07.1–1120 Testing electronic diesel system (EDS)

Preceding work:

Operation no. of operation texts and work units or standard texts and flat rates: 07–1120

A. Engine 602.96, Model 201 (USA) Federal Model Year 1987
B. Engine 603.96, Models 124 and 126 (USA) Federal and California Model Year 1986/87
C. Engine 603.96, Model 124 (J) Model Year 1988
D. Engines 602.96 and 603.96, Models 124 and 201 (A) (J) Model Year 1989
E. Engines 602.96 and 603.96 (A) Model Year 1990 and (FIN) Model Year 1991
F. Engines 602.962 and 603.970, (USA) Model Year 1990
G. Engines 602.96 and 603.96, Models 124 and 201 Basic Version Code 62/0, (A) (FIN) (CH) (DK) (J) (USA) as of Model Year 1992
H. Engine 603.971, Model 140 (USA) Model Year 1992

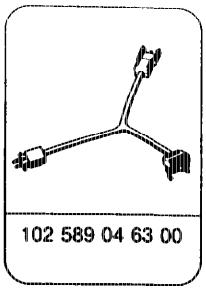
Test conditions

- Coolant temperature approx. 80 °C
- Air conditioner: **OFF**
- Selector lever position "P"
- Fuse at overvoltage protection relay or base module (engine 603.971) in order
- Battery voltage approx. 12 volts at overvoltage protection between contacts 1 and 5 or engine 603.971 battery voltage approx. 12 V at EDS control unit between contact 1 and contact 14.

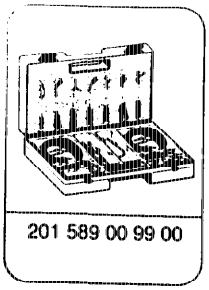
Note engine 603.971

Before reading the stored faults by means of the pulse output, the battery must on no account be disconnected, base module and EDS control unit (N39) must on no account be unplugged.

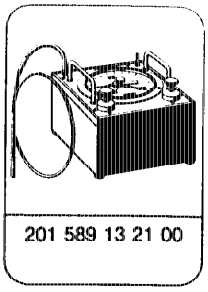
Special tools



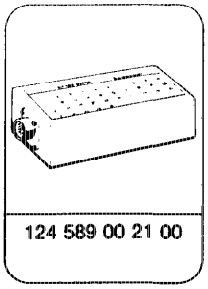
102 589 04 63 00



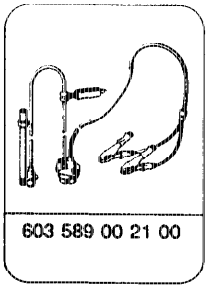
201 589 00 99 00



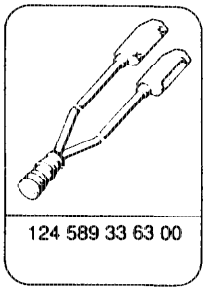
201 589 13 21 00



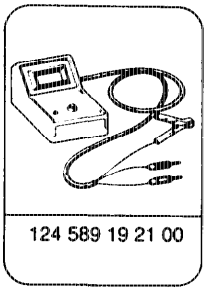
124 589 00 21 00



603 589 00 21 00



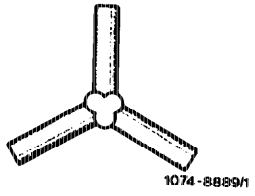
124 589 33 63 00



124 589 19 21 00

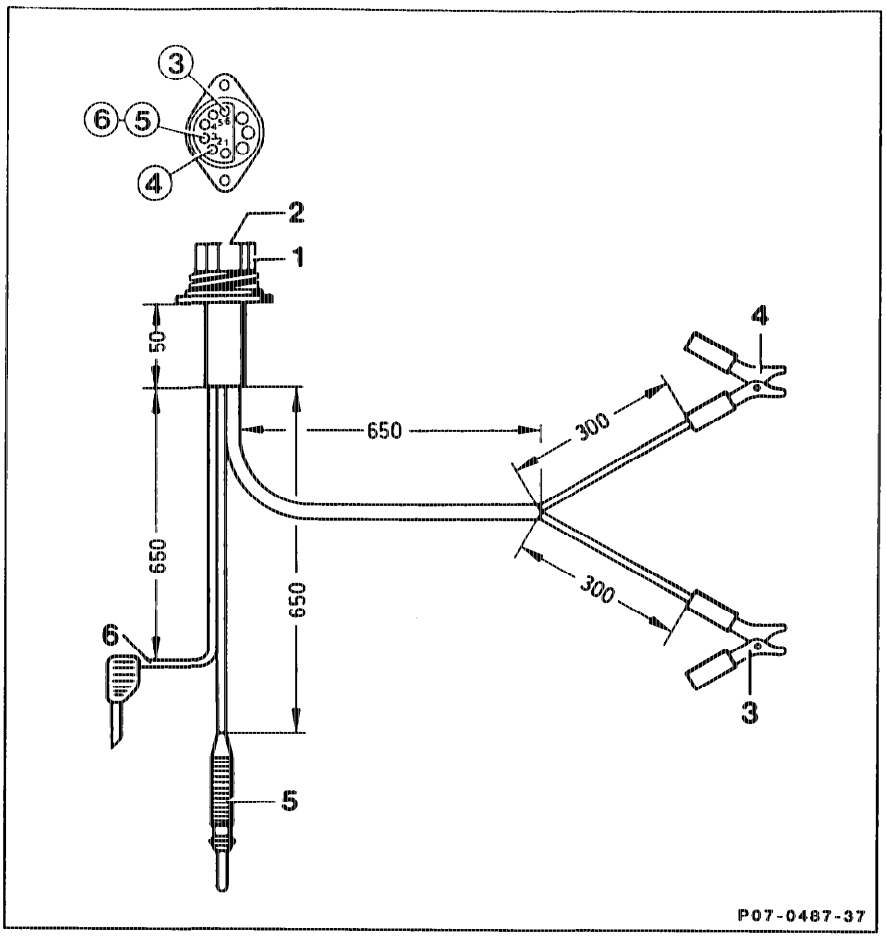
Commercially available tools

Designation	e. g. make, order no.
Multimeter	Sun, DMM-5
Digital testers	Sun, EMT-1019/Master 3 Sun, DIT 9000, DMA1000 Sun, MEA 1500 All-Test, 3610-MB Hermann 421, MO941, D960 Bosch, MOT 002.01, MOT 103, 301/401
Y distributor	117 078 01 45
Lambda control tester	Bosch KDJE-P600 Hermann L 115



Test cable
shop-made

Test cable (X11)



Pin assignment of test socket
Position 3 to jack 6
Position 4 to jack 2
Position 5 to jack 3
Position 6 to jack 3

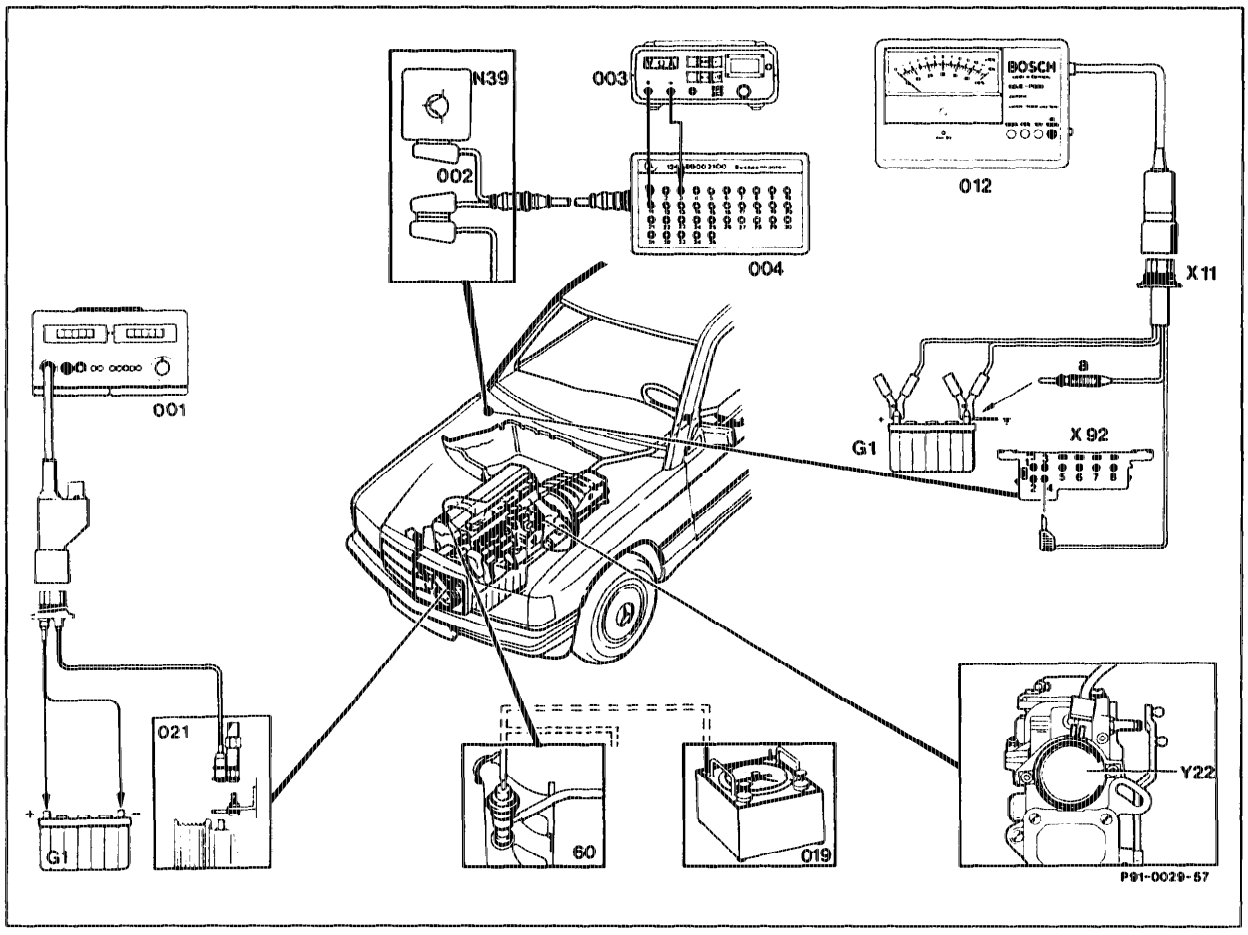
Scope of parts

Position	Designation	Part no.	Quantity/dimension
1	Test socket	123 545 00 26	1
2	Jacks	001 545 28 26	3
--	Cable	Commercial	Length as per drawing
3	Terminal, red	Commercial	1
4	Terminal, black	Commercial	1
5	Connector	Commercial	Ø 4.8 mm
6	Connector	Commercial	Ø 4 mm

A. Engine 602.96, Model 201 (USA) Federal Model Year 1987

a) Short-test
b) Testing components
c) Testing electronic idle speed control

a) Short-test



Digital tester (001) and pulse counter (021) . . . . . connect, disconnect.

Lambda control tester (012) . . . . . connect to battery (G1) and test connector (X92).
Connect, disconnect, press 100 % IR switch.

Contact box (004)	connect, disconnect with test cable (002) to EDS control unit (N39).
Vacuum tester (019)	connect, disconnect with Y distributor at ARF valve.
Digital tester (003)	connect to contact box (004), disconnect.
Fuse at overvoltage protection (K1/1)	test.
Selector lever	move into position "P".
Air conditioning/automatic climate control	switch off.
Engine	bring to operating temperature (coolant temperature to 80 °C).

Note
When performing the test work, the air intake hose between the air flow sensor and exhaust gas turbocharger must be fitted, otherwise no signal will pass from the air flow sensor to the EDS control unit (N39).

Connector "a"	hold approx. 1 second to battery ground 100 % readout.
Connector "a"	take off. 0 % readout, no fault in system. Readout fluctuates, fault in system (refer to troubleshooting table).

Note
One pulse = 0 % – 100 % – 0 %.

The number of pulses indicates which electrical component is faulty.

Repeat test until there are no further pulses displayed.

Troubleshooting table

Fault readout	Component or circuit not operating
1	Engine speed sensor (L3)
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1) electrical faults
4	Altitude sensor (B18)
5 [1])	Exhaust control circuit, electrical and mechanical faults a. Exhaust gas recirculation valve ARF (60) b. Vacuum transducer (Y31/1) c. Air flow sensor (B2/1)
8	Coolant temperature sensor (B11/4)
9	Intake air temperature sensor in air flow sensor (B2/1a)
10	Reference resistor (R18/2) exhaust gas recirculation (ARF)
11	Resistance trimming plug (R18/1) idle speed control (ELR)

[1]) Hold readout only at 1200/min for at least 5 seconds, otherwise no readout.

Double connector of ELR solenoid Y22	disconnect and fit on again (at least 3 seconds). Engine speed increases briefly.
Engine	run engine at approx. 1200/min and approx. 250 mbar. Briefly apply full throttle. Vacuum drops to 0 mbar.
Engine	switch off.
ARF valve	pressurize ARF valve with approx. 300 mbar vacuum. ARF valve is heard to close.

b) Testing components

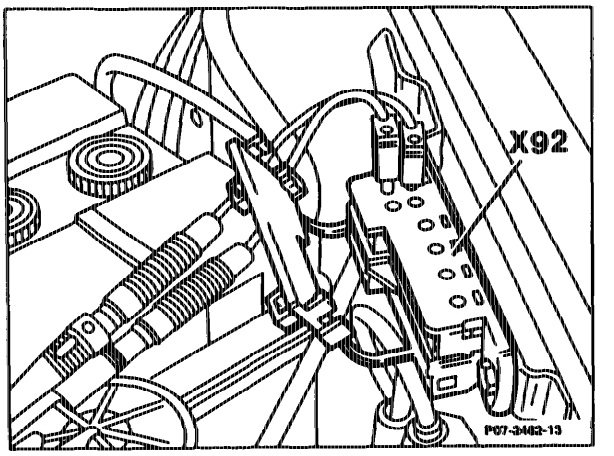
Fault readout "1"

Testing engine speed signal
Connect multimeter to test connector (X92), jacks 1 and 2. Press button "V~". Engine idling.

Readout: >2.8 V~

Yes	No

End of test



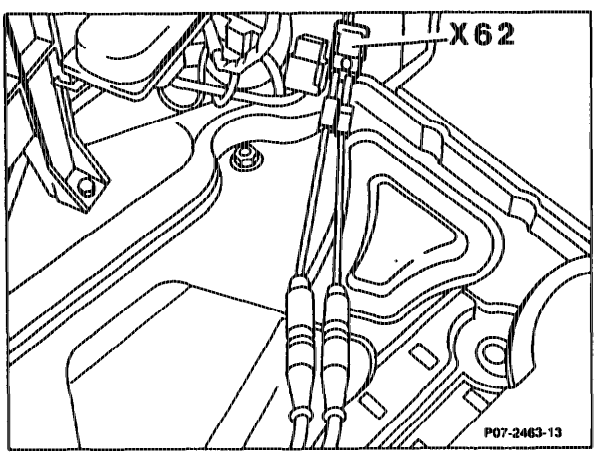
Engine switched off. Separate plug connection (X62). Connect multimeter to speed sensor plug connection (X62) and press button "Ω". Test resistance.

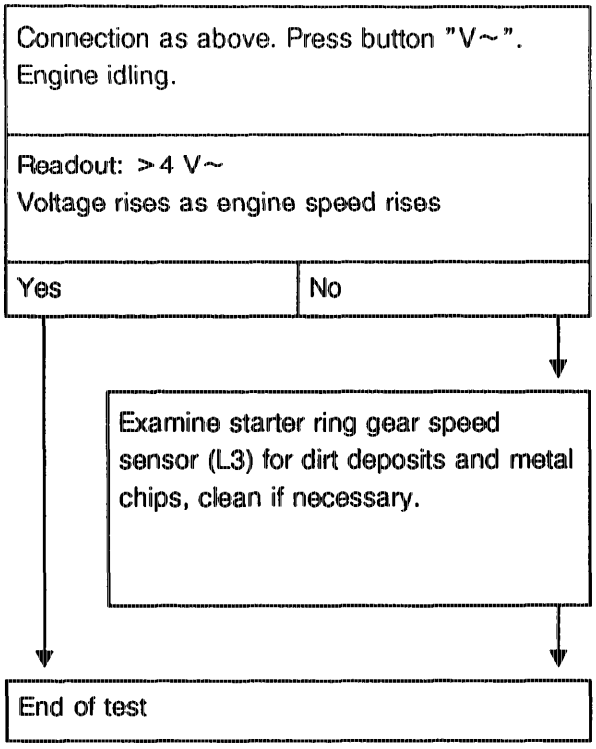
Readout: 0.4–2.5 kΩ

Yes	No

Replace starter ring gear speed sensor (L3)

End of test



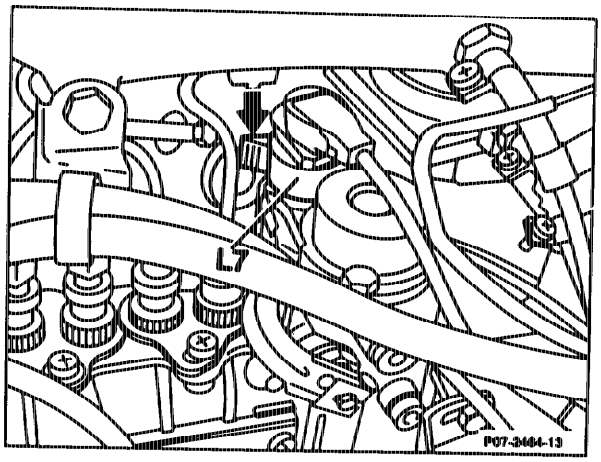

Connection as above. Press button "V~".
Engine idling.
Readout: >4 V~
Voltage rises as engine speed rises
Yes
No
Examine starter ring gear speed sensor (L3) for dirt deposits and metal chips, clean if necessary.
End of test

Fault readout "2"

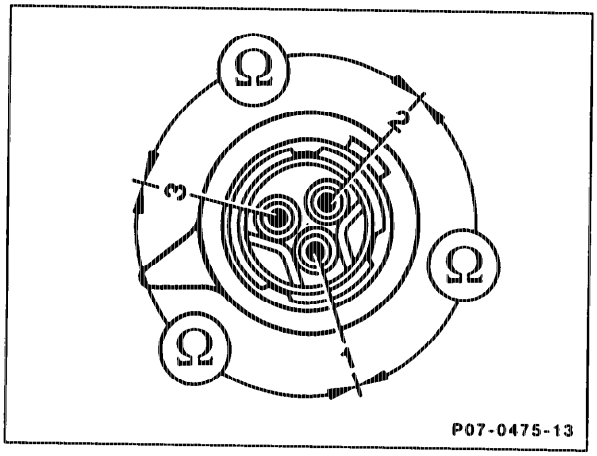
Testing control rod travel sensor (L7)
Engine switched off. Turn anti-twist lock (arrow) counter-clockwise and detach connector on the injection pump. Press multimeter button "Ω". Test resistance according to drawing.

Readout:
Terminals 1 and 2 = approx. 25 ± 2 Ω
Terminals 1 and 3 = approx. 25 ± 2 Ω
Terminals 2 and 3 = approx. 50 ± 2 Ω

Yes | No



Renew injection pump.

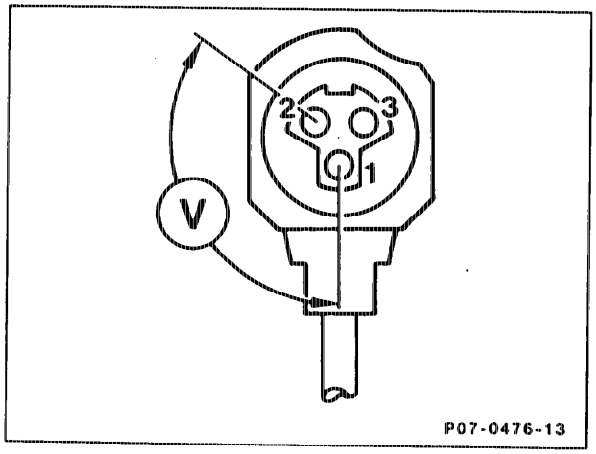


Engine switched off. Ignition on
Press multimeter button "V=". Measure voltage between the jacks 1–2.

Readout approx. 10 volts

Yes | No

Rectify interrupt according to wiring diagram.
Renew control unit (N39).



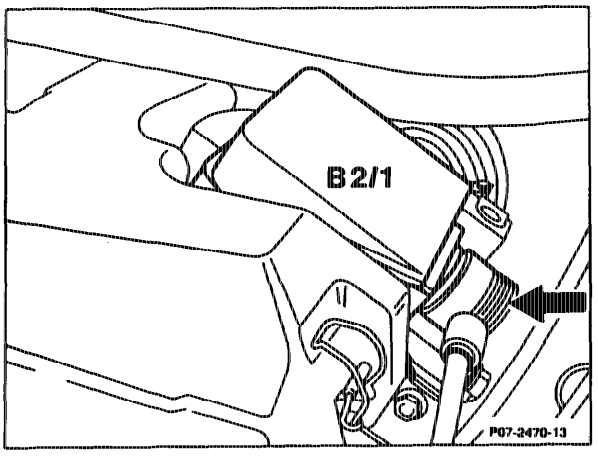
End of test

Testing airflow sensor potentiometer (B2/1)
Engine switched off. Detach connector (arrow) from airflow sensor. Multimeter button "Ω". Measure resistance between jacks 1 and 3 on airflow sensor.

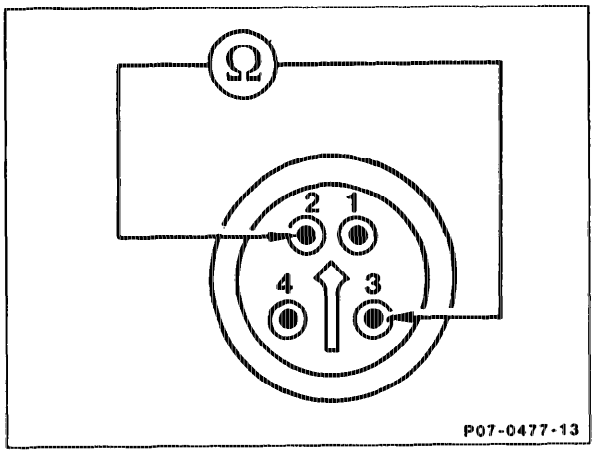
Readout:
airflow sensor plate in idle position = approx. 50–200 Ω

airflow sensor plate fully deflected = approx. 560–1100 Ω

Yes	No



Examine airflow sensor plate for ease of movement and fouling. Renew airflow sensor if necessary.

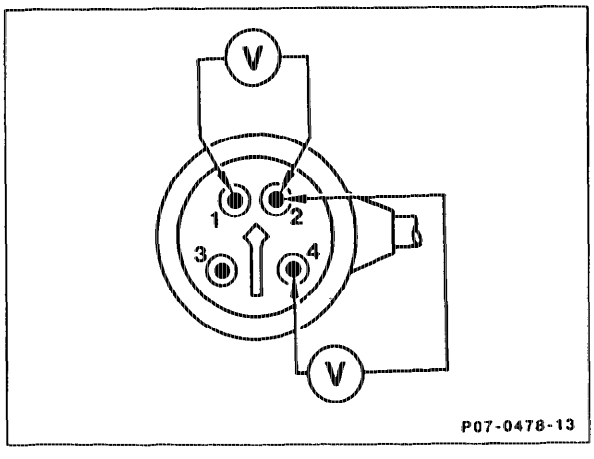


Engine switched off ignition: ON. Press multimeter button "V=". Measure voltage between jacks 1 and 2 or 2 and 4, resp.

Readout: approx. 5 volts

Yes	No

Rectify interrupt according to wiring diagram
Renew control unit (N39).



End of test

Note
If airflow sensor removed, also perform "Testing air temperature sensor (B2/1a)" (Fault readout 9).

Testing altitude sensor (B18)
Engine switched off. Ignition key in position "2". Press multimeter button "V= ". Measure voltage between jacks 1 – 2.

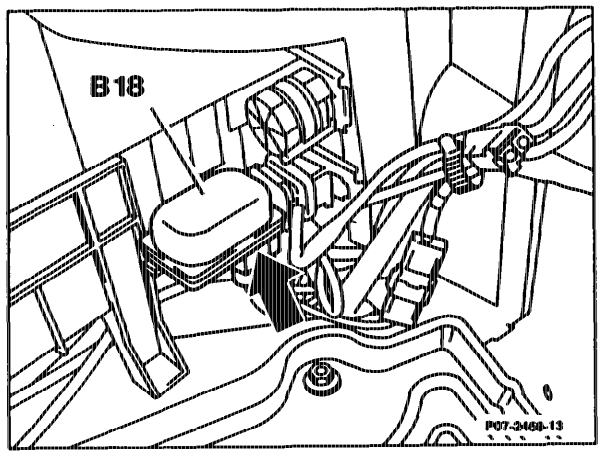
Readout: approx. 5 volts

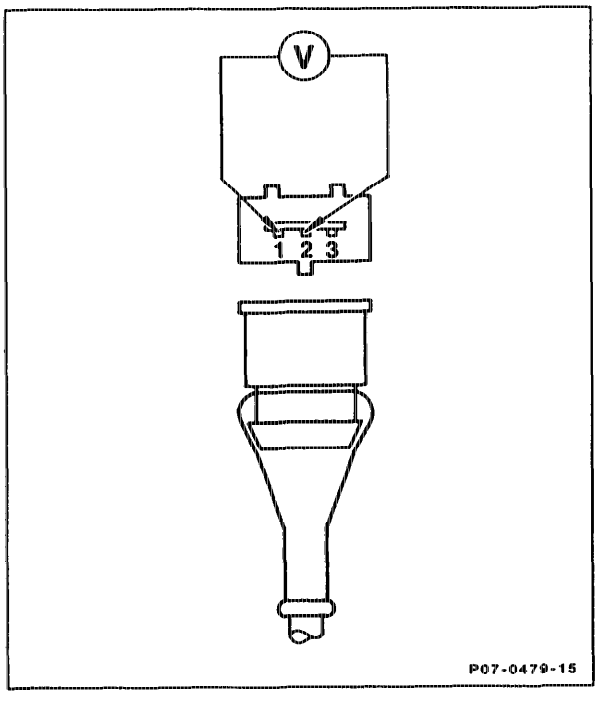
Yes	No

Rectify interrupt according to wiring diagram.
Renew control unit (N39) if necessary.

Renew altitude sensor.

End of test





Testing exhaust control circuit

a) **Test ARF valve (60) when engine not running**

Pressurize ARF valve approx. 300 mbar vacuum. Detach vacuum line.

ARF valve is heard and felt to close.

Yes	No

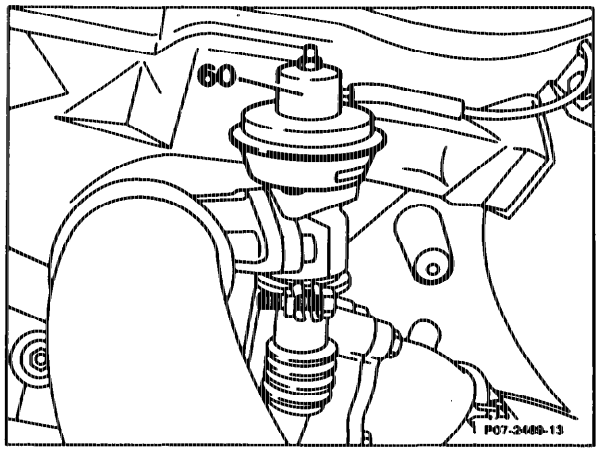
Remove ARF valve and pressurize vacuum tester with approx. 520 mbar.

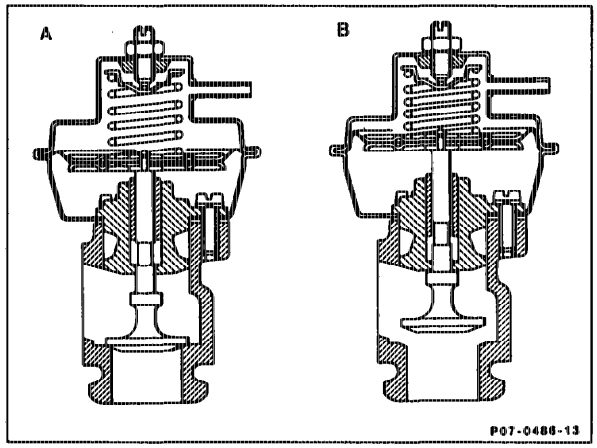
ARF valve rises approx. 5 mm off its seat (end stop).

Detach vacuum line. ARF valve must be heard to close.

If one of these test steps is not reached, renew ARF valve.

End of test





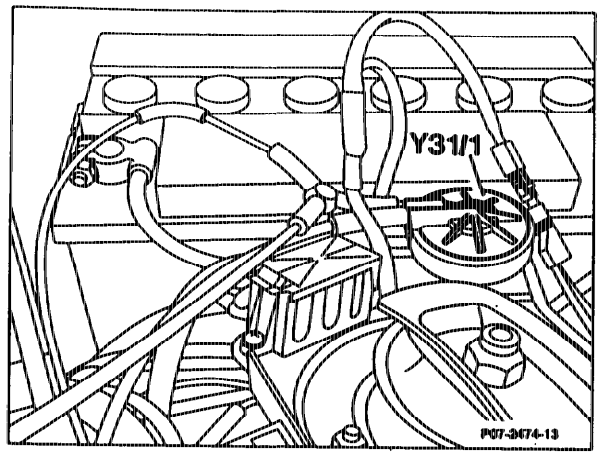
A closed
B open

b) Testing vacuum transducer (Y31/1)

Connect vacuum tester with Y distributor to vacuum transducer (Y31/1). Connect multimeter with test cable to transducer (Y31/1). Press button "A". Increase engine speed until approx. 250 mbar is reached.

Note

Ensure that connector of vacuum transducer (Y31/1) is correctly connected.



Refer to diagram for specified values.
Example: 250 mbar = 400–500 mA

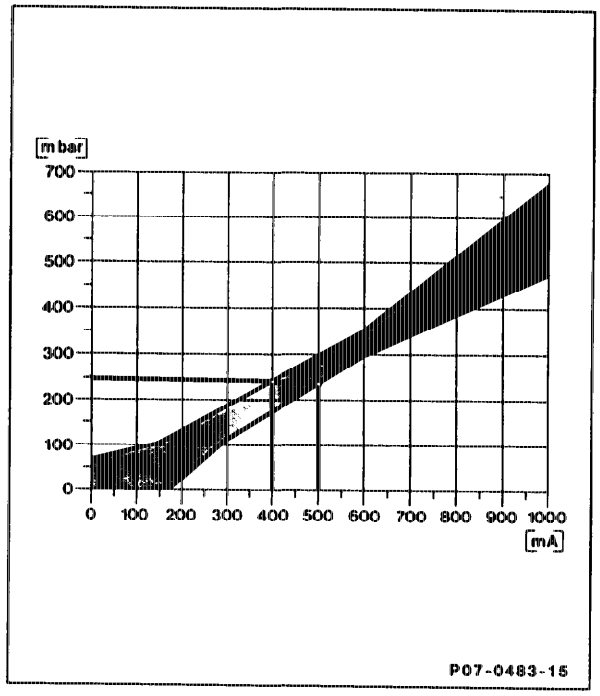
Current at vacuum transducer

0 mA too low too high

Check that air admission line (black) and filter are clear.

Check that supply line (blue) is clear. Check whether there is an interruption in vacuum line (white/purple/brown) between transducer and ARF valve. If vacuum line and vacuum are in order, renew vacuum transducer (Y31/1).

End of test



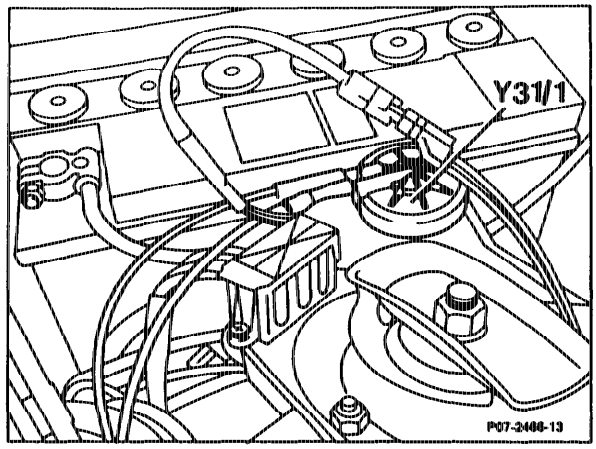
Engine switched off. Glow start switch in position "2". Detach double connector on ARF vacuum transducer (Y31/1), and measure voltage with multimeter button "V=".

Readout: approx. 12 volts

Yes	No

Rectify interrupt according to wiring diagram. Renew control unit (N39), if necessary.

End of test

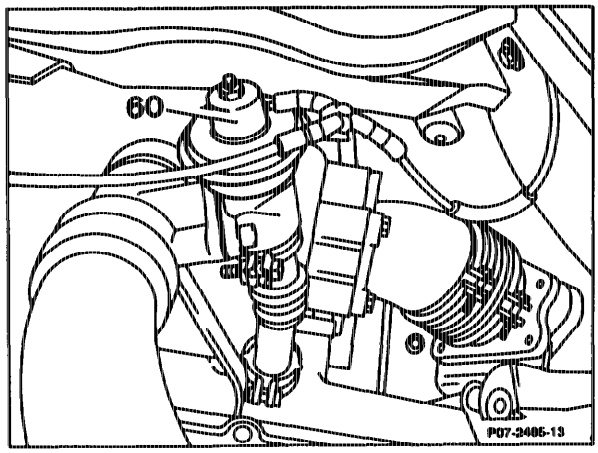


Connect vacuum tester with Y distributor to ARF valve (60). Take reading of vacuum at 850/min. Accelerate briefly, vacuum drops.

Yes	No

Renew vacuum transducer (Y31/1). Check mechanical operation of air flow sensor (B2/1) (refer to section "c"). If these components are in proper order, renew control unit (N39).

End of test



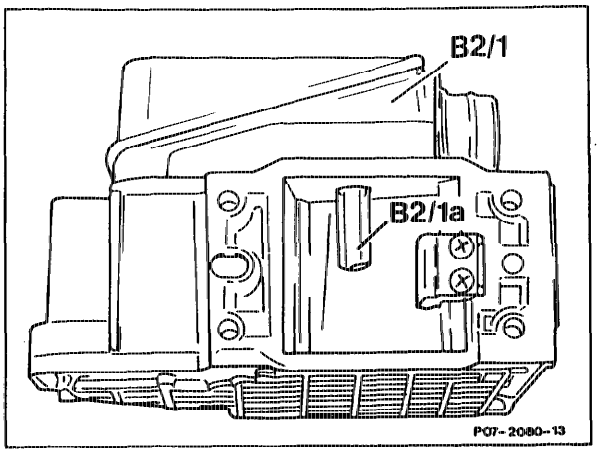
c) **Mechanical check of air flow sensor (B2/1).**

Check ease of operation of air flow sensor flap. Air flow sensor flap must not stick.

Yes	No

Renew air flow sensor (B2/1).

End of test

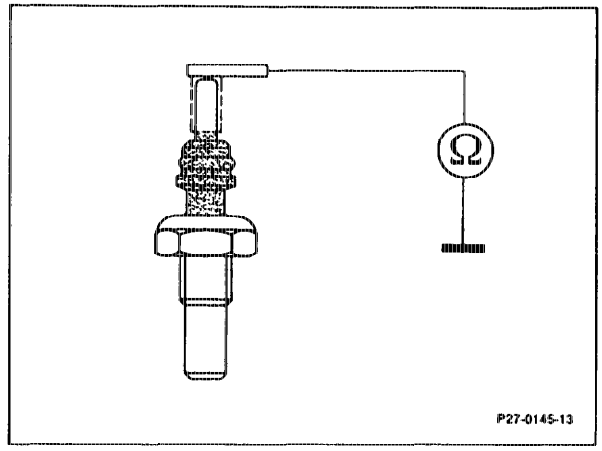


Testing coolant temperature sensor (B11/4)
Engine switched off. Detach connector at coolant temperature sensor. Test resistance to ground with multimeter position "Ω".

Refer to diagram of "coolant temperature sensor and intake air" for specified value.

Yes	No

Renew temperature sensor (B11/4)

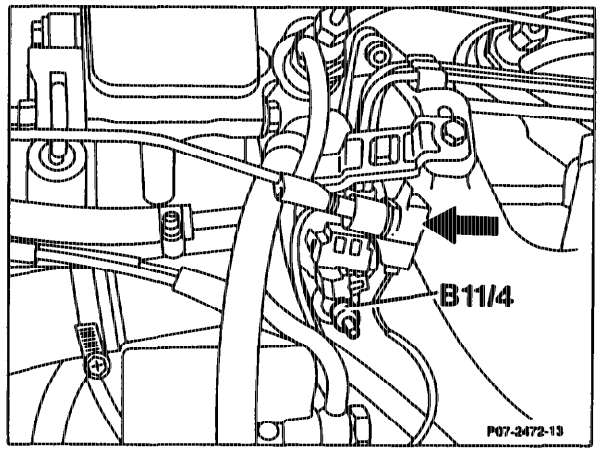


Test voltage at 1-pin connector (arrow) with multimeter in position "volts".
Ignition: ON.

Readout: approx. 5 volts

Yes	No

Rectify interrupt according to the wiring diagram. Renew control unit (N39).



End of test

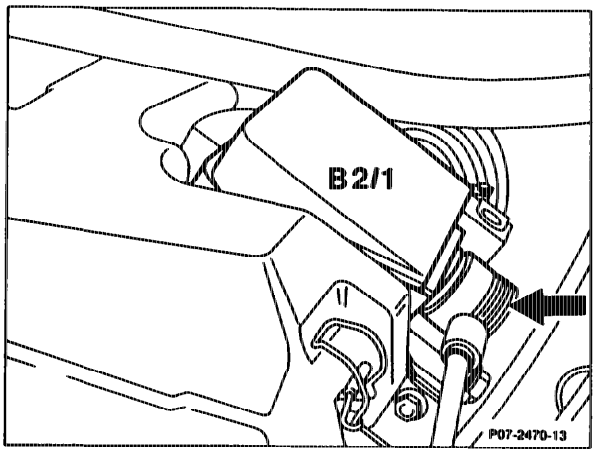
Testing air temperature sensor (B2/1a)
Engine switched off. Detach connector (arrow) from air flow sensor. Multimeter button "Ω". Test resistance according to table.

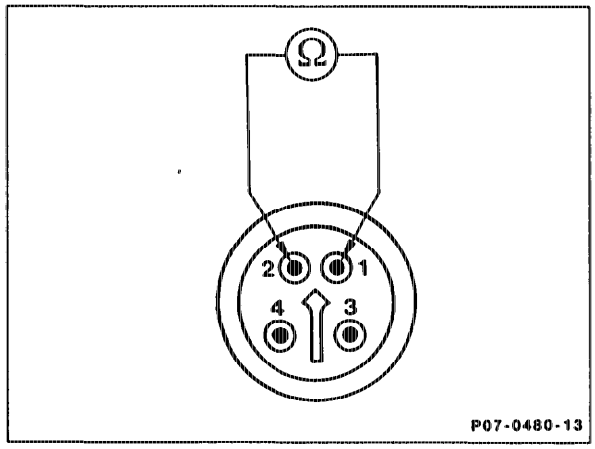
Refer to diagram for specified value.

Yes	No

Renew air flow sensor.

End of test





Coolant temperature sensor and intake air

Temperature in °C	Resistance (±10%)	Voltage in V (±10%)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

Testing reference resistor (R18/2)
Detach reference resistor. Switch off engine. Ignition: **ON**. Press multimeter button "V = ". Check voltage.

Readout: approx. 5 volts

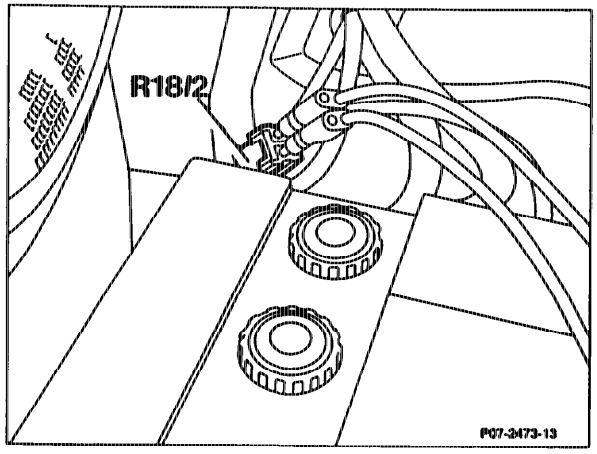
Yes	No

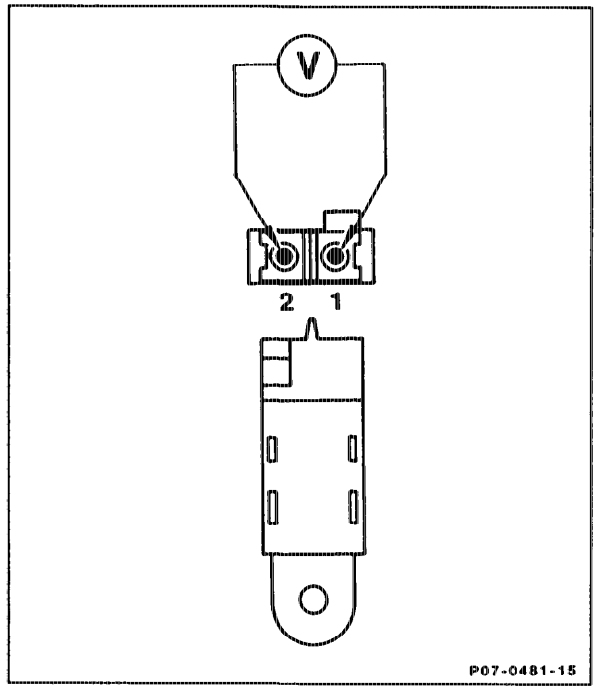
Rectify interrupt according to wiring diagram.

Renew reference resistor (R18/2).

End of test

Note
When renewing the reference resistor (R18/2), fit only plug with an identical part no.





Testing ELR resistance trimming plug (R18/1)
Detach resistance trimming plug. Engine switched off. Ignition: ON. Press multimeter button "V=". Check voltage.

Readout: approx. 5 volts

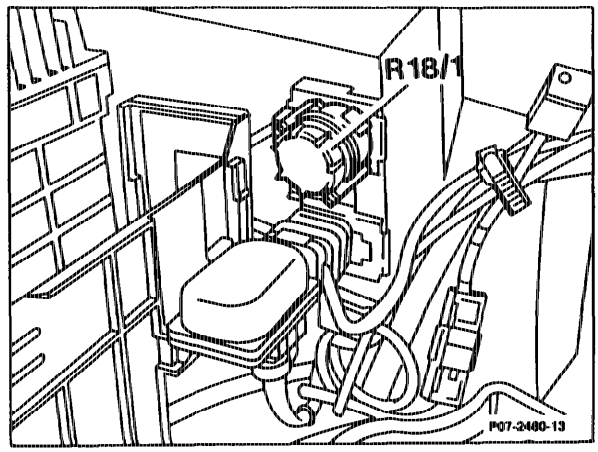
Yes	No

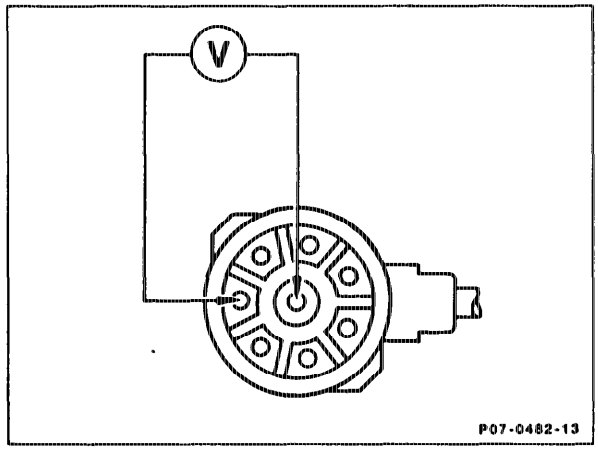
No → Rectify interrupt according to wiring diagram. Renew control unit (N39).

Yes → Renew ELR resistance trimming plug.

End of test

Note
The resistance trimming plug ELR (R18/1) is installed in position "4".





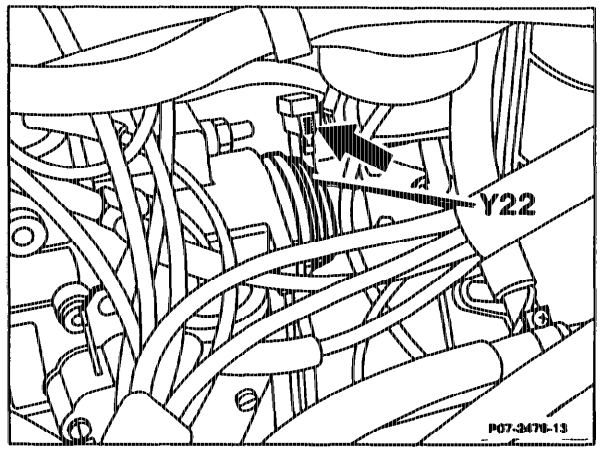
c) Testing electronic idle speed control

Testing idle speed control

Engine idling. Detach double connector (arrow) at actuator (Y22) for at least 3 s and fit on again.

When connecting, idling speed briefly increases.

Yes	No

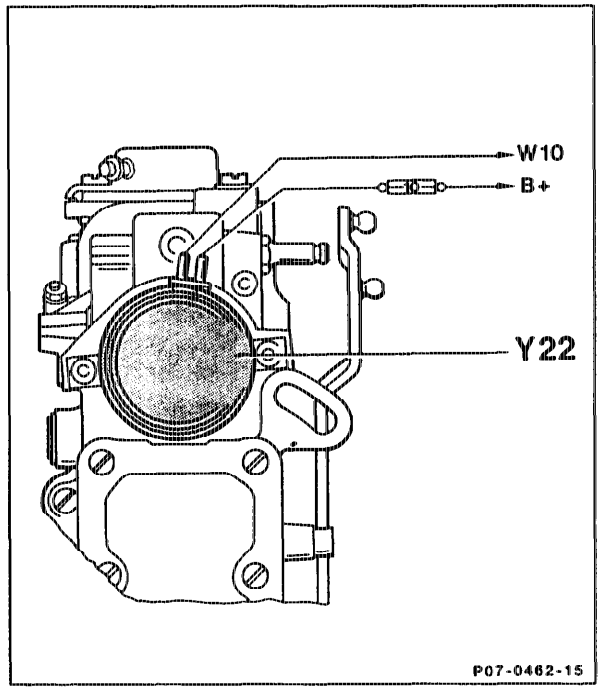


Briefly (max. 3 s) apply battery voltage (approx. 12 V) to actuator (Y22).

Note
Actuator (Y22) is damaged if battery voltage is applied for longer than 3 s.

Engine speed increases.

Yes	No

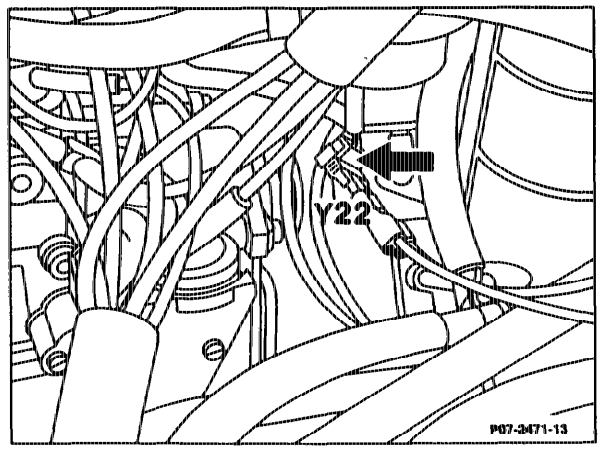


Renew actuator.

Engine idling. Detach double connector (arrow) at actuator (Y22) and measure voltage with multimeter button "V".
Measure voltage.

Display approx. 12 volts

Yes	No



Test resistance trimming plug ELR (R18/1).
Rectify interrupt according to wiring diagram.
Renew EDS control unit (N39), if necessary.

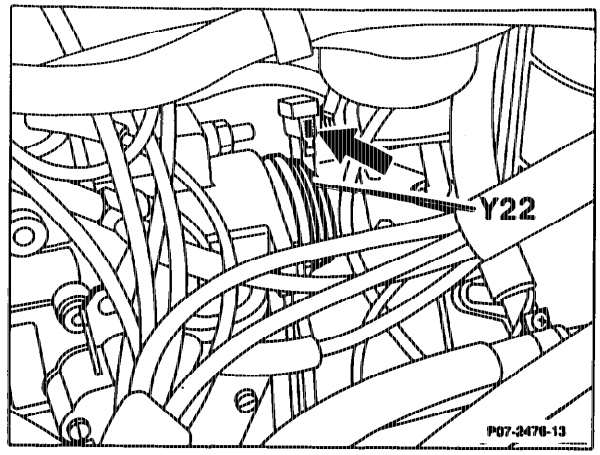
Engine idling. Detach double connector at actuator (Y22). Test idling speed.

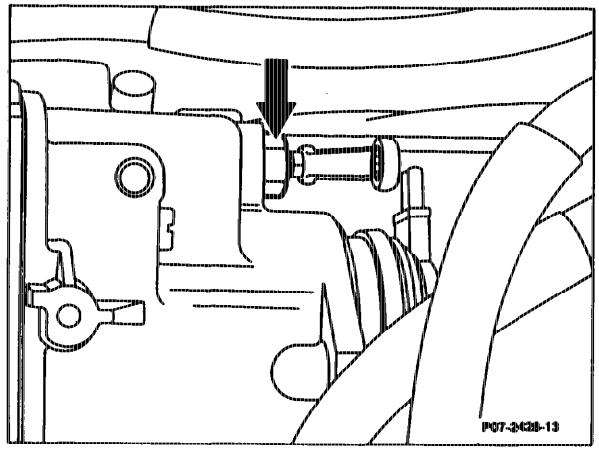
Specification: 620 ± 40/min

Yes	No

Set idling speed. Slacken locking nut (arrow) for this step.

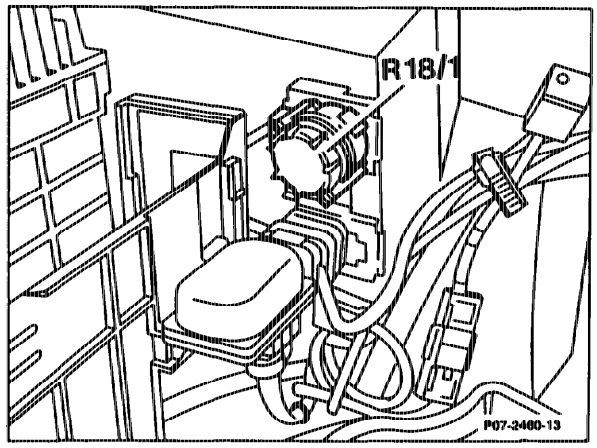
End of test





Setting idling speed by means of resistance trimming plug (R18/1)
If complaints are received regarding idling, idling speed can be altered.

The positions of the resistance trimming plug are listed in the table below.

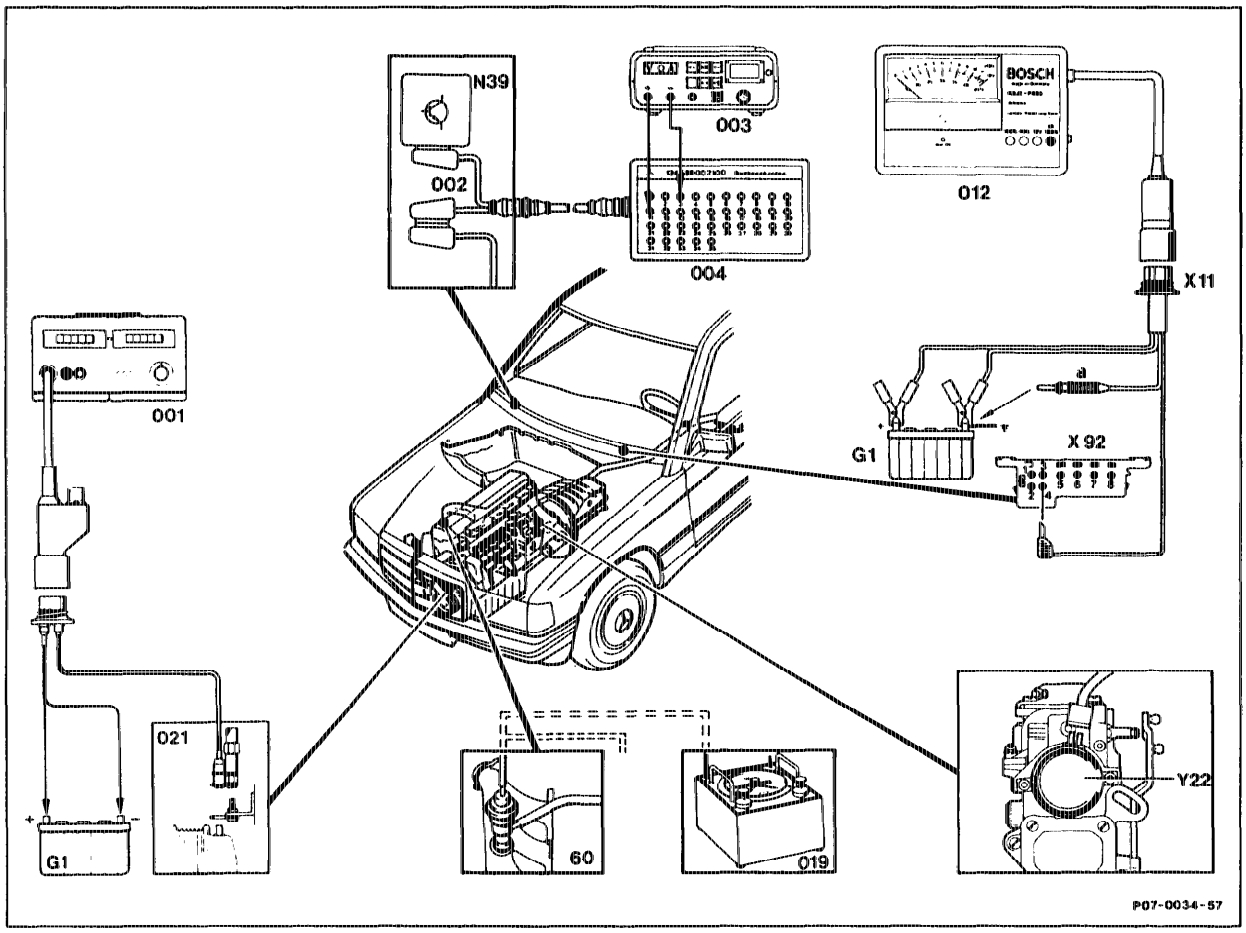


Position of resistance trimming plug	Idling speed rpm
1	610 ± 20
2	630 ± 20
3	650 ± 20
4	680 ± 20
5	700 ± 10
6	720 ± 20
7	740 ± 20

B. Engine 603.96, Models 124 and 126 (USA) Federal and California Model Year 1986/87

a) Short-test
b) Testing components
c) Testing electronic idle speed control

a) Short-test



Digital tester (001) and pulse counter (021)	connect, disconnect.
Lambda control tester (012)	connect, disconnect to battery (G1) and with adaptor to test connector (X92).
Contact box (004)	connect, disconnect with test cable (002) to EDS control unit (N39).
Vacuum tester (019)	connect, disconnect with Y distributor at ARF valve.
Digital multimeter (003)	connect, disconnect to contact box (004).
Fuse at overvoltage protection (K1/1)	test.
Selector lever	move into position "P".
Air conditioning/automatic climate control	switch off.
Engine	bring to operating temperature (Coolant temperature approx. 80 °C)
	Note When performing the test work, the air intake hose between the air flow sensor and exhaust gas turbocharger must be fitted, otherwise no signal will pass from the air flow sensor to the control unit (N39).
Connector "a"	hold approx. 1 second to battery ground; 100 % readout.
Connector "a"	take off; 0 % readout, no fault in system. Readout fluctuates, fault in system (refer to troubleshooting table).
	Note One pulse = 0 % – 100 % – 0 %
	The number of pulses indicates which component is defective.
	Repeat test step until no further pulses are displayed.

Troubleshooting table

Fault readout	Component or circuit not operating
1	Engine speed sensor (L3)
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1) electrical faults
4	Altitude sensor (B18)
5 [1])	Exhaust gas control circuit, electrical and mechanical faults a. Exhaust gas recirculating valve ARF (60) b. Vacuum transducer ARF (Y31/1) c. Air flow sensor (B2/1) d. Test recirculating air valve (137b) e. Test vacuum transducer, recirculating air valve (Y31)
8	Coolant temperature sensor (B11/4)
9	Air temperature sensor in air flow sensor (B21a)
10	Reference resistor (R18/2) exhaust gas recirculation (ARF)
11	Resistance trimming plug (R18/1) idle speed control (ELR)

[1]) Hold readout only at 1200/min for at least 5 seconds, otherwise no readout.

Double connector	connect, disconnect to ELR actuator Y22 (at least 3 seconds).
	Engine speed increases briefly.
Engine	run at approx. 1200 rpm and set approx. 250 mbar vacuum. Briefly apply full throttle. Vacuum drops to 0 mbar.
Engine switched off, pressurize ARF valve	with approx. 300 mbar vacuum and pull off further.
	ARF valve is heard to close.

b) Testing components

Fault readout "1"

Testing engine speed signal

Connect multimeter to test connector (X29/4) jacks 1 and 2. Set multimeter to "V~". Engine idling.

Readout: > 2.8 V~

Yes	No

→ End of test

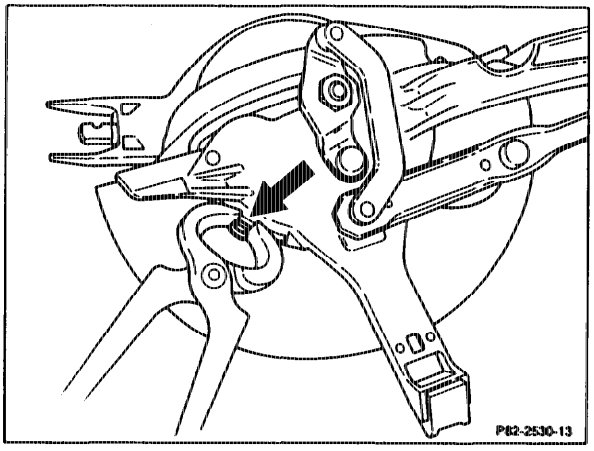
Engine switched off. Separate plug connection (X62). Connect multimeter and press button "Ω". Test resistance.

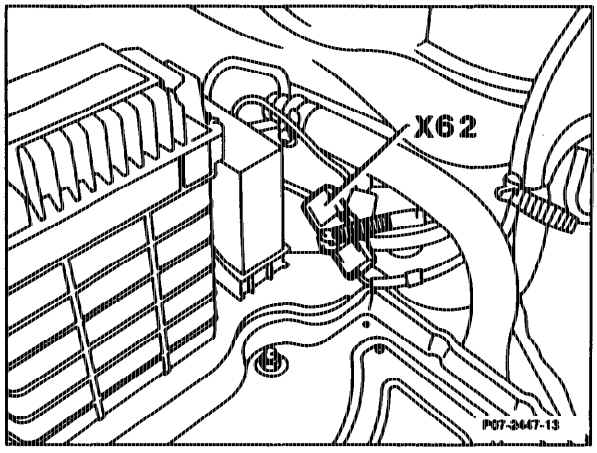
Readout: 0.4–2.5 kΩ

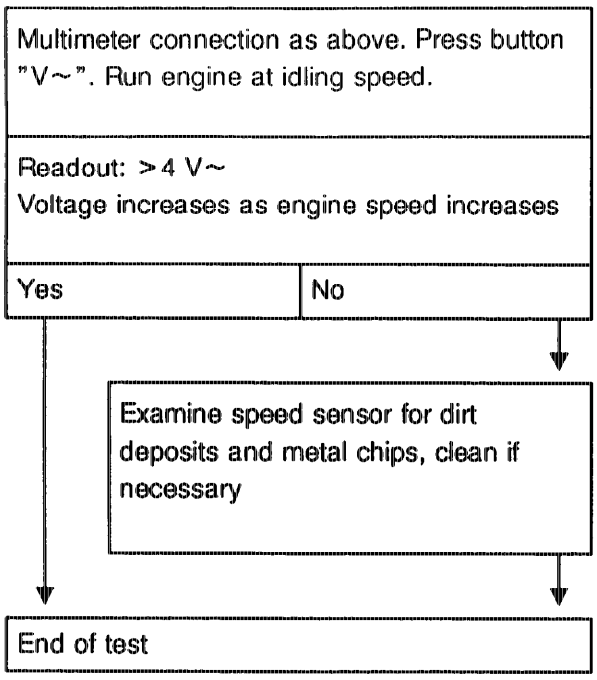
Yes	No

→ Renew speed sensor (L3).

→ End of test






Multimeter connection as above. Press button "V~". Run engine at idling speed.
Readout: > 4 V~
Voltage increases as engine speed increases
Yes
No
Examine speed sensor for dirt deposits and metal chips, clean if necessary
End of test

Fault readout "2"

Testing control rod travel sensor (L7)
Engine switched off. Turn anti-twist lock to the left (arrow). Detach connector on the injection pump. Press multimeter button "Ω".
Test resistance.

Readout:
Terminals 1 and 2 = approx. 25 ± 2 Ω
Terminals 1 and 3 = approx. 25 ± 2 Ω
Terminals 2 and 3 = approx. 50 ± 2 Ω

Yes	No

→ Renew injection pump.

Engine switched off. Ignition on. Press button "V=" on multimeter.
Test voltage between terminals 1 and 2 on control rod travel sensor.

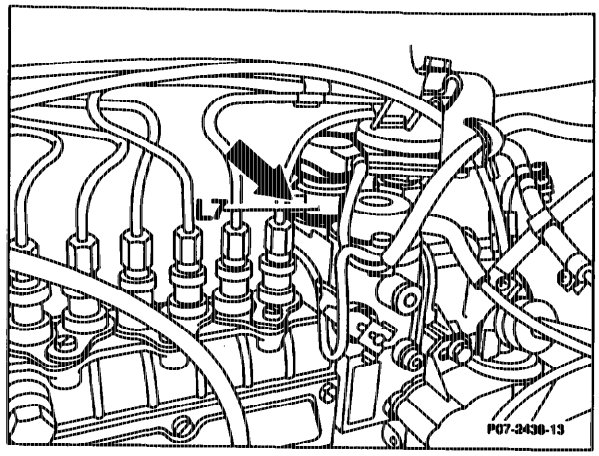
Readout approx. 10 volts

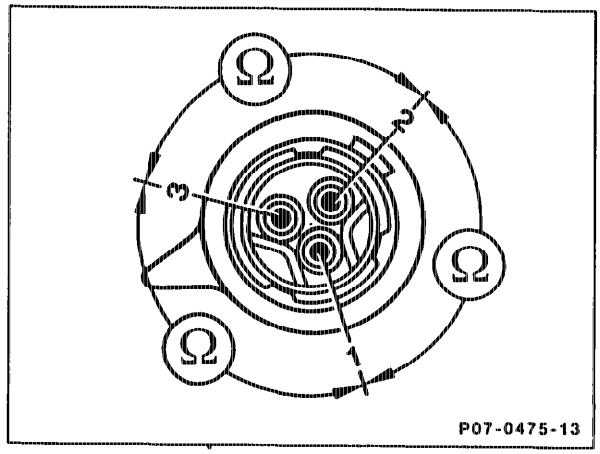
Yes	No

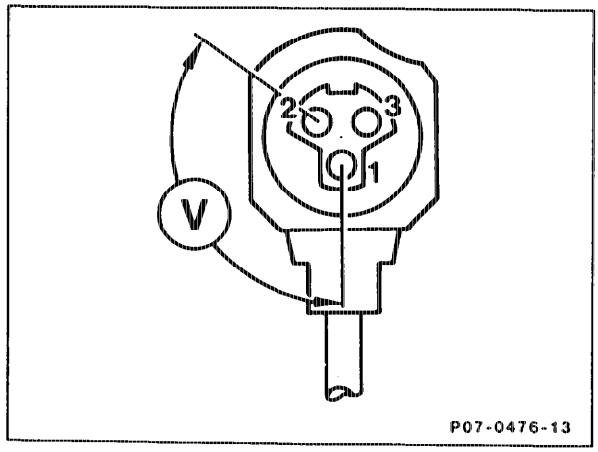
→ Rectify interrupts according to wiring diagram.
Renew EDS control unit (N39) if necessary.

End of test

Note
Renew EDS control unit, if fault readout "2" continues to be displayed.





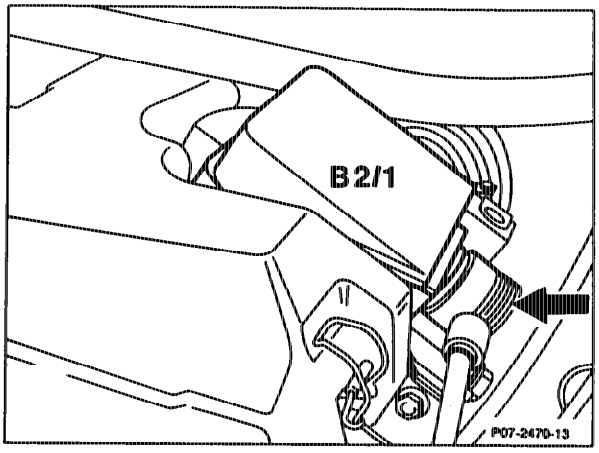


Testing air flow sensor potentiometer (B2/1)
Engine switched off. Detach connector (arrow) from air flow sensor potentiometer. Press multimeter button "Ω". Measure resistance between terminals 2 and 3 on the air flow potentiometer.

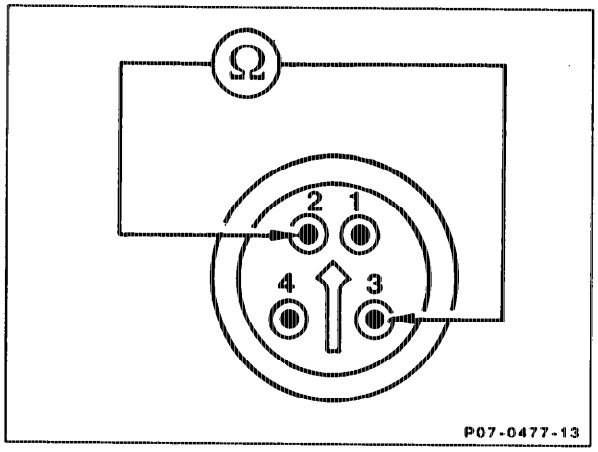
Specification:
Air flow sensor plate in idle position = approx. 50–200 Ω

Air flow sensor plate fully open = approx. 560–1100 Ω

Yes	No



Examine air flow sensor plate for dirt deposits and signs of jamming.
Renew air flow sensor potentiometer if necessary.

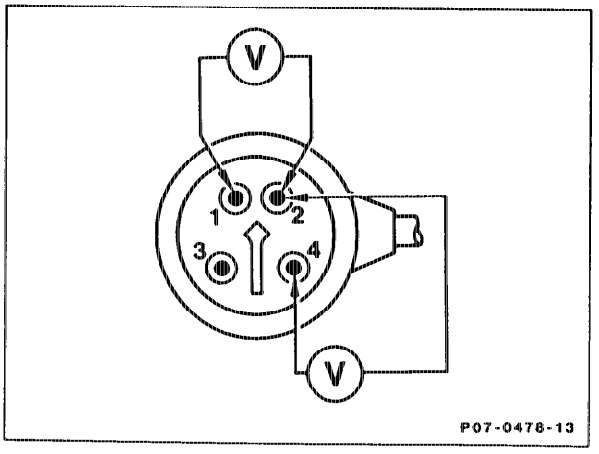


Engine switched off. Ignition: ON. Press multimeter button "V=". Measure voltage between terminals 1 and 2 or 2 and 4, respectively.

Readout: approx. 5 volts

Yes	No

Rectify interrupt according to wiring diagram.
Renew control unit (N39).



End of test

Note
If air flow sensor potentiometer has been removed, also perform "Testing air temperature sensor (B2/1a)" (fault readout 9).

Testing altitude sensor (B18)
Engine switched off. Steering lock in position "2". Detach connector (arrow) from altitude sensor. Press button "V=" on multimeter and test voltage between terminals 1 and 2 on connector for altitude sensor.

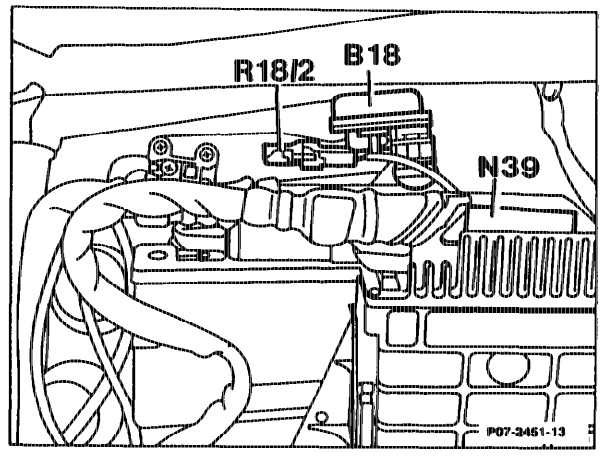
Readout: approx. 5 volts

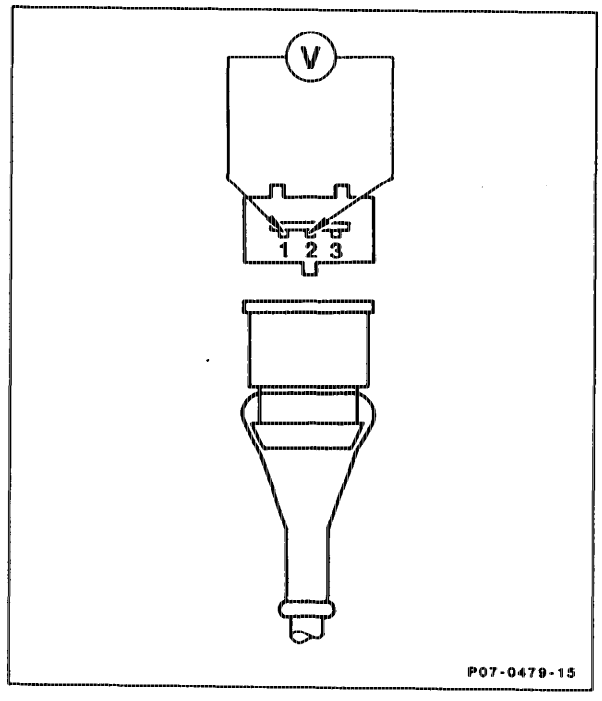
Yes	No

Rectify line interrupt according to wiring diagram. Renew EDS control unit (N39), if required.

Renew altitude sensor (B18).

End of test





Testing exhaust control loop

a) Testing ARF valve (60) when engine not running.

Pressurize ARF valve with approx. 300 mbar vacuum. Detach vacuum line.

ARF valve closes audibly and detectably.

Yes	No

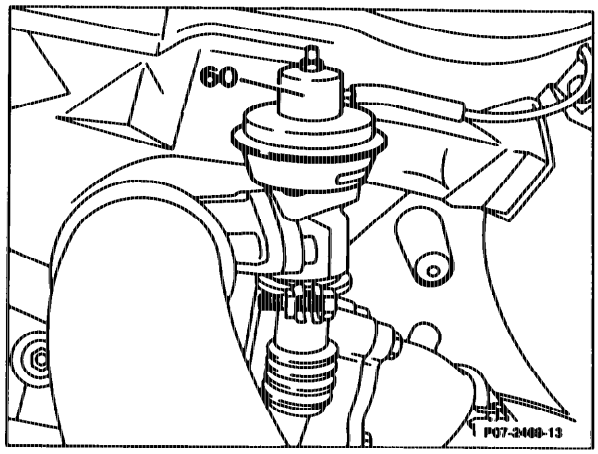
Remove ARF valve and pressurize with approx. 520 mbar with vacuum tester.

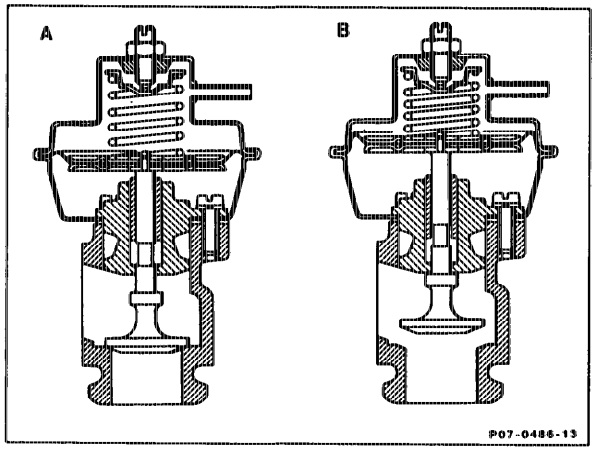
ARF valve lifts approx. 5 mm off seat (end stop).

Detach vacuum line. ARF must close audibly.

If one of these test steps is not achieved, renew ARF valve.

End of test





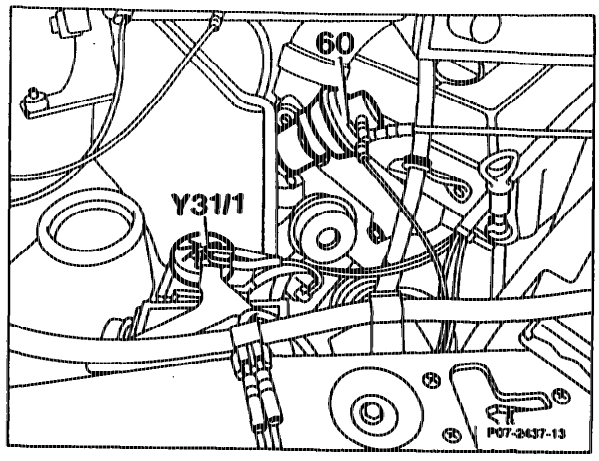
A closed
B open

b) Test ARF vacuum transducer (Y31/1)
Connect vacuum tester with Y distributor to ARF valve (60). Connect multimeter with test cable between vacuum transducer (Y31/1) and cable harness. Press button "mA". Allow engine to run and increase engine speed until approx. 250 mbar is reached.

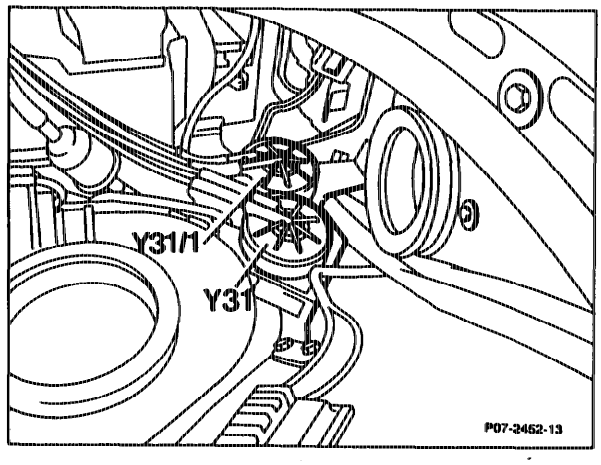
Note
Ensure that connector of vacuum transducer (Y31 and Y31/1) is correctly connected.

Refer to diagram for specified values.
Example: 250 mbar = 400 to 500 mA.

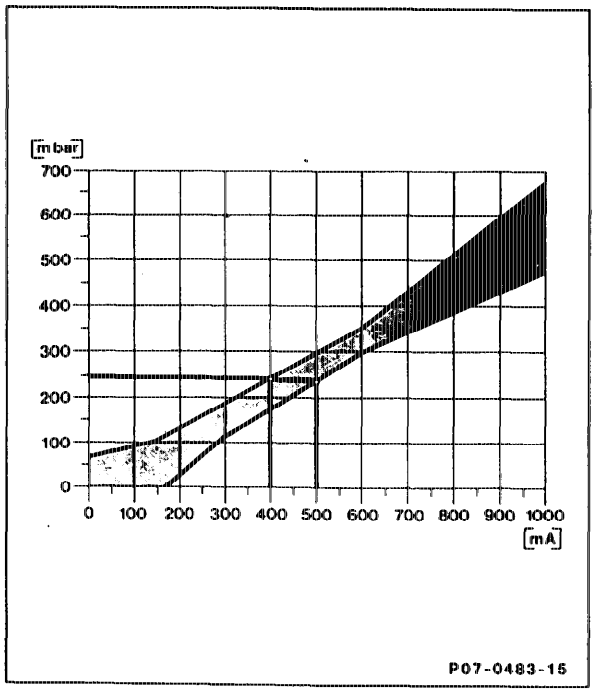
Current at vacuum transducer
0 mA too low too high



Check that air admission (black) to car interior and filter are clear.



Check whether the vacuum supply line (white/brown) is blocked. Check whether there is an interruption in vacuum line (white/purple/brown) between transducer and ARF valve. Test vacuum pump. If vacuum lines and vacuum pump are in order, renew ARF vacuum transducer (Y31/1).



End of test

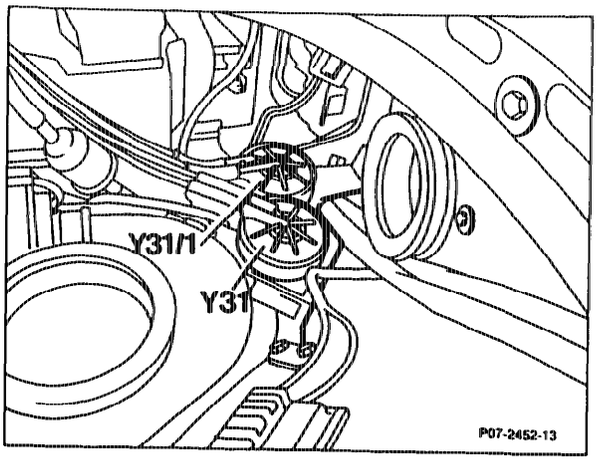
Engine switched off. Glow start switch in position "2". Detach double connector at vacuum transducer (Y31/1). Test voltage at 2-pin plug connection with multimeter button "V".

Readout: approx. 12 volts

Yes	No

Rectify interrupt in accordance with wiring diagram. Renew EDS control unit, if necessary.

End of test

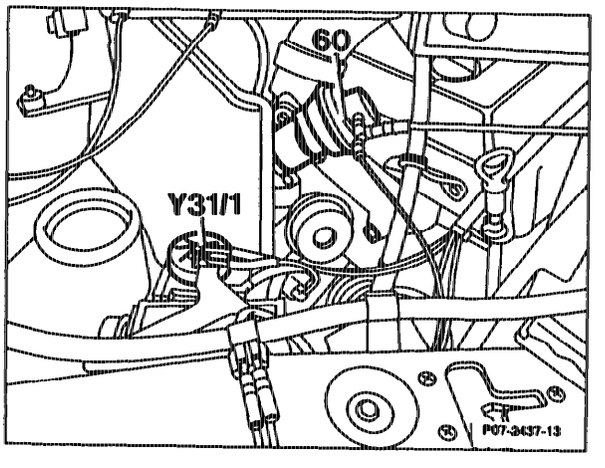


Connect ARF vacuum transducer (Y31/1) with Y distributor to ARF valve (60). Run engine at 1200/min and take reading of vacuum. Accelerate briefly, vacuum drops.

Yes	No

Renew ARF vacuum transducer (Y31/1). Check air flow sensor (B2/1) to determine whether it operates properly (refer to section "c"). Renew EDS control unit (N39), if necessary.

End of test



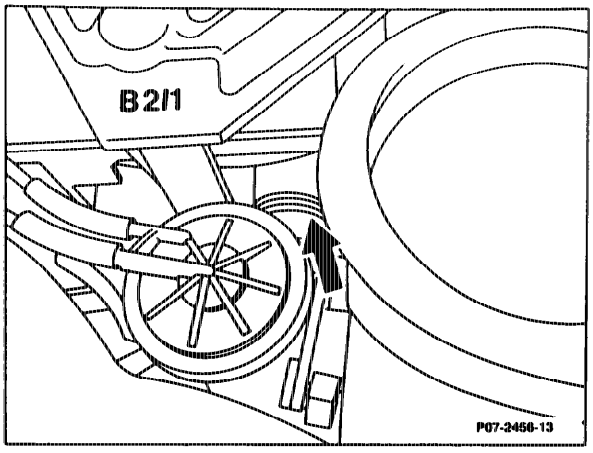
c) Mechanical check of air flow sensor potentiometer (B2/1)

Check air flow sensor plate for ease of movement and dirt. Air flow sensor plate must not stick.

Yes	No

Renew air flow sensor potentiometer (B2/1).

End of test



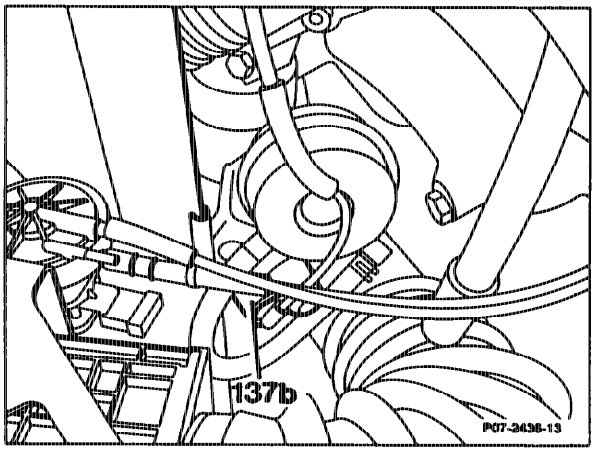
d) Testing recirculating air valve (137b)

Connect vacuum tester to recirculating air valve and apply a vacuum of 400 mbar. The vacuum must not drop by more than 50 mbar within 1 minute.

Yes	No

Renew circulating air valve (137b).

End of test



e) Testing vacuum transducer of recirculating air valve (Y31)

Connect vacuum tester with Y distributor between recirculating air valve (137b) and vacuum transducer of recirculating air valve (Y31). Connect multimeter with test cable to vacuum transducer. Press button "mA".

Test values at the following speeds:

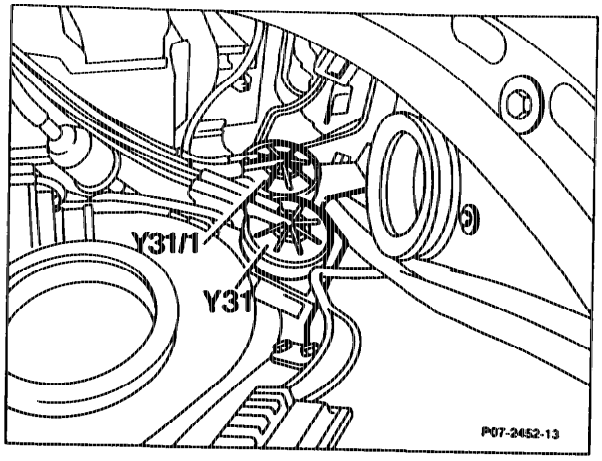
Speed	mbar	mA
Idling speed	max. 60	0
approx. 1300	approx. 500 [1]) [1]) refer to diagram	approx. 900
Test data in order	Vacuum not in order	Current not in order

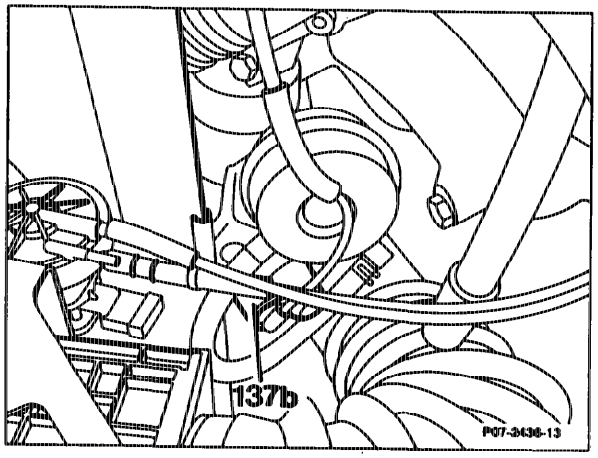
End of test

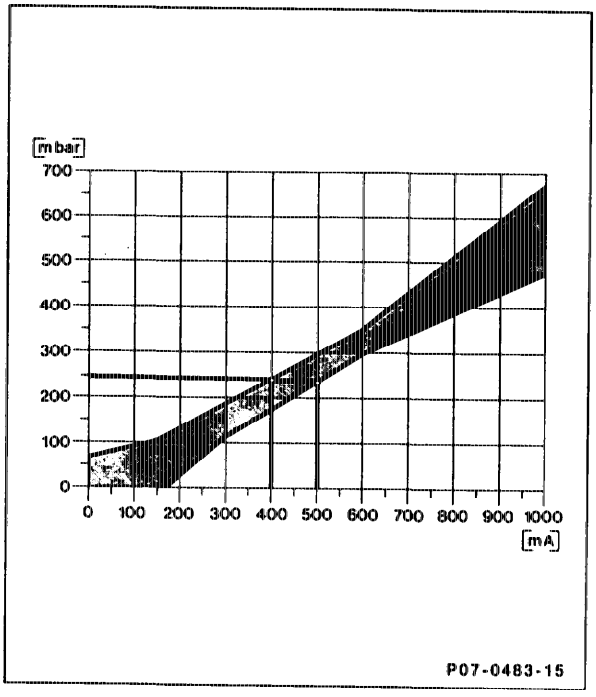
Vacuum reading too high:
Check that the air admission line (black) to car interior and filter is clear.

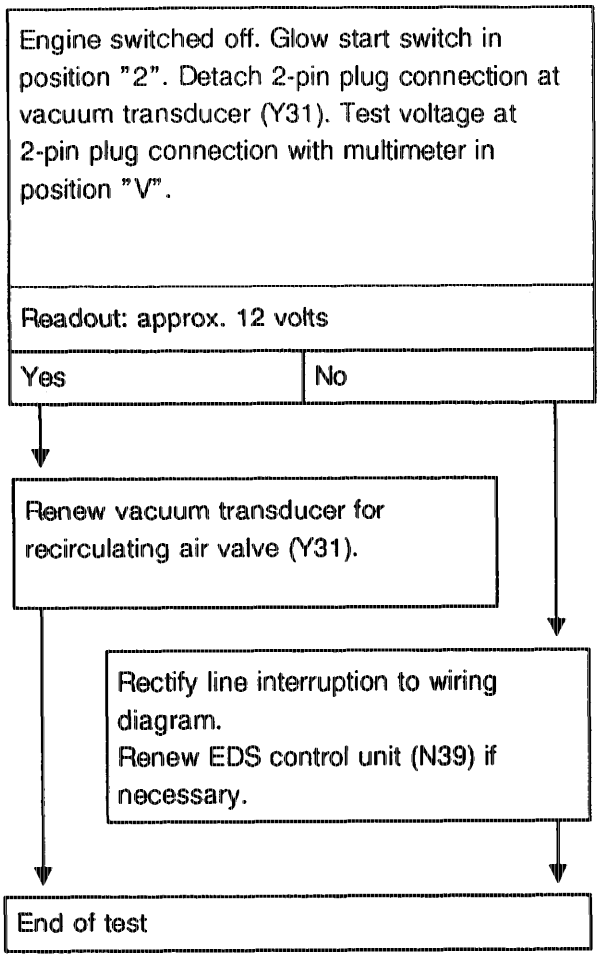
Vacuum reading too low:
Check whether the vacuum supply line (white/brown) is clear. Check whether vacuum line between recirculating air valve vacuum transducer (Y31) and recirculating air valve is in order. If all the above-mentioned components are in order, renew vacuum transducer for recirculating air valve (Y31).

End of test







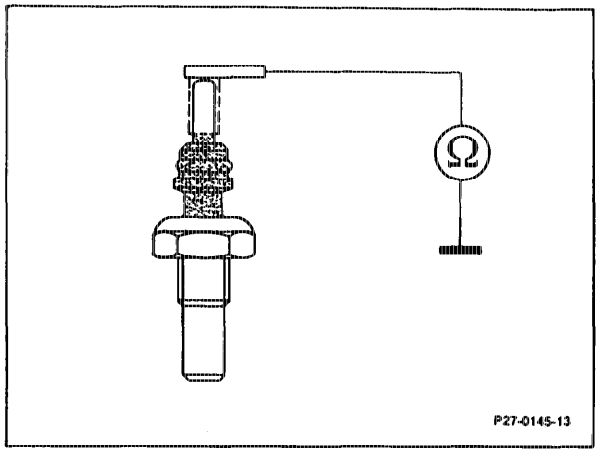

Engine switched off. Glow start switch in position "2". Detach 2-pin plug connection at vacuum transducer (Y31). Test voltage at 2-pin plug connection with multimeter in position "V".
Readout: approx. 12 volts
Yes
No
Renew vacuum transducer for recirculating air valve (Y31).
Rectify line interruption to wiring diagram.
Renew EDS control unit (N39) if necessary.
End of test

Testing coolant temperature sensor (B11/4)
Engine switched off. Detach connector on coolant temperature sensor. Test resistance to ground with multimeter position "Ω".

Refer to diagram for specified values "coolant temperature sensor and intake air". Test resistance at two temperature measuring points. Example:
20 °C : 2.5 kΩ 80 °C : 327 Ω

Yes | No

→ Renew coolant temperature sensor (B11/4).

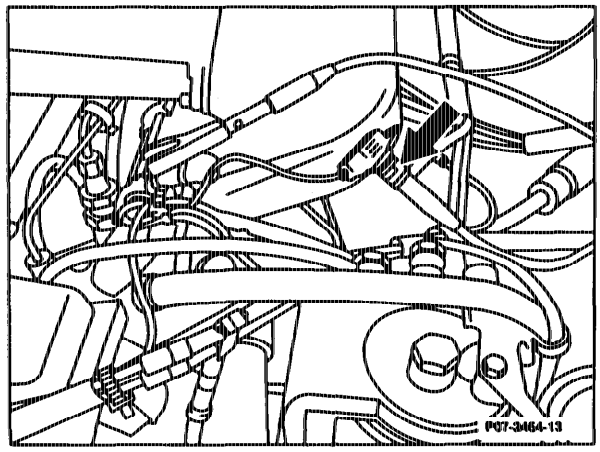


Ignition: **ON**. Test voltage at 1-pin connector (arrow) with multimeter in position V.

Readout: approx. 5 volts

Yes | No

→ Rectify line interruption.
Renew EDS control unit (N39) if necessary.



End of test

Coolant temperature sensor and intake air

Temperature in °C	Resistance (± 10%)	Voltage in V (± 10%)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

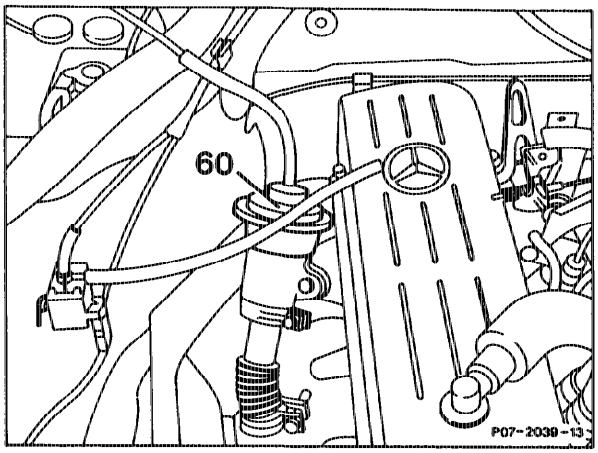
Testing air temperature sensor (B2/1a)
Engine switched off. Detach connector (arrow) from air flow sensor (B2/1). Connect multimeter and press button "Ω". Test resistance.

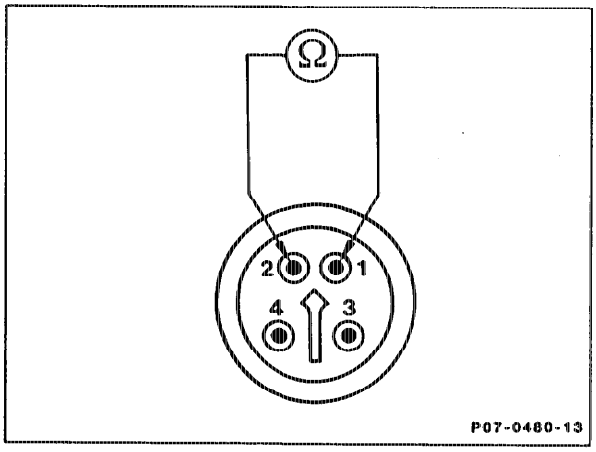
Refer to table "coolant temperature sensor and intake air" for specified value.

Yes	No

Renew air flow sensor.

End of test





Coolant temperature sensor and intake air

Temperature in °C	Resistance (±10%)	Voltage in V (±10%)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

Testing reference resistor (R18/2)
Detach reference resistor. Engine switched off. Ignition: **ON**. Press multimeter button "V = ". Check voltage.

Readout: approx. 5 volts

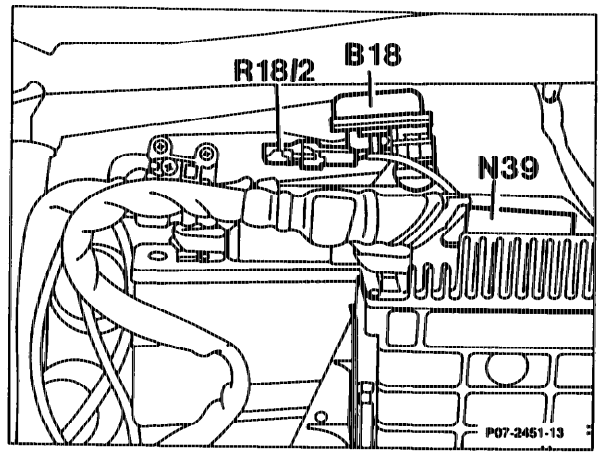
Yes	No

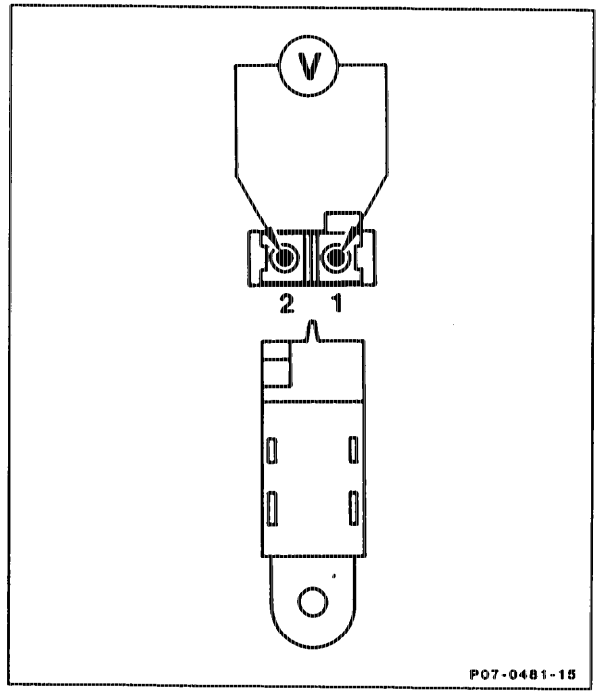
Rectify interrupt according to wiring diagram.

Renew reference resistor (R18/2).

End of test

Note
When renewing the reference resistor (R18/2) fit only plug with an identical part no.





Testing ELR resistance trimming plug (R18/1)
Detach ELR resistance trimming plug. Engine switched off. Ignition: **ON**. Press multimeter button "V=". Test voltage.

Readout: approx. 5 volts

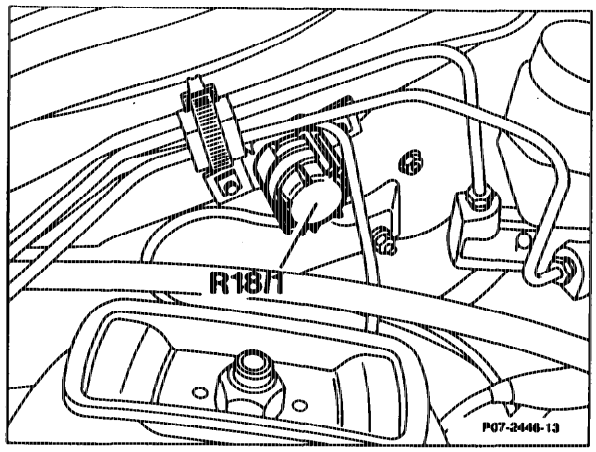
Yes	No

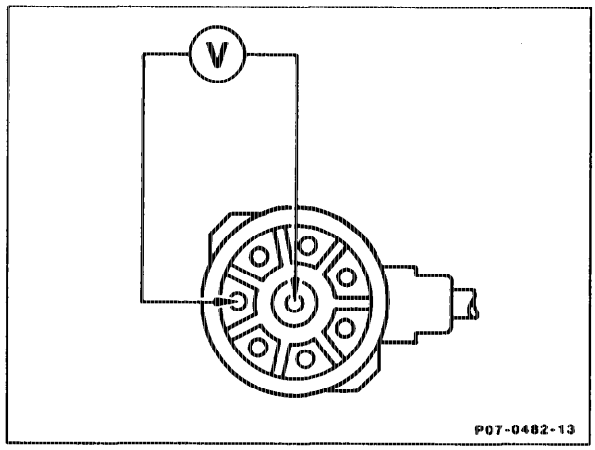
Rectify line interruption in accordance with wiring diagram. Renew EDS control unit (N39) if necessary.

Renew ELR resistance trimming plug.

End of test

Note
The ELR resistance trimming plug (R18/1) is installed in position "4".





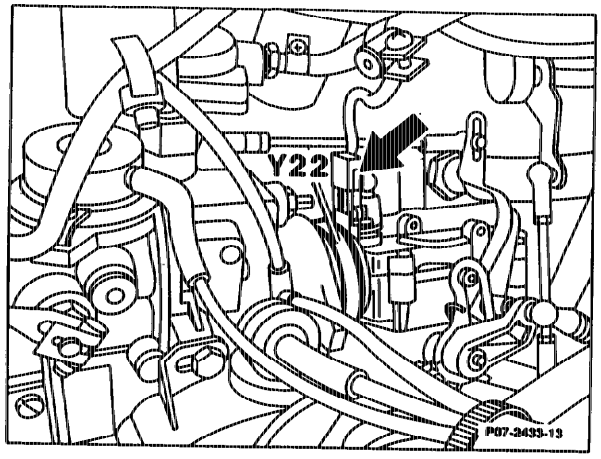
c) Testing electronic idle speed control

Testing idle speed control

Engine idling. Detach 2-pin connector (arrow) at actuator (Y22) for at least 3 s and fit on again.

When connecting, idling speed briefly increases.

Yes	No

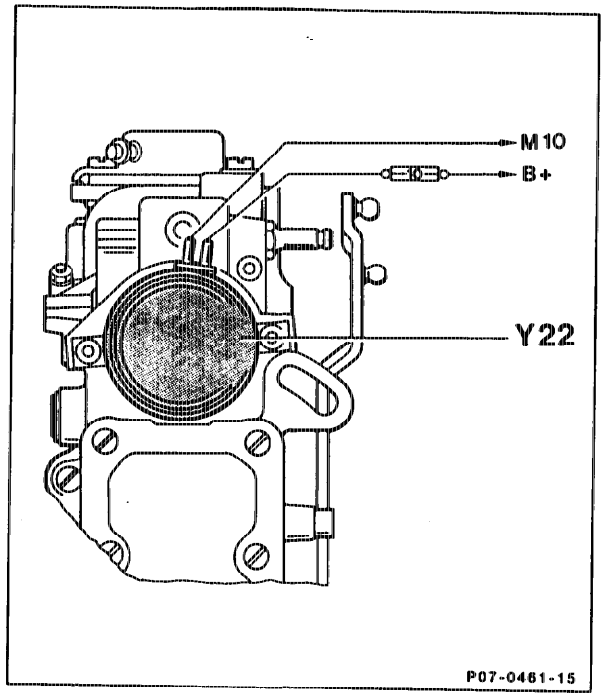


Briefly (max. 3 s) apply battery voltage (approx. 12 V) to actuator (Y22).

Note
The actuator is damaged if voltage is applied to the actuator (Y22) for longer than 3 s.

Engine speed increases.

Yes	No



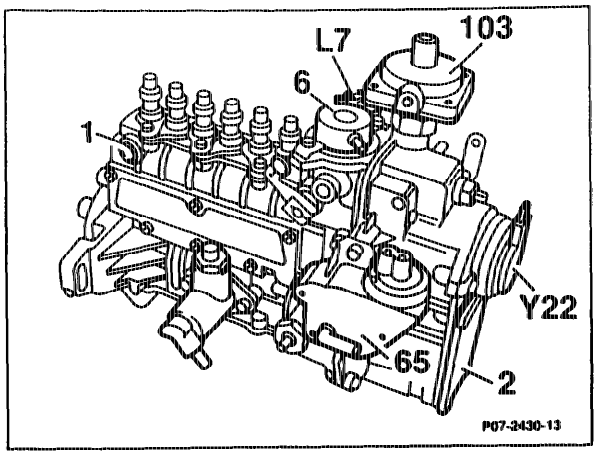
Renew actuator.

Engine idling. Detach 2-pin connector at actuator (Y22) and measure voltage with multimeter, button "V".

Readout approx. 12 volts

Yes	No

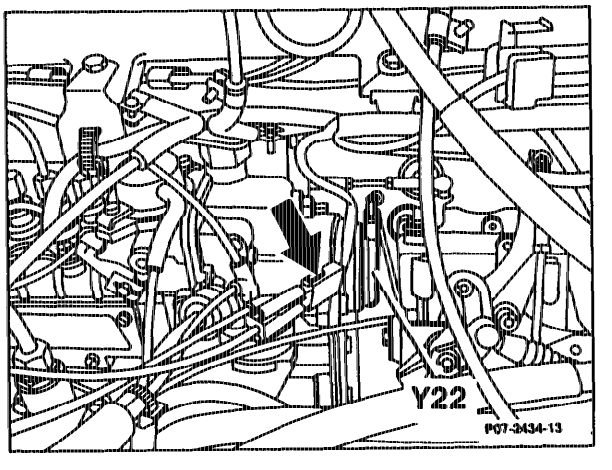
Test fuse for overvoltage protection relay (K1).
Test lines for interrupt according to wiring diagram.
Renew EDS control unit (N39) if necessary.



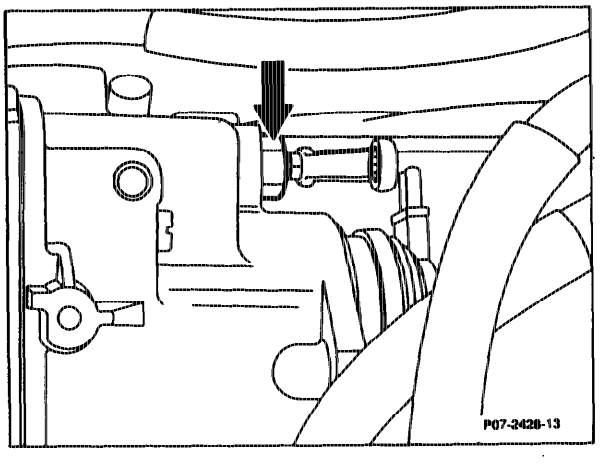
Engine idling. Detach 2-pin connector (arrow) at actuator (Y22).
Check idle speed.

Specification: 570 ± 40/min

Yes	No



Slacken locking nut and set idling speed (arrow).



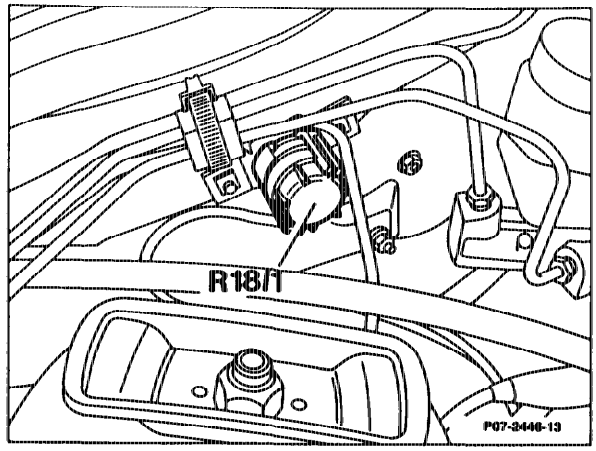
End of test

Setting idle speed by means of resistance trimming plug (R18/1)

If complaints are received regarding idling, idle speed can be altered.

The coded plug positions are listed in the table below.

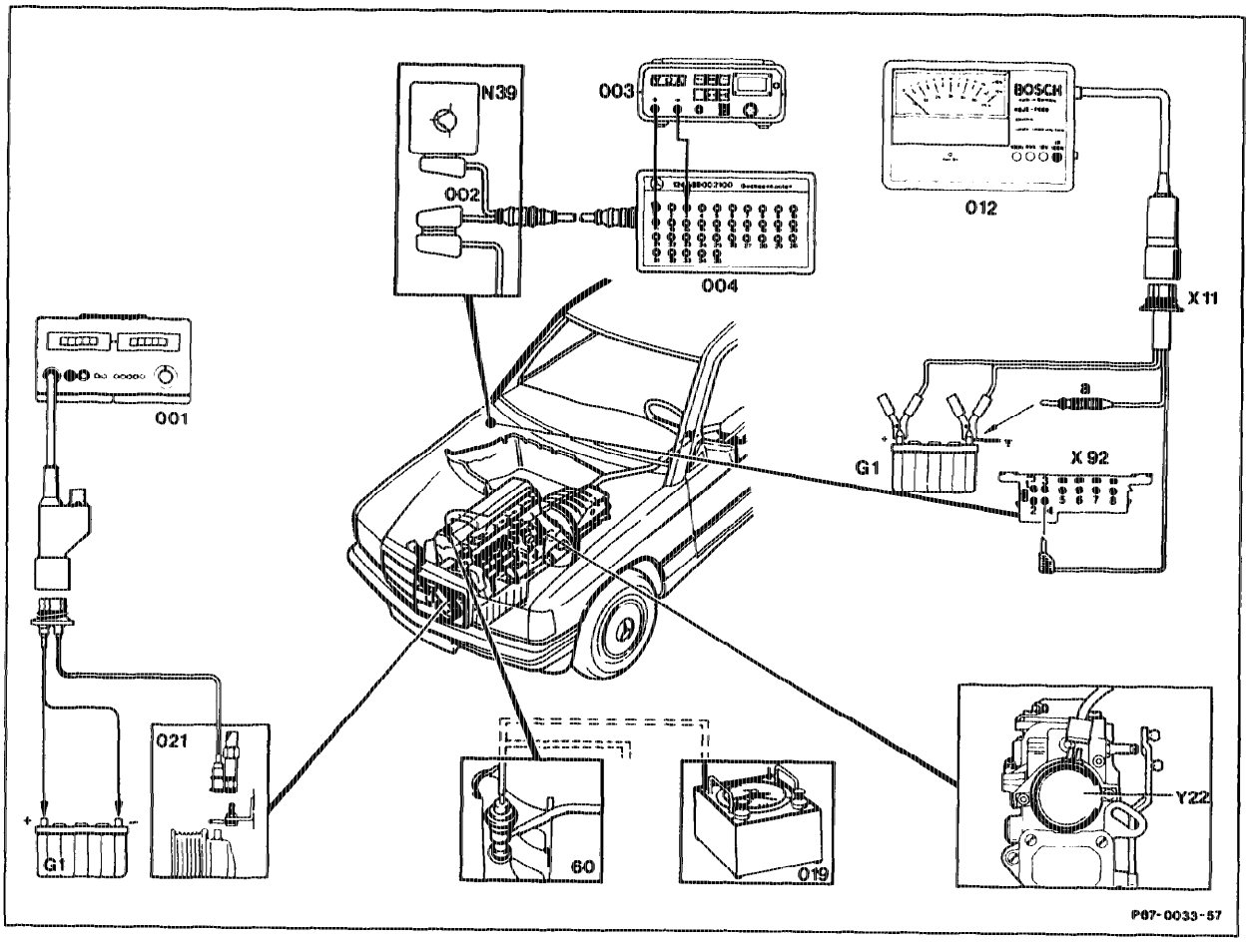
Position of resistance trimming plug	Idling speed rpm
1	570 ± 20
2	590 ± 20
3	610 ± 20
4	630 ± 20
5	650 ± 20
6	670 ± 20
7	700 ± 20



C. Engine 603.96, Model 124 (J) Model Year 1988

a) Short-test
b) Troubleshooting plan "electronic diesel system"
c) ELR and ARF function test

a) Short-test



Digital tester (001) and pulse counter (021)	connect, disconnect.
Lambda control tester (012)	connect, disconnect to battery (G1) and with adapter to test connecter (X92).
Contact box (004)	connect, disconnect with test cable (002) to EDS control unit (N39).
Vacuum tester (019)	connect, disconnect with Y distributor at ARF valve.
Digital multimeter (003)	connect, disconnect at contact box (004).
Fuse at overvoltage protection relay (K1/1)	test.
Selector lever	move into position "P".
Air conditioning/automatic climate control	switch off.
Engine	bring to operating temperature (coolant temperature approx. 80 °C).

Note
When performing the test work, the intake air hose between air flow sensor and exhaust gas turbocharger must be fitted, otherwise no signal will pass from the air flow sensor to the EDS control unit (N39).

Connector "a"	hold approx. 1 second to battery ground, 100 % readout.
Connector "a"	take off. 0 % readout, no fault in system. Readout fluctuates, fault in system (refer to troubleshooting table).

If interruption in engine speed sensor (L3) = constant readout = 100 %

Fault stored in system
Readout fluctuates and indicates stored fault.

Note
One pulse = 0 % – 100 % – 0 %

The number of pulses indicates which electrical component is faulty and whether components in the control circuit are faulty.

Repeat test step until no further pulse is displayed.

Troubleshooting table

Pulse readout	Component/control loop
1	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) altitude sensor
5 [1])	Vacuum transducer (Y31/1) or fault in exhaust control loop
6	EDS control unit (N39) internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Power supply
11 [2])	ELR actuator (Y22) or vacuum transducer
12	EDS control unit (N39) idle stage

[1]) Readout only at 1200 rpm for at least 5 seconds. Fault is not stored.
[2]) Readout only in case of short-circuit.

Refer to sections b, and c for further tests.

Note indicated faults and rectify according to troubleshooting schedule (section "b").

Erasing fault memory
is performed after completing repairs. Each pulse displayed must be erased after termination of the last deflection by connecting pin "a" to battery ground for between 6 and 8 seconds.

2-pin connector on ELR actuator (Y22) . . . . . detach and fit on again (for at least 3 seconds) Engine speed increases briefly.

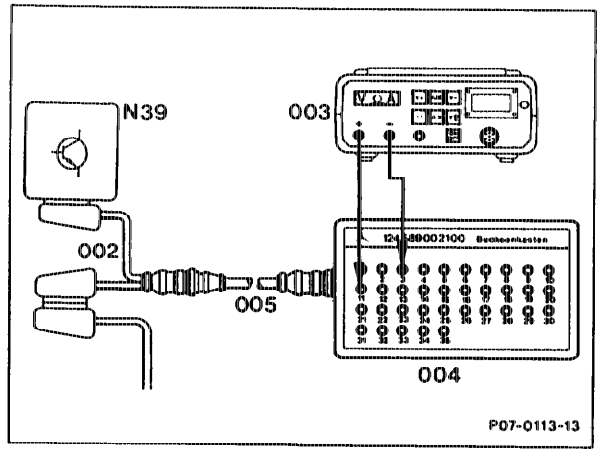
Engine . . . . . run at approx. 1200 rpm and set approx. 250 mbar vacuum. Briefly apply full throttle. Vacuum drops to 0 mbar.

Engine . . . . . switched off.

Pressurize ARF valve . . . . . at approx. 300 mbar vacuum ARF valve is heard to close.

b) Troubleshooting schedule in "electronic diesel system"

Connection diagram contact box



002 25-pin cable harness, 124 589 33 63 00
003 Multimeter
004 Contact box 124 589 00 21 00
005 Test cable 124 589 34 63 00
N39 EDS control unit

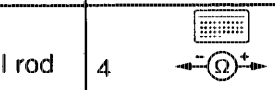
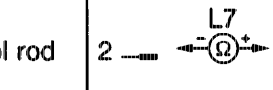
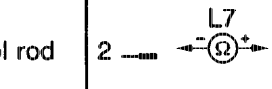
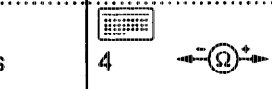
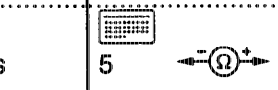
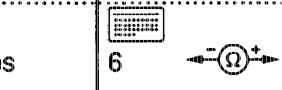
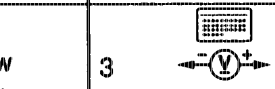
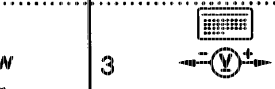
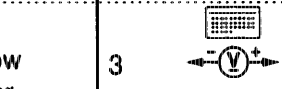
Test program with contact box

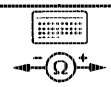
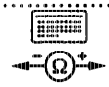
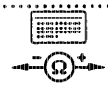
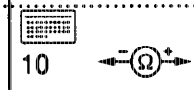
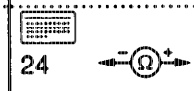
Symbols for test instruments:

Contact box
Lambda tester
Battery
Multimeter
Contact
Pin

Note
If the pulse readout is constant, first perform test steps 1–3. If the specified value of a test step, e.g. step 7, is in order, it is then no longer necessary to perform test step 7.1.

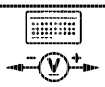
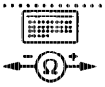
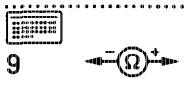
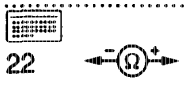
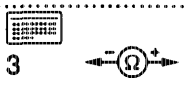
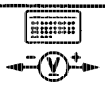
Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
1	1	–	–	–	No fault stored
2	2.0 Control rod travel sensor (L7)	4 – Ω + 5	Ignition: OFF EDS control unit disconnected	50 ±4 Ω	Renew control travel sensor or injection pump
	2.1 Control rod travel sensor (L7)	4 – Ω + 6		25 ±2 Ω	Cable interrupt
	2.2 Control rod travel sensor (L7)	4 – Ω + 3		∞	

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
[2]	2.3 Control rod travel sensor (L7)	 4 — 1		∞	
	2.4 Control rod travel sensor (L7)	 L7 2 — 3	Ignition: OFF Connector on control rod travel sensor (L7) detached	50 ±4 Ω	Renew injection pump
	2.5 Control rod travel sensor (L7)	 L7 2 — 1		25 ±2 Ω	Renew injection pump
	2.6 Cables	 4 — L7 — 3	Connector on control rod travel sensor (L7) detached	< 1 Ω	Cable interrupt
	2.7 Cables	 5 — L7 — 2		< 1 Ω	Cable interrupt
	2.8 Cables	 6 — L7 — 1		< 1 Ω	Cable interrupt
3	3.0 Air flow sensor potentio-meter (B2/1)	 3 — 24	Ignition: ON EDS control unit (N39) connected	5 ±0.5 V	Air flow sensor potentiometer (B2/1) Cables
	3.1 Air flow sensor potentio-meter (B2/1)	 3 — 10		< 0.5 V	EDS control unit (N39)
	3.2 Air flow sensor potentio-meter (B2/1)	 3 — 10	Engine idling	1.2 ± 0.2 V	

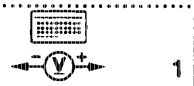
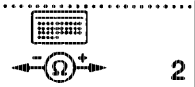
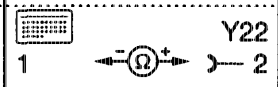
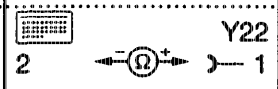
Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[3]	3.3 Air flow sensor potentiometer (B2/1)	 3 — 24	Ignition: **OFF** EDS control unit (N39) disconnected:	500–1200 Ω	Air flow sensor potentiometer (B2/1)
	3.4 Air flow sensor potentiometer (B2/1)	 3 — 10	Off position	50–200 Ω	Air flow sensor potentiometer (B2/1)
	3.5 Air flow sensor potentiometer (B2/1)	 3 — 10	Air flow sensor plate fully deflected Intake hose detached	560–1100 Ω	Air flow sensor potentiometer (B2/1)
	3.6 Cables	 10 — B2/1 — 3	Connector on air flow sensor potentiometer (B2/1) detached	< 1 Ω	Cable interrupt
	3.7 Cables	 24 — B2/1 — 4		< 1 Ω	Cable interrupt
4	4.0	–	–	–	Renew EDS control unit (N39). Altitude sensor.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
5	5.0 Vacuum transducer (Y31/1)	 7 — V — 1 Vacuum at ARF valve	Engine approx. 1200/min Approx. 250 mbar EDS control unit connected	3.6 ± 0.2 V	Supply line (white/purple/brown) leaking Air admission line (black) blocked. Air admission filter (62a) closed. Supply line (white/blue) or vacuum line (white/purple/brown) closed or interrupted. Vacuum transducer (Y31/1). Cables EDS control unit, air flow sensor potentiometer, ARF valve
6	6.0	–	–	–	Internal power supply. Renew EDS control unit (N39)
7 [1]) or 100 %	7.0 TD signal	 3 — V — 20	Engine idling EDS control unit (N39) connected	> 1.5 V	Engine speed sensor (L3), distance, dirt, Cables EDS control unit (N39).
	7.1 Engine speed sensor (L3)	 3 — V — 25		> 2.8 V	Engine speed sensor (L3), distance, dirt, Cables
	7.2 Engine speed sensor (L3)	 3 — Ω — 20 L3x 1 — Ω — 2	Ignition: OFF Detach EDS control unit (N39)	0.4–2.5 kΩ	Engine speed sensor (L3).
	7.3 Cables	 20 — Ω — L3x — 2	Cable connection (L3x) detached	< 1 Ω	Cable interrupt
	7.4 Cables	 3 — Ω — L3x — 1		< 1 Ω	Cable interrupt

[1]) Readout only in the case of short-circuit.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
8	8.0 Coolant temperature sensor (B11/4)	 3 — V — 9	EDS control unit connected Ignition: **ON**	Refer to table	Coolant temperature sensor (B11/4) Cables EDS control unit (N39)
	8.1 Cable	 14 — Ω — 9	Ignition: **OFF** Control unit disconnected	Refer to table	Coolant temperature sensor (B11/4), cable
	8.2 Cable	 9 — Ω — B11/4	Ignition: **OFF** EDS control unit (N39) disconnected	< 1 Ω	Cable interrupt
9	9.0 Intake air temperature sensor (B2/1a)	 3 — V — 22	Ignition: **ON** EDS control unit (N39) connected	Refer to table	Temperature sensor Air flow sensor Cables EDS control unit
	9.1	 22 — Ω — B2/1 — 1	Ignition: **OFF** Control unit disconnected Connector on air flow sensor disconnected (B2/1)	< 1 Ω	Cable interrupt
	9.2	 3 — Ω — B2/1 — 2		> 1 Ω	Cable interrupt
10	10.0 Power supply	 14 — V — 1	Control unit connected Engine approx. 1500/min	11–14 V	Alternator regulator Voltage > 18 V
11 [1])	11.0 ELR actuator (Y22)	 3 — V — 2	Ignition: **ON** EDS control unit connected	11–14 V	Actuator (Y22) Cables EDS control unit (N39)

[1]) Readout only in the case of short-circuit.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[11] [1])	11.1		Engine idling	2 ± 0.5 V	
	11.2	 2 — V — 1	Ignition: OFF EDS control unit disconnected	3.9 Ω	Actuator (Y22) Cables
	11.3	 1 — Ω — 2	Ignition: OFF EDS control unit disconnected	3.9 Ω	Actuator (Y22) Cables
	11.4	 1 — Ω — Y22 — 2	Connector at actuator (Y22) disconnected	< 1 Ω	Cable interrupt
	11.5	 2 — Ω — Y22 — 1		< 1 Ω	Cable interrupt
12	12.0	–	–	–	Idling output stage in control unit faulty, renew EDS control (N39).

[1]) Readout only in the case of short-circuit.

Table of coolant temperature sensor and intake air

Temperature in °C	Resistance (± 10%)	Voltage in V (± 10%)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

c) ELR and ARF function test

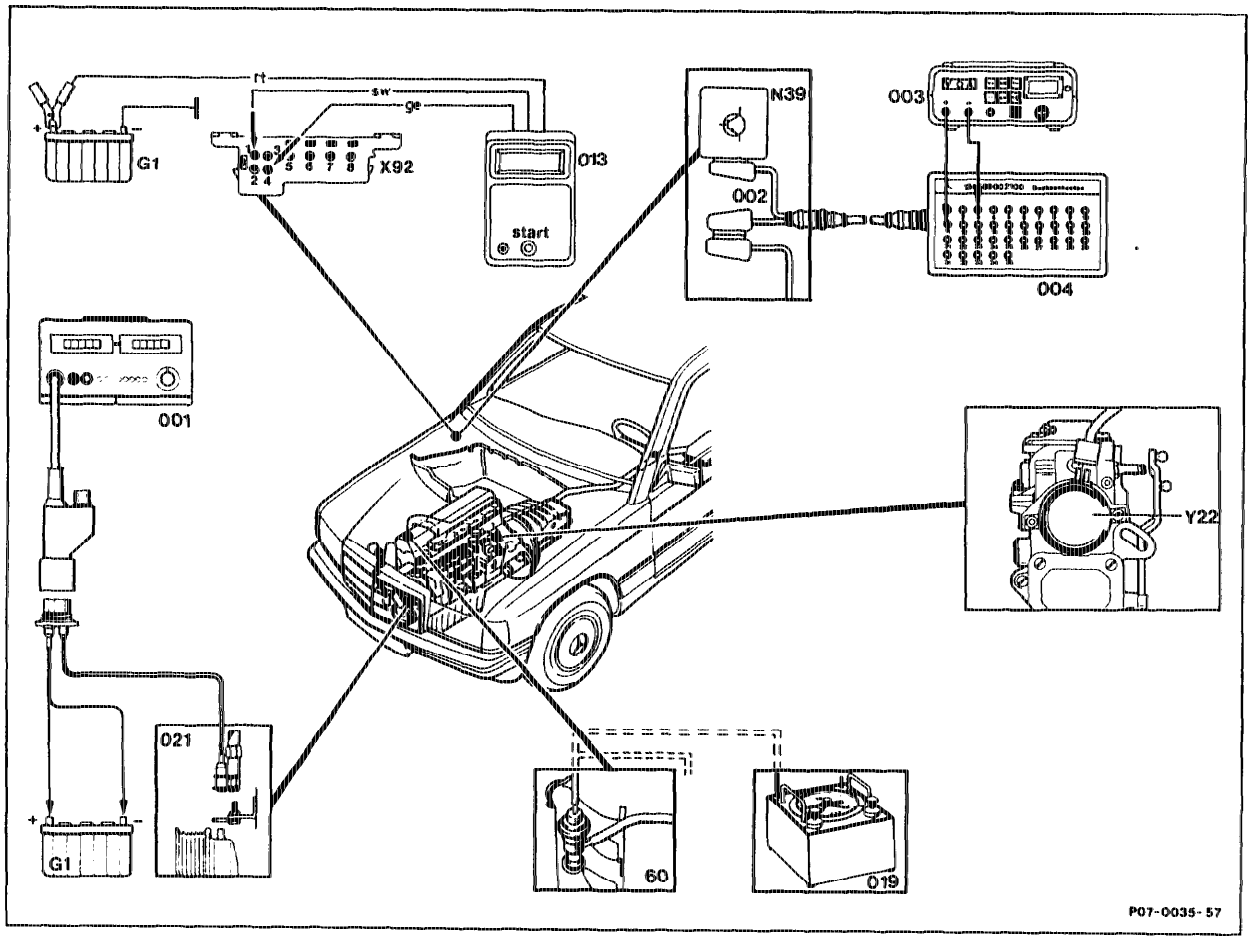
Note
This test should be conducted if complaint has been received but no fault is indicated on the pulse readout.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/remedy
–	Idle speed control	Revolution counter with TDC generator	Engine idling Coolant temperature approx. 80 °C	630 ±20 rpm	Actuator, injection pump, engine speed sensor (L3), control unit (N39), refer to test steps 7 and 11.
			Plug detached from actuator	580 ±20 rpm	Set speed at injection pump, renew injection pump.
–	Exhaust control circuit	Connect vacuum tester with Y distributor to ARF valve	Engine running at 1200 rpm and 250 mbar. Briefly apply full throttle	Vacuum drops	Perform mechanical test of vacuum transducer (Y31/1) (test step 5), Check air flow sensor plate for ease of operation, control unit (N39), ARF valve.
–	ARF valve	Connect vacuum tester directly to ARF valve	Engine switched off Pressurize ARF valve with 300 mbar and disconnect again.	ARF valve is heard to close	Renew ARF valve.

D. Engines 602.96 and 603.96, Models 124 and 201
(A) (J) Model Year 1989

a) Short-test
b) Testing with pulse counter
c) Troubleshooting schedule "electronic diesel system"
d) ELR and ARF function test

a) Short-test



Digital tester (001) and pulse counter (021)	connect, disconnect.
Pulse counter (013)	connect, disconnect to battery (G1) and with adapter to test connector (X92)
Contact box (004)	connect, disconnect with test cable (002) to EDS control unit (N39).

Digital multimeter (003)	connect, disconnect at contact box (004).
Vacuum tester (019)	connect, disconnect with Y distributor at ARF valve.
Fuse at overvoltage protection relay (K1/1)	test.
Selector lever	move into position "P".
Air conditioning/automatic climate control	switch off.
Engine	bring to operating temperature (coolant temperature approx. 80 °C).
Start button of pulse counter (013)	operate for 2–4 seconds.
Display	read off and note.
Start button	press once again. If no new display appears, there is no further fault in the system.

The number of pulses indicates whether and which electrical component is faulty and whether components in the control circuit are faulty.

Troubleshooting table

Pulse readout	Component/control
1	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) altitude sensor
5 [1])	Vacuum transducer (Y31/1) or fault in exhaust control loop
6	EDS control unit (N39) internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Power supply
11 [2])	ELR actuator or vacuum transducer

[1]) Readout only at 1200 rpm for at least 5 seconds. Fault is not stored.
[2]) Readout only in the case of short-circuit.

Refer to sections b, c and d for further tests.

b) Testing with pulse counter

Notes regarding pulse readout

If a complaint is received but no fault is indicated on the pulse readout, perform the function test, section "d". The number 1 indicates no fault **detected** in the electronic system. All other numbers are assigned to a particular fault group. The numbers from 1 to 11 appear on the display of the pulse counter.

- If the LED U-Batt appears after connecting, pulse count and pulse supply for the pulse counter are in order.

Testing

- Connect pulse counter as shown in connection diagram.

Note

LED U-Batt in display panel must light up; if not:

a) test fuse of pulse counter
b) test jack 1 of test connector (X92 or X11/4) to battery positive (11–14 V).
c) test jack 4 of test connector (X92 or X11/4) to jack 1 (2–6 V).

- Engine idling.
- Operate start button for between 2 and 4 seconds.
- Take readout of pulse output and note.
- Again press start button for between 2 and 4 seconds. If no fault exists in the system, the previous readout appears once again.
- Rectify noted faults (pulse readout) according to troubleshooting schedule.
- Perform components test.

Erasing fault memory

After a fault has been rectified, the pulse displayed must be erased as follows:

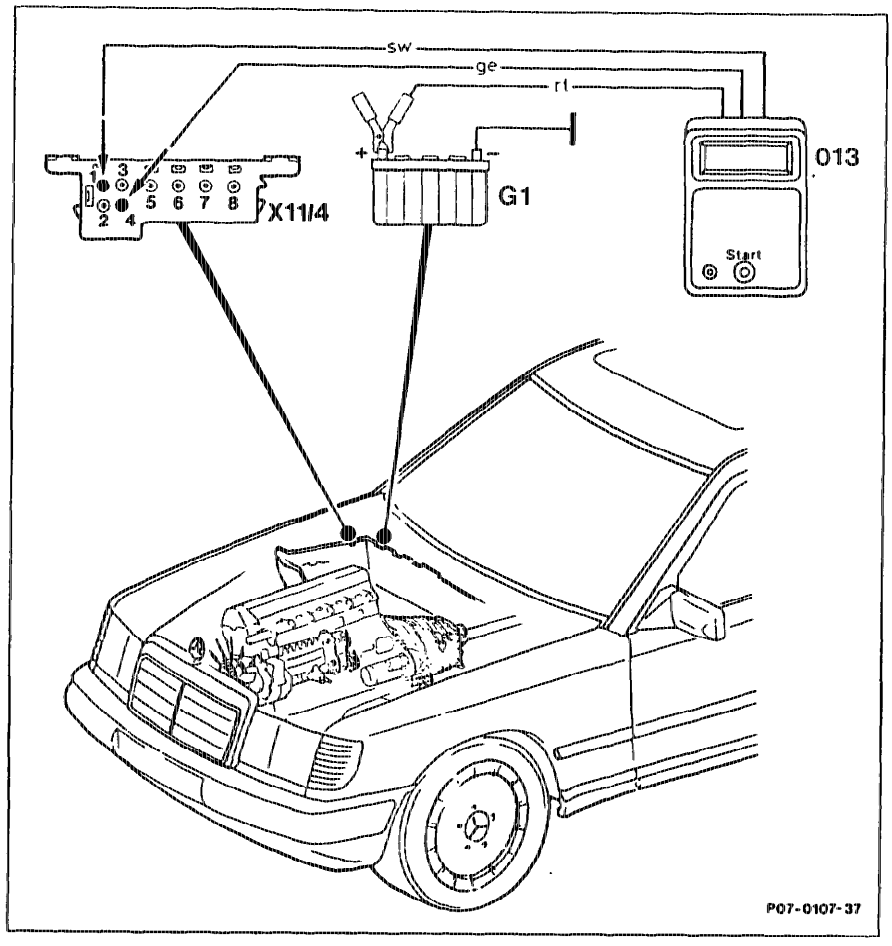
- Operate start button and readout the rectified fault, then press start button for 6–8 seconds.

Note

Each displayed pulse must be erased **individually.**

- No readout: stored fault is erased.
- Display of a number (larger than 1), further faults in system.

Connection diagram



013 Pulse counter
X11/4 Test connector for diagnostics
G1 Battery

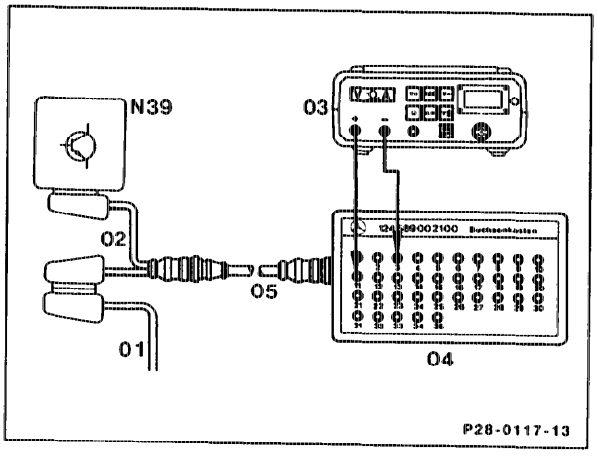
Test connector for diagnostics (X11/4)
1 Ground
2 TD signal
3 Exhaust test signal (only for production tuning)
4 Diagnostic signal

The number of pulses indicates whether and which electrical component is faulty and whether components in the control circuit are faulty.

Pulse readout	Component/control loop
1	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39), altitude sensor
5 [1])	Vacuum transducer (Y/31/1) or fault in exhaust control loop
6	EDS control unit (N39) internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B11/4)
9	Air intake temperature sensor (B2/1a)
10	Power supply
11 [2])	ARF actuator or vacuum transducer

[1]) Readout only at 1200 rpm for at least 5 seconds. Fault is not stored.
[2]) Readout only in the case of short-circuit.

Connection diagram contact box



001 25-pin cable harness
002 25-pin test cable 124 589 33 63 00
003 Multimeter
004 Contact box 124 589 00 21 00
005 Test cable 124 589 34 63 00
N39 EDS control unit

c) Troubleshooting schedule "electronic diesel system"

Symbols for test instruments:


Contact box


Lambda sensor

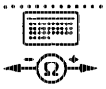
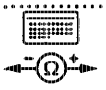
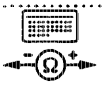
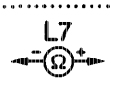

Battery

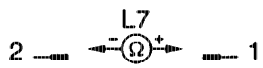
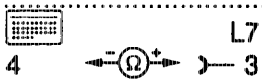
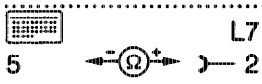
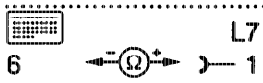
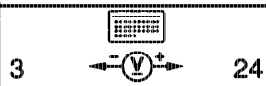
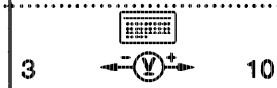
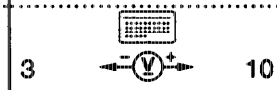

Multimeter

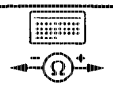
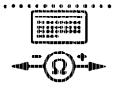
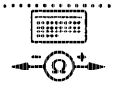
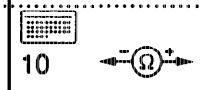
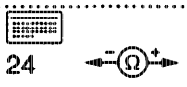
Contact

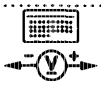
Connecting pin

Note
If the pulse readout is constant, first perform test steps 1–3. If the specified value of a test step, e.g. step 7, is in order, it is not then necessary to also perform test step 7.1.

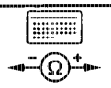
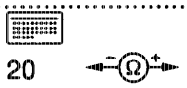
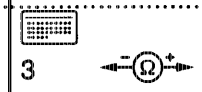
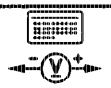
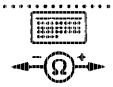
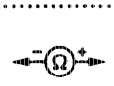
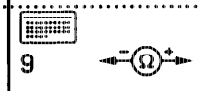
Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
1	1	–	–	–	No fault stored
2	2.0 Control rod travel sensor (L7)	 4 5	Ignition: **OFF** EDS control unit detached	50 ± 4 Ω	Renew control rod travel sensor or injection pump
	2.1 Control rod travel sensor (L7)	 4 6		25 ± 2 Ω	Cables
	2.2 Control rod travel sensor (L7)	 4 3		∞	
	2.3 Control rod travel sensor (L7)	 4 1		∞	
	2.4 Control rod travel sensor (L7)	 L7 2 3	Ignition: **OFF** Connector on control rod travel sensor (L7) detached	50 ± 4 Ω	Renew injection pump

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
[2]	2.5 Control rod travel sensor (L7)			25 ± 2 Ω	Renew injection pump
	2.6 Cables		Connector on control rod travel sensor (L7) detached	< 1 Ω	Cable interrupt
	2.7 Cables			< 1 Ω	Cable interrupt
	2.8 Cables			< 1 Ω	Cable interrupt
3	3.0 Air flow sensor potentio-meter (B2/1)		Ignition: ON EDS control unit (N39) connected	5 ± 0.5 V	Air flow sensor potentiometer (B2/1), Cables
	3.1		Engine idling	< 0.5 V	Test value in order although fault was stored
	3.2			**Engine 603** 1.2 ± 0.2 V **Engine 602** 1.7 ± 0.2 V	Air flow sensor plate jammed briefly during starting; replace air flow sensor if necessary. EDS control unit (N39)

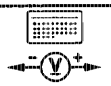
Pulse readout	Test step/ test scope	Test connection	Operation/ Requirement	Specification	Possible cause/remedy
[3]	3.3 Air flow sensor potentiometer (B2/1)	 3 — 24	Ignition: OFF EDS control unit (N39) disconnected:	500–1200 Ω	Air flow sensor potentiometer (B2/1)
	3.4 Air flow sensor potentiometer (B2/1)	 3 — 10	Air flow sensor plate in off position	50–200 Ω	Air flow sensor potentiometer (B2/1)
	3.5 Air flow sensor potentiometer (B2/1)	 3 — 10	Air flow sensor plate fully deflected	560–1100 Ω	Air flow sensor potentiometer (B2/1)
	3.6 Cables	 10 — B2/1 — 3	Detach connector on air flow sensor potentiometer (B2/1)	< 1 Ω	Cable interrupt
	3.7 Cables	 24 — B2/1 — 4		< 1 Ω	Cable interrupt
4	4.0	–	–	–	Renew EDS control unit (N39) Altitude sensor

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
5 [1])	5.0 Vacuum transducer (Y31/1)	 7 1 Vacuum at ARF valve	Engine approx. 900 rpm approx. 250 mbar	 2.5 ± 0.5 V	Supply line (white/brown) leaking Air admission line (white) blocked Air admission filter (62a) closed. Supply line (white/blue) or vacuum line (white/purple/ brown) closed or interrupt-ed. Vacuum transducer (Y31/1), cables, EDS control unit, air flow sensor potentiometer, ARF valve.
	5.1 Cables	 7 Y31/1 1	Connector at vacuum transducer (Y31/1) detached	< 1 Ω	Cable interrupt
	5.2 Cables	 1 Y31/1 2		< 1 Ω	Cable interrupt
6	6.0	–	–	–	Internal power supply. Renew EDS control unit (N39)
7	7.0 TD signal	 3 20	Engine idling EDS control unit (N39) connected	> 1.5 V	Engine speed sensor, distance, dirt, cables.
	7.1 Engine speed sensor (L3)	 3 25	Engine idling EDS control unit connected	> 2.8 V	Cable N39 to X92 or X11/4 short circuit or control unit (N39)

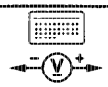
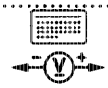
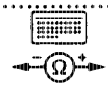
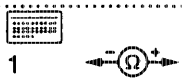
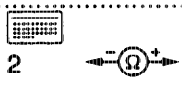
[1]) Readout only at 1200 rpm for at least 5 seconds. Fault is not stored.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[7]	7.2 Engine speed sensor (L3)	 3 — 20	Ignition: **OFF** EDS control unit disconnected	0.4– 2.5 kΩ	Engine speed sensor (L3) Cables
	7.3 Engine speed sensor (L3)	 L3x 1 — 2	Plug connector (L3x) detached	0.4– 2.5 kΩ	Engine speed sensor (L3)
	7.4 Cables	 L3x 20 — 2		< 1 Ω	Cable interrupt
	7.5 Cables	 L3x 3 — 1		< 1 Ω	Cable interrupt
8	8.0 Coolant temperature sensor (B11/4)	 3 — 9	Ignition: **ON** EDS control unit connected	[3])	Coolant temperature sensor, cables, EDS control unit
	8.1 Coolant temperature sensor (B11/4)	 3 — 9	Ignition: **OFF** EDS control unit (N39) disconnected	[3])	Coolant temperature sensor (B11/4), cable
	8.2 Coolant temperature sensor (B11/4)	 B11/4	Cable connection (B11/4) disconnected	[3])	Coolant temperature sensor (B11/4)
	8.3 Cable	 B11/4 9	Ignition: **OFF** EDS control unit disconnected	< 1 Ω	Cable interrupt

[3]) Refer to table of coolant temperature sensor and intake air.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
9	9.0 Intake air temperature sensor (B2/1a)	 3 — V — 22	Ignition: **ON** EDS control unit connected	[3]	Temperature sensor Air flow sensor Cables EDS control unit
	9.1 Intake air temperature sensor (B2/1a)	 3 — V — 22	Ignition: **OFF** EDS control unit disconnected	[3]	Cable to temperature sensor, temperature sensor
	9.2 Intake air temperature sensor (B2/1a)	B2/1 1 — Ω — 2	Connector at air flow sensor (B2/1) detached	[3]	Temperature sensor Air flow sensor Cables EDS control unit
	9.3 Cables	 B2/1 22 — Ω — 1	Ignition: **OFF** Control unit disconnected Connector at air flow sensor (B2/1) disconnected	< 1 Ω	Cable interrupt
	9.4 Cables	 B2/1 3 — Ω — 2		< 1 Ω	Cable interrupt
10	10.0 Power supply	 14 — V — 1	Engine approx. 1500/min	11–14 V	Alternator regulator Voltage > 18V

[3] Refer to table of coolant temperature sensor and intake air.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
11 [2])	11.0 ELR actuator (Y22)	3  2	Ignition: **ON** EDS control unit connected	11–14 V	Actuator (Y22), Cables, Control unit (N39)
	11.1 ELR actuator (Y22)	2  1	Engine idling	2.5 ± 0.5 V	
	11.2 ELR actuator (Y22)	1  2	Ignition: **OFF** EDS control unit dis-connected	3.9 ± 0.2 Ω	Actuator (Y22) Cables
	11.3 Cables	1  Y22 ⟩— 2	Connector on actuator (Y22) disconnected	< 1 Ω	Cable interrupt
	11.4 Cables	2  Y22 ⟩— 1		< 1 Ω	Cable interrupt

[2]) Readout only in the case of short-circuit.

Table of coolant temperature sensor and intake air

Temperature in °C	Resistance (± 10%)	Voltage in V (± 10%)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

d) ELR and ARF function test

Note
This test is to be conducted if complaint has been received but no fault is indicated on the pulse readout.

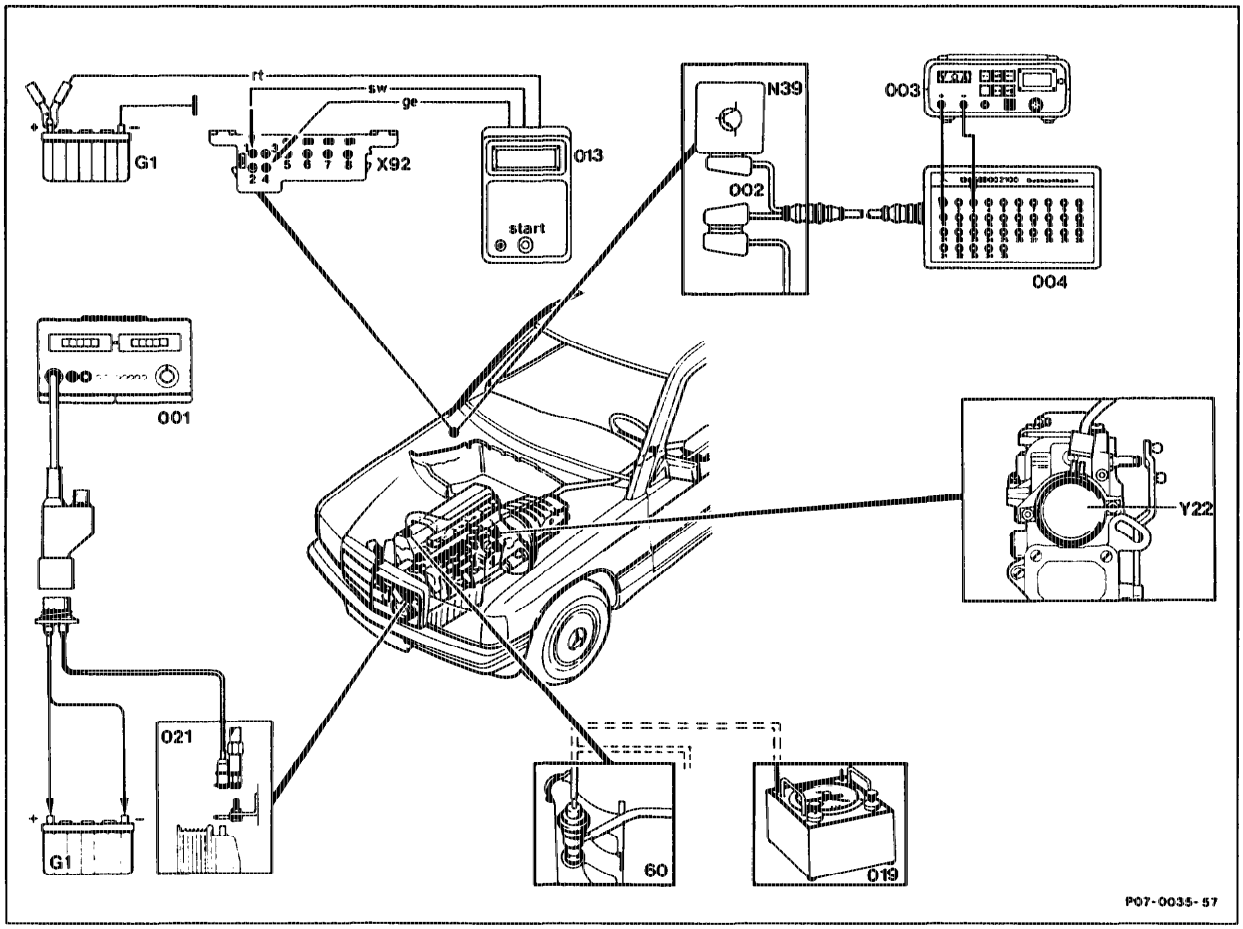
Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
–	Idle speed control	Revolution counter with TDC generator	Engine idling Coolant temperature approx. 80 °C	**Engine 602.96** 740 ± 20 rpm[1]) 680 ± 20 rpm[2]) **Engine 603.96** 630 ± 20 rpm 680 ± 20 rpm[3])	Actuator, injection pump, engine speed sensor (L3), control unit (N39), refer to test steps 7 and 11
			Plug detached from actuator	**Engine 602.96** 690 ± 20 rpm[1]) 620 ± 20 rpm[2]) **Engine 603.96** 580 ± 20 rpm 620 ± 20 rpm[3])	Set speed at injection pump, renew injection pump
–	Exhaust control circuit	Connect vacuum tester with Y distributor to ARF valve	Engine running at 900/min and 250 mbar Briefly apply full throttle	Vacuum drops	Perform mechanical test of vacuum transducer (Y31/1), air flow sensor (B2/1), EDS control unit (N39), ARF valve
–	ARF valve	Connect vacuum tester directly to ARF valve	Engine switched off ARF valve with 300 mbar and disconnect again	ARF valve is heard to close	Renew ARF valve

[1]) Manual transmission
[2]) Automatic transmission
[3]) 4MATIC with manual transmission

E. Engines 602.96 and 603.96 (A) model year 1990 and (FIN) model year 1991

a) Short-test
b) Testing with pulse counter
c) Troubleshooting schedule
d) Test program with contact box
e) ELR and ARF function test

a) Short-test



Digital tester (001) and pulse counter (021)	connect, disconnect.
Pulse counter (013)	connect, disconnect to battery (G1) and with adapter to test connector (X92 or X11/4).
Contact box (004)	connect, disconnect with test cable (002) to EDS control unit (N39).
Digital multimeter (003)	connect, disconnect at contact box (004).
Vacuum tester (019)	connect, disconnect with Y distributor to ARF valve.
Fuse at overvoltage protection (K1/1)	test.
Selector lever	move into position "P".
Air conditioning/automatic climate control	switch off.
Engine	bring to operating temperature. (Coolant temperature approx. 80 °C)
Start button of pulse counter (013)	operate for 2–4 seconds.
Display	read off and note.
Start button	press once again. If no new display appears, there are no further faults in the system.

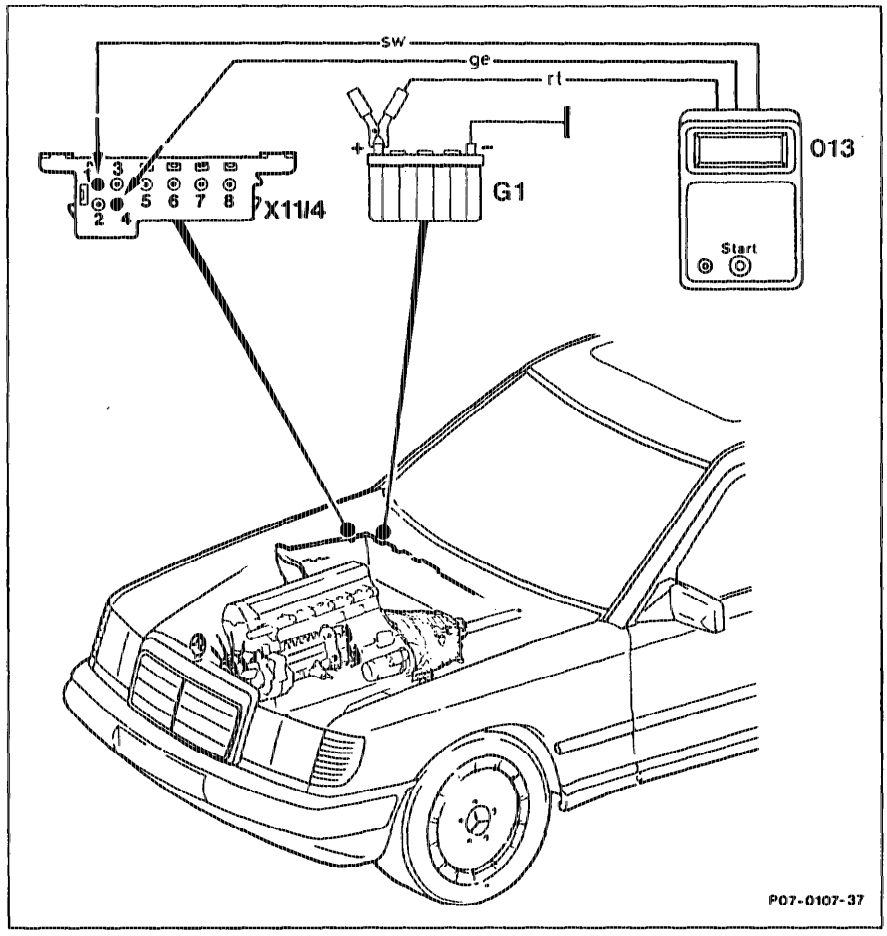
The number of pulses indicates whether and which electrical component is faulty and whether components in the control circuit are faulty.

Pulse readout	Component/control loop
1	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) altitude sensor
5 [2)]	Vacuum transducer (Y31/1) or fault in exhaust control loop
6	EDS control unit (N39) internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B11/4)
9	Air intake temperature sensor (B2/1a)
10	Power supply
11 [1)]	ELR actuator or vacuum transducer

1) Readout only in the case of short circuit.
2) Readout only at 1200 rpm for at least 5 seconds. Fault is not stored.

b) Testing with pulse counter

Connection diagram



013 Pulse counter
X11/4 Test connection for diagnostics
G1 Battery

Assignment (X11/4)
1 Ground
2 TD signal
3 Pulse output ARA control unit (N8/2)
4 Pulse output EDS control unit (N39)

Notes regarding pulse readout

If a complaint is received but no fault is indicated on the pulse readout, perform the function test, section "e".

The number 1 indicates no fault detected in the electronic system. All other numbers are assigned to a particular fault group.

The numbers from 1 to 11 appear in the display panel of the pulse counter.

If the LED U-Batt appears after connecting, pulse counter and power supply for pulse counter are in order.

Testing

1 Connect pulse counter according to wiring diagram.

Note

LED U-Batt in display panel must light up; if not:

a) test fuse of pulse counter.
b) test jack 1 of test connector (X92 or X11/4) to battery positive (11–14 V).
c) test jack 4 of test connector (X92 or X11/4) to jack 1 (6–12 V).

2 Engine idling.

3 Operate start button for between 2 and 4 seconds.

4 Take readout of pulse output and note.

Readout "1" = no fault
Greater than "1" = fault in system

5 Operate start button again for between 2 and 4 seconds. If there is no further fault in the system, the previous value appears again. If there is a further fault in the system, its fault code is displayed.

6 Repeat again until the first fault is displayed again.

7 Eliminate faults noted (pulse output) through troubleshooting program.

8 Perform testing of components.

Erasing fault memory

After a fault has been eliminated the pulse displayed must be erased as follows:

9 Operate start button and read out the eliminated fault, then operate start button for 6–8 seconds.

Note

Each fault displayed must be erased individually.
If the fault is eliminated and erased, the fault code no longer appears on the fault output.
If a number larger than 1 is displayed, there are further faults in the system.

c) Troubleshooting schedule

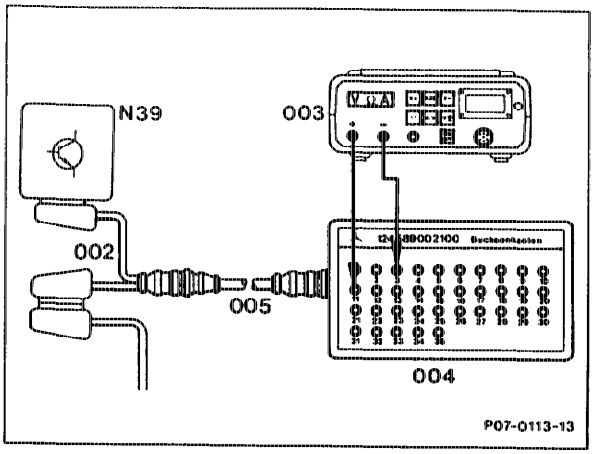
The number of pulses indicates whether and which electrical component is faulty and whether components in the control circuit are faulty.

Pulse readout	Component/Control loop
1	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) altitude sensor
5 [2])	Vacuum transducer (Y31/1) or fault in exhaust control loop
6	EDS control unit (N39) internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Power supply
11 [1])	ELR actuator or vacuum transducer

[1]) Readout only in the case of short-circuit.
[2]) Readout only at 1200 rpm for at least 5 seconds. Fault is not stored.

d) Test program with contact box

Connection diagram contact box



002 25-pin test cable 124 589 33 63 00
003 Multimeter
004 35-pin contact box 124 589 00 21 00
005 Test cable 124 589 34 63 00
N39 EDS control unit

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
1	1.0	–	–	–	No fault stored
2	2.0 Control rod travel sensor (L7)	N39 4 – Ω + 5 4 – Ω + 6 4 – Ω + 3 4 – Ω + 1	Ignition: OFF EDS control unit detached	50 ± 4 Ω 25 ± 4 Ω ∞ ∞	Renew control rod travel sensor or injection pump Cables
	2.1 Control rod travel sensor (L7)	L7 2 – Ω + 3	Ignition: OFF Connector on control rod travel sensor (L7) detached	50 ± 4 Ω	Renew injection pump
		L7 2 – Ω + 1		25 ± 2 Ω	Renew injection pump

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[2]	2.2 Cables	N39 4 — Ω — L7 3	Connector on control rod travel sensor (L7) detached	<1 Ω	Cable interrupt
		N39 5 — Ω — L7 2		<1 Ω	Cable interrupt
		N39 6 — Ω — L7 1		<1 Ω	Cable interrupt
3	3.0 Air flow sensor potentiometer (B2/1)	N39 3 — V — 24	Ignition: **ON** EDS control unit (N39) connected	5 ± 0.5 V	Air flow sensor potentiometer (B2/1) Cables
		N39 3 — V — 10		<0.5 V	
		N39 3 — V — 10	Engine idling	**Engine 603** 1.2 ± 0.2 V **Engine 602** 1.7 ± 0.2 V	Test value in order although fault was stored. Cause: Air flow sensor plate jammed briefly during starting. Replace air flow sensor if necessary EDS control unit (N39)
	3.1 Air flow sensor potentiometer (B2/1)	N39 3 — Ω — 24	Ignition: **OFF** EDS control unit (N39) detached	500–1200 Ω	
		N39 3 — Ω — 10	Air flow sensor plate in off position	50–200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 — Ω — 10	Air flow sensor plate fully deflected	560–1100 Ω	Air flow sensor potentiometer (B2/1)

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[3]	3.2 Cables	N39 B2/1 10 — Ω — 3	Connector on Air flow sensor potentiometer (B2/1) detached	< 1 Ω	Cable interrupt
		N39 B2/1 24 — Ω — 4		< 1 Ω	Cable interrupt
4	4.0	–	–	–	Renew EDS control unit (N39) (atmospheric pressure sensor)
5 [2])	5.0 Vacuum transducer (Y31/1)	N39 1 — V — 18	Engine approx. 900 rpm		
		Vacuum at ARF valve	Approx. 250 mbar	2.5 ± 0.5 V	Supply line (black/white) leaking. Air admission line (black) blocked. Air admission filter (62a) closed. Supply line (black/white) closed or interrupted. Vacuum transducer (Y31/1). Cables. EDS control unit, air flow sensor potentiometer, ARF valve.
	5.1 Cables	N39 Y31/1 18 — Ω — 1	Ignition: OFF Connector on vacuum transducer (Y31/1) detached	< 1 Ω	Cable interrupt
		N39 Y31/1 1 — Ω — 2		< 1 Ω	Cable interrupt

[2]) Readout only at 900 rpm for at least 5 seconds, fault is not stored.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
6	6.0	–	–	–	Internal power supply. Renew control unit (N39).
7	7.0 TD signal	N39 3 (V) 20	Engine idling EDS control unit connected	> 2.8 V ⏦ [4]	Engine speed sensor, distance, dirt, cables. Cable (N39) to X11/4 Short-circuit or control unit (N8/1) or (N39).
	7.1 Cables	N39 20 (Ω) X11/4 2	Ignition: OFF	< 1 Ω	Cable interrupt
	7.2	N8/2 6 (Ω) X11/4 2	Control unit (N8/2) detached	< 1 Ω	Cable interrupt
8	8.0 Coolant temperature sensor (B11/4)	N39 3 (V) 9	Ignition: ON EDS control unit connected	[3]	Coolant temperature sensor (B11/4), cables, EDS control unit
	8.1 Coolant temperature sensor (B11/4)	N39 3 (Ω) 9	Ignition: OFF EDS control unit detached	[3]	Coolant temperature sensor (B11/4), cable
		⊥ (Ω) B11/4	Plug connector (B11/4) disconnected	[3]	Coolant temperature sensor (B11/4)
	8.2 Cable	N39 9 (Ω) B11/4	Ignition: OFF EDS control unit detached	< 1 Ω	Cable interrupt

[3] Refer to table of temperature sensors for coolant and intake air.
[4] Voltage drops as speed increases.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
9	9.0 Intake air temperature sensor (B2/1a)	N39 3 (V) 22	Ignition: **ON** EDS control unit connected	[3]	Temperature sensor, air flow sensor, cables, EDS control unit
	9.1 Intake air temperature sensor (B2/1a)	N39 3 (Ω) 22	Ignition: **OFF** EDS control unit disconnected	[3]	Cable to temperature sensor, temperature sensor
		B2/1 1 (Ω) 2	Connector on air flow sensor (B2/1) detached	[3]	Temperature sensor
	9.2 Cables	N39 B2/1 22 (Ω) 1	Ignition: **OFF** EDS control unit disconnected Detach connector on air flow sensor (B2/1)	< 1 Ω	Cable interrupt
		N39 B2/1 3 (Ω) 2		< 1 Ω	Cable interrupt
10	10.0 Power supply	N39 14 (V) 1	Engine approx. 1500 rpm	11–14 V	Alternator regulator Voltage > 18 V

[3] Refer to table of coolant temperature sensor and intake air.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
11 [1])	11.0 ELR actuator (Y22)	N39 3 — V — 2 N39 2 — V — 1	Ignition: **ON** Engine idling, EDS control unit connected	9.5–12 V 3.5 ± 0.5 V	Actuator (Y22) Cables Control unit (N39)
	11.1	N39 1 — Ω — 2	Ignition: **OFF** EDS control unit dis-connected	4.0 ± 0.5 Ω	Actuator (Y22) Cables
	11.2 Cables	N39 — Y22 1 — Ω — 2 N39 — Y22 2 — Ω — 1	Detach connector on actuator (Y22)	< 1 Ω < 1 Ω	Cable interrupt Cable interrupt

[1]) Readout only in the case of short-circuit.

Table of coolant temperature sensor and intake air

Temperature in °C	Resistance (± 10%)	Voltage in V (± 10%)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

e) ELR and ARF function test

Note
This test should be conducted if a complaint has been received but no fault is indicated on the pulse readout.

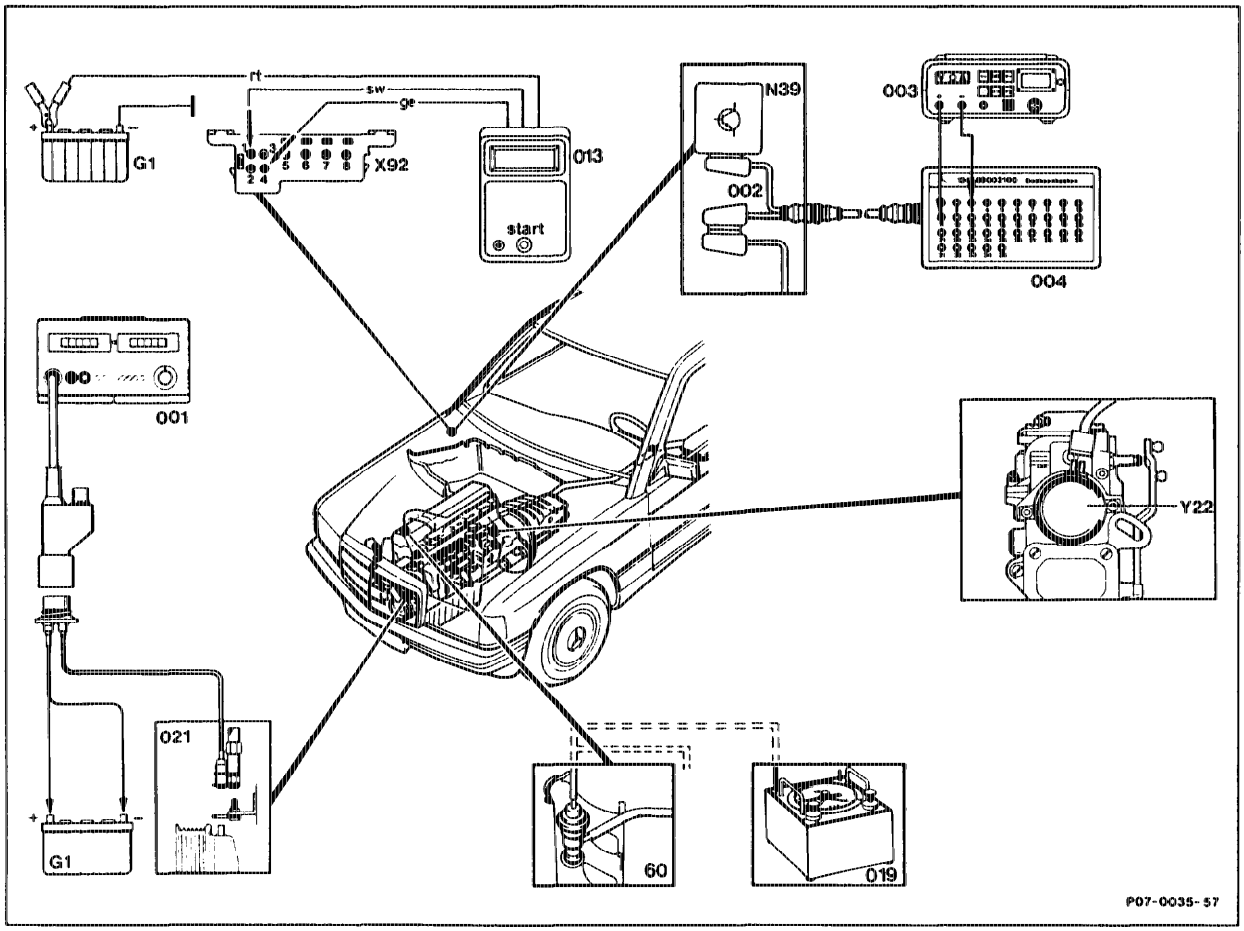
Test step/ test scope	Test connection/ test instrument	Operation/ requirement	Specification	Possible cause/remedy
Idle speed control	Revolution counter with TDC generator	Engine idling Coolant temperature approx. 80 °C	**Engine 602.96** 680 ± 20 rpm[1]) 740 ± 20 rpm[2]) **Engine 603.96** 630 ± 20 rpm 680 ± 20 rpm[3])	Actuator (Y22), injection pump, engine speed sensor (L3), control unit (N39) refer to test steps 7 and 11
		Plug detached from actuator (Y22)	**Engine 602.96** 620 ± 40 rpm[1]) 690 ± 40 rpm[2]) **Engine 603.96** 580 ± 20 rpm 620 ± 20 rpm[3])	Set speed at injection pump, injection pump
Exhaust control circuit	Connect vacuum tester with (Y) distributor to ARF valve	Engine running at 900 rpm and 250 mbar Briefly apply full throttle	Vacuum drops	Vacuum transducer (Y31/1). Perform mechanical test of air flow meter (B2/1). EDS control unit (N39) ARF valve
ARF valve	Connect vacuum tester directly to ARF valve	Engine switched off Pressurized ARF valve with 300 mbar, vacuum line disconnected	ARF valve is heard to close	Renew ARF valve

[1]) Automatic transmission
[2]) Manual transmission
[3]) 4MATIC with manual transmission

F. Engines 602.962 and 603.970, (USA) Model Year 1990
Engine 602.962 (CH) (DK) Model Year 1991

a) Short-test
b) Testing with pulse counter
c) Troubleshooting schedule
d) Test program with contact box
(Engine 602.962)
e) ELR, ARF function test, P2 control
f) Test program with contact box
(Engine 603.970)
g) ELR and ARF function test (Engine 603.970)

a) Short-test



Digital tester (001) and pulse counter (021)	disconnect, connect.
Pulse counter (013)	connect, disconnect to battery (G1) and with adapter to test connector (X92 or X11/4).
Contact box (004)	connect, disconnect with test cable (002) to EDS control unit (N39).
Digital multimeter (003)	connect, disconnect at contact box (004).
Vacuum tester (019)	connect, disconnect with Y distributor at ARF valve.
Fuse at overvoltage protection (K1/1)	test.
Selector lever	move into position "P".
Airconditioning/automatic climate control	switch off.
Engine	bring to operating temperature (coolant temperature approx. 80 °C).
Start button of pulse counter (013)	operate for 2–4 seconds.
Display	read off and note.
Start button	press once again. If no new display appears, there is no further fault in the system.

Engine 602.962

The number of pulses indicate whether and which component is faulty and whether components in the control circuit are faulty.

Pulse readout	Component/control loop
1 [3])	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) atmospheric pressure sensor
5 [2])	Vacuum transducer (Y31/1) or fault in exhaust control loop
6	EDS control unit (N39) internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Not assigned
11 [1])	ELR actuator or vacuum transducer (Y31/1)
12	Not assigned
13	EDS control unit (N39) defective (internal memory)
14	Pressure sensor (B5/1), EDS defective
15	Vacuum transducer, charge pressure control (Y31/2) pressure transducer pressure control flap (Y31/3) or faults in charge pressure control loop

[1]) Readout only in the case of short-circuit.
[2]) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[3]) In the event of complaints perform functional test on ELR, ARF, P2 control.

Engine 603.970

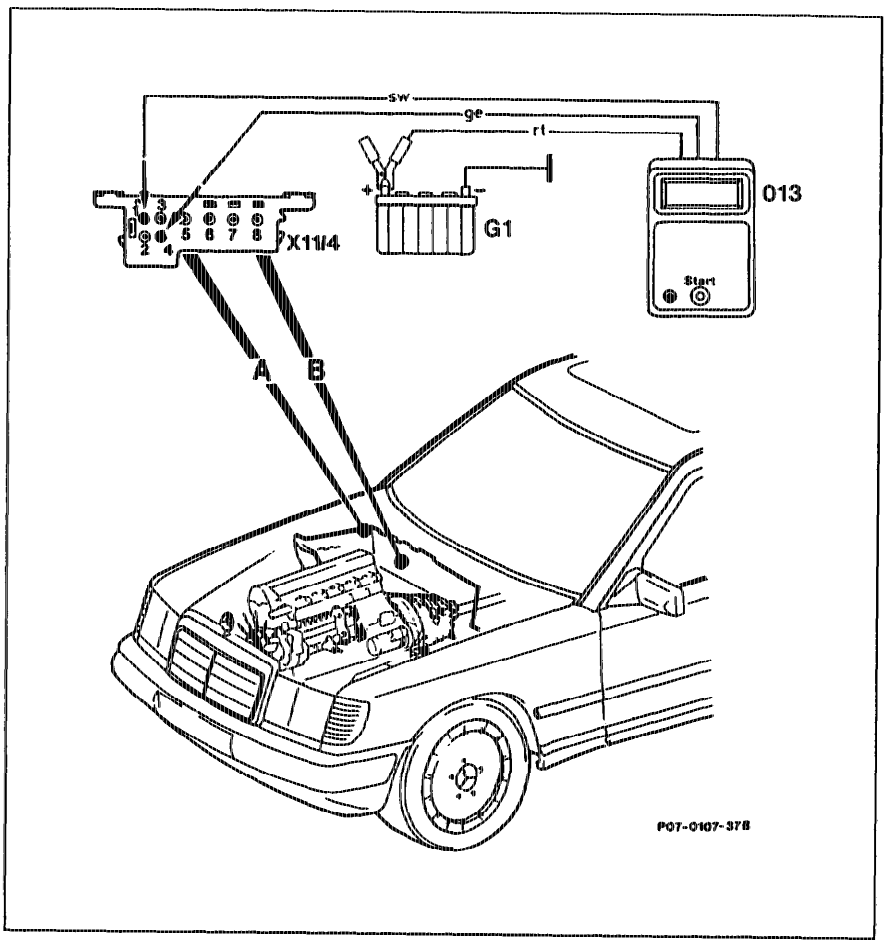
The number of pulses indicates whether and which component is faulty and whether components in the control circuit are faulty.

Pulse readout	Component/control loop
1 [3]	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) altitude sensor
5 [2]	Vacuum transducer (Y31/1) or fault in exhaust control loop
6	EDS control unit (N39) Internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Power supply
11 [1]	ELR actuator or vacuum transducer (Y31/1)
12	Not assigned
13	EDS control unit (N39) defective

[1] Readout only in case of short-circuit.
[2] Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[3] In the event of complaints, perform ELR and ARF function tests.

b) Testing with pulse counter

Connection diagram



013 Pulse counter
G1 Battery
X11/4 Test connector for diagnostics

A Model 124
B Model 126

Assignment (X11/4)
1 Ground
2 TD signal
3 Pulse output
Exhaust test signal (only for production tuning)
4 Pulse readout, control unit (EDS)

Notes regarding pulse readout

If a complaint is received but no fault is indicated on the pulse readout, perform the function test, section "7.4".

The number 1 indicates no fault detected in the electronic system. All other numbers are assigned to a particular fault group.

The numbers from 1 to 11 appear on the display panel of the pulse counter.

If the LED U-Batt appears after connecting, pulse counter and power supply for pulse counter are in order.

Testing

1 Connect pulse counter as shown in the connection diagram.

Note

LED U-Batt in display panel must light up; if not:

a) test fuse of pulse counter.
b) test jack 1 of test connector (X11/4) to battery positive (11–14 V).
c) test jack 4 of test connector (X11/4) to jack 1 (6–12 V).

2 Engine idling.

3 Operate start button for between 2 and 4 seconds.

4 Take readout of pulse output and note.

Display "1" = no fault
Greater than "1" = fault in system

5 Again press start button for between 2 and 4 seconds. If no further fault exists in system, the previous readout appears once again.

6 Repeat until the first fault is diplayed again.

7 Rectify noted faults (pulse readout) according to trouble-shooting schedule.

8 Perform component test.

Erasing fault memory

After a fault has been rectified, the pulse display must be erased as follows:

9 Operate start button and read out the rectified fault, then press start button for 6–8 seconds.

Note

Each display pulse must be erased **individually**.
The fault is eliminated and erased when the fault code no longer appears on the fault display.
Display of a number larger than 1, further faults in system.

c) Troubleshooting schedule

Engine 602.962

The number of pulses indicates whether and which component is faulty and whether components in the control circuit are faulty.

Pulse readout	Component/control loop
1 [3])	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) atmospheric pressure sensor
5 [2])	Vacuum transducer (Y31/1) or faults in exhaust control loop
6	EDS control unit (N39) internal power supply
7	Engine speed sensor (L3)
8	Engine coolant sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Not assigned
11 [1])	ELR actuator or vacuum transducer (Y31/1)
12	Not assigned
13	EDS control unit (N39) defective (internal memory)
14	Pressure sensor (B5/1), EDS defective
15	Vacuum transducer, charge pressure control (Y31/2). Vacuum transducer, pressure control flap (Y31/3) or fault in charge pressure control circuit

[1]) Readout only in the case of short-circuit.
[2]) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[3]) In the event of complaints perform functional test on ELR, ARF, P2 control.

Engine 603.970

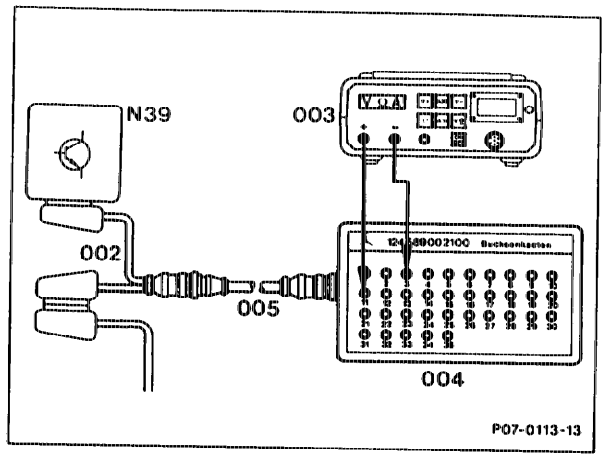
The number of pulses indicates whether and which component is faulty and whether components in the control circuit are faulty.

Pulse readout	Component/control loop
1 [3])	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39) atmospheric pressure sensor
5 [2])	Vacuum transducer (Y31/1) or faults in exhaust control loop
6	EDS control unit (N39) Internal power supply
7	Engine speed sensor (L3)
8	Coolant temperature sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Power supply
11 [1])	ELR actuator or vacuum transducer (Y31/1)
12	Not assigned
13	EDS control unit (N39) faulty

[1]) Readout only in the case of short-circuit.
[2]) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[3]) In the event of complaints perform ELR and ARF function test.

d) Test program with contact box (Engine 602.962)

Connection diagram contact box

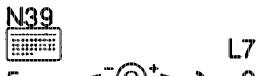
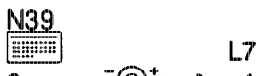
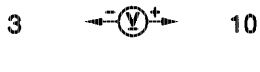


002 25-pin test cable 124 589 33 63 00
003 Multimeter
004 35-pin contact box 124 589 00 21 00
005 Test cable 124 589 34 63 00
N39 EDS control unit

Symbols for test instruments

Contact box
Multimeter
Jack
Pin
Voltage measurement (volt, direct voltage)
Resistance measurement (ohms)

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
1	1.0	–	–	–	
2	2.0 Control rod travel sensor (L7)	N39 4 Ω 5 4 Ω 6 4 Ω 3 4 Ω 1	Ignition: OFF EDS control unit disconnected	50 ± 4 Ω 25 ± 2 Ω ∞ Ω ∞ Ω	Renew control rod travel sensor or injection pump Cables

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[2]	2.1 Control rod travel sensor (L7)		Ignition: **OFF** Connector on control rod travel sensor (L7) disconnected	50 ± 4 Ω	Renew control rod travel sensor or injection pump
				25 ± 2 Ω	Renew control rod travel sensor or injection pump
	2.2 Cables		Ignition: **OFF** Connector on control rod travel sensor (L7) disconnected	< 1 Ω	Cable interrupt
				< 1 Ω	Cable interrupt
			Ignition: **OFF**	< 1 Ω	Cable interrupt
3	3.0 Air flow sensor potentiometer (B2/1)		Ignition: **ON** EDS control unit (N39) connected	5 ± 0.5 V	EDS control unit (N39)
				< 0.5 V	Cables Test value in order although fault was stored. Cause: Air flow sensor plate jammed briefly during starting; replace air flow sensor if necessary.
			Engine idling	1.7 ± 0.2 V [1])	EDS control unit (N39)

[1]) Voltage rises as speed increases.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[3]	3.1 Air flow sensor potentiometer (B2/1)	N39 3 Ω 24	Ignition: **OFF** EDS control unit (N39) disconnected	500–1200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 Ω 10	Air flow sensor in off position	50–200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 Ω 10	Air flow sensor plate fully deflected	560–1100 Ω	Air flow sensor potentiometer (B2/1)
	3.2 Cables	N39 10 Ω B2/1 — 3	Connector on air flow sensor potentiometer (B2/1) disconnected	< 1 Ω	Cable interrupt
		N39 24 Ω B2/1 — 4		< 1 Ω	Cable interrupt
4	4.0	–	–	–	Renew EDS control unit (N39) (atmospheric pressure sensor)
5 [2])	5.0 Vacuum transducer (Y31/1) ARF valve	N39 18 V 1 Vacuum at ARF valve	Engine 900/min. ± 50	> 3 V [4]) approx. 300 mbar [4])	 Supply line black/white leaking. Air admission line (black) blocked. Air admission filter (62a) dirty. Supply line black/white or vacuum line black (rubber) blocked or leaking. Vacuum transducer (Y31/1). Cables, EDS control unit, air flow sensor potentiometer, ARF valve

[2]) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[4]) Apply full throttle briefly, vacuum and voltage drops. The test values are reference values.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[5] [2])	5.1 Cables	N39 18 Ω Y31/1 1	Ignition: **OFF** Connector on vacuum transducer (Y31/1) detached	< 1 Ω	Cable interrupt
		N39 1 Ω Y31/1 2		< 1 Ω	Cable interrupt
6	6.0	–	–	–	Internal power supply. Renew EDS control unit
7	7.0 Engine speed sensor (L3)	N39 3 V 20	Engine idling EDS control unit disconnected	> 3 V [1])	Engine speed sensor, distance, dirt, cables
	7.1 TD signal	N39 3 V 25	Engine idling EDS control unit connected	> 3.5 V [6])	Cable (N39) to (X11/4) Short circuit or EDS control unit
	7.2 Engine speed sensor (L3)	N39 3 Ω 20	Ignition: **OFF** EDS control unit disconnected	Beru [5]) 527 Ω ± 10 % VDO [5]) 1900 Ω ± 10 %	Engine speed sensor (L3) Cables
		L3x 1 Ω 2	Plug connector (L3x) detached	Beru [5]) 527 Ω ± 10 % VDO [5]) 1900 Ω ± 10 %	Engine speed sensor (L3) (M27)

[1]) Voltage rises as speed increases.
[2]) Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[5]) Measured at 20 °C ambient temperature (for each 10 °C change in ambient temperature the resistance changes by 4 %).
[6]) Voltage drops by approx. 0.5 V and stabilises.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[7]	7.3 Cables	N39 20 — Ω — L3x 2		< 1 Ω	Cable interrupt
		N39 3 — Ω — L3x 1		< 1 Ω	Cable interrupt
8	8.0 Coolant temperature sensor (B11/4)	N39 3 — V — 9	Ignition: ON EDS control unit connected	[3]	Coolant temperature sensor, cables, EDS control unit
	8.1 Coolant temperature sensor (B11/4)	N39 14 — Ω — 9	Ignition: OFF EDS control unit connected	[3]	Coolant temperature sensor
		⊥ — Ω — B11/4	Plug connector (B11/4) detached	[3]	Coolant temperature sensor
	8.2 Cable	N39 9 — Ω — B11/4	Ignition: OFF EDS control unit disconnected	< 1 Ω	Cable interrupt
9	9.0 Intake air temperature sensor (B2/1a)	N39 3 — V — 22	Ignition: ON EDS control unit connected	[3]	Temperature sensor, intake air, air flow sensor, cables, EDS control unit

[3] Refer to table of coolant temperature sensor and intake air.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[9]	9.1 Intake air temperature sensor (B2/1a)	N39 3 Ω 22	Ignition: **OFF** EDS control unit disconnected	[3]	Cable to intake air temperature sensor Temperature sensor
		B2/1 1 Ω 2	Connector on air flow sensor (B2/1) disconnected	[3]	Intake air temperature sensor
	9.2 Cables	N39 22 Ω B2/1 1	Ignition: **OFF** EDS control unit disconnected Connector on air flow sensor potentiometer (B2/1) detached	< 1 Ω	Cable interrupt
		N39 3 Ω B2/1 2		< 1 Ω	Cable interrupt
10	10.0 Power supply	N39 14 V 1	Engine approx. 1500/min	11–14 V	Alternator regulator Lima Voltage > 18 V
11 [1]	11.0 ELR actuator (Y22)	N39 3 V 2	EDS control unit connected	11–14 V	Actuator (Y22) Cables
		N39 2 V 1	Ignition: **ON** Engine idling	2.5 ± [2] 0.5 V	EDS control unit (N39)

[1] Readout only in the case of short-circuit.
[2] Reference value, voltage drops as speed increases.
[3] Refer to table of coolant temperature sensor and intake air.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[11] [1]	11.1	N39 1 2	Ignition: OFF EDS control unit disconnected	4 ± 1 Ω	Actuator (Y22) Cables
	11.2 Cables	N39 1 Y22 2	Ignition: OFF Detach connector at actuator (Y22)	< 1 Ω	Cable interrupt
		N39 2 Y22 1		< 1 Ω	Cable interrupt
13					Internal memory Renew EDS control unit (N39)
14	14.0 Pressure sensor (B5/1)	N39 3 12	Ignition: ON EDS control unit connected	> 5 V	Pressure sensor Pressure lines Electrical cables
	14.1 Pressure sensor (B5/1)	N39 3 17	Engine idling	> 1.5 V 0 mbar	Pressure sensor Pressure lines Electrical cables
		Pressure tester with Y distributor on pressure sensor	Apply full throttle briefly	Voltage rises, pressure rises > 500 mbar	
	14.2 Pressure sensor (B5/1)	N39 3 12	Ignition: OFF EDS control unit detached	1.4 ± 0.2 kΩ	
	14.3 Cables	N39 3 B5/1 3		< 1 Ω	Cable interrupt

[1] Readout only in the case of short-circuit.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[14]	14.4 Cables	N39 12 — Ω — B5/1 2	Ignition: **OFF** EDS control unit disconnected	< 1 Ω	Cable interrupt
	14.5 Cables	N39 17 — Ω — B5/1 1	Ignition: **OFF** EDS control unit disconnected	< 1 Ω	Cable interrupt
15	15.0 Vacuum transducer (Y31/2)	N39 7 — V — 1	Engine idling EDS control unit connected	Approx. 0.4 V < 100 mbar	Vacuum transducer (Y31/2) Vacuum lines EDS control unit
	Vacuum unit, pressure control flap	Vacuum tester with Y distributor on vacuum transducer (Y31/2) Output (OUT)	Increase speed slowly to approx. 2000/min	Vacuum increases Voltage rises	
	15.1 Cables	N39 7 — Ω — Y31/2 1	Ignition: **OFF** EDS control unit disconnected Connector on (Y31/2) detached	< 1 Ω	Cable interrupt
	15.2 Cables	N39 1 — Ω — Y31/2 2	Connector on (Y31/2) detached	< 1 Ω	Cable interrupt
	15.3 Vacuum transducer (Y31/3)	N39 8 — V — 1	Engine idling EDS control unit connected	Approx. 4 V < 300 mbar	Vacuum transducer (Y31/3) Vacuum lines EDS control unit
	Vacuum unit, charge pressure control valve	Vacuum tester with Y distributor on vacuum transducer (Y31/3) Output (OUT)	Increase speed slowly to approx. 2000/min	Voltage drops Vacuum drops	Vacuum transducer (Y31/3) Vacuum lines EDS control unit

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/remedy
[15]	15.4 Cables	N39 1 — Y31/3 2	Ignition: OFF EDS control unit disconnected	< 1 Ω	Cable interrupt
		N39 8 — Y31/3 1		< 1 Ω	Cable interrupt

Coolant temperature sensor and intake air

Temperature in °C	Resistance (± 10%)	Voltage in V (± 10%)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

e) ELR, ARF function tests, P2 control, Engine 602.962

Note
This test is to be performed when in the event of complaint concerning the pulse readout, no fault is displayed

Test step/ test scope	Test connection/ test instrument	Operation/ requirement	Specifi- cation	Possible cause/ remedy
1.0 Idle speed control	Revolution counter with TDC generator	Engine idling Coolant tempera- ture approx. 80 °C	Automatic transmission: 680 ± 20 rpm Manual transmission: 740 ± 20 rpm	Actuator, injection pump, engine speed sensor, EDS control unit (N39), refer to test steps 7 and 11
		Plug detached from actuator	Automatic transmission: 610 ± 20 rpm Manual transmission: 690 ± 20 rpm	Set speed at injection pump. Injection pump
2.0 Exhaust control circuit	Connect vacuum tester with Y distributor to ARF valve	Engine running at 900 rpm ± 50 and approx. 300 mbar Briefly apply full throttle	Vacuum drops	Perform mechanical test on vacuum transducer (Y31/1) and air flow sensor (B2/1). EDS control unit (N39) ARF valve
3.0 ARF valve	Connect vacuum tester directly to ARF valve.	Engine switched off Pressurize ARF valve with 300 mbar and disconnect again	ARF valve is heard to close	Renew ARF valve

Test step/ test scope	Test connection/ test equipment	Operation/ requirement	Specifi- cation	Possible cause/remedy
4.0 Charge pressure control	Connect vacuum tester (020) with Y distributor to output (OUT) from vacuum transducer (Y31/3)	Engine idling	>300 mbar	Vacuum supply Vacuum line Vacuum transducer (Y31/3) EDS control unit (N39)
Vacuum unit Charge pressure control valve		Slowly increase speed to approx. 2000 rpm	Vacuum reduces	
4.1 Vacuum unit Pressure control flap (100)	Connect vacuum tester (020) with Y distributor to vacuum unit pressure control flap (100)	Engine idling	<100 mbar	Vacuum supply Vacuum line
		Slowly increase speed to approx. 2000 rpm	Vacuum increases	Vacuum transducer (Y31/2) Pressure line on pressure sensor (B5/1) EDS control unit

f) Test program with contact box (Engine 603.970)

Symbols for test instruments:

- Contact box
- Multimeter
- Jack
- Pin
- Voltage measurement (volt, direct voltage)
- Resistance measurement (ohm)

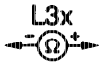
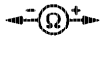
Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/remedy
1	1.0	–	–	–	No fault stored
2	2.0 Control rod travel sensor (L7)	N39 4 – 5 4 – 6 4 – 3 4 – 1	Ignition: OFF EDS control unit disconnected	50 ±4 Ω 25 ±2 Ω ∞ ∞	Renew control rod travel sensor or injection pump. Cables
	2.1 Control rod travel sensor (L7)	L7 2 – 3	Ignition: OFF Connector on control rod travel sensor (L7) detached	50 ±4 Ω	Renew control rod travel sensor or injection pump
		L7 2 – 1	Connector control rod travel sensor (L7) detached	25 ±2 Ω	Renew control rod travel sensor (L7) or injection pump
3	3.0 Air flow sensor potentiometer (B2/1)	N39 3 – 24	Ignition: ON EDS control unit (N39) connected	5 ±0.5 V	Air flow sensor potentiometer Cables Test value in order. Fault was, however, stored.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/remedy
[3]	[3.0]	N39 3 (V) 10		< 0.5 V	Cause: Air flow sensor plate jams during starting, renew air flow sensor if necessary EDS control unit (N39)
		N39 3 (V) 10	Engine idling	1.4 ± 0.2 V	
	3.1 Air flow sensor potentiometer (B2/1)	N39 3 (Ω) 24	Ignition: OFF EDS control unit (N39) disconnected	500–1200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 (Ω) 10	Air flow sensor plate in off position	50–200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 (Ω) 10	Air flow sensor plate fully deflected	560–1100 Ω	Air flow sensor potentiometer (B2/1)
	3.2 Cables	N39 10 (Ω) B2/1 — 3	Connector on air flow sensor potentiometer (B2/1) detached	< 1 Ω	Cable interrupt
		N39 24 (Ω) B2/1 — 4		< 1 Ω	Cable interrupt
4	4.0				Renew atmospheric pressure sensor, EDS control unit (N39)

2) Readout only at 900/min for at least 5 seconds, fault is not stored.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/remedy
5 [2]	5.0 Vacuum transducer (Y31/1) ARF valve	N39 18 (V) 1 Vacuum at ARF valve	Engine 900 rpm ±50 [4] approx. 300 mbar [4]	 >3 V [4]	Supply line (red/brown) leaking Air admission line (black) blocked. Air admission filter closed (62a). Supply line (red/brown) or vacuum line (rubber) closed or interrupted. Vacuum transducer (Y31/1). Cables, EDS control unit, air flow sensor potentiometer, ARF valve
	5.1 Cables	N39 18 (Ω) Y31/1 — 1	Connector on vacuum transducer (Y31/1) detached	<1 Ω	Cable interrupt
		N39 1 (Ω) Y31/1 — 2		<1 Ω	Cable interrupt
6	6.0	–	–	–	Internal power supply Renew EDS control unit (N39)
7	7.0 Engine speed sensor (L3)	N39 3 (V) 20	Engine idling EDS control unit disconnected	>3 V [1]	Engine speed sensor, distance, dirt, cables
	7.1 TD signal	N39 3 (V) 25	Engine idling EDS control unit connected	>2.8 V [6]	Cable N39 closed (X11/4) Short-circuit or EDS control unit (N39)

[1] Voltage increases as speed increases.
[2] Readout only at 900 rpm for at least 5 seconds, fault is not stored.
[4] Apply full throttle briefly, vacuum and voltage drops. The test values are reference values.
[6] Voltage falls by approx. 0.5 V and stabilizes.

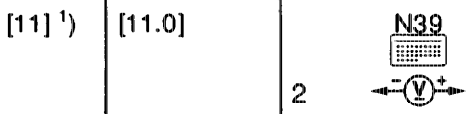
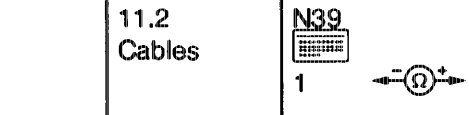
Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/remedy
[7]	7.2 Engine speed sensor (L3)	N39 3  20	Ignition: **OFF** EDS control unit detached	Beru [5]) 527 Ω ± 10 % VDO [5]) 1900 Ω ± 10 %	Engine speed sensor (L3) Cables
		L3x 1  2	Plug connector (L3x) separated	Beru [5]) 527 Ω ± 10 % VDO [5]) 1900 Ω ± 10 %	Engine speed sensor (L3)
	7.3 Cables	N39 20  L3x 2		< 1 Ω	Cable interrupt
		N39 3  L3x 1		< 1 Ω	Cable interrupt
8	8.0 Coolant temperature sensor (B11/4)	N39 3  9	Ignition: **ON** EDS control unit connected	[3])	Coolant temperature sensor, cables, EDS control unit
	8.1 Coolant temperature sensor (B11/4)	N39 3  9	Ignition: **OFF** EDS control unit dis-connected	[3])	Coolant temperature sensor, cable
		⊥  B11/4	Plug connector (B11/4) detached	[3])	Coolant temperature sensor (B11/4)
	8.2 Cable	N39 9  B11/4	Ignition: **OFF** EDS control unit dis-connected	< 1 Ω	Cable interrupt

[3]) Refer to table for coolant temperature sensor and intake air.

[5]) Measured at 20 °C ambient temperature (for each 10 °C change in ambient temperature the resistance changes by 4 %).

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/remedy
9	9.0 Intake air temperature sensor (B2/1a)	N39 3 (V) 22	Ignition: **ON** EDS control unit connected	[3]	Intake air temperature sensor, air flow sensor (B2/1), cables, EDS control unit
	9.1 Intake air temperature sensor (B2/1a)	N39 3 (Ω) 22	Ignition: **OFF** EDS control unit disconnected	[3]	Cable to intake air temperature sensor, temperature sensor
		B2/1 1 (Ω) 2	Connector on air flow sensor (B2/1) detached	[3]	Intake air temperature sensor
	9.2 Cables	N39 22 (Ω) B2/1 1	Ignition: **OFF** EDS control unit disconnected Connector on air flow sensor (B2/1) detached	< 1 Ω	Cable interrupt
	9.3	N39 3 (Ω) B2/1 2		< 1 Ω	Cable interrupt
10	10.0 Power supply	N39 14 (V) 1	Engine approx. 1500/min	11–14 V	Alternator regulator Voltage > 18 V
11 [1]	11.0 ELR actuator (Y22)	N39 3 (V) 2	Ignition: **ON** EDS control unit connected	11–14 V	Actuator (Y22) Cables EDS control unit (N39)

[1] Readout only in event of short-circuit.
[2] Reference value, voltage drops as speed increases.
[3] Refer to table for coolant temperature sensor and intake air.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specifi-cation	Possible cause/remedy
[11] [1]	[11.0]	N39  2 1	Engine idling	2.5 ± [2] 0.5 V	
	11.1	N39  1 2	Ignition: OFF EDS control unit detached	4 ± 0.5 Ω	ELR actuator Cables
	11.2 Cables	N39 Y22  1 2	Ignition: OFF Connector on actuator (Y22) detached	< 1 Ω	Cable interrupt
		N39 Y22  2 1		< 1 Ω	Cable interrupt
13					Renew EDS control unit (N39)

1) Readout only in the event of short-circuit.
2) Reference value, voltage drops as speed increases.

Coolant temperature sensor and intake air

Temperature in °C	Resistance (± 10%)	Voltage in V (± 10%)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

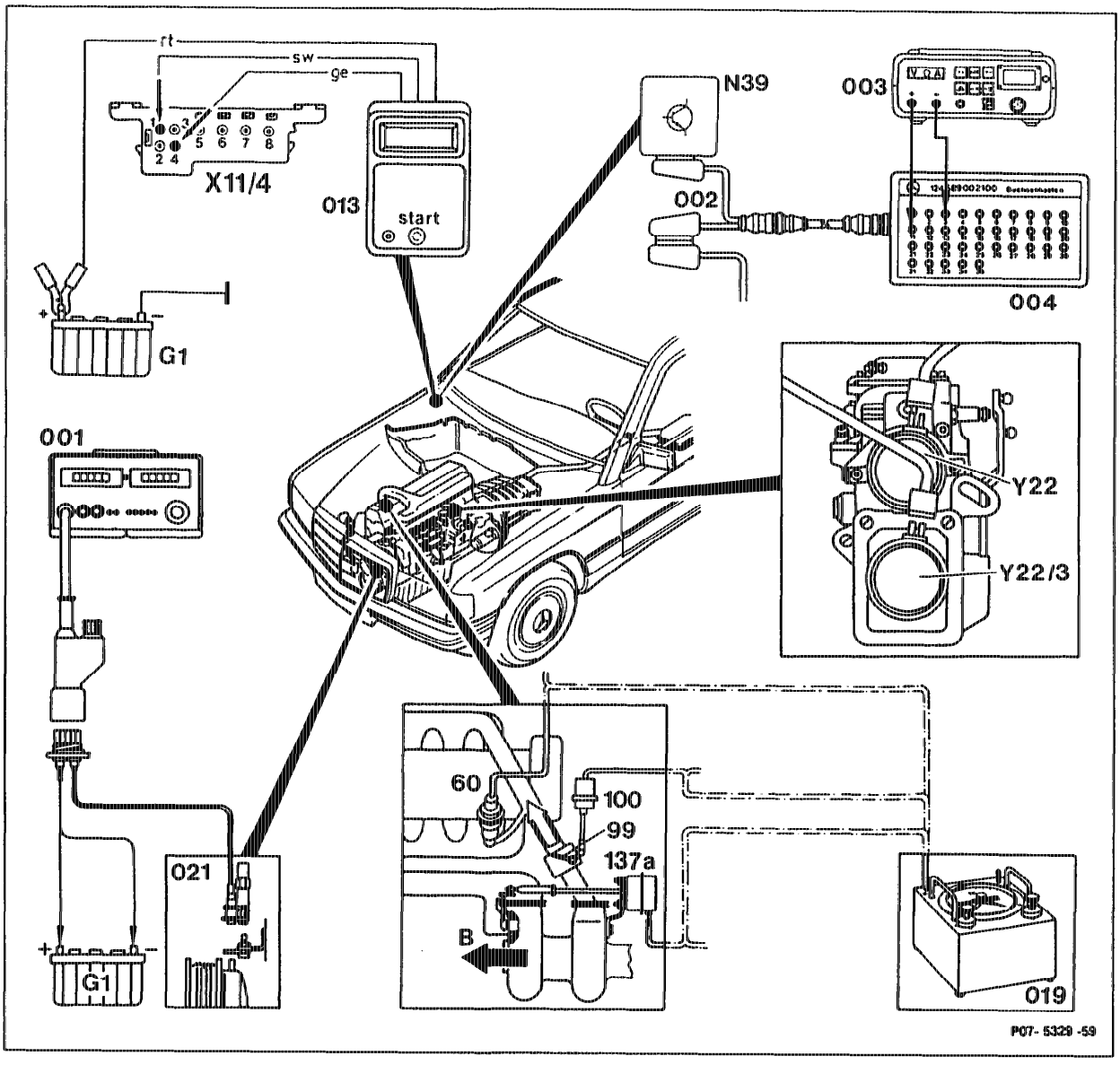
g) ELR and ARF function test (Engine 603.970)

Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specifi- cation	Possible cause/ remedy
Idle speed control	Drehzahlmesser mit OT-Geber	Engine idling Coolant temperature approx. 80 °C	630 rpm ±20	Actuator, injection pump, engine speed sensor (L3), EDS control unit, refer to test steps 6 and 10
		Plug from actuator detached	580 rpm ±20	Set speed at injection pump, injection pump
Exhaust control loop	Connect vacuum tester with Y distributor to ARF valve	Engine at 900 rpm ±50 and approx. 300 mbar Apply full throttle briefly	Vacuum drops	Perform mechanical test on vacuum transducer (Y31/1) Air flow sensor (B2/1) EDS control unit ARF valve
ARF valve	Connect vacuum tester directly to ARF valve	Engine switched off Pressurize ARF valve with 300 mbar and disconnect again	ARF valve closes audibly	Renew ARF valve

G. Engines 602.96 and 603.96, Models 124 and 201 Basic Version Code 62/0 as of 06/91 (A) (FIN) (CH) (DK) (J) (USA) as of Model Year 1992

a) Short-test, engine 602.96, 603.96
b) Testing with pulse counter
c) Troubleshooting schedule
d) Test program with contact box, engine 602.96
e) Test program, anti-jerk control (ARA), engine 602.96 with manual transmission
f) ELR, ARF function test, P2 control, ARA, engine 602.96
g) Test program with contact box, engine 603.96
h) ELR, ARF function test, engine 603.96
i) Test program for components not covered with pulse readout, engines 602.96, 603.96

a) Short-test, engine 602.96, 603.96

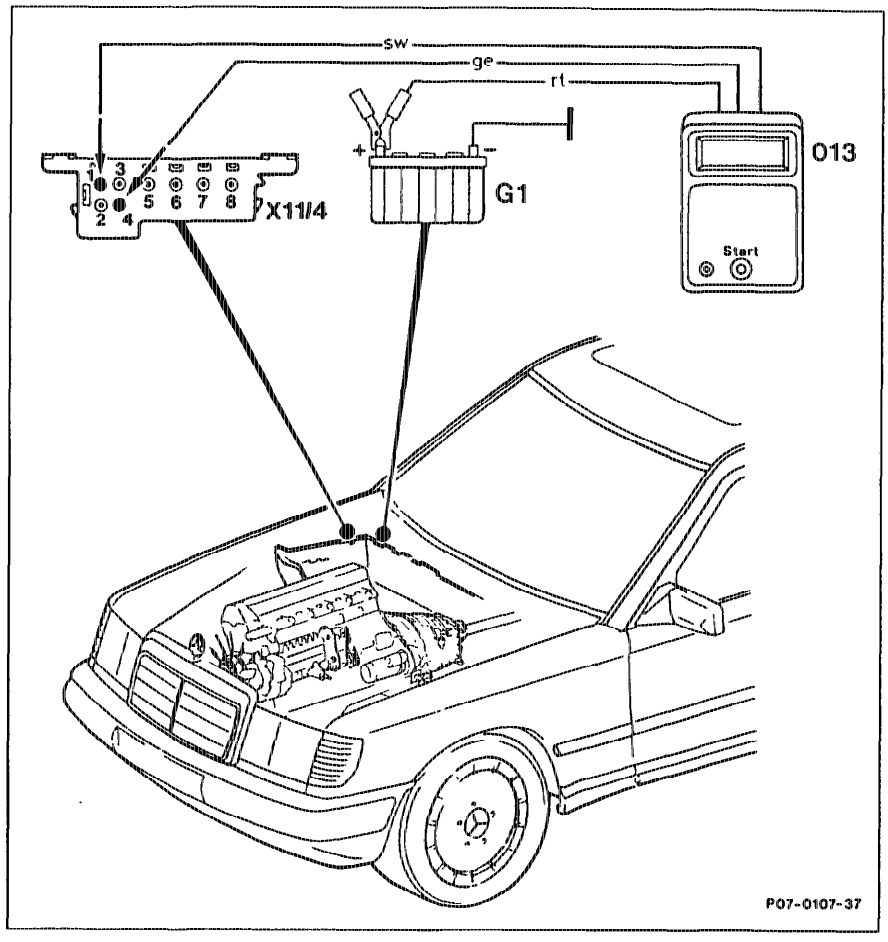


Digital tester (001) and pulse counter (021)	connect, disconnect.
Pulse counter (013)	connect to battery (G1) and to test coupling (X11/4), disconnect.
Contact box (004) with test cable (002)	connect to EDS control unit (N39), disconnect.
Digital multimeter (003)	connect to contact box (004), disconnect.
Vacuum tester (019)	connect with Y distributor to ARF valve or to vacuum unit, charge pressure control and vacuum unit, vacuum control flap, disconnect.
Fuse at overvoltage protection relay (K1/1)	check.
Selector lever	move into position "P".
Air conditioner/automatic climate control	switch off.
Battery voltage at overvoltage protection, contacts 1 and 5	test (specification 12 V).
Engine	warm up to operating temperature (coolant temperature approx. 80 °C).
Start button of pulse counter (013)	press for 2–4 seconds.
Display	read and note.
Start button	press once again; if no new display appears, no further fault in system.

The number which appears in the display field of the pulse readout indicates whether and which component is faulty or whether components in the control loop are faulty.
See fault table section c).

b) Testing with pulse counter

Connection diagram



013 Pulse counter
G1 Battery
X11/4 Test coupling for diagnosis

Contact assignment (X11/4)

1 Ground
2 TD signal
3 Pulse output, ARA control unit (N8/2) (only manual transmission)
4 Pulse output, EDS control unit

Notes regarding pulse readout
If no fault is displayed via the pulse output even though a complaint exists, perform the function test, section "f" (engine 602.96) or section "h" (engine 603.96).

The figure 1 indicates no fault stored in the electronic system. All other figures are assigned to a particular component/fault group.

The figures from 1 to 15 appear in the display field of the pulse counter.
If the U-Batt LED lights up after connecting the pulse counter, the pulse counter and voltage supply of the pulse counter are in order.

Testing with pulse counter
1 Connect pulse counter as specified in the connection diagram.

Note
U-Batt LED in the display field must light up; if not:
a) Check fuse of pulse counter.
b) Test contact 1 of test coupling (X11/4) to battery positive (11–14 V).
c) Test contact 4 of test coupling (X11/4) to contact 1 (6–12 V).

2 **Engine idling**
If the fault memory is read with the pulse counter with ignition **"ON"**, the pulse readout "7" (engine speed sensor) appears.

3 Press start button for between 2 and 4 seconds.

4 Read off pulse output display and note.
Display "1" = no fault stored.
Greater than "1" = fault in system.

5 Once again press start button for between 2 and 4 seconds. If no further fault is stored in the system, the previous readout appears once again. If there is a further fault in the system, its fault code is displayed.

6 Repeat this procedure until the first fault is again displayed.

7 Rectify noted faults (pulse output) as stated in the troubleshooting schedule.

8 Perform components test.

Erasing fault memory
After a fault has been rectified, the pulse displayed must be erased as follows:

9 Press start button and read the rectified fault, then press start button for 6–8 seconds.

Note
Each fault displayed must be erased **individually.**
Once the fault has been rectified and erased, the fault code no longer appears in the fault output.
If a figure greater than 1 is displayed, further faults exist in the system.

c) Troubleshooting tables

The number of pulses in the display indicates whether and which components are faulty and whether components in the control circuit are faulty.

EDS control unit

Pulse readout	Component/control loop	602.96	603.96
1 [1])	No fault stored	X	X
2	Control rod travel sensor (L7)	X	X
3	Air flow sensor potentiometer (B2/1)	X	X
4	EDS control unit (N39), altitude sensor	X	X
5	Vacuum transducer (Y31/1) or fault in exhaust control loop	X	X
6	EDS control unit (N39), internal power supply	X	X
7	Engine speed sensor (L3)	X	X
8	Coolant temperature sensor (B11/4)	X	X
9	Intake air temperature sensor (B2/1a)	X	X
10	Power supply	—	X
11	ELR actuator or vacuum transducer (Y31/1)	X [2])	X
12	not assigned	X	X
13	EDS control unit (N39) faulty (internal memory)	X	X
14	EDS pressure sensor (B5/1) faulty	X	—
15	Charge pressure control/vacuum control flap vacuum transducer (Y31/5) or fault in boost pressure control loop	X	—

[1]) If complaints received, perform function test ELR, ARF, P2 control, ARA (manual transmission).
[2]) Display only if short-circuit exists. The fault display also appears on EDS control units up to production date 168 (August 1991) even if no fault exists.

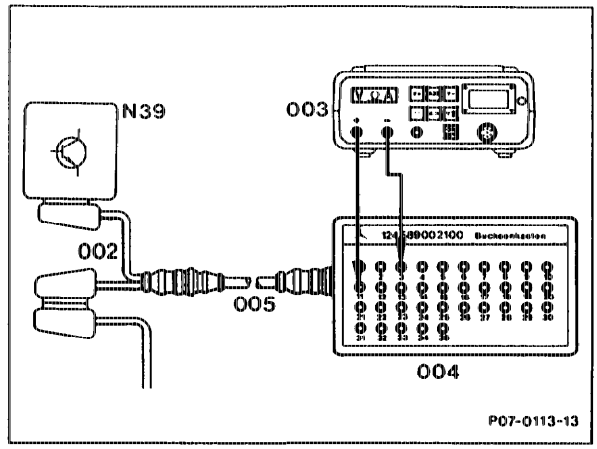
ARA control unit

Pulse readout	Component/control loop
1 [3])	No fault stored
2	Engine speed sensor (L3)
3	Coolant temperature sensor (B11/4)
4	not assigned
5	Anti-jerk control (ARA) control unit (N8/2) ARA control loop "fault"

[3]) If complaints received, perform ARA function test (manual transmission).

d) Test program with contact box, engine 602.96

Contact box connection diagram



002 25-pin test cable 124 589 33 63 00
003 Multimeter
004 35-pin contact box 124 589 00 21 00
005 Test cable 124 589 34 63 00
N39 EDS control unit

Symbols for test instruments

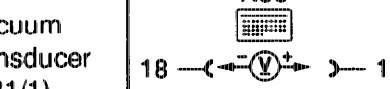
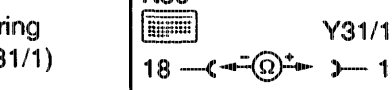
Contact box
Multimeter
Contact
Pin
Voltage measurement (volts, DC voltage)
Resistance measurement (ohms)

Test program

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
1	1.0	–	–	–	No fault stored
2	2.0 Control rod travel sensor (L7)	N39 4 — Ω — 5 4 — Ω — 6 4 — Ω — 3 4 — Ω — 1	Ignition: OFF EDS control unit unplugged	50 ± 4 Ω 25 ± 2 Ω ∞ Ω ∞ Ω	Replace control rod travel sensor or injection pump. Wiring
	2.1 Control rod travel sensor (L7)	L7 2 — Ω — 3	Ignition: OFF Coupling at control rod travel sensor (L7) unplugged	50 ± 4 Ω	Replace control rod travel sensor or injection pump.
		L7 2 — Ω — 1		25 ± 2 Ω	Replace control rod travel sensor or injection pump.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
[2]	2.2 Wiring	N39 L7 4 — Ω — 3	Ignition: **OFF** Coupling at control road travel sensor (L7) unplugged	< 1 Ω	Open circuit in wiring
		N39 L7 5 — Ω — 2		< 1 Ω	Open circuit in wiring
		N39 L7 6 — Ω — 1		< 1 Ω	Open circuit in wiring
3	3.0 Air flow sensor potentiometer (B2/1)	N39 3 — V — 24	Ignition: **ON** EDS control unit (N39) connected	5 ± 0.5 V	EDS control unit (N39)
		3 — V — 10		< 0.5 V	Wiring Air flow sensor
		N39 3 — V — 10	Engine: **Idling**	1.7 ± 0.2 V [1]	EDS control unit (N39)
	3.1 Air flow sensor potentiometer (B2/1)	N39 3 — Ω — 24	Ignition: **OFF** EDS control unit (N39) disconnected	500–1200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 — Ω — 10	Air flow sensor plate in off position	50–200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 — Ω — 10	Air flow sensor plate fully deflected	560–1100 Ω	Air flow sensor potentiometer (B2/1)
	3.2 Wiring	N39 B2/1 22 — Ω — 1 3 — Ω — 2 10 — Ω — 3 24 — Ω — 4	Coupling at air flow sensor potentiometer (B2/1) unplugged	< 1 Ω	Open circuit in wiring

[1] Voltage rises as engine speed rises.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
4	4.0	–	–	–	Replace EDS control unit (N39) (altitude sensor)
5	5.0 Vacuum transducer (Y31/1) ARF valve	N39  18 — 1 Vacuum at ARF valve with Y distributor	Engine 700/min. ±50	>3 V [1] > 250 mbar [1]	Supply line sw/ws (black/white) leaking. Air admission line (sw = black) blocked. Air admission filter (62a) fouled. Supply line sw/ws (black/white) or vacuum line sw (black) (rubber) blocked or leaking. Vacuum transducer (Y31/1). Wiring, EDS control unit, air flow sensor potentiometer, ARF valve
	5.1 Wiring (Y31/1)	N39 Y31/1  18 — 1 N39 Y31/1  1 — 2	Ignition: OFF Coupling at vacuum transducer (Y31/1) disconnected	<1 Ω <1 Ω	Open circuit in wiring Open circuit in wiring
	5.2 ARF microswitch (S27/3)	S27/3  1 — 3	Ignition: OFF Coupling at microswitch disconnected. Accelerator pedal not in full throttle position Accelerator pedal in full throttle pos.	∞ Ω <1 Ω	ARF microswitch (S27/3)
	5.3 Cable between ARF microswitch (27/3) and ARF switch-over valve (Y27)	S27/3 Y27  3 — 1	Ignition: OFF Coupling at ARF switch-over valve (Y27) and microswitch (S27/3) disconnected	<1 Ω	Open circuit in wiring

[1] Depress briefly to full throttle, vacuum and voltage drop. Test values are reference values.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
[5]	5.4 ARF switchover valve (Y27)	Vacuum at switchover valve (side outlet)	Engine: **Idling** **Full throttle**	>250 mbar <10 mbar	ARF switchover valve (Y27)
6	6.0	–	–	–	Internal supply voltage Replace EDS control unit
7	7.0 Engine speed sensor (L3)	N39 3 — 20	Engine: **Idling** EDS control unit unplugged	>2 V [1])	Engine speed sensor, clearance, dirt, wiring
	7.1 TD signal automatic transmission manual transmission	N39 3 — 25 N39 3 — 20	Engine: **Idling** EDS control unit connected	>3,5 V [3])	Cable (N39) to (X11/4) short-circuit or EDS control unit
	7.2 Engine speed sensor (L3) automatic transmission	N39 3 — 20	Ignition: **OFF** EDS control unit unplugged.	Beru [2]) 527 Ω ±10 % VDO [2]) 1900 Ω ±10 %	Engine speed sensor (L3), wiring
	7.3 Engine speed sensor (L3) manual transmission	N8/2 10 — 12	Ignition: **OFF** ARA control unit unplugged.	Beru [2]) 527 Ω ±10 % VDO [2]) 1900 Ω ±10 %	Engine speed sensor (L3), wiring

1) a) automatic transmission: Voltage rises as engine speed rises.
b) manual transmission: Voltage drops as engine speed rises.

2) Measured at 20 °C ambient temperature (each 10 °C change in ambient temperature alters resistance by 4 %).

3) Voltage drops as engine speed rises.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
[7]	7.4 Engine speed sensor (L3)	L3x 1 — Ω — 2	Plug connection (L3x) separated	Beru [1]) 527 Ω ±10 % VDO [1]) 1900 Ω ±10 %	Engine speed sensor (L3)
	7.5 Wiring automatic transmission	N39 / L3x 20 — Ω — 2	Plug connection (L3x) separated EDS control unit unplugged	<1 Ω	Open circuit in wiring
	7.6	N39 / L3x 3 — Ω — 1		<1 Ω	Open circuit in wiring
	7.7 Wiring manual transmission	N8/2 L3x 12 — Ω — 1	Plug connection (L3x) separated ARA control unit unplugged	<1 Ω	Open circuit in wiring
		N8/2 L3x 10 — Ω — 2		<1 Ω	Open circuit in wiring
8	8.0 Coolant temperature sensor (B11/4)	N39 3 — V — 9	Ignition: **ON** EDS control unit connected	[2])	Coolant temperature sensor, wiring, EDS control unit
	8.1 Coolant temperature sensor (B11/4)	N39 14 — Ω — 9	Ignition: **OFF** EDS control unit unplugged	[2])	Coolant temperature sensor, wiring
		B11/4 ⊥ — Ω —	Plug connection (B11/4) separated	[2])	Coolant temperature sensor
	8.2 Cable	N39 / B11/4 9 — Ω —	Ignition: **OFF** EDS control unit disconnected	<1 Ω	Open circuit in wiring

[1]) Measured at 20 °C ambient temperature (each 10 °C change in ambient temperature alters resistance by 4 %).
[2]) See table, coolant and intake air temperature sensor.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
9	9.0 Intake air temperature sensor (B2/1a)	N39 3 — (V) — 22	Ignition: **ON** EDS control unit connected	[2]	Intake air temperature sensor, air flow sensor, wiring, EDS control unit
	9.1 Intake air temperature sensor (B2/1a)	N39 3 — (Ω) — 22	Ignition: **OFF** EDS control unit disconnected	[2]	Cable to intake air temperature sensor, temperature sensor
		B2/1 1 — (Ω) — 2	Coupling at air flow sensor (B2/1) disconnected	[2]	Intake air temperature sensor
	9.2 Wiring	N39 — B2/1 22 — (Ω) — 1	Ignition: **OFF** EDS control unit disconnected Coupling at air flow sensor (B2/1) disconnected	< 1 Ω	Open circuit in wiring
		N39 — B2/1 3 — (Ω) — 2		< 1 Ω	Open circuit in wiring
10	10.0 Voltage supply	N39 14 — (V) — 1	Engine approx. 1500 rpm	11–14 V	Alternator regulator voltage > 18 V
11 [1]	11.0 ELR actuator (Y22)	N39 3 — (V) — 2	Engine approx. 1500 rpm EDS control unit connected	11–14 V	Actuator (Y22) Wiring
		N39 2 — (V) — 1	Engine: **idling**	2.5 ± 0.5 V [3]	EDS control unit (N39) Perform test steps 5 and 15 (output stage)

[1] Readout only if short-circuit exists.
[2] See table, coolant and intake air temperature sensors.
[3] Reference value, voltage drops if engine speed rises.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
[11]	11.1	N39  1 — Ω — 2	Ignition: **OFF** EDS control unit disconnected	4 ± 1 Ω	Actuator (Y22) Wiring
	11.2 Wiring	N39  Y22 1 — Ω — 2	Ignition: **OFF** Disconnect coupling at actuator (Y22)	< 1 Ω	Open circuit in wiring
		N39  Y22 2 — Ω — 1		< 1 Ω	Open circuit in wiring
13					Internal memory Replace EDS control unit (N39)
14	14.0 Pressure sensor (B5/1)	N39  3 — V — 12	Ignition: **ON** EDS control unit connected	> 4.9 V	Pressure sensor Pressure lines Wiring
	14.1 Pressure sensor (B5/1)	N39  3 — V — 17 Pressure tester with Y distributor to pressure sensor	Engine: **Idling** Briefly full throttle	> 1.3 V 0 mbar Voltage rises pressure rises > 500 mbar	Pressure sensor Pressure lines Wiring
	14.2 Pressure sensor (B5/1)	N39  3 — Ω — 12	Ignition: **OFF** EDS control unit disconnected	30 ± 5 kΩ	Pressure sensor (B5/1)
	14.3 Wiring	N39  B5/1 3 — Ω — 2		< 1 Ω	Open circuit in wiring

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
[14]	14.4 Wiring	N39 B5/1 12 — Ω — 1	Ignition: **OFF** EDS control unit disconnected	< 1 Ω	Open circuit in wiring
	14.5 Wiring	N39 B5/1 17 — Ω — 3	Ignition: **OFF** EDS control unit disconnected	< 1 Ω	Open circuit in wiring
15	15.0 Vacuum transducer (Y31/5) boost pressure control/ vacuum control flap	N39 8 — V — 1 Vacuum at outlet OUT of vacuum transducer	Engine: **idling**	> 4 V [1] > 300 mbar [1]	Supply line sw/ws leaking Air admission line (sw) blocked. Air admission filter (62a) fouled. Supply line sw/ws or vacuum line sw (rubber) blocked or leaking. Vacuum transducer (Y31/5), wiring, EDS control unit
	15.1 Wiring vacuum transducer (Y31/5)	N39 Y31/5 8 — Ω — 1 N39 Y31/5 1 — Ω — 2	Ignition: **OFF** EDS control unit disconnected	< 1 Ω < 1 Ω	Open circuit in wiring
	15.2 Boost pressure control switchover valve (Y27/4)	N39 7 — V — 1	EDS control unit connected		Boost pressure control switchover valve (Y27/4) EDS control unit
		Vacuum at switchover valve (Y27/4) (side connection)	Engine: **idling** **Engine speed** > 1000 rpm [2]	12 V > 300 mbar < 1 V < 10 mbar	Open circuit in wiring

[1] Voltage and vacuum drop as engine speed rises.
[2] Slowly increase engine speed to 1000 rpm **(from idling speed)**.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
[15]	15.3 Vacuum control flap switchover valve (Y27/5)	N39 7 — (V) — 1 Vacuum at switchover valve (Y27/5) (side connection)	EDS control unit connected Engine: **idling** **Engine speed** >1000 rpm[2])	12 V <10 mbar <1 V >150 mbar	Boost pressure control switchover valve (Y27/4) EDS control unit Open circuit in wiring
	15.4 Wiring boost pressure control switchover valve (Y27/4)	N39 27/4 7 — (Ω) — 1 N39 27/4 1 — (Ω) — 2	Ignition: **OFF** EDS control unit connected	<1 Ω <1 Ω	Open circuit in wiring
	15.5 Wiring vacuum control flap switchover valve (Y27/5)	Y27/4 Y27/5 1 — (Ω) — 1 Y27/4 Y27/5 2 — (Ω) — 2	Ignition: **OFF**	<1 Ω <1 Ω	Open circuit in wiring

[2]) Slowly increase engine speed to 1000 rpm (**from idling speed**).

Coolant and intake air temperature sensors

Temperature in °C	Resistance (±10 %)	Voltage in V (±10 %)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

e) Test program anti-jerk control (ARA), engine 602.96 with manual transmission

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
1	1.0	–	–	–	no fault stored
2	2.0 Engine speed sensor (L3)	L3x 1 — V — 2	Engine: **Idling**	> 1.5 V [1]	Engine speed sensor, clearance, fouling
	2.1 Engine speed sensor (L3)	L3x 1 — Ω — 2	Plug connection (L3x) separated	Beru [2] 527 Ω ± 10 % VDO [2] 1900 Ω ± 10 %	Engine speed sensor
3	3.0 Coolant temperature sensor (B11/4)	⊥ — Ω — B11/4	Plug connection (B11/4) disconnected	[3]	Coolant temperature sensor
5	5.0 Actuator (Y22/3)	Y22/3 1 — Ω — 2	Coupling at ARA actuator (Y22/3) unplugged	4 ± 1 Ω	ARA actuator (Y22/3)
	5.1 ARA control unit (N8/2)	Y22/3 1 — V — 2	Engine idling. Coupling at ARA actuator (Y22/3) unplugged. Briefly full throttle	Voltage rises	ARA control unit (N8/2) Wiring
	5.2 Wiring (Y22/3)	Y22/3 2 — Ω — N39 1	Coupling at ARA control unit unplugged	< 1 Ω	Open circuit in wiring
		Y22/3 1 — Ω — N8/2 5	Coupling at EDS control unit unplugged Coupling at ARA actuator unplugged	< 1 Ω	Open circuit in wiring

[1] Voltage increases as engine speed rises.
[2] Measured at 20 °C ambient temperature (each 10 °C change in ambient temperature varies resistance by 4 %).
[3] See table coolant and intake air temperature sensors.

f) **Function test ELR, ARF, P2 control, ARA, Engine 602.96 (ARA only with manual transmission)**

Note
This test should only be performed if a complaint is received but no fault is displayed via the pulse readout.

Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specifi- cation	Possible cause/ remedy
1.0 Idle speed control	Tachometer with TDC sensor	Engine idling Coolant tempera- ture approx. 80 °C	Automatic transmiss.: 680 rpm ±20 Manual transmiss.: 740 rpm ±20	Actuator, injection pump, engine speed sensor (L3), EDS control unit (N39), see test steps 7 and 11
		Connector unplugged from actuator	Automatic transmiss.: 610 rpm ±20 Manual transmiss.: 690 rpm ±20	Set speed at injection pump. Injection pump
2.0 Exhaust control loop	Connect vacuum tester with Y distributor to ARF valve	Engine at 900 rpm ±50 and approx. 300 mbar Briefly full throttle	Vacuum drops	Perform mechanical test of vacuum transducer (Y31/1), air flow sensor (B2/1). EDS control unit (N39) ARF valve
3.0 ARF valve	Connect vacuum tester directly to ARF valve	Engine switched off Pressurize ARF valve with 300 mbar Detach vacuum line	ARF valve closes audibly	Replace ARF valve

Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specifi- cation	Possible cause/ remedy
4.0 Boost pressure control	Connect vacuum tester (020) with Y distributor to output (OUT) of vacuum transducer (Y31/5).	Engine idling	>300 mbar	Vacuum supply Vacuum line Vacuum transducer (Y31/5) EDS control unit (N39)
Vacuum unit Boost pressure control valve		Slowly increase engine speed to approx. 2000 rpm	Vacuum drops	
4.1 Vacuum unit vacuum control flap (100)	Connect vacuum tester (020) with Y distributor to vacuum unit, vacuum control flap (100)	Engine idling	<100 mbar	Vacuum supply Vacuum line
		Slowly increase engine speed to approx. 2000 rpm	Vacuum rises	Vacuum transducer (Y31/5) Pressure line at pressure sensor (B5/1) EDS control unit
5.0 ARA actuator (Y22/3)	Test voltage at 2-pin coupling of ARA actuator with multimeter	Briefly depress to full throttle from idling speed	Voltage rises	ARA actuator (Y22/3)

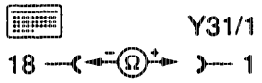
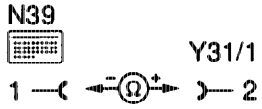
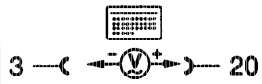
g) Test program with contact box, engine 603.96

Symbols for test instruments

- Contact box
- Multimeter
- Contact
- Pin
- Voltage measurement (volts, DC voltage)
- Resistance measurement (ohms)

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
1	1.0	–	–	–	no fault stored
2	2.0 Control rod travel sensor (L7)	N39 4 — Ω — 5 4 — Ω — 6 4 — Ω — 3 4 — Ω — 1	Ignition: OFF EDS control unit disconnected	 50 ± 4 Ω 25 ± 2 Ω ∞ ∞	Replace control rod travel sensor or injection pump. Wiring
	2.1 Control rod travel sensor (L7)	L7 2 — Ω — 3	Ignition: OFF Coupling at control rod travel sensor (L7) disconnected	50 ± 4 Ω	Replace control rod travel sensor (L7) or injection pump.
		L7 2 — Ω — 1	Coupling at control rod travel sensor (L7) disconnected	25 ± 2 Ω	Replace control rod travel sensor (L7) or injection pump.
	2.2 Wiring	N39 — L7 4 — Ω — 3	Ignition: OFF Coupling at control rod travel sensor (L7) disconnected	< 1 Ω	Open circuit in wiring
		N39 — L7 6 — Ω — 1		< 1 Ω	Open circuit in wiring
		N39 — L7 5 — Ω — 2		< 1 Ω	Open circuit in wiring

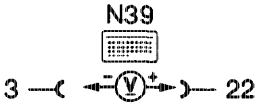
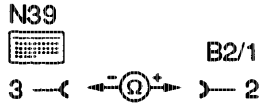
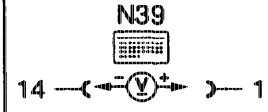
Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
3	3.0 Air mass sensor potentiometer (B2/1)	N39 3 — (V) — 24	Ignition: **ON** EDS control unit (N39) connected	5 ± 0.5 V	Air flow sensor potentiometer Wiring
		N39 3 — (V) — 10		< 0.5 V	Air flow sensor EDS control unit (N39)
		N39 3 — (V) — 10	Engine: **idling**	1.4 ± 0.2 V	
	3.1 Air mass sensor potentiometer (B2/1)	N39 3 — (Ω) — 24	Ignition: **OFF** EDS control unit (N39) disconnected	500–1200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 — (Ω) — 10	Air flow sensor plate in off position	50–200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 — (Ω) — 10	Air flow sensor plate fully deflected	560–1100 Ω	Air flow sensor potentiometer (B2/1)
	3.2 Wiring	N39 B2/1 22 — (Ω) — 1; 3 — (Ω) — 2; 10 — (Ω) — 3; 24 — (Ω) — 4	Coupling at air flow sensor potentiometer (B2/1) disconnected	< 1 Ω	Open circuit in wiring
4	4.0				Altitude sensor EDS control unit (N39), replace

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
5	5.0 Vacuum transducer (Y31/1) ARF valve	N39  18 — 1 Vacuum at ARF valve	Engine 900 rpm ±50 [4])	>3 V [4]) approx. 300 mbar [4])	Leak in supply line (tr/br) Air admission line (sw) blocked. Air admission filter (62a) closed. Supply line (tr/br) or vacuum line sw (rubber) closed or interrupted. Vacuum transducer (Y31/1). Wiring, EDS control unit, air flow sensor potentiometer, ARF valve
	5.1 Wiring (Y31/1)	N39 Y31/1  18 — 1 N39 Y31/1  1 — 2	Coupling at vacuum transducer (Y31/1) disconnected	<1 Ω <1 Ω	Open circuit in wiring Open circuit in wiring
6	6.0	–	–	–	Internal supply voltage. Replace EDS control unit (N39)
7	7.0 Engine speed sensor (L3)	N39  3 — 20	Engine: **Idling** EDS control unit disconnected	>3 V [1])	Engine speed sensor, clearance, fouling, wiring
	7.1 TD signal	N39  3 — 25	Engine: **Idling** EDS control unit connected	>2.8 V [6])	Cable N39 to (X11/4) short-circuit or EDS control unit (N39)

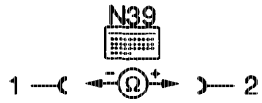
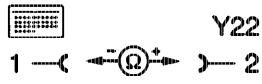
[1]) Voltage rises as engine speed rises.
[4]) Briefly apply full throttle. Vacuum and voltage drop. The test values are reference values.
[6]) Voltage drops by about 0.5 V and stabilizes.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
[7]	7.2 Engine speed sensor (L3)	N39 3 — Ω — 20	Ignition: **OFF** EDS control unit disconnected	Beru [5]) 527 Ω ±10 % VDO [5]) 1900 Ω ±10 %	Engine speed sensor (L3), wiring
		L3x 1 — Ω — 2	Plug connection (L3x) separated	Beru [5]) 527 Ω ±10 % VDO [5]) 1900 Ω ±10 %	Engine speed sensor (L3)
	7.3 Wiring	N39 — L3x 20 — Ω — 2		<1 Ω	Open circuit in wiring
		N39 — L3x 3 — Ω — 1		<1 Ω	Open circuit in wiring
8	8.0 Coolant temperature sensor (B11/4)	N39 3 — V — 9	Ignition: **ON** EDS control unit connected	[3])	Coolant temperature sensor, wiring, EDS control unit
	8.1 Coolant temperature sensor (B11/4)	N39 3 — Ω — 9	Ignition: **OFF** EDS control unit disconnected	[3])	Coolant temperature sensor, wiring
		B11/4 ⊥ — Ω	Plug connection (B11/4) disconnected	[3])	Coolant temperature sensor
	8.2 Cable	N39 — B11/4 9 — Ω	Ignition: **OFF** EDS control unit disconnected	<1 Ω	Open circuit in wiring

[3]) See table, coolant and intake air temperature sensors.
[5]) Measured at 20 °C ambient temperature (each 10 °C change in ambient temperature alters resistance by 4 %).

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
9	9.0 Intake air temperature sensor (B2/1a)	N39  	Ignition: **ON** EDS control unit connected	[3])	Intake air temperature sensor, air flow sensor (B2/1), wiring, EDS control unit
	9.1 Intake air temperature sensor (B2/1a)	N39  	Ignition: **OFF** EDS control unit disconnected	[3])	Cable to intake air temperature sensor, temperature sensor
		B2/1  	Coupling at air flow sensor (B2/1) disconnected	[3])	Intake air temperature sensor
	9.2 Wiring	N39  	Ignition: **OFF** EDS control unit disconnected Coupling at air flow sensor (B2/1) disconnected	< 1 Ω	Open circuit in wiring
	9.3	N39  		< 1 Ω	Open circuit in wiring
10	10.0 Voltage supply	N39  	Engine approx. 1500 rpm	11–14 V	Alternator regulator voltage > 18 V

[3]) See table, coolant and intake air temperature sensors.

Pulse readout	Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specifi-cation	Possible cause/ remedy
11 [1]	11.0 ELR actuator (Y22)	N39  3 — 2	Ignition: **ON** EDS control unit connected	11–14 V	Actuator (Y22) Wiring EDS control unit (N39) Perform test step 5 (output stage)
		N39  2 — 1	Engine: **Idling**	2.5 ± [2] 0.5 V	
	11.1	N39  1 — 2	Ignition: **OFF** EDS control unit dis-connected	4 ± 0.5 Ω	ELR actuator Wiring
	11.2 Wiring	N39 Y22  1 — 2	Ignition: **OFF** Coupling at actuator (Y22) disconnected	< 1 Ω	Open circuit in wiring
		N39 Y22  2 — 1		< 1 Ω	Open circuit in wiring
13					Replace EDS control unit (N39)

[1]) Readout only if short-circuit exists.
[2]) Reference value, voltage drops if engine speed rises.

Coolant and intake air temperature sensors

Temperature in °C	Resistance (± 10 %)	Voltage in V (± 10 %)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

h) Function test ELR, ARF engine 603.96

Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specifi- cation	Possible cause/ remedy
Idle speed control	Tachometer with TDC generator	Engine idling Coolant temperature approx. 80 °C	630 rpm ± 20 680 rpm ± 20 [1]	Actuator, injection pump, engine speed sensor (L3), EDS control unit see test steps 6 and 10
		Connector unplugged from actuator	580 rpm ± 20 620 rpm ± 20 [1]	Set speed at injection pump, injection pump
Exhaust control loop	Connect vacuum tester with Y distributor to ARF valve	Engine at 900 rpm ± 50 and approx. 300 mbar Briefly full throttle	Vacuum drops	Perform mechanical test of vacuum transducer (Y31/1), air flow sensor (B2/1). EDS control unit, ARF valve
ARF valve	Connect vacuum tester directly to ARF valve	Engine switched off Pressurize ARF valve with 300 mbar Detach vacuum line	ARF valve closes audibly	Replace ARF valve

[1] 4MATIC with manual transmission

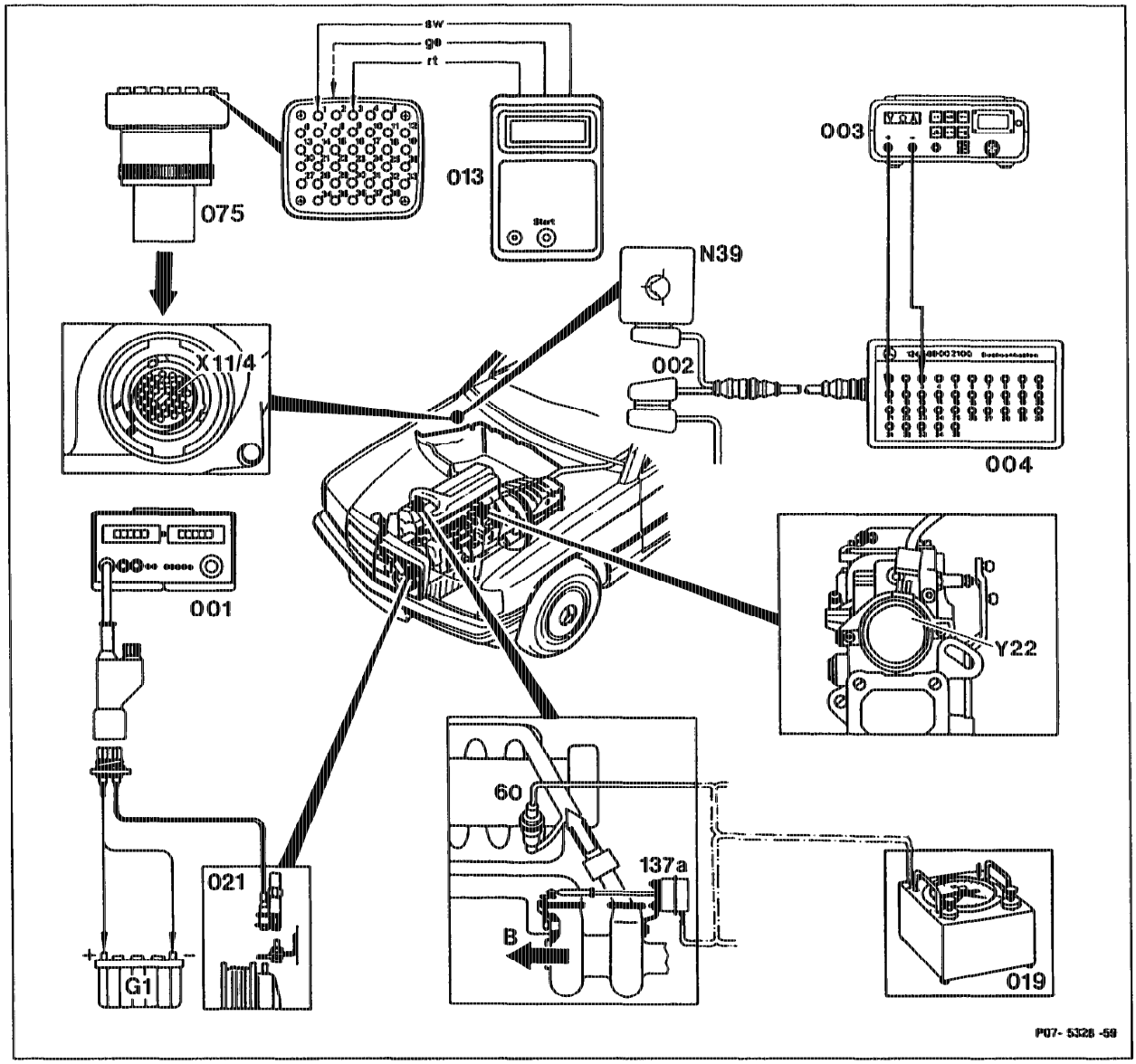
i) Test program for components not covered with pulse readout, engines 602.96, 603.96

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
–	1 ARF switchover valve (Y27) and ARF microswitch (S27/3)	Vacuum at switchover valve (side outlet)	Engine 900 rpm ± 50 Full throttle	>250 mbar <10 mbar	ARF switchover valve (Y27) ARF microswitch (S27/3)
–	2 ARF microswitch (S27/3)	S27/3 1 — Ω — 3	Ignition: OFF Coupling at microswitch disconnected. -Accelerator pedal not in full throttle position -Accelerator pedal in full throttle position	∞ Ω <1 Ω	ARF microswitch (S27/3)
–	3 Cable between ARF microswitch (S27/3) and ARF switchover valve (Y27)	Y27 — S27/3 1 — Ω — 3	Ignition: OFF Coupling at ARF switchover valve (Y27) and coupling at ARF microswitch (S27/3) disconnected	<1 Ω	Open circuit in wiring

H. Engine 603.971, Model 140 (USA) Model Year 1992

a) Short-test
b) Testing with pulse counter
c) Troubleshooting schedule
d) Test program with contact box
e) Test program for components not covered with pulse output
f) Function test ELR, ARF, P2 control
g) Testing key-operated engine stop

a) Short-test


sw
ge
rt
075
013
003
N39
X11/4
002
004
001
Y22
60
137a
B
021
G1
019
P07- 5328 -59

Digital tester (001) and pulse counter (021)	connect, disconnect.
Pulse counter (013)	connect with adapter (075) to test coupling (X11/4), disconnect.
Contact box (004) with test cable (002)	connect to EDS control unit (N39), disconnect.
Digital multimeter (003)	connect to contact box (004), disconnect.
Vacuum tester (019)	connect with Y distributor to ARF valve or to boost pressure control vacuum unit, disconnect.
Fuse at overvoltage protection (K1/1)	check.
Selector lever	move into position "P".
Air conditioner/automatic climate control	switch off.
Engine	warm up to operating temperature (coolant temperature approx. 80 °C)
Fuse of base module	check (read pulse output base module contact 8), see Diagnosis Manual Chassis Volume 1.

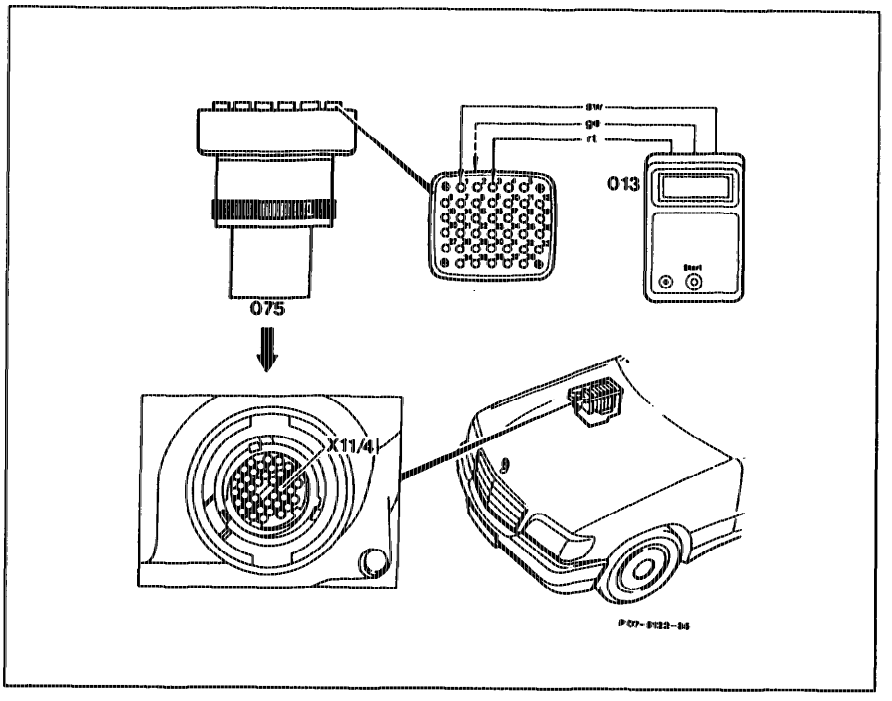
Note
Before reading the stored faults via the pulse output, the battery must on no account be disconnected, base module and EDS control unit (N39) must on no account be unplugged.

Start button of pulse counter (013)	press for 2–4 seconds.
Display	read and note.
Start button	once again press. If no new display appears, no further fault in system.

The number which appears in the display of the pulse readout indicates whether and which component is faulty or whether components in the control loop are faulty. See fault table section c).

b) Testing with pulse counter

Connection diagram



013 Pulse counter
075 Pulse counter adapter
X11/4 Test coupling for diagnosis, pulse signal (38-pin)

Contact assignment of pulse counter adapter

1 Ground, terminal 31
2 Terminal 87
3 Terminal 30
4 EDS pulse readout

Notes regarding pulse readout
If a complaint is received but no fault is displayed via the pulse readout, perform the function test, section "e".
The figure 1 indicates no fault detected in the electronic system. All further figures are assigned to a particular component/fault group. The figures from 1 to 15 appear in the display field of the pulse counter.

If the U-Batt LED lights up after connecting the pulse counter, pulse counter and pulse counter power supply are in order.

1 Connect pulse counter as stated in the connection diagram.

Note
The U-Batt LED in the display field must light up; if not:
a) Check fuse of pulse counter.
b) Test contact 1 of test coupling (X11/4) to battery positive (11–14 V).
c) Test contact 4 of test coupling (X11/4) to contact 1 (6–12 V).

2 **Engine idling.**
If the fault counter is read with the pulse counter with ignition **"ON"**, the pulse readout "7" (engine speed sensor) appears.

3 Press start button for between 2 and 4 seconds.

4 Read off pulse output and note.
Readout "1" = no fault stored.
Greater than "1" = fault in system.

5 Once again press start button for between 2 and 4 seconds. The previous figure re-appears if no further fault is stored in the system. If a further fault is present in the system, its fault code is displayed.

6 Repeat this procedure until the first fault is again displayed.

7 Rectify noted faults (pulse readout) according to troubleshooting schedule.

8 Perform components test.

Erasing fault memory
After a fault has been erased, the pulse displayed must be erased as follows:

9 Press start button and read the rectified fault, then press start button for 6–8 seconds.

Note
Each fault displayed must be erased **individually.**
Once the fault has been rectified and erased, the fault code no longer appears in the fault output.
If a figure greater than 1 is displayed, further fault in the system.

c) Fault table

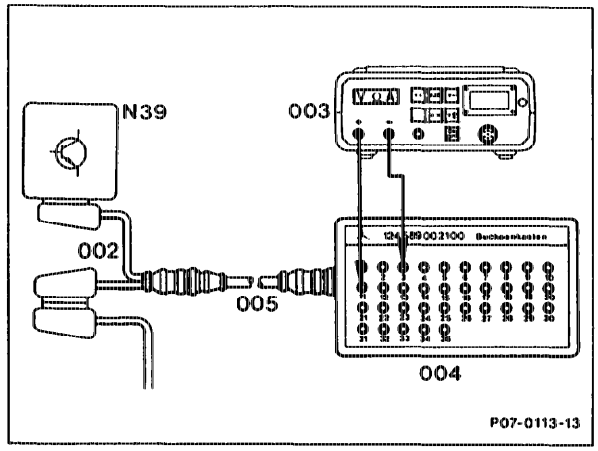
The figure in the display field of the pulse readout indicates whether and which component is faulty or whether components in the control loop are faulty.

Pulse readout	Component/fault loop
1 [1])	All functions "in order"
2	Control rod travel sensor (L7)
3	Air flow sensor potentiometer (B2/1)
4	EDS control unit (N39), altitude sensor
5	Vacuum transducer (Y31/1), switchover valve (Y31/6) or fault in exhaust control loop [4])
6	EDS control unit (N39), internal power supply
7	Engine speed sensor (L3) (is not stored)
8	Coolant temperature sensor (B11/4)
9	Intake air temperature sensor (B2/1a)
10	Power supply
11 [3])	ELR actuator [2]), vacuum transducer (Y31/1), vacuum transducer (Y31/4) or boost pressure cutoff switchover valve (Y31/6)
12	not assigned
13	EDS control unit (N39) faulty (internal memory)
14	EDS pressure sensor (B5/1) faulty (electric)
15	Fault in boost pressure control circuit (overpressure)

[1]) If complaints received, perform function test ELR, ARF, P2 control or "test program for components not covered with pulse output".
[2]) Fault is not stored, readout if short-circuit and open circuit.
[3]) Readout only if open circuit.
[4]) Readout if interruption in pneumatic supply, e. g. vacuum line faulty.

d) Test program with contact box

Connection diagram of contact box



002 25-pin test cable 124 589 33 63 00
003 Multimeter
004 35-pin contact box 124 589 00 21 00
005 Test cable 124 589 34 63 00
N39 EDS control unit

Symbols for test instruments

Contact box
Multimeter
Contact
Pin
Voltage measurement (volts, DC voltage)
Resistance measurement (ohms)

Test program

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
1	1.0	–	–	–	no fault stored
2	2.0 Control rod travel sensor (L7)	N39 4 — Ω — 5 4 — Ω — 6 4 — Ω — 3 4 — Ω — 1	Ignition: OFF EDS control unit disconnected	50 ±5 Ω 25 ±3 Ω ∞ ∞	Replace control rod travel sensor or injection pump. Wiring Plug connection, engine separation point (X26/2)

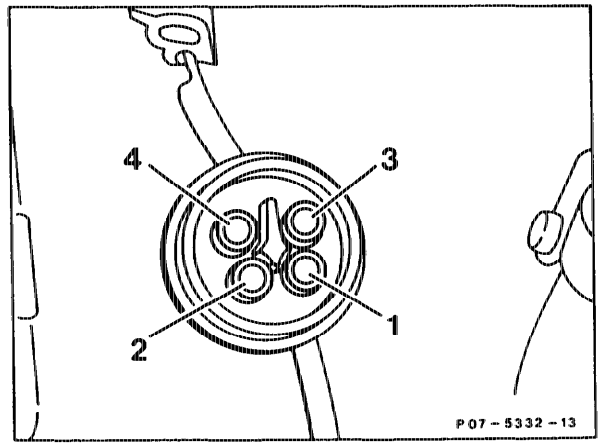
Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
[2]	2.1 Control rod travel sensor (L7)	L7 2 — Ω — 3	Ignition: OFF Coupling at control rod travel sensor (L7) disconnected	50 ±4 Ω	Replace control rod travel sensor or injection pump.
		L7 2 — Ω — 1	Coupling at control rod travel sensor (L7) disconnected	25 ±2 Ω	Replace control rod travel sensor (L7) or injection pump.
	2.2 Wiring	N39 — L7 4 — Ω — 3 6 — Ω — 1 5 — Ω — 2		<1 Ω	Open circuit in wiring Plug connection, engine separation point (X26/2), contact 16 contact 8 contact 9
3	3.0 Air flow sensor potentiometer (B2/1)	N39 3 — V — 24	Ignition: ON EDS control unit (N39) connected	5 ±0.5 V	Air flow sensor potentiometer Wiring
		N39 3 — V — 10	Ignition: ON	<0.5 V	Replace air flow sensor EDS control unit (N39)
		N39 3 — V — 10	Engine idling	1.4 ± 0.2 V	Air flow sensor
	3.1 Air flow sensor potentiometer (B2/1)	N39 3 — Ω — 24	Ignition: OFF EDS control unit (N39) disconnected	500– 1200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 — Ω — 10	Air flow sensor plate in off position	50– 200 Ω	Air flow sensor potentiometer (B2/1)
		N39 3 — Ω — 10	Air flow sensor plate fully deflected	560– 1100 Ω	Air flow sensor potentiometer (B2/1)

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
[3]	3.2 Wiring	N39 B2/1 22 — Ω — 1 3 — Ω — 2 10 — Ω — 3 24 — Ω — 4	Coupling at air flow sensor potentiometer (B2/1) disconnected	< 1 Ω	Open circuit in wiring
4	4.0				Altitude sensor Replace EDS control unit (N39)
5	5.0 Vacuum transducer (Y31/1) (pneumatic) ARF valve	Vacuum at ARF valve	Engine 900 rpm ± 50 [4])	approx. 300 mbar [4])	Supply line (tr/br) leaking Air admission line (sw) blocked. Air admission filter (62a) closed. Supply line (tr/br) or vacuum line sw (rubber) closed or interrupted. Vacuum transducer (Y31/1). ARF valve
	5.1 [5]) Boost pressure shutoff switchover valve (Y31/6) (pneumatic)	N39 7 — V — 1	Engine idling, slowly increase to 1100 rpm	11–14 V	Replace EDS control unit (N39) Boost pressure shutoff switchover valve (Y31/6) Vacuum line, supply line, air admission line

[4]) Briefly depress to full throttle. Vacuum drops. The test values are reference values.

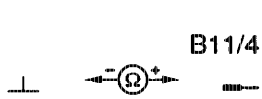
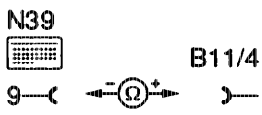
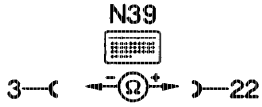
[5]) Readout only if short-circuit or fault in boost pressure control circuit.

Contact assignment of plug connection, air flow sensor potentiometer (B2/1)

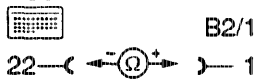
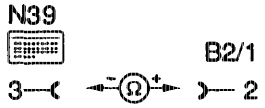
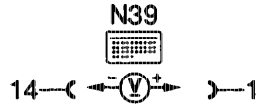


Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
6	6.0	–	–	–	Internal supply voltage. Replace EDS control unit (N39)
7	7.0 Engine speed sensor (L3)	N39 3 — (V) — 20	Engine idling	>3 V [1]	Engine speed sensor, clearance, fouling, wiring, plug connection engine separation point (X26/2)
	7.1 TD signal	N39 3 — (V) — 25	Engine idling EDS control unit connected	>2.8 V [6]	Cable N39 to (X11) Short-circuit or EDS control unit (N39)
	7.2 Engine speed sensor (L3)	N39 3 — (Ω) — 20	Ignition: OFF EDS control unit disconnected	Beru [5] 527 Ω ± 10 % VDO [5] 1900 Ω ± 10 %	Engine speed sensor (L3), wiring
		L3x1 1 — (Ω) — 2	Plug connection (L3x1) released and separated	Beru [5] 527 Ω ± 10 % VDO [5] 1900 Ω ± 10 %	Engine speed sensor (L3)
	7.3 Wiring	N39 20 — (Ω) — L3x1 2		<1 Ω	Open circuit in wiring Plug connection engine separation point (X26/2), contact 5
		N39 3 — (Ω) — L3x1 1		<1 Ω	Open circuit in wiring Plug connection engine separation point (X26/2), contact 15

[1] Voltage rises as engine speed rises.
[5] Measured at 20 °C ambient temperature (each 10 °C change in ambient temperature alters resistance by 4 %).
[6] Voltage drops as engine speed rises.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
8	8.0 Coolant temperature sensor (B11/4)	N39  	Ignition: **ON** EDS control unit connected	[3]	Coolant temperature sensor, wiring, EDS control unit, plug connection engine separation point (X26/2)
	8.1 Coolant temperature sensor (B11/4)	N39  	Ignition: **OFF** EDS control unit disconnected	[3]	Coolant temperature sensor, wiring
		B11/4 	Plug connection (B11/4) separated	[3]	Coolant temperature sensor
	8.2 Cable	N39 B11/4  	Ignition: **OFF** EDS control unit disconnected	< 1 Ω	Open circuit in wiring, plug connection engine separation point (X26/2), contact 4
9	9.0 Intake air temperature sensor (B2/1a)	N39  	Ignition: **ON** EDS control unit connected	[3]	Intake air temperature sensor, air flow sensor (B2/1), wiring, EDS control unit
	9.1 Intake air temperature sensor (B2/1a)	N39  	Ignition: **OFF** EDS control unit disconnected	[3]	Cable to intake air temperature sensor, temperature sensor
		B2/1  	Coupling at air flow sensor (B2/1) disconnected	[3]	Intake air temperature sensor

[3] See table, coolant and intake air temperature sensors.

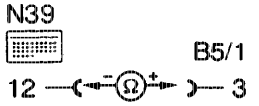
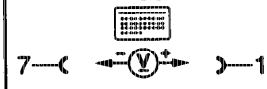
Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
[9]	9.2 Wiring	N39  B2/1 22 — Ω — 1	Ignition: **OFF** EDS control unit disconnected Coupling at air flow sensor (B2/1) disconnected	< 1 Ω	Open circuit in wiring
		N39  B2/1 3 — Ω — 2		< 1 Ω	Open circuit in wiring
10	10.0 Voltage supply	N39  14 — V — 1	Engine idling	11–14 V	Voltage > 18 V Generator regulator
11 [1])	11.0 ELR actuator (Y22)	N39  3 — V — 2	Ignition: **ON** EDS control unit connected	11–14 V	Actuator (Y22) Wiring EDS control unit (N39), plug connection engine separation point (X26/2)
		N39  2 — V — 1	Engine idling	2.5 ± [2]) 0.5 V	
	11.1	N39  1 — Ω — 2	Ignition: **OFF** EDS control unit disconnected	4 ± 0.5 Ω	ELR actuator Wiring
	11.2 Wiring	N39  Y22 1 — Ω — 2	Ignition: **OFF** Coupling at actuator (Y22) disconnected	< 1 Ω	Open circuit in wiring, plug connection engine separation point (X26/2), contact 11
		N39  Y22 2 — Ω — 1		< 1 Ω	Open circuit in wiring, plug connection engine separation point (X26/2), contact 10

[1]) Readout only if short-circuit.
[2]) Reference value, voltage drops as engine speed rises.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
[11]	11.3 [3] Vacuum transducer (Y31/1) (electric)	N39 18 — (V) — 1	Engine 900/min. ± 50 [4]	> 3 V [4]	Vacuum transducer (Y31/1). Wiring, EDS control unit, air flow sensor potentiometer
	11.4 Wiring	N39 — Y31/1 18 — (Ω) — 2	Coupling at vacuum transducer (Y31/1) disconnected	< 1 Ω	Open circuit in wiring
		N39 — Y31/1 1 — (Ω) — 1		< 1 Ω	Open circuit in wiring
13					Replace EDS control unit (N39)
14	14.0 Pressure sensor (B5/1)	N39 3 — (V) — 12	Ignition: ON EDS control unit connected	> 5 V	Pressure sensor Pressure lines Wiring, plug connection engine separation point (X26/2)
	14.1 Pressure sensor (B5/1)	N39 3 — (V) — 17 Pressure tester with Y distributor to pressure sensor	Engine idling Briefly full throttle	> 1.3 V < 10 mbar Voltage rises Pressure rises > 300 mbar	Pressure sensor Pressure lines Wiring
	14.2 Pressure sensor (B5/1)	N39 3 — (Ω) — 17	Ignition: OFF EDS control unit disconnected	4.5 ± 0.5 kΩ	Pressure sensor
	14.3 Wiring	N39 — B5/1 3 — (Ω) — 2		< 1 Ω	Open circuit in wiring

[3] Readout only if open circuit.

[4] Apply full throttle. Voltage drops. The test values are reference values.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
[14]	14.4 Wiring	N39  B5/1 12 — 3	Ignition: OFF EDS control unit disconnected	< 1 Ω	Open circuit in wiring, plug connection engine separation point (X26/2), contact 2
	14.5 Wiring	N39  B5/1 17 — 1	Ignition: OFF EDS control unit disconnected	< 1 Ω	Open circuit in wiring, plug connection engine separation point (X26/2), contact 1
15	15.0 Fault in boost pressure control circuit	–	–	–	Pressure sensor (B5/1) Pressure and vacuum lines EDS control unit (N39)
	15.1 [3] Vacuum transducer (Y31/4) (electric) Boost pressure control valve vacuum unit	N39  8 — 1 Vacuum tester with Y distributor to vacuum transducer (Y31/4) Outlet (OUT)	Engine idling. EDS control unit connected Slowly increase engine speed up to approx. 2000 rpm	approx. 4 V >300 mbar Voltage drops Vacuum drops	Vacuum transducer (Y31/4) Vacuum lines EDS control unit
	15.2 Wiring	N39  Y31/4 1 — 1 N39  Y31/4 8 — 2	Ignition: OFF EDS control unit disconnected	< 1 Ω < 1 Ω	Open circuit in wiring Open circuit in wiring
	15.3 [3] Boost pressure shutoff switchover valve (Y31/6) (electric)	N39  7 — 1	Engine idling. Coupling at switchover valve (Y31/6) disconnected	11–14 V	Replace EDS control unit (N39) Boost pressure shutoff switchover valve (Y31/6) Open circuit in wiring

[3] Readout only if open circuit.
[4] Apply full throttle. Voltage drops. The test values are reference values.

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
[15]	15.4 Wiring	N39  Y31/6 7 — Ω — 1 N39  Y31/6 1 — Ω — 2	Ignition: **OFF** EDS control unit (N39) disconnected	< 1 Ω < 1 Ω	Open circuit in wiring Open circuit in wiring

e) Test program for components not covered with pulse output

Pulse readout	Test step/ test scope	Test connection	Operation/ requirement	Specification	Possible cause/ remedy
–	1 ARF switchover valve (Y27) and compressor shutoff/ARF microswitch (S27/6)	Vacuum at switchover valve (side outlet)	Engine 900 rpm ± 50 Full throttle	> 250 mbar < 10 mbar	ARF switchover valve (Y27) Compressor shutoff/ARF microswitch (S27/6)
–	2 Compressor shutoff/ARF microswitch (S27/6)	S27/6 1 — Ω — 3	Ignition: **OFF** Coupling at microswitch disconnected -Accelerator **not** in full throttle position -Accelerator in full throttle position	∞ Ω < 1 Ω	Compressor shutoff/ARF microswitch (S27/6)
–	3 Cable between compressor shutoff/ARF microswitch (S27/6) and ARF switchover valve (Y27)	Y27 S27/6 1 — Ω — 3	Ignition: **OFF** Coupling at ARF switchover valve (Y27) and coupling at compressor shutoff/ARF microswitch (S27/6) disconnected	< 1 Ω	Open circuit in wiring Plug connection, engine separation point (X26/2), contact 12

Coolant and intake air temperature sensors

Temperature in °C	Resistance (± 10 %)	Voltage in V (± 10 %)
20	2.5 kΩ	3.85
30	1.7 kΩ	3.47
40	1.18 kΩ	3.05
50	833 Ω	2.63
60	600 Ω	2.22
70	440 Ω	1.85
80	327 Ω	1.5
90	243 Ω	1.22
100	185 Ω	0.99

f) Function test ELR, ARF, P2 control

Note
This test should only be performed if a complaint is received but no fault is indicated with the pulse readout.

Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specification	Possible cause/ remedy
1.0 Idle speed control	Tachometer with TDC sensor	Engine idling Coolant temperature approx. 80 °C	610 rpm ±20	Actuator, injection pump, engine speed sensor (L3), EDS control unit (N39), see test steps 7 and 11
		Connector unplugged from actuator	560 rpm ±40	Set speed at injection pump. Injection pump
2.0 Exhaust control loop	Connect vacuum tester with Y distributor to ARF valve	Engine at 900 rpm ± 50 and > 300 mbar Briefly full throttle	Vacuum drops	Perform mechanical test of vacuum transducer (Y31/1), air flow sensor (B2/1). EDS control unit (N39) ARF valve
3.0 ARF valve	Connect vacuum tester directly to ARF valve	Engine off Pressurize ARF valve with 300 mbar Detach vacuum line	ARF valve closes audibly	Replace ARF valve
4.0 Boost pressure control	Connect vacuum tester (020) with Y distributor to outlet (OUT) of vacuum transducer (Y31/4).	Engine idling	>300 mbar	Vacuum supply Vacuum line Vacuum transducer (Y31/4) EDS control unit (N39)
Boost pressure control valve vacuum unit		Slowly increase engine speed to approx. 2000 rpm	Vacuum drops	

g) Testing key-operated engine stop

Test step/ test scope	Test instrument/ test connection	Operation/ requirement	Specifi- cation	Possible cause/ remedy
1.0 Key-operated engine stop	Connect vacuum tester with Y distributor to Stop vacuum unit	Engine idling Stop engine	0 mbar 5–6 sec. > 300 mbar	Key-operated engine stop relay Key-operated engine stop switchover valve Vacuum lines Stop vacuum unit Fuses 17, 24 faulty
2.0 Key-operated engine stop relay	2-pin coupling at switchover valve (Y9/1) Connect multimeter in parallel	Engine idling Stop engine	 >12 V for 5–6 sec.	Fuses 17, 24 faulty Key-operated engine stop relay (N17/3) faulty
3.0 Key-operated engine stop switchover valve	Connect vacuum tester with Y distributor to connection 2 of switchover valve (Y9/1)	Engine idling	>500 mbar	Vacuum pump Supply line colour: tr