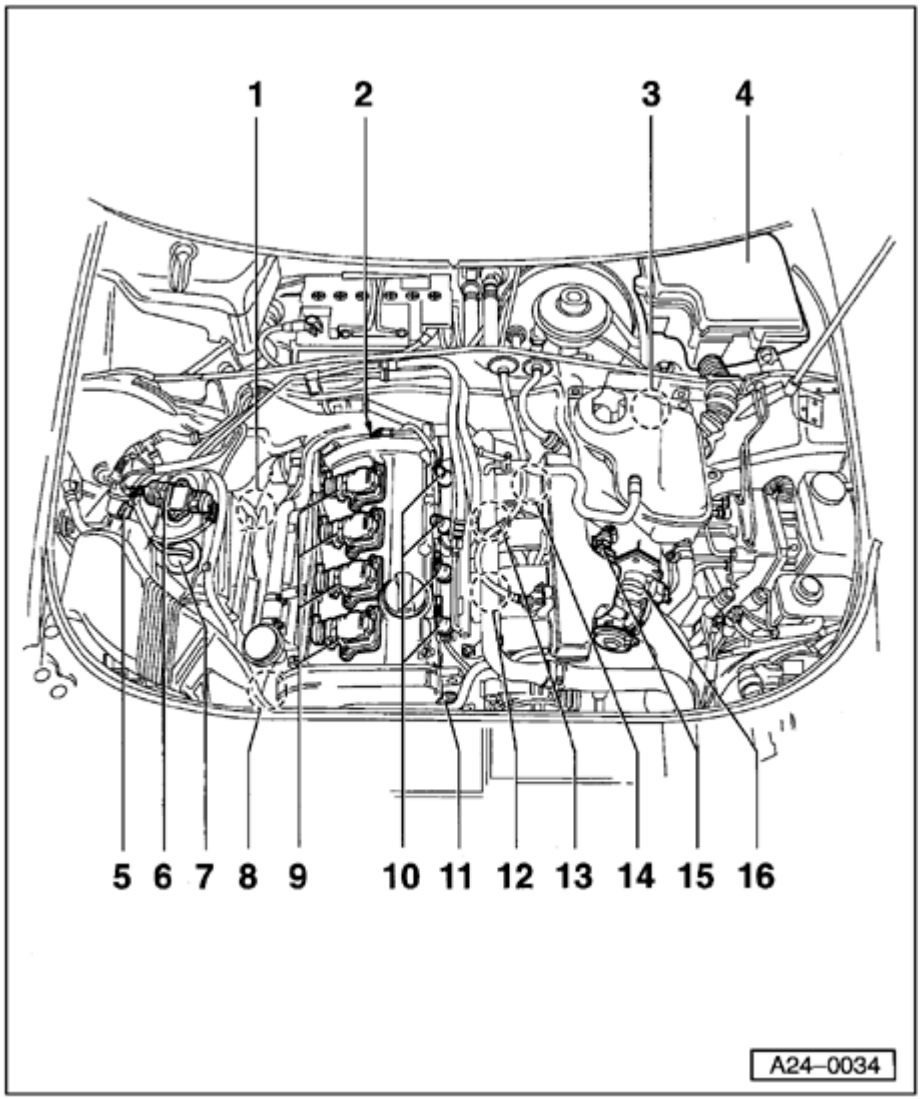
24-1



Motronic Multiport Fuel Injection (MFI) and ignition system

Component locations, overview

---- **Data Link Connector (DLC)**

- Located under knee bar, left side of steering wheel

---- **Fuel pump relay**

- Position 6 on relay panel in driver's side footwell

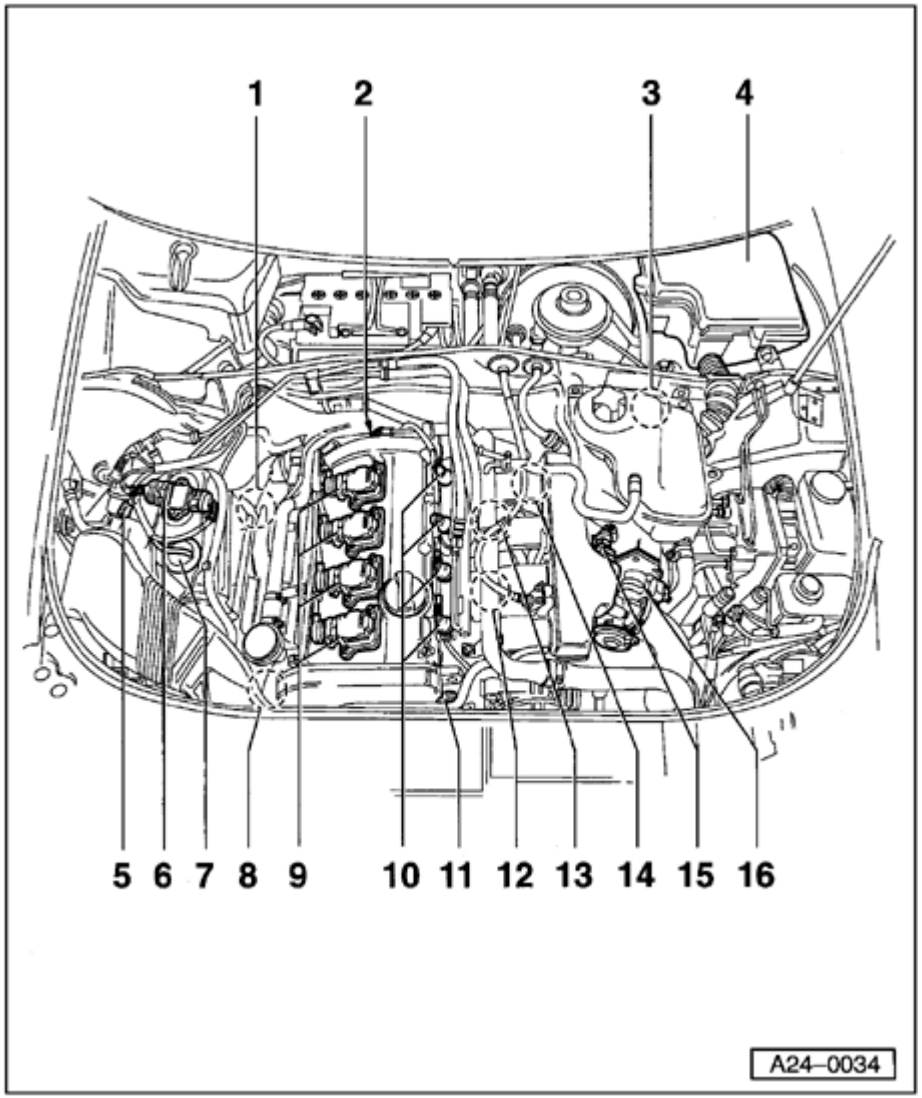
---- **Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G130- with Oxygen Sensor (O2S) heater -Z29-**

- In exhaust system behind TWC

---- **EVAP system Leak Detection Pump (LDP) -V144-**

- In left-rear wheelhousing behind splash shield

24-2



1 - Heated Oxygen Sensor (HO2S) -G39- with Oxygen Sensor (O2S) heater -Z19-

2 - Engine Coolant Temperature (ECT) sensor -G62-

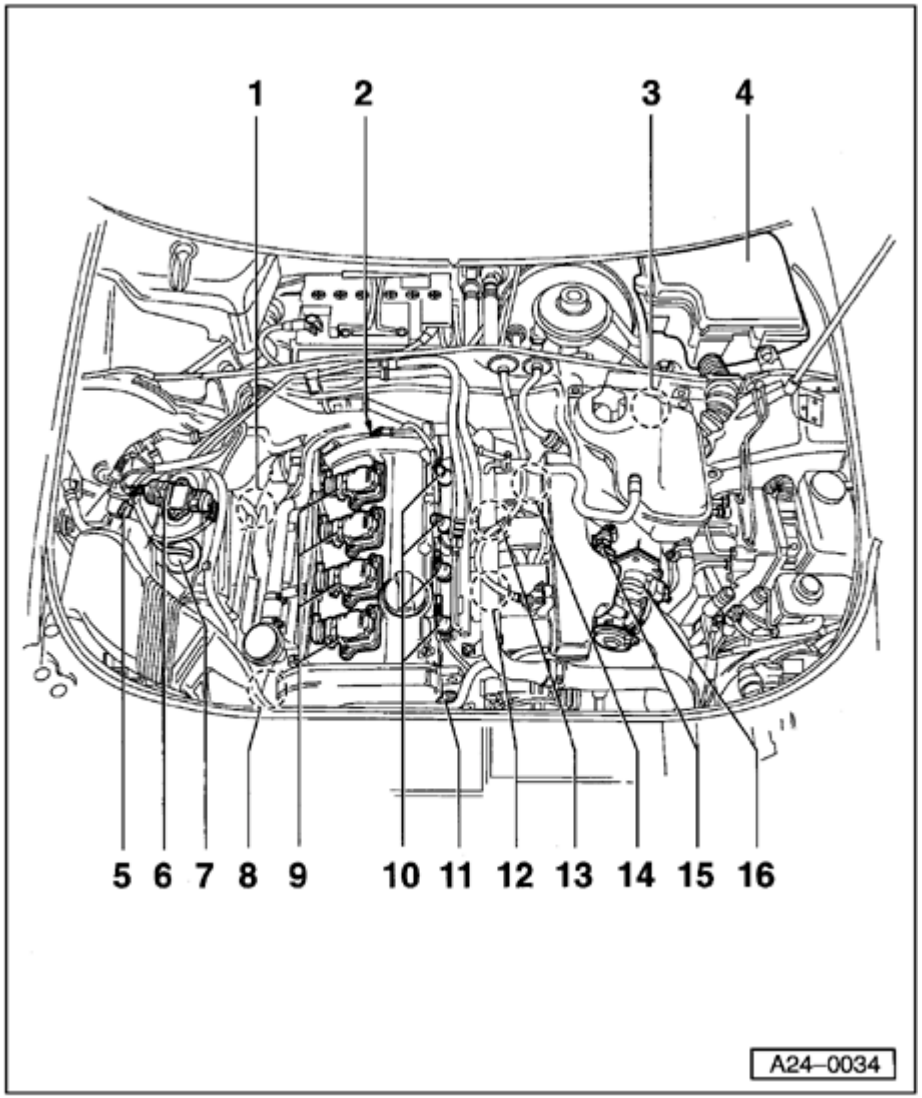
- 4-pin connector

3 - Harness connector for:

- Heated Oxygen Sensor (HO2S) -G39- and Oxygen Sensor (O2S) heater -Z19- (4-pin, brown)
- Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G130- with Oxygen Sensor (O2S) heater -Z29- (4-pin, black)
- Engine speed (RPM) sensor -G28- (3-pin, gray)
- Knock sensor (KS) 1 -G61 (3-pin, green)
- Knock sensor (KS) 2 -G66- (3-pin, blue)

4 - Electronics box (E-box) with:

- Motronic Engine Control Module (ECM) -J220-
- Barometric Pressure (BARO) sensor -F96-



5 - EVAP canister purge regulator valve -N80-

6 - Power output stage -N122-

- 5-pin connector: signal wiring from ECM
- 4-pin connector: coil primary circuit connections

7 - Mass Air Flow (MAF) sensor -G70-

- In upper air cleaner housing

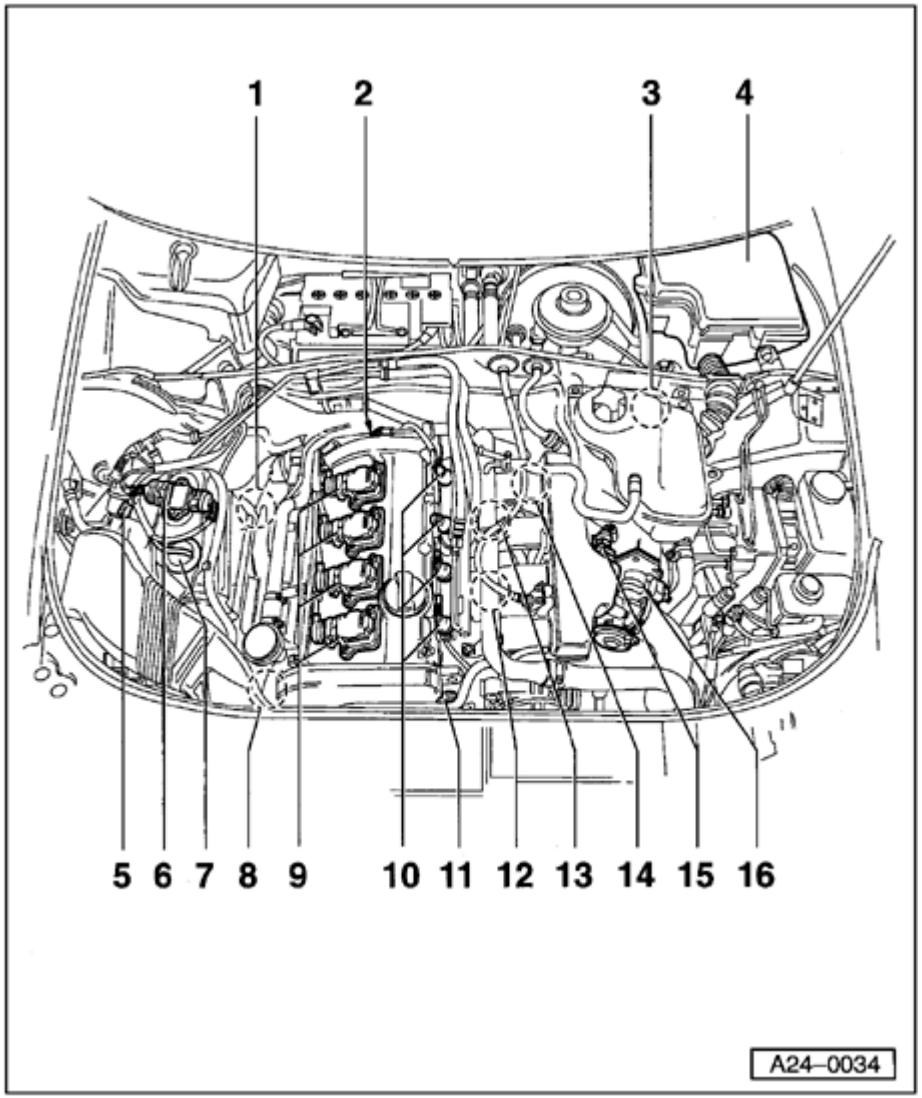
8 - Wastegate bypass regulator valve -N75-

9 - Ignition coils

- Cylinder 1: -N-
- Cylinder 2: -N128-
- Cylinder 3: -N158-
- Cylinder 4: -N163-

10 - Fuel injectors

- Cylinder 1: -N30-
- Cylinder 2: -N31-
- Cylinder 3: -N32-
- Cylinder 4: -N33-



11 - Camshaft Position (CMP) sensor -G40-

12 - Knock Sensor (KS) 1 -G61-

13 - Knock Sensor (KS) 2 -G66-

14 - Engine speed (RPM) sensor -G28-

(behind oil filter housing on engine cylinder block)

15 - Intake Air Temperature (IAT) sensor -G42-

16 - Throttle valve control module -J338-

Including:

- Throttle drive -G186-
- Angle sensor 1 for throttle drive -G187-
- Throttle Position (TP) sensor -G69-
- Closed Throttle Position (CTP) switch -F60-

Safety precautions

WARNING!

Fire hazard! Do not smoke, work near heaters or open flame, or have anything nearby that could ignite fuel. The fuel system is under pressure. Before opening, cover connections with a rag, and open carefully to release pressure. Be alert when working on or near the engine and ignition wires. High secondary ignition voltage can cause serious personal injury and damage vehicle components.

- ***DO NOT touch or disconnect ignition system wires when the engine is running or being cranked at starting RPM.***
- ***DO NOT operate starter if fuel injectors are removed.***

Be sure the ignition is switched OFF, when:

- ***Disconnecting or connecting the battery, ignition wires, or test equipment leads***
- ***Disconnecting fuel injection system wiring***
- ***Washing the engine or engine compartment.***

BEFORE cranking engine at starting RPM (e.g. for compression testing) disable ignition and fuel injection systems:

- ***Disconnect both ignition coil power output stages, and both Motronic fuses at the E-box in the plenum.***
- ***Disconnect harness connectors from all fuel injectors.***
- ***Afterward, erase DTC memory.***

CAUTION!

BEFORE disconnecting the battery:

- ***Stop the engine.***
- ***Be sure the ignition is switched OFF (also applies when connecting the battery). Failure to do so may damage the Engine Control Module (ECM).***
- ***Be sure of the proper radio code (for vehicles equipped with coded anti-theft radio).***

Be sure the battery negative (-) cable is disconnected, when:

- ***Working on the electrical system***
- ***Resistance (spot) welding or electric arc welding anywhere on the vehicle.***

When connecting and disconnecting electrical test equipment (LED voltage tester, multimeter, etc.):

- ***Be sure the ignition is switched OFF.***
- ***Use correct adapters from the VW 1594***

connector test kit.

For any work affecting the Engine Control Module (ECM):

- ***BEFORE disconnecting the ECM harness connector, switch the ignition OFF and WAIT at least 20 seconds. Failure to do so may damage the ECM.***

- ***DO NOT connect any outside voltage source to stimulate an output signal at the ECM.***

Rules of cleanliness

CAUTION!

Whenever carrying out work on the fuel supply and fuel injection systems, carefully observe the following five rules of cleanliness.

1. Thoroughly clean fuel system line and hose connections and the surrounding area before disconnecting.

2. Place removed components on a clean surface and cover. Use plastic sheeting or paper. Do not use fluffy rags that could leave lint!

3. Carefully cover over or seal any components that have been opened if repairs are not carried out immediately.

4. Install only clean parts:

- Do not remove replacement parts from the packaging until immediately before they are to be installed.

- Do not use parts that have been stored without packaging (e.g. in toolboxes, etc.).

5. When the fuel system is opened:

- Avoid working with compressed air whenever possible.
- Avoid moving the vehicle if possible.

24-8

Technical data

Engine code		AEB	
Engine idle speed: not adjustable, maintained by Idle Air Control (IAC)		820-900 RPM	
Engine speed (RPM) upper limit: actuated by switching off fuel injectors		approx. 6500 RPM	
Fuel system pressure at idle	Vacuum hose for pressure regulator connected:	approx. 3.5 bar (50 psi)	
	Vacuum hose for pressure regulator disconnected:	approx. 4.0 bar (58 psi)	
Residual fuel pressure after 10 minutes		at least 2.5 bar	
Fuel injectors	Spray pattern:	approx. the same for all fuel injectors	
	Resistance [1]:	11-13 ohm	

[1] Engine at room temperature; with the engine at normal operating temperature the resistance increases by approx. 4-6 ohms.

Fuel injection system, servicing

Servicing ignition system:

⇒ *Repair Group 28*

Notes:

- *Fuel hoses in the engine compartment must be secured with spring-type clamps. Screw-type clamps or equivalent must not be used.*
- *The Engine Control Module (ECM) has On Board Diagnostic (OBD) capability, and is equipped with Diagnostic Trouble Code (DTC) memory. Before repairing or adjusting any components or systems, first check DTC memory. Also check all vacuum connections for leaks ("false air").*
- *For proper operation of electrical and electronic components, a Battery Positive Voltage (B+) supply of at least 11.5 volts is required.*
- *Do not use any gasket sealers or other automotive chemical compounds that contain silicone. Traces of silicone drawn into the engine pass unburned into the exhaust and can damage the oxygen sensors.*

- *Do not use any electrical contact sprays or equivalent near oxygen sensor connections. Proper oxygen sensor function requires reference to outside air via the cable. If any contact spray reaches the oxygen sensor, it can cause damage or improper function.*

- *During some tests, malfunctions are recognized by the ECM and stored in DTC memory. For this reason, always check DTC memory after all tests and repairs, and erase DTC memory as necessary.*

Safety precautions ⇒ Page 24-5

Rules of cleanliness ⇒ Page 24-7

Technical data ⇒ Page 24-8

24-11

Idle speed, checking

Notes:

- *Idle speed, ignition timing and CO-content cannot be adjusted.*
- *Idle speed is maintained by the Throttle valve control module.*
- *CO-content is maintained and adjusted by Oxygen Sensor (O2S) control. Malfunctions in O2S control are recognized by On Board Diagnostic (OBD) and stored in DTC memory.*

Required special tools and test equipment

- VAG 1551 Scan Tool (ST) with VAG 1551/3 adapter cable

Test conditions

- No malfunctions stored in DTC memory ⇒ Page 01-15
- Engine Coolant Temperature (ECT) at least 85 ° C (185 ° F)

  All electrical consumers switched off

- (radiator coolant fan must not run during test)
- A/C switched off
- Exhaust system free of leaks
- Automatic transmission selector lever in "P" or "N" position

24-12

Checking

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ Page 01-7 .

Rapid data transfer HELP Select function XX

➢ Indicated on display

- Press buttons -0- and -4- to select "Basic Setting" function 04, and press -Q- button to confirm input.

System in Basic Setting HELP Input display group number XXX

➢ Indicated on display

- Press buttons -0-, -0- and -1- to input display group number 1, and press -Q- button to confirm input.

System in Basic Setting 1 → 1 2 3 4

➢ Indicated on display (1-4 = display fields)

Note:

After selecting function 04, the ECM initiates the following:

- *EVAP canister purge regulator valve is closed*
- *A/C compressor is switched off*

Continue with the test only when the operating conditions in display field 4 are satisfied.

- Briefly raise engine speed (acceleration burst) and let engine run at idle

for another 2 minutes.

24-13

- Compare display with specified values (display fields 1-4):

	Display fields			
	1	2	3	4
Display group 1: Engine idle speed				
Display	xxxx RPM	xxx.x °C	xx.x%	xxxxxx
Indicates	Idle speed	Engine Coolant Temperature (ECT)	Oxygen sensor control	Adjustment conditions
Range	0-6800 RPM (in 40 RPM steps)	---	-25.0 to 25.0 %	---
Specified value	760-960 RPM	80.0°-105.0° C	In the range from -10.0 to 10.0 %, the value must change by at least 2 %	111111
	If not as specified ⇒ Page 24-99 , Throttle valve control module, checking	---	If not as specified ⇒ Page 24-99 , Throttle valve control module, checking	Explanation ⇒ Page 24-15

If displayed values are OK (as specified):

- Press -C- button.

- Press buttons -0-, -5- and -6- to input display group number 56, and press -Q- button to confirm input.

System in Basic Setting 56 →

1 2 3 4

< Indicated on display (1-4 = display fields)

24-14

- Compare display with specified values (display fields 1-4):

	Display fields			
	1	2	3	4
Display group 56: Engine idle speed				
Display	xxxx RPM	xxxx RPM	x.xx g/s	xxxx
Indicates	Engine speed (actual)	Engine speed (specified)	Mass air flow (idle speed control)	Operating conditions
Range	0-2550 RPM (steps of 10 RPM)	---	-2.80 to 4.17 g/s	---
Specified value	820-900 RPM	860 RPM	-1.11 to 1.11 g/s	0000
	If not as specified ⇒ Page 24-99 , Throttle valve control module, checking	---	If not as specified ⇒ Page 24-99 , Throttle valve control module, checking	Explanation ⇒ Page 24-16

- Press →button to advance program sequence.

- Press buttons -0- and -6- to select "End Output" function 06, and press -Q- button to confirm input.

- Road test vehicle, then repeat test.

- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

24-15

Evaluation of 6-digit display:

- "1" = Adjustment conditions fulfilled
- "0" = Adjustment conditions not fulfilled
- If adjustment conditions have been fulfilled (indicated in display field 4), a series of 6 numerals ("1") will be displayed. If one of the digits in the 6-digit display is "0," the adjustment condition has not been fulfilled. Repair the cause of the unfulfilled condition, and repeat the test.

Explanation (display = 1)						
x	x	x	x	x	x	Adjusting conditions (display group 1)
					1	Engine Coolant Temperature (ECT) above 80° C
				1		Engine speed less than 2000 RPM
			1			Throttle valve closed
		1				Oxygen sensor control active
	1					Closed Throttle Position (CTP) switch closed
1						A/C compressor off

24-16

Evaluation of 4-digit display:

Explanation (display = 0)				
x	x	x	x	(Display group 56)
			0	A/C compressor off ("0" = off; "1" = on)
		0		Transmission selector lever in "P" or "N" position ("0" = "P" or "N" position; "1" = 2/3/4/R/D)
	0			Not used ("0" is always displayed)
0				Not used ("0" is always displayed)

24-17

Heated Oxygen Sensor (HO2S) and oxygen sensor control (before TWC), checking

Notes:

- *Connector for Heated Oxygen Sensor (HO2S) before Three Way Catalytic Converter (TWC): 4-pin, brown*

- *Component location* ⇒ *Page 24-1*

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable
- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VW 1594 connector test kit
- Wiring diagram

Test conditions

- Engine Coolant Temperature (ECT) at least 85° C (185° F)

Checking

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ Page 01-7 .

Rapid data transfer **HELP**

Select function XX

➢ Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block **HELP**

Input display group number XXX

➢ Indicated on display

- Press buttons -0-, -3- and -2- to input display group number 32, and press -Q- button to confirm input.

Read Measuring Value Block 32 →

1 2 3 4

➢ Indicated on display (1-4 = display fields)

24-19

- Check oxygen sensor control learning values (display fields 1 and 2):

	Display fields			
	1	2	3	4
Display group 32: Oxygen sensor control learning values				
Display	xx.x %	xx.x %		
Indicates	Oxygen sensor control learning value at idle (additive) (before TWC)	Oxygen sensor control learning value at partial load (multiplicative) (before TWC)		
Range	-26.0 to 26.0 %	-25.0 to 25.0 %		
Specified value	-8.0 to 8.0 % (can vary slightly)	-8.0 to 8.0 % (can vary slightly)		
	If not as specified ⇒ Page 24-22 , Evaluation of display group 32			

If displayed values are OK (as specified):

- Press -C- button.

- Press buttons -0-, -3- and -3- to input display group number 33, and press -Q- button to confirm input.

Read Measuring Value Block 33 →

Indicated on display (1-4 = display fields)

1 2 3 4

24-20

- Check oxygen sensor control (display fields 1 and 2):

	Display fields			
	1	2	3	4
Display group 33: Oxygen sensor control				
Display	xx.x %	x.xxx V		
Indicates	Oxygen sensor control (before TWC)	Oxygen sensor voltage (before TWC)		
Range	-25.0 to 25.0 %	0.000-1.000 V		
Specified value	Within the range from -10.0 to 10.0 % the value must change by at least 2 %	Within the range from 0.000 to 1.000 V the value must fluctuate at least 30 times per minute, and change by at least 0.3 volts		
	If not as specified ⇒ Page 24-21 , Continuation	If not as specified ⇒ Page 24-23 , Evaluation of display group 33		

24-21

Continuation

If the value in display field 1 is NOT OK, or if the value does not fluctuate by at least 2 %:

- Road test to condition oxygen sensor (eliminate possible contamination) and repeat test.

If the value in display field 1 is still NOT OK, or if it still does not fluctuate by at least 2 %:

- Check Oxygen Sensor (O2S) heater ⇒ Page 24-27 .

If the value in display field 1 remains constant:

- Check oxygen sensor voltage (display field 2).

- Press →button to advance program sequence.

- Press buttons -0- and -6- to select "End Output" function 06, and press -Q- button to confirm input.

- Switch ignition off.

Evaluation of display group 32

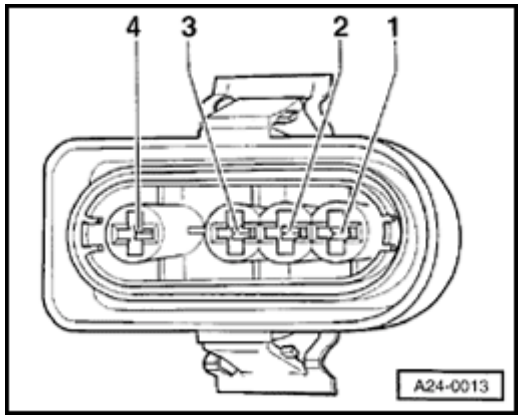
Display group: 32 Display fields: 1 + 2	Possible cause	Corrective action
O2S control learning value: -26.0 to -8.0 %	♦ Engine oil dilution (when partial load learning value is normal, ⇒ display field 2)	- Change engine oil, or carry out extensive road test and check again.
	♦ Fuel pressure too high	- Check fuel pressure regulator ⇒ Page 24-93
	♦ Fuel injector leaking	- Check fuel injectors ⇒ Page 24-87
	♦ Oxygen Sensor (O2S) heater malfunction	- Check O2S heater ⇒ Page 24-27
O2S control learning value: 8.0-26.0 %	♦ Intake air leaks ("false air") or exhaust manifold leaks (when partial load learning value is normal, ⇒ display field 2)	- Check intake air system for leaks ⇒ Page 24-97 - Check exhaust system for leaks: ⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Engine Mechanical, Engine Code(s): AEB, ATW, Repair Group 26*
	♦ Fuel pressure too low	- Check fuel pressure regulator ⇒ Page 24-93
	♦ Oxygen Sensor (O2S) heater malfunction	- Check O2S heater ⇒ Page 24-27

	♦ Fuel injector does not open, or partially opens	- Check fuel injectors ⇒ Page 24-87
O2S control learning value: constant 0.0 %	♦ Oxygen sensor control learning not active	- Check Mass Air Flow (MAF) sensor -G70- ⇒ Page 24-57

24-23

Evaluation of display group 33

Display group: 33 Display field: 2	Possible cause	Corrective action
approx. 0.435 V	♦ Open circuit in wiring between HO2S connector terminal 4 and ECM	- Check reference voltage ⇒ Page 24-24 .
approx. 0.435 V	♦ Open circuit in wiring between HO2S connector terminal 3 and ECM	
approx. 1.085 V	♦ Short circuit to positive (B+) between HO2S connector terminal 4 and ECM	- Check HO2S wiring ⇒ Page 24-25 .
approx. 0.000 V	♦ Short circuit to Ground between HO2S connector terminal 4 and ECM	



Checking HO2S reference voltage

- Disconnect 4-pin connector -1- (brown) for HO2S -G39-.

- Connect multimeter US 1119 (Fluke 83 or equivalent) between harness connector terminals 3 and 4 (to ECM), using adapter cables from VW 1594 connector test kit.
- Start engine and measure voltage.

  Specified value: 0.40-0.50 volts
- Switch ignition off.

If voltage is NOT OK:

- Check HO2S wiring ⇒ Page 24-25

If voltage is OK:

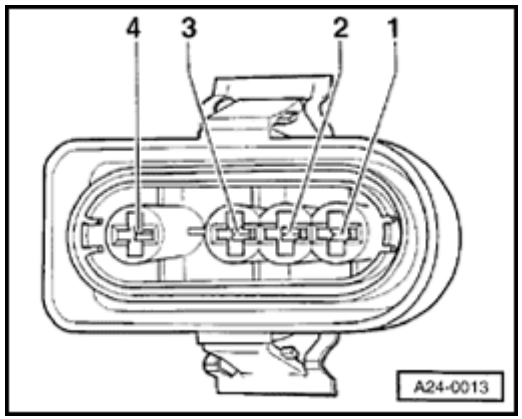
- Replace Heated Oxygen Sensor (HO2S) -G39-.

24-25

Checking HO2S wiring

- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .

- Disconnect 4-pin connector (brown) for HO2S - G39-.



- Check wiring for open circuit between ECM/test box and 4-pin HO2S harness connector (to ECM).
  - Connector terminal 3 to ECM/test box socket 25
  - Connector terminal 4 to ECM/test box socket 26
  - Specified value: max. 1.5 Ω
- Check wiring for short circuits between terminals of 4-pin connector, and between connector and ECM/test box.
  - Connector terminal 4 to ECM/test box socket 25
  - Specified value: ∞ Ω
- Check wiring for short circuits to wiring harness shielding.
  - Connector terminal 3 to ECM/test box socket 2
  - Connector terminal 4 to ECM/test box socket 2
  - Specified value: ∞ Ω

24-26

If wiring is OK:

- Replace Motronic ECM -J220- ⇒ Page 01-57 .
- Carry out adaptation of throttle valve control module to ECM ⇒ Page 24-119 .
- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

Oxygen Sensor (O2S) heater (before TWC), checking

Notes:

- *Harness connector for Oxygen Sensor (O2S) heater: 4-pin, brown*
- *Component locations* ⇒ *Page 24-1* .

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable
- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VW 1594 connector test kit
- Wiring diagram

Test requirements

- Fuse for Oxygen Sensor (O2S) heater OK

- Engine Coolant Temperature (ECT) at least 85° C (185° F)

24-28

Checking

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ Page 01-7 .

Rapid data transfer HELP
Select function XX

Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block HELP
Input display group number XXX

Indicated on display

- Press buttons -0-, -4- and -1- to input display group number 41, and press -Q- button to confirm input.

Read Measuring Value Block 41 →
1 2 3 4

Indicated on display (1-4 = display fields)

24-29

- Compare display and specified values (display fields 1 and 2):

	Display fields			
	1	2	3	4
Display group 41: Oxygen Sensor (O2S) heating				
Display	xx.x Ω	Htg.bC.ON/Htg.bC.OFF	xx.x Ω	Htg.aC.ON/Htg.aC.OFF
Indicates	Resistance of oxygen sensor heater (before TWC)	O2S heater on or O2S heater off (before TWC)	Resistance of oxygen sensor heater (after TWC)	O2S heater on or O2S heater off (after TWC)
Range	0.0-65.0 Ω	---	---	---
Specified value	4.9-19.9 Ω	Htg.bC.ON	---	---
	If not as specified ⇒ Page 24-30 , Continuation		---	---

If displayed values are OK (as specified):

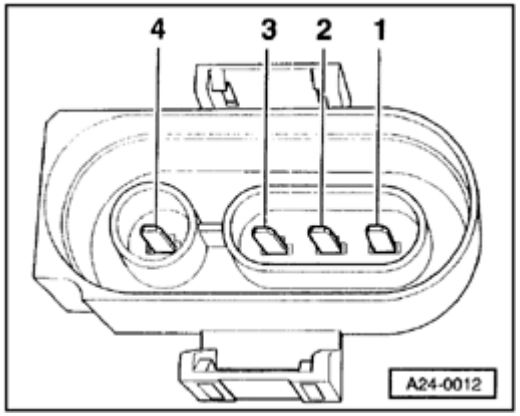
- Press →button to advance program sequence.

- Press buttons -0- and -6- to select "End Output" function 06, and press -Q- button to confirm

input.

- Switch ignition off.

Continuation



- Disconnect 4-pin connector -1- (brown) for Heated Oxygen Sensor (HO2S) -G39-.

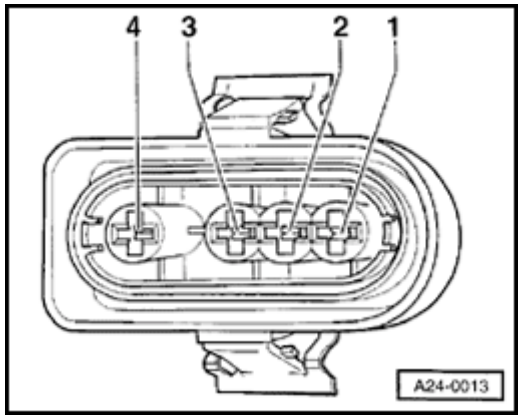
- Connect multimeter US 1119 (Fluke 83 or equivalent) between HO2S connector terminals 1 and 2, using VW 1594 connector test kit.
- Measure resistance.

  Specified value: 0.0-19.9 Ω

If resistance is NOT OK:

- Replace Heated Oxygen Sensor (HO2S) -G39-.

24-31



If resistance is OK:

- Switch multimeter to 20 VDC measuring range.

- Connect multimeter between harness connector terminals 1 and 2 (to ECM), using VW 1594 connector test kit.
- Measure voltage supply and check display in display group 41, display field 2.

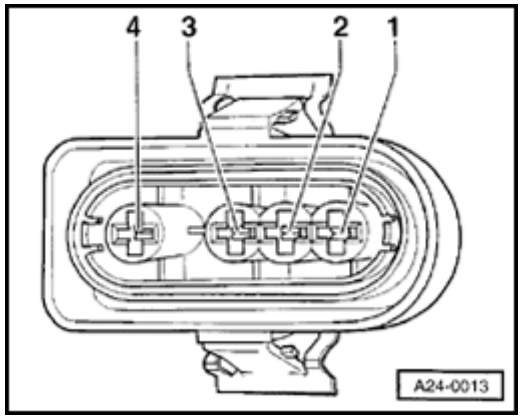
If display = Htg.bC.ON:

- Specified value: 11.0-14.5 volts

If display switches between "Htg.bC.ON" and "Htg.bC.OFF:"

- Specified value: 0.0-12.0 volts (oscillating)

24-32



If there is no voltage:

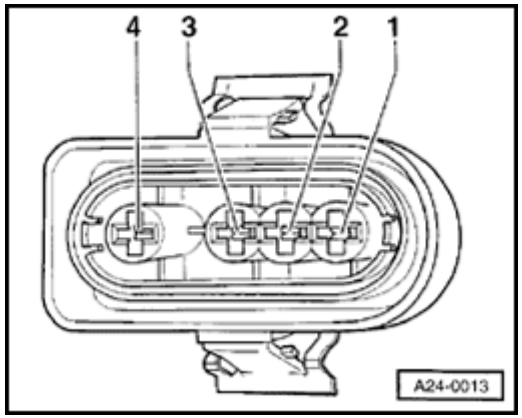
- Connect multimeter between harness connector terminal 1 (to ECM) and vehicle Ground, using VW 1594 connector test kit.

  Specified value: 11.0-14.5 volts

If there is still no voltage:

- Check wiring between terminal 1 and relay panel using appropriate wiring diagram.

24-33



If there is voltage:

- Connect multimeter between harness connector terminal 2 (to ECM) and Battery Positive Voltage (B+), using VW 1594 connector test kit.
- Measure voltage supply and check display in display group 41, display field 2.

If display = Htg.bC.ON:

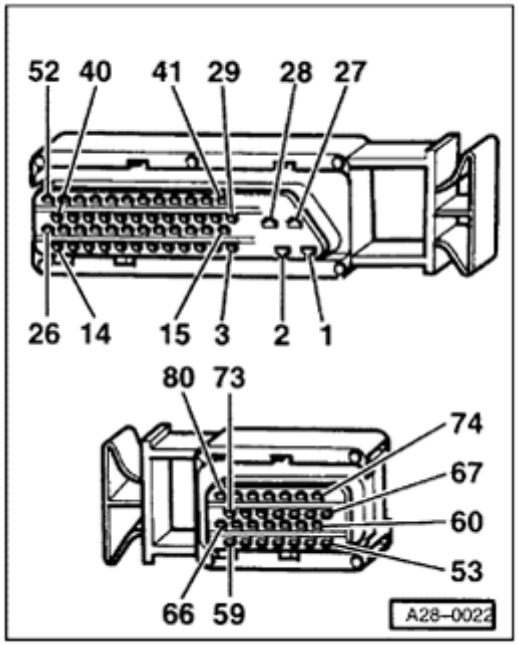
- Specified value: 11.0-14.5 volts

If display switches between "Htg.bC.ON" and "Htg.bC.OFF:"

- Specified value: 0.0-12.0 volts (oscillating)

- Switch ignition off.

24-34



If there is no voltage:

- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .

- Check wiring for open circuit between ECM/test box and 4-pin HO2S harness connector (to ECM).
  - Connector terminal 2 to ECM/test box socket 27
  - Specified value: max. 1.5 Ω

If wiring is OK:

- Replace Motronic ECM -J220- ⇒ Page 01-57
- Initiate adaptation of throttle valve control module to ECM ⇒ Page 24-119 .
- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

24-35

Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) and oxygen sensor control, checking

Notes:

- *Harness connector for Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC): 4-pin, black*

- *Component locations* ⇒ *Page 24-1*

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable
- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VW 1594 connector test kit
- Wiring diagram

Test requirements

- Engine Coolant Temperature (ECT) at least 85° C (185° F)

24-36

Function test

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ Page 01-7 .

Rapid data transfer **HELP**

Select function XX

Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block **HELP**

Input display group number XXX

Indicated on display

- Press buttons -0-, -3- and -6- to input display group number 36, and press -Q- button to confirm input.

Read Measuring Value Block 36 →

1 2 3 4

Indicated on display (1-4 = display fields)

24-37

- Compare display and specified values (display fields 1 and 2):

	Display fields			
	1	2	3	4
Display group 36: Heated Oxygen Sensor (HO2S) behind Three Way Catalytic Converter (TWC)				
Display	x.xxx V	B1-S2 ON B1-S2 OFF		
Indicates	Voltage supply to HO2S behind TWC	HO2S behind TWC ON/OFF		
Range	0.000-1.000 V	---		
Specified value	0.000-1.000 V (can oscillate slightly)	B1-S2 ON		
	If not as specified ⇒ Page 24-38 , Continuation			

Continuation

If displayed values are NOT OK (not as specified):

- Road test to condition oxygen sensor (eliminate possible contamination) and repeat test.

If the values in display fields 1 and 2 are still NOT OK:

- Check Oxygen Sensor (O2S) heater ⇒ Page 24-43 .

- Briefly accelerate engine over 3000 RPM.

If the value in display field 1 remains constant:

page ⇒ Page 24-39 , Evaluation of display group 36.

24-39

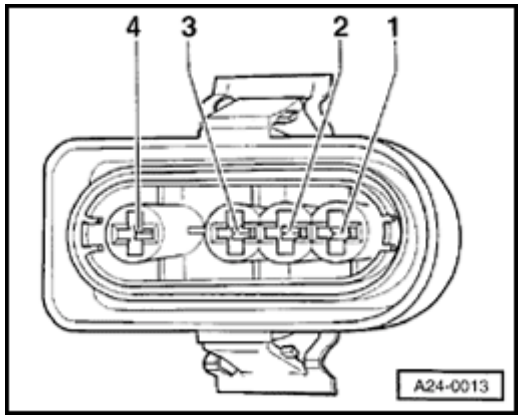
Evaluation of display group 36

Display group: 36 Display field: 1	Possible causes	Corrective action
approx. 0.435 V	♦ Open circuit in wiring -4- between oxygen sensor and ECM	- Check basic voltage ⇒ Page 24-40
approx. 0.440 V	♦ Open circuit in wiring -4- between oxygen sensor and ECM	
approx. 1.085 V	♦ Short circuit to B+ in wiring -4- between oxygen sensor and ECM	- Check wiring for oxygen sensor ⇒ Page 24-41
approx. 0.000 V	♦ Short circuit to Ground in wiring -4- between oxygen sensor and ECM	

24-40

Checking HO2S reference voltage

- Disconnect 4-pin connector (black) for Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G108-.



- Connect multimeter US 1119 (Fluke 83 or equivalent) between harness connector terminals 3 and 4 (to ECM), using adapter cables from VW 1594 connector test kit.
- Start engine and measure voltage.

  Specified value: 0.40 to 0.50 volts
- Switch ignition off.

If voltage is NOT OK:

- Check HO2S wiring ⇒ Page 24-41

If voltage is OK:

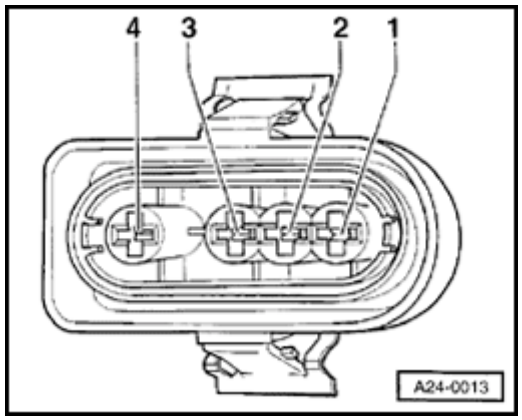
- Replace HO2S behind TWC -G108-.

24-41

Checking HO2S wiring

- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .

- Disconnect 4-pin connector (black) for Heated Oxygen Sensor (HO2S) behind Three Way Catalytic Converter (TWC) -G108-.



- Check wiring for open circuit between ECM/test box and 4-pin HO2S harness connector (to ECM).
  - Connector terminal 3 to ECM/test box socket 51
  - Connector terminal 4 to ECM/test box socket 52
  - Specified value: max. 1.5 Ω
- Check wiring for short circuits between terminals of 4-pin connector, between connector, ECM/test box, and shielding for wiring harness.
  - Connector terminal 4 to ECM/test box socket 51
  - Connector terminal 3 to ECM/test box socket 2
  - Connector terminal 4 to ECM/test box socket 2
  - Specified value: ∞ Ω

24-42

If wiring is OK:

- Replace Motronic ECM -J220- ⇒ Page 01-57 .
- Carry out adaptation of throttle valve control module to ECM ⇒ Page 24-119 .
- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

24-43

Oxygen Sensor (O2S) heater (behind TWC), checking

Notes:

- *Harness connector for Oxygen Sensor (O2S) heater: 4-pin, black*
- *Component locations* ⇒ *Page 24-1*

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable
- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VW 1594 connector test kit
- Wiring diagram

Test requirements

- Fuse for Oxygen Sensor (O2S) heater OK

- Engine Coolant Temperature (ECT) at least 85° C (185° F)

Checking

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ Page 01-7 .

Rapid data transfer **HELP**

Select function XX

Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block **HELP**

Input display group number XXX

Indicated on display

- Press buttons -0-, -4- and -1- to input display group number 41, and press -Q- button to confirm input.

Read Measuring Value Block 41 →

1 2 3 4

Indicated on display (1-4 = display fields)

24-45

- Compare display and specified values (display fields 3 and 4):

	Display fields			
	1	2	3	4
Display group 41: Oxygen Sensor (O2S) heater, before and after Three Way Catalytic Converter (TWC)				
Display	xx.x Ω	Htg.bC.ON/Htg.bC.OFF	xx.x Ω	Htg.aC.ON/Htg.aC.OFF
Indicates	Resistance of Oxygen Sensor (O2S) heater before TWC	O2S heater on or O2S heater off (before TWC)	Resistance of oxygen sensor (O2S) heater (after TWC)	O2S heater on or O2S heater off (after TWC)
Range	---	---	0.0-65.0 Ω	---
Specified value	---	---	4.9-19.9 Ω	Htg.aC.ON
	---	---	If not as specified ⇒ Page 24-46 , Continuation	---

If displayed values are OK (as specified):

- Press →button to advance program sequence.

- Press buttons -0- and -6- to select "End Output"

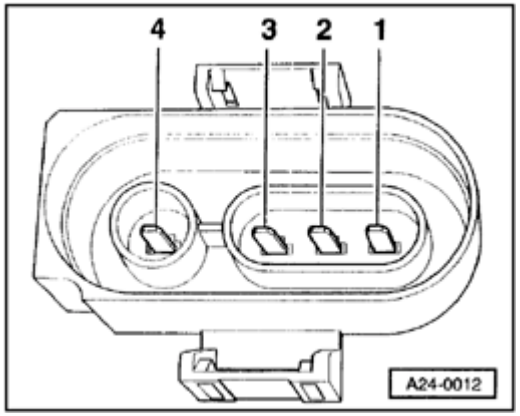
function 06, and press -Q- button to confirm input.

- Switch ignition off.

24-46

Continuation

- Disconnect 4-pin connector (black) for Oxygen Sensor (O2S) 2 -G108- behind Three Way Catalytic Converter (TWC).



- Connect multimeter US 1119 (Fluke 83 or equivalent) between HO2S connector terminals 1 and 2, using VW 1594 connector test kit.
- Measure resistance.

  Specified value: 0.00-19.9 Ω

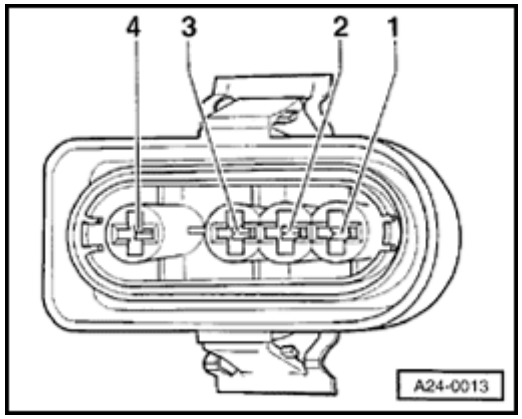
If resistance is NOT OK:

- Replace Heated Oxygen Sensor (HO2S) behind TWC -G108-.

If resistance is OK:

- Switch multimeter to 20 VDC measuring range.

24-47



- Connect multimeter between harness connector terminals 1 and 2 (to ECM), using VW 1594 connector test kit.
- Measure voltage supply and check display in display group 41, display field 4.

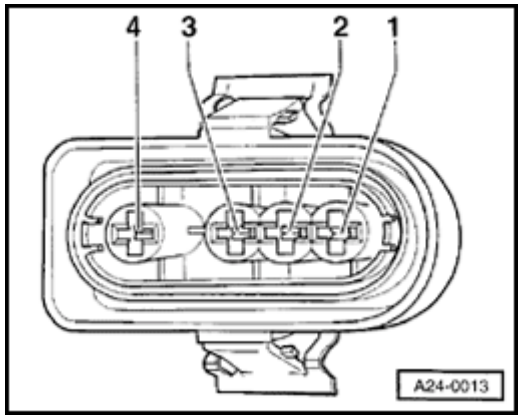
If display = Htg.aC.ON:

- Specified value: 11.0-14.5 volts

If display is switching between "Htg.aC.ON" and "Htg.aC.OFF"

- Specified value: 0.0-12.0 volts (oscillating)

24-48



If there is no voltage:

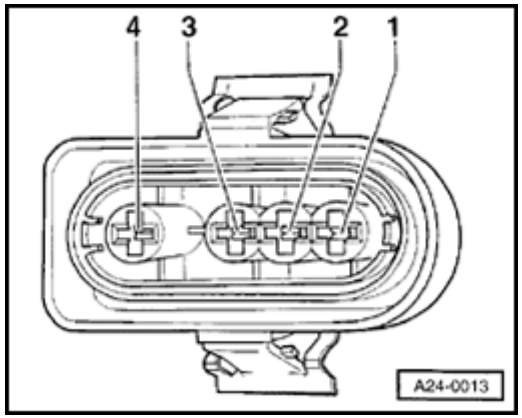
- Connect multimeter between harness connector terminal 1 (to ECM) and vehicle Ground, using VW 1594 connector test kit.

  Specified value: 11.0-14.5 volts

If there is still no voltage:

- Check wiring between terminal 1 and relay panel using appropriate wiring diagram.

24-49



If there is voltage:

- Connect multimeter between harness connector terminal 2 (to ECM) and Battery Positive Voltage (B+), using VW 1594 connector test kit.
- Measure voltage supply and check display in display group 41, display field 4.

If display = Htg.aC.ON:

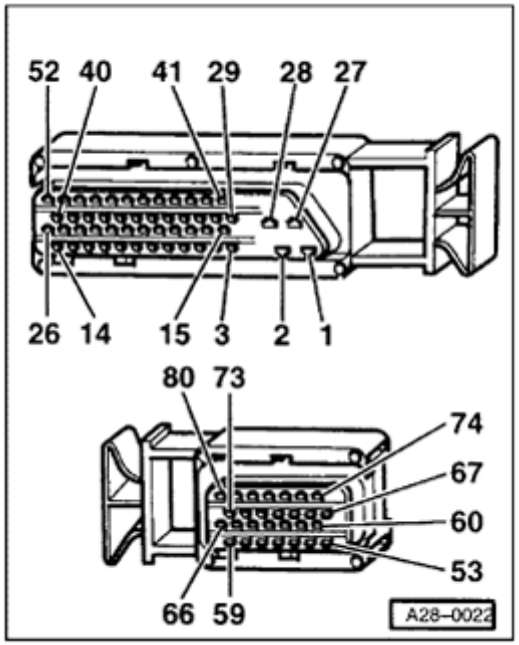
- Specified value: 11.0-14.5 volts

If display switches between "Htg.aC.ON" and "Htg.aC.OFF:"

- Specified value: 0.0-12.0 volts (oscillating)

- Switch ignition off.

24-50



If there is no voltage:

- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .

- Check wiring for open circuit between ECM/test box and 4-pin HO2S harness connector (to ECM).
  - Connector terminal 2 to ECM/test box socket 28
  - Specified value: max. 1.5 Ω

If wiring is OK:

- Replace ECM -J220- ⇒ Page 01-57
- Carry out adaptation of throttle valve control module to ECM ⇒ Page 24-119 .
- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

Oxygen Sensor (O2S) aging, checking

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable

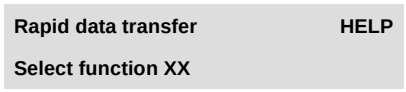
Test requirements

- Engine Coolant Temperature (ECT) at least 85 ° C (185 ° F)

24-52

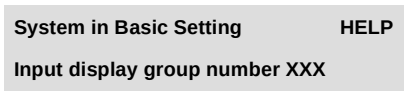
Function test

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ Page 01-7 .



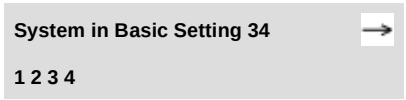
➢ Indicated on display

- Press buttons -0- and -4- to select "Basic Setting" function 04, and press -Q- button to confirm input.



➢ Indicated on display

- Press buttons -0-, -3- and -4- to input display group number 34, and press -Q- button to confirm input.



➢ Indicated on display (1-4 = display fields)

- Increase engine speed to 1800-2200 RPM and compare display with specified values for oxygen sensor aging (display fields 1-4).

Note:

To be sure that the temperature is within the specified range, the specified RPM has to be maintained for at least 1 minute. Observe status of oxygen sensor control in display field 4.

24-53

	Display fields			
	1	2	3	4
Display group 34: Oxygen sensor aging (time period check of oxygen sensor)				
Display	xxxx RPM	xx.xx ms	xx.xx s	Test OFF/Test ON B1-S1 OK/B1-S1 n.OK
Indicates	Engine speed (in 40 RPM steps)	Engine load	Time period oxygen sensor	Diagnostic status Diagnostic result
Range	0-6800 RPM	0.00-8.50 ms	0.00-5.00 s	---
Specified value	1800-2200 RPM	0.8-2.0 ms	0.00-3.30 s	B1-S1 OK
	---	---	If not as specified ⇒ Page 24-54 , Continuation	

24-54

Continuation

If displayed value is NOT OK (not as specified):

- Road test to condition oxygen sensor (eliminate possible contamination) and repeat test.

If displayed value is still NOT OK:

- Replace HO2S -G39-.

- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

24-55

Engine operating conditions (engine electronics), checking

Note:

This test checks whether the Motronic Engine Control Module (ECM) -J220- recognizes the engine operating conditions.

Required special tools and test equipment

- VAG 1551 or VAG 1552 scan tool with VAG 1551/3 adapter

Test requirements

- Engine oil temperature at least 80 °C (176 °F)

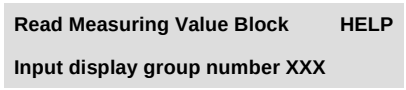
Checking

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ Page 01-7 .

Rapid data transfer **HELP**	
Select function XX	

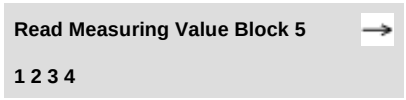
Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.



Indicated on display

- Press buttons -0-, -0- and -5- to input display group number 5, and press -Q- button to confirm input.



Indicated on display (1-4 = display fields)

24-56

- Check engine operating conditions (display field 4):

	Display fields			
	1	2	3	4
Display group 5: Engine electronics-operating conditions				
Display	xxx RPM	xx.xx ms	xxx km/h	Idle Part throt Full throt [1)] Decel Enrich
Indicates	Engine speed (in 40 RPM steps)	Engine load	Vehicle speed	Operational condition
Range	0-6800 RPM	0.00-8.50 ms	---	---
Specified value	760-960 RPM	0.50-1.50 ms	0 km/h	Idle: "Idle" Throttle slightly open: "Part throt" Throttle quickly closed: "Decel" Quick acceleration over 3000 RPM: "Enrich"

1) Possible only while driving

If displayed values are NOT OK (not as specified):

- Check free movement of accelerator pedal and cable.

- Check throttle valve control module ⇒ Page 24-99 .

Mass Air Flow (MAF) sensor, checking

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable
- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VW 1594 connector test kit
- Wiring diagram

Test requirements

- All electrical consumers switched off (coolant fan must not run during test).
- A/C must be switched off
- Fuse for MAF sensor OK

Test sequence

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ Page 01-7 .

Rapid data transfer **HELP**

Select function XX

Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block **HELP**

Input display group number XXX

Indicated on display

- Press buttons -0-, -0- and -2- to input display group number 2, and press -Q- button to confirm input.

Read Measuring Value Block 2 →

1 2 3 4

Indicated on display (1-4 = display fields)

24-59

- Compare display with specified values for engine load (display fields 2 and 4):

	Display fields			
	1	2	3	4
Display group 2: Load measurement				
Display	xxx RPM	xx.xx ms	xx.xx ms	xx.x g/s
Indicates	Engine speed (in 40 RPM steps)	Engine load	Injection time	Mass air flow
Range	0-6800 RPM	0.00-8.50 ms	0.00-25.00 ms	
Specified value	760-960 RPM	0.50-1.50 ms	1.00-3.00 ms	1.8-4.0 g/s
	2520 RPM	0.80-2.00 ms	1.50-4.00 ms	7.5-12.0 g/s
	---	If not as specified ⇒ Page 24-60 , Evaluation of display group 2	---	If not as specified ⇒ Page 24-60 , Evaluation of display group 2

If displayed values are OK (as specified):

- Press →button to advance program sequence.

- Press buttons -0- and -6- to select "End Output" function 06, and press -Q- button to confirm input.

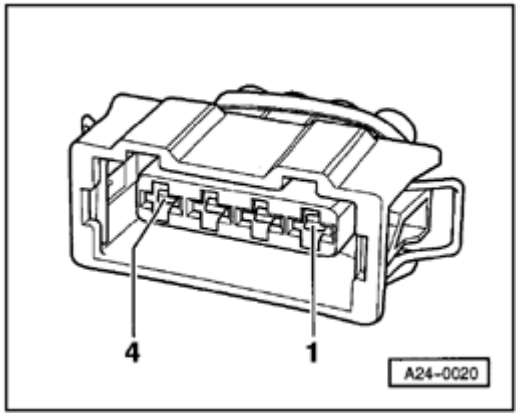
- Switch ignition off.

Evaluation of display group 2

Display group: 2 Display field: 2	Possible cause	Corrective action
less than 0.50 ms	♦ Smaller values can only occur while driving during deceleration	
more than 1.50 ms	♦ Shift into drive range (auto. transmission) ♦ Engine is affected by additional consumers	- Move shift lever to P or N - Illuminate load (A/C, power steering, generator)
	♦ Poor idle (does not run on all cylinders)	- Check spark plugs - Check fuel injectors ⇒ Page 24-87
	♦ Throttle valve control module -J338 faulty	- Check throttle valve control module ⇒ Page 24-99
Display field: 4	**Possible cause**	**Corrective action**
less than 1.8 g/s	♦ Large amount of false air between intake air duct and Mass Air Flow (MAF) sensor	- Check intake air system for leaks (false air) ⇒ Page 24-97
larger than 4.0 g/s	♦ Shift lever in drive range (auto. transmission) ♦ Engine affected by additional consumers	- Move shift lever to P or N - Eliminate load (A/C, power steering, generator)

	♦ Open circuits in wiring 3 or 4 between MAF sensor and ECM	- Check voltage supply ⇒ Page 24-61
	♦ Open circuit in wiring 1 or 2 between MAF sensor and ECM	- Check wiring ⇒ Page 24-61

24-61



Checking voltage supply

- Disconnect 4-pin harness connector from Mass Air Flow sensor (MAF).
- Connect multimeter US 1119 (Fluke 83 or equivalent) between harness connector terminals 1 and 3 (to ECM), using adapter cables from VW 1594 connector test kit.

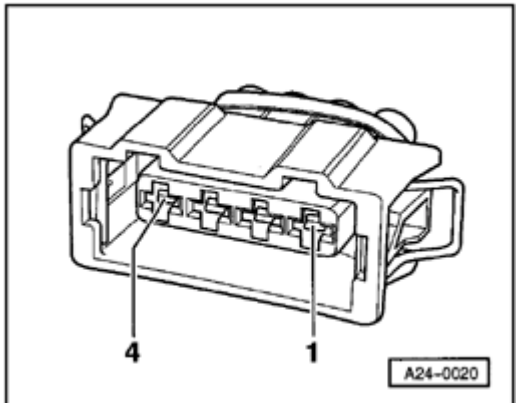
  Specified value: 9.0-14.5 volts

If there is no voltage:

- Switch ignition off.
- Check wiring using applicable wiring diagram.

Checking wiring

- Switch ignition off.
- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .



- Check wiring for open circuits between ECM/test box and 4-pin MAF sensor harness connector.
  - Connector terminal 2 to ECM/test box socket 12
  - Connector terminal 4 to ECM/test box socket 13
  - Specified value: max. 1.5 Ω

24-62

- Check wiring for short circuits between terminals of 4-pin connector, and between connector and ECM/test box.
  - Connector terminal 4 to ECM/test box socket 12
  - Specified value: ∞ Ω
- Switch multimeter to 20 VDC measuring range.
- Check wiring at 4-pin connector for short circuit to B+ (battery positive voltage), according to applicable wiring diagram.
  - Connector terminal 2 to vehicle Ground
  - Connector terminal 4 to vehicle Ground
  - Specified value: 0 volts

If wiring is OK:

- Replace Mass Air Flow sensor (MAF) -G70-.
- Check readiness code ⇒ Page 01-59 . If

Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

Engine Coolant Temperature (ECT) sensor, checking

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable
- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VW 1594 connector test kit
- Wiring diagram

Test requirements

- Engine cold

24-64

Checking

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with ignition switched on) ⇒ Page 01-7 .

Rapid data transfer HELP **Select function XX**

Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block HELP **Input display group number XXX**

Indicated on display

- Press buttons -0-, -0- and -1- to input display group number 1, and press -Q- button to confirm input.

Read Measuring Value Block 1 → **1 2 3 4**

Indicated on display (1-4 = display fields)

24-65

- Compare display with specified value for engine coolant temperature sensor (display field 2):

	Display fields			
	1	2	3	4
Display group 1: Basic function, engine idle speed				
Display	xxxx RPM	xxx.x °C	xx.x%	XXXXXX
Indicates	Engine speed (in 40 RPM steps)	Engine coolant temperature	Oxygen sensor control	Adjustment conditions
Range	0-6800 RPM	-46.5° to 141.0° C	-25.0 to 25.0 %	---
Specified value	0 RPM	approx. ambient temperature[1)]	Between -10.0 and 10.0%, value must fluctuate by at least 2 %	---
	---	If not as specified ⇒ Page 24-66 , Evaluation of display group 1	---	---

1) If indicated temperature deviates significantly from the ambient temperature, check ECT sensor wiring for resistance or open circuits.

- Start engine and let run at idle.

- Temperature value must increase evenly

Notes:

- *Temperature is displayed in increments of 1.5 ° C.*
- *If engine performance problems occur within certain temperature ranges, and if the temperature values do not increase without interruption, the temperature signal is intermittently interrupted and the sensor must be replaced.*

24-66

If NOT:

- Replace Engine Coolant Temperature (ECT) sensor -G62-.
- Press → button to advance program sequence.
- Press buttons -0- and -6- to select "End Output" function 06, and press -Q- button to confirm input.
- Switch ignition off.

Evaluation of display group 1

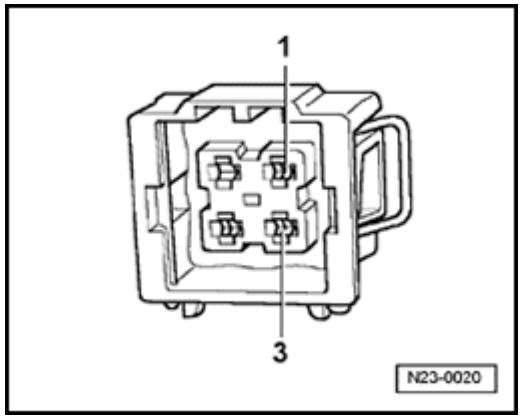
Display group: 1 Display field: 2	Possible cause	Corrective action
approx. -46.5 ° C	♦ Open circuit or short circuit in wiring to B+	- Check wiring ⇒ Page 24-66
approx. 141.0 ° C	♦ Short circuit to Ground	

Checking wiring

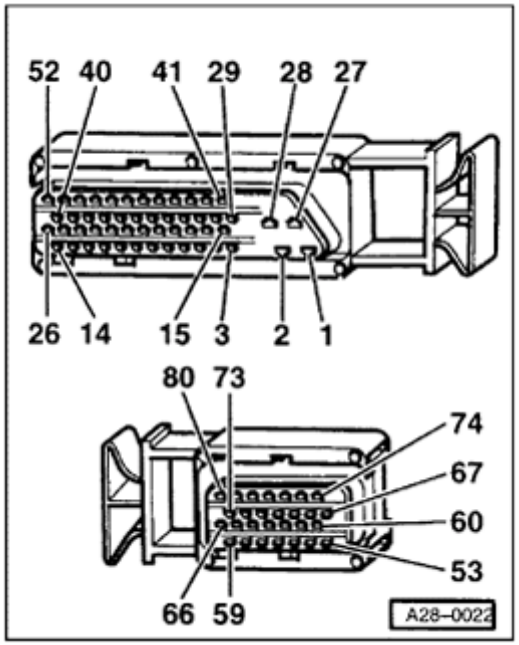
- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .

- Disconnect 4-pin connector from ECT sensor - G62-.

24-67



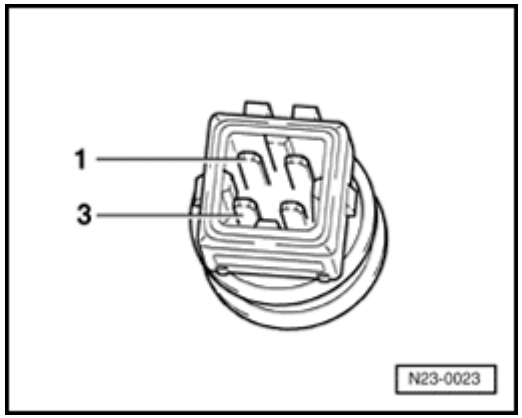
- Check wiring resistance for open circuit between ECM/test box and 4-pin ECT sensor connector.
  - Connector terminal 1 to ECM/test box socket 53
  - Connector terminal 3 to ECM/test box socket 67
  - Specified value: max. 1.5 Ω



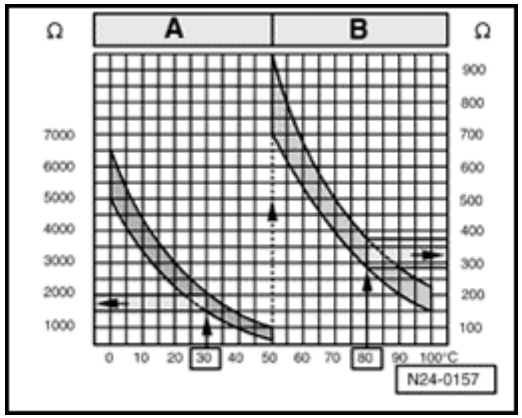
- Check wiring for short circuit between ECM/test box and 4-pin harness connector according to wiring diagram.
  - Connector terminal 1 to vehicle Ground
  - Connector terminal 1 to ECM/test box socket 67
  - Connector terminal 1 to terminal 3
  - Connector terminal 3 to vehicle Ground
  - Specified value: ∞ Ω
- Check wiring between ECM and 4-pin harness connector for short circuit to battery B+. Specified value: 0 volts
  - Connector terminal 1 to vehicle Ground
  - Connector terminal 3 to vehicle Ground

24-68

If wiring is OK:



- Check ECT sensor resistance across terminal 1 (signal) and terminal 3 (ground).
- Check measured resistance value for appropriate temperature range using graph below (N24-0157).
  - Range A: 0 to 50 ° C
  - Range B: 50 to 100 ° C



Examples:

- At 30 ° C, ECT sensor resistance should be 1500-2000 Ω
- At 80 ° C, ECT sensor resistance should be 275-375 Ω

If resistance is NOT OK:

- Replace Engine Coolant Temperature (ECT) sensor -G62-.
- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

Intake Air Temperature (IAT) sensor, checking

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable
- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VW 1594 connector test kit
- Wiring diagram
- Chilling spray (commercially available)

Checking

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with ignition switched on) ⇒ Page 01-7 .

Rapid data transfer **HELP**

Select function XX

Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block **HELP**

Input display group number XXX

Indicated on display

- Press buttons -0-, -0- and -4- to input display group number 4, and press -Q- button to confirm input.

Read Measuring Value Block 4 →

1 2 3 4

Indicated on display (1-4 = display fields)

24-71

- Compare displayed value with specified value for intake air temperature (display field 4):

	Display fields			
	1	2	3	4
Display group 4: Engine basic settings				
Display	xxx RPM	xx.xxx V	xxx.x °C	xxx.x °C
Indicates	Engine speed (in 40 RPM steps)	Battery Positive Voltage (B+)	Engine coolant temperature	Intake air temperature
Range	0-6800 RPM	0.000-16.500 V	-46.5 to 141.0	-46.5 to 141.0
Specified value	0 RPM	10.000-14.500 V	---	approx. ambient temperature[1)]
	---	---	---	Continuation ⇒ Page 24-72 , Evaluation of display group 4

[1)] If temperature displayed deviates significantly from ambient temperature, check sensor wiring for contact resistance or open circuit.

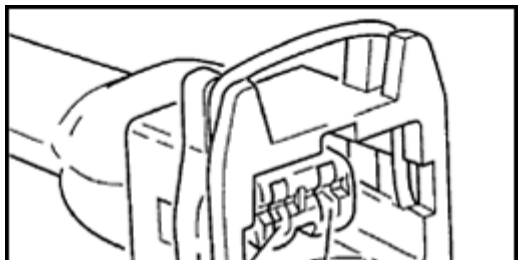
24-72

Evaluation of display group 4

Display group: 4 Display field: 4	Possible cause	Corrective action
-46.5 ° C	♦ Open or short circuit in wiring to B+	⇒ Page 24-72 , check wiring
141.0 ° C	♦ Short circuit to ground	
approx. ambient temperature	♦ Signal intermittently interrupted	- Check IAT sensor ⇒Continuation of test, page ⇒ Page 24-74

Wiring, checking:

- Switch ignition off.
- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .
- Disconnect 2-pin connector from Intake Air Temperature (IAT) sensor -G42-.



- Check wiring for open circuit between ECM/test box and 2-pin IAT harness connector (to ECM).
  - ♦ Connector terminal 1 to ECM/test box socket 54
  - ♦ Connector terminal 2 to ECM/test box socket 67

- Specified value: max. 1.5 Ω

24-73

- Check wiring for short circuit between ECM/test box and 2-pin harness connector according to wiring diagram.
  - Connector terminal 1 to vehicle Ground
  - Connector terminal 1 to ECM/test box socket 67
  - Connector terminal 1 to terminal 2
  - Connector terminal 2 to vehicle Ground
  - Specified value: $\infty\ \Omega$
- Check wiring between ECM and 2-pin harness connector for short circuit to battery B+.
  - Connector terminal 1 to vehicle Ground
  - Connector terminal 2 to vehicle Ground
  - Specified value: 0 volts

- Check resistance across terminals of IAT sensor -G42-.

Specified value: approx. 1.6-2.8 kΩ

If resistance is NOT OK:

- Replace intake air temperature sensor -G42-.

24-74

Continuation of test

(when IAT sensor indicates approx. ambient temperature)

- Without disconnecting harness connector, remove IAT sensor -G42-.

- Monitor intake air temperature value in display field 4.

- Spray sensor with commercially available chilling spray and check temperature value in display field 4.

  - Temperature value must decrease

If NOT:

- Replace intake air temperature sensor -G42-.

- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

24-75

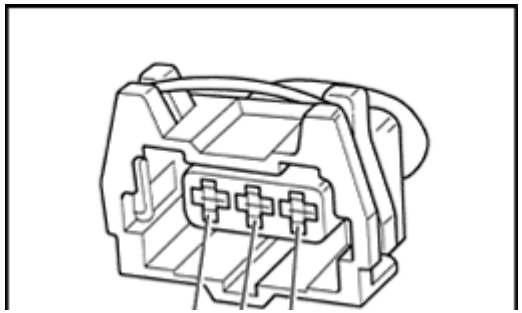
Engine Speed (RPM) sensor, checking

Required special tools and test equipment

- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VW 1594 connector test kit
- Wiring diagram

Checking

- Disconnect 3-pin harness connector from engine speed sensor ⇒ Page 24-1 , Component locations
- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .



- Check wiring for open circuit between ECM/test box and 3-pin harness connector.
  - Connector terminal 1 to ECM/test box socket 56
  - Connector terminal 2 to ECM/test box socket 63
  - Connector terminal 3 to ECM/test box socket 2

- Specified value: max. 1.5 Ω

24-76

- Check wiring for short circuit between ECM/test box and 4-pin harness connector, according to wiring diagram.

  - Connector terminal 1 to ECM/test box socket 2
  - Connector terminal 1 to ECM/test box socket 63
  - Connector terminal 2 to ECM/test box socket 56
  - Specified value: $\infty\ \Omega$

If wiring is OK:

- Replace engine speed (RPM) sensor -G28-.
- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected, generate new readiness code ⇒ Page 01-62 .

24-77

Voltage supply to Engine Control Module (ECM)

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable
- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VW 1594 connector test kit
- Wiring diagram

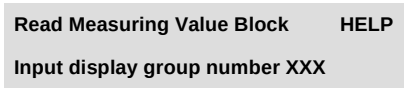
Checking

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with ignition switched on) ⇒ Page 01-7 .

Rapid data transfer **HELP**	
Select function XX	

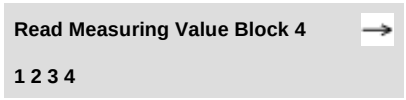
Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.



➢ Indicated on display

- Press buttons -0-, -0- and -4- to input display group number 4, and press -Q- button to confirm input.



➢ Indicated on display (1-4 = display fields)

24-78

- Check battery positive voltage (B+) in display field 2.

	Display fields			
	1	2	3	4
Display group 4: Basic engine setting				
Display	xxx RPM	xx.xxx V	xxx.x °C	xxx.x 5C
Indicates	Engine speed (in 40 RPM steps)	Battery Positive Voltage (B+)	Engine coolant temperature	Intake air temperature
Range	0-6800 RPM	0.000-16.500 V	-46.5 to 141.0	-46.5 to 141.0
Specified value	0 RPM	10.000-14.500 V	---	---
	---	If not as specified ⇒ Page 24-79 , Evaluation of display group 4	---	---

If displayed value is OK (as specified):

- Press →button to advance program sequence.

- Press buttons -0- and -6- to select "End Output" function 06, and press -Q- button to confirm input.

24-79

Evaluation of display group 4

Display group: 4 Display field: 2	Possible cause	Corrective action
No VAG 1551 display	♦ Fuse for ECM faulty	- Replace fuse
	♦ Open circuit in wiring	- Voltage supply at terminal 15 ⇒ Page 24-80
Displayed value changes between 10.0-14.5 V	♦ Intermittent connection	- Voltage supply at terminal 30 ⇒ Page 24-79
0.0-10.0 V	♦ Battery discharged/faulty ♦ Voltage regulator faulty	- Check battery - Check generator - Check voltage regulator
14.5-16.5 V	♦ Generator faulty ♦ Voltage regulator faulty	- Check generator - Check voltage regulator

Checking voltage supply at terminal 30

- Switch ignition off.
- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .

- Connect multimeter US 1119 (Fluke 83 or equivalent) between ECM/test box sockets 2 (Ground) and 3 (B+), using adapter cables from VW 1594 connector test kit.

  Specified value: 10-14.5 volts

If voltage is NOT OK:

- Check wiring according to applicable wiring diagram.

Checking voltage supply at terminal 15

- Switch ignition off.

- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .

- Connect multimeter between ECM/test box sockets 1 (B+) and 2 (Ground), using adapter cables from VW 1594 connector test kit.

- Switch ignition on, and check voltage.

  Specified value: 10-14.5 volts

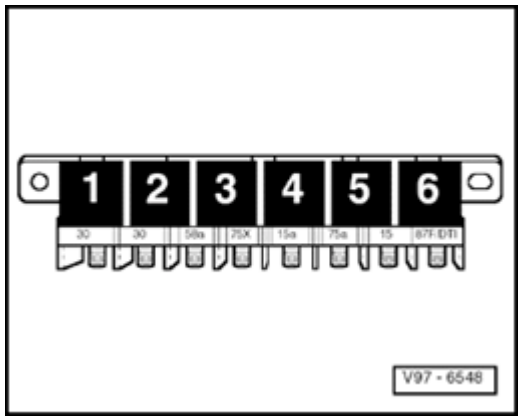
If voltage is NOT OK:

- Check wiring according to applicable wiring diagram.

- Check readiness code ⇒ Page 01-59 . If Diagnostic Trouble Code (DTC) memory has been erased, or ECM was disconnected,

generate new readiness code ⇒ Page 01-62 .

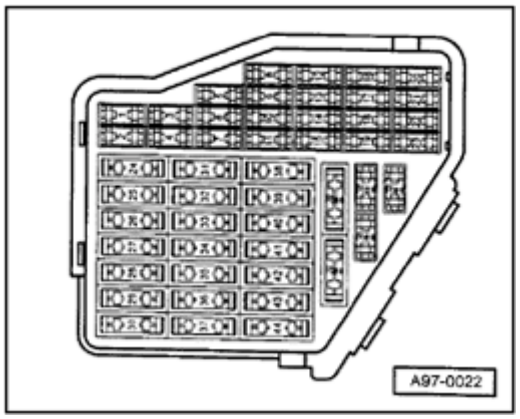
Fuel pump relay and connections, checking



➢ The fuel pump relay is located at relay position 4 on the relay panel on the left side under the instrument panel.

Checking function of fuel pump relay -J17-

- Remove storage shelf in left-front footwell.



➢
- Remove fuses 28, 29 and 34 from fuse panel.
- Connect VAG 1527B LED voltage tester between Ground and one of the two terminals for fuse 28.
- Briefly crank starter.
  - ♦ LED test light must light up.
  - ♦ Fuel pump relay must be actuated (sound and vibration)

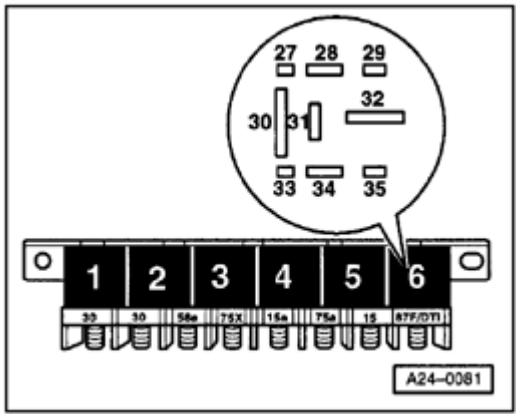
24-82

If the fuel pump does not respond:

- Check power supply wiring ⇒ Page 24-84 .

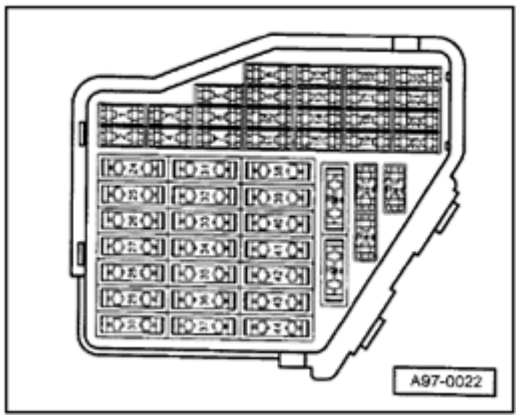
If the LED test light does not light up:

- Repeat test at other terminal of fuse 28.



If the LED light still does not light up:

- Check wiring for open or short circuits between fuse 28 and terminal 30 at relay position 6, using the applicable wiring diagram. Repair wiring as necessary.



- Connect VAG 1527B LED voltage tester between Ground and one of the two terminals for fuse 29.

Note:

This step lets the fuel pump run without the engine running. The closed throttle position switch must be closed during the test, or the selected fuel injector will discharge fuel when it is actuated 5 times.

- Initiate output Diagnostic Test Mode (DTM) and advance to test of

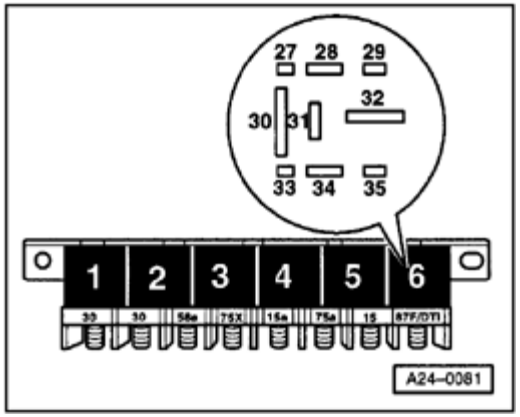
cylinder 1 fuel injector -N30- ⇒ Page 01-42 .

- LED test light must light up
- Fuel pump relay must be activated
- Fuel pump must run

24-83

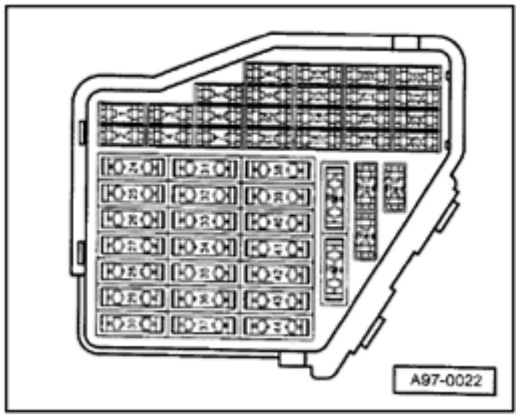
If the LED test light does not light up:

- Repeat test at other terminal of fuse 29.



If the LED test light does not light up:

- Check wiring for open circuit between fuse 29 and terminal 30 at relay position 6, using the applicable wiring diagram. Repair wiring as necessary.



- Connect VAG1527 LED voltage tester between Ground and one of the two terminals of fuse 34.

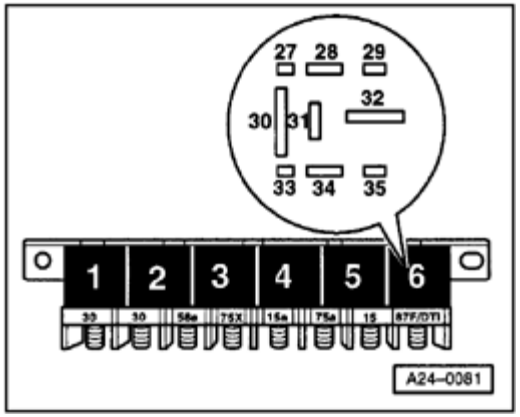
Note:

This step lets the fuel pump run without the engine running. The closed throttle position switch must be closed during the test, or the selected fuel injector will discharge fuel when it is actuated 5 times.

- Initiate output Diagnostic Test Mode (DTM) and advance to test of cylinder 1 fuel injector -N30- ⇒ Page 01-42 .
  - ♦ LED test light must light up
  - ♦ Fuel pump relay must be activated

- Fuel pump must run

24-84



If the LED test light does not light up:

- Repeat test at other terminal of fuse 34.

If the LED test light does not light up:

- Check wiring for open circuit between fuse 34 and terminal 31 at relay position 6, using the applicable wiring diagram. Repair wiring as necessary.

Checking fuel pump relay voltage supply

- Remove fuel pump relay -J17- from relay panel position 6.
- Switch ignition on.
- Connect multimeter US 1119 (Fluke 83 or similar) and check for voltage at relay socket:
  - Terminals 28 (B+) and 34
  - Terminals 32 (B+) and 34
  - Specified values: approx. Battery Positive Voltage (B+)

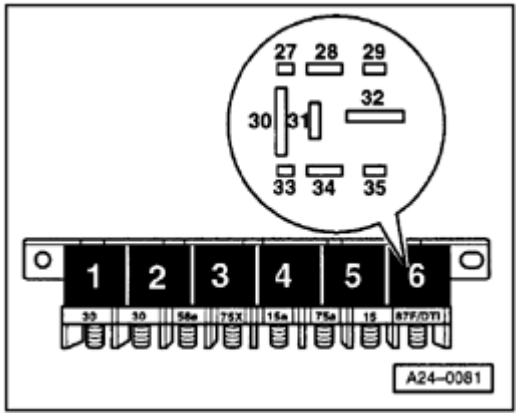
If voltage is NOT OK:

- Repair wiring according to applicable wiring diagram.

24-85

Checking fuel pump relay signal

- Fuel pump relay -J17- removed
- Fuses 28, 29 and 34 removed from fuse panel

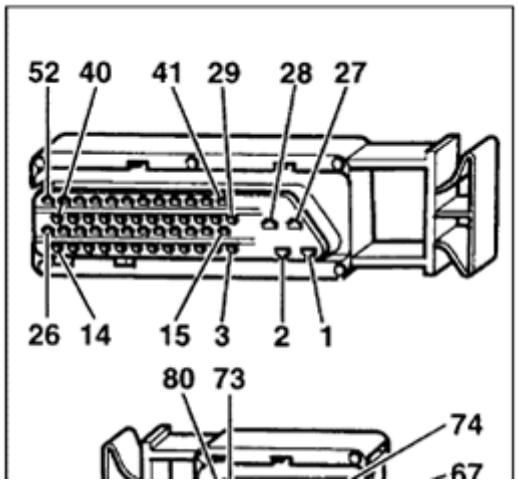


- Connect VAG 1527B LED voltage tester between relay socket terminals 28 (B+) and 29.

  LED test light must light up (dimly).

- Briefly crank starter; LED test light must continue to light up (dimly).

If the LED test light does not light up while cranking the starter, check wiring as follows.



- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 . (Numbers marked on ECM connector match those on test box).
- Connect multimeter US 1119 (Fluke 83 or equivalent) to check for open circuit between relay socket terminal 29 and test box socket 4.

  Specified value: max. 1 Ω

If resistance is NOT OK:

- Repair wiring using applicable wiring diagram.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations.*

24-86

If the wiring is OK, but the LED test light does not light up:

- Replace Engine Control Module (ECM) ⇒ Page 01-57 .

If the wiring is OK, and the signal to the fuel pump relay is OK:

- Replace fuel pump relay -J17-.

- Reinstall fuses.

24-87

Fuel injector actuation, checking

Triggering fuel injectors via output Diagnostic Test Mode (DTM) ⇒ Page 01-42

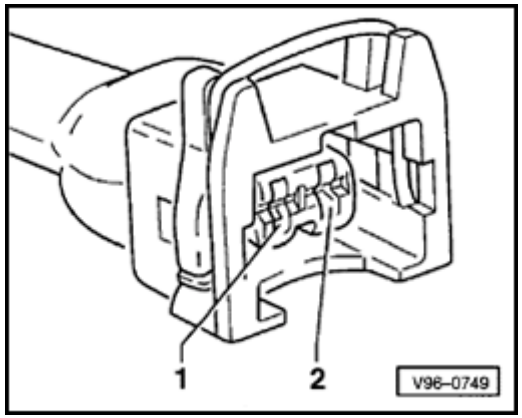
Required special tools and test equipment

- VAG 1598/22 test box
- Multimeter US 1119 (Fluke 83 or equivalent)
- VAG 1527B LED voltage tester
- VW 1594 connector test kit
- Wiring diagram

Test requirements

- Fuse for fuel injectors OK
- Engine speed (RPM) sensor OK
- Fuel pump relay OK

24-88



Checking

- Disconnect harness connector from cylinder 1 fuel injector.
- Connect VAG 1527B LED voltage tester between connector terminals (to ECM), using adapters from VW 1594 connector test kit.
- Disconnect harness connectors from fuel injectors for cylinders 2, 3 and 4.
- Crank starter briefly to check voltage supply for cylinder 1 fuel injector.

  LED must flicker.
- Repeat test for fuel injectors for cylinders 2, 3 and 4.

24-89

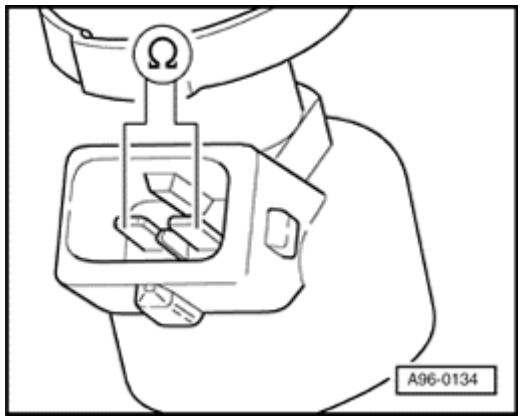
If LED does not flicker:

- Switch ignition off.
- Connect VAG 1598/22 test box to ECM harness connector ⇒ Page 01-56 .
- Check wiring for open circuits between ECM/test box and fuel injector harness connectors:
  - Cyl. 1 fuel injector terminal 2 to ECM/test box socket 73
  - Cyl. 2 fuel injector terminal 2 to ECM/test box socket 80
  - Cyl. 3 fuel injector terminal 2 to ECM/test box socket 58
  - Cyl. 4 fuel injector terminal 2 to ECM/test box socket 65
  - Specified value: max. 1.5 Ω
- Check wiring for open circuit between fuel injector connector terminal 1 and relay panel, according to wiring diagram.

Specified value: max. 15 Ω

- Check wiring for short circuits between wires and connector terminals.

Specified value: ∞ Ω



Fuel injector resistance, checking

- Check resistance of individual fuel injectors.

  Specified value: 11-13 Ω

Note:

With engine at operating temperature, resistance increases by approx. 4-6 Ω

If resistance is NOT OK:

- Replace affected fuel injector.

24-91

Fuel injectors, checking for leakage

WARNING!

The fuel system is under pressure! Before loosening hoses or opening the test connection, cover the connection with a rag. Only then, open carefully to slowly release pressure.

Required special tools and test equipment

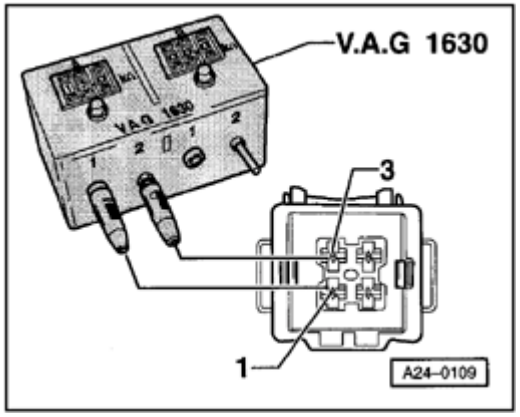
- VW 1594 connector test kit
- VAG 1630 digital potentiometer
- VAG 1602 fuel analyzer

Checking

- Disconnect harness connector for Camshaft Position (CMP) sensor -G40-.
- Disconnect vacuum hose from fuel pressure regulator.
- Remove fuel rail together with fuel injectors.

- Insert fuel injectors in VAG 1602 fuel analyzer.

24-92



- Disconnect harness connector for Engine Coolant Temperature (ECT) sensor -G62-.
- Adjust VAG 1630 digital potentiometer to 15 kΩ setting.
- Connect to ECT sensor harness connector terminals 1 and 3, using adapter cables from VW 1594 connector test kit.
- With the aid of a helper, briefly crank starter.

  Fuel injectors must spray according to the firing order.
- Switch ignition off, and check for leaks at fuel injectors.

  Fuel injectors may not drip more than 2 drops per minute.

Note:

When reinstalling the fuel injectors be careful not to damage the O-rings.

Fuel pressure regulator and residual pressure, checking

The fuel pressure regulator controls the fuel pressure depending on intake manifold pressure.

Required special tools and test equipment

- Pressure tester VAG 1318
- Adapter 1318/11
- Adapter 1318/12
- Adapter 1318/13

Test requirements

- Fuel pump delivery rate must be OK; checking:

⇒ *Repair Manual, Fuel Supply System, Repair Group 20.*

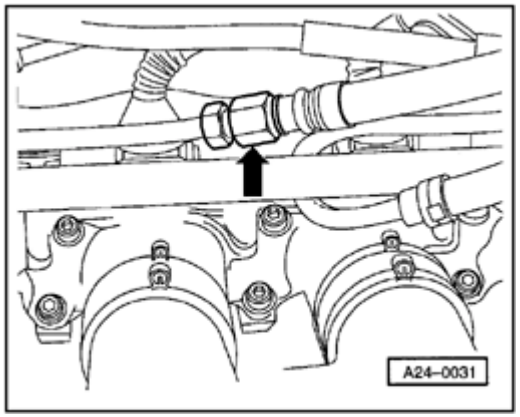
Checking

WARNING!

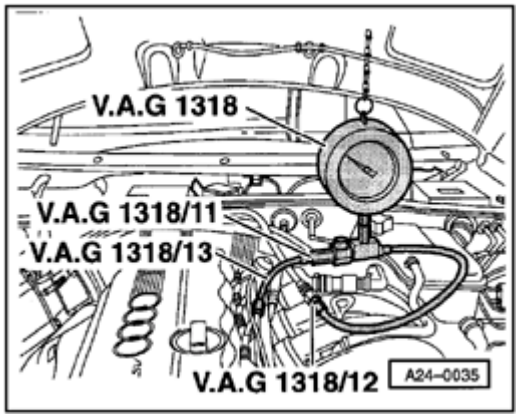
The fuel system is under pressure! Before loosening hoses or opening the test connection, cover the connection with a rag. Only then, open carefully to slowly release pressure.

24-94

- Open fuel filler cap briefly (release pressure).



- Cover the fuel supply line connection (arrow) to protect against fuel spray.
- Slowly open connection and catch leaking fuel.



- Connect pressure tester VAG 1318 to fuel rail using adapters VAG 1318/11, VAG 1318/12 and VAG 1318/13.

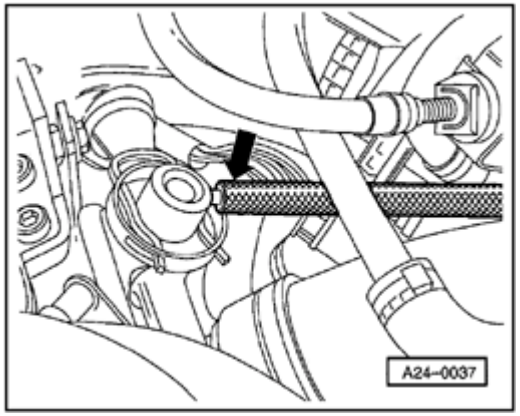
Note:

The valve on the pressure tester must be open (lever pointing in direction of flow).

- Start engine and let run at idle.
- Measure fuel pressure.

  Specified value: approx. 3.5 bar (50 psi)

24-95



- Disconnect vacuum hose (arrow) for fuel pressure regulator.

  Fuel pressure must increase to approximately 4.0 bar (58 psi)

- Reconnect vacuum hose.
- Switch ignition off.
- Check for residual fuel pressure by monitoring decrease in pressure on gauge. Specified value:

  After 10 minutes: at least 2.5 bar (36 psi)

If residual pressure drops below 2.5 bar (36 psi):

- Start engine and let run at idle.
- After pressure has built up, at the same time:
  - Switch ignition off.
  - Close valve on pressure tester VAG 1318-lever in OFF position (arrow).
- Monitor decrease in pressure on gauge.

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If residual pressure still drops below 2.5 bar (36 psi), possible malfunctions are:

- Leaking connection between pressure tester and fuel line
- Leaking connection between fuel supply line and fuel rail
- Faulty check valve in fuel pump; removing and installing:

⇒ *Repair Manual, Fuel Supply System, Repair Group 20*

If residual pressure no longer drops below 2.5 bar (36 psi), the possible malfunctions are:

- Leaking fuel pressure tester connections after shut-off valve.
- Faulty fuel pressure regulator
- Leaking fuel injectors

Note:

When disconnecting the pressure tester, close the shut-off valve, disconnect adapter VAG 1328/12, then catch excess fuel in a container by opening the shut-off valve.

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Intake air system, checking for leaks (false air)

Required special tools and test equipment

- VAG 1551 or VAG 1552 Scan Tool (ST) with VAG 1551/3 adapter cable
- Engine leak detector spray G 001 800 A1

Notes:

- *If there are leaks, intake manifold vacuum will draw in the leak detector spray with outside air. The spray reduces the ability of the fuel/air mixture to ignite, which causes a drop in engine speed and a significant increase in CO-content.*
- *Observe the safety precautions listed on the container.*

Checking

- Connect VAG 1551 or VAG 1552 scan tool and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ Page 01-7 .

Rapid data transfer HELP	<	Indicated on display

Select function XX

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block HELP

Input display group number XXX

➢ Indicated on display

- Press buttons -0-, -0- and -1- to input display group number 1, and press -Q- button to confirm input.

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Read Measuring Value Block 1 →

1 2 3 4

< Indicated on display (1-4 = display fields)

- Monitor oxygen sensor control in display field 3.

	Display fields			
	1	2	3	4
Display group 1: Idle test				
Display	xxxx RPM	xxx.x °C	xx.x%	xxxxxx
Indicates	Engine speed (in 40 RPM steps)	Engine temperature	Oxygen sensor control	Adjustment conditions
Range	0-6800 RPM	---	-25.0 to 25.0 %	---
Specified value	760-960 RPM	---	In the range of -10.0 to 10.0% the value must fluctuate by at least 2%	---

- Systematically spray parts of intake air system with engine leak detector spray.

If engine speed drops, or the value displayed for oxygen sensor control changes:

- Check for leaks in area of intake air system most recently sprayed, and eliminate leaks.