °C	0.1...1.0 sec.	B1-P1 OK

	Display zones			
Note				If "B1-P1 n. OK" appears on display: interrogate fault memory => Page 4 .

If the specification "B1-P1 OK" is obtained in display zone 4:

- Press C key.

Work step 7: diagnosis of condition of lambda probe after catalytic converter

- Engine idling

-> Indicated on display:

```
Introduction of basic setting      Q
Enter display group number XXX
```

- Enter "036" for "Display group number 036" and confirm with Q key.

-> Indicated on display

```
System in basic setting      36
     1     2     3     4
```

- Check the readout in display zone 2:

	Display zones			
	1	2	3	4
Display group 036: Condition of lambda probe after catalytic converter				
Display	x.xxx V	Test ON		
Indicates	Voltage of lambda probe after catalytic converter bank 1	Status of diagnosis		
Range	0.000V...1.000 Volt	Test OFF Test ON B1-P2 OK B1-P2 n. OK		
Specification	0.500...0.800 V	B1-P2 OK		
Note		If "B1-P2 n. OK" appears on display: interrogate fault memory => Page 4 .		

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If the specification is obtained:

B1-P2 OK in display zone 2

- Press C key.

Work step 8: diagnosis of lambda control system

- Engine idling

-> Indicated on display:

```
Introduction of basic setting      Q
Enter display group number XXX
```

- Enter "037" for "Display group number 037" and confirm with Q key.

-> Indicated on display

```
System in basic setting      37
     1     2     3     4
```

- Check the readout in display zone 4:

	Display zones			
	1	2	3	4
Display group 037: Lambda control system				
Display	xx.x %	x.xxx V	xxx ms	**Test ON**
Indicates	Engine load	Voltage of lambda probe after catalytic converter	Lambda compensating value between lambda probe 1 and lambda probe 2	**Status of diagnosis**
Range	0...175 %	0.000...1.000 Volt	---	**Test OFF Test ON Syst. OK Syst. n. OK**
Specification	14...24 %	0.000...1.000 Volt	-800ms...800ms	**Syst. OK**
Note				**If the display shows "Syst. n. OK", interrogate fault memory => Page 4 .**

If the specification "Syst. OK" is obtained in display zone 4:

- Press C key.

Work step 9: diagnosis of catalytic converter

-> Indicated on display:

```
Introduction of basic setting      Q
Enter display group number XXX
```

- Enter "046" for "Display group 046" and confirm entry with Q key.

-> Indicated on display:

```
System in basic setting 46
     1     2     3     4
```

- Increase engine speed to approx. 3000 rpm until the exhaust temperature (display zone 2) reaches 550°C.
- Check the readout in display zone 4:

Note:

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The diagnostic test of the catalytic converter takes approx. 60 seconds.

	Display zones			
	1	2	3	4
Display group 046: Diagnosis of catalytic converter (bank 1)				
Display	xxxx rpm	xxx °C	x.x s	**---**
Indicates	Engine speed	Exhaust temperature	Catalytic converter: conversion	Status of diagnosis
Range	min.: 550 rpm max.: 7200rpm	70...850 °C	0.0...1.0 sec.	Test OFF Test ON Cat B1 OK Cat B1 n. OK
Specification	1800..2200 rpm	400 ... 600°C	0.0...0.09 sec.	Cat B1 OK

	Display zones			
Note				If "Cat B1 n. OK" appears on display, interrogate fault memory => Page 4 . If there is no fault stored in fault memory, replace catalytic converter.

If the specification "Cat B1 OK" is obtained in display zone 4 :

- Press C key.

Work step 10: diagnosis of secondary air system

-> Indicated on display:

```
Introduction of basic setting      Q
Enter display group number XXX
```

- Enter "077" for Display group 077 and confirm entry with Q key.

-> Indicated on display:

```
System in basic setting 77
     1     2     3     4
```

- Check the readout in display zone 4:

Note:

The diagnostic test of the secondary air system takes approx. 60 seconds.

	Display zones			
	1	2	3	4
Display group 077: Diagnosis of secondary air system				
Display	xxxx rpm	xx.x g/s	xx %	**Test ON**
Indicates	Engine speed	Air mass	Percentage variation from specified value for secondary air system	Status of diagnosis
Range	min.: 550 rpm max.: 7200rpm			Test OFF Test ON Syst. OK Syst. n. OK Abort
Specification	600...900 rpm	2.5 ... 4.5 g/s	-40 %...40 %	**Syst. OK**
Note				**If the display shows "Syst. n. OK", interrogate fault memory => Page 4 .**

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If the specification "Syst. OK" is obtained in display zone 4:

- Press⇒key.

Work step 11: reading off readiness code.

- Read off the readiness code (=>Page 26) once again as an additional check.

24 - Mixture preparation, Injection

1 - Servicing Motronic injection system

1.1 - Servicing Motronic injection system

1.2 - Safety precautions

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

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

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

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- 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 connectors from the output stages for the ignition coils and also the connectors on the injectors.
- During some of the tests the control unit may identify and record faults. The fault memory should therefore be interrogated and (if necessary) erased after completing the tests and any repair work that may be required.
- 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.

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

1.3 - Rules for cleanliness

When working on the fuel supply/injection system, pay careful attention to the following guidelines for cleanliness:

- Thoroughly clean all unions and the adjacent areas before disconnecting.
- Place parts that have been removed on a clean surface and cover them over. Do not use fluffy cloths.
- Carefully cover over or seal opened components if the repair cannot be completed 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.
- Unplugged electrical connectors:
  Keep clean and dry.

Connect only when dry.

1.4 - Technical data

Engine code		APT (1.8 ltr. / 5V naturally aspirated / 92 kW engine)
Idling speed Not adjustable - controlled by idling speed stabilisation		810 ... 910 rpm
Maximum engine rpm Engine speed limited by closing throttle valve		6800 rpm
Fuel pressure at idling speed	Vacuum hose connected	approx. 3.5 bar
	Vacuum hose disconnected	approx. 4.0 bar
Holding pressure after 10 minutes		at least 2.5 bar
Injectors	Spray pattern	same at all injectors
	Injection quantity (30 sec.)	85...105 ml
	Resistance (room temperature)1)	12 ... 13 ω

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

1.5 - Fitting locations overview

Components A to F are not shown in the exploded drawing.

A - Brake light switch (F) and brake pedal switch (F47)

- In footwell on pedal bracket near brake pedal

B - Diagnostic connector

- In rear ashtray

C - Fuel pump relay

- In micro central electrics behind storage compartment on driver's side, relay position 4

D - Clutch pedal switch (F36)

- In footwell on pedal bracket near clutch pedal

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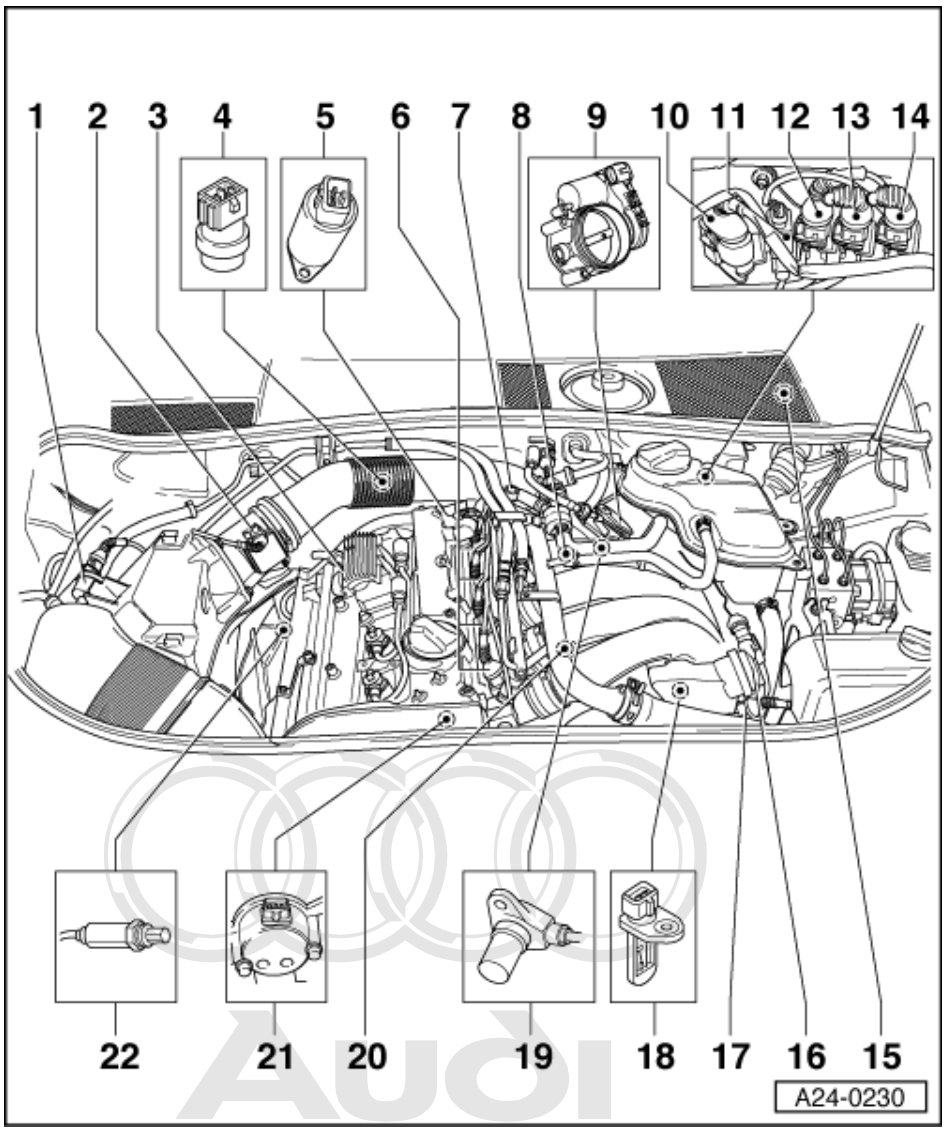

E - Accelerator pedal sender (G79) and accelerator pedal sender 2 (G185)

- In footwell on accelerator pedal (both senders are fitted in one housing)

F - EPC warning lamp

- In dash panel insert
  (Notes on warning lamp
  =>Page 115)

1 Solenoid valve for activated carbon filter (N80)
2 Air mass meter (G70)
3 Ignition coils (N and N128) with output stage (N122)
4 Coolant temperature sender (G62)
5 Camshaft adjustment valve 1 (N205)

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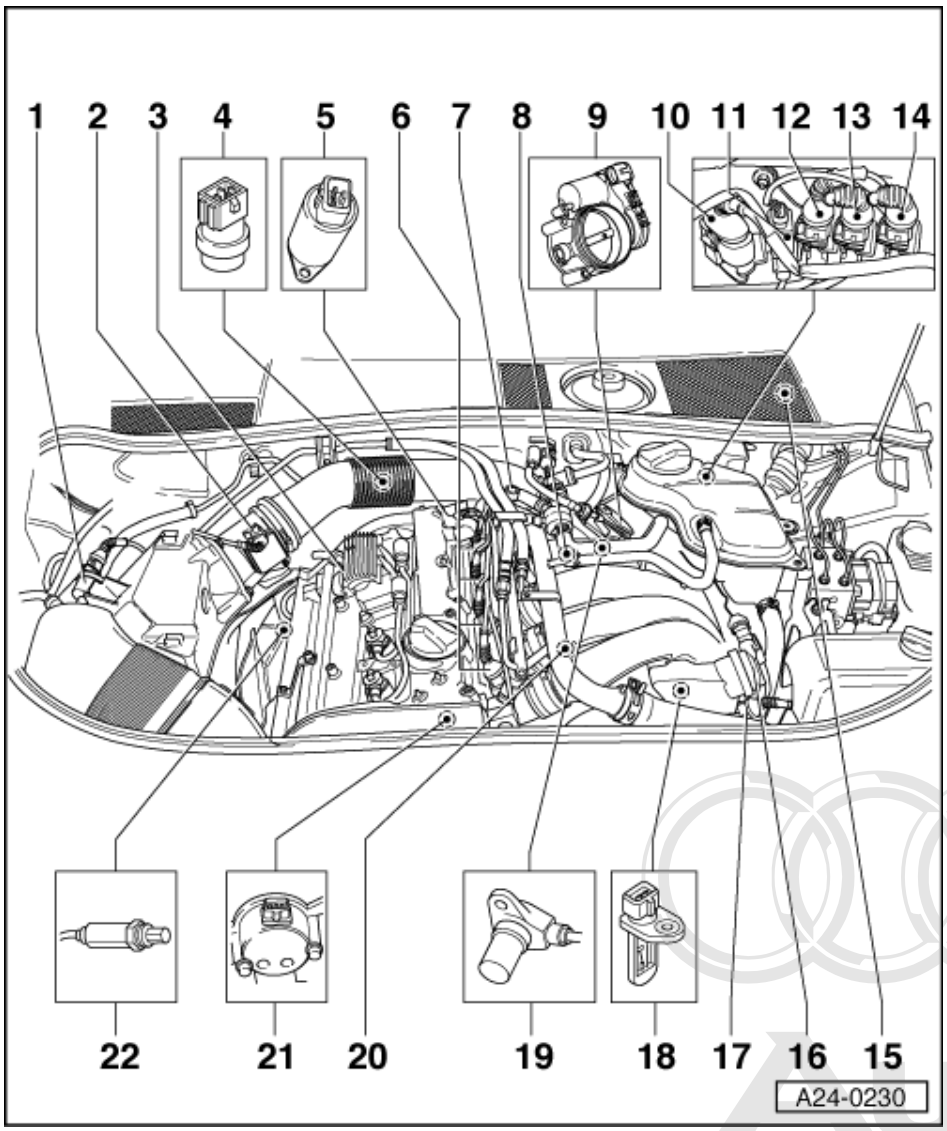

6 Injectors (N30, N31, N32, N33)
7 Fuel pressure regulator
8 Knock sensor 2 (G66)
9 Throttle valve control part (J338)
- With throttle valve drive (G186), angle sender for throttle valve drive (G187) and angle sender 2 for throttle valve drive (G188)

10 4-pin connector for Lambda probe
11 4-pin connector for oil sensors
12 3-pin connector for enginespeed sender (G28)

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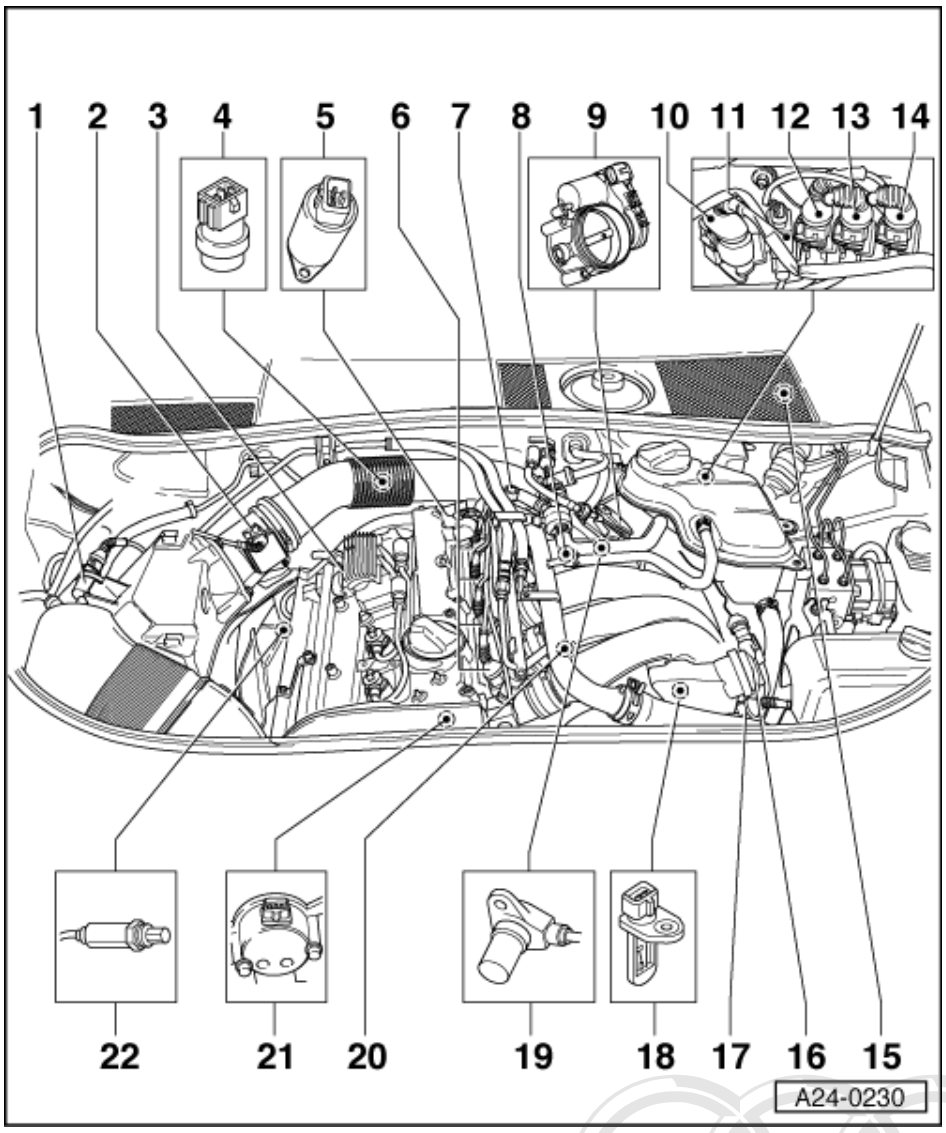

13 3-pin connector for knock sensor 2 (G66)
14 3-pin connector for knock sensor 1 (G61)
15 Electronics box
- Engine control unit
- Altitude sender

16 Vacuum unit for intake manifold change-over function
17 Intake manifold change-over valve (N156)
18 Intake air temperature sender (G42)
19 Engine speed sender (G28)
20 Knock sensor 1 (G61)
21 Hall sender (G40)
22 Lambda probe (G39) with lambda probe heating (Z19)

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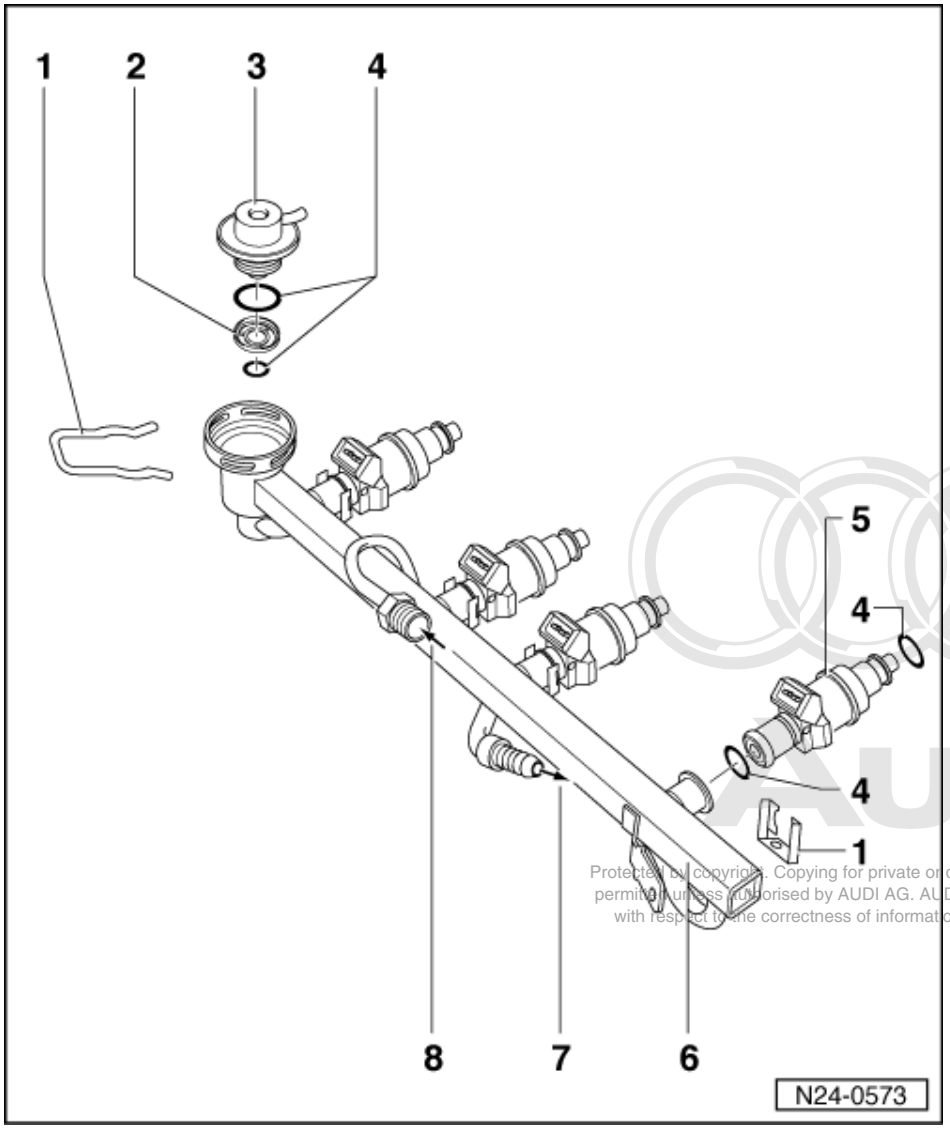
1.6 - Dismantling and assembling fuel rail with injectors



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1 Retaining clip
- Ensure seated correctly at injector and fuel rail

2 Strainer

3 Fuel pressure regulator

4 O ring
- Renew if damaged

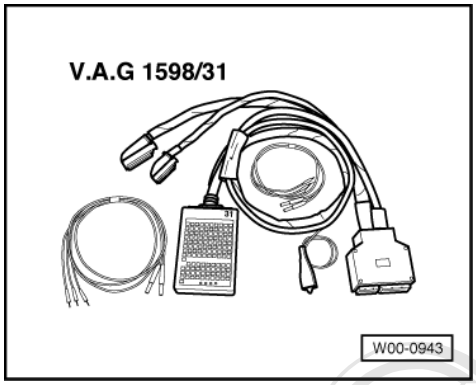
5 Injectors (N30...N33)

6 Fuel rail

7 Return flow connection

8 Supply connection

1.7 - Testing wiring and components with test box V.A.G 1598/31



Notes:

- -> The test box V.A.G. 1598 / 31 is designed so it can be simultaneously connected to the control unit wiring harness and to the control unit itself.
- This has the advantage of enabling the engine management system to remain fully operational even with the test box connected (for example, when testing signals while the engine is running).
- The instructions for performing the individual tests indicate whether or not the engine control unit itself also needs to be connected to the test box.

- 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 test box 1598/31, always use the adapter leads from adapter set V.A.G 1594.

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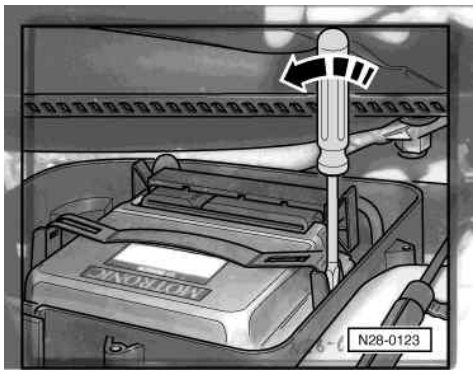
Warning!
To prevent damage to the electronic components, switch to the respective measuring range before connecting the measuring cable and observe the test prerequisites.

Connecting test box V.A.G 1598/31



- Switch off ignition.
- Remove cover of protective housing for control units.
- -> Carefully lever off the retainer bar with a screwdriver -arrow-.
- Then release connectors on control unit and pull off.

- Connect test box V.A.G 1598/31 to connector on wiring harness. Also connect the earth clamp on the test box to the battery negative terminal. The instructions for performing the individual tests indicate whether or not the engine control unit itself also needs to be connected to the test box.
- Carry out test as described in the repair instructions.

After installing the engine control unit, carry out the following operations:

- After re-connecting the engine control unit, perform adaption of engine control unit to throttle valve control part
=>Page 112 .

- In vehicles with automatic gearbox, perform adaption of kick-down switch => Page 120 .

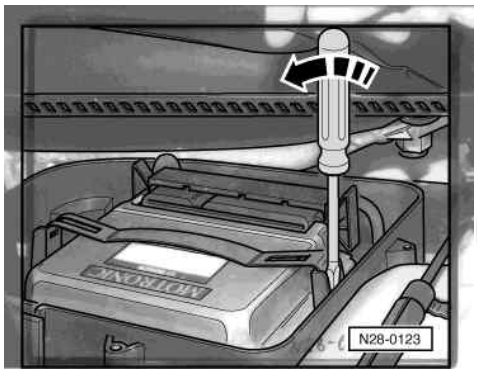
1.8 - Renewing engine control unit

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

- Switch off ignition.
- Remove cover of protective housing for control units.



- -> Carefully lever off the retainer bar with a screwdriver -arrow-.
- Then release connectors on control unit and pull off.
- Lift out the old engine control unit and insert the new one.

Installing engine control unit

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Installation is performed in the reverse sequence.

After installing the engine control unit, carry out the following operations:

- Perform adaption of immobilizer to engine control unit

=> Electrical system; Repair group 01; Self-diagnosis of immobilizer; Adaptation procedure when engine control unit is replaced Self-diagnosis of immobilizer Adaptation procedure when engine control unit is replaced

- Code the new engine control unit
  => Page 23
- Perform adaption of throttle valve control part (J338)
  => Page 112 .
- On vehicles with cruise control (identifiable from the steering column switch), activate the cruise control function in the engine control unit.

=> Electrical system; Repair group 01; Self-diagnosis of cruise control system (CCS). Self-diagnosis of cruise control system (CCS).

- An adaption from kick-down switch has to be performed in vehicles with an automatic gearbox => Page 120 .
- Interrogate fault memory and erase if necessary
  => Page 4

1.9 - Testing idling speed

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 (vehicles with automatic gearbox)

Notes:

- The idling speed cannot be adjusted.
- The idling speed is tested during the basic setting of the engine.
- During the basic setting of the engine the air conditioner compressor is automatically switched off and the solenoid valve for the activated charcoal filter (ACF valve) is closed.

Testing idling speed

- 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 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).

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Warning!
The electric radiator fan should not be running.

-> Indicated on display:

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

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

-> Indicated on display:

```
Basic setting
Enter display group number XXX
```

- Press keys 0, 5 and 6 for Display Group 56 and confirm entry with the Q key.

-> Indicated on display:
(1...4 = display zones)

```
System in basic setting      56
     1     2     3     4
```

- Check whether the engine speed shown in display zone 1 (actual engine speed) is within the specified tolerance range (810...910 rpm).

	Display zones			
	1	2	3	4
Display Group 56: Idling speed stabilisation with engine idling at normal operating temperature				
Display	xxx rpm	xxx rpm	x.x %	X X X X X
Indicates	Engine speed (actual)	Engine speed (specified)	Idling speed control - torque change	Operating status

	Display zones			
Range	min.: 750 rpm max.: 6800 rpm	min.: 750 rpm max.: 6800 rpm	min.: -5 % max.: 5 %	
Specification	810...910 rpm	860 rpm	x.x %	0 0 0 0
Note	If readout does not meet specification =>Page 44			For explanation of figures in display => Page 44

Note:

- The value shown in display zone 1 is the actual engine speed.
- The value shown in display zone 2 (specified engine speed) is a theoretical value calculated by the engine control unit.

- When the engine is idling the engine control unit tries constantly to adjust the actual engine speed so that it matches the specified value.
- This means that the actual engine speed when idling should always be approximately the same as the specified engine speed.
- Display zones 3 and 4 provide additional information which is not relevant when checking the idling speed.

- Press ⇒key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- If the readout does not match the specification, interrogate fault memory again.

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 (marked with dots):

- Solenoid valve for activated charcoal filter constantly open
  Test =>Page 101 .
- Perform adaption of throttle valve control part =>Page 112 .

Relevance of figures in 3-digit readout for Display Group 56

x	x	x	x	x	Display zone 4
				X	AC compressor off/on 0 = AC compressor off 1 = AC compressor on
			X		Selector lever in P or N 0 = Selector lever in P or N 1 = Selector lever in 2/3/4/R/D
		X			Not used
	X				Not used
X					Not used

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1.10 - Checking fuel pressure regulator and holding pressure

Test conditions

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

Note:

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

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

- Briefly open fuel tank filler cap (to release pressure).

- Cover pressurised union with a cloth.

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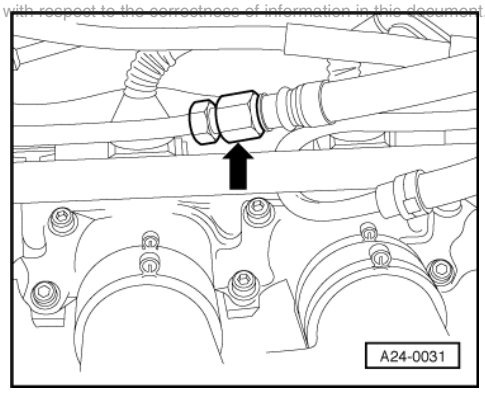
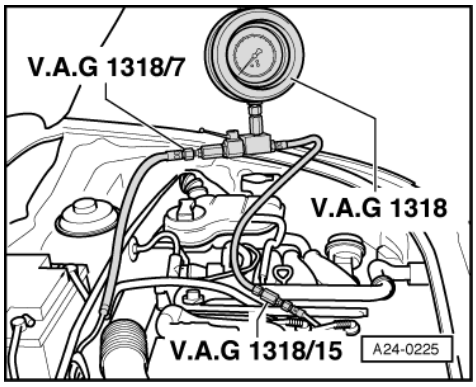
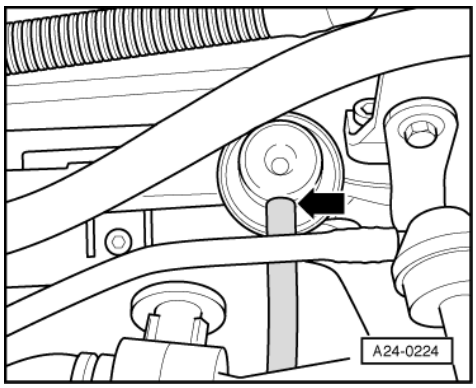


- -> Open the union -arrow- and catch escaping fuel with a cloth.



- Connect pressure gauge V.A.G 1318 into fuel supply pipe using adapters 1318/7 and 1318/15.
- -> Open cut-off valve on pressure gauge (valve handle points in direction of flow).
- Start the engine and run at idling speed.
- Measure fuel pressure.

  Specification: approx. 3.5 bar



- -> Pull vacuum hose -arrow- off fuel pressure regulator.

Note:

If fuel flows out at the vacuum connection on the fuel pressure regulator during the following pressure test, fit a new fuel pressure regulator.

The fuel pressure must increase to approx. 4.0 bar.

If specification is not obtained:

- Replace the fuel pressure regulator as a trial measure and repeat the 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.

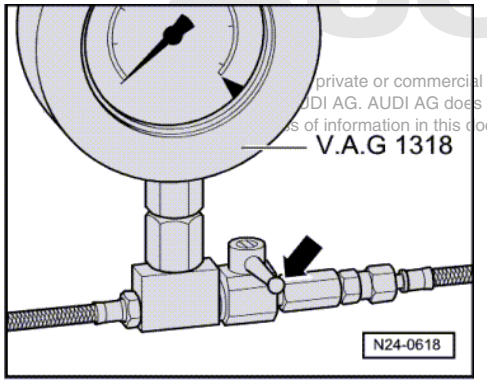
If specification is obtained:

- Reconnect vacuum hose.
- Switch off ignition.
- Observe pressure drop on gauge.

After 10 minutes the remaining pressure should be at least 2.5 bar.

If the holding pressure drops below 2.5 bar:

- Start the engine and run at idling speed.



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- -> Switch ignition off after the pressure has built up. At the same time, close cut-off valve on pressure gauge V.A.G 1318 (lever at 90° to throughflow direction).
- Observe pressure drop on gauge.

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

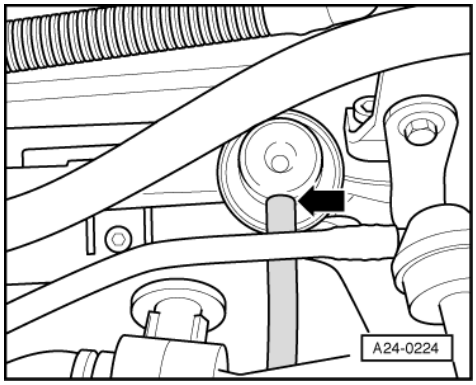
- Fuel pressure regulator defective
- Injectors leaking
- Unions on pressure gauge downstream of cut-off valve leaking

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

=> 4-cylinder Engine, Mechanics; Repair Group 20; Removing and installing fuel pump Removing and installing fuel pump

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

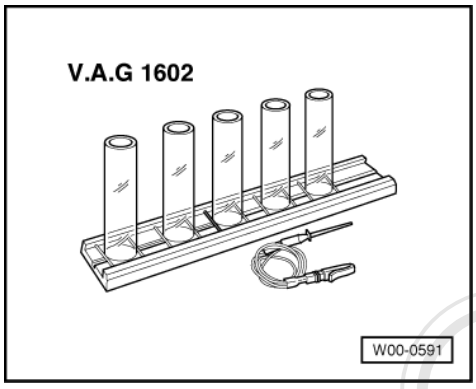


Test conditions

- Fuel pressure OK; testing => Page 44 .

Testing injectors for leaks

- -> Pull vacuum hose -arrow- off fuel pressure regulator.
- Unplug connectors from injectors and from Hall sender.
- Unbolt fuel manifold from intake manifold and pull it upwards and off the intake manifold together with the injectors.



- -> Place the injector which is to be tested into a measuring glass from injection quantity tester V.A.G 1602.
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

- Bridge contacts 1 and 65 on the test box using test leads from adapter set V.A.G 1594 A. (This creates an earth connection to one side of the fuel pump relay coil.)
- Switch on ignition.

Note:

Once the ignition has been switched on the fuel pump runs continuously, even if the engine is not running. This is because when the ignition is switched on the fuel pump relay receives a positive voltage supply via the central electrics. The negative voltage supply for the fuel pump relay comes via the cable bridge on the test box.

- 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 (turn off ignition) and renew the faulty injector.

Checking injection quantity

- Place the injector which is to be tested into a measuring glass from injection quantity tester V.A.G 1602.

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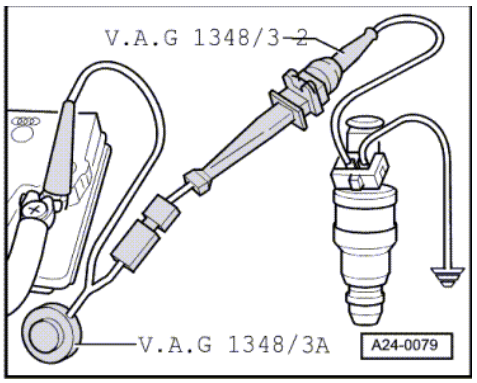


- -> Connect one of the injector contacts to engine earth using test lead and crocodile clamp from V.A.G 1594 A.
- Connect second injector contact to positive using remote control V.A.G 1348/3 A, adapter cable V.A.G 1348/3-2 and auxiliary cable.
- Switch on ignition.
  - The fuel pump should run.
- Activate remote control V.A.G 1348/3A for 30 seconds.
- Carry out measurement on all injectors.
- Once all four injectors have been actuated, place measuring glasses on a level surface.

  Specification: 85...105 ml at each injector

If none of the injectors delivers the specified quantity:
- Test fuel pressure => Page 44 .

If only one injector fails to deliver the specified quantity:
- Renew the affected injector.

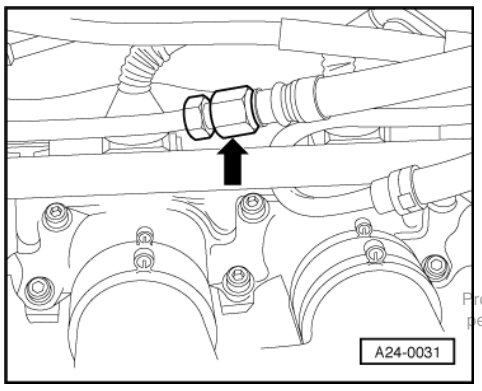
Note:
When checking the injection quantity, also check the spray pattern. The spray pattern should be the same for all the injectors.

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.
- Check to make sure that the retainer clamps are properly seated.

1.12 - Removing and installing injectors

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



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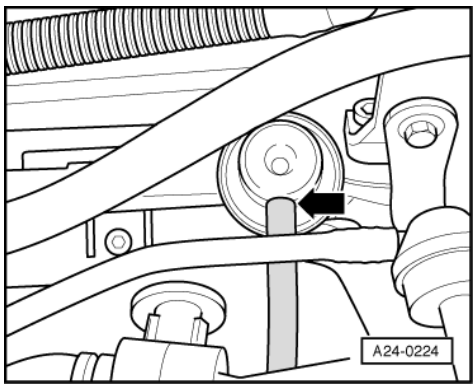
Removing injectors

- Briefly open fuel tank filler cap (to release pressure).
- Cover pressurised union with a cloth.
- -> Open the union -arrow- and catch escaping fuel with a cloth.



- -> Pull vacuum hose -arrow- off fuel pressure regulator.
- Unplug connectors from injectors and from Hall sender.
- Unbolt fuel manifold from intake manifold and pull it upwards and off the intake manifold together with the injectors.
- Pull retainer clip off connection between injector and fuel manifold, then remove injector from fuel manifold.

Installing injectors

Notes:

- Renew O rings.
  (When renewing the front O ring, do not remove the plastic cap on the injector head. The O ring should be pulled off over the plastic cap.)
- Make sure that the retainer clips are properly fitted.

- Lightly lubricate O rings with clean engine oil.

- Insert injectors vertically as far as they will go into the fuel manifold and secure with retainer clips.
- Position fuel manifold with injectors (secured by retainer clips) on intake manifold and press in evenly all round so that it is fully seated.
- Insert securing bolts, press fuel manifold lightly against intake manifold and tighten bolts.

Remaining steps of installation procedure are as per removal procedure in reverse sequence.

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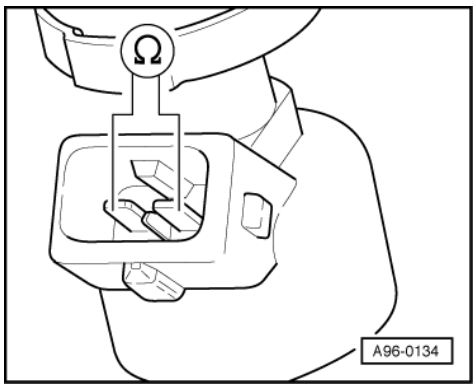
1.13 - Checking injectors

Electrical testing of injectors



- Remove plug connector from the injector which is to be tested.
- -> Connect hand-held multimeter to injector (resistance measurement range).

  Specification: 11...18 ω

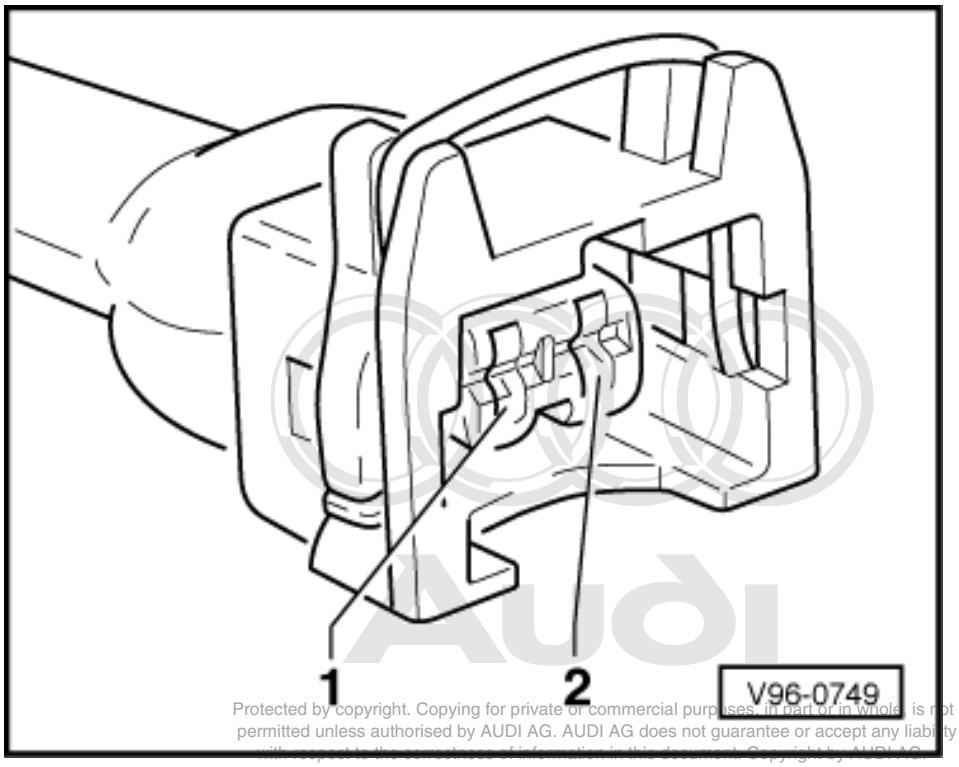
If the specification is not obtained:

- Renew injector

If specification is met:

- Test voltage supply
  => Page 50 .

Testing voltage supply



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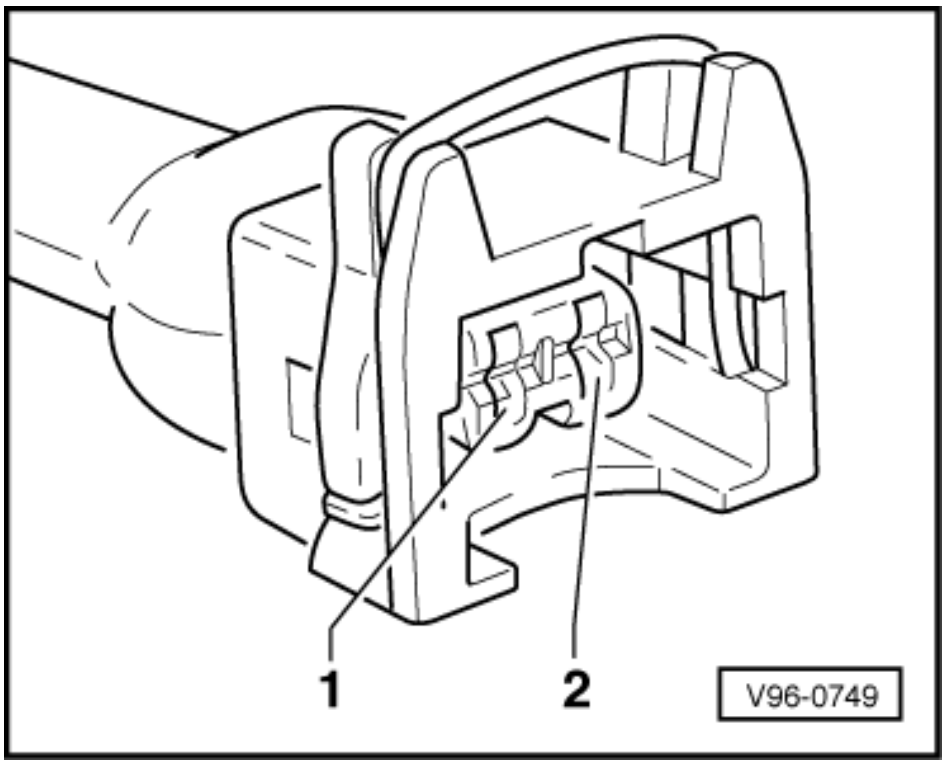
- Remove plug connector from the injector which is to be tested.
- -> Connect diode test lamp (for measuring voltage) between earth and socket 1 of connector.
- Operate starter for a few seconds (the engine can be allowed to start).

  Specification: The diode test lamp should light up.

If the diode test lamp lights up:

- Check wiring connections => Page 51 .

If the diode test lamp does not light up:

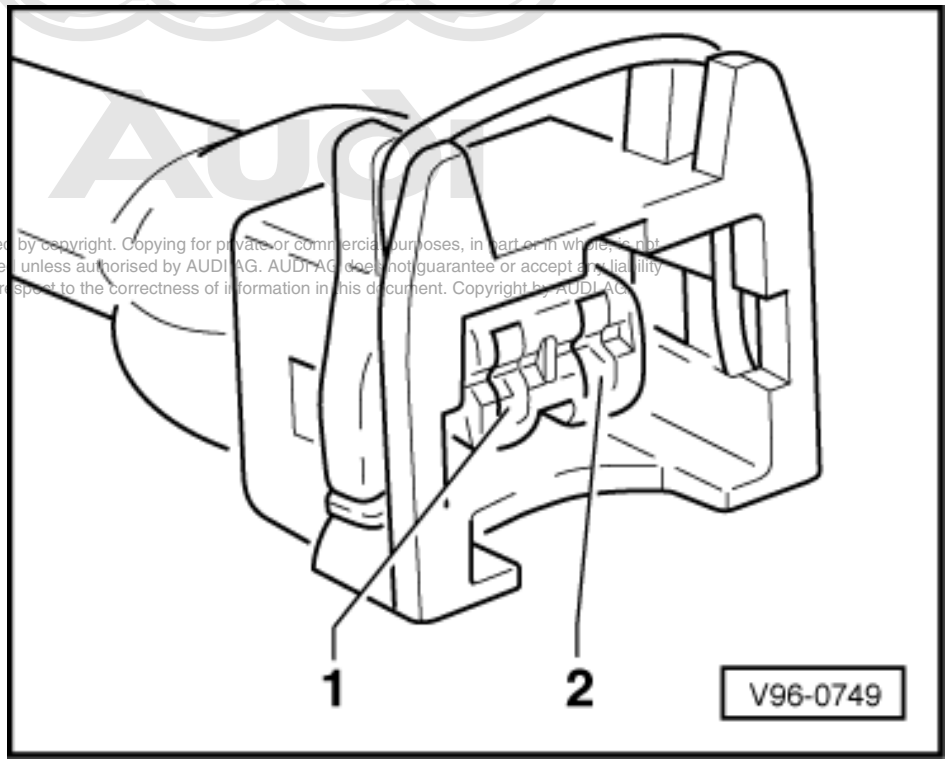


- -> Test for continuity in the wiring from socket 1 to fuel pump relay via fuse for injectors. If necessary, rectify open circuit.

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

Checking wiring connections

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



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- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .
- -> Test for open circuit and short to positive or earth in the following wiring connections:

Cylinder	2-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
1	2	96
2	2	89
3	2	97
4	2	88

- Rectify any open/short circuit as necessary.

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

- If wiring connection is OK, renew engine control unit
  => Page 42 .

1.14 - Testing fuel pump relay -J17 and activation

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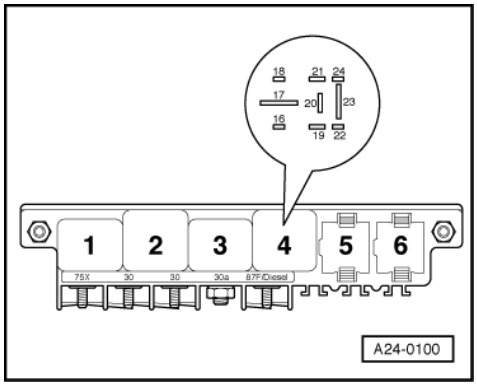
The fuel pump and some of the injection system components are powered via the fuel pump relay -J17.

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

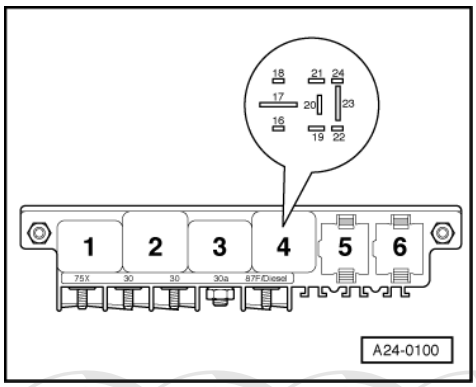


- Battery voltage OK.

Functional test of fuel pump relay

-> Fitting location of fuel pump relay: micro central electrics behind storage compartment on driver's side, relay position 4.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.



- Start final control diagnosis => Page 17 . The fuel pump must be running.

  -> The fuel pump relay should pick up and the fuel pump should run.

If the relay does not pick up:

- Test activation of fuel pump relay=>Page 53 .

If fuel pump does not run:

- Test activation of fuel pump and other components =>Page 55 .

Testing activation of fuel pump relay

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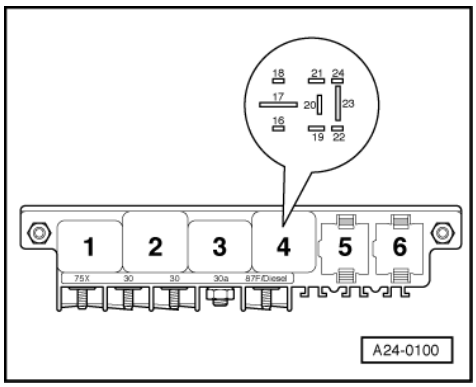
- Switch off ignition.
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .
- Connect sockets 65 and 2 of test box to each other using auxiliary cable from V.A.G 1594.
- Switch ignition on.

  Specification: the fuel pump relay (relay position 4) should pick up.

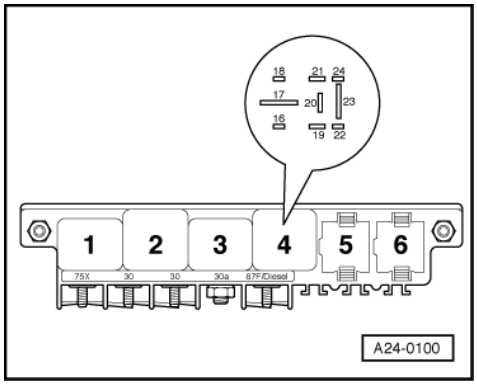


If the relay picks up now but not during the final control diagnosis:

- Replace engine control unit =>Page 42 .

If the relay does not pick up:

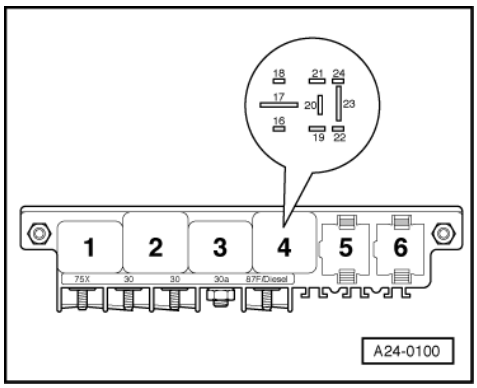
- Switch off ignition.
- -> Disconnect fuel pump relay from relay panel (relay position 4).



- -> Connect hand-held multimeter (voltage measurement range) between earth and contact 19 on relay panel.
- Switch ignition on.

  Specification: approx. battery voltage

If the specification is not obtained:



- Check the wiring.

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

If the specification is obtained:

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

Micro central electrics on left of driver's footwell, relay position 4 Contact	Test box V.A.G 1598/31 Socket
16	65

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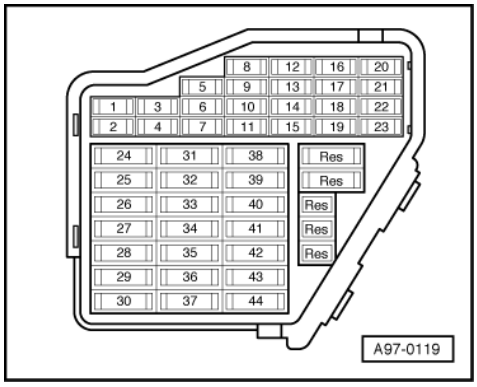


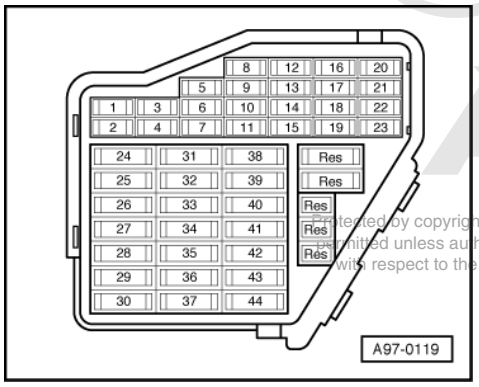
- Rectify any open/short circuit as necessary.

If no wiring fault is detected:

- Fit a new fuel pump relay -J17.

Testing activation for fuel pump and other components

- -> Remove fuses 28 and 29 (=>current flow diagram).



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- Start final control diagnosis => Page 17 .
- -> Connect hand-held multimeter (voltage measurement range) between earth and either left or right contact on the following fuses (only one contact on each fuse is live):

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

If the specifications are not obtained:

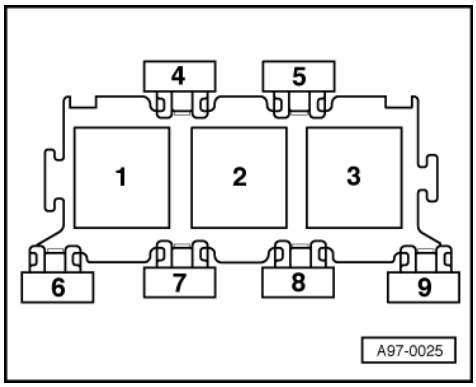
- Check wiring

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

If no wiring fault is detected:

- Fit a new fuel pump relay -J17.

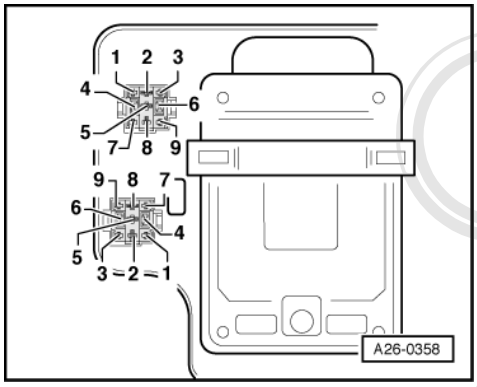
1.15 - Testing Motronic current supply relay -J271



-> Fitting location of current supply relay: relay position 3 in electronics box in plenum chamber.

Test activation of current supply relay

- Switch off ignition.
- Remove cover of electronics box in plenum chamber.
- Pull current supply relay out of relay carrier.
- Connect test box 1598/31 to wiring harness of engine control unit. Do not connect engine control unit itself => Page 41 .



- Test for open circuit or short circuit in the following wiring connections.

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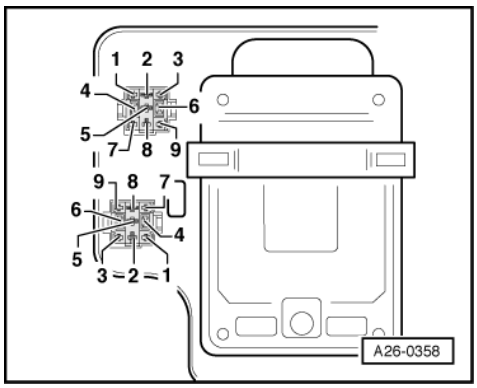
Test box V.A.G 1598/31, socket	Current supply relay, Contact
21	4 => Current flow diagrams, Electrical fault finding and Fitting locations

Wiring resistance: not more than 1.5 Ohm

- Rectify any open circuit or short circuit as necessary.

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

If wiring is OK:



- Test voltage supply of current supply relay.

Testing voltage supply

- Switch off ignition.
- -> Connect hand-held multimeter (voltage measurement range) between earth and contacts 2 and 9 of relay socket.

Specification: approx. battery voltage

If the specification is not attained, check voltage supply according to current flow diagram.

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

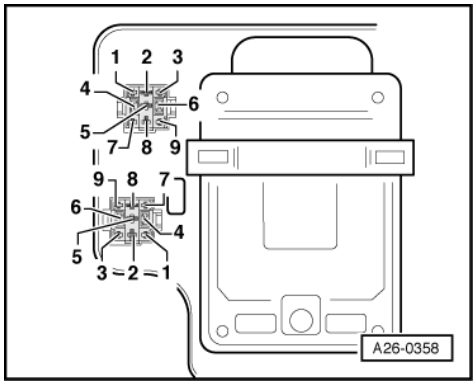
If the specification is attained, test wiring connection between current supply relay and engine control unit.

Testing wiring connection between current supply relay and engine control unit

- Test fuse 29 (see current flow diagram).

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

If fuse is OK:



- Test for open circuit or short circuit in the following wiring connections.

Test box V.A.G 1598/31, socket	Current supply relay, Contact
121	6 => Current flow diagrams, Electrical fault finding and Fitting locations

Wiring resistance: not more than 1.5 Ohm

- Rectify any open circuit/short circuit as necessary.

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

If no fault has been found during any of the tests, renew current supply relay -J271.

1.16 - Testing air mass meter -G70

Test conditions

- Coolant temperature at least 80 °C
- Electrical consumers switched off (radiator fan must not run during test)
- Air conditioner switched off
- Fuse for air mass meter OK

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

Testing operation

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2) When doing this the engine must be idling.

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-> Indicated on display:

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

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

Note:

During the basic setting the engine control unit closes the activated charcoal filter solenoid valve (ACF valve - N80) and switches off the air conditioner compressor.

-> Indicated on display:

```
Basic setting      Q
Enter display group number      XXX
```

- Press keys 0, 0 and 2 for Display Group 02 and confirm entry with the Q key.

-> Indicated on display:

```
System in basic setting 2
     1     2     3     4
```

- Check display values for engine load.

	Display zones			
	1	2	3	4
Display Group 2: Intake air mass at idling speed with engine at normal operating temperature				
Display	xxx rpm	**xx.x %**	x.x ms	**xxx.x g/s**
Indicates	Engine speed (in steps of 40 rpm)	**Load**	Average injection period	**Air mass**
Range	min.: 750 rpm max.: 6800 rpm	**min.: 0 % max.: 120.0 %**	min.: 0 ms max.: 100 ms	**min.: 0 g/s max.: 360.0 g/s**
Specification	810...910 rpm	**15.0....25.0 %**	1.0....4.0 ms	**2.0....4.5 g/s**
Note	---	---	**If specification is not met: =>reading display zone 3, Page 58**	**If specification is not met: =>reading display zone 4, Page 59**

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If the specification is obtained:

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

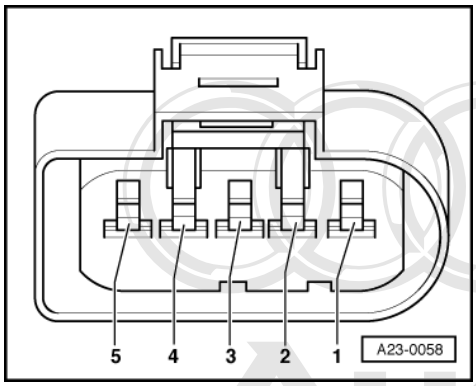
Reading Display Group 002

Display zone 3	Possible cause of fault	Fault remedy
Less than 1.0 ms	- Lower values can only occur when vehicle is on overrun	
More than 4.0 ms	- Load on engine due to ancillaries	- Eliminate load (air conditioner, power steering, alternator)
	- Rough idling (engine not running on all cylinders)	- Test spark plugs Test injectors => Page 49
	- Throttle valve control part -J338 defective	- Test throttle valve control part => Page 111

Reading Display Group 002

Display zone 4	Possible cause of fault	Fault remedy
Less than 2.0 g/s	- Large quantity of unmetered air between intake manifold and air mass meter - Voltage supply to air mass meter or wiring to - engine control unit	- Rectify air leaks (unmetered air) Test voltage supply and wiring => Page 59
More than 4.5 g/s	- Load on engine due to ancillaries	- Eliminate load (air conditioner, power steering, alternator)
	- Voltage supply to air mass meter or wiring to - engine control unit	- Test voltage supply and wiring => Page 59

Testing power supply to air mass meter



- Unplug connector from air mass meter.
- -> Connect hand-held multimeter (voltage measurement range) between engine earth and socket 2 of connector.
- Operate the starter briefly.

Specification: approx. battery voltage

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Note:

The air mass meter receives its voltage supply via the fuel pump relay.

If the reading does not match the battery voltage:

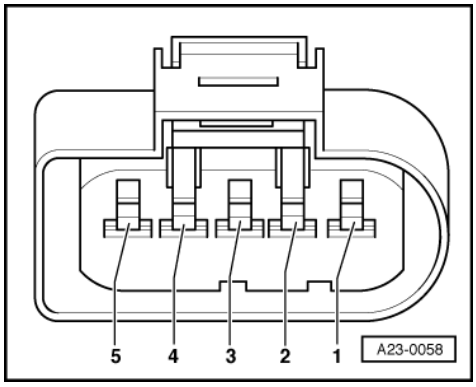
- Test for open circuit or short to earth in wiring between fuel pump relay and socket 2 on connector via fuse. Repair if necessary.

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

If specification is met:

- Test earth connection from control unit => Page 59 .

Testing earth connection



- -> Connect hand-held multimeter (voltage measurement range) between sockets 2 and 3 of connector.
- Operate the starter briefly.

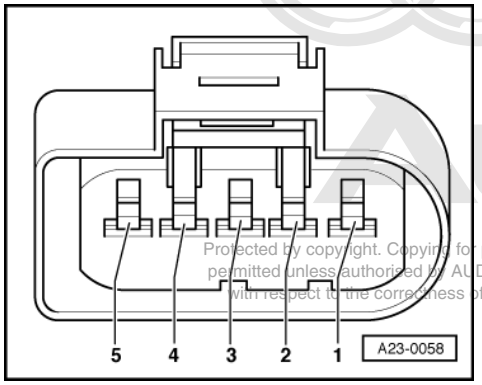
  Specification: approx. battery voltage

Note:

Socket 3 on the connector is the earth connection from the engine control unit.

If the specification is not attained:

- Test the wiring => Page 60 .



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- -> Connect hand-held multimeter (voltage measurement range) between sockets 3 and 4 of connector.
- Switch ignition on.

  Specification: approx. 5 V

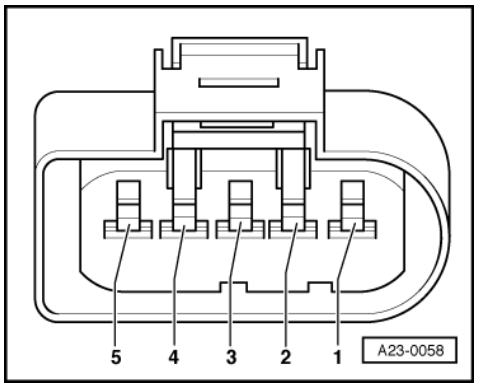
If the specification is not attained:

- Test the wiring => Page 60 .

Testing wiring for air mass meter

Note:

The signal wire is also tested in the wiring test.



- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .
- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector for air mass meter -G70, socket	Test box V.A.G 1598/31, socket
3	27

Connector for air mass meter -G70, socket	Test box V.A.G 1598/31, socket
4	53
5 (signal wire)	29

- Rectify short circuit or open circuit if necessary.

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

- Test all wires for short circuits with each other.

Connector for air mass meter -G70, socket	Test box V.A.G 1598/31, socket
3	53 and 29
4	27 and 29
5 (signal wire)	27 and 53

Specification: infinity ω(open circuit)

- If the wiring and the power supply are OK, fit a new air mass meter -G70.

1.17 - Testing intake air temperature sender -G42

Fitting location of sender and connector
=> Page 36 .

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.

-> 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      HELP
Input display group number XXX
```

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- Press keys 0, 0 and 4 to select Display Group 4 and confirm entry with Q key.

-> Indicated on display:
(1...4 = display zones)

```
Read measured value block 4
     1     2     3     4
```

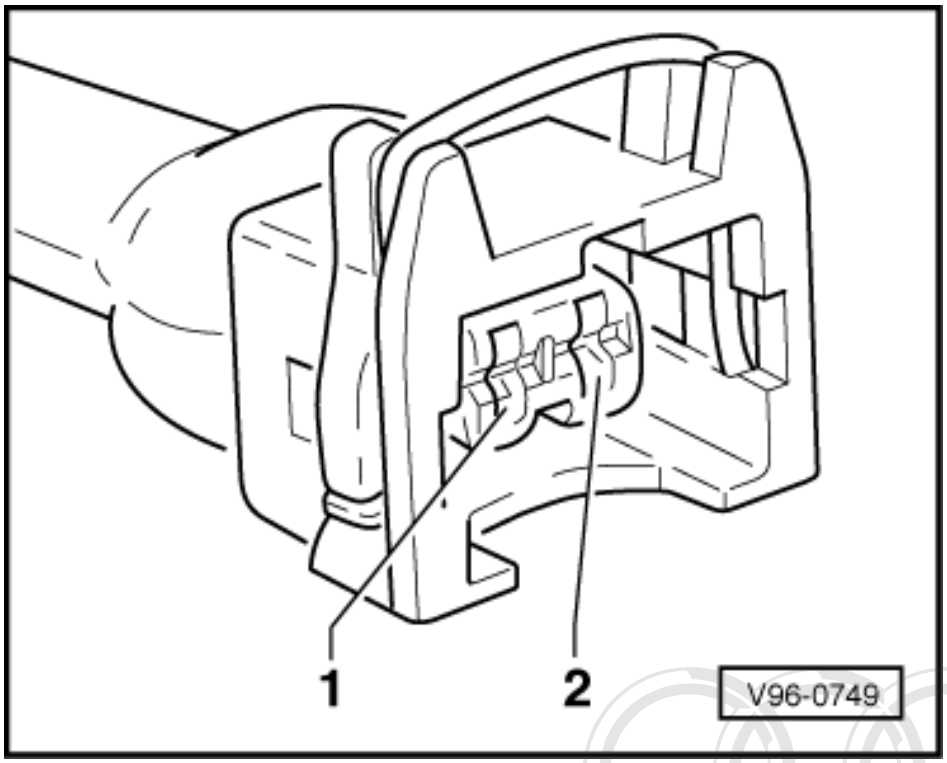
- Check display value for intake air temperature sender(display zone 4):

	Display zones			
	1	2	3	4
Display Group 4: Intake air temperature with engine idling				
Display	xxxx rpm	xx.xxx V	xxx.x °C	**xxx.x °C**
Indicates	Engine speed	Battery voltage	Coolant temperature	**Intake air temperature**
Range	min.: 750 rpm max.: 6800 rpm	min.:0.000 V max.: 15.000 V	min.: -40.0 °C max.: 120.0 °C	**min.: -40.0 °C** **max.: 120.0 °C**

	Display zones			
Specification	810 ... 910 rpm	10.000...14.500 V	80.0...110.0 °C	Between ambient temperature and 120 °C 1)
Note				If the display shows a temperature that differs excessively from surrounding temperature, test wiring => Page 62

Testing wiring

- Switch off ignition.
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .



- -> Test wiring between connector for intake air temperature sender...
- ... and engine control unit for open circuit and short circuit.
- Test for short circuits between the wires.

2-pin connector on wiring harness, socket	Test box 1598/31, socket
1	108

Specification: infinity ω(no connection)

If no fault is detected:

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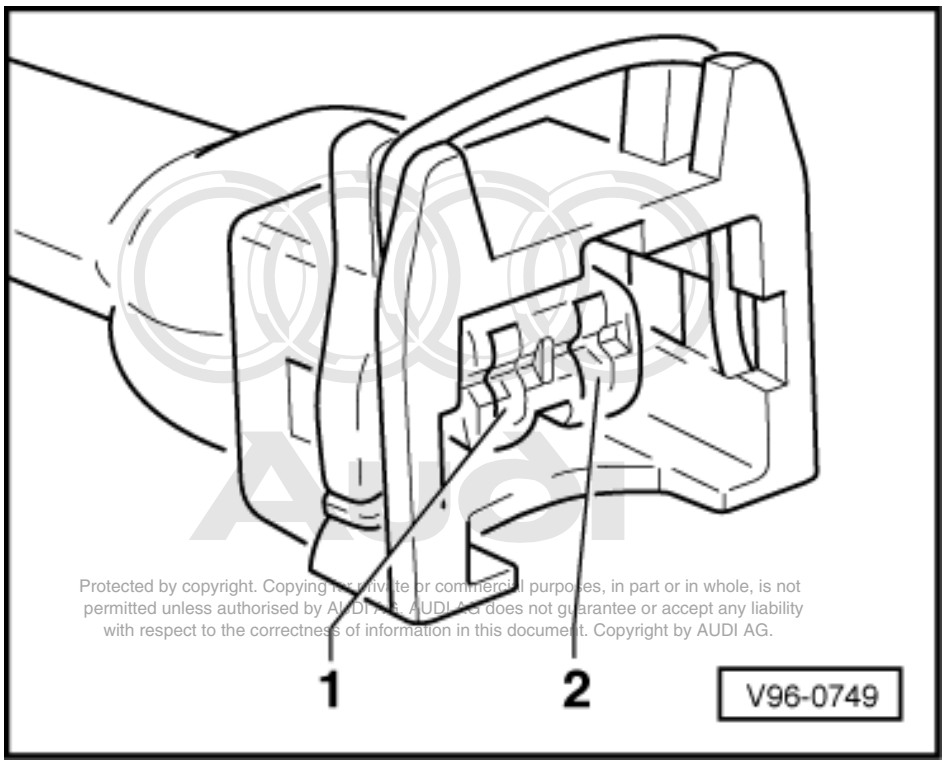

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- -> Test for open circuit and short to positive or earth in the following wiring connections:

2-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
1	85
2	108

Resistance in wiring: max. 1.5 ω

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

If no fault is detected:

- Fit a new intake air temperature sender (G42).

1.18 - Testing coolant temperature sender -G62

Fitting location of coolant temperature sender
=> Page 36 .

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

-> 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
```

- Press keys 0, 0 and 4 to select Display Group 4 and confirm entry with Q key.

-> Indicated on display:

```
Read measured value block 4
     1     2     3     4
```

- Check display readout for coolant temperature sender (display zone 3).

	Display zones			
	1	2	3	4
Display Group 4: Coolant temperature with engine idling				
Display	xxx rpm	xx.xxx V	**xx.x °C**	xxx.x °C
Indicates	Engine speed	Battery voltage	**Coolant temperature**	
Range	min.: 750 rpm max.: 6800 rpm	min.: 0.000 V max.: 15.000 V	**min.: -40.0 °C max.: 120.0 °C**	min.: -40.0 °C max.: 120.0 °C
Specification	810 ... 910 rpm	12.000...14.500 Volt	**80.0...105.0 ° C**	Ambient temperature
Note			**-Temperature should rise evenly -If specification is not met, test sender / wiring connections =>Page 64**	

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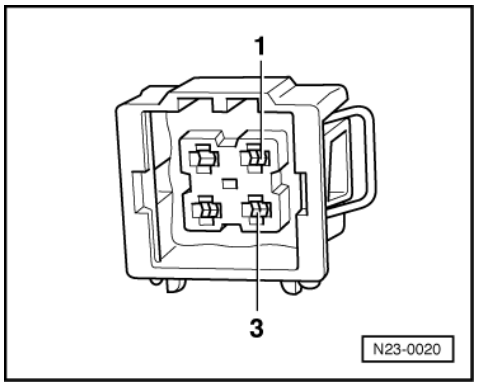
Testing wiring

Fitting location of sender and connector
=> Page 36 .

- Switch off ignition.
- Unplug connector from sender.



- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .
- -> Test for open circuit and short to positive or earth in the following wiring connections:

4-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
1	93
3	108

Resistance in wiring: max. 1.5 ω

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

- Rectify any open/short circuit as necessary.

If no fault is detected:

- Fit a new coolant temperature sender -G62.

2 - Testing lambda control (engine codes:APT, ARG)

2.1 - Testing lambda control (engine codes:APT, ARG)

The lambda probes compare the oxygen content in the air with the residual oxygen content in the exhaust gas and send a voltage signal to the control unit.

The voltage signal for "Mixture too rich" (low residual oxygen) is between about 0.5 and 1.0 V (relative to reference earth).

The voltage signal for "Mixture too lean" (high residual oxygen) is between about 0 and 0.5 V (relative to reference earth).

The transition from "rich" to "lean" is accompanied by a voltage jump from between 0.5 and 1.0 V to between 0 and 0.5 V (relative to reference earth), and vice versa (λ = 1.0).

Because of the sharp voltage jump the lambda control cannot maintain a constant ideal mixture composition of λ = 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); =>Interrogate fault memory.
- Lambda probe damaged by contact spray or similar product. (The contact spray is drawn through the fine cavities in the electrical wiring as a result of thermal 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.)

2.2 - Testing lambda probe and lambda control

Notes:

- For the purposes of fault-finding it is possible to switch off the lambda control by selecting Display Group 99 in "Basic setting" mode and to switch it on again by selecting Display Group 99 in "Read measured value block" mode.
- After selecting Display Group 99 (either in "Basic setting" mode or in "Read measured value block" mode) it is possible to switch back and forth between function 04 ("Basic setting") and function 08 "Read measured value block") by pressing keys 4 and 8 on fault reader V.A.G 1551.
- When exiting the "Basic setting" mode (function 04) the lambda control is automatically switched on again.

Test conditions

- Take the car for a test drive and do not erase the fault memory.
- Coolant temperature at least 85 °C

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Testing operation

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)

When doing this the engine must be idling.

-> Indicated on display:

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

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

Note:

During the basic setting the activated charcoal filter solenoid valve (ACF valve -N80) is closed and the air conditioner compressor is switched off.

-> Indicated on display:

```
Basic setting
Enter display group number XXX
```

- Press keys 0, 3 and 0 to select Display Group 30 and confirm entry with the Q key.

-> Indicated on display:
(1...4 = display zones)

```
Basic setting 30
     1     2     3     4
```

- Check lambda probe status (display zone 1).

Note:

The "Lambda probe status" display indicates the status of the lambda control and lambda probes.

	Display zones			
	1	2	3	4
Display Group 30: Lambda probe status at idling speed (coolant temperature at least 85°C)				
Display	**0 0 0**			
Indicates	**Lambda probe status**			
Range	**0 = off 1 = on**			
Specification	**1 1 1**			
Note	**- Explanation of the display => Page 72**			

Relevance of 3-figure display in Display Group 30

X	X	X	**Display zone 1**
		X	Lambda control 0= inactive 1= active
	X		Lambda probe condition 0= inactive 1= active
X			Status of lambda probe heating 0= inactive 1= active

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Testing lambda probe learned values and lambda control

- Press key C.
- Press keys 0, 3 and 2 to select Display Group 32 and confirm entry with the Q key.

-> Indicated on display:
(1...4 = display zones)

```
Basic setting 32
     1     2     3     4
```

- Take vehicle for a test drive (about 10 minutes).

Important:
Secure fault reader to rear seat and operate from this location. When doing this, always observe the relevant safety precautions => Page 35 .

- Check lambda control
  (display zones 1 and 2):

	Display zones			
	1	2	3	4
Display Group 32: Lambda learned values with engine idling				
Display	xx.x %	xx.x %		
Indicates	Lambda learned value at idling speed (additive)	Lambda learned value at part throttle (multiplicative)		
Range	min.: -25.0 % max.: 25.0 %	min.: -25.0 % max.: 25.0 %		
Specification	-10.0...10.0 % can fluctuate slightly	-10.0...10.0 % can fluctuate slightly		
Note	If readout does not match specification =>Page 68	If readout does not match specification =>Page 68		

If specification is met:

- Press key C.
- Press keys 0, 3 and 3 to select Display Group 33 and confirm entry with the Q key.

-> Indicated on display:
(1...4 = display zones)

```
System in basic setting 33
     1     2     3     4
```

- Check lambda control
  (display zones 1 and 2):

	Display zones			
	1	2	3	4
Display Group 33: Lambda control at idling speed				
Display	xx.x %	x.xxx V		
Indicates	Lambda control	Lambda probe voltage		
Range	min.: -25.0 % max.: 25.0 %	min.: 0.000 V max.: 1.000 V		
Specification	Within -10.0...10.0% range, value should fluctuate by at least 2 %.	Within 0.000...1.000 V range, voltage should fluctuate.		

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	Display zones			
Note	If specification is not met =>Page 68	If specification is not met =>Page 69		

If the readout in display zone 1 does not match the specification, or if the readout does not fluctuate by at least 2 %:

- Take car for a test drive to free lambda probe of any deposits, then repeat the test.

If the readout in display zone 1 still does not match the specification even after the test drive, or if the readout still does not fluctuate by at least 2 %:

- Test the lambda probe heating => Page 69 .
- Test the lambda probe signal wiring and activation => Page 72 .
- Check intake system for air leaks and rectify as necessary.
- Press ⇒key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Switch off the ignition.

Reading Display Group 32

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Display Group 32 Display zones 1 / 2	Possible cause of fault	Fault remedy
Lambda learned values between -10.0 and -25.0 %	- Oil dilution	- Carry out oil change or drive car at moderate to high speeds on out-of-town roads
	- High oil consumption	
	- Air mass meter defective	- Test air mass meter => Page 57
	- Solenoid valve for activated charcoal filter sticking in open position	- Test solenoid valve for activated charcoal filter => Page 101
	- Fuel pressure too high	- Test fuel pressure regulator => Page 44
	- Injector leaking	- Test injectors => Page 49

Reading Display Group 32

Display Group 32 Display zones 1 / 2	Possible cause of fault	Fault remedy
Lambda learned values between 10.0 and 25.0 %	- Unmetered air in intake tract	- Check intake system for leaks and eliminate unmetered air
	- Fuel pressure too low	- Test fuel pressure regulator => Page 44
	- Lambda probe heating defective	- Test lambda probe heating => Page 69
	- Injector not opening or only opening partially	- Test injectors => Page 49
	- Solenoid valve for activated charcoal filter sticking in open position	- Test solenoid valve for activated charcoal filter => Page 101

Reading Display Group 33

Display Group 33 Display zone 2	Possible cause of fault	Fault remedy
Approx. 0.450 V	- Open circuit in wire 4 between lambda probe and control unit - Open circuit in wire 3 between lambda probe and control unit - Lambda probe heating defective - Lambda probe defective	- Test signal wire and activation => Page 72 - Check lambda probe heating => Page 69 Renew lambda probe
Higher than 1.100 V	- Short to positive in wire 4 between lambda probe and control unit	- Test lambda probe wiring => Page 72
Less than 0.100 V	- Short to earth in wire 4 between lambda probe and control unit	- Test signal wire and activation => Page 72

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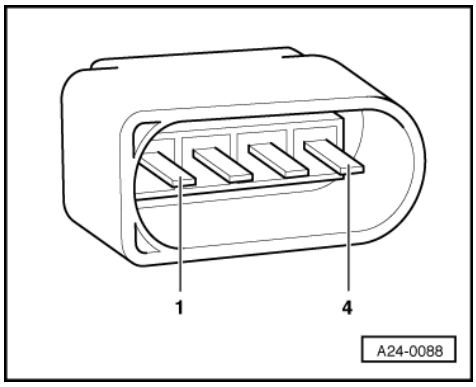
2.3 - Checking Lambda probe heating

Note:

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



- Interrogate fault memory => Page 4 .
- Unplug 4-pin connector for lambda probe -G39.
- -> Connect hand-held multimeter (resistance measurement range) between contacts 1 and 2 of the lambda probe connector using test leads from V.A.G 1594.
- Measure the resistance.

  Specification at room temperature: 2...15 ω

Note:

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

If the specification is not attained:

- Renew the lambda probe.

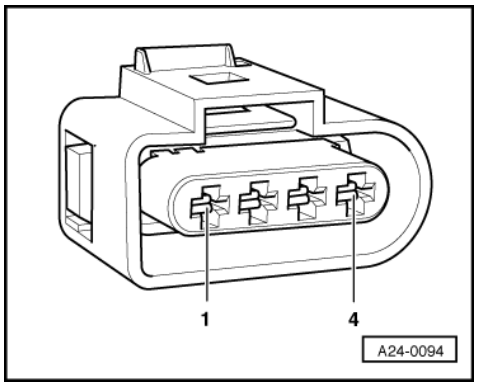
If the specification is obtained:

- Test voltage supply for lambda probe heating

Testing voltage supply for lambda probe heating

- Test fuse for lambda probe heating

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

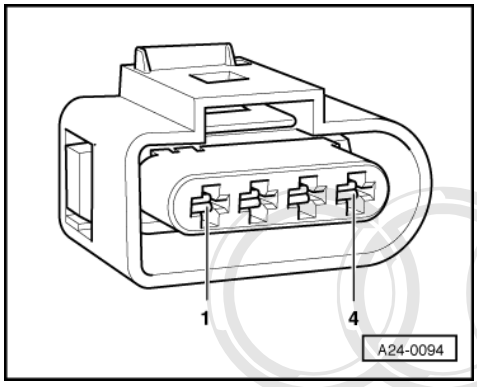


If the fuse is OK:

- -> Connect hand-held multimeter (voltage measurement range) between sockets 1 (positive) and 2 (earth) using test leads from V.A.G 1594.
- Operate the starter briefly.

  Specification: approx. battery voltage

If there is no voltage reading:



- -> Connect hand-held multimeter (voltage measurement range) between socket 1 (positive) and vehicle earth using test leads from V.A.G 1594.
- Operate the starter briefly.

  Specification: approx. battery voltage

If there is still no voltage reading:

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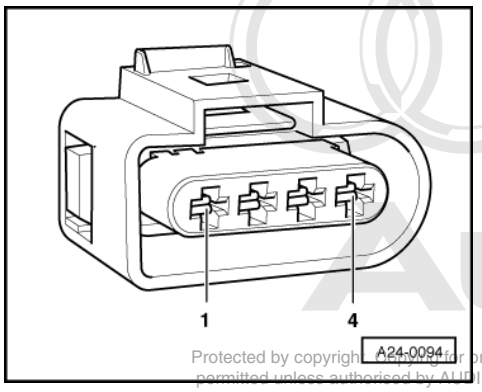
- Test for open circuit and/or short circuit in wiring between fuel pump relay and socket 1 on the lambda probe connector (on wiring harness) via fuse.

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

If the voltage supply is OK:



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- -> Connect hand-held multimeter (voltage measurement range) between socket 2 (switched earth connection from engine control unit) and battery positive terminal using test leads from V.A.G 1594.
- Start the engine.

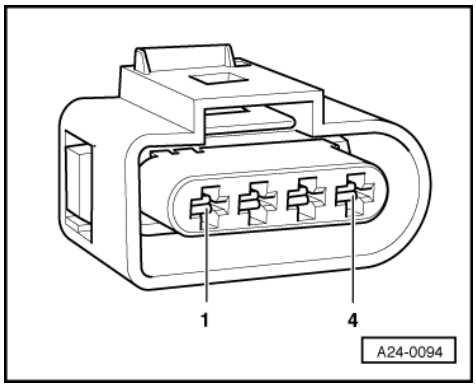
  Specification: approx. battery voltage (fluctuating)

Note:

At certain points in the operating range the engine control unit continuously "switches" the earth connection to the lambda probe heating. In other words, it repeatedly makes and breaks the earth connection at these points. For this reason the voltage reading on the tester may fluctuate.

- Switch off ignition.

If there is no voltage reading:



- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .
- -> Test for open circuits in the following wiring connection:

Connector Socket	Test box V.A.G 1598/31 Socket
2	5

- Rectify any open circuits.

If the wiring is OK but the lambda probe heating still has no earth connection:

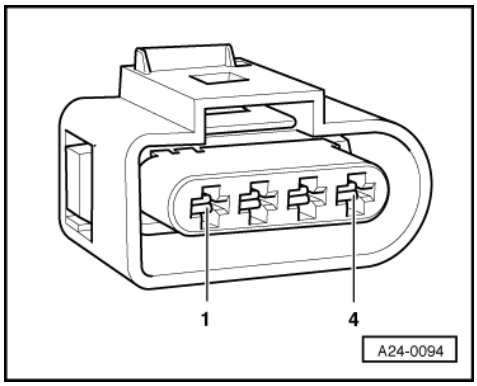
- Fit a new engine control unit => Page 42 .

2.4 - Testing lambda probe signal wiring and activation

Note:

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

- Interrogate fault memory =>Page 4 .



- If a fault in the lambda probe is displayed and the lambda probe heating is OK, unplug the lambda probe connector.
- -> Test voltage by connecting hand-held multimeter V.A.G 1526 (measuring range 2 V) between sockets 3 and 4 of connector on wiring harness.
- Switch ignition on.

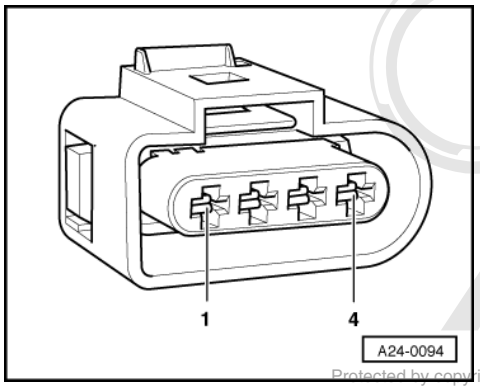
  Specification: 450 ± 50 mV.

If the specification is not attained:

- Test lambda probe wiring
  => Page 72

If the specification is obtained:

- Renew the lambda probe.



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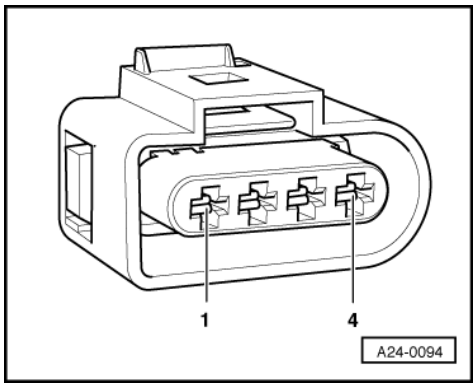
Test lambda probe wiring

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .
- -> Test the following wiring connections for open circuits:

Connector on wiring harness, socket	Test box V.A.G 1598/31 Socket
3	51
4	70



Resistance in wiring: max. 1.5 ω

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

- -> Test wires on 4-pin connector for short circuits with each other.

Connector on wiring harness, socket	Test box V.A.G 1598/31 Socket
4	51

Specification: infinity ω(open circuit)

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

- Test screening wire for short circuit to probe wiring.

Connector on wiring harness, socket	Test box V.A.G 1598/31 Socket
4	32
3	32

Specification: infinity ω(open circuit)

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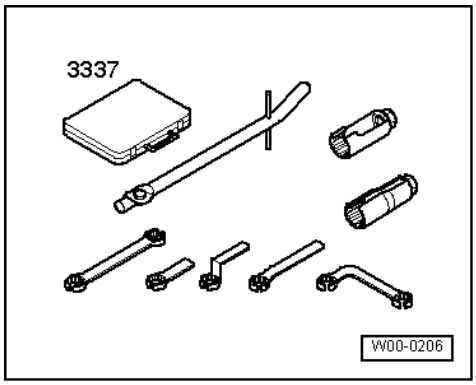
=> Current flow diagrams, Electrical fault finding and Fitting locations binder

If no faults are found in the wiring:

- Fit a new engine control unit -J220
  => Page 42 .

2.5 - Removing and installing lambda probe

Removing lambda probe



- Unplug the lambda probe connector.
- Unscrew the lambda probe using ring spanner 3337/9.

Installing lambda probe

When installing, note the following points:

Notes:

- When installing, the lambda probe wire must be secured in exactly the same position as before in order to avoid contact between the wire and the exhaust pipe.
- The screw thread on the lambda probe is coated with a special paste (high-temperature lubricant). This paste must not be allowed to penetrate the openings on the probe.
- Tightening torque: 55 Nm.

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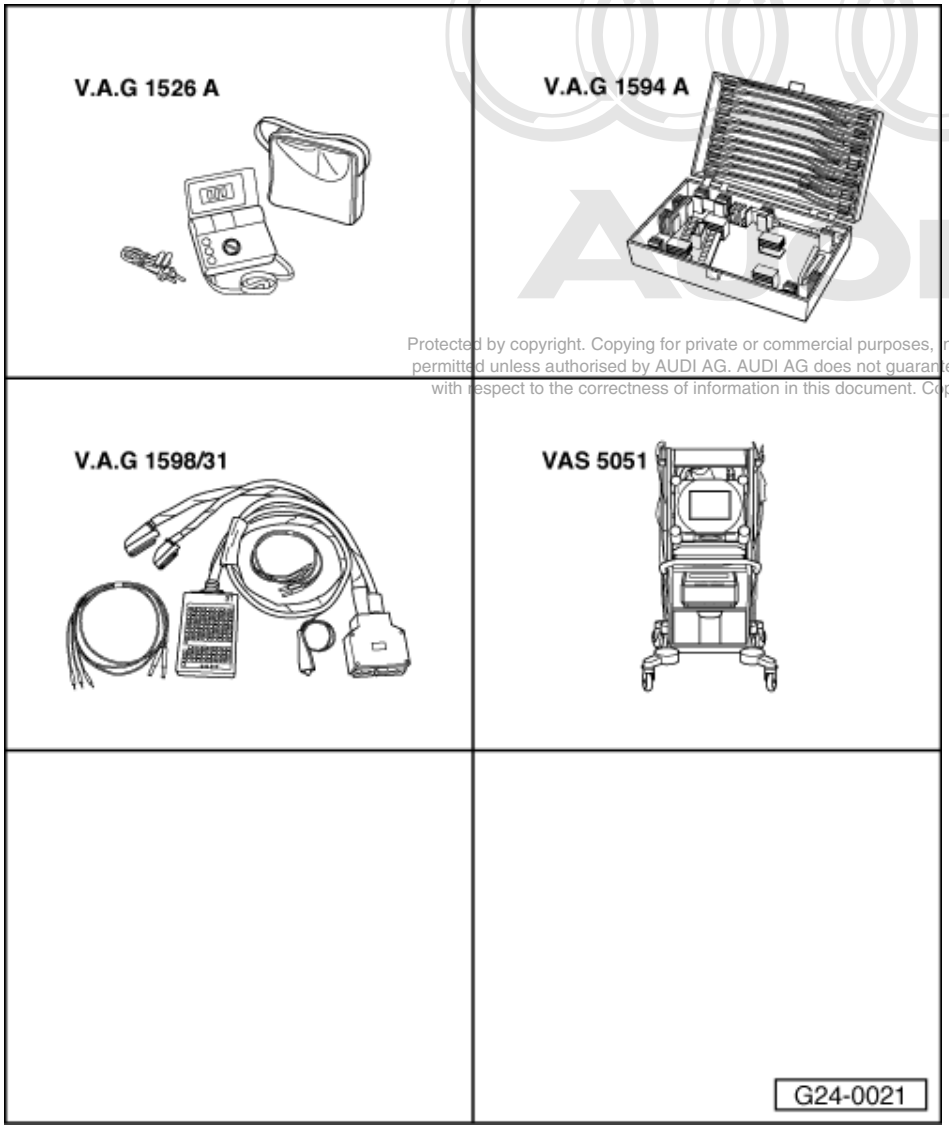
3 - Testing lambda control (engine code: AVV)

3.1 - Testing lambda control (engine code: AVV)



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3.2 - Testing lambda probe and lambda control (before catalytic converter)

Special tools and workshop equipment required

- V.A.G 1526 A
- V.A.G 1594 A
- V.A.G 1598/31
- VAS 5051 with VAS 5051/1

or

- V.A.G 1551 with V.A.G 1551/3 A

Requirements for test:

- Exhaust system free of leaks

- Coolant temperature at least 80 °C

Test sequence

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

-> Indicated on display:

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

- Enter "04" to select "Basic setting" and confirm with Q key.

-> Indicated on display:

```
Basic setting     Q
Enter display group number XXX
```

- Enter "030" to select Display Group 030 and confirm entry with Q key.
- Check readout in display zone 1.

Notes:

- The specified readouts can be obtained more quickly by increasing the engine speed.
- The "lambda probe status" indicates the status of the lambda control and the lambda probes.

	Display zones			
	1	2	3	4
Display Group 030: Lambda probe status				
Display	**X X X**	XXX		
Indicates	**Lambda probe status Bank 1, probe 1**	Lambda probe status Bank 1, probe 2		
Range	**0 = off 1 = on**	0 = off 1 = on		
Specification	**1 1 1**	110		
Note	**If readout does not match specification => Page 76 .**			

Significance of three-digit display in Display group 030			
X	X	X	**Display zones 1 and 2**
		X	Lambda control : 0= inactive; 1= active
	X		Lambda probe condition: 0= inactive; 1= active
X			Status of lambda probe heating: 0= inactive; 1= active

Note:

The first digit in this three-digit display (heating) fluctuates between 0 and 1.

- Do not continue test until display "111" has been indicated in display zone 1 at least once.

Testing lambda probe learned values and lambda control

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- Press C key.

-> Indicated on display:

```
Basic setting     Q
Enter display group number XXX
```

- Enter "032" to select Display Group 032 and confirm entry with Q key.

-> Indicated on display:

```
Basic setting 32
     1     2     3     4
```

- Check lambda learned values in display zones 1 and 2.

	Display zones			
	1	2	3	4
Display Group 032: Lambda learned values				
Display	xx.x %	xx.x %		
Indicates	Lambda learned value, Bank 1, Probe 1 at idling speed (additive)	Lambda learned value, Bank 1, Probe 1 at part throttle (multiplicative)		
Specification	-6.0...6.0 %	-10.0...10.0 %		
Note	If the specification is not attained =>Page 78			

- Press C key.

-> Indicated on display:

```
Basic setting     Q
Enter display group number XXX
```

- Enter "033" to select Display Group 033 and confirm entry with Q key.

-> Indicated on display:

```
Basic setting 33
     1     2     3     4
```

- Check readouts for lambda control in display zones 1 and 2.

	Display zones			
	1	2	3	4
Display Group 033: Lambda control				
Display	xx.x %	x.xxx V		
Indicates	Lambda control Bank 1, Probe 1	Lambda probe voltage Bank 1, Probe 1		
Specification	The readout should fluctuate by at least 2 % in a range between -10.0...10.0 %	0.130...3.600 V		
Note	If readout does not match specification =>Further notes, Page 77	If readout does not match specification =>Reading Display Group 033, Page 78		

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Note on display zone 2:

The display indicates the lambda probe voltage signal after it is processed and smoothed by the engine control unit. A display of 1.5 V equals lambda 1.

Further notes

If the readout in display zone 1 does not match the specification, or if the readout does not fluctuate by at least 2 %:

- Take car for a test drive to free lambda probe of any deposits, then repeat the test.

If the readout in display zone 1 still does not match the specification even after the test drive, or if the readout still does not fluctuate by at least 2 %:

- Test the basic voltage => Page 79 .
- Test the lambda probe heating before catalytic converter=>Page 83 .
- Check the lambda probe (before the catalytic converter) for ageing => Page 80

Reading Display Group 032

Display zone 1 / 2	Possible cause of fault	Fault remedy
Lambda learned values below specified range	- Air leak in intake system	- Check intake system for leaks and eliminate unmetered air
	- Oil dilution	- Change oil or drive car at moderate to high speeds on out-of-town roads
	- High oil consumption	
	- Air mass meter defective	- Test air mass meter => Page 57
	- Solenoid valve for activated charcoal filter sticking in open position	- Test solenoid valve for activated charcoal filter => Page 101
	- Fuel pressure too high	- Test fuel pressure regulator => Page 44
	- Injector does not close	- Test injectors => Page 49
	- Lambda probe heating defective - Lambda probe defective	- Test lambda probe heating => Page 83

Reading Display Group 032

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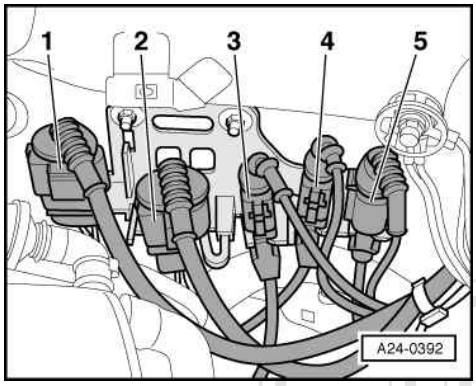
Display zone 1 / 2	Possible cause of fault	Fault remedy
Lambda learned values above specified range	- Unmetered air in intake tract	- Check intake system for leaks and eliminate unmetered air
	- Fuel pressure too low	- Test fuel pressure regulator => Page 44
	- Air mass meter defective	- Test air mass meter => Page 57
	- Lambda probe heating defective - Lambda probe defective	- Test lambda probe heating => Page 83
	- Injector not opening or only opening partially	- Test injectors => Page 49
	- Solenoid valve for activated charcoal filter sticking	- Test solenoid valve for activated charcoal filter => Page 101

Reading Display Group 033

Display zone 2	Possible cause of fault	Fault remedy
Above 4.800 V	- Short to positive in wire between lambda probe and control unit - Lambda probe defective	- Test lambda probe wiring (lambda probe before catalytic converter) => Page 79
Less than 0.130 V	- Short to earth in wiring between lambda probe and control unit - Lambda probe defective	- Replace lambda probe before catalytic converter

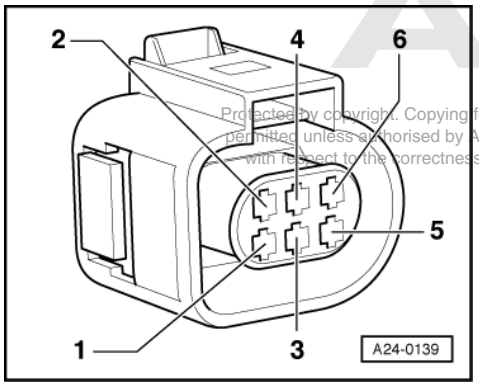
Testing basic voltage



- -> Unplug 6-pin connector (black) for lambda probe (before catalytic converter) -G39.

Note:

For access to connector, unscrew bolts securing coolant expansion tank and pivot expansion tank clear to the side. The coolant hoses do not have to be disconnected.



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- -> Connect multimeter (voltage measurement range) between contacts 1 and 5.
- Switch ignition on.
  - Specification: 0.400 ... 0.500 V
- Switch off ignition.

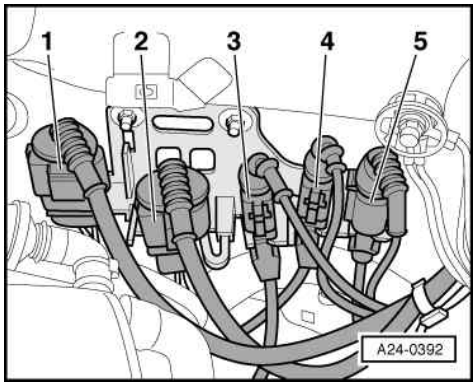
If the specification is not obtained:

- Test lambda probe wiring.

If the specification is obtained:

- Replace the lambda probe (before catalytic converter) -G39.

Testing lambda probe wiring

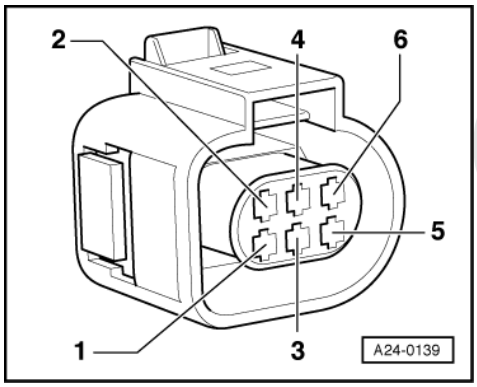


- -> Unplug 6-pin connector (black) for lambda probe (before catalytic converter) -G39.

Note:

For access to connector, unscrew bolts securing coolant expansion tank and pivot expansion tank clear to the side. The coolant hoses do not have to be disconnected.

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .



- -> Test the following wiring connections for open circuits:

Connector Contact	Test box V.A.G 1598/31 Socket
1	70
2	71
5	51
6	52

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- Rectify any open circuits.

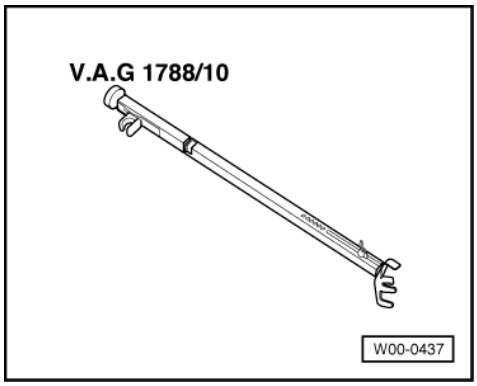
=> Current flow diagrams, Electrical fault finding and Fitting locations binder

- Test for short circuits between the wires.

If the wiring is OK:

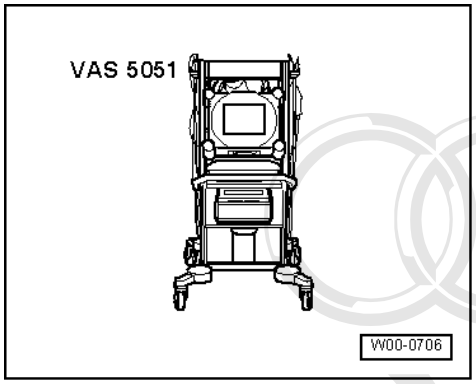
- Fit a new engine control unit => Page 42 .

3.3 - Testing lambda probe (before catalytic converter) for ageing



Special tools and workshop equipment required

- -> V.A.G 1788/10 Engine speed regulator



- VAS 5051 and VAS 5051/1

or

- V.A.G 1551 and V.A.G 1551/3 A

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Test requirement:

- Coolant temperature at least 80 °C

Test sequence

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

-> Indicated on display:

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

- Enter "04" to select "Basic setting" and confirm with Q key.

-> Indicated on display:

```
Basic setting     Q
Enter display group number XXX
```

- Enter "034" for Display Group 034 and confirm entry with Q key.

-> Indicated on display:

```
System in basic setting 34
     1     2     3     4
```

- Set engine speed between 2300 and 2800 rpm using speed regulator V.A.G 1788/10.
- Check the specification in display zone 4:

Note:

This process can take a few minutes.

	Display zones			
	1	2	3	4
Display group 034: Diagnosis of lambda probe ageing				

	Display zones			
Display	xxxx rpm	xxx °C	**x.x**	**---**
Indicates	Engine speed	Exhaust temperature	**Dynamic factor**	Status of diagnosis
Range				**Test OFF Test ON B1-P1 O.K. B1-P1 n. O.K.**
Specification	2300...2800 rpm	Higher than 350 °C	**0.5...2.5**	B1-P1 O.K.
Note			**If specification is not attained, refer to Page 82**	

Note on display zone 2:

Value calculated from engine speed and engine load.

Note on display zones 3 and 4:

The dynamic factor signifies the lambda probe ageing. Decreasing dynamic factor indicates increased lambda probe ageing.

Further notes

If the readout in display zone 3 or 4 does not match the specification:

- Take car for a test drive to free lambda probe of any deposits, then repeat the test.

If the readout in display zone 3 or 4 still does not match the specification even after the test drive:

- Replace the lambda probe 1 (before catalytic converter) -G39.

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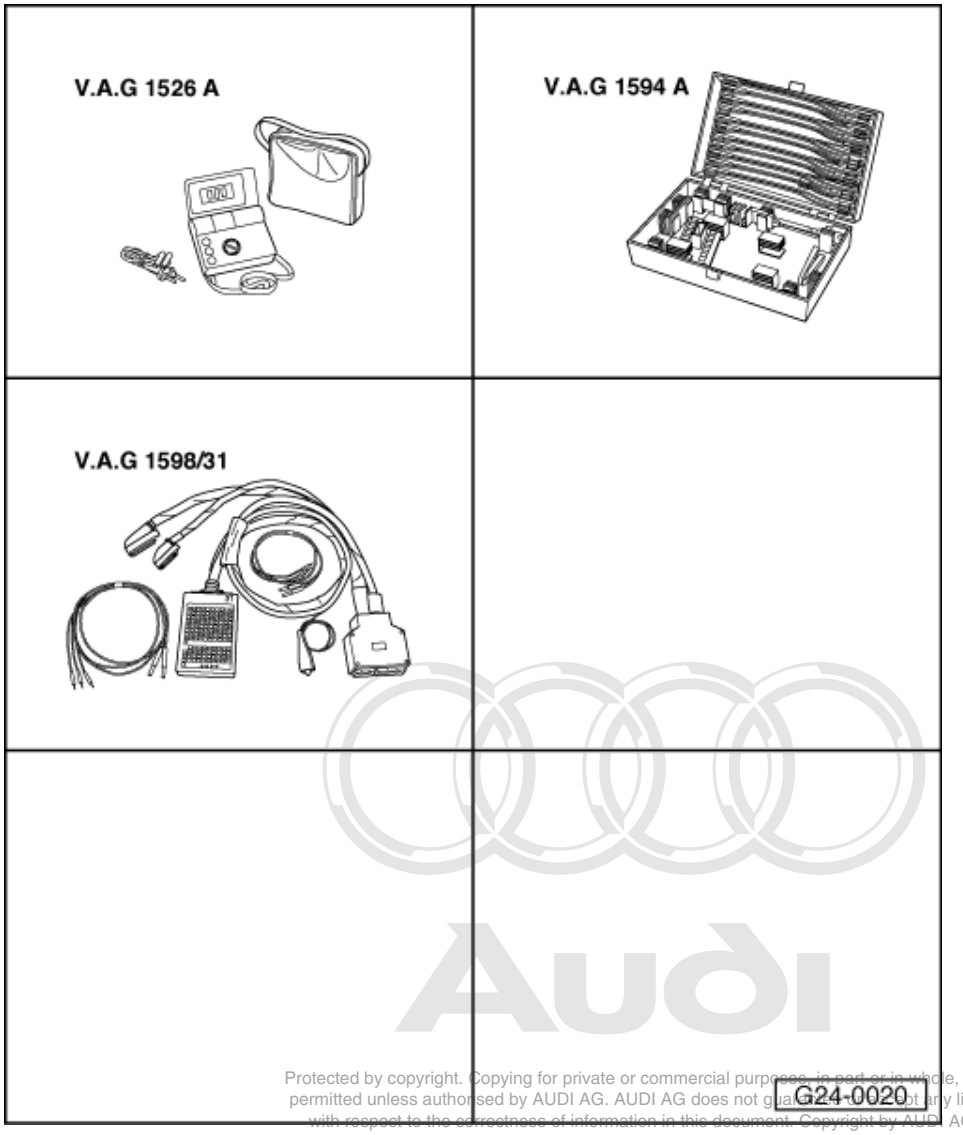
3.4 - Testing lambda probe heating -Z19 at lambda probe (before catalytic converter)



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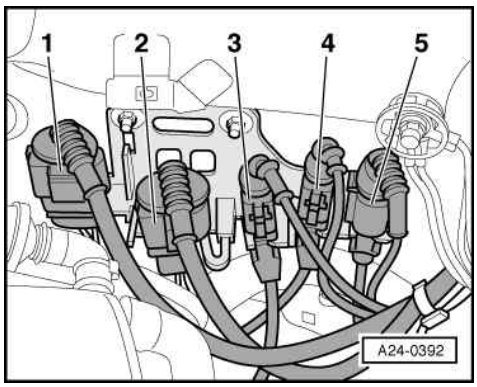
Special tools and workshop equipment required

- V.A.G 1526 A
- V.A.G 1594 A
- V.A.G 1598/31

Requirements for test:

- Coolant temperature at least 80 °C



- Fuse for lambda probe heating OK

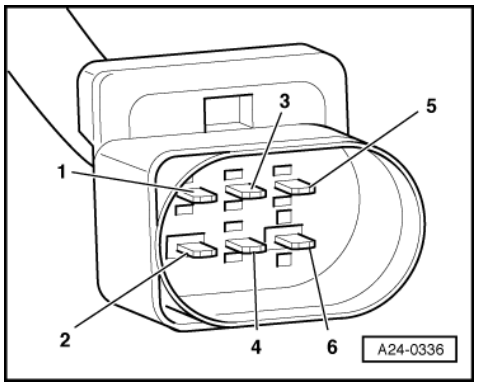
=> Current flow diagrams, Electrical fault finding and Fitting locations binder

Test sequence

- -> Unplug 6-pin connector (black) for lambda probe (before catalytic converter) -G39.

Note:

For access to connector, unscrew bolts securing coolant expansion tank and pivot expansion tank clear to the side. The coolant hoses do not have to be disconnected.



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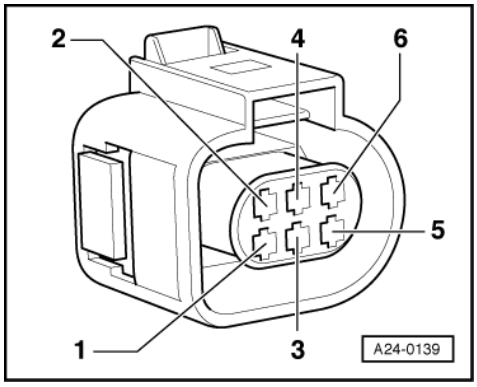
- -> Connect multimeter (resistance measurement range) between contacts 3 and 4.
  - Specification: 2.5 ... 10 ω(at room temperature)

If the specification is not attained:

- Replace the lambda probe 1 (before catalytic converter) -G39.

If the specification is obtained:

- Test voltage supply for lambda probe heating.

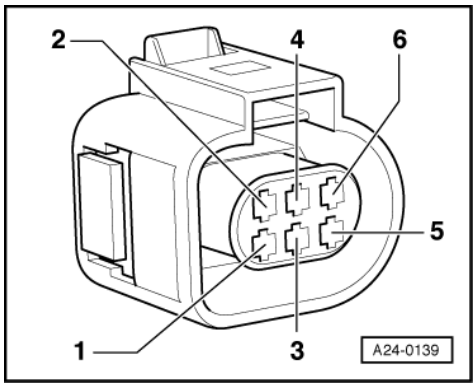


Testing voltage supply for lambda probe heating

- -> Connect multimeter (voltage measurement range) between contacts 3 and 4.
- Start the engine.
  - Specification: approx. battery voltage

Note:

If required, observe Display Group 041, display zone 2 in the "Read measured value block" function to find out when the engine control unit is switching the lambda probe heating on and off.



If no voltage is present:

- -> Connect multimeter (voltage measurement range) as follows:

Connector Contact	Measure against
3 (positive)	Vehicle earth

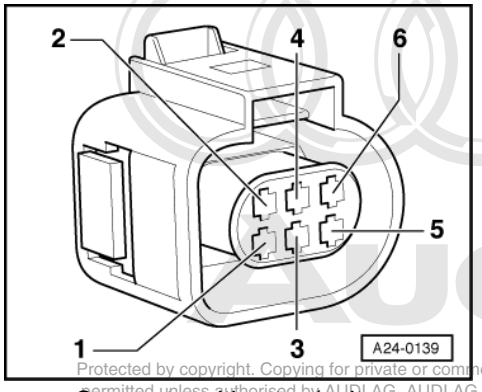
- Operate starter briefly.
  - Specification: approx. battery voltage

If there is still no voltage reading:

- Test for open circuit in wiring connection between fuel pump relay and contact 3 on connector via fuse:

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

If the voltage supply is OK:



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- -> Connect multimeter (voltage measurement range) as follows:

Connector Contact	Measure against
4 (switched earth connection from engine control unit)	Battery positive

- Start the engine.
  - Specification: approx. battery voltage

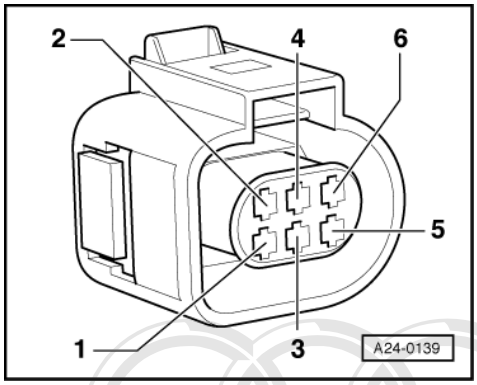
Note:

If required, observe Display Group 041, display zone 2 in the "Read measured value block" function to find out when the engine control unit is switching the lambda probe heating on and off.

- Switch off ignition.

If no voltage is present:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .



- -> Test for open circuits in the following wiring connection:

Connector Contact	Test box V.A.G 1598/31 Socket
4	5

- Rectify any open circuits.

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

If the wiring connection is O.K. but the lambda probe heating still has no earth connection:

- Fit a new engine control unit => Page 42 .

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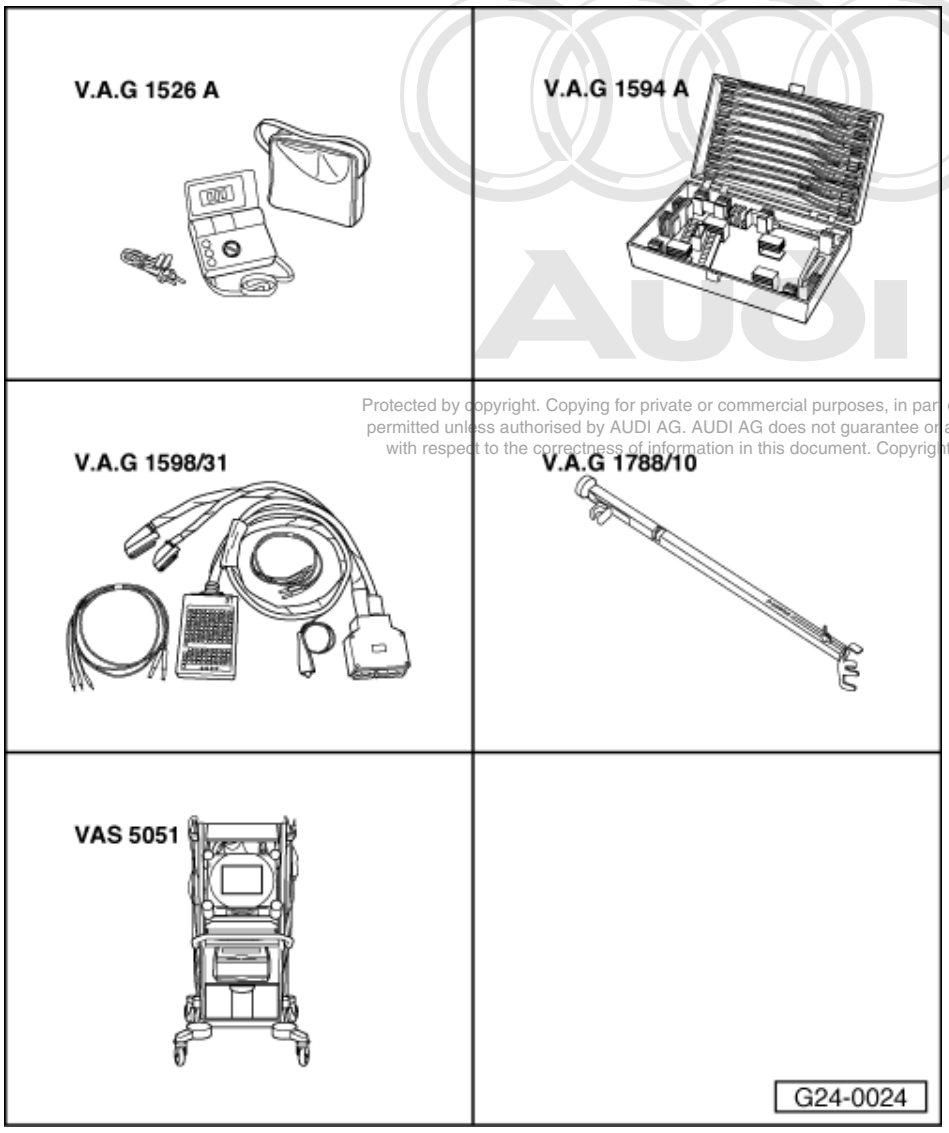
3.5 - Testing lambda probe and lambda control (after catalytic converter)

Note:

The lambda probe before catalytic converter (Bank 1, Probe 1) holds the value atlambda = 1. If the function of this lambda probe is impaired due to dirt or overheating, the controlled value can alter. The lambda probe after catalytic converter (Bank 1, Probe 2) detects any deviations from lambda = 1. It corrects variations (positive or negative) by increasing or reducing the lambda control before catalytic converter accordingly.



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Special tools and workshop equipment required

- V.A.G 1526 A
- V.A.G 1594 A
- V.A.G 1598/31
- V.A.G 1788/10
- VAS 5051 with VAS 5051/1

or

- V.A.G 1551 with V.A.G 1551/3 A

Requirements for test:

- Exhaust system free of leaks
- Coolant temperature at least 80 °C

Test sequence

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

- Apply engine speed regulator V.A.G 1788/10 to accelerator pedal and set engine speed to 2600 rpm.

Test requirement:

- Engine running at 2600 rpm

-> Indicated on display:

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

- Enter "04" to select "Basic setting" and confirm with Q key.

-> Indicated on display:

```
Basic setting     Q
Enter display group number XXX
```

- Enter "030" to select Display Group 030 and confirm entry with Q key.
- Check lambda probe status in display zone 2.

Note:

The "lambda probe status" display indicates the status of the lambda control and lambda probes.

	Display zones			
	1	2	3	4
Display Group 030: Lambda probe status at idling speed				
Display	X X X	X X X		
Display	Lambda probe status Bank 1, Probe 1	Lambda probe status Bank 1, Probe 2		
Range	0 = off 1 = on	0 = off 1 = on		
Specification	1 1 1	1 1 0		
Note	If readout does not match specification => Page 92 .			

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Significance of three-digit display in Display group 030			
X	X	X	Display zones 1 and 2
		X	Lambda control : 0= inactive; 1= active
	X		Lambda probe condition: 0= inactive; 1= active
X			Status of lambda probe heating: 0= inactive; 1= active

Notes:

- The first digit of the three-digit display (heating) fluctuates between 0 and 1.
- The lambda control of lambda probe (after the catalytic converter; B1-P2) is not active when the engine is not running under load.

- Do not continue test until display "110" is indicated in display zone 2 at least once.

Testing lambda control (after catalytic converter)

Test requirement:

- Engine still running at 2600 rpm

- Press C key.

-> Indicated on display:

```
Basic setting     Q
Enter display group number XXX
```

- Enter "037" for Display Group 037 and confirm entry with Q key.

-> Indicated on display:

```
System in basic setting 37
     1     2     3     4
```

- Check lambda probe voltage in display zone 2:
- Check the lambda compensating value in display zone 3 and the result of the diagnosis in display zone 4.

	Display zones			
	1	2	3	4
Display group 037: Diagnosis of lambda control system				
Display	xxx %	**x.xxx V**	**x.xx**	**---**
Indicates	Engine load	**Lambda probe voltage Bank 1, Probe 2**	**Lambda compensating value between Bank 1, Probe 1 and Bank 1, Probe 2**	Status of diagnosis
Range				**Test OFF Test ON SYST. O.K. SYST. n. O.K.**
Specification	13...40 %	**0.100...0.950 V**	**less than 0.02**	SYST. O.K.
Note		**If the specification is not attained: Reading => Page 89**		**If "SYST. n. O.K." appears on the display, interrogate fault memory => Page 4**

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Note on display zone 2:

The lambda probe voltage (Bank 1, Probe 2) should remain more or less constant. Large voltage fluctuations indicate that the catalytic converter is damaged.

Reading Display Group 037

Display zone 2	Possible cause of fault	Fault remedy
Approx. 0.450 V (constant)	- Open circuit in wire 4 between lambda probe and control unit	- Test basic voltage => Page 90
	- Open circuit in wire 3 between lambda probe and control unit	
More than 0.950 V	- Short to positive in wire 4 between lambda probe and control unit	- Test wiring of lambda probe (after the catalytic converter) => Page 91
Less than 0.100 V	- Short to earth in wire 4 between lambda probe and control unit	

Further notes

If the readout in display zone 3 or 4 does not match the specification:

- Take car for a test drive to free lambda probe of any deposits, then repeat the test.

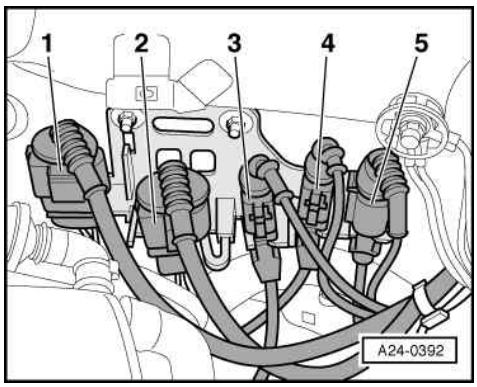
If the readout in display zone 3 or 4 still does not match the specification even after the test drive:

- Replace the lambda probe (before the catalytic converter) -G39.

Note:

If the lambda probe voltage is OK and the compensating value is still above 0.02 even after a test drive, this points to excessive ageing of the lambda probe before catalytic converter.

Testing basic voltage



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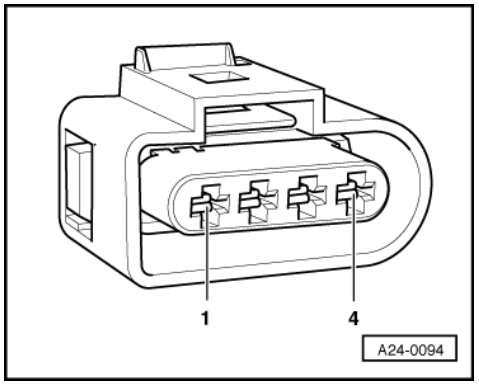
- -> Unplug 4-pin connector (brown) for lambda probe (after catalytic converter) -G130.

Note:

For access to connector, unscrew bolts securing coolant expansion tank and pivot expansion tank clear to the side. The coolant hoses do not have to be disconnected.



- -> Connect multimeter (voltage measurement range) between contacts 3 and 4.
- Switch ignition on.
  - Specification: 0.400 ... 0.500 V
- Switch off ignition.

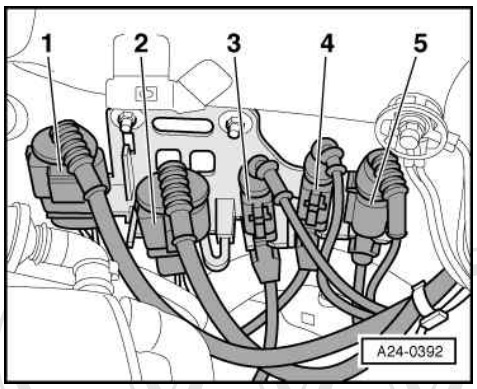
If the specification is not obtained:

- Test lambda probe wiring.

If the specification is obtained:

- Replace the lambda probe (after catalytic converter) -G130.

Testing lambda probe wiring



- -> Unplug 4-pin connector (brown) for lambda probe (after catalytic converter) -G130.

Note:

For access to connector, unscrew bolts securing coolant expansion tank and pivot expansion tank clear to the side. The coolant hoses do not have to be disconnected.

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

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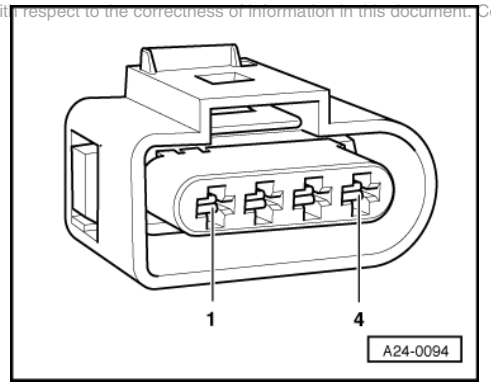


- -> Test the following wiring connections for open circuits:

Connector Contact	Test box V.A.G 1598/31 Socket
3	68
4	69

- Rectify any open circuits.

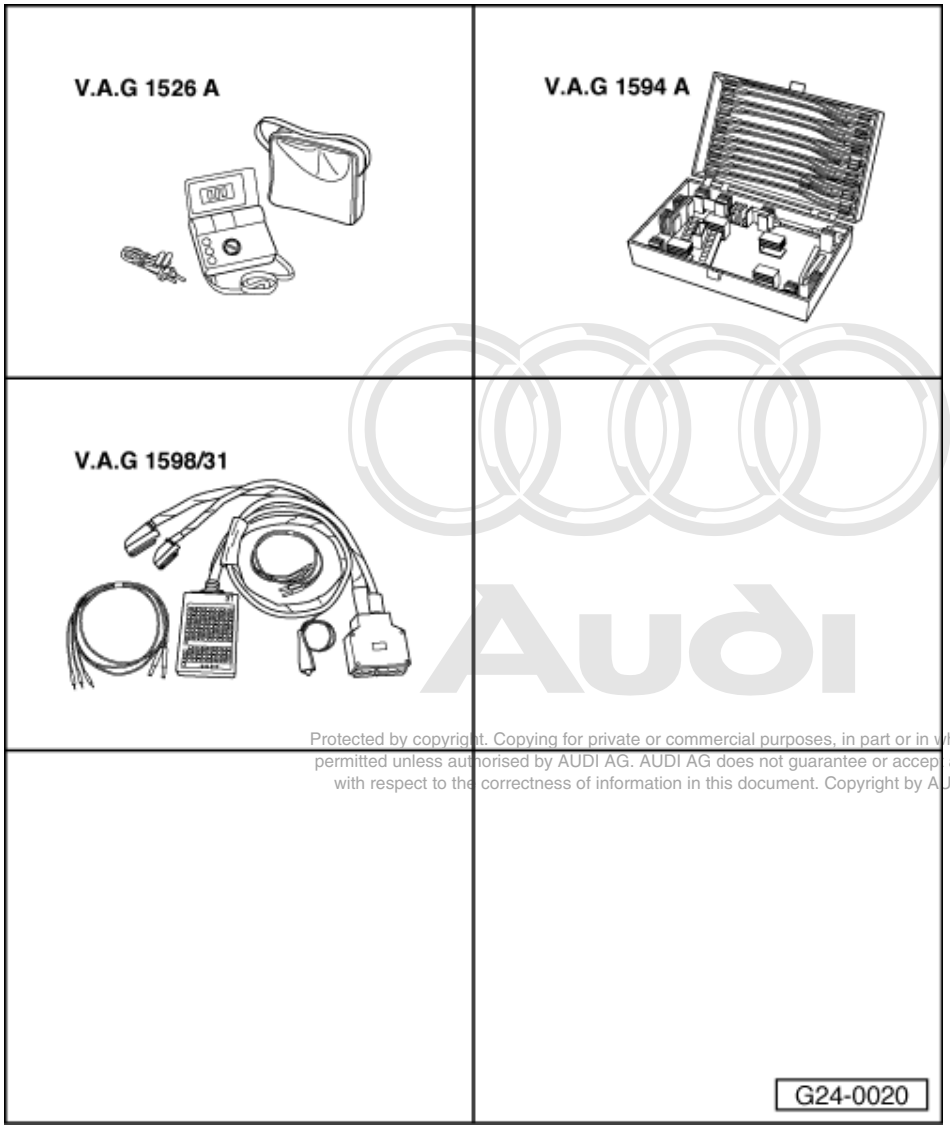
=> Current flow diagrams, Electrical fault finding and Fitting locations binder

- Test for short circuits between the wires.

If the wiring is OK:

- Fit a new engine control unit => Page 42 .

3.6 - Testing lambda probe heating -Z29 at lambda probe (after catalytic converter)



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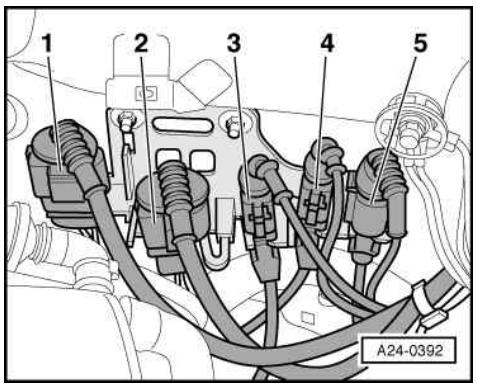
Special tools and workshop equipment required

- V.A.G 1526 A
- V.A.G 1594 A
- V.A.G 1598/31

Requirements for test:

- Coolant temperature at least 80 °C



- Fuse for lambda probe heating OK

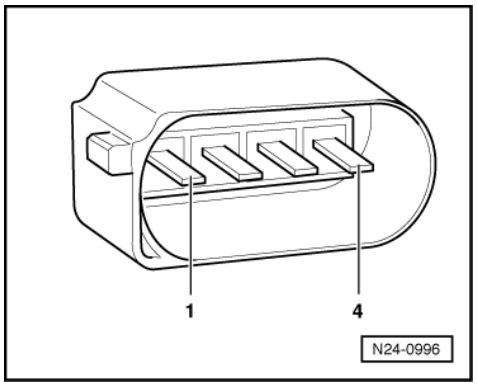
=> Current flow diagrams, Electrical fault finding and Fitting locations binder

Test sequence

- -> Unplug 4-pin connector (brown) for lambda probe (after catalytic converter) -G130.

Note:

For access to connector, unscrew bolts securing coolant expansion tank and pivot expansion tank clear to the side. The coolant hoses do not have to be disconnected.



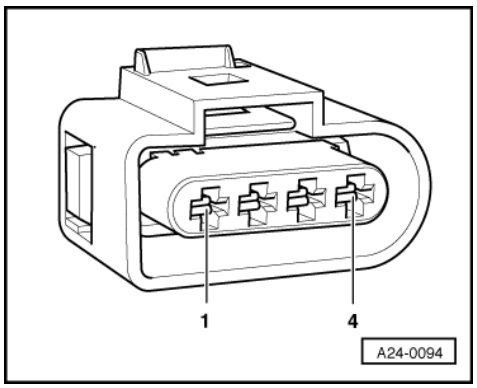
- -> Connect multimeter (resistance measurement range) between contacts 1 and 2.
  - Specification: 2 ... 15ω(at room temperature)

If the specification is not attained:

- Replace the lambda probe (after catalytic converter) -G130.

If the specification is obtained:

- Test voltage supply for lambda probe heating.



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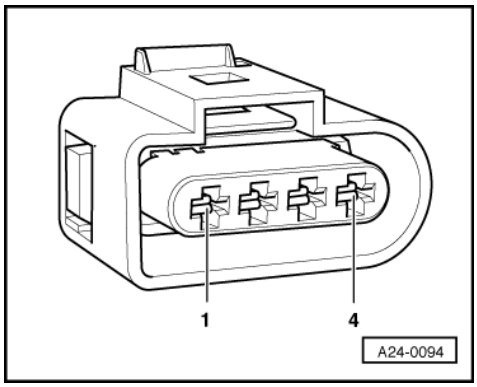
Testing voltage supply for lambda probe heating

- -> Connect multimeter (voltage measurement range) between contacts 1 (positive) and 2 (earth).
- Start the engine.
  - Specification: approx. battery voltage

Note:

If required, observe Display Group 041, display zone 4 in the "Read measured value block" function to find out when the engine control unit is switching the lambda probe heating on and off.



If no voltage is present:

- -> Connect multimeter (voltage measurement range) as follows:

Connector Contact	Measure against
1 (positive)	Vehicle earth

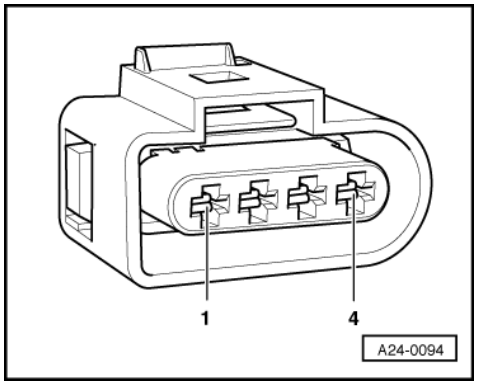
- Operate starter briefly.
  - Specification: approx. battery voltage

If there is still no voltage reading:

- Test for open circuit in wiring connection between fuel pump relay and contact 1 on connector via fuse:

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

If the voltage supply is OK:



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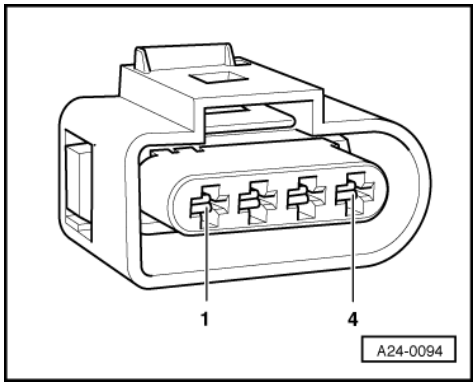
- -> Connect multimeter (voltage measurement range) as follows:

Connector Contact	Measure against
2 (switched earth connection from engine control unit)	Battery positive

- Start the engine.
  - Specification: approx. battery voltage (may fluctuate)
- Switch off ignition.

If no voltage is present:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .



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- -> Test for open circuits in the following wiring connection:

Connector Contact	Test box V.A.G 1598/31 Socket
2	63

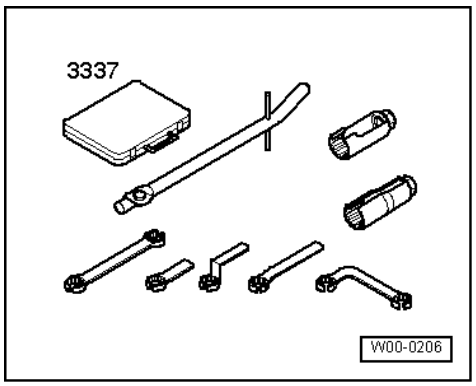
- Rectify any open circuits.

If the wiring connection is O.K. but the lambda probe heating still has no earth connection:

- Fit a new engine control unit => Page 42 .

3.7 - Removing and installing lambda probe

Removing lambda probe



- Unplug the lambda probe connector.

- Unscrew the lambda probe using ring spanner 3337/9.

Installing lambda probe

When installing, note the following points:

Notes:

- When installing, the lambda probe wire must be secured in exactly the same position as before in order to avoid contact between the wire and the exhaust pipe.
- The screw thread on the lambda probe is coated with a special paste (high-temperature lubricant). This paste must not be allowed to penetrate the openings on the probe.
- Tightening torque: 55 Nm.

4 - Testing intake manifold change-over function

4.1 - Testing intake manifold change-over function

This test should only be carried out if the vehicle is losing power or if a fault is stored in the fault memory.

The intake manifold change-over function switches over from the long intake tract to the short intake tract according to engine speed and throttle opening.

4.2 - Testing operation

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

-> 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
```

- Press keys 0, 9 and 5 for Display Group 95 and confirm entry with the Q key.

-> Indicated on display:

```
Read measured value block 95
     1     2     3     4
```

- Check display values for intake manifold change-over.

	Display zones			
	1	2	3	4
Display Group 95: Intake manifold change-over at idling speed				
Display	xxx rpm	x.xx %	xxx.x °C	**IMC-V OFF**
Indicates	Engine speed (in steps of 40 rpm)	Load	Coolant temperature	**Intake manifold change-over**
Range	min.: 750 rpm max.: 6800 rpm	min.: 0.00 % max.: 120.00 %		**IMC-V OFF** **IMC-V ON**

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	Display zones			
Specification	810...910 rpm	15.0....25.0 %	80.0...105.0 ° C	**IMC-V OFF**
Note				

- Check readout in display zone 4.

  Specification: IMC-V OFF

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

- The intake manifold change-over function should be activated (display zone 4).

	Display zones			
	1	2	3	4
Display Group 95: Intake manifold change-over with vehicle being driven				
Display	xxxx rpm	x.xx %	xxx.x ° C	**IMC-V ON**
Indicates	Engine speed (in steps of 40 rpm)	Load	Coolant temperature	**Intake manifold change-over**
Range	min.: 750 rpm max.: 6800 rpm	min.: 0.00 % max.: 120.00 %		**IMC-V OFF** **IMC-V ON**
Specification	4500...6680 rpm	15.0...120.00 %	80.0...105.0 ° C	**IMC-V ON**
Note				**Observe change-over function at vacuum unit (located at front left of intake manifold)**

If the display shows "IMC-V ON" but the vacuum unit for the intake manifold change-over function is not activated, test the following components:

- Test intake manifold change-over valve
  => Page 97 .
- Check vacuum system for leaks
  => Page 100

4.3 - Testing intake manifold change-over valve -N156

Fitting location => Page 36 .

Testing intake manifold change-over valve -N156

- Run engine at idling speed for 2 or 3 minutes to build up vacuum.
- Switch engine off.
- Switch ignition on.

-> Perform final control diagnosis and activate intake manifold change-over valve => Page 17 .

```
Final control diagnosis
Intake manifold press. change valve -
N156
```

The valve should click (clicking can be heard and felt). After 1 minute the final control diagnosis is terminated.

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

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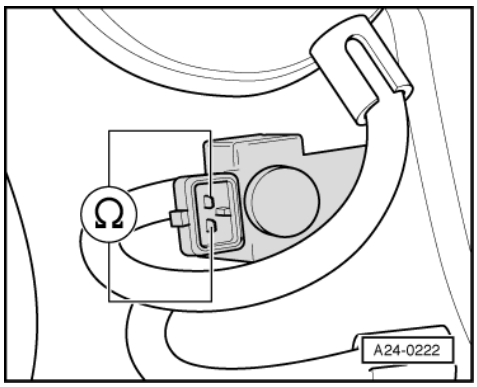

- Unplug connector from intake manifold change-over valve -N156.
- -> Measure resistance between contacts of solenoid valve using V.A.G 1526.

  Specification: 25...35 ω

- If the reading does not match the specification, renew intake manifold change-over valve -N156.

If the reading matches the specification, test voltage supply
=> Page 98 .

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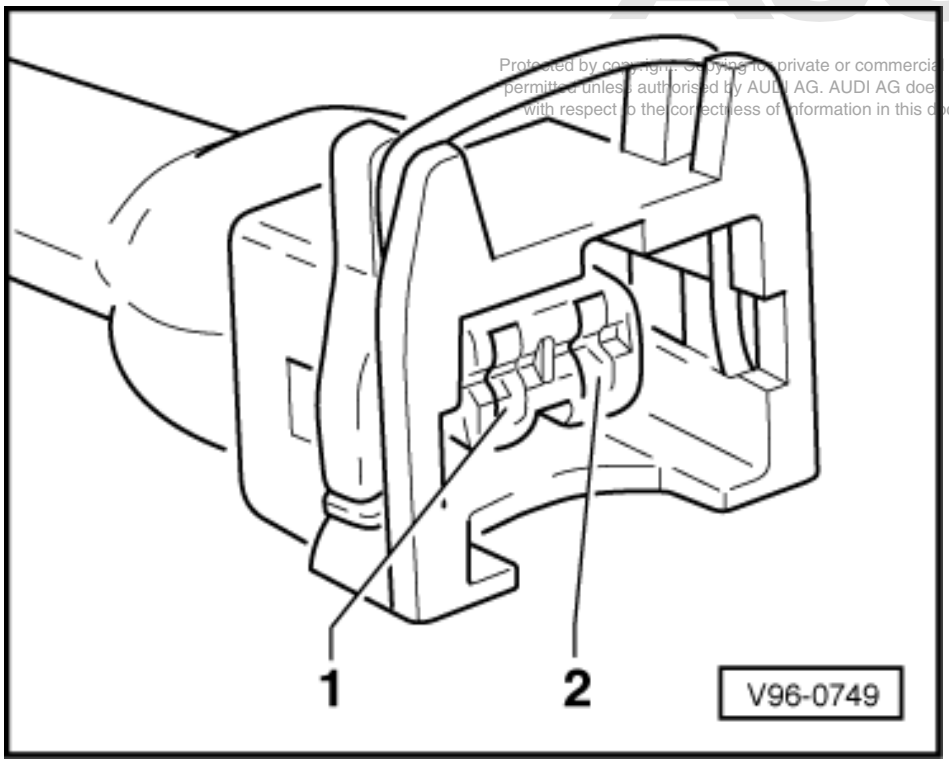


Testing voltage supply to intake manifold change-over valve

-N156

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

The diode test lamp should light up.

- If the diode test lamp does not light up:

- Test fuse for intake manifold change-over valve.

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

If the fuse is OK:

- Test for open circuit and short circuit in wiring between fuel pump relay and socket 1 on connector via fuse for intake manifold change-over valve.

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

If the voltage supply is OK, test activation. => Page 99

Testing activation of intake manifold change-over valve

- Connect diode test lamp V.A.G 1527 between sockets 1 (positive) and 2 on connector for intake manifold change-over valve using test leads from auxiliary cable set V.A.G 1594.

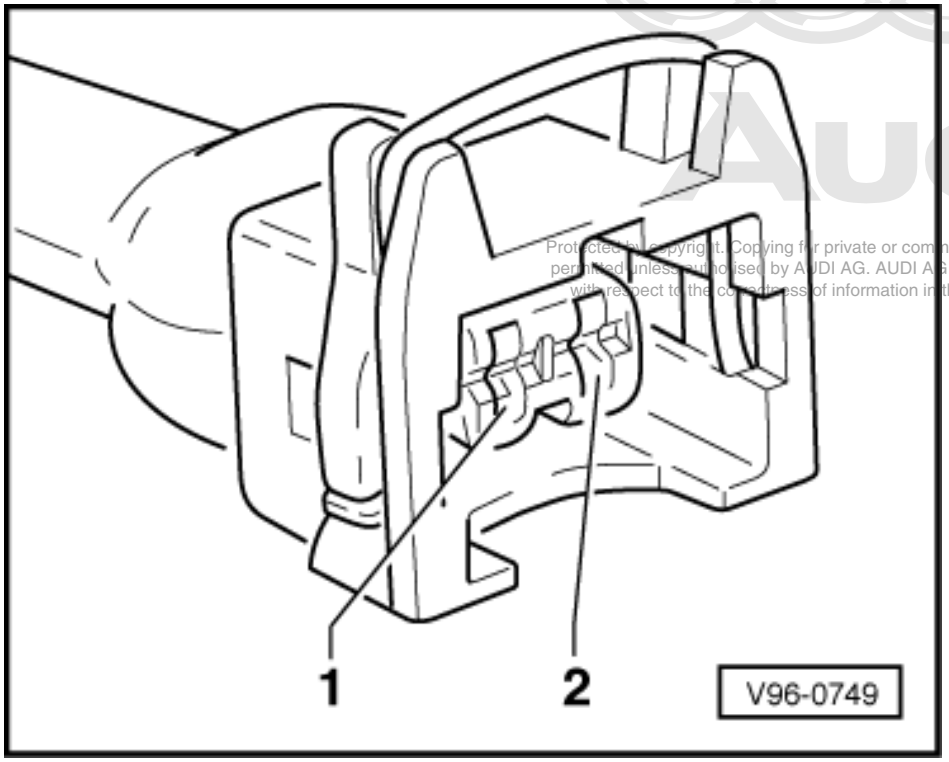
-> Perform final control diagnosis and activate intake manifold change-over valve=> Page 17 .

```
Final control diagnosis
Intake manifold press. change valve -
N156
```

If the diode test lamp does not flash or lights up continuously, test the wiring.

Testing wiring

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .



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Test the following wiring connections for open circuits and short to positive or earth.

Connector for intake manifold change-over Socket	Test box V.A.G 1598/31 Socket
2	104

Resistance in wiring: max. 1.5 ω

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

- If the wiring is OK, fit a new engine control unit
  =>Page 42 .
- Test operation of intake manifold change-over valve -N156 again
  =>Page 96 .

4.4 - Testing vacuum system

Checking valve for obstructions and leaks

- Remove intake manifold change-over valve.
- Reconnect valve to wiring harness.

-> Perform final control diagnosis and activate intake manifold change-over valve => Page 17 .

```
Final control diagnosis
Intake manifold press. change valve -
N156
```

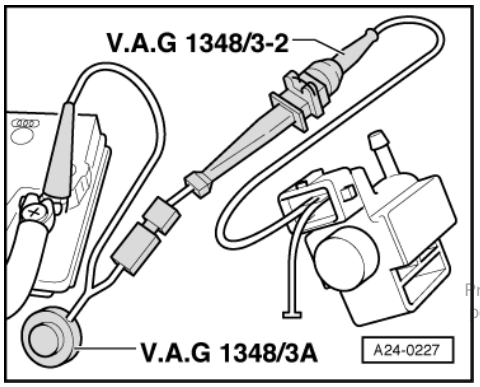
- While the final control diagnosis is running, blow through the valve connection to check whether the valve is opening and closing properly.

If the valve does not open and close:

- Renew intake manifold change-over valve.

If no faults have been found in any of the tests so far:

- Re-install intake manifold change-over valve.
- Test vacuum system for leaks => Page 100



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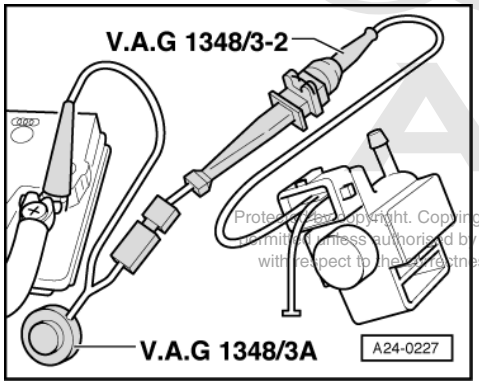
Testing vacuum system for leaks

- 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.



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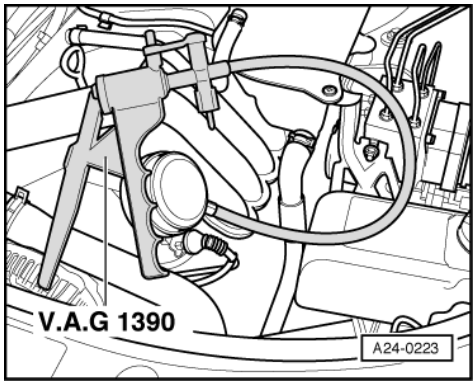
- -> Connect the second contact on the solenoid valve to positive using remote control V.A.G 1348/3A, adapter lead V.A.G 1348/3-2 and an auxiliary cable.
- -> Operate remote control V.A.G 1348/3A for about 2 or 3 minutes. During this time the vacuum unit should remain in the "pulled-in" position.

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



- Disconnect vacuum hose from vacuum unit for intake manifold change-over system.
- -> Connect hand-held vacuum pump V.A.G 1390 to vacuum unit.
- Operate hand-held vacuum 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 the vacuum unit returns to its "rest" position:

- Renew vacuum unit.

5 - Testing fuel tank breather system

5.1 - Testing fuel tank breather system

5.2 - Testing solenoid valve 1 for activated charcoal filter -N80

Testing for leaks

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

- Disconnect hoses from solenoid valve 1 for activated charcoal filter -N80.
- Connect an auxiliary hose to one of the connections on the ACF valve.
- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.
- Start final control diagnosis and select solenoid valve for activated charcoal filter -N80 (tank breather valve) =>Page 17 .

-> Indicated on display:

```
Final control diagnosis
ACF solenoid 1 -N80
```

The valve should click...
...and should open and close (test by blowing into auxiliary hose).

- If the valve does not click, carry out electrical test of solenoid valve 1 for activated charcoal filter => Page 102 .
- If valve does not open and close properly, renew solenoid valve 1 for activated charcoal filter.

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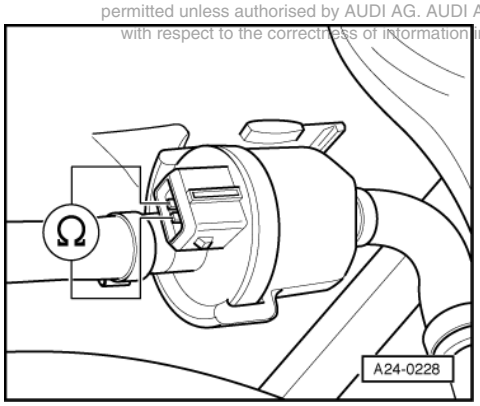


Electrical test of solenoid valve 1 for activated charcoal filter -N80

- Unplug connector from ACF valve -N80.
- -> Measure resistance between contacts on valve using hand-held multimeter V.A.G 1526.

Specification: 22...30 ω

If the specification is not attained:

- Renew solenoid valve for activated charcoal filter system -N80.

If the specification is obtained:

- Test voltage supply => Page 102 .

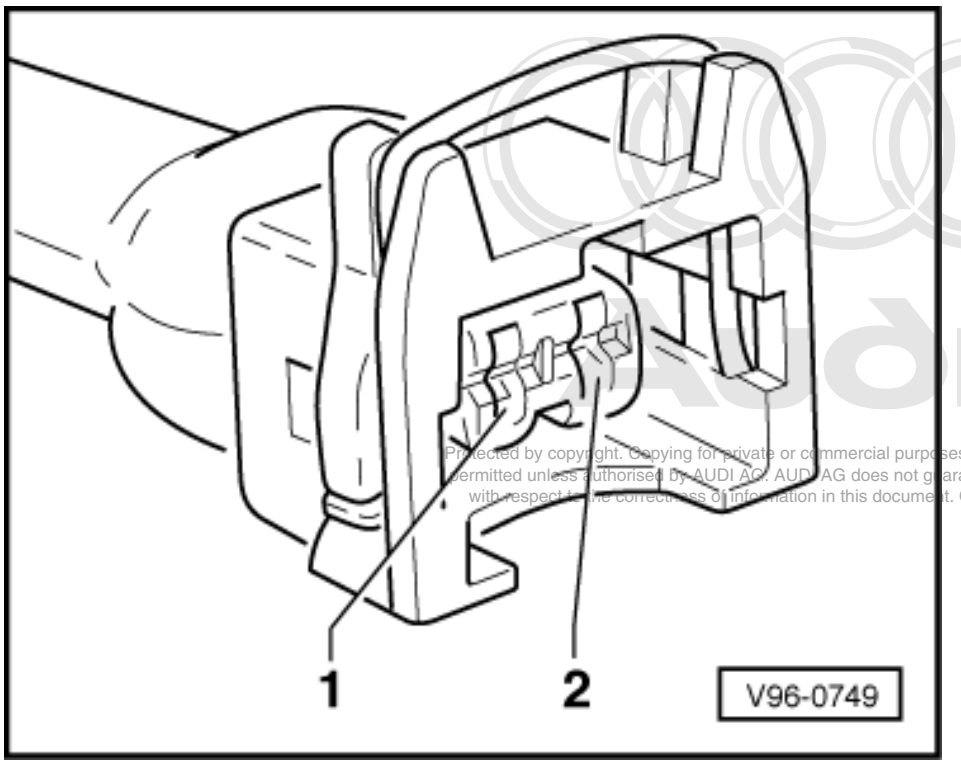
Testing power supply to solenoid valve

Note:

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

Test conditions

- Fuse for ACF valve OK



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- Unplug connector on ACF valve -N80.
- -> Connect diode test lamp V.A.G 1527 between engine earth and socket 1 on the connector.
- Operate starter.

The diode test lamp should light up.

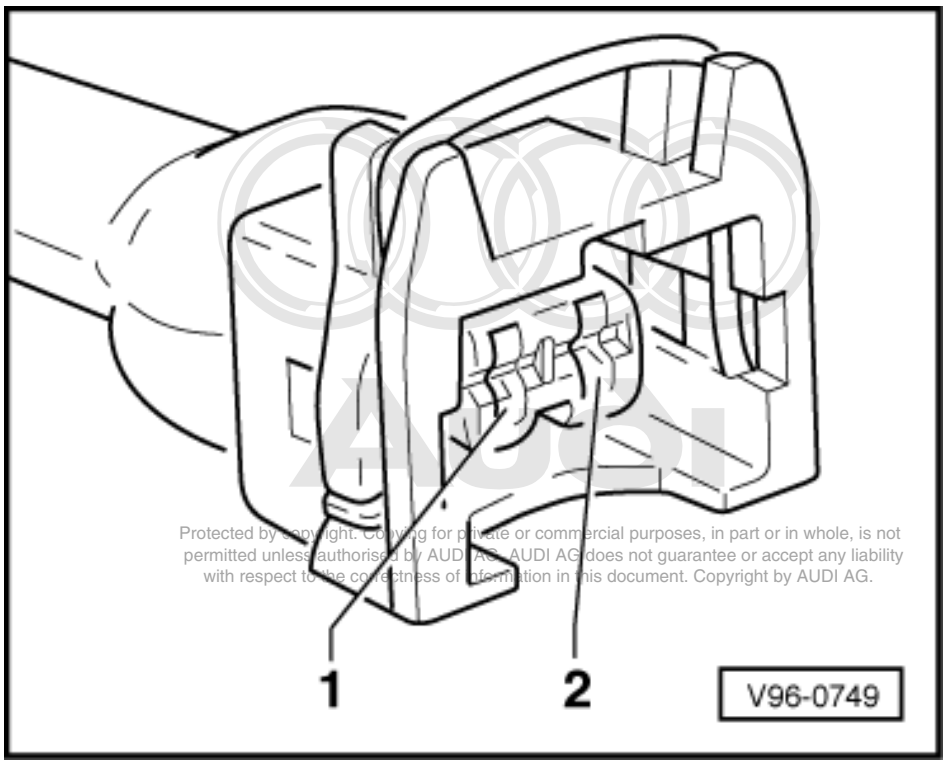
If diode test lamp does not light up:

- Test continuity of wiring from socket 1 to fuel pump relay via fuse. Rectify open circuit if necessary.

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

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

If the diode test lamp lights up, test activation
=> Page 104 .



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Testing activation of ACF solenoid valve

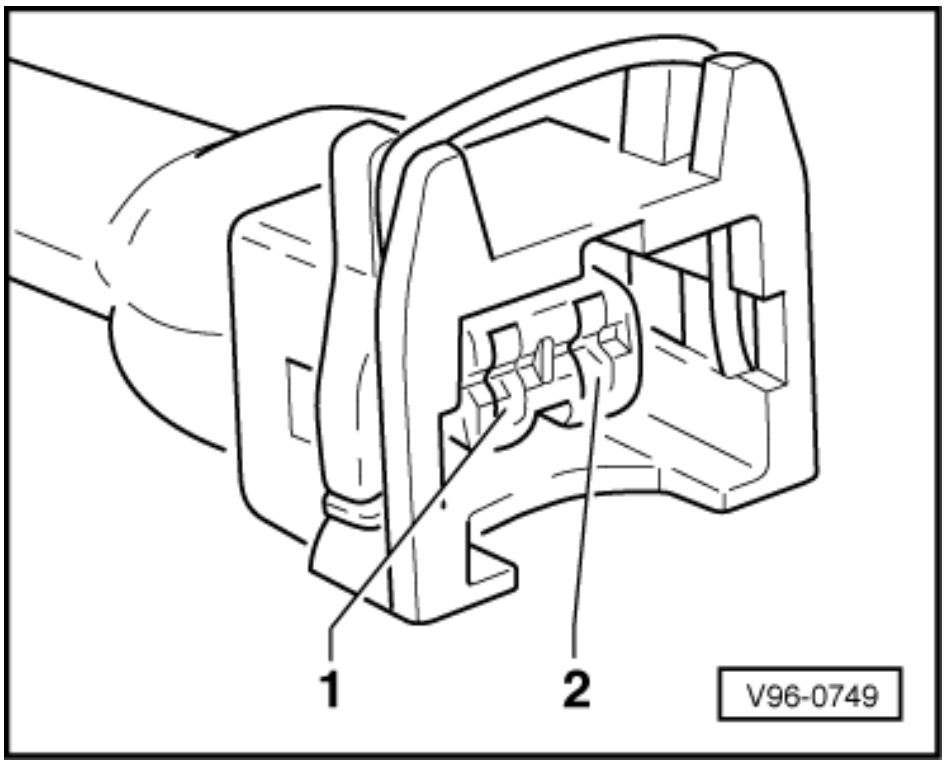
- -> Connect diode test lamp V.A.G 1527 between sockets 1 (positive) and 2 of plug connector.
- Start final control diagnosis and select solenoid valve for activated charcoal filter -N80
  =>Page 17 .

The diode test lamp should flash.

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

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

If the diode test lamp lights up continuously:



- Test for short to earth in the following wiring connections:

2-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
2	64

If the diode test lamp does not flash:

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

2-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
2	64

Resistance in wiring: max. 1.5 ω

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

- 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 -J220
  => Page 42 .

6 - Testing secondary air inlet valve -N112

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6.1 - Testing secondary air inlet valve -N112

The secondary air inlet valve is located on the intake manifold below the coolant expansion tank.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.
- Start final control diagnosis and activate secondary air inlet valve

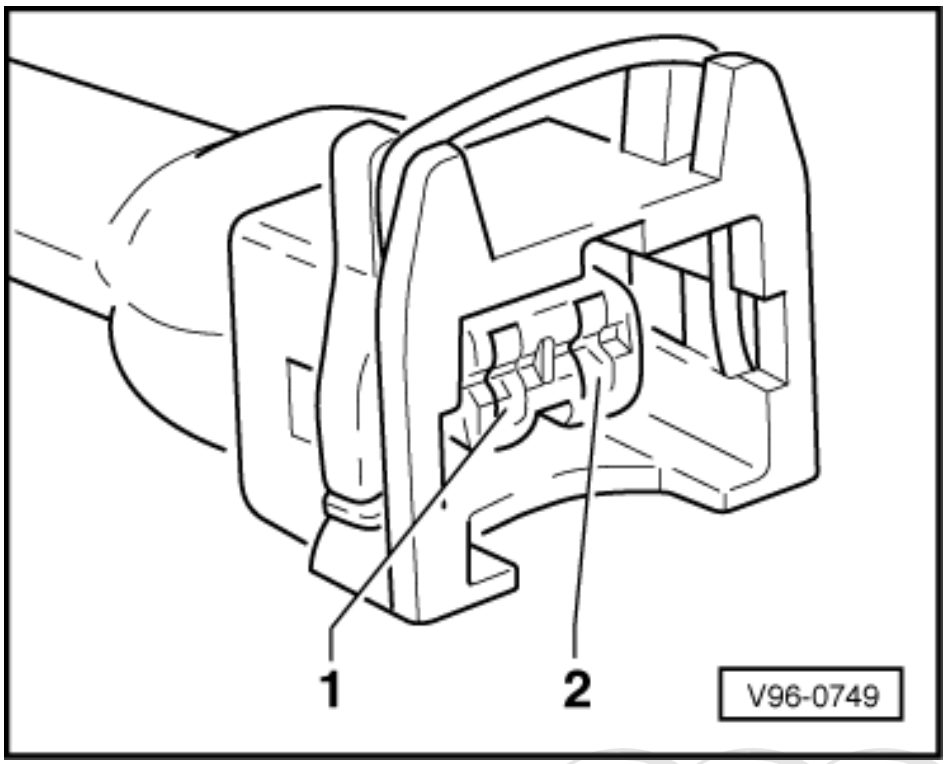
=>Page 17 .

-> Indicated on display:

```
Final control diagnosis
Secondary air inlet valve -N112
```

The secondary air inlet valve should click.

If the secondary air inlet valve does not click:



- -> Unplug 2-pin connector from valve.
- Connect diode test lamp V.A.G 1527 to disconnected connector using test leads from V.A.G 1594.
- Repeat final control diagnosis.

If the diode test lamp now flashes during the final control diagnosis:

- Fit a new secondary air inlet valve.

If the diode test lamp still does not flash:

- Switch off ignition.
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

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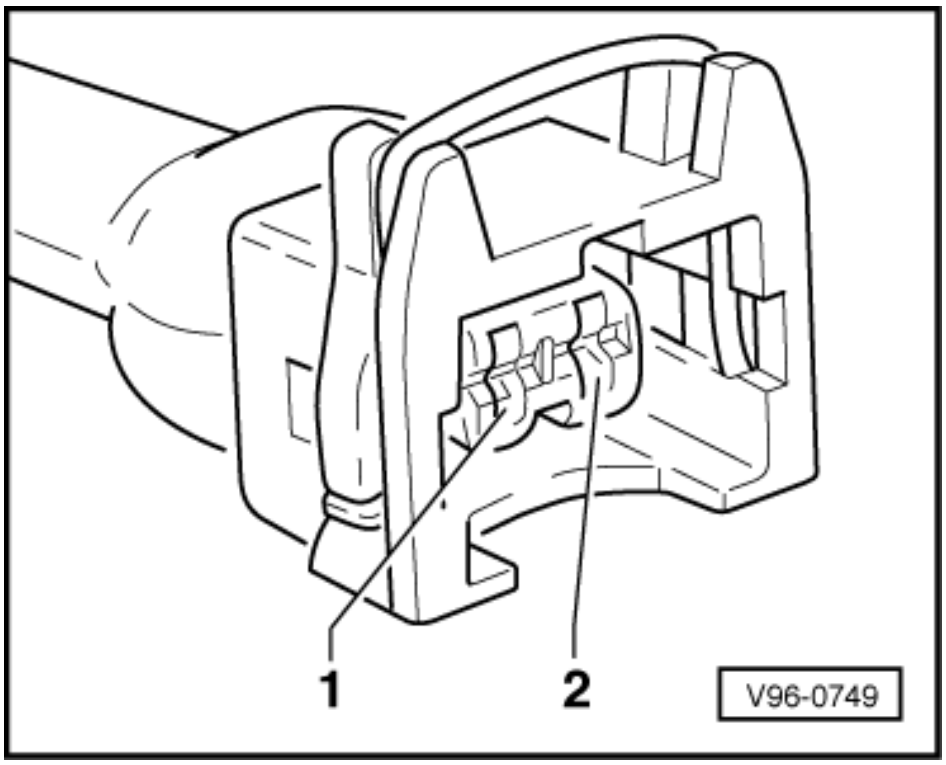

- Test for open circuit in the following wiring connection:

Socket of 2-pin connector on wiring harness	Socket on test box V.A.G 1598/31
2	9

Resistance in wiring: max. 1.5 ω

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

If no fault in wire is detected:

- Test voltage supply to secondary air inlet valve using current flow diagram.

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

6.2 - Testing secondary air pump relay -J299

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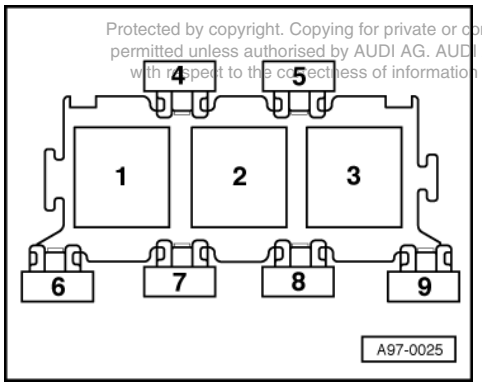


-> The secondary air pump relay is located in the electronics box in the plenum chamber, relay position 2.

Secondary air pump motor -V101 is located on the longitudinal member (right side).

- Start final control diagnosis and activate secondary air pump relay -J299 =>Page 17 .
  - -> The secondary air pump relay should pick up and secondary air pump motor -V101 should run intermittently.

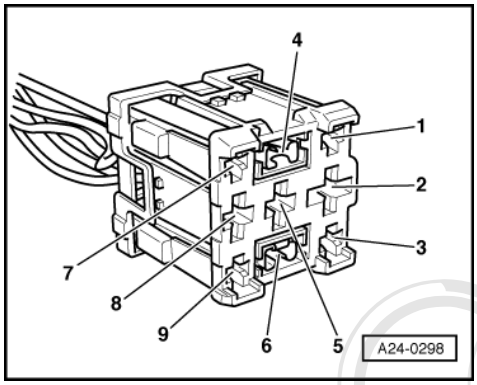
A - If the relay does not pick up:

- Test voltage supply of secondary air pump relay=>Page 108 .
- Test activation of secondary air pump relay=>Page 109 .

B - If the relay picks up but the secondary air pump motor does not run:

- Test voltage supply of secondary air pump motor=>Page 110 .

Testing voltage supply of secondary air pump relay



- Disconnect secondary air pump relay.
- -> Connect hand-held multimeter (voltage test range) as follows:

3-way relay carrier (electronics box in plenum chamber) socket position 2: contact	Test against
8	Engine earth

  - Specification: approx. battery voltage

If the specification is not obtained:

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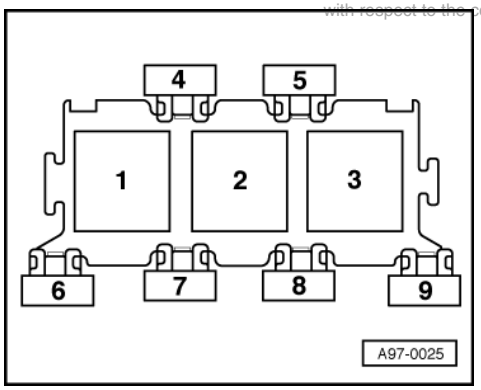
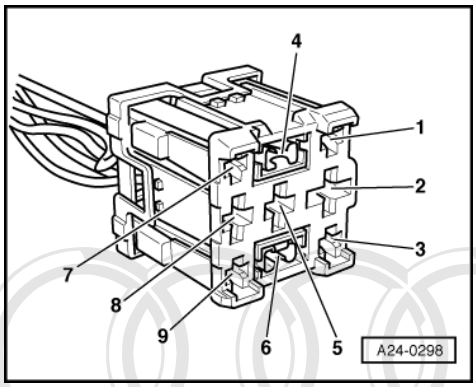


- Carry out the following tests (marked with dots):

• -> Test fuse No. S130 (40 A) in 3-way relay carrier in electronics box, in plenum chamber, socket position 7

- Test for open circuit in wiring from battery + (terminal 30) via fuse No. S130 to secondary air pump relay - J299 (located in socket position 2 of 3-way relay carrier in electronics box in plenum chamber.)

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



- -> Connect hand-held multimeter (voltage test range) as follows:

3-way relay carrier (electronics box in plenum chamber) socket position 2: contact	Test against
4	Engine earth

- Operate starter briefly.
  - Specification: approx. battery voltage

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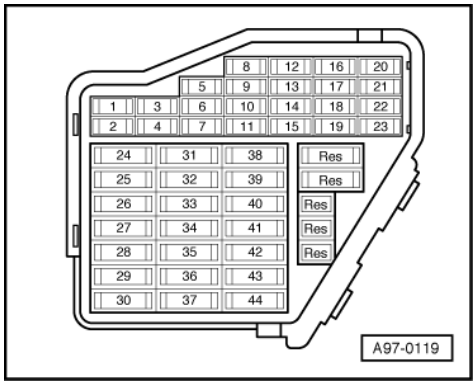
If the specification is not obtained:

- Carry out the following tests (marked with dots):

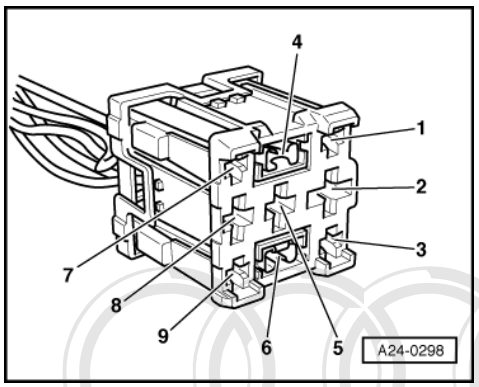


- -> Test fuse No. S234 (in fuse box, socket 34).
- Test for open circuit in wiring from secondary air pump relay -J299 (located in 3-way relay carrier in electronics box in plenum chamber) to fuel pump relay via fuse No. S234 (in fuse box, socket 34).

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

Testing activation of secondary air pump relay

- Switch off ignition.
- Disconnect secondary air pump relay.



- -> Connect voltage tester V.A.G 1527 B as follows:

3-way relay carrier (electronics box in plenum chamber) socket position 2: contact	Test against
6	Engine earth

- Start final control diagnosis and activate secondary air pump relay -J299 =>Page 17 .
  - The LED should flash.

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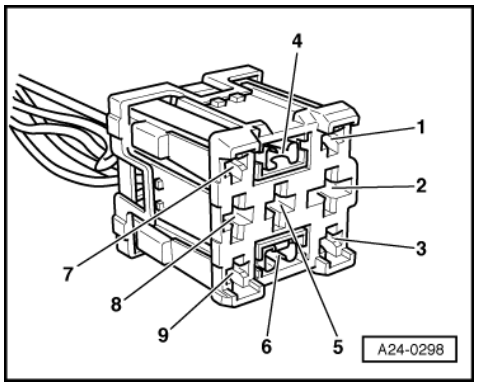
If the LED does not flash:

- Switch off ignition.
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself. => Page 41 .



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

3-way relay carrier (electronics box in plenum chamber) socket position 2: contact	Test box V.A.G 1598/31 socket
6	66

- Rectify any open/short circuit as necessary.

If no fault is found:

- Fit a new secondary air pump relay -J299.

Testing voltage supply to secondary air pump motor

- Unplug connector from secondary air pump motor -V101.
- Connect voltage tester V.A.G 1527 B between contacts 1 and 2.
- Start final control diagnosis and activate secondary air pump relay -J299 =>Page 17 .

- The LED should light up.

If the LED does not light up:

- Carry out the following tests (marked with dots):

• Test for open circuit in wiring from connector for secondary air pump motor -V101 to secondary air pump relay -J299 (located in 3-way relay carrier in electronics box in plenum chamber, socket position 2)

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

• Test for open circuit in wiring from connector for secondary air pump motor -V101 to earth connection 1 in engine compartment harness

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

If no fault is found:

- Renew secondary air pump motor -V101.

7 - Testing electronic engine power control (electronic throttle)

7.1 - Testing electronic engine power control (electronic throttle)

7.2 - Operation of electronic throttle system

With the electronic throttle the throttle valve is not operated by a cable connected to the accelerator pedal. There is no mechanical link between the accelerator and the throttle valve.

The position of the accelerator pedal is communicated to the engine control unit by two accelerator position senders (variable resistors, both fitted in a single housing) which are connected to the accelerator pedal.

The accelerator position (as determined by the driver) is one of the main input values for the engine control unit.

The throttle valve is actuated by a servomotor (throttle valve positioner) in the throttle valve control part over the full range of engine speeds and load conditions.

The throttle valve positioner actuates the throttle valve according to the commands it receives from the engine control unit.

When the engine is running (i.e. under load) the engine control unit can open and close the throttle valve freely (i.e. independently of the signals being sent by the accelerator position sender).

The electronic throttle is not simply a combination of two or three components, but rather a complete system comprising all the elements that together determine the position of the throttle valve and also control and monitor it. For example, the accelerator position sender, throttle valve control part, EPC warning lamp, engine control unit etc.

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7.3 - Testing throttle valve control part -J338

The housing for the throttle valve control part contains the following components (the housing must not be opened):

- Throttle valve drive -G186

(This is an electric motor activated by the engine control unit. The motor opens the throttle valve by applying force to overcome the spring pressure.)
- Angle sender for throttle valve drive -G187
- Angle sender 2 for throttle valve drive -G188

Note:

The angle senders are in the form of potentiometers (variable resistors). Each sends its own separate signal to inform the engine control unit of the position of the throttle valve (i.e. one of the signals is redundant).

The potentiometers cannot be adjusted mechanically. Adaption can be performed using the basic setting function (function 04) with vehicle diagnostic, testing and information system VAS 5051 or with fault reader V.A.G 1551 or 1552.

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7.4 - Performing adaption of throttle valve control part

The adaption process enables the engine control unit to learn the different positions of the throttle valve with the ignition switched on and the engine not running. These positions are stored in the control unit. The feedback signal indicating the position of the throttle valve comes from the two angle senders for throttle valve drive.

If the throttle valve control part -J338 or the engine control unit is removed and refitted or replaced, or if the power supply to the engine control unit is interrupted, an adaption must be performed.

The learning process (adaption process) is carried out:

- By selecting "Basic setting" (function 04), Display Group 60 with the ignition switched on.
- Automatically if the ignition is switched on for at least 6 seconds without operating the starter or depressing the accelerator, and if the engine control unit registers a "learning requirement". (In this case, however, there is no way of knowing whether the adaption process was successful or not.) The engine control unit will register a learning requirement if the previously stored voltage readings from the angle senders do not correspond (within a certain tolerance range) to the new voltage readings.

Test conditions

- No faults stored in fault memory
  => Page 4 , Interrogating fault memory
- Accelerator not depressed
- Coolant temperature between 5°C and 100°C
- Intake air temperature above 5°C
- Power supply to engine control unit more than 11 V
  Testing =>Page 136

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.

-> Indicated on display:

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

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

-> Indicated on display:

```
Basic setting
Enter display group number     XXX
```

- Press keys 0, 6 and 0 for Display Group 60 and confirm entry with Q key.

-> Indicated on display:

```
System in basic setting 60
     1     2     3     4
```

When the Q key is pressed the current supply to the throttle valve positioner will be disconnected.

In this condition the throttle valve is pulled into an "emergency running" or default position by a spring in the throttle valve control part. The values supplied by the two angle senders for this position are stored in the engine control unit.

The throttle valve is then opened by a predetermined amount. As soon as it reaches this position the current supply to the throttle valve positioner is again disconnected. The spring should then close the throttle valve mechanically to the previously learned default position within a specified period of time (spring test).

The throttle valve positioner then closes the throttle valve and the values supplied by the angle senders in the throttle valve control part are stored in the engine control unit.

If the engine control unit disconnects the current supply to the throttle valve positioner while the vehicle is being driven, the result will be an increase in idling speed with fluctuating engine rpm (hunting) and very slow throttle response.

- Check display values for throttle valve control part (display zones 3 and 4).

	Display zones			
	1	2	3	4
Display Group 60: Adaption of throttle valve control part with ignition on				
Display	x.x %	x.x %	---	---
Indicates	Throttle valve angle (angle sender 1)	Throttle valve angle (angle sender 2)	**Learning stage counter**	**Adaption status**
Range	min.: 0 % max.: 100 %	min.: 0 % max.: 100 %	**0 to 8**	**ADP running** **ADP O.K.** **ADP ERROR**
Specification	xxx %	xxx %	**Learning stage counter must run from 0 to 8 during adaption process (some digits may also skip).**	**ADP running**
Note			**If specification is not met: notes => Page 113 .**	

- Check display values for throttle valve control part (display zones 3 and 4).

	Display zones			
	1	2	3	4
Display Group 60: Adaption of throttle valve control part with ignition on				
Display	x.x %	x.x %	---	---
Indicates	Throttle valve angle (angle sender 1)	Throttle valve angle (angle sender 2)	**Learning stage counter**	**Adaption status**
Range	min.: 0 % max.:100%	min.: 0 % max.: 100%	**0 to 8**	**ADP running** **ADP O.K.** **ADP ERROR**
Specification	xxx %	xxx %	8	**ADP O.K.**
Note			**If specification is not met: notes => Page 113**	

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Note:

If the adaption process is terminated by the control unit and the tester display shows "Function is unknown or cannot be carried out at the moment", the cause could be one of the following:

- All test conditions must be met=>Page 112 .
- The throttle valve is unable to close completely (e.g. because of dirt)
- Throttle valve control part or wiring is defective.
- The engine was started or the accelerator depressed during the adaption process.

- Distortion of throttle valve housing (check bolts)

- End the engine basic setting by pressing the⇒ key.
- Press keys 0 and 6 for the "End data transfer" function and confirm input with the Q key.

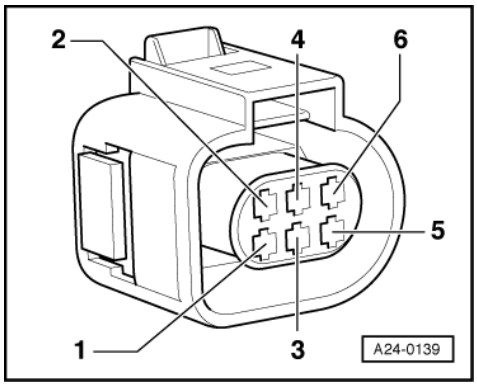
7.5 - Testing angle senders for throttle valve drive -G187 and -G188

The angle senders for throttle valve drive (-G187 and -G188) inform the engine control unit of the position of the throttle valve. Both angle senders are located in the throttle valve control part.

If a fault affecting angle senders for throttle valve drive -G187 or -G188 is recorded in the memory, test voltage supply to throttle valve control part.

Testing voltage supply to throttle valve control part

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



- -> Connect hand-held multimeter (voltage range) between the following sockets on the connector:

6-pin connector on wiring harness, socket	Specification
2 + earth	approx. 5 V
2 + 6	approx. 5 V

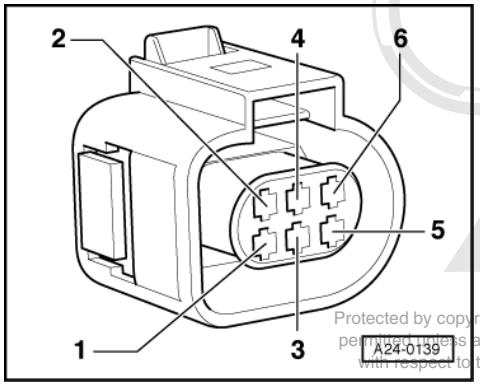
If the specifications are not obtained, test wiring connections from engine control unit to throttle valve control part => Page 114 .

If the readouts match the specifications, test also the signal wires and activation wires for the throttle valve positioner => Page 114 .

Testing wiring for voltage, signal and activation

- Unplug connector from throttle valve control part.

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .



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Test the following wiring connections for open circuits and short to positive or earth.

6-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
1	92
2	83
3	117
4	84
5	118
6	91

Resistance in wiring: max. 1.5 ω

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- Rectify any open/short circuit as necessary.

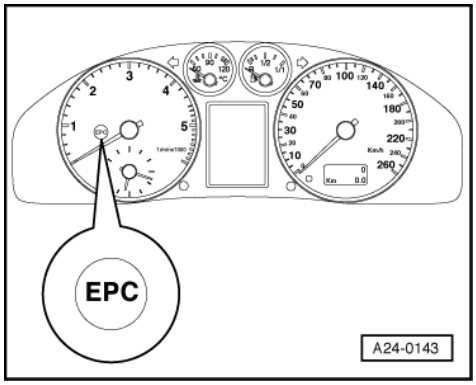
=> Current flow diagrams, Electrical fault finding and fitting locations binder

If no fault is detected:

- Fit a new throttle valve control part.

7.6 - Notes on EPC warning lamp (fault warning lamp for electronic throttle -K132)

"EPC" stands for Electronic Power Control and refers to the electronic throttle control system.



-> Fitting location of EPC warning lamp

The engine control unit switches on the EPC warning lamp when the ignition is switched on.

After the engine has been started, the engine control unit tests all parts for faults relating to the electronic throttle control system.

During this test sequence the EPC warning lamp lights up for about 3 seconds. If a fault is detected during this test phase the warning lamp will remain lit.

If a fault is detected in the electronic throttle system while the engine is running, the engine control unit will activate the EPC warning lamp (see Fault Table for list of possible faults). At the same time a fault code is stored in the fault memory of the engine control unit.

Testing operation of warning lamp

- Start engine.

Specification: if no faults relating to the electronic throttle are stored in the fault memory, the EPC warning lamp should light up for about 3 seconds after the engine is started.

If the EPC warning lamp does not light up:

- Test wiring from engine control unit to EPC warning lamp in dash panel insert as follows:

If the EPC warning lamp lights up for more than three seconds (or if lamp is constantly lit), test wiring connections for short to earth
=>Page 116 .

Testing wiring from engine control unit to EPC warning lamp in dash panel insert

- Switch off ignition.
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .
- Jump sockets 1 and 48 using test leads from V.A.G 1594.
- Switch ignition on.

The EPC warning lamp should light up.

If the EPC warning lamp does not light up:

- Test EPC warning lamp in dash panel insert (to find out if it is burnt out) and warning lamp's power supply using current flow diagram.

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

If warning lamp and its power supply are okay, check wiring connection to dash panel insert using current flow diagram.

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

If no fault is found in wiring connection:

- Renew engine control unit -J220
  => Page 42 .

Testing wiring connections for short to earth

- Start the engine and allow it to run at idling speed.

  Specification: EPC warning lamp should go out.

If the EPC warning lamp does not go out:

- Interrogate fault memory of engine control unit.

If no faults are stored:

- Switch off ignition.
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

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Test the following wiring connection for short to earth.

Test box V.A.G 1598/31, socket	Dash panel insert, socket
48	=> Current flow diagrams, Electrical fault finding and Fitting locations binder

Specification: infinity ω(open circuit)

If specification is not met:

- Rectify short to earth in wiring connection between engine control unit and EPC warning lamp using current flow diagram.

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

If no fault is found in wiring:

- Renew engine control unit -J220
  => Page 42 .

8 - Testing accelerator position senders -G79 and -G185

8.1 - Testing accelerator position senders -G79 and -G185

Accelerator position senders -G79 and -G185 are located on the accelerator pedal. Both senders inform the engine control unit of the driver's throttle requirement (pedal position), but each functions completely independently of the other (redundancy principle). Both senders are located in a single housing.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.

-> 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      Q
Enter display group number     XXX
```

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- Press the keys 0, 6 and 2 to select Display Group 62 and confirm entry with Q key.

-> Indicated on display:

```
Read measured value block 62
     1     2     3     4
```

- Check display values for electronic throttle potentiometer voltages.

	Display zones			
	1	2	3	4
Display Group 62: Electronic throttle potentiometer voltages with ignition on				
Display	xx %	**xx %**	xx %	**xx %**
Indicates	Throttle valve angle (angle sender 1)	**Throttle valve angle (angle sender 2)**	Accelerator position sender	**Accelerator position sender 2**
Range	min.: 0 % max.: 100 %	**min.: 0 % max.: 100 %**	min.: 0 % max.: 100 %	**min.: 0 % max.: 100 %**
Specification	3...93 %	**97...3 %**	12...97 %	**4...49 %**

Note:

The engine control unit converts the voltage readings from the angle senders into percentages of 5 V and displays them as percentages. (A signal voltage of 5 V is equivalent to 100%.)

- Observe display zones 3 and 4.
- Slowly depress accelerator to full throttle position.

The percentage value in display zone 3 should rise steadily between 12 and 97 % but without covering the full range of values.

The percentage value in display zone 4 should also rise steadily but without covering the full range of values (in this case 4...49 %).

Note:

The value shown in display zone 3 should always be about double the value shown in display zone 4.

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If the display values do not appear as described:

- Test voltage supply and wiring to accelerator position senders
  =>Page 114 .

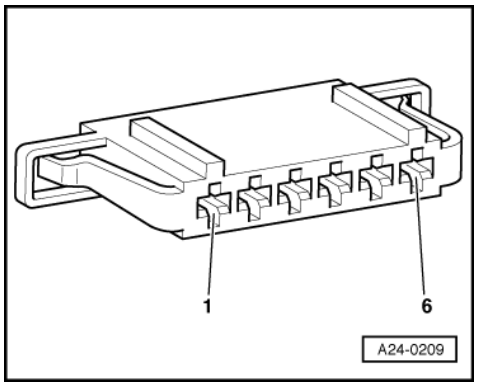
Testing voltage supply to accelerator position senders

- Remove storage compartment on driver's side.

=> General body repairs, Interior; Repair group 68; Storage compartments, covers and trim parts; Removing and installing driver's storage compartment Storage compartments, covers and trim parts Removing and installing driver's storage compartment

- Unplug connector for accelerator position sender.

Note:



The connector is clipped onto the pedal bracket near the brake light switch.

Left-hand drive vehicles:

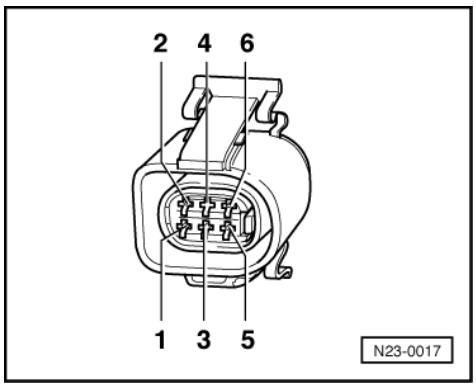
- Switch ignition on.
- -> Connect hand-held multimeter (voltage range) between the following sockets on the connector:

6-pin connector on wiring harness, socket	Specification
1 + earth	approx. 5 V
1 + 5	approx. 5 V
2 + earth	approx. 5 V

6-pin connector on wiring harness, socket	Specification
2 + 3	approx. 5 V

Right-hand drive vehicles

- Switch ignition on.



- -> Connect hand-held multimeter (voltage range) between the following sockets on the connector:

6-pin connector on wiring harness, sockets	Specification
2 + earth	approx. 5 V
2 + 3	approx. 5 V
5 + earth	approx. 5 V
5 + 4	approx. 5 V

All models

If the specifications are obtained:

- Test the signal wiring => Page 119 .

If the specifications are not obtained:

- Test wiring between engine control unit and accelerator position senders => Page 119 .

Testing signal wiring and wiring connections between accelerator position senders and engine control unit

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

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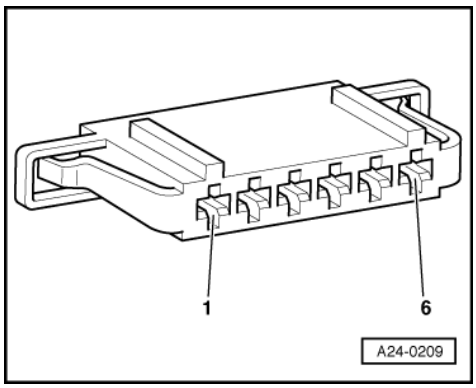
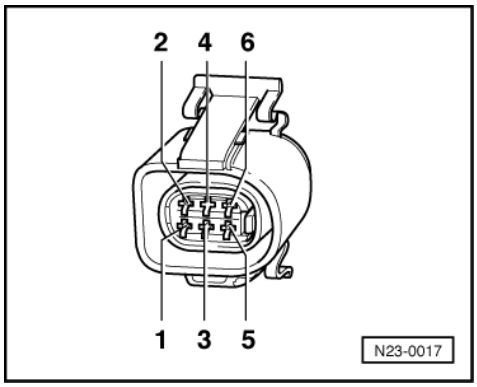
Left-hand drive vehicles



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

Connector Socket	Test box V.A.G 1598/31 Socket
1	72
2	73
3	36
4 (signal wiring)	35
5	33
6 (signal wiring)	34

Right-hand drive vehicles



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

Connector Socket	Test box V.A.G 1598/31 Socket
1 (signal wiring)	35
2	73
3	36
4	33
5	72
6 (signal wiring)	34

All models

- Rectify any open/short circuit as necessary.

If no fault is detected:

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- Renew accelerator position senders.

=> Fuel supply system, Petrol engines; Repair group 20; Servicing accelerator linkage - right-hand drive vehicles Servicing accelerator linkage - right-hand drive vehicles

8.2 - Testing kick-down switching point

The kick-down switch in vehicles with an automatic gearbox has to be programmed if the engine control unit or accelerator pedal have been renewed.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)

When doing this the ignition must be switched on.

-> 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:

```
Basic setting
Enter display group number XXX
```

- Press keys 0, 6 and 3 to select "Display group 63" and confirm entry with the Q key.

-> Indicated on display:

```
Basic setting      63
     1     2     3     4
```

- Observe display in display zone 4.

	Display zones			
	1	2	3	4
Display group 63: Programming kick-down switch				
Display	xx %	**xx %**	Kick down	Operate
Indicates	Accelerator position sender 1	**Accelerator position sender 2**	**Switch**	Programming
Range	min.: 12 % max.: 97 %	**min.: 4 % max.: 49 %**	**Kick down**	Operate ADP runs ADP OK ADP ERROR
Specification	10...20 %	**4...10 %**	**Kick down**	Operate
Note				

- Press accelerator pedal beyond kick-down pressure point to floor.
- Hold pedal at this point for at least 2 seconds.

	Display zones			
	1	2	3	4
Display group 63: Programming kick-down switch with ignition on				
Display	xx %	**xx %**	Kick down	ADP OK
Indicates	Accelerator position sender 1	**Accelerator position sender 2**	**switch**	Programming
Range	min.: 12 % max.: 97 %	**min.: 4 % max.: 49 %**	**Kick down**	Operate ADP runs ADP OK ADP ERROR
Specification	85...95 %	**40...50 %**	**Kick down**	ADP OK
Note				If specification is not met, kick-down switch must be re-programmed when display reads "ERROR"

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8.3 - Checking brake light switch -F and brake pedal switch -F47

Because the injection system operates with an accelerator pedal sender (potentiometer) which may be defective, the engine is throttled back for reasons of safety when the brakes are operated. To do this the control unit

requires signals from the brake light switch and also the brake pedal switch. This means that if the brakes are operated when the accelerator pedal is held at a constant position the engine speed is immediately reduced by the control unit. Badly adjusted switches can cause the engine to be throttled back when this is not desired.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.

-> 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
```

- Press keys 0, 6 and 6 to select Display group 66 and confirm entry with the Q key.

-> Indicated on display:

```
Read measured value block 66
     1     2     3     4
```

- Observe display in display zone 2.

	Display zones			
	1	2	3	4
Display group 66: Signals to engine control unit with ignition on				
Display	xxx km/h	**0 0 0 0**	xxx km/h	0 0 0 0
Indicates	Actual speed	**Switch positions**	**Specified speed**	Switch positions for cruise control system
Range		**off = 0 on = 1**		off = 0 on = 1
Specification		**0 0 0 0**		
Note		**Relevance of figures => Page 122**		

- Depress brake pedal

Relevance of figures in 4-digit readout in display zone 2

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x	x	x	x	**Display zone 2**
			X	**Brake light switch 0 = Brake pedal not depressed 1 = Brake pedal depressed**
		X		**Brake pedal switch 0 = Brake pedal not depressed 1 = Brake pedal depressed**
	X			Clutch pedal switch 0 = Clutch pedal not depressed 1 = Clutch pedal depressed
X				Cruise control system (CCS) 0 = CCS deactivated 1 = CCS enabled

	Display zones			
	1	2	3	4
Display group 66: Signals to engine control unit				
Display	xxx km/h	**0 0 1 1**	xxx km/h	0 0 0 0
Indicates	Actual speed	**Switch positions**	**Specified speed**	Switch positions for cruise control system
Range		**off = 0 on = 1**		off = 0 on = 1
Specification		**0 0 1 1**		
Note		**Both readouts must change from 0 to 1.**		

- Allow brake pedal to return slowly to its normal position.
- Both readouts should return from 1 to 0.

If one or both of the displays does not change from 0 to 1:

- Test voltage supply
  => Page 123 .

Testing voltage supply

- Remove storage compartment on driver's side.

=> General body repairs, Interior; Repair group 68; Storage compartments, covers and trim parts; Removing and installing driver's storage compartment Storage compartments, covers and trim parts Removing and installing driver's storage compartment

- Unplug 4-pin connector on brake pedal.
- Connect hand-held multimeter (voltage range) between the following sockets on the connector:
- Switch ignition off.

4-pin connector on wiring harness, socket	Specification
1 + earth	Battery voltage

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- Switch ignition on.

4-pin connector on wiring harness, socket	Specification
3 + earth	Battery voltage

If specifications are met:

- Test wiring connections => Page 123 .

If specifications are not met:

- Test wiring connections from sockets 1 and 3 of connector for open circuit or short to earth.

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

- Rectify any open/short circuit as necessary.

Checking wiring connections

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.

=> Page 41 .

Test the following wiring connections for open circuits and short to positive or earth:

4-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
2	56
4	55

Resistance in wiring: max. 1.5 ω

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

- Rectify any open/short circuit as necessary.

If no open circuits are found in wiring:

- Renew brake light switch / brake pedal switch.

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8.4 - Testing clutch pedal switch -F36

This signal prevents engine speed fluctuations and load change jolts when the clutch is disengaged. The signal is also required for the cruise control system.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.

-> 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
```

- Press keys 0, 6 and 6 to select Display group 66 and confirm entry with the Q key.

-> Indicated on display:

```
Read measured value block 66
     1     2     3     4
```

- Observe display in display zone 2.

	Display zones			
	1	2	3	4
Display group 66: Signals to engine control unit				
Display	xxx km/h	**0 0 0 0**	xxx km/h	0 0 0 0
Indicates	Actual speed	**Switch positions**	**Specified speed**	Switch positions for cruise control system
Range		**off = 0 on = 1**		off = 0 on = 1
Specification		**0 0 0 0**		

	Display zones			
Note		Relevance of figures => Page 125		

- Depress clutch pedal

Relevance of figures in 4-digit readout in display zone 2

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x	x	x	x	Display zone 2
			X	Brake light switch 0 = Brake pedal not depressed 1 = Brake pedal depressed
		X		Brake pedal switch 0 = Brake pedal not depressed 1 = Brake pedal depressed
	X			**Clutch pedal switch** **0 = Clutch pedal not depressed** **1 = Clutch pedal depressed**
X				Cruise control system (CCS) 0 = CCS deactivated 1 = CCS enabled

	Display zones			
	1	2	3	4
Display group 66: Signals to engine control unit				
Display	xxx /rpm	**0 1 0 0**	xxx km/h	0 0 0 0
Indicates	Actual engine speed	**Switch positions**		Switch positions for cruise control system
Range		**off = 0 on = 1**		off = 0 on = 1
Specification		**0 1 0 0**		
Note		**Readout must change from 0 to 1**		

- Allow clutch pedal to return slowly to its normal position.
- Readout should return from 1 to 0.

If readout does not change from 0 to 1:

- Test voltage supply => Page 125 .

Testing voltage supply

- Remove storage compartment on driver's side.

=> General body repairs, Interior; Repair group 68; Storage compartments, covers and trim parts; Removing and installing driver's storage compartment Storage compartments, covers and trim parts Removing and installing driver's storage compartment

- Unplug 2-pin connector from clutch pedal.
- Switch on ignition.
- Connect hand-held multimeter (voltage range) between the following sockets on the connector:

2-pin connector on wiring harness Socket	Specification

1 + earth	Battery voltage

If specification is obtained:

- Test wiring connections => Page 126 .

If specification is not obtained:

- Test for open circuit or short to earth in wiring between fuel pump relay and contact 1 on connector via fuse.

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

Testing wiring connection

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

Test the following wiring connections for open circuits and short to positive or earth.

2-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
2	39

Resistance in wiring: max. 1.5 ω

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

- Rectify any open/short circuit as necessary.

If no open circuits are found in wiring:

- Renew clutch pedal switch.

9 - Testing auxiliary signals

9.1 - Testing auxiliary signals

9.2 - Checking engine speed signal

Note:

The signal generated by engine speed sender -G28 is processed by the engine control unit and transmitted via contact 37 (on the engine control unit) to various electronic systems, e.g. the air conditioner control unit, automatic gearbox and ABS/EDL. These systems monitor the engine speed signal and the wiring.

To obtain engine speed, proceed as follows:

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the ignition must be switched on.

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-> Indicated on display:

```
Rapid data transfer      HELP
Enter address word XX
```

- Test all control units for a missing rpm signal via the "Automatic test sequence."
- Press the 0 key twice to select "Automatic test sequence" function and confirm entry by pressing Q key.

No faults relating to a "missing engine speed signal" should be stored in any of the control units.

If one of the control units indicates a fault:

- Test for open circuit or short circuit between engine control unit and the control unit concerned.

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

9.3 - Testing fuel consumption signal

This signal is required for the fuel consumption indicator in the dash panel insert.

If the the dash panel insert shows an incorrect fuel consumption rate:

- Adjust the fuel consumption indicator so that it shows the actual fuel consumption rate.

=> Electrical system; Repair group 01; Self-diagnosis of dash panel insert; Adaption Self-diagnosis of dash panel insert Adaption

If the dash panel insert does not show any fuel consumption rate:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

Test the following wiring connections for open circuits and short to positive or earth.

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Test box V.A.G 1598/31, socket	Dash panel insert, contact
81	=> Current flow diagrams, Electrical fault finding and Fitting locations binder

- Rectify any open/short circuit as necessary.

9.4 - Testing crash signal

In the event of an accident (crash) in which the airbags/belt tensioners are triggered, the engine control unit switches of the activation of the fuel pump relay. This prevents excessive loss of fuel should the fuel system be damaged.

As long as the fault reading "Crash switch-off triggered" is stored in the engine control unit or until the fault reading is erased, the engine control unit disables the initial fuel pump delivery when the ignition is switched on (i. e. no supply pressure is built up in the fuel system). This can result in a delayed engine start.

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect the engine control unit itself => Page 41 .

Test for open circuit and short to positive or earth in the following wiring connections.

Test box V.A.G 1598/31, socket	Airbag control unit, contact
67	=> Current flow diagrams, Electrical fault finding and Fitting locations binder

Wiring resistance: not more than 1.5 ohm

- Rectify short circuit or open circuit if necessary.

If wiring is O.K:

- Interrogate fault memory in airbag control unit.

9.5 - Testing road speed signal

Notes:

- The road speed signal is generated by the road speed sender -G68 (on the gearbox) and is processed in the dash panel insert.
- The processed signal goes to contact 54 on the engine control unit and is used for idling speed stabilisation and for the damping of load change jolts when changing gear.

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- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

-> 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
```

- Press keys 0, 0 and 5 to select Display Group 5 and confirm entry with Q key.

-> Indicated on display:

```
Read measured value block 5
     1     2     3     4
```

- Take 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 35 .

- Check display value for vehicle speed.

	Display zones			
	1	2	3	4
Display Group 5: Vehicle speed				
Display	xxxx rpm	xxx.xx %	**xxx km/h**	Text
Indicates	Actual engine speed (in steps of 40 rpm)	Engine load	**Vehicle speed**	Operating status
Range	min.: 750 rpm max.: 6800 rpm	min.: 0 % max.: 120.00 %	**min.: 0 km/h** **max.: 250 km/h**	Idling / part throttle / full throttle / overrun cut-off / acceleration enrichment
Specification	xxxx rpm	xxx.xx %	**current speed**	---

	Display zones			
Note			The display should show the approximate current speed (compare with speedometer reading). If readout does not match specification, test wiring =>Page 129	

If the vehicle speed is not displayed:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

Test the following wiring connections for open circuits and short to positive or earth.

Test box V.A.G 1598/31, socket	Dash panel insert, contact
54	=> Current flow diagrams, Electrical fault finding and Fitting locations binder

Resistance in wiring: max. 1.5 ω

- Rectify any open/short circuit as necessary.

If no wiring fault is detected:

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- Establish which electrical "consumers" (e.g. radio, automatic gearbox, air conditioner etc.) are using the speed signal, disconnect them one by one from the dash panel insert, then keep repeating the test until the cause of the problem has been identified.

9.6 - 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:
  - Under heavy acceleration (full throttle in 1st gear)
  - In emergency running mode (back-up)
  - If the coolant temperature exceeds 120°C
  - When a signal is received from the gearbox control unit (kickdown switch)
  - When the "Basic setting" function is started (function 04)

Test conditions

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

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

-> 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
```

- Press keys 0, 5 and 0 to select Display Group 50 and confirm entry with the Q key.

-> Indicated on display:

```
Read measured value block 50
Enter display group number XXX
```

- Check air conditioner compressor shut-off (display zone 4).

	Display zones			
	1	2	3	4
Display Group 50: Signals to engine control unit				
Display	xxx rpm	xxx rpm		**Compr. OFF**
Indicates	Actual engine speed (true value)	Specified engine speed (theoretical value)		**A/C compressor status**
Range				**Compr. OFF Compr. ON**
Specification				**Compr. OFF**

- Switch on the air conditioner by pressing the "Auto" key. The compressor should run (display zone 4).
- Set air conditioner to maximum hot or cold air output.

	Display zones			
	1	2	3	4
Display Group 50: Signals to engine control unit				
Display	xxx rpm	xxx rpm		**Compr. ON**
Indicates	Actual engine speed (true value)	Specified engine speed (theoretical value)		**A/C compressor status**
Range				**Compr. OFF Compr. ON**
Specification				Compr. ON

- Floor and release the accelerator quickly (short blip).
  - Specification for display zone 4: The display should change from "Compr.ON" to "Compr.OFF" for a few seconds (air conditioner compressor shut-off during acceleration).

If the readout in display zone 4 is not as described:

- Switch off ignition.
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

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Test the following wiring connections for open circuits and short to positive or earth.

Test box V.A.G 1598/31, socket	A/C unit Contact
41	=> Current flow diagrams, Electrical fault finding and Fitting locations binder

Resistance in wiring: max. 1.5 ω

- Rectify any open/short circuit as necessary.

- 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

9.7 - Testing data exchange between engine control unit, ABS/EDL control unit and gearbox control unit

Notes:

- The data exchange between the various control units is carried out via a data bus.
- The term "bus" refers to a system for transmitting and distributing data.
- The wires which connect the control units and convey the data between them are called data wires.
- Data is transmitted via data wires in sequence, i.e. in a specific order to the connected control units (e.g. engine rpm and accelerator pedal position).

Testing bus system

If the fault table indicates that the data exchange between the engine control unit, gearbox control unit, ABS control unit and dash panel insert should be tested:

- Check that the multi-pin connectors on the control units are securely fitted.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.
- Press key 0 twice for address word "Automatic test sequence" and confirm entry with Q key. The V.A.G 1551 transmits all known address words one after the other.

When a control unit answers with its identification the number of stored faults appears on the display or "No fault recognised".

Any system faults that are stored will be displayed one after the other and printed out. The V.A.G 1551 will then transmit the next address word.

-> The automatic test sequence has ended when the following appears on the display:

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

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If the display shows faults relating to the "Data bus drive" or "No message from ...." :

- Read out the faults stored in the control units.
- Check that the vehicle is fitted with the correct control units for engine, gearbox, ABS, dash panel insert and AICC (Autonomous Intelligent Cruise Control - if fitted); check Part Nos. and coding.

If the correct control units are installed:

Testing a "two-wire bus system"

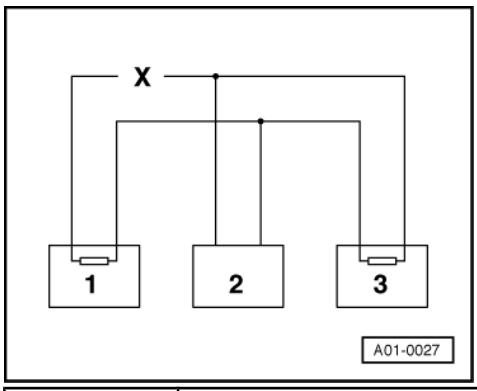
Three or more control units communicating via a "two-wire bus system"

- Read out the faults stored in the control units.

This will help to trace a fault in the wiring.

Example 1:

From the faults present in the fault memories, you can see that control unit 1 has no connection to control units 2 or 3.



Control unit	Faults present in fault memory:
1	- No message from control unit 2 - No message from control unit 3
2	- No message from control unit 1
3	- No message from control unit 1

- Switch off ignition.
- Disconnect the control units which are linked by the bus wires and check whether there is an open circuit in one of the bus wires

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

- If no fault can be found in the bus wires replace control unit 1.

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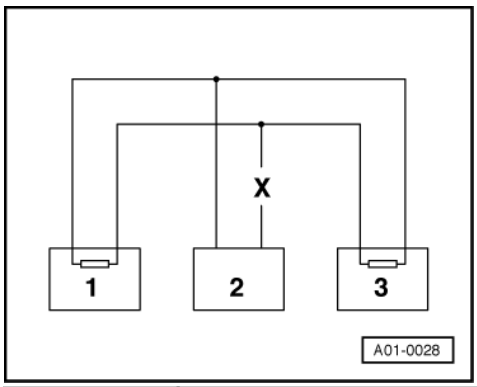
Example 2:

From the faults present in the fault memories, you can see that control unit 2 has no connection to control units 1 or 3.



Control unit	Faults present in fault memory:
1	- No message from control unit 2
2	- No message from control unit 1 - No message from control unit 3
3	- No message from control unit 2

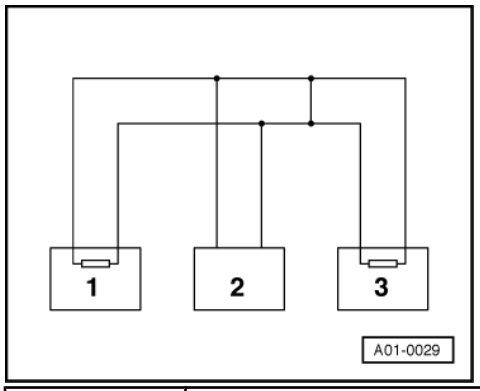
- Switch off ignition.
- Disconnect the control units which are linked by the bus wires and check whether there is an open circuit in one of the bus wires

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

- If no fault can be found in the bus wires replace control unit 2.

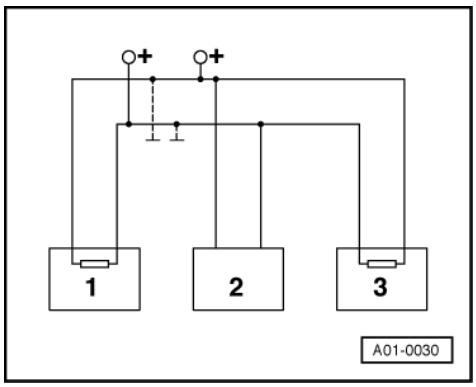
Example 3:

From the faults present in the fault memories, you can see that none of the control units are able to transmit or receive signals.



Control unit	Faults present in fault memory:
1	- Data bus drive defective
2	- Data bus drive defective
3	- Data bus drive defective

- Switch off ignition.
- -> Disconnect the control units which are linked by the bus wires and check for a short circuit between the bus wires



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

- -> Check the bus wires for short to positive and short to earth.

If the cause of the fault "Data bus drive defective" cannot be found in any of the bus wires, proceed as follows to check whether one of the control units is causing the fault.

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At this stage all the control units which communicate via the CAN data bus are disconnected. The ignition is switched off.

- Connect one of the control units.
- Connect fault reader V.A.G 1551. Switch on the ignition and erase the fault memory of the control unit which has just been connected. End output from fault reader with function 06 "End output".
- Switch the ignition off and then on again.
- Leave the ignition switched on for 10 seconds. Then interrogate the fault memory of the control unit that has just been connected, using the fault reader.
- If the fault "Data bus drive defective" is now indicated, replace the control unit which has just been connected.
- If the fault "Data bus drive defective" is not indicated, connect the next control unit, and repeat the above procedure.

28 - Ignition system

1 - Testing ignition system

1.1 - Testing ignition system

1.2 - General notes on ignition system

- The engine control unit is equipped with self diagnosis.
- For trouble-free operation of the electrical components a voltage of at least 11.5 V is necessary.
- During some of the tests it is possible that the control unit will detect and record a fault. The fault memory must therefore be interrogated and if necessary erased when all tests and repair work have been completed.
- After completing fault finding, repairs or component tests, it is possible that the engine will start, run for a short period and then cut out. If this happens it may be that the immobilizer is blocking the engine control unit. In such cases the fault memory must be interrogated and if necessary the control unit must be adapted.

1.3 - Safety precautions

To prevent injuries to persons and/or damage to the fuel injection and ignition system, note the following points:

- 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 the battery, otherwise the engine control unit may be damaged.
- 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 stages of the ignition coils and from all the injectors. After completing the work, interrogate and erase the fault memory.
- The ignition must always be switched off when cleaning the engine.

1.4 - Technical data for ignition system

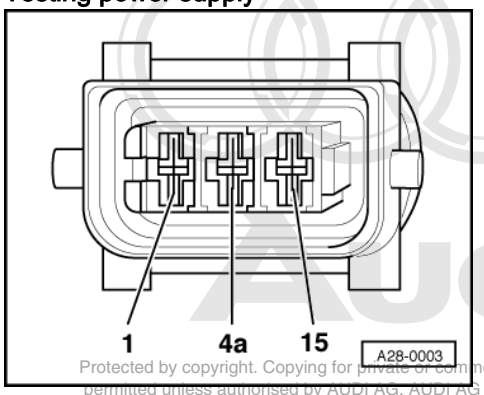
Engine code	APT 1.8 ltr./ 5V naturally aspirated / 92 KW
Idling speed Idling speed is not adjustable (controlled by idling speed stabilisation)	810...910 rpm
Maximum engine rpm Rpm limited by closing throttle	6800 ± 40 rpm
Ignition timing is determined by the control unit. Ignition timing cannot be adjusted.	
Ignition system	Dual-spark system with 2 ignition coils
Spark plugs	Tightening torque 30 Nm
Firing order	1-3-4-2

1.5 - Testing dual-spark ignition system (2 coils)

Note:
Each ignition coil is combined with its output stage as a single component.
It is not possible to test this component using conventional measuring equipment and methods.
If there is a fault in the ignition system:
- Test power supply => Page 135
- Test activation of output stages
  => Page 135

If the tests do not reveal any faults but there is still no ignition spark:
- Renew output stage with ignition coils.

Testing power supply



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- Unplug connector from ignition coils
  => Fitting locations overview, Page 36 .
- -> Connect hand-held multimeter (voltage test range) to contact 4a and to earth.
- Switch ignition on.

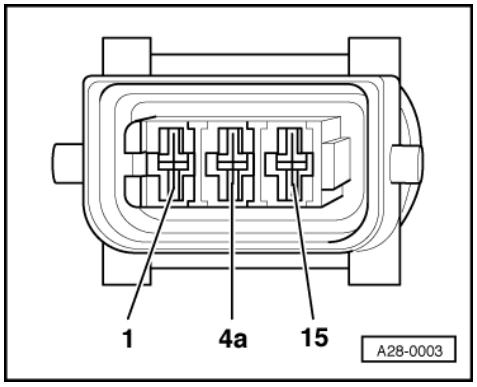
  Specification: approx. battery voltage

If the specification is not obtained:
- Check the wiring.

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

Testing activation of output stages
- Unplug the connectors from all four injectors.

Note:
It is important to ensure that no fuel is injected during the test as this would damage the catalytic converter. The connectors on the injectors must therefore be unplugged.
- Unplug connector on ignition coils
  => Fitting locations overview, Page 36 .
- Switch ignition on.

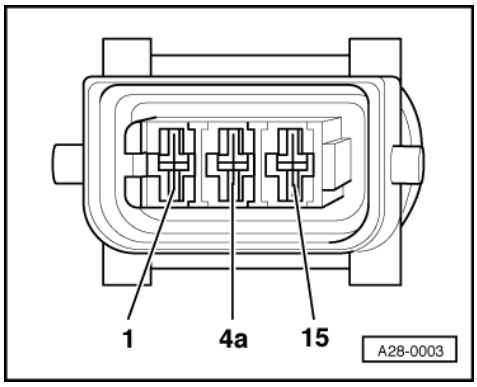


- -> Connect diode test lamp V.A.G 1527 to the following sockets on the connector:
- Operate starter for a few seconds.

3-pin connector on wiring harness, socket	Specification
1 + earth	Diode test lamp should flash (brief impulse)
15 + earth	

If the specifications are not obtained:

- Switch off ignition.
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .



Check the following wiring connections for open circuits and short to positive or earth.

3-pin connector on wiring harness, socket	Test box V.A.G 1598/22, socket
1	103
15	102

- Rectify any open/short circuit as necessary.

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

1.6 - Checking control unit voltage supply

Test requirements:

- Fuse for engine control unit OK

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

- Battery voltage at least 11 V
- Alternator OK

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2). When doing this the engine must be idling.

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-> 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
```

- Press keys 0, 0 and 4 to select Display Group 4 and confirm entry with Q key.

-> Indicated on display:

```
Read measured value block 4
     1     2     3     4
```

- Check readout for battery voltage (display zone 2).

	Display zones			
	1	2	3	4
Display Group 4: battery voltage with engine idling				
Display	xxxx rpm	xx.xxx V	xxx.x °C	**xxx.x °C**
Indicates	Engine speed	Battery voltage	Coolant temperature	**Intake air temperature**
Range	min.: 750 rpm max.: 6800 rpm	min.: 0.000 V max.: 15.000 V		
Specification	xxxx rpm	12.000...14.500 V	80.0...105.0 °C	**Between ambient temperature and 90 °C**
Note		If specification is not met => Page 137 Reading display zone 2		

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Reading Display Group 4

Display zone 2	Possible cause of fault	Fault remedy
Readout fluctuates between 10.000 and 14.500 V	- Loose contact	- Test voltage supply from terminals 15 and 30 => Page 137
0.000...10.000 V	- Battery discharged/ defective - Voltage regulator defective	- Test voltage supply from terminals 15 and 30 => Page 137 Test battery Test voltage regulator Test alternator
14.500...16.500 V	- Voltage regulator defective - Alternator defective	- Test voltage regulator Test alternator

Testing voltage supply from terminals 15 and 30

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .

- Connect hand-held multimeter V.A.G 1526 (voltage measurement range) to the following sockets on the test box:

Voltage supply from terminal 15

	Socket	Specification
Ignition on	1 (earth) + 3 (positive)	approx. battery voltage

	Socket	Specification
Ignition on	2 (earth) + 3 (positive)	approx. battery voltage

Voltage supply from terminal 30

	Socket	Specification
Ignition off	1 (earth) + 62 (positive)	approx. battery voltage
Ignition off	2 (earth) + 62 (positive)	approx. battery voltage

If the specifications are not obtained:

- Check the wiring.

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

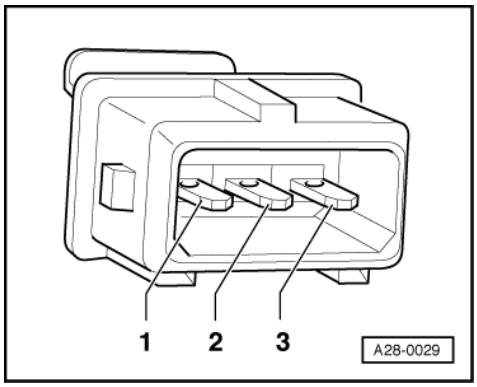
1.7 - Testing engine speed sender -G28

Notes:

- The engine speed sender is a combined speed sender and reference mark sender.
- Without a signal from engine speed sender -G28 the engine cannot be started.
- If the signal from engine speed sender -G28 fails while the engine is running, the engine will cut out immediately.

Testing engine speed sender

Fitting location of sender and connector
=> Page 36 .



- Before carrying out the test, make sure that the sender is correctly installed and firmly seated.
- Check for damage or metal particles on sender and sender wheel.
- Unplug connector for engine speed sender (grey connector).
- -> Connect hand-held multimeter V.A.G 1526 A (resistance test range) to contacts 1 and 2 on connector in connector support bracket using test lead from V.A.G 1594.

  Specification: approx. 450...1000 ω

Notes:

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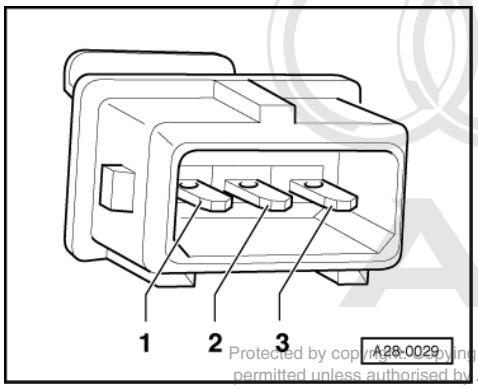
- The resistance value for the engine speed sender is based on a temperature of 20 °C.
- The resistance increases as the temperature rises.

If the specification is not attained:



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- Fit a new engine speed sender.

If the specification is attained:

- -> Connect hand-held multimeter V.A.G 1526 (resistance test range) between contacts 2 and 3 (earth) and between contacts 1 and 3 (earth).

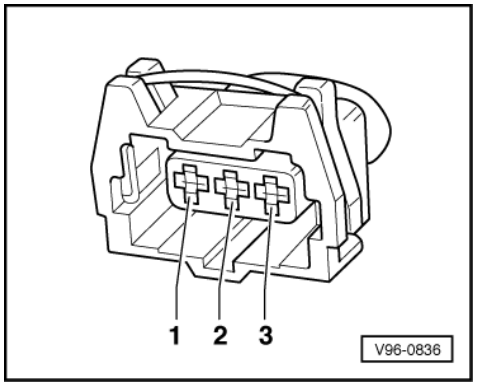
  Specification: ∞ω (infinity / open circuit) in each test

If the specification is not attained:

- Fit a new engine speed sender.

If the specification is attained:

- Test the wiring between the sender connector and the engine control unit as follows:
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .



- -> Test wiring connection from 3-pin connector (sender connector) ...
- ... to engine control unit for open circuit and/or short circuit to positive or earth.

3-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
1 (signal wire)	82
2 (earth wire)	90
3 (screening)	108

Resistance in wiring: max. 1.5 ω

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

- Rectify any open/short circuit as necessary.

If no fault is found in the wiring:

- Slowly rotate the engine and check that sender wheel has no run-out and is securely mounted.
- If no faults have been found in any of the tests so far, fit a new engine control unit =>Page 42 .

1.8 - Testing knock sensor control limit

If the fault message "Knock sensor - control limit reached" is recorded in the fault memory the following tests must be carried out:

	Possible cause of fault	Fault remedy
Fault message relating to all cylinders or cylinders 1/2 or 3/4	- Poor fuel quality	- Change to higher quality fuel (see Owner's Manual)
	- Wrong tightening torque on knock sensor	- Loosen knock sensor, then tighten to 20 Nm
	- Knock sensor defective	- Test knock sensor => Page 140 .
	- Corrosion on connector	
	- Loose components on engine	- Secure loose components
Fault message relating to one cylinder	- Mechanical engine damage	- Test compression pressure
	- Loose components on engine	- Secure loose components

1.9 - Testing knock sensors -G61 and -G66

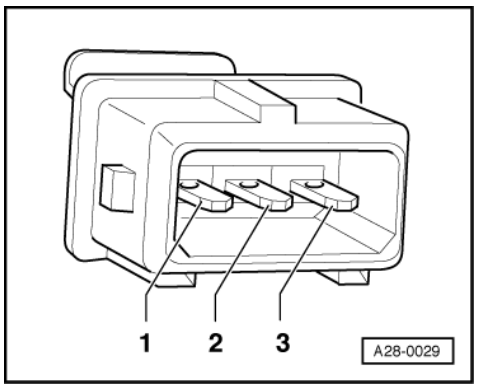
Notes:

- It is not possible to carry out an electrical test of knock sensors -G61 and -G66 themselves. ("Interrogate fault memory" => Page 4 .)
- To ensure that the knock sensors function properly it is important to keep exactly to the specified tightening torque of 20 Nm.
- Check connectors for corrosion.
- Use only gold-plated contacts when repairing the contacts in the plug connectors for the knock sensors.
- Check for corrosion in connection between knock sensor and wiring harness.

Testing knock sensors

Fitting location of connectors => Page 36 .

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



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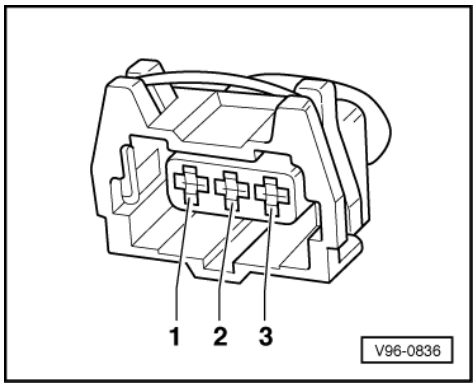
- -> Test for short circuits between all three contacts in the knock sensor connector (contacts 1+2, 1+3 and 2+3).

  Specification: There must be no contact between the wires (infinity ω).

- If there is a connection between the contacts, fit a new knock sensor.
- If there is no short circuit, test wiring for knock sensors.

Testing wiring between knock sensors and engine control unit



- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .
- -> Test wiring connection from the relevant sensor connector ...
- ... to engine control unit for open circuit and/or short to positive or earth.

Knock sensor 1 -G61 (cylinders 1 and 2)

3-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
1 (signal)	106
2 (earth)	99
3 (screening)	108

Knock sensor 2 -G66 (cylinders 3 and 4)

3-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
1 (signal)	107
2 (earth)	99
3 (screening)	108

Resistance in wiring: max. 1.5 ω

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

- Rectify any open/short circuit as necessary.

1.10 - Testing Hall sender -G40

The Hall sender indicates the ignition position for Cylinder 1.

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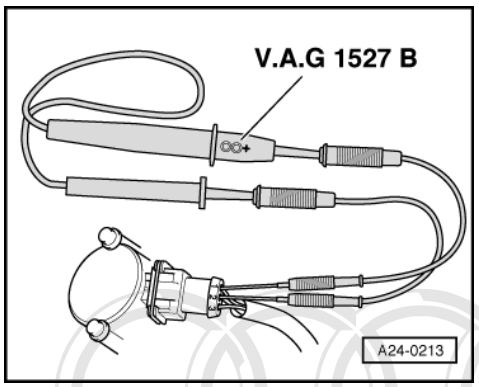
If the Hall sender fails to function, the knock control is switched off and the ignition timing is retarded slightly because the signals can no longer be assigned to the cylinders.

Even without a signal from the Hall sender the engine will continue to run and can also be re-started.

- When a fault is detected the engine control unit produces one spark per crankshaft revolution for each cylinder.
- The fact that the injection system is one revolution out of phase does not have any noticeable effect on the fuel injection. If this happens, the fuel is injected upstream of the closed inlet valve instead of while the inlet valve is open. This has only a minor influence on the quality of the air/fuel mixture.



Testing activation of Hall sender

Use test leads from adapter set V.A.G 1594 when carrying out the following tests.

Fitting location of Hall sender -G40 =>Page 36 .

- Push back rubber sleeve on Hall sender connector.
- -> Connect diode test lamp V.A.G 1527 to contacts 1 and 2 of the Hall sender connector from behind (without unplugging the connector from the Hall sender).

Note:

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

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- Operate starter for a few seconds.

The diode test lamp should flash briefly once every two engine revolutions.

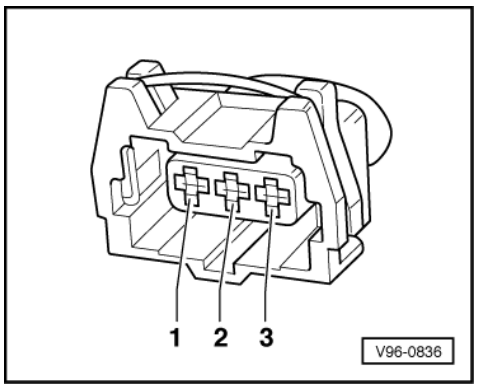
Note:

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

If the diode test lamp does not flash, test the voltage supply.

Test voltage supply for Hall sender:

- Unplug connector from Hall sender.
- Switch ignition on.



- -> Connect hand-held multimeter V.A.G 1526 (voltage measurement range) between engine earth and socket 1 of connector.

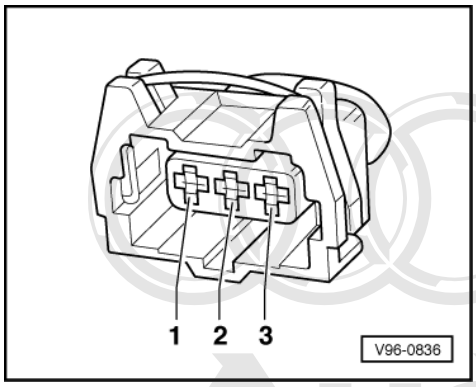
  Specification: approx. 5 V

Testing signal wire for Hall sender:

- Switch ignition on.
- -> Connect hand-held multimeter V.A.G 1526 (voltage measurement range) between engine earth and socket 2 of relevant connector.

  Specification: approx. battery voltage

Testing earth connection for Hall sender:



- -> Connect hand-held multimeter V.A.G 1526 (resistance measurement range) between socket 3 on connector and engine earth.

  Specification: Continuity
  Resistance in wiring: max. 1.5 ω

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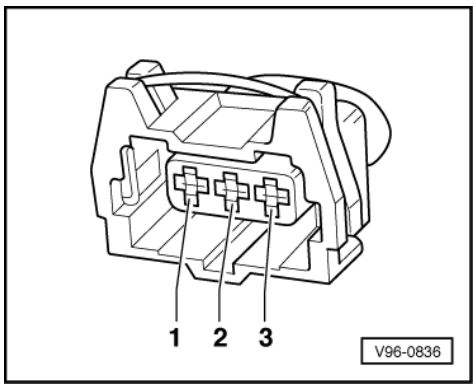
If all the readouts match the specifications but the diode test lamp does not flash (measurement taken between socket 1 and 2 without unplugging connector and while operating starter):

- Renew Hall sender.

If the readouts do not match the specification, test the wiring.

Testing wiring between Hall sender and engine control unit

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .



- -> Test wiring connection from Hall sender ....

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

3-pin connector on wiring harness, socket	Test box V.A.G 1598/31, socket
1 (positive)	98
2 (signal)	86
3 (earth)	108

Resistance in wiring: max. 1.5 ω

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

- Rectify any open/short circuit as necessary.
- If all the test results so far have been OK but a fault related to the camshaft sensor (Hall sender) is displayed again after erasing the fault memory as a test measure, the cause may be as follows:
  - Rotor ring for Hall sender misaligned; test phase position => Page 144 .

Testing phase position of Hall sender

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

-> 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
```

- Press keys 0, 9 and 3 to select Display Group 93 and confirm entry with Q key.

-> Indicated on display:

```
Read measured value block 93
     1     2     3     4
```

- Check display values for Hall senders.

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	Display zones			
	1	2	3	4
Display Group 93: Phase position of Hall sender with engine idling				
Display	xxx rpm	xx %	**0 ± 7 ° crankshaft**	
Indicates	Engine speed	Engine load	**Phase position Bank 1**	
Range	min.: 750 rpm max.: 6800 rpm		**min.: -20.3 ° crankshaft max.: 14.8 ° crankshaft**	
Specification	810...910 rpm		**0 ± 7 ° crankshaft**	
Note			**If readouts do not match specifications, unbolt Hall sender and check whether rotor ring is properly mounted on camshaft. If it is wrongly mounted, the locating lug will be flattened when the securing bolt is tightened. Also check valve timing.**	

2 - Testing camshaft timing control

2.1 - Testing camshaft timing control

2.2 - Operation of camshaft timing control

The timing of the inlet camshaft is controlled according to engine load and engine speed. The timing of the exhaust camshaft is not variable.

The electrically operated solenoid valve for camshaft adjustment transmits oil pressure to the mechanical camshaft adjusters.

The mechanical camshaft adjusters then advance the inlet camshafts, which means that the inlet valves will open earlier.

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Testing operation of camshaft timing control

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 .)
  When doing this the engine must be idling.

-> 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
```

- Press the keys 0, 9 and 1 to select Display Group 91 and confirm entry with Q key.

-> Indicated on display:

```
Read measured value block 91
     1     2     3     4
```

- Check display value for camshaft timing control.

	Display zones			
	1	2	3	4
Display Group 91: Camshaft timing control				
Display	xxx rpm	xx.x %	CS-ctrl. OFF	xx.x °cr/shaft
Indicates	Engine speed (in steps of 40 rpm)	Load	Camshaft timing control off / on	Feedback signal for adjustment (via Hall sender -G40)
Range	min.: 750 rpm max.: 6800 rpm	min.: 0 % max.: 145 %	CS-ctrl OFF CS-ctrl. ON	min.: -3.0 °cr/shaft max.: 25.0 °cr/shaft
Specification	Current engine speed	CS-ctrl. OFF	CS-ctrl OFF	-3.0...3.0 °cr/shaft
Note				Normal position

- Take 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 35 .

- Accelerate rapidly from standstill in 1st gear (manual gearbox) or in selector lever position 2 (automatic gearbox) and check display values for camshaft timing control (display zones 3 and 4).

	Display zones			
	1	2	3	4
Display Group 91: Camshaft timing control at 2000...3600 rpm				
Display	xxxx rpm	xx.x %	CS-ctrl. ON	xx.x °cr/shaft
Indicates	Engine speed (in steps of 40 rpm)	Load	Camshaft timing control off / on	Feedback signal for adjustment (via Hall sender - G40)
Range	min.: 750 rpm max.: 6920 rpm	min.: 0 % max.: 145 %	CS-ctrl. OFF CS-ctrl. ON	min.: -3.0 °cr/shaft max.: 25.0 °cr/shaft
Specification	2000...3600 rpm	higher than 140 %	CS-ctrl. ON	17.0....25.0 °cr/shaft
Note				Adjusted position: if specification is not met, test solenoid valve for camshaft timing control =>Page 146

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Notes:

- Display zone 3 indicates whether or not the engine control unit is activating the camshaft timing control.
  - CS-ctrl. OFF = camshaft timing control not activated
  - CS-ctrl. ON = camshaft timing control activated
- Display zone 4 indicates whether or not the camshaft position has actually been adjusted (feedback signal via Hall sender).
  - Normal position: -3.0 °....3.0°cr/shaft
  - Adjusted position: 17.0 °....25.0°cr/shaft
- If "CS-ctrl. ON" appears in display zone 3 and a value between 3.0 °cr/shaft and 16.0 °cr/shaft in display zone 4 during the test drive, this means that the camshaft adjustment solenoid valve is diverting the oil pressure to the mechanical camshaft adjuster correctly, but the mechanical adjuster is not reaching its end position (e.g. because it is not moving freely).

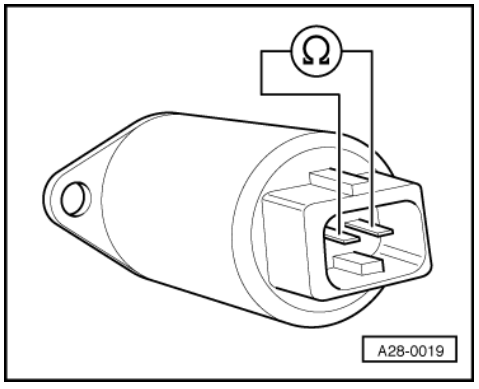
2.3 - Testing solenoid valves for camshaft adjustment -N205.

- Switch ignition on.
- Perform final control diagnosis and activate camshaft timing control => Page 17 .

-> Indicated on display:

```
Final control diagnosis
Camshaft timing control 1
```

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



If this result is not obtained, carry out the following tests:

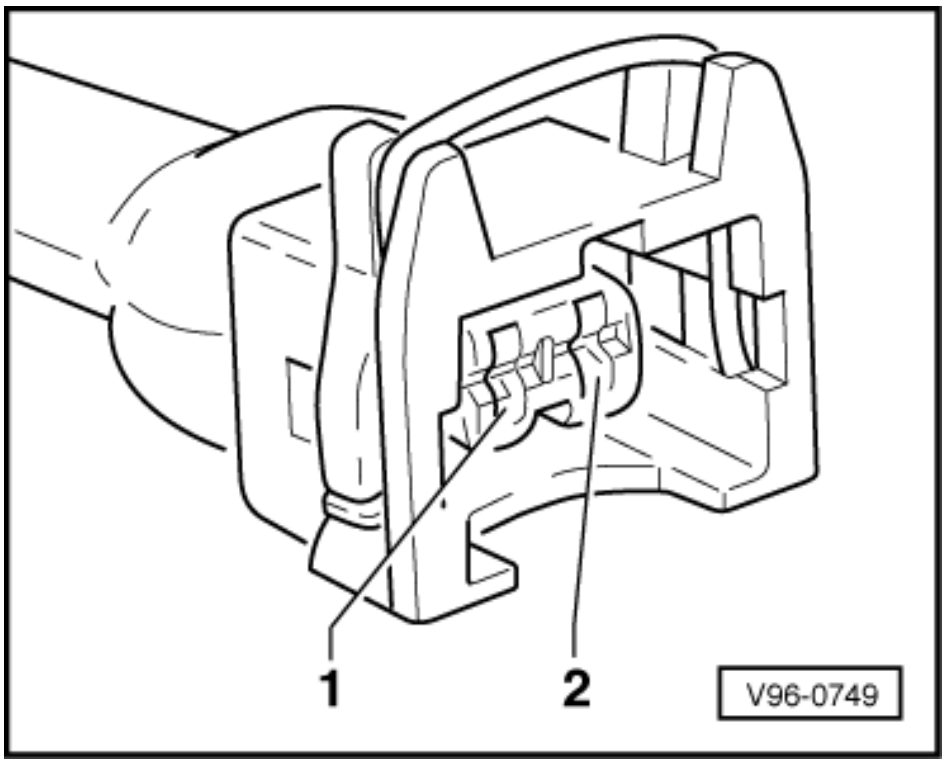
Electrical test of solenoid valve for camshaft adjustment

- Unplug connector from solenoid valve for camshaft adjustment.
- -> Measure resistance between the valve contacts using hand-held multimeter V.A.G 1526.

  Specification: 10 ... 18 ω

If the reading does not match the specification:

- Renew solenoid valve for camshaft adjustment.



Testing voltage supply to camshaft adjustment valve

- Unplug connector from solenoid valve.
- -> Connect diode test lamp V.A.G 1527 between engine earth and socket 1 (positive) of the connector using test leads from auxiliary test set V.A.G 1594.
- Operate the starter for a few seconds. The engine can be allowed to start.

The diode test lamp should light up.

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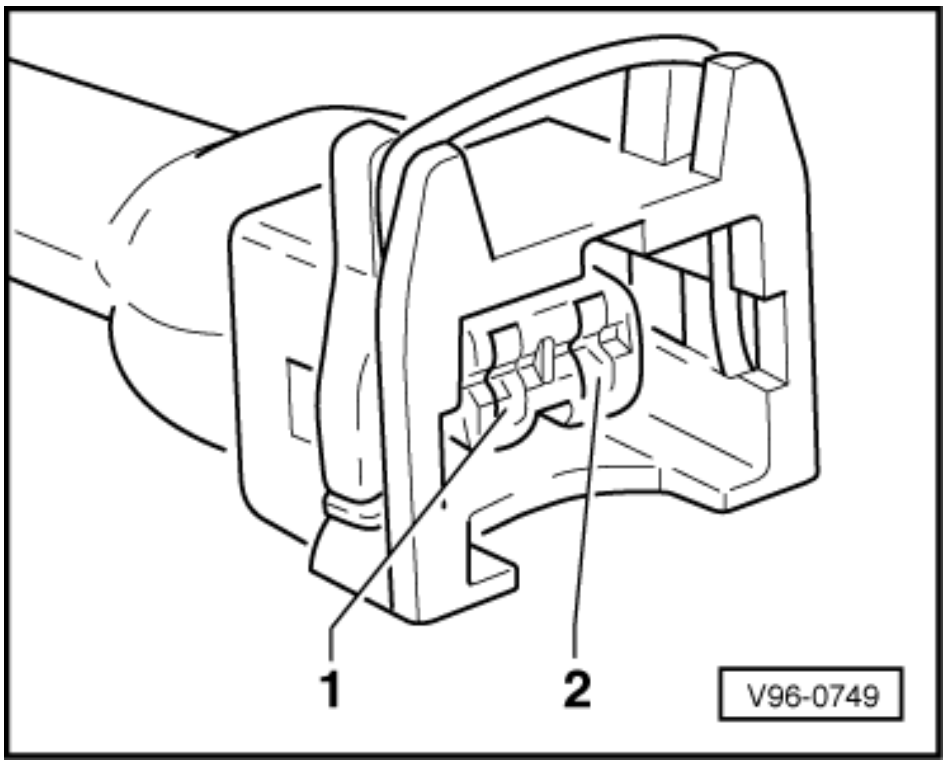
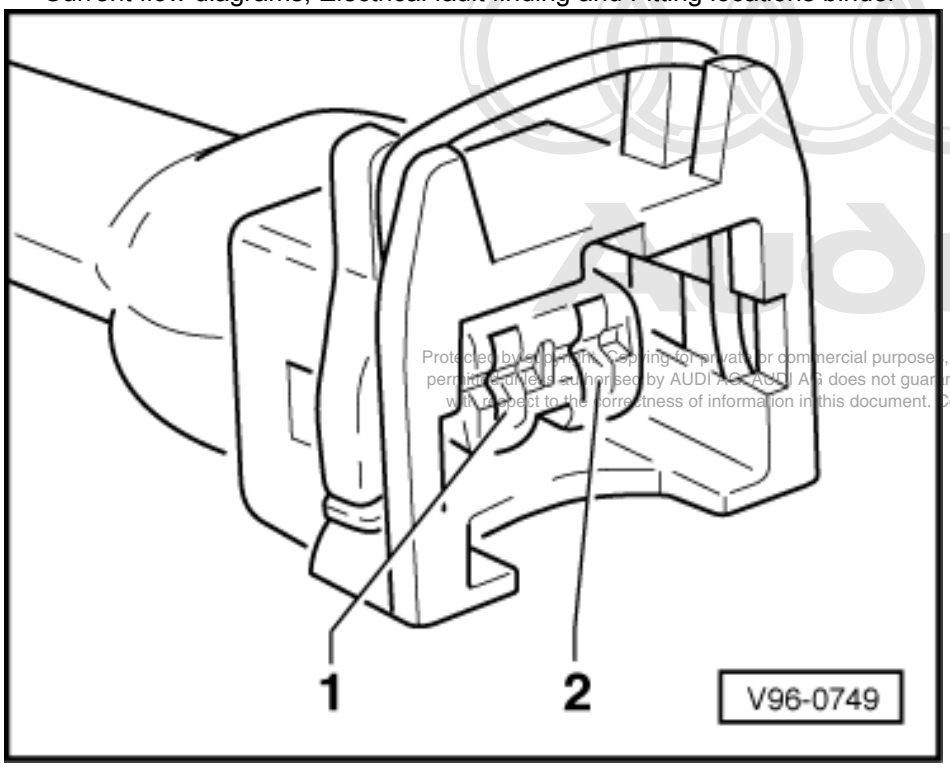


If the diode test lamp does not light up, carry out the following tests:
- Test fuse for camshaft adjustment valve.

=> Current flow diagrams, Electrical fault finding and Fitting locations binder
If the fuse is okay:
- -> Test for continuity in wiring from socket 1 on connector for camshaft adjustment valve to fuel pump relay (via fuse)

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



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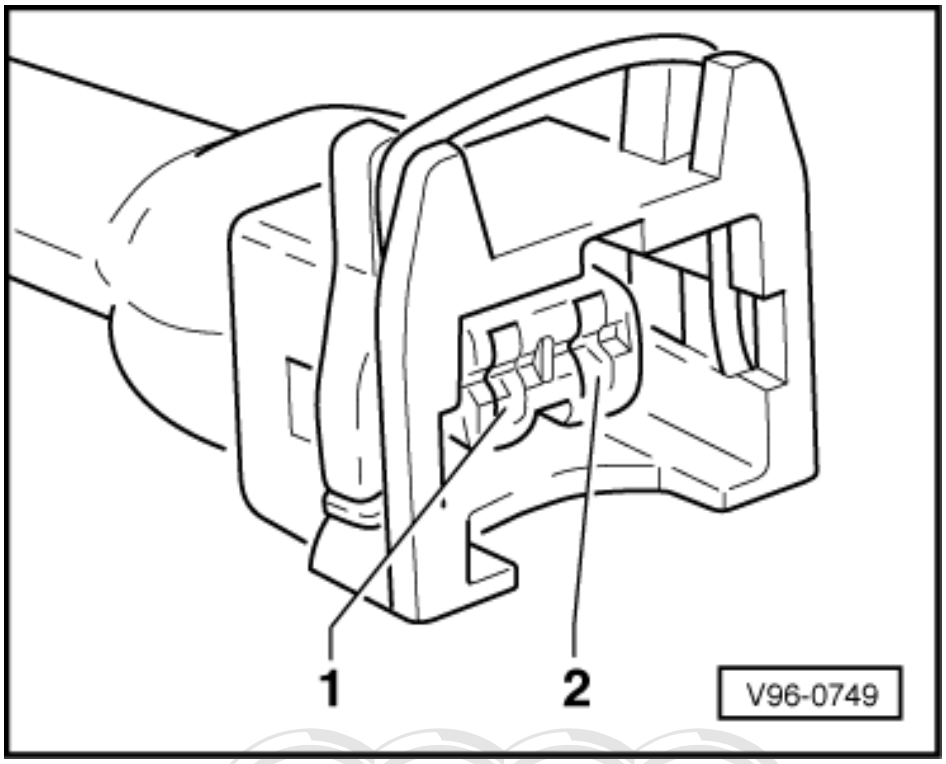
Testing activation of camshaft adjustment valve

- Unplug connector from solenoid valve.
- -> Connect diode test lamp V.A.G 1527 between sockets 1 (positive) and 2 of the valve connector using test leads from auxiliary cable set V.A.G 1594.
- Perform final control diagnosis and activate camshaft timing control => Page 17 .

-> 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 lights up continuously:

- -> Test for short to earth in wiring from socket 2 on connector for camshaft adjustment valve.

If the diode test lamp does not flash:

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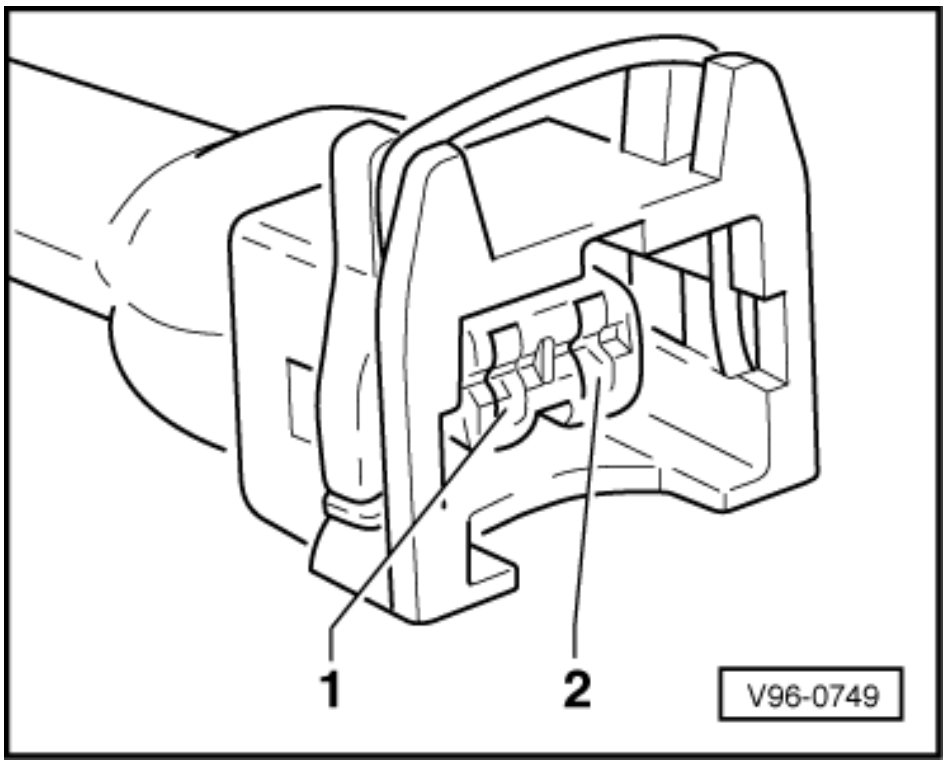

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 41 .
- -> Test for open circuit or short to positive in wiring of connector for camshaft adjustment valve.

2-pin connector on wiring harness, contact	Socket on test box V.A.G 1598/31
2	115

Resistance in wiring: max. 1.5 ω

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

- Rectify any open circuits or short circuits.

If no open circuits or short circuits are found, fit a new engine control unit => Page 42 .

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- If no faults have been found in any of the tests so far, renew the mechanical camshaft adjuster.

=> 4-Cylinder engine, Mechanics; Repair group 15; Cylinder head, valve gear; Removing and installing camshafts and camshaft adjuster Cylinder head, valve gear Removing and installing camshafts and camshaft adjuster