ELECTRONIC IGNITION AND INJECTION SYSTEM I.A.W. (Marelli Weber)

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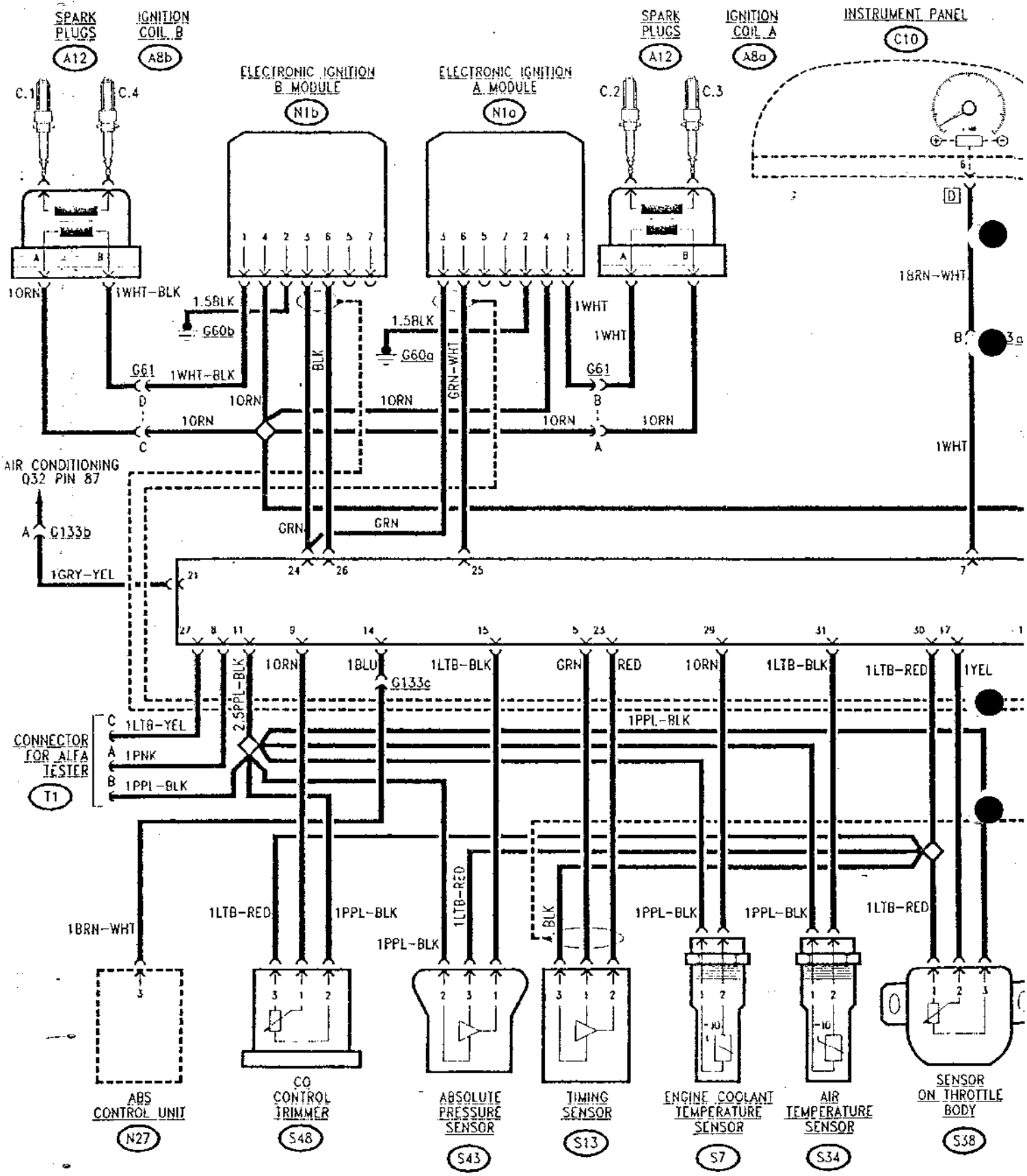
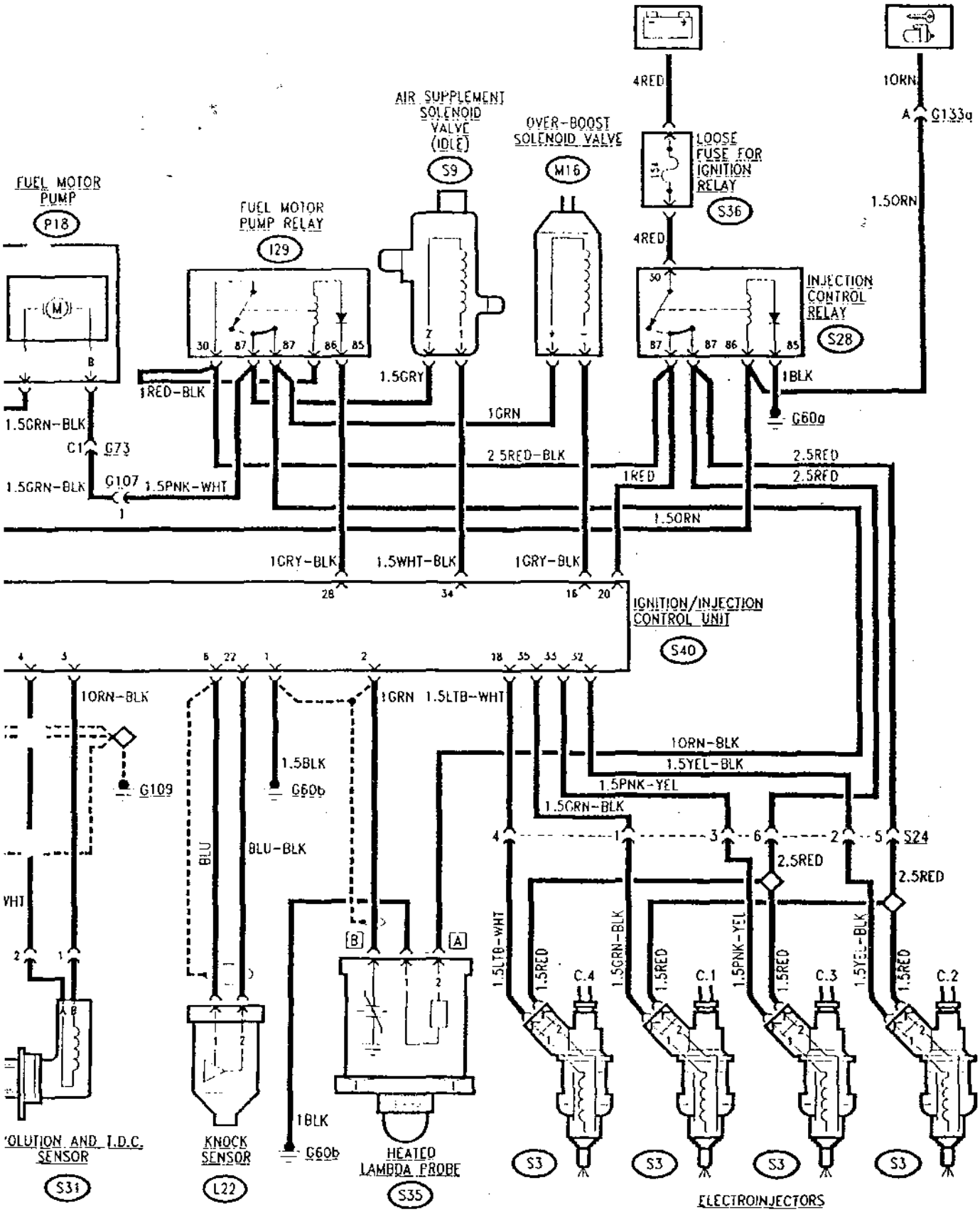
WIRING DIAGRAM




FUEL MOTOR PUMP
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GENERAL DESCRIPTION

The electronic control system I.A.W. defines and controls all the engine parameters, optimizing performance and consumption through a real time response to the different operating conditions.
A single control unit governs both injection, ignition and regulates boosting.
Injection is the multi-Point type, an injector for each cylinder, supplied at low pressure and driven in a sequential and timed way by the control unit.
The control unit calculates the amount of air taken by indirectly measuring, using signals provided by the temperature sensors, the engine revs and the absolute pressure of the air itself: on the basis of this value the amount of fuel to be injected is calculated.
A "static distribution" electronic ignition has also been adopted (semi-conductors without distributor, with two double outlet coils).
This solution significantly improves reliability as it becomes possible to eliminate rotating components, which consequently leads to a reduction in noise; in addition sparks are not produced externally, which reduces the risk of interference; finally it also reduces the number of high voltage cables and connections.

The control unit also determines the optimum ignition advance by consulting a memorized map, in function with the different operating parameters, so as to optimize the requirements of maximum power, minimum consumption, and a low level of exhaust emissions.

For this reason the "lambda" probe also intervenes, and provides the control unit with information regarding the amount of oxygen present in the exhaust, and consequently allows the correct air - fuel ratio to be determined: with a lean mix, the control unit will increase the amount of fuel, and decrease it for a rich mix.

The control unit also controls the idle speed by adjusting a valve which regulates the flow of air parallel to the throttle (by-pass) when it is closed.

The I.A.W. system also realizes a particular boost control strategy known as "boost-drive", continuously and proportionally regulated: a three way solenoid valve, electronically controlled by the control unit, regulates the boost pressure in the turbocharger: when high power is requested, the solenoid valve "releases" the waste-gate valve and increases the engine's boosting.

N.B. the simultaneous management of all these functions by the same control unit, allows each parameter to be regulated in function with the others, so as to exploit the full potential of all the systems.
The system is also equipped with a "self diagnosis" system which memorizes any eventual faults, making them easier to identify and correct.
The self diagnosis systems also allows any faults to be identified rapidly and effectively by connecting into the ALFA ROMEO tester (see suitable publications).
Trouble shooting is also possible even without the help of this instrument following the indications outlined below in this section (See "Troubleshooting").

OPERTATING LOGIC

INJECTION: the control unit establishes the amount of fuel to be injected on the basis of the result of the intaken air quantity calculation (in weight): this calculation, dictated by the "speed- density of the intaken air", is performed with information from the temperature sensors, the intaken air pressure and the engine revs.
The control unit consults a memorized map which, in function with the load and on the basis of the engine's optimum volumetric efficiency value, provides a value which activates the electroinjectors: the controlled parameter is the opening time of the injectors themselves, which is proportional to the amount of incoming fuel, as the pressure below the injectors is kept constant by a mechanical regulator.

Fuel Control: using the oxygen probe (or "lambda" probe) the control unit verifies in real time the amount of oxygen present during exhaust, and consequently the correct air-fuel metering.

The signal that the probe sends to the control unit suffers a sharp variation when the composition of the mixture deviates from lambda = 1 (optimal stoichiometric mixture).
When the mixture is "lean", the control unit increases the amount of fuel, when it is "rich" it decreases it: in this way the engine functions as near as possible to the ideal lambda value.
This probe makes it possible to accurately and retroactively regulate the engine fuel.

Together with a catalytic converter fitted to the exhaust, this also allows emissions to be limited to levels permitted by the law in any condition.
The IAW system also allows altitude to be automatically compensated for, as variations in air density directly adjust delivery by the injectors through the signal from the absolute pressure sensor.
The probe is heated by an electrical resistance in order to quickly reach the correct operating temperature (approx. 300°).

A regulating device (trimmer) allows emissions to be controlled and the CO to be regulated at idle speed (for more details see "155 - REPAIR MANUAL - ENGINES", Group 04).

IGNITION: a mapping system within the control unit calculates the ignition advance on the basis of the load and the number of revs.

Through the rev and timing sensors, the control unit knows the exact position of each cyclinder with respect to the TDC: in this way, the impulse is sent to the correct spark-plug in exactly the right moment when it is required.
The ignition system is the static type, realized by two coils, each of which supplies two different cylinders by simultaneously sending an impulse to the spark plug of one cylinder (working spark) and to the other one (lost spark).
A power module for each coil supplies the required voltage.

Control of knocking: the knock sensor measures the intensity of the vibrations (knocking) caused by knocking in the combustion chamber. In this situation, the control unit increases the amount of fuel and reduces the advance values calculated by the map, so as to eliminate this phenomenom as soon as possible: the advance curves are reduced by approx. 2°, and if necessary by a further 2° etc. (upto a max. of 6°), until the knocking disappears, after which the advance is reset corresponding with the original map.
N.B.: this device is essential in boosted engines, as it is easy for knocking to occur.

REGULATING IDLE SPEED: the idle speed is dynamically regulated through a valve which is controlled by the control unit and which modulates the amount of air in the throttle by-pass.
This device acts as an additional air chamber and regulator for the operation of the various functions (eg. air conditioning compressor): with the throttle valve at the stop limit, the valve regulates the by- pass clearance compensating for the power requested by the functions so as to guarantee an idle speed as far as possible constant around the value 850 ± 30 revs/min..
To maintain the idle speed constant from the moment in which the engine is started up, the amount of fuel injected also needs to be increased: the control unit intervenes here, warning of this condition through the engine temperature sensor.

Fast idle: when the accelerator is released and braking starts, for four wheel drive vehicles, the action of the engine brake must be reduced, which causes a decrease in the adhesive force in particular at the rear: this is achieved by increasing the throttle by-pass flow, and subsequently, the engine speed ("fast idle").
The ABS system (described later) is connected to the injection and ignition control unit in order to activate this function according to the following logic:

- insertion of "idle fast" as soon as braking is started with poorroad holding (ABS intervenes)
- function is interrupted if the clutch pedal is pressed, if the vehicle speed is less than 24 km/h (these two parameters are detected by the ABS control unit), or if the engine is already running at idle speed (less than 1100 r.p.m.)

BOOST CONTROL: the engine boosting, activated by the turbocharger, is controlled by:

- a (mechanical) by-pass valve, whose task is to reduce the phenomenom known as "hammering" on the turbine; this phenomenom can be noticed every time the accelerator is released sharply;
- a "waste-gate" valve which keeps the increase in pressure constant over the turbocharger, and consequently the boosting pressure: this is achieved through a by-pass of exhaust gas to the turbine exhaust
- a solenoid valve, driven by the control unit, which increases the boost and releases part of the pressure

on the waste-gate valve, when max. power is requested.

The latter valve does not act with a continuous command, but with a "duty-type" signal (12V impulses with a 15Hz frequency), which allows the boost pressure to be "softly" modulated, in order to obtain a progressive and regular supply of power.
For safety reasons the control unit will interrupt injection if the boost pressure exceeds 1.5 bar.

In addition to the above points the system also controls the following functions:

Fuel pump control: the control unit drives the electric fuel pump according to a very precise logic which guarantees maximum safety:

- during start-up, the pump's supply is interrupted after a given time (variable between 0.5 and 10 secs in function with the engine temperature) if the engine has not already started to rotate regularly.
- the pump is continuously supplied as long as a signal provides the r.p.m.; if this signal stops for any reason (if there is an accident and the engine cuts out) the pump is immediately disactivated.

Control of cold starting: during the cold starting phase the control unit uses the advance and injection time values so as to obtain the "automatic starter" function.

In addition, in this situation the idle speed control logic also varies (see).

Control of enrichment during acceleration: when accelerating the control unit increases the injection in order to reach the required torque/power ratio as quickly as possible.

This function can be recognised by the rapid variation in both the intaken air density, and the signal of the potentiometer positioned on the throttle which immediately signals to the control unit that "maximum power" has been requested.
An enrichment of the amount of fuel injected is achieved during acceleration starting with the throttle angle above 30° (max. speed).

Fuel cut-off during deceleration: with the throttle closed and the r.p.m. above the threshold value (approx. 1.100 revs plus 200 hysterisis revs), the control unit disenables the fuel injection; in this way the number of revs decreases rapidly towards the idle speed and above all there is a considerable saving in fuel, and a considerable consumption control.

Limitation of r.p.m.: the control unit automatically reduces the fuel injection when the engine speed reaches a high value, close to the maximum threshold, and protects the engine from operating in these critical conditions.

Control of knocking: as already seen, the knock sensor hears the knocking in the combustion chamber. In this condition it reduces the amount of fuel to eliminate this phenomenom as quickly as possible.

Connection with the air conditioning compressor: the control unit is connected to the air conditioning system so that it can adapt the engine idle speed to the increase in load every time that the compressor is activated.

Fuel vapour recovery: N.B.: in this system the electronic control unit does not control the fuel vapour recovery, it is controlled pneumatically (see "155 ⊠ - REPAIR MANUAL - ENGINES", Group 04)

SELF DIAGNOSIS

The control unit is equipped with a self diagnosis system, which continually verifies the signals originating from the various sensors and compares them with the maximum allowed limits, memorizing any faults.
These faults can be easily identified by connecting to the ALFA ROMEO Tester (see suitable publications).

COMPONENTS:

The electronic control unit (S40) receives signals from the sensors which "read" the functioning of the engine, it processes them according to a logic memorized internally in "maps" which are correlate, in the best way, the various parameters, which in turn activate the actuators so that the engine always functions with the highest degree of performance and regularity.
The "maps" are the result of long bench and on-road tests to determine the optimal values and are stored in a permanent "read only" ROM memory programmed during control unit assembly and that can not be modified.

The parameters are calculated for every engine revolution, which allows a "real time" response to the systems's operating conditions.
The control unit is also able to adapt the signal sent to the actuators in function with the supply voltage, because varying this voltage would cause the actuators to respond differently.

The control sensors are:

- revolution and TDC sensor (S31);
- timing sensor (S13)
- engine coolant temperature sensor (S7);
- air temperature sensor (S34);
- absolute pressure sensor (S43);
- sensor on throttle body (S38)
- heated lambda probe (S35)
- knock sensor (L22)

The actuators controlled by the system are:

- electroinjectors (S3);
- ignition coil (A8a; A8b) with ignition modules (N1a; N1b);
- fuel motor pump (P18);
- air supplement solenoid valve (idle) (S9);
- "overboost" solenoid valve (waste-gate control) (M16)

The control unit is also connected to:

- the heater/ventilation system, which signals when the compressor has been activated to adapt the engine idle speed
- the ABS control unit N27 which signals when the idle fast is to be activated
- instrument panel C10 to which the rev counter signal is provided.

The control unit S40 is also connected to the CO control trimmer (S48).

The system is completed by two relays which activate the engine fuel pump (fuel pump relay I29) and the injectors (injection control relay S28), by a loose protection fuse (S36) and three ground points (G60a, G60b and G109).

Finally it is connected to the ALFA ROMEO tester through connector T1.

FUNCTIONAL DESCRIPTION

The control unit S40 controls and regulates the entire electronic ignition and injection system, as well as the boosting.

The control unit S40 is supplied to pin 20 of the injection control relay S28. This supply is protected by fuse S36 (15A).

Relay S28, excited with the key in "run" position signal, supplies the control unit to pin 20 and the fuel pump relay I29; it also provides a consensus signal to the injectors S3.

The petrol pump relay I29, excited by a negative signal from the control unit S40 from pin 28, supplies the fuel electric pump P18, and provides a consensus signal to the over boost solenoid valve M16, to the air supplement solenoid valve S9 and the lambda probe S35.

For safety reasons, the control unit S40 controls the supply to the fuel pump: this takes place through the consensus signal to relay I29, to pin 28, according to the logic described above.

The control unit S40 receives signals from the various sensors, and keeps all the engine's operating parameters under control.

From pin 30 of the control unit a "filtered and controlled" supply signal is sent to the numerous sensors, whilst a "filtered" ground signal is sent from pin 11 to a series of other sensors.

The revolution and T.D.C. sensor S31 and the timing sensor S13 supply information regarding engine speed and timing.

Sensor S31 is of the inductive type and measures the engine r.p.m. by varying a magnetic field produced by the passing of the teeth of the "phonic" wheel assembled on the crankshaft pulley; the wheel has four teeth, dephased by 90° which allows the speed to be identified and the passage to T.D.C to be recognised: it receives a

control unit ground from pin 3, and sends out a signal to pin 4.

The timing sensor **S13** reconstructs the timing value through a Hall effect device fitted to the cam shaft, exhaust side: it receives a control unit ground at pin 5, a supply at pin 30 and sends out a signal to the pin 23 of the control unit; all three cables are protected.
The control unit **S40** compares this signal with the rev and T.D.C. sensor **S31** and identifies the operating time for each cylinder and consequently pilots the injection sequence.

The sensor on throttle body **S38**, controlled by the control unit **S40** from pin 30 and 11, generates a signal through a potentiometer which is sent to pin 17 which is proportional to the degree of opening of the throttle itself. The mobile part of the potentiometer is fitted directly on the shaft which makes the throttle rotate.

The air temperature sensor - in the intake manifold - **S34**, controlled by the control unit **S40** from pin 11, supplies a signal to pin 31 which is proportional to the temperature in the intake manifold, measured by the NTC type thermistor (resistance which decreases with the temperature.)

The engine temperature sensor **S7**, controlled by the control unit **S40** from pin 11, supplies a signal to pin 29 in proportion with the engine coolant temperature measured, close to the thermostat, with an NTC thermistor (resistance which decreases with the temperature).

The absolute pressure sensor **S43**, controlled by the control unit **S40** from pins 30 and 11, generates a signal sent to pin 15 which is proportional to the incoming air absolute pressure.
This signal is of the piezoresistive type: an internal electronic device within the sensor itself amplifies the deformations of a membrane which "hears" on one side the absolute vacuum and on the other the vacuum in the intake manifold.

The knock sensor **L22**, controlled by a ground from the control unit **S40** to pin 6, supplies a signal, to pin 22 - protected - proportional to the vibrations of the hammering phenomenom (knocking) in the combustion chamber. A piezoelectric material generates a voltage proportional to the vibrations detected.

The heated lambda probe **S35** supplies information to the control unit **S40** regarding the correct air-fuel mixture composition by measuring the concentration of oxygen in the exhaust gases; this takes place through a signal sent to pin 2 of the control unit **S40**; the above mentioned signal is of a very low intensity and is therefore protected. The probe is heated with a resistance, in order to ensure a correct functioning even with the engine cold; the resistance is supplied by the fuel pump relay **I29**.

On the basis of the signals received from the sensors and the calculations performed, the control unit **S40** controls the opening of the injectors **S3** through the pins 18, 35, 33 and 32. The injectors receive the consensus for opening from relay **S28**.

The ignition is the static type and is controlled directly by the control unit which consequently regulates automatically the advance.

The ignition modules **N1a** and **N1b** are supplied by relay **S28** to pin 4; pin 2 is grounded, whilst pin 3 receives the consensus through a ground from the control unit **S40**, pin 24.
The control signal is sent from pins 25 and 26 of the control unit **S40** to pin 6 of **N1a** and **N1b**: these signals are of a very low intensity and are therefore protected. The modules **N1a** and **N1b** generate the impulses sent, from pin 1 to the coils **A8a** and **A8b** and from the spark plug **A12**.

The air supplement solenoid valve **S9** realizes an air flow by-pass around the throttle; it is composed of an electromagnetic winding which moves the piston to vary the section of the gap, modulating the quantity of air in the by-pass. The control signal originates from pin 34 of the control unit **S40**, and the supply fron relay **I29**.

The overboost solenold valve **M16**, is activated to regulate the waste-gate valve by the control unit **S40** through the signal to pin 16, whilst the supply originates from relay **I29**. It is a three way valve where, with the winding excited, it will close the gap towards the waste-gate valve, and release the pressure supplied by the turbocharger into the intake channel,; this allows an increase in the boosting pressure ("boost-drive" logic).

The CO control trimmer **S48**, controlled by the control unit **S40** from pin 11 and 30, is connected to pin 9 to

which it sends a signal proportional to the rotaion of the CO adjusting screws.

The control unit **S40**, through sensor **S31**, is continually aware of the r.p.m: this information is sent to the revs counter indicator, situated on the instrument panel **C10**, through the signal from pin 7.

The control unit **S40** is connected with the air conditioning system through pin 21.
This allows the idle speed to be adjusted to the power increases every time the compressor is activated.

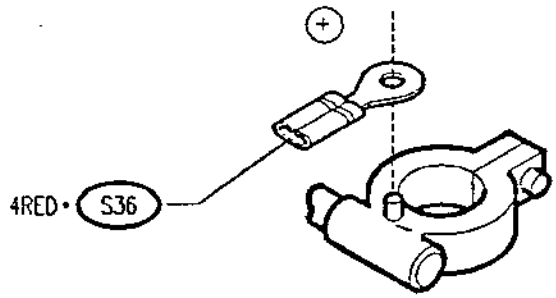
Pin 14 is connected to the ABS control unit **N27**, which signals when the "idle fast" is enabled or excluded.

The control unit **S40** is equipped with a self diagnosis system, which can be used by connecting it to connector **T1** of the ALFA ROMEO tester; the fault signals for at least one of the system's components are sent here from the control unit, pin 27, whilst pin 8 provides the reference supply and pin 11 the controlled ground.

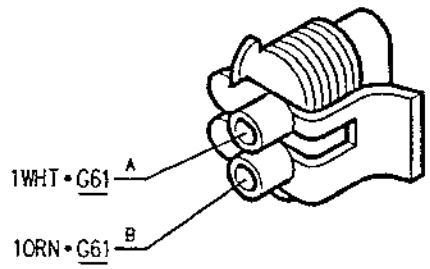
Finally pins 1 and 19 of the control unit **S40** are grounded (**G60b** and **G60a** respectively).

COMPONENTS AND CONNECTORS

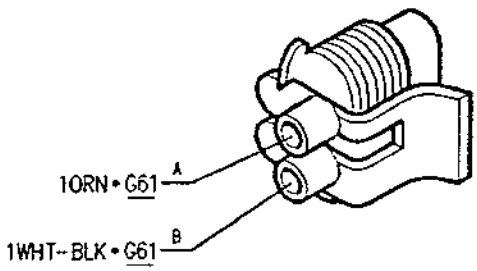
Battery	A1



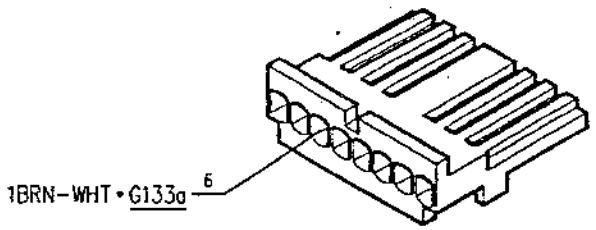
Ignition coil A	A8a



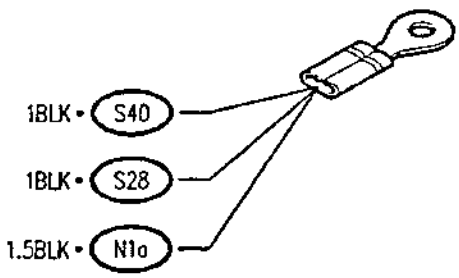
Ignition coil B	A8b



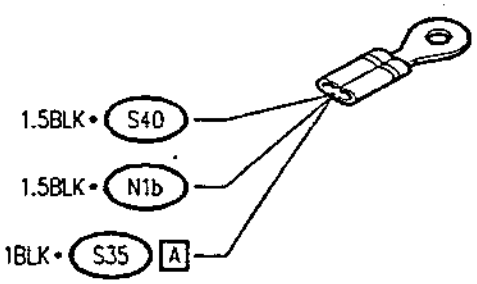
Instrument panel	C10 D



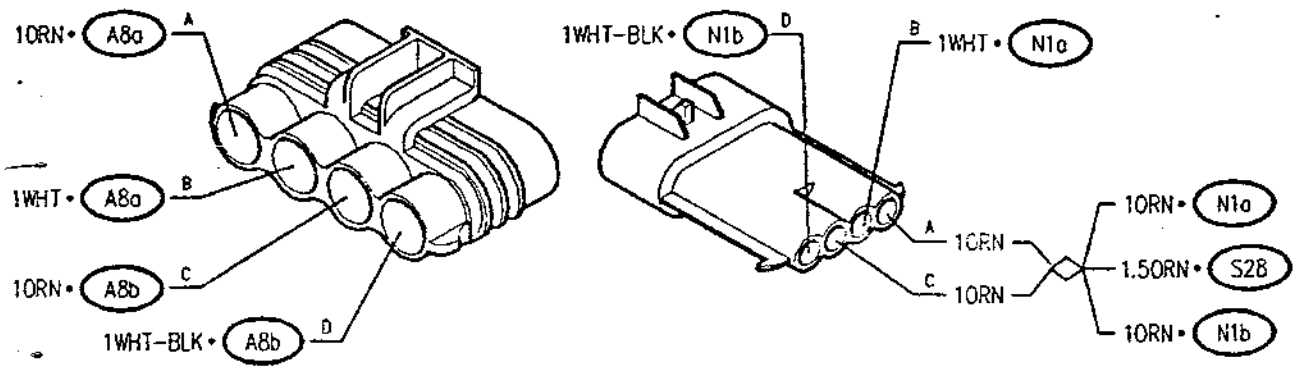
Injection wiring ground	G60a



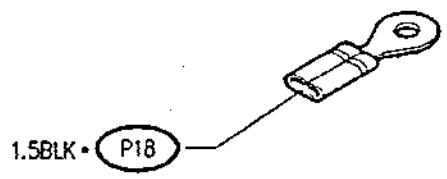
Injection wiring ground	G60b



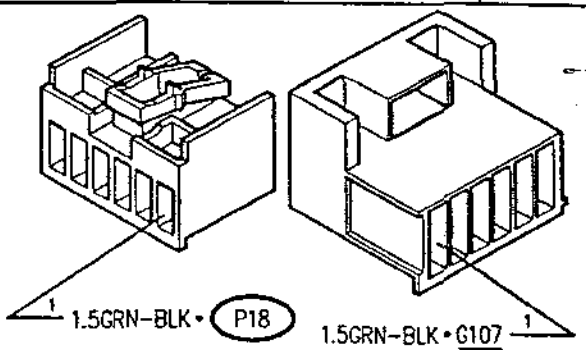
Injection coil connection	G61



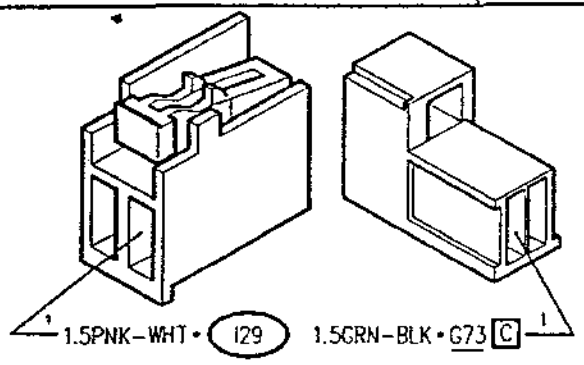
Rear right ground	G63a



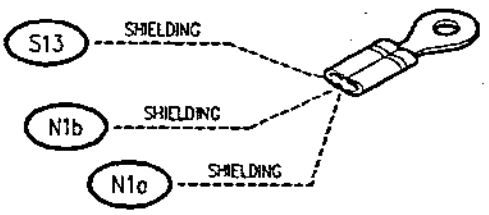
Connector for rear services	G73 C



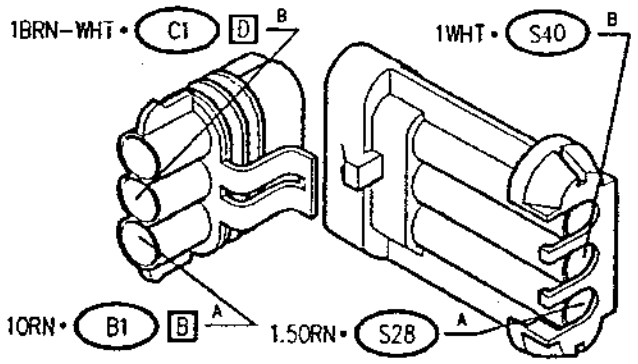
Connector for fuel pump	G107



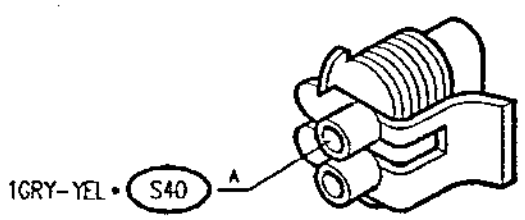
Injection wiring ground	G109



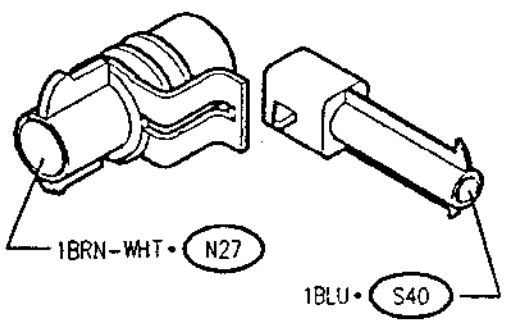
Electronic ignition/injection wiring connection A	G133a



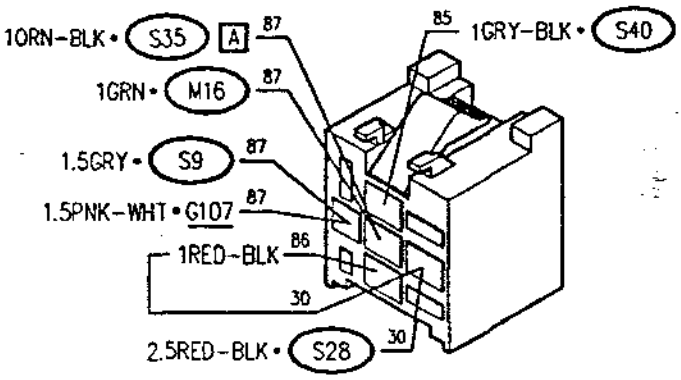
Electronic ignition/injection wiring connection B	G133b



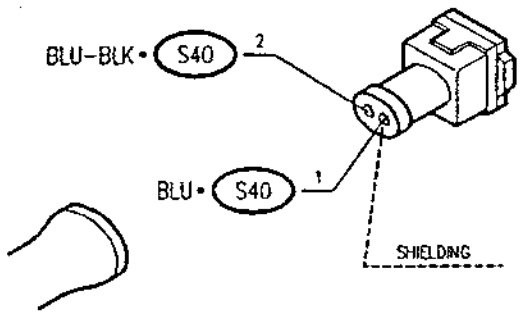
Electronic igntion/injection wiring connection C	G133c



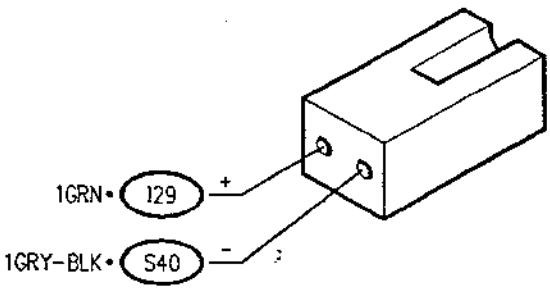
Fuel pump relay	I29



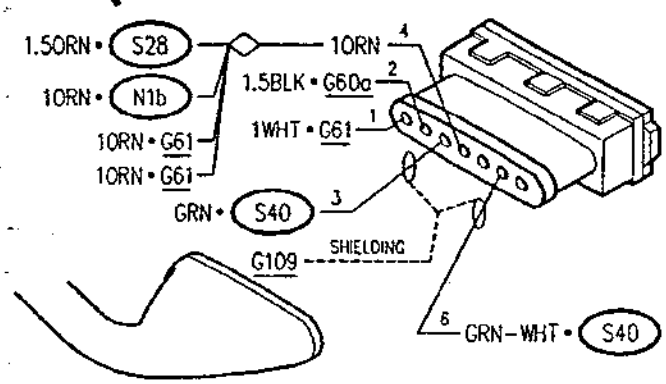
Knock sensor (L22)



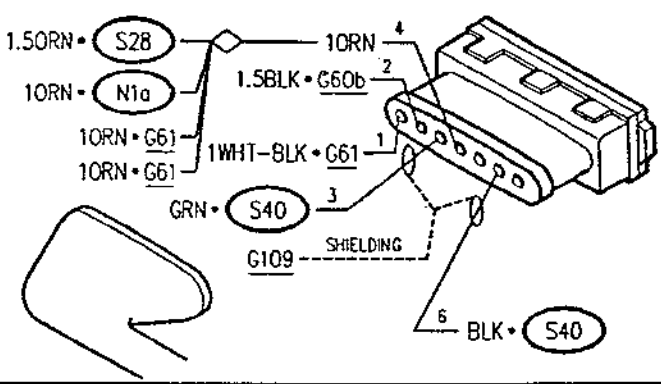
Over-boost solenoid valve (M16)



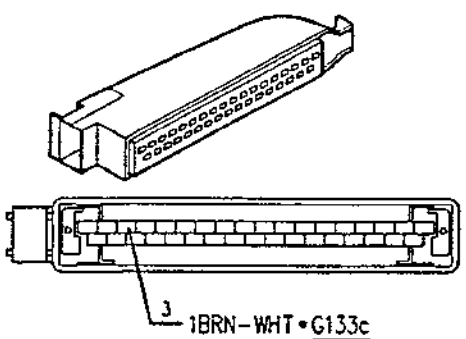
Electronic ignition module A (N1a)



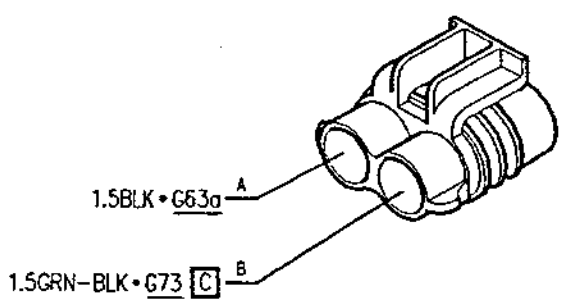
Electronic ignition module B (N1b)



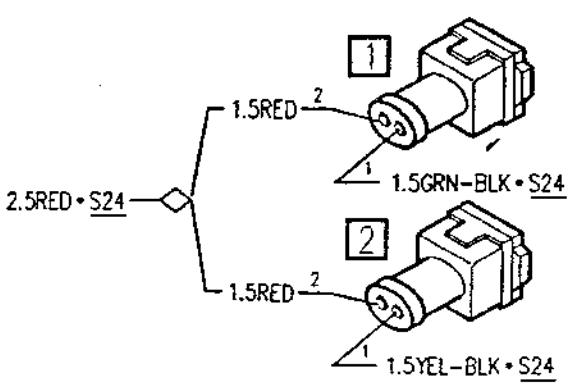
ABS system electronic control unit (N27)

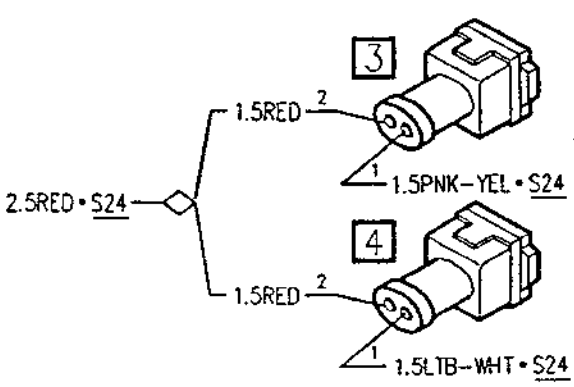


Fuel motor pump (P18)

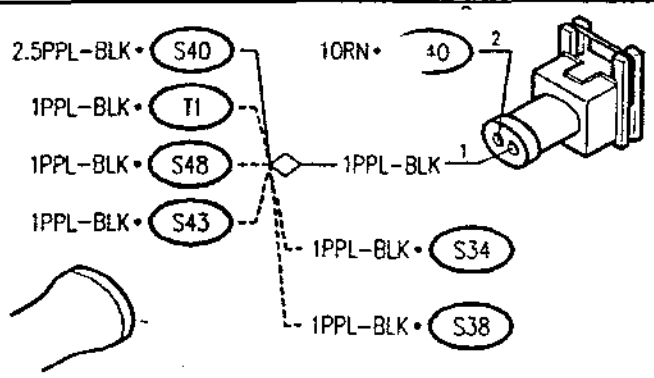


Electroinjectors (S3)

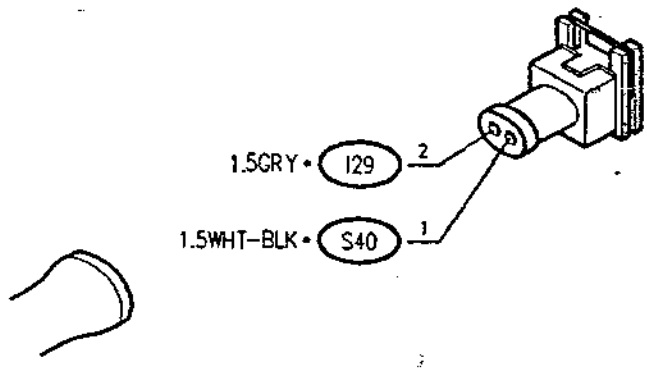




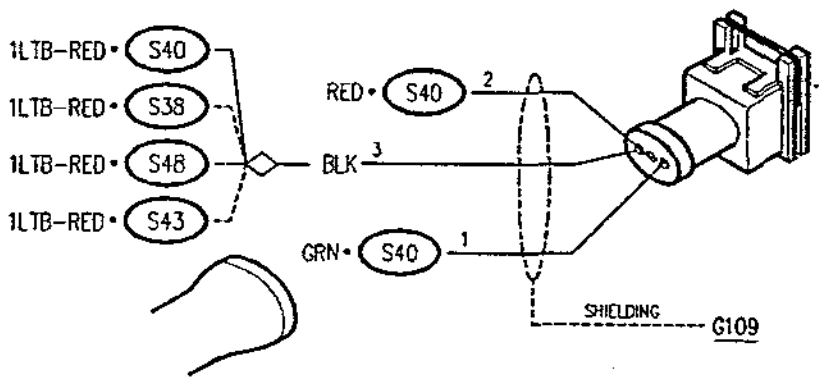
Engine coolant temperature sensor — S7



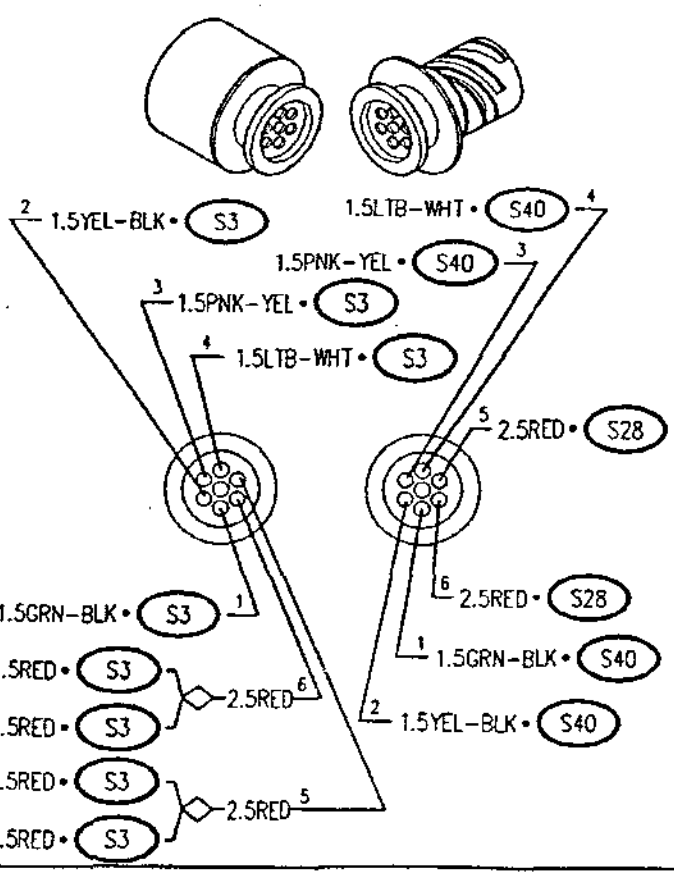
Air supplement solenoid valve (idle) — S9



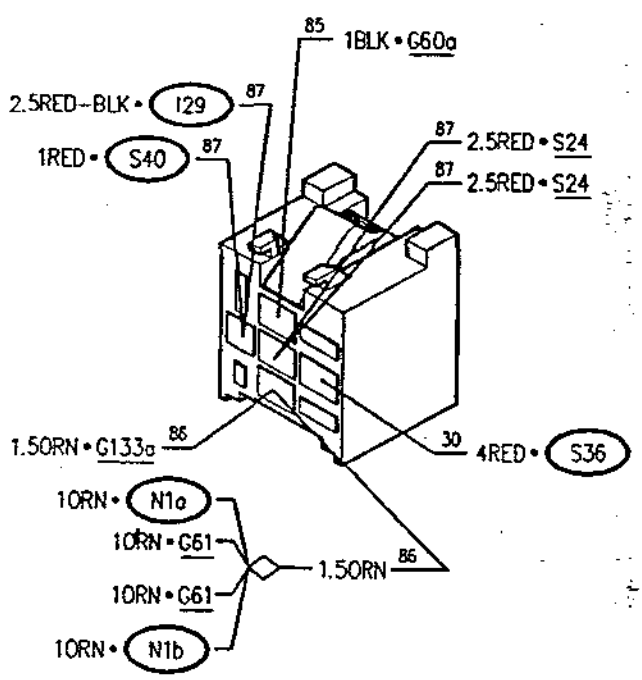
Timing sensor — S13



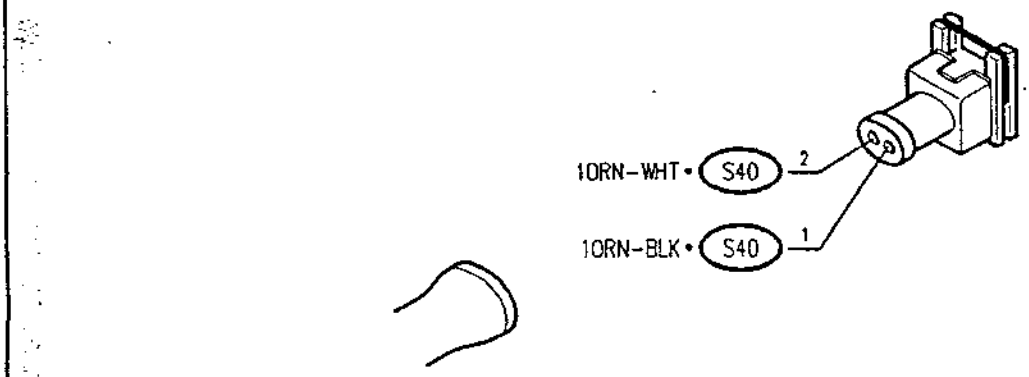
Connector for electroinjectors — S24



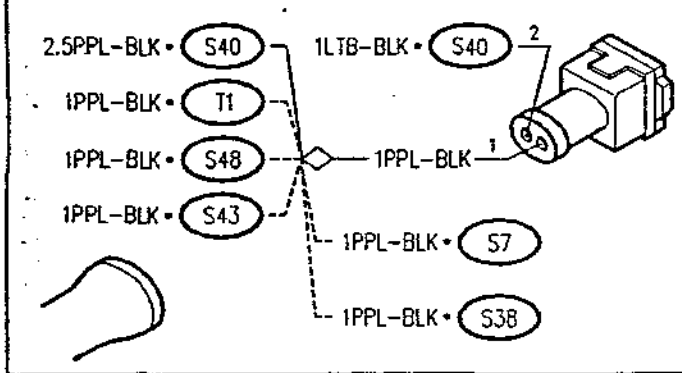
Injection control relay — S28



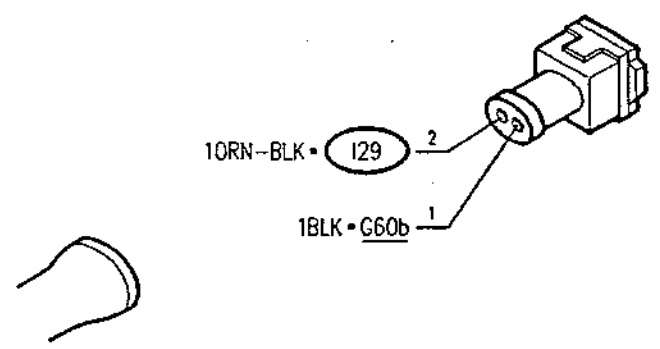
Revolution and T.D.C. sensor — S31



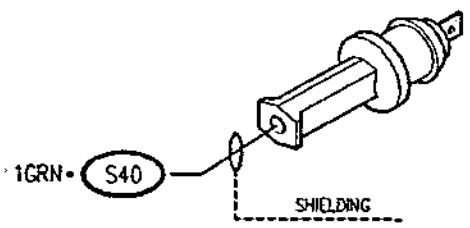
Air temperature sensor — S34



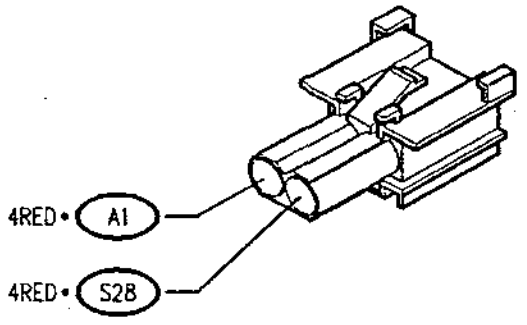
Heated lambda probe — S35 A



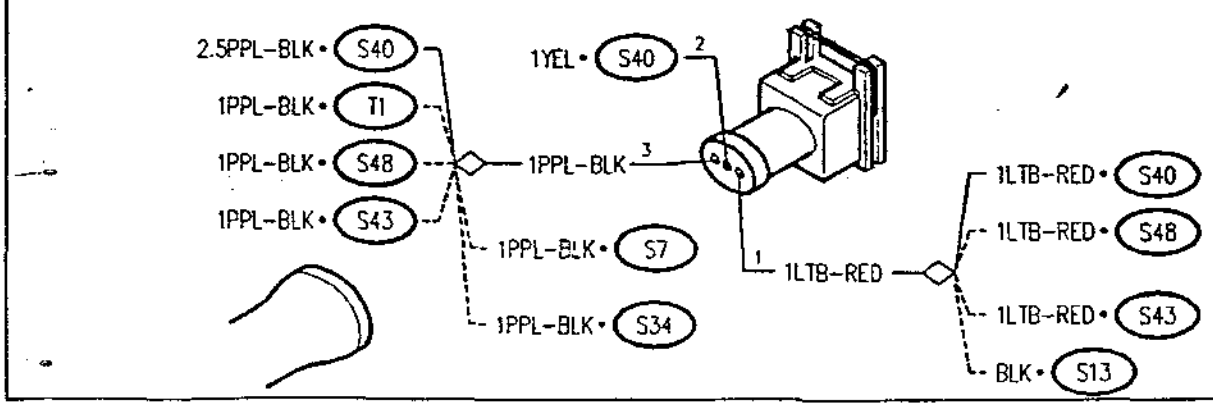
Heated lambda probe — S35 B



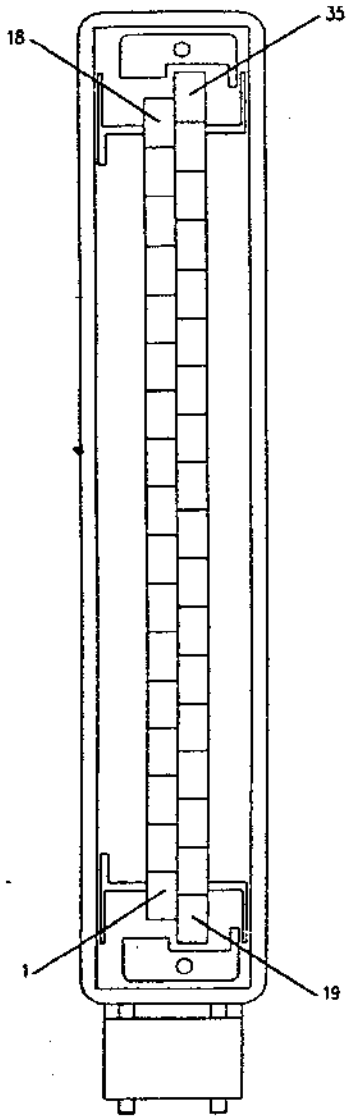
Loose fuse for ignition relay — S36

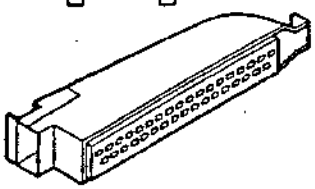


Sensor on throttle body — S38



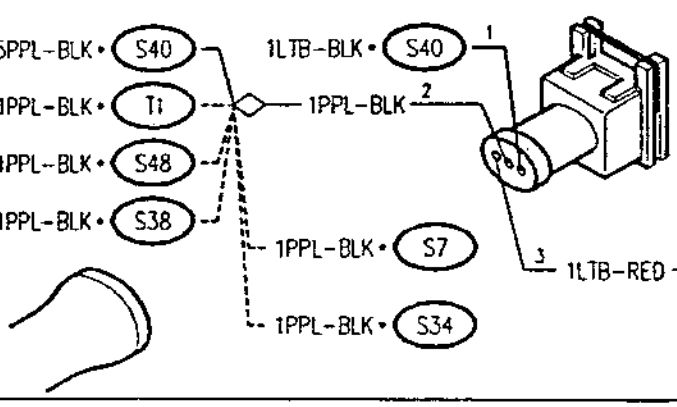
Ignition/injection control unit — S40



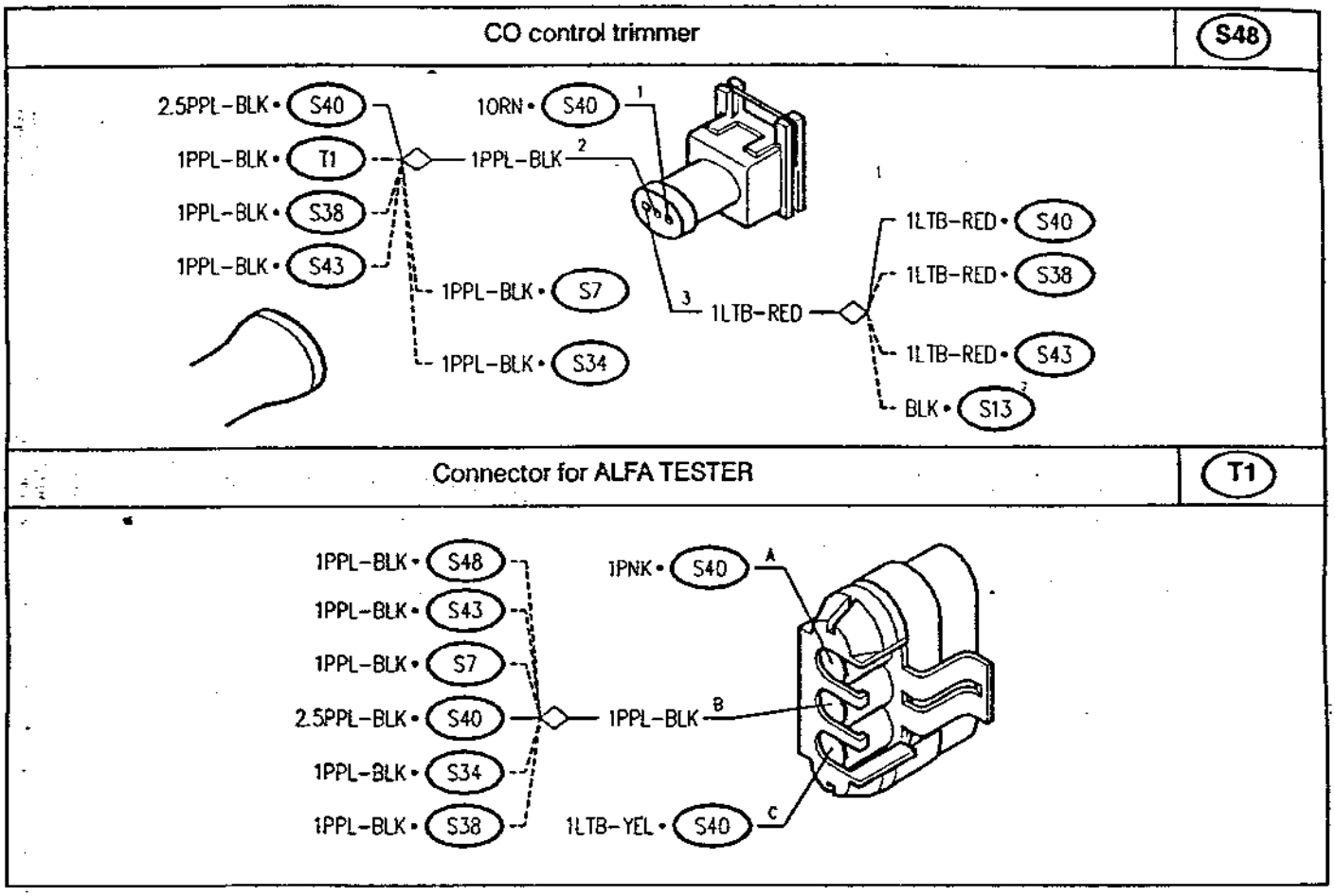


1 — 1.5BLK • G60b — SHIELDING
2 — 1GRN • S35 [B]
3 — 1ORN-BLK • S31
4 — 1ORN-WHT • S31
5 — GRN • S13
6 — BLU • L22 — SHIELDING
7 — 1WHT • G133a
8 — 1PNK • T1
9 — 1ORN • S48
11 — 2.5PPL-BLK → 1PPL-BLK • S43; 1PPL-BLK • T1; 1PPL-BLK • S48; 1PPL-BLK • S34; 1PPL-BLK • S7; 1PPL-BLK • S38
14 — 1BLU • G133c
15 — 1LTB-BLK • S43
16 — 1GRY-BLK • M16
17 — 1YEL • S38
18 — 1.5LTB-WHT • S24
19 — 1BLK • G60a
20 — 1RED • S28
21 — 1GRY-YEL • G133b
22 — BLU-BLK • L22
23 — RED • S13
24 — GRN • N1a; GRN • N1b
25 — GRN-WHT • N1a
26 — BLK • N1b
27 — 1LTB-YEL • T1
28 — 1GRY-BLK • I29
29 — 1ORN • S7
30 — 1LTB-RED → 1LTB-RED • S38; BLK • S13; 1LTB-RED • S43; 1LTB-RED • S48
31 — 1LTB-BLK • S34
32 — 1.5YEL-BLK • S24
33 — 1.5PNK-YEL • S24
34 — 1.5WHT-BLK • S9
35 — 1.5GRN-BLK • S24

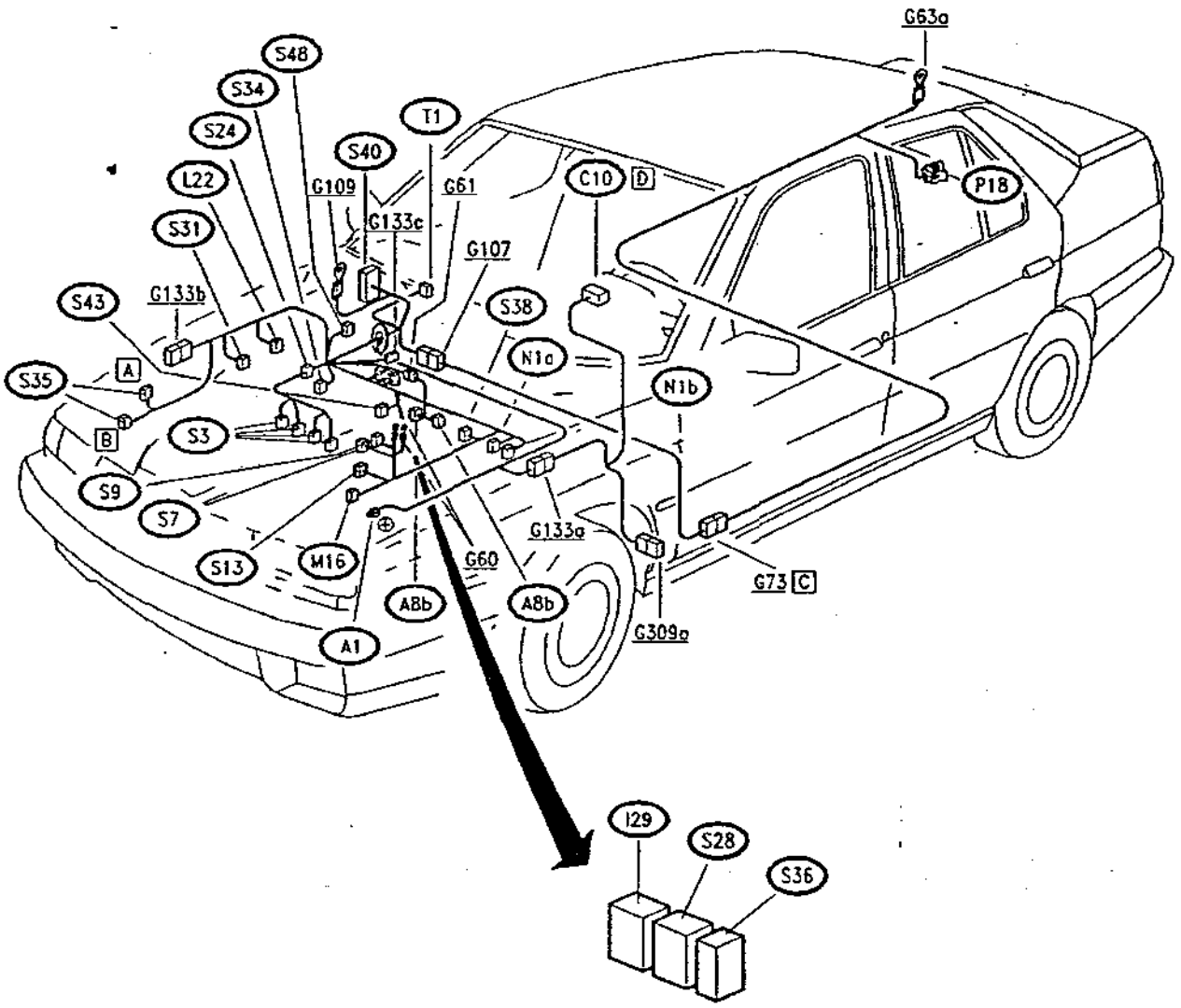
Absolute pressure sensor — S43



2.5PPL-BLK • S40
1PPL-BLK • T1
1PPL-BLK • S48
1PPL-BLK • S38
1PPL-BLK • S7
1PPL-BLK • S34
1LTB-BLK • S40 — 1
1PPL-BLK — 2
3 — 1LTB-RED → 1LTB-RED • S40; 1LTB-RED • S48; 1LTB-RED • S38; BLK • S13


CO control trimmer
S48
2.5PPL-BLK • S40
1PPL-BLK • T1
1PPL-BLK • S38
1PPL-BLK • S43
1PPL-BLK • S7
1PPL-BLK • S34
1ORN • S40
1PPL-BLK
1LTB-RED
1LTB-RED • S40
1LTB-RED • S38
1LTB-RED • S43
BLK • S13
Connector for ALFA TESTER
T1
1PPL-BLK • S48
1PPL-BLK • S43
1PPL-BLK • S7
2.5PPL-BLK • S40
1PPL-BLK • S34
1PPL-BLK • S38
1PNK • S40
1PPL-BLK
1LTB-YEL • S40
A
B
C

LOCATION OF COMPONENTS



TROUBLESHOOTING

NOTE: for a complete trouble shooting guide for the IAW electronic ignition/injection system, refer to "155 - REPAIR MANUAL - ENGINES", Group 04.

Only the functional tests to check the electrical aspect of all the system's components are reported below (from **TEST B** to **TEST N**)

Every test is to be considered separately, and should be performed to test the affected component only.

A particular case is represented by **TEST A**, which researches all the causes for incorrect or nonexistent power supply affecting the whole system.

The final test - **TEST O** - checks the whole system starting from a problem signalled by the user: ignition problems.

Any problems signalled by the user which may be connected with these tests are indicated in "155 - REPAIR MANUAL - ENGINES", Group 04.

For other problems signalled by the user (problems regarding fuel supply and idle speed due to the compressor being activated) refer to other sections or to the above mentioned publication.

NOTE: in addition to this trouble shooting guide, it is also possible to quickly identify any faults through the control unit **S40** using the ALFA ROMEO Tester, through connector **T1** (see special publications).

Malfunction	A1	S28	S36
System power supply	•	•	•
Throttle sensor			
Engine temperature sensor			
Air temperature sensor			
Timing sensor			
Rev. and T.D.C. sensor			
Absolute pressure sensor			
Knock sensor			
Lambda probe			
Air supplement valve (idle)			
"Over-boost" valve			
CO Potentiometer			
Electroinjectors		•	
Fuel pump		•	
Irregular ignition			
Irregular injection			
Irregular idle speed (compressor activation)			
Irregular "fast idle" (connection with ABS)			

TROUBLESHOOTING TABLE

Component																	Test
9	S38	S7	S34	S13	S31	S43	L22	S35	S9	M16	S48	S3	P18	S40	A12	A8	N1	
														•				A
	•													•				B
		•												•				C
●			•											•				D
				•										•				E
●					•									•				F
						•								•				G
							•							•				H
▸								•						•				I
▸									•					•				J
▸										•				•				K
											•			•				L
												•		•				M
▸ ●													•	•				N
														•	•	•	•	O
●																		*
																		**
																		***

* See **tests M and N**, or "155 ⊠ - REPAIR MANUAL - ENGINES" Group 04.

** See **test J**, or section "Air Conditioning"

*** See section "ABS system". Always check connection between pin 3 of ABS control unit **N27** and pin 14 of contr unit **S40**, through connector **G133c** (BLU and BRN-WHT)

NO POWER SUPPLY TO SYSTEM	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK BATTERY VOLTAGE – Check that the battery voltage is 12V	OK ➔ OK ➔	Carry out **step A2** Restore correct voltage by recharging or replacing the battery **A1** **NOTE:** if the battery voltage falls, even by only a little, below 12V, not only this, but also other electronic systems could be negatively affected
A2 CHECK FUSE – Check the integrity of the loose fuse **S36**	OK ➔ OK ➔	Carry out **step A3** Replace fuse **S36** (15A)
A3 CHECK RELAY – Check that relay **S28** functions correctly	OK ➔ OK ➔	Carry out **step A4** Replace relay **S28** if defective
A4 CHECK GROUND – Check that pin 1 and 19 of control unit **S40** are grounded (0V)	OK ➔ OK ➔	Carry out **step A5** Restore wiring between pin in question and respective grounds **G60b** and **G60a** (BLK)

(continues)

NO POWER SUPPLY TO SYSTEM	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A5 CHECK VOLTAGE – Verify 12 V at pin 30 of relay **S28**	OK ➔ OK ➔	Carry out **step A6** Restore wiring between battery **A1** and pin 30 of **S28**, through fuse **S36** (RED)
A6 CHECK VOLTAGE – Verify, with key rotated, 12 V at pin 86 of relay **S28**	OK ➔ OK ➔	Carry out **step A7** Restore wiring between ignition switch **B1** and pin 86 of **S28**, through pin A of connector **G133a** (ORN)
A7 CHECK GROUND – Verify ground (0V) at pin 85 of **S28**	OK ➔ OK ➔	Carry out **step A8** Restore wiring between pin 85 of S28 and ground **G60a** (BLK)
A8 CHECK VOLTAGE – Verify, with key rotated, 12 V at pin 20 of control unit **S40**	OK ➔ OK ➔	The control unit **S40** is correctly supplied: if it does not function, replace it. Restore wiring between pin 20 of **S40** and pin 87 of S28 (RED).

CHECK THROTTLE SENSOR (*)	TEST B

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
B1 CHECK CONTINUITY – Check continuity between pin 2 of **S38** and pin 17 of control unit **S40**	OK →	Carry out **step B2**
	~~OK~~ →	Restore wiring between pin 2 of **S38** and pin 17 of control unit **S40** (YEL)
B2 CHECK VOLTAGE – Verify, with system functioning, 5V at pin 1 of **S38**	OK →	Carry out **step B3**
	~~OK~~ →	Restore wiring between pin 1 of **S38** and pin 30 of control unit **S40**, across the solder (LTB-RED)
B3 CHECK GROUND – Verify, with system functioning, a filtered ground (0V) at pin 3 of **S38**	OK →	Carry out **step B4**
	~~OK~~ →	Restore wiring between pin 3 of **S38** and pin 11 of control unit **S40**, across the solder (PPL-BLK)

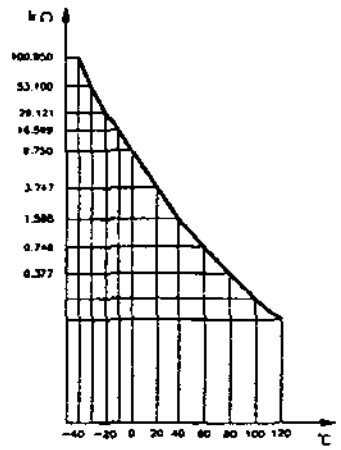
(continues)

(*) The throttle sensor is assembled and set directly on the throttle body: do not under any circumstances tamper with the regulating or fastening screws; for more details see "155 ☒ - REPAIR MANUAL - ENGINES - Group 04"

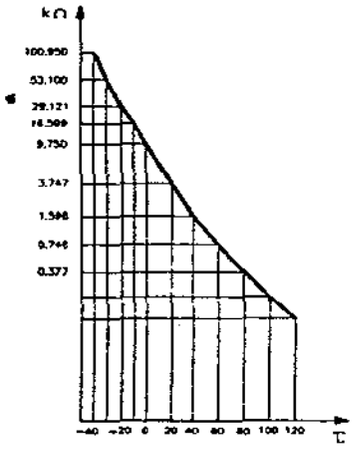
CHECK THROTTLE SENSOR	TEST B

TEST PROCEDURE		RESULT	CORRECTIVE ACTION
B4	CHECK SENSOR		
– With the key rotated and the throttle closed (in minimum position), between pin 2 and 3 verify a voltage value between 120 and 420 mV; open the throttle completely and verify a value less than or equal to 4.83 V.		OK ➔	The sensor under inspection functions correctly: check the control unit S40 or other components
		OK ➔	In this case the sensor must be reset, by adjusting the regulating slots until the required voltage values indicated above are obtained. If this is not possible, replace the sensor S38. NOTE If replaced, once the operation is terminated, the fuse S36 or the battery A1 should be disconnected for five minutes, in order to eliminate any error introduced into the memory of the self diagnosis system

CHECK ENGINE TEMPERATURE SENSOR	TEST C

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
C1 CHECK SENSOR – Check that the resistance value at top of S7 varies with the temperature according to the graph reported here (eg. perform a test at room temperature and one at approx. 100°C)  	OK ➔ OK ➔	Carry out step C2 Replace engine temperature sensor S7
C2 CHECK CONTINUITY – Check continuity between pin 2 of S7 and pin 29 of control unit S40	OK ➔ OK ➔	Carry out step C3 Restore wiring between pin 2 of S7 and pin 29 of control unit S40 (ORN)
C3 CHECK GROUND – Verify, with system functioning, a filtered ground (0V) at pin 1 of S7	OK ➔ OK ➔	The sensor under examination functions correctly: check the control unit S40 or other components Restore wiring between pin 1 of S7 and pin 11 of control unit S40, across the solder (PPL-BLK)

CHECK AIR TEMPERATURE SENSOR	TEST D

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
D1 CHECK SENSOR – Check that the resistance value at the top of S34 varies with the temperature according to the graph reported here (eg. perform a test at room temperature and one at approx. 100°C)  	OK ➔ OK ➔	Carry out step D2 Replace air temperature sensor S34
D2 CHECK CONTINUITY – Check continuity between pin 2 of S34 and pin 31 of control unit S40	OK ➔ OK ➔	Carry out step D3 Restore wiring between pin 2 of S34 and pin 31 of control unit S40 (LTB-BLK)
D3 CHECK GROUND – Verify, with system functioning, a filtered ground (0V) at pin 1 of S34	OK ➔ OK ➔	The sensor under examination functions correctly: check the control unit S40 or other components Restore wiring between pin 1 of S34 and pin 11 of control unit S40, across the solder (PPL-BLK)

CHECK TIMING SENSOR	TEST E

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
E1 CHECK SENSOR – Verify, with the engine turing over very slowly (eg. with the key rotated, push the vehicle), that the outgoing signal from the sensor (pin 2 of S13) is either 0V or 5V approx. when the engine timing is varied (there will be two voltage peaks for each cycle)	OK ➔ ~~OK~~ ➔	Carry out step E2 Replace timing sensor S13
E2 CHECK CONTINUITY – Check continuity between pin 2 of S13 and pin 23 of control unit S40	OK ➔ ~~OK~~ ➔	Carry out step E3 Restore wiring between pin 2 of S13 and pin 23 of control unit S40 (RED)
E3 CHECK VOLTAGE – Verify, with system functioning, 5V at pin 3 of S13	OK ➔ ~~OK~~ ➔	Carry out step E4 Restore wiring between pin 3 of S13 and pin 30 of the control unit S40, across the solder (BLK and LTB-RED)
E4 CHECK GROUND – Check, with system functioning, a filtered ground (0V) at pin 1 of S13	OK ➔ ~~OK~~ ➔	The sensor under examination functions correctly: verify the control unit S40 or other components Restore wiring between pin 1 of S13 and pin 5 of the control unit S40 (GRN). Verify the state of the plaited shielding, it must be grounded

CHECK REV. AND T.D.C. SENSOR	TEST F

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
F1 CHECK AIR GAP – Check the correct gap value between the sensor and the crankshaft pulley (see "155 ⊠ - REPAIR MANUAL - ENGINES" Group 04)	OK ➔	Carry out step F2
	~~OK~~ ➔	Restore tha correct gap value
F2 CHECK SENSOR – Cold check an internal resistance between the top of sensor 610 - 750 Ω; in addition with the engine started up, check for a variable frequency signal between pin 1 and 2 of sensor S31. This signal varies as the r.p.m. varies.	OK ➔	Carry out step F3
	~~OK~~ ➔	Replace sensor S31
F3 CHECK CONTINUITY – Check continuity between: - pin 1 of S31 and pin 3 of the control unit S40 - pin 2 of S31 and pin 4 of the control unit S40	OK ➔	The sensor under examination functions correctly: check the control unit S40 or other component
	~~OK~~ ➔	Restore wiring between: - pin 1 of S31 and pin 3 of the control unit S40 (ORN-BLK) - pin 2 of S31 and pin 4 of the control unit S40 (ORN-WHT)

CHECK ABSOLUTE PRESSURE SENSOR	TEST G

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
G1 CHECK SENSOR – Check that the outgoing signal (in voltage) from sensor (pin 1 of **S43**) varies with the continuity, varying the pressure acting on the sensor itself	OK ➤ OK ➤	Carry out **step G2** Replace absolute pressure sensor **S43**
G2 CHECK CONTINUITY – Check continuity between pin 1 of **S43** and pin 15 of the control unit **S40**	OK ➤ OK ➤	Carry out **step G3** Restore wiring between pin 1 of **S43** and pin 15 of the control unit **S40** (LTB-BLK)
G3 CHECK VOLTAGE – Verify, with system functioning, 5V at pin 3 of **S43**	OK ➤ OK ➤	Carry out **step G4** Restore wiring between pin 3 of **S43** and pin 30 of the control unit **S40**, across the solder (LTB-RED)
G4 CHECK GROUND – Verify, with system functioning, a filtered ground (0V) at pin 2 of **S43**	OK ➤ OK ➤	The sensor under inspection functions correctly: check the control unit **S40** or other component Restore wiring between pin 2 of **S43** and pin 11 of the control unit **S40**, across the solder (PPL-BLK)

CHECK KNOCK SENSOR	TEST H

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
H1 CHECK SENSOR – Check that the sensor L22 functions correctly. When there is an intense vibration (6-10 kHz), the sensor sends out a signal (pin 1 of L22) with a voltage varying between 40 mV at rest and 200 mV and above when a vibration is detected.	OK →	Carry out step H2
	~~OK~~ →	Replace knock sensor L22
H2 CHECK CONTINUITY – Check continuity between pin 2 of L22 and pin 22 of the control unit S40	OK →	Carry out step H3
	~~OK~~ →	Restore wiring between pin 2 of L22 and pin 22 of the control unit S40 (BLU-BLK)
H3 CHECK CONTINUITY – Check continuity between pin 1 of L22 and pin 6 of the control unit S40	OK →	The sensor under examination functions correctly: check the control unit S40 or other components
	~~OK~~ →	Restore wiring between pin 1 of L22 and pin 6 of the control unit S40 (BLU) Also check the state of the plaited shielding, which must be grounded

CHECK LAMBDA PROBE	TEST I

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
I1 CHECK AIR SUPPLY – Verify the integrity of the air intake channel and the air filter	OK ➔ ~~OK~~ ➔	Carry out **step I2** Clean or replace the affected parts
I2 CHECK SPARK PLUGS AND INJECTORS – Check the integrity of the spark plugs **A12** and the injectors **S3** (if necessary see **test M**)	OK ➔ ~~OK~~ ➔	Carry out **step I3** Clean or replace the affected parts
I3 CHECK PROBE RESISTANCE – Check that between the heads of the probe resistance **S35** (pin A1 and A2) there is a resistance of approx. 3 Ω	OK ➔ ~~OK~~ ➔	Carry out **step I4** Replace probe **S35**
I4 CHECK VOLTAGE – Verify, with system functioning, 12V at pin A2 of probe **S35**	OK ➔ ~~OK~~ ➔	Carry out **step I5** Restore wiring between pin A2 of **S35** and pin 87 of fuel pump relay **I29** (ORN-BLK); if necessary check functioning of this relay

(continues)

CHECK LAMBDA PROBE	TEST I

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
I5 CHECK GROUND – Check that pin A1 of probe S35 is grounded (0V)	OK ➔	Carry out step I6
	OK ➔	Restore wiring between pin A1 of S35 and ground G60b (BLK)
I6 CHECK SIGNAL – Start-up engine and wait until it ticks over. Verify a voltage signal at pin 2 of the control unit S40 between 0.1 and 1 mV	OK ➔	The lambda probe under inspection functions correctly; verify control unit S40 or other components.
	OK ➔	Carry out step I7
I7 CHECK SIGNAL – Start up the engine and wait until it ticks over. Verify a voltage signal at pin B of S35 between 0.1 and 1 mV	OK ➔	Restore the wiring between pin B of S35 and pin 2 of the control unit S40 (GRN) Also check the state of the plaited shielding, it must be grounded
	OK ➔	Replace probe S35

CHECK AIR SUPPLEMENT VALVE (IDLE)	TEST J

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
J1 CHECK VALVE – When cold, verify an internal resistance value between the two terminals of **S9** of approx. 7 Ω	OK ➡	Carry out **step J2**
	OK ➡	Replace idle valve **S9**
J2 CHECK VOLTAGE – With the engine started up, verify 12 V at pin 2 of **S9**	OK ➡	Carry out **step J3**
	OK ➡	Restore wiring between pin 2 of **S9** and pin 87 of relay **I29** (GRY); if necessary also check the functioning of this relay.
J3 CHECK CONTINUITY – Check continuity between pin 1 of **S9** and pin 34 of the control unit **S40**	OK ➡	The idle valve under examination functions correctly: check the control unit **S40** or other components
	OK ➡	Restore wiring between pin 1 of **S9** and pin 34 of the control unit **S40** (WHT-BLK)

CHECK "OVER-BOOST" VALVE	TEST K

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
K1 CHECK VALVE – Verify an internal resistance value between the two terminals of **M16** of approx. 20 Ω	OK →	Carry out **step K2**
	~~OK~~ →	Replace "over-boost" valve **M16**
K2 CHECK VOLTAGE – With the engine running, verify 12 V at pin + of **M16**	OK →	Carry out **step K3**
	~~OK~~ →	Restore wiring between pin + of **M16** and pin 87 of relay **I29** (GRN); if necessary check the functioning of the relay.
K3 CHECK CONTINUITY – Check continuity between pin - of **M16** and pin 16 of the control unit **S40**	OK →	The "over-boost" valve under examination functions correctly: check the control unit **S40** or other components
	~~OK~~ →	Restore wiring between pin - of **M16** and pin 16 of the control unit **S40** (GRY-BLK)

CHECK CO POTENTIOMETER	TEST L

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
L1 CHECK POTENTIOMETER – Verify an internal resistance value between pin 3 and 1 of S48 of approx. 10 kΩ.	OK ➡ OK ➡	Carry out **step L2** Replace potentiometer **S48**
L2 CHECK CONTINUITY – Check continuity between pin 1 of S48 and pin 9 of the control unit **S40**	OK ➡ OK ➡	Carry out **step L3** Restore wiring between pin 1 of **S38** and pin 9 of the control unit **S40** (ORN)
L3 CHECK VOLTAGE – Verify, with system functioning, 5V at pin 3 of **S48**	OK ➡ OK ➡	Carry out **step L4** Restore wiring between pin 3 of **S48** and pin 30 of the control unit **S40**, across the solder (LTB-RED)
L4 CHECK GROUND – Verify, with system functioning, a filtered ground (0V) at pin 2 of **S48**	OK ➡ OK ➡	The potentiometer under inspection functions correctly: check the control unit **S40** or other components Restore wiring between pin 2 of **S48** and pin 11 of the control unit **S40**, across the solder (PPL-BLK)

CHECK ELECTROINJECTORS	TEST M

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
M1 CHECK ELECTROINJECTORS – Check integrity and the correct mechanical functioning of the electroinjectors S3 (see "155 🖂 - REPAIR MANUAL - ENGINES, Group 04) Also check that the resistance value at the heads of the injector S3 is approx. 14.5 Ω	OK ➔ ~~OK~~ ➔	Carry out step M2 Replace defective injectors
M2 CHECK VOLTAGE – With the engine running, verify 12 V at pin 2 of the electroinjectors S3	OK ➔ ~~OK~~ ➔	Carry out step M3 Restore wiring between pin 2 of the injectors and pin 87 of relay S28, across the solders and the connector S24 (RED); if necessary check the functioning of the relay

(continues)

CHECK ELECTROINJECTORS	TEST M

TEST PROCEDURE		RESULT	CORRECTIVE ACTION
M3	CHECK CONTINUITY		
– Check continuity between pin 1 of injectors S3 and pin 18, 32, 33 and 35 of the control unit S40		OK ➔	The injectors under inspection function correctly: check the control unit S40 or other components
		OK ➔	Restore wiring between: - pin 1 of electroinjector S3 of cylinder N. 1 and pin 35 of the control unit S40, through connector S24 (GRN-BLK) - pin 1 of electroinjector S3 of cylinder N. 2 and pin 32 of the control unit S40, through connector S24 (YEL-BLK) - pin 1 of injector S3 of cylinder N. 3 and pin 33 of the control unit S40, through connector S24 (PNK-YEL) - pin 1 of injector S3 of cylinder N. 4 and pin 18 of the control unit S40, through connector S24 (LTB-WHT)

CHECK FUEL PUMP	TEST N

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
N1 CHECK RELAY – Check that fuel pump relay functions correctly **I29**	OK ➡	Carry out **step N2**
	OK ➡	Replace relay if defective
N2 CHECK VOLTAGE – With the key inserted, verify 12 V at pin 30 of relay **I29**	OK ➡	Carry out **step N3**
	OK ➡	Restore wiring between pin 30 of **I29** and pin 87 of relay **S28** (RED-BLK); if necessary check functioning of relay
N3 CHECK VOLTAGE – With the key inserted, verify 12 V at pin 86 of relay **I29**	OK ➡	Carry out **step N4**
	OK ➡	Restore wiring between pin 86 and pin 30 of **I29** (RED-BLK)
N4 CHECK GROUND SIGNAL – With the engine running check that a ground signal (0V) reaches pin 85 of **I29**	OK ➡	Carry out **step N6**
	OK ➡	Carry out **step N5**

(continues)

CHECK FUEL PUMP	TEST N

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
N5 CHECK GROUND SIGNAL – With the engine running check that a ground signal (0V) reaches pin 28 of the control unit **S40**	OK →	Restore wiring between pin 28 of **S40** and pin 85 of I29 (GRY-BLK)
	~~OK~~ →	Check and if necessary replace the control unit **S40**
N6 CHECK VOLTAGE – With the engine running, verify 12 V at pin B of the petrol pump **P18**	OK →	Carry out **step N7**
	~~OK~~ →	Restore wiring between pin B of **P18** and pin 87 of I29, through pin C1 of connector **G73** and pin 1 of connector **G107** (GRN-BLK and PNK-WHT)
N7 CHECK VOLTAGE – Check that pin A of **P18** is grounded (0V)	OK →	Replace pump **P18**
	~~OK~~ →	Restore wiring between pin A of **P18** and ground **G63a** (BLK)

IRREGULAR IGNITION	TEST O

TEST PROCEDURE		RESULT	CORRECTIVE ACTION
O1	CHECK SPARK PLUGS		
– Visibly check the state of the spark plugs		OK ➡	Carry out **step O2**
		OK ➡	Replace defective spark plugs **A12**
O2	CHECK CABLES (*)		
– Check that the cables connecting the coils and spark plugs are not damaged. Check, for each cable, for a total resistance between coil and spark plug, including the supressors of approx. 0.8 kΩ		OK ➡	Carry out **step O3**
		OK ➡	Replace defective cables and supressors
O3	CHECK COILS		
– Check the total resistance of the circuits of the coils **A8a** and **A8b**: •primary (pin A-B) approx. 0.55 Ω •secondary (spark plug side) approx. 7.4 kΩ		OK ➡	Carry out **step O4**
		OK ➡	Replace defective coil/s **A8a** or **A8b**

(continues)

(*) The presence of unburned fuel irreparably damages the catalytic converter: never disconnect the spark plug cables with the engine running.

IRREGULAR IGNITION	TEST O

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
O4 CHECK VOLTAGE – Verify, with the key rotated, 12 V to pin A of coils **A8a** and **A8b** and to pin 4 of modules **N1a** and **N1b**	OK ➔ OK ➔	Carry out **step O5** Restore wiring between: - pin A of **A8a** and pin 86 of relay **S28**, through pin A of connector **G61** and solder (ORN) - pin A of **A8b** and pin 86 of relay **S28**, through pin C of connector **G61** and solder (ORN) - pin 4 of **N1a** and pin 86 of relay **S28**, across the solder (ORN) - pin 4 of **N1b** and pin 86 of relay **S28**, across the solder (ORN)
O5 CHECK GROUND – Check that pin 2 of modules **N1a** and **N1b** are grounded	OK ➔ OK ➔	Carry out **step O6** Restore wiring between: - pin 2 of **N1a** and ground **G60a** (BLK) - pin 2 of **N1b** and ground **G60b** (BLK)

(continues)

IRREGULAR IGNITION	TEST O

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
O6 CHECK CONTINUITY – Check continuity between: • pin B of **A8a** and pin 1 of **N1a** • pin B of **A8b** and pin 1 of **N1b**	OK ➔	Carry out step O7
	OK ➔	Restore wiring between: - pin B of **A8a** and pin 1 of **N1a**, through pin B of connector **G61** (WHT) - pin B of **A8b** and pin 1 of **N1b**, through pin D of connector **G61** (WHT-BLK)
O7 CHECK VOLTAGE SIGNAL – Verify, with system functioning, a voltage signal to pin 6 of modules **N1a** and **N1b**	OK ➔	Carry out step O8
	OK ➔	Restore wiring between: - pin 6 of **N1a** and pin 25 of **S40** (GRN-WHT) - pin 6 of **N1b** and pin 26 of **S40** (BLK) Also check the state of the plaited shielding, which must be grounded

(continues)

IRREGULAR IGNITION	TEST O

TEST PROCEDURE		RESULT	CORRECTIVE ACTION
O8	CHECK GROUND SIGNAL		
– Verify, with system functioning, a filtered ground (0V) at pin 3 of modules **N1a** and **N1b**		OK ➔	Check and if necessary replace the control unit **S40**
		OK ➔	Restore wiring between: - pin 3 of **N1a** and pin 24 of **S40** (GRN) - pin 3 of **N1b** and pin 24 of **S40** (GRN) Also check the state of the plaited shielding, which must be grounded