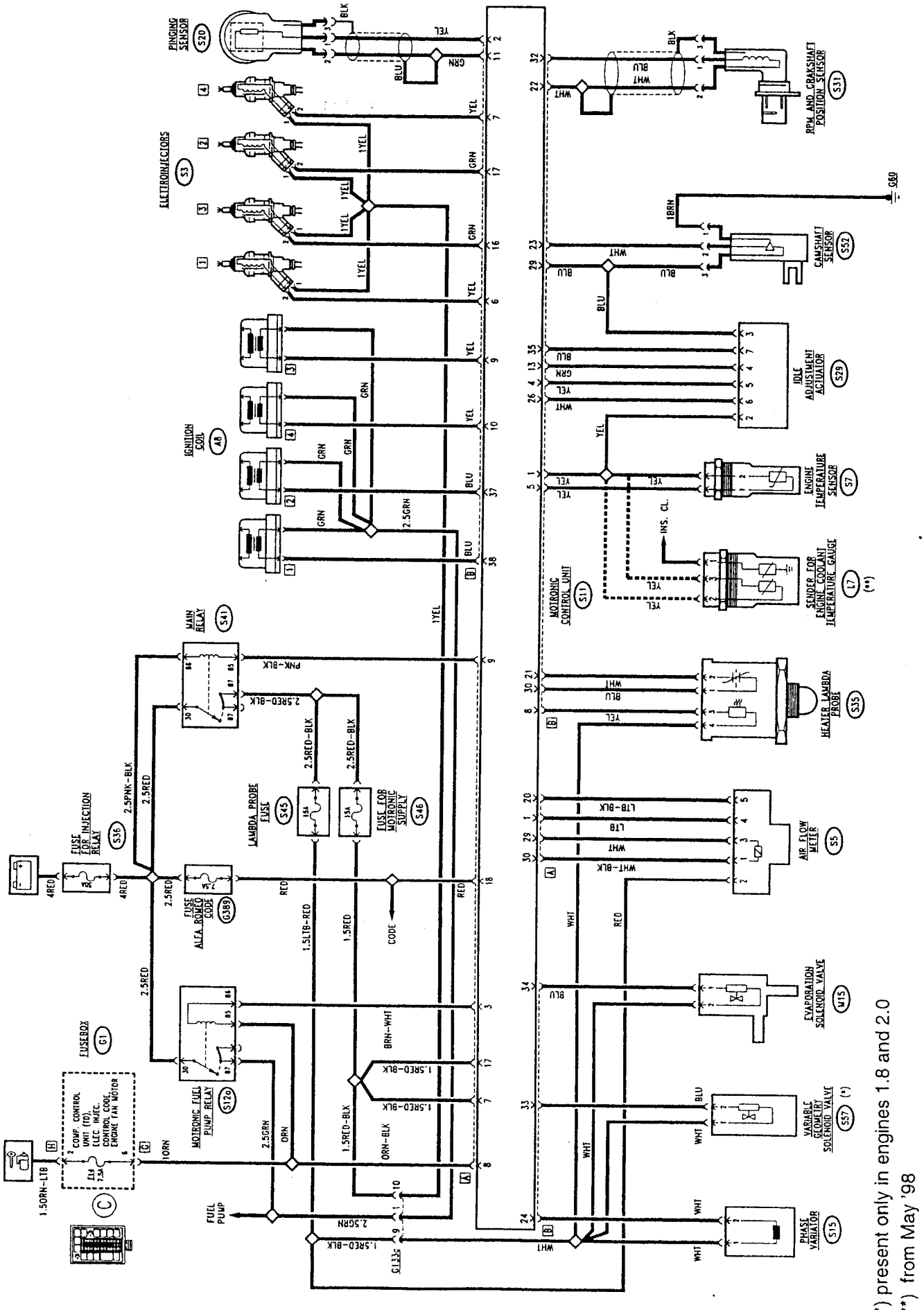
MOTRONIC M1.5.5 INJECTION/IGNITION SYSTEM - 1.4, 1.6, 1.8 and 2.0 T.SPARK 16v engines

INDEX

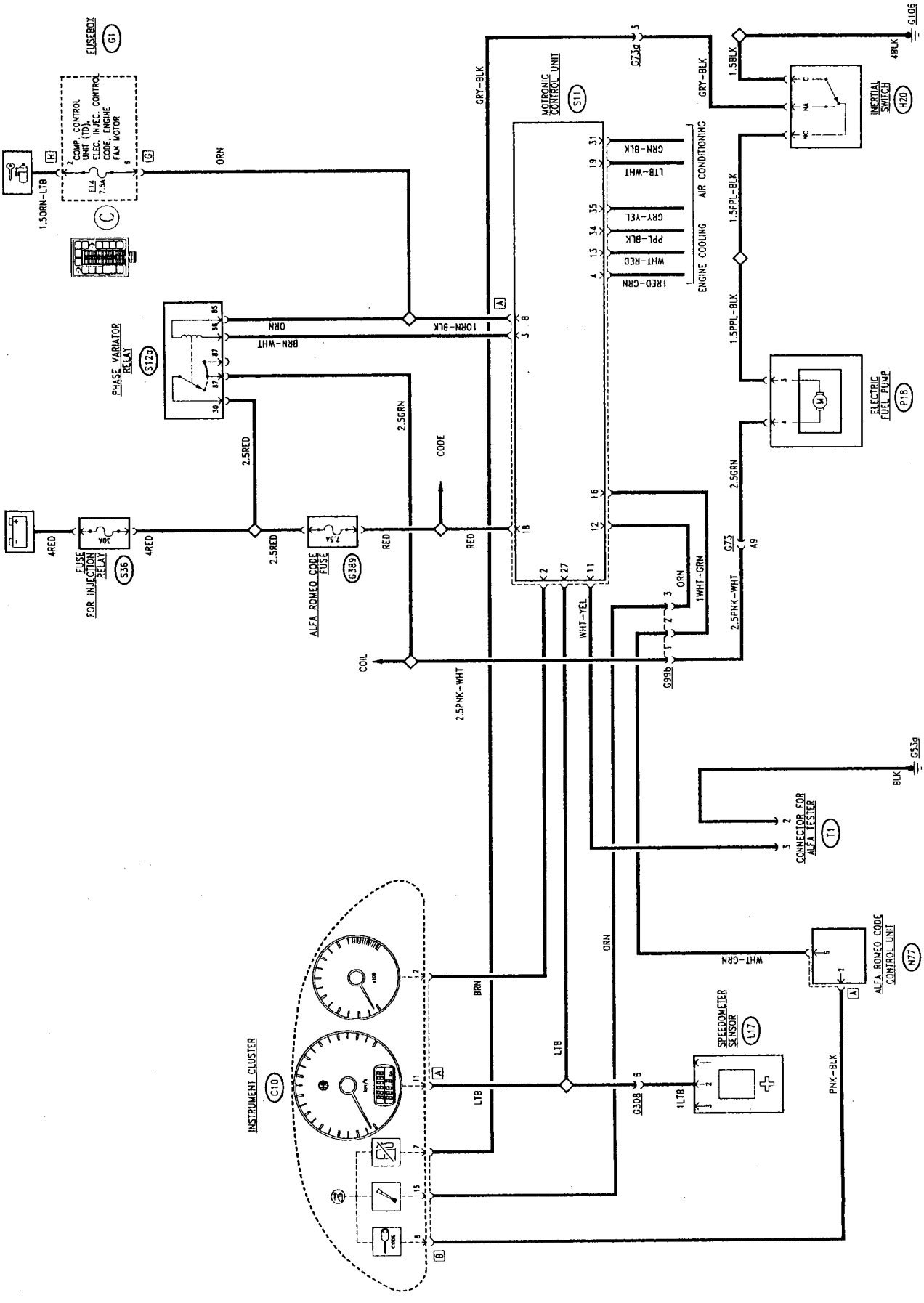
WARNING:
the new MOTRONIC M1.5.5 version replaces the previous MOTRONIC M2.10.4 version from MODEL YEAR '98

WIRING DIAGRAM "A"



(*) present only in engines 1.8 and 2.0
(**) from May '98

WIRING DIAGRAM "B"



GENERAL DESCRIPTION

An electronic control system monitors and adjusts all the engine parameters, optimising performance and consumption levels through response in real time to the different operating conditions.
The system is managed by a single control unit which controls both double ignition (static with lost spark) and injection (timed).
On the basis of signals received from a number of sensors, the control unit commands the actuators connected to it, controlling the following systems:

- fuel supply;
- air supply;
- engine cooling;
- exhaust with catalytic silencer;
- fuel vapour recirculation.

The control unit also controls the electrohydraulic timing variator, which is only used on T. SPARK engines.
Engines 1.8 and 2.0 are characterized by the use of variable geometry intake system, controlled by the control unit according to the engine operating conditions.

The Bosch Motronic M1.5.5 system belongs to the category of systems integrated with:

- digital electronic ignition with inductive discharge;
- static distribution;
- timed sequential electronic injection (1-3-4-2).

At idle speed the control unit controls:

- the ignition instant;
- air flow rate;

with the advantage of keeping the engine running smoothly as the environment conditions and loads applied change.

The control unit monitors and controls injection in such a way that the stoichiometric ratio (air/fuel) is always within the optimum value.
The essential conditions that must be met in preparing the air - fuel mixture for running controlled-ignition engines satisfactorily are mainly the following:

- "metering" (air fuel ratio) must be kept as close as possible to the stoichiometric value, to ensure the necessary combustion speed, avoiding pointless fuel consumption.
- "homogeneity" of the mixture, formed of fuel vapours, scattered in the air as finely and evenly as possible.

The information processed by the control unit to command optimum metering, is received through electric signals issued by:

- air-flow meter with integrated air temperature sensor, for the exact amount of intake air
- rpm sensor, which generates an alternate single-phase signal, the frequency of which indicates engine rpm
- throttle position potentiometer (integrated in the constant idle speed actuator), to detect the idle, partial and full load conditions
- lambda sensor to determine the oxygen contained in the exhaust gas.

The ignition system is of the static inductive discharge type (i.e. without High Voltage distributor) with power modules located inside the injection control unit.
The system has a single coil for each spark plug (MONOCOIL); the advantages of this solution are:

- lower electric overload;
- constant discharge on each spark plug.

The control unit storage contains a map of the whole series of optimum spark advance values (for the cylinder in the bursting stroke) that the engine can use according to the engine speed and load required.

The control unit corrects the advance value mainly according to:

- engine coolant fluid temperature
- intake air temperature
- pinging
- throttle valve position.

The information processed by the control unit to drive the monocoils, is received through electric signals issued by:

- air-flow meter with integrated air temperature sensor, for the exact amount of intake air
- rpm sensor, which generates an alternate single-phase signal, the frequency of which indicates engine rpm
- pinging sensor (on the rear of the crankcase between the 2nd and 3rd cylinder) to detect the cylinder that is pinging and correct the spark advance accordingly
- throttle position potentiometer (integrated in the constant idle speed actuator), to detect the idle, partial and full load conditions.

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- 1.4, 1.6, 1.8 and 2.0 T.SPARK 16v engines

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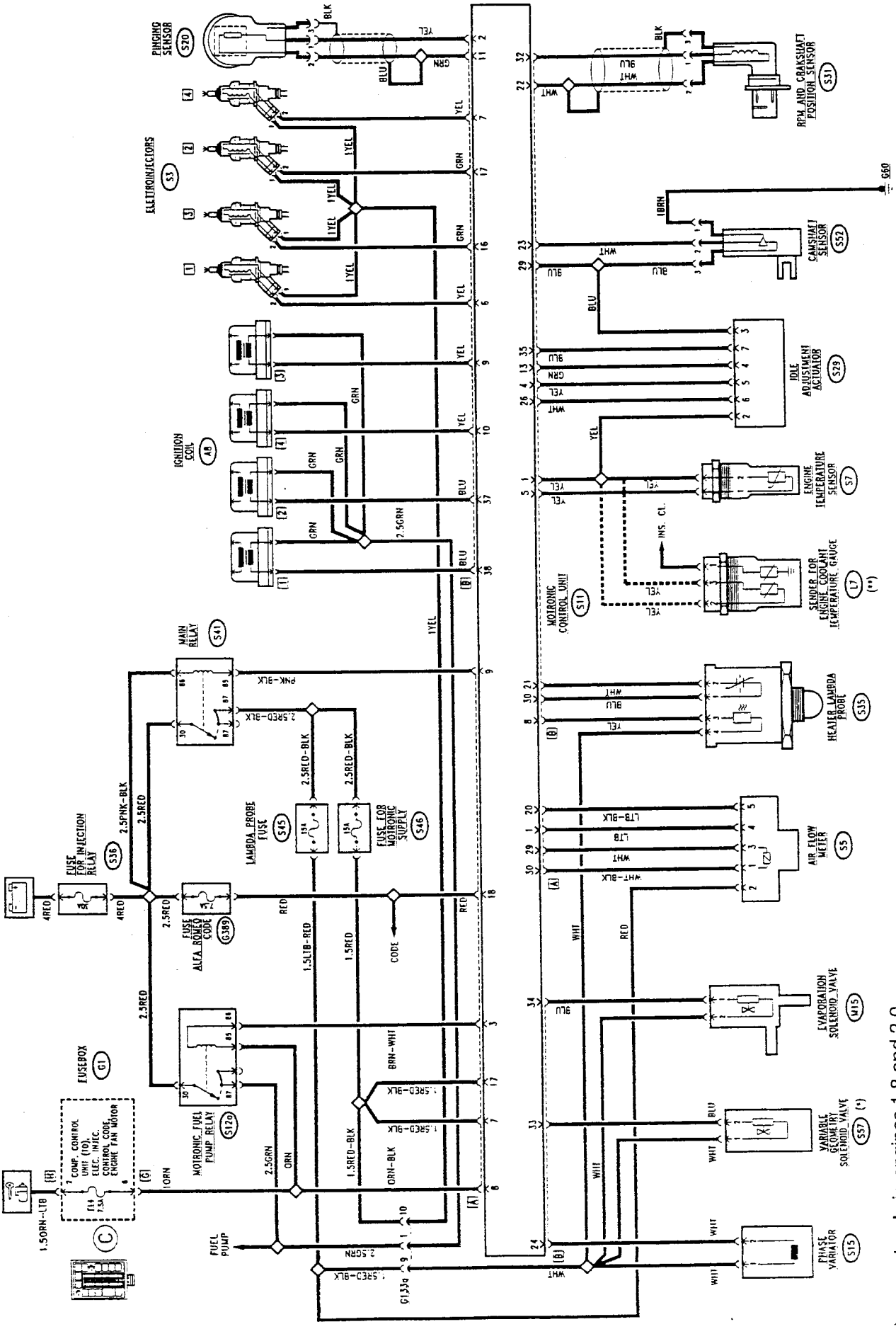

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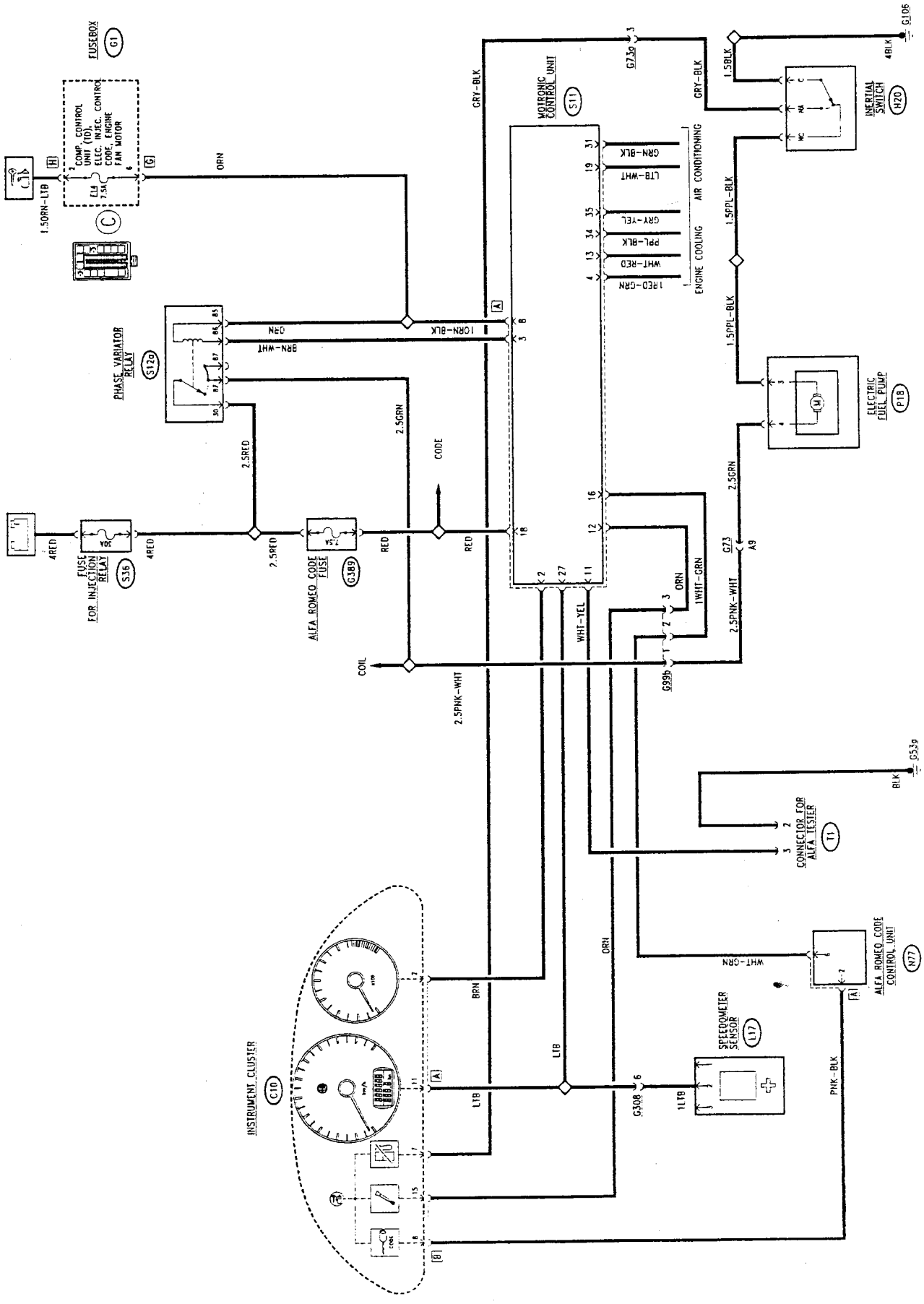
WIRING DIAGRAM "B"



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- pinging sensor (on the rear of the crankcase between the 2nd and 3rd cylinder) to detect the cylinder that is pinging and correct the spark advance accordingly
- throttle position potentiometer (integrated in the constant idle speed actuator), to detect the idle, partial and full load conditions.

FUNCTIONAL DESCRIPTION

The engine control unit **S11** controls and adjusts the entire electronic ingition and injection system.
The direct system supply leads from the battery via the line of the maxi wander fuse **S36**.
The key-operated supply leads from the line protected by fuse **F14** of fusebox **G1**.
The control unit **S11** is supplied directly by the battery at pin 18 of connector A, through the line protected by fuse **G389**. The "key-operated" supply reaches pin 8 of connector A.
The main relay **S41** controls the entire system: it is energised by a command signal (earth) leading from pin 9 of connector A of control unit **S11** and sends the supply accordingly:

- to pin 7 and 17 of connector A of the control unit itself and to the injectors **S3** through the line protected by fuse **S46**;
- to the air-flow meter **S5**, to the fuel vapour recovery solenoid valve **M15**, to the variable geometry solenoid control valve **S57**, to the timing variator **S15** and to the lambda sensor **S35**; (all these lines are protected by fuse **S45**).

The fuel pump relay **S12a** receives the "key-operated" supply through fuse **F14** of **G1**. It is energised with a command signal (earth) leading from pin 3 of connector A of control unit **S11** and supplies the electric fuel pump **P18**, which is connected to earth through the inertial switch **H20**, which in the event of a crash cuts off the circuit thereby stopping the dangerous delivery of fuel.

In case of intervention on switch **H20**, the relative telltale light on the panel **C10** is also turned on.

Remote switch **S12a** supplies power to the ignition coils **A8**.

The engine control unit motore **S11** receives the signals from the different sensors, thereby keeping all the engine operating parameter under control.

The rpm sensor **S31** through a frequency signal sent to pin 22 and 32 of connector B of control unit **S11**, supplies information about engine speed: these two signals are very low in intensity and are therefore suitably screened.

The timing sensor (cam angle **S52**) is supplied from pin 29 of connector B of control unit **S11** and sends a frequency signal corresponding to the phase to pin 23 of connector B of the control unit itself.

The engine temperature sensor **S7** receives a reference earth from 1 of connector B of control unit **S11** and supplies a signal proportionate with the temperature of the engine fluid at pin 5 of connector B of the control unit itself.

Starting from May '98, an engine temperature sender unit **L7** has been adopted which receives a reference earth from pin 1 of connector B of the control unit and provides a signal proportional to the temperature of the engine coolant to pin 5 of the same connector.

The heated lambda sensor **S35** sends the control unit **S11** information about the correct composition of the air-fuel mixture: the signal is sent to pin 30 of connector B of **S11**, while pin 21 supplies the reference earth. The sensor **S35** is heated with a resistance, to make sure that it works properly also when it is cold. The resistance is supplied by relay **S12a** and receives an earth signal from pin 8 of connector B of control unit **S11**.

The pinging sensor **S20**, through a frequency signal sent to pin 2 of connector B of control unit **S11**, makes it possible to obtain information about pinging conditions: it receives a reference earth from pin 11 of connector B. These signals are very low in intensity and are therefore suitably screened.

The air-flow meter **S5** (supplied by relay **S12a**) receives from pin 1 of connector A of control unit the reference voltage and sends to pin 20 of connector A a signal proportionate with the air flow rate. Inside **S5** there is also an air temperature sensor: the reference earth of the sensor is supplied by pin 29 of connector A di **S11**, while pin 30 of connector A receives the air temperature signal.

The control unit **S11** controls opening of the single injectors **S3**, through special duty-cycle signals sent from pin 6 (cyl 1), 17 (cyl 2), 16 (cyl 3) and 7 (cyl 4) of connector B of **S11**.

The injectors **S3** receive the enable supply from the main relay **S41**.

The control unit **S11** also controls the coils **A8** through command signals (earth) for the primary windings of the coils, while the secondary sends the pulse to the spark plugs: from pin 38 and 10 of connector B for cylinders 1-4 and from pin 9 and 37 pin of connector B of **S11** for cylinders 2-3.

The primaries of the coils **A8** receive the enable supply for opening from the main relay **S41**.

The idle speed actuator **S29** adjusts the flow of air at idle speed through the throttle. It receives the supply and the reference earth from pin 1 and 29 of connector B of control unit **S11**: pin 4 and 13 of connector B are connected with the potentiometer which detects the position of the throttle; pin 26 and 35 of connector B control the actuator of the throttle itself.

The fuel vapour recovery solenoid valve **M15** allows the flow of fuel vapours towards the engine intake, where they are added to the mixture that enters the combustion chamber. The valve **M15**, supplied by the main relay **S41**, is opened by the control unit when the engine is under load, through a signal - duty-cycle - by pin 34 of connector B of **S11**.

The variable geometry solenoid control valve (**only for engines 1.8 and 2.0**) **S57** is controlled by pin 33 of connector B of control unit **S11**.

The timing variator **S15** mechanically controls the timing advance at the intake : it is controlled by pin 24 of connector B of control unit **S11**.

The control unit **S11** is connected with the ALFA ROMEO CODE control unit at pin 6 of **N77** through the special line of pin 16 of connector A.

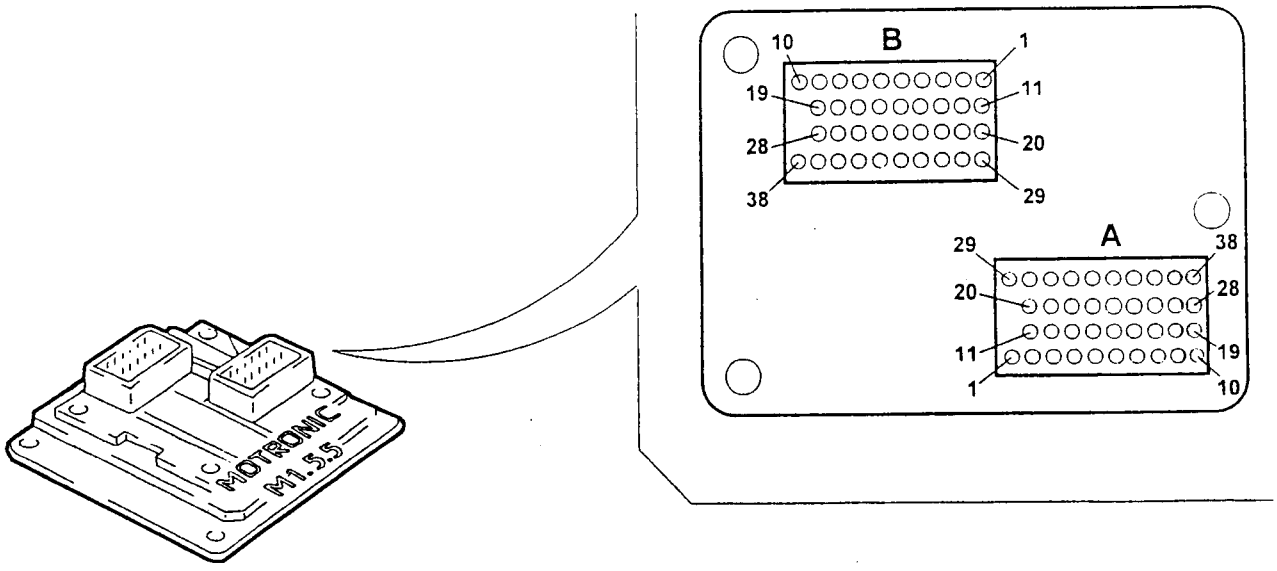
The control unit has a self-diagnosis system, which can be used connecting to the diagnosis connector **T1**: the signals reach it from pin 11 of connector A from the control unit **S11** through the special diagnosis line. The self-diagnosis system also generates the signal for the "injection failure" warning light, on the instrument cluster **C10**, which leads from pin 12 of connector A of control unit **S11**.

The tachometric signal (car speed) reaches pin 27 of connector A of control unit **S11** from sensor **L17**.

The control unit **S11** sends from pin 2 of connector A a signal proportionate with engine rpm to the instrument cluster **C10**.

The control unit **S11** is connected with the air conditioning system via pin 19 and 31 of connector A. This makes it possible to adapt the engine idle speed to the increased load each time the compressor is engaged, or to cut it off in the case of high speed or high engine loads.

The control unit also controls the engine cooling system: pin 4, 13, 34 and 35 of connector A control engagement of the corresponding fan.



Control unit pin-out

Connector A

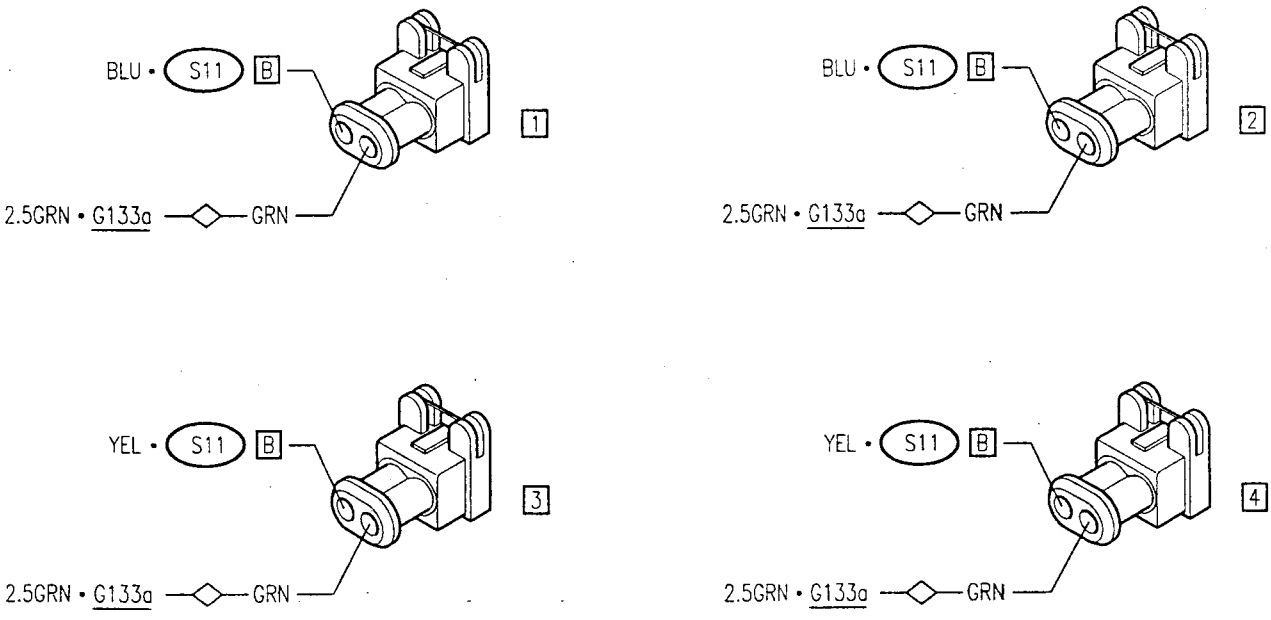
1. Sensor supply (air-flow meter)
2. Rev counter signal
3. Fuel pump relay command
4. Cooling fan 2nd speed relay command
5. N.C.
6. N.C.
7. Main relay supply
8. Key-operated supply
9. Main relay command
10. N.C.
11. Diagnosis connection (line K)
12. "i.e. failure" warning light
13. Cooling fan 1st speed relay command
14. N.C.
15. N.C.
16. Alfa Romeo CODE connection
17. Supply from main relay
18. Direct supply (battery)
19. Conditioner compressor relay command
20. Air-flow meter signal
21. N.C.
22. N.C.
23. N.C.
24. N.C.
25. N.C.
26. N.C.
27. Tachometric sensor signal
28. N.C.
29. Sensor earth
30. Air temperature sensor signal
31. Conditioning request switch (from pressure switch)
32. N.C.
33. N.C.
34. Request to turn on fan 1st speed
35. Request to turn on fan 2nd speed
36. N.C.
37. N.C.
38. N.C.

Connector B

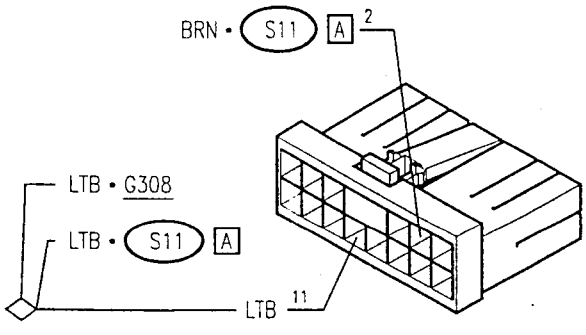
1. Sensor earth
2. Pinging sensor signal
3. N.C.
4. Throttle position potentiometer signal
5. Coolant fluid temperature sensor signal
6. Injector command for cyl 1
7. Injector command for cyl 4
8. Lambda sensor heating signal
9. Ignition coil control for cyl 3
10. Ignition coil control for 4
11. Pinging sensor signal
12. N.C.
13. Throttle potentiometer signal
14. N.C.
15. Idle switch signal
16. Injector command for cyl 3
17. Injector command for cyl 2
18. N.C.
19. N.C.
20. N.C.
21. Lambda sensor reference earth
22. Engine rpm sensor signal
23. Timing sensor signal
24. Timing variator actuator command
25. N.C.
26. Throttle actuator command
27. N.C.
28. N.C.
29. Sensor supplies
30. Lambda sensor
31. N.C.
32. Engine rpm sensor signal
33. Intake manifold solenoid valve command (present only in engines 1.8 and 2.0
34. Fuel vapour recovery solenoid valve command
35. Throttle actuator command
36. N.C.
37. Ignition coil control for cyl 2
38. Ignition coil control for cyl 1

COMPONENTS AND CONNECTORS

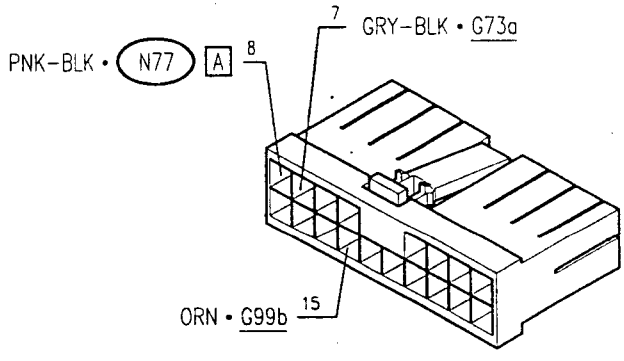
Ignition coils — A8



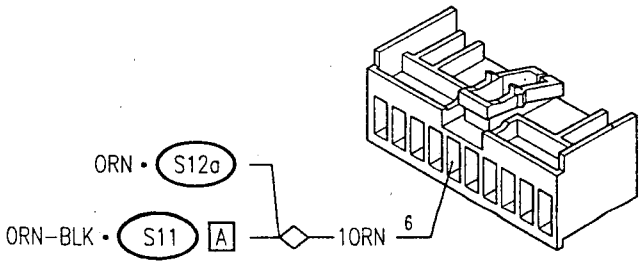
Instrument cluster — C10 A



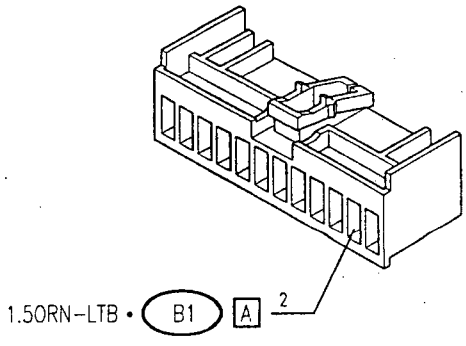
Instrument cluster — C10 B



Fusebox — G1 G

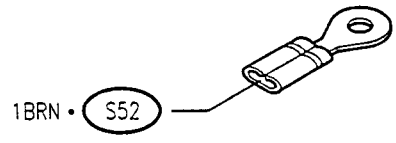


Fusebox — G1 H

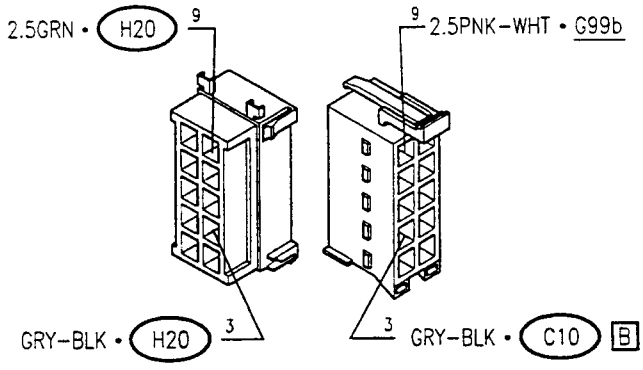


COMPONENTS AND CONNECTORS (continued)

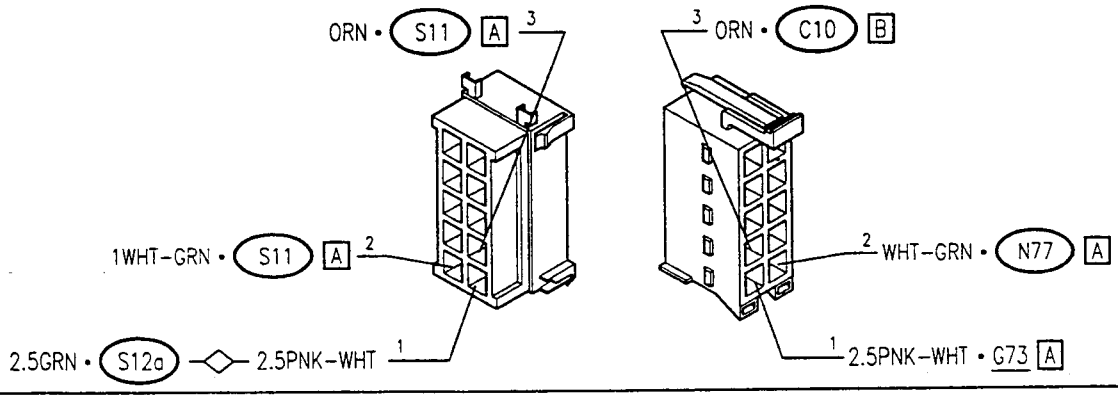
Injection wiring earth	G60



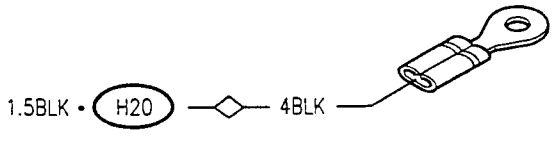
Rear services connector	G73 A



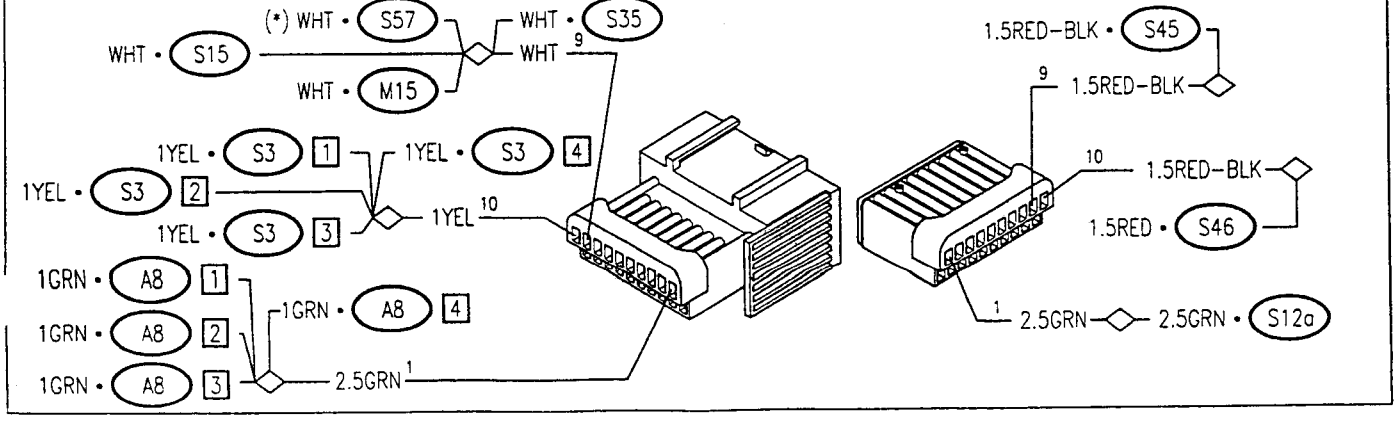
Dashboard/engine wiring connector	G99b



Seat crossmember earth	G106



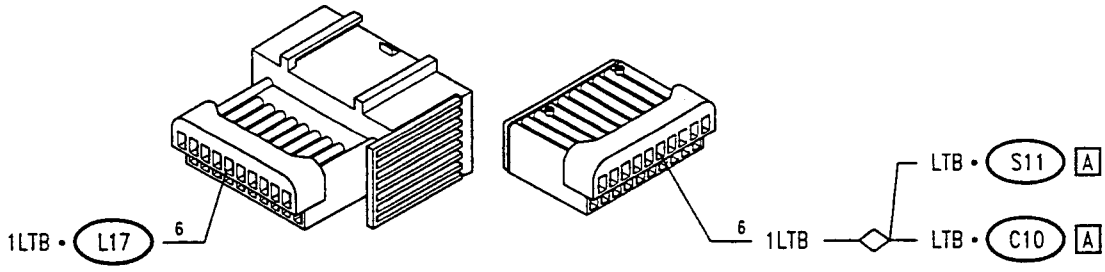
Electr. injection wiring connector A	G133a



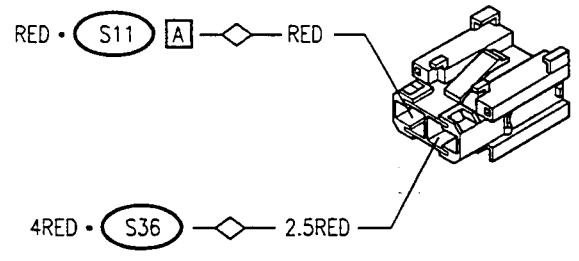
(*) only in engines 1.8 and 2.0

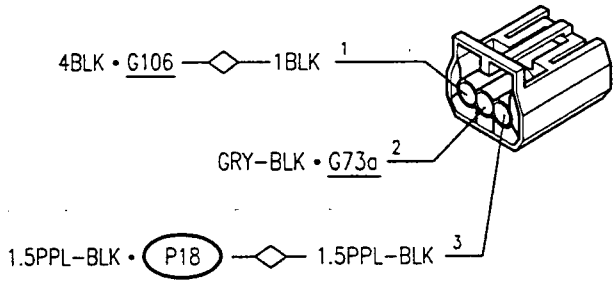
COMPONENTS AND CONNECTORS (continued)

Engine sensor connector	G308

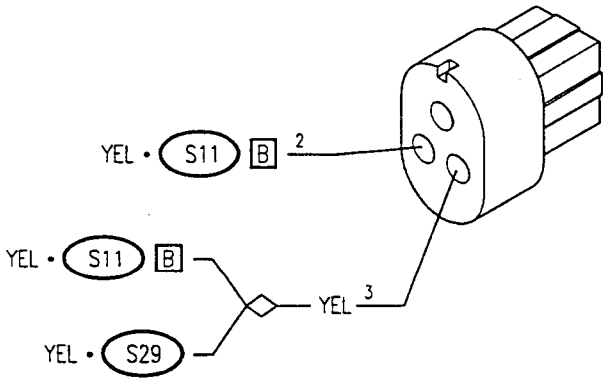


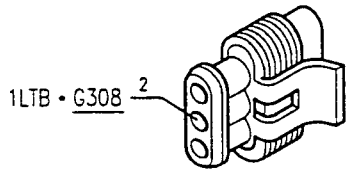
ALFA ROMEO CODE fuse	G389	Inertial switch	H20



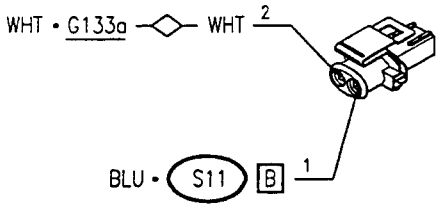


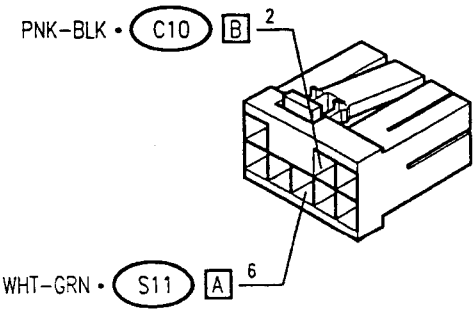
Sender for engine coolant temperature gauge (*)	L7	Tachometric sensor	L17





Evaporative solenoid valve	M15	ALFA ROMEO CODE control unit	N77 A

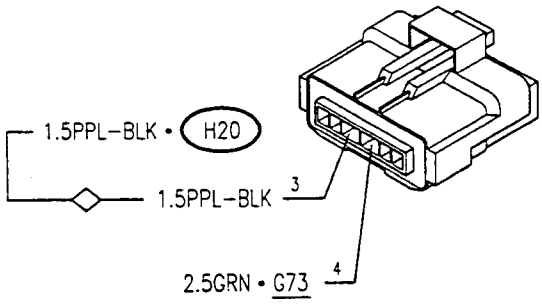




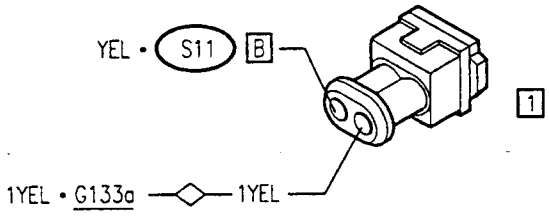
(*) from May '98

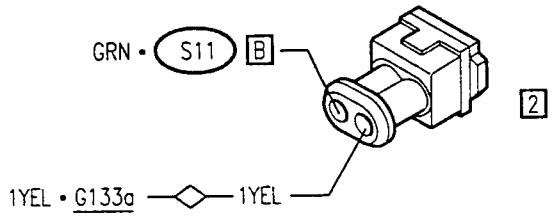
COMPONENTS AND CONNECTORS (continued)

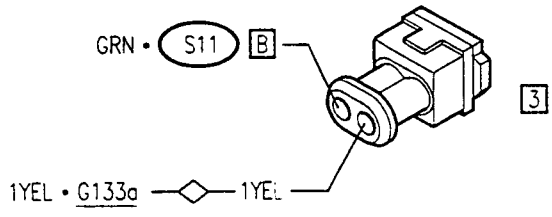
Electric fuel pump — P18

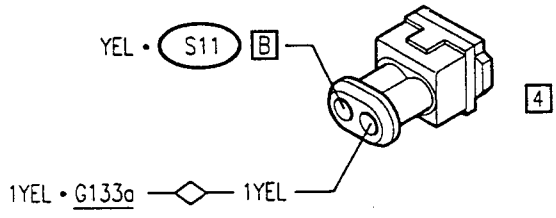


Injectors — S3

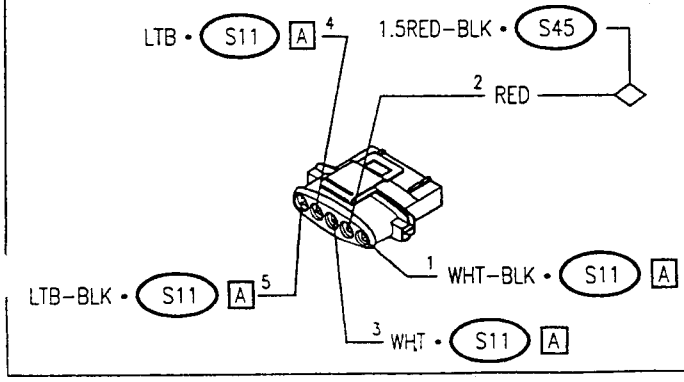




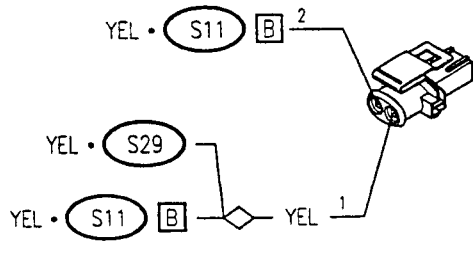




Air flow meter — S5



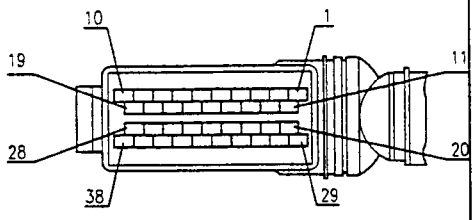
Engine temperature sensor — S7



COMPONENTS AND CONNECTORS (continued)

Motronic control unit — S11 A

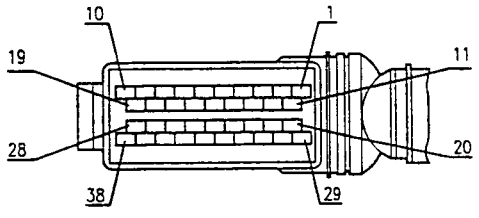
1 — LTB • S5
2 — BRN • C10 A
3 — BRN-WHT • S12a
4 — 1RED-GRN • I100
5 — N.C.
6 — N.C.
7 — 1RED-BLK — 1.5RED • S46; 1.5RED-BLK • G133a
8 — ORN-BLK — ORN • S12a; 1ORN • G1 G
9 — PNK-BLK • S41
10 — N.C.
11 — WHT-YEL • T1
12 — ORN • G99b
13 — WHT-RED • G1 G
14 — N.C.
15 — N.C.
16 — 1WHT-GRN • G99b
17 — 1RED-BLK
18 — RED — RED • G389
19 — LTB-WHT • Q22
20 — LTB-BLK • S5
21 — N.C.
22 — N.C.
23 — N.C.
24 — N.C.
25 — N.C.
26 — N.C.



27 — LTB — LTB • C10 A; LTB • G308
28 — N.C.
29 — WHT • S5
30 — WHT-BLK • S5
31 — GRN-BLK • S5
32 — N.C.
33 — N.C.
34 — PPL-BLK • Q20
35 — GRY-YEL • Q20
37 — N.C.
38 — N.C.

Motronic control unit — S11 B

1 — YEL — YEL • S7; YEL • L7 (**); YEL • S29
2 — YEL • S20
3 — N.C.
4 — YEL • S29
5 — YEL • S7
5 — YEL • L7 (**)
6 — YEL • S3 1
7 — YEL • S3 4
8 — YEL • S35
9 — YEL • A8 3
10 — YEL • A8 4
11 — GRN • S20
12 — N.C.
13 — GRN • S29
14 — N.C.
15 — N.C.
16 — GRN • S3 3
17 — GRN • S3 2
18 — N.C.
19 — N.C.
20 — N.C.
21 — WHT • S35
22 — WHT • S31
23 — WHT • S52
24 — WHT • S15
25 — N.C.

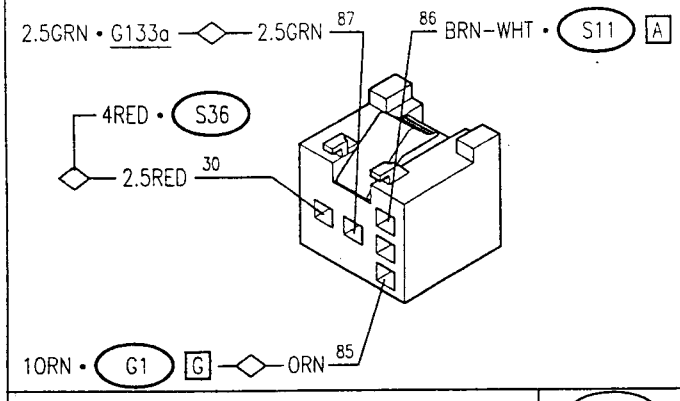


26 — YEL • S29
27 — N.C.
28 — N.C.
29 — BLU — BLU • S52; BLU • S29
30 — BLU • S35
31 — N.C.
32 — BLU • S31
33 — BLU • S57
34 — BLU • M15
35 — BLU • S29
36 — N.C.
37 — BLU • A8 2
38 — BLU • A1 1

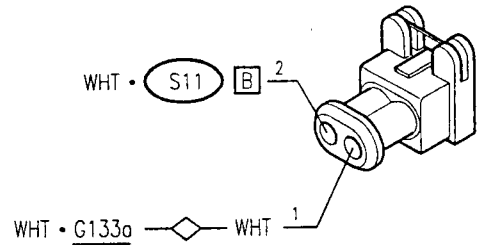
(*) only in engines 1.8 and 2.0
(**) from May '98

COMPONENTS AND CONNECTORS (continued)

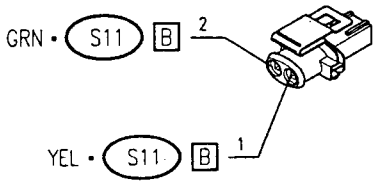
Motronic fuel pump relay — S12a



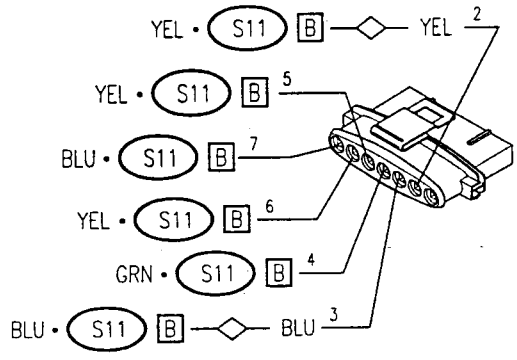
Timing variator — S15



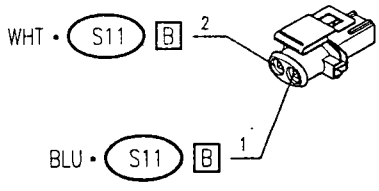
Pinging sensor — S20



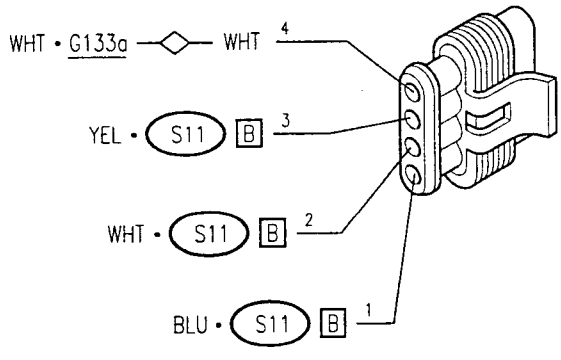
Idle speed adjustment actuator — S29



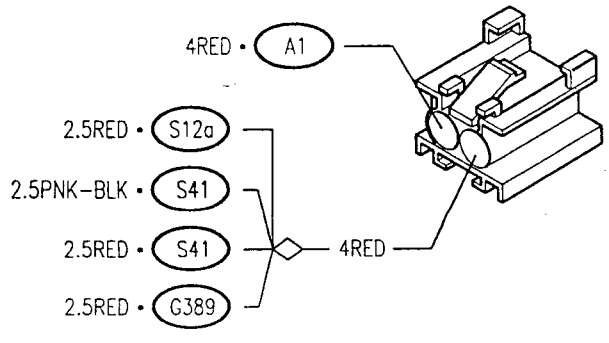
Rpm & crankshaft position sensor — S31



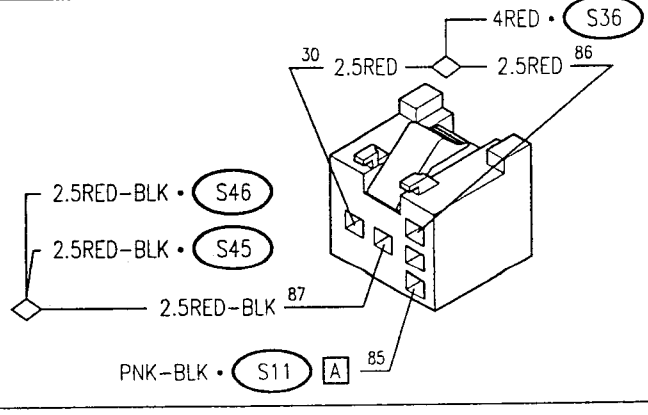
Heated lambda sensor — S35



Injection wander fuse — S36

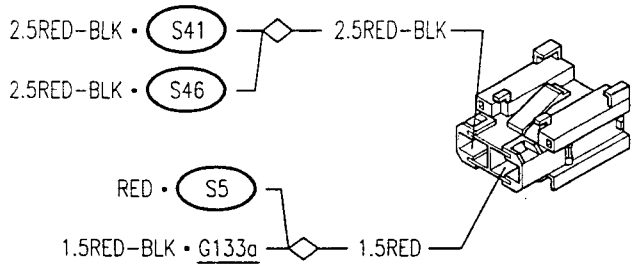


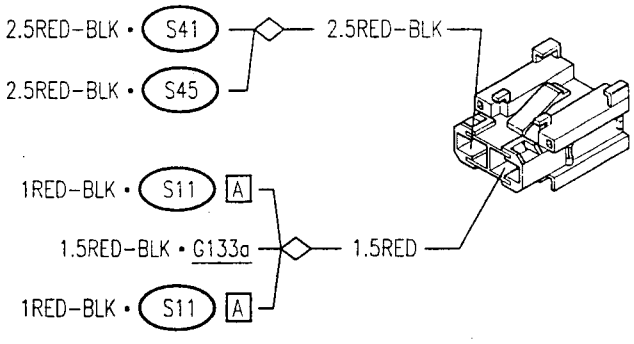
Main relay — S41



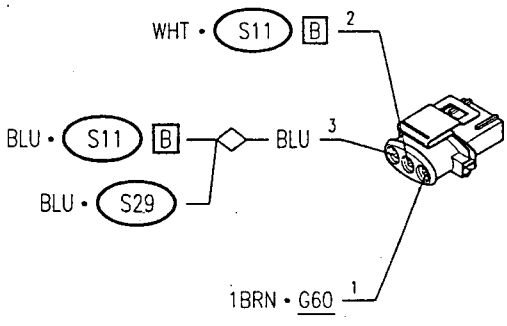
COMPONENTS AND CONNECTORS (continued)

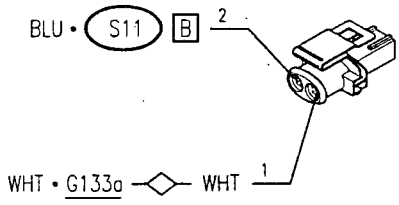
Lambda sensor wander fuse	S45	Motronic supply wander fuse	S46



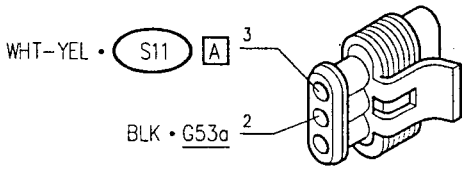


Cam angle sensor	S52	Variable geometry solenoid valve (*)	S57



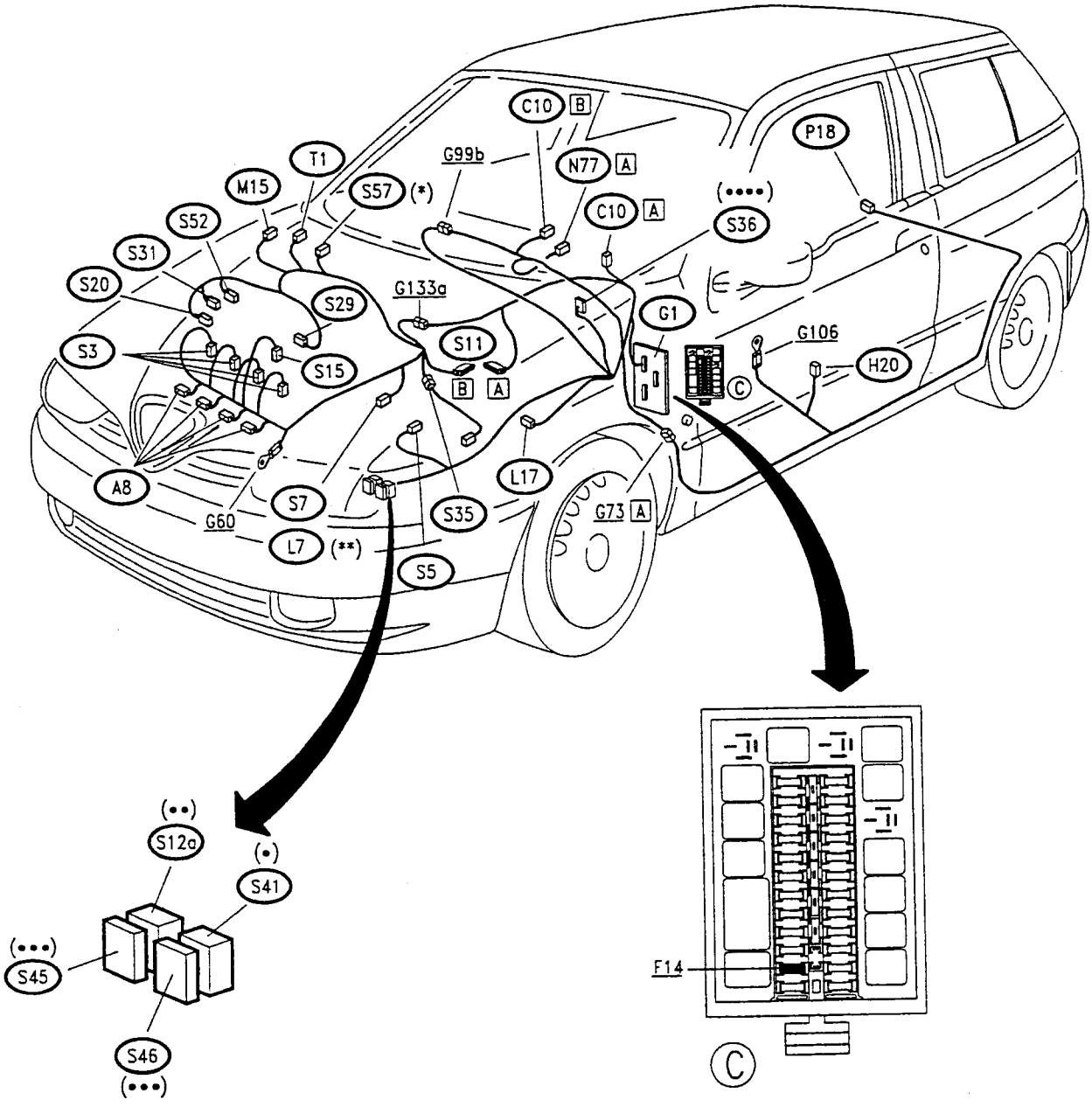


Connector for ALFA TESTER (Motronic)	T1



(*) only in engines 1.8 and 2.0

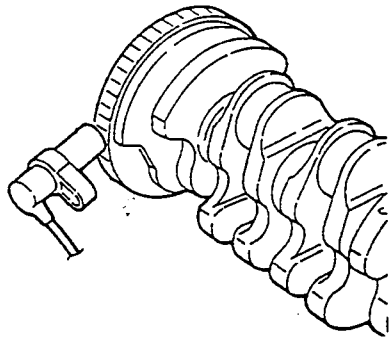
.OCATION OF COMPONENTS



(•) White base
(••) Black base
(••) Light blue fuseholder
(••••) Black fuseholder
(*) Only in engines 1.8 and 2.0
(**) from May '98

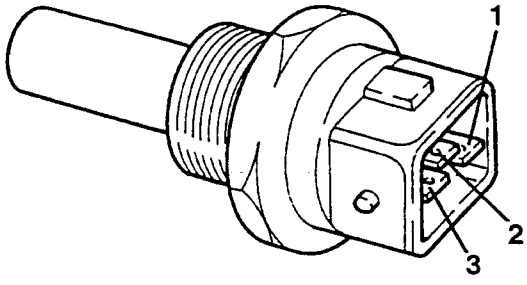
CHECKING COMPONENTS

Rpm sensor (S31)



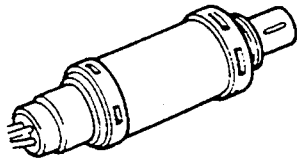
SPECIFICATIONS	
Sensor winding resistance (20 °C)	860 Ω ± 10%

Sender engine temperature (L7)



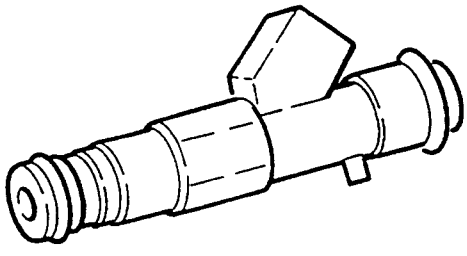
SPECIFICATIONS	
Nominal resistance (at 20 °C) between pins 2 and 3	2300 ÷ 2600 Ω

Sonda Lambda (S35)



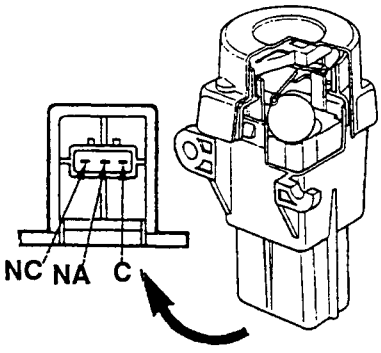
SPECIFICATIONS	
Heating resistance	9 ± 0.5 Ω

Injectors (S3)



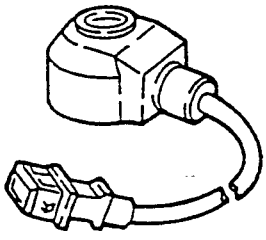
SPECIFICATIONS	
Winding resistance	15.9 ± 0.35 Ω

I. tial switch (H20)



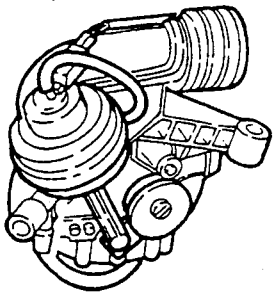
SPECIFICATIONS
Check continuity between pin NC and C: this continuity is interrupted in the event of a crash; the contact is closed again pressing the special button

Pinging sensor (S20)



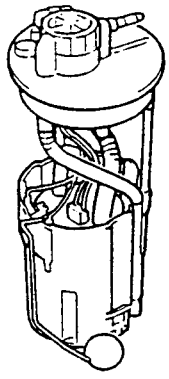
SPECIFICATIONS	
Resonance frequency	> 20 kHz
Impedence	≥ 1 MΩ

Variable geometry solenoid valve (S57)
(Only in engines 1.8 and 2.0)



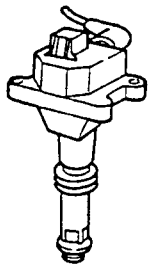
SPECIFICATIONS	
Winding resistance	40 ± 5 Ω

Fuel pump (P18)



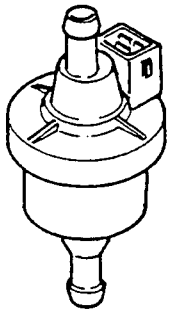
SPECIFICATIONS	
Pressure	3.5 ± 0.2 bar
Rated voltage	12V

Ignition coils (A8)



SPECIFICATIONS	
Primary resistance	0.3 Ω ± 12%
Secondary resistance	7 kΩ ± 12%

Evaporative solenoid valve (M15)



SPECIFICATIONS	
Winding ohmic resistance	26 ± 4 Ω