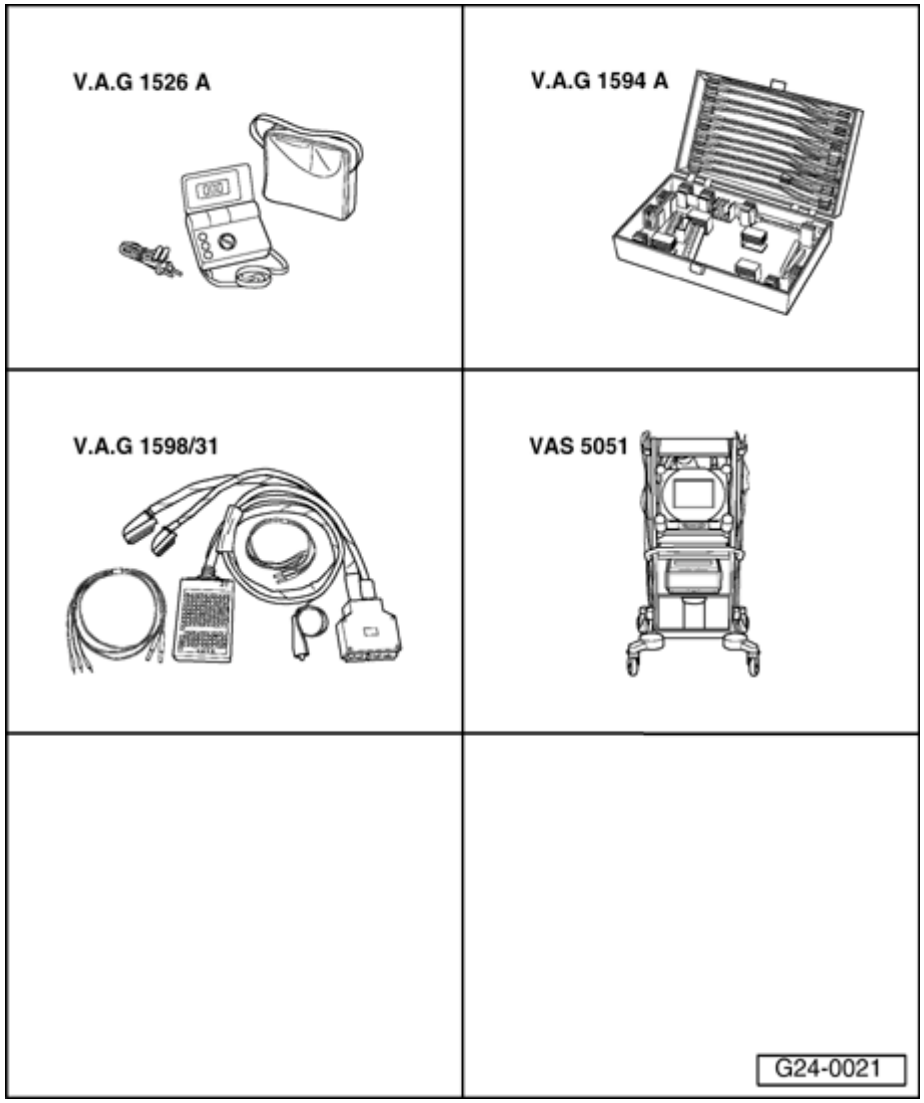
24-71



Oxygen sensor control, checking

Oxygen sensor and oxygen sensor control before catalytic converter, checking

Special Tools and Equipment

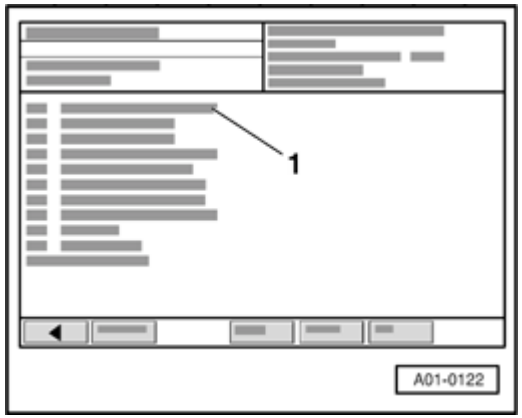
- VAG1526A
- VAG1594A
- VAG1598/31
- VAS5051 with VAG5051/1

Test requirements:

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

Test sequence

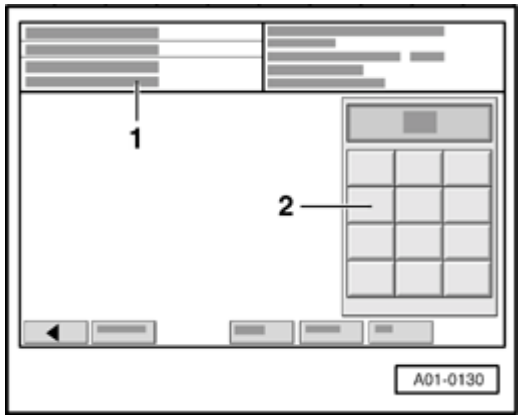
- Connect VAS5051 tester ⇒ Page 01-7 and select vehicle system "01 - Engine electronics". Engine must run at idle for this.



➢ Display on VAS5051:

- In selection -1-, click on the diagnostic function "04 - Basic setting".

24-73



➢ Display on VAS5051:

1 - Enter display group Max. input value = 255

- Select function "030" in button field -2- for "display group number 030" and press Q button to confirm input.

➢ Display on VAS5051:

- Check specified value in display field -1-.

Notes:

- *Increase engine speed to obtain specified values faster.*
- *"Oxygen sensor status" indicates status of oxygen sensor control and oxygen sensors.*

24-74

	Display fields			
	1	2	3	4
Display group 030: Oxygen sensor status				
Display	**X X X**	X X X		
Indicated	**Oxygen sensor status, bank 1, sensor 1**	Oxygen sensor status, bank 2, sensor 1		
Functional range	**0 = off** **1 = on**	0 = off 1 = on		
Specified value	**1 1 1**	1 1 0		
Note	**If specified value is not obtained ⇒ Page 24-81** **If specified value is obtained but there is a malfunction stored in DTC memory ⇒Check oxygen sensor adaptation values and control, ⇒ Page 24-75**			

Significance of 3 digit indications in display group 030			
X	X	X	**Display fields 1 and 2**
		X	Oxygen sensor control: 0= not active; 1 = active
	X		Operational readiness of oxygen sensor: 0= not active; 1 = active
X			Condition of oxygen sensor heater: 0= not active; 1 = active

Note:

The first field of the 3 digit indication (heating) fluctuates between 0 and 1.

24-75

Display on VAS5051:

- Do not continue test until indication in display field -1- has reached "111" at least once.

Checking oxygen sensor adaptation values and control

- Press ▲ button 2 times to change into display group 032.
- Check oxygen sensor adaptation values in display fields -1- and -2-.

	Display fields			
	1	2	3	4
Display group 036: Oxygen sensor adaptation values				
Display	**xx.x %**	**xx.x %**		
Indicated	**Oxygen sensor adaptation value bank 1, sensor 1at idle (additive)**	**Oxygen sensor adaptation value bank 1, sensor 1at partial throttle(multiple)**		
Specified value	**-6.0 to 6.0 %**	**-10.0 to 10.0 %**		
Note	**If specified value is not obtained ⇒ Page 24-78**			

24-76

- Press ▲ button to change into display group 033.

- Check oxygen sensor control in display fields -1- and -2-.

	Display fields			
	1	2	3	4
Display group 033: Oxygen sensor control				
Display	**xx.x %**	**x.xxx V**		
Indicated	**Oxygen sensor control bank 1, sensor 1**	**Oxygen sensor voltage, Bank 1, sensor 1**		
Specified value	**Value must fluctuate at least 2 % in the range -10.0 to 10.0 %**	**0.130 to 3.600 volts**		
Note	**If specified value is not obtained ⇒ Continuation, ⇒ Page 24-77**	**If specified value is not obtained ⇒ Evaluation display group 033, ⇒ Page 24-80**		

Note for display field 2:

The oxygen sensor voltage signal which is processed and calendered by the Engine Control Module (ECM) will be displayed. 1.5 volts in display corresponds to Lambda 1.

Continuation

If specified value in display field 1 is not obtained or if value does not fluctuate at least 2 %:

- Road test vehicle in order to free oxygen sensor of possible residue and repeat test.

If specified value in display field 1 is not obtained even after road test or if value does not fluctuate at least 2 %:

- Check primary voltage ⇒ Page 24-81 .
- Test oxygen sensor heater before catalytic converter ⇒ Page 24-89 .
- Check oxygen sensor before catalytic converter for aging ⇒ Page 24-84 .

Display group 032

Display field: 1 / 2	Possible cause	Corrective action
Oxygen sensor adaptation values below specified range	♦ Leak in intake area (pressure side between turbocharger and intake manifold)	- Check intake system for leaks and repair false air ⇒ Page 24-68
	♦ Oil thinning	- Oil change or perform swift country road test
	♦ High oil consumption	
	♦ Mass Air Flow (MAF) sensor faulty	- Mass Air Flow (MAF) sensor, checking ⇒ Page 24-59
	♦ Evaporative Emission (EVAP) canister purge regulator valve remains stuck in open position	- Check Evaporative Emission (EVAP) canister purge regulator valve ⇒ Page 24-114
	♦ Fuel pressure too high	- Check fuel pressure regulator ⇒ Page 24-32
	♦ Fuel injector does not close	- Check fuel injectors ⇒ Page 24-37 .
	♦ Oxygen sensor heating faulty ♦ Oxygen sensor faulty	- Check oxygen sensor heating ⇒ Page 24-89

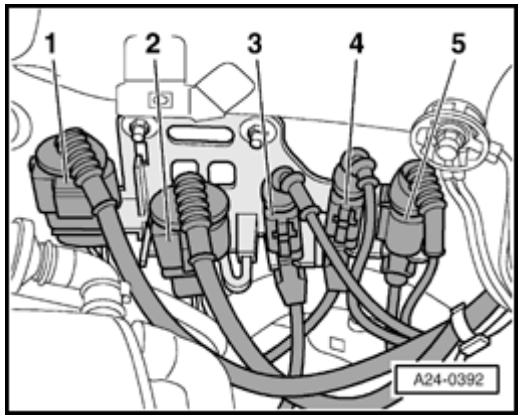
Display group 032

Display field: 1 / 2	Possible cause	Corrective action
Oxygen sensor adaptation values via specified range	♦ False air in intake area	- Check intake system for leaks and repair false air ⇒ Page 24-68
	♦ Fuel pressure too low	- Check fuel pressure regulator ⇒ Page 24-32
	♦ Mass Air Flow (MAF) sensor faulty	- Mass Air Flow (MAF) sensor, checking ⇒ Page 24-59
	♦ Oxygen sensor heating faulty ♦ Oxygen sensor faulty	- Check oxygen sensor heating ⇒ Page 24-89
	♦ Fuel injector does not open or opens only partially	- Check fuel injectors ⇒ Page 24-37 .
	♦ Evaporative Emission (EVAP) Canister Purge Regulator Valve sticks	- Check Evaporative Emission (EVAP) canister purge regulator valve ⇒ Page 24-114

Evaluation display group 033

Display field: 2	Possible cause	Corrective action
larger than 4.800 V	♦ Short circuit to B+ in wire connections between oxygen sensor and control module ♦ Oxygen sensor faulty	- Check oxygen sensor wires of oxygen sensor before catalytic converter ⇒ Page 24-82
smaller than 0.130 V	♦ Short circuit to Ground (GND) in wire connections between oxygen sensor and control module ♦ Oxygen sensor faulty	- Replace oxygen sensor before catalytic converter

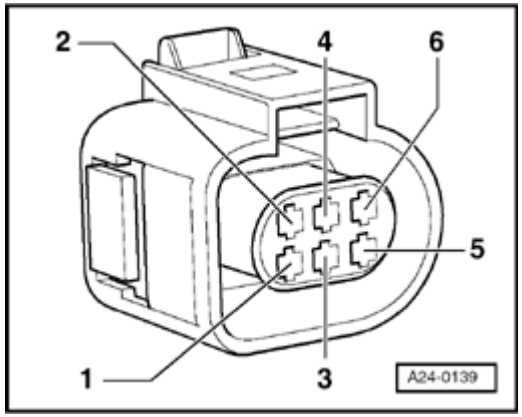
Checking primary voltage



- Disconnect 6-pin harness connector (black) -2- to Heated Oxygen Sensor (HO2S) -G39- before catalytic converter.

Note:

Coolant reservoir screws must be removed and coolant reservoir must be placed to side in order to access the harness connector. The coolant hoses can remain connected.



- Connect multimeter between terminal 1 and 5 for voltage measurement.
- Switch ignition on.
  - ♦ Specification: 0.400 to 0.500 V
- Switch ignition off.

24-82

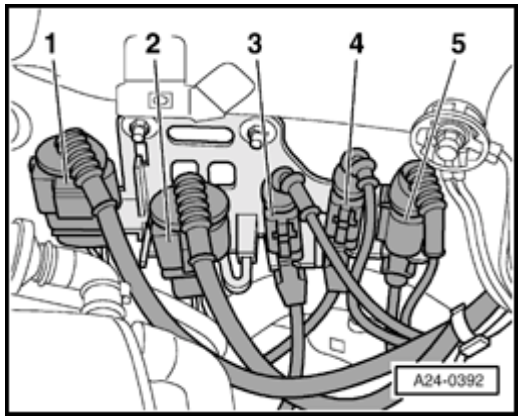
If specified value is not obtained:

- Check oxygen sensor wiring.

If specified value is obtained:

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

Checking oxygen sensor wires



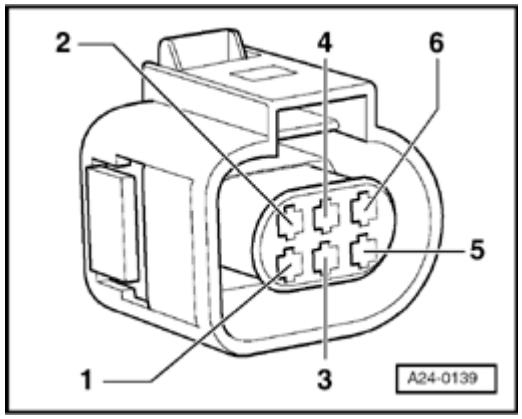
- Disconnect 6-pin harness connector (black) -2- to Heated Oxygen Sensor (HO2S) -G39- before catalytic converter.

Note:

Coolant reservoir screws must be removed and coolant reservoir must be placed to side in order to access the harness connector. The coolant hoses can remain connected.

- Connect VAG1598/31 test box at wiring harness to Engine Control Module (ECM), do not connect ECM ⇒ Page 24-19 .

24-83



- Check the following wire connections for open circuit.

Harness connector Terminal	VAG1598/31 test box Socket
1	70
2	71
5	51
6	52

- Repair open circuit if necessary.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Check wires to each other for short circuit.

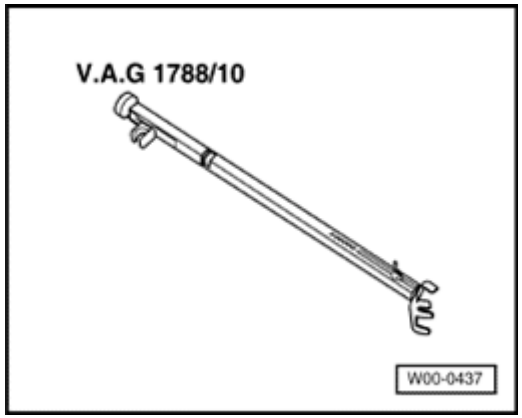
If wire connection is OK:

- Replace Engine Control Module (ECM) ⇒ Page 24-22

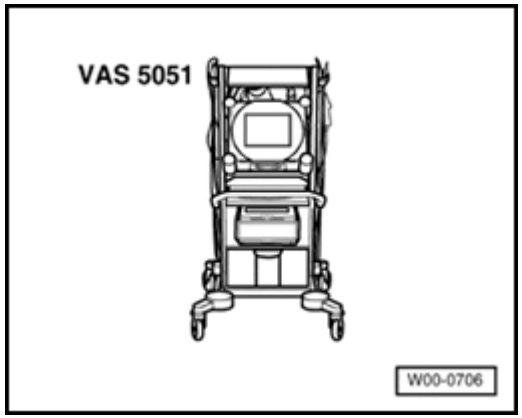
24-84

Oxygen sensor aging, oxygen sensor before catalytic converter, checking

Special Tools and Equipment



- VAG1788/10 RPM adjuster



- VAS5051 with VAG5051/1

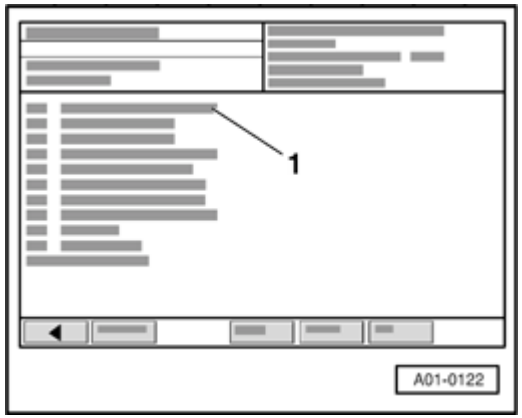
Test requirement:

- Coolant Temperature at least 80 °C.

24-85

Test sequence

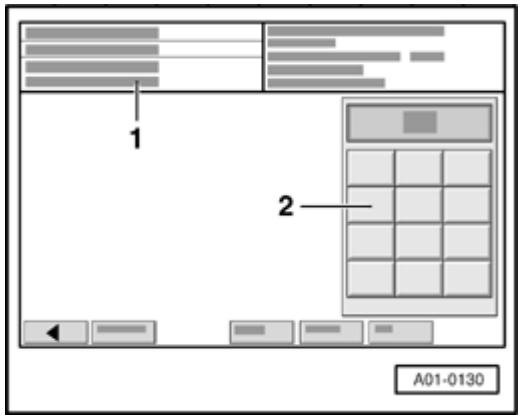
- Connect VAS5051 tester ⇒ Page 01-7 and select vehicle system "01 - Engine electronics". Engine must run at idle for this.



➢ Display on VAS5051:

- In selection -1-, click on the diagnostic function "04 - Basic setting".

24-86



➢ Display on VAS5051:

1 - Enter display group Max. input value = 255

- Select function "034" in button field -2- for "display group number 034" and press Q button to confirm input.
- Use VAG1788/10 RPM adjuster to adjust engine speed to between 2300 and 2800 RPM.

➢ Display on VAS5051:

- Check specified value in display field -4-.

Note:

This process can take a few minutes.

24-87

	Display fields			
	1	2	3	4
Display group 034: Diagnostic oxygen sensor aging				
Display	xxxx/min	xxx ° C	**x.x**	**---**
Indicated	Engine speed (RPM)	Exhaust temperature	**Dynamic factor**	Diagnostic condition
Functional range				**Test OFF** **Test ON** **B1-S2 OK** **B1-S2 not OK**
Specified value	2300 to 2800 RPM	larger than 350 ° C	**0.5 to 2.5**	B1-S2 OK
Note			**If specified value is not obtained ⇒ Continuation, ⇒ Page 24-88**	

Note for display field 2:

Calculated value from engine speed and engine load.

Note for display fields 3 and 4:

The dynamic factor is a characteristic for oxygen sensor aging. The smaller the dynamic factor, the further the oxygen sensor aging process has advanced.

24-88

Continuation

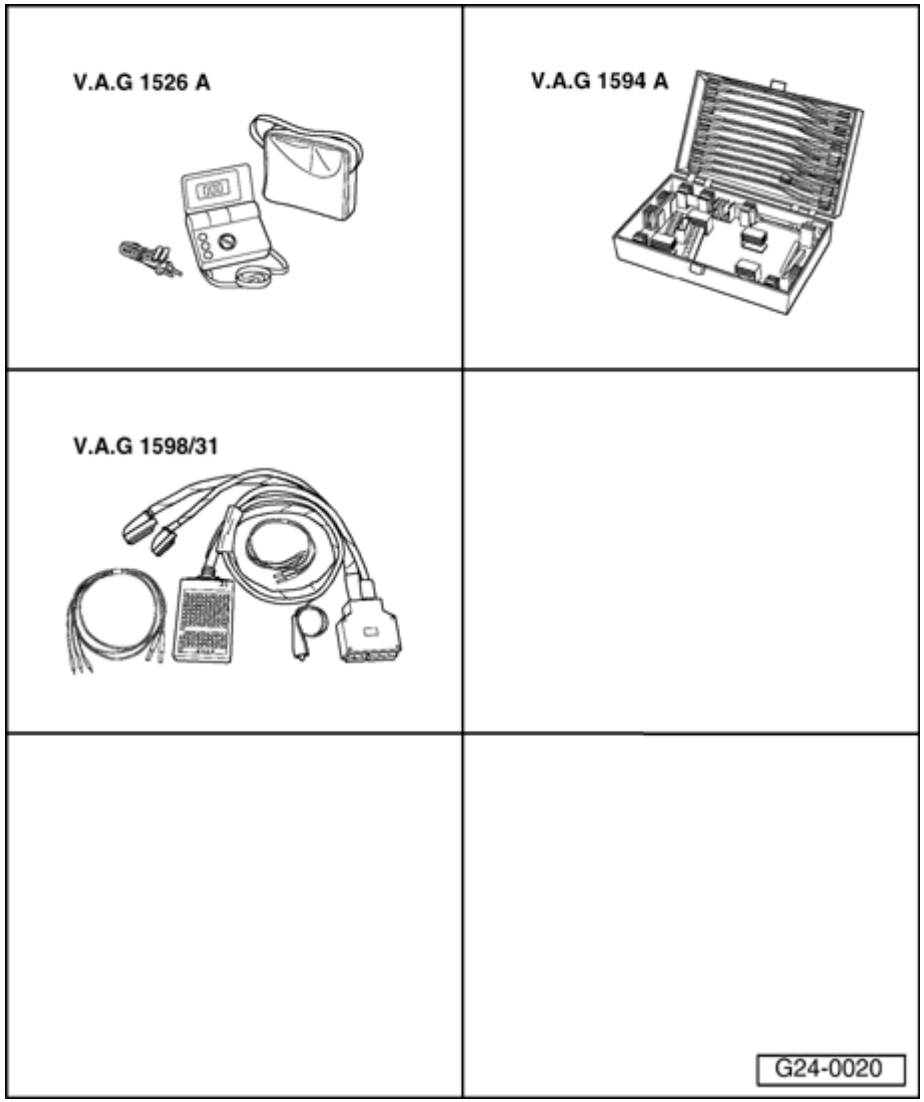
If specified value in display field 3 and 4 is not obtained:

- Road test vehicle in order to free oxygen sensor of possible residue and repeat test.

If specified value in display field 3 and 4 is not obtained, even after road test:

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

24-89



Oxygen sensor heating, Oxygen Sensor (O2S) Heater -Z19- before catalytic converter, checking

Special Tools and Equipment

- VAG1526A
- VAG1594A
- VAG1598/31

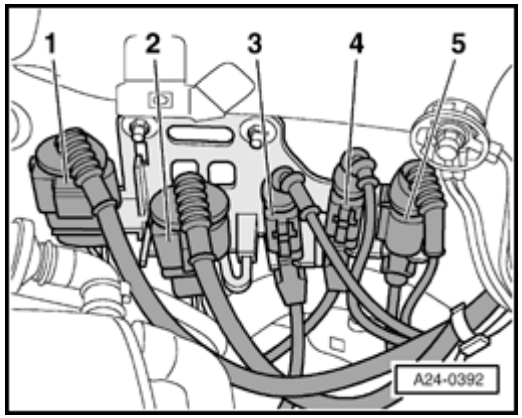
24-90

Test requirements:

- Coolant Temperature at least 80 °C.
- Fuse for oxygen sensor heating OK

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

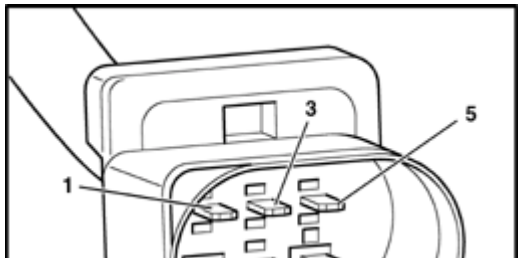
Test sequence



- Disconnect 6-pin harness connector (black) -2- to Heated Oxygen Sensor (HO2S) -G39- before catalytic converter.

Note:

Coolant reservoir screws must be removed and coolant reservoir must be placed to side in order to access the harness connector. The coolant hoses can remain connected.



- Connect multimeter between terminal 3 and 4 for resistance measurement.
  - Specified value at room temperature: 2.5 to 10 Ω

If specified value is not obtained:

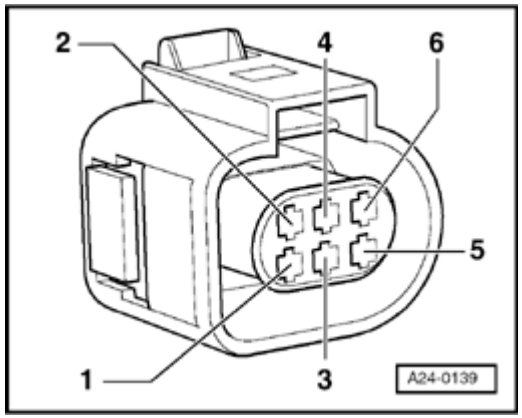
- Replace Heated Oxygen Sensor (HO2S)-G39-.

24-91

If specified value is obtained:

- Check voltage supply of oxygen sensor heating.

Checking voltage supply for oxygen sensor heating

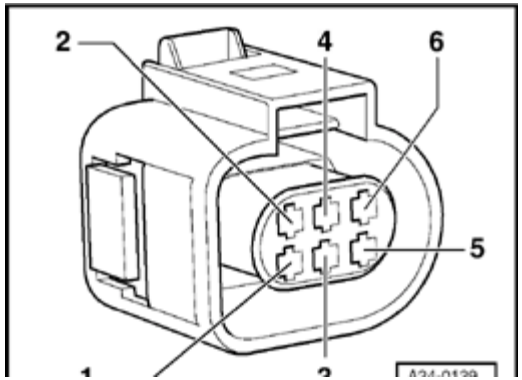


- Connect multimeter between terminal 3 and 4 for voltage measurement.
- Start engine.
  - ♦ Specification: approx. battery voltage

Note:

When the Engine Control Module (ECM) switches oxygen sensor heating on and off, it may be observed via the function "read measuring value block", in display group number 041 display field 2.

If there is no voltage:



- Connect multimeter for voltage measurement as follows.

Harness connector **Terminal**	**Measure to**
3 (B+)	Vehicle Ground (GND)

24-92

- Operate starter briefly.

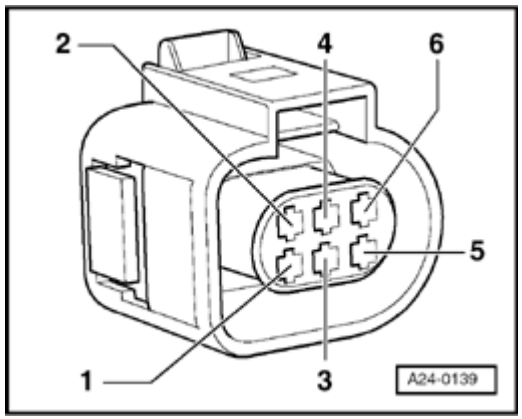
  ♦ Specification: approx. battery voltage

If there is no voltage again:

- Check wire connection from terminal 3 of connector to Fuel Pump (FP) relay via fuse for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If voltage supply is OK:



- Connect multimeter for voltage measurement as follows:

Harness connector **Terminal**	**Measure to**
4 (Ground -GND- activation of Engine Control Module -ECM-)	B+

- Start engine.

  ♦ Specification: approx. battery voltage

Note:

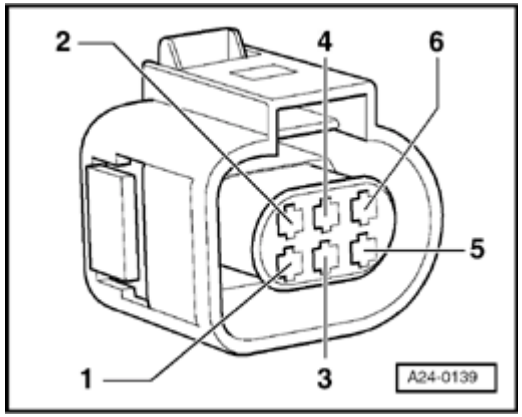
When the Engine Control Module (ECM) switches oxygen sensor heating on and off, it may be observed via the function "read measuring value block", in display group number 041 display field 2.

24-93

- Switch ignition off.

If there is no voltage:

- Connect VAG1598/31 test box at wiring harness to Engine Control Module (ECM), do not connect ECM ⇒ Page 24-19 .



- Check the following wire connection for open circuit:

Harness connector Terminal	VAG1598/31 test box Socket
4	5

- Repair open circuit if necessary.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If wire connection is OK, but there is no Ground (GND) supply for oxygen sensor heating:

- Replace Engine Control Module (ECM) ⇒ Page 24-22

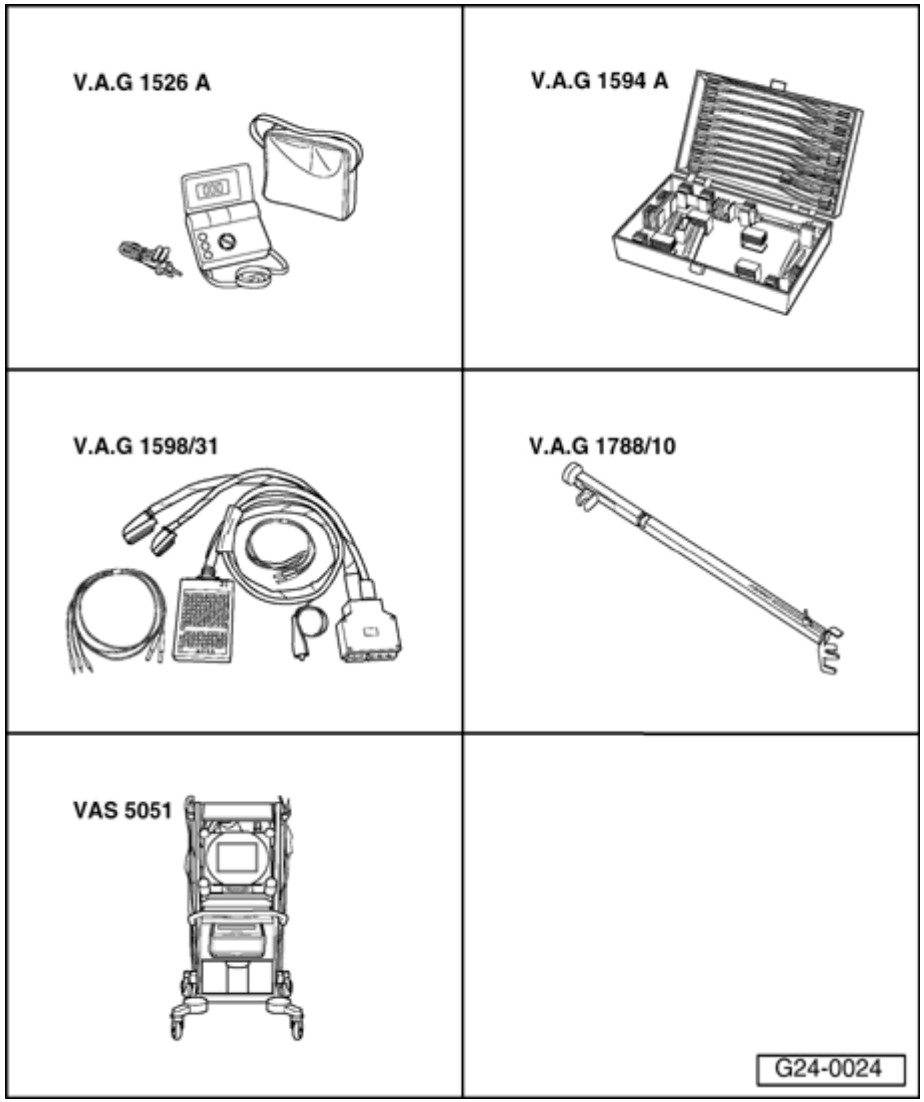
24-94

Heated Oxygen Sensor (HO2S) and oxygen sensor control after Three Way Catalytic Converter (TWC), checking

Note:

The oxygen sensor before catalytic converter (bank 1, sensor 1) regulates to Lambda 1. If this oxygen sensor is damaged, e.g. due to soiling or overheating, the regulation value may have shifted. Deviations from Lambda 1 are detected by the oxygen sensor after catalytic converter (bank 1, sensor 2). If it recognizes the deviations downward or upward, it influences the regulation before catalytic converter, generally increasing or decreasing it respectively.

24-95



Special Tools and Equipment

- VAG1526A
- VAG1594A
- VAG1598/31
- VAG1788/10 RPM adjuster
- VAS5051 with VAG5051/1

24-96

Test requirements:

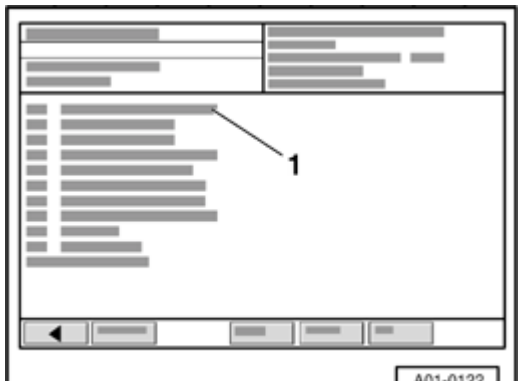
- Exhaust system free of leaks.
- Coolant Temperature at least 80 °C.

Test sequence

- Connect VAS5051 tester ⇒ Page 01-7 and select vehicle system "01 - Engine electronics". Engine must run at idle for this.
- Install VAG1788/10 RPM adjuster on the accelerator pedal and raise the engine speed to 2600 RPM.

Test requirement:

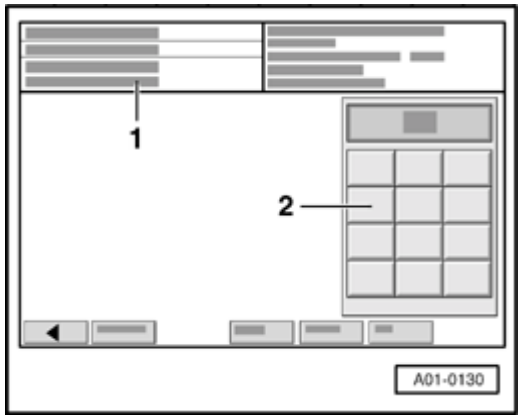
- Engine running at 2600 RPM.



Display on VAS5051:

- In selection -1-, click on the diagnostic function "04 - Basic setting".

24-97



➢ Display on VAS5051:

1 - Enter display group Max. input value = 255

- Select function "030" in button field -2- for "display group number 030" and press Q button to confirm input.

➢ Display on VAS5051:

- Check specified value in display field -2-.

Note:

"Oxygen sensor status" indicates status of oxygen sensor control and oxygen sensors.

24-98

	Display fields			
	1	2	3	4
Display group 030: Oxygen sensor status				
Display	X X X	**X X X**		
Indicated	Oxygen sensor status, bank 1, sensor 1	**Oxygen sensor status bank 2, sensor 1**		
Functional range	0 = off 1 = on	**0 = off** **1 = on**		
Specified value	1 1 1	**1 1 0**		
Note	**If specified value is not obtained ⇒ Page 24-107**			

Significance of 3 digit indications in display group 030			
X	X	X	**Display fields 1 and 2**
		X	Oxygen sensor control: 0= not active; 1 = active
	X		Operational readiness of oxygen sensor: 0= not active; 1 = active
X			Condition of oxygen sensor heater: 0= not active; 1 = active

Notes:

- *The first position of the 3 digit indication (heating) fluctuates between 0 and 1.*
- *Oxygen sensor control of oxygen sensor after catalytic converter (B1-S2) is not active without engine load.*

24-99

➢ Display on VAS5051:

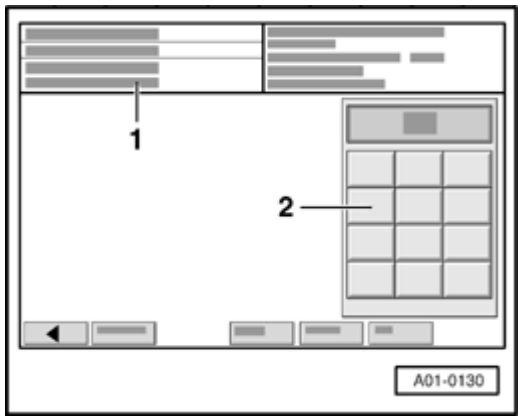
- Do not continue test until indication in display field -2- has reached "110" at least once.

Checking oxygen sensor control after catalytic converter

Test requirement:

- Engine continues to run at 2600 RPM.

- Click on ◀ - button



➢ Display on VAS5051:

1 - Enter display group Max. input value = 255

- Select function "037" in button field -2- for "display group number 037" and press -Q- button to confirm input.

24-100

➢ Display on VAS5051:

- Check oxygen sensor voltage in display field -2-.
- Check oxygen sensor correction value in display field -3- and diagnostic result in display field -4-.

24-101

	Display fields			
	1	2	3	4
Display group 037: Diagnostic oxygen sensor control system				
Display	xxx %	**x.xxx V**	**x.xx**	**---**
Indicated	Engine load	**Oxygen sensor voltage Bank 2, sensor 1**	**Oxygen sensor correction value between bank 1, sensor 1 and bank 1, sensor 2**	Diagnostic condition
Functional range				**Test OFF** **Test ON** **System OK** **System not OK**
Specified value	13 to 40 %	**0.100 to 0.950 volts**	**smaller than 0.02**	System OK
Note		**If specified value is not obtained: Evaluation ⇒ Page 24-102**		**If "System not OK" is displayed: Check DTC memory ⇒ Page 01-12**

Note for display field 2:

Oxygen sensor voltage bank 1, sensor 2 should remain fairly constant. Strong voltage fluctuations point to a damaged catalytic converter.

24-102

Evaluation display group 037

Display field: 2	Possible cause	Corrective action
constant about 0.450 V	♦ Open circuit in wire 4 between oxygen sensor and control module	- Check primary voltage ⇒ Page 24-104
	♦ Open circuit in wire 3 between oxygen sensor and control module	
larger than 0.950 V	♦ Short circuit to B+ in wire 4 between oxygen sensor and control module	- Check oxygen sensor wiring, oxygen sensor after catalytic converter ⇒ Page 24-105
smaller than 0.100 V	♦ Short circuit to Ground (GND) in wire 4 between oxygen sensor and control module	

24-103

Continuation

If specified value in display field 3 and 4 is not obtained:

- Road test vehicle in order to free oxygen sensor of possible residue and repeat test.

If specified value in display field 3 and 4 is not obtained, even after road test:

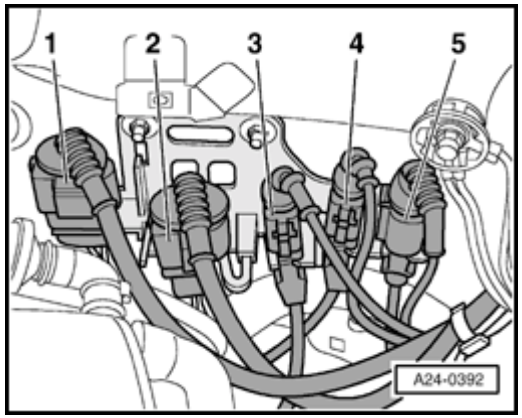
- Replace Heated Oxygen Sensor (HO2S) - G39-.

Note:

If oxygen sensor voltage is OK and oxygen sensor correction value is still above 0.02 ms, even after a road test, this suggests aging of an oxygen sensor before catalytic converter.

24-104

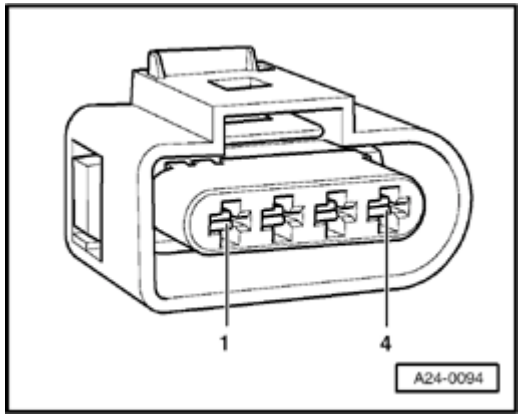
Checking primary voltage



- Disconnect 4-pin harness connector -1- (brown) to Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G130-.

Note:

Coolant reservoir screws must be removed and coolant reservoir must be placed to side in order to access the harness connector. The coolant hoses can remain connected.



- Connect multimeter between terminal 3 and 4 for voltage measurement.
- Switch ignition on.
  - ♦ Specification: 0.400 to 0.500 V
- Switch ignition off.

24-105

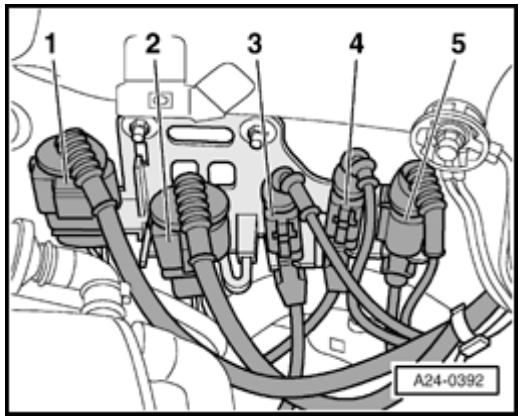
If specified value is not obtained:

- Check oxygen sensor wiring.

If specified value is obtained:

- Replace Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G130-.

Checking oxygen sensor wires



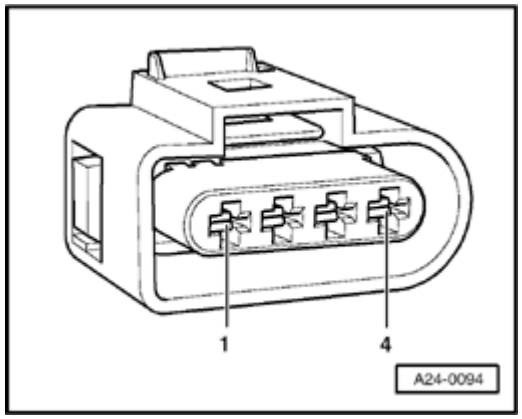
- Disconnect 4-pin harness connector -1- (brown) to Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G130-.

Note:

Coolant reservoir screws must be removed and coolant reservoir must be placed to side in order to access the harness connector. The coolant hoses can remain connected.

- Connect VAG1598/31 test box at wiring harness to Engine Control Module (ECM), do not connect ECM ⇒ Page 24-19 .

24-106



- Check the following wire connections for open circuit.

Harness connector Terminal	VAG1598/31 test box Socket
3	68
4	69

- Repair open circuit if necessary.

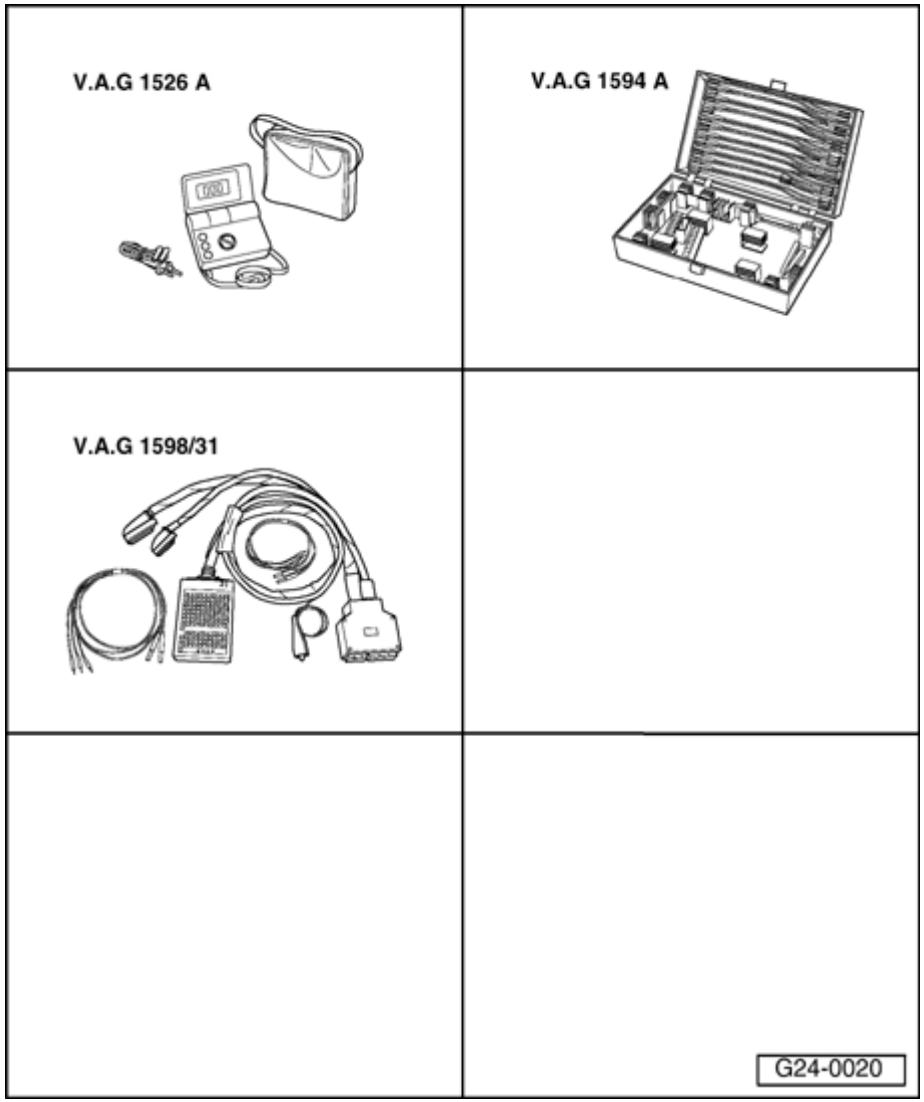
⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Check wires to each other for short circuit.

If wire connection is OK:

- Replace Engine Control Module (ECM) ⇒ Page 24-22

24-107



Oxygen sensor heating, Oxygen Sensor (O2S) Heater 1 -Z29- after catalytic converter, checking

Special Tools and Equipment

- VAG1526A
- VAG1594A
- VAG1598/31

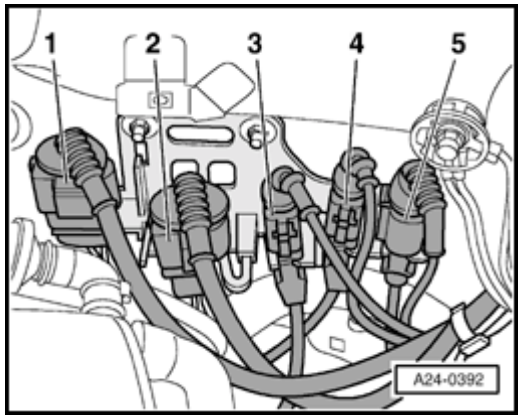
24-108

Test requirements:

- Coolant Temperature at least 80 ° C.
- Fuse for oxygen sensor heating OK

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

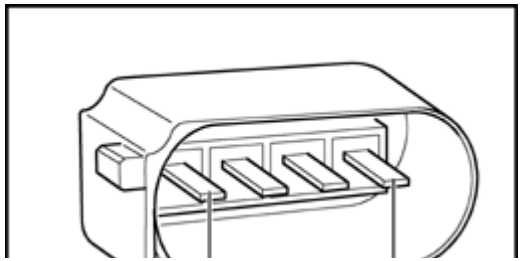
Test sequence



- Disconnect 4-pin harness connector -1- (brown) to Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G130-.

Note:

Coolant reservoir screws must be removed and coolant reservoir must be placed to side in order to access the harness connector. The coolant hoses can remain connected.



- Connect multimeter between terminal 1 and 2 for resistance measurement.
  - Specified value at room temperature: 6.4 to 47.5 Ω

If specified value is not obtained:

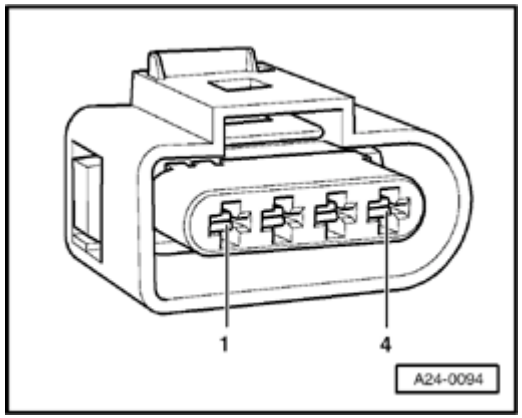
- Replace Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G130-.

24-109

If specified value is obtained:

- Check voltage supply of oxygen sensor heating.

Checking voltage supply for oxygen sensor heating

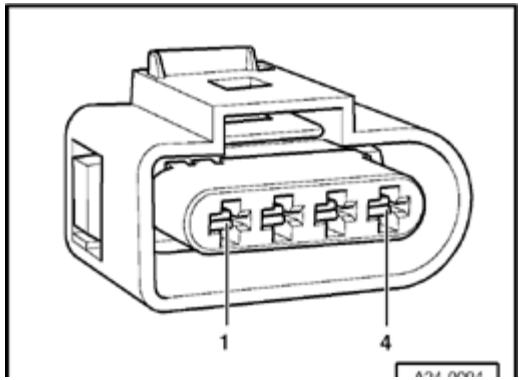


- Connect multimeter between terminal 1 (B+) and 2 (Ground -GND-) for voltage measurement.
- Start engine.
  - Specification: approx. battery voltage

Note:

When the Engine Control Module (ECM) switches oxygen sensor heating on and off, it may be observed via the function "read measuring value block", in display group number 041 display field 4.

If there is no voltage:



- Connect multimeter for voltage measurement as follows:

Harness connector Terminal	Measure to
1 (B+)	Vehicle Ground (GND)

- Operate starter briefly.

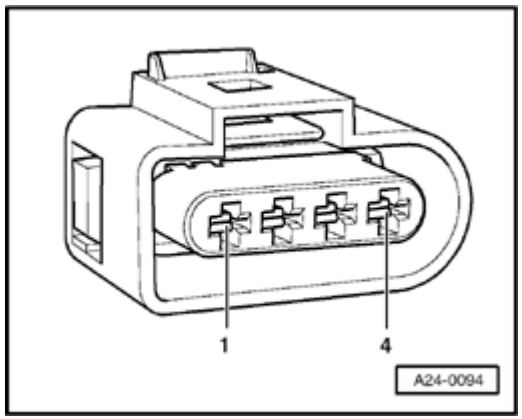
  ♦ Specification: approx. battery voltage

If there is no voltage again:

- Check wire connection from terminal 1 of connector to Fuel Pump (FP) relay via fuse for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If voltage supply is OK:



- Connect multimeter for voltage measurement as follows:

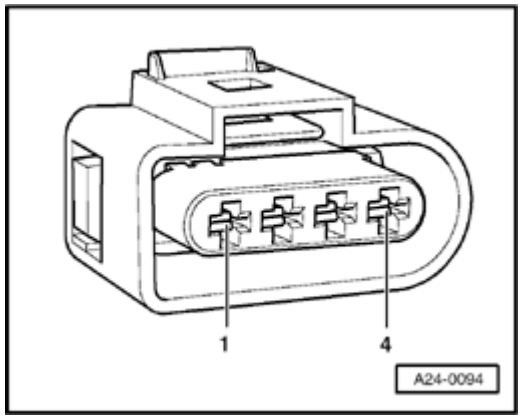
Harness connector **Terminal**	**Measure to**
2 (Ground -GND- activation of Engine Control Module -ECM-)	B+

- Start engine.

  ♦ Specification: approx. battery voltage, possibly fluctuating

- Switch ignition off.

24-111



If there is no voltage:

- Connect VAG1598/31 test box at wiring harness to Engine Control Module (ECM), do not connect ECM ⇒ Page 24-19 .

- Check the following wire connection for open circuit:

Harness connector Terminal	VAG1598/31 test box Socket
2	63

- Repair open circuit if necessary.

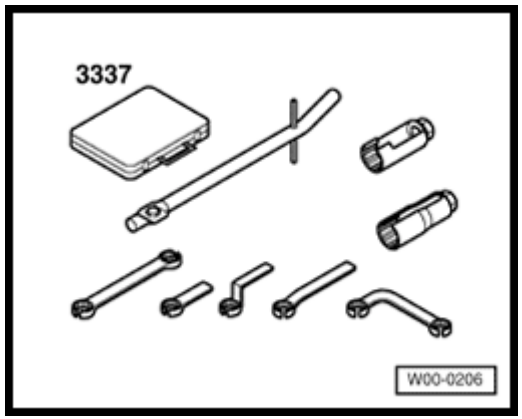
If wire connection is OK, but there is no Ground (GND) supply for oxygen sensor heating:

- Replace Engine Control Module (ECM) ⇒ Page 24-22

24-112

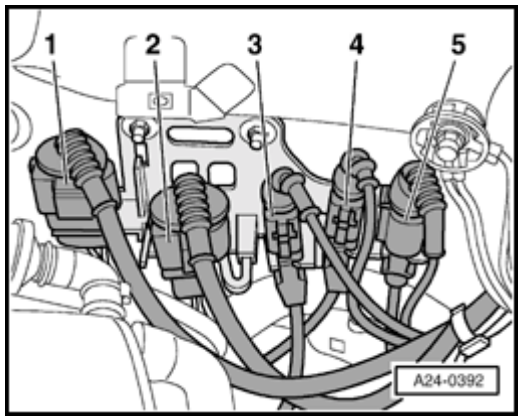
Oxygen sensor, removing and installing

Special tools and equipment



- 3337 wrench, 7-piece set
- Locking compound G 052 112 A3

Procedure



- Disconnect oxygen sensor harness connector and lay to side.

1 - (brown) for Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G130-

2 - (black) for Heated Oxygen Sensor (HO2S) -G39- before catalytic converter

Note:

Coolant reservoir screws must be removed and coolant reservoir must be placed to side in order to access harness connectors. The coolant hoses can remain connected.

- Unscrew oxygen sensor using special tool 3337.

24-113

Note the following when installing:

Notes:

- *Oxygen sensor threads are coated with an assembly paste. This paste must not contact sensor openings.*
- *Tightening torque: 55 Nm*
- *Cable of oxygen sensor must always be secured in the same position when installing so that contact with the exhaust pipe is avoided.*