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Audi

The New 20V Turbo Engine
for the
Audi 200 Quattro

Service Training
Self-Study Information

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Always check P-circulars and the microfiche system for information that may supersede any information included in this booklet.

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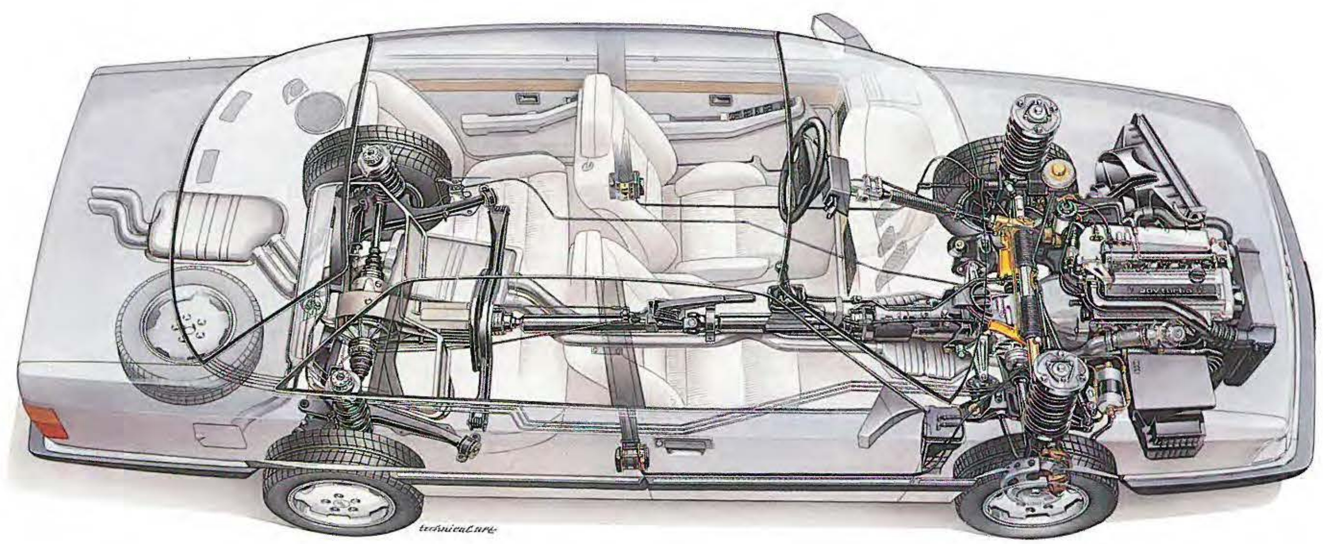
Introduction

Audi is introducing a new engine for the 1991 200 Quattro. The engine is a 20-valve 5-cylinder turbo with Motronic Engine Management System.

The new engine is based on the 5-cylinder 2.2 liter. Its main features are a water-cooled turbo and 20-valve cylinder head. The engine can deliver maximum torque of 228 foot-pounds at 1,950 rpm and peak power of 217 HP is obtained at 5,700 rpm.

With the maximum torque developed at 1,950 rpm, turbo lag has been reduced to a point where the engine's performance range is similar to that of a normally aspirated engine.

The suspension, brakes, and wheels and tires for the 200 Quattro 20-Valve Turbo are the same as the Audi V8.



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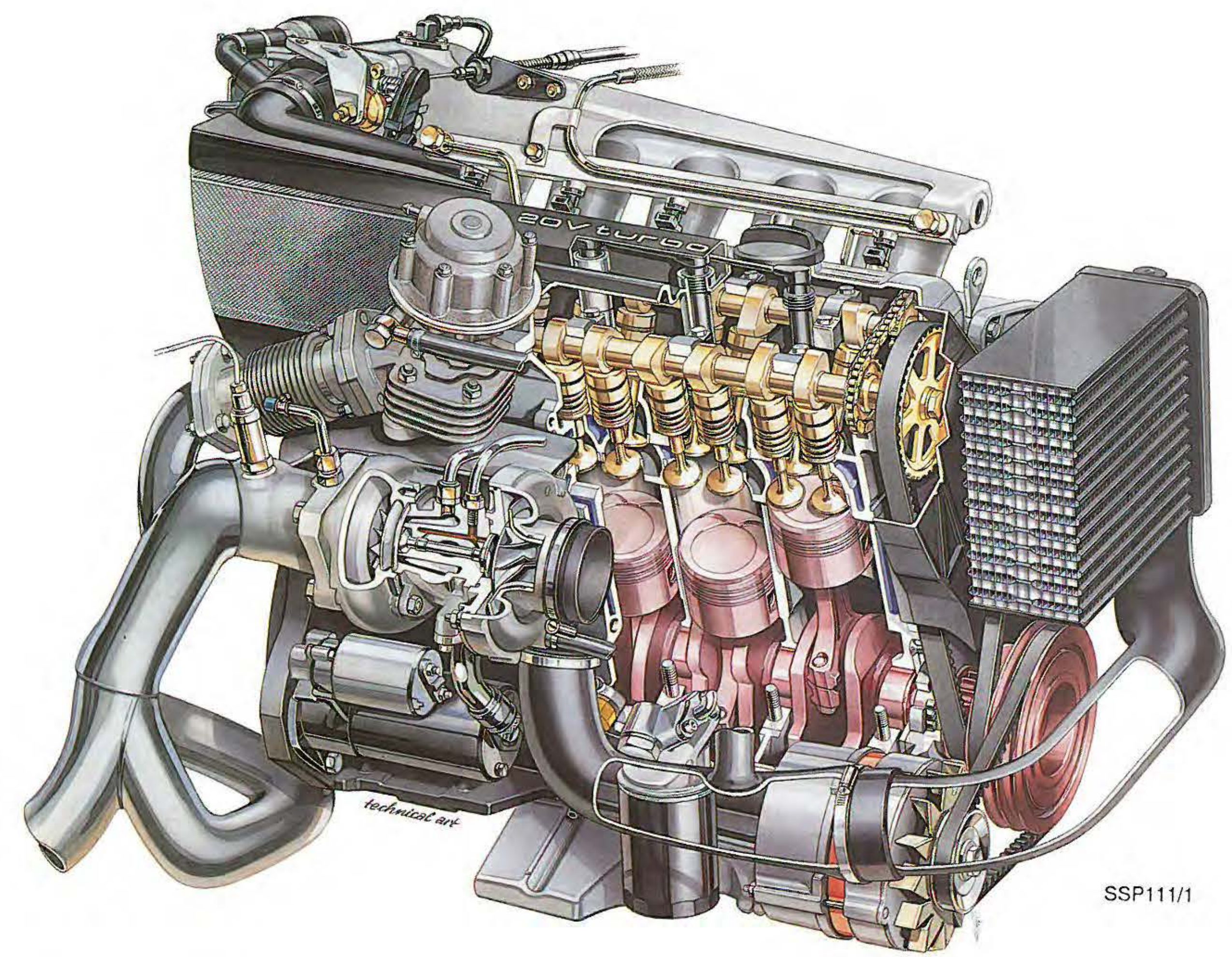
20V Turbocharged Engine



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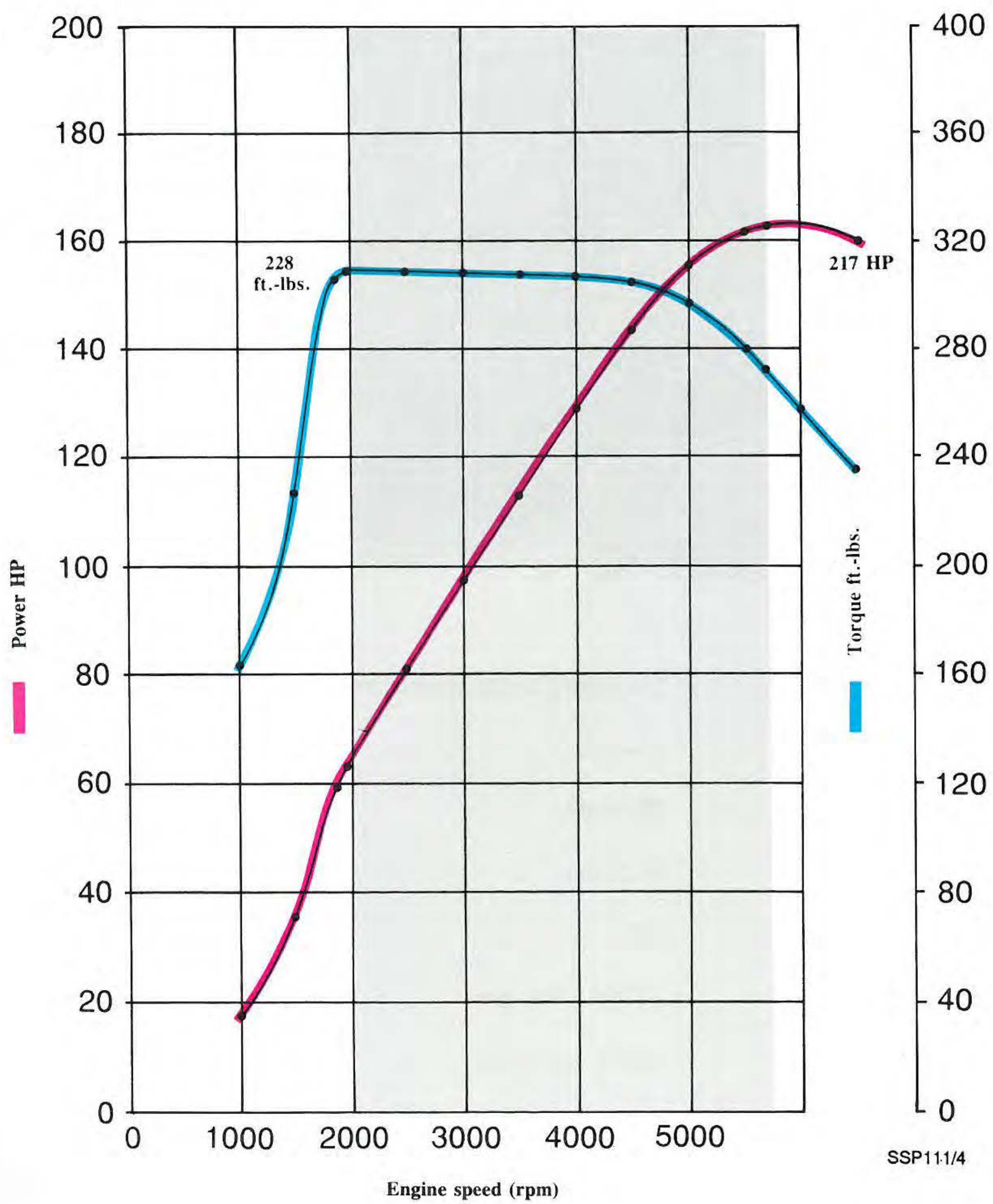
Technical Data

Type:	5-cylinder in-line turbocharged engine with 4 valves per cylinder
Displacement:	2226 cc
Stroke:	86.4 mm
Bore:	81.0 mm
Compression:	9.3:1
Horsepower:	217 @ 5,700 rpm
Maximum torque:	228 @ 1,950 rpm
Engine Management System:	Motronic

Performance And Torque

The five-cylinder turbocharged 20V engine develops its maximum torque of an impressive 228 ft.-lbs. at the unusually low engine speed of 1,950 rpm, while the maximum power output of 217 HP is reached at 5,700 rpm. This results in an extremely wide, engine power range.



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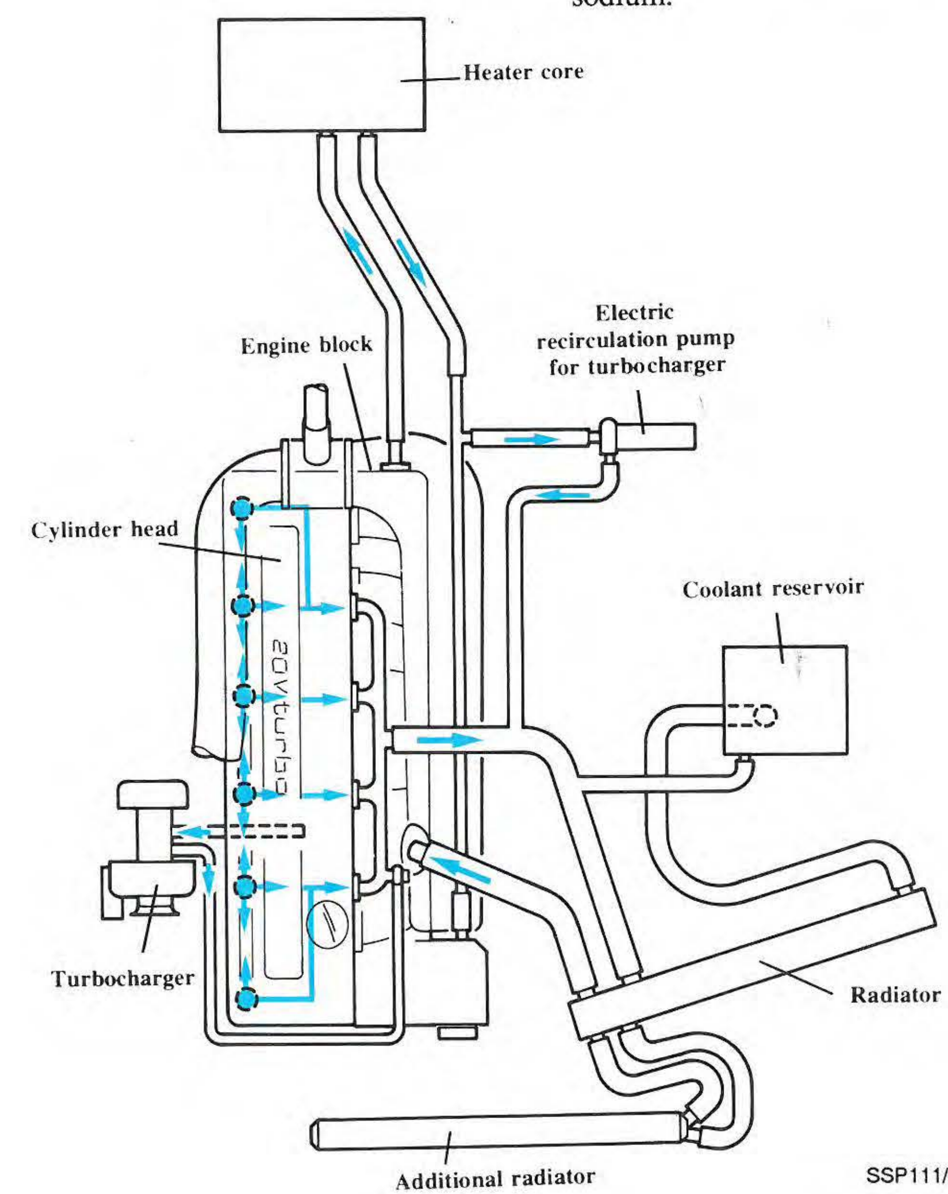
Cooling System

A new feature is the cross-flow cooling system for the cylinder head. The coolant enters the cylinder head on the exhaust side and exits on the intake side. This ensures uniform cooling of all cylinders and all combustion chambers.

Special control ribs in the water ducts ensure proper cooling of hot spots around valve seats and the areas around the spark plugs.

In addition to the above cooling, oil spray jets are located at the bottom of each cylinder bore to cool the pistons, and the exhaust valves are filled with sodium.



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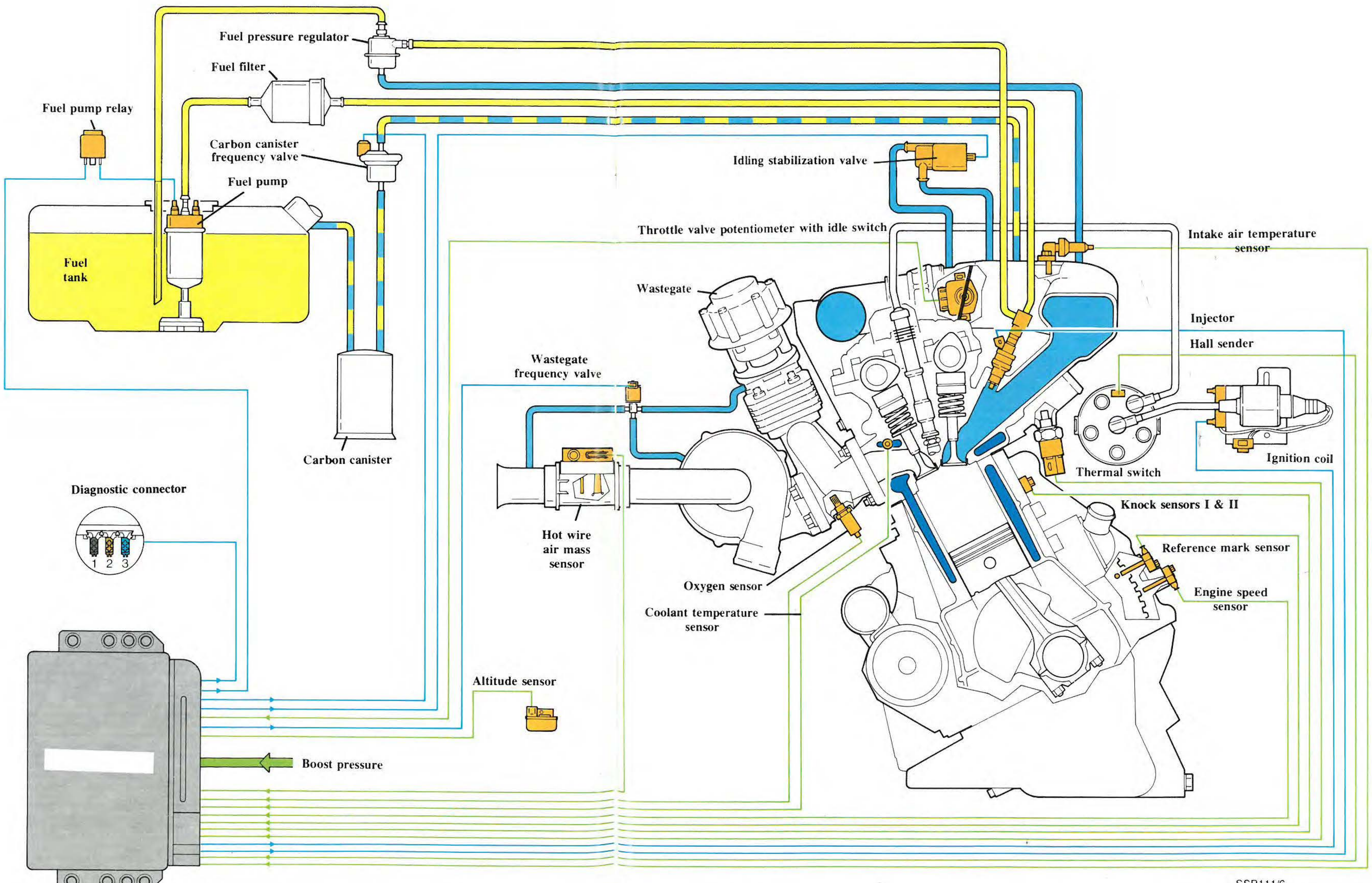
System Layout



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Motronic Control Unit

The Motronic control unit performs the following functions:

Sequential fuel injection
- Basic fuel mixture control via map in the ECU's memory
- Starting enrichment
- After-start enrichment
- Warm-up enrichment
- Acceleration enrichment
- Deceleration fuel shut-off
- Engine speed limitation
- Oxygen sensor control

Ignition timing control
- Basic timing control via an ignition map in the ECU's memory
- Dwell angle control
- Ignition timing correction based on air temperature
- Start control
- Warm-up correction
- Digital idle stabilization
- Cylinder-selective knock control

Boost pressure control
- Boost pressure control via map in the ECU's memory
- Altitude correction

Idle stabilization
- Idle speed control via map in the ECU's memory with adaptive learning capability
- Starting correction
- Idle speed increase with A/C

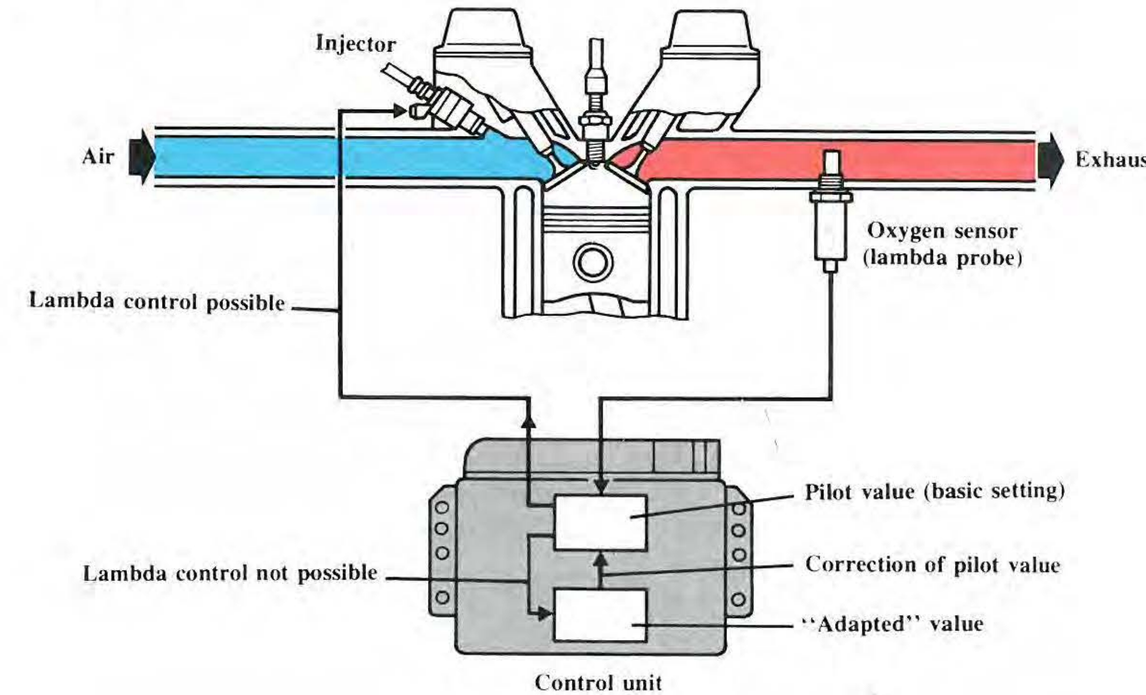
Fuel tank ventilation
- Fuel tank vapor flow controlled via map inside ECU
- Frequency valve operation controlled via map inside ECU

Self-Diagnosis
- Monitor sensor inputs
- Monitor outputs
- Fault output via V. A. G 1551
- Display individual values via V. A. G 1551
- Perform output checks
- Emergency mode operation

Adaptive Learning

A system is said to be adaptive when it is capable of replacing standard control values with modified values due to changes in operating conditions.

Adaptation by way of example of the lambda (oxygen) control system:



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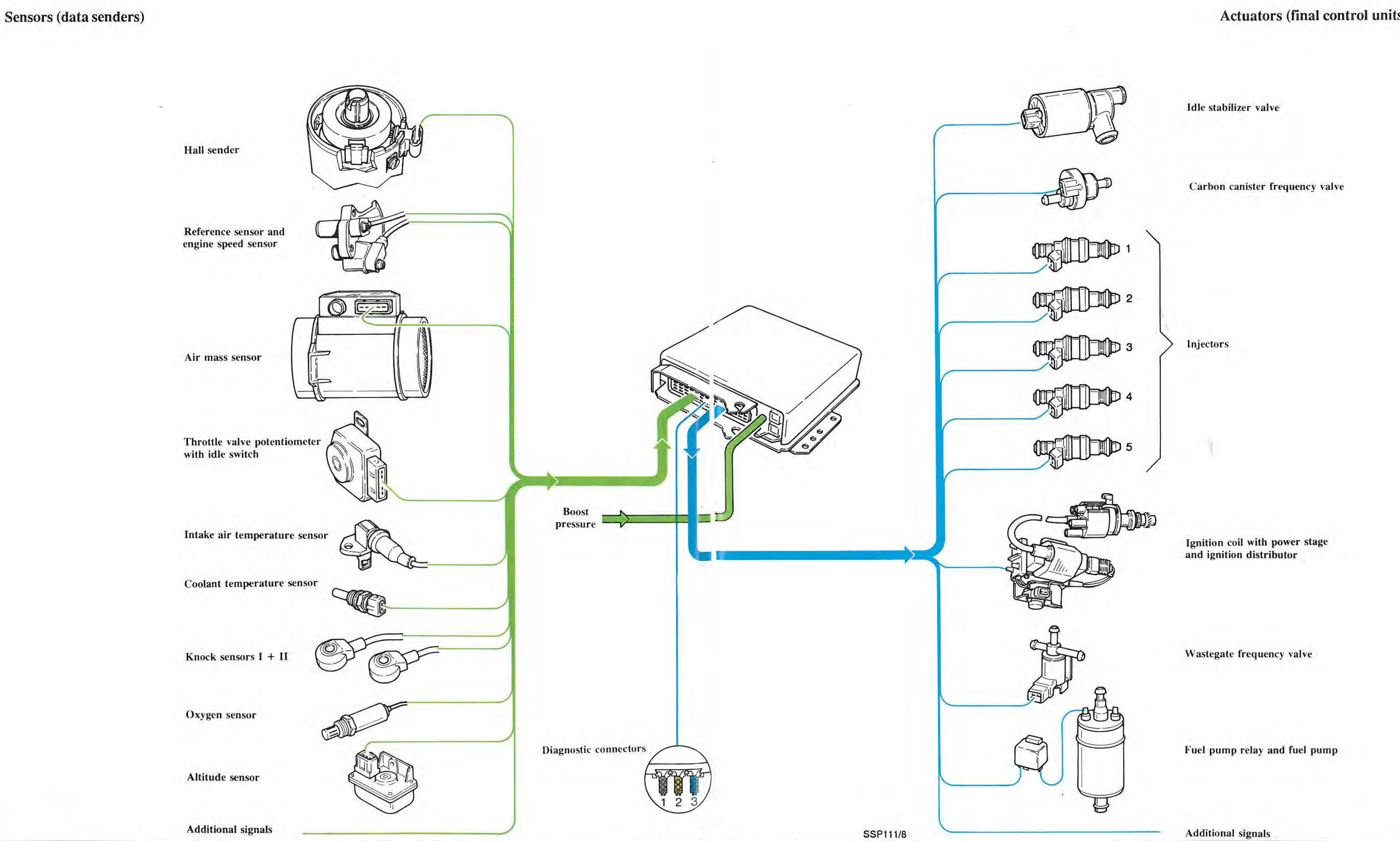
For example:

When the oxygen sensor senses that the fuel mixture is too rich, the control unit changes the fuel mixture to a leaner value by shortening the injector opening time.

If the mixture is still too rich and the control unit's rich limit is exceeded, the control unit will adapt to this condition and establish a new basic setting. This new basic setting (pilot valve) will then be used in both open and closed loop engine operation. This eliminates the need for periodic CO adjustments.

System Diagram



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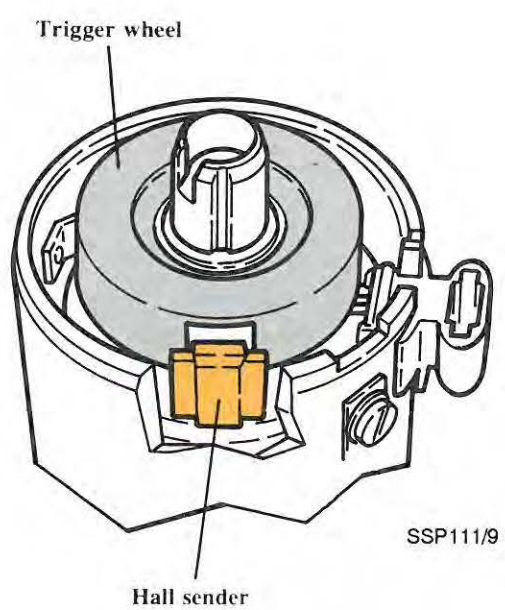
Hall Sender (G 40)



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The Hall sender and trigger wheel are located in the distributor. The trigger wheel has a 40° wide opening (Hall window).

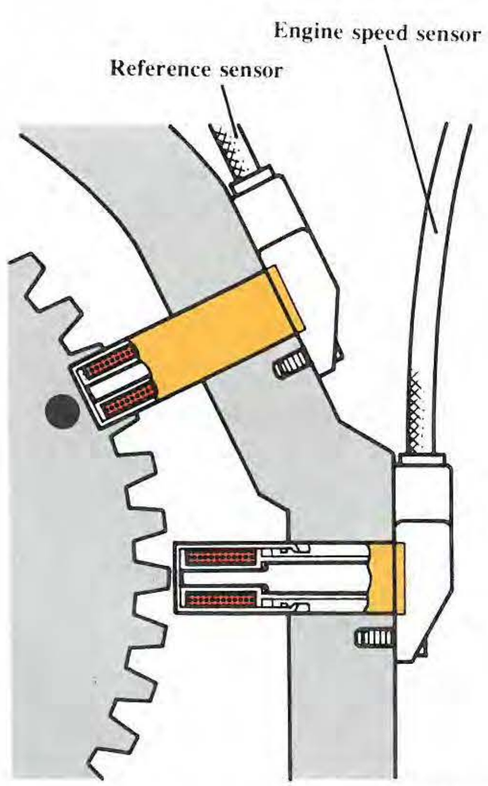
The signal that the Hall sender provides is used to:

- Ignition firing point signal for #1 cylinder when engine is first started
- Determine injection timing and sequence
- Cylinder reference signal for knock sensors

Substitute function

If the Hall sender fails, the engine cannot be restarted. If the Hall sender fails when the engine is running, the engine will continue to run by using the reference sensor and engine speed sensor signals, but the ignition timing is retarded 6°.

Reference Mark (G 4) and Engine Speed Sensors (G 28)



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Both sensors are identical in design and are located on the left side of the engine compartment, near the flywheel.

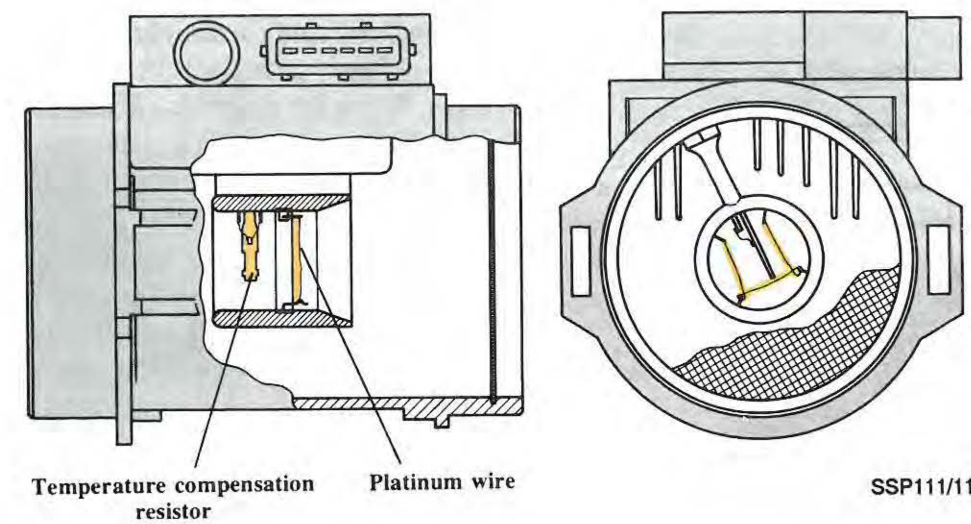
The reference sensor is used by the control unit to identify crankshaft position. A steel pin is pressed into the flywheel 62° before TDC for #1 cylinder. The pin, along with the sensor, generates one signal per crankshaft revolution.

The speed sensor produces an AC voltage signal by scanning the teeth of the flywheel. This signal is used by the control unit to measure engine speed.

Substitute function

If either of the sensors fail, the engine cannot be started. However, if the reference sensor fails when the engine is running, the system will use the #1 cylinder signal that was used when the engine was started.

Air Mass Sensor (G 70)



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A hot wire air mass sensor is located ahead of the turbocharger and is mounted to the air filter housing. The sensor is used to measure the air flow into the engine. The sensor uses a glass-coated, thin platinum wire to measure the air flow, and contains no moving parts.

The sensor uses a baffle screen to reduce air turbulence at the measuring point.

The platinum wire inside the sensor is heated electrically. An air temperature sensor is used to determine the amount of current to heat the platinum wire.

As air flows over the heated wire, the wire is cooled, which changes the resistance of the wire. The Motronic control unit uses this resistance change to calculate air flow volume and air density.

In this way, the actual volume of air is calculated by its weight or mass. This measurement will not require any additional corrections because it already accounts for any possible changes in air temperature and/or air pressure.

Since contamination of the hot wire surface can cause inaccurate readings, the hot wire is heated electrically to a temperature of 1,000°C (1,810°F) for one second each time the engine is switched off. This is to burn off any possible contamination.

The burn-off signal is provided by the Motronic control unit. Due to this fact, it is important to remember that the connector plug for the Motronic control unit must not be removed before 20 seconds has elapsed after the ignition has been switched off.

No repairs can be performed to the air mass sensor.

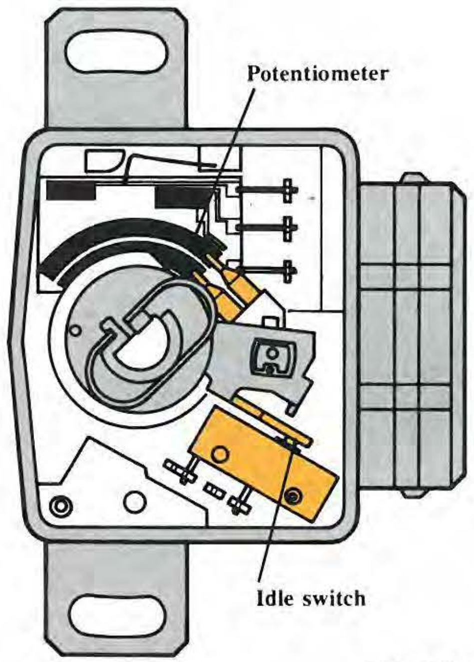
Substitute function

If the air mass sensor should fail, the engine will continue to run under two conditions.

When the throttle is closed (idle switch closed), the engine runs at the idle ignition timing map and a preprogrammed amount of air.

When the idle switch is opened (part load), the ignition timing goes to a fixed position of 20° and the fuel mixture is leaned. This allows the vehicle to be driven to the closest dealer.

Throttle Valve Potentiometer (G 69) With Idle Switch (F 60)



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An idle switch and throttle valve potentiometer are used on the throttle assembly. The idle switch closes at approximately 1.3° before the throttle plate closes. When the switch is closed, this signal is used to activate the following functions:

- Idle stabilization
- Deceleration fuel shut-off with engine warm and above 1,400 rpm. Fuel supply is reactivated when the engine speed falls below 1,200 rpm
- Special ignition map for deceleration

The throttle potentiometer is connected to the throttle shaft and is supplied 5 volts. The signal it provides is used to determine the position of the throttle plate and the speed of the throttle plate movement.

The throttle valve potentiometer is only used for boost regulation. The throttle valve position is a reference value for the boost control map. Boost regulation will take place when the throttle plate is open greater than 35°.

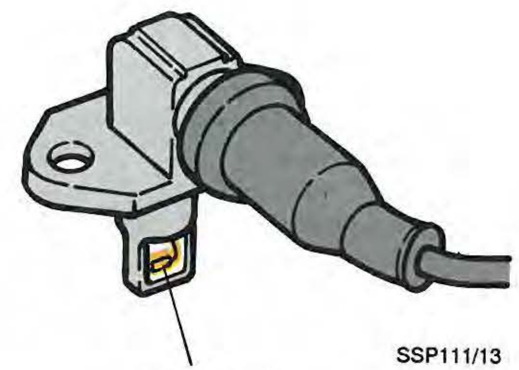
The Motronic system does not use a full throttle switch. The control unit detects full load on the relationship of engine load to engine speed.

Substitute function

If the idle switch should fail, the idle stabilization system will not operate.

If the potentiometer should fail, boost pressure is controlled mechanically by the wastegate at a lower value than what is programmed in the ECU.

Intake Air Temperature Sensor (G 42)



SSP111/13

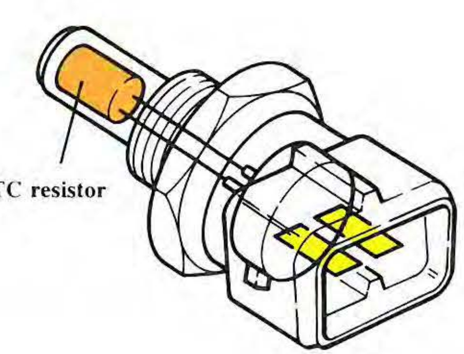
An intake air temperature sensor is located in the intake manifold near the throttle valve housing. It is used for ignition timing, knock regulation and boost pressure control. The sensor is a PTC resistor.

The ignition timing adapts to current intake air temperature. As the intake air temperature increases, the boost pressure is reduced to prevent detonation.

Substitute function

If the sensor should fail, the ignition timing is retarded and a replacement value of 40° C is used for boost regulation.

Coolant Temperature Sensor (G 62)



SSP111/4

A coolant temperature sensor is located at the back of the cylinder head. It is an NTC resistor.

The sensor is used for ignition timing, injection timing during cold and hot starting, warm-up enrichment and idle stabilization.

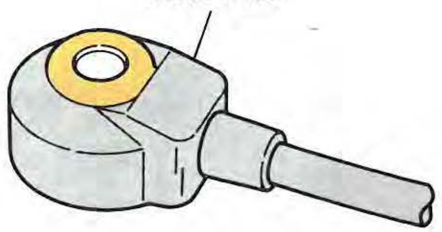
Substitute function

If the coolant temperature sensor should fail, a substitute value is used based on a signal from the air temperature sensor.

For example:

- Air temperature greater than 0° C (32°F) - the substitute value is 80°C (176°F)
- Air temperature less than 0°C - the substitute value is the intake air temperature for three minutes and then switched to 80°C

Knock Sensor I (G 61) And Knock Sensor II (G 66)



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The 20-Valve turbo uses two knock sensors. Knock sensor I is located next to cylinder #2 and is used for cylinders #1, #2 and #3. Knock sensor II is located next to cylinder #4 and is used for cylinders #4 and #5.

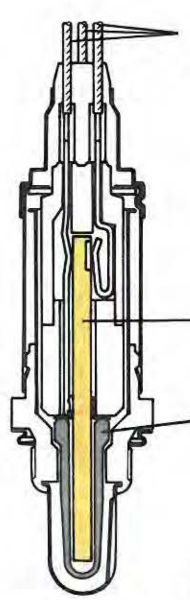
The use of two knock sensors makes it possible for the system to be more sensitive to knock.

If knocking is detected for an extended period of time, the ignition timing is retarded and the boost pressure is reduced.

Substitute function

If knock sensor I should fail, the ignition timing for cylinders #1, 2 and 3 will be retarded by 6°. If knock sensor II should fail, the ignition timing will be retarded by 6° for cylinders #4 and 5.

Oxygen Sensor (G 39)



SSP111/16

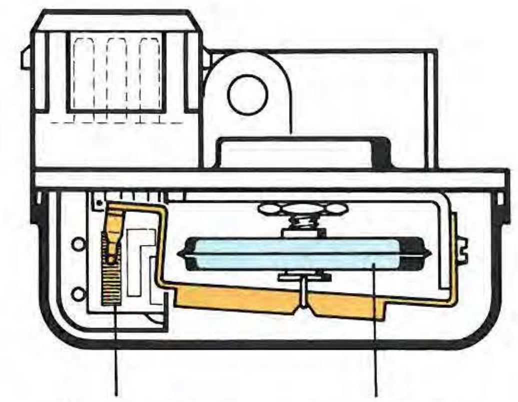
A heated oxygen sensor is used for this system. The sensor is located in the exhaust outlet of the turbocharger.

The sensor measures oxygen content in the exhaust gas and is used to regulate the air/fuel mixture.

Substitute function

If the sensor should fail, the engine will run on the adapted fuel mixture at the point of failure.

Altitude Sensor (F 96)



SSP111/17

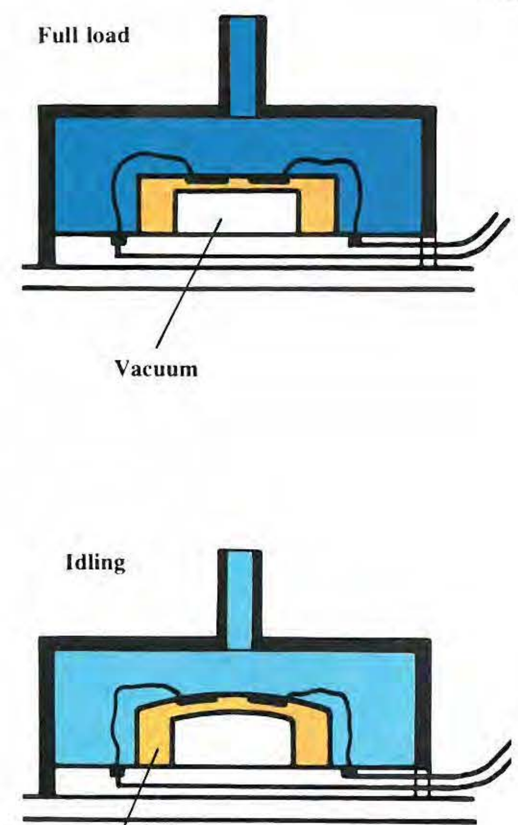
The altitude sensor is located behind the left kick panel, near the "A" pillar. When there is a change in the air pressure, the barometric cell moves a sliding contact over the set of resistors. This informs the control unit of the current air pressure or altitude.

The altitude sensor is only used for boost pressure control. At altitudes above 3,300 feet, the boost pressure is reduced as the altitude is increased. The reason for this is to avoid overrevving of the turbocharger.

Substitute function

If the sensor should fail, an altitude of 13,124 feet is assumed and the boost pressure is reduced to its minimum level.

Intake Manifold Pressure Sensor (G 71)



SSP111/18

An intake manifold pressure sensor is used to measure the amount of boost pressure in the intake manifold. The sensor is located inside the Motronic ECU.

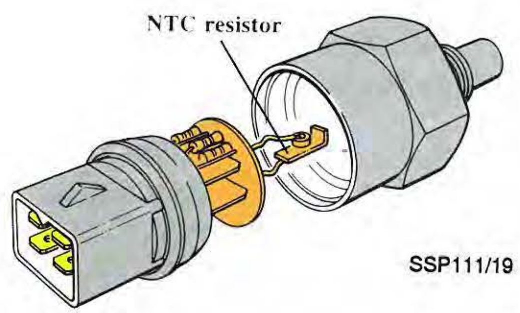
A vacuum line from the intake manifold to the control unit is used to transmit the manifold pressure signal. The ECU converts this signal into an electrical signal.

The sensor consists of a crystal chip and two semi-conductors. The crystal is shaped in such a way that it allows a small amount of vacuum to be trapped between the base plate and the crystal.

The crystal will flex depending on the amount of manifold pressure. The two semi-conductors attached to the top of the crystal sense the flexing.

The flexing of the chip causes the semi-conductors to alter their shape. This changes the resistance values of the semi-conductors. The change in resistance values is used by the control unit to determine the amount of boost pressure.

Multi-Function Temperature Sensor (F 76)

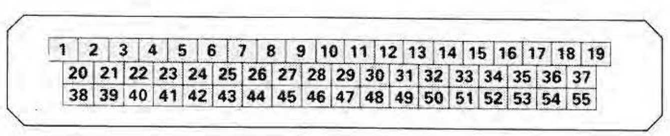


SSP111/19

The multi-function temperature sensor is located in the coolant flange on the cylinder head. This sensor has several functions:

- When coolant temperature exceeds 119°C (245°F), the boost pressure is reduced
- Engine temperature gauge
- Engine temperature warning light
- Climate control compressor clutch operation

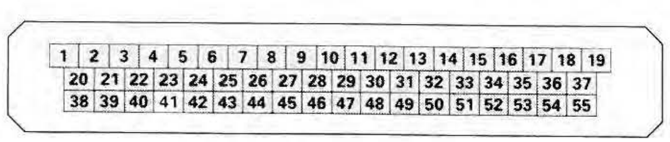
Additional Signal: A/C Compressor ON/OFF Signal



Pin #40 at control unit

When the A/C compressor is switched on, a signal is sent to the Motronic control unit via pin #40 of the ECU. This signal is used to increase the rest position (closing value) for the idle stabilizer valve when the idle switch is open. This function reduces load slap caused by the A/C compressor.

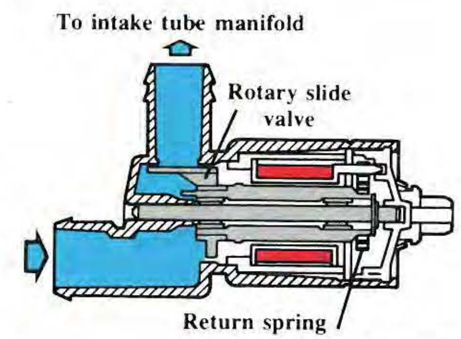
Additional Signal: A/C Compressor Idle Speed Increase Signal



Pin #41 at control unit

When the A/C is switched on, pin #41 of the ECU receives a signal that the A/C is on. This increases the duty cycle to the idle stabilizer and raises the idle speed.

Idle Stabilizer Valve (N 71)



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The idle stabilizer valve for the 20-Valve turbo is a single winding, rotary-type.

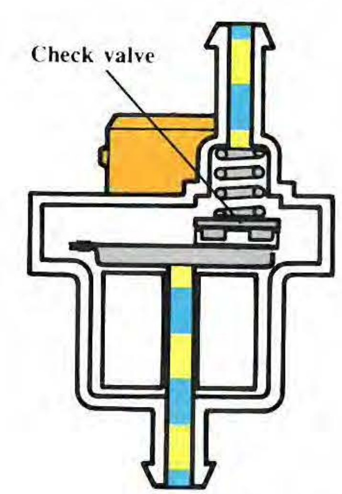
The idle stabilizer consists of a small single winding electric motor, rotary valve and a return spring attached to the motor's armature.

The motor is operated by a cycled DC voltage which will cause the armature to work against the return spring. The duty cycle determines the position of the rotary valve and the size of the opening.

Substitute function

If the valve should fail, the engine runs with a constant quantity of air at idle, which is the same idle speed as if the valve was unplugged electrically.

Carbon Canister Frequency Valve (N 80)



SSP111/21

Vapors from the fuel tank are collected in the carbon canister. A frequency valve is used to regulate the flow of fuel vapors that are drawn into the intake manifold from the carbon canister.

The frequency valve is operated by the Motronic control unit. The valve is controlled by a duty cycle. The valve's duty cycle will vary depending on engine temperature, load and speed.

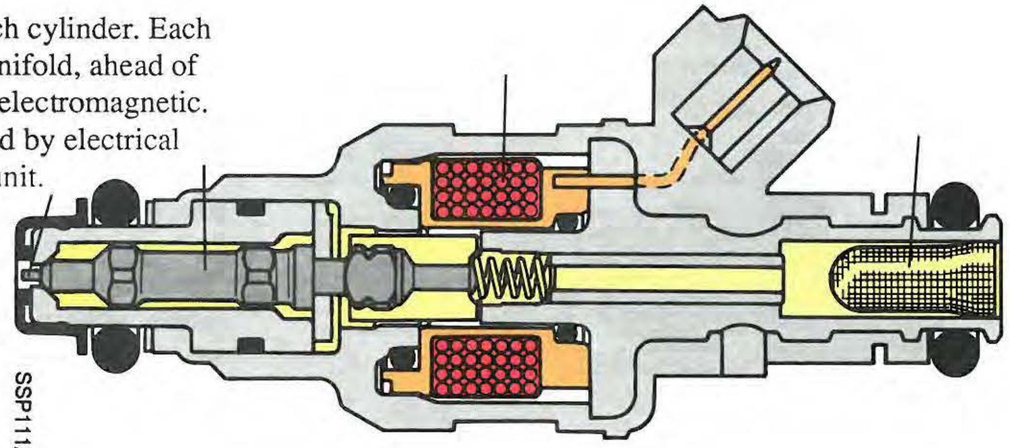
When the engine is off, a check valve stops the flow of vapors from entering the engine.

Substitute function

If power to the frequency valve is interrupted or cut off completely when the engine is running, vacuum from the engine will open the check valve to allow tank ventilation.

Fuel Injectors (N 30, N 31, N 32, N 33, N 83)

One fuel injector is assigned to each cylinder. Each injector is located in the intake manifold, ahead of the intake valve. The injectors are electromagnetic. The injectors are opened and closed by electrical pulses from the Motronic control unit.



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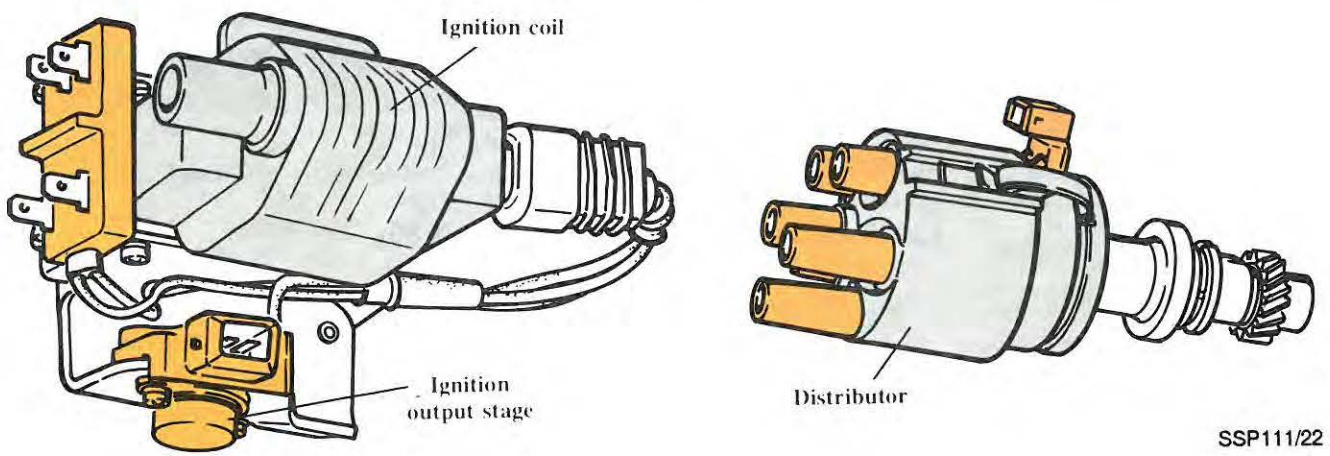
Ignition Coil (N), Ignition Output Stage (N 70) and Distributor (0)



SSP111/22

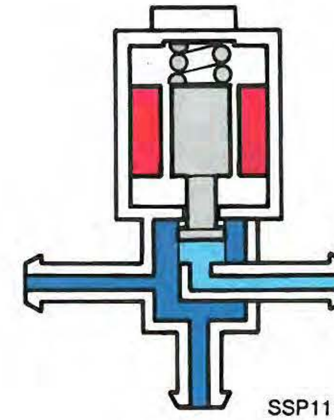
An ignition coil with a separate power stage is used with the Motronic system. The power stage is a Darlington-type of transistor which switches the primary current for the ignition coil on and off.

The power stage completes a ground circuit for terminal #1 of the ignition coil when it receives a voltage signal from the Motronic control unit.

The distributor is mounted on the end of the cylinder head and is driven by the intake camshaft.

Sensors, Actuators

Wastegate Frequency Valve (N 75)



SSP111/23

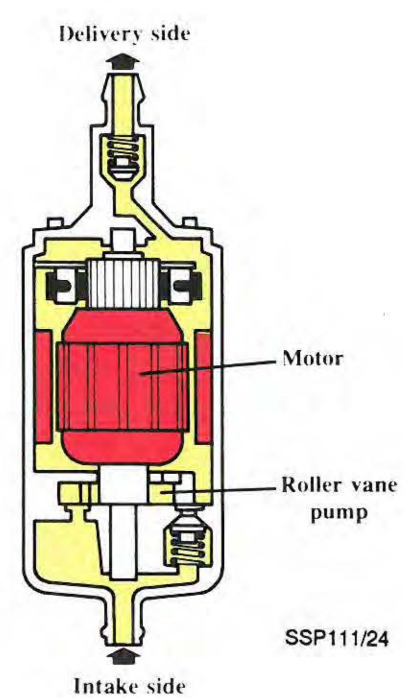
The wastegate frequency valve is located near the turbocharger and intake air duct and regulates the flow of intake manifold pressure to the wastegate. It is operated by the Motronic control unit.

The frequency valve is operated by a duty cycle of 0-100%. By regulating the frequency valve's duty cycle, the control unit can regulate the boost pressure to match the predetermined value from the map in the control unit.

Substitute function

If the wastegate frequency valve should fail, the boost pressure is controlled at a lower value mechanically by the wastegate.

Fuel Pump Relay (J 17) And Fuel Pump



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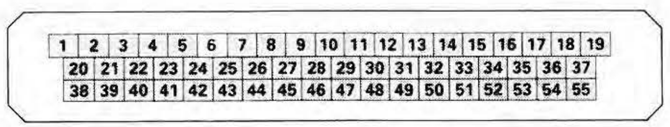
The fuel pump is located in the fuel tank. The fuel pump is activated by the fuel pump relay. The Motronic control unit supplies a ground signal to the fuel pump relay when the engine speed is greater than 25 rpm.

Sensors, Actuators

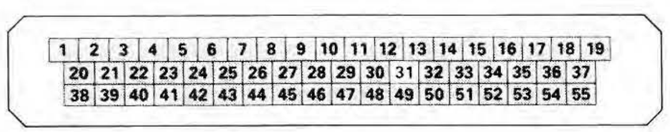
Additional Signal: Tachometer/Trip Computer



Pin #6 at control unit

The control unit supplies an engine speed signal for the tachometer and the trip computer.

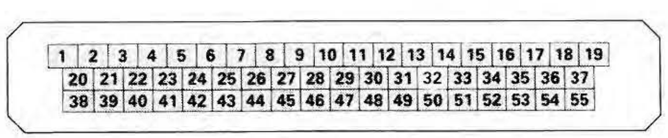
Additional Signal: Boost Pressure Indicator



Pin #31 at control unit

The control unit provides an analog signal to the trip computer for boost pressure indication.

Additional Signal: Fuel Consumption

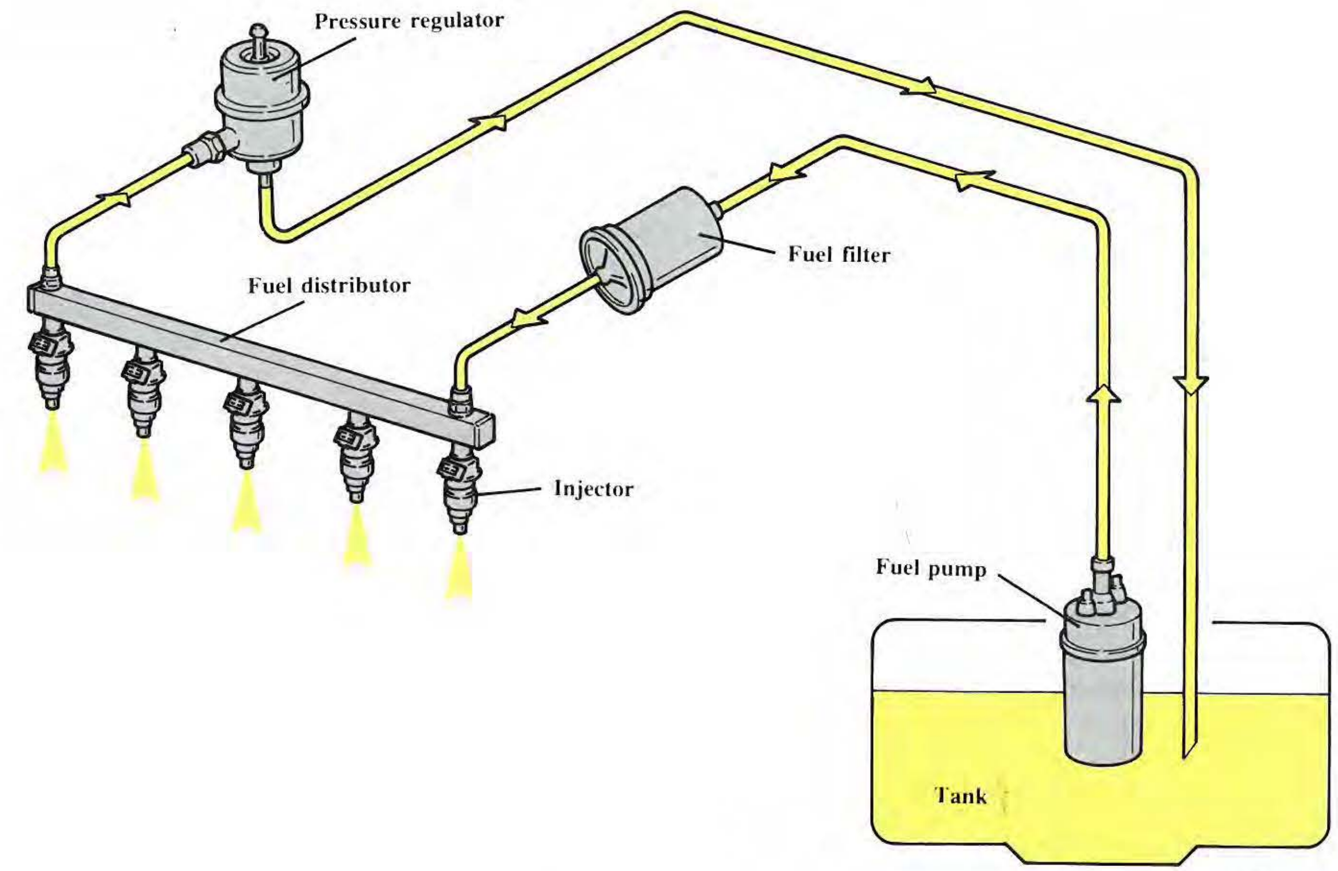


Pin #32 at control unit

The control unit provides a fuel consumption signal for the trip computer. This signal is calculated directly from the injection timing.

Fuel System

The fuel pump located in the fuel tank delivers the fuel to the injectors via the fuel filter. The fuel returned from the injectors is routed through the fuel pressure regulator.



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Fuel Pressure Regulator

Fuel pressure is regulated by a diaphragm-type pressure regulator. The pressure regulator maintains the fuel pressure at approximately 3 bar (43.5 psi) above intake manifold pressure.

A vacuum line from the intake manifold to the pressure regulator is used to transmit the varying intake manifold pressures.

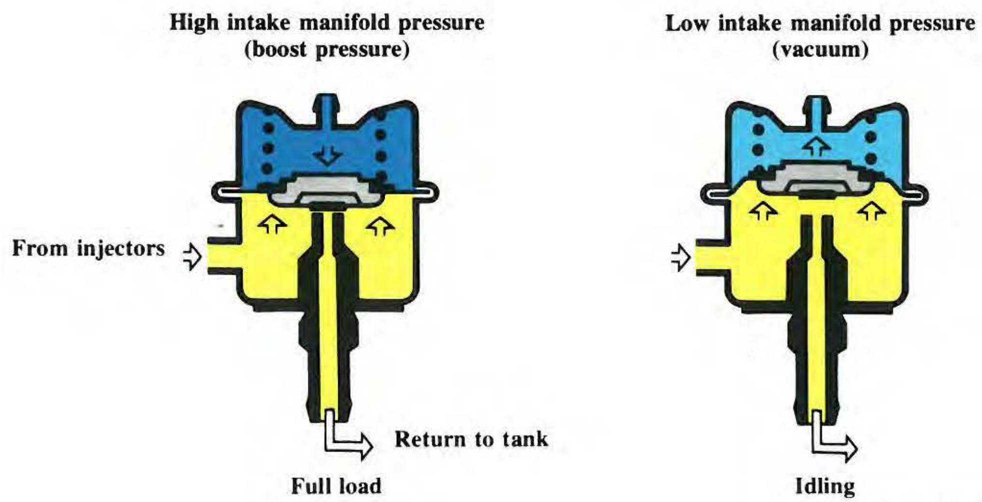
For example:

At idle, only a small quantity of fuel is needed to maintain engine operation. Vacuum from the intake manifold is applied to the diaphragm and spring in the pressure regulator which allows more fuel to return to the fuel tank to maintain correct fuel pressure.

When the engine is under full load, the fuel consumption is greater. Manifold pressure is increased due to boost pressure from the turbo. This pressure closes the diaphragm in the pressure regulator allowing less fuel to return to the fuel tank to maintain correct fuel pressure.

When the engine is switched off, the diaphragm in the pressure regulator is completely closed due to spring pressure. This creates a holding pressure between the pressure regulator and the fuel pump.

Pressure Regulator



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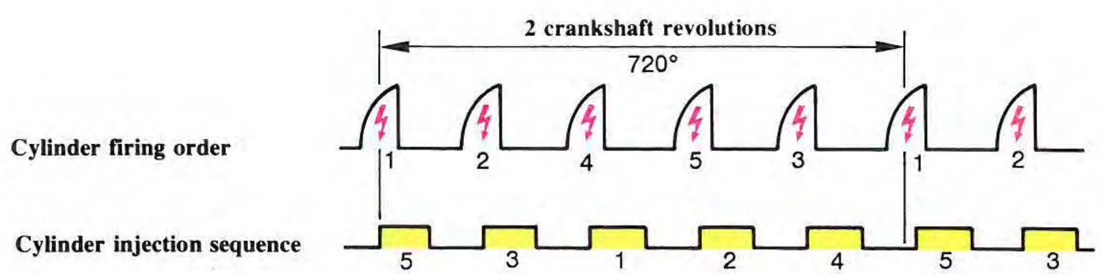
Sequential Injection

The Motronic Engine Management System uses sequential injection that is similar to the MPI system used on the 20-Valve Coupe and 90 Quattro.

The Motronic control unit triggers the fuel injectors sequentially in the firing order of the engine. Each injector is triggered 360° before the ignition firing point.

The control unit operates the injectors by completing a ground circuit. The fuel mixture is determined by the duration or length of time that the injectors are held open.



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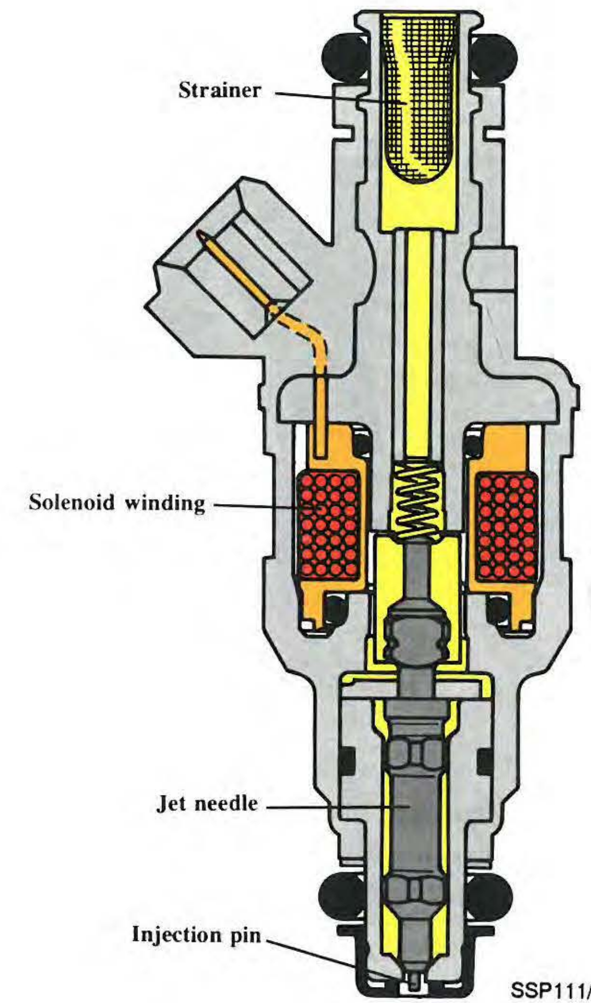
Injectors

The injectors for the Motronic system are a single jet nozzle-type. The injectors consist of a valve housing, needle jet and armature.



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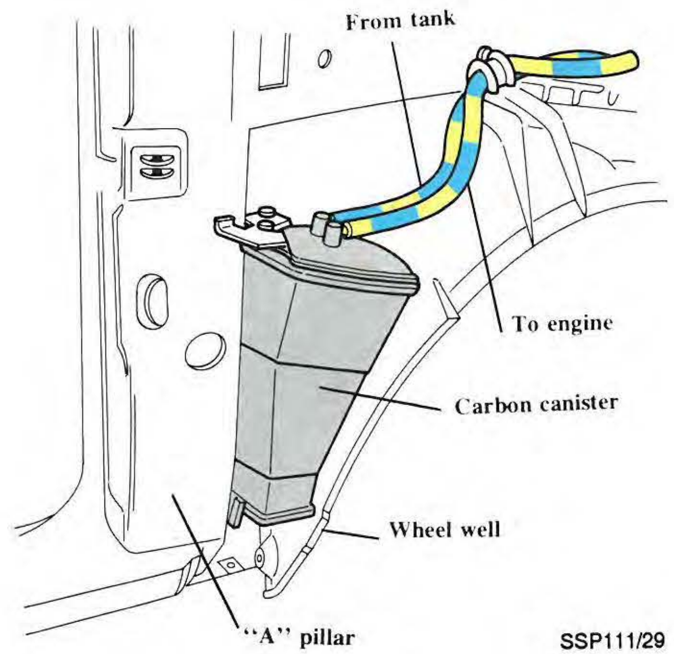
The housing contains the solenoid winding and the guide for the needle jet. When a ground is supplied to the solenoid winding, the needle jet is pulled away from the seat and the pressurized fuel exits the injector.

Fuel vapors that are formed in the fuel tank are drawn into the engine for combustion via the carbon canister.

The carbon canister is located on the right side of the vehicle in front of the "A" pillar.



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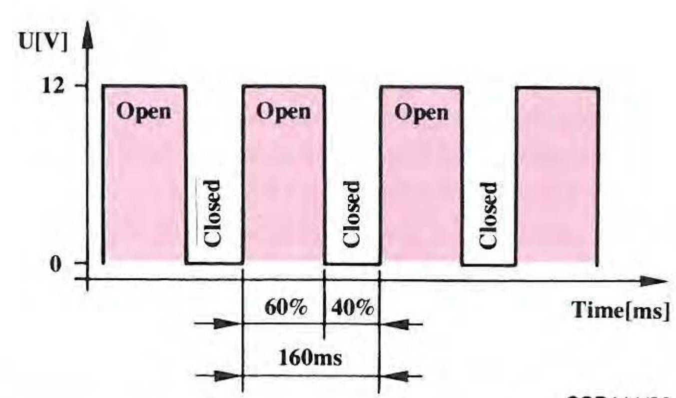
The duty cycle for the carbon canister frequency valve can range from 0-100% depending on engine load. Below is an example of a 40% duty cycle.



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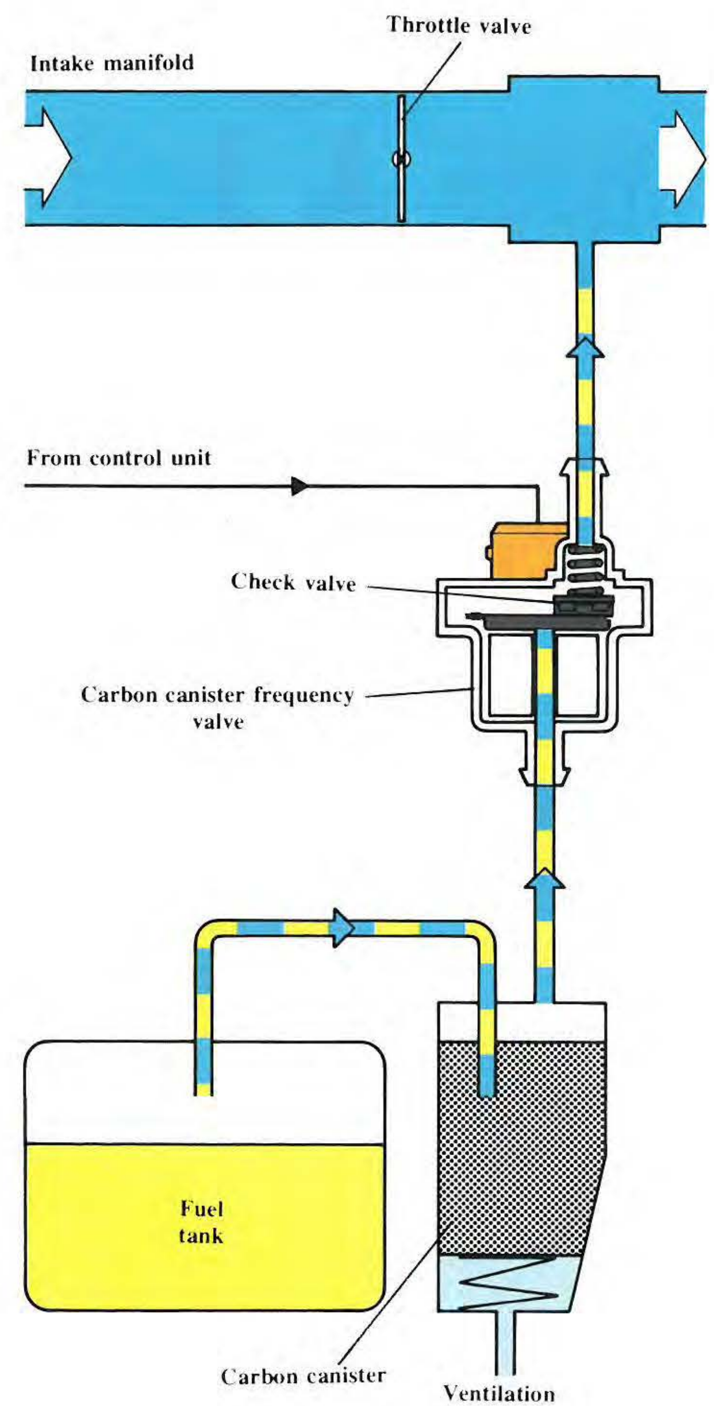
Fuel Tank Ventilation System



When driving, fuel vapors are drawn into the intake manifold from the fuel tank via the carbon canister and then the frequency valve.

Depending on engine load and the oxygen sensor signal, the frequency valve will regulate the quantity of vapors entering the intake manifold. In this way, an excessively rich fuel mixture is avoided.

A spring-loaded check valve within the frequency valve closes when the engine is off. This keeps the fuel vapors from entering the intake manifold and causing a rich mixture on a restart.

If power to the frequency valve is interrupted or lost when the engine is running, vacuum from the intake manifold will open the check valve and allow a calibrated amount of vapors to enter the intake manifold.

Boost Pressure Control

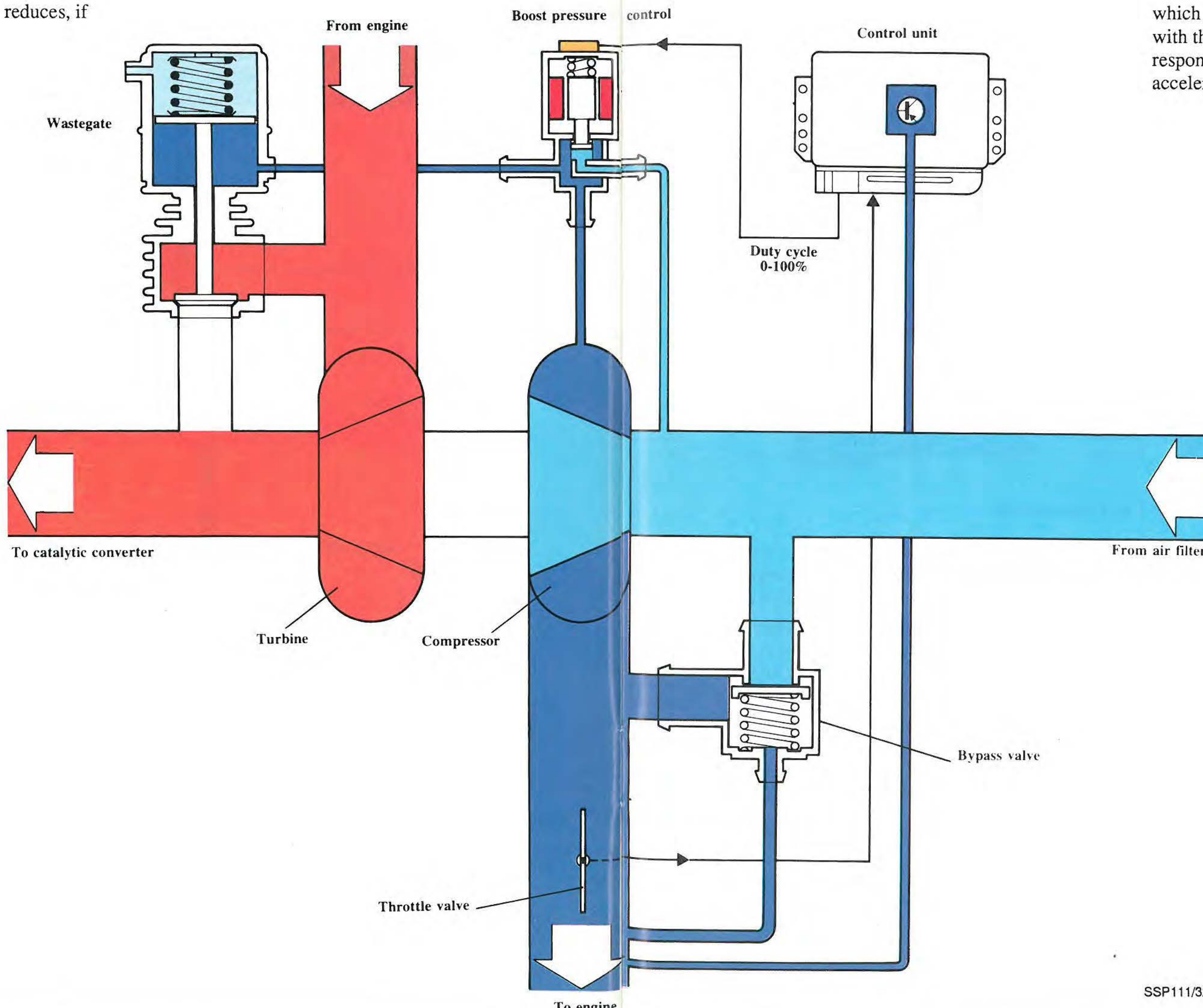
The purpose of the boost pressure control system is to ensure optimum boost pressure conditions throughout the entire operating range of the engine.

At full throttle, the boost pressure reaches a maximum of 1.83 bar at 1,950 rpm. This reduces, if not eliminates, "turbo lag." On other systems, maximum boost pressure is not reached until the engine speed is greater.

Four components are used to regulate boost pressure: a bypass valve, wastegate, wastegate frequency valve and the Motronic control unit.

The bypass valve is used to reduce boost pressure in the intake air duct when the throttle plate is closed, such as, at idle or when decelerating.

The use of the bypass valve serves another function, which is to maintain a higher speed of the turbo with the throttle closed. This improves the response characteristics of the turbocharger when accelerating.



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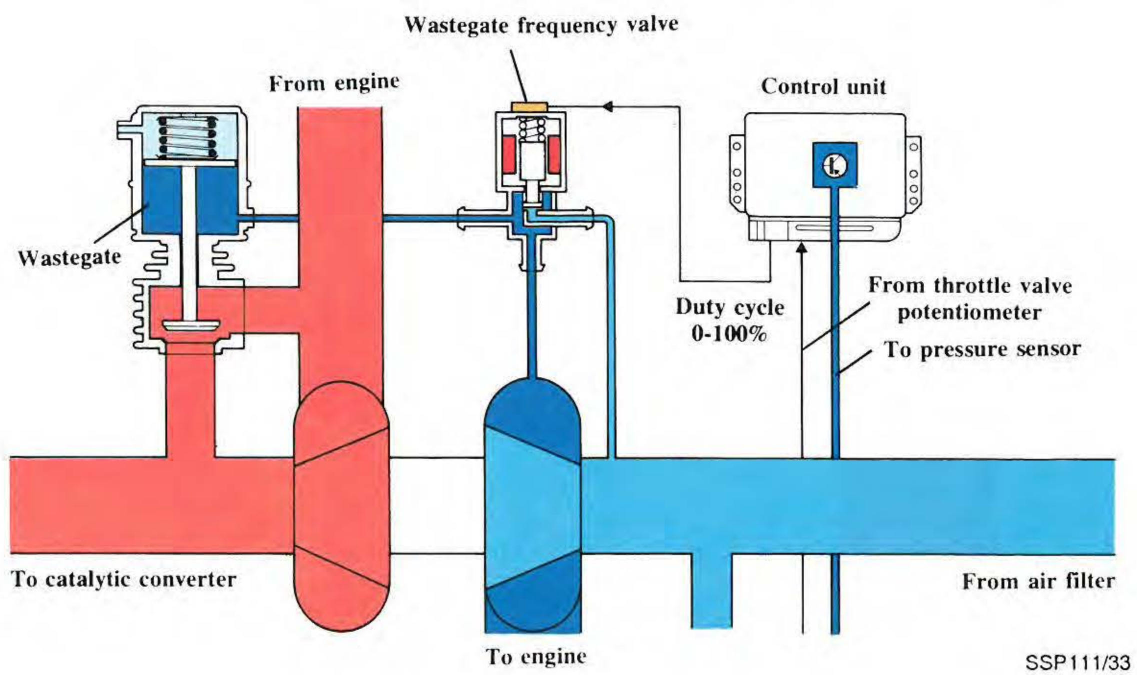
Boost Pressure Control

Wastegate Frequency Valve

The wastegate frequency valve controls boost pressure by controlling the wastegate.

The Motronic control unit senses intake manifold pressure by a pressure sensor inside the control unit. Based on the amount of intake manifold pressure, the control unit determines the appropriate duty cycle for the frequency valve.

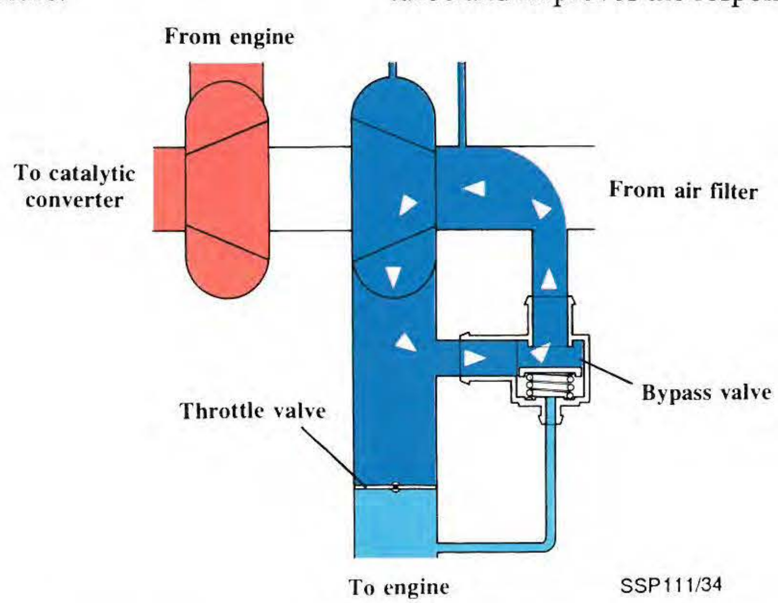
Depending on the duty cycle, the frequency valve will regulate the amount of intake manifold boost pressure to the wastegate to control boost pressure.



Bypass Valve For The Turbocharger

The bypass valve is operated by intake manifold vacuum. During idle or deceleration with the throttle valve closed, the bypass valve is opened by vacuum against spring pressure.

When the valve is open, intake air is recirculated and the turbo is free to spin but doesn't develop any boost pressure. This maintains a higher speed of the turbo and improves the response of the turbo.

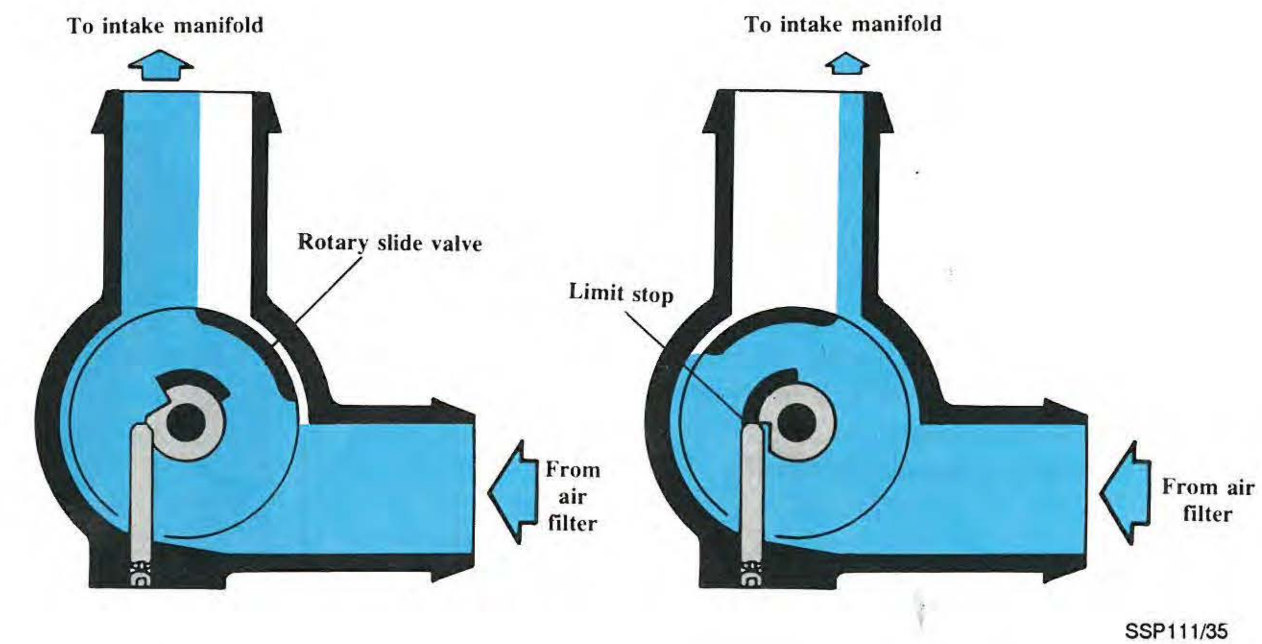


Idling Stabilization

Idle Stabilizer

The idle speed is controlled by ignition timing and an idle stabilizer. The ignition timing is used to quickly adjust the idle speed during load changes. The idle stabilizer is used to maintain the corrected air volume.

The idle stabilizer is a single winding rotary-type. When current is supplied to the valve, the rotary valve will rotate against spring pressure to the desired opening. The opening is determined by the Motronic control unit.



"Normal function"

"Emergency running" and "engine off"

If the current to the valve is interrupted or lost, the rotary valve is forced back by spring pressure to a stop. This fixed position corresponds to a warm engine idle speed.

Knock Control

Engine knock indicates increased thermal and mechanical load of the engine. When an engine starts to knock is determined by compression ratio, fuel mixture, fuel quality and engine temperature.

The knock sensor system for the 20-Valve turbo uses two knock sensors. The use of two knock sensors allows the system to detect the slightest knocking noise and which cylinder caused the knock.

The Motronic control unit will then retard the ignition timing for that cylinder, depending on engine temperature and boost pressure.

Basic design of the knock sensor system:

System response to knock:

— The ignition timing is retarded in 3° increments

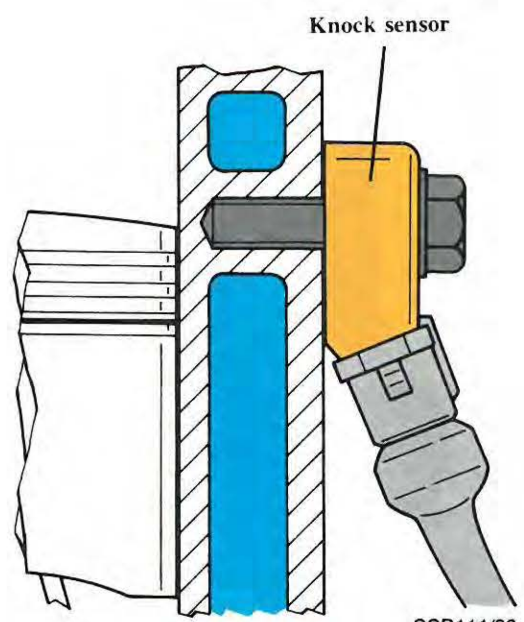
System response to continued knock after timing retard:

— The fuel mixture is enriched to reduce the combustion temperature which reduces knock

System response to continued knock after timing retard and fuel mixture enrichment:

— Boost pressure is reduced to a predetermined level to decrease knock

When the knocking has been eliminated, the ignition timing is returned to its normal value in 1.3° increments and boost pressure is returned to its normal value.



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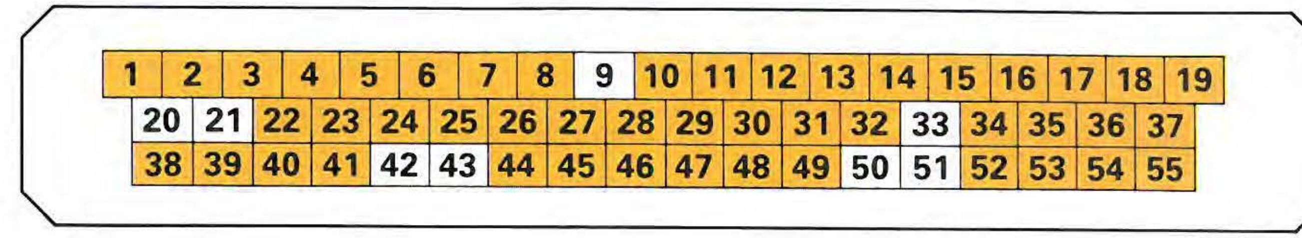
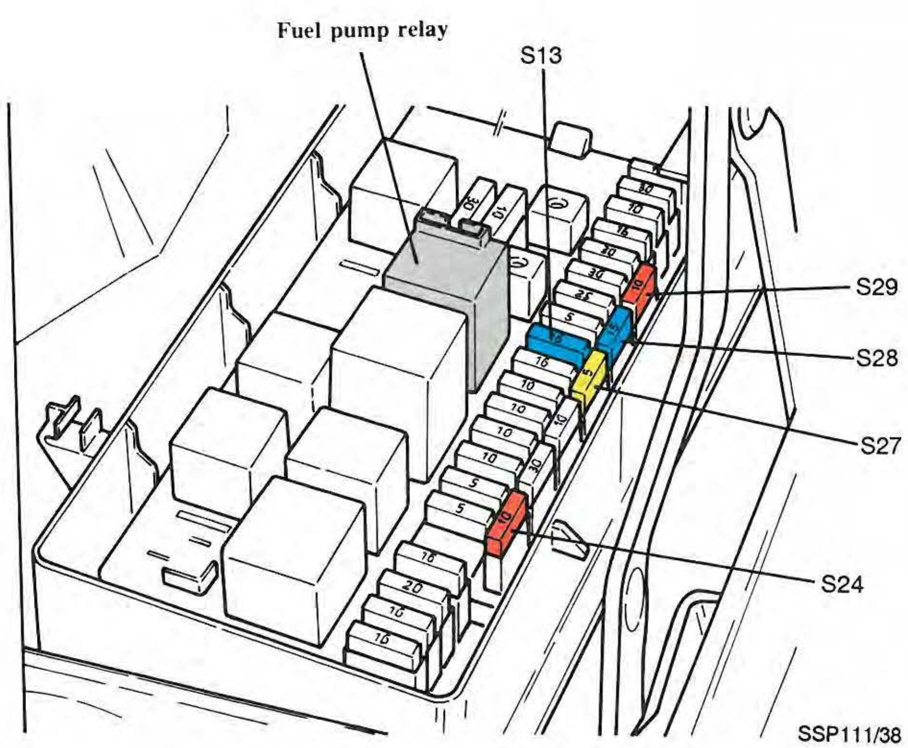


Pin	Assignment	Pin	Assignment
1	Output stage for ignition coil	28	Oxygen sensor (signal wire)
2	Coding plug	29	Knock sensor II
3	Fuel pump relay	30	Ground
4	Idle stabilizer	31	Boost pressure indicator for trip computer
5	Carbon canister frequency valve	32	Trip computer
6	Tachometer/trip computer	33	Open
7	Air mass sensor	34	Injector #5 (-)
8	Hall sender (signal wire)	35	Injector #4 (-)
9	Open	36	Multi-function switch (Pin R)
10	Ground	37	Voltage output
11	Knock sensor I	38	Coding plug
12	Hall sender, altitude sensor, throttle valve potentiometer and coding plug (+)	39	Coding plug
		40	A/C compressor
13	Diagnostic plug connector (L wire)	41	Idle speed increase signal (A/C On)
14	Control unit ground	42	Open
15	Injector #3 (-)	43	Open
16	Injector #2 (-)	44	Intake air temperature sensor
17	Injector #1 (-)	45	Coolant temperature sensor
18	Terminal #30 (+)	46	Altitude sensor
19	Control unit ground	47	Engine speed sensor
20	Open	48	Ground for data sending units
21	Open	49	Reference sensor
22	Diagnostic plug connector (output)	50	Open
23	Wastegate frequency valve (-)	51	Open
24	Control unit ground	52	Idle switch
25	Air mass sensor (+ Pin 4)	53	Throttle valve potentiometer
26	Air mass sensor (+ Pin 2)	54	Coding plug
27	Terminal #15	55	Diagnostic plug connector (K wire)

The fuses below are for the Motronic Engine Management System.

No.	Rating	Description	Connection	Engine condition when fuse is defective
S13	15 A	Fuel pump	Fuel pump	Off
S24	10 A	Engine control	Wastegate frequency valve, idle stabilizer, carbon canister frequency valve	Running in emergency mode (limp-home)
S27	5 A	Engine control (Motronic)	Terminal #30 for control unit	Off
S28	15 A	Engine control (Motronic)	Injectors, air mass sensor	Off
S29	10 A	Oxygen sensor heating element	Oxygen sensor heating element	Runs

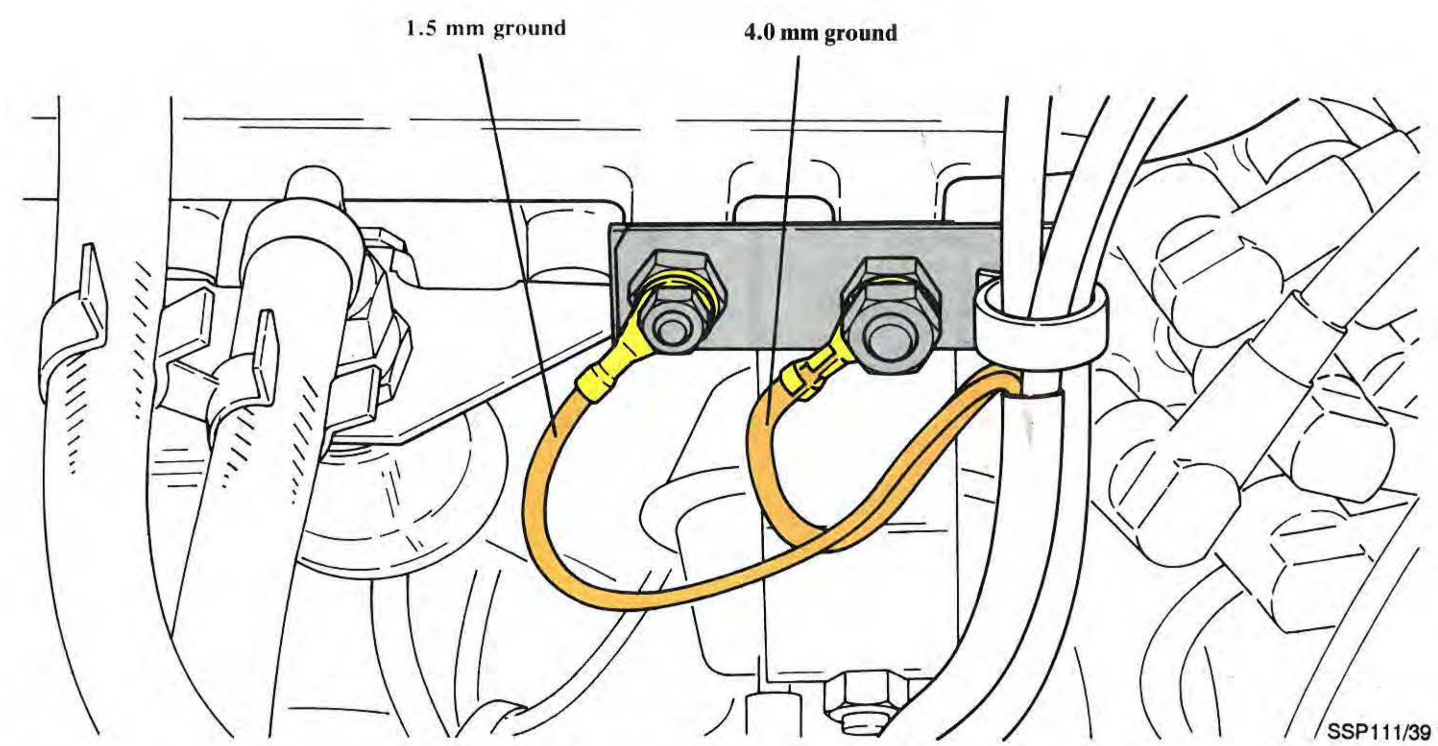
Color codes for fuses:
5 Amp: Beige
10 Amp: Red
15 Amp: Blue



Ground Connections

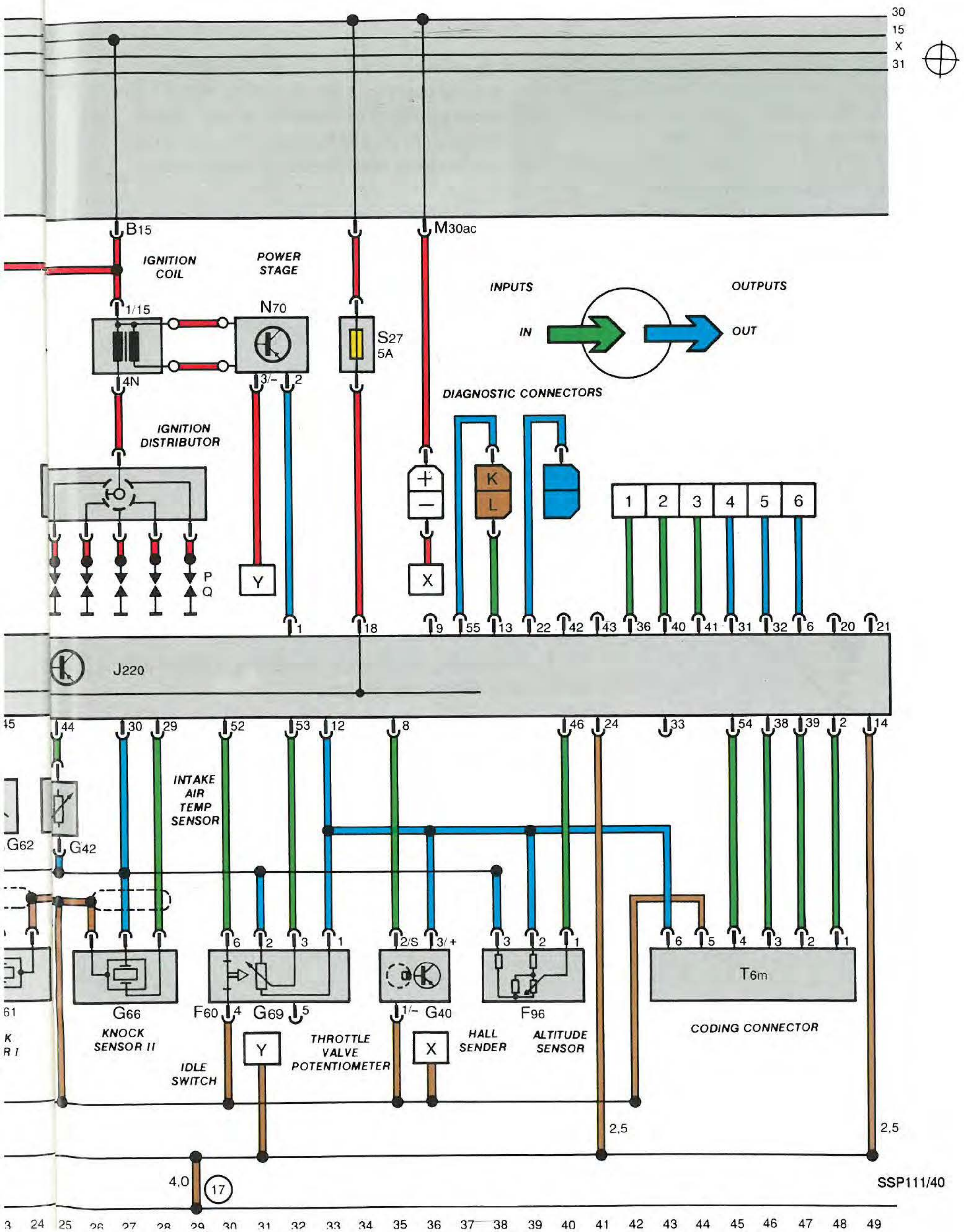
Ground connections for the Motronic Engine Management System are located on the engine block next to the ignition distributor.

One ground is used for the sensors, control unit and the shielding of the sensor wires. The ground wire for these components is 1.5 mm in diameter.



The second ground connection is used for the output stage actuators (fuel injectors, etc.) and a second ground for the control unit. The diameter of this ground wire is 4.0 mm.

Wiring Diagram

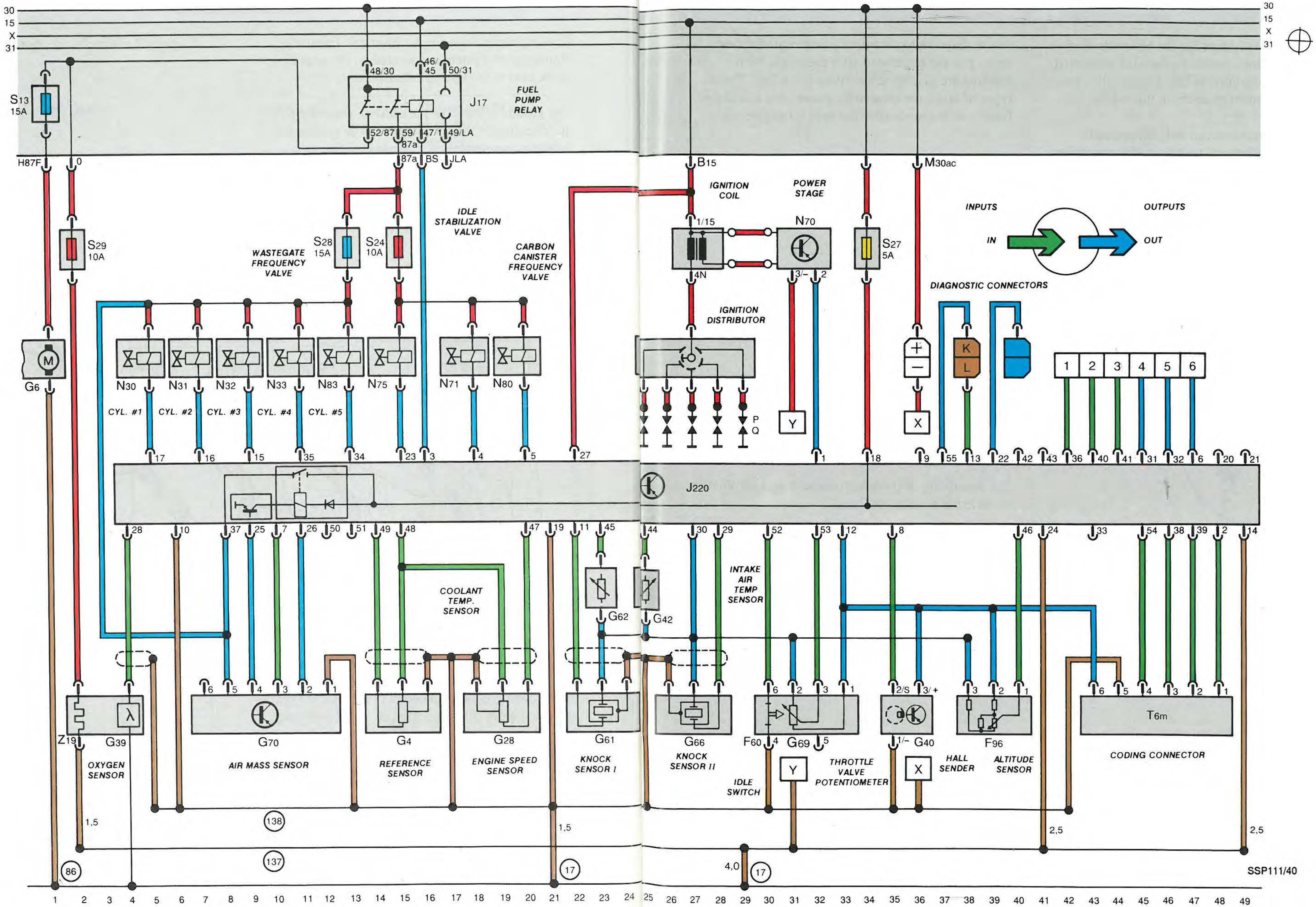


Color coding
Green = Input signal
Blue = Output signal
Red = Power supply
Brown = Ground

Legend

F 60	Idle switch
F 96	Altitude sensor
G 4	Ignition reference sensor
G 6	Fuel pump
G 28	Engine speed sensor
G 39	Heated oxygen sensor
G 40	Hall sender
G 42	Intake air temperature sensor
G 61	Knock sensor I
G 62	Coolant temperature sensor
G 66	Knock sensor II
G 69	Throttle valve potentiometer
G 70	Hot wire (air mass sensor)
J 17	Fuel pump relay
J 220	Motronic control unit
N 30	Fuel injector, cyl. #1
N 31	Fuel injector, cyl. #2
N 32	Fuel injector, cyl. #3
N 33	Fuel injector, cyl. #4
N 83	Fuel injector, cyl. #5
N 70	Power stage (ignition coil)
N 71	Idle stabilizer valve
N 75	Wastegate frequency valve
N 80	Carbon canister frequency valve
P	Spark plug connectors
Q	Spark plugs
S 13	Fuse, fuel pump
S 24	Fuse, engine electronics
S 27	Fuse, engine control (Motronic)
S 28	Fuse, engine control (Motronic)
S 29	Fuse, heating element for oxygen sensor
T 6m	Coding connector
Z 19	Heating element for oxygen sensor
137	Ground connection at engine block
138	Ground connection at engine block

Wiring Diagram



The self-diagnosis system for the Motronic Engine Management System monitors signals transmitted by sensors and actuators. If faults occur, they are stored in a permanent memory in the control unit.

The permanent memory can only be erased by disconnecting the control unit plug, disconnecting the battery or by using the V. A. G 1551.

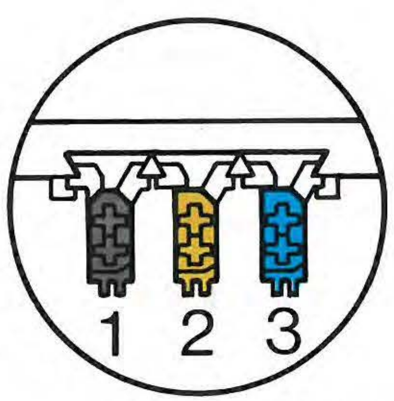
Faults that occur sporadically (intermittently) or faults that are not erased after they have been repaired are displayed as "sporadic faults." These types of faults are cleared by the control unit if the fault does not recur after the next 10 engine starts.

Diagnostic Connectors

The diagnostic connectors are located in the footwell on the driver's side, next to the pedals.

The diagnostic connectors consist of three plug connectors.

The possibility of incorrect connection is eliminated by different housing designs.



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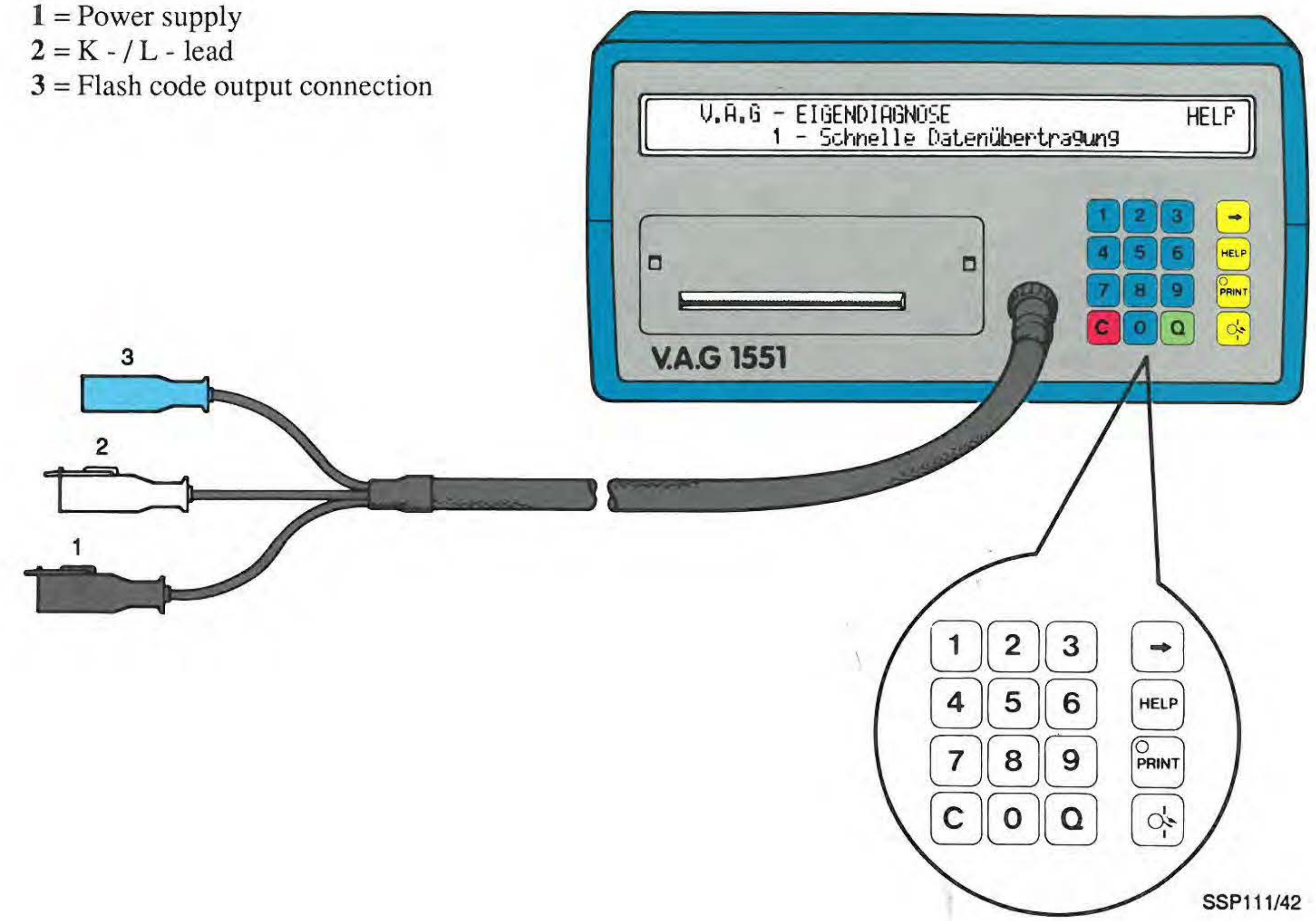
1 = Voltage supply
2 = Fast data transfer
3 = Flash code

1 = Power supply
2 = K - / L - lead
3 = Flash code output connection



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After connecting the 1551, the appropriate address word needs to be selected.

01 - Engine electronics

When *engine electronics* is selected, the following functions can be called:

01 - Check control unit version
02 - Check fault memory
03 - Output check diagnosis
04 - Introduction of basic settings
05 - Erase fault memory
06 - End output

If the function, "04, Introduction of Basic Setting" is selected, the following values should appear in the display:

System in basic setting:
200 25 80 128 100 130 48 128 128 36

Engine temperature
Set value 184 ... 215
(corresponds to 85 ... 105 °C)

Engine speed
Set value 77 ... 83
(corresponds to 770 ... 830 rpm)

Lambda control
Set value 123 ... 133
(corresponds to 0.5 ... 0.9 vol. % should be set after 90 s)

Ignition firing point
Set value 35 ... 37
(corresponds to 8 ... 12° before TDC)

The actual values can be checked and compared with the set values. If the actual values deviate from the set values, refer to the Repair Manual Microfiche for further troubleshooting information.

Output Check Diagnosis

Actuator diagnosis is provided through the use of the 1551 to provide a quick check of the wiring and mechanical operation of certain components.

When this function is selected, the control unit will operate the components below one after another by a pulsed voltage. For complete output diagnosis procedures, consult the Repair Manual Microfiche.

Fuel injector, cylinder #1	(N 30)
Fuel injector, cylinder #2	(N 31)
Fuel injector, cylinder #4	(N 33)
Fuel injector, cylinder #5	(N 83)
Fuel injector, cylinder #3	(N 32)
Idle stabilizer valve	(N 71)
Carbon canister frequency valve	(N 80)
Wastegate frequency valve	(N 75)

The actuators are checked acoustically (clicking noise). The clicking noise does not guarantee absolute function of the component during engine operation. Additional testing may prove necessary.

In order to bring training information to in-dealership personnel, Service Training develops and issues Self-Study booklets. The booklets describe and explain new product changes, and system and component operation. These booklets are produced on an as-needed basis as product changes and developments take place.

Five booklets are normally shipped to all Audi dealers participating in the Automatic Supply Program. In order to make it possible for extra copies to be obtained if needed, additional booklets may be ordered via normal ordering procedures. The booklets will then be shipped directly to the ordering dealer and the parts account billed accordingly.

The following booklets are available and can be ordered:

Book Title	Part #	Price
CIS-Electronic Fuel Injection	WSP-521-142-00	$9.00
CIS-E III Engine Management System	WSP-521-146-00	$7.50
Digital Climate Control (up to 1988 M.Y.)	WSP-521-137-00	$6.50
Audi Coupe Electronic Instrument Display	WSP-521-138-00	$6.50
The New Audi 80 and Audi 90	WSP-521-151-00	$12.50
The New Audi 100 and Audi 200	WSP-521-170-00	$10.00
1989 Model Change Information	WSP-521-180-00	$10.00
Audi Coupe Quattro with 20-Valve Engine	WSP-521-200-00	$10.00
The New Audi V8 Quattro	WSP-521-201-00	$12.00