Oxygen sensor control, checking

Oxygen sensor control, function

Notes:

The oxygen sensors compare the oxygen content of the air with residual oxygen content in exhaust and deliver a voltage signal to the control module.

The voltage signal "mixture rich (too little residual oxygen)" is approx. 0.7 to 1.0 V.

The voltage signal "mixture lean (a lot of residual oxygen)" is approx. +0.0 to 0.3 V.

At the transition from "rich" to "lean" and vice-versa (λ = 1.0) voltage will jump from 0.7 to 1.0 V to 0.0 to +0.3 V (or viceversa).

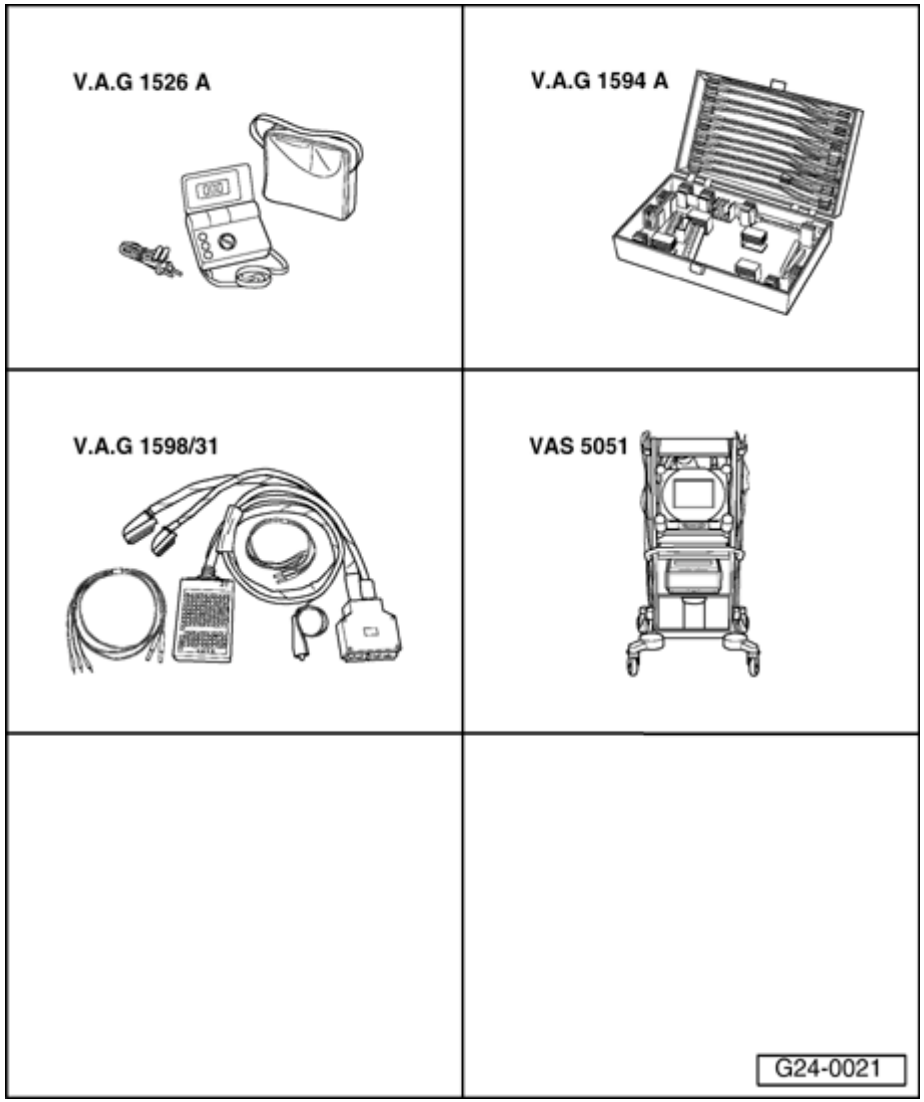
Due to the steep voltage jump, oxygen sensor control cannot maintain the ideal mixture of λ = 1.0 as constant. Oxygen sensor control constantly fluctuates back and forth between the conditions "slightly too lean" and "slightly too rich".

24-77

If voltage change does not occur or occurs only slowly, the following malfunctions could be present:

- *Slits or holes in sensor head clogged.*
- *Sensors suffered thermal overload.*
- *Transition resistance in signal wire or Ground (GND) wire.*
- *Sensor too cold, sensor heating not functioning.*
- *Sensor damaged by contact spray or similar substance (contact spray is drawn through the fine hollow interiors by thermal fluctuations and capillary action into the electrical wiring in sensor).*
- *Sensor damaged by silicon vapors (the use of sealants containing silicon leads to trace elements of silicon being taken in by the engine. These silicon elements are not combusted and damage the oxygen sensor).*

24-78



Oxygen sensors and oxygen sensor control before catalytic converter, checking

Special Tools and Equipment

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

- or

- VAG1551 with VAG1551/3B

24-79

Notes:

- *For the defined troubleshooting procedure, it is possible, to switch oxygen sensor control off by selecting display group 099 under "basic setting" and switch it on again under "read measuring value block".*

- *After selecting display group 099 (either in "basic setting" or "read measuring value block"), it is possible to switch back and forth between "basic setting" (function 04) and "read measuring value block" (function 08) by pressing buttons 4 or 8 on the VAG1551.*

- *Once function 04 "basic setting" is exited, oxygen sensor control is automatically switched on again.*

Test requirements:

- Road test performed and DTC memory erased.

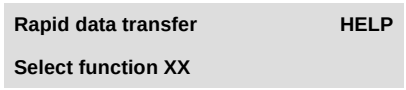
- Coolant temperature at least 80 °C ⇒ Display group 4, display field 3

24-80

Function test

- Connect VAS5051 tester or VAG1551 scan tool and select the control module for engine electronics using "address word" 01 ⇒ Page 01-9 .

Engine must run at idle for this.

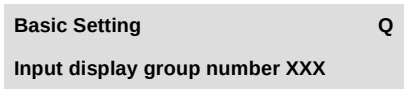


When indicated on display:

- Press buttons -0- and -4- to select "Initiate basic setting" and press -Q- button to confirm input.

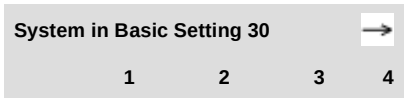
Note:

During basic setting, the Evaporative Emission (EVAP) canister purge regulator valve (EVAP valve -N80-) is closed and the A/C compressor is switched off



When indicated on display:

- Press buttons -0-, -3- and -0- to select "display group number 030" and press -Q- button to confirm input.



When indicated on display:

- Check oxygen sensor status in display fields 1 and 3.

Note:

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

24-81

	Display fields			
	1	2	3	4
Display group 030: Oxygen sensor status with engine at idle				
Display	**X X X**	X X X	**X X X**	X X X
Indicated	**Oxygen sensor status, bank 1, sensor 1**	Oxygen sensor status, bank 2, sensor 1	**Oxygen sensor status, bank 2, sensor 1**	Oxygen sensor status, bank 2, sensor 2
Functional range	**0 = off** **1 = on**	0 = off 1 = on	**0 = off** **1 = on**	0 = off 1 = on
Specified value	**1 1 1**	1 1 0	**1 1 1**	1 1 0
Notes	**Meaning of display ⇒ Page 01-90** **If specified value is not obtained ⇒ Page 24-89** **If specified value is obtained but there is a malfunction stored in DTC memory ⇒Check oxygen sensor adaptation values and control, page ⇒ Page 24-83**			

24-82

Significance of 3 digit indication of display group 030

X	X	X	**Display fields 1 to 4**
		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 heating 0= not active 1 = active

Notes:

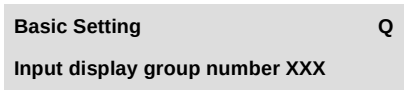
- *The oxygen sensor control of the oxygen sensors behind catalytic converter (B1-S2 and B2-S2) are not active at certain operation points without engine load, that means that the third position of the oxygen sensor controls behind catalytic converter can fluctuate between 0 and 1.*

- *The first position of the 3 digit indication (heating) fluctuates between 0 and 1 at certain operation points.*

24-83

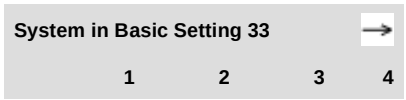
Checking oxygen sensor adaptation values and control

- Press -C- button.



When indicated on display:

- Press buttons -0-, -3- and -3- to select "display group number 033" and press -Q- button to confirm input.



When indicated on display:

- Check oxygen sensor control in display fields 1 and 3.

24-84

	1	2	3	4
Display group 033: Oxygen sensor control before catalytic converter				
Display	**xx.x %**	x.xxx volts	**xx.x %**	x.xxx V
Indicated	**Oxygen sensor control Bank1**	Oxygen sensor voltage bank 1	**Oxygen sensor control Bank2**	Oxygen sensor voltage bank 2
Functional range	**-25.0 to 25.0 %**	0.100 to 1.000 V	**-25.0 to 25.0 %**	0.100 to 1.000 V
Specified value	**Value must fluctuate by at least 2 % in the range 10.0 to 10.0 %**	Value must fluctuate approx. 0.3 V in the range 0.100 to 1.000 volts	**Value must fluctuate by at least 2 % in the range 10.0 to 10.0 %**	Value must fluctuate approx. 0.3 V in the range 0.100 to 1.000 volts
Notes	**If specified value is not obtained ⇒ Page 24-85**		**If specified value is not obtained ⇒ Page 24-85**	

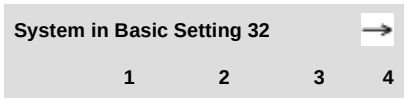
Evaluation display group 033

Display field: 1 / 3	Possible cause	Corrective action
Values in range: -10.0 to -25.0 % or Values in range: 10.0 to 25.0 % or Value does not fluctuate by at least 2 %	♦ Oxygen sensor heating faulty	- Check oxygen sensor heating ⇒ Page 24-116
	♦ Open circuit in wires between oxygen sensor and control module	- Check primary voltage ⇒ Page 24-89
	♦ Short circuit to Ground (GND) or B+ between oxygen sensor and control module	- Check oxygen sensor wires bank 1 ⇒ Page 24-90 - Check oxygen sensor wires bank 2 ⇒ Page 24-91
	♦ False air in intake area	- Check intake system for leaks and repair false air ⇒ Page 24-64
	♦ Fuel pressure too low or too high	- Check fuel pressure regulator ⇒ Page 24-30
	♦ Fuel return line is kinked or clogged	- Check fuel return line.

24-86

- Press -C- button.

- Press buttons -0-, -3- and -2- to select "display group number 032" and press -Q- button to confirm input.



When indicated on display:

- Check oxygen sensor control in display fields 1 to 4:

	Display fields			
	1	2	3	4
Display group 032: Oxygen sensor adaptation values before catalytic converter				
Display	**xx.x %**	**xx.x %**	**xx.x %**	**xx.x %**
Indicated	**Oxygen sensor adaptation value Bank 1 at idle (additive)**	**Oxygen sensor adaptation value bank 1 at partial throttle (multiple)**	**Oxygen sensor adaptation value Bank 2 at idle (additive)**	Oxygen sensor adaptation value bank 2 at partial throttle (multiple)
Functional range	**-25.0 to 25.0 %**	**-25.0 to 25.0 %**	**-25.0 to 25.0 %**	**-25.0 to 25.0 %**
Specified value	**-10.0 to 10.0 %** **can fluctuate slightly**	**-10.0 to 10.0 %** **can fluctuate slightly**	**-10.0 to 10.0 %** **can fluctuate slightly**	**-10.0 to 10.0 %** **can fluctuate slightly**
Notes	**If specified value is not obtained ⇒ Page 24-87**			

24-87

Evaluation display group 032

Display field: 1 / 3 or 2 / 4	Possible cause	Corrective action
Oxygen sensor adaptation value in range: -10.0 to .-25.0 %	♦ 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 24-56
	♦ Evaporative Emission (EVAP) canister purge regulator valve remains stuck in open position	- Check Evaporative Emission (EVAP) Canister Purge Regulator Valve ⇒ Page 24-128
	♦ Fuel pressure too high	- Check fuel pressure regulator ⇒ Page 24-30
	♦ Fuel return line is kinked or clogged.	- Check fuel return line.
	♦ Fuel injector does not close	- Check fuel injectors ⇒ Page 24-36

24-88

Evaluation display group 032

Display field: 1 / 3 or 2 / 4	Possible cause	Corrective action
Oxygen sensor adaptation value in range: 10.0 to 25.0 %	♦ False air in intake area	- Check intake system for leaks and repair false air. ⇒ Page 24-64 .
	♦ Fuel pressure too low	- Check fuel pressure regulator ⇒ Page 24-30
	♦ Mass Air Flow (MAF) sensor faulty	- Mass Air Flow (MAF) sensor, checking ⇒ Page 24-56
	♦ Oxygen sensor heating faulty ♦ Oxygen sensor faulty	- Check oxygen sensor heating ⇒ Page 24-116
	♦ Fuel injector does not open or opens only partially	- Check fuel injectors ⇒ Page 24-36
	♦ Evaporative Emission (EVAP) Canister Purge Regulator Valve sticks	- Check Evaporative Emission (EVAP) Canister Purge Regulator Valve ⇒ Page 24-128
	♦ Ignition coil or spark plug faulty	- Check ignition coils ⇒ Page 28-7

24-89

Checking primary voltage

Component location of harness connectors ⇒ Overview of component locations, page ⇒ Page 24-5

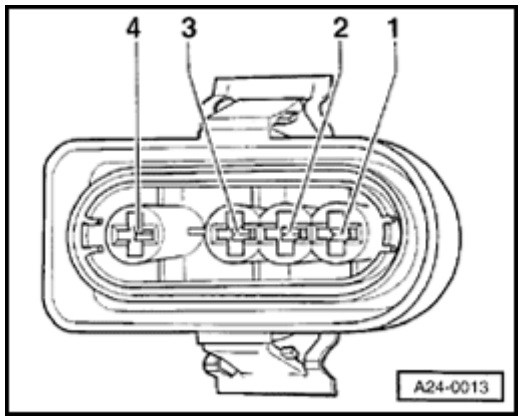
Note:

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

Test requirement:

- Fuse for oxygen sensor are OK

- Disconnect 4-pin harness connector leading to respective oxygen sensor.



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

If specified value is not obtained:

- Check oxygen sensor wires ⇒ Bank 1, page ⇒ Page 24-90 or ⇒ Bank

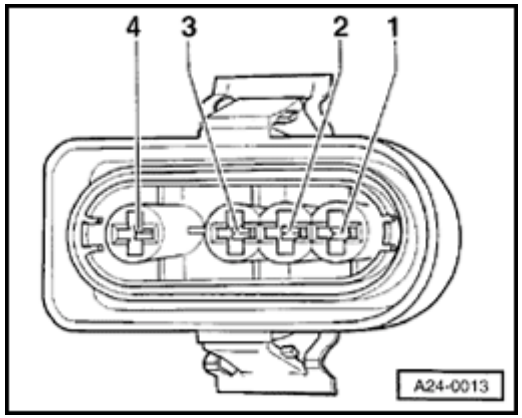
2, page ⇒ Page 24-91 .

Check oxygen sensor wires bank 1 for Heated Oxygen Sensor (HO2S) 2 -G39-.

Component location of harness connectors ⇒ Overview of component locations, page ⇒ Page 24-5

- Disconnect black 4-pin harness connector to bank 1 Heated Oxygen Sensor (HO2S) -G39-.

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM ⇒ Page 24-17 .



- Check the following wire connections for open circuit.

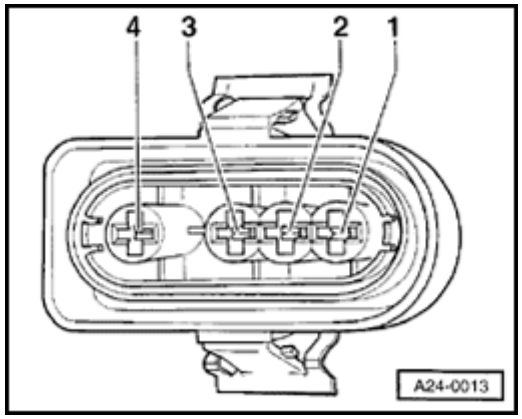
Harness connector Terminal	VAG1598/31 test box Socket
3	51
4	70

- Repair open circuit if necessary.

- Check wires to each other for short circuit.

Harness connector Terminal	VAG1598/31 test box Socket
4	51

24-91



- Check shielded wire for short circuit to sensor wires.

Harness connector Terminal	VAG1598/31 test box Socket
3	32
4	32

If no malfunctions are found in wires:

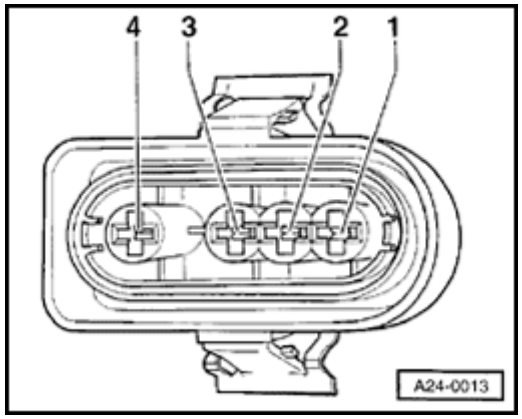
- Replace Engine Control Module (ECM) ⇒ Page 24-21 .

Check oxygen sensor wires bank 2 for Heated Oxygen Sensor (HO2S) 2 -G108-.

Component location of harness connectors ⇒ Overview of component locations, page ⇒ Page 24-5

- Disconnect black 4-pin harness connector to bank 2 Heated Oxygen Sensor (HO2S) 2 -G108-.
- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM ⇒ Page 24-17 .

24-92



- Check the following wire connections for open circuit.

Harness connector Terminal	VAG1598/31 test box Socket
3	12
4	13

- Repair open circuit if necessary.
- Check wires to each other for short circuit.

Harness connector Terminal	VAG1598/31 test box Socket
4	12

- Check shielded wire for short circuit to sensor wires.

Harness connector Terminal	VAG1598/31 test box Socket
3	32
4	32

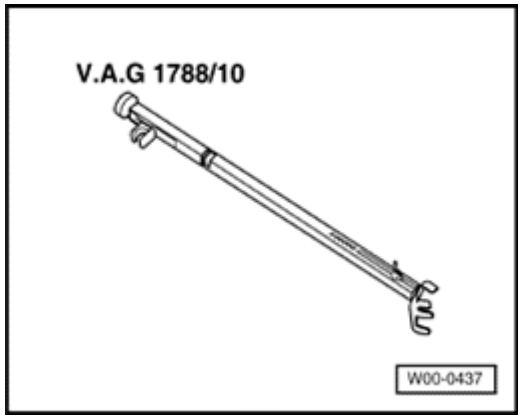
If no malfunctions are found in wires:

- Replace Engine Control Module (ECM) ⇒ Page 24-21 .

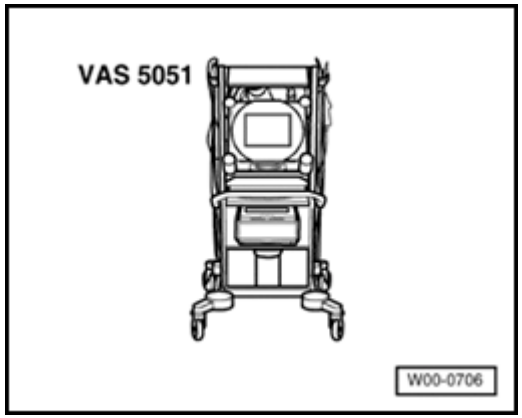
24-93

Oxygen sensor aging (oxygen sensor before catalytic converter), checking

Special Tools and Equipment



- VAG1788/10 RPM adjuster



- VAS5051 with VAG5051/1

  or

- VAG1551 with VAG1551/3B

Test requirement:

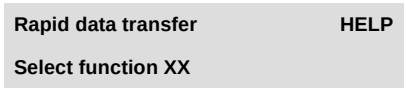
- Coolant temperature at least 80 °C ⇒ Display group 4, display field 3

24-94

Test sequence

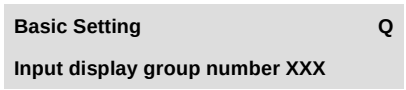
- Connect VAS5051 tester or VAG1551 scan tool and select the control module for engine electronics using "address word" 01 ⇒ Page 01-9 .

Engine must run at idle for this.



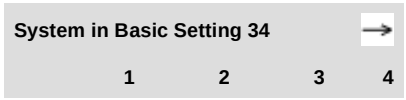
When indicated on display:

- Press buttons -0- and -4- to select "Initiate basic setting" and press -Q- button to confirm input.



When indicated on display:

- Press buttons -0-, -3- and -4- to select "display group number 034" and press -Q- button to confirm input.



When indicated on display:

- Use VAG1788/10 RPM adjuster to adjust engine speed to between 1000 and 2400 RPM.
- Check specified value in display field 4 after indication "Test ON" appears:

Note:

This process can take a few minutes.

24-95

	Display fields			
	1	2	3	4
Display group 034: Oxygen sensor aging diagnostic, oxygen sensor before catalytic converter (bank 1)				
Display	xxxx/min	xxx °C	**x.x s**	**---**
Indicated	Engine speed (RPM)	Exhaust temperature	**Period duration Oxygen sensor before Catalytic converter**	Diagnostic condition
Functional range	630 to 6800	70 to 850 °C	**0 to 3.0 s**	**Test OFF** **Test ON** **B1-S2 OK** **B1-S2 not OK**
Specified value	1000 to 2400 RPM	above 380 °C	**0.1 to 1.8 s**	B1-S2 OK
Notes			**If the specified value is not reached, replace oxygen sensor 1 before catalytic converter (bank 1)**	

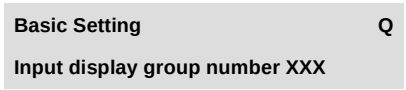
Note for display field 2:

Calculated value from engine speed and engine load.

Note for display fields 3 and 4:

Period duration is the time between two oxygen sensor voltage jumps (e.g. rich - lean - rich) and is therefore a measurement of the aging condition of the oxygen sensor. If the specified time is exceeded, display field 4 will indicate = B1-S1 not OK.

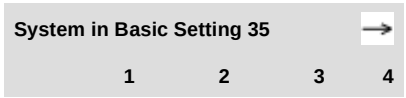
- Press -C- button.



When indicated on display:

24-96

- Press buttons -0-, -3- and -5- to select "display group number 035" and press -Q- button to confirm input.



When indicated on display:

- Check specified value in display field 4.

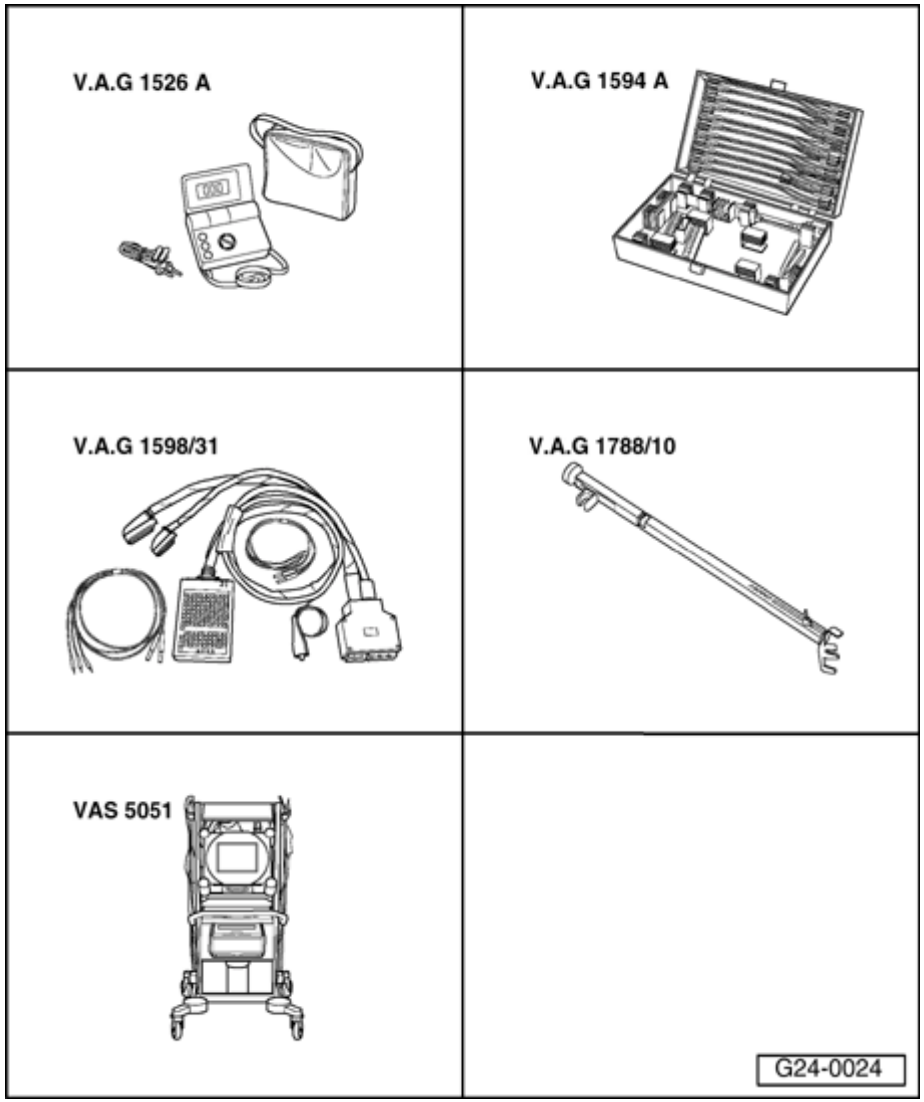
Note:

The test in display group 035 is activated simultaneously with the test in display group 034 Therefore the test result is indicated immediately after display group 035 is selected.

	Display fields			
	1	2	3	4
Display group 035: Oxygen sensor aging diagnostic, oxygen sensor before catalytic converter (bank 2)				
Display	xxxx/min	xxx °C	**x.x s**	**---**
Indicated	Engine speed (RPM)	Exhaust temperature	**Period duration Oxygen sensor before Catalytic converter**	Diagnostic condition
Functional range	630 to 6800	70 to 850 °C	**0 to 3.0 s**	**B1-S2 OK** **B1-S2 not OK**
Specified value	1000 to 2400 RPM	above 380 °C	**0.1 to 1.8 s**	B1-S2 OK
Notes			**If the specified value is not reached, replace oxygen sensor 2**	

			before catalytic converter (bank 1)

24-97



Oxygen sensor and oxygen sensor control behind catalytic converter, checking

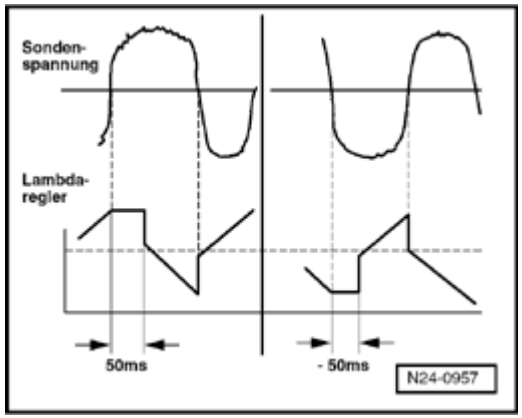
Special Tools and Equipment

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

- or

- VAG1551 with VAG1551/3B

24-98



Notes:

- *The oxygen sensor control behind catalytic converter overrules the oxygen sensor control before catalytic converter. It serves as a corrective control.*

- *It corrects slight changes in the mixture (i.e. enrichment) via the oxygen sensor before catalytic converter by holding oxygen sensor control before catalytic converter at its higher or lower point for a specific time (dwell time). If this time is in the positive range (i.e. 50 ms), mixture is shifted in the -enrich- direction. If it is in the negative range (i.e.--50 ms), mixture is shifted in the -lean- direction.*

Test requirements:

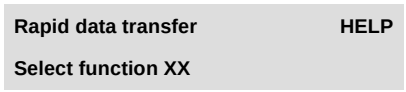
- Road test performed and DTC memory erased.
- Coolant temperature at least 80 ° C ⇒ Display group 4, display field 3

Test sequence

- Connect VAS5051 tester or VAG1551 scan tool and select the control module for engine electronics using "address word" 01 ⇒ Page 01-9 .

  Engine must run at idle for this.

24-99

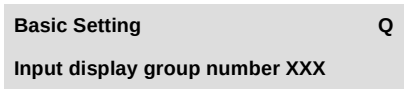


When indicated on display:

- Press buttons -0- and -4- to select "Initiate basic setting" and press -Q- button to confirm input.

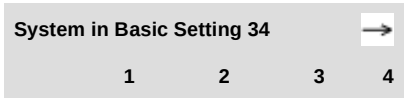
Note:

During basic setting, the Evaporative Emission (EVAP) canister purge regulator valve (EVAP valve -N80-) is closed and the A/C compressor is switched off



When indicated on display:

- Press buttons -0-, -3- and -4- to select "display group number 034" and press -Q- button to confirm input.



When indicated on display:

- Use VAG1788/10 RPM adjuster to adjust engine speed to between 2800 and 3200 RPM.
- Continue test as soon as display field 2 indicates an exhaust temperature of more than 380 ° C

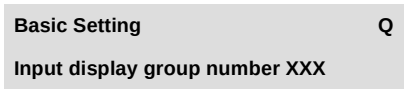
Note:

This process can take a few minutes.

24-100

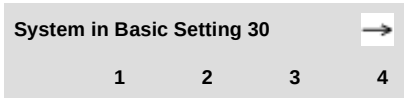
- Press -C- button.

- Let engine continue to idle



When indicated on display:

- Press buttons -0-, -3- and -0- to select "display group number 030" and press -Q- button to confirm input.



When indicated on display:

- Check oxygen sensor status for oxygen sensor behind catalytic converter in display fields 2 and 4.

Note:

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

24-101

	Display fields			
	1	2	3	4
Display group 030: Oxygen sensor status with engine at idle				
Display	X X X	**X X X**	X X X	**X X X**
Indicated	Oxygen sensor status, bank 1, sensor 1	**Oxygen sensor status Bank 2, sensor 1**	Oxygen sensor status, bank 2, sensor 1	**Oxygen sensor status Bank 2, sensor 2**
Functional range	0 = off 1 = on	**0 = off** **1 = on**	0 = off 1 = on	**0 = off** **1 = on**
Specified value	1 1 1	**1 1 0**	1 1 1	**1 1 0**
Notes	**Meaning of display ⇒ Page 24-102** **If specified value is not obtained ⇒ Page 24-111** **If specified value is obtained but there is a malfunction stored in DTC memory ⇒Check oxygen sensor control, page ⇒ Page 24-105**			

Notes:

- *Oxygen sensor control of oxygen sensor behind catalytic converter (bank 1 sensor 2 and bank 2 sensor 2) are not active without engine load, meaning that the display is 0.*

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

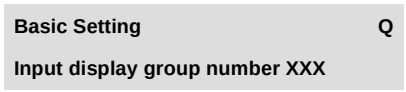
- *The third position of the 3 digit indication (oxygen sensor control) fluctuates between 0 and 1.*

24-102

Significance of 3 digit indication of display group 030

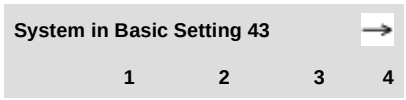
X	X	X	**Display fields 1 to 4**
		X	Oxygen sensor control 0= not active 1 = active
	X		Operational readiness of oxygen sensor 0= not active 1 = active
X			Condition of oxygen sensor heating 0= not active 1 = active

- Press -C- button.



When indicated on display:

- Press buttons -0-, -4- and -3- to select "display group number 043" and press -Q- button to confirm input.



When indicated on display:

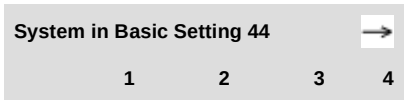
- Check specified value in display field 4 after indication "Test ON" appears:

24-103

	Display fields			
	1	2	3	4
Display group 043: Oxygen sensor aging, oxygen sensor behind catalytic converter (bank 1)				
Display	xxxx/min	xxx ° C	x.xxx V	**---**
Indicated	Engine speed (RPM)	Exhaust temperature	Voltage of oxygen sensor behind catalytic converter, bank 1	Diagnostic condition
Functional range	630 to 6800 RPM	70 to 850 ° C	0.100 to 1.000 volts	Test OFF Test ON B1-S2 OK B1-S2 not OK
Specified value	1800 to 2400 RPM	above 380 ° C	0.100 to 1.000 volts	B1-S2 OK
Notes				**If specified value is not obtained ⇒Check oxygen sensor heater ⇒ Page 24-116**

If specified value B1-S2 OK" is obtained:

- Press -C- button.
- Press buttons -0-, -4- and -4- to select "display group number 044" and press -Q- button to confirm input.



When indicated on display:

- Check specified value in display field 4 after indication "Test ON" appears:

24-104

	Display fields			
	1	2	3	4
Display group 044: Oxygen sensor aging, oxygen sensor behind catalytic converter (bank 2)				
Display	xxxx/min	xxx ° C	x.xxx V	**---**
Indicated	Engine speed (RPM)	Exhaust temperature	Voltage of oxygen sensor behind catalytic converter, bank 2	Diagnostic condition
Functional range	670 to 6800 RPM	70 to 850 ° C	0.100 to 1.000 volts	Test OFF Test ON B2-S2 OK B2-S2 not OK
Specified value	1800 to 2400 RPM	above 380 ° C	0.100 to 1.000 volts	B2-S2 OK
Notes				**If specified value is not obtained ⇒Check oxygen sensor heater ⇒ Page 24-116**

If specified value B2-S2 OK" is obtained:

- Press -C- button.

24-105

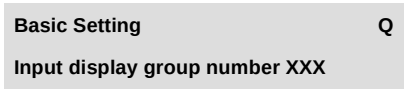
Checking oxygen sensor control behind catalytic converter

- Perform a test drive of approx. 10 minutes.

WARNING!

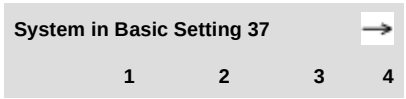
Observe safety precautions to reduce the risk of accidents during road test ⇒ ***Page 24-1*** .

- Let engine continue to run at idle.



When indicated on display:

- Press buttons -0-, -3- and -7- to select "display group number 037" and press -Q- button to confirm input.



When indicated on display:

- Check oxygen sensor voltage in display field 2.
- Check dwell time between oxygen sensor 1 before catalytic converter and oxygen sensor 2 behind catalytic converter in display field 3 and diagnostic result in display field 4.

24-106

	Display fields			
	1	2	3	4
Display group 037: Diagnostic, oxygen sensor control system (bank 1)				
Display	xxx %	x.xxx volts	**xxx ms**	**---**
Indicated	Engine load	Oxygen sensor voltage behind catalytic converter, bank 1	**Oxygen sensor correction value between oxygen sensor 1 and oxygen sensor 2, bank 1**	Diagnostic condition
Functional range	12.0 to 100.0 %	0.100 to 1.000 V	**-800 to 800 ms**	**Test OFF** **Test ON** **System OK** **System not OK**
Specified value	12.0 to 26.0 %	0.100 to 1.000 V	**-800 to 800 ms**	System OK
Notes		If specified value is not obtained: Evaluation display field 2 ⇒ Page 24-109	**If specified value is not obtained ⇒ Page 24-110**	**If "System not OK" is displayed: Check Diagnostic Trouble Code (DTC) memory ⇒ Page 01-15** **or continuation ⇒ Page 24-110**

Note for display field 3:

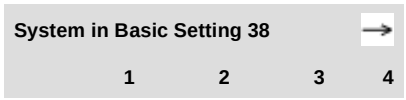
The oxygen sensor control behind catalytic converter overrules the oxygen sensor control before catalytic converter. It corrects slight changes in the mixture (i.e. toward rich or lean) due to the oxygen sensor before catalytic converter by holding oxygen sensor control before catalytic converter at its higher or lower point for a specific time (dwell time). If this time is in the positive range (i.e. 50 ms), mixture is shifted in the -enrich- direction. If this time is in the negative range (i.e. -50 ms), mixture

is shifted in the -lean- direction.

24-107

- Press -C- button.

- Press buttons -0-, -3- and -8- to select "display group number 038" and press -Q- button to confirm input.



When indicated on display:

- Check specified value in display field 4.

Note:

The test in display group 038 is activated simultaneously with the test in display group 037 Therefore the test result is indicated immediately after display group 038 is selected.

24-108

	Display fields			
	1	2	3	4
Display group 038: Diagnostic of oxygen sensor control system (Bank 2)				
Display	xxx %	x.xxx V	xxx ms	**---**
Indicated	Engine load	Oxygen sensor voltage behind catalytic converter, bank 2	Oxygen sensor correction value between oxygen sensor 2 and oxygen sensor 2, bank 1	Diagnostic condition
Functional range	12.0 to 100.0 %	0.100 to 1.000 V	-800 to 800 ms	**System OK** **System not OK**
Specified value	12.0 to 26.0 %	0.100 to 1.000 V	-800 to 800 ms	System OK
Notes		If specified value is not obtained: Evaluation display field 2 ⇒ Page 24-109	If specified value is not obtained ⇒ Page 24-110	**If "SYST not OK" is displayed: Check Diagnostic Trouble Code (DTC) memory ⇒ Page 01-15** **or continuation ⇒ Page 24-110**

Note for display field 3:

The oxygen sensor control behind catalytic converter overrules the oxygen sensor control before catalytic converter. It corrects slight changes in the mixture (i.e. toward rich or lean) due to the oxygen sensor before catalytic converter by holding oxygen sensor control before catalytic converter at its higher or lower point for a specific time (dwell time). If this time is in the positive range (i.e. 50 ms), mixture is shifted in the -enrich- direction. If this time is in the negative range (i.e. -50 ms), mixture is shifted in the -lean- direction.

24-109

Evaluation of display group 037 and 038

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 24-111
	♦ Open circuit in wire 3 between oxygen sensor and control module	
larger than 1.000 V	♦ Short circuit to B+ in wire 4 between oxygen sensor and control module	- Check oxygen sensor wiring and oxygen sensor behind catalytic converter ⇒ Page 24-112
smaller than 0.150 V	♦ Short circuit to Ground (GND) in wire 4 between oxygen sensor and control module	

24-110

If specified value in display group 037 and 038 display field 3 or 4 is not obtained:

- Search for leaking air at exhaust system or catalytic converter (check screw clamps and exhaust system for damage).

- Check if possibly the oxygen sensors behind catalytic converter of cylinder bank 1 and 2 have been switched, in case of extremely different values (e.g. +500 ms, - 500 ms) of display fields 3 (oxygen sensor correction value) in the measuring value blocks 037 and 038.

If none of the listed causes applies:

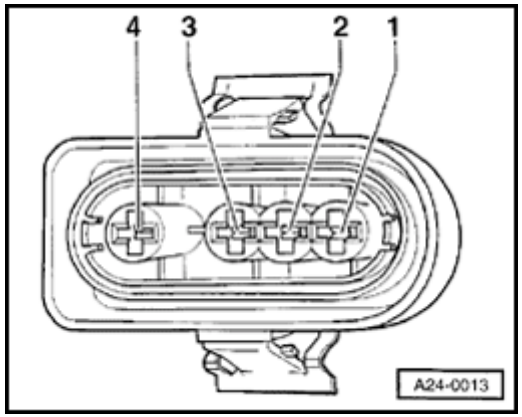
- Replace respective oxygen sensor -before- catalytic converter

24-111

Checking primary voltage

Component location of harness connectors ⇒ Overview of component locations - page ⇒ Page 24-5

- Disconnect 4-pin harness connector leading to respective oxygen sensor.



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

If specified value is not obtained:

- Check oxygen sensor wires ⇒ Bank 1 page ⇒ Page 24-112 or bank 2 page ⇒ Page 24-114 .

If specified value is obtained:

- Replace appropriate oxygen sensor behind catalytic converter.

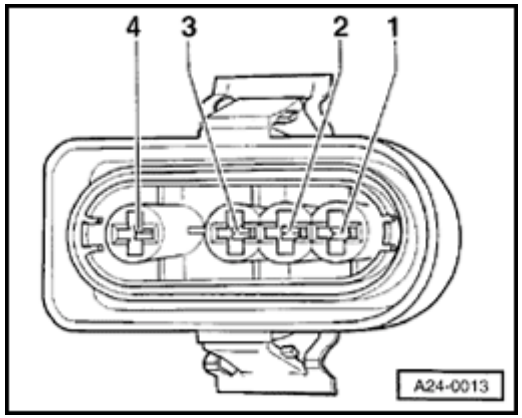
24-112

Testing Oxygen Sensor Wires

Component location of harness connectors ⇒ Overview of component locations, page ⇒ Page 24-5

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

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM ⇒ Page 24-17 .



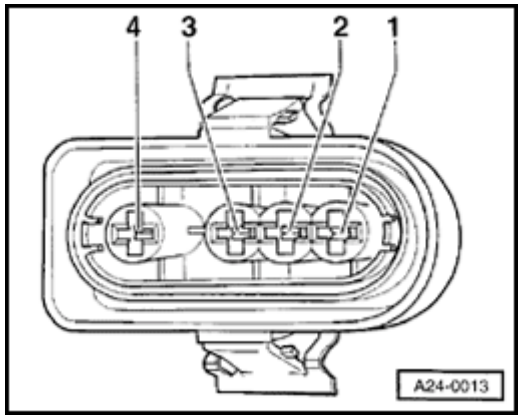
- Check the following wire connections for open circuit.

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

- Repair open circuit if necessary.
- Check wires to each other for short circuit.

Harness connector Terminal	VAG1598/31 test box Socket
4	68

24-113



- Check shielded wire for short circuit to sensor wires.

Harness connector Terminal	VAG1598/31 test box Socket
3	32
4	32

If no malfunctions are found in wires:

- Replace Engine Control Module (ECM) ⇒ Page 24-21 .

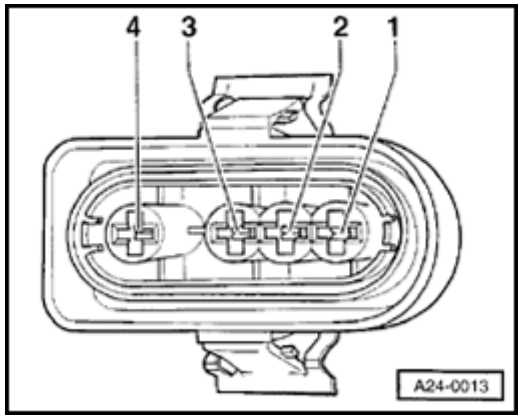
24-114

Check oxygen sensor wires for Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) -G131-.

Component location of harness connectors ⇒ Overview of component locations, page ⇒ Page 24-5

- Disconnect brown 4-pin harness connector 2 to Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) -G131-.

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM ⇒ Page 24-17 .



- Check the following wire connections for open circuit.

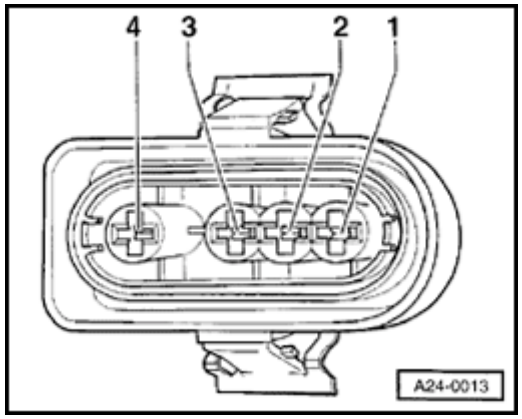
Harness connector Terminal	VAG1598/31 test box Socket
3	10
4	11

- Repair open circuit if necessary.
- Check wires to each other for short circuit.

Harness connector Terminal	VAG1598/31 test box Socket


4
10

24-115



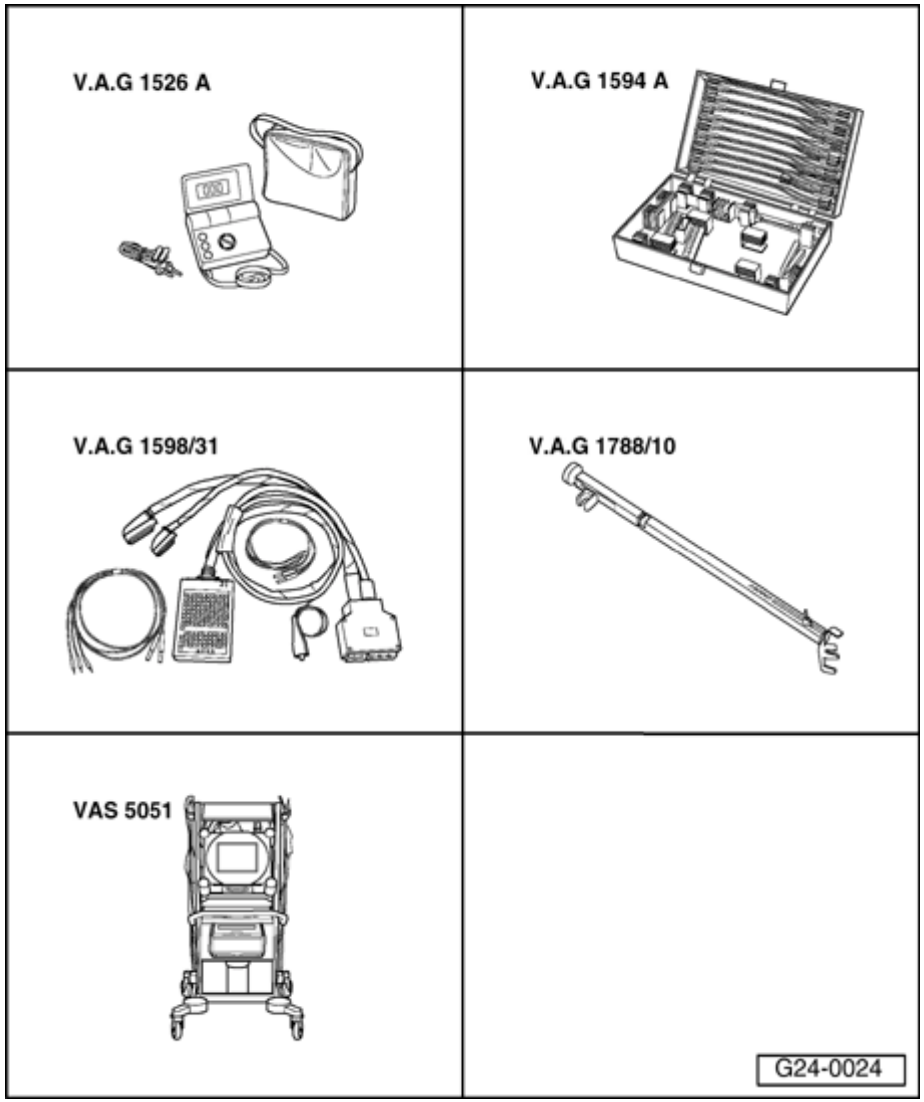
- Check shielded wire for short circuit to sensor wires.

Harness connector Terminal	VAG1598/31 test box Socket
3	32
4	32

If no malfunctions are found in wires:

- Replace Engine Control Module (ECM) ⇒ Page 24-21 .

24-116



Oxygen sensor heating for oxygen sensors before and behind catalytic converter, checking

Special Tools and Equipment

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

- or

- VAG1551 with VAG1551/3B

24-117

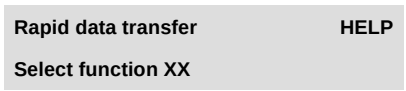
Note:

The heating circuit of the oxygen sensor is monitored by On Board Diagnostic (OBD),

Check DTC memory ⇒ *Page 01-15* .

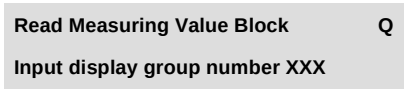
- Connect VAS5051 tester or VAG1551 scan tool and select the control module for engine electronics using "address word" 01 ⇒ Page 01-9 .

Engine must run at idle for this.



When indicated on display:

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



When indicated on display:

- Press buttons -0-, -4- and -1- to select "display group number 041" and press -Q- button to confirm input.

When indicated on display:

- Check specified values in display fields 1 and 3.

Note:

Increasing engine speed accelerates the obtaining of specified values.

24-118

	Display fields			
	1	2	3	4
Display group 041: Oxygen sensor heating (bank 1) at idle				
Display	**xxx kOhm**	---	**xxx kOhm**	---
Indicated	**Bank 1, sensor 1**	Condition of heating	**Bank 2, sensor 1**	Condition of heating
Functional range		Htng. bef. cat. ON Htng. bef. cat. OFF		Htng. beh. cat. ON Htng. beh. cat. OFF
Specified value	**0 to 0.9 kOhm**	Htng. bef. cat. ON/OFF	**0 to 0.9 kOhm**	Htng. beh. cat. ON/OFF

Important notes to display fields 1, 2, 3 and 4:

- *If oxygen sensors have not yet reached their operating temperature, there will be no indication in display fields 1 and 3, i.e. they will both be empty. (increase engine speed to obtain specified values).*
- *After reaching operating temperature of the two oxygen sensors, a resistance of less than 0.9 kOhm must be indicated in display fields 1 and 3.*
- *Do not continue test until a resistance of less than 0.9 kOhm is indicated in display fields 1 and 3.*
- *At certain points of operation, the ECM "pulses" oxygen sensor heating. This means that oxygen sensor heating is switched on and off at these points. It is entirely possible that the specified value "Htng. bef. Cat. OFF" or "Htng. beh. Cat. OFF" will appear in display fields 2 and 4*

- Press -C- button.

Read Measuring Value Block **Q**

Input display group number XXX

When indicated on display:

- Press buttons -0-, -4- and -2- to select "display group number 042" and press -Q- button to confirm input.

24-119

When indicated on display:

- Check specified values in display fields 1 and 3.

	Display fields			
	1	2	3	4
Display group 042: Oxygen sensor heating (bank 2) at idle				
Display	**xxx kOhm**	---	**xxx kOhm**	---
Indicated	**Bank 2, sensor 1**	Condition of heating	**Bank 2, sensor 2**	Condition of heating
Functional range		Htng. bef. cat. ON Htng. bef. cat. OFF		Htng. beh. cat. ON Htng. beh. cat. OFF
Specified value	**0 to 0.9 kOhm**	Htng. bef. cat. ON/OFF	**0 to 0.9 kOhm**	Htng. beh. cat. ON/OFF

Important notes to display fields 1, 2, 3 and 4:

- *If oxygen sensors have not yet reached their operating temperature, there will be no indication in display fields 1 and 3, i.e. they will both be empty. (increase engine speed to obtain specified values).*
- *After reaching operating temperature of the two oxygen sensors, a resistance of less than 0.9 kOhm must be indicated in display fields 1 and 3.*
- *Do not continue test until a resistance of less than 0.9 kOhm is indicated in display fields 1 and 3.*
- *At certain points of operation, the ECM "pulses" oxygen sensor heating. This means that oxygen sensor heating is switched on and off at these points. It is entirely possible that the specified value "Htng. bef. Cat. OFF" or "Htng. beh. Cat.*

OFF" will appear in display fields 2 and 4

24-120

If specified value is not obtained:

- Check voltage supply of oxygen sensor heating ⇒ Page 24-121 .

- Check oxygen sensor signal wire and activation ⇒ Page 24-112 or ⇒ Page 24-114 .

24-121

Checking voltage supply for oxygen sensor heating

Test requirement:

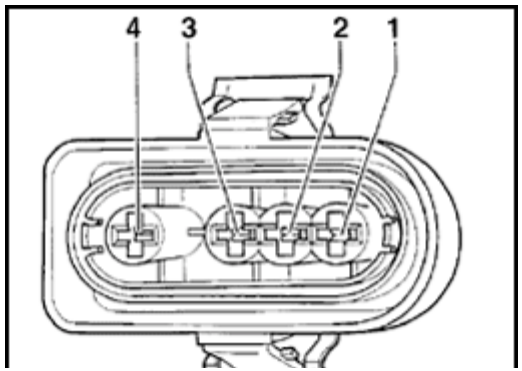
- Fuse for oxygen sensor heating OK

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

- Fuel Pump (FP) OK, checking ⇒ Page 24-49 .

Component location of harness connectors ⇒ Overview of component locations, page ⇒ Page 24-5

- Disconnect 4-pin harness connector leading to respective oxygen sensor.



- Connect multimeter between terminal 1 and 2 for voltage measurement.

24-122

- Start engine.

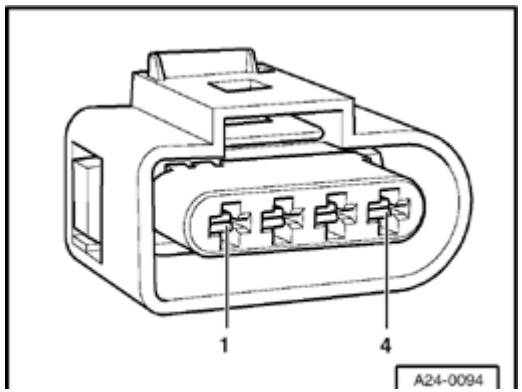
  - Specification: approx. battery voltage, possibly fluctuating

Notes:

- *At certain operating points, the ECM "pulses" the Ground (GND) for oxygen sensor heating. This means that the Ground (GND) is constantly switched on and off at these points. It is therefore possible that the voltage displayed on the tester will fluctuate.*

- *It is possible to observe the ECM switching oxygen sensor heating on and off within the function "read measuring value block", display group numbers 041 and 042.*

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

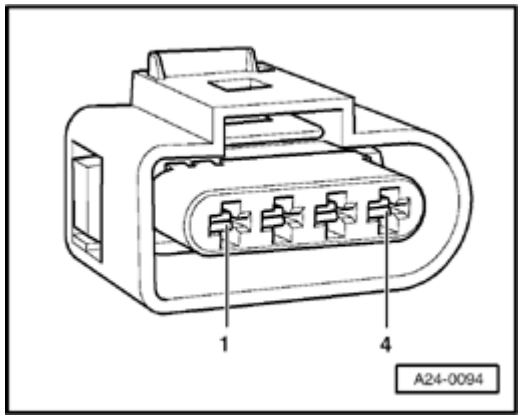
24-123

If there is no voltage again:

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

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

If voltage supply is OK:



- Connect multimeter for voltage measurement as follows:

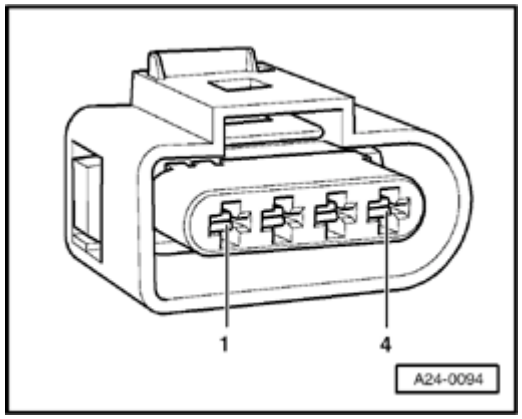
Harness connector **Terminal**	**Measure to**
2 (Ground -GND- activation of Engine Control Module - ECM-)	B+

- Start engine.
  - ♦ Specification: approx. battery voltage, possibly fluctuating
- Switch ignition off.

If there is no voltage:

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM ⇒ Page 24-17 .

24-124



- Check the following wire connection for open circuit:

- Oxygen Sensor (O2S) heater -Z19- bank 1 before catalytic converter:

Harness connector Terminal	VAG1598/31 test box Socket
2	5

- Oxygen Sensor (O2S) heater -Z28- bank 2 before catalytic converter:

Harness connector Terminal	VAG1598/31 test box Socket
2	4

- Oxygen Sensor (O2S) heater -Z29- bank 1 behind catalytic converter:

Harness connector Terminal	VAG1598/31 test box Socket
2	63

- Oxygen Sensor (O2S) heater -Z30- bank 2 behind catalytic converter:

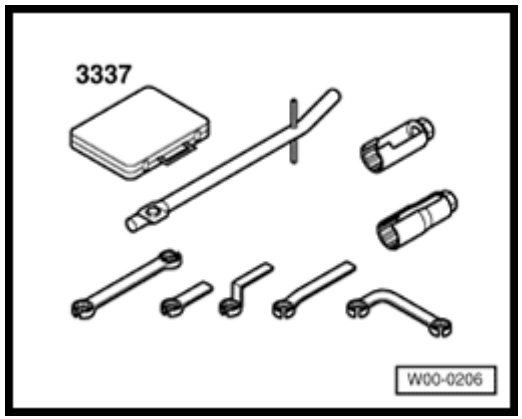
Harness connector Terminal	VAG1598/31 test box Socket
2	6

24-125

If no malfunctions are found in wires:

- Replace appropriate Oxygen Sensor (O2S).
- Read readiness code ⇒ Page 01-78 . If DTC memory was erased, readiness code must be re-generated ⇒ Page 01-82 .

24-126



Oxygen sensor, removing and installing

Special tools and equipment

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

Removing

Component location of harness connectors ⇒ Overview of component locations, page ⇒ Page 24-5

- Disconnect 4-pin harness connector leading to respective oxygen sensor.
- Open cable ties.
- Unscrew oxygen sensor using special tool 3337.

24-127

Installing

Note the following when installing:

Notes:

- *Oxygen sensor threads are coated with an assembly paste. This paste must not contact sensor openings.*
- *Cable ties must always be installed again in exactly the same place to prevent the sensor wire from contacting the exhaust pipe.*
- *Tightening torque: 55 Nm*