

# MOTRONIC M1.5.5 INJECTION/IGNITION SYSTEM

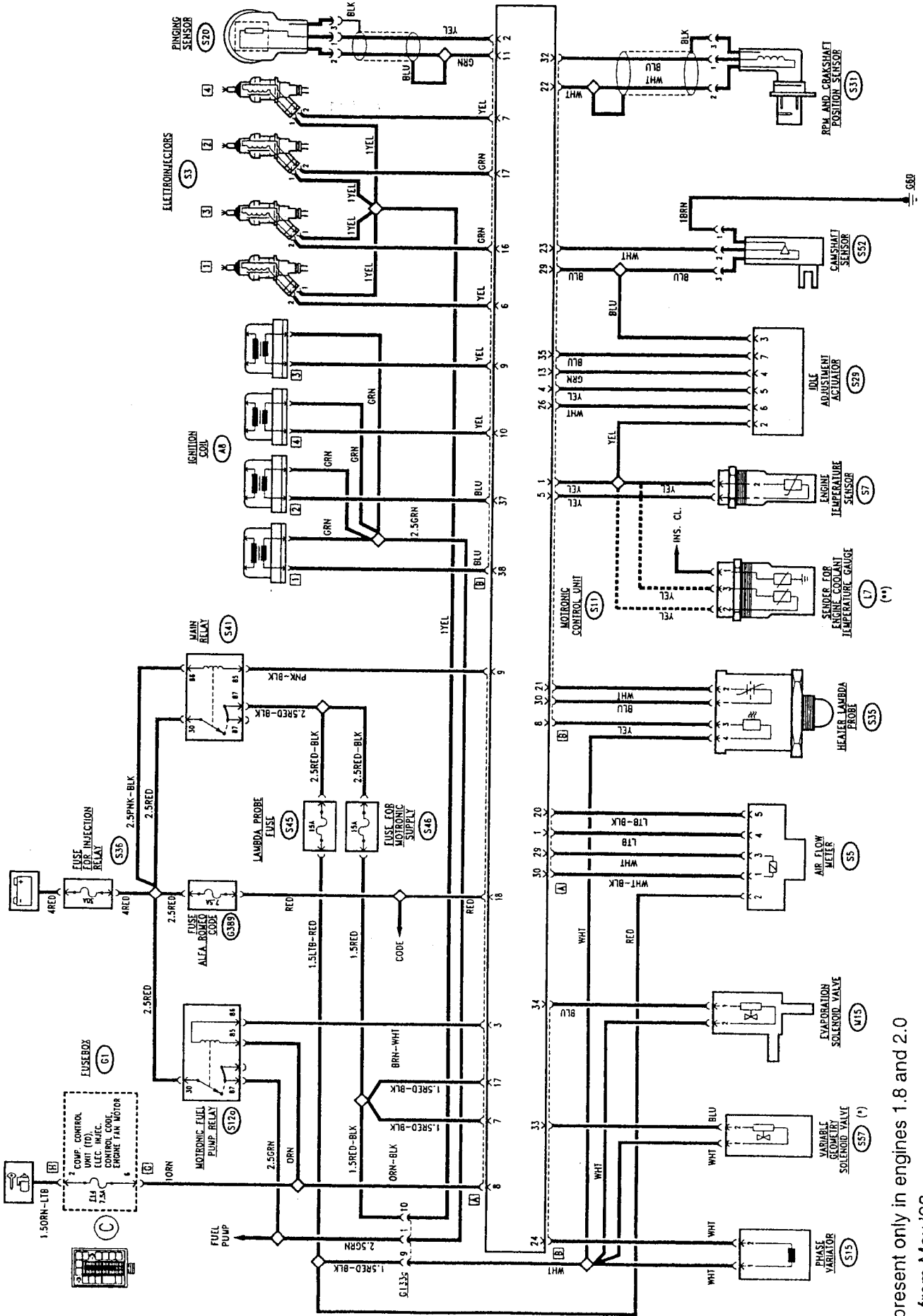
- 1.4, 1.6, 1.8 and 2.0 T.SPARK 16v engines

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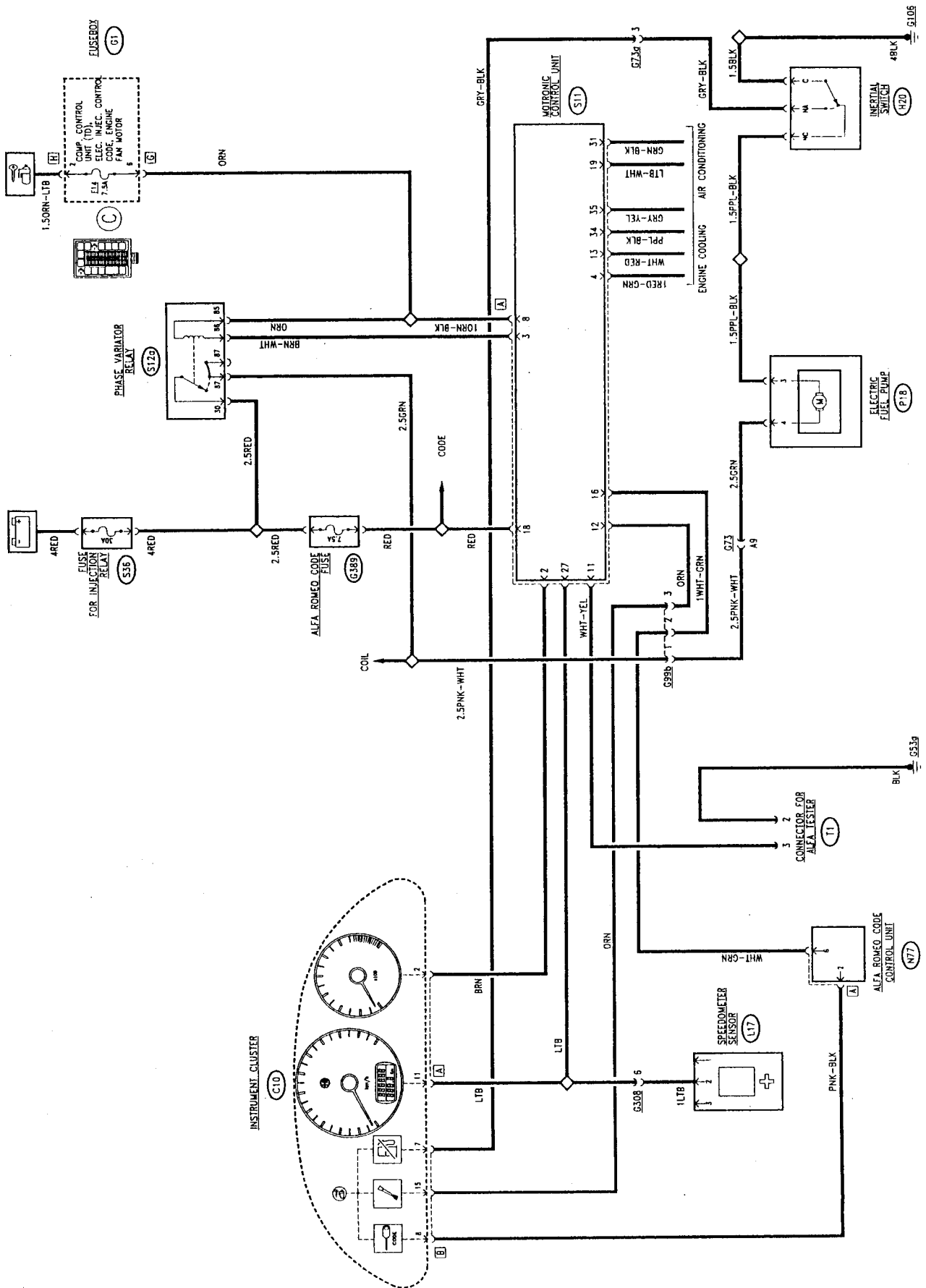
**WARNING:**  
the new MOTRONIC M1.5.5 version replaces the previous  
MOTRONIC M2.10.4 version from MODEL YEAR '98

### 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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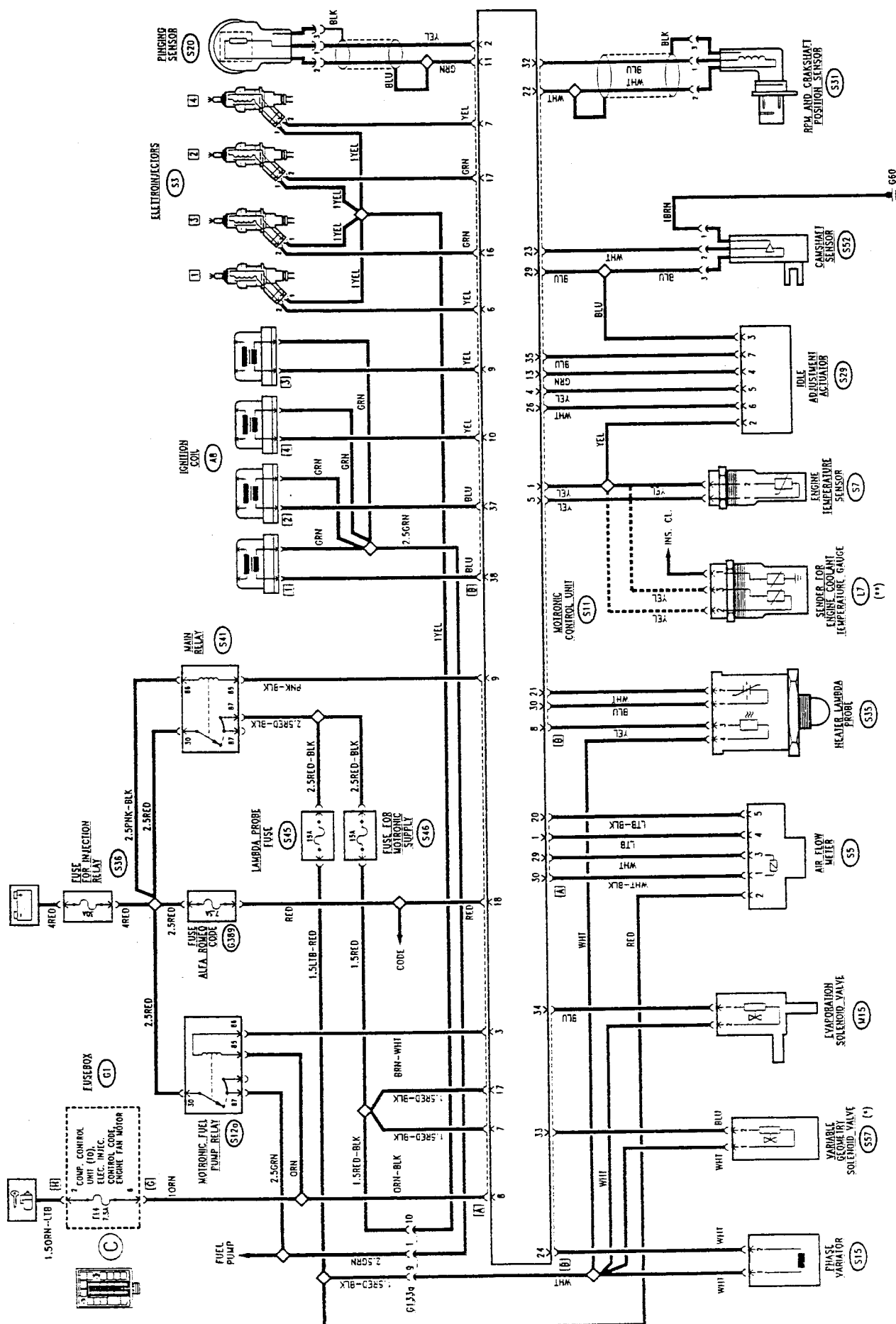
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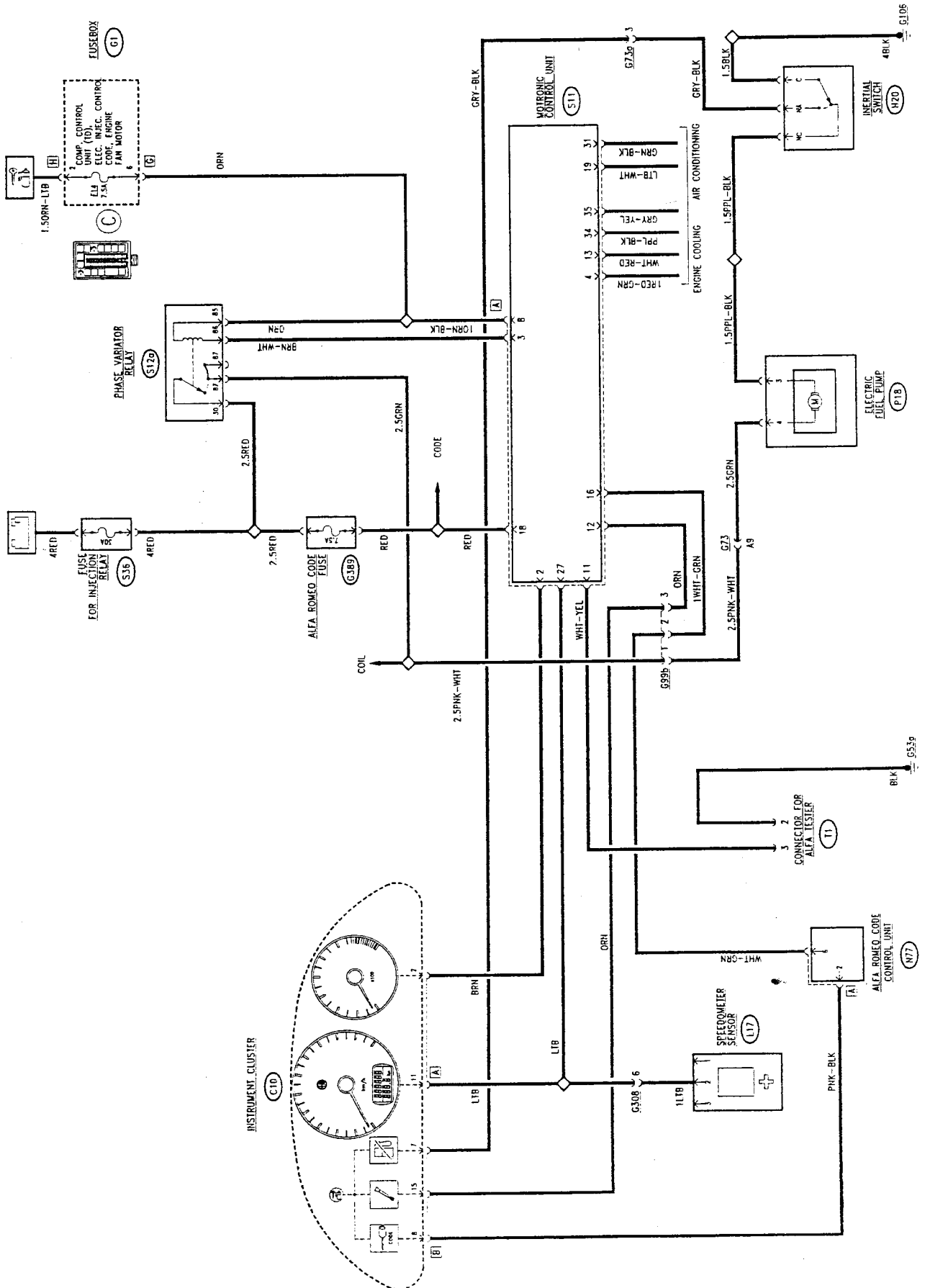
WIRING DIAGRAM "A"



(\*) 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;
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The control unit also controls the electrohydraulic timing variator, which is only used on T. SPARK engines.

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- digital electronic ignition with inductive discharge;
- static distribution;
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- the ignition instant;
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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.

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- 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;
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- engine coolant fluid temperature
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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
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- 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 ignition 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 of **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.

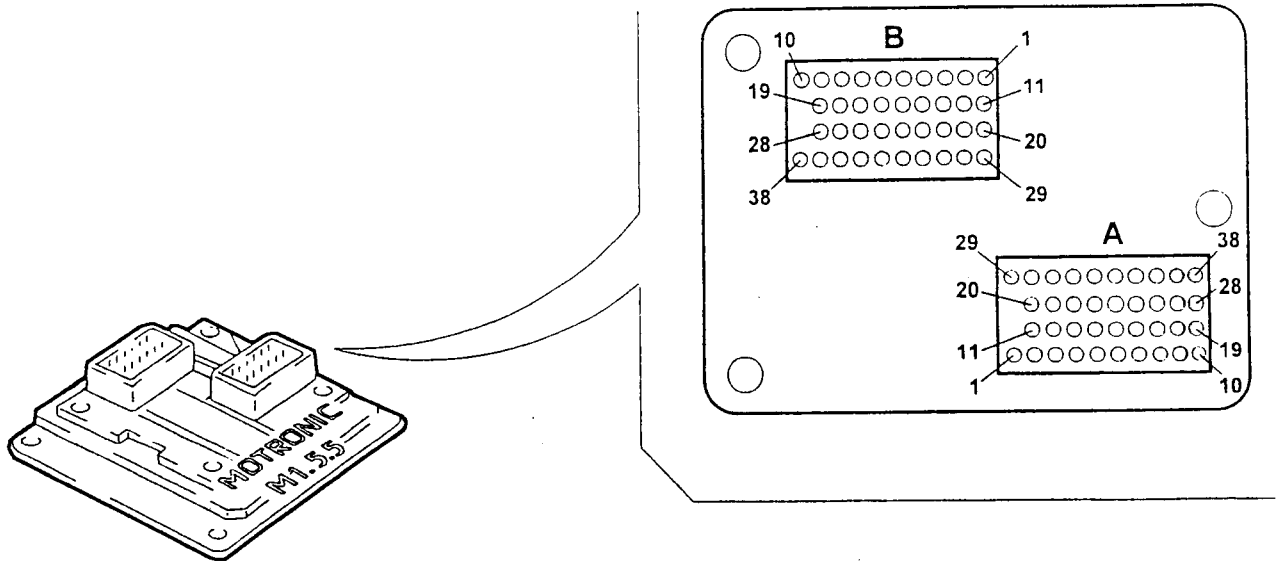
The control unit has a self-diagnosis system, which can be used connecting to the diagnosis connector **T1**: the signals reach it from pin 11 of connector A from the control unit **S11** through the special diagnosis line. The self-diagnosis system also generates the signal for the "injection failure"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

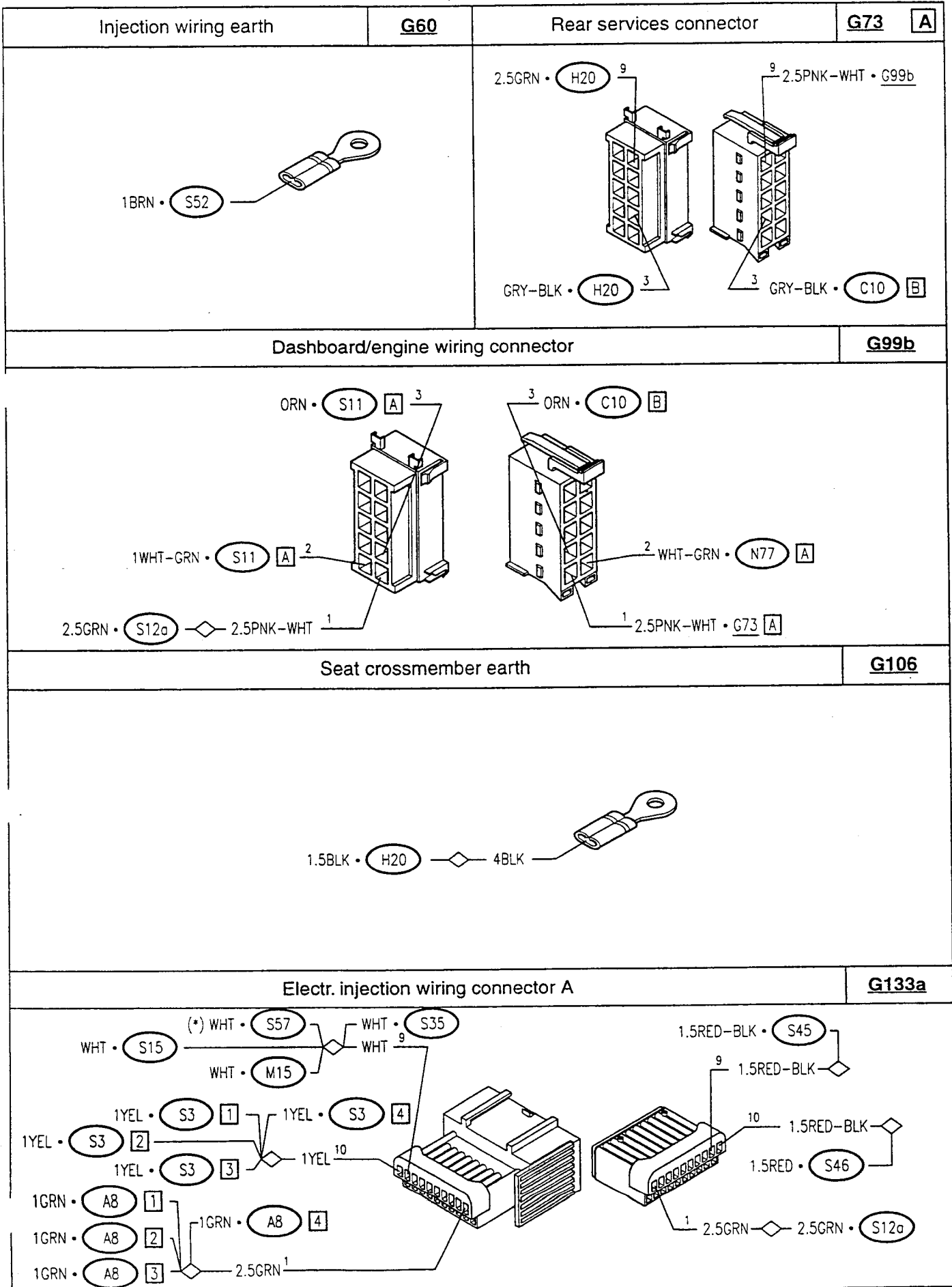
#### Connector B

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	
<p>BLU • S11 B</p> <p>2.5GRN • G133a GRN</p> <p>1</p>	<p>BLU • S11 B</p> <p>2.5GRN • G133a GRN</p> <p>2</p>		
<p>YEL • S11 B</p> <p>2.5GRN • G133a GRN</p> <p>3</p>	<p>YEL • S11 B</p> <p>2.5GRN • G133a GRN</p> <p>4</p>		
Instrument cluster	C10 A	Instrument cluster	C10 B
<p>BRN • S11 A 2</p> <p>LTB • G308</p> <p>LTB • S11 A</p> <p>LTB 11</p>		<p>PNK-BLK • N77 A 8</p> <p>GRY-BLK • G73a 7</p> <p>ORN • G99b 15</p>	
Fusebox	G1 G	Fusebox	G1 H
<p>ORN • S12a</p> <p>ORN-BLK • S11 A 10RN 6</p>		<p>1.5ORN-LTB • B1 A 2</p>	

## COMPONENTS AND CONNECTORS (continued)



(\*) only in engines 1.8 and 2.0

### COMPONENTS AND CONNECTORS (continued)

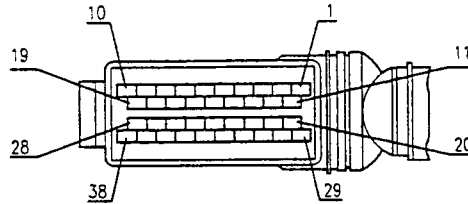
<b>Engine sensor connector</b>		<b>G308</b>	
<b>ALFA ROMEO CODE fuse</b>	<b>G389</b>	<b>Inertial switch</b>	
<b>H20</b>			
<b>Sender for engine coolant temperature gauge (*)</b>	<b>L7</b>	<b>Tachometric sensor</b>	
<b>L17</b>			
<b>Evaporative solenoid valve</b>	<b>M15</b>	<b>ALFA ROMEO CODE control unit</b>	<b>N77 [A]</b>

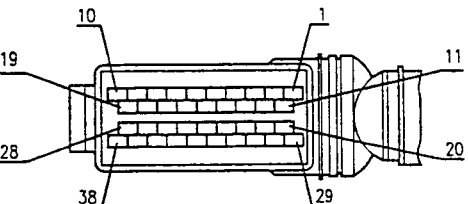
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## COMPONENTS AND CONNECTORS (continued)

Electric fuel pump		P18
Injectors		S3
Air flow meter	S5	Engine temperature sensor

### COMPONENTS AND CONNECTORS (continued)

Motronic control unit			S11 A
<p>1 LTB • S5</p> <p>2 BRN • C10 A</p> <p>3 BRN-WHT • S12a</p> <p>4 1RED-GRN • I100</p> <p>5 N.C.</p> <p>6 N.C.</p> <p>7 1RED-BLK — 1.5RED • S46 1.5RED-BLK • G133a</p> <p>8 ORN-BLK — ORN • S12a 1ORN • G1 G</p> <p>9 PNK-BLK • S41</p> <p>10 N.C.</p> <p>11 WHT-YEL • T1</p> <p>12 ORN • G99b</p>	<p>13 WHT-RED • G1 G</p> <p>14 N.C.</p> <p>15 N.C.</p> <p>16 1WHT-GRN • G99b</p> <p>17 1RED-BLK</p> <p>18 RED — RED • G389</p> <p>19 LTB-WHT • Q22</p> <p>20 LTB-BLK • S5</p> <p>21 N.C.</p> <p>22 N.C.</p> <p>23 N.C.</p> <p>24 N.C.</p> <p>25 N.C.</p> <p>26 N.C.</p>	 <p>27 LTB — LTB • C10 A LTB • G308</p> <p>28 N.C.</p> <p>29 WHT • S5</p> <p>30 WHT-BLK • S5</p> <p>31 GRN-BLK • S5</p> <p>32 N.C.</p> <p>33 N.C.</p> <p>34 PPL-BLK • Q20</p> <p>35 GRY-YEL • Q20</p> <p>37 N.C.</p> <p>38 N.C.</p>	

Motronic control unit			S11 B
<p>1 YEL — YEL • S7 YEL • L7 (**) YEL • S29</p> <p>2 YEL • S20</p> <p>3 N.C.</p> <p>4 YEL • S29</p> <p>5 YEL • S7</p> <p>5 YEL • L7 (**)</p> <p>6 YEL • S3 1</p> <p>7 YEL • S3 4</p> <p>8 YEL • S35</p> <p>9 YEL • A8 3</p> <p>10 YEL • A8 4</p> <p>11 GRN • S20</p>	<p>12 N.C.</p> <p>13 GRN • S29</p> <p>14 N.C.</p> <p>15 N.C.</p> <p>16 GRN • S3 3</p> <p>17 GRN • S3 2</p> <p>18 N.C.</p> <p>19 N.C.</p> <p>20 N.C.</p> <p>21 WHT • S35</p> <p>22 WHT • S31</p> <p>23 WHT • S52</p> <p>24 WHT • S15</p> <p>25 N.C.</p>	 <p>26 YEL • S29</p> <p>27 N.C.</p> <p>28 N.C.</p> <p>29 BLU — BLU • S52 BLU • S29</p> <p>30 BLU • S35</p> <p>31 N.C.</p> <p>32 BLU • S31</p> <p>33 BLU • S57</p> <p>34 BLU • M15</p> <p>35 BLU • S29</p> <p>36 N.C.</p> <p>37 BLU • A8 2</p> <p>38 BLU • A1 1</p>	

(\*) only in engines 1.8 and 2.0  
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(\*\*) from May '98  
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## COMPONENTS AND CONNECTORS (continued)

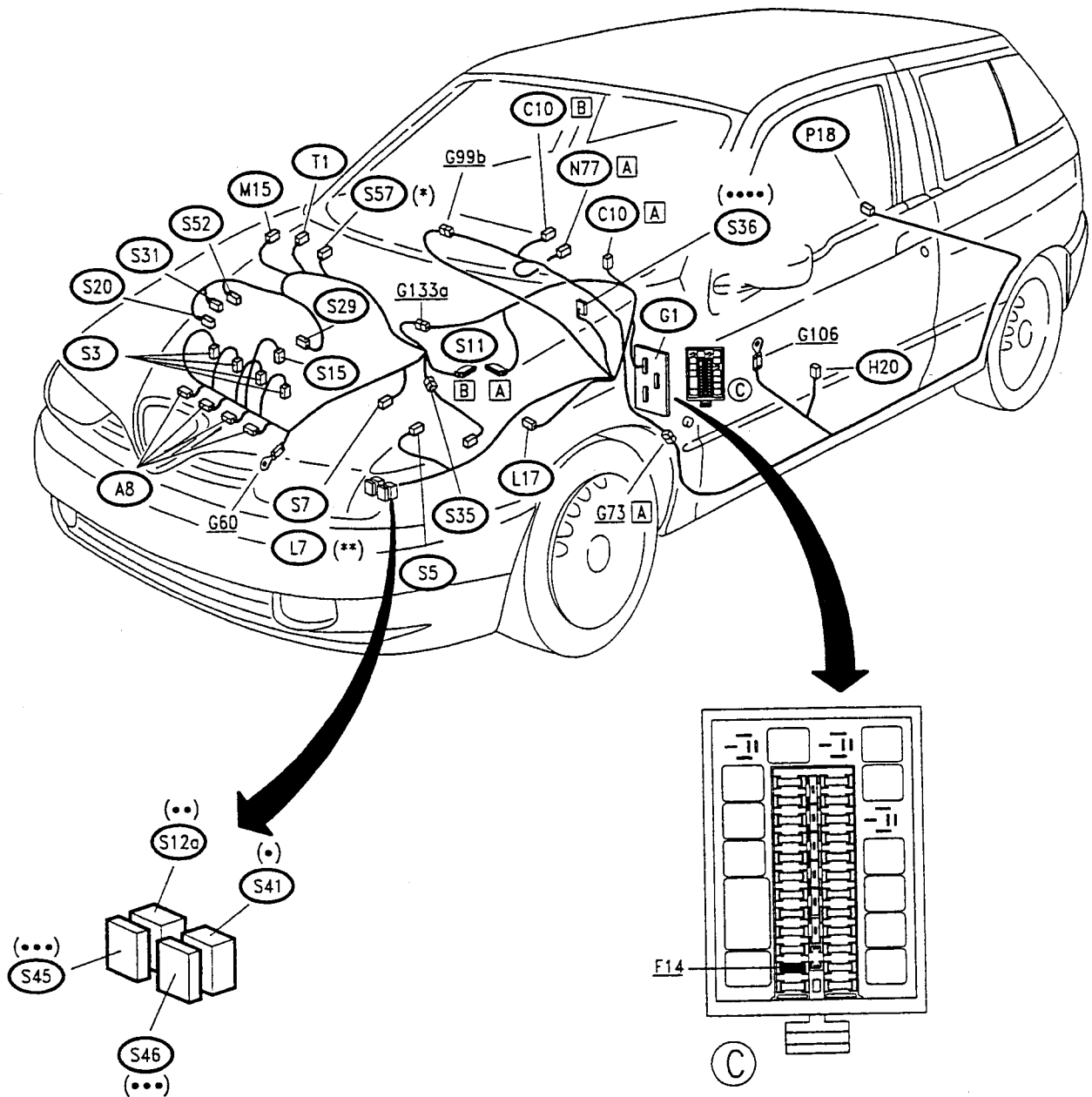
<p>Motronic fuel pump relay</p>	<p>S12a</p>	<p>Timing variator</p>	<p>S15</p>
<p>2.5GRN • G133a —◇— 2.5GRN 87          BRN-WHT • S11 [A] 86          4RED • S36          2.5RED 30          10RN • G1 [G] —◇— ORN 85</p>		<p>WHT • S11 [B] 2          WHT • G133a —◇— WHT 1</p>	
<p>Pinging sensor</p>	<p>S20</p>	<p>Idle speed adjustment actuator</p>	<p>S29</p>
<p>GRN • S11 [B] 2          YEL • S11 [B] 1</p>		<p>YEL • S11 [B] —◇— YEL 2          YEL • S11 [B] 5          BLU • S11 [B] 7          YEL • S11 [B] 6          GRN • S11 [B] 4          BLU • S11 [B] —◇— BLU 3</p>	
<p>Rpm &amp; crankshaft position sensor</p>	<p>S31</p>	<p>Heated lambda sensor</p>	<p>S35</p>
<p>WHT • S11 [B] 2          BLU • S11 [B] 1</p>		<p>WHT • G133a —◇— WHT 4          YEL • S11 [B] 3          WHT • S11 [B] 2          BLU • S11 [B] 1</p>	
<p>Injection wander fuse</p>	<p>S36</p>	<p>Main relay</p>	<p>S41</p>
<p>4RED • A1          2.5RED • S12a          2.5PNK-BLK • S41          2.5RED • S41 —◇— 4RED          2.5RED • G389</p>		<p>4RED • S36          2.5RED —◇— 2.5RED 30          2.5RED-BLK • S46          2.5RED-BLK • S45          2.5RED-BLK 87          PNK-BLK • S11 [A] 85</p>	

### COMPONENTS AND CONNECTORS (continued)

<p>Lambda sensor wander fuse</p>	<p><b>S45</b></p>	<p>Motronic supply wander fuse</p>	<p><b>S46</b></p>
<p>Cam angle sensor</p>	<p><b>S52</b></p>	<p>Variable geometry solenoid valve (*)</p>	<p><b>S57</b></p>
<p>Connector for ALFA TESTER (Motronic)</p>			<p><b>T1</b></p>

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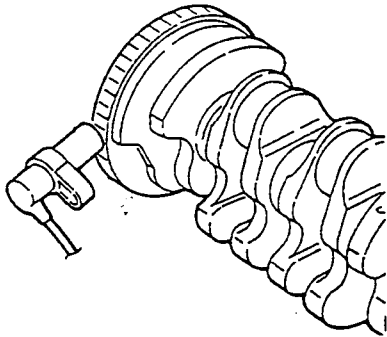
## LOCATION OF COMPONENTS



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

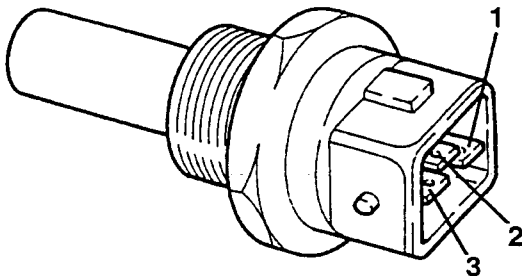
## CHECKING COMPONENTS

Rpm sensor (S31)



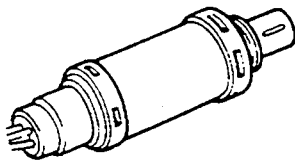
SPECIFICATIONS	
Sensor winding resistance (20 °C)	860 Ω ± 10%

Sender engine temperature (L7)



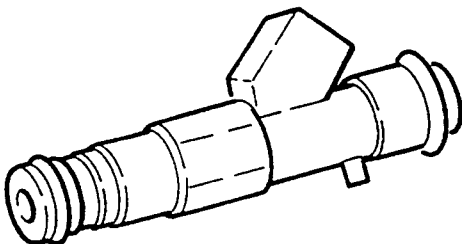
SPECIFICATIONS	
Nominal resistance (at 20 °C) between pins 2 and 3	2300 ÷ 2600 Ω

Sonda Lambda (S35)



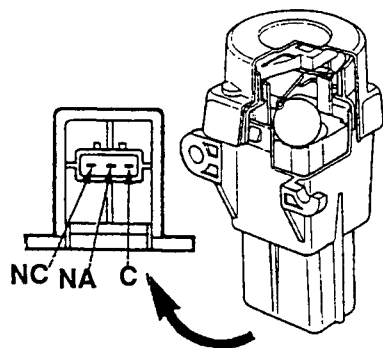
SPECIFICATIONS	
Heating resistance	9 ± 0.5 Ω

Injectors (S3)



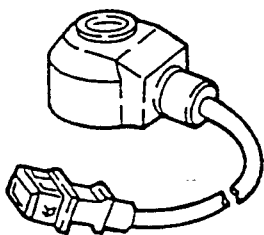
SPECIFICATIONS	
Winding resistance	15.9 ± 0.35 Ω

## Initial switch (H20)



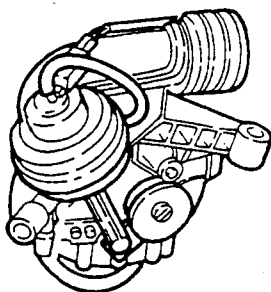
SPECIFICATIONS	
Check continuity between pin NC and C: this continuity is interrupted in the event of a crash; the contact is closed again pressing the special button	

## Pinging sensor (S20)



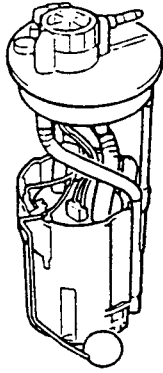
SPECIFICATIONS	
Resonance frequency	> 20 kHz
Impedence	≥ 1 MΩ

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



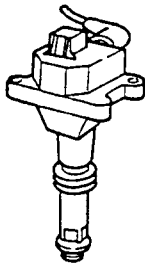
SPECIFICATIONS	
Winding resistance	40 ± 5 Ω

## Fuel pump (P18)



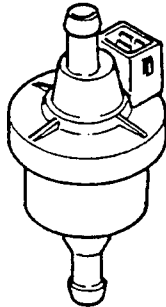
SPECIFICATIONS	
Pressure	3.5 ± 0.2 bar
Rated voltage	12V

## 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