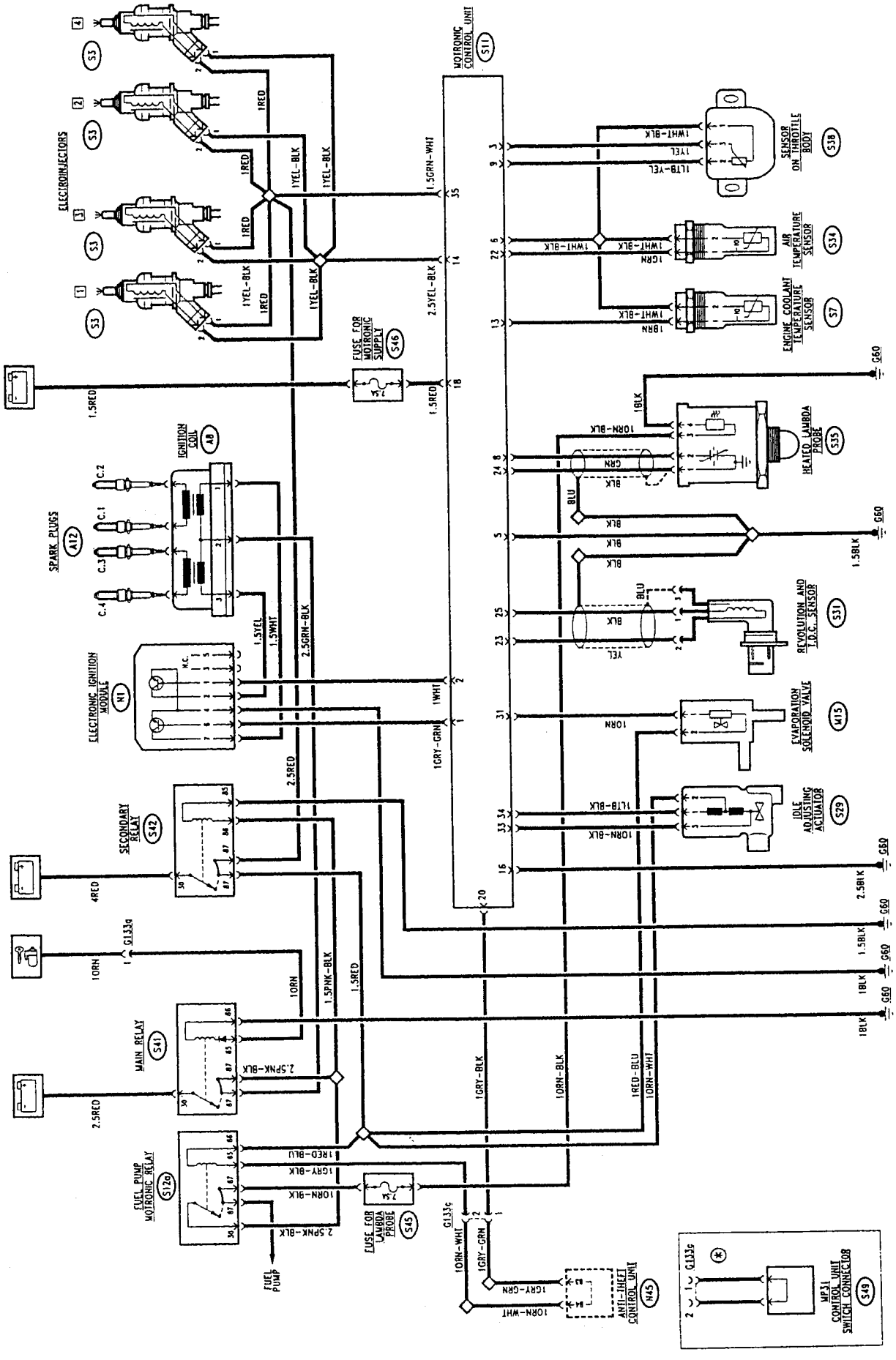
MOTRONIC MP3.1 INJECTION/ IGNITION SYSTEM (*)
- Boxer 1.6 Engine -

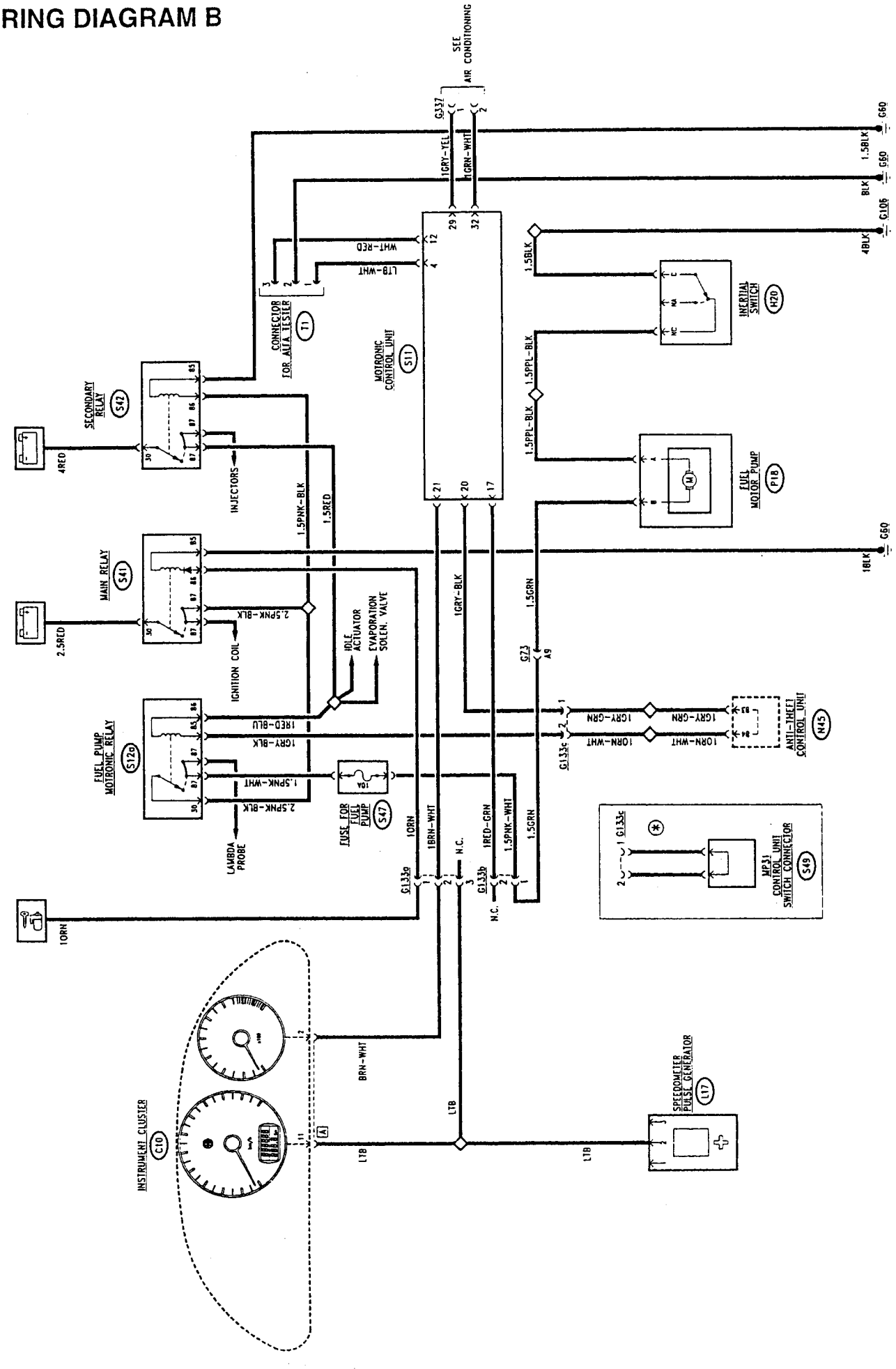
INDEX

(*) Only present up to chassis No.____, then replaced by the ROCHESTER system (Sect. 55-35A)

WIRING DIAGRAM A



WIRING DIAGRAM B



GENERAL DESCRIPTION

The MOTRONIC MP3.1 electronic control unit supervises and adjusts all the parmeters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions.
A single control unit governs both ignition and injection: in fact the point of operation of the engine is located by special sensors and the actuators are operated accordingly which carry out the following functions:

- injection time adjustment;
- ignition adjustment;
- combustion control - lambda sensor;
- idle speed control;
- fuel pump control;
- cold-starting control;
- control of enrichment during acceleration;
- fuel cut-off during deceleration;
- max. rpm limiting;
- fuel vapour recovery;
- connection with the air conditioning system;
- connection with the anti-theft system;

The system also possesses a "self-diagnosis function which memorises any faults simplifying their location and correction.

Operating logic

- **Adjustment of injection times (quantity of fuel):** the control unit controls the injectors extremely rapidly and accurately, calculating their opening time on the basis of the engine load (measured by the pressure sensor and corrected according to the air temperature) and the engine speed (detected by the rpm sensor), taking account also of other operating parameters such as battery voltage and engine temperature and also taking account of the signals from the lambda sensor.
  Injection is of the "pressure-speed" type and it is simultaneous, i.e. all the injectors are opened simultaneously at each turn, enabling correct supply to all the cylinders and improved operation during transient states.
- **Ignition adjustment (calculation of spark advances):**
  the control unit calculates the optimum advance for each engine condition according to the engine speed and the absolute pressure at the intake.
  The electronic ignition is of the "static distribution type" (with semi-conductors, without distributor) This solution considerably improves reliability and reduces the high voltage cables and connections.
  Ignition takes place with two coils controlled by a power module.
- **Combustion control- lambda sensor:** the oxygen sensor (or "lambda" probe) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering (lambda coefficient = 1). The electric signal that the sensor sends to the control unit changes sharply when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.
  The lambda signal is processed inside the control unit by a special integrator which prevents abrupt "swaying".
  The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).
  Therefore, through this sensor it is possible to adjust engine carburetion precisely and retroactively - closed loop control. This also makes it possible to keep exhaust emissions within the limits specified by law.
- **Idle speed control**: the adjustment of the engine idle speed is carried out through the special actuator which acts on the the throttle by-pass.
  This device acts as a regulator for cutting in the various services (e.g. conditioner compressor): in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.
- **Fuel pump control**: the control unit logic cuts off the supply to the fuel pump as soon as the engine stops: in fact the supply is cut off at the pump and at the ignition coil.In addition, on this car the pump control system is integrated by the **inertial switch device:** this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that connects the fuel pump to earth, thereby stopping the fuel pump instantaneously. This device is particularly important, integrating the safety offered by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents that do not cause the engine to stop immediately.
- **Cold-starting control:** during cold starting (up to a certain number of rpms) the control unit uses special advance and injection time ratings.
  During cold starts the amount of fuel injected and the advance are also increased until the engine reaches a determinate temperature.
- **Control of enrichment during acceleration**: upon the need for acceleration the control unit increases injection in order to quickly reach the load required. This function is carried out by the detection of a rapid increase of the values of the parameter of the po-

tiometer located on the throttle which signals the need for acceleration.

- **Fuel cut-off during deceleration**: with the throttle closed and an engine speed above a certain threshold the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed and above all the car speed is reduced and also fuel consumption, which is controlled to a greater degree. The cut-off threshold value varies according to the temperature of the engine.
- **Rpm limiting:** the control unit automatically cuts off the injection of fuel when the engine rpm reaches a certain threshold, thereby preventing the engine from over- revving.
- **Fuel vapour recovery:** the fuel vapours collected in a special canister are ducted towards the engine where they are burnt; this takes place through a solenoid valve which is opened by the control unit only when the engine is in a load condition that will allow correct combustion without adversely affecting the operation of the engine.
- **Connection with the conditioner compressor:** the control unit is connected with the air conditioning system so that the idle rpm can be adapted to the increased power each time the compressor cuts in.
- **Connection with the anti-theft device:** if the car is fitted with the electronic anti-theft device, the Motronic control unit receives consent to operate from the anti-theft control unit via the signal which operates the fuel pump relay, which is therefore de-activated when the anti-theft device is operational.

Components

The electronic control unit (**S11**) receives the signals from the **sensors** which "read" the operation of the engine and processes them according to a logic stored inside in "maps" which correlate the various parameters with one another in the best way possible, and it operates the **actuators** accordingly so that the engine always operates with the highest possible regularity and yield.

The control sensors are the following:

- engine temperature sensor (**S7**);
- air temperature sensor (**S34**);
- sensor on throttle body (**S38**);
- rpm and timing sensor (**S31**);
- heated lambda sensor (**S35**)
- absolute pressure sensor (inside the control unit): this is connected to the intake box by a special pipe, also fitted with a stabilizer chamber.

The actuators controlled by the system are the following:

- electroinjectors (**S3**);
- ignition coil (**A8**), with power module (**N1**);
- fuel pump (**P18**);
- idle speed adjustment actuator (**S29**);
- vapour recovery solenoid valve (**M15**).

The control unit is also connected with:

- heating and ventilation system,
- anti-theft control unit (**N45**),
- the instrument cluster **(C10)** to which it supplies the signal for the rev. counter.

The system is completed by three relays: the main relay (**S41**), the secondary relay (**S42**) and the fuel pump relay (**S12a**) which operates the fuel pump, the injectors, the coils and the other components of the system. The supply line is protected by a wander fuse (**S46**), while special fuses protect the pump (**S47**), and the resistance of the lambda sensor (**S45**).
The main and secondary relays are located with the fuses in the engine compartment near the terminal branch board, while relay (**S12a**) is to be found, for some versions, in the container of the control unit (**S11**); only for some vehicles without alarm system is located in the engine bay next to the injection relay.

Lastly, there is an earth point (**G60**) on the engine.

Connector (**T1**) used for the connection with the ALFA ROMEO Tester is located in the engine bay in an easily accessible position. For some vehicles it is located near the control unit.

FUNCTIONAL DESCRIPTION

The Motronic control unit **S11** controls and adjusts the entire electronic ignition and injection system.
The control unit is supplied at pin 18 directly by the battery via fuse **S46** (7.5A).
Pin 5 and 16 are earthed.

Three relays control the entire system:

- The main relay **S41**, energized with the signal that the key is in the "MARCIA" position, supplies the secondary relay **S42**, the fuel pump relay **S12a**, and the primary windings of the coil **A8a**.
- The secondary relay **S42**, energized by the main relay **S41**, supplies the fuel pump relay **S12a**, the vapour recovery solenoid valve **M15**, the idle speed actuator **S29** and the injectors **S3**, in addition to the actual control unit **S11**, at pin **35**.
- The fuel pump relay **S12a**, supplied by the two above-mentioned relays, is energized by a signal (earth) leading from pin 20 of the control unit **S11** which crosses the anti-theft control unit **N45**, which gives the necessary consent. If the anti-theft device

is not installed, the connector of connection (**G133c**) is bridged with connector **S49**.

- The relay supplies the resistance of the lambda sensor **S35** and the fuel pump **P18**; this supply line is protected by a special fuse **S47** (10A).
  Additionally, the earth **P18** reaches the pump via the inertial switch **H20** which cuts off the circuit in the event of an impact.

The control unit **S11** receives numerous signals from the different sensors, thereby keeping all the engine parameters under control.

The rpm and timing sensor **S31** supplies, through the signal sent to pin 23 of the control unit, information about the engine rpm and timing, while from a reference earth is sent from pin 25; these two signals are very low in intensity, therefore they are suitably screened. The sensor is inductive and it detects the engine rpm through the change in a magnetic field produced by the passage of the teeth of a "phonic" wheel fitted on the flywheel: the wheel has 60 teeth, two of which are missing through which the timing is detected.

The throttle body sensor **S38**, is supplied by the control unit with 5 V from pin 9, while pin 6 supplies the reference earth; through a potentiometer a signal is generated which is sent to pin 3 and is proportionate with the degree of opening of the throttle itself.

The engine temperature sensor **S7**, to which the control unit supplies the reference earth from pin 6, sends a signal to pin 13 proportionate with the temperature of the engine coolant, detected with an NTC material (resistance that lowers with the temperature).
The intaken air temperature sensor **S34**, to which the control unit supplies the reference earth from pin 6, sends a signal to pin 22 that is proportionate with the temperature of the air in the intake capacity, detected with an NTC material (resistance that lowers with the temperature).

The heated lambda sensor **S35** supplies the control unit information about the correct composition of the air-fuel mixture detecting the concentration of oxygen in the exhaust gas; this takes place through the signal sent to pin 8 of the control unit, while pin 24 supplies the reference earth; these two signals are very low in intensity and are therefore suitably screened.
The sensor is heated by a resistance to make sure that it operates correctly also when the engine is cold; the resistance is supplied by the fuel pump relay **S12a** and it is protected by a specific fuse **S45** (7.5A).

NOTE: the control unit also processes a signal leading from the absolute pressure sensor, inside it, and connected to the intake box by a special pipe: inside the control unit, the pressure signal is then transformed into an electrical signal.

On the basis of the signals received from the sensors and of the calculations carried out, the control unit **S11** controls the opening of the injectors **S3** via pin 14. The injectors receive the supply from relay **S42**.

Ignition is static and controlled directly by the control unit which adjusts the advance automatically. A control signal (earth) is sent by the control unit, from pins 1 and 2, to the power module **N1** which generates the high voltage pulses sent to the coil **A8**: the primary windings are supplied by the module **N1**, the secondary winding sends the pulse to the spark plugs **A12**.

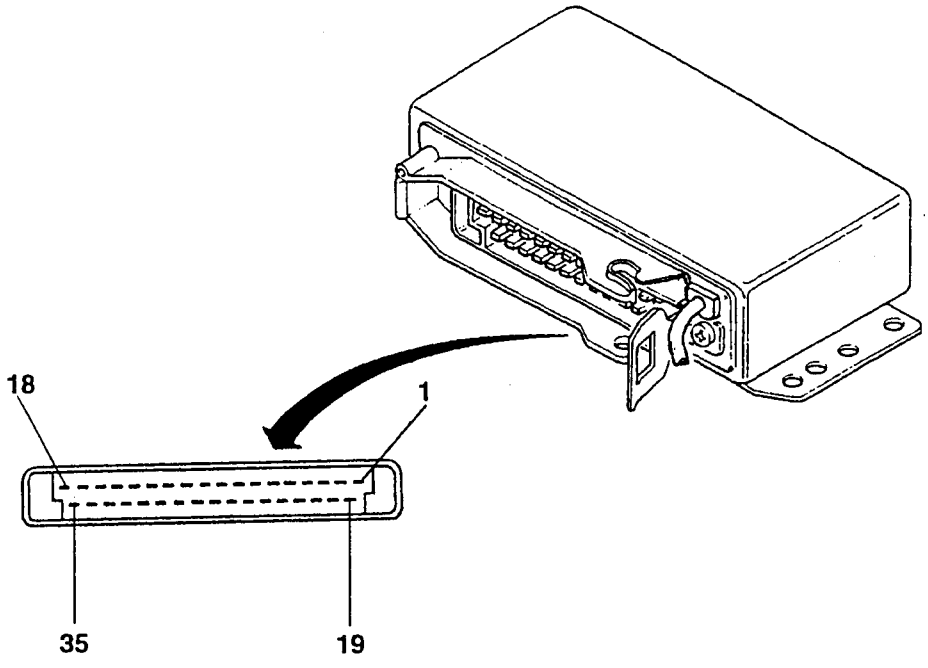
The idle speed adjustment actuator **S29** forms a by-pass line for the flow of air; this comprises two windings: one opens and the other closes a valve the adjusts the gap of the by- pass section; a safety spring establishes a mean opening value in the event of a failure to this device; the actuator is controlled by the control unit through the signals from pin 34 (opening) and 33 (closing).

The vapour recovery solenoid valve **M15** allows the passage of the vapours towards the engine intake where they are added to the mixture entering the combustion chamber; this is activated by the control unit when the engine is under load through a duty cycle signal from pin 31.

The control unit **S11** is informed instant by instant of the engine rpm through the sensor **S31**: this information is sent to the rev counter located on the instrument cluster **C10**, via the signal from pin 21.

The control unit **S11** is connected with the air conditioning system via pins 29 and 32.
This makes it possible to adapt the engine rpm to th increased power each time the compressor cuts in, for further details see the "Heating and Ventilation" section.

The control unit **S11** is fitted with a self-diagnosis system which can be used connecting the ALFA ROMEO Tester to connector **T1**; here, the control unit sends the fault signals via the diagnosis line L -pin 4- and line K - pin 12, while the earth is supplied from **G60.**

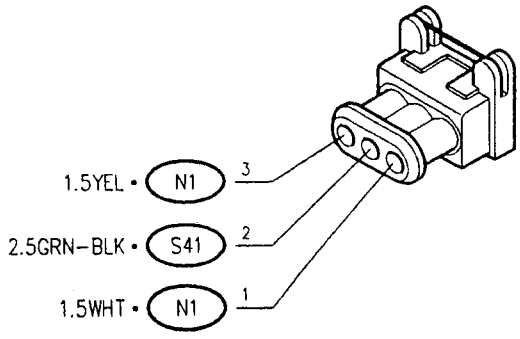


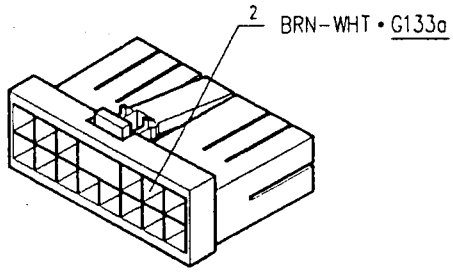
CONTROL UNIT PIN-OUTS

1. Ignition control module (for cyl. 1 & 4)
2. Ignition control module (for cyl. 2 & 3)
3. Throttle position signal
4. Diagnosis line L
5. Power earth
6. Electronic earth for sensors
7. N.C.
8. Lambda sensor signal
9. Reference voltage (5V) for throttle sensor
10. N.C.
11. N.C.
12. Diagnosis line K
13. Engine temperature signal
14. Electroinjector control
15. N.C.
16. Power earth
17. N.C.
18. Direct control unit supply
19. N.C.
20. Supply for fuel pump relay (via anti-theft control unit)
21. Rev counter signal
22. Intaken air temperature signal
23. Rpm sensor signal
24. Earth for lambda sensor
25. Earth for rpm sensor
26. N.C.
27. N.C.
28. N.C.
29. Compressor cut-in request signal
30. N.C.
31. Evaporative solenoid valve control
32. Compressor cut-in signal
33. Idle speed actuator control - closing
34. Idle speed actuator control - opening
35. Control unit supply ("key-operated")

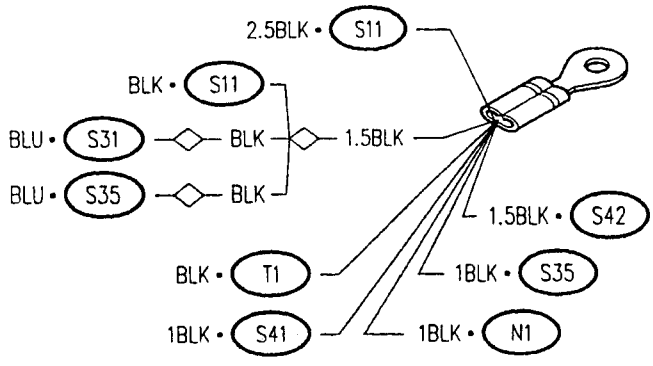
COMPONENTS AND CONNECTORS

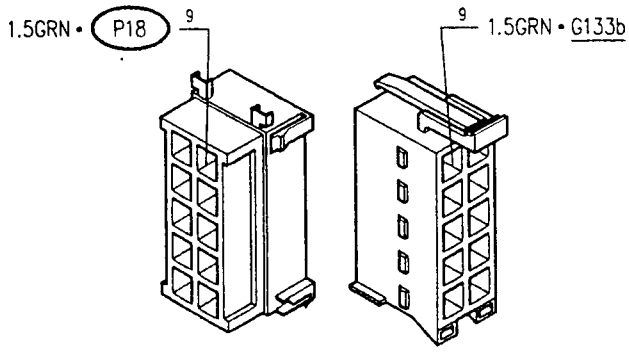
Ignition coil	A8	Instrument cluster	C10 A



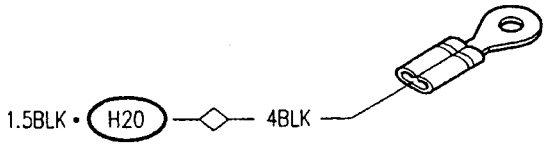


Injection wiring earth	G60	Rear services connector	G73 A

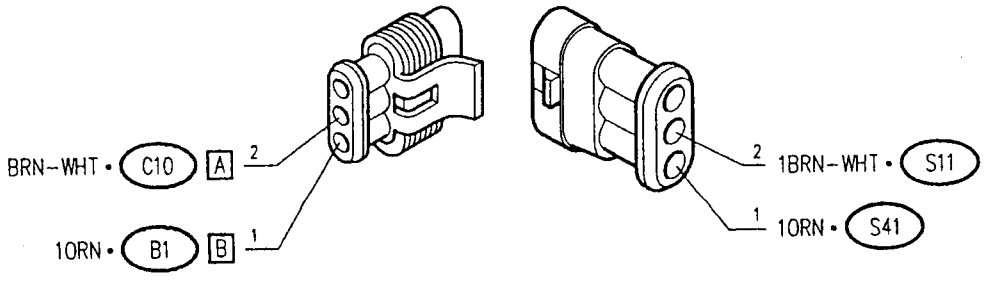




Seat cross rail earth	G106

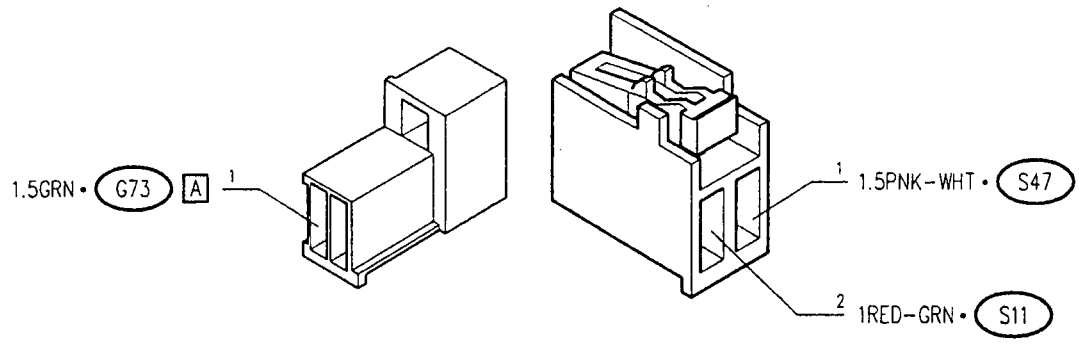


Electronic injection wiring connector A	G133a

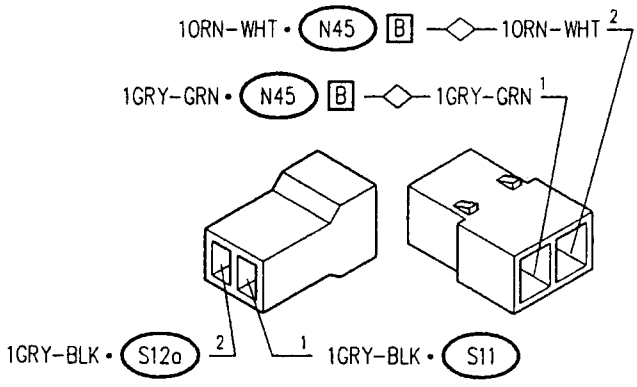


COMPONENTS AND CONNECTORS (cont.d)

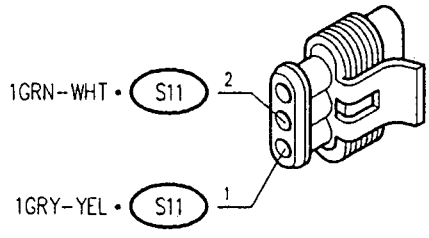
Electronic injection wiring connector B	G133b



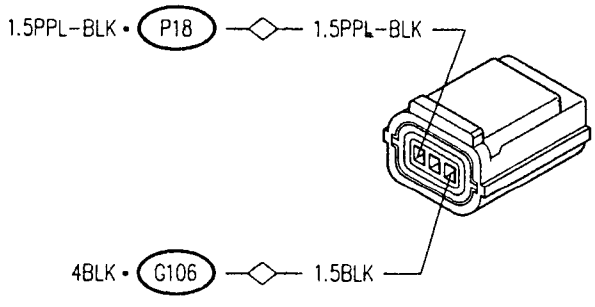
Electronic injectionwiringconnector C	G133c



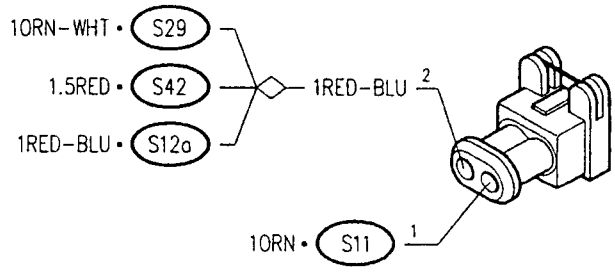
Conditioner/injection system connector	G337



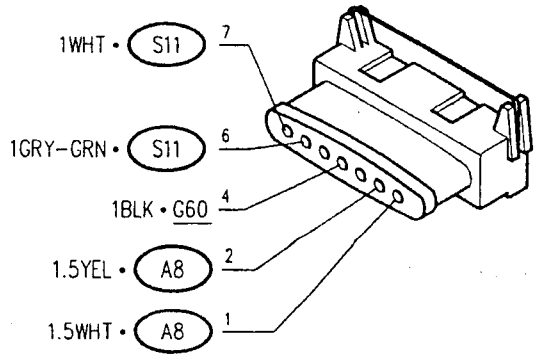
Inertial switch	H20



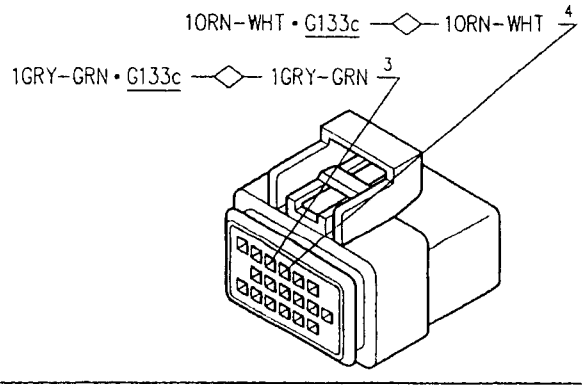
Evaporative solenoid valve	M15



Electronic ignition module	N1

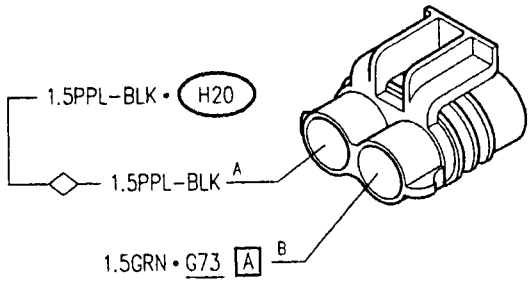


Anti-theft system control unit	N45 B

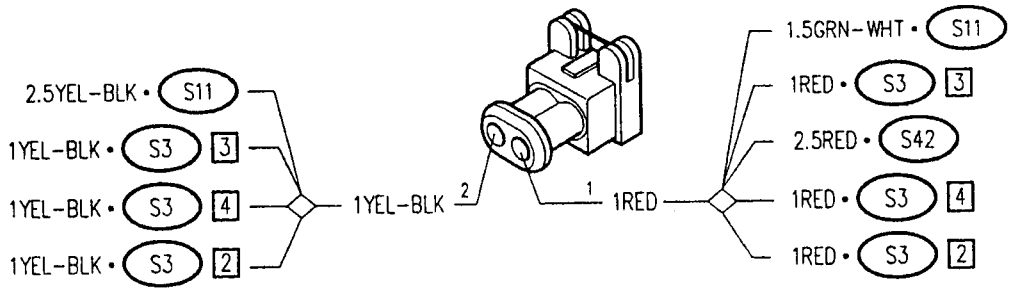


COMPONENTS AND CONNECTORS (cont.d)

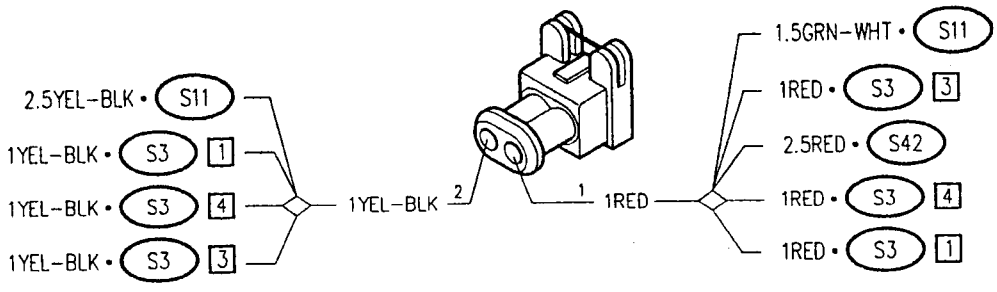
Electric fuel pump — P18



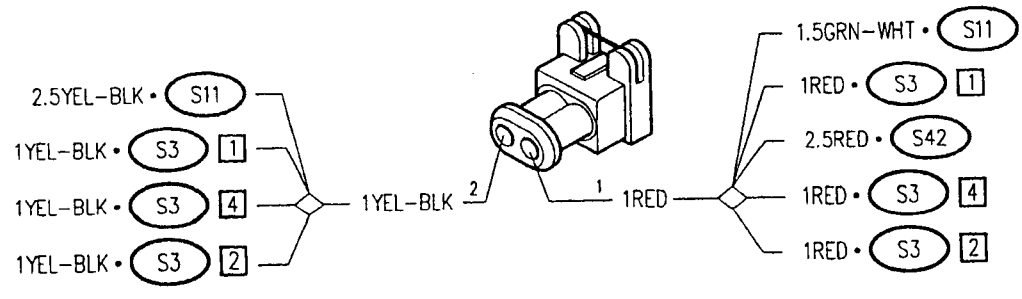
Electroinjector — S3 1



Electroinjector — S3 2

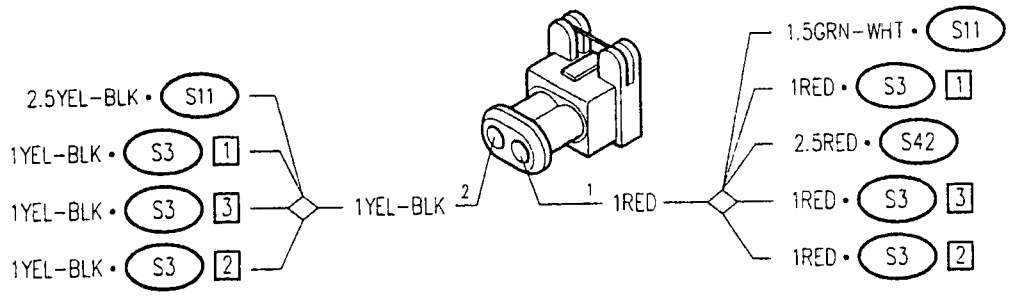


Electroinjector — S3 3

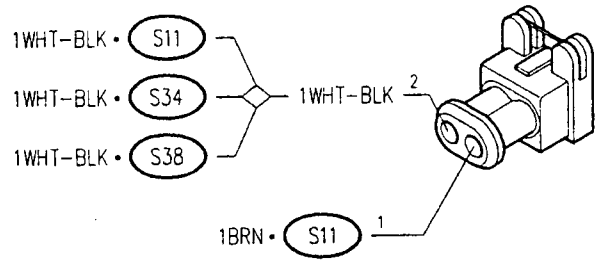


COMPONENTS AND CONNECTORS (cont.d)

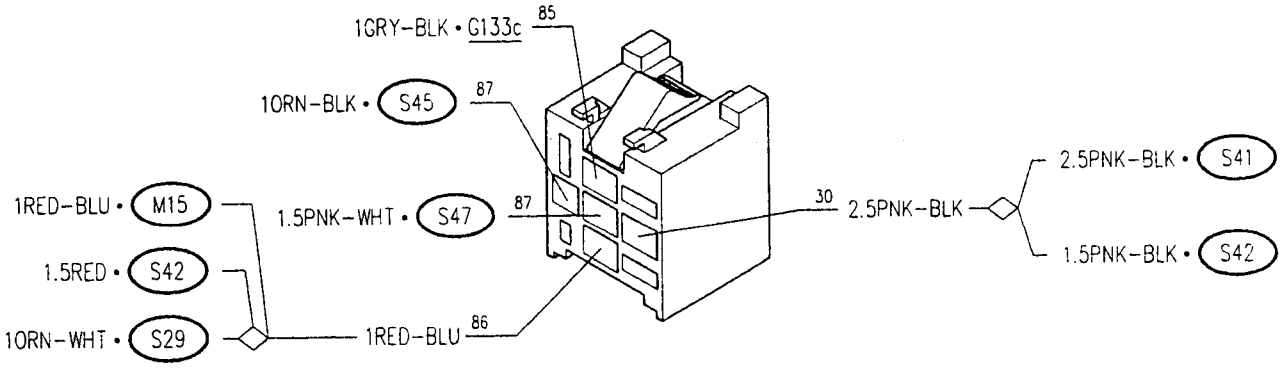
Electroinjector — S3 4



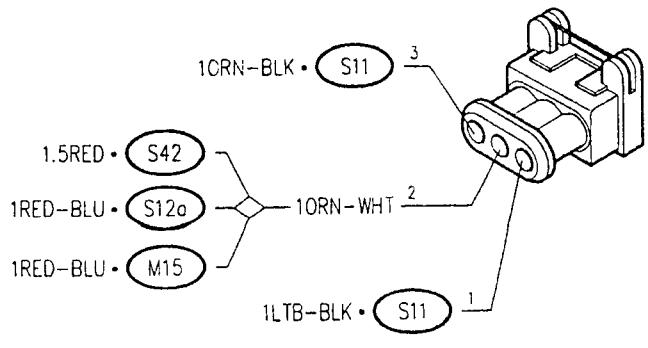
Engine temperature sensor — S7



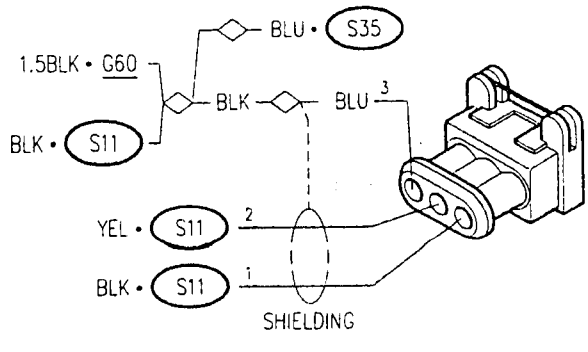
Fuel pump Motronic relay — S12a



Idle speed adjustment actuator — S29

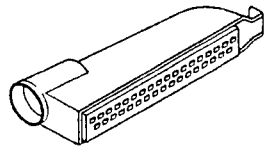


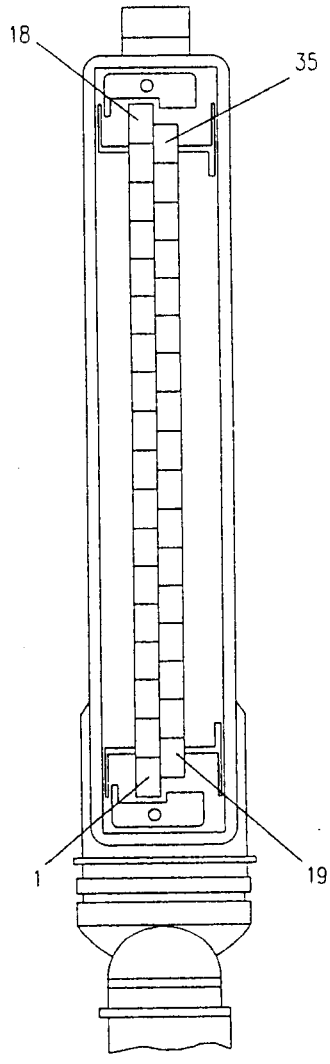
Rpm and crankshaft position sensor — S31



COMPONENTS AND CONNECTORS (cont.d)

Motronic control unit — S11

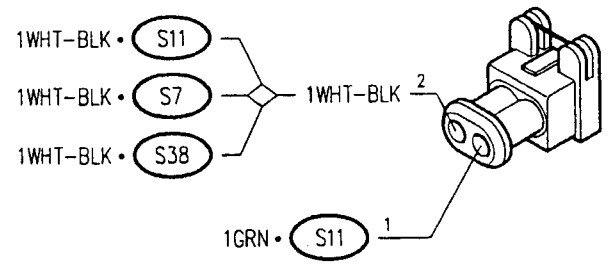




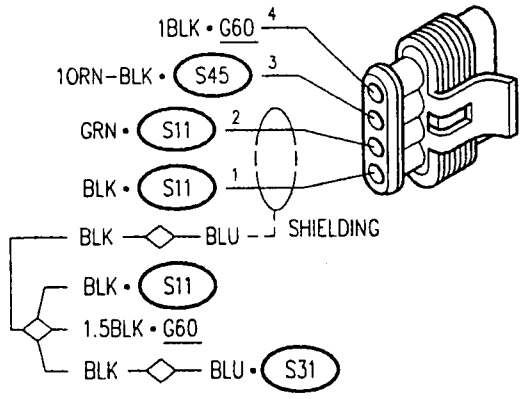
1 — 1GRY-GRN • N1
2 — 1WHT • N1
3 — 1YEL • S38
4 — LTB-WHT • T1
5 — BLK — 1.5BLK • G60; BLK — BLU • S31; BLK — BLU • S35
6 — 1WHT-BLK — 1WHT-BLK • S38; 1WHT-BLK • S34; 1WHT-BLK • S7
8 — GRN • S35
9 — 1LTB-YEL • S38
12 — WHT-RED • T1
13 — 1BRN • S7
14 — 2.5YEL-BLK — 1YEL-BLK • S3 [1]; 1YEL-BLK • S3 [2]; 1YEL-BLK • S3 [3]; 1YEL-BLK • S3 [4]
16 — 2.5BLK • G60
17 — 1RED-GRN • G133b
18 — 1.5RED • S46
20 — 1GRY-BLK • G133c
21 — 1BRN-WHT • G133o
22 — 1GRN • S34
23 — YEL • S31
24 — BLK • S31
25 — BLK • S35
29 — 1GRY-YEL • G337
31 — 1ORN • M15
32 — 1GRN-WHT • G337
33 — 1ORN-BLK • S29
34 — 1LTB-BLK • S29
35 — 1.5GRN-WHT — 1RED • S3 [1]; 1RED • S3 [2]; 1RED • S3 [3]; 1RED • S3 [4]; 2.5RED • S42

COMPONENTS AND CONNECTORS (cont.d)

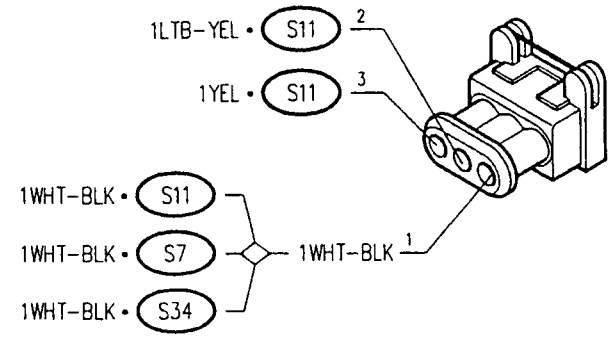
Air temperature sensor — S34



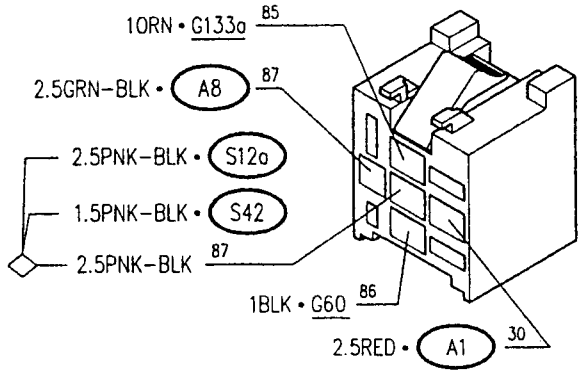
Heated lambda sensor — S35



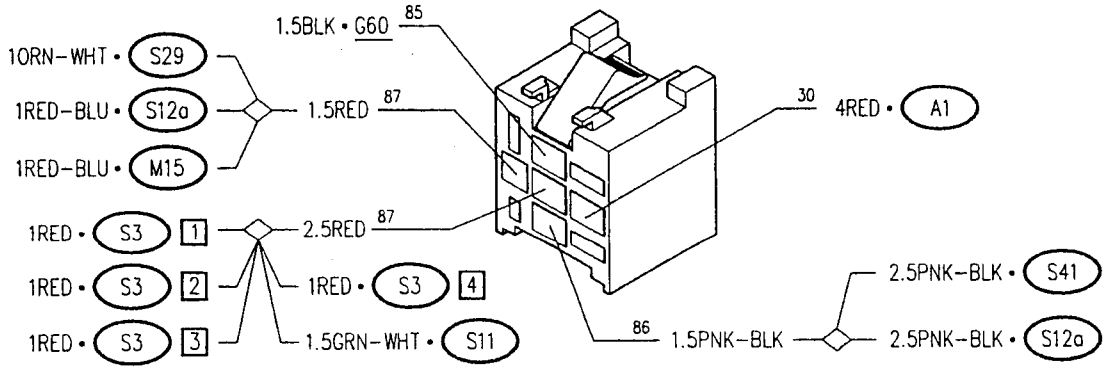
Sensor on throttle body — S38



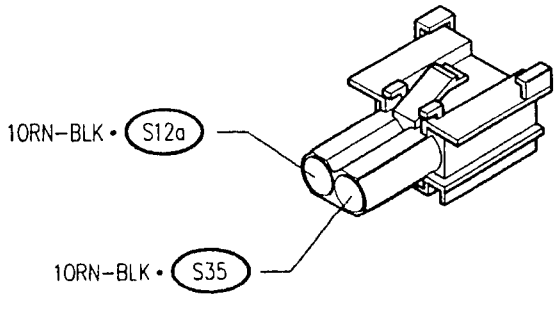
Main relay switch — S41



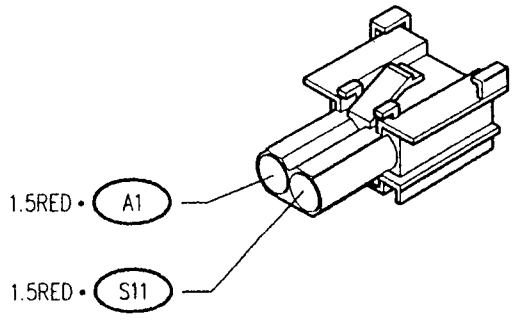
Secondary relay switch — S42



Lambda sensor wander fuse — S45

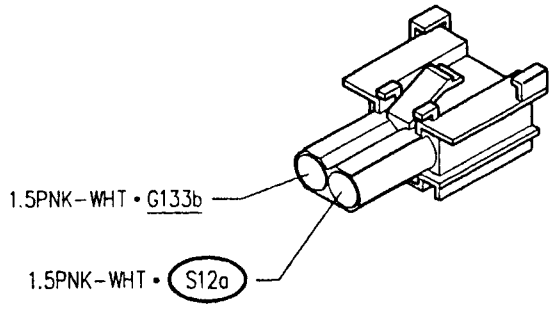


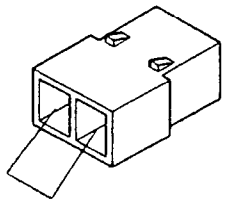
Motronic supply wander fuse — S46



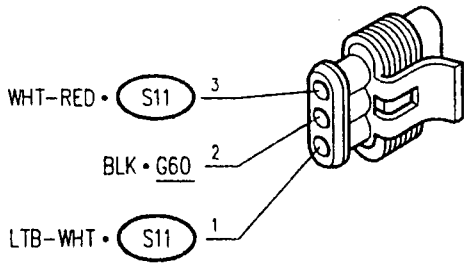
COMPONENTS AND CONNECTORS (cont.d)

Fuel pump wander fuse	S47	MP31 control unit switching connector	S49

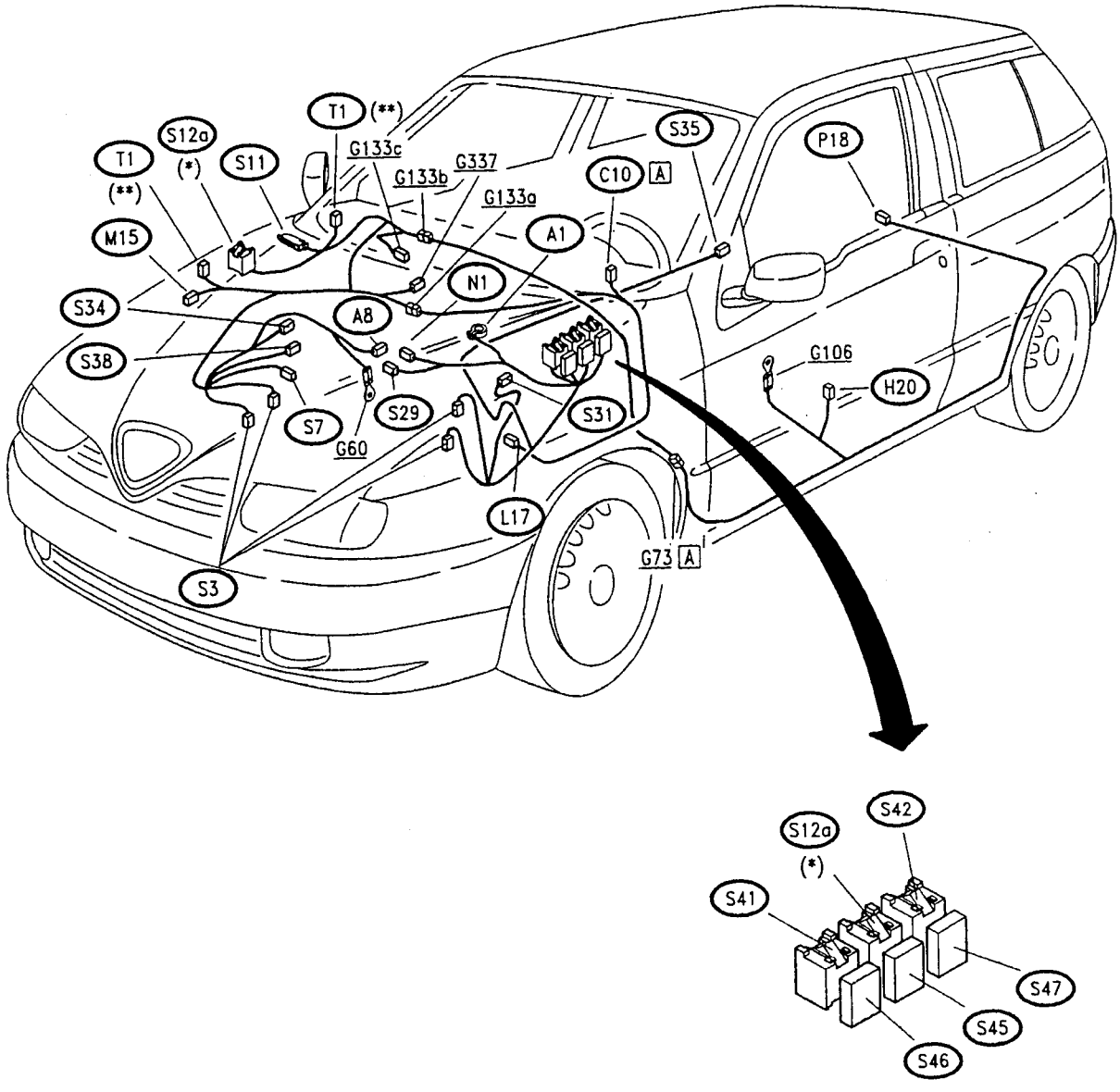




Connector for ALFA TESTER (Motronic)	T1



LOCATION OF COMPONENTS



(*) Relay **S12a** is, for some vehicles only, located in the engine bay next to other relays; in all other cases it is located in the container of control unit **S11**.
(**) The connector **T1** is, for some vehicles only, located near the control unit **S11**; in all other cases it is located in the engine bay.

FAULT-FINDING

The control unit is fitted with a self-diagnosis, which continuously checks the signals from the different sensors for plausibility and compares them with the limit values allowed: if these limits are exceeded, the system detects a failure: if the failure is not sporadic and remains "present" permanently it is acknowledged as "important" and stored in the memory. In addition, in the event of a failure, for certain parameters, the abnormal values are replaced by suitable mean values to make it possible for the car to "limp" to a Service Centre. The self-diagnosis system also enables quick and effective fault-finding connecting to the ALFA ROMEO Tester.

Diagnosis using the ALFA TESTER

N.B.
Before carrying out diagnosis with the Tester, carry out the preliminary check described below (**TEST A**).

The connection between the Tester and the electronic control unit must be carried out as follows:

1. Power the Tester either through the cigar lighter socket or connecting it directly to the battery using the cable provided.
2. Connect the Tester socket to that of the control unit (the socket is to be found near the control unit itself).

The information the instrument can give comprises:

– display of the parameters;

– display of errors;

– active diagnosis.

Error clearing

Before ending diagnosis the contents of the "permanent" memory should be cleared by the Tester in the "Active Diagnosis" function.

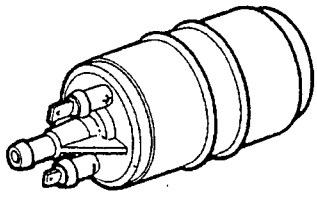
In the failure to do so, the next time the Tester is connected, errors that have already been examined will be signalled.

CHECKING COMPONENTS

Electroinjectors (S3)

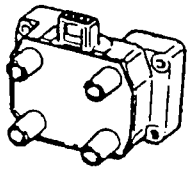
SPECIFICATIONS	
Winding resistance	16 ± 0.5 Ω

Fuel pump (P18)



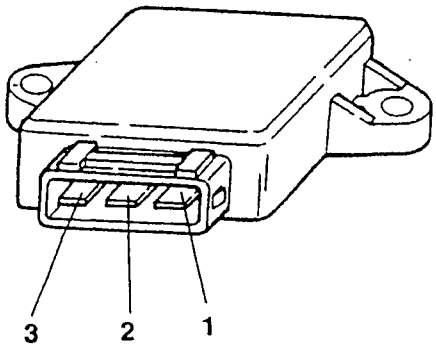
SPECIFICATIONS	
Flow rate	≥ 120 l/h
Pressure	4 bar
Nominal voltage	12 V

Ignition coil (A8)



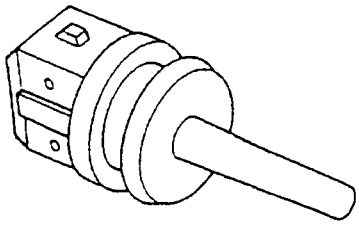
SPECIFICATIONS	
Primary resistance	0.5 Ω
Secondary resistance	13.3 Ω

Throttle position sensor (S38)



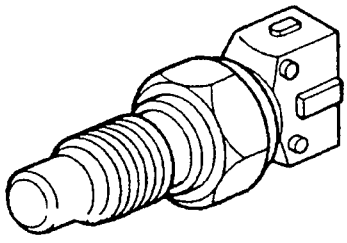
SPECIFICATIONS	
Resistance between terminals:	
1-2 (fixed)	≃ 2 kΩ
1-3 (throttle closed)	≃ 1 kΩ
1-3 (throttle completely open)	≃ 2.7 kΩ

Intaken air temperature sensor (S34)



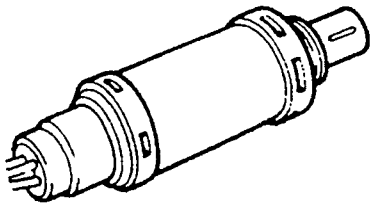
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10	8100 ÷ 10770
+ 20	2280 ÷ 2720
+ 80	292 ÷ 362

Engine temperature sensor (S7)



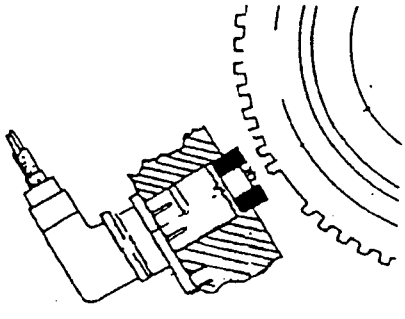
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10	8100 ÷ 10770
+ 20	2280 ÷ 2720
+ 80	292 ÷ 362

Lambda sensor (S35)



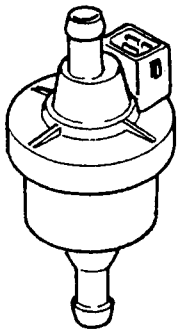
SPECIFICATIONS	
Heating resistance	3 Ω

Rpm and timing sensor (S31)



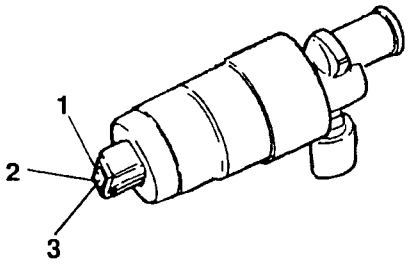
SPECIFICATIONS	
Sensor winding resistance at 20°C	486 ÷ 594 Ω
Distance (gap) between sensor & flywheel ring gear	0.25 ÷ 1.3 mm

Evaporative solenoid valve (M15)



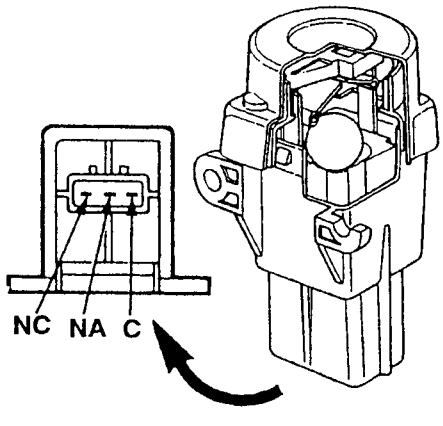
SPECIFICATIONS	
Air flow rate	Min. 0.08 m^3/h Max. 3.0 m^3/h
Duty-cycle signal	12 V; 10 Hz
Winding ohmic resistance	45 Ω ± 1%
When not energized the solenoid valve is normally open	

Idle speed adjustment actuator (S29)



SPECIFICATIONS	
Resistance between terminals 1-3	40 Ω
Resistance between terminals 2-3	20 Ω

Inertial switch (H20)



SPECIFICATIONS
Check continuity between pins NC and C: this continuity is cut off in the event of a crash; the contact is re-connected pressing the special pushbutton

PRELIMINARY CHECK FOR BOSCH MP3.1 SYSTEM	TEST A

NOTE: Beforehand, check that the anti-theft device is working properly (See "Antitheft Device" section) which might have cut off the supply to the system!

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check intactness of fuses **S45**, **S46** and **S47**	OK ▶ ~~OK~~ ▶	Carry out **step A2** Change fuses **S45** : 7.5 A **S46** : 7.5A **S47** : 10A
A2 CHECK VOLTAGE – Check for 12 V at pin 30 of relay **S41** and at pin 30 of relay **S42**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Restore the wiring between la batteria **A1**, ed i teleruttori **S41** e **S42**
A3 CHECK VOLTAGE – With the key turned, check for 12 V at pin 85 of relay **S41**, at pin 30 and 86 of relay **S12a** and at pin 86 of **S42**	OK ▶ ~~OK~~ ▶	Carry out **step A4** Restore the wiring between the ignition switch **B1** and relay **S41**, between **S41** and **S12a** and between **S42** and **S12a**
A4 CHECK RELAYS – Check for correct operation of relays **S41**, **S42** e **S12a**	OK ▶ ~~OK~~ ▶	Carry out **step A5** Change any faulty relays
A5 CHECK CONTROL UNIT SUPPLY – Check for 12 V aT pin 18 of control unit **S11**; with the key turned 12 V also at pin 35 of **S11** and appr. 0 V (very low voltage) at pin 20 of **S11**	OK ▶ ~~OK~~ ▶	Carry out **step A6** Restore the wiring between control unit **S11** and the relays and between the control unit and fuse **S46**
A6 CHECK EARTH – Check for an earth at pins 5 and 16 of **S11**. Also check for an earth at pin 85 of **S42** and at pin 86 of **S41**	OK ▶ ~~OK~~ ▶	**CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER** Restore the wiring between **S11** and the relays and earth **G60**