Fiat Punto

DOCUMENTATION MODIFICATIONS / UPDATES

Date	Referent	File name	Description of modification

Index

1 Briefing

1.1 General features

1.1.1 Introduction

Nuova Punto: a new, dynamic and exciting car, capable of blending style and sporting features into an irresistible mix. Nuova Punto stands out to reaffirm the excellent Italian car design tradition and FIAT's calling for youth-appealing sportscars.

The determined line of new Fiat Punto, tailored by Giugiaro, has a tremendous pull on those who wish to own a car for the young, comfortable and carefully planned to the last detail.

In fact, Nuova Punto is targeted mainly at the young and the young at heart, thanks to its trim engine, driving pleasure and comfort.

Nuova Punto stands out from its main competing cars for the following:

STYLE, meant as the capability of coming up to the expectations of the end customer thanks to designs and versions that appeal to the customer and make the latter eager to own a Nuova Punto.

DRIVING PLEASURE, meant as the capability of accommodating all the passengers into a comfortable, nice car, and also pointing up those aspects which come up to the customer's expectations in terms of safety, comfort and quality, as well as the technical features of the vehicle, ensuring driving behaviour that stands out from the competing models.

BRIGHTNESS, meant as the capability of combining low operating costs and the vehicle's performance.

The **launch** product offer envisages two petrol engine versions and three diesel engine versions, the main features of which are as follows:

Petrol engines:
1.2 8v (65 HP)
1.4 8v (75 HP)

Diesel engines:
1.3 Multijet 16V (75 HP)
1.3 Multijet 16V (90 HP)
1.9 Multijet 16V (120 HP)

with four different body versions that stand out for their contents and engine models, capable of coming up to the expectations of the targeted customer groups: active, dynamic, elegance and sport.

1.1.2 Market and customers

Today, the segment to which Nuova Punto belongs accounts for 26% of the West European car market, that is to say, the “market core”, with approximately 3,750,000 units sold annually. In Italy, this segment accounts for as much as 37% of the market, which is made up of petrol engines (56%) and diesel engines (44%).

FIAT has always been a key player in the small/average car segment. Despite the crisis of the past few years, Fiat Punto has been the best selling car in Italy and the third best seller in West Europe.

Today, Nuova Punto aims at being a market leader again, not only in Italy but also all around Europe. How can this goal be achieved? By taking advantage of Nuova Punto’s dynamic and determined style, expressed through the typical Italian car design and simple, clever solutions.

This step will allow the FIAT brand to make a comeback, which has somehow started with Nuova Panda and currently in progress with Idea and Croma.
The main goal of Nuova Punto is to win back the young customers thanks to its dynamic and sporting character, through a typically Italian style – the symbol of personality and elegance. Therefore, Nuova Punto is a car for the young at heart – people who wish to express their personality in a distinctive way by making choices with a heavy emotional component.

To better meet the customer's needs, Nuova Punto comes with four body building levels:

ACTIVE: it is mainly for the young aged between 25 and 30, who are sensitive and open to the most noticeable expressions of performance-related values – dynamic, open-minded people full of energy.

DYNAMIC: for the young-to-middle aged people between 30 and 45 – resourceful people, hovering between emotional impulse and rationality, youthful enthusiasm and adult 'control'.

ELEGANCE: for mature people who make firm choices and count on high-quality outfit and optimum comfort – people sensitive to design proposals that are meant to enrich the automobile world with new drives and enthusiasm.

SPORTING: mainly intended for dynamic, sporting young people (both men and women) who are looking for highly distinctive style features and performance elements. Style, emotion, comfort, safety, low cost – what people are really looking for in a car.

Style, emotion, comfort, safety, low cost – this is what people are really looking for in a car.

Nuova Punto will offer to you:

Distinctive, Italian style
More space: 50 mm longer than the current Punto
Safety levels comparable with the best competing cars
Sturdiness
Diesel engines standing out in their categories: 1.3 (75 & 90 HP) and 1.9 (120 HP).

Considering that a vehicle's line is the main appeal as regards the reasons for purchasing, Nuova Punto means to become the leader within its own market segment by relying on a modern, fascinating line launching out to the young world thanks to its nimbleness and versatility that distinguish it from ordinary two-box cars.

1.2 The vehicle

1.2.1 Style

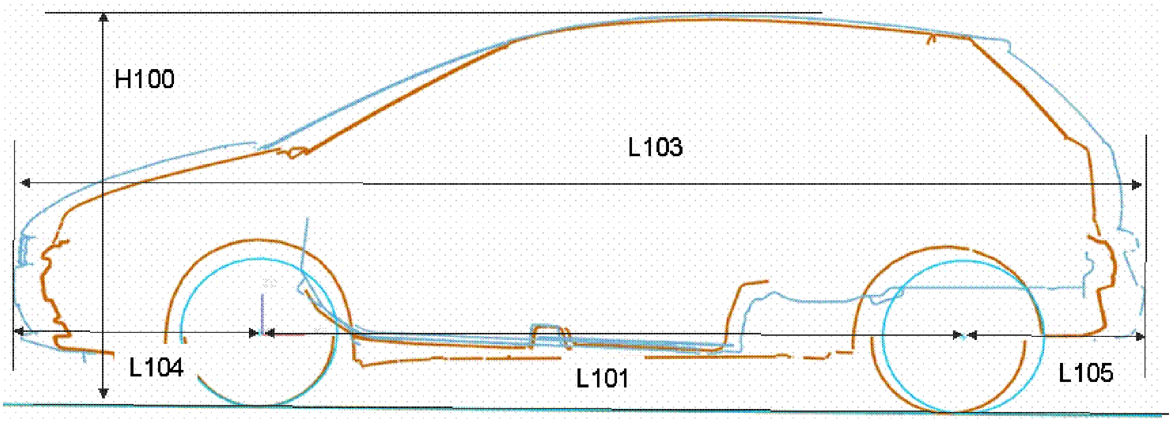
Nuova Punto features a design style and lines that are deeply rooted in the most authentic and renowned tradition of Italian car-making, with a surprising, unexpected shapes that make it go against the current compared with the trends followed by nearly all of the European car manufacturers.
A 'real' automobile line, which originally and nicely combines style, sporting character, elegance and beauty while following the modern customer's tastes.

1.2.2 Dimensions

Outer dimensions

Nuova Punto's outer dimensions are a consequence of market expectations and the resulting choices made in terms of style. However, outer dimensions have also been influenced by the progress made by the law regulations with regard to occupant safety, which has conditioned the choice of peculiar layouts.

The final outcome, as far as some dimensions are concerned, sets Nuova Punto at the top of its market segment (see table below).



Competitor car comparing table

	Outer dimensions (mm)	N	P	OPEL CORSA 5P	PEUGEOT 206 5P	FIESTA '02	RENAULT CLIO '98	NISSAN MICRA	TOYOTA YARIS 5P	CITROEN C3	VW POLO '02 5P
L101	Wheelbase	2510	2460	2491	2441	2486	2472	2427	2373	2460	2460
L103	Vehicle length	4030	3835	3816	3837	3917	3772	3717	3607	3849	3897
	Width	1687	1660	1645	1650	1680	1640	1660	1660	1670	1650
L104	Front pivot	876	775	747	787	772	714	685	710	756	800
L105	Rear pivot	647	600	578	609	659	586	605	524	633	634
H100	Vehicle height	1490	1480	1442	1436	1467	1418	1525	1516	1534	1465

P: Current Fiat Punto

N: Nuova Punto

To sum up, Nuova Punto is longer than the competing cars of its market segment by approximately 20 cm, whereas it is perfectly in line as far as width and height are concerned.

1.2.3 Body versions

Nuova Punto comes with four body versions characterized by specific interior trim and features that customize the dashboard, panels and seats:
Active, Dynamic, Elegance, Sporting.

The ACTIVE version features the following standard items:

ABS
Electric power steering
Electric window regulators
Dual airbag

The DYNAMIC version features the following standard items:

ACTIVE contents
Remote control
Height-adjustable driver's seat
Rear split seat (5-door version)
Height-adjustable steering wheel
Rear headrests

The ELEGANCE version features the following standard items:

DYNAMIC contents
Leather-covered steering wheel and gear shift lever cap
Car radio/CD player
Air conditioner

Alloy wheel rims

The SPORTING version features the following standard items:

DYNAMIC contents

Vehicle Dynamic Control (ESP)

Fog lights

Alloy wheel rims and tyres (17")

Side skirts

Leather sports steering wheel (perforated central rungs and coloured seams)

Special measuring instrument

Sports-design front seats (greater restraint)

Car radio/CD player

Air conditioner

Below are other optional items:

Knee airbag

Window-bag

Side-bag

Front seat anti-whiplash (whiplash restraint)

Rear electric window regulators (5-door versions)

Front armrest

Electric lumbar adjustment

Automatic air conditioner

Cruise control

Rain sensor

Parking sensor

Tyre pressure sensor (TPMS)

Leather upholstery

Alloy wheel rims (different designs and dimensions)

“Skydome” sunroof

Rear spoiler

Bumper bands

Car radio/CD-MP3 player

Hi-fi system

Kit Bluetooth

Headlamp washer

6-speed gearshift (1.3 Multijet 16V, 90 HP)

1.2.4 Engines

Below are the engines fitted to the vehicle **at the commercial launch**:

PETROL ENGINES

1.2 8V 65 HP

1.4 8V 75 HP

DIESEL ENGINES

1.3 Multijet 16V 75 HP

1.3 Multijet 16 V 90 HP

1.9 Multijet 8V 120 HP

1.2.5 Gearbox

Nuova Punto comes with four types of gearbox which ensure, when properly optimized, excellent gear control actuation and very high operation smoothness.

GEARBOX	NO. OF SPEEDS	ENGINE
C 514	5	1.2 8V and 1.4 8V
C 510	5	1.3 Multijet 16V, 75 and 90 HP
M20	6	1.3 Multijet 16 V, 90 HP (option)
M32	6	1.9 Multijet 8V, 120 HP

1.2.6 Range

PETROL ENGINES:

			Active	Dynamic	Elegance	Sport
1.2 8V	65 CV	Manual, 5-speed	X	X		
1.4 8V	77 CV	Manual, 5-speed	X	X		

DIESEL:

			Active	Dynamic	Elegance	Sport
1.3 Multijet 16V	75 HP	Manual, 5-speed	X	X		
1.3 Multijet 16V	90 HP	Manual, 5/6-speed		X	X	
1.9 Multijet 8V	120 HP	Manual, 6-speed				X

1.2.7 Active safety

Active safety is meant as the whole of the technical solutions that help avoid road accidents. Nuova Punto features the mechanic and electronic safety systems below:

ABS: all versions feature an integrated anti-lock system that controls the braking action so as to prevent the wheels from being locked;
EBD: electronic braking distributor between the front and rear wheels;
ESP: an active safety system, which comes into operation in emergency situations, for controlling the vehicle during dynamic on-road manoeuvres.

The ESP system comes as a standard item on the Sporting version only. The entire range is equipped with ABS system with EBD and ventilated brake discs on the front wheels (except for the 1.2 8V engine version, which is equipped with non-ventilated discs).

1.2.8 Passive safety

Passive safety is meant as the whole of the technical and product solutions that protect the driver and the passengers in case of accident. The technical solutions adopted aim at protecting the driver and the passengers in case of head-on, side and rear collisions.

With Nuova Punto, FIAT has made important progress as far as safety is concerned. Innovative design and construction solutions have been adopted on Nuova Punto, so as to obtain the best results in terms of occupant protection.

Nuova Punto features a standard occupant protection system made of up of the items below:
front safety restraint system including driver's and passenger's front airbags of the dual-stage type;
front safety belts with pre-tensioner and load limiter;
"my car" electronic system for passenger's side front and side airbag disable.

Moreover, the following optional items are available:

side-bag on the front seats, to ensure higher protection of the thorax and pelvis;
window-bags located in the rails below the roof, to better protect the occupants' heads against dangerous penetrating objects and parts.

When designing Nuova Punto, Fiat has paid great attention to the safety of the children on the vehicle and the pedestrians as well.
Children safety is ensured by devices that make it possible to achieve the maximum protection that can be obtained at present, i.e. isofix mounts on the rear seats and passenger's airbag disable through the vehicle's trip computer.
Pedestrian safety has also been enhanced, though it has somehow affected the vehicle's style solutions adopted, to meet the newer law requirements that establish specific conditions to protect the pedestrians in case of accidents.

Finally, passive safety is further enhanced by features such as the controlled-deformation body, the collapsible steering column and steering pedals, and the anti-whiplash seats (option).

1.2.9 Tyres and wheels

To optimize the vehicle performance, especially with regard to road holding, safety and driving comfort, the following tyres have been fitted to Nuova Punto:

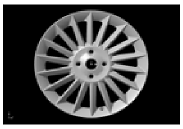
175/65 R15 -- Active / Dynamic

185/65 R15 – Active (option) / Dynamic (option) / Elegance / Sport (option – tyres can be fitted with snow chains)

195/55 R16 -- Dynamic (option) / Elegance (option)

205/45 R17 -- Elegance (option) / Sport.

As far as alloy rims are concerned, Nuova Punto comes with a full range that stands out for style, dimensions and paint colours:

15"	ALLOY RIMS 5 dual rungs colour: **silver standard**	
	ALLOY RIM 10 rungs (of which, 5 dual rungs) colour: **aluminium**	
16"	ALLOY RIM 195/55/R16 tyres 14 rungs (thick/thin) colour: **aluminium**	
	ALLOY RIM 195/55/R16 tyres 18 triangular-section rungs colour: **aluminium**	
17"	ALLOY RIM NON-CATENABILE 205/45/R17 tyres 15 flat-surface rungs colour: **silver standard**	
	ALLOY RIM NON-CATENABILE 205/45/R17 tyres 15 flat-surface rungs colour: **chrome shadow**	
	ALLOY RIM NON-CATENABILE 205/45/R17 tyres 3 dual rungs (spider-type) colour: **chrome shadow**	

1.2.10 Tyre repair kit

Nuova Punto is equipped with the new version of the "Fix&Go" kit to repair punctured tyres (max. puncture diameter: 4 mm).

The new kit includes one single component made up of a compressor, a sealant bottle, a silicone tube for tyre repair, a tube equipped with a spout for tyre check and inflation, and an electric cable for power supplying through the cigar lighter socket.

The kit is even easier to use.

The procedure to repair a punctured tyre is essentially as follows. Connect the electric cable to the cigar lighter socket, connect the silicone tube to the tyre valve, then switch the compressor on: the sealant will be automatically injected into the tyre, mixed with air. The repair will be completed when the tyre pressure reaches the prescribed value.

The Fix&Go kit may also be used to check and restore the tyre pressure, by connecting the special tube equipped with the quick coupling.

1.2.11 Comfort

Ergonomics and comfort are among the most outstanding features of Nuova Punto (easy access, visibility):

pedal position,
steering wheel alignment,
adequate position of the armrest plane,
adequate position of the footrest plane,
very good gearshift knob controllability,
full visibility of instruments and main drive controls,
excellently profiled, snug seats, which comfortably constrain the driver's body even in the most dynamic driving situations.

In order to make Nuova Punto a landmark car within its own category, great care has been specially devoted to the following:

passenger compartment soundproofing;
interior noise;
rolling noise and vibration filtering;
acoustic sensitivity to the excitation transmitted through solid pathways;
vehicle compactness on rough road surfaces;
dynamic systems: engine, intake and exhaust.

1.2.12 Interior comfort and room

When evaluating a passenger compartment, customers seem to base their assessment of the vehicle interior comfort mainly on the driver's seat comfort.

The area around the driver's seat is, together with the components included in it, the passenger compartment portion that bears the greatest significance when the customer has to make a final judgement of the driving comfort that the whole of the vehicle passenger compartment can offer.

The designing of Nuova Punto has focussed on ergonomics. Optimum balance has been achieved between the style prerogatives and the customer's unavoidable needs in terms of interior comfort, easy access into the vehicle, inner visibility (all controls are easily visible and within reach) and outer visibility (thanks to the large dimensions of side rear-view mirrors).
Nuova Punto can accommodate occupants of all builds: this has been achieved without affecting the dimensions of the boot, which features a minimum holding capacity of 263 litres with the standard running trim.
"Feeling good on board " means having a lot of space available, and such space should be available just where it is needed for. Nuova Punto features living space volume (cubic volume) values at the top of its category.
The passenger compartment profile makes it possible to easily accommodate two passengers on the rear seat of the 3-door vehicle; yet, approval for five-passenger seating can be asked for (by fitting the third rear safety belt, too).
The vehicle layout setting has been guided by the most advanced, state-of-the-art criteria for defining the basic ergonomic functions, consistently with the style and safety prerequisites:
Interior space and volume
Interior comfort and room
Easy access into the vehicle
Visibility
Luggage compartment
Utilization capabilities
These functions are related to parameters that measure the vehicle's capability of meeting with the interior comfort requirements.

1.2.13 Air conditioning

Psychophysical wellbeing of the vehicle occupants is guaranteed by an air-conditioning system that creates the optimum conditions for travelling.

The range offer makes three different systems available:

heater;

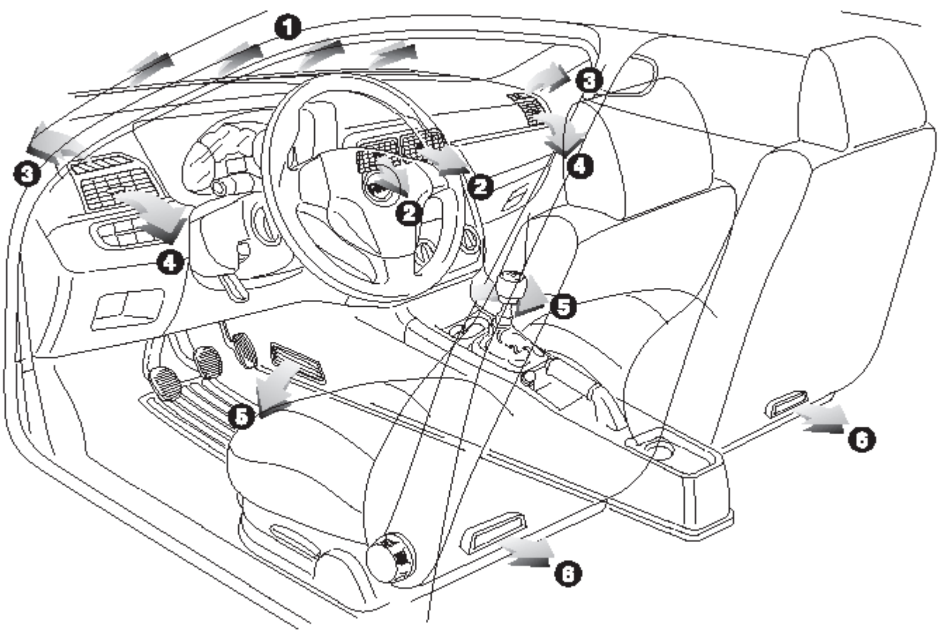
air conditioner;

automatic, two-zone air conditioner with provision for obtaining different air temperatures and distribution patterns both for the driver and the passenger.

These systems make it possible to choke and direct the air flow in many ways, so as to create the desired effect, which is always homogeneous in the entire passenger compartment.

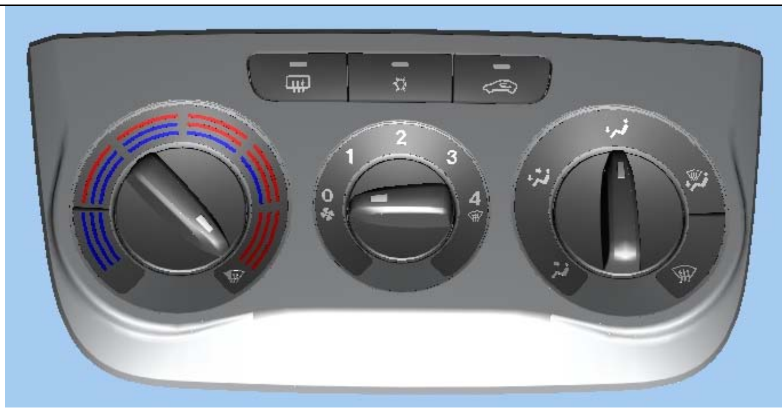
In addition, the windscreen demisting function comes as a useful tool.

The versions equipped with air conditioner feature air ducts in the rear passenger foot zone.



Air flow and vent diagram

Heater



Air conditioner

Automatic, two-zone air conditioner

Air conditioning control layout

1.2.14 Sunroof

The Nuova Punto sunroof includes a special wide-glass system called "Skydome", made up of two glass panels (one front sliding panel and one rear fixed panel).

The glass surface is so large that it takes the place of approximately 70% of the roof panel.

During the opening phase, the front moving panel slides out of the roof panel ("spoiler" position).

The wide roof glass surface lets a lot of sunshine into the vehicle interior.

This helps increasing the feeling of much interior space available to the occupants.

The Skydome sunroof is equipped with sliding curtains that allow less sunshine into the passenger compartment.

1.2.15 Audio system

The sound sources available depending on the versions are a radio tuner and a CD/MP3 player. The sound system found on the vehicle may be of two different kinds:

standard;

hi-fi sound system.

Standard system.

This system is made up of 6 loudspeakers as follows:

mid-woofer loudspeakers (40 W, diameter: 160 mm) located on the front doors, designed to reproduce low-middle frequencies. The technology used for these components (of the water-resistant type) allows the latter to stand water jets (if any) from inside the door without being damaged;

tweeter loudspeakers (30 W) located on the door opening handle, designed to reproduce the highest frequencies;

full-range loudspeakers (40 W, diameter: 130 mm) located on the rear side frames, which can reproduce the entire range of the sound frequencies. These components feature the “water resistant” technology.

Hi-fi sound system:

This system is made up of 6 loudspeakers and a sub-woofer box containing a single-channel power amplifier.

Below are the main features of the components:

mid-woofer loudspeakers (40 W, diameter: 160 mm) located on the front doors, designed to best reproduce the low-middle frequencies (the “water resistant” technology is used with these components);

tweeter loudspeakers (40 W) located on the door opening handle, designed to reproduce the highest frequencies;

full-range loudspeakers (40 W, diameter: 130 mm) located on the rear side frames, which can reproduce the entire range of the sound frequencies. These components feature the “water resistant” technology”;

sub-woofer box of the “bass-reflex” type (6.5-7 l. volume) including a loudspeaker (100 W, diameter: 130 mm) to reproduce the lowest frequencies. This box is fitted into the luggage compartment, on the right wheelbox side;

single-channel sound power amplifier, located inside the sub-woofer box and used for sub-woofer drive.

1.3 Accessory line

The Nuova Punto accessories have been designed with the specific intent to provide the customer with options suited to satisfy the customer's need to customize their own car in an emotional, functional way.

The accessory designing activity has been supported by the FIAT Style Centre and has been guided by the search for exclusive products consistent with the vehicle identity, integrated into the vehicle's essential lines and of high practical value.

The accessory offer can be divided in the following areas:

1.3.1 Sporting character

In order to satisfy the need to enjoy your own car in a more emotional way, a kit has been designed which includes side skirts, a "spoiler" on the rear hatch, streamlined attachments on the front bumper. These items give the vehicle a modern, 'aggressive' look.

Moreover, two kits are available, which include a 16" and a 17" alloy wheel rims, to be used with 195/55R16 and 205/45R17 tyres, respectively.

The tailored sporting accessories also include leather steering wheel and gearshift lever knob, and aluminium pedal covers with rubber inserts, for safer, comfortable driving.

1.3.2 Comfort – utility – leisure time

Optimum driving comfort is ensured by a range of accessories such as modern anti-whirl vent windows, bumper protection rubber kit, side buffer bands, interior rubber or "carpeted" mat covers, tailored seat linings, miscellaneous object restraint grids, dog restraint partition net which can be combined with a semi-rigid polypropylene receptacle for easier luggage compartment cleaning.

Finally, an aluminium sill board is available, which must be positioned on the vehicle's internal sill.

As far as leisure time is concerned, the ACCESSORY LINE includes transverse bars used to carry various items such as SKIS, BICYCLES and SURFING BOARDS.

Two different types of towing hooks (of the removable ball type) are available for towing purposes.

Those who own I-Pod Applemay choose a dedicated set that allows the former to be used by controlling its content through the factory-installed radio system.

1.3.3 Safety

The vehicle active and passive safety is ensured by a special range of alarms and the parking sensor kit, to be positioned on the license plate sides.
The traditional anti-theft system, provided in a modular make-up with door opening-closing/actuation remote control, exchanges data through the CAN network with the vehicle's electronic control unit. Any break-in is signalled by a siren located in the engine compartment.
The CLEAR BOX, or GPS-GSM locator, is the best device that current technology may offer in the field of automotive satellite/cellular protection.

The ACCESSORY LINE module matched with the traditional anti-theft system allows you to always keep your vehicle under control, by clearly identifying its position, and also receive any break-in message.
The ultrasound parking sensor is actuated when the reverse gear is engaged and gives out an acoustic signal to warn you of the obstacles that cannot be seen by means of the rear-view mirrors.
Moreover, the Bluetooth "MetaBlue" hand-free set system makes it possible to easily speak on the mobile phone without handling the same, with no connecting cable. The calls are managed by means of one single control button, and you can listen to the person you are talking to directly through the vehicle's audio system, both is the radio has been factory-installed and if the unit is owned by the customer, and even if only the (loudspeaker) preset is available. All of this means safe, comfortable driving, in compliance with the rules of the Highway Code.

Children safety

The ISOFIX UNIVERSALE child seat is available with the vehicles equipped with specific mounts, for children weighing 9 to 18 kg.

The range is made complete by traditional seats such as:

CRADLE, for children weighing up to 10 kg;

KIDDY LIFE seat, for children weighing 9 to 36 kg.

2 Technical specifications

2.1 Engine

2.1.1 Type of engine

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Type code	350A1000	199A3000	199A4000	199A2000	939A1000
Location on the vehicle	Front	Front	Front	Front	Front
Orientation	Transverse	Transverse	Transverse	Transverse	Transverse
No. of cylinders	4	4	4	4	4
Position of cylinders	In-line	In-line	In-line	In-line	In-line
No. of valves per cylinder	2	4	2	4	2
Cycle	Otto	Diesel	Otto	Diesel	Diesel
Timing	1ACT with phase variator	2ACT	1ACT	2ACT	1ACT
	With mechanic tappets	Finger rocker arm with hydraulic tappet	With mechanic tappets	Finger rocker arm with hydraulic tappet	With mechanic tappets
Fuel	Petrol	Diesel	Petrol	Diesel	Diesel
Fuel feed	MPI (electronic, sequential, timed)	MultiJet direct injection of the Common Rail type, with variable-geometry turboblower and intercooler	MPI (electronic, sequential, timed)	MultiJet direct injection of the Common Rail type, with turboblower and intercooler	MultiJet direct injection of the Common Rail type, with variable-geometry turboblower and intercooler

2.1.2 Engine data

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Bore (mm)	72	69.6	70.8	69.6	82
Stroke (mm)	84	82	78.86	82	90.4
Total displacement (cm^3)	1368	1248	1242	1248	1910
Compression ratio	11:1	17.6:1	11:1	17.6:1	18:1
Max. rating (EC HP)	77	90	65	75	120
Max. rating (EC KW)	56	66	48	55	88
Max. power speed (r.p.m.)	5750	4000	5500	4000	4000
Max. torque (EC Nm)	114	200	102.2	190	280
Max. torque (EC kgm)	11.6	20.4	10.4	19.4	28.5
Max. torque speed (r.p.m.)	3000	1750	3000	1750	2000
Idling speed (r.p.m.)	750±50	n.d.	750±50	n.d.	n.d.

2.2 Timing angles

Valve play

	1.4 8V	1.3 Multijet 16V 90 cv	1.2 8V	1.3 Multijet 16V 75 cv	1.9 Multijet 8V 120 cv
Cold-operation valve play – Intake (mm)	0.3	-	0.3	-	n.d.
Cold-operation valve play – Exhaust (mm)	0.4	-	0.4	-	n.d.

Intake

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Opening before T.D.C. (°)	-7°	n.d.	1	n.d.	n.d.
Closing after B.D.C. (°)	41°	n.d.	47	n.d.	n.d.

Exhaust

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Opening before B.D.C. (°)	57°	n.d.	51°	n.d.	n.d.
Closing after T.D.C. (°)	-9°	n.d.	-3°	n.d.	n.d.

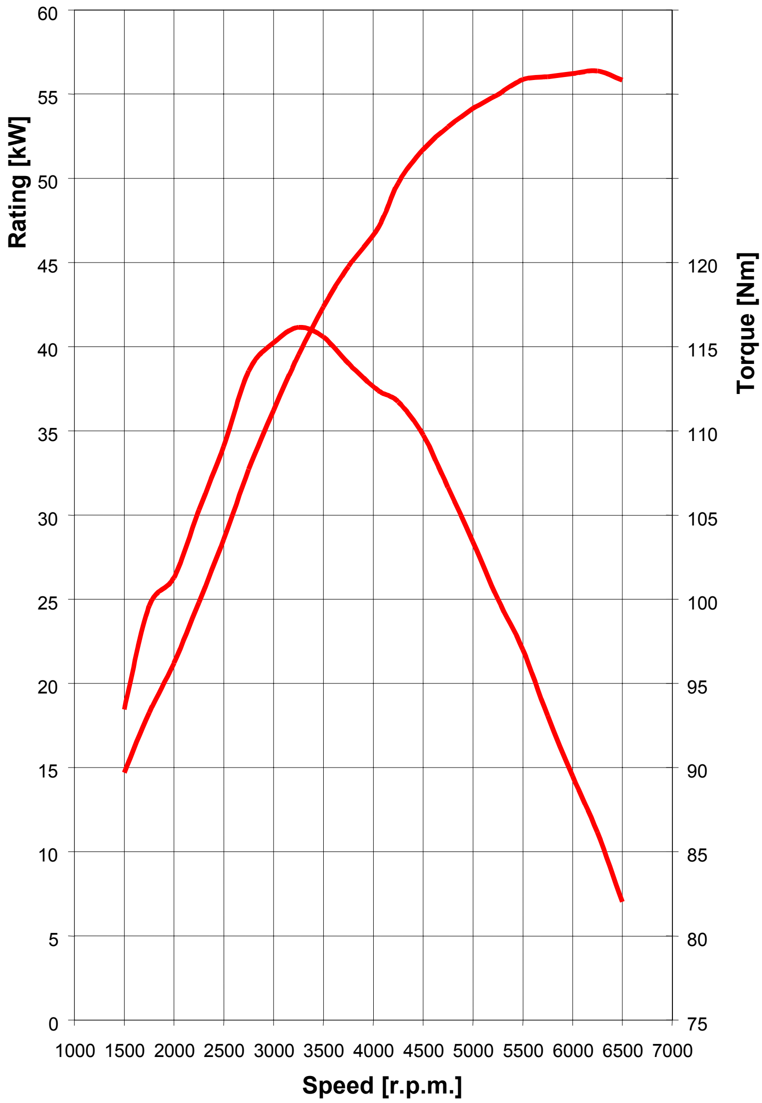
Injection

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V 120 (HP)
Type	Marelli 5SF3	Marelli 6F3	Marelli 5SF3	Marelli 6F3	Bosh EDC16C9
Injection sequence	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2

Ignition

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Coils	F.M. BAE 940A	-	F.M. BAE 940A	-	-
No. of coils	4	-	4	-	-
Spark plugs	NGK ZKR7A-10	-	NGK ZKR7A-10	-	-
Preheating drive control unit	-	Bitron	-	n.d.	n.d.
Preheating spark plugs	-	Beru 4L01192	-	n.d.	n.d.
Ignition sequence	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2

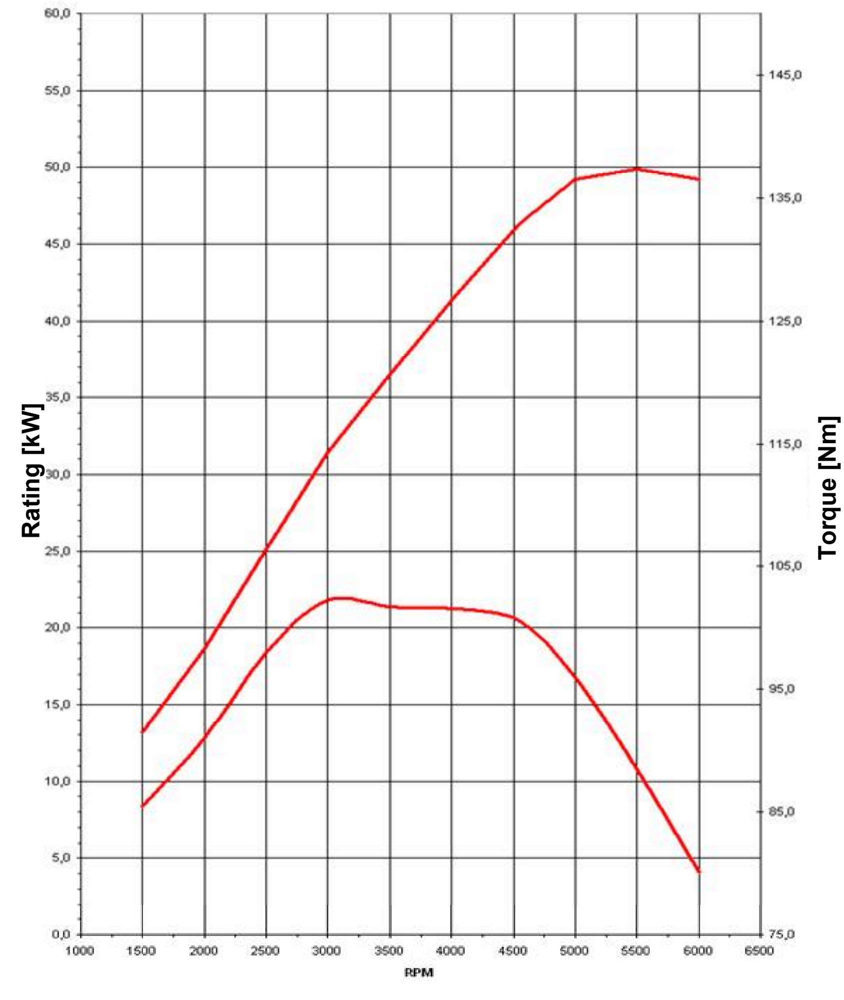
2.3 Engine characteristic curves



Engine: 1.4 8V

Max. torque: 114 Nm at 3,000 r.p.m.

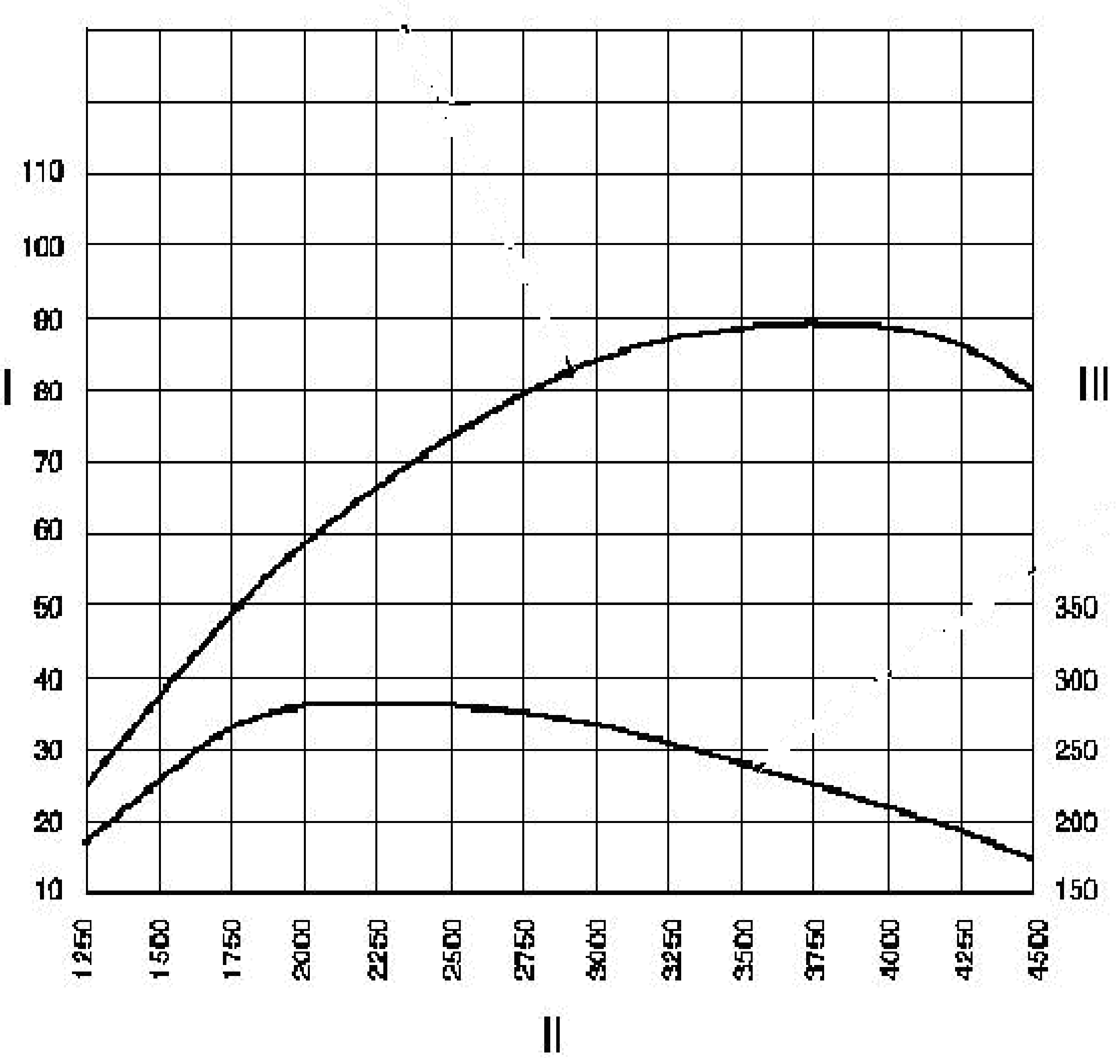
Max. rating: 56 KW at 5,750 r.p.m.



Engine: 1.2 8V

Max. torque: 102.2 Nm at 3,000 r.p.m.

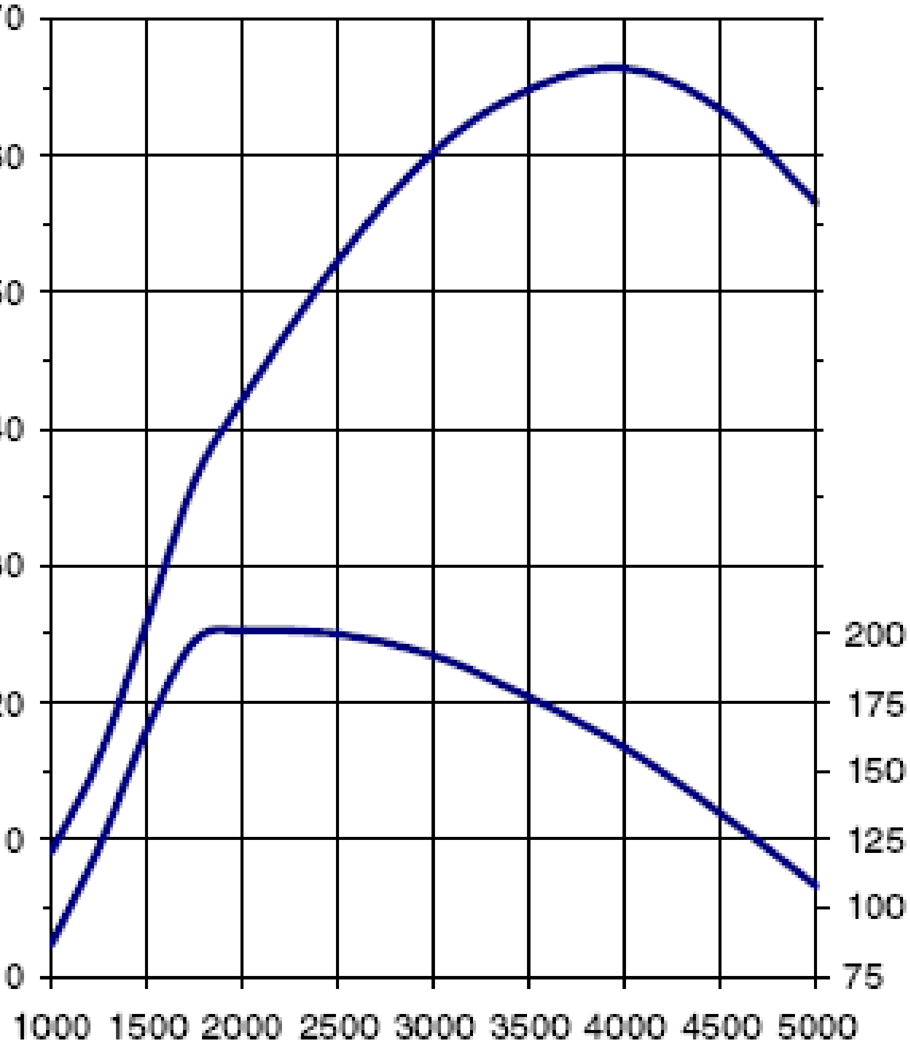
Max. rating: 49.5 KW at 5,500 r.p.m.



Engine: 1.9 Multijet 8V (120 HP)

Max. torque: 280 Nm at 2,000 r.p.m.

Max. rating: 88 Kw at 4,000 r.p.m.



Engine: 1.3 Multijet 16V (90 HP)

Max. torque: 200 Nm at 1,750 r.p.m.

Max. rating: 66 Kw at 4,000 r.p.m.

2.4 Transmission

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Drive	Front/Transv.	Front/Transv.	Front/Transv.	Front/Transv.	Front/Transv.

2.5 Clutch

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Drive	Push-type	Push-type	Push-type	Push-type	Push-type
Control	Hydraulic, with external actuator	Hydraulic, with external actuator	Hydraulic, with external actuator	Hydraulic, with external actuator	Hydraulic, with external actuator and SAC (*)
Disc spring load (daN)	n.d.	n.d.	n.d.	n.d.	n.d.
Supplier	Valeo	Luk	AP	Valeo	Luk

(*): play recovery device

2.6 Gearbox

	1.4 8V/1.2 8V	1.3 Multijet 16V (75/90 HP)	1.3 Multijet 16V (90 HP) / 1.9 Multijet 8V (120 HP)
Type	C514	C510	M20/M32
Configuration	2 cascade shafts supported on ball bearings	2 cascade shafts supported on ball bearings (output shaft rear & front)	3 shafts supported on ball bearings
Total length (from the engine flywheel) (mm)	372.75	382.5 (on main axle)	332
Weight (kg)	33 (dry), (34.5 with oil)	35.5 (dry), (37.3 with oil)	45 (dry) (46.5 with oil) / 47 (dry) (48.5 with oil)
Synchronizers	1, 2, 3, 4, 5, R	1, 2, 3, 4, 5, R	1, 2, 3, 4, 5, 6, R
Gears	HCR (High Contact Ratio) toothing	HCR (High Contact Ratio) toothing	HCR (High Contact Ratio) toothing
Gear ratio (1)	3.909	3.818	3.818
Gear ratio (2)	2.158	2.053	2.053
Gear ratio (3)	1.480	1.302	1.302
Gear ratio (4)	1.121	0.959	0.959
Gear ratio (5)	0.921	0.744	0.744
Gear ratio (6)	-	-	0.614
Gear ratio (REV)	3.818	3.909	3.545

2.7 Braking system

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Type	Hydraulic, servo-assisted	Hydraulic, servo-assisted	Hydraulic, servo-assisted	Hydraulic, servo-assisted	Hydraulic, servo-assisted
Power brake cylinder diameter	10''	10''	10''	10''	10''
Anti-lock system	Bosch 8.0	Bosch 8.0	Bosch 8.0	Bosch 8.0	Bosch 8.0

2.7.1 Front brakes

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Type of disc	Self-ventilated	Self-ventilated	Non-ventilated	Self-ventilated	Self-ventilated
Disc diameter (mm)	257	284	257	257	284
Rated thickness (mm)	22	22	12	22	22
Type of caliper	Bosch ZOH	Bosch ZOH	Bosch ZOH	Bosch ZOH	Bosch ZOH
Caliper piston diameter (mm)	54	54	54	54	54

2.7.2 Rear brakes

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Type	Drum	Drum	Drum	Drum	Disc
Drum diameter (mm)	228	228	203	228	264
Rated thickness (mm)	n.d.	n.d.	n.d.	n.d.	11
Type of caliper	n.d.	n.d.	n.d.	n.d.	Bosch BIR III

2.8 Steering

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Type	Electric, EPS	Electric, EPS	Electric, EPS	Electric, EPS	Electric, EPS
Steering diameter (m)	10.1	10.76	10.1	10.1	11
No. of steering wheel turns (for full steering)	2.8	2.8	2.8	2.8	2.8
Steering box ratio (mm/turn)	51	60-44	51	60-44	60-44
Steering wheel angle/wheel angle ratio	15.7	13.4	15.7	13.4	13.4
Rack travel					
Effort on the steering wheel from stationary position (Nm)	2.5 (mod. city)	2.5 (mod. city)	2.5 (mod. city)	2.5 (mod. city)	2.5 (mod. city)

2.9 Front suspensions

Helical springs

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Edge diameter (mm)	11.2	11.5	11.2	11.5	11.8
No. of active coils	4.32	4.82	4.32	4.82	5.32
Helix direction	Rightward	Rightward	Rightward	Rightward	Rightward
Free spring height (mm)	353	377	353	377	402
Pack spring height	60	67	60	67	75
Spring height under control load (mm)	178	178	178	178	178

Shock-absorbers

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Type	Dual-tube, size: 22 x 32 x 46.5 (diameters: stem / piston / ext. tube). Traditional, mechanic stop	Dual-tube, size: 22 x 32 x 46.5 (diameters: stem / piston / ext. tube). Traditional, mechanic stop	Dual-tube, size: 22 x 32 x 46.5 (diameters: stem / piston / ext. tube). Traditional, mechanic stop	Dual-tube, size: 22 x 32 x 46.5 (diameters: stem / piston / ext. tube). Traditional, mechanic stop	Dual-tube, size: 22 x 32 x 46.5 (diameters: stem / piston / ext. tube). Traditional, mechanic stop
Open length (start of plugging) (mm)	527	527	527	527	527
Close length (at abutting end) (mm)	351	351	351	351	351
Travel (mm)	176	176	176	176	176

(different calibration)

Front stabilizer bar

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Bar diameter (mm)	18	19	n.d.	n.d.	n.d.

2.10 Rear suspensions

Helical springs

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Edge diameter (mm)	10.5	10.,5	n.d.	n.d.	n.d.
No. of active coils	4.2	4.2	n.d.	n.d.	n.d.
Helix direction	Rightward	Rightward	n.d.	n.d.	n.d.
Free spring height (mm)	291.5	279	n.d.	n.d.	n.d.
Spring height under theoretic project load	155	155	n.d.	n.d.	n.d.
Pack spring height (mm)	58	58	n.d.	n.d.	n.d.

Shock-absorbers:

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Type	Dual-tube, size: 14.2 x 27 x 38 (diameters: stem / piston / ext. tube). Traditional, mechanic stop	Dual-tube, size: 14.2 x 27 x 38 (diameters: stem / piston / ext. tube). Traditional, mechanic stop	Dual-tube, size: 14.2 x 27 x 38 (diameters: stem / piston / ext. tube). Traditional, mechanic stop	Dual-tube, size: 14.2 x 27 x 38 (diameters: stem / piston / ext. tube). Traditional, mechanic stop	Dual-tube, size: 14.2 x 27 x 38 (diameters: stem / piston / ext. tube). Traditional, mechanic stop
Open length (start of plugging) (mm)	651.0	651.0	651.0	651.0	651.0
Close length (at abutting end) (mm)	388.0	388.0	388.0	388.0	388.0
Travel (mm)	263	263	263	263	263

The stabilizer bar is not available and has been replaced by a twisting link of adequate thickness.

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
“Soft“ link (mm)	4.5	4.5	4.5	4.5	4.5
“Medium” link (mm)	5.9	5.9	5.9	5.9	5.9
“Hard” link (mm)	7.1	7.1	7.1	7.1	7.1

Crossbar

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
"Soft " link (mm)	4.5	4.5	n.d.	n.d.	n.d.
"Medium" link (mm)	5.9	5.9	n.d.	n.d.	n.d.
"Hard" link (mm)	7.1	7.1	n.d.	n.d.	n.d.

2.11 Suspension characteristic angles and trim

Standard A = vehicle unloaded, incl. spare wheel, tools, accessories, fuel and fluid filling.
Standard 0 = vehicle unloaded, incl. spare wheel tools, accessories, fluid filling, with 5 litres fuel.

N.B. Only front wheel toe-in can be adjusted at a workshop.

2.11.1 Front

Toe-in

Engine versions	Tyres	Standard 0	Standard A
1.2 8V	175/65 R15 84T	+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.4 8V		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.2 8V		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.4 8V		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.4 16V	185/65 R15 88T	+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.3 Multijet 16V 90 cv		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.4 16V		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.3 Multijet 16V 90 cv		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.9 Multijet 8V 120 cv		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.4 16V	195/55 R16 87H	+ 2 mm +/- 1 mm	+ 1,87 mm +/- 1mm
1.9 Multijet 8V 120 cv		+ 2 mm +/- 1 mm	+ 1,87 mm +/- 1mm

Camber angle

Engine versions	**Tyres**	**Standard 0**	**Standard A**
1.2 8V	175/65 R15 84T	-22' +/- 20'	-27' +/- 20'
1.4 8V		-22' +/- 20'	-27' +/- 20'
1.2 8V		-22' +/- 20'	-27' +/- 20'
1.4 8V		-22' +/- 20'	-27' +/- 20'
1.4 16V	185/65 R15 88T	-26' +/- 20'	-28' +/- 20'
1.3 Multijet 16V 90 cv		-26' +/- 20'	-28' +/- 20'
1.4 16V		-26' +/- 20'	-28' +/- 20'
1.3 Multijet 16V 90 cv		-26' +/- 20'	-28' +/- 20'
1.9 Multijet 8V 120 cv		-26' +/- 20'	-28' +/- 20'
1.4 16V	195/55 R16 87H	-19' +/- 20'	-21' +/- 20'
1.9 Multijet 8V 120 cv		-19' +/- 20'	-21' +/- 20'

2.11.2 Rear

Toe-in

Engine versions	Tyres	Standard 0	Standard A
1.2 8V	175/65 R15 84T	+1,3mm+/-2mm	+1,5mm+/-2mm
1.4 8V		+1,3mm+/-2mm	+1,5mm+/-2mm
1.2 8V		+1,3mm+/-2mm	+1,5mm+/-2mm
1.4 8V		+1,3mm+/-2mm	+1,5mm+/-2mm
1.4 16V	185/65 R15 88T	+1,3mm+/-2mm	+1,5mm+/-2mm
1.3 Multijet 16V 90 cv		+1,3mm+/-2mm	+1,5mm+/-2mm
1.4 16V		+1,3mm+/-2mm	+1,5mm+/-2mm
1.3 Multijet 16V 90 cv		+1,3mm+/-2mm	+1,5mm+/-2mm
1.9 Multijet 8V 120 cv		+1,3mm+/-2mm	+1,5mm+/-2mm
1.4 16V	195/55 R16 87H	+1,3mm+/-2mm	+1,5mm+/-2mm
1.9 Multijet 8V 120 cv		+1,3mm+/-2mm	+1,5mm+/-2mm

Camber angle

Engine versions	**Tyres**	**Standard 0**	**Standard A**
1.2 8V	175/65 R15 84T	-1°+/-20’	-1°+/-20’
1.4 8V		-1°+/-20’	-1°+/-20’
1.2 8V		-1°+/-20’	-1°+/-20’
1.4 8V		-1°+/-20’	-1°+/-20’
1.4 16V	185/65 R15 88T	-1°+/-20’	-1°+/-20’
1.3 Multijet 16V 90 cv		-1°+/-20’	-1°+/-20’
1.4 16V		-1°+/-20’	-1°+/-20’
1.3 Multijet 16V 90 cv		-1°+/-20’	-1°+/-20’
1.9 Multijet 8V 120 cv		-1°+/-20’	-1°+/-20’
1.4 16V	195/55 R16 87H	-1°+/-20’	-1°+/-20’
1.9 Multijet 8V 120 cv		-1°+/-20’	-1°+/-20’

2.12 Battery and alternator

Vehicle models without air conditioner

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Battery capacity (Ah)	40	50	40	50	60
Alternator (A)	70	75	70	75	120

Vehicle models with air conditioner

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Battery capacity (Ah)	50	50	50	50	60
Alternator (A)	70	90	70	90	120

2.13 Fluids and lubricants

Oils and fluids

Recommended product features:

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Engine oil	Selenia K	Selenia WR	Selenia K	Selenia WR	Selenia WR
Gearbox/front differential oil	Tutela car Technyx	Tutela car Matryx	Tutela car Technyx	Tutela car Technyx	Tutela car Matryx
Brake fluid	Tutela Top 4	Tutela Top 4	Tutela Top 4	Tutela Top 4	Tutela Top 4
Radiator fluid	Paraflu up (50%)	Paraflu up (50%)	Paraflu up (50%)	Paraflu up (50%)	Paraflu up (50%)

Grease

Recommended product features:

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Front constant-velocity universal joint (differential side)	Tutela MRM Zero	Tutela Star 325	Tutela MRM Zero	Tutela MRM Zero	Tutela Star 325
Front constant-velocity universal joint (wheel side)	Tutela Star 500	Tutela Star 500	Tutela Star 500	Tutela Star 500	Tutela Star 500
Wheel hubs, steering rods, various members	n.d.	n.d.	n.d.	n.d.	n.d.
Underbody member protection lubrication	n.d.	n.d.	n.d.	n.d.	n.d.
Brake circuit component lubrication	n.d.	n.d.	n.d.	n.d.	n.d.
Steering box and rack	n.d.	n.d.	n.d.	n.d.	n.d.

Lubricant capacity

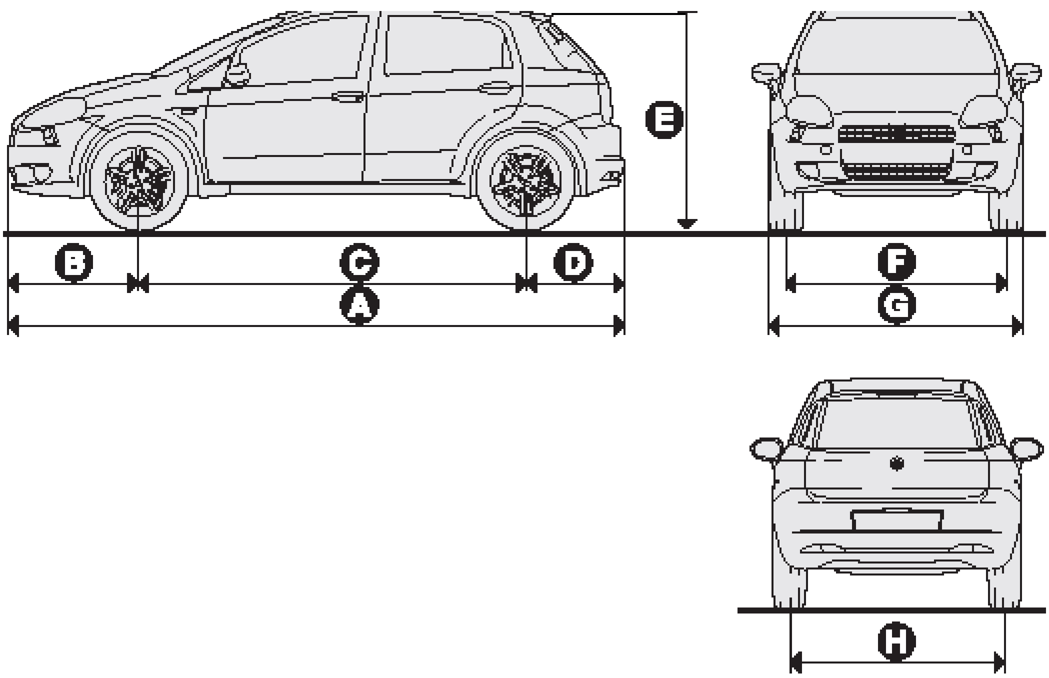
Oil amounts:

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Engine oil (amount for regular replenishment, sump and filter) (litres)	2.6	3.2	2.6	3.2	4.18
Gearbox oil/front differential (kg)	1.5	2.08	1.5	1.8	2.08

2.14 Vehicle features

2.14.1 Dimensions

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
A	4,030	4,030	4,030	4,030	4,030
B	875	875	875	875	875
C	2,510	2,510	2,510	2,510	2,510
D	645	645	645	645	645
E	1,490	1,490	1,490	1,490	1,490
F	1,473	1,473	1,473	1,473	1,473
G	1,687	1,687	1,687	1,687	1,687
H	1,466	1,466	1,466	1,466	1,466



2.14.2 Performance

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Top speed (k.p.h.)	170	185	155	165	190 (*195)
Acceleration (sec) (0 to 100 k.p.h. - 2 persons + 20 kg)	12	12	14.3	14.5	9

*= sporting body version

2.14.3 Fuelling and filling

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Fuel tank capacity (l.)	45	45	45	45	45
Fuel reserve (l.)	(5-7)	(5-7)	(5-7)	(5-7)	(5-7)
Cooling system (l.)	5.27	7.4	5.27	7.3	6.35
Oil sump and filter (l.)	2.6	3.2	2.6	3.2	4.18
Brake circuit (kg)	0.5	0.5	0.5	0.5	0.5

2.14.4 Consumption

(EC Directive 199/100/CE – litres per 100 km)

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Urban	7.7	5.9	7.9	5.9	7.5 (*7.6)
Extra-urban	5.2	3.9	5.1	4.0	4.5 (*4.6)
Combined	6.1	4.6	6.1	4.7	5.6 (*5.7)

*= sporting body version

2.14.5 Emissions

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
CO2 (g/Km)	145	122	145	123	149(*150)

*= sporting body version

All engines complying with the Euro 4 emission level requirements.

2.14.6 Tyres

	1.4 8V	1.3 Multijet 16V (90 HP)	1.2 8V	1.3 Multijet 16V (75 HP)	1.9 Multijet 8V (120 HP)
Standard items	175/65 R15 84T 185/65 R15 88T	185/65 R15 88T 195/55 R16 87H 205/45 R17 88V	175/65 R15 84T 185/65 R15 88T	175/65 R15 84T 185/65 R15 88T	185/65 R15 88T 195/55 R16 87H 205/45 R17 88V
Snow tyres	175/65 R15 84T 185/65 R15 88T	185/65 R15 88T 195/55 R16 87H	175/65 R15 84T 185/65 R15 88T	175/65 R15 84T 185/65 R15 88T	185/65 R15 88T 195/55 R16 87H
Spare wheel	175/65 R15 84T 185/65 R15 88T	185/65 R15 88T	175/65 R15 84T 185/65 R15 88T	175/65 R15 84T 185/65 R15 88T	185/65 R15 88T

2.14.7 Inflating pressure (bar)

Version: 1.4 8V

Size	Inflating pressure with average front load	Inflating pressure with average rear load	Inflating pressure with full front load	Inflating pressure with full rear load
175/65 R 15 84T	2.2	2.1	2.2	2.2
185/65 R 15 88T	2.2	2.0	2.2	2.2

Version: 1.3 Multijet 16V (90 HP)

Size	Inflating pressure with average front load	Inflating pressure with average rear load	Inflating pressure with full front load	Inflating pressure with full rear load
185/65 R 15 88T	2.3	2.1	2.3	2.3
195/55 R 16 87H	2.3	2.1	2.4	2.4
205/45 R 17 88V	2.4	2.2	2.5	2.4

Version: 1.2 8V

Size	Inflating pressure with average front load	Inflating pressure with average rear load	Inflating pressure with full front load	Inflating pressure with full rear load
175/65 R 15 84T	2.2	2.1	2.2	2.2
185/65 R 15 88T	2.2	2.0	2.2	2.2

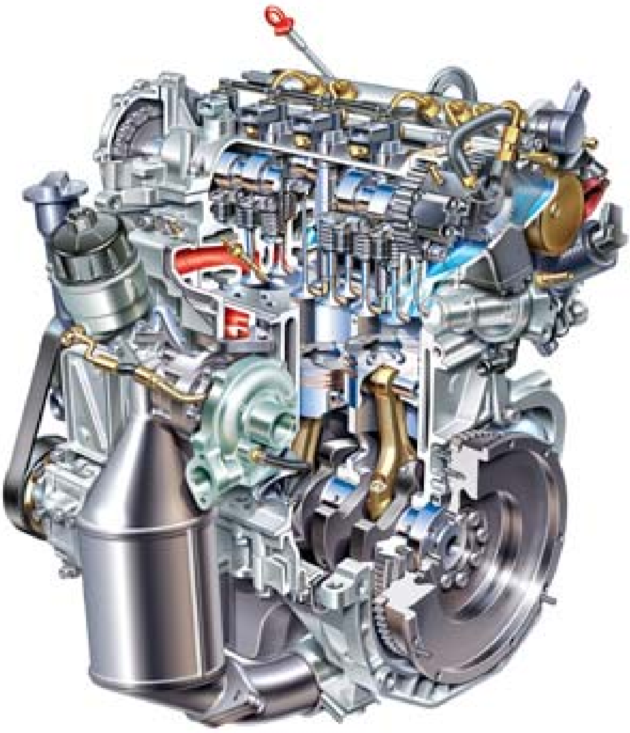
Version: 1.3 Multijet 16V (75 HP)

Size	Inflating pressure with average front load	Inflating pressure with average rear load	Inflating pressure with full front load	Inflating pressure with full rear load
175/65 R 15 84T	2.4	2.1	2.5	2.2
185/65 R 15 88T	2.3	2.1	2.3	2.3

Version: 1.9 Multijet 8V (120 HP)

Size	Inflating pressure with average front load	Inflating pressure with average rear load	Inflating pressure with full front load	Inflating pressure with full rear load
185/65 R15 88H	2.4	2.2	2.4	2.2
195/55 R 16 87H	2.4	2.2	2.6	2.4
205/45 R 17 88V	2.6	2.3	2.8	2.5

3 1.3 Multijet 16V, 75 and 90 HP engines



3.1 General remarks

Turbo diesel, direct-injection engine with no precombustion chamber, with 4 in-line cylinders, total displacement: 1,248 c.c., 4 valves per cylinder with hydraulic tappets, two overhead camshafts with motion gear drive, air boosting by means of a turboblower and an intercooler, no-load weight: 137 kg (75 HP) and 139 kg (90 HP), Magneti Marelli MJD 6F3 Common Rail electronic injection system.
These engines make use of a "Magneti Marelli Common Rail" high-pressure electronic injection system for fast diesel engines, which is fully controlled by a Multijet MJD6F3 control unit.

The engines feature the performance levels below:
max. rating: 55 kW (75 HP) EC at 4,000 r.p.m.; 66 kW (90 HP) EC at 4,000 r.p.m.
max. torque: 190 Nm (19.4 kgm) EC at 1,750 r.p.m.; 200 Nm (20.4 kgm) at 1,750 r.p.m.

To reduce polluting emissions, these engines are equipped with:

- exhaust system with oxidizing catalytic converter;
- exhaust gas recirculation (E.G.R.) system (modified for the 90 HP version) with heat exchanger;
- engine base vapour/gas recirculation system;
- UEGO oxygen sensor (temperature sensors for DPF available as options for 90 HP versions only);
- new DRV 2 pressure regulator;
- new RDS 4 air pressure sensor.

The unit consists of a system made up of the engine and all the systems required for its operation:

- fuel feed system;
- air boosting system;
- engine cooling system;
- exhaust system with catalytic converter;
- oil vapour recirculation system;
- exhaust gas recirculation (E.G.R.) system with heat exchanger;

The operation of these systems can be optimized by means of an electronic control system managed by a control unit.
Understanding the control unit operation logic allows you to get an overall picture of the entire system.

3.2 Components

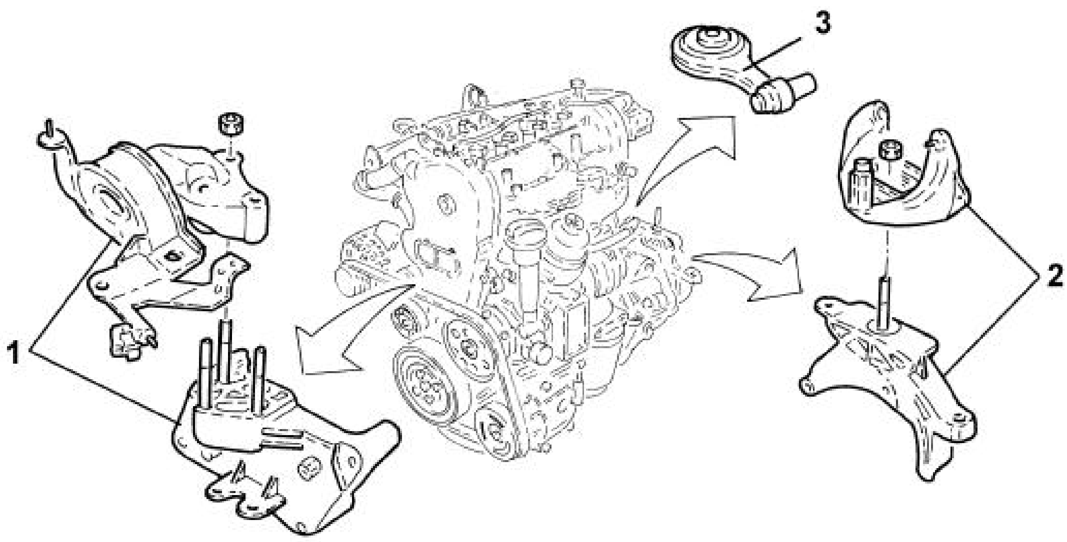
3.2.1 Power unit supports

The function of the power unit supports is to ensure structural connection between the power unit and the body.

These supports are dimensioned so as to bear the weight of the power unit, and also withstand the loads resulting from the torque transmitted by the engine. They have been modified in the 90 HP versions in order to withstand greater weight and torque values (200 Nm).

Each support features a metal-rubber dowel used to dampen the vibrations generated by the engine, thus reducing to a significant extent the vibrations transmitted to the body.

The power unit support is of the barycentre type: it is made up of two dowels and a reaction link (which acts as a tie-rod) where the new supports are aligned to an axis passing through the engine barycentre, so as to obtain reaction forces with nil arm. Moreover, the 90 HP version features one further support for the right-hand axle shaft.



1 Support on the valve gear side

2 Support on the gearbox side

3 Reaction tie-rod

Right axle shaft support for 1.3 Multijet 90 HP version

3.2.2 Engine base

The engine base is made of ductile cast iron.

The cylinders are obtained directly into the base and are classified into three dimensional classes plus one oversize class.

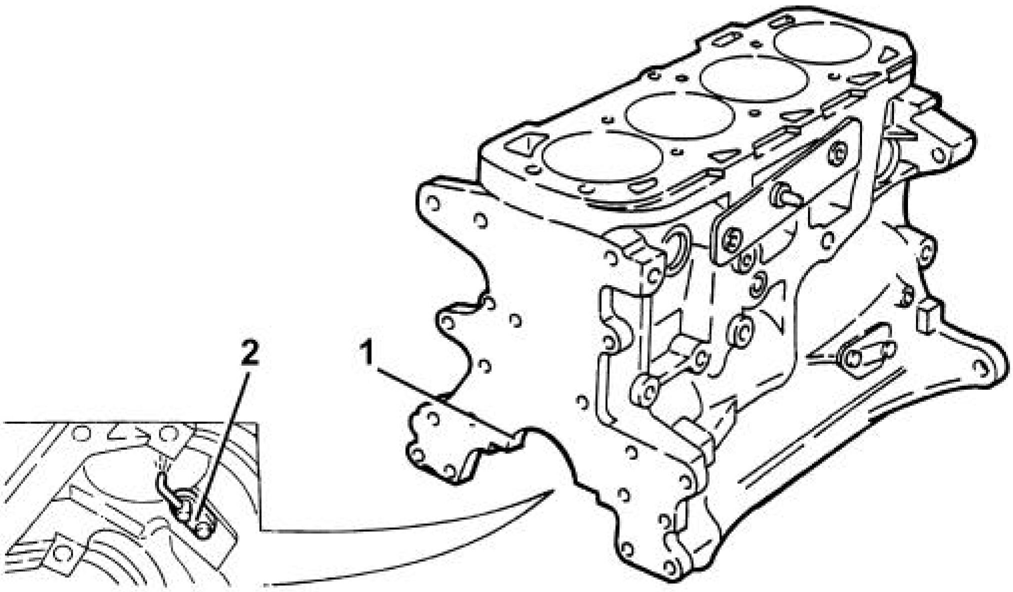
- Class A
- Class B
- Class C

Plus one oversize

The drive shaft is rested by means of five main bearings (1).

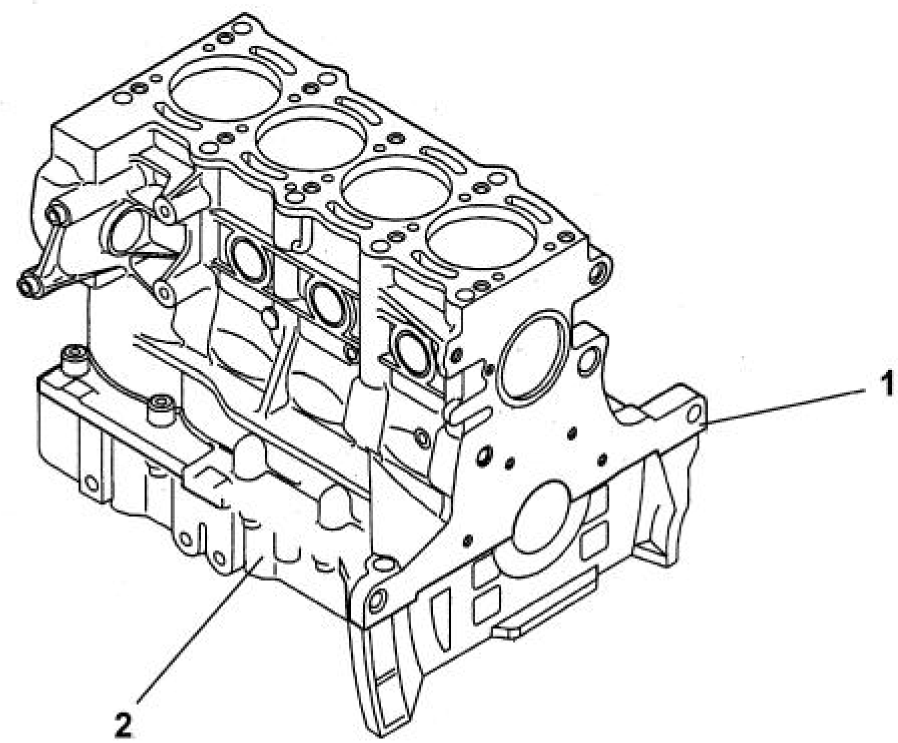
Special channels, obtained in the base walls, allow the cooling fluid and the lubricating oil to flow through.

A nozzle (2) is fitted into the lower part of each cylinder, through which oil is sprayed on the piston crown in order to cool the piston and ensure pin lubrication through falling.



3.2.3 Lower engine base

The lower engine base is made of die-cast aluminium alloy, with cast iron main caps.
The main bearing and cap finishing operations are carried out by joining with the upper engine base.
Joining with the upper base is carried out by means of screws and dowel bolts that ensure assembling accuracy.
A bead of sealant is put between the two engine bases, to avoid engine oil leaks.
The figure below illustrates the upper engine base (1) and the lower base (2).


1
2

3.2.4 CYLINDER HEAD

The cylinder head is of the single-structure type and is made from aluminium and silicium alloy.

Two overhead camshafts, made of ductile cast iron, are housed within an overhead; the drive is of the combined chain-gear type.

The four valves per cylinder (parallel and vertical) are located in their respective guides and driven by rocker arms actuated by the cams of the cam axles and kept into contact with the valves by means of hydraulic tappets.

The valve guides are driven into the respective cylinder head housings by interference. The inner diameter is optimized, after assembling, by means of a special boring machine.

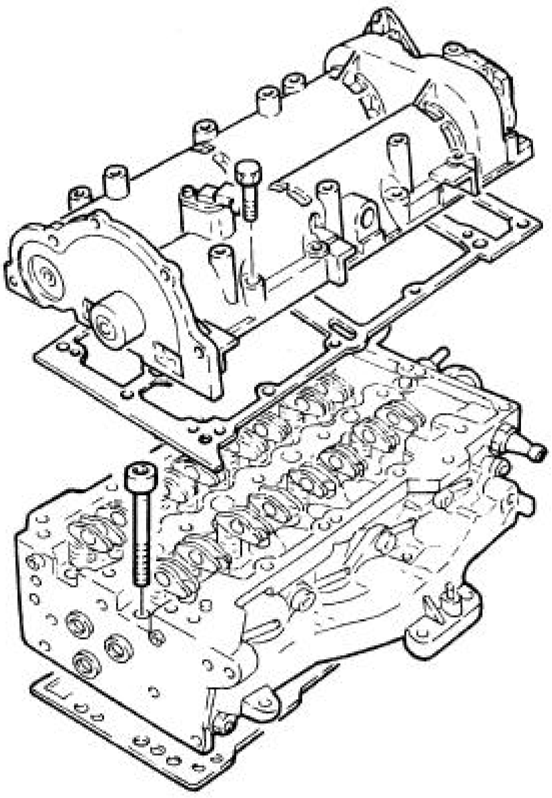
Compared with the cylinder heads with precombustion chamber, the entire combustion process takes place in the combustion chamber obtained on the piston.

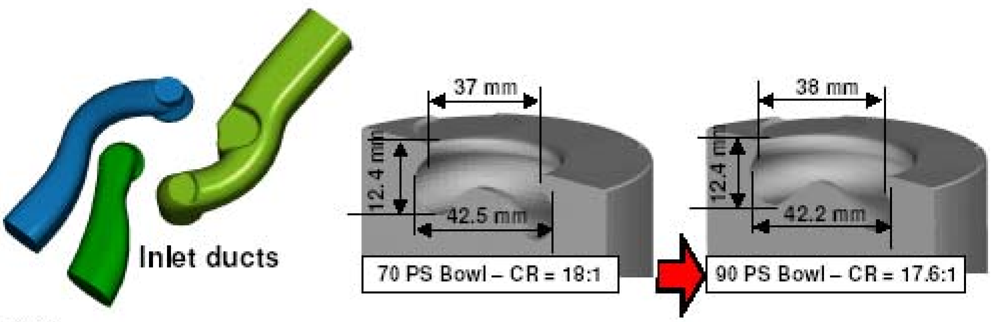
The gasket between the cylinder head and the engine base is made of metal; moreover, the cylinder head shall not be retightened during the entire engine life.

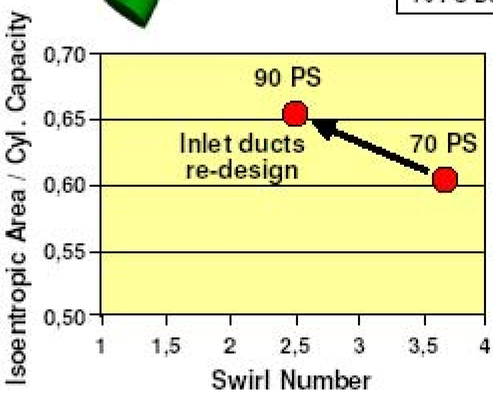
On the versions fitted with the 90 HP engine, the combustion system has been necessarily modified in order to improve the input and output flows.

The inlet duct design has been modified by increasing the flow capacity; at the same time, volumetric efficiency at high speeds has been improved, following a reduction of the swirl level.

The combustion chamber design has been modified, by increasing the chamber diameter and, as a result, reducing the compression ratio from 18:1 to 17.6:1.



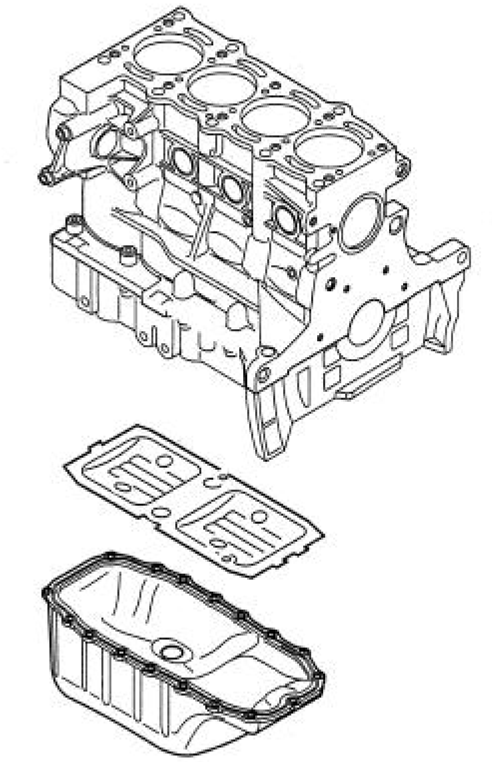




Nozzle features	70 PS	90 PS
Type	KS - microsac	
Holes number	5	6
Nominal hole diam (mm)	0.13	0.12
Flow rate (cm³/30s)	270	280

3.2.5 Base sump and covers

The engine base oil sump is a structural part of the engine with mechanic functions, which is used to hold the engine lubricating oil.
It is made of stamped sheet metal and includes the threaded hole with cap for engine oil drain.
Sealing with the engine base is achieved by means of a bead of silicone sealant.
A bulkhead is put between the engine base and the oil sump, which prevents the engine oil from being shaken off (due to the vehicle and drive shaft motion) and also ensures that the level remains constant.

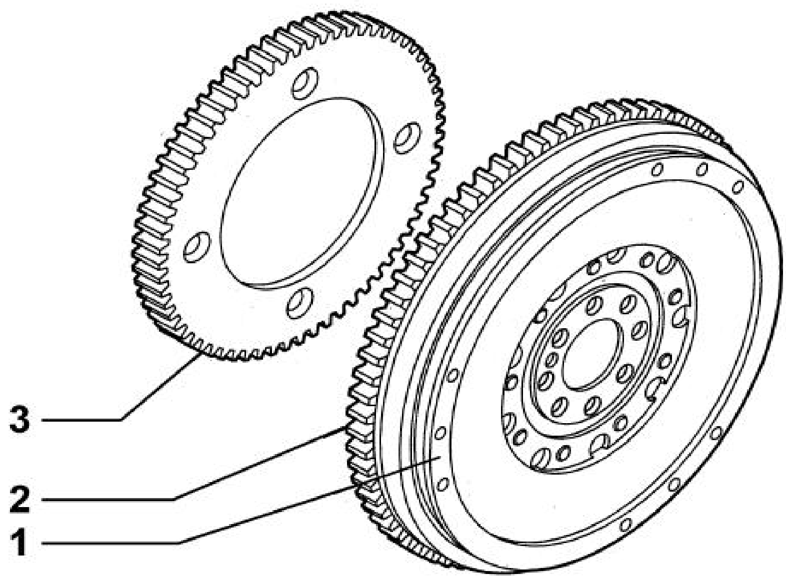


3.2.6 Oil seals on the drive shaft

Front drive shaft sealing is achieved by means of an oil seal fitted onto the valve gear cover. Rear drive shaft sealing is achieved by means of an oil seal fitted directly into the housing obtained between the engine base and the underbase.

3.2.7 Engine flywheel

The engine flywheel is made of cast iron with set steel ring gear.
The flywheel is secured to the drive shaft through a flange with bolts; a phonic wheel (for the revs sensor) is secured toward the engine side.



1 Engine flywheel

2 Set ring gear

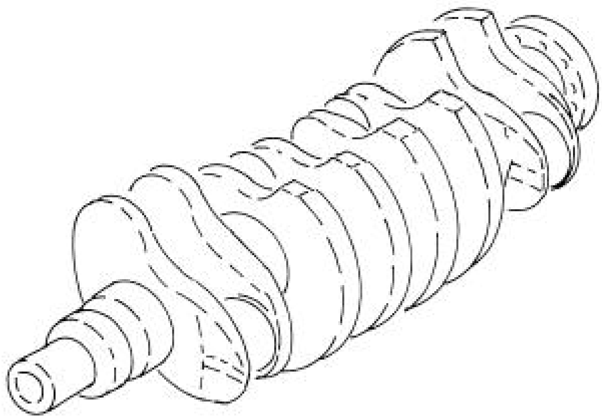
3 Phonic wheel for revs number

Operation

The engine flywheel is a member that makes engine rotation uniform, by accumulating energy during the active phases (expansion) and giving the same back during the passive phases. The flywheel is dimensioned so as to allow the engine to idle without coming to a halt, and overcoming the friction work developed by the same during no-load operation.

3.2.8 Drive shaft

It is made of forged steel and rests on five main bearings. Its axial play is controlled by two half-rings housed in the central main bearing.
Accurate balancing of the rotating masses is ensured by eight counterweights.
A number of channels run through the drive shaft for lubrication of journals and crankpins.



3.2.9 Pistons

The pistons are made of silicium-based aluminium alloy with antifriction inserts. They are divided into three dimensional classes.

Class A: 69,520 + 69,530 (75 HP) nd (90 HP)

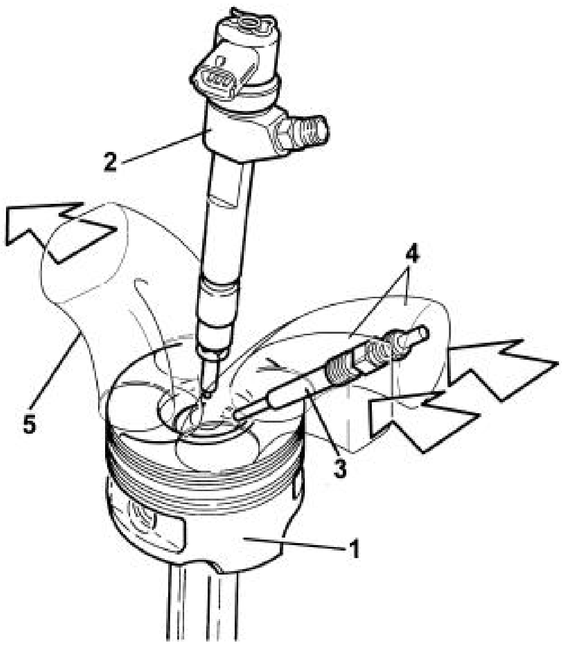
Class B: 69,530 + 69,540 (75 HP) nd (90 HP)

Class C: 69,540 + 69,550 (75 HP) nd (90 HP)

The “OMEGA” combustion chamber is obtained on the piston crown, to improve combustion efficiency (see “Cylinder head”).

A channel is obtained inside the pin, through which the oil sent to the nozzles flows, thus ensuring better piston cooling.

Coupling with the pin is carried out by means of two copper-alloy bushings.



1 Piston

2 Electric injector

3 Preheating spark plugs

4 Air inlet

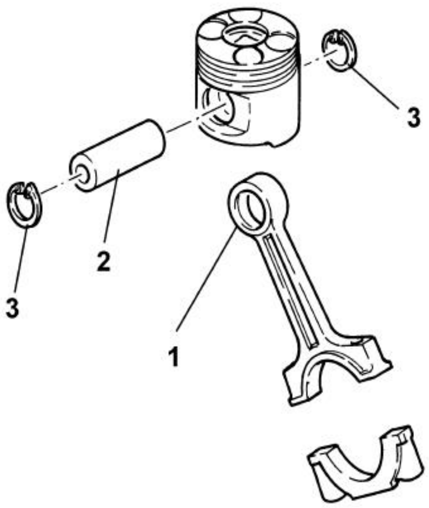
5 Exhaust gas outlet

3.2.10 Connecting rods

The connecting rods are made of hardened and tempered steel, with a copper bushing (1) driven for coupling with piston pin (2).

The pins (of the float type) are retained by two expansion snap rings (3) found in the special slots obtained within the pin housing.

Coupling between the connecting rod and the cap through machined surfaces. To withstand specific pressure values in the 90 HP engine, the upper bronze bushings have been modified. Refer to the diagram.



Con rod bearing

New material due to increased specific pressure:

	70HP	90HP
Main bearing (lower)	AS16	AS16
Main bearing (upper)	AS16	AS16
Conrod (lower side)	CL157	CL157
Conrod (upper side)	CL118	CL119

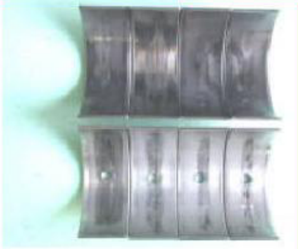


Foto TE03043/1

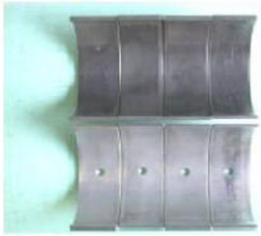
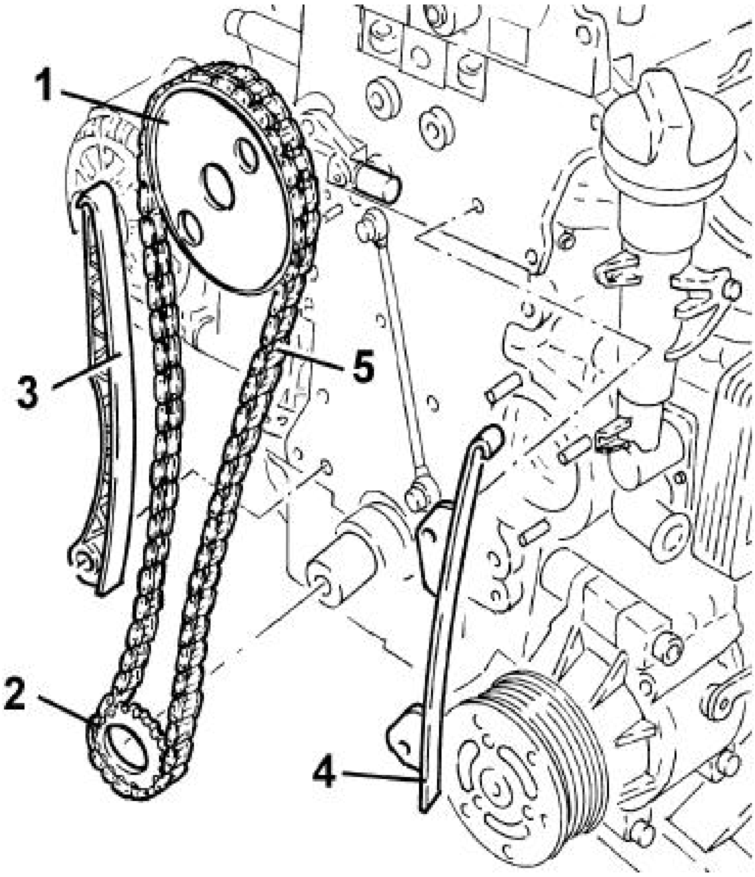


Foto TE03043/6

90HP better than 70 HP even if the specific pressure is higher

3.2.11 Camshaft drive

The camshaft drive is of the direct type, and takes place by means of a chain.



1 Driven gear

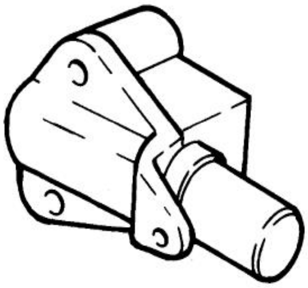
2 Driving gear

3 Moving shoe

4 Fixed shoe

5 Timing chain

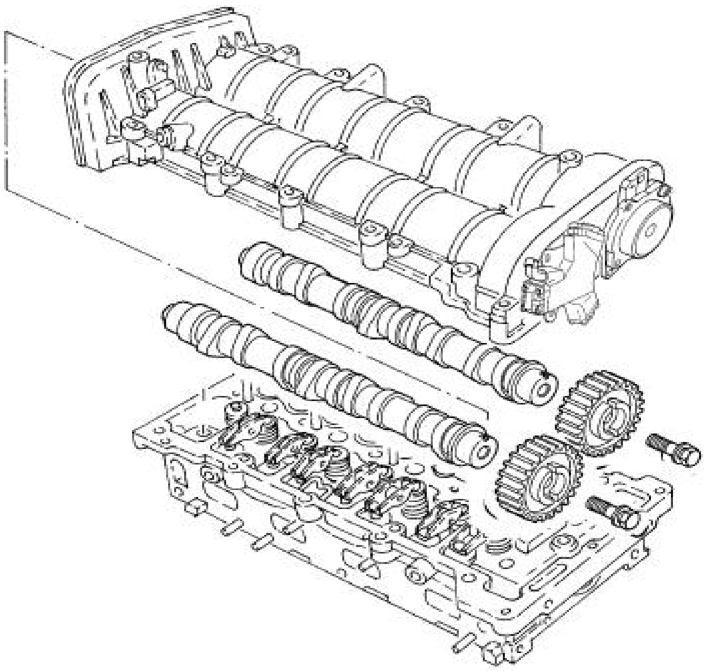
3.2.12 Camshaft drive idlers



The timing chain is stretched by an automatic, oil-pressure operated stretching device (which minimizes maintenance operations), fitted inside the valve gear on the block, which acts on the moving shoe.

3.2.13 Distributing shafts in the upper head

These are two camshafts made of cast iron, with induction-hardened cams.



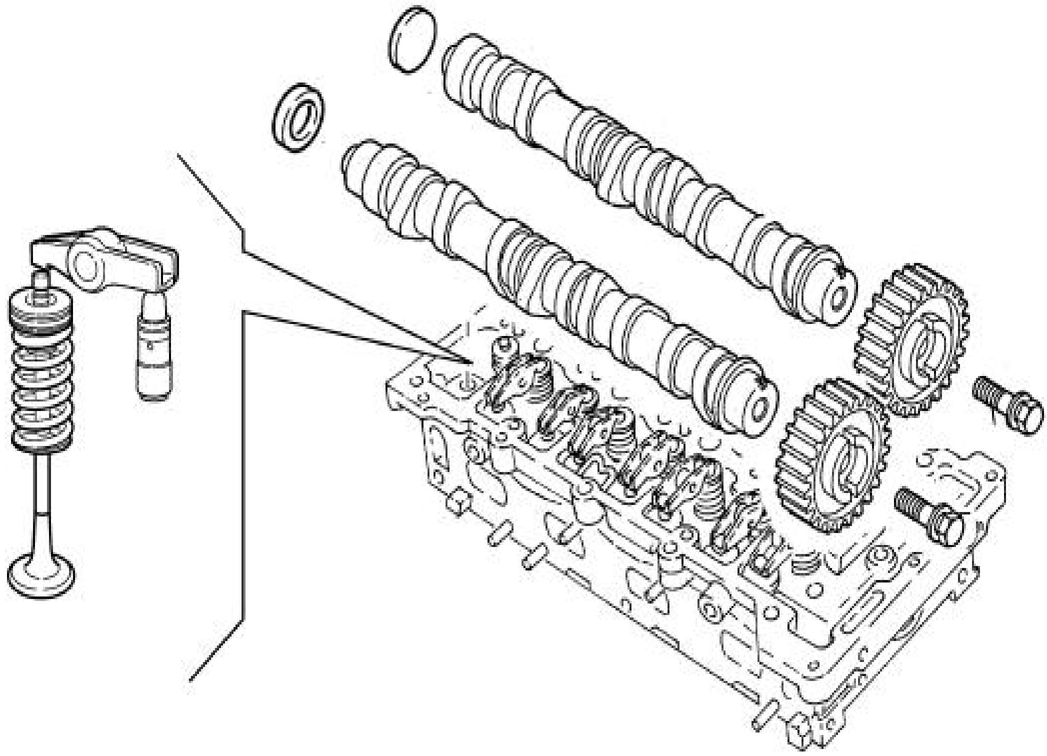
The distributing shaft (on the exhaust side) is directly driven by the chain and transmits the motion to the distributing shaft (on the intake side) by means of a pair or straight-toothed gears.

The distributing shaft on the exhaust side also drives the high-pressure pump, whereas the one on the intake side drives the vacuum pump.

3.2.14 Tappets

A hydraulic tappet is used for every single valve, which is actuated by a rocker arm that is, in turn, driven by the cam axle.

The rocker arms are made in such a way as to avoid serious damage to the other engine members in case of timing chain breaking or stepping. In fact, they are able, thanks to a pre-established fracture section, to get deformed so as to absorb the stress caused by the contact between the valves and the pistons.



Intake-exhaust valve diameter: 21.47 mm

3.2.15 Spark plug preheating control unit

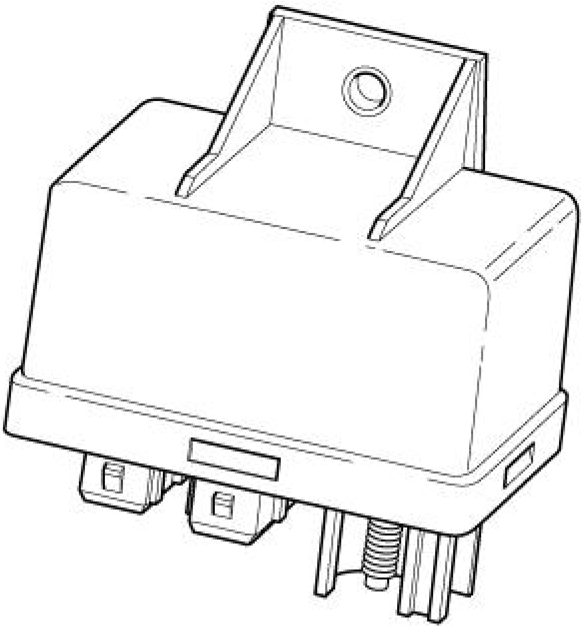
Features

This device is interfaced and controlled by the engine control system according to the EOBD protocol. It has been designed to perform all the functions for driving and monitoring the operating condition of every single spark plug during the diesel engine preheating phase.

The control unit includes a protection device against high current and overvoltage, and also features an electronic, self-resetting logic.

Considering the thermal and weather-resistance features, the device can be fitted directly to the engine compartment.

The control unit is protected against any possible electric connections with battery polarity reversal on all of its terminals, and has been designed so as to withstand all the stress found in the vehicle.

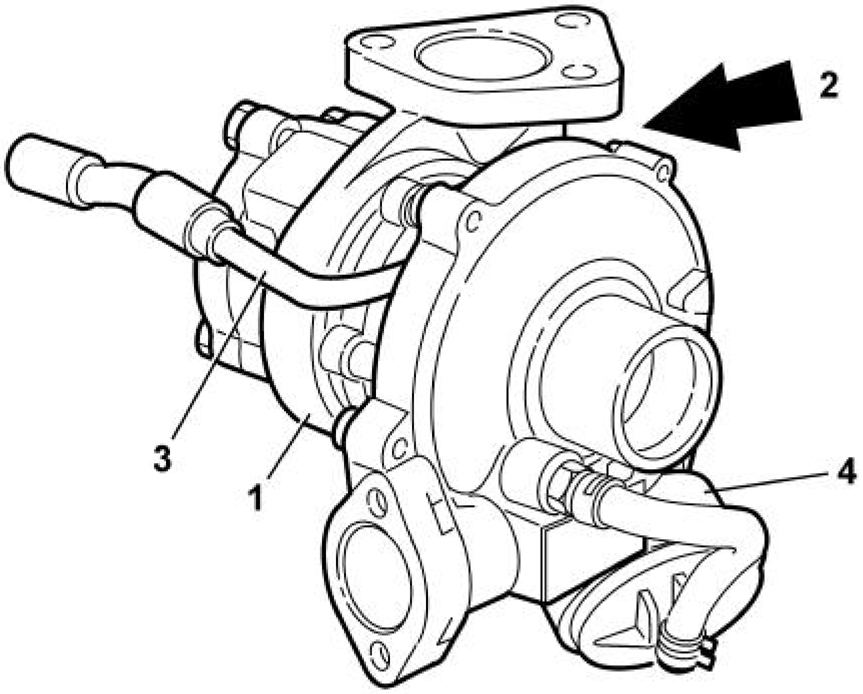


The unit is equipped with the connecting terminals below:

Terminal	Name
30	Direct connection to the battery positive (+Vbat) for spark plug power supply
G1, G2, G3, G4	Spark plug connection output
86	Power supply from the engine control unit
31	Ground connection (GND)
ST	Input for control start from the engine control unit
K	Input for control start from the engine control unit
DI	Output for direct diagnosis toward the engine control unit

3.2.16 Turboblower

The turboblower (1) is connected to the exhaust manifold; it is used to enhance the engine's volumetric efficiency.
It is essentially made up of two impellers force-fitted to one single shaft that rotates on floating bearings lubricated through a branch (3) of the engine lubricating circuit.



1 Turboblower

2 Waste gate

3 Lubricating circuit branch

4 Pneumatic actuator

The oil used eliminates part of the large amount of heat yielded by the exhaust gas to the turbine. The turboblower incorporates a WASTE - GATE valve (2) controlled by a pneumatic actuator (4), which makes it possible to choke the exhaust gas flow to the turbine, depending on the pressure reached at the compressor outlet.

BORG WARNER VNT 90 HP turboblower

The 1.3 MJTD, 90 HP engine features a new generation of turboblowers: the VNT (Variable Nozzle Turbines) turboblower. The distributor blades are actuated electro-pneumatically. This technology makes it possible to achieve optimum turboblower with all engine speeds.

Purpose of a turboblower

The purpose of a turboblower is to achieve very high torque values and, therefore, greater engine performance. All of this can be obtained by compressing the sucked air. Thanks to the greater density at every intake phase, a greater amount of oxygen can be let into the engine's combustion chamber. The greater oxygen content improves combustion and, as a result, increases power.

The thermal and kinetic energy of the engine's exhaust gas is best used to actuate the turboblower exhaust-gas turbine: the latter actuates the compressor which compresses the sucked air by heating it. Then, the air is cooled again in the intercooler.

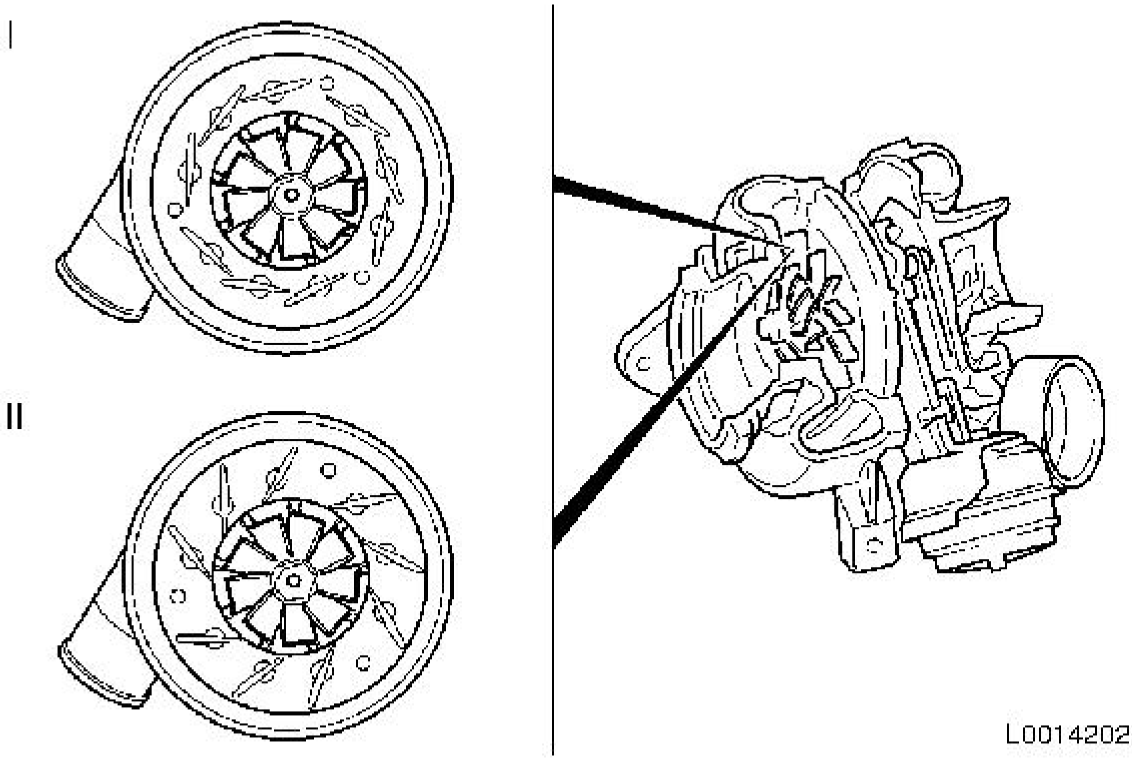
Operation

At low speeds, the turboblower's distributor blades are actuated electrically and positioned (i) by vacuum in such a way that the exhaust gas flow hits the outer edge of the turbine blades. This causes the exhaust gas flow to be restricted and involves increasing exhaust gas flow speed and boosting pressure. According to the principle of the lever, all of this involves a higher torque at low speeds.

If the engine revs number increases, the exhaust gas inlet section will be increased by displacing the distributor blades (II). Now the gas particles will not preferably hit the outer edge of the distributor blades any longer: they will be found along the entire length of the blades. The turboblower will operate less efficiently, which will however be compensated for by the greater exhaust gas volume at high engine speeds.

If, however, the engine's maximum power is required (e.g. when overtaking), the electro-pneumatically operated blades will be displaced to the low speed position, which will significantly enhance the turbine performance and, as a result, the boosting pressure, thus making the engine's maximum power available.

Turboblower view



1. Low engine revs number and small exhaust gas amount

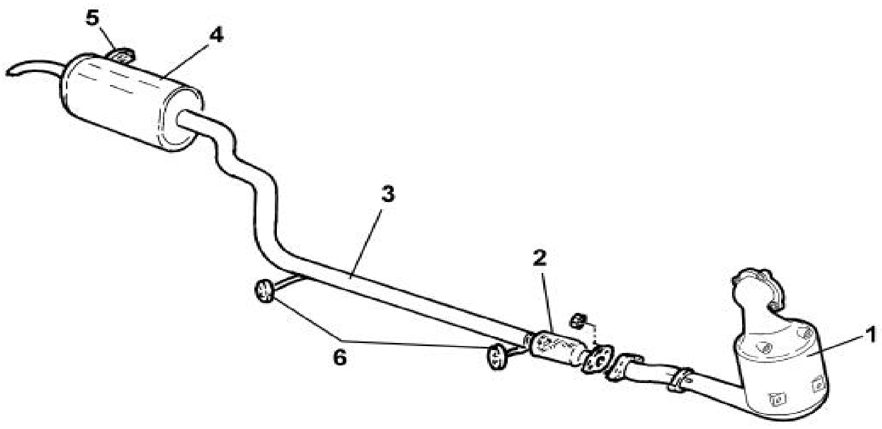
2. High engine revs number and large exhaust gas amount

3.2.17 Inlet manifold

The air capacity box (made of plastic material) receives pressure air, cooled by the intercooler, and conveys the same directly to the cylinder head.
The overpressure sensor, connected to the injection control unit, is fitted onto the box. A diffuser is positioned at the manifold intake, which is used to let in the exhaust gas from the E.G.R. valve and flowing toward the cylinders.

3.2.18 Exhaust pipes and silencer

The engine's exhaust gas flows through the manifold to the turboblower and, next, to the oxidizing catalytic converter (1).
A flexible element (2) is found in the front part of the exhaust pipe, which is used to reduce the transmission of vibrations.
The rear exhaust section is made up of a, intermediate pipe (3) and a rear silencer (4).
Special guards reduce heat diffusion toward the body.
The various components are supported by means of special supports (5) and snap rings (6) secured to the underbody.

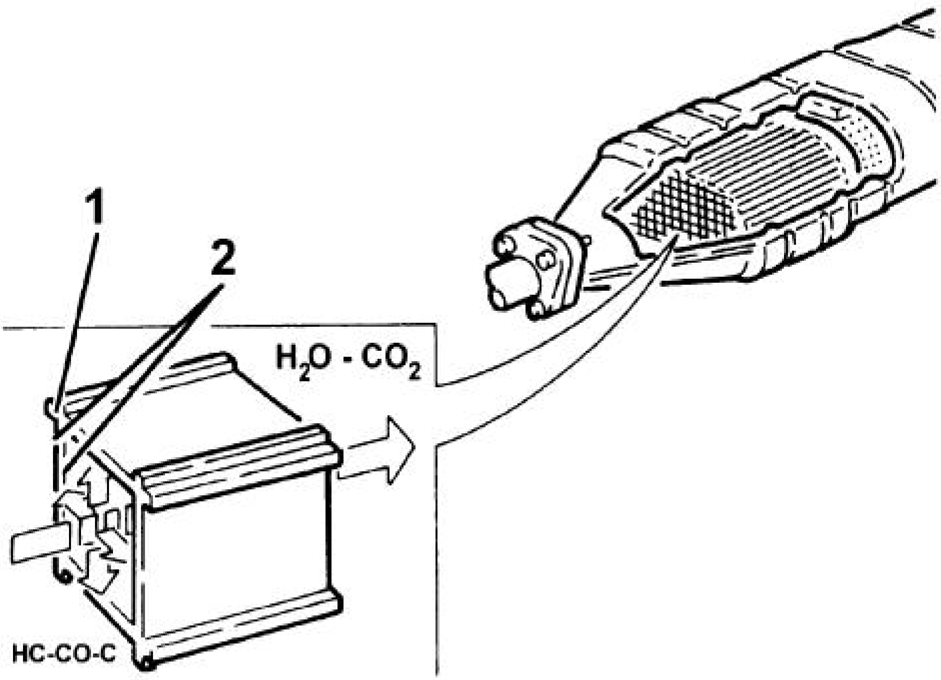


3.2.19 Exhaust emission control system

3.3 Catalytic converter

The oxidizing catalyst is a post-treatment device to oxidize the CO, HC's and particulate, so as to transform the same into carbon dioxide (CO2) and water vapour (H2O).

The catalytic converter is made up of a ceramic, honeycomb monolith (1), the cells of which are soaked with platinum (2), a catalyzing substance of oxidation reactions.



Operation

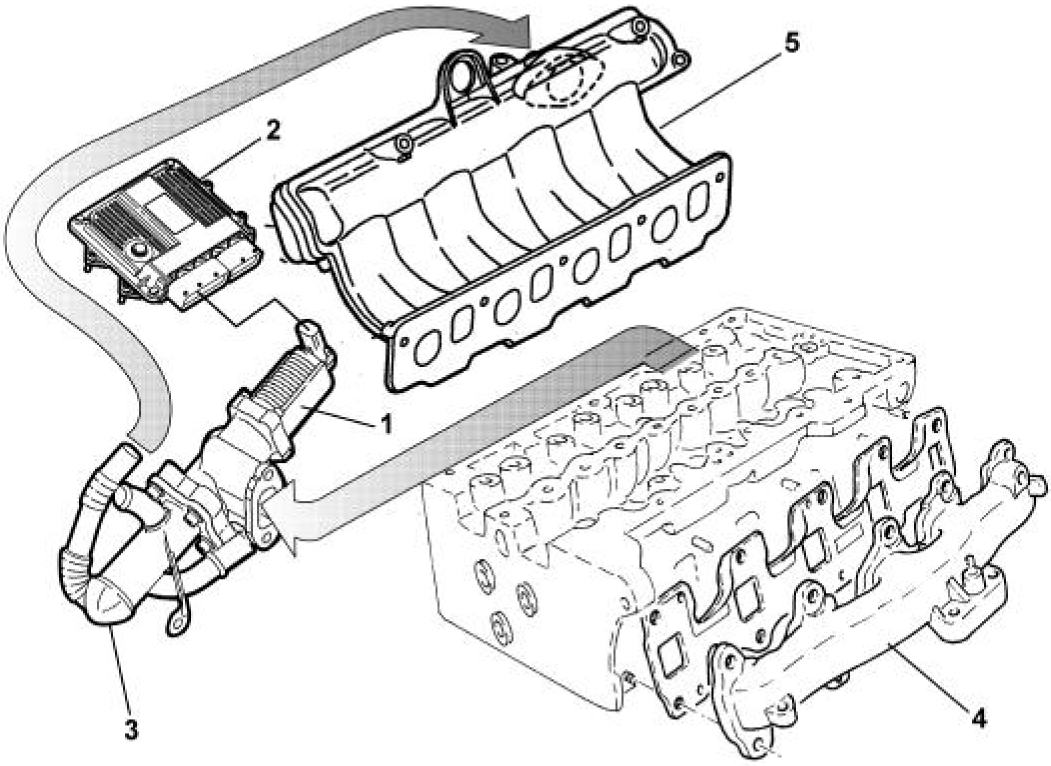
The exhaust gas flowing through the cells heats the catalyst, thus triggering the conversion of polluting substances into inert compounds.

The chemical reaction for CO, HC and particulate oxidation is efficient at temperatures ranging between 200°C and 350°C.

Beyond 350°C, the sulphur contained in the diesel fuel starts oxidizing, thus giving rise to sulphur dioxide and sulphur trioxide.

3.3.1 Exhaust gas recirculation (E.G.R.) system

This system makes it possible, under certain operating conditions, to convey a portion (5 ÷ 15%) of the exhaust gas to the intake.
Thus, the temperature peak is lowered in the combustion chamber, thus reducing the formation of nitric oxides (NOx).
The function of the E.G.R. solenoid valve (1), controlled by the injection control unit (2), is to let a portion of the exhaust gas drawn by exhaust manifold (4) again into the engine intake.
A heat exchanger (3) makes it possible to partially cool the exhaust gas, by further lowering the combustion chamber temperature.



E.G.R. solenoid valve
Injection control unit
Heat exchanger
Exhaust manifold
Air inlet manifold

Operation

The injection control unit drives, with coolant temperature of more than 20°C and engine speed ranging between 800 and 3,000 r.p.m., the E.G.R. solenoid valve through a square-wave signal.
Variation of this signal allows the E.G.R. coil to displace a shutter, thus controlling the flow of burnt gas from the exhaust manifold to the inlet manifold. Two results will thus be obtained:
less air is let in;
the combustion temperature is lowered (due to the presence of inert gas), thus reducing the formation of NOx (nitric oxides).
The injection control unit is constantly informed about the amount of recirculated gas by the data from the air flow meter. In fact, if a certain amount of air (Qam) is to be sucked with a given engine speed, and the value provided by the air flow meter (Qar) is smaller, the difference (Qgr) will be the value of the recirculated gas amount.

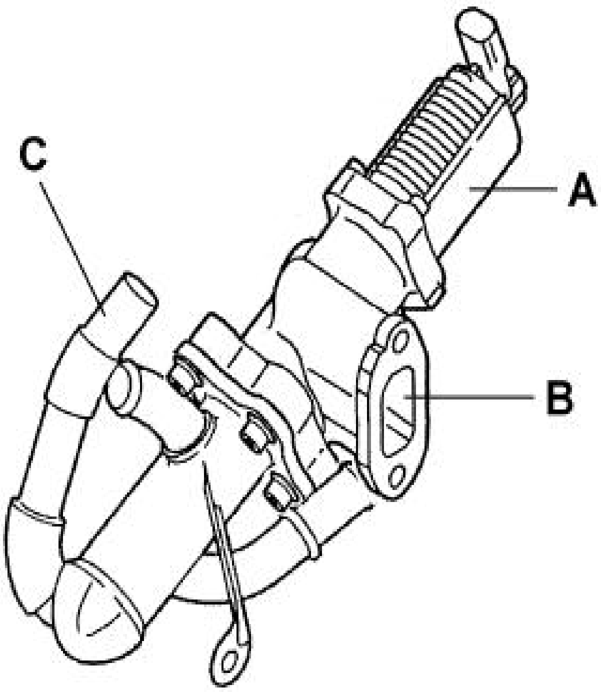
Qam - Qar = Qgr

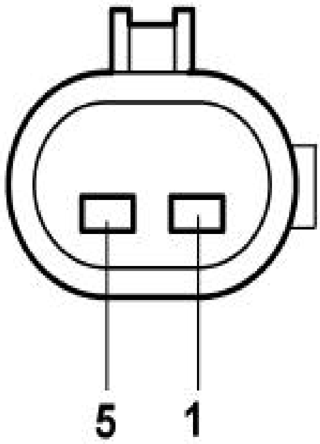
Qam – Stored theoretic air amount
Qar – Actual air amount
Qgr – Recirculated gas amount

The atmospheric pressure signal is used when driving the E.G.R. solenoid valve to recognize the high-altitude driving condition, so as to reduce the amount of recirculated gas and avoid engine smokiness.

E.G.R. solenoid valve

The purpose of the Pierburg E.G.R. solenoid valve (fitted to the cylinder head) is to modulate the exhaust gas flow to the intake, depending on the control of the injection control unit. Modulation takes place by means of the inner solenoid (PWM-controlled by the control unit), which actuates the control rod of the inner valve that conveys, after it has opened, the gas into the inlet manifold.





E.G.R. valve body

Gas inlet from the exhaust manifold

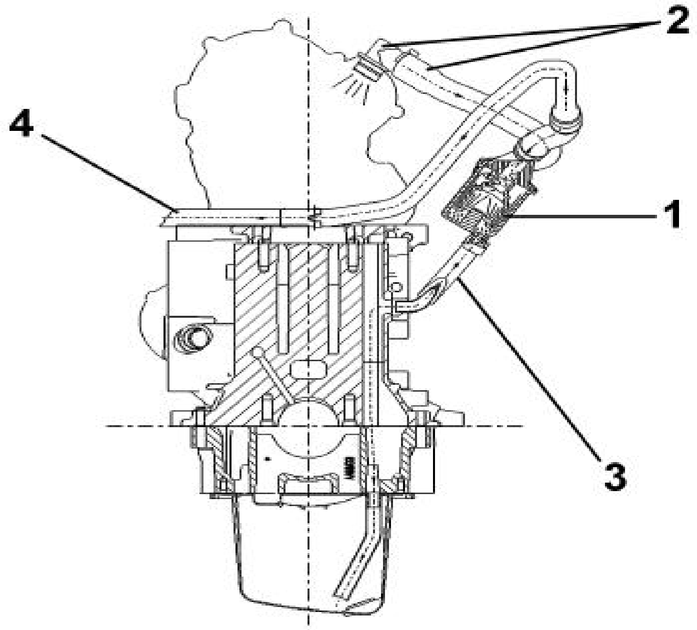
Gas outlet to the inlet manifold

Solenoid positive

Solenoid negative

3.3.2 Engine base vapour/gas recirculating system

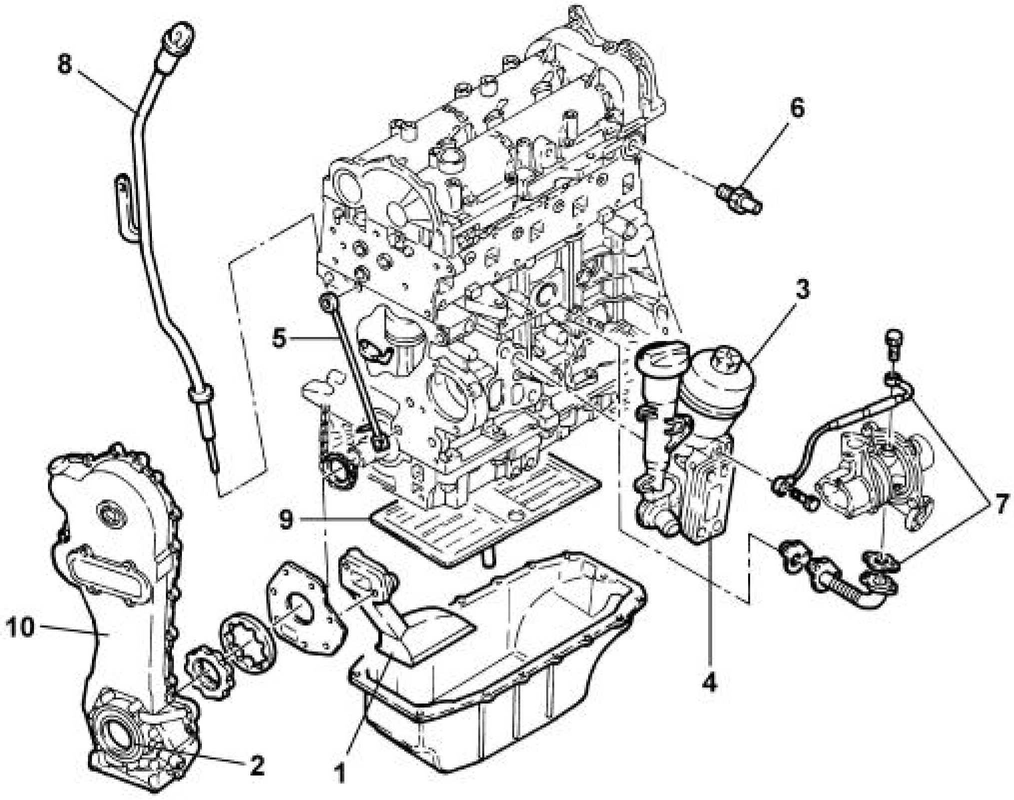
The oil vapour emissions are controlled by means of an oil separator (1) that collects the vapour from the engine base and the valve gear cover through pipe (2). Condensed vapour returns to the sump through pipe (3), whereas non-condensed vapour is conveyed, through pipe (4), to the turboblower air inlet sleeve.



1 Oil separator
2 Oil vapour outlet from the cover
3 Condensed vapour return to the sump
4 Pipe for sending the vapour to the intake

3.3.3 Engine oil lubricating circuit

Below is a representation of the engine lubricating system.



Plummet with filter strainer

Oil pump

Oil filter (with replacement cartridge)

Engine oil cooling water/oil heat exchanger

Nozzle (timing chain lubrication)

Engine oil pressure warning light switch

Turboblower lubrication pipes

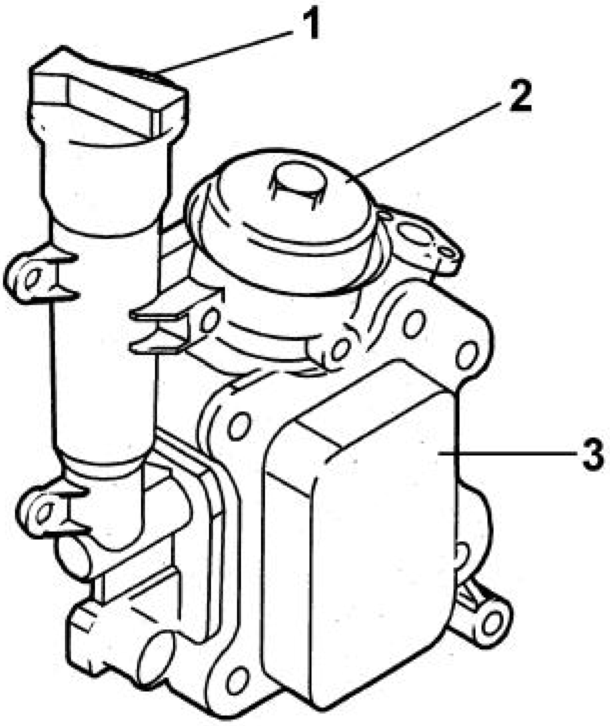
Engine oil level dipstick

Engine oil level maintaining and scraper ring bulkhead

Timing chain cover

3.3.4 Heat exchanger and oil filter assembly

This assembly includes both the filter element and the heat exchanger (the latter features the oil filling cap on its side).



1 Oil filling cap

2 Filter element cover

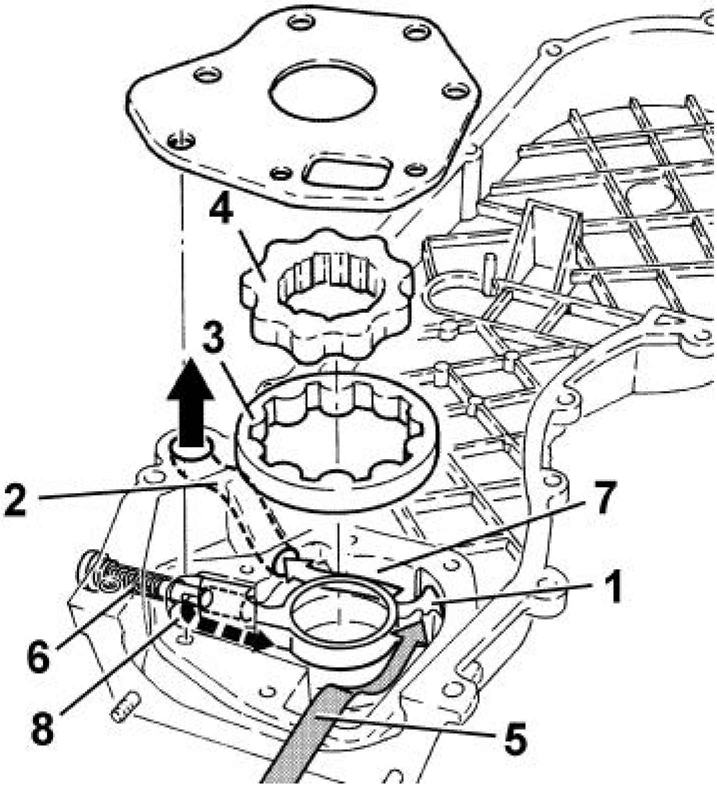
3 Water/oil heat exchanger

3.3.5 Engine oil pump

The engine oil is sucked by the sump through the vacuum generated by the rotation of the gears force-fitted onto the drive shaft.

The vacuum is found starting from the gear partition bulkhead (1) up to the oil sump plummet. Conversely, the pressure develops starting from the partition bulkhead (1) in all the engine oil supply ducts (2).

When pressure exceeds 5 bar, the thrust applied on relief valve (6) overcomes the reaction of the spring underneath and moves the valve until the connecting duct (8) between pressure chamber (7) and low-pressure chamber (5) is opened.



1 Partition bulkhead

2 Oil supply duct

3 Driven gear

4 Driving gear

5 Low-pressure chamber

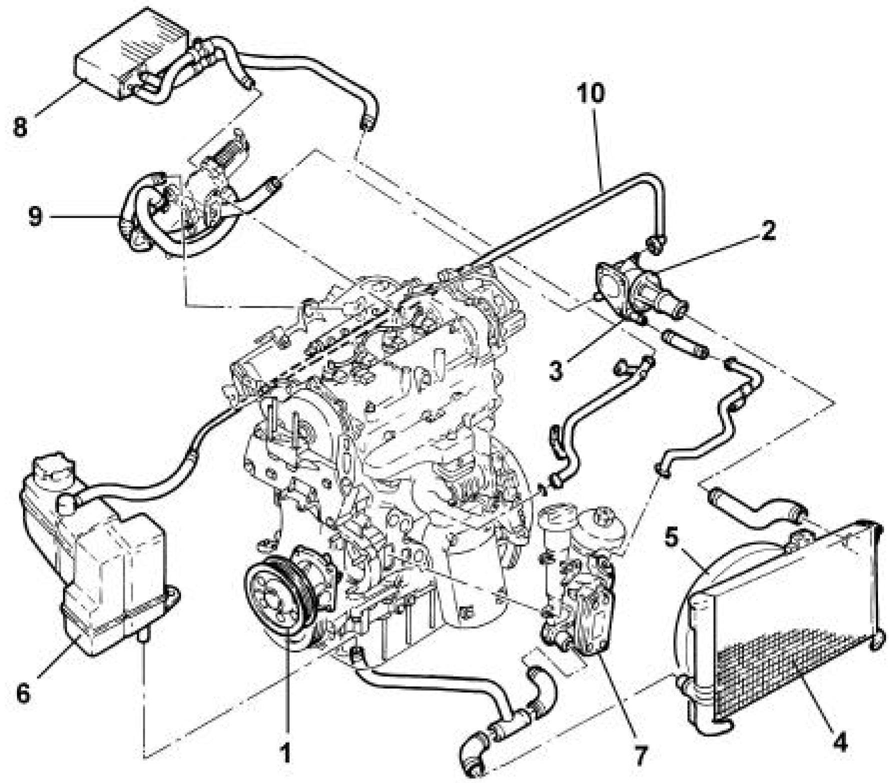
6 Relief valve

7 Pressure chamber

8 Connecting duct between high and low pressure

3.3.6 Engine cooling

Engine cooling system



Water pump

Engine coolant temperature sensor

Thermostat

Radiator

Electric fan

Feed tank

Engine oil heat exchanger

Vehicle interior heating radiator

E.G.R. exhaust gas heat exchanger

Water recirculation pipe

3.3.7 Engine cooling tank and radiator

3.4 Engine cooling feed tank

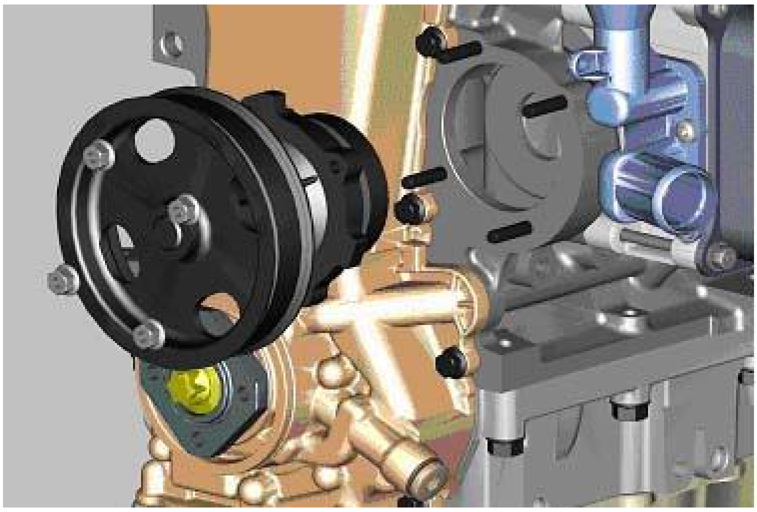
In addition to feeding the circuit, the tank absorbs the cooling fluid volume variations as the engine temperature changes.
By means of a special calibrated valve, included in the pressurized cap, the following will be obtained:

air flows out of the circuit, which is collected by the pipe from the thermostat;
air flows in when the circuit is in vacuum condition (due to engine cooling).

Engine cooling radiator

It is made up of a core and two side trays for coolant inlet and outlet.
The core pipes and fins are made of aluminium, whereas the tanks are made of plastic.

3.4.1 Water pump and thermostat

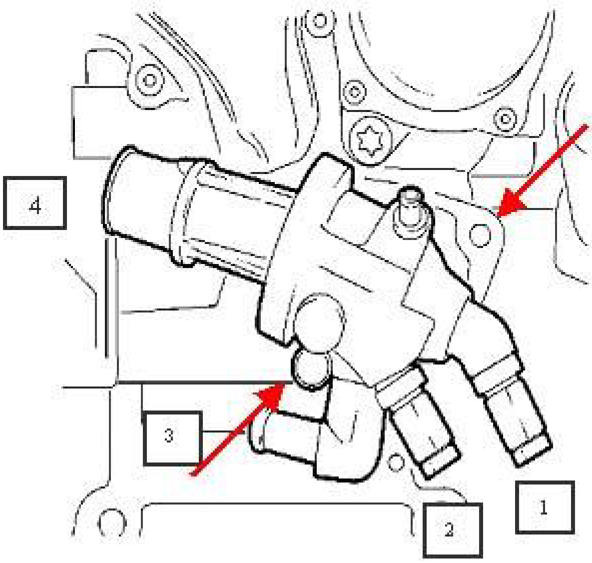


Water pump

The water pump is of the centrifugal, vane type, with pump body and impeller made of phenol resin and arbor made of steel.

It is secured to the engine base and driven directly through the service belt.

Thermostat



1 EGR valve output

2 temperature sensor

3 oil filter output

4 radiator output

It is fitted on the rear side of the cylinder head, and is used to keep the engine at the optimum temperature:

if the temperature if less than 80 ± 2°C, the thermostatic valve (closed) diverts the fluid directly toward the pump;

if the temperature is more than 80 ± 2°C, the thermostatic valve (open) conveys the cooling fluid toward the radiator.

The engine water temperature sensor (connected to the injection control unit and the main panel) is fitted onto the thermostat.

3.4.2 Water temperature control devices

Electric fans

The 2-speed electric cooling fans make it possible to increase the heat discharge capacity of the radiator and/or air-conditioning system condenser.

They are controlled directly by the injection control unit according to a specific operating logic.

3.4.3

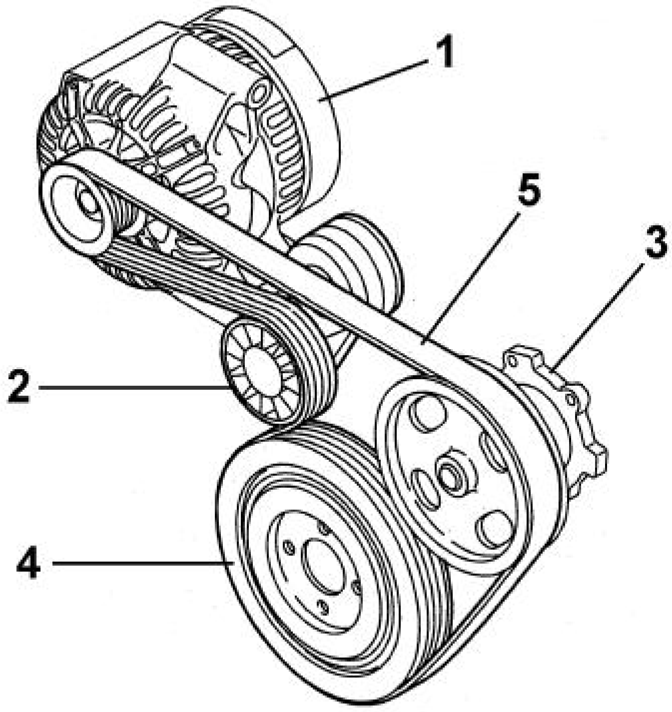
3.5 Service control

Construction

The single engine member drive belt (5) is of the poly-V type: it drives the alternator (1), water pump (3) and air-conditioning compressor (6) (where available).

Tensioning is obtained by means of an automatic idler (2) that makes preventive maintenance operations useless.

The drive shaft pulley (4) incorporates an elastic sector that reduces the torsion vibrations of the drive shaft and the stress on the belt (and, therefore, on the engine's auxiliary members).



Alternator

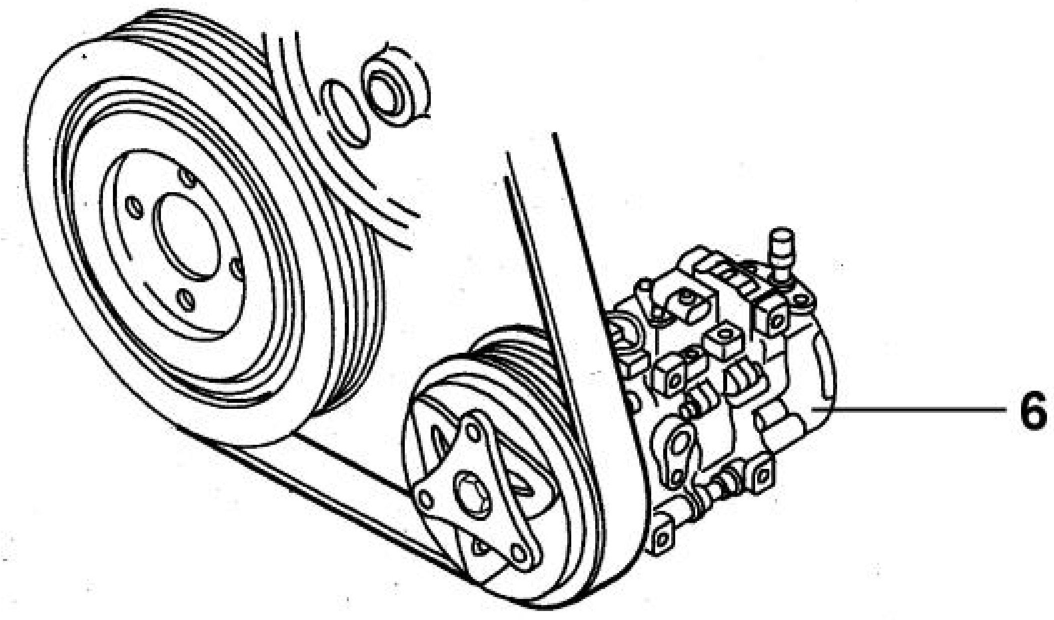
Belt stretcher

Water pump

Drive shaft pulley

Engine member drive belt

Versions with air conditioner.



3.6 Fuel feed system

3.6.1 Features

This fuel injection system makes use of electronically controlled high injection pressure and fuel supply obtained by means of one main injection and one or several pilot injections (according to the engine's operating conditions), which are electronically controlled by the injection control unit through electric injector (CR1MI2.2). This system is capable of carrying out up to five cycle injections (depending on the engine's operating conditions).

The pressure value represents one of the main parameters in order to optimize fuel consumption and exhaust smoke levels.

The engine control by means of several pilot injections makes preheating possible in the combustion chamber, so as to avoid the pressure peak caused by quick combustion, thus ensuring smoother operation, and also allows emissions to be further reduced.

The injection pressure can be controlled thanks to the construction features of the system, which is equipped with a pressure pump, pressure regulator, pressure sensor and separate electric injectors, all of which are managed by a control unit. Thus, the injection pressure is independent from the engine rotation speed.

Below are the main features of the fuel feed system:

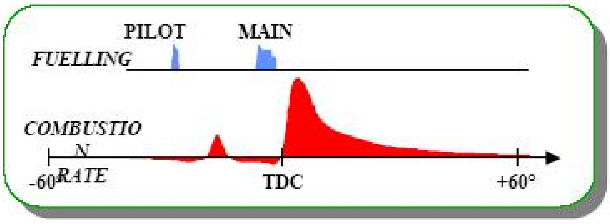
high injection pressure: 1,400 bar (75 HP) 1,600 bar (90 HP);

the injection pressure can be modulated from 150 to 1,400/1,600 bar under any working condition of the engine;

fuel is let in up to 50 mm3/cycle within engine speeds of 100 to 5,200 r.p.m.;

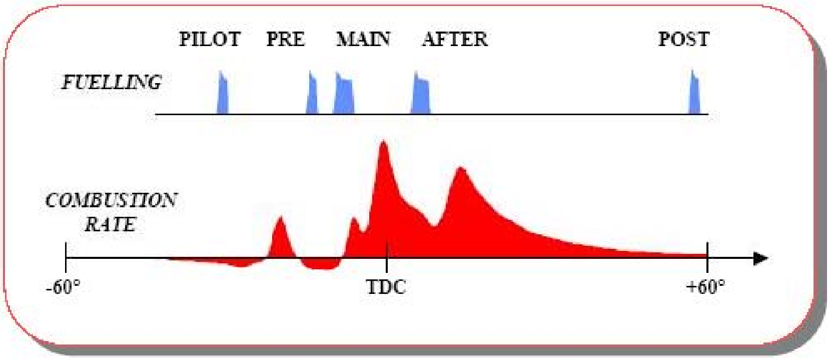
accurate injection control, both as advance and duration;

one or two pilot injections before the T.D.C., manages according to the revs number and the engine load, which make it possible to distribute the pressure into the combustion chamber more evenly, with lower noise levels.



From the pilot injection

To the multiple injection



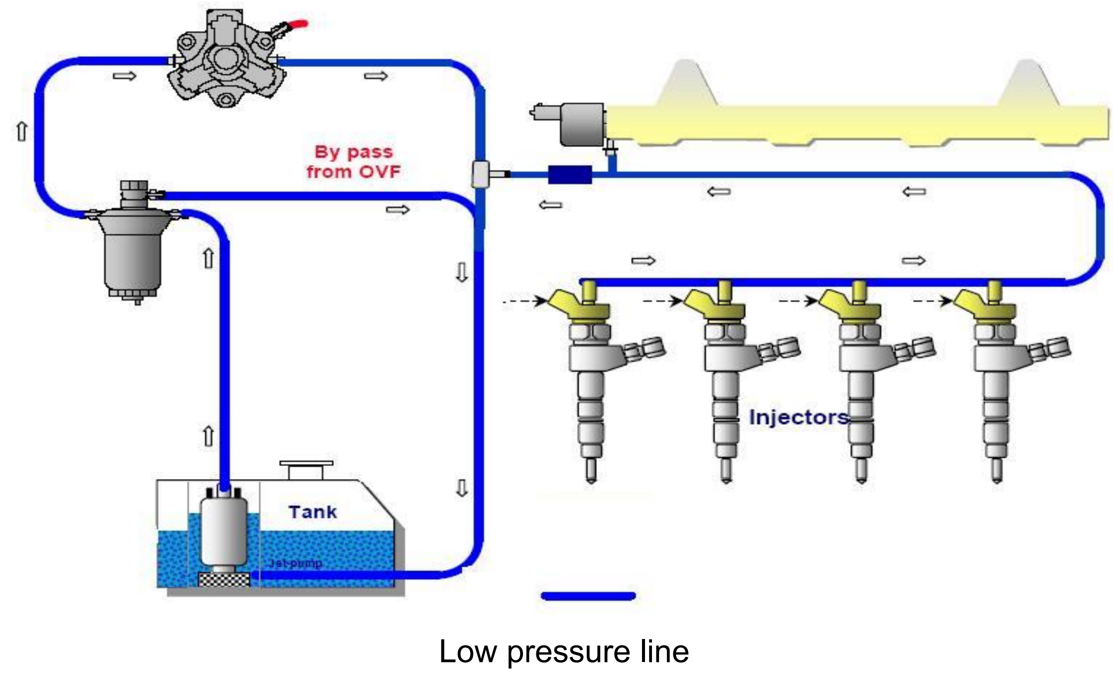
Construction

The fuel feed system is divided into a low pressure circuit and a high pressure circuit.

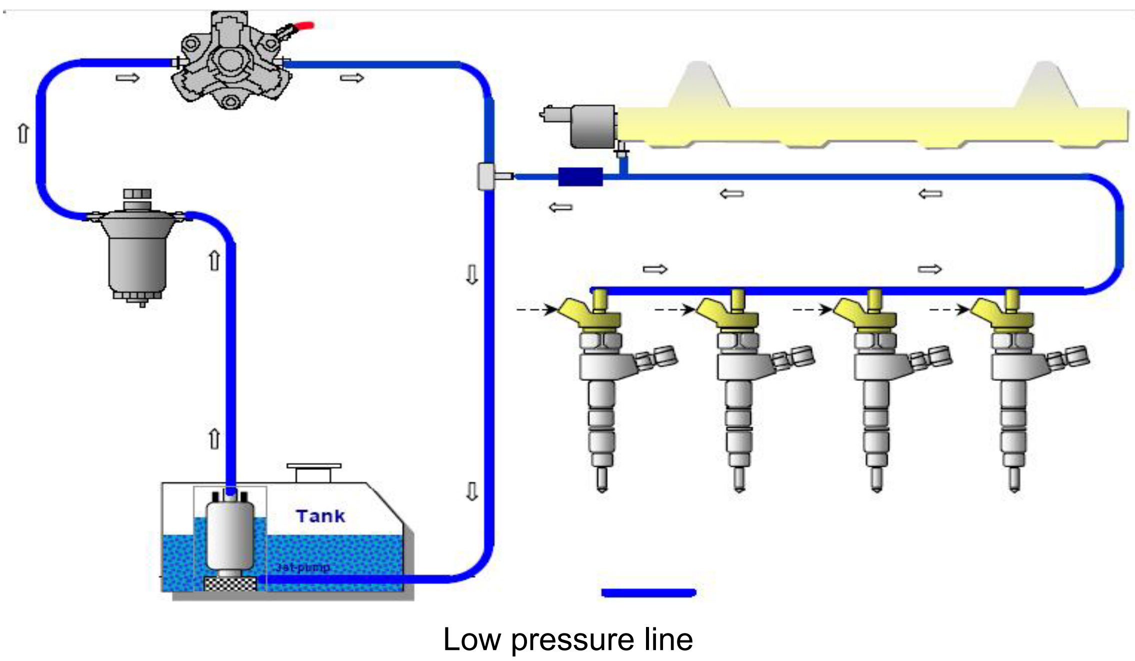
Low pressure circuit

It is made up of the following items:

- auxiliary electric pump immersed into the tank;
- fuel filter with inner cartridge;
- fuel return manifold pipe;
- connecting pipes.



Low pressure circuit (75 HP)

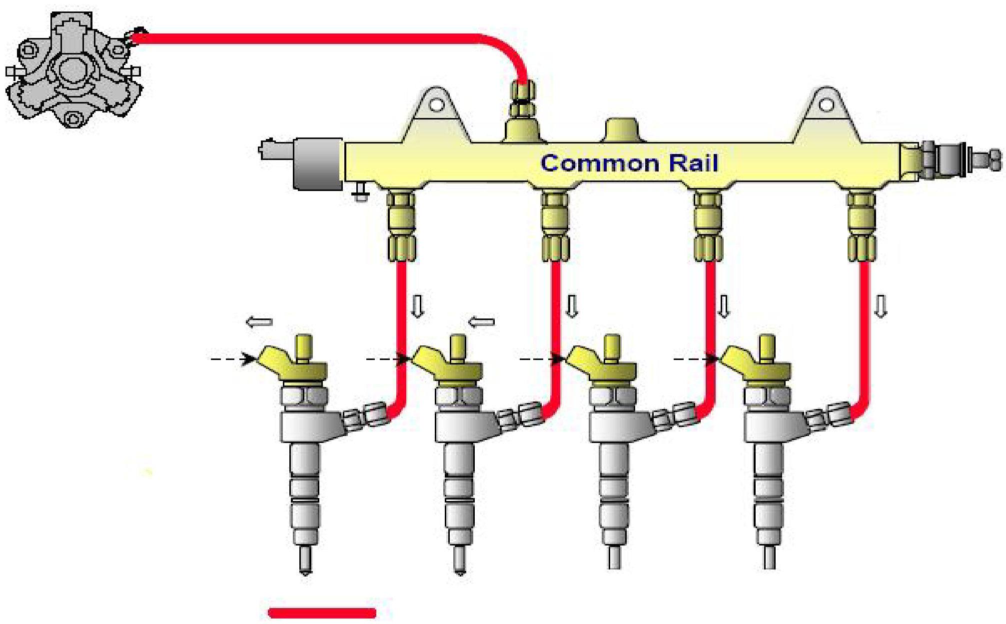


Low pressure circuit (90 HP)

High pressure circuit

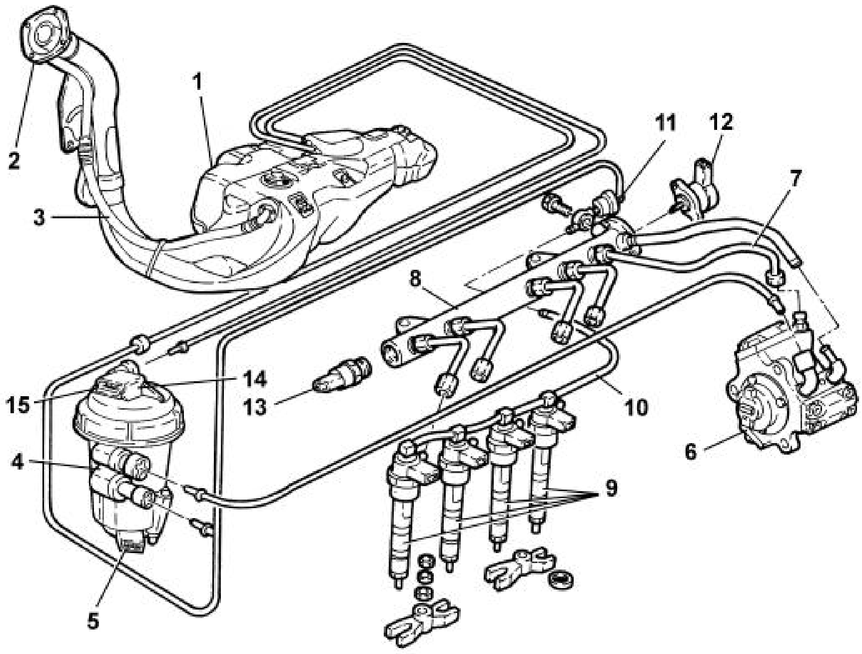
It is made up of the following items:

- pressure pump: CP1 (75 HP), CP1H (90 HP)
- single fuel manifold pipe with built-in pressure regulator and pressure sensor
- electric injectors CR1MI2.2
- connecting pipes.



High pressure line

Injectors (75 HP & 90 HP) = CR1MI2.2



Assembly drawing

1 Fuel tank

2 Fuel filling pipe

3 Backflow pipe

4 Fuel filter

5 Fuel filter water sensor

6 Pressure pump

7 High pressure pipes

8 Single fuel manifold pipe (rail)

9 Electric injectors (CR1MI2.2)

10 Pipe from electric injectors to fuel return manifold pipe

11 Fuel return manifold pipe

12 Pressure regulator (DRV 2)

13 Fuel pressure sensor (RDS 4)

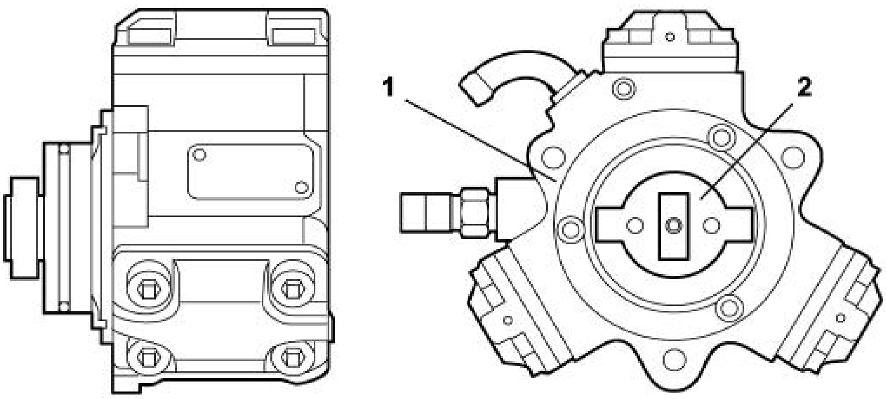
14 Fuel temperature sensor

15 Fuel heater

3.6.2 Bosch CP1 high-pressure pump (75 HP)

Features

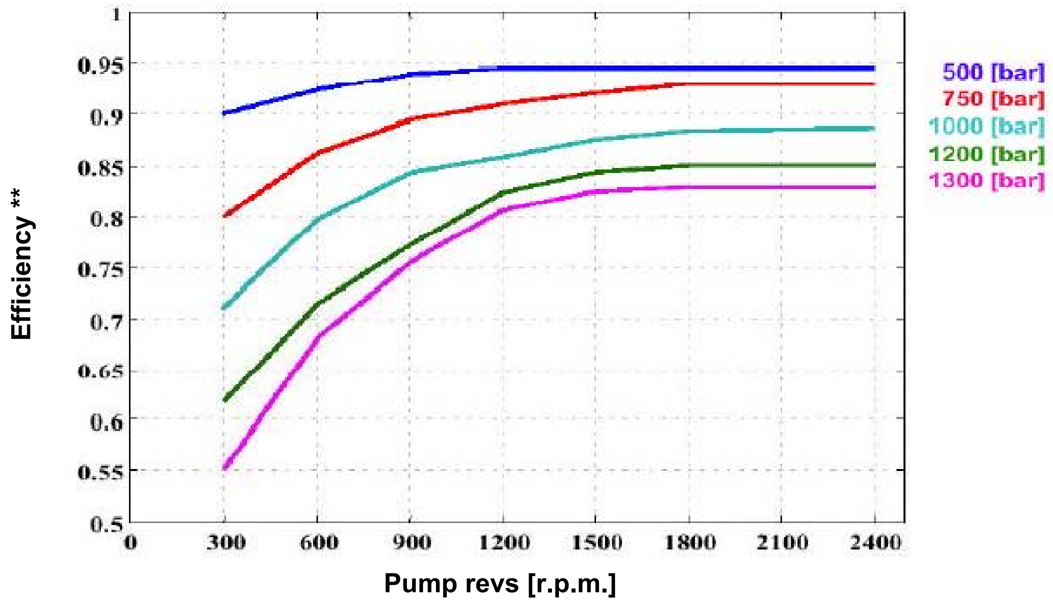
The high-pressure pump is of the CP1 Compact type, with three radial pistons (radialjet). The pump features a capacity of 567 mm3/rev, and a rotation speed equal to half the rotation speed of the drive shaft (step-down ratio: 2:1) (owing to the pump being fitted onto the camshaft through an Oldham coupling). The pump needs no timing; moreover, it is lubricated and cooled by the fuel flow that runs through it: the necessary flow is supplied by the low-pressure pump. The latter feeds the pump with a fuel amount that is always larger than the engine needs, so as to make the fuel circulate back to the tank: by doing so, pump lubrication and cooling will be achieved (the former taking priority over the latter).
Piston motion is obtained through a cam integral to the pump shaft: the latter actuates a polygonal ring that acts on the piston foot.
Each pumping unit is equipped with a gate intake valve and a ball delivery valve.
The pump features a valve referred to as “shutoff valve", which makes it possible to protect the pump in case of low flow rate from the low-pressure delivery, thus allowing the pumping units and the eccentric mechanism to be lubricated.



1 Pressure pump

2 Oldham coupling for camshaft connection

Hydraulic pump efficiency

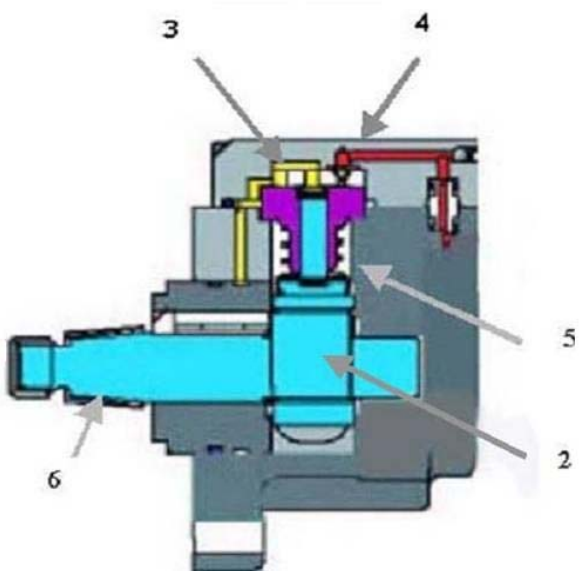


Pump efficiency
- increases as revs do
- decreases as pressure does

Construction

Each pumping unit is made up of the following items: three pistons (5) actuated by a cam (2) integral to the pump shaft (6); one gate intake valve for each piston (3); one ball delivery valve for each piston (4). The pressure pump must be fed with a pressure of at least 0.7 bar; therefore, the fuel feed system is equipped with an auxiliary electric pump immersed into the tank. The maximum discharge pressure reaches 1,400 bar.

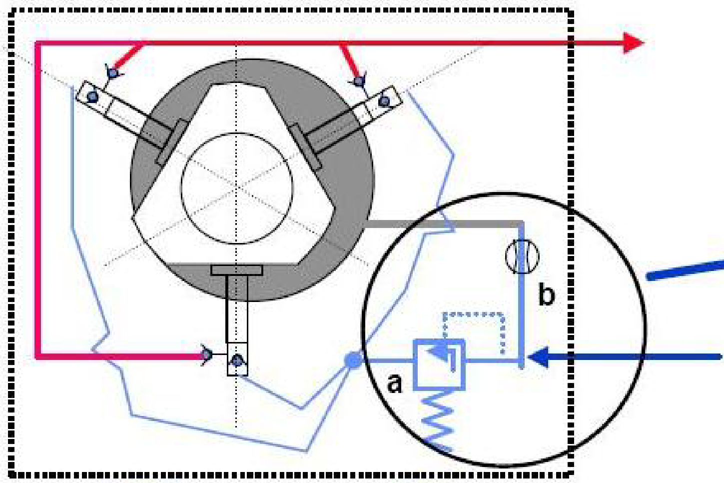
The pressure pump is lubricated and cooled by the fuel itself through special channelling.

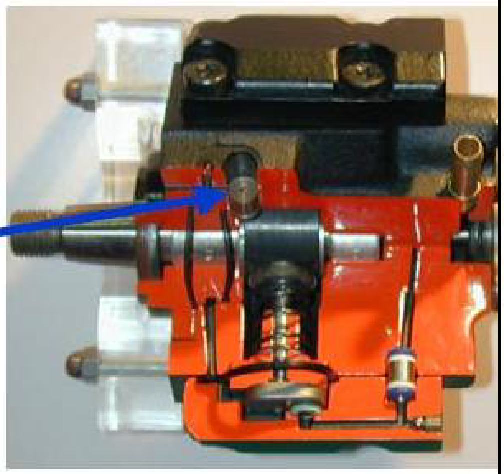


Pump section

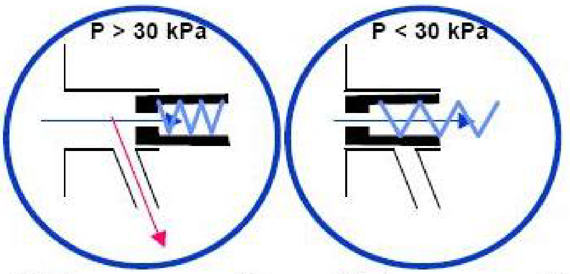
View of the three plungers

CP1 pump diagram and section





CP1 pump section

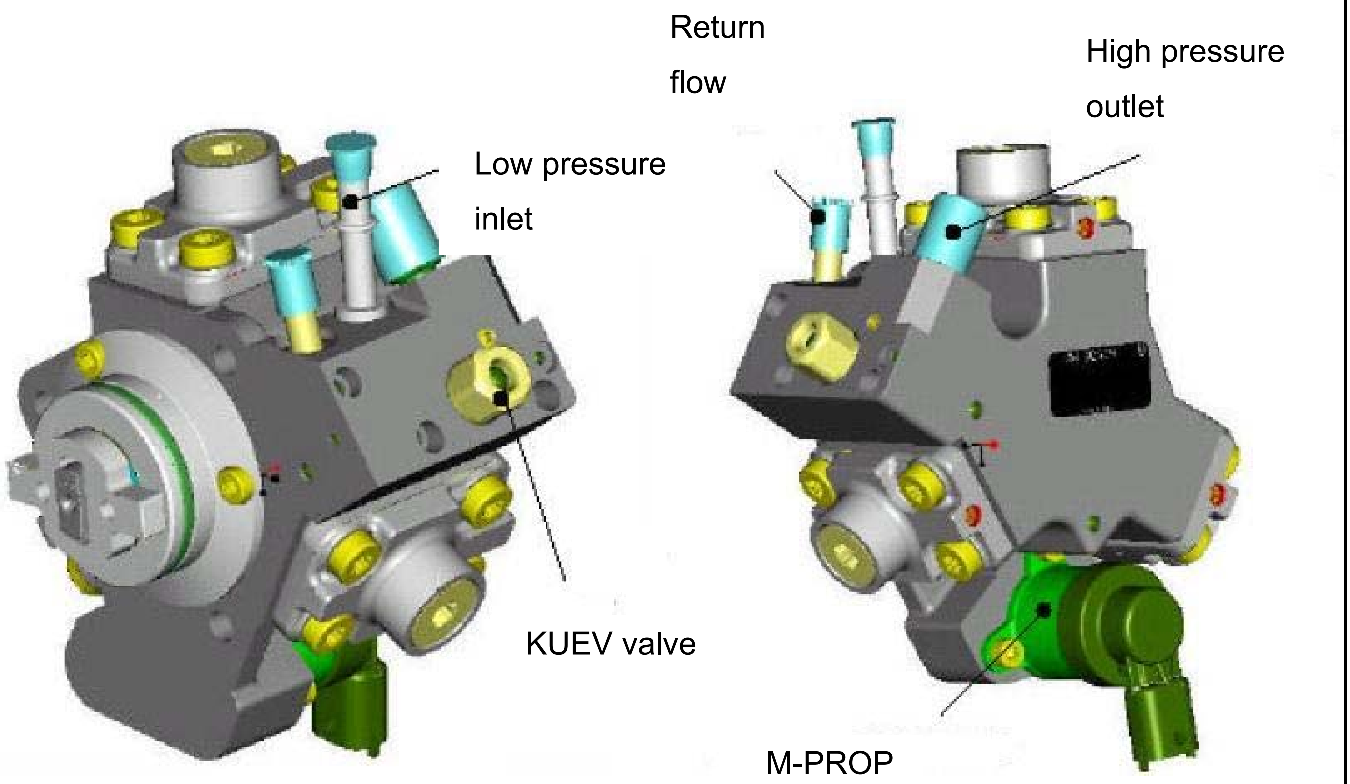


High pressure active   High pressure off

a: Shut-off valve

b: Lubrication hole holeazione

3.6.3 Bosch CP1H high-pressure pump (90 HP)



Features

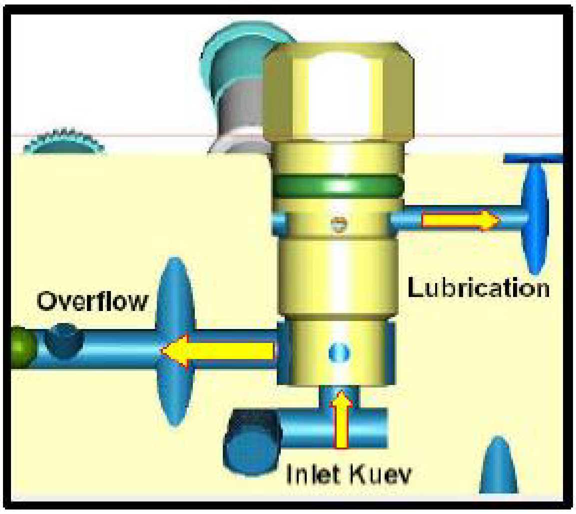
The 90 HP engine features a Bosch CP1H high-pressure pump, which is a step forward compared with the CP1 pump. Now, the high-pressure pump makes a system pressure of up to 1,600 bar available in the rail. This has been achieved by reinforced drive, modified valve units and measures taken to increase the body sturdiness. To ensure a sufficient amount of fuel, the high-pressure pump has been set to reach a total flow rate of 160 l/h.

The required flow rate is adjusted continuously by means of the M-PROP solenoid valve, found on the high-pressure pump. This valve adjusts the fuel amount let into the rail to the system requirement. Such flow rate adjustment makes it possible to reduce both the high-pressure pump power absorption and the maximum fuel temperature. The feed pressure required for the high-pressure pump is made available by an electrically-operated fuel feed pump found in the tank module. The high-pressure pump volume flow rate is distributed as follows:

approximately 22% is injected by the injectors and burnt in the cylinder;
approximately 28% is used to lubricate the high-pressure pump and is recovered through the KUEV valve;
approximately 50% corresponds to the excess fuel recovered through the pressure accumulator and the injectors.

KUEV valve

The purpose of this mechanic valve is to keep the pressure inside the pump constant (it discharges any overpressure, to prevent pressure peaks from damaging the pump), and also control the fuel flow needed to cool and lubricate the eccentric shaft and the plungers of the CP1-H.

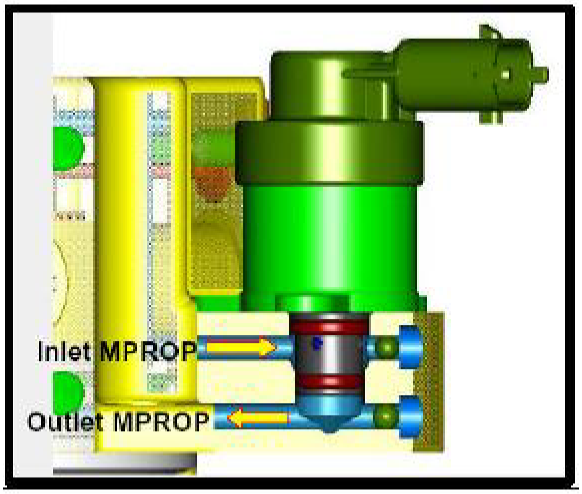


M-PROP valve

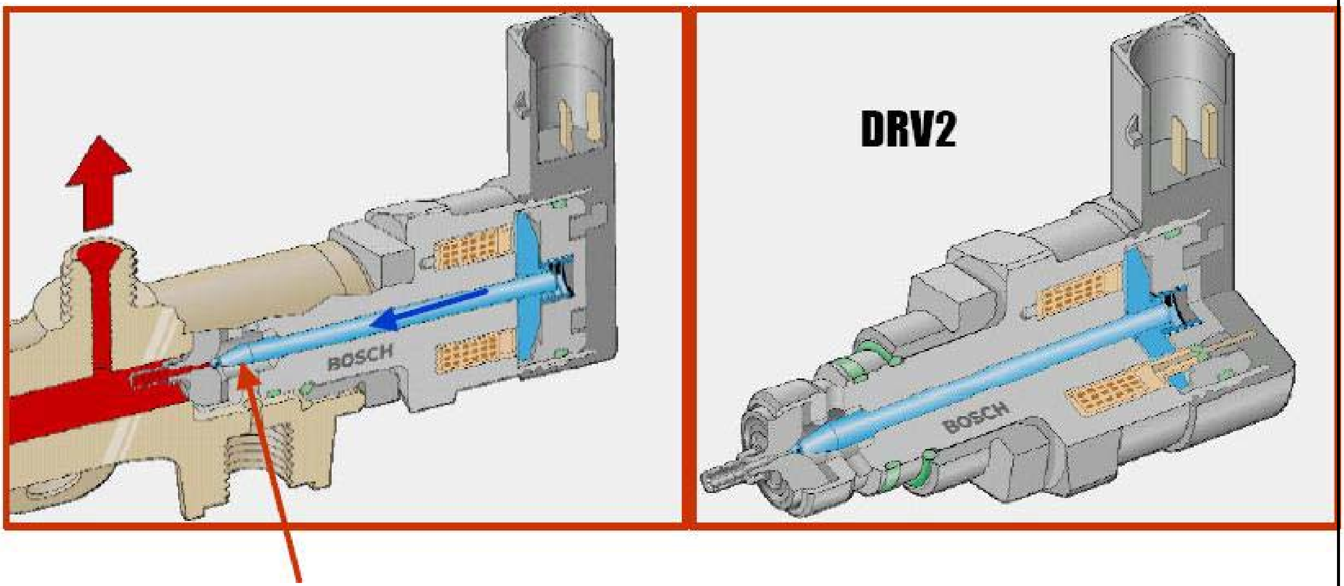
This electronically-controlled valve is used to modulate the feed rate from the low pressure circuit to the high-pressure pump by rotating a flap inside the valve directly controlled by the ECM.

@ I = 0 amp max. flow rate (even if disconnected)

@ I = 2.5 amp zero flow rate

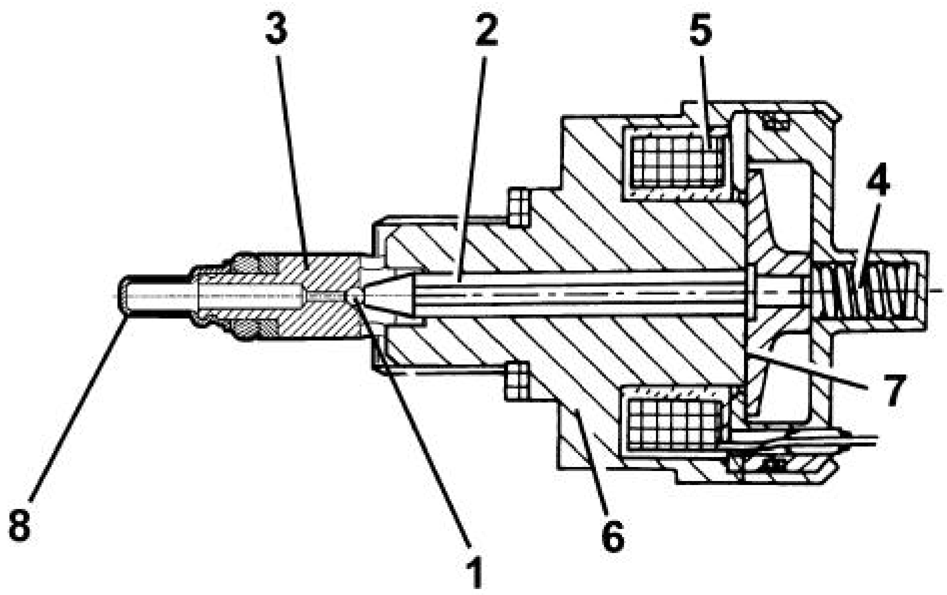


DRV 2 pressure regulator



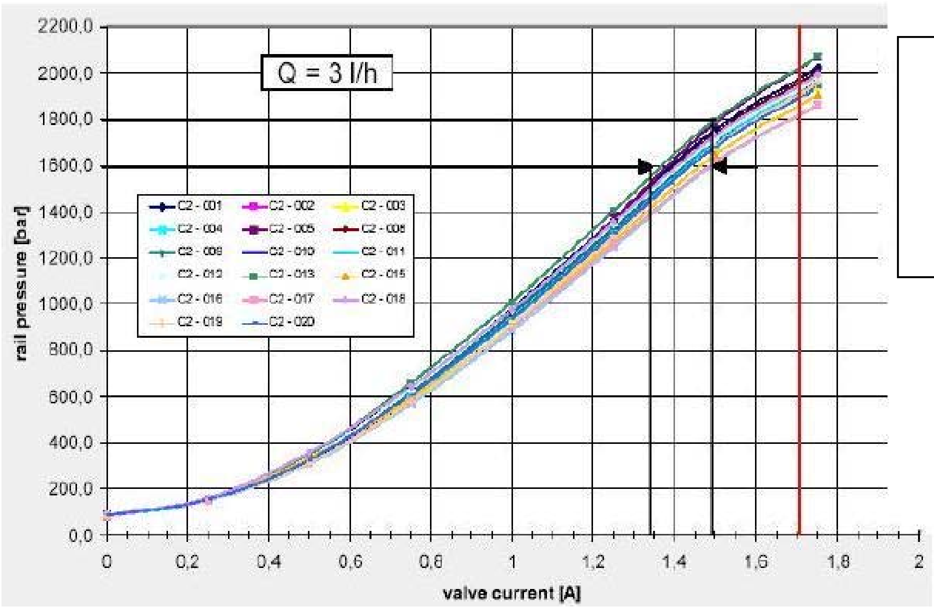
It is fitted onto the rail and controlled by the injection control unit. It is used to control the fuel feed pressure to the electric injectors.

The pressure regulator is essentially made up of the following items:



1 Round shutter
2 Pin
3 Valve
4 Preload spring (max. sealing pressure: 50 bar)
5 Coil
6 Body
7 Anchorage
8 Filter

Current graph depending on the DRIVING DUTY (PWM %)



Pressure regulator

I OFF P=50 bar

PWM 1,000 HZ

I @ 1,600 bar 1.3 A

Pressure driving parameters:

75 HP

Idling engine rail pressure: 250 bar

Max. engine speed rail pressure: 1,400 bar

90 HP

Idling engine rail pressure: 250 bar

Max. engine speed rail pressure: 1,600 bar

3.6.4 Electric injectors and pipes

CR1- MI 2.2 electric injectors

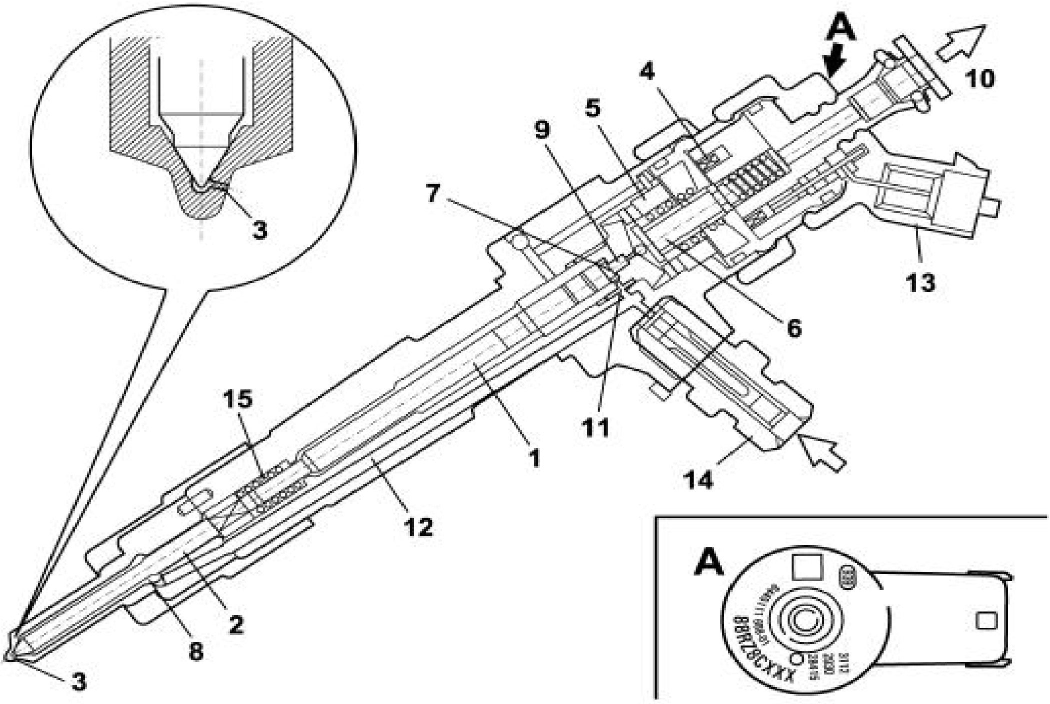
The electric injectors are fitted onto the cylinder head and controlled by the injection control unit.

The electric injector can be divided into two parts:

1 actuator/nozzle;

2 control solenoid valve.

The electric injector operation can be divided into three phases.



REST POSITION: coil (4) is de-energized, and shutter (6) is in the closing position and does not allow fuel to be let into cylinder Fc > Fa (Fc: due to the line pressure that acts on control area 7 of rod 1; Fa: due to the line pressure that acts on feed volume 8).

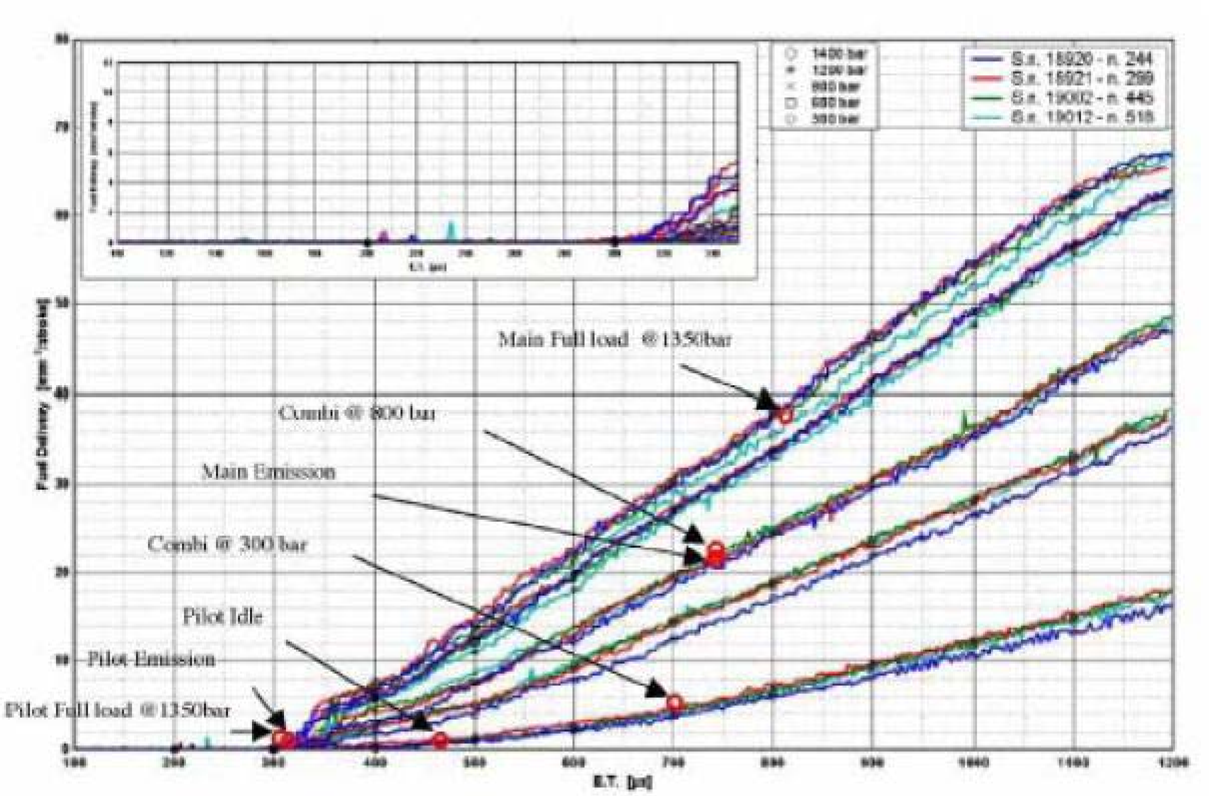
START OF INJECTION: coil (4) is energized and causes shutter (6) to be raised.
The control volume fuel (9) flows out toward return manifold (10), thus causing a pressure drop on control area (7). At the same time, the line pressure through feed duct (12) exerts a force Fa > Fc in feed volume (8), thus causing pin (2) to be lifted, with resulting fuel flow into the cylinders through holes (3) (such holes amount to 6 in the CR1 MI 2.2 injector; they feature a diameter of 0.121 mm and a flow rate of 280 cm3 / 30 s at 100 bar).

END OF INJECTION: coil (4) is de-energized and causes shutter (6) to go back to its closing position, which gives rise to such a force balance that pin (2) is made to go back to its closing position, and injection is terminated, accordingly.

IMA classification

Injector classification according to the IMA method aims at improving the engine performance and emission levels, by properly matching the construction features of every single injector with the software control strategies within the engine management control unit.
Thus, the production tolerances can be recovered: each injector is tested at 7 characteristic operation points, associated with special control time and fuel pressure conditions, which reproduce the engine's typical operation points (idling, fully loaded, etc.).
The characteristic points are termed as follows:

- Main at full load
- Main at emission
- Pilot at emission
- Pilot at full load
- Pilot at idle
- Combi at 800 Bar
- Combi at 300 Bar



The chart illustrates the characteristic curves of 4 injectors based on the control time (ET) for various rail pressure levels. The axis of ordinates shows the amount of fuel delivered at every injection instance (mm_3/ciclo); the highlighted points are those where the measurements for IMA classification are made.

The features of each electric injector are identified by a set of 9 alphanumeric characters factory-printed on the electric injector body at the BOSCH premises.

The production plants of the POWERTRAIN engine have to receive and interpret the IMA codes for every single electric injector (reading by means of a camera), in order to match the same with the corresponding cylinder to which the injector is fitted, and also produce a label that is put onto the timing belt cover. The FIAT bodywork plants match the engine management control units with the respective software control strategies by means of special in-line test equipment which reads the data shown on the label and then carries out the operation with the diagnosis services described below.

The new spare control units and the ones supplied at the FIAT plant are delivered with a standard default IMA code with a 00 hex value; the vehicles fitted with control units that have

NOT yet been classified, can be handled even before the operation has been carried out by means of suitable diagnosis equipment. Under these conditions, and prior to performing IMA classification, the MIL (failure warning light) upon every Power On (key turned to MARCIA – engine stopped or rotating) will be managed in the Blink (blinking) mode, and an error with P1301 code and “current” status will be found in the error memory until classification has been completed.

After classification has ended, the P1301 error will be automatically invalidated and will become intermittent until Key-OFF.

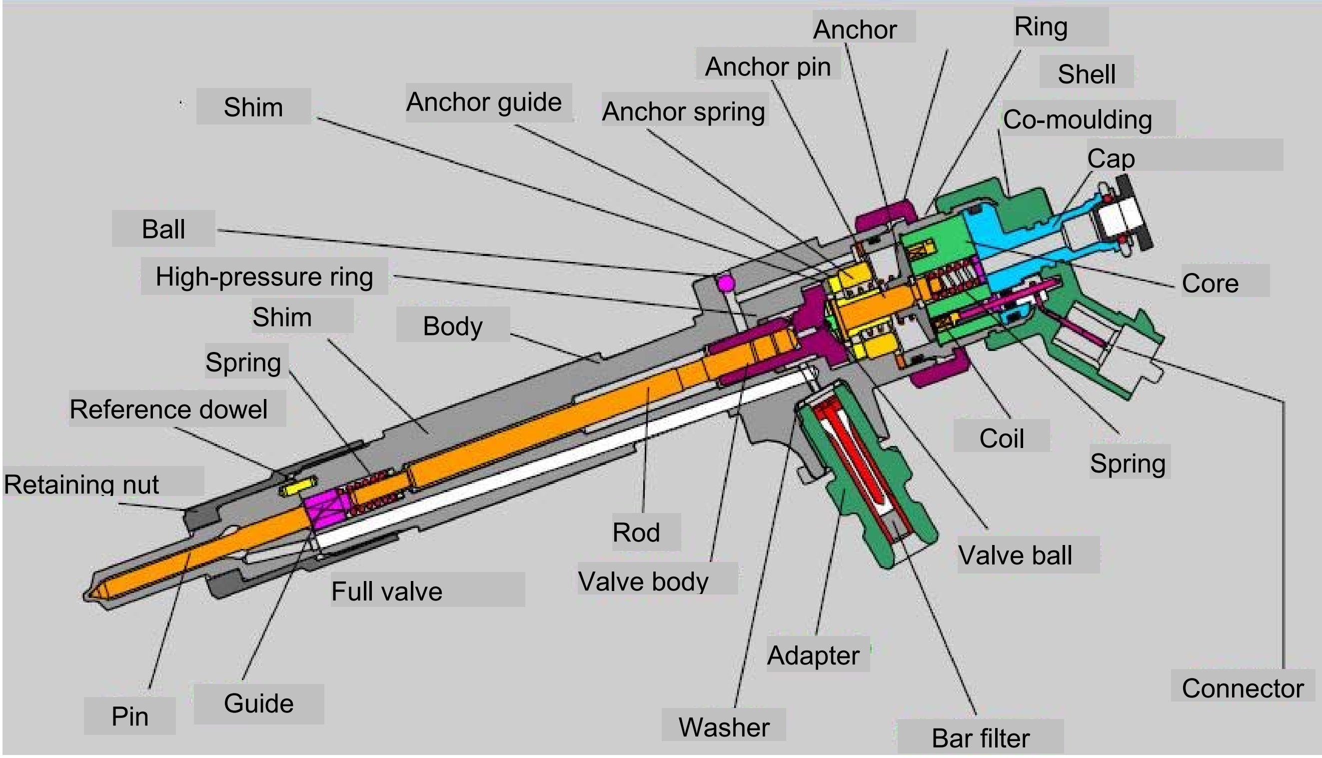
To cause the DTC to be (automatically) cleared off the error memory, a key-OFF – key-ON operation shall be carried out (complete with power latch) after classifying the four injectors.

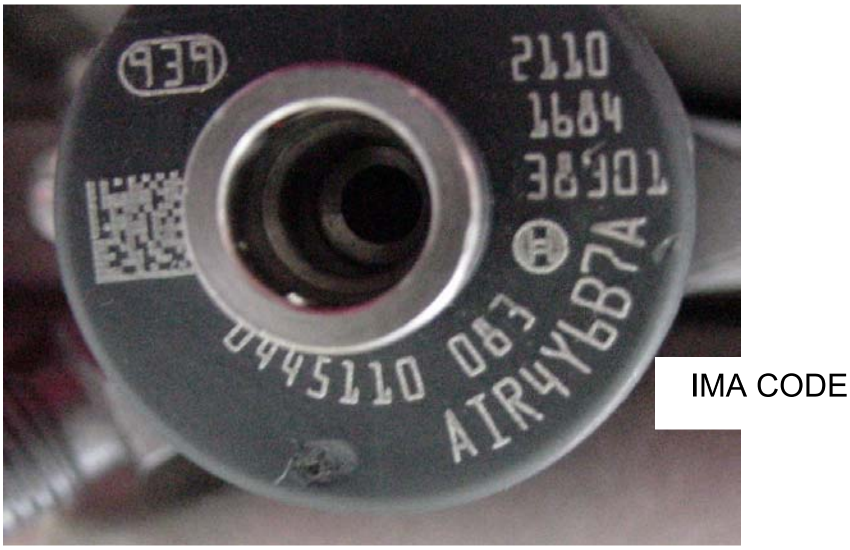
The DTC can no longer appear over the entire control unit life cycle, after it has been cleared off the error memory; the CCM cannot, after the operation has been carried out, be brought back to the virgin state when classification has to be performed.

Classification shall ALWAYS be carried out at the FIAT production plant and at the Service Centre every time the CCM control unit/injector needs be replaced.

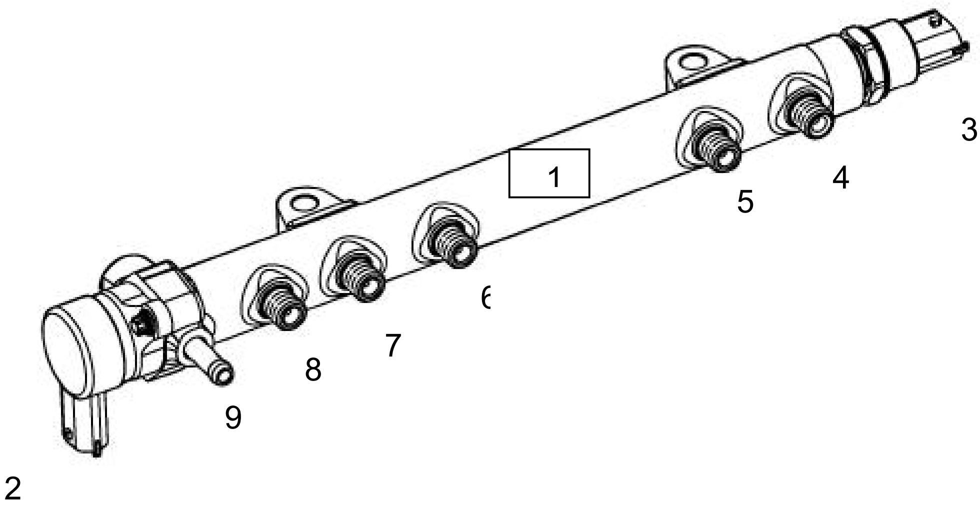
Classification will not be completed until even one of the cylinders/injectors is worth 0x00; the operation shall be necessarily carried out with the key turned to RUNNING and ENGINE STOPPED.

Below is the electric injector drawing:





3.6.5 Single fuel manifold pipe



1 COMMON RAIL (FR / LWR)

2 QUANTITY CONTROL VALVE (DRV 2)

3 PRESSURE SENSOR (RDS 4)

4 5 6 7 CR1-MI 2.2 INJECTOR FEED

8 FEED FROM HIGH PRESSURE (CP1 / CP1H)

9 RETURN (OVER FLOW)

Two types of single fuel manifold pipes (rail) are available: one standard, forged rail-FR for the 75 HP engine version; one standard laser-welded rail-LWR for the 90 HP engine versions, fitted to the cylinder head on the intake side.

With a volume of approximately 20 cm³, it dampens the fuel pressure oscillations due to:

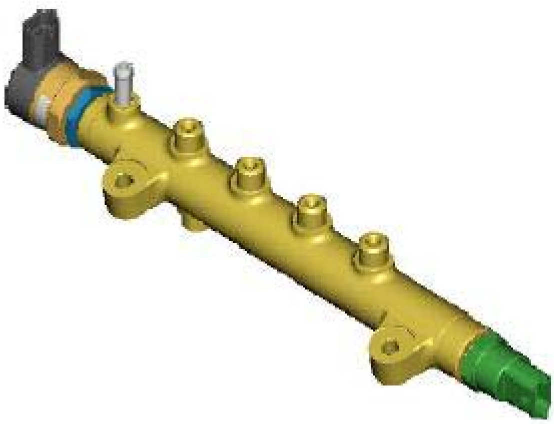
the pressure pump operation;

the opening of the electric injectors.

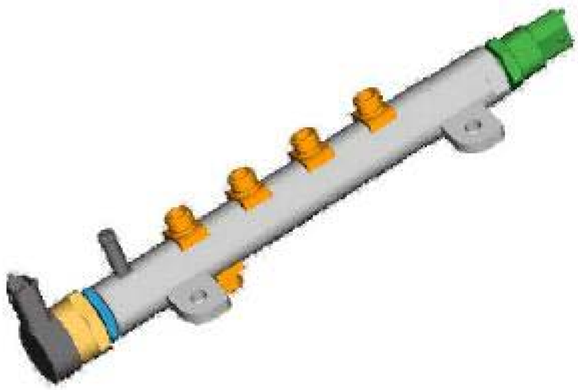
The difference between the two rails lies with the manufacturing procedure: one is forged (FR), whereas the other is made with laser welds (LWR) that ensure more accurate manufacture and higher resistance to high pressures (1,600 bar).

The fuel pressure sensor (RDS 4) is fitted to one side of the RAIL delivery manifold, whereas the pressure regulator (RDS 4) is connected to the other side.

The hydraulic, high-pressure connections between the pump-manifold and the electric injectors-manifold are made by means of steel pipes with inner diameter of 2 mm and outer diameter of 6 mm. With regard to these pipes, special wrenches shall be used for disassembling and assembling, and a torque wrench shall be used when tightening to less than 20 Nm.



Standard Forged Rail - **FR**



Standard **L**aser **W**elded **R**ail -**LWR**

3.6.6 Fuel tank and components

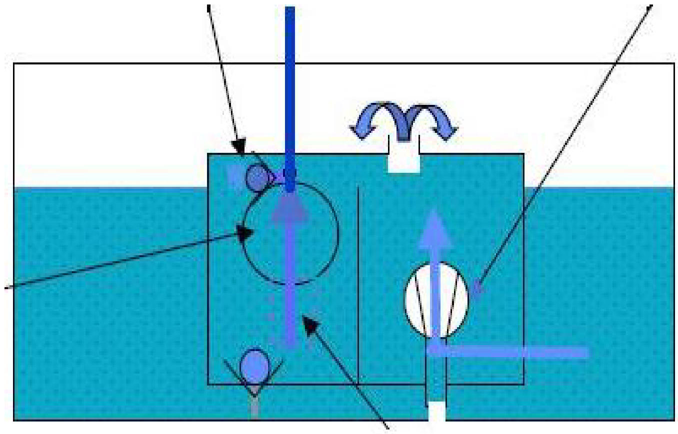
Submergible pump assembly (complete with level gauge control)

The fuel electric pump is fitted into one single assembly into the level gauge and the fuel filter; therefore, the components cannot be replaced as individual items.

The function of the fuel electric pump is to feed the high-pressure pump. It is fully immersed into the fuel inside the tank. The pump unit is realized so as to obtain the maximum fuel level in the suction area.

This function is implemented by means of a Venturi pipe placed on the suction return pipe with respect to the one of the tank. The pumping unit is of the roller type and makes it possible to achieve a flow rate of 160 litres/h.

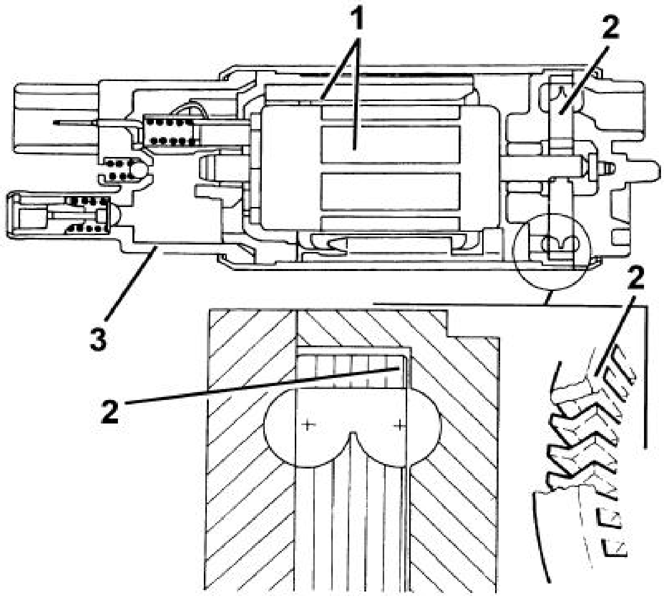
Pump tray

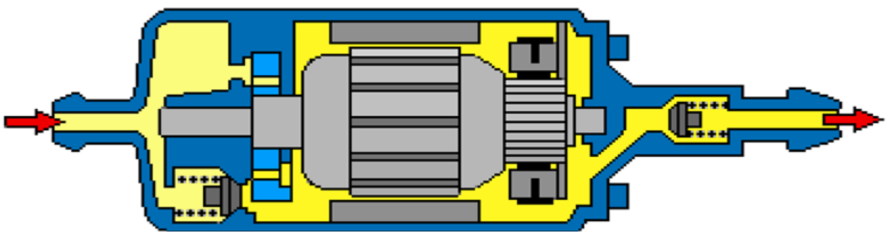


The fuel electric pump includes a permanent-magnet electric motor (1) that controls the pump impeller (2), and an end support cover (3) that contains the electric and hydraulic connections. The electric pump stage is of the single, peripheral-flow type, with high performance in low voltage and temperature conditions.

The advantages compared with the electric pumps operating according to the volumetric principle are as follows:

- less weight;
- small dimensions.

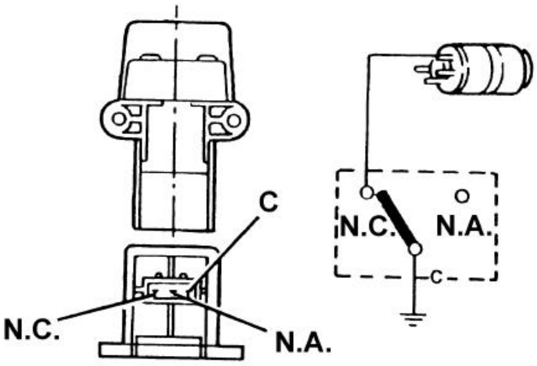




Power supply	13 V
Current absorption	4 / 6 A
Pressure	2 to 4 bar
Flow rate	160 litres/h

3.6.7 Inertia switch

The inertia switch is fitted to the right side, under the dashboard on the passenger side. In case of vehicle collision, the switch cuts off the ground connection of the fuel electric pump and, as a result, the fuel supply to the injection system.

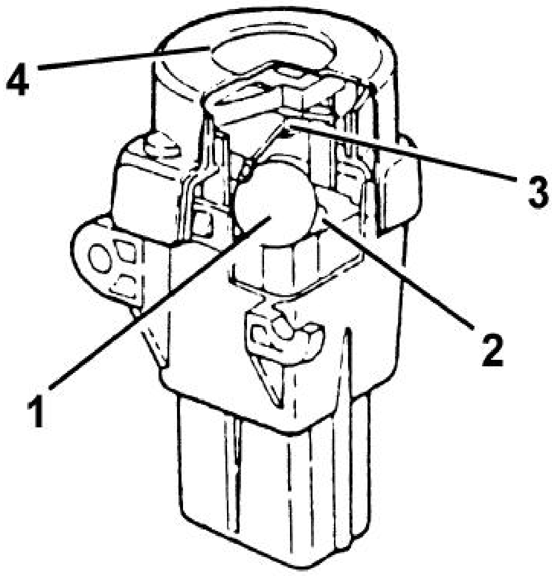


A steel ball (1) fitted into a tapered housing (2) is normally kept secured through the attraction force of an adjacent magnet.

Under specific acceleration loads, the ball is released from the magnetic retainer and gradually comes out of the tapered support with an upward movement, according to the cone angle. Above the ball is a quick-connect mechanism (3) that makes up the normally closed (N.C.) electric circuit.

The mechanism changes position when it is hit by the ball, from N.C. circuit to normally open (N.A.) circuit, thus cutting off the fuel electric pump ground circuit.

The switch can be restored by pushing a button protected by a flexible cover (4).



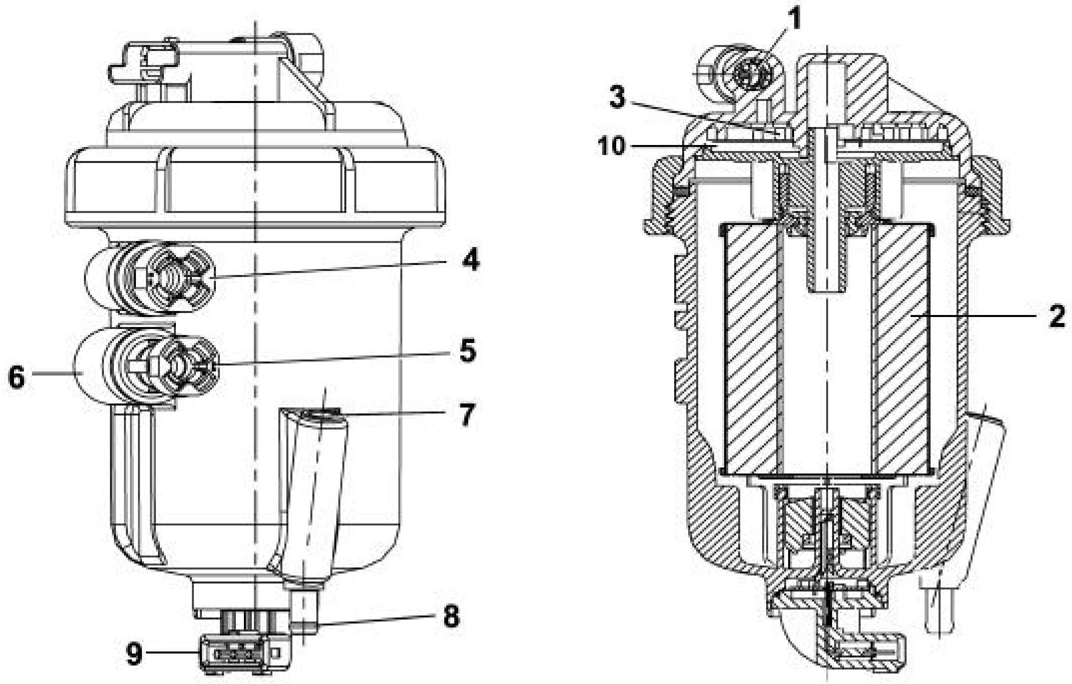
NOTE. Following any collision (even a slight one), the switch shall not be actuated again if fuel smell is smelt or leaks are found from the fuel feed system. The fault shall be located and remedied, to avoid the risk of fire.

Otherwise, if no leak is noticed and the vehicle can be started, press the button to actuate the electric pump again.

3.6.8 Fuel filters

Description of components

The fuel filter (GREEN FILTER) is fitted to the engine compartment, on the right side.
It is made up of a plastic shell that incorporates a filtering cartridge made of synthetic material, which is highly efficient in terms of performance, service life and water separation.

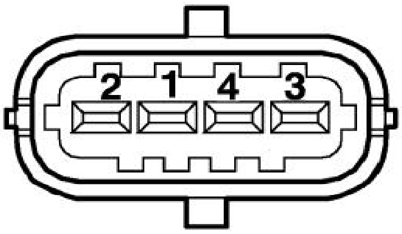


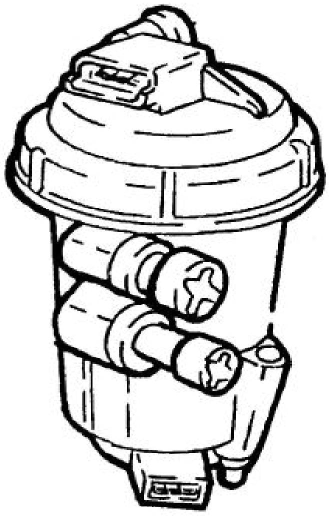
1 Diesel fuel inlet
2 Filtering cartridge (sealing O-ring supplied)
3 Temperature sensor
4 Diesel fuel outlet from the injection system
5 Diesel fuel outlet from the control valve toward the tank
6 Regulating valve inside the outlet
7 Water drain actuating screw
8 Water escape zone
9 Water presence sensor electric connection
10 Diesel fuel heater

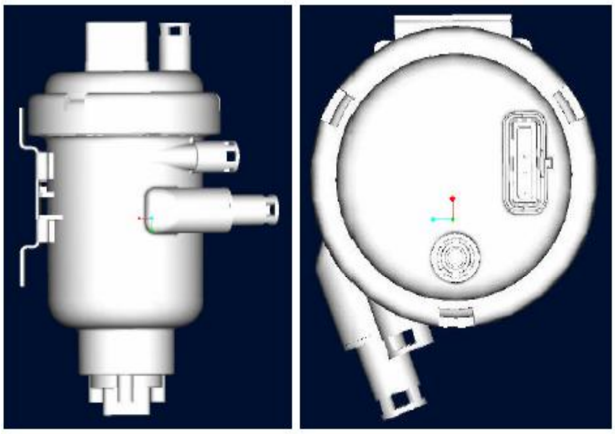
Water sensor

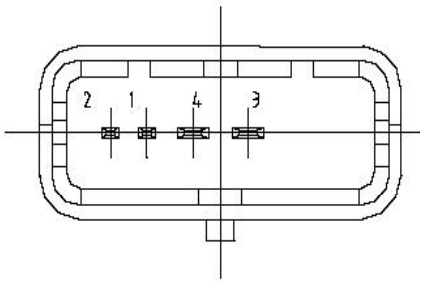
3.6.9 Fuel temperature sensor and heating device

The fuel filter is equipped with a fuel preheating device and a fuel temperature sensor through a NTC thermistor fitted inside the cover.
The heater is controlled by the injection control unit depending on the signal of the fuel temperature sensor.
Refer to the fuel temperature sensor for specifications.

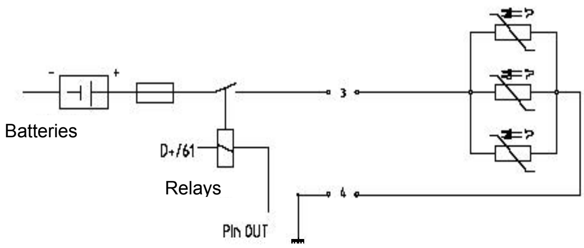




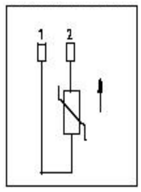




HEATER WIRING DIAGRAM



NTC WIRING DIAGRAM



PIN-OUT

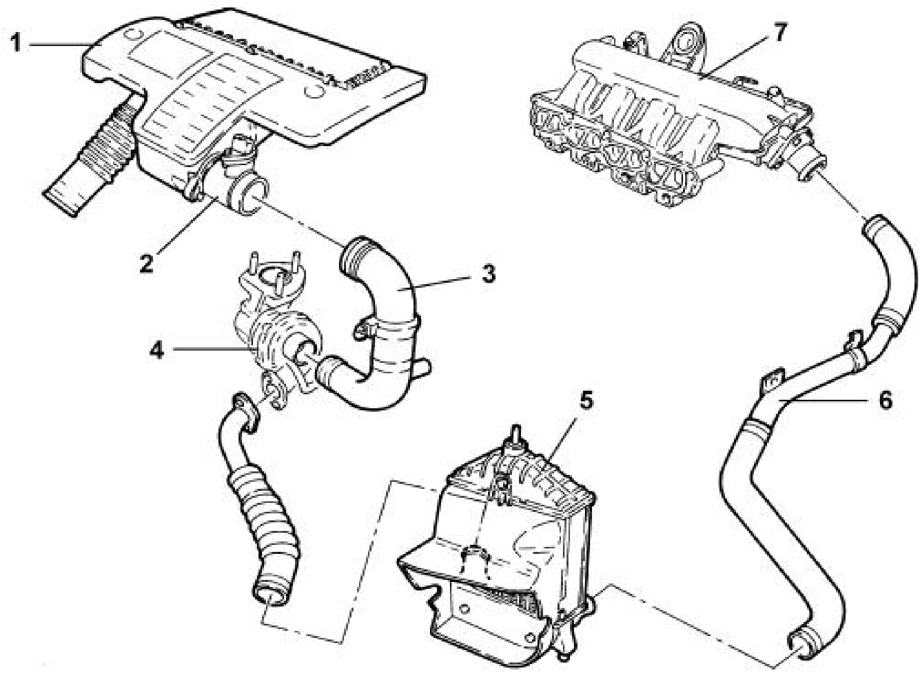
1 SENSOR GROUND

2 TEMPERATURE SIGNAL (analog output toward the ECM)

3 POWER SUPPLY, 12 V (from the ECM)

4 GROUND

3.7 Engine air feed circuit



1 Air filter complete with resonator

2 Digital air flow meter

3 Sleeve for connection with the turboblower

4 Turboblower with waste-gate (75 HP) VNT with VGT valve (90 HP)

5 Air-air heat exchanger (intercooler)

6 Intercooler-air inlet manifold connecting sleeve

7 Air intake (manifold)

3.8 MJD 6F3 diesel engine management control unit

3.8.1 Features

The Magneti Marelli MJD 6F3 common rail is a high-pressure (1,400 bar, 75 HP – 1,600 bar, 90 HP) electronic injection system, with the possibility of modulating these pressures from 150 bar up to the maximum working value of 1,400/1,600 bar, regardless of the rotation speed and the engine load:

operation at high engine speeds (up to 5,000 r.p.m. in full-loaded conditions);

injection control accuracy (advance and injection duration);

- less consumption;
- lower emission levels.

The main functions of the system are essentially as follows:

fuel temperature control;

engine coolant temperature control;

injected fuel amount control;

idling speed control;

fuel cut-off during the release phase (cut-off);

idling cylinder balancing control;

engine jerk prevent check;

acceleration exhaust smoke level control;

exhaust gas recirculation (E.G.R.) control;

max. torque restraint control;

peak r.p.m. restraint control;

preheating spark plug control;

air-conditioning system actuation control (vehicles equipped with A/C);

auxiliary fuel pump control;

timing cylinder position control;

main and multiple injection advance control;

injection pressure closed cycle control;

electric balance control;

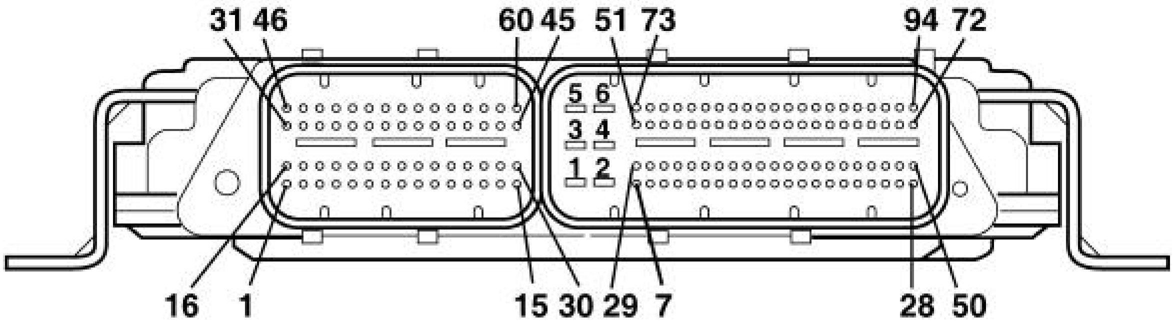
IMA injector calibration.

It is fitted to the engine compartment.

The control unit is of the "flash e.p.r.o.m." type, i.e. it can be re-programmed from outside without acting on the hardware.

The injection control unit incorporates the absolute pressure sensor.

3.8.2 PIN-OUT



CONNECTOR A

Cylinder 4 injector positive

Not connected

Not connected

Fuel pressure regulator positive

Positive from the main relay

Fuel pressure sensor negative

Not connected

Fuel pressure sensor positive

Low engine oil pressure sensor signal

Air flow meter air temperature signal

Not connected

Not connected

Not connected

Air flow meter air flow rate signal

E.G.R. solenoid valve negative

Cylinder 1 injector negative

Cylinder 2 injector positive

Not connected

Not connected

Not connected

Phase sensor negative

Not connected

Sucked air temperature and boosting pressure sensor positive

Sucked air temperature and boosting sensor negative

Phase sensor positive

Not connected

Air flow meter negative

Not connected

Engine coolant temperature sensor ground

Not connected

Cylinder 3 injector negative

Not connected

Not connected

Fuel pressure regulator negative

Not connected

Not connected

Not connected

Fuel pressure sensor signal

Not connected

Air flow meter positive

Booster pressure signal

Not connected

Engine revs sensor positive

Not connected

Not connected

Cylinder 4 injector negative

Cylinder 1 injector negative

Cylinder 3 injector negative

Cylinder 2 injector negative

Not connected

Not connected

Not connected

Not connected

Engine coolant temperature sensor signal

Not connected

Phase sensor signal

Not connected

Not connected

Revs sensor negative

Not connected

Connector B

Control unit power ground

Control unit power ground

Control unit power ground

Control unit power supply (12 V)

Control unit power supply (12 V)

Control unit power supply (12 V)
Electric fan 1 control (–)
Electric fan 2 control (–)
Not connected
Conditioner compressor linear sensor negative
Not connected
Not connected
Fuel temperature sensor ground
Not connected
Race 2 positive on the accelerator pedal potentiometer
Not connected
Not connected
Not connected
Not connected
Not connected
Not connected
Not connected
Key-controlled power supply
Not connected
Not connected
Not connected
Not connected
Request for air conditioner actuation from the control button
Engine revs number signal for robotized gearbox
Not connected
Not connected
Accelerator potentiometer race 2 negative
Not connected
Not connected

Accelerator potentiometer race 1 negative

Not connected

Conditioner compressor linear sensor positive

Not connected

Not connected

High speed CAN 1 line

Accelerator potentiometer race 2 signal

Not connected

Not connected

Not connected

Not connected

Not connected

Not connected

Not connected

Not connected

Direct power supply from the battery

Not connected

Not connected

Not connected

Not connected

Not connected

Not connected

Not connected

Not connected

Not connected

Not connected

Fuel temperature sensor signal

Not connected

Not connected

High speed H CAN 1 line

Accelerator potentiometer race 1 signal

Communication line W

Not connected

Brake pedal switch signal (N.C.)

Not connected

Preheating control unit diagnosis input

Not connected

Not connected

Not connected

Spark plug preheating relay control

Fuel pump relay control

Fuel heater relay control

Not connected

Injection system failure warning light (MIL)

Air conditioning compressor control

Main relay control

Not connected

Not connected

Accelerator potentiometer race 1 power supply

Not connected

Not connected

Not connected

Air conditioner linear sensor signal

Diagnosis line K

Not connected

Diesel fuel filter water presence sensor signal

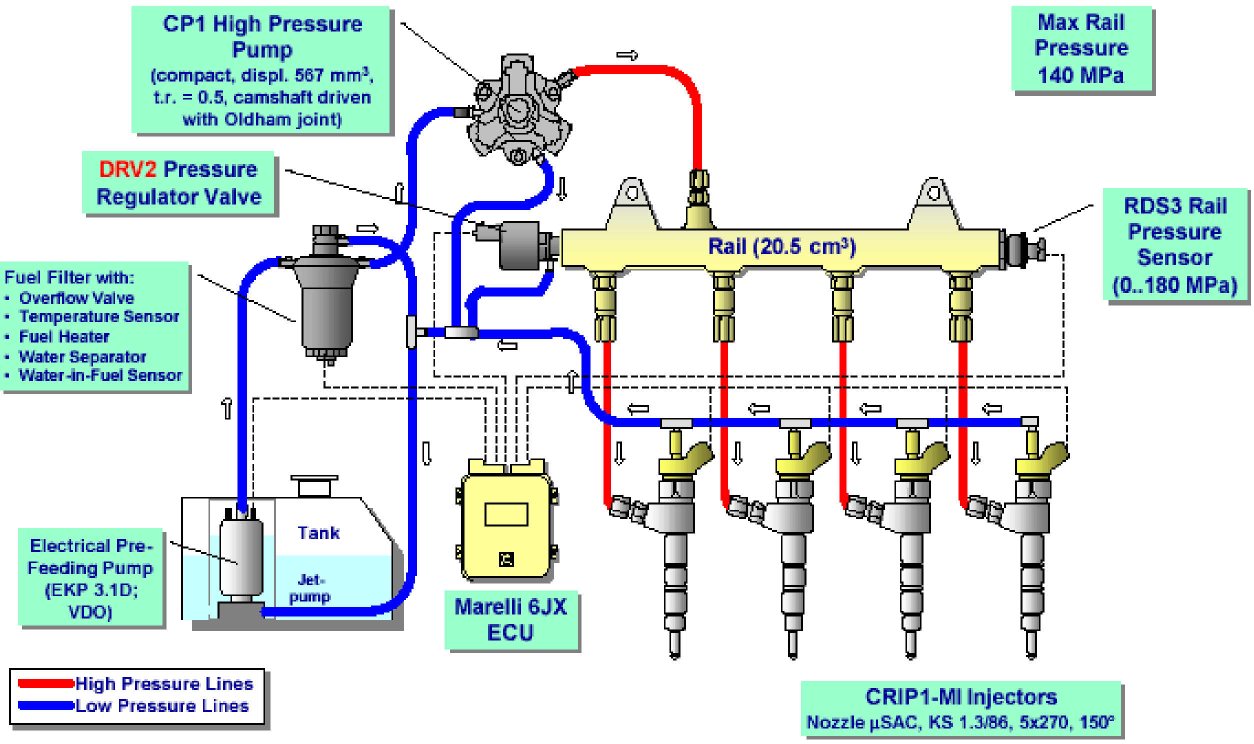
Not connected

Brake pedal switch signal (N.A.)

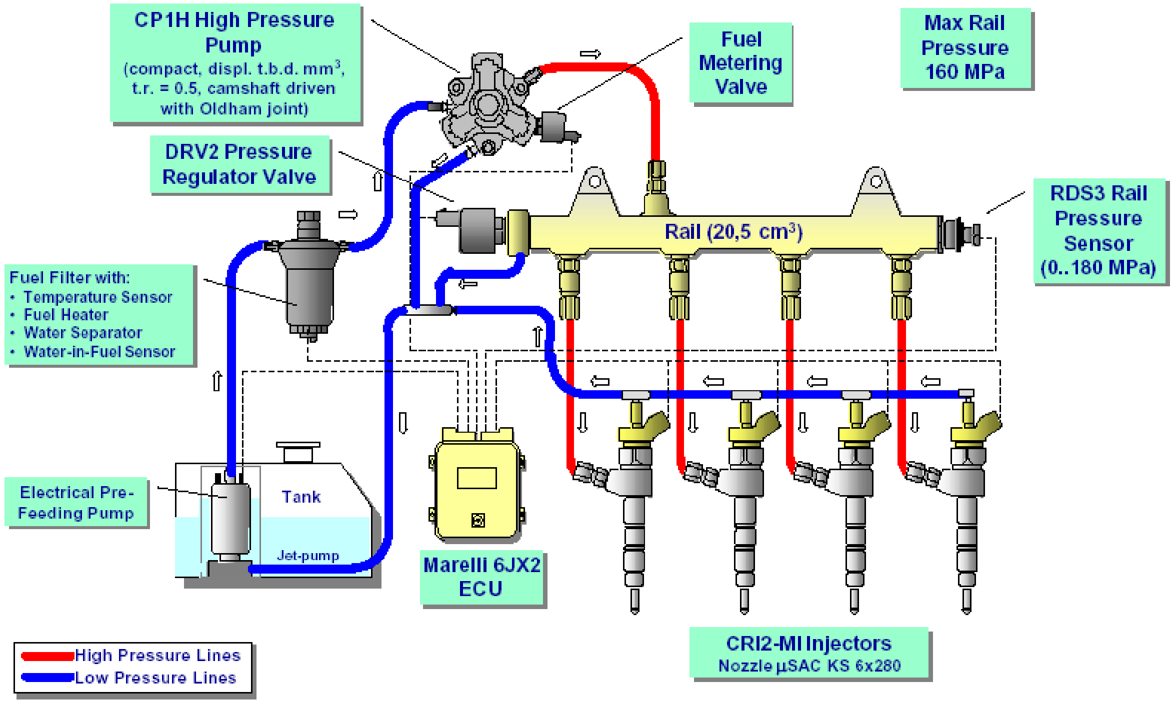
Clutch pedal switch

3.8.3 Types of configuration

75 HP system with CP1 pump



90 HP system with quantity control valve downstream the CP1 H pump



3.8.4 Operation

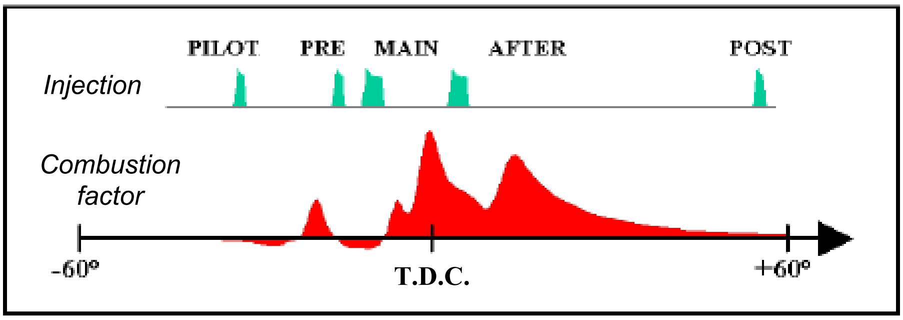
Operation logic

The MARELLI MJD6F3 Euro 4 engine control system (with EOBD) features multiple injection control, from which the term “Multijet” is derived. Below is a short description of the system.

Multiple injection

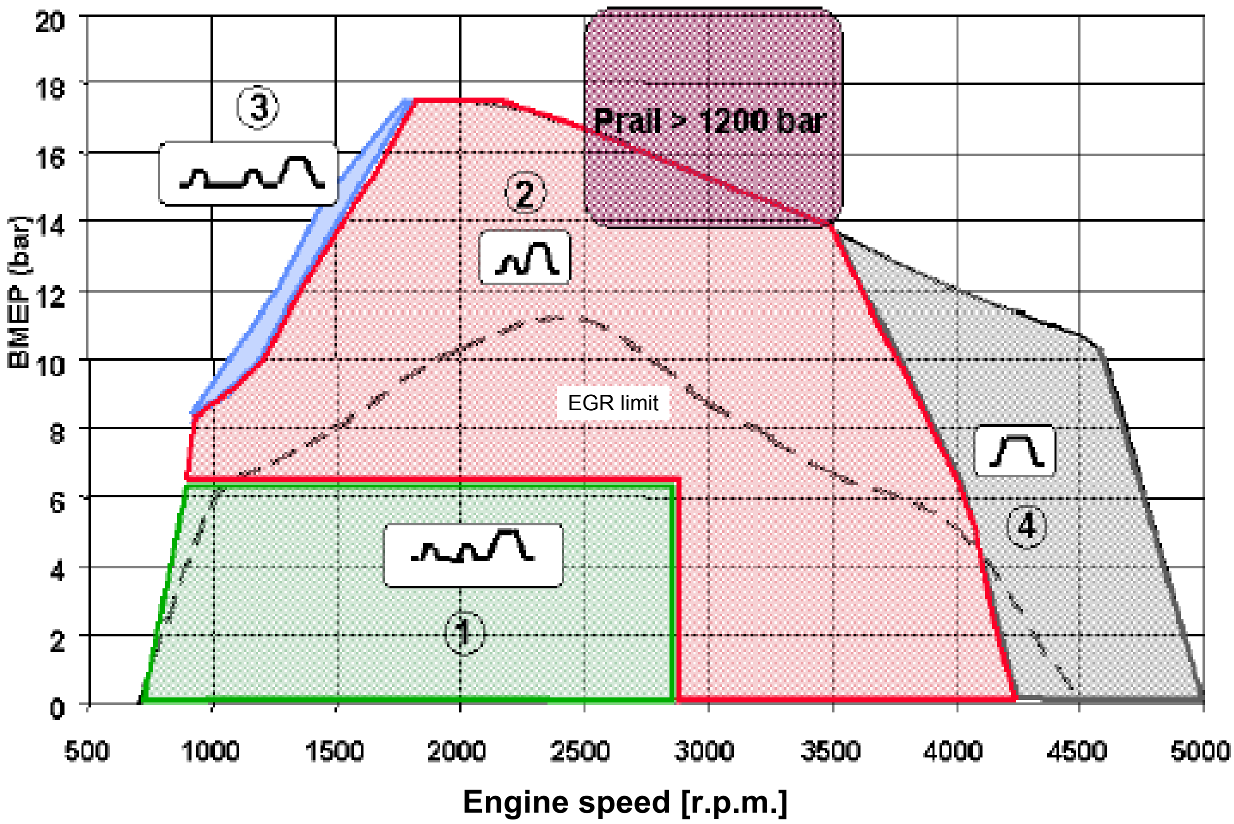
The multiple injection operation strategy makes it possible to accurately control the combustion process within the cylinder. Injections are modulated so as to avoid too high pressure gradients, which would cause the combustion noise to increase and the mechanic components to be stressed unnecessarily.
Multiple injections make it possible to reduce the pollutants to a significant extent while ensuring optimum engine performance. The engine management control unit can perform up to 5 injections per engine cycle, which are referred to as follows:

- PILOT injection
- PRE injection
- MAIN injection
- AFTER injection
- POST injection.



Four work areas can be identified in this application:

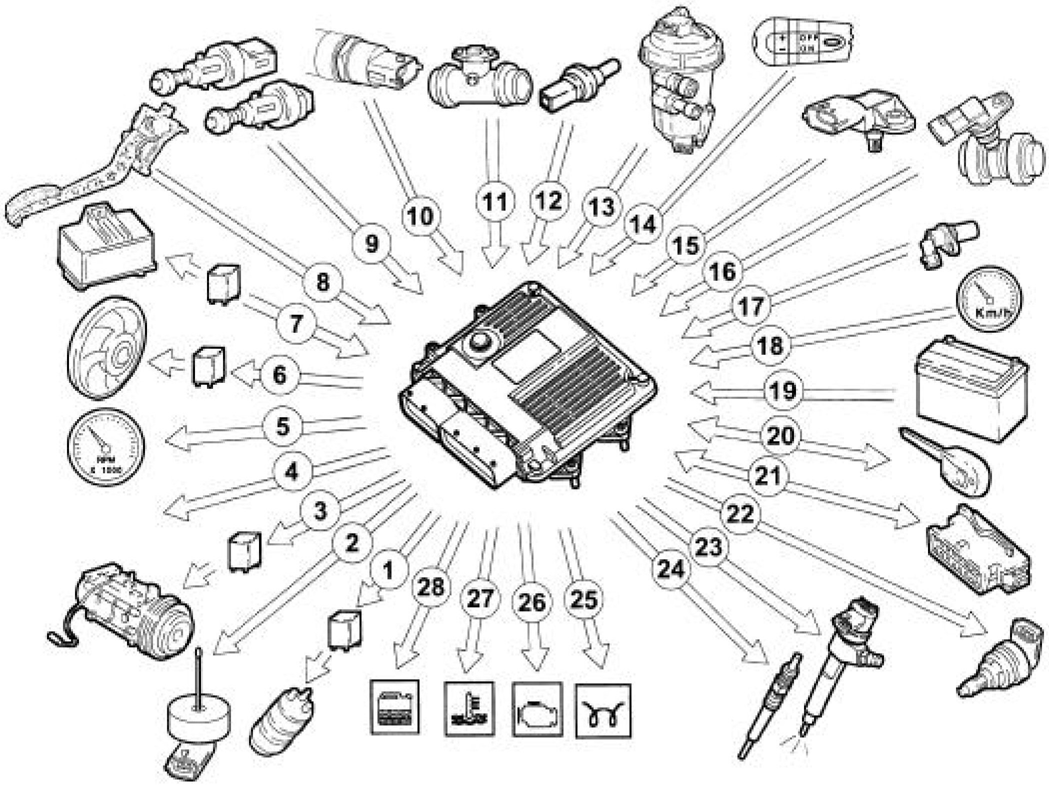
1 PILOT injection + PRE + MAIN
2 PRE injection + MAIN
3 PILOT injection + PRE + MAIN (with dwell time between PILOT and PRE > 1000 usec.)
4 MAIN injection



Below is the information processed by the control unit to control the amount of fuel to be injected:

- engine revs;
- cooling fluid temperature;
- boosting pressure;
- air temperature (from the air flow meter);
- sucked air amount;
- battery voltage;
- diesel fuel pressure;
- accelerator pedal position;
- diesel fuel temperature.

3.8.5 Control unit ingoing/outgoing information diagram



1 Auxiliary fuel electric pump

2 Diesel fuel water presence sensor

3 Conditioner compressor (where available)

4 E.G.R. solenoid valve

5 Revs counter

6 Electric fans

7 Spark plug preheating control unit

8 Dual-trace accelerator pedal potentiometer

9 Dual brake pedal switch – clutch pedal switch

10 Fuel pressure sensor

11 Air flow meter

12 Cooling fluid temperature sensor

13 Fuel temperature sensor

14 Cruise Control (where available)

15 Overpressure sensor
16 Phase sensor
17 Revs sensor
18 Speedometer
19 Battery
20 FIAT CODE (body computer)
21 Diagnosis connector
22 Pressure regulator
23 Electric injectors
24 Preheating spark plugs
25 Spark plug preheating warning light
26 Injection warning light
27 Max. water temperature warning light
28 Fuel water presence warning light

3.9 Self-diagnosis

The control unit self-diagnosis system checks the signals from the sensors and compares them with the permitted limit data.

3.9.1 FAULT SIGNALLING UPON VEHICLE START

Warning light ON until the engine has been started: test phase.

Warning light OFF after the engine has been started: no fault is found on the components that affect the system safety.

Warning light ON when the engine is running: a fault is present.

3.9.2 FAULT SIGNALLING DURING VEHICLE OPERATION

Warning light ON: a fault is present.

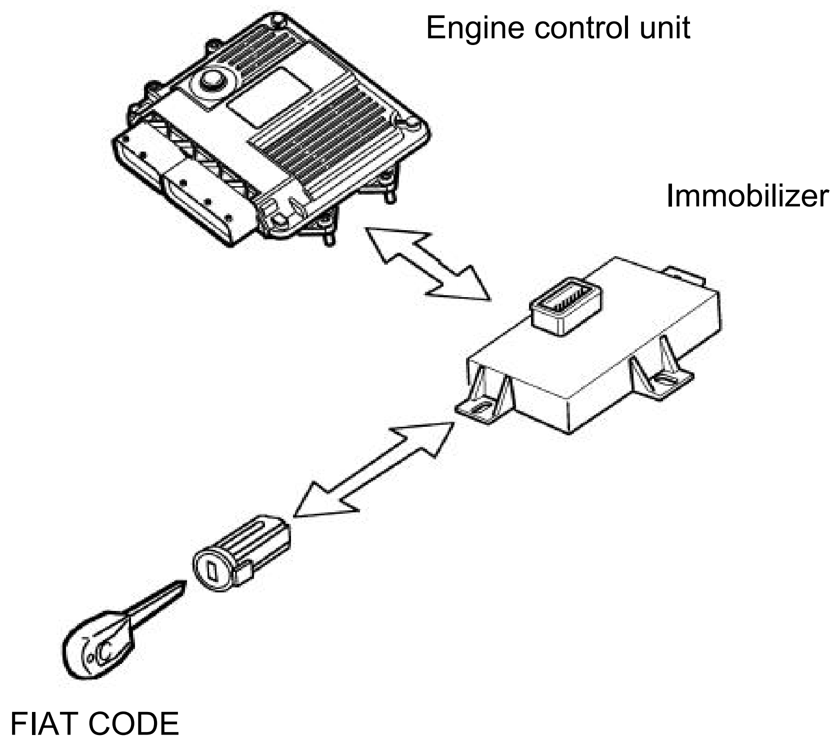
Warning light OFF: no fault is found on the components that affect the system safety.

RECOVERY

The control unit defines each time the type of recovery depending on the broken components. The recovery parameters are managed by the components in good working order.

3.9.3 FIAT CODE recognition

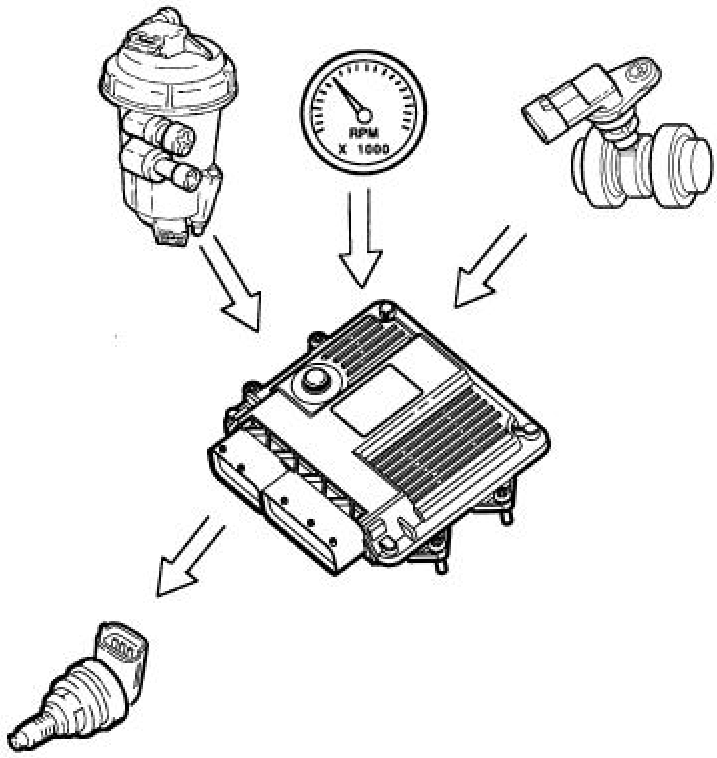
The control unit exchanges, at the instant when it receives the key turned to "MAR" signal, data with the body computer through the CODE function, to obtain start enable.



3.10 Checks

3.10.1 Fuel temperature check

When the fuel temperature is 80°C (as measured by the sensor in the diesel fuel filter), the ECM controls the pressure regulator in order to reduce the line pressure; if this is not enough, it will also reduce the amount of injected fuel.



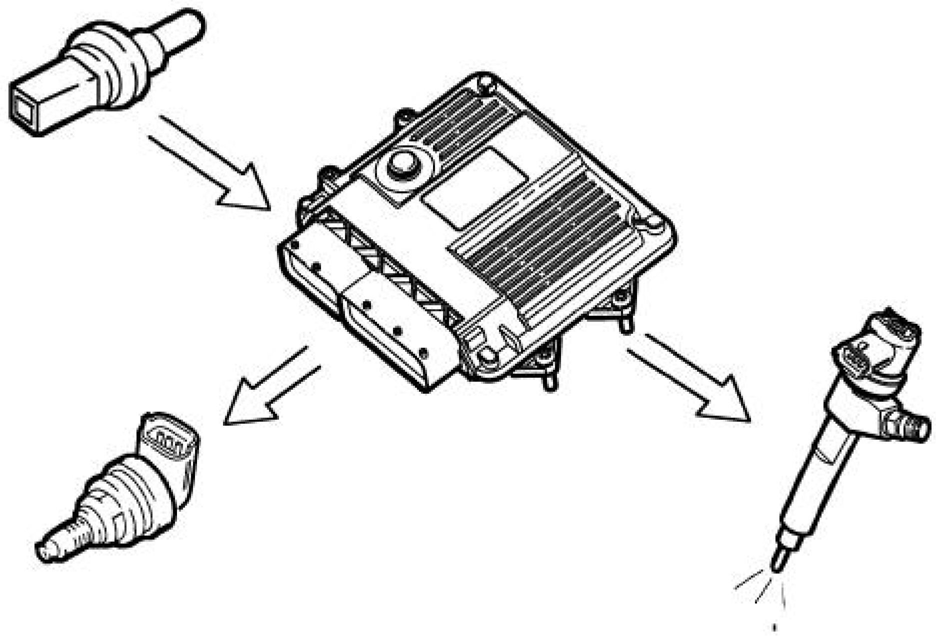
3.10.2 Engine coolant temperature check

When the engine coolant temperature is higher than 105°C:

the ECM reduces the amount of injected fuel (i.e. reduces the engine power);

controls the cooling electric fans;

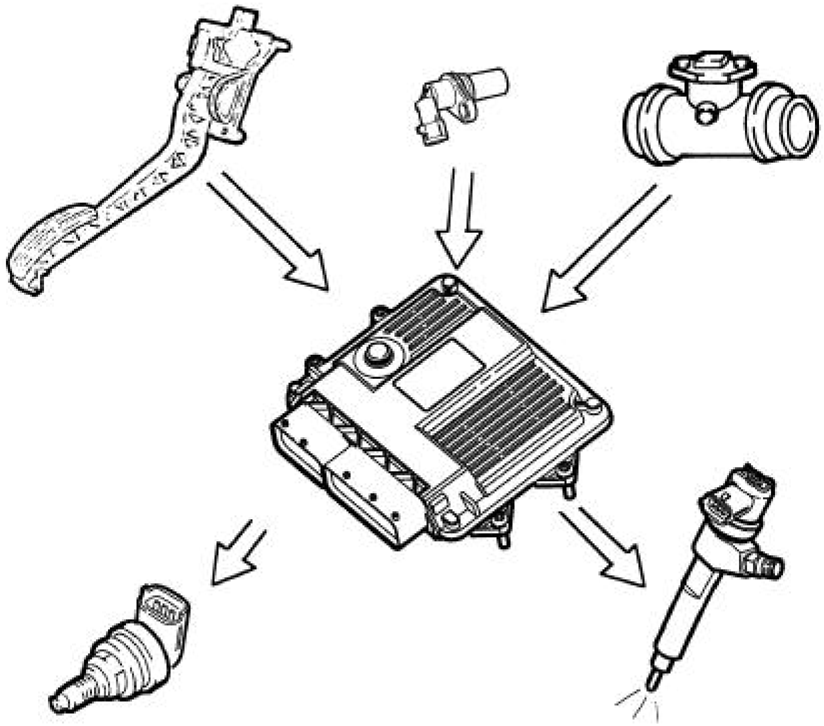
causes the cooling fluid temperature warning light to come on.



3.10.3 Injected fuel amount check

The control unit carries out the following operations, depending on the signals from the sensors and on the measured values:

controls the pressure regulator;
varies the "pilot" injection time over the entire revs range;
varies the "main" injection time.

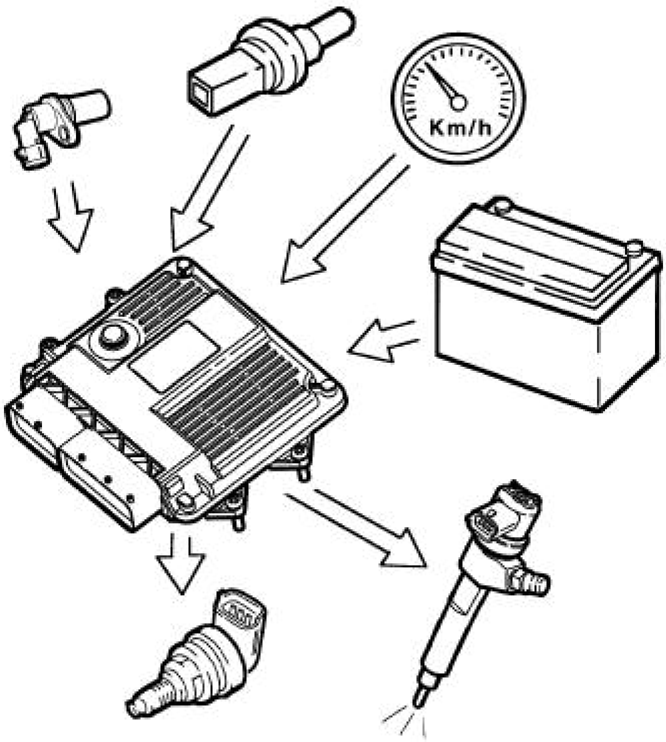


3.10.4 Idling speed check

The control unit processes the signals from the various sensors (engine revs; engine temperature; vehicle speed) and adjusts the amount of injected fuel:

it controls the pressure regulator (DRV2);
it varies the injection time of electric injectors (CR1MI2.2).

Within some thresholds, the speed allows for the battery voltage.



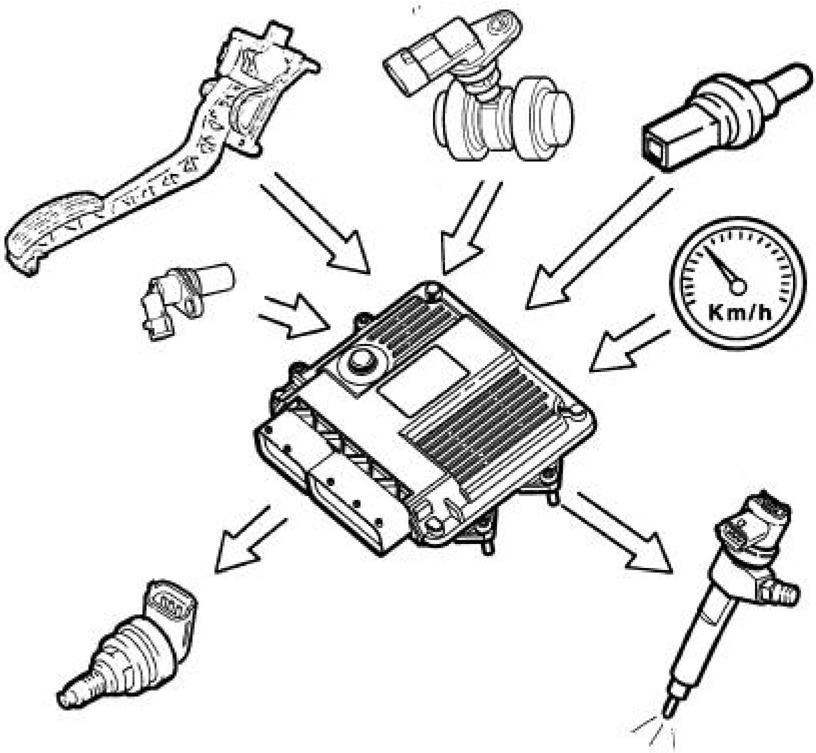
3.10.5 Fuel cut-off during the release phase (cut-off)

The control unit performs, during the accelerator pedal release phase, the following logics:

it sets the injection time to zero;

it partially varies the electric injector injection time before the idling speed is reached;

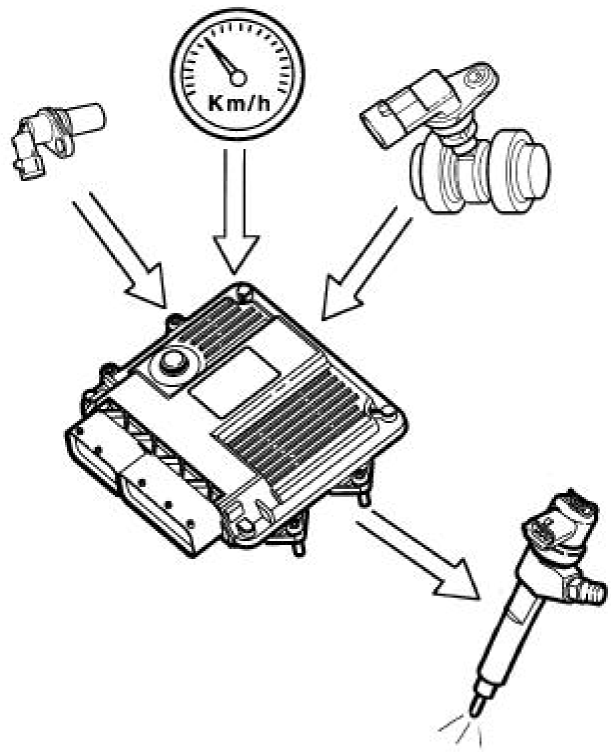
controls the fuel pressure regulator.



3.10.6 Idling cylinder balancing check

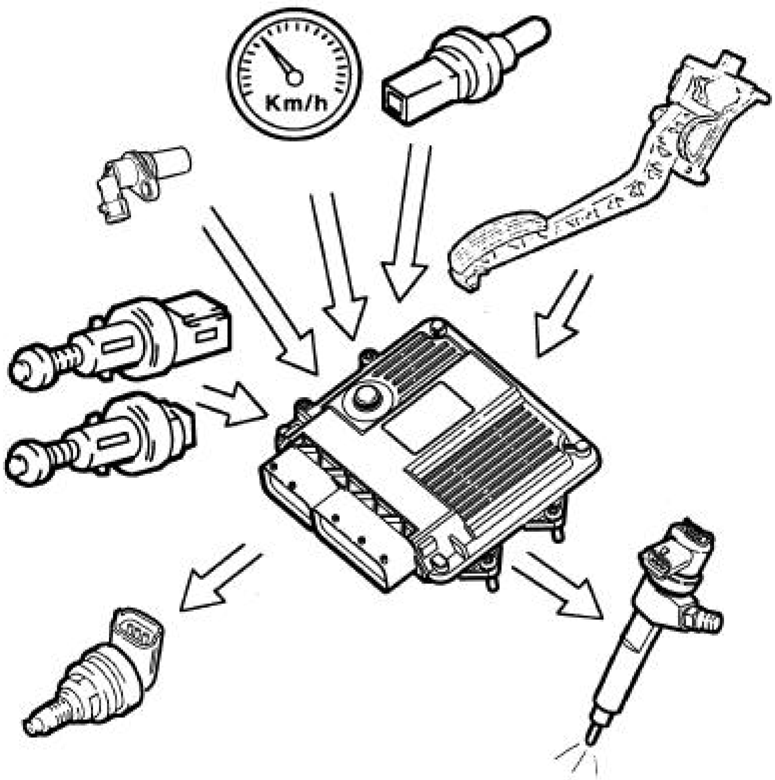
The control unit checks, depending on the signals from the various sensors (engine revs; vehicle speed; phase sensor), that the torque is correct until the idling speed is reached:

it varies the amount of injected fuel in every single electric injector (i.e. it varies the injection time).



3.10.7 Engine jerk prevent check

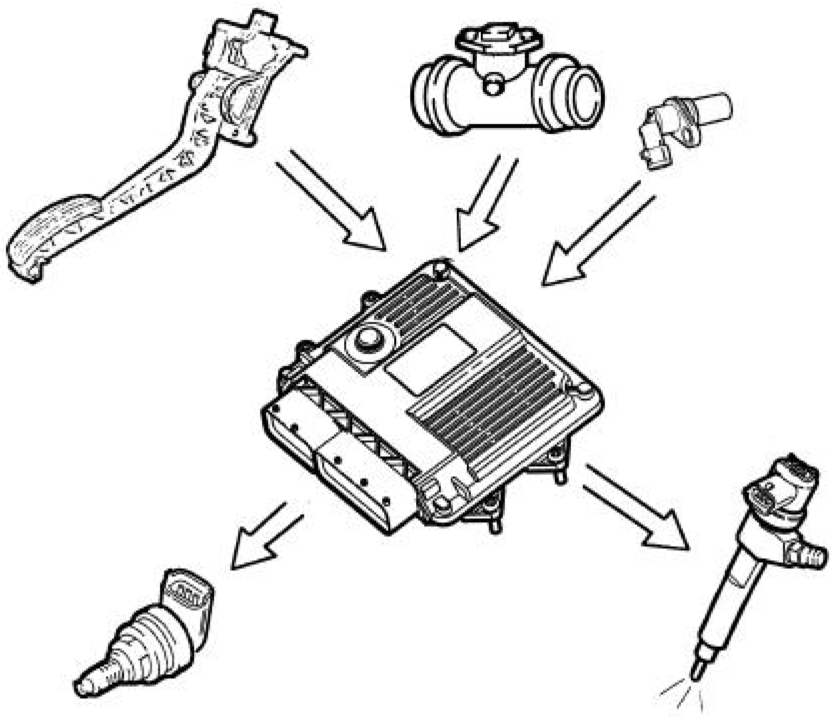
The control unit processes the signals from the various sensors (engine revs; vehicle speed; engine temperature; accelerator pedal potentiometer; brake and clutch switches) and corrects the amount of fuel to be injected in order to improve driveability by reducing the running jerks through the opening time of electric injectors CR1MI2.2 and the amount control valve DRV2.



3.10.8 Checking the exhaust smoke level during acceleration

In order to reduce the smoke during quick transients, the control unit reduces, depending on the signals from the accelerator pedal potentiometer, the air flow meter and the engine revs, the amount of fuel to be injected through:

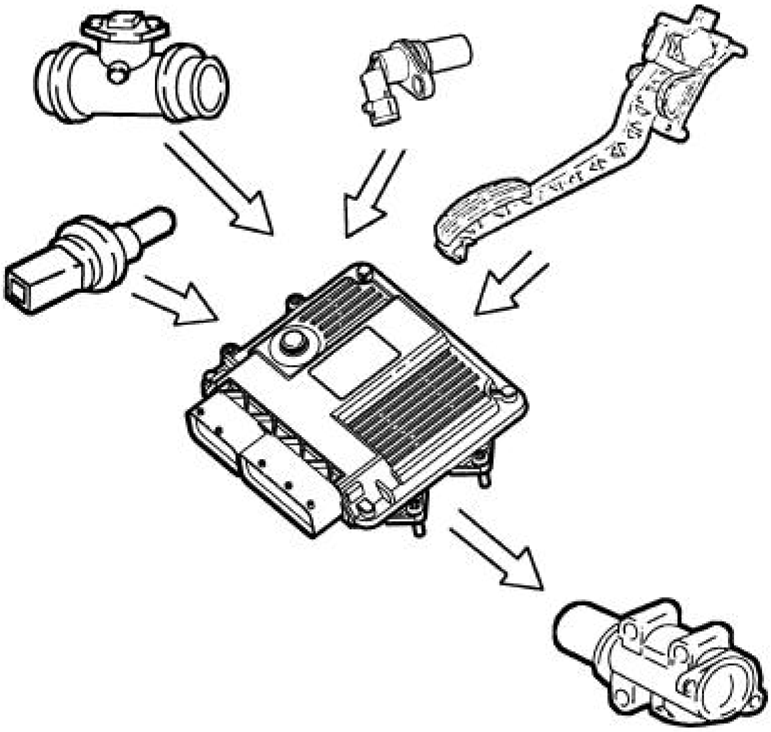
- pressure regulator (DRV2);
- the injection time of electric injectors (CR1MI2.2).



3.10.9 Exhaust gas recirculation (E.G.R.) check

According to the EURO 3/4 anti-pollution regulatory standard, the control unit reduces, depending on the engine load and the signal from the accelerator pedal potentiometer, the amount of sucked fresh air by partially sucking the exhaust gas through:

the adjustment of the electric E.G.R. valve opening.



3.10.10 Max. torque restraint check

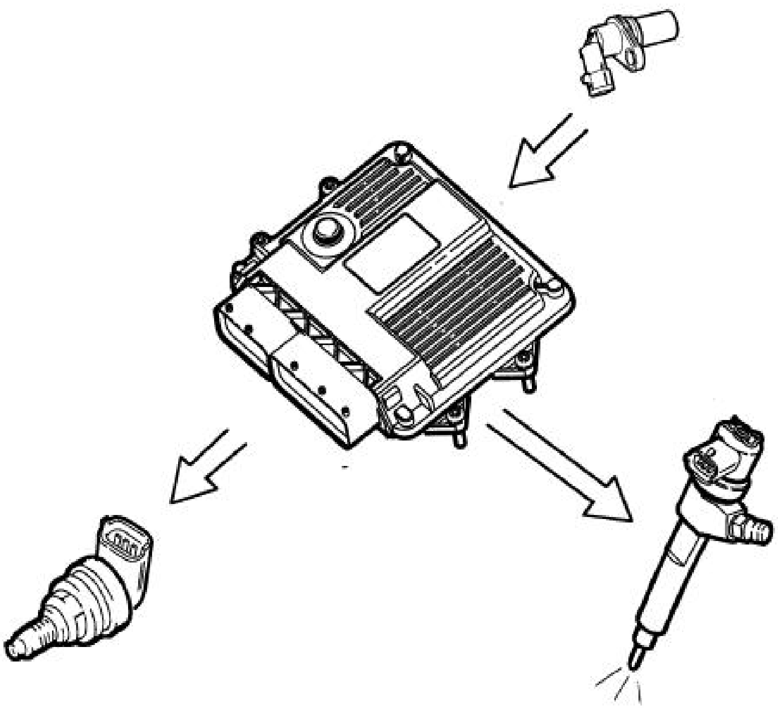
The control unit calculates, depending on the revs number, the following values on preset maps:

- the limit torque;
- the permitted smoke (limit) level.

It compares these minimum values and corrects the same by means of other parameters:

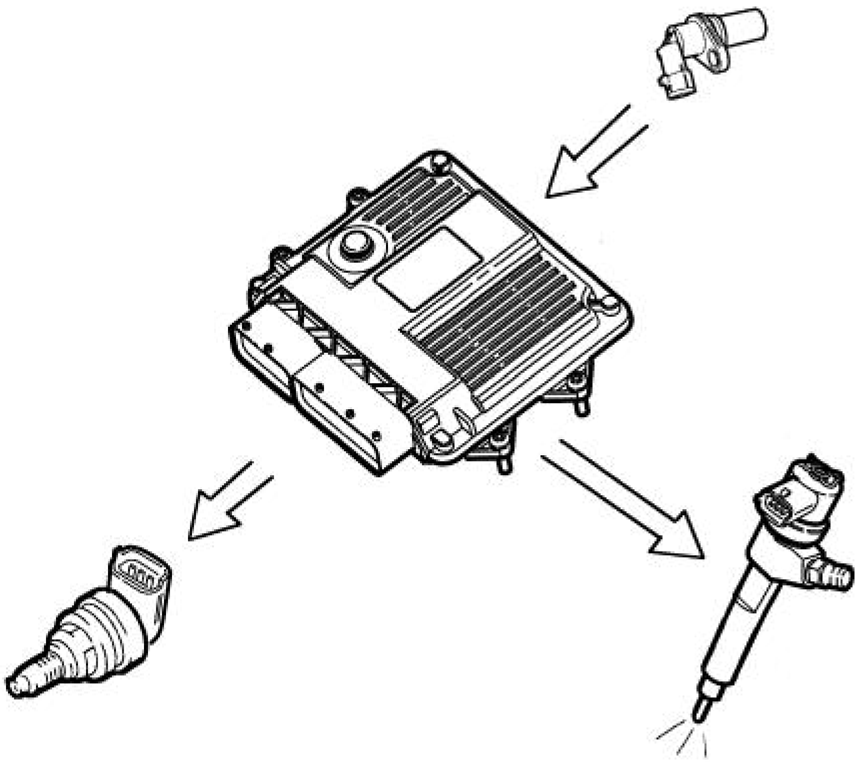
- cooling fluid temperature;
- engine revs number;
- vehicle speed;
- air temperature.

The control unit also controls the amount of fuel to be injected (pressure regulator – electric injectors).



3.10.11 Max. r.p.m. restraint check

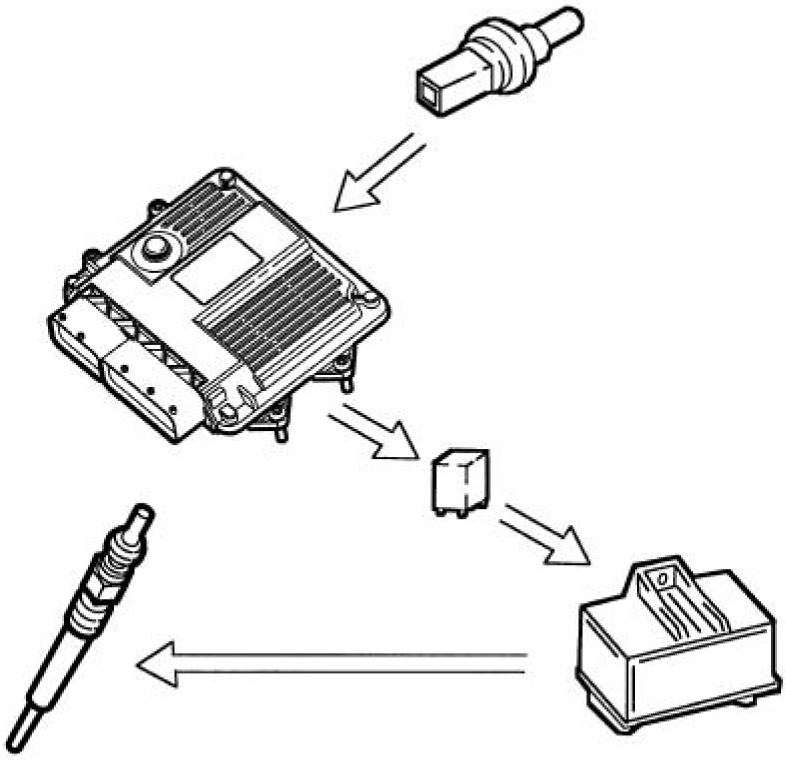
When the engine reaches 5,200 r.p.m., the control unit cuts off injector drive; as a result, the feed pressure will be reduced.



3.10.12 Preheating spark plug check

During the phases below:

- starting phase,
- post-starting phase,
- the control unit manages timed operation of the spark plug preheating control unit (BITRON) depending on the engine temperature.

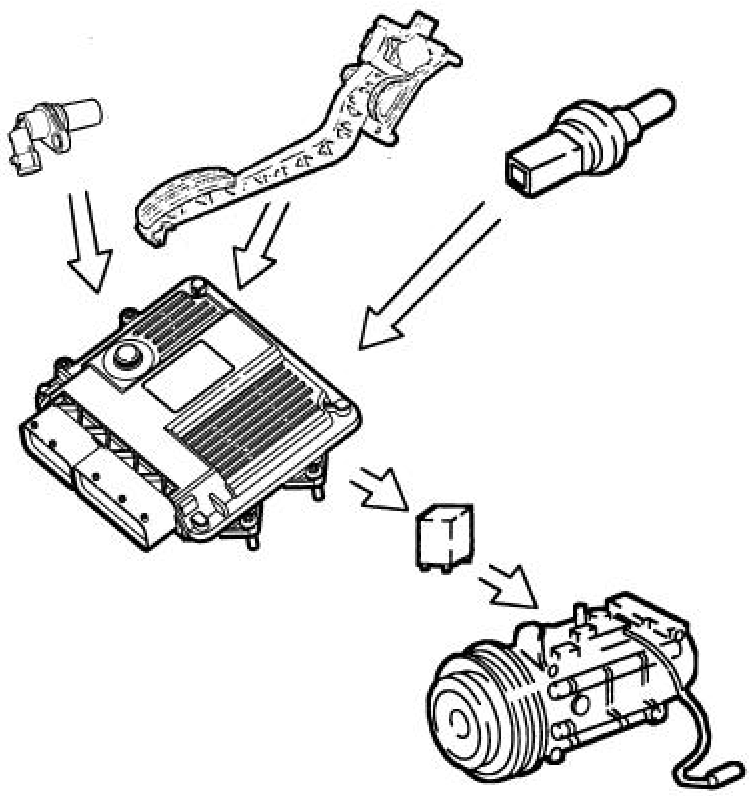


3.10.13 Air-conditioning system actuation check

The control unit drives the air conditioner compressor:

by turning it ON/OFF when the respective switch is pressed;

by turning it off temporarily (i.e. a few seconds) in case of heavy acceleration or when the maximum power is requested.

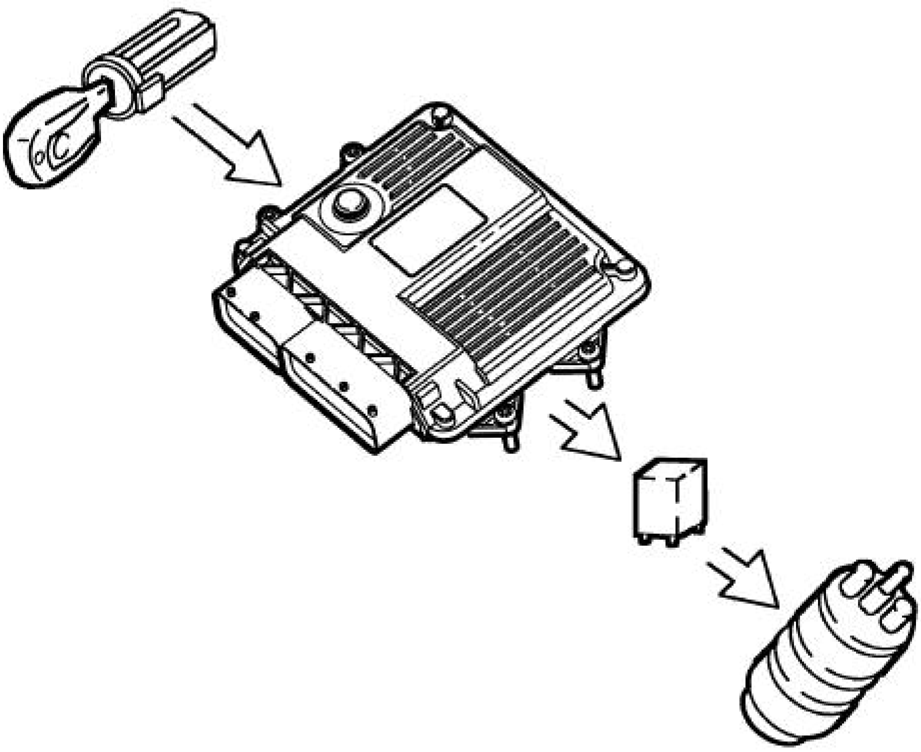


3.10.14 Auxiliary fuel electric pump check

Regardless of the revs number, the control unit:

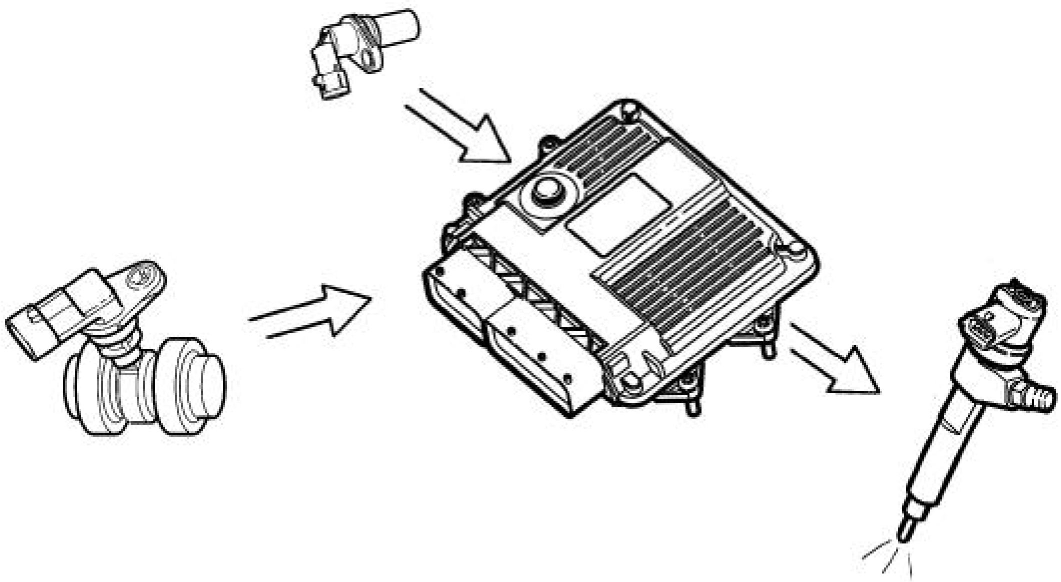
powers the auxiliary fuel pump with the key turned to “MAR”;

cuts the auxiliary pump power supply off if the engine is not started within a few seconds.



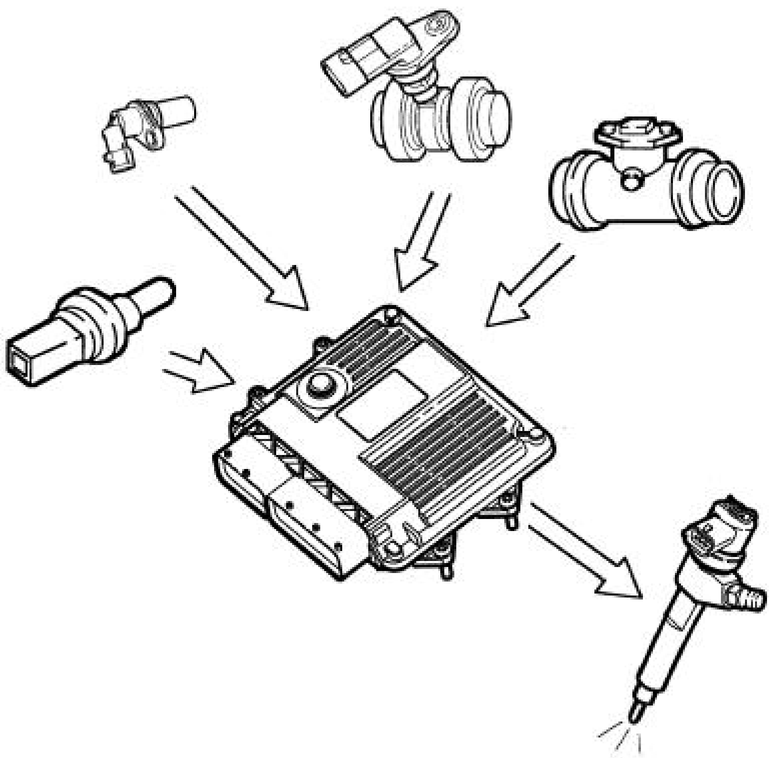
3.10.15 Cylinder position check

The control unit recognizes, during every single engine rev, the cylinder in the bursting stroke through the phase sensor, and controls the injection sequence to the proper cylinder.



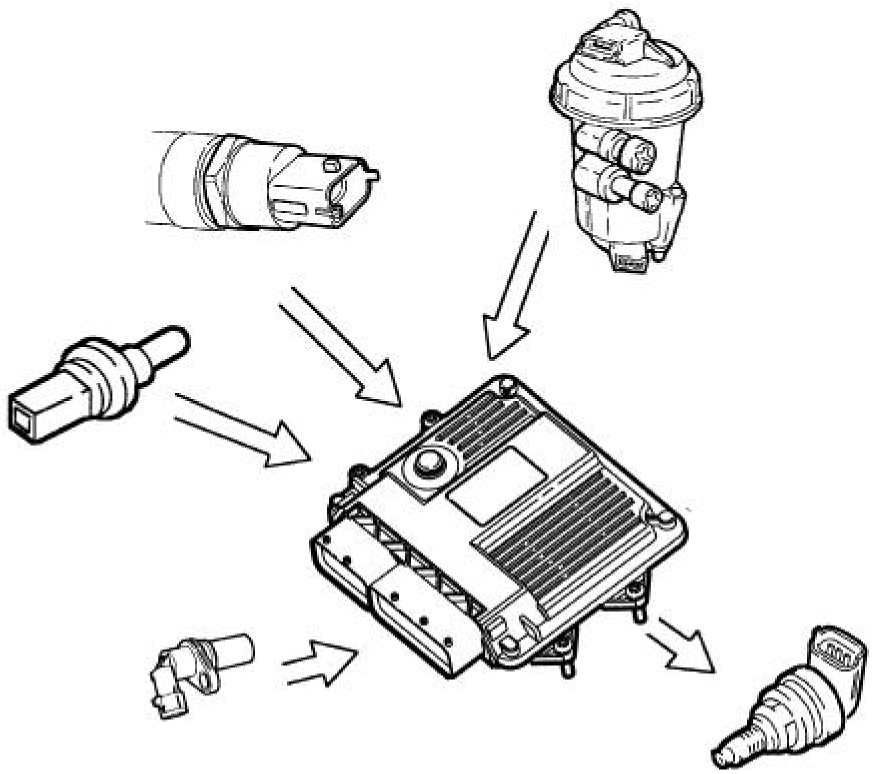
3.10.16 Main injection and pilot injection advance check

Depending on the signals from the various sensors (engine temperature; engine revs; camshaft sensor; air mass meter including the absolute pressure sensor built into the control unit itself), the control unit determines, according to internal mapping, the optimum injection point based on the driving comfort and also the emission limits laid down by the EURO 3/4 standards.



3.10.17 Injection pressure closed cycle check

Depending on the engine load (as determined by processing the signals from the various sensors, i.e. engine revs; engine temperature; RDS4 rail pressure sensor; fuel temperature), the control unit drives the regulator in order to obtain optimum line pressure.



3.10.18 Electric balance check

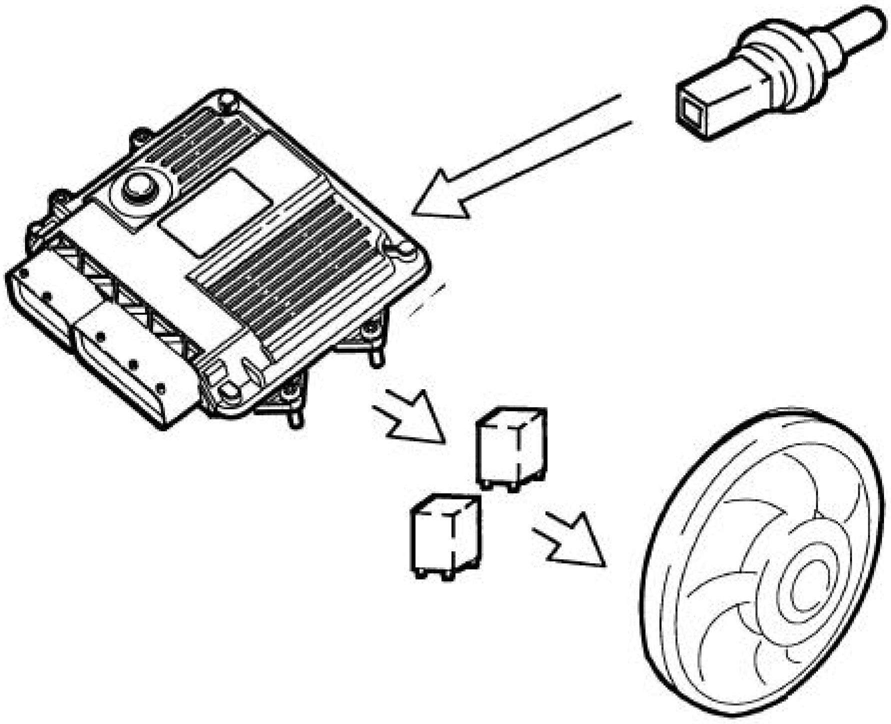
The control unit varies the idling speed depending on the battery voltage:

it increases the injection time of electric injectors (CR1MI2.2);
it controls the line pressure by means of the pressure regulator (DRV2).

3.10.19 Electric fan check

Depending on the engine water temperature and the coolant pressure in the air-conditioning system, the control unit drives:

the actuation of the electric fans to the first or second speed.

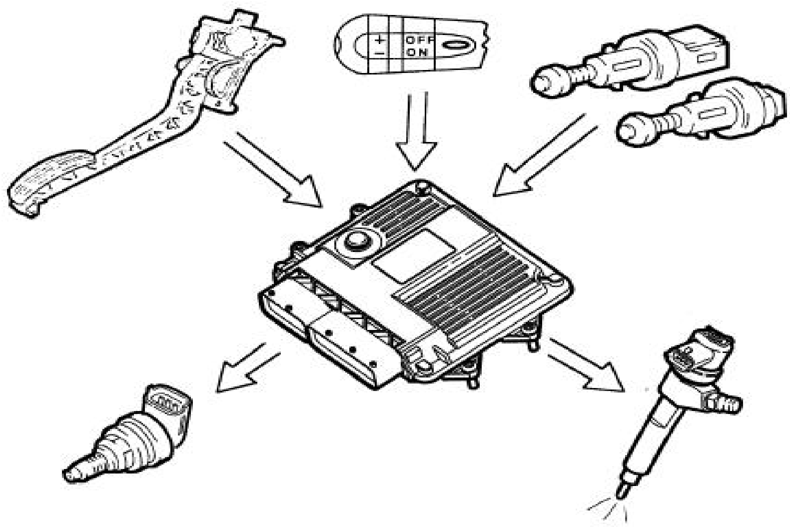


3.10.20 Cruise Control system check (where available)

Depending on the position of the Cruise Control control lever, the control unit directly controls the amount of injected fuel to control and keep the vehicle speed stored in the memory.
A warning light (actuated by the control unit) on the dashboard indicates the system’s operation or deactivation state.
The Cruise Control is temporarily disabled:

by pressing the brake pedal;
by pressing the clutch pedal;
the speed stored in the memory will be resumed by pressing the "Resume" button.

The Cruise Control will not be disabled in case heavy acceleration is requested (e.g. when overtaking), and will resume the vehicle’s set speed as soon as the accelerator pedal is released.
The ASR (antispin) function takes priority over the Cruise Control, for safety reasons.



Summarizing list of components

Components / functions	75 HP	90 HP
HFM6	X	X
DRV2	X	X
High-pressure pump	CP1	CP1-H
Boosting pressure sensor (+ air temperature)	NO	X
Boosting pressure sensor (– air temperature)	X	NO
DPF	OPT	OPT
Turboblower actuator	NO	X
Max. rail pressure	1400	1600
Injectors	CRI2-MI uSAC KS 6 x280	CRI2-MI uSAC KS 6 x280
Control system	DRV2 on the rail	MPROP in CP1-H + DRV2 on the rail
Functions	Multiple injection EGR control DPF control Oxygen sensor control Cylinder balancing control Injection correction control IMA procedure	Multiple injection EGR control DPF control Oxygen sensor control Cylinder balancing control Injection correction control IMA procedure VGT control

3.11 Sensors

Revs sensor

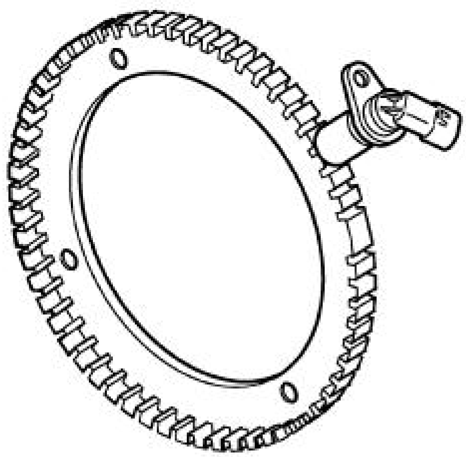
It is fitted onto the engine base and “faces” towards the phonic wheel positioned on the engine flywheel.

It is of the induction type, i.e. it operates through the variation of the magnetic field generated by the passage of the phonic wheel teeth (60 – 2 teeth).

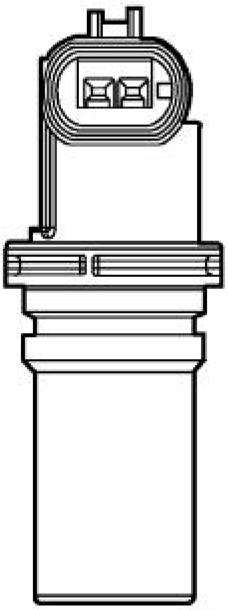
The injection control unit uses the revs sensor signal to:

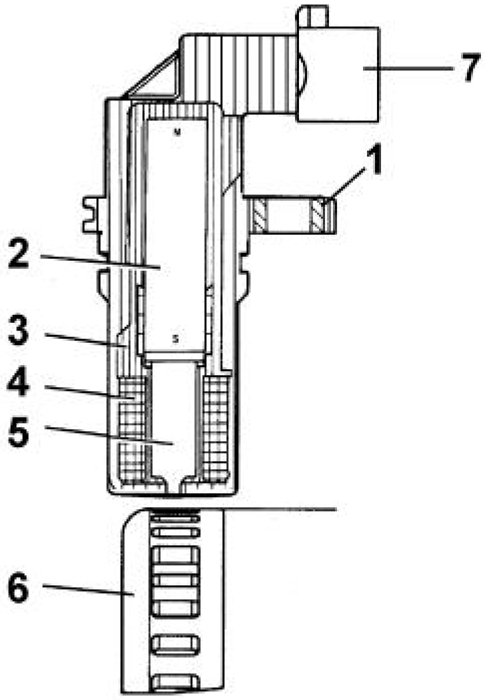
determine the engine rotation speed;

determine the angular position of the drive shaft.



The figure illustrates the revs sensor components.





1 Brass metal bushing

2 Permanent magnet

3 Plastic sensor body

4 Coil-winding

5 Polar core

6 Ring gear or phonic wheel

7 Coaxial two-wire cable or electric connection

PIN-OUT

Pin	Name	Type of signal
1	Phonic wheel signal (A)	Frequency output
2	Phonic wheel signal (B)	Frequency output

Technical features

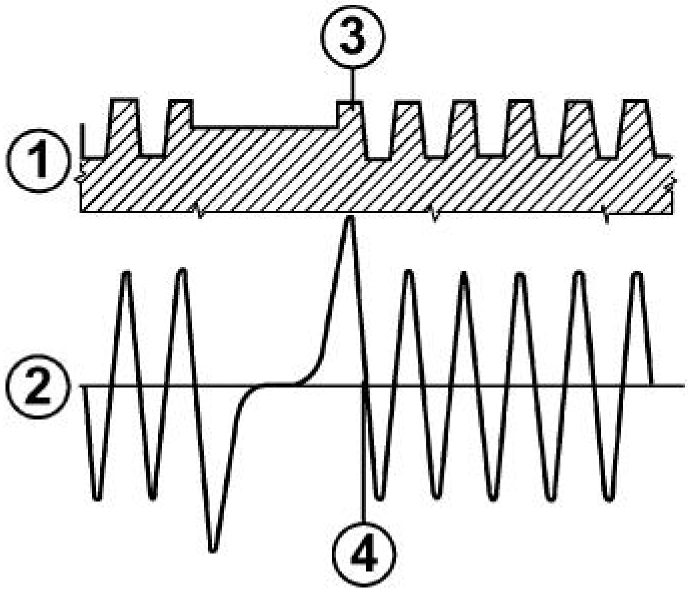
Winding resistance: 790 Ω ± 20%

Winding resistance: 680 mH ± 20% (f=1KHz)

The distance (gap) required between the sensor end and the phonic wheel to obtain correct signals shall be included in the range of 0.8 to 1.5 mm.

This distance cannot be adjusted; therefore, if an out-of-tolerance gap value is found, verify that the sensor and the phonic wheel are intact.

The diagram shows the sensor output signal in connection with the horizontal development of the phonic wheel.



1 Toothed wheel contour

2 Revs sensor signal

3 Reference tooth

4 Measuring point for T.D.C. recognition

Operation

The shift from the full to the empty condition, due to the presence or absence of the tooth, causes a variation of the magnetic flux which is enough to generate an induced, alternating voltage resulting from the count of the teeth placed onto one ring (or phonic wheel).

The frequency and amplitude of the voltage sent to the electronic control unit provide the latter with the measurement of the drive shaft angular speed.

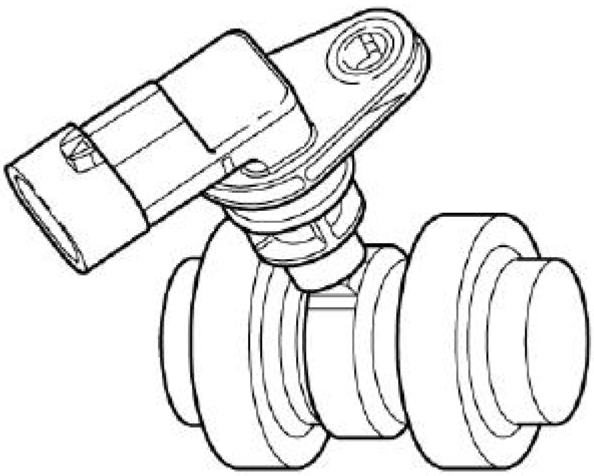
Cam or phase angle sensor

This is a Hall-effect sensor fitted to the overhead just next to the distributing shaft, on the exhaust side.

A tooth is obtained on the overhead, which allows the phase sensor to signal the engine timing position.

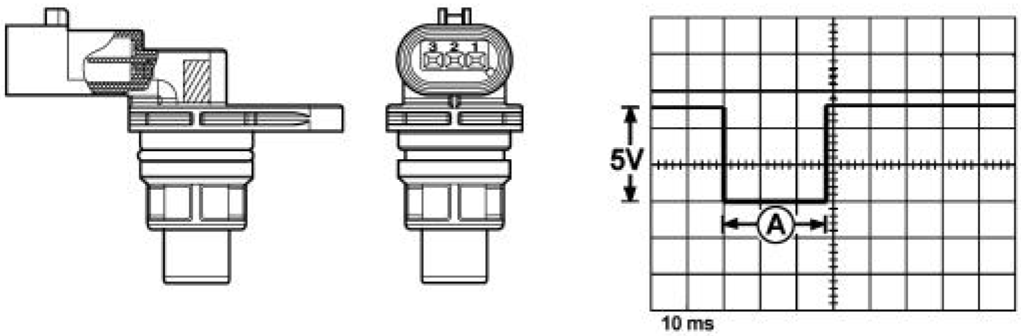
The injection control unit uses the phase sensor signal to know the top dead centres at the end of the compression phase and also synchronize, during the starting phase, the injections with respect to the position of the pistons.

Phase sensor



Operation

A semiconductor layer, through which current flows, immersed into a standard magnetic field (lines of force perpendicular to the direction of the current), generates a potential difference (known as "Hall" voltage) at its ends.
If the current intensity remains constant, the generated voltage will depend only on the magnetic field intensity. Therefore, it is enough for the magnetic field intensity to vary periodically in order to obtain a modulated electric signal, the frequency of which is proportional to the speed by which the magnetic field changes. To obtain this change, the sensor is periodically moved near by a tooth obtained on the inner side of the pulley.



PIN-OUT

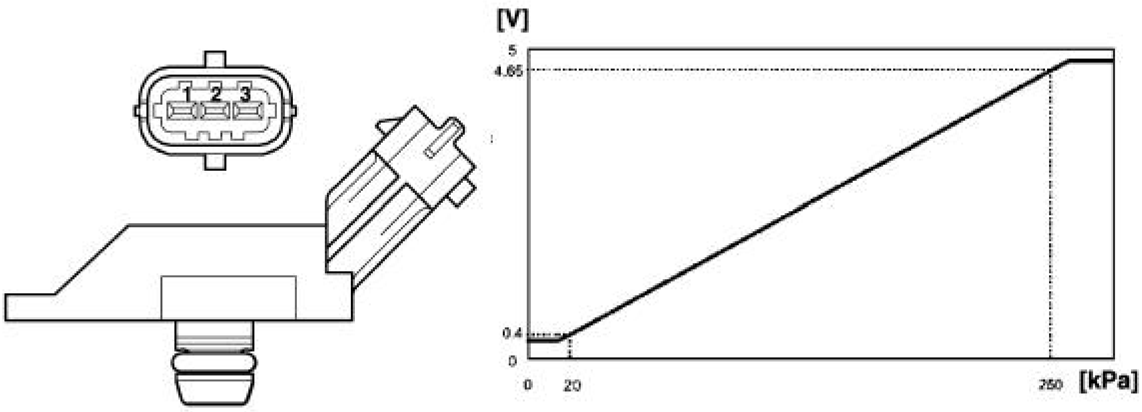
Pin	Name	Type of signal
1	Ground	Ground
2	Phase signal	Frequency output
3	Power supply	Input (12 V)

In the specific case of the phase sensor, this is powered by the engine management control unit with 5 V.

Every time the rotor passes in front of the sensor, the output voltage from the sensor is varied, due to the Hall effect: this variation takes place during all the time when the rotor passes in front of the sensor, then the signal returns to the initial value (5V).
N.B. If the sensor is faulty, the control unit will make use of internal emergency mapping which will allow the engine to be started in any case.

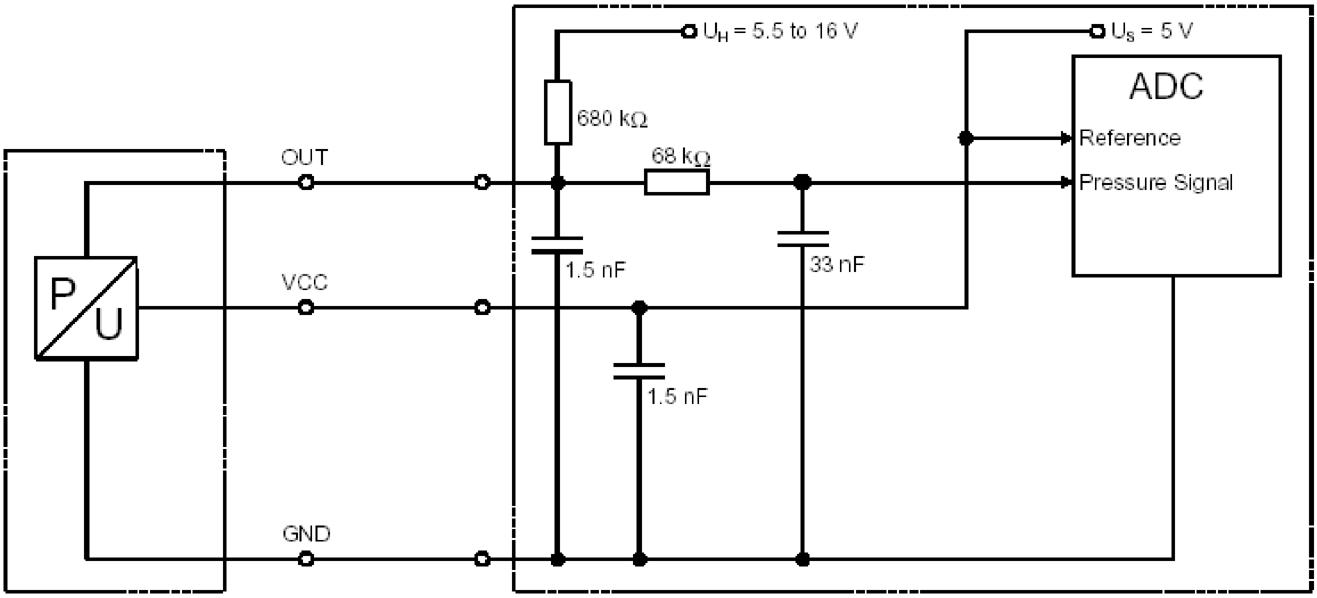
Boosting pressure sensor

The boosting pressure sensor is fitted to the inlet manifold and makes it possible to measure a suction pressure up to 1.5 bar (corresponding with 2.5 absolute bar).
The sensitive element consists of a piezoresistive element, the signal of which is amplified by an electronic circuit built into the sensor. The sensor is directly powered by the electronic control unit with 5 V and provides the output voltage directly proportional to the boosting pressure.

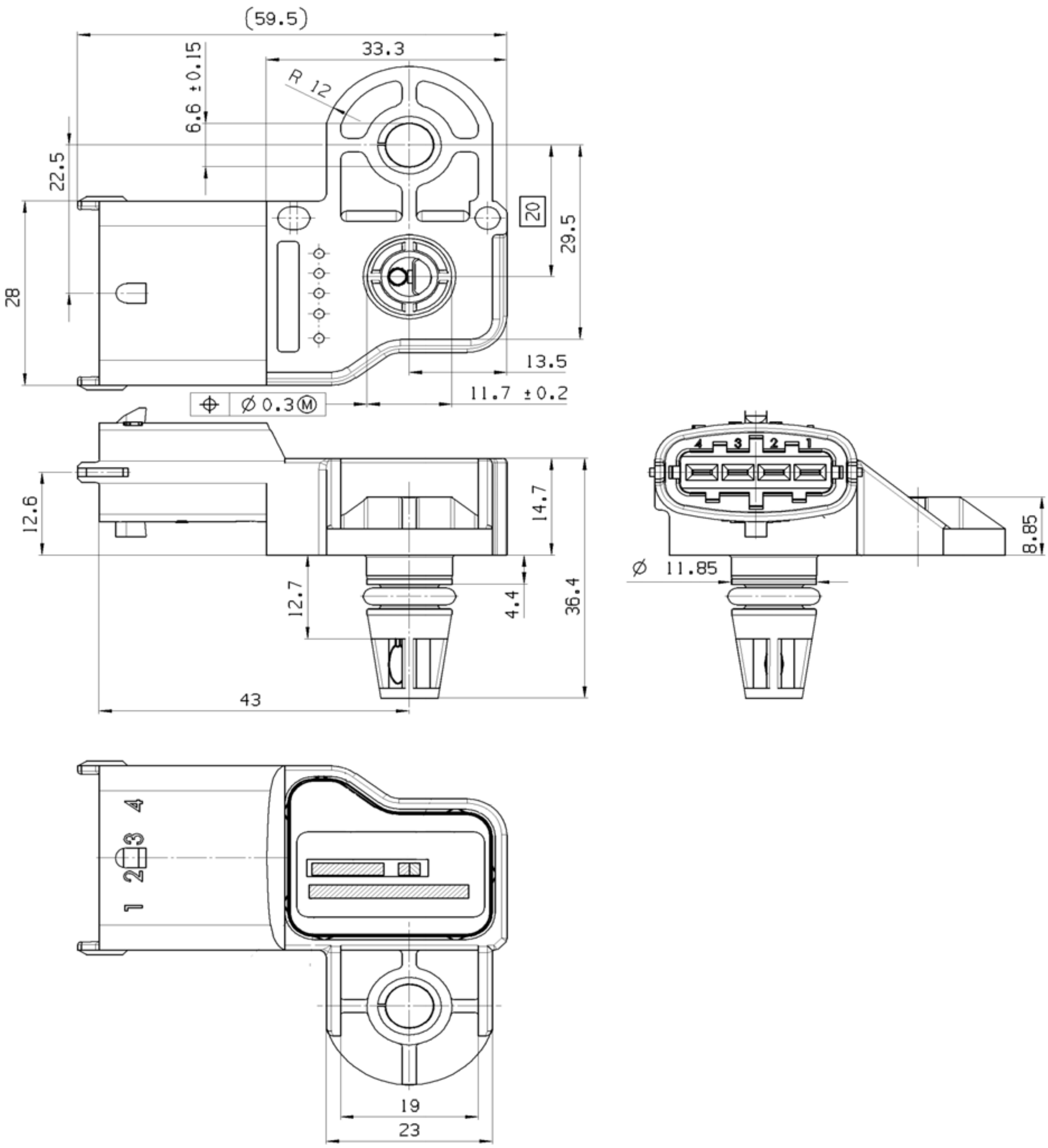


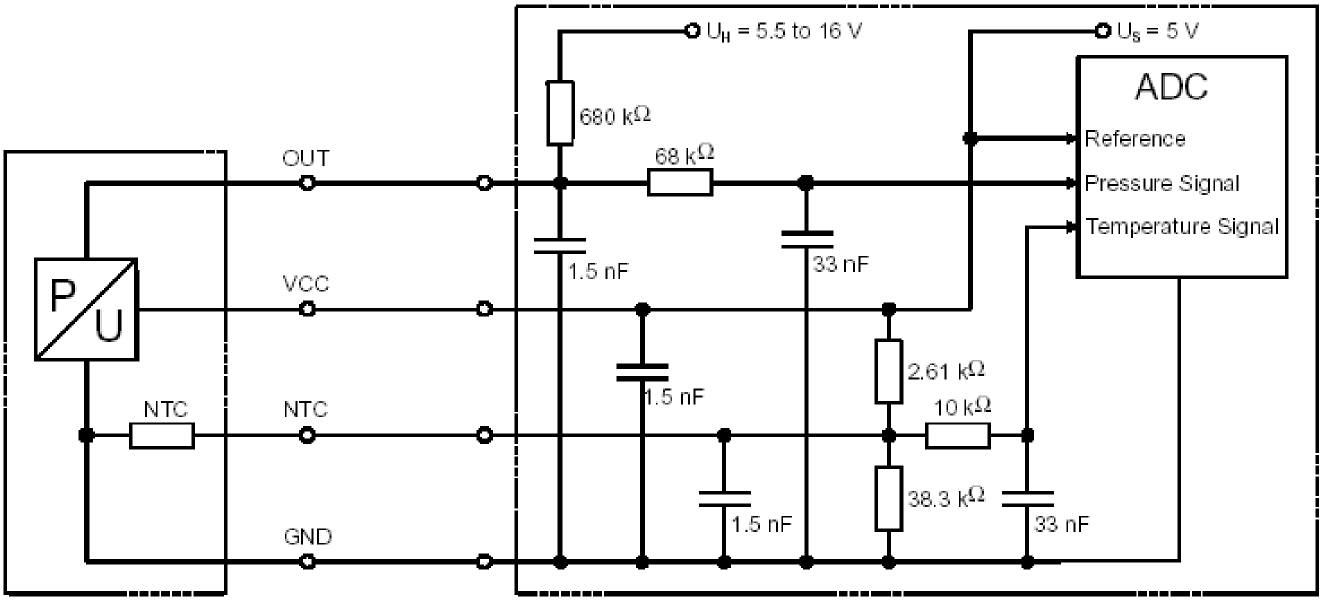
Overpressure sensor pin-out

Pin	Name	Type of signal
1	Power supply	Input (5 V)
2	Ground	Ground
3	Sensor output	Analog output



In the 90 HP engine version, the sensor also incorporates the boosting temperature sensor.



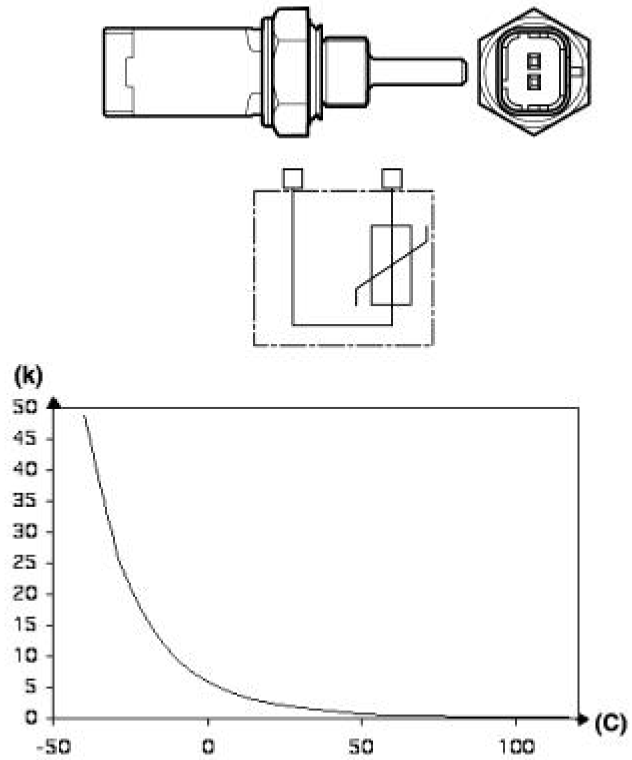


Pin-out

1 Pressure signal output
2 Power supply from the control unit (5 V)
3 Temperature signal output
4 Ground

Engine water temperature sensor

It is fitted to the thermostat and measures the water temperature by means of a NTC with negative resistance coefficient.



Engine water temperature sensor features

Temperature (C°)	Resistance (KΩ)
-40	48.80
-30	27.41
-20	15.97
-10	9.62
0	5.97

10	3.81
20	2.5
30	1.68
40	1.15
50	0.81
60	0.58
70	0.42
80	0.31
90	0.23
100	0.18
110	0.14
120	0.11
130	0.08

3.12 Air flow meter with built-in air temperature sensor (HFM 6)

Below are the advantages of the new air flow meter:

greater protection of the sensitive element put into the sensor against the air impurities (particles, water, oil vapour, etc.);

greater measurement accuracy.

Below are the differences between the HFM6 air flow meter and the earlier versions:

air flow rate and temperature digital signals;

4-wire electric connection;

different channelling of the air flow which hits against the sensitive measuring element (new by-pass);

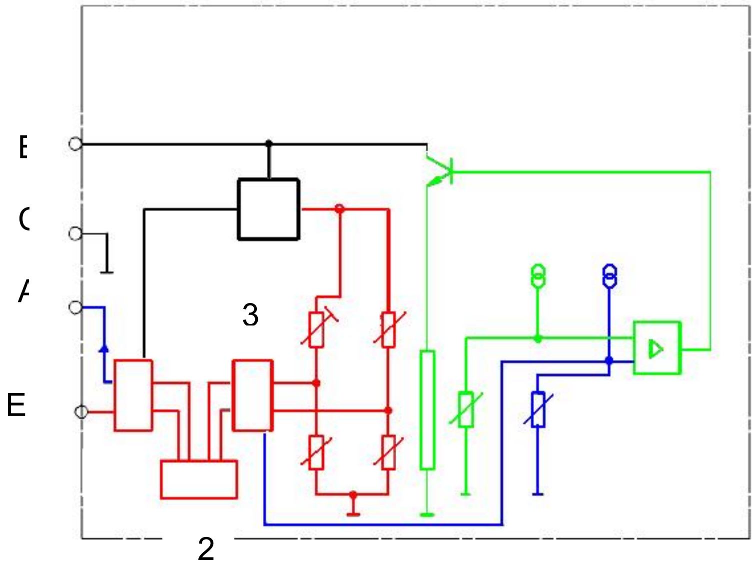
turret welded to the air flowing duct;

protection grid at the air flowing duct outlet section (with oil vapour condensing function).

The HFM6 air flow meter features a new plastic grid (1) positioned on the sensor housing duct outlet section, which protects the measuring sensor (sensitive element) against the blow-by vapour that might flow back during the engine switch-off phase.

In the digital air flow meter, the turret (2) is welded to the sensor housing duct and cannot therefore be separated from it. In the analog air flow meter, the turret is secured to the duct by means of two screws.

Diagram for sucked air temperature ground digital meter



A = temperature value digital output

B = power supply (12 V)

C = ground

E = air flow value digital output.

1 = function generator

2 = data memory

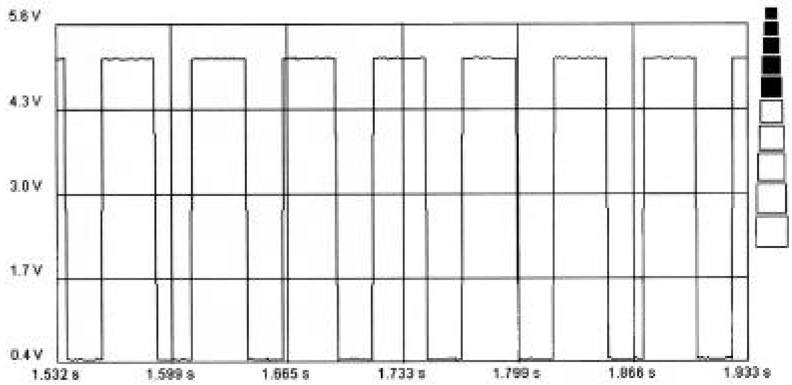
3 = A/D converter.

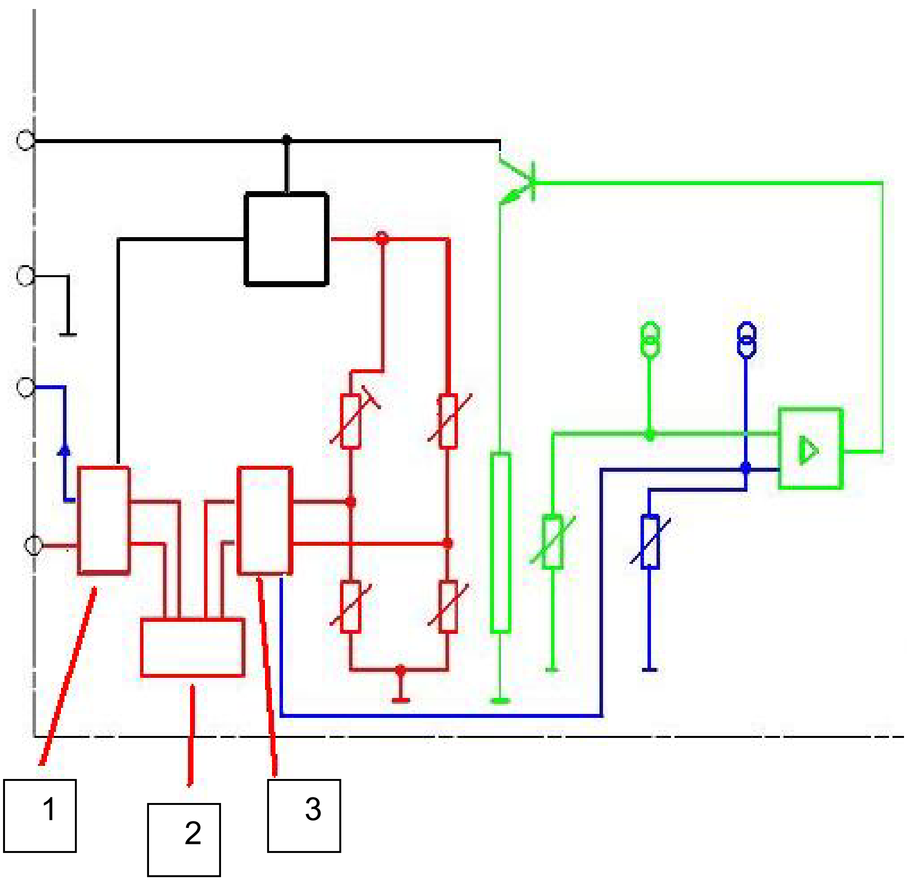
DIGITAL AIR FLOW METER OPERATION

Temperature signal trend

In the digital air flow meter, the temperature value (sent to the engine management control unit) is a signal of the PWM, duty-cycle type (fixed frequency).

The working voltage is 5 V, whereas the measuring interval ranges between –50 ºC and +150 ºC (with a resulting duty-cycle value in the range of 10% to 90%).

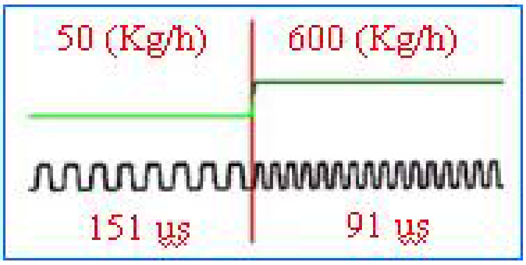




The resistive value variation is converted from analog into logic thanks to a “digital analog converter” (3). The data item obtained is stored in a data memory (2). Data are sent to the engine management control unit through a “function generator” (1).

Air flow rate signal trend

In the digital air flow meter, the signal sent to the engine management control unit features an amplitude of 5 V and is frequency-variable (1.4 kHz and 12 kHz).
An increase in inlet air flow rate is matched by an increase in the frequency of the output signal from the meter (and, as a result, a decrease in the period value).



Air flow rate

Frequency output

Digital air flow meter: AIR FLOW RATE signal

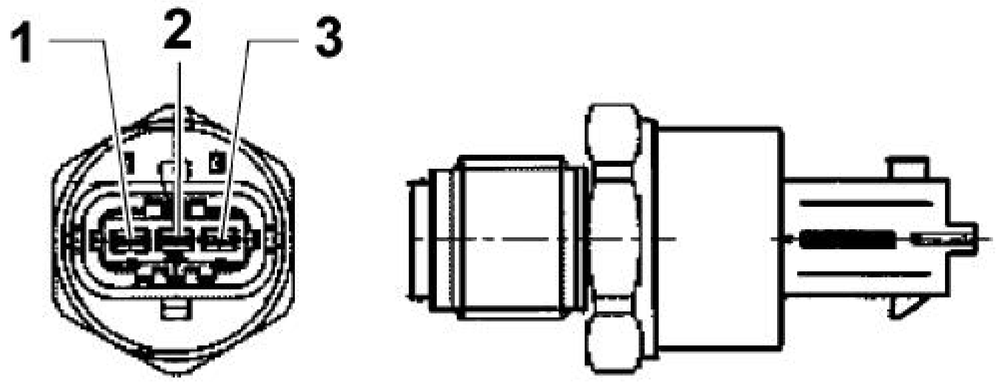
To measure and check the signal amplitude (voltage: 5 V), a graphic voltmeter is needed. To measure the frequency value, you will just need to use a multimeter with selection of the frequency measurement and the respective prods connected as follows: one to the air flow meter ground pin; one to the air flow rate signal pin.

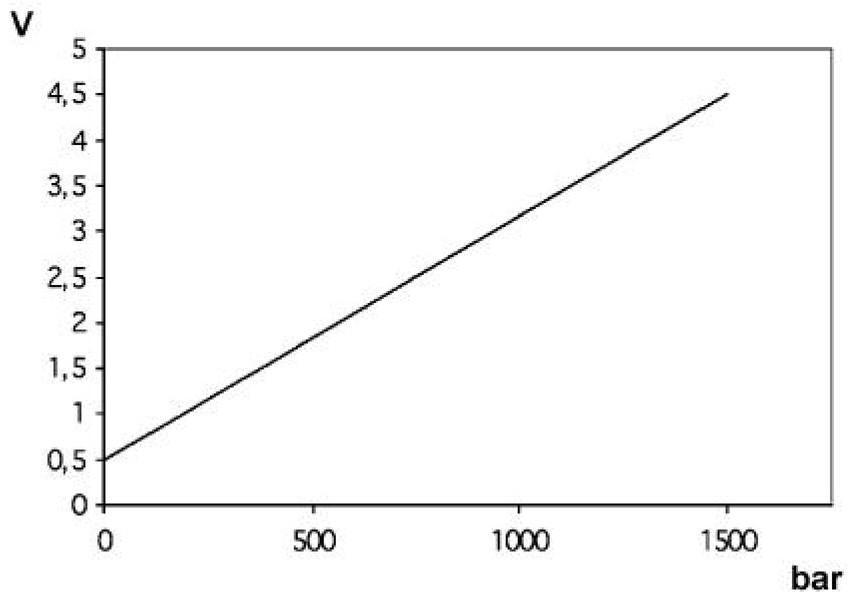
Fuel pressure sensor (RDS 4)

It is fitted to the end of the “rail” single fuel manifold pipe, and is used to provide the injection control unit with a "feedback" signal in order to:

adjust the injection pressure;
adjust the injection time.

The sensor is powered directly by the engine management control unit with 5 V. The output voltage varies in a linear fashion between 0.5 V (0 bar) and 4.5 V (1,500 bar).





Fuel pressure sensor pin-out

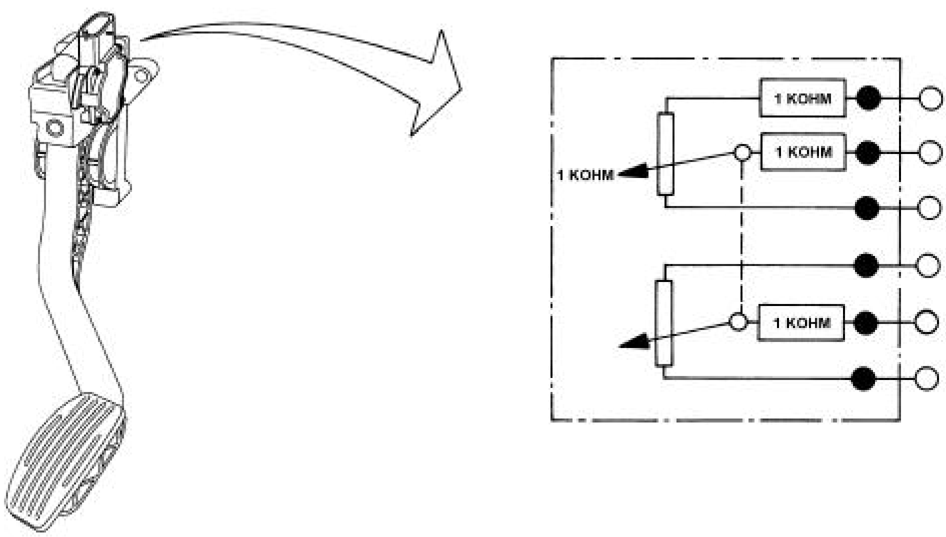
Pin	Name	Type of signal
1	Ground	Ground
2	Sensor output	Analog output
3	Power supply	Input (5 V)

If the sensor is faulty, the control unit drives, through emergency mapping, the quantity control valve (DRV2) so as to raise the bottom pressure by 100 bar (from 250 bar to 350 bar).

N.B. The engine can be started and operate even if the sensor is faulty.

Accelerator pedal potentiometer

The sensor is made up of a frame secured to the accelerator pedal, which houses a shaft placed in an axial position and connected with the two potentiometers (main potentiometer and safety potentiometer).
A helical spring fitted onto the shaft ensures proper compressive strength, whereas one further spring ensures the return when releasing.
Redundant signal reading makes it possible to continuously monitor the plausibility of measured values, so as to ensure full driving safety even in case of failure.



Operation

The accelerator pedal position is converted into an electric voltage signal and sent to the injection control unit from the potentiometer connected with its respective pedal.
The accelerator pedal position signal is processed together with the revs number data, to obtain the injection time and pressure.

Pin	Name	Type of signal
1	Race 2 power supply	Input (5 V)
2	Race 1 power supply	Input (5 V)
3	Race 1 ground	Ground
4	Race 1 signal	Analog output
5	Race 2 ground	Ground
6	Race 2 signal	Analog output

Technical features of the Bosch sensor

Supply voltage: 5 V ± 0.3 V

Resistance at the potentiometer cursor terminals: 1 KΩ ± 0.4 KΩ

Race 1 resistance: 1.2 KΩ ± 0.4 KΩ

Race 2 resistance: 1.7 KΩ ± 0.8 KΩ

Technical features of the hella sensor

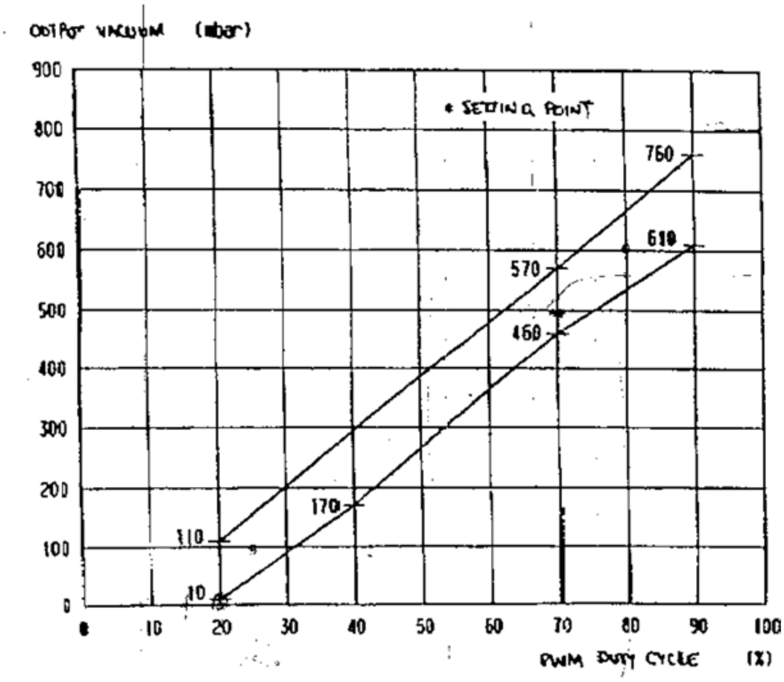
Supply voltage: 5 V ± 0.3 V

Resistance at the potentiometer cursor terminals: 1 KΩ ± 0.4 KΩ

Race 1 resistance: 0.9 KΩ ± 35% ….1.4 KΩ ± 35%

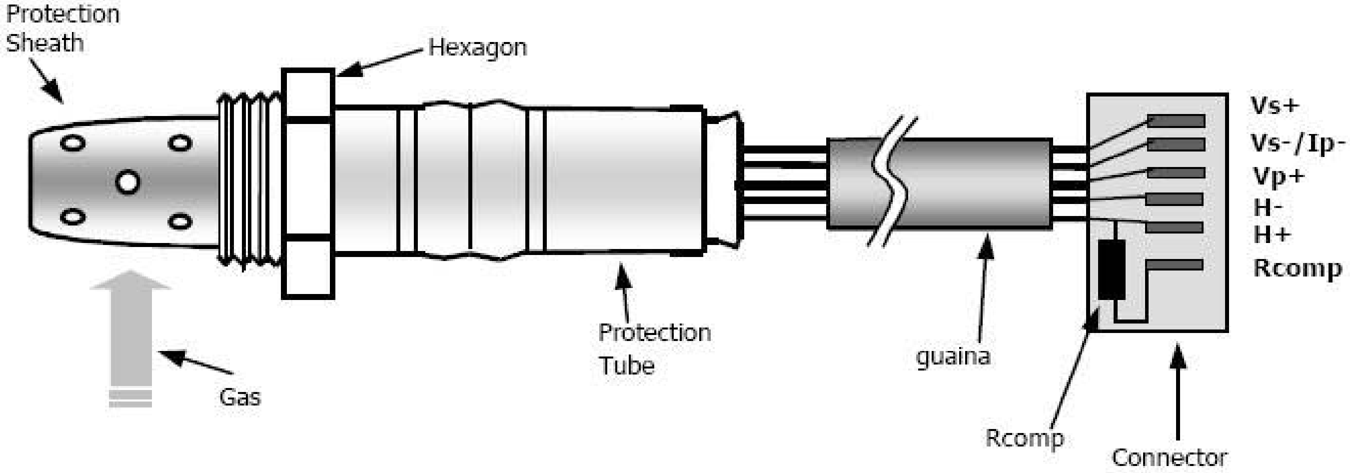
Race 2 resistance: 1.2 KΩ ± 35% ….2.0 KΩ ± 35%

3.13 VGT solenoid valve

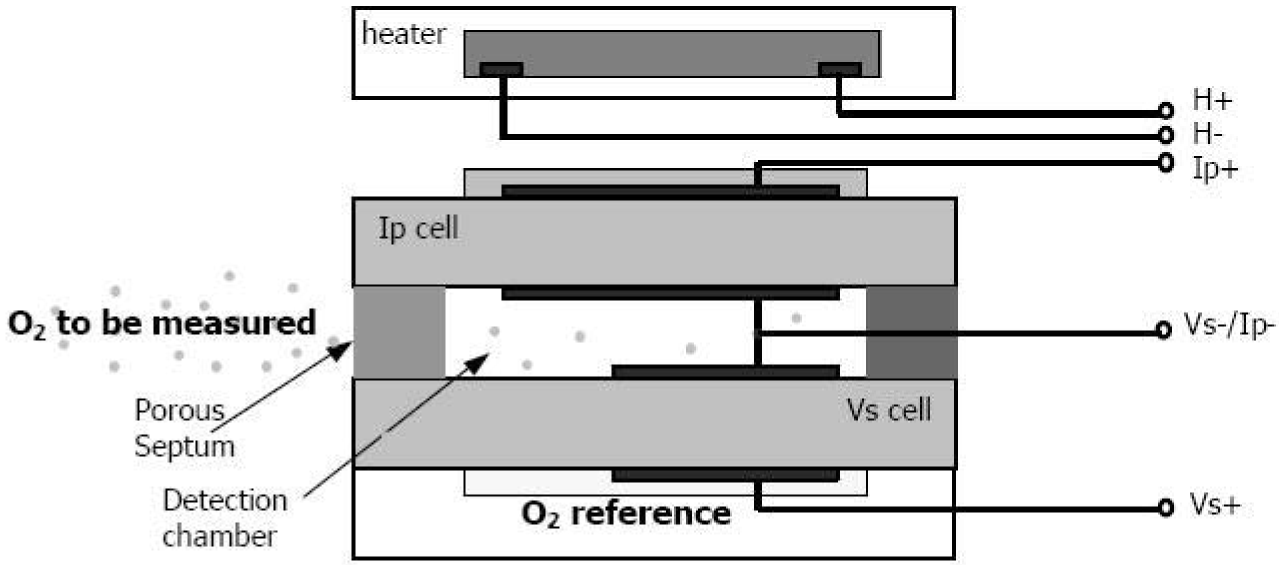


ELECTRIC FEATURES OF THE ACTUATOR	Solenoid valve; Rated voltage: 12 V Operating voltage range: 10 – 16 V Control signal: PWM-modulated square wave Modulation frequency: 500 Hz Electric resistance: 15.4 ± 0.7 Ω at 20°C;
TYPE OF CONTROL	PWM (V=12V)
MEASURING MEANS	Oscilloscope or analog instrument (Examiner with SMA)

UEGO oxygen sensor


Protection Sheath
Hexagon
Vs+
Vs-/Ip-
Vp+
H-
H+
Rcomp
Protection Tube
guaina
Gas
Rcomp
Connector

UEGO Sensor: Universal Exhaust Gas Oxygen Sensor



4 8-valve 1.4 engine

4.1 General remarks

The development of the 8-valve 1.4 engine has caused the Fire 8V engine to be shifted to the segment B vehicles and light commercial vehicles. This engine can be compared with the Fire 1.2 16V MPI as far as performance is concerned, with better consumption levels and cost-efficiency.

The development of the 8-valve 1.4 engine has made it possible to cut down fuel consumption by 6% (NED) through two actions:

the modification made to the valve train with smaller valve weight, and the introduction of low-load valve springs – both of these improvements have reduced fuel consumption by 2% (NEDC);

the use of the CVCP (continuous phase variator) on the 8V engines, which helped cutting down fuel consumption by 4%.

The power and, above all, the low-speed torque of this engine enhance the elasticity features of Fiat Punto, ensuring smooth driving and quick pick-up without having to shift down, with very good consumption levels.

The introduction of the continuous phase variator and a new concept of variable-turbulence combustion chamber have made it possible to significantly reduce fuel consumption and exhaust emission, especially when driving in the city traffic and out of town.

The new combustion chamber (with a compression ratio of 11:0), combined with the new intake and exhaust pipes, the new inlet manifold, and optimized valve gear timing, ensure bright performance, low fuel consumption and emission levels. The 1.4 engine complies with the Euro 4 regulatory standard.

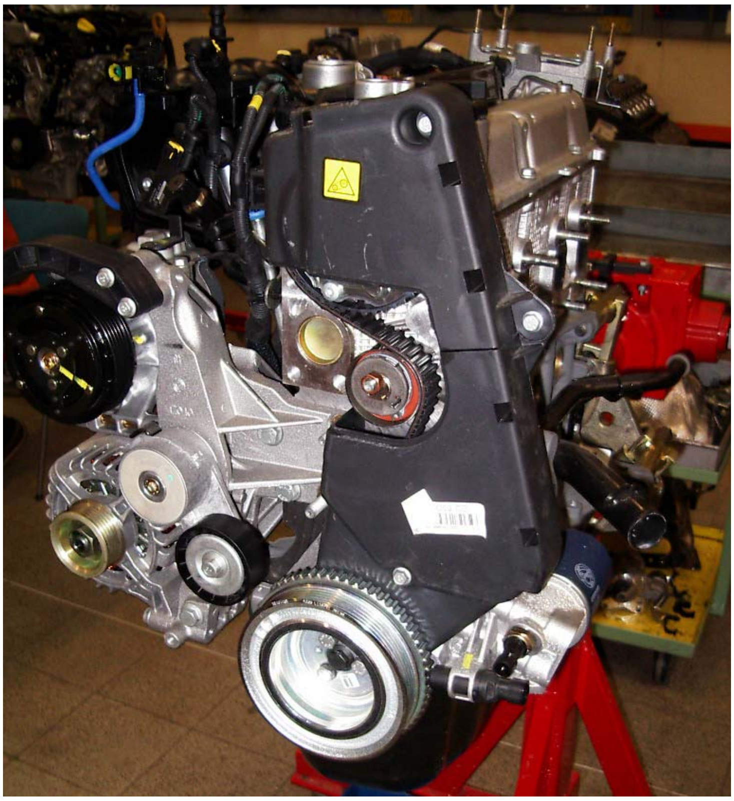
Below are the main features of this new engine:

8-valve, 4-cylinder in-line OHC engine;

aluminium alloy head;
valve control by means of a camshaft and mechanic tappets of the bucket-and-adjust type;
electronically-controlled, hydraulic continuous phase variator;
cast iron engine block;
variable-turbulence combustion chamber;
fluid cooling with forced circulation by means of a centrifugal pump secured to the engine base and sealed circuit;
radiator and auxiliary expansion tank;
engine timing by means of a timing belt;
flexible flywheel, with resulting reduction of the power unit vibrations transmitted inside the passenger compartment;
power-driven, drive-by-wire throttled body and PCB control unit fitted onto the engine;
gear pump for forced lubrication;
optimized rod-piston crank mechanism for reduction of the alternate mass, which is the main cause of engine vibration excitation;
single-block coils with ignition (elimination of lost sparks) and knock control on a cylinder-by-cylinder basis;
Magneti Marelli engine control unit of the “torque-based” type (resistant to the engine’s mechanic and thermal stress);
very low consumption and exhaust gas levels;
diagnosis through EOBD connector;
2 heated oxygen sensors and trivalent catalytic converter;
compliance with the Euro 4 standard.

The optimization of the valve gear timing and the introduction of such items as:
electronically-controlled, hydraulic continuous phase variator;
variable-turbulence combustion chamber;
special intake and exhaust ducts;
special inlet manifold;

make it possible for the vehicle to reach optimum performance levels and also circulate, within the combustion chamber, a significant amount of the exhaust gas (approximately 25%), thus reducing to a considerable extent fuel consumption and exhaust emission when the vehicle is being driven with a partial load.

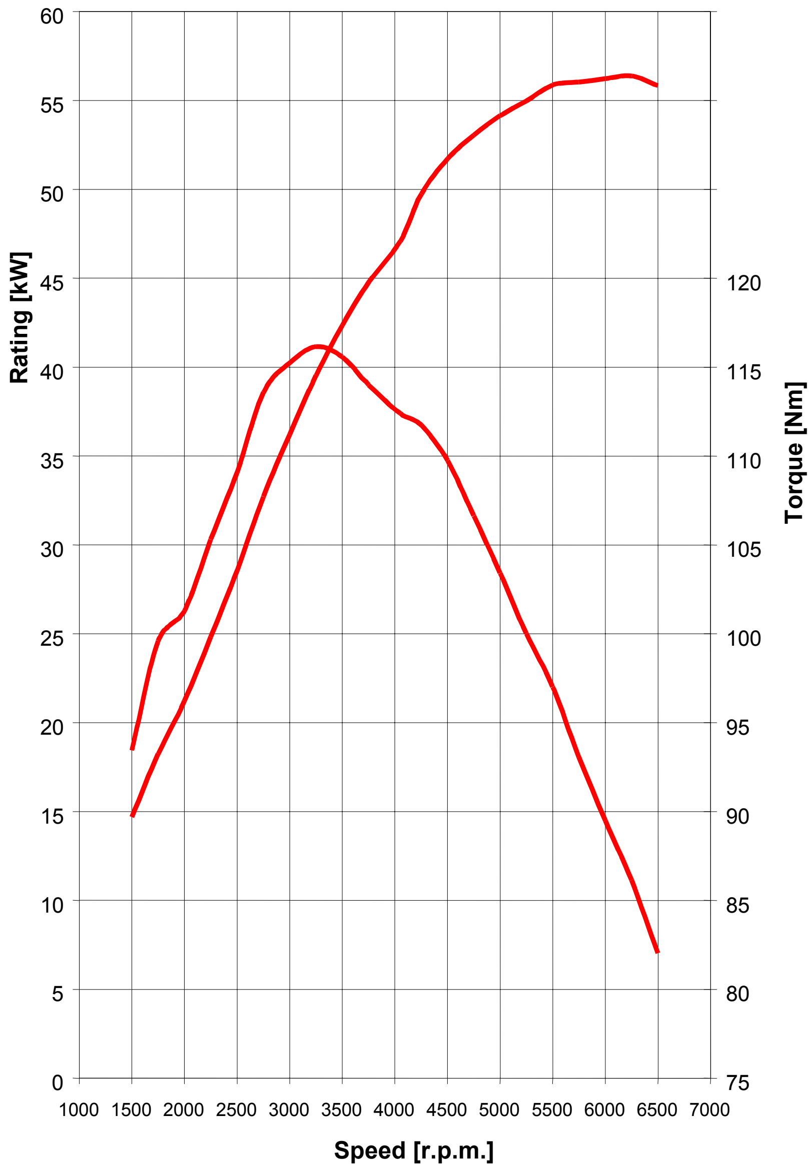


8-valve 1.4 litre engine specifications

Engine type	1.4 8v
Displacement	1,368 cm³
Bore	72 mm
Stroke	84 mm
Intake valve diameter	N.D.
Exhaust valve diameter	N.D.

Max. power / engine speed	57 KW / 6,000 r.p.m.
Max. power / engine speed	75 HP / 6,000 r.p.m.
Max. torque / engine speed	115 Nm / 3,000 r.p.m.
Compression ratio	11 : 1
Engine management control unit	Marelli 5SF3
Anti-pollution regulatory standard	Euro 4

Torque curve and power curve



Engine identification codes

ENGINE	1.4 8V
TYPE CODE	350A1000

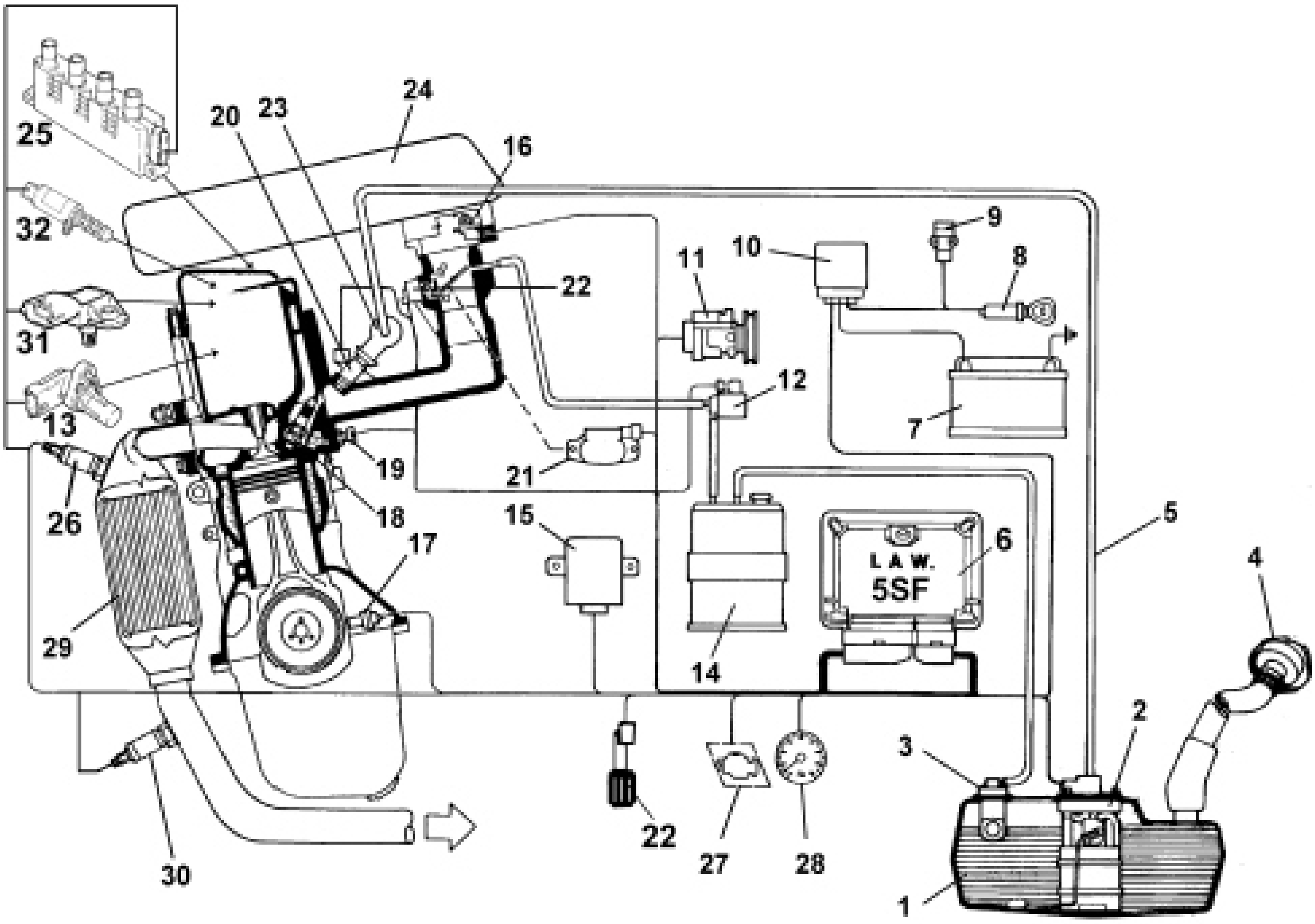
4.2 IAW 5SF injection/ ignition control unit

4.2.1 Injection system architecture

The Marelli IAW 5SF systems falls into the category of the integrated systems for:

- digital, electronic ignition with inductive discharge;
- static distribution;
- electronic injection of the phased, sequential type (1-3-4-2).

The figure below provides an overall view of the system.



Fuel tank

Fuel electric pump

Multi-purpose valve

Safety valve

Fuel delivery pipe

Injection-ignition electronic control unit

Battery

Ignition switch

Inertia switch

Engine compartment branching-off control unit

Air-conditioning unit

Fuel vapour cut-off solenoid valve

Injection phase sensor

Active carbon filter

Body computer (diagnosis connector and Fiat CODE signal)

Temperature and absolute pressure sensor

T.D.C. and revs sensor

Spark plugs

Coolant temperature sensor

Electric injectors

Throttle control actuator and throttle position sensor

Accelerator pedal potentiometer

Fuel feed manifold

Air filter

Ignition coils

Oxygen sensor (upstream)

System failure optical indicator

Revs counter

Catalyst

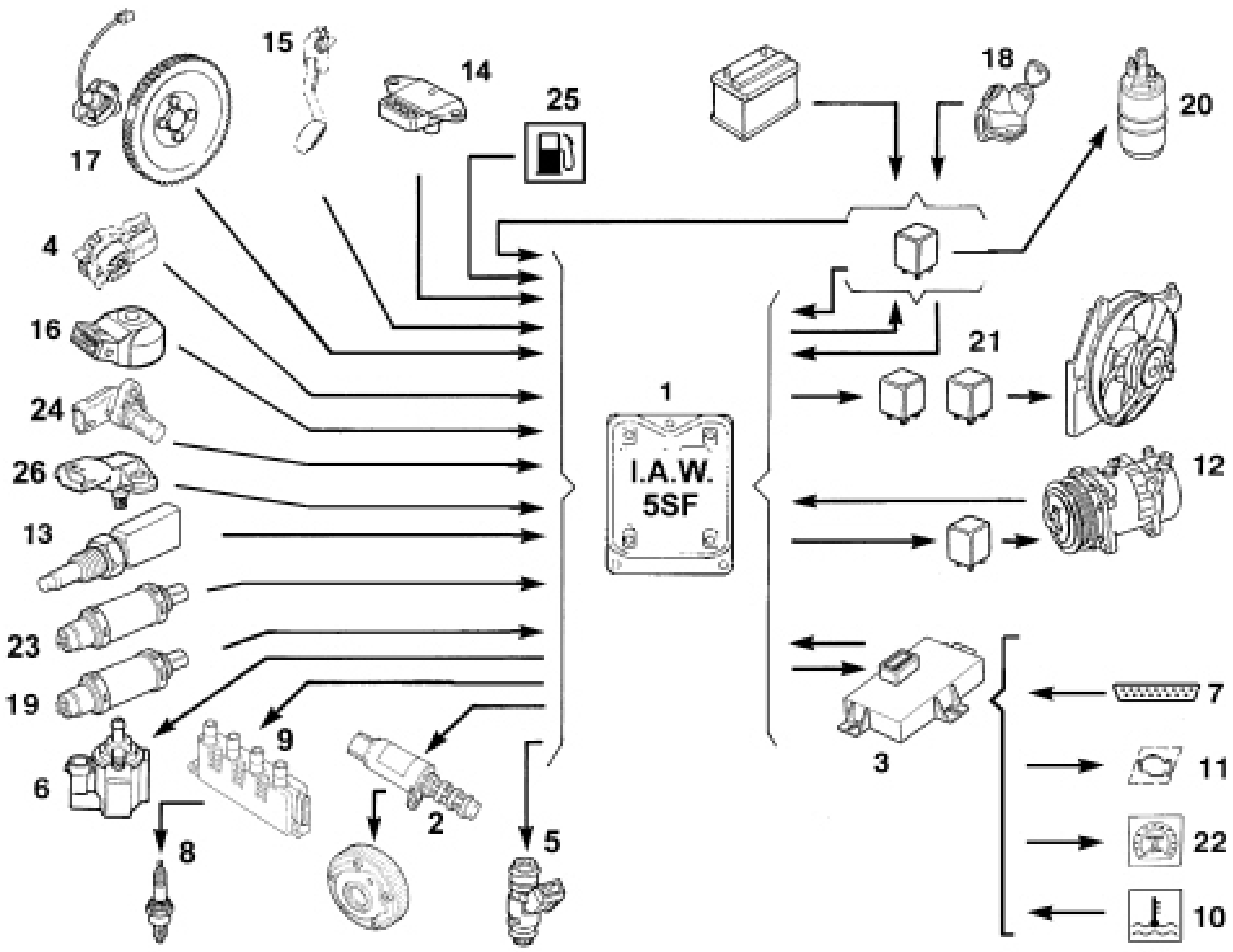
Oxygen sensor (downstream)

Atmospheric pressure sensor

Phase variator drive solenoid valve

Control unit ingoing/outgoing information diagram

Control unit ingoing/outgoing information diagram



Electronic control unit

Phase variator drive solenoid valve

Body computer (with built-in Fiat CODE control unit)

Throttle control actuator and throttle position sensor

Electric injectors

Fuel vapour solenoid valve

Diagnosis connector

Spark plugs

Ignition coils

High engine coolant temperature warning light

Injection failure warning light

Air-conditioning system

Engine coolant temperature sensor

Sucked air temperature and pressure sensor

Accelerator pedal sensor

Knock sensor

T.D.C. and revs sensor

Ignition switch

Oxygen sensor (pre-catalyst)

Fuel electric pump

Radiator electric fan high/low speed control remote-control switches

Speedometer / odometer

Oxygen sensor (post-catalyst)

Injection phase sensor

Fuel level sensor

Atmospheric pressure sensor

4.2.2 Main features

The control unit is fitted onto the engine compartment on a support integral to the engine (see photos) and is able to withstand high temperatures.

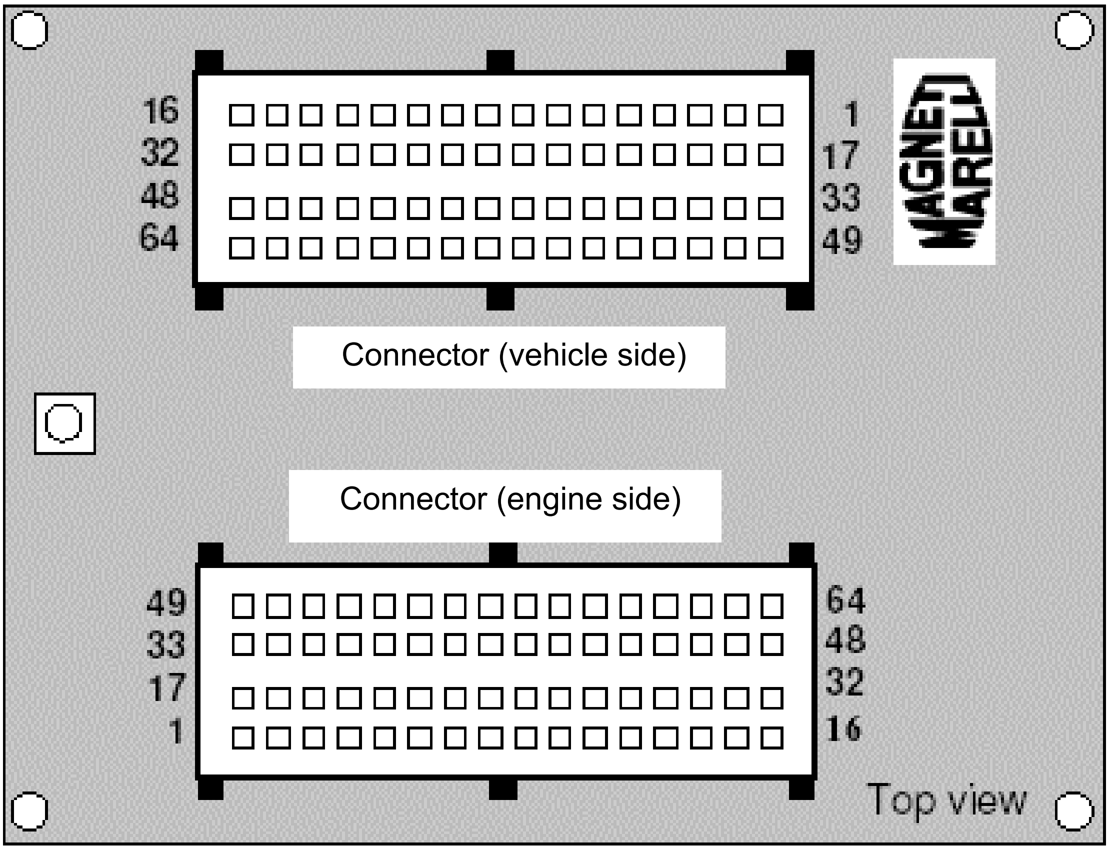
It is of the digital, microprocessor-operated type, and features very high calculating capacity, low energy consumption and no maintenance requirements.

The function of the electronic control unit is to process the signals from the various sensors by applying software algorithms, and also drive the actuators (in particular, the electric injectors, ignition coils, and the power-driven throttle) in order to achieve optimum engine operation.

The introduction of the Fiat CODE protection system does not make it possible to exchange control units among different Fiat Punto vehicles of the same engine version.

ECM (engine control unit)

Control unit pin-out



Connector A, vehicle side (Tyco 3-284272-0)

Pin	I/O/S	Supply source	Function	Max. content
1	S	Battery +30	Battery output voltage	6,4 A @ 13.5V
2	S	+5V (ECU)	Accelerator pedal potentiometer 1 power supply	100 mA @ 5 V
3	S	+5V (ECU)	Linear pressure sensor AC and accelerator pedal potentiometer 2 power supply	100 mA @ 5 V
4			Not connected	
5	I		Linear pressure sensor AC	0,01 mA @ 5 V
6			Not connected	
7			Not connected	
8	I		Engine oil level switch (not used)	10 mA @ 12 V
9			Not connected	
10			Not connected	
11			Not connected	
12			Not connected	
13			Not connected	
14			Not connected	
15	S	sig_GND (ECU)	Linear pressure sensor AC and accelerator pedal potentiometer 2 ground	
16	I		Remote-control switch (key +)	5 mA @ 16 V
17	O		Engine management system remote-control switch	400 mA @ 13,5 V
18			Not connected	
19	I/O		D+ signal alternator	24 mA @ 5 V
20			Not connected	
21			Not connected	
22			Not connected	
23			Not connected	
24			Not connected	

Pin	I/O/S	Supply source	Function	Max. content
25			Not connected	
26	I		Reverse gear switch	10 mA @ 13.5 V
27			Not connected	
28			Not connected	
29			Not connected	
30			Not connected	
31			Not connected	
32	I		Clutch pedal switch	10 mA @ 13.5 V
33			Not connected	
34			Not connected	
35	I		Speedometer pulse generator	10 mA @ 5 V
36	I		Engine oil condition sensor	2 mA @ 5 V
37			Not connected	
38	I		Accelerator pedal potentiometer 2 signal	0.01 mA @ 5 V
39	I		Oil temperature sensor	5 mA @ 5 V
40	O		Starting motor remote-control switch	500 mA @ 13.5 V
41			Not connected	
42			Not connected	
43			Not connected	
44			Not connected	
45	S	Sig_GND (ECU)	Accelerator pedal potentiometer 1 ground	
46			Not connected	
47	S	Main relay	Engine management system remote-control switch	6,4 A @ 13.5V
48	S	Main relay	Engine management system remote-control switch	6,4 A @ 13.5V
49	I/O		C-Can L	-
50	I/O		C-Can H	-
51	I		Accelerator pedal potentiometer 1 signal	0.01 mA @ 5 V
52	I		Brake pedal switch warning light	10 mA @ 13.5 V
53			Not connected	

Pin	I/O/S	Supply source	Function	Max. content
54			Not connected	
55	I		Engine oil pressure sensor	4 mA @ 5 V
56	O		Fuel pump remote-control switch	500 mA @ 13.5 V
57			Not connected	
58	O		Engine revs sensor for MTA	40 mA @ 13.5 V
59	O		Engine cooling electric fan 2 remote-control switch	300 mA @ 13.5 V
60			Not connected	
61			Not connected	
62	O		A/C compressor remote-control switch	200 mA @ 13.5 V
63	O		Engine cooling electric fan 1 remote-control switch	200 mA @ 13.5 V
64	O		Malfunction warning light	200 mA @ 13.5 V

Connector B, engine side (Tyco 2-284272-9)

Pin	**I/O/S**	**Supply source**	**Function**	**Max. content**
1	O		Coil 4 control	9 A @ 16 V
2	O		VVT solenoid valve	
3	O		Coil 3 control	9 A @16 V
4	S		Power supply from the main relay for VVT solenoid valve	
5	S	Pow_GND	Engine ground A	
6	S	Pow_GND	Engine ground A	
7	S	sig_GND (ECU)	Phase sensor/air temperature sensor/ atmospheric pressure sensor ground	
8			Not connected	
9	I		Engine revs sensor	10 mA @ 5 V
10			Not connected	
11			Not connected	
12			Not connected	
13	S	+5V (ECU)	Phase sensor/air temperature sensor/ atmospheric pressure sensor power supply	100 mA @ 5 V
14			Not connected	

Pin	I/O/S	Supply source	Function	Max. content
15	S	+5V (ECU)	Throttled body sensor power supply	100 mA @ 5 V
16			Not connected	
17	O		Coil 1 control	9 A @ 16 V
18			Not connected	
19	O		Coil 2 control	9 A @ 16 V
20			Not connected	
21	S	Pow_GND	Engine ground A	
22	S	Pow_GND	Engine ground A	
23	I		Engine revs sensor	10 mA @ 5 V
24	I		Phase sensor	2 mA @ 5 V
25			Not connected	
26			Not connected	
27			Not connected	
28			Not connected	
29			Not connected	
30	I		Sensor 2 throttled body position	0.01 mA @ 16 V
31	I		Intake pipe pressure	0.1 mA @ 5 V
32	O		Oxygen sensor upstream the catalyst	1.4 A @ 16 V
33	O		Cylinder 4 injector	1.2 A @ 16 V
34	O		Cylinder 2 injector	1.2 A @ 16 V
35	S	sig_GND (ECU)	Throttled body sensor ground	
36	S	sig_GND (ECU)	Engine water temperature sensor ground	
37			Not connected	
38			Not connected	
39			Not connected	
40			Not connected	
41	I		Knock sensor	0.01 mA @ 5 V
42	I		Oxygen sensor downstream the catalyst	0.01 mA @ 5 V
43	I		Oxygen sensor upstream the catalyst	0.01 mA @ 5 V
44	I		Sensor 1 throttled body position	0.01 mA @ 16 V
45	I		Engine water temperature sensor	5 mA @ 5 V
46			Not connected	
47			Not connected	

48	S	sig_GND (ECU)	Knock sensor ground	0.01 mA @ 5 V
49	O		Cylinder 3 injector	1.2 A @ 16 V
50	O		Cylinder 1 injector	1.2 A @ 16 V
51	O		Canister solenoid valve	1.2 A @ 16 V
52	O		Throttled body actuator negative	6 A @ 16 V
53			Not connected	
54			Not connected	
55			Not connected	
56			Not connected	
57	O		Throttled body actuator positive	6 A @ 16 V

Pin	I/O/S	Supply source	Function	Max. content
58	S	sig_GND (ECU)	Ground for oxygen sensor downstream the catalyst	0.01 mA @ 5 V
59			Not connected	
60	S	sig_GND (ECU)	Ground for oxygen sensor upstream the catalyst	0.01 mA @ 5 V
61	I		Atmospheric pressure sensor	
62			Not connected	
63	I		Sucked air temperature	2.5 mA @ 5 V
64	O		Oxygen sensor downstream the catalyst	1.4 A @ 16 V

4.3 Components

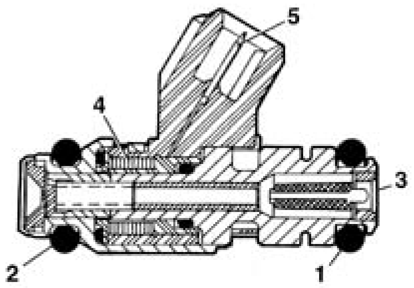
4.3.1 Electric injectors

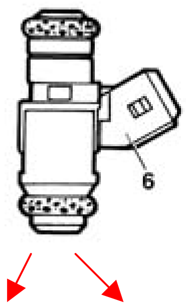
Description

The electric injectors are of the miniature (Pico) type; they are powered with 12 V and feature internal resistance of 13.8 ÷ 15.2 Ω at 20°C.

The injectors are secured by the fuel manifold, which pushes the injectors themselves into their respective seats obtained in the inlet manifold pipes, whereas the fluoridated rubber O-rings (1) and (2) ensure the sealing on the intake manifold and the fuel manifold.

Fuel is fed from the upper part (3) of the electric injector, the body of which includes the winding (4) connected to the terminals (5) of electric connector (6).





Fuel manifold

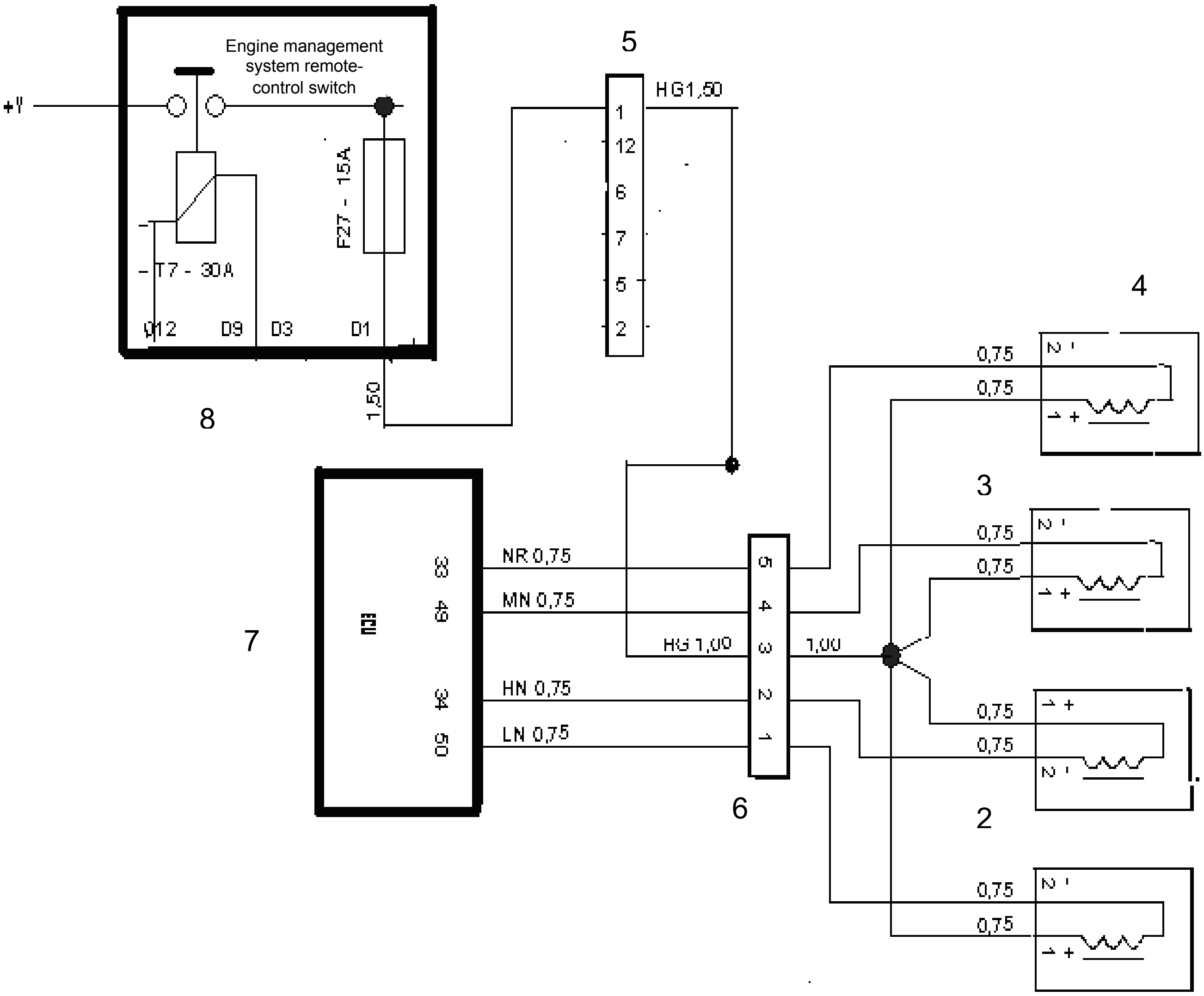
Intake manifold

The fuel jet comes, at the absolute pressure of 3,5 bar, out of the injector and is immediately atomized.

Operation

The injector control logic is of the “phased, sequential” type, i.e. the four injectors are controlled according to the intake phases of every single cylinder.

Electric features



1,2,3,4: Electric injectors

5,6: Junction

7:ECM

8:FDU (Engine management remote-control switch)

Position of injectors on the vehicle

Injector housing on the intake pipe

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin	Receiving item pin	Receiving item pin
Electric injector 1	1	S	Power supply from the battery	3 (junction)	1 (junction)	D1 (FDU)
	2	I	Electric injector 1 control	1 (junction)	50 (ECM connector B)	—

Component	Component connector pin	I/O/S	Function	Receiving item pin	Receiving item pin	Receiving item pin
Electric injector 2	1	S	Power supply from the battery	3 (junction)	1 (junction)	D1 (FDU)
	2	I	Electric injector 2 control	2 (junction)	34 (ECM connector B)	—

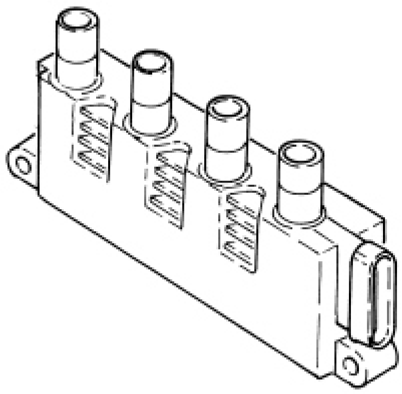
Component	Component connector pin	I/O/S	Function	Receiving item pin	Receiving item pin	Receiving item pin
Electric injector 3	1	S	Power supply from the battery	3 (junction)	1 (junction)	D1 (FDU)
	2	I	Electric injector 3 control	4 (junction)	49 (ECM connector B)	—

Component	Component connector pin	I/O/S	Function	Receiving item pin	Receiving item pin	Receiving item pin
Electric injector 4	1	S	Power supply from the battery	3 (junction)	1 (junction)	D1 (FDU)
	2	I	Electric injector 4 control	5 (junction)	33 (ECM connector B)	—

4.3.2 Ignition coils

Description

The coils are integrated into one single body secured to the engine head. They are of the magnetic closed circuit type, i.e. made up of a plate pack, the core of which (made of silicon steel interrupted by a small gap) carries both windings.

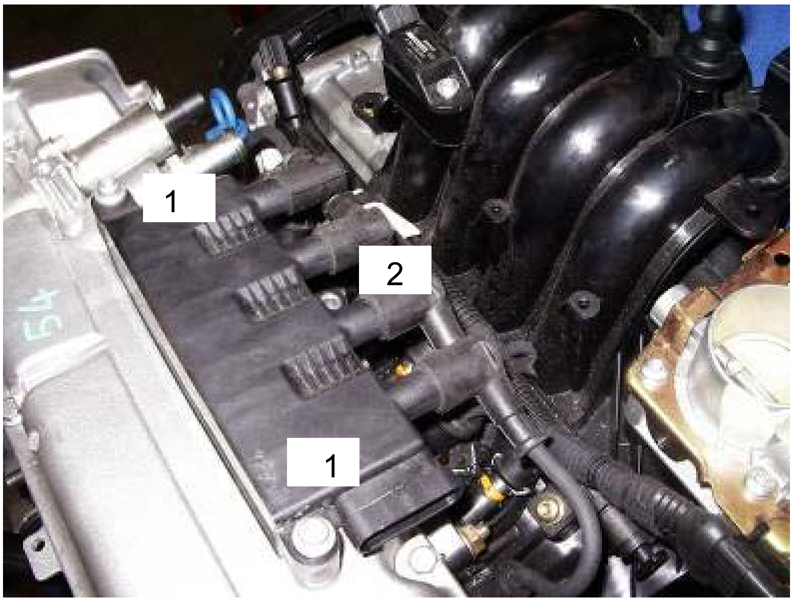


Operation

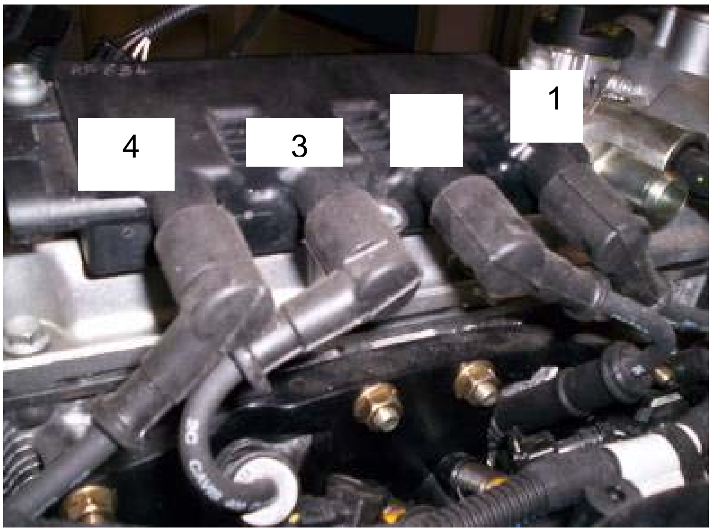
The windings are covered by a stamped plastic container and insulated by being immersed into a epoxy resin and quartz compound that gives them outstanding dielectric, mechanic and thermal properties, since they are able to withstand very high temperatures, too.
The vicinity of the primary to the magnetic core makes it possible to reduce the magnetic flux loss, thus making the most of the coupling on the secondary.

N.B. When the ignition module is being assembled, first tighten the two screws located outside, and then tighten the central screws to the specified torque value. Otherwise, the module might be broken.

Position of components



1,1,2: Tightening order for the ignition module fastening screws

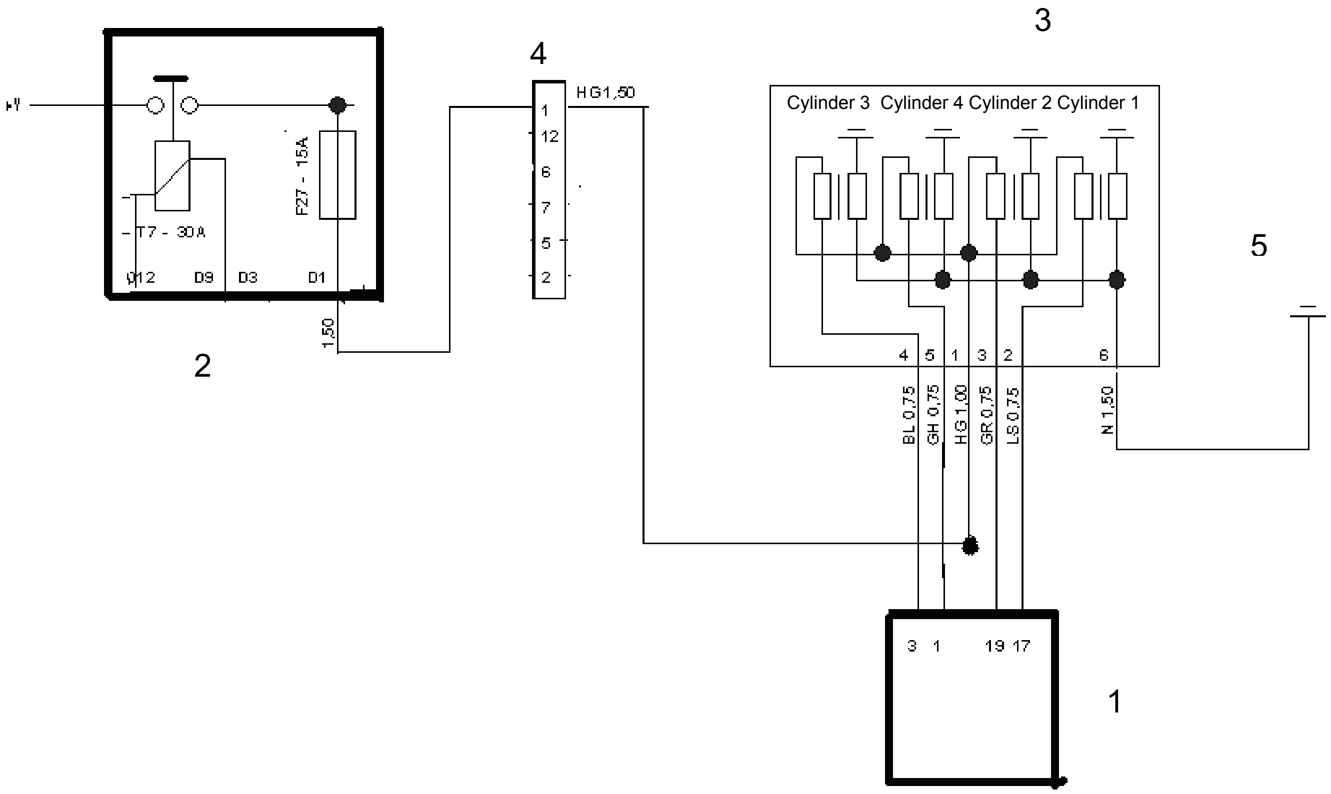


1,2,3,4: Spark plug outlets

Electric features

Primary circuit resistance: 0.5 Ω ± 10% at 23 ± 3°C

Secondary circuit resistance: 6.0 kΩ ± 10% at 23 ± 3°C.



1: ECM

2: FDU (engine management remote-control switch)

3: Ignition module

4: Junction

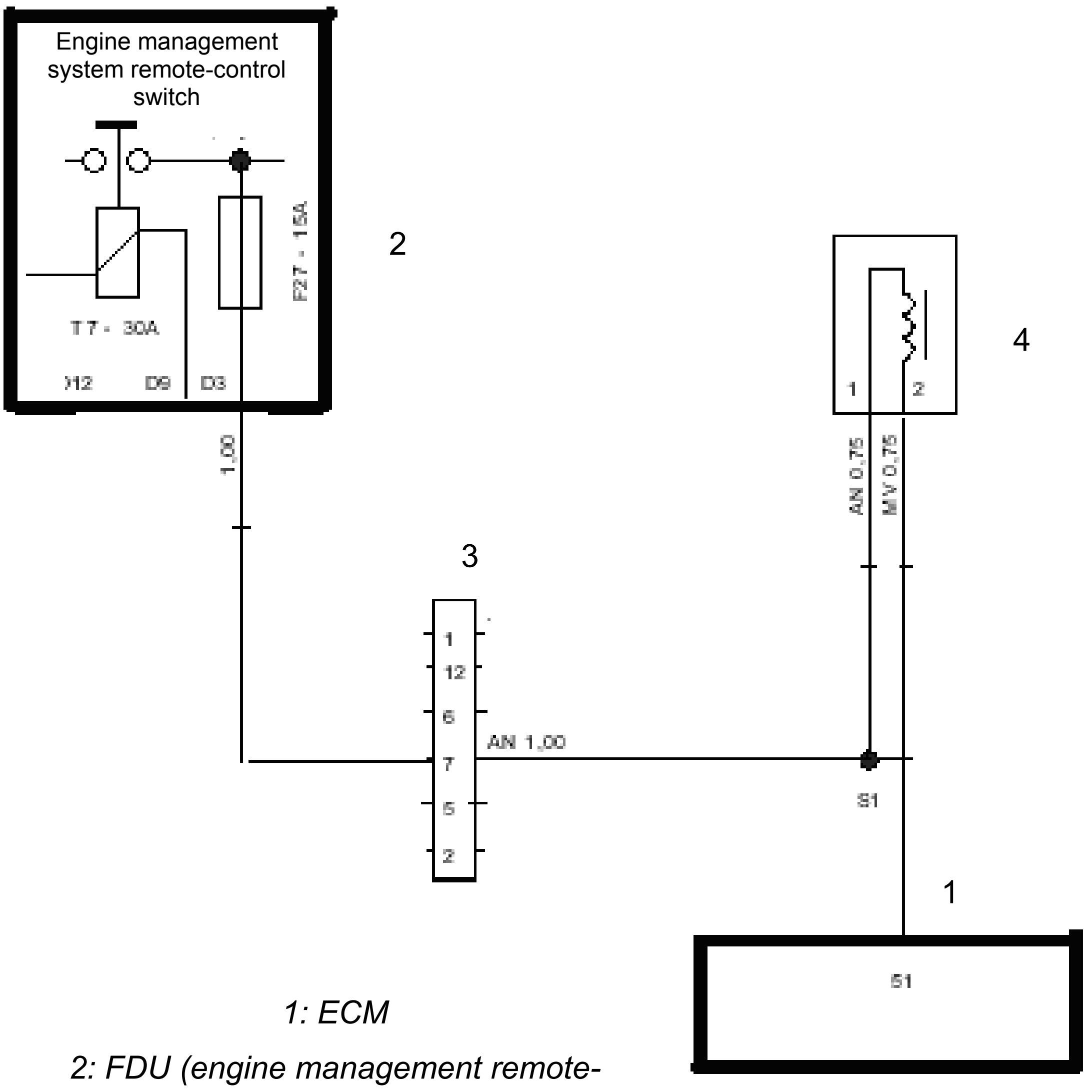
5: Engine ground B

Pin-out

Component	**Component connector pin**	**I/O/S**	**Function**	**Receiving item pin**	**Remarks**
Coils	1	S	Power supply from the main relay	1 (JUNCTION)	The wires reaches FDU until pin D1
	2	I	Cylinder 1 ignition control	17 (ECM connector B)	—
	3	I	Cylinder 2 ignition control	19 (ECM connector B)	—
	4	I	Cylinder 3 ignition control	3 (ECM connector B)	—
	5	I	Cylinder 4 ignition control	1 (ECM connector B)	—
	6	S	Engine ground	Engine ground B	—

4.3.3 Petrol vapour recovery solenoid valve (canister)

Electric features



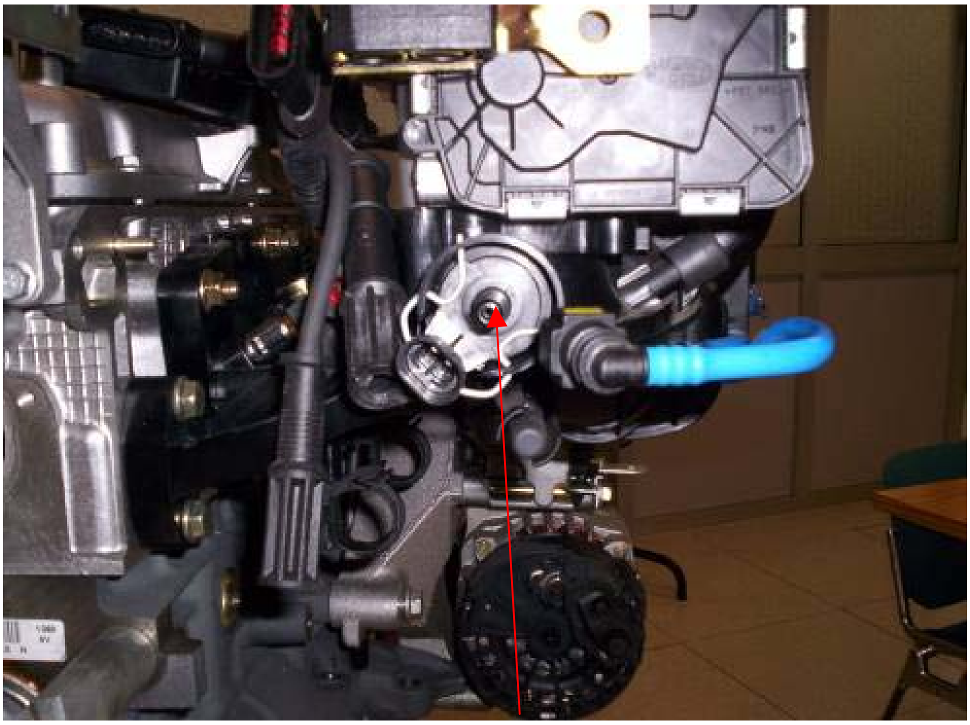
1: ECM

2: FDU (engine management remote-control switch)

3: Junction

4: Canister solenoid valve

Position of components on the vehicle



Canister

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin	Remarks
Petrol vapour recovery solenoid valve	1	S	Power supply from the battery	7 (junction)	The wire reaches FDU until pin D3
	2	I	Canister valve control	51 (ECM connector B)	—

4.3.4 Throttled body

Description

The throttled body is secured to the inlet manifold and controls the amount of air sucked by the engine.
The injection control unit controls, depending on the signal from the accelerator pedal potentiometer, the opening of the throttle by means of a direct-current motor integrated into the throttled body.

Operation

The opening of the throttle takes place from 0° to 82°, thus including the idling speed control.
The throttled body is equipped with two integrated potentiometers, so that the injection control unit knows when either of them is broken.
In the event that both potentiometers are broken, or if the power supply is missing, the control unit will, depending on the accelerator pedal position, perform a recovery strategy, with resulting degraded operation (which will be perceived by the driver), and disables EOBD diagnosis.
The replacement of the throttled body or injection control unit or air intake manifold does not ask for the execution of the self-learning procedure.

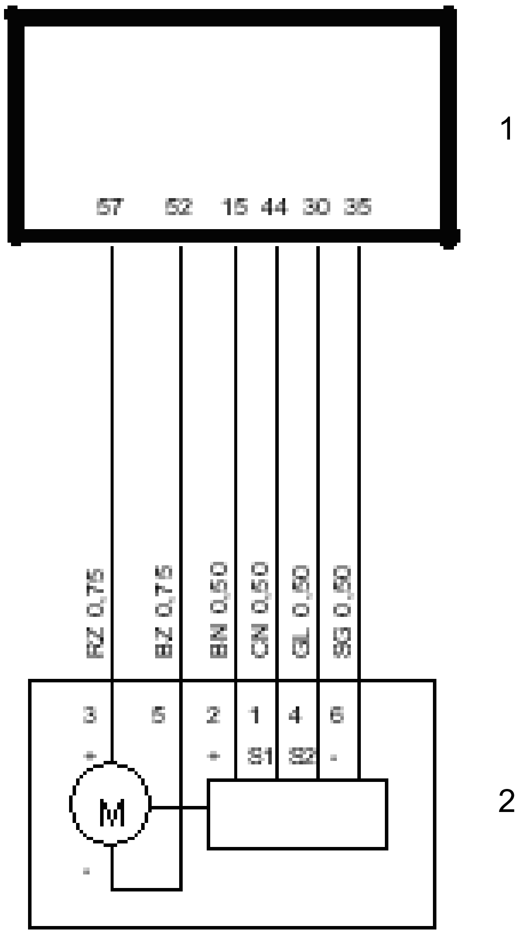
Position on the vehicle

Throttle

Potentiometers

Motor

Electric features



1: ECM

2: Throttle actuator

Pin-out

Component	**Component connector pin**	**I/O/S**	**Function**	**Receiving item pin**
Throttled body	1	O	Potentiometer 1 position	44 (ECM connector B)
	2	S	Power supply from the ECU	15 (ECM connector B)
	3	I	Throttle motor positive	57 (ECM connector B)
	4	O	Potentiometer 2 position	30 (ECM connector B)
	5	I	Throttle motor negative	52 (ECM connector B)
	6	S	Ground from the ECU	35 (ECM connector B)

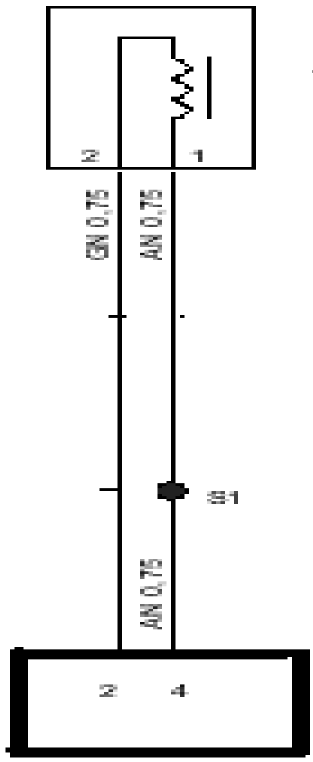
Recovery

In case of failure, a value is set, which is calculated starting from the values read by the absolute pressure sensor: if the latter is broken, a fixed value equal to 50° throttle opening will be set.

The dash-pot and mixture ratio/idling speed self-adapting strategies will be blocked.

4.3.5 Hydraulic valve for camshaft phase control

Electric features



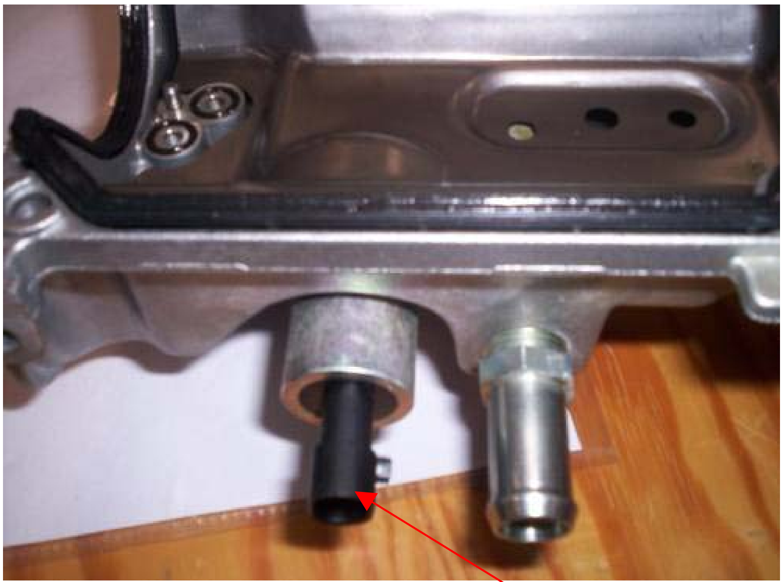
1

2

1: Camshaft phase control valve

2: ECM

Position on the vehicle



Phase control valve

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin
Valve	1	S	Power supply form the main relay	4 (ECM connector B)
	2	S	Ground from the ECU	2 (ECM connector B)

Recovery

In the event that the phase variator has got stuck in a position (max. advance, max. delay, or an intermediate position) due to a mechanic fault to the variator or short-circuit to the variator drive solenoid valve, the solenoid valve will not be controlled by the ECM any longer.
In the event that the variator is slow, the ECM will control the solenoid valve so as to hold the variator in a max. advance position (rest position).

4.3.6 Head

The aluminium head is characterized by a peculiar shape (see Figure “A”) that makes it possible to obtain a variable-turbulence combustion chamber. This feature, combined with the new intake and exhaust pipes and optimized valve gear timing, ensure bright performance, low fuel consumption and emission levels. Moreover, this system makes it possible to recirculate a considerable amount (approximately 25%) of the exhaust gas in the combustion chamber.

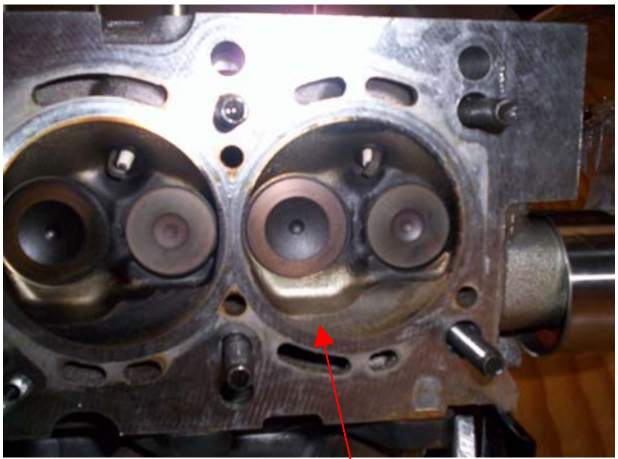
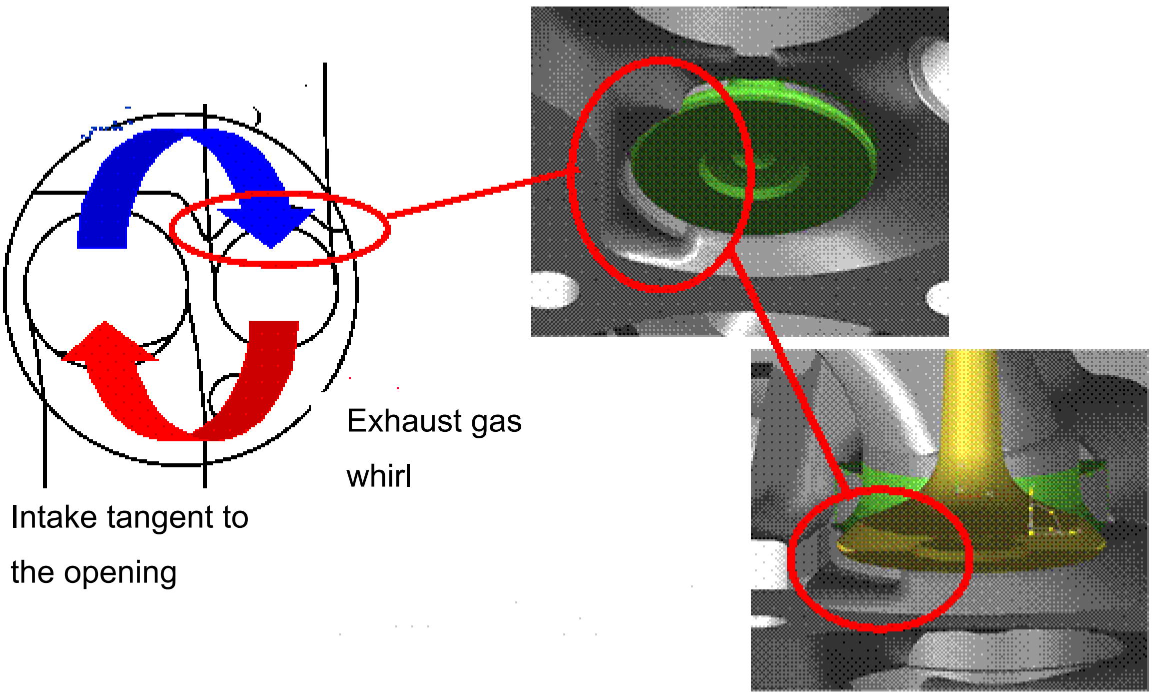


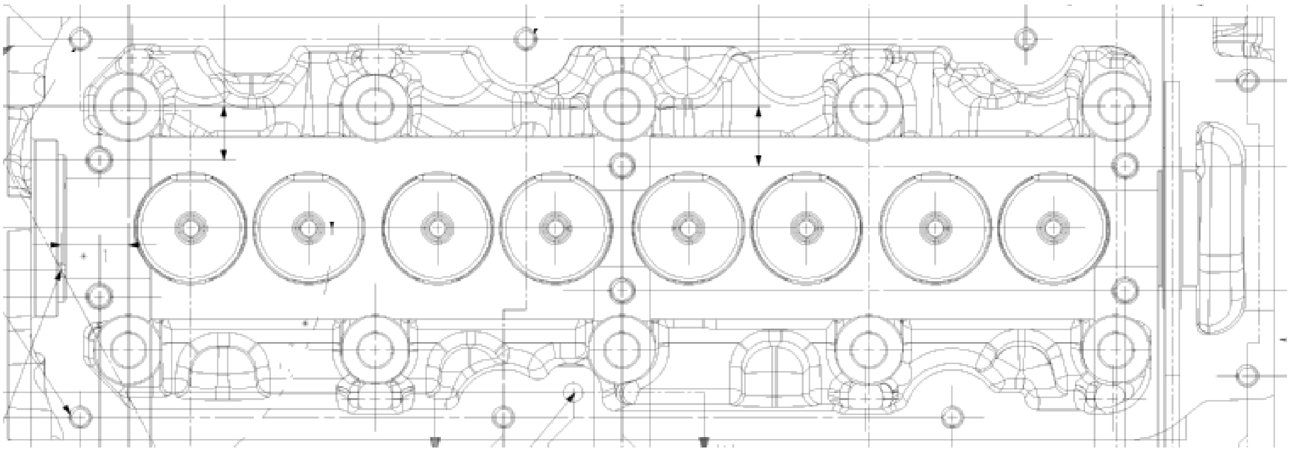
Figure “A”

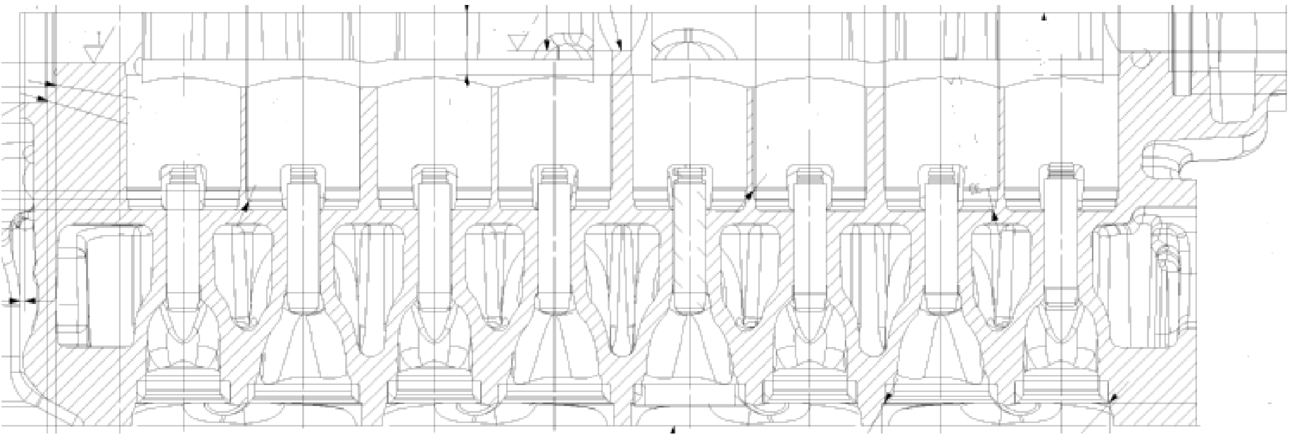
Exhaust gas masking



Variable-turbulence system

Technical drawing

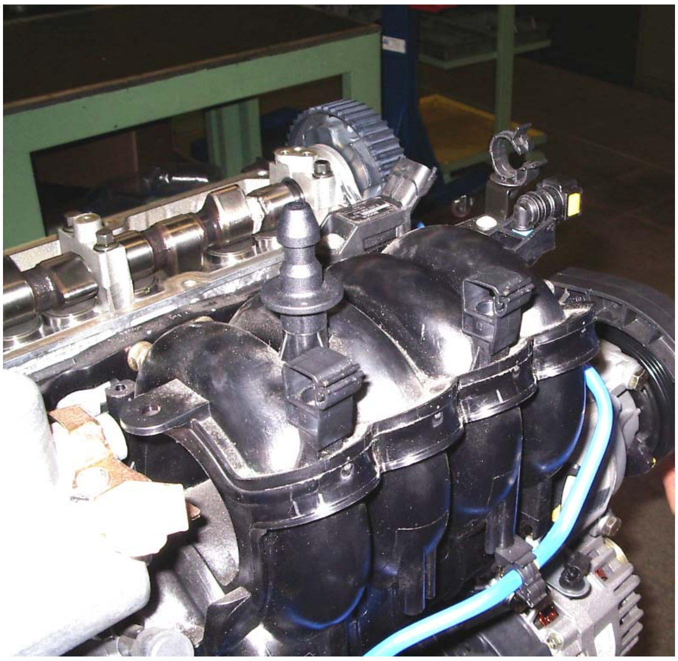




4.3.7 Pistons

4.3.8 Inlet manifold

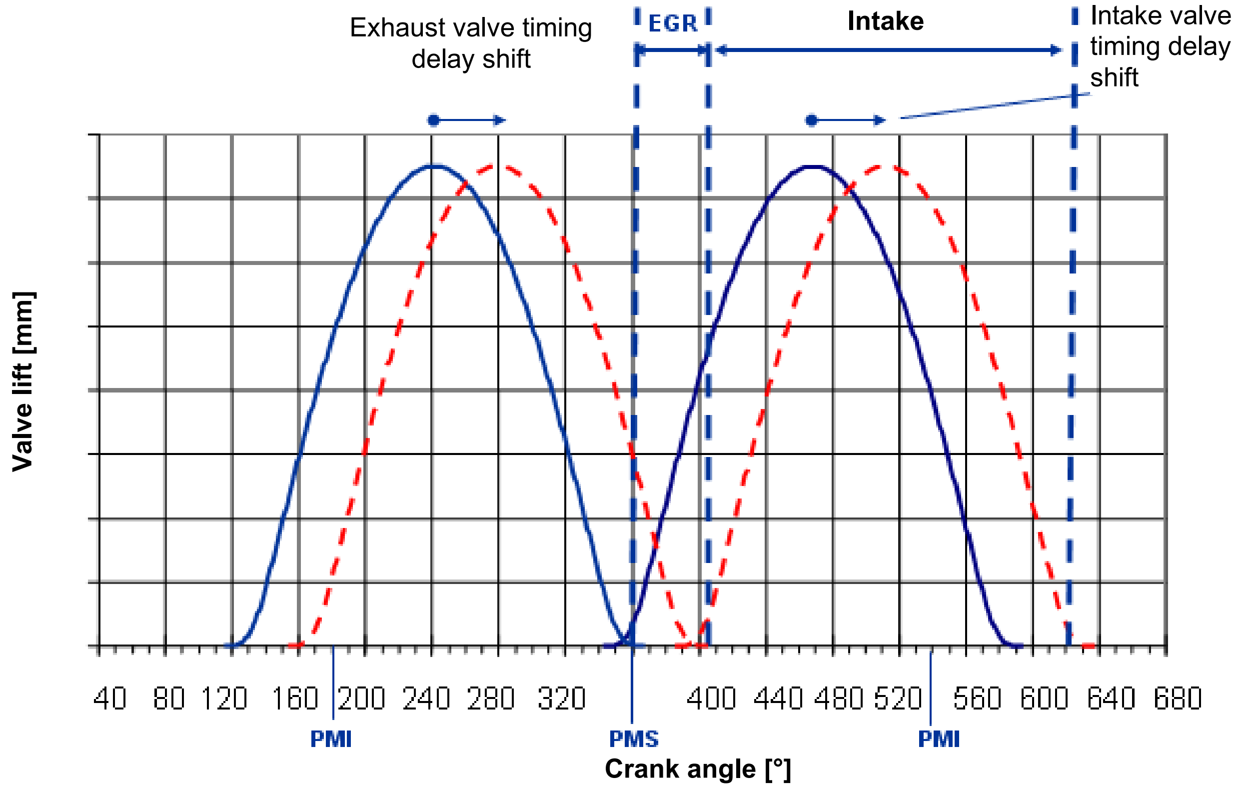
Newer inlet manifold.



4.3.9 CVCP continuous phase variator

The Fire 1.4 8V engine is equipped with a continuous phase variator (*Continuos Variable Cam Phaser*), i.e. a device capable of continuously modifying, during operation, the position of the camshaft with respect to the drive shaft, thus obtaining an engine timing variation.
Thus, the engine will at any instant be operating with optimum timing in terms of fuel consumption.
An approximate 5% reduction of consumption over the NEDC cycle is achieved.

The phase variator modifies the engine timing in the delay direction.
By delaying the intake valve opening and the exhaust valve closing, a portion of the intake stroke (the greater the phase variator stepping, the greater such portion) will take place with the intake valve closed and the exhaust valve still open, whereby a portion of the burnt gas will be sucked by the exhaust (EGR). Such gas will take the place of a portion of the cylinder volume (less displacement). In order to let the same amount of fresh air in, and achieve the same engine performance (i.e. the same torque/power) at that operation point, the throttle will have to be opened further. The engine operation (performance being equal) with the throttle opened to a larger extent will reduce the pumping loss that occurs during the charge replacement phase (exhaust/intake phases); thus, consumption will be reduced significantly.



Description

The CVCP is fully managed by the engine management control unit (ECM) which:

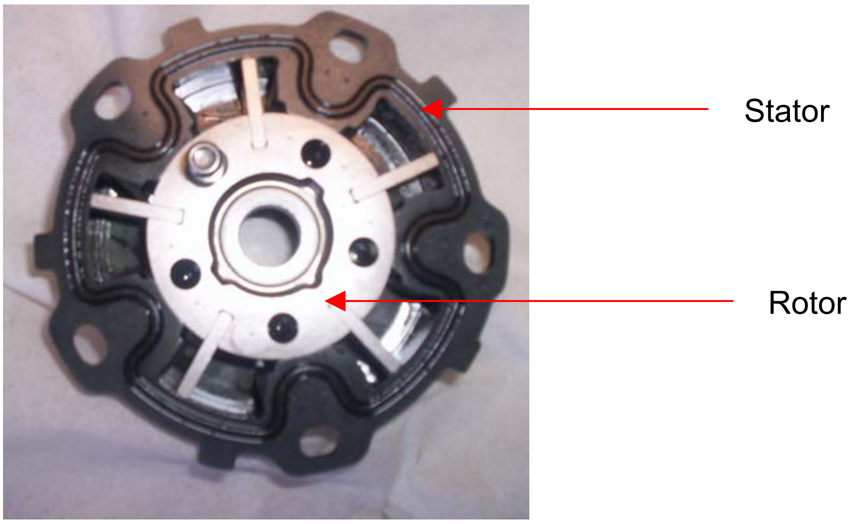
Identifies the camshaft position through the phase sensor;

modifies this position based on the engine operation point, according to a calibrated map;

keeps the camshaft position under control.

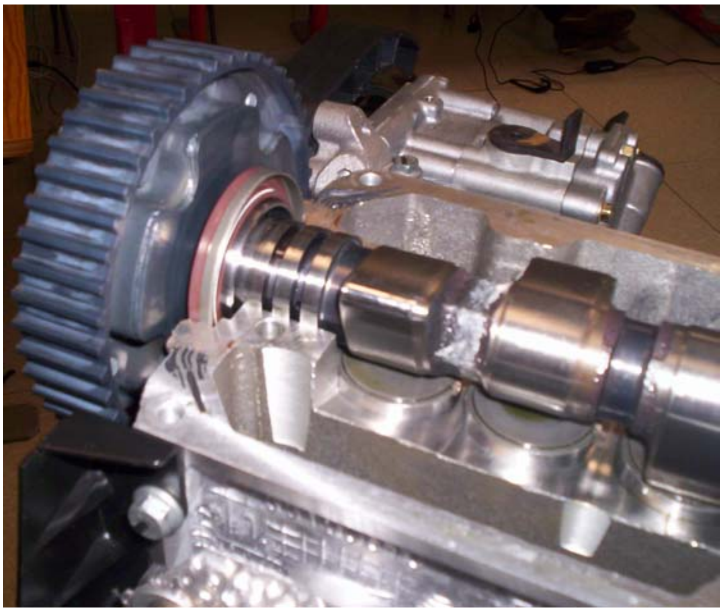
The CVCP is made up of:

a rotor integral to the camshaft that can rotate with respect to the pulley (stator) set moving by the drive shaft;

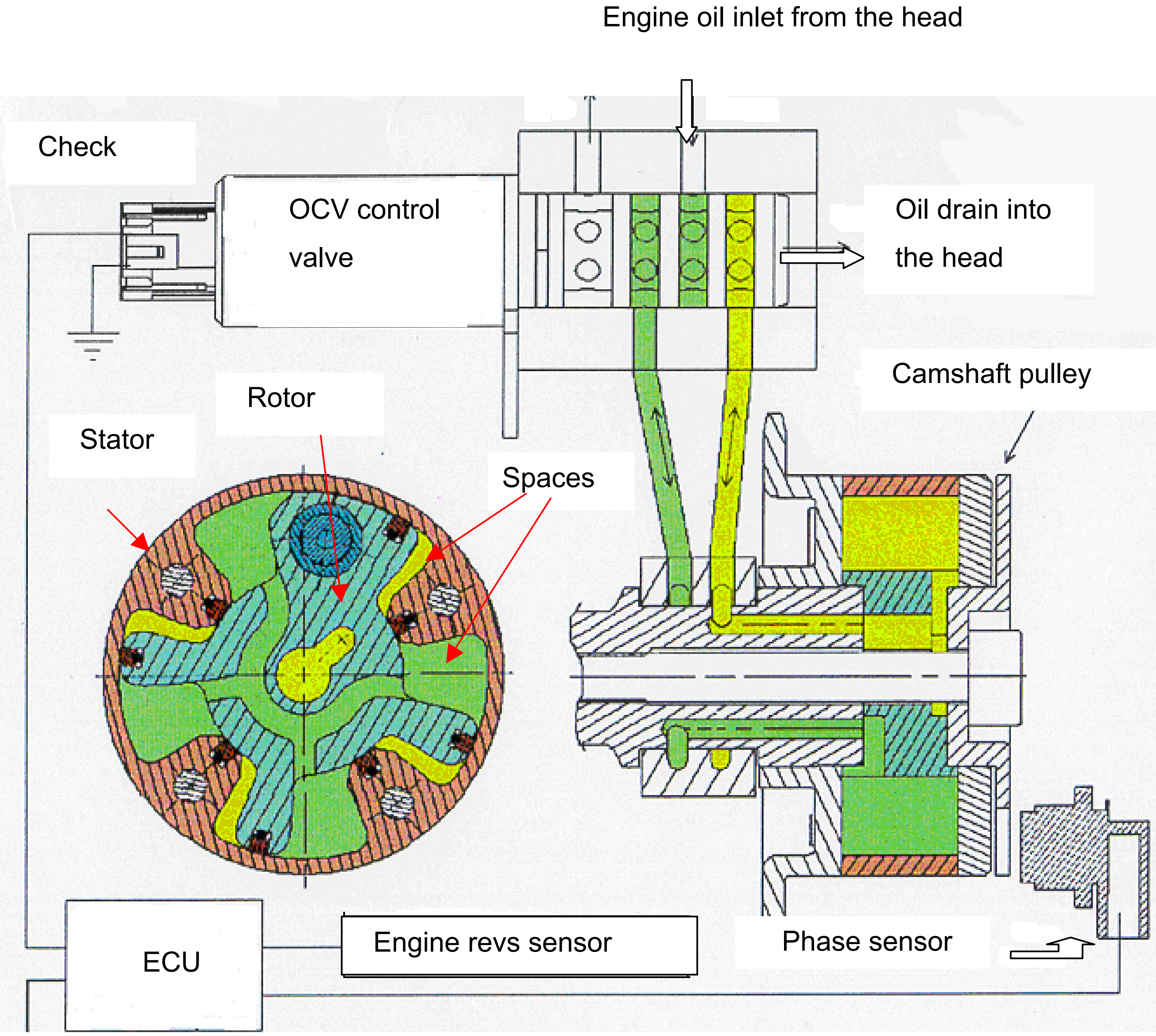


a box solenoid valve that allows oil to flow into the openings, by making the advance or delay openings to be connected with the oil channels in the engine head.

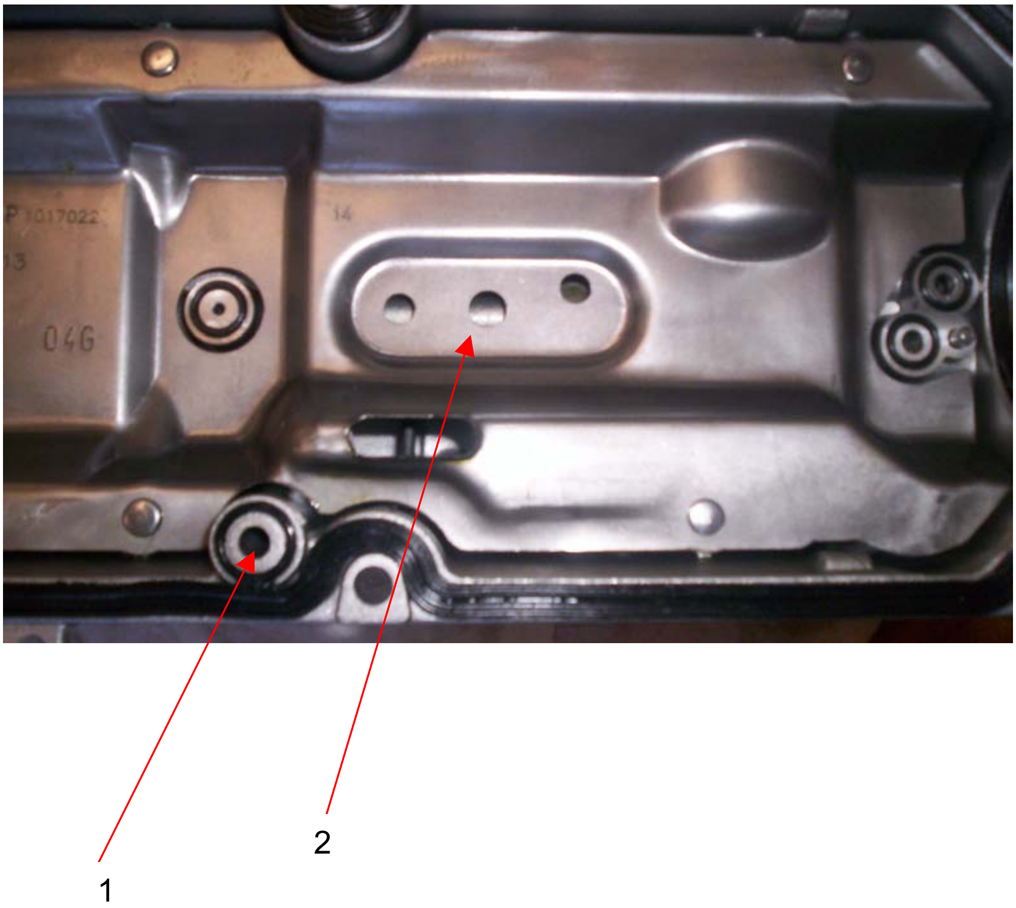
Position on the vehicle



Operation


Engine oil inlet from the head
Check
OCV control valve
Oil drain into the head
Camshaft pulley
Rotor
Stator
Spaces
ECU
Engine revs sensor
Phase sensor

The engine oil flows into the tappet cover at point 1 and then into the channel to the right (2).



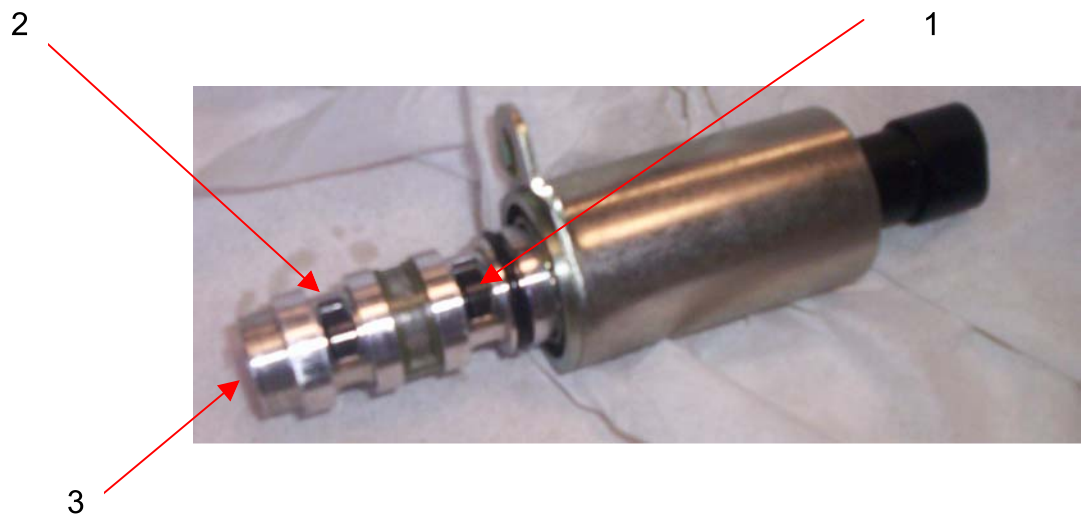
The engine oil reaches the box valve seat through a hole (flywheel side) in the tappet cover (1).

The oil flows into the valve through a filter (2).

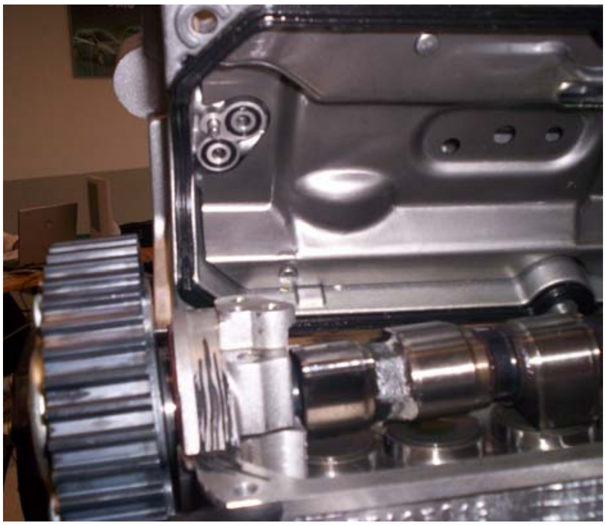
1

2

The box solenoid valve makes the rotor advance or delay openings to communicate with the oil channels in the engine head through two holes (1, 2). A hole conveys the pressure oil to set the rotor blade moving, whereas the other is made to communicate with the drain (3) by the solenoid valve. Therefore, each of holes 1 and 2 (1, 2) will always act an in inlet (in the direction of the variator) and an outlet (in the direction of the head, respectively, depending on whether the phase is to be delayed or advanced by the engine control unit.

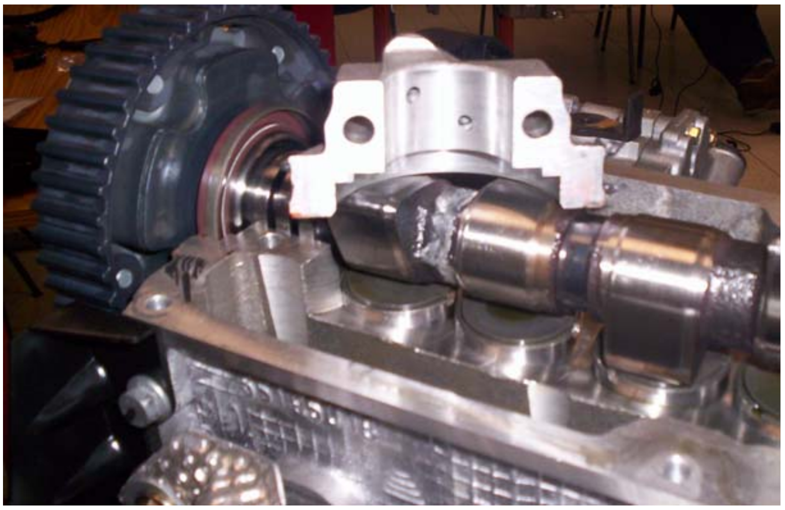


The following figures (a, b, c, d) illustrate the section that makes the solenoid valve and the phase variator to communicate with each other.



a

b



c

d

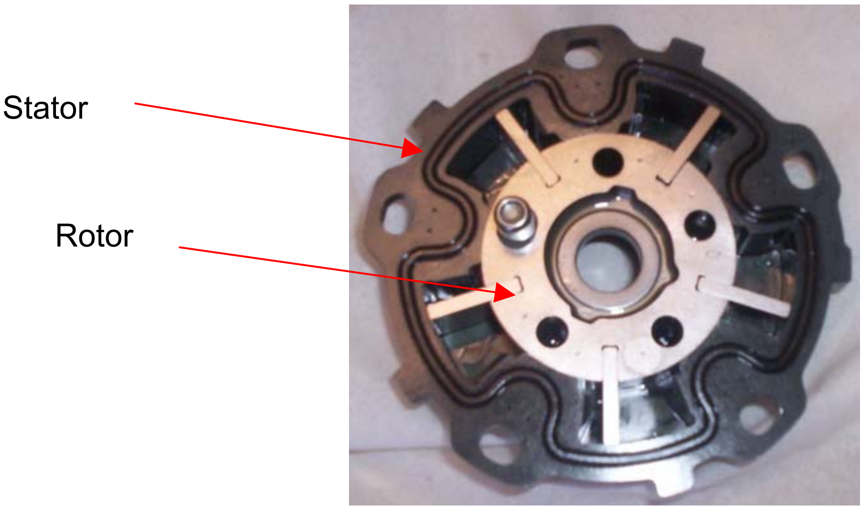
As we have said above, the phase variator is made up of a rotor and a stator. The rotor is equipped with blades and moves due to the effect of the engine oil pressure in the blades themselves. Two openings (advance and delay openings) are obtained at the sides of each of the blades: the engine oil may flow into either opening.

The pressure of the oil flowing into an opening pushes the blade on one side, whereas the oil found in the other opening is drained into the engine head through the solenoid valve (as we have said above, one of the holes on the solenoid valve is made to communicate with the drain by the solenoid valve itself). Thus, the rotor – and, therefore, the camshaft – is made to rotate in one given direction (advance or delay).

If the oil flows into both openings alternately and continuously for an equal time period, dynamic pressure balance will be achieved at the two rotor sides: as a result, the rotor will be stationary.

The advance position corresponds to the rest position: in fact, the spring that acts as a flexible coupling (i.e. prevents the camshaft play from occurring especially when the vehicle is started, due to poor oil pressure) is loaded to the advance position.

Spring


Stator
Rotor

Blades on the rotor

Effects of delay timing variation

4.4 Sensors

4.4.1 Knock sensor

Description

The piezoelectric knock sensor is fitted to the engine base and measures the intensity of the vibrations caused by the knock in the combustion chamber.

The knocks generate a mechanic rebound on a piezoelectric crystal that sends a signal to the control unit: the engine control unit will, based on this signal, reduce the ignition advance until the phenomenon disappears. Next, the advance is gradually restored to the base values.

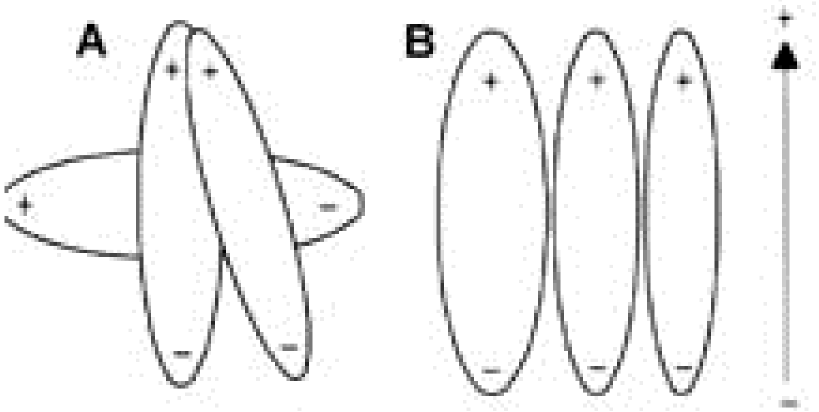
Position on the vehicle

1: phase sensor

1

Operation

The molecules of a quartz crystal are characterized by electric polarization.
In rest conditions (A), the molecules doe not feature a peculiar orientation.
When the crystal is subjected to pressure or a collision (B), the molecules orient themselves: the higher the pressure to which the crystal is subjected (quartz characteristic), the more pronounced the molecule orientation.
Such orientation generates a voltage at the crystal ends. Therefore, such voltage is the result of the vibrations generated by the burst in the various cylinders.
The reference wave amplitudes are mapped in the engine control unit (with correct engine operation).
The engine control unit interprets the wave amplitudes differing from the reference ones as failed ignition; therefore, it will actuate an emergency program.



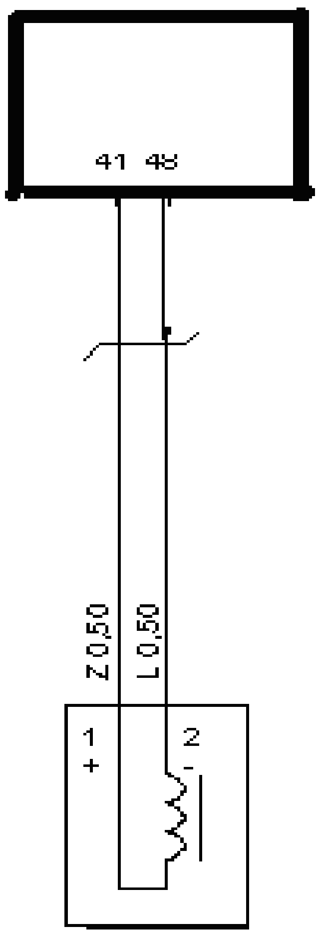
A. Rest position

B. Position under pressure

Electric features

- resistance: 532÷588 Ω at 20°C.

1



2

1: ECM

2: Knock sensor

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin
Knock sensor	1	O	Knock sensor signal	41 (ECM connector B)
	2	S	Ground from the ECU	48 (ECM connector B)

Recovery

In case of sensor failure, the engine management control unit actuates more conservative ignition advance “maps” in order to protect the engine.

4.4.2 Oxygen sensor

Description

Two oxygen sensors are available: one upstream and one downstream the catalyst.

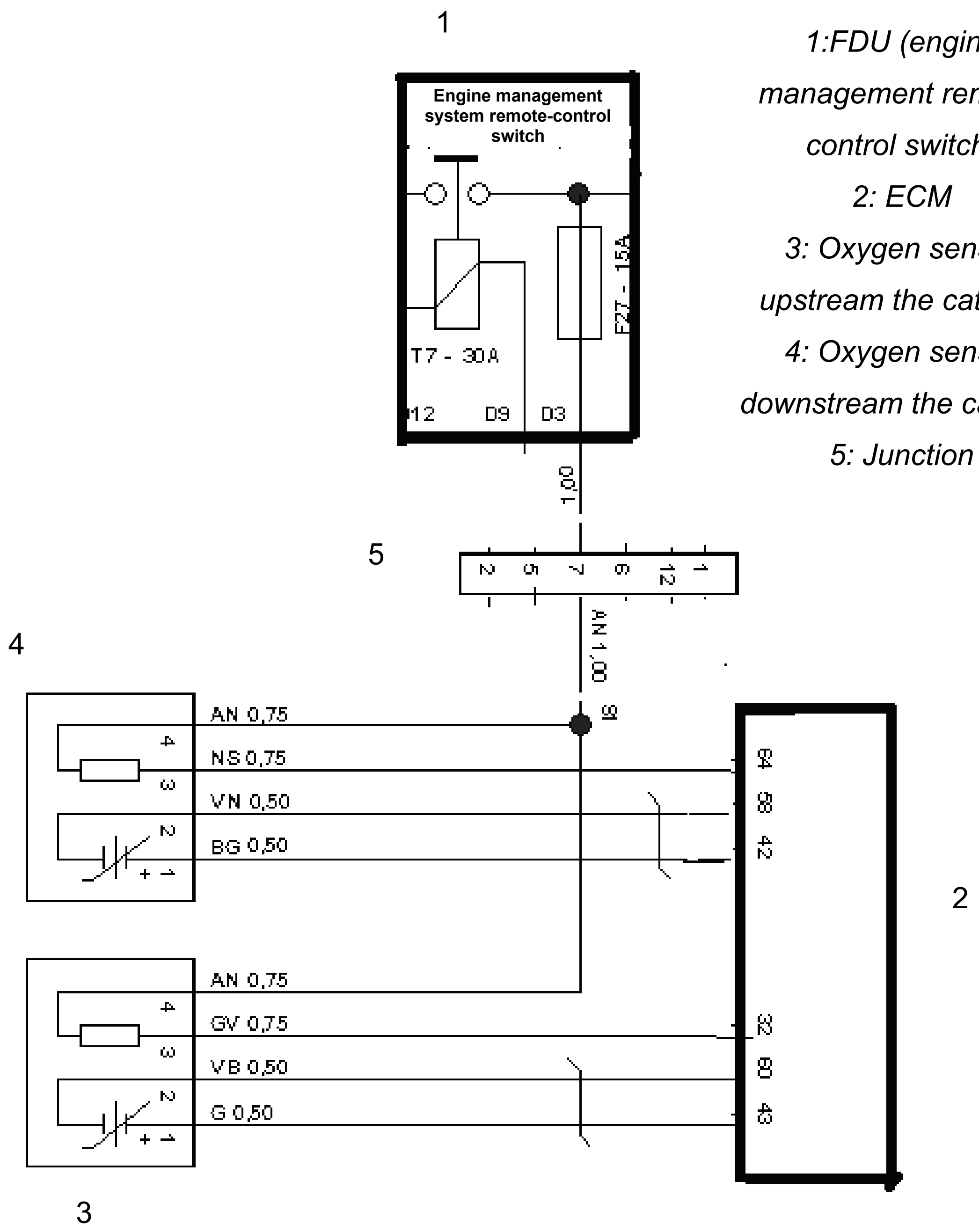
The oxygen sensor upstream the catalyst is used to check the combustion result. The control unit analyzes its signal and corrects the stoichiometric ratio so as to always keep combustion within the limits necessary for emissions.
The oxygen sensor downstream the catalyst is used to check the actual efficiency of the catalyst: the control unit analyzes its signal and informs you of catalyst deterioration through the MIL warning light.

Position on the vehicle

1: oxygen sensor upstream the catalyst

2: oxygen sensor downstream the catalyst

Electric features



1:FDU (engine management remote-control switch)

2: ECM

3: Oxygen sensor upstream the catalyst

4: Oxygen sensor downstream the catalyst

5: Junction

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin	Remarks
Oxygen sensor upstream the catalyst	1	O	Oxygen sensor signal	43 (ECM connector B)	—
	2	S	Ground from the ECU	60 (ECM connector B)	—
	3	I	Oxygen sensor heating control	32 (ECM connector B)	—
	4	S	Power supply from the battery	7 (Junction)	The wire reaches FDU until pin D3

Component	Component connector pin	I/O/S	Function	Receiving item pin	Remarks
Oxygen sensor downstream the catalyst	1	O	Oxygen sensor signal	42 (ECM connector B)	—
	2	S	Ground from the ECU	58 (ECM connector B)	—
	3	I	Oxygen sensor heating control	64 (ECM connector B)	—
	4	S	Power supply from the battery	7 (Junction)	The wire reaches FDU until pin D3

4.4.3 Engine revs number sensor

Description:

It is fitted to the engine base and “overlooks” the phonic wheel positioned on the drive shaft pulley.
It is of the inductive type, i.e. it works through the magnetic field variation generated by the passage of the phonic wheel teeth (60-2 teeth).

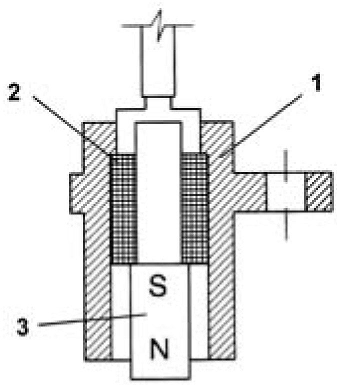
The injection control unit uses the revs sensor signal to:

determine the rotation speed;

determine the angular position of the drive shaft.

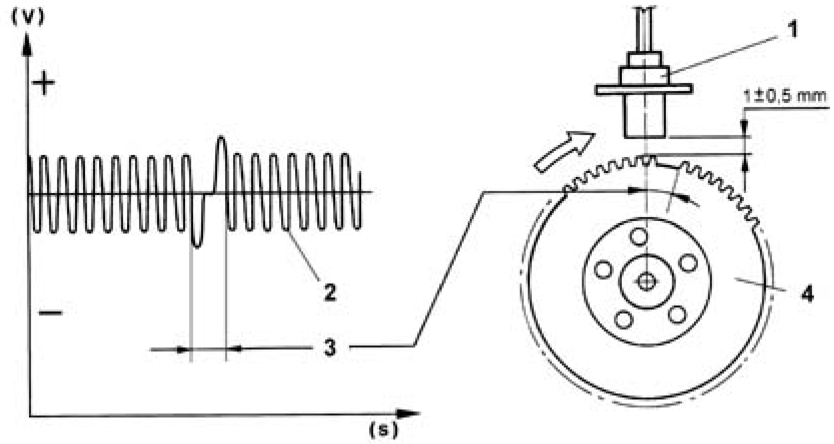
Operation

The sensor is made up of a tubular casing (1) which incorporates a permanent magnet (3) and an electric winding (2).



The magnetic flux created by the magnet (3) undergoes, due to the passage of the phonic wheel teeth, oscillations resulting from the gap variation.

These oscillations induce an electromotive force in the winding (2): an alternately positive (tooth facing the sensor) and negative (slot facing the sensor) voltage is found at the winding ends.



1. Sensor

2. Output signal

3. Signal corresponding to the two missing teeth

4. Drive shaft pulley with phonic wheel

The sensor output voltage peak value depends, other factors being equal, on the distance between the sensor and the tooth (gap).

Sixty teeth are obtained on the phonic wheel; two of these teeth are removed so as to make a reference: the wheelbase will therefore correspond to an angle of 6° (360° divided by 60 teeth).

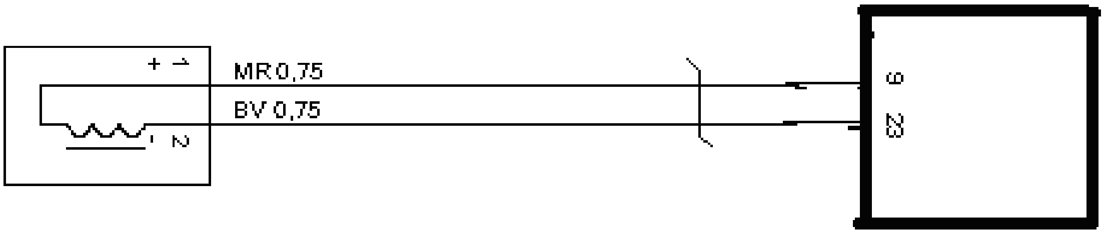
The synchronism point is recognized at the end of the first tooth following the space of two missing teeth: when the latter passes below sensor, the engine's piston pair 1-4 will be found at 114° before the T.D.C.

Electric features

resistance = 1134 ÷ 1386 Ω at 20°C.

The distance (gap), required to obtain correct signals, between the sensor end and the phonic wheel shall be in the range of 0.5 to 1.5 mm.

2



1

1: Revs sensor

Engine pulley

The engine revs sensor seat has no adjustments; therefore, the sensor assembling poses no problem.

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin
Engine revs number sensor	1	O	Engine revs signal A	9 (ECM connector B)
	2	O	Engine revs signal B	23 (ECM connector B)

4.4.4 Phase sensor

Description

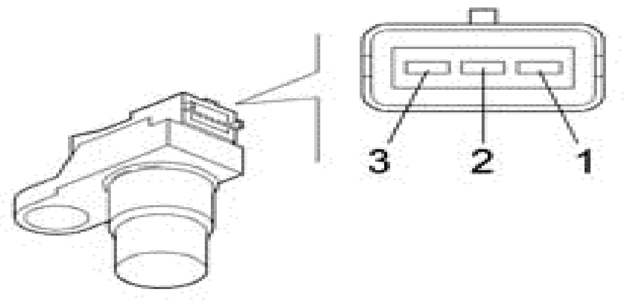
The sensor is of the “Hall-effect” type. A semiconductor layer, through which current flows, immersed into a standard magnetic field, generates a potential difference (known as “Hall” voltage) at its ends.

1: Phase sensor

Operation

The pulley on the cam axle is made up of 4 projections. During the pulley rotation, the distance between the pulley and the phase sensor varies, and a low voltage signal is generated at each projection.
Conversely, when these projections are not found, the sensor will generate a higher voltage signal.
It follows that the high signal alternates with the low signal four times every single engine cycle.
This signal, together with the T.D.C. and revs signal, allows the control unit to recognize the cylinders and determine the injection and ignition point.

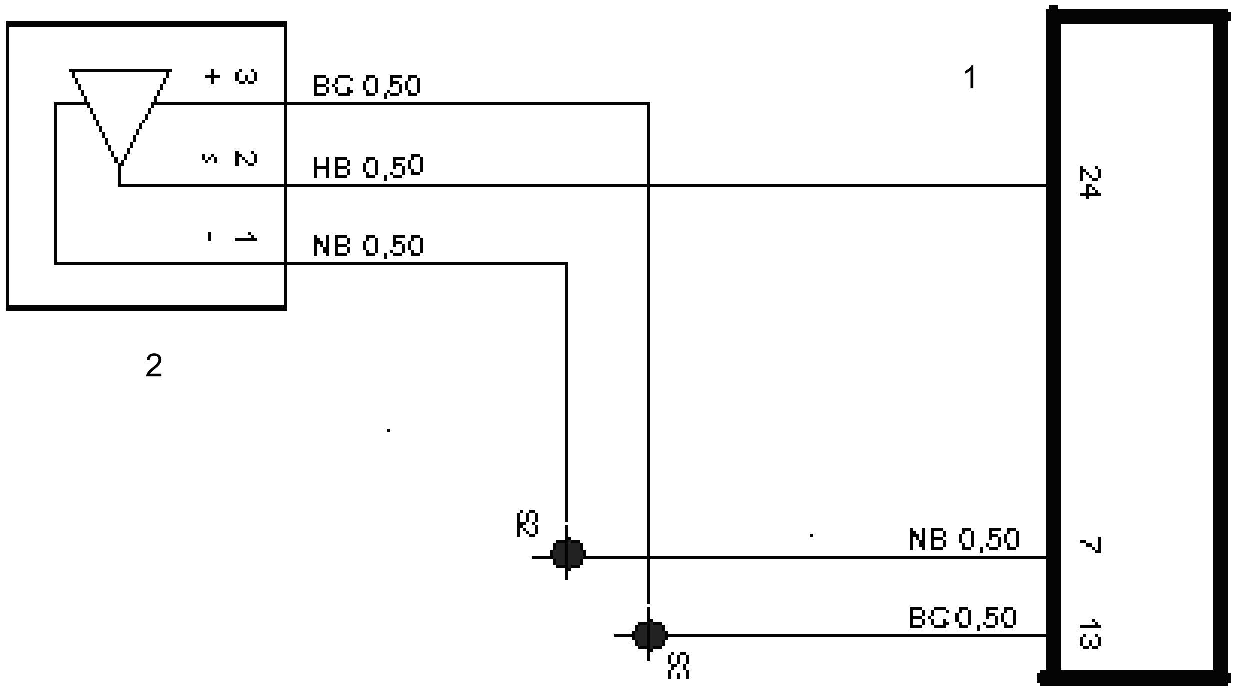
Electric features



1: Ground

2: Output or signal

3: Supply voltage



1: ECM

2: Phase sensor

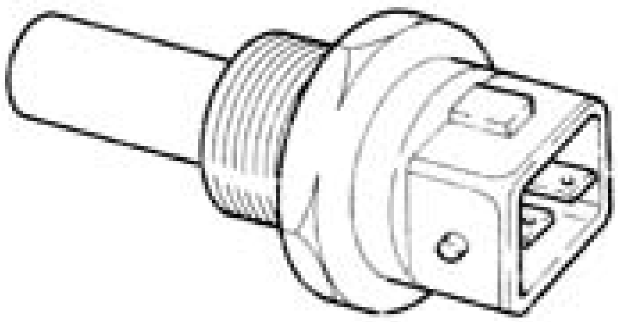
Pin-out

Component	**Component connector pin**	**I/O/S**	**Function**	**Receiving item pin**
Phase sensor	1	S	Ground from the ECU	7 (ECM connector B)
	2	O	Phase sensor signal	24 (ECM connector B)
	3	S	Power supply from the ECU	13 (ECM connector B)

4.4.5 Engine coolant temperature sensor

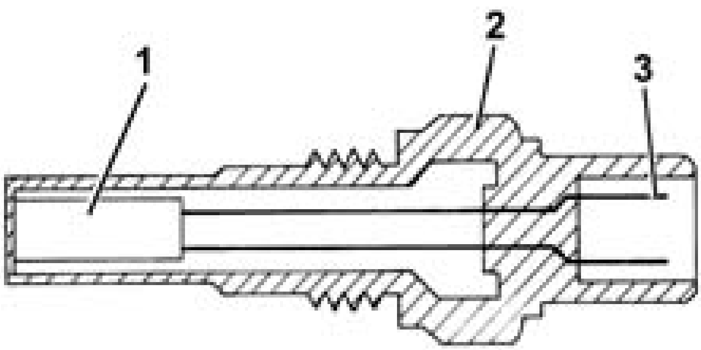
Description

It is fitted to the thermostatic unit and measures the water temperature by means of a NTC sensor with negative resistance coefficient.



Construction

The figure below illustrates the sensor construction.



1: NTC resistor

2: Sensor body

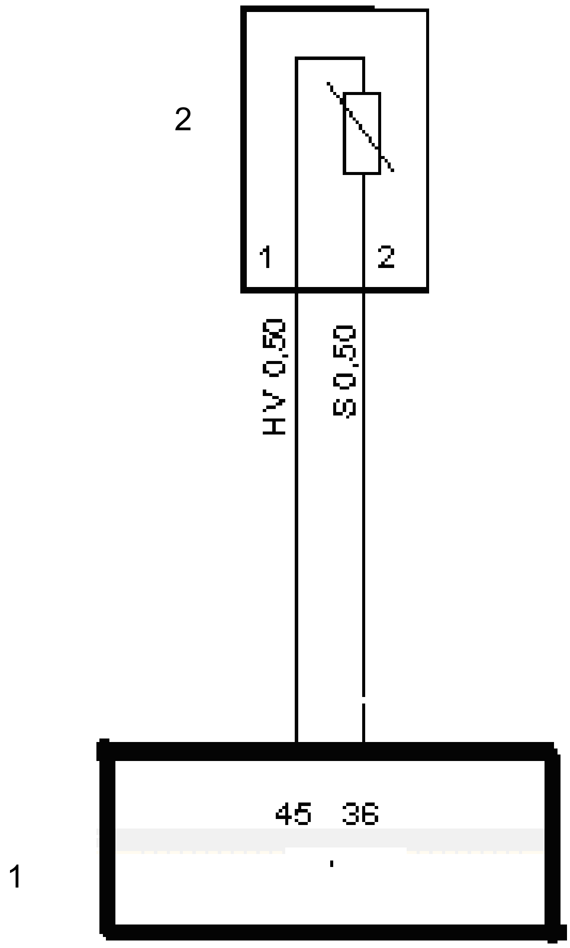
3: Electric connector

Operation

The reference voltage for the injection system NTC element is 5 V. Since the input circuit in the control unit has been designed as a voltage divider, such voltage is distributed between a resistor available in the control unit and the sensor's NTC resistor.
It follows that the control unit is capable of evaluating the sensor resistance variations through the voltage variations, and thus obtaining the temperature piece of information.

°C	Ω
-20	15971
-10	9620
0	5975
10	3816
20	2502
25	2044
30	1679
40	1152
50	807
60	576
70	418
80	309
90	231
100	176

Electric features



1: ECM

2: Engine water temperature sensor

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin
Engine water temperature sensor	1	O	Engine temperature signal	45 (ECM connector B)
	2	S	Ground from the ECU	36 (ECM connector B)

Recovery

Coolant temperature sensor.
In case of failure, the ECU cuts out the idling mixture ratio self-adaptation.
It sets the latest measured temperature value; in the event that it does not correspond with the running speed one, the ECU will increase it gradually depending on the time since the engine start, until a temperature of 80 °C is reached.
The radiator cooling fan is actuated.

4.4.6 Sucked air pressure and temperature sensor

Description

The sucked air pressure and temperature sensor is an integrated component used to measure the pressure and temperature of the air inside the inlet manifold.
Both of the above pieces of information are used by the injection control unit to define the amount of air sucked by the engine: the latter piece of information is subsequently used to calculate the injection time and the ignition point. The sensor is fitted to the inlet manifold.

Position on the vehicle

Sucked air pressure and temperature sensor

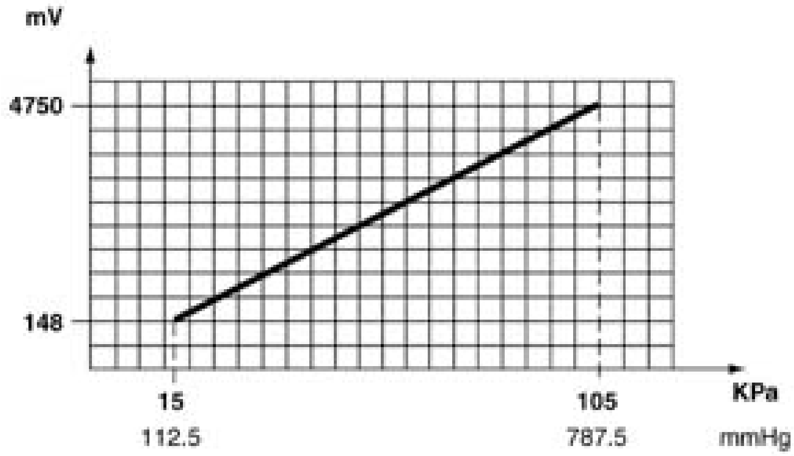
Operation

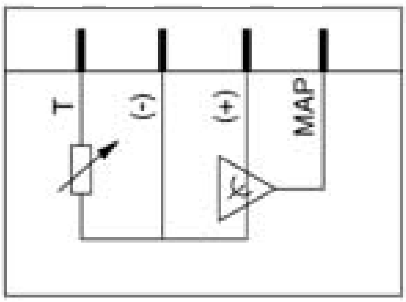
The air temperature sensor is made up of a NTC (Negative Temperature Coefficient) thermistor.
The resistance exhibited by the sensor decreases as the temperature increases.
The control unit input circuit distributes the 5 V reference voltage between the sensor resistance and a fixed reference value, thus obtaining a voltage proportional to the resistance (and, therefore, to the temperature).
The pressure sensor sensitive element is made up of a Wheatstone bridge silk-screen printed on a ceramic membrane.
The absolute reference vacuum is found on one face of the membrane; the vacuum found in the inlet manifold acts on the opposite face.
The signal (of a piezoresistive nature) resulting from the distortion suffered by the membrane is amplified by an electronic circuit contained in the support that houses the ceramic membrane and is then conveyed to the engine management control unit.
The diaphragm bends, with the engine off, depending on the atmospheric pressure value; thus, the exact altitude information is obtained, with the key inserted.
During the engine operation, the effect of the vacuum causes a mechanic action on the sensor membrane: the latter bends, thus making the resistance value to change.
Since the power supply is strictly kept constant (5 V) by the control unit, the resistance value variation causes the output voltage value to vary, too.

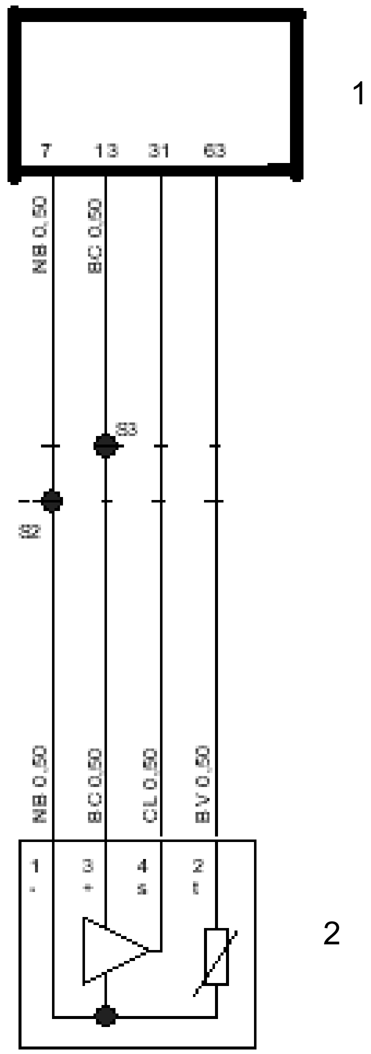
Electric features

The figure below illustrates the sensor's electric features.

T °C	Ω	± Ω %
-40°	49.933	13.6
-30	26.628	12.1
-20	15.701	10.8
-10	9.539	9.6
0	5.959	8.5
+10°	3.820	7.4
+20	2.509	6.5
+25	2.051	6.0
+30	1.686	6.0
+40	1.157	5.9
+50	0.810	5.8
+60	0.578	5.7
+70	0.419	5.6
+80	0.309	5.5
+85	0.263	5.5
+90	0.231	5.5
+100	0.176	5.4
+110	0.135	6.0
+120	0.105	6.5
+125	0.092	6.7
+130	0.083	7.0







1: ECM

2: Sucked air pressure and temperature sensor

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin
Sucked air pressure & temperature sensor	1	S	Ground from the ECU	7 (ECM connector B)
	2	O	Temperature sensor signal	63 (ECM connector B)
	3	S	Power supply from the ECU	13 (ECM connector B)
	4	O	Pressure sensor signal	31 (ECM connector B)

Recovery

If the error is found upon vehicle starting:

• a value of 50 °C is assumed;

• the mixture ratio self-adaptivity is cut out.

If the error is found in the other conditions:

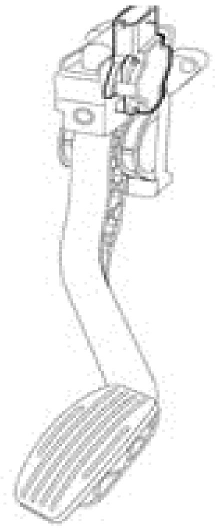
• the latest valid value is stored, which is updated depending on the coolant temperature.

4.4.7 Accelerator pedal potentiometer

Description

The accelerator pedal features two built-in potentiometers:

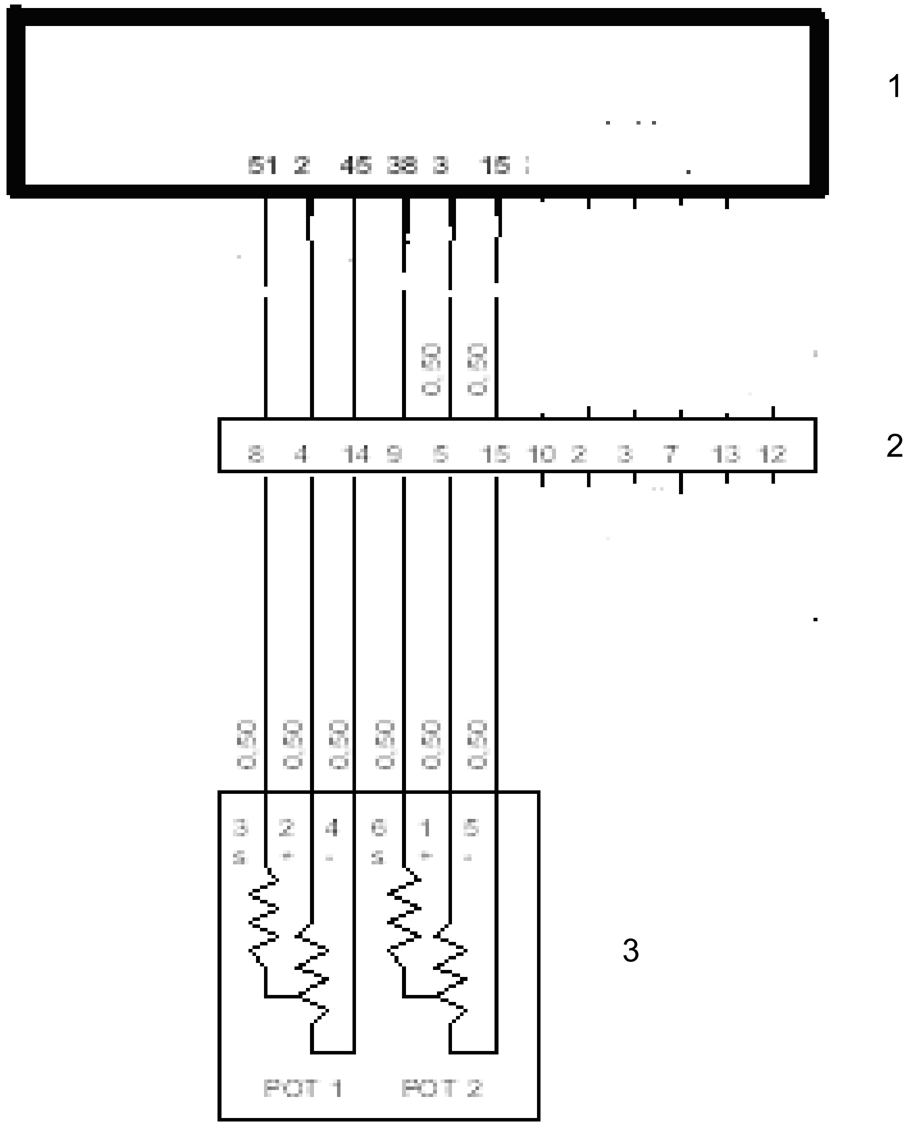
one main potentiometer;
one safety potentiometer.



Operation

The sensor is made up of a frame (secured to the accelerator pedal support) which incorporates a shaft placed in an axial position and connected to the dual-race potentiometer. A helical spring fitted onto the shaft ensures proper compressive strength, whereas one further spring ensures the return when releasing.
Operating range: 0° to 70°; mechanic stop at 88°.

Electric features



1: ECM

2: Junction

3: Dual accelerator pedal potentiometer

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin	Receiving item pin
Accelerator potentiometer	1	S	Potentiometer 2 power supply from the ECU	5 (Junction)	3 (ECM connector A)
	2	S	Potentiometer 1 power supply from the ECU	4 (Junction)	2 (ECM connector A)
	3	O	Potentiometer 1 signal	8 (Junction)	51 (ECM connector A)
	4	S	Potentiometer 1 ground from the ECU	14 (Junction)	45 (ECM connector A)
	5	S	Potentiometer 2 ground from the ECU	15 (Junction)	15 (ECM connector A)
	6	O	Potentiometer 2 signal	9 (Junction)	38 (ECM connector A)

Recovery

The injection control unit implements the following "recovery" strategies under the conditions below:
in case of failure to either potentiometer, it allows the throttle to open up to a maximum of 40° over a very long time period;
in case of full failure to both potentiometers, it cuts throttle opening out.

4.4.8 A/C linear sensor

Description

The A/C linear sensor checks correct system operation by taking over the task carried out by the quadrinary pressure switch. The sensor continuously analyzes the air-conditioning system circuit pressure and provides the engine control unit with real-time data of pressure variations, thus making the actuation threshold management more flexible.

Position on the vehicle

1: A/C linear pressure sensor (placed on the high-pressure duct)

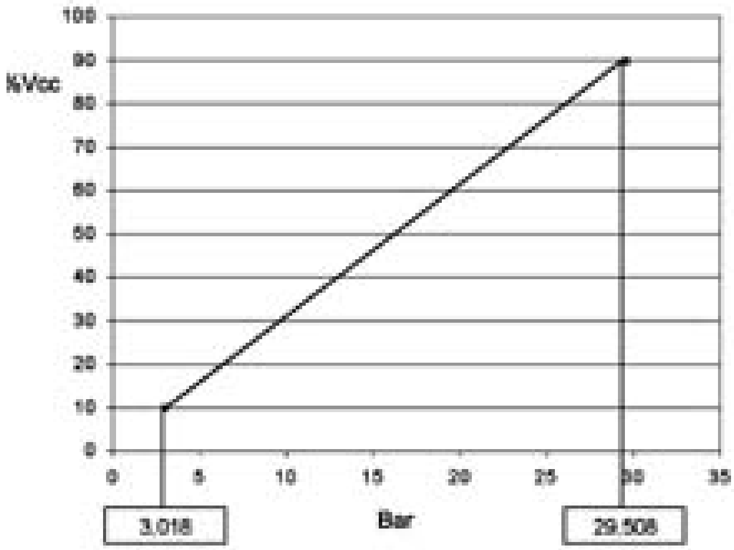
1: High-pressure duct

2: Low-pressure duct

Operation

Every single pressure variation is matched by a voltage signal used by the engine control unit to actuate the electric fan speeds and turn the compressor off if the pressure goes above or below the permitted limits (safety function).

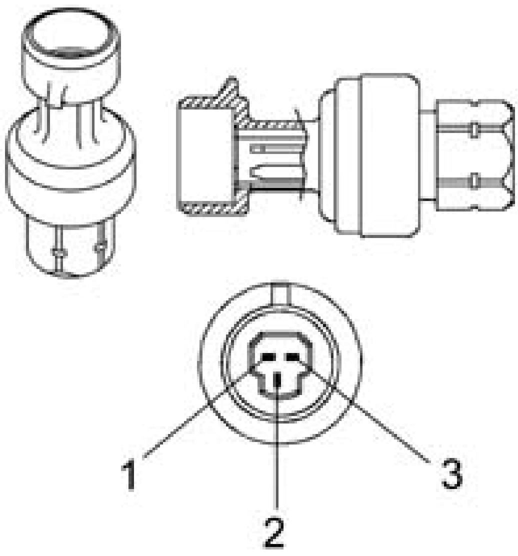
The linear sensor operating range goes from 3,018 bar to 29,508 bar according to the following characteristic curve for pressure (bar) – output voltage percentage (%Vcc):



Both compressor actuation enable and electric fan speed control (depending on the pressure variation) take place within this pressure range. Below and above these values, the compressor will be turned off as a safety condition to avoid damaging the system itself.

The supply voltage may undergo a variation of ± 10%, whereas the sensor's utilization temperature is included between –5°C and 80°C.

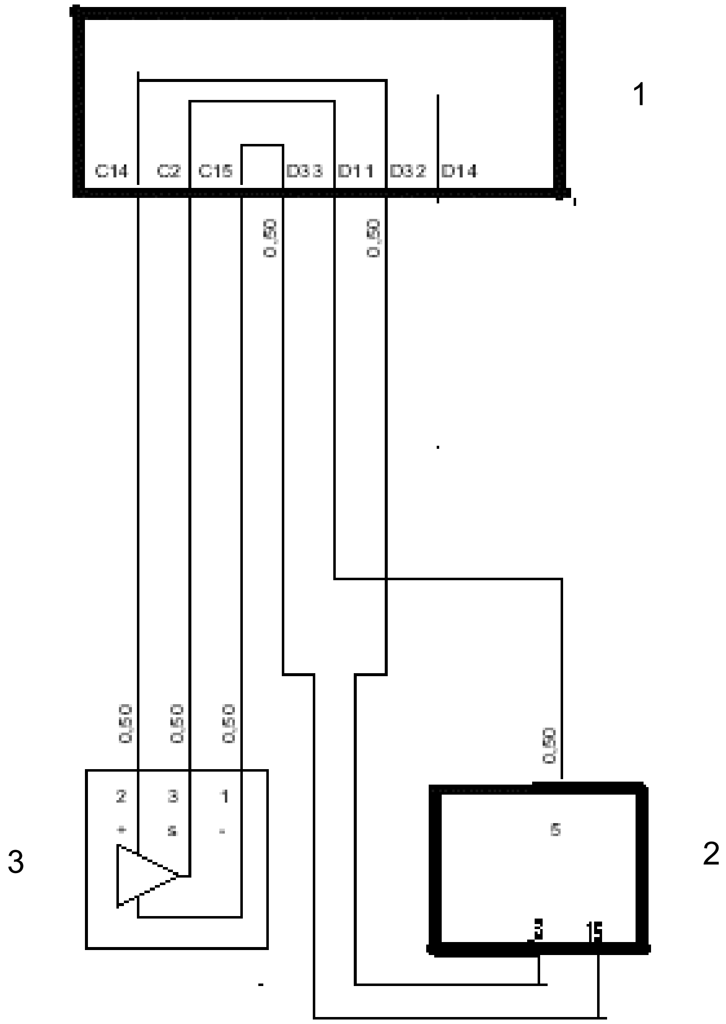
Electric features



1: Ground

2: Supply voltage

3: Output signal



1: FDU

2: ECM

3: A/C linear pressure sensor

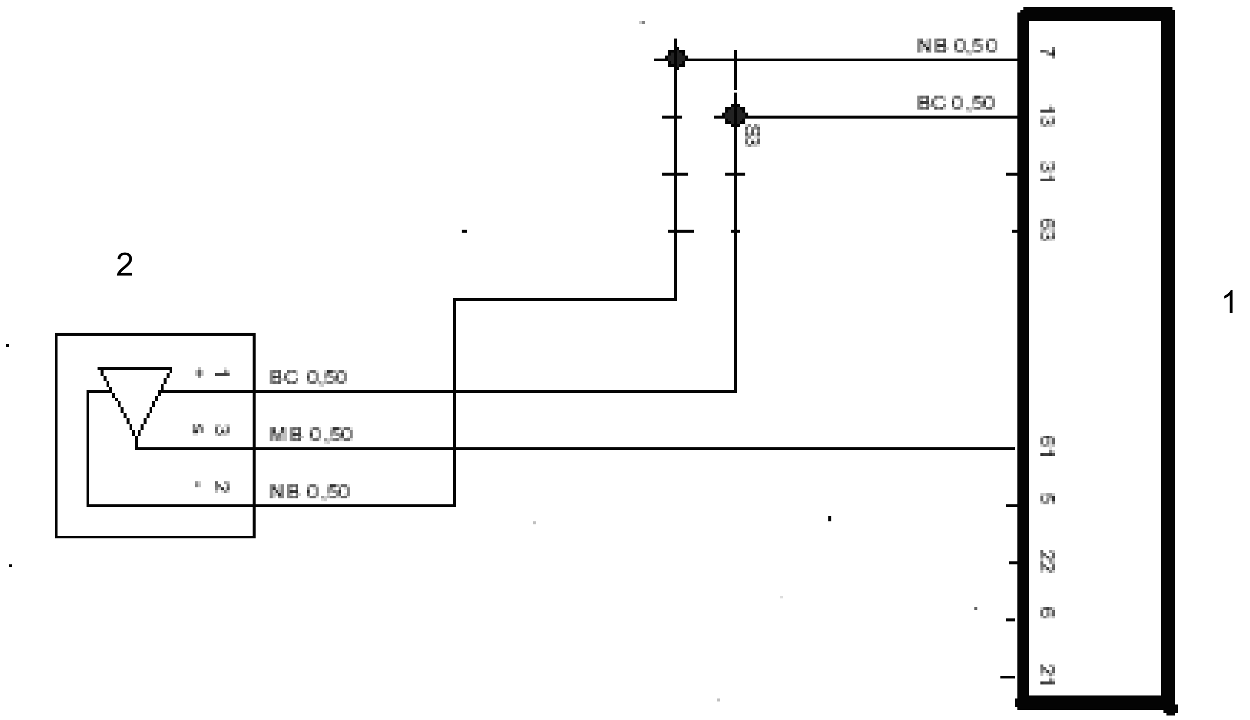
Pin-out

Component	**Component connector pin**	**I/O/S**	**Function**	**Receiving item pin**
A/C linear sensor	1	S	Ground from the ECU	15 (ECM connector A)
	2	S	Power supply from the ECU	3 (ECM connector A)
	3	O	A/C sensor signal	5 (ECM connector A)

Atmospheric pressure sensor

Atmospheric pressure sensor

Electric features



1: ECM

2: Atmospheric pressure sensor

Position on the vehicle

Atmospheric pressure sensor position

Pin-out

Component	Component connector pin	I/O/S	Function	Receiving item pin
Atmospheric pressure sensor	1	S	Power supply from the ECU	13 (ECM connector B)
	2	S	Ground from the ECU	7 (ECM connector B)
	3	O	Atmospheric pressure sensor signal	61 (ECM connector B)

Recovery

In case of sensor failure, the value found in the inlet manifold upon key-ON or in fully-loaded conditions (throttle fully open) will be considered as the atmospheric pressure value.

4.5 Operation logic

4.5.1 System self-adaptation

The control unit features self-adaptive functions that recognize the changes occurring in the engine following time-adjustment processes and component or engine ageing.
These changes are stored into the memory as basic mapping modifications: their purpose is to adapt the system operation to the progressive engine and component alterations compared with as-new features.
This self-adapting feature also makes it possible to compensate for the unavoidable differences (due to production tolerances) of replaced components (if any).
The control unit modifies, through the exhaust gas analysis, the basic mapping with respect to the as-new features of the engine.
The self-adaptive parameters will not be cleared when the battery is disconnected.

4.5.2 Self-diagnosis and recovery

The control unit self-diagnosis system checks correct operation of the system and signals any anomaly by means of a warning light (MIL) on the instrument board, the colour and ideograph of which comply with the European normalization standards.

This warning light signals both the engine management faults and the anomalies found by the EOBD diagnosis strategies.

The MIL warning light operation logic is as follows:

with both the key and the instrument board ON, the warning light illuminates and remains ON until the engine has been started;

the control unit self-diagnosis system checks the signals from the sensors and compares them with the permitted limit data.

Fault signalling upon engine starting:

the warning light's failure to go out after the engine has been started indicates the presence of an error stored in the control unit.

Fault signalling during operation:

the blinking warning light comes on to indicate possible catalyst damage due to misfire;

the warning lights illuminates and remains ON steadily to indicate the presence of engine management faults or EOBD diagnosis faults.

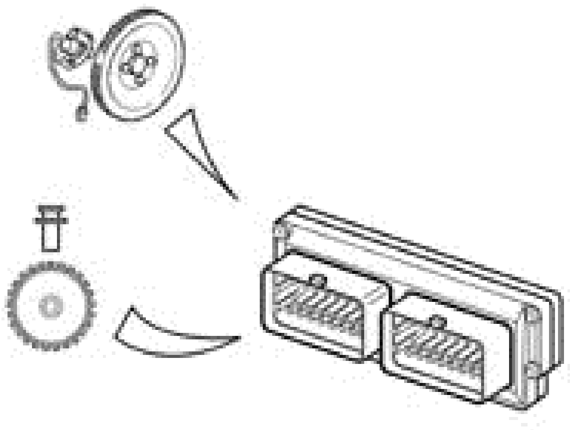
The control unit defines each time the type of recovery depending on the broken components.

The recovery parameters are managed by the unbroken components.

4.5.3 Cylinder position recognition

The engine phase signal, together with the top dead centre (T.D.C.) and engine revs signal, allows the engine control unit to recognize the cylinder sequence to implement the timed injection.

This signal is generated by a Hall-effect sensor positioned on the tappet cover just next to the phonic wheel obtained on the distributing shaft pulley.



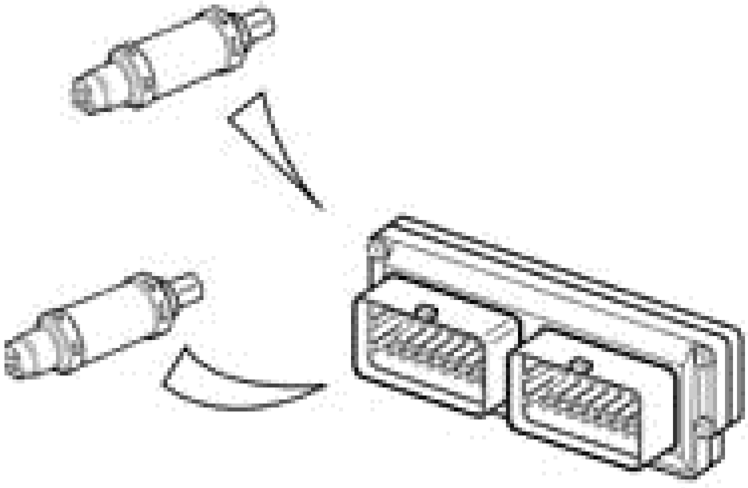
4.5.4 Oxygen sensor – combustion check

In EOBD systems, two oxygen sensors (which are of the same type but cannot be exchanged with one another) are available: one before the catalyst system (pre-catalyst) and one after the same (post-catalyst). The pre-catalyst sensor determines the loop 1 mixture ratio control (pre-catalyst sensor closed loop).

The post-catalyst sensor is used to diagnose the catalyst and finely modulate the loop 1 control parameters.

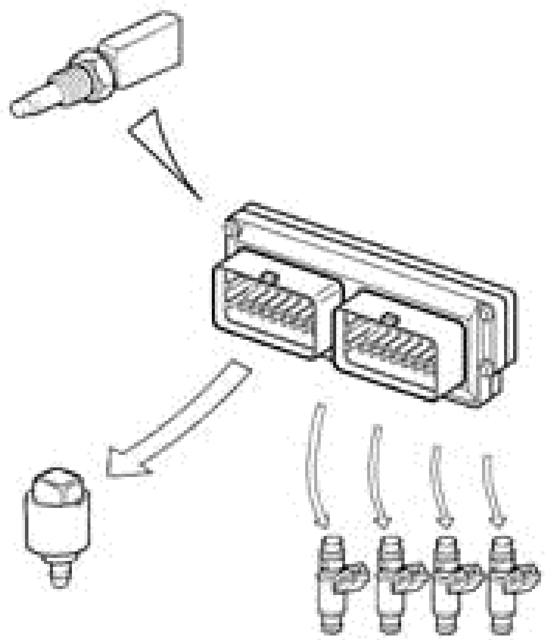
To this regard, the purpose of loop 2 adaptivity is to recover both the production dispersions and the slow drift that the pre-catalyst sensor response may exhibit due to ageing and contamination.

This control is referred to as loop 2 control (post-catalyst sensor closed loop).



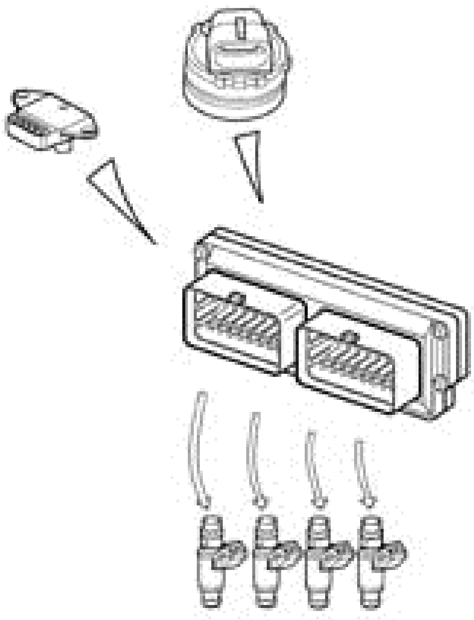
4.5.5 Cold operation

Under these conditions, the mixture becomes lean due to poor turbulence of fuel particles at low temperatures, less evaporation, and heavy condensation on the inlet manifold inner walls. All of this is enhanced by the greater viscosity of the lubricating oil which, as everyone knows, increases, at low temperatures, the rolling resistance of the engine's mechanic members.
The electronic control unit recognizes this condition based on the cooling fluid temperature signal, and increases the injection base time.



4.5.6 Fully-loaded operation

The fully-loaded condition is detected by the control unit by means of the values provided by the throttle position and absolute pressure sensors.
Under fully-loaded conditions, the injection base time has to be increased in order to obtain the maximum power delivered by the engine.



4.5.7 Operation during deceleration

Two strategies overlap during this engine utilization phase:

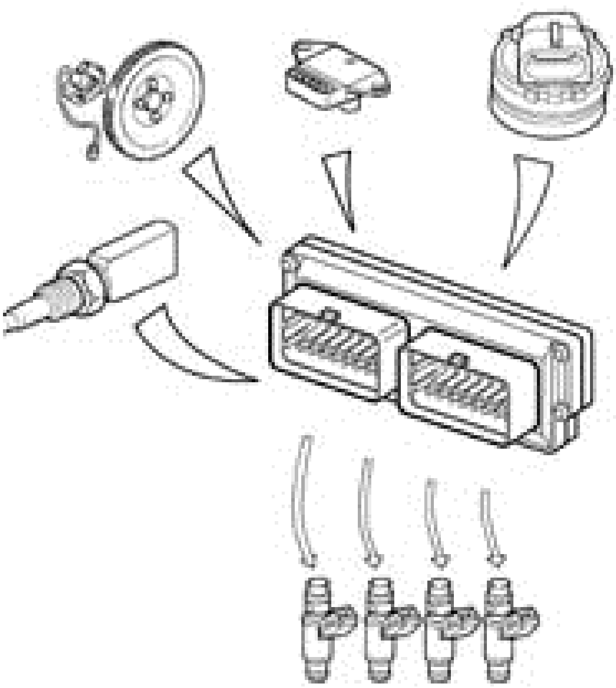
- a transient strategy, to keep the fuel amount supplied to the engine stoichiometric (less pollution); this phase is recognized by the control unit when the throttle potentiometer signal shifts from a high voltage value to a lower one
- a strategy for soft “escorting” to a lower engine speed in order to implement the variation of delivered torque (reduced exhaust brake).

4.5.8 Atmospheric correction

The atmospheric pressure varies depending on the altitude; this causes such a volumetric efficiency variation that requires a correction of the base ratio (injection time).
The injection time correction will depend on the altitude variation and will be automatically updated by the electronic control unit every time the engine is switched off and also under certain throttle position and revs number conditions (typically with low engine speed and throttle opened to a large extent) (dynamic atmospheric correction adjustment).

Cut-off operation
The cut-off (fuel cut-off) strategy is implemented when the control unit recognizes the accelerator pedal released position: pedal percent value = 0% and engine speed of more than approximately 1,350 r.p.m. (this value is approximate and varies depending on a few parameters, the most significant of which are essentially the temperature and the running condition).
The recognition of the accelerator pedal non-released condition and engine speed of less than 1,270 r.p.m. (approximate value varying according to the various models) enables engine feed again.

In case of very high engine speeds, the cut-off strategy is implemented also when the throttle valve is not fully closed, but when the pressure in the inlet manifold is significantly low (partial cut-off).

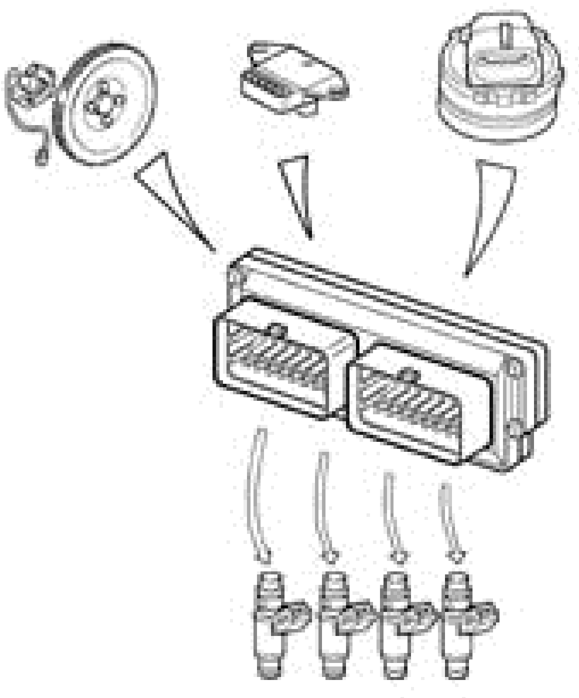


4.5.9 Operation during acceleration

During this phase, the control unit adequately increases the fuel amount required by the engine (to achieve maximum torque) depending on the signals from the following components:

- throttle potentiometer;
- T.D.C. and revs sensor.

The “base” injection time is multiplied by a coefficient depending on the engine coolant temperature, the accelerator throttle opening rate and the pressure increase in the inlet manifold.
If the sudden change of the injection time is calculated when the injector is already closed, the control unit will open the injector (extra pulse) again, to be able to compensate for the ratio as quick as possible; conversely, the following injections will be increased according to the above-mentioned coefficients.

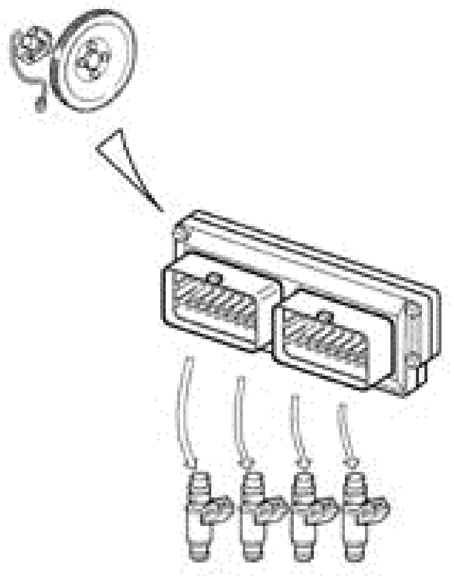


4.5.10 Out-of-revs protection

When the engine rotation speed exceeds the value of 6,530 r.p.m. set by the manufacturer, the engine itself will be operating in ‘’critical‘’ conditions.

When the electronic control unit recognizes that the aforesaid speed has been exceeded, it will disable electric injector driving.

When the revs number falls again into a non-critical value (6,500 r.p.m.), the driving will be restored.

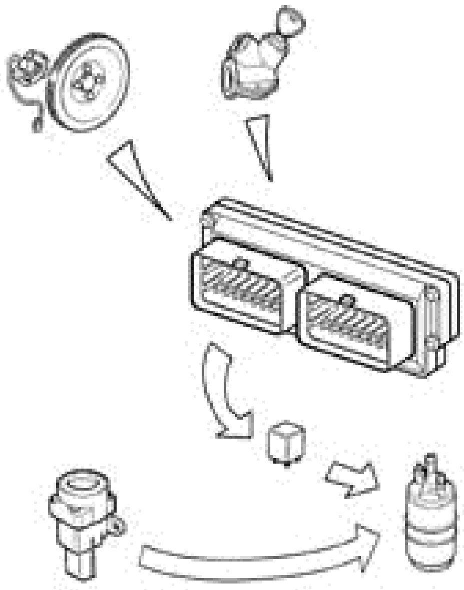


4.5.11 Fuel electric pump control

The fuel electric pump is driven by the engine management control unit by means of a remote-control switch.

The pump is stopped:

- if the engine speed falls below approximately 40 r.p.m.;
- after some time (approximately 6 seconds) when the ignition switch has been set to the "MAR" position and the starting operation is not carried out (timed enable);
- if the inertia switch has come into action.

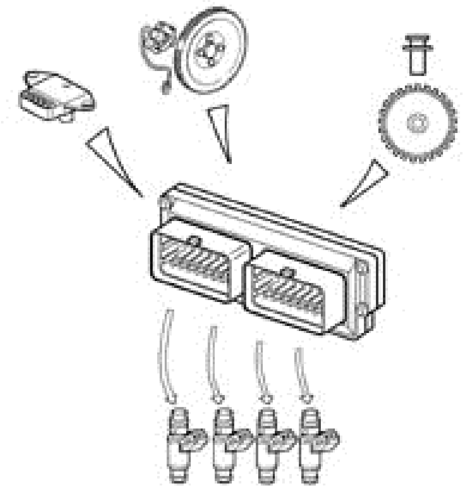


4.5.12 Electric injector control

The electric injector control is of the phased, sequential type, i.e. the single injections correspond to the intake phases of every single cylinder.

However, the electric injectors will, during the starting phase, be first driven in parallel (full group).

The electric injector control timing varies depending engine speed and the sucked air pressure, in order to improve cylinder filling with advantages in terms of consumption, driveability and pollution prevention.



4.5.13 Knock control

The purpose of this strategy is to detect any knock condition by processing the signal from the respective sensor.

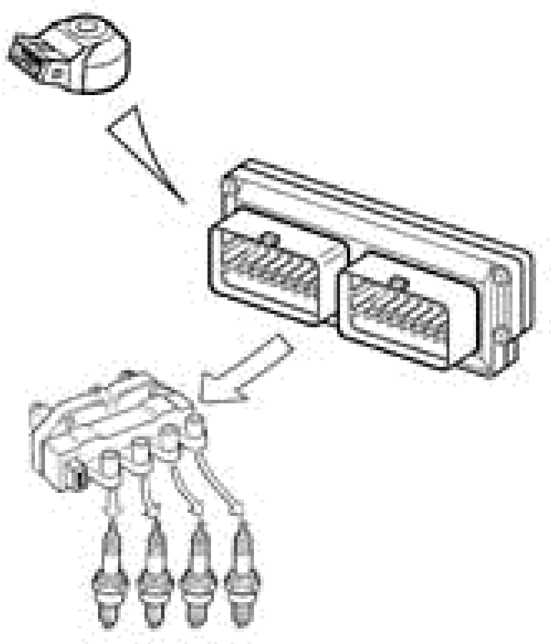
This strategy continuously compares the signal from the sensor with a threshold value (which is continuously updated) to allow for basic noise levels and engine ageing.

If the system recognizes that knock is present, the strategy will act so as to reduce the ignition advance until the phenomenon disappears. Next, the advance will be gradually restored up to the base value or until the phenomenon occurs again.

In particular, the advance increases are implemented in a gradual way, whereas the decreases are implemented immediately.

During acceleration, the strategy will make use of a higher threshold, to allow for increased engine noise under this condition.

Moreover, this strategy features a self-adapting function that memorizes, in a non-permanent fashion, the advance reductions that might occur continuously, so as to adapt the advance to the different conditions suffered by the engine (e.g. when fuel with a low octane number has been used). The strategy is capable of resuming the advance to the threshold value stored in the memory when the conditions that caused reduction to occur are not present any more.



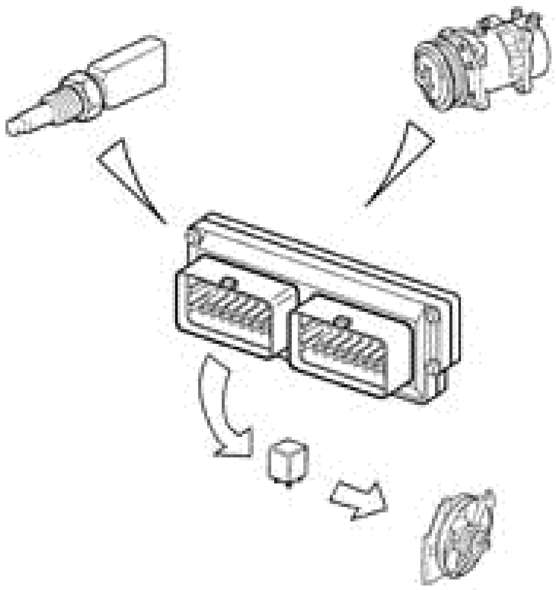
4.5.14 Radiator electric fan control

The control unit directly controls the radiator electric fan operation depending on the engine coolant temperature and the air-conditioning system actuation.

The electric fan is switched off when the temperature exceeds 95°C (1st speed) or 105°C (2nd speed).

The switch-off takes place with hysteresis 3°C lower than the actuation threshold (approximate values varying according to the various models and based on experimental tests).

The high and low speed functions are managed by the actuation of special remote-control switches placed in the air-conditioning system management control unit and driven by the injection control unit.



4.5.15 Engine idling control management

The control unit recognizes the idling condition through the accelerator pedal “release” position. The control unit drives, in order to control the idling speed depending on the devices turned off and the brake/clutch pedal signals, the power-driven throttle position.
The idling speed envisaged for hot operation is 750 ± 50 r.p.m.

4.5.16 Optimization of thermal operating conditions

The revs number is corrected above all depending on the engine coolant temperature.
When the optimum temperature is reached, the idling speed management will only depend on the signal from the engine revs sensor; when external loads are applied, the control unit drives the throttle control actuator to adjust the engine revs to the conditions that have occurred and also manage the engine load by sustaining the idling speed.

4.5.17 Fuel vapour recirculation control

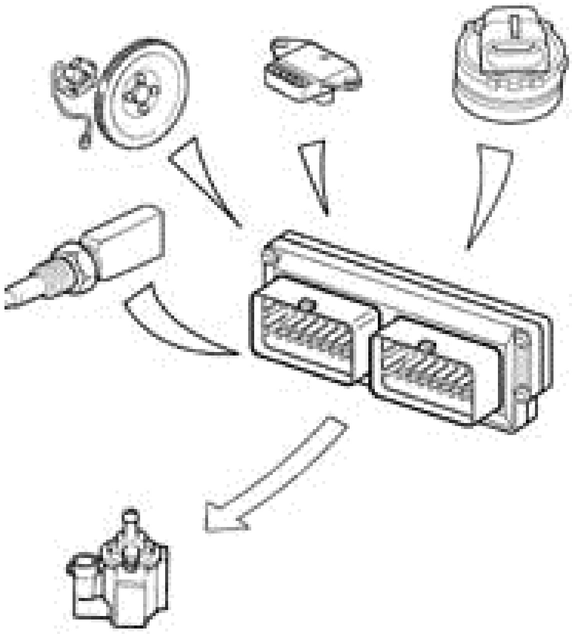
This strategy controls the vapour cut-off solenoid valve position as follows:

- during the starting phase, the solenoid valve remains closed, thus preventing the fuel vapour from excessively enriching the mixture: this condition persists until the engine coolant temperature reaches 65°C;
- with the engine is thermal condition, the electronic control unit sends the solenoid valve a square-wave signal (duty-cycle) that modulates its opening.

Thus, the control unit checks the amount of fuel vapour sent to the intake, thus avoiding significant variations of the mixture ratio.

To improve the engine operation, the solenoid valve control is inhibited, by keeping the same closing position, under the operating conditions listed below:

- throttle valve in the closing position;
- engine speed of less than 1500 r.p.m.;
- intake manifold pressure lower than a limit value calculated by the control unit depending on the revs number.



4.5.18 Air-conditioning system control

The injection/ignition control unit is connected, from the operational viewpoint, to the air-conditioning system since:

- it receives the request for compressor actuation and implements the respective actions (additional air);
- enables compressor actuation when the conditions envisaged by the strategies have been checked;
- receives the information about the linear pressure-switch condition and implements the respective actions (radiator electric fan control).

If the engine runs at idling speed, the control unit will increase the throttle opening and, therefore, the air flow rate in advance compared with the compressor actuation and, conversely, will resume the normal throttle position behind time compared with the compressor switch-off.

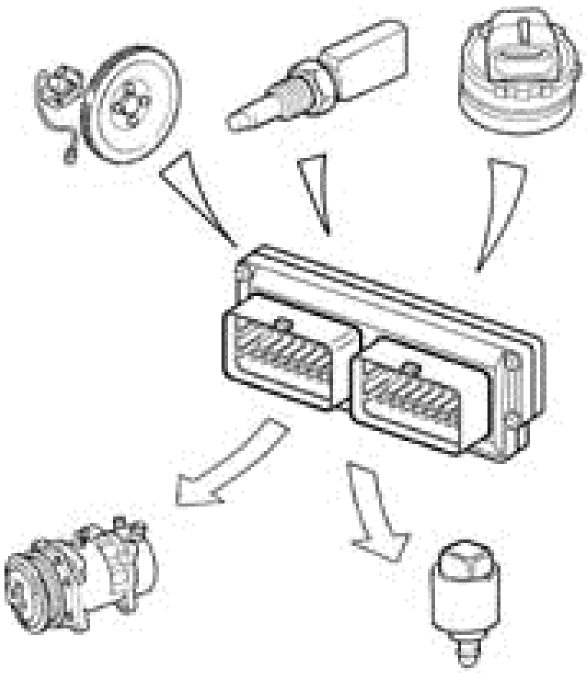
The control unit will automatically control the compressor switch-off:

- with engine coolant temperatures of more than 120 °C;
- with engine speed of less than 650 r.p.m.

The compressor will be switched on again when the engine speed reaches 750 r.p.m. again.

The control unit temporarily controls the compressor switch-off (for a few seconds):

- when very high engine power is requested (heavy acceleration);
- upon engine pick-up.



4.5.19 Phase variator control

The phase variator is fully managed by the engine management control unit which:

measures the camshaft position through the phase sensor;
modifies such position depending on the engine operation point according to a calibrated map;
keeps the camshaft position under control.
The phase variator motion takes place through the pressure of the engine oil that flows into the advance/delay openings. A box solenoid valve makes the oil flow into the advance openings (the variator will move in the direction of the advance, which corresponds to the rest position) or the delay openings (the variator will move in the direction of the delay), or into the advance and delay openings alternately and continuously (the variator remains in the controlled position).
The control unit drives the variator driving solenoid valve through a duty-cycle command.

4.6 Procedures

4.6.1 Camshaft assembling position self-learning procedure

When and why should this procedure be carried out?

This procedure allows the ECM to self-learn the camshaft position with respect to the phonic wheel, in order to diagnose any assembling anomalies.

The procedure must be carried out again in the following cases:

phonic wheel actuation/replacement;
revs sensor actuation/replacement;

phase sensor actuation/replacement;
camshaft actuation/replacement;
drive shaft actuation/replacement;
phase variator actuation/replacement;
cylinder head disassembling;
timing belt actuation/replacement;
ECM replacement/reprogramming.

NOTE: In the event that the ECM is moved from one vehicle to another, the procedure shall be carried out again.

Which tools should be used?

Examiner diagnosis tool.

Operations required to carry out the procedure:

The self-learning procedure is fully automatic. It starts with the cranking phase and finishes after 30 seconds at most, provided that the following enable conditions are met.

Enable conditions upon execution of the procedure:
The engine coolant temperature shall exceed i 20°C. During the starting phase, the accelerator pedal needs be fully released, i.e. the engine rotation speed should be in the range of 650 to 1,300 r.p.m.
After 30 seconds have elapsed from starting, switch the key contact to the OFF position, then wait for data item recording in the permanent memory.

Upon completion of the procedure, the following conditions may occur:

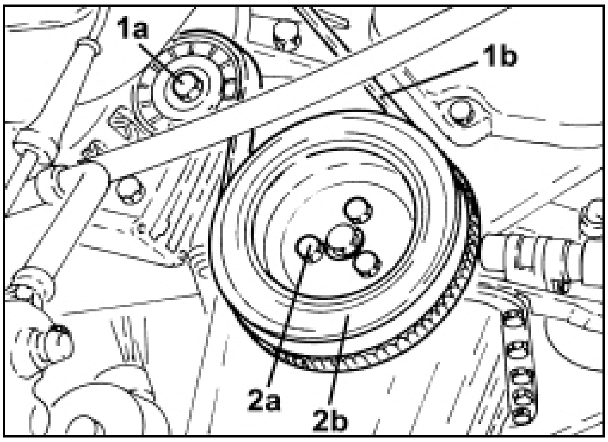
Error memory reading	Possible problem	Solution
DTC P 0016 [76]	Engine timing does not fall within the permitted tolerances.	The engine must be disassembled and the current timing shall be checked
.DTC P 0016 [76]	The enable conditions are not met upon execution of the procedure.	Repeat the procedure.
No DTC	Engine timing falls within the permitted tolerances.	None.
No DTC	The enable conditions are not met upon execution of the procedure.	If this condition occurs immediately after reprogramming, repeat the procedure. Otherwise, no remedying action is required.

In the event that a vehicle is allowed to travel in the traffic with engine timing out of the permitted tolerances, the engine itself may be broken.

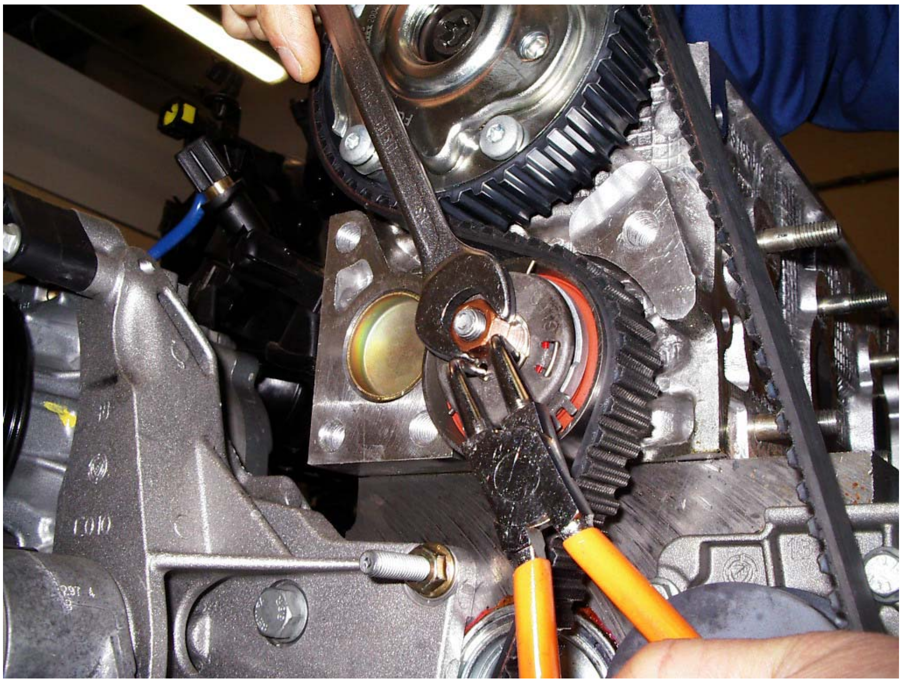
4.6.2 Timing detachment/reattachment camshaft drive

Act on the moving idler (1a) with a wrench in the counterclockwise direction, then remove the single engine member drive belt (1b).

Unscrew screws (2a), then remove the drive shaft pulley (2b).



Moving idler

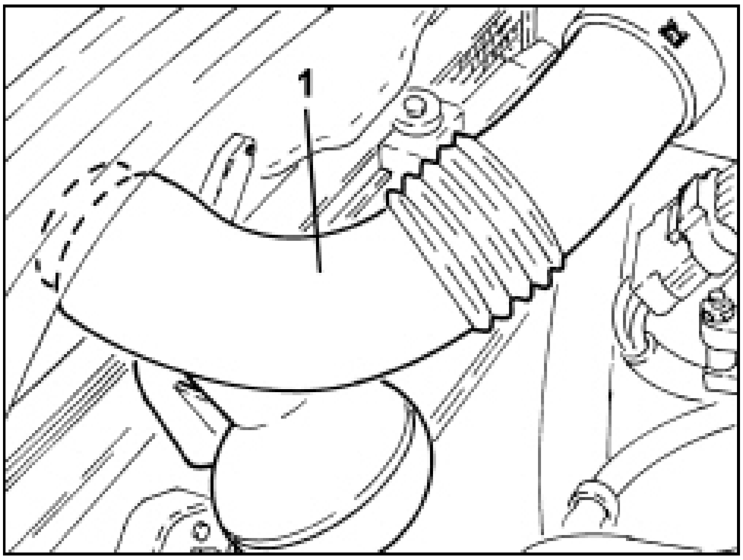


Moving idler

(1a)

Drive shaft pulley (2b)

Press the clips, then remove the coil air inlet sleeve.

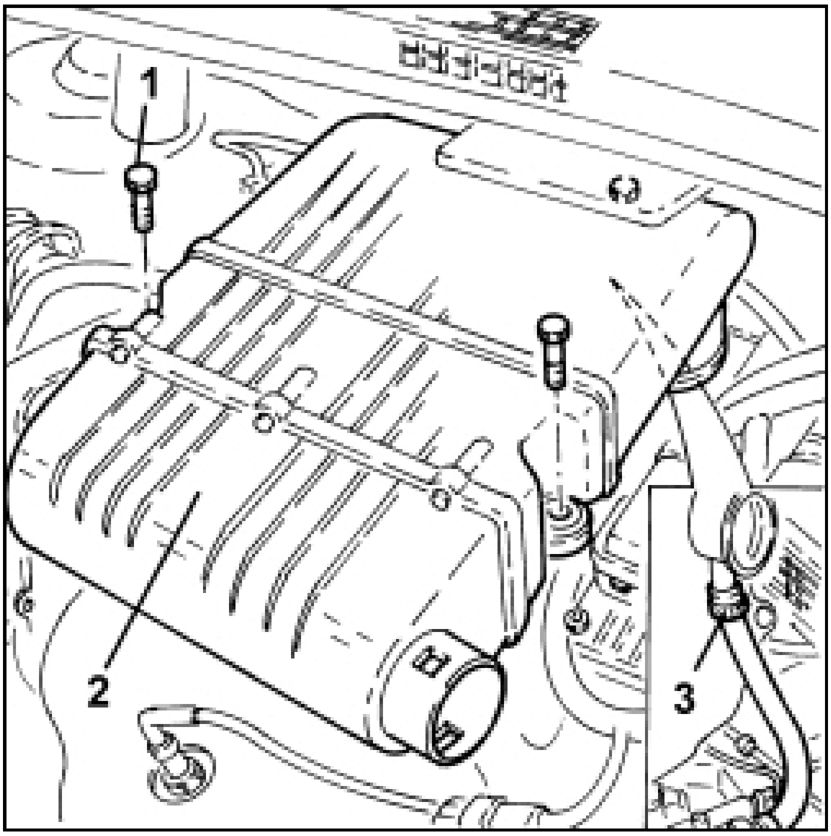


Air inlet sleeve

Unscrew the air filter fastening screws.

Lift the air filter.

Loosen the strap, then disconnect the engine oil vapour pipe from the air filter and remove it.

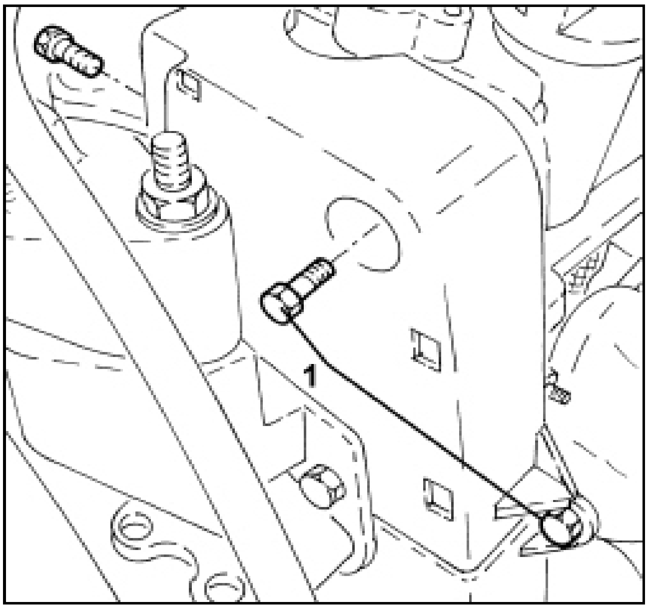


Air filter fastening screws

Air filter

Engine oil
vapour pipe

1. Unscrew the timing belt protection upper cover fastening screws.



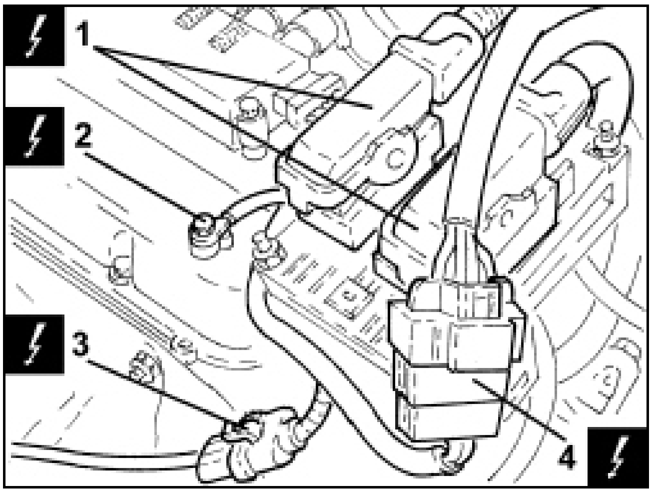
Timing belt upper and lower protection

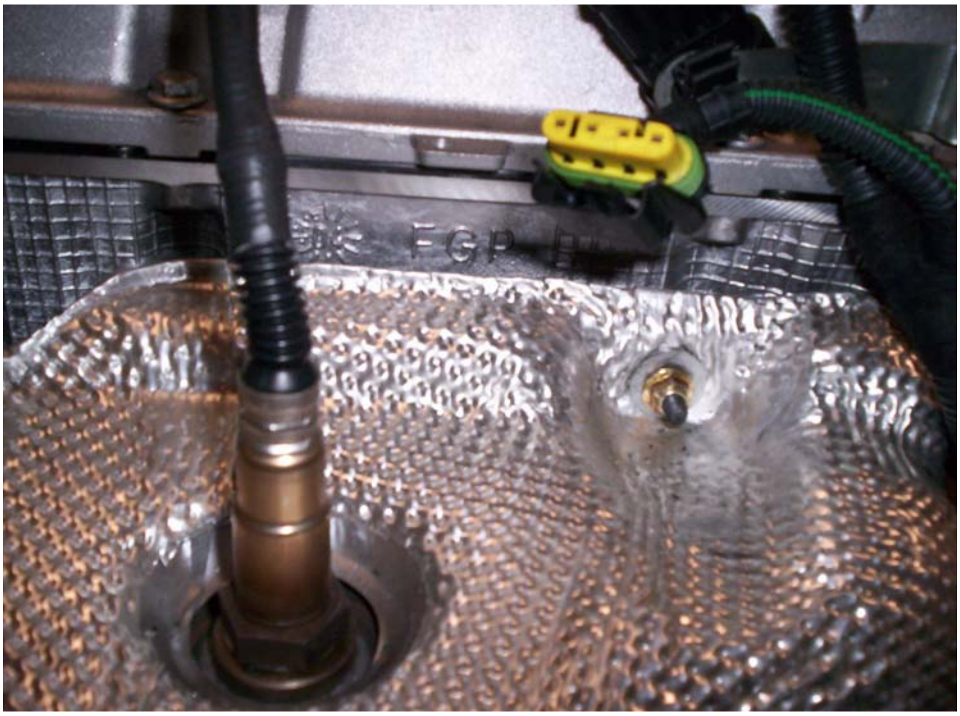
Disconnect the electric connections from the injection control unit.

Disconnect the ground cable.

Disconnect the electric connection of the oxygen sensor upstream the catalyst.

Disconnect the front engine junction.





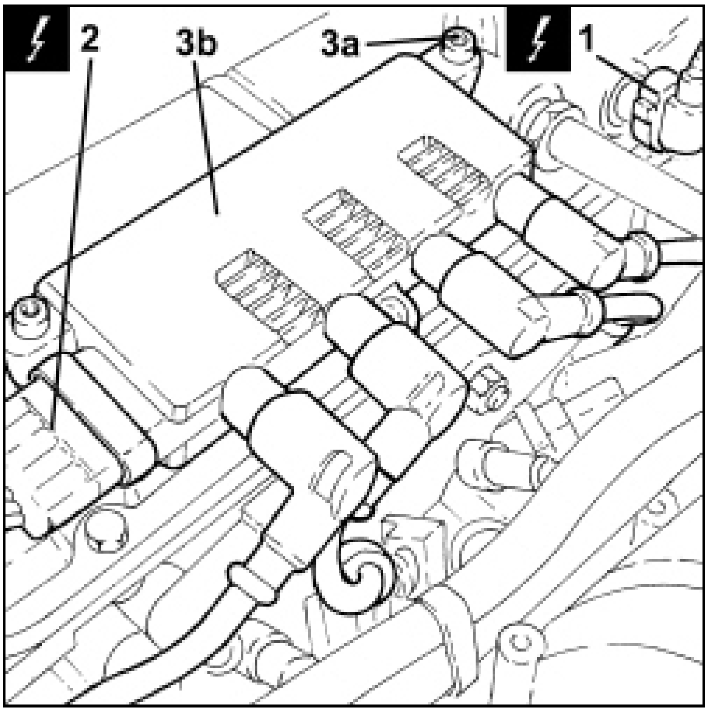
Oxygen sensor upstream the catalyst, with its respective connection

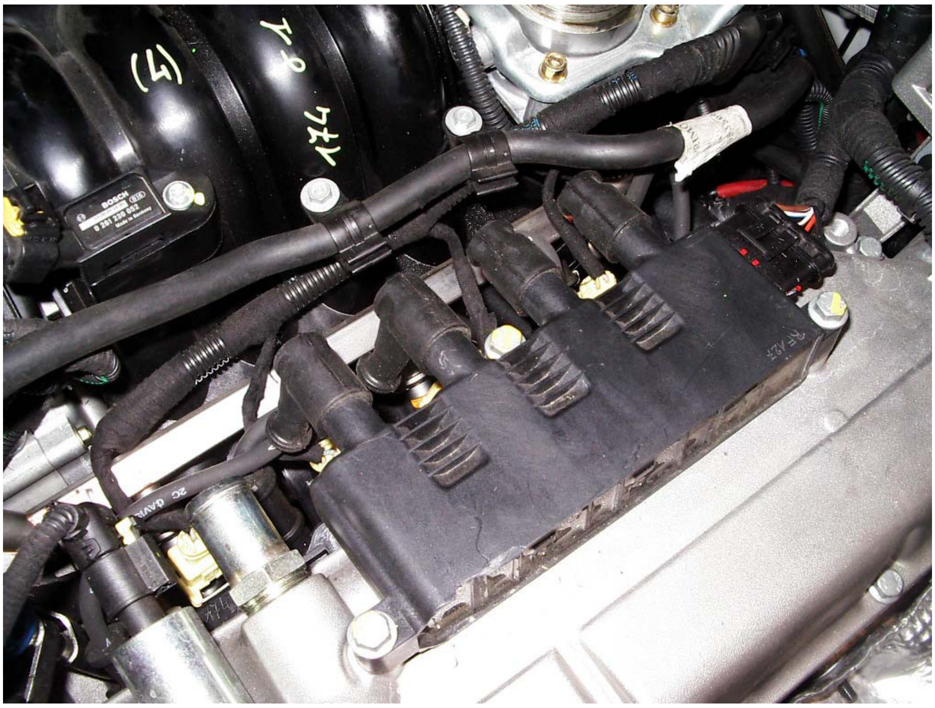
Disconnect the phase variator control electromagnet electric connection.

Disconnect the electric connection from the ignition coil module.

Unscrew screws (3a), then remove the ignition coil module (3b).

Remove the electric connection from the phase sensor.



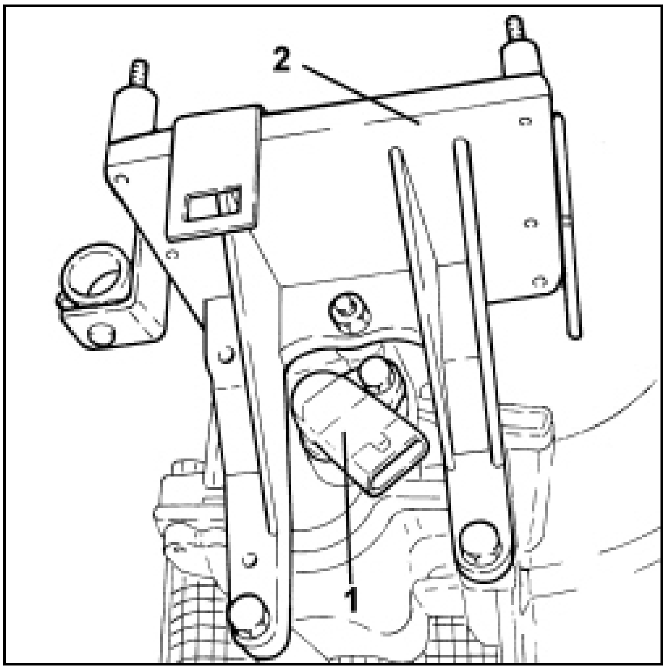


Ignition coil module

Phase variator control electromagnet with its respective connection

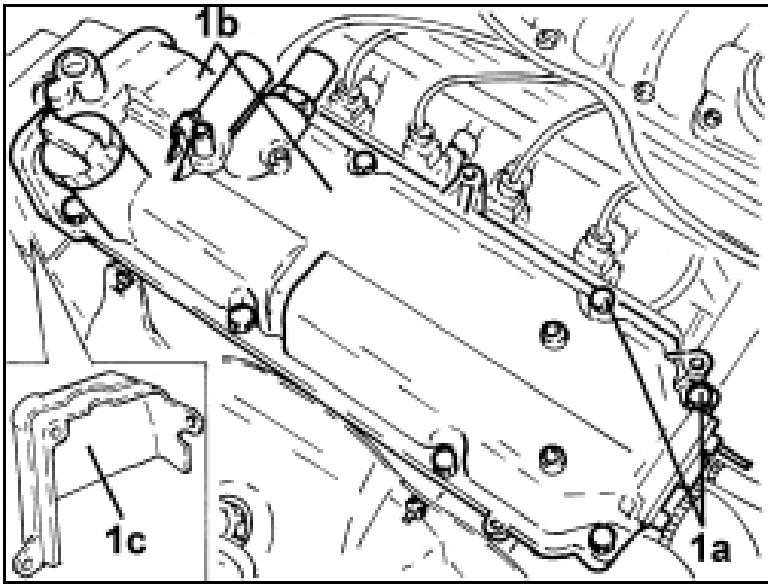
Unscrew the screw, then remove the phase sensor.

Unscrew the screws, then remove the injection control unit support.



Phase sensor

1. Unscrew screws (1a), then remove tappet cover (1b) and timing belt upper cover (1c).

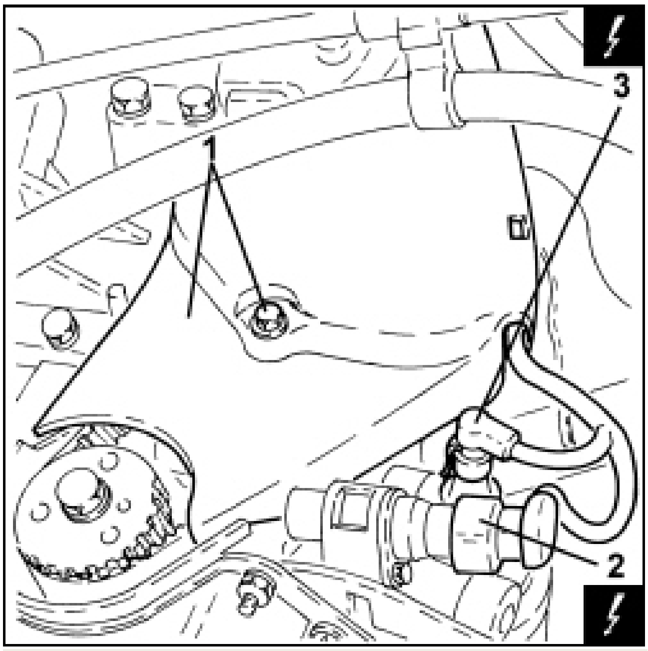


Timing belt upper cover

Unscrew the screws, then remove the timing belt lower cover.

Disconnect the revs sensor electric connection.

Disconnect the minimum oil pressure switch connection.

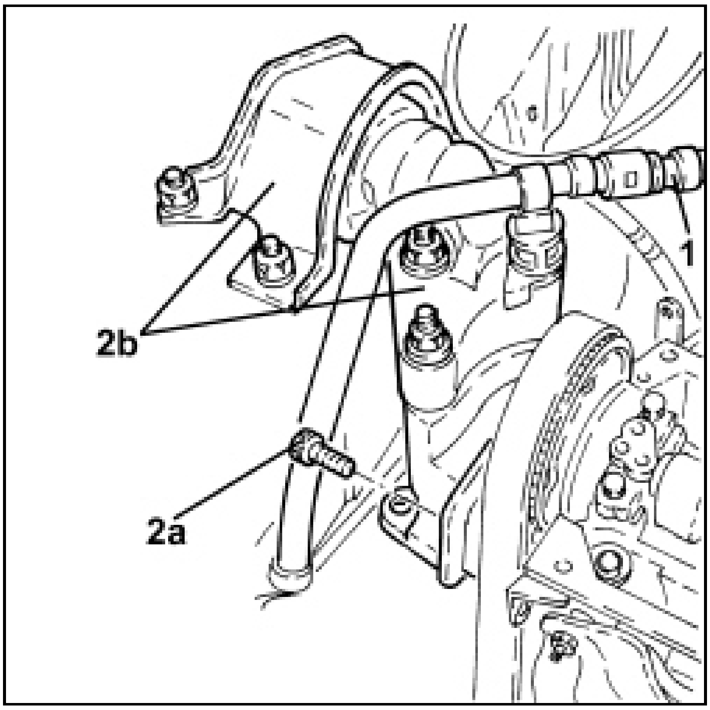


Timing belt lower cover

Disconnect the intermediate junction of the degassing pipe.

Position an arm lifting device below the engine oil sump.

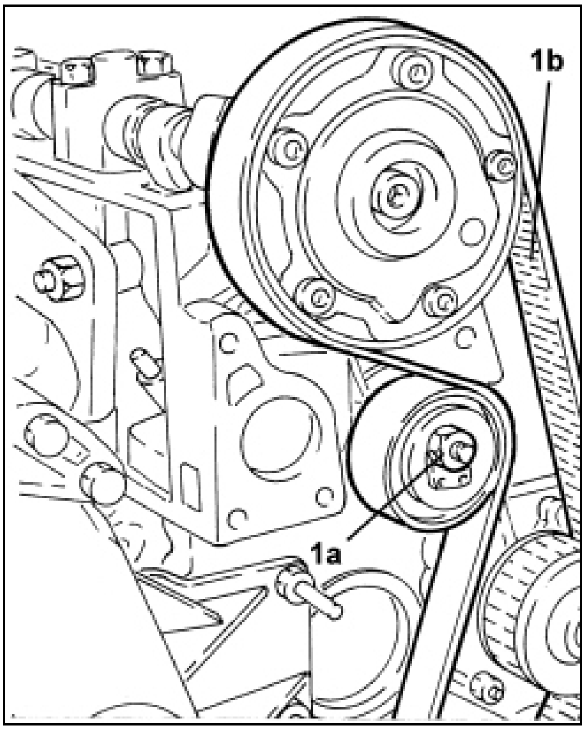
Unscrew fasteners (2a), then remove the power unit cover on the valve gear side (2b).

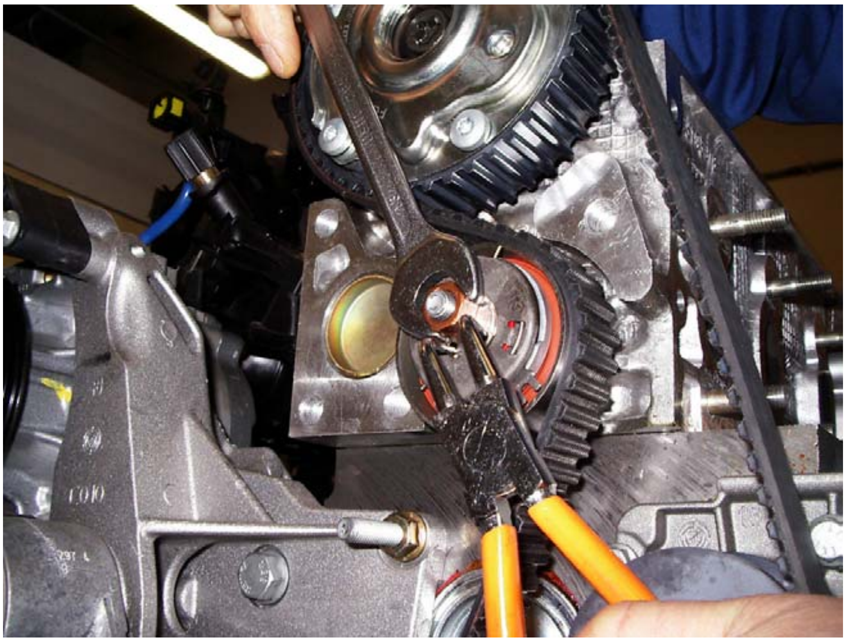


Power unit support

(valve gear side)

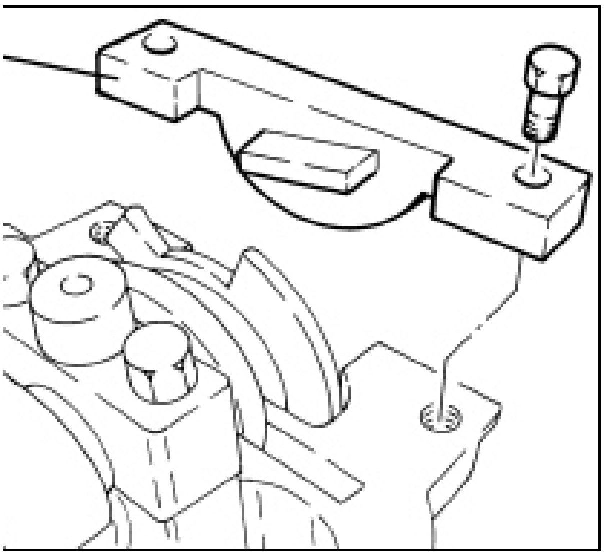
Act on belt stretcher (1a) to remove timing belt (1b).

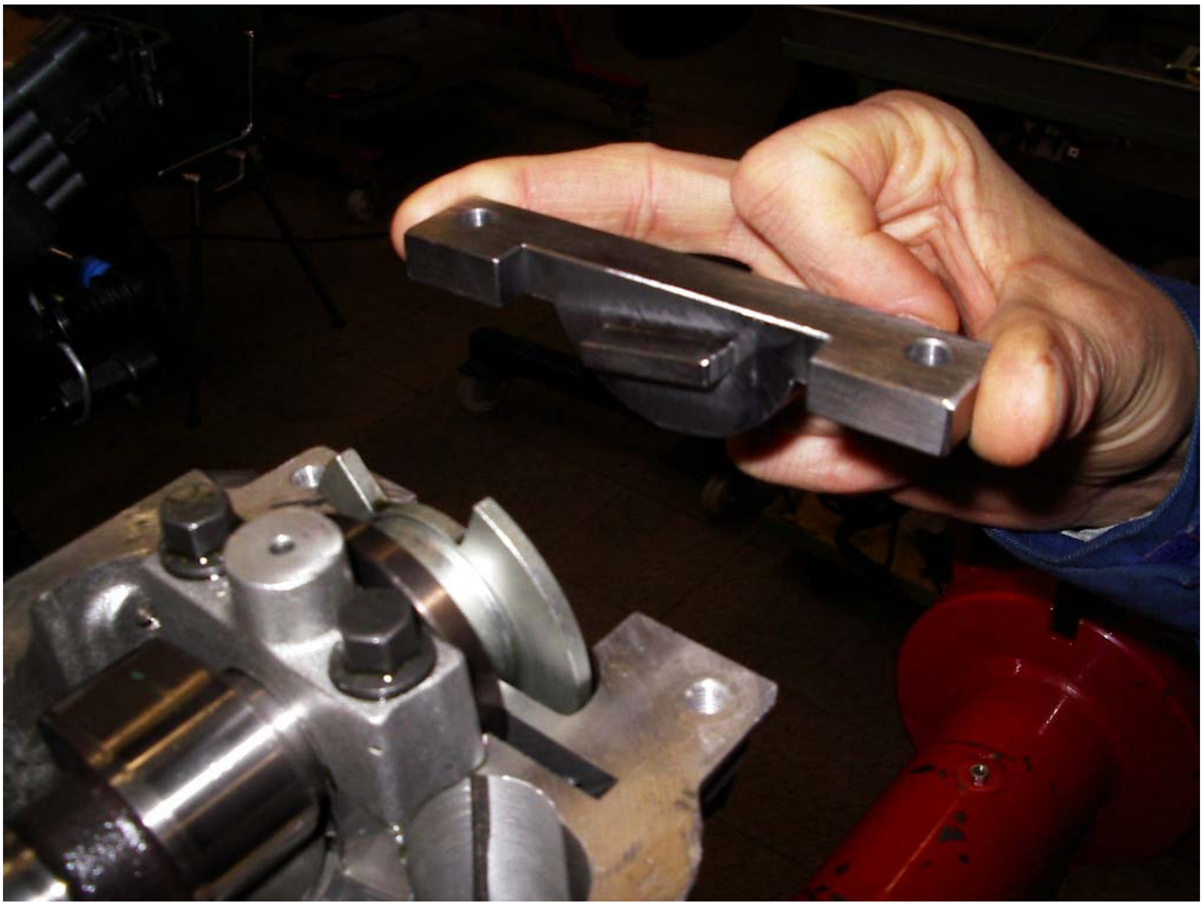


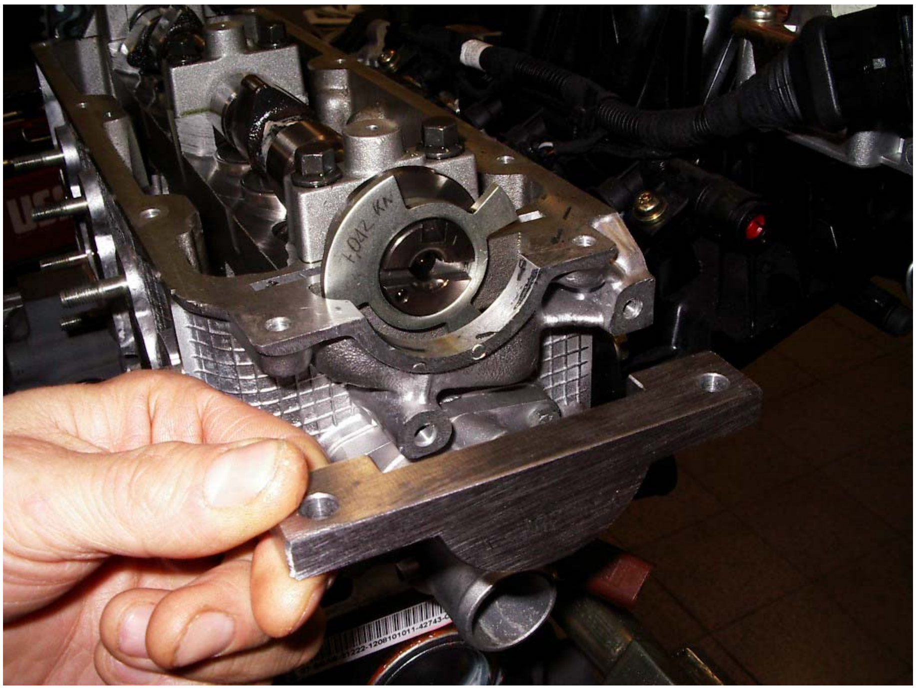


Moving belt stretcher

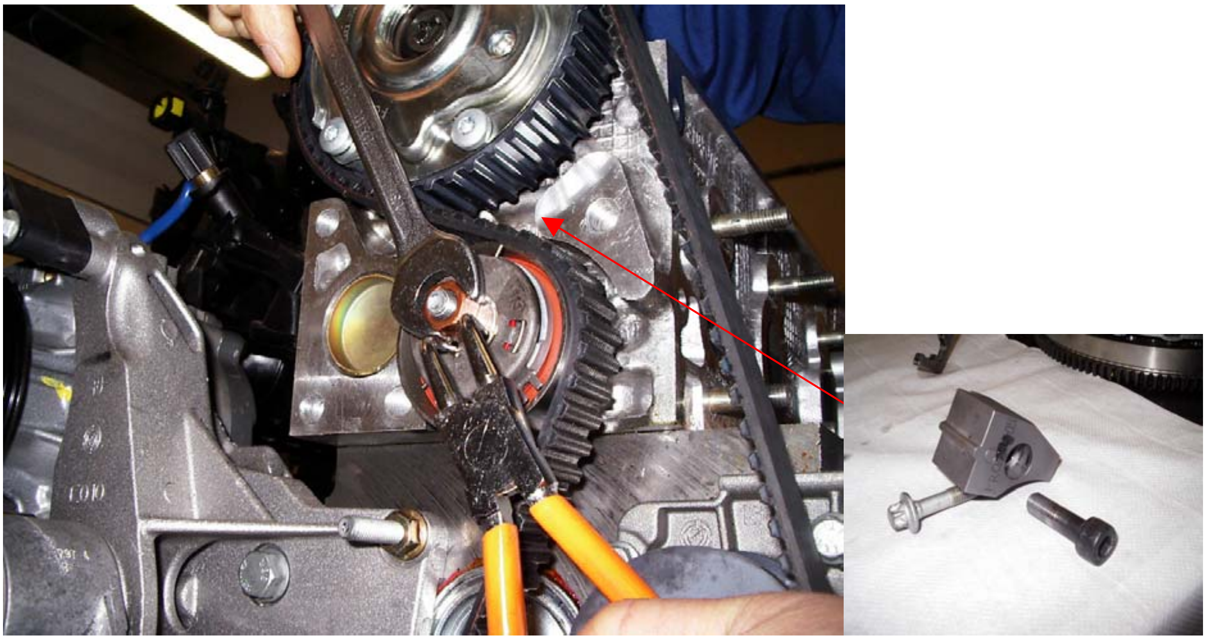
Fit template (2000004400) onto the distributing shaft rear shank.



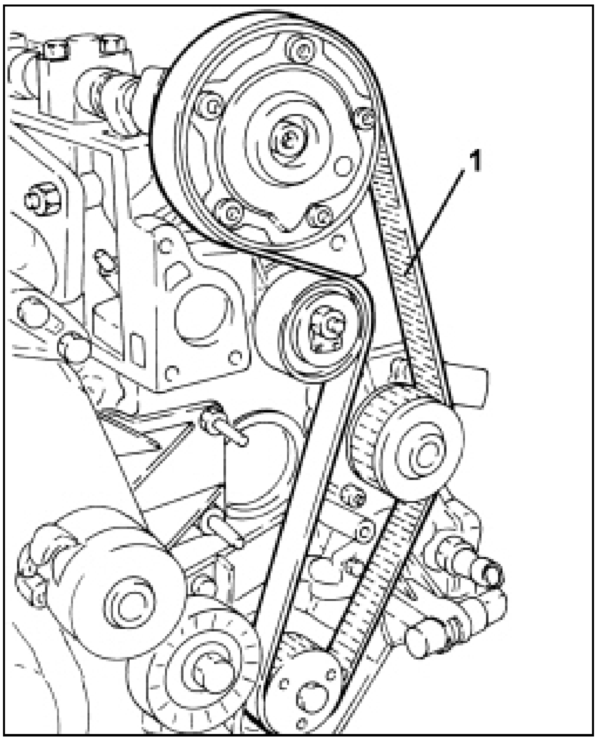




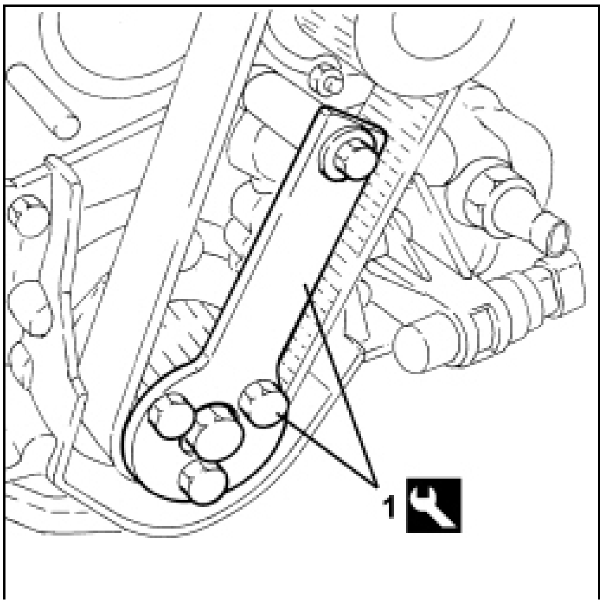
Fit the template securing the pulley to the camshaft.

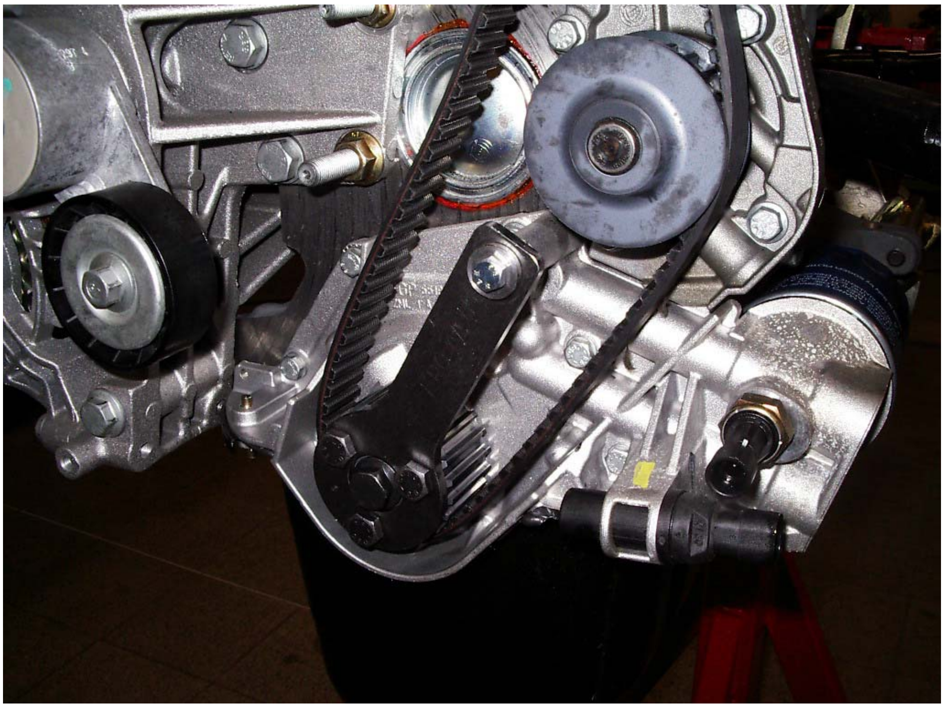


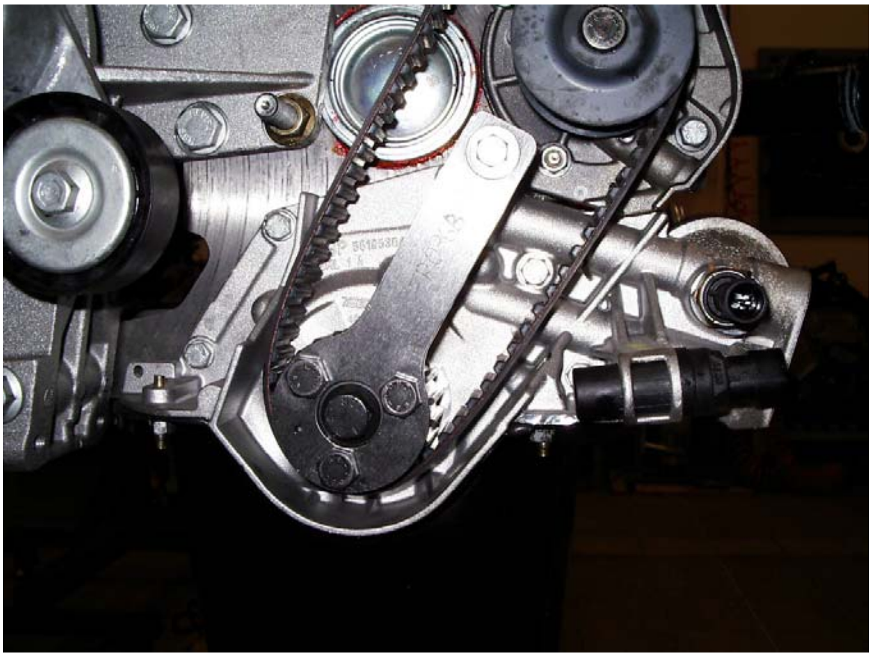
Fit in the timing belt.



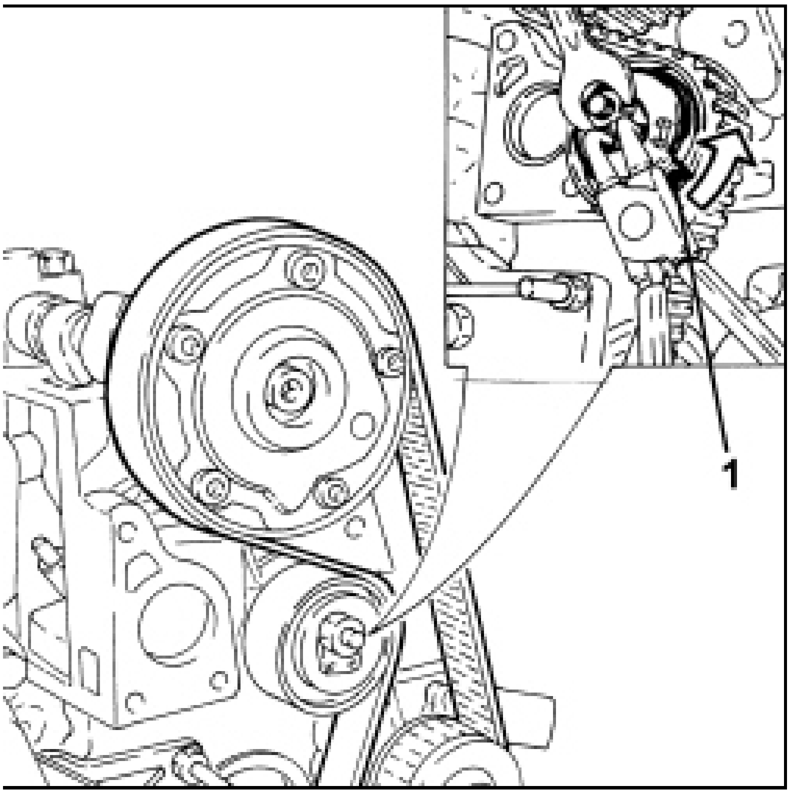
Fit drive shaft timing template (2000004500) onto the driving pulley.

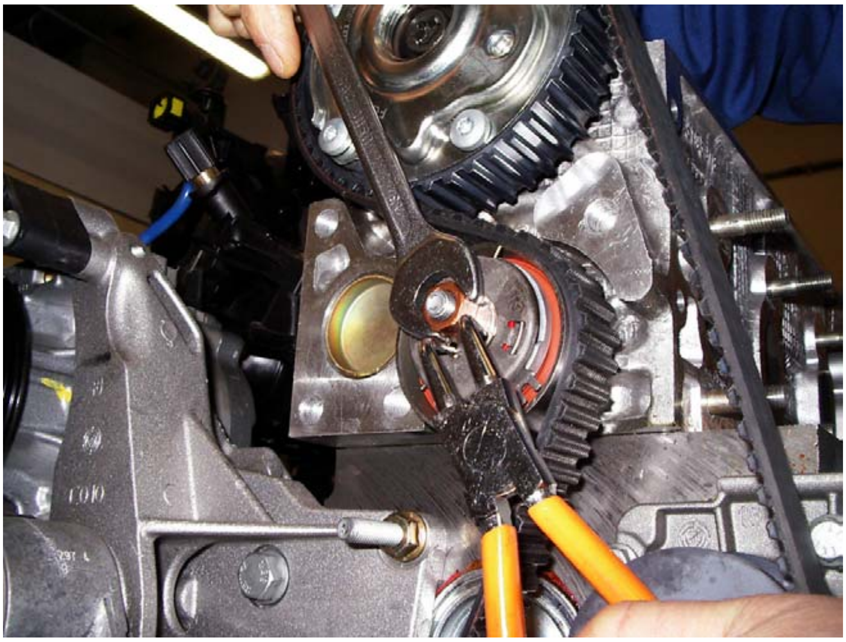






Proceed as shown in the figure to bring the automatic stretcher reference fork to the abutting end.



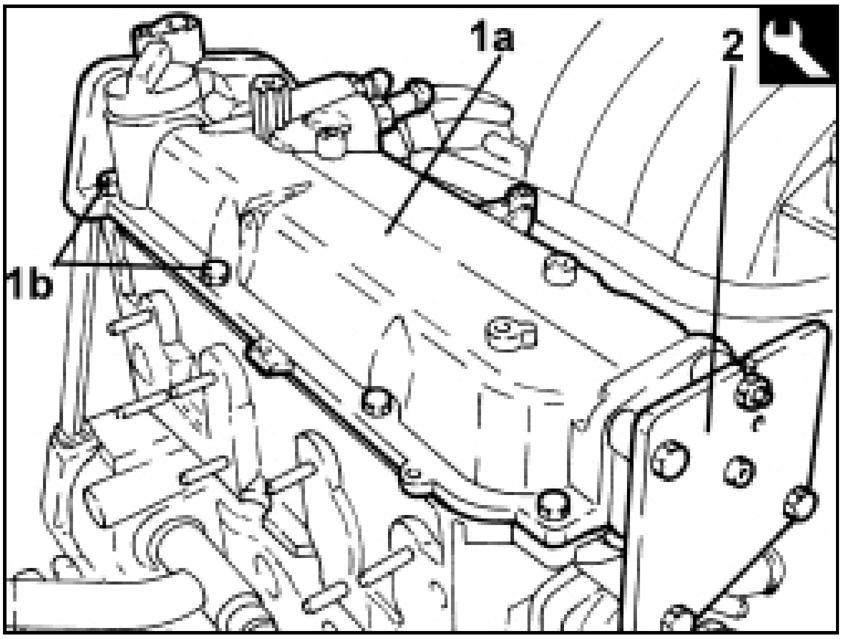


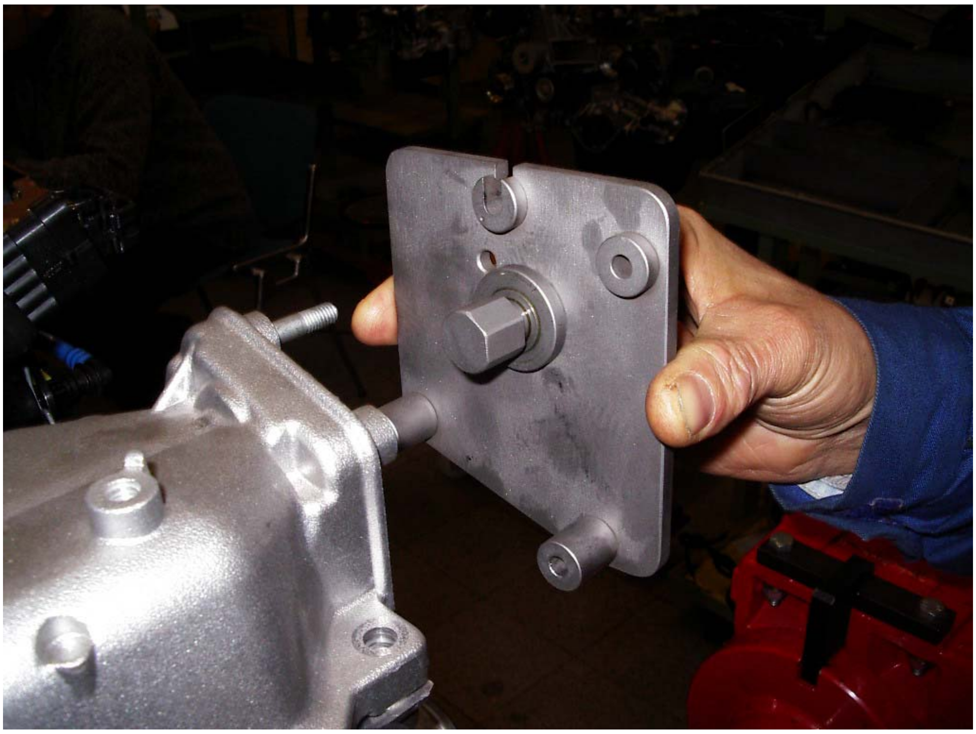
Remove the templates previously fitted, then make the engine turn twice to settle the engine timing belt.
Loosen the belt stretcher fastening nut, then act on the front fork until the latter coincides with the rear fork.
Tighten the belt stretcher fastening nut to the specified torque (2.5 ÷ 3.0 daNm).

Fit the templates previously removed, in order to check engine timing.

Position tappet cover (1a) onto the head, then draw fastening screws (1b) closer.

Fit tappet cover centring tool (2000004300).



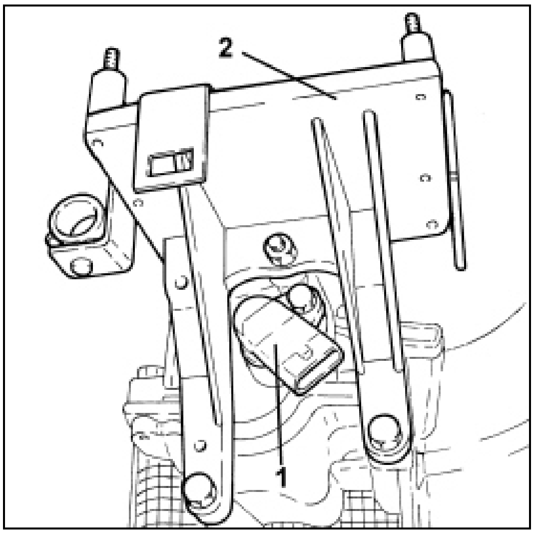


Tighten the tappet cover screws previously drawn nearer to the specified torque (0.8 ÷ 1.0 daNm).

Remove the tappet cover centring tool previously fitted.

Fit the phase sensor.

Fit the injection control unit support.



Fit the power unit support (valve gear side), then secure it by means of the fasteners to the specified torque (5.4 ÷ 6.6 daNm) and the front support elastic dowels (4.5 ÷ 5.5 daNm).

Remove the engine oil sump arm lifting device.

Connect the intermediate junction of the degassing pipe.

Connect the revs sensor electric connection.

Connect the minimum oil pressure switch electric connection.

Fit the timing belt protection lower cover, then secure it by means of its respective screws.

Fit the drive shaft pulley, then tighten the screws to the specified torque (2.2 ÷ 2.7 daNm).

Act on the belt stretcher to fit the auxiliary member belt.

Fit the timing belt upper cover.

Fit the ignition coil module, then tighten the respective screws to the specified torque (0.8 ÷ 1.0 daNM).

Connect the ignition coil module electric connection.

Connect the phase sensor electric connection.

Connect the front engine junction.

Connect the electric connection of the oxygen sensor upstream the catalyst.

Connect the injection control unit ground cable.

Connect the injection control unit electric connections.

List of tools

Type	Item code	Function
Template	2000004500	Drive shaft timing
Template	2000004400	Camshaft timing
Tool	2000004300	Tappet cover centring

5 M20 gearbox

5.1 Features

The M20/6 gearbox belongs to a new family of three-axle transmission units aimed at improving driveability and characterized by enhanced compact design compared with traditional, two-axle gearbox units.
This type of gearbox can sustain and transmit very high torque values (230 Nm): for this reason, it has been fitted to the most performing diesel engine versions (1.3 Multijet 16V, 90 HP).

Below are the main features of this gearbox:

very good gear shift control;
optimum synchronization;
very high transmissible torque;
small dimensions.

The gearbox configuration is of the transverse type, with 3 shafts and a differential.
HCR (High Contact Ratio) toothing is provided for all the gears.
Precision finishing after the thermal treatment is provided for all the gears and the final reduction, in order to ensure total toothing accuracy and, therefore, noiseless operation.
Both the wheelcase and the clutch housing have been optimized for lightweight and soundproofing features by means of a F.E.M. (Finite Element Method) structural analysis method.
The synchromesh for all the forwards gears and the reverse gear is of the free-loop brass type (Borg-Warner type) and is placed on the countershafts (upper shaft for the 3rd, 4th gears and the reverse gear; lower shaft for the 1st, 2nd, 5th and 6th gears).

The synchromesh features a triple-cone design on the 1st and 2nd gears (i.e. the gears most frequently used and subjected to stress) and a double-cone design on the 3rd and 4th gears, to ensure significantly lower engaging effort compared with a traditional, single-cone synchromesh of equal dimensions.
The new internal gear control system, which provides for 4 selection levels, with central bearing gear positioner, gives the advantage of low hysteresis and, therefore, smaller gear selection loads.
The wheels and kinematic mechanisms inside the gearbox are lubricated dynamically through channelled oil flow paths through holes on the cases and shafts. This ensures better torque transmission performance and higher efficiency in terms of wear and manoeuvrability even at low temperatures, thanks to the use of multigrade oil.

5.2 Component

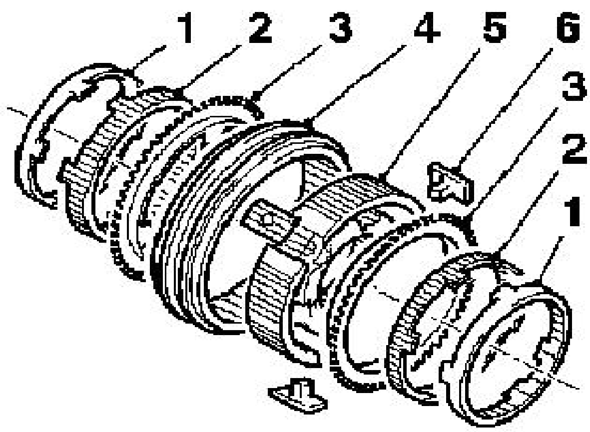
5.2.1 Synchromesh

The M32-6 gearbox features the upgraded synchromesh unit previously fitted to the F40 manual gearbox. The synchronization springs and pins used so far have been replaced by push dowels. Accurate synchromeshes are used with the single gears, too. Two- or three-cone synchromeshes are used. Below are some illustrations that show the synchromeshes used with every single gear.

1st/2nd gears

The three-cone synchromesh is used with the 1st and 2nd gears.

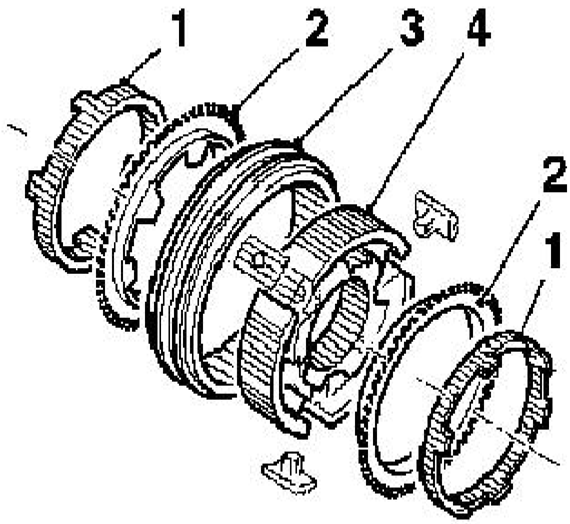
1. Inner synchromesh ring
2. Intermediate ring
3. Outer synchromesh ring
4. Engaging sleeve
5. Synchromesh hub
6. Push dowels



3rd/4th gears

The two-cone synchromesh is used with the 3rd and 4th gears.

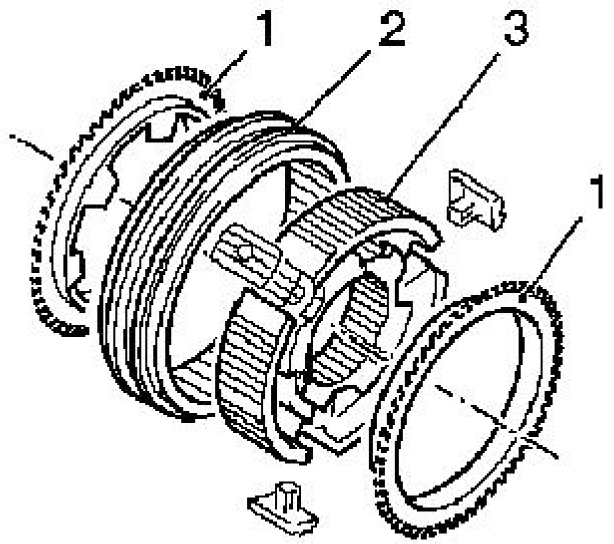
1. Intermediate ring
2. Synchromesh ring
3. Engaging sleeve
4. Synchromesh hub



5th/6th gears

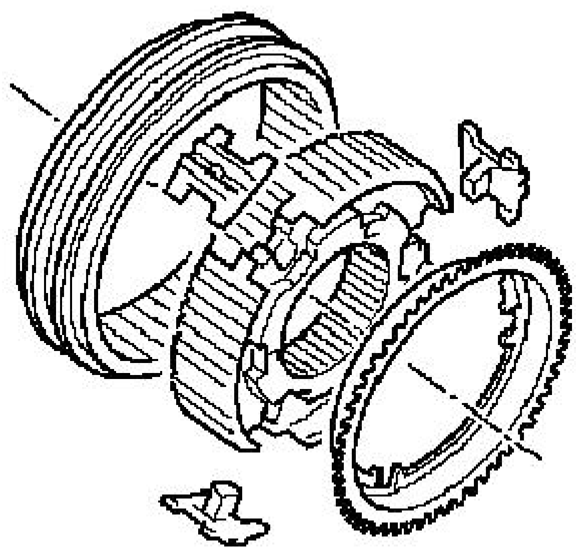
The single-cone synchromesh is used with the 5th and 6th gears.

1. Synchromesh ring Intermediate ring
2. Engaging sleeve
3. Synchromesh hub

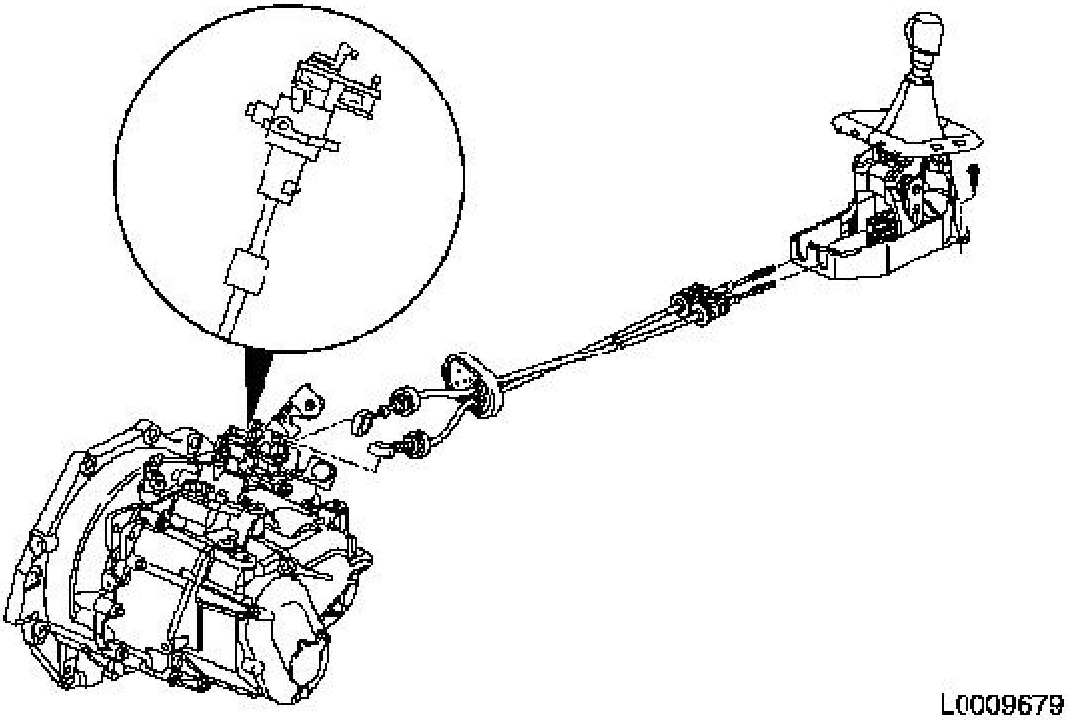


Reverse gear

The reverse gear features a single-cone synchromesh, just like the 5th and 6th gears.

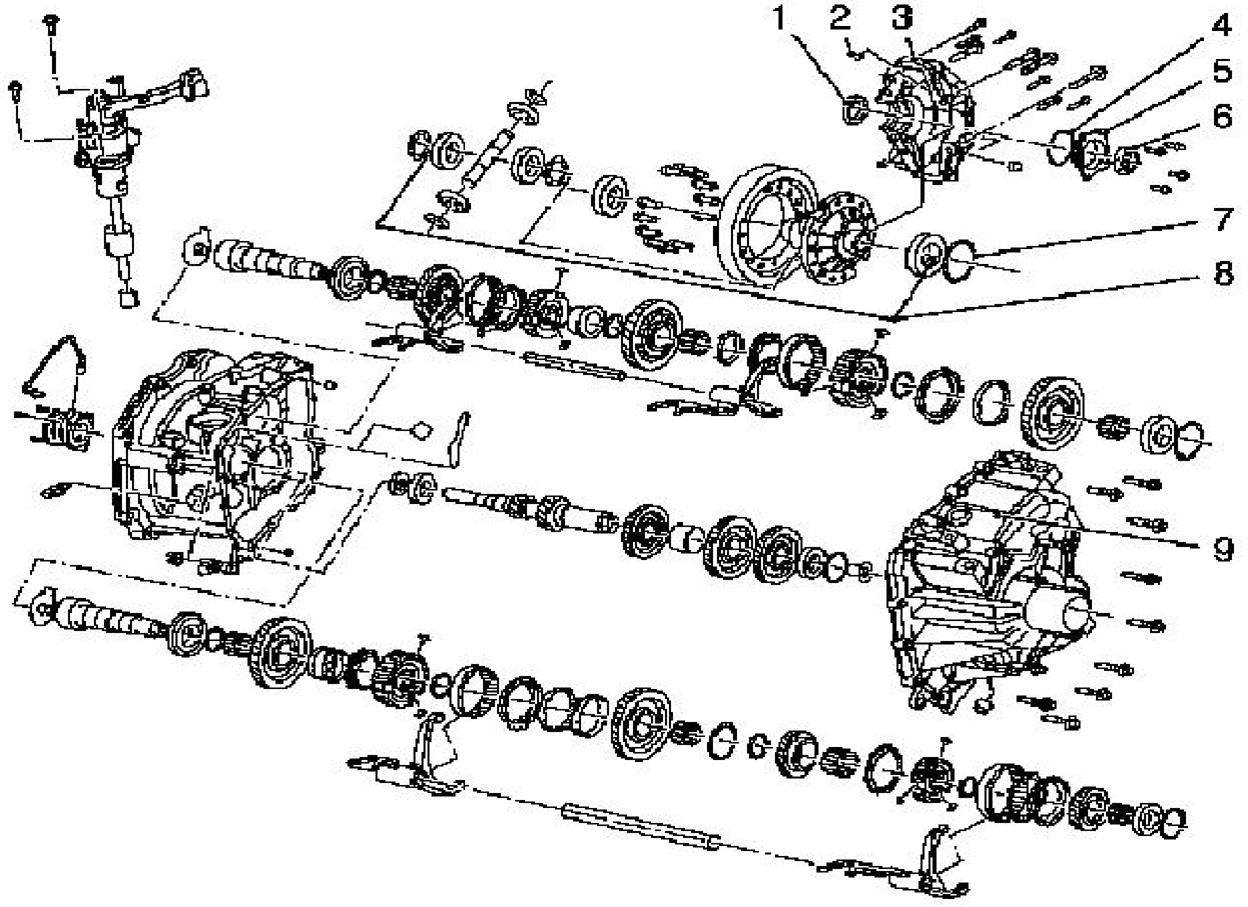


5.2.2 Drive



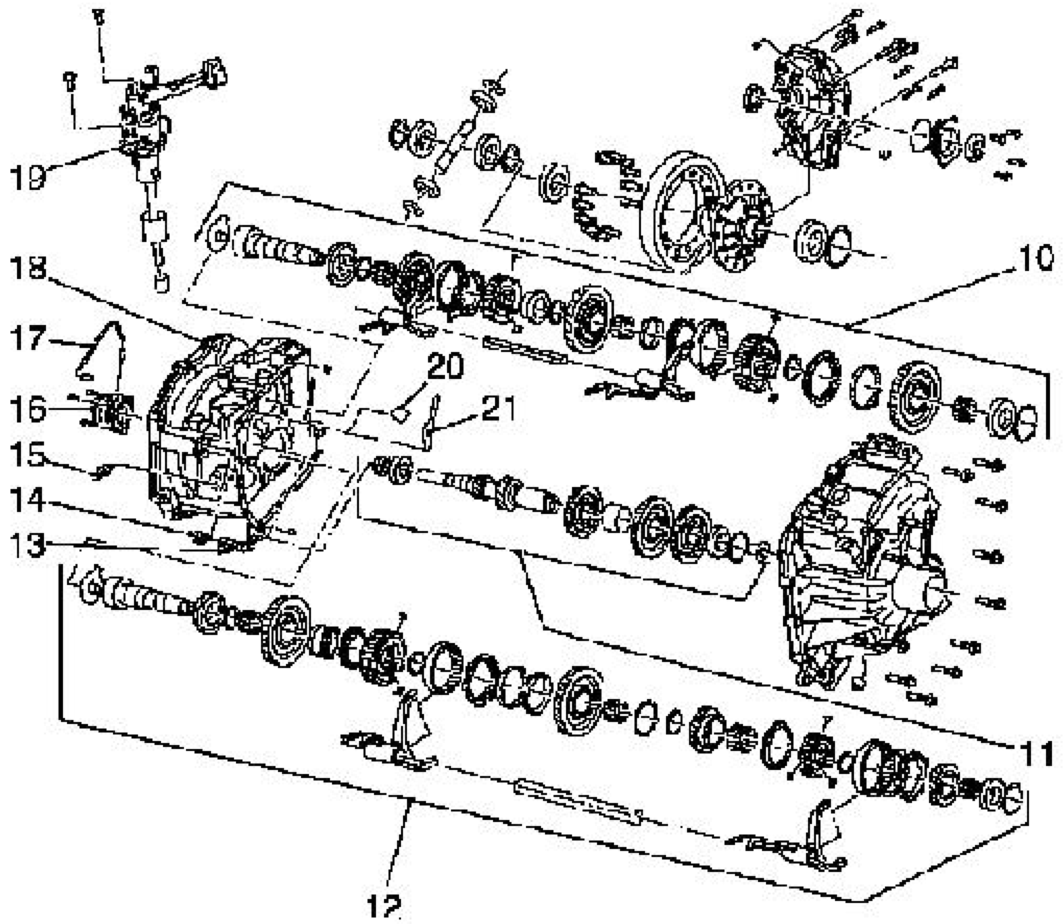
The M20-6 manual gearbox features a tie-rod drive. Every single gear is selected by means of a central control unit.

5.2.3 Shafts



Assembly drawing

1. Axle shaft seal
2. Differential case guide bushing
3. Differential case
4. Axle shaft seal ring sealing flange
5. Axle shaft seal ring sealing flange
6. Axle shaft sealing
7. Differential
8. Differential unit
9. Transmission case



Assembly drawing

10. Upper output shaft assembly

11. Top gear shaft assembly

12. Lower output shaft assembly

13. Clutch vent coupling

14. Fastening bushing

15. Reverse gear headlamp switch

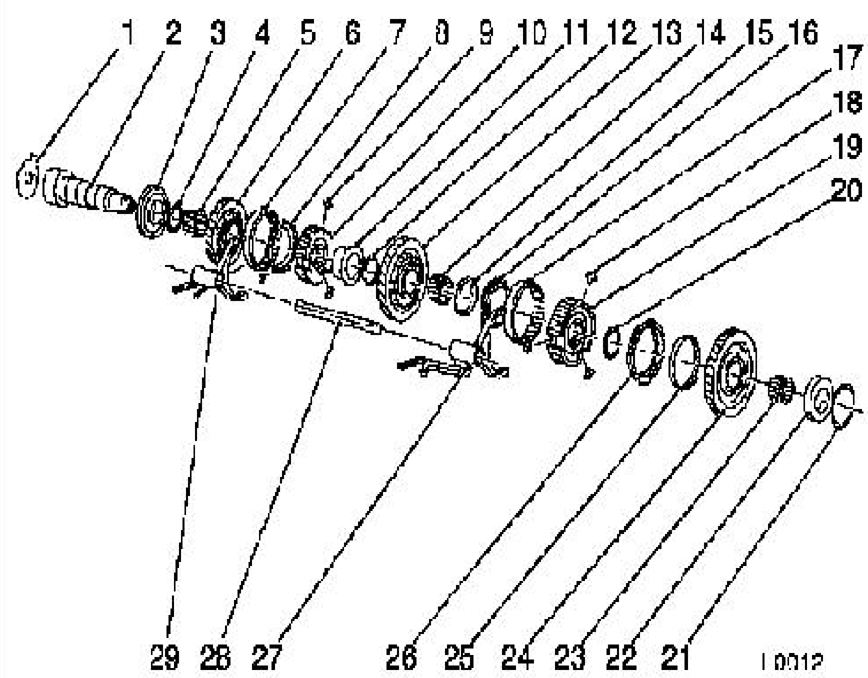
16. Central disengagement

17. Pressure pipe

18. Clutch housing

19. Gearbox control assembly

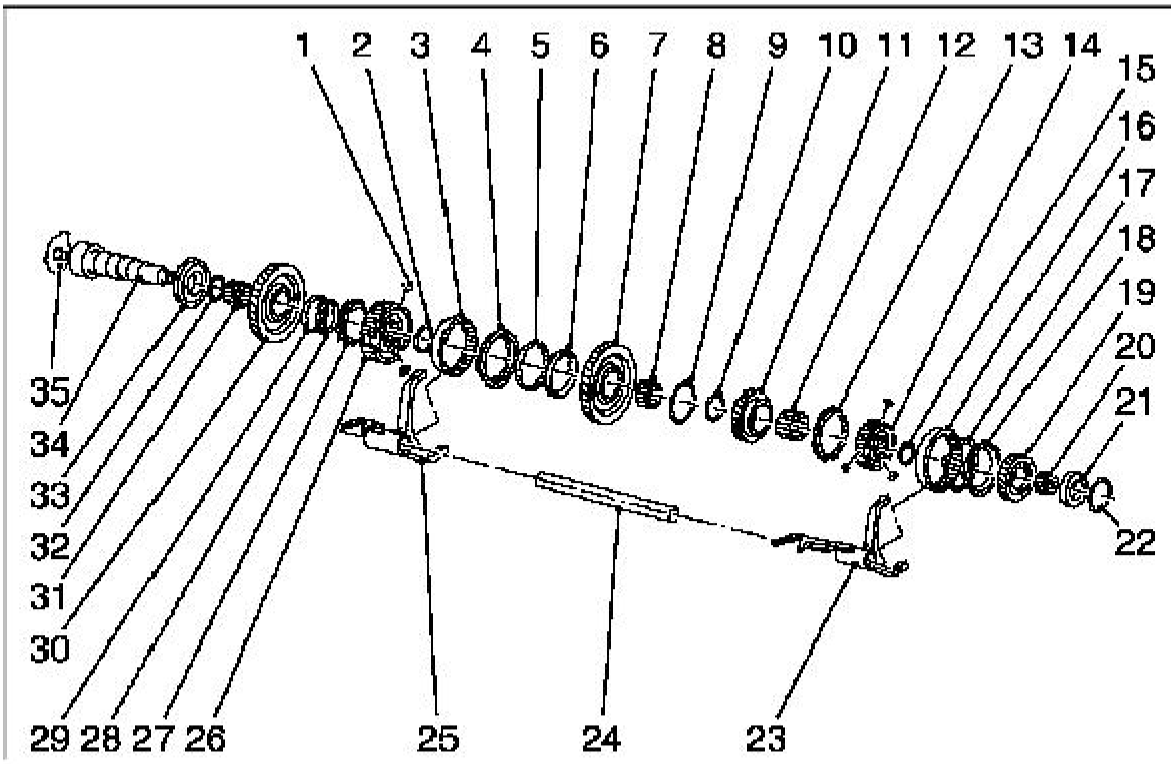
20. Magnet



Position of the upper output shaft components

1. Oil recovery pipe
2. Upper output shaft
3. Upper output shaft roller bearing
4. Safety ring
5. Reverse gear roller bearing
6. Reverse speed gear (driven)
7. Reverse gear engaging sleeve
8. Reverse gear synchromesh ring
9. Push dowel
10. Synchromesh hub
11. Spacer bushing
12. Safety ring
13. 3rd speed gear (driven)
14. 3rd speed gear roller bearing
15. Intermediate ring

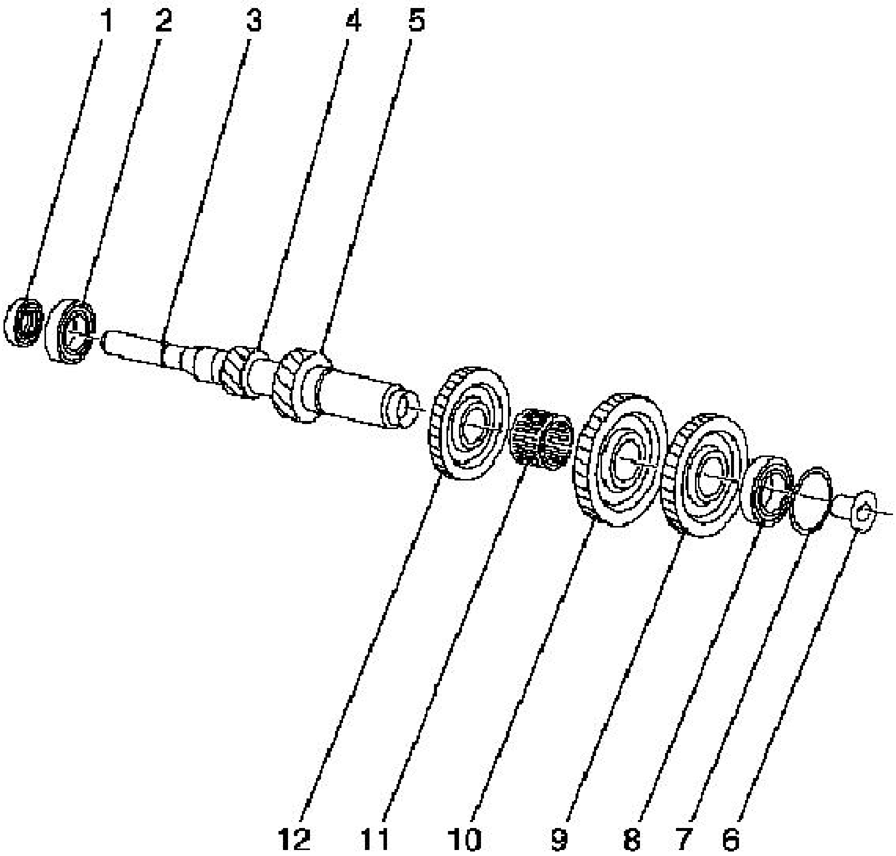
16. Synchromesh ring
17. 3rd/4th speed engaging sleeve
18. Push dowel
19. Synchromesh hub
20. Safety ring
21. Differential
22. Output shaft roller bearing
23. 4th speed gear roller bearing
24. 4th speed gear
25. Intermediate ring
26. Synchromesh ring
27. 3rd/4th speed engaging fork
28. Gearshift lever pin
29. Reverse gear engaging fork



Position of the lower output shaft components

1. Push dowel
2. Safety ring
3. $1^{st}/2^{nd}$ speed engaging sleeve
4. Outer synchromesh ring
5. Outer synchromesh ring
6. Inner synchromesh ring
7. 2^{nd} speed gear (driven)
8. 2^{nd} gear roller bearing
9. Closing ring
10. Thrust washer
11. 5^{th} speed gear (driven)
12. 2^{nd} speed gear roller bearing
13. Synchromesh ring
14. Push dowel
15. Synchromesh hub

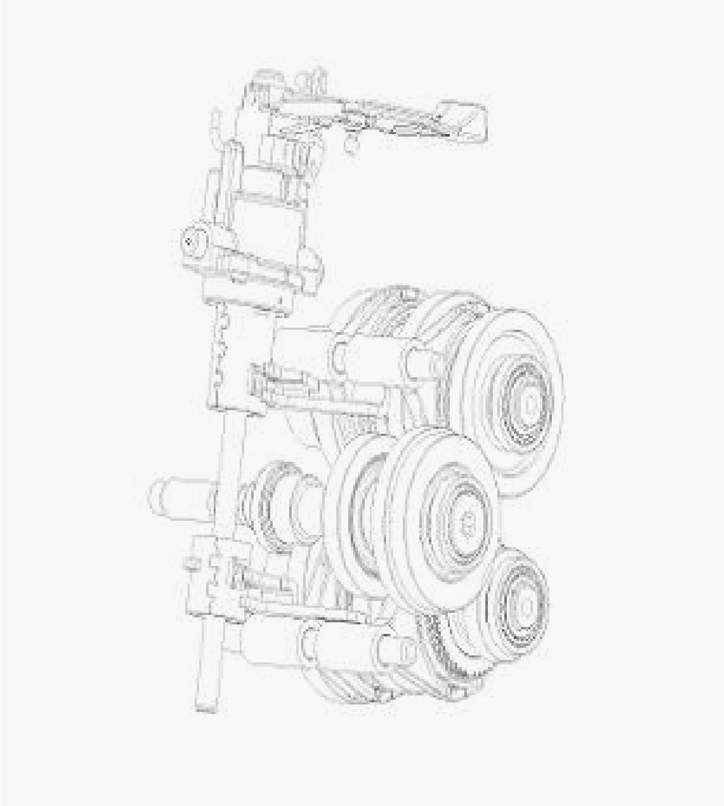
16. Safety ring
17. 5th/6th speed engaging sleeve
18. Synchromesh ring
19. 6th speed gear (driven)
20. 6th gear roller bearing
21. Output shaft roller bearing
22. Differential
23. 5th/6th speed engaging fork
24. Gearshift lever pin
25. 1st/2nd speed engaging fork
26. Synchromesh hub
27. Outer synchromesh ring
28. Intermediate ring
29. Inner synchromesh ring
30. 1st speed gear (driven)
31. 1st speed gear roller bearing
32. Safety ring
33. Output shaft roller bearing
34. Output shaft
35. Oil recovery pipe



Position of the top gear shaft components

1. Top gear shaft seal ring
2. Roller bearing
3. Top gear shaft
4. 1^{st} speed gear (driving)
5. 2^{nd} speed gear (driving)
6. Top gear shaft screw
7. Differential
8. Top gear shaft bearing
9. 6^{th} speed gear (driving)
10. 4^{th} speed gear (driving)
11. Spacer bushing
12. $3^{rd}/5^{th}$ speed gear

5.3 Configuration

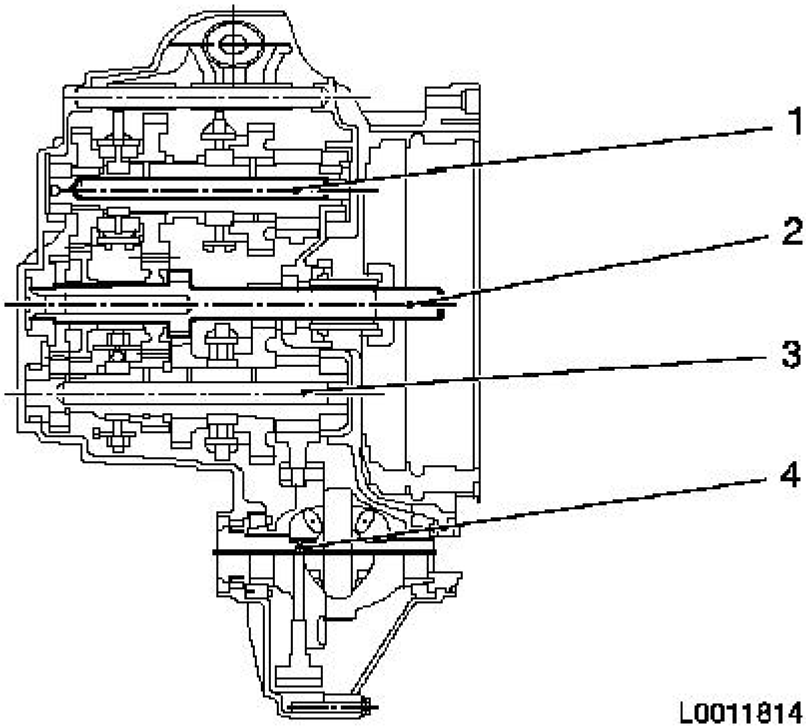


Transverse, with 3 shafts supported on ball bearings

6 forward gears + reverse gear

Transmissible torque: 230 Nm

Total length (from the engine flywheel): 332 mm.



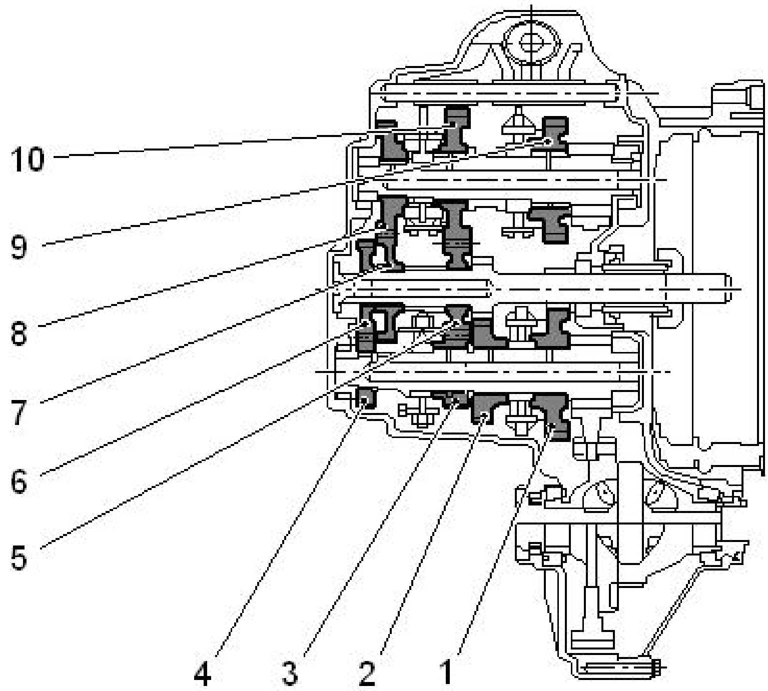
Shaft position

The cutaway figure below illustrates the position of the respective shafts according to the 3-shaft arrangement in the M20 6-speed gearbox:

1. Upper output shaft
3. Lower output shaft
2. Top gear shaft
4. Differential

Oblique, tapered-roller bearings are used with all the shafts in this gearbox unit. These bearings require some bearing play as well as a bearing pre-load. Both the bearing play and preload are obtained, during the manufacture, by using compensating washers under the oblique, tapered-roller bearings in the transmission case.

5.4 Speed gear arrangement

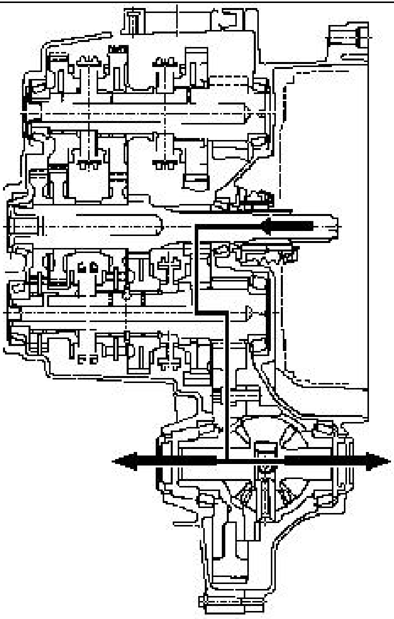
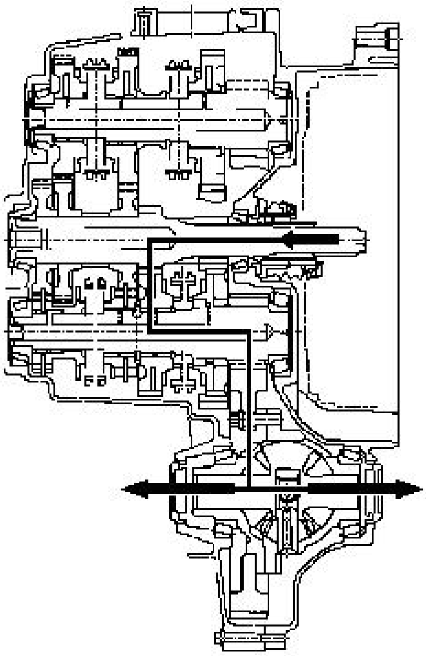


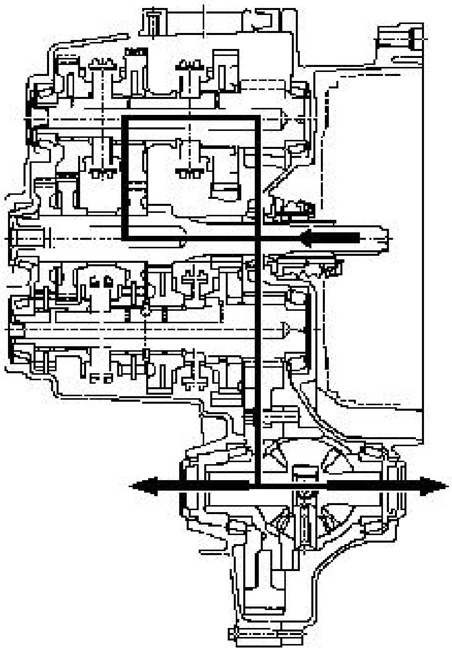
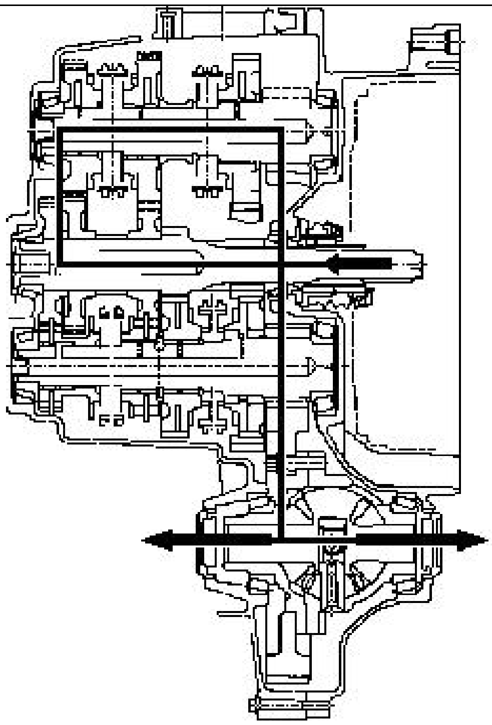
Position of the speed gears on their respective shafts

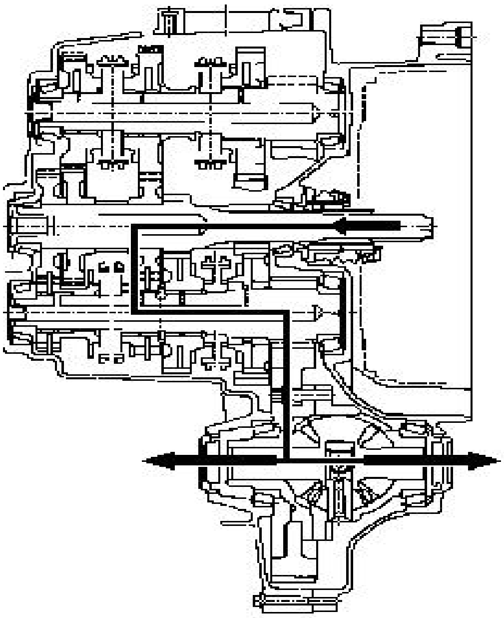
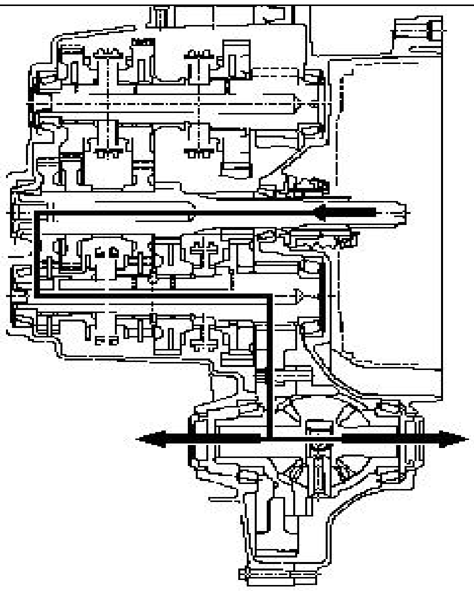
1. 1st speed gear
2. 2nd speed gear
3. 5th speed gear
4. 6th speed gear
5. 3rd/5th speed gear
6. 6th speed gear
7. 4th speed gear
8. 4th speed gear
9. Reverse speed gear
10. 3rd speed gear

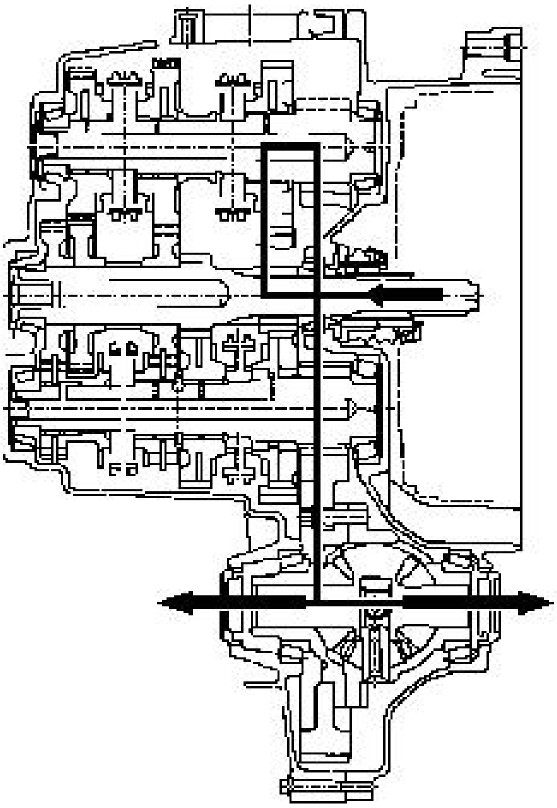
This 3-shaft gearbox unit is advantageous in that the 3rd speed gear on the top gear shaft is also used for the 5th speed.

5.5 Kinematic route of the single gears

	1st speed
	2nd speed

	3rd speed
	4th speed

	5th speed
	6th speed



Reverse speed

6 Brakes

6.1 Description

The braking system fitted to Nuova Punto includes, in its fullest version, the following items:

ABS: wheel antilock system;

EBD: electronic braking distributor between the front and rear wheels;

ESP: electronic vehicle stability control (available on request);

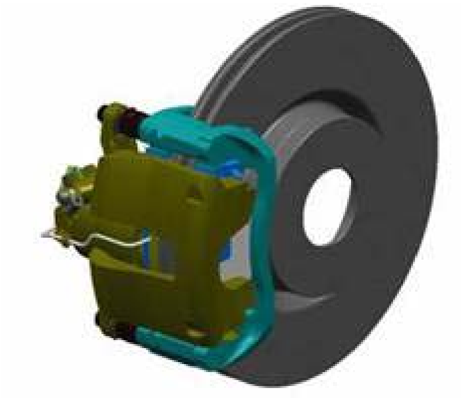
ASR: traction control;

MSR: wheel antilock function in case of excessive exhaust braking;

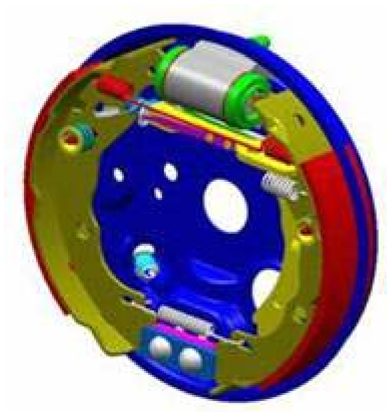
Hill-holder (with ESP): a device that allows the driver to park and start the vehicle again along steep roads without using the handbrake;

HBA: emergency braking assist device.

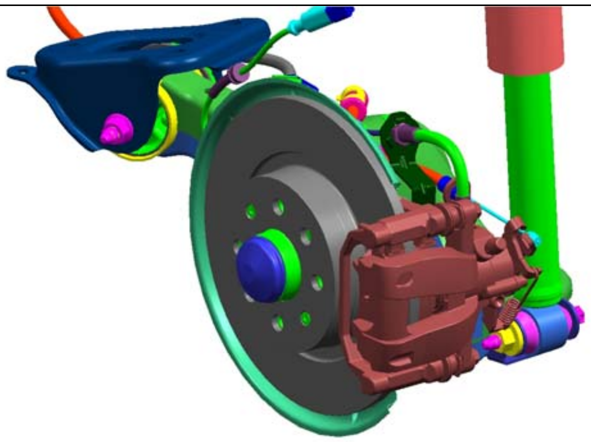
The braking system is of the hydraulic, power-assisted type and is made up of 2 self-contained crossed circuits (each circuit acts on a front wheel and the diagonally opposing rear wheel) in order to ensure braking and vehicle stability even when one of the circuits is broken.



Ventilated front disc



Rear drum



Rear disc

The new braking system features different characteristics, due to the different weight and rating of the various engine versions:

1.2 8V engine version:
front solid disc diameter: 257 x 12 mm;
Bosch ZOH brake calipers with piston diameter of 54 mm;
brake pad surface area: 43 cm^2;
rear drum diameter: 203 mm.

1.4 8V & 1.3jtd 70 HP engine version:
ventilated front disc diameter: 257 x 22 mm;
Bosch ZOH brake calipers with piston diameter of 54 mm;
brake pad surface area: 43 cm^2;
rear drum diameter: 228 mm.

1.3jtd 90 HP engine version:

ventilated front disc diameter: 284 x 22 mm;

Bosch ZOH brake calipers with piston diameter of 54 mm;

brake pad surface area: 52 cm^2;

rear drum diameter: 228 mm.

1.9 jtd 120 HP engine version:

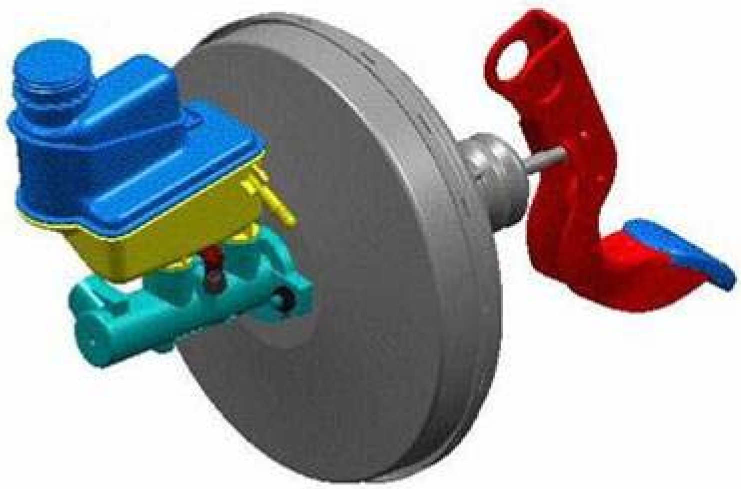
ventilated front disc diameter: 284 x 22 mm;

Bosch ZOH brake calipers with piston diameter of 54 mm;

brake pad surface area: 52 cm^2;

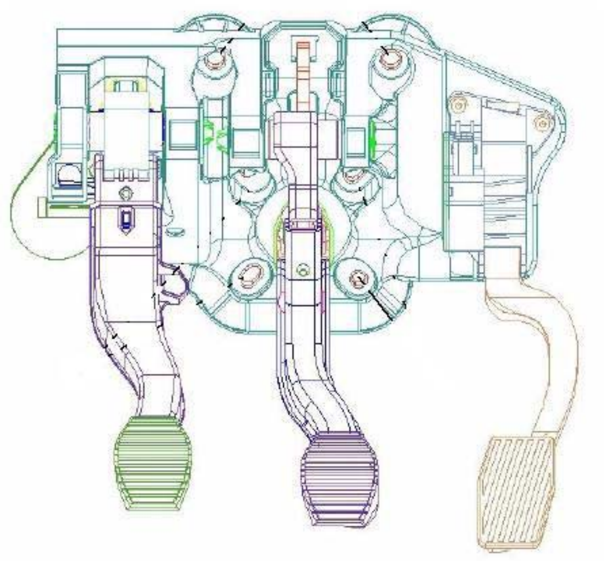
Bosch BIR II brake caliper solid disc (264 x 11 mm).

6.2 Power brake



Nuova Punto features a 10” power brake, with 15/16” pump and tank.

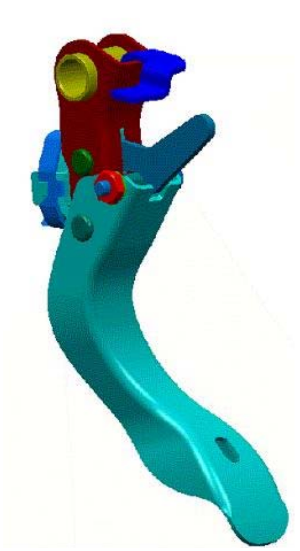
6.3 Pedal unit



Nuova Punto incorporates a pedal unit with plastic supports, which includes the brake, clutch and accelerator pedals. The accelerator and clutch pedals are made of plastic.

The pedal unit features a device that allows the brake pedal to collapse in case of collision, thus minimizing its penetration into the passenger compartment and, therefore, lower limb injury.

In case of disconnection, the pedal shall be replaced.



The pedal unit system is made up of the following components:

plastic pedal support;

plastic accelerator pedal, with a potentiometer;

metal brake pedal;

plastic clutch pedal.

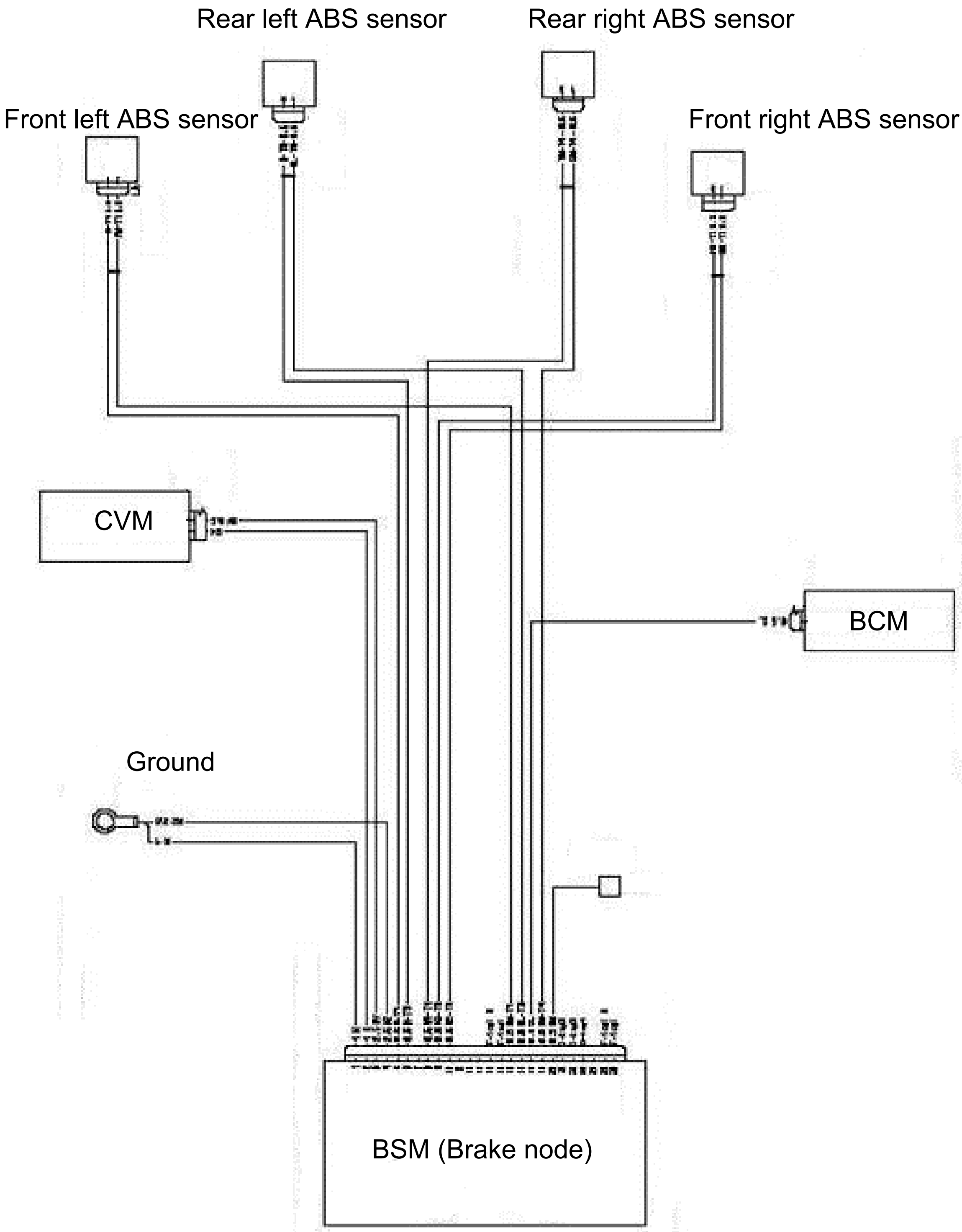
6.4 ABS system

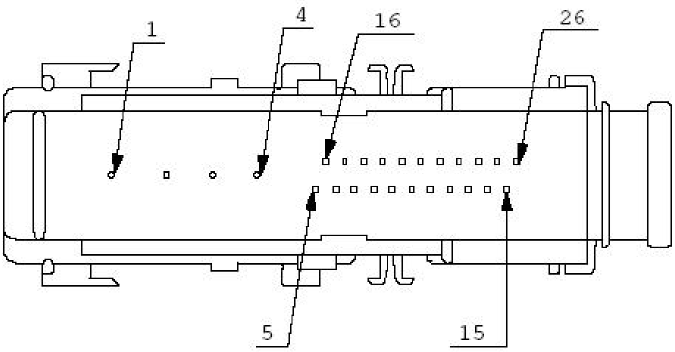
All the Nuova Punto versions are equipped with the Bosch 8.0 ABS antilock system, with built-in EBD (Electronic Brake force Distribution), which controls the braking action so as to prevent rear wheels from being locked, thus ensuring correct distribution of the braking action to the axles under any condition.
The Bosch 8.0 ABS system is one of the most advanced systems currently available on the market. The system is made up of the components below: one hydraulic control unit with 12 solenoid valves, 4 active sensors and 4 channels with braking corrector (distributor).

The system's peculiarities as far as active safety is concerned are as follows:
it ensures that every wheel about to be locked is braked as efficiently as possible, compatibly with the road grip conditions available;
it ensures full vehicle control under extreme conditions, when the wheels are about to get locked;
it ensures prompt control response;
it is capable of adjusting itself automatically to a wide range of operating conditions;
the control unit is lightweight.
The function of the active sensors is to measure the wheel speed.
The main peculiarity of active sensors is that the signal is processed directly by the sensor.
The active sensors enhance the accuracy of the vehicle's control systems, thanks to the capability of detecting very low speeds (2.7 k.p.h.).

Moreover, the information gained by the ABS active sensors are used to update, by means of the GPS (Global Position System) satellite detection system, the position of the vehicle on the maps included in the memory. Therefore, continuous information is essential, even at low speeds, about the road along which the vehicle is driven, to calculate the exact position of the vehicle.

6.4.1 ABS wiring diagram



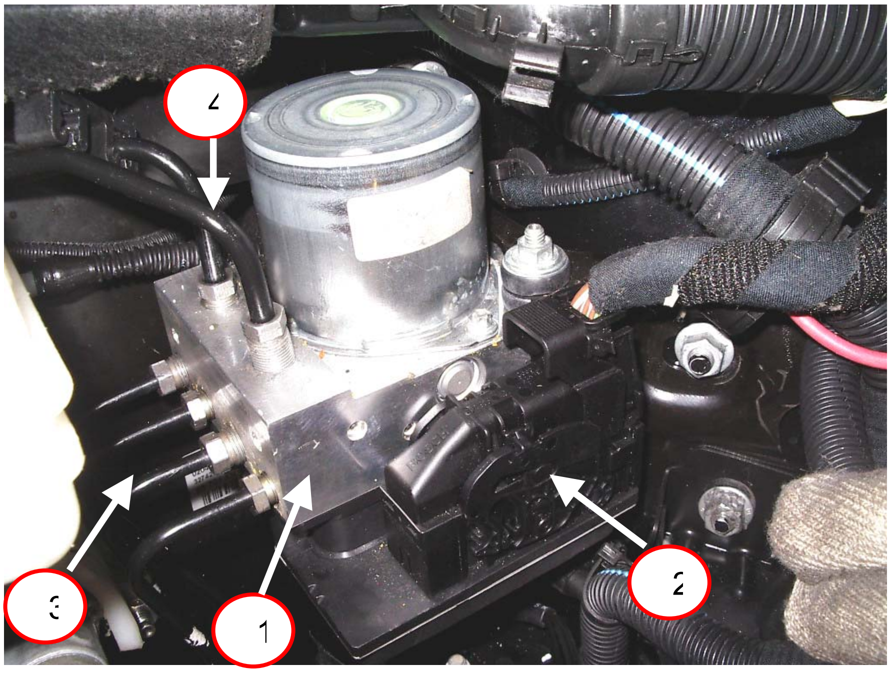


ABS control unit pin-out

1. Pump ground
2. Pump +30
3. Solenoid valve +30
4. Solenoid valve ground
5. Front left ABS sensor signal
6. Rear left ABS sensor power supply
7. N.C.
8. Rear right ABS sensor power
9. Front right ABS sensor power supply
10. Front right ABS sensor signal
11. K line
12. N.C.
13. N.C.
14. C-CAN L1 in
15. C-CAN L1 out
16. Front left ABS sensor power supply
17. Rear left ABS sensor signal
18. Body Computer node
19. Rear right ABS sensor signal
20. Brake lights
21. ASR button input
22. ASR button LED
23. VSO output
24. N.C.
25. C-CAN H1
26. C-CAN H”

6.4.2 ABS hydraulic unit

The ABS electro-hydraulic control unit (1) is connected to the brake pump and calipers through the braking system pipes and makes up, together with the electronic control unit (2), the electro-hydraulic driving unit. This unit is fitted in a vertical position and incorporates 4 couplings (3) on its side: two front pipe couplings and two rear pipe couplings. Moreover, two pipes from the master cylinder are found on the upper part (4).



ABS hydraulic unit

6.5 E.S.P.

The E.S.P. (Electronic Stability Program) is an active safety system for controlling the vehicle during dynamic manoeuvres. It comes into operation in emergency situations and has been designed to correct the path of the vehicle in case of sudden manoeuvres (which are often unintentional), thus enhancing active safety, especially on slippery road surfaces. In fact, the E.S.P. promptly responds both to oversteering and understeering, and is set to resume the vehicle's stability condition while allowing the driver to fully control the vehicle.
The system continuously monitors the vehicle motion conditions (side acceleration, longitudinal and angular speed, road grip) and the driver's setting (steering wheel angle, accelerator pedal). The system corrects the vehicle motion when it "feels" that the vehicle is about to reach a condition of instability (sideslip, understeering, oversteering, etc.): in this case, it acts on the deflecting torque control and applies a proper braking torque distributed to each of the four wheels.
Direction is controlled by taking advantage from the tyre's longitudinal grip: the different braking action between the two vehicle sides generates a rectifying (yawing) torque that stabilizes the vehicle.
The ESP function is managed by the ABS control unit which monitors, by processing the values of the quantities acquired from the various sensors (side acceleration sensor, yaw sensor, steering angle sensor, wheel revs sensors and pressure sensors) through algorithms implemented in the software, the dynamic control parameters (wheel slip, axle drift, trim angle) and interprets the mistakes (if any) made by the driver, thus taking adequate actions in order to resume the vehicle's stability condition.

The system is made up of the following components:
4 wheel speed sensors fitted into special seats on the front and rear pillars;
1 side acceleration and yaw sensor incorporated into one single device fitted onto the central tunnel;
1 electro-hydraulic unit fitted onto the special support in the engine compartment;
1 switch on the brake pedal;

1 ON/OFF button (available on the dashboard) to switch the A.S.R. off;

1 steering angle sensor built into the steering column;

1 longitudinal acceleration sensor (**YRS)** built into the yaw sensor (available only with the Hill Holder option).

In addition to the above-mentioned sensors (and, of course, the control unit), the system is interfaced with the items below:

high speed CAN line (ABS data exchange with the engine control unit / automatic transmission control unit);

power assembly (specific brake pump);

power-driven throttled body (petrol versions; data exchange with the ASR);

instrument board (warning lights of the active type);

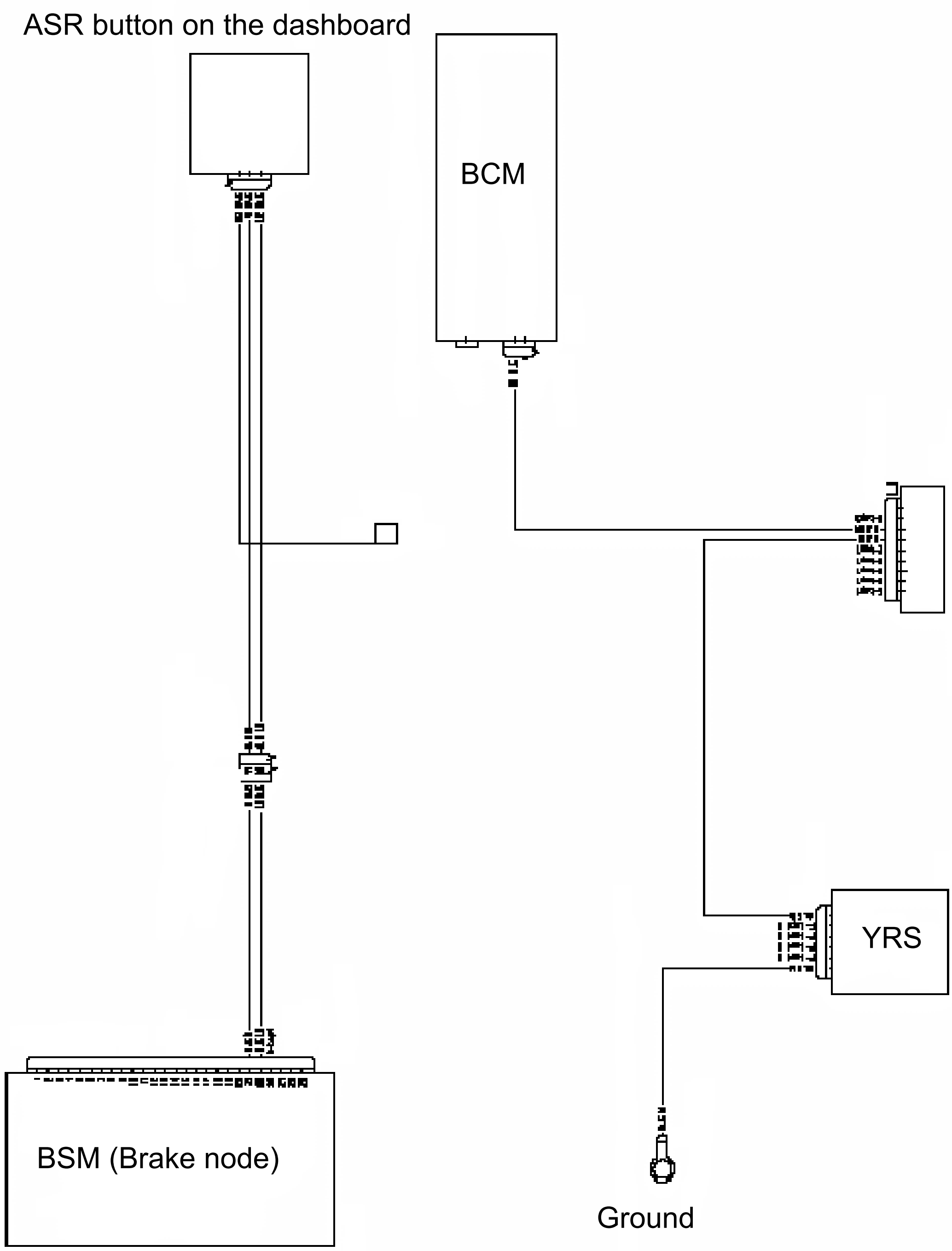
steering angle sensor fitted to the steering column;

yaw sensor located on the central floor, in the central cabinet area (to detect the vehicle's side acceleration and inclination);

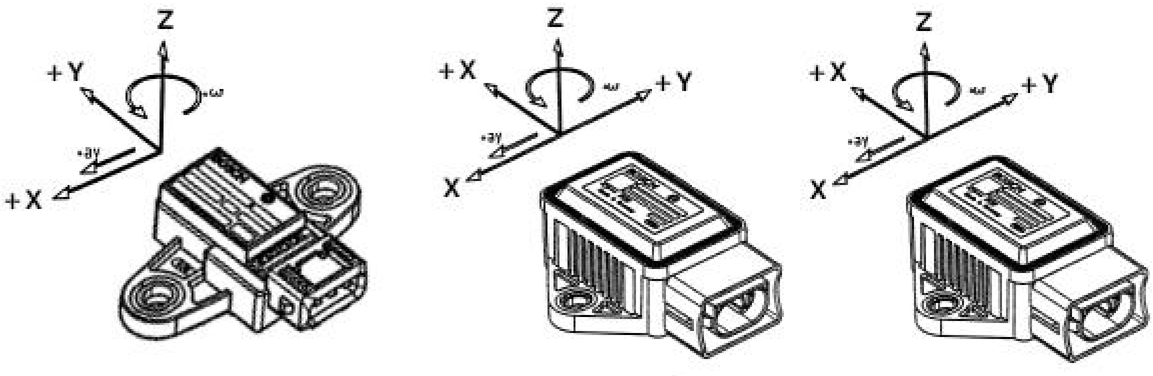
special control unit fitted to the engine compartment.

The E.S.P. is automatically switched on when the vehicle is started and cannot be switched off.

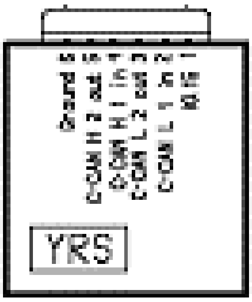
6.5.1 ESP wiring diagram



6.5.2 YRS (Yaw Rate Sensor)



The YRS must be assembled with the arrow stamped on the sheet facing the direction of running, and the connector facing the vehicle rear part.



	1. Power supply
	2. C-Can L1
	3. C-Can L2
	4. C-Can H1
	5. C-Can H1
	6. Ground

This node incorporates the yaw, longitudinal acceleration and transverse acceleration sensors into one single component.

6.5.3 A.S.R. (Anti Slip Regulator)

This is a vehicle drive control function that comes into operation automatically when one or both of the driving wheels skid. This function is available only with the ESP.

Two different control systems are actuated, depending on the slip conditions:

if both the driving wheels slip, the ASR comes into operation by reducing the power delivered by the engine;

if only one driving wheel slips, the ASR comes into operation by automatically braking the slipping wheel.

The ASR system is very useful especially if the following conditions occur:

inner wheel slip when cornering, due to dynamic load variations or excessive acceleration;

excessive power transmitted to the wheels, even depending on the road surface conditions;

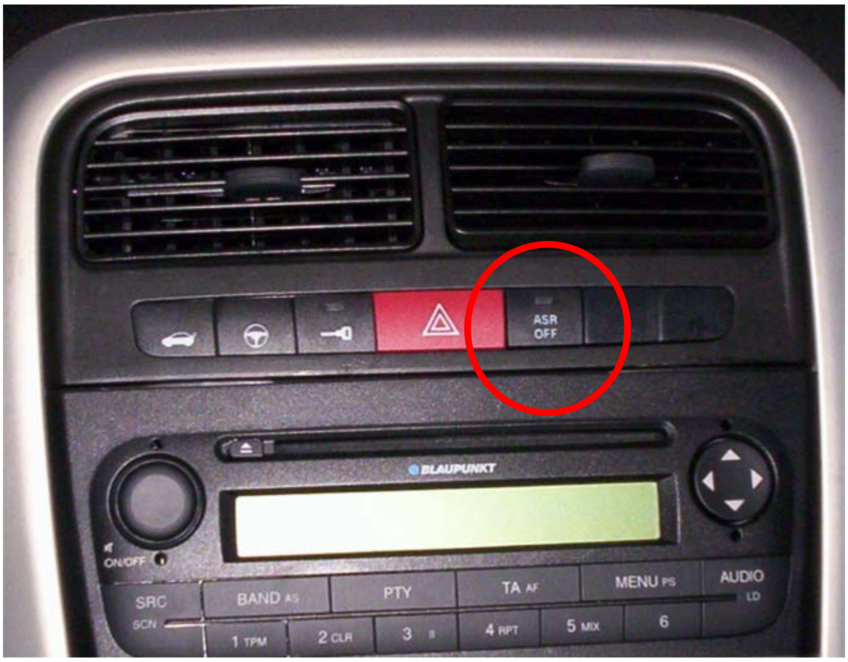
vehicle acceleration on slippery, snow-covered or icy road surfaces;

loss of grip on wet roads.

A.S.R. switch-on/off

The ASR is switched on automatically every time the engine is started.

The ASR can be switched off and then on again when the vehicle is running, by pressing the special switch located among the controls on the instrument board.



When travelling on snow-covered roads with the snow-chains fitted to the wheels, the ASR can be switched off: under these conditions, the driving wheel slip during the pick-up phase makes it possible to achieve better traction.

To ensure correct operation of the ASR system, all the tyres should be of the same type on all the wheels; moreover, they should be in perfect conditions and, above all, of the prescribed type, make and dimensions.

6.5.4 M.S.R

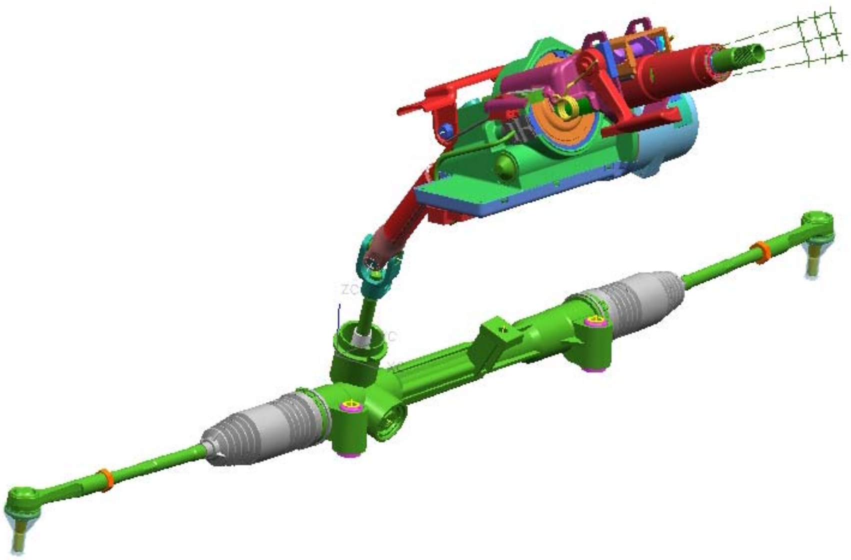
This function is an integral part to the ASR and comes into operation in case of a sudden shift-down, by delivering torque to the engine again. Thus, excessive driving wheel drag is avoided, which may cause the vehicle's loss of grip, especially in poor grip conditions.

6.5.5 Hill Holder

The "Hill-holder" function, combined with the ESP system, assists the driver in starting the vehicle uphill. This function combines the information gained, through special sensors, from the pedal unit, gearbox and engine management control unit, so as to automatically deliver the braking torque required to keep the vehicle stationary until when the driver releases the clutch pedal and the deflecting torque is enough to set the vehicle moving.

7 Electric drive

7.1 Description



All the Nuova Punto versions are equipped with electric power steering (E.P.S.).

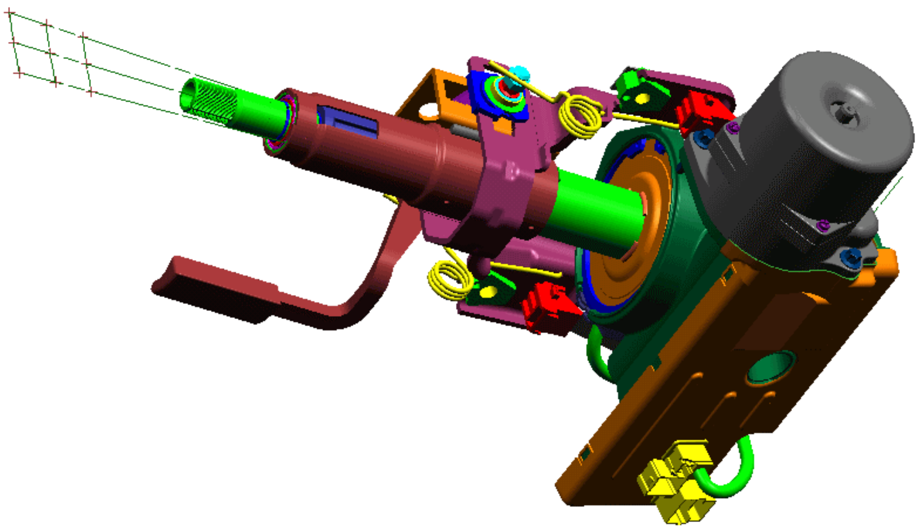
The Nuova Punto steering control has been designed to minimize the driver's effort on the steering wheel during the parking manoeuvres, combined with accuracy and safety during high-speed driving.

2.8 steering wheel turns are required for full stop-to-stop steering, and the kerb-to-kerb steering diameter is 10.1 m (vehicles equipped with long-travel rack and 175 tyres) or 10.76 m (vehicles equipped with short-travel rack and any other type of tyre).

The electric power steering is actuated by an electric motor that is more compact and lightweight compared with the previous systems.

It is made up of a steering column with integrated, electric drive system, and a special management control unit.

7.2 Electric Power Steering (EPS)



The electric power steering comes as a standard item on all versions. Power steering is ensured by an electric motor located in the dashboard area, which transfers the generated torque directly onto a toothed wheel coaxial and integral to the column.

The torque delivered at the input by the driver is detected by a sliding-contact potentiometer sensor.

The electric steering column fitted to the Nuova Punto incorporates the steering angle sensor, too: this signal is also used by the ESP control unit (if available). In case of service procedures, the steering angle sensor shall be reset by means of a suitable diagnosis instrument.

The driver can choose from two drive programs (City and Normal), which can be selected by means of a button available on the dashboard.

“City” button

The “City” program maximizes comfort during the parking manoeuvres, with record-breaking effort on the steering wheel (2.5 Nm compared with 4-6 Nm of traditional power steering systems). The “Normal” program ensures average performance during the parking manoeuvres while ensuring a gradual, optimum effort on the steering wheel even at low speeds, especially in poor road grip conditions. In any case, both programs provide varying interlocking depending on the vehicle speed (gradual power-assistance), therefore with no compromise between the performance during the parking manoeuvres and the steering control quality when the vehicle is running.

A special calibration for both programs is provided for every single body/engine versions.

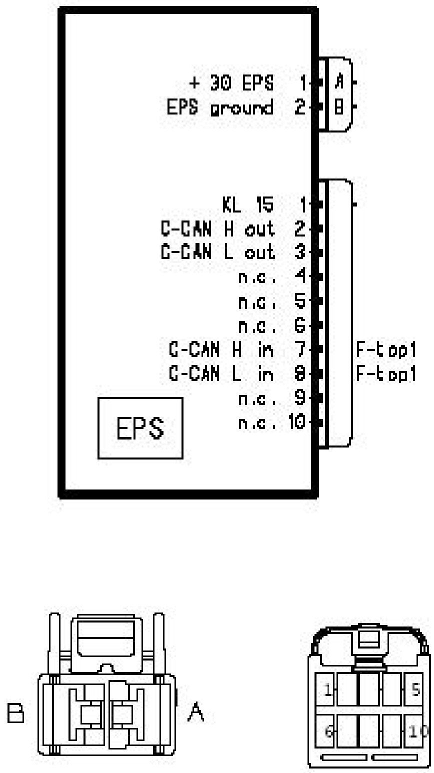
Control unit

The control unit processes the input signals received by the sensors and also drives the electric motor, by delivering the current required to obtain the desired interlocking torque. Moreover, it manages the communication on the C-CAN network and performs continuous self-diagnosis of the system to ensure correct operation of the latter.

The alternator and vehicle speed values are read on the C-CAN line.

The position and torque signals from the sensors represent the base values by means of which the microprocessor processes the output data in terms of current delivered to the engine.

The drive interlocking management control unit is secured onto the electric drive body.



1. Power supply from the battery
2. Ground
1. Body computer
2. C-CAN H
3. C-CAN L
4. N.C.
5. N.C.
6. N.C.
7. C-CAN H
8. C-CAN L
9. N.C.
10. N.C.

7.3 Drive housing

It features two drive rations.

Technical features for petrol engines:

reduction ratio: 51 mm/rev;

steering wheel angle/wheel angle ratio: 15.7 steering wheel degrees/wheel degrees

steering wheel turns: 2.8, with kerb-to-kerb steering diameter of 10.1 m.

Technical features for diesel engines:

reduction ratio: 60-44 mm/rev;

steering wheel angle/wheel angle ratio: 13.4 steering wheel degrees/wheel degrees in the middle, and 18.2 steering wheel degrees/wheel degrees at the end of travel;

steering wheel turns: 2.8, with kerb-to-kerb steering diameter of 10.76 m.

7.4 Steering column

The steering column consists of two coaxial stubs. It contributes to a significant extent to avoiding dangerous steering wheel penetration into the passenger compartment in case of head-on collisions.

The lower portion consists of a metal tube that slides to keep the steering wheel position fixed in case of collision. The max. sliding load is 8 kg and is obtained by means of an injected plastic insert. The upper portion, manufactured in such a way as to ensure steering wheel position adjustment, is:

sliding, to allow for axial adjustments (when requested or previously provided for by the body version), and

pivoting, to allow for vertical adjustment (when requested or previously provided for by the body version).

The steering column is borne by a support which is, in turn, bound to a bracket (both of these items are made of steel). These components contribute to a significant extent, thanks to their very high rigidity, to reduce the steering wheel vibrations.

All of this makes it possible to achieve important results in terms of:

vehicle passive safety;

driving comfort.

The vehicle's safety performance is further enhanced by the collapsible steering column. The device is based on magnesium capsules (of the wafer type) with plastic injection. In case of collision, the column folds back by causing controlled energy absorption. All of this reduces to a large extent the load suffered by the occupant's thorax during the collision.

8 Suspensions

8.1 Description

The suspensions fitted to the Nuova Punto have been completely re-designed compared with the previous model.

The main differences with respect to the known models are as follows:

wider wheel tracks and greater tyre dimensions compared with the current Punto (15 to 17 inches wheel rims with 175/65 15” to 205/45 17” tyres, compared with 14 and 15 inches rims and the 165/70 14” to 185/55 15” tyres of the current Punto).

Front suspension geometry with right-angled triangle lower arms, realized in order to decouple to a larger extent the effect of the braking loads from the effect of the cornering loads, thus ensuring optimum balance under any running condition. The new front geometry has also made it possible to reduce the vehicle steering diameter to values similar to the current model, despite the use of wider wheels with a higher wheelbase.

Torsional axle rear suspension designed in order to increase both structural rigidity and loaded suspension flexibility, obtained by optimizing the bushing that connects the rear axle with the body. The development of the new suspension has also concerned the plugging configuration in order to improve the dynamic response when cornering.

Great attention has been devoted, during the component design phase, to the comfort features, by introducing technical solution typical of upper-class vehicles, such as the use of a dome dowel of the “double” type (“dual-path”) at the front, and the positioning of the vertical shock-absorber at the rear. These measures have made it possible to reduce to a large extent the effect of the vibrations generated by the road surface, without affecting the structural rigidity to the detriment of higher driving accuracy.

The elastic bushing dimensions have been increased to improve the damping of road roughness and increase the driving comfort.

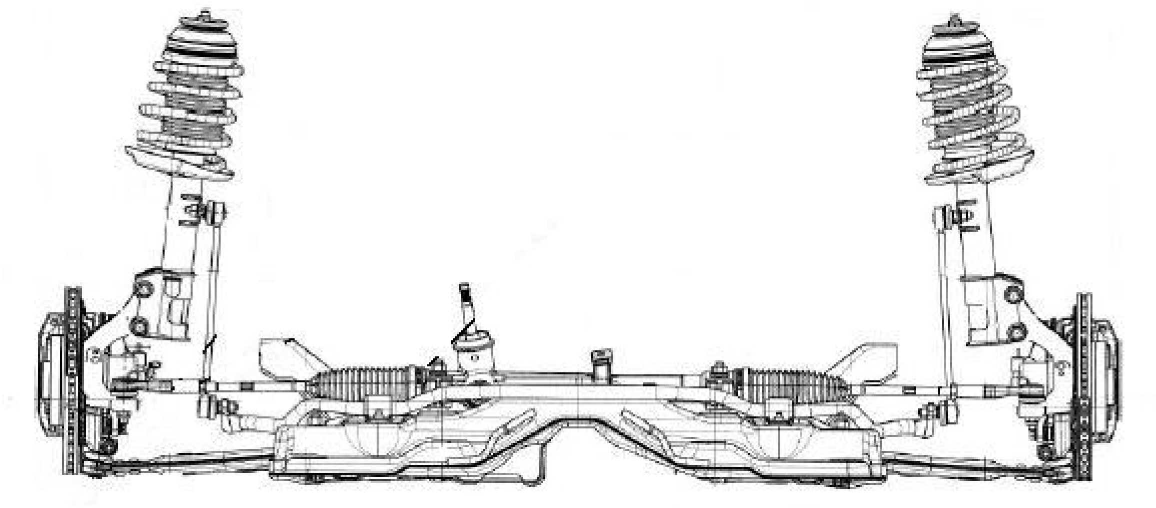
Shock-absorbers with 22 mm stems on all versions, to increase the stability limit conditions when cornering.

Increased structural rigidity of the suspension anchoring front crossbar, to achieve better acoustic vibration.

Both the front and rear suspensions feature, as we have said above, an increased wheel track compared with the current Punto, both to adapt to the greater outer dimensions of the new model and to improve the driving stability (70 mm at the front and 75 mm at the rear, on average).

8.2 Front suspensions

8.2.1 General remarks



The front suspensions feature an independent wheel configuration of the Mc Pherson type.

In particular, the main components of this structural layout are as follows:

two-shell swinging arms made of stamped sheet metal (instead of cast iron, as with the current Punto), with a significant weight reduction;

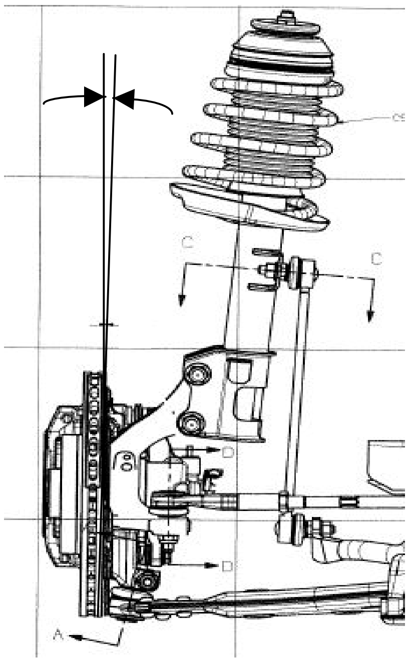
use of bushings with larger rubber volume than the bushings fitted to the current Punto, to improve comfort (to dampen minor roughness) and, at the same time, ensure optimum road holding and stability when cornering;

front suspension crossbar with high structural rigidity, with transverse connecting “strap” next to the arm front mounts (except for the 1.2 8V model);
reinforced pillars to ensure better road holding when cornering;
dome dowels of the “double” type (“dual-path” layout) to reduce to a large extent the effect of the vibrations generated by the road surface, without affecting the structural rigidity to the detriment of driving accuracy;
stabilizer bar with rods for anchoring to the shock-absorbers instead of the swinging arm, which makes it possible to achieve greater stabilizing efficiency and prompt dynamic response when cornering;
offset helical springs for thrust axis optimization, in order to reduce the tangential forces on the shock-absorber stem and, therefore, the internal friction, with resulting better damping of minor road roughness;
Hydraulic, telescopic dual-effect shock absorbers with stem diameter of 22 mm on all the versions, for very high side rigidity to improve road holding when cornering.
Moreover, the body attachment rigidity has been increased. The greater rigidity of the upper attachment dome (made of aluminium) makes it possible to reduce the noise let into the body, thus improving the comfort.
The front suspension crossbar is the lowest part of the vehicle, since the body struts have been lowered to improve the vehicle performance during the crash test.

Only toe-in can be adjusted on the front suspension.

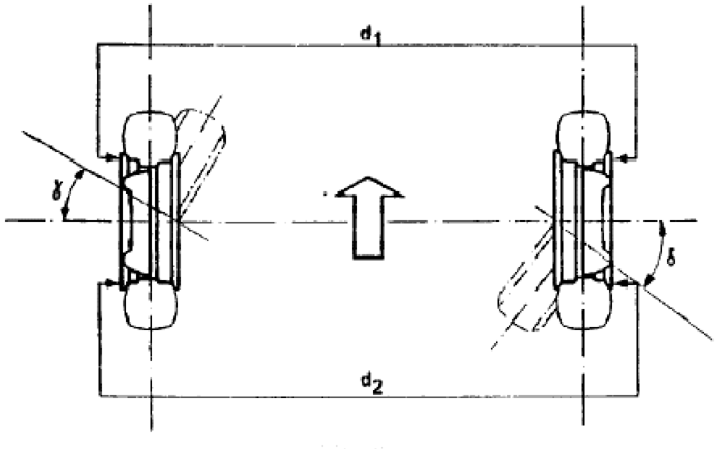
8.2.2 Characteristic angles

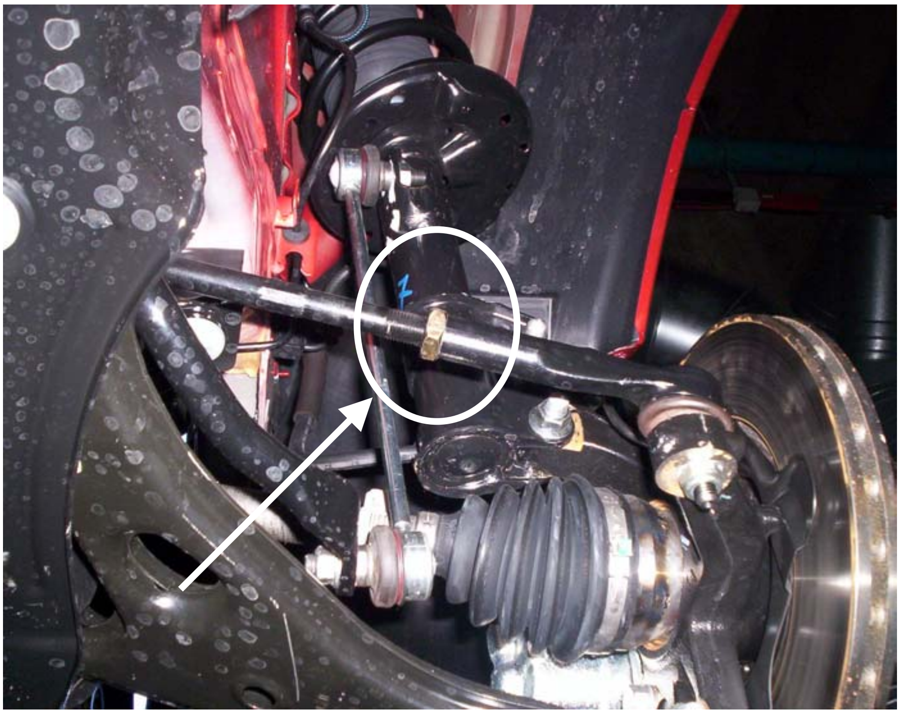
Camber angle



ENGINE VERSIONS	TYRES	Loading conditions STD. O	STD. A
1.2 8V	175/65 R15 84T	-22' +/- 20'	-27' +/- 20'
1,4 8V.LE		-22' +/- 20'	-27' +/- 20'
1.3 MJet 70 CV		-22' +/- 20'	-27' +/- 20'
1.2 8V		-22' +/- 20'	-27' +/- 20'
1.3 MJet 70 CV		-22' +/- 20'	-27' +/- 20'
1.4 8V		-22' +/- 20'	-27' +/- 20'
1,3 MJet 90 CV	185/65 R15 88T	-26' +/- 20'	-28' +/- 20'
1,3 MJet 90 CV		-26' +/- 20'	-28' +/- 20'
1,9 MJet 120 CV		-26' +/- 20'	-28' +/- 20'
1,9 MJet 120 CV	195/55 R16 87H	-19' +/- 20'	-21' +/- 20'

Toe-in





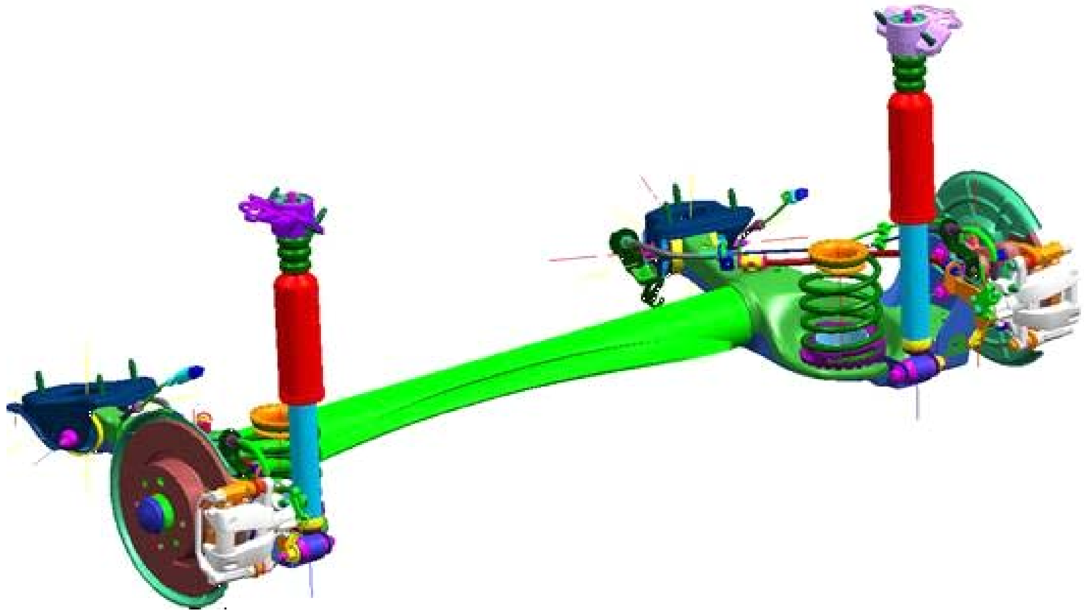
		Loading conditions	
ENGINE VERSIONS	**TYRES**	**STD. O**	**STD. A**
1.2 8V	175/65 R15 84T	+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.4 8V		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.3 MJet 70 CV		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.2 8V		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.3 MJet 70 CV		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.4 8V		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.3 MJet 90 CV	185/65 R15 88T	+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.3 MJet 90 CV		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.9 MJet		+ 2 mm +/- 1 mm	+ 1,88 mm +/- 1mm
1.9 MJet	195/55 R16 87h	+ 2 mm +/- 1 mm	+ 1,87 mm +/- 1mm

Represented by mm (d2 – d1, see figure above).

Only toe-in can be adjusted in the traditional way, by acting on the steering connecting rod nuts.

8.3 Rear suspensions

8.3.1 General remarks



The Nuova Punto has introduced a suspension layout whereby the wheels are interconnected by a torsional axle, made up of a tube-bent sheet metal, with an open central section.

The wider body attachments and the optimization of the torsional contour have made it possible to achieve greater structural rigidity despite the weight reduction.

The peculiar configuration of the torsional contour (with different thicknesses depending on the versions) has made it possible to obtain optimum roll stabilizing rigidity, even if an antiroll bar has not been added; therefore, the antiroll bar shall not fitted to any of the Nuova Punto models.

The vertical arrangement of the shock absorbers with the body attachment inside the wheelbox has made it possible to dampen the road surface roughness to optimum levels, to the advantage of the acoustic comfort inside the passenger compartment.

Neither toe-in nor the camber angle can be adjusted: the correct values shall therefore be guaranteed during the assembling phase.

8.3.2 Characteristic angles

Camber angle

ENGINE VERSIONS	TYRES	Loading conditions STD. O	STD. A
1.2 8V	175/65 R15 84T	-1°+/- 20'	-1°+/- 20'
1,4 8V.LE		-1°+/- 20'	-1°+/- 20'
1.3 MJet 70 CV		-1°+/- 20'	-1°+/- 20'
1.2 8V		-1°+/- 20'	-1°+/- 20'
1.3 MJet 70 CV		-1°+/- 20'	-1°+/- 20'
1.4 8V		-1°+/- 20'	-1°+/- 20'
1,2 JTD (90 CV)	185/65 R15 88T	-1°+/- 20'	-1°+/- 20'
1,2 JTD (90 CV)		-1°+/- 20'	-1°+/- 20'
1,9 JTD		-1°+/- 20'	-1°+/- 20'
1,9 JTD	195/55 R16 87H	-1°+/- 20'	-1°+/- 20'

Toe-in

		Loading conditions	
ENGINE VERSIONS	**TYRES**	**STD. O**	**STD. A**
1.2 8V	175/65 R15 84T	+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm
1.4 8V		+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm
1.3 MJet 70 CV		+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm
1.2 8V		+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm
1.3 MJet 70 CV		+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm
1.4 8V		+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm
1.3 MJet 90 CV	185/65 R15 88T	+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm
1.3 MJet 90 CV		+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm
1.9 MJet		+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm
1.9 MJet	195/55 R16 87h	+ 1,3 mm +/- 2 mm	+ 1,5 mm +/- 2mm

N.B. The wheels of the previous Punto models cannot be fitted to the Nuova Punto, since the dimensions (e.g. the centre line between the bolts) have changed: trying to do so would affect the integrity of the wheel-hub components and, above all, the driving safety.

9 Electric system

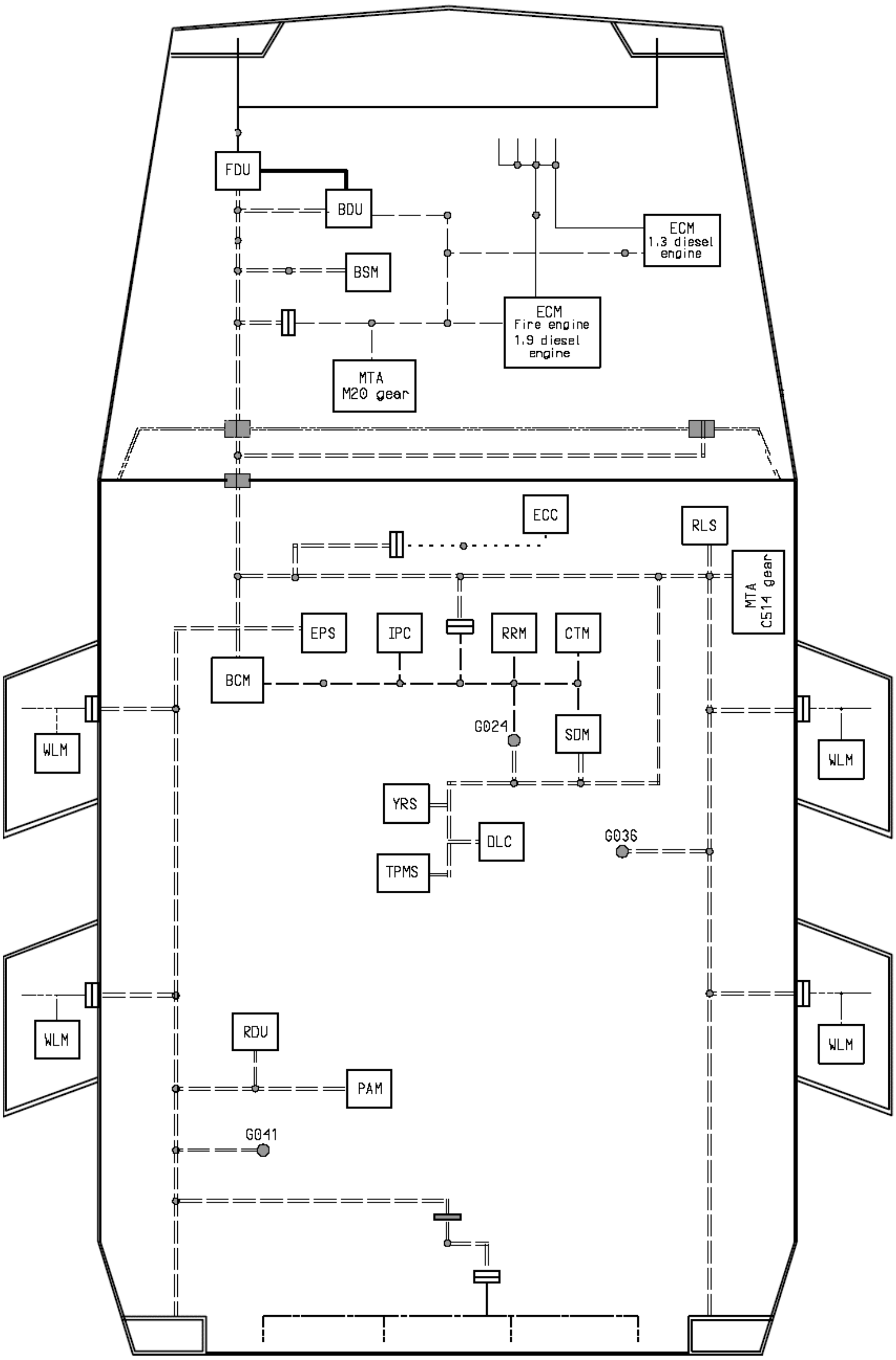
9.1 General description of the system

The technology used for the electric system of the Nuova Punto is based on the complex architecture called “Famiglia1”, first used on a FIAT model.

Modular system

To obtain the minimum number of wiring families, each circuit connected to a sectioning joint holds the same position inside the joint, regardless of the trim level; also the position and type of the joint on the vehicle does not depend on the body version level.
To safeguard the modular arrangement of the cable harnesses, the inputs/outputs of each control unit shall not differ, for the various body/engine versions, in the connector positions and the cable/terminal/connector interface.

9.1.1 General features



	Description	Description
BCM	Body Computer Module	Body Computer node
CTM	Convergence Telematic Module	Convergence node
ECC	Electronic Climate Control	Air conditioner node
IPC	Instrument Cluster Module	Instrument board node
PAM	Parking Assistant Module	Parking node
RRM	Radio Receiver Module	Radio receiver node
SDM	Sensing and Diagnostic Module	Airbag node
TPMS	Tyre Pressure Module	Tyre pressure node
BSM	Brake System Module	Braking node
ECM	Engine Control Module	Engine control node
EPS	Electronic Power Steering	Electric drive node
MTA	Manual Transmission Automatic	Robotized gearbox node
YRS	Yaw Rate Sensor	Acceleration/yaw sensor
RLS	Rain & Light Sensor	Rain and light sensor
DLC	Diagnostic Connector	Diagnosis connector
RDU	Rear Distribution Unit	Luggage compartment node
FDU	Front Distribution Unit	Engine compartment node
BDU	Battery Distribution Unit	Battery fuse control unit
WLM	Window Lift Module	Window regulator module

9.1.2 Serial lines and networks

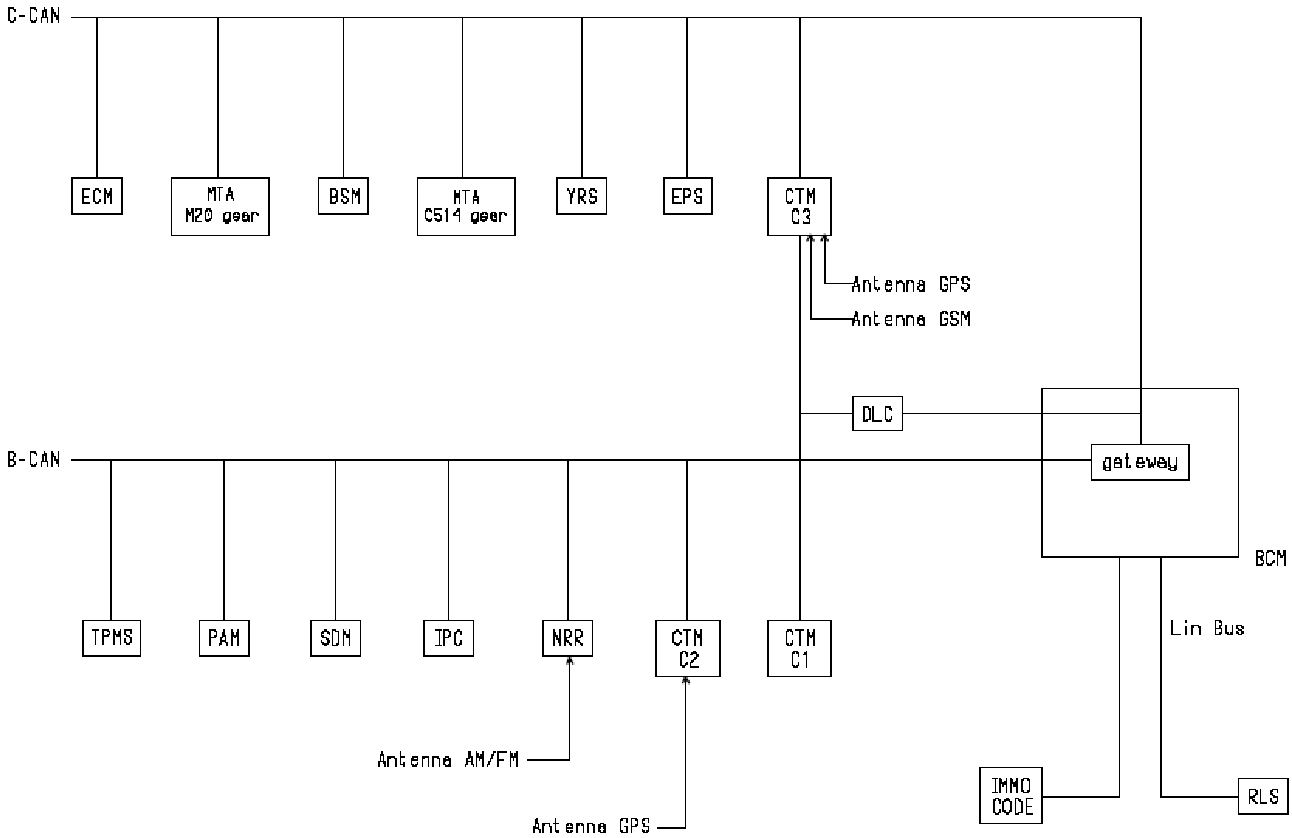
The Famiglia 1 architecture, especially designed for the Nuova Punto, controls the vehicle's electric system.

As regards the system's optimization, the architecture follows the topological, local approach: each control unit (either electronic or electro-mechanic) is placed in a barycentric position with respect to the functions managed.

This makes it possible to minimize the power and signal distributing system, even by making extensive use of the serial communication lines, thus making it possible to solve the dimension, reliability, weight and cost problems.

A node is meant as an electric control unit equipped with a CAN interface.

The most complete structure is made up of two CAN communication lines that connect nodes belonging to two different areas (dynamic vehicle control and bodywork function/on-board information) and also an additional “LIN bus” serial line (first used on a FIAT model of this segment).



The developed architecture is compatible with various user interfacing solutions (control arrangement, information display modes and assignment).

The electric protections (fuses) and the remote-control switches are grouped in the power distribution control units, positioned in the engine compartment and in the dashboard. These control units also act as interconnections for the various wirings and as electric distributors.

9.1.3 Network architecture

The most complete structure is made up of two CAN communication networks connected through a gateway for common information transfer:

NAME	DESCRIPTION
B-CAN	CAN low speed twin wire (50 Kbit/s)
C-CAN	CAN high speed twin wire (500 Kbit/s)
LIN	Serial data bus single wire (9.6 Kbit/s)

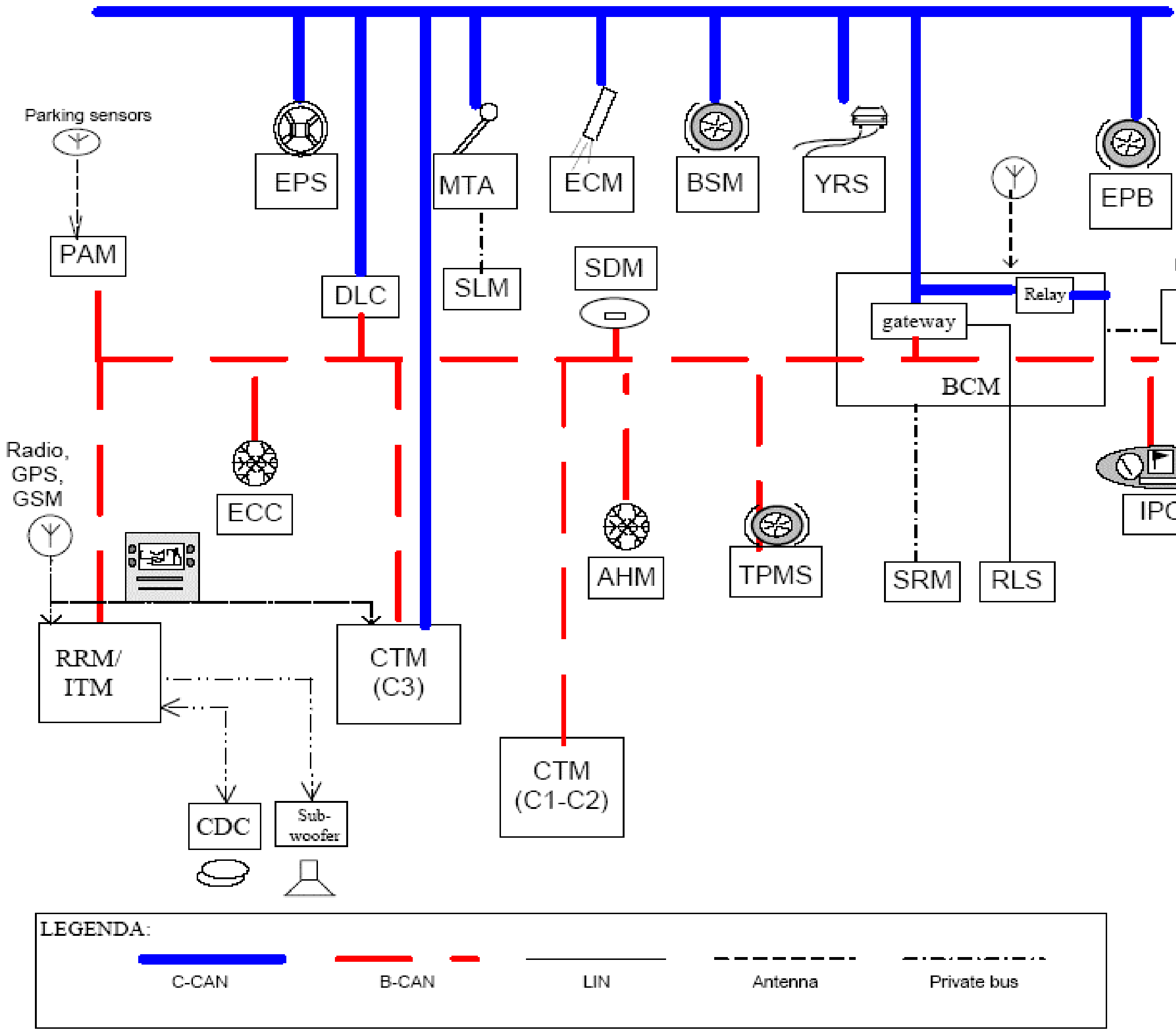
B-CAN network for data communication/bodywork standard function management.
C-CAN network for dynamic vehicle control.
The gateway for the communication between C-CAN and B-CAN is located in the Body Computer node.
A LIN serial communication line is also available between the Body Computer control unit and the control unit on the rain sensor: in this case, the Body Computer node performs the gateway function between the LIN serial line and the CAN networks.
The node diagnosis, in the B-CAN and C-CAN, is performed, for the first time on a FIAT model, through the CAN line by using a protocol on the CAN network (ISO 14229).

B-CAN network features	Values
Bit rate	50 kbit/s
Max. number of nodes that can be connected to the network	9
Max. network length	14 m

C-CAN network features	Values
Bit rate	500 kbit/s
Max. number of nodes that can be connected to the network	7
Max. network length	16.6 m

$$R = \frac{1}{\frac{1}{R1} + \frac{1}{R2}} = \frac{1}{\frac{1}{120} + \frac{1}{120}} = \frac{1}{\frac{2}{120}} = \frac{1}{1} \times \frac{120}{2} = 60$$

Full optional network architecture



Diagnostic architecture

The situation of the diagnostic architecture, both as regards the control units integrated to the CAN network (nodes) and the ones not equipped with a CAN interface, is summarized in the table below:

System / node	Bus	Diagnosis	Communication
Tyre pressure control unit	B-CAN	YES	B-CAN
Audio amplifier	/	NO	/
Rain sensor control unit	LIN	NO	/
System / node	Bus	Diagnosis	Communication
Sunroof control unit	/	No	/
Airbag node	B-CAN	YES	B-CAN
Body Computer node	B-C CAN	YES	B-C CAN
Air conditioner node	B-CAN	YES	B-CAN
Convergence node	B-CAN B-C CAN	YES	B-CAN B-C CAN
Instrument board node	B-CAN	YES	B-CAN
Radio receiver node	B-CAN	NO	/
Parking sensor node	B-CAN	YES	B-CAN
Auxiliary heater node	B-CAN	YES	B-CAN
Engine control node	C-CAN	YES	C-CAN
Robotized gearbox node	C-CAN	YES	C-CAN
Braking node	C-CAN	YES	C-CAN
Electric drive node	C-CAN	YES	C-CAN
Yaw sensor node	C-CAN	NO	/

Some control units and nodes are indicated as “diagnosis-free”, despite their featuring self-diagnosis functions (e.g. rain sensor control unit): in fact, they do not feature any implemented diagnostic protocol, and their errors (if any) are detected through the diagnosis of other control units (e.g. BCM).

9.1.4 Diagnosis instrument adapter

The diagnosis of Fiat Punto, which makes use of a serial network of the CAN HIGH SPEED type, can be performed by means of the new A16HS high-speed cable. Moreover, release 6.30 (or any other subsequent release) shall be installed on the Examiner in order to access all the functions.
The CAN A16HS high-speed interface is made up of an EOBD standard connector, a Bantamate female connector (for connection with the Examiner) which includes an electronic circuit and a yellow/green LED for indicating the operating status.

Installation and diagnosis

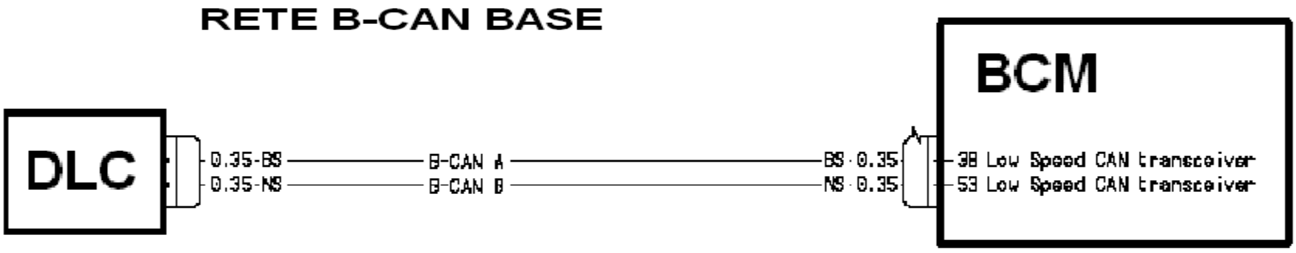
Insert the CAN A16HS high-speed interface between the vehicle's diagnosis connector and the Examiner extension cord. After making the connection, the take-off LED will blink, then it will blink steadily in a green colour. After actuating communication with the control unit on the CAN line, the LED will be ON steadily, yet it will turn yellow. The continuous blinking of the yellow LED indicates that a communication error has occurred.

C-CAN network terminating resistors

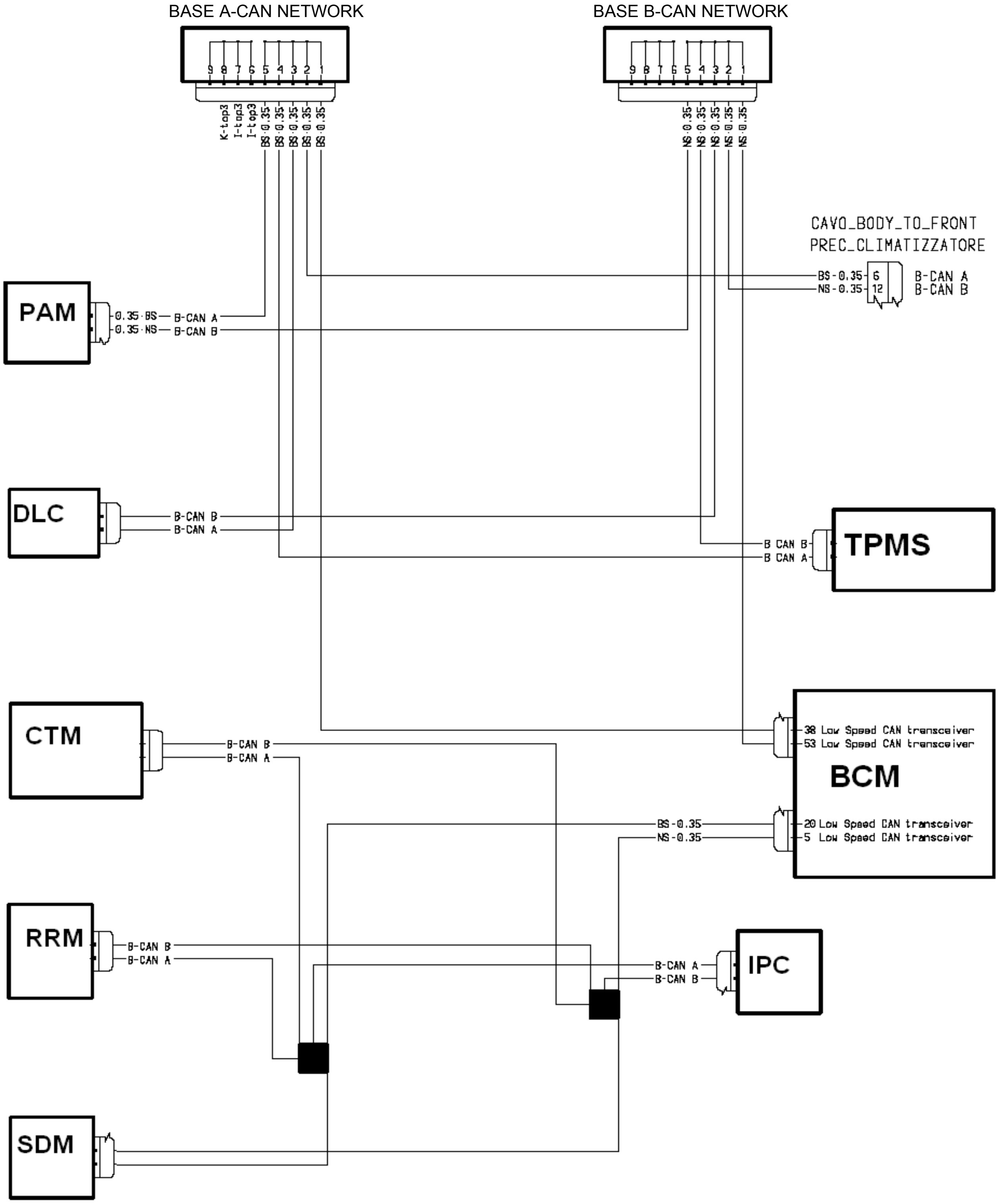
Node	Description	Terminating resistor	
		Available	Not available
BCM	Body Computer node	X	
BSM	Brake node		X
CTM	Convergence		X
EPS	Steering node		X
YRS	Yaw sensor		X
MTA	Robotized gearbox		X
ECM	Engine control node	X	

The terminating resistor on the C-CAN network is available both in the ECM and the BCM and features a value of 120 Ω for both of them.

9.1.5 B-CAN low-speed line

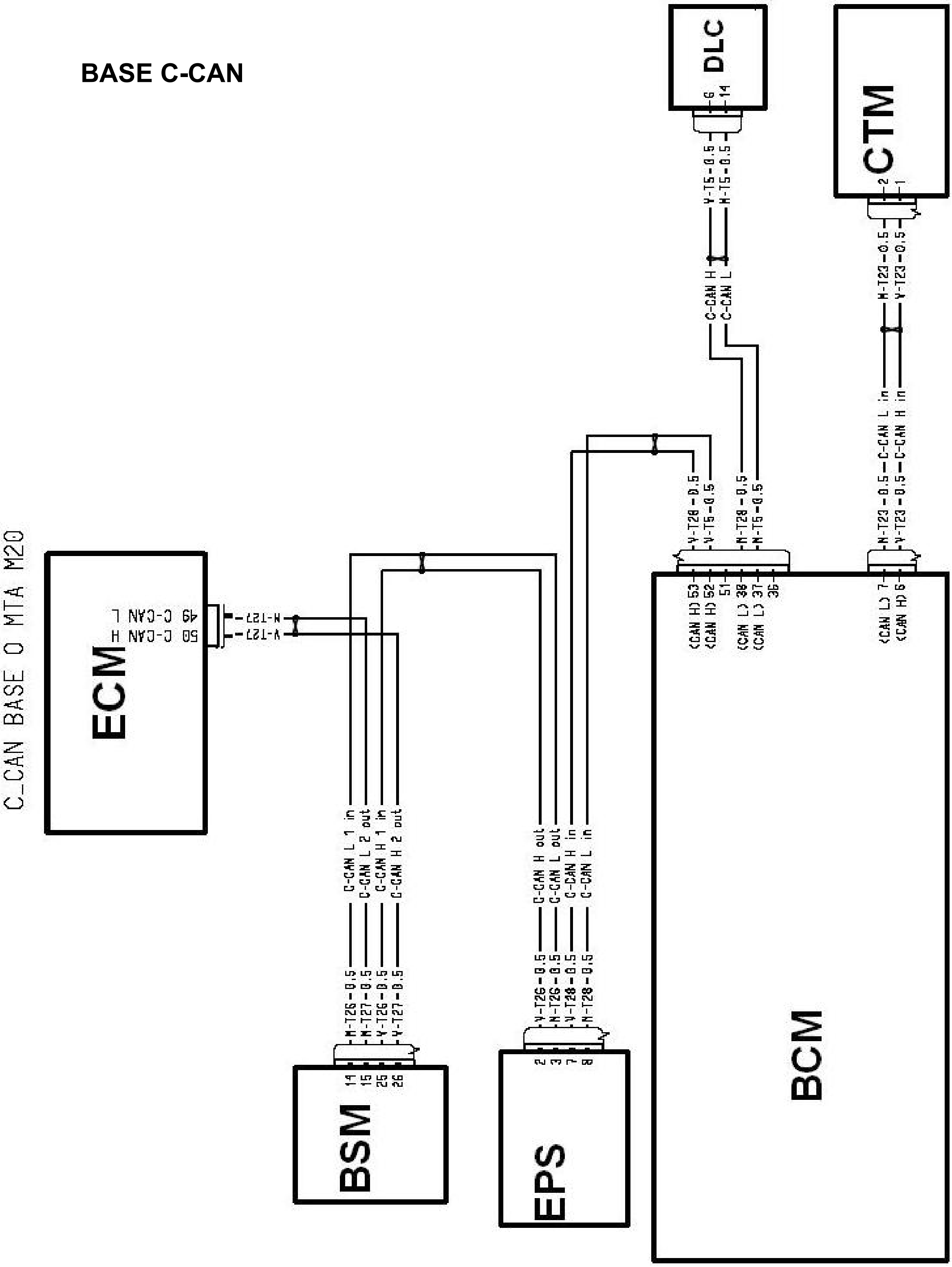


FULL B-CAN NETWORK



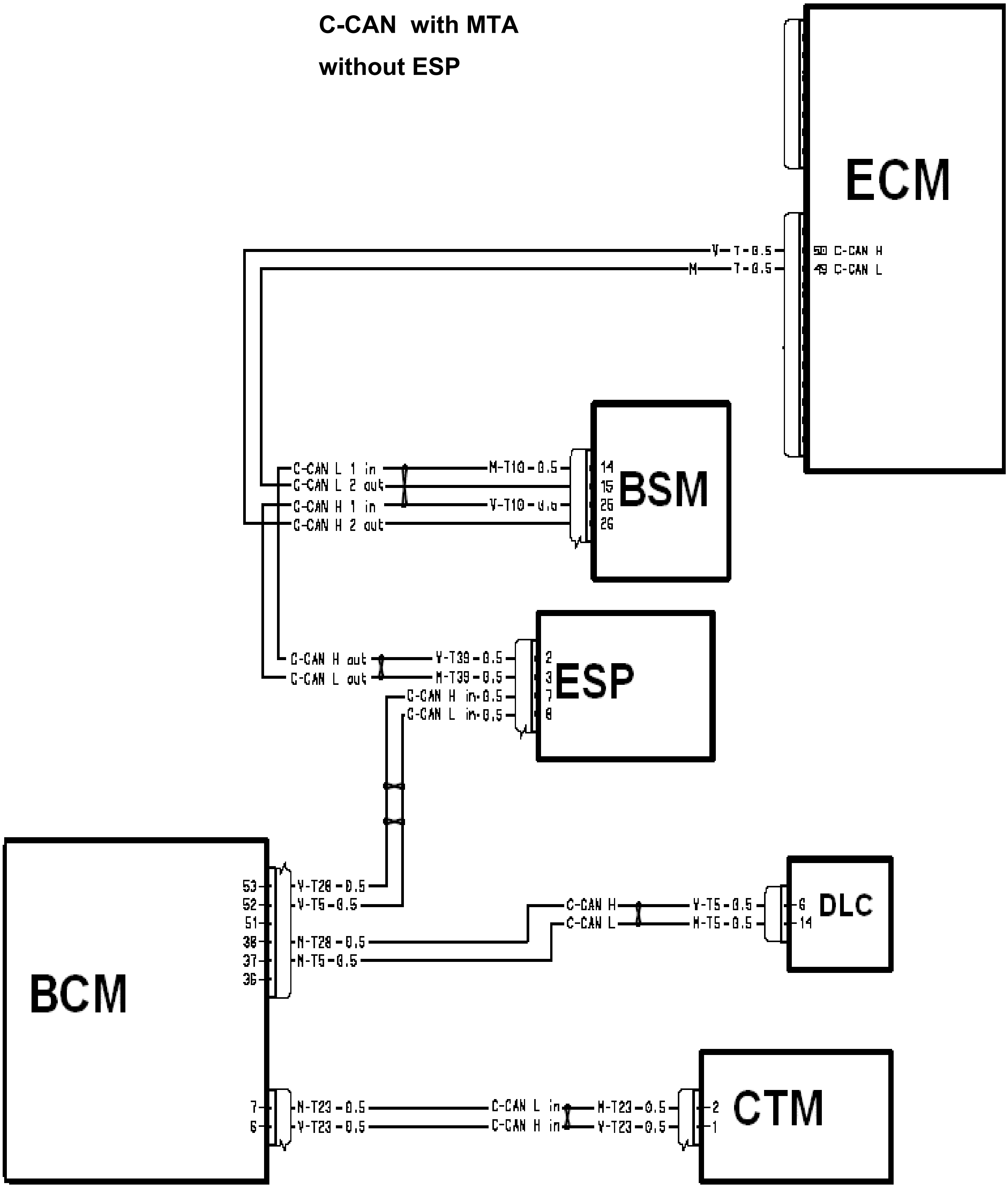
9.1.6 C-CAN high-speed line

BASE C-CAN



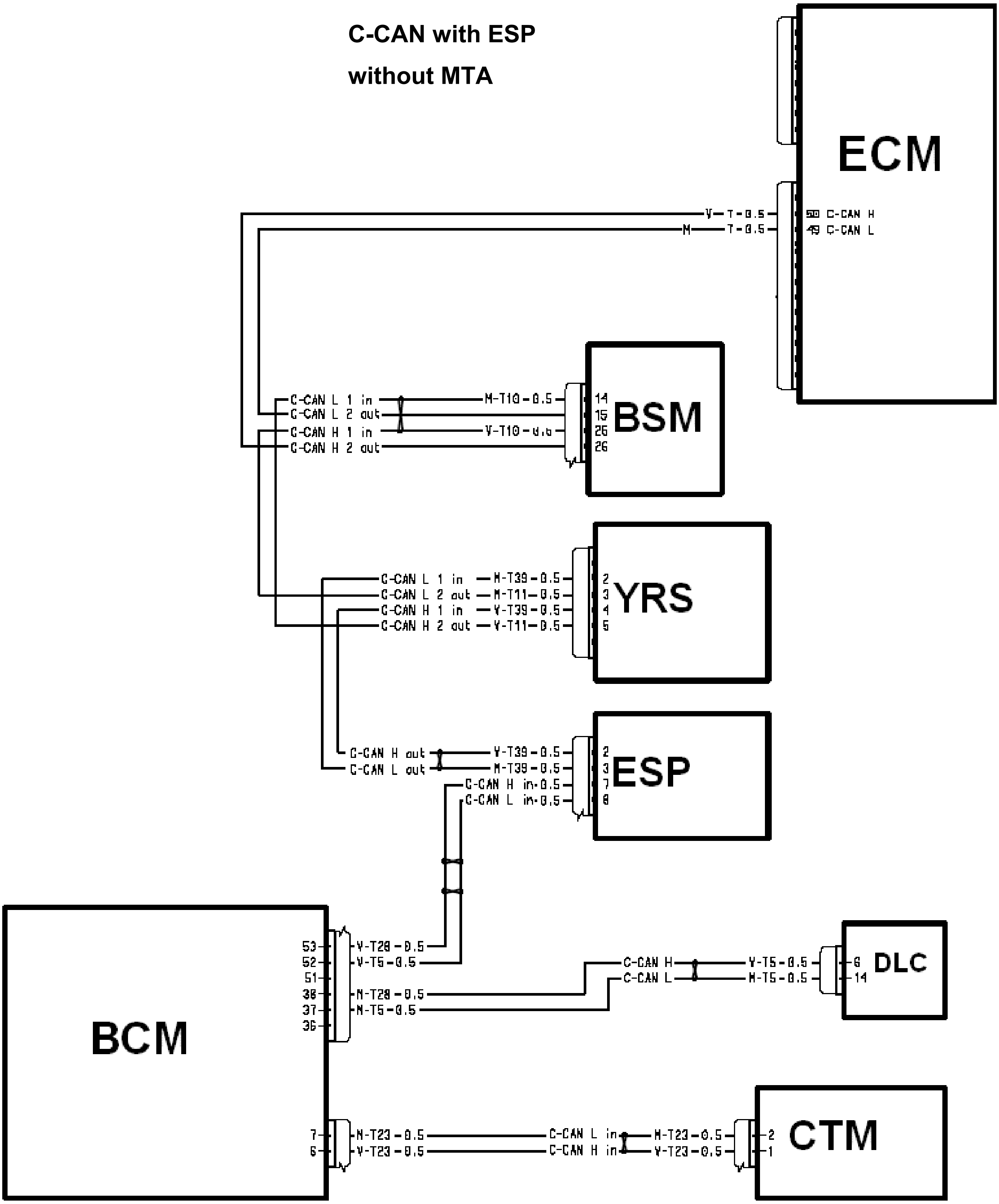
C-CAN with MTA

without ESP

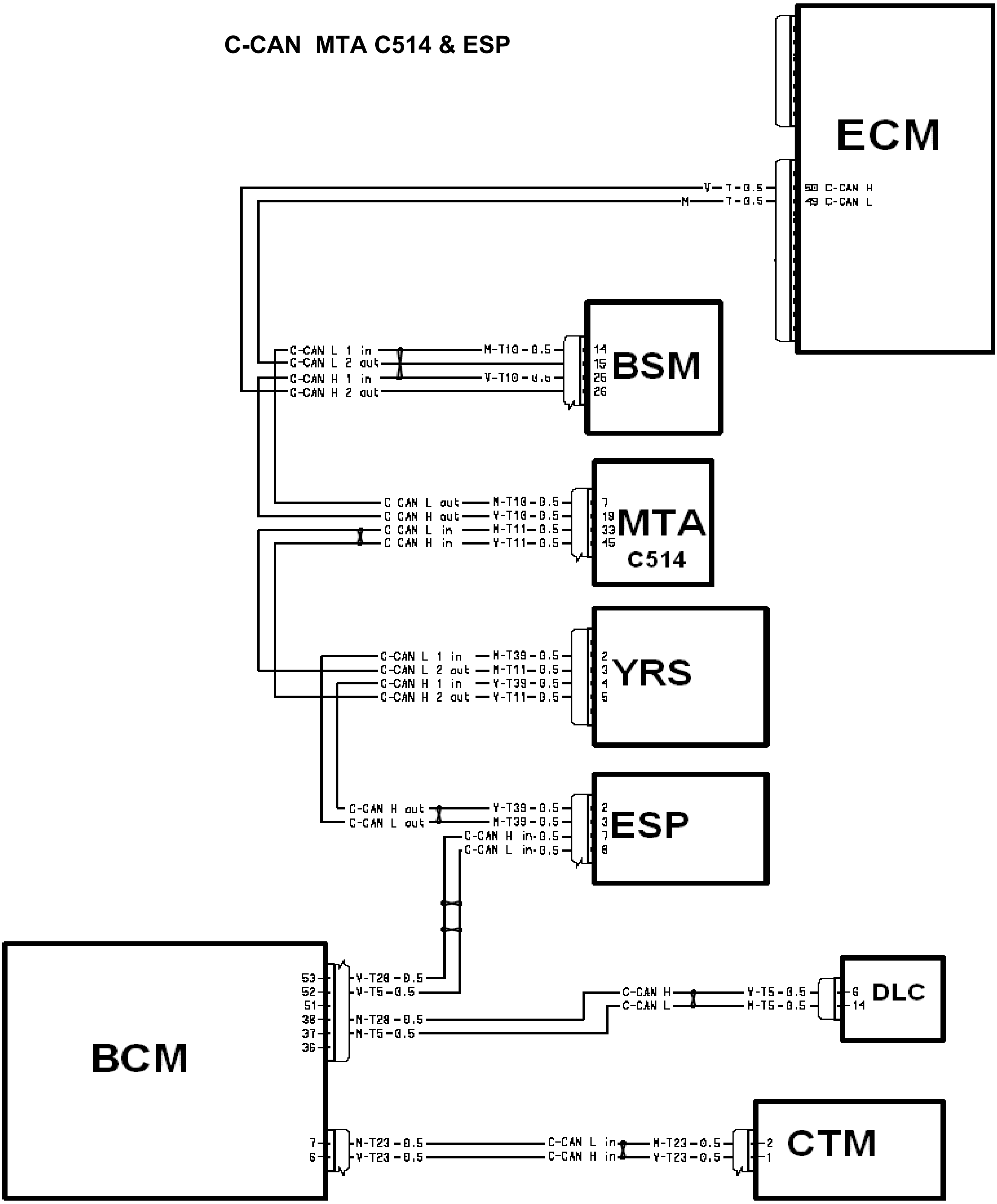


C-CAN with ESP

without MTA



C-CAN MTA C514 & ESP



LIN line

9.1.7 Remote-control switch/Fuse holder unit

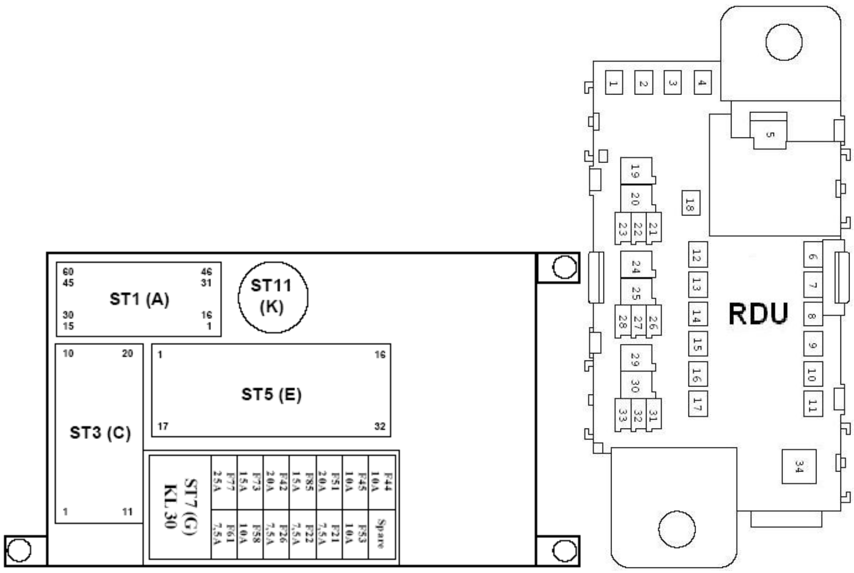
The Nuova Punto features various types of power distribution units realized by means of 3 different technologies:

power PCB;

sheared circuit;

wired with sheared circuit.

In particular:



Body Computer node control unit (BCM–Body Computer Module), realized with Power PCB.

Engine compartment control unit (FDU – Front Distribution Unit), realized by means of a sheared circuit.

Fuse control unit on the battery positive pole (BDU - Battery Distribution Unit), realized by means of a sheared circuit.

Optional fuse control unit on the battery positive pole (BDU-S Battery Distribution Unit-supplementary), realized by means of a sheared circuit.

Luggage compartment control unit (RDU – Rear Distribution Unit), wired with a sheared circuit.

BCM fuses

	A	DESCRIPTION OF COMPONENT FUNCTION
F21	7.5	EPS
F22	7.5	Brake pedal switch (normally open), clutch switch, IPC
F26	7.5	BSM, SAS, brake pedal switch (normally closed), cable stretcher (EPB), YRS, ASR deactivation switch
F42	20	Bidirectional window washing pump
F44	-	ESL
F45	10	IPC, diagnosis connector (DLC), display, DAB
F51	15	ITM or radio, CTM or mobile phone connector
F53	10	Front dome light, rear dome light, glove compartment light, sun visor light, front door mudguard light, boot light
F58	10	Airbag module (SDM), weight sensor
F61	7.5	Rain/twilight sensor, parking assist module, CTM or mobile phone connector, CSS control illumination (LED), ELC control illumination (LED), SWC control illumination (LED), TPMS, sunroof motor.
F73	15	Luggage compartment door unlock actuator
F77	10	Engine fuel lid and door closing
F85	15	Reserve output

FDU fuses

Identif. code on FDU	Component identif. code	Description
01	F2	BCM
10	F4	Engine BSM
53	F5	Valve BSM
09	F12	Engine cooling fan (low-middle speed or single speed)
08	F13	Engine cooling fan (high speed)
38	F14	Left low-beam headlamp
39	F15	Right low-beam headlamp
40	F16	Left high-beam headlamp
41	F17	Right high-beam headlamp
05	F18	Passenger's glove compartment
47	F20	ECM
50	F23	MTA and gearshift lever
48	F24	HVAC, ACC, driver's door control, side mirrors, reversing light (MTA C514)
46	F25	LHM, RHM
34	F27	Oxygen sensor heater heating, EGR, canister, etc. (secondary loads)
30	F28	Ignition coils, injectors or ECM (2nd power supply) (primary loads)
33	F29	Power supply ECM
51	F30	Fuel pump
25	F31	Fog lights
27	F32	Headlamp washing pump
37	F33	Horn
42	F34	A/C compressor
49	F35	Starter relay
29	F36	Valves (Bi-power)
29	F36	Fuel filter heater
04	F37	Robotized gearbox pump
54	F38	+30 A/C control panel, ECC
36	F39	+30 Selespeed or MTA or TCM
32	F43	ECM
31	F54	Cigar lighter or 12 V output
45	F59	Fuel water sensor, reversing light, flow meter hot film
02	F69	Rear heated window
43	F70	Side mirror defrosting
26	F85	Front right window regulating motor
28	F86	Front left window regulating motor
52	FS2	Spare
44	FS4	Spare

9.1.8 Wiring

Table 1: Engine compartment

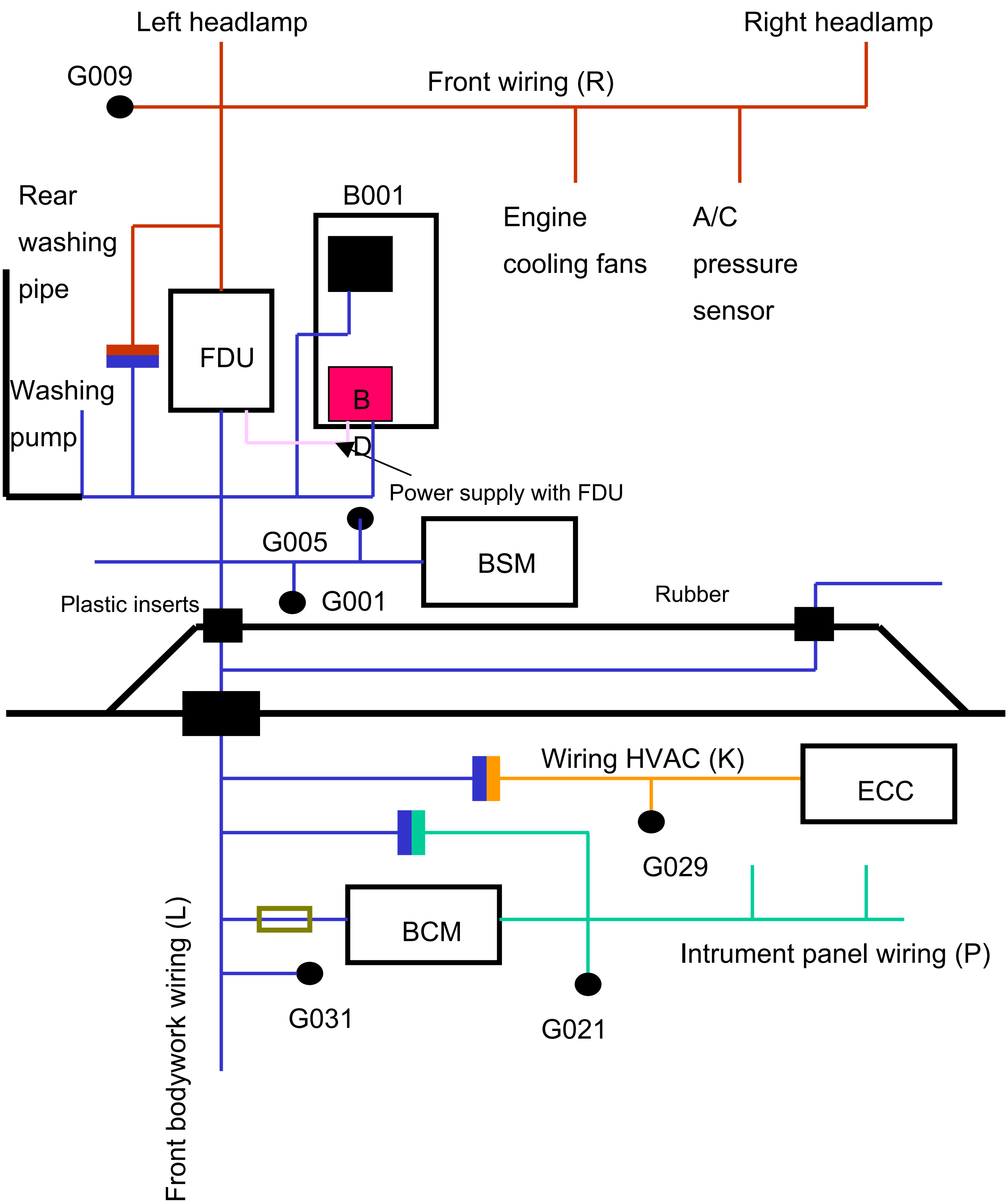


Table 2: Engine power supply

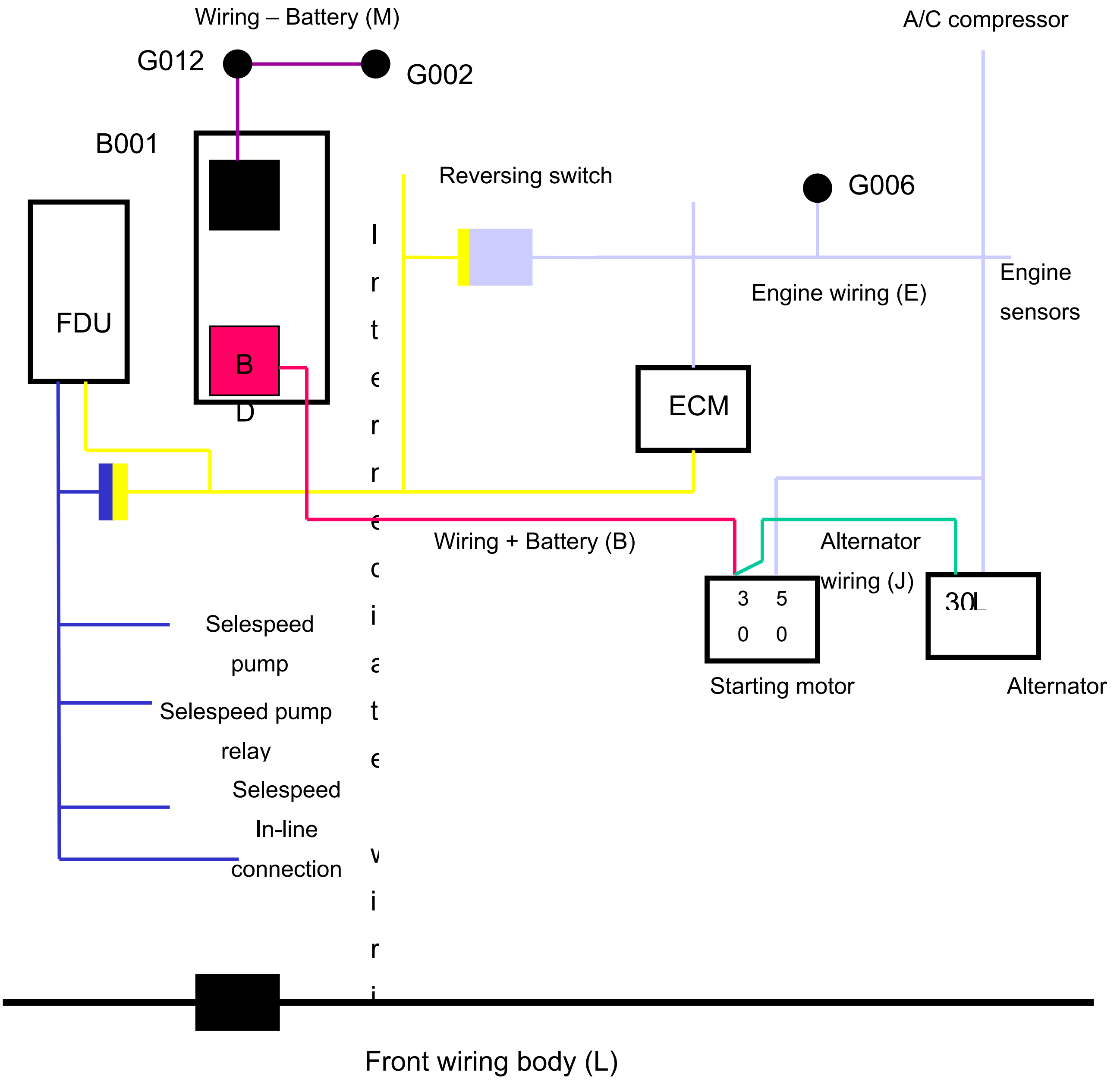
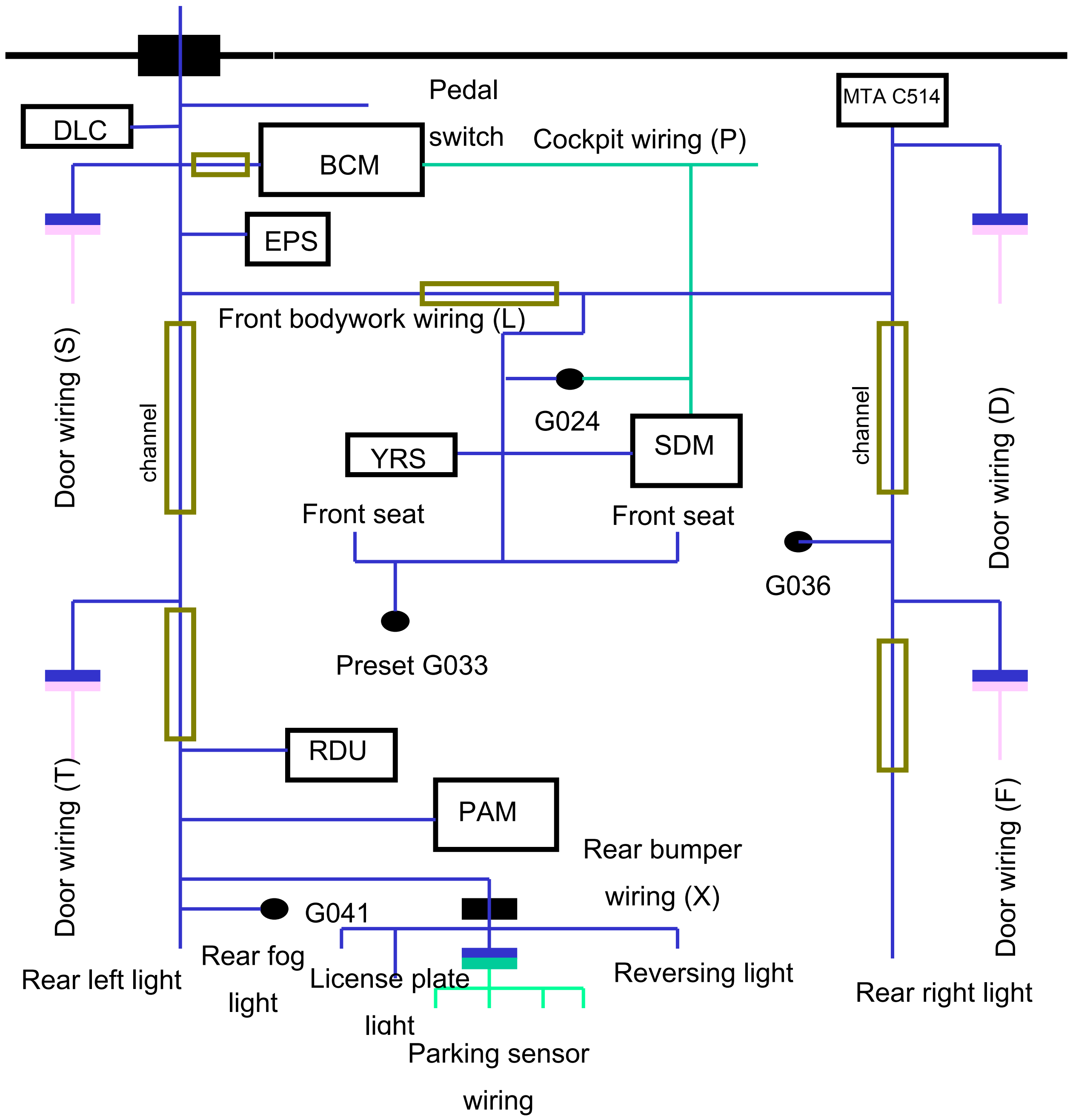


Table 3: Bodywork



9.1.9 Electronic components

The "Famiglia1" architecture is made up of the elements listed in the table below:

Name	Origin
TPMS (Tyre pressure measuring control unit)	Derived from Nuova Croma
PAM (Parking sensor node)	New
Audio hi-fi amplifier	Derived from Punto
BCM (Body Computer node)	New
IPC (Instrument board node)	New
RRM (Radio receiver node)	Derived from Ypsilon
CTM (Convergence node)	Derived from 159 (Alfa 939)
RLS (Rain sensor control unit)	New
SRM (Sunroof control unit)	Derived from Ypsilon
SDM (Airbag node)	New
MTA (Robotized gearbox node for petrol version) (1.4 Fire)	New
MTA (Robotized gearbox node for diesel version) (1.3 jtd, 90 HP)	New
ECC (Air conditioning node)	Derived from Ypsilon
ECM (Engine control node)	New/Derived (for engine versions)
BSM (Braking system node)	New
YRS (Yaw sensor)	New
EPS (Electric drive node)	New
AHM (Auxiliary heater node)	New

The derived components differ in the HW/SW implementation from the components used on the reference models (e.g. Nuova Croma).

Use control module

The Nuova Punto “Famiglia1” architecture provides for integration of the user controls within switch holder modules.

The modules are listed in the table below, together with the other controls.

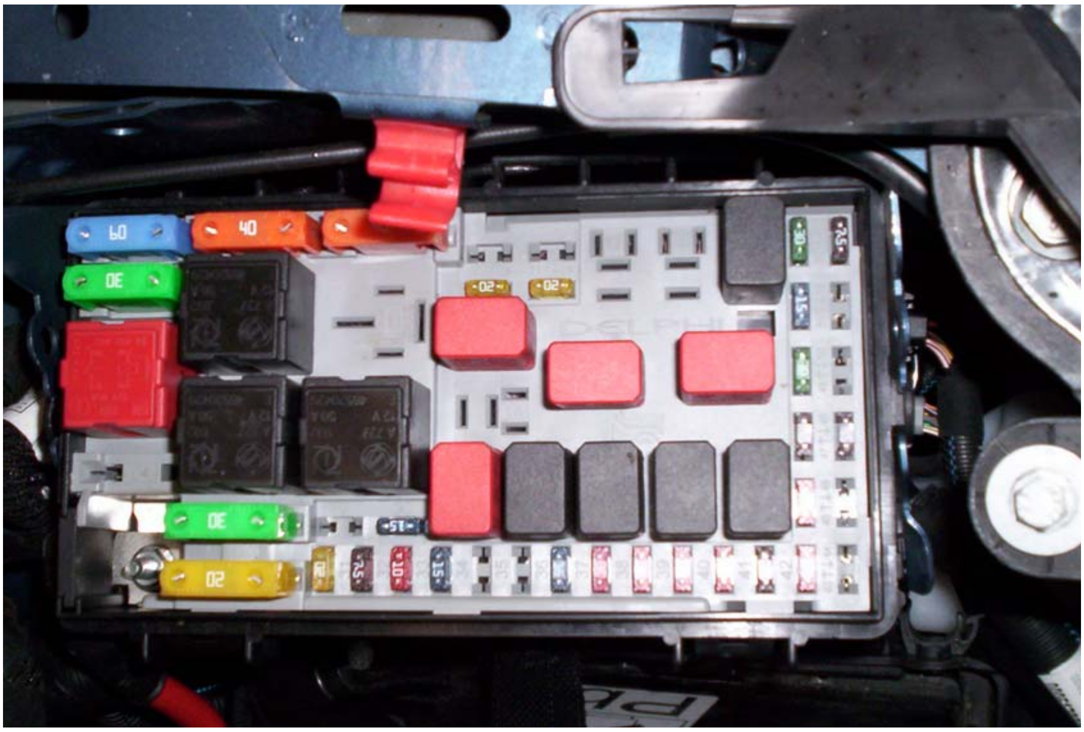
Modules	**Origin**
CDC,RDC (Passenger’s rear/front door window regulator control)	New
Stop switch	Common component derived from Opel
CSM (Steering column stalk control module)	Derived from Ypsilon
Switch on the clutch	Common component derived from Opel
Control dashboard on the driver’s side front door	New
CSS (Central control dashboard)	New
ELC (Left control dashboard)	New
Gearshift control lever	New
Steering wheel controls for the horn and the audio/telephone systems	New
Information-communication/roof control dashboard on the ceiling light fixture	New

The derived components feature the same interface to the vehicle wiring (wiring diagram/connector) as the reference model.

9.2 Description of components

9.2.1 Engine compartment control unit (FDU)

The FDU control unit is a branching-off unit with sheared circuits, installed in a sealed container located in the engine compartment in the left headlamp area, which holds fuses and remote-control switches and protects the electric loads.
The FDU node is interconnected to the front bodywork cable harness, the front cable harness, and the engine service pre-wired cable harness.



Functions

The front distribution nodes manages the following functions:

headlamp washing;

right and left side rear-view mirrors;

rear heated window;

cigar lighter;

horns;

engine cooling fans.

9.2.2 Luggage compartment node

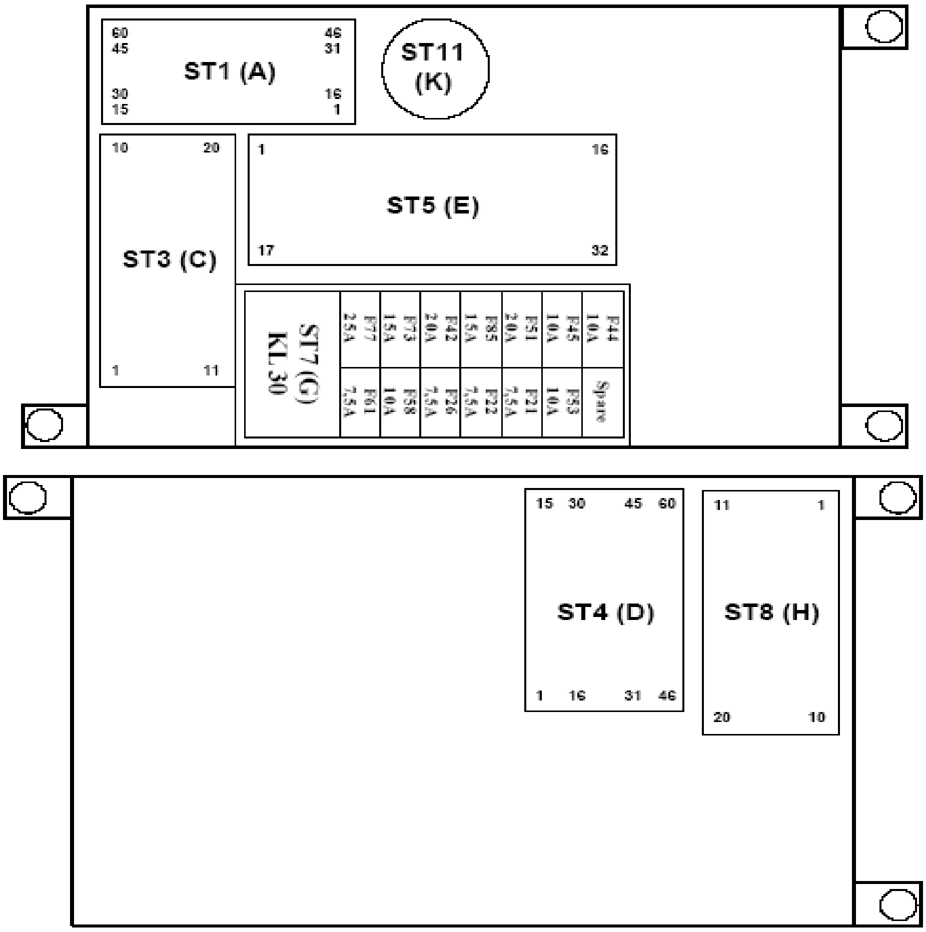
This node is located in the left bottom part of the luggage compartment, next to the rear headlamp. It also houses some fuses used to protect the systems managed by the node.

9.2.3 Body Computer node (BCM)

The Body Computer node is located inside the instrument board (in the bottom left part, under the left control dashboard). It can be easily located since it houses the instrument board fuses (see figure below).

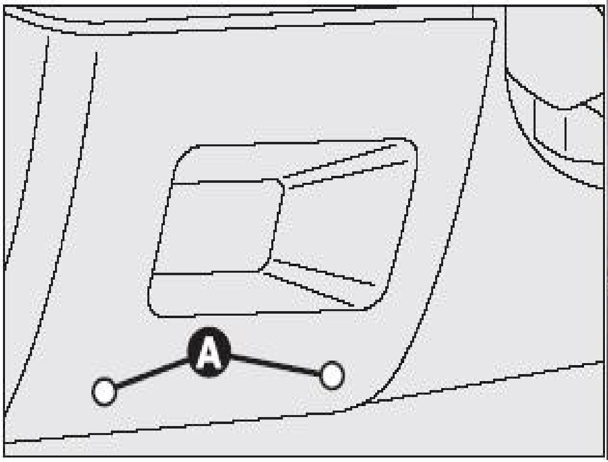
Body Computer node (BCM)

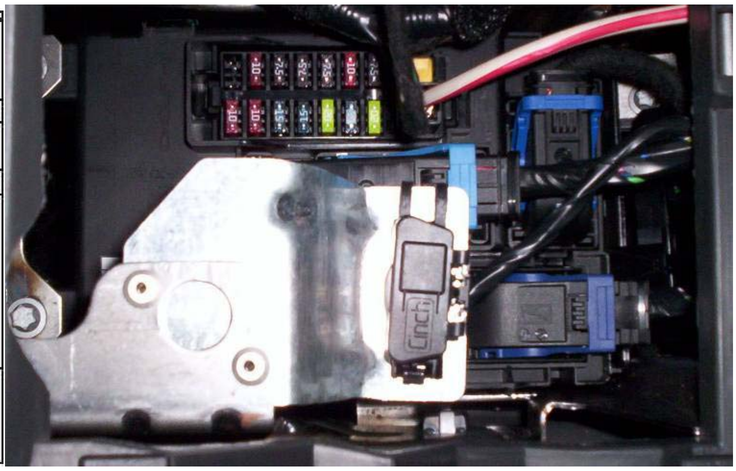
The Body Computer node is interconnected to the front bodywork cable harness and the dashboard cable harness.



Position on the vehicle

To gain access to the fuse holder control unit on the instrument board, unscrew screws **A**, then remove the cover.





Functions managed

The Body Computer node (BCM) is an electric/electronic component used both to distribute the electric power (power PCB) and manage the vehicle's serial lines as well as the functions below:

passenger compartment interior lighting;

external lighting (sidelights, brake lights, low/high-beam headlamps);

indicator lights;

reversing lights;

wiper operation;

rear heated window;

door and boot lock/unlock;

fuel level;

fuel pump;

key status management and acquisition;

gateway between the B-CAN and C-CAN networks, and between the LIN and B-CAN.

The immobilizer and remote control RF antenna interfaces are provided on the BCM.

Pin-out

Connector LA	
Pin	**Description**
1	Kl 15 relay control (T6)
2	Switch lighting
7	Fog light relay control
4	KL 15a relay control (T30)
5	VSO output 2
3	Headlamp washing pump sensor signal
6	Driver’s door ajar signal to the MTA
8	Four indicator LED control
9	Horn relay control
10	High-beam headlamp relay control
11	Comfort closing WLW
12	Rear defrosting LED control
13	KL 15a relay control T5
14	Not connected
15	Not connected
16	Low-beam headlamp relay control
17	Boot opening switch signal
18	Four indicator switch signal
19	Light switch signal (normally closed)
20	Rear defrosting switch signal
21	Brake oil level signal
22	Front wiper parking contact signal
23	Reserve input
24	Front wiper contact signal
25	Clutch switch signal
26	After-sales anti-theft system signal
27	Front brake pad wear sensor signal
28	Brake light switch signal (normally open)
29	Front driver’s door key cylinder switch (lock/unlock)
30	Front passenger’s door key cylinder switch (lock/unlock)
31	Reserve output
32	Antenna RF (GND) – coaxial cable

33	Quick signal 1 unlock
34	Quick signal 3 unlock
35	Roof LIN
36	Front high speed CAN-L to ACC, LHL
37	HS Powertrain/Chassis CAN-L to the diagnosis connector
38	HS Powertrain/Chassis CAN-L to wiring L
39	LS CAN-A on wiring L
40	Fuel level sensor ground
41	Rear left door closing switch signal
42	Boot closing switch signal (normally closed)
43	Handbrake sensor or damaged cable signal
44	Right door rear glass detection switch
45	Fuel level sensor signal
46	Rear window defrosting relay control
47	Antenna RF (Signal) – coaxial cable
48	Quick signal 2 lock
49	A/C request signal

50	Serial line ASM
51	Front HS CAN-H to ACC, LHL
52	HS Powertrain/Chassis CAN-H to the a diagnosis connector
53	HS Powertrain/Chassis CAN-H on wiring L
54	LS CAN-B on wiring L
55	Rear right door closing switch signal
56	Front passenger's door closing switch signal
57	Front driver's door closing switch signal
58	Left door rear glass detection switch
59	External temperature sensor ground
60	External temperature sensor signal

Connector LC	
Pin	**Description**
1	Front right indicator light

2	Front right light control
3	Ceiling light control
4	Front right light control
5	
6	
7	Front right parking light
8	Front left parking light
9	Front right indicator light
10	Right side indicator light
11	Rear right indicator light
12	Rear fog light
13	Central brake light
14	License plate light
15	Right brake light
16	Left brake light
17	Rear right dimmer
18	Rear left dimmer
19	Left side indicator light
20	Rear left indicator light

Connector PD	
Pin	**Description**
1	Immobilizer antenna
2	Spare
3	Spare
4	Bus LIN
5	B-CAN B
6	C-CAN H
7	Rear window regulator relay control
8	Spare
9	Light switch module
10	Four indicator button LED
11	Central locking button LED
12	Rear window button LED
13	Parking assist deactivation LED

14	Spare
15	Immobilizer coil power supply

16	Immobilizer antenna
17	C-CAN H
18	Spare
19	Ground
20	B-CAN A
21	C-CAN L
22	Power steering control
23	Four indicator button control
24	Rear window regulator switch
25	Boot button actuation control
26	Spare
27	Spare
28	“City” button control
29	Windscreen wiper control
30	Fog light control
31	Acc signal
32	+15 signal
33	Spare
34	Reference ground
35	C-CAN L
36	Spare
37	Blinking control
38	Light self-actuation control
39	Lock/unlock signal
40	Front wiper adjustment control
41	Cruise Control settings
42	Reference ground
43	Spare
44	Rear fog light control signal
45	Cooling fluid level signal
46	Spare
47	Spare

48	Ignition key power supply
49	Ground
50	Steering wheel control 2
51	Indicator light control
52	Steering wheel controls 3
53	Steering wheel horn controls
54	Wiper controls (speeds 1 and 2, automatic, intermediate)
55	Front/rear window washing control
56	Spare
57	Ground signal BCM
58	Defrosting button signal
59	A/C signal
60	Window washing fluid level signal

Connector LE	
Pin	**Description**
1	Central door deadlock control power supply
2	Cigar lighter socket light
3	Bi-directional washing pump control
4	Right dome light control
5	Rear dome light control
6	Pam, Tpms, roof power supply
7	Rain sensor power supply
8	Brake switch normally open
9	Clutch switch
10	Spare
11	Spare
12	Spare
13	Spare
14	Bi-directional washing pump control (rear)
15	Rear wiper switch control power supply
16	Wiper high speed control power supply
17	Spare
18	Door locking control power supply

19	Central door locking/unlocking control power supply
20	Brake module power supply
21	Comfort function enable power supply
22	Brake switch power supply
23	ASR button power supply
24	EPS power supply
25	Front ceiling light fixture power supply
26	Rear ceiling light fixture power supply
27	Front mudguard light power supply
28	Luggage compartment light power supply
29	EOBD connector power supply
30	Boot lock power supply
31	Driver's door unlocking control
32	Front wiper low speed power supply

Connector LK	
Pin	**Description**
1	RF antenna signal
2	RF antenna ground

Connector LG	
Pin	**Description**
1	+ 30
2	Spare
3	Radio power supply
4	Spare
5	IPC + 15
6	EPS + 15
7	SDM + 15
8	EOBD connector power supply
9	Spare
10	Ground BCM
11	+ 30 esl
12	Display power supply
13	Telephone + 30
14	Spare
15	Glove compartment chest light power supply
16	Glove compartment light power supply
17	ELC light power supply
18	Spare
19	Spare
20	Spare

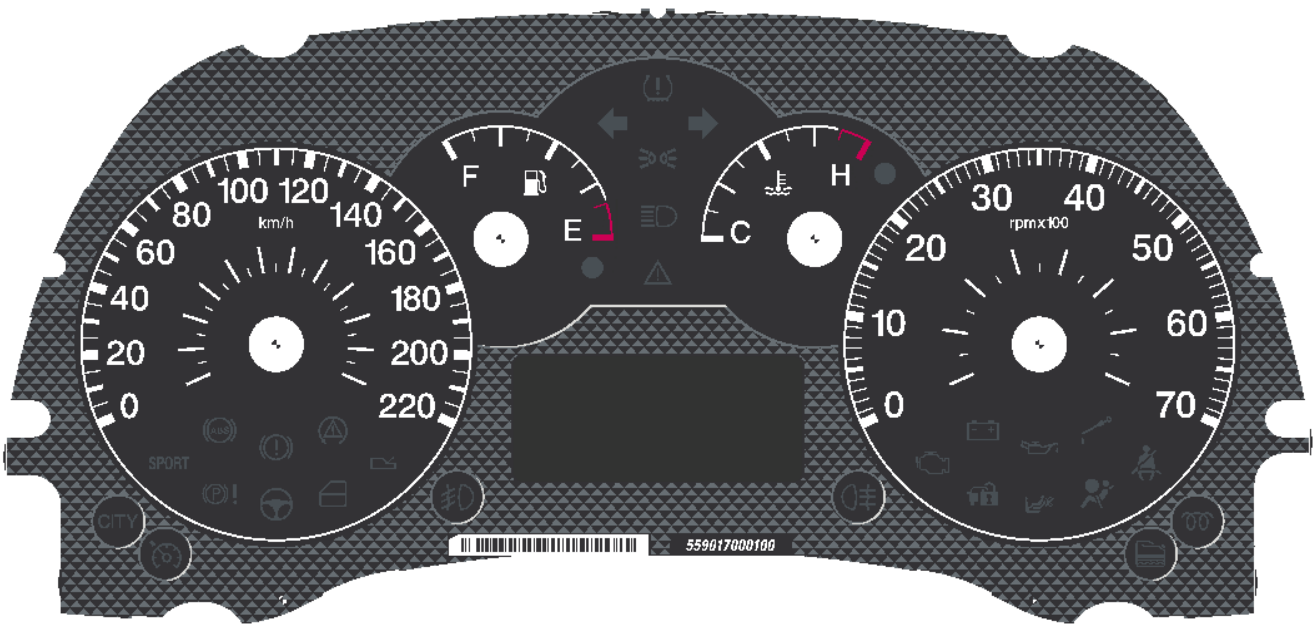
9.2.4 Instrument board node (IPC)

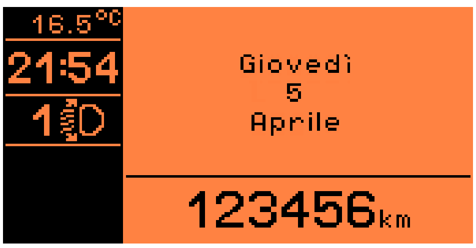
Features

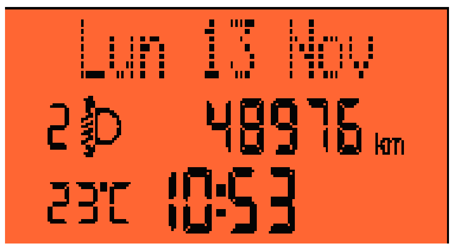
The design of the 199 instruments has been realized by establishing a "*family feeling*" with the other FIAT vehicles of its generation, such as Stilo, Punto Face Lifting and Panda, all of which feature orange background illumination.

The instrument board node (IPC) is an electronic component connected to the B-CAN network and the dashboard cable harness: it acquires some user controls and manages the vehicle menu and the headlamp trim control. The connector provides for discrete interfacing with other vehicle systems (engine control) and is available in two versions with three type of display:

Version with black graphic elements

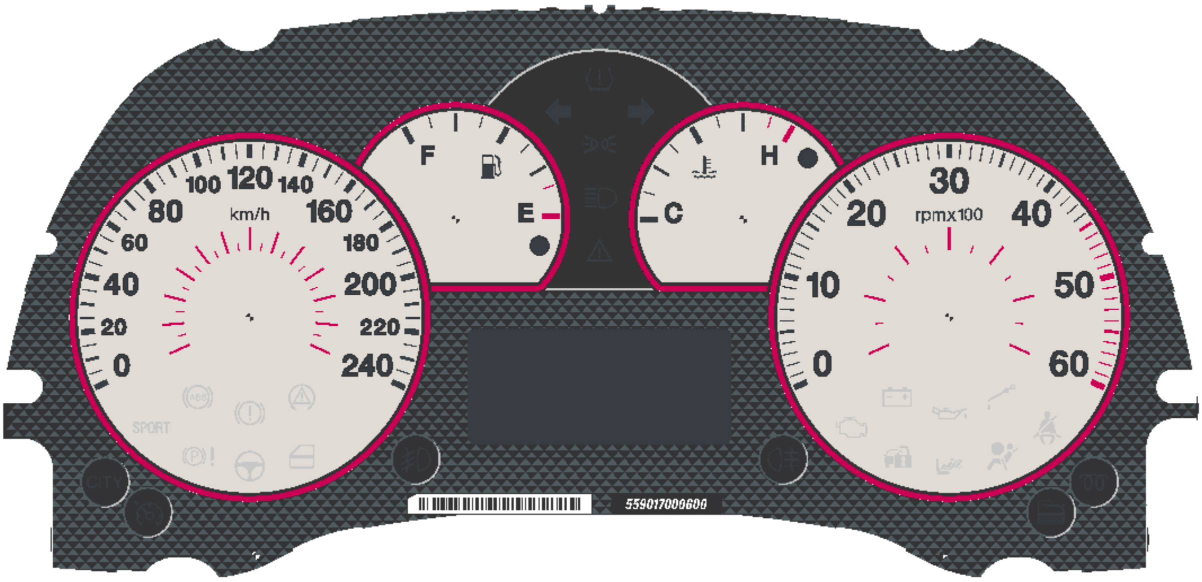


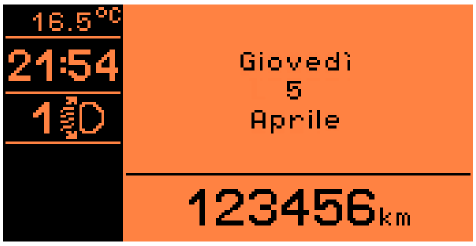


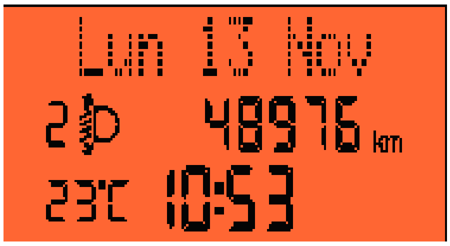


Mode display | Comfort display | Matrix display

Version with white graphic elements







Mode display | Comfort display | Matrix display

Vehicle panel with re-configurable matrix display, connected to the B-CAN network and standardized for the right-hand and left-hand drive versions, with various indicators. The electronic architecture of the indicators is realized by means of a microprocessor and stepping motors, ensuring accuracy and continuity (no tripping or crawling) over the entire reading scale under the operating limit conditions.

It is equipped with a maximum of 30, 28 and 23 LED light-up warning lights (Mode, Comfort and Matrix, respectively), with negative contrast (2 warning light presettings that can be actuated through the CAN network).

Speedometer

The instrument board provides a speed reading slightly higher than the actual speed, due to safety reasons. This increase is calculated by the panel. Upon key-ON, the indicator reaches 0 (zero) k.p.h. (or m.p.h.) and the instrument board displays the vehicle speed information.

Revs counter

Upon key-ON, the indicator reaches 0 (zero) r.p.m. and the instrument board displays the engine revs information. Moreover, a revs counter anti-oscillation logic is available in the engine idle running conditions.

Fuel level indicator

Two seconds after the key-ON, the indicator displays the fuel level information.

The indication corresponding to the start of the “fuel reserve” is red, and the relevant warning light is made of an amber LED (positioned among the indicator’s graphic elements). The indicator calibration ensures greatest accuracy at the start of the red sector.

Engine coolant temperature indicator

Two seconds after the key-ON, the indicator displays the engine coolant temperature information.

The indication corresponding to the start of the “hazard area” is red, and the relevant warning light is made of a red LED (positioned among the indicator’s graphic elements). The indicator calibration ensures greatest accuracy at the start of the red sector.

Pointer behaviour:

- if the temperature is ≤ 50°C, the pointer will position itself on the first mark/grade of the scale;
- if the temperature is included between 50°C and 80°C, the pointer will move linearly;
- in the temperature is included between 80° and 15°C (*normal operation*), the pointer will remain stable in the middle of the scale;
- if the temperature is included between 115° and 124°C (uphill) and between 120° and 115°C (downhill), the pointer will move linearly.

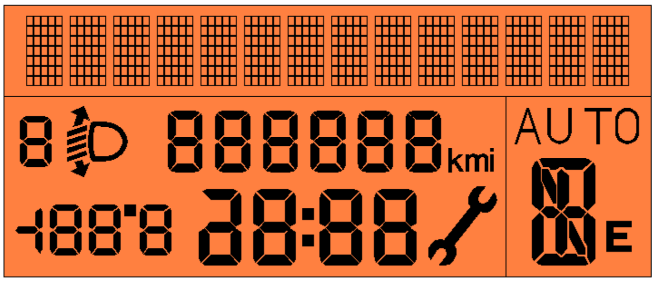
- If the temperature is 124°C (uphill), the pointer will remain at the start of the red hazard sector of the scale (124°C÷130°C);
- if the temperature equal to or higher than 124°C, the max. engine coolant temperature warning light will come on; at the same time, the pointer will position itself at the bottom of the scale.

MODE panel

Dimensions	52 x 36.6 mm^2
Visible area	44 x 24.6 mm^2
Power supply	5 V

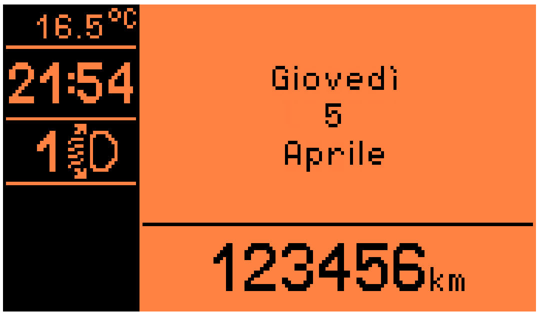
COMFORT panel

Dimensions	73.5 x 54 mm^2
Visible area	64.5 x 27 mm^2
Pixel dimensions	0.7 x 0.94 mm^2
Max. interpixel dimensions	0.03 mm
Power supply	4 / 7 V



MATRIX panel

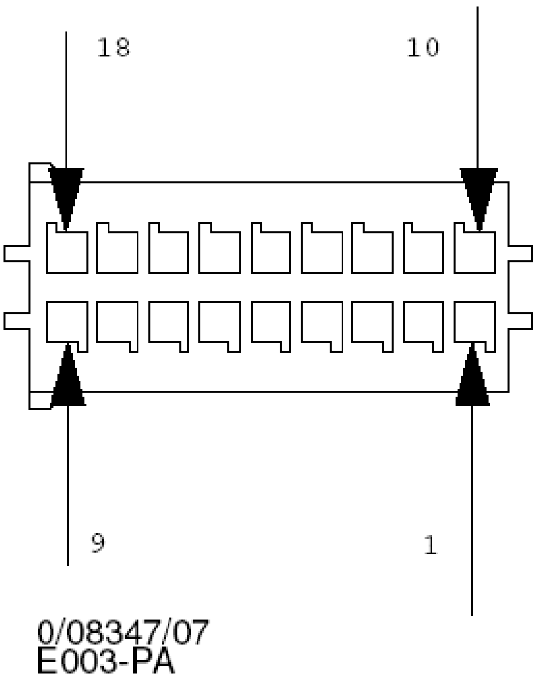
Dimensions	80 x 48 mm^2
Visible area	67 x 35 mm^2
Pixel dimensions	0.37 x 0.37 mm^2
Max. interpixel dimensions	0.02 mm



Position on the vehicle

The IPC is located in the driver's side dashboard.

Instrument board pin-in/pin-out



PIN	PIN FUNCTION
1	IPC ground
2	+30 IPC
3	KL 15
4	
5	B-CAN A
6	B-CAN B
7	
8	
9	Control menu trip from the CSM (steering column stalk)
10	
11	
12	
13	
14	
15	
16	
17	
18	MIL warning light control form the ECM

IPC functions

Acquiring, from the B-CAN line, the airbag status signal (ON, OFF, Flash) from the SDM.

Transmitting, on the B-CAN line through the airbag warning light signal, the airbag warning light status (ON, OFF, Fail).

Diagnosing the airbag warning light and the front passenger's airbag deactivation warning light, and storing possible faults (permanently, until their are remedied) into the IPC memory.

If the signal from the SDM in the B-CAN is delayed, the IPC shall make the airbag warning light to come on.

Trip Computer

The trip computer makes it possible to show, on the vehicle panel display, the values relative to the route, consumption and the distance covered by the vehicle.

Two trip computer modes (A and B) are provided for the Comfort and Matrix panels, which are fully independent from each other and can be shown on the display by pressing the “TRIP” button (dedicated) located on the right lever of the steering column stalk.

The Mode panel features only the “Trip A” mode.

Data displaying by the driver follows a pre-established sequence (see list below):

TRIP A	TRIP B
Distance covered- Fuel distance	Distance covered
Average consumption	Average consumption
Average speed	Average speed
Driving time	Driving time
Instant consumption	
Fuel distance	

The values shown can be represented by means of the decimal system (km, k.p.h., k.p.l., l/100 km) or the British system (miles, m.p.h., m.p.g.),depending on the driver’s choice (see the set-up menu).

The trip computer is reset (new mission):

- “manually” by the user by pressing the “TRIP” button for some time;
- “automatically” when the covered distance reaches the maximum value [9999.9 km (miles) for the Comfort and Matrix panels, or 3999.9 km (miles) for the Mode panel], or when the driving time reaches 99:59 (99 hours and 59 minutes);

every time after the battery is reconnected.

When the maximum kilometre distance that can be displayed on the trip odometer is reached, the latter will display 0.0 again.

Example (Mode panel)

Trip Computer items:

Fuel distance [km] or [miles]: it indicates the estimated distance hat can be covered with the fuel found in the tank, by assuming that the driver will keep on driving by following the same driving behaviour.

Covered distance [km] o [miles]: it indicates (0 to 9999.9 for the Comfort and Matrix panels, 0 to 3999.9 for the Mode panel) the distance covered by the vehicle from the start of the mission, i.e. since the trip odometer has been reset by the driver. The indication is consistent with the value shown on the odometer. The display is updated every 100 metres.

Average consumption [k.p.l.] or [l/100 km] or [m.p.g.]: it indicates the average consumption from the start of the mission. The unit of measurement [k.p.l.] cannot be selected in the Mode panel.

Instant consumption [k.p.l.] or [l/100 km] or [m.p.g.]: it indicates the fuel consumption constantly updated. It helps the driver be aware of the consumption differences according to the driving behaviour. The unit of measurement [k.p.l.] cannot be selected in the Mode panel.

Average speed [k.p.h.] or [m.p.h.]: it is calculated starting from the start of the missions.

Driving time [hh:mm]: it indicates the time [00:00 to 99:59) elapsed since the start of the mission, with resolution and updating of 1 minute. When the maximum value is reached, the count will be reset automatically.

Set-up menu

The set-up menu functions can be actuated only when the vehicle is stopped, except for the “speed limit” function (speed limit threshold and speed limit actuation/deactivation selection). Pressing the “Menu / Esc”, “+” and “–“ buttons will allow you to select, adjust and set the displayed values.

If no operation is carried out for some time, the standard screen will be resumed.

Mode panel

Speed: speed limit threshold selection and setting: the “SPEED” writing appears in place of the odometer; “k.p.h.” or “mph” writing depending on the set unit of measurement; “OFF” or “ON” writing and speed limit in place of the clock, with a range of 30 to 250 k.p.h. (20-155 m.p.h.) and a step equal to 5 k.p.h. (5 m.p.h.).

Clock setting: the “Hour” writing appears in place of the odometer.

Buzzer setting (one single setting for the alarms, faults, warnings, button pressing): 0 (mute) to 7 (max. volume) with the “Buzz” writing in place of the odometer.

Setting the unit of measurement (distance): “Unit” writing in place of the odometer.

Comfort and Matrix panels

Speed: speed limit threshold selection and setting.

Twilight sensor sensitivity level control (where the twilight sensor if available).

Trip “B” actuation/deactivation.

Clock and time format (12/24 h) setting.

Date setting.

Audio information repeat actuation/deactivation.

Actuation/deactivation of automatic door/boot locking above 20 k.p.h.

Setting the units of measurement (distance, consumption, temperature).

Language setting (Italian, English, German, Portuguese, Spanish, French, Dutch, Polish).

Alarm/fault/warning buzzer volume setting.

Button pressing buzzer volume setting (roger beep).

Seat belt reminder re-actuation.

Servicing slip expiry displaying (km/miles).

Passenger’s airbag actuation/deactivation.

Initial setting – Instrument initialization

The table below shows the factory-made instrument settings for the vehicle.

	COMFORT/MATRIX PANELS		MODE PANEL	
Feature	**Available**	**Automatic**	**Available**	**Automatic**
Speed limit (ON/OFF)	YES	OFF	YES	OFF
Speed limit (threshold)	YES	130 k.p.h.	YES	130 k.p.h.
Twilight sensor sensitivity (1…3)	YES	2	NO	
Trip B (ON/OFF)	YES	ON	NO	
Clock setting (hh/mm)	YES	0:00	YES	0:00
Time format (12/24 h)	YES	24 h	NO	
Date setting (dd/mm/yyyy)	YES	01/01/aaaa yyyy: year of release SW	NO	
Audio information repeat (ON/OFF)	YES	ON	NO	
Door/boot locking with speed > 20 k.p.h. (ON/OFF)	YES	OFF	NO	
Distance unit of measurement (km/miles)	YES	km if the speedometer scale is represented by the kilometre; mi if the speedometer scale is represented by the mile	YES	km if the speedometer scale is represented by the kilometre; mi if the speedometer scale is represented by the mile
Consumption unit of measurement (k.p.l., l/100 km, m.p.g.)	YES	l/100 km if the speedometer scale is represented by the kilometre; m.p.g. if the speedometer scale is represented by the mile	NO	

Temperature unit of measurement (°C/°F)	YES	°C	NO	
Language (Italian, English, German, Portuguese, Spanish, French, Dutch, Polish)	YES	Italian	NO	
Buzzer volume (0…7)	YES	4	YES (unified)	4
Button volume (0…7)	YES	4		
SBR re-actuation	YES	---	NO	
Service (km or miles)	YES	km if the speedometer scale is represented by the kilometre; mi if the speedometer scale is represented by the mile	NO	
Passenger's airbag actuation/deactivation	YES	Depending on the signals from the SDM Confirmation: always NO	NO	

Preventive maintenance signalling (Comfort and Matrix panels)

When the term of the preventive maintenance (the so-called “servicing slip”) is about to expire, the “Service” message and the “Wrench” icon (followed by the number of kilometres, or miles, left before the vehicle is to be serviced) will be automatically display upon key-ON (after the initial check procedure).
The displaying information can also shown on the display at the user’s request, by selecting a special item in the set-up menu, regardless of the set expiry: the display will show the kilometres (or miles) left before the vehicle is to be serviced. In this case, the “Wrench” icon will not appear.
The preventive maintenance schedule provides for 9 “servicing slips” organized in such a way that each of them is carried out not later than 30,000 km (or 18,000 miles) from the preceding one.

Automatic displaying

The first expiry message will be automatically displayed only once upon key-ON if the kilometres (or miles) left before the vehicle is to be serviced are equal to or less than ≤ 2,000 km (1,240 miles).
Next, the message will be displayed only once upon key-ON, with the following threshold values:
1,800, 1,600, 1,400, 1,200, 1,000, 800, 600, 400, 200, 100, 50 km
1,240, 1,116, 992, 868, 744, 620, 496, 372, 248, 124, 62, 31 miles will no longer be displayed during the time period in between.
When the limit expiry value (0 km/miles) has been reached, the “Servicing expired” message will be displayed. The driver can interrupt this message by pressing the “Menu/Esc” button.

Displaying at request

The expiry value can be displayed at request at any time by means of a specific item of the set-up menu.
When the limit expiry value (0 km/miles) has been reached, the “Servicing expired” message will be displayed.

Displaying after the 9 slips have been carried out

After the nine servicing slips have been completed, no message will be displayed automatically any longer, and the respective item from the set-up menu cannot be selected any more (i.e. it cannot be actuated).

Reset by the servicing dealership

Upon every scheduled expiry, the following operations shall be carried out:

the “km” (or mile) counter shall be reset to the starting values, through the diagnosis instrument;

the execution of the preventive maintenance (“servicing slip”) operation shall be stored in the memory: therefore, the latest “slip” carried out shall be traceable, through such indications as the date of servicing, number of the slip, and the total distance covered (kilometres). These stored data are kept even if the battery is disconnected from the vehicle.

Vehicle panel replacement

In case of vehicle panel replacement, the following operations shall be carried out:

resume the covered kilometres (or miles) as indicated by the odometer;

check the number of servicing slips carried out and write them down on the new vehicle panel;

check the counter that calculates the kilometres (or miles) left before the vehicle is to be serviced again, then write them down on the new vehicle panel.

Other functions:

Clock

As regards the Mode and Comfort panels, the hour/minute indication will always be available, both upon key-ON and key-OFF. As regards the Matrix panel, the hour/minute indication will be available only upon key-ON: the clock will not be displayed upon key-OFF.

Time setting as an item of the set-up menu

As regards the Comfort and Matrix panels, the “24 h” (0–23 h) or “12 h” (1–12 h) mode can be selected from the set-up menu. The “AM” and “PM” indications will not be displayed. As regards the Mode panel, only the “24 h” mode can be displayed, since the respective set-up menu item is not available.

Headlamp trim correction (“C.A.F.”)

The headlamp trim correction function provides for 4 preset vertical headlamp orientation. These positions can be obtained by pressing the “CAF+” (light beam raising) and “CAF–“ (light beam lowering) buttons: an electric motor connected inside the headlamp causes the reflectors to be rotated automatically.

The current headlamp position is signalled on the vehicle panel by the headlamp inclination icon and the corresponding number (0 to 3).

The C.A.F. buttons are active only when the key is ON and the low-beam headlamps have been switched on.

Upon key-OFF, the function is disabled, and the vehicle panel memorizes the position of the headlamp trim corrector. When the low-beam headlamps are not active any longer, handling will be disabled and the current position of the headlamp reflectors will be maintained.

Upon key-ON, and when the low-beam headlamp ON control is available, both the “headlamp trim corrector” symbol and the number for the current position will light up on the instrument board display.

When the low-beam headlamps are switched off, both the symbol and the respective number will go out, and the function will be disabled.

"Speed limit" function

A speed limit can be set (within a range of 30 to 250 k.p.h. and steps of 5 k.p.h., i.e. 20 to 155 m.p.h. and steps of 5 m.p.h.), which actuates, when the limit is exceeded, the following driver warning procedure:

the relevant "speed limit exceeded" message will be displayed. As regards the Mode panel, the fixed "Speed" writing (in place of the odometer), "k.p.h." or "m.p.h." writing will appear, depending on the set unit of measurement, or a fixed writing indicating the speed limit exceeded, together with the unit of measurement (km/miles) in place of the clock.

Acoustic buzzer signal

The message will disappear after the warning cycle has been completed and/or when the vehicle speed falls below 5 k.p.h. (or the equivalent m.p.h. value) with respect to the set limit value.

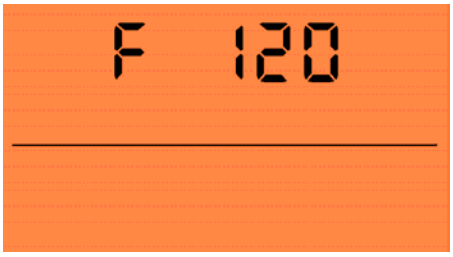
"Follow me home" function

This function makes it possible to obtained timed illumination outside the vehicle (e.g. low-beam headlamps) even after the vehicle has been stopped (for safety reasons, safe homecoming, etc.).

The vehicle panel display will show the "F XXX" or "Follow me XXXs" writing, where:

- "F" (Mode panel) or "Follow me" (Comfort and Matrix panels) represents the "Follow me home" function message;
- "XXX" indicates the illumination time (seconds) set through the steering column stalk. A maximum of 7 steering column stalk pulses (i.e. 210 seconds) is permitted.

The writing will be displayed for about 20 seconds after the latest pulse given, unless the function is deactivated (through the steering column stalk).



EXAMPLE (Mode panel)

Dualogic (robotized gearbox) function (Comfort and Matrix panels)

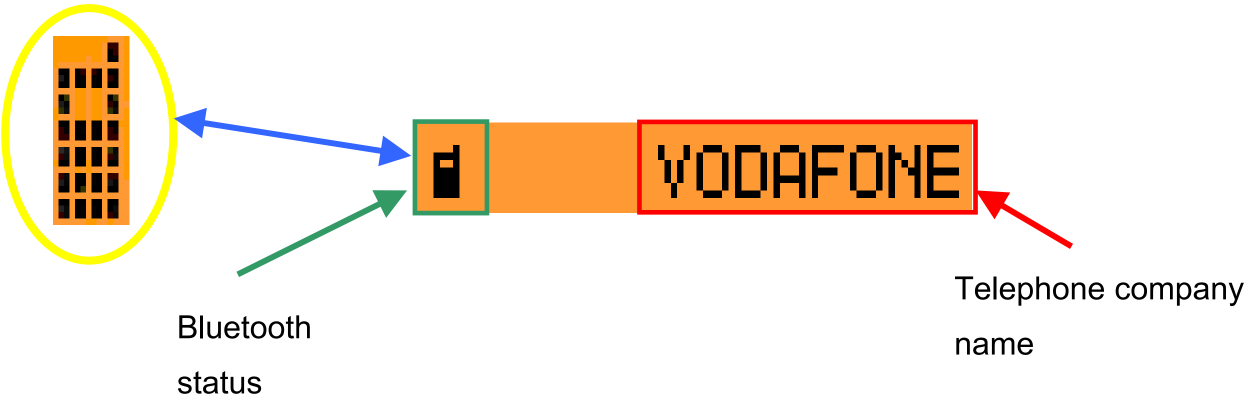
The vehicle panel is capable of managing all the robotized gearbox displaying functions.

The gearbox information is always made available, under any operating condition.

Telephone displaying through the Convergence module (Comfort panel)

The panel displays the Convergence status:

- BLUETOOTH status
- telephone company name.



Example

The panel also displays the information sent by Convergence module through a dynamic multi-message. The number of frames that can be received depends on the number of characters sent by the Convergence module.

TTS LEVEL ⇕

MARIO ROSSI

▲BOOK / LAST▼

Examples

Displaying form the Convergence module (Matrix panel)

Telephone displaying

The Convergence status and the information sent by the Convergence module will be displayed on one single screen.

Navigator displaying

The following information is displayed:

Navigation pictograph

Distance to the next turn

Unit of measurement

Name of the street or road

Logistic mode

This function can be actuated/deactivated only through the diagnostic network and makes it possible to cut down consumption (current absorbed) so as to prevent the battery from running down.

In particular, the vehicle board disables the following displaying (upon key-OFF and key-ON):
clock;
odometer (even when the front doors are opened or closed).

Warnings and messages

Message displaying (Comfort and Matrix panels).
The messages on the display are divided into four different classes:
high-priority anomalies;
low-priority anomalies;
warning messages (e.g. doors/boot open);
feedback (e.g. ASR ON/OFF).
When a fault occurs on the vehicle, the following will be displayed:
the warning light (and/or the icon on the Matrix display) corresponding to the fault;
the message corresponding to the description of the anomaly and/or the actions to be taken by the driver. The display will illuminate at its maximum brightness (except for “Ice danger” and the feedback messages).
The most important warnings and messages are accompanied by an acoustic signal simultaneous with the message displaying. All the information contained in the display section reserved for message displaying will be replaced by the information on the anomaly.
The messages are displayed upon very key-ON until the malfunction is identified and remedied. In any case, the displaying can be interrupted by the driver by pressing the “Menu/Esc” button. When the message displaying has been completed, and if the anomalous condition persists, the warning light (and/or the icon on the Matrix panel) will remain ON.
In the event that several anomalies are found simultaneously, the display will show, in a “rolling” fashion, each of the anomaly messages/ideographs over the duration of one displaying cycle.
All the messages that fall within the abovementioned four classes are managed as follows:
Comfort panel: on displaying strings, each of them lasts 1.5 seconds max. and occupies 5 rows max (these strings make up a displaying cycle);
Matrix panel: on one single screen.

The displaying time may vary depending on the class of the message:

- high priority anomalies: 20 seconds (Matrix panel) or 8 cycles (Comfort panel);
- warning/low priority anomalies: 10 seconds (Matrix panel) or 4 cycles (Comfort panel)
- feedback: 5 seconds (Matrix panel) or 1 cycle (Comfort panel).

Anomalies that require being checked with the engine running:

the following warnings and messages shall only be displayed when the engine is running:

- “battery charge status” icon (Matrix panel);
- “low engine oil pressure” message;
- “engine check required” message.

Message displaying (Mode panel)

On the Mode panel, the anomalies are signalled by the lighting of their respective warning lights.

Moreover, the messages below are displayed:

- speed limit exceeded (for 10 seconds);
- inertia switch actuation: the respective message is displayed in place of the odometer: the message will remain ON until such the inertia switch is being actuated.

Speed limit exceeded

Inertia switch actuation

Acoustic buzzer

Some functions and warnings are accompanied by an acoustic signal.

The vehicle panel features an internal buzzer that performs the following functions:

- alarm/warning/danger signalling;
- robotized gearbox request signalling (where the robotized gearbox is available);
- parking sensor signalling (where the parking sensor is available);
- safety belt reminder signalling;

- indicator/emergency light ticking sound;
- button pressure “roger beep”.

The acoustic signals may differ in loudness and frequency, depending on the signalled function.

The alarm signal volume can be set down to 0 (acoustic signal OFF), except for the robotized gearbox, parking sensor, SBR and indicator/emergency ticking signals, for which a volume other than zero is provided.

The access priority among the various signals is managed by a priority table in the vehicle panel.

LED diagnosis

LED diagnosis is provided for the warning lights listed below (the vehicle panels memorize and transmit, through the CAN network, the warning light status (ON/OFF) and the presence of possible failure):

handbrake ON/low brake fluid level/EBD failure;

ABS system failure;

ESP system actuation/failure;

AIRBAG system failure;

passenger’s AIRBAG deactivation;

safety belts not fastened (SBR);

electric drive failure.

Signalling safety belts not fastened

It may be of 3 types, in automatic operation:

A) *First warning cycle*: signalling by means of the warning light.

The “safety belt” warning light informs that the safety belt has not been fastened (both on the driver’s and passenger’s sides) by coming on steadily since the key-ON.

B) *Warning cycle*: signalling by means of the warning light and the acoustic signal.

The warning light on the board starts blinking, and the acoustic signal sounds intermittently for 90 seconds if any of the following conditions occurs:

elapsed time of 60 sec and vehicle speed higher than 10 k.p.h.;

vehicle speed higher than 25 k.p.h.;

covered distance longer than 500 m.

If the belts are fastened during the cycle, the warning cycle will be automatically interrupted and will be repeated only when the unfastened belt condition occurs again.

Warning cycle switch-off mode: the driver may switch the warning cycle off temporarily before the key-ON (by fastening the front safety belt(s), by keeping the same for at least 20 seconds with the key ON and then releasing it) or permanently, by asking for the assistance of the Technical Service personnel. The warning cycle is actuated again upon every key-ON (with the temporary switch-off mode).

Warning cycle re-actuation mode: the driver may actuate the warning cycle again (it the latter has been switched off permanently) by either asking for the assistance of the Technical Service personnel (Mode panel) or through a special item of the set-up menu (Comfort and Matrix panels). This item will disappear when the warning cycle is actuated again.

External temperature displaying

Available with the Comfort and Matrix panels.

The external temperature indication is ensured, if the external temperature sensor is available, in standard screen conditions.

The desired unit of measurement (°C or °F) can be selected from the set-up menu.

Warning/danger signalling: "Ice"

Available with the Comfort and Matrix panels.

In order to warn the driver that icy patches may be found on the road surface, when the measured external temperature is equal to or less than 3°C, the Comfort panel display shows the warning message:

the blinking external temperature (for the duration of the message);

the respective icon (“snow” symbol) (Matrix panel only).
The warning cycle is carried out only once after an external temperature equal to or lower than 3°C has been recognized; it can be repeated only if the temperature reaches a value of more than 6°C and then is again equal to or lower than 3°C.

Warning/danger signalling: “Doors/boot open”

In order to warn the driver that one or several doors or the boot are open, the corresponding message will be shown on the display as soon as a door or the boot opens. The warning light/icon will remain ON until all the doors and the boot of the vehicle are perfectly closed.
Moreover, an acoustic signal is actuated when the doors are open while the vehicle is running.

Tyre pressure control (OPT TPMS)

Available only with the Comfort and Matrix panels.
The TPMS system monitors two tyre pressure control thresholds corresponding to the low pressure and tyre puncture conditions.
In the event that each of these thresholds is exceeded, the respective signalling warning light/icon will be actuated, and the respective message will be shown on the display. In case of tyre puncture, the panel will also generate an acoustic signal.
Moreover, a TPMS failure signalling (warning light/icon + message) is available.

Operating conditions

The following functional degrading is permitted during the thermal motor starting phase:
no display back-lighting;
softer panel back-lighting (graphic elements and pointers).
After the transient is over, all the functions will be restored.
However, the maintenance and subsequent use of the data relative to the functions below shall be ensured during this phase, even following a reset (if any) during the cranking phase:
clock/date;
trip computer (A and B);
trip odometer (included in the trip computer).

Moreover, the loss of the following data/parameter is not permitted:

odometer;

displaying and calculation logic parameter (e.g. revs counter anti-oscillation thresholds, check time, recovery time, delay time, etc.);

EOL, Proxi and DTC data;

brightness softening and CAF levels (dimming);

set-up menu setting parameters memorized by the user.

Following a reset during the cranking phase, the panel shall also:

- carry out a consistency check of the stored data not found in the EEPROM and restore valid data;
- restart the check phase upon key-ON, as described below:

warning light check: it starts over for the warning lights driven by the panel, and continues for the warning lights driven by a signal in a discrete fashion;

indicators: zeroing is permitted in order to carry out total recovery.

Checking upon key-ON: it starts over.

Automatic service messages: they are displayed again.

Checking upon key-ON

Upon every key-ON, the check phase will start for all the electronic control units fitted to the vehicle, and some warning lights will illuminate on the panel.

Comfort and Matrix panels:

The standard screen (time and date) will be displayed on the panel.

In the event that any anomaly is found during the check phase, the same will be displayed 5 seconds after the key-ON.

Illumination

The vehicle panel lighting provides for two different modes:

active with the lights ON: indicators, graphic elements, display;

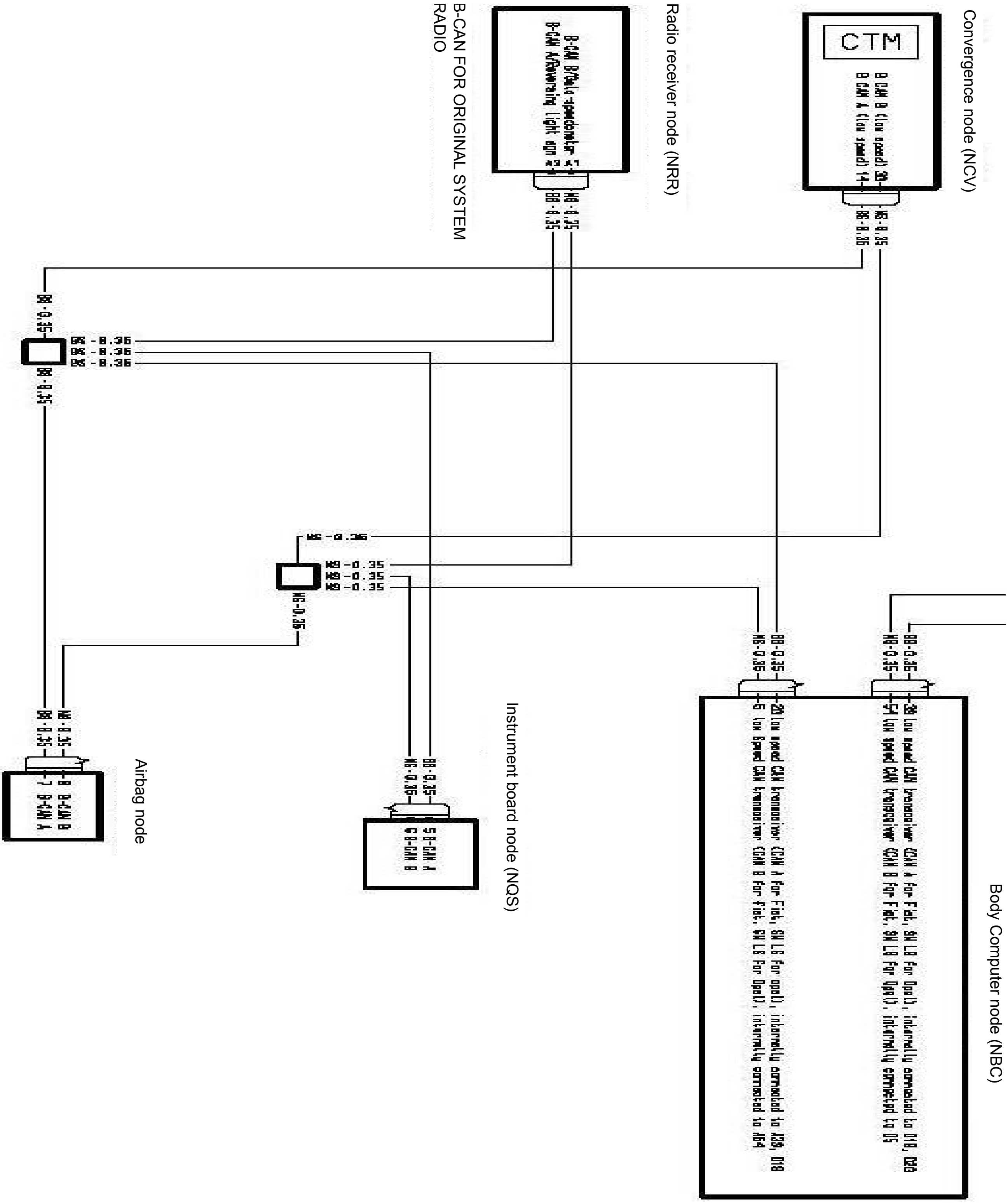
active with the key ON (key-ON): display.

9.2.5 Steering column stalk control module (CSM)

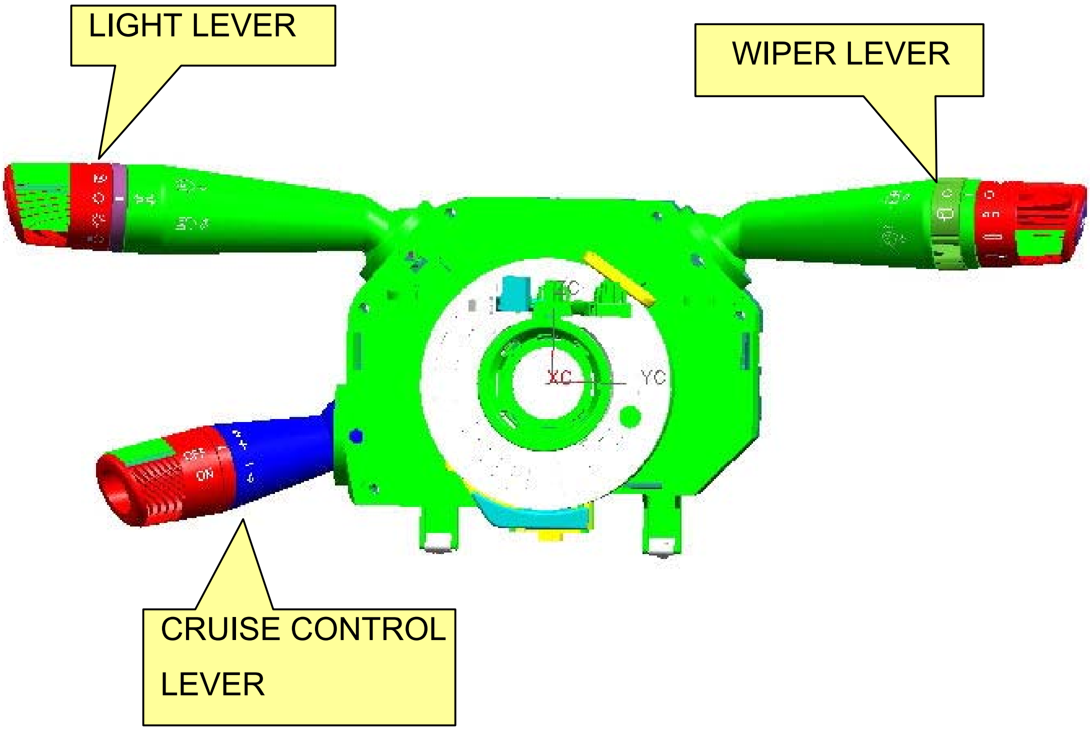
The steering column stalk control module (CSM) incorporates the external lighting controls (on the light lever located on the left) and the window/rear window wiping and washing controls (on the wiper lever located on the right).

The module may include the Trip function (available on all the body versions) and the Cruise Control function (available as an option).

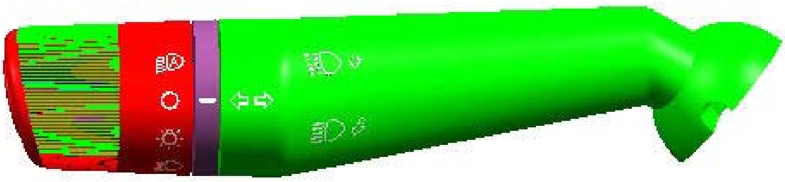
It is interconnected through the dashboard cable harness.


Convergence node (NCV)
CTM
Radio receiver node (NRR)
B-CAN FOR ORIGINAL SYSTEM
RADIO
Instrument board node (NQS)
Airbag node
Body Computer node (NBC)

General remarks



Light control lever



Below are the controls associated with this lever:

light selector;

flashing light/steady high-beam headlamp switch;

indicator and lane change lights.

The controls are actuated by acting on the levers as follows:

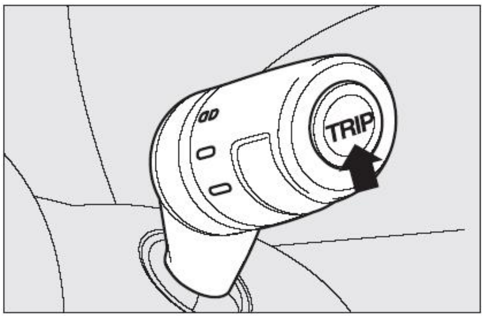
movement on the steering wheel plane in both directions, with double click (the former is unstable, the latter is stable);

pulling movement towards the driver, with double click (unstable);

ring rotation by 3 or 4 clicks.

Light selector: it consists of a ring with 3 stable positions, located at the lever end, which is actuated by rotation along the lever axis.

Wiping control lever



Windscreen wiper control: the windscreen wiper is controlled by a ring with 3 stable positions, located at the lever end, which is actuated by rotation along the lever axis. Three different speeds can be chosen: intermittent/automatic operation, continuous speed 1, continuous speed 2.

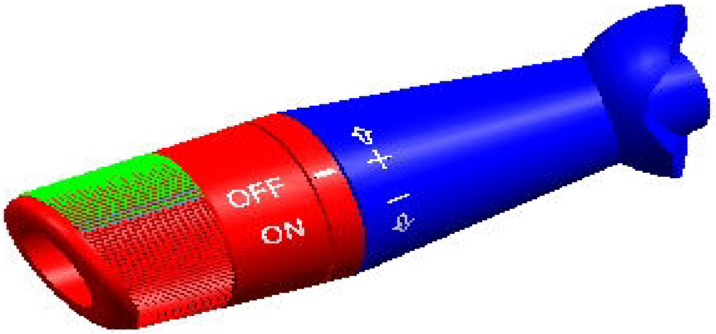
Window washer control: the bi-directional pump for front window washing is actuated by pulling the lever towards the steering wheel crown. This actuation is unstable; therefore, the lever shall return to its rest position when it is released, thus opening the contact again.

Rear window wiper control: the rear window wiper is controlled by turning a ring with 2 stable positions, located in the middle of the lever.

Rear window washing control: the bi-directional pump for rear window washing is actuated by pushing the lever towards the dashboard. This actuation is unstable; therefore, the lever shall return to its rest position when it is released, thus opening the contact again.

“Trip” function button: by pressing the unstable button located at the lever end, the “Trip” function will be commanded to the vehicle panel.

Cruise Control control lever



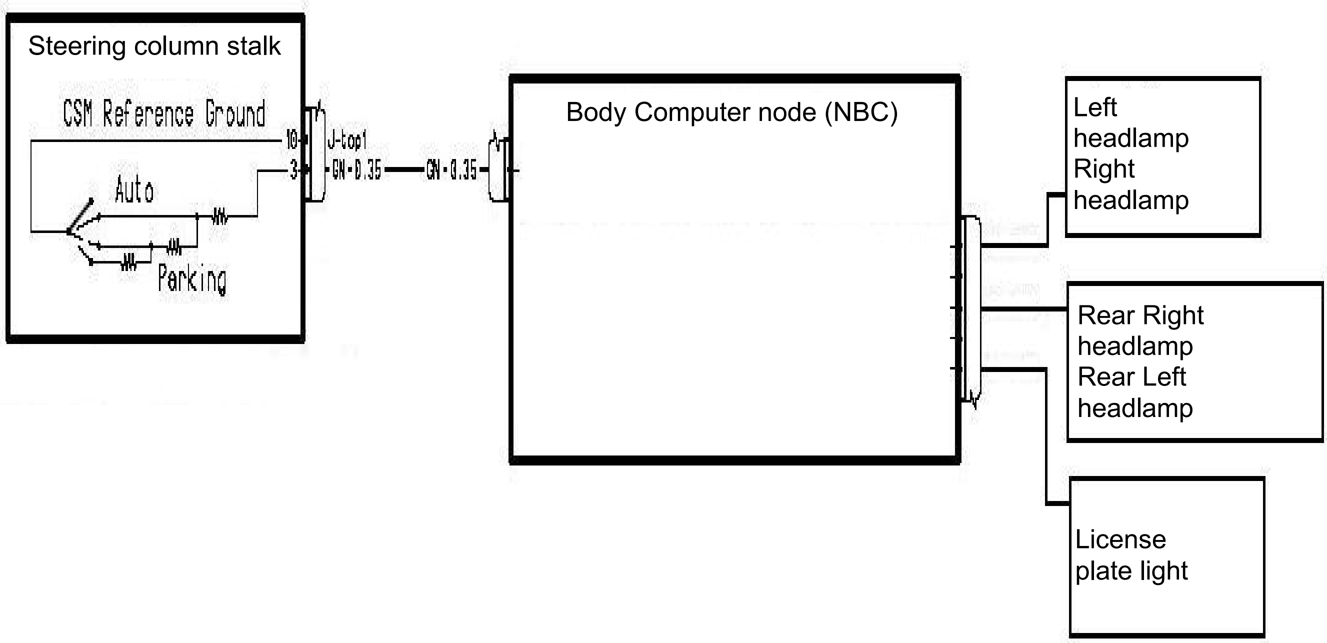
This system is managed by the engine control unit and makes it possible to easily maintain the set vehicle speed, regardless of the varying running conditions.

Steering column stalk functions

Flashing light/steady high-beam headlamp switch: the flashing light control is obtained by pulling the lever from the rest position towards the steering wheel crown while preventing the lever from going past the first click ("flashing light" contact). This actuation in UNSTABLE; therefore, the lever shall return to its rest position when it is released, thus opening the "flashing light" contact again.
The "steady high-beam headlamp" control is obtained by pulling the lever the same way as the flashing light control; in this case, however, the lever shall be allowed to travel a longer stroke, up to the second click ("high-beam headlamps" contact). Here too, the actuation is UNSTABLE: the lever shall return to its rest position, thus opening the "high-beam headlamp" and "flashing light" contacts.
The high-beam headlamps can be turned off by pulling the lever again up to the high-beam headlamp position, the same way as during ignition.

Indicator and lane change light control: this control is obtained by making the lever to move along the steering wheel plane in both directions (upwards and downwards). The translatory motion of the lever in each direction of rotation involves two different ways to actuate the electric contact itself: an UNSTABLE one (referred to "lane change") and a STABLE one (referred to as "direction change"). The "lane change" function is actuated through a smaller angular travel than the one required to actuate the "direction change".

Light actuation diagram



Manual wiping mode: by moving the ring of the steering column stalk lever (located on the driver's right) to any of the three position below:

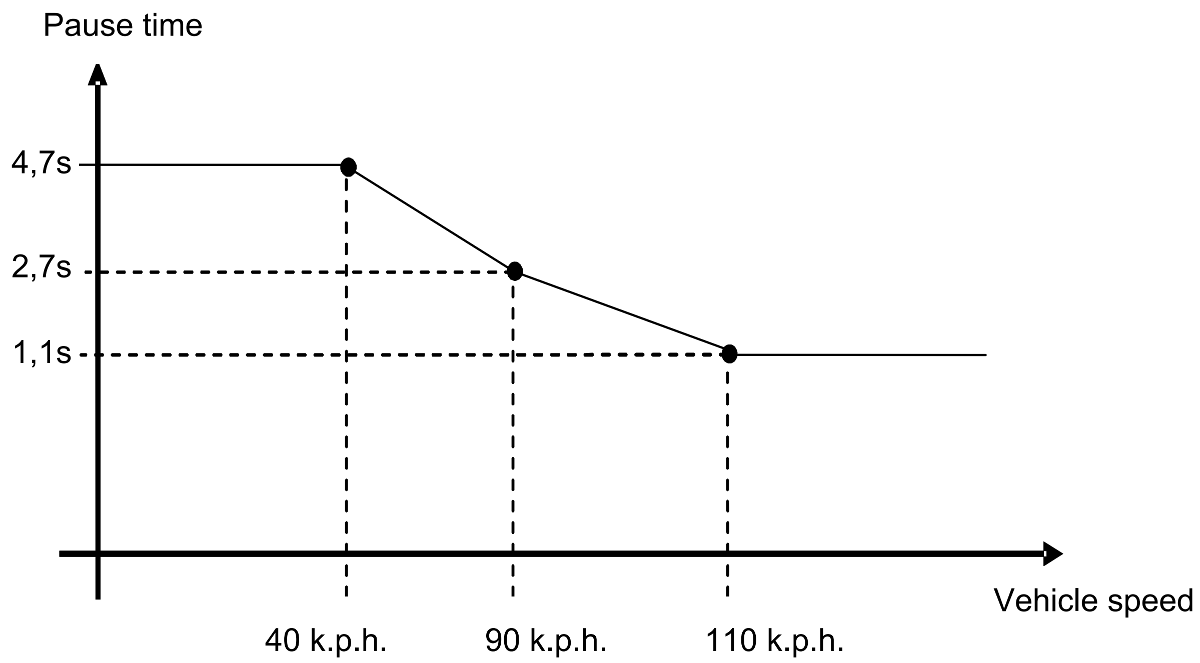
intermittent operation,

continuous speed 1,

continuous speed 2,

the windscreen wiper motor will be actuated as described below.

Intermittent operation: the windscreen wiper is controlled at speed 1, yet with a pause between two subsequent strokes that varies depending on the vehicle speed, in accordance with the diagram below:



Continuous speed 1: the windscreen wiper is driven at speed 1 (45 strokes per minute).

Continuous speed 2: the windscreen wiper is driven at speed 2 (65 strokes per minute).

Automatic wiping mode (rain sensor).

The rain sensor is actuated by turning the ring of the steering column stalk right-hand lever to the intermittent/automatic operation position. Thus, the frequency of the windscreen wiper strokes can be set depending on the amount of water found on the windscreen.

Such frequency may vary from no stroke at all (no rain – dry windscreen) to continuous speed 2 (heavy rain – wet windscreen).

The rain sensor actuation drives the execution of a windscreen wiper stroke acting as a feed-back for sensor switch-on. The user may vary the rain sensor sensitivity by means of the vehicle set-up menu on the instrument panel.

If the vehicle is switched off and the lever ring is left in the intermittent/automatic operation position, no wiping cycle will be carried out when the vehicle is next started, even if is rains: this will avoid unintentional actuation.

To restore the system's automatic operation, the user shall move the ring from the intermittent-automatic operation position to any other position, and then return to intermittent-automatic operation position.

When the rain sensor operation is resumed, a windscreen wiper stroke will occur, regardless of the windscreen conditions, to inform the user that the operation has been resumed.

When the steering column stalk ring is moved from the speed 1 position to the intermittent/automatic operation position, a windscreen wiper stroke will occur to indicate that the rain sensor has been actuated.

If the rain sensor sensitivity is modified (i.e. its value is increased) when the rain sensor is operating, a windscreen wiper stroke will occur to indicate that the modification has been made.

In case of rain sensor anomaly (sensor failure), the following strategies will be performed:

if the anomaly occurs upon actuation (when the ring is being turned from the rest position to the intermittent/automatic operation position), the windscreen wiper will be immediately set to the intermittent operation, regardless of whether rain is found on the windscreen.

If the anomaly occurs during operation (the ring has already been turned to the intermittent/automatic operation position, with resulting rain sensor actuation), the windscreen wiper will be driven according to the latest command sent by the rain sensor until the user either selects other speeds (continuous speed 1 or 2) or turns the windscreen wiper operation off (ring position: OFF). In the event that any of the above-mentioned actions is carried out, any further resumption of the intermittent/automatic position will make the windscreen wiper to operate in the intermittent mode, regardless of whether rain is found on the windscreen.

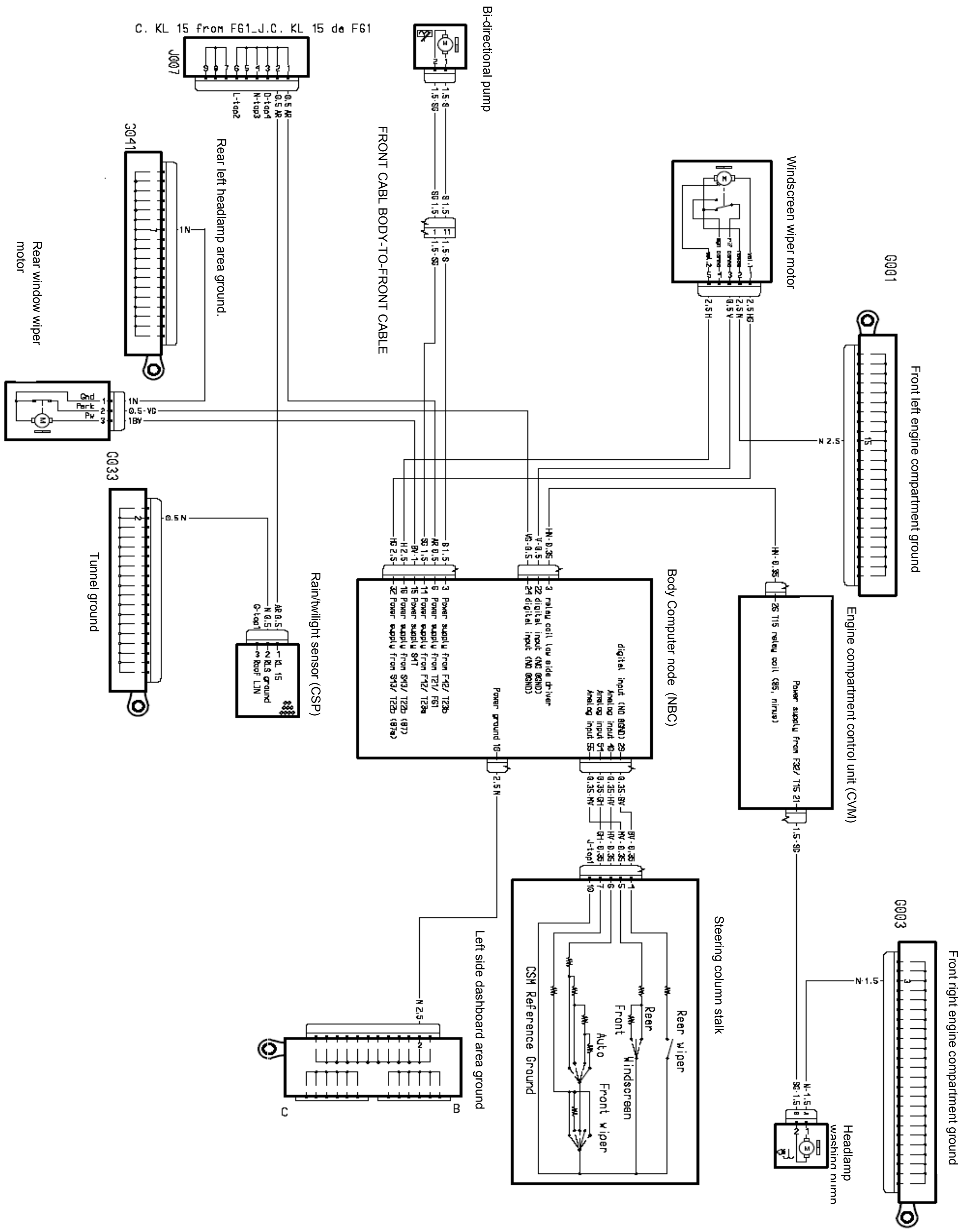
In any case, the instrument board will signal the sensor failure; this makes it possible to inform the user of wrong sensor operation. The failure indication will remain ON until the failure is no longer found.

Smart front washing: By pulling the steering column stalk lever to the right, front washing will be actuated. If the lever is pulled upwards for more than 0.5 seconds, the windscreen wiper will be automatically made to operate at continuous speed 1. When the control is released, the washing will be turned off and three further windscreen wiping strokes will occur, followed by one further wiping every 6 seconds to remove dripping.

In the event that the windscreen wiper has already been actuated prior to actuating the washing control through the lever, the smart washing logic will only be performed to actuate the same in the intermittent mode.

Manual rear window wiper operation mode: by turning the ring of the steering column stalk rear window wiper lever, located on the driver's right, to ON, the windscreen wiper will be actuated as described below:
intermittent operation: a pause of 2.7 seconds between two subsequent strokes;
interlocking to the windscreen wiper (in case of simultaneous request): synchronous operation at a frequency equal to half the windscreen wiper.
continuous operation: with the reverse gear engaged.

Smart rear washing: by moving the steering column stalk right-hand lever, rear washing will be actuated. By keeping the lever pushed for more than 0.5 seconds, the rear window wiper will be automatically actuated at continuous speed. When the control is released, the washing will be turned off and three further rear window wiping strokes will occur, followed by one further wiping every 6 seconds to remove dripping.
In the event that the rear window wiper has already been actuated prior to actuating the washing control through the lever, the smart washing logic will only be performed to actuate the same in the intermittent mode.


Bi-directional pump
C. KL 15 from FG1_J.C. KL 15 da FG1
J007
FRONT CABL BODY-TO-FRONT CABLE
Windscreen wiper motor
G001
Front left engine compartment ground
Rear left headlamp area ground.
3041
Rear window wiper motor
G033
Tunnel ground
Rain/twilight sensor (CSP)
Body Computer node (NBC)
Engine compartment control unit (CVM)
Steering column stalk
CSM Reference Ground
Left side dashboard area ground
G003
Front right engine compartment ground
Headlamp washing pump

Headlamp washing: When front washing is requested through the steering column stalk, with the high-beam headlamps ON, headlamp washing will be actuated for 1.2 seconds.

Cruise Control function operation: the system operates in the following modes:
- speed memorization achieved, discrete and continuous speed increase (set +);
- speed memorization achieved, discrete and continuous speed decrease (set -);
- memorized speed recall (resume).

A warning light on the board, actuated by the engine management control unit, indicates the system's operating status.
To actuate the system, turn the "ON/OFF" ring to the "ON" ignition position, then bring the vehicle to the desired speed (the vehicle speed shall in any case be higher than 40 k.p.h.) and act on the "set+" or "set–" controls: now, the accelerator can be released, and the Cruise Control may be allowed to operate automatically.
This system may function over the entire range of revs permitted by the engine, and may manage vehicles equipped both with manual and robotized gearbox units. However, the system control does not come into action in the following cases:
- neutral;
- reverse gear;
- 1st speed (mechanic gearbox);
- vehicle speed lower than 40 k.p.h.

The Cruise Control can be deactivated by simply actuating either the brake or the clutch; pressing the "RES" (resume) button will subsequently make it possible to resume the speed conditions previously set in the memory.
If the Cruise Control is ON, it will not be disabled by an acceleration request by the driver (e.g. when overtaking): yet, it will automatically resume the vehicle's set speed as soon as the accelerator pedal is released.
The main ring switch-off action will turn the system off and clear any speed previously set.
The ASR (wheel antiskid) function takes priority over the Cruise Control, for safety reasons. After the ASR system has stopped operating, the Cruise Control function is automatically resumed to the latest speed value stored in the memory.

“Set” function: this function, actuated through discrete action of the lever towards the “+” or “–“ sign, makes it possible to set and maintain, in the Cruise Control, the vehicle speed to the value corresponding to the instant when the lever is actuated.

“Accelerate” function: this function makes it possible to increase the vehicle speed previously set in the Cruise Control, so as to generate, as long as the lever is kept operating in the “+” direction, a steady-slope acceleration ramp. When the lever is released, the system will maintain and memorize the new speed reached by the vehicle.

“Tip up” function: this function makes it possible to increase the vehicle speed previously set in the Cruise Control by a constant value every time the lever is slightly moved towards the “+” sign and subsequently released, thus causing the speed to increase by steps of equal size. When the lever is released, the system will maintain and memorize the new speed reached by the vehicle.

“Decelerate” function: this function makes it possible to decrease the vehicle speed previously set in the Cruise Control, so as to generate, as long as the lever is kept operating in the “–” direction, a steady-slope deceleration ramp. When the lever is released, the system will maintain and memorize the new speed reached by the vehicle. The system may only reduce the set speed (not the actual speed) if the engine is already pulled (e.g. vehicle running downhill and high gear).

“Tip down” function: this function makes it possible to decrease the vehicle speed previously set in the Cruise Control by a constant value every time the lever is slightly moved towards the “–” sign and subsequently released, thus causing the speed to decrease by steps of equal size. When the lever is released, the system will maintain and memorize the new speed reached by the vehicle.

"Resume" function: this function makes it possible to resume, by pressing the "RES" button, the latest vehicle speed value stored by the Cruise Control if the latter has not been switched off due to particular conditions (e.g. pressing the brake or clutch pedal). If the gearbox is of the mechanic type, it is recommended that the same speed previously selected is maintained.
If a speed value has not yet been stored into the memory or the vehicle conditions do not permit this, pressing the button will produce no effect at all.

"ON/OFF" function: this function makes it possible to actuate and deactivate the Cruise Control system by actuating the ring switch.

Manual switch-off

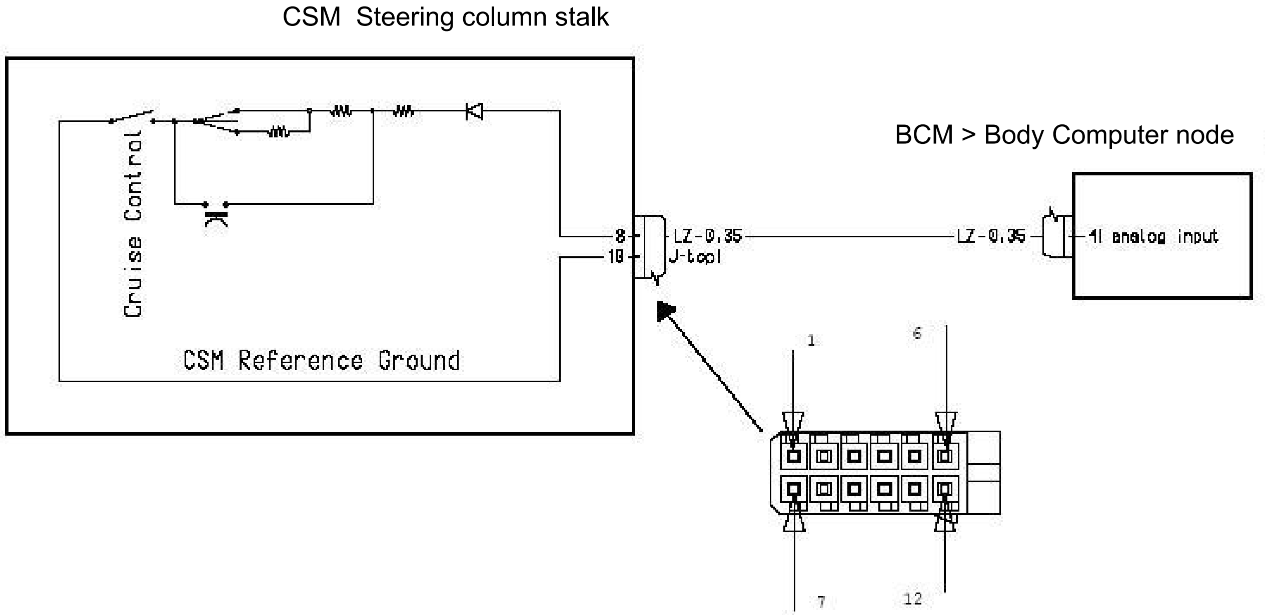
Main ring switch set to "OFF";
engine switch-off or key-OFF;
action on the brakes (including the handbrake): the latest set speed will remain stored in the memory (it can be recalled by pressing the resume ("RES") button);
action on the clutch: the latest set speed will remain stored in the memory (it can be recalled by pressing the resume ("RES") button);
request for gear shift through the lever (with the Dualogic gearbox unit): in the manual mode, the latest set speed will remain stored in the memory (it can be recalled by pressing the resume ("RES") button);
vehicle speed below the established minimum value (40 k.p.h.): the latest set speed will remain stored in the memory (it can be recalled by pressing the resume ("RES") button);
action on the accelerator: in this case, the system will not be actually switched off, yet the request for acceleration will take priority over the system, thus allowing the manoeuvre requested by the driver. In any case, the Cruise Control will remain ON, without having to press the resume ("RES") button to resume the previous conditions once acceleration has ended.

Automatic switch-off

The Cruise Control is temporarily disabled in case of ABS or VDC actuation (longer than a permitted maximum time); the latest set speed will remain stored in the memory (it can be recalled by pressing the resume ("RES") button).

The Cruise Control can be deactivated automatically in case of unintentional or wrong actuation of the lever buttons and acceleration higher than a pre-established limit value; in this case, the function can be resumed by acting on the main switch (ON/OFF) during switch-off and switch-on, and then starting over with the desired speed setting operations.

In the event that a fault is found in the Cruise Control or the engine control system, the Cruise Control will be disabled until key-OFF. In this case, the Technical Service centre shall be contacted.



9.2.6 Radio receiver node (RRM)

The radio receiver node (RRM) is an electronic component connected to the B-CAN network and the dashboard cable harness.

Interfacing with an external audio amplifier is provided on the radio receiver node (RRM), with a CD changer and an external module for GSM (telephone) and GPS (navigation) management.

9.2.7 Rear parking sensor node (PAM)

General remarks

The parking assist system provides the driver, during the reversing operation, and information on the distance when approaching obstacles placed behind the vehicle. This device helps you park the vehicle in safer conditions, since it makes it possible to locate any obstacle found out of the driver's field of vision.

The obstacle presence/distance information is transmitted to the driver through acoustic pulse signals, the frequency of which varies with the vehicle's distance from the obstacle.

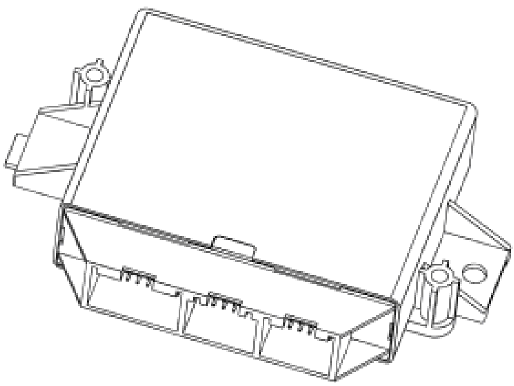
By combining the visual information with the acoustic information generated by the system, the driver will be able to avoid collisions.

The parking sensor node (PAM) is an electronic component connected to the B-CAN network and the body-to-front cable harness, which assists driving during the manoeuvres with the reverse gear engaged, thus recognizing any obstacle at the rear. The interfaces for the sensors on the rear bumpers, the trailer control unit, and a buzzer placed into the IPC instrument board node are provided on the PAM parking sensor node.

The parking assist system of FIAT Nuova Punto is made up of the following components:

- ultrasound sensors on the rear bumper;
- one dedicated electronic control unit;

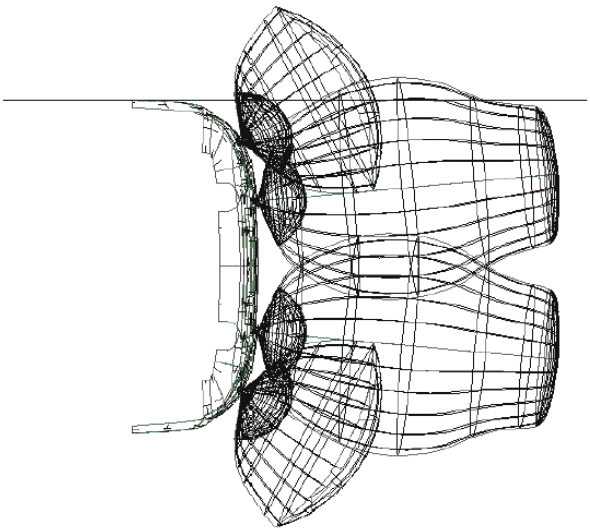
Active ultrasound sensor



Electronic control unit drawing

The electronic control unit actuates and controls the sensor functioning, processes the signals received from the sensors and actuates the acoustic device.
The sensors are ultrasound technology-based electronic components which act as smart transmitters/receivers with ultrasound technology according to a triangulation method: it allows better measurement in critical situations or when small obstacles are found.
The emitted pulses are reflected by the obstacles (if any) found in the ray path; thus, the transducer receives an echo that is converted into a digital signal and sent to the electronic control unit. The acoustic device is located inside the instrument board; moreover, it signals the system actuation when the reverse gear is engaged and the fault (if any).

System coverage area

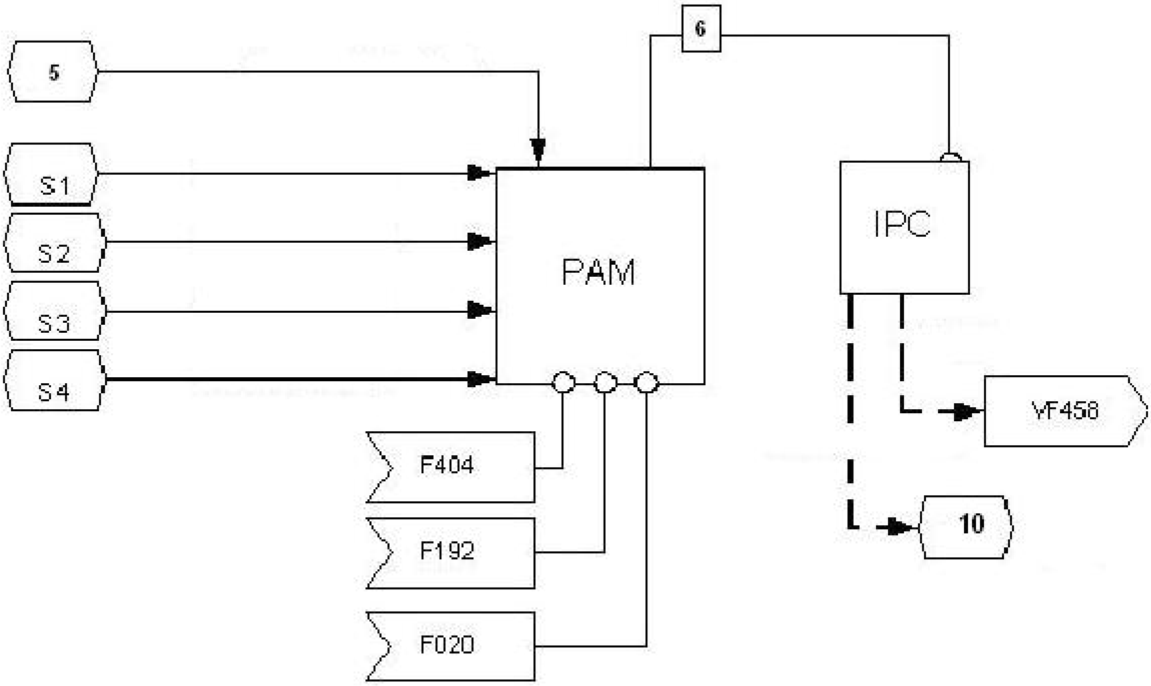


PAM parking node functions

- Acquiring the signals from the rear ultrasound sensors.
- Acquiring the towing hook presence (when the towing hook is available, the system shall be switched off).
- Acquiring the external temperature signal for the diagnosis strategy (see diagnosis specification).
- Parking sensor management.
- Transmitting, on the B-CAN line, parking sensor correct operation.

- Transmitting, on the B-CAN line, the request to the IPC to actuate the obstacle detection acoustic signal.
- Acquiring, on the B-CAN line, the request for obstacle presence acoustic signal actuation.
- Acquiring, on the B-CAN line, the parking sensor correct operation.
- System failure indication.
- Actuating the obstacle detection acoustic signal.

Functional diagram



S1-S2-S3-S4	Ultrasound sensors 1-4	Electric wire connection
5	Towing hook available	Electric wire connection
6	Output signals (see PAM)	B-CAN line
F404	Reverse gear actuation status	B-CAN line
F192	External temperature acquisition	B-CAN line
VF458	Buzzer actuation	Internal connection
F020	Vehicle speed/correct operation	B-CAN line
10	Failure warning light	Internal connection

System actuation and deactivation

When the vehicle is started (ignition key turned to “MAR”), a self-diagnosis test is carried out by the control unit and the sensors: the system will be actuated when the reverse gear is engaged, and will be deactivated when the reverse gear is disengaged.

The acoustic signal emitted by the system warns the driver that the vehicle is drawing near an obstacle. It consists of pulse sound signals: the signal duration is constant, whereas the pause between the signals is directly proportional to the obstacle distance: pulses in a quick sequence indicate the presence of a very near object.

A continuous signal indicates that the distance from the obstacle is smaller than 30 cm. If several obstacles are found, the nearest obstacle will be signalled on approaching. The acoustic signal will immediately cease if the obstacle distance increases.
The sound cycle remains constant if the distance measured by the central sensors does not change; conversely, if this situation occurs with the side sensors, the signal will be interrupted after 3 seconds (in order to avoid, for instance, signals in case of manoeuvres along walls parallel to the vehicle axis).
If a trailer is coupled with the vehicle, rear obstacles will not be signalled.
The system covers the vehicle's rear side and median areas.
If the obstacle is positioned in the median rear area, the obstacle will be detected at a distance of less than 1,50 m. If the obstacle is positioned in a side area, the obstacle will be detected at a distance of less than 0.6 m.

Work conditions

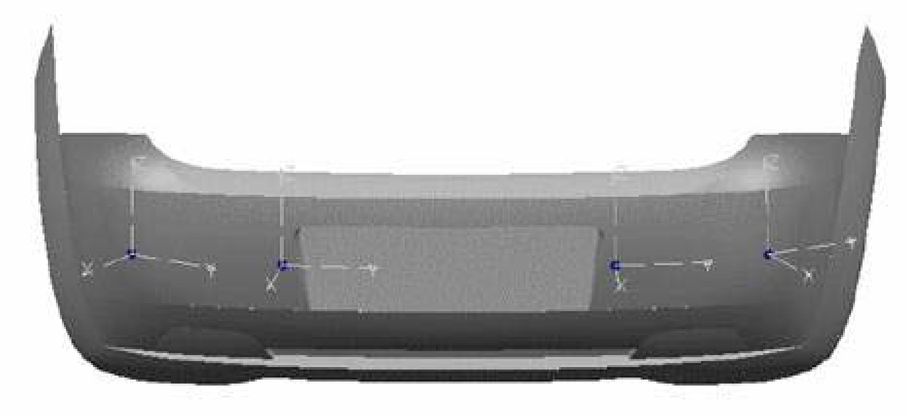
Work conditions	Functionality	Remarks
Ignition OFF (+30)		
Ignition ON (+15)	Parking assist management	The system is active with the following conditions: key ON and reverse gear engaged.
Timed with ignition OFF		
Deactivated during the start		
Deactivated with battery low		

Diagnosis

Upon starting, the control unit carries out a self-diagnosis and sensor test.
Sensors are continuously diagnosed during the system's operation.
Failure to even one single sensor will disable the operation of the entire system: in this case, the system will cut itself off and send a failure message.

Any failure/error will be immediately signalled by means of the vehicle panel and an acoustic signal.

General position of sensors



9.2.8 External audio amplifier for the hi-fi system

The external audio amplifier is an electronic component connected through the body-to-front cable harness. The audio amplifier receives the signals from the audio outputs of the radio receiver node (RRM). Moreover, it receives the consent to actuation from the radio receiver node itself (RRM).

9.2.9 Spiral cable

The spiral cable is an interconnecting component supplied with the steering column stalk control module (CSM), which ensure connection between the dashboard cable harness, the controls on the steering wheel (SWC) (audio and telephone systems) and the airbag modules.

9.2.10 Rain sensor control unit (RLS)

The rain sensor control unit (RLS) is an electronic component connected to the Body Computer node (BCM) through a LIN serial line. It manages, together with a control located on the steering column stalk module (CSM), the windscreen wiper stroke speed setting function. The rain sensor control unit is connected through a special bridle located on the internal rear-view mirror, which is connected to the front body wiring harness. It is made up of a infrared LED sensor fitted to the vehicle's front window and is capable of detecting the presence of rain and, as a result, managing the wiping operation depending on the amount of water found on the glass.


9.2.11 Brake pedal switch

This switch is located on the brake pedal and is connected to the body-to-front cable harness. Its function is to indicate the brake pedal status in order to report the latter to the control units that request so.

It is a control with two contacts (N.O. + N.C.) with separate power supply and the same interface on the cable harness side.

Below are the control units that request the indication of the brake pedal status:

Body Computer control unit;

engine management control unit;

braking system control unit (for both versions: ABS and ESP);

robotized gearbox.

9.2.12 Control board on the driver's side front door (DDC)

The control board on the driver's side front door (DDC) is a module that integrates the different controls located on the driver's side front door and is interfaced with the driver's side front door cable harness. The DDC control board receives the power supply for ideograph lighting and correct control operation. It may feature the following controls, depending on the body version level:

front electric window regulator control;
rear electric window regulator (if available) controls;
rear electric window regulator (where available) cut-off controls, with respective LED
electric side mirror selector;
electric side mirror control joystick.

Three window regulator control module models are available, depending on the vehicle's body version, which feature three different types of window regulator motor controls.

The electric window regulator controls of the base model directly drive the motors of the driver's and passenger's side front window regulators only, with no electronic control on the motors themselves. This model does not feature rear electric window regulator control.

The second model incorporates an electronic module for controlling the up and down movement of the driver's side front electric window regulator only, in automatic mode.

Conversely, the passenger's side front electric window regulator control directly drives the passenger's side window regulator motor with no electronic control of the motor itself. Similarly with the first model, rear electric window regulator control is not available.

The third model features control of both the front electric window regulators and the rear electric window regulators: in this case, the controls are acquired by an electronic module located inside the window regulator motor. This model features a function with an automatic device both for the up and down movement on all four window regulators, including the anti-pinch protection.

Moreover, this model features a control used to disable the window regulator controls placed on the rear doors, complete with its respective signalling LED.

Window regulator control on the passenger's side front door (CDC)

The window regulator control on the passenger's side front door is connected through the passenger's side front door cable harness, to provide the respective window regulator motor with the control. It receives the power supply for ideograph lighting and correct operation of the control itself.

Two passenger's side front window regulator control models are available, depending on the body version.

The window regulator control of the base model directly drives the electric motor on the passenger's side front door with no electronic control of the motor itself.

The window regulator control of the second model is acquired by an electronic module located inside the electric motor on the passenger's side front door. This model features automatic functioning both during the up and down movement, with anti-pinch protection.

Electric window regulator control on the rear doors (RDC)

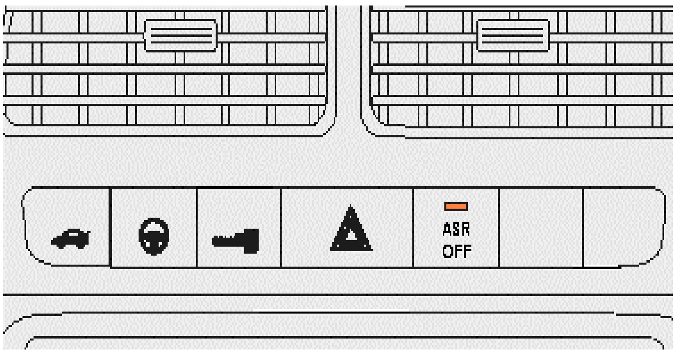
The control on the rear door (left side and right side) (RDC) is connected through the cable harness on the rear door. It is acquired by an electronic module located inside the window regulator motor on the rear door, with automatic functioning both during the up and down movement and anti-pinch protection.

The control receives the power supply for ideograph lighting and correct operation of the control itself from the disable control placed on the control board on the driver's side front door.

9.2.13 Switch on clutch pedal

The clutch pedal signalling switch is fitted to the clutch pedal and is connected through the body-to-front cable harness. It informs the engine management control unit about the pedal status.

9.2.14 Central control board (CSS)



The central control board (CSS) includes the following buttons:

"City" button for actuation/deactivation of the City mode on the electric drive;

ASR deactivation and its respective optical indicator (LED on the button);

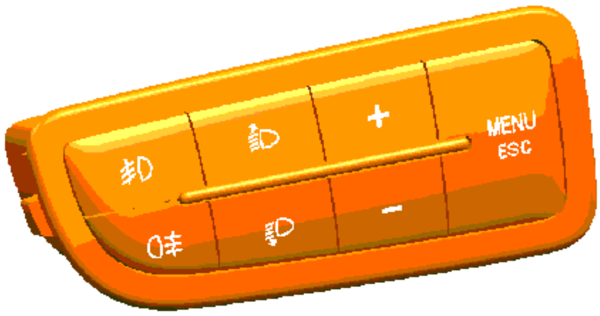
door locking/unlocking and its respective LED (the LED signals the door locking status when the button is pressed and is lit continuously; moreover, it lights up intermittently to serve as a deterrent when the vehicle is locked from the outside);

boot opening;

“Hazard” button for emergency light blinking;

“ECO” button to select the “Economy” mode (versions equipped with robotized gearbox).

9.2.15 Left control board (ELC)



The left control board (ELC) consists of a module that incorporates the controls on the steering wheel outer side and is interfaced to the Body Computer node (BCM) and the instrument panel node (IPC) through the dashboard cable harness.

The left control board (ELC) receives the power supply for ideograph lighting and includes the following controls:

fog lights;

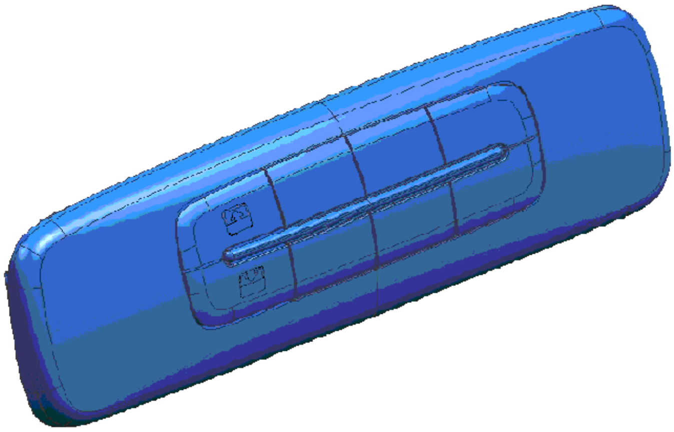
rear fog lights;

headlamp trim corrector;

mode:

mode +/ mode – control (used to control different functions depending on the instrument).

Control mask on the front ceiling light fixture



The control mask on the front ceiling light fixture includes the roof opening/closing controls, which are interfaced with the electric sunroof management control unit through a dedicated bridle, as well as the Convergence nod controls, which are connected through the front body cable harness.

9.2.16 TPMS tyre pressure control system

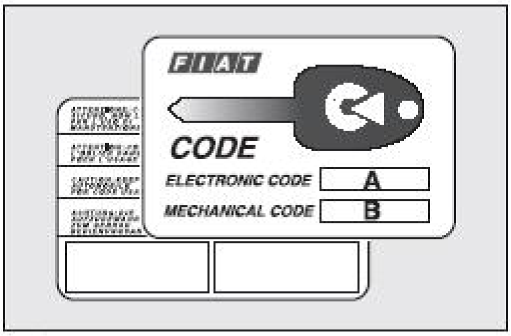
The TPMS (tyre management) system monitors two tyre pressure control thresholds corresponding to the low tyre pressure and tyre puncture conditions. If any of these thresholds is exceeded, the respective warning light/signalling icon (available with the Comfort panel only) and the respective message on the display will be actuated. In case of tyre puncture, the panel will also emit an acoustic signal. Moreover, a TPMS failure signal (warning light/icon + message) is available.

9.3 Central locking

9.3.1 General remarks

The keys are supplied in duplicate together with the vehicle.

They are accompanied by the CODE Card.



A electronic code;

B mechanic code of the key, to be notified to the FIAT Dealership if a key duplicate is requested.

It is recommended that you always bring the electronic code with yourself.

WARNING! To ensure optimum efficiency of the electronic devices fitted inside the key, the latter should not be exposed to the sunshine.

Below is a summary of the main functions that can be actuated by the key (with and without the remote control):

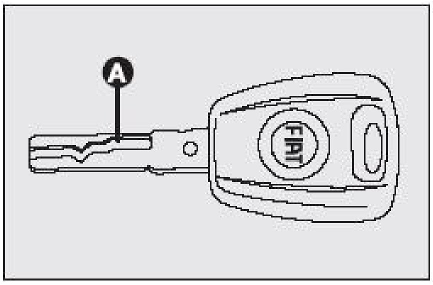
Type of key	Lock unlocking	Lock locking from the outside	(where available) actuation	Lock unlocking	Windows down	Windows up
Mechanic key	Key turned counter-clockwise (driver's side)	Key turned clockwise (driver's side)	-	-		
Key equipped with remote control	Key turned counter-clockwise (driver's side)	clockwise (driver's side)	-	-		
	Button pressed briefly	Button pressed briefly	Button pressed twice	Button pressed	Button pressed fir a long time	Button pressed for a long time
Indicator light blinking (only with key equipped with remote control)	2 blinks	1 blink	3 blinks	2 blinks	2 blinks	1 blink
Deterrent LED	Switch-off	ON steadily for approximately 3 seconds, then deterrent blinking	Blinks twice, then deterrent blinking	Deterrent blinking	Switch-off	blinking

System components

Mechanic key

The mechanic key is used to get on the vehicle and lock/unlock the driver's and passenger's doors. It features a coded, mechanic insert matched with the driver's and passenger's front lock latches. This insert can be removed from the key head upon utilization.

The latch on the driver's door, fitted onto the handle, allows you to unlock all the doors by means of the mechanic key, whereas the latch on the passenger's door, fitted onto the handle, allows you to unlock the single passenger's door.

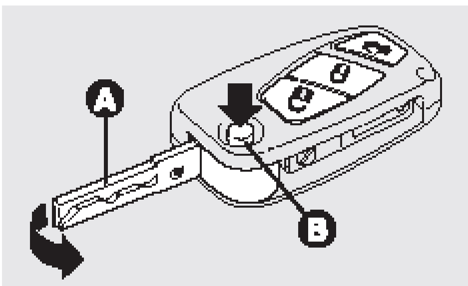


The key's metal part (**A**) is fixed.

Key equipped with remote control.

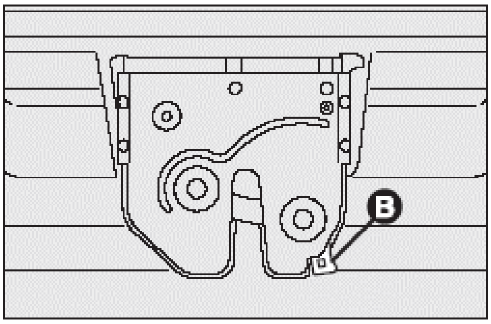
This key consists of a fold-away metal insert (A) and a handle enclosing the same. The metal insert can be removed by pressing the special button (B) on the handle, and can be fitted back into place by keeping the same button depressed and rotate the metal insert in the handle until the locking click (which indicates correct locking) is heard.

The key actuates the starting device and the front door locks.



Boot

If the “independent driver’s door unlocking” option is active, the boot will not be unlocked (the customer has requested that the vehicle can be accessed only through the driver’s door). The boot is always independent with respect to the door status, and can be opened only by means of a special control.



In the event that the battery does not deliver enough power for the electric door lock/handle function, the boot can in any case be unlocked and opened by actuating a special lever that can be reached by removing a mask located on the luggage board. No latch is found on the boot. The boot can also be opened from the inside (in case of electric system malfunction) by means of a mechanic safety device that can be actuated through a mask located in the upper portion of the luggage board.

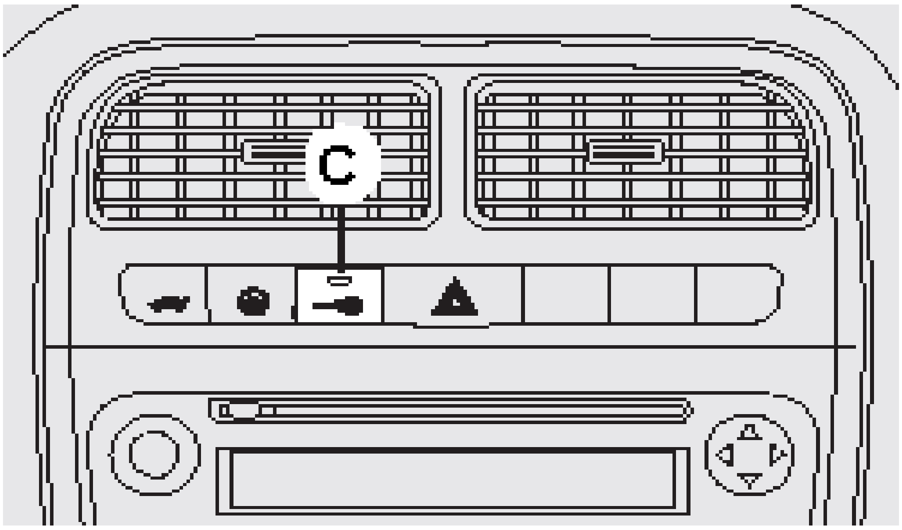
9.3.1 System functions

Door locking/unlocking

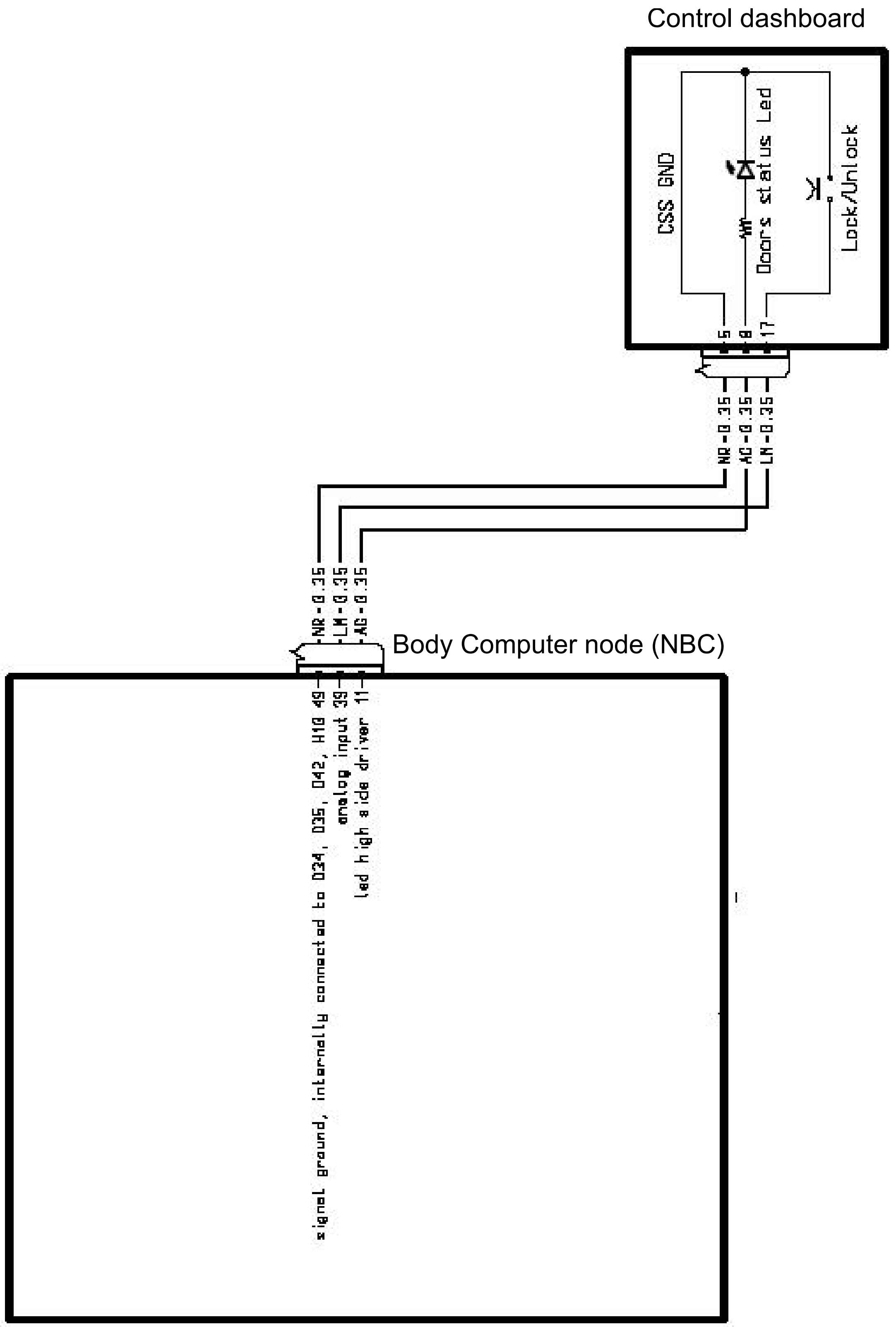
The door locking system makes it possible to control the locks of the various doors from the vehicle.
The door locks can be unlocked from the outside by putting the mechanic key into the latch (driver’s door) and turning the same.
The vehicle’s doors cannot be locked if one or several doors are not fully closed. In this case, a light signal informs you that the doors have not been locked.
In the event that the boot is open, the doors can be locked; yet, an acoustic signal will inform you that an anomaly is found.
If the vehicle is locked from the outside, the door’s central locking/unlocking buttons will be disabled and will be enabled again the next time the doors are unlocked.

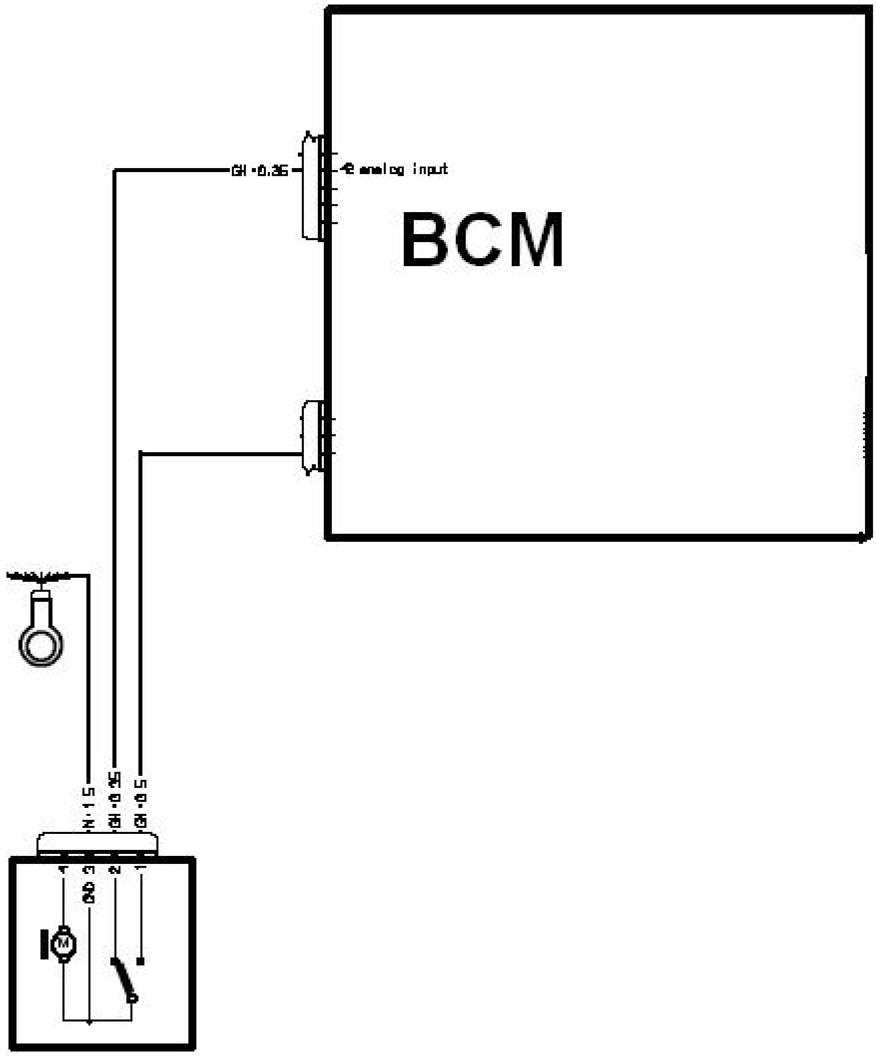
Locking/unlocking actuation

The boot and door locking/unlocking can be actuated from the central board by means of button C. Button  actuates the remote opening of the boot.



If the doors are locked, the LED will light up for approximately 3 seconds and then will start blinking (deterrent function). If the boot or one or several doors are not closed correctly, the LED will blink quickly together with the indicator lights.


Control dashboard
CSS GND
Doors status Led
Lock/Unlock
5
8
17
NR-0.35
AG-0.35
LN-0.35
NR-0.35
LN-0.35
AG-0.35
Body Computer node (NBC)
signal ground, internally connected to D34, D35, D42, H10 49
analog input 39
led high side driver 11



Boot lock actuator

Automatic central locking with the vehicle running (Autoclose)

This function makes it possible, when actuated (ON), to automatically lock the doors when a speed of 20 k.p.h. is exceeded.

The function can be actuated (ON) or deactivated (OFF) as follows:

– briefly press the **MENU ESC** button: the display will show a submenu;

– briefly press the **MENU ESC** button: the display will show (ON) or (OFF) in the blinking mode (depending on what has been previously set);

– select by pressing the **+** or **–** button;

– briefly press the **MENU ESC** button to go back to the submenu screen, or press the button for a long time to go back to the main menu screen without storing in the memory;

– press the **MENU ESC** button again for a long time to go back to the standard screen or the main menu, depending on the menu point reached.

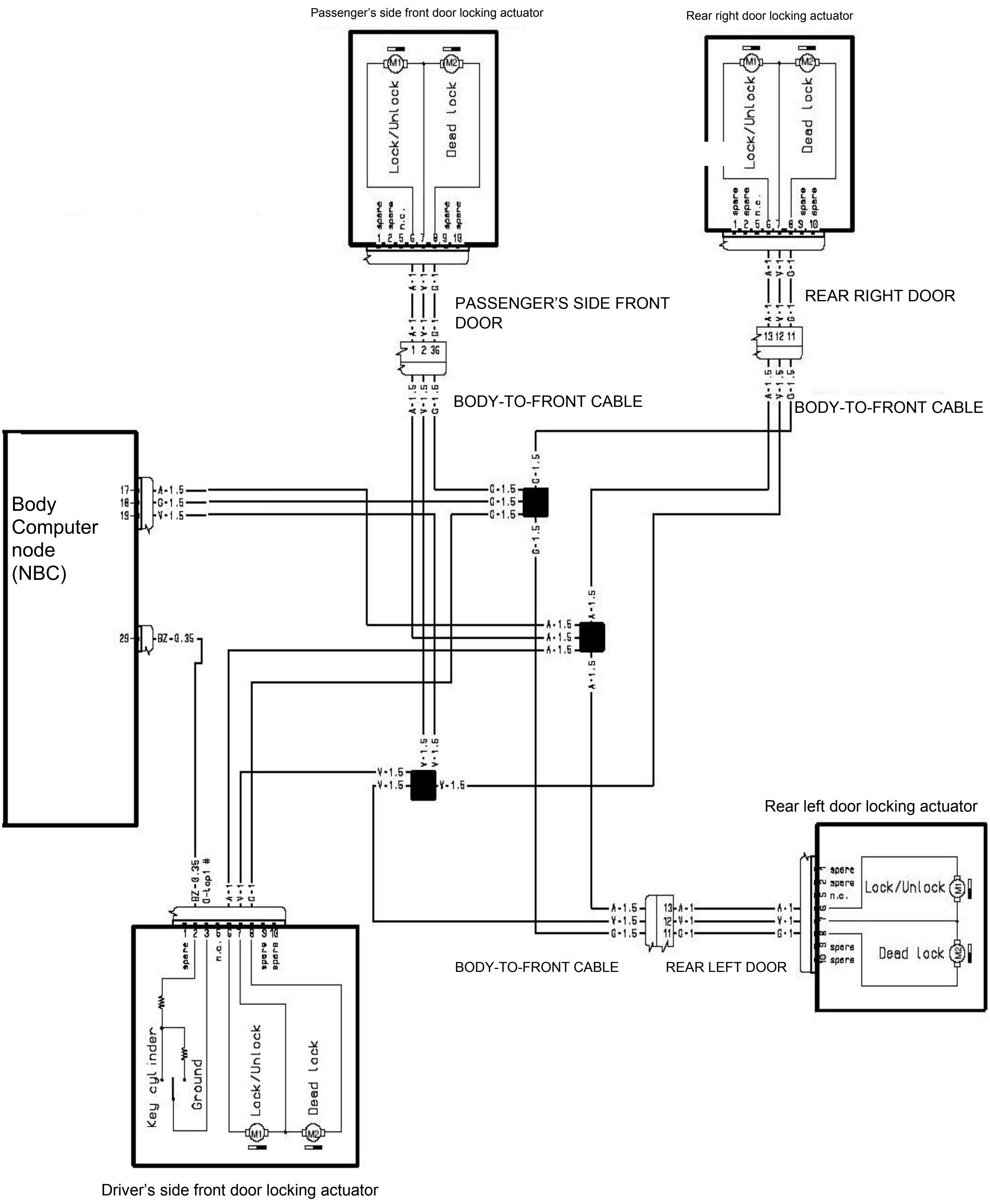
Deadlock device

This is a safety device (where available) that disables the operation of the following items:

inner handles;

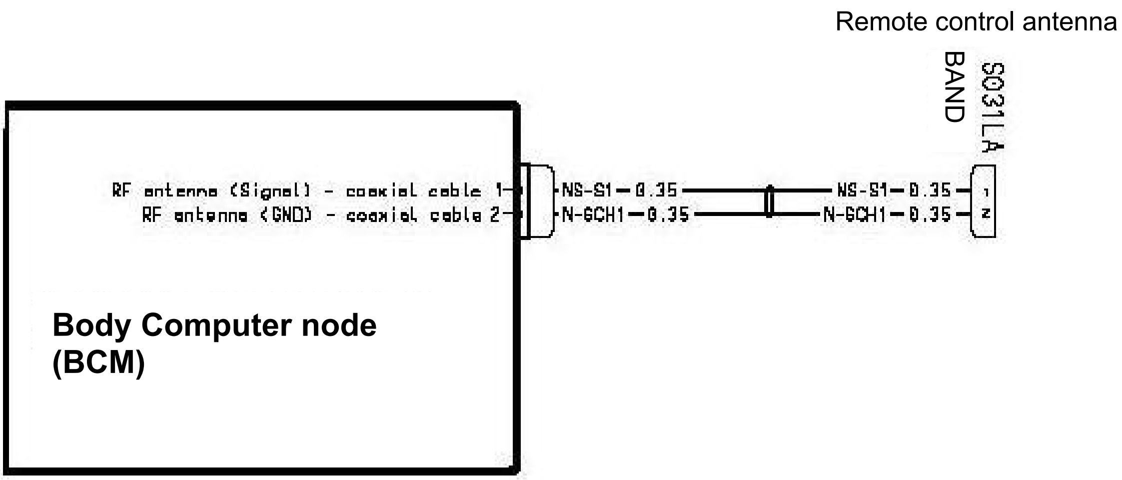
locking/unlocking button;

thus preventing the doors from being opened from inside the passenger compartment in the event that an attempt at breaking into the vehicle has been made (e.g. glass breaking). Therefore, the deadlock ensure the best protection against any attempt at theft. It is recommended that the system is actuated every time the vehicle is left parked.


Passenger's side front door locking actuator
Lock/Unlock
Dead lock
PASSENGER'S SIDE FRONT DOOR
BODY-TO-FRONT CABLE
Rear right door locking actuator
Lock/Unlock
Dead lock
REAR RIGHT DOOR
BODY-TO-FRONT CABLE
Body Computer node (NBC)
Rear left door locking actuator
Lock/Unlock
Dead lock
BODY-TO-FRONT CABLE
REAR LEFT DOOR
Key cylinder
Ground
Lock/Unlock
Dead lock
Driver's side front door locking actuator

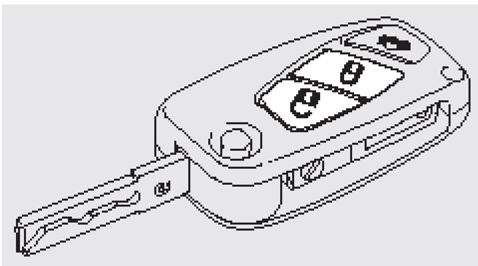
Device actuation and deactivation

The device is automatically actuated on all the doors if the button on the key (equipped with the remote control) is pressed twice quickly.



The device actuation is signalled by 3 blinks of the indicator lights and the blinking of the LED located on the button placed between the controls on the dashboard.

The device cannot be switched on if one or several doors are not closed correctly: this prevents anybody from getting on the vehicle through the open door and then getting stuck inside the passenger compartment after the door has been closed.



The device will be automatically deactivated on all the doors when:

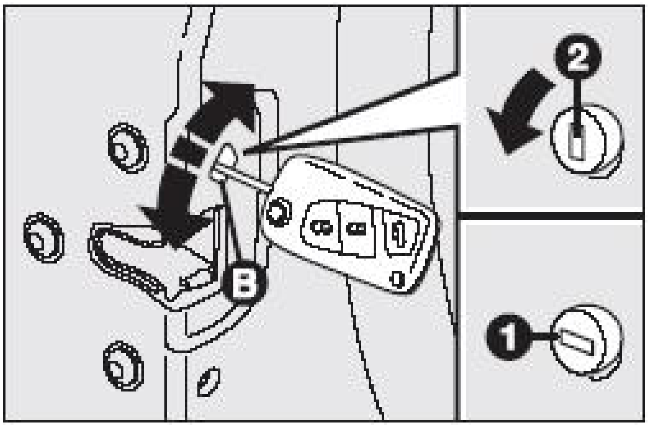
the mechanic starting key is turned to the opening position in the driver's side door;

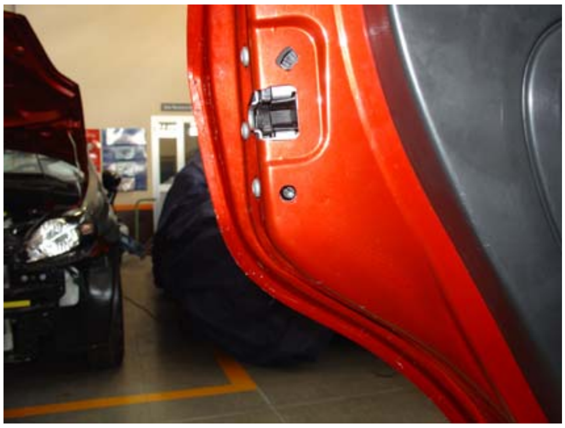
the doors are unlocked by means of the remote control;

the starting key is turned to position.

Rear door locking emergency device.

The rear doors feature a device that makes it possible to lock the doors when the current is missing.





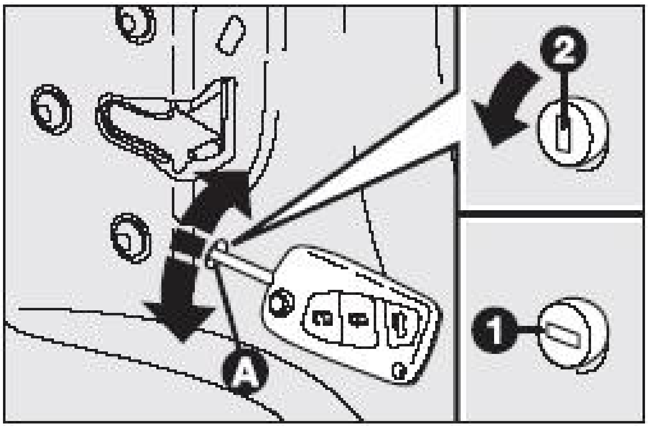
In this case, the following procedure shall be followed:

- put the starting key into latch B;
- turn the device from position 2 to position 1, then close the leaf.

After the device has been switched on, the rear doors can be opened by acting on the vehicle's inner handles.

Child safety device (5-door versions)

This device prevents the rear doors from being opened from the inside, and comes useful especially when children are carried on the vehicle.



The device can be actuated only when the doors are open.

Position 1: device ON (door locked).

Position 2: device OFF (the door can be opened from inside the vehicle).
The device will remain ON even if the doors are unlocked electrically.

NOTE. Do not actuate the rear door locking emergency device simultaneously with the child safety device.

9.4 Electric window regulators

9.4.1 General remarks

The electric window regulator controls for both the front doors (all the range versions) and the rear doors (where available) are managed on the driver's side front door.
The other window regulators are controlled directly from their respective doors.

Controls and operation (front window regulators only).

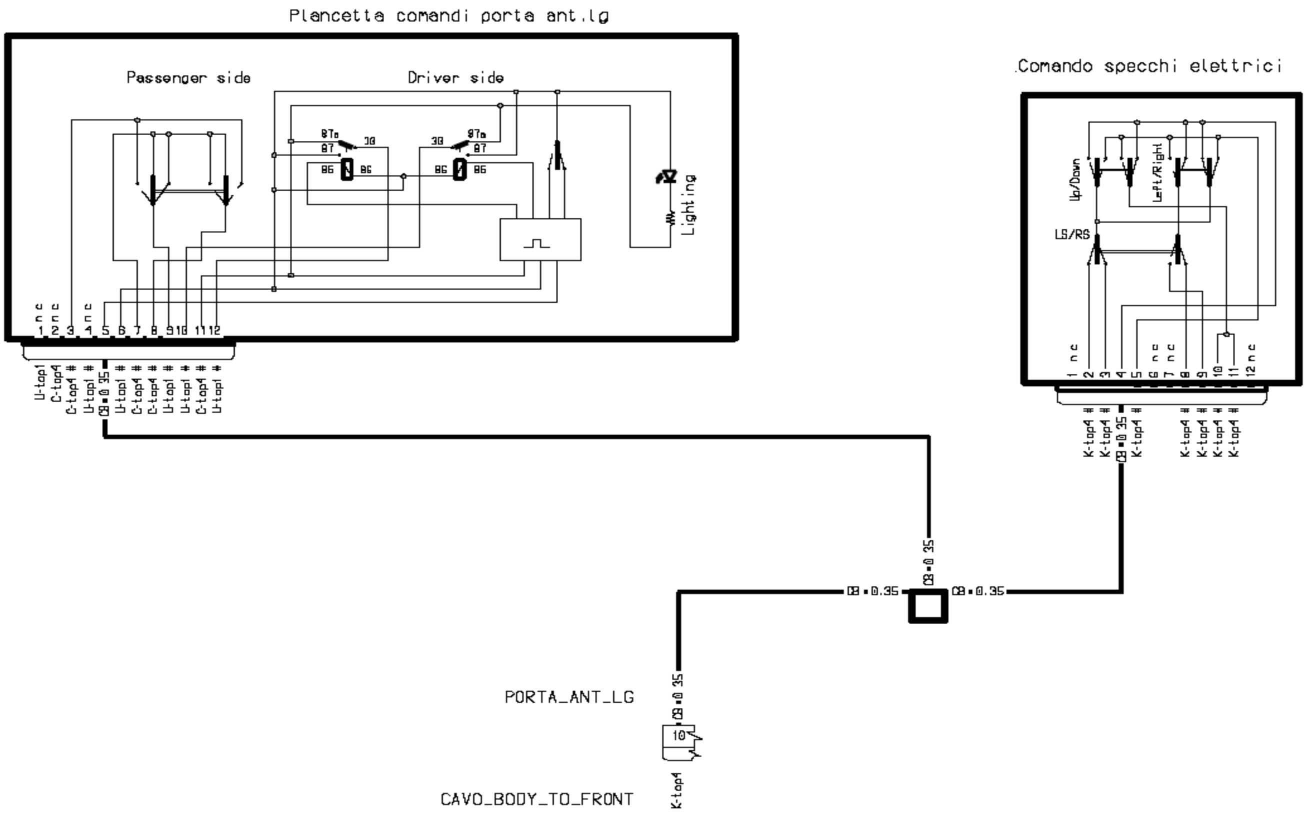
Versions not equipped with the automatic device.
The front electric window regulators can be operated only manually: the window start and stop are controlled manually by the user by pressing the respective button. When the latter is released, the motor will stop. The window regulating function can be actuated on both sides (right & left) only when the key is inserted.
Following the key-OFF, the front windows can only be actuated manually over a period of 3 minutes. After this time has elapsed, the system will not be acquiring new commands any more.

Version equipped with the automatic device (on the driver's side).
The driver's side window regulator can be operated both manually and automatically. The passenger's side window can be operated in manual mode only.

The window regulating function can be actuated on both sides (right & left) only when the key is inserted.

Following the key-OFF, the front windows can only be actuated manually over a period of 3 minutes. After this time has elapsed, the system will not be acquiring new commands any more.

ALZACRISTALLI ANTERIORI con AUTOMATISMO E SENZA ANTIPINCH GSX E GDX
BASIC VERSION



Controls and operation (versions with 4 window regulators).

All the window regulators can be operated both manually and automatically, depending on the logic described below.

Manual mode:

The window can be started and stopped manually by the user by pressing the control button briefly (50 to 300 ms). When this button is released, the motor will stop.

Automatic mode:

the window is started manually by the user by pressing the control button for a long time (longer than 300 ms). The window regulator will not be actuated when the control buttons are pressed for less than 50 ms.

The window regulator operation will be interrupted when automatic operation is under way and the window lifting or lowering control is pressed again.

The window regulating function can be actuated on all the windows only when the key is inserted, except for window central closing/opening by means of the remote control and during the timed period during which the key is not inserted, as described below.

Following the key-OFF, the front windows can only be actuated manually over a period of 3 minutes. After this time has elapsed, the system will not be acquiring new commands any more.

In the event that, during the timing, door opening is detected, new commands will no longer be acquired: only the commands (if any) received prior to the door opening will be completed.

If, upon key-OFF, any of the doors is open, the commands (if any) received prior to the door opening will be completed.

The driver's side window actuation is managed by the local controls.

The passenger's side window actuation is managed both by the local and driver's side control.

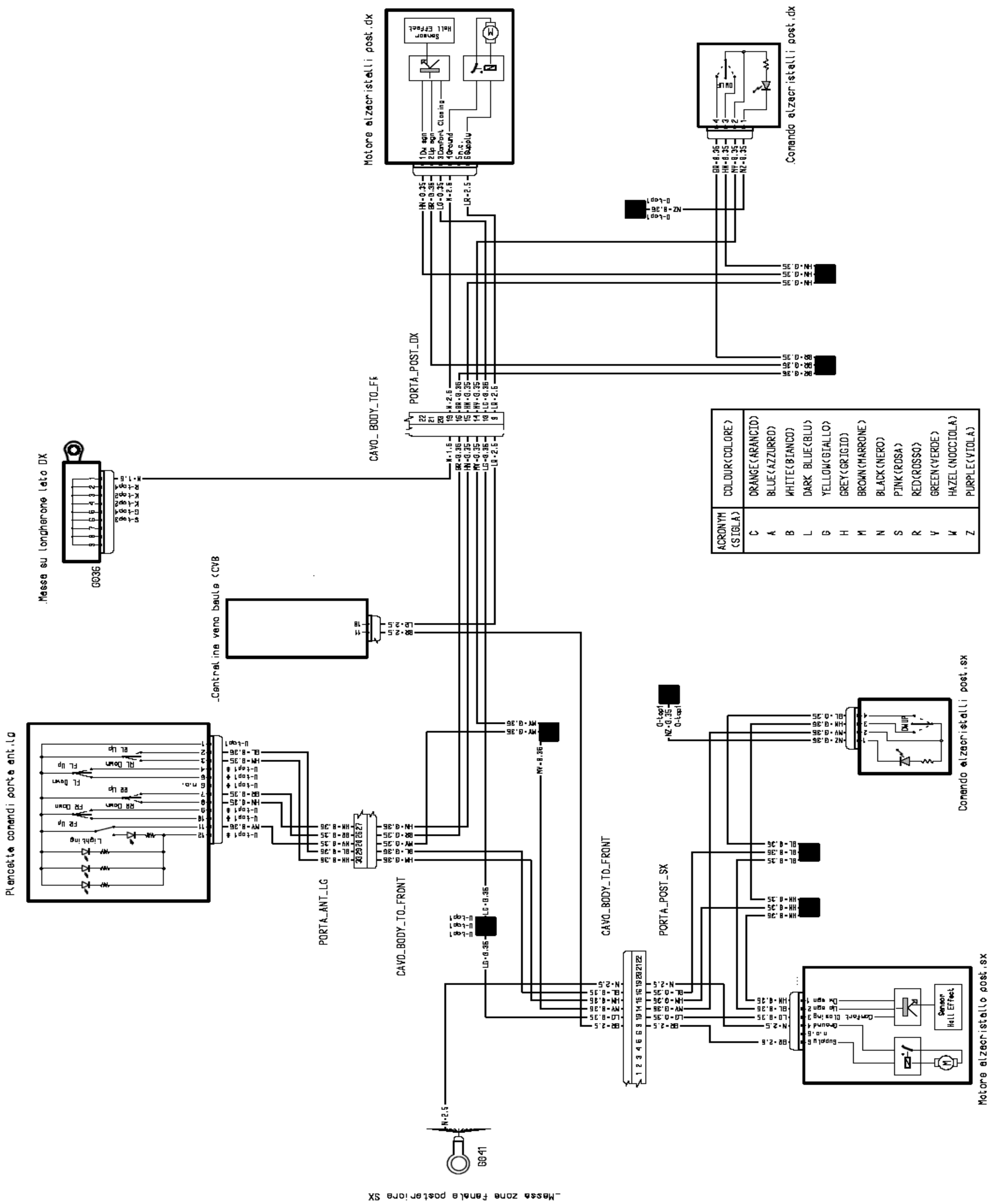
The rear window actuation is managed both by the local controls (one per window) and the driver's side controls.

Electric window regulator control mask

The driver’s side door inner armrest incorporates two or, where provided for, five switches that allow you to carry out, with the starting key turned to position, the following operations:
- front left window opening/closing;
- front right window opening/closing;
- rear left window opening/closing (where provided for);
- rear right window opening/closing (where provided for);
- rear door switch control disable (where provided for).

Central window actuation (4 window regulators)

This function makes it possible to fully close the side windows by one single operation.
The central locking function can be implemented through the remote control or the door lock latch (of the driver's side front door external handle) and is actuated only upon key-OFF.
The window central closing/opening actuation is not simultaneous for the 4 windows: it follows a programmed sequence.


Motore alzacristalli post.dx
Comando alzacristalli post.dx
PORTA_POST_DX
CAVO_BODY_TO_FK
Massa su longherone lato DX
G036
Centraline vano baule (CVB
Plancette comandi porta ant.lg
PORTA_ANT_LG
CAVO_BODY_TO_FRONT
CAVO_BODY_TO_FRONT
PORTA_POST_SX
Comando alzacristalli post.sx
Motore alzacristallo post.sx
G041
Massa zona fanale posteriore SX
ACRONYM (SIGLA)
COLOUR(COLORE)
C ORANGE(ARANCIO)
A BLUE(AZZURRO)
B WHITE(BIANCO)
L DARK BLUE(BLU)
G YELLOW(GIALLO)
H GREY(GRIGIO)
M BROWN(MARRONE)
N BLACK(NERO)
S PINK(ROSA)
R RED(ROSSO)
V GREEN(VERDE)
K HAZEL(NOCCIOLA)
Z PURPLE(VIOLA)

Anti-pinch safety device

The versions equipped with four electric window regulators (front and rear) feature a safety system capable of detecting the presence of an obstacle during the window upward closing movement. When such an obstacle is detected, the system will interrupt the window travel and, depending on the window position, will also reverse its motion.

The system causes the window regulator motion to be reversed every time an obstacle (e.g. finger, hand, etc.) is detected during the window travel, thus avoiding accidental crushing. This feature ensure a very high degree of safety, even in the event that a window regulator is unintentionally actuated by a child on the vehicle. This makes it possible to actuate window superior opening/closing when you leave the vehicle. The anti-pinch function is ON during both manual and automatic operation of the window.

Two zones (“inversion” and “non-inversion”) can be defined fro the anti-pinch system:

the “inversion” zone corresponds to the space included between 200 mm from the upper edge and the latter;

the “non-inversion” zone corresponds to the remaining space.

If an obstacle is detected in the “inversion zone” during the window upward movement, the system will interrupt the upward movement and will immediate reverse the direction.

If, on the contrary, an obstacle is detected in the “non-inversion zone” during the window upward movement, the system will interrupt the upward movement.

No control will be accepted during this time.

If the anti-pinch protection comes into operation five times in a row within one minute or is out of order, the automatic window upward operation will be disabled, i.e. it will only be allowed with jerks lasting half a second, with button release for the subsequent operation.

To resume the correct operation of the system, any of the following restore conditions shall be met:

a key-OFF/key-ON operation;

a downward movement (actuated by the user) of the window at issue.

In the event that the battery is disconnected and re-connected, the following procedure shall be carried out in order to resume correct operation of the front windows:

move the right or left front window to its lower end of travel, and keep the opening control depressed for a time of 5 to 10 seconds, then carry out the same operation with the upper end of travel, by keeping the closing control depressed for a time of 5 to 10 seconds.

9.5 External lighting

General remarks and components

Dimmers

When the user turns on the dimmers (with the key ON) or requests the “parking light” or “Follow me home” (with the key OFF) function, the trip computer will command the actuation of the dimmer bulbs (left/right; front/rear). Except for the “Follow me home” function, some requests will involve switching the license plate lights on.

Low-beam/high-beam headlights

With the low-beam headlights ON, the actuation of the high-beam headlight control will disable the low-beam headlights. Subsequent deactivation of the high-beam headlight control (still with the low-beam headlight control ON) will involve switching the low-beam headlights on again.

Parking lights

This function makes it possible to switch both the dimmers and the license plate lights on with the vehicle key OFF, in order to signal the presence of the vehicle when the latter is stationary (parking). It can be actuated only with the key OFF by turning the steering column stalk light ring from OFF→ dimmers or low-beam headlights.

The function can be deactivated by moving the steering column stalk light ring to OFF or upon the key-ON. The latter operation will reset the function, and the trip computer will control the lights according to the control selected on the steering column stalk ring.

Every time the key is next OFF, the function will no longer be active: it can be actuated again by repeating the aforesaid actuating operation.

Fog lights

The fog lights can be switched on by pressing the 'fog light' button only if the dimmers have already been switched on. They can be switched off if the same button is pressed again or the dimmers are switched off.

Switching the dimmers on again will not involve switching the fog lights on again. The trip computer will also actuate the indication on the panel.

When the fog lights are ON, switching to key-OFF will cause the fog lights to be turned off. Upon the following key-ON, the fog lights will remain OFF: they can be switched on again by pressing the button.

With both the panel and the fog lights ON, starting the vehicle will not cause the fog light control to be reset.

License plate lights

The two external license plate lights are switched on when the driver requests that either the dimmers or the parking lights are switched on.

The diagnosis is also carried out for every single license plate light (with the actuating control ON), followed by the "license plate light failure" indication (if any) on the instrument board (with the key ON).

Rear fog lights

The rear fog light can be switched on by pressing the 'rear fog light' button only if either the low-beam headlights or the fog lights (with only the dimmers ON) have already been switched on. It can be switched off by pressing the same button again, or if the low-beam headlights or the fog lights (with only the dimmers ON) are switched off.

If the rear fog light has been switched off through the low-beam headlights or the fog lights, switching the low-beam headlights or fog lights on again will not involve switching the rear fog light on again. They can be switched on again by pressing the button.

When the rear fog light is switched on, the respective indication will appear on the panel.

Turning the vehicle off (key-OFF) with the rear fog light ON will cause the latter to be switched on. Upon the following key-ON, the rear fog lights will remain OFF.

The trip computer will diagnose the rear fog light: if an anomaly is found, the corresponding "rear fog light failure" signal will be actuated.

Indicator/emergency lights

Following the indicator light controls by means of the steering column stalk left lever (upon key-ON), the trip computer will drive the single indicator light bulbs of the selected vehicle side (front, side and rear left, or front, side and rear right).

Simultaneously with the bulb driving, an acoustic signal will be generated inside the vehicle. If the lever is moved to the rest position again, the lights and the other turning indications will go out.

The indicator lights will, if they are ON, be switched off upon key-OFF.

Following the emergency light control (with both key-ON and key-OFF), the trip computer will drive all the 6 indicator bulbs (front, side and rear, both left and right): moreover, the LED will light up on the emergency button, and an acoustic signal will be generated inside the passenger compartment.

If the emergency button is pressed with "indicator lights", the lights/indications previously ON will keep on operating intermittently, with no interruption or delay.

If an anomaly is found on any of the front or rear indicator light bulbs (on the vehicle side selected for the "indicator light" function or still for the "emergency light" function), the failure indication will light up and, simultaneously, the blinking frequency of the corresponding visual indication and the acoustic signal will increase.

N.B. The blinking frequency of the external lights and the LED (if any) on the emergency button will not change.

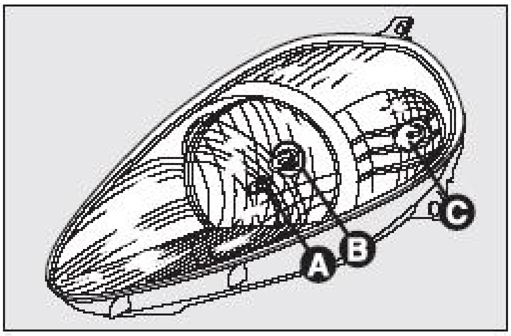
Brake lights

When the brake pedal is pressed, the two brake lights and the "third brake light" will come on.

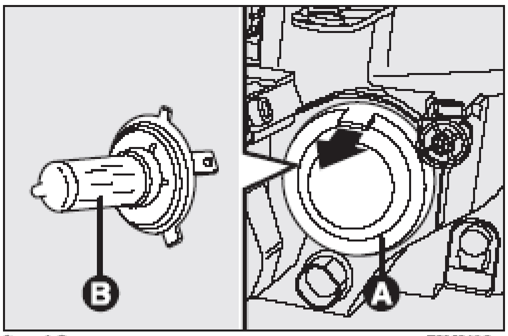
The diagnosis will be carried out for every single brake light bulb and the third brake light bulb as well. If an anomaly is found, the failure signalling will be actuated on the instrument board

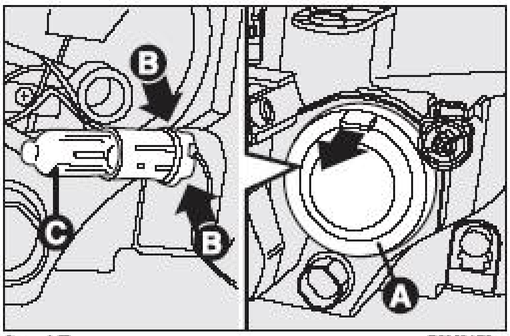
Headlamps

The newly-designed transparent glass front light clusters contain the bulbs for dimmers **A** (W 5 W bulb), low-beam/high-beam headlights **B** (H4 55/60 W bulb) and indicator lights **C** (PY 21 W bulb). Headlamp trim is controlled by electric motors.



Lamp replacement: the low-beam/high-beam headlight and dimmer bulbs can be replaced by removing the rubber cap **A** force-fitted at the light cluster rear. Release H4 bulb **B** and take it out. As regards dimmer W5W bulbs **C**, take it out of seat **B** (without taking the light cluster off the vehicle). The light indicator bulbs can be removed by steering the front right or left wheels outwards to gain access to the lid on the wheelbox, which will be released by turning the locking device counterclockwise. Now, the bulb holder cover can be removed by being rotated counterclockwise.





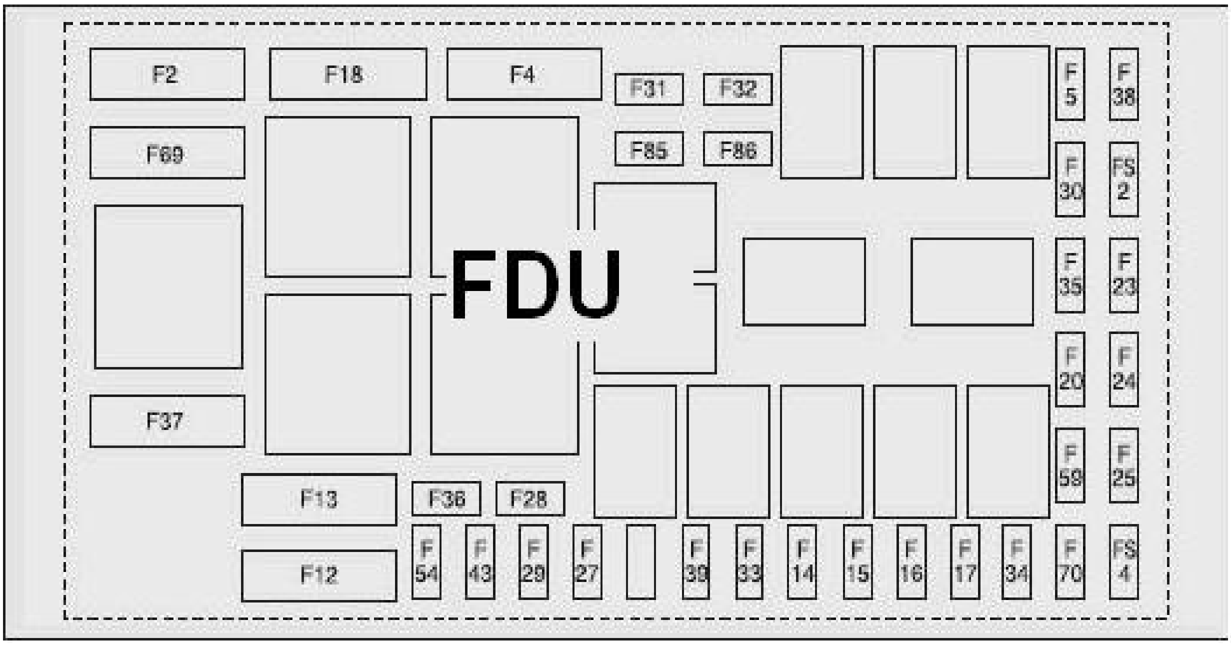
Protection fuse replacement: the protection fuses are found inside the engine compartment control unit (CVM) left low-beam headlight fuse: F14; right low-beam headlight: F15; left high-beam headlight fuse: F16; right high-beam headlight fuse: F17.

Fog headlamps

The are built (where available) into the bumper and are equipped with a H1 bulb.

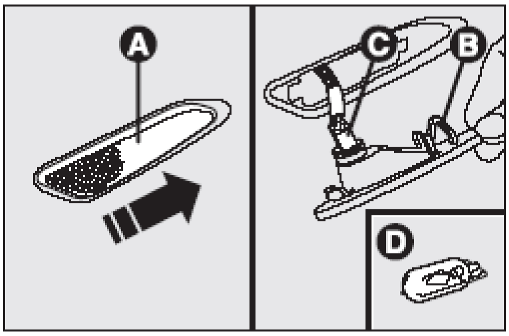
Bulb replacement: to replace the lamp, unscrew the cap, release the retaining clip and take the bulb out (the headlamp shall not be taken off the bumper).

Fuse replacement: the F31 protection fuse is located inside the engine compartment control unit (FDU).



Side repeater

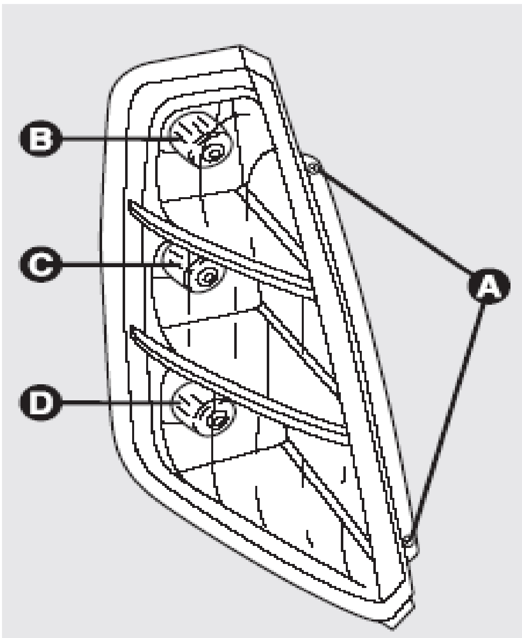
They feature an oblong shape and are fitted onto the front bumper (WY5W bulb **D**).



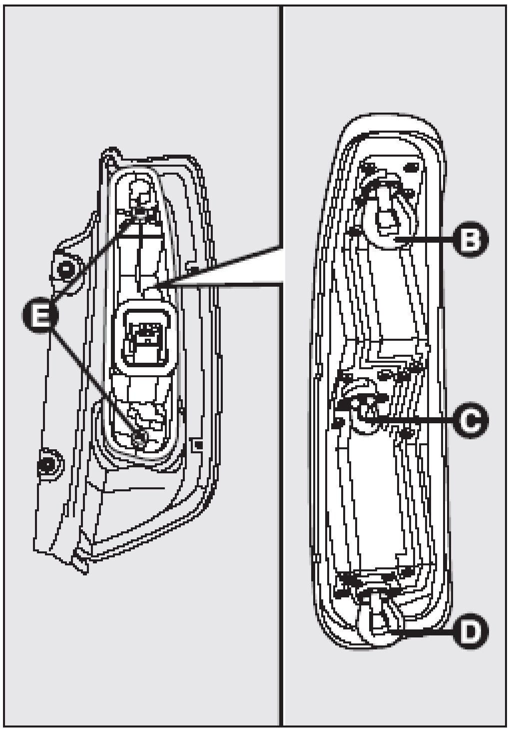
Bulb replacement: move transparent glass **A** forward so as to press clip **B**, then take the unit off. Rotate connector **C**, then take bulb **D** off.

Fixed rear headlamps

These rear headlamps are fitted to the red rear pillar, with function distribution: dual position with R5W bulbs **C**, brake light/dimmer P21/5W bulb **D**, and indicator light P21W bulb **B** arranged vertically. Screws **A** are used to remove the headlamps from the pillar and replace the bulbs.



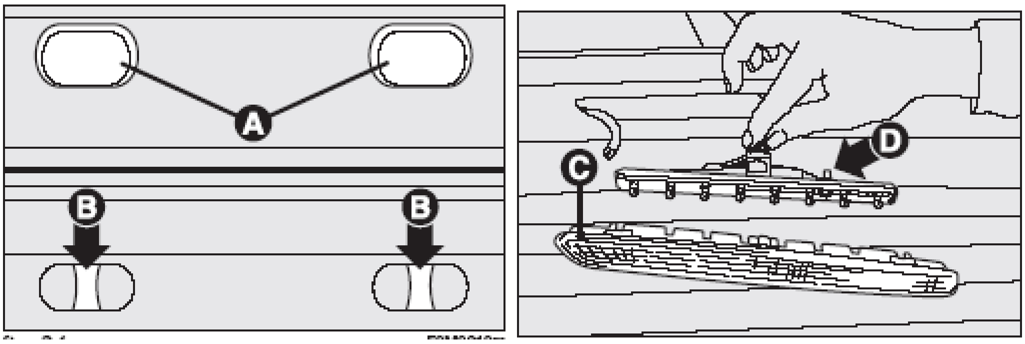
Bulb replacement: after the headlamp has been removed from the pillar, undo screw **E** to release the bulb holder.



Third brake lamp

This lamp, located outside and positioned above the rear heated window, incorporates the wiping function (detergent outlet nozzle) and the lighting function (by means of 8 bulbs).

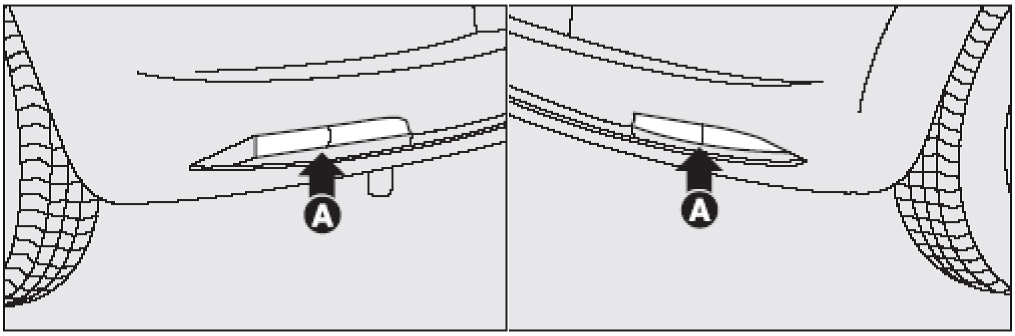
Bulb replacement: open the rear hatch, remove rubber caps **A**, press on elements **B** and take transparent glass **C** out, disconnect the connector, act on fins **D** in an opposing way to remove the bulb holder, then take out the force-fitted bulbs and replace the same.



NOTE. Take care of the wiping nozzle tube.

Rear fog lights/reversing lights

These lights are housed onto the rear bumper. Left-hand rear fog light P21W bulb **A**, right-hand reversing light P21W bulb **A** (for left-hand drive versions). Reverse arrangement for right-hand drive versions. Built-in reflector.

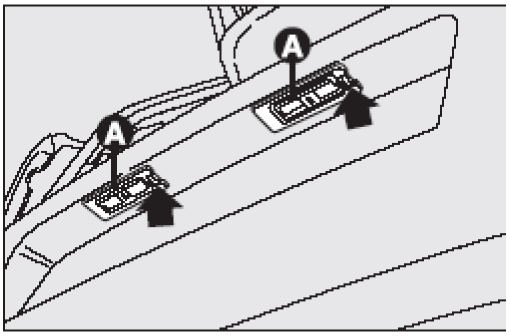


Bulb replacement: disconnect, from under the bumper, the connector, then take the bulb holder off. The lights shall not be removed from the bumper.

License plate lights

Two lights with W5W bulbs, housed onto the rear bumper. Optimum homogeneity of light distribution, which allows the license plate to be clearly seen.

Bulb replacement: act to tabs **A** to release the transparent glasses from the bumper, then replace the bulbs by taking the bulb holder off the transparent glass.



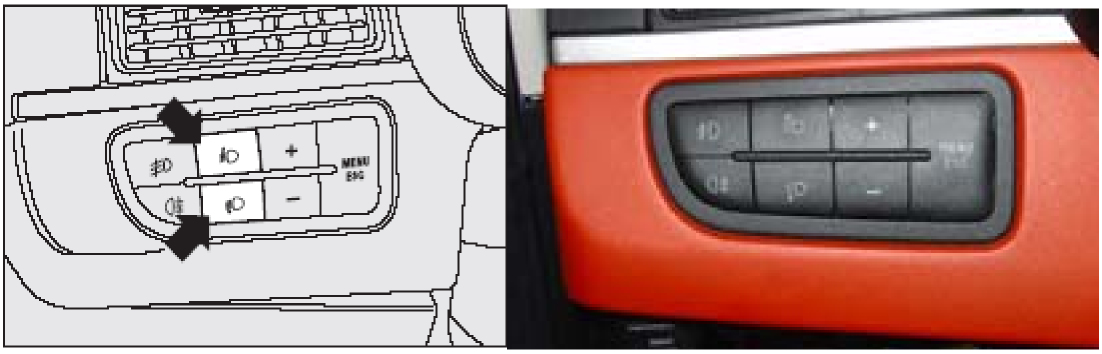
Functions

The diagnosis is carried out by the trip computer, with the actuation control ON, as follows:

Side	Anomaly recognition
Front	Failure to one bulb
Rear	Failure to at least two bulbs

When a bulb anomaly is found, the trip computer signals (upon key-ON) the dimmer failure indication.

Headlamp trim control: it operates with the starting key turned to **“MAR”** and the low-beam headlights ON.
The vehicle slopes backwards when it is loaded, thus causing the light beam to be raised. In this case, the headlamps shall be orientated correctly again.
The trim can be controlled by pressing the buttons indicated by the arrows and located on the control mask.
The instrument board display provides a visual indication of the control positions:
position **0**: one or two persons sitting on the front seats;
position **1**: five persons travelling on the vehicle;
position **2**: five persons travelling on the vehicle and luggage compartment loaded;
position **3**: driver plus maximum permitted load stored in the luggage compartment.



Follow me home: this function makes it possible to achieve timed switch-on of the dimmers (except for the licence plate lights) and the low-beam headlights immediately after the vehicle has been switched off.

The function can be deactivated only within 2 minutes from the key-OFF, through the flashing light control by means of the steering column stalk (“Follow me home” actuation).

“Follow me home” time increase: with both the dimmers and the low-beam headlights ON, the trip computer will, every time the flashing lights are actuated, increase the lights ON time by further 30 seconds, up to a maximum time of 210 seconds. The control for increasing the lights ON time is valid only if less than 7 controls have been provided after the “Follow me home” function has been last actuated (and is still ON).

Function deactivation: keeping the flashing light control for more than 2 seconds causes both dimmers and the low-beam headlights to be switched off, the lights ON time to be reset, and the counter for the 7 valid commands to be reset.

N.B. The deactivation control shall not necessarily provided within 2 minutes after key-OFF, nor shall any of the 7 valid commands to increase the lights ON time. It will be valid, provided that the “follow me home” function is ON.

After deactivation, the “Follow me home” function can be switched on again by actuating the flashing light lever within 2 minutes after key-OFF.

Shifting from key-OFF to key-ON with the “Follow me home” function ON will cause the latter to be switched off.

End of function: when the lights ON time expires, the “Follow me home” function will be switched off: therefore, both the dimmers and the low-beam headlights will be switched off.

9.6 Audio system

Two audio sources are available: radio tuner, and audio CD/MP3 player. The sound system fitted to the vehicle may be of two standard types:

- standard;
- hi-fi sound system.

General features of the standard system.

The system consists of 6 loudspeakers, fitted to the vehicle as follows:

- mid-woofer loudspeakers (40 W, diameter: 160 mm) located in the front doors and designed to reproduce middle-low frequencies. The technology used for these components (of the water-resistant type) allows the latter to stand water jets (if any) from inside the door without being damaged;
- tweeter loudspeakers (30 W) located on the door opening handle, designed to reproduce the highest frequencies;
- full-range loudspeakers (40 W, diameter: 130 mm) located on the rear side frames, which can reproduce the entire range of the sound frequencies. These components feature the “water resistant” technology.

General features of the hi-fi sound system.

This system consists of 6 loudspeakers and a sub-woofer box containing a single-channel power amplifier.

Below are the main features of the components:

- mid-woofer loudspeakers (40 W, diameter: 160 mm) located on the front doors, designed to best reproduce the low-middle frequencies (the “water resistant” technology is used with these components);
- tweeter loudspeakers (40 W) located on the door opening handle, designed to reproduce the highest frequencies;

- full-range loudspeakers (40 W, diameter: 130 mm) located on the rear side frames, which can reproduce the entire range of the sound frequencies. These components feature the "water resistant" technology";
- sub-woofer box of the "bass-reflex" type (6.5-7 l. volume) including a loudspeaker (100 W, diameter: 130 mm) to reproduce the lowest frequencies. This box is fitted into the luggage compartment, on the right wheelbox side;
- single-channel sound power amplifier, located inside the sub-woofer box and used for sub-woofer drive.

CAR RADIO

The Radio Receiver node (RRM) is held in a DIN compartment, whereas the front radio mask on the dashboard occupies one and a half compartment.

Two versions are available: radio/CD player and radio/CD-MP3 player.

All the versions are set for connection with the low-speed CAN interface on the B-CAN line, in order to allow data to be exchanged with the other system nodes.

The following information is transferred through this interface:

- anti-theft code;
- ignition control (for switch-off logic);
- volume control depending on the vehicle speed;
- lighting control;

- remote controls from the steering wheel (where available);
- radio information repetition on the vehicle panel.

General features:

- music sound power: 4 x 30 W;
- graphic 7-band equalizer;
- digital tuner;
- built-in, large-sized alphanumeric display (20 characters per RDS functions + control icons);
- easily controlled menu to adjust the settings for the radio and any external interface (CH-changer, telephone);
- “Mute” function actuated by pressing the volume knob for a brief time;
- “Soft mute” function during the source/radio channel changing operations;
- volume control depending on the vehicle speed (can be selected through the menu);
- car radio switch-off timing control (immediate switch-off or 20 minutes after key-OFF);
- antenna power supply;
- remote control form the steering wheel;
- provision for interfacing with external Blaupuntk CD-changer through a private BUS line;
- provision for connection with a mobile phone hand-free set;
- active control of the hi-fi system (where available).

Radio features (radio/CD player and radio/CD-MP3 player):

high-selectivity digital tuner (digital selection with dynamically-varying bandwidth);

- multi-search FM;
- provision for selecting the HICUT (High-cut, i.e. dynamic high sound reduction depending on the RF signal) function;
- autostore function (automatic memorization of the radio channels with the best signal);

- RDS (Radio Data System) with EON, AF (alternative frequencies), TA, TP, PTY and REG function (can be selected by the user);
- TA (Traffic Announcements);
- automatic PTY search;
- automatic TP (Traffic Program) search;
- automatic and manual station search;
- provision for Local/Distance control for automatic frequency search;

storing provision:

- 18 FM stations (6 of which can be stored through the “Autostore” function);
- 6 MW stations;
- 6 LW stations;
- 6 stations for PTY types of programs (FM only);
- “Scan” mode (listening to a station for a short time and shifting to the next station automatically);
- scanning on the used frequency band;
- scanning on the stored channels.

CD features:

- power-driven eject loading;
- pause;
- selection of the next/previous track;
- FF / F-REW;
- TPM (Track Program Memory) function, for 30 CDs of 40 tracks each;
- track scanning function;
- “Mix” function;
- “Track Repeat” function;
- CD naming (8 characters for 30 CDs);
- CD display (displaying the name of the disc/track elapsed time);

- printed audio CD, CD-R and CD-RW play.

CD/MP3 player features:

- power-driven eject loading;
- “MP3-Info” function;
- directory UP/DOWN selection;
- track UP/DOWN selection;
- pause;
- FF/F-REW;
- track scanning function;
- “Mix” function (random playing of the tracks included in a folder or the entire disc);
- “Repeat” function (repetition of one single track or single folder);
- MP3 display (folder, ID3-TAG information, track elapsed time, file name);
- printed, audio or data CD, CD-R and CD-RW playing.

Sound features:

- bass;
- treble;
- balance;
- fader;
- loudness;
- 7-band equalization: Preset (default), Rock, Jazz, Classic, User (provision for customization);
- Blaupunkt CD-changer audio input.

Blaupunkt CD- changer (10-disc) features:

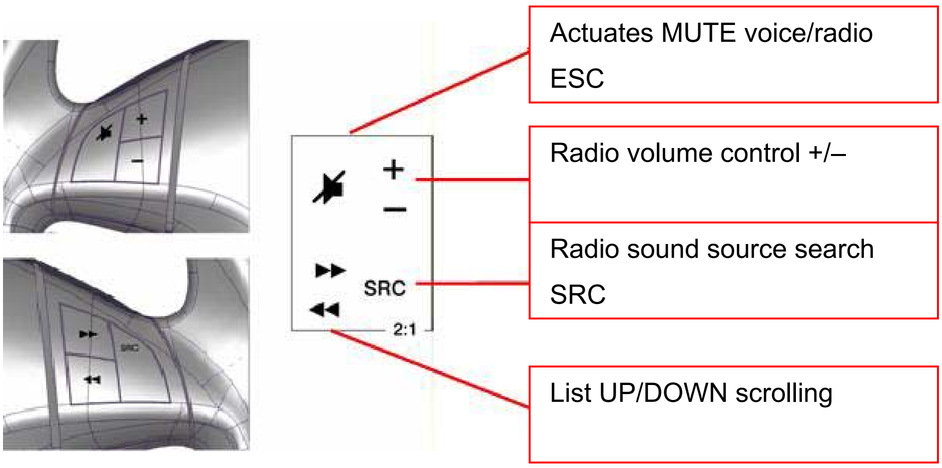
- power-driven eject loading;
- CD and track selection (UP & DOWN);
- pause;
- FF/F-REW;
- “Scan” function;
- “Track Repeat” and “CD Repeat” functions;
- “Mix” (CD–magazine) function;
- TPM (Track Program Memory) function;
- CD Naming (8 characters for 30 CDs).

Telephone section features:

- telephone mute ON/OFF function;
- telephone volume function (telephone volume control through the volume knob).

Steering wheel radio controls.

The car radio system features remote controls on the steering wheel (see figures below).



9.7 Airbag system

9.7.1 General remarks

The safety performance ensured by Nuova Punto result from accurate combination between the structural components and the high number of special devices that make up the occupant's protection system:

- head-on collision;
- back collision;
- side collision;
- overturning.

All of this results in better performance levels than the prescribed ones, with virtually zero occupant injury risk.

Head-on collision

Two types of vehicle head-on collisions are taken into consideration: one head-on collision at a speed of 64 k.p.h. against a deformable barrier, (typical of a head-on collision between two vehicles); one head-on collision at a speed of 56 k.p.h. against a fixed, rigid barrier, (typical of a collision against a fixed, rigid obstacle).

Nuova Punto is capable, in case of head-on collision, of retaining the load located in the luggage compartment which may hit the passengers seriously if not properly secured.

Side collision.

Nuova Punto ensures front and rear passenger safety during high-speed side collisions by means of two main types of test: a crash that simulates a collision between two vehicles at a speed of 50 k.p.h., and a crash against fixed obstacles of small side dimensions such as trees or posts (which represents the most dangerous type of collision to a vehicle's driver or passengers. Thanks to the sturdy structural construction and the use of energy-absorption highly-efficient materials, the intrusion levels for this type of test have proved to be very low on

Nuova Punto and make it possible to avoid significant inertial stress on the occupants; in any case, inertial stress is absorbed perfectly thanks to the side airbag system.

Back collision.

Attention is, during the back collision tests, turned (from the structural viewpoint) to restraining the passenger compartment deformation and avoiding damage to the fuel tank, which may cause fire.

Child protection.

Nuova Punto features all the devices that make it possible to ensure the maximum child safety that can be achieved at present. Below are the main child safety devices:

isofix mounts on the rear seats for correct installation of child seats;

passenger airbag deactivation directly through the trip computer, to protect the fitted child seat.

Description.

The occupant protection system fitted to Nuova Punto consists of the following components:

Driver's and passenger's front airbags with dual actuation stage;

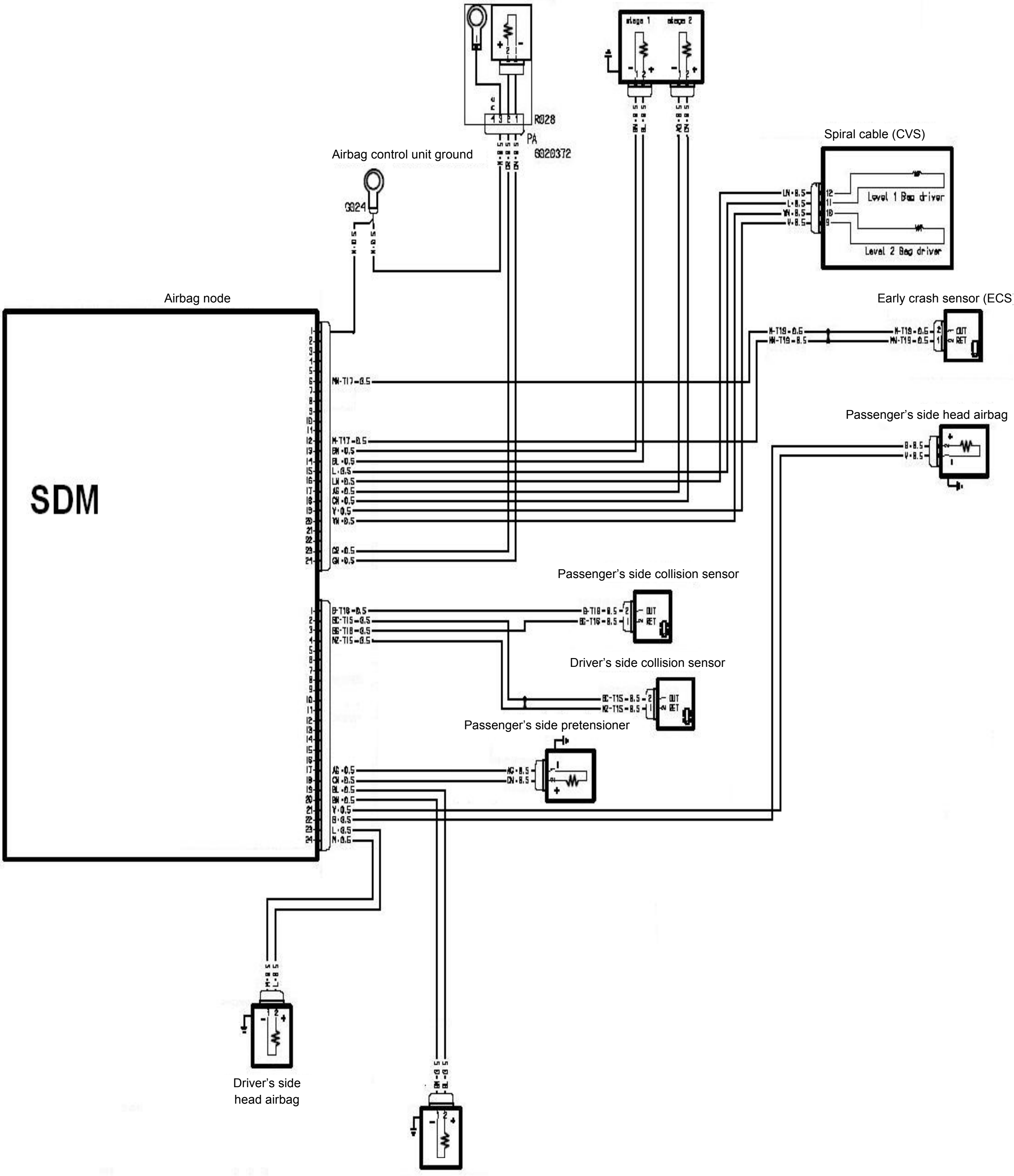
front seat belts with pre-tensioner with electronic control and load limiter;

electronic system for passenger's airbag deactivation.

Moreover, a side protection system is available as an optional item, which features two bags on the front seats and two curtain bags in the rails under the roof and two side collision detecting sensors.

The protection system also benefits from the collapsible steering column support and the special seat design that allows part of the energy to be absorbed during both head-on and side collisions.

Moreover, Nuova Punto features front seat headrests with heightwise control and lowering lock, combined with the new bio-mechanic **antiwhiplash** system (optional item). This system comes into operation in case of a collision following the heavy load transfer caused by the occupant's body pushing against the seat back after the crash, and allows the headrest to further draw near the occupant's head, so as to soften the bump.

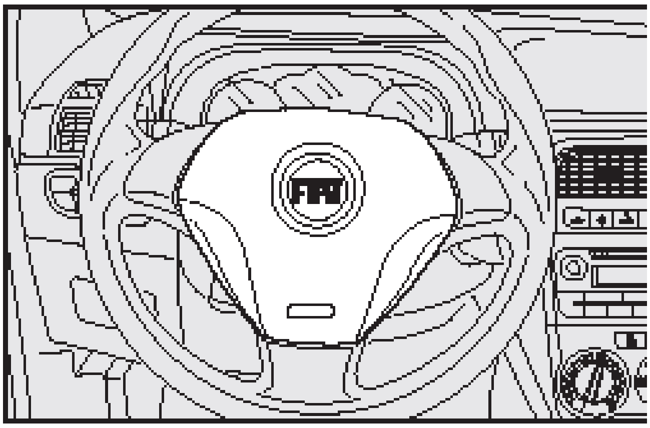

Driver's side knee bag
Passenger's side front airbag
R028
PA
G020372
Airbag control unit ground
G024
Spiral cable (CVS)
Level 1 Bag driver
Level 2 Bag driver
Airbag node
Early crash sensor (ECS
SDM
Passenger's side head airbag
Passenger's side collision sensor
Driver's side collision sensor
Passenger's side pretensioner
Driver's side
head airbag
Driver's side pretensioner

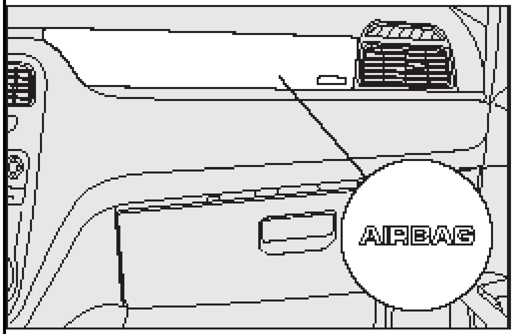
9.7.2 Smart 2 airbag system

The vehicle occupants are protected during head-on collisions by an innovative restraint system called “Air-Bag Smart 2”, which is capable of adapting the actuation parameters automatically depending on the seriousness of the accident.

Driver’s and passenger’s front airbags with dual actuation stage: in fact, the current restraint systems are inevitably dimensioned to guarantee adequate protection only in 10% of all head-on collisions. For this reason, airbags with dual actuation stage have been designed. When a medium seriousness collision takes place, the electronic control unit will only drive the first airbag actuation stage, avoiding the development of unnecessary energy for the occupant’s protection. Conversely, in case of very serious collisions, the control unit will drive both stages, so as to absorb the occupant’s greatest kinetic energy before the occupant hits against the steering wheel or the dashboard.

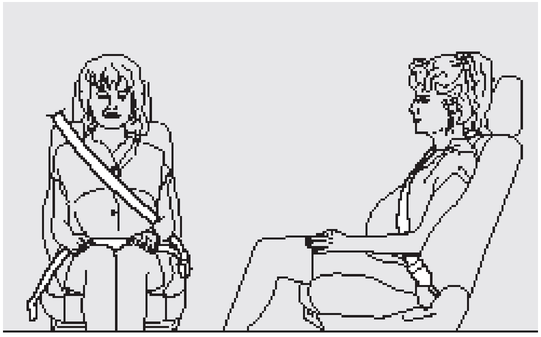
Driver’s side front airbag: it consists of an instantly inflating cushion held in a special compartment located in the middle of the steering wheel.

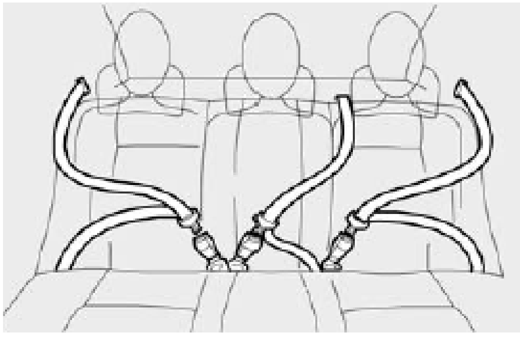




Passenger's side front airbag (where available). It consists of an instantly inflating cushion held in a special compartment located in the instrument board (the cushion volume is greater than the driver's side cushion).

Safety belts with pretensioner and load limiter: the sensors that control the airbags also control the actuation of the safety belt pretensioners. Their function is to recover the belt tape play (if any) and hold the occupant tight to the vehicle form the very first instants of the collision, thus reducing the overall displacement of the occupant inside the passenger compartment. The belts also feature load limiters that reduce the force transmitted by the belts to the thorax. The load limiters combine, in the front seats, with the airbags to better restrain the occupants.



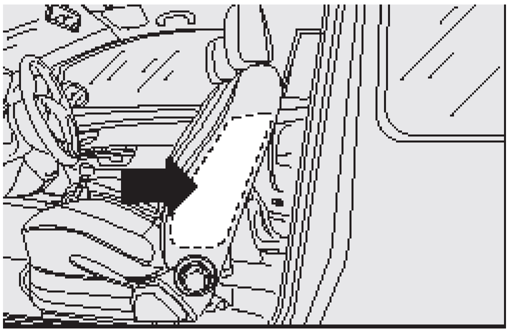


Passenger detecting sensor. This sensor makes it possible to detect the presence of a passenger and, if necessary, warn the driver that the safety belts have to be fastened, by emitting a visual and sound signal through the vehicle panel.

Auxiliary, central head-on collision sensor. The auxiliary deceleration sensor located on the vehicle's front structure (ECS – Early Crash Sensor) helps the main electronic control unit to advance airbag actuation compared with traditional systems, by nullifying the risk of minor injuries resulting from the airbag actuation phase (this phase shall therefore be completed before the occupant starts moving forward towards the steering wheel or the dashboard.

Side protection system.

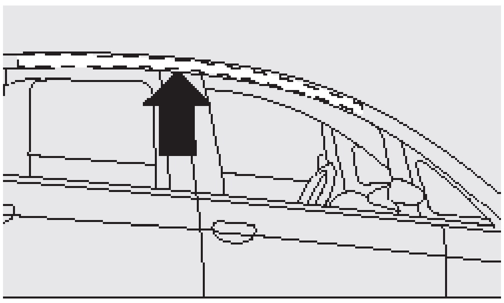
Front side airbags: they are of the thorax/pelvis type and ensure, together with the door panels, the protection of critical body parts such as the ribs, abdomen and pelvis. They are fitted to the seat so as to always ensure the maximum efficiency depending on the seat position.



Front side thorax/pelvis airbags ("side bags") (where available).

They consist of two types of instantly inflating cushions housed in the seat backs, which are used to protect the occupant's thorax and pelvis in case of medium-to-high seriousness side collision.

Curtain airbags: they are actuated together with the side airbags (where available) and interpose themselves between the occupant and the vehicle exterior, thus preventing the occupant's head from hitting highly intruding objects. The curtain airbags protect both the front and rear passengers since they range from the front pillar to the luggage compartment.

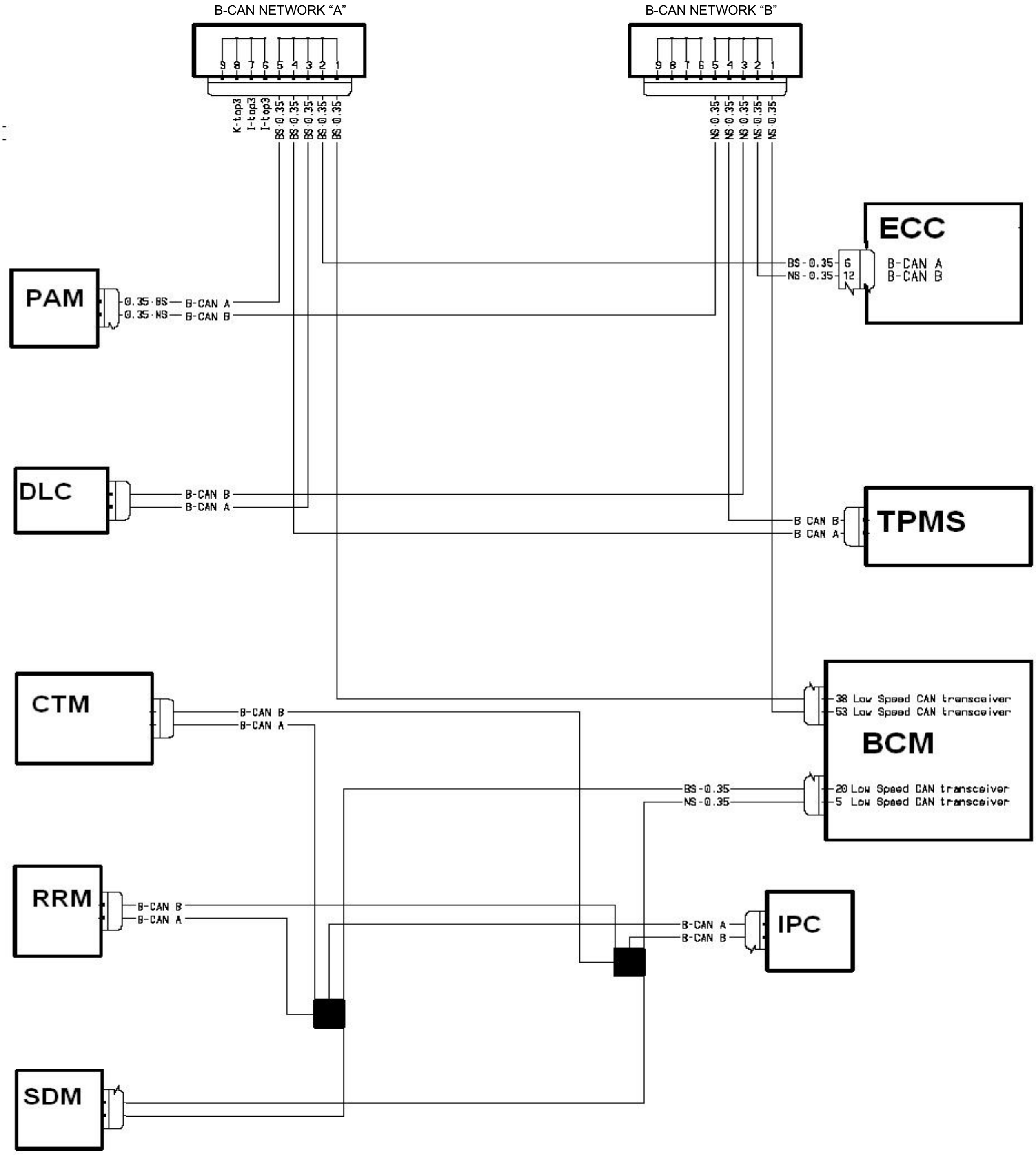


Side head protection airbags ("window bags") (where available).

They consist of two "curtain" cushions housed in the side roof panel coverings and coated with special trimmings. They are used to protect the front and rear occupants' heads in case of side collisions, thanks to the wide deployment surface of the cushions.

Connections

The airbag node (SDM) is connected to the B-CAN line.



9.7.3 Airbag node (SDM)

It constitutes the “core” of the occupant restraint system and is located on the front tunnel. It simultaneously controls all the restraint system actuation and detection devices by processing signals from the various sensors found on the vehicle. It decides on the specific protection devices are to be actuated in case of accident (and when the same have to be actuated) through the signals from the sensors it incorporates.

Moreover, it prevents the aforesaid devices from being actuated when a minor collision takes place. A capacitor (which acts as a power reserve) ensures full operation of the front bags in the event that no power is supplied by the electric system (i.e. when a collision causes the battery or the power cables to be broken).

The algorithm used for the head-on collision situations is, in the operators and experts’ jargon, referred to as “Crash Severity Algorithm” since it can tell whether a collision is serious, so as to properly actuate the dual-stage airbags.

SDM functions

System fault acquisition.

Transmitting the airbag status signal (ON, OFF, Flash) on the B-CAN line.

Acquiring the airbag warning light status (ON, OFF, Fail) from the B-CAN line through the warning light itself.

Performing real-time memorization of the airbag warning light status (ON, OFF, Fail) (the permanent memory for the collisions already occurred is also available).

If an airbag warning light failure occurs, the SDM shall set the passenger’s airbag deactivation warning light to the ON condition for 4 seconds.

If the test phase is not completed, through the external diagnosis instrument, the drive unit shall command airbag warning light blinking indefinitely, until the correct command is received from the external diagnosis equipment.

Acquiring data from the various side and front sensors.

Actuating the various airbags and pretensioners.

Passenger's side front airbag deactivation.

Fuel supply cut-off.

Passenger's airbag disable: the vehicle panel set-up menu allows the user to deactivate the passenger's bag, so that a child seat facing against the direction of running can be fitted with no risk at all. Airbag deactivation is signalled by the lighting of the respective warning light on the instrument panel.

Actuation/deactivation of passenger's side front and side thorax/pelvis protection airbags ("side bags") (where available) (BAG P).

This function makes it possible to actuate/deactivate the passenger's side airbags without deactivating the side head protection airbag ("window bag") (where available).

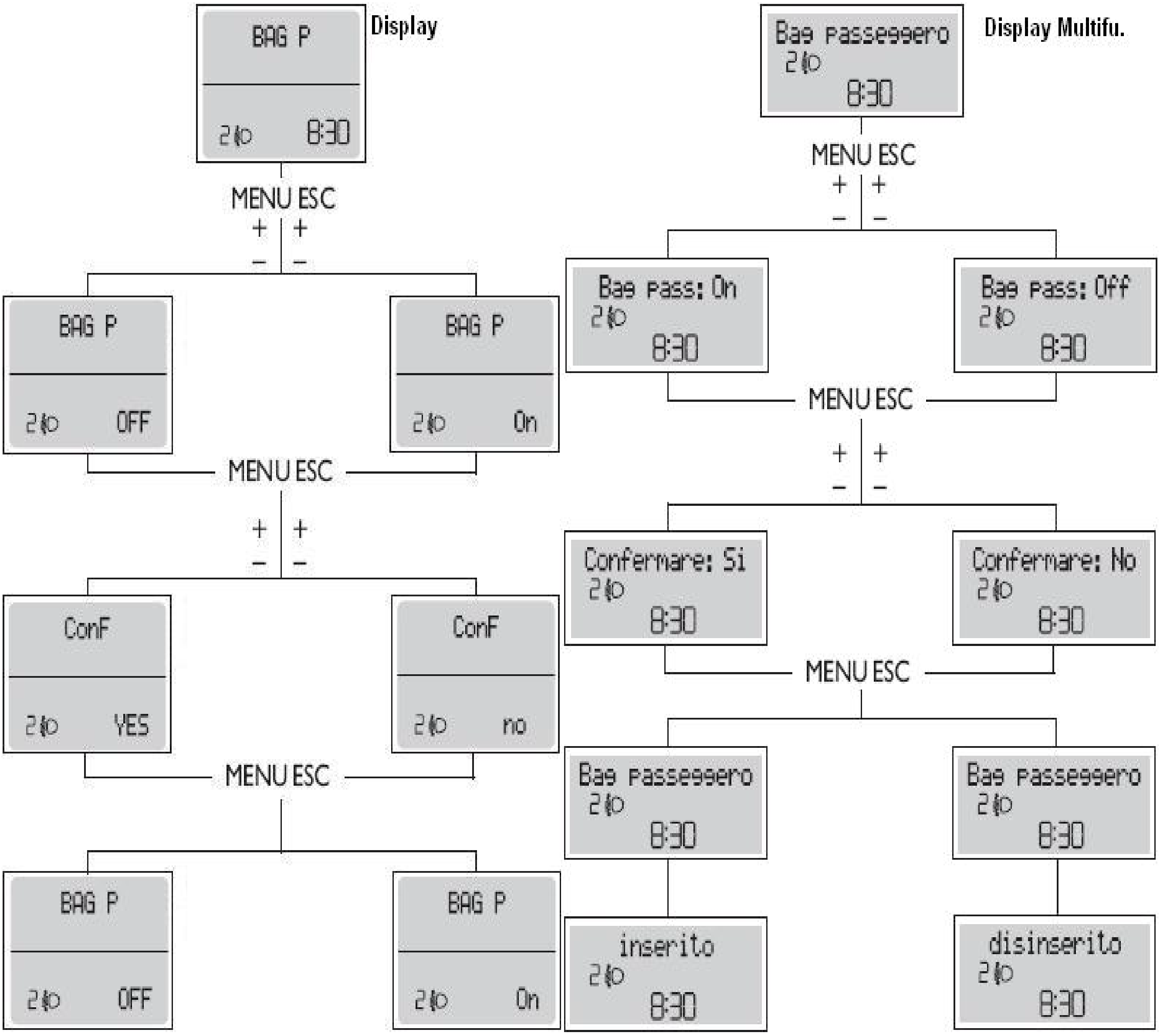
Proceed as follows:

press the **MENU ESC** button; then, after displaying the "BAG P OFF or Bag Pass: OFF" message (to deactivate) or the "BAG P ON or Bag Pass: ON" message (to actuate) on the display by pressing the **+** or **–** buttons, press the **MENU ESC** button once again;

the confirmation request message will be shown on the display;

select "YES" (to confirm actuation/deactivation) or "NO" (to give up) by pressing the "+" or "–" buttons;

press the MENU ESC button for a short time: a selection confirmation message will be shown, and the menu screen will be resumed; alternately, press the button for a long time to go back to the standard screen without storing in the memory.


Display
BAG P
8:30
MENU ESC
BAG P
OFF
BAG P
On
MENU ESC
ConF
YES
ConF
no
MENU ESC
BAG P
OFF
BAG P
On
Display Multifu.
Bag passeggero
8:30
MENU ESC
Bag pass: On
8:30
Bag pass: Off
8:30
MENU ESC
Confermare: Si
8:30
Confermare: No
8:30
MENU ESC
Bag passeggero
8:30
Bag passeggero
8:30
inserito
8:30
disinserito
8:30

9.7.4 Diagnosis and recovery

Airbag warning light (SDM side).

Based on the airbag status signal on the B-CAN, the SDM communicates the following conditions to the IPC:
- airbag system failure (the airbag warning light comes on through the signal from the SDM);
- test not completed (the airbag warning light blinks through a signal from the SDM);
- check upon key-ON (the airbag warning light comes on through an automatic combination set by the IPC for 4 seconds: the signal comes from the SDM).

From the other side, the IPC sends the SDM (through the B-CAN line) the airbag warning light signal and informs the SDM for the warning light status diagnosis.

Upon key-ON:
- the warning message will be shown for 20 seconds if the light is still ON after the typical time “tAB” (15 s) since the key-ON;
- if, after the typical time “tAB” (15 s), the signal comes from the SDM (while the message is being displayed), then the message will further remain ON for a maximum of 5 seconds.

Work conditions	Function	Remarks
Switch-off (+30)	Signal not available	
Key-controlled power supply (+15)	Signal (CrashOutputSts) available	The function is cut off during the first 4 seconds after key-ON
Ignition OFF	Signal not available	
Cut-off upon starting	Signal (CrashOutputSts) available	The function is cut off during the first 4 seconds after key-ON. The function is ensured by an internal power reserve during engine starting or any other condition in which voltage is missing. The node will turn off below 6 V. When the voltage goes up again, the

		node will exhibit the same behaviour as the preceding step. Key-controlled power supply (+15).
Cut-off with run-down battery	Signal (CrashOutputSts) available	The function is ensured by an internal power reserve for a maximum time of 150 msec.

In case of collision, the SDM will transmit, through the B-CAN line, a proper collision signal (STATUS SDM.CrashOutputSts): this signal will inform the network about the type of collision and the time when it occurred.

The airbag node will perform its functions, as shown in the table below:

Functions	**Driver's side airbag**	**Passenger's side airbag**	**Front airbag**	**X Internal accelerom.**	**Y Internal accelerom.**	**X Safety function**	**Actuation threshold**
Front protection			X	X		X	Pretensioner
Side protection	X	X			X		Side limiter
Rear protection				X			TBD
Fuel cut-off			X	X	X	X	

Recovery

R1 = Accelerometer signal X: actuation not ensured.

Accelerometer signal Y: front airbags and pretensioners enabled; side and head airbags disabled.

Power reserve: actuation not ensured.

ASIC: actuation ensured

Microprocessor: actuation disabled.

Memory: actuation disabled (ECU reset).

Sensor safing: front airbag and pretensioner disabled, side and head airbags ensured.

R2 = unsafe actuation due to faults.

R3 = in case of collision, the control unit will try actuation.

R4 = passenger's front airbag disable and passenger's airbag warning light lighting.

R5 = actuation ensured.

R6 = actuation disabled by the control unit.

R7 = the CAN communication will stop for 1 second. The passenger's airbag will be switched off during this time.

R8 = relative to side and head airbag disable. The opposed side and head airbags will be ensured. The front airbags and pretensioners will be ensured.

R9 = actuation available. It may be cleared off the event memory when all of the following conditions apply:

· one airbag and pretensioner is not actuated;

· pretensioner actuation other than the third one;

· side airbag actuation other than the third one.

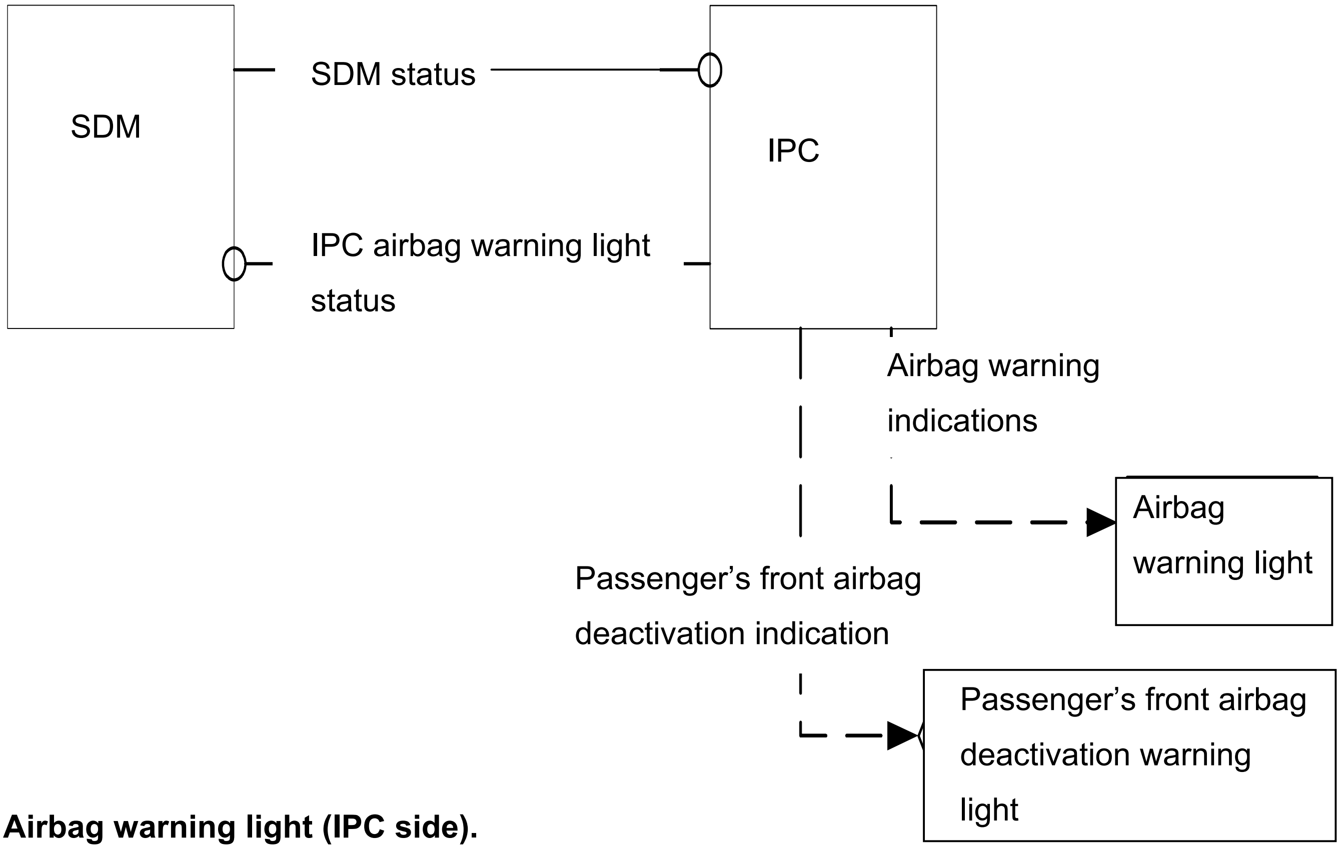
R10 = front and passenger's airbag disabled, and passenger's airbag warning light ON.

R11 = if the passenger's airbag deactivation warning light status or switch are not clear (either of them is faulty, or out-of-time message), the warning light will be actuated immediately and the passenger's airbag will be promptly deactivated.

DTC	Description
B0108	Front Driver Side Bag, Value too low, see page 122
B0108	Front Driver Side Bag, Value too high, see page 122
B0109	Front Passenger Side Bag, see page 123
B0109	Front Passenger Side Bag, see page 123
B0109	Front Passenger Side Bag, see page 123
B0109	Front Passenger Side Bag, see page 123
B0110	Front Passenger Airbag Disable Switch, Short to Battery, see page 123
B0110	Front Passenger Airbag Disable Switch, Value too low, see page 123
B0110	Front Passenger Airbag Disable Switch, Value too high, see page 124
B0110	Front Passenger airbag Disable Switch, Defective Signal, see page 124
B0110	Front Passenger Airbag Disable Switch, Plausibility, see page 124
B0111	Front Driver Side Satellite, Defective Signal, see page 124
B0111	Front Driver Side Satellite, Internal Error, see page 124
B0112	Front Passenger Side Satellite, Defective Signal, see page 125
B0112	Front Passenger Side Satellite, Internal Error, see page 125
B0113	Front Driver Airbag, 2nd Stage, Short to Ground, see page 125
B0113	Front Driver Airbag, 2nd Stage, Short to Battery, see page 125
B0113	Front Driver Airbag, 2nd Stage, Value too low, see page 125
B0113	Front Driver Airbag, 2nd Stage, Value too high, see page 125
B0114	Driver Head Bag, Short to Ground, see page 126
B0114	Driver Head Bag, Short to Battery, see page 126
B0114	Driver Head Bag. Value too low, see page 126
B0114	Driver Head Bag. Value too high, see page 126
B0115	Passenger Head Bag, Short to Ground, see page 126
B0115	Passenger Head Bag, Short to Battery, see page 127
B0115	Passenger Head Bag, Value too low, see page 127
B0115	Passenger Head Bag, Value too high, see page 127
B0116	Driver Knee Bag, Short to Ground, see page 127
B0116	Driver Knee Bag, Short to Battery, see page 127
B0116	Driver Knee Bag, Value too low, see page 128
B0116	Driver Knee Bag, Value too high, see page 128
B0117	(Driver) Early Crash Sensor, Defective Signal, see page 128
B0117	(Driver) Early Crash Sensor, Internal Error, see page 128
B0118	Configuration Mismatch, see page 128
B0119	Pretensioner Crash Data, see page 128
B0120	Front Airbag and Pretensioner Crash Data, see page 129
B0121	Driver Side Crash Data, see page 129
B0122	Passenger Side Crash Data, see page 129
U0001	CAN no message, see page 129
U0001	Can bus-off, see page 129
U1700	BCM signal below allowable, see page 129
U1700	NQS node mute, see page 129
U1703	NQS signal below allowable, see page 129
U1703	NQS node mute, see page 129

Airbag warning light.

This function describes how the SDM signals the system status, error condition and test incomplete condition.



Airbag warning light (IPC side).

Upon key-ON, the airbag warning light will, if the AIRBAG and passenger's AIRBAG deactivation warning lights are ON, be kept ON by the IPC. It will illuminate upon key-ON for a preset time, regardless of the signals form the SDM**.**

After this check time, the warning light control will be based again on the signals received from the SDM.

Warning messages from the airbag (IPC side).

The SDM will start its diagnosis activity upon key-ON; thus, it will be able to detect any airbag system trouble.

Signalling warning light.

Class A errors: any error that represents a risk of incorrect minimum actuation of the airbag squibs. With this type of error, the warning light will remain ON, even when the error is intermittent and has been solved, until the ECU is reset.

Class B errors: any error that does not represent a risk of incorrect actuation of the airbag squibs. With this type of error, the warning light will remain ON for 30 seconds and then will go out.

9.8 Fire protection

In the late 1990s, the introduction of the new European regulations on the crash tests and also of the injection fuel feed system has made FIAT AUTO aware of the need to define from the start the bodywork construction design principles and the layout of the various systems fitted to motorcars.

For this reason, the whole of Fiat Punto, from the body to every single component, has been designed so as to comply with the strictest, latest FIAT in-house fire prevention regulations.

Fire Prevention System (FPS).

All the petrol and diesel engine versions feature the FPS (Fire Prevention System) inertia switch, which causes the engine to be switched off immediately a few milliseconds after a collision.

The plastic tank, conforming to the forthcoming directives, is located in an area protected in case of collision. It can withstand distortion (if any) with no risk of fuel escape; moreover, it poses no explosion hazard if the vehicle is set on fire, due to its being made of plastic.

Engine compartment electric system.

The main sectioning of the positive, high-power cables is carried out directly on the battery's positive pole through a box complete with fuses. This solution is advantageous since no cable sections are found which are not protected by a fuse (and, therefore, subjected to casual short-circuits).

All the cables are electrically insulated and placed inside corrugated coverings for mechanic protection against the possible risk of rubbing.

The electric insulation of the battery/starting motor power cable is made of a material which features high resistance against the abrasions and cuts. Moreover, the cable routing has been optimized, and special fasteners have been used.

Electric system inside the passenger compartment.

All the cables are protected by fuses located in the interconnecting control units located in the engine compartment (FDU, front left side), passenger compartment (BCM, left side under the dashboard) or luggage compartment (RDU, wired on the vehicle cable and positioned in the rear left headlamp area).

The cable routing is properly arranged, to avoid cable pinching when the trimmings are fitted.

10 Air conditioner

10.1 General remarks

10.1.1 System configurations

The range offered makes three different system available:

heater;

air conditioner;

automatic, two-zone air conditioner, with provision for obtaining different air temperatures and distribution patterns both for the driver and the passenger.

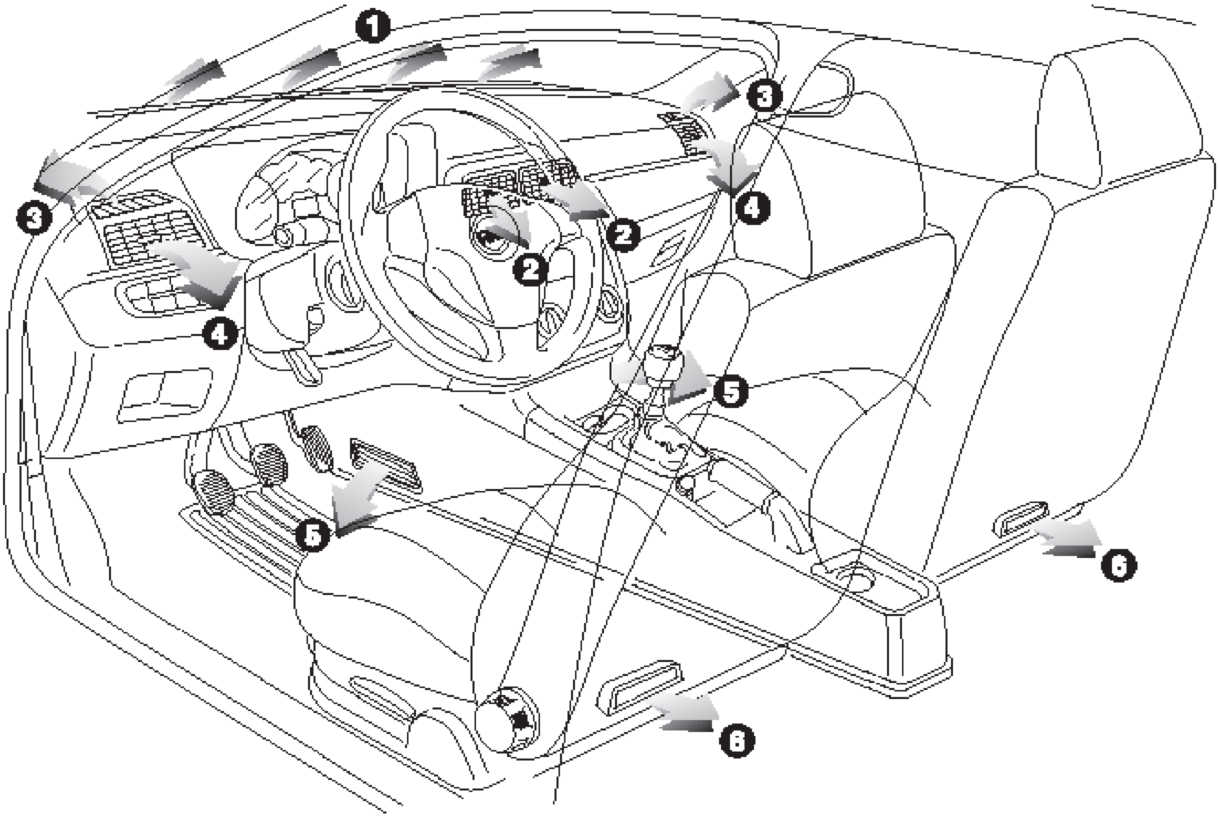
The versions equipped with air conditioning (an optional item on the heated versions) feature pipes for air distribution to the rear passenger foot area.

The heater and air conditioner controls feature the same layout characterized by 3 knobs: the left knob allows the user to control the temperature of the air let into the passenger compartment; the central knob makes it possible to control the fan speed (four different speeds can be selected); the right knob allows the user to control air distribution (five positions shown in the area around the knob).

During the designing of the special knob and control shape, ergonomics has taken priority over style, thus obtaining intuitive, easy-to-reach controls.

Inside the mask are also the buttons for recirculation control, rear heated window actuation and compressor switch-on (versions with air conditioner only).

10.1.2 Air flows



Air flow and vent diagrams

10.2 Components

10.2.1 ECC (Electronic Climate Control) control unit

As we have said above, the automatic air conditioner is available in the two-zone configuration only; this version is the only one that makes use of the ECC.

ECC pin-out

No.	I/O	Description
1		CAN L
2		CAN H
3	N.C.	N.C.
4	N.C.	N.C.
5	O	PWM output
6	N.C.	
7	O	Spreading sensor power supply
8	N.C.	N.C.
9	I	Temperature sensor 1 signal
10	I	Spreading sensor signal
11	O	Sensor ground
12	O	-
13	N.C.	N.C.
14	N.C.	N.C.
15	N.C.	N.C.
16	N.C.	
17	I	Temperature sensor 4 signal
18	I	Temperature sensor 3 signal
19	I	Spreading sensor signal
20	I	Temperature sensor 2 signal
21	N.C.	
22	O	-
23	N.C.	N.C.
24	O	-
25	I	Left mixing motor position signal

26	I	Right mixing motor position signal
27	I	Right distributing motor position signal
28	I	Left distributing motor position signal
29	I	Fan input
30	I	Power supply
31	O	Mixing and distributing motor power supply
32	O	-
33	O	-
34	O	-
35	O	-
36	O	-
37	O	-
38	O	-
39	I	+ 15
40	O	Ground

10.2.2 Actuators and sensors

The air-conditioning system is made up of the following items:

A) controls (knobs, buttons and displays);

B) sensors:

passenger compartment temperature sensor;

external temperature sensor;

left/right dashboard mixed air temperature sensor;

left/right foot area temperature sensor;

solar sensor.

C) actuators:

left/right mixing actuator;

recirculation actuator;

DEF SX – dashboard – foot area air distribution actuator;

DEF DX – dashboard – foot area air distribution actuator;

fan speed actuator;

compressor disable actuator;

MAX DEF function actuator;

rear heated window actuator.

D) connecting lines with:

Body Computer CAN network.

10.2.3 Compressor

Nuova Punto is equipped with the variable-displacement, magnetic clutch-free Denso 5SL12 compressor. It makes it possible to gradually vary the flow rate of the cooling fluid reaching the evaporator; as a result, the anti-frost sensor would be redundant and has therefore not been fitted to the system.

Control is based on the intake pressure value, according to the following logic:

low pressure: the compressor displacement tends to the minimum value;

high pressure: the displacement is increased.

This operating logic refers to the following actual conditions:

“low pressure” means that the load imposed to the air conditioner is such that it does not require very high fluid flow rate;

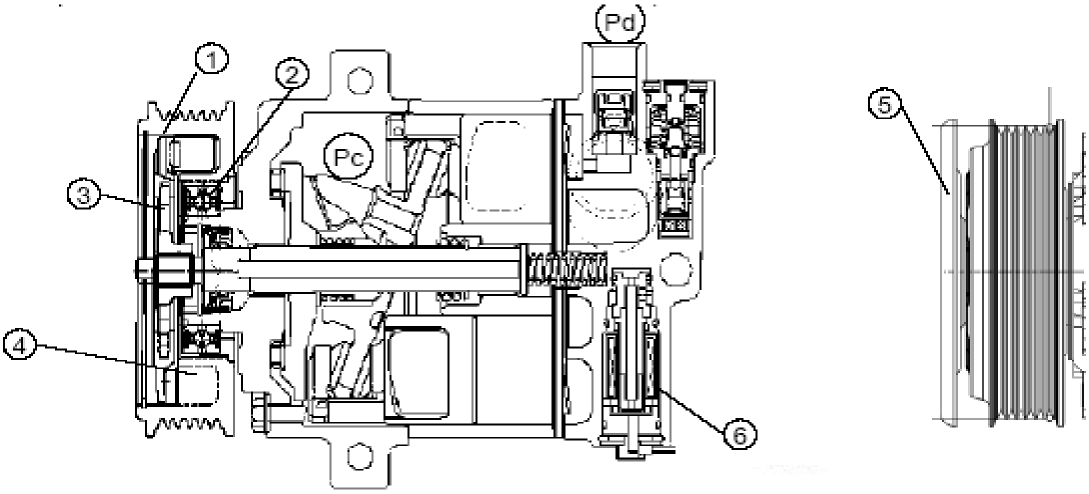
“high pressure” means that a very high load is imposed to the air conditioner, and the required amount of cooling fluid is great.

Operation

The pulley motion is transmitted continuously to the compressor shaft by means of jumpers, referred to as “limiters” (3), which are interrupted in case of seizure due to a compressor fault, thus preventing the pulley from getting stuck and, therefore, the auxiliary member belt from being broken.

In order to reduce the torque fluctuations that generate noise, special dampers referred to as “dumpers” (4) and an inertia ground (5) directly secured to the shaft are also used.

Since the motion is always transmitted to the compressor shaft, the compressor switch-on/off function is entrusted to the “ON/OFF” valve (6).



Sectional view of the compressor

Technical features

The 5SL 12 compressor flow rate may vary depending on the load variations requested from the system, as well as changing external temperature and/or humidity conditions, and sudden engine load changes.

Below are the main technical features of the compressor:

direction of rotation: clockwise;

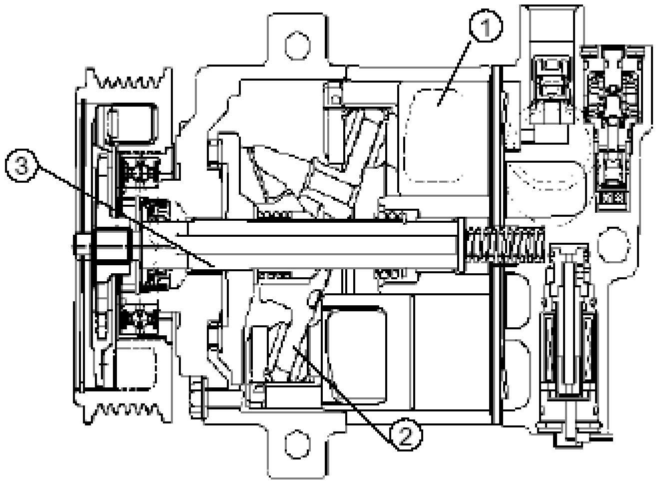
max. number of continuous revs: 8,500

number of pistons: 5

minimum displacement: 0 cm^3/rev

maximum displacement: 126 cm^3/rev

amount of lubricant: 80 cm^3.



The compressor is made up of 5 pistons (1) secured to an oscillating plate (2). The pistons move inside the cylinders, obtained in the compressor body, and are set moving by the plate oscillations. The plate motion is generated by the rotation of the propeller shaft (3).
The latter is made to rotate by the pulley, connected to the engine by means of the auxiliary member belt. The coolant flow rate is controlled by varying the compressor displacement and also the inclination of the rod-holder plate (2).

10.2.4 Filters and condenser

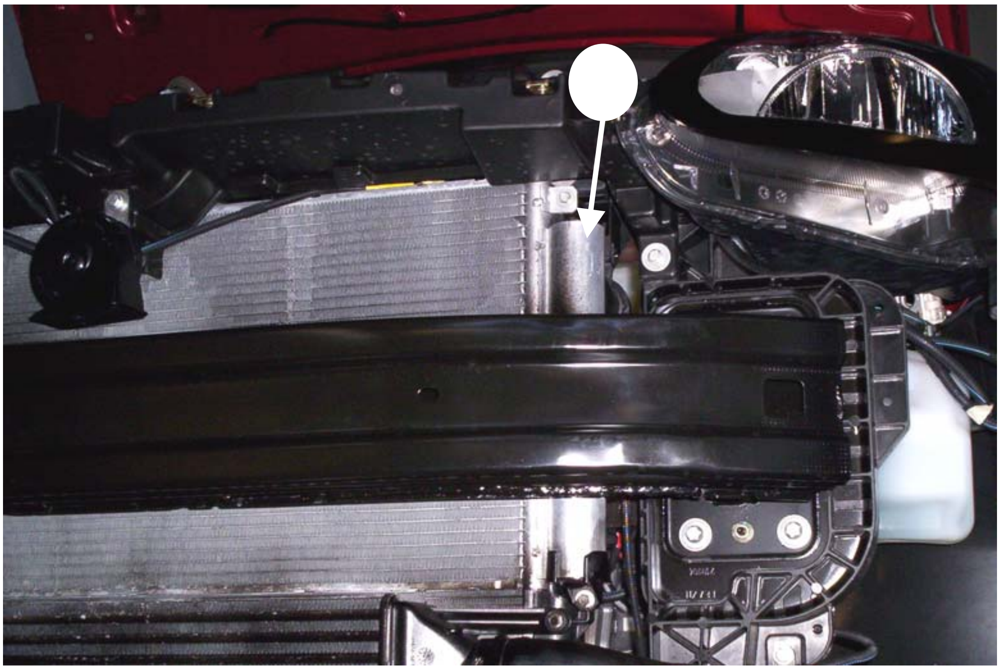
The condenser is a heat exchanger located in front of the engine cooling radiator.

The coolant at the gaseous state flows through the condenser pipes and is liquefied (at a temperature of 60˚C, on average).

The condenser is skirted by the external air generated by the vehicle motion. When the vehicle is stationary or runs slowly in a column or queue, the air flow is generated by the engine radiator fan.

Insufficient thermal exchange in the condenser will cause the pressure to increase in the system and the coolant to be condensed only in part, thus reducing the system's efficiency.

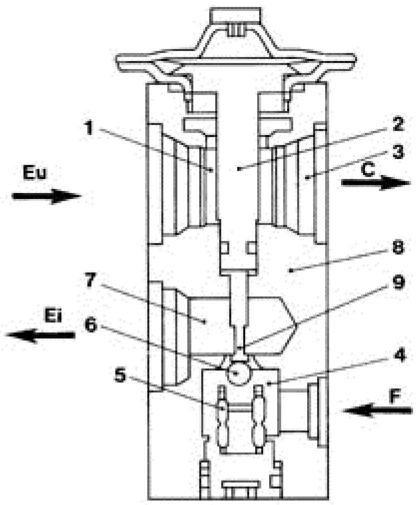
The right side of the condenser incorporates the seat for the cylindrical, fully integrated dehydrating filter (1). This arrangement makes it possible to optimize the system layout.



The pollen filter features a rectangular shape. It can be replaced by removing the plastic guard located inside the passenger compartment, on the passenger's side under the glove compartment.

10.2.5 Expansion valve

The figure below illustrates a sectional view of the expansion valve, together with the main components of the same.



1, Evaporator outgoing fluid pipe

2, Thermo-sensitive element

3, To the compressor intake coupling

4, Pressure fluid

5, Contrast spring

6, Calibrated hole and ball

7, Expanded fluid (to the evaporator inlet coupling)

8, Valve body

9, Rod

C, To the compressor

F, To the dehydrating filter

Ei, Inlet evaporator

Eu, Outlet evaporator

10.2.6 Fluids

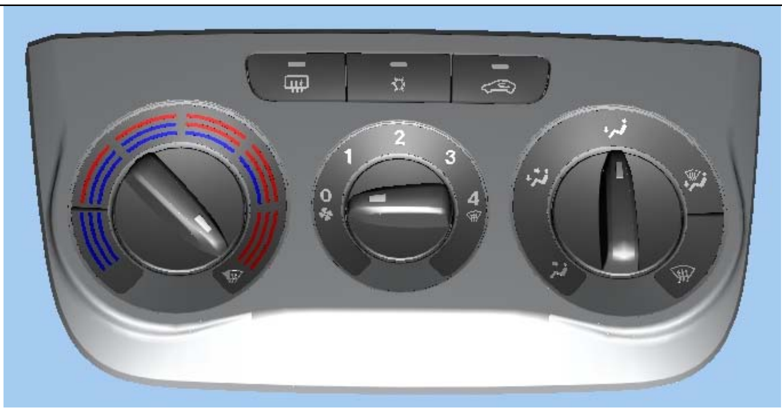
The compressor oil (80 cm^3) is of the ND8 grade type and must not be replaced.

The amount of the R134A coolant is 500 +/– 40 g for all the engine versions. The points for connection with the recharge apparatus are different depending on the models; in any case, they can be easily located.

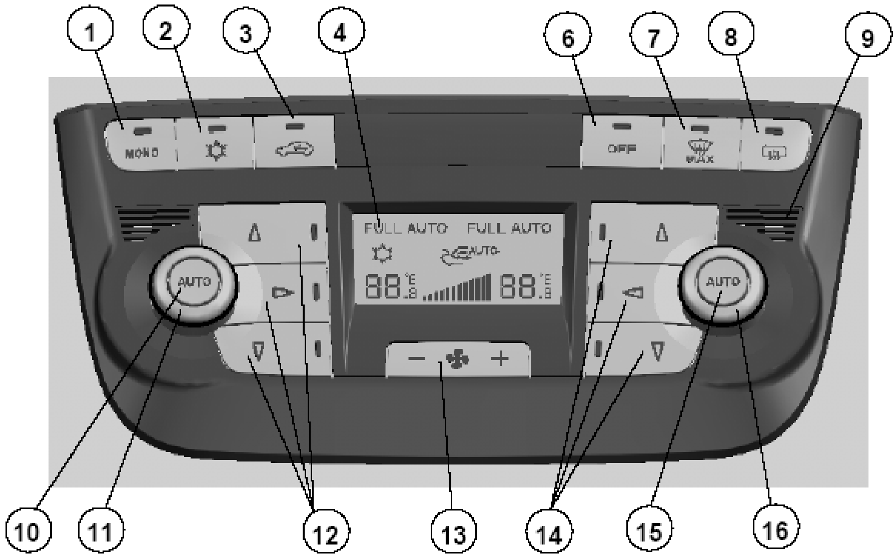
10.3 Operation logic

The air conditioner control layout varies according to the body versions (heater, manual conditioner, automatic, two-zone air conditioner).

Heater



Air conditioner



Automatic, two-zone air conditioner

With reference to the figure illustrating the automatic, two-zone air conditioner, the button functions are as described below:

1) single/differentiated temperature selection control MONO button (yellow LED);

2) compressor enable/disable control button (yellow LED);

3) air recirculation control button (yellow LED);

4) display;

6) system deactivation control OFF button (yellow LED);

7) MAX DEF function control button (yellow LED);

8) rear heated window (yellow LED);

9) passenger compartment temperature sensor protection grid;

10) AUTO SX button for automatic control of left-hand temperature, left-hand air distribution, fan, compressor and air recirculation;

11) driver's side temperature selection knob;

12) left-hand air distribution selection buttons (three green LEDs);

13) fan speed pivoting button (increase/decrease);

14) right-hand air distribution selection buttons (three green LEDs);

15) AUTO DX button for automatic control of right-hand temperature, right-hand air distribution, fan, compressor and air recirculation;
16) passenger's side temperature selection knob.

The system makes it possible to adapt the passenger compartment air temperature (in the driver's side and passenger's side parts) to the temperature requested in automatic mode. The air flow rate, air distribution, compressor deactivation, recirculation state and the MAX DEF function (which turns the rear heated window on automatically) can be selected manually. Moreover, the system can, by means of the MONO button, be set to operate in a single-zone mode, i.e. the air temperature and distribution in the passenger compartment, as requested by the passenger, can be adapted to the one requested by the driver.
The operation logic is based on the equivalent temperature.

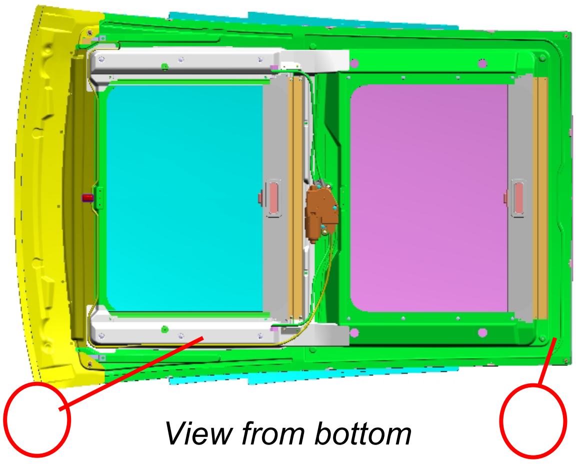
10.4 Diagnosis

Control unit proxy procedure
The control unit is capable, by means of special sensor control logic and setting logic with actuator "self-learning", to record and store in the memory a number of anomalies and faults that may affect the system.
These stored errors can be read by getting connected to the Body Computer diagnosis connector.
This operation makes the system learn the end-of-travel position of the air-conditioning control unit electric actuators.
The established procedure can be carried out by means of the computer-assisted diagnosis equipment.
This operation shall be repeated after at least one actuator has been replaced.
The procedure shall be started again in case of interruption.

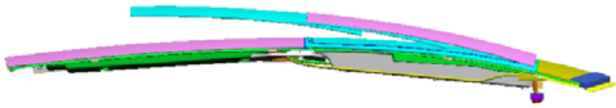
11 Sunroof

11.1 Description

The sunroof fitted to Nuova Punto consists of a special, wide-glass system referred to as "Skydome", made up of two glass panels (one fixed rear panel and one front sliding pane) and a front fin which acts as an air baffle.
The glass extends to such an extent that it takes the place of over 70% of the sheet metal roof panel surface.
The glass allows, when closed, the external light to be let into the vehicle while allowing the occupants inside the passenger compartment to have a very good vision of the outside. The glass, allows, when opened, the roof compartment to be opened to approximately half its surface area.
During the opening phase, the front mobile panel slides out of the roof panel ("spoiler" function).
In particular, the sunroof consists of the following:



View from bottom



Side view

a sheet metal frame on which the other components are secured (D);

a system (right and left) of mechanisms, secured to the chassis, for front glass panel handling, which are driven by an electric motor by means of a metal spiral cable (E);

two tempered glass panels (thickness: 4 mm) with low energy and light transmission values (a moving front panel “A”, which can also act as a spoiler, and a fixed rear panel “B” secured to the chassis);

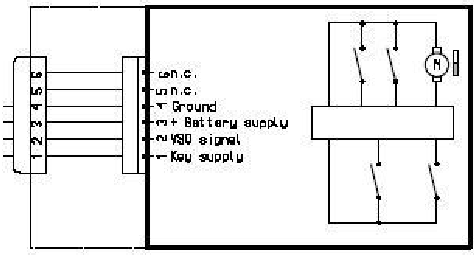
a front fin (C) which acts as an air baffle (it lifts when the roof is opened);

two polyester roller-type window shades (front and rear) with manual, two-position control (open/closed).

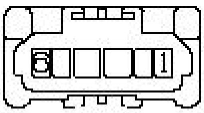
The sunroof is controlled by means of the components below:

control push-button panel;

electric motor and sunroof control unit (built-in)



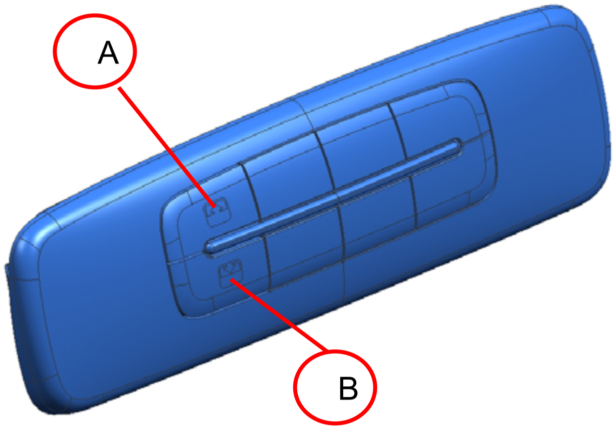
Built-in motor & control unit



Motor/control unit pin-out

1. Key-ON (+15)
2. Speed signal from the brake node
3. Power supply (+30)
4. Ground
5. N.C.
6. N.C.

11.2 Operation



Control mask

The “Skydome” sunroof is operated by pressing the opening (A) and closing (B) buttons located in the mask close to the front central ceiling light fixture. The operation logic described below is implemented through actuation of an electric motor managed by an electronic control unit. **The sunroof movements, obtained by the control button, are permitted only with the panel ON (key-ON).**

11.2.1 Sunroof opening

The front glass panel can be opened in two different ways, by pressing the respective button (on the opening side) upon key-ON:

automatic opening: by pressing the button on the “opening” side for more than 300 ms, the front glass panel (fully closed) will open to the “spoiler opening position”, so as to ensure very low drag noise. By pressing the button again on the same side, the front glass panel will reach the maximum opening position. Following the initial opening control, the glass panel may be stopped at intermediate positions by pressing the button again.

Manual opening: by pressing the button briefly (for 60 to 300 ms), the front glass panel (fully closed) will move to open proportionally to the time (T) during which the button is pressed, and will stop when the button is released. By pressing the button again and again on the same side (still within the time range of 60 to 300 ms), the panel will jolt along until it reaches the maximum opening position. This function allows the user to position the front panel at intermediate positions with respect to the maximum opening position.

11.2.2 Sunroof closing

Similarly with the opening operation, the front glass panel can be closed in two different ways, by pressing the respective button (on the closing side) upon key-ON:

automatic closing: by pressing the button on the "opening" side for more than 300 ms, the front glass panel (fully opened) will reach the "spoiler opening position". By pressing the button again on, the panel will reach the closing position. Following the initial opening control, the glass panel may be stopped at intermediate positions by pressing the button again.

Manual opening: by pressing the button briefly (for 60 to 300 ms), the front glass panel (fully opened) will move to close proportionally to the time (T) during which the button is pressed (60 to 300 ms) and will stop when the button is released. By pressing the button again and again on the same side (still within the time range of 60 to 300 ms), the panel will jolt along until it reaches the maximum closing position.

11.2.3 Window shades

The passenger compartment interior luminosity can be modified by means of two window shades: one for the front mobile panel, one for the fixed rear panel. The window shades are made of polyester: each of them slides and can be rolled up along sliding guides, thus preventing the guides from being detached. They can be opened manually and be either fully closed or opened (no intermediate positions). The window shade closing is independent from the front panel opening position.

11.3 Sunroof closing anti-pinch feature

The antipinch system, managed by the electronic control unit, conforms to the requirements of EC Directive 2000/4 and comes into action during horizontal and vertical closing of the front panel when an obstacle (e.g. finger, hand, etc.) is found:

as far as the horizontal closing motion is concerned, the system is active over the entire travel (if the glass is opened for more than 4 mm): when an obstacle is found on the front side of the glass panel, it reverses the glass motion over a distance of 100 mm from the point where the motion has been reversed;

as far as the vertical closing motion is concerned, the system is active over the entire travel (if the glass is opened for more than 4 mm from the gasket edge): when an obstacle is found on the rear side of the glass panel, it reverses the glass motion until the compass opening position is reached.

In both cases, the load that causes motion inversion is less than 100 N, as laid down by the EC Directive 2000/4. Possible pinching from the vehicle interior in the panel side zones is avoided by making use of side guards that prevent the hazard zones from being reached.

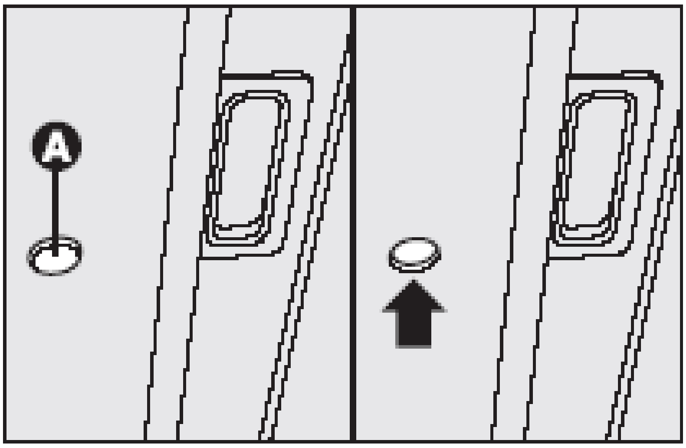
11.4 Emergency actuation

The front glass panel can be opened or closed manually in an emergency (or if maintenance operations are carried out when the power supply is not available) by following the procedure below:

remove the protection cap located on the inner covering, between the two due window shades;

procure the Allen wrench supplied with the tool kit located in the luggage compartment;

put the wrench into seat A, then rotate it (clockwise to open the sunroof, counterclockwise to close it).



11.5 Initialization

In case of battery disconnection or manual emergency glass handling, the sunroof shall be initialized.

Follow the procedure below:

keep button A depressed in the closing position;

keep the button depressed, so that the sunroof jolts along to be fully closed;

wait, after the sunroof has fully closed, for the electric motor to come to a halt.

