Oxygen sensor control, checking

Function of oxygen sensor control

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

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

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

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

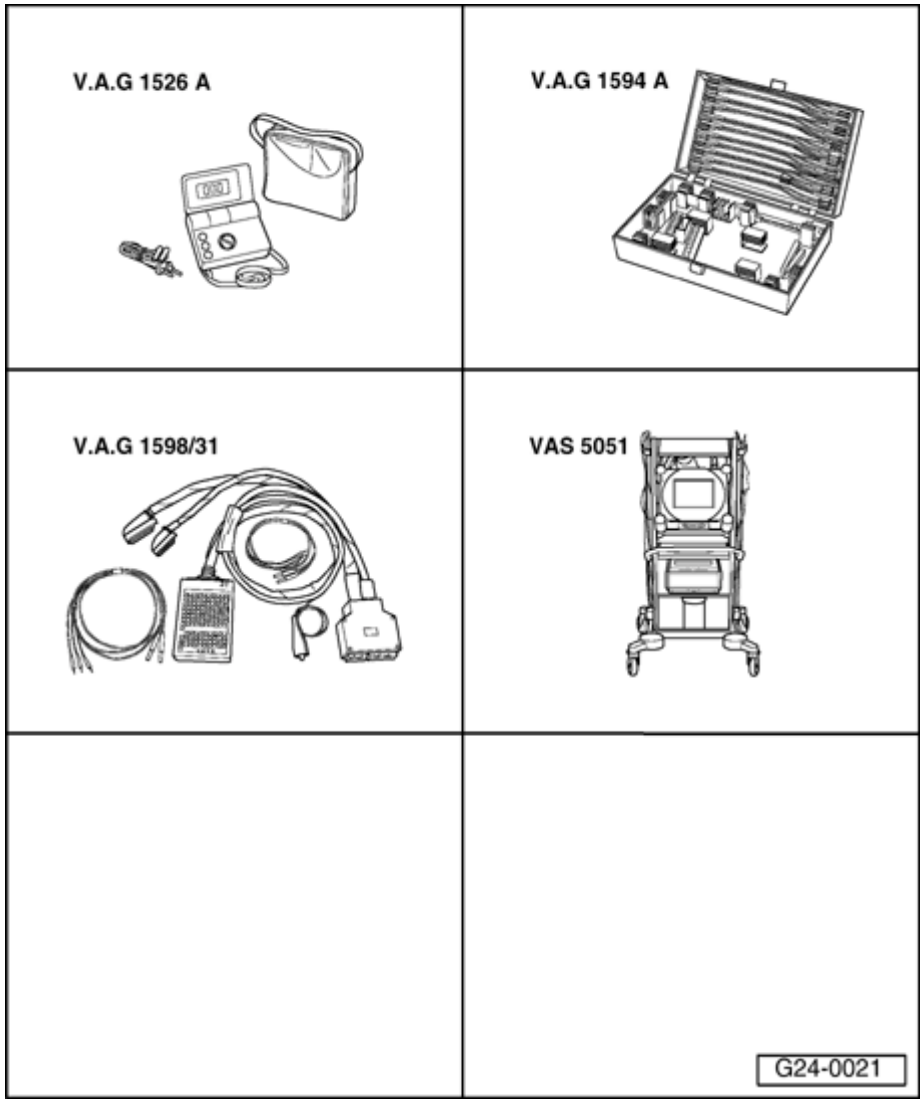
Because of the sharp voltage jump the oxygen sensor control cannot maintain a constant ideal mixture composition of λ = 1.0. The system fluctuates continuously between "slightly too lean" and "slightly too rich".

24-80

If the voltage does not change or only changes slowly the following malfunctions are possible:

- Slits or holes in probe head are blocked.
- Oxygen sensor has been subjected to excessive thermal stress.
- Contact resistance in signal wire or Ground (GND) wire.
- Oxygen sensor too cold; sensor heater not working.
- Oxygen sensor damaged by contact spray or similar product. (The contact spray is drawn through the fine cavities in the electrical wiring as a result of thermal fluctuations and capillary effect.)
- Oxygen sensor damaged by silicone vapors. (The engine draws in traces of any silicone-based sealants that may have been used. The silicone does not burn and damages the oxygen sensor.)

24-81



Oxygen sensor and oxygen sensor control before Three Way Catalytic Converter (TWC), checking

Special tools and shop equipment

- Fluke 83 (or equivalent) A
- VAG1594 A
- VAG1598/31
- VAS5051 with VAS5051/1

- or

- VAG1551 with VAG1551/3B

24-82

Notes:

- *For the defined troubleshooting procedure, it is possible to switch off the oxygen sensor control by selecting Display Group 99 in "Basic Setting" mode and to switch it on again by selecting Display Group 99 in "Read Measuring Value Block" mode.*

- *After selecting Display Group 99 (either in "Basic Setting" mode or in "Read Measuring Value Block" mode) it is possible to switch back and forth between function 04 ("Basic Setting") and function 08 "Read Measuring Value Block") by pressing buttons 4 and 8 on VAG1551 scan tool.*

- *When exiting the "Basic Setting" mode (function 04) the oxygen sensor control is automatically switched on again.*

Test conditions

- Perform road test and do not erase DTC memory.

- Coolant temperature at least 85 ° C (Display group 004, display field 3)

Checking function

- Connect vehicle diagnostic, testing and information system VAS5051 or VAG1551 scan tool and select engine electronics control module by entering address word "01" ⇒ Page 01-9 . When doing this the engine must be at idle.

Rapid data transfer **HELP**

Select function XX

➢ Indicated on display

- Press buttons -0- and -4- to select function "Basic Setting" and confirm entry with -Q- button.

Note:

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

Basic Setting

Input display group number XXX

➢ Indicated on display

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

System in Basic Setting 30 →

1 2 3 4

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

- Check oxygen sensor status in display fields 1 to 4.

24-84

Note:

The "Oxygen sensor status" display indicates the status of the oxygen sensor control and oxygen sensors.

	Display fields			
	1	2	3	4
Display Group 030: Oxygen sensor status at idle speed (coolant temperature at least 85 °C)				
Display	**0 0 0**	0 0 0	**0 0 0**	0 0 0
Indicates	**Oxygen sensor status bank 1, sensor 1**	Oxygen sensor status bank 1, sensor 2	**Oxygen sensor status bank 2, sensor 1**	Oxygen sensor status bank 2, sensor 2
Work range	**0 = off** **1 = on**	0 = off 1 = on	**0 = off** **1 = on**	0 = off 1 = on
Specification	**1 1 1**	0 1 0	**1 1 1**	0 1 0
Note	**Significance of display ⇒ Page 24-85** **If specification is obtained, but a malfunction is stored in the DTC memory: Check oxygen sensor adaptation values and oxygen sensor control ⇒ Page 24-86** **If specification is not obtained: Check oxygen sensor signal wire and activation ⇒ Page 24-122**			

24-85

Significance of 3 digit indication in Display Group 30

1	1	1	**Display fields 1 through 3**
		X	Oxygen sensor control 0= inactive 1= active
	X		Operational readiness of oxygen sensor 0= inactive 1= active
X			Condition of oxygen sensor heater 0= inactive 1= active

Note:

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

- *The first position of the 3 digit display (Heater) fluctuate at certain operating conditions between 0 and 1.*

Checking oxygen sensor adaptation and oxygen sensor control

- Connect vehicle diagnostic, testing and information system VAS5051 or VAG1551 and select engine electronics control module by entering address word "01" ⇒ Page 01-9 . When doing this the engine must be idling.

Rapid data transfer HELP
Select function XX

➢ Indicated on display

- Press buttons -0- and -4- to select function "Basic Setting" and confirm entry with -Q- button.

Note:

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

Basic Setting
Input display group number XXX

➢ Indicated on display

- Press buttons -0-, -3- and -3- to select Display Group 33 and confirm entry with -Q- button.

System in Basic Setting 33			→
1	**2**	**3**	**4**

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

24-87

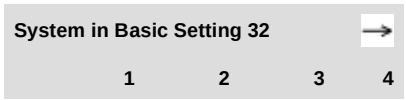
- Check oxygen sensor control in display fields 1 to 4:

	Display fields			
	1	2	3	4
Display Group 33: Oxygen sensor control at idle speed				
Display	**xx.x %**	**xx.x V**	**xx.x %**	**xx.x V**
Indicates	**Oxygen sensor control, bank 1**	**Oxygen sensor voltage, bank 1**	**Oxygen sensor control, bank 2**	Oxygen sensor voltage, bank 2
Work range	**min.: -25.0 %** **max.: 25.0 %**	**min.: 0.000 Volt** **max.: 1.000 Volt**	**min.: -25.0 %** **max.: 25.0 %**	**min.: 0.000 Volt** **max.: 1.000 Volt**
Specification	**-4.0 to 4.0 %** **(The value must fluctuate by 2 %)**	**Between 0.000 and 1.000 V the voltage should fluctuate**	**-4.0 to 4.0 %** **(The value must fluctuate by 2 %)**	**Between 0.000 and 1.000 V the voltage should fluctuate**
Note	**If readout does not match specification ⇒ Page 24-89**	**If readout does not match specification ⇒ Page 24-92**	**If readout does not match specification ⇒ Page 24-89**	**If readout does not match specification ⇒ Page 24-92**

- Press button -C-.

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

24-88



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

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

	Display fields			
	1	2	3	4
Display Group 32: Oxygen sensor adaptation at idle speed				
Display	**xx.x %**	**x.xxx %**	**xx.x %**	**x.xxx %**
Indicates	**Oxygen sensor adaptation value, bank 1, sensor 1 at idle (additive)**	**Oxygen sensor adaptation value, bank 1, sensor 1 at partial throttle (multiple)**	**Oxygen sensor adaptation value, bank 2, sensor 1 at idle (additive)**	Oxygen sensor adaptation value, bank 2, sensor 1 at partial throttle (multiple)
Range	**min.: -25.0 %** **max.: 25.0 %**	**min.: -25.0 %** **max.: 25.0 %**	**min.: -25.0 %** **max.: 25.0 %**	**min.: -25.0 %** **max.: 25.0 %**
Specification	**-4.0 and 4.0 %** **can fluctuate slightly**	**-4.0 and 4.0 %** **can fluctuate slightly**	-4.0 and 4.0 % **can fluctuate slightly**	-4.0 and 4.0 % **can fluctuate slightly**
Note	**If readout does not match specification ⇒ Page 24-90 and ⇒ Page 24-91**	**If readout does not match specification ⇒ Page 24-90 and ⇒ Page 24-91**	**If readout does not match specification ⇒ Page 24-90 and ⇒ Page 24-91**	**If readout does not match specification ⇒ Page 24-90 and ⇒ Page 24-91**

If the specified values in display fields 1 and/or 3 do not match the specifications, or if the readout does not fluctuate by at least 2 %:

- Check oxygen sensor heater ⇒ Page 24-114 .
- Check oxygen sensor signal wire and activation ⇒ Page 24-122 .
- Check intake system for leaks and eliminate false air ⇒ Page 24-76 .
- Check fuel pressure regulator ⇒ Page 24-33 .
- Fuel return line kinked or plugged.
- Press → button.
- Press button -0- and -6- to select function "End Output" and confirm with -Q- button.
- Switch ignition off.

Evaluation display group 032

Display group 32 **Display fields: 1/3**	**Possible cause**	**Corrective action**
Oxygen sensor adaptation values in range: -4.0 to -25.0 %	♦ Oil thinning	- Carry out oil change or carry out road test on highway
Display fields: 2/4	♦ High oil consumption	
Oxygen sensor adaptation values in range: -4.0 to -25.0 %	♦ Mass Air Flow (MAF) Sensor faulty	- Check Mass Air Flow (MAF) Sensor ⇒ Page 24-59
	♦ EVAP canister purge regulator valve remains in stuck in open position	- Check EVAP canister purge regulator valve ⇒ Page 24-134
	♦ Fuel pressure too high ♦ Fuel return line kinked or pluged	- Check fuel pressure regulator ⇒ Page 24-33 - Check fuel return line
	♦ Fuel injector leaking	- Check fuel injectors ⇒ Page 24-39

Evaluation display group 032

Display Group 32 Display fields: 1/3	Possible cause	Corrective action
Oxygen sensor adaptation values in range: 4.0 and 25.0 %	♦ Un-metered air in intake area	- Check intake system for un-metered air and eliminate leaks
Display field: 2/4	♦ Fuel pressure too low	- Check fuel pressure regulator ⇒ Page 24-33
Oxygen sensor adaptation values in range: 4.0 - 25.0 %	♦ Oxygen sensor heater faulty	- Check oxygen sensor heater ⇒ Page 24-114
	♦ Injector not opening or only opening partially	- Check injectors ⇒ Page 24-39
	♦ EVAP canister purge regulator valve remains in stuck in open position	- Check EVAP canister purge regulator valve ⇒ Page 24-134

Evaluation display group 33

Display Group 33 Display field: 2/4	Possible cause	Corrective action
Approx. 0.450 V	♦ Open circuit in wire 4 between oxygen sensor and control module ♦ Open circuit in wire 3 between oxygen sensor and control module	- Check signal wire and activation ⇒ Page 24-122
	♦ Oxygen sensor heater faulty	- Check oxygen sensor heater ⇒ Page 24-114 - Replace oxygen sensor
	♦ Oxygen sensor faulty	
More than 1.100 V	♦ Short to B+ in wire 4 between oxygen sensor and control module	- Check oxygen sensor wiring, bank 1, sensor 1 ⇒ Page 24-123
Less than 0.100 V	♦ Short to Ground (GND) in wire 4 between oxygen sensor and control module	- Check oxygen sensor wiring, bank 2, sensor 1 ⇒ Page 24-127

Oxygen sensors aging, oxygen sensor before catalytic converter, checking

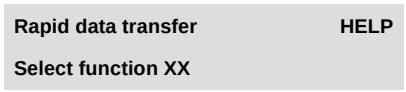
Test requirements

- Coolant temperature min. 85 ° C (185 ° F) (Display group 004, display field 3)

Test sequence for oxygen sensor 1 before catalytic converter bank 1

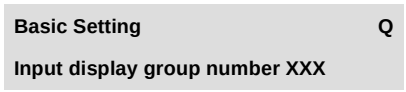
- Connect vehicle diagnostic, testing and information system VAS5051 or VAG1551 and select engine electronics control module by entering address word "01" ⇒ Page 01-9 . When doing this the engine must be at idle.

24-94



Indicated on display

- Press buttons -0- and -4- to select "Basic Setting" and confirm with -Q- button.

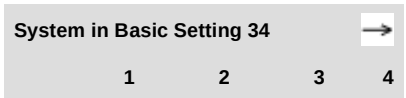


Indicated on display

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

Test requirements

- Engine runs at 1900 - 2200 RPM



Indicated on display

- Continue test as soon as display field 4 indicates "Test ON".

24-95

Note:

This procedure can take a few minutes

	Display fields			
	1	2	3	4
Display field 034: Diagnostic oxygen sensor aging (Bank 1)				
Display	xxxx/RPM	xxx °C	x.x s	**Test ON**
Indicated	Engine speed (RPM)	Exhaust temperature	Period duration oxygen sensor before catalytic converter	**Diagnostic condition**
Working range	0 - 6800	70 - 850 °C	0 - 3.0 Seconds	**Test OFF** **Test ON** **B1-S1 OK** **B1-S1 not OK**
Specification	1900 - 2200/RPM	greater than 260 °C	0.1 - 1.0 s	**B1-S1 OK**
Note			**If specified value is not obtained ⇒Continuation Page ⇒ Page 24-96**	

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 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.

24-96

Continuation

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

- Replace Heated Oxygen Sensor (HO2S) before Three Way Catalytic Converter Bank 1 -G39.

Test sequence for oxygen sensor 1 before catalytic converter bank 2

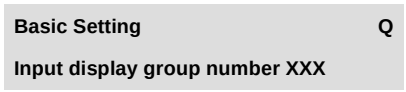
- Connect vehicle diagnostic, testing and information system VAS5051 or VAG1551 and select engine electronics control module by entering address word "01" ⇒ Page 01-9 . When doing this the engine must be at idle.

Rapid data transfer **HELP**	
Select function XX	

Indicated on display

- Press buttons -0- and -4- to select "Basic Setting" and confirm with -Q- button.

24-97

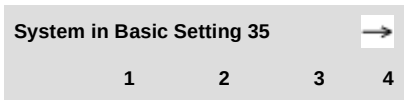


Indicated on display

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

Test requirements

- Engine runs at 1900 - 2200 RPM



Indicated on display

- Continue test as soon as display field 4 indicates "Test ON".

Note:

This procedure can take a few minutes

24-98

	Display fields			
	1	2	3	4
Display field 035: Diagnostic oxygen sensor aging (Bank 2)				
Display	xxxx/RPM	xxx ° C	x.x s	**Test ON**
Indicated	Engine speed (RPM)	Exhaust temperature	Period duration oxygen sensor before catalytic converter	**Diagnostic condition**
Working range	0 - 6800	70 - 850 ° C	0 - 3.0 Seconds	**Test OFF** **Test ON** **B1-S1 OK** **B1-S1 not OK**
Specification	1900 - 2200/RPM	greater than 260 ° C	0.1 - 1.0 s	**B1-S1 OK**
Note			**If specified value is not obtained ⇒Continuation Page ⇒ Page 24-99**	

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 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 =B2-S1 not OK.

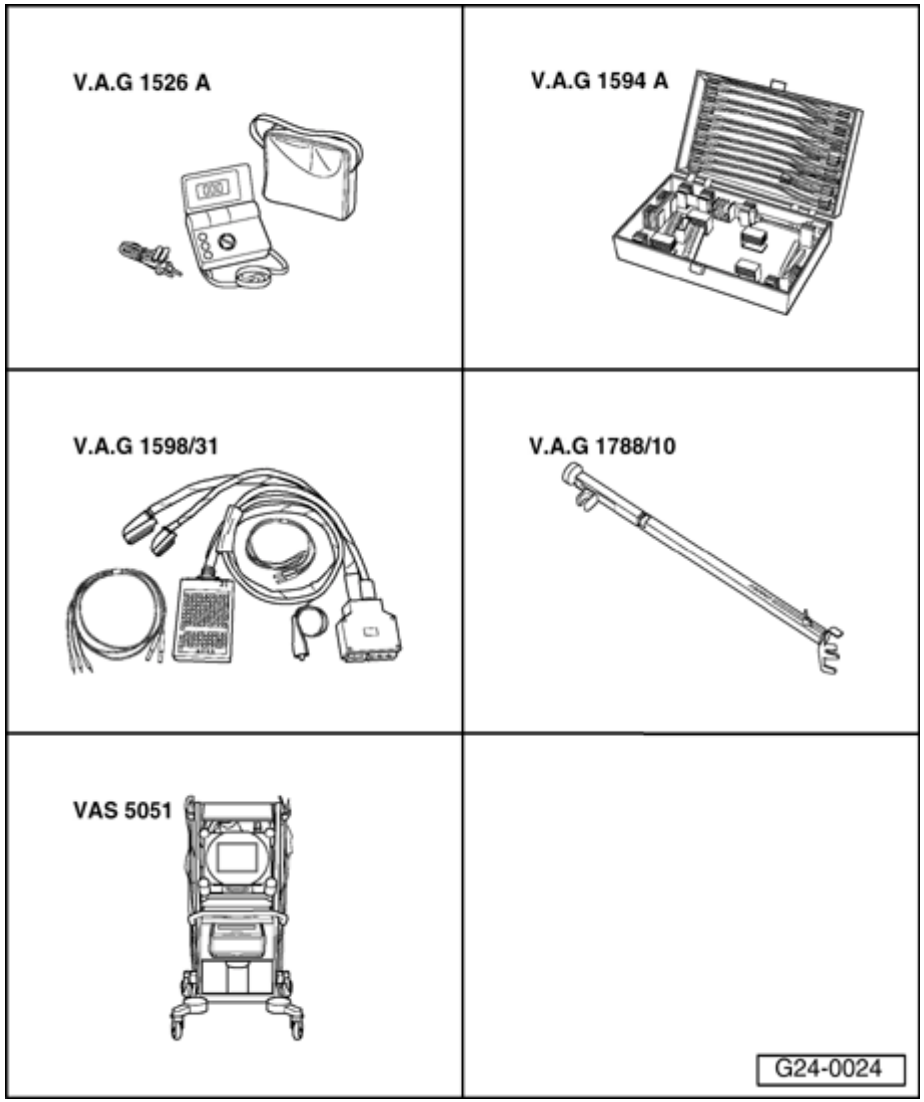
24-99

Continuation

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

- Replace Heated Oxygen Sensor (HO2S) before Three Way Catalytic Converter Bank 2 -G108.

24-100



Oxygen sensor and oxygen sensor control behind catalytic converter, checking

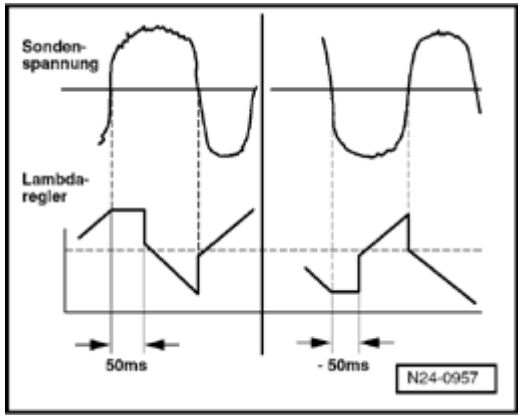
Test equipment and shop tools

- Fluke 83 (or equivalent)
- VAG1594 A
- VAG1598/31
- VAG1788/10
- VAS5051 with VAS5051/1

- or

- VAG1551 with VAG1551/3B

24-101



Notes:

- *Oxygen sensor control behind the catalytic converter is responsible for final control correction. It is the primary sensor and can override the signal from the oxygen sensor control before the catalytic converter..*

- *It corrects slight changes in the mixture (i.e. enrichment) via the oxygen sensor before catalytic converter by holding the oxygen sensor control before catalytic converter at its higher or lower limit for a specific time (duration). 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.*

Component location of harness connectors ⇒ **Page 24-5**

24-102

Test conditions

- Perform road test and do not erase DTC memory.
- Coolant temperature at least 85 °C (185 °F) (Display group 004, display field 3)

- Connect vehicle diagnostic, testing and information system VAS5051 or VAG1551 scan tool and select engine electronics control module by entering address word "01" ⇒ Page 01-9 . When doing this the engine must be at idle.

Rapid data transfer HELP **Select function XX**	➢	Indicated on display

- Press buttons -0- and -4- to select function "Basic Setting" and confirm entry with -Q- button.

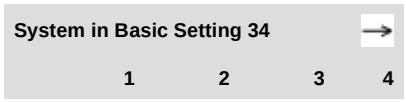
Note:

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

Basic Setting **Input display group number XXX**	➢	Indicated on display

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

24-103



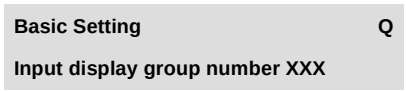
When indicated on display:

- Adjust engine speed using VAG1788/10 to 2800 - 3200 RPM.
- Continue test as soon as display field 2 indicates an exhaust temperature of more than 320 ° C.

Note:

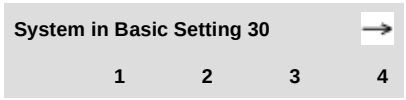
This process can take a few minutes.

- Press -C- button.
- Adjust engine speed using VAG1788/10 to 1900 - 2200 RPM.



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 field 2.

Note:

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

24-104

	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 1, sensor 2**	**Oxygen sensor status, bank 2, sensor 1**	Oxygen sensor status bank 2, sensor 2
Working area	0 = off 1 = on	**0 = off** **1 = on**	0 = off 1 = on	**0 = off** **1 = on**
Specified value:	1 1 1	**1 1 1**	1 1 1	**1 1 1**
Note:	**Significance of display ⇒ Page 24-105** **If specified value is not obtained:** **Check oxygen sensor signal wire and activation ⇒ Page 24-122** **Check oxygen sensor heater ⇒ Page 24-114**			

Notes:

- *Oxygen sensor control of oxygen sensor behind catalytic converter (Bank 1-Sensor 2 and Bank 2 -Sensor 2) is not active without engine load.*
- *The first position of the 3 digit indication (heater) fluctuates between 0 and 1.*

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

24-105

Significance of 3 digit indication in Display Group 030

1	1	1	**Display fields 1 to 4**
		X	Oxygen sensor control 0= inactive 1= active
	X		Operational readiness of oxygen sensor 0= inactive 1= active
X			Condition of oxygen sensor heater 0= inactive 1= active

- Press -C- button.

Basic Setting **Q**

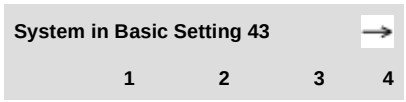
Input display group number XXX

When indicated on display

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

Test requirements

- Engine runs at 1900 - 2200 RPM



When indicated on display

- Check specified value in display field 4.

24-106

	Display fields			
	1	2	3	4
Display group 043: Oxygen sensor aging oxygen sensor behind catalytic converter (Bank 1)				
Display	xxxx/RPM	xxx °C	x.xxx V	**Test ON**
Indicated	Engine speed (RPM)	Exhaust temperature	Voltage of oxygen sensor behind CAT, Bank 1	**Diagnostic condition**
Work range	0 - 6800/RPM	70 - 850 °C	0.000 - 1.000 Volt	**Test OFF** **Test ON** **B1-S2 OK** **B1-S2 not OK**
Specified value	1900 - 2200/RPM	greater than 320 °C	0.000 - 1.000 Volt	**B1-S2 OK**
Note				**If specified value is not reached. Check oxygen sensor heater ⇒ Page 24-114**

If the specified value of "B1-S2 OK" is reached:

- Press -C- button.

Test requirements

- Engine runs at 1900 - 2200 RPM

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

24-107

	Display fields			
	1	2	3	4
Display group 044: Oxygen sensor aging oxygen sensor behind catalytic converter (Bank 2)				
Display	xxxx/RPM	xxx ° C	x.xxx V	**Test ON**
Indicated	Engine speed (RPM)	Exhaust temperature	Voltage of oxygen sensor behind CAT, Bank 1	**Diagnostic condition**
Work range	0 - 6800/RPM	70 - 850 ° C	0.000 - 1.000 Volt	**Test OFF** **Test ON** **B2-S2 OK** **B2-S2 not OK**
Specified value	1900 - 2200/RPM	greater than 320 ° C	0.000 - 1.000 Volt	**B1-S2 OK**
Note				**If specified value is not reached. Check oxygen sensor heater ⇒ Page 24-114**

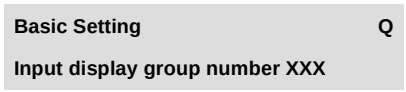
If the specified value of "B2-S2 OK" is reached:

- Press -C- button.

24-108

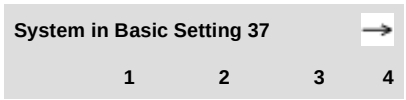
Checking oxygen sensor control behind catalytic converter

- Carry out road test for approx.: 10 minutes.



Indicated on display

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



Indicated on display

- Check oxygen sensor voltage in display field 2.
- Check dwell time (hold up) 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.

24-109

	Display fields			
	1	2	3	4
Display group 037: Diagnostic oxygen sensor control (Bank 1)				
Display	xxx %	x.xxx Volt	xxx ms	**Test ON**
Indicated	Engine load	Oxygen sensor voltage behind catalytic converter, Bank 1	Correction value between oxygen sensor 1 and sensor 2, bank 1	**Diagnostic condition**
Work range	15.0 - 175.0 %	0.000 - 1.000 V	-1200 - 1200 ms	**Test OFF** **Test ON** **SYST. OK** **SYST. not OK**
Specified value	15.0 - 25.0 %	0.000 - 1.000 V	-500 - 500 ms	**SYST. OK**
Note		**If specified value is not obtained: Evaluation display field 2 ⇒ Page 24-112**	**If specified value is obtained: Continuation ⇒ Page 24-113**	**If "SYST. not OK" is displayed: Check DTC memory ⇒ Page 01-15** **or Continue ⇒ Page 24-113**

Note for display field 3:

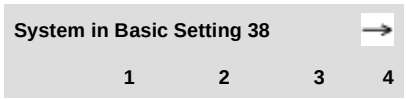
Oxygen sensor control behind catalytic converter is superior to oxygen sensor control before catalytic converter and is the primary control. It corrects slight changes in the mixture (i.e. enrichment or thinning) by holding the oxygen sensor control before catalytic converter at its higher or lower point for a specific time (duration). 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.

24-110

- Press -C- button.

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



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

24-111

	Display fields			
	1	2	3	4
Display group 038: Diagnostic oxygen sensor control (Bank 2)				
Display	xxx %	x.xxx Volt	xxx ms	**Test ON**
Indicated	Engine load	Oxygen sensor voltage behind catalytic converter, Bank 2	Correction value between oxygen sensor 1 and sensor 2, bank 2	**Diagnostic condition**
Work range	15.0 - 175.0 %	0.000 - 1.000 V	-1200 - 1200 ms	**Test OFF** **Test ON** **SYST. OK** **SYST. not OK**
Specified value	15.0 - 25.0 %	0.000 - 1.000 V	-500 - 500 ms	**SYST. OK**
Note		If specified value is not obtained: Evaluation display field 2 ⇒ Page 24-112	If specified value is obtained: Continuation ⇒ Page 24-113	**If "SYST. not OK" is displayed: Check DTC memory ⇒ Page 01-15** **or Continue ⇒ Page 24-113**

Note for display field 3:

Oxygen sensor control behind catalytic converter is superior to oxygen sensor control before catalytic converter and is the primary control. It corrects slight changes in the mixture (i.e. enrichment or thinning) by holding the oxygen sensor control before catalytic converter at its higher or lower point for a specific time (duration). 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.

24-112

Evaluation display group 037 and 038

Display Group: 037/038 Display field: 2	Possible cause	Corrective action
approx.: 0.450 V	♦ Open circuit in wire 4 between oxygen sensor and control module ♦ Open circuit in wire 3 between oxygen sensor and control module ♦ Oxygen sensor heater faulty ♦ Oxygen sensor faulty	- Check signal wire and activation ⇒ Page 24-122 - Check oxygen sensor heater ⇒ Page 24-114 - Replace oxygen sensor
greater than 1.100 V	♦ Short circuit to B+ in wire 4 between oxygen sensor and control module	- Check oxygen sensor wiring bank 1 sensor 2 (behind converter) ⇒ Page 24-125
smaller than 0.100 V	♦ Short circuit to Ground (GND) in wire 4 between oxygen sensor and control module ♦ Short circuit between wire 3 and 4	- Check oxygen sensor wiring bank 2 sensor 2 (behind converter) ⇒ Page 24-129

24-113

Continuation

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

- Check exhaust system and catalytic converter for leaks (check clamps and exhaust for damage)

- If the difference of the values in measuring blocks, display fields 3 (oxygen sensor correction value) is to large (e.g.:+500 ms, -500 ms), it is possible that the oxygen sensor are interchanged (mixed up).

If none of the causes are identified:

- Replace particular oxygen sensor "before" catalytic converter.

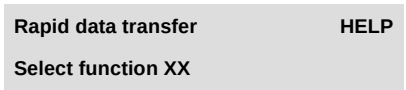
24-114

Oxygen sensor heater for oxygen sensor, checking

Note:

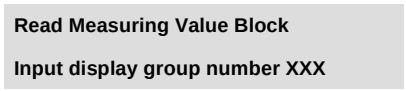
The oxygen sensor heating circuit is monitored by the On Board Diagnostic (OBD). Check DTC memory ⇒ *Page 01-15* .

- Connect vehicle diagnostic, testing and information system VAS5051 or VAG1551 scan tool and select engine electronics control module by entering address word "01" ⇒ Page 01-9 . When doing this the engine must be at idle.



Indicated on display

- Press buttons -0- and -8- to select function "Read Measuring Value Block" and confirm entry with -Q- button.



Indicated on display

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

Indicated on display

24-115

- Adjust engine speed to approx: 3000 RPM

- Check resistance of oxygen sensor heater.

	Display fields			
	1	2	3	4
Display Group 041: Oxygen sensor heater, Bank 1 (at idle speed)				
Display	**xxx kOhm**	**Htg.bC.ON**	**xxx kOhm**	**Htg.aC.ON**
Indicates	**Bank 1, Sensor 1**	**Status of heater**	**Bank 1, Sensor 2**	**Status of heater**
Range		**Htg.bC.ON** **Htg.bC.OFF**		**Htg.aC.ON** **Htg.aC.OFF**
Specified value	**0 - 0.5 kOhm**	**Htg.bC.ON/OFF**	**0 - 0.5 kOhm**	**Htg.aC.ON/OFF**
Note	**It can take a few minutes until specification are obtained**		**It can take a few minutes until specified values are obtained**	

- Press -C- button.

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

	Display fields			
	1	2	3	4
Display Group 042: Oxygen sensor heater, Bank 2 (at idle speed)				
Display	**xxx kOhm**	**Htg.bC.ON**	**xxx kOhm**	**Htg.aC.ON**
Indicates	**Bank 2, Sensor 1**	**Status of heater**	**Bank 2, Sensor 2**	**Status of heater**
Range		**Htg.bC.ON** **Htg.bC.OFF**		**Htg.aC.ON** **Htg.aC.OFF**
Specified value	**0 - 0.5 kOhm**	**Htg.bC.ON/OFF**	**0 - 0.5 kOhm**	**Htg.aC.ON/OFF**
Note	**It can take a few minutes until specifications are obtained**		**It can take a few minutes until specifications are obtained**	

If the specification is not attained:

- Check voltage supply for oxygen sensor heater
  ⇒ Page 24-117 .

- Check oxygen sensor signal wire and activation
  ⇒ Page 24-122 .

24-117

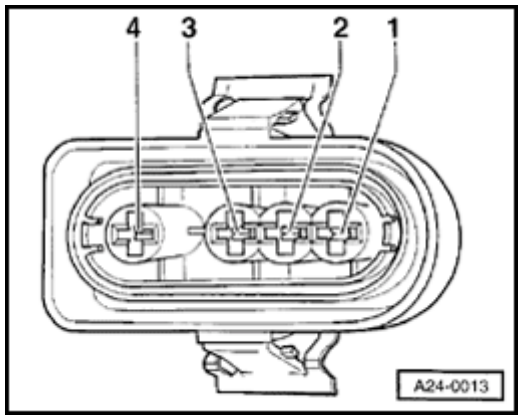
Checking voltage supply for oxygen sensor heater

Component location of 4-pin harness connector of oxygen sensors ⇒ Page 24-5 .

- Check fuse for oxygen sensor heater

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Disconnect 4-pin harness connector of particular oxygen sensor.



- Connect hand-held multimeter (voltage measurement range) between sockets 1 (B+) and 2 (Ground (GND)) using test leads from VAG1594 connector test kit.
- Operate starter briefly.

  Specified value: approx. battery voltage

If there is no voltage reading:

- Connect hand-held multimeter (voltage measurement range) between socket 1 (B+) and vehicle Ground (GND) using test leads from VAG1594 connector test kit.

24-118

- Operate starter briefly.

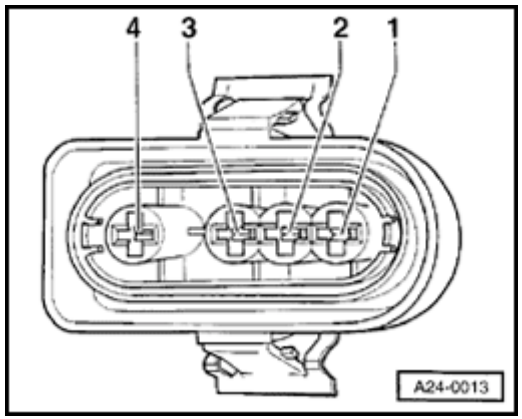
  Specified value: approx. battery voltage

If there is still no voltage reading:

- Check for open circuit and/or short circuit in wiring between fuel pump relay and socket 1 on the relevant oxygen sensor connector (on wiring harness) via fuse.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If the voltage supply is OK:



- Connect hand-held multimeter (voltage measurement range) between socket 2 (switched Ground (GND) connection from engine control module) and B+ terminal using test leads from VAG1594 connector test kit.

24-119

- Start engine.

  Specified value: approx. battery voltage (fluctuating)

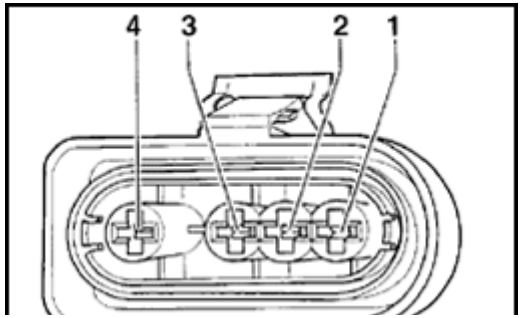
Note:

At certain points in the operating range the engine control module continuously "switches" the Ground (GND) connection to the oxygen sensor heater. That means, it repeatedly connects and disconnects the Ground (GND) connection at these points. For this reason the voltage reading on the tester may fluctuate.

- Switch ignition off.

If there is no voltage reading:

- Connect VAG1598/31 test box to wiring harness for engine control module. Do not connect to the engine control module itself ⇒ Page 24-20 .



- Check for open circuits in the following wiring connection:

Heated Oxygen Sensor (HO2S) -G39	
Connector on wiring harness, socket	**VAG1598/31 test box, socket**
2	5 (Ground)
Heated Oxygen Sensor (HO2S) 2 -G108	
Connector on wiring harness, socket	**VAG1598/31 test box, socket**
2	4 (Ground)
Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) -G130	
Connector on wiring harness, socket	**VAG1598/31 test box, socket**
2	63 (Ground)
Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) -G131	
Connector on wiring harness, socket	**VAG1598/31 test box, socket**
2	6 (Ground)

Resistance in wiring: max. 1.5 Ohm

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

24-121

If the wiring is OK but the oxygen sensor heater still has no Ground (GND) connection:

- Replace particular oxygen sensor.

- Display readiness code ⇒ Page 01-101 . The readiness code must be generated if the DTC memory was erased ⇒ Page 01-105 .

24-122

Oxygen sensor signal wire and activation, checking

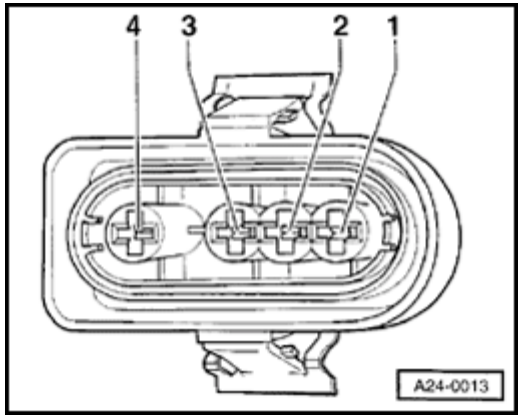
Note:

The oxygen sensor signal is monitored by the OBD system.

- Check DTC memory ⇒ Page 01-15 .

- If a oxygen sensor malfunction is displayed and the oxygen sensor heater is OK, disconnect harness connector for relevant oxygen sensor.

Component location of 4-pin harness connector of oxygen sensor ⇒ Page 24-5 .



- Test voltage by connecting hand-held multimeter Fluke 83 (or equivalent) (measuring range 2 V) between sockets 3 and 4 of connector on wiring harness.
- Switch ignition on. Specified value: 450 ± 50 mV.

If the Specified value is not obtained, check oxygen sensor wiring:

Bank 1, Sensor 1 ⇒ Page 24-123 .

Bank 1, Sensor 2 ⇒ Page 24-125 .

Bank 2, Sensor 1 ⇒ Page 24-127 .

Bank 2, Sensor 2 ⇒ Page 24-129 .

24-123

If Specified value is obtained:

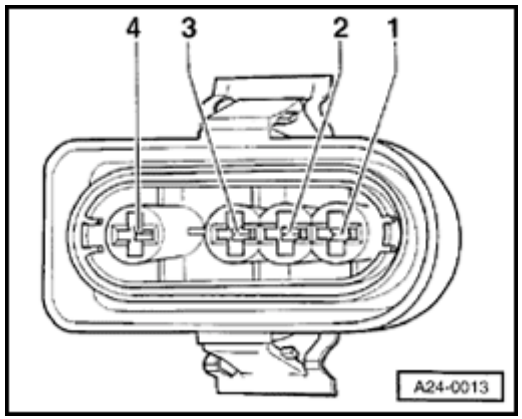
- Replace relevant oxygen sensor.

Checking oxygen sensor wiring for Heated Oxygen Sensor (HO2S) -G39

Component location of 4-pin harness connector of oxygen sensor ⇒ Page 24-5 .

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

- Connect VAG1598/31 test box to wiring harness for engine control module. Do not connect to engine control module itself ⇒ Page 24-20 .

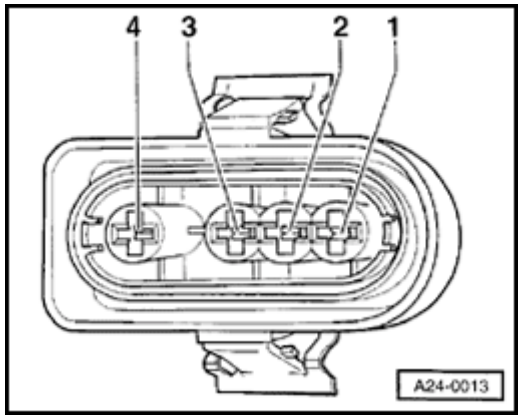


- Check following wiring connections for open circuits:

Connector on wiring harness, socket	VAG1598/31 test box socket
3	51
4	70

Resistance in wiring: max. 1.5 Ohm

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*



- Check wiring also on 4-pin harness connector for short circuits to each other.

Connector on wiring harness, socket	VAG1598/31 test box socket
4	51

Specified value: infinite ohms (open circuit)

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Check shielded wire for short circuit to sensor wiring.

Connector on wiring harness, socket	VAG1598/31 test box socket
4	32
3	32

Specified value: infinite ohms(open circuit)

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If no malfunction is identified in the wiring:

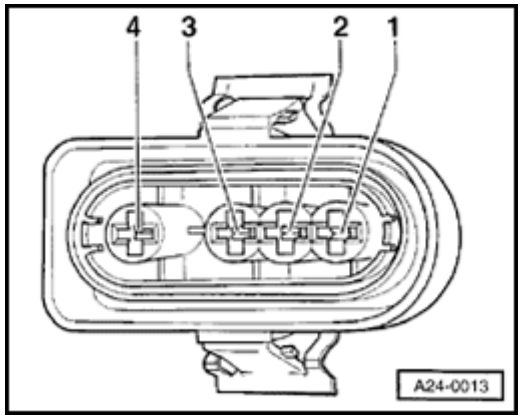
- Replace Motronic Engine Control Module (ECM) -J220 ⇒ Page 24-24 .

Checking wiring for Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) -G130

Component location of 4-pin harness connector of oxygen sensor ⇒ Page 24-5 .

- Disconnect 4-pin connector (black) for Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) -G130.

- Connect VAG1598/31 test box to wiring harness for engine control module. Do not connect to the engine control module itself ⇒ Page 24-20 .

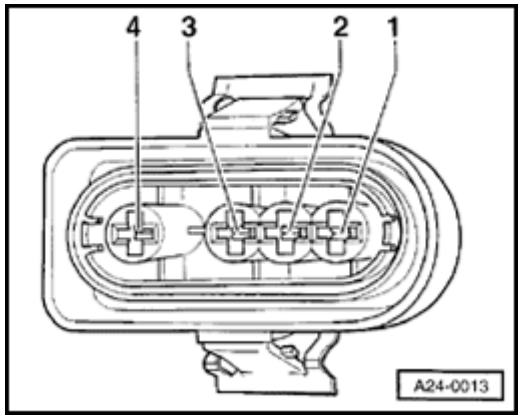


- Check following wiring connections for open circuits:

Connector on wiring harness, socket	VAG1598/31 test box socket
3	68
4	69

Resistance in wiring: max. 1.5 ohm

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*



- Check wiring also on 4-pin harness connector for short circuits to each other.

Connector on wiring harness, socket	VAG1598/31 test box socket
4	68

Specified value: infinite ohms (open circuit)

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Check shielded wire for short circuit to sensor wiring.

Connector on wiring harness, socket	VAG1598/31 test box socket
4	32
3	32

Specified value: infinite ohms (open circuit)

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If no malfunction is identified in the wiring:

- Replace Motronic Engine Control Module (ECM) -J220 ⇒ Page 24-24 .

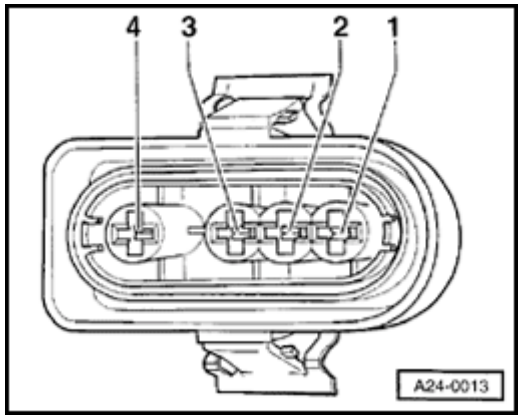
24-127

Checking wiring for Heated Oxygen Sensor (HO2S) 2 -G108

Component location of 4-pin harness connector of oxygen sensor ⇒ Page 24-5 .

- Disconnect 4-pin connector (black) for Heated Oxygen Sensor (HO2S) 2 -G108.

- Connect VAG1598/31 test box to wiring harness for engine control module. Do not connect to the engine control module itself ⇒ Page 24-20 .

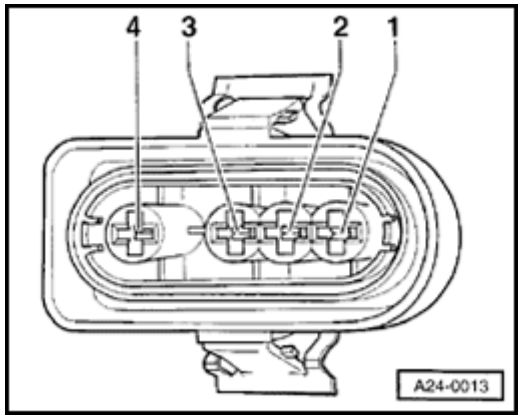


- Check following wiring connections for open circuits:

Connector on wiring harness, socket	VAG1598/31 test box socket
3	12
4	13

Resistance in wiring: max. 1.5 ohm

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*



- Check wiring also on 4-pin harness connector for short circuits to each other.

Connector on wiring harness, socket	VAG1598/31 test box socket
4	12

Specified value: infinite ohms (open circuit)

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Check shielded wire for short circuit to sensor wiring.

Connector on wiring harness, socket	VAG1598/31 test box socket
4	32
3	32

Specified value: infinite ohms (open circuit)

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If no malfunction is identified in the wiring:

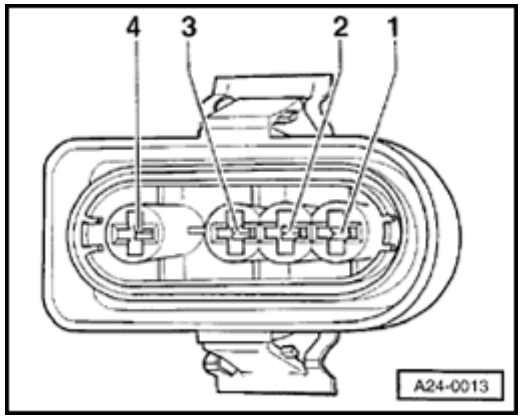
- Replace Motronic Engine Control Module (ECM) -J220 ⇒ Page 24-24 .

Checking wiring for Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) -G131

Component location of 4-pin harness connector of oxygen sensor ⇒ Page 24-5 .

- Disconnect 4-pin connector for Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) -G131

- Connect VAG1598/31 test box to wiring harness for engine control module. Do not connect to the engine control module itself ⇒ Page 24-20 .

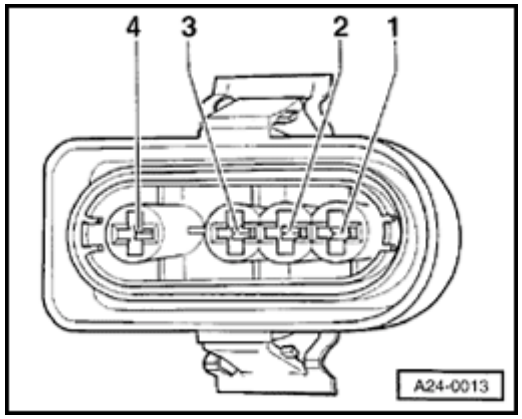


- Check following wiring connections for open circuits:

Connector on wiring harness, socket	VAG1598/31 test box socket
3	10
4	11

Resistance in wiring: max. 1.5 ohm

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*



- Check wiring also on 4-pin harness connector for short circuits to each other.

Connector on wiring harness, socket	VAG1598/31 test box socket
4	10

Specified value: infinite ohms (open circuit)

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Check shielded wire for short circuit to sensor wiring.

Connector on wiring harness, socket	VAG1598/31 test box socket
4	32
3	32

Specified value: infinite ohms (open circuit)

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If no malfunctions are identified in the wiring:

- Replace Motronic Engine Control Module (ECM) -J220 ⇒ Page 24-24 .

24-131

If no malfunction can be identified in the wiring:

- Replace Motronic Engine Control Module (ECM) -J220 ⇒ Page 24-24 .

- Display readiness code ⇒ Page 01-101 . The readiness code must be generated if the DTC memory was erased ⇒ Page 01-105 .

Oxygen sensors, removing and installing

Removing

- Disconnect harness connector of particular oxygen sensor before catalytic converter for bank 1 and bank 2 (component location ⇒ Page 24-5).

- Disconnect harness connector of particular oxygen sensor behind catalytic converter for bank 1 and bank 2 (component location ⇒ Page 24-5).

- Remove particular oxygen sensor with 3337/7 special tool.

- Lower transmission, in order to remove oxygen sensors behind catalytic converter.

⇒ *Repair Manual, 6 Spd. Manual Transmission 01E, Repair Group 34, Transmission removing and installing.*

24-133

When installing observe the following:

Note:

- *The wiring from the oxygen sensor must be fastened at the exact location as previously installed, to avoid contact with exhaust pipe.*
- *The oxygen sensor threads are coated with a tread sealing compound that must not come in contact with the slits in the sensor tip.*
- *Tightening torque: 55 Nm (41 ft lb)*