# Motronic 1992

- 20V-Engine
- V8-Engine

## Construction and Operation.

Self Study Programme No. 143.

Audi

Service Department.

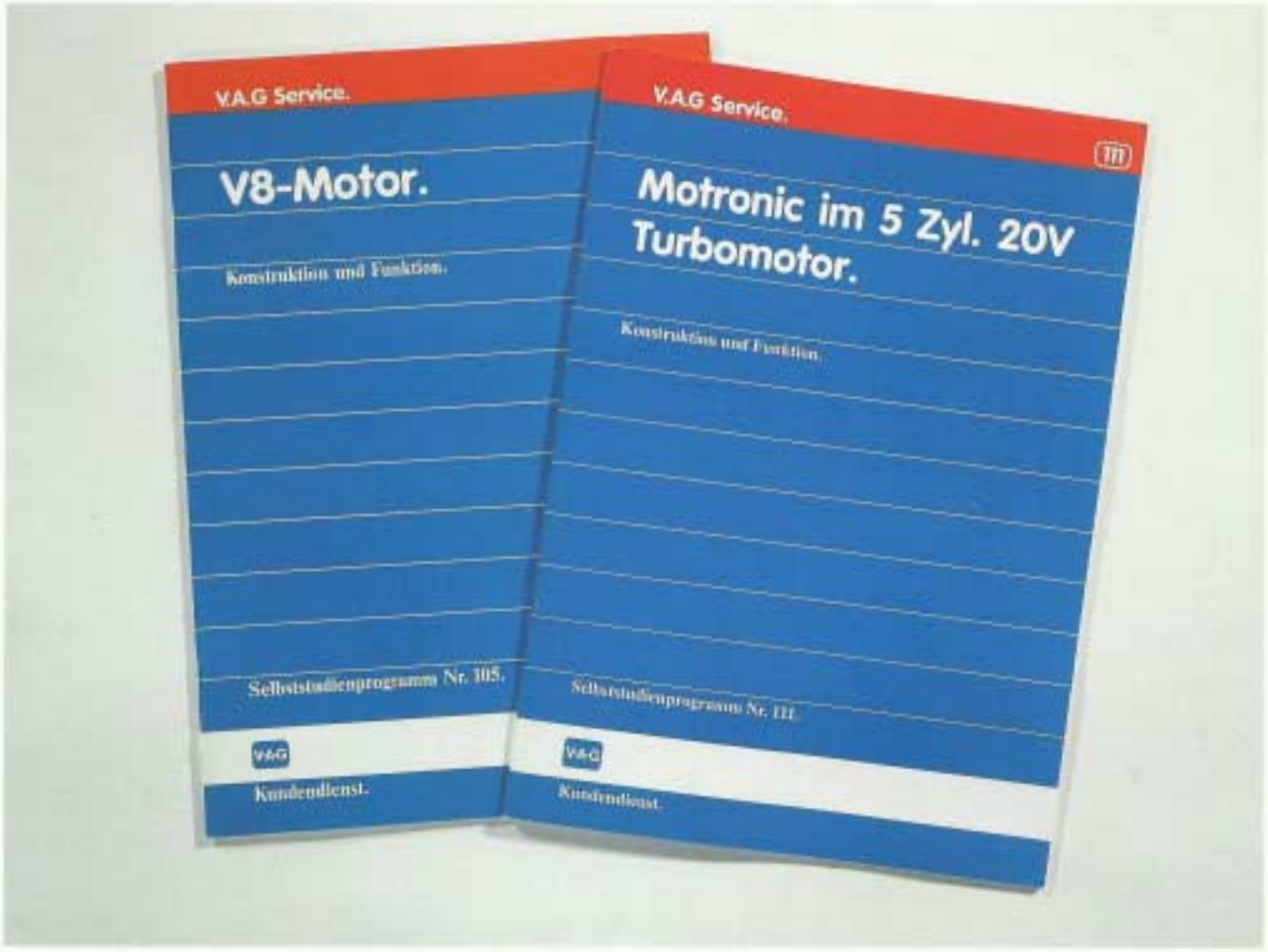
# Motronic for 20V Engine and V8 Engine

The **Motronic** engine management system is known from the 20V engine (turbocharged) and V8 engine (3.6 ltr.) and is described in Self Study Programmes 111 and 105.

The modifications on engines in 1992 models have also resulted in further development of Motronic.

The most important changes for both engine management systems are described in this Self Study Programme.

**Important:**
The Motronic modifications for the V8 engine with 4.2 litre displacement are also applicable to the V8 engine with 3.6 litre displacement as from 1992 models on.




*SSP 143/01*

Information About Designations:

| | | | |
|---|---|---|---|
| Old Motronic 20V engine: | M 2.3 | New Motronic 20V engine: | M 2.3.2 |
| Old Motronic V8 engine: | M 2.4 | New Motronic V8 engine: | M 2.4.1 |

# Contents



Refer to the concerned workshop manual for precise testing, adjusting and repairing instructions.

Complaint reports can be used to report recommendations concerning our self study programmes to Dept. VK-12.

## 20V Engine – AAN

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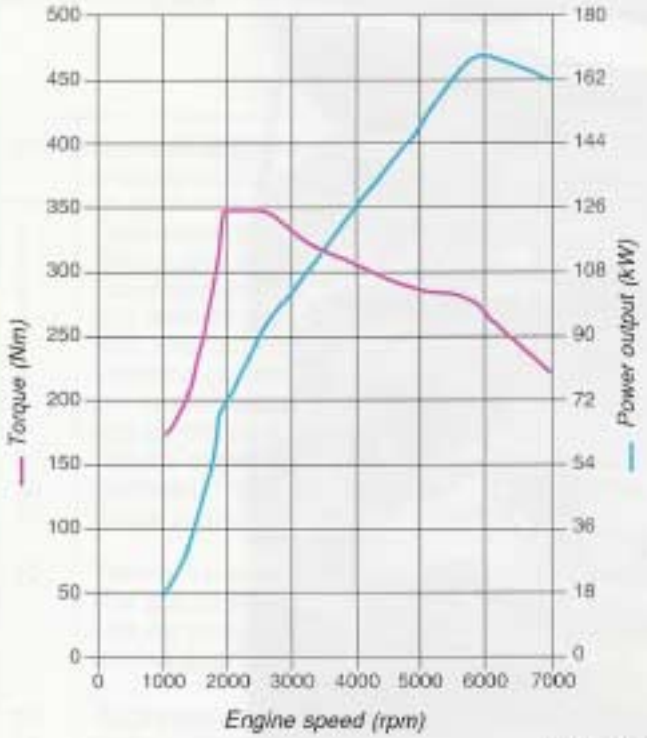
### Technical Data

| | |
|---|---|
| Type: | 5-cyl., in-line, turbocharged engine with 4 valves per cyl. |
| Displacement: | 2226 $cm^3$ |
| Power: | 169 kW (230 HP) |
| Rated speed: | 5900 rpm |
| Bore dia.: | 81.0 mm |
| Stroke: | 86.4 mm |
| Compression ratio: | 9.3 : 1 |
| Charge pressure: | Max. 1.15 bar |
| Fuel and ignition systems: | Motronic M 2.3.2 |
| Emission control: | Lambda control with 2 catalytic converters |
| Petrol grade: | Unleaded premium with RON 95/98 |
| Engine code: | AAN |

## Performance Diagram

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### Torque Increase

The maximum torque of **350 Nm** is already available at an engine speed of 1950 rpm. The torque curve shows that the engine has enormous tractive power throughout the entire speed range.

### Power Output Increase

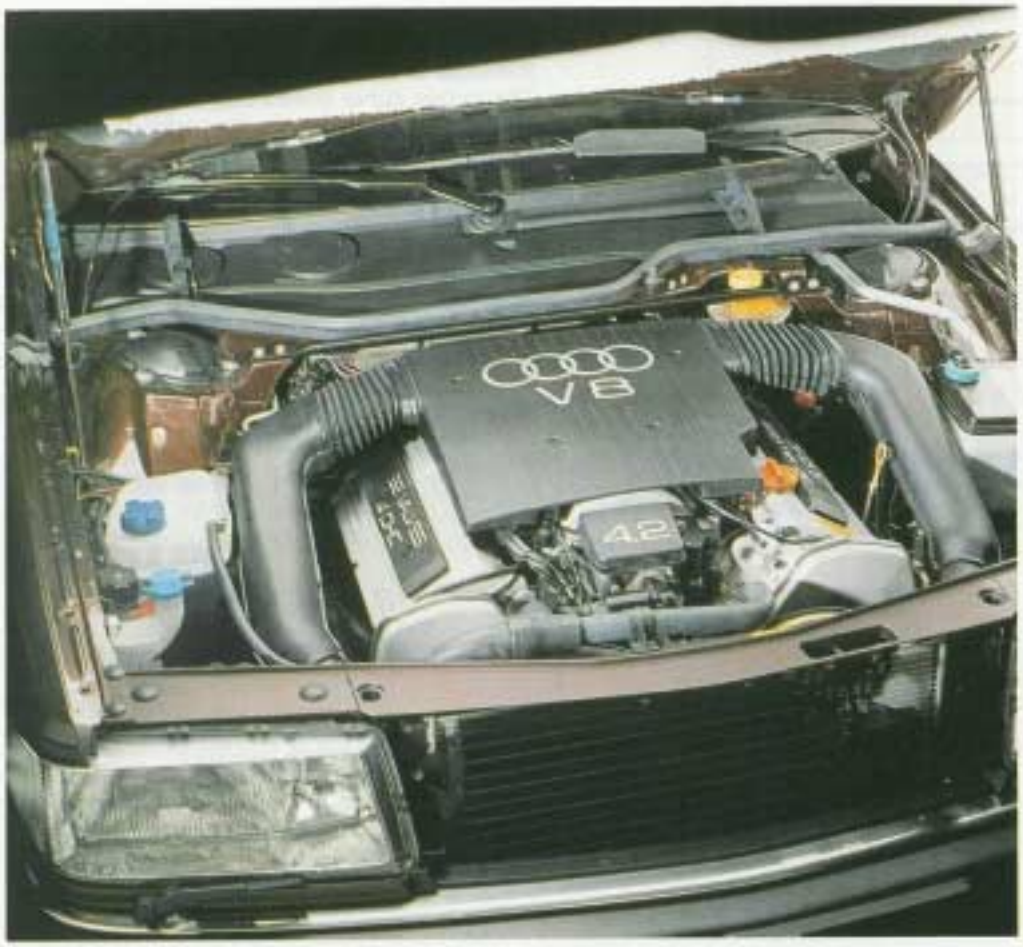
The maximum power output of 230 HP (169 kW) is reached at an engine speed of 5900 rpm.

The curves and values in the performance diagram are determined in accordance with Standard 80/1269/EC and are applicable for 95/98 RON petrol with catalytic converter.

## Mechanical Engine Innovations

- New intake manifold
- New pressure regulator on fuel distribution pipe
- Greater difference in pressure (4 bar) between intake manifold pressure and fuel pressure
- Adapted fuel injectors in 4-hole ejection design
- Modified crankcase ventilation
- Modified oil sump with new oil splash plate and changed oil intake
- Two part flywheel with adapted vibration damper
- Modified cooling system due to omission of additional cooler

## V8 Engine – ABH

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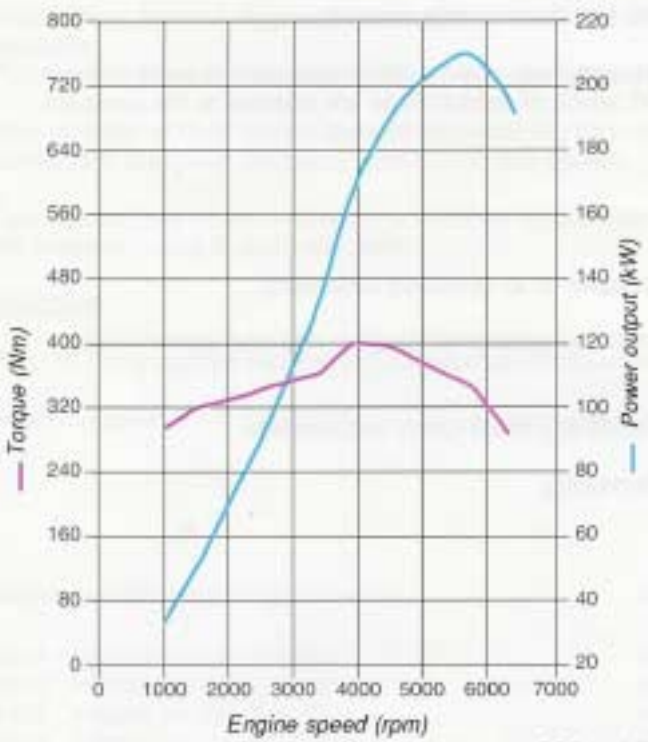
### Technical Data

| | |
|---|---|
| Type: | 8-cylinder V-engine with 4 valves per cylinder |
| Displacement: | 4172 $cm^3$ |
| Power: | 206 kW (280 HP) |
| Rated speed: | 5800 rpm |
| Bore dia.: | 84.5 mm |
| Stroke: | 93.0 mm |
| Compression ratio: | 10.6 : 1 |
| Fuel and ignition systems: | Motronic M 2.4.1 |
| Emission control: | Lambda control with 2 catalytic converters |
| Petrol grade: | Unleaded premium with RON 95/98 |
| Engine code: | ABH |
| | Note: The V8 engine with 3.6 ltr. displacement as from 10.91 on has the same engine code PT as previously. |

## Performance Diagram

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### Torque Increase

The torque has been increased from 350 Nm to **400 Nm.**
The engine developes its maximum torque at a speed of 4000 rpm.

### Power Output Increase

The maximum power output of 280 HP (206 kW) is reached at an engine speed of 5900 rpm.

The curves and values in the performance diagram are determined in accordance with Standard 80/1269/EC and are applicable for 95/96 RON petrol with catalytic converter.

## Mechanical Engine Innovations

- Greater distance between cylinders (90.0 mm) without changing length of engine block
- Larger displacement by increasing stroke to 93.0 mm (+ 6.6 mm) and bore dia. to 84.5 mm (+ 3.5 mm)
- Modified crankshaft with new bearing locations
- Pistons adapted to stroke and modified combustion chamber shape
- Modified camshaft with adapted timing
- Modified throttle valve assembly
- Insulated exhaust manifolds with flat gaskets
- New single-pipe cooler with improved cooling power

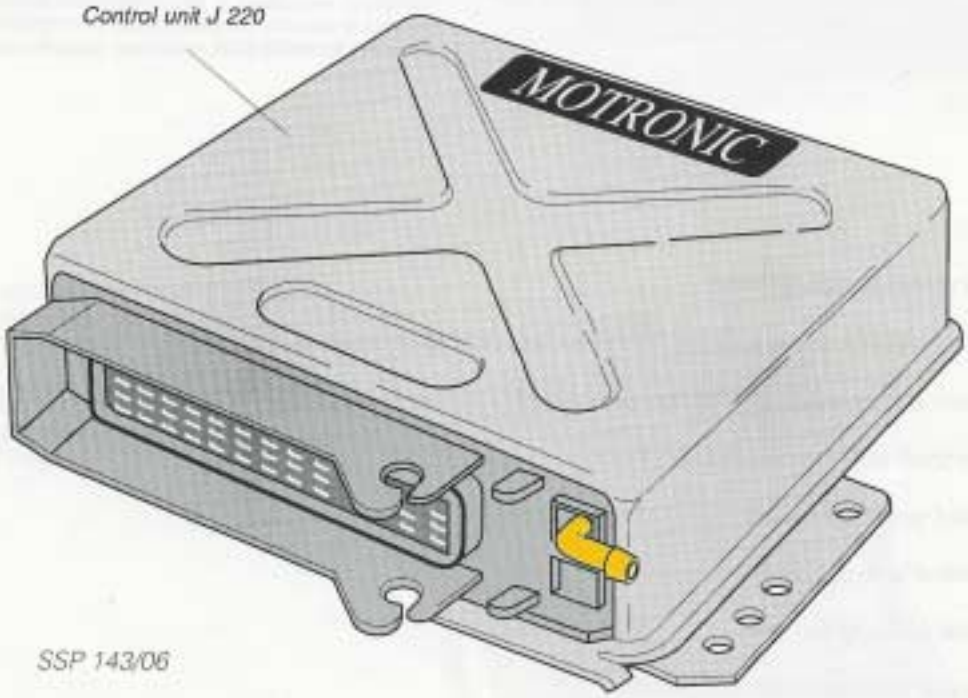
# Motronic

The **Motronic** engine management system combines the ignition system and fuel injection system and controls both electronically.
In this manner it is possible to optimize ignition timing and the fuel injection rate mutually.

The brain of Motronic is an electronic control unit (J 220) with a digitally working micro-computer. A great number of three-dimensional maps are stored there in a memory, with which all subfunctions are adapted to the pertinent operating condition of the engine.

## Advantages of Motronic:

- Optimal economy due to low fuel consumption by adaptation to all operating conditions.
- Ecologically harmless due to emission control with optimal adaptation of injection rate and ignition timing in conjunction with catalytic converter engineering.
- Maximum ride comfort due to perfected control techniques and small space requirement.
- No maintenance and easy servicing due to optimal diagnosing.

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## Innovations on Motronic Engine Management System

### 20V Engine

**NEW!**

- One ignition coil, which is activated by two final output stages, for each cylinder.
- Adaptive charge pressure control (CPC) with higher nominal charge pressure.
- Engine adapted for 98 RON petrol and adaptive knock control as for Audi V8 engine.
- Driving range and shift point signal with automatic gearbox.
- Bidirectional (in + out) A/C compressor control and utilization of road speed signal for idling speed stabilization (ISS).
- Two adaptation ranges for lambda control in fault memory.
- Consumption signal adapted for signal-receiving control units (e.g. J 217, automatic gearbox).
- Utilization of signal from throttle valve potentiometer as substitute function for air volume meter and idling speed switch.
- Utilization of signal from altitude sender for altitude-dependent start control.
- Signal from throttle valve potentiometer adapted for signal-receiving control units (e.g. J 217, automatic gearbox).
- Omission of electronic thermoswitch F 76 as signal for Motronic.
- Improved self-diagnosis for Motronic.

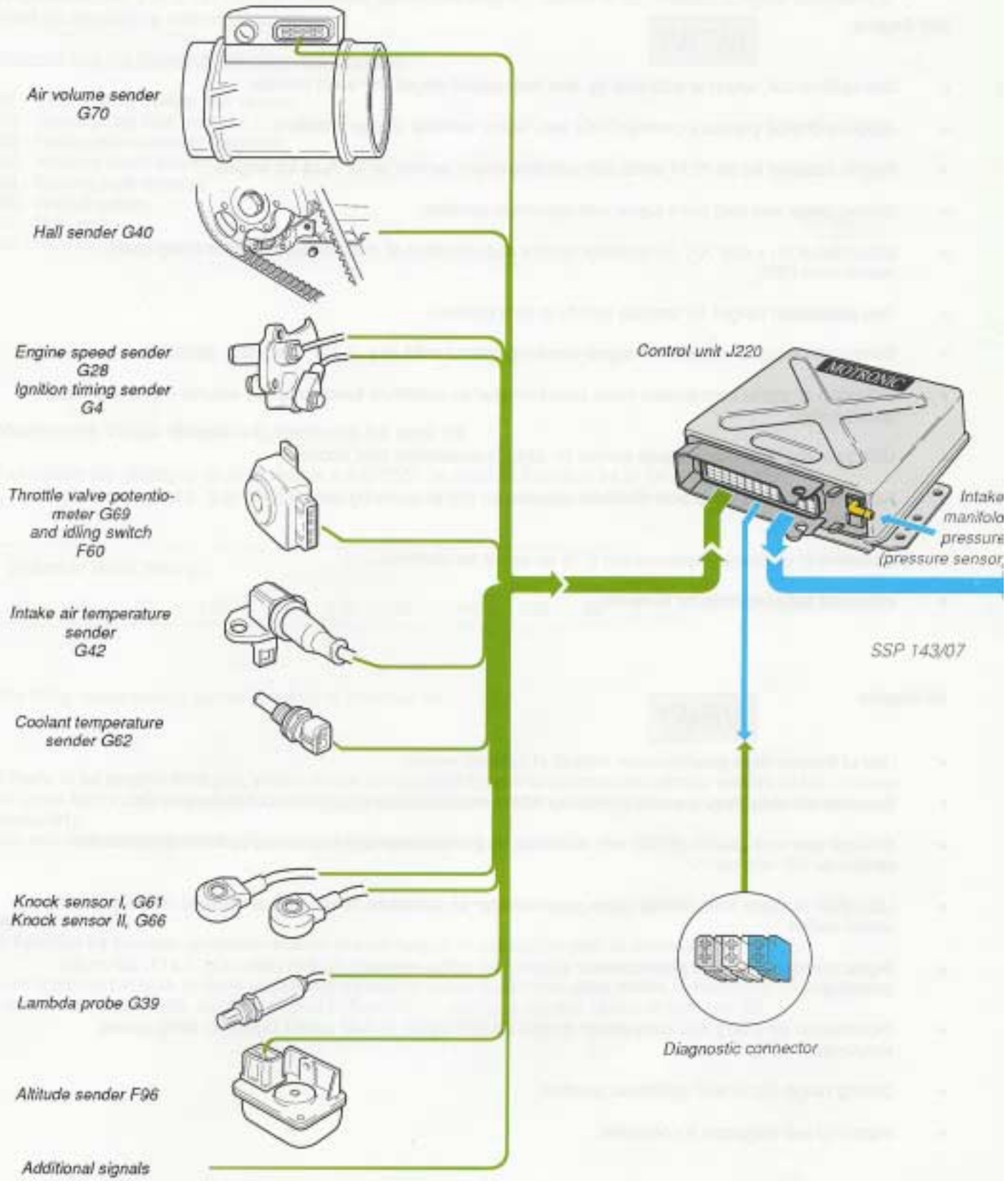
### V8 Engine

**NEW!**

- Use of throttle valve potentiometer instead of full load switch.
- Separate connection pins on control unit (J 220) permit separate diagnosis of all fuel injectors.
- Exhaust gas recirculation (EGR) with activation by pulsed valve and monitoring by EGR temperature sensor for US version.
- Utilization of signal from throttle valve potentiometer as substitute function for air volume meter and idling speed switch.
- Signal from throttle valve potentiometer adapted for signal-receiving control units (e.g. J 217, automatic gearbox).
- Bidirectional (in + out) A/C compressor control and utilization of road speed signal for idling speed stabilization (ISS).
- Driving range signal with automatic gearbox.
- Improved self-diagnosis for Motronic.

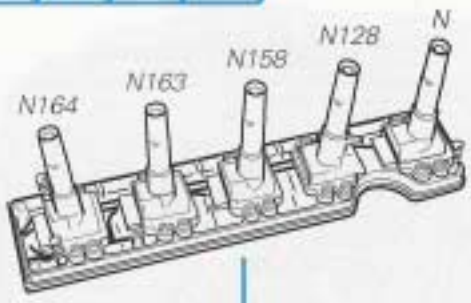
# System Survey - 20V Engine

## Sensors (Information Senders)



## Actuators (Drives)


*Fuel injectors*

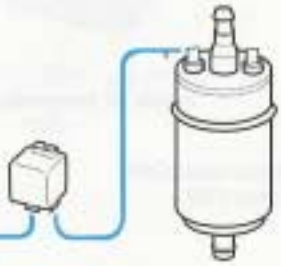



*Ignition coils*

*Idling stabilization valve N71*

*Pulsed charge pressure control valve N75*

*Activated charcoal filter solenoid valve I N80*



*Fuel pump relay J17 and fuel pump G6*

*Additional signals*

## Subsystems

Sequential Fuel Injection

- Basic adaptation via map
- Start control
- Post-start enrichment
- Acceleration enrichment
- Overrun cut-out
- Engine speed governor
- Lambda control with adaptation

Ignition

- Basic adaptation via map
- Dwell angle control
- Warm-up correction
- Start control
- Initial shift point control (automatic gearbox)
- Digital idling stabilization (DIS)
- Cylinder-selective knock control with adaptation

Idling speed stabilization (ISS) with adaptation

- Map controlled
- Start control
- Initial climate control
- Initial driving range control (automatic gearbox)

Charge pressure control with adaptation

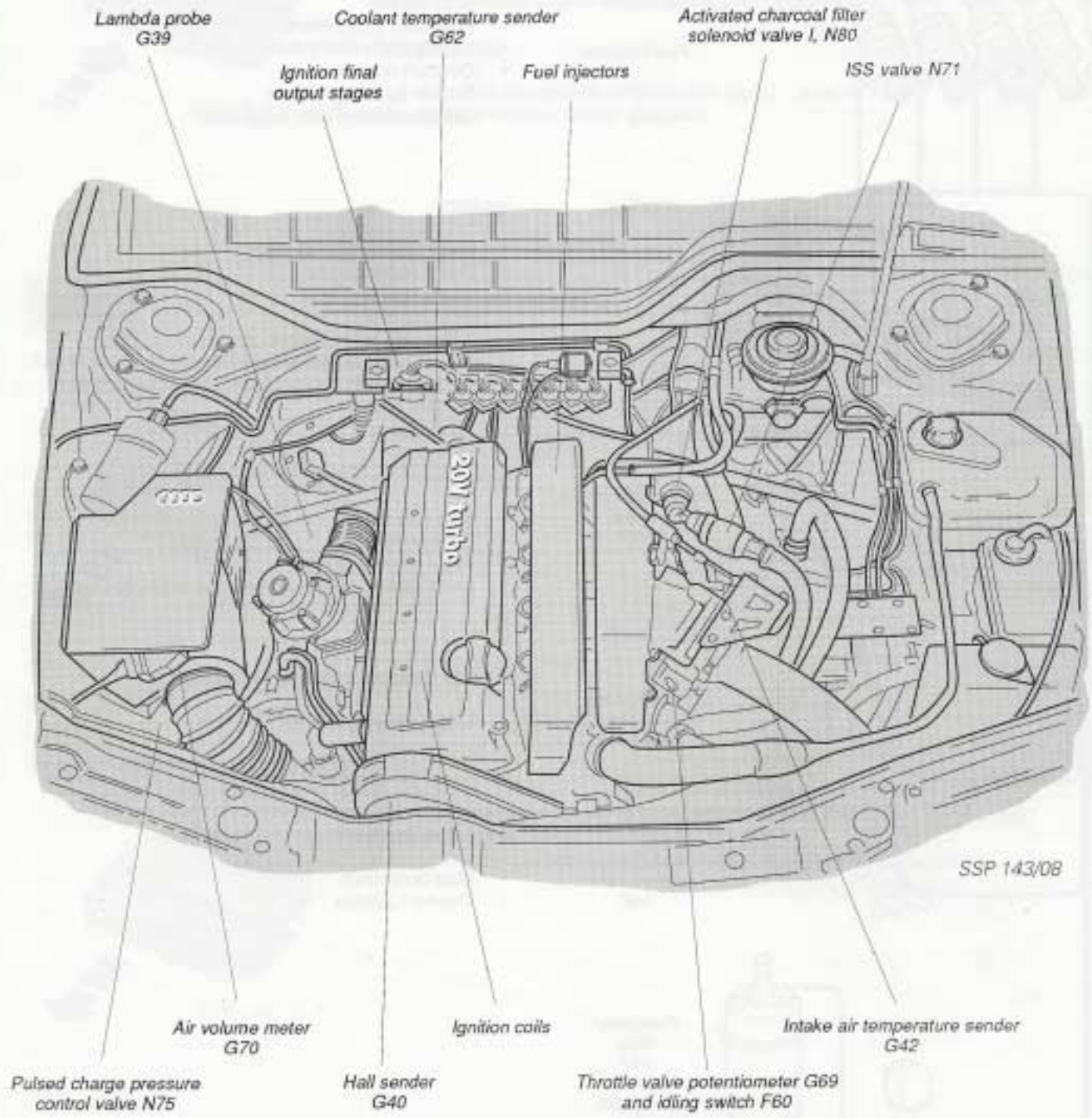
- Map controlled

Tank vent system

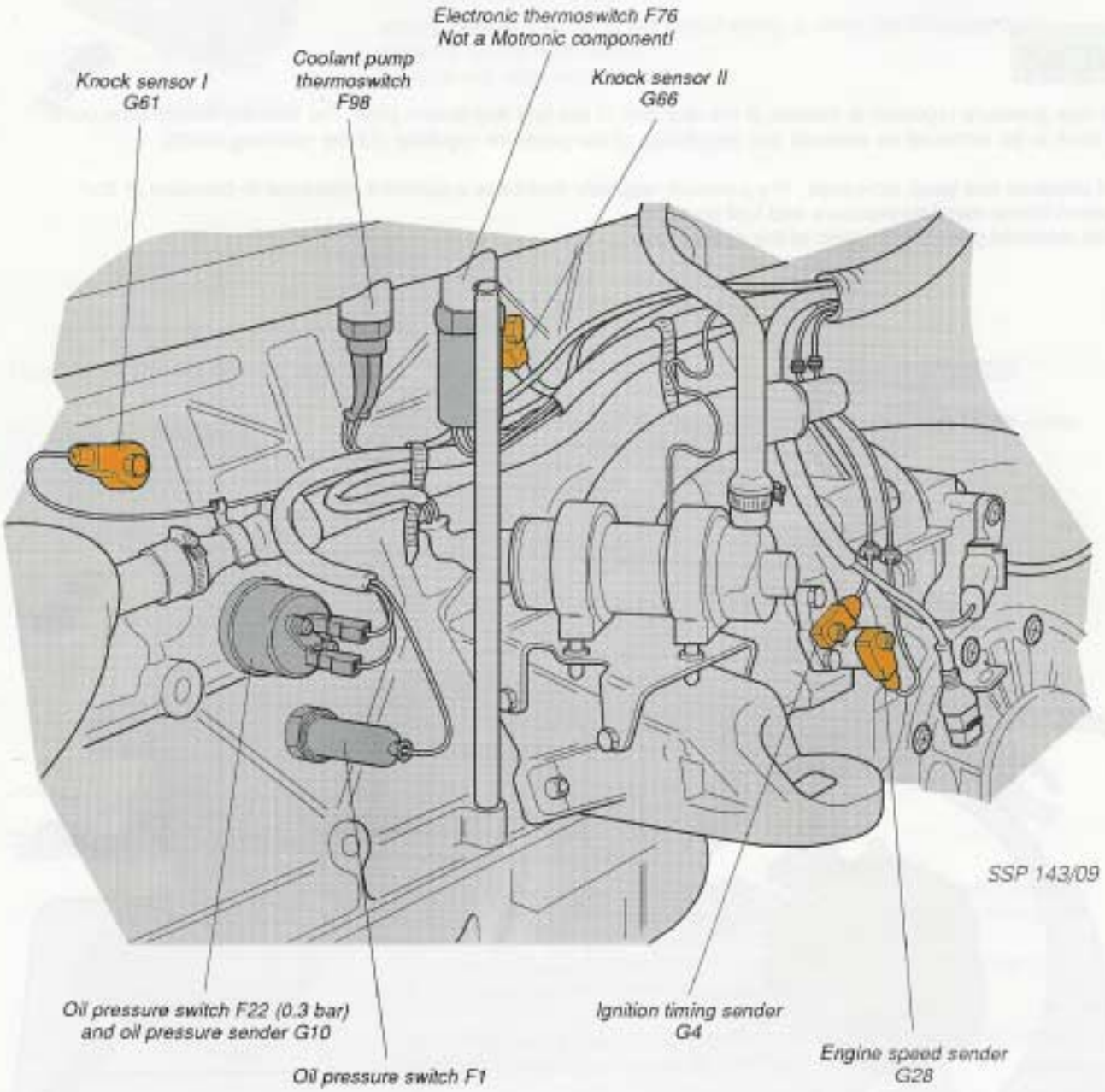
- Map controlled
- Overrun cut-out

# Location of Components

Many components of Motronic are installed on 20V engines at new locations.



The new component locations are shown in the following views of the engine compartment.



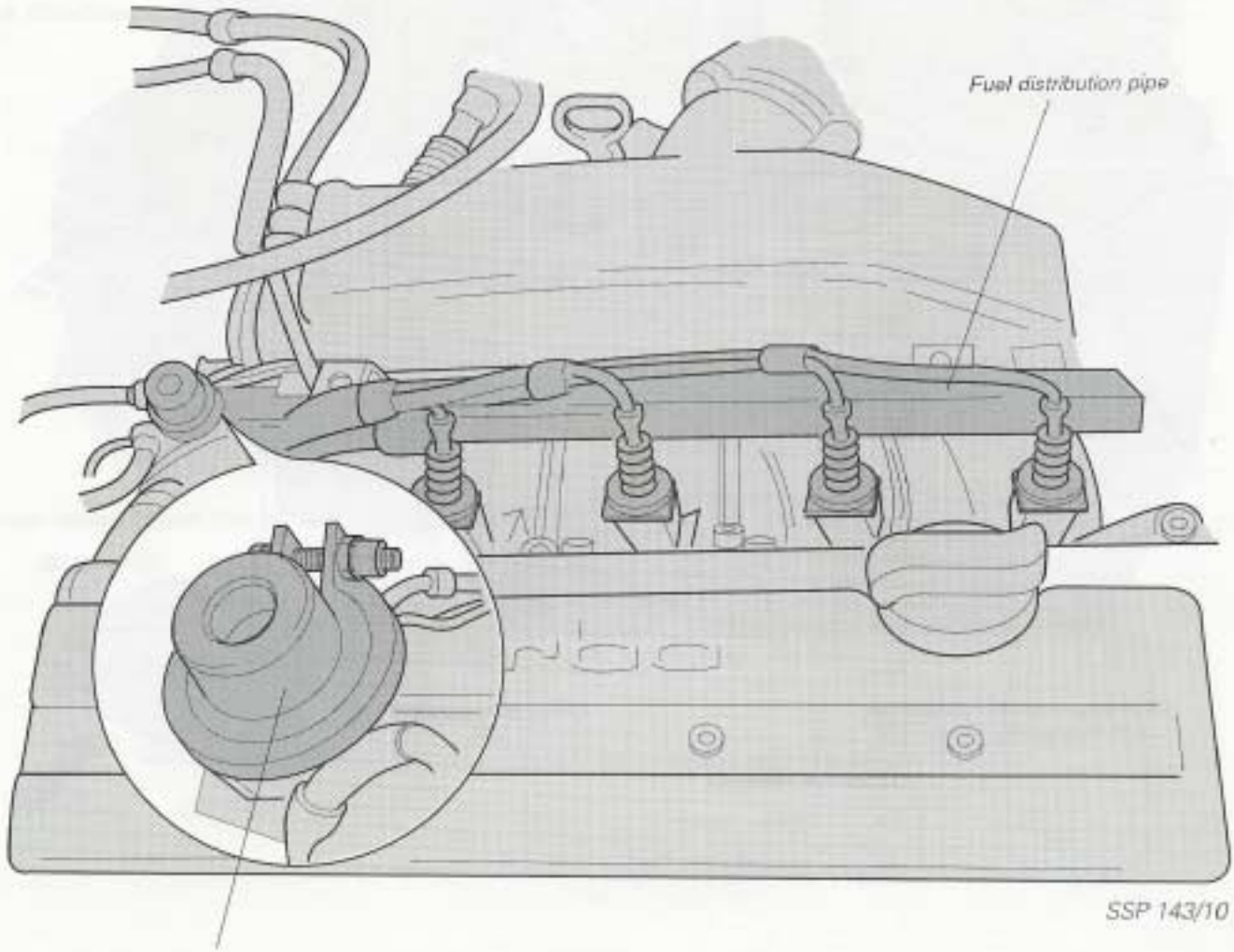
## Fuel System

The fuel distribution pipe is located under a plastic cover between the new intake manifold and the cylinder head. The 4-hole ejection designed fuel injectors are secured direct to the fuel distribution pipe and eject petrol directly in front of the inlet valve.

**NEW!**

The new pressure regulator is located at the rear end of the fuel distribution pipe. The fuel distribution pipe does not have to be removed for removal and installation of the pressure regulator via the retaining clamp.

Fuel pressure has been increased. The pressure regulator maintains a constant difference in pressure (4 bar) between intake manifold pressure and fuel pressure.
Intake manifold pressure is taken at the intake pipe.

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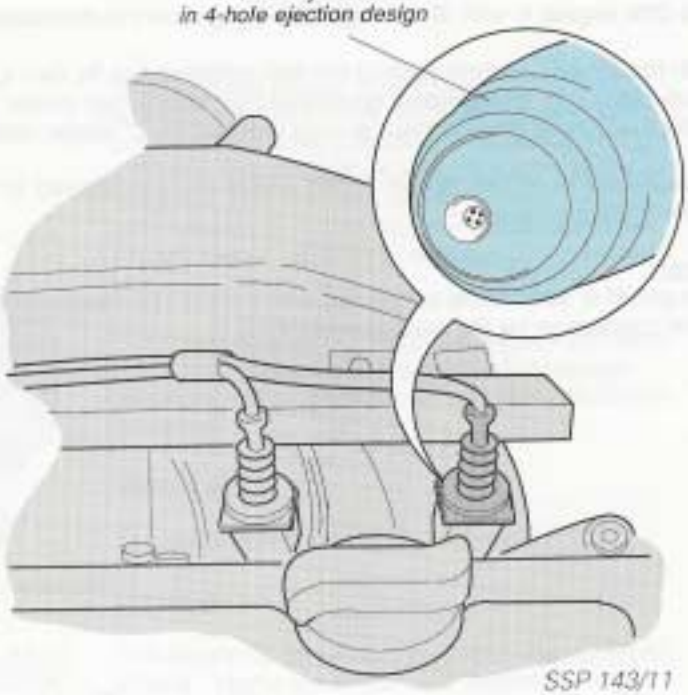
## Fuel Injectors N 30, 31, 32, 33, 83

Power is supplied to fuel injectors via a thermo fuse (S 72).
A separate output stage is provided for each fuel injector for sequential activation of the injectors.

Self-diagnosis:
Self-diagnosis recognizes faults in the circuit of fuel injectors. It makes a difference between the types of fault "break/short to earth" and "short to positive".
The concerned output stage is switched off if a fault is recognized. Lambda and idling speed stabilization adaptation are interrupted.

*Fuel injector in 4-hole ejection design*



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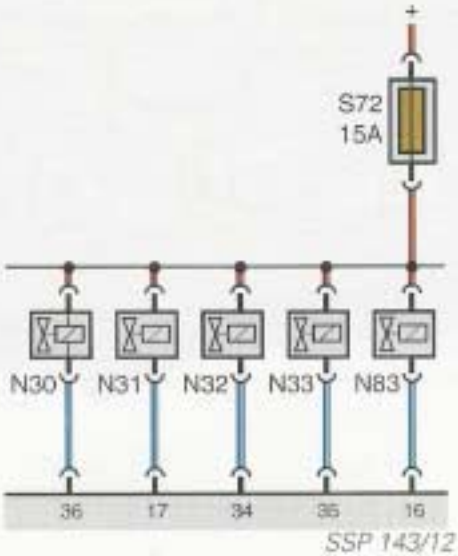
**Electric Circuit:**

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36 = Injection signal, cyl. no. 1 (out)
17 = Injection signal, cyl. no. 2 (out)
34 = Injection signal, cyl. no. 3 (out)
35 = Injection signal, cyl. no. 4 (out)
16 = Injection signal, cyl. no. 5 (out)

## Ignition System

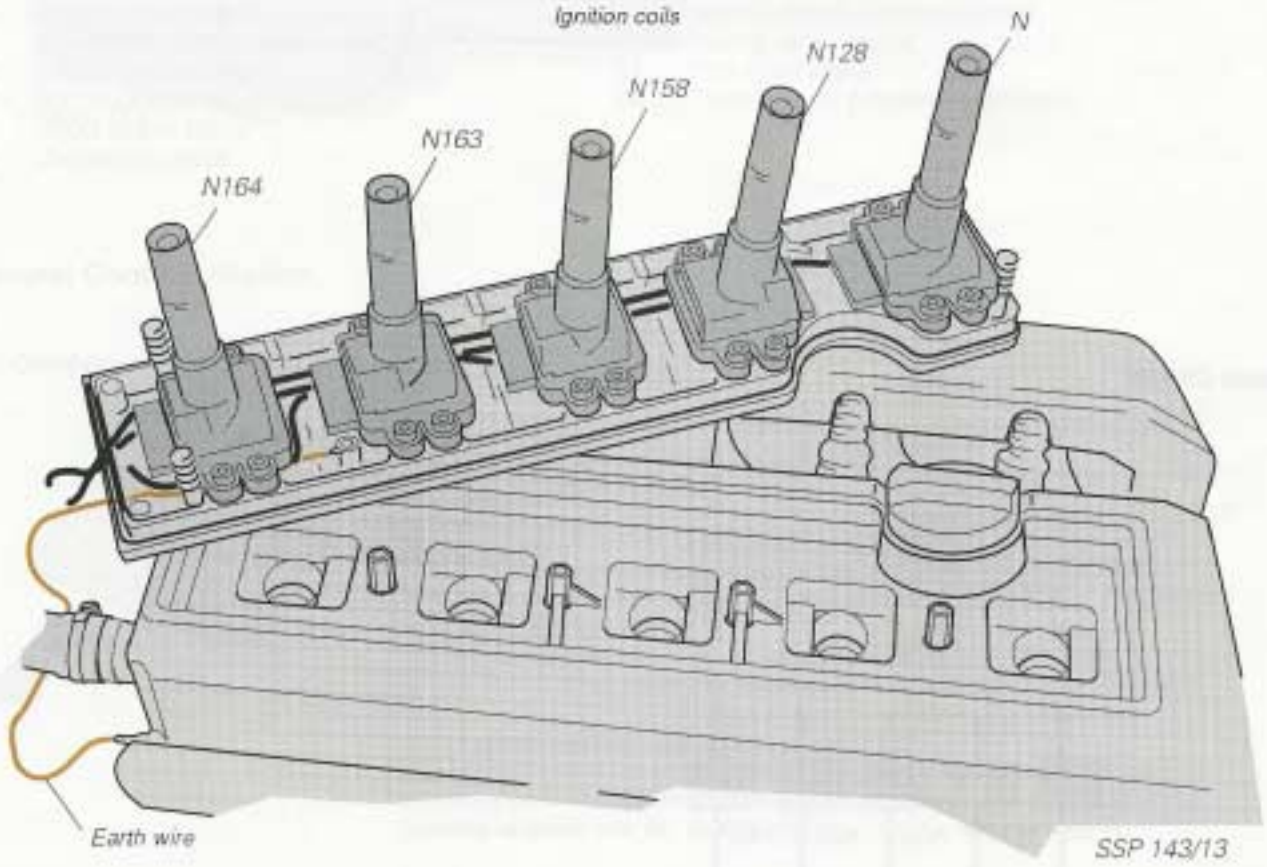
**NEW!**

The 20V engine is with **direct** high tension ignition (no distributor).

With this ignition system each of the five cylinders has its own ignition coil, which is located directly above a spark plug. This arrangement guarantees especially high power ignition sparks. They are necessary to safely ignite the fuel/air mixture even in case of "overboost" (upper most control range of the charge pressure map).

Ignition coils N, N 128, N 158, N 163 and N 164 are secured in a guard which is mounted on the cylinder head cover by four screws.

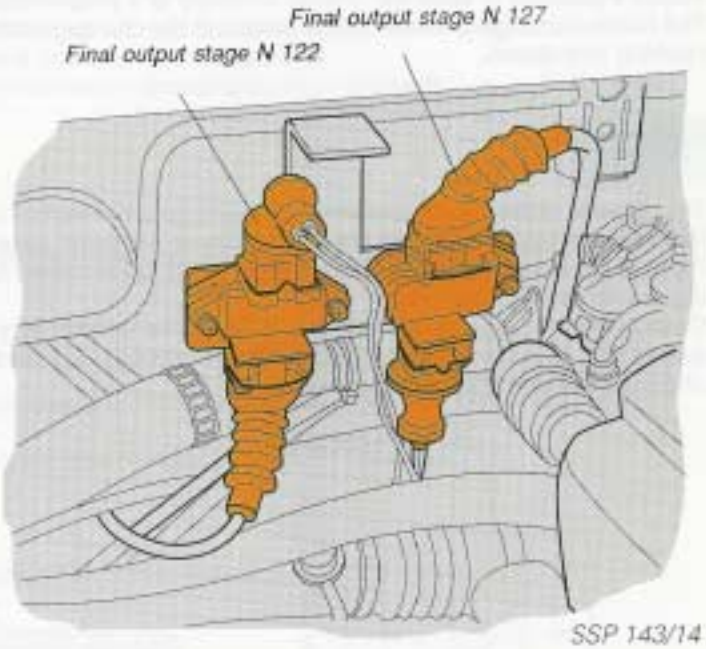
**Note:**
The guard is additionally connected with the cylinder head cover via an earth wire, in order to guarantee perfect earth connection for the secondary winding.



**NEW!**

## Final Output Stages N 122 and N 127

The final output stages are secured on the splash wall in the engine compartment.
Final output stage N 122 controls the ignition coil for cylinders 1, 2 and 3, while final output stage N 127 is for the ignition coil of cylinders 4 and 5.

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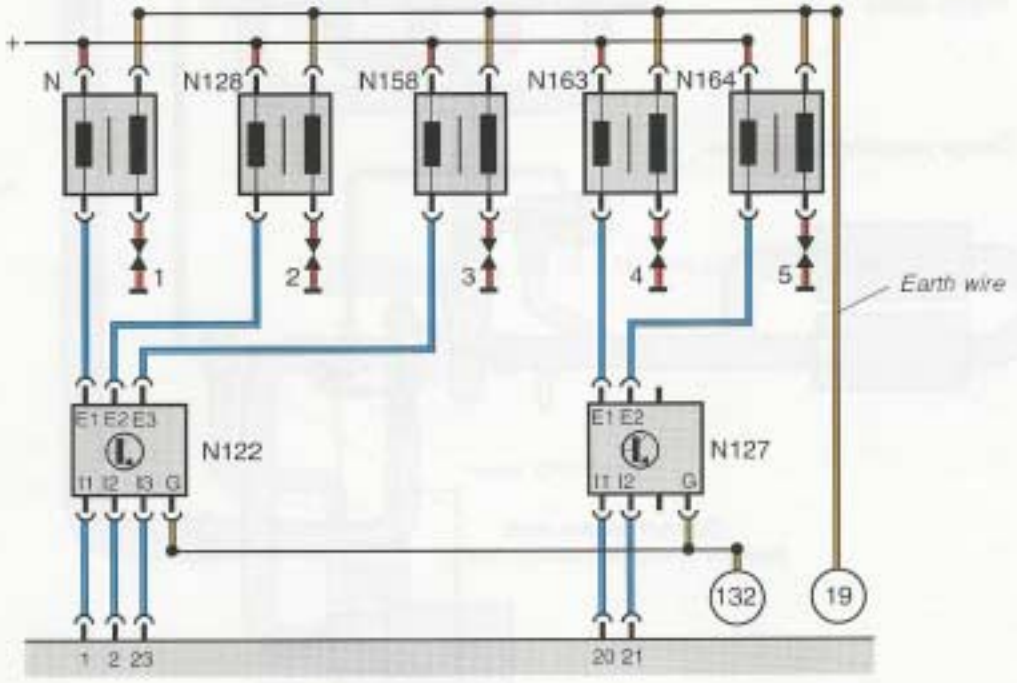
**Electric Circuit:**

1 = Ignition signal for cyl. no. 1 (out)
2 = Ignition signal for cyl. no. 2 (out)
23 = Ignition signal for cyl. no. 3 (out)
20 = Ignition signal for cyl. no. 4 (out)
21 = Ignition signal for cyl. no. 5 (out)

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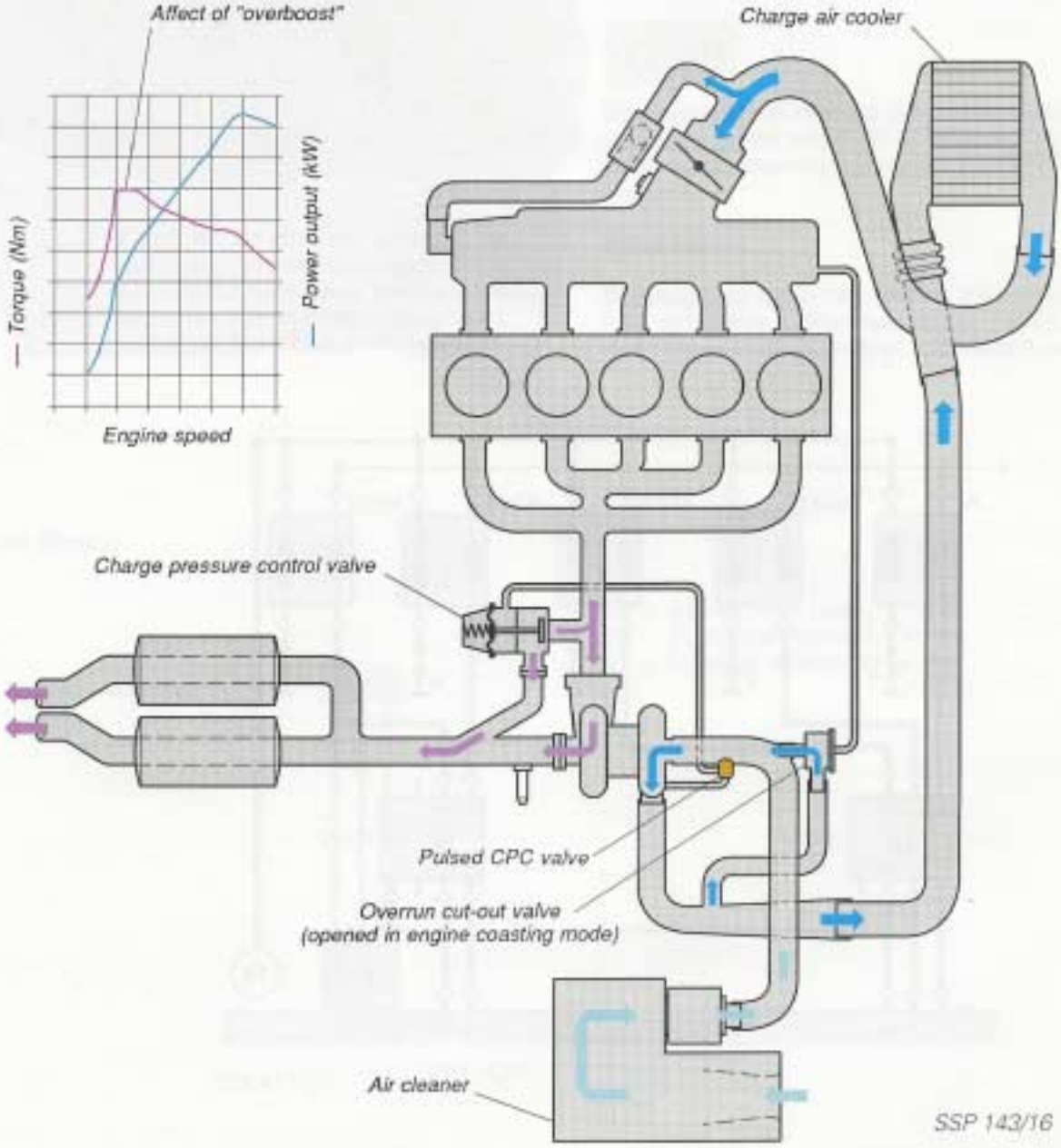
## Turbocharging with Charge Pressure Control

The 20V engine is equipped with a turbocharger and electronic charge pressure control. Charge pressure control makes it possible to keep the charge pressure at a programmed value throughout the entire speed range.
The nominal charge pressure value stored in the charge pressure map depends on the throttle valve's angle of opening and speed.

**NEW!**

The nominal charge pressure was increased from the former value of 0.82 bar to 1.15 bar. In this manner engine torque is increased from 309 Nm to 350 Nm at the same speed.
Fast charge pressure rise is programmed in the lower speed range, the so-called "overboost", in order to have especially good acceleration.
Charge pressure control is **adaptive**. It learns the optimal duty cycle for activation of the pulsed charge pressure control valve via the characteristic of charge pressure rise. In this manner optimal pressure rise is guaranteed under all ambient and engine conditions.



## Pulsed CPC Valve N 75

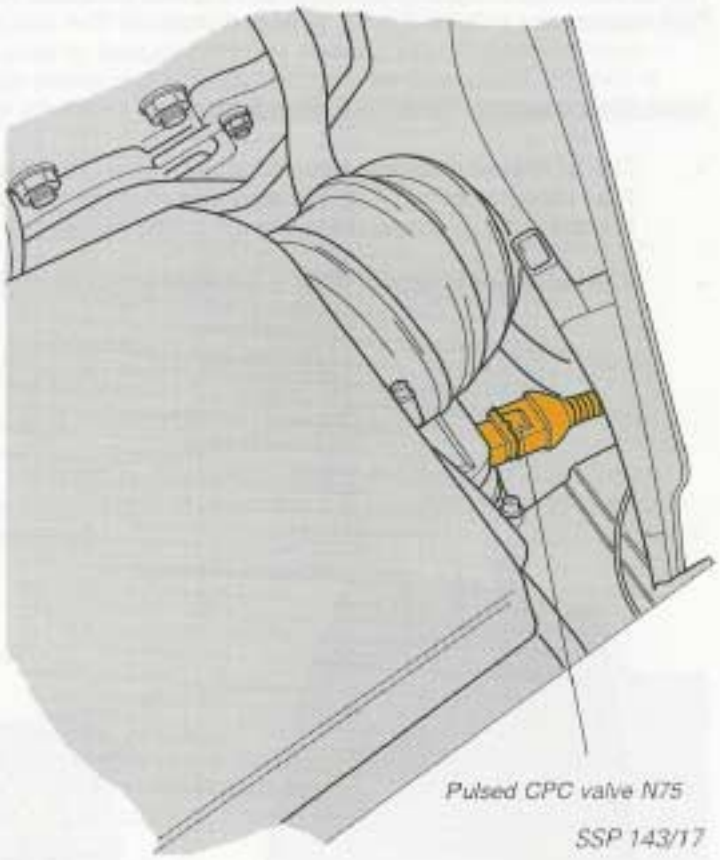
The pulsed CPC valve regulates the charge pressure to a programmed absolute pressure in accordance with the charge pressure map.
Control pressure, with which the lower chamber of the charge pressure control valve (wastegate) is filled, is produced by way of pulsed earth activation (duty cycle 5 to 95 %).

Self-diagnosis:

**- Electrical Fault**
Self-diagnosis recognizes faults in the circuit of N 75. It makes a difference between the types of fault "break/short to earth" and "short to positive".

**- Mechanical Fault**
Self-diagnosis recognizes when maximum charge pressure is exceeded.
Charge pressure control is then switched off. The overrun cut-out is activated in case of extremely high charge pressure.

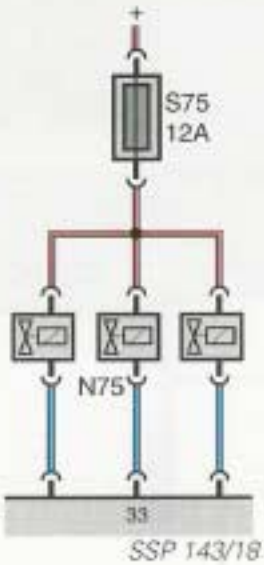
Important:
Extreme signal peaks from the air volume meter caused by electrical and mechanical faults can also lead to the same fault display and therefore to overrun cut-out.



*Pulsed CPC valve N75*

*SSP 143/17*

**Electric Circuit:**




*SSP 143/18*

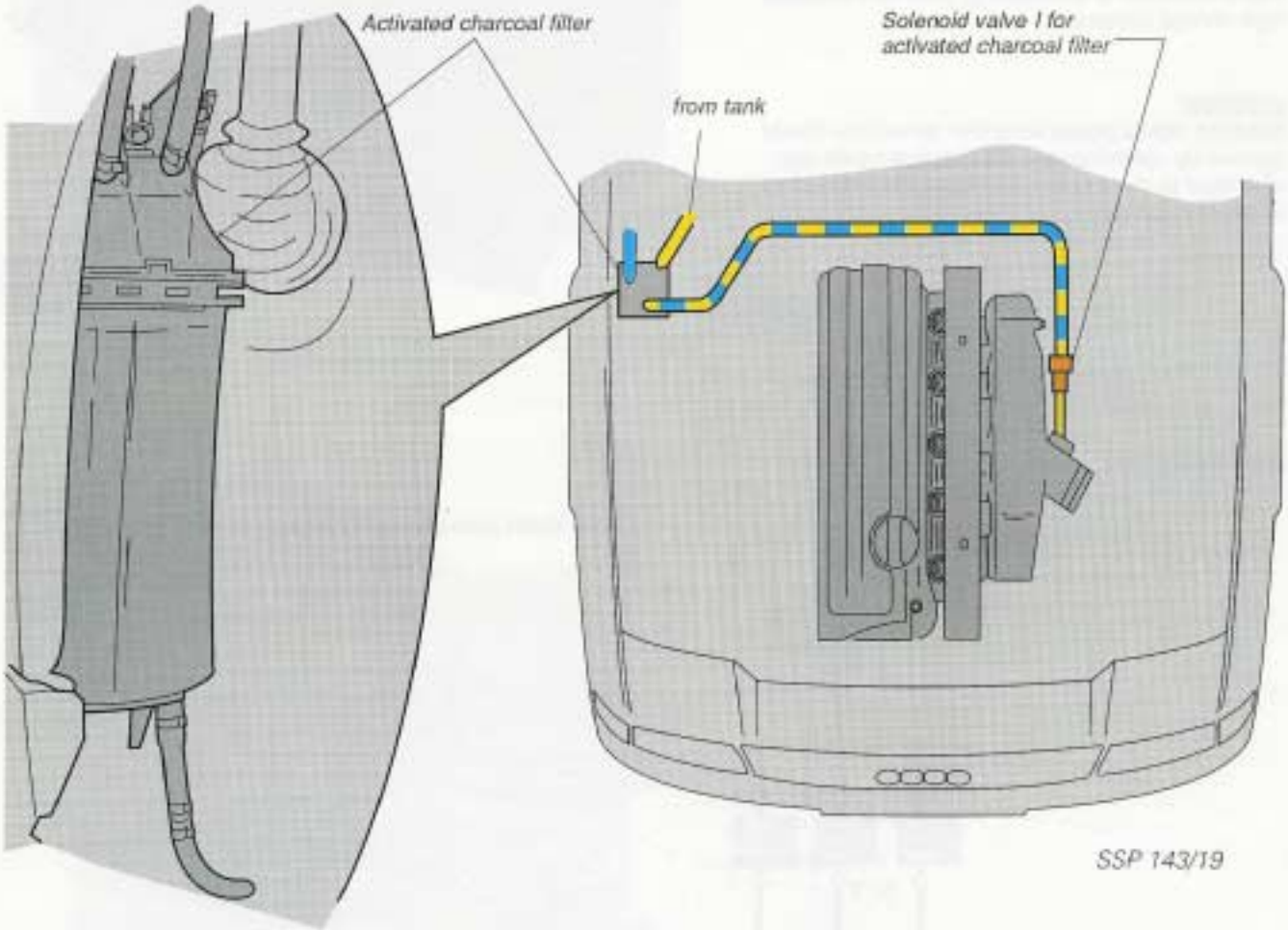
33 = Earth activation of charge pressure control (out)

## Tank Ventilation System

The tank ventilation system prevents fuel vapours produced in the fuel tank from escaping into the atmosphere. Fuel vapours are collected in the activated charcoal filter and fed from there to the engine for combustion.

Major Components of Tank Ventilation System:

- The **activated charcoal filter solenoid valve I, N 80** is mounted on the intake manifold. Fuel vapours coming from the activated charcoal filter are drawn via the solenoid valve into the crankcase breather pipe and from there into the intake manifold.
- The **activated charcoal filter** is mounted on the A-pillar under the right-hand wing.

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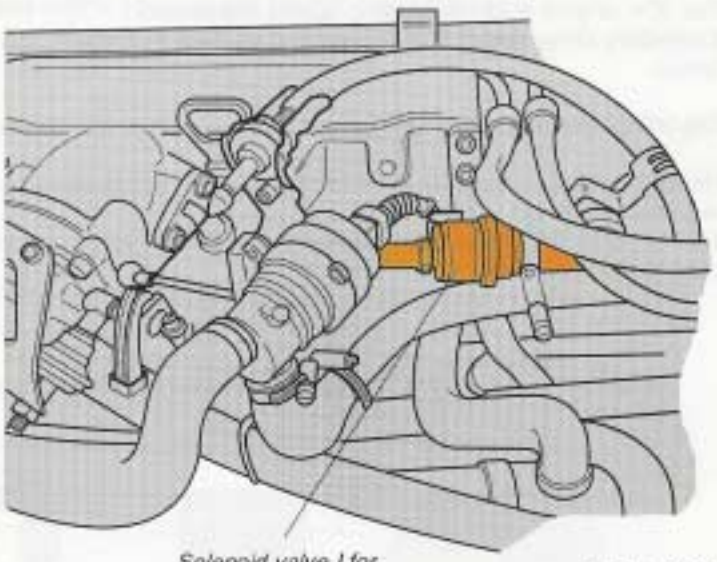
## Solenoid Valve I for Activated Charcoal Filter N 80

The pulsed earth activation of N 80 regulates the discharging of the activated charcoal filter into the intake manifold when the engine is operated.
N 80 is opened when without current.
The solenoid valve works as soon as lambda control is activated.
After stopping the engine the solenoid valve is kept closed for several seconds so the "after-running" of the engine is prevented under all operating conditions.
Power reguired for this purpose is supplied via the holding relay in the control unit.

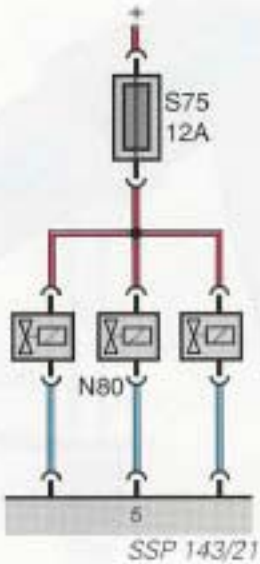
Self-diagnosis:
Self-diagnosis recognizes faults in the circuit of N 80. It makes a difference between the types of fault "break/short to earth" and "short to positive".
Adaptation of idling speed stabilization is stopped when a fault is recognized.
However, ventilation takes place via a spring loaded non-return valve in N 80 in case of a break in the circuit when the engine is idling (strong vacuum).



*Solenoid valve I for activated charcoal filter*

*SSP 143/20*

**Electric Circuit:**




*SSP 143/21*

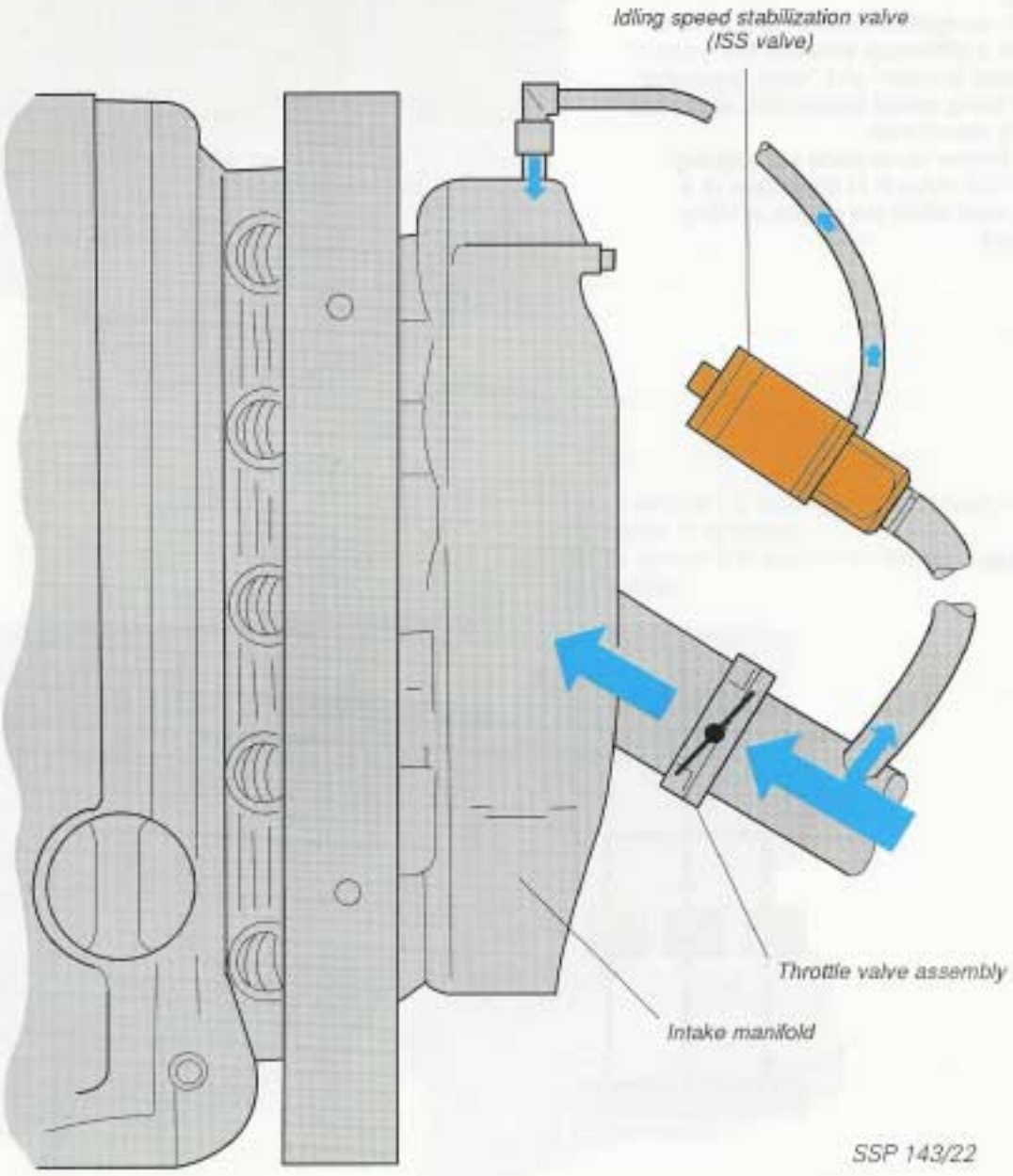
5 = Earth activation of tank ventilation (out)

## Air Supply for Idling Speed Stabilization (ISS)

The 20V engine works with idling speed stabilization.
It prevents idling speed fluctuations and permits a constant, low and therefore fuel consumption saving idling speed.

The idling speed stabilization valve is located next to the throttle valve assembly.

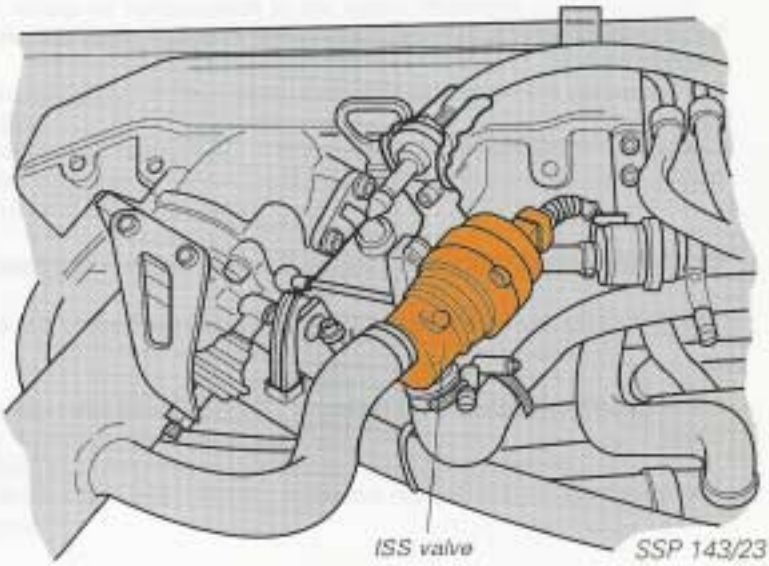
Motronic activates the ISS valve to regulate the size of the cross section opening and therefore the volume of air required for idling.
This idling air volume is branched off of the throttle valve and fed in at the rear end of the intake manifold (by-pass to throttle valve).



## Idling Speed Stabilization Valve N 71 (ISS Valve)

Pulsed earth activation (duty cycle 25 to 95 %) of the ISS valve regulates the idling speed to the nominal value under all temperature and load conditions. The ISS valve is also responsible for the control of air for starting and coasting (over-run).

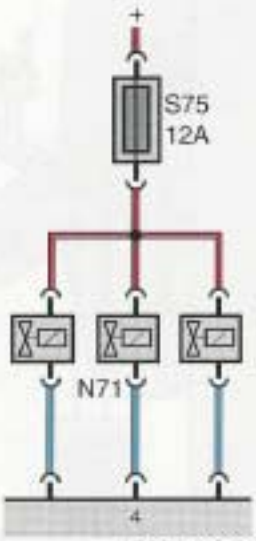
Self-diagnosis:
Self-diagnosis recognizes faults in the circuit of N 71. It makes a difference between the types of fault "break/short to earth" and "short to positive". The final output stage is switched off when a fault is recognized. The emergency operation cross section size opening of the ISS valve permits slightly higher idling speed.
Adaptation of idling speed stabilization will be stopped; overrun cut-out is activated when the idling switch recognizes an idling speed above 1500 rpm.



SSP 143/23

**Electric Circuit:**

4 = Earth activation of ISS (out)



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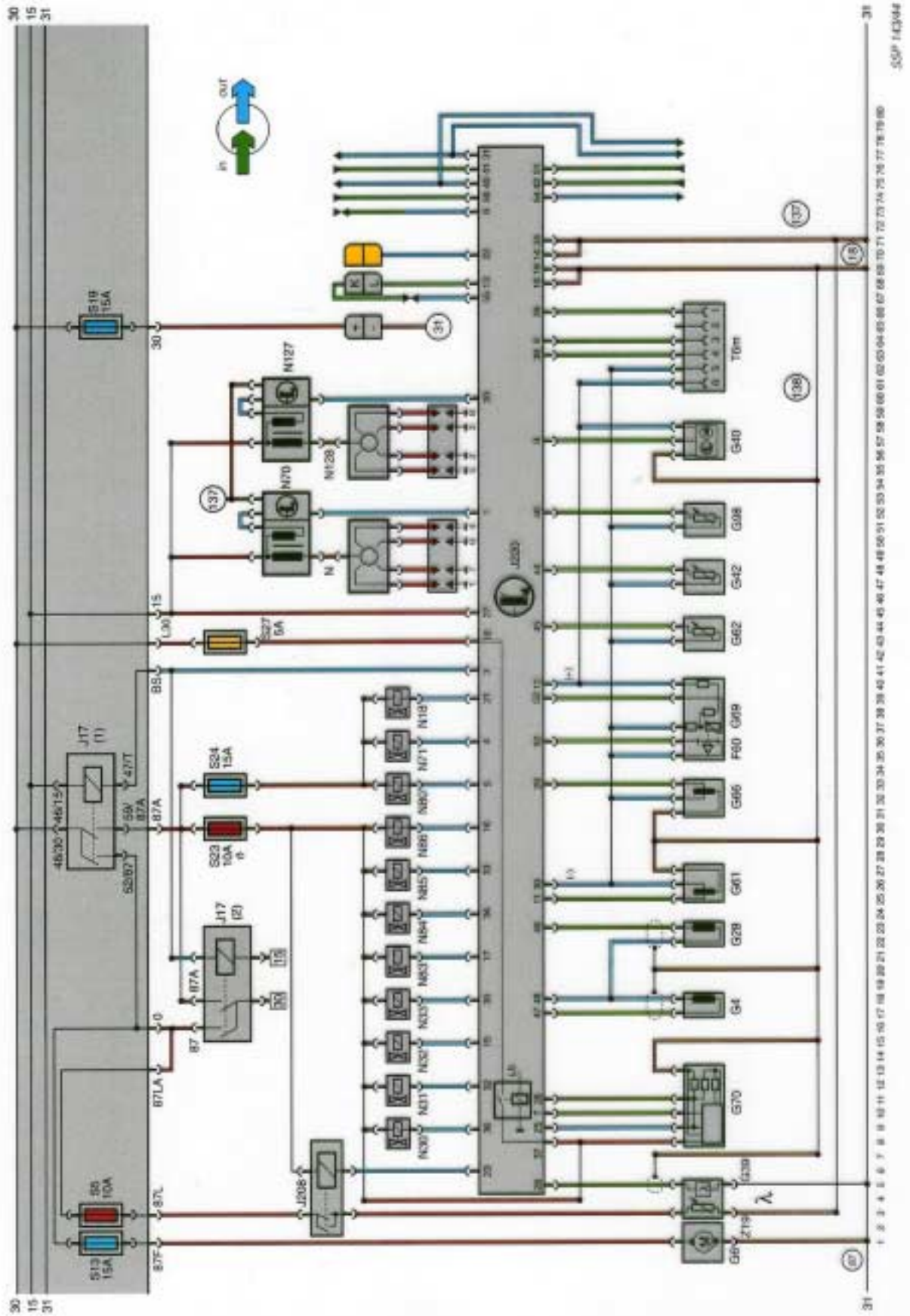
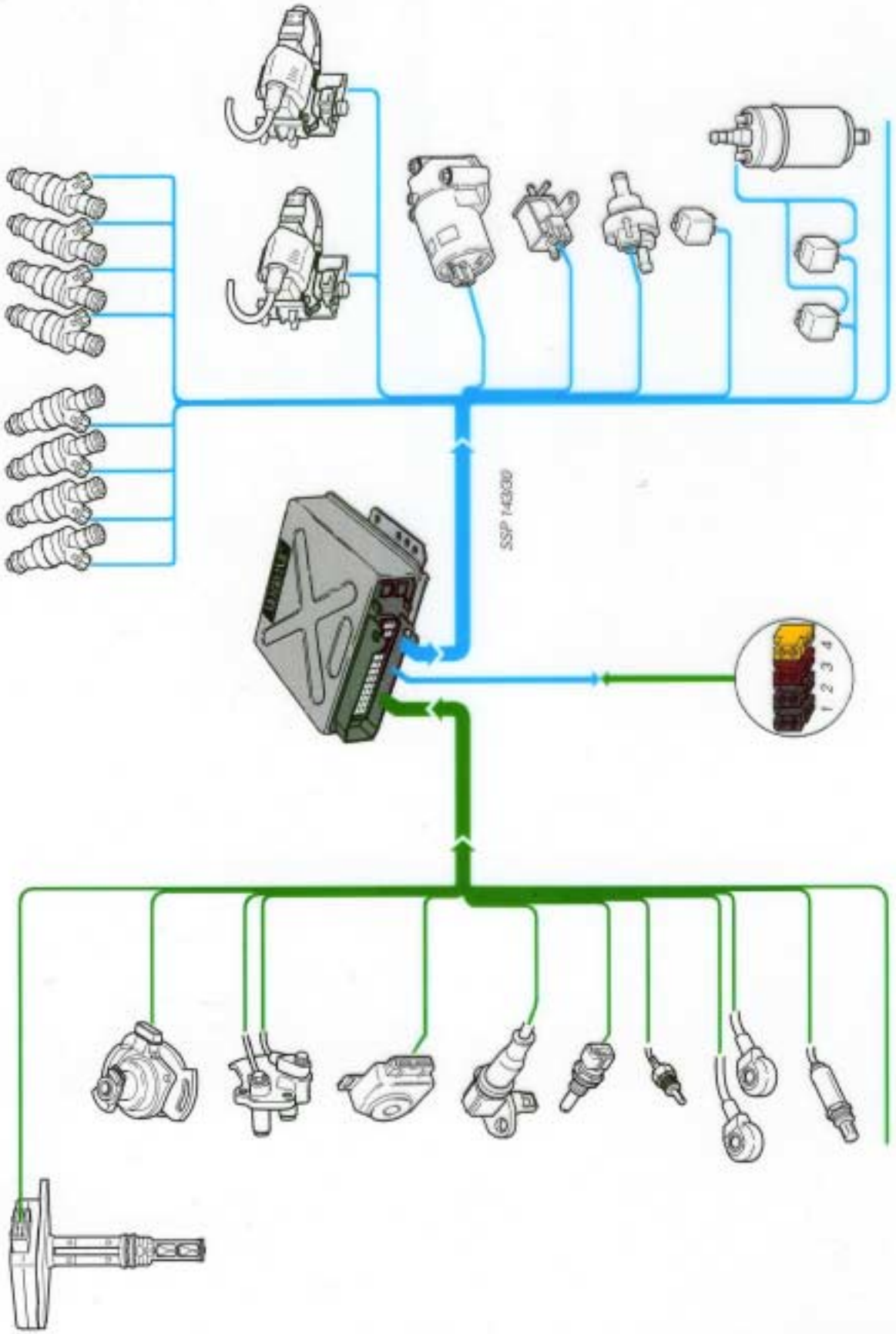
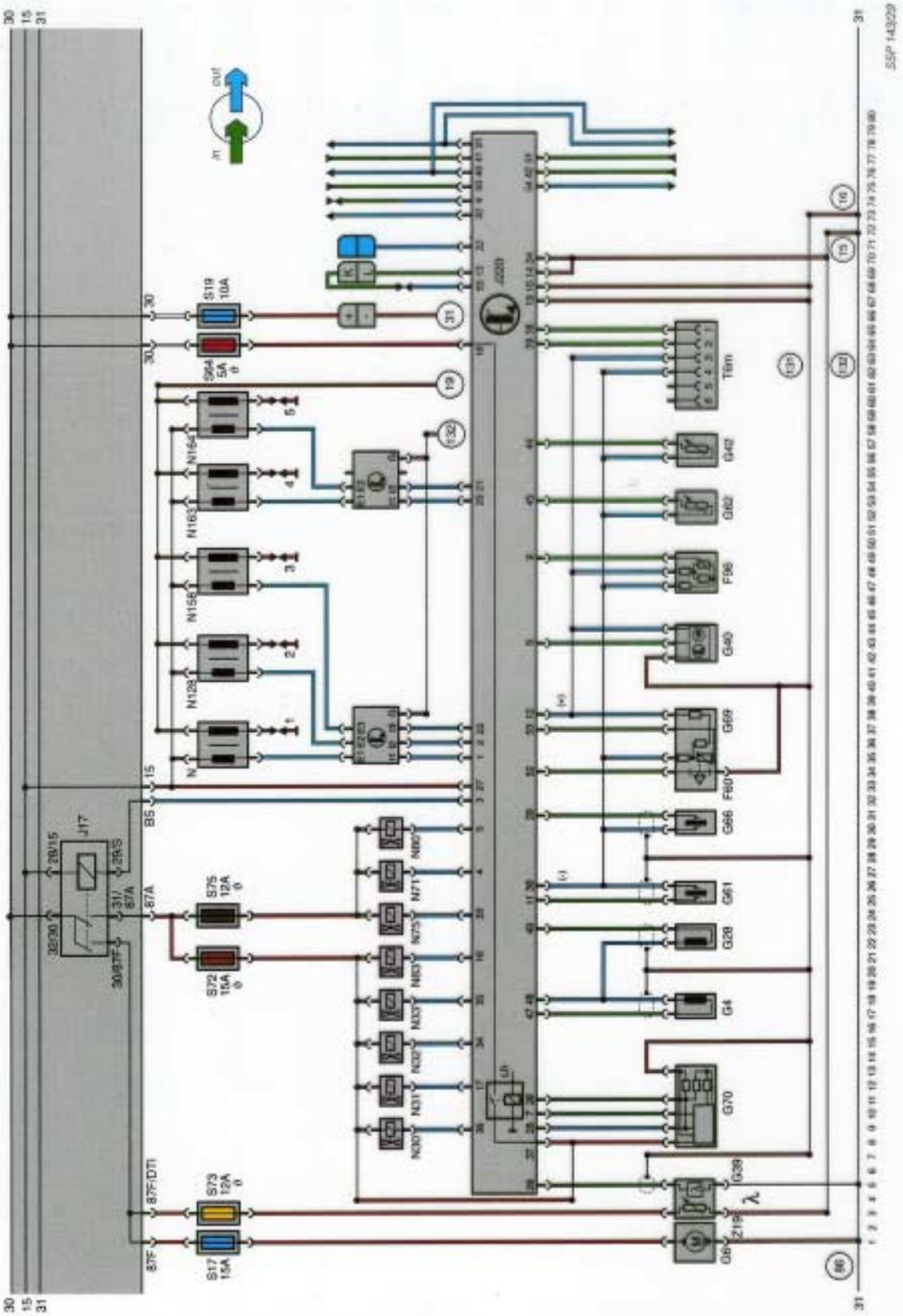



SSP 143/30
1 2 3 4


SSP 143/29
J220
J17
S19 10A
S64 5A
S75 12A
S72 15A
S73 12A
S17 15A
N164
N163
N156
N128
N
N80
N71
N75
N83
N337
N307
N311
N301
T5m
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G70
G39
G6
Z19
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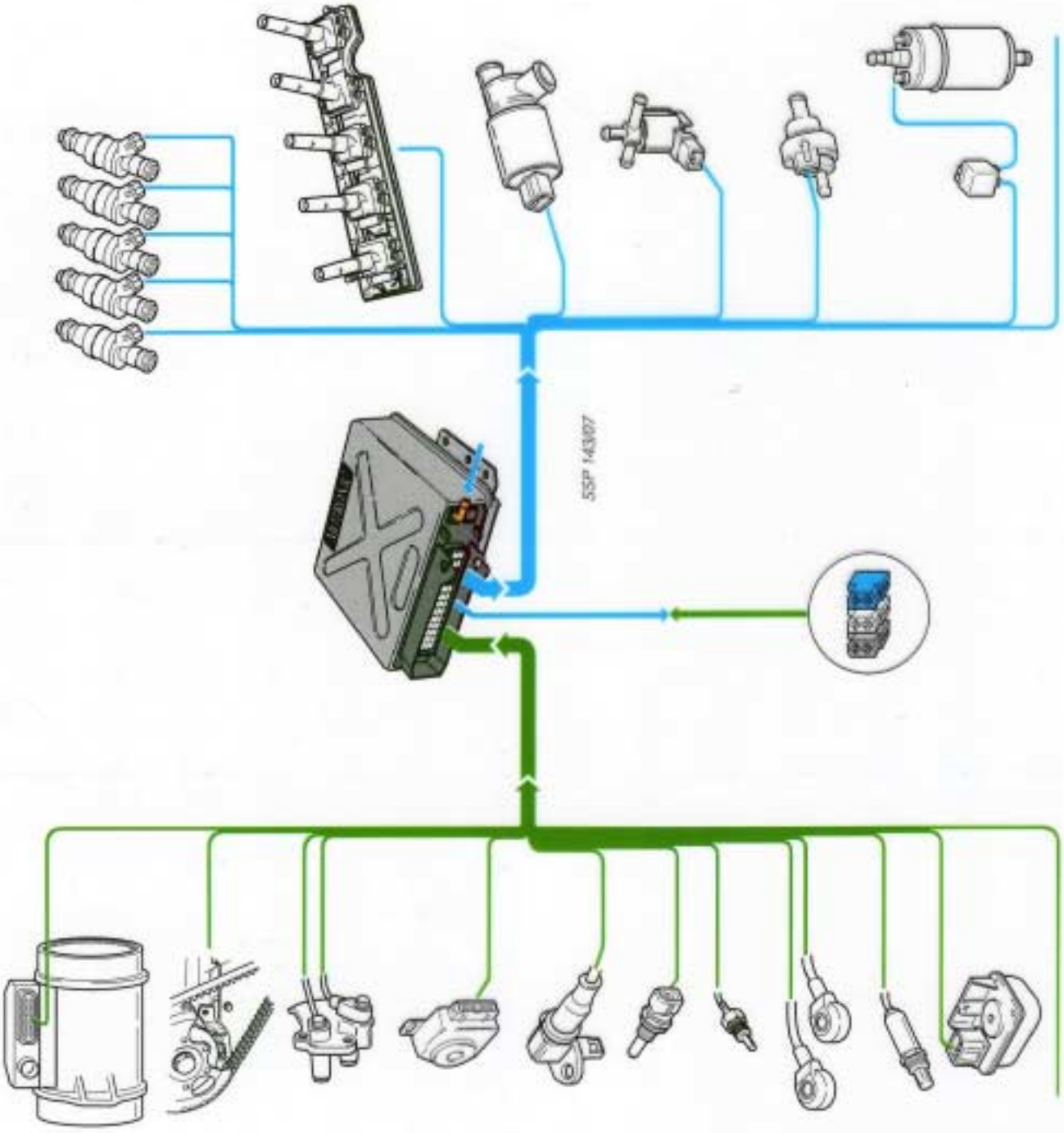
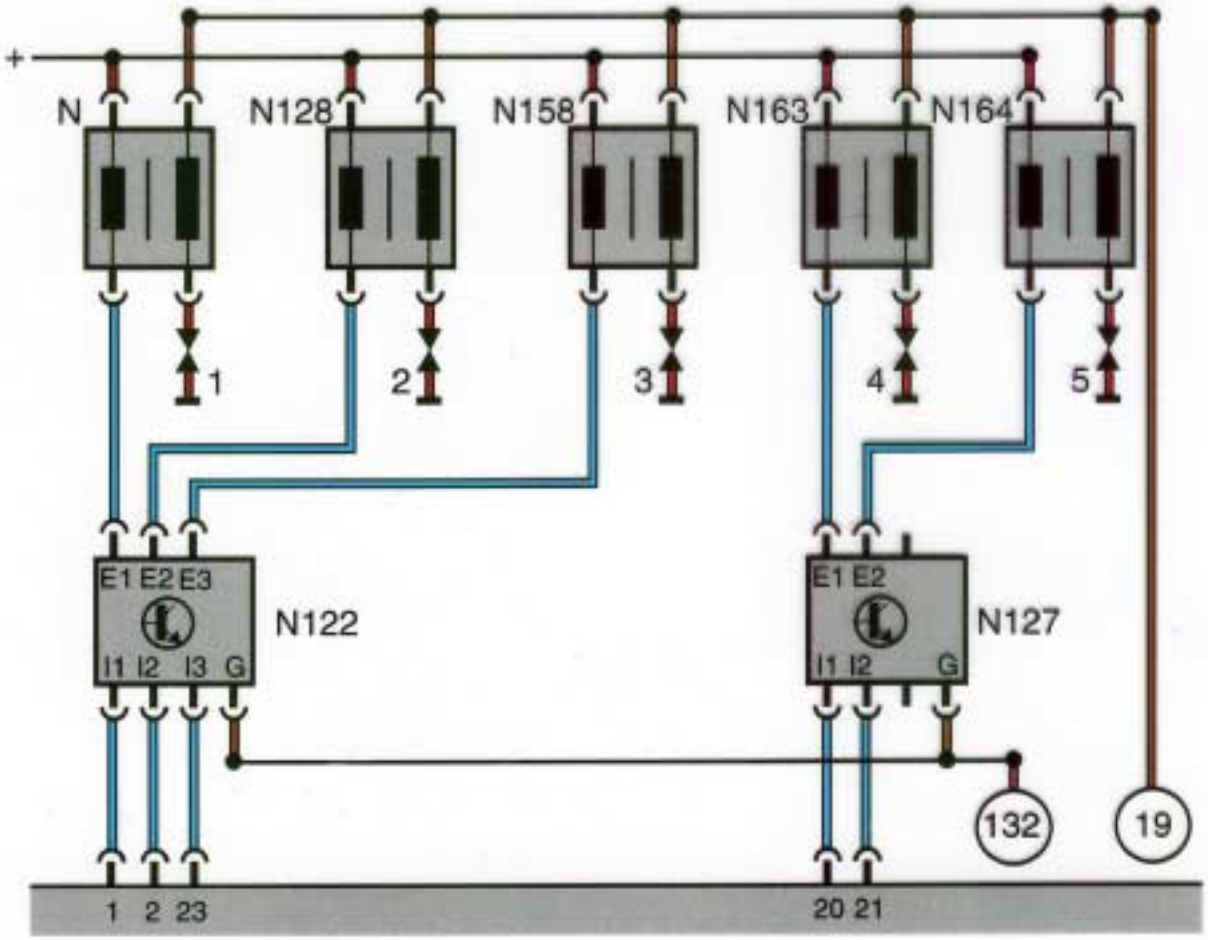

SSP 143/07


+
N
N128
N158
N163
N164
1
2
3
4
5
E1 E2 E3
I1 I2 I3 G
N122
E1 E2
I1 I2 G
N127
132
19
1 2 23
20 21

*SSP 143/15*

# Crankcase Ventilation

Crankcase ventilation is not operated electrically, but instead mechanically.
It is **not** a subsystem of Motronic.

In spite of this crankcase ventilation does exercise influence on the engine management system, e.g. by way of lambda control.
Consequently crankcase ventilation is described in this brochure.

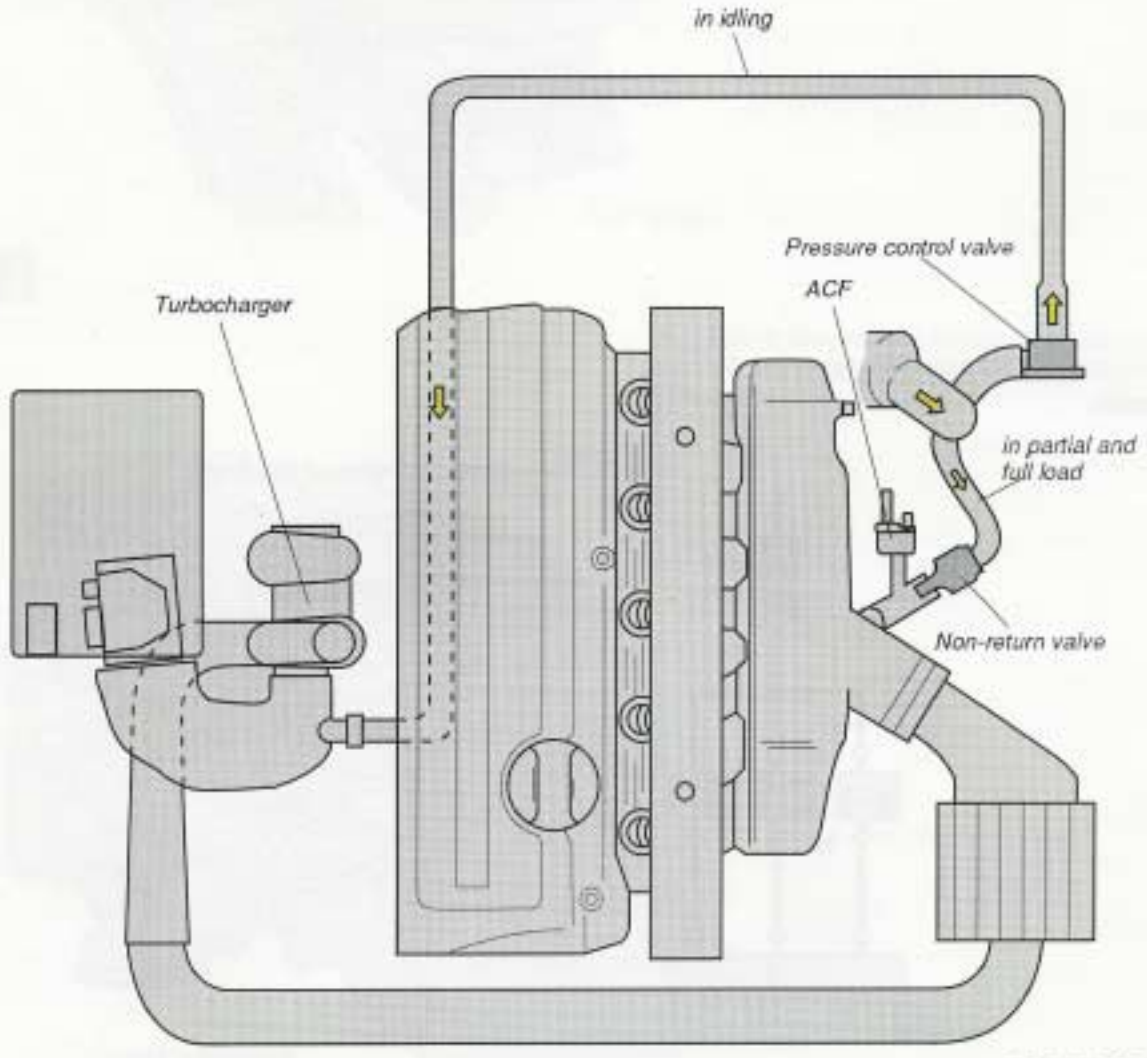
Crankcase ventilation is a closed system. Oil vapours and unburnt hydrocarbons cannot escape into the atmosphere.

**Crankcase Ventilation with Closed Throttle Valve (High Intake Manifold Vacuum - Idling)**

The pollutants are drawn through the non-return valve into the intake manifold.

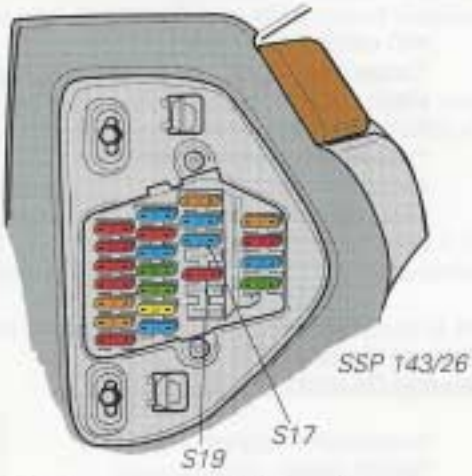
**Crankcase Ventilation with Opened Throttle Valve (Decreasing Intake Manifold Vacuum - Partial and Full Load)**

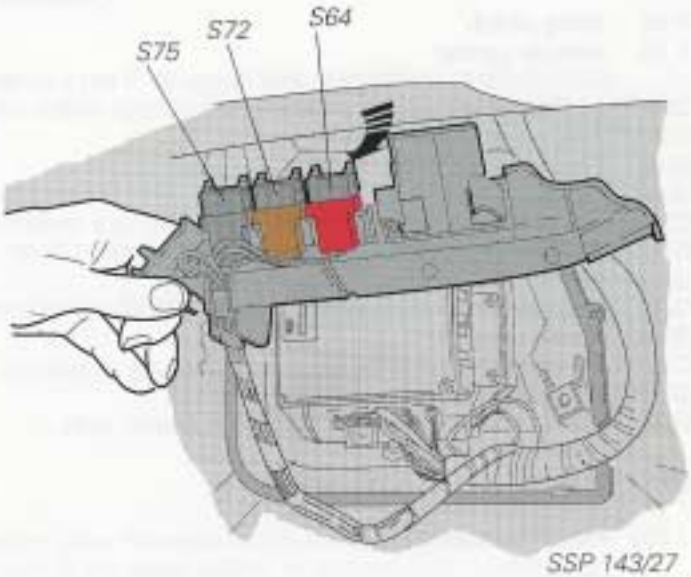
The pollutants are fed via the pressure control valve into the intake cowl in front of the turbocharger.

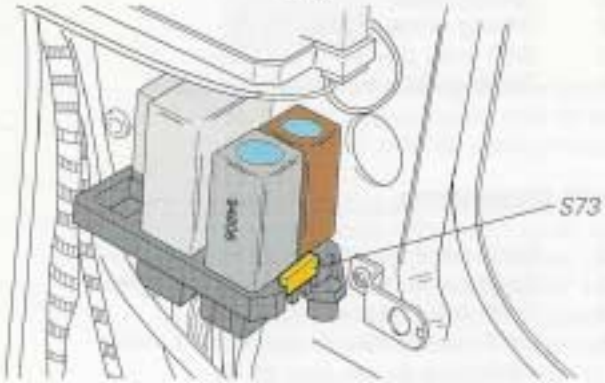



SSP 143/25

**Important Fuses of Motronic (also refer to Functional Diagram):**

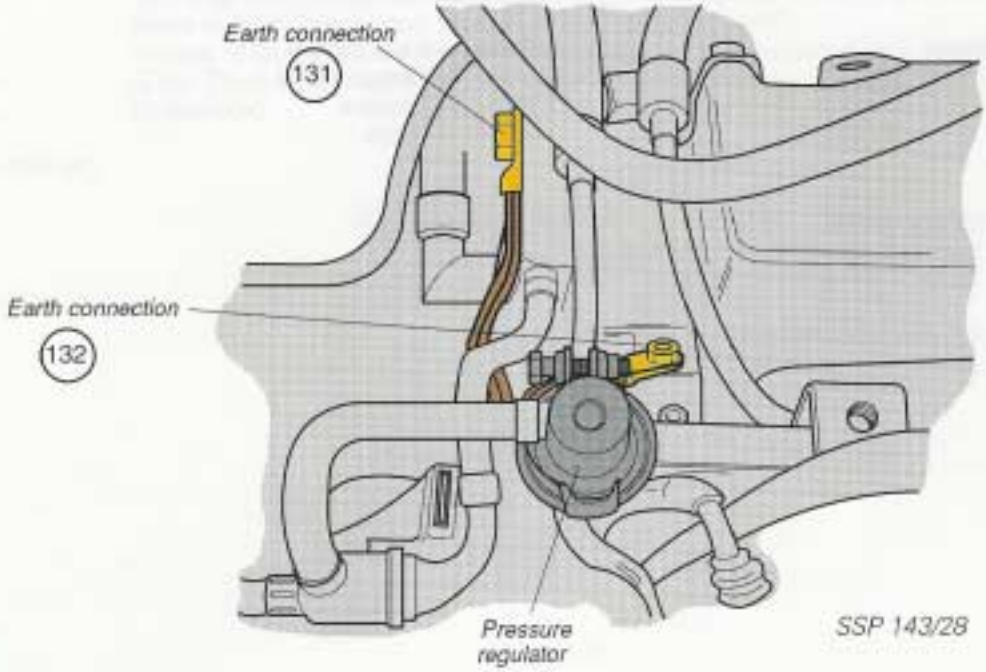



Note: Fuse S 73 is located on the additional relay carrier III at the right-hand A-pillar.

**Important Earth Connections of Motronic (also refer to Functional Diagram):**



# Functional Diagram - 20V Engine

**Components:**

F 60 Idling switch
F 96 Altitude sender

G 4 Ignition timing sender
G 6 Fuel pump
G 28 Engine speed sender
G 39 Lambda probe
G 40 Hall sender
G 42 Intake air temperature sender
G 61 Knock sensor I
G 62 Coolant temperature sender
G 66 Knock sensor II
G 69 Throttle valve potentiometer
G 70 Air volume meter
G 71 Intake manifold pressure sender (in control unit)

(J) Holding relay in control unit
J 17 Fuel pump relay
J 220 Motronic control unit

N Ignition coil 1 (cyl. no. 1)
N 122 Final output stage 1 (cyl. no. 1, 2 and 3)
N 127 Final output stage 2 (cyl. no. 4 and 5)
N 128 Ignition coil 2 (cyl. no. 2)
N 158 Ignition coil 3 (cyl. no. 3)
N 163 Ignition coil 4 (cyl. no. 4)
N 164 Ignition coil 5 (cyl. no. 5)
N 30 Injector, cyl. no. 1
N 31 Injector, cyl. no. 2
N 32 Injector, cyl. no. 3
N 33 Injector, cyl. no. 4
N 71 Idling speed stabilization valve
N 75 Charge pressure control pulsing valve
N 80 Solenoid valve I for activated charcoal filter
N 83 Injector, cyl. no. 5

T6m Coding plug

Z 19 Lambda probe heater

**Fuses:**

S 17 Fuse for G 6
S 19 Fuse for diagnostic connector
S 64 Thermo fuse for terminal 30, permanent positive
S 72 Thermo fuse for N 30, N 31, N 32, N 33, N 83 and G 70
S 73 Thermo fuse for lambda probe heater
S 75 Thermo fuse for N 75, N 71 and N 80

**Additional Signals (Pin) – General Communication:**

6 A/C compressor signal
13 Exciter wire signal
22 Flash code output
31 Consumption signal
40 Engine speed signal
41 Air conditioner signal
50 Road speed signal
55 Diagnostic signal

**Additional Signals (Pin) – Automatic Gearbox Communication:**

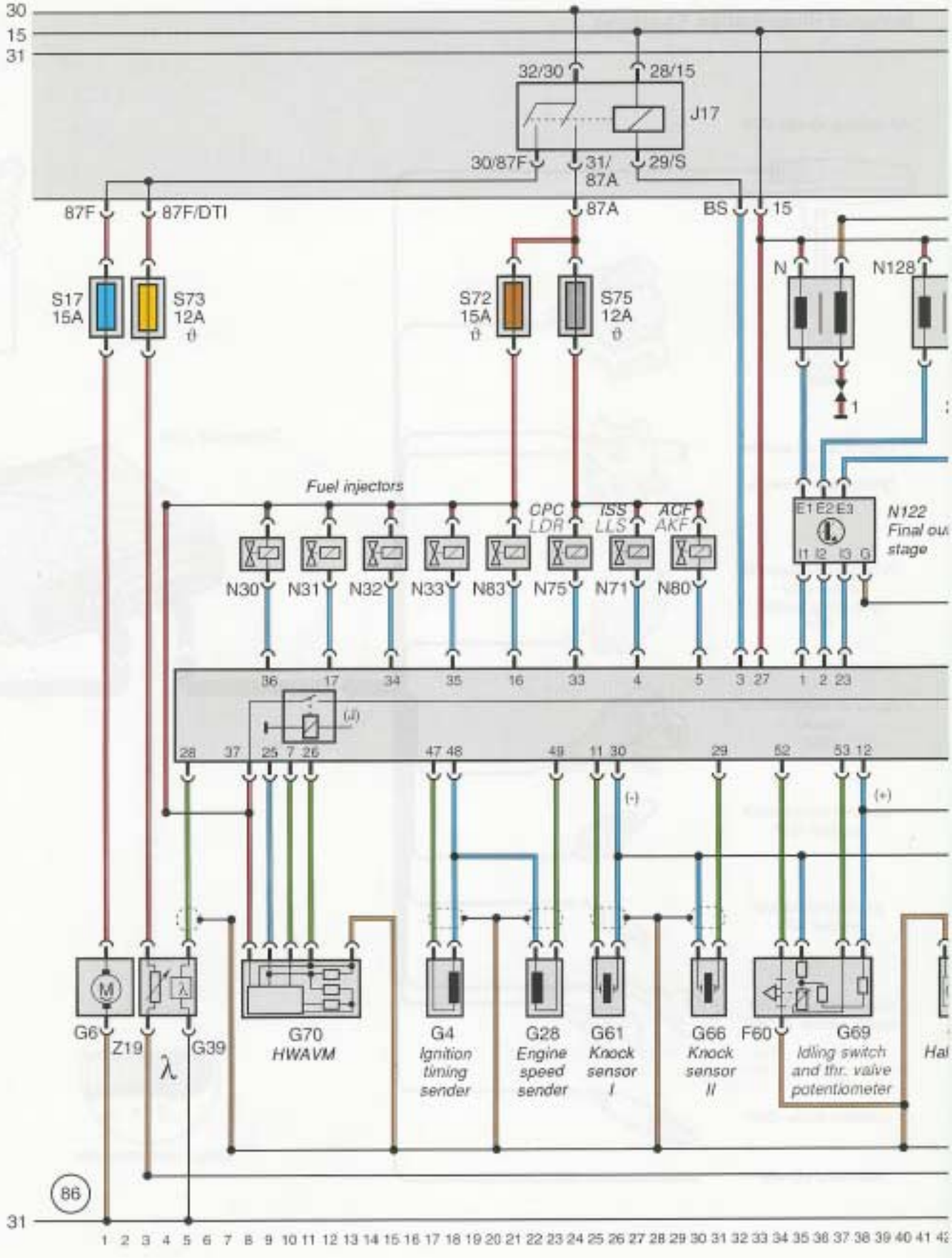
31 Consumption signal
40 Speed signal
42 Driving range signal
51 Shift point signal
54 Throttle valve potentiometer signal

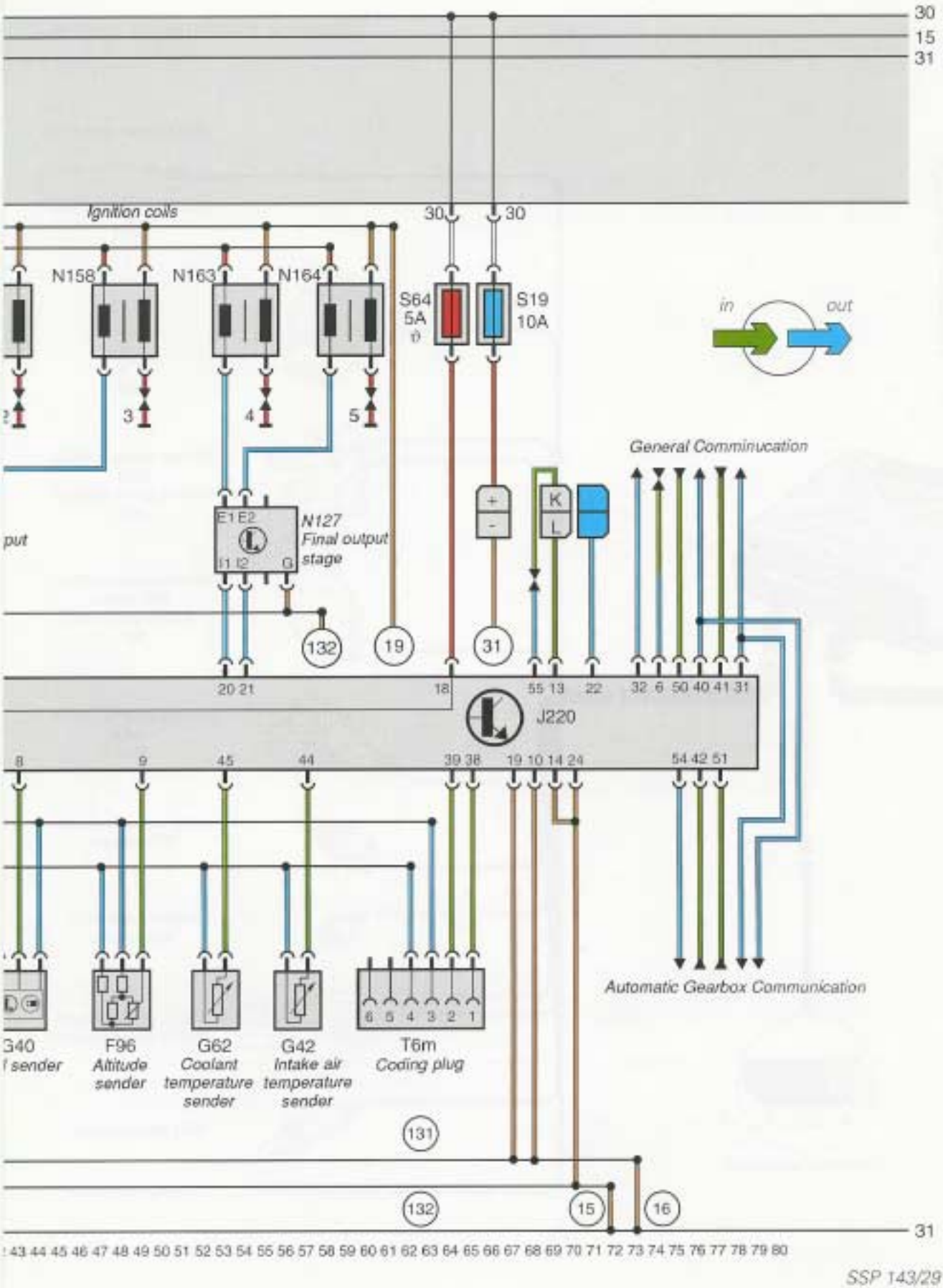
**Earth Connections:**

15 Earth point on cylinder head
16 Earth point -1- on cylinder head cover
19 Earth point near ignition coil
86 Earth connection -1- in rear end wiring loom
131 Earth connection -2- in engine compartment wiring loom
132 Earth connection -3- in engine compartment wiring loom

**Colour Codes:**

Green = Input signal
Blue = Output signal
Red = Positive
Brown = Earth

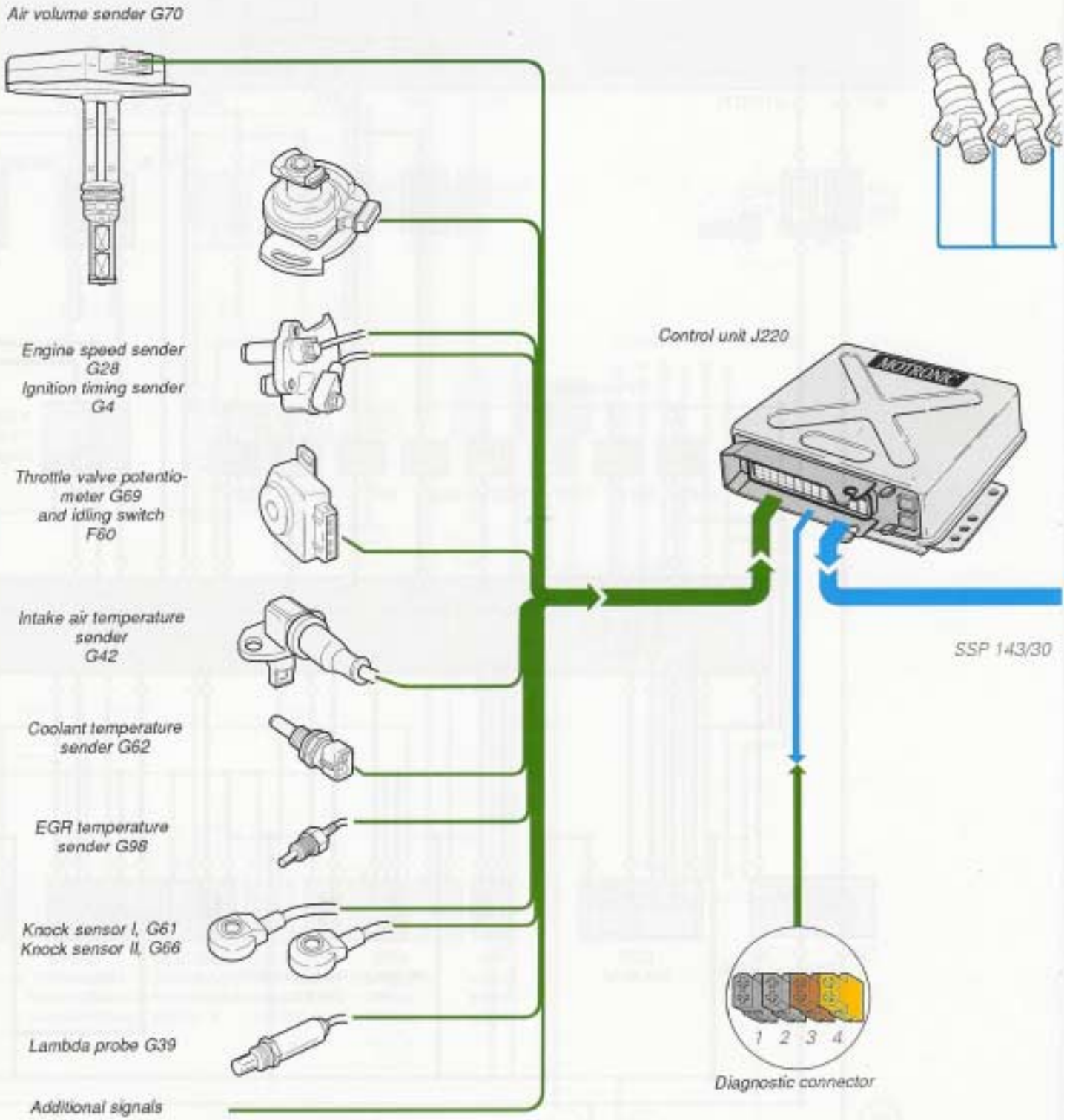

30
15
31
32/30
28/15
J17
30/87F
31/
87A
29/S
87F
87F/DTI
87A
BS
15
S17
15A
S73
12A
S72
15A
S75
12A
N
N128
Fuel injectors
CPC
LDR
ISS
LLS
ACF
AKF
N30
N31
N32
N33
N83
N75
N71
N80
E1 E2 E3
I1 I2 I3 G
N122
Final ou
stage
86
31
G6
Z19
G39
G70
HWAVM
G4
Ignition
timing
sender
G28
Engine
speed
sender
G61
Knock
sensor
I
G66
Knock
sensor
II
F60
G69
Idling switch
and thr. valve
potentiometer


30
15
31
Ignition coils
30
30
N158
N163
N164
S64
5A
S19
10A
in
out
3
4
5
General Comminucation
E1 E2
N127
Final output
stage
I1 I2
G
132
19
31
K
L
20 21
18
55 13
22
32 6 50 40 41 31
J220
8
9
45
44
39 38
19 10 14 24
54 42 51
Automatic Gearbox Communication
G40
sender
F96
Altitude
sender
G62
Coolant
temperature
sender
G42
Intake air
temperature
sender
T6m
Coding plug
6 5 4 3 2 1
131
132
15
16
31
43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

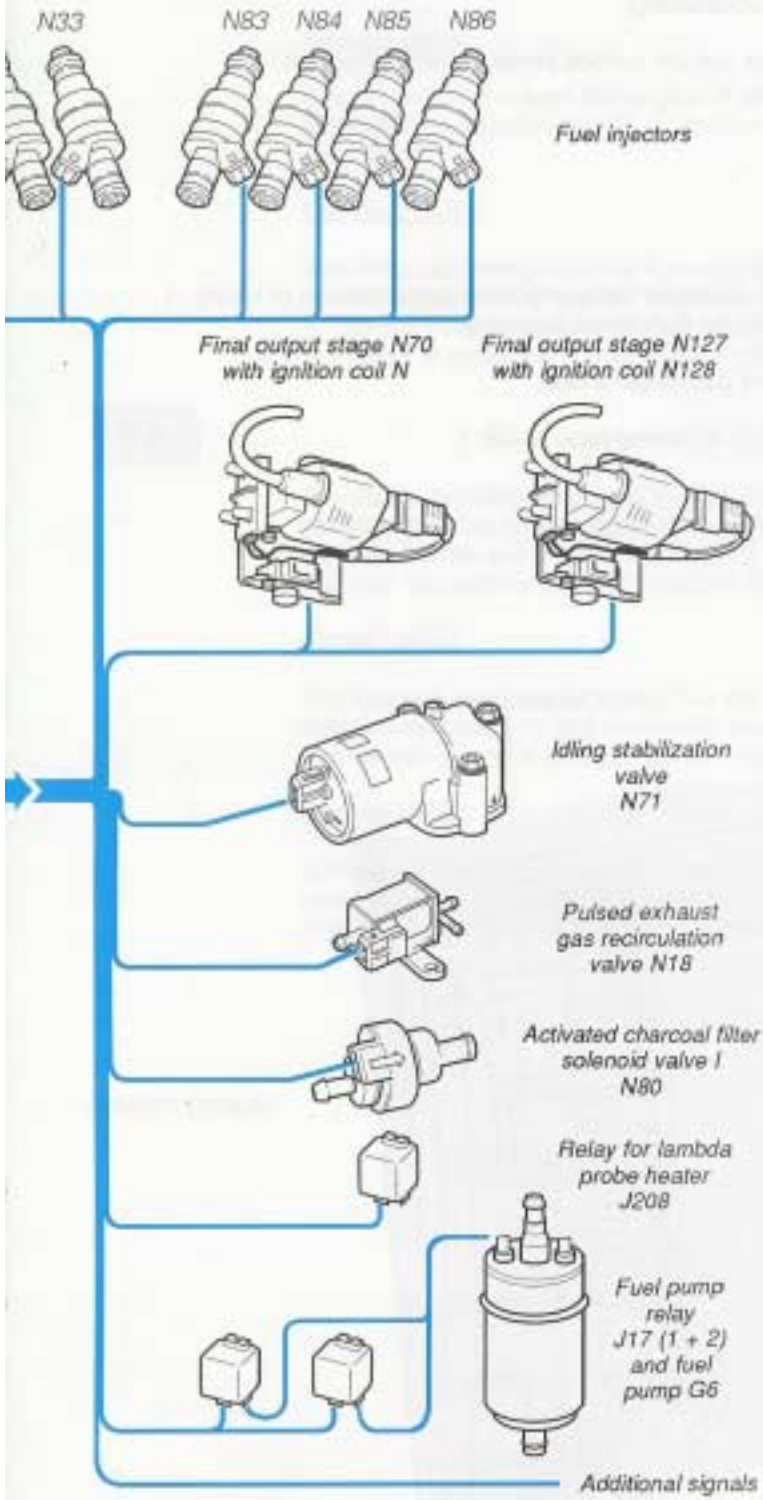
SSP 143/29

# System Survey - V8 Engine

## Sensors (Information Senders)



## Actuators (Drives)




## Subsystems

Sequential Fuel Injection

- Basic adaptation via map
- Start control
- Post-start enrichment
- Acceleration enrichment
- Overrun cut-out
- Engine speed governor
- Lambda control with adaptation

Ignition

- Basic adaptation via map
- Dwell angle control
- Warm-up correction
- Start control
- Initial shift point control (automatic gearbox)
- Digital idling stabilization (DIS)
- Cylinder-selective knock control with adaptation

Idling speed stabilization (ISS) with adaptation

- Map controlled
- Start control
- Initial climate control
- Initial driving range control (automatic gearbox)

Exhaust gas recirculation (US version)

- Map controlled
- Exhaust temperature monitor
- Overrun cut-out

Tank vent system

- Map controlled
- Overrun cut-out

Lambda probe heater

- Temperature controlled
- Map controlled

The following subsystems of Motronic in the V8 engine have basically remained unchanged in construction and operation:

- Ignition system
- Tank ventilation system
- Idling speed stabilization (road speed signal now used additionally)

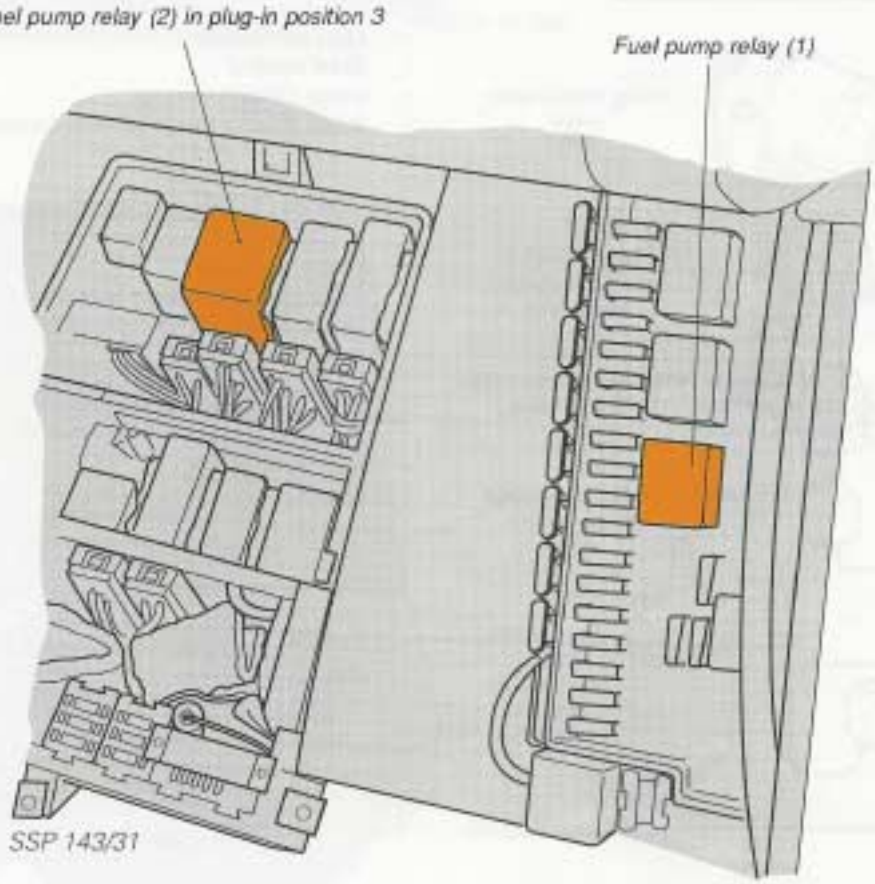
Changes have been made in the fuel system. New additions are the lambda probe heating activation via Motronic and exhaust gas recirculation for the US version.

## Fuel System

The Motronic engine management system is equipped with a second fuel pump relay in the interest of safety. It is wired parallel with the actual fuel pump relay (also refer to the Functional Diagram).

There is an additional relay station in the footwell at the front passenger's side.

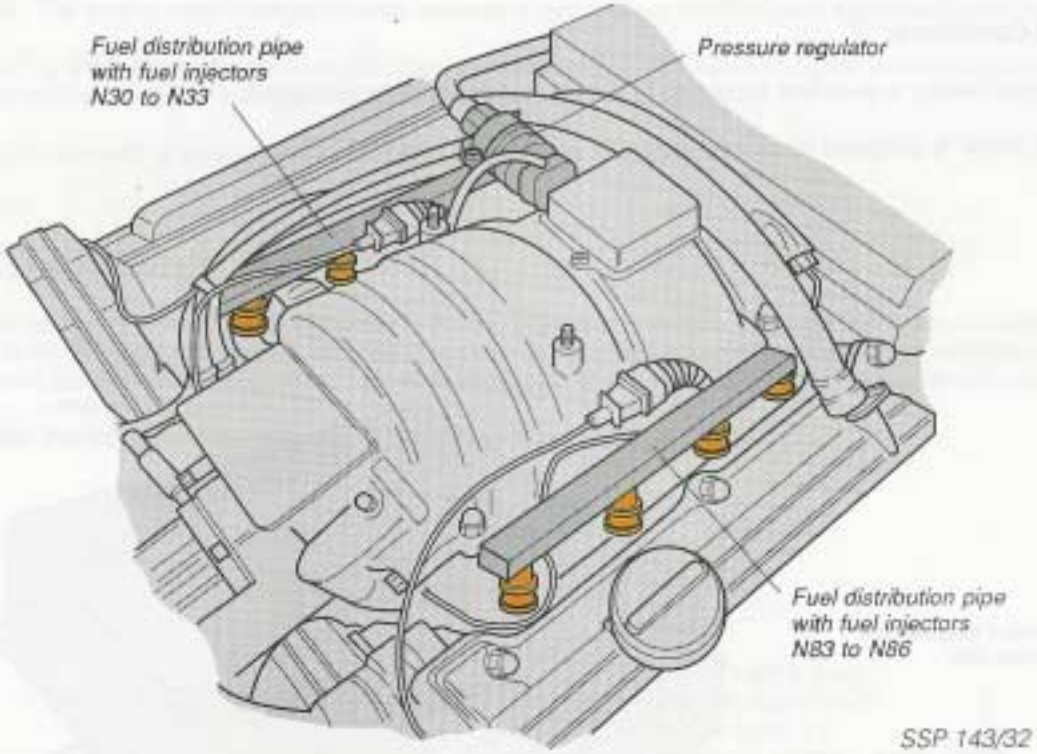
The second fuel pump relay is located at plug-in position 3 of additional relay carrier I.



## Fuel Injectors N 30, 31, 32, 33, 83, 84, 85, 86

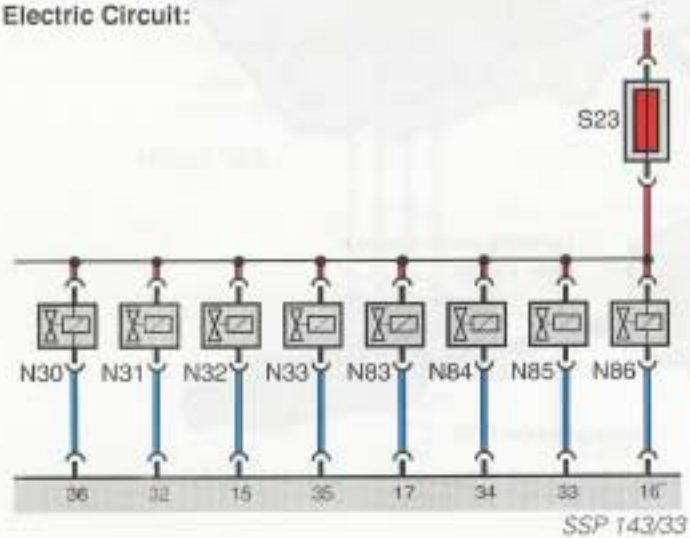
The fuel injectors of the left and right banks of cylinders are supplied with petrol from one each fuel distribution pipe.
The pressure regulator is mounted at the rear end of the right-hand fuel distribution pipe.
Each fuel injectors has its own connection pin on the Motronic control unit.
Activation of fuel injectors is still accomplished by pairs (1 + 5, 2 + 7, 3 + 6, 4 + 8).
Self-diagnosis can now recognize whether there is a fault in a separate fuel injector belonging to a pair of fuel injectors. Final control element diagnosis must be applied to determine which injector is faulty.

Self-diagnosis:
Self-diagnosis recognizes faults in the circuit of fuel injectors. It makes a difference between two types of faults: "break/short to earth" and "short to positive".
The concerned final output stage will be switched off in case of a recognized fault. Adaptaion of lambda control and idling speed stabilization is interrupted.




SSP 143/32

**Electric Circuit:**




36 = Injection signal, cyl. no. 1 (out)
32 = Injection signal, cyl. no. 2 (out)
15 = Injection signal, cyl. no. 3 (out)
35 = Injection signal, cyl. no. 4 (out)
17 = Injection signal, cyl. no. 5 (out)
34 = Injection signal, cyl. no. 6 (out)
33 = Injection signal, cyl. no. 7 (out)
16 = Injection signal, cyl. no. 8 (out)

SSP 143/33

## Lambda Probe Heater

Lambda probe G 39 is heated.
The lambda probe heater is switched on and off via relay J 208 by the Motronic control unit.

**Switching On Conditions:**

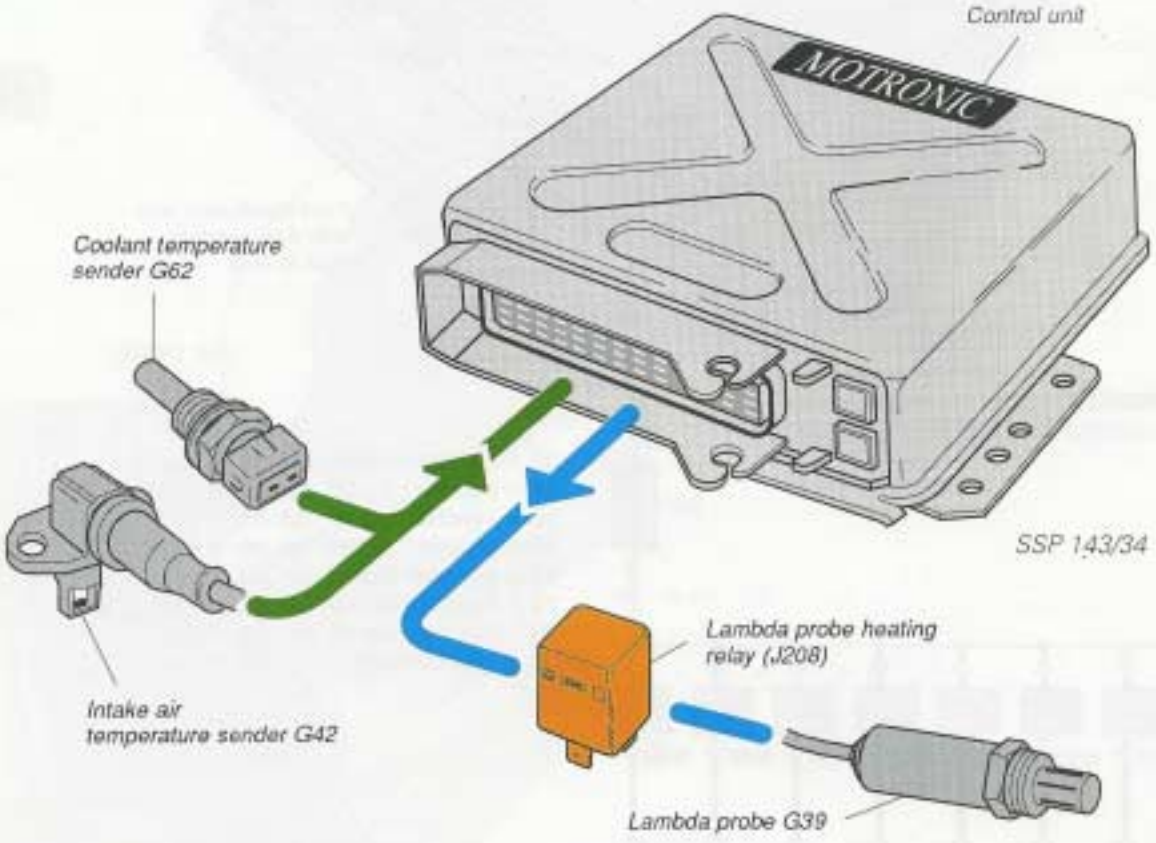
If the intake air temperature is below 16° C (intake air temperature sender G 42) when starting the engine, the lambda probe heater will first be switched on after the engine temperature has reached 40° C (coolant temperature sender G 62).
This is for protection of the lambda probe. Any condensation on the lambda probe can evaporate.

If the intake air temperature is above 16° C when starting the engine, the lambda probe heater is switched on immediately.

**Switching Off Conditions:**

The lambda probe heater is switched according to a map and **depending on speed.**

Lambda probe heater is switched on at idling speed.

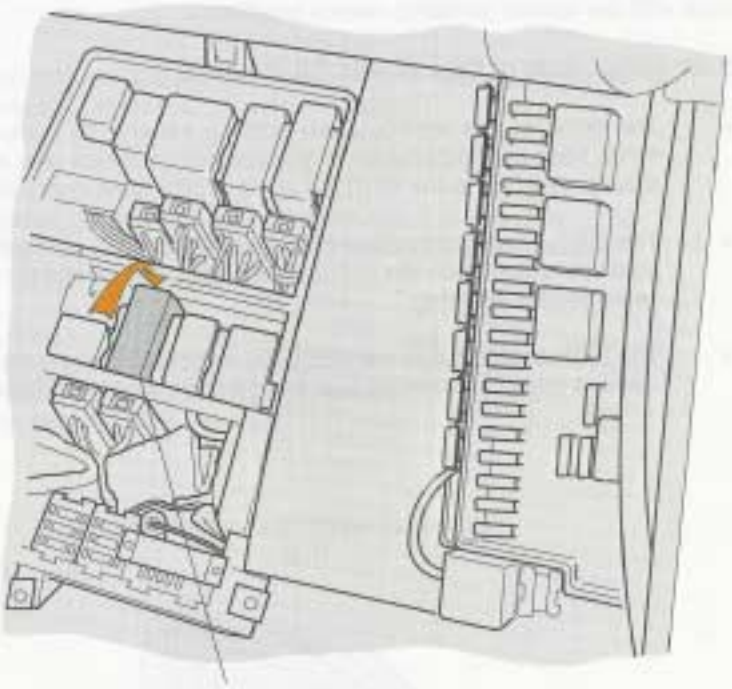


## Lambda Probe Heating Relay J 208

An additional relay station is located on the foot-well at the front passenger's side.

The lambda probe heating relay is mounted at plug-in position 18 (rear row of plug-in positions) of additional relay carrier II.

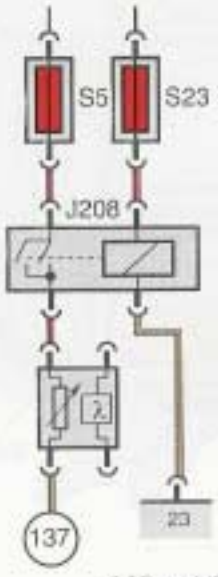
Self-diagnosis:
Self-diagnosis recognizes faults in the circuit of J 208. It makes a difference between two types of faults: "break/short to earth" (recognized only in start) and "short to positive".
Lambda control and tank ventilation are switched off when a fault is recognized.



*Plug-in pos. 13, behind it plug-in pos. 18* *SSP 143/35*

**Electric Circuit:**

23 = Earth activation of heating (out)



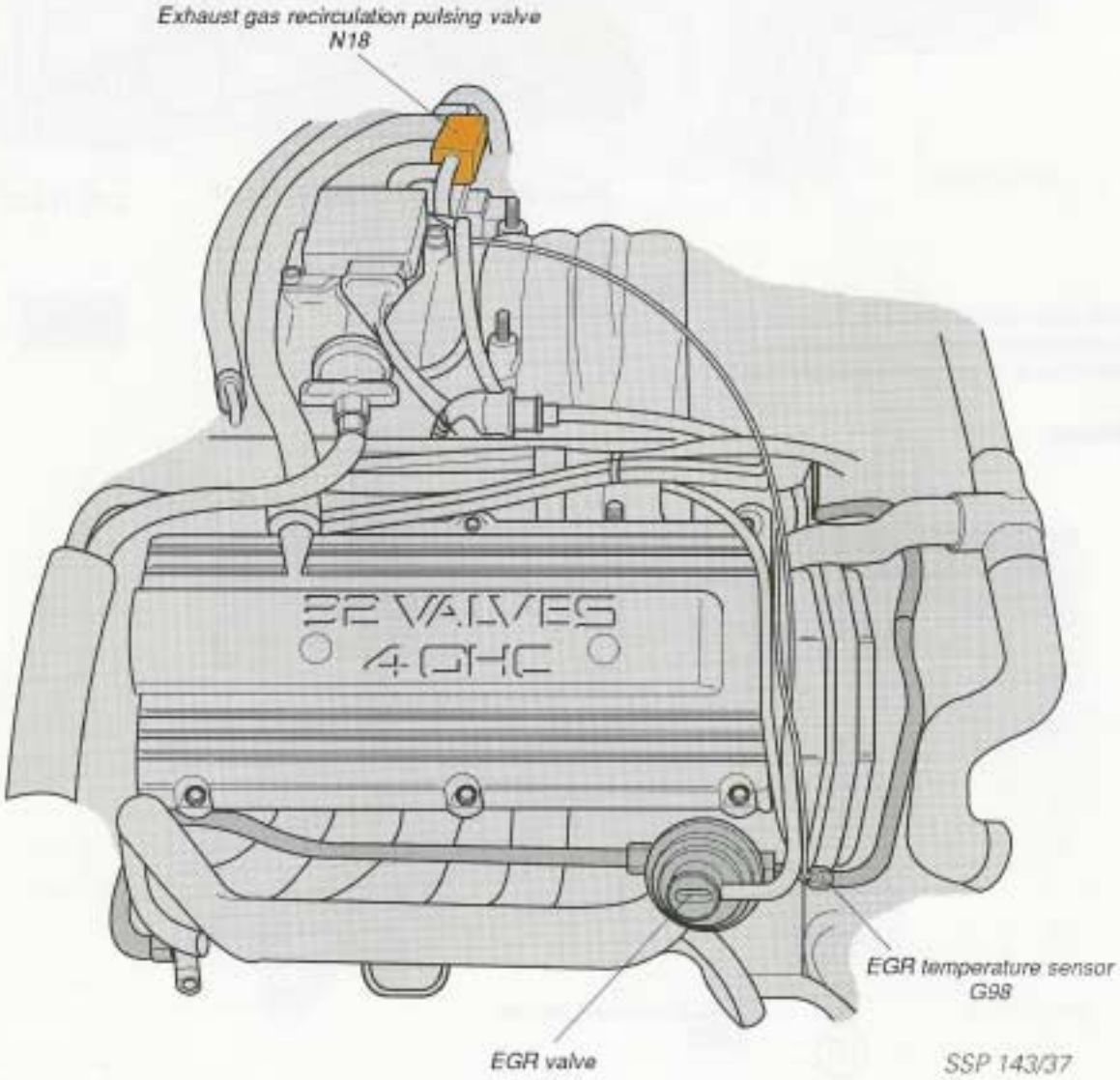

*SSP 143/36*

## Exhaust Gas Recirculation – US Version

The V8 engine in US version vehicles (California) is now fitted with exhaust gas recirculation (EGR) for conformance with the stricter emission control legislation.

Major Components of Exhaust Gas Recirculation:

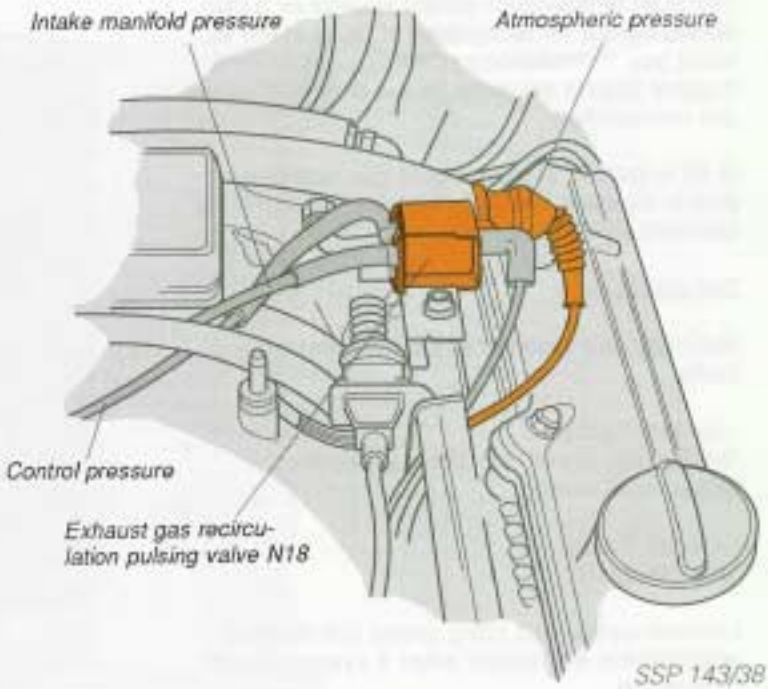
- The **exhaust gas recirculation pulsing valve N 18** is mounted on the left-hand fuel distribution pipe. It has hose connections for intake manifold pressure and atmospheric pressure. Produced control pressure is supplied to the EGR valve via a third hose connection.
- The mechanically controlled **EGR valve** is located on the right bank of cylinders and depending on control pressure determines the exhaust gas recirculation rate for reduction of nitrogen oxide by the size of its cross section opening.
- The **EGR temperature sensor G 98** is located in the exhaust gas recirculation pipe behind the EGR valve. It measures the exhaust temperature and is used for self-diagnosis of exhaust gas recirculation.



## Exhaust Gas Recirculation Pulsing Valve N 18

The earth activation of the pulsing valve determines the opening of the EGR valve and therefore the exhaust gas recirculation rate depending on load and speed.

Self-diagnosis:
Self-diagnosis recognizes faults in the circuit of N 18. It makes a difference between two types of faults: "break/short to earth" and "short to posi- tive".
Exhaust gas recirculation remains closed if the circuit has a break.
In case of a recognized fault, adaptations for lambda control and idling speed stabilization are interrupted and the last learned values are used.




SSP 143/38

**Electric Circuit:**

21 = Earth activation of exhaust gas recirculation (out)


SSP 143/39

## EGR Temperature Sensor G 98

The EGR temperature sensor is used as a diagnosing sensor for recognition of faults in the exhaust gas recirculation system.
It signal has no influence on the control of exhaust gas recirculation.

G 98 is located in the exhaust gas recirculation pipe in direction of flow behind the mechanically operated EGR valve.

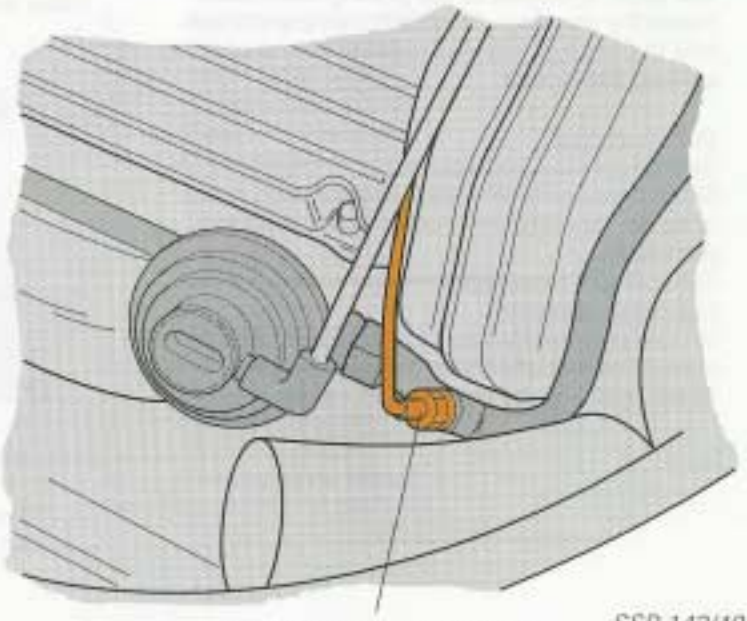
Self-diagnosis:

Self-diagnosis recognizes the following types of faults.

- System Faults
"implausible signal" (continuously opened or closed EGR valve).

- Electric Faults
"short to earth".

Lambda control and idling speed stabilization adaptation is interrupted when a system fault is recognized.
EGR control is switched off in case of an electric fault.



*EGR temperature sensor G98*

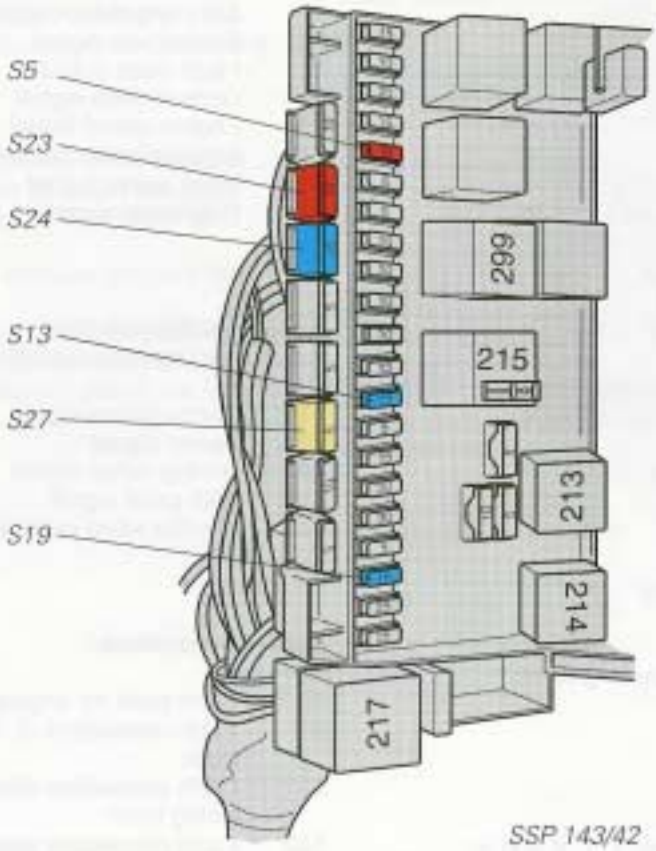
*SSP 143/40*

**Electric Circuit:**


*SSP 143/41*

30 = Sender earth (out)
46 = Exhaust temperature signal (in)

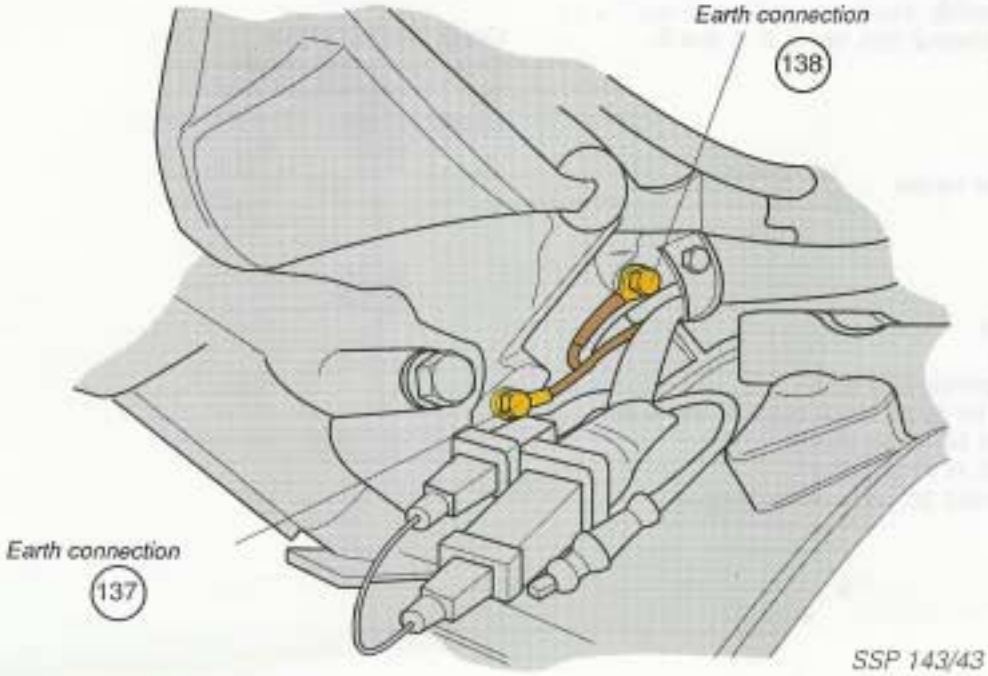
**Important Fuses of Motronic (also refer to Functional Diagram):**




SSP 143/42

**Earth Connections of Motronic (also refer to Functional Diagram):**

Earth connections are located on the bottom of the engine block below the left cylinder head.




SSP 143/43

# Functional Diagram - V8 Engine

**Components:**

F 60 Idling switch

G 4 Ignition timing sender
G 6 Fuel pump
G 28 Engine speed sender
G 39 Lambda probe
G 40 Hall sender
G 42 Intake air temperature sender
G 61 Knock sensor I
G 62 Coolant temperature sender
G 66 Knock sensor II
G 69 Throttle valve potentiometer
G 70 Air volume meter
G 71 Intake manifold pressure sender (in control unit)
G 98 EGR temperature sensor (US Version)

(J) Holding relay in control unit
J 17 Fuel pump relay (1)
J 17 Fuel pump relay (2)
J 220 Motronic control unit
J 208 Lambda probe heating relay

N Ignition coil 1
N 18 Exhaust gas recirculation pulsing valve (US Version)
N 30 Injector, cyl. no. 1
N 31 Injector, cyl. no. 2
N 32 Injector, cyl. no. 3
N 33 Injector, cyl. no. 4
N 70 Final output stage 1 (cyl. no. 1, 7, 6 and 4)
N 71 Idling speed stabilization valve
N 80 Solenoid valve I for activated charcoal filter
N 83 Injector, cyl. no. 5
N 84 Injector, cyl. no. 6
N 85 Injector, cyl. no. 7
N 86 Injector, cyl. no. 8
N 127 Final output stage 2 (cyl. no. 5, 2, 2 and 8)
N 128 Ignition coil 2

T6m Coding plug

Z 19 Lambda probe heater

**Fuses:**

S 5 Fuse for G 39
S 13 Fuse for G 6
S 19 Fuse for diagnostic connector
S 23 Thermo fuse for N 30, N 31, N 32, N 33, N 83, N 84, N 85, N 86, G 70, J 208
S 24 Fuse for N 80, N 71 and N 18
S 27 Fuse for terminal 30, permanent positive

**Additional Signals (Pin) – General Communication:**

6 A/C compressor signal
13 Exciter wire signal
22 Flash code output
31 Consumption signal
40 Engine speed signal
41 Air conditioner signal
50 Road speed signal
55 Diagnostic signal

**Additional Signals (Pin) – Automatic Gearbox Communication:**

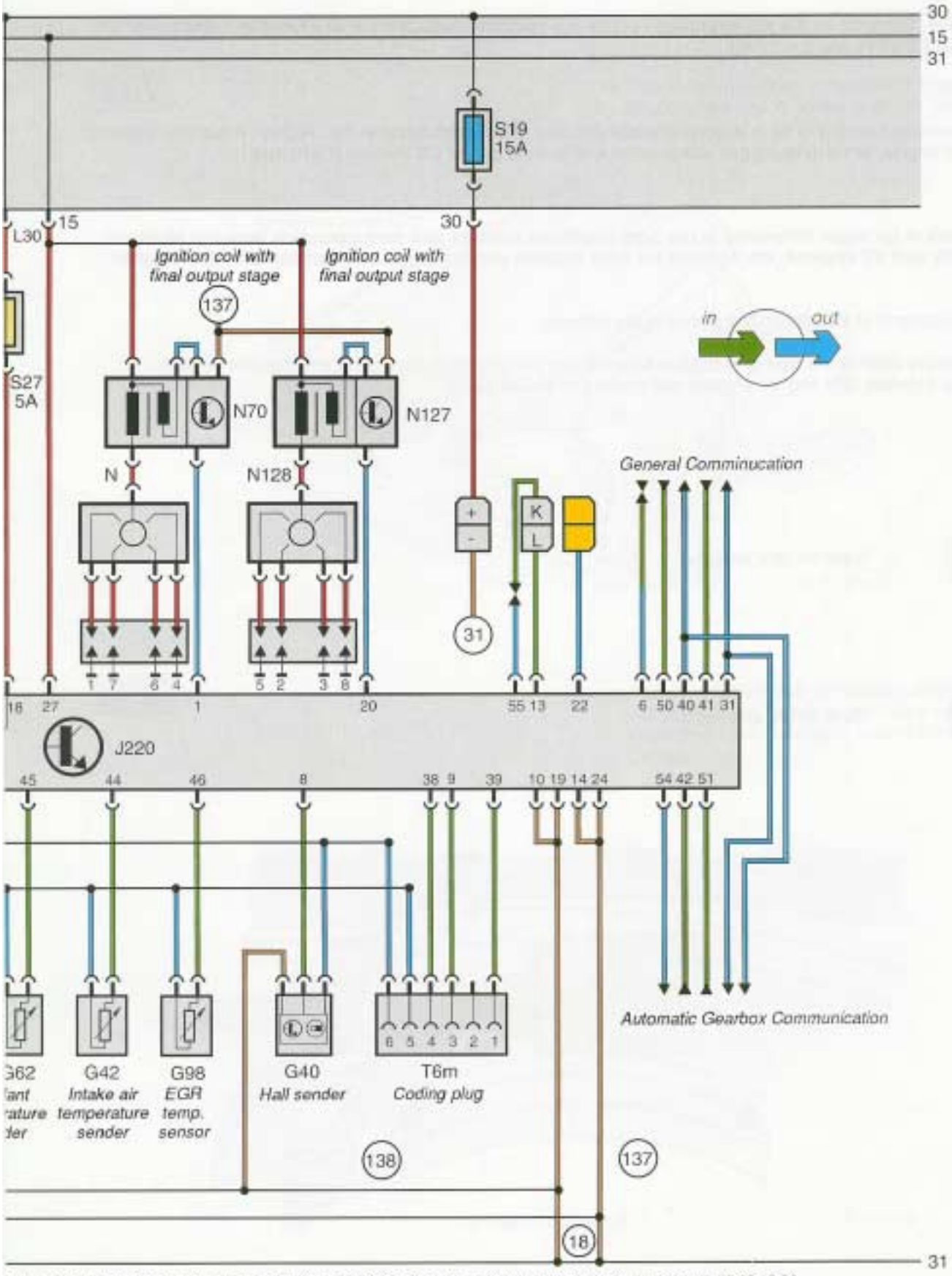
31 Consumption signal
40 Speed signal
42 Driving range signal
51 Shift point signal
54 Throttle valve potentiometer signal

**Earth Connections:**

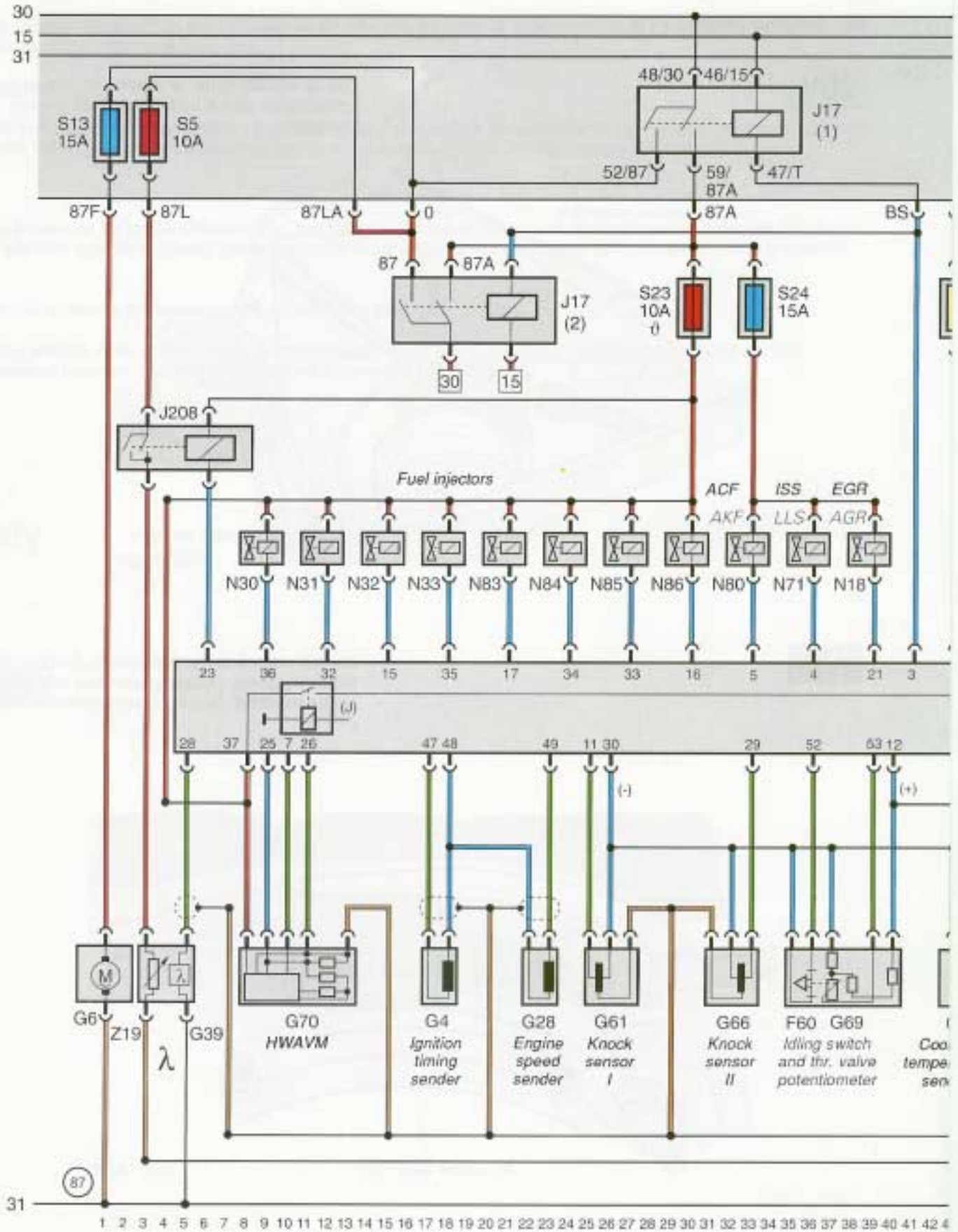
18 Earth point on engine block
87 Earth connection -2- in rear end wiring loom
137 Earth connection (final stage) in Motronic wiring loom
138 Earth connection (electronic) in Motronic wiring loom

**Colour Codes:**

Green = Input signal
Blue = Output signal
Red = Positive
Brown = Earth


30
15
31
S19
15A
L30
15
30
Ignition coil with final output stage
Ignition coil with final output stage
137
in
out
S27
5A
N70
N127
N
N128
General Comminucation
+
-
K
L
31
1 7 6 4
5 2 3 8
16 27 1 20 55 13 22 6 50 40 41 31
J220
45 44 46 8 38 9 39 10 19 14 24 54 42 51
6 5 4 3 2 1
G62
G42
Intake air temperature sender
G98
EGR temp. sensor
G40
Hall sender
T6m
Coding plug
Automatic Gearbox Communication
138
137
18
31
3 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

SSP 143/44


30
15
31
S13
15A
S5
10A
48/30
46/15
J17
(1)
52/87
59/
87A
47/T
87F
87L
87LA
0
87A
BS
87
87A
J17
(2)
S23
10A
S24
15A
30
15
J208
Fuel injectors
ACF
AKF
ISS
LLS
EGR
AGR
N30
N31
N32
N33
N83
N84
N85
N86
N80
N71
N18
23
36
32
15
35
17
34
33
16
5
4
21
3
(J)
28
37
25
7
26
47
48
49
11
30
29
52
53
12
(-)
(+)
G6
Z19
G39
G70
HWAVM
G4
Ignition timing sender
G28
Engine speed sender
G61
Knock sensor I
G66
Knock sensor II
F60
G69
Idling switch and thr. valve potentiometer
87
31
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42

The chapter "Sensors" on the following pages contains a complete description of all information senders for Motronic 2.3.2 (20V) and 2.4.1 (V8).

Exception:

EGR temperature sensor G 98 is described under Exhaust Gas Recirculation in the chapter "Actuators, Systems" for the V8 engine, since exhaust gas recirculation is only valid for the US Version (California).

**Since there is no major difference in the type of applied sensors and their operation between Motronic for the 20V and V8 engines, the sensors for both engines are described and compared in this chapter.**

Different locations of installation are shown in the pictures.

Some sensors differ in the type of substitute function and self-diagnosis for a pertinent Motronic version. Deviations between 20V and V8 engines are marked as shown below.

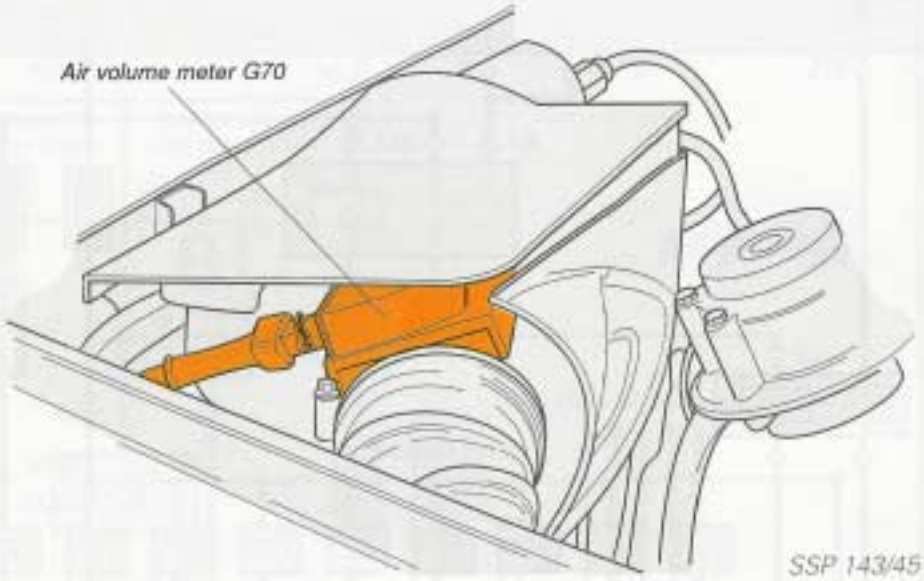
20V Valid for 20V engines

V8 Valid for V8 engines

## Air Volume Meter G 70

**20V**

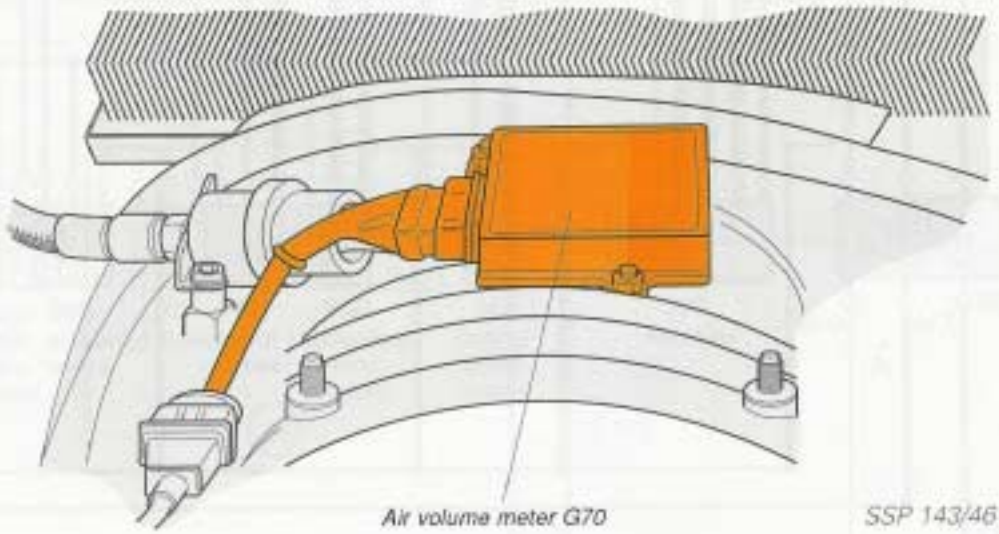
The air volume meter is located in front of the turbocharger and is bolted to the air cleaner housing.




SSP 143/45

**V8**

The air volume meter is mounted direct on the intake manifold. Its probe protrudes into the intake manifold. Sealing is accomplished with O-rings.




SSP 143/46

The voltage signal from the air volume meter is used as a load signal depending on the air volume current. This load information is a major input variable for all load and speed dependent calculations such as, for example, ignition timing, injection time, activation of tank ventilation or adaptation of idling speed stabilization.

This signal is not precise enough when starting the engine.

**20V** Altitude and temperature dependent fixed values are used for engine starting.

**V8** Temperature dependent fixed values are used for engine starting.

After switching the engine off the hot wire in G 70 is operated to glow briefly and in this manner contamination is burned off of the wire.
Requirements: The engine must have previously reached a temperature of 30° C and exceeded the speed limit of 2000 rpm.
Contamination on the hot wire would have the affect of insulation, so that the load signal would not be correct and could, for example, lead to leaning of the fuel/air mixture.

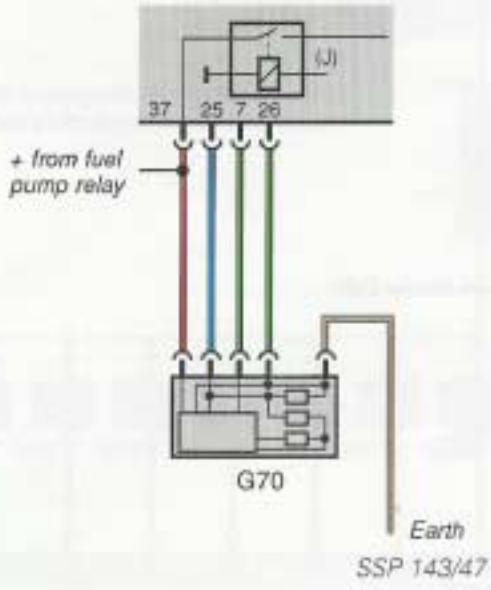
Power supply for burn-off is guaranteed by a holding relay in the control unit.

Self-diagnosis and Substitute Function:

Self-diagnosis recognizes faults in the circuit of G 70 and makes a difference between two types of faults: "break/short to earth" (signal too small) and "short to positive" (signal too large). Adaptation of lambda control and idling speed stabilization is interrupted and tank ventilation is switched off when a fault is recognized.

The signal from throttle valve potentiometer G 69 is used as a substitute function.

**Electric Circuit:**

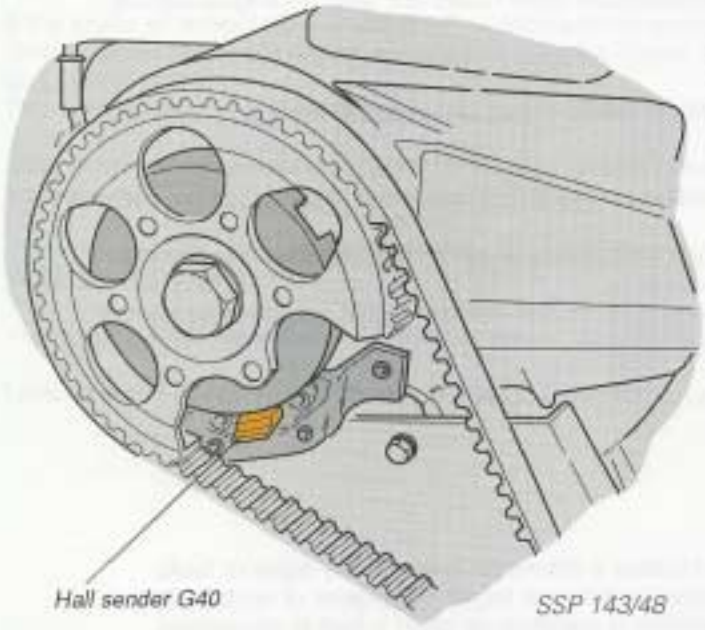



SSP 143/47

37 = Power supply (out)
25 = Burn-off signal (out)
7 = Engine load (in)
26 = Reference voltage, earth (in)

## Hall Sender G 40

**20V**

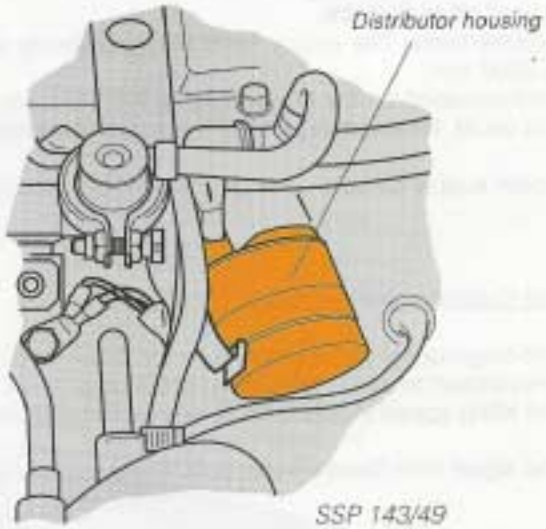



SSP 143/48

**NEW!**

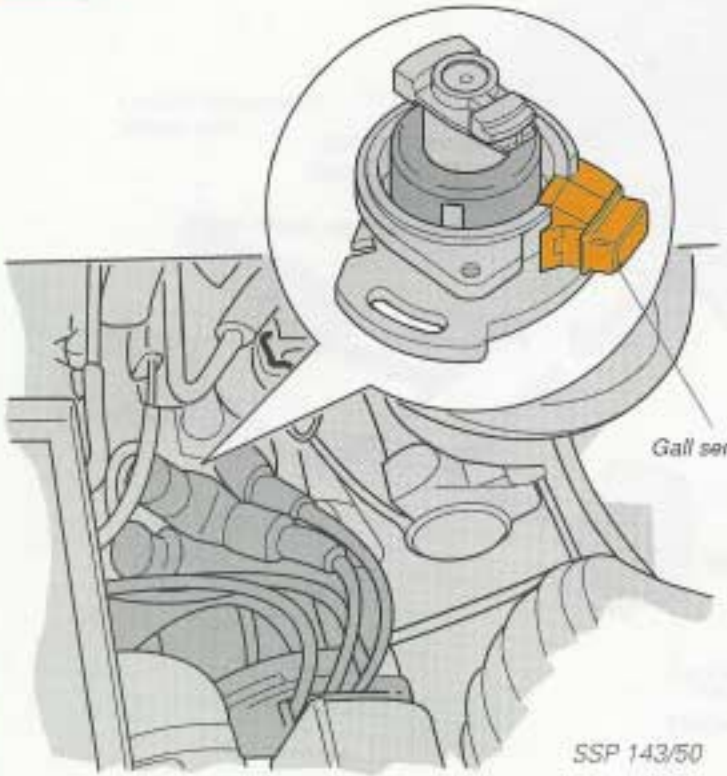
The Hall sender with mounting ring is now located behind the camshaft sprocket.

**Note:**
The first AAN engines are still fitted with a distributor housing, in which the Hall sender is located for these vehicles.




SSP 143/49

**V8**




SSP 143/50

The Hall sender is integrated in the distributor of the left bank of cylinders.

## 20V

The Hall sender signal is used to recognize ignition TDC in cylinder no. 1 for engine starting, whereby the Hall sender signal and ignition timing signal must be put in mutually. It is also required for cylinder-selective knock recognition during engine operation.

Signal Failure:

It is not possible to start the engine. If the signal fails during engine operation, the ignition timing will be retarded by 11°. In addition, charge pressure control and knock control will be interrupted.

Self-diagnosis:

Self-diagnosis recognizes the following types of fault for G 40:
- "mechanical fault" and/or "fault in basic setting"
- "break/short to positive" and/or "signal at positive"
- "short to earth" and/or "signal at earth"

## V8

The Hall sender signal is used to recognize ignition TDC in cylinder no. 1 for engine starting, whereby the Hall sender signal and ignition timing signal must be put in mutually. Motronic can then initiate the correct sequence of injection.
It is also required for cylinder-selective knock recognition during engine operation.

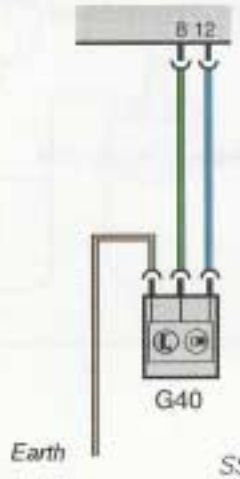
Signal Failure:

The injection sequence is started via the ignition timing signal. It is possible to displace the injection sequence by 360 crankshaft degrees.
The ignition timing is retarded by 16° in the interest of safety.

Self-diagnosis:

Self-diagnosis recognizes faults in the circuit of G 40 and makes a difference between two types of faults: "break/short to positive" and "short to earth".
The "no signal" fault code is simultaneously recognized by the computer of knock control.

**Electric Circuit:**



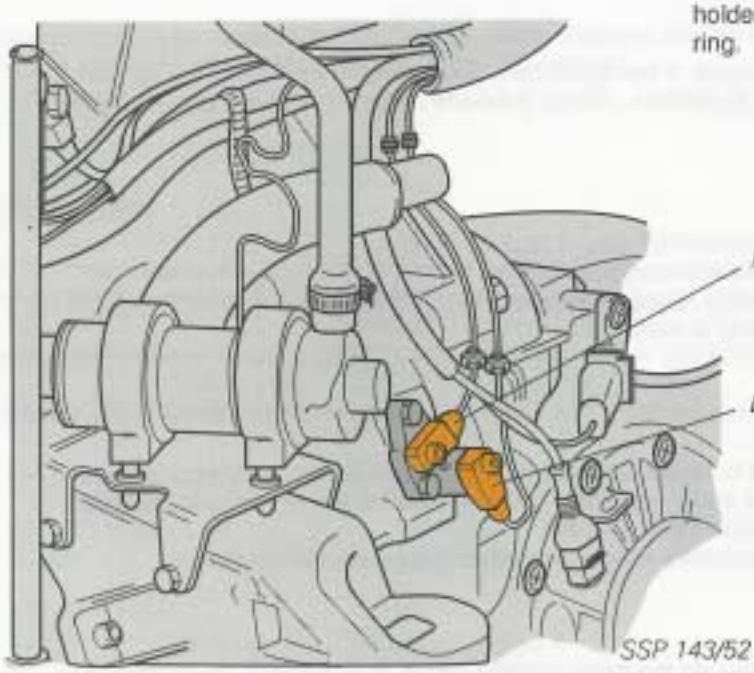

8 = Hall sender signal (in)
12 = Power supply (out)

SSP 143/51

## Ignition Timing Sender G 4 and Engine Speed Sender G 28

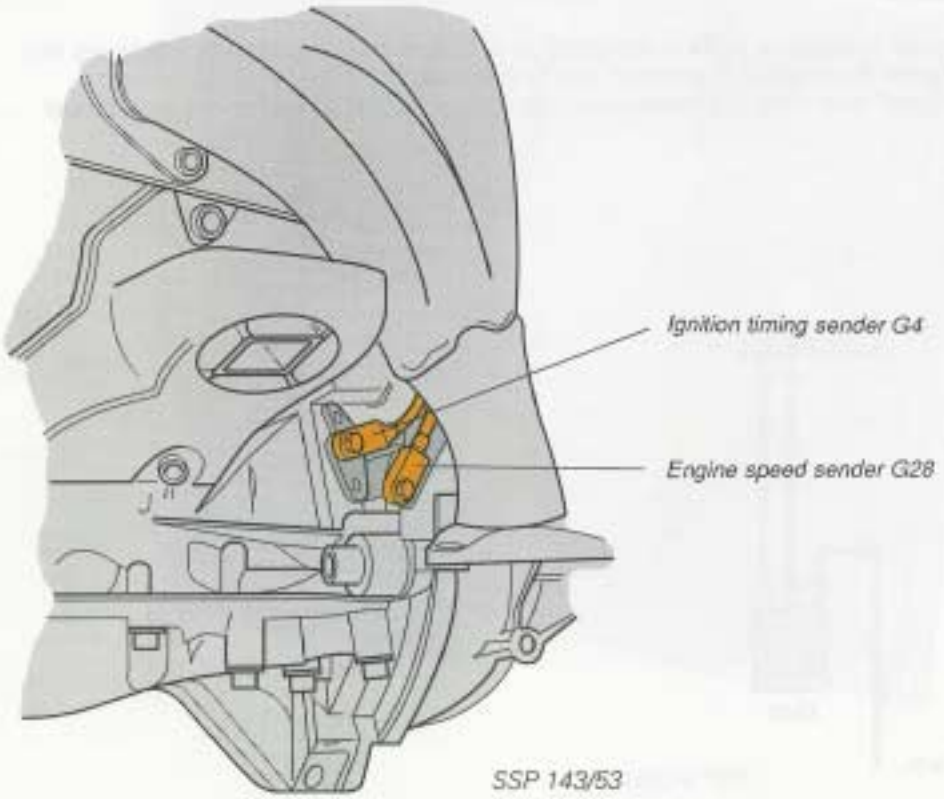
**20V**

Both senders are identical and located in a mutual holder at the left-hand side on the starter gear ring.




SSP 143/52

**V8**




SSP 143/53

**G 4** scans a steel pin press-fitted on the back of the flywheel.
In this manner an inductive signal is sent to the control unit. Ignition TDC of cylinder no. 1 is recognized together with the Hall sender signal for engine starting.

**20V** Inductive signal 62° before TDC

**V8** Inductive signal 72° before TDC

**G 28** scans the teeth of the starter gear ring. It produces inductive voltage signals for recognition of engine speed (teeth per unit of time) and recognition of angular ignition spacing (number of teeth up to ignition and injection on next cylinder).

**20V** 135 teeth on starter gear ring, 54 teeth up to next ignition and injection

**V8** 136 teeth on starter gear ring, 34 teeth up to next ignition and injection

Signal Failure:

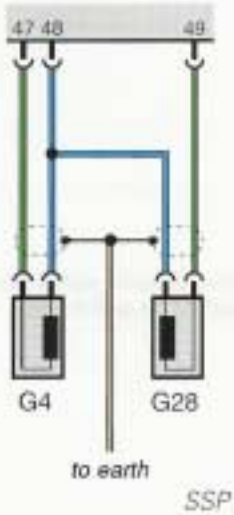
The engine cannot be started when signals from G 4 and G 28 fail. The engine continues running if the G 4 signal fails during operation. The signal is not required for engine operation.

Self-diagnosis:

Self-diagnosis recognizes types of fault for

G 4/G 28 – "no signal"
G 28: – "mechanical fault" (G 4 and G 28 mixed up)
G 28: – "implausible signal" (Hall sender or timing maladjusted)

**Electric Circuit:**

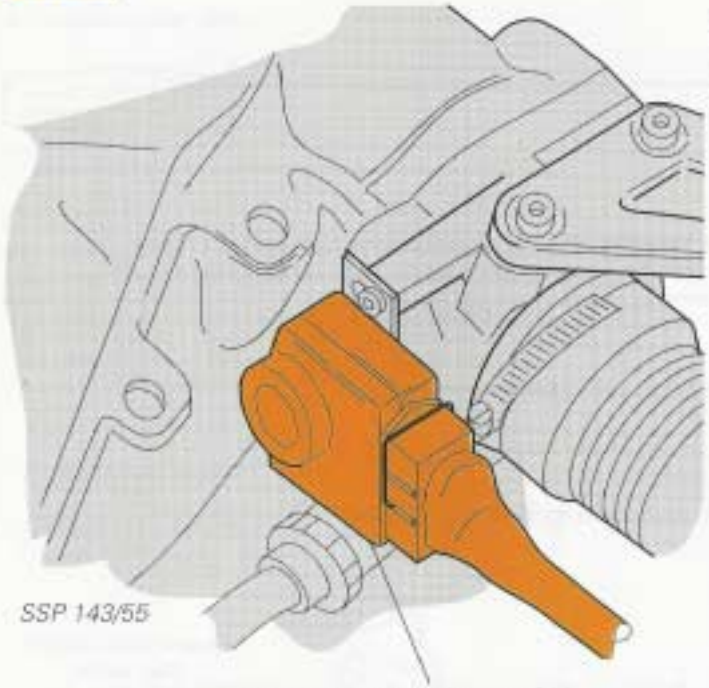



47 = Ignition timing signal (in)
48 = G 4 and G 28 sender earth (out)
49 = Speed signal (in)

SSP 143/54

## Throttle Valve Potentiometer G 69 with Idling Switch F 60

**20V**



SSP 143/55

*Throttle valve potentiometer G69 with idling switch F60*

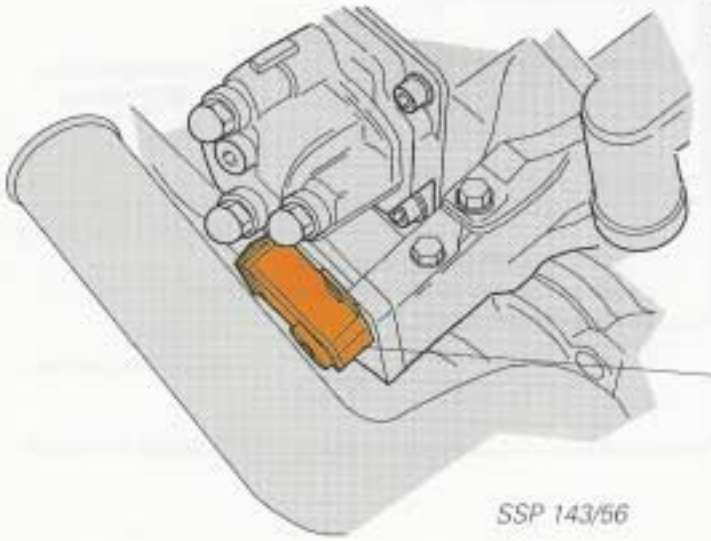
Throttle valve potentiometer and idling switch are installed in a mutual housing which is located on the throttle valve assembly.
They are operated by the throttle valve shaft.

**V8**

Throttle valve potentiometer and idling switch are installed in a mutual housing.
It is located at the front end of the intake manifold below the idling speed stabilization valve.

***NEW!***

The signal from the throttle valve potentiometer is now also an input signal for Motronic.



*Throttle valve potentiometer G69 with idling switch F60*

SSP 143/56

The signal from **idling switch F 60** is used for recognition of idling speed, overrun cut-out regulation, idling speed stabilization and digital idling speed stabilization regulation, overrun air volume and overrun ignition timing control as well as activation of idling speed stabilization adaptation.

Signal Failure:
Idling speed is recognized via the throttle valve potentiometer if the F 60 signal fails. Adaptation of idling speed stabilization is interrupted. Engine torque is reduced via the safety ignition map if the signal from the throttle valve potentiometer also fails.

Self-diagnosis:
Self-diagnosis recognizes faults in the circuit of F 60 and makes a difference between two types of fault: "break/short to positive" (F 60 opened continuously) and "short to earth" (F 60 closed continuously).

The signal from **throttle valve potentiometer G 69** is equal to the throttle valve opening angle in degrees.

The throttle valve opening above 35° is used for calculation of nominal charge pressure.

**20V**

***NEW!***

The signal from G 69 is now also used for other Motronic functions, as a substitute function for the air volume meter and for diagnosis of the idling switch. In addition, it is available for other control units as a preparatory (digitalizing) signal.

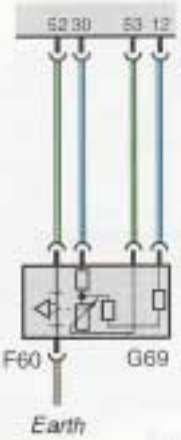
Self-diagnosis and Substitute Function:
Self-diagnosis recognizes faults in the circuit of G 69 and makes a difference between types of fault: "break/short to positive" and "short to earth".
The "signal too large/too small" fault is simultaneously recognized by the computer for charge pressure control and knock control.
In case of fault a throttle valve opening angle of 28° is assumed as a substitute function for G 69 and charge pressure control is switched off. There could then be disturbances in signal receiving control units (e.g. J 217, automatic gearbox).

**V8**

The signal from G 69 is used for several Motronic functions and as a substitute function for the air volume meter and for diagnosis of the idling switch.

Self-diagnosis and Substitute Function:
Self-diagnosis recognizes faults in the circuit of G 69 and makes a difference between two types of fault: "break/short to positive" and "short to earth".
In case of fault a throttle valve opening angle of 23° is assumed as a substitute function for G 69. There could then be disturbances in signal receiving control units (e.g. J 217, automatic gearbox).

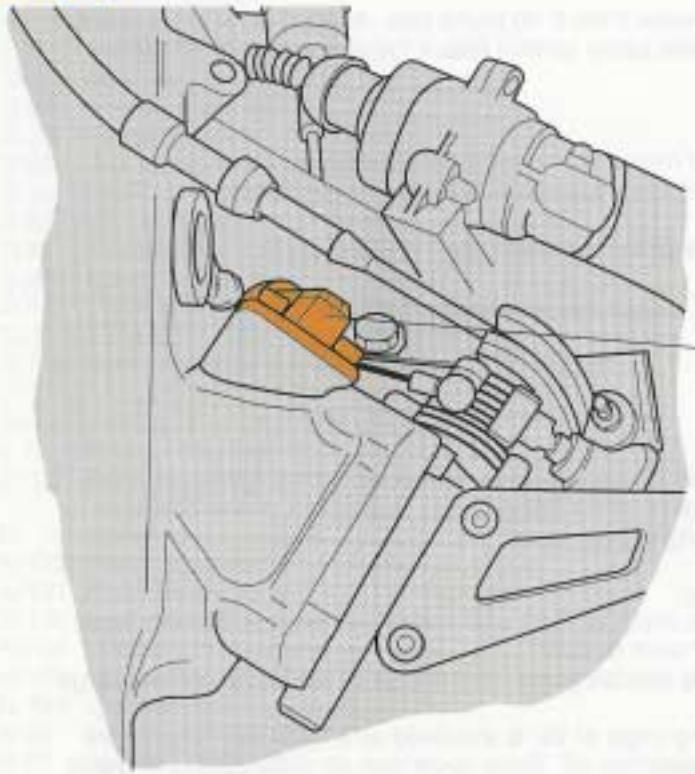
**Electric Circuit:**




52 = Idling recognition (in)
30 = Sender earth (out)
53 = Throttle valve opening (in)
12 = Power supply (out)

## Intake Air Temperature Sender G 42

**20V**

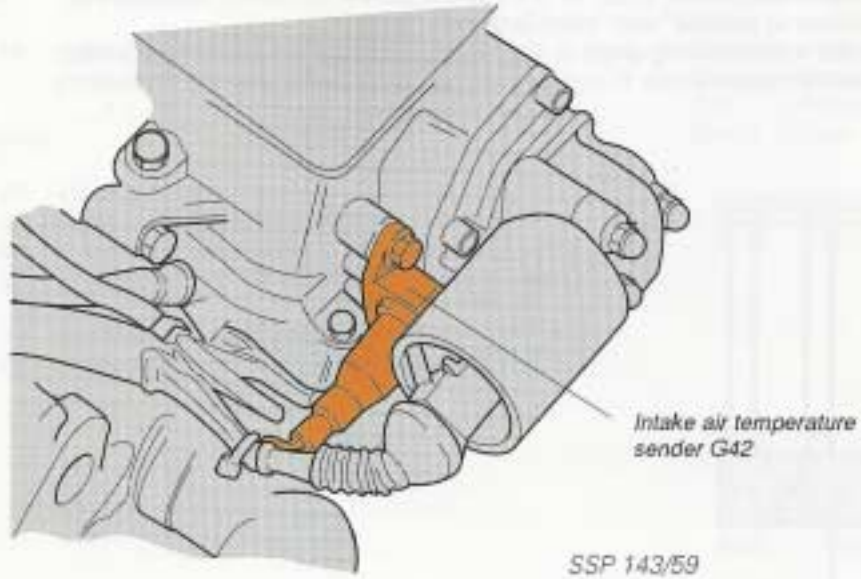



The intake air temperature sender is mounted on the intake manifold behind the throttle valve.

SSP 143/58

**V8**

The intake air temperature sender is mounted on the front end of the intake manifold next to the idling speed stabilization valve.




SSP 143/59

## 20V

G 42 supplies information about the intake air temperature in the intake manifold.
If the intake air temperature is too hot, Motronic reacts by retarding the ignition timing and reducing the charge pressure.

Self-diagnosis and Substitute Function:

Self-diagnosis recognizes faults in the circuit of G 42 and makes a difference between two types of fault: "break/short to positive" and "short to earth".

A substitute value of 40° C is assumed in case of recognized fault.

## V8

G 42 supplies information about the intake air temperature in the intake manifold.
If the intake air temperature is too hot, Motronic reacts by retarding the ignition timing.

Self-diagnosis and Substitute Function:

Self-diagnosis recognizes faults in the circuit of G 42 and makes a difference between two types of fault: "break/short to positive" and "short to earth".

A substitute value of 20° C is assumed in case of recognized fault.

**Electric Circuit:**

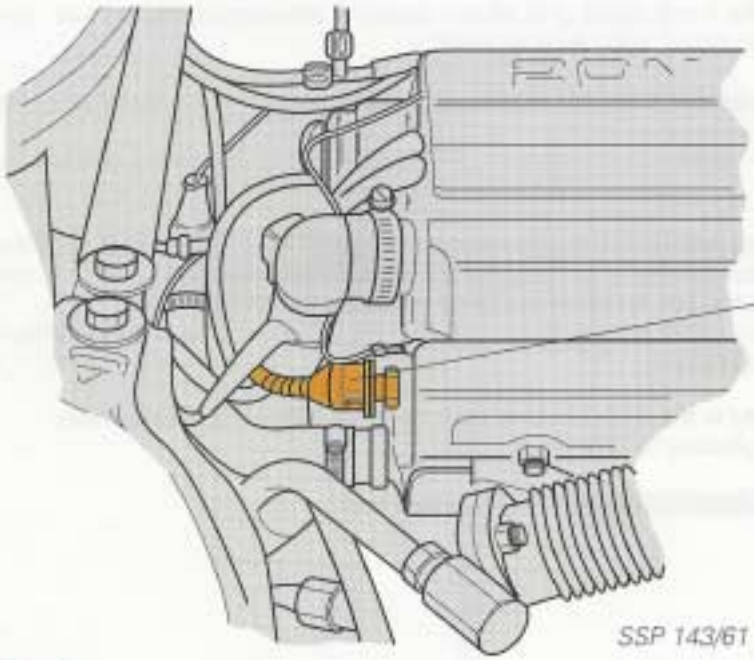

30 = Sender earth (out)
44 = Intake air temperature signal (in)

*SSP 143/60*

## Coolant Temperature Sender G 62

**20V**

The coolant temperature sender is located on the rear end of the cylinder head.

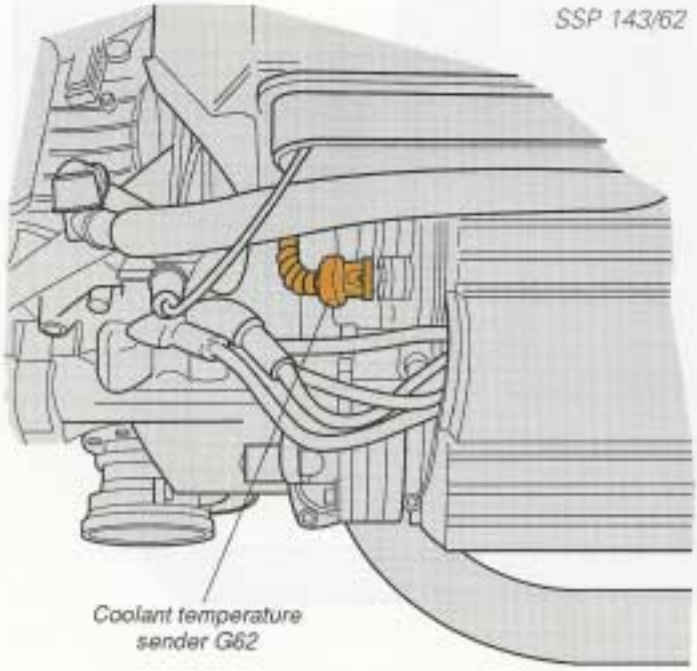



SSP 143/61

**V8**

The coolant temperature sender is located on the rear end of the cylinder head for the right bank of cylinders.

SSP 143/62



The information about coolant temperature (engine temperture) is used by Motronic for temperature dependent correction of injection time, ignition timing, idling speed stabilization and so on.
In addition, various functions such as lambda control and overrun cut-out are started depending on the temperature.

Self-diagnosis and Substitute Function:

**20V**

Self-diagnosis recognizes faults in the circuit of G 62 and makes a difference between two types of fault: "break/short to positive" and "short to earth".

If the signal from G 62 fails and the intake air temperature is above 20° C, a coolant temperature of 70° C will be assumed.
If the intake air temperature is below 20° C, this value and after three minutes 70° C will be assumed as the coolant temperature.
Adaptation of lambda control and idling speed stabilization are interrupted. The tank ventilation system is activated only with an assumed substitute value of 70° C.

**V8**

Self-diagnosis recognizes faults in the circuit of G 62 and makes a difference between two types of fault: "break/short to positive" and "short to earth".

If the signal from G 62 fails and the intake air temperature is above 40° C, a coolant temperature of 80° C will be assumed.
If the intake air temperature is below 40° C, this value and after three minutes 80° C will be assumed as the coolant temperature.
Adaptation of lambda control and idling speed stabilization are interrupted.

**Electric Circuit:**

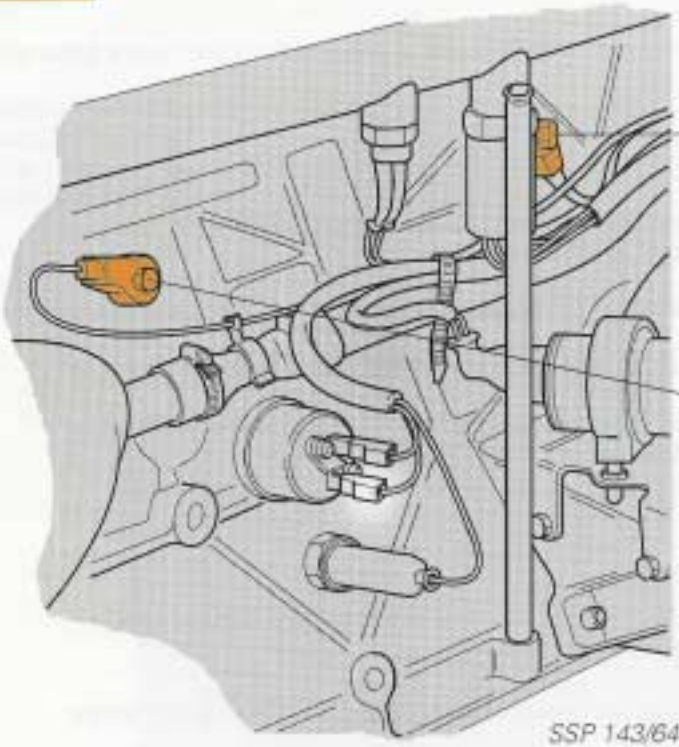

30 = Sender earth (out)
45 = Engine temperature signal (in)

*SSP 143/63*

## Knock Sensors I and II, G 61 and G 66

**20V**

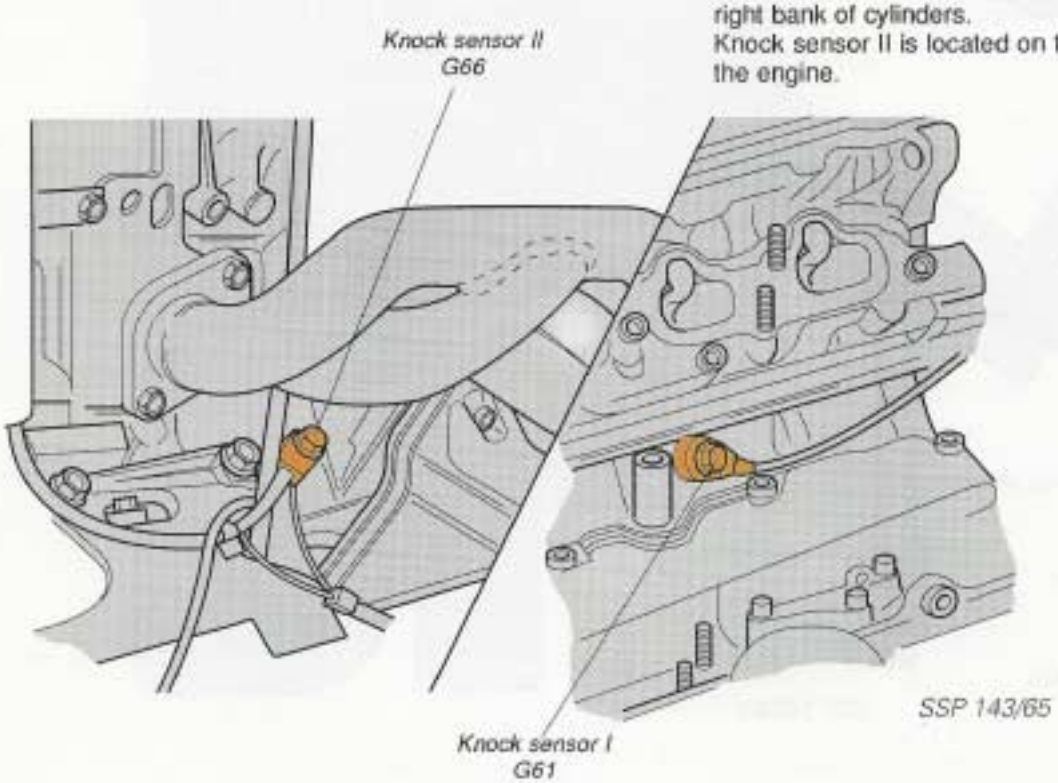
Both knock sensors I and II are located on the left-hand side of the engine.




SSP 143/64

**V8**

Knock sensor I is mounted on the inside of the right bank of cylinders.
Knock sensor II is located on the left-hand side of the engine.




SSP 143/65

## 20V

Cylinders 1, 2 and 3 are monitored by knock sensor G 61, and cylinders 4 and 5 by knock sensor G 66.
Signals from the knock sensors are used by knock control for cylinder-selective knock recognition of cylinders 1 through 5. Ignition timing of the concerned cylinder is retarded, if knock is recognized. In addition, if knocking is persistent the fuel/air mixture will be enrichened and the charge pressure reduced.

**NEW!**

Knock control is now **adaptive**. Knock control is capable of adaptation to parts of the ignition timing map.

Self-diagnosis and Substitute Function:

Self-diagnosis recognizes the type of fault: "no signal".

In case of recognized knock sensor I or II failure, the ignition timing of cylinders 1, 2 and 3 or 4 and 5 will be retarded by 11° in the map ranges, in which there is the greatest knock tendency, and the fuel/air mixture is enrichened.

## V8

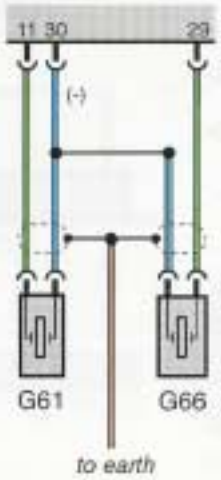
Cylinders 1 through 4 are monitored by knock sensor G 61, and cylinders 5 through 8 by knock sensor G 66. Signals from the knock sensors are used by adaptive knock control for cylinder-selective knock recognition of cylinders 1 through 8. Ignition timing of the concerned cylinder is retarded, if knock is recognized. In addition, if knocking is persistent the fuel/air mixture will be enrichened.

Self-diagnosis and Substitute Function:

Self-diagnosis recognizes the type of fault: "no signal".

In case of recognized knock sensor I or II failure, the ignition timing of cylinders 1 through 4 or 5 through 8 will be retarded by 16° in the map ranges, in which there is the greatest knock tendency, and the fuel/air mixture is enrichened.

**Electric Circuit:**




11 = Knock tendency of cyl. 1, 2, 3 (in) for 20V
Knock tendency of cyl. 1 to 4 (in) for V8
30 = Sender earth (out)
29 = Knock tendency of cyl. 4, 5 (in) for 20 V
Knock tendency of cyl. 5 to 8 (in) for V8

*SSP 143/66*

## Lambda Probe G 39

**20V**

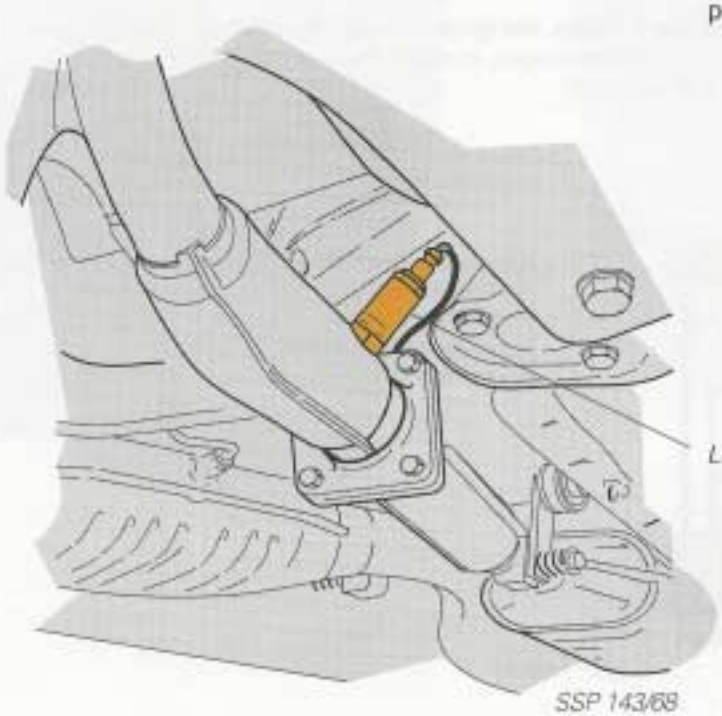
The lambda probe is located in the stream of exhaust gas behind the turbine outlet of the exhaust gas turbocharger.


SSP 143/67

**V8**

**NEW!**

This engine has a twin exhaust system.
The lambda probe is located in the left-hand exhaust pipe in front of the catalytic converter.




SSP 143/68

The signal from the lambda probe is equal to the residual oxygen content in the exhaust gas.
When idling and in partial load, the mixture is regulated to lambda = 1 according to the signal from G 39 to ensure optimal catalytic converter efficiency.

Lambda control is adaptive. In accordance with the regulating tendency, the basic activation of fuel injectors is adapted in such a manner that regulation has the smallest possible regulating travel.
Consequently it is no necessary to adjust the CO content or mean regulating position manually.

Signal Failure:

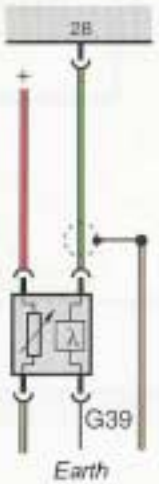
If there is failure of the lambda probe signal, there will not be lambda control and adaptation of lambda control is interrupted. The tank ventilation system is switched off.

Self-diagnosis:

Self-diagnosis recognizes faults in the circuit of G 39 and makes a difference between types of fault: "short to positive", "break" and "short to earth".
In addition, self-diagnosis recognizes faults in lambda control and mixture correction (adaptation).

Note:
A lead-resistent probe is used in engines which are operated on leaded petrol.

**Electric Circuit:**

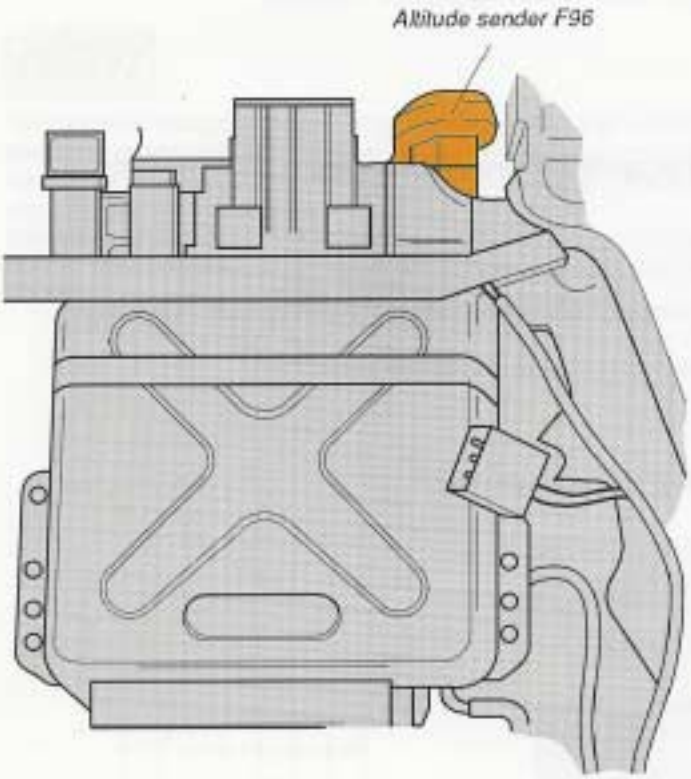



28 = Mixture composition (in)

SSP 143/69

## Altitude Sender F 96

20V




SSP 143/70

**NEW!**

Altitude sender F 96 is located in the electronic box.

F 96 reports the current pressure altitude to the control unit. At altitudes above approx. 1000 mtr. (low air pressure) the nominal charge pressure will be reduced to avoid excessive turbocharger loads. At low air pressure it would have to turn much faster to supply maximum nominal charge pressure than, for example, at sea level.
Charge pressure control is switched off from a pressure altitude of approx. 3000 metres.

**NEW!**

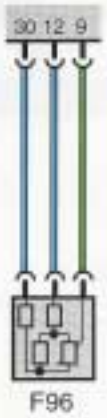
Start regulation of injection is now also controlled depending on the altitude in order to avoid starting problems at extremely low temperature and at high altitude.

Self-diagnosis:

Self-diagnosis recognizes faults in the circuit of F 96 and makes a difference between types of fault: "break/short to positive" and "short to earth".

**Electric Circuit:**

30 = Sender earth (out)
12 = Power supply (out)
9 = Pressure altitude signal (in)

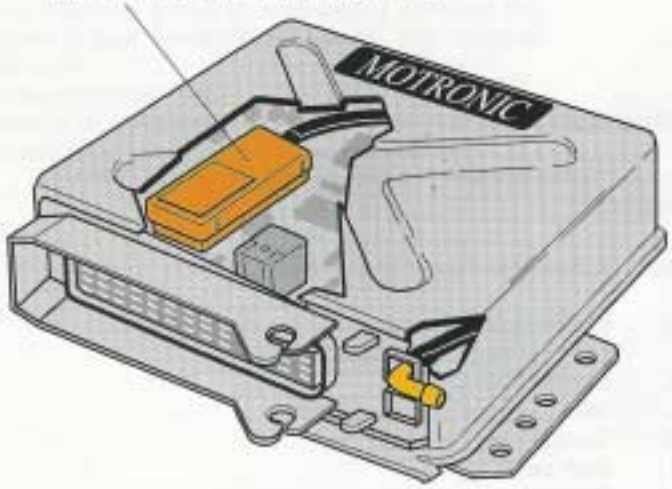



SSP 143/71

## Intake Manifold Pressure Sender (Pressure Sensor) G 71

20V

*Intake manifold pressure sender G71*




*SSP 143/72*

The pressure sensor is integrated in the control unit and therefore does not have a connection pin on the control unit. It is subject to intake manifold pressure through a hose and measures absolute pressure. The pressure sensor converts the variable "charge pressure" being measured into an electric signal, which is processed in the control unit.

For charge pressure control the measured intake manifold pressure is the current actual charge pressure, which is compared with nominal charge pressure.

Signal Failure:

Charge pressure control is switched off.

Self-diagnosis:

Self-diagnosis makes a difference between types of fault: "signal too small" and "signal too large".

**Note:**
The pressure sensor cannot be renewed. The control unit may not be opened.

**Electric Circuit:**

The pressure sensor is integrated in the circuit of the control unit.

# Additional Signals

As shown in the system surveys for 20V and V8 engines, the Motronic control unit J 220 is connected with a number of sensors (information senders) and actuators (drives or final control elements).

In addition, a number of **additional signals,** which are

- either required primarily in the Motronic engine management system, but are simultaneously offered to other vehicle systems as additional information,
- or produced in other vehicle systems, but are also used in Motronic as additional information,

are active in the Motronic engine management system.

**The number of additional signals and their pin connections is identical for the 20V and V8 engines.**

A difference is made in the additional signals between those for "General Communication" and those for "Automatic Gearbox Communication" (also refer to Functional Diagram).

| Pin | General Communication |
|---|---|
| 6 | A/C compressor signal |
| 13 | Exciter wire signal |
| 22 | Flash code output |
| 31 | Consumption signal |
| 32 | Charge pressure signal (only 20V) |
| 40 | Engine speed signal |
| 41 | Air conditioner signal |
| 50 | Road speed signal |
| 55 | Diagnostic signal |

| Pin | Automatic Gearbox Communication |
|---|---|
| 31 | Consumption signal (also General Communication) |
| 40 | Engine speed signal (also General Communication) |
| 42 | Driving range signal |
| 51 | Shift point signal |
| 54 | Throttle valve potentiometer signal |

## General Communication

### A/C Compressor Signal (Pin 6, in + out)

SSP 143/73

Control unit J 153 for the magnetic coupling (manual air conditioner) or control and display unit E 87 is connected on Pin 6.
The signal is bidirectional (in + out).

in:
When switching the A/C compressor on, the idling speed stabilization valve is opened further in order to compensate for the higher engine load.
out - only manual gearbox:
The compressor is switched off for maximum 12 seconds at a road speed of less than 7 km/h when the throttle valve is opened quickly (acceleration).
out - manual gearbox and automatic gearbox:
The compressor is switched off for maximum 3 seconds in first gear (recognized from road speed and engine speed) and with a throttle valve opening of more that 65° (full load).

**Exciter Wire Signal (Pin 13, in)**

SSP 143/74

The exciter wire signal is used for activation of quick data transfer with fault reader V.A.G via the white diagnostic plug (L-wire).

Signal Failure:

When there is a break in the signal wiring (L-wire) the following text appears on the fault reader:
"control unit does not answer".

**Flash Code Output (Pin 22, out)**

SSP 143/75

This signal is used to put the flash code out. The fault lamp in the dash panel of vehicles in US Version (California) is activated.

**Consumption Signal (Pin 31, out)**

SSP 143/75

The consumption signal is information about the instantaneous fuel consumption. It is calculated direct from the injection time and discharging rate of the tank ventilation system.
The on-board computer uses the consumption signal for display of current and average fuel consumption values.

It is simultaneously used as a load signal by electronic gearbox control (Automatic Gearbox Communication).

Self-diagnosis:

Self-diagnosis is accomplished by signal-receiving systems, e.g. by automatic gearbox control unit J 217.

# Additional Signals

### Engine Speed Signal (Pin 40, out)

SSP 143/75

The engine speed signal is produced by the signal from engine speed sender G 28. It is used by the tachometer for display of engine speed.

It is simultaneously used as engine speed information by electronic gearbox control (Automatic Gearbox Communication).

Self-diagnosis:

Self-diagnosis is accomplished by signal-receiving systems, e.g. by automatic gearbox control unit J 217.

### Air Conditioner Signal (Pin 41, in)

SSP 143/74

The air conditioner signal comes from the air conditioner switch for a manual air conditioner or control and display unit E 87 for the digital air conditioner.
It is used to boost the engine speed when switching the air conditioner on; the initial control value of idling speed stabilization is increased. With digital air conditioning the signal is set when higher cooling or heating power is required.

### Road Speed Signal (Pin 50, in)

SSP 143/74

The road speed signal is information about the current road speed and comes from speedometer G 21.
It is used for idling speed stabilization (active below 6 km/h) and compressor cut-out (also compare with Pin 6).

Self-diagnosis:

Self-diagnosis recognizes type of fault: "no signal".

### Diagnostic Signal (Pin 55, in + out)

SSP 143/73

The diagnostic signal is used for communication between Motronic control unit and fault reader V.A.G 1551.
The signal is bidirectional (in + out).

Signal Failure:

When there is a break in the signal wiring (K-wire) the following text appears on the fault reader:
"control unit does not answer".

## Automatic Gearbox Communication

### Consumption Signal (Pin 31, out)

Refer to General Communication.

### Engine Speed Signal (Pin 40, out)

Refer to General Communication.

### Driving Range Signal (Pin 42, in)

SSP 143/74

The driving range signal comes from the multi-function switch.
Idling speed is reduced after selection of a driving range in order to reduce the vehicle's tendency to creep.

# Additional Signals

**Shift Point Signal (Pin 51, in)**

SSP 143/74

The shift point signal comes from automatic gearbox control unit J 217.
The Motronic control unit uses this signal to recognize upshifts and downshifts of the automatic gearbox.
For additional shifting comfort Motronic retards the ignition timing and therefore reduces engine torque during shift operations.

Self-diagnosis:

Self-diagnosis recognizes a continuous signal ("short to earth").
The signal is then no longer accepted.

***NEW!***

**Throttle Valve Potentiometer Signal (Pin 54, out)**

SSP 143/75

The signal from the throttle valve potentiometer is digitalized (pulse width modulated) in the Motronic control unit and delivered to automatic gearbox control unit J 217.

20V **The 20V engine has another additional signal.**

**Charge Pressure Signal (Pin 32, out)**

SSP 143/75

The charge pressure signal is an analog voltage signal and increases with rising charge pressure.
It is used in the on-board computer for display of the charge pressure.

# Holding Relay in Control Unit

A holding relay is integrated in the Motronic control unit for 20V and V8 engines.

Fuel pump relay J 17 is only activated when a speed signal (more than 23 rpm) is put in.

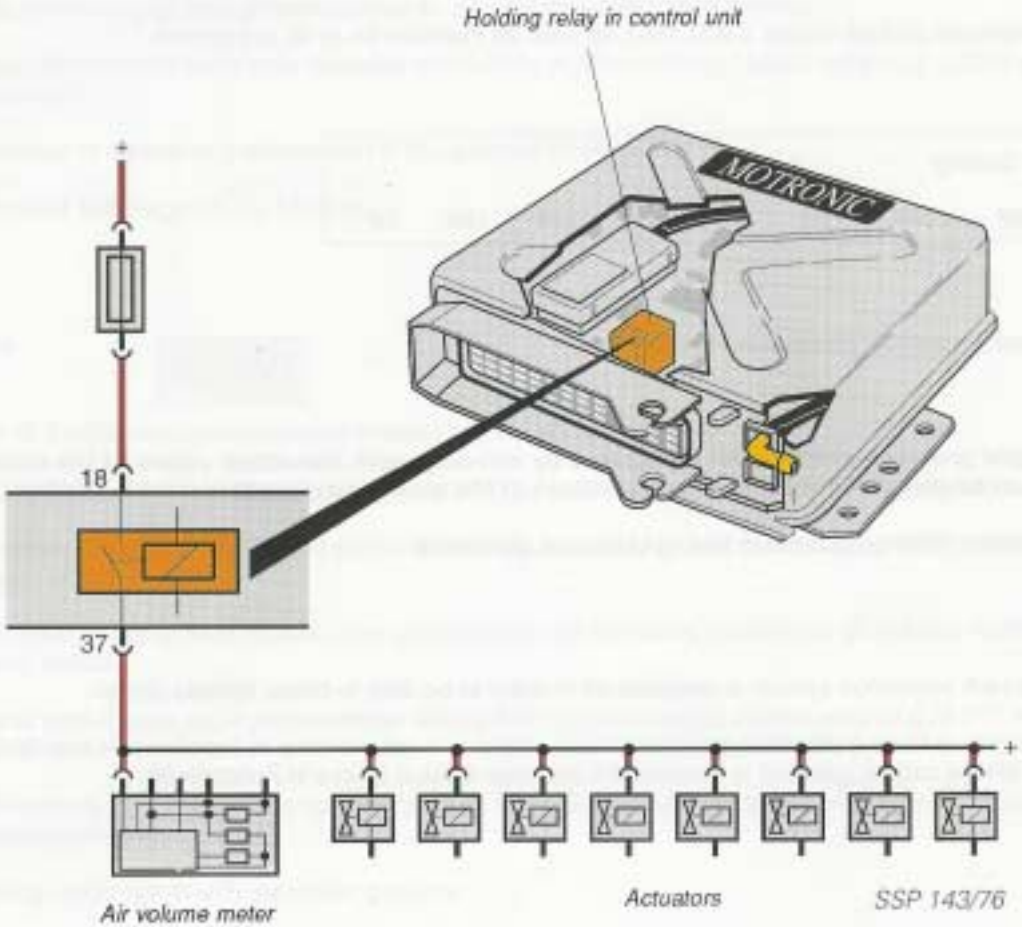
Consequently with "ignition on" and before the engine is started the holding relay switches power supply to the air volume meter, fuel injectors, idling speed stabilization valve, charge pressure control pulsing valve (only 20V), EGR pulsing valve (only V8) and solenoid valve I for the activated charcoal filter.

This is an important requirement for engine starts and final control element diagnosis.

After "ignition off" the holding relay is held in continuity; Pin 37 still has voltage for approx. five seconds (engine speed must have previously exceeded 2000 rpm and the engine temperature 30° C).

In this manner the air volume meter has voltage to burn-off (clean) the hot-wire.

Power is simultaneously supplied to activated charcoal filter solenoid valve I, which can be closed by the control unit. This prevents "after-running" of the engine.



## Rapid Data Transfer with Fault Reader V.A.G 1551

After connecting V.A.G 1551 to the diagnostic connection plug the system to be checked, **Engine Electronics**, must be selected by entering Code **01**.

Motronic has the following self-diagnosis functions:

**01** - Interrogating control unit version
**02** - Interrogating fault memory
**03** - Final control element diagnosis
**04** - Initiating basic setting
**05** - Erasing fault memory
**06** - Ending output
**07** - Not used
**08** - Reading measured value block

## Measured Value Block – Functions 04 and 08

Ten values are displayed on fault reader V.A.G 1551 as soon as Function 04 or 08 is selected.

| System in Basic Setting: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 200 | 25 | 80 | 128 | 100 | 130 | 48 | 128 | 128 | 36 |

The idling speed values can be checked in Function 04.

**If there is an engine problem, which is not recognized by self-diagnosis, the actual values of the measured value block can be compared with the nominal values in the workshop manual test table (Repair Group 01).**
The test table contains information on fault finding in case of deviations.

**Note:**
In Function 04 the tank ventilation system is switched off in order to be able to check lambda control.

Later it will be possible to have a standard measured value output in 4-value blocks in Functions 04 and 08. Then two 4-value blocks can be selected in Function 04 and nine 4-value blocks in Function 08.

## Function 03 – Final Control Element Diagnosis

Final control element diagnosis is provided to check the mechanical motion and electrical wiring of final control elements.
This function can only be carried out with the **engine stopped and ignition switched on**.

After initiation of final control element diagnosis the Motronic control unit is induced to activate the final control elements in the given sequence with electric test pulses.

Operation of final control elements is checked accoustically. Consequently ambient noise must be avoided as the switching noise is quiet and brief.

**Attention:**

Refer to the workshop manual for precise final control element diagnosis procedures.

Switching noise is not guarantee for perfect component operation. Additional test might be necessary.

**Activation Sequence - 20V Engine**

4411 Injector for cyl. 1, N 30
4412 Injector for cyl. 2, N 31
4413 Injector for cyl. 3, N 32
4414 Injector for cyl. 4, N 33
4421 Injector for cyl. 5, N 83
4431 Idling speed stabilization valve, N 71
4343 Solenoid valve I for ACF, N 80
4442 Charge pressure control pulsing valve, N 75

**Activation Sequence - V8 Engine**

4411 Injectors for cyl. 1 + 5, N 30 + N 83
4412 Injectors for cyl. 2 + 7, N 31 + N 85
4413 Injectors for cyl. 3 + 6, N 32 + N 84
4414 Injectors for cyl. 4 + 8, N 33 + N 86
4421 Injectors for cyl. 5 + 1, N 83 + N 30
4422 Injectors for cyl. 6 + 3, N 84 + N 32
4423 Injectors for cyl. 7 + 2, N 85 + N 31
4424 Injectors for cyl. 8 + 4, N 86 + N 33
4431 Idling speed stabilization valve, N 71
4343 Solenoid valve I for ACF, N 80
4312 Pulsing valve for EGR, N 18
4334 Lambda probe heating relay, J 208

**Activation of Fuel Injectors in V8 Engine**

The fuel injectors are activated with test pulses in pairs for final control element diagnosis (refer to Activation Sequence).
The activation sequence is repeated a second time so that all fuel injectors can be checked.

If a pair of fuel injectors has been activated five times, the next pair of injectors is tested.

For precise diagnosis of separate fuel injectors, the plug of the second injector must be disconnected each time a pair of injectors is activated.

Example:
Injectors 1 + 5: injector for cylinder no. 5 disconnected – cylinder no. 1 is tested.
Injectors 5 + 1: injector for cylinder no. 1 disconnected – cylinder no. 5 is tested.

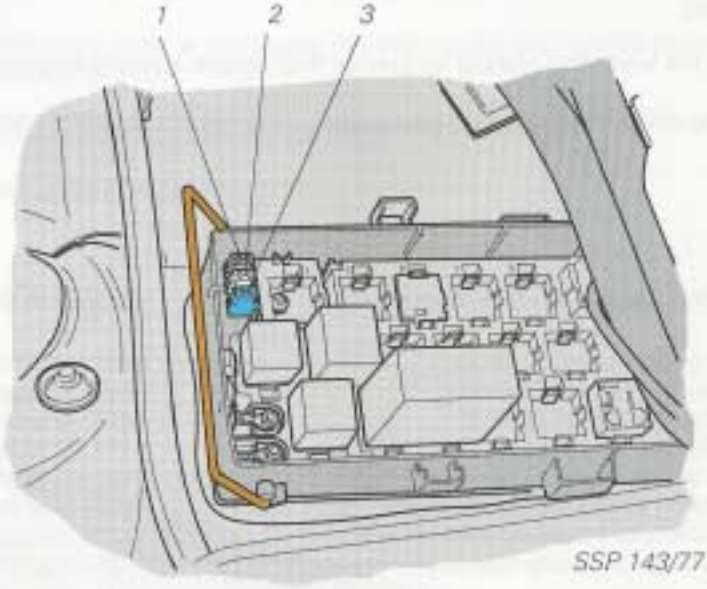
## Diagnostic Connector

The diagnostic connector serves as a diagnosing interface to permit rapid data transfer from the Motronic control unit to fault reader V.A.G 1551 and vice versa.

### 20V Engine

The diagnostic connector is located in the relay station in the water box at left-hand side as seen looking in forward direction.

1 = Power supply
2 = Rapid data transfer
3 = Flash code

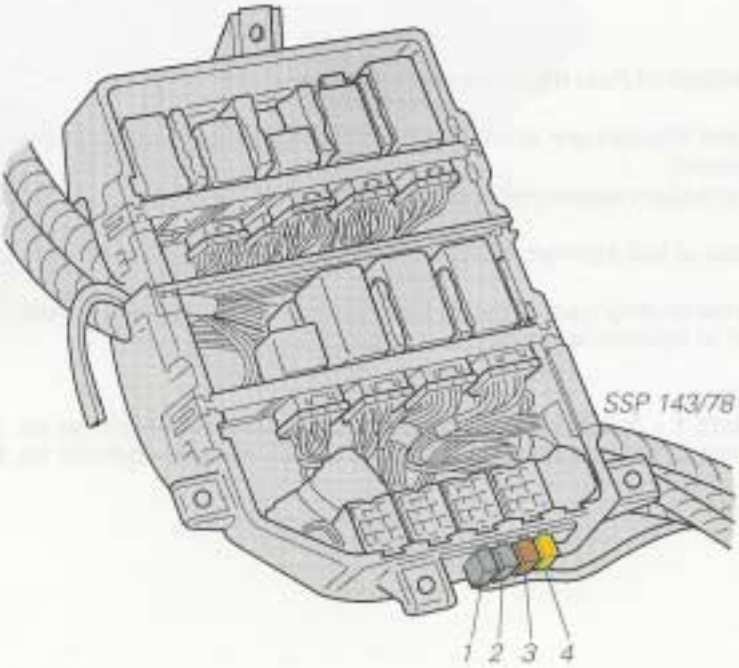


SSP 143/77

### V8 Engine

The diagnostic connector is located in the footwell at the passenger's side below the additional relay station.

1 = Power supply
2 = Rapid data transfer
3 = Dash panel insert
4 = Flash code



SSP 143/78

## 20V Engine

The reference list is a summary information and reference list with cross reference to page numbers. It is compiled according to pin numbers on the Motronic control unit in ascending sequence.

| Pin | Connected Component (Functional Diagram Symbols) | Information/Function for Motronic (Type of Signal: IN/OUT) | Page |
|---|---|---|---|
| 1 | Final output stage 1 - Pin I1 | Ignition signal for cylinder 1 (out) | 17 |
| 2 | Final output stage 1 - Pin I2 | Ignition signal for cylinder 2 (out) | 17 |
| 3 | Fuel pump relay (J 17) | Earth activation of relay (out) | 27 |
| 4 | ISS valve (N 71) - Pin 2 | Earth activation of ISS (out) | 23 |
| 5 | ACF solenoid valve I (N 80) - Pin 1 | Earth activation of tank ventilation (out) | 21 |
| 6 | Magnetic coupling control unit (J 153) | A/C compressor signal (in + out) | 58 |
| 7 | Air volume meter (G 70) - Pin 3 | Engine load (in) | 40 |
| 8 | Hall sender (G 40) - Pin S | Hall sender signal (in) | 42 |
| 9 | Altitude sender (F 96) - Pin 1 | Pressure altitude signal (in) | 56 |
| 10 | Lambda probe (G 39) | Earth for lambda probe (in) | 27 |
| 11 | Knock sensor I (G 61) - Pin 1 | Knock tendency for cylinders 1, 2, 3 (in) | 52 |
| 12 | Throttle valve potentiometer (G 69) - Pin 1,<br>Hall sender (G 40) - Pin +,<br>Altitude sender (F 96) - Pin 2,<br>Coding plug (T 6m) - Pin 3 | Power supply (out)<br>- " -<br>- " -<br>- " - | 27 |
| 13 | Diagnostic connector (L-wire) | Exciter wire signal (in) | 59 |
| 14 | Fuel injectors (N 30 to 83) | Power earth on intake manifold (out) | 25 |
| 15 | Not used | — | — |
| 16 | Fuel injector (N 83) - Pin 2 | Injection signal, cylinder 5 (out) | 15 |
| 17 | Fuel injector (N 31) - Pin 2 | Injection signal, cylinder 2 (out) | 15 |
| 18 | Motronic control unit (J 220) | Permanent positive, terminal 30 (in) | 27 |
| 19 | Electronics, sensors, screenings | Electronic earth on intake manifold (out) | 25 |
| 20 | Final output stage 2 - Pin I1 | Ignition signal for cylinder 4 (out) | 15 |
| 21 | Final output stage 2 - Pin I2 | Ignition signal for cylinder 5 (out) | 15 |
| 22 | Diagnostic connector (lamp wire) | Flash code output, US Version (out) | 59 |
| 23 | Final output stage 1 - Pin I3 | Ignition signal for cylinder 3 (out) | 15 |
| 24 | Actuators other than fuel injectors | Power earth on intake manifold (out) | 25 |
| 25 | Air volume meter (G 70) - Pin 4 | Burn-off signal for hot-wire (out) | 40 |
| 26 | Air volume meter (G 70) - Pin 2 | Reference voltage, earth (in) | 40 |
| 27 | Motronic control unit (J 220) | Power supply, terminal 15 (in) | 27 |
| 28 | Lambda probe (G 39) | Mixture composition (in) | 54 |
| 29 | Knock sensor II (G 66) - Pin 1 | Knock tendency for cylinders 4, 5 (in) | 52 |
| 30 | Knock sensor I (G 61) - Pin 2,<br>Knock sensor II (G 66) - Pin 2,<br>Altitude sender (F 96) - Pin 3,<br>Throttle valve potentiometer (G 69) - Pin 2,<br>Coolant temperature sender (G 62) - Pin 2, | Sender earth (out)<br>- " -<br>- " -<br>- " -<br>- " - | 27 |

## 20V Engine (continued)

| Pin | Connected Component (Functional Diagram Symbols) | Information/Function for Motronic (Type of Signal: IN/OUT) | Page |
|---|---|---|---|
| 30 | Intake air temperature sender (G 42) - Pin 2, Coding plug (T 6m) - Pin 4 | Sender earth (out) - " - | 27 |
| 31 | On-board computer - Pin 15, Control unit (J 217) - Pin 21 | Consumption signal (out) - " - | 59 |
| 32 | On-board computer - Pin 9 | Charge pressure signal (out) | 27 |
| 33 | CPC pulsing valve (N 75) - Pin 2 | Earth activation of charge pres. contr. (out) | 19 |
| 34 | Fuel injector (N 32) - Pin 2 | Injection signal, cylinder 3 (out) | 15 |
| 35 | Fuel injector (N 33) - Pin 2 | Injection signal, cylinder 4 (out) | 15 |
| 36 | Fuel injector (N 30) - Pin 2 | Injection signal, cylinder 1 (out) | 15 |
| 37 | Air volume meter (G 70) - Pin 5, Fuel injectors (N 30 to N 83) - Pin 1 and other actuators (ACF, CPC, ISS) | Power supply with ignition "ON" (out) - " - | 63 |
| 38 | Coding plug (T 6m) - Pin 1 | Version coding (in) | 27 |
| 39 | Coding plug (T 6m) - Pin 2 | Version coding (in) | 27 |
| 40 | Tachometer - Pin 12, Control unit (J 217) - Pin 3 | Speed signal (out) - " - | 60 |
| 41 | Air conditioner (manual/digital) | Air conditioner signal (in) | 60 |
| 42 | Selector lever switch (autom. gearbox) - Pin 4 | Driving range signal (in) | 61 |
| 43 | Not used | — | — |
| 44 | Intake air temperature sender (G 42) | Intake air temperature signal (in) | 48 |
| 45 | Coolant temperature sender (G 62) | Engine temperature signal (in) | 50 |
| 46 | Not used | — | — |
| 47 | Ignition timing sender (G 4) - Pin 2 | Ignition timing signal (in) | 44 |
| 48 | Ignition timing sender (G 4) - Pin 1, Engine speed sender (G 28) - Pin 1 | Sender earth (out) - " - | 27 |
| 49 | Engine speed sender (G 28) - Pin 2 | Speed signal (in) | 44 |
| 50 | Instrument cluster (G 68) - Pin 7 | Road speed signal (in) | 60 |
| 51 | Control unit (J 217) - Pin 32 | Shift point signal (in) | 62 |
| 52 | Idling switch (F 60) - Pin 6 | Idling recognition (in) | 46 |
| 53 | Throttle valve potentiometer (G 69) - Pin 3 | Throttle valve opening (in) | 46 |
| 54 | Control unit (J 217) - Pin 47 | Throttle valve potentiometer signal (out) | 62 |
| 55 | Diagnostic connector (K-wire) | Diagnostic signal (in + out) | 61 |

## V8 Engine

The reference list is a summary information and reference list with cross reference to page numbers. It is compiled according to pin numbers on the Motronic control unit in ascending sequence.

| Pin | Connected Component (Functional Diagram Symbols) | Information/Function for Motronic (Type of Signal: IN/OUT) | Page |
|---|---|---|---|
| 1 | Final output stage 1 - Pin 2 | Ignition signal for cylinders 1, 7, 6, 4 (out) | 39 |
| 2 | Not used | — | — |
| 3 | Fuel pump relay (J 17) | Earth activation of relay (out) | 39 |
| 4 | ISS valve (N 71) - Pin 2 | Earth activation of ISS (out) | 39 |
| 5 | ACF solenoid valve I (N 80) - Pin 1 | Earth activation of tank ventilation (out) | 39 |
| 6 | Magnetic coupling control unit (J 153) | A/C compressor signal (in + out) | 58 |
| 7 | Air volume meter (G 70) - Pin 3 | Engine load (in) | 40 |
| 8 | Hall sender (G 40) - Pin S | Hall sender signal (in) | 42 |
| 9 | Coding plug (T 6m) - Pin 3 | Version coding (in) | 39 |
| 10 | Lambda probe (G 39) | Earth for lambda probe (in) | 39 |
| 11 | Knock sensor I (G 61) - Pin 1 | Knock tendency for cylinders 1, 2, 3, 4 (in) | 52 |
| 12 | Throttle valve potentiometer (G 69) - Pin 1,<br>Hall sender (G 40) - Pin +,<br>Coding plug (T 6m) - Pin 3 | Power supply (out)<br>- " -<br>- " - | 39 |
| 13 | Diagnostic connector (L-wire) | Exciter wire signal (in) | 59 |
| 14 | Fuel injectors (N 30 to 86) | Power earth on intake manifold (out) | 37 |
| 15 | Fuel injector (N 30) - Pin 2 | Injection signal, cylinder 3 (out) | 31 |
| 16 | Fuel injector (N 86) - Pin 2 | Injection signal, cylinder 8 (out) | 31 |
| 17 | Fuel injector (N 83) - Pin 2 | Injection signal, cylinder 5 (out) | 31 |
| 18 | Motronic control unit (J 220) | Permanent positive, terminal 30 (in) | 39 |
| 19 | Electronics, sensors, screenings | Electronic earth on intake manifold (out) | 37 |
| 20 | Final output stage 2 - Pin 2 | Ignition signal for cylinders 5, 2, 3, 8 (out) | 39 |
| 21 | Pulsing valve for EGR (N 18) - Pin 2 | Earth activation of EGR, US Version (out) | 34 |
| 22 | Diagnostic connector (lamp wire) | Flash code output, US Version (out) | 59 |
| 23 | Lambda probe heating relay (J 208) | Earth activation of heating (out) | 32 |
| 24 | Actuators other than fuel injectors | Power earth on intake manifold (out) | 37 |
| 25 | Air volume meter (G 70) - Pin 4 | Burn-off signal for hot-wire (out) | 40 |
| 26 | Air volume meter (G 70) - Pin 2 | Reference voltage, earth (in) | 40 |
| 27 | Motronic control unit (J 220) | Power supply, terminal 15 (in) | 39 |
| 28 | Lambda probe (G 39) | Mixture composition (in) | 54 |
| 29 | Knock sensor II (G 66) - Pin 1 | Knock tendency for cylinders 5, 6, 7, 8 (in) | 52 |
| 30 | Knock sensor I (G 61) - Pin 2,<br>Knock sensor II (G 66) - Pin 2,<br>Idling switch (F 60) - Pin 4,<br>Throttle valve potentiometer (G 69) - Pin 2,<br>Coolant temperature sender (G 62) - Pin 2,<br>Intake air temperature sender (G 42) - Pin 2, | Sender earth (out)<br>- " -<br>- " -<br>- " -<br>- " -<br>- " - | 39 |

## V8 Engine (continued)

| Pin | Connected Component (Functional Diagram Symbols) | Information/Function for Motronic (Type of Signal: IN/OUT) | Page |
|---|---|---|---|
| 30 | EGR temperature sensor (G 98) - Pin 2,<br>Coding plug (T 6m) - Pin 5 | Sender earth, US Version (out)<br>Sender earth (out) | 39 |
| 31 | On-board computer - Pin 15,<br>Control unit (J 217) - Pin 21 | Consumption signal (out)<br>- " - | 59 |
| 32 | Fuel injector (N 31) - Pin 2 | Injection signal, cylinder 2 (out) | 31 |
| 33 | Fuel injector (N 85) - Pin 2 | Injection signal, cylinder 7 (out) | 31 |
| 34 | Fuel injector (N 84) - Pin 2 | Injection signal, cylinder 6 (out) | 31 |
| 35 | Fuel injector (N 33) - Pin 2 | Injection signal, cylinder 4 (out) | 31 |
| 36 | Fuel injector (N 30) - Pin 2 | Injection signal, cylinder 1 (out) | 31 |
| 37 | Air volume meter (G 70) - Pin 5,<br>Fuel injectors (N 30 to N 86) - Pin 1<br>and other actuators (ACF, CPC, ISS) | Power supply with ignition "ON" (out)<br>- " - | 63 |
| 38 | Coding plug - Pin 4 | Version coding (in) | 39 |
| 39 | Coding plug - Pin 1 | Version coding (in) | 39 |
| 40 | Tachometer - Pin 12,<br>Control unit (J 217) - Pin 3 | Speed signal (out)<br>- " - | 60 |
| 41 | Air conditioner (manual/digital) | Air conditioner signal (in) | 60 |
| 42 | Selector lever switch (autom. gearbox) - Pin 4 | Driving range signal (in) | 61 |
| 43 | Not used | — | — |
| 44 | Intake air temperature sender (G 42) - Pin 1 | Intake air temperature signal (in) | 48 |
| 45 | Coolant temperature sender (G 62) - Pin 1 | Engine temperature signal (in) | 50 |
| 46 | EGR temperature sensor (G 98) - Pin 1 | Exhaust temp. signal, US Version (in) | 36 |
| 47 | Ignition timing sender (G 4) - Pin 2 | Ignition timing signal (in) | 44 |
| 48 | Ignition timing sender (G 4) - Pin 1,<br>Engine speed sender (G 28) - Pin 1 | Sender earth (out)<br>- " - | 39 |
| 49 | Engine speed sender (G 28) - Pin 2 | Speed signal (in) | 44 |
| 50 | Instrument cluster (G 21) - Pin 7 | Road speed signal (in) | 60 |
| 51 | Control unit (J 217) - Pin 32 | Shift point signal (in) | 62 |
| 52 | Idling switch (F 60) - Pin 6 | Idling recognition (in) | 46 |
| 53 | Throttle valve potentiometer (G 69) - Pin 3 | Throttle valve opening (in) | 46 |
| 54 | Control unit (J 217) - Pin 47 | Throttle valve potentiometer signal (out) | 62 |
| 55 | Diagnostic connector (K-wire) | Diagnostic signal (in + out) | 61 |

# Personal Notes

100.2809.61.20 Technical state as at: 12/91

This paper is made of bleached pulp free from chlorine.