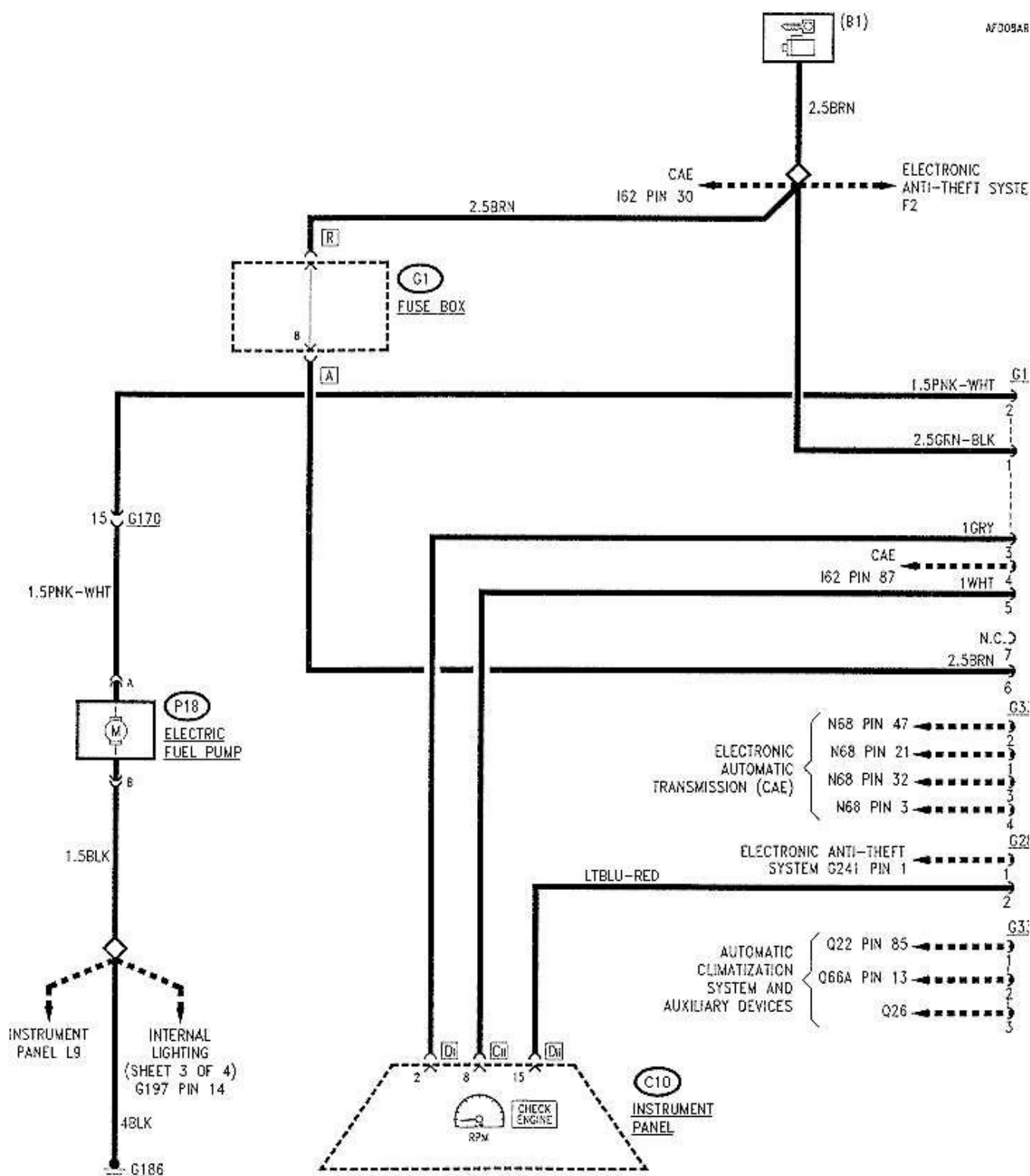


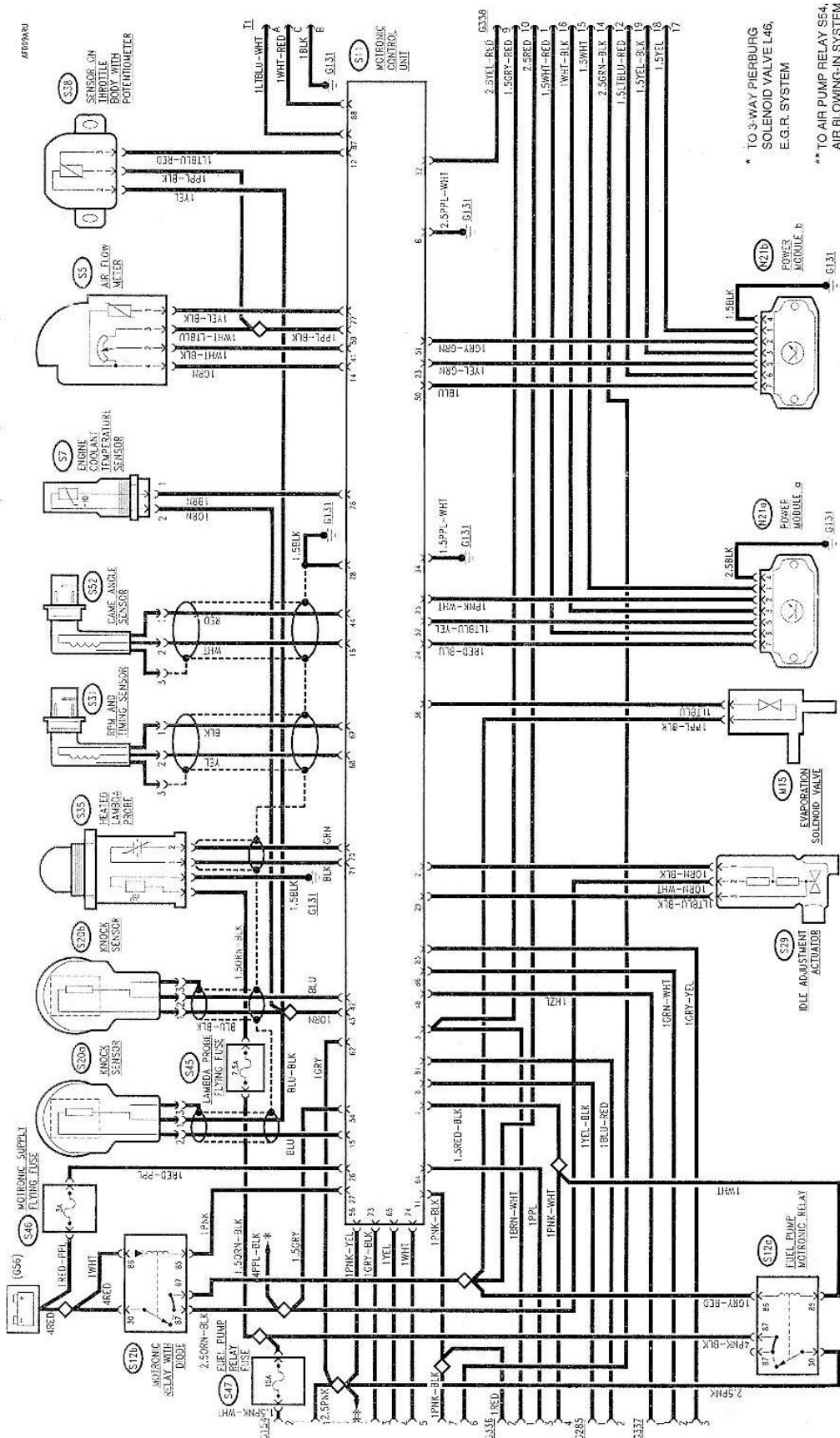
MOTRONIC M1.7 INJECTION AND IGNITION SYSTEM

1870948



WIRING DIAGRAM SYSTEM SIDE (SHEET 1 OF 2) - AUTOMATIC TRANSMISSION VERSION

AF009AKU



NEWBURY

MSD1048U



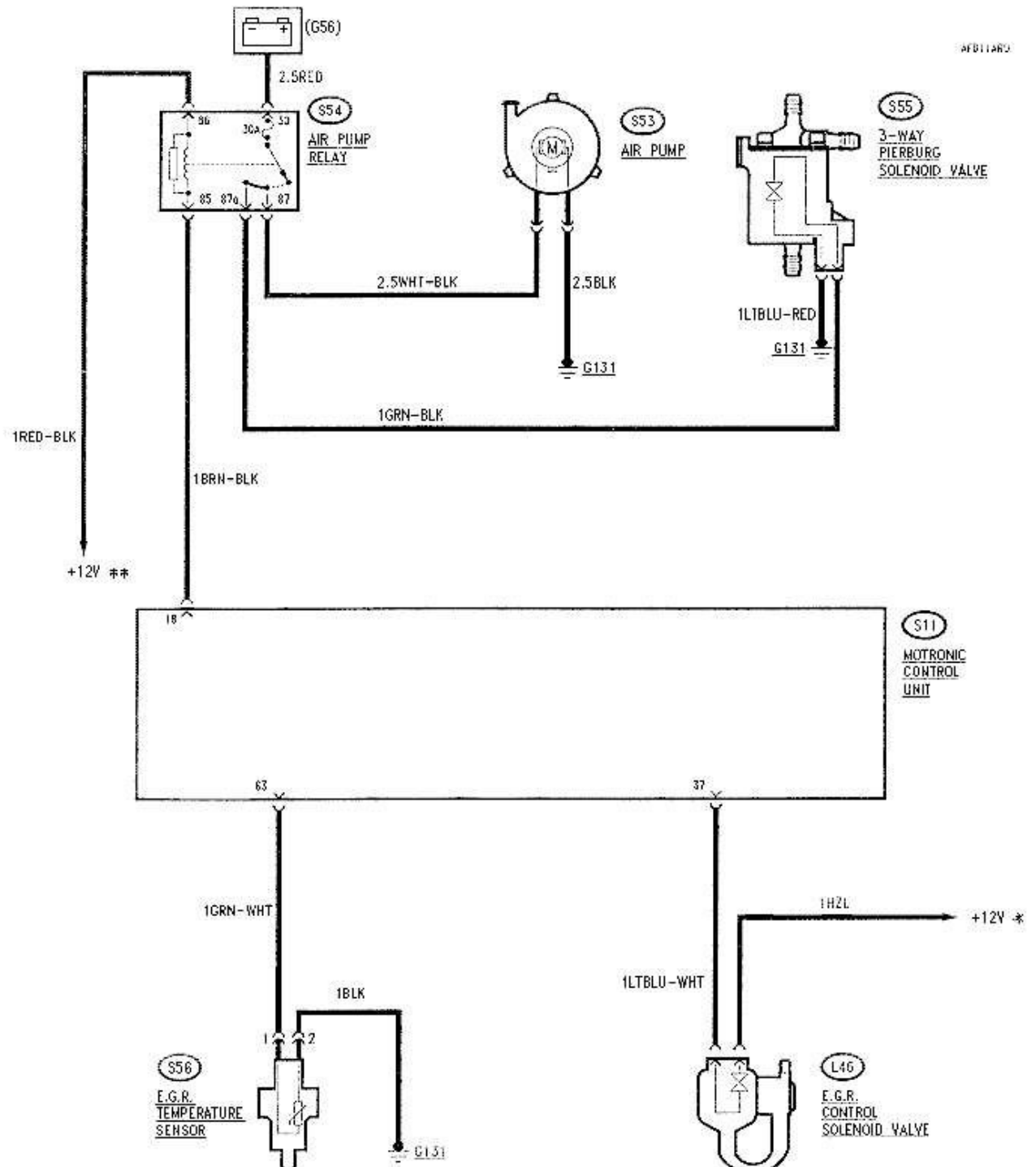
TO AIR PUMP RELAY S54,
AIR BLOWING-IN SYSTEM

MSD1048U



TO AIR PUMP RELAY S54,
AIR BLOWING-IN SYSTEM

EXHAUST GAS RECIRCULATION SYSTEM - AIR BLOWING-IN SYSTEM



* TO MOTRONIC RELAY WITH DIODE S12b, WIRING DIAGRAM SYSTEM SIDE (SHEET 1 OF 2)

** TO FUEL PUMP MOTRONIC RELAY S12a, WIRING DIAGRAM SYSTEM SIDE (SHEET 1 OF 2)

GENERAL DESCRIPTION

The Motronic M1.7 (BOSCH) system is a technologically modern system which manages the injection and ignition of 164 vehicle engines.

A control unit governs and adjusts all the engine parameters, optimizing performance and consumption by responding in real time to the differing running conditions. This new system mainly differs from its predecessors for its use of a "static distribution" type electronic ignition (with semi-conductors rather than distributor).

This solution definitely brings with it advantages, as it eliminates moving parts subjected to wear, reduces noise levels and completely eliminates sparks, which consequently reduces the risk of interference: high voltage cables and connections are also reduced.

Another characteristic of this system is its "self-adaptation", i.e. its ability to identify the changes taking place in the engine and compensate for them, in accordance with adaptive functions which correct the fuel plans and air flow programmed in the control unit.

There are two adaptive functions in particular for the fuel plan which operate in relation to the state of the evaporative solenoid valve (open or closed) plus an adaptive plan at idle speed; the latter is able to efficiently compensate for any air infiltrations. The continuous self-adaptation of the fuel plan allows the correct quantity of fuel to be maintained whatever the temperature and height.

NOTE: It is consequently necessary, after every intervention, to drive the vehicle for at least 10 minutes within the various running conditions, in order to signal to the control unit any changes which have taken place in the system and allow it to adapt to them.

The system is protected by three fuses:

- **S45 (7.5A) LAMBDA PROBE FLYING FUSE**

- **S46 (3A) MOTRONIC SUPPLY FLYING FUSE**
- **S47 (15A) FUEL PUMP RELAY FLYING FUSE**

SYSTEM FUNCTIONS

The system's main functions are the following:

- regulation of injection times;
- regulation of ignition advance;
- control of cold starting;
- control of enrichment during acceleration;
- fuel cut-off during deceleration;
- constant idle speed control;
- limitation of max. r.p.m.;
- fuel control - lambda probe;
- fuel vapor recovery;
- control of exhaust gas recirculation
- control of air blowing-in system
- connection with heater/ventilation system;
- connection with the electronic automatic gearbox (only for vehicles equipped with electronic automatic gearbox);
- self diagnosis.

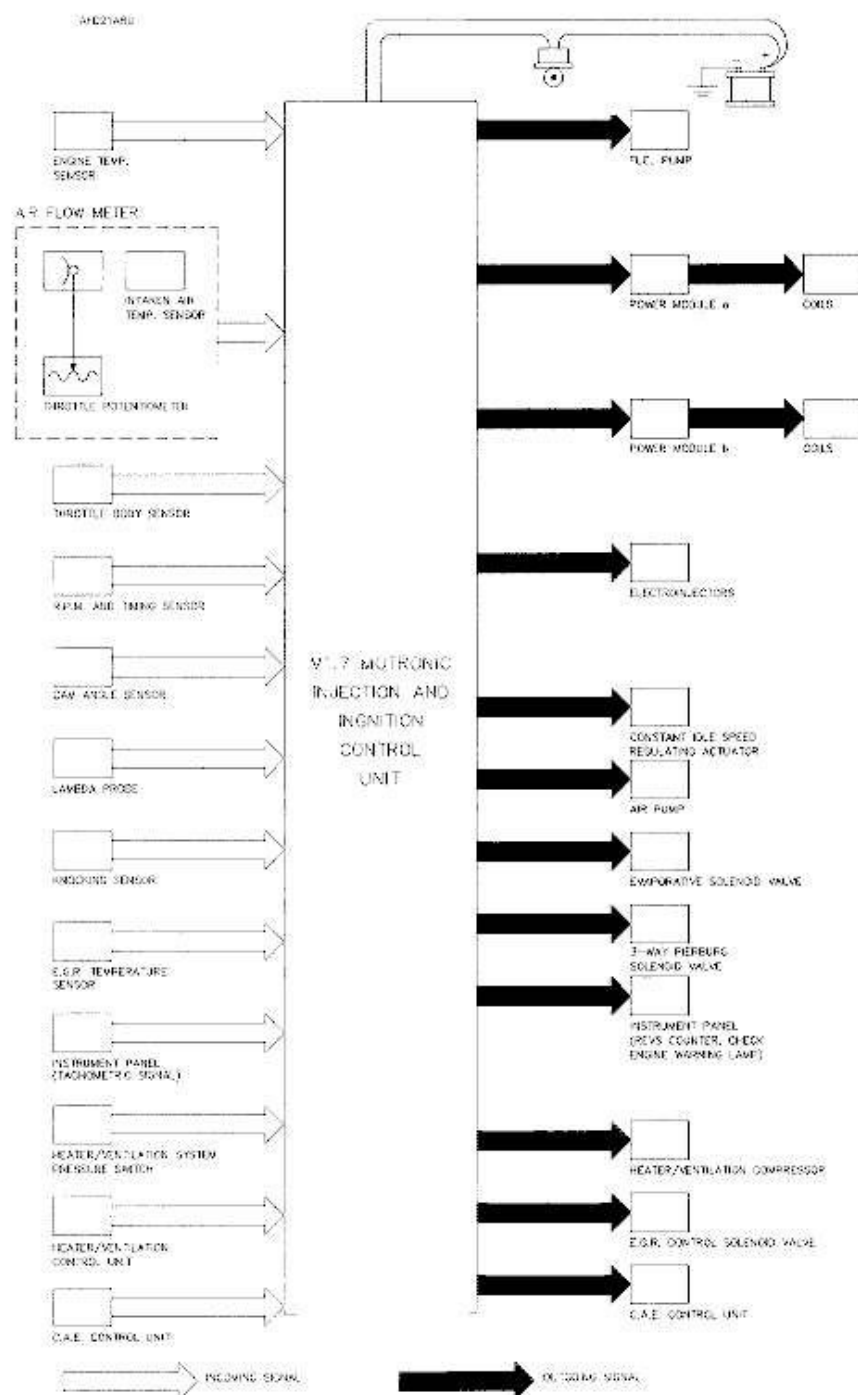


Diagram demonstrating the system's main functions

The diagram which follows demonstrates the functions described.

Regulation of injection times

Digital technology has made it possible to optimize consumption and performance using programmed maps, memorized within the electronic control unit, in relation to r.p.m. and engine load.

The control unit, with the help of the sensors which detect the many variants in play, controls the electroinjectors with extreme precision and speed. The injection time is mainly corrected on the basis of the battery voltage and the engine temperature.

Regulation of the ignition advance

Thanks to a mapping memorized within the control unit, the latter is able to calculate the advance in relation to engine load, the temperature of the intaken air and the engine. Once this information has been processed, the control unit delays ignition selectively on the cylinder which requires it through the combination of the values recorded by the knocking and cam angle sensors.

Control of cold starting

During cold starting, the system controls the ignition advance and injection time. The ignition advance depends exclusively from r.p.m. and the engine temperature; its value reaches a maximum with the temperature at -6°C (21°F). The injection time is obtained from a value programmed in the control unit and corrected by measuring the intake air temperature, the engine temperature, the battery voltage and r.p.m. During the start-up stage, the control unit also controls the injection at each ignition impulse. When a certain r.p.m. is reached (in relation to engine temperature) the control unit returns the system to normal operating ie. injection control for each revolution of the crankshaft.

Control of enrichment during acceleration

During acceleration, if the variation in the signal from the air flow meter exceeds a predetermined value, the control unit adapts the injection to this new request as well as

increasing it further in order that it rapidly reaches the r.p.m. requested. As it approaches the set r.p.m., the injection increase is progressively eliminated.

NOTE: the request for acceleration is also detected by the potentiometer located on the throttle; this allows optimal running conditions to be ensured, should the air flow meter fail, until an assistance point is reached.

Fuel cut-off during deceleration

The fuel cut-off during deceleration is of the adapted type. When the throttle is closed and the r.p.m. exceeds 1,700 (for engine speeds lower than 1,700 r.p.m., the cut-off function is not operative in order that an optimal drive ability can be maintained) the injection of fuel is deactivated. If the supply is interrupted, the r.p.m. will start to fall more or less quickly in relation to vehicle conditions.

Before reaching idle speed, the dynamics of the fall in r.p.m. is checked. If this exceeds a certain value, the fuel supply system is partially reactivated on the basis of a logic which envisages the "soft accompaniment" of the engine at idle speed. When this condition has been reached, the normal functions at idle speed are reactivated and cut-out during deceleration will only be reactivated if the fuel cut-off threshold is exceeded to prevent the engine from jerking. The reactivation thresholds for the fuel supply and cut-off vary in relation to engine temperature. Another fuel cut-off logic has been developed within the control unit which intervenes during partial deceleration, ie. when a lower engine load is requested. The function is only activated if the new conditions last for a set period of time and after the ignition angle has been adapted to the new situation.

Constant idle speed control

The regulation of the idle speed is driven, in all operating conditions, by the constant idle speed actuator which acts on the by-pass of the throttle. As well as controlling idle speed, it also acts as an additional air chamber and regulator for the operation of the various accessories (eg heater/ventilation compressor); with the throttle valve at the stop limit, the actuator regulates the by-pass compensating for the power requested by the accessories in order to guarantee an idle speed which is, as far as possible, constant around 700 r.p.m. The actuator used in this version guarantees high speed regulation as both the

opening and closing of the by-pass are controlled by magnetic coils. The correction of idle speed is carried out by regulating the advance as well as by the idle speed actuator as it takes effect quicker.

Limitation of max. r.p.m.

Once vehicles equipped with a manual gearbox have exceeded the threshold of 7,100 r.p.m. (6,500 r.p.m. for vehicles equipped with the electronic automatic gearbox) the injection of fuel is interrupted, which prevents the engine from overloading and to protect it when the r.p.m. is excessively high. For versions fitted with the electronic automatic gearbox, there is a particular function which limits the r.p.m. if the gear lever should accidentally be inserted in the "D" (drive) position when the r.p.m. is very high, in order to avoid damaging the gearbox.

Fuel control - lambda probe

The lambda probe informs the control unit of the state of the combustion of the AIR-FUEL mixture (LEAN MIXTURE and RICH MIXTURE). To obtain an optimal mixture, the quantity of air drawn in by the engine should be equal to the theoretical value which is necessary to burn all the fuel which is injected.

This means that the lambda coefficient (λ) is equal to 1:

$$\lambda = \frac{\text{QUANTITY OF INTAKEN AIR}}{\text{THEORETICAL QUANTITY OF AIR REQUIRED TO BURN ALL THE FUEL INJECTED}}$$

Therefore:

- $\lambda = 1$ IDEAL MIXTURE
- $\lambda < 1$ RICH MIXTURE
- $\lambda > 1$ LEAN MIXTURE

The lambda probe, in contact with the exhaust gases, generates an electrical signal, the voltage value of which depends on the oxygen concentration present in the gases themselves. This voltage is characterized by a sudden variation when the composition of the mixture moves away from $\lambda = 1$. When the probe provides a low level of voltage (lower than 200 mV) the control unit recognises that the mixture is lean ($\lambda > 1$) and slightly

increases the quantity of fuel injected. When the probe provides a high level of voltage (greater than 800 mV) the control unit recognises that the mixture is rich ($\lambda < 1$) and decreases the quantity of fuel injected. The lambda probe varies the injection time so that the measurements oscillate between these two voltage values, so the engine normally works with a lambda coefficient between 0.98 and 1.006, values very close to the theoretical value of 1.

Fuel vapor recovery

The vapors in the fuel (which cause pollution according to the regulations) are collected in a vapor-liquid separator (canister) where they are condensed and from here they return in a liquid state to the tank through the pipes.

The remaining vapors which come out of the separator are sent towards the engine where they are burned; this takes place through a solenoid valve which is controlled by a control unit in accordance with a precise logic.

After the solenoid valve has been closed for 60 seconds it opens to a certain gradient for 90 seconds. At the same time, the lambda probe measures the fuel and if there are no variations with respect to the base map, the control unit closes the solenoid valve. If a variation is recorded in the carburation, ie. if it becomes necessary to "wash" the canister, the control unit will extend the time for which the solenoid valve remains open by a further 90 seconds.

Nominally the canister washing flow (solenoid valve opening) is 1% of the air flow measured by the air flow meter; this is in order to have the most balanced adaptive plan in order to obtain a constant washing percentage with respect to the quantity of air measured by the air flow meter; this is to avoid disturbing the drive ability as much as possible.

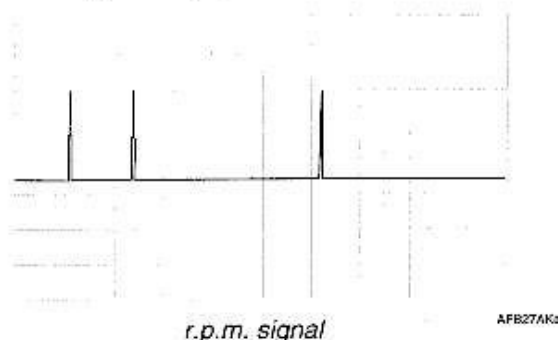
Connection with the heater/ventilation system

When the heater/ventilation system is activated, the compressor absorbs the power from the engine which, at idle speed, may cut-out. To avoid this problem, the control unit adapts the air flow to the new request for power, by controlling the relative actuator (adaptation also takes place during use to maintain an optimal "drive ability"). The system has another function which is to interrupt the supply to the compressor for 5-10 seconds if the engine requests a high degree of power (quick acceleration).

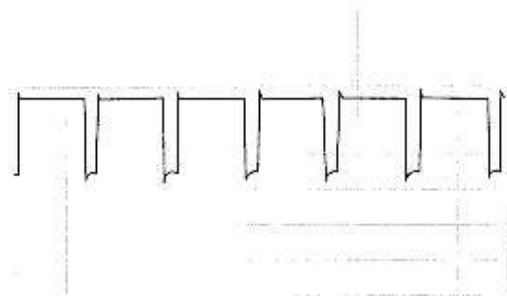
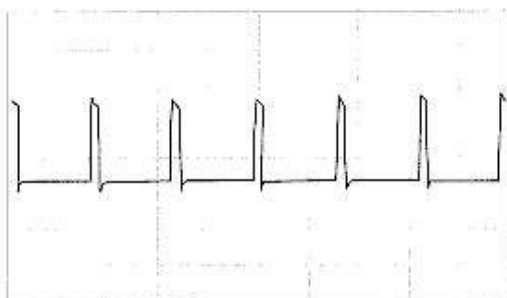
Connection with the electronic automatic gearbox

The injection/ignition system sends the following information to the control unit which controls the electronic automatic gearbox:

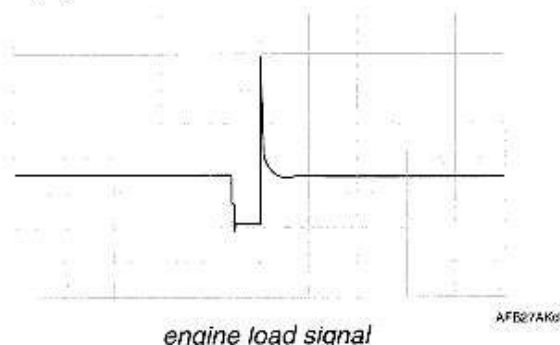
- r.p.m. signal: used as a parameter to protect the engine from reaching an excessively high r.p.m. (outside acceptable limits) and to control the reduction in engine torque,



- throttle angle opening and engine temperature signal: used to determine the gear change points, in relation to vehicle speed and the choice of the operating program made by the driver;



- engine load signal: used to calculate the modulating pressure so as to guarantee the quality of gear engagement.



The injection/ignition system receives an engine torque reduction signal from the electronic automatic gearbox control unit each time the ratio changes, in order to facilitate and reduce the gear engaging times.

Exhaust gas recirculation (E.G.R. valve)

In order to reduce the NOx (nitric oxide) emissions, the fuel supply system is equipped with an E.G.R. solenoid valve. The function of this valve is to sample a portion of exhaust gas and send them to the air intake box, where it is mixed with the intaken air and burnt in the combustion chamber.

The E.G.R. valve opening, which determines the exhaust gas quantity returned to the combustion chambers, corresponds to the vacuum pressure modulated by the solenoid valve which is in turn controlled by the Motronic control unit, in relation to the engine r.p.m. and vehicle load conditions.

The E.G.R. valve is activated when the engine is at its operating temperature (engine coolant temperature >80°C (176°F)) whilst the valve is by-passed when the engine is idling or not excessively loaded. The valve is also by-passed with high engine load conditions, or when the engine exceeds 3500 r.p.m. due to the extremely high temperatures which would enter the recirculation circuit and consequently damage it; the E.G.R. valve operation is thus ensured at standard highway speeds. The 3-wire solenoid valve, directly controlled by the Motronic control unit, alternatively connects the vacuum chamber either with the shut-off valve of the air blowing in system and the E.G.R. control modulating valve.

Air blowing in system (air pump)

For further reducing the toxic emissions in the exhaust system, the vehicle is equipped with a pump which blows air in the exhaust ducts. It is known that during the cranking procedure with cold engine, a higher quantity of petrol is needed to aid starting and guarantee a smooth running during the very first minutes of operation. The pump function is to deliver a higher percentage of air in order to burn the petrol in excess (which would not be handled by the catalytic converter), thus decreasing the level of unburnt hydrocarbons upstream the catalytic converter. Upon a Motronic control unit signal, the pump is activated for approx. 1.5 minutes after start-up, with the engine coolant temperature ranging within -8°C (17.5°F) and $+40^{\circ}\text{C}$ (104°F). When the engine revolutions exceed 3200 r.p.m. the pump is stopped to avoid an excess of air

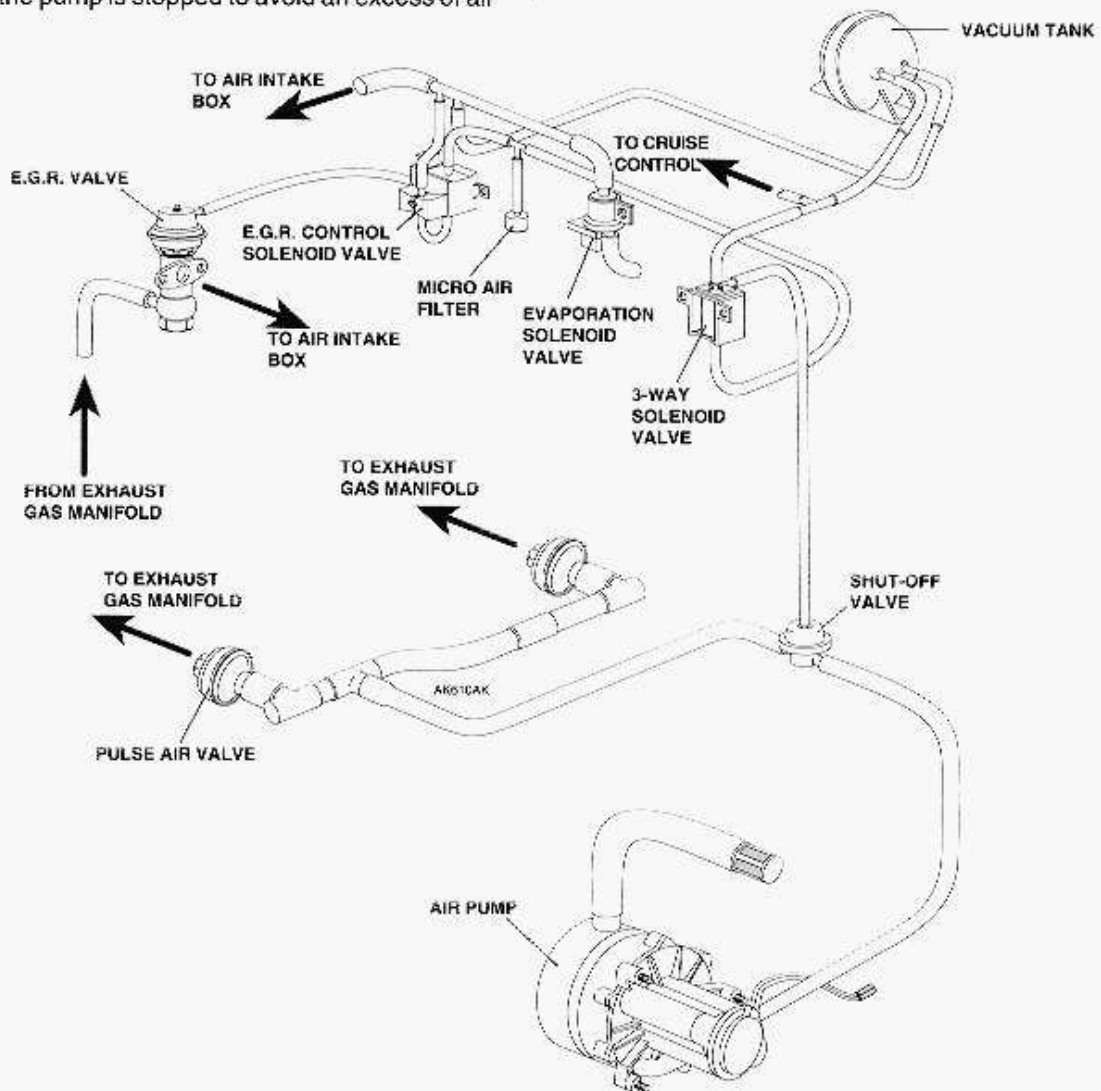
delivery which would overheat the catalytic converter.

The circuit comprises three valves:

- a shut-off valve, pneumatically controlled by the 3 way solenoid valve timed with the air pump, which prevents the engine from intaking air from the pump during a vacuum pressure condition.
- two pulse-air valves, (check valves) which prevent extremely hot gas from flowing back from the exhaust manifolds.

A centrifugal dust filter, mounted on the pump inlet prevents dust from entering the system.

NOTE: during cranking procedures with engine coolant temperature lower than -8°C (17.5°F) the pump does not intervene. It is thus normal that the pump starts when the engine is already running, that is when the coolant temperature reaches -8°C (17.5°F).



Exhaust gas recirculation - Air blowing in system

Autodiagnostics

The control unit is equipped with an autodiagnostics system.

Should the system malfunction, the control unit detects the fault and, where possible, replaces the missing signals with fixed parameters guaranteeing that the vehicle will make it as far as the nearest assistance point even though the running conditions are far from optimal: this method is known as the "limp home" method.

The parameters which can, in the event of a breakdown, be replaced by the control unit are: air flow meter, idle speed regulating actuator, engine temperature sensor, throttle body sensor, vapor recovery solenoid valve and knocking sensor.

If the control unit, the timing and r.p.m. sensor or the injectors malfunction, the system will not identify the defect and the vehicle will stop.

If there is a fault with the cam angle sensor, the system is equipped with safety advances in a map, as it is not possible to identify the cylinder which is knocking.

The faults can be read on the control unit, if requested by the user, by using the Alfa Romeo tester 1.827.014.000 (ex. C.1.0160). This reading system is described in a specific publication.

SENSORS

The system sensors are:

- air flow meter
- timing and r.p.m. sensor
- engine temperature sensor
- sensor on throttle
- knocking sensor
- cam angle sensor
- lambda probe
- E.G.R. temperature sensor

Air flow meter

The driver regulates the performance required by the engine using the gas pedal, which moves the throttle valve and varies the quantity of air sucked in by the engine.

The air flow meter quantifies the flow of air and sends a signal to the control unit which, together with other correc-

tive signals, determines the exact dosage of fuel (injection time).

The air flow meter functions according to the principle of the floating throttle moved by the intaken air.

A spiral spring acts as the force on the throttle itself, and so with a determined air flow a precise angular position will be obtained.

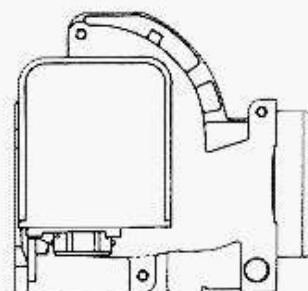
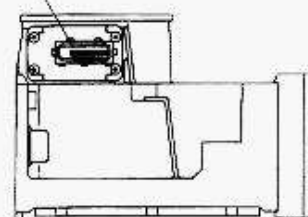
A compensating throttle is connected to the measuring throttle; in this way the pressure oscillations due to the intake stroke of the single cylinders act equally on both. In this way the moments compensate for each other and do not affect the measurement.

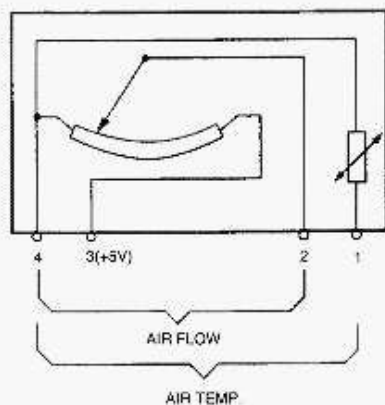
The signal is generated by the movement of a cursor which transmits a voltage corresponding to the angle of the floating throttle to the electronic control unit.

The air flow meter has a geometry which provides logarithmic correlation between the air flow and the angular position, guaranteeing a high precision even with a low flow value.

The air flow meter houses a temperature sensor (NTC) which measures the temperature of the air which has been drawn in and therefore the density of the air itself and consequently its specific weight (see engine temperature sensor).

CONNECTOR





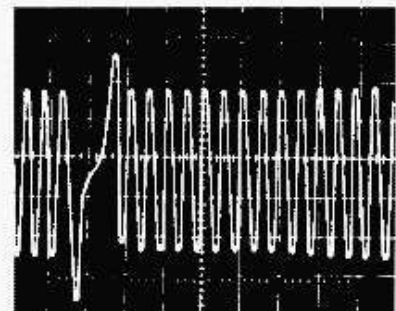
Wiring diagram

This device (NTC sensor) conveys a signal to the control unit which then proceeds to compensating the injection time in relation to the variation in the air-fuel weight ratio so that complete combustion of the mixture is obtained at idle.

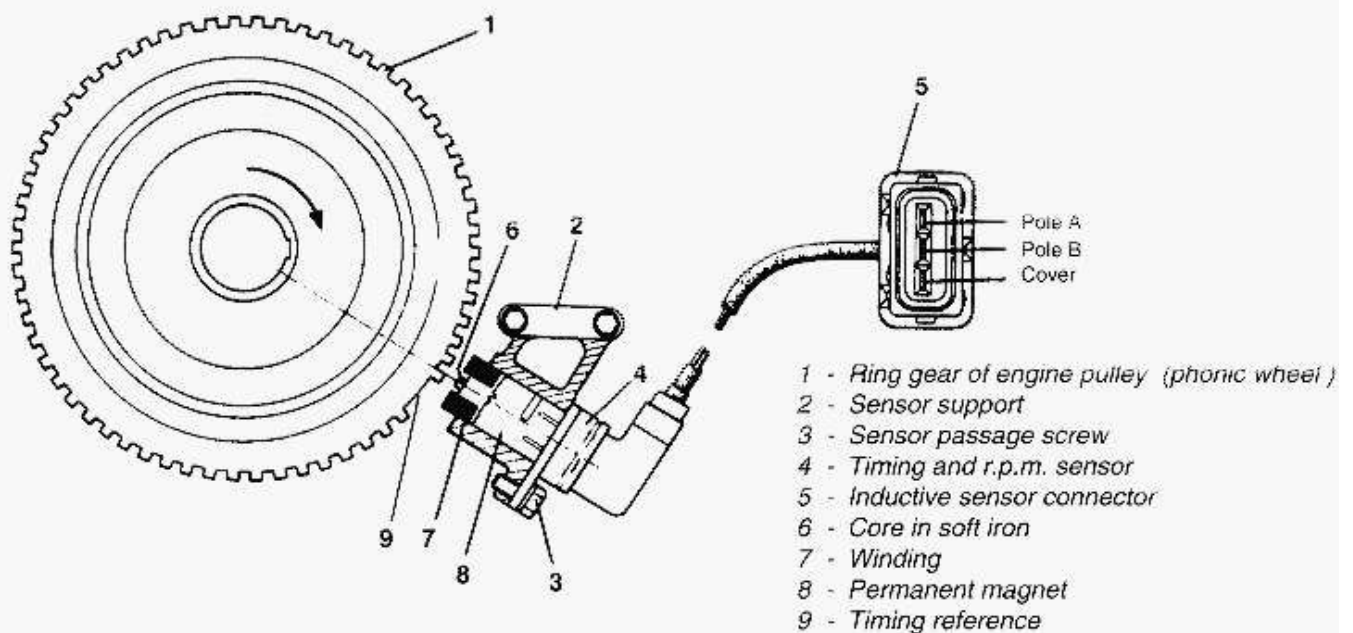
Timing and r.p.m. sensor

The sensor which detects r.p.m. is of the inductive type and functions through the variation of a magnetic field generated by the passage of the teeth of a drive pulley (phonic wheel) fitted on the crankshaft. The teeth which

pass in front of the generator of the magnetic field vary the gap between the pulley and the sensor; for this reason the flow, which consequently varies, induces an alternate voltage of the sinusoidal form in the coils of the sensor, the amplitude of which depends on the peripheral speed of the phonic wheel, on the gap between the teeth and the sensor, on the shape of the teeth, on the sensor's magnetic characteristics on the support sensor and on the support system. The outgoing signal which varies between 0.5V and 100V, in relation to r.p.m., is processed by the control unit. The interval between the start of one tooth and the next is 6° except for the reference mark realized by eliminating two of the 60 teeth of the pulley. The space left by the removal of the two teeth provides the control unit with a reference point for the crankshaft and each of the phonic wheel's successive teeth signals to the control unit an increase in its angular position.

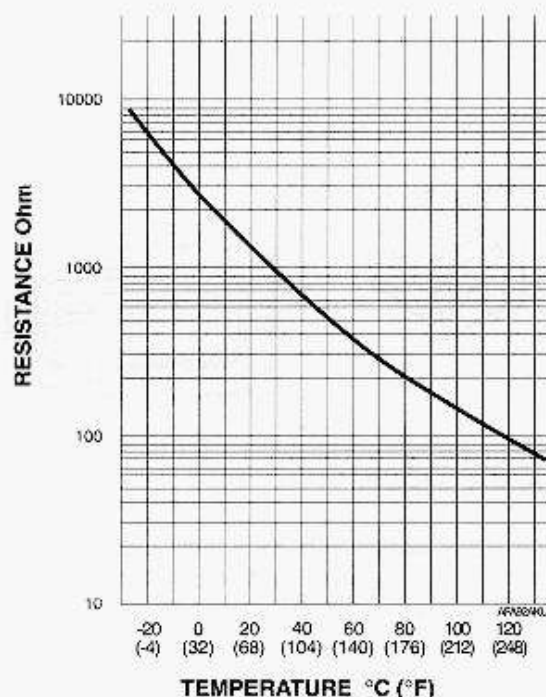


Signal on oscilloscope timing and r.p.m. sensor

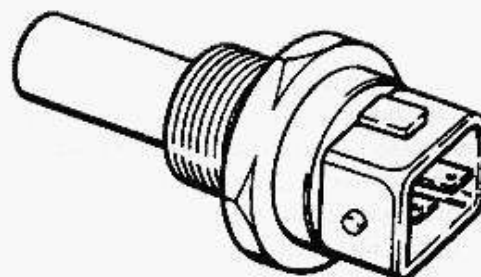
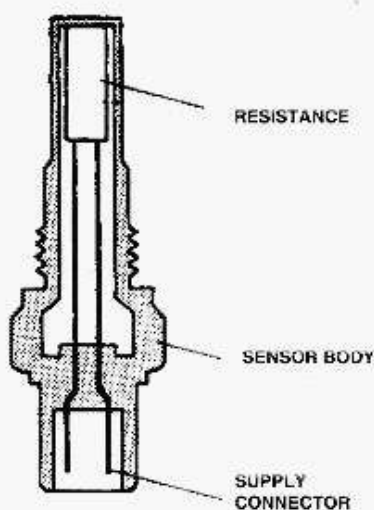


Engine temperature sensor

The engine temperature sensor is fitted with the sensitive part emerged in a coolant and is made up of a resistance with negative temperature coefficient (NTC) realised with semiconductor technology; for this reason, if the temperature of the sensor increases as the coolant temperature increases, the resistive value decreases.



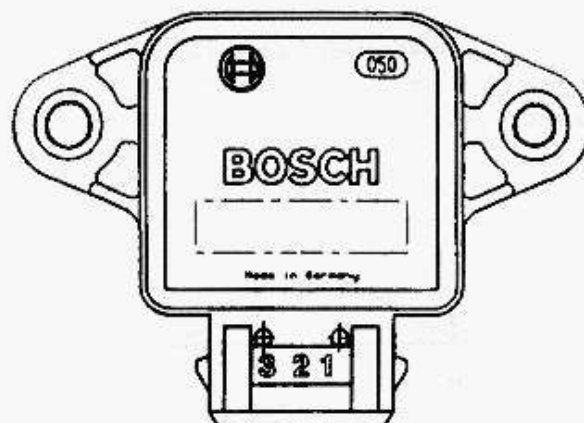
As the variation in resistance is not linear, it is greater for increases at low temperatures than at higher temperatures when the increase in temperature is equal.



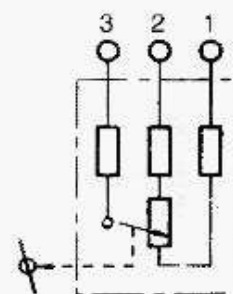
NOTE: The operating principle is valid for the air temperature sensor as well, which is inserted in the air flow meter.

Sensor on throttle

The sensor on the throttle is made up of a potentiometer which detects the degree of opening of the throttle and sends an electric signal to the control unit.



Sensor on throttle



Sensor on throttle - Wiring diagram

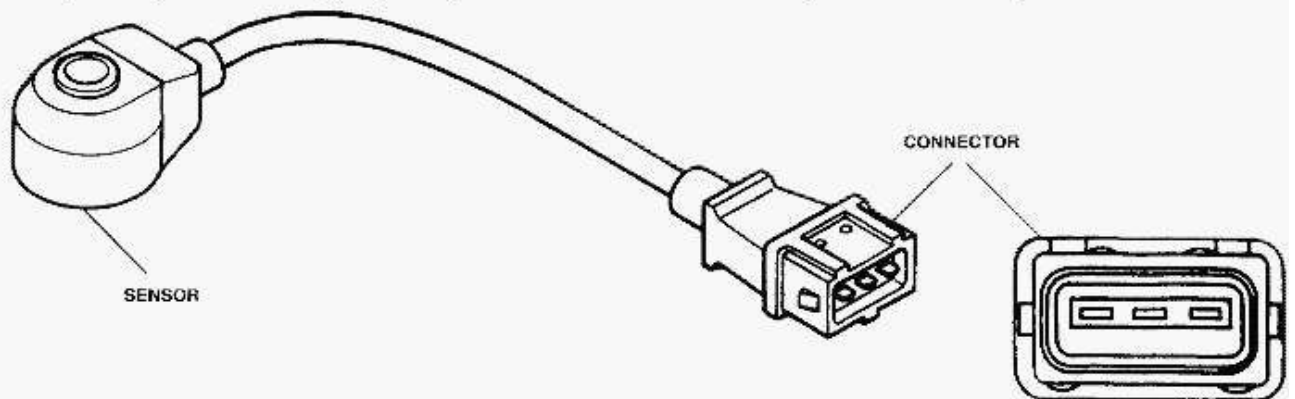
Knocking sensor

The knocking sensors are located on the engine block in the engine vee. They are made up of a piezoelectric plate and a seismic mass contained in plastic. Their function is to measure the vibrations produced by the engine, by exploiting a particular characteristic of the piezoelectric materials, which generate an outgoing voltage when sub-

jected to mechanical stress. This voltage is filtered and analysed by the control unit which corrects the ignition angle with a "delay".

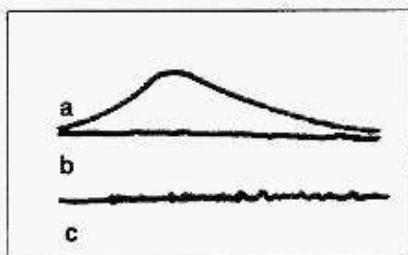
The recognition and limitation of the knocking takes place for each cylinder.

As the knocking signals are assigned to the relative cylinder (see cam angle sensor), it is possible to perform an individual adjustment for each cylinder.

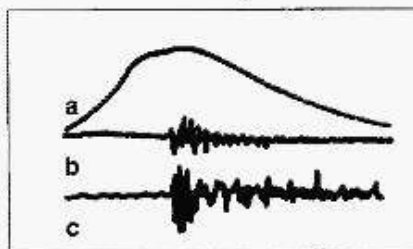


The knocking sensor gives out a signal (c), which corresponds to the pressure trend (a) of the cylinder. The filtered pressure signal is represented by (b).

Without knocking in head



With knocking in head

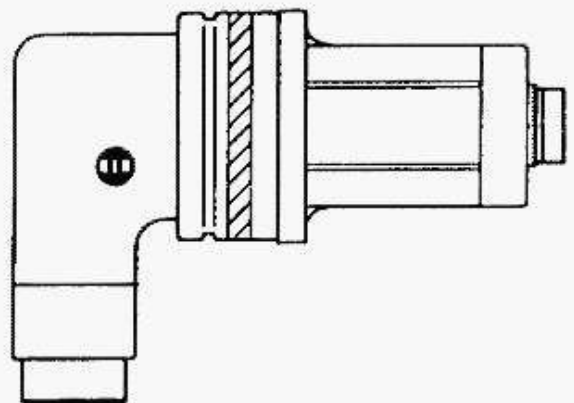


Knocking sensor signals

Cam angle sensor

The cam angle sensor acts as a timing sensor which recognises the explosion of the first cylinder.

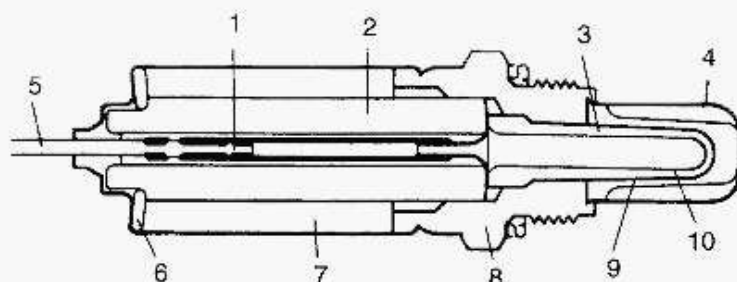
It is located on the head of the engine in correspondence with the exhaust camshaft and measures the passage of a tooth on the shaft itself, 120° before the top dead center of cylinder no. 1 in the explosion stroke. In the event of knocking, the control unit processes the signal of the cam angle sensor with the signal obtained from one of the two knocking sensors and activates a selective delay for each cylinder in the explosion stroke. If the sensor malfunctions, the control unit controls the ignition of the spark plugs 1-5, 4-3, 2-6 simultaneously.



Lambda probe

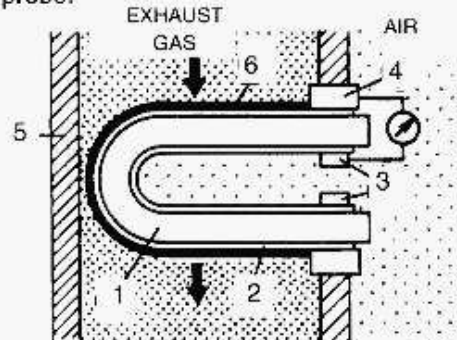
The lambda probe is made up of a capsule of ceramic material which acts as a support for the platinum electrodes. The shape and assembly position of the probe ensure that one electrode is in contact with the exhaust gases and the other is in contact with the atmosphere. To prevent the exhaust gases from corroding the electrode in contact with them, the platinum is covered by a layer of porous ceramic and by a metal capsule which protect the ceramic from impact by any solid particles present in the gases. An electrode is connected directly to ground, whilst the other is connected electrically to a control unit. At high temperatures (above 300°C (572°F)) the layer of ceramic becomes porous and lets the oxygen ions contained in the exhaust gases to pass through, ions

which are deposited on the platinum electrode. Oxygen ions present in the atmosphere are deposited on the electrode in contact with the atmosphere. Due to the different concentration of oxygen ions present on the electrodes, insulated by the ceramic support, a potential difference to the order of a few hundred mV is created, a voltage which indicates if the mixture is lean or rich. In order that the probe rapidly reaches 300°C (572°F), the temperature necessary for its correct functioning, there is a heating resistance present within it (3-20Ω) which is supplied when the engine is in running. Despite the presence of the resistance, for approx. 1 minute from start-up, the probe does not provide any electrical signal. It is crucial that UNLEADED PETROL be used, as the chemical component would irreparably damage the lambda probe.



- | | |
|---------------------------------------|--------------------------------|
| 1. Contact | 6. Cup spring |
| 2. Ceramic support | 7. Protective cover (air side) |
| 3. Probe ceramic | 8. Casing (-) |
| 4. Protective pipe (exhaust gas side) | 9. Electrode (-) |
| 5. Electric connection | 10. Electrode (+) |

Lambda probe



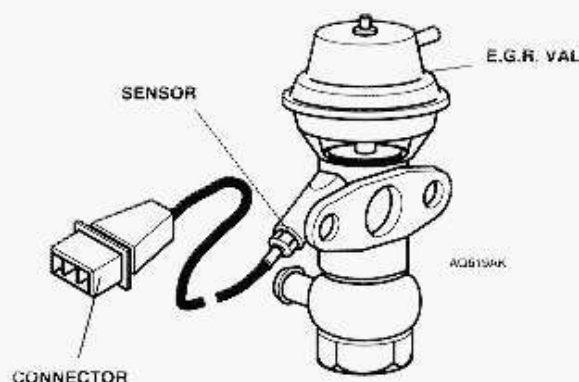
- | | |
|-----------------------|--------------------------------------|
| 1. Probe ceramic | 5. Exhaust duct |
| 2. Electrode | 6. Ceramic protective layer (porous) |
| 3. Contacts | |
| 4. Contact on casing. | |

Lambda probe functioning

E.G.R. temperature sensor

The temperature sensor, mounted on the E.G.R. valve, detects the exhaust gas temperature. The sensor is made up of a negative temperature coefficient resistance (NTC) designed according to the latest semiconductor technology; as a consequence, if the exhaust gas temperature increases, the resistive value decreases according to the value indicated in the table below.

temperature	resistance (KΩ)
50°C (122°F)	635 ± 77
100°C (212°F)	85.3 ± 8.8
200°C (392°F)	5.1 ± 0.61



ACTUATORS

The actuators are:

- electroinjector;
- constant idle speed actuator
- air pump
- 3-way pierburg solenoid valve
- E.G.R. control solenoid valve

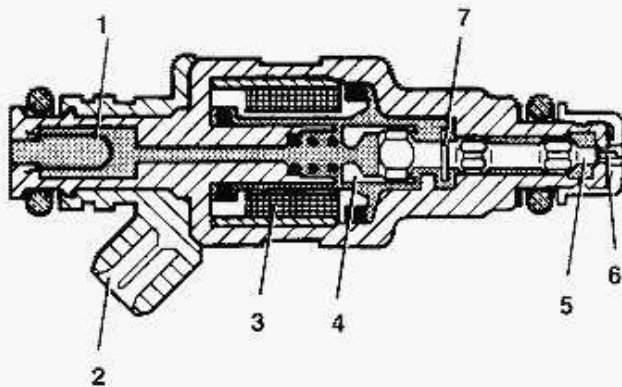
Electroinjector

The pin within the electroinjector is activated due to the effect of the magnetic field created by the coil controlled by the control unit.

The mobile core, and therefore the pin, complete a very limited stroke (0.15 mm/0.0059 in.) due to the stop limit which is also used to stop the mobile core from knocking against the internal fixed part.

The injector pin shape allows it to realise a conic spray which improves the vaporization of the fuel.

For this reason the positioning of the electroinjector has been studied so that the spray does not lap the walls of the manifold, but deposits on the head of the valve which is the hottest point.

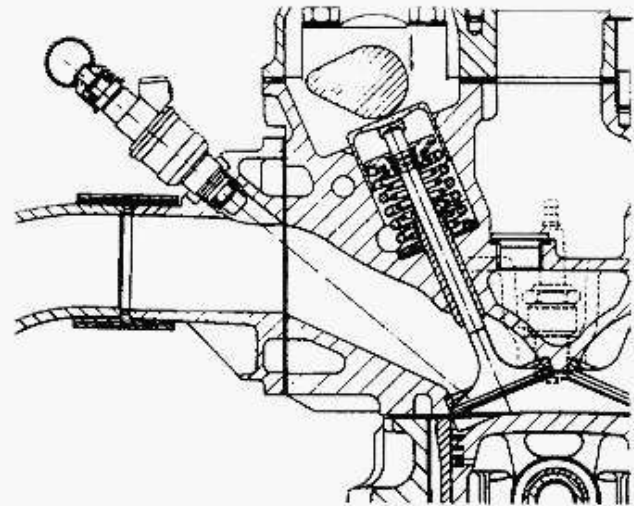


1. Filter
2. Supply connection
3. Winding
4. Magnetic armature
5. Nozzle
6. Sprayer pin
7. Stop limit

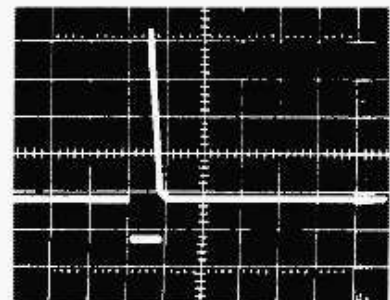
This causes further vaporization of fuel, particularly useful when injection takes place with the valve closed.

The end of the electroinjector is also fitted with a protective thermic bushing in teflon in order to prevent the evaporation of the fuel which causes the dry residue on the pin to crystalize.

The electroinjectors are controlled in parallel and inject at the same time, once for each revolution of the crankshaft except during the start-up stage.



Electroinjector positioning



Pulsations on electroinjector oscilloscope

Constant idle speed actuator

A by-pass line is envisaged on the throttle body realized with a hose, where an idle speed regulator has been inserted.

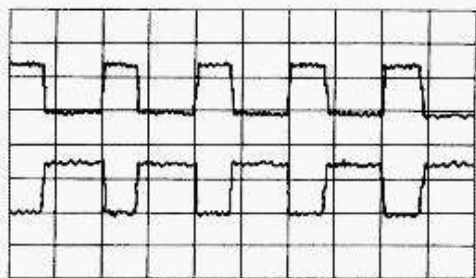
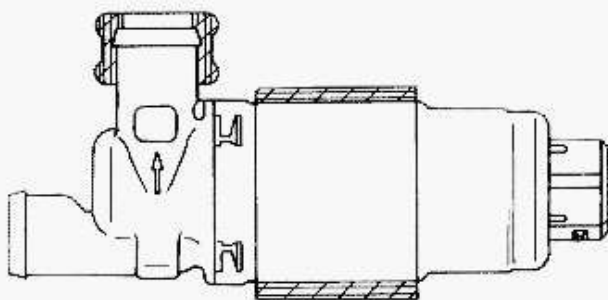
Its passage section determines, when the throttle is closed or only slightly open, a flow of air not controlled by the accelerator but by the electronic control unit.

The constant idle speed actuator uses a rotating double-winding regulator; when ordered to do so by the control unit it moves a rotating box in the opening and closing direction. The control of the constant idle speed actuator is carried out with a variable number of pulsations (variable duty cycle) at a fixed frequency of 100 Hz.

For a set number of pulsations, with a constant battery voltage and winding temperature, the rotating box has a well defined angular position and consequently a precise by-pass opening section.

The idle speed regulator is managed by the relative part of the program memorized in the control unit.

The constant idle speed regulator is mainly used to determine the exact quantity of air during start-up and to maintain an ideal idle speed regardless of the engine's running conditions.



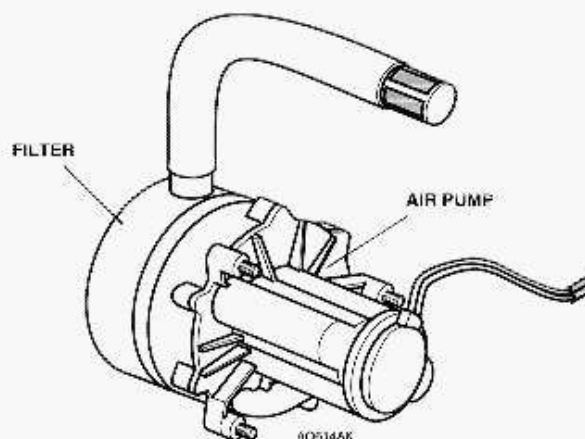
Constant idle speed actuator control signal

Air pump

The electric air pump, with a delivery flow rate of approx. 2.2 psi (15 kPa) is located under the left-side lokari.

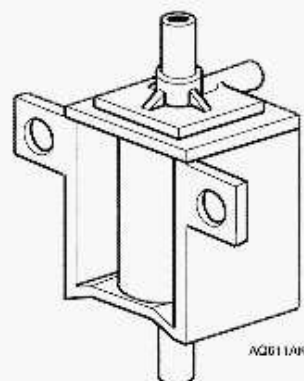
This pump blows air inside the exhaust manifolds, thus reducing toxic emissions during start-up.

A centrifugal dust filter, mounted on the pump inlet, prevents dust from entering the system.



3-way pierburg solenoid valve

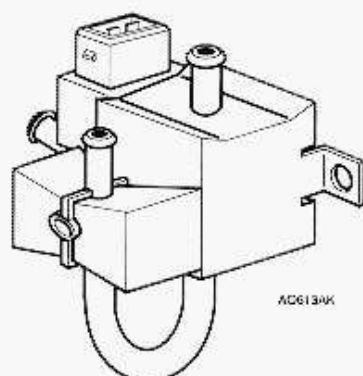
The Pierburg solenoid valve, mounted near the air filter, connects the vacuum chamber either with the shut-off valve (air pump - exhaust manifolds connection) and the E.G.R. valve. The switching control signal is sent by the Motronic control unit, according to a prefixed internal mapping.



E.G.R. control solenoid valve

The E.G.R. control solenoid valve is located beside the air filter.

Upon the Motronic control unit signal, the solenoid valve modulates the E.G.R. valve opening, through the vacuum pressure obtained in the vacuum chamber.



FUNCTIONAL DESCRIPTION

The Motronic control unit **S11** controls and regulates the whole electronic ignition and injection system.

This control unit contains a memorized program which controls the injection and ignition time of the spark plugs in relation to r.p.m. and engine load, incoming air temperature and engine temperature.

The control unit **S11** has two power supplies at 12V: one, originating directly from the battery through 3A fuse **S46**, applied at pin 26, the other, represented by 12 V with the key turned, originates from the ignition switch applied at pin 56.

Relay **S12b** supplies power to pin 54 and 62 of the control unit only when the ignition key is in the "RUN" position and the control unit has given the ground consensus (pin 27) to relay **S12b** itself.

The control unit **S11** activates the electric fuel pump through relay **S12a**: this relay is energized when pin 1 of control unit **S11** is grounded.

The control unit **S11** calculates and controls the opening time of the electroinjectors **S3** on the basis of the internal program and the information obtained from the various sensors. The six electroinjectors **S3** are supplied in

parallel by 12V with the key turned; the activation is controlled by the control unit which grounds simultaneously two pairs of three injectors, each through pins 3 and 32.

The engine speed is supplied at pins 67 and 68 of the control unit **S11** by the timing and r.p.m. sensor **S31**: this sensor is of the inductive type and measures the magnetic variations caused by the teeth on the phonic wheel integrated into the crankshaft.

The throttle sensor **S38** is made up of a potentiometer which provides a signal proportional to the opening angle of the throttle at pin 12 of control unit **S11**.

The engine temperature sensor **S7** is a NTC resistance (negative temperature coefficient) and provides the information relative to the engine temperature at pin 78 of control unit **S11**.

The air flow meter **S5** measures the flow of air coming into the engine and provides a signal to the control unit **S11** which allows the correct dosage of fuel to be supplied. The signal is generated by a potentiometer integrated into a mobile flap sensitive to the air coming into the engine: this potentiometer transmits a voltage corresponding to the angle of the mobile flap to pin 41 of the control unit **S11**.

The air temperature sensor (NTC) located within the air flow meter **S5** measures the temperature of the air which has been sucked in. When the throttle is closed or only partially open, the control unit **S11** controls the flow of air through the constant idle speed actuator **S29** which functions like a by-pass line on the throttle body.

The constant idle speed actuator **S29** is controlled by a part of the program in the control unit **S11** and is used to maintain the idle speed at a constant value regardless of engine conditions.

The ignition system is integrated into the control unit **S11** and in the power modules **N21a** and **N21b** and allows the spark to be regulated through a memorized program.

The ignition control signals are supplied by pins 24, 52, 25 and 50, 23, 51 of control unit **S11** respectively to the power modules **N21a** and **N21b**: the three outlets for each power module send activation signals to the coils which in turn generate high voltage impulses for the spark plugs. The evaporative solenoid valve **M15** supplied at 12V, is opened by the control unit **S11** (pin 36) only when the ignition key is in the "RUN" position and the engine is under loaded; vice versa it is closed when the engine is cold or at idle speed.

The heated lambda probe **S35**, in contact with the exhaust gases, generates an electric signal, the value of

which depends on the concentration of residue oxygen in the exhaust gases themselves.

This signal is characterised by a sudden variation when the air-fuel mixture is not optimal.

When the signal voltage of the probe **S35** is low, the control unit recognises when the mixture is lean and increases slightly the amount of fuel injected. When the signal voltage is high, the control unit recognises that the mixture is rich and slightly decreases the amount of fuel injected.

The heated lambda probe **S35** is heated by a resistance supplied by the fuel pump relay **S12a** through a 7.5A fuse **S45**. The heater/ventilation system (if present) is activated by the control unit **S11** on the basis of the engine's operating conditions.

To this end the control unit **S11** receives the activation request from the user at pin 86 and the consensus by the heater/ventilation system at pin 85 (freon pressure in accordance with the norm, no ice on evaporator): if the engine operating conditions permit it, the control unit **S11** (pin 48) sends the activation command for the electromagnetic coupling of the air conditioning.

For vehicles equipped with the electronic automatic gearbox there is an information exchange between the ignition/injection control unit **S11** and the automatic gearbox control unit.

This exchange of information takes place through the coupling **G336**: in particular the injection control unit

sends the information regarding the engine load, throttle angle and r.p.m to pin A, B and D of the electronic automatic gearbox control unit whilst pin C receives the engine torque reduction signal.

The Motronic control unit is equipped with a self diagnosis system which allows, as far as possible, the replacement of the incorrect functioning parameters due to the presence of faults with the other parameters memorized which guarantees the functioning of the system.

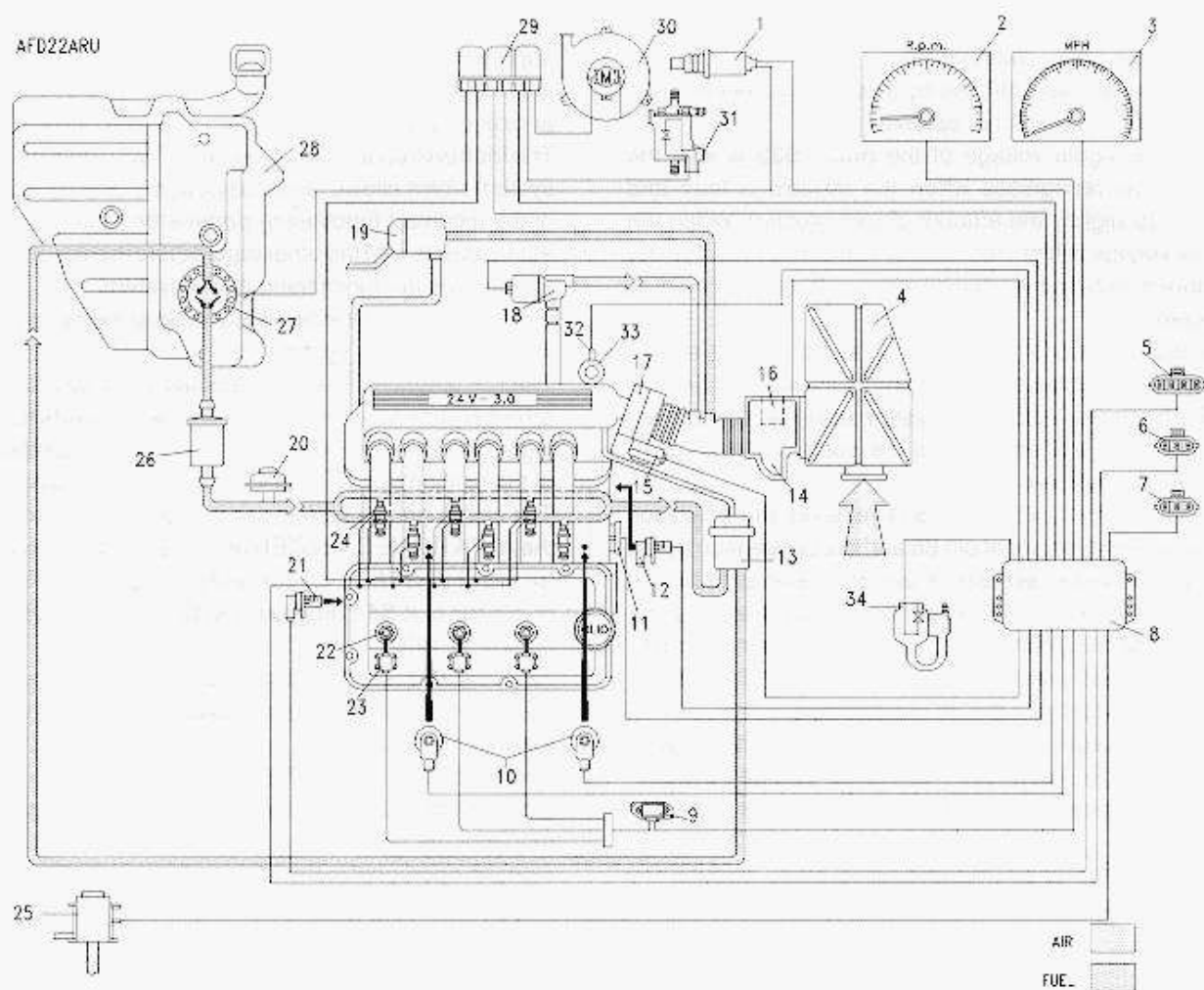
The self diagnosis system is also able to memorize the faults found in the system.

The self diagnosis of the control unit is not able to pick up errors in parameters which directly challenge its functioning such as: r.p.m./timing sensor and some components of the ignition system and the presence of power supply.

The self diagnosis system can be used by connecting it to the ALFA ROMEO TESTER at connector **T1**: this connector has 3 pins (A, B, C) connected respectively to pin 8 of control unit **S11**, to ground **G131** and to pin 88 of the control unit **S11**.

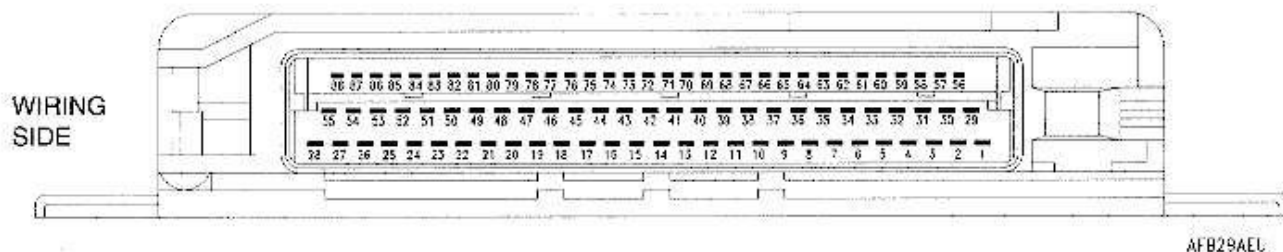
Air pump **S53** and the 3-way solenoid valve are activated by relay **S54** which is in turn piloted by control unit **S11** thru pin 18.

Solenoid valve **L46** for the E.G.R. valve control, is energized by pin 37 of control unit **S11**, whilst sensor **S56** monitors the recirculation gas temperature and sends a signal proportional to the temperature on pin 63 of control unit **S11**.



- | | |
|--|-----------------------------------|
| 1. Lambda probe | 18. Constant idle speed actuator |
| 2. Tachometer | 19. Oil vapor separator |
| 3. Speedometer | 20. Pulsation damper |
| 4. Air filter | 21. R.p.m. and timing sensor |
| 5. Connection with Electronic Automatic Transmission | 22. Spark plug |
| 6. Heater/ventilation unit connection | 23. Ignition coil |
| 7. Socket for system diagnosis (Fiat Tester) | 24. Electroinjectors |
| 8. Ignition/injection control unit | 25. Evaporative solenoid valve |
| 9. Power module | 26. Fuel filter |
| 10. Knock sensor | 27. Fuel electropump |
| 11. Thermostat with coolant temperature sensor (NTC) | 28. Fuel tank |
| 12. Cam angle sensor | 29. Relay assembly |
| 13. Fuel pressure regulator | 30. Air pump |
| 14. Air flow meter | 31. 3-way pierburg solenoid valve |
| 15. Throttle potentiometer | 32. E.G.R. temperature sensor |
| 16. Intake air temperature sensor | 33. E.G.R. valve |
| 17. Throttle body | 34. E.G.R. control solenoid valve |

Functional diagram of ignition and injection system



AFB29AEL

Motronic M1.7 control unit comb

PIN	DESTINATION	PIN	DESTINATION	PIN	DESTINATION
1.	pump relay activation	30.	N.C.	61.	N.C.
2.	R.P.M. signal (CAE)	31.	N.C.	62.	type version
3.	idle speed actuator closure winding control	32.	electroinjector control (group 2)	63.	E.G.R. temperature sensor
4.	electroinjector control (group 1)	33.	N.C.	64.	N.C. (CM)
5.	N.C.	34.	actuator piloting ground phase	65.	torque control (CAE)
6.	injector group piloting ground phase	35.	N.C.	66.	N.C. (CM)
7.	N.C.	36.	evaporation solenoid valve	67.	selected gear signal relay (CAE)
8.	N.C. (malfunction warning lamp)	37.	E.G.R. control solenoid valve	68.	N.C.
9.	N.C.	38.	N.C.	69.	R.P.M. and timing sensor (warning pole) signal
10.	N.C.	39.	N.C.	70.	R.P.M. and timing sensor (control pole) ground
11.	N.C. (CM)	40.	N.C.	71.	N.C.
12.	throttle angle/engine temp. (CAE)	41.	air flow meter signal	72.	lambda probe sensor
13.	throttle angle position signal	42.	knock sensor	73.	lambda probe signal ground
14.	N.C.	43.	ground for: sensor on throttle body (pot.)/knock sensors/engine coolant temp. sensor	74.	N.C.
15.	ground for air flow meter	44.	came angle sensor	75.	revolution sensor
16.	knock sensor	45.	N.C.	76.	revolution sensor
17.	came angle sensor	46.	N.C.	77.	N.C.
18.	N.C.	47.	N.C.	78.	air temperature sensor
19.	Air pump relay	48.	compressor relay activation	79.	engine temperature sensor
20.	N.C.	49.	N.C.	80.	N.C.
21.	N.C.	50.	power module control b	81.	N.C.
22.	N.C.	51.	power module control b	82.	anti-theft
23.	power module control a	52.	power module control a	83.	N.C.
24.	power module control a	53.	N.C.	84.	N.C.
25.	positive direct from battery	54.	key operated +12V (from relay with diode)	85.	compressor cut-in request (from heat/vent)
26.	motronic relay activation with diode	55.	ground for ignition system	86.	compressor cut-in permit (trinal and min. pressure)
27.	Electronic ground and shielding	56.	key operated +12V (from auxiliary relay)	87.	diagnosis line L
28.	idle speed actuator opening winding control	57.	N.C.	88.	diagnosis line K
29.		58.	N.C.		
		59.	+5V (throttle body potentiometer/air flow meter power supply)		
		60.	N.C.		

TROUBLESHOOTING THROUGH SELF DIAGNOSIS

The Motronic M1.7 system uses two different self diagnosis procedures which both allow the most common defects observed when the vehicle is used to be identified:

- procedure using the ALFA ROMEO TESTER (see suitable publication)
- procedure using FLASHING CODE (CHECK ENGINE warning light)

This troubleshooting is based on the indications of the FLASHING CODE.

Each fault is highlighted according to the composition of the fault code.

Some faults which may occur within the system can not be recognised by the self diagnosis system within the control unit **S11**: for this reason supplementary checks are provided for the components which are not controlled by the FLASHING CODE.

In general each test should be considered separately and should only be carried out on the component affected.

There are the following exceptions:

- TEST A allows an incorrect or non existent power supply to the whole system to be identified.
- TESTS Q, R, S allow a fault which leads to the incapability of the vehicle to start to be identified.
- TEST T allows the communication lines between the ignition/injection control unit and the electric automatic gearbox to be checked.

- TEST X allows the air pump faulty operation to be identified
- TEST Y allows the 3-way pierburg solenoid valve faulty operation to be identified

FLASHING CODE

The Motronic M1.7 control unit is equipped with a built-in auto diagnostic system able to provide the list of the error memorized during running by the flashing of the CHECK ENGINE warning light located on the instrument panel. Each error code is made up of 4 blocks.

The first block of information is made up of short flashes each of which lasts 0.5 secs at an interval of 0.5 secs. THE NUMBER OF FLASHES SHOULD BE NOTED.

At the end and after a pause of approx. 2.5 secs, the second block starts and so on for the third and fourth blocks.

Obviously, for each of the four blocks, the number of flashes must be noted which, at the end, will give a four figure number which represents the fault code which should then be looked up in the attached table.

The procedure is the following:

- Turn the ignition key to "RUN".
- Press the gas pedal 5 times in less than 5 seconds and check that the warning light flashes.

Note the number of flashes in order to identify the error code memorized.

Continue the diagnosis on the basis of the indication contained in the attached table relative to the error code that has been identified.

If the warning light does not flash, carry out test A to check the supply voltage to control unit **S11**.

CODE	FAULT	SEE TEST
	No flash - supply circuit control unit faulty	A
4444	No stored faults	If it does not start carry out tests Q, R, S
1211	Incorrect battery voltage	Restore correct voltage by recharging or replacing the battery
1214	Engine temperature sensor faulty	B
1216	Throttle angle sensor faulty	C
1221	Air flow meter faulty	D
1222	Constant idle speed actuator faulty (opening winding)	E
1223	Lambda probe regulation faulty	F
1224	Heated lambda probe faulty	G
1225	Air temperature sensor faulty	H
1226	ECU faulty	Replace control unit S11
1231	Electroinjectors faulty	I
1232	Electroinjectors faulty	I
1233	Constant idle speed actuator faulty (closing winding)	E
1235	A/C input signal faulty	J
1236	Heater/ventilation system (compressor control faulty)	K
1243	Petrol pump relay faulty	L
1244	Evaporative solenoid valve faulty	M
1251	Eprom control unit faulty	Replace control unit S11
1252	Speed sensor faulty	N
1254	Throttle angle sensor faulty	C

(Cont.)

CODE	FAULT	SEE TEST
1255	Cam angle sensor faulty	O
1274	E.G.R. control solenoid valve faulty	U
1275	E.G.R. gas delivery valve faulty	V
1276	No power supply to air pump relay	W
2111	Knock sensor 1 faulty	P
2112	Knock sensor 2 faulty	P
2113	Knock regulator faulty (voltage regulator)	Replace control unit S11
2116	Knock regulator faulty (voltage regulator)	Replace control unit S11
	R.p.m. and timing sensor	Q
	Fuel circuit	R
	Ignition	S
	Check communication lines between Electronic automatic gearbox	T

CHECK POWER SUPPLY TO CONTROL UNIT		TEST A	
TEST STEPS		RESULTS	REMEDY
A1	BATTERY VOLTAGE CHECK		
- Check that the battery voltage is 12V NOTE: disconnecting the battery will cause the errors memorized within the control unit S11 to be lost and it will be necessary, in order to re-memorize them, to carry out on-road tests		 ► Go to step A2	
		 ► Restore the correct voltage by recharging or replacing the battery A1	
A2	FUSE CHECK		
- Check the state of the fuse S46 NOTE: removing the fuse S46 and the general loss of supply to pin 26 of control unit S11 will cause the errors memorized to be lost and it will be necessary to carry out on road tests in order to re-memorize them		 ► Go to step A3	
		 ► Replace the 3A fuse S46 after having checked the insulation with respect to ground of the wiring relative to pin 26 of control unit S11	
A3	VOLTAGE CHECK		
- Remove relay S12b - Verify +12V (battery voltage) at pins 30 and 86 of the base of relay S12b		 ► Go to step A4	
		 ► Restore the wiring between the branch terminal board G56 and pin 30 and/or 86 of relay S12b	
A4	VOLTAGE CHECK		
- Turn the ignition key to "RUN" - Verify 0V (zero voltage) at pin 85 of base of relay S12b		 ► Go to step A9	
		 ► Go to step A5	
A5	GROUND CHECK		
- Disconnect the comb of control unit S11 NOTE: Disconnecting the comb will cause the errors memorized in the control unit S11 to be lost and it will be necessary to carry out on-road tests in order to re-memorize them		 ► Go to step A6	
- Verify that pins 6, 28, 34, 55 (and pin 63 for vehicles equipped with electronic automatic gearbox) of control unit S11 are grounded (0V)		 ► Restore wiring between the pins in question and the ground G131	

(Cont.)

CHECK POWER SUPPLY TO CONTROL UNIT

TEST A

TEST STEPS		RESULTS	REMEDY
A6	VOLTAGE CHECK	 ►	Go to step A7
	- Verify +12V (battery voltage) at pin 26 of control unit S11	 ►	Restore wiring between pin 26 of S11 and the derivation terminal board G56 , through the loose fuse S46
A7	VOLTAGE CHECK	 ►	Go to step A8
	- Turn key to "RUN" position - Verify +12V (battery voltage) at pin 56 of control unit S11	 ►	Restore wiring between the ignition switch B1 and pin 56 of S11 through the connector G154 (pin 1)
A8	CONTINUITY CHECK	 ►	Replace control unit S11
	- Verify the continuity between pin 85 of relay S12b and pin 27 of control unit S11	 ►	Restore the wiring between pin 85 of relay S12b and pin 27 of control unit S11
A9	RELAYS CHECK	 ►	Go to step A10
	- Reinstall relay S12b - Turn the key to "RUN" and verify 12V (battery voltage) at the two pins 87 of relay S12b	 ►	Replace relay S12b
A10	VOLTAGE CHECK	 ►	Go to step A11
	- Disconnect relay S12a - Turn the key to "RUN" and verify 12 V (battery voltage) at pin 30 of base of relay S12a	 ►	Restore the wiring between ignition switch and pin 30 of relay S12a through connector G154 (pin 1)
A11	CONTINUITY CHECK	 ►	The control unit supply voltage is present. Repeat the procedure to visualise the errors of control unit S11
	- Disconnect the comb of control unit S11 and verify the continuity between pin 87 of relay S12b and pin 54/62 of comb of control unit S11	 ►	Restore the wiring between pin 87 of relay S12b and pin 54 and/or 62 of the comb of control unit S11

End of test A

CHECK ENGINE TEMPERATURE SENSOR (PIN 78 WIRING)

TEST B

TEST STEPS		RESULTS	REMEDY
B1	RESISTANCE CHECK		
- Disconnect the connector from the engine temperature sensor S7 - Position the multimeter at 20 Kohm F.S. - Check the resistance dependent on the temperature as in the curve below:		OK ► Go to step B2	
RESISTANCE Ohm TEMPERATURE °C (°F)		~~OK~~ ► Replace the engine temperature sensor S7	
B2	CONTINUITY CHECK		
- Check continuity between pin 78 of comb of injection control unit S11 and connector of engine temperature sensor S7 pin 1 (BRN wire)		OK ► Go to step B3	
		~~OK~~ ► Restore the wiring between sensor connector S7 and pin 78 of S11	
B3	CONTINUITY CHECK		
- Check continuity between pin 43 of comb of control unit S11 and engine temperature sensor connector S7 pin 2 (orange wire)		OK ► Replace the control unit S11	
		~~OK~~ ► Restore the wiring between sensor S7 and pin 43 of S11	

End of test

CHECK THROTTLE ANGLE SENSOR (PIN 12 CONTROL UNIT)

TEST C

TEST STEPS		RESULTS	REMEDY
C1	VOLTAGE CHECK	 ►	Go to step C4
	- Turn ignition key to "RUN" - Verify 5V between pin 1 and pin 2 of throttle angle sensor S38	 ►	Go to step C2
C2	CONTINUITY CHECK	 ►	Go to step C3
	- Disconnect the throttle angle sensor S38 and check the continuity between pin 1 of connector sensor S38 and pin 59 of control unit S11	 ►	Restore the continuity of the wiring between pin 1 of throttle angle sensor connector S38 and pin 59 of control unit S11
C3	CONTINUITY CHECK	 ►	Replace control unit S11
	- Check the continuity between pin 2 of throttle angle sensor connector S38 and pin 43 of control unit S11	 ►	Restore the continuity of the wiring between pin 2 of throttle angle sensor connector S38 and pin 43 of control unit S11
C4	VOLTAGE CHECK	 ►	Go to step C5
	- Turn ignition key to "RUN" - Check that the voltage value between pins 2 and 3 of the throttle angle sensor connector S38 varies with the continuity as the degree of opening of the throttle varies from 0 to 5V	 ►	Replace the throttle angle sensor S38
C5	CONTINUITY CHECK	 ►	Go to step C6
	- Disconnect the connector of the throttle angle sensor S38 and check the continuity of the wiring between pin 3 of connector and pin 12 of comb of control unit S11	 ►	Restore the continuity of the wiring between pin 3 of the throttle angle sensor connector S38 and pin 12 of the control unit S11
C6	INSULATION CHECK	 ►	Replace the control unit S11
	- Check the insulation with respect to ground and at +12V of the wiring between pin 3 of throttle angle sensor connector S38 and pin 12 of comb of control unit S11	 ►	Restore the insulation of the wiring between pin 3 of the throttle angle sensor connector S38 and pin 12 of control unit S11

End of test

CHECK AIR FLOW METER (PIN 41 CONTROL UNIT)		TEST D	
TEST STEPS		RESULTS	REMEDY
D1	VOLTAGE CHECK	 ►	Go to step D4
	- Position the multimeter to 20 V F.S. - Turn the key to "RUN" - Verify 5V between pins 4 and 3 of air flow meter connector S5	 ►	Go to step D2
D2	CONTINUITY CHECK	 ►	Go to step D3
	- Disconnect the air flow meter S5 and check the continuity between pin 3 of connector of air flow meter S5 and pin 59 of control unit S11	 ►	Restore the continuity of the wiring between pin 3 of connector of air flow meter S5 and pin 59 of control unit S11
D3	CONTINUITY CHECK	 ►	Replace control unit S11
	- Check the continuity between pin 4 of connector of air flow meter S5 and pin 14 of control unit S11	 ►	Restore continuity of wiring between pin 4 of connector of air flow meter S5 and pin 14 of control unit S11
D4	VOLTAGE CHECK	 ►	Go to step D5
	- Start up engine - Verify a voltage between 100mV and 300mV at pin 2 of connector of air flow meter S5 - Accelerate and verify that the voltage increases to a value of approx. 5V without gaps in between	 ►	Replace the air flow meter S5
D5	CONTINUITY CHECK	 ►	Replace the control unit S11
	- Disconnect the connector of the air flow meter S5 and check the continuity of the wiring between pin 2 of connector and pin 41 of comb of control unit S11	 ►	Restore the continuity of the wiring between pin 2 of connector of air flow meter S5 and pin 41 of control unit S11

End of test I

CHECK CONSTANT IDLE SPEED ACTUATOR

TEST E

TEST STEPS		RESULTS	REMEDY
E1	VOLTAGE CHECK	 ►	Go to step E2
	- Position the multimeter at 20 V F.S. - Turn the ignition key to "RUN" - Verify 12V (battery voltage) at pin 2 of connector of constant idle speed actuator S29	 ►	Restore the continuity of the wiring between pin 2 of constant idle speed actuator S29 and pin 87 of relay S12b
E2	RESISTANCE CHECK	 ►	Go to step E3
	- Disconnect the connector of the constant idle speed actuator S29 - Verify a resistance of approx. 13 ohm between pins 1 and 2 of constant idle speed actuator S29	 ►	Replace the constant idle speed actuator S29
E3	RESISTANCE CHECK	 ►	Go to step E4
	- Verify a resistance of approx. 26 ohm between pins 2 and 3 of the constant idle speed actuator S29	 ►	Replace the constant idle speed actuator S29
E4	CONTINUITY CHECK	 ►	Go to step E5
	- Remove the ignition key and disconnect the combs of the injection control unit S11 - Check the continuity between pin 1 of the connector of the constant idle speed actuator S29 and pin 2 of comb of control unit S11	 ►	Restore the continuity of the wiring between pin 1 of connector of constant idle speed actuator S29 and pin 2 of control unit S11
E5	CONTINUITY CHECK	 ►	The constant idle speed actuator functions correctly; check control unit S11
	- Check continuity between wiring of pin 3 of connector of constant idle speed actuator S29 and pin 29 of comb of control unit S11	 ►	Restore the continuity of the wiring between pin 3 of connector of constant idle speed actuator S29 and pin 29 of control unit S11

End of test I

CHECK LAMBDA PROBE ADJUSTMENT

TEST F

TEST STEPS		RESULTS	REMEDY
F1	VOLTAGE CHECK	 ►	Replace the control unit S11
	- Position multimeter at 20 V F.S. - Start up engine and, when hot, check, within the r.p.m. range, a voltage value between 0V and 1V at pin 1 of connector of lambda probe S35	 ►	Go to step F2
F2	FOR AIR INFILTRATIONS CHECK	 ►	Go to step F3
	- Check for unwanted air in the air delivery circuit	 ►	Eliminate the unwanted intake of air by checking clamps, condition of sleeves etc.
F3	AIR FILTER CHECK	 ►	Go to step F4
	- Check the state of the air filter during suction	 ►	Replace the air filter
F4	CABLES AND SPARK PLUGS CHECK	 ►	Go to step F5
	- Check that the cables and spark plugs function correctly	 ►	Replace the spark plugs and/or any defective cables
F5	INJECTORS CHECK	 ►	Replace the control unit S11
	- Check that the injectors function correctly	 ►	Replace the injectors which are blocked or unable to close

End of test

CHECK HEATED LAMBDA PROBE

TEST G

TEST STEPS		RESULTS	REMEDY
G1	VOLTAGE CHECK - Turn the key to "RUN" - Verify 12V (battery voltage) on orange-black wire of connector of lambda probe S35	 ►	Go to step G6
		 ►	Go to step G2 Check the state of the fuse S45 and the condition of the wiring from fuse S45 to heating resistance of lambda probe S35 . Replace the fuse or restore the wiring as required.
G2	RESISTANCE CHECK - Verify a resistance of approx. 3 ohm between the black and orange wires of lambda probe S35	 ►	Go to step G3
		 ►	Replace lambda probe S35
G3	INSULATION CHECK - Verify the insulation with respect to ground of the wiring between the orange-black wire of connector of lambda probe S35 and fuse S45	 ►	Go to step G4
		 ►	Restore the insulation of the wiring between the orange-black wire of connector of lambda probe S35 and fuse S45
G4	CONTINUITY CHECK - Check the continuity of the wiring between the orange-black wire of connector of lambda probe S35 and pin 2 of connector G154 through fuse S45 and S47	 ►	Go to step G5
		 ►	Restore the condition of the wiring between the orange-black wire of connector of lambda probe S35 and pin 2 of connector G154 ; if necessary replace any burned fuses
G5	GROUND CHECK - Check that the black wire of the connector of the lambda probe is grounded (0V)	 ►	Go to step G6
		 ►	Restore the wiring between the black wire of the connector of the lambda probe S35 and the ground G131

(Cont.d)

CHECK HEATED LAMBDA PROBE

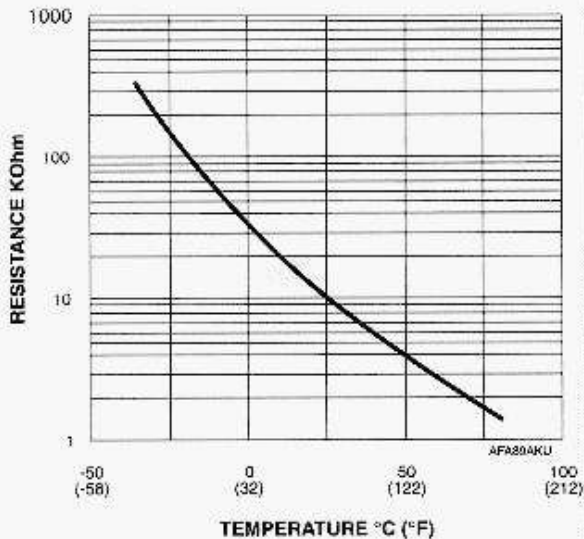
TEST G

TEST STEPS		RESULTS	REMEDY
G6	VOLTAGE CHECK		
Start up the engine and, when hot, verify, within the r.p.m. range, a voltage value between approx. 0V and 1V at pin 1 of connector of lambda probe S35		 ► Replace the control unit S11	
		 ► Go to step G7	
G7	CONTINUITY CHECK		
Disconnect the comb of the control unit S11 and the connector of the lambda probe S35; verify the continuity of the wiring between pin 71 of comb of control unit S11 and pin 1 of connector, wiring side of lambda probe S35		 ► Go to step G8	
		 ► Restore the continuity of the wiring between pin 71 of control unit S11 and pin 1 of connector wiring side of lambda probe S35	
G8	CONTINUITY CHECK		
Check the continuity of the wiring between pin 70 of comb of control unit S11 and pin 2 of connector wiring side of lambda probe S35		 ► Replace the lambda probe S35	
		 ► Restore the continuity of the wiring between pin 70 of comb of control unit S11 and pin 2 of connector wiring side of lambda probe S35	

End of test

CHECK AIR TEMPERATURE SENSOR (PIN 77 CONTROL UNIT)

TEST H

TEST STEPS		RESULTS	REMEDY
H1	RESISTANCE CHECK		
- Position the multimeter at 20 Kohm F.S - Verify between pins 1 and 4 of the air flow meter S5 the resistance dependent on the temperature as in the curve below:		☒ OK ► Go to step H2	
 RESISTANCE Kohm TEMPERATURE °C (°F) AFA20AKU		☐ OK ► Replace the air flow meter S5	
H2	CONTINUITY CHECK		
- Check the continuity between pin 1 of connector of air flow meter S5 and pin 77 of comb of control unit S11		☒ OK ► Go to step H3	
		☐ OK ► Restore the wiring between pin 1 of air flow meter S5 and pin 77 of control unit S11	
H3	CONTINUITY CHECK		
- Check the continuity between pin 4 connector of air flow meter S5 and pin 14 of comb of control unit S11		☒ OK ► Replace the control unit S11	
		☐ OK ► Restore the wiring between pin 4 of air flow meter S5 and pin 14 of control unit S11	

End of test

CHECK ELECTROINJECTORS MAIN BEARING 1 (2)

TEST I

TEST STEPS		RESULTS	REMEDY
I1	VOLTAGE CHECK		
- Turn the key to "RUN" - Verify 12V at pin 87 of purple-black wire of relay S12b		 ► Go to step I2	
		 ► Check that the relay S12b and the supply are correct by carrying out TEST A	
I2	RESISTANCE CHECK		
- Check a resistance of approx. 6 ohm between the terminals of each electroinjector		 ► Go to step I3	
		 ► Identify and replace the electroinjectors which are interrupted or short circuited	
I3	CONTINUITY CHECK		
- Check the electrical continuity between pin 87 of relay S12b and red conductor of each electroinjector		 ► Go to step I4	
		 ► Restore the wiring from pin 87 of relay S12b to the electroinjectors by passing through the intermediary stapling	
I4	CONTINUITY CHECK		
- Check the electrical continuity between pin 3 of the control unit S11 (wiring side) and the grey-red conductors of the electroinjectors relative to cylinders 1, 2 and 4		 ► Go to step I5	
		 ► Restore the wiring from pin 3 of the control unit S11 to the electroinjectors of the main bearing 1	
I5	CONTINUITY CHECK		
- Check the electrical continuity between pin 32 of the control unit S11 (wiring side) and the yellow-red conductors of the electroinjectors relative to cylinders 3, 5 and 6		 ► Replace the control unit S11	
		 ► Restore the wiring from pin 32 of the control unit S11 to the electroinjectors of main bearing 2	

End of test

CHECK HEATER/VENTILATION INLETS

TEST J

TEST STEPS		RESULTS	REMEDY
J1	SYSTEM CHECK		
- Disconnect the connector G337 and check the wiring between the heater/ventilation system vehicle side connector G337 (pin B and C)		OK ►	Go to step J2
		~~OK~~ ►	Restore the wiring or replace the faulty components of the heater/ventilation system
J2	INSULATION CHECK		
- Disconnect the comb of the control unit S11 - Check the insulation of the wiring between pins B and C of connector G337 system side and pins 86 and 85 of comb of control unit S11		OK ►	Go to step J3
		~~OK~~ ►	Restore the insulation of wiring between pins B and C connector G337 system side and pin 86 and 85 of comb of control unit S11
J3	CONTINUITY CHECK		
- Check the continuity of the wiring between pin B and C of connector G337 system side and the respective pins 86 and 85 of comb of control unit S11		OK ►	Replace the control unit S11
		~~OK~~ ►	Restore the continuity of the wiring between pin B and C connector G337 system side and pin 86 and 85 of comb of control unit S11

End of test

CHECK HEATER/VENTILATION SYSTEM COMPRESSOR CONTROL

TEST K

TEST STEPS		RESULTS	REMEDY
K1	INSULATION CHECK	OK ►	Go to step K2
	- Disconnect the connector G337 and check insulation of pin A of connector G337 system side with respect to ground	~~OK~~ ►	Restore the insulation of wiring between pin A connector G337 system side and ground
K2	CONTINUITY CHECK	OK ►	Go to step K3
	- Disconnect the comb of control unit S11 and check the continuity of the wiring between pin A of connector G337 system side and pin 48 of control unit S11	~~OK~~ ►	Restore the continuity of the wiring between pin A of connector G337 system side and pin 48 of control unit S11
K3	SYSTEM CHECK	OK ►	Replace the control unit S11
	- Carry out TEST D procedure relative to the heater/ventilation system	~~OK~~ ►	Eliminate the defects from the heater/ventilation system

End of test K

CHECK FUEL PUMP RELAY

TEST L

TEST STEPS		RESULTS	REMEDY
L1	VOLTAGE CHECK	OK ►	Go to step L2
	Remove the relay S21a and verify, with the key in the "RUN" position, 12V at pin 30 of base of relay S12a	 ►	Restore the wiring between pin 30 relay S12a and pin 1 of connector G154
L2	RESISTANCE CHECK	OK ►	Go to step L3
	Check that the resistance of winding of relay S12a is approx. 50 ohm	 ►	Replace relay S12a
L3	CONTINUITY CHECK	OK ►	Replace control unit S11
	Disconnect the comb of control unit and check the continuity between pin 1 of control unit S11 and pin 85 of relay S12a	 ►	Restore the continuity of wiring between pin 1 of control unit S11 and pin 85 of relay S12a

End of test I

CHECK EVAPORATIVE SOLENOID VALVES

TEST M

TEST STEPS		RESULTS	REMEDY
M1	VOLTAGE CHECK	OK ►	Go to step M2
	- Disconnect the purple/black wire from the solenoid valve M15 and, with the key in the "RUN" position, verify 12V (battery voltage) on purple/black wire	~~OK~~ ►	Restore the wiring between the purple/black wire of solenoid valve M15 and pin 87 base of relay S12b
M2	CONTINUITY CHECK	OK ►	Go to step M3
	- Disconnect the light blue wire from the solenoid valve M15 and the comb of the control unit S11 ; check the continuity between pin 36 of control unit S11 and the light blue wire of the solenoid valve M15	~~OK~~ ►	Restore the continuity of the wiring between the light blue wire of the solenoid valve M15 and pin 36 of the control unit S11
M3	INSULATION CHECK	OK ►	Go to step M4
	- Check insulation between the light blue wire of solenoid valve M15 and ground	~~OK~~ ►	Restore the insulation of the wiring between the light blue wire of the solenoid valve M15 and ground
M4	RESISTANCE CHECK	OK ►	Replace control unit S11
	- Verify approx. 50 ohm at ends of solenoid valve M15 with wiring disconnected	~~OK~~ ►	Replace solenoid valve M15

End of test M

CHECK SPEED SENSOR

TEST N

TEST STEPS		RESULTS	REMEDY
N1	VISUAL CHECK	OK ►	Go to step N2
	- Check that the speedometer on the instrument panel C10 functions correctly	~~OK~~ ►	Repair the circuits generating the speedometer signal
N2	CONTINUITY CHECK	OK ►	Go to step N3
	- Disconnect the connector G154 and check the continuity between pin 3 of connector G154 vehicle side and pin 2 Di of instrument panel C10	~~OK~~ ►	Restore the continuity of the wiring between pin 3 of connector G154 vehicle side and pin 2 Di of instrument panel C10
N3	CONTINUITY CHECK	OK ►	Replace the control unit S11
	- Disconnect the comb of control unit and check the continuity between pin 3 of connector G154 system side and pin 73 of control unit S11	~~OK~~ ►	Restore the continuity of the wiring between pin 3 of connector G154 system side and pin 73 of the control unit S11

End of test N

CHECK CAM ANGLE SENSOR S52

TEST O

TEST STEPS		RESULTS	REMEDY
O1	VOLTAGE CHECK - Position the multimeter at 2V C.A. - Start up the engine and verify approx. 1.5V at pin 2 of cam angle sensor S52	 ►	Go to step O5
		 ►	Go to step O2
O2	RESISTANCE CHECK - Position the multimeter at 200 ohm F.S. - Remove the ignition key and disconnect the sensor S52 from the wiring and verify directly at pins 1 and 2 of sensor S52 a resistance of approx. 20 ohm	 ►	Go to step O3
		 ►	Replace the cam angle sensor S52
O3	INSULATION CHECK - Disconnect the comb of control unit S11 - Check insulation with respect to ground of pin 16 of comb of control unit S11	 ►	Go to step O4
		 ►	Restore the insulation of the wiring between pin 16 of comb of control unit S11 and pin 2 of cam angle sensor S52
O4	INSULATION CHECK - Check insulation with respect to ground of pin 44 of comb of control unit S11	 ►	Restore insulation between ground and pin 1 and/or cam angle sensor S52
		 ►	Restore the insulation of the wiring between pin 44 of comb of control unit S11 and pin 1 of cam angle sensor S52
O5	CONTINUITY CHECK - Disconnect the comb of control unit S11 and check the continuity between pin 44 of comb of control unit S11 and pin 1 of cam angle sensor S52	 ►	Go to step O6
		 ►	Restore the continuity between pin 44 of comb of control unit S11 and pin 1 of cam angle sensor S52
O6	CONTINUITY CHECK - Check continuity between pin 16 of comb of control unit S11 and pin 2 of cam angle sensor S52	 ►	Replace the control unit S11
		 ►	Restore the continuity between pin 16 of comb of control unit S11 and pin 2 of cam angle sensor S52

End of test (

CHECK KNOCKING SENSOR WIRING 1/2

TEST P

TEST STEPS		RESULTS	REMEDY
P1	RESISTANCE CHECK	OK ►	Go to step P2
	- Position the multimeter at 200 ohm F.S. - For each of the two knocking sensors S20a and S20b disconnect the connector of the knocking sensor and verify directly at pins of sensor an infinite resistance	~~OK~~ ►	Replace the defective knocking sensor
P2	RESISTANCE CHECK	OK ►	The knocking sensors S20a and S20b are correctly insulated with respect to ground
	- For each of the knocking sensors S20a and S20b, verify an infinite resistance directly between each pin of the sensor and the ground	~~OK~~ ►	Replace the defective knocking sensor

End of test I

CHECK R.P.M. AND TIMING SENSOR		TEST Q	
TEST STEPS		RESULTS	REMEDY
Q1	VOLTAGE CHECK	OK ►	Go to TEST R
	- Position the multimeter at 20 V F.S. IN ALTERNATING CURRENT - Try to start engine and verify a voltage greater than 1.5 V at pin 2 of r.p.m. and timing sensor S31	~~OK~~ ►	Go to step Q2
Q2	RESISTANCE CHECK	OK ►	Go to step Q3
	- Position the multimeter at 200 ohm F.S. - Remove the ignition key and disconnect the r.p.m. and timing sensor S31 from the wiring - Verify directly at pins 1 and 2 of sensor S31 a resistance of approx. 20 ohm	~~OK~~ ►	Replace the r.p.m. and timing sensor S31
Q3	INSULATION CHECK	OK ►	Go to step Q4
	- Disconnect the comb of control unit S11 and check insulation with respect to ground of pin 68 of comb of control unit S11	~~OK~~ ►	Restore the insulation of the wiring between pin 68 of comb of control unit S11 and pin 2 of r.p.m. and timing sensor S31
Q4	INSULATION CHECK	OK ►	Restore the insulation between ground and pin 1 and/or r.p.m. and timing sensor S31
	- Check the insulation with respect to ground of pin 67 of comb of control unit S11	~~OK~~ ►	Restore the insulation of the wiring between pin 67 of comb of control unit S11 and pin 1 of r.p.m. and timing sensor S31
Q5	CONTINUITY CHECK	OK ►	Go to step Q6
	- Disconnect the comb of control unit S11 and check the continuity between pin 67 of comb of control unit S11 and pin 1 of the r.p.m. and timing sensor S31	~~OK~~ ►	Restore the continuity between pin 67 of the comb of the control unit S11 and pin 1 of the r.p.m. and timing sensor S31
Q6	CONTINUITY CHECK	OK ►	Replace the control unit S11
	- Check the continuity between pin 68 of the comb of control unit S11 and pin 2 of the r.p.m. and timing sensor S31	~~OK~~ ►	Restore the continuity between pin 68 of the comb of the control unit S11 and pin 2 of the r.p.m. and timing sensor S31

End of test

CHECK FUEL CIRCUIT		TEST R	
TEST STEPS		RESULTS	REMEDY
R1	PRESSURE CHECK	 ►	Go to TEST S
	- Connect a pressure gauge to the fuel distribution pipe - Turn the key to "START" - Check that the fuel pressure reaches approx. 2.8 bar NOTE: It is possible that the pump is already rotating	 ►	Go to step R2
R2	VOLTAGE CHECK	 ►	Go to step R9
	- With the key in the "START" position, verify 12V (battery voltage) directly on the connections of the fuel pump P18 (pin A)	 ►	Go to step R3
R3	VOLTAGE CHECK	 ►	Go to step R4
	- Remove the relay S12a and verify, with the key in the "RUN" position, 12V at pin 30 of base of relay S12a	 ►	Restore the continuity of the wiring between pin 30 of relay S12a and pin 1 of connector G154
R4	VOLTAGE CHECK	 ►	Go to step R6
	- Check, with the key in the "RUN" position, 0V (zero voltage) at pin 85 of relay S12a	 ►	Go to step R5
R5	CONTINUITY CHECK	 ►	Replace the control unit S11
	- Disconnect the comb of the control unit and check the continuity between pin 1 of the control unit S11 and pin 85 of relay S12a	 ►	Restore the continuity of the wiring between pin 1 of control unit S11 and pin 85 of relay S12a
R6	RESISTANCE CHECK	 ►	Go to step R7
	- Verify that the resistance of the winding of the relay S12a is approx. 50 ohm	 ►	Replace the relay S12a

(Cont.)

CHECK FUEL CIRCUIT		TEST R	
TEST STEPS		RESULTS	REMEDY
R7	CONTINUITY CHECK		
- Disconnect the connector G154 and check the continuity of the wiring between pin 87 (pink-black wire) of base of relay S12a and pin 2 of connector G154 system side		OK ►	Go to step R8
		~~OK~~ ►	Restore the continuity of the wiring between pin 87 (pink-black wire) of base of relay S12a and pin 2 of connector G154 system side. (Check condition of fuse S47)
R8	CONTINUITY CHECK		
- Check the continuity of the wiring between pin 2 of connector G154 vehicle side and pump P18 (pin A) through the coupling G170		OK ►	Go to step R9
		~~OK~~ ►	Restore the continuity of the wiring between pin 2 of connector G154 vehicle side and pump P18 (pin A) through the coupling G170
R9	CONTINUITY CHECK		
- Check the continuity of the wiring between ground G186 and pump P18 (pin B)		OK ►	Replace the pump P18
		~~OK~~ ►	Restore the continuity of the wiring between ground G186 and pump P18

End of test

CHECK IGNITION CIRCUIT		TEST S	
TEST STEPS		RESULTS	REMEDY
S1	VOLTAGE CHECK		
- Turn the key to "RUN" - Disconnect the connector G338 and verify 12V (battery voltage) at pin 12 of connector G338 system side		 ► Go to step S3	
		 ► Go to step S2	
S2	VOLTAGE CHECK		
- Disconnect the connector G154 and verify 12V (battery voltage) at pin 6 of connector G154 vehicle side		 ► Restore the continuity of the wiring between pin 6 of connector G154 system side and pin 12 connector G338 system side	
		 ► Restore the continuity of the wiring between pin 6 connector G154 and ignition switch B1 through the fuse box G1	
S3	VOLTAGE CHECK		
- Position the multimeter at 2 F.S. IN ALTERNATING CURRENT - Try to start engine and verify approx. 800 mV at pins 7, 5, 2 of connector of power module N21a and N21b		 ► Go to step S6	
		 ► Go to step S4	
S4	CONTINUITY CHECK		
- Disconnect the comb of the control unit S11 and check the continuity of the wiring respectively to pins 24, 25, 52 (50, 51, 23) of comb of S11 and pins 7, 2, 5 of power module N21a (N21b)		 ► Go to step S5	
		 ► Restore the continuity of the wiring between pins 24, 25, 52 (50, 51, 23) of comb of S11 and pins 7, 2, 5 of power module N21a (N21b)	
S5	INSULATION CHECK		
- Check the insulation of pins 24, 25, 52 (23, 50, 51) of comb of S11 with respect to ground and between each other		 ► Replace the control unit S11	
		 ► Restore the insulation of the defective wiring	
S6	RESISTANCE CHECK		
- Position the multimeter at 200 ohm F.S. - Verify a resistance lower than 1 ohm between pin 4 of power module N21a (N21b) and ground G131		 ► Go to step S7	
		 ► Restore the continuity of the wiring between pin 4 of connector of power module N21a (N21b) and ground G131	

(Cont.d)

CHECK IGNITION CIRCUIT

TEST S

TEST STEPS		RESULTS	REMEDY
S7	CONTINUITY CHECK	OK ►	Go to step S8
	- Disconnect the connector G338 and check the continuity between pin 6, 3, 1 of power module N21a (N21b) and pins 16, 15, 14 (19, 18, 17) of connector G338 system side	~~OK~~ ►	Restore the continuity of defective wiring
S8	RESISTANCE CHECK	OK ►	Check spark plugs and power unit
	- Verify a resistance lower than 20 ohm between pins 16, 15, 14, 19, 18, 17 of connector G338 and ground	~~OK~~ ►	Restore the continuity of the wiring and if necessary replace the ignition coil relative to the faulty line

End of test

CHECK COMMUNICATION LINES BETWEEN ELECTRONIC AUTOMATIC GEARBOX

TEST T

TEST STEPS		RESULTS	REMEDY
T1	SIGNALS CHECK	OK ►	Go to step T3
		OK/NOOK ►	Go to step T2

- Start up engine and maintain it at approx 2000 r.p.m.
- Using a oscilloscope, check that on the coupling **G336** there are the following signals which conform to the relative forms of the characteristic waves:

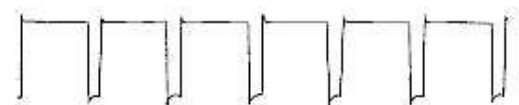
- pin D of **G336**: r.p.m. (*)
- pin B of **G336**: throttle angle (*)
- pin A of **G336**: engine load (*)

(*) See drawings in this page



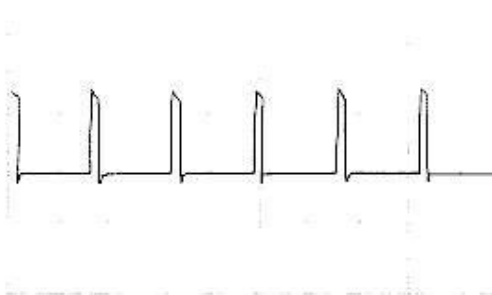
AFB27AK6

r.p.m. signal

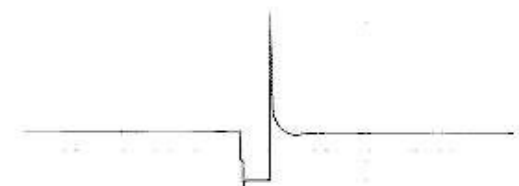


AFB27AK6

throttle signal approx. 80%



throttle signal approx. 20%



AFB27AK6

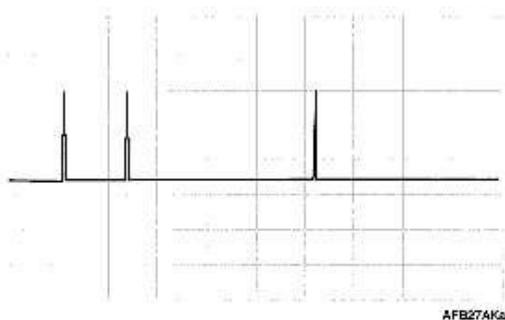
engine load signal

(Cont.)

CHECK COMMUNICATION LINES BETWEEN ELECTRONIC AUTOMATIC GEARBOX

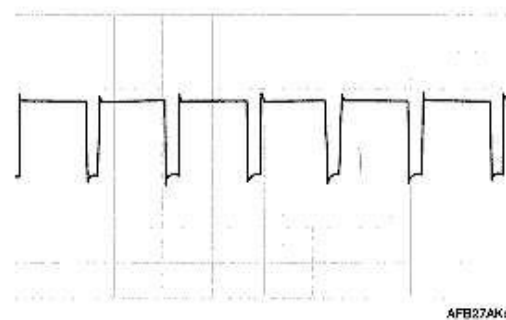
TEST T

TEST STEPS		RESULTS	REMEDY
T2	SIGNALS CHECK		
- Disconnect the control unit S11 - Using an oscilloscope, check that at the connectors of the control unit S11 there are the following signals which conform to the form of the characteristic waves: • pin 1 of S11: r.p.m (*) • pin 11 of S11: throttle angle (*) • pin 3 of S11: engine load (*) - Reconnect the control unit S11 (*) See drawings in this page		OK ▶ Restore the defective wiring	
		~~OK~~ ▶	Replace the control unit S11



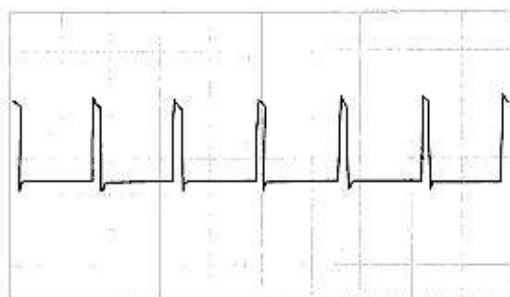
AFB27AKa

r.p.m. signal

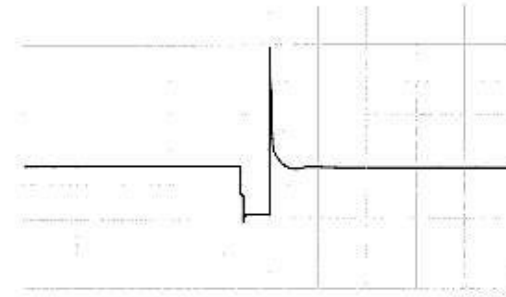


AFB27AKa

throttle signal approx. 80%



throttle signal approx. 20%



AFB27AKd

engine load signal

(Cont.)

CHECK COMMUNICATION LINES BETWEEN ELECTRONIC AUTOMATIC GEARBOX

TEST T

TEST STEPS		RESULTS	REMEDY
T3	TORQUE REDUCTION SIGNAL CHECK	OK ►	Replace the control unit S11
	- Using an oscilloscope, check, whilst the vehicle is running, that at pin 64 of the Motronic control unit S11 a ground signal arrives for every ratio change	OK/No signal ►	Go to step T4
T4	WIRING CHECK	OK ►	Electronic Automatic Gearbox circuits faulty
	- Disconnect the control unit S11 - Check the continuity and insulation of the connection between pin 32 of connector of control unit of electronic automatic gearbox N68 and pin 64 of Motronic control unit S11 - Reconnect the control unit S11	OK/No signal ►	Restore the efficiency of the wiring, through coupling G336 , pin C

End of test

E.G.R. CONTROL SOLENOID VALVE FAULTY

TEST U

TEST STEPS		RESULTS	REMEDY
NOTE: Crank the engine			
U1	VOLTAGE CHECK	OK ▶	Go to step U2
- Connect: - voltmeter (-) lead to known, good ground. - voltmeter (+) lead to solenoid valve L46 (HZL wire) Meter reads 12V?		~~OK~~ ▶	Repair wiring between solenoid valve L46 and pin 87 of relay S12b
U2	ISOLAMENTO CHECK	OK ▶	Go to step U3
- Check for an open circuit (resistance = ∞) across solenoid valve L46 (LT BLU-WHT wire) and a good ground		~~OK~~ ▶	Restore wiring insulation to ground across L46 (LT BLU-WHT wire) and ground
U3	FUNCTIONAL CHECK	OK ▶	Go to step U4
- Connect the solenoid valve L46 (LT BLU-WHT wire) to ground. Does the minimum r.p.m. become irregular?		~~OK~~ ▶	Replace solenoid valve L46
U4	CONTINUITY CHECK	OK ▶	Replace control unit S11
- Check for continuity across pin 37 of control unit S11 and solenoid valve L46 (LT BLU-WHT wire)		~~OK~~ ▶	Repair wiring

E.G.R. GAS DELIVERY VALVE FAULY

TEST V

TEST STEPS		RESULTS	REMEDY								
V1	VOLTAGE CHECK										
- Connect: - voltmeter (+) lead to known +12V - voltmeter (-) lead to pin 2 of sensor S56 Meter reads 12V?		 ►	Go to step V3								
		 ►	Go to step V2								
V2	VOLTAGE CHECK										
- Move voltmeter (-) lead to ground G131 Meter reads 12V?		 ►	Repair wiring between pin 2 of sensor L56 and ground G131								
		 ►	Repair ground G131								
V3	FUNCTIONAL CHECK										
- Disconnect sensor S56 - Place the sensor in an oven and check for a resistance variation across pin 1 and 2 of the sensor in relation to the temperature variation as shown in table below:		 ►	Go to step V4								
		 ►	Replace sensor S56								
<table><tr><td>temperature</td><td>resistance (KΩ)</td></tr><tr><td>50°C (122°F)</td><td>635 ± 77</td></tr><tr><td>100°C (212°F)</td><td>85.3 ± 8.8</td></tr><tr><td>200°C (392°F)</td><td>5.1 ± 0.61</td></tr></table>		temperature	resistance (KΩ)	50°C (122°F)	635 ± 77	100°C (212°F)	85.3 ± 8.8	200°C (392°F)	5.1 ± 0.61		
temperature	resistance (KΩ)										
50°C (122°F)	635 ± 77										
100°C (212°F)	85.3 ± 8.8										
200°C (392°F)	5.1 ± 0.61										
V4	CONTINUITY CHECK										
- Check for wiring continuity across pin 63 of control unit S11 and pin 1 of sensor S56		 ►	Replace control unit S11								
		 ►	Repair wiring								

NO POWER SUPPLY TO AIR PUMP RELAY

TEST W

TEST STEPS		RESULTS	REMEDY
NOTE: turn ignition key to "RUN" position.			
W1	VOLTAGE CHECK	OK ▶	Go to step W2
	- Connect: - voltmeter (-) lead to known good ground - voltmeter (+) lead to pin 86 of relay S54 Meter reads 12V?	~~OK~~ ▶	Repair wiring between pin 86 of relay S54 and pin 1 of connector G154
W2	VOLTAGE CHECK	OK ▶	Replace relay S54
	- Crank the engine with a coolant temperature ranging between -8°C (46.5°F) and +40°C (104°F) - Move voltmeter (-) lead to pin 85 of relay S54 Meter reads 12V for 1.5 minutes after cranking?	~~OK~~ ▶	Go to step W3
W3	CONTINUITY CHECK	OK ▶	Replace control unit S11
	- Check for continuity across pin 85 of relay S54 and pin 18 of control unit S11	~~OK~~ ▶	Repair wiring

DURING CRANKING, WITH ENGINE COOLANT TEMPERATURE RANGING BETWEEN -8°C (46.5°F) and +40°C (104°F), THE AIR PUMP DOES NOT START

TEST X

TEST STEPS		RESULTS	REMEDY
X1	FUSE CHECK	 ►	Go to step X2
	- Check fuse (30A) of relay S54	 ►	Replace fuse
X2	VOLTAGE CHECK	 ►	Go to step X3
	- Connect: • voltmeter (-) lead to known good ground • voltmeter (+) lead to pin 30 of relay S54 Meter reads 12V?	 ►	Repair wiring between pin 30 of relay S54 and circuit board G56
X3	VOLTAGE CHECK	 ►	Go to step X5
	- Move voltmeter (-) lead to pump S53 (BLK wire) Meter reads 12V?	 ►	Go to step X4
X4	VOLTAGE CHECK	 ►	Repair wiring between pump S53 (BLK wire) and ground G131
	- Move voltmeter (-) lead to ground G131 Meter reads 12V?	 ►	Repair ground G131
X5	VOLTAGE CHECK	 ►	Replace pump S53
	- Crank the engine with a coolant temperature ranging between -8°C (46.5°F) and +40°C (104°F) - Move voltmeter (+) lead to pump S53 (WHT-BLK wire) Meter reads 12V for 1.5 minutes after cranking?	 ►	Go to step X6
X6	CONTINUITY CHECK	 ►	Replace relay S54
	- Check for continuity across pin 87 of relay S54 and pump S53 (WHT-BLK wire)	 ►	Repair wiring

THE AIR PUMP IS WORKING BUT THE 3-WAY PIRBURG SOLENOID VALVE REMAINS CLOSED
TEST Y

TEST STEPS		RESULTS	REMEDY
Y1	FUSE CHECK		
- Connect: • voltmeter (+) lead to known +12V • voltmeter (-) lead to solenoid valve S55 (LT BLU-RED wire) Meter reads 12V?		 ► Go to step Y3	
		 ► Go to step Y2	
Y2	VOLTAGE CHECK		
- Move voltmeter (-) lead to ground G131 Meter reads 12V?		 ► Repair wiring between solenoid valve S55 (LT BLU-RED wire) and ground G131	
		 ► Repair ground	
Y3	VOLTAGE CHECK		
- Crank the engine with a coolant temperature ranging between -8°C (46.5°F) and +40°C (104°F)		 ► Replace solenoid valve S55	
- Move voltmeter (+) lead to solenoid valve S55 (GRN-BLK wire) Meter reads 12V for 1.5 minutes after cranking?		 ► Go to step Y4	
Y4	CONTINUITY CHECK		
- Check for continuity across pin 87a of relay S54 and solenoid valve S55 (GRN-BLK wire)		 ► Replace relay S54	
		 ► Repair wiring	

THE AIR PUMP IS WORKING BUT THE 3-WAY PIRBURG SOLENOID VALVE REMAINS CLOSED
TEST Y

TEST STEPS		RESULTS	REMEDY
Y1	FUSE CHECK		
- Connect: • voltmeter (+) lead to known +12V • voltmeter (-) lead to solenoid valve S55 (LT BLU-RED wire) Meter reads 12V?		 ► Go to step Y3	
		 ► Go to step Y2	
Y2	VOLTAGE CHECK		
- Move voltmeter (-) lead to ground G131 Meter reads 12V?		 ► Repair wiring between solenoid valve S55 (LT BLU-RED wire) and ground G131	
		 ► Repair ground	
Y3	VOLTAGE CHECK		
- Crank the engine with a coolant temperature ranging between -8°C (46.5°F) and +40°C (104°F)		 ► Replace solenoid valve S55	
- Move voltmeter (+) lead to solenoid valve S55 (GRN-BLK wire) Meter reads 12V for 1.5 minutes after cranking?		 ► Go to step Y4	
Y4	CONTINUITY CHECK		
- Check for continuity across pin 87a of relay S54 and solenoid valve S55 (GRN-BLK wire)		 ► Replace relay S54	
		 ► Repair wiring	