

## Diesel injection system

### General information

Modifications as compared to model year 1990/1991:

- Injection pump (cam shape),
- Vacuum line layout,
- EDS control unit (reference map),
- EDS test program,
- EGR shut-off microswitch,
- Electric wiring diagrams (see Electrical Troubleshooting Manual),
- Prechamber with increased volume,
- Electric switchover valves: EGR, boost pressure control, pressure control flap,
- Single vacuum transducer for boost pressure control and pressure control flap.

The following was deleted:

- Boost pressure control vacuum transducer,
- Engine overload protection,
- Vacuum amplifier and vacuum amplifier switchover valve.

### Fuel injection system components

Engine	602.962
Injection pump model designation	PES 5 M 55 C 320 RS 177
Bosch number (for test sheet)	0 400 075 944
Fuel pump (Bosch designation)	FP/KG 24 M 150
Injection nozzle (Bosch designation)	DN 0 SD 265
Injection nozzle part no.	001 017 49 12
Nozzle holder (Bosch designation)	KCA 27 S 55
Injection nozzle and holder complete (Part no.)	002 017 40 21

**Test and adjustment values**

Engines		602.962
Idle speed at 60–80 °C coolant temperature	rpm	680 ± 20
Injection pump timing (reference impulse) adjustment value		14 + 0.5° after TDC <sup>1)</sup>
Injection pump timing (reference impulse) nominal value		15 ± 1° after TDC
Boost pressure at 4,000 rpm, under load	bar	0.75 – 0.85
Injection nozzle opening pressure with new injection nozzles	bar	135 – 145
Injection nozzle opening pressure with used injection nozzles	bar	120

<sup>1)</sup> One-time adjustment at 15,000 miles, adjust to 14 + 0.5° after TDC

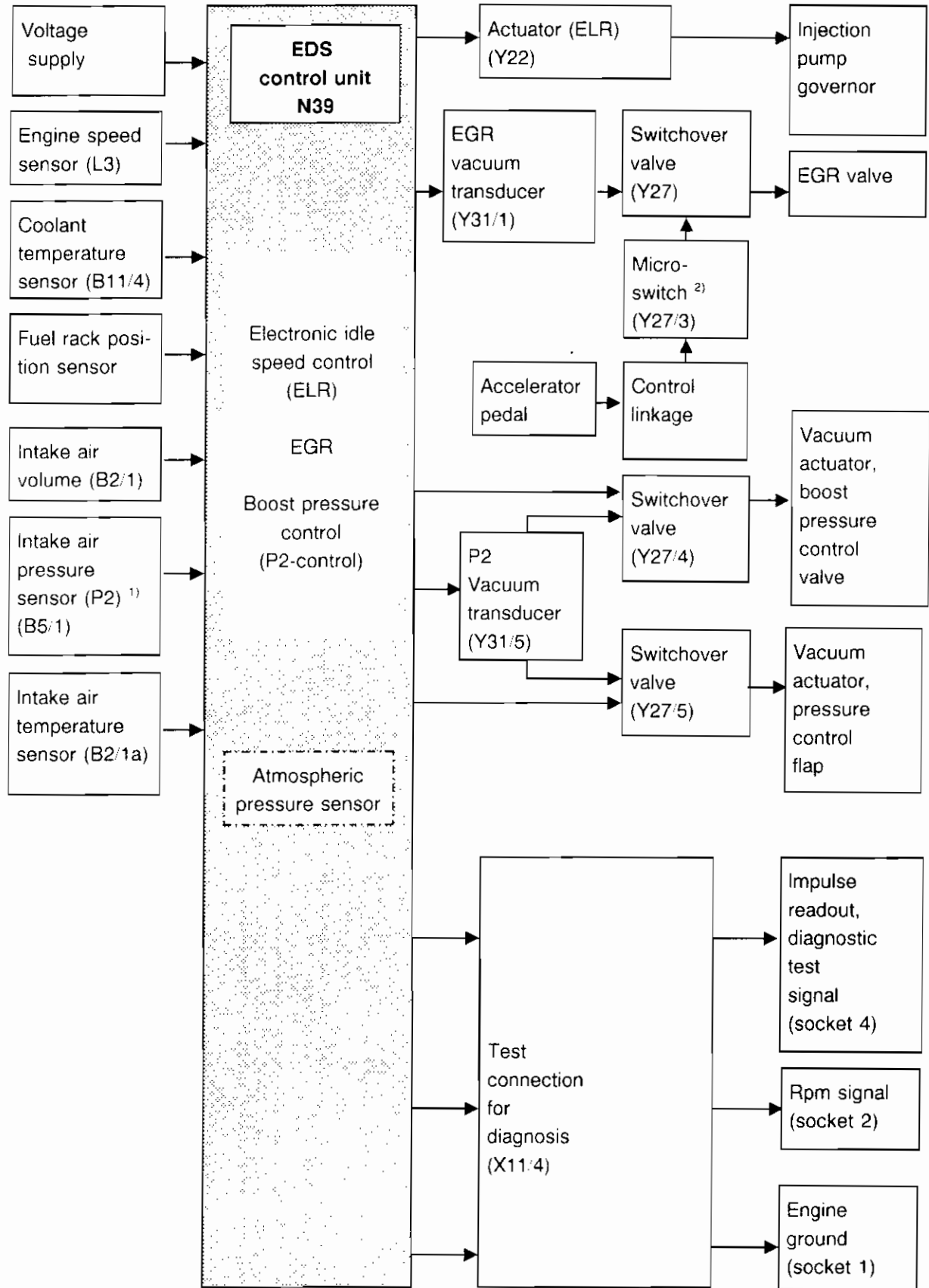
**Electronic diesel system (EDS)**

The EDS control unit processes the following functions:

- Electronic idle speed control (ELR),
- Exhaust gas recirculation (EGR),
- Boost pressure control (P2-control),
- System diagnostics.

The EDS control unit processes the incoming signals and delivers a milliamp current to the vacuum transducer(s) and to the electro-magnetic actuator on the injection pump. The entire system can be tested with an impulse counter i.e. the malfunction memory can be read by means of an output signal to the test connection (X11/4).

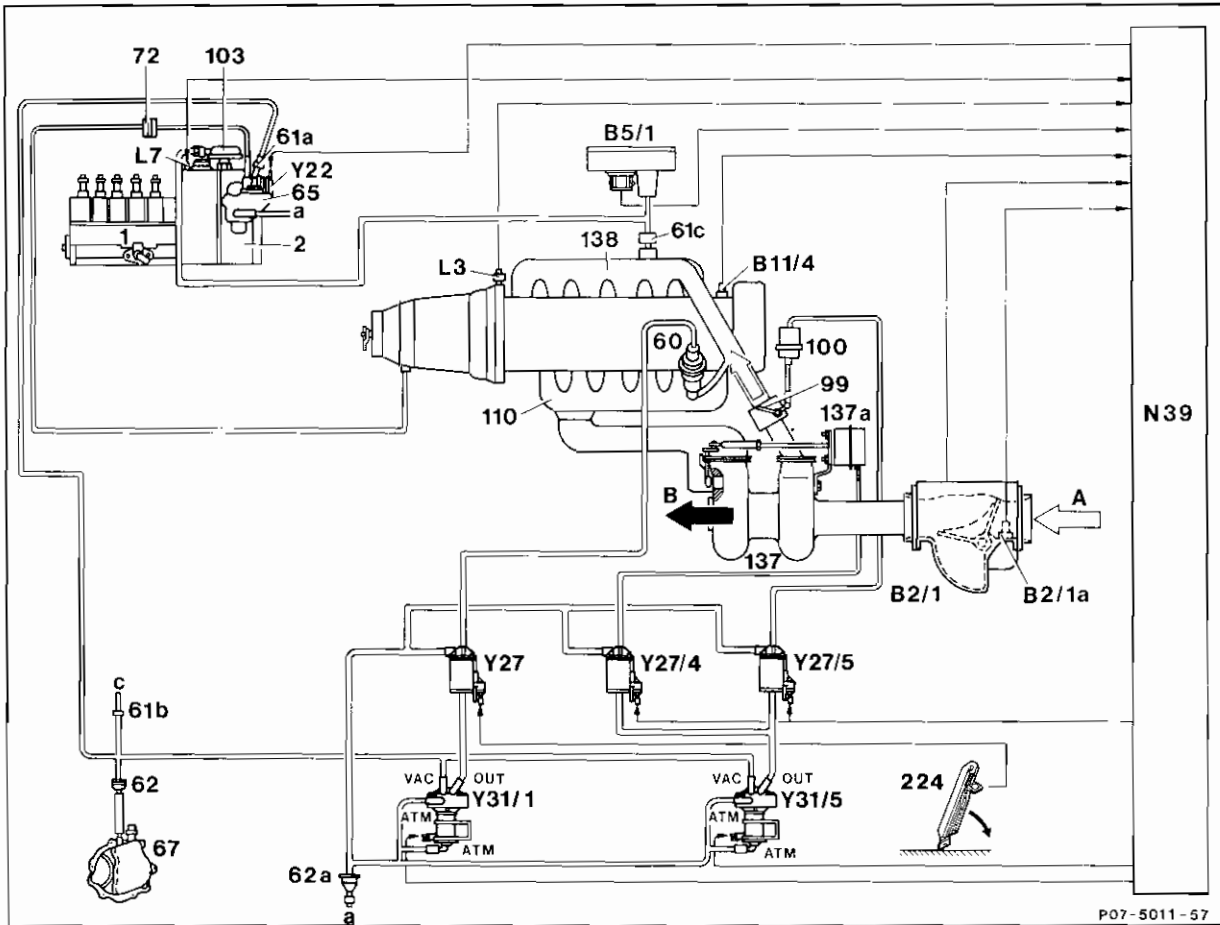
Block diagram, EDS



<sup>1)</sup> Pressure before the intake valves

<sup>2)</sup> The switchover valve is activated by the control linkage microswitch 10° before full load.

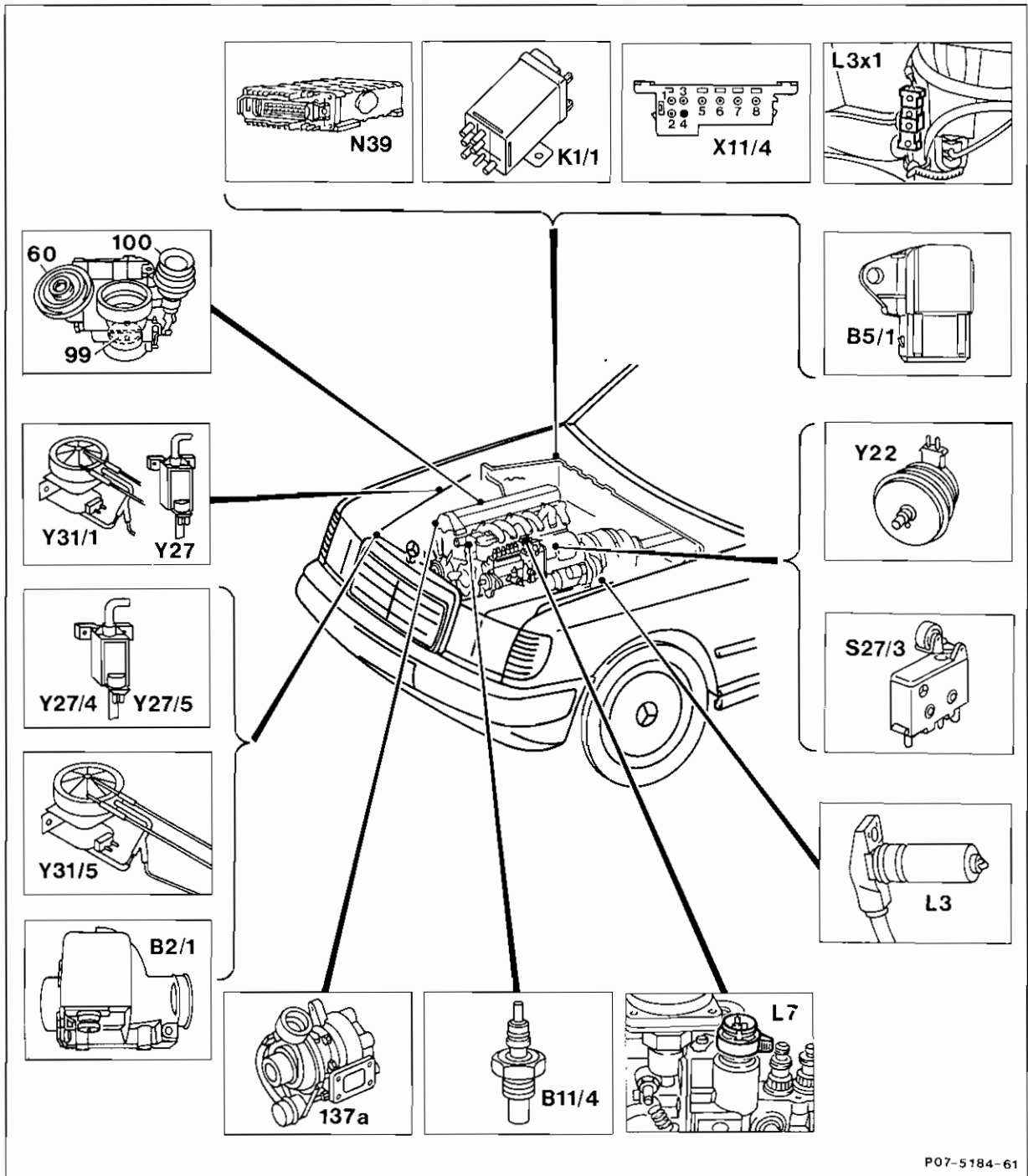
Function diagram, EDS



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- |       |  |       |  |
|-------|--|-------|--|
| 1     | Injection pump                               | N39   | EDS control unit   |
| 2     | Governor                                     | Y22   | Electromagnetic actuator, electronic idle speed control (ELR)  |
| 60    | EGR valve                                    | Y27   | EGR switchover valve   |
| 61a   | Orifice                                      | Y27/4 | Boost pressure control switchover valve                        |
| 61b   | Orifice 0.5                                  | Y27/5 | Pressure control flap switchover valve                         |
| 61c   | Orifice 0.7                                  | Y31/1 | EGR vacuum transducer  |
| 62    | Filter                                       | Y31/5 | Boost pressure control/pressure control flap vacuum transducer |
| 62a   | Filter                                       |       |  |
| 65    | Vacuum control valve                         | A     | Intake air   |
| 67    | Vacuum pump                                  | B     | Exhaust gas  |
| 72    | Vacuum damper                                | a     | Vent line to passenger compartment                             |
| 99    | Pressure control flap and housing            | c     | Remaining vacuum consumers                                     |
| 100   | Pressure control flap vacuum actuator        |       |  |
| 103   | Aneroid compensator (ALDA)                   |       |  |
| 110   | Exhaust manifold                             |       |  |
| 137   | Turbocharger                                 |       |  |
| 137a  | Boost pressure control valve vacuum actuator |       |  |
| 138   | Intake manifold                              |       |  |
| 224   | Accelerator pedal                            |       |  |
| B2/1  | Air flow sensor                              |       |  |
| B2/1a | Intake air temperature sensor                |       |  |
| B5/1  | Pressure sensor (EDS)                        |       |  |
| B11/4 | Coolant temperature sensor (EDS)             |       |  |
| L3    | Starter ring gear speed sensor               |       |  |
| L7    | Fuel rack position sensor                    |       |  |
- 
- Pressure and vacuum connections at vacuum transducers**
- |     |   |
|-----|---|
| VAC | Vacuum from vacuum pump   |
| ATM | Vent line to passenger compartment                                      |
| OUT | From vacuum transducer (Y31/1) to EGR switchover valve (Y27)            |
| OUT | From vacuum transducer (Y31/5) to switchover valves (Y27/4) and (Y27/5) |

Component locations



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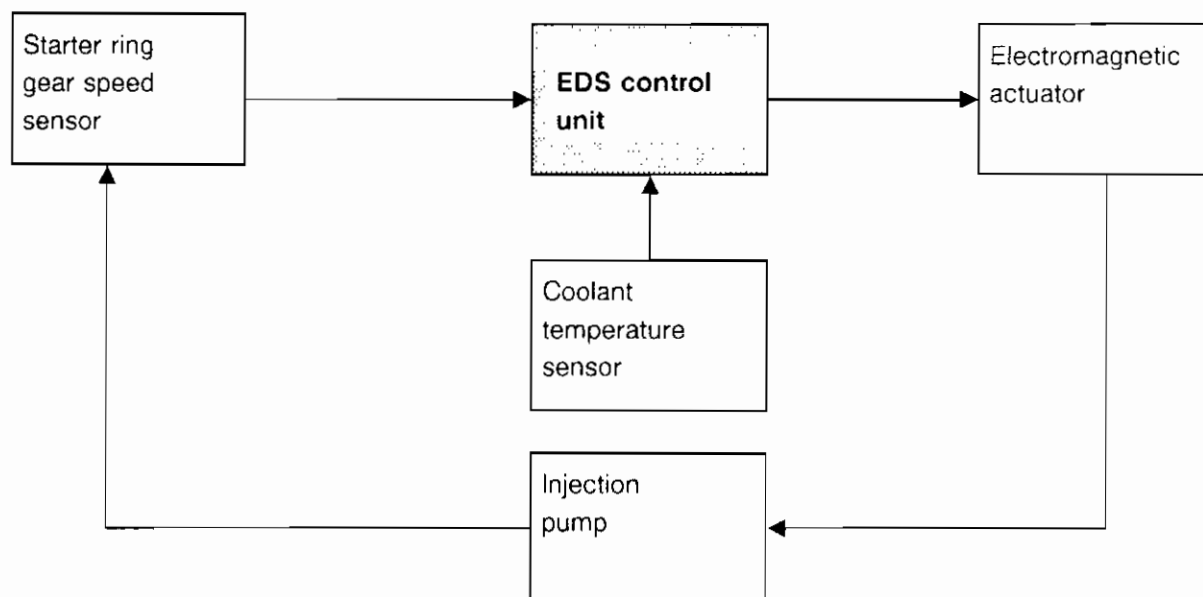
B2/1	Air flow sensor and air intake temperature sensor	Y27	EGR switchover valve
B5/1	Pressure sensor (EDS)	Y27/4	Boost pressure control switchover valve
B11/4	Coolant temperature sensor (EDS)	Y27/5	Pressure control flap switchover valve
K1/1	Overvoltage protection relay, 87E	Y31/1	EGR vacuum transducer
L3	Starter ring gear speed sensor	Y31/5	Boost pressure control/pressure control flap vacuum transducer
L3x1	Connector, starter ring gear speed sensor		
L7	Fuel rack position sensor		
N39	EDS control unit	60	EGR valve
S27/3	EGR microswitch	99	Pressure control flap and housing
X11/4	Test connection for diagnosis (impulse readout, 8-pole)	100	Pressure control flap vacuum actuator
Y22	Electromagnetic actuator, electronic idle speed control (ELR)	137a	Boost pressure control valve vacuum actuator

### Electronic idle speed control (ELR)

The starter ring gear speed sensor (L3) picks up the engine speed (144 impulses per revolution) and sends it in the form of an AC voltage signal to the EDS control unit. The EDS control unit processes the rpm signal and performs a nominal/actual value comparison.

As a result, the idle speed is held constant by the electromagnetic actuator regardless of engine load. At coolant temperatures below 60 °C, the idle speed nominal value is increased according to a preset reference map.

#### Block diagram, idle speed control



### Exhaust gas recirculation (EGR)

Exhaust gas recirculation occurs as soon as the following conditions are met:

- Coolant temperature between 60 °C and 110 °C
- Battery voltage 11–14 Volt
- Fuel rack travel < 9 mm
- Engine speed up to approx. 3500 rpm

According to the input signals from sensors e.g. fuel rack travel, engine speed, etc., the EDS control unit calculates the corresponding volume of exhaust gas recirculation for the respective operating conditions.

Control current is applied to the vacuum transducer which delivers a respective amount of vacuum to the EGR valve.

The EGR volume is reduced as engine speed and load increase.

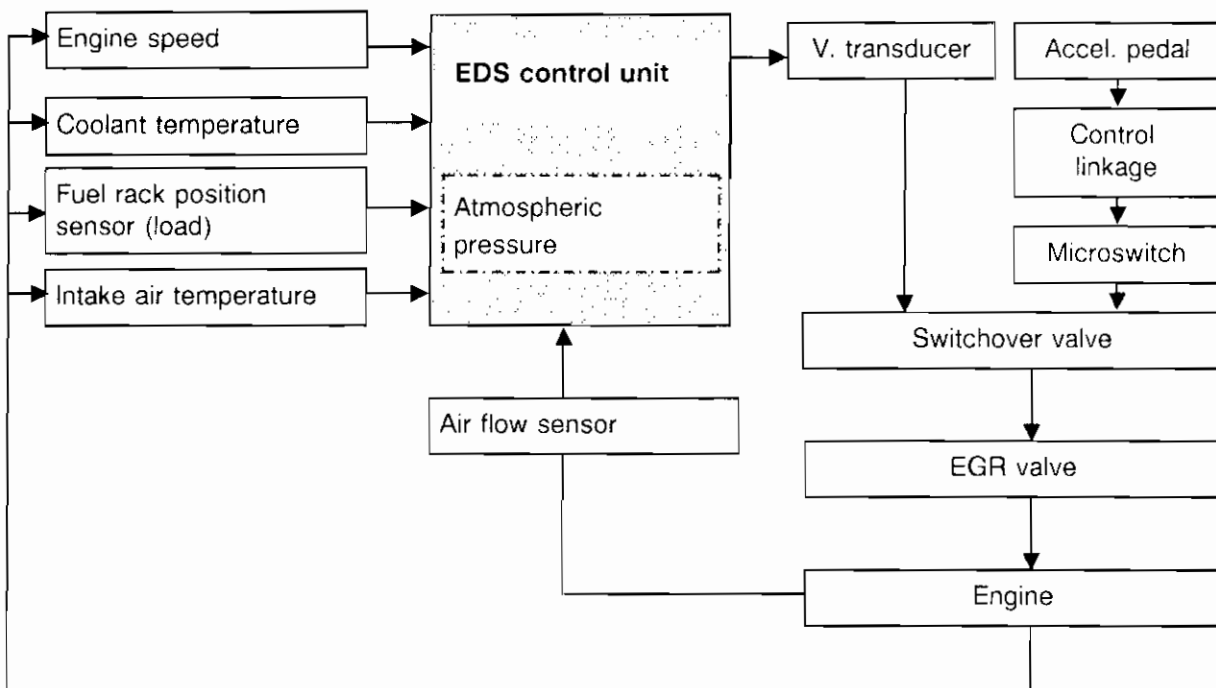
This means:

Increasing control current = increasing EGR volume

Decreasing control current = decreasing EGR volume.

**In addition:** EGR shut-off at 10° before full load via control linkage microswitch and switchover valve in vacuum line. As a result, smoke emission is reduced during load changes towards full load.

Block diagram, EGR



The EGR system with vacuum transducer, EGR switchover valve, EGR valve, air flow sensor and EDS control unit operates as a closed loop.



### Boost pressure control (P2-control)

A “reference map” (for P2-control) is stored in the EDS control unit. The pressure values received by the control unit relative to injection volume and engine speed generate optimal engine performance with respect to consumption, NOx, HC and particulate emission.

By reducing the pressure (P2) ahead of the intake valves during partial load operation, it is possible to achieve a reduction in particulate emission.

The EDS control unit contains a closed loop circuit which compares pressures “P2 actual” with “P2 nominal” (see block diagram).

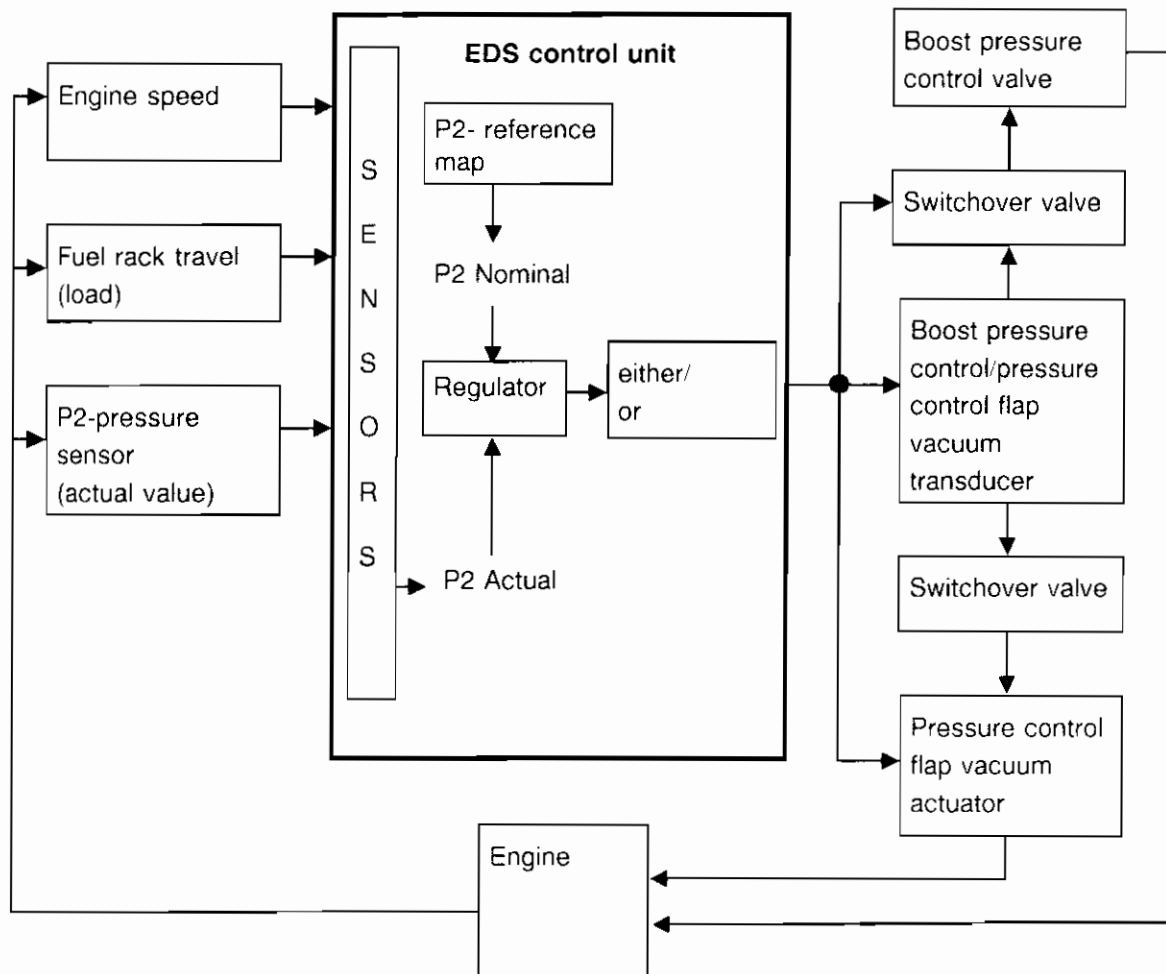
Any difference between the two pressure values is equalized either by the boost pressure control valve or by the pressure control flap.

The boost pressure control valve is activated by electronically adjustable vacuum from the vacuum transducer and electric switchover valve.

#### Boost pressure control is dependent on:

- Intake air pressure,
- Engine speed,
- Fuel rack position (travel).

Block diagram, boost pressure control (P2-control)



## System diagnostics

The self-check program integrated into the EDS control unit tests the electronic diesel system i.e. detects and stores system malfunctions. Intermittent malfunctions, which occur for longer than 4 seconds, are also stored.

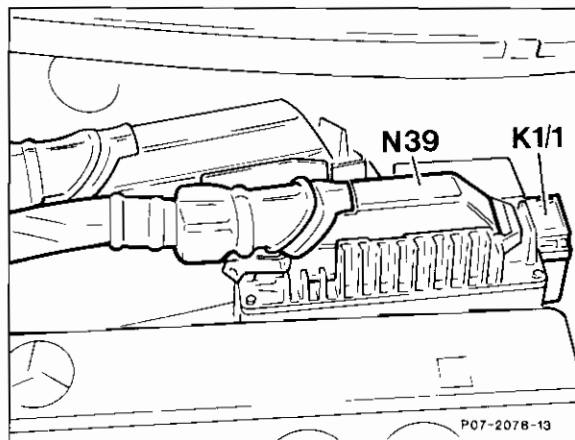
For example, sensor malfunctions, with the exception of engine speed sensor, are stored into memory, as well as short circuits in the actuators and their input wiring.

Through the use of an impulse counter at socket 4 of test connection (X11/4), the individual malfunctions can be recalled for evaluation. The proper diagnosis can be determined according to the indicated malfunction.

## Component operation

### EDS control unit (N39)

The control unit processes the incoming signals and delivers a milliamp current to the two vacuum transducers, to the electromagnetic actuator on the injection pump, and the boost pressure control and pressure control flap switchover valves. The entire system can be tested with an impulse counter i.e. the malfunction memory can be read by means of the test connection (X11/4, socket 4).

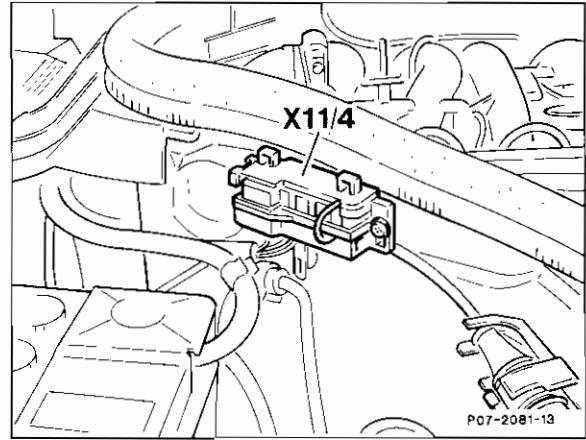


### Atmospheric pressure sensor (integrated into control unit)

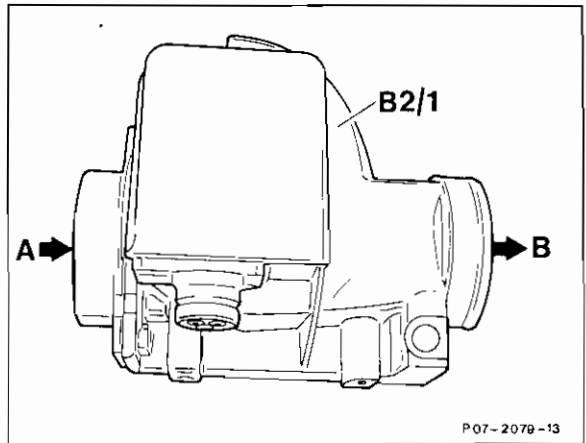
Depending on altitude or atmospheric pressure, the atmospheric pressure sensor influences EGR volume and boost pressure. The atmospheric pressure sensor sends the control unit a decreasing voltage signal at decreasing air pressures (increasing altitudes). The EGR and P2 reference map values are adapted according to a pressure dependent characteristic.

**Test connection for diagnosis (X11/4)**

The impulse readout for diagnosis can be picked up at this test connection.

**Air flow sensor (B2/1)****Intake air temperature sensor (B2/1a)**

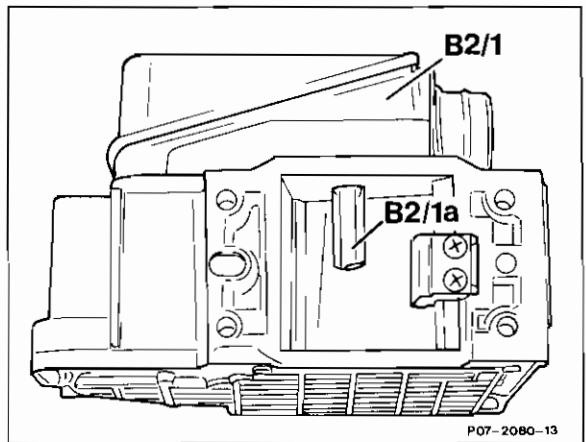
Located in the air flow between the air filter and the turbocharger.



A from air filter  
B to turbocharger

Acting against a return spring, intake air opens the air flow sensor plate to a specific angle. The position of the plate is measured by a potentiometer which converts the position into a voltage signal.

The intake air temperature is read by the temperature sensor (B2/1a) in the air flow sensor.

**Vacuum transducers (Y31/1, Y31/5)**

Respective to operating conditions, the vacuum transducers receive a control current from the control unit. The vacuum transducers then deliver a corresponding amount of vacuum for the electric switchover valves.

Y31/1 EGR valve vacuum transducer  
Y31/5 Boost pressure control/pressure control valve vacuum transducer (not visible, located under air filter)

