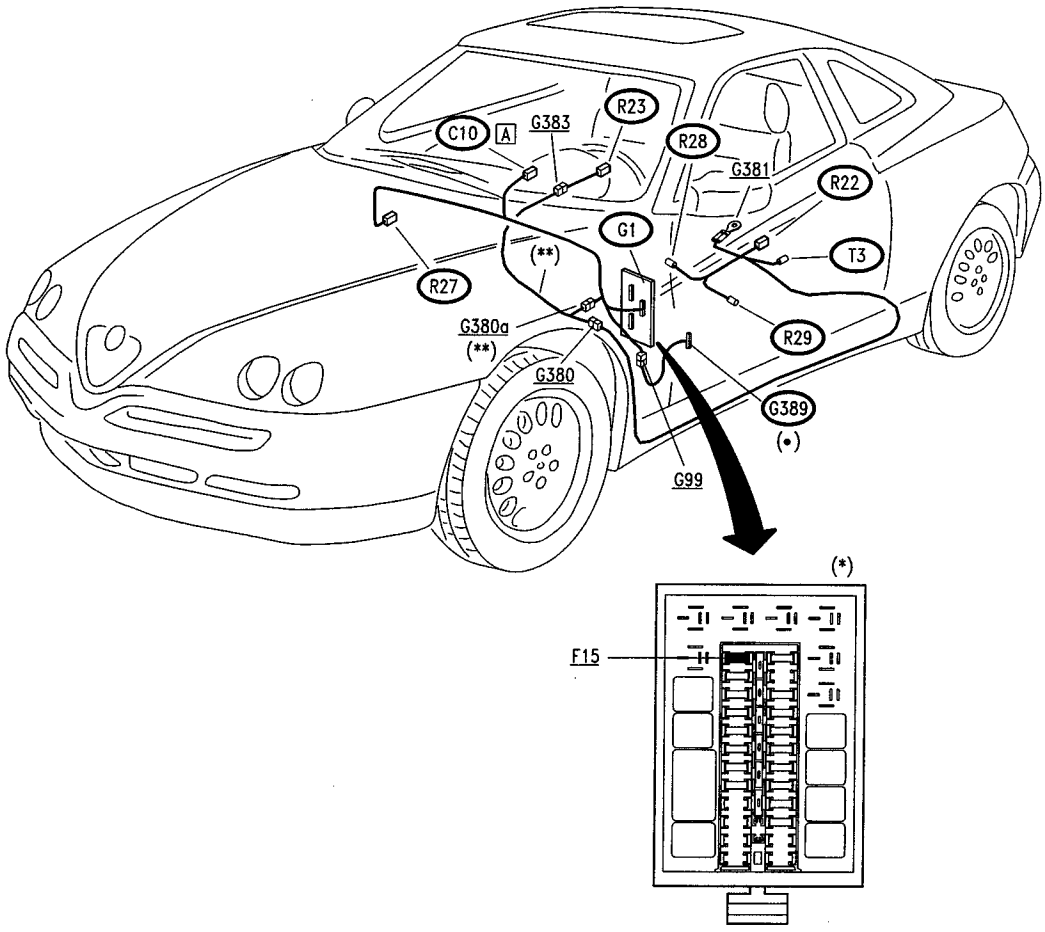
LOCATION OF COMPONENTS

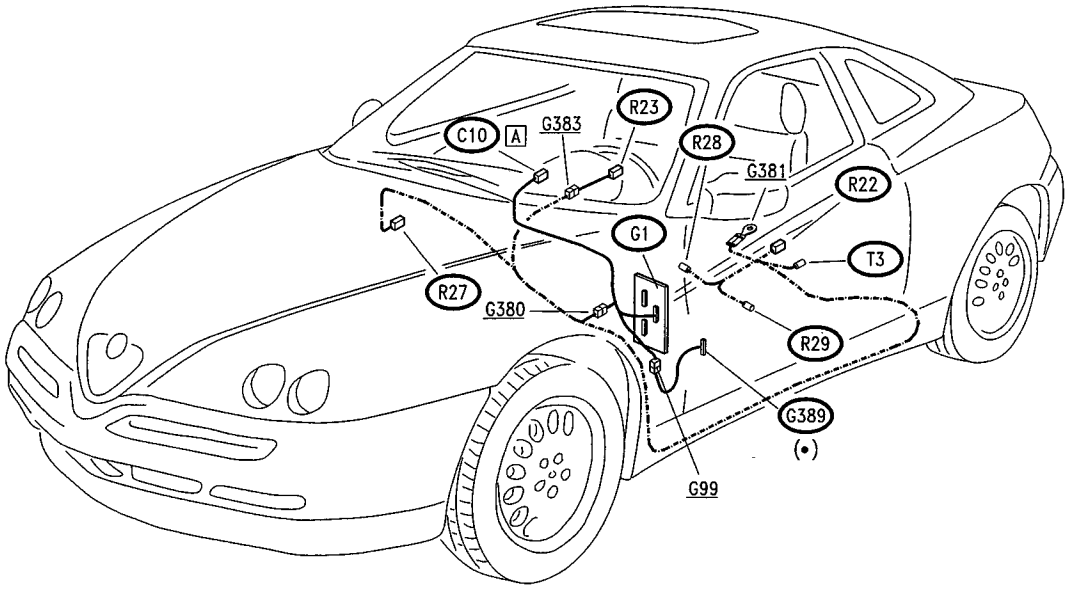
(BECKER control unit - up to chassis no.6016878)



(*) Up to chassis no.____
(**) From chassis no.____

(•) Red fuse holder

LOCATION OF COMPONENTS
(TRW control unit - from chassis no.6016879)



---- Specific cable for Air Bag, with yellow sheath
(•) Red fuseholder

SYSTEM DIAGNOSIS

During the whole time the vehicle is travelling the electronic control unit performs a diagnosis cycle every 100 msec. checking the Air Bag system and memorising any faults in the FAULT-MEMORY whether they are momentaneous or continuous. The moment the fault is detected, besides memorising it, the control unit turns on the Air Bag warning light to inform the driver that the fault may prevent the use of this system. The User must then take the vehicle **at the soonest** to the nearest Service Centre to have the system checked with the ALFA TESTER.

Diagnosis using the ALFA TESTER

N.B. Before carrying out diagnosis using the flashing code, carry out the preliminary test described later (TEST A).

To prevent the accidental deployment of Air Bags or pre- tensioners during diagnosis, it is necessary to disconnect their wiring and connect the dummy resistances supplied with the ALFA TESTER Cartridge to the connectors.

NOTE:
When the ignition key is disengaged the time and type of fault or error code are kept in the FAULT MEMORY. Once the fault has been repaired the memory will be cancelled by the TESTER. Intermittent faults are stored in the FAULT MEMORY for 48 hours, counted from the moment in which they occur (time calculated only with the ignition key in the MARCIA position).

Diagnosing the system using the flashing codes (with control unit BECKER only)

As an alternative to the ALFA TESTER it is possible to diagnose the system by reading the number of flashes of the Air Bag warning light  .

N.B. Before carrying out diagnosis using the flashing code, carry out the preliminary test described later (TEST A).

To perform diagnosis, with the ignition key engaged, earth pin 3 of the electronic control unit for between 1 and 5 seconds (pin 3 of the control unit connects the Air Bag failure warning light and pin 1 of connector **T3**).

The following table shows the possible faults and the remedies to be adopted, according to the number of flashes of the warning light.

Once the fault has been repaired, the test must be repeated to check that other faults are not present. Remember that the control unit signals one fault at a time, in decreasing order, until the system has been repaired completely. When the repairs have been completed, the FAULT MEMORY is cancelled by earthing pin 3 of the control unit for between 5 and 10 seconds. All the errors stored must be cancelled one by one, repeating the procedure each time, until the FAULT-MEMORY has been cancelled completely.

NOTE:
Diagnosis with the flashing code is not foreseen with the TRW control unit.

NO. OF FLASHES	POSSIBLE FAULT	REMEDIES
1	No faults detected	-
2	Faulty control unit (or piezolectric sensor inside)	Change control unit **R22**
3	Air Bag module triggering circuit in contact with +12V	Check the wiring
4	Air Bag module triggering circuit in contact with earth	Check the wiring
5	Driver's side module triggering device resistance out of tolerance	Check the wiring or change the driver's side module **R23**
6	Passenger's side module triggering device resistance out of tolerance	Check the wiring or change the passenger's module **R27**
7	Supply voltage below 9.5 V	Check fuse **F15** of fusebox **G1** or recharge or change the battery **A1**
8	Warning light circuit fault	Check the wiring or change the instrument cluster **C10**
9	Memorising of a CRASH that has occurred (*)	-
10	Pretensioner triggering circuit in contact with + 12 V	Check the wiring
11	Pretensioner triggering circuit in contact with earth	Check the wiring
12	Driver's side pretensioner wiring cut off	Check the wiring or change the pretensioner **R29**
13	Passenger's side pretensioner cut off	Check the wiring or change the pretensioner **R28**

(*) It is NOT possible to read the CRASH data stored in the control unit using the ALFA ROMEO TESTER

PRELIMINARY CHECKS ON THE AIR BAG SYSTEM	TEST A

Each time work is carried out on the system, it is necessary to disconnect one of the two modules from the wiring and replace it with a dummy resistance.

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check the intactness of fuse **F15** of fusebox **G1** (up to chassis no.___) or wander fuse **G389** (from chassis no.___) is intact	OK ▶ ~~OK~~ ▶	Carry out **step A2** Change the fuse
A2 CHECK CONTINUITY – Check continuity of the cable between fusebox **G1** connector B (up to chassis no.___) or between wander fuse **G389** (from chassis no.___) and the Air Bag control unit **R22** (pin 9 BECKER - pin 15 TRW)	OK ▶ ~~OK~~ ▶	Carry out **step A3** Restore wiring continuity
A3 CHECK CONTINUITY – Check continuity of the cable between the control unit **R22** (pin 8 BECKER - pin 14 TRW) and earth **G381**	OK ▶ ~~OK~~ ▶	Carry out **step A4** Restore wiring continuity
A4 WARNING LIGHT – Check that the warning light is intact in the instrument cluster **C10**	OK ▶ ~~OK~~ ▶	Carry out **step A5** Change the instrument cluster **C10**
A5 CHECK CONTINUITY – Check the continuity of the cables between module **R27** and the control unit **R22**	OK ▶ ~~OK~~ ▶	Carry out **step A6** Restore wiring continuity
A6 CHECK CONTINUITY – Check the continuity of the cables between module **R23** and the control unit **R22**	OK ▶ ~~OK~~ ▶	Carry out **step A7** Restore wiring continuity
A7 CHECK CONTINUITY – Check continuity of the cables between the pretensioners **R28** and **R29** and the control unit **R22**	OK ▶ ~~OK~~ ▶	CONNECT TO THE DIAGNOSIS SOCKET **T3** AND CONTINUE OPERATIONS WITH THE ALFA TESTER OR WITH THE FLASHING CODE (with control unit BECKER only) Restore wiring continuity

SUNROOF (GTV only)

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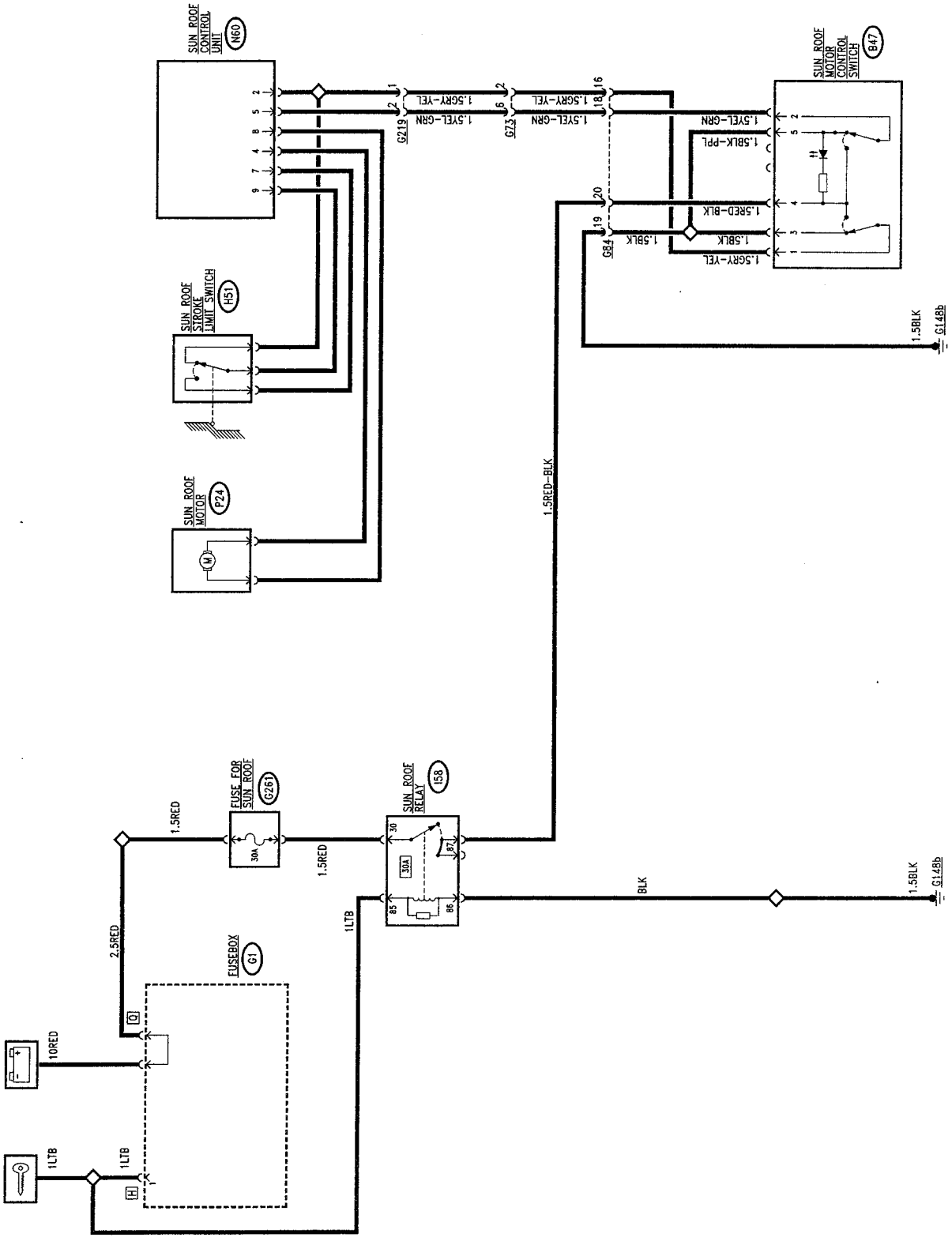
WIRING DIAGRAM



GENERAL DESCRIPTION

The sliding roof offers extra ventilation for the passenger compartment in warm weather and, when necessary, quick air changing, thereby increasing passenger comfort.
The mobile part of the roof comprises a glass pane and an interior sliding blind which is concealed in the roof panel trim.
A double switch, located next to the front ceiling light, operates a motor in two different ways: in the first, the motor raises the panel to the "quarter light" position, in the second, it opens the actual panel (for further details see GROUP 70 - "BODY-SUNROOF").
The whole system is controlled electronically by a control unit which regulates the various functions.
The sunroof can only be operated with the ignition key engaged.

FUNCTIONAL DESCRIPTION

The sunroof opening control system is powered by a special relay **I58**, located near the fusebox **G1**. The line is protected by wander fuse **G261**; system supply only takes place via the key-operated supply at pin 4 of the control switch **B47**, while pin 5 of the latter is connected to earth.

The system is a single functional unit comprising :

– control unit **N60**;

– motor **P24**;

– stroke limit contact **H51**.

The control switch **B47** is located on the tunnel console.

The control unit **N60** receives the operating signals from switch **B47** and controls the motor **P24** accordingly, taking account of any signal leading from the microswitch **H51**.

The system works according to the following logic:

– switch **B47** controls opening/closing of the sunroof: pin 4 of the same switch is supplied at 12 V: the pressing of the pushbutton in one direction controls sunroof opening, closing the contact on pin 2, thereby sending 12 V to pin 5 of the control unit; pressing in the opposite direction controls closing of the sunroof, closing the contact on pin 1, sending 12 V to pin 2 of the control unit;

– Pins 2 and 5 receive the control signals from switch **B47**; pins 9 and 7 are connected with the "zero" microswitch **H51** the contact of which is closed when the sunroof is in the "compass" position and open in all the other positions;

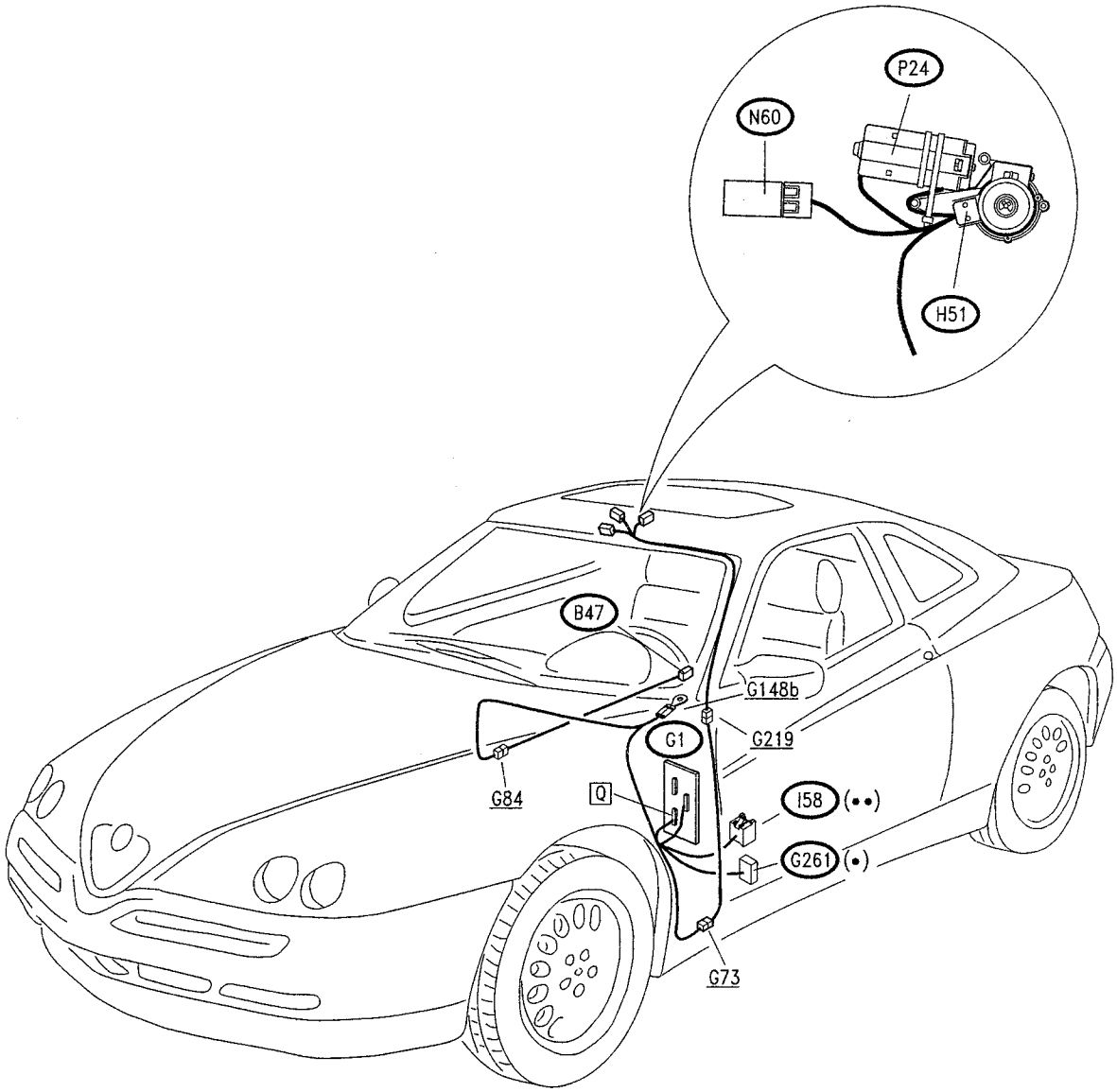
– pins 4 and 8 connect with the motor **P24** operating it in the two directions sending alternately 12 V and earth signals.

FAULTFINDING TABLE

Fault	Component to be checked					
	G261	I58	N60	P24 (1)	B47	H51 (1)
Sunroof fails to operate	•	•	•	•	•	
Sunroof fails to close properly			•			•

(1) N.B.: P24 and H51 are together in a single sunroof control unit N60 which must be changed completely in the event of a failure to a component.

LOCATION OF COMPONENTS



(•) Green fuseholder
(••) Red base

HEATING AND VENTILATION SYSTEM: HEATER

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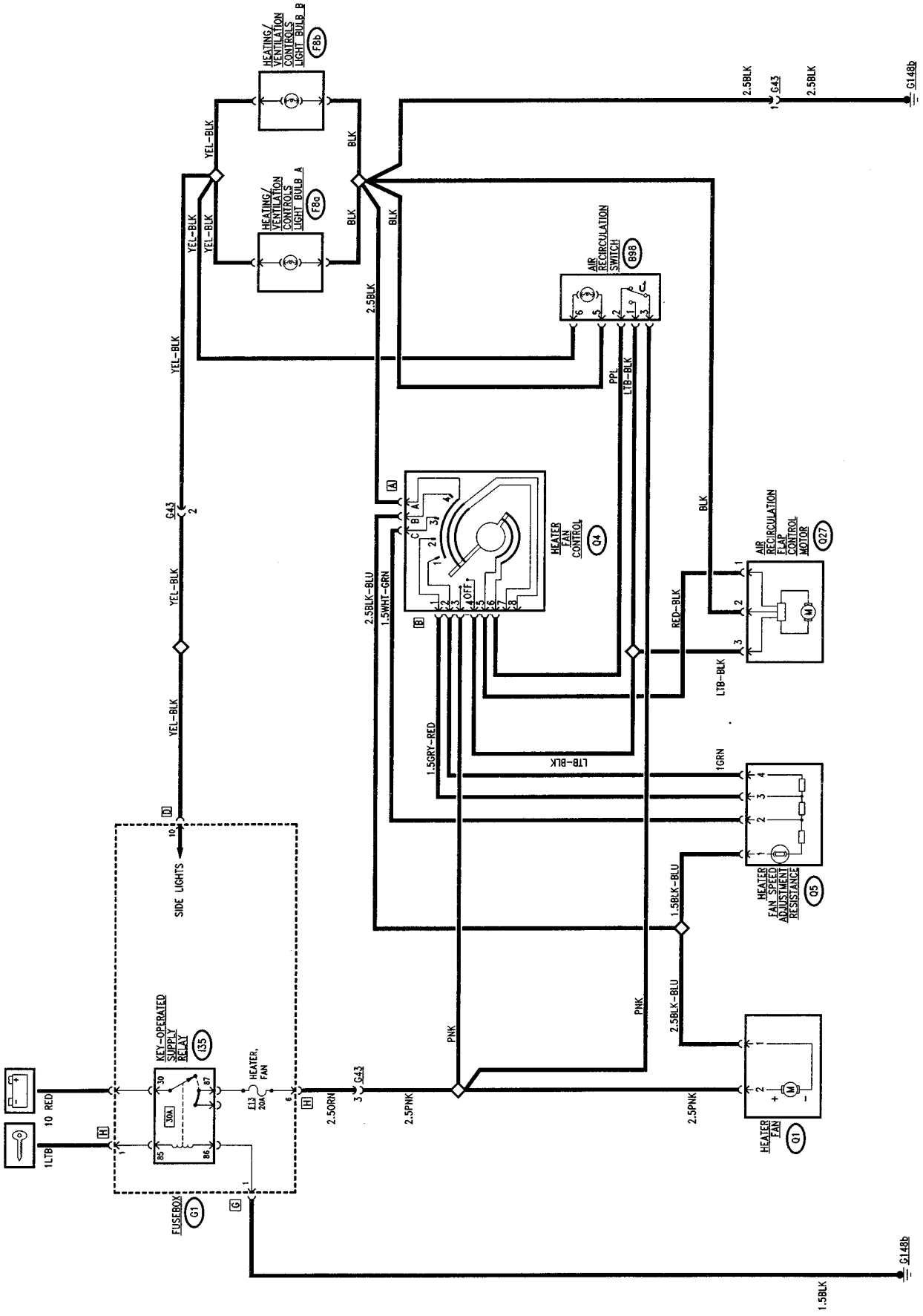
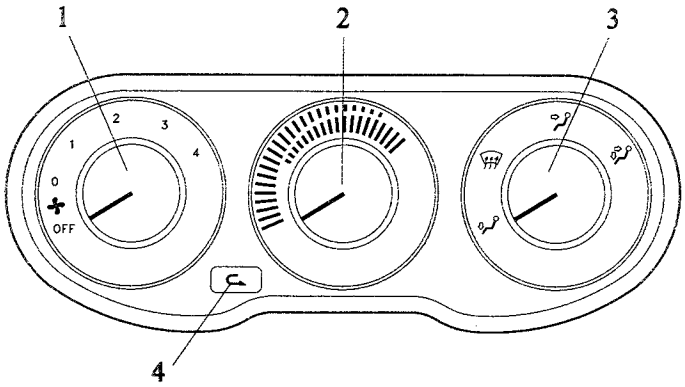
WIRING DIAGRAM



GENERAL DESCRIPTION

Climate control through the heater is controlled by three knobs of the control unit located on the panel: these controls act on the heater- distributor -air flow unit as follows:



- the left-hand knob (1) mechanically operates the ports which adjust the flow of air: @PUNTO = OFF: air inlet shut off
  - 0: inlet of outside air without fan (dynamic air)
  - from 1 to 4: a switch is operated which turns on the fan through a four-speed regulator. The regulator and corresponding resistor are fitted on the air flow unit near the fan.

NOTE:the heater can only be turned on with the ignition key engaged.

- the centre knob (2) - mechanically operates the mixing port between warm air (red) and cold air (blue): when turned completely to the left, it shuts off the radiator closing a special tap.
  NOTE: the radiator comprises a heat exchanger which exploits the engine coolant fluid to warm the air sent to the passenger compartment: in fact it is supplied by a special pipe of the engine cooling circuit.
- the right-hand knob (3) adjusts the distribution of the flow acting, still by a mechanical transmission, on the distribution ports, sending air into the passenger compartment in the directions shown schematically on the ideograms.
- the recirculation function takes place pressing push-button (4) which acts on a motor that moves a flap: this closes the outside air duct, simultaneously opening that of the air recirulating from inside the passenger compartment.

The recirculation function makes it possible to withdraw the air to be treated from inside the passenger compartment, shutting off the flow of outside air which under certain circumstances might be unwanted: bad smells, smoke, unventilated tunnels, etc.

NOTE: remember that the only functions controlled electrically are:

- fan control and speed adjustment;
- operating the "recirculation" function while the others are controlled mechanically.

FUNCTIONAL DESCRIPTION

Fan:

The heating and ventilation fan **Q1** is supplied with battery voltage via the key-operated services relay **I35** - located in fusebox **G1** -; in addition to the relay, the supply line also crosses fuse **F13** of fusebox **G1**.
The fan motor **Q1** is operated with an earth signal from the control knob **Q4**. This signal crosses the speed regulator **Q5**, comprising three resistances in series, the crossing of which determines the four different speeds, depending on the signal from the knob **Q4**: from pin 2 of connector B (1st speed), from pin 1 of connector B (2nd speed), from pin C of connector A (3rd speed) and lastly from pin B of connector A (4th speed) with a direct signal that does not cross the regulator **Q5**.
The regulator **Q5** has a built-in thermal safety fuse which deactivates the circuit if the temperature exceeds 98°C.

Recirculation:

The recirculation function is carried out by operating motor **Q27** according to the following supply logic:

- pin 2 of **Q27** always at earth;
- 12 V at pin 3 of **Q27**: the motor turns engaging the recirculation function;
- 12 V at pin 1 of **Q27**: the motor turns shutting off recirculation;

The function is turned on through switch **B98**, but with switch **Q4** at "0", "1", etc...:

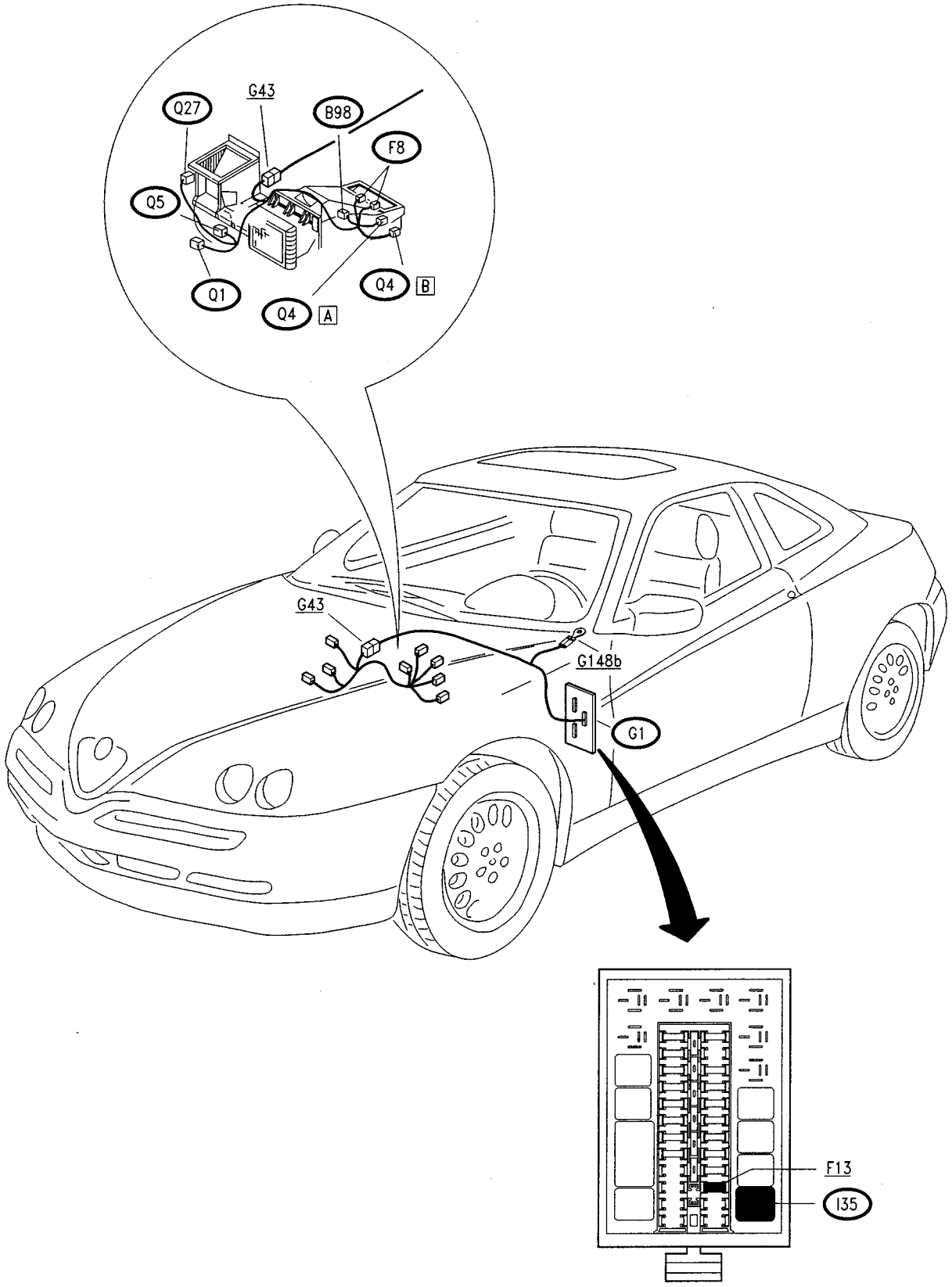
- switch **B98** not pressed: recirculation not engaged;
- switch **B98** pressed: recirculation engaged.

N.B.: With switch **Q4** at "OFF" recirculation is still activated, regardless of the position of switch **B98**

Controls lighting:

Lights **F8a** and **F8b**, inside the control panel together with the leds next to switch **B98** are supplied by the sidelights circuit - connector D of fusebox **G1**.

LOCATION OF COMPONENTS



FAULT-FINDING TABLE

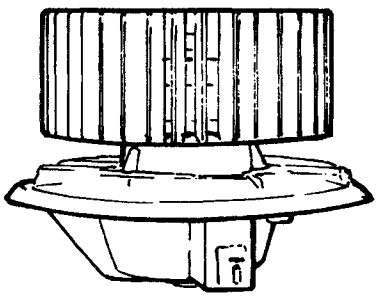
NOTE: air distribution to the passenger compartment and air heating/cooling are controlled mechanically. Therefore for failures such as the lack of heating/ventilation, incorrect air distribution, etc...., see Group 50 "HEATING AND VENTILATION"

Fault	Component to be checked							
	F13	Q1	Q5	Q4	Q27	B98	F8a (1)	F8b (1)
Fan engagement	•	•		•				
Fan engagement at different speeds			•	•				
Recirculation function				•	•	•		
Control panel lighting							•	•

(1) it is possible to change individual bulbs with their bulb holder.

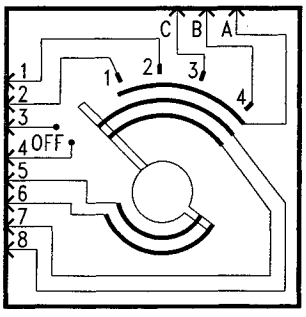
CHECKING COMPONENTS

Heater fan Q1



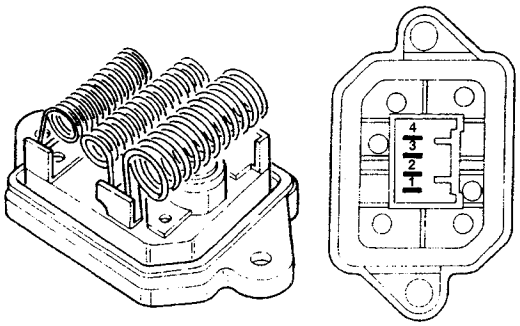
SPECIFICATIONS	
Nominal voltage	12V
Speed at 12V/25°C in free air with impeller and support	3400 $^{+200}_{-100}$ rpm
Power yielded at 12V/25°C at above-mentioned speed	90 W
Motor direction of rotation	leftwards impeller side

Heating/ventilation fan control Q4



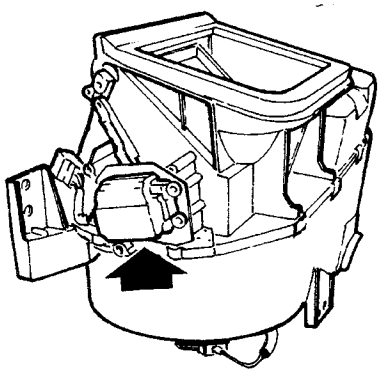
Check the contacts corresponding to the different positions of the knob.

Heating/ventilation fan speed adjustment resistance (Q5)



SPECIFICATIONS		
Piece crossed	Total resistance	Fan speed
4-1 3-1 2-1 none	3.55 Ω 1.35 Ω 0.35 Ω -	1st 2nd 3rd 4th
Thermal fuse cut in temperature		98°C

Recirculation flap control motor (Q27)



SPECIFICATIONS
12 V at pin 1 and 0 V at pin 2 = **counterclockwise** rotation of output shaft
12 V at pin 3 and 0 V at pin 2 = **clockwise** rotation of output shaft

HEATING AND VENTILATION: AIR CONDITIONER

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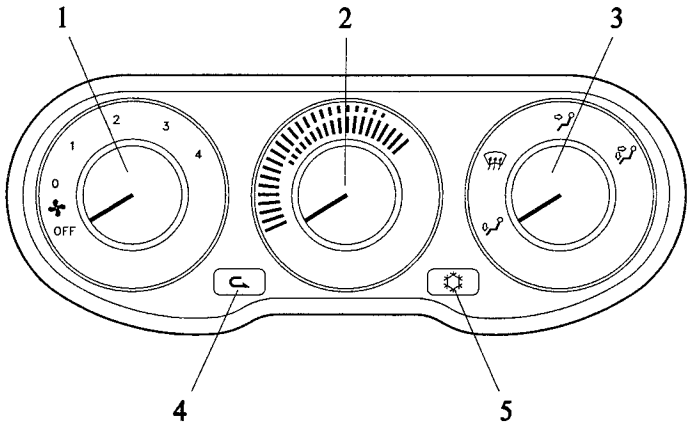
GENERAL DESCRIPTION

The system with manually operated air conditioner integrates the simple though functional heater producing cold and dehumidified air obtained by turning on the compressor and the cooling system.



The control unit located on the dashboard comprises three knobs and two pushbuttons:

- through a flexible drive the left-hand knob (1) mechanically operates the opening of the ports which adjust the flow of air:
  - OFF: air inlet shut off
  - 0: inlet of outside air without fan (dynamic air)
  - from 1 to 4: a switch is operated electronically which turns on the electric fan through a four-speed regulator. The regulator and the corresponding resistor are fitted on the duct near the fan.
    NOTE: the fan may only be turned on with the ignition key engaged.
- the centre knob (2) mechanically operates the mixing port between hot air (red) and cold air (blue); when turned completely to the left it cuts off the radiator closing a special tap.
  NOTE: the radiator comprises a heat exchanger which exploits the engine coolant to release the heat to the air which is sent to the passenger compartment: in fact it is supplied by a special hose of the engine cooling circuit.
- the right-hand knob (3) adjusts the air flow distribution acting mechanically on the distribution ports directing air to the passenger compartment as schematically shown on the ideograms.
- the special pushbutton (4) turns on the "recirculation" function by operating a motor which closes the outside air duct port, simultaneously opening the one for recirculating air from inside the passenger compartment.
  (The recirculation function makes it possible to withdraw the air to be treated from inside the passenger compartment, thereby shutting off the flow of air from outside which under certain circumstances might be unwanted: bad smells, smoke, unventilated tunnels, etc...)
- pushbutton (5) turns on the cooling system which produces cold and dehumidified air.

Air cooling system:

This is a closed loop system in which a fluid condenses and evaporates removing the heat from the air in the evaporator. It mainly comprises:

the **compressor**, operated by the crankshaft through a belt: it is turned on and off through an electromagnetic joint operated by the conditioning system (as described below) and controlled by: the compressor is controlled by the engine electronic management system which adapts the idle speed if the compressor is operated, or prevents it from being turned on under circumstances in which the absorption of power would adversely affect the performance of the vehicle;

NOTE:
For the 3.0 V6 engine **a variable displacement compressor** is used and for the 2.0 T.S. engine one with **variable flow rates**: both these "variable load" configurations make it possible to meet the different needs of cold air without turning the electromagnetic joint on and off continuously: in fact, when the need is high, the compressor will move to the maximum load configuration and vice-versa for minimal requirements.

condenser, fitted in front of the engine coolant radiator: if the car is at a standstill, the air needed for heat exchange is supplied operating the engine radiator fan;

evaporator, exchanger which cools the air, located in the air duct-distributor;

accumulator/drier, which separates the fluid in the liquid state from the gas and also acts as a storage tank and filter for any foreign particles;

expansion valve, which suitably lowers the fluid pressure and temperature, quickening the passage from liquid to vapour;

three-level presure switch (trinary): which controls the safety and correct operation of the fluid circuit:

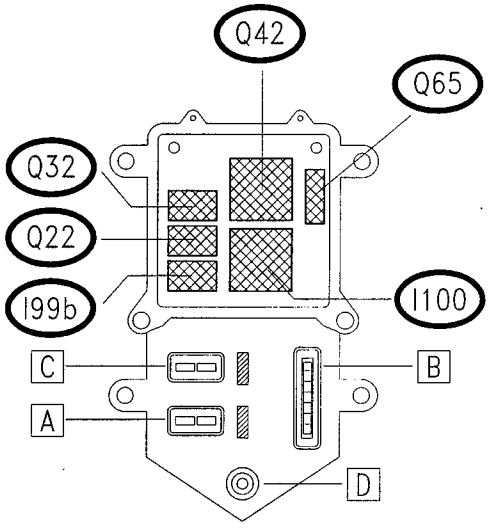
- it turns on the radiator fan when necessary (eg. if the car is at a standstill) thereby preventing an increase of pressure at the condenser (cut in at appr. 15 bar);
- it stops the compressor, de-energizing the electromagnetic joint, if the pressure reaches very high, thus dangerous, values (above appr. 28 bar), or very low values to ensure correct operating conditions (below appr. 2.45 bar);

minimum pressure switch (defroster) - 2.0 T.S. 16v engine only - : this disconnects the compressor when the pressure is too low (<1.8 bar) to prevent the danger of the evaporator "frosting". It also protects the compressor from sharp pressure falls, caused for example by leaks in the circuit.

N.B.: For the 2.0 T.S. 16v engine - from chassis no. 6023907 - a **4-level pressure switch is used**, which engages the fan at two different speeds

The 4 levels cut in at:

- level 1 = minimum pressure for compressor engagement.
- level 2 = pressure requiring engagement of the 1st speed of the fans.
- level 3 = pressure requiring engagement of the second speed of the fans (level not present in previous 3-level pressure switches).
- level 4 = maximum pressure for compressor engagement.



Engine fan control

When the car is travelling at low speed the cooling action of the dynamic air on the condenser is reduced and it is necessary to turn on the two fans which cool the engine radiator and the actual condenser. This is done by the trinary pressure switch which cuts in preventing an increase of the pressure at the condenser (over 15.2 bar) or 4-level (about 15 and 20 bar).

• 3.0 V6 and 2.0 T.S. with MOTRONIC M2.10.3

The engine fans are firstly turned on at first speed, then through a timer they gradually pass to second speed avoiding sudden actuations and overloads at the relay contacts.

The delay device works according to the following logic:

- The first speed is turned on with a signal from the pressure switch on the cooling fluid circuit: after appr. 8-12 seconds, if this signal persists, the delaying device operates the second speed.
- When the signal from the pressure switch ceases, the second speed is turned off immediately and the delaying device operates the first speed for appr. 1 second more.

• 2.0 TS 16v with MOTRONIC M210.4

The injection/ignition control unit directly manages engagement of the fans at the two different speeds.

Fuses and relays:

• 3.0 VS and 2.0 TS 16v only up to chassis no.6023906

There is a box (**Q41**) in the engine compartment at the passenger's side which contains the relays and fuses associated with the air conditioning system:

- cooling fan delaying device (**Q42**);
- compressor electromagnetic joint relay (**Q22**);
- additional compressor relay (**Q32**);
- 1st fan speed relay (**I99b**);
- 2nd fan speed relay (**I100**);
- floating 7.5A fuse (**Q65**);

There are also wander fuses for supplying the engine fan - 30A (**Q39**) and 50A (**G254**) - , and - for the 2.0 T.S. 16v engine - the 15A fuse (**Q40**) for supplying the set of fuses and relays (**Q41**); they are to be found next to the fuses and relays of the electronic ignition/injection system, and the floating fuse for supplying the heating and cooling fan **G255** (30A), to be found on the bracket next to the fusebox.

• 2.0 TS 16v from chassis no. 6023907

The fuses and relays are grouped in the engine compartment, next to those of the ignition/injection unit:

- relay **Q22**;
- relay **Q32**;
- 50A fuse: **G254**

or under the dashboard on the bracket next to the fusebox:

- relay **I99**;
- relay **I100**;

30A fuse: **G255**.

For further details concerning this system, refer to Group 50 "HEATING AND VENTILATION".

FAN AND RECIRCULATION CONTROL

Fan:

The heater and ventilation fan **Q1** is through relay **Q15** and the line leading from fuse **G255**; the relay is energized with the "key-engaged" signal with the line that crosses the key- operated services relay **I35** and fuse **F13** of fusebox **G1.**

The motor of fan **Q1** is operated with an earth signal leading from the control knob **Q4**. This signal crosses the speed regulator **Q5**, which is formed of three resistances in series and which determine the four different speeds depending on the signal from knob **Q4**: from pin 2 of connector B (1st speed), from pin 1 of connector B (2nd speed), from pin C of connector A (3rd speed) and lastly from pin B of connector A (4th speed) with a direct signal that does not cross the regulator **Q5**.

NOTE : the regulator **Q5** has a built-in thermometric safety switch which de-activates the circuit if a temperature of 90±5°C is exceeded due to excess voltage (it closes again when the temperature falls by appr. 10°C).

First fan speed with the compressor operating:

With control **Q4** in the "0" position the fan **Q1** is stopped but it is is operated at first speed if the compressor is turned on: in this case a special relay **Q69** controls the fan supply at first speed. In fact, this switch is energized by the same signal (12V) that turns the compressor on (from switch **Q68** through pins 7 and 8 of connector B of knob **Q4**) and sends a signal to the regulator **Q5** in correspondence of the 1st speed.

Recirculation:

The recirculation function is achieved by actuating motor **Q27**, according to the following supply logic:

- pin 2 of **Q27** always earthed;
- 12 V at pin 3 of **Q27**: the motor turns operating recirculation;
- 12 V at pin 1 of **Q27**: the motor turns shutting off recirculation.

Turning on takes place through switch **Q68** but with switch **Q4** on "0", "1", etc...:

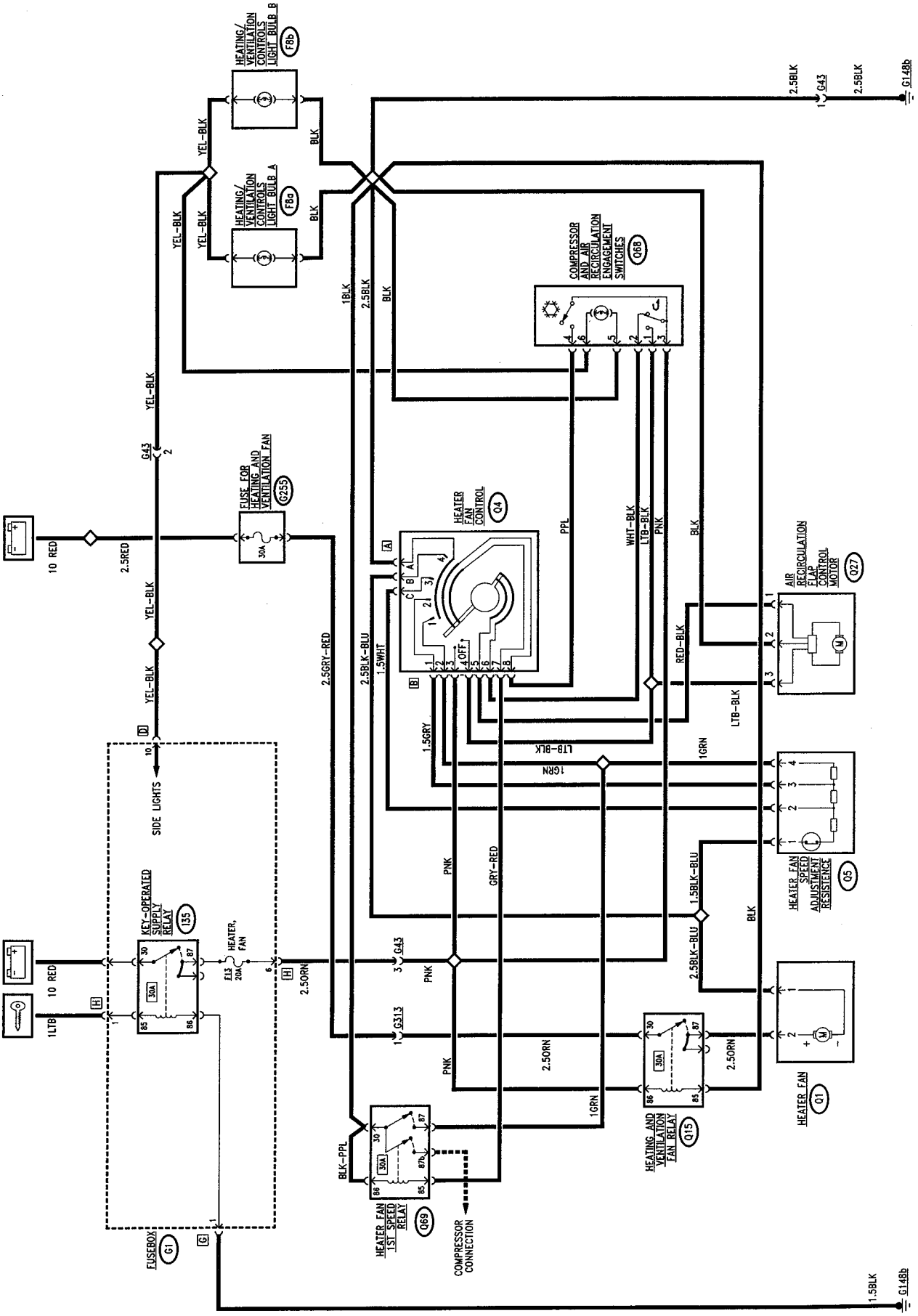
- switch **Q68** not pressed: recirculation not turned on;
- switch **Q68** pressed: recirculation turned on.

N.B.: With switch **Q4** at "OFF" recirculation is operational regardless of the position of switch **Q68**.

Controls lighting:

Lights **F8a** and **F8b**, located inside the control panel, together with the led next to switch **Q68** are supplied by the side lights circuit - connector D of fusebox **G1**.

Wiring diagram



COMPRESSOR CONNECTION

(for 3.0 V6 and 2.0 TS 16v engine - up to chassis no.6023906)

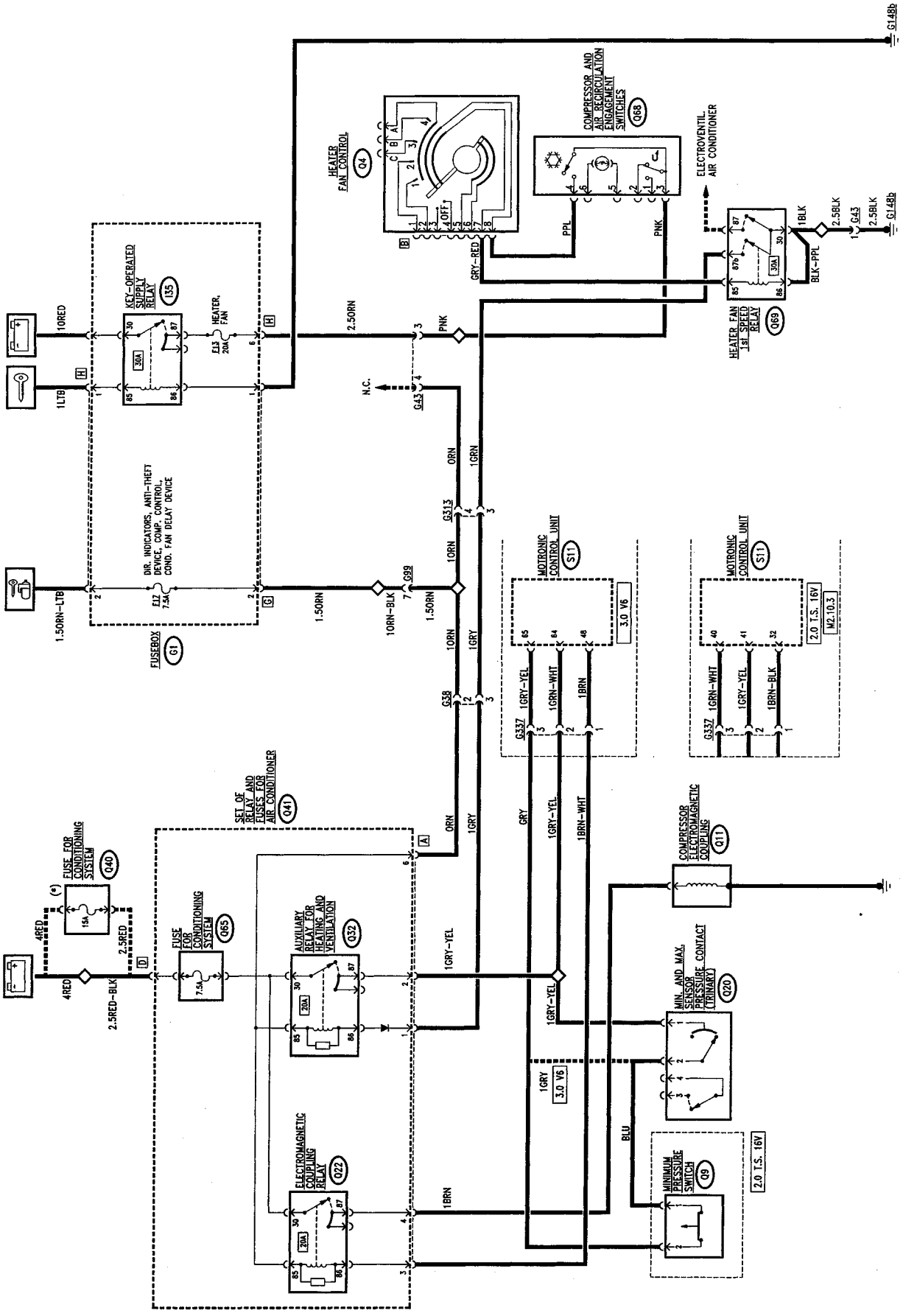
The electromagnetic joint which operates the compressor **Q11** is controlled by relays **Q22 and Q32**, to be found in the set of relays and fuses **Q41**.

Relays **Q22** and **Q32**, have the coil supplied from the ignition switch (line protected by fuse **F17** of **G1**); their power line is supplied by battery voltage through fuse **Q65** (7.5A), also located in group **Q41** for the 2.0 T.S. 16v from chassis no.___ also through fuse **Q40** (15A).

Relay **Q22** is energized and consequently supplies 12V to the electromagnetic joint **Q11**, according to the following logic:

- Relay **Q32** is energized by an earth signal leading from relay **Q69**, which is in turn energized with a positive signal leading from the compressor operating switch **Q68**; this signal crosses the control knob **Q4** which interrupts it when the knob itself is in the "OFF" position: in fact, in this condition, the compressor cannot be turned on. It should be remembered that the same signal controls the first speed of the fan contemporaneously ("Fan and Recirculation Control").
- consequently, relay **Q32** sends two signals to the Motronic control unit **S11**: a direct signal as "request" to turn on the compressor pin 41 for the 2.0 T.S. 16v engine and pin 64 for the 3.0 V& engine - and a second signal which crosses the minimum pressure switch (antifrost) **Q9** (only for the 2.0 T.S. 16v engine) and the minimum and maximum pressure switch (trinary) **Q20** which intervene if the pressure in the cooling system is too high or too low: in this case the signal does not reach the control unit - pin 40 for the 2.0 T.S. 16v engine and pin 65 for the 3.0 V6 engine - and the control unit does not command the turning on of the compressor
- the control unit "refers" the command signal - pin 32 of **S11** - for the 2.0 T.S. 16v engine and pin 48 for the 3.0 V6 engine - to relay **Q22** which is energized and supplies joint **Q11** which turns on the compressor, but only when the internal logic has ascertained determinate conditions (for example the compressor does not turn on in the event of the engine requiring full power, etc...)

Wiring diagram
(for 3.0 V6 and 2.0 TS 16v engine - up to chassis no.6023906)



(*) for 2.0 T.S. 16v from chassis no.____

COMPRESSOR ENGAGEMENT

(for 2.0 T.S. 16v engine - from chassis no. 6023907)

The electromagnetic joint that operates the compressor **Q11** is controlled by relays **Q22** and **Q32** located next to he relays and fuses of the injection/ignition unit.

The coil of relays **Q22** and **Q32** receive the key-operated supply (line protected by fuse **F17** of **G1**); their power line is supplied by battery voltage.

Relay **Q22** is energised and therefore supplies 12V current to the electromagnetic joint **Q11**, according to the following logic managed by the M2.10.4 injection-ignition control unit, which is connected with the air conditioning system through:

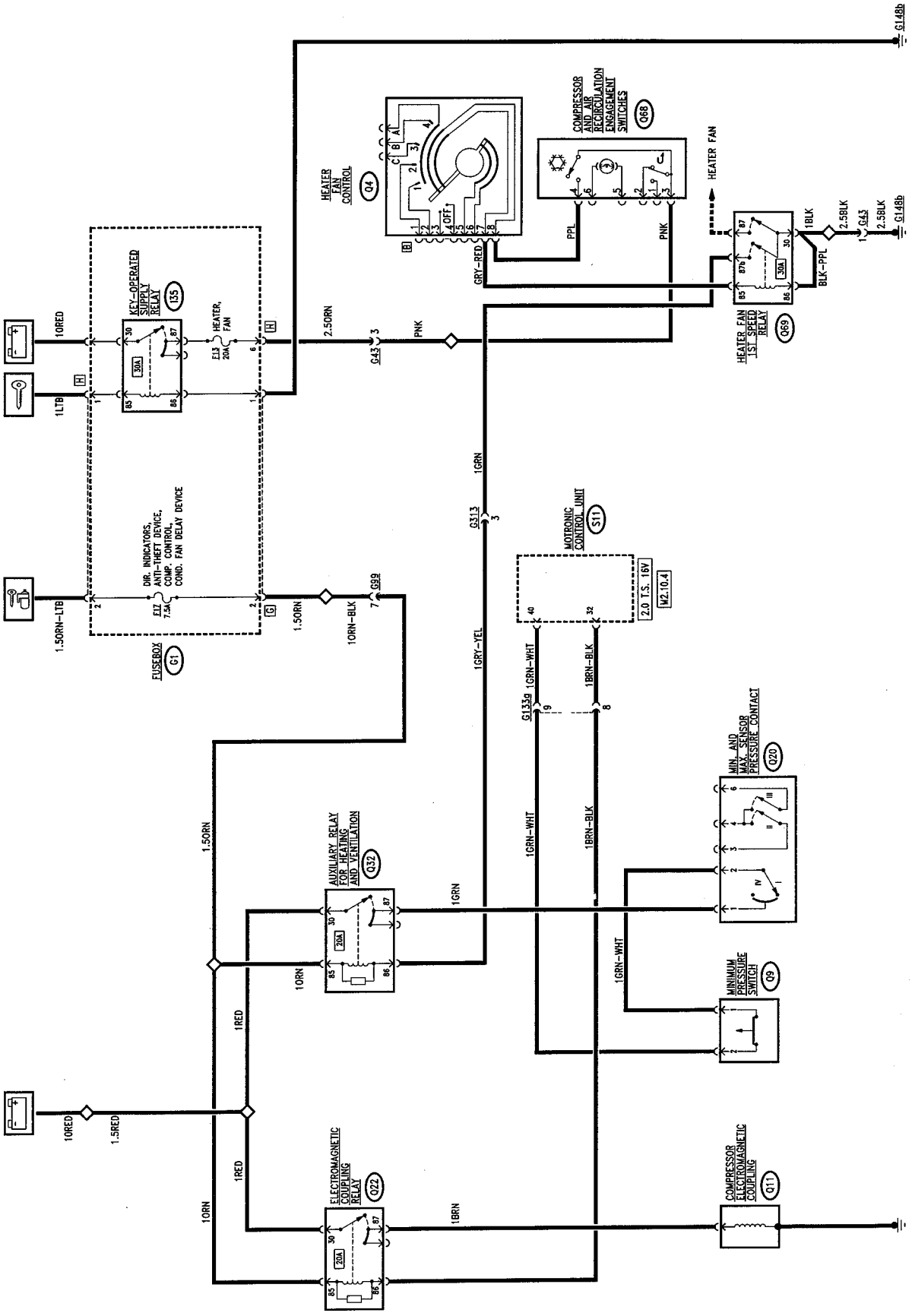
- pin 40 which receives the signal requesting engagement of the system itself from the the conditioner circuit;
- pin 32 from which a "low" (earth) signal leads which commands relay **Q22** for engaging the air conditioner compressor **Q11**.

A special logic enables this engagement, as follows:

- it adapts idle speed to compensate the increased absorbed power resulting from engagement of the compressor;
- in the event of the need for high power at the engine (high throttle opening speed), full load or high engine temperature, it momentarily disengages the compressor.

Relay **Q32** is energised by an earth signal leading from relay **Q69** which is in turn energised by a positive signal leading from the compressor engagement switch **Q68**; this signal crosses the control knob **Q4** which interrupts it when the knob is at "OFF"; in fact, in this position, the compressor cannot be engaged. The same signal simultaneously controls compressor engagement at 1st speed ("Fan and Recirculation Control"); relay **Q32** sends a signal to the Motronic control unit **S11**: to "request compressor engagement" - pin 40 - which crosses the minimum pressure switch (antifrost) **Q9** and pressure switch **Q20** which cut in if the pressure of the cooling system is too high or too low: in the case the signal does not reach he control unit which does not engage the compressor.

Wiring diagram
(2.0 TS 16v engine - from chassis no.6023907)



ENGINE COOLING FANS CONTROL

3.0 V6 Engine

Two fans **P2a** and **P2b** warrant the necessary ventilation of the cooling air for the engine and air conditioning system condenser.

N.B.: the two fans are set in parallel and they are always operated together, following the same logic.

The two fans are always supplied by battery voltage: the first one (**P2a**) has the line protected by floating fuse **G254**; the second one (**P2b**) is protected by floating fuse **Q39** (30A); they are therefore operated by an earth signal: this signal arrives directly (2nd speed) or through the additional resistances **O22** and **022b** (1st speed) fitted with a thermal safety fuse.

The delaying device **Q42**, in group **Q41**, controls the gradual turning on of the fans which are operated at two different speeds also via two relays **I99b** and **I100**, also part of group **Q41**.

The delaying device works according to the following logic:

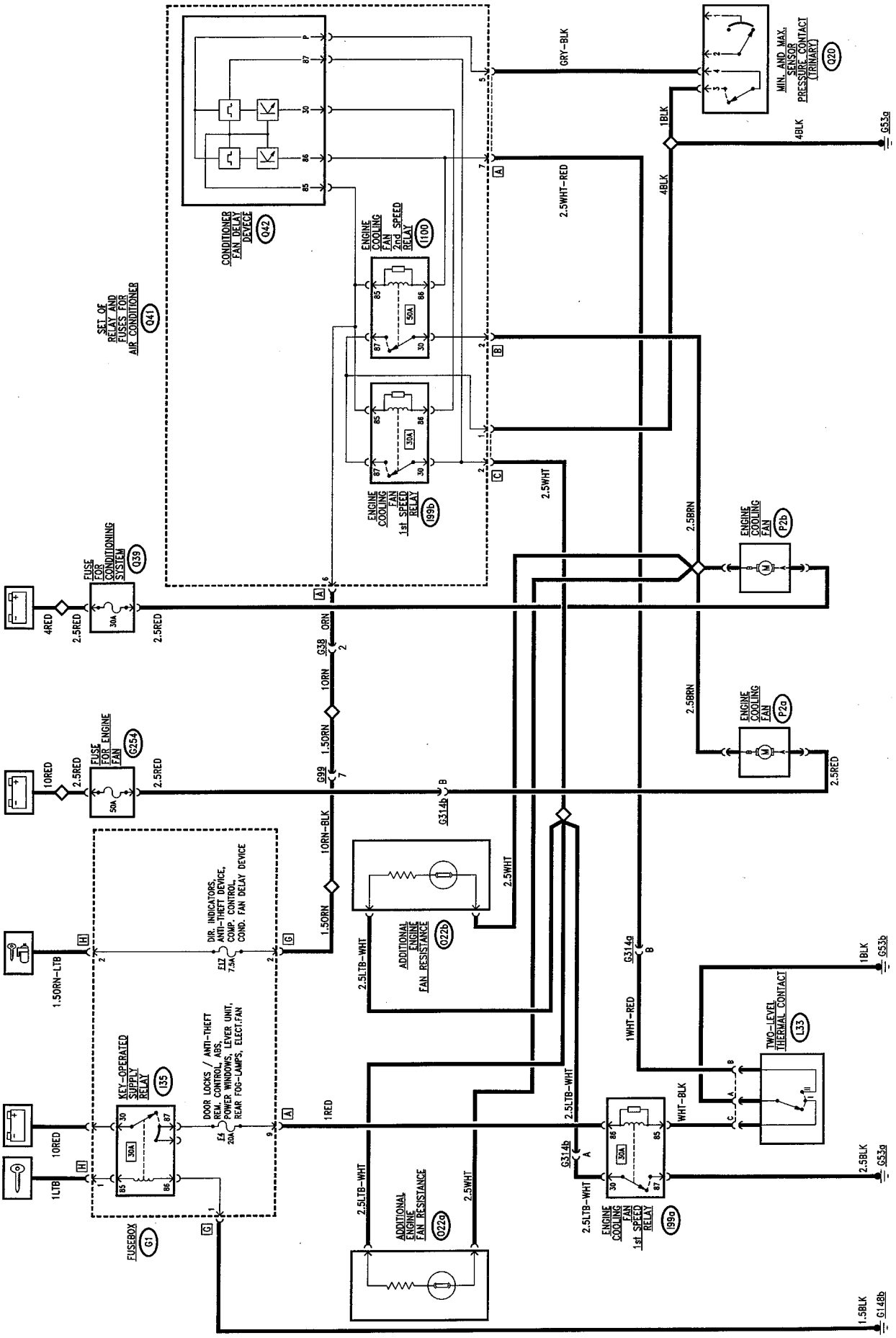
The "key-operated" voltage (line protected by fuse **F17** of **G1**) supplies the coil and electronic devices of the delaying device **Q42** -pin 85, and relays **I99b** and **I100**; the coil of delaying device **Q42** is energized by an earth signal -pin P- which leads from the trinary pressure switch **Q20**: this causes an earth signal to be sent immediately - pin 30 - to energize relay **I99b** which sends the earth to the two engine cooling fans **P2a e P2b** through the additional resistances **O22a** and **022b**: 1st speed.

After appr. 8-12 seconds, if the signal from the trinary persists, the delaying device operates the second speed: in fact, the earth signal from pin 30 is cut off and another signal leaves pin 86 which goes to energize relay **I100** which sends the earth signal directly to the two engine cooling fans **P2a e P2b:** 2nd speed. When the signal from the pressure switch ceases the fans turn off.

The two fans are operated at the two different speeds also by the two-level thermal contact **L33** which controls the temperature of the coolant in the engine radiator: when a first level is reached, relay **I99a** is energized, which is located on the bracket next to fusebox **G1** - which sends the earth signal to the two engine cooling fans **P2a** and **P2b** through resistances **O22a** and **022b**: 1st speed. Relay **I99a** receives the "key-operated" supply from the line protected by fuse **F4** of **G1**.

If the second temperature level is reached, relay **I100** is energized, which is located in group **Q41**, and this sends the earth signal directly to the two engine cooling fans **P2a and P2b**: 2nd speed.

Wiring diagram (3.0 V6 engine)



ENGINE COOLING FAN/S CONTROL

2.0 T.S. 16v engine (up to chassis no. 6023906)

Only one fan **P2** provides ventilation for cooling the engine radiator and air conditioner condenser:

This fan **P2** is supplied by battery current up to chassis no.___ via fuse **Q39** (30A) and from chassis no.__ by fuse **G254** (50A), and it is controlled by an earth signal in the same way as described for the 3.0 V6 engine, with the exception of the fact that there is only one additional resistance **O22** for operating 1st speed.

2.0 T.S. 16v engine (from chassis no. 6023907)

Two fans **P2a** and **P2b** provide the necessary ventilation of the air for cooling the engine radiator and the conditioner system condenser.

N.B.: the two fans are in parallel and are therefore always operated together, always following the same logic:

The two fans are always supplied by battery current via the line protected by wander fuse **G254**; they are operated by an earth command signal: this signal arrives directly (2nd speed) or through the additional resistances **O22a** and **O22b** (1st speed), fitted with a safety thermal fuse.

The M2.10.4 injection - ignition control unit handles the control of the engine coolant and air conditioning system fluid fans.

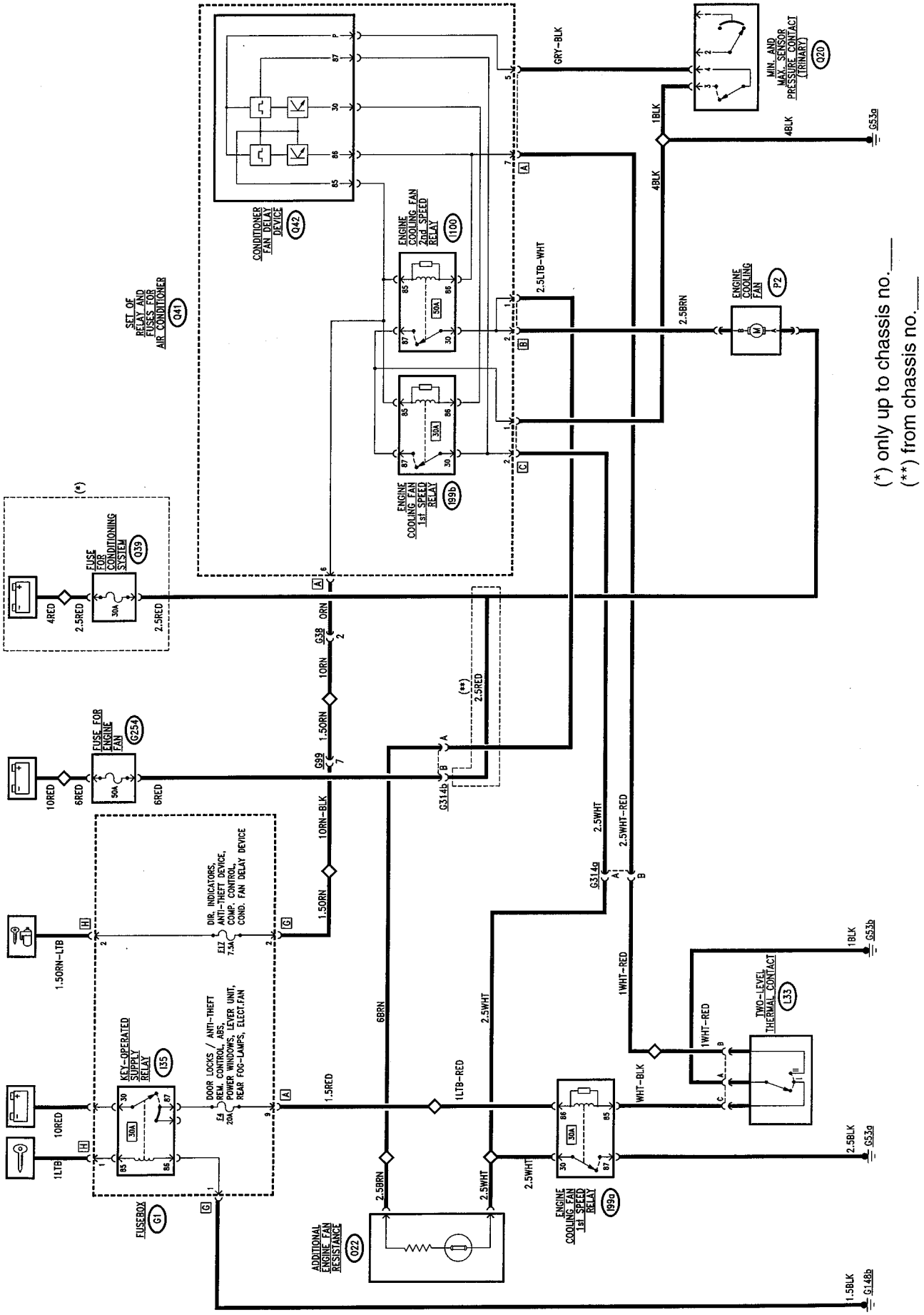
This way the thermal contact usually located on the radiator has been eliminated. The two speeds of the fans are operated depending on the engine temperature, which is detected by the special sensor: a low "earth" signal leaves pin 26 which commands the 1st speed relay I99, and a "low" (earth) signal leaves pin 25 which commands the 2nd speed relay **I100**.

Akso pressure switch **Q20** sends special signals to the control unit for engaging the fans if the pressure of the coolant fluid in the circuit exceeds determinate values:

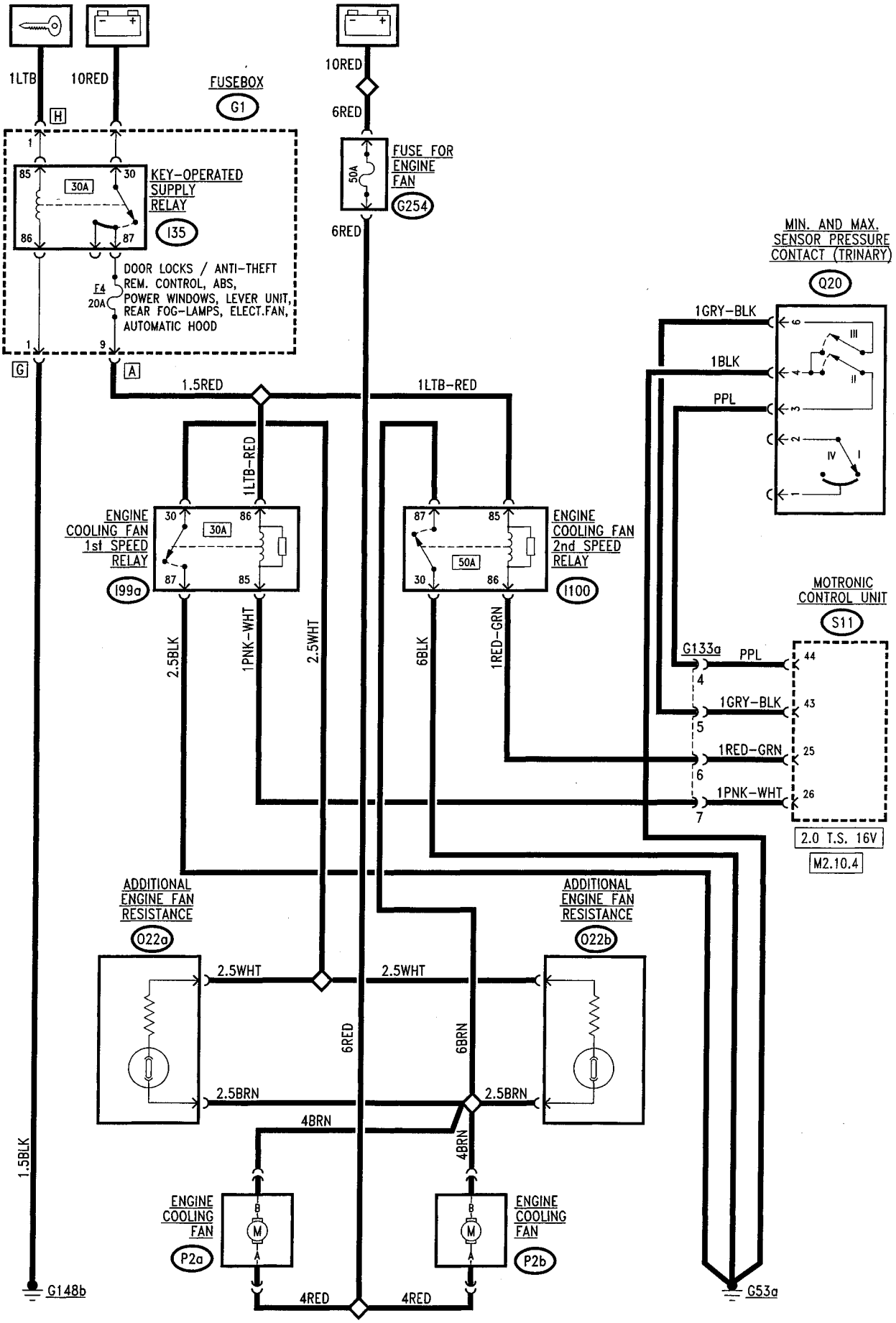
- over 15 bar appr. the signal is sent to pin 44 for engaging 1st speed;
- over 20 bar appr. to pin 43 for 2nd speed.

The "key-operated" voltage (line protected by fus **F4** of **G1**) supplies the coil of relays **I99** and **I100**; which are operated by the above-mentioned earth signals.

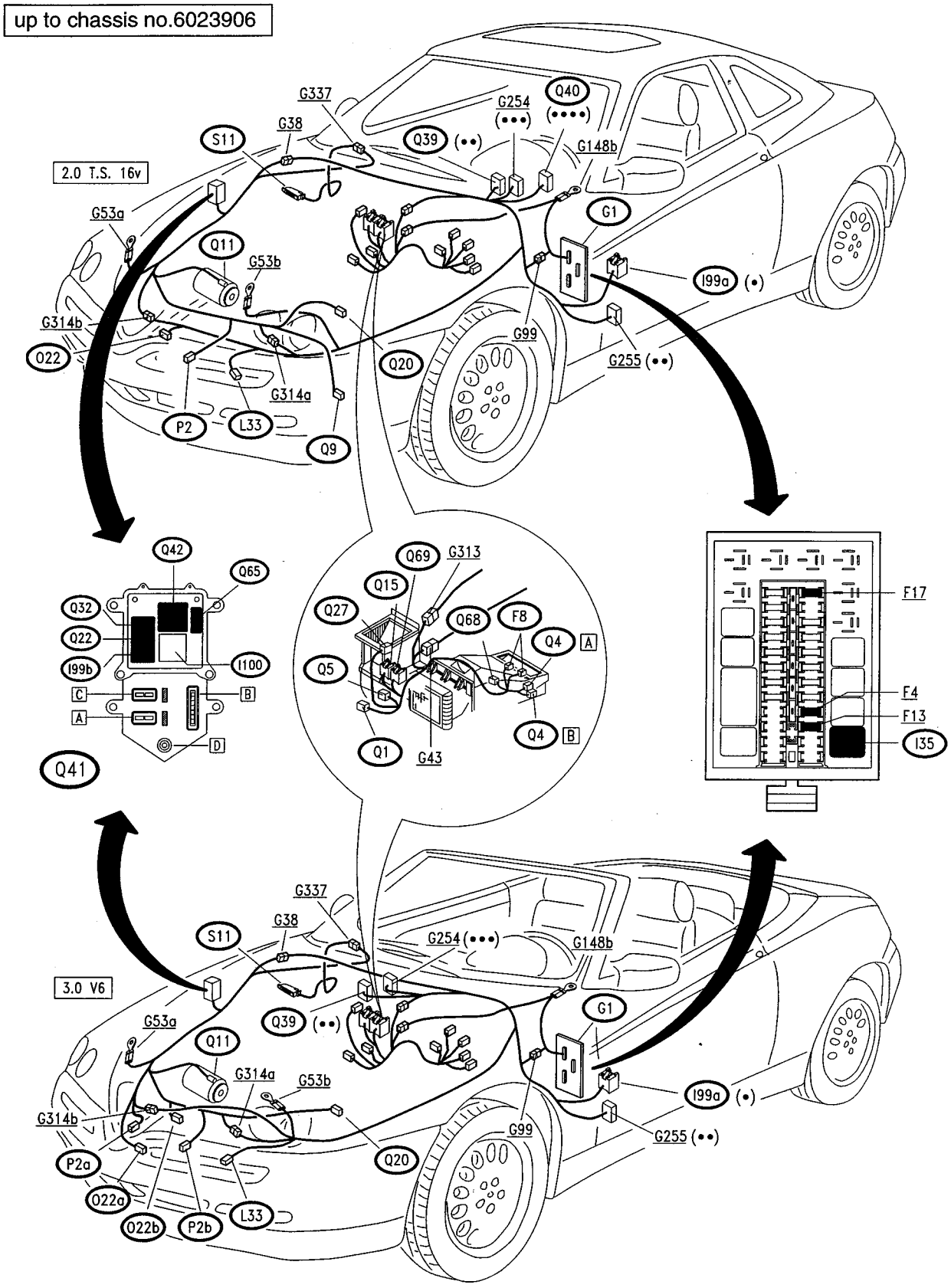
Wiring diagram (2.0 T.S. 16v engine - up to chassis no.6023906)



Wiring diagram (2.0 T.S. 16v engine - from chassis no.6023907)



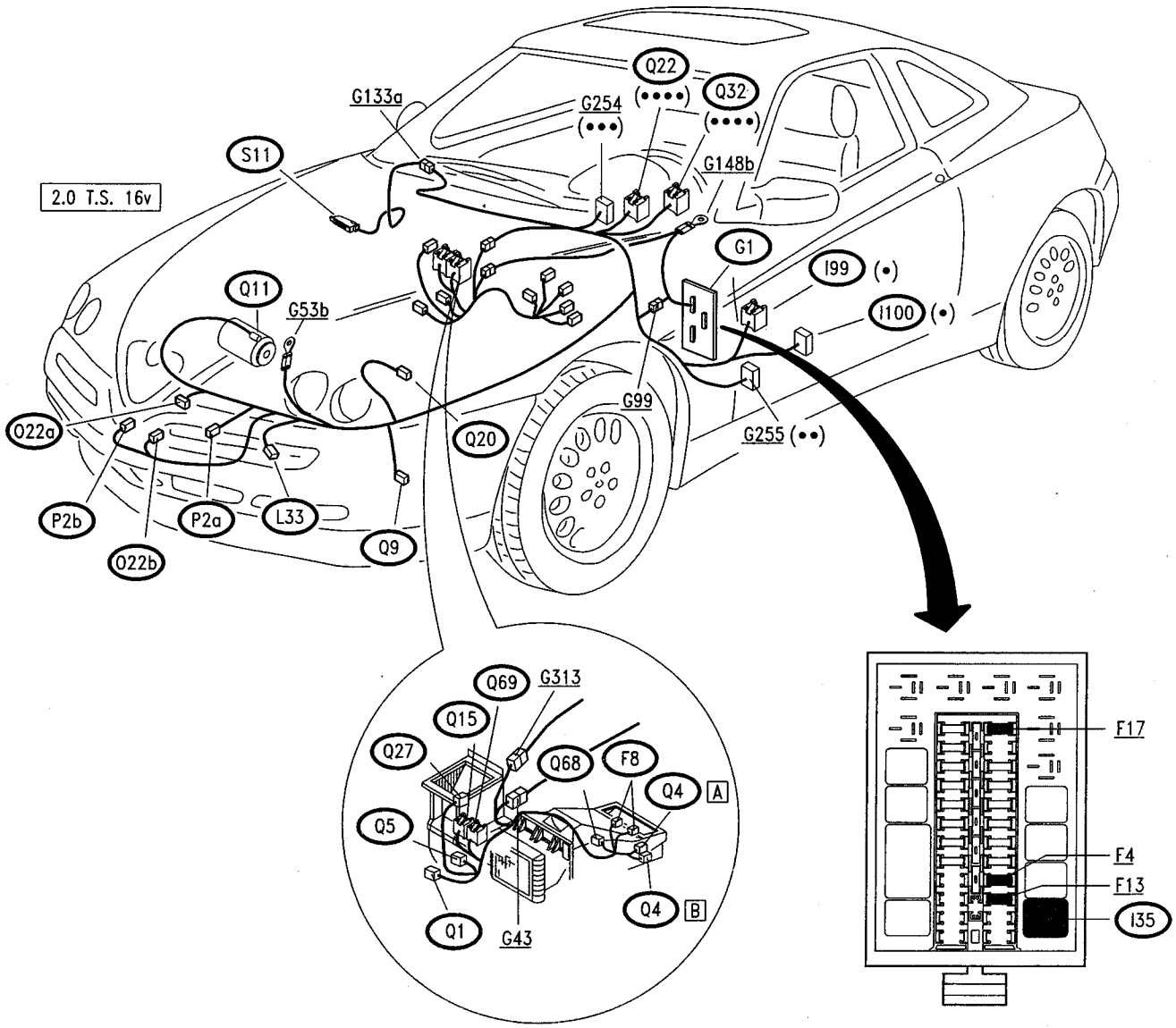
LOCATION OF COMPONENTS



(•) Yellow base
(••) Green fuseholder
(•••) Black fuse holder
(••••) Blue fuseholder

LOCATION OF COMPONENTS

from chassis no.6023907



(•) Yellow base
(••) Green fuseholder
(•••) Black fuseholder
(••••) Grey fuseholder

FAULT-FINDING TABLE

NOTE:
In order to make it easier to understand, the fault-finding table for the air conditioner has been subdivided into three sections which refer to the three functions also described separately in the wiring diagrams:

– **Heating, ventilation and recirculation**

– **Compressor control**

– **Engine fan/s control**

Heating, ventilation and recirculation fan

Fault	Component to be checked										
	F13	G255	Q1	Q15	Q5	Q4	Q27	Q68	F8a (1)	F8b (1)	Q69
Fan cutting in	•	•	•	•							
Fan cutting in at diffferent speed					•	•					
Fan cutting in at 1st speed with the compressor on						•		•			•
Recirculation function						•	•	•			
Heating & ventilation control panel lighting									•	•	

(1) It is possible to change the single bulbs with bulb holders

Compressor control

Fault	Component to be checked												
	Q40 (*)	Q65 (*)	F17	F13	Q11	Q20	Q9	Q22	Q32	Q69	Q4	Q68	S11
Compressor cutting in (in all circumstances)	•	•	•	•	•			•	•	•	•	•	•
Compressor cutting in (only in certain circumstances) **(•)**						•	•						•

(*) Only for 2.0 T.S. 16v up to chassis no.6023906.

(•) You are reminded that the compressor is cut out by the system logic under the following conditions:
– coolant fluid pressure > 28 bar appr.;

– coolant fluid pressure < 2.5 bar appr. (circuit drained);

– coolant temperature > 160°C (only for 2.0 T.S. 16v engine);
This is also determined by the logic of the ignition/injection control unit (see the corresponding sections).

Engine cooling fan/s control

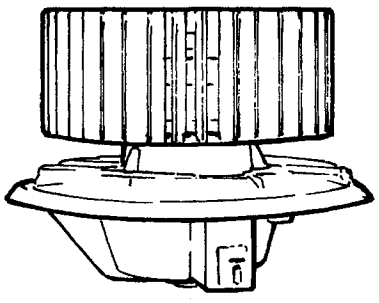
Fault	Component to be checked												
	Q39	G254	F17	P2	P2a/b	O22	022a/b	L33 (*)	S11 (**)	Q20	Q42	I99a	I100
Fan/s cutting in (in all circumstances)	•	•		•									
Fan/s cutting in at two different speeds (only one speed working)			•			•					•	•	•
Fan/s cutting in due to high engine temp. (at two speeds)								•	•				
Fan cutting in due to high coolant fluid pressure (at two speeds)										•			

(*) 2.0 TS 16v engine, up to chassis n°6023906

(**) 3.0 V6 engine from chassis no.6023907

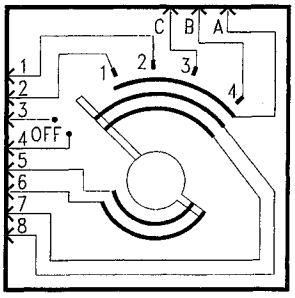
CHECKING COMPONENTS

Heating and ventilation fan (Q1)



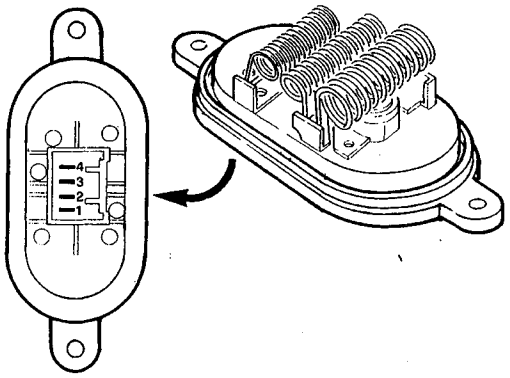
SPECIFICATIONS	
Nominal voltage	12V
Speed at 12V/25°C in free air with impeller and support	3400 $^{+200}_{-100}$ rpm
Power output at 12V/25°C at the above speed	90 W
Direction of motor rotation	leftwards impeller side

Heating and ventilation fan control (Q4)



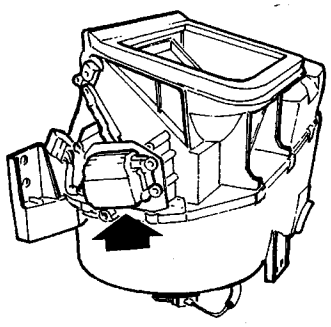
Check the contacts corresponding to the different positions of the knob.

Heating & ventilation fan speed adjustment coil (Q5)



SPECIFICATIONS		
Section crossed	Total resistance	fan speed
4-1 3-1 2-1 none	2.9 Ω 0.8 Ω 0.3 Ω -	1st 2nd 3rd 4th
Thermal contact cut-in temperature		90 ± 5°C

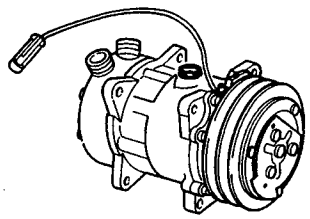
Recirculation port control motor (Q27)



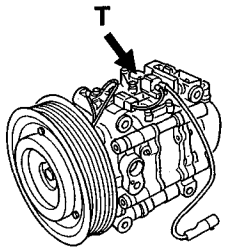
SPECIFICATIONS
12 V at pin 1 and 0 V at pin 2 = **counter-clockwise** rotation of output shaft
12 V at pin 3 and 0 V at pin 2 = **clockwise** rotation of output shaft

Compressor electromagnetic joint (Q11)

3.0 V6



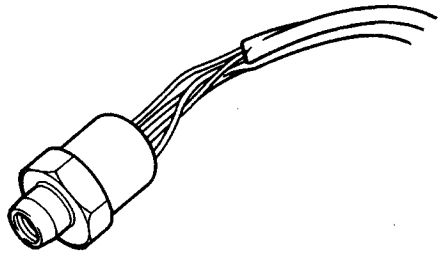
2.0 T.S. 16v



SPECIFICATIONS	
Supply voltage	12 V
absorbed current	4 A (3.0 V6) 2.2 A (2.0 T.S. 16v)
Compressor cutout thermal contact (only 2.0 T.S. 16v) (T)	
contact opens	> 160°C
contact closes	< 140°C

Minimum and maximum pressure switch (trinary) (Q20)

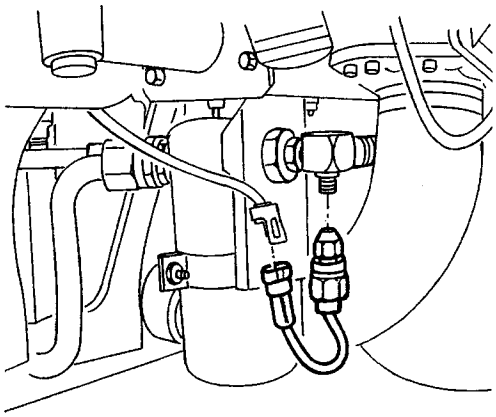
(2.0 TS 16v engine up to chassis no.6023906)



SPECIFICATIONS	
1. level:	
contact opens	2.45 ± 0.25 bar
contact closes	2.85 ± 0.50 bar
2. level:	
contact closes	15.2 ± 0.98 bar
contact opens	11.28 ± 1.99 bar
3. level:	
contact opens	$28\ ^{+2}_{-3}$ bar
contact closes	$22\ ^{+4}_{-5}$ bar

Minimum pressure switch (antifrost) (Q9)

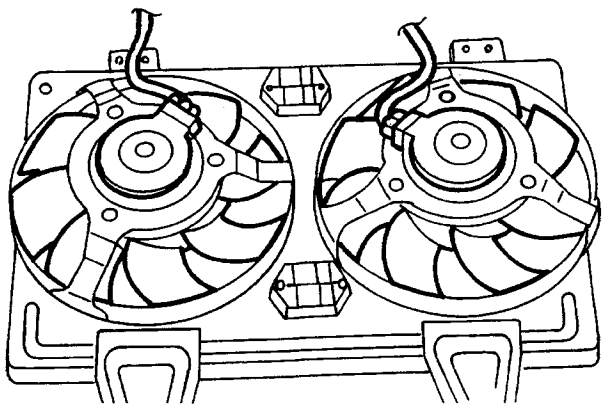
(for 2.0 T.S. 16v engine only)



SPECIFICATIONS	
Contact opening pressure	1.8 ± 0.07 bar
Contact closing pressure	3 ± 3.5 bar

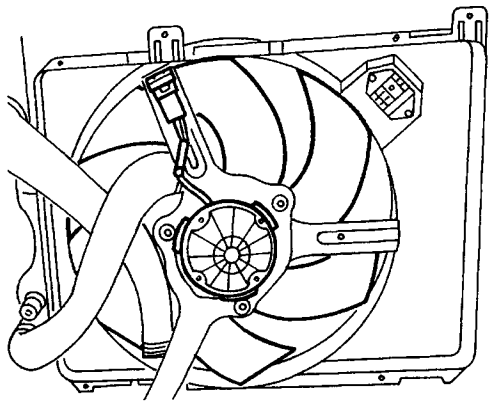
Cooling fan (P2a) (P2b)

(3.0 V6 and 2.0 TS 16v from chassis no.6023907)



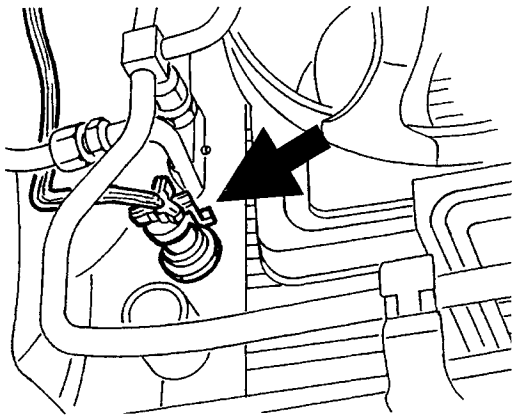
SPECIFICATIONS	
Nominal voltage	12V
Max. current absorption	26A
Speed at 12V in free air with duct	3600 ± 150 rpm (minimum)
Motor direction of rotation (shown on duct)	rightwards (impeller side)

Cooling fan (P2)
(2.0 T.S. 16v up to chassis no.6023906)



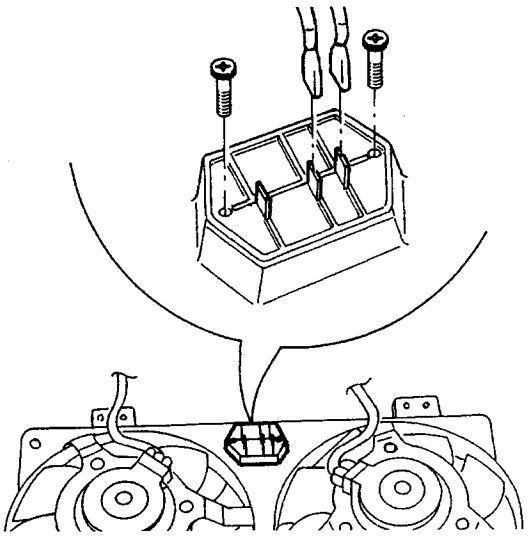
SPECIFICATIONS	
Nominal voltage	12V
Max. current absorption	25A
Speed at 12V in free air with duct	2350 ± 150 rpm (minimum)
Motor direction of rotation (shown on duct)	rightwards (impeller side)

Two-level thermal contact (L33)
(2.0 TS 16v up to chassis no.6023906)



SPECIFICATIONS	
1. level:	
contact closes	92 ± 2 °C
contact opens	87 ± 2 °C
2. level:	
contact closes	97 ± 2 °C
contact opens	92 ± 2 °C

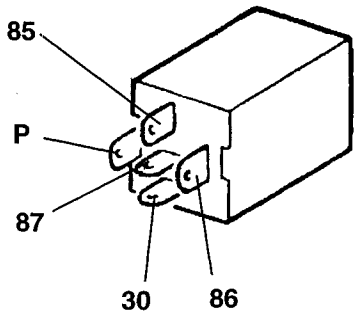
Engine fan resistance (O22)

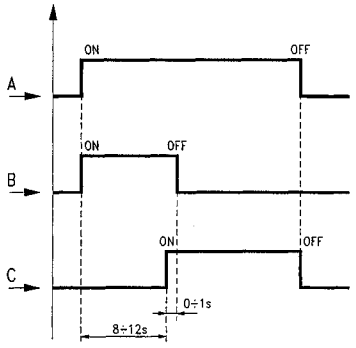


SPECIFICATIONS	
resistance	0.18 ± 10%Ω
thermal fuse cut in	126 °C

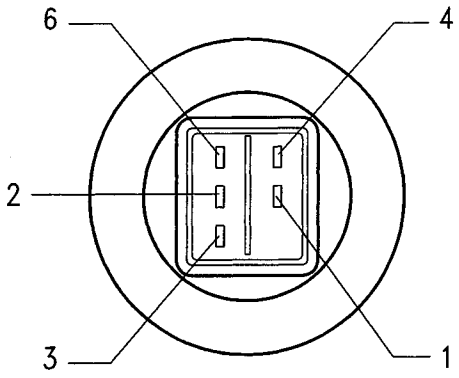
Engine fan delaying device (Q42)

(3.0 V6 and 2.0 TS 16v up to chassis no.6023906)



SPECIFICATIONS
A = pin P: earth signal B = output pin 30: 1st speed C = output pin 86: 2nd speed  Operating diagram

4-level pressure switch (2.0 TS 16v from chassis no. 6023907)



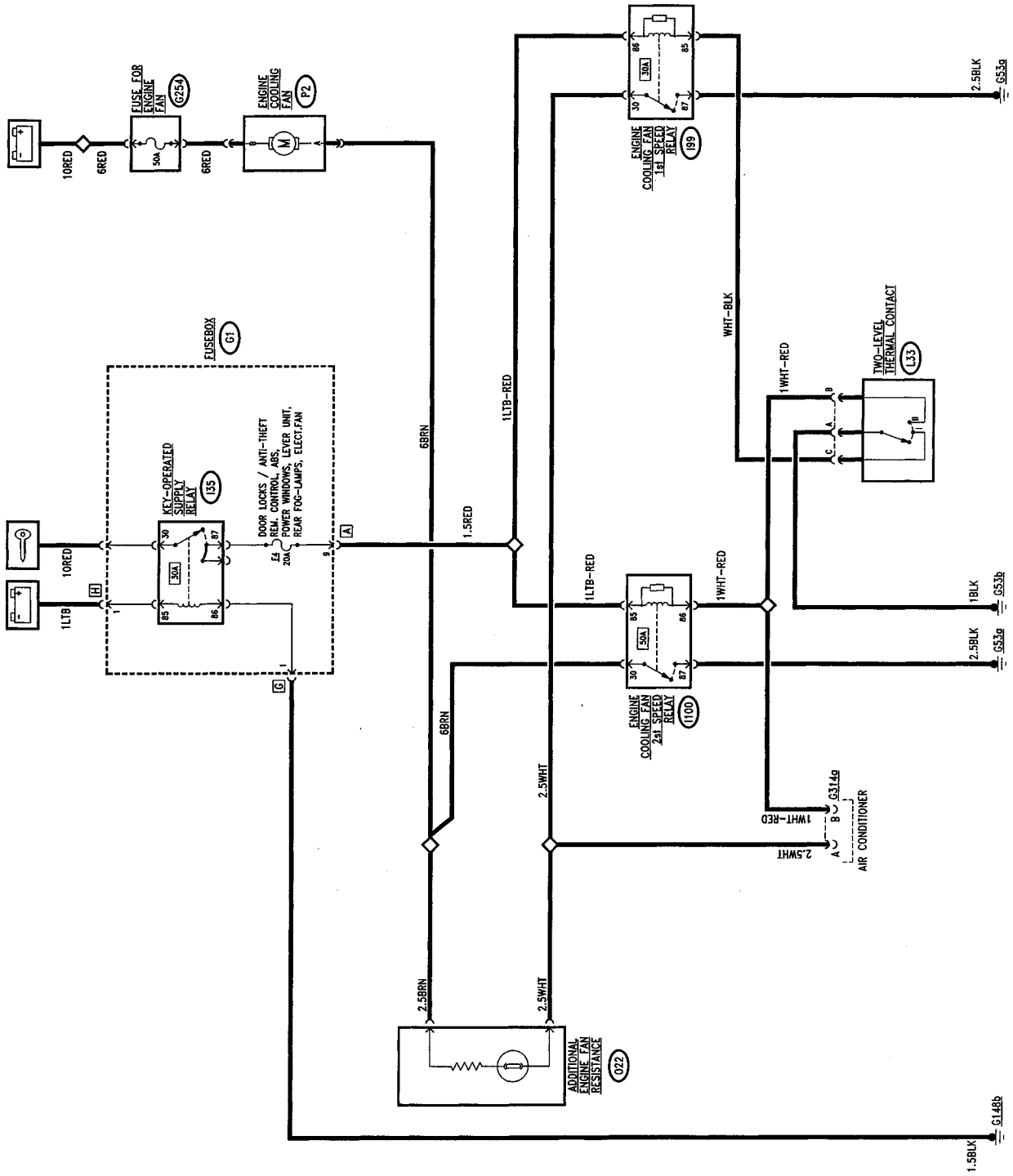
SPECIFICATIONS	
1st level: contact opens contact closes	 2.45 ± 0.35 bar max 3.5 bar
2nd level: contact closes contact opens	 15 ± 1 bar 11 ± 2 bar
3rd level: contact closes contact opens	 20 ± 1.2 bar 16 ± 2.2 bar
4th level: contact opens contact closes	 28 ± 2 bar 22 ± 4 bar

pin 1 and 2 *1st and 4th level*
pin 3 *2nd level*
pin 4 *earth*
pin 5 *N.C.*
pin6 *3rd level*

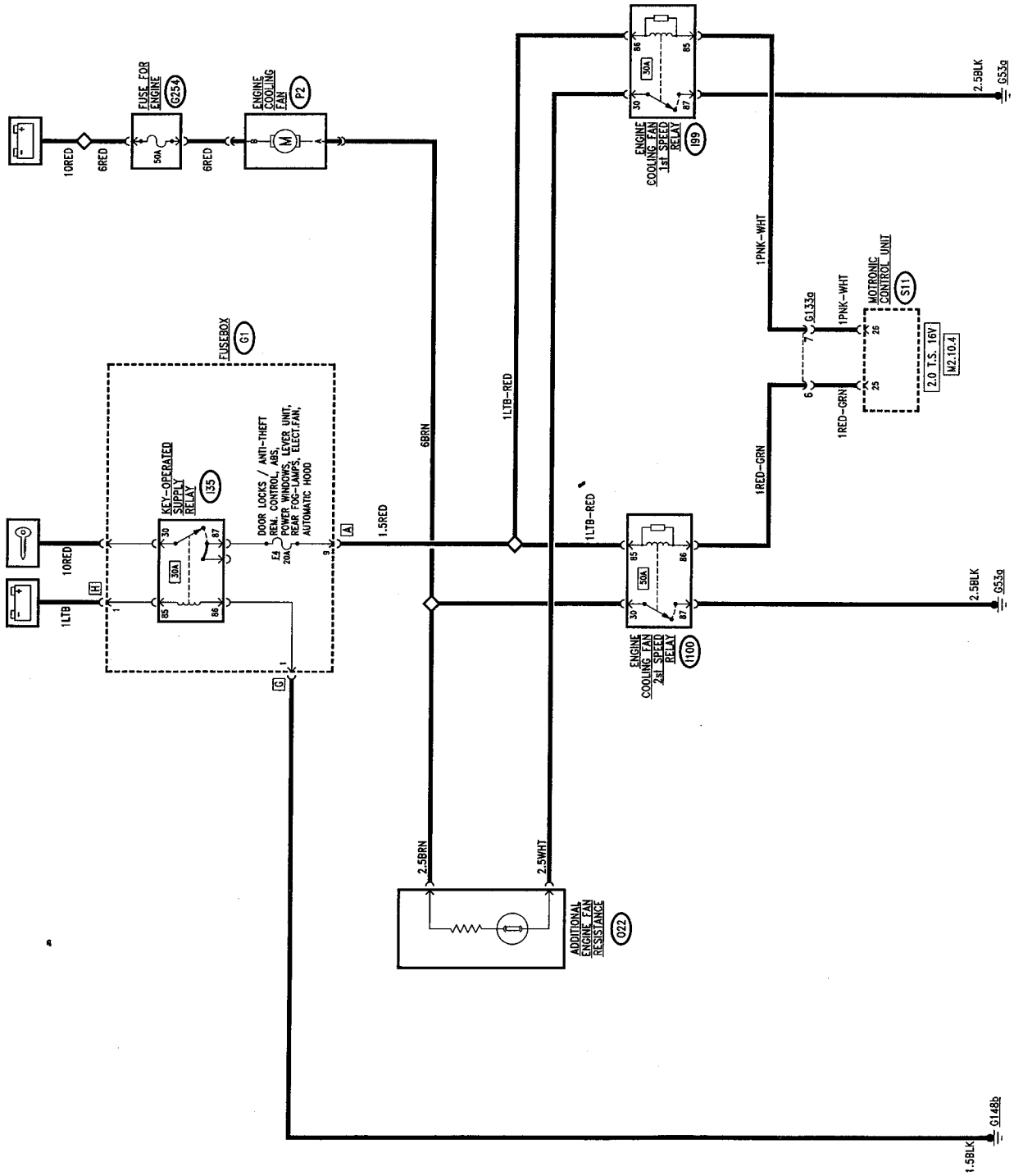
ENGINE COOLING
(versions with heater)

INDEX

WIRING DIAGRAM (3.0 V6 and 2.0 TS 16v up to chassis no.6023906)



WIRING DIAGRAM (2.0 TS 16v from chassis no.6023907)



GENERAL DESCRIPTION

A fan helps the radiator to disperse the heat of the engine coolant, due to a thermometric switch that detects when the coolant temperature is too high and turns on the fan at two different speeds: the first one is operated at a first level of temperature of the coolant; the second is operated at a higher temperature.
N.B. This wiring diagram only refers to cars with heater: for cars fitted with air conditioner, see the "engine cooling fan/s control" electric circuit shown in the "Air Conditioner" section.

N.B: The fan is operated by relays suppled from the ignition block: therefore **the fan will not turn on if the ignition switch is not in the MARCIA position**.

FUNCTIONAL DESCRIPTION

The fan **P2** is supplied directly with battery voltage via a special fuse **G254** (50A), and is actuated through an earth at the opposite terminal: if this earth leads directly from relay **I100** the 2nd speed is activated; when it leads from relay **I99** and crosses the additional resistance **O22**, the 1st speed is activated.

In fact, the fan operates at two different speeds, due to an additional resistance: the first speed is engaged at the first temperature level of the coolant detected by the thermal contact; the second speed cuts in at higher temperature (second level). The additional resistance is protected internally by a thermal fuse that cuts off the electric circuit if the temperature exceeds 126°C appr.

3.0 V6 and 2.0 TS 16v engine, up to chassis no.6023906

The signal from the 1st level (87-92°C) of the two-level thermal contact **L33** energizes relay **I99** - supplied from the ignition switch by the line of relay **I35** and fuse **F4** of **G1** - thereby sending an earth signal to the additional resistance **O22** and from this to the fan, which is operated at the 1st speed.

Conversely, if the coolant fluid reaches the 2nd level (92 - 97°C) of thermal contact **L33**, the earth signal energizes the coil of relay **I100** - supplied from the ignition block via relay **I105** directly operating the fan **P2** at 2nd speed.

NOTE: the diagram also shows the connections with the air conditioning system, which utilises part of this circuit as illustrated in the "Air Conditioner" section.

2.0 TS 16v engine, from chassis no.6023907

The M2.10.4 injection - ignition control unit also handles the control of the engine coolant and air conditioning system fluid fans.
This way the thermal contact **L33** located on the radiator has been eliminated.

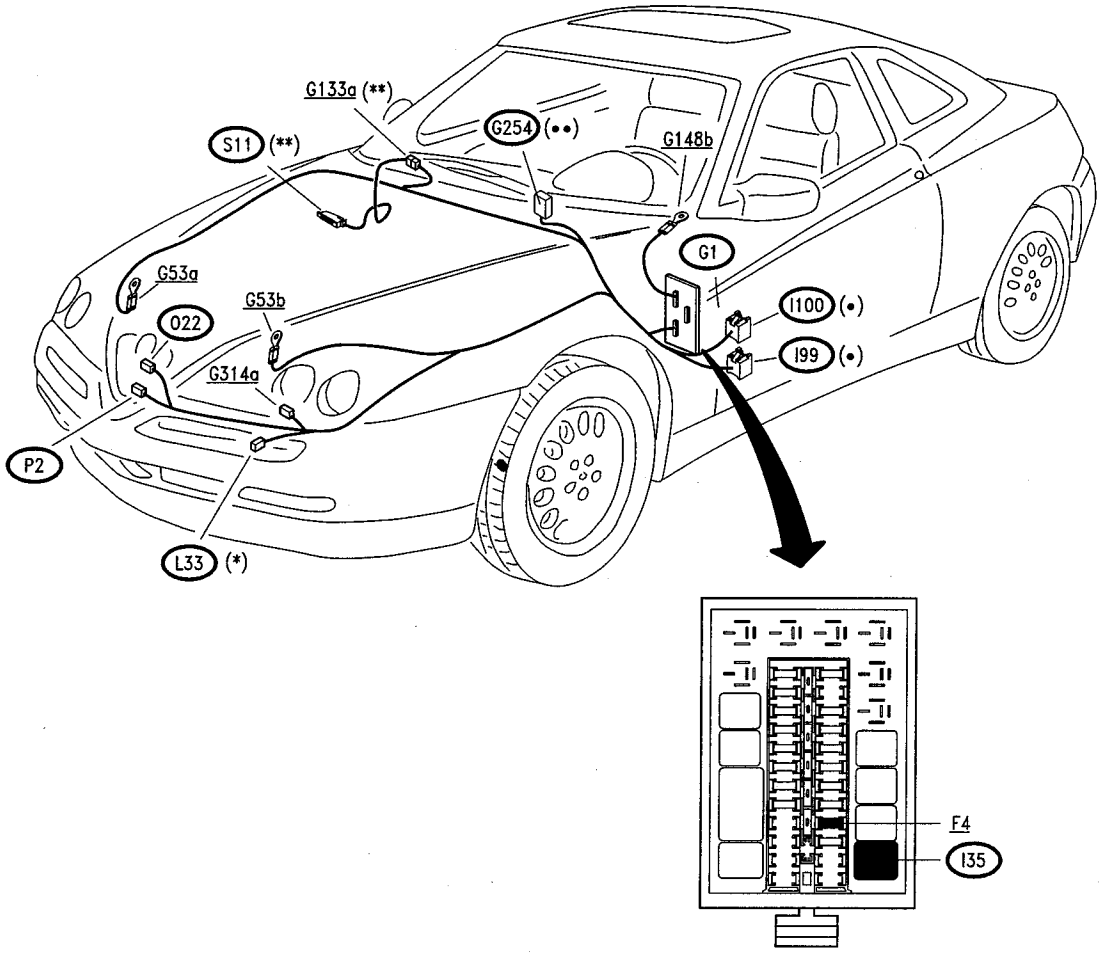
The two speeds of the fans are operated depending on the engine temperature, which is detected by control unit **S11** through the special sensor: a low "earth" signal leaves pin 26 which commands the 1st speed relay **I99**, and a "low" (earth) signal leaves pin 25 which commands the 2nd speed relay **I100**.

FAULT-FINDING TABLE

Fault	Component to be checked							
	F4	G254	P2	L33 (*)	S11 (**)	O22	I99	I100
Fan (at all times)	•	•	•					
Fan (fails to start though the fluid temperature is high)				•	•	•		•
Fan, at 2 different speeds				•	•	•	•	•

(*) 2.0 TS 16v engine: up to chassis no.6023906
(**) 2.0 TS 16v engine: from chassis no.6023907

LOCATION OF COMPONENTS

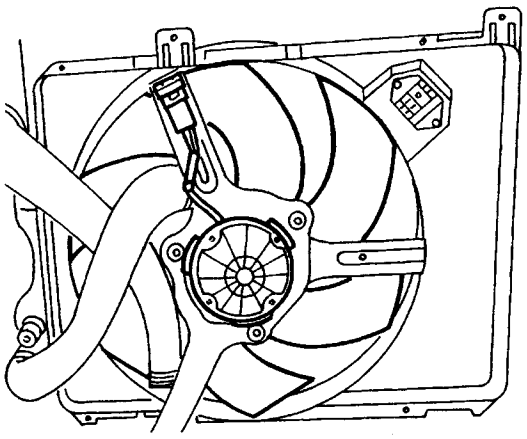


(*) 2.0 TS 16v engine - up to chassis no.6023906
(**) 2.0 TS 16v engine - from chassis no.6023907

(•) Yellow base
(••) Black fuseholder

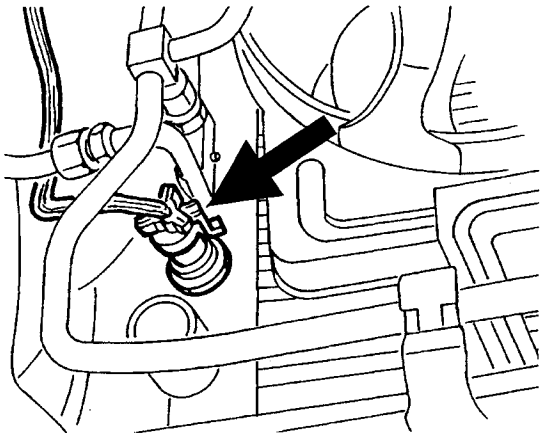
CHECKING COMPONENTS

Cooling fan (P2)



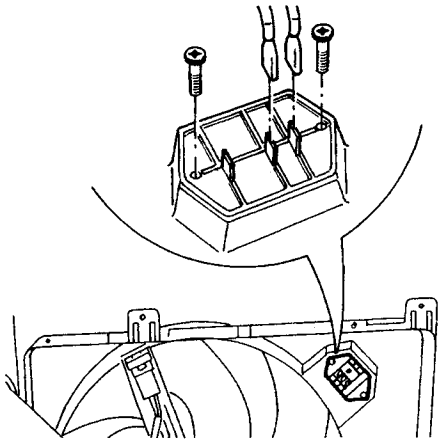
SPECIFICATIONS	
Nominal voltage	12V
Max. current absorption	25A
Speed at 12V in free air in duct	2350 ± 150 rpm (minimum)
Direction of rotation of motor (indicated on duct)	rightwards (impeller side)

Fan two-level thermal contact (L33)



SPECIFICATIONS	
1st level: contact closes contact opens	 92 ± 2°C 87 ± 2°C
2nd level: contact closes contact opens	 97 ± 2°C 92 ± 2°C

Fan resistance (O22)



SPECIFICATIONS	
resistance	0.18 ± 10% Ω
thermal fuse cut in	126 °C

ALFA ROMEO CODE

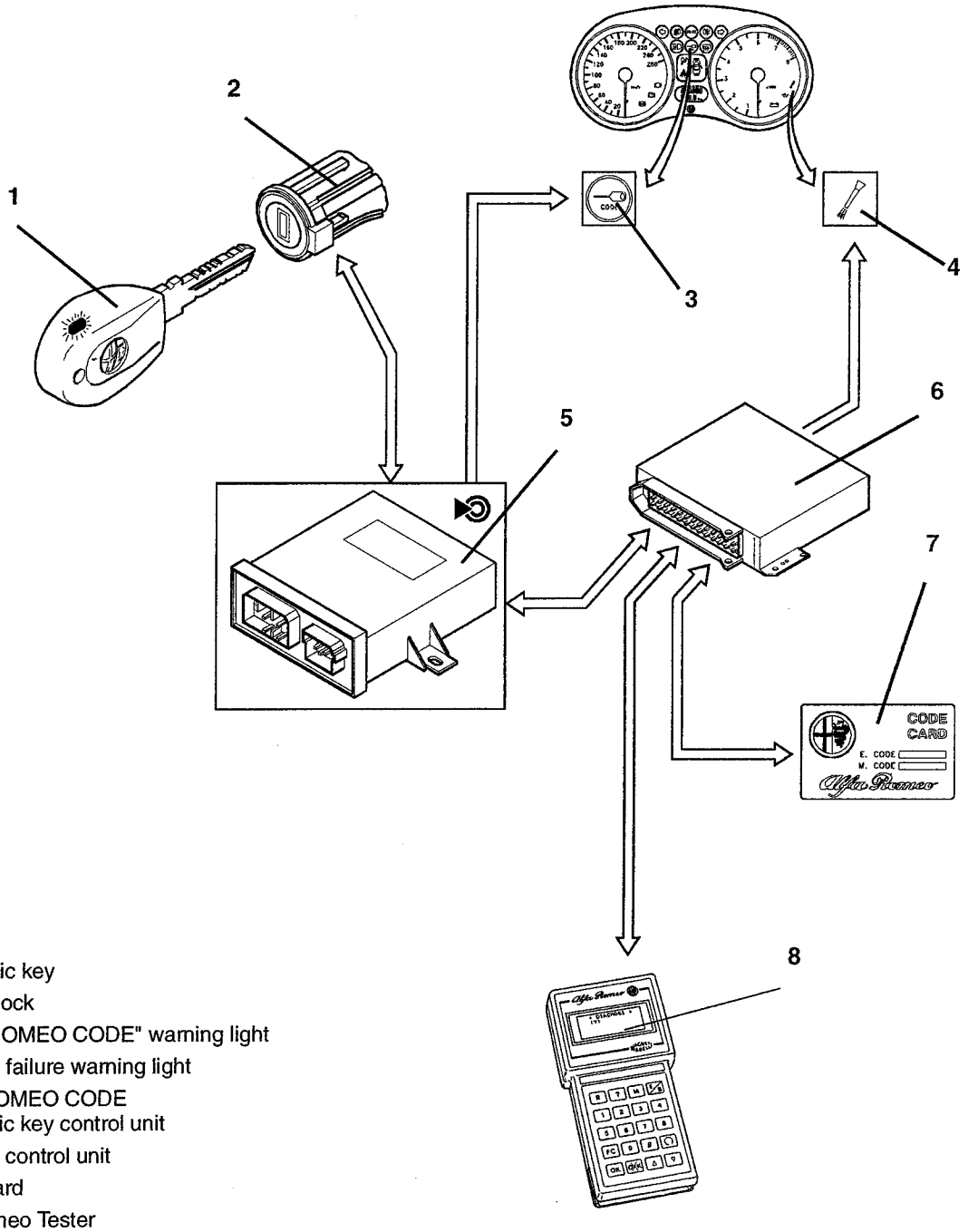
INDEX

GENERAL DESCRIPTION

The car is fitted with an electronic code system (ALFA ROMEO CODE) which inhibits the control of the engine operated by the ignition keys.

Turning the key to the MARCIA position the Engine Control System Control unit (**C.C.M.**) requests the code from the Control unit of the ALFA ROMEO CODE system - Electronic Key Control Unit (**C.C.E.**). Once it has received the code, it compares it with the code in its memory (**MASTER CODE**).
If the comparison of the code received with the one memorised is positive the C.C.M proceeds with normal electronic engine management (starting, ignition, injection, etc.).
If not, (wrong code, various faults, etc.) the C.C.M. does not carry out engine management and the car will not start.
The C.C.M. offers the possibility to start the car without having received the MASTER CODE by the emergency procedures using the Code Card or the Alfa Tester (see recovery procedures).
The code transmitted to the engine control system control unit (allowing over 4 billion combinations) is computed by an algorithm which makes each transmission between C.C.M. and C.C.E. different from the previous one. (variable, crypted code).

If the code has not been recognised correctly the ALFA ROMEO CODE warning light stays on, together with the injection system failure warning light.



1. Electronic key
2. Ignition lock
3. "ALFA ROMEO CODE" warning light
4. Injection failure warning light
5. ALFA ROMEO CODE Electronic key control unit
6. Injection control unit
7. Code Card
8. Alfa Romeo Tester

DESCRIPTION OF COMPONENTS

The system comprises the following components:

Keys

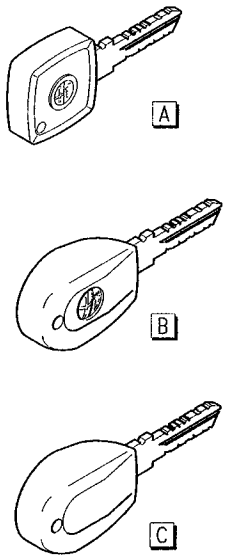
The following are supplied:

– An electronic key ***A:*** **"MASTER" key**

– Two main electronic keys ***B*** **(with Alfa Romeo badge)**

– An electronic **service key *C* (without Alfa Romeo badge)** only to be used when leaving the car in custody as it is impossible to use it for opening the luggage compartment and glove box.

The keys contain an electronic circuit called Transponder, which contains the code which characterises them; this is transmitted to the Electronic key control unit (C.C.E.) when the key is turned to the MARCIA position. Each electronic key possesses its own code, which must be memorised by the system's electronic control unit.



The cars are produced with the codes of the keys supplied with them already memorised, as described below:

– The C.C.E. contains the codes of the two main keys and the MASTER CODE (code of the master key)

– The C.C.M. only contains the MASTER CODE

It is very important to keep the MASTER key most carefully, since its code is memorised, through a special specific procedure (described later), in the electronic injection control unit, therefore the two control units are linked indissolubly.

If the MASTER key goes astray or is damaged, further memorising procedures of new keys will not be possible; without the MASTER key in the event of a failure to the C.C.E. it will be necessary to change the C.C.E. and the C.C.M.

The user is advised to keep the MASTER key in a safe place outside the car. In fact, it serves as an "access key" for memorising further codes (keys). The MASTER key should only be used when needing to memorise new keys.

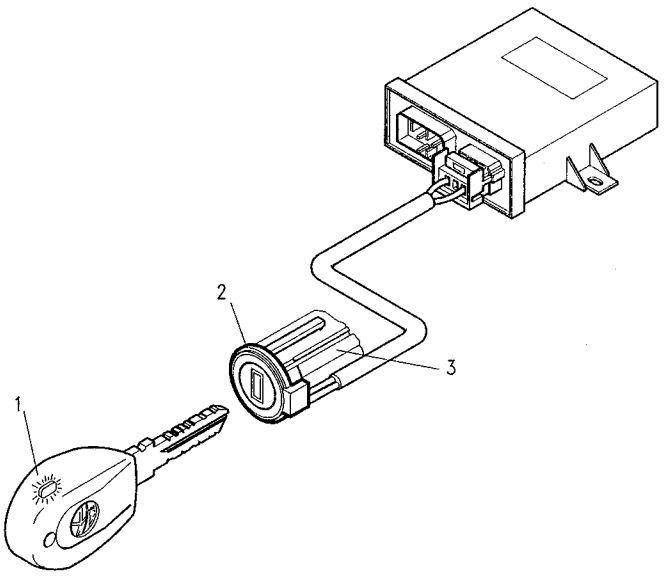
The Transponder inside the key comprises a minute integrated circuit (which contains the code), and a coil (which supplies the integrated circuit and transmits the code).

In the main keys, the Transponder is inserted in an accessible manner, while the MASTER key has the possibility to transfer the component to another MASTER key, if the need arises (for example if the ignition lock needs replacing).

The **MASTER** key is proof of the ownership of the car: it must therefore be present (together with the Code Card), when the car is sold.

Aerial

The aerial is a loop coil which is wound round the ignition lock and is connected to the C.C.E. by a specific connector (see figure) The purpose of the aerial is firstly to supply the transponder so that it can send the code and secondly to receive the Transponder signal.

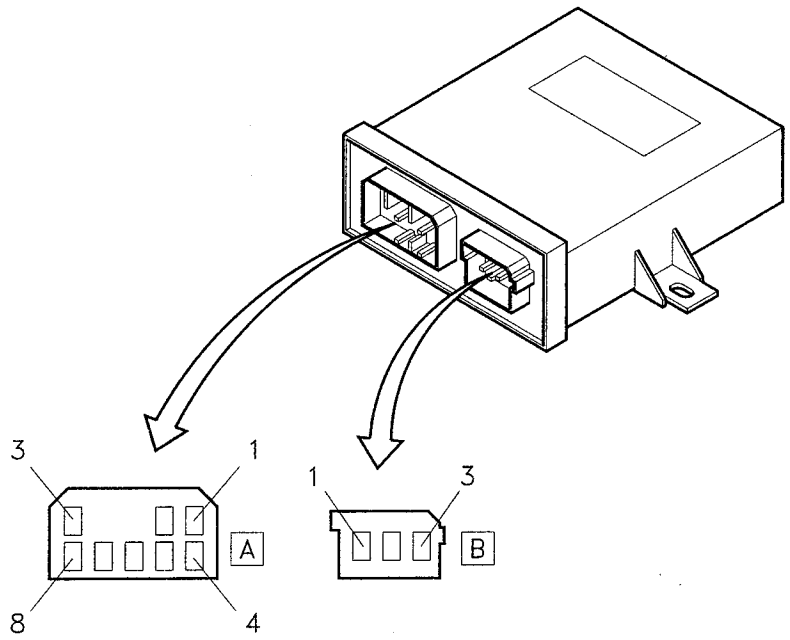


1. Transponder
2. aerial
3. ignition lock

Electronic Key Control unit (C.C.E.)

The C.C.E. is located above the fusebox; it is interfaced with the car via two connectors: B (3-way) and A (8-way) and it has the following functions:

- It detects rotation of the key in the ignition switch to the MARCIA position
- It emits an electromagnetic field to give power and activate the Transponder of the key
- It receives and computes the secret code sent by the key
- It manages the serial line (one wire) with the Motronic injection control unit
- It manages the special diagnosis warning light on the instrument cluster
- It memorises up to 8 secret codes, one of which is the MASTER CODE
- It recognises connection with the Alfa Tester and allows the use of the serial line for diagnosis



CONNECTOR A
pin 1: N.C.
pin 2: warning light signal
pin 3: direct supply
pin 4: earth
pin 5: diagnosis line K
pin 6: serial line towards the C.C.M.
pin 7: signal for outside relay (N.C.)
pin 8: key-operated supply

CONNECTOR B
pin 1: aerial signal
pin 2: N.C.
pin 3: aerial earth

Engine Control System Control Unit (C.C.M.) with software (programme) for ALFA ROMEO CODE :

Thw engine control system control units adopted on these cars are provided with functions for management of the ALFA ROMEO CODE electronic key: these functions, which are activated when the key is turned, are the following:

- Permanent memorising of the MASTER key code (MASTER CODE) by a specific procedure carried out during production testing or when the C.C.M. is changed.
- Request of the MASTER key code to the C.C.E.
- Recognition of the MASTER CODE and engine control enabling (starting the car)
- Recognition of the message (transmitted by the C.C.E.) warning that an unauthorised key has been inserted (the car will not start).
- Recovery function via the Alfa Romeo Tester (it is necessary to know the ELECTRONIC CODE written on the Code Card)
- Recovery function by entering the ELECTRONIC CODE written on the Code Card using the accelerator pedal.
- Control of the diagnosis warning light (injection failure warning light)

Absolutely never exchange the injection control units between cars to check whether they are working properly.

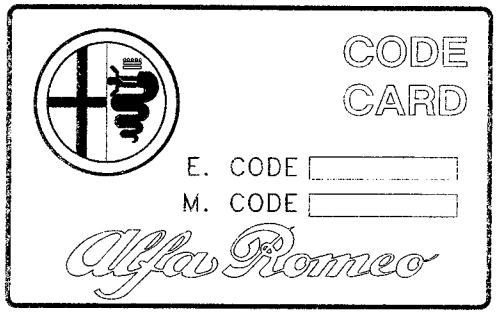
Therefore, during fault-finding operations, avoid changing the injection control unit, if you are not sure that it is the cause of the problem on the car (firstly check the actuators and sensors and the wiring, etc.) bearing in mind that the installation of a new control unit (never used before) will involve the permanent memorising of the MASTER CODE inside it of the next key that is turned to MARCIA; therefore, from that moment onwards this control unit will only work in combination with the keys and C.C.E. of that car.

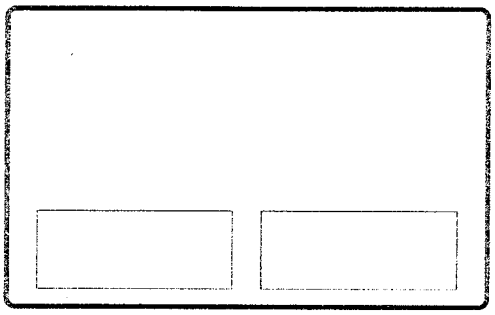
Code Card (card with secret code)

This is a memo card the size of a credit card which is supplied with the car. (see illustration).

It contains a five-digit code (**ELECTRONIC CODE**) which makes it possible to start the engine (recovery function) when the electronic keys have been lost or damaged.

Two cards are supplied.





NOTE: Clearly this emergency procedure only takes account of the electronic code associated with the keys, and not the mechanical parts shared with other cars.

The Code Card should not be kept in the car, but it should be kept at hand because through the code, it will be possible to start the car without the ALFA ROMEO CODE (see the specific recovery procedure).

The Code Card, as well as the ELECTRONIC CODE (**"E. CODE"**), contains the mechanical code of the keys (**"M. CODE"**): through this code it is possible to request other keys suited to the ignition switch and to be memorised in the C.C.E.

On the back there are two special spaces for applying the labels of the transmitters supplied with the optional alarm system (V.A.S. alarm).

OPERATION: Anti-theft strategy

Each time the ignition key is turned to MARCIA the following main operations are carried out in sequence: The injection control unit asks the C.C.E. for the MASTER CODE (the one of the MASTER key memorised previously).

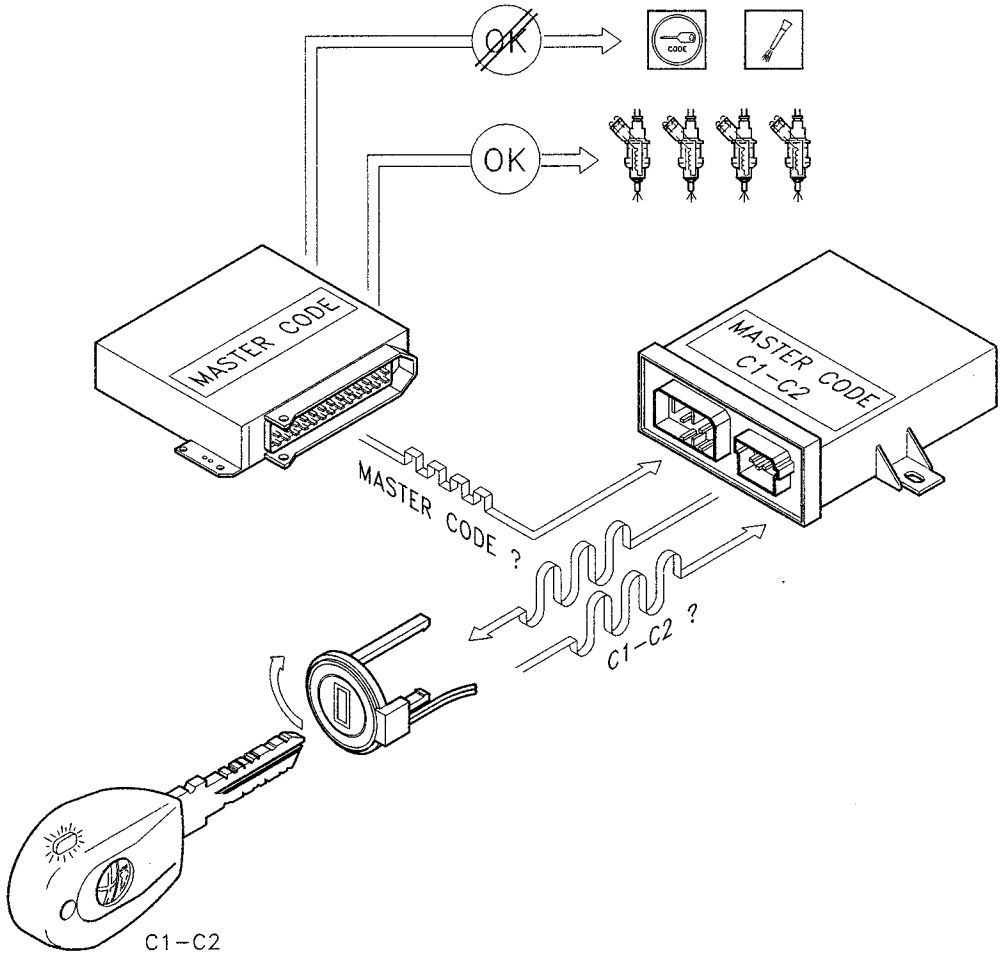
The C.C.E. checks that the code of the key engaged in the ignition lock corresponds to one of the codes contained in its memory.

If the key corresponds to one of the memorised codes:

the C.C.E. sending the MASTER CODE, to the injection control unit, **enables starting** (see illustration).

If the code of the key engaged in the ignition lock does not correspond to one of those memorised:

The C.C.E. informs the injection control unit that an extraneous key has been engaged and **starting will not be enabled** (see illustration) this situation will be indicated by the turning on of the electronic injection system failure warning light and the ALFA ROMEO CODE warning light.



C1, C2 = key codes

Interaction between key and C.C.E.

When the C.C.E. detects the engagement of the key it sends a signal to the ends of the aerial thereby generating an electromagnetic field.

This way the Transponder coil is inductively connected and it receives the energy to supply the integrated circuit to which it is connected.

At this point the integrated circuit transmits the code.

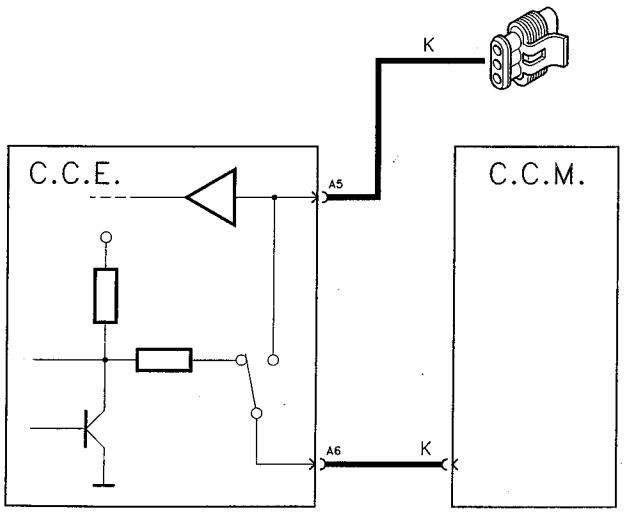
Sharing of the serial line of the diagnosis functions and the ALFA ROMEO CODE system

(M3.7 injection - 3.0 V6 and M2.10.3 - 2.0 TS 16v engine up to chassis no. 60923906)

Inside the C.C.E. there is a shunt relay which has the purpose of enabling dialogue between the C.C.M. and the Alfa Tester or the C.C.E. itself. Pin A6 is usually dedicated to dialogue between the C.C.E. and the C.C.M (see illustration).

Line K of the diagnosis socket is connected to the C.C.E. at pin A5.

The shunt relay is normally in such a position as to allow dialogue between the C.C.E. and the C.C.M (default position).



When diagnosis begins connecting with the Alfa Tester (turning the ignition key to MARCIA) the C.C.E., after ending dialogue with the C.C.M. recognises the request for diagnosis and pilots the relay to connect pin A5 and A6 to one another, thereby enabling dialogue between the tester and the C.C.M. The C.C.E enables connection with the Alfa Tester only when the following conditions occur contemporaneously:

- There is not activity on the serial line between the C.C.E. and the C.C.M.
- A low level (of voltage) is present on pin A5 for a time of between 500ms and 5s (a low level for over 5s is considered as a short circuit towards earth)

The relay returns to the default position when there is no activity on pin A5 for over 30s.

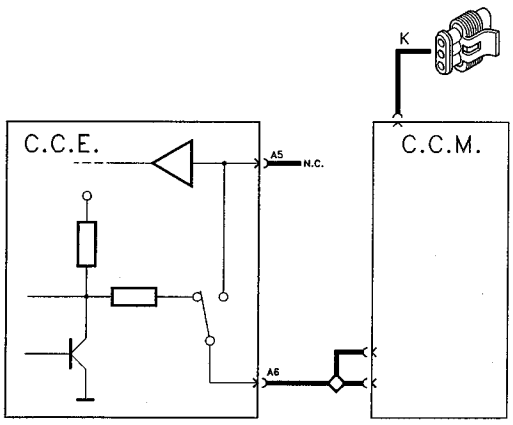
When the control unit detects that the Alfa Tester has been engaged, it turns on the ALFA ROMEO CODE warning light to indicate correct switching of the relay.

Dedicated serial line between C.C.E. and C.C.M.

(M2.10.4 injection - TS 16v engine from chassis no. 60923907)

Some injection control units have a special provision for a serial line for dialogue between the C.C.M. and the C.C.E., using pin A6 of the C.C.E. (see diagram). Line K of the diagnosis socket is NOT connected to the C.C.E. at pin A5, but it leads directly from the C.C.M. to the Tester.

Diagnosis line K is enabled by the C.C.M. only at the end of dialogue between the C.C.M. and the C.C.E.



Dialogue between C.C.E. and C.C.M.

As mentioned previously, the C.C.E. and C.C.M. "dialogue" via a serial line formed of a single cable. The serial line is two-way, this means that the information travels sequentially from the C.C.M. to the C.C.E. and vice- versa. The information exchanged between the

two control units may concern the following operating conditions:

A) Checking the code

C.C.E. memorised C.C.M. memorised:

Each time the key is turned to MARCIA (also during starting) the C.C.M., before starting engine management, asks the C.C.E. for the MASTER CODE. The C.C.E. can answer in one of the following three ways:

1. It sends the MASTER CODE (crypted), enabling the C.C.M. to start the car

2. It sends a code which inhibits starting the engine (if the key engaged has not been memorised, or it is a key without Transponder, aerial failure, etc.)

3. It does not answer (C.C.E. failure)

The function is governed by a programme which takes account of all the variables that might be present in the system.

B) Memorising the codes

These operations concern the system when at least one control unit (C.C.E. or C.C.M) is brand new.
The following instances may arise:

C.C.E brand new and C.C.M. brand new:

When both the control units are brand new (C.C.E. and C.C.M.) the C.C.E. answers the request of the injection control unit sending a universal code crypted by an algorithm. This condition is indicated by a characteristic flash.(1.6 Hz) of the warning light: this only takes place if the C.C.E. has detected the presence of a Transponder. Conversely, if the aeriai is broken or disconnected or there is no Transponder in the key, the C.C.E. will not answer).
In this situation the system is not protected yet, and it is ready to start the key memorising procedure.

C.C.E. memorised and C.C.M. brand new:

When the ignition key has been turned to MARCIA the C.C.M. will ask the C.C.E. for the MASTER CODE to memorise it; the C.C.E. sends the MASTER CODE only if it has recognised a key among those memorised in the ignition lock: from this moment the MASTER CODE is memorised in the C.C.M. which is thus indissolubly linked with the car.

C.C.E. brand new and C.C.M. with MASTER CODE memorised:

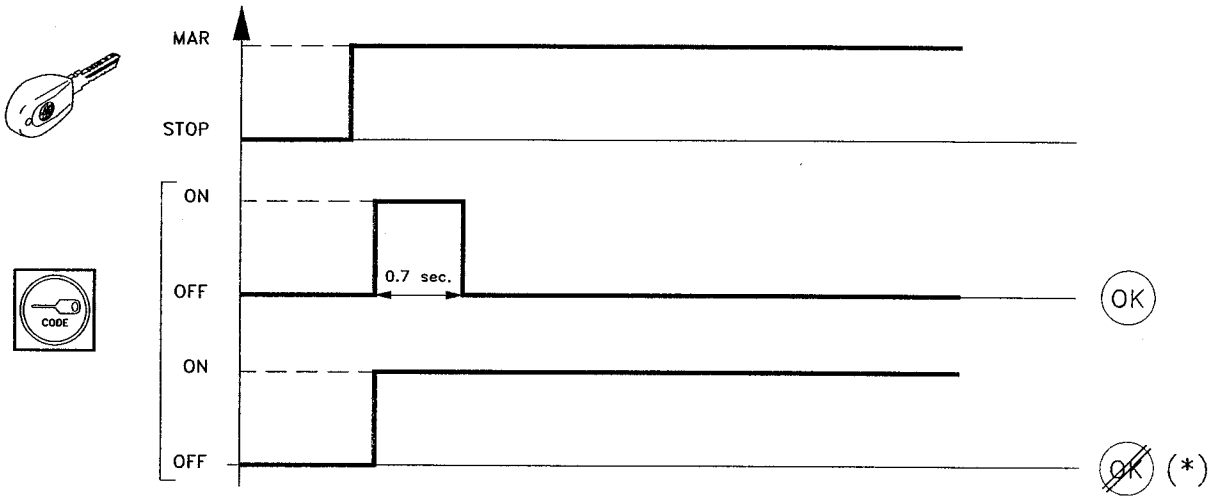
When the ignition key has been turned to MARCIA the C.C.M. asks for the MASTER CODE to be enabled for starting. As the C.C.E. is brand new, it answers sending the universal code, only if it reads a code correctly in the Transponder. (It might be a key without Transponder or with a key with the Tramsponder not working or the aerial might be disconnected or damaged, etc.).

The C.C.M. prevents the engine from being started as it does not recognise the universal code: it is necessary to memorise the keys in the C.C.E., MAKING SURE THAT THE MASTER KEY IS THE ONE WHICH OPENS AND CLOSES THE PROCEDURE (see programming).

Piloting times of the ALFA ROMEO CODE warning light

The diagnosis warning light on the instrument panel is controlled by the C.C.E. to inform the user and workshops of the system status. There are two types of characteristic flashing:

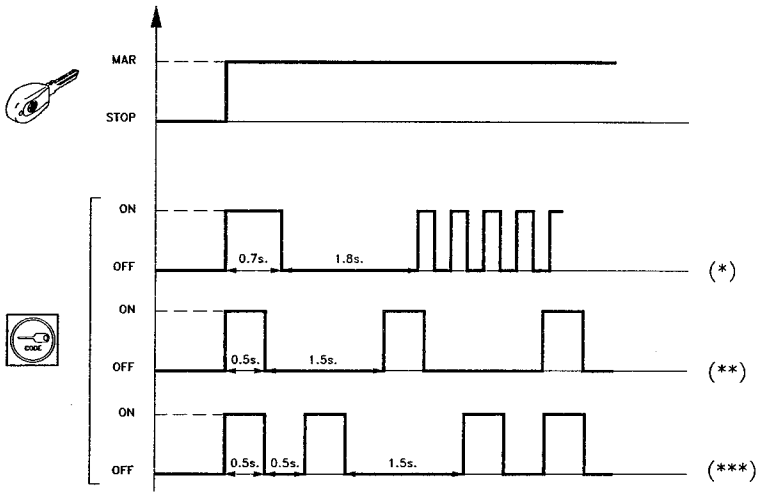
1. **When the keys have already been memorised** (see illustration) it indicates the correct operation of the system or a problem:



(1)

(*) - Transponder not recognised/absent/faulty
- lack of connection between C.C.E. and C.C.M
- aerial faulty/disconnected
- C.C.E. faulty
- re-memorising not carried out correctly

2. **When the system is still brand** new the flash (1.6 Hz after 2.5 seconds) means that the system is intact and working, the car is not protected until a key memorising procedure has been carried out, other faults detected are also indicated (see illustration)



(2)

(*) system intact, working but brand new, car not protected

(**) lack of connection between CCE and CCM
(***) -Transponder not recognised/absent/faulty
- aerial faulty/disconnected

WARNING!
If the ALFA ROMEO CODE warning light turns on momentaneously or permanently while travelling or starting the car, this does not necessarily mean a system failure, but, in certain cases, it means a condition that can be interpreted as an attempt to manipulate the vehicle by a thief.

Should this occur, to correctly check the car, turn the engine off and move the key to STOP; then turn the key back to MARCIA: the warning light should turn on and off in less than one second.

If it stays on after this procedure, repeat the operation, leaving the key at STOP for more than 30 seconds. If the warning light still stays on when the key is in the MARCIA Position, carry out diagnosis on the ALFA ROMEO CODE system.

PROGRAMMING THE KEYS

The system is capable of memorising up to 7 keys plus the MASTER KEY. Correct memorising needs two keys plus the MASTER key.

During production testing the keys were memorised and the system is tested and working. If the need arises, for servicing reasons, to replace faulty components or there is the need for more keys than those supplied, the key memorising procedure must be carried out. There are two types of ways to memorise the keys :

- **Memorising** procedure, with a brand new system (C.C.E. and C.C.M. new).
- **Re-memorising** procedure, which is carried out under the following circumstances:
  - the addition of other keys besides those already memorised in the C.C.E.
  - if it is absolutely necessary to change the ignition lock. In this circumstance, in fact, it is possible to keep the only the Transponder of the MASTER key of the old set of keys, which, once inserted in the new key (see specific procedure) makes it possible to memorise the other keys provided with the new ignition lock.
  - changing the C.C.E.

MEMORISING

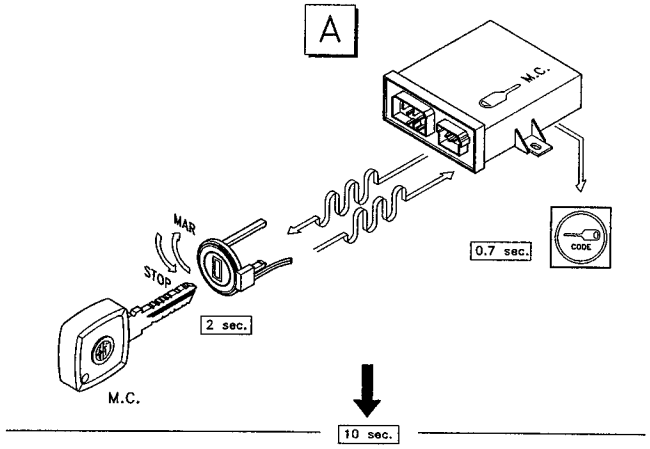
Before starting to programme the keys, it is necessary to check whether the system is brand new or if any keys have been memorised; this can be done by displaying the indications of the diagnosis warning light or connecting to the Alfa Tester. **The use of a faulty or already memorised C.C.E. would in fact involve the irreversible memorising of an incorrect code in the C.C.M. which it will no longer be possible to use in future on other cars.**

The memorising procedure is divided into two strictly consecutive phases:

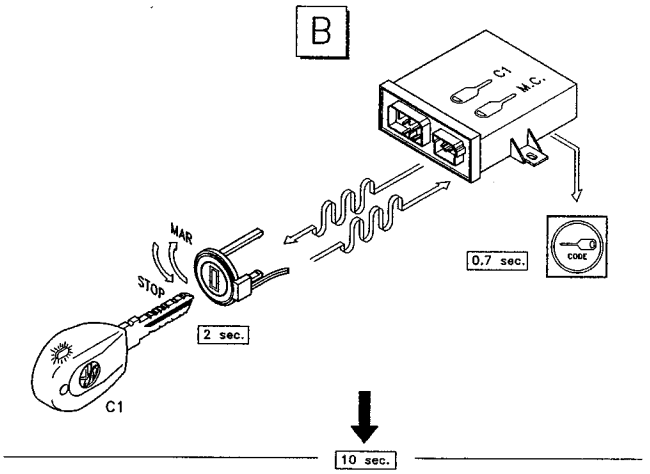
1. Memorising the keys inside the C.C.E.
2. Memorising the MASTER CODE in the engine control system control unit (if brand new)
   This is carried out only when the first one has been carried out with a positive result, turning the key to MARCIA.

MEMORISING PROCEDURE WITH BRAND NEW SYSTEM

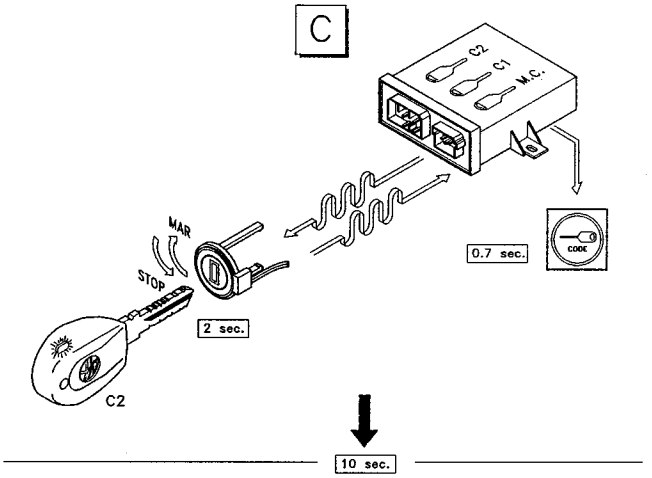
A Insert the **MASTER key** in the ignition lock
Turn the MASTER key to MARCIA and move it back to STOP as soon as the ALFA ROMEO CODE warning light goes off.



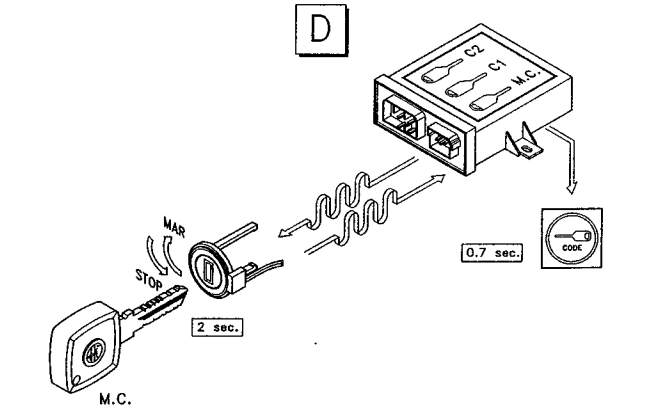
B Within 10 seconds:
Remove the MASTER key from the ignition lock, insert **a main key** in the lock
Turn the key to MARCIA. As soon as the ALFA ROMEO CODE warning light goes out, turn the key to the STOP position.



C Within 10 seconds:
Remove the key from the ignition lock, insert **a second main** key in the lock.
Turn the key to MARCIA. As soon as the ALFA ROMEO CODE warning light goes out, turn the key to the STOP position.



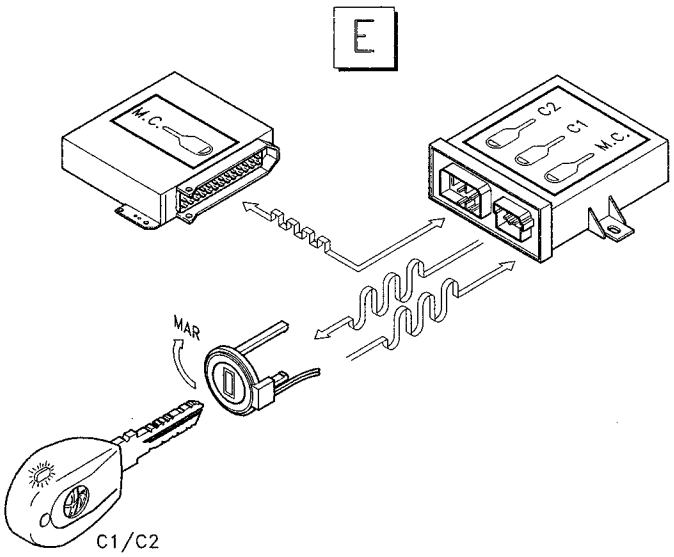
D Within 10 secondsi:
Remove the key from the ignition lock, insert **the MASTER key** in the ignition lock **again**
Turn the key to MARCIA. As soon as the ALFA ROMEO CODE warning light goes out, move it back to the STOP position.



M.C. = MASTER CODE C1, C2 = key codes

At this point the keys are memorised in the C.C.E.

E **Insert** any one of the memorised keys **and turn it to MARCIA**: the ALFA ROMEO CODE warning light will turn off and go out after 0.7 seconds.
Wait for 2 seconds: if the ALFA ROMEO CODE warning light stays off, that means that the key memorising procedure has been carried out correctly, and the MASTER key code has been memorised in the injection control unit.
Conversely, if the warning light flashes again (1.6 Hz), it means that the memorising procedure has not been carried out correctly.



M.C. = MASTER CODE C1, C2 = key codes

If, for any reason and in any moment, you think you have mistaken the procedure:

- **Move the key to MARCIA for more than 2 seconds or move the key to STOP for more than 10 seconds.**
- **Repeat the procedure from the start inserting all the keys.**

As may be deduced, during the procedure the key should never be kept at MARCIA for over 2 seconds, while it should never be kept at STOP for over 10 seconds.

Each time the key is turned to MARCIA, the warning light turns on (0.7 s), indicating the correct sequence of the procedure.

The above-mentioned procedure includes three keys: the MASTER key and two main keys.
Up to seven main keys may be inserted, using more keys between two insertions of the MASTER key.The MASTER key must always be inserted for the first and last time during programming.

The procedure is interrupted if the following situations occur:

- The same key is inserted twice consecutively
- The same key is inserted twice or more times between two insertions of the MASTER key
- A key stays at MARCIA for more than 2 seconds
- A key is kept at STOP (during the procedure) for more than 10 seconds

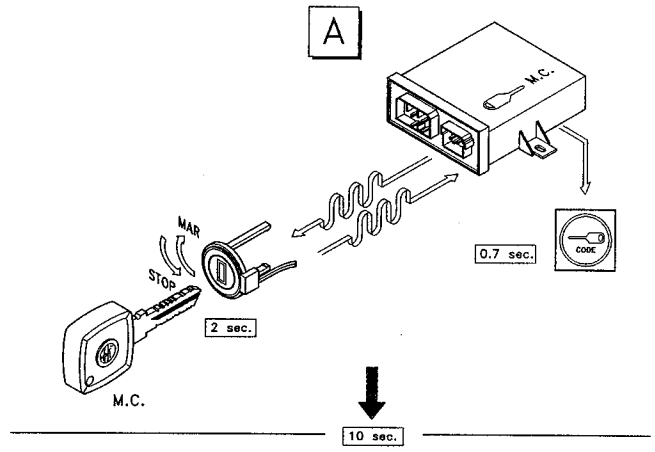
KEY RE-MEMORISING PROCEDURE

This procedure is similar to the previous one, and consists in inserting the main keys between two insertions of the MASTER Key.

During the sequence the new main keys and the old ones are inserted.

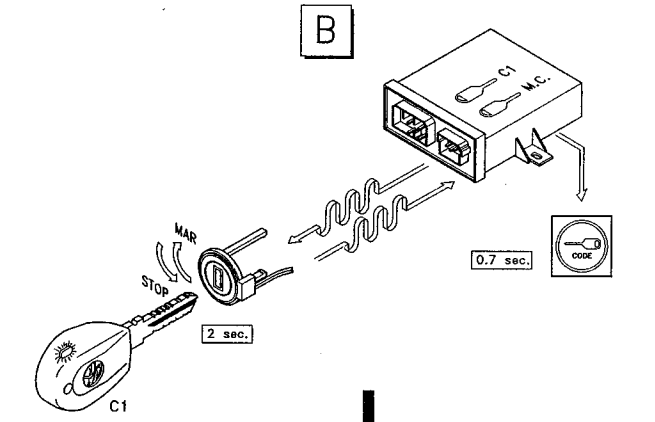
If the main keys memorised previously are not inserted, their code will be erased from the memory of the control unit.

A Insert the **MASTER key** in the ignition lock
Turn the MASTER key to MARCIA and move it back to STOP as soon as the ALFA ROMEO CODE warning light goes out.



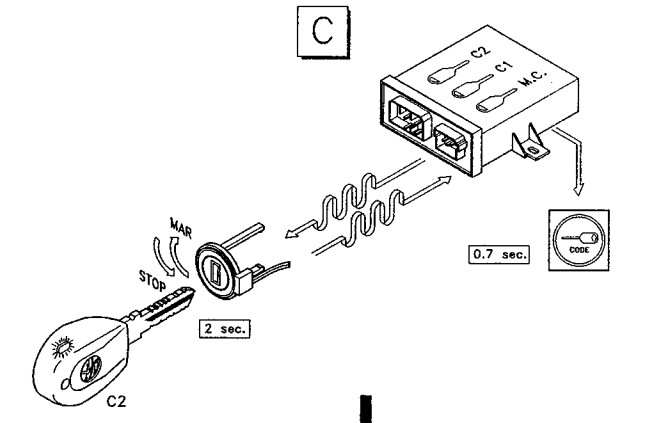
10 sec.

B Within 10 seconds:
Remove the MASTER key from the ignition lock, insert **a main key (known or new)** in the lock.
Turn the key to MARCIA : when the ALFA ROMEO CODE warning light goes out, turn the key to the STOP position.



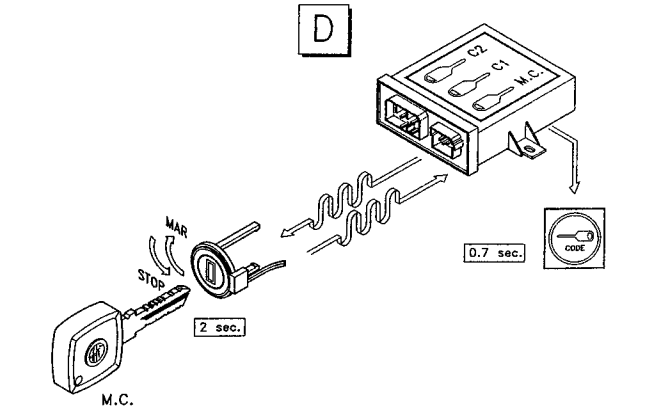
10 sec.

C Within 10 seconds:
Insert **a second main key (known or new)** in the ignition lock
Turn the key to MARCIA : when the ALFA ROMEO CODE warning light goes out, turn the key to the STOP position.



10 sec.

D Within 10 seconds:
Remove the key from the ignition lock, insert **the MASTER** key in the lock **again**
Turn the key to MARCIA and when the ALFA ROMEO CODE warning light goes out, move it back to the STOP position.



M.C. = MASTER CODE C1, C2 = key codes

If, for any reason and in any moment, you think you have mistaken the procedure:

- **Move the key to MARCIA for more than 2 seconds or move the key to STOP for more than 10 seconds.**
- **Repeat the procedure from the start inserting all the keys..**

As may be deduced, during the procedure the key should never be kept at MARCIA for over 2 seconds, while it should never be kept at STOP for over 10 seconds.

Each time the key is turned to MARCIA, the warning light turns on (0.7 s), indicating the correct sequence of the procedure.

The above-mentioned procedure includes three keys: the MASTER key and two main keys.
Up to seven main keys may be inserted, using more keys between two insertions of the MASTER key.The MASTER key must always be inserted for the first and last time during programming.

The procedure is interrupted if the following situations occur:

- The same key is inserted twice consecutively
- The same key is inserted twice or more times between two insertions of the MASTER key
- A key stays at MARCIA for more than 2 seconds
- A key is kept at STOP (during the procedure) for more than 10 seconds

Memorising the MASTER CODE in the C.C.M. (if the latter is changed:

This operation takes place turning the key to MARCIA after having memorised all the keys in the C.C.E.

Warning:

- **Once the codes have been programmed, the C.C.E. is capable of transferring the MASTER CODE to the injection control unit (which stores it permanently), each time the key is turned to MARCIA.**
- **Do not use brand new C.C.M.s to check that the system is working properly.**
- **Do not swop C.C.M.s among cars.**

Memorising with brand new C.C.E. and memorised C.C.M.:

This function is carried out following the normal memorising procedure, as if the whole system were brand new; the MASTER Key must be the same with which the injection control unit was memorised previously.

WARNINGS:

- **Before starting the procedure make sure that the C.C.E. is truly brand new. The use of a faulty or already memorised C.C.E. will cause the irreversible memorisation of a wrong code in the C.C.M., which will no longer be able to be used in future on other cars.**
- **WARNING:**
  If the ALFA ROMEO CODE warning light stays on during re- memorisation, it means that the procedure has not been carried out correctly and it has been interrupted.
  Repeat the re-memorising procedure from the start.

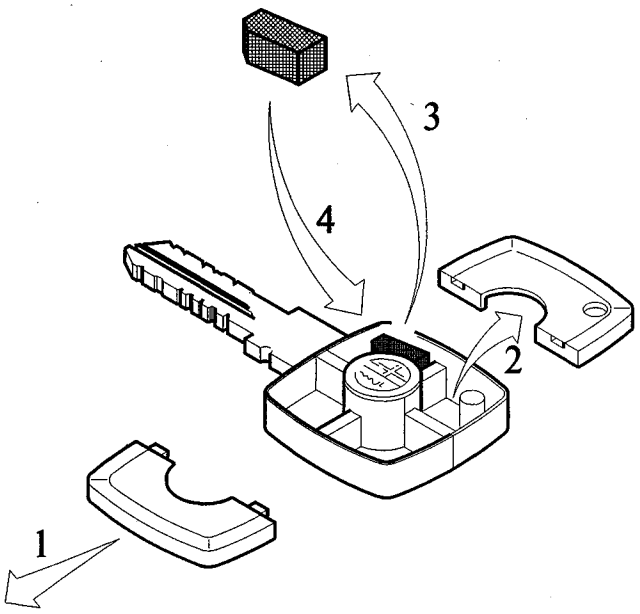
- **If the ALFA ROMEO CODE warning light stays on when the MASTER key has been inserted twice consecutively, this does not mean a malfunctioning, but that the re-memorising procedure has been opened (key at MARCIA) and interrupted (second key at MARCIA). To resume the correct operation of the warning light, move the key to STOP.**

TRANSPONDER TRANSFER PROCEDURE

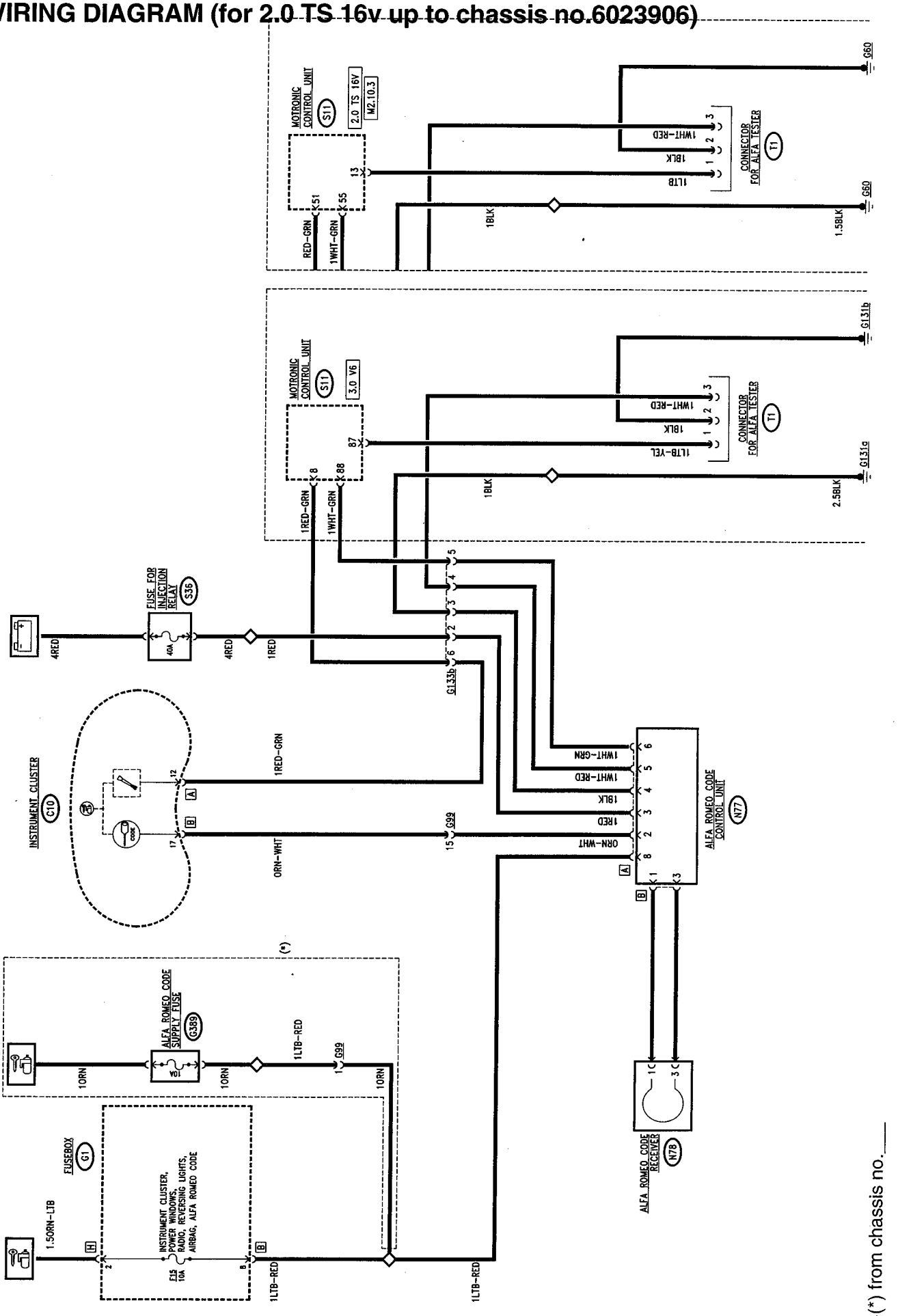
When needing to change the ignition lock or a door lock, for example, it is possible to transfer the Transponder from MASTER key to another: this way the memory of the Electronic Key Control Unit (C.C.E.) can be "re-opened" to memorise the new main keys (with new locks). Otherwise it would be necessary to change both the C.C.E. and the Master Key Control Unit (C.C.M.) as it would be impossible to re-open the memory of the latter using another Transponder.

To transfer a Transponder, proceed as follows:

1. Open the MASTER key removing the mobile part.
2. Lift the other art, acting on the two notches. Operate carefully in order to avoid damages to the key.
3. Remove the Transponder taking care not to damage it.
3. Insert the Transponder in another MASTER key. N.B.: The Transponder rests in place in the key and is not restrained.

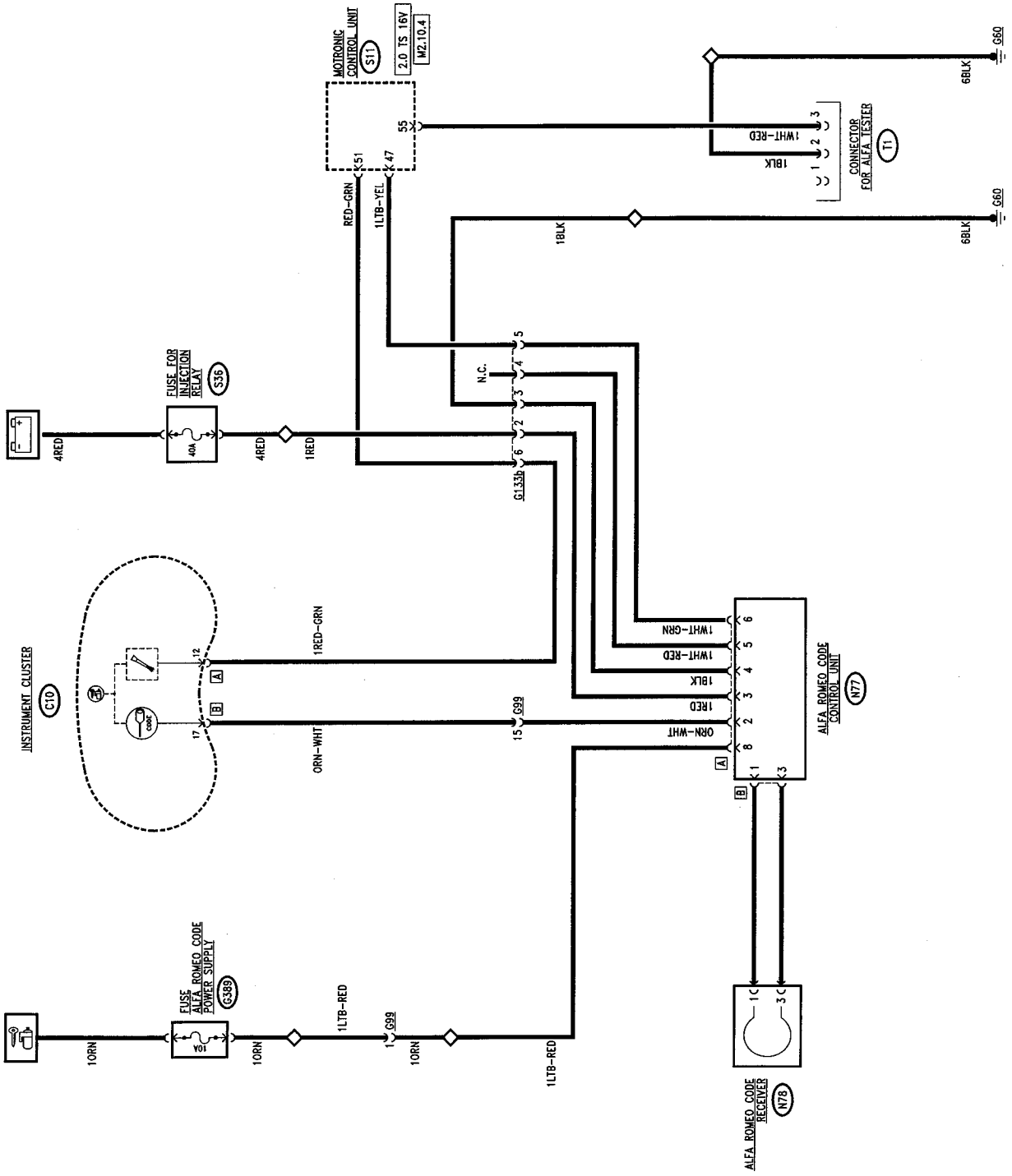


WIRING DIAGRAM (for 2.0 TS 16v up to chassis no.6023906)



(*) from chassis no.___

WIRING DIAGRAM (for 2.0 TS 16v from chassis no.6023907)



FUNCTIONAL DESCRIPTION

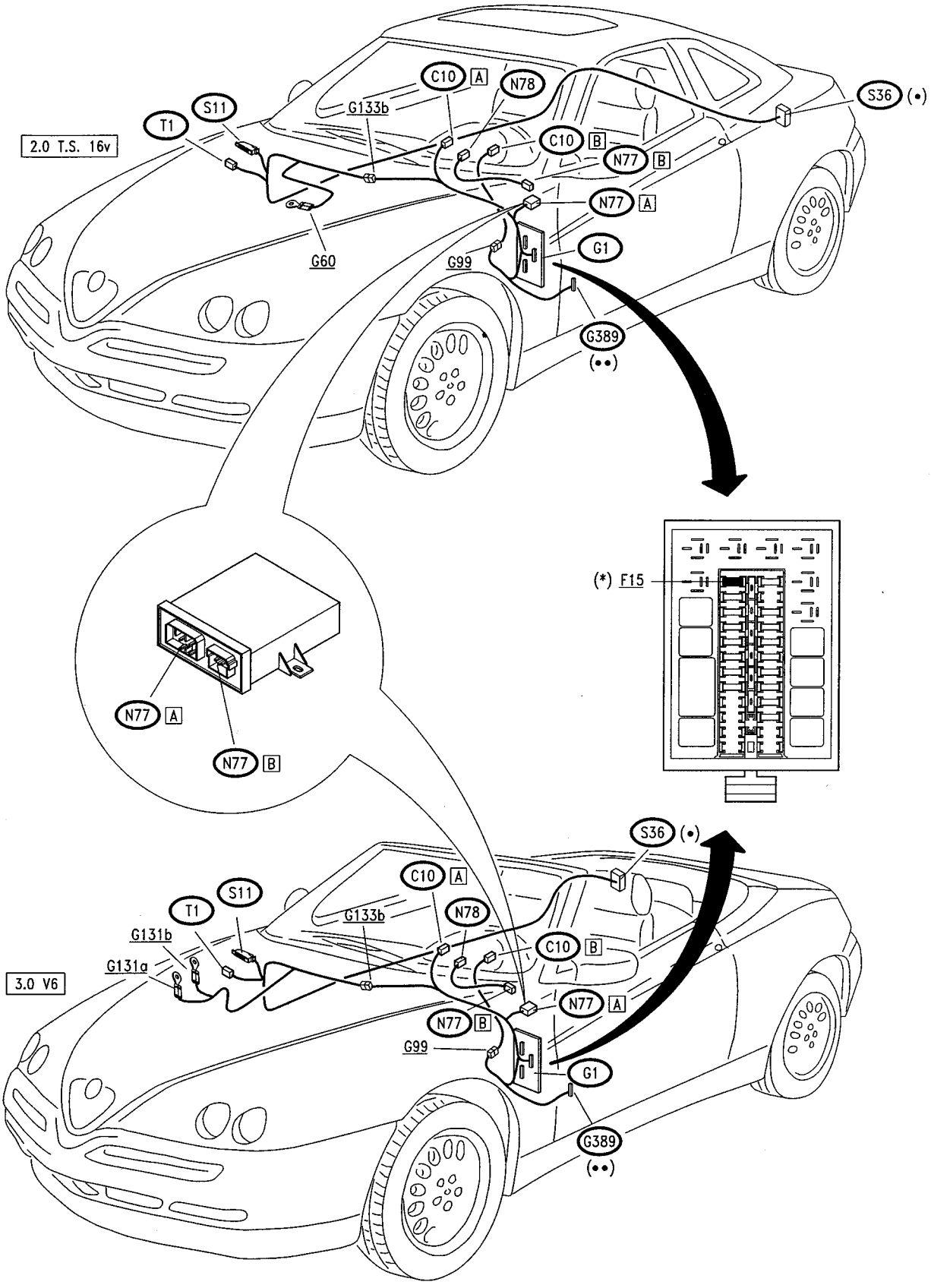
The ALFA ROMEO CODE control unit **N77**, to be found next to the fusebox **G1,** is connected via connector B to a special pair of cables to the receiver **N78**, consisting in a coaxial aerial with the ignition switch. Through connector A it is connected to the Motronic control unit **S11** and to the other systems: at pin 8 it receives the "key- operated" supply via the line of fuse **F15** of **G1** - up to chassis no.___ - and from wander fuse **G389** - from chassis no.___ - while at pin 3 it receives the direct supply via fuse **S36** of the Motronic system, and pin 4 is connected to earth.
The connection line with the ALFA ROMEO CODE warning light on the instrument panel leaves from pin 2.

Pins 5 and 6 manage communication between the ALFA ROMEO CODE control unit **N77** and the Motronic control unit **S11**: this communication takes place "cutting off" the diagnosis line K which leads from **S11** to the diagnosis connector **T1**.

Pins 5 and 6 manage communication between the ALFA ROMEO CODE control unit **N77** and the Motronic control unit **S11: for the 3.0 V6 and 2.0 TS 16v engine with MOTRONIC M2.10.3** injection this communication takes place "intercepting" diagnosis line K which leads from **S11** to the diagnosis connector **T1**.

For the 2.0 TS 16v engine with MOTRONIC M2.10.4 injection there is a direct connection line between the control unit **N77** (pin 6) and **S11** (pin 47).

LOCATION OF COMPONENTS



(•) Black fuseholder
(••) Red fuseholder

(*) Only up to chassis no.___

DIAGNOSIS

The C.C.E. cannot be tested directly via the Alfa Tester.

To the injection control unit, which already possesses a sophisticated self-diagnosis, the possibility has been added to test and display the more important functions of the ALFA ROMEO CODE.

Dialogue between the C.C.M. and the Alfa Tester begins when the key has been turned to MARCIA and when communication between the C.C.M. and the C.C.E. has ended.

The information, concerning the ALFA ROMEO CODE, supplied to the Alfa Tester, may belong to two different environments:

Errors:
generally displayed by the tester with priority depending on the importance.

There is a counter inside the control unit, which is activated when an error is stored and it decreases each time the error is no longer present; when the counter reaches zero, the control unit erases the error from the memory.

Therefore, the error memorised can be distinguished as PRESENT or not PRESENT.

The errors memorised are:

- Serial line not active, code not received or time-out: this error indicates that the control units (C.C.E. and C.C.M.) have not succeeded in communicating and the probable causes can be line interrupted or short circuited or some problem on the actual control units (or - with brand new system - faulty or disconnected aerial or faulty or lacking Transponder).
- Received incorrect code: the injection control unit has received from the C.C.E. a code that does not correspond to its memorised MASTER CODE; the probable cause can be an exchange of the injection control unit or the use of another main key during re-memorisation.
- Incorrect code in the C.C.E.: this means that a key unknown to the control unit has been inserted and starting of the car has not been allowed.

Parameters:

This is the environment of the Tester after connection with the C.C.M. (if no errors are present).

This environment is used to display the engineering parameters which define the status of a system.

The parameters are the following:

- brand new C.C.M.
- Starting inhibition procedure; (an un-memorised key has been inserted, the C.C.M. has not been enabled to start by the C.C.E.)
- brand new C.C.E. connected correctly

RECOVERY PROCEDURES

The emergency procedures should be carried out, when it is not possible to start the engine with the keys available.

This procedure requires the possession of the Code Card; with the corresponding ELECTRONIC CODE (5-figure code written on the card. The procedure, (carried out either with the Alfa Tester or with the accelerator pedal) consists in entering the ELECTRONIC CODE directly in the inection control unit.

This procedure makes it possible to start the engine only once; the procedure must be repeated to start the engine again (or a "known" key must be inserted, i.e. already memorised in the control unit).

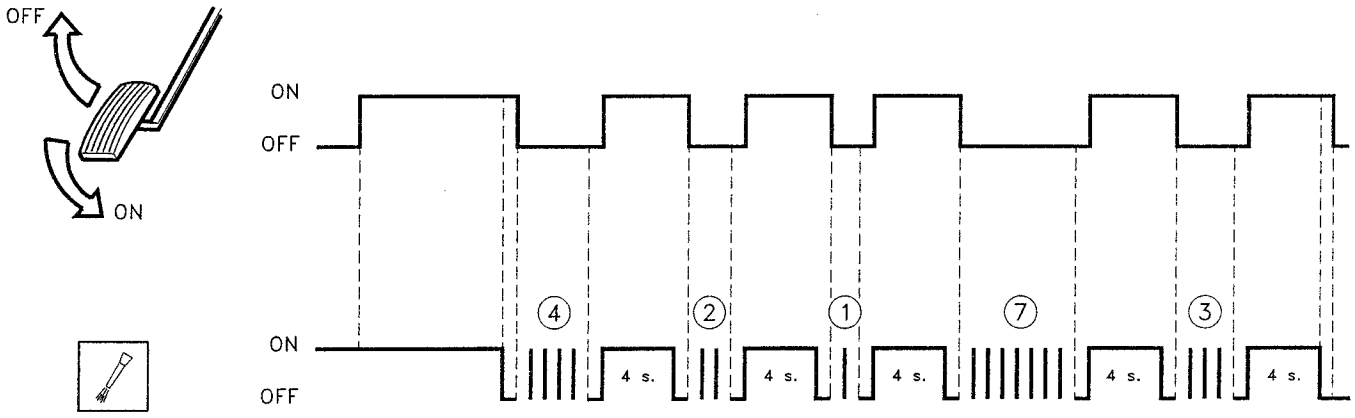
Emergency starting procedure (using the accelerator pedal)

This procedure should be carried out using the accelerator pedal and carefully watching the indications of the injection control unit warning light.

- Turn the key to MARCIA
- Press the accelerator pedal and keep it pressed until the warning light goes out.
- When the warning light goes out release the accelerator pedal.
- At this point the warning light begins to flash; after the number of flashes corresponding to the first number of the code on the Code Card (ELECTRONIC CODE) depress the accelerator pedal completely.
- The warning light turns on and stays on for 4 seconds then it goes out.
- When the warning light goes out, release the accelerator pedal
- The warning light starts to flash again; after the number of flashes corresponding to the second number of the ELECTRONIC CODE, press the accelerator fully home again.
- Proceed in the same way for the other numbers of the ELECTRONIC CODE.
- Also after the last number, keep the accelerator pressed until the warning light goes out (appr. 4 seconds)
- Release the accelerator pedal.

If the warning light flashes quickly, it means that the operation has been carried out correctly, thus the car can be started: if the warning light stays on, the code has not been entered correctly, move the key to STOP and back to MARCIA again, and repeat the procedure.

EXAMPLE: ELECTRONIC CODE = "42173"



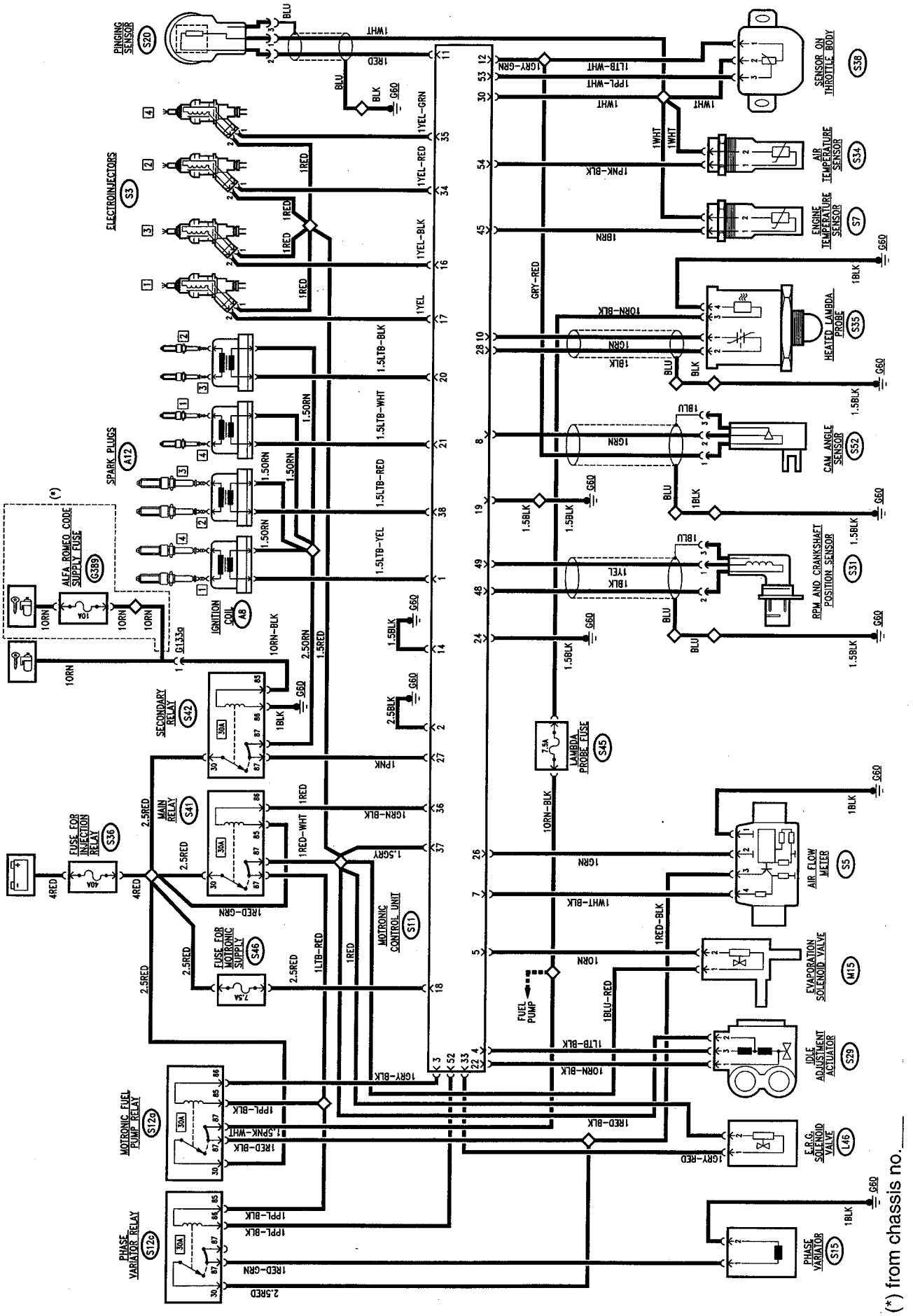
NOTE : If this procedure is not activated correctly, check the throttle potentiometer and the corresponding wiring, and also the throttle itself (throttle stroke without obstacles or sticking); also check the supply to the C.C.M..

CONTROL SYSTEM - 2.0 T.SPARK 16v Engine: BOSCH MOTRONIC M2.10.3

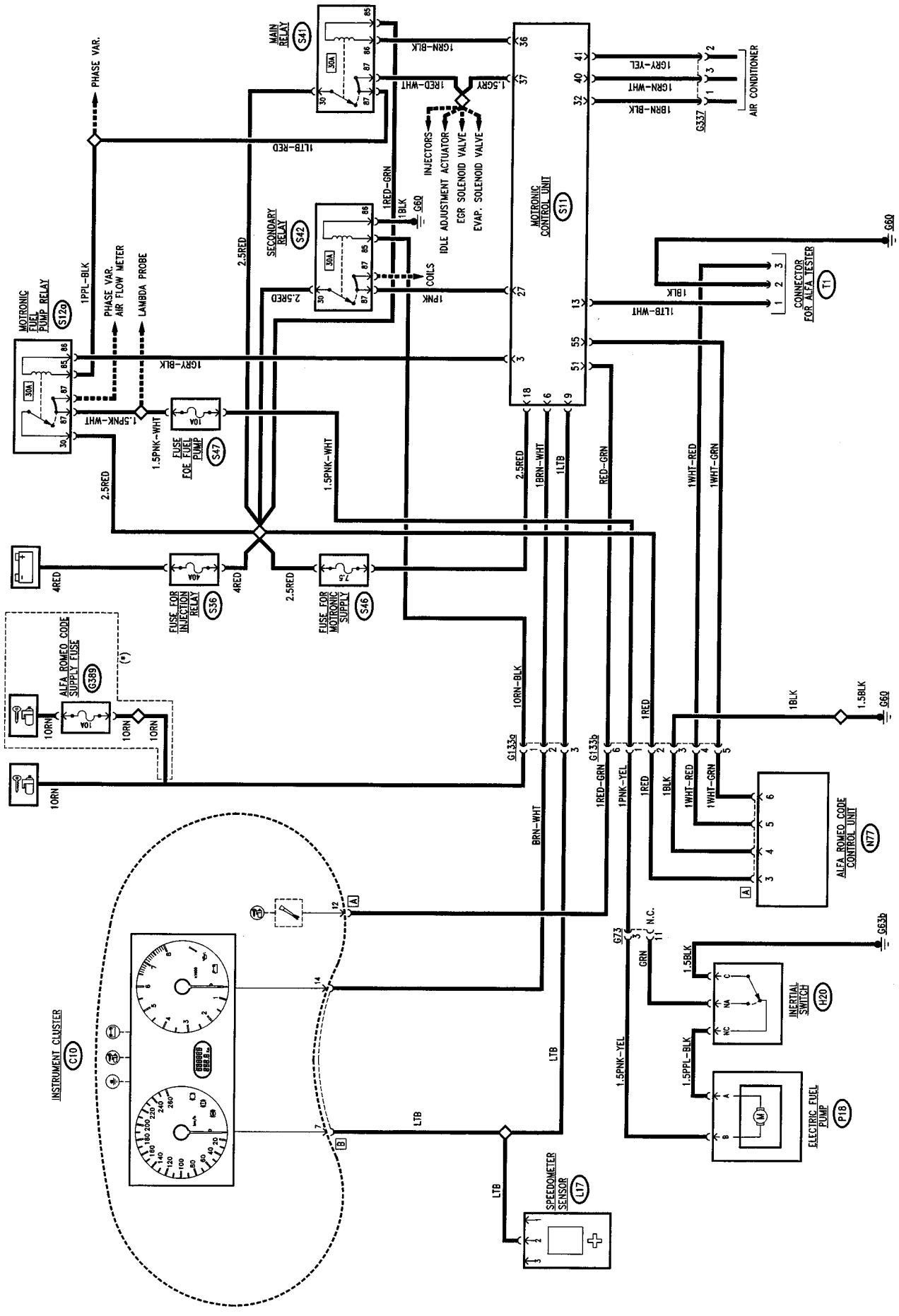
INDEX

WARNING
Up to chassis no.6023906

WIRING DIAGRAM A



WIRING DIAGRAM B



GENERAL DESCRIPTION

An electronic control system supervises and regulates all the parameters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions: this sophisticated latest generation system consists of a single control unit which controls both ignition (static with lost spark) and injection (timed).

This is the M 2.10.3 version of the proven and reliable BOSCH MOTRONIC system.

Compared with the previous versions this new M 2.10.3 system adopts a control unit - with 55 pins - with advanced design and production technology, it also possesses many possibilities for inserting auxiliary functions.

As a result of the use of new sensors and revision of the control programmes, the system makes it possible to achieve considerable improvements in terms of consumption and emission levels and vehicle handling.

Another feature of this system is self-adaptation, i.e. the capability to recognise the changes that take place in the engine and to compensate them, according to functions which mainly correct:

- the mixture titration
- the caburetion parameters according to the command of the evaporative solenoid valve
- an adaptive programme for idle speed control.

FUNCTIONS OF THE SYSTEM

Sequential and timed injection (S.E.F.I.)

With this control unit, fuel injection is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake manifolds by the opening of the injectors) is not simultaneous for all the cylinders, but takes place for each cylinder in correspondence with the optimal point of injection, calculated by the control unit according to special maps depending on the load, speed and temperature of the engine.

NOTE: the instant considered in the design of the maps is that of the start of injection (the cylinder is in the exhaust stroke - intake valve still closed).

Static ignition

An electronic ignition system has been adopted with "static distribution" (with semi-conductors, without distributor). This solution makes it possible to eliminate rotary components; in addition, it does not produce external sparks thus reducing the risk of interferences; lastly it reduces the number of high voltage cables and connectors; as the power modules for controlling the primary windings of the coil are inside the control unit.

Static ignition takes place through four coiis, according to the so-called "lost spark" logic: this solution exploits the different pressures and environments existing contemporaneously in a pair of cylinders: when one of the cylinders approaches the bursting stroke, with a mixture of air and fuel, the corresponding cylinder is at the end of the exhaust stroke in the presence of exhaust gas.

In a 4-cylinder in line engine, the paired cylinders are 1/4 and 2/3.

The solution adopted for this engine (T.SPARK and 16 valves) has required the adoption of a larger "central" spark plug and a smaller "side" spark plug.

Two of the four coils supply the small spark plugs and the other wto supply the large ones simultaneously the large one of the paired cylinder.

NOTE:
This way it is impossible to invert the spark plug cables during servicing operations.

Metering the air flow rate

The air flow meter adopted is of a more modern design known as the "hot film" type.

Outside, the air-flow meter looks like a part of duct between the intake manifold and the air cleaner.

Inside the air-flow meter there is an electronic circuit and a plate that is crossed by the air which passes into the duct. The film plate is kept at a constant temperature (appr. 120°C over the temperature of the incoming air) by a heating resistance placed in contact with it.

The mass of air flowing through the manifold tends to withdraw heat from the plate: therefore, to keep its temperature constant, a certain current needs to flow through the heating resistance: this current, suitably measured, is proportionate with the mass of flowing air.

N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port", thereby eliminating problems of temperature, altitude, pressure, etc.)

Cylinder detection

Following the sequential and timed injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the bursting stroke when the engine is started, in order to be able to start the correct injection sequence. The sensor is formed of a Hall-effect device by which the voltage signal sent to the control unit "lowers" suddenly when the tooth machined on the camshaft pulley passes in front of the actual sensor; therefore a signal is sent every two turns of the crankshaft.

Conversely, the rpm sensor sends a reference signal for each turn of the engine and each subsequent tooth of the phonic wheel informs the control unit of an increase of the angular position of the crankshaft, so that injection is sent correctly to the suitable cylinder and the spark to the corresponding pair of cylinders.

Fuel pump

The complex control logic of the fuel pump carried out by the control unit (mainly based on the rpm signal) immediately cuts off the supply to the pump as soon as the engine stops.
Moreover, the pump will not operate with the key engaged and the engine not running.

In this car, this logic is integrated - in order to further higher the standards of safety - by the **inertial switch** device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that takes the earth to the fuel pump, which stops instantaneously. This device is particularly important as an integration of the safety guaranteed by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents in which the engine does not stop immediately.

Timing variator

This T.SPARK 16 valve engine is fitted with an electromechanical-hydraulic timing variator which is connected to the camshaft and controls and adjusts intake timing (advance) in such a way that a larger amount of air is taken in. This device is activated by the control unit only after exceeding a determinate rpm and engine load to avoid adversely affecting correct operation of the engine at low speeds.

Percentage of exhaust gas recirculation

Nox (nitric oxide) is developed at high temperatures in the combustion chambers.
To reduce these emissions an E.G.R. (Exhaust Gas Recirculation) system is adopted which by recirculating part of the exhaust gases, lowers the temperature, thus the Nox produced, in the combustion chambers.
In fact, part of the exhaust gas is withdrawn through the special EGR Valve and re-admitted to the intake box where it is mixed with the intaken air and burnt again in the engine. The EGR valve is modulated by a solenoid valve controlled by the injection control unit and, as a result of the type of control, in addition to reducing the amount of Nox, consumption levels are also reduced.

The percentage of exhaust gas to be returned to the engine is established by the control unit taking account of a specific characteristic curve which depends on the load, speed and temperature of the engine.

OPERATING LOGIC

– Identification of the "operating point":

the "point of operation of the engine" is located mainly through two sensors: the rpm sensor informs the control unit of the speed of rotation of the engine; the air flow meter supplies the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

– Adjustment of injection times (quantity of fuel):

the control unit controls the injectors very quickly and precisely, calculating the opening time on the basis of engine load (rpm and air flow), also taking into account the battery voltage and the temperature of the engine.
Injection is "sequential", i.e. the injectors are opened in correspondence of the exhaust stroke of the corresponding cylinder.

– Ignition adjustment (calculation of advances):

the control unit calculates the advance on the basis of the engine load (rpm and air flow); the value is also corrected according to the temperature of the intaken air and that of the engine: ignition is "static" as described previously.

– Cold starting control:

during cold starts the control unit uses special advance values and injection times.
When a determinate temperature/rpm ratio is reached, the control unit resumes normal operating conditions.

– Control of enrichment during acceleration:

upon the need for acceleration, the control unit increases injection in order to reach the required load as quickly as possible.
This function takes place through the potentiometer located on the throttle which instantaneously informs the control unit of the need to accelerate.

– Fuel cut-off during deceleration:

with the throttle closed and an engine speed above a certain threshold, the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed reducing the speed and fuel consumption.
The cut-off threshold value varies according to the temperature of the engine and the speed of the car.

– Control of idle speed:

the adjustment of the engine idle speed is carried out through the special actuator fitted directly on the throttle body which acts on the throttle by-pass: in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.

– Maximum Rpm limiting:

above a certain threshold the control unit automatically stops the injection of fuel preventing the engine from "over-revving".

– Combustion control -lambda probe-:

the oxygen sensor (or "lambda" probe) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering.

The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric mixture). The electric signal sent by the probe to the control unit changes abruptly when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.
The signal from the lambda probe is processed inside the control unit by a special integrator which prevents sudden "oscillations".
The probe is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).
Through this probe it is therefore possible to adjust engine carburetion precisely. Among other items, this makes it possible to meet emission limit regulations.

– Timing variator control:

The electro-mechanical-hydraulic timing variator, connected to the camshaft, controls and adjusts the intake timing according to the load and rpm of the engine. This device is activated by the control unit at higher engine operating speeds (above 1,600 rpm and with load above 30%).

– Knocking control:

Through a knock sensor the control unit is informed if any pinging or "knocking" occurs and it corrects the spark advance "delaying" it accordingly; a further correction also takes account of the air temperature, in fact, when the temperature of the intake air is high, pinging is more accentuated.

N.B. The intaken air temperature sensor to be found just downstream of the air-flow meter, is not used to calculate the engine load but to control the knocking parameters.

– Fuel vapour recovery:

the fuel vapours collected from the various points of the supply circuit in a special active carbon canister are ducted to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition that allows correct combustion without adversely affecting the operation of the engine: in fact the control unit compensates this amount of fuel by reducing delivery to the injectors.

– E.G.R. valve control

The percentage of exhaust gas to be returned to the engine is determined by the control unit taking account of a specific characteristic curve which depends on the engine load and speed: recirculation is only activated when the engine speed is between 2500 and 4000 rpm., also in relation to the temperature of the engine (higher recirculation percentage with high temperatures).

– Connection with the air conditioner compressor:

the control unit is connected with the air conditioner compressor and it cuts in the compressor in relation to operation of the engine. As this service absorbs a considerable amount of power, the control unit:

- adapts the engine idle speed each time the compressor cuts in; if the engine speed falls below 700 rpm, the compressor is turned off;
- when there is the need for high power - high speed - over 6000 rpm, it momentaneously cuts out the compressor
- when the engine is being started the compressor is disabled until normal operating conditions have been reached.

– Connection with ALFA ROMEO CODE system:

on cars fitted with the ALFA ROMEO CODE system, as soon as the Motronic control unit receives the signal that the key has been turned to MARCIA, it "asks" the above-mentioned system for consent to start the engine: this consent is given only if the ALFRA ROMEO CODE control unit recognizes the code of the key engaged in the ignition switch as correct. This dialogue between the two control units takes place on diagnosis line K already used for the Alfa Romeo Tester.

– Self-diagnosis:

the control unit possesses a **self-diagnosis system**, which continuously monitors the plausibility of the signals from the various sensors and compares them with the limits allowed: if these limits are exceeded, the system detects a fault and turns on the corresponding warning light on the instrument cluster.

The warning light turns on when the engine is started to indicate the initial test of the entire system (appr. 4 seconds), it then turns off if no errors have been memorised: otherwise it stays on.

For certain parameters, the control unit replaces the abnormal values with suitable ones so that the car can "limp" to a point of the Service Network.
These "recovery" values depend on the other correct signals and they are defined individually by the control unit operating logic.

The self-diagnosis system also enables quick and effective location of faults connecting with the ALFA

ROMEO Tester (see "Fault-finding"), through which all the errors memorised can be displayed. It is also possible to check the operating parameters recorded by the control unit and operate the single actuators to check whether they are working properly.

COMPONENTS

The electronic control unit receives the signals leading from the **sensors** which measure the engine operating parameters. It processes them according to a logic stored inside in "maps" which correlate the different parameters in the best way possible and it operates the **actuators** accordingly so that the engine always works with the highest level of regularity and yield.

The sensors are the following:

– engine temperature sensor (**S7**);

– air temperature sensor (**S34**);

– sensor on throttle body (**S38**);

– rpm sensor (**S31**);

– cam angle sensor (**S52**);

– heated lambda sensor (**S35**)

– air-flow meter (**S5**);

– knock sensor (**S20**);

The actuators are the following:

– electroinjectors (**S3**);

– ignition coils (**A8**);

– fuel pump (**P18**);

– idle adjustment actuator (**S29**);

– vapour recovery solenoid valve (**M15**) ;

– E.G.R. solenoid valve (**L46**);

– timing variator (**S15**).

The control unit is also connected with:

– the climate control unit;

– the ALFA ROMEO CODE control unit (**N77**);

– the instrument cluster (**C10**) to which it supplies the signal for turning on the diagnosis warning light and for the rev counter,

– the tachometric sensor (**L17**) from which it receives the car speed signal.

The system is completed by five relays: the first three - the main relay (**S41**), secondary relay **S42** and the fuel pump relay **S12a** operate the fuel pump, the injectors, the coils and the other components of the system, while the fourth - the air-flow meter relay (**S12e**) and the fifth - the timing variator relay (**S12c**) supply the corresponding components.

The supply line for the entire system is protected by fuse **S36**, while the control unit is protected by wander fuse (**S46**); other special fuses protect the pump (**S47**), and the lambda probe resistance (**S45**).
Lastly, there is an earth point (**G60**) on the engine.
Connector **T1** enables connection with the ALFA ROMEO Tester: this is located inside the car next to the control unit.

FUNCTIONAL DESCRIPTION

The Motronic control unit **S11** controls and adjusts the entire electronic ignition and injection system; all the system supplies are protected by fuse **S36** (40A).

The control unit is supplied at pin 18 directly by the battery through fuse **S46** (7.5A). At pin 37 it receives the supply from the main relay **S41**, while at pin 27 it receives the "key- operated" supply from the secondary relay **S42**.

Pins 2, 14, 19 and 24 are earthed and serve as reference respectively for the ignition, the injectors, electronic screening and the final power stages.

Two relays control the entire system:

The main relay **S41**, acts as supply relay for the whole system; it is energized by a control signal - earth - leading from pin 36 of the control unit and consequently sends the supply (12V) to pin 37 of the control unit itself, to the fuel pump relay **S12a**, to the timing variator relay **S12c**, to the vapour recovery solenoid valve **M15**, to the idle speed actuator **S29**, to the EGR solenoid valve **L46** and lastly to the injectors **S3**.

The secondary relay **S42**, energized by the "key-operated" - from chassis no.___ via wander fuse **G389** supply, supplies the control unit at pin 27 and the primary windings of the coils **A8**.

The fuel pump relay **S12a**, supplied by the main relay **S41**, is energized by a control signal - earth - leading from pin 3 of the control unit **S11**. Consequently, the relay supplies the resistance of the lambda probe **S35**, that of the timing variator **S12c** and of course the fuel pump **P18**; this supply line is protected by a special fuse **S47** (10A).

The earth reaches the pump **P18** via the inertial switch **H20** which cuts off the circuit in the event of impact.

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

Through a frequency signal sent to pins 48 and 49 of the control unit, the rpm sensor **S31** supplies information about the engine rpm; the two above-mentioned signals are very low in intensity and are therefore suitably screened.

The sensor is inductive and detects the number of revolutions of the engine through the change in a magnetic field produced by the passage of the teeth

of a "phonic" wheel (60-2 teeth) fitted on the crankshaft.

The cam angle sensor **S52** (timing sensor), supplied at 5 V by pin 12 of the control unit, and sends a signal in frequency corresponding to the phase to pin 8 of the control unit itself; these two signals are very low in intensity and are therefore suitably screened.
The sensor comprises a Hall effect device due to which the voltage signal sent to the control unit "lowers" abruptly when the hollow machined on the camshaft passes in front of the sensor.

The heated lambda sensor **S35** supplies the control unit information about the correct composition of the air-fuel mixture detecting the concentration of oxygen in the exhaust gas; this takes place through the signal sent to pin 10 of the control unit, while pin 28 supplies the reference earth; these two signals are very low in intensity and are therefore suitably screened.
The sensor is heated by a resistance to make sure that it operates correctly also when the engine is cold; the resistance is supplied by the fuel pump relay **S12a** and it is protected by a specific fuse **S45** (7.5A).

The throttle body sensor **S38**, is supplied by the control unit from pins 12 and 30 and through a potentiometer it sends a signal to pin 53 which is proportionate with the degree of opening of the throttle itself.

The engine temperature sensor **S7**, connected to the electronic earth at pin 30, supplies a signal to pin 45 proportionate with the temperature of the engine coolant, detected with an NTC material (resistance that lowers with the temperature).

The intaken air temperature sensor **S34**, connected to the electronic earth at pin 30, supplies a signal at pin 54 that is proportionate with the temperature of the air entering the intake box, detected with an NTC material (resistance that lowers with the temperature).

The knock sensor **S20**, through a frequency signal sent to pin 11 of the control unit, supplies information about the knocking conditions, while an electronic earth leads from pin 30; these two signals are very low in intensity and are therefore suitably screened.

The sensor comprises a piezoelectric plate which detects the vibrations produced when the engine is running, exploiting a particular characteristic of piezoelectric materials which generate an output voltage when subjected to mechanical stresses; this voltage is filtered and analysed by the control unit which corrects the ignition parameters accordingly.

The air flow meter **S5**, is supplied by the special relay **S12a**: from pin 26 of the control unit it receives the reference earth, while it sends a signal proportionate with the air flow to pin 7.

The air flow meter is of the "heated film" type: a diaphragm is interposed in a measurement channel, through which the intake air flows: this diaphragm is kept at a constant temperature by a heating resistance; the mass of air that crosses the measurement channel tends to withdraw heat from the diaphragm, therefore, in order to maintain its temperature constant, a certain amount of current must flow through the resistance: this current, appropriately measured, is proportionate with the mass of air flowing in the channel.

On the basis of the signals received from the sensors and of the calculations carried out, the control unit **S11** controls the opening of the single injectors **S3** through special signals - of the duty-cycle type - pins 17 (cyl. 1), 34 (cyl. 2), 16 (cyl. 3) and 35 (cyl. 4). The injectors receive consent (12V) to open from the main relay **S41**.

The static ignition system is controlled by the control unit directly which automatically adjusts the advance. N.B. the power modules which generate the high voltage pulses are located inside the control unit. The control signals (earth) for the primary windings of the coils **A8** lead from the control unit, while the secondary winding sends the pulse to the spark plugs **A12**: from pins 1 and 21 for cylinders 1- 4 and from pins 28 and 30 for cylinders 2-3.
The primary windings of the coils **A8** are supplied at 12 V ("key-operated") by relay **S42**.

The power modules inside the control unit are connected to earth via pin 2.

The idle speed adjustment actuator **S29** forms a by-pass line for the flow of air; this comprises two windings: one opens and the other closes a valve that adjusts the gap of the by- pass section; it is controlled by the control unit through the duty-cycle signals of pins 22 (closing) and 4 (opening).

The vapour recovery solenoid valve **M15** allows the passage of the fuel vapours towards the engine intake where they are added to the mixture entering the combustion chamber; this valve, supplied by the main relay **S41**, is opened by the control unit when the engine is under load through a duty cycle signal from pin 5.

The E.G.R. solenoid valve **L46**, controlled by the control unit, operates the actual E.G.R. valve modulating its opening: the latter is a vacuum-operated diaphragm valve: the electropneumatic valve works by changing this vacuum which is withdrawn from the same "takeoff" used for the servobrake.

The solenoid valve is controlled from pin 33 of the control unit while it is supplied at 12 V by main relay **S41**.

The timing variator **S15** mechanically controls timing advance at the intake; it is operated by the corresponding relay **S12c**: this relay is supplied by relays **S12a** and **S41** and it is energized via a negative signal from the control unit (pin 52), thus supplying the timing variator **S15**: this signal operates the actuator which controls the flow of oil in the hydraulic unit of the device that adjusts camshaft rotation.

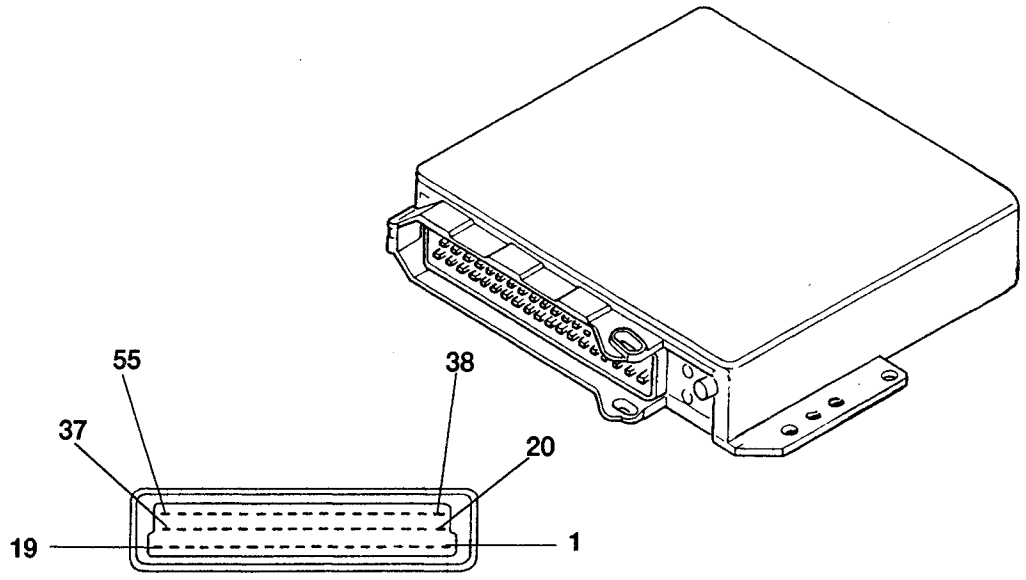
variator **S15**: this signal operates the actuator which controls the flow of oil in the hydraulic unit of the device that adjusts camshaft rotation.

The tachometric signal (car speed) reaches the control unit at pin 9 via sensor **L17**; while from pin 6 the control unit sends a "pulse" signal to the cluster which is proportionate with the number of revolutions of the engine; the signal for the "Check Engine" warning light on the cluster **C10** leads from pin 51.

The control unit **S11** is connected with the air conditioning system through pins 32, 40 and 41.
This makes it possible to adapt the engine idle speed to the increased power each time the compressor cuts in, or to cut it out in the case of high speed or engine loads. For further details see the "Climate control" section.

The control unit **S11** is connected by pin 55 with the ALFA ROMEO CODE control unit **N77** via the diagnosis line K; if the ALFA ROMEO CODE system does not recognise a correct "key code" it will not enable the Motronic control unit to start the engine.

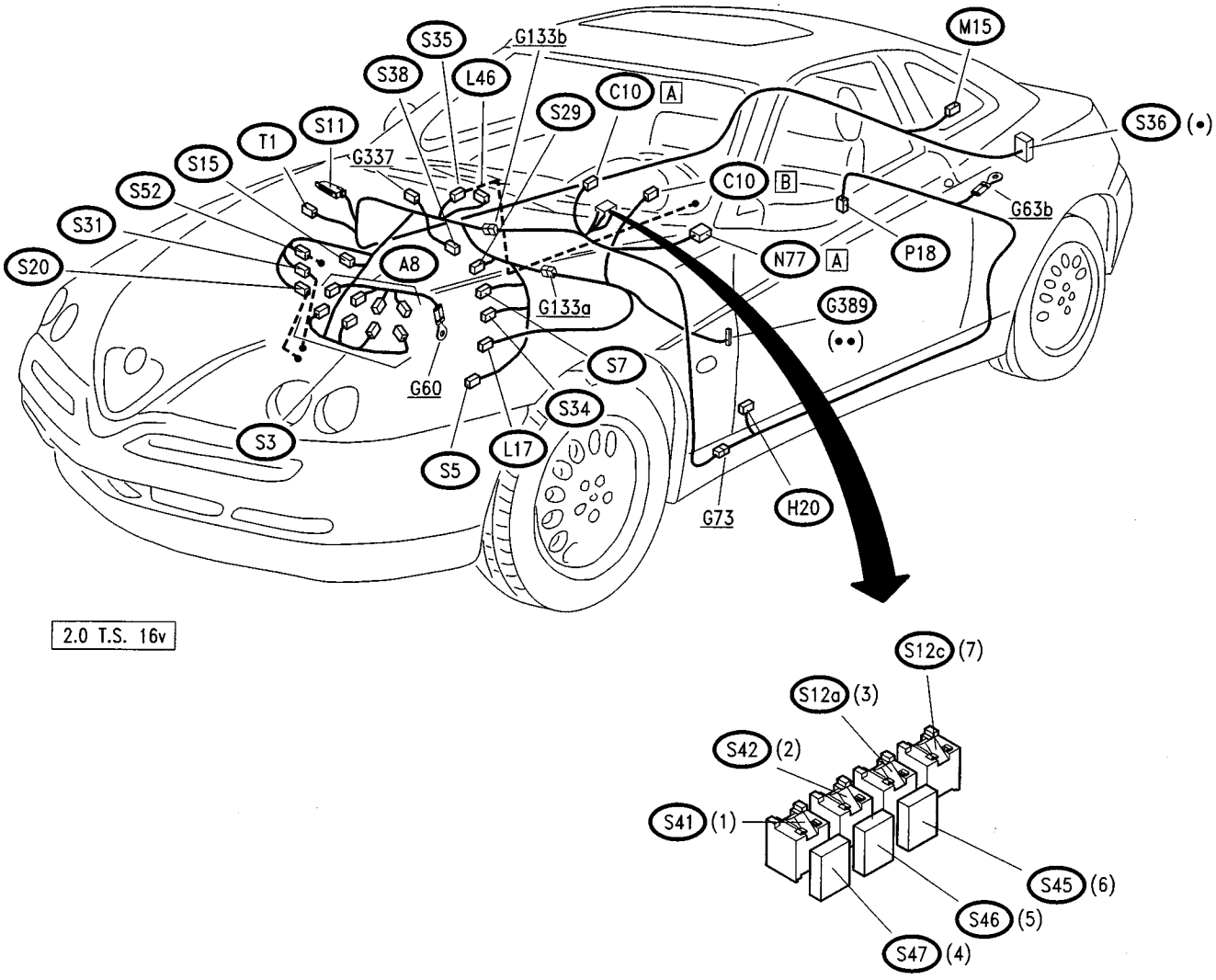
The control unit possesses a self-diagnosis system which can be used through connection to the ALFA ROMEO Tester at connector **T1**; the tester receives the fault signals from the control unit through the diagnosis lines L - pin 13 -and K - pin 55 -, while the earth leads from **G60** (line K is also used by the ALFA ROMEO CODE control unit).



CONTROL UNIT PIN-OUTS

1. Ignition coil control - cyl. 1 and 4 -
2. Earth for ignition
3. Fuel pump relay control
4. Idle actuator control - opening
5. Evaporative solenoid valve control
6. Rev counter signal
7. Air flow meter signal
8. Timing signal
9. Car speed signal
10. Lambda probe signal
11. Knock sensor signal
12. Stabilized voltage (5V) for sensors
13. Diagnosis line L
14. Earth for injectors
15. N.C.
16. Cyl. 3 injector
17. Cyl. 1 injector
18. Direct supply
19. Electronic screening earth
20. Ignition coil control - cyl. 3 and 2
21. Ignition coil control - cyl. 4 and 1
22. Idle speed actuator control - closing
23. N.C.
24. Earth for final stages
25. N.C.
26. Air-flow meter earth
27. "Key-operated" supply, from secondary relay
28. Lambda probe earth
29. N.C.
30. Electronic earth for sensors
31. N.C.
32. Conditioner compressor relay control
33. E.G.R. solenoid valve control
34. Injector cyl. 2
35. Injector cyl. 4
36. Main relay control
37. Supply from main relay
38. Cyl. 2 and 3 ignition coil control
39. N.C.
40. Conditioning system control
41. Compressor cut-in request
42. N.C.
43. N.C.
44. N.C.
45. Engine temperature signal
46. N.C.
47. N.C.
48. Signal for rpm sensor
49. Rpm sensor signal
50. N.C.
51. "Check Engine" warning light
52. Timing variator control
53. Throttle position signal
54. Intaken air temperature signal
55. Diagnosis line K (also for ALFA ROMEO CODE)

LOCATION OF COMPONENTS

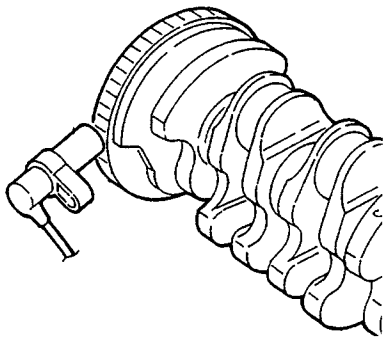


(•) Black fuseholder
(••) Red fuseholder

(1)	Black base	(5)	Brown fuseholder
(2)	Black base	(6)	Brown fuseholder
(3)	Black base	(7)	Black base
(4)	Red fuseholder		

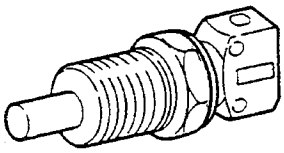
CHECKING COMPONENTS

Rpm sensor (S31)



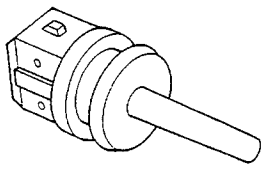
SPECIFICATIONS	
Sensor winding resistance 20 °C	486 ÷ 594 Ω
Gap between sensor and phonic wheel	0.5 ÷ 1.5 mm

Engine temperature sensor (S7)



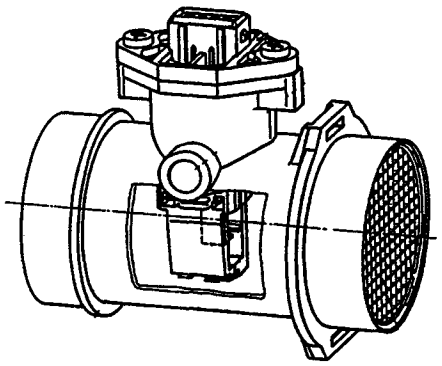
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

Intaken air temperature sensor (S34)

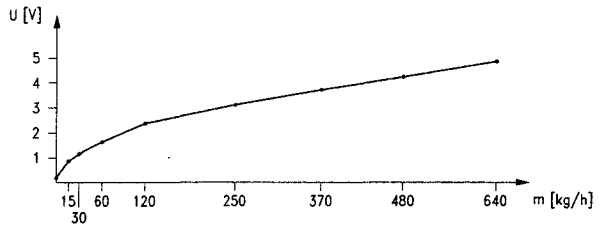


SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

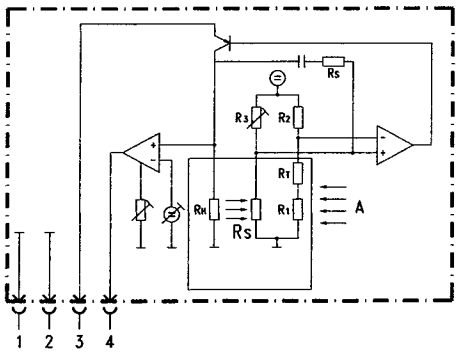
Air flow meter (S5)



SPECIFICATIONS	
Current that crosses the diaphragm:	
flow rate (kg/h)	current (A)
0 640	≤ 0.25 ≤ 0.80

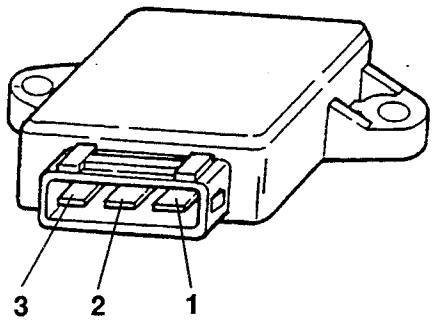


Characteristic curve of sensor
m = flow rate
U = voltage between pins 4 and 2



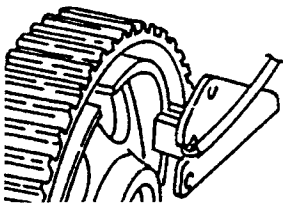
pin 1 - Earth
pin 2 - Reference earth
pin 3 - 12 V supply
pin 4 - Measurement signal
A = air
Rs = hot film sensor

Throttle position sensor (S38)

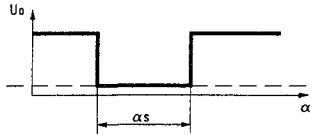


SPECIFICATIONS	
Resistance between terminals:	
1 - 2 (fixed)	≃ 2 kΩ
1 - 3 (throttle closed)	≃ 1 kΩ
1 - 3 (throttle completely open)	≃ 2.7 kΩ

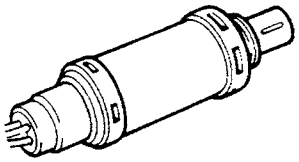
Cam angle sensor (S52)



SPECIFICATIONS
The voltage signal "lowers" sharply when the hollow machined on the camshaft passes in front of the sensor itself:

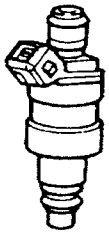


Lambda probe (S35)



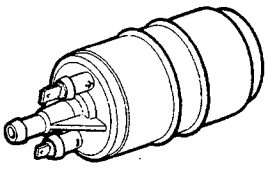
SPECIFICATIONS	
Heating resistance	3 Ω

Electroinjectors (S3)



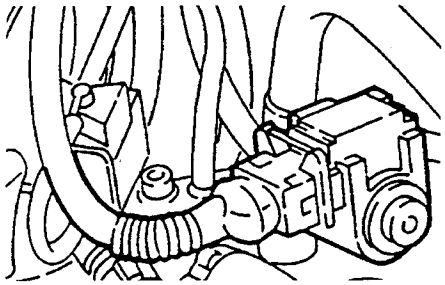
SPECIFICATIONS	
Winding resistance	15.9 ± 0.35 Ω

Fuel pump (P18)



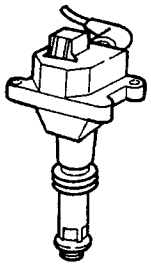
SPECIFICATIONS	
Flow rate	≥120 l/h
Pressure	4 bar
Nominal voltage	12V

Idle speed adjustment actuator (S29)



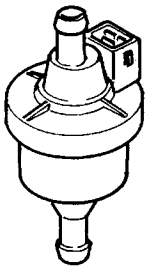
SPECIFICATIONS	
Resistance between terminals:	
1 - 3	~ 33 Ω
1 - 2	~ 17.5 Ω
2 - 3	~ 15.5 Ω

Ignition coils (A8)



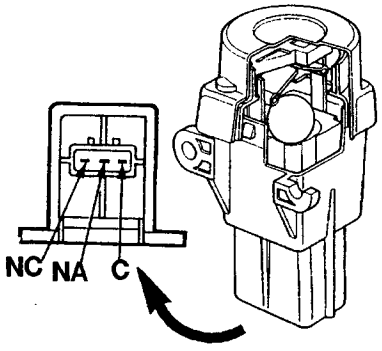
SPECIFICATIONS	
Primary resistance	0.3 Ω ± 12%
Secondary resistance	7 kΩ ± 12%

Evaporative solenoid valve (M15)



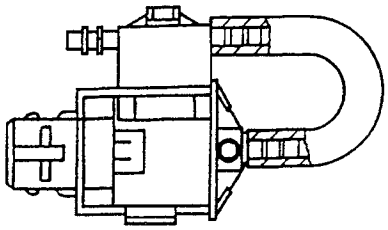
SPECIFICATIONS	
Duty-cycle signal	12 V; 10 Hz
Ohmic resistance of the winding	26 ± 4 Ω
When not energized the solenoid valve is normally closed	

Inertial switch (H20)



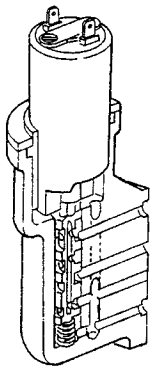
SPECIFICATIONS
Check the continuity between pins NC and C: this continuity is cut off in the event of a crash; the contact is re- connected by pressing the special pushbutton

E.G.R. Solenoid valve (L46)



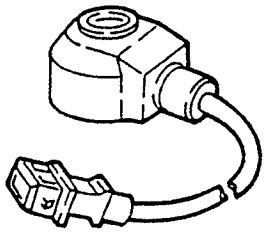
SPECIFICATIONS	
Duty cycle signal	12V; 15.3 Hz
Ohmic resistance of winding (at 20°C)	26.6 ± 1.4 Ω

Timing variator (S15)



SPECIFICATIONS	
Resistance between the two terminals	~ 10 Ω
Max. absorption at 13.5 V	1.34 A

Knock sensor (S20)



SPECIFICATIONS		
Resonance frequency		> 20 kHz
Impedance		≥ 1 MΩ
Vibration allowed	for long periods	≤ 80 g
	for short periods	≤ 400 g

FAULT-FINDING

The control unit possesses a self-diagnosis system which continuously monitors the signals leading from the different sensors for plausibility and compares them with the allowed limits: if these limits are exceeded the system detects a fault, memorizes it and turns on the warning light on the instrument cluster.

For certain parameters the control unit replaces the abnormal values with suitable mean values to enable the car to "limp" to a point of the Service Network.

These "recovery" values depend on the other correct signals and are defined each time by the operating logic of the control unit.

The self-diagnosis system also makes it possible to quickly and effectively locate faults by connection with the ALFA ROMEO TESTER, through which all the errors memorised may be "read". It is also possible to check the operating parameters recorded by the control unit and command the engagement of the single actuators to check whether they are working properly.

Diagnosis using the ALFA TESTER

N.B. Before carrying out diagnosis with the Tester, make the preliminary check given on the next page (**TEST A**).

The Tester and the control unit should be connected as follows:

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

The Tester can give the following information:

– display of parameters;

– display of errors;

– active diagnosis.

Error clearing

Before ending diagnosis the contents of the "permanent" memory must be erased using the Tester in the Active Diagnosis mode.

Otherwise, when the Tester is re-connected it would signal errors already examined.

The "permanent" memory can be cleared in the following ways:

– through the Tester in Active Diagnosis;

– if the cause of the error is no longer present and the engine has been started 10 times (running for no less than 20 minutes) with at least 2 minutes between one start and the next.

N.B.:
Disconnecting the control unit for at least 30 seconds the "permanent" memory is cleared.

PRELIMINARY CHECK OF THE BOSCH M2.10 SYSTEM	TEST A

NOTE: Check beforehand that the ALFA ROMEO CODE is working properly which might have cut off the supply to the system!

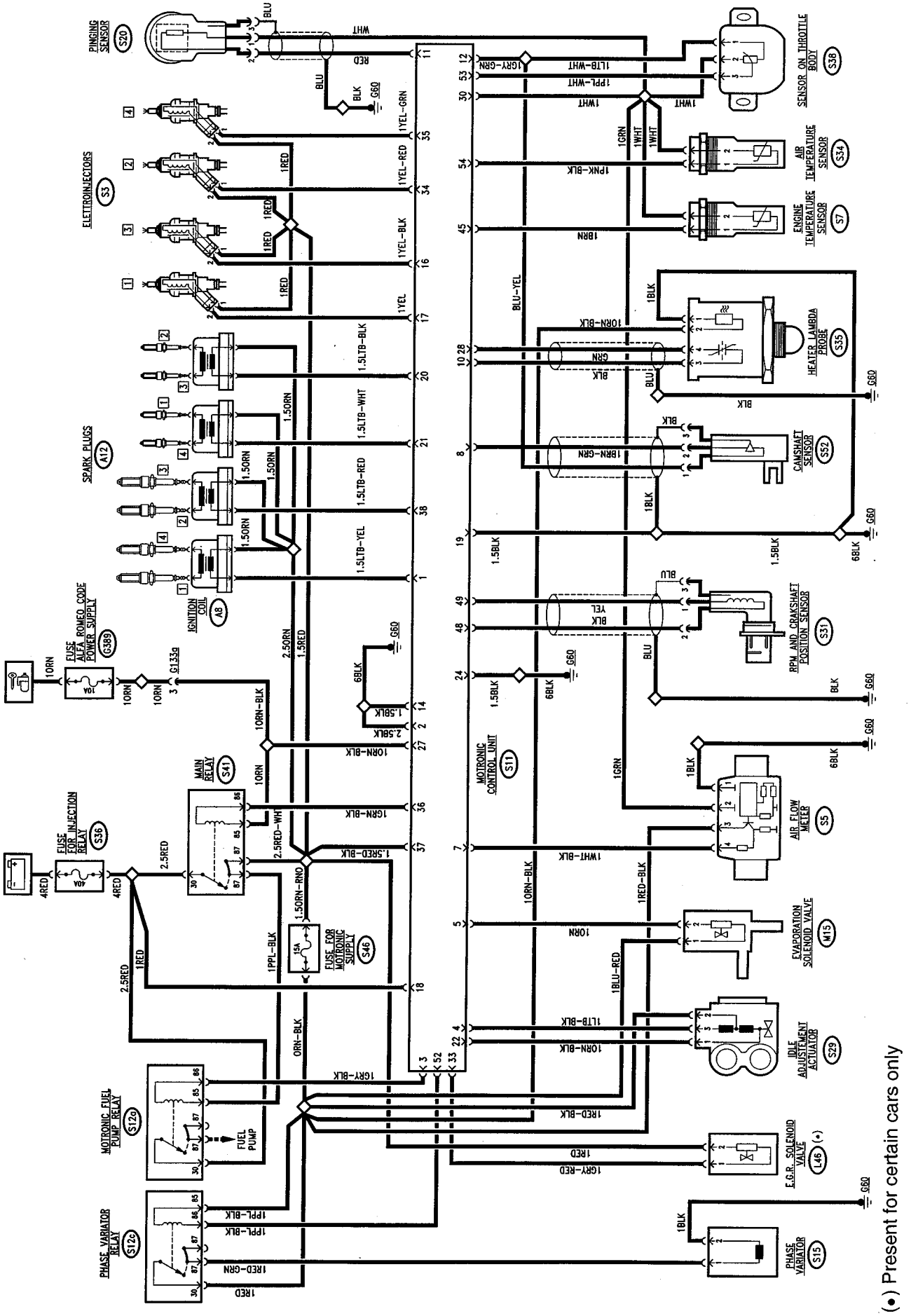
TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK FUSE – Check intactness of fuses **S36**, **S46**, **S47** and **G389**	OK ➡	Carry out **step A2**
	~~OK~~ ➡	Change fuses **S36**: 40A **S46**: 7.5A **S47** : 10A **G389** : 10A (from chassis no.___)
A2 CHECK VOLTAGE – Check for 12 V at pin 30 of relays **S41, S42** and **S12a** and also at pin 85 of **S41**	OK ➡	Carry out **step A3**
	~~OK~~ ➡	Restore the wiring between the battery **A1** and relays **S41, S42** and **S12a**
A3 CHECK VOLTAGE – With the key turned, check for 12 V at pin 85 of relay **S42**	OK ➡	Carry out **step A4**
	~~OK~~ ➡	Restore the wiring between the ignition switch **B1** and relay **S42** and from chassis no.___ - between the fuse **G389**
A4 CHECK RELAYS – Check the correct operation of relays **S41**, **S42** and **S12a**	OK ➡	Carry out **step A5**
	~~OK~~ ➡	Change any faulty relays
A5 CHECK CONTROL UNIT SUPPLY – Check for 12 V at pin 18 of control unit **S11**; with the key turned 12 V also at pins 27 and 37 of **S11** and appr. 0 V (very low voltage) at pin 3 and 36 of **S11**	OK ➡	Carry out **step A6**
	~~OK~~ ➡	Restore the wiring between the control unit **S11** and the relays and between the control unit and fuse **S46**
A6 CHECK EARTH – Check for an earth at pins 19 and 24. Also check for an earth at pin 86 of **S42** .	OK ➡	**CONTINUE DIAGNOSIS USING THE ALFA ROMEO TESTER**
	~~OK~~ ➡	Restore the wiring between **S11** and the relays and earth **G60**

CONTROL SYSTEM - 2.0 T.SPARK 16v engine: BOSCH MOTRONIC M2.10.4

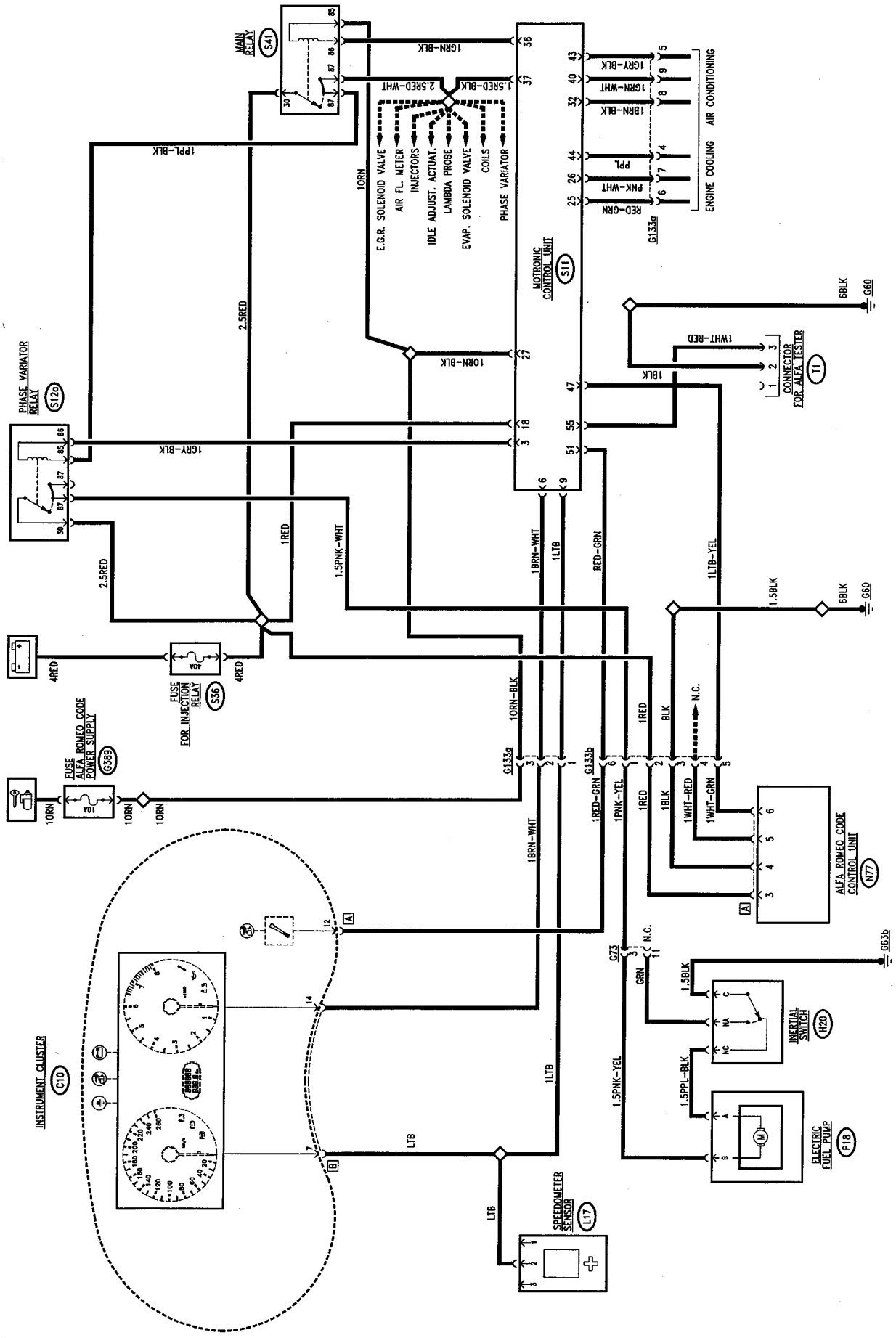
INDEX

from chassis N°6023907, replaces the previous version MOTRONIC M2.10.3

WIRING DIAGRAM "A"



WIRING DIAGRAM "B"



GENERAL DESCRIPTION

An electronic control system supervises and regulates all the parameters of the engine, optimising performance and consumption levels through response in real time to the different operating conditions: this sophisticated latest generation system consists of a single control unit which controls both ignition (static with lost spark) and injection (timed).

This is the M 2.10.4 version of the proven and reliable BOSCH MOTRONIC system.

Compared with the previous versions this new M 2.10.4 system adopts a control unit - with 55 pins - with advanced design and production technology, it also possesses many possibilities for inserting auxiliary functions (engine cooling fan).

As a result of the use of new sensors and revision of the control programmes, the system makes it possible to achieve considerable improvements in terms of consumption, emission levels and vehicle handling.

Another feature of this system is self-adaptation, i.e. the capability to recognise the changes that take place in the engine and to compensate them, according to functions which mainly correct:

- the mixture titration
- the caburetion parameters according to the command of the evaporative solenoid valve
- an adaptive programme for idle speed control.

FUNCTIONS OF THE SYSTEM

Sequential and timed injection (S.E.F.I.)

With this control unit, fuel injection is sequential and timed for each cylinder: the injection instant (delivery of fuel into the intake manifolds by the opening of the injectors) is not simultaneous for all the cylinders, but takes place for each cylinder in correspondence with the optimal point of injection, calculated by the control unit according to special maps depending on the load, speed and temperature of the engine.

Static ignition

An electronic ignition system has been adopted with "static distribution" (with semi-conductors, without distributor). This solution makes it possible to eliminate rotary components; in addition, it does not produce external sparks thus reducing the risk of interferences.

Static ignition takes place through four coils, according to the so-called "lost spark" logic: this solution exploits the different pressures and environments existing contemporaneously in a pair of cylinders: when one of the cylinders approaches the bursting stroke, with a mixture of air and fuel, the corresponding cylinder is at the end of the exhaust stroke in the presence of exhaust gas.

In a 4-cylinder in line engine, the paired cylinders are 1/4 and 2/3.

The solution adopted for this engine (T.SPARK and 16 valves) has required the adoption of a larger "central" spark plug and a smaller "side" spark plug.

Two of the four coils supply the small spark plug of the cylinder below and simultaneously the other two supply the large ones.

NOTE: This way it is also impossible to invert the spark plug cables during servicing operations.

Metering the air flow rate

The air flow meter adopted is of a more modern design known as the "hot film" type.

Outside, the air-flow meter looks like a part of duct between the intake manifold and the air cleaner.

Inside the air-flow meter there is an electronic circuit and a plate that is crossed by the air which passes into the duct. The film plate is kept at a constant temperature (appr. 120°C over the temperature of the incoming air) by a heating resistance placed in contact with it.

The mass of air flowing through the manifold tends to withdraw heat from the plate: therefore, to keep its temperature constant, a certain current needs to flow through the heating resistance: this current, suitably measured, is proportionate with the mass of flowing air.

N.B. This air flow meter measures directly the mass of air (and not the volume as in the previous versions with "floating port", thereby eliminating problems of temperature, altitude, pressure, etc.)

Cylinder detection

Following the sequential and timed injection system, a timing sensor has been introduced (cam angle sensor): this makes it possible to detect which cylinder is in the bursting stroke when the engine is started, in order to be able to start the correct injection sequence. The sensor is formed of a Hall-effect device by which the voltage signal sent to the control unit "lowers" suddenly when the tooth machined on the camshaft pulley passes in front of the actual sensor; therefore a signal is sent every two turns of the crankshaft.

Conversely, the rpm sensor sends a reference signal for each turn of the engine and each subsequent tooth of the phonic wheel informs the control unit of an increase of the angular position of the crankshaft, so that injection is sent correctly to the suitable cylinder and the spark to the corresponding pair of cylinders.

Fuel pump

The complex control logic of the fuel pump carried out by the control unit (mainly based on the rpm signal) immediately cuts off the supply to the pump as soon as the engine stops.
Moreover, the pump will not operate with the key engaged and the engine not running.

In this car, this logic is integrated - in order to further higher the standards of safety - by the **inertial switch** device: this is an electromechanical switch which, in the event of heavy shocks, opens to cut off the circuit that takes the earth to the fuel pump, which stops instantaneously. This device is particularly important as an integration of the safety guaranteed by the logic of the control unit, especially if the car is hit from behind or in the case of other accidents in which the engine does not stop immediately.

Timing variator

This T.SPARK 16 valve engine is fitted with an electromechanical-hydraulic timing variator which is connected to the camshaft and controls and adjusts intake timing (advance) in such a way that a larger amount of air is taken in. This device is activated by the control unit only after exceeding a determinate rpm and engine load to avoid adversely affecting correct operation of the engine at low speeds.

Percentage of exhaust gas recirculation

Nox (nitric oxide) is developed at high temperatures in the combustion chambers.
To reduce these emissions an E.G.R. (Exhaust Gas Recirculation) system is adopted which by recirculating part of the exhaust gases, lowers the temperature, thus the Nox produced, in the combustion chambers.
In fact, part of the exhaust gas is withdrawn through the special EGR Valve and re-admitted to the intake box where it is mixed with the intaken air and burnt again in the engine. The EGR valve is modulated by a solenoid valve controlled by the injection control unit and, as a result of the type of control, in addition to reducing the amount of Nox, consumption levels are also reduced.

The percentage of exhaust gas to be returned to the engine is established by the control unit taking account of a specific characteristic curve which depends on the load, speed and temperature of the engine.

OPERATING LOGIC

– Identification of the "operating point":

the "point of operation of the engine" is located through two sensors: the rpm sensor informs the control unit of the speed of rotation of the engine; the air flow meter supplies the value of the mass of air actually entering the cylinders, defining the instantaneous volumetric yield of the engine.

– **Adjustment of injection times (quantity of fuel):** the control unit controls the injectors extremely quickly and precisely, calculating the opening time on the basis of engine load (rpm and air flow), also taking into account the battery voltage and the temperature of the engine. .

– Ignition adjustment (calculation of advances):

the control unit calculates the advance on the basis of the engine load (rpm and air flow); the value is also corrected according to the temperature of the intaken air and that of the engine: ignition is "static" as described previously.

– Cold starting control:

during cold starts the control unit uses special advance values and injection times.

When a determinate temperature/rpm ratio is reached, the control unit resumes normal operating conditions.

– Control of enrichment during acceleration:

upon the need for acceleration, the control unit increases injection in order to reach the required load as quickly as possible.
This function takes place through the potentiometer located on the throttle which instantaneously informs the control unit of the need to accelerate.

– Fuel cut-off during deceleration:

with the throttle closed and an engine speed above a certain threshold, the control unit de-activates fuel injection; this way the rpms decrease rapidly towards idle speed reducing the speed and fuel consumption. The cut-off threshold value varies according to the temperature of the engine and the speed of the car.

– Control of idle speed:

the adjustment of the engine idle speed is carried out through the special actuator fitted directly on the throttle body which acts on the throttle by-pass: in fact, when the throttle is closed, this valve adjusts the by-pass gap compensating the load required by the services in order to ensure that idle speed is as constant as possible.

– Maximum Rpm limiting:

above a certain threshold the control unit automatically stops the injection of fuel preventing the engine from "over-revving".

– Combustion control -lambda sensor-:

the oxygen sensor (or "lambda" sensor) informs the control unit of the amount of oxygen at the exhaust, and therefore the correct air-fuel metering.

The optimum mixture is obtained when the lambda coefficient = 1 (optimum stoichiometric mixture). The

electric signal sent by the sensor to the control unit changes abruptly when the composition of the mixture departs from lambda = 1. When the mixture is "lean" the control unit increases the amount of fuel, reducing it when the mixture is "rich": this way the engine operates as far as possible around the ideal lambda rating.

The signal from the lambda sensor is processed inside the control unit by a special integrator which prevents sudden "oscillations".

The sensor is heated by an electrical resistance so that it quickly reaches the correct operating temperature (appr. 300 °C).

Through this sensor it is therefore possible to adjust engine carburetion precisely. Among other items, this makes it possible to meet emission limit regulations.

– Timing variator control:

The electro-mechanical-hydraulic timing variator, connected to the camshaft, controls and adjusts the intake timing according to the load and rpm of the engine. This device is activated by the control unit at higher engine operating speeds (above 1,600 rpm and with load above 30%).

– Pinging control:

Through a knock sensor the control unit is informed if any pinging or "pinging" occurs and it corrects the spark advance "delaying" it accordingly; a further correction also takes account of the air temperature, in fact, when the temperature of the intake air is high, pinging is more accentuated.

N.B. The intaken air temperature sensor to be found just downstream of the air-flow meter, is not used to calculate the engine load but to control the pinging parameters.

– Fuel vapour recovery:

the fuel vapours collected from the various points of the supply circuit in a special active carbon canister are ducted to the engine where they are burnt: this takes place through a solenoid valve which is opened by the control unit only when the engine is in a condition that allows correct combustion without adversely affecting the operation of the engine: in fact the control unit compensates this amount of fuel by reducing delivery to the injectors.

– E.G.R. valve control

The percentage of exhaust gas to be returned to the engine is determined by the control unit taking account of a specific characteristic curve which depends on the engine load and speed: recirculation is only activated when the engine speed is between 2500 and 4000 rpm., also in relation to the temperature of the engine (higher recirculation percentage with high temperatures).

– Connection with the air conditioner compressor:

the control unit is connected with the air conditioner system and it cuts in the compressor in relation to operation of the engine.

For further details see section "Air Conditioner"

– Connection with the radiator cooling fan

in this version the thermal contact for controlling the cooling fan on the radiator has been eliminated. The command for the first and second speed of the fan is in fact supplied by the injection control unit in relation to the temperature measured by the coolant fluid temperature sensor.

– Connection with ALFA ROMEO CODE system:

as soon as the Motronic control unit receives the signal that the key has been turned to MARCIA, it "asks" the above-mentioned system for consent to start the engine: this consent is given only if the ALFRA ROMEO CODE control unit recognizes the code of the key engaged in the ignition switch as correct.

This dialogue between the two control units takes place on the special serial line which connects them.

– Self-diagnosis:

the control unit possesses a **self-diagnosis system**, which continuously monitors the plausibility of the signals from the various sensors and compares them with the limits allowed: if these limits are exceeded, the system detects a fault and turns on the corresponding warning light on the instrument cluster.

The warning light turns on when the engine is started to indicate the initial test of the entire system (appr. 4 seconds), it then turns off if no errors have been memorised: otherwise it stays on.

For certain parameters, the control unit replaces the abnormal values with suitable ones so that the car can "limp" to a point of the Service Network.

These "recovery" values depend on the other correct signals and they are defined individually by the control unit operating logic.

The self-diagnosis system also enables quick and effective location of faults connecting with the ALFA ROMEO Tester (see "Fault-finding"), through which all the errors memorised can be "read". It is also possible to check the operating parameters recorded by the control unit and operate the single actuators to check whether they are working properly.

COMPONENTS

The electronic control unit receives the signals leading from the **sensors** which measure the engine operating parameters. It processes them according to a logic stored inside in "maps" which correlate the different parameters in the best way possible and it operates the **actuators** accordingly so that the engine always works with the highest level of regularity and yield.

The sensors are the following:

– engine temperature sensor (**S7**);

– air temperature sensor (**S34**);

– sensor on throttle body (**S38**);

– rpm sensor (**S31**);

– cam angle sensor (**S52**);

– heated lambda sensor (**S35**)

– air-flow meter (**S5**);

– pinging sensor (**S20**);

The actuators are the following:

– injectors (**S3**);

– ignition coils (**A8**);

– fuel pump (**P18**);

– idle adjustment actuator (**S29**);

– vapour recovery solenoid valve (**M15**) ;

– E.G.R. solenoid valve (**L46**); (only for certain cars)

– timing variator (**S15**).

The control unit is also connected with:

– the climate control unit and engine cooling system;

– the ALFA ROMEO CODE control unit (**N77**);

– the instrument cluster (**C10**) to which it supplies the signal for turning on the diagnosis warning light and for the rev counter,

– the tachometric sensor (**L17**) from which it receives the car speed signal.

The system is completed by three relays: the first two - the main relay (**S41**) and the fuel pump relay **S12a** operate the fuel pump, the injectors, the coils and the other components of the system, while the third - the timing variator relay (**S12c**) supplies the corresponding component.

The supply line for the entire system is protected by fuse **S36**, while the control unit is protected by wander fuse (**S46**).
Lastly, there is an earth point (**G60**) on the engine.
Connector **T1** enables connection with the ALFA ROMEO Tester: this is located inside the car next to the control unit.

FUNCTIONAL DESCRIPTION

The Motronic control unit **S11** controls and adjusts the entire electronic ignition and injection system; all the system supplies are protected by fuse **S36** (40A).

The control unit is supplied at pin 18 directly by the battery through fuse **S46** (7.5A). At pin 37 it receives the supply from the main relay **S41**, while at pin 27 it receives the "key- operated" supply.

Pins 2, 14, 19 and 24 are earthed and serve as reference respectively for the ignition, the injectors, electronic screening and the final power stages.

The main relay **S41** controls the entire system; it is energized by a control signal - earth - leading from pin 36 of the control unit and consequently sends the supply (12V) to pin 37 of the control unit itself, to the fuel pump relay **S12a**, to the injectors **S3**, to the coils **A8**, to the EGR solenoid valve **L46** (if present), to the air flow meter **S5** to the sensor **S35**; in addition - through fuse **S46** (15A) - to the timing variator relay **S12c**, to the fuel vapour recovery solenoid valve **M15**, and to the idle speed actuator **S29**.

The fuel pump relay **S12a**, supplied by the main relay **S41**, is energized by a control signal - earth - leading from pin 3 of the control unit **S11**. Consequently, the relay supplies the fuel pump **P18**. In addition the earth reaches the pump **P18** via the inertial switch **H20** which cuts off the circuit in the event of impact.

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

Through a frequency signal sent to pins 48 and 49 of the control unit, the rpm sensor **S31** supplies information about the engine rpm; the two above-mentioned signals are very low in intensity and are therefore suitably screened.

The sensor is inductive and detects the number of revolutions of the engine through the change in a magnetic field produced by the passage of the teeth of a "phonic" wheel (60-2 teeth) fitted on the crankshaft.

The cam angle sensor **S52** (timing sensor), supplied at 5 V by pin 12 of the control unit, and sends a signal in frequency corresponding to the phase to pin 8 of the control unit itself; these two signals are very low in intensity and are therefore suitably screened

The sensor comprises a Hall effect device due to which the voltage signal sent to the control unit "lowers" abruptly when the hollow machined on the camshaft passes in front of the sensor.

The heated lambda sensor **S35** supplies the control unit information about the correct composition of the air-fuel mixture detecting the concentration of oxygen in the exhaust gas; this takes place through the signal sent to pin 28 of the control unit, while pin 10 supplies the reference earth; these two signals are very low in

intensity and are therefore suitably screened.
The sensor is heated by a resistance to make sure that it operates correctly also when the engine is cold; the resistance is supplied by the main relay **S41** and it is protected by a specific fuse **S45**.

The throttle body sensor **S38**, is supplied by the control unit from pins 12 and 30 and through a potentiometer it sends a signal to pin 53 which is proportionate with the degree of opening of the throttle itself.

The engine temperature sensor **S7**, connected to the electronic earth at pin 30, supplies a signal to pin 45 proportionate with the temperature of the engine coolant, detected with an NTC material (resistance that lowers with the temperature).

The intaken air temperature sensor **S34**, connected to the electronic earth at pin 30, supplies a signal at pin 54 that is proportionate with the temperature of the air entering the intake box, detected with an NTC material (resistance that lowers with the temperature).

The pinging sensor **S20**, through a frequency signal sent to pin 11 of the control unit, supplies information about the pinging conditions, while an electronic earth leads from pin 30; these two signals are very low in intensity and are therefore suitably screened.

The sensor comprises a piezoelectric plate which detects the vibrations produced when the engine is running, exploiting a particular characteristic of piezoelectric materials which generate an output voltage when subjected to mechanical stresses; this voltage is filtered and analysed by the control unit which corrects the ignition parameters accordingly.

The air flow meter **S5**, is supplied by the relay **S41**: from pin 30 of the control unit it receives the reference earth, while it sends a signal proportionate with the air flow to pin 7.

The air flow meter is of the "heated film" type: a diaphragm is interposed in a measurement channel, through which the intake air flows: this diaphragm is kept at a constant temperature by a heating resistance; the mass of air that crosses the measurement channel tends to withdraw heat from the diaphragm, therefore, in order to maintain its temperature constant, a certain amount of current must flow through the resistance: this current, appropriately measured, is proportionate with the mass of air flowing in the channel.

On the basis of the signals received from the sensors and of the calculations carried out, the control unit **S11** controls the opening of the single injectors **S3** through special signals - of the duty-cycle type - pins 17 (cyl. 1), 34 (cyl. 2), 16 (cyl. 3) and 35 (cyl. 4). The injectors receive consent (12V) to open from the main relay **S41**.

The static ignition system is controlled by the control unit directly which automatically adjusts the advance. N.B. the power modules which generate the high voltage pulses are located inside the control unit. The control signals (earth) for the primary windings of the coils **A8** lead from the control unit, while the secondary winding sends the pulse to the spark plugs **A12**: from pins 1 and 21 for cylinders 1- 4 and from pins 28 and 30 for cylinders 2-3.

The primary windings of the coils **A8** are supplied at 12 V ("key-operated") by relay **S42**.

The power modules inside the control unit are connected to earth via pin 2.

The idle speed adjustment actuator **S29** forms a by-pass line for the flow of air; this comprises two windings: one opens and the other closes a valve that adjusts the gap of the by- pass section; it is controlled by the control unit through the duty-cycle signals of pins 22 (closing) and 4 (opening).

The vapour recovery solenoid valve **M15** allows the passage of the fuel vapours towards the engine intake where they are added to the mixture entering the combustion chamber; this valve, supplied by the main relay **S41**, is opened by the control unit when the engine is under load through a duty cycle signal from pin 5.

The E.G.R. solenoid valve **L46** (if present), controlled by the control unit, operates the actual E.G.R. valve modulating its opening: the latter is a vacuum-operated diaphragm valve: the electropneumatic valve works by changing this vacuum which is withdrawn from the same "takeoff" used for the servobrake.

The solenoid valve is controlled from pin 33 of the control unit while it is supplied at 12 V by main relay **S41**.

The timing variator **S15** mechanically controls timing advance at the intake; it is operated by the corresponding relay **S12c**: this relay is supplied by relay **S41** and it is energized via a negative signal from the control unit (pin 52), thus supplying the timing variator **S15**: this signal operates the actuator which controls the flow of oil in the hydraulic unit of the device that adjusts camshaft rotation.

The tachometric signal (car speed) reaches the control unit at pin 9 via sensor **L17**; while from pin 6 the control unit sends a "pulse" signal to the cluster which is proportionate with the number of revolutions of the engine; the signal for the "Check Engine" warning light on the cluster **C10** leads from pin 51.

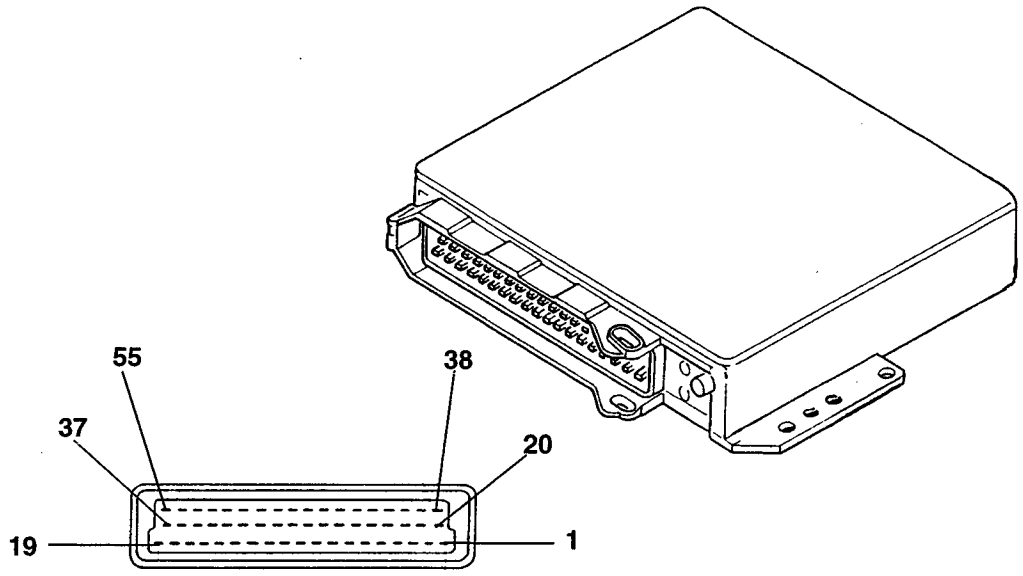
The control unit **S11** is connected with the air conditioning system through pins 32, 40 and 43.
This makes it possible to adapt the engine idle speed to the increased power each time the compressor cuts in, or to cut it out in the case of high speed or engine loads.

The control unit **S11** controls and adjusts the system for engaging the engine water cooling fan/s **P2**.

Pins 26 and 25 respectively send the command for engaging the first and second fan speed, while pin 14 recevies consent (earth) for engaging the fan from the pressure switch **Q20**.

The control unit **S11** is connected by pin 55 with the ALFA ROMEO CODE control unit **N77** via the special serial line from pin 47; this way if the ALFA ROMEO CODE system does not recognise a correct "key code" it will not enable the Motronic control unit to start the engine.

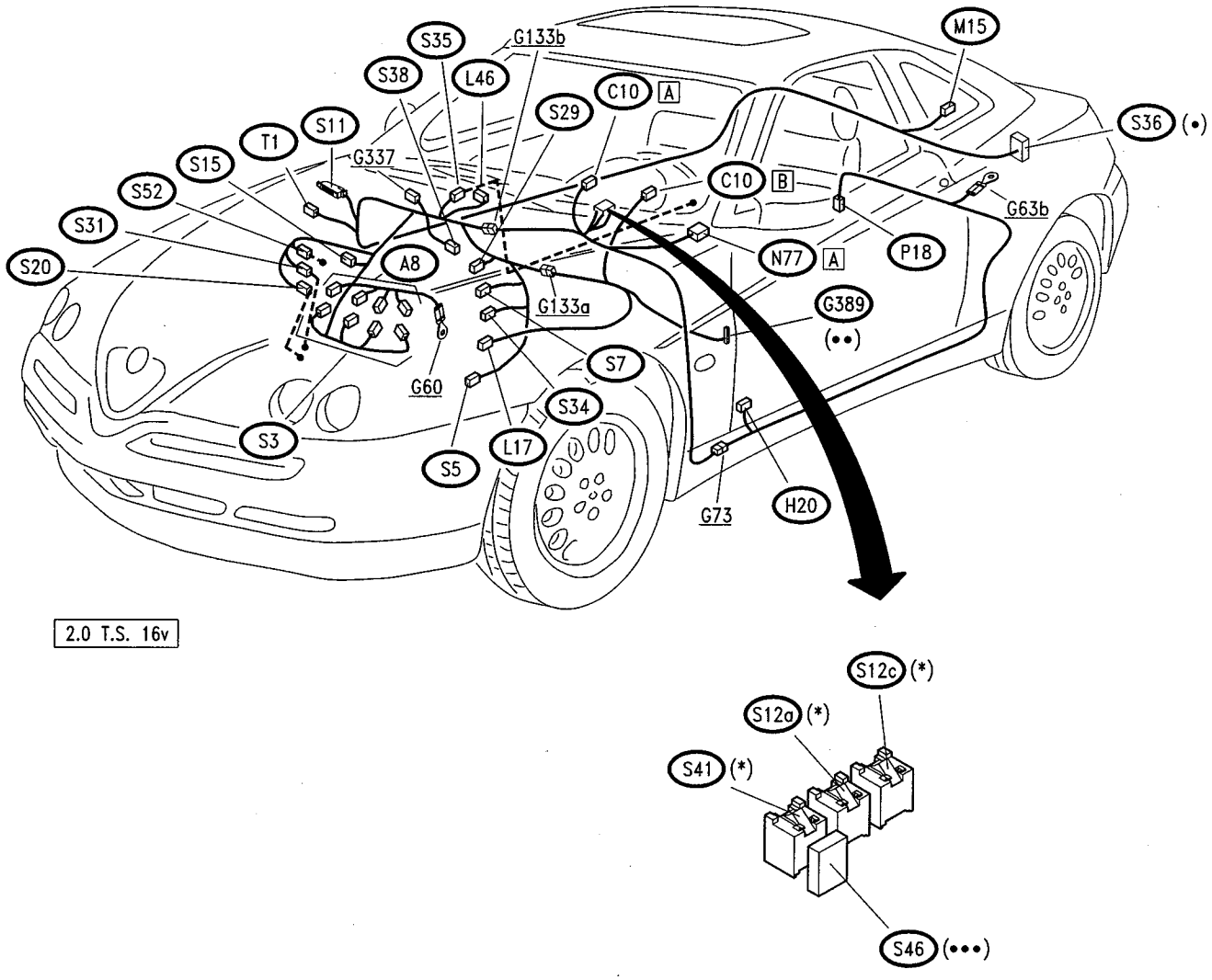
The control unit possesses a self-diagnosis system which can be used through connection to the ALFA ROMEO Tester at connector **T1**; the tester receives the fault signals from the control unit through the diagnosis line K - pin 55 -, while the earth leads from **G60**.



CONTROL UNIT PIN-OUT

1. Ignition coil control - cyl. 1 and 4 -
2. Earth for ignition
3. Fuel pump relay control
4. Idle actuator control - opening
5. Evaporative solenoid valve control
6. Rev counter signal
7. Air flow meter signal
8. Timing signal
9. Car speed signal
10. Lambda sensor signal
11. Pinging sensor signal
12. Stabilized voltage (5V) for sensors
13. N.C.
14. Earth for injectors
15. N.C.
16. Cyl. 3 injector
17. Cyl. 1 injector
18. Direct supply
19. Electronic screening earth
20. Ignition coil control - cyl. 3 and 2
21. Ignition coil control - cyl. 4 and 1
22. Idle speed actuator control - closing
23. N.C.
24. Earth for final stages 25. Fan 2nd speed command
26. Fan 1st speed command
27. "Key-operated" supply
28. Lambda sensor earth
29. N.C.
30. Electronic earth for sensors
31. N.C.
32. Conditioner compressor relay control
33. E.G.R. solenoid valve control (only for certain cars)
34. Injector cyl. 2
35. Injector cyl. 4
36. Main relay control
37. Supply from main relay
38. Cyl. 2 and 3 ignition coil control
39. N.C.
40. Compressor engagement request
41. N.C.
42. N.C.
43. Fand second speed engagement request
44. Fan first speed engagement request
45. Engine temperature signal
46. N.C.
47. Connection line with ALFA ROMEO CODE
48. Signal for rpm sensor
49. Rpm sensor signal
50. N.C.
51. "Check Engine" warning light
52. Timing variator control
53. Throttle position signal
54. Intaken air temperature signal
55. Diagnosis line K

LOCATION OF COMPONENTS

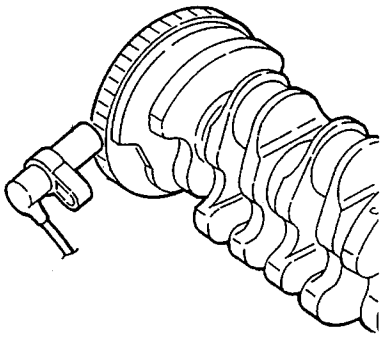


(*) Black base

(•) Black fuseholder
(••) Red fuseholder
(•••) Brown fuseholder

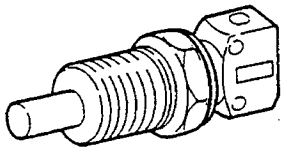
CHECKING COMPONENTS

Rpm sensor (S31)



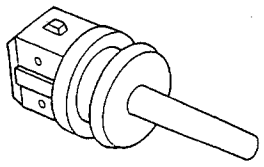
SPECIFICATIONS	
Sensor winding resistance (20 °C)	486 ÷ 594 Ω
Distance (gap) between sensor and phonic wheel	0.5 ÷ 1.5 mm

Engine temperature sensor (S7)



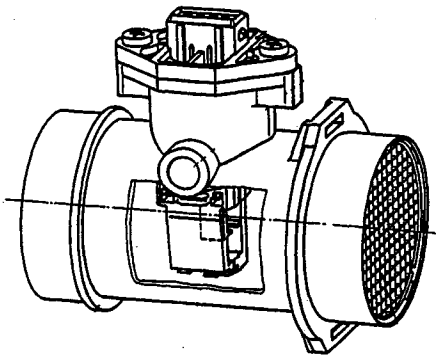
SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

Intake air temperature sensor (S34)

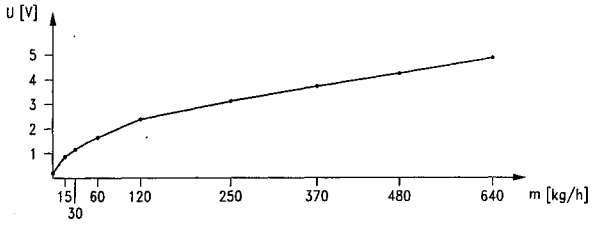


SPECIFICATIONS	
Temperature (°C)	Resistance (Ω)
- 10°C	8100 ÷ 10770 Ω
+ 20°C	2280 ÷ 2720 Ω
+ 80°C	292 ÷ 362 Ω

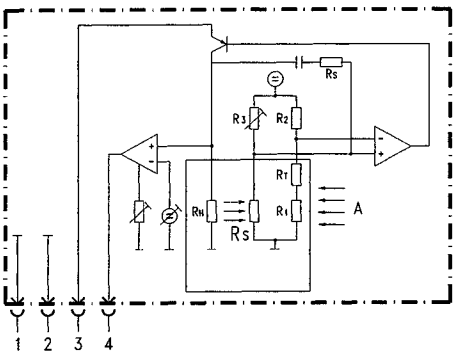
Air flow meter (S5)



SPECIFICATIONS	
Current that crosses the diaphragm:	
capacity (kg/h)	current (A)
0 640	≤ 0.25 ≤ 0.80

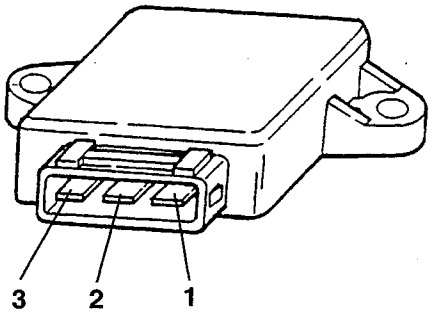


Sensor characteristic curve
m = capacity
U = voltage between pin 4 and 2



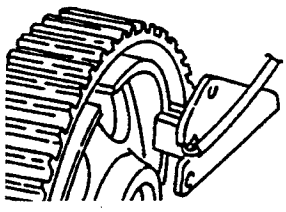
pin 1 - Earth
pin 2 - Reference earth
pin 3 - 12 V supply
pin 4 - Measurement signal
A = air
Rs = hot film sensor

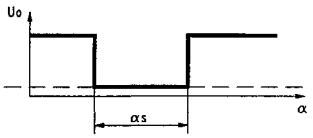
Throttle position sensor (S38)



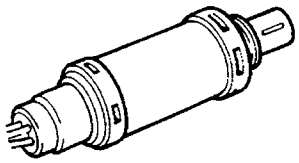
SPECIFICATIONS	
Resistance between terminals:	
1 - 2 (fixed)	≃ 2 kΩ
1 - 3 (throttle closed)	≃ 1 kΩ
1 - 3 (throttle completely open)	≃ 2.7 kΩ

Cam angle sensor (S52)



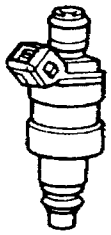
SPECIFICATIONS
The voltage signal "lowers" abruptly when the hollow machined on the camshaft passes in front of the sensor: 

Lambda sensor (S35)



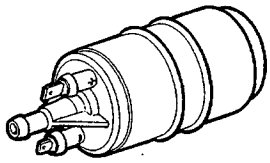
SPECIFICATIONS	
Heating resistance	3 Ω

Injectors (S3)



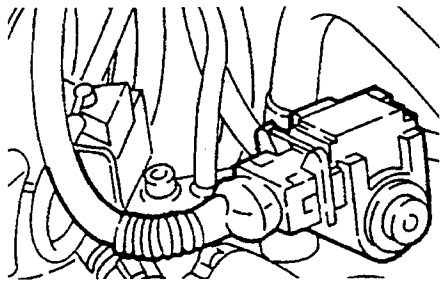
SPECIFICATIONS	
Winding resistance	15.9 ± 0.35 Ω

Fuel pump (P18)



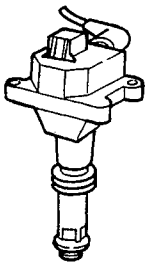
SPECIFICATIONS	
Capacity	≥120 l/h
Pressure	4 bar
Nominal voltage	12V

Idle speed adjustment actuator (S29)



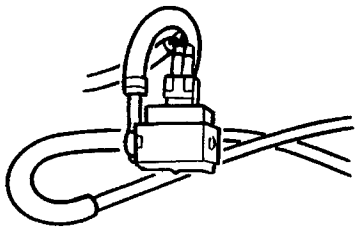
SPECIFICATIONS	
Resistance between terminals:	
1 - 3	~ 33 Ω
1 - 2	~ 17.5 Ω
2 - 3	~ 15.5 Ω

Ignition coils (A8)



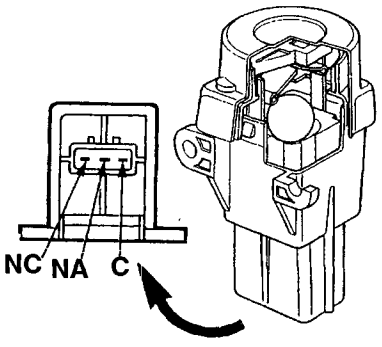
SPECIFICATIONS	
Primary resistance	0.3 Ω ± 12%
Secondary resistance	7 kΩ ± 12%

Evaporative solenoid valve (M15)



SPECIFICATIONS	
Duty-cycle signal	12 V; 10 Hz
Winding ohmic resistance ohmica	26 ± 4 Ω
When not energised the solenoid valve is normally closed	

Inertial switch (H20)



SPECIFICATIONS
Check continuity between pin NC and C: this continuity is cut off in case of a crash: the contact is closed again pressing the special push-button