Training Academy

FIAT 500

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BRIEFING

The Nuova Fiat 500 was first presented on the 4th of July 1957 in Turin. A true icon of our times, for Fiat the Nuova 500 represented the culmination of the reconstruction that began in the post-war years. On the 4th of July 2007, exactly fifty years later, the new Fiat 500 will be presented, once again in Turin, ready for distribution immediately after the launch. Like fifty years ago, with this car Fiat Automobiles SpA competes another, equally important cycle of renewal.

Realized by the Fiat Styling Center and manufactured in the establishment in Tichy (Poland), the new 500 is a 3-door utility: it is 355 centimeters long, 165 cm wide and 149 cm high, with a wheelbase of 230 centimeters. The car is really fun to drive thanks mainly to its choice of three engines: the 1.3 turbo diesel 16v Multijet and the two petrol versions: the 1.2 8V with 69 HP and the 1.4 16v with 100 HP, all with five or six gear manual transmissions.

The model confirms the undisputed leadership of Fiat Automobiles SpA in this category – thanks to an extraordinary patrimony of technical, design and human resources accumulated in over a century of activity – and represents a true leap forward in terms of comfort and safety, technology and equipment. The new 500 is the most advanced response for people looking to “live” the car in complete freedom, who want a car they can appreciate in everyday use, that’s fun to drive and functional, ecological and affordable, but with good looks and a touch of fascination too.

A symbol of Italian stylistic excellence, the new 500 is the most advanced response for people looking to "live" the car in complete freedom, who want a car they can appreciate in everyday use, that's fun to drive and functional, ecological and affordable, but with good looks and a touch of originality. In short, the model confirms the undisputed leadership of Fiat Automobiles in this category - thanks to an extraordinary patrimony of technical, design and human resources accumulated in over a century of activity – and represents a true leap forward in terms of comfort and safety, technology and equipment, all in full respect of its historical, cultural and industrial identity.

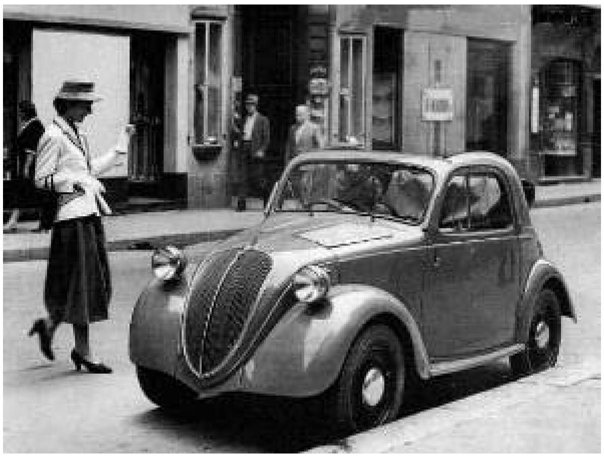
The 500 and the market

Fiat has chosen the new 500 to be the driver of its image in the world. The new 500 brings with it all the emotional and social values so closely linked with the old 500; thanks to its new features, the Fiat 500 looks to the market from a broader perspective. Indeed, though the Fiat 500 is without a doubt a small car (and as such in competition with certain competitors), it also has great emotive content (and as such competes on an entirely different level).
Customers looking for a Fiat 500 are a mixed group who share the values and attitudes of a small car, but with great content and a significant history.

The Story of a Legend

4th of July 1957 “The new 500”

“Around halfway through the ‘fifties, Fiat began thinking about a possible successor to the 500 Topolino. It had to be a small, very cheap car to side the newly released 1955 600, and cover the gap in the lower end of the market, but it didn’t have to compete as a direct alternative to the 600, sales of which were booming. That was the part of the brief that probably had the most influence on the extremely Spartan character of the new 500.



The initiative was encouraged and driven by Chairman of the times Vittorio Valletta, who also established the essential requisites of the new little car: lowest possible production cost and extremely low consumption. Those were the years of the Suez crisis, and the continual increases in fuel prices were starting to be felt.

The design was entrusted to Dante Giacosa. He gave due consideration to the styling ideas of Hans Peter Bauhof, the young German designer working at Deutsche-Fiat in Weinsberg who, in 1953, first forwarded the idea of creating a little two-seater inspired on the lines of the celebrated Volkswagen Beetle, in production since the ‘forties, driven by a two-stroke engine he had designed in 1950. The volume would be half that of the Beetle, with half the seats: two instead of four, but it would have the same rear wheel drive and rear-mounted engine.

Giacosa didn’t like the engine suggested by Bauhof because it wasn’t compatible with Fiat’s demands for economy and long life, but he really did appreciate the bodywork lines, and so had plaster prototypes made to begin defining the form of the new car, personally dedicating a vast amount of time to this highly important phase of the design.

Once the body was defined, work concentrated on the engine. Having rejected Bauhof’s original two-stoke, a series of prototype twin-cylinder, air-cooled four-stroke engines were made in a variety of configurations: with side-valves or overhead valves, overhead cam or crankshaft cam with push-rods and rockers, in-line or boxer, mounted transverse or longitudinal.

The boxer version was immediately opposed by Giacosa himself due to its high cost, the others were rejected for their poor reliability or excessive vibration. The final choice was for a longitudinally mounted air-cooled engine with two parallel cylinders, overhead valves. pushrods and rockers, two valves per cylinder, with total displacement 479 cc. This engine was capable of delivering 13 HP, but never managed to get over the vibration problem caused by the design choice of parallel pistons. This was compensated for by mounting the engine on a spring suspension anchored to the rear cross-member, that immediately became one of the most characteristic features of the 500.

The first series

The car was presented to the public on the 4th of July 1957 with the name “Nuova 500” to distinguish it from the 500 Topolino, which had reached version “C” and gone out of production a few years earlier. Its maximum speed was 85 kilometers per hour, and its price 490,000 Lira, a little high if compared to the only slightly more expensive 600.
The first series was really Spartan, above all lacking the chrome plating so loved by the Italians of those years. It didn’t even have light switch and indicator stalks on the steering column, with the lights controlled entirely from the six-position Bosch ignition switch (only sidelights, neutral, run lights off, with sidelights, headlights, beams), and the indicator by a transparent toggle switch on the centre of the dashboard just above the ignition switch. The windows were all sealed except for the two compass-opening quarter lights that when fully opened hampered the driver’s hands on the steering wheel. The roof was substituted by an ample cloth soft-top with a vinyl rear window that dropped down to the edge of the rear bonnet. It was supported by a pantograph frame and could be rolled-up. There was no rear seat, only an unpadded bench, since the car was only approved as a two-seater. The wheel rims were cream colored, attached by bolts you could see, without the chrome hub caps so much in vogue at the time. Ventilation was provided through two slits just under the front headlights (later eliminated and replaced by the front indicators), that delivered air through two pipes in the luggage compartment to two butterfly outlets under the dashboard. The heating system used the engine forced cooling air.
The windscreen demister was optional. Much of the welding was visible and the interior upholstery very poor. As was typical of the times, the doors were rear-hinged instead of front-hinged. Cooling air for the engine, that also served to heat the passenger compartment, was drawn in through the intake grill characterizing the rear of the car just under the rear window. Drive was rear-wheel, like most automobiles of the period, and the gearbox had four forward gears plus reverse. The suspension was the same as the 600: leaf springs and shock absorbers to the front and helical springs with coaxial shock absorbers to the rear. The 500 also inherited the 600’s four drum braking system, but with self-centering shoes. The side direction indicators were teardrop-shaped, and there were no front indicators. The dashboard was very Spartan and included a little eyebrow dashboard, a six-position ignition and lights switch, dashboard light switch, three-position windscreen wiper switch: stop, start, return (there was no automatic return, and the transparent toggle switch for the indicators. The dashboard had the speedometer, odometer, headlights on light (green), and generator, petrol and oil pressure lights (red). The speedometer went up to 100 kilometers per hour, and there was a sheet metal shelf fitted under the dashboard. Steering wheel, dashboard trim and gear lever knob were in a neutral beige color. At the base of the gear lever, on the tunnel, there were two metal levers, one controlling the starter motor and the other the choke, to enrich the mixture to help on cold starts.
There were three optionals available: windscreen demister, plastic sun visors and white-wall tires.
Initial public response was a little cooler than expected, if not cold. The little new car just looked too spartan for most people, now used to the shiny chrome adorning most other cars. The target customer identified by Fiat was the owner of an old Topolino who used scooters for short everyday trips. Many of these, however, didn’t like having just two seats and thought it was too expensive compared to its big sister the 600: better to save up a bit an buy a 600. It was also criticized for its poor performance, the engine wasn’t very flexible, power modest and maximum speed a bit too low. To customers wanted a little more from the car, and so Fiat went back to the drawing board. They worked on both the engine and the trim. Changes to the engine included revised timing and cam rise, improving power to 15 HP at 4000 rpm.

The body was given all the special details like chrome trim and winding windows. Maximum speed rose to 90 kph.

So, in the month of November the same year, only four months after its launch, Fiat launched two new versions: the economic Nuova 500 and the normal Nuova 500, presented at the Turin motor show. The first series was taken out of production. The economic version was substantially identical to the first series but with the new 15 HP engine and a few new details like catches on the quarter lights, the price was lowered to 465,000 Lira. The normal was sold at 490,000 like the first series, but in addition to the new engine it also had all the new trimmings. In an act of great humility, Fiat reimbursed all purchasers of the first series with a cheque for 25,000 Lira, offering in alternative a free upgrade. This is why an original example of the first series today is exceptionally rare.

It is important to note that the economic 500 wasn't the first 500 produced. That was the so-called first series that remained in production for just four months, from July 1957 to November 1957. The official name of the first series is the Nuova 500. Subsequent series have retained the name, but accompanied by a specific denomination (economic, normal, sport, station wagon, D, F, L, R; in the convertible and sunroof versions), unfortunately almost never indicated on the bodywork in a clear and univocal way.

The 500 economica

Presented in November 1957 at the Turin motor show, the 500 economica is almost identical to the first series, but mounts the 15 HP engine and has revisions to some small details, among with the catch for opening the quarter lights. Top speed 90 kph. The price was lowered to 465.000.

The 500 normale

Presented in November 1957 along with the economica at the Turin motor show, this was the model with which Fiat intended to relaunch the 500, captivating the Italians with its looks. It mounted the 15 HP engine and could do 90 kph. The standard equipment was much richer, offering headlights with chrome frames, sun visors, aluminium trim on the front bonnet and mouldings on the sides, chrome hub caps, winding front windows, quarter lights with open catch, padded rear seat, indicator and light stalks on the steering column, with an indicator repeater light in place of the indicator switch on the centre dashboard. The Nuova 500 insignia appeared on the rear bonnet. The price remained at the 490,000 Lira of the first series, but now the car was at least more complete.

This car began the 500 boom that was to culminate in the 'sixties with the version D. The little car became well-liked, sales soared and it became a social phenomenon just like the 600 or even more so. There were those who bought it because they could afford nothing else, and those who bought it precisely because they could afford everything.

The 500 sport

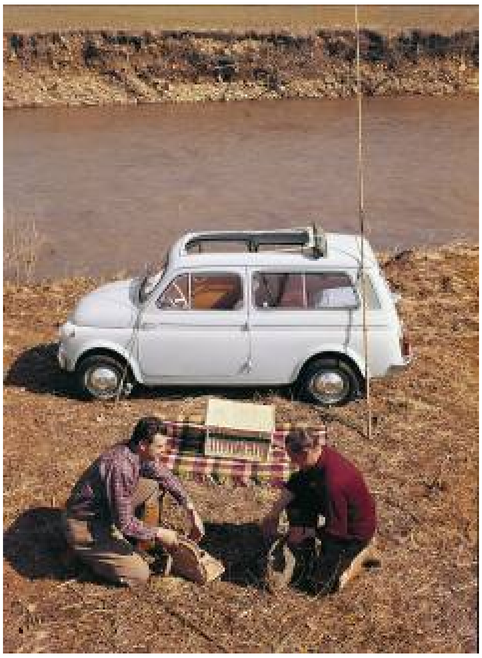
The 500 sport was presented in 1958 to offer a car with a bit more go to enthusiasts and to boost the sales of the other versions thanks to the image return from sporting events, through the 500 championship and participations in important races for its category. A lot of modifications were made to both engine and bodywork. The sport is immediately recognizable for its hard top, without sunroof, with its ribbing and the characteristic livery, white with a red stripe running down the side at mid height, red rims and different shaped rear lights. The engine was bored out to 499.5 cc giving it 21.5 HP and top speed rose to over 105 kph, also thanks to a different ratio at the axle. This engine was subsequently adopted, a little revised and tamed, on the D, f and L versions.
The price was set at 560,000 Lira. Shortly after, a convertible version was marketed, with a smaller top and silver hub caps. It was cheaper than the hard top, at just 495,000 Lira, because in those days most of the cost of producing cars depended on how much sheet metal was needed.
Already in the first months after its launch it began winning prizes: the 500 Sport was an immediate success in many races and public interest in the whole range grew, just like Fiat had planned.

The 500 convertible and the 500 sunroof

In 1959 the 500 was approved as a four-seater and presented at the Geneva motor show, with two new models to replace the economica and the normale: the Nuova 500 convertible and the Nuova 500 sunroof. The rear seats were far better padded and the soft top smaller, only over the front seats, in place of the longer version that dropped down to the rear bonnet and had the built-in vinyl rear window. Now the roof was mostly in metal and had a glass rear window. The innovation only concerned the normal version, that from then on was called the Nuova 500 sunroof. The economic version kept the long soft top and two-seater approval, and from then on was called the Nuova 500 convertible. The Sport was also

modified and a a soft top model introduced. A space was created on the floor under the front seats to give the rear passengers more leg room. The rear suspension was reinforced.
The engine was revised again and its power increased to 16.5 HP, and maximum speed exceeded 90 kph. The prices also changed: the convertible was offered at 395,000 Lira and the sunroof at 435,000 Lira.
In October of the same year, the range was upgraded to comply with the new highway code. The headlights were changed, and the ventilation grills under the headlights were liminated and replaced with the front indicators that also served as sidelights. The side indicators changed shape, from teardrop to round. The new rear lights were like the ones used on the 600.

The 500 station wagon and the 500 commercial



1960 was a year that saw many innovations for the entire range, and the birth of the first station wagon, and then the version D. There had been a gap in the market since the demise of the old Topolino ‘belvedere’, what we now call a station wagon or family car. The problem was serious because the rear engine prevented the construction of an elongated rear compartment. Once again the genious of designer Dante Giacosa came up with an interesting technical solution: the flat engine, that could be housed entirely under the luggage platform. From this came the 500 station wagon in May 1960.
In substance, the cylinders were rotated to horizontal, the air duct modified to envelope the new engine and the centrifugal fan was replaced by a radial fan. The air intake was replaced by two column intakes built-in to the rear pillars. The displacement was the same as the 500 sport engine, but a little tamer to adapt to the different use. The engine delivered 17.5 HP and the car could reach 95 kph.
The bodywork was radically revised. The new version had the same body as the saloon up to the back of the doors, and so the doors were still rear hinged, and from there was elongated toward the rear with a more squared shape. The tail end was all new and squared, with a side-hinged tailgate in place of the rear bonnet, opening like a door. The wheelbase was extended by 10 cm. The rear windows were rectangular and sliding. The upper part of the rear lights was teardrop shaped, and the license plate light was different. The roof was only partly in metal, and the long soft top made a new appearance. The suspension and brakes were strengthened to compensate for the increased weight and payload, with the hubs and drums derived fromt he ones used on the 600. The rear seat back could be folded down to extend the payload space, initially not flat due to the residual angle, and later rendered completely flat thanks to thinner padding used on the seat back. The station wagon was larger than the saloon: 3.185 meters long (21.5 cm longer) and 1.354 meters tall (2 cm taler).
The equipment was very similar to that of the saloon, with which it would share all future upgrades. It differed for the Autobianchi hub caps, flatter, and for the presence of a windscreen washer (manual) and

the external rear view mirror mounted on the left front pillar, an accessory at the time only mandatory for public service vehicles. The price was set at 565,000 Lira.
A variant of the station wagon was produced, called the 500 commercial.
It only had two front seats but the cargo space was much larger thanks to the absence of the rear seats. The rear windows and soft top were replaced by rigid sheet metal and the roof was strengthened by four ribs.
Production of the station wagon later moved to the Autobianchi plant in Desio, which also assembled the Autobianchi panoramica, more commonly known as the Bianchina, based on the engine and frame of the station wagon, but with different equipment and minor bodywork details. In March 1968 the station wagon changed make and became Autobianchi, with a number of differences: side grills in plastic instead of aluminum, side direction indicators, black steering wheel and dashboard,Autobianchi emblem on the front. The last ones built had compass-opening rear side windows. It went out of production in 1977.

The 500 D

In the Autumn of 1960, shortly after the station wagon, a very much renewed version of the saloon was presented, the Nuova 500 D. It replaced all the previous models, including the Sport. The “D” appeared as the continuation of the nomenclature of the 500 Topolino, that had reached version “C” before being taken out of production. From then on, the sunroof and convertible variants ceased and were unified into to new version D.
It was derived directly from the 500 sunroof, adopting all the alterations made in 1959 but mounting the 499.5 cc engine from the Sport, slightly toned down to deliver 17.5 CV at 4400 rpm instead of the original 21 HP. It was approved for 4 people. The standard equipment was enriched with a few details: folding back rear seat, with better padding, padded dashboard profile, blue high beam indicator on the dashboard, rear lights with thicker aluminum base, starter and choke levers with plastic grip instead of plain metal, onion shaped tank to improve trunk capacity. White wall tires were still offered as optional. Maximum speed was 95 kph, like the station wagon.
During 1961, sun visors were introduced as standard, along with the dashboard ashtray, the manual screen washer pump and the automatic courtesy light triggered by the driver’s side door. In 1964 the windscreen wipers became self-returning. The version remained in production until 1965.

The 500 F

The Nuova 500 F, successor to the “D” was presented in 1965, and was destined to become the largest selling of all the versions made. The innovations were above all aesthetic: the most obvious were the front hinged doors. It was also the start of the age of plastic in place of metal. Many other important details were changed. The windscreen was broader offering better visibility, the roof was made from a single piece and was no longer bolted together, the front emblem whiskers were separate, the door handles were chromed and suitably shaped for the new type of door opening, white wall tires became standard, mounted on steel instead of aluminum rims. The headlights had chromed frames instead of aluminum and fitted asymmetric beam headlights, the rear lights no longer had the thick aluminum base and were more square, the soft top closed by means of a large central hook in black plastic instead of two little metal clip, the aluminum trim on the bonnet and side moldings were eliminated, the three dashboard switches (lights, dashboard light, windscreen wiper) were aligned, the plastic glove box pocket was larger, the fuel tank was no longer onion shaped by semi-cylindrical with 22 liter capacity. The engine timing was revised again, and the engine delivered 18 HP. The suspension was strengthened and the transfer shafts were given larger diameter. The braking system was also upgraded, with larger master cylinders.
In 1968 a number of modifications appeared along with the version “L” it sided. The “Nuova 500” disappeared from the rear, replaced by one reading “Fiat 500”, the license plate light holder was plastic instead of aluminum, the front Fiat emblem no longer had separate whiskers, but all in a single piece in plastic rather than aluminum, even the internal door handles were changed from aluminum to black plastic, and the fake leather seats returned to being single color instead of two-tone.

The 500 L

The luxury version to side the 500 F, the Nuova 500 L, was presented in 1968. The differencfes were only aesthetic but nevertheless significant. The most evident is the *ercolino* consisting of tubular metal elements that supplement the bumpers to limit minor damage to the bodywork when parking.
The hub caps also changed, and radial tires were offered as standard in place of the usual crossply, the shiny metal trim around the window seals appeared, the Fiat emblem became the new rhomboid design, the front license plate was screwed to the bumper and not the cowling, and the “Nuova 500” insignia on the rear bonnet (now a little senseless given the longevity of the model) was replaced by the “Fiat 500 L” plate. The interior was given more attention, the floor was carpeted and the dashboard in black plastic. The dashboard was all new, with an elongated rectangular shape similar to the dash used on the 850, the tachometer was long an thin, a fuel gauge was provided, the steering wheel was given the two spoke in perforated metal, the horn button changed shape, the seats had fake leather covers and in addition to the glove ox under the dash, two pockets were made in the doors. Another tiny compartment was made behind the gear lever, and the lever was given an anatomical knob. The new colors available were: black, yellow ochre, coral red. The price was set at 525,000 Lira.

The 500 R

The final version, destined to close the long lived and evergreen range 500 range, was presented at the Turin motor show in 1972: the 500 R. It was presented at the same time as the Fiat 126. The letter “R” stood for “Renewed”.
It replaced the F and L versions, which went out of production, and took up the standard of the old 500: simple and spartan. However, the engine was the same as for the first series 126, although powered down.
So, many of the chromed details disappeared, except for the fenders, that lost the *ercolino* and returned to being straight, the rims were in metal without hub caps and looked like the ones from the 126, the chevron disappeared, replaced by the unified rhomboid emblem, the horn, that was housed behind the chevron in the previous versions, ended up under the front panel, the dashboard and steering wheel returned to the version “F” type but in black plastic instead of beige plastic, the dashboard light switch was eliminated, since the dash came on automatically with the sidelights, so there were only two switches instead of three, the gear lever knob was a ball and the rear seat back returned to being fixed. The engine was from the first series 126, with displacement of 564 cc but lower maximum power to compensate for the lower weight of the 500: it delivered 18 HP instead of 23. The gearbox was also from the 126, although it didn’t have synchroniszers, but just engagement forks rather like on a motorcycle. The transfer shafts were strengthened. The car’s maximum speed now reached the fateful 100 kph mark.
Radial tires were the only optional, that on the “L” version were standard.
From 1971 onwards the car was produced not only in Turin, but also at the Autobianchi plant in Desio and in Sicily at Termini Imerrese, Province of Palermo. Production was later shifted entirely to the Sicilian plant. It finally went out of production in August 1975, a good 18 years after the launch of the first series in 1957. Between 1957 and 1975 the number of Fiat 500’s produced amounted to around 3,800,000.

Historic models from 1957 to 1975

Code	Improvements	From		To	
1st series		July	1957	September	1957
1st series improved	int.	September	1957	November	1957
2nd series economic	mech..	November	1957	March	1958
2nd series normal	aesth./int./mech..	November	1957	March	1958
2nd series normal America	aesth.	December	1957	March	1958
3rd series economic	int./mech..	March	1958	July	1958
3rd series normal	int./mech..	March	1958	July	1958
3rd series America	aesth.	March	1958	July	1958
sport Zagato gran turismo	prototipo	November	1957	November	1957
sport convertible I° series	aesth./int./mech..	June	1958	March	1959
sport saloon I° series	aesth./int./mech..	June	1958	March	1959
sport convertible 1st series America	aesth./int./mech..	June	1958	March	1959
4th series economic	int./mech..	July	1958	March	1959

4^{th} series normal	int./mech..	July	1958	March	1959
4^{th} series normal America	aesth.	July	1958	March	1959
5^{th} series economic convertible	aesth./int./mech ..	March	1959	March	1959
5th series 59 sunroof	aesth./int./mech ..	March	1959	March	1959
5^{th} series sunroof America	aesth./int./mech ..	March	1959	March	1959
5^{th} series 59 convertible America	aesth.	March	1959	March	1959
5^{th} series 59 sunroof America	aesth.	March	1959	March	1959
6^{th} series 59 convertible	aesth./int.	March	1959	July	1959
6^{th} series sunroof	int.	March	1959	July	1959
6^{th} series 59 convertible America	aesth.	March	1959	July	1959
6^{th} series sunroof America	aesth.	March	1959	July	1959
7^{th} series 59 convertible	aesth.	July	1959	July	1959
7^{th} series 59 sunroof	aesth.	July	1959	October	1959
7^{th} series 59 convertible improved	int.	July	1959	October	1959
7^{th} series convertible America	aesth.	July	1959	November	1959
7^{th} series sunroof America	aesth.	July	1959	November	1959
7^{th} series 59 luxus (Germany)	aesth.	September	1959	November	1959

7th series 59 convertible	aesth.	October	1959	November	1959
7th series 59 sunroof	aesth.	October	1959	November	1959
sport saloon 2nd series 59	aesth./int./mech..	March	1959	March	1959
sport convertible 2nd series 59	aesth./int./mech..	March	1959	March	1959
sport convertible 2nd series 59 America	aesth.	March	1959	March	1959
sport slaoon 3rd series 59	int.	March	1959	July	1959
sport convertible sunroof 3rd series 59	int.	March	1959	July	1959
sport convertible 3rd series 59 America	aesth.	March	1959	July	1959
sport saloon 4th series 59	aesth.	July	1959	October	1959
sport convertible sunroof 4th series 59	aesth.	July	1959	October	1959
sport convertible sunroof 4th series 59 America	aesth.	July	1959	November	1959
sport saloon 5th series 59	aesth.	October	1959	November	1959
sport convertible sunroof 5th series 59	aesth.	October	1959	November	1959
9th series convertible 60	aesth./int.	November	1959	October	1960
9th series convertible 60	aesth.	March	1960	November	1960
9th series convertible sunroof 60	aesth./int.	November	1959	October	1960
9th series convertible 60 America	aesth.	November	1959	October	1960

9th series sunroof 60 America	aesth.	November	1959	October	1960
10th series convertible 61	mech..	October	1960	March	1961
10th series convertible D 61 America	aesth./int./mech ..	October	1960	March	1961
sport saloon 6th series 59	aesth./int./mech ..	November	1959	October	1960
sport convertible sunroof 6th series 60	aesth./int./mech ..	November	1959	October	1960
sport convertible sunroof 6th series 60 America	aesth.	November	1959	October	1960
D 1st series	aesth./int./mech ..	October	1960	November	1961
D 2nd series	aesth./int.	November	1961	July	1962
D 2nd series America	aesth.	November	1961	July	1962
D 3rd series	int.	July	1962	Febbraio	1963
D 3rd series America	aesth.	July	1962	Febbraio	1963
D 6th series	int.	Febbraio	1963	Gennaio	1964
D 6th series America	aesth.	Febbraio	1963	Gennaio	1964
D 5th series	mech..	Gennaio	1964	September	1964
D 5th series America	aesth.	Gennaio	1964	September	1964
D 6th series	aesth.	September	1964	March	1965
F 1st series	aesth./int./mech ..	March	1965	Aprile	1965
F 2nd series	aesth.	Aprile	1965	July	1965
F 3rd series	int.	July	1965	November	1965

F 4th series	aesth.	November	1965	March	1966
F 5th series	aesth.	March	1966	Agosto	1968
F 6th series	int.	Agosto	1968	October	1968
F 7th series	aesth./int.	October	1968	Febbraio	1970
F 8th series	aesth.	Febbraio	1970	July	1970
F 9th series	int.	July	1970	November	1972
L 1st series	aesth./int./mech..	Agosto	1968	Febbraio	1970
L 2nd series	aesth.	Febbraio	1970	November	1970
L 3rd series	int.	November	1970	November	1972
R	aesth./int./mech..	November	1972	Agosto	1975

TECHNICAL DATA

Engine

Egine type

	1.2 8V	1.4 16V	1.3 Multijet 16V
Type code	169A4000	169A3000	169A1000
Position in vehicle	Front	Front	Front
Orientation	Transverse	Transverse	Transverse
N° of cylinders	4	4	4
Cylinder alignment	in line	in line	in line
Valves per cylinder	2	4	4
Cycle	Otto	Otto	Diesel
Valve timing	1ACT with timing adjuster	2ACT	2ACT
	Mechanical tappets	Hydraulic tappets	Rocker with hydraulic tappet
Fuel	Petrol	Petrol	Diesel
Fuel supply	MPI	MPI	Common Rail Multijet direct injection
Turbocompressor	NO	NO	KKK (Borg Warner) KP35

Engine specifications

	1.2 8V	1.4 16V	1.3 Multijet 16V
Bore (mm)	70.8	72	69,6
Stroke (mm)	78.86	84	82
Total displacement (cm^3)	1242	1368	1248
Compression ratio	11.1±0.2	10.8±0.2	17.6:1
Maximum power (KW EEC)	51	73,5	55
Maximum power revs (rpm)	5500	6000	4000
Maximum torque (Nm EEC)	102	131	145
Maximum torque revs (rpm)	3000	4250	1500
Idle speed (rpm)	750 ± 50	750 ± 50	830 ± 50

Valve play

	1.2 8V	1.4 16V	1.3 Multijet 16V
Intake valve play (cold, mm)	0.3	-	-
Exhaust valve play (cold, mm)	0.4	-	-

Intake

	1.2 8V	1.4 16V	1.3 Multijet 16V
Open	7° after TDC	2° after TDC	12° after TDC
Close	35° after BDC	42° after BDC	6° after BDC

Exhaust

	1.2 8V	1.4 16V	1.3 Multijet 16V
Open	62° before BDC	35° before BDC	40° before BDC
Close	-9° before TDC	2° before TDC	12° before TDC

Injection

	1.2 8V	1.4 16V	1.3 Multijet 16V
Type	MPI M. Marelli IAW 5SF8.MR	MPI Bosch ME 7.9.10	Marelli MDJ 6F3.B1/B2
Injection order	1-3-4-2	1-3-4-2	1-3-4-2

Ignition

	1.2 8V	1.4 16V	1.3 Multijet 16V
Type	Spark	Spark	Spontaneous
Coils	Champion BAE 940 A	Federal Mogul BAE 403C	-
Number of coils	4	4	-
Spark plugs	NGK DCPR7E-N-10	NGK DCPR7E-N-10	-
Glowplugs	-	-	Bosch 250.203.002
Firing order	1-3-4-2	1-3-4-2	1-3-4-2

Transmission

	1.2 8V	**1.4 16V**	**1.3 Multijet 16V**
Drive	Front Transverse	Front Transverse	Front Transverse

Clutch

	1.2 8V	**1.4 16V**	**1.3 Multijet 16V**
Operation	Thrust	Thrust	Thrust
Command			
Supplier			

Gearbox

	1.2 8V	**1.4 16V**	**1.3 Multijet 16V**
Type	C514	C514	C514
Configuration	2 shafts in cascade	2 shafts in cascade	2 shafts in cascade
Total length (from flywheel, mm)			
Weight kg			
Synchronisers	1,2,3,4,5,RM	1,2,3,4,5,6,RM	1,2,3,4,5,RM
1st gear ratio	3,909	3,545	3,909
2nd gear ratio	2,158	2,158	2,158
3rd gear ratio	1,480	1,480	1,345
4th gear ratio	1,121	1,121	0,974
5th gear ratio	0,897	0,921	0,766
6th gear ratio	-	0,766	-
RG ratio	3,818	3,818	3,818
Differential final ratio	3,438	4,071	3,438

Braking system

	1.2 8V	1.4 16V	1.3 Multijet 16V
Type	Hydraulic servo assisted	Hydraulic servo assisted	Hydraulic servo assisted
Brake servo cylinder diameter	10’’	10’’	10’’
Anti-lock system	Bosch 8.1	Bosch 8.1	Bosch 8.1

Front brakes

	1.2 8V	1.4 16V	1.3 Multijet 16V
Disk type	full	self-ventilating	self-ventilating
Disk diameter (mm)	240	257	240
Rated thickness (mm)	11	22	20
Calliper type	Bosch ZOH	Bosch ZOH	Bosch ZOH
Brake pad diameter (mm)	48	54	48

Rear brakes

	1.2 8V	1.4 16V	1.3 Multijet 16V
Type	Drum	Disk (full)	Drum
Drum diameter (mm)	180	-	180
Disk diameter (mm)	-	240	-
Rated thickness (mm)	-	11	-
Calliper type	-	Bosch BIRIII	-
Cylinder diameter (mm)	20,6	-	20,6
Brake pad diameter (mm)	-	34	-

Suspension

Suspension setup and characteristic angles

Standard A = vehicle unladen, with spare wheel, tools, accessories, all fluids, full fuel tank, tyres inflated to specified pressure.

N.B. They only workshop adjustment possible is convergence.

Front

Convergence

Engine type	Standard A
1.2 8V – 1.3 Mjet 14” wheel	+ 0.5 mm +/- 1 mm
1.2 8V – 1.4 Mjet 15” wheel	+ 0.5 mm +/- 1 mm
1.2 8V – 1.4 Mjet 16” wheel	+ 0.5 mm +/- 1 mm

Rear

Convergence

Engine type	Standard A
1.2 8V – 1.3 Mjet 14” wheel	+3.6mm+/- 3mm
1.2 8V – 1.4 16V 15” wheel	+3.6mm+/- 3mm
1.2 8V – 1.4 16V – 1.3 Mjet 16” wheel	+3.6mm+/- 3mm

Springs

Front suspension

	1.2 8V (electric power steering)	**1.2 8V**	**1.4 16V**	**1.3 Multijet 16V**
Wire diameter (mm)	11,9	12,6	12,6	12,5
Number of working coils	3,5	3,4	3,4	4,09
Spring winding	Clockwise	Clockwise	Clockwise	Clockwise
Free spring length (mm)	326	291	298	341
Pack spring length (mm)	76,1	79,3	79,3	87,3
Control load (daN) with spring length at 189 mm	268,2 ±10	260 ±10	277,2 ± 10	315,6 ± 10
Color	2 blue stripes	2 pink stripes	2 brown stripes	2 white stipes

Front suspension

	1.2 8V	1.4 16V	1.3 Multijet 16V
Wire diameter (mm)	11,6	12,1	11,6
Number of working coils	3,56	3,56	3,56
Spring winding	Clockwise	Clockwise	Clockwise
Free spring length (mm)	279	270	279
Pack spring length (mm)	75,2	78,6	75,2
Control load (daN) with spring length at 189 mm	217 ± 10	227 ± 10	217 ± 10
Color	2 pink stripes	2 purple stripes	2 pink stripes

Battery and alternator

Version without air-conditioner

	1.2 8V	1.4 16V	1.3 Multijet 16V
Battery capacity (Ah)	40	40	50
Alternator (A)	70	70	75

Versions with air-conditioner

	1.2 8V	1.4 16V	1.3 Multijet 16V
Battery capacity (Ah)	50	50	50
Alternator (A)	90	90	90 - 105

Air-conditioner

	1.2 8V	1.4 16V	1.3 Multijet 16V
Conditioner circuit quantity (g)	450 ± 40	450 ± 40	450 ± 40

Fluids and lubricants

Oils and liquids

Recommended products

	1.2 8V	1.4 16V	1.3 Multijet 16V
Engine oil	Selenia K Pure Energy	Selenia K Pure Energy	Selenia WR Pure Energy
Gearbox / front differential oil	Tutela car Technyx	Tutela car Technyx	Tutela car Technyx
Brake fluid	Tutela Top 4	Tutela Top 4	Tutela Top 4
Radiator fluid	Paraflu up at 50%	Paraflu up at 50%	Paraflu up at 50%

Grease
Recommended products

	1.2 8V	1.4 16V	1.3 Multijet 16V
Differential side front CV joint	Tutela Star 325	Tutela Star 325	Tutela Star 325
Wheel side front CV joint	Tutela All Star	Tutela All Star	Tutela All Star

Lubricant capacities

Oil quantities

	1.2 8V	1.4 16V	1.3 Multijet 16V
Engine oil (quantity for periodic change, sump and filter, litres)	2.8	2.9	3.0
Gearbox / front differential oil (Kg)	1.65	1.65	1.65

Vehicle specifications

Performance

	1.2 8V	1.4 16V	1.3 Multijet 16V
Maximum speed (Kph)	160	182	165

Fluid capacities

	1,2 8V	1.4 16V	1.3 Multijet 16V
Fuel tank (litres)	35	35	35
Fuel reserves (litres)	5	5	5
Cooling system (litres)	4,85	4,4	6,3
Oil sump and filter (litres)	2,8	2,9	3,0
Brake circuit (kg)	0,55	0,55	0,55

(*) versions with ABS

Consumption
(Dir. 199/100/CE litres per 100 km)

	1.2 8V	1.4 16V	1.3 Multijet 16V
Combined	5,1	6,3	4,2

Emissions

	1.2 8V	1.4 16V	1.3 Multijet 16V
CO_2 (g/Km)	119	149	111

All engines meet Euro 4 emissions limits

Tyres

1.2 8V version

Size	Front tyre pressures (bar). Medium load	Rear tyre pressures (bar). Medium load	Front tyre pressures (bar). Full load	Rear tyre pressures (bar). Full load
165/65 R14	2,0	2,0	2,2	2,2
175/65 R14	2,0	2,0	2,2	2,2
185/55 R15	2,2	2,1	2,3	2,3
195/45 R16	2,2	2,1	2,4	2,3

1.4 16V version

Size	Front tyre pressures (bar). Medium load	Rear tyre pressures (bar). Medium load	Front tyre pressures (bar). Full load	Rear tyre pressures (bar). Full load
185/55 R15	2,2	2,1	2,3	2,3
195/45 R16	2,2	2,1	2,4	2,3

1.3 Multiject version

Size	Front tyre pressures (bar). Medium load	Rear tyre pressures (bar). Medium load	Front tyre pressures (bar). Full load	Rear tyre pressures (bar). Full load
175/65 R14	2,2	2,0	2,3	2,2
185/55 R15	2,2	2,1	2,3	2,3
195/45 R16	2,2	2,1	2,4	2,3

Mini spare wheel

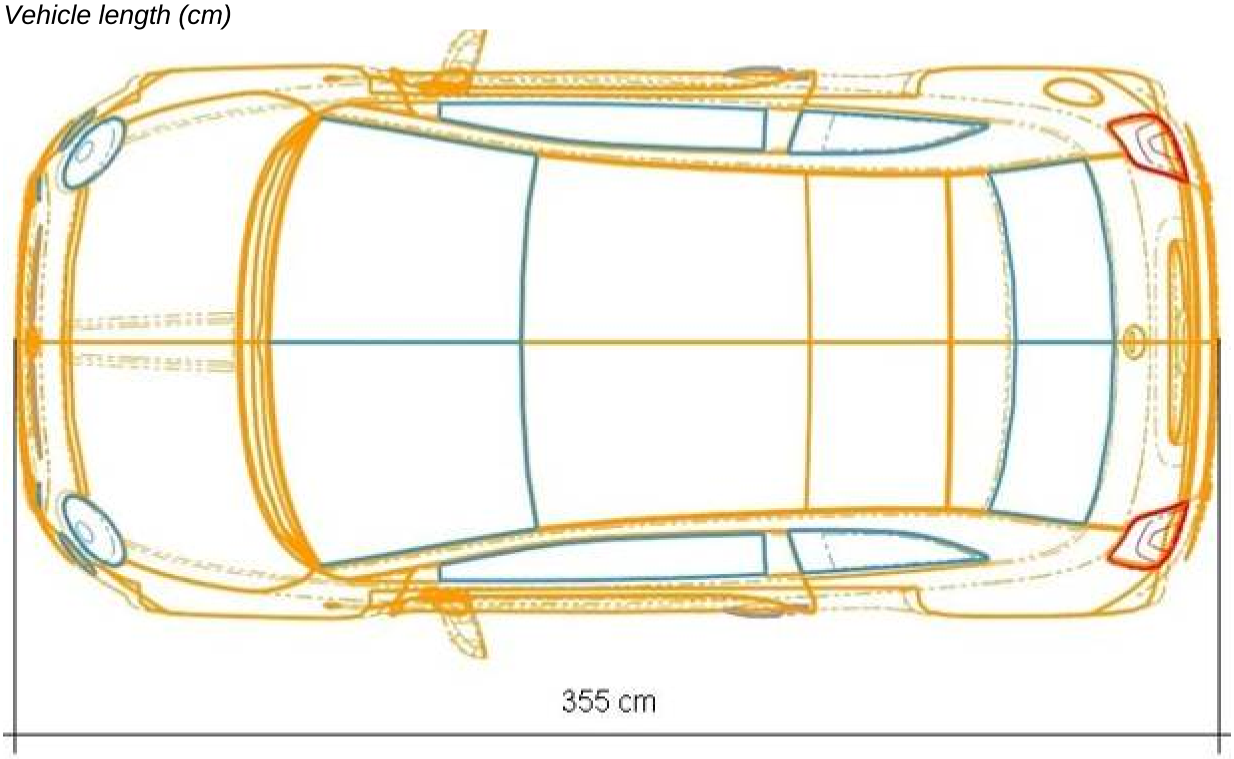
	1,2 8V	**1.4 16V**	**1.3 Multijet 16V**
135/80 R14	2,8	2,8	2,8

Turning circle

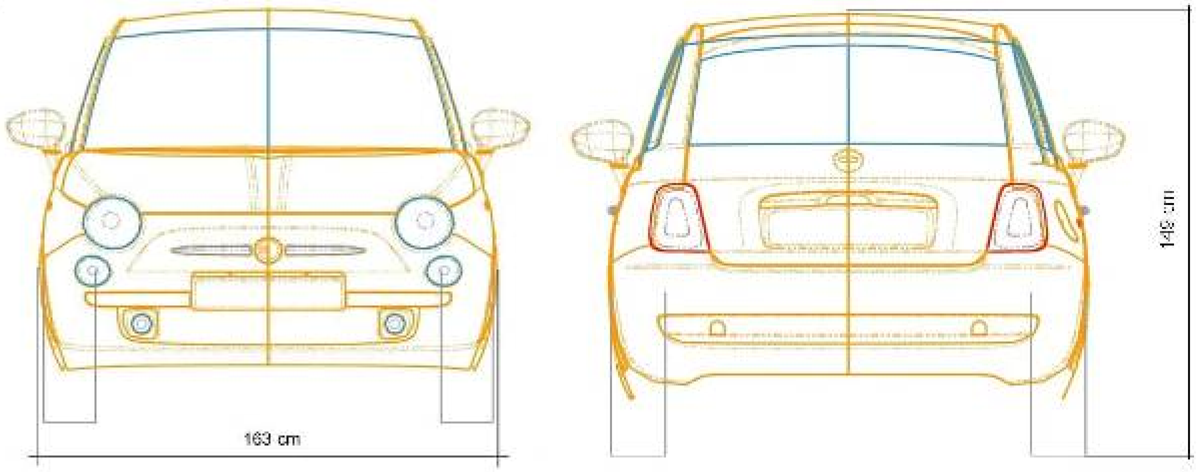
	1,2 8V	**1.4 16V**	**1.3 Multijet 16V**
Minimum turning circle (mm)	9285	10680	9285

Vehicle dimensions

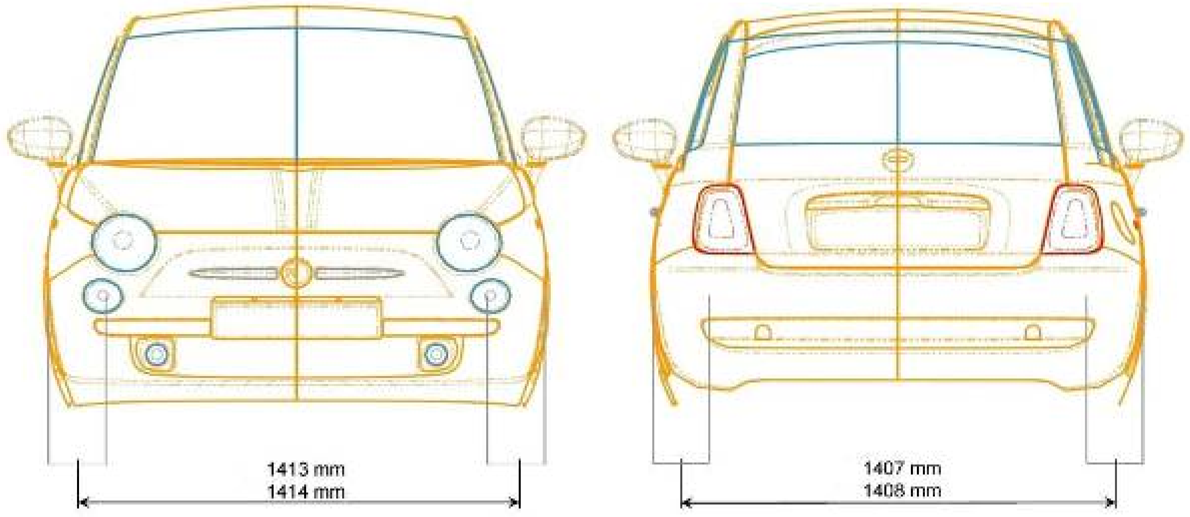
Vehicle length (cm)



Vehicle bredth and height (cm)

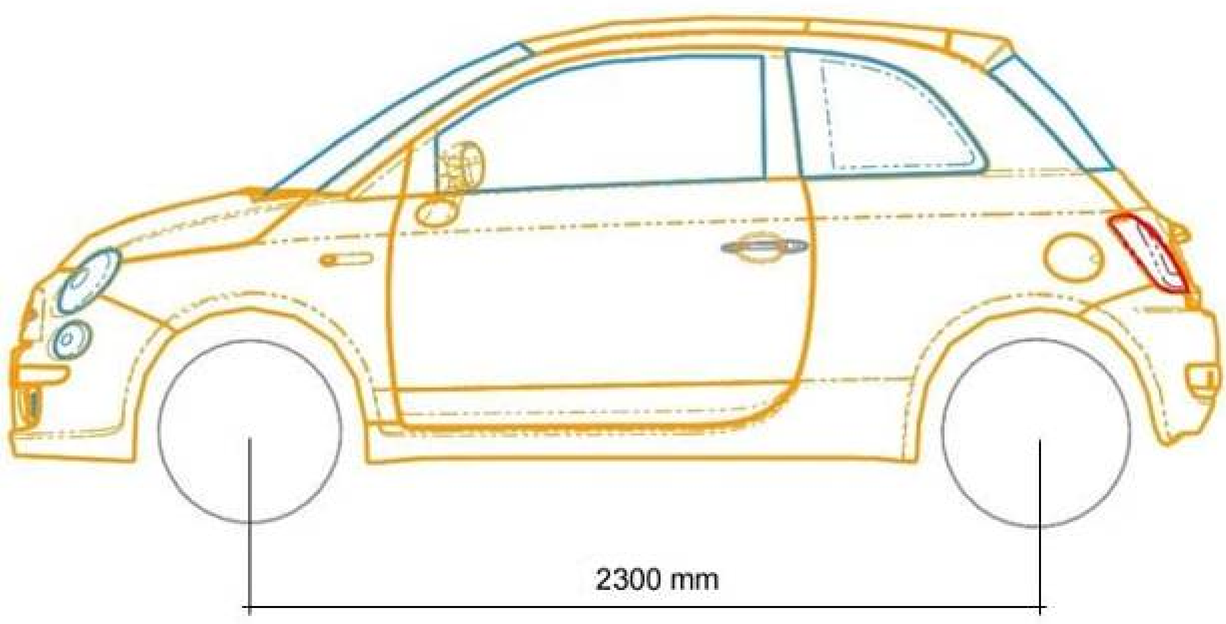


Gauge (mm)



Front gauge 1414 mm is with tyre size 195/45 R16;
Rear gauge 1408 is for the 1.4 16V version;

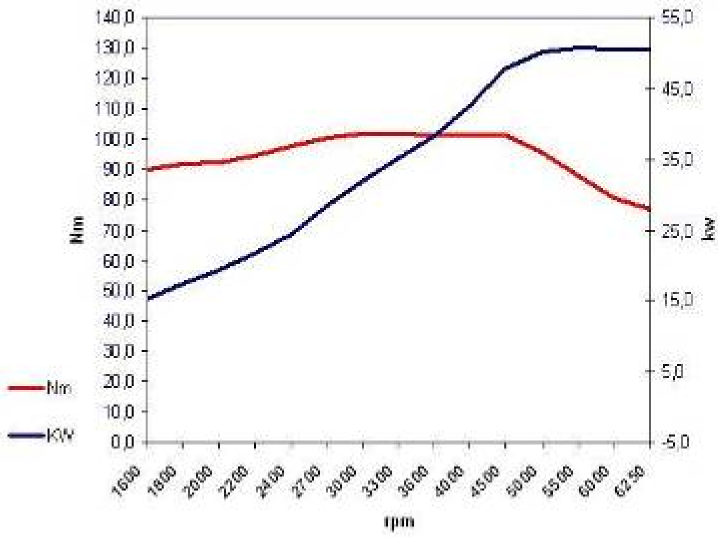
Wheelbase (cm)



ENGINES

1.2 8 V EVO 2 Engine

This chapter describes the 1.2 8V EVO 2 engine, derived from the 1.2 8V engine used on the Fiat Panda, with the addition of the timing adjuster and new engine control unit.



Technical data sheet

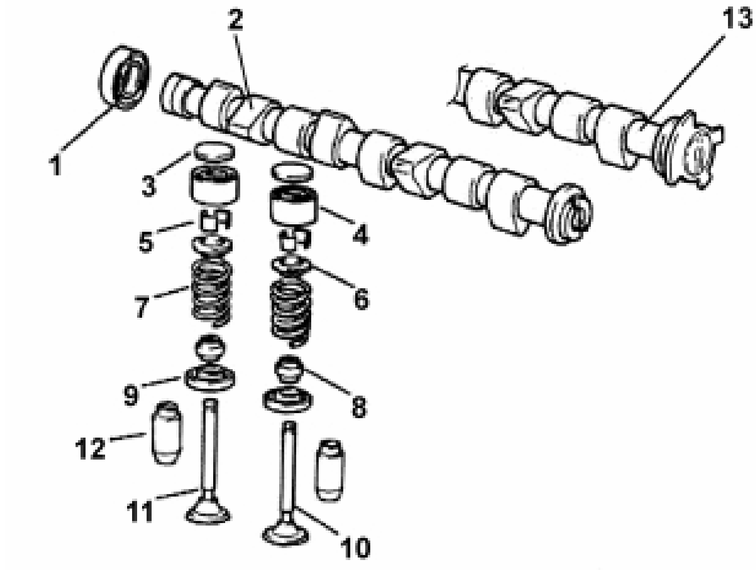
ENGINE		
Engine	FIRE 1242 8V RL MM for new	
Strokes	4	
Cylinders	4	
Valves per cylinder	2 parallel	
Bore	70,80 mm	
Stroke	78,86 mm	
Total displacement	1241,861 CC	
Single cylinder	310,465	
Combustion chamber volume	30,68 (18.5 in head) cm2	
Maximum power	51 (KW EEC) at 5500 RPM	
Maximum torque	102 (Nm EEC) at 3000 RPM	
Compression ratio	11,1 ± 0,2	
Emissions level	EEC PHASE 4	
Recommended fuel	EUROSUPER RON 95 MON 85	
Engine markings	169A4000	
Mounting	Front transverse	
Inclination	12° forward	
VALVE TIMING SYSTEM		
Valve Timing system	1 ACT 8-gauge direct drive belt, profile P8S	
Valve train type	INTAKE	EXHAUST
Combustion chamber side head duct diameter	28 mm	24 mm

Corresponding valve diameter	31	26,5
Rise on valve axis without play	8	8
Timing (tolerance +/- 3°)	7/35	62/-9
Valve axis play for timing control	0,8 mm	0,8 mm
Valve axis functional play (engine cold)	0.3 ± 0.05 mm	0.3 ± 0.05 mm

INJECTION SYSTEM	
Mixture formation system	I.A.W. RL Magneti Marelli, 5SF8 integrated injection and ignition system, with motorized throttle
IGNITION SYSTEM	
Ignition system	I.A.W. RL Magneti Marelli, 5SF8 integrated injection and ignition system
Ignition coil	Champion BAE 940 A
Spark plugs	NGK DCPR7E-N-10
Advance control at 700± -70 rpm	9° ± 4°
Firing order	1;3;4;2
Alternator	70A; 90 A 105 A
LUBRICATION SYSTEM	
Type of pump	Frontal gear pump with FULL FLOW filter
Type of lubricant	SELENIA K
First filling lubricant quantity	2.750 kg
Oil pressure at 100°	At idle > 0.7 bar at 4000 rpm > 4 bar
COOLING SYSTEM	
Type	Centrifugal pump driven by timing belt
Thermostat	By-pass thermostat control vehicle heating from manifold
Liquid	Water + Paraflù
Thermostat calibration	87° ± 2° C
INTAKE SYSTEM	
Type	Intake manifold in plastic material with Engine Control Module built-in to throttle body
EXHAUST SYSTEM	
Type	Exhaust manifold in cast iron with catalytic converter
ANTI-EMISSIONS SYSTEMS	
Idle speed	700 ±50 rpm
CO	= 0,1%
HC	= 50 ppm

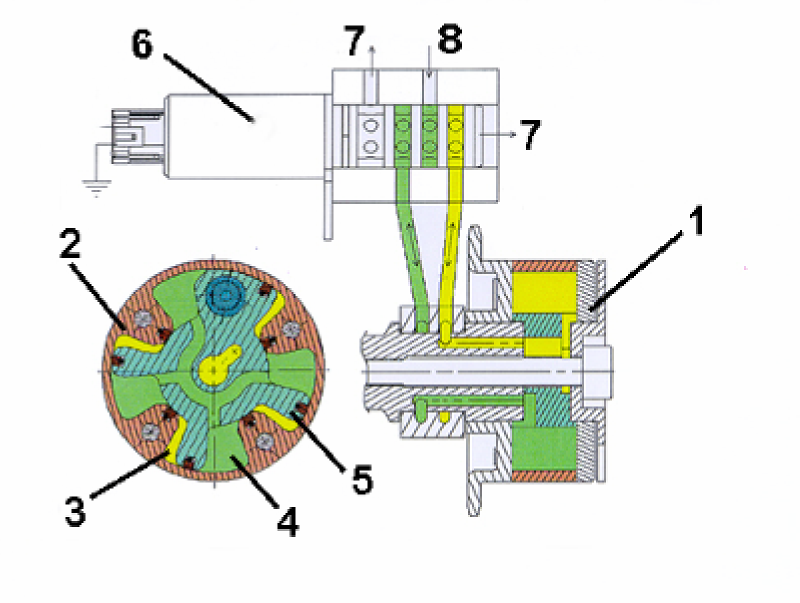
Valve timing

Overhead camshaft in “nodular cast iron”, driven by a timing belt.
The shaft has suitably oriented and profiled cams, one for each of the valves. To the front there is the fitting for the toothed pulley that transfers drive from the crankshaft via a positive drive timing belt.
On the 1.2 8V version the positive drive pulley is built-in to the timing adjuster described further on.



Key
1. Crankshaft oil seal
2. Camshaft (1.2 8V version)
3. Tappet adjuster plate
4. Tappets
5. Cotters
6. Upper plate
7. Spring
8. Oil seal
9. Lower plate
10. Intake valve
11. Exhaust valve
12. Valve guide
13. Camshaft with phonic wheel

Timing adjuster



Key
1. Drive pulley
2. Stator
3. Advance chamber
4. Retard chamber
5. Rotor
6. Box solenoid valve
7. Oil return
8. Oil delivery

Specifications and function
The 1.2 8V EVO2 engine is fitted with a “constant” timing adjustment system capable of altering the camshaft position in relation to the crankshaft.
In this way the engine operates with optimal timing at all points.
The timing adjuster is totally managed by the engine control unit, which
- Detects the position of the camshaft through the timing sensor.
- Modifies this position based on a preset map according to engine conditions
- Monitors camshaft position.

The timing adjuster actuator consists of a rotor anchored to the camshaft that can rotate with respect to the pulley (stator) driven by the crankshaft. The rotor has blades and moves by effect of engine oil pressure acting on these.
In effect, two chambers are created (advance and retard) to the two sides of these blades. Oil can flow into one chamber or the other.
The pressure of the oil entering a chamber pushes the blade to one side and the oil in the other chamber is discharged into the cylinder head. This shifts the rotor and thus the camshaft in a given direction (advance or retard).
If the oil enters alternately in one and then the other chamber continually and for the same time, there is a dynamic pressure balance to the two sides of the rotor and so it remains stationary.
The oil flow is enabled by a box solenoid valve that opens the oil channels present in the cylinder heads to the advance or retard chambers.

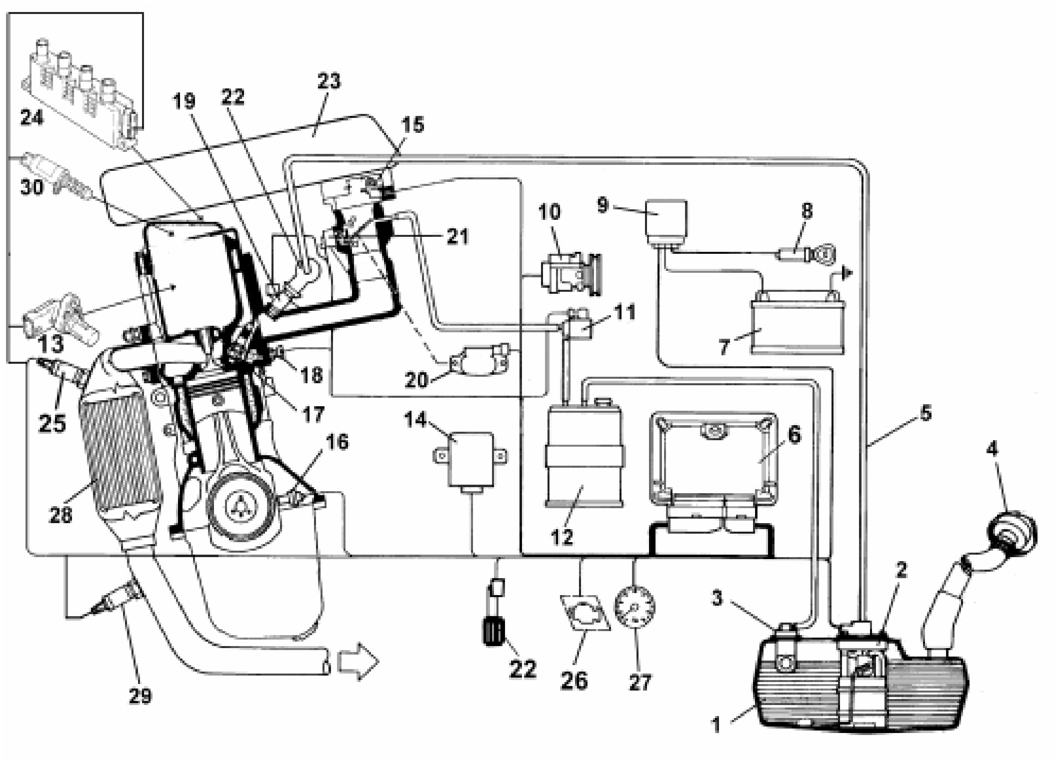
TEST 10560 Timing adjuster check

STEP	CHECK	REMEDY IF CHECK NOT OK
1	Timing adjuster check -Disconnect the timing adjuster command solenoid connector. -Start the engine. -Connect the solenoid valve terminals to the battery for a few sconeds. -Check that there is a significant variation in idle speed.	Replace the timing adjuster command solenoid valve [PR_1056B48] Replace the timing adjuster group [PR_1036C40] TIMING ADJUSTER ON INTAKE CAMSHAFT IN CYLINDER HEAD – S.R. WITH SHAFT REMOVED

Engine management system

The Marelli IW 5SF8 system belongs to the category of integrated:
- Digital electronic inductive spark ignition
- Timed sequential static distribution-electronic ignition (1-3-4-2).

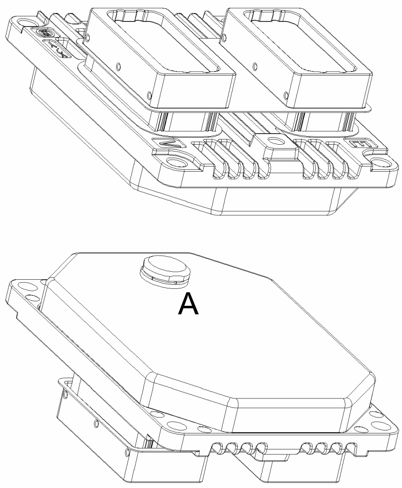
The diagram below gives an overview of the system.



Key
1. Fuel tank
2. Fuel pump
3. Multifunctional valve
4. Safety valve
5. Fuel delivery pipe
6. Engine Control Module, with integrted atmospheric pressure sensor.
7. Battery
8. Ignition switch
9. Engine bay junction control unit
10. Air-conditioner
11. Fuel vapor shut-off valve
12. Active carbon filter
13. Timing sensor
14. Body Computer (Fiat CODE signal)
15. Absolute pressure and temperature sensor.
16. Revs and TDC sensor
17. Spark plugs
18. Coolant temperature sensor
19. Electroinjectors
20. Throttle actuator and position sensor
21. Accelerator pedal potentiometer.
22. Fuel intake manifold
23. Air filter
24. Ignition coils
25. Lambda probe (pre-cat)
26. System fault warning light
27. Rev counter
28. Catalytic converter
29. Lambda probe (post-cat)
30. Timing adjuster pilot solenoid valve

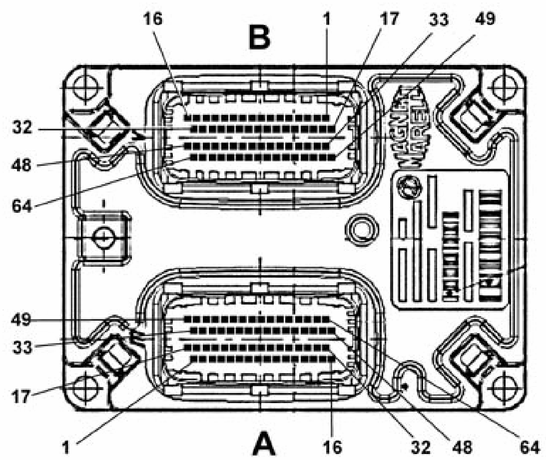
Components
This chapter describes the main components of the IAW 5SF8 engine control system.

IAW 5SF8 Engine Control Module



General features
The Engine Control Module is mounted in the engine bay on a solid support and is capable of withstanding high temperature.
It is a digital type microprocessor unit with high computing capacity, precision, reliability, versatility and low energy consumption, and is maintenance-free.
The function of the electronic control unit is to process signals from the various sensors through the embedded software algorithms, and control the actuators (specifically electroinjectors, ignition coils and throttle) in order to realize the best possible conditions of engine function.
The adoption of Fiat CODE does not permit interchangeability of control units between vehicles
Note: The Engine Control Module has a built-in atmospheric pressure sensor (A)

Pin - out
The diagram below shows the pin-out of the electronic control unit.



(A) VEHICLE SIDE HARNESS CONNECTOR

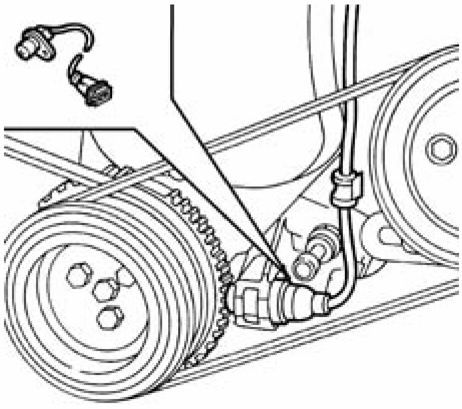
1. Battery direct + 12 V from F18 (7.5 A)
2. Accelerator pedal sensor 1 power supply (+5V)
3. Accelerator pedal sensor 2/ conditioner linear pressure switch power supply (+5V)
4. Not connected
5. Conditioner linear pressure switch signal
6. Not connected
7. Not connected
8. Oil level switch **Not used**
9. Accessories resume **Not used**
10. K serial line **Not used**
11. Not connected
12. Not connected
13. Not connected
14. Alternator terminal F **Not used**
15. Accelerator pedal ground / conditioner linear pressure switch
16. Key - On and power supply under key
17. Main engine control relay T09
18. Not connected
19. D+ alternator signal / alternator failure signal input.
20. Not connected
21. Not connected
22. Not connected
23. Neutral switch for automatic gearboxes **Not used**
25. Not connected
26. Reversing switch
27. Not connected
28. Not connected
29. Not connected
30. Not connected
31. Not connected
32. Clutch pedal switch (for versions without MTA)
33. C-CAN L network (repetition) **Not used**
34. C-CAN H network (repetition) **Not used**
35. Vehicle speed sensor **Not used**
36. Oil condition sensor **Not used**
37. Not connected
38. Accelerator pedal potentiometer 2 signal
39. Oil temperature sensor **Not used**
40. Driver starter relay **Not used**
41. Not connected
42. Not connected
43. Not connected
44. Not connected
45. Accelerator pedal potentiometer 1 ground
46. Not connected
47. DBW engine control power from (F17 10 A).
48. DBW engine control power from (F17 10 A).
49. C - CAN L line
50. C - CAN H line
51. Accelerator pedal potentiometer 1 signal
52. Brake switch signal
53. Fuel level **Not used**
54. Not connected
55. Oil minimum pressure signal
56. fuel pump relay (T31
57. Engine cooling fan PWM command Engine **not used**
58. Engine revs for MTA **Not used**
59. Fan high speed enable relay (T07
60. Not connected
61. Not connected
62. Conditioner enable relay (T05)
63. Fan low speed enable relay (T06)
64. Injection system fault light command **Not used**

(B) ENGINE SIDE HARNESS CONNECTOR

1. Coil 4 ignition command
2. WT fan
3. Coil 3 ignition command
4. Lambda probe heater, canister solenoid valve, WT-solenoid valve power from main relay
5. Engine block ground A
6. Engine block ground A
7. Manifold pressure/temperature and timing ground.
8. Not connected
9. Revs sensor / TDC positive
10. Not connected
11. Not connected
12. Not connected
13. Manifold temperature and timing sensor power (+ 5 V) .
14. Not connected
15. DBW power (+5 V) DBW (motorized throttle)
16. Not connected
17. Coil 1 ignition command
18. Not connected
19. Coil 2 ignition command
20. Not connected
21. Engine block ground A
22. Engine block ground A
23. Revs sensor / TDC negative
24. Timing sensor signal
25. Not connected
26. Not connected
27. Not connected
28. Not connected
29. Not connected
30. Motorized throttle 2 sensor signal.
31. Manifold pressure and temperature sensor signal.
32. Upstream lambda probe heater command

33. Cylinder 4 injector command
34. Cylinder 2 injector command
35. Motorized throttle 1 sensor ground
36. Water temperature sensor ground
37. Not connected
38. Not connected
39. Not connected
40. Not connected
41. Pinging sensor positive
42. Downstream Lambda probe “+” signal
43. Upstream Lambda probe “+” signal
44. Motorized throttle 1 sensor signal 1
45. Water temperature signal
46. Not connected
47. Not connected
48. Pinging sensor negative
49. Cylinder 3 injector command
50. Cylinder 1 injector command
51. Canister cleaning solenoid valve command
52. DBW engine negative command (motorized throttle)
53. Not connected
54. Not connected
55. Not connected
56. Not connected
57. DBW engine positive command (motorized throttle)
58. Upstream Lambda probe “-” signal
59. Not connected
60. Upstream Lambda probe “-” signal
61. Not connected
62. Not connected
63. Air temperature signal
64. Downstream lambda probe heater command

Revs sensor



Specifications and function

Mounted on engine block facing toward the phonic wheel on the crankshaft pulley
The revs sensor is inductive, and so functions through variations in the magnetic field generated by the passage of the teeth of the phonic wheel (60-2 teeth).
The Engine Control Unit uses the revs sensor signal to:

- Determine engine rotation speed
- Determine crankshaft angular position.

The phonic wheel has sixty teeth, two of which are removed to create a reference point. Each tooth therefore corresponds to an angle of 6° (360° divided by 60 teeth).
The timing point is recognized at the end of the first tooth after the two spaces: when this transits under the sensor, the engine has pistons 1-4 at 114° before top dead centre.

Phonic wheel fault teach-in procedure

This procedure is only available for EOBD versions It allows the ECU to teach-in phonic wheel faults due to mECManical dispersion in order to correctly diagnose misfire

The procedure should be carried out in the following cases

1) Works on /replacement of Phonic wheel
2) Works on /replacement of Revs sensor
3) Replacement / reprogramming of ECU

In cases 1) and 2) before carrying out the procedure, reset the phonic wheel teach-in using the appropriate active diagnosis
At the end of the vehicle production line, with engine warmed up (RDI 1003: Engine coolant temperature > 77°C), the phonic wheel fault teach-in procedure must be carried out for correct misfire diagnosis function.

To carry out the teach-in, proceed as follows:

1. Turn the ignition key to ON and start the engine
2. If warning light MI flashes on the instrument panel, the phonic wheel teach-in procedure needs repeating;
3. With engine running, wait for coolant temperature to reach >= 77°C

With gearbox in neutral, make 3 accelerations up to recommended speed **6000 rpm** (teach-in is possible from a minimum 5000 rpm but we recommend releasing the accelerator pedal at a speed significantly higher than the minimum); after each acceleration, fully release the accelerator and wait for revs to drop to idle speed
After this, if warning light MI continues to flash, it means that teach-in is not complete. Continue with the accelerations as above until the light goes out.
Turn the ignition OFF and wait 1 minute while the data is permanently saved in the memory.
With the diagnosis instrument it is possible to check phonic wheel teach-in correctness, regardless of warning light MI, by checking the error memory.

When the phonic wheel error teach-in procedure has been carried out correctly, error **P1300** is automatically deleted from the error memory.

Electrical specifications:
Coil resistance 1100 ohm +/- 10% at 20 °C.

Mechanical specifications
The required distance (gap) between the phonic wheel and the sensor to obtain correct signals must be between 0.5 - 1.5 mm.

Pin - out

Pin	Signal
1	Revs and TDC sensor positive
2	Revs and TDC sensor negative

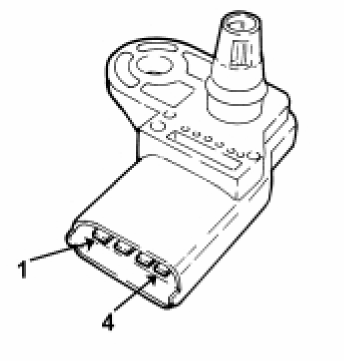
Timing sensor

Specifications and function
The sensor is “Hall” effect sensor. A layer of semiconductor with current running through it, immersed in a normal (flux lines perpendicular to the direction of current) magnetic field, generates a potential difference between its terminals, known as “Hall” voltage
If the current intensity remains constant, the voltage generated only depends on the intensity of the magnetic field. It is thus sufficient that the intensity of the magnetic field varies periodically to obtain a modulated electrical signal, the frequency of which is proportional to the rate at which the magnetic field varies.
To obtain this variation, the distance between the sensor and the pulley on the camshaft is varied, as this pulley has a phonic wheel with four notches
As the pulley rotates, the distance varies generating a low voltage electrical signal at each passage
Vice-versa, where there is no notch, the sensor generates a higher voltage signal.
It follows that the high signal and low signal alternate four times for each engine cycle.
This signal, along with the revs and TDC signals, allows the control unit to recognize the cylinders and determine the injection and ignition points.

Pin - out

Pin	Signal
1	Timing sensor negative
2	Timing sensor signal
3	Timing sensor positive

Absolute air pressure and temperature sensor

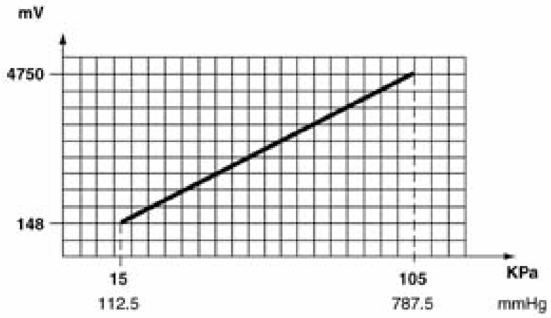


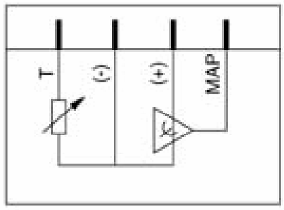
Specifications and function

The intake air temperature and pressure sensor is an embedded component that serves to measure air pressure and temperature in the intake manifold
Both of these signals are used by the Injection control unit to define the quantity of air drawn-in by the engine, for subsequent use in computing injection time and ignition point. The sensor is mounted on the intake manifold.
The air temperature sensor consists of an NTC (Negative Temperature Coefficient) thermistor.
The resistance of the sensor decreases as temperature increases.
The control unit input circuit splits the 5V reference voltage between the resistors of the sensor and a fixed reference, obtaining a voltage proportional to resistance, and thus temperature.
The sensitive element of the pressure sensor consists of a Wheatstone bridge printed onto a ceramic membrane.
The face of the membrane has the absolute reference vacuum, while the vacuum present in the intake manifold acts on the other face
The signal (piezoresistive) deriving from deformation of the membrane, prior to being sent to the ECM, is amplified by an electronic circuit in the mounting that houses the ceramic membrane.
With engine off, the diaphragm deflects according to atmospheric pressure. With key-on this is translated into altitude information.
With engine running, the effect of the vacuum causes a mECManical effect on the sensor membrane, which deforms, varying the resistance value.
Since the power supply is maintained strictly at 5V by the control unit, varying resistance varies output voltage.

Electrical specifications
The following diagram shows the electrical features of the sensor.

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

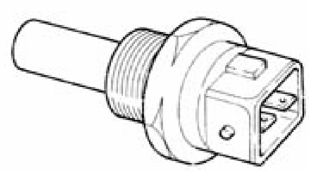




Pin - out

Pin	Signal
1	Ground
2	Timing sensor signal
3	+ 5v power supply
4	Absolute pressure sensor signal

Engine coolant temperature sensor



Specifications and function
This is mounted on the thermostat cup and measures coolant temperature by means of an NTC thermistor with negative resistance coefficient
For the NTC element the reference voltage is 5V. Since the Engine Control Module input circuit is designed as a voltage splitter, this voltage is split between a resistor in the Engine Control Module and the NTC resistor in the sensor.
The Engine Control Module can thus evaluate the variations in sensor resistance through changes in voltage and thereby obtain temperature information.

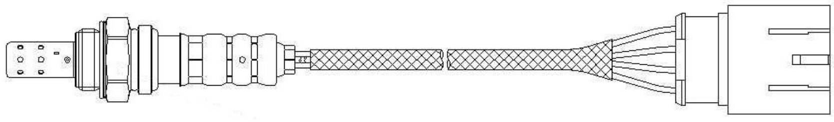
Electrical specifications
5V power supply.
Temperature and resistance table

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

Pin - out

Pin	Signal
1	Engine temperature sensor ground
2	Engine temperature sensor signal

Lambda probe



Specifications and function
Both the Lambda proves, the one upstream and the other downstream of the catalytic converter, are NGK OZA641-A1 type.
The connector has four pins, two for the heater and two for the signal
They are used to measure the quantity of oxygen present in the exhaust gas, and therefore to:
- Compute the stoichiometric ratio
- Monitor catalytic converter function

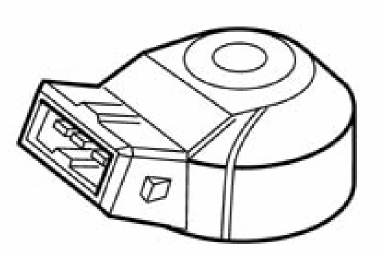
Electrical specifications
Heating element resistance 6 +/- 06 ohm

Mechanical specifications
Tightening torque 45+/- 4,5 Nm
Working temperature 250/950. °C

Pin - out

Pin	*Signal*
1	Engine temperature sensor ground Lambda probe signal +
2	Engine temperature sensor ground Lambda probe signal +
3	Lambda probe heater command
4	Lambda probe heater +12V power supply

Pinging sensor



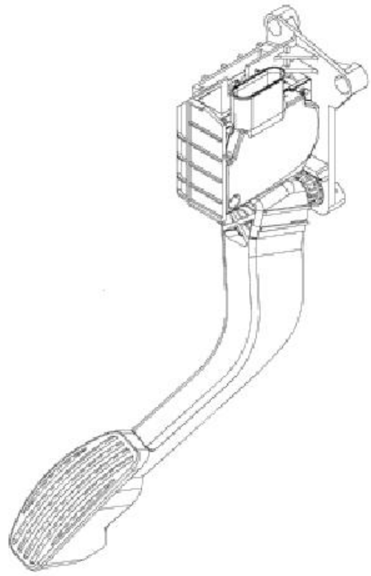
Specifications and function
The piezoelectric pinging sensor is mounted on the engine block and detects the intensity of vibration caused by pre-ignition in the combustion chamber.
This phenomenon generates a mECManical repercussion on the piezoelectric crystal that sends a signal to the control unit, which according to the signal reduces ignition advance until the phenomenon ceases.
After adjustment, advance is gradually restored to the base value.
The molecules of a quartz crystal are electrical polarized.
In rest condition (A) the molecules have no particular alignment.
When the crystal is subjected to pressure or impact (B), the molecules align, the more organized the greater the pressure applied.
This alignment produces a voltage at the terminals.

Electrical specifications:
Resistance: 560 +/- 28 kohm at 20 °C.

Pin - out

Pin	Signal
1	Pinging sensor positive
2	Pinging sensor negative

Accelerator pedal potentiometer.



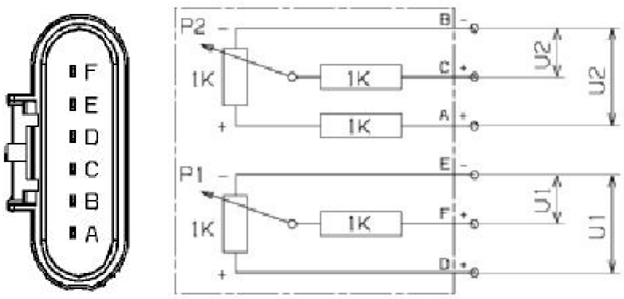
Specifications and function
The accelerator pedal has two embedded potentiometers

- One main;
- One safety.

The Engine Control Unit actuates the two "recovery" strategies in the following conditions:

- In case of failure of one of the two potentiometers, it permits throttle aperture up to a maximum 40° over a long time;
- In case of total failure of both potentiometers, it disables throttle aperture.

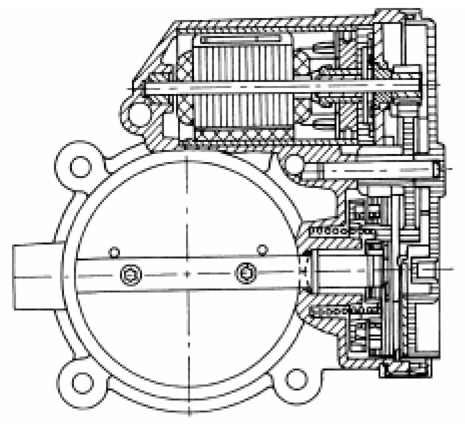
The sensor consists of a casing, fastened to the accelerator pedal support, in which there is an axially mounted shaft connected to the twin-track potentiometer.
A spring on the shaft offers the right level of resistance to pressure while another spring assures pedal return on release.



Pin - out

Pin	Name	Signal type
A	Stage 2 power supply	5 V input
B	Stage 2 common ground2	Ground
C	Stage 2 output	Analogue output
D	Stage 1 power supply	5 V input
E	Stage 1 common ground	Ground
F	Stage 1 output	Analogue output

Throttle body



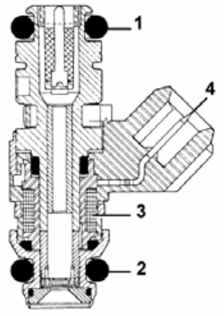
Specifications and function

The throttle body is fastened to the intake manifold and regulates the quantity of air drawn in by the engine
According to the signal received from the accelerator pedal accelerometer, the Engine Control Module commands throttle opening by means of a direct current servo motor built-in to the throttle body.
Throttle aperture is between 0° and 82°, thus including idle speed regulation.
The throttle body has two integrated potentiometers, each controlling the other.
If one of the two potentiometers fails, according to accelerator positions the Engine Control Module applies a recovery strategy with consequent degraded function perceivable by the driver, and disables EOBD diagnosis.
Replacement of the throttle body, Engine Control Module or intake manifold does not require execution of the teach-in procedure.
Throttle aperture is commanded by an electronically controlled servo motor.
The Marelli 5SF8 system pilots the throttle according to the demand for torque;
The Engine Control Module controls throttle position by means of a potentiometer built-in to the throttle body.

Pin - out

Pin	Signal
1	Throttle sensor 1 signal
2	Throttle sensors +5V power supply.
3	Throttle motor command positive.
4	Throttle sensor 2 signal
5	Throttle motor command negative
6	Throttle sensors ground.

Electroinjectors



Specifications and function

The electroinjectors are miniaturized type (Pico).
The injectors are mounted on the manifold that presses them into their respective seats in the intake manifold, while two rings (1) and (2) in fluorine rubber assure the seal on the intake duct and fuel manifold.
Fuel is delivered to the upper part of the injector, which contains the winding (3) connected to the terminals (4) of the electrical connector
Never apply more than 120 Nm torque to the injector connector when removing/replacing to prevent damage
The fuel spray, at the absolute pressure of 3.5 bar created by the returnless system, exits the injector and atomizes immediately.
The injector control logic is “timed sequential” type, in practice the four injectors are commanded in sequence with the intake stroke.

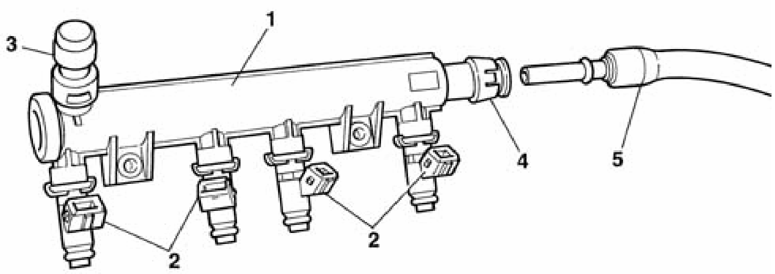
Electrical specifications

Power supply 12 V.
Internal resistance 13.8 – 15.2 Ohm at 20 °C.

Pin - out

Pin	Signal
1	Power supply 12 V
2	Injector command.

Fuel intake manifold

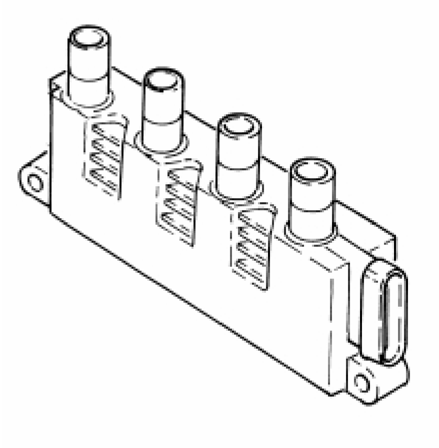


Key
1. Fuel manifold
2. Injector
3. Fuel pressure check connector
4. Quick connector
5. Fuel delivery pipe

Specifications and function

The fuel manifold is fastened to the inner part of the intake manifold and serves to deliver fuel to the injectors.
In addition to the injector seats, the manifold also has a quick connector to connect the fuel delivery pipe and a connector for fuel supply pressure checks

Ignition coils



Specifications and function
The BAE 940A ignition coils are embedded in a single body fastened to the tappet cover and are magnetic closed circuit type, forming a laminar pack in which the central core, in silicon steel split by a thin spacer, carries both windings
The windings are covered by a molded plastic container and insulted by immersion in a quartz epoxy resin compound that gives them exceptional dielectric, mECManical and thermal properties, and so able to withstand very high temperatures.
The vicinity of the primary winding to the magnetic core reduces magnetic flux dissipation and gives maximum primary to secondary coupling.

Electrical specifications
- Primary circuit resistance: 0.5 Ohm ± 10% a 23 ± 3 °C;
- Secondary circuit resistance: 5.2 kOhm ± 10% a 23 ± 3 °C.(value not measurable due to presence of a diode on secondary winding

Pin - out

Pin	Signal
1	Common +12V power supply
2	Cylinder 1 coil command
3	Cylinder 2 coil command
4	Cylinder 3 coil command
5	Cylinder 4 coil command
6	Common ground

Engine Management

Main functions

At idle speed and to maintain regular engine function as environmental parameters and applied loads vary, the Engine Control Module controls:

- Ignition point
- Air flow-rate

The Engine Control Module controls and manages injection such that the stoichiometric ratio (air/fuel) is always at the optimal value.
The functions of the system are essentially as follows:

- System self-adaptation
- Self-diagnosis
- Fiat CODE recognition
- Cold starting control
- Combustion control – Lambda probe
- Pinging control
- Enrichment on acceleration control
- Fuel cut-off on release
- Fuel vapor recovery
- Engine maximum speed limitation
- Fuel supply – fuel pump control
- Connection with air-conditioning system.
- Cylinder position recognition
- Injection time regulation
- Ignition advance regulation
- Idle speed control and management
- Engine cooling fan control
- Timing adjuster control
- Starter motor control

Injection system

The essential conditions that must always be met in preparing the fuel-air mixture for optimal function of a controlled ignition engine are mainly:

- The “dosing” (air/fuel ratio) is kept as close as possible to the stoichiometric value, in order to assure the required rapidity of combustion, preventing unnecessary fuel consumption;
- The “regularity” of the mixture, consisting of petrol vapor, diffused as finely and as uniformly as possible in the combustion air.

To calculate the air/fuel mixture ratio, the Engine Control Module uses an indirect type measurement system known as “SPEED DENSITY-LAMBDA”, meaning angular rotation speed, intake air density and mixture control (retroactive control).
In practice, the system uses ENGINE SPEED (RPM) and AIR DENSITY (pressure and temperature) to measure the quantity of air drawn in by the engine.
The quantity of air drawn in by each cylinder, for each engine cycle depends not only on the density of the air, but also on the unitary displacement, volumetric efficiency and eventual turbo charging.
Air density is understood as that of the air drawn in by the engine and calculated according to the absolute pressure and temperature, both measured in the intake manifold.
Volumetric efficiency is understood as the parameter related to the cylinder filling coefficient computed on the basis of experimental tests carried out on engines over the entire range of operation and subsequently memorized in the Engine Control Module.
Having established the quantity of air drawn in, the Engine Control Module has to provide the quantity of fuel according to the required ratio.
The injection end pulse or delivery timing is contained in a map memorized in the Engine Control Module and varies according to the engine speed and intake manifold pressure.
In practice, this is a process that the electronic control unit runs to command timed and sequential aperture of the four injectors, one for each cylinder, for the time strictly necessary for forming the fuel-air mixture as close as possible to the stoichiometric ration.

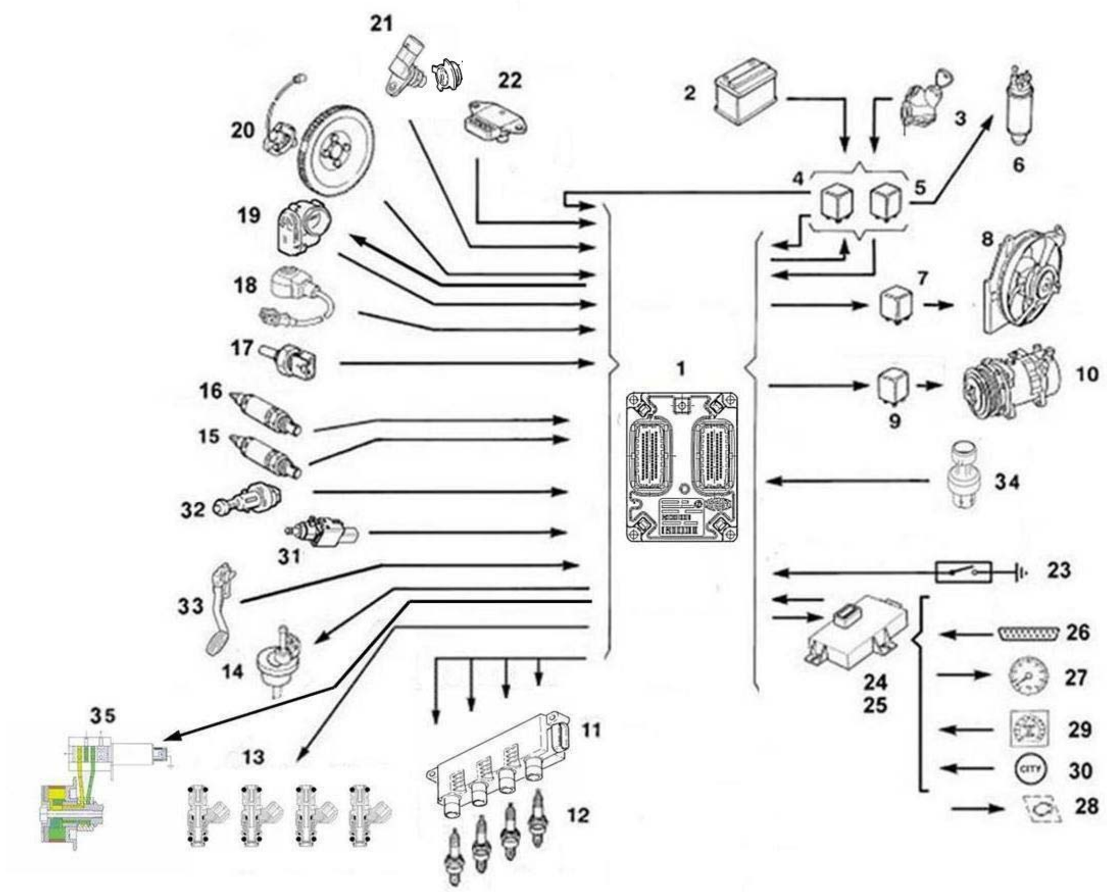
The fuel is injected directly into the manifold in the vicinity of the intake valve at a pressure of approx. 3.5 bar
While the speed (RPM) and air density (pressure and temperature) are used to measure the quantity of air drawn in, after which the quantity of fuel is added according to the required mixture, the other sensors present in the system (coolant fluid temperature, throttle valve position, battery voltage) allow the control unit to correct the base strategy to all the various engine operating conditions.
To keep the air-fuel mixture as close as possible to the stoichiometric value is indispensable for the correct function and long working life of the catalytic converter, as well as in reducing pollutant emissions.

Ignition system
The ignition system is static inductive spark type, meaning without high tension distributor with power modules inside the Engine Control Module.
The system has two twin-output high-tension coils in a single casing located directly at the spark plugs
The primary of each coil is connected to the power relay (so powered by battery voltage) and to the pins of the electronic control unit for connection to ground.
After starting, the Engine Control Module controls base ignition advance based specific maps according to:

- Engine speed
- Absolute pressure value (mbar) measured in the intake manifold.

This advance value is corrected according to engine coolant and intake air temperature
The spark plugs are each connected by high tension cables to the secondary terminals of the respective coils.
This solution, also known as “single spark” in that the energy accumulated by the coil discharges almost exclusively on the electrodes of the corresponding plug on the cylinder in compression, permitting ignition of the mixture
The coils are enclosed in a single casing located on the tappet cover

Information input/out from the control unit.
Via CAN line, the control unit receives fuel level and vehicle speed data.
The information concerning the robotic gearbox (where fitted) comes from the injection control unit via C-CAN line



Key

1. Engine Control Module with built-in atmospheric pressure sensor
2. Battery
3. Ignition switch
4. Engine control system relay
5. Fuel pump relay
6. Fuel pump
7. Radiator fan relay/s
8. Radiator fan
9. Compressor activation relay
10. Compressor
11. Ignition coils
12. Spark plugs
13. Electroinjectors
14. Active carbon filter cleaning solenoid valve
15. Lambda probe (pre-catalyzer)
16. Lambda probe (post-catalyzer)
17. Coolant temperature sensor
18. Pinging sensor
19. Throttle actuator and position sensor
20. Engine speed and TDC sensor
21. Timing sensor
22. Absolute air pressure and temperature sensor
23. Low oil pressure switch
24. Body computer (connection to C-CAN network)
25. CODE function (via CAN network)
26. Diagnosis instrument socket (via CAN network)
27. Rev counter (via CAN network)
28. System fault warning light (via CAN network)
29. Tachometer (via CAN network)
30. City/Sport button for power steering (via CAN network)
31. NO switch: brake pedal
32. Clutch pedal switch
33. Accelerator pedal
34. Linear pressure sensor for air-conditioner
35. Timing adjuster solenoid valve

Functional logic

System self-adaptation

The Engine Control Module is equipped with a self-adapting function that serves to recognize changes taking place in the engine due to wear over time and ageing of engine components
These changes are memorized in the form of modifications to the base mapping, and serve to adapt system function to the progressive alteration of the engine and components with respect to their as-new tolerance.
This self-adapting function also compensates the inevitable differences (due to production tolerances) of any replaced components.
From analysis of the exhaust gas, the Engine Control Module modifies the base mapping to the new engine characteristics.
The self-adaptive parameters are not deleted if the battery is disconnected.

Recovery and self-diagnosis

The Engine Control Module self-diagnosis system controls correct system function and indicates any faults by means of a warning light (MIL) on the panel, with European standard ideogram and color
The command is transmitted by message over CAN network.
This warning light indicates both engine management faults and faults detected by the EOBD diagnosis strategy
The functional logic of the warning light (mil) is as follows: with key to run the warning light comes on and remains on until engine start.
The Engine Control Module self-diagnosis system checks the signals from the sensors comparing them with the admissible limit parameters
Fault indications with engine started:

- Light on with engine running indicates an error memorized in the Engine Control Module

Fault indications when running:

- Flashing light indicates possible damage to catalytic converter due to misfire
- Warning light steady on indicates engine control errors or EOBD diagnosis errors

The Engine Control Module defines the type of recovery according to the failed component
The recovery parameters are managed by the remaining functional components

Fiat CODE recognition

When it receives the key to “RUN” signal, the Engine Control Module dialogues with the Body Computer (Fiat CODE function) to enable starting
Communication is via CAN line connecting the two control units

Cylinder position recognition

The engine timing signal, along with the engine revs signal and top dead centre signal (TDC), allows the Engine Control Module to recognize the succession of cylinders in order to command timed injection.
This signal is generated by a Hall effect sensor.

Combustion control – Lambda probe

In EOBD systems, the Lambda probes, all of the same type but not interchangeable, are located upstream and downstream of the catalytic converter. The upstream probe determines 1st loop mixture control (closed loop).
The downstream probe is used to diagnose the converter and to fine tune the 1st loop control parameters.
In this context, the adaptiveness of the second loop serves to recover both production tolerance and deterioration in the response of the pre-catalyzer probes as they age and wear
This control is referred to as 2nd loop control (closed loop).

Running when cold

In these conditions there is a natural leanness of the mixture caused by the poor low-temperature turbulence of the fuel particles, reduced evaporation and greater lubricating oil viscosity which, as is known, at low temperatures increase rolling friction of all mECManical engine components.

The Engine Control Module recognizes these conditions through the engine coolant temperature signal,, increasing the base injection time.

Running at full load
Full load condition is recognized by the control unit through the values provided by the throttle position and absolute pressure sensors.
In full load conditions, the base injection time has to be increased in order to obtain maximum power from the engine.
Deceleration
In this phase of engine operation there are two strategies:
- A negative transient strategy to maintain the quantity of fuel delivered to the engine within the stoichiometric ratio (less pollution). This phase is recognized by the control unit when the throttle potentiometer signal passes from a high value to a low value.
- Gentle accompaniment to the lower speed strategy (dash pot) to attenuate variations in torque delivered (reduced engine braking).

Atmospheric correction
The system has an atmospheric pressure sensor built-in to the Engine Control Module.
Atmospheric pressure varies according to altitude, determining a variation in volumetric efficiency of an entity requiring correction to the base mixture (injection time).

Cut-off
The cut-off strategy (fuel) is actuated when engine speed exceeds the threshold: Target_Minimum (engine temperature) +threshold (gear). With engine warm this is 800+570=1370 rpm.
Cut-off disable is actuated either by pedal not released or when speed drops below the threshold: Target_Minimum (engine temperature) +threshold (gear). With engine warm this is 800+490=1290 rpm.
For very high engine speeds, cut-off is also implemented with throttle valve not fully closed but with particularly low pressure in the intake manifold (partial cut-off

Acceleration
In this phase, the Engine Control Module suitably increases the quantity of fuel delivered to the engine (to obtain maximum torque) according to the signals received from the following components:
- Throttle potentiometer
- Revs and TDC sensor

The “base” injection time is multiplied by a coefficient according to coolant temperature, throttle aperture rate and increase in intake manifold pressure.
If a rapid variation in injection time is demanded when the injector is already closed, the Engine Control Module will reopen it (for an extra pulse), in order to compensate the mixture more rapidly. The subsequent injections will instead be increased according to the previously mentioned coefficients.

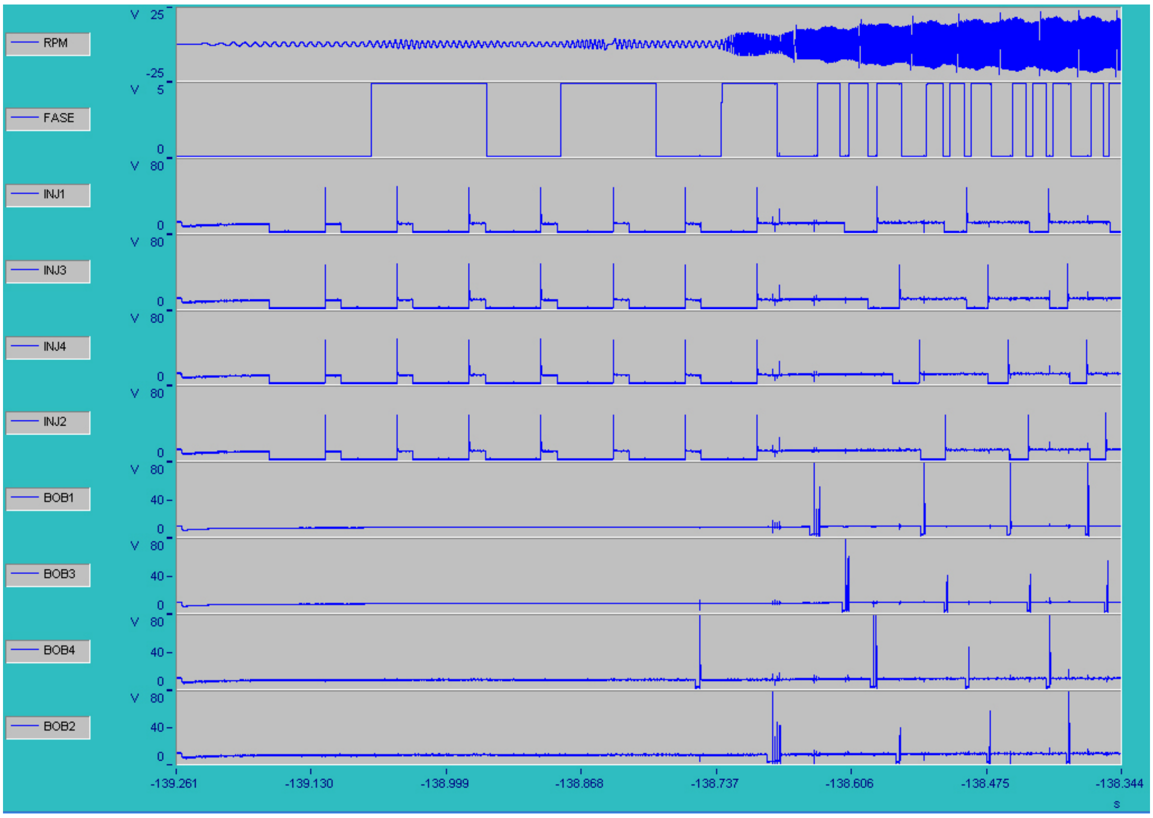
Overspeed protection
If engine speed exceeds the value of 6600 rpm set by the manufacturer, the engine is in “critical” operating conditions..
When the electronic control unit recognizes this condition, it disables injector piloting.
When engine speed returns to a non-critical value (6400 rpm), injector piloting is re-enabled.

Fuel pump command
The electric fuel pump is piloted by the Engine Control Module via a relay.
The pump stops if:
- engine speed drops below 40 rpm.
- After a certain period (3 seconds) with the ignition switch to RUN without starting the engine (timed enable)
- If the fuel cut-off function is activated (via inertia switch)

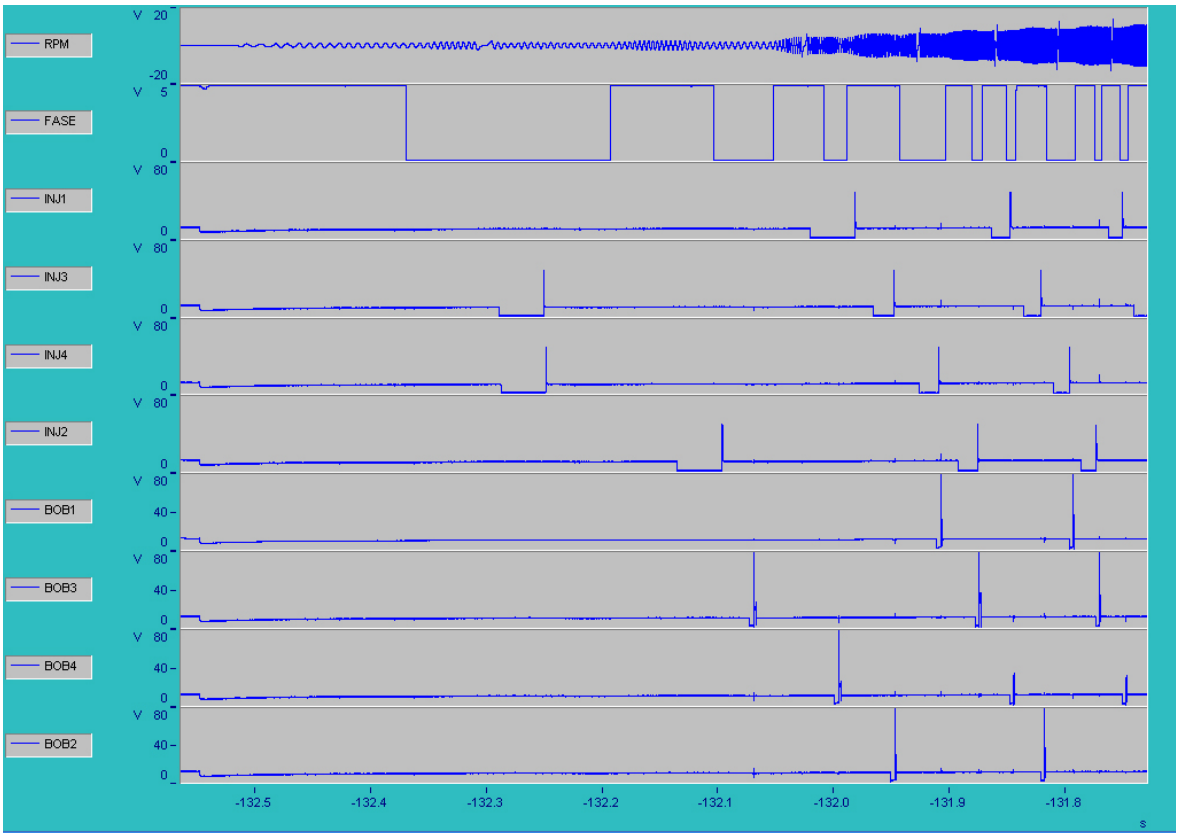
Injector command
Injector command is timed-sequential.

If engine temperature is less than 11°C, when starting the injectors are piloted in synchronous mode (full-group) for a number of revolutions.
The injector timing control can vary according to engine speed and intake air pressure in order to improve cylinder filling with advantages in terms of consumption, drivability and emissions.

The diagram below gives an example of the phases of a low temperature start, showing the FULL GROUP control of the injectors (INJ1, INJ3, INJ4, INJ2).



Whereas the diagram below illustrates starting with temperature 20°C



Pinging control
The Engine Control Module detects the presence of pre-ignition (pinging) by processing the signal from the corresponding sensor.
The Engine Control Module constantly compares the signals from the sensor with a threshold value, which is in turn constantly monitored to take account of background noise and engine ageing
If the system detects pinging, the strategy reduces ignition advance until the phenomenon ceases. After this, advance is gradually increased until reaching the programmed value, or until the phenomenon starts again.
Specifically, increases in ignition advance are gradual, whereas reduction is implemented immediately.
In acceleration condition, the strategy applies a higher threshold, to account for increased engine noise in that condition.
The strategy also has a self-adaptive function, which records a non-permanent memory of any advance reductions occurring with continuity, in order to adapt advance to the various engine operating conditions (for example, when burning low-octane fuel).
The strategy is capable of restoring advance to the threshold value as soon as conditions that caused the reduction cease.

Radiator fan control
The Engine Control Module controls radiator fan function directly, according to engine coolant temperature and air-conditioner status.
The fan comes on when temperature exceeds 97°C (1st speed) and 101°C (2nd speed).
The fan cuts-out with hysteresis of 3°C less than the cut-in threshold (indicative values, variable from model to model and based on experimental testing).
The high and low speed functions are controlled by specific relays in the air-conditioner control unit and commanded by the Engine Control Module.

Engine idle speed control
The Engine Control Module recognizes engine idling condition through the “released” position of the accelerator pedal To control engine idle speed according to the utilities being used aboard the vehicle

and the brake/clutch pedal signal, the control unit evaluates the need for power from the engine and adjusts advance and throttle positions accordingly.
Idle speed when warm is 750 ± 50 rpm.
Target idle speed depends on engine temperature and ranges from 1300 rpm (for T = 30°) down to 800 rpm with engine fully warmed up.
Moreover, if engine temperature exceeds a threshold (50°C), if the Engine Control Module recognizes stable idle speed for a set time (200 ms) and the engine remains in this state for a set time (600 ms), idle speed drops to a settable 'super-idle' speed (100 rpm). In case of torque demand, the unit quits superidle state for speeds greater than 4 kph.

Warming up
The number of revs is adjusted according to engine coolant temperature
On reaching the set temperature, idle sped control depends exclusively on the signal given by the revs sensor.
When external loads are applied, the Engine Control Module commands the throttle actuator to adapt the engine speed to the changed load conditions, effectively managing engine load.

Fuel vapor recirculation management
The strategy controls the position of the fuel vapor shut-off solenoid valve as follows:

- During start-up, the valve remains closed, preventing fuel vapor from enriching the mixture. This condition persists until the engine coolant has reached 55°C
- With the engine warm, the control unit sends a square wave signal (duty-cycle command) that modulates aperture.

In this way the control unit controls the quantity of fuel vapor sent to the intake, preventing any substantial variation in the ratio of the mixture.
To improve engine performance, the valve command is disabled, holding the valve closed, in the following operating conditions:

- Throttle valve closed
- Revs less than 1400 rpm
- Intake manifold pressure less than a limit value, calculated by the Engine Control Module according to engine revs.

Air-conditioning system control

The Engine Control Module is functionally connected to the air-conditioning system, since:

- It receives the compressor enable command via C-CAN network and makes corrections to torque.
- It enables compressor activation in the conditions foreseen by the strategies;
- It receives information on conditioning system pressure through the status of the linear pressure switch, and makes the corresponding compensations (radiator fan command).

The Engine Control Module automatically commands compressor disable

- With engine coolant temperature greater than 120°C
- For engine speeds less than 600 rpm.

The compressor activates automatically when engine speed is above 750 rpm.
The Engine Control Module simultaneously commands temporary compressor deactivation:

- With high power demand from engine (heavy acceleration)
- On engine pick-up.

Timing adjuster control
The timing adjuster is totally managed by the engine control unit, which

- Detects the position of the camshaft through the timing sensor.
- Modifies this position based on a preset map according to engine conditions
- Monitors camshaft position.

The Engine Control Module commands the adjuster pilot valve through a duty-cycle command.

Starter motor control
The starter motor is commanded directly from the ignition switch.

Recover logic

Air temperature sensor
If the error is present on starting
- a value of 40°C is taken;
- Mixture self-adaptation is disabled.

If the error is present in other conditions:
- The last valid value is memorized, and updated according to coolant temperature.

Pinging sensor
In case of sensor fault, the engine control unit implements the most conservative ignition advance “maps” to safeguard the engine.

Pressure sensor
If the error is present on starting, the control unit takes a value of 1024 mbar.
When running, the value taken is calculate according to the parameters provided by the throttle position sensor and revs sensor.
Mixture self-adaptation is disabled.

Throttle valve position sensor
In case of fault, the value set is calculated on the basis of absolute pressure sensor readings and, if this fails, the throttle is set to 50° aperture.
Dash-pot strategy is disabled, as well as idle and mixture self-adaptation

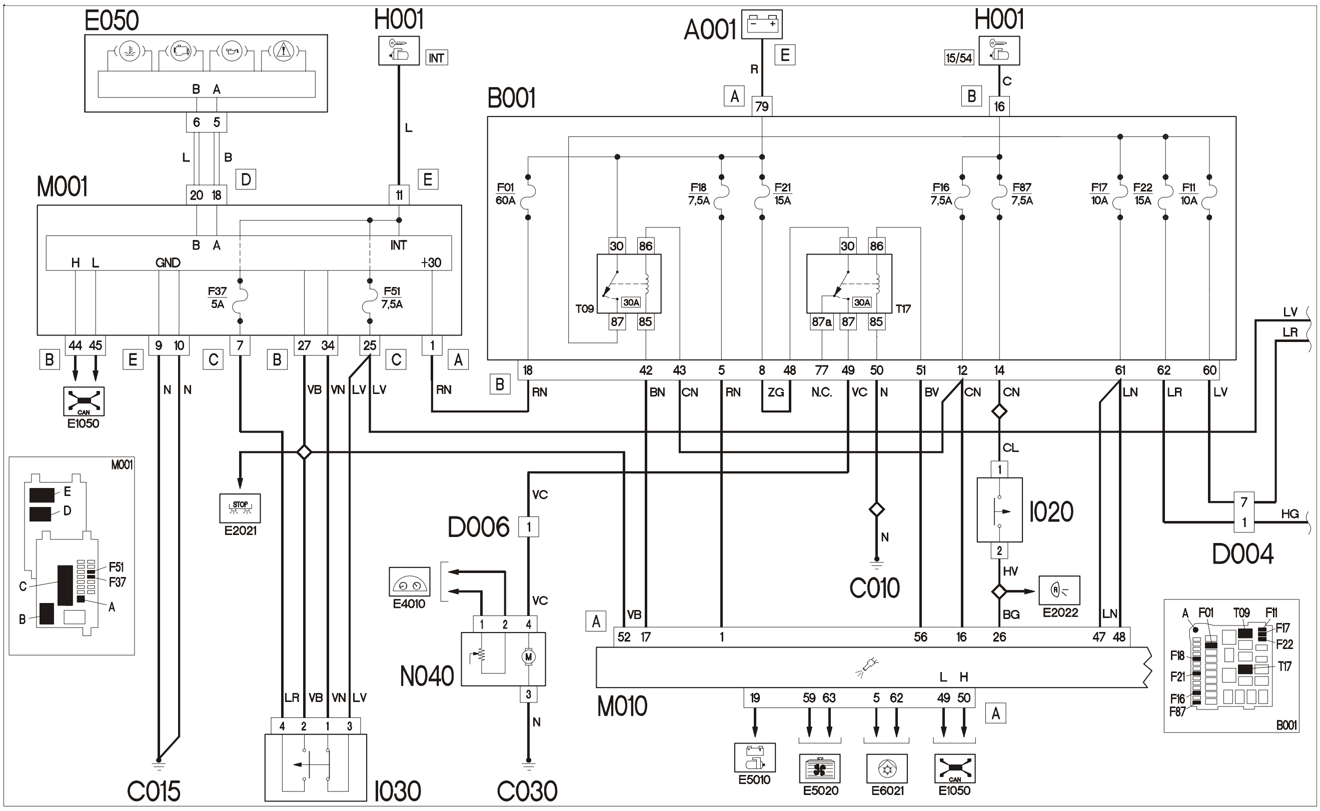
Coolant temperature sensor
In case of fault, the Engine Control Module disables mixture and idle speed self-adaptation.
It sets the last read temperature value. If this does not correspond to warm-up temperature, the injection control unit gradually increases it according to time from engine start, until reaching 80°C
The radiator fan is activated.

Atmospheric pressure sensor
In case of sensor fault, the pressure in the intake manifold in full load conditions on key-on is taken as atmospheric pressure (throttle fully open).

Timing adjuster
If the timing adjuster seizes in any position (maximum advance, maximum retard, or intermediate position) due to mECManical failure or solenoid valve short-circuit, the solenoid valve is no longer piloted by the Engine Control Unit.
In case of slow adjuster, the Engine Control Module commands the solenoid valve to keep the adjuster in maximum advance position (rest position).

Magneti Marelli 5SF8 engine control system circuit diagram

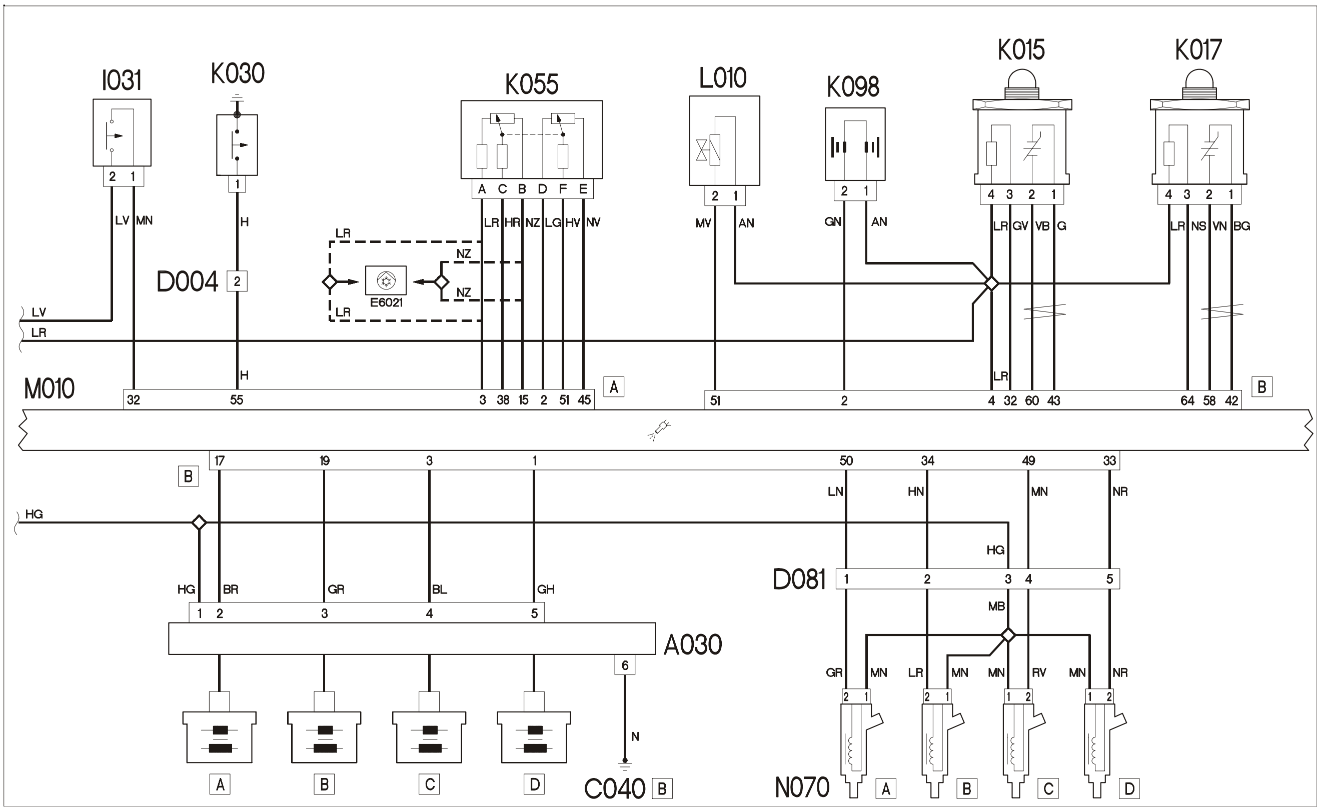
Diagram E5030 A



Key

A001 BATTERY
B001 JUNCTION BOX UNIT
C010 GROUND
C015 GROUND
C030 GROUND
D006 JUNCTION
D004 JUNCTION
E050 INSTRUMENT PANEL
I020 REVERSING LIGHTS SWITCH (GEARBOX HARNESS)
I030 BRAKE PEDAL SWITCH
H001 COMMUTATORE DI ACCENSIONE
M001 BODY COMPUTER
M010 ENGINE CONTROL MODULE
N040 FUEL PUMP AND GAUGE

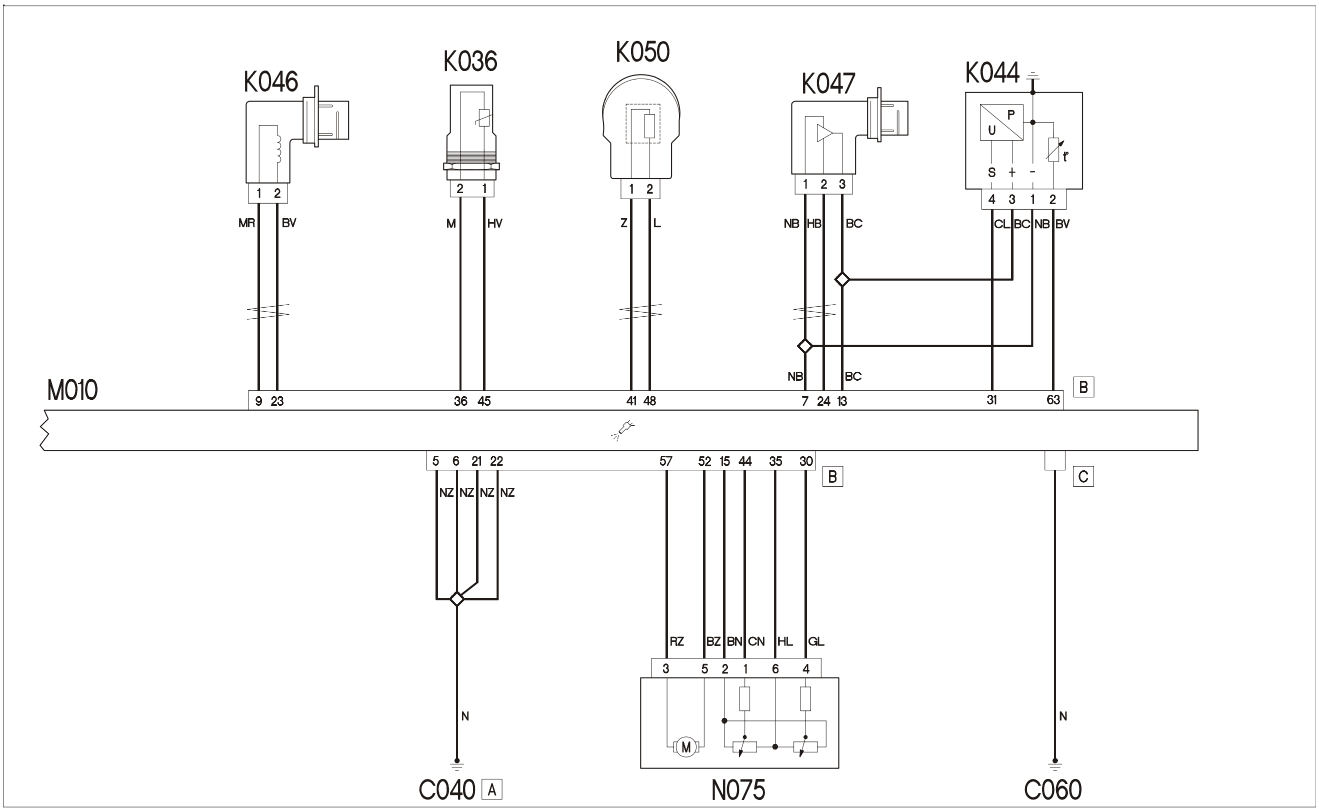
Diagram E5030 B



Key

A030 IGNITION COIL
C040 GROUND
D004 JUNCTION
D081 INJECTOR JUNCTION
I031 CLUTCH PEDLA SWITCH
K015 PRE-CAT LAMBDA PROBE
K017 POST-CAT LAMBDA PROBE
K030 ENGINE OIL PRESSURE SENSOR (SWITCH)
K055 ACCELERATOR PEDAL POTENTIOMETER
K098 TIMING ADJUSTER SOLENOID VALVE
L010 FUEL VAPOR RECOVERY VALVE
M010 ENGINE CONTROL MODULE
N070 INJECTORS

Schema E5030 C

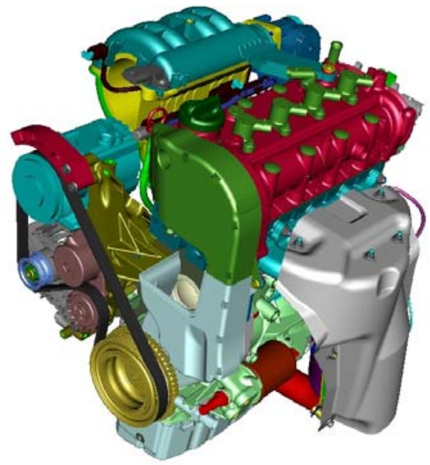


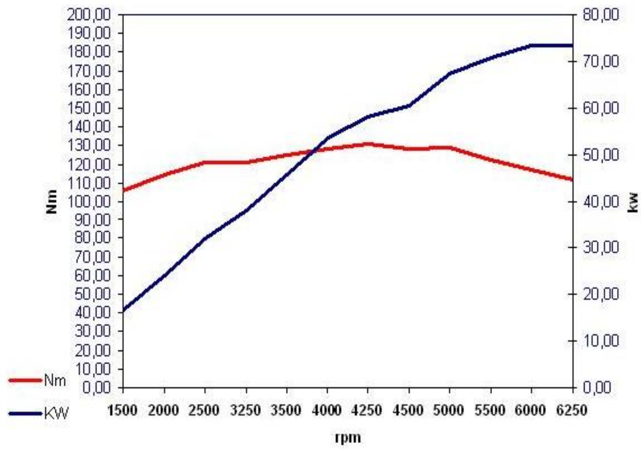
Legenda

C040 GROUND
C060 GROUND
K036 ENGINE COOLANT TEMPERATURE SENSOR/TRANSMITTER
K044 INTEGRATED AIR PRESSURE AND TEMPERATURE SENSOR
K047 TIMING SENSOR
K048 PRESSURE SENSOR
K050 KNOCK SENSOR
M010 ENGINE CONTROL MODULE
N075 THROTTLE ACTUATOR

1.4 16V Engine

This chapter describes the new 16 V 1.4 engine derived from the engines already used on the Fiat Panda, and equipped with a new engine management system.





Technical data sheet

ENGINE		
Engine	FIRE 1368 16V RL BOSCH E5 for new 500	
Strokes	4	
Cylinders	4	
Valves per cylinder	2 parallel	
Bore	72 mm	
Stroke	84 mm	
Total displacement	1368 CC	
Single cylinder	342	
Combustion chamber volume	34.8 (14.3 in head) cm2	
Maximum power	73.5 (KW EEC) at 6000 RPM	
Maximum torque	131 (Nm EEC) at 4250 RPM	
Compression ratio	10,8 ± 0,2	
Emissions level	EEC PHASE 4	
Recommended fuel	EUROSUPER RON 95 MON 85	
Engine markings	169A3000	
Mounting	Front transverse	
Inclination	12° forward	
VALVE TIMING SYSTEM		
Valve Timing system	2 ACT 8-gauge direct drive belt, profile P8S	
Valve train type	INTAKE	EXHAUST
Combustion chamber side head duct diameter	22.7 mm	18.8 mm
Corresponding valve diameter	25.48 mm	20.6 mm
Rise on valve axis without play	8 mm	7.5 mm
Timing (tolerance +/- 3°)	-2/42	34/-2
Valve axis play for timing control	0.45 mm	0.45 mm
Valve axis functional play (engine cold)	0 mm	0 mm
INJECTION SYSTEM		
Mixture formation system	Bosch ME 7.9.10 ME returnless integrated injection-	

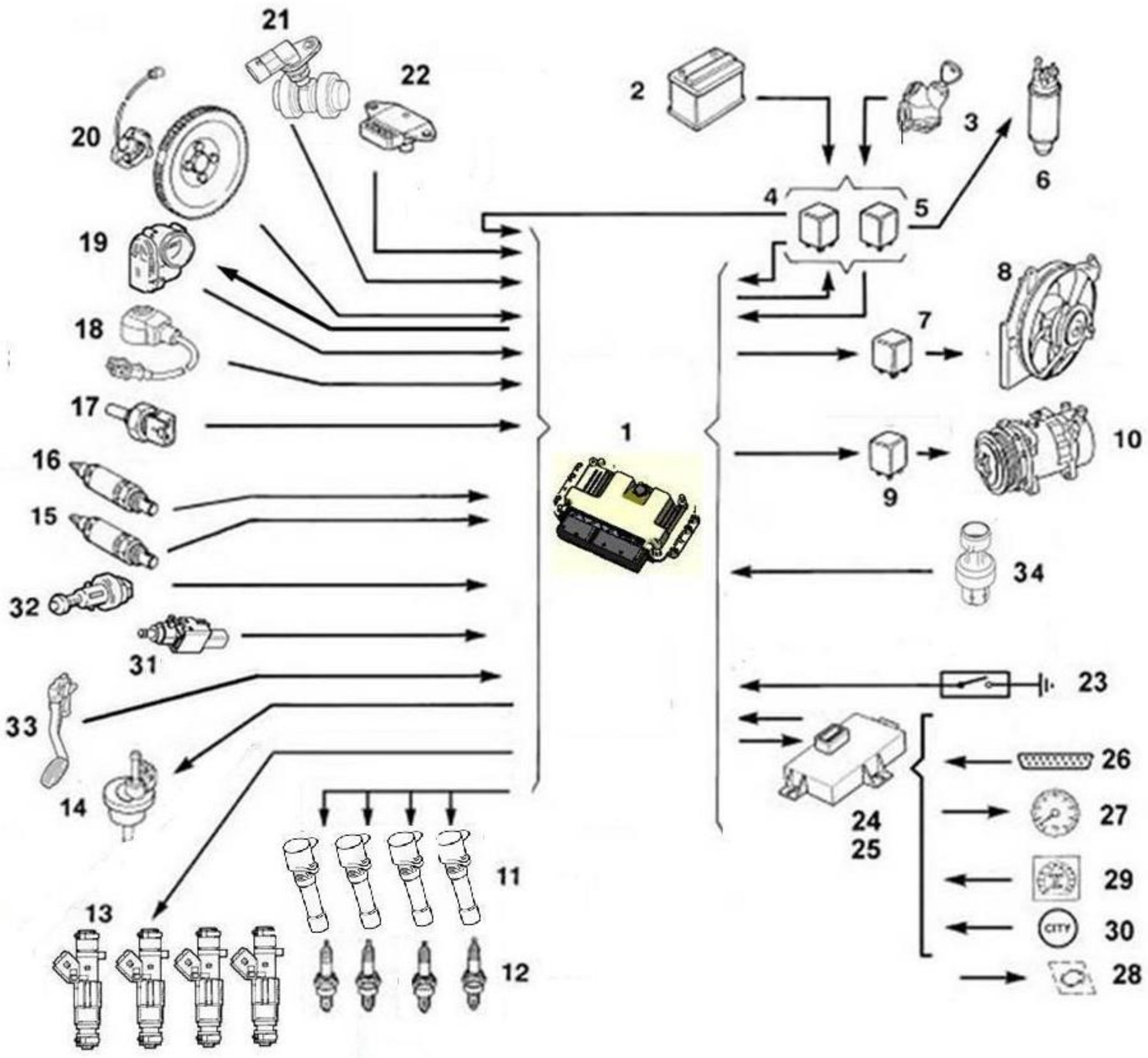
	ignition system
IGNITION SYSTEM	
Ignition system	Bosch ME 7.9.10 ME returnless integrated injection-ignition system
Ignition coil	Federal mogul BAE 403 C
Spark plugs	NGK DCPR7E-N-10
Advance control at 750± 50 rpm	8° ± 4°
Firing order	1;3;4;2
Alternator	90 A
LUBRICATION SYSTEM	
Type of pump	Frontal gear pump with FULL FLOW filter
Type of lubricant	SELENIA K
First filling lubricant quantity	2.85kg
Oil pressure at 100°	At idle > 0.7 bar at 4000 rpm > 4 bar
COOLING SYSTEM	
Type	Centrifugal pump driven by timing belt
Thermostat	By-pass thermostat control vehicle heating from manifold
Liquid	Water + Paraflù
Thermostat calibration	88° ± 2° C
INTAKE SYSTEM	
Type	Intake manifold in plastic material
EXHAUST SYSTEM	
Type	Exhaust manifold in cast iron with catalytic converter
ANTI-EMISSIONS SYSTEMS	
Idle speed	750 ±50 rpm
CO	= 0,3%
HC	= 50 ppm

Engine Management

This chapter present the BOSCH ME 7.9.10 engine control system applied to the 1.4 16 V normal intake engine.

Engine Control Module input/output scheme

The diagram below shows the control module inputs and outputs

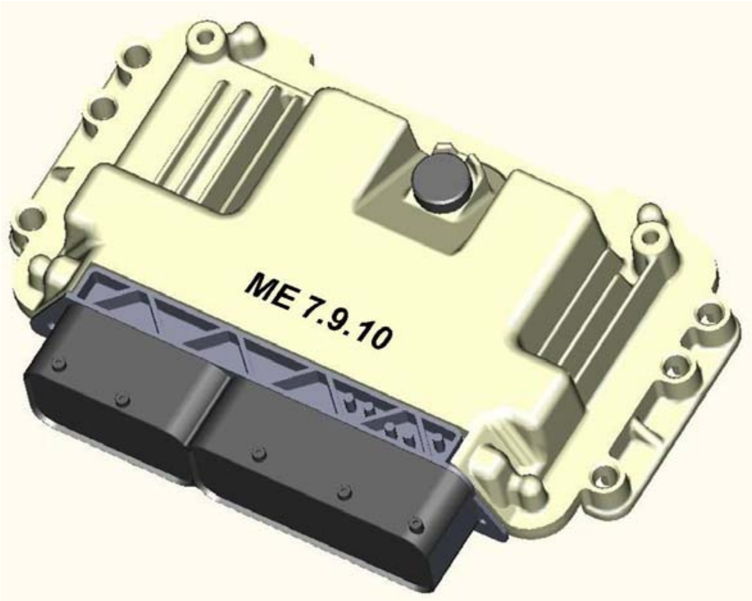


Key

1. Engine Control Module with built-in atmospheric pressure sensor
2. Battery
3. Ignition switch
4. Engine control system relay
5. Fuel pump relay
6. Fuel pump
7. Radiator fan relay/s
8. Radiator fan
9. Compressor activation relay
10. Compressor
11. Ignition coils
12. Spark plugs
13. Electroinjectors
14. Active carbon filter cleaning solenoid valve
15. Lambda probe (pre-catalyzer)
16. Lambda probe (post-catalyzer)
17. Coolant temperature sensor
18. Pinging sensor
19. Throttle actuator and position sensor
20. Engine speed and TDC sensor
21. Timing sensor

22. Absolute air pressure and temperature sensor
23. Low oil pressure switch
24. Body computer (connection to C-CAN network)
25. Engine Control Module CODE (via CAN network)
26. Diagnosis instrument socket (via CAN network)
27. Rev counter (via CAN network)
28. System fault warning light (via CAN network)
29. Tachometer (via CAN network)
30. City/Sport button for power steering (via CAN network)
31. NO switch: brake pedal
32. Clutch pedal switch
33. Accelerator pedal
34. Linear pressure sensor for air-conditioner

Engine Control Module



Type
Bosch Motronic **ME 7.9.10 A1** torque-control based motorized throttle Engine Control Module. The unit belongs to family of timed sequential type electronic injection-ignition systems The Engine Control Module has a “flash EPROM” type memory, reprogrammable from the outside without intervening on hardware
Replacement of the Engine Control Module or throttle body requires execution of the throttle position self-teaching procedure.

Function
The Engine Control Module serves to control the engine and all systems connected to it.

Location
The Engine Control Module is located in the engine bay and is capable of withstanding high temperature.

Specifications and function
Through the various sensors, the Engine Control Module regulates the quantity of air/fuel and ignition advance, to permit regular engine function as torque demand and driving conditions vary.
The fuel injection system is direct type, with injectors spraying their fuel charge behind the intake valves.
The ignition system is static type with coils and spark plugs, with power modules contained in the Engine Control Module.
Through the pre-catalyzer Lambda probe the Engine Control Module verifies that combustion is within optimal values.

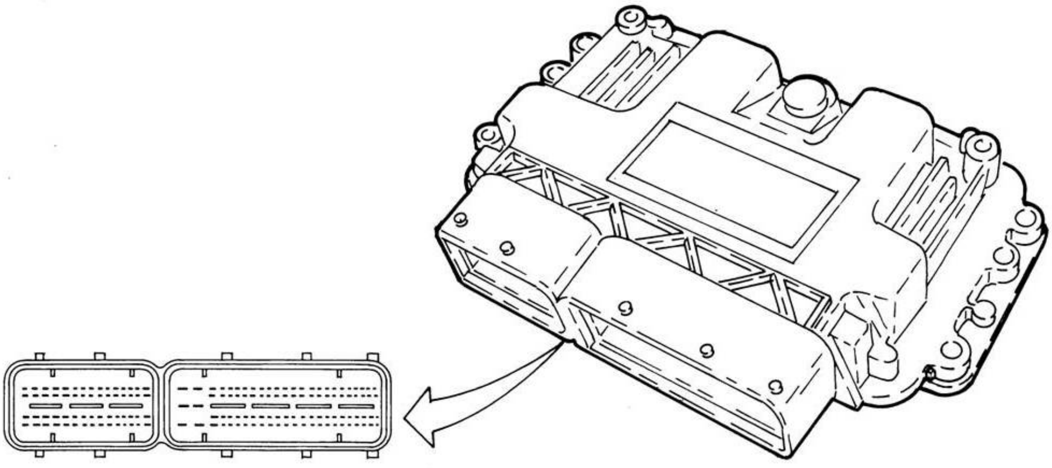
The Engine Control Module is self-adapting, and so capable of recognizing changes taking place in the engine and compensating for them using self-adaptive processes, both at idle speed and under high loads.
The system complies with EOBD standards and so is capable of detecting misfire, verifying the functional integrity of the catalytic converter and indicating through the MIL warning light, all malfunctions that may have an influence on emissions.
The fuel supply system is returnless. The fuel pump is controlled by the Engine Control Module.
Through the corresponding relays, the Engine Control Unit controls activation of the engine cooling fan and the air-conditioner compressor.
The Engine Control Module is connected to the C-CAN communication unit, of which it is a terminal.
The connection of the MIL engine control warning light is direct.

Messages sent and received via C-CAN network
The Engine Control Module transmits and receives a series of messages over the C-CAN network. These messages are used mainly for carrying out certain functions in synergy with other modules (for example data exchange for ESP function, or engine temperature information for the Instrument Panel Module).
The following is a list of the most important messages defined as states, since, in addition to the basic information; generally they also include the error state.

Messages transmitted over C-CAN network
- Request BCM enable code (IMMO code) for CODE function.
- Engine revs state
- Minimum oil pressure state
- Engine temperature state
- Engine overtemperature state
- Brake pedal state
- Clutch pedal state
- Fuel consumption state
- Conditioner compressor active state
- ESP/ASR control parameters state
- Engine parameters state for robotic gearbox control.

Messages receiver from C-CAN network
- BCM enable code for CODE function.
- Key ON network state
- Vehicle speed state
- Brake Module parameters state for ESP/ASR control.
- Robotic Gearbox Module parameters state
- Sport button pressed state from Body Computer Module
- Alternator state
- Fuel level state

Electrical connections



Engine Control Module pinout

Note: This list includes all Pins, including the ones not effectively connected or that are not used for the New Fiat 500

60-way engine side connector

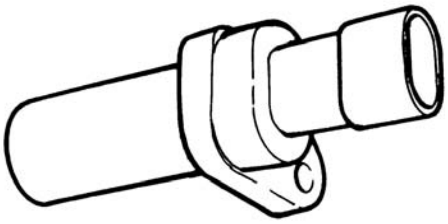
Pin 1 Downstream Lambda probe command (-) .
Pin 2 Cylinder 3 injector command (-)
Pin 3 Canister solenoid command (-)
Pin 4 Cylinder 2 injector command (-)
Pin 5 N.C.
Pin 6 CNG injector **not used**
Pin 7 CNG injector **not used**
Pin 8 CNG injector **not used**
Pin 9 N.C.
Pin 10 5V throttle potentiometers power.
Pin 11 Timing sensor 5V power
Pin 12 Timing sensor signal
Pin 13 Throttle potentiometer round reference
Pin 14 Engine oil temperature ground reference **not used**
Pin 15 Alternator terminal (D+)
Pin 16 Upstream Lambda probe control (-) .
Pin 17 Cylinder 1 injector command (-)
Pin 18 Waste gate command (-) **not used**
Pin 19 Cylinder 4 injector command (-)
Pin 20 CNG injector **not used**
Pin 21 N.C.
Pin 22 “TPS2” throttle potentiometer signal
Pin 23 N.C.
Pin 24 Intake air temperature signal
Pin 25 Intake air pressure signal
Pin 26 N.C.
Pin 27 oil level switch **not used**
Pin 28 Timing sensor ground reference
Pin 29 Engine temperature sensor ground reference
Pin 30 Exhaust gas temperature sensor **not used**
Pin 31 Cylinder 1 ignition coil command
Pin 32 CNG rail temperature sensor signal **not used**
Pin 33 Exhaust gas temperature signal **not used**
Pin 34 Engine oil temperature sensor **not used**
Pin 35 Engine oil pressure switch
Pin 36 Pinging sensor ground
Pin 37 Revs sensor (-)
Pin 38 Revs sensor (+)
Pin 39 N.C.
Pin 40 N.C.
Pin 41 N.C.
Pin 42 “TPS1” throttle potentiometer signal
Pin 43 Engine temperature sensor signal
Pin 44 N.C.
Pin 45 N.C.
Pin 46 Cylinder 3 ignition coil command
Pin 47 Cylinder 4 ignition coil command
Pin 48 Cylinder 2 ignition coil command
Pin 49 Throttle servo motor power (+)
Pin 50 Throttle servo motor power (-)
Pin 51 Pinging sensor signal
Pin 52 Upstream Lambda probe ground reference (-) .
Pin 53 Downstream Lambda probe signal .
Pin 54 Downstream Lambda probe ground.

Pin 55 Upstream Lambda probe signal .
Pin 56 N.C.
Pin 57 Alternator terminal F **not used**
Pin 58 CNG rail pressure sensor **not used**
Pin 59 Oil condition sensor **not used**
Pin 60 N.C.

94-way engine side connector

Pin 1 Engine system ground on battery negative
Pin 2 Engine system ground on battery negative
Pin 3 12Vda F17 10 A positive power supply
Pin 4 Engine system ground on battery negative
Pin 5 12Vda F17 10 A positive power supply
Pin 6 12Vda F16 7.5 A positive power supply
Pin 7 Engine linear pressure sensor ground reference
Pin 8 LSD starter control relay **not used**
Pin 9 N.C.
Pin 10 N.C.
Pin 11 Fuel pump relay power supply
Pin 12 Engine cooling fan relay command (second speed)
Pin 13 Engine cooling fan relay command (first or single speed)
Pin 14 N.C.
Pin 19 N.C.
Pin 27 5V to accelerator potentiometer power “POT. 2”
Pin 28 Linear pressure sensor 5V power
Pin 29 Ground reference for accelerator pedal potentiometer “POT. 2”
Pin 30 Ground reference for accelerator pedal potentiometer “POT. 1”
Pin 31 HSD starter control relay **not used**
Pin 32 N.C.
Pin 33 Alternator L terminal D + **not used**
Pin 34 N.C.
Pin 35 N.C.
Pin 36 N.C.
Pin 37 N.C.
Pin 38 N.C.
Pin 39 N.C.
Pin 40 N.C.
Pin 41 N.C.
Pin 42 N.C.
Pin 43 N.C.
Pin 44 N.C.
Pin 45 N.C.
Pin 46 N.C.
Pin 47 N.C.
Pin 48 N.C.
Pin 49 5V to accelerator potentiometer power “POT. 1”
Pin 50 N.C.
Pin 51 N.C.
Pin 52 N.C.
Pin 53 CAN protection ground **not used**
Pin 54 CNG fuel selector switch **not used**
Pin 55 Signal from accelerator potentiometer power “POT. 2”
Pin 56 N.C.
Pin 57 Linear pressure sensor signal
Pin 58 N.C.
Pin 59 G force sensor **not used**
Pin 60 Vehicle speed sensor **not used**
Pin 61 Clutch switch signal
Pin 62 N.C.
Pin 63 Clutch pedal switch signal
Pin 64 N.C.
Pin 65 N.C.
Pin 66 CAN-L network (transit) **not used**
Pin 67 CAN-H network (transit) **not used**
Pin 68 Conditioner compressor command.
Pin 70 Positive power from F18 7.5 A.
Pin 71 N.C.
Pin 72 Engine control system main relay command
Pin 73 CNG pressure valve (shut-off valve) **not used**
Pin 74 N.C.
Pin 75 CNG tank valve **not used**
Pin 76 Key accessories switch **not used**
Pin 77 CNG tank pressure sensor **not used**
Pin 78 N.C.
Pin 79 Signal from accelerator pedal potentiometer “POT. 1”
Pin 80 Clutch potentiometer **not used**
Pin 81 N.C.
Pin 82 N.C.
Pin 83 N.C.
Pin 84 Reversing switch signal
Pin 85 N.C.
Pin 86 N.C.
Pin 87 Stop lights switch signal
Pin 88 CAN C-CAN-L network
Pin 89 CAN C-CAN-H network
Pin 90 W Line fiat Code **not used**
Pin 91 N.C.
Pin 92 N.C.
Pin 93 N.C.
Pin 94 Engine revs signal **not used**

Revs sensor

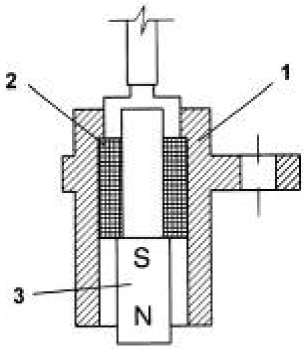


Type
The revs sensor is inductive, and so functions through variations in the magnetic field generated by the passage of the teeth of the phonic wheel (60-2 teeth).

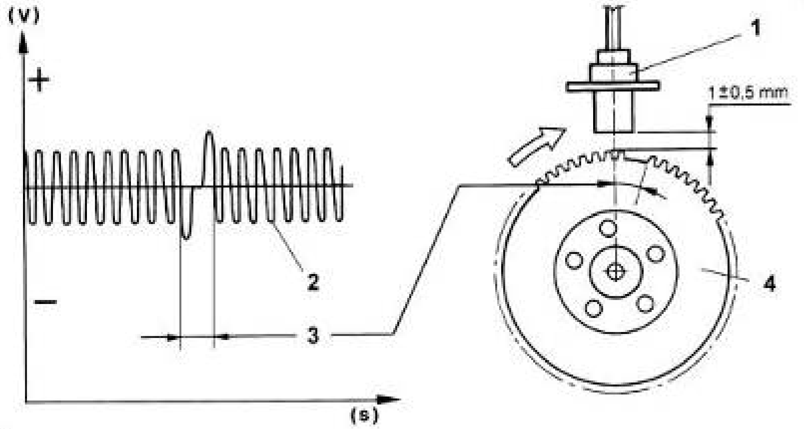
Function
The Engine Control Module uses the revs sensors signal to:
- Determine crankshaft rotation speed
- Determine crankshaft angular position.

Location
The engine revs sensor is mounted on a bracket fastened to the engine block “facing” toward the phonic wheel mounted on the crankshaft pulley.

Specifications and function



The sensor consists of a tubular sheath (1) which contains a permanent magnet (3) and an electrical winding (2).
Due to the passage of the phonic wheel teeth, the magnetic flux created by the magnet (3) oscillates due to the variation in the gap.
This oscillation induces an electromotive force in the winding (2), alternately generating a positive voltage (tooth facing sensor) and negative voltage (valley facing sensor) at the winding terminals.



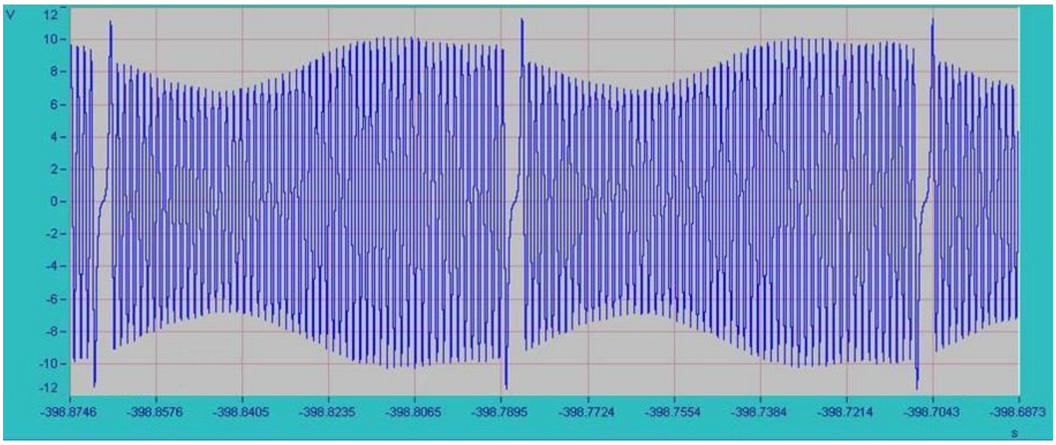
Key
1. Sensor
2. Output signal
3. Signal corresponding to two missing teeth
4. Crankshaft pulley with phonic wheel

Other factors being equal, the peak voltage output by the sensor depends on the distance between the sensor and tooth (gap)
The phonic wheel has sixty teeth, two of which remove to create a reference point. Each tooth therefore corresponds to an angle of 6° (360° divided by 60 teeth).
The timing point is recognized at the end of the first tooth after the two spaces: when this transits under the sensor, the engine has pistons 1-4 at 114° before top dead centre.

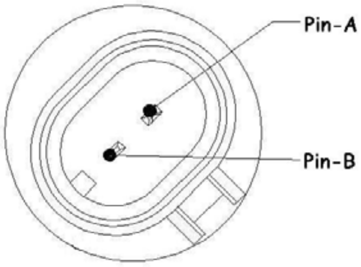
Electrical specifications
Resistance at the sensor terminals is 860 Ω +/- 20% at 20°C.

Mechanical specifications
The required distance (gap) between the phonic wheel and the sensor to obtain correct signals must be between 0.5 - 1.5 mm.

Example of revs signal obtained with the oscilloscope

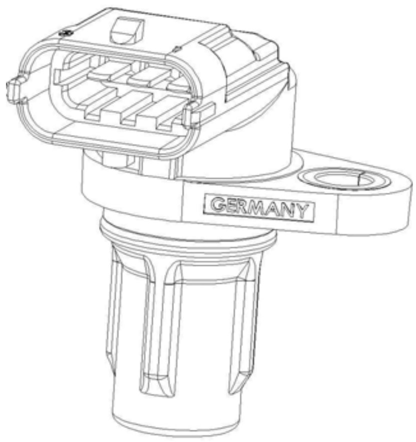


Electrical connections



Pin	Signal
Pin A	Signal +
Pin B	Signal -

Timing sensor

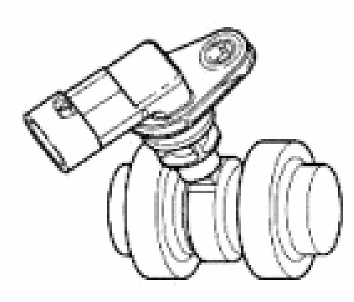


Type
The timing sensor is a “Hall” effect type sensor. A wafer of semiconductor with current, immersed in a normal magnetic field generates a potential difference at its terminals, known as the Hall effect.

Function
The timing sensor is used by the Engine Control Module along with the revs and TDC signals to recognize the position of the cylinders and determine injection and ignition point.

Location
The timing sensor is located on the upper head in a specific housing, and faces toward the camshaft, intake side.

Specifications and function

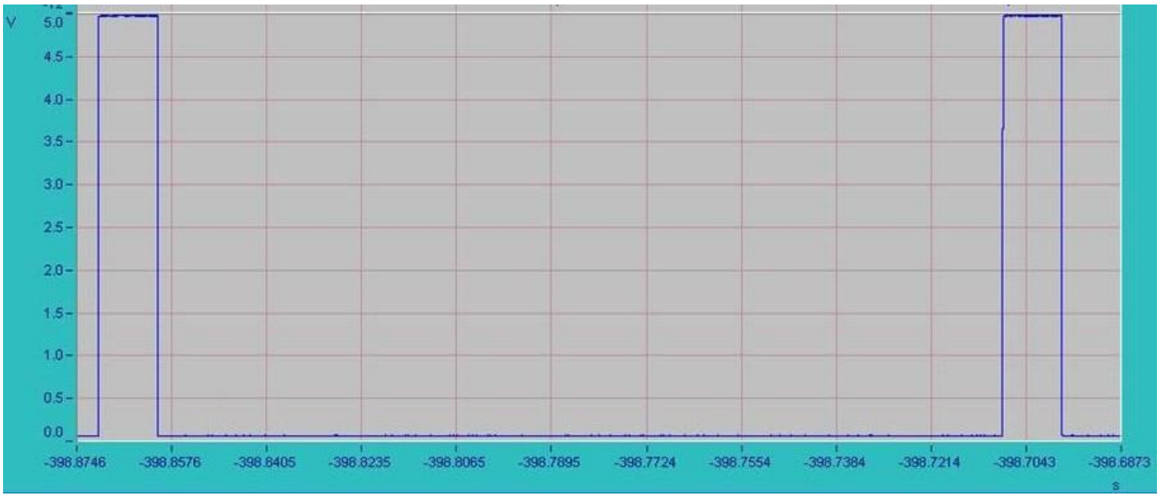


A wafer of semiconductor with current, immersed in a normal magnetic field (force lines perpendicular to the current direction) generates a potential difference at its terminals, known as the Hall effect.
If the current intensity remains constant, the voltage generated only depends on the intensity of the magnetic field. It is thus sufficient that the intensity of the magnetic field varies periodically to obtain a modulated electrical signal, the frequency of which is proportional to the rate at which the magnetic field varies.
To obtain this change, the distance between the sensor and the phonic wheel on the intake camshaft is varied, in this case utilizing the valve timing reference notch.
As the pulley rotates the distance varies and a high voltage signal generated on passage of the reference notch

Electrical specifications
Power supply 5V +/- 10%
Maximum voltage 16V

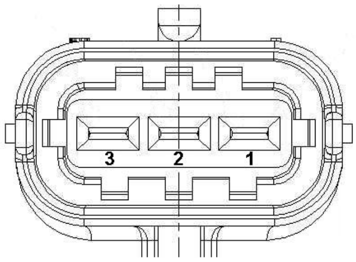
Mechanical specifications
Gap 1 +/- 0,5 mm
Fastener torque 8 +/- 1.6 Nm

Example of timing signal obtained with the oscilloscope



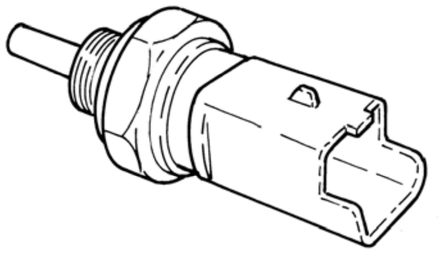
Note: the sensor is powered directly by the Engine Control Module

Electrical connections



Pin	Signal
Pin 1	Ground
Pin 2	Signal
Pin 3	5V power supply

Engine coolant temperature sensor

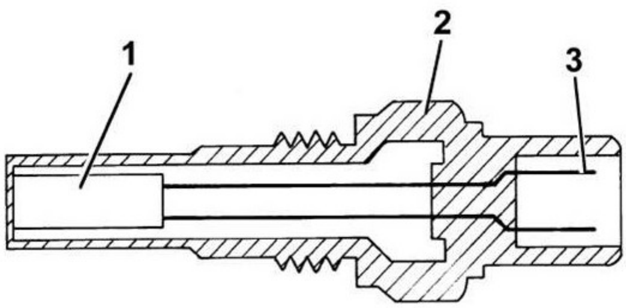


Type
This is an NTC type sensor (Negative Temperature Coefficient).

Function
The engine coolant temperature sensor is used by the Engine Control Module to calculate engine temperature.
To provide a signal, the sensor element varies its resistance according to temperature,

Location
The temperature sensor is mounted on the thermostat cup.

Specifications and function



Key

1. NTC element
2. Sensor body
3. Electrical connector

For the NTC element the reference voltage is 5V. Since the Engine Control Module input circuit is designed as a voltage splitter, this voltage is split between a resistor in the Engine Control Module and the NTC resistor in the sensor.
The Engine Control Module can thus evaluate the variations in sensor resistance through changes in voltage and thereby obtain temperature information.

Electrical specifications
5V power supply
Maximum current 2.5 mA
Maximum power at 25 °C 15 mW

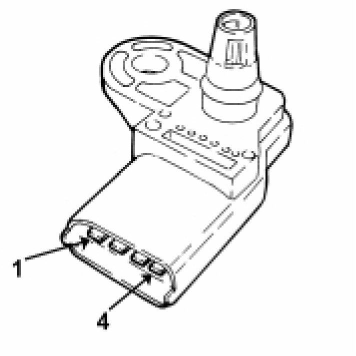
°C / Ω comparison table Indicated and nominal internal resistance			
°C	**Ω**		
-40	48805	50	806,9
-30	27414	60	575,8
-20	15971	70	418,1
-10	9620	80	308,6
0	5975	90	231,2
10	3816	100	175,7
20	2502	110	135,2
25	2044	120	105,4
30	1679	130	83,1
40	1152	140	66,2

MBCManical specifications
Tightening torque 22 Nm

Electrical connections

Pin	Signal
Pin 1	signal
Pin 2	ground

Absolute air pressure and temperature sensor



Type
The sensor incorporates
- An NTC (Negative Temperature Coefficient) sensor, to measure intake air temperature;
- A pressure sensor consisting of a Wheatstone bridge printed onto a ceramic membrane.

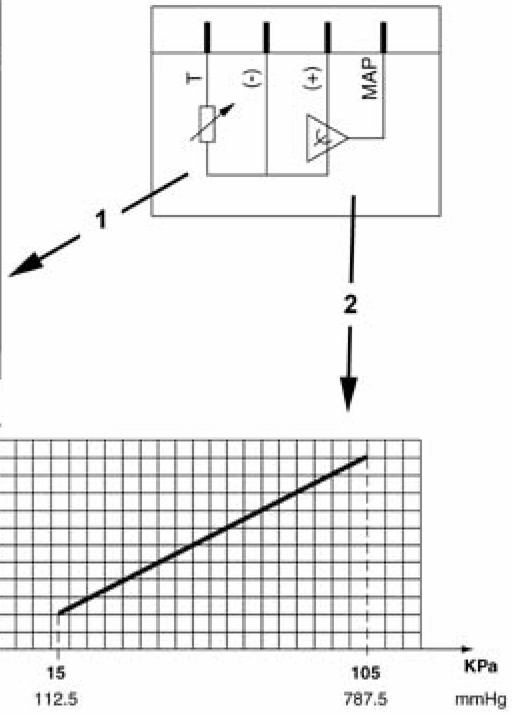
Function
The intake air pressure and temperature sensor is used by the Engine Control Module to:
- Calculate pressure in the intake manifold downstream of the throttle
- Calculate temperature in the intake manifold downstream of the throttle

This information is used by the BCM to define the quantity of air drawn in by the engine. It is then used to calculate injection time and ignition point.

Location
The air pressure and temperature sensor is mounted on the intake manifold

Specifications and function

T °C	Ω	T °C	Ω
-40°	49.933	+60	0.578
-30	26.628	+70	0.419
-20	15.701	+80	0.309
-10	9.539	+85	0.263
0	5.959	+90	0.231
+10°	3.820	+100	0.176
+20	2.509	+110	0.135
+25	2.051	+120	0.105
+30	1.686	+125	0.092
+40	1.157	+130	0.083
+50	0.810		



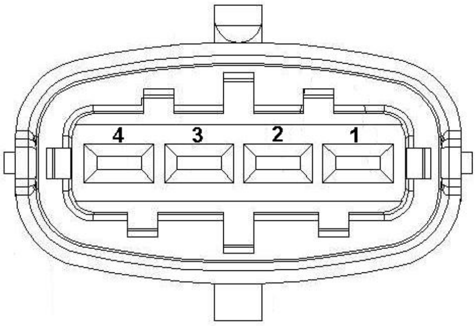
Temperature sensor

The air temperature sensor consists of an NTC (Negative Temperature Coefficient) thermistor.
The resistance of the sensor decreases as temperature increases.
The control unit input circuit splits the 5V reference voltage between the resistors of the sensor and a fixed reference, obtaining a voltage proportional to resistance, and thus temperature.

Absolute pressure sensor

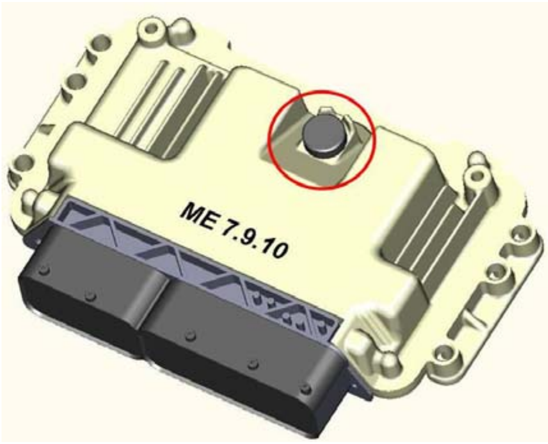
The sensitive element of the pressure sensor consists of a Wheatstone bridge printed onto a ceramic membrane.
The face of the membrane has the absolute reference vacuum, while the vacuum present in the intake manifold acts on the other face
The signal (piezoresistive) deriving from deformation of the membrane, prior to being sent to the BCM, is amplified by an electronic circuit in the mounting that houses the ceramic membrane.
With engine off, the diaphragm deflects according to atmospheric pressure. With key-on this is translated into altitude information.
With engine running, the effect of the vacuum causes a mBCManical effect on the sensor membrane, which deforms, varying the resistance value.
Since the power supply is maintained strictly at 5V by the control unit, varying resistance varies output voltage.

Electrical connections



Pin	Signal
Pin 1	Ground
Pin 2	Air temperature sensor signal
Pin 3	5V power supply
Pin 4	Air pressure in intake manifold signal

Atmospheric pressure sensor

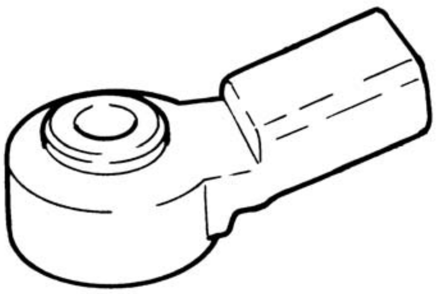


Type
The atmospheric pressure sensor serves to measure atmospheric pressure

Location
The sensor is built-in to the Engine Control Module

Specifications and function
The information is used by the BCM to correct the quantity of air drawn in by the engine according to altitude.
The information is used to calculate injection time and ignition advance.

Pinging sensor

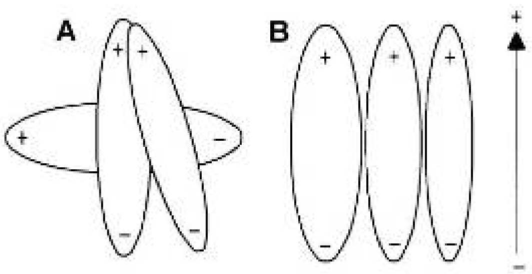


Type
The pining sensor is piezoelectric

Function
The sensor is used by the BCM to recognize any pre-ignition in the combustion chamber

Location
The sensor is mounted on the engine block to the rear and measures the intensity of vibration caused by pre-ignition in the combustion chamber.

Specifications and function



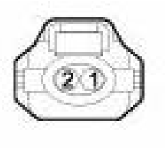
The molecules of a quartz crystal are electrical polarized.
In rest condition (A) the molecules have no particular alignment.
When the crystal is subjected to pressure or impact (B), the molecules align, the more organized the greater the pressure applied.
This alignment produces a voltage at the terminals of the crystal, which is interpreted and adapted over time (shifts due to engine ageing) by the BCM, allowing it to reduce ignition advance to eliminate the phenomenon.
After adjustment, advance is gradually restored to the base value.

A. Rest position
B. Under pressure position

Electrical specifications
The resistance at the sensor terminals is circa 4.87 Mohm +/- 20%

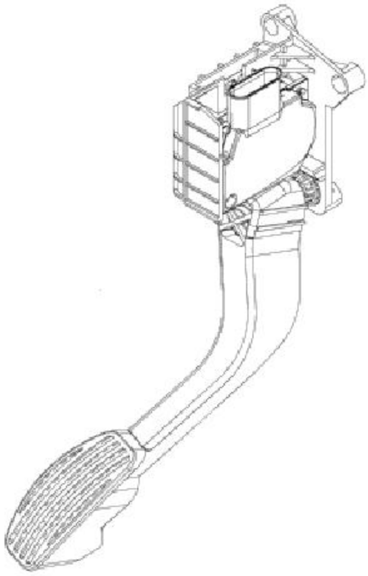
Mechanical specifications
The pinging sensor has to be tightened to a torque of 20 Nm +/- 20%

Electrical connections



Pin	Signal
Pin 1	signal
Pin 2	ground

Accelerator pedal sensor



Type
The accelerator pedal consists of two potentiometers, on master and the other as back-up, built-in to a single casing.

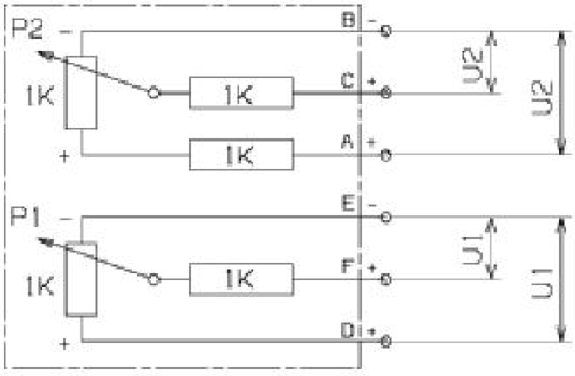
Function
The sensor is used by the engine control module to recognize accelerator pedal position in order to manage the torque demanded by the driver.

Location
The sensor is located on the accelerator pedal

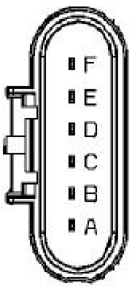
Specifications and function
The sensor consists of a casing, fastened to the accelerator pedal support, in which there is an axially mounted shaft connected to the two built-in potentiometers.
A spring on the shaft offers the right level of resistance, and another spring assures pedal return on release.
The injection control unit actuates the two “recovery” strategies in the following conditions:

- In case of failure of one of the two potentiometers, the control unit using the remaining track, without limiting torque, and controls plausibility with the brake pedal.
- In case of total failure of both potentiometers, it disables throttle aperture.

Accelerator pedal sensor circuit diagram



Electrical connections



Pin	Signal
Pin A	Potentiometer 2 5V power supply
Pin B	Potentiometer 2 ground
Pin C	Potentiometer 2 signal
Pin D	Potentiometer 1 5V power supply
Pin E	Potentiometer 1 ground
Pin F	Potentiometer 1 signal

Lambda probe

Sonda Pre Catalizzatore

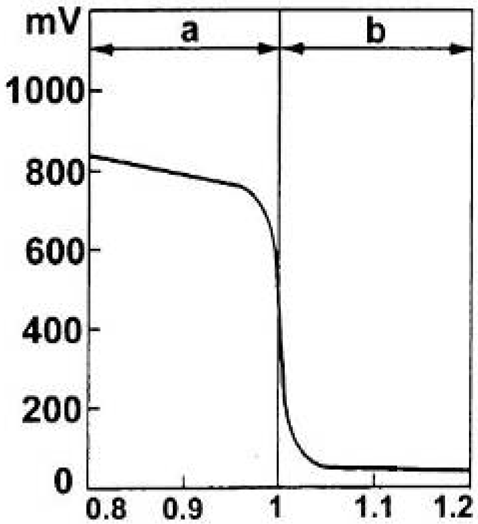
Sonda Post Catalizzatore

Type
The Lambda probes are **Bosch LSF4. 2** and are both planar

Function
The Lambda probes are used by the Engine Control Module to:

- ➢ Check combustion performance (stoichiometric ratio) (Pre Cat)
- ➢ Make self-adapting corrections (Pre Cat)
- ➢ Check the performance of the catalytic converter (post Cat)

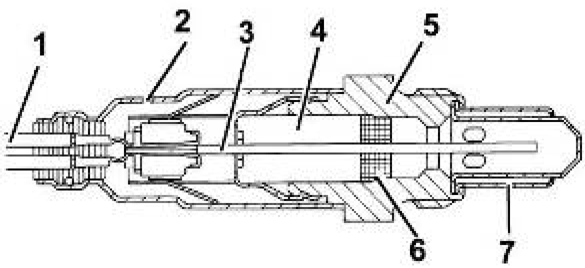
Note: to obtain an optimal mixture the quantity of air drawn in by the engine must be equal to the theoretical quantity required to burn all of the fuel injected.
In this case the lambda factor (l), or ratio between the quantity of air drawn in and the quantity theoretically required to burn all the injected fuel, is equal to 1.
Therefore:
Lambda = 1 ideal mixture
Lambda > 1 lean mixture
Lambda < 1 rich mixture



- ❖ Rich mixture (lacking air)
- ❖ Rich mixture (excess of air)

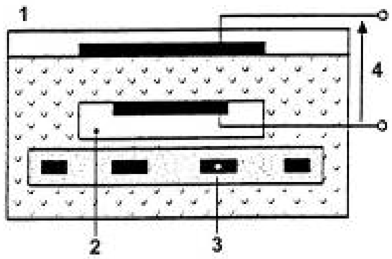
Location
The probes are mounted one upstream and the other downstream of the catalytic converter.

Specifications and function
On contact with exhaust gas, the Lambda probe generates an electrical signal, the value of which depends on the concentration of oxygen present in the gas.
This voltage is characterized by an abrupt variation when the composition of the mixture shifts from the Lambda = 1 value.
Lambda probe heating is managed by the injection control unit proportionally to exhaust gas temperature.
This prevents thermal shock to the ceramic body due to contact with condensation present in exhaust gas with engine cold.
The measuring cell and heater are built-n to the ceramic stratified element, with the advantage of obtaining rapid heating of the cell, so as to permit “closed loop” control (Lambda = 1) within 10 seconds of starting the engine.



Key
1. Connector
2. Protective sheath
3. Planar sensor element
4. Ceramic support tube
5. Probe seat
6. Ceramic gasket
7. Protective tube

Lambda probe function is based on the principle of an oxygen concentration cell with solid electrolyte. The surfaces of the measuring cell are coated with micro porous layers of noble material.

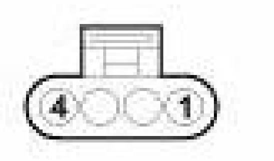


1. Side exposed to exhaust gas
2. Side exposed to atmosphere
3. Heating element
4. Terminals of probe with potential difference

Heater electrical specifications
Nominal voltage 12V
Maximum voltage 14V
Nominal power 7W
Resistance 9 Ohm at 20°C
Maximum current 2.1° at 13V

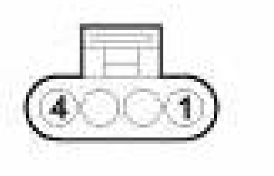
Tightening torque
45 +/-4.5 Nm

Electrical connections
Pre Catalyzer Probe



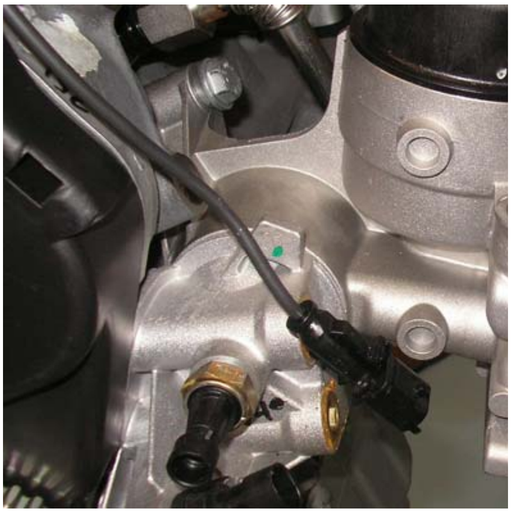
Pin	Signal
Pin 1	Signal
Pin 2	Signal ground
Pin 3	Heater command
Pin 4	12V power supply

Post Catalyzer Probe



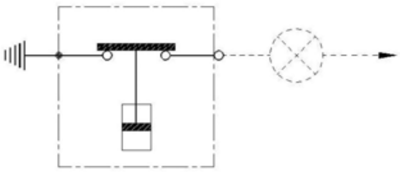
Pin	Signal
Pin 1	Signal
Pin 2	Signal ground
Pin 3	Heater command
Pin 4	12V power supply

Engine oil pressure sensor



Type
The sensor is manocontatto type.

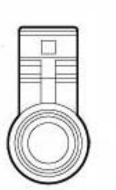
Function



The pressure sensor is used by the Engine Control Module to recognize the preset oil pressure value. This signal is sent via C-CAN network to the Body Computer Module to manage the logic for lighting the warning light on the instrument panel.

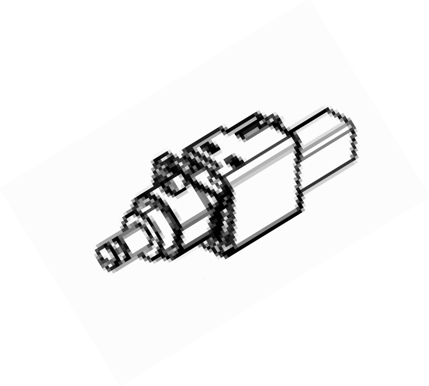
Location
The sensor is positioned on the engine oil filter support

Electrical connections



Pin	Signal
Pin 1	Connection with the Engine Control Module

Stop pedal switch



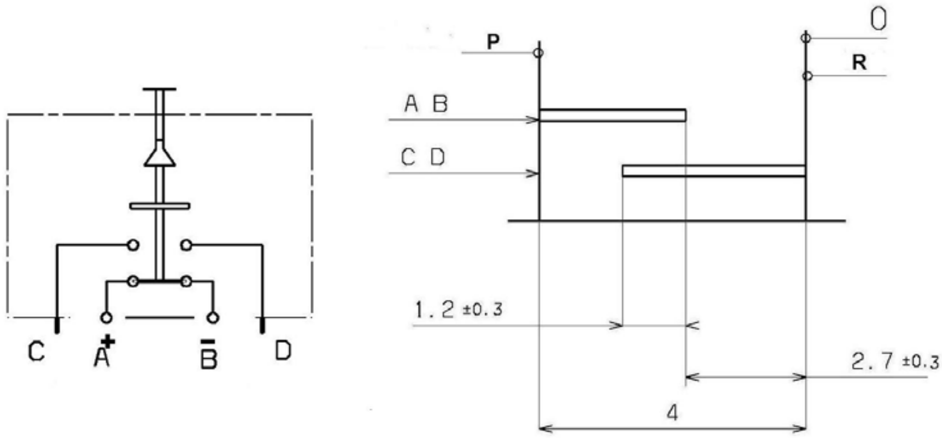
Type
Two-stage switch

Function
The stop pedal switch is used by the Engine Control Module to manage the strategies associated with drivability.

Location
The switch is located on the brake pedal

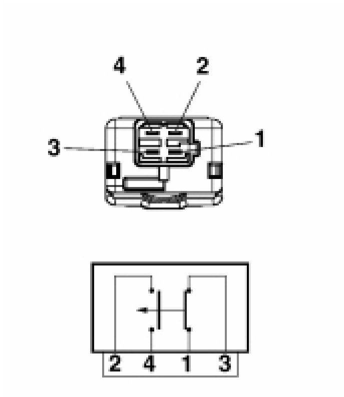
Specifications and function
The switch consists of a container with two switches, one normally open (NO) and the other normally closed (NC).
As the brake pedal is pressed the normally open (NA) switch closes while the normally closed switch (NC) opens, so the NC switch serves to recognize brake pedal at rest while the NO switch recognizes brake pedal pressed.
The figure below shows the electrical circuit with brake pedal pressed and the function diagram.

Note: on the Fiat 500, only the NO contact is connected to the Engine Control Module. The NC contact is connected instead to the Body Computer Module, which gives state information via C-CAN network



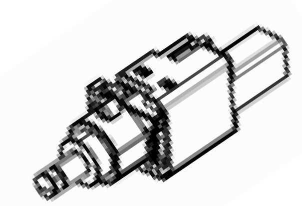
Key:
A. power supply positive
B. user power supply
C/D redundant control switch.
P brake pedal pressed state
R pedal released state
Note: at approx. halfway, both switches are closed. This situation is used for coherence control of the signals from the two switches.

Electrical connections



Pin	Table
Pin 1	normally closed switch signal
Pin 2	normally open switch signal
Pin 3	normally closed switch + key power supply
Pin 4	normally open switch + key power supply

Clutch pedal switch

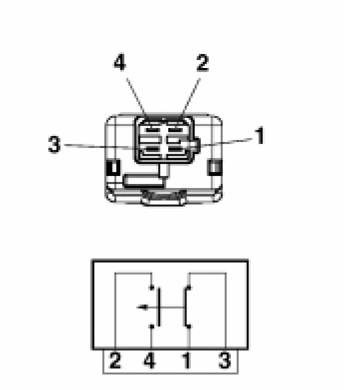


Type
Electrical switch
Function
The clutch pedal switch is used by the Engine Control Module to manage the strategies associated with drivability.

Location
The switch is located on the clutch pedal
Note: the switch is not present on versions with MTA gearbox.

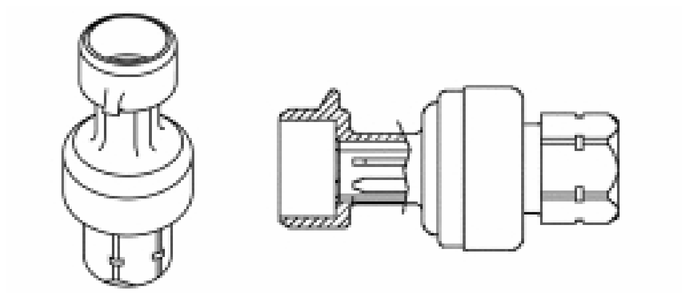
Specifications and function
The switch consists of a container with a normally open switch (NO) that closes when the clutch pedal is pressed.

Electrical connections



Pin	Signal
Pin 1	NC
Pin 2	connection to frame ground
Pin 3	NC
Pin 4	switch signal

Linear pressure sensor for air-conditioner



Type
Linear pressure switch for air-conditioning systems

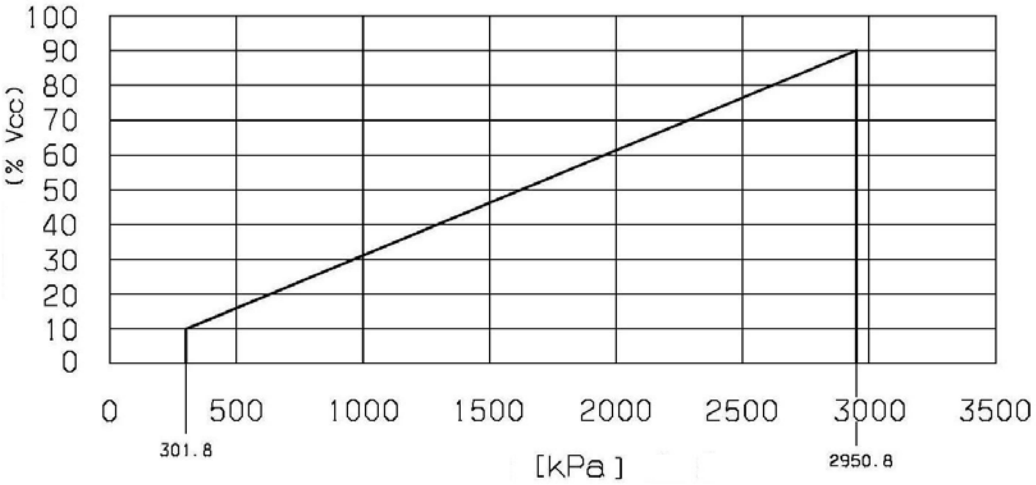
Function
The linear pressure switch measures pressure ins the cooling system on the high pressure branch. It is sued by the Engine Control Module to:

- command activation of the cooling system compressor safety function
- control activation of the engine cooling fan

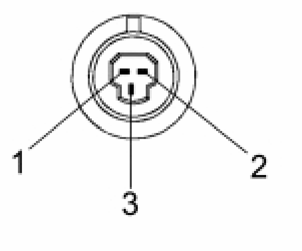
Location
It is mounted on the cooling system high pressure circuit

Specifications and function
Each variation in pressure corresponds to a voltage signal.
The range of the linear sensor varies from 3.018 bar to 29.508 bar according to the following characteristic curve of pressure (Bar) over percentage output voltage (%Vdc).
Compressor and fan activation according to pressure variation takes place in this range of pressures. Above and below this range the compressor is disabled as safety to prevent damage to the system.

Electrical specifications
Voltage 5V+/-10%
Temperature range -5°C - 80°C
Current 7mA Max
Mechanical specifications
Tightening torque 8.5 +/-3 Nm



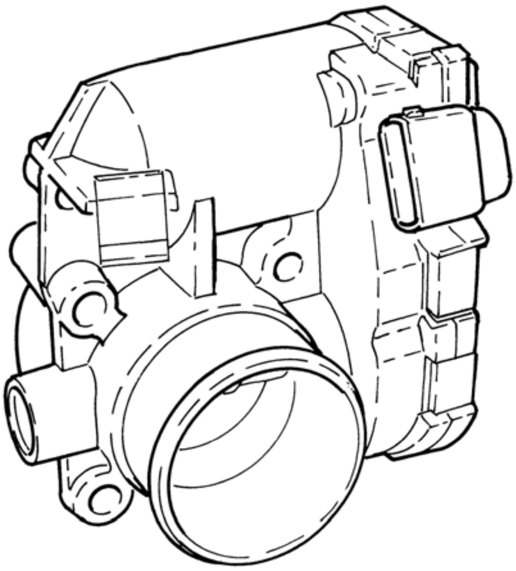
Note: In the diagram the pressures are expressed in KPa
Electrical connections



Pin	Signal
Pin 1	Ground
Pin 2	Power supply
Pin 3	Output signal

Note: power supply may vary by +/- 10% and sensor operating temperature is between 5°C and 80°C.

Motorized Throttle



Type
Throttle body with servo driven valve and position sensors

Function
The motorized throttle is used by the Engine Control Module to regulate the quantity of air drawn in by the engine.

Location
The motorized throttle is mounted on the intake manifold

Specifications and function
The ME 7.9.10 system pilots the throttle on the basis of torque demand.
The demand for torque may, for example, be evaluated on the basis of the signal from the accelerator pedal, this signal is processed by the Engine Control Module, which produces aperture laws accentuated to a greater or lesser degree.
The throttle is opened by a direct current servo motor with PWM signal, built-in to the throttle body.
Throttle aperture is between 0° and 80°, thus including idle speed regulation.
The throttle body has two integrated potentiometers, each controlling the other.
In case of failure of both potentiometers, or power failure, according to accelerator position, the Engine Control Module reduces engine torque:

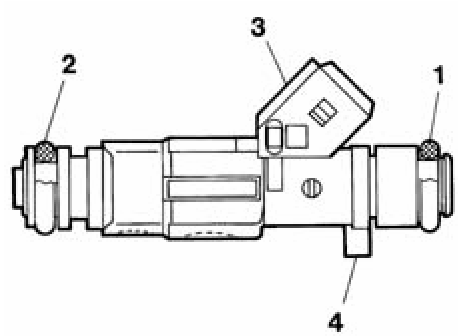
- Pressed full down, it cuts fuel to one or more pistons until reaching a maximum speed of 2,500 rpm.
- In intermediate positions, it cuts fuel to one or more pistons until reaching a maximum speed of 1,200 rpm.

Note: Replacement of the throttle body, Injection Control Module or intake manifold requires execution of the teach-in procedure.

Electrical connections

Pin	Signal
Pin 1	Throttle servo ground
Pin 2	TPS1 and TPS2 potentiometer ground
Pin 3	TPS1 and TPS2 potentiometer 5V positive
Pin 4	Throttle servo positive
Pin 5	TPS2 potentiometer signal
Pin 6	TPS1 potentiometer signal

Injectors



Key
1. Gasket on rail
2. Gasket on intake manifold
3. connector
4. Reference notch for correct mounting

Type
Bosch EV14 ET Top Feed injectors (fuel input from top of injector, where the electromagnet is).

Function
Used by the BCM to inject fuel into the intake ducts behind the intake valves.

Location
Fastened in specific seat in the intake manifold and facing the ducts of the two intake valves. They are connected by a common feed pipe fitted with a bleed valve.

Specifications and function

The injector consists of:

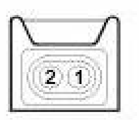
- A central body housing the command solenoid, connected to its connector,
- the shutter-sprayer assembly,
- the gaskets, one between injector and Rail connection, the other between injector and intake manifold
- A reference notch for correct injector alignment

The injectors are double-jet type (with spray inclined with respect to the injector axis), specific for 4-valve per cylinder engines, and are designed to suitably direct the fuel jet toward the intake valves.

The injectors are commanded by a ground command from the Engine Control Module in a timed sequential manner. This means that the four injectors are commanded according to the firing order. Injection already can start for each cylinder in the expansion phase, up to intake phase already started. When the Engine Control Module closes the circuit to ground, the winding is charged and generates a magnetic field that attracts the shutter, opening the passage for pressurized fuel through the sprayer. The quantity of fuel injected depends on the shutter opening time, which in turn depends on the length of time the electromagnet is excited. This time, called injection time, is calculated by the Engine Control Module according to engine operating conditions.

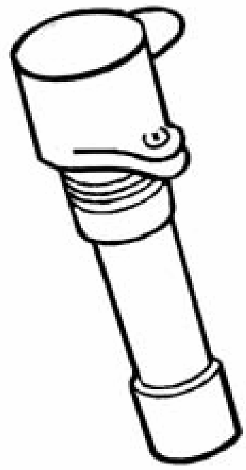
Electrical specifications
Tensione di alimentazione 12 V
Resistenza 14,5 ± 5% ohm.

Collegamenti elettrici



Pin	Segnale
Pin 1	Alimentazione + 12 v
Pin 2	Comando a massa da nodo Controllo Motore

Ignition coils



Type
The coils are “plug top” type directly connected to the spark plugs
Function
Le bobine di accensione vengono utilizzate dal Nodo Controllo Motore per alimentare le candele di accensione con tensioni elevate

Location
The coils are installed on the rocker cover inside the plug recesses present on the cylinder head, and are connected by a heavily insulated high tension cable to the spark plugs.

Specifications and function
The coils consist of a magnetic core (double E) made up of a laminar pack, in silicon steel, at the head of the coil. The primary and secondary coils are wound around the core.
The windings are inserted in a molded plastic container with the low voltage connected and the bush fastening to the cylinder head, and is insulated by being immersed in epoxy resin that has optimal dielectric properties, since the coils are exposed to high temperature. The head of the coil is connected to the spark plug by a silicon rubber cap that contains a spring that transfers the high tension from the secondary winding to the spark plug terminal.
The coils are commanded directly by the Engine Control Module in a sequential timed manner.
The power drivers are built-in to the Engine Control Module
When the Engine Control Module grounds the primary circuit a strong magnetic field is generated in the primary winding. When the primary circuit is opened, a high voltage is generated by induction in the secondary coil.
This high tension discharges to ground through the spark plug electrodes.
generating the spark that ignites the fuel/air mixture.

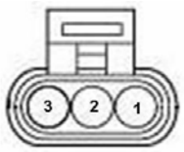
Note: the type of spark depends on the dielectric between the two electrodes

The Engine Control Module closes the primary circuit, taking account of the calculated ignition advance and coil charging time.

Electrical specifications
Primary circuit resistance 0.5 Ω ± 10% at 23°C
Secondary circuit resistance 6300 Ω ± 10% at 23°C

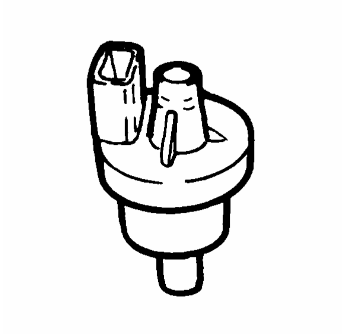
Mechanical specifications
Coppia di serraggio della vite di fissaggio alla semitesta superiore 8 +/-1 Nm

Collegamenti elettrici



Pin	Segnale
Pin 1	Comando a massa da nodo Controllo Motore del circuito primario
Pin 2	Collegamento alla massa del motore circuito secondario
Pin 3	Alimentazione + 12 V circuito primario

CANISTER solenoid valve

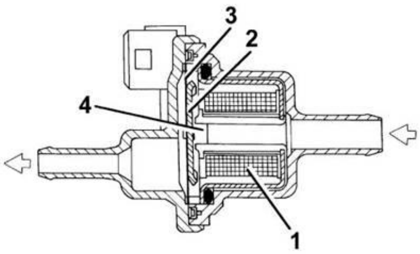


Type
Normally open electrovalve for fuel vapor recirculation.

Function
E' utilizzata dal Nodo Controllo Motore per pulire il filtro a carboni attivi dell'impianto antievaporativo

Ubicazione
It is mounted in the lower part of the intake manifold, in a position not visible.

Specifications and function

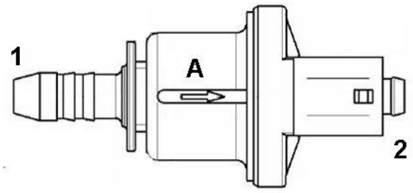


The solenoid valve consists of a plastic outer casing containing an electromagnet and a shutter. Externally there are two sockets for connecting the anti-evaporation system piping.
The solenoid valve is commanded in PWM by the Engine Control Module on the basis of the mapped strategies.
When the electromagnet (1) is excited, it attracts the shutter (2) that overcomes the force of the leaf spring (3), closing the hole (4) and prevent passage of fuel vapor.
If not excited, the valve is normally closed, preventing fuel vapor from excessively enriching the mixture.

Electrical specifications
Tensione alimentazione: 13.5 V
Resistenza a 20°C: 26 ohm
Frequenza di pilotaggio: fino a 30 Hz
Corrente assorbita a 13.5 V: 0.5 A

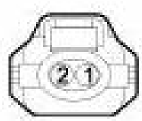
Caratteristiche meccaniche

Always mount the valve in the direction indicated in the figure by arrow A. When mounting the valve,



Key
1. CANISTER side socket
A arrow toward flow.
2. intake side socket

Electrical connections

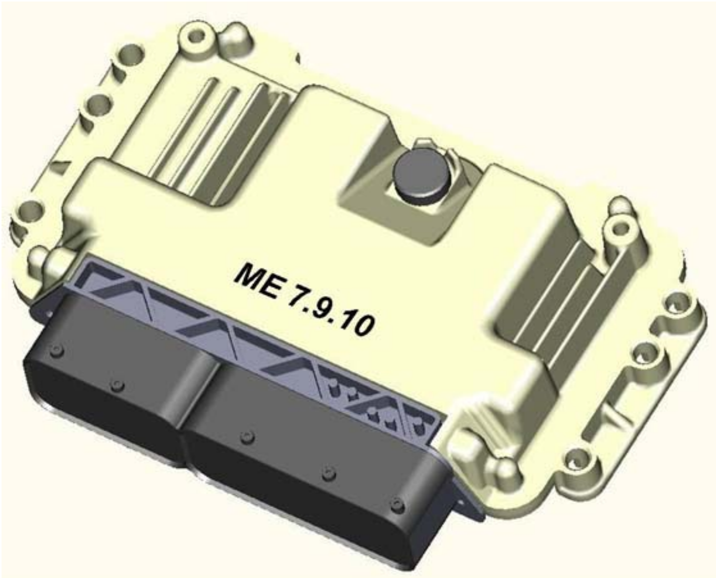


Pin	Signal
Pin 1	Alimentazione + 12 V
Pin 2	Comando a massa da Nodo Controllo Motore

Engine Management

Introduction

This chapter describes the functional strategies adopted by the Engine Control Module



Injection system

The essential conditions that must always be met in preparing the fuel-air mixture for optimal function of a controlled ignition engine are mainly:

- The “dosing” (air/fuel ratio) must be kept as close as possible to the stoichiometric value;
- The “regularity” of the mixture, consisting of petrol vapor, diffused as finely and as uniformly as possible in the combustion air.

In order to assure:

- The necessary speed of combustion, preventing unnecessary fuel consumption and excessive exhaust emissions;
- The integrity and efficiency over time of the catalyzer.

To calculate the air/fuel mixture ratio, the Engine Control Module uses an indirect type measurement system known as “SPEED DENSITY-LAMBDA”, meaning angular rotation speed, intake air density and mixture control (retroactive control).
In practice, the Engine Control Module uses ENGINE SPEED (RPM) and AIR DENSITY (pressure and temperature) to measure the quantity of air drawn in by the engine.
The quantity of air drawn in by each cylinder, for each engine cycle depends not only on the density of the air, but also on the unitary displacement, volumetric efficiency and eventual turbo charging.

- Air density is understood as that of the air drawn in by the engine and calculated according to the absolute pressure and temperature, both measured in the intake manifold.
- Volumetric efficiency is understood as the parameter related to the cylinder filling coefficient computed on the basis of experimental tests carried out on engines over the entire range of operation and subsequently memorized in the Engine Control Module.

Having established the quantity of air drawn in, the Engine Control Module has to provide the quantity of fuel according to the required ratio.
The injection end pulse or delivery timing is contained in a map memorized in the Engine Control Module and varies according to the engine speed and intake manifold pressure.
In practice, this is a process that the electronic control unit runs to command timed and sequential aperture of the four injectors, one for each cylinder, for the time strictly necessary for forming the fuel-air mixture as close as possible to the stoichiometric ration.

The fuel is injected directly into the manifold in the vicinity of the intake valves at a delivery pressure of 3.5 bar. Since the system is returnless, the variations in injected quantity generated by the variation in intake manifold pressure are compensated by the Engine Control Module through the injection times.
Since the engine management system is based on torque management, the quantity of fuel is always calculated considering the factors that determine increase or decrease in torque, naturally based on the previous concepts on computing the air/fuel ratio.
The other sensors in the system (accelerator pedal, coolant temperature, throttle position, battery voltage, etc.) allow the Engine Control Module to correct the base injection time throughout the full range of engine operating conditions.

Ignition system

The ignition system is static inductive spark type, meaning without high tension distributor with power modules inside the injection-ignition control module.
The primary of each coil is connected to the power relay (so powered by battery voltage) and to the pins of the electronic control unit for connection to ground.
As in the case of fuel injection, control is timed sequential type.
After starting, the Engine Control Module controls base ignition advance based specific maps according to:

- Engine speed
- Absolute pressure value (mmHg) measured in the intake manifold.
- Engine temperature

Ignition advance is corrected, as in fuel injection, by the torque management strategy.
The cylinder spark plugs are connected directly to the terminals of the coil secondary winding (one per spark plug).

Self-teaching

The Engine Control Module implements self-teaching logic in the following conditions:

- Removal/replacement of substitution o the injection control module
- Removal/replacement or substitution of the throttle body

The values memorized by the Engine Control Module are maintained even with battery disconnected.

Functional strategies

The main functions of the system are as follows:

- Fiat CODE recognition
- Fuel pump control
- Cylinder position recognition
- Engine starting strategy
- Cold starting control
- Engine torque management
- Idle speed management
- Injection time regulation
- Enrichment on acceleration control
- Fuel cut-off on release
- Ignition advance regulation
- Pinging control
- Engine maximum speed control
- Controllo combustione con sonda lambda;
- Controllo elettroventola raffreddamento motore.
- Air-conditioning system control
- Emissions control systems
- Recovery and self-diagnosis
- Self-adaptation

Fiat CODE recognition
When it receives the key to "RUN" signal, the Engine Control Module sends the IMMO request to the Body Computer module. If the key is recognized, the Body Computer responds (IMMO code) allowing the Engine Control Module to start the engine

Note: The starter motor is commanded directly by the key and not by the Engine Control Module.

Communication between the two modules is via C-CAN line.

Note: the latest versions no longer use the W recovery line

Fuel supply – fuel pump control
The Engine Control Module powers the fuel pump:

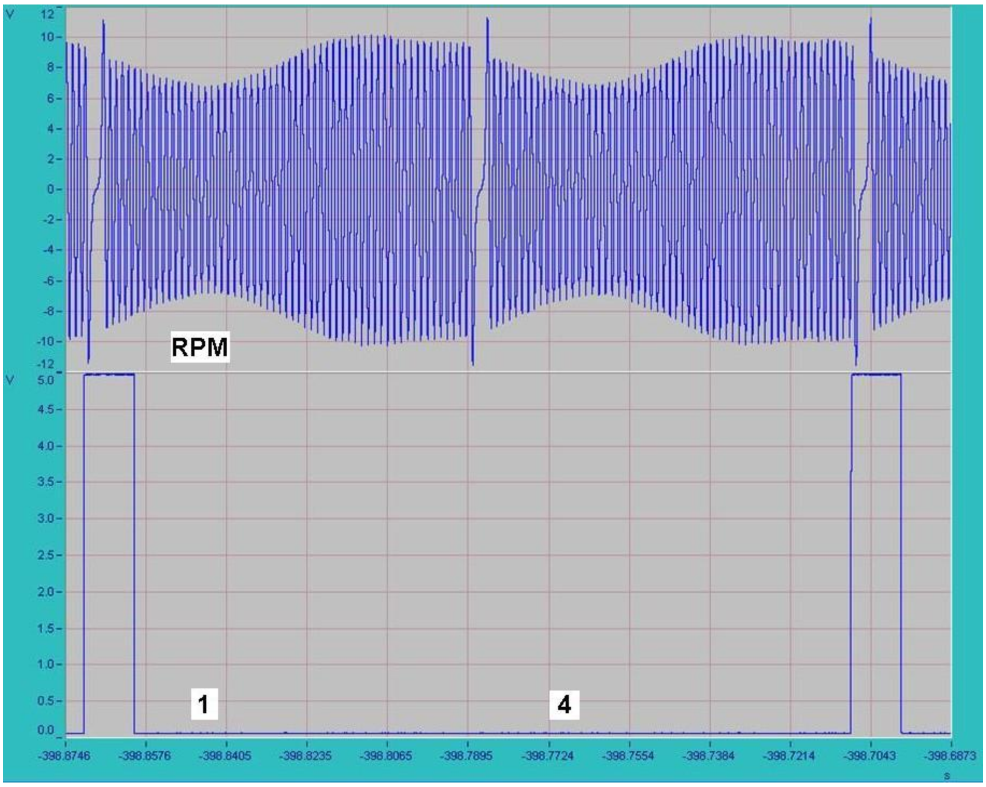
- With key on for 0.8 sec.
- With key to RUN and engine revs > 20 rpm.

The Engine Control Module cuts power to the pump:

- With key to STOP
- With engine revs < 40 rpm.

The fuel system is returnless type with constant 3.5 bar pressure.

Cylinder position recognition
The engine timing signal, along with the engine revs signal and top dead centre signal (TDC), allows the control unit to recognize the succession of cylinders in order to command timed sequential injection and ignition
The signal is generated by a Hall effect sensor mounted opposite a phonic wheel on the intake camshaft.
As can be seen in the graph, with the two missing teeth on the shaft phonic wheel aligned with the timing notch,(sensor signal high), the next cylinder in compression will be cylinder n. 1, otherwise without the two spaces and timing notch (sensor signal low) cylinder 4 is the next in compression.



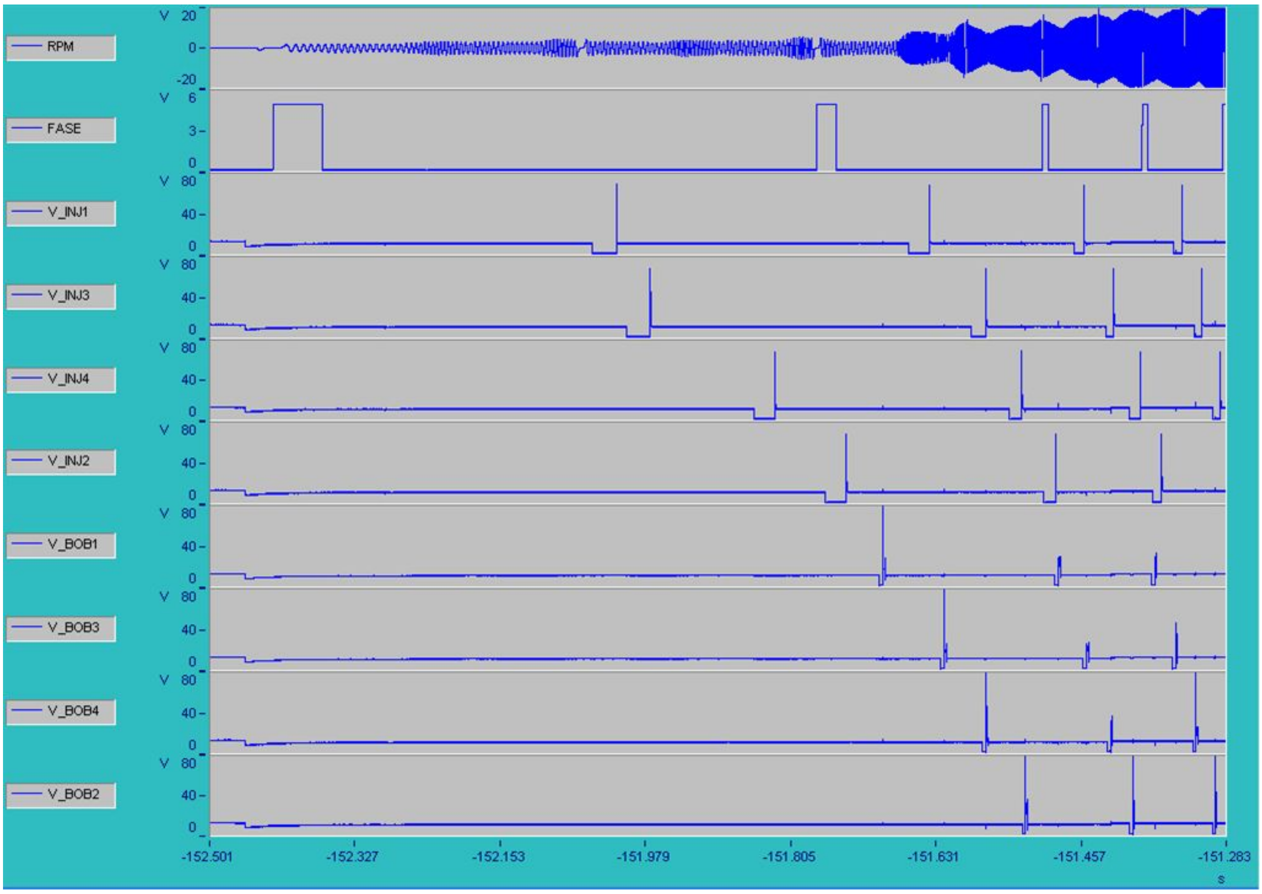
Key
RPM segnale giri
1-4 coppia dei cilindri 1-4

Engine starting strategy
When starting, the Engine Control Module reads engine temperature and establishes the appropriate injection time and ignition advance.
After passing the 20 rpm threshold, engine timing is recognized and the Engine Control Module commands the ignition coils in timed sequence.
Timed sequential mode is used on starting to reduce unburned hydrocarbon emissions from the exhaust.
If the engine fails to start, the Engine Control Module reduces the quantity of fuel by a multiplication factor M to reduce the possibility of flooding the engine.

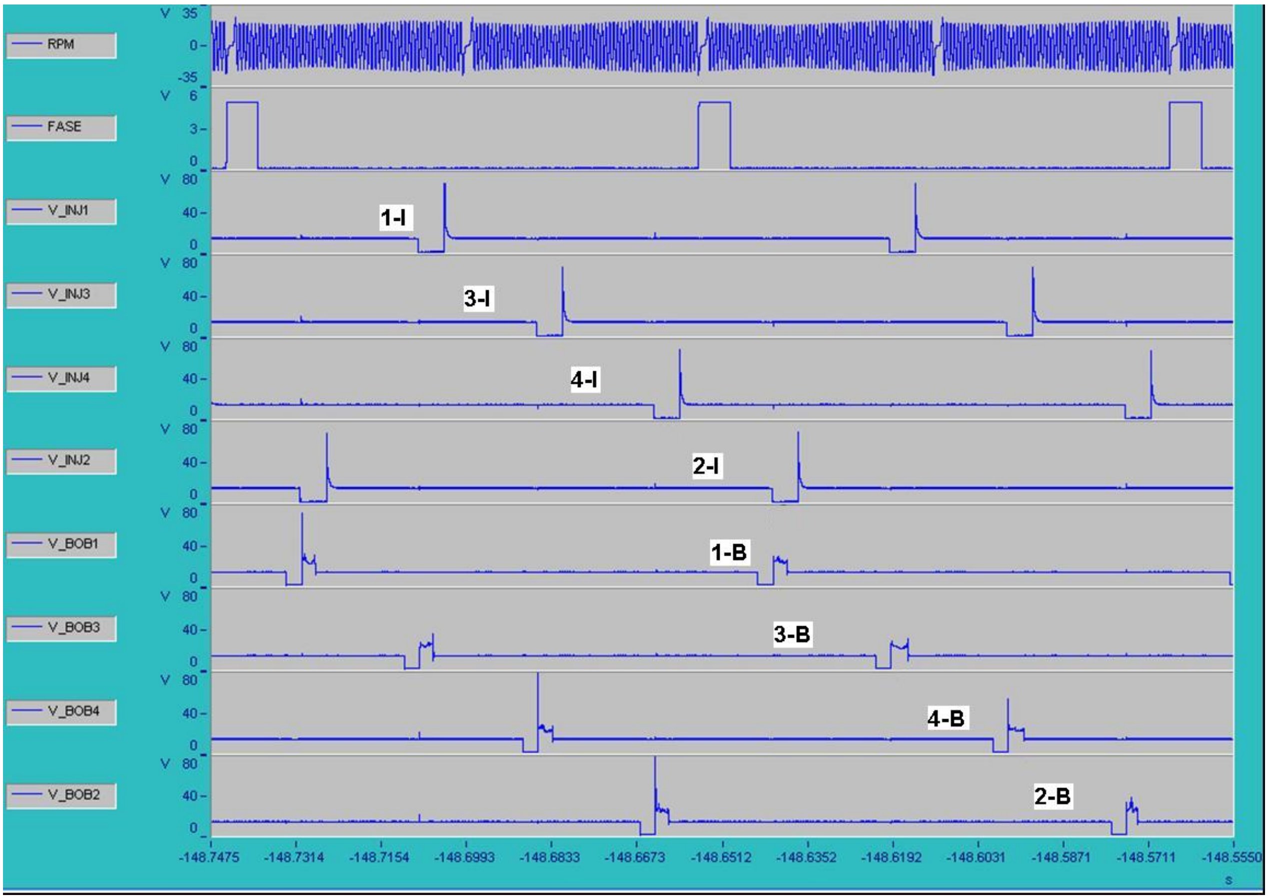
Note: The panels illustrated below have a solely educational purpose, and only serve to show that in the starting phase control is not FULL GROUP, but timed sequential, and to illustrate the signals panel with the engine starting

Signal panel with engine starting

Note: the firing order of the injectors and coils is 1,3,4,2



Signal panel with engine started



Key
RPM signal
Timing signal
V_INJ1 injector one command
V_INJ3 injector three command
V_INJ4 injector four command
V_INJ2 injector two command
V_BOB1 coil one command
V_BOB3 coil three command
V_BOB4 coil four command
V_BOB2 coil two command

Cold starting control

In cold starting conditions there is:

- A natural leanness of the mixture caused by poor low-temperature turbulence of the fuel particles
- Reduced fuel evaporation.
- Fuel condensation on the inner walls of intake ducts
- High lubricating oil viscosity.

The Engine Control Module recognizes this condition and corrects injection time according to.

- Engine coolant temperature
- Intake air temperature
- Battery voltage
- Engine revs

Ignition advance is regulated exclusively according to engine revs and coolant temperature.
Beneath a certain threshold,(from approx. 15 °C to approx. -25 °C) “multispark” starting mode is enabled.
This strategy, obtained by commanding the coils to give a rapid series of consecutive sparks, facilitates ignition of the cold mixture.
Engine idle speed decreases as temperature rises and the engine warms up

Torque management
In managing the various functional strategies, the Engine Control Module mainly uses torque control.
There are two torque delivery laws, defined as follows:

- Torque delivery with mBCManical law: this mode is used for high loads, in practice when the throttle reading is greater than the full load throttle position (95% of load) calculated according to engine revs.
- Torque delivery with controlled law (this mode is enabled when mixture ratio control is active).

The delivery range defined as “controlled” is when:
The Engine Control Module detects the demand for torque by the driver through the accelerator pedal.
After computing, it then acts on ignition advance, throttle aperture and injection times.
There are three main tables for calculating engine torque, these being

- Low loads calculation table
- High loads calculation table
- Reverse gear calculation table.

For the versions with SPORT function, a further three tables are included, these being.

- Low loads calculation table with SPORT function active
- High loads calculation table with SPORT function active
- Reverse gear calculation table with SPORT function active

Engine torque appraisal
The required torque is delivered from the engine to the wheel through the transmission (clutch, gearbox, transfer shafts, etc..)
The engine/transmission assembly may thus be seen as a system with an input, the torque delivered by effect of combustion of the air-fuel mixture, and an output, consisting of a series of kinematic quantities of interest, such as:

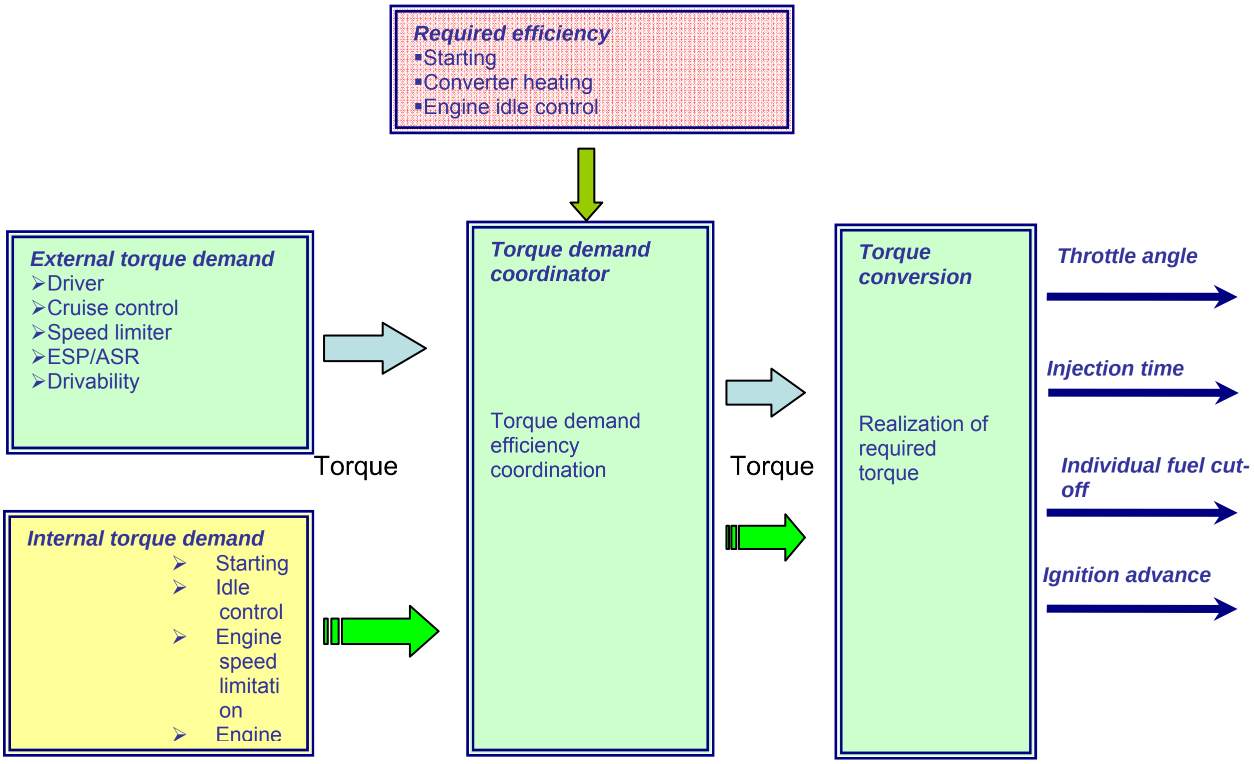
- The angular velocity of the crankshaft and flywheel.
- The angular acceleration of the wheels, linked by a proportional factor to speed and longitudinal acceleration.

The generation of torque by the engine can be broken down into two modes

- Rapid mode torque generation, varying only ignition advance.
- Slow mode torque generation, varying the throttle aperture angle

Note: the first mode activated is rapid torque
The application of torque has the immediate effect of increasing vehicle acceleration.
This will reach the new speed value after a series of oscillations, which may cause discomfort to the passengers (longitudinal accelerations, juddering).
The “DRIVABILITY” strategies serve to reduce this judder, though without introducing excessive delays between the demand for torque and its effective application.
The system can be described in the form of a block diagram, as shown in the following diagram:
In practice, an acceleration/deceleration demand by the driver is first translated into a demand for torque, and then into a demand for rapid torque or slow torque.
Once converted, rapid torque will be translated into an ignition advance value
Instead, once converted, slow torque will define the throttle aperture angle
Estimation of air intake allows the Engine Control Module to calculate the quantity of fuel, and thus the injector aperture time.

The following diagram gives a model of engine torque management.



Injection time regulation

The Engine Control Module calculates the injector aperture time and commands the injectors extremely rapidly and precisely according to engine point (number of revs and intake rate) determined by the demand for torque.

Being timed sequential, injection into each cylinder takes place at the optimal “injection start” point, maintaining the “injection end” point fixed.

The air flow rate is calculated on the basis of the following parameters.

- Pressure measured in the intake manifolds
- Air temperature in intake manifolds

Along with flow rate correction factors such as:

- Atmospheric pressure from sensor in the Engine Control Module.

Idle speed management

The Engine Control Module recognizes engine idling condition through the “released” position of the accelerator pedal

To control idle speed the Engine Control Module pilots the throttle valve according to the electrical loads present in the system

Idle speed when warm is 750 ± 50 rpm.

Electrical balance

The Engine Control Module implements electrical balance strategy on the basis of battery voltage

When battery voltage drops at a rate greater than a set threshold, the minimum target is increased (ramp).

Enrichment on acceleration control

In this phase, the Engine Control Module activates the most suitable torque control strategy for obtaining maximum possible torque according to the signals received from the following components

- Accelerator pedal potentiometer.
- Revs and TDC sensor

Base injection time is increased according to

- Engine coolant temperature, throttle aperture
- Increased pressure in the intake manifolds

If a rapid variation in injection time is demanded when the injector is already closed, the Engine Control Module will reopen it (for an extra pulse), in order to compensate the mixture more rapidly. The subsequent injections will instead be increased according to the previously mentioned coefficients

Note: in ASR and ESP management the Engine Control Module is required to reduce torque and thus injection time as well as acting on the throttle and ignition advance

Fuel cut-off on release

When the accelerator is released, and over a predetermined engine speed threshold, the Engine Control Module

- Cuts-off fuel to the injectors
- Restores fuel to the injectors at 2000 rpm in 1st gear, at 1320 rpm in 2nd, 3rd and 4th gear, at 120rpm in 5th at 1120 rpm in 6th and at 1480 rpm in reverse.

Without fuel, engine sped drops more or less rapidly according to vehicle travelling conditions
Engine deceleration is checked before reaching idle speed, and if greater than a certain value, fuel is partially restored to accompany the engine gently to idle speed
The fuel cut-off and restore thresholds can vary according to

- Engine coolant temperature
- Vehicle speed
- Engine revs.

Vehicle drivability strategy

Drivability strategies include all the actions the Engine Control Module carries out to reduce longitudinal oscillation caused by vehicle dynamics in speed transitions, to render use of the vehicle as comfortable as possible.

Note: transitions are understood as more or less accentuated accelerations and decelerations due to actions on the accelerator pedal and gear changes.

The Engine Control Module recognizes acceleration and deceleration transitions through

- The accelerator pedal sensor
- The clutch and brake pedal switches,

and intervenes on torque management, adapting it through the calculation modules called TIP-UP and TIP-DOWN
According to the situation, the Engine Control Module works by setting rapid torque control, acting on ignition advance, and if this is not sufficient, a slow torque control acting on throttle aperture and consequently on injection times

Ignition advance regulation

The Engine Control Module, thanks to the maps memorized in it, is capable of calculating ignition advance on the basis of

- Engine load (idle, partial, full, according to engine revs and air flow-rate).
- Intake air temperature
- Engine coolant temperature

Ignition can be retarded selectively cylinder by cylinder, through the combination of the value recorded by the revs sensor and the “timing” data

Pinging control

The Engine Control Module detects the presence of pre-ignition (pinging) by processing the signal from the corresponding sensor.
The Engine Control Module constantly compares the signals from the sensor with a threshold value, which is in turn constantly monitored to take account of background noise and engine ageing
The Engine Control Module is thus able to detect pining (or incipient pining) in each individual cylinder, and consequently reduce ignition advance non the cylinder affected (in 3° steps up to a maximum of 6°) until the phenomenon ceases. After this, advance is gradually restored to the base value (in 0.8° steps)
In acceleration, a higher threshold is used, to take account of increased engine noise in that condition
The pining control logic also has a self-adapting function, which memorizes reductions in advance that repeat with a certain continuity, in order to adapt the mapping to the various conditions the engine finds itself in.

Engine maximum speed control

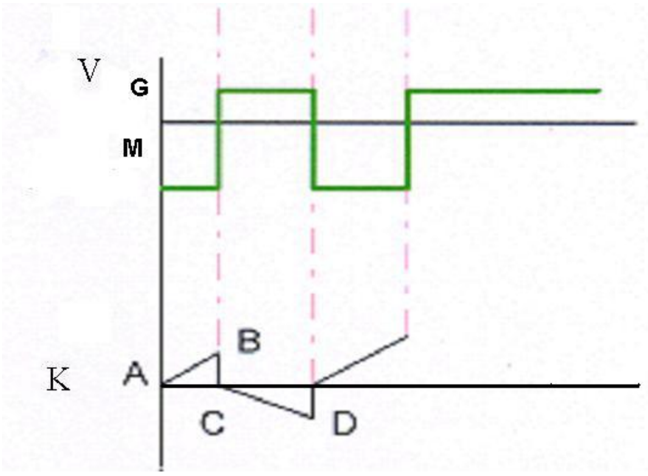
Maximum engine speed is controlled by the Engine Control Module, by limiting torque
First, the Engine Control Module cuts fuel by acting on injection time
If this is not sufficient, it closes the throttle.
The maximum number of revs is 7000 rpm for 10 seconds. If this time is exceeded, the limit drops to 6500 rpm.

Lambda probe combustion control

In EOBD systems the Lambda probes are mounted upstream and downstream of the catalytic converter.
The pre-catalyser probe determines 1st loop mixture ratio control (upstream probe closed loop).
The post-catalyser probe is used for catalytic converter diagnosis and to finely tune the 1st loop control parameters.
In this context, the adaptiveness of the second loop serves to recover both production tolerance and deterioration in the response of the pre-catalyser probes as they age and wear
This control is called 2nd loop control (post-catalyser probe closed loop). First loop mixture ratio control is activated when the pre-catalyser probe is able to provide a reliable signal, which happens a certain time after the engine starts
Probe activation time depends on the initial temperature of the engine
Second loop control is activated some time after first loop, for example,
if first loop mixture control starts 80 seconds after engine start, second loop mixture control starts after 450 seconds.

Note: the voltage of the downstream probe is approx. 630mV and is constant (if it starts to fluctuate, it means the catalytic converter is worn).

Fuel injection time correction strategy



Calculation of fuel injection time correction parameter K

Key
V Lambda probe voltage
G rich range
M lean range
K correction parameter
A;B;C;D variation points
In order to limit exhaust emissions, the air/fuel ratio of the mixture is controlled by means of a parameter, which we call K, which modifies the fuel injection time
This parameter is calculated by a suitable algorithm in the control module, considering only the rich/lean and lean/rich transitions of the probe voltage, V-probe.
In turn, this control strategy causes oscillation in the probe voltage
The K parameter calculation strategy is a compromise between the need to obtain mixture ratio shift of less than 3% while obtaining a high probe voltage oscillation frequency: in practical terms, a frequency of 2 Hz is achieved, since any higher will cause ratio error greater than 3%.

Note: the closer the probe is to the combustion chamber, the greater the possible probe voltage oscillation frequency
Note: according to Lambda voltage (lean-rich peak, up and down switching time value) the Engine Control Module carries out Lambda probe diagnosis.

Radiator cooling fan control
According to the engine coolant temperature, the Engine Control Module commands activation of the radiator fan:
- 1st speed cut-in temperature 97°C with hysteresis approx. 5°C.
- 2nd speed cut-in temperature 102°C with hysteresis approx. 5°C

There is then a further control (linear pressure sensor signal),that cuts-in the fan at speed 1 or 2 according to coolant gas pressure with air-conditioner running.
Without a coolant temperature signal, the Engine Control Module implements a recovery function by enabling fan speed 2 until the error ceases.

Connection with air-conditioning system.
The air-conditioner is always managed under torque control The torque demanded by the conditioner is added to the torque demanded by the driver, if the result is less than a threshold calibrated according to engine speed, conditioner function is enabled. If instead the result is greater than this threshold, and vehicle speed is less than 10 kph, conditioner function is disabled.

The Engine Control Module temporarily cuts power to the compressor::

- When starting
- Switching it off with engine temperature > 115°C and restarting it with hysteresis of 5.3°C
- On pick-up with accelerator fully pressed.

Emissions control system

The emissions control system includes devices designed to reduce toxic emissions into the atmosphere

The main emissions caused by the vehicle are

- Exhaust emissions
- Gas/vapor emissions from the crankcase
- Fuel vapor emissions from the fuel system

Exhaust emissions are limited by a trivalent catalytic converter, controlled by two Lambda probes, the upstream one for obtaining the optimal stoichiometric value to improve converter performance, and the downstream one for controlling efficiency (see EOBD strategy).

To assure the correct function and long working life of the catalytic converter, the Engine Control Module evaluates exhaust gas temperature using a calculation model mapped in its memory

The vapor/gas emissions from the crankcase are managed by the vapor recovery system.

Note: this system is not managed by the Engine Control Module

Fuel vapor emissions from the supply circuit are managed by the anti-evaporation system, through a solenoid valve controlled by the Engine Control Module

The canister valve permits cleaning of the active carbon filter in order to prevent its saturation and consequent emissions of the fuel vapor formed in the fuel tank into the atmosphere, in particular when external temperature is high or if the vehicle is subject to strong vibration.

Opening the valve, exploiting the vacuum formed in the intake manifold, permits passage of fresh air (from the outside) to pass through the filter and remove fuel vapor, depositing it in the intake manifold and thus into the engine.

This operation leads to a shift in mixture richness that is then compensated by the control unit (mixture ratio control).

Adaptive parameters are disabled during the canister cleaning operation

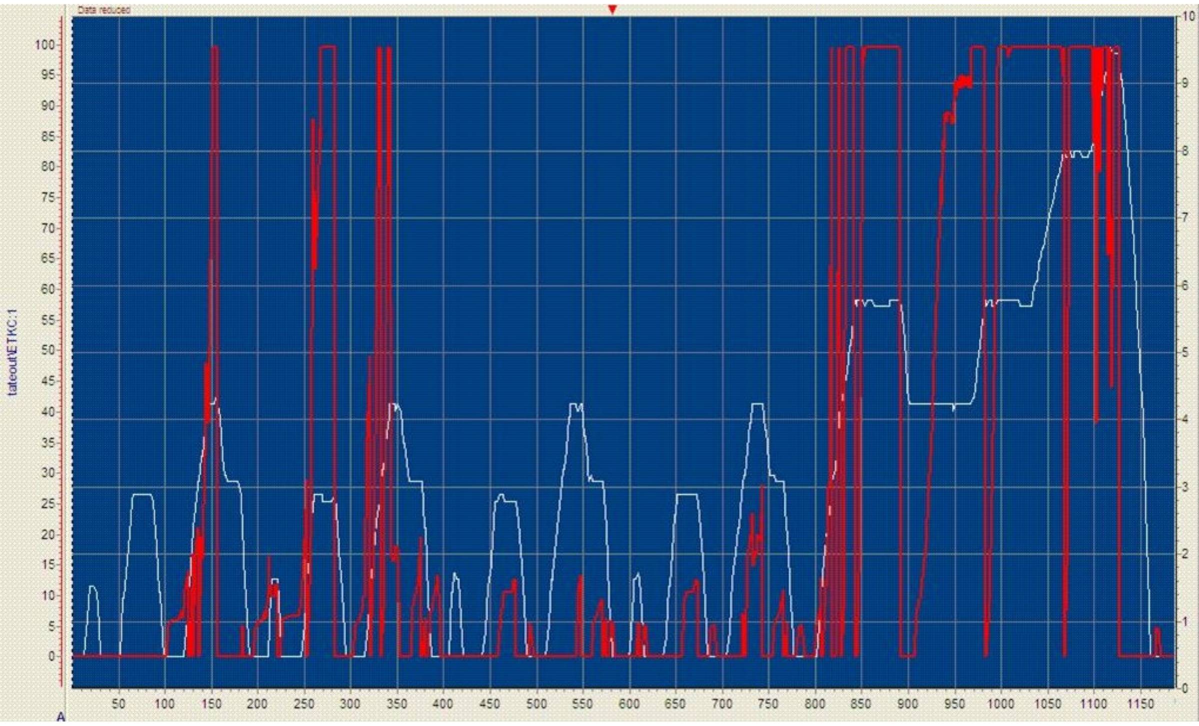
CANISTER cleaning takes place in the following conditions

- At idle speed: periodically
- At determined engine points, cleaning is partialized

As example, we give partialized function taking into consideration the zones of the NEDC cycle.

- On the third ramp of the 1st urban subcycle
- On the second and third ramps of the 2nd urban subcycle
- Practically over the entire EUDC cycle

Throughout the cycle, cleaning is disabled in gear changes and cut-offs.



The figure shows an acquisition on the NEDC cycle of the “canister valve target aperture” variable (in red), also showing “vehicle speed” (in white) in order to identify cycle zone
The most consistent cleaning obviously takes place with valve aperture at 100%.

Recovery and self-diagnosis

The Engine Control Module self-diagnosis system controls correct system function and indicates any faults by means of a warning light (MIL) on the panel, with European standard ideogram and color
This warning light indicates both engine management faults and faults detected by the EOBD diagnosis strategy
The MIL warning light functional logic is as follows:
With key to run the light comes on and remains on until the engine starts. The Engine Control Module self-diagnosis system checks the signals from the sensors, comparing them with admissible limit values.
Fault indications with engine started:

- Light on with engine running indicates an error memorized in the Engine Control Module
- Fault indications when running:
- Flashing light indicates possible damage to catalytic converter due to misfire
- Warning light steady on indicates engine control errors or EOBD diagnosis errors
- The Engine Control Module defines the type of recovery according to the failed component

The recovery parameters are managed by the remaining functional components
The recovery strategies that can be implemented by the Engine Control Module are:

- Limp home after throttle body error.
- Limp home after accelerator pedal error.
- turbo:
  - ✓ During increase in turbo pressure in acceleration transitions, if the difference (target)-(read) >200mbar the throttle is closed.
  - ✓ If there is an error on the accelerator pedal or on the throttle actuator, turbo pressure is limited.

EOBD controls

Since 1970, in Europe, there has been a standard for controlling automobile exhaust emissions (Directive 70/220/EEC) which, over the course of the years, has undergone many changes and updates, the most recent of which dates back to October 1998 (Directive CE 98/69).

Directive CE 98/69 sets forth the first requirements for approving EOBD systems, defining “EOBD” as a diagnostics system aboard the vehicle for controlling emissions, capable of identifying areas with faults by means of codes entered in the memory of a computer. The system includes a warning light on the instrument panel (known as a Malfunction Indicator, MI) that serves to warn the driver of the presence of a fault likely to cause the vehicle to produce a higher level of emissions than permitted by current legislation.

According to the standard, this system must undergo a series of official approval tests and control tests on vehicles in circulation, chosen at random by the Approval Authority.

To gain approval, the vehicle, with an equivalent age of 80,000 kilometers, must undergo a check on average emissions of carbon monoxide (CO), unburned hydrocarbons (HC) and nitrogen oxides (NO_x). The test, conducted in the laboratory on dynamometric benches, consists of carrying out a standard functional cycle (NEDC cycle).

The European standard requires that the EOBD system is capable of carrying out at least 4 diagnoses on engine subsystems with direct influence on emissions:

- Fuel system diagnosis
- Lambda probe diagnosis
- Catalytic converter diagnosis.
- Diagnosis on irregular ignition (misfire diagnosis) that prevents correct function of the catalytic converter, causing in some cases irreversible damage

In detail:

- Fuel system diagnosis serves to detect any malfunctions in the fuel lines.
- Lambda probe diagnosis detects faults in the upstream probe by comparing certain measured quantities with the corresponding thresholds.
- Catalytic converter diagnosis services to detect degradation of the converter through indirect measurement of its capacity to store oxygen
- Misfire diagnosis serves to detect misfiring destructive for the converter as well as non-destructive misfire causing high emissions levels

System self-adaptation

The Engine Control Module is equipped with a self-adapting function that serves to recognize changes taking place in the engine due to wear over time and ageing of engine components

These changes are memorized in the form of modifications to the base mapping, and serve to adapt system function to the progressive alteration of the engine and components with respect to their as-new tolerance.

This self-adapting function also compensates the inevitable differences (due to production tolerances) of any replaced components.

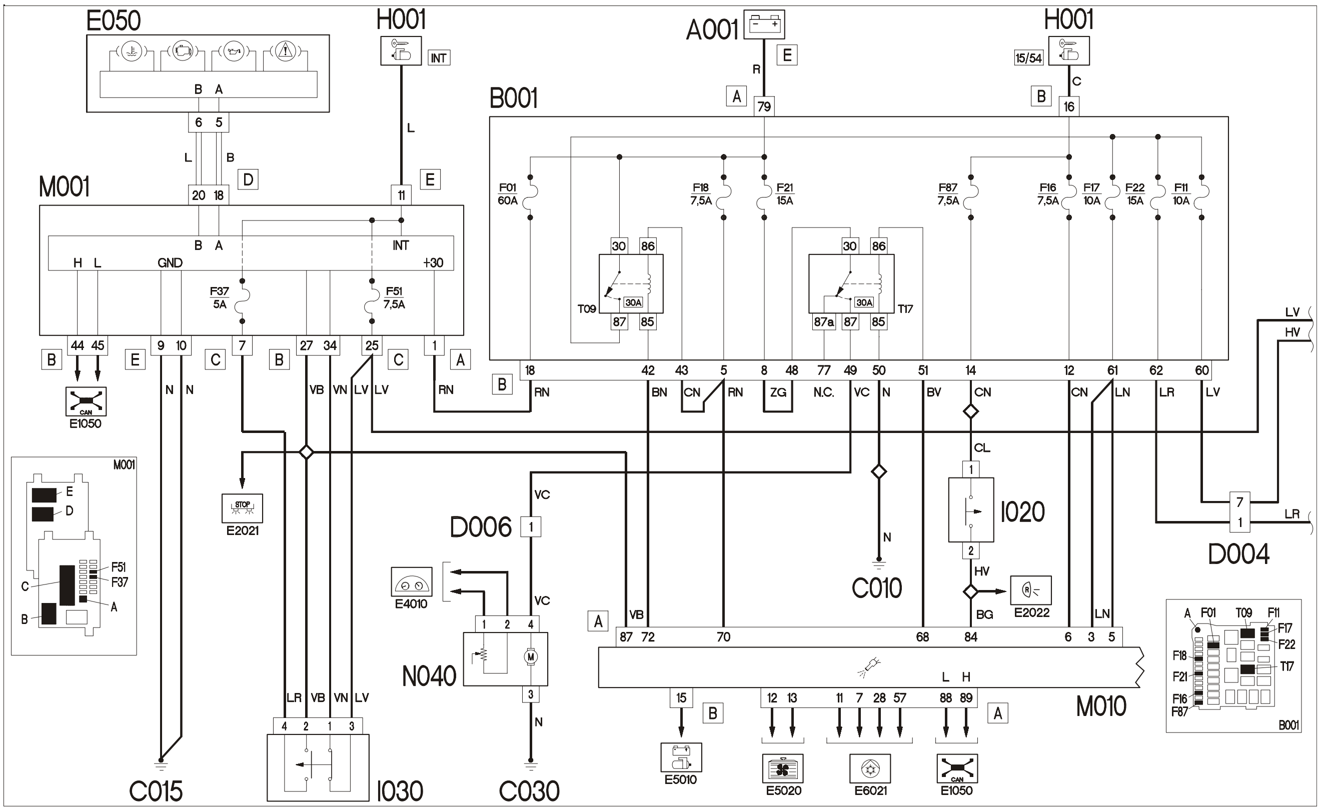
From analysis of the exhaust gas, the Engine Control Module modifies the base mapping to the new engine characteristics.

In detail, the Engine Control Module implements the following self-adaptation strategies:

- Multiplicative coefficient mixture ratio control (FRA). Takes account of deviation in mixture ratio caused by the drift of probes, injectors and intake manifold (leaks). This is constantly updated during vehicle function (when mixture control is active).
- Additive coefficient mixture ratio control (ORA). Corrects for injector losses. Updates at idle.

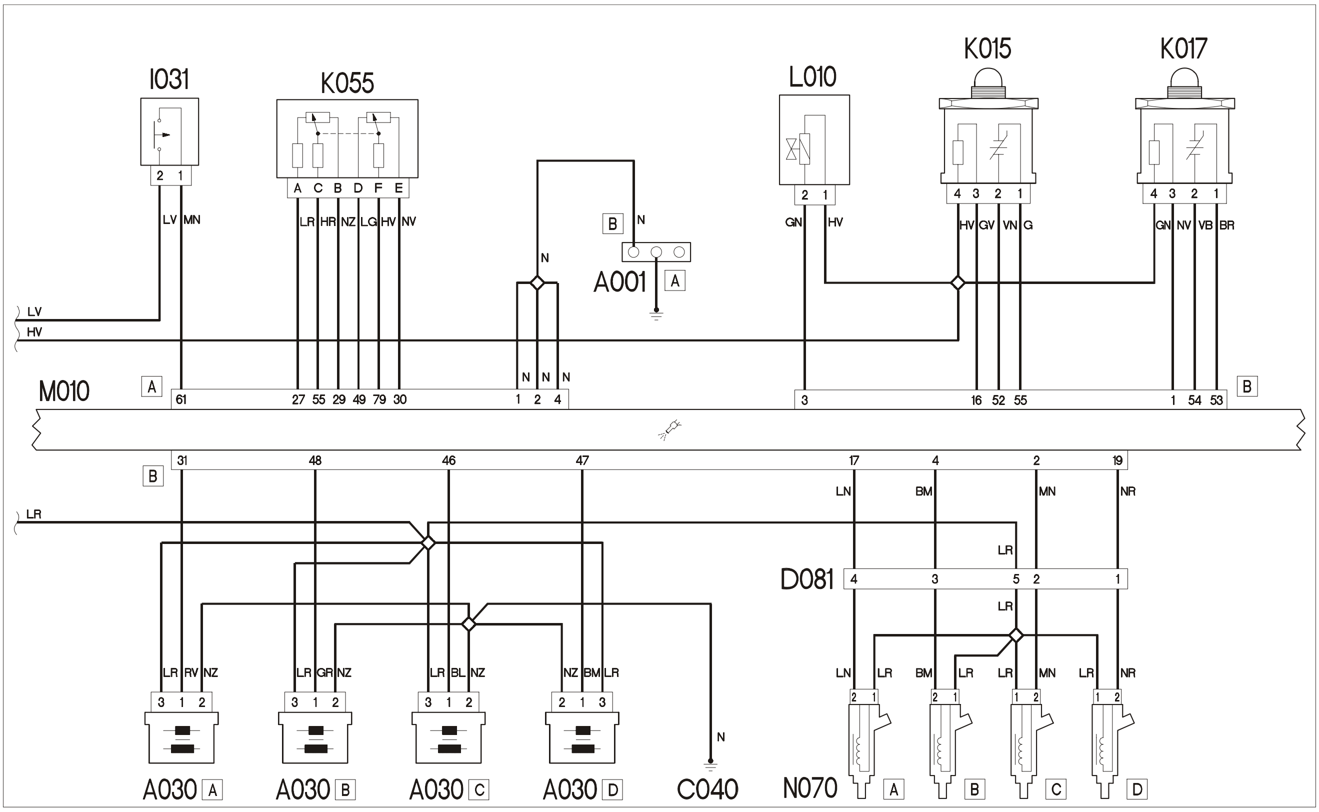
The self-adapting parameters are not deleted when the battery is disconnected.

Bosch ME 7.9.10 engine control unit circuit diagram
Diagram E5030 A



Key
A001 BATTERY
B001 JUNCTION BOX UNIT
C010 GROUND
C015 GROUND
C030 GROUND
D006 JUNCTION
D004 JUNCTION
E050 INSTRUMENT PANEL
I020 REVERSING LIGHTS SWITCH (GEARBOX HARNESS)
I030 BRAKE PEDAL SWITCH
H001 IGNITION SWITCH
M001 BODY COMPUTER
M010 ENGINE CONTROL MODULE
N040 FUEL PUMP AND GAUGE

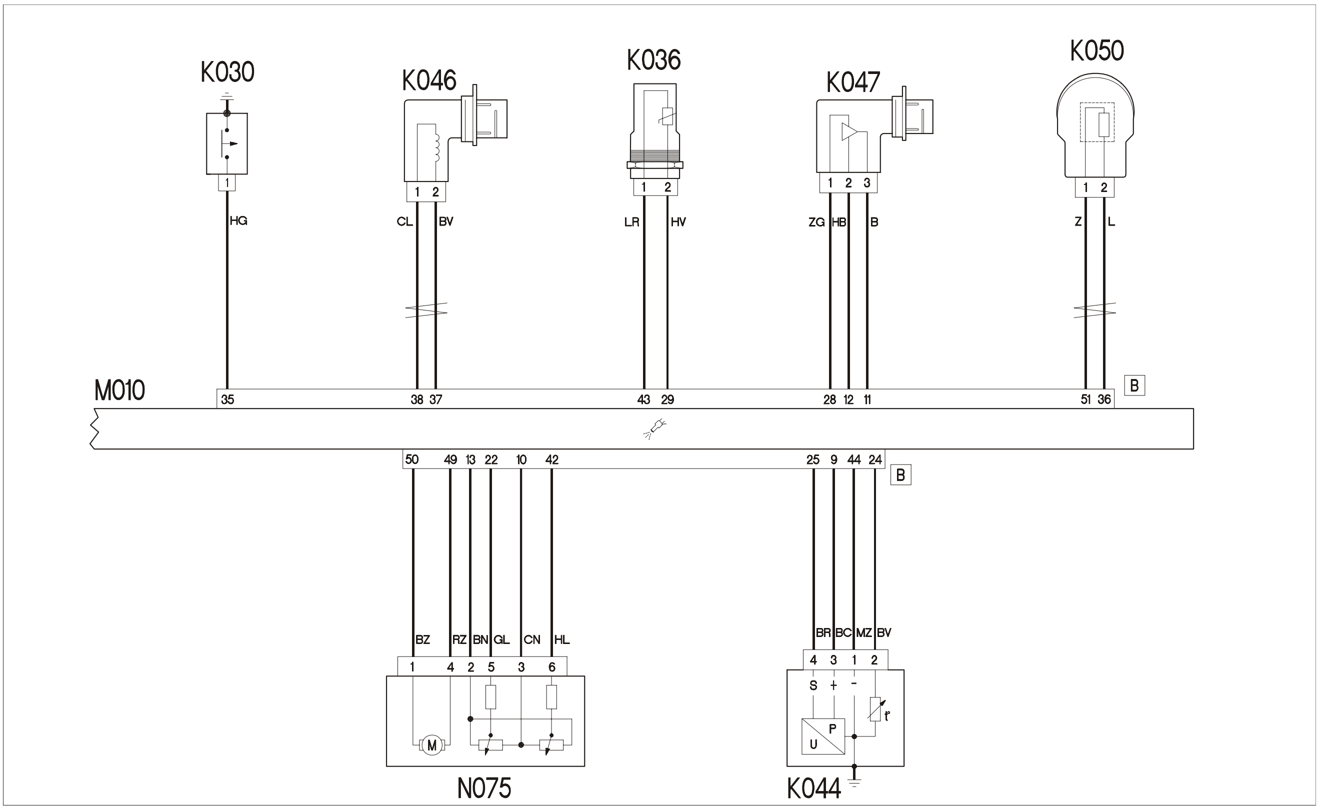
Diagram E5030 B



Key

A001 BATTERY
A030 IGNITION COIL
C040 GROUND
D081 INJECTOR JUNCTION
I031 CLUTCH PEDAL SWITCH
K015 PRE-CAT LAMBDA PROBE
K017 POST CAT LAMBDA PROBE
K055 ACCELERATOR PEDAL POTENTIOMETER
L010 FUEL VAPOR RECOVERY VALVE
M010 ENGINE CONTROL MODULE
N070 INJECTORS

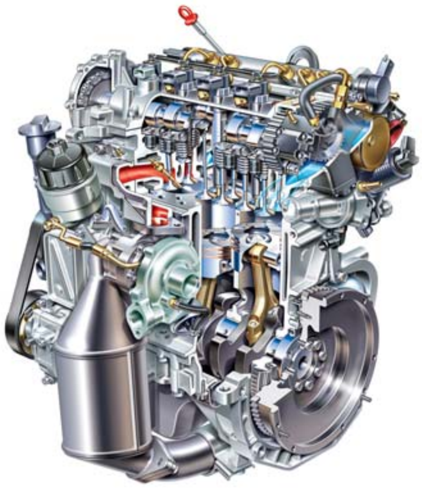
Diagram E5030 C

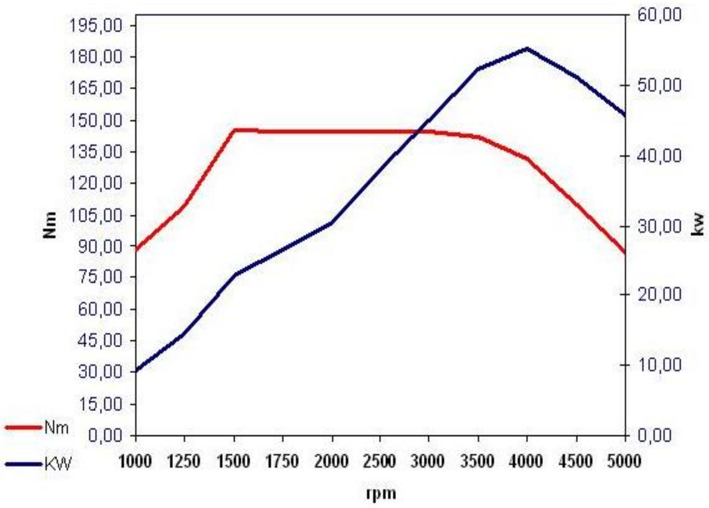


Key
C040 GROUND
C060 GROUND
K030 ENGINE OIL PRESSURE SENSOR (SWITCH)
K036 ENGINE COOLANT TEMPERATURE SENSOR/TRANSMITTER
K044 INTEGRATED AIR PRESSURE AND TEMPERATURE SENSOR
K047 TIMING SENSOR
K048 PRESSURE SENSOR
K050 KNOCK SENSOR
M010 ENGINE CONTROL MODULE
N075 THROTTLE ACTUATOR

Motore 1.3 16 V MJT Engine

This chapter describes the 1.3 16VMJT engine derived from the engine already used on the Fiat Panda.





Technical data sheet

ENGINE		
Engine	Common Rail direct Diesel injection	
Strokes	4	
Cylinders	4	
Valves per cylinder	4	
Bore	69,6 mm	
Stroke	82 mm	
Total displacement	1247.907 cc	
Single cylinder	311,977	
Combustion chamber volume	18.91 (0.722 in head) cm2	
Maximum power	55 (KW EEC) at 4000 RPM	
Maximum torque	145 (Nm EEC) at 1500 RPM	
Compression ratio	17,6 ± 0,40	
Emissions level	EEC PHASE 4	
Recommended fuel	Diesel	
Engine markings	169A1000	
Mounting	Front transverse	
Inclination	0°	
VALVE TIMING SYSTEM		
Valve Timing system	2 ACT chain driven	
Rocker type valve train with hydraulic tappets	INTAKE	EXHAUST
Combustion chamber side head duct diameter	18,5 mm	18,5 mm
Corresponding valve diameter	21,5 mm	21,5 mm
Rise on valve axis without play	6,4 mm	7,5 mm
Timing in degrees	-12/6	40/-12
Valve axis play for timing control	0,5 mm	0,5 mm
INJECTION SYSTEM		
Injection system	Magneti Marelli MJD 6F3 Common Rail	

PRE-WARMING SYSTEM	
Pre-warming glowplug unit	Bitron N° 38430003
Glowplugs	Bosch 0.250.203.002
Firing order	1;3;4;2
Alternator	75 A basic version 90 A air-conditioned version
LUBRICATION SYSTEM	
Type of pump	Gear pump driven by crankshaft with FULL-FLOW filter
Type of lubricant	SELENIA WR
First filling lubricant quantity	2.940g
Oil pressure at 100°	At idle > 1 bar at 4000 rpm > 3-3.5 bar
COOLING SYSTEM	
Type	Centrifugal pump driven by timing belt
Thermostat	By-pass thermostat control vehicle heating from manifold
Liquid	Water + Paraflù
Thermostat calibration	88° ± 2° C
TURBO CHARGING SYSTEM	
Type	Exhaust gas turbocompressor (KKK) KP35 with waste gate managed by engine control in DPF versions
Turbo pressure	1.2 Bar
ANTI-EMISSIONS SYSTEMS	
Idle speed	830 ±50 rpm
Maximum loadless speed	5200 rpm
Anti-emissions system	EGR valve
Exhaust anti-emissions system	UEGO lambda probe, in alternative DPF system, catalytic converter.

Engine Management

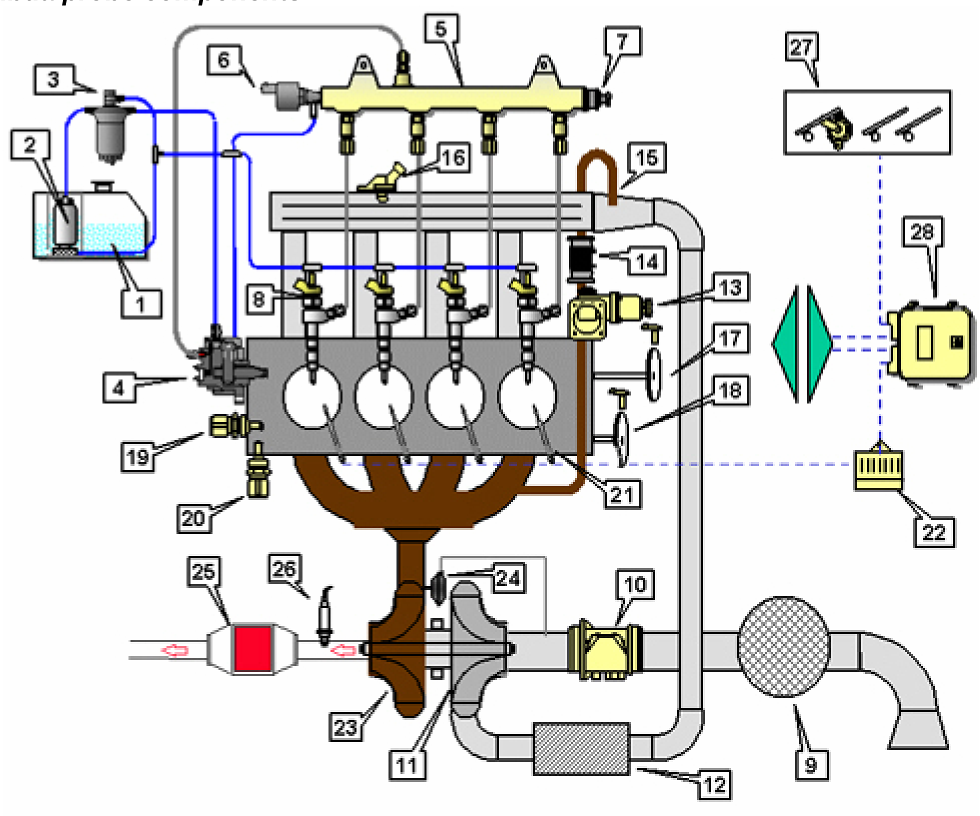
The Magneti Marelli MJD 6F3 common rail is a high pressure electronic injection system for fast, direct injection Diesel engine
Its main features are:

- High injection pressure availability (1400 bar)
- Pressure modulation from 150 bar to max working pressure of 1400 bar for the 75 HP version and
- Capability of running at high speed (up to 5000 rpm at full load
- Precise injection control (injection advance and time);
- Reduced fuel consumption;
- Reduced emissions

The main functions of the system are essentially as follows:

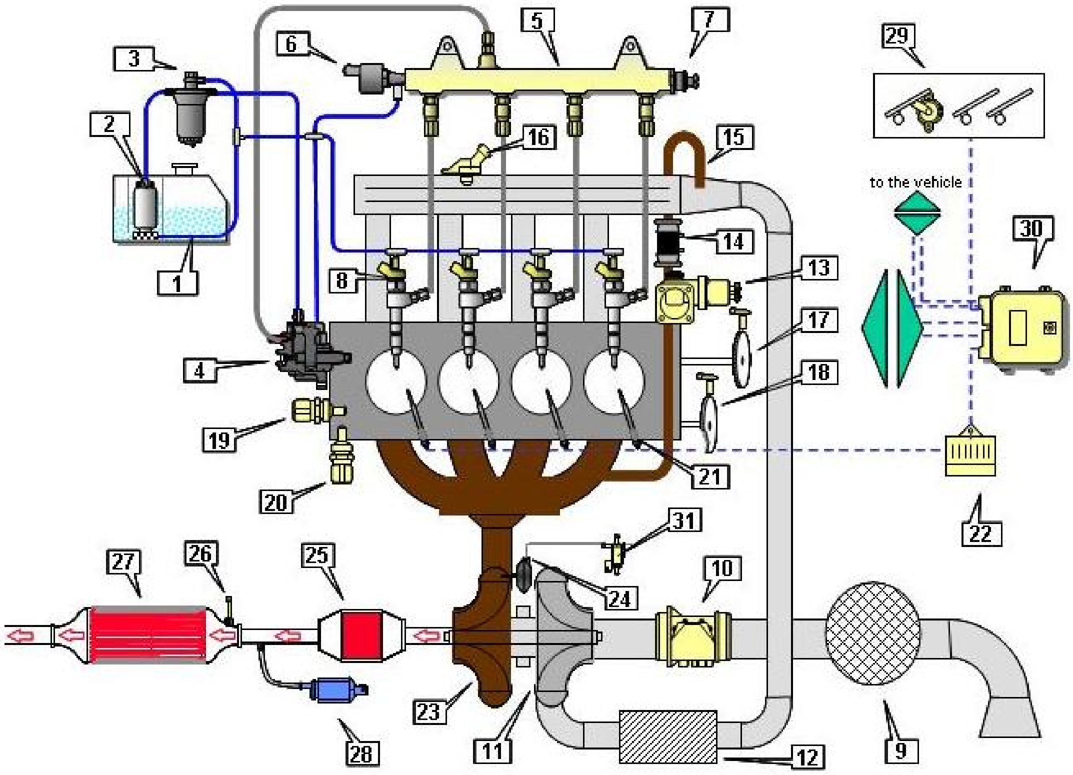
- Engine coolant temperature control;
- Injected fuel quantity control
- Idle speed management
- Fuel cut-off on release
- Cylinder balancing control at idle
- Smoothness control
- Exhaust smoke control on acceleration control
- Exhaust gas recycling control (E.G.R.);
- Maximum torque limit control
- Maximum speed limit control;
- Glowplugs control;
- Air-conditioning enable control (if present);
- Auxiliary fuel pump control;
- Cylinder position control for timing;
- Main and multiple injection advance control;
- Injection pressure closed loop control;
- Electrical balance control;
- IMA code injector calibration;
- Fuel pressure control;
- Lambda probe control;
- DPF control **(for versions with DPF).**
- Engine oil life control **(for versions with DPF).**

UEGO Lambda probe components



Key
1. Fuel tank
2. Auxiliary fuel pump
3. Fuel filter
4. Pressure pump
5. Rail
6. Pressure regulator
7. Fuel pressure sensor
8. Electroinjectors
9. Air filter
10. Air flow-rate meter (debimeter)
11. Compressor
12. Intercooler
13. E.G.R. solenoid valve
14. Water-exhaust gas heat exchanger for E.G.R
15. E.G.R. diffuser
16. Overpressure sensor
17. Revs sensor
18. Timing sensor
19. Water temperature sensor
20. Engine oil minimum pressure switch
21. Glowplugs
22. Pre-warming glowplug unit
23. Turbocompressor
24. Waste-gate actuator
25. Catalytic converter
26. Lambda probe (UEGO)
27. Pedal board
28. Engine Control Module

Diagram of components with DPF* "Diesel Particulate Filter" *(OPT)



Key

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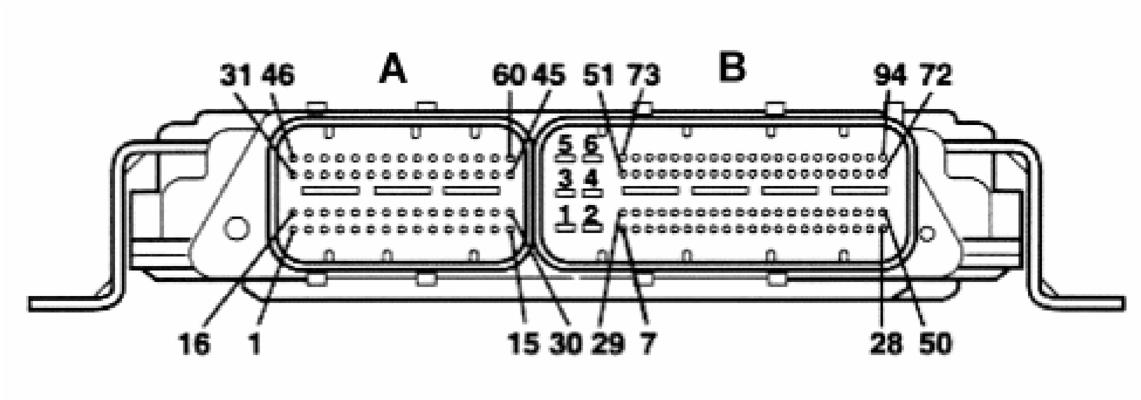
19. Water temperature sensor
20. Engine oil minimum pressure switch
21. Glowplugs
22. Pre-warming glowplug unit
23. Turbocompressor
24. Waste-gate actuator
25. Catalytic converter
26. DPF temperature sensor
27. DPF **(Diesel Particulate Filter)**
28. DPF relative pressure sensor
29. Pedal board
30. Engine Control Module
31. Turbo pressure regulator actuator

Components
This paragraph describes the main components, sensors and actuators in the 6F3 engine control applied to 1.3 Multijet engines

Injection control unit (MJD 6F3 magneti marelli common rail)
The electronic unit is located in the engine bay and is "flash EPROM" type, programmable from the outside without works on hardware.
The injection control unit has a built-in absolute barometric pressure sensor.



Pin - out

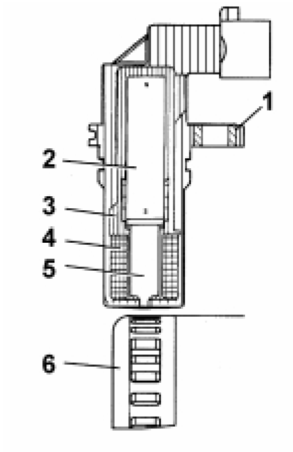
Connector A (Engine side)

1. Cylinder 4 injector negative
2. Not connected
3. Not connected
4. Fuel pressure regulator positive
5. Engine Control Module and E.G.R positive power from F11
6. Fuel pressure sensor
7. Not connected
8. Fuel pressure sensor positive
9. Low engine oil pressure sensor signal
10. Air temperature debimeter signal
11. Not connected
12. Not connected
13. Not connected
14. Air flow rate debimeter signal
15. E.G.R. solenoid valve negative
16. Cylinder 1 injector negative
17. Cylinder 2 injector negative
18. Not connected
19. Not connected
20. Not connected
21. Timing sensor negative
22. Not connected
23. Turbo pressure sensor +5%V positive
24. Turbo pressure sensor negative
25. Timing sensor +5V positive
26. Not connected
27. Debimeter negative
28. Not connected
29. Engine coolant temperature sensor ground
30. Waste gate solenoid valve **(ver. DPF)**
31. Cylinder 3 injector negative
32. Not connected
33. Not connected
34. Fuel pressure regulator negative
35. Not connected
36. Not connected
37. Not connected
38. Fuel pressure sensor signal
39. Not connected
40. Not connected
41. Turbo pressure signal
42. Not connected
43. Engine revs sensor positive
44. Not connected
45. Not connected
46. Cylinder 4 injector positive
47. Cylinder 1 injector positive
48. Cylinder 3 injector positive
49. Cylinder 2 injector positive
50. Not connected
51. Not connected
52. Not connected
53. Not connected
54. Engine coolant temperature sensor signal
55. Alternator signal
56. Timing sensor signal
57. Not connected
58. Not connected
59. Revs sensor negative
60. Not connected

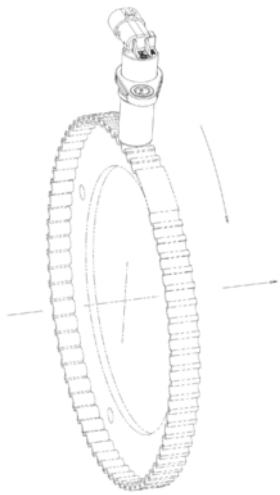
Connector B (vehicle side)

1. Control unit power ground
2. Control unit power ground
3. Control unit power ground
4. Engine Control Module 12 V power supply
5. Engine Control Module 12 V power supply
6. Engine Control Module 12 V power supply
7. Engine cooling fan low sp. Command (-)
8. Engine cooling fan high sp. Command (-)
9. Not connected
10. Conditioner compressor linear sensor negative
11. **Post catalyzer sensor negative (ver. DPF)**
12. **Lambda probe heating negative (ver. UEGO)**
13. Fuel temperature sensor signal
14. **+5 V catalyzer differential sensor (particulate) (ver. DPF)**
15. Accelerator pedal potentiometer track 2 positive
16. Not connected
17. Not connected
18. Not connected
19. Not connected
20. Not connected
21. Not connected
22. Clutch pedal switch
23. Engine Control Module INT power supply
24. Not connected
25. Not connected
26. Not connected
27. Not connected
28. Not connected
29. Not connected
30. Not connected
31. Not connected
32. Accelerator pedal potentiometer track 2 negative
33. **Catalyzer differential sensor negative (particulate) (ver. DPF)**
34. Not connected
35. Accelerator pedal potentiometer track 1 negative
36. Not connected
37. Conditioner compressor linear sensor positive
38. Not connected
39. Not connected
40. C - CAN L line
41. Accelerator pedal potentiometer track 2 signal
42. Not connected
43. Not connected
44. **Lambda probe signal (VS+) (ver UEGO)**
45. **Lambda probe signal (IP+) (ver UEGO)**
46. **Lambda probe ground reference (VS+) (ver UEGO)**
47. **Lambda probe (RC) (ver UEGO)**
48. Not connected
49. **Catalyzer differential sensor negative (particulate) (ver DPF)**
50. Direct power from battery +30
51. Not connected
52. Not connected
53. Not connected
54. Not connected
55. Not connected
56. Not connected
57. Not connected
58. Not connected
59. Not connected
60. Not connected
61. Fuel temperature sensor signal
62. Not connected
63. Not connected
64. CAN 1 high speed line H
65. Accelerator pedal potentiometer track 1 signal
66. Not connected
67. Not connected
68. Not connected
69. Not connected
70. Pre-warming control unit diagnosis input
71. Not connected
72. Not connected
73. Starter motor relay command
74. Glowplug pre-warming relay command
75. Not connected
76. Fuel heater relay command
77. Not connected
78. Stop lights switch
79. Air conditioner compressor command
80. Main relay command
81. Stop lights switch
82. Not connected
83. Accelerator pedal potentiometer track 1 power supply
84. Not connected
85. Fuel pump relay command
86. Not connected
87. Conditioner linear sensor signal
88. Not connected
89. Not connected
90. Water in Diesel filter signal
91. **Post catalyzer temperature sensor signal (ver. DPF)**
92. Not connected
93. Not connected
94. Reversing switch

Revs sensor



Key
1. Brass bush
2. Permanent magnet
3. Plastic sensor body
4. Coil winding
5. Pole core
6. Toothed crown or phonic wheel



Specifications and function
Mounted on engine block facing toward the phonic wheel on the flywheel
The revs sensor is inductive, and so functions through variations in the magnetic field generated by the passage of the teeth of the phonic wheel (60-2 teeth).
The injection control unit uses the revs sensor signal to:

- Determine crankshaft rotation speed
- Determine crankshaft angular position.

Passage from full to empty, due to the presence or absence of the tooth, determines a variation in the magnetic flux sufficient to generate an induced alternating voltage, deriving from the number of teeth on the crown (or phonic wheel).
The frequency and amplitude of the voltage delivered to the electronic control unit provides the crankshaft angular velocity and position.

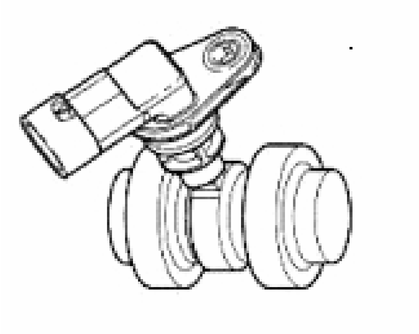
Pin - out

Pin	Name	Signal type
1	Phonic wheel signal (A)	Output frequency
2	Phonic wheel signal (B)	Output frequency

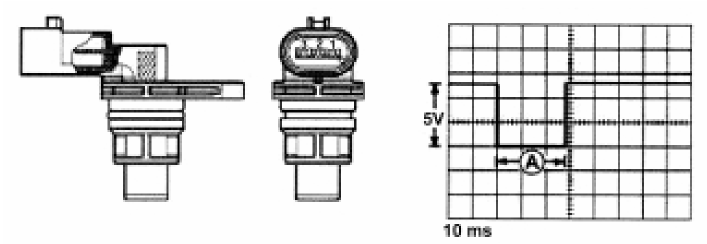
Electrical specifications
Winding resistance 790 Ohm +/- 20%

MBCManical specifications
The required distance (gap) between the phonic wheel and the sensor to obtain correct signals must be between 0.8 - 1.5 mm.
This gap is not adjustable, therefore, if outside tolerance, check sensor and phonic wheel integrity.

Cam angle sensor



Specifications and function
This is a Hall effect sensor, mounted on the upper cylinder head and “faces” onto the camshaft.
The camshaft has a notch that allows the Timing sensor to indicate engine timing position.
The Engine Control Unit uses the timing sensor signal to find the TDC point at the end of the compression stroke and during start-up to synchronize the control unit with the engine.
The sensor is installed on the camshaft, exhaust side.



A wafer of semiconductor with current, immersed in a normal magnetic field (force lines perpendicular to the current direction) generates a potential difference at its terminals, known as the Hall effect.
If the current intensity remains constant, the voltage generated only depends on the intensity of the magnetic field. It is thus sufficient that the intensity of the magnetic field varies periodically to obtain a modulated electrical signal, the frequency of which is proportional to the rate at which the magnetic field varies.
To obtain this change, the sensor is periodically approached by a notch in the inner part of the pulley

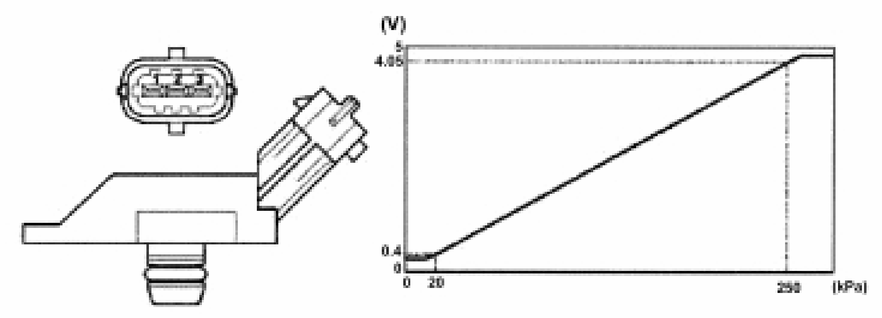
Pin - out

Pin	Name	Signal type
1	Ground	Ground
2	Timing signal	Output frequency
3	Power supply	12 V input

Electrical specifications

The timing sensor in particular is powered at 5 Volts by the engine control module
Every time the rotor passes in front of the sensor, a voltage variation is generated by Hall effect at the sensor output. This variation lasts the whole time the rotor passes in front of the sensor, after which the signal returns to its initial value (5 V).

Turbo pressure sensor



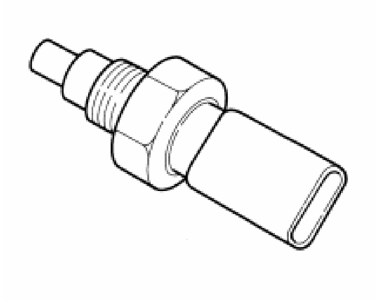
Specifications and function

The turbo pressure sensor is mounted on the intake manifold and permits measurement of intake pressure up to 1.5 bar (corresponding to 2.5 bar absolute).
The sensitive element consists of a piezoresistive element, the signal from which is amplified by an electronic circuit embedded in the sensor. The sensor is powered directly from the control unit at 5 V and gives an output voltage directly proportional to turbo pressure.

Pin - out

Pin	Name	Signal type
1	Power supply	5 V input
2	Ground	Ground
3	Sensor output	Analogue output

Engine coolant temperature sensor

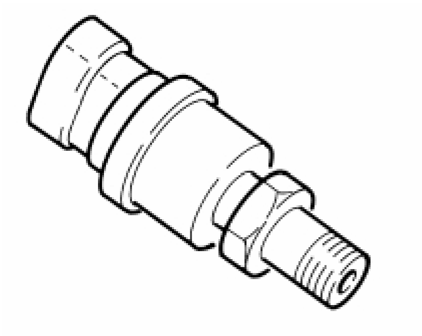


Specifications and function

This is mounted on the thermostat and measures coolant temperature by means of an NTC thermistor with negative resistance coefficient.
Temperature and electrical resistance scale

Temperature (C°)	Resistance (Kohm)	Temperature (C°)	Resistance (Kohm)
- 40	48.80	50	0.81
- 30	27.41	60	0.58
- 20	15.97	70	0.42
- 10	9.62	80	0.31
0	5.97	90	0.23
10	3.81	100	0.18
10	3.81	110	0.14
20	2.50	120	0.11
30	1.68	130	0.08
40	1.15		

Fuel pressure sensor



Specifications and function

This sensor is mounted at the end of the single fuel manifold “rail” and provides the injection control unit with a “feedback” signal for:

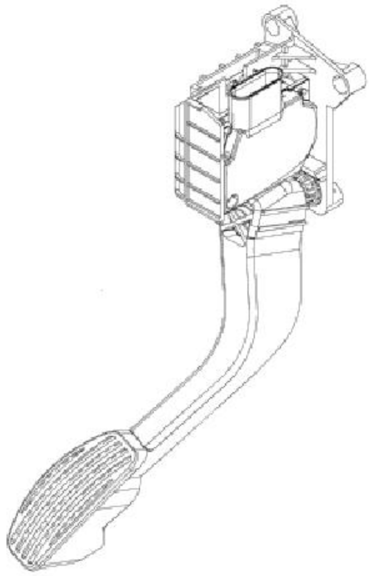
- Regulating injection pressure;
- Regulating injection time.

The sensor is powered directly by the control unit with 5V.
The output voltage varies linearly between 0.5 V (0 bar) and 4.5 V (1500 bar).

Pin - out

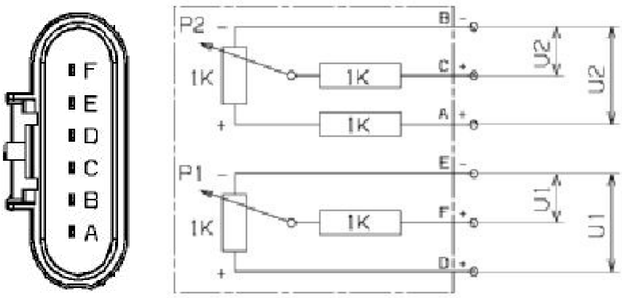
Pin	Name	Signal type
1	Ground	Ground
2	Sensor output	Analogue output
3	Power supply	5 V input

Accelerator pedal potentiometer.



Specifications and function

The sensor is fastened to the accelerator pedal support, in which there is an axially mounted shaft connected to two potentiometers: one main and one safety.
A spring on the shaft offers the right level of resistance to pressure while another spring assures pedal return on release.
The redundant reading of the signal permits constant monitoring of the plausibility of the values read, in order to assure complete driving safety even in case of failure.
The position of the accelerator pedal is transformed into an electrical voltage signal and sent to the Engine Control Unit by the potentiometer connected to the pedal.
The accelerator pedal position sensor signal is processed with the information on engine revs to obtain injection times and corresponding pressure.

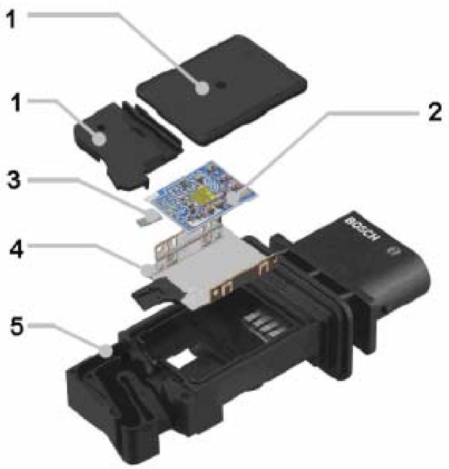


Pin - out

Pin	Name
A	Stage 2 power supply
B	Stage 2 common ground
C	Stage 2 output
D	Stage 1 power supply
E	Stage 1 common ground
F	Stage 1 output

Air flow-rate meter (debimeter) with built-in air temperature sensor.

Specifications and function
The debimeter is located on the air intake manifold, and functions on the "heated film" principle.
The intake air temperature sensor is inside the debimeter, built-in to its support.



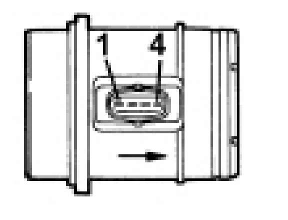
Key
1. Electronic circuit cover and measurement passage cover.
2. Electronic control circuit
3. Sensitive element with built-in intake air temperature sensor
4. Metal electronic circuit and sensitive element support plate.
5. Plastic supporting body

Note: The debimeter cannot be dismantled.

The functional principle is based on heating of a membrane (sensitive element containing two elements upstream and downstream of the support) with a measuring passage (by-pass) between them for the air drawn in by the engine.

The hot film membrane is maintained at constant temperature (approx. 120 °C above intake air temperature) by the heating element controlled by the control electronics.
Removing heat from the membrane, the air mass passing through the measurement passage thermally unbalances the two elements by a quantity directly proportional to the mass of incoming fluid, which translates for the control circuit into a variation in resistance, electronically processed and translated into a frequency value to send to the engine control unit.
The unbalance between the resistance values also permits instantaneous determination of air column direction.
The information on air temperature is sent to the engine control unit through the dedicated pin in the form of a duty cycle signal (rectangular wave).
The value of the duty cycle is proportional to the temperature value.

Note: the debimeter measures the mass of air (not the volume), thus eliminating the problem of compensation correlated to the temperature, altitude, pressure values, etc.

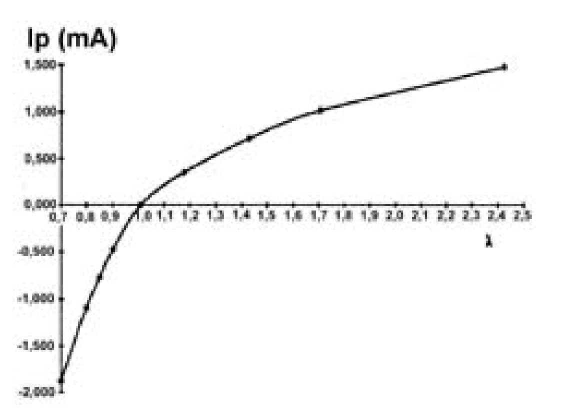


Pin - out

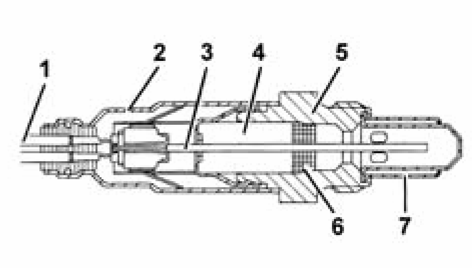
1. Power supply (12 V)
2. Ground
3. Air temperature signal
4. Air mass signal

Pin	Signal type
1	Power supply 12V
2	Ground
3	Air temperature signal
4	Air temperature signal

UEGO Lambda probe



Specifications and function
The UEGO planar type linear Lambda probe is mounted on the catalytic converter in provides information to the control unit on combustion performance.
The probe is an oxygen sensor consisting of a comparative cell that measures the λ values (ratio between quantity of intake air theoretically necessary to fully burn the injected quantity of fuel) over a wide range from λ=0.7 (rich mixture) to air value (λ = (lean mixture).
It is used to compare the reading from the debimeter with the mapping in the control unit and correct fuel injection if necessary, in order to comply with emissions limits.
The sensor compares the concentration of oxygen present in the reference cell, housed in the sensor, with the exhaust gas flowing in the adjacent comparative cell. According for the unbalance found, the control unit modulates a current signal (Ip) that rebalances the oxygen content of the comparison cell by electrochemical action The Ip value obtained is proportional to the λ value measured as indicated in the graph below:



Key
1. Connector cable
2. Protective sheath
3. Planar sesnor element
4. Ceramic support pipe
5. Probe seat
6. Ceramic gasket
7, Protective pipe

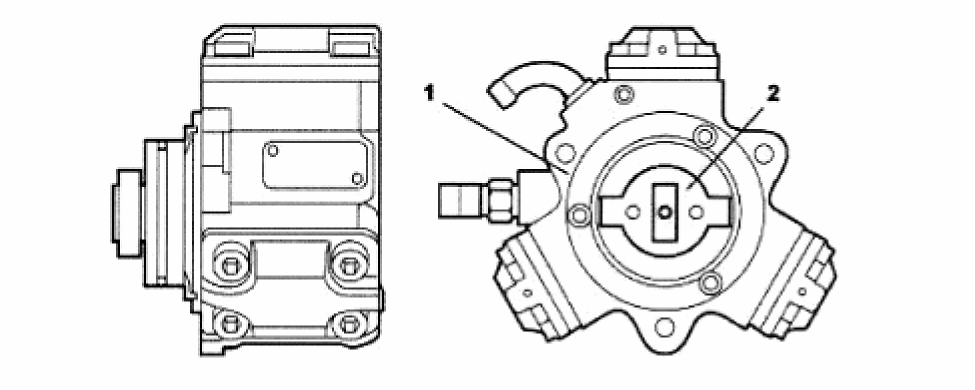
To activate rapid sensor function, the probe has an internal heating element controlled by the engine control unit through a duty-cycle, according to the programmed strategy.
The two comparison cells and the heater are built-in to the same planar ceramic element (a sandwich of various ceramic elements) to render the structure compact and assure high response speed and rapid element heating.

Electrical specifications
Heater max power 7.5 V from control unit
Heating element 3.2 ± 0.8 Ω

Pin out

Pin	Name
1	Pumping current (Ip)
2	Virtual ground
3	Heater (-)
4	Heater (+)
5	Calibration current
6	Nerst voltage

High pressure fuel pump

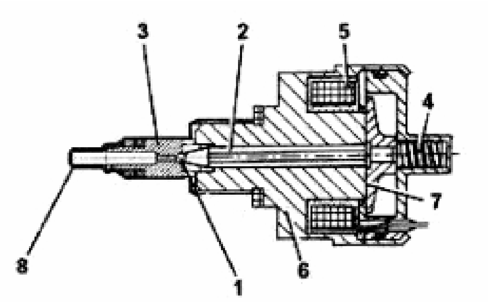


Specifications and function
The "CP1" pressure pump is a radial jet type pump (total displacement 0.567 c.c.) driven by the camshaft via an "oldham" joint (2). It has no timed positions.
Structure
Each pump group consists of:

- A piston driven by a cam fastened to the pump shaft;
- An intake plate valve;
- A delivery ball valve.

The pressure pump must be fed under at lest 0.7 bar pressure, so there is an auxiliary pump immersed in the fuel tank.
The maximum delivery pressure reaches 1400 bar.
The pressure pump is lubricate and cooled by the fuel itself, through suitable channels.

Pressure regulator



Key
1. Ball shutter
2. Pin
3. Valve
4. Preloading spring
5. Coil
6. Body
7. Anchor
8. Filter

Specifications and function
The pressure regulator is mounted on the rail and controlled by the Engine Control Module. It regulates fuel delivery pressure to the electroinjectors.
The pressure regulator consists essentially of:

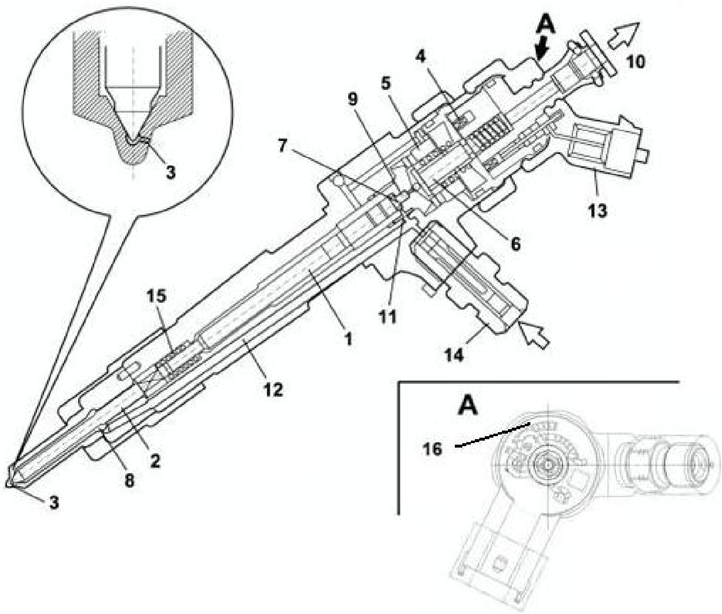
- A ball shutter (1);
- A valve (3) command pin (2);

- A preloading spring (4);
- A coil (5).

Pin - out

Pin	Name
1	Regulator power supply
2	Fuel pressure regulator command signal

Electroinjectors



Key

1. Push rod
2. Needle
3. Nozzle
4. Coil
5. Pilot valve
6. Ball shutter
7. Control area
8. Feed volume
9. volume
10. Fuel return – low pressure
11. Control passage
12. Feed passage
13. Electrical connection
14. Fuel intake connector – high pressure
15. Spring
16. IMA Code

Specifications and function

The electroinjectors are mounted on the cylinder head and controlled by the Engine Control Module.
An electroinjector can be subdivided into two parts

- Actuator / atomizer consisting of push rod (1), spring (2) and nozzle (3);
- Solenoid control valve consisting of coil (4) and pilot valve (5).

Electrovalve function can be divided into three phases:
REST position, the coil (4) is not excited and the shutter (6) is in closed position, not permitting entry of fuel into the cylinder Fc > Fa (Fc due to line pressure acting on the control area (7) of the rod (1); Fa: due to the line pressure acting on the feed volume (8).
INJECTION START, the coil (4) is excited and causes the shutter to rise (6).
The fuel in the control volume (9) flows toward the return manifold (10) causing a pressure drop in the control area (7). At the same time, the line pressure through the feed passage (12) exercises a force on the feed volume (8) of Fa > Fc causing the needle (2) to rise consequently injecting fuel into the cylinder.

INJECTION END, The coil (4) is no longer excited causing the shutter (6) to return to closed position, which closes the needle (2), completing the injection cycle.

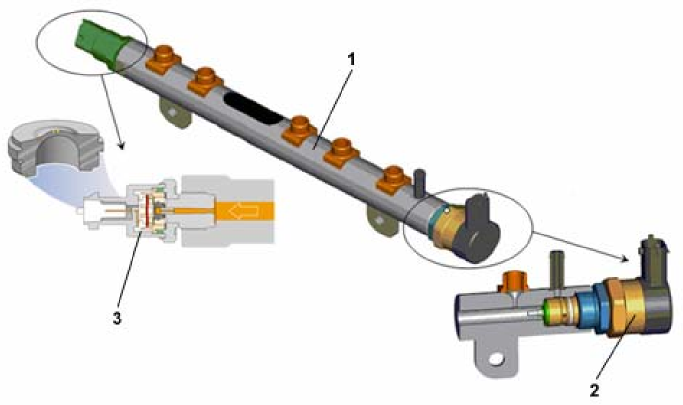
IMA Classification

On final assembly the injectors are tested to verify their performance in various pressure/flow-rate conditions.
All the injectors that are not up to a certain standard are rejected. The remaining ones are classified with a none-figure alphanumerical code, called the IMA code, which is laser-etched on the upper part of the magnet.
When fitted, the Engine Control Module has to be loaded with the code of each injector by means of the diagnosis instrument. The same procedure must be carried out if one or more injectors are substituted. The code change has to be entered in the Engine Control Module using the diagnosis instrument.

Pin - out

Pin	Name
1	Engine Control Module power supply
2	Command from Engine Control Module

Common rail



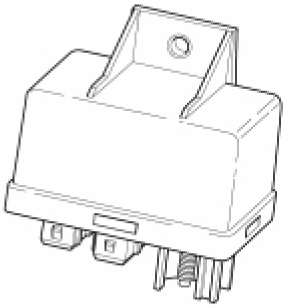
Key
1. Rail
2. Pressure regulator
3. Fuel pressure sensor

Specifications and function

The rail is mounted on the cylinder head intake side.
With its volume of circa 20.5 c.c. the rail dampens fuel pressure oscillation due to:
- Pressure pump function
- Electroinjector aperture.

The fuel pressure sensor (3) is mounted on one side of the delivery manifold (1), and the pressure regulator (2) is connected from the other.
The hydraulic connections (high pressure) between rail-pump and manifold-electroinjectors are made by steel pipes with ext. diameter 6 mm.

Pre-warming glowplug control unit

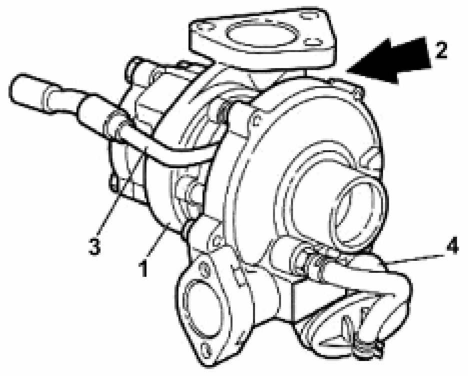


The device is interfaced with and controlled by the Engine Control Module according to EOBD protocol. It is designed to perform all piloting and monitoring functions on the individual glowplugs during the Diesel engine pre-warming phase.
The pre-warming control unit incorporates overcurrent and overvoltage protection and is equipped with control logic that, in the event of failure, behaves exactly like an electronic self-resetting fuse.
Since it is resistant to atmospheric agents, the device can be mounted directly in the engine compartment.
All terminals of the pre-warming control unit are protected against battery polarity inversion and built to withstand all forces acting on the vehicle

The unit has the following connections:

Terminal	Name
30	Direct connection to battery positive (+Vbatt) to power the glowplugs.
G1, G2, G3, G4	Glowplug connection output
86	Power supply from Engine Control Module
31	Ground connection (GND)
ST	Control start input from Engine Control Module
K	Control start input from Engine Control Module
DI	Direct diagnosis output to Engine Control Module

UEGO version turbo compressor



Key
1. Turbocompressor
2. Waste gate
3. Lubrication circuit branch
4. Pneumatic actuator

Specifications and function
The turbocompressor (1) is connected to the exhaust manifold. It serves to increase engine volumetric performance.
It essentially consists of two impellers fitted to the same shaft, which turns on floating bearings lubricated by a branch pipe (3) from the engine lubrication circuit.
The oil used dissipates a substantial proportion of the heat deliver to the impellers by the exhaust gas.
The turbocompressor is also fitted with a WASTE-GATE valve (2) commanded by an pneumatic actuator (4), that regulates the flow of exhaust gas to the turbine, according to the pressure reached at the compressor output.

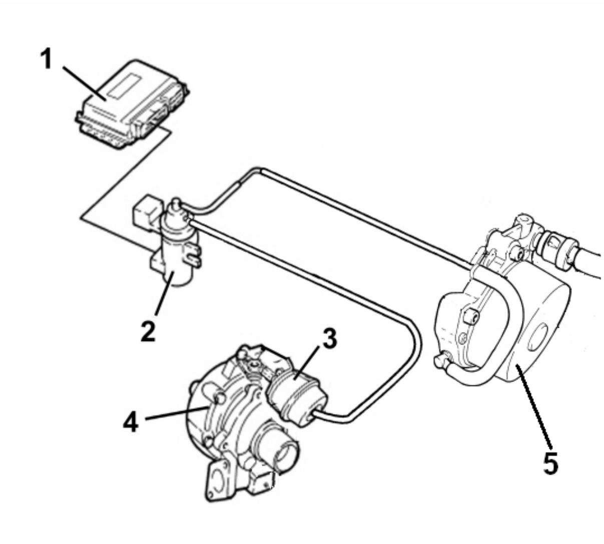
DPF version turbo compressor

This is fixed geometry with turbo pressure control, connected to the exhaust manifold. It serves to increase engine volumetric performance.

The turbocompressor consists of:

- A centrifugal compressor
- A turbine
- A pneumatic turbo pressure control valve (boost-control)

Turbo pressure performance is controlled by the engine control unit through the boost-control valve.

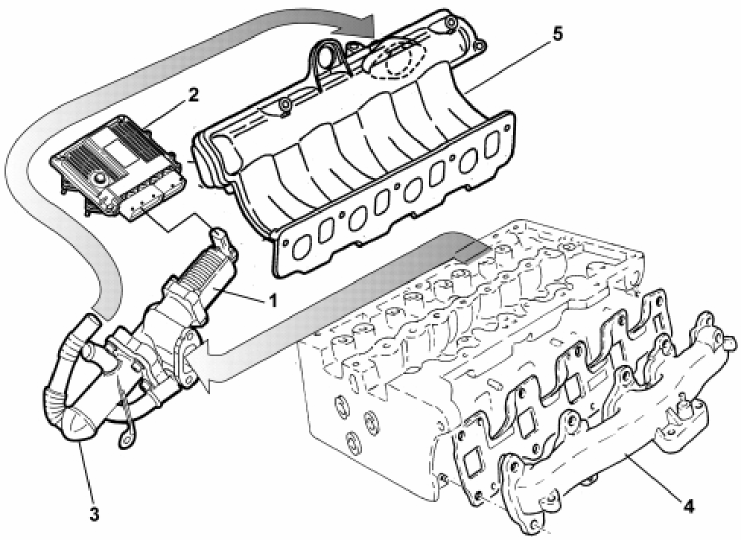


Key
1. Engine Control Module
2. Boost control solenoid valve
3. Boost control command actuator
4. Turbocompressor
5. Depressor

The turbocompressor is also fitted with a boost control valve commanded by an pneumatic actuator (4), which regulates the flow of exhaust gas to the turbine, according to the power/torque demand from the engine.

EGR system

This system injects a part of the exhaust gas (5 – 15%) to the engine intake, in certain operating conditions.
This lowers the temperature peak in the combustion chamber, which limits the formation of nitrous oxides (Nox).
The E.G.R. solenoid valve (1) commanded by the Engine Control Module (2) serves to inject part of the exhaust gas drawn from the exhaust manifold (4) into the engine intake.
A heat exchanger (3) partially cools the exhaust gas, further lowering temperature in the combustion chamber.



Key
1 - E.G.R. solenoid valve
2 – Engine Control Module
3 – Heat exchanger
4 – Exhaust manifold
5 – Air intake manifold

With coolant temperature <20°C and engine speed between 800 and 3000 rpm, the Engine Control Module pilots the E.G.R. solenoid valve with a square wave signal.
Variations in this signal make the E.G.R. coil to move a shutter, thereby regulating the flow of exhaust gas from the exhaust manifold to the intake manifold, obtaining two results:

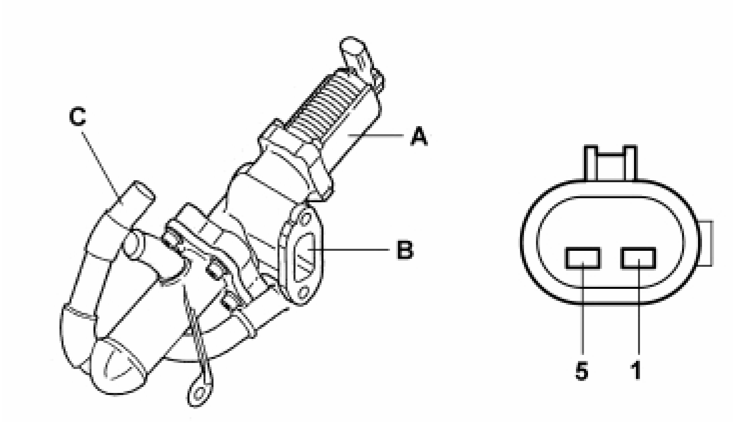
- Less air is introduced;
- Combustion temperature is lowered (due to presence of inert gas), reducing the consequent formation of Nox (nitrogen oxides).

The Engine Control Module is constantly informed on the quantity of recirculated gas by data from the debimeter. If for a certain engine speed a given quantity of intake air is foreseen (Qam) and the value sent by the debimeter (Qar) is lower, the difference (Qgr) corresponds to the quantity of recirculated gas.
Qam - Qar = Qgr
Qam – Theoretical air quantity memorized
Qar – Real air quantity
Qgr – Recirculated gas quantity
The atmospheric pressure signal is used in piloting the E.G.R. valve to recognize altitude conditions, in order to reduce the quantity of recirculated gas to prevent engine smoke.

E.G.R. solenoid valve

The Pierburg E.G.R. valve mounted on the cylinder head serves to modulate the flow of exhaust gas to the air intake on the basis of commands received from the Engine Control Module.

This modulation is effectuated by an internal solenoid, commanded in PWM by the Engine Control Module, which actuates the control rod of the internal valve, which once open conveys gas to the intake manifold.



Key

A - E.G.R. valve body

B – Gas input from exhaust manifold

C – Gas output to intake manifold

Pin - out

Pin	Name
1	Solenoid positive
2	Solenoid negative

Functional logic

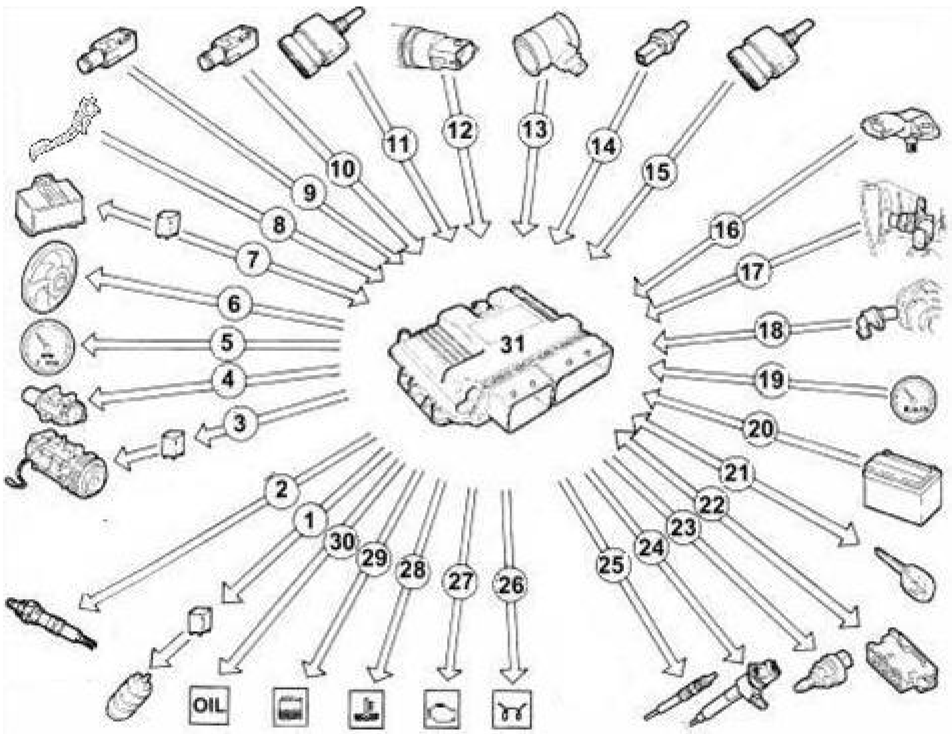
The common rail system permits up to two pilot injections prior to TDC with the advantage of distributing pressure in the combustion chamber more uniformly, reducing the combustion noise typical of direct injection engines, and of delivering up to two injections after the main injection, with the advantage of decreasing emissions levels (DPF version only).

The control unit controls the quantity of fuel injected, regulating line pressure and injection time.

The information that the control unit processes to control injected fuel quantity includes:

- Engine revs;
- Engine coolant temperature;
- Turbo pressure;
- Air temperature (from debimeter);
- Intake air quantity;
- Battery voltage;
- Diesel fuel pressure;
- Accelerator pedal position;
- Diesel fuel temperature;
- Lambda probe.
- **DPF pressure differential (on DPF version)**
- **DPF temperature (on DPF version)**

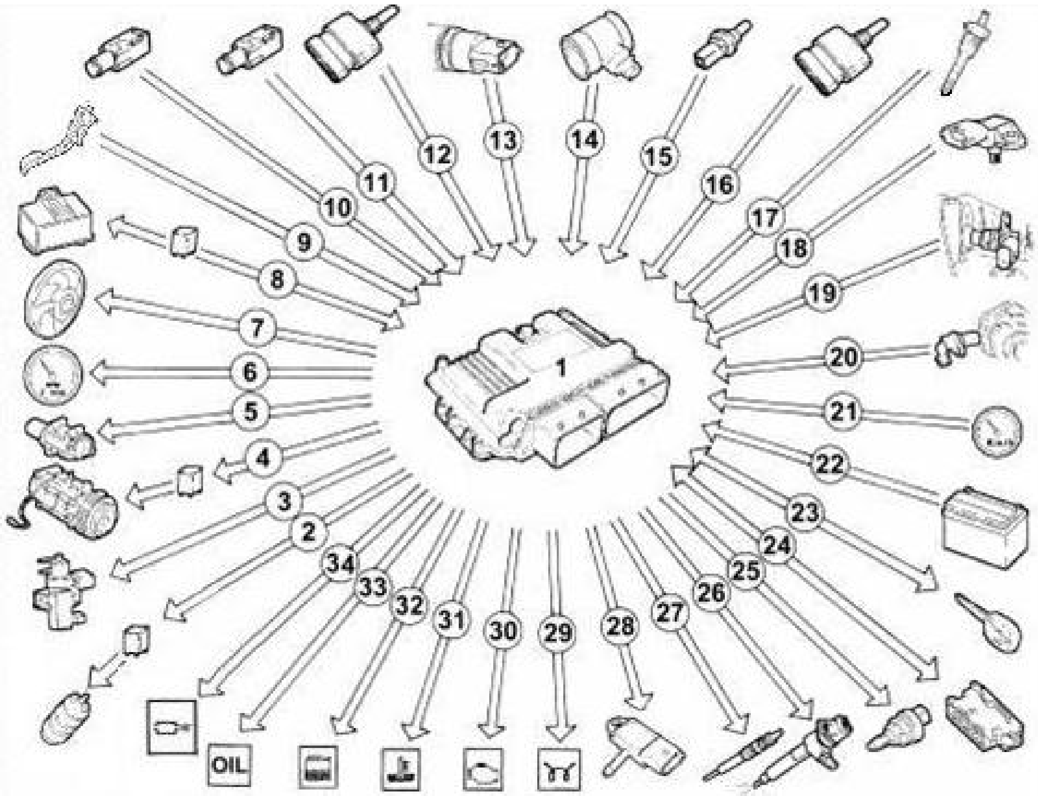
Engine Control Module input/output scheme – UEGO version.



Key
1. Auxiliary fuel pump
2. Lambda probe
3. Conditioner compressor (if fitted)
4. E.G.R. solenoid valve
5. Rev counter
6. Engine cooling fan
7. Glowplug control unit
8. Two-track accelerator pedal potentiometer
9. Brake pedal switch
10. Clutch pedal switch
11. Fuel temperature sensor
12. Fuel pressure sensor
13. Debimeter
14. Engine coolant temperature sensor
15. Water in Diesel filter sensor
16. Air temperature/pressure sensor
17. Timing sensor
18. Revs sensor
19. Tachometer

20. Battery
21. Fiat CODE (body computer)
22. Diagnosis socket
23. Pressure regulator on rail
24. Electroinjectors
25. Glowplugs
26. Glowplugs warning light
27. Injection warning light
28. Max water temp warning light
29. Water in fuel filter warning light
30. OIL pressure warning light
31 Engine Control Module

Engine Control Module input/output scheme – DPF version.



Key
1. Engine Control Module
2. Auxiliary fuel pump
3. Waste Gate actuator control solenoid valve
4. Conditioner compressor (if fitted)
5. E.G.R. solenoid valve
6. Rev counter
7. Engine cooling fan
8. Glowplug control unit
9. Two-track accelerator pedal potentiometer
10. Brake pedal switch
11. Clutch pedal switch
12. Fuel temperature sensor
13. Fuel pressure sensor
14. Debimeter
15. Engine coolant temperature sensor
16 Water in Diesel filter sensor
17. Exhaust gas temperature sensor
18. Overpressure sensor
19. Timing sensor
20. Revs sensor
21. Tachometer
22. Battery
23. Fiat CODE (body computer)
24. Diagnosis socket
25. Pressure regulator on rail
26. Electroinjectors
27. Glowplugs
28. Differential pressure sensor
29. Glowplugs warning light
30. MIL warning light
31. Max water temp warning light
32. Water in fuel filter warning light
33. OIL pressure warning light
34. Particulate filter clogged warning light

Self-diagnosis
The Engine Control Module self-diagnosis system checks the signals from the sensors comparing them with the admissible limits.

Fault indications on starting:
- Warning lights on until engine starts, indicating test phase;
- Warning light off after engine start indicating no fault in components of the system essential for safety
- Warning light on with engine running indicates fault

Fault indications when running:
- Warning light on indicates fault
- Warning light off after engine start indicating no fault in safety-essential system components.

Recovery
The Engine Control Module defines the type of recovery according to the failed component
Recovery parameters are managed by components that are fault-free

Fiat Code recognition
When it receives the key to “RUN” signal, the Engine Control Module dialogues with the Body Computer via the Fiat CODE function to enable starting.

Fuel temperature control
With fuel temperature at 80°C measured by the sensor in the fuel filter, the control unit commands the pressure regulator to reduce line pressure and, if not sufficient, also reduce the quantity of fuel injected.

Engine coolant temperature control
With engine coolant fluid temperature over 105°C, the Engine Control Unit:
- Reduces the quantity of fuel injected (reduces engine power);
- Activates the cooling fan
- Activates the coolant fluid temperature warning light

Injected fuel quantity control
According to the signals received from the sensors and the mapped value, the Engine Control Module:
- Commands the pressure regulator on the Rail
- Varies pilot injection time over the full engine speed range;
- Varies “main” injection time.

Idle speed control
The Engine Control Unit processes the signals received from the sensors and regulates the injected quantity of fuel:
- Commands the pressure regulator;
- Varies the injection time.

Within certain limits, it also takes account of battery voltage.

Fuel cut-off on release
When the accelerator pedal is released, the Engine Control Unit actuates the following logic:
- It sets injector aperture zero;
- Partially varies injection time before reaching idle speed;
- Commands the fuel pressure regulator;

Cylinder balancing control at idle
According to the signals received from the sensors, the control unit controls the regularity of torque down to idle speed:
- It varies the quantity of fuel injected into the individual injectors (injection time).

Smoothness control
The control unit processes the signals received from the various sensors and corrects the quantity of fuel to inject in order to improve drivability, improving driving smoothness by modulating injector aperture time.

Exhaust smoke control on acceleration
In order to reduce the smoke produced in speed transitions, according to the signals received from the accelerator pedal potentiometer, Lambda probe, debimeter and engine revs, the control unit limits the quantity of fuel to inject through:

- The pressure regulator
- Injection time modulation.
- E.G.R.

Exhaust gas recycling control (E.G.R.)
According to the new EURO 4 anti-pollution standards, according to engine load and the signal coming from the accelerator pedal potentiometer, the control unit has to limit the quantity of fresh air intake, implementing partial intact of exhaust gas by:

- Regulating aperture of the electric E.G.R. valve.

Maximum torque limit control
According to the number of revs, using the predefined maps the Engine Control Module calculates:

- The torque limit;
- The admissible smoke (limit)

Comparing these minimum values and correcting the with other parameters:

- Engine coolant temperature;
- Engine revs;
- Vehicle speed;
- Air temperature.

And commands the quantity of fuel to inject (Pressure regulator - Electroinjectors).

Maximum speed limit control
When the engine reaches 5200 rpm, the control unit cuts-off injector piloting and consequentially reduces fuel supply pressure.

Glowplugs control
The engine control module, during:

- *Starting;*
- *Post-starting;*

times function of the Glowplugs control unit according to engine temperature.

Air-conditioning system compressor cut-in control
The engine control module commands the air-conditioner compressor:

- Switching it on/off when the corresponding button is pressed
- Temporarily switching off (for a few seconds) in case of heavy acceleration or demand for maximum power.

Auxiliary fuel pump control
Regardless of engine speed, the Engine Control Module:

- Powers the auxiliary fuel pump with key to RUN;
- Cuts-off power to the auxiliary pump if engine is not started within a few seconds.

Cylinder position recognition
During each engine revolution, the engine control module recognizes which cylinder is in the ignition stroke and commands the injection sequence accordingly.

Main injection advance and pilot injection control
According to the signals received from the various sensors, including the absolute pressure sensor embedded in the unit itself, the engine control module determines the optimal injection point based on its internal mapping, not only to achieve driving comfort, but also to comply with EURO 4 emissions limits.

Injection pressure closed loop control
According to engine load, determined by processing the signals from the various sensors, the engine control module commands the regulator on the rail to achieve optimal line pressure.

Electrical balance control
According to battery voltage, the engine control module varies idle speed:

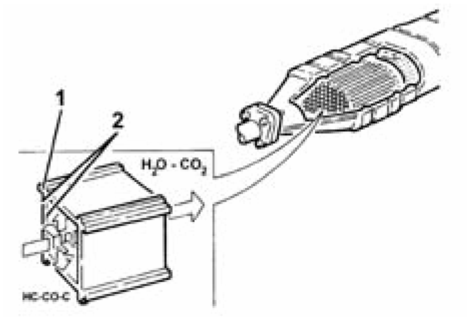
- increasing injection time.
- regulating line pressure.

Cooling fan control
According to engine coolant temperature and pressure in the conditioning system, the engine control module commands:

- Fan cut-in at first, second or third speed

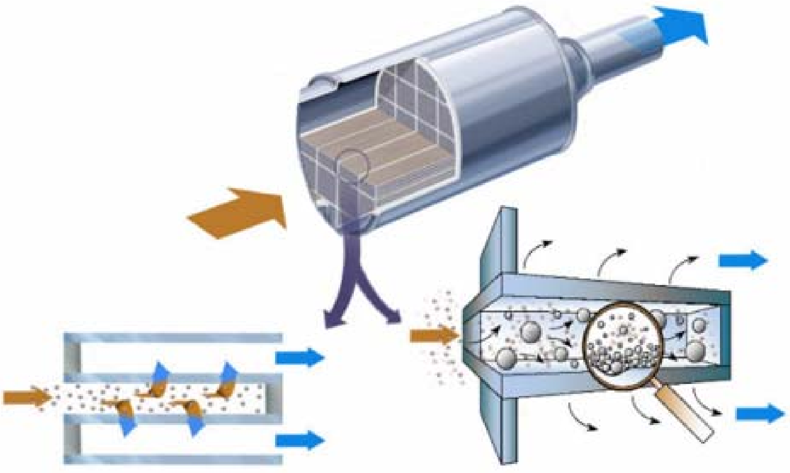
Exhaust emissions control

Catalytic converter



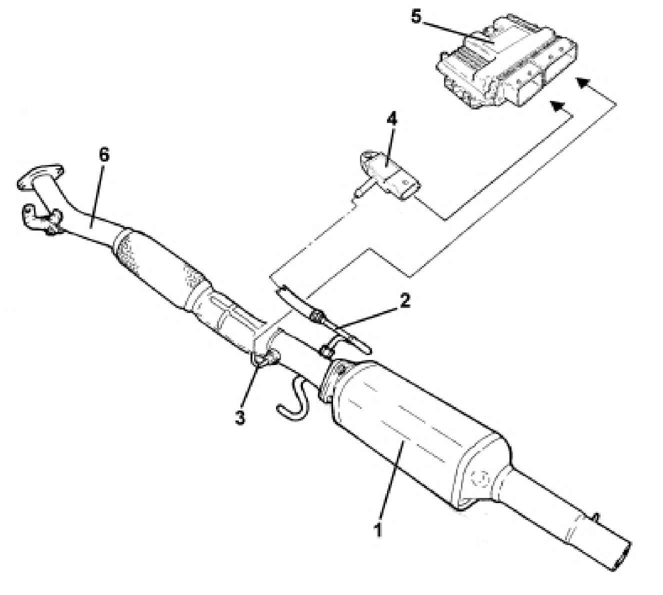
The oxidizing catalyzer is a post-treatment device for oxidizing the HC and particulate in exhaust gas, converting it to carbon dioxide (CO2) and water vapor (H2O).
The catalytic converter consists of a ceramic honeycomb block (1), with cells impregnated with platinum (2), the oxidation reaction catalyst.
The exhaust gas passing through the cells heats the catalyzer, triggering the conversion of the pollutants into inert compounds
The oxidation reaction of the CO, HC and particulate is effective at temperatures between 200 and 350°C.
Indeed, over 350°C the sulphur contained in Diesel begins to oxidize, producing sulphur monoxide and dioxide.

DPF system(diesel particulate filter)



Specifications and function

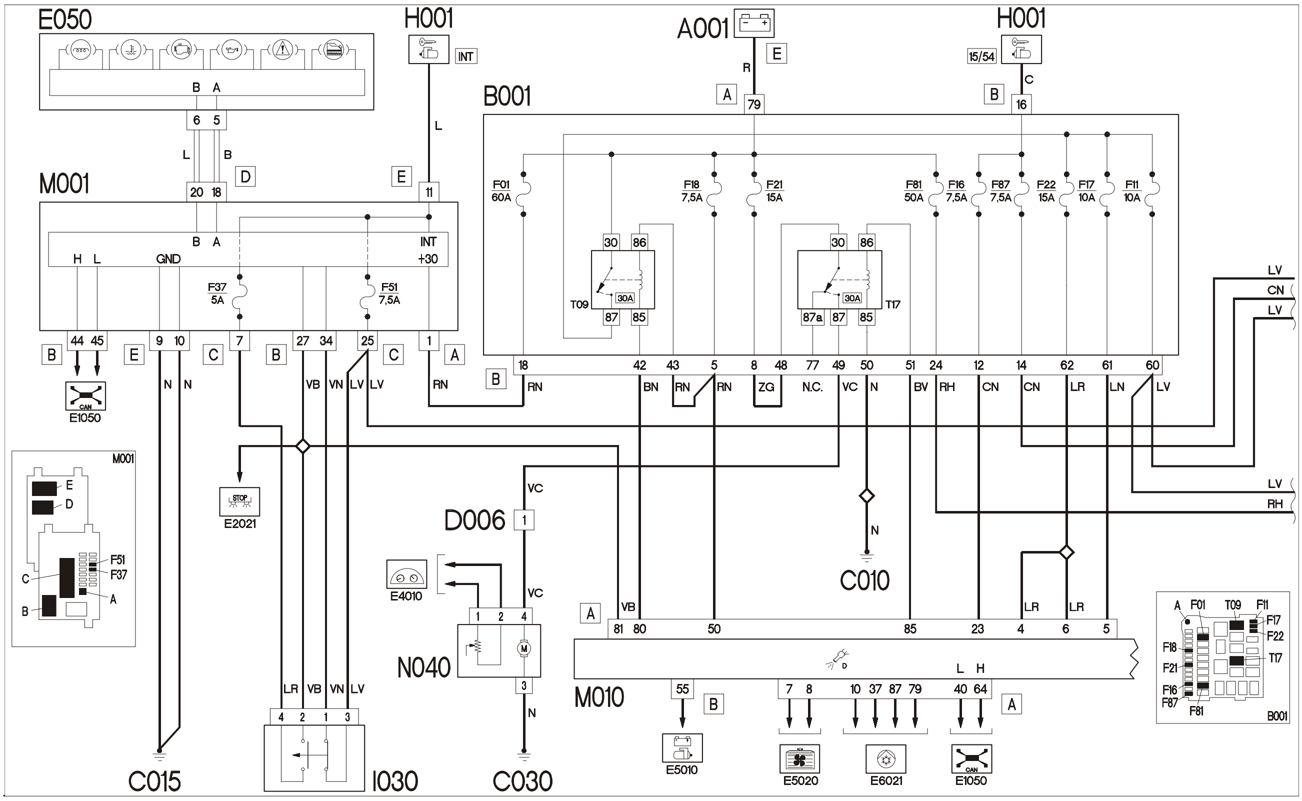
This is a mBCManical filter that traps carbon particles and ash from the oil present in the exhaust gas of the Diesel engine.
The action of the DPF permits an approx. 90% abatement of the particulate content of the exhaust, in line with Euro 4 and 5 standards.
The function of the DPF system is controlled, with suitable strategies, by the injection control unit.
In addition to the accumulation trap, the DPF system has an exhaust gas temperature sensor and a differential pressure sensor.
Through specific pipes, the differential pressure sensor measures exhaust gas pressure downstream of the trap, indicating the gradual accumulation of particulate in the filter. The accumulation of particulate in the trap and corresponding rise in exhaust gas pressure inside the trap depends on engine load, vehicle weight, engine size and engine power. The filter therefore must be periodically regenerated by means of a procedure that uses multiple injections to raise exhaust gas temperature (approx. 600°C) to burn away the particulate. The regeneration procedure is controlled by the injection control unit and acts: on the dosing of fuel (up to five injections in the same engine cycle per cylinder) and on air control (E.G.R. and turbo pressure).
The regeneration takes only a few minutes and does not have any effect on the torque delivered by the engine with respect to normal function.



Key
1. Particulate filter (DPF)
2. Exhaust gas pressure take-off
3. Exhaust gas temperature sensor
4. Differential pressure sensor
5. Engine Control Module
6. Exhaust pipe with flexible section.

UEGO version electrical system

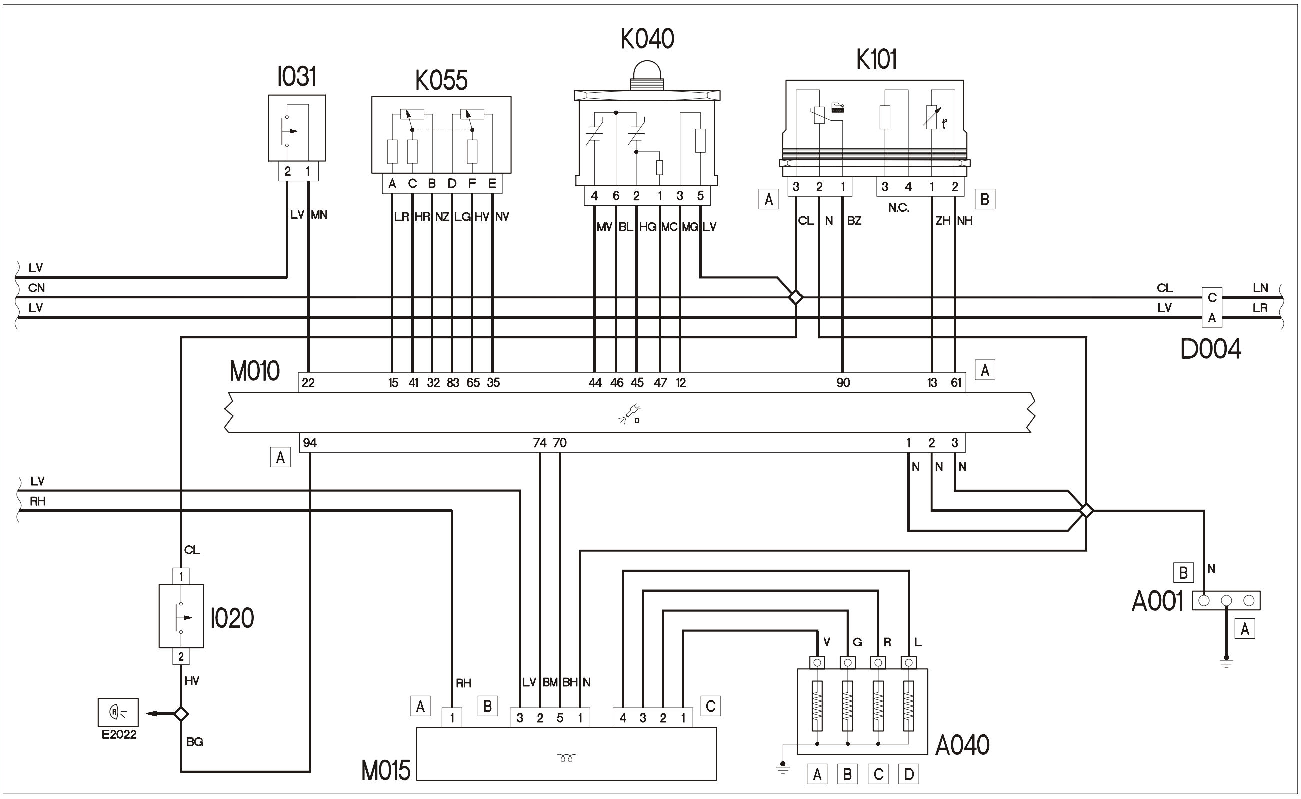
Diagram E5030 A



Key

A001 BATTERY
B001 JUNCTION BOX UNIT
C010 GROUND
C015 GROUND
C030 GROUND
D006 JUNCTION
E050 INSTRUMENT PANEL
I030 BRAKE PEDAL SWITCH
I031 CLUTCH PEDLA SWITCH
H001 IGNITION SWITCH
M001 BODY COMPUTER
M010 ENGINE CONTROL MODULE
N040 FUEL PUMP AND GAUGE

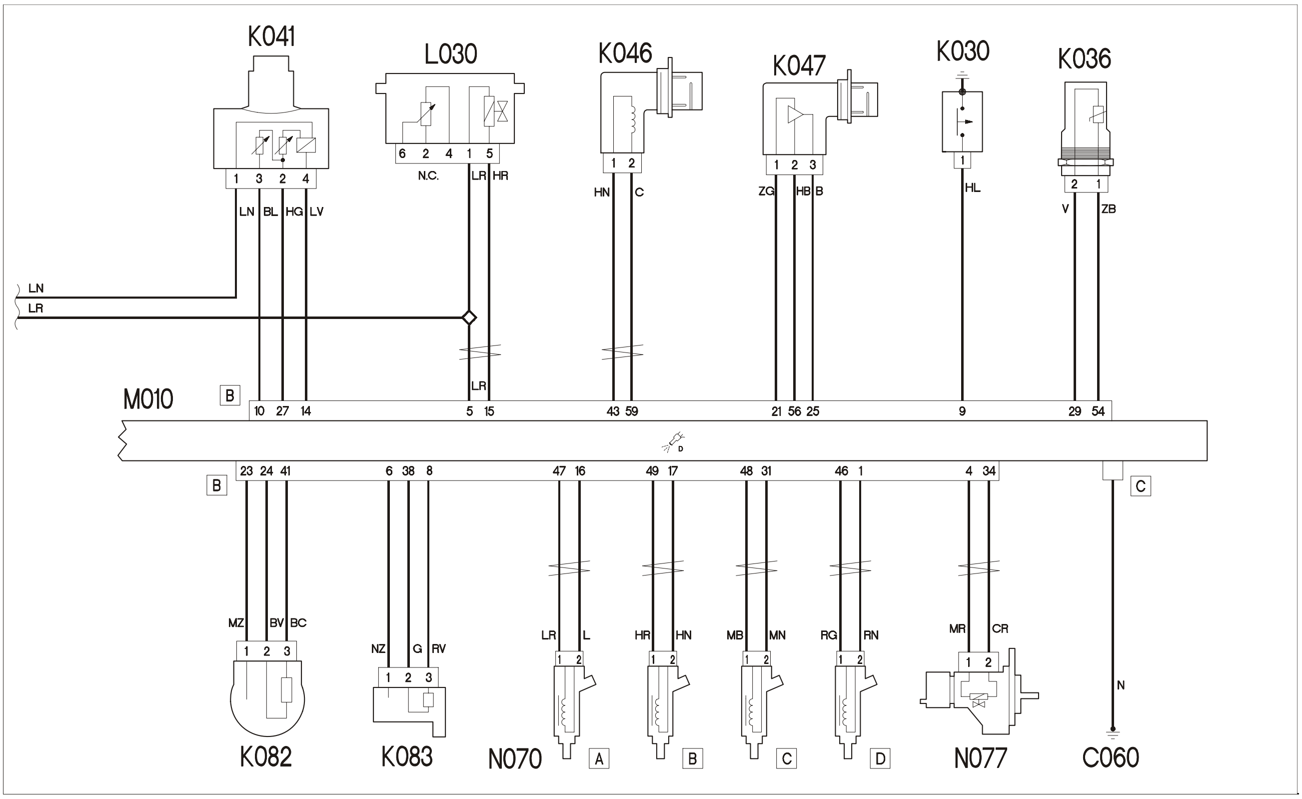
Diagram E5050B



Key

A001 BATTERY
A040 GLOWPLUGS
D004 JUNCTION
D029 ENGINE HARNESS / ENGINE SERVICE HARNESS JUNCTION
I020 REVERSING LIGHTS SWITCH (GEARBOX HARNESS)
I031 CLUTCH PEDLA SWITCH
K040 LAMBDA PROBE
K055 ACCELERATOR PEDAL POTENTIOMETER
K101. FUEL TEMPERATURE AND WATER IN FUEL FILTER SENSOR
M010 ENGINE CONTROL MODULE
M015 GLOWPLUGS CONTROL UNIT

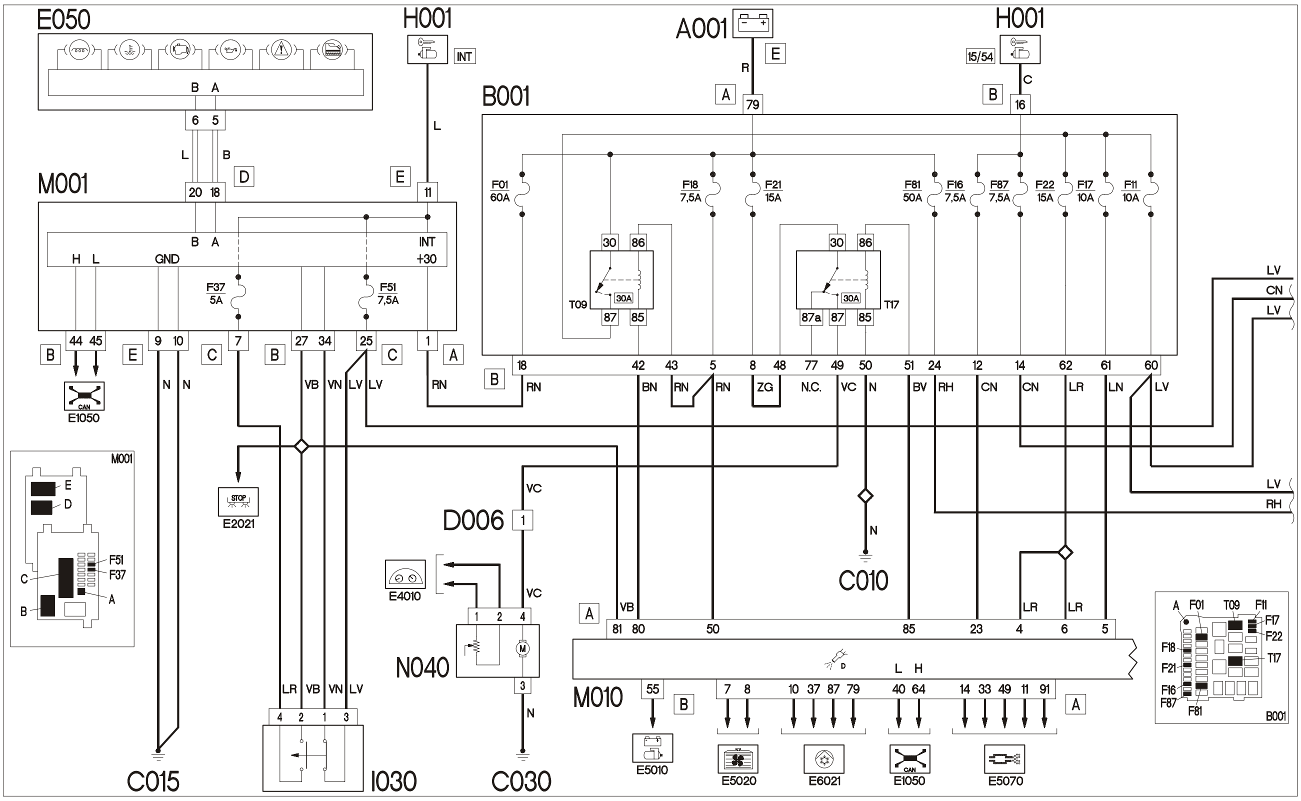
Diagram E5030 C



Key
C030 GROUND
K030 ENGINE OIL PRESSURE SENSOR (SWITCH)
K036 ENGINE COOLANT TEMPERATURE SENSOR/TRANSMITTER
K041 DEBIMETER
K046 REVS SENSOR
K047 TIMING SENSOR
K082 TURBO PRESSURE SENSOR
K083 FUEL PRESSURE SENSOR
L030 EGR SOLENOID VALVE
M010 ENGINE CONTROL MODULE
N070 ELECTROINJECTOR
N077 FUEL PRESSURE REGULATOR

DPF version electrical system

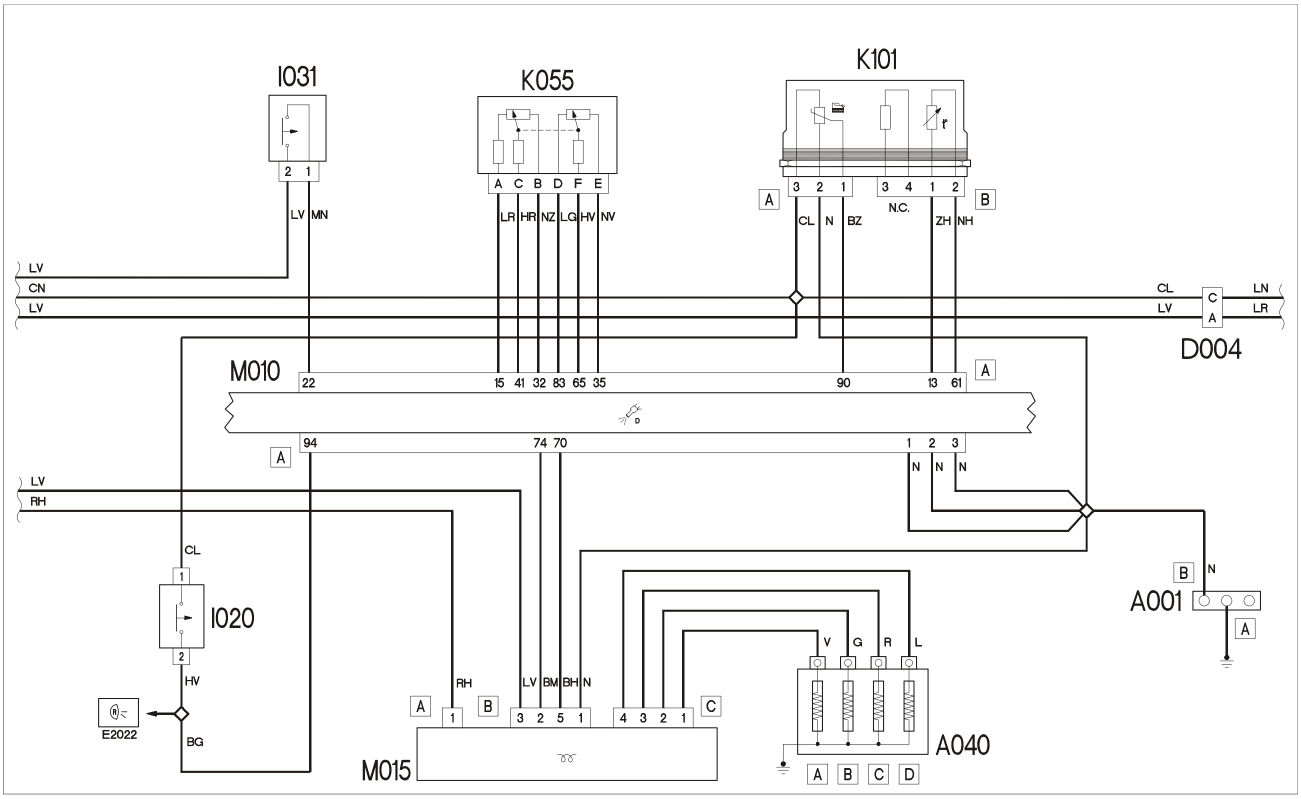
Diagram E5030 A DPF



Key

A001 BATTERY
B001 JUNCTION BOX UNIT
C010 GROUND
C015 GROUND
C030 GROUND
D006 JUNCTION
E050 INSTRUMENT PANEL
I030 BRAKE PEDAL SWITCH
I031 CLUTCH PEDAL SWITCH
H001 IGNITION SWITCH
M001 BODY COMPUTER
M010 ENGINE CONTROL MODULE
N040 FUEL PUMP AND GAUGE

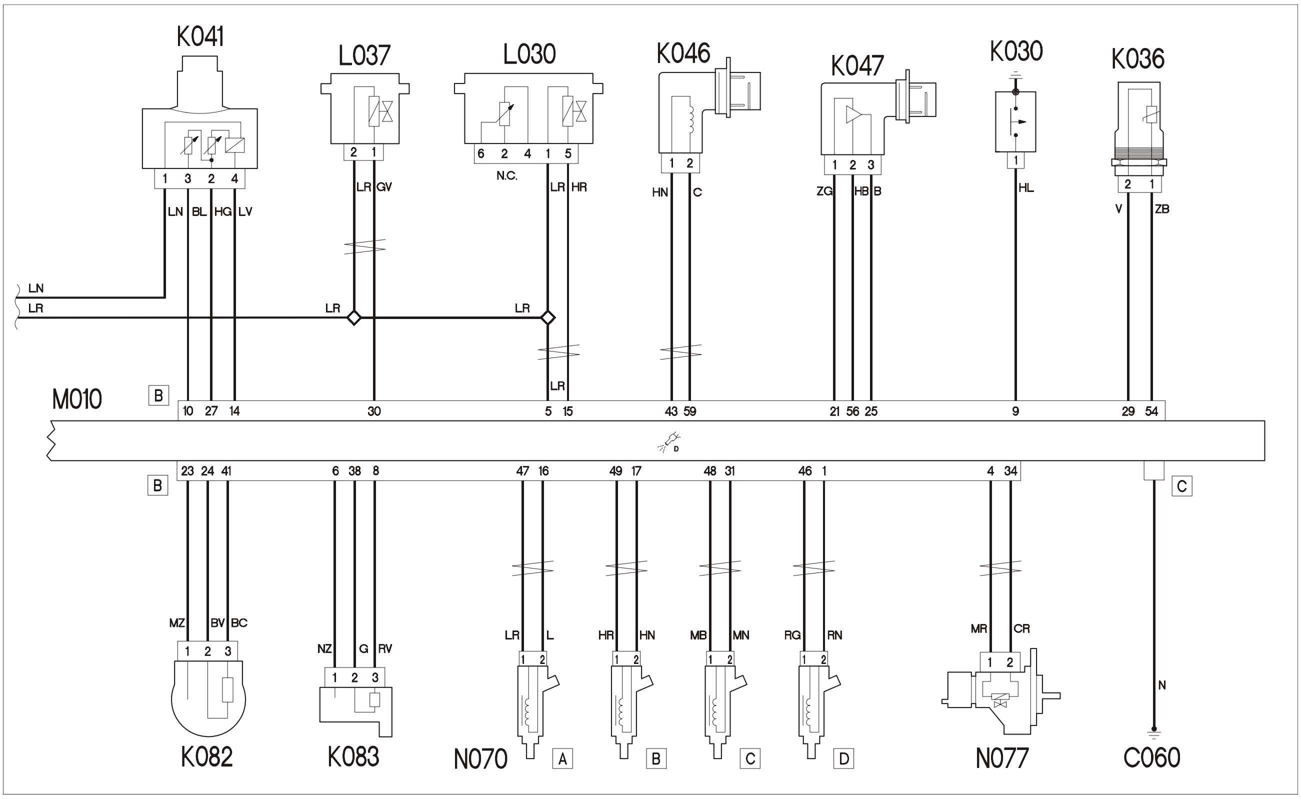
Diagram E5050B DPF



Key

A001 BATTERY
A040 GLOWPLUGS
D004 JUNCTION
D029 ENGINE HARNESS / ENGINE SERVICE HARNESS JUNCTION
I020 REVERSING LIGHTS SWITCH (GEARBOX HARNESS)
I031 CLUTCH PEDAL SWITCH
K055 ACCELERATOR PEDAL POTENTIOMETER
K101. FUEL TEMPERATURE AND WATER IN FUEL FILTER SENSOR
M010 ENGINE CONTROL MODULE

Diagram E5030 C DPF

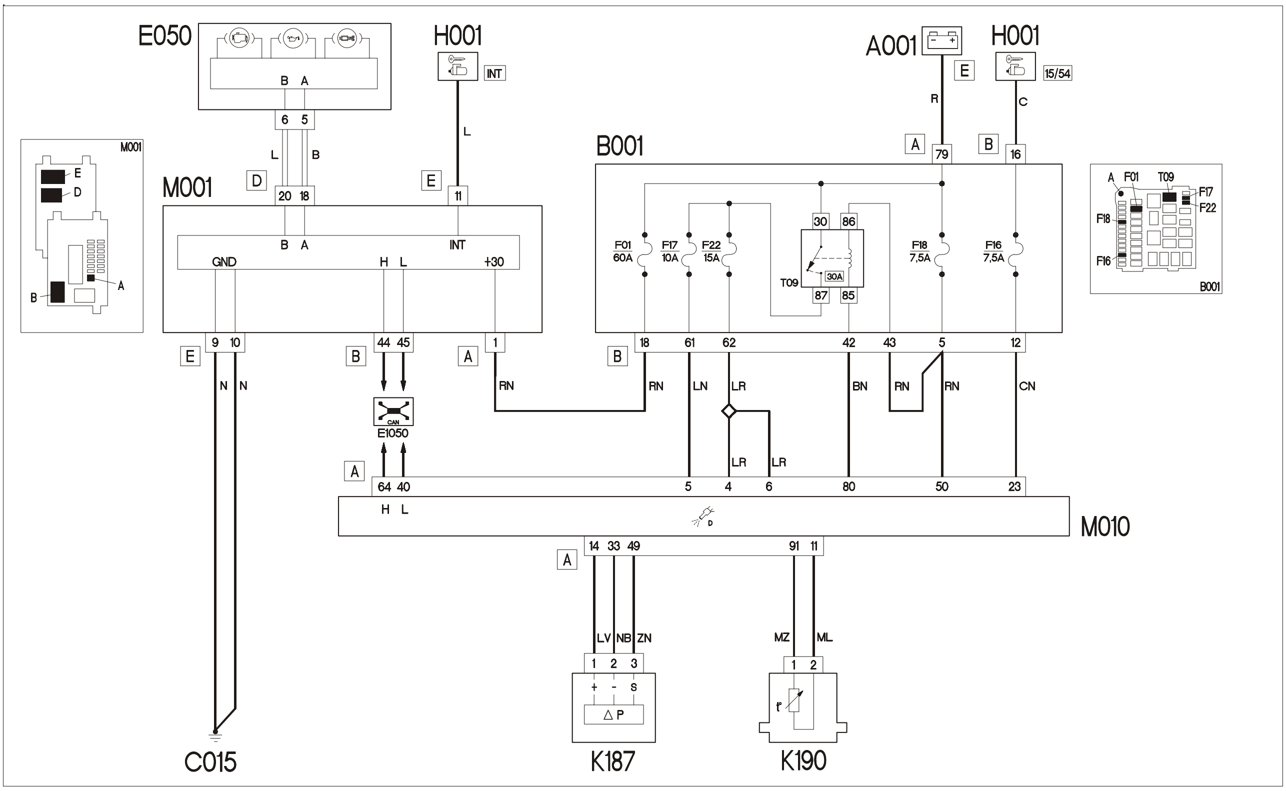


Key

C030 GROUND
K030 ENGINE OIL PRESSURE SENSOR (SWITCH)
K036 ENGINE COOLANT TEMPERATURE SENSOR/TRANSMITTER
K041 DEBIMETER
K046 REVS SENSOR
K047 TIMING SENSOR
K082 TURBO PRESSURE SENSOR
K083 FUEL PRESSURE SENSOR
L030 EGR SOLENOID VALVE
L037 WASTE GATE COMMAND SOLENOID VALVE
M010 ENGINE CONTROL MODULE
N070 ELECTROINJECTOR
N077 FUEL PRESSURE REGULATOR

DPF circuit diagram

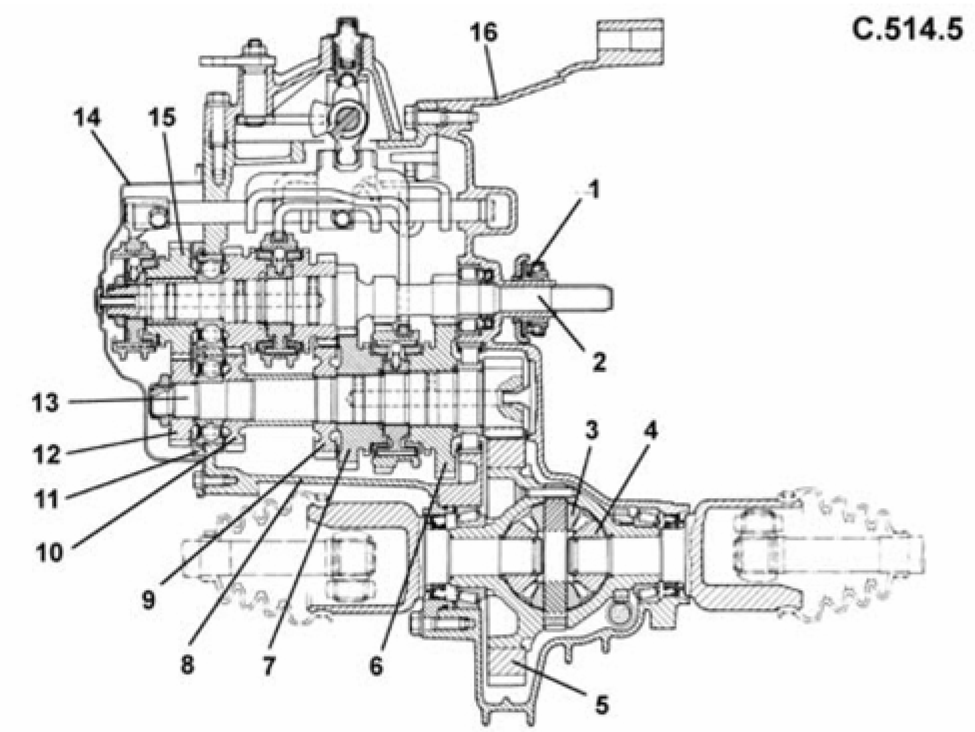
Diagram E5070



Key
A001 BATTERY
B001 JUNCTION BOX UNIT
C015 GROUND
E050 INSTRUMENT PANEL
H001 IGNITION SWITCH
K187 FAP DIFFERENTIAL PRESSURE SENSOR
K190 UPSTREAM PARTICULATE FILTER (DPF) TEMPERATURE SENSOR
M001 BODY COMPUTER
M010 ENGINE CONTROL MODULE

GEARBOX

514 5-speed gearbox



Key
1. Thrust bearing
2. Primary shaft
3. Satellites
4. Planets
5. Crown wheel
6. 1st gear driven cog
7. 2nd gear driven cog
8. Gear train box
9. 3rd gear driven cog
10. 4th gear driven cog
11. Rear bearing retainer plate
12. 5th gear drive cog
13. Secondary shaft
14. Rear cover
15. 5th gear drive cog
16. Gearbox to engine union box

The structure of the C514 5-speed gearbox consists of:
- A gear box that contains and supports the primary and secondary shafts, the engagement rods and forks and the gear selection and engagement device;
- The rear cover that contains the 5th gear cogs and the rear retainer plate for the primary and secondary shaft bearings;
- An engine to gearbox union box that contains the clutch and related command levers. For the version with electro hydraulic actuator, the box is adapted to support the group selector.

Primary shaft
The primary shaft consists of:
- 1st, 2nd gear and RG cut directly onto the shaft;
- 3rd, 4th and 5th gear cogs fitted to shaft.

The primary shaft is carried out a front roller bearing and a rear ball bearing.

Secondary shaft
The secondary shaft carries the 1st, 2nd, 3rd, 4th and 5th gears.
The secondary shaft bearings consist of:
- A front roller bearing
- A rear ball bearing.

Gears
The gear cogs are:
- Helical tooth for the forward gears.
- Straight tooth for the reverse gear.

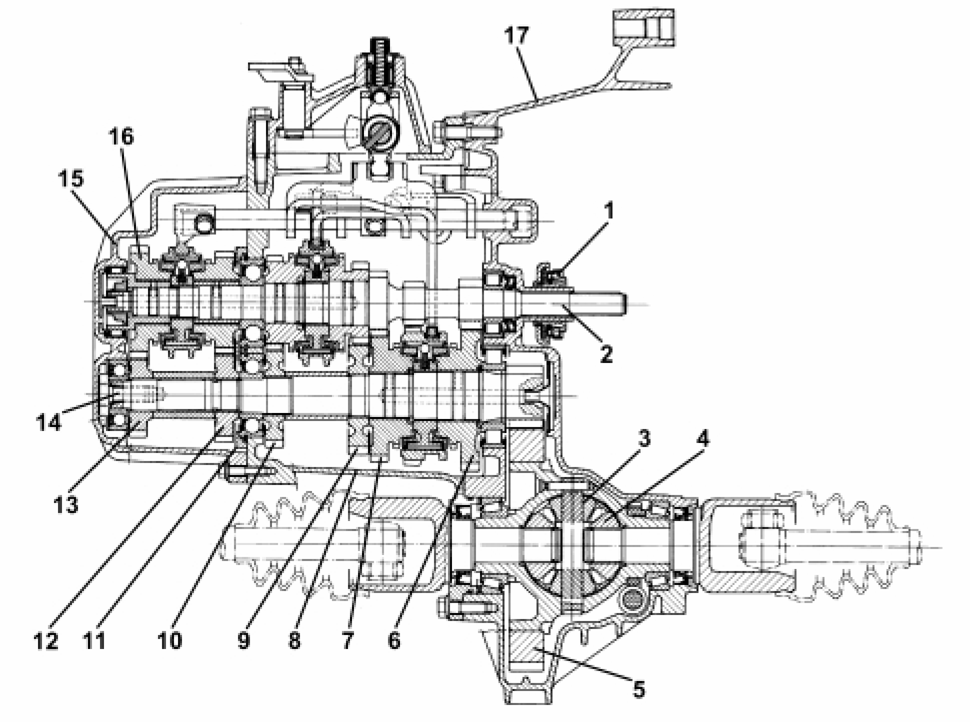
Synchronizers
The synchronizers for all forward gears are Borg-Warner type.
The scheme adopted for the synchronizers is the doubled type, since the synchronizers for 1st and 2nd gear are fitted to the secondary shaft, while those for the 3rd, 4th and 5th gears are on the primary shaft.
This solution reduces gear change noise during passage through neutral since 3 of the 5 gear pairs are not being driven.
Engagement and synchronization force are also reduced due to the corresponding reduced rotating mass downstream of the crankshaft.

Differential
In the C.514 -5 gearbox the differential group is located to the rear of the gearbox.
This consists of:
- A beveled reduction pair
- A single piece differential box with built-in planet and satellite gears.

The differential is carried by two tapered roller bearings.
The planets have splines for connecting the two joints connected to the two transfer shafts driving the wheels.

The speedometer drive gear is fitted to the outside of the gearbox.

514 6-speed gearbox



Key
1. Thrust bearing
2. Primary shaft
3. Satellites
4. Planets
5. Crown wheel
6. 1st gear driven cog
7. 2nd gear driven cog
8. Gear train box
9. 3rd gear driven cog
10. 4th gear driven cog
11. Rear bearing retainer plate
12. 5th gear driven cog
13. 6th gear driven cog
14. Secondary shaft
15. Rear cover
16. 6th gear drive cog
17. Engine to gearbox union box

The structure of the gearbox consists of:
- A gear box that contains and supports the primary and secondary shafts, the engagement rods and forks and the gear selection and engagement device;
- The rear cover that contains the 5th and 6th gear cogs and the rear retainer plate for the primary and secondary shaft bearings;
- An engine to gearbox union box that contains the clutch, the thrust bearing and related command levers.

Primary shaft
The primary shaft consists of:
- 1st, 2nd gear and RG cut directly onto the shaft;
- 3rd, 4^{th}, 5^{th} and 6th gear cogs fitted to shaft.

The primary shaft is carried out a front roller bearing and a rear ball bearing.

Secondary shaft
The secondary shaft carries the 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, 5^{th} and 6^{th} gears.
The secondary shaft bearings consist of:
- A front roller bearing
- A rear ball bearing.

Gears
The gear cogs are:
- Helical tooth for the forward gears.
- Straight tooth for the reverse gear.

Synchronizers
The synchronizers for all forward gears are Borg-Warner type.
The scheme adopted for the synchronizers is the doubled type, since the synchronizers for 1^{st} and 2^{nd} gear are fitted to the secondary shaft, while those for the 3^{rd}, 4^{th}, 5^{th} and 6^{th} gears are on the primary shaft.
This solution reduces gear change noise during passage through neutral since 3 of the 6 gear pairs are not being driven.
Engagement and synchronization force are also reduced due to the corresponding reduced rotating mass downstream of the crankshaft.

Differential
In the C.514 -6 gearbox the differential group is located to the rear of the gearbox.
This consists of:
- A beveled reduction pair
- A single piece differential box with built-in planet and satellite gears.

The differential is carried by two tapered roller bearings.
The planets have splines for connecting the two joints connected to the two transfer shafts driving the wheels.

Robotised transmission (Dual Logic)

INTRODUCTION

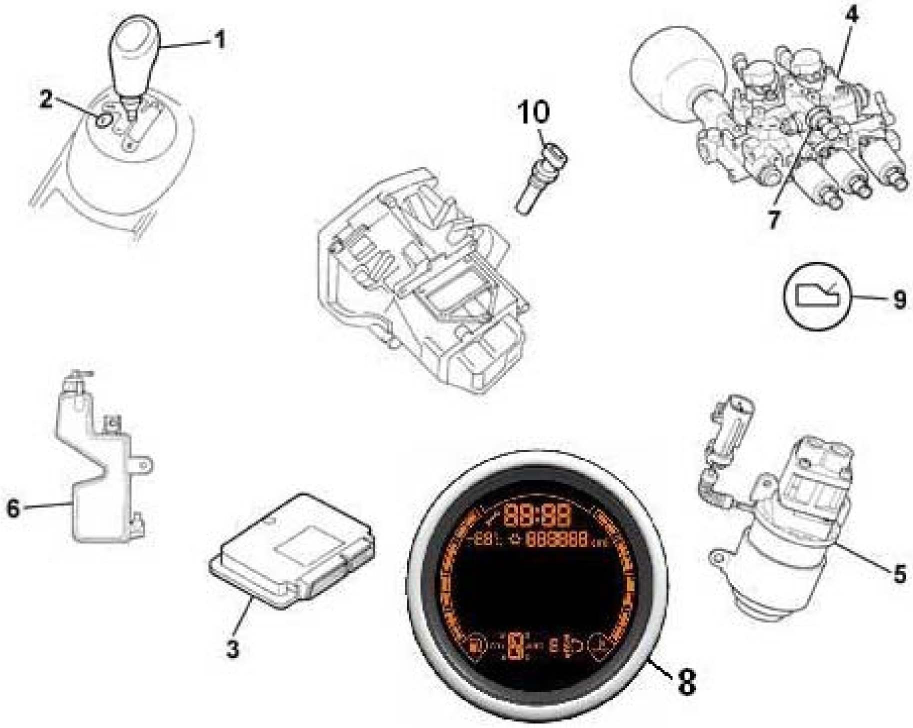
A C514 mechanical transmission with hydraulic control unit may be fitted aboard 1.2 8V and 1.4 16v versions.
This system is designed to automate the clutch and gear lever controls of a conventional mechanical transmission by means of an electrical-hydraulic assistance system. As a result, the system:

- avoids the need to control the clutch pedal and the conventional gear stick by the driver
- improves driving safety by means of a direct control that prevents driving mistakes and transmission system misuse
- provides a state-of-the-art interface
- offers a hydraulic transmission and clutch assistance with the benefits of a dry clutch and mechanical gearbox system (low weight, robust design, reliability, low energy consumption)
- simplifies use and reduces driving fatigue, particularly in city traffic
- ensures comfortable or sporty gear shift patterns according to state-of-the-art control logics
- there is no clutch pedal
- the control lever is replaced by a lever on the tunnel ("Up, Down, Neutral, Reverse").

The robotized gearbox has two operating modes:

- SEMIAUTOMATIC MODE (MANUAL): The driver can shift gears by means of the lever on the tunnel (Up/Down).
- AUTOMATIC MODE (AUTO): The electronic system shifts gears according to two strategies, the first focusing on comfort (NORMAL) and the second on efficient consumption (ECO).

Main components of the robotised transmission system

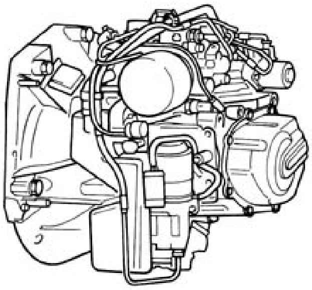


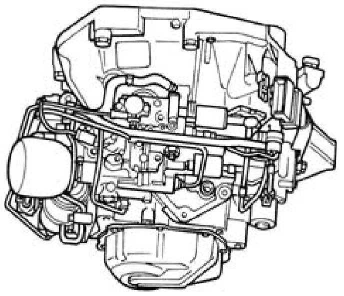
Key:
1. Gear shift lever on tunnel
2. ECO/NORMAL button
3. Transmission ECU
4. Hydraulic control unit
5. Pump
6. Reservoir
7. Oil pressure sensor
8. Gear and operating mode display
9. Transmission failure warning light
10. Primary speed sensor

SYSTEM COMPONENTS

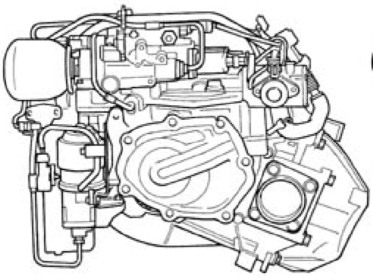
Hydraulic control unit kit on transmission
The hydraulic control unit kit is arranged on the C514 gearbox as shown in the following illustrations:

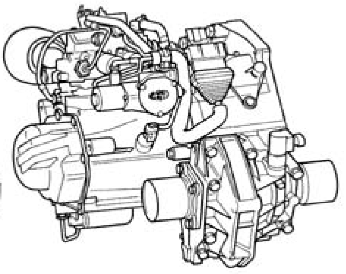
Front view





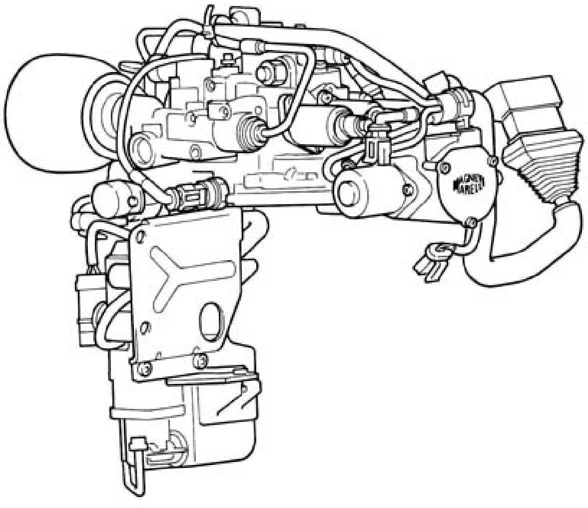
Side view



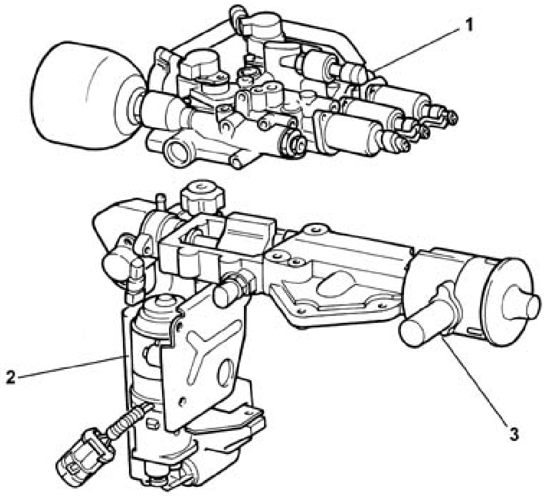


Hydraulic control unit kit components
The hydraulic control unit kit is an assembly of three main parts:

- a mechanical gear control assembly which interfaces directly with the gearbox through an opening in the casing similar that of a manual mechanical system;
- a solenoid valve unit which transformed the hydraulic energy into mechanical energy by means of an engagement piston interfacing with the control shaft;
- a power unit consisting of a hydraulic pump and reservoir.



The main parts of the hydraulic control kit fitted on the C514 gearbox are shown below.

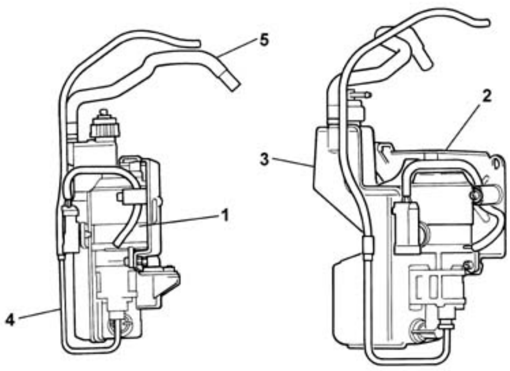


Key:
1. Solenoid valve unit
2. Pump and reservoir power unit
3. Mechanical unit

The kit can be disassembled into three fundamental parts: the upper part (valve unit) and the lower part (mechanical part) connected to the hydraulic power part (pump + reservoir).

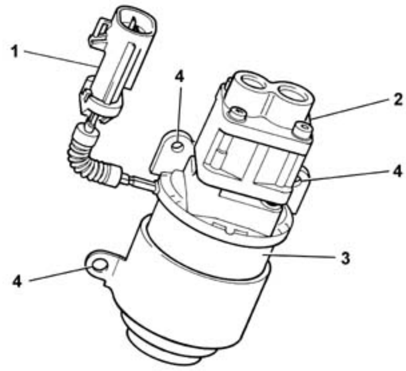
Power unit
The power unit feeds the hydraulic power needed to actuate the gear shifts and the clutch.
The unit consists of:

- a pump (electrical motor and geared pump)
- an oil reservoir.



Key:
1. Pump
2. Fastening bracket
3. Reservoir
4. High pressure delivery tube
5. Low pressure return tube

Pump
This is fastened directly to the fastening bracket in three points.



Key:
1. Electrical connector
2. Gear pump
3. Electric motor
4. Fastening points to bracket

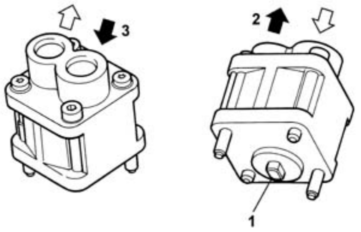
This is a gear pump, approximately 0.25 cm^3/rev, driven via a joint by a 12V direct current electrical motor via a relay governed by the C.F.C328F unit.

The pump is activated when the accumulated pressure drops under 40 bars and is stopped (off) when the accumulated pressure is 50 bars.
The electrical motor and the pump and fastened by screws and a flange.

The main technical features that the system must ensure for correct operation are:

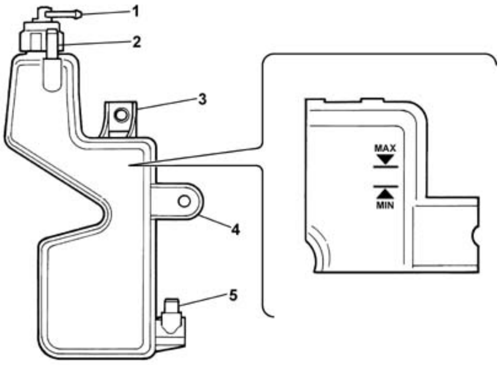
- Working hydraulic pressure from 41 to 51 bars
- Operating temperature from -30˚C to + 125 ˚C
- Cranking is must be possible also at -30°C
- The pump flow rate is 0.8 l/min at 60°C
- The accumulator volume is 280 cm^3 preloaded at 27 [bar] at 25°C (this value is important because it determines the discharge time)

Mechanical gear pump



Key:
1. Engine connection
2. High pressure delivery (threaded connection to HP delivery semi-rigid pipe)
3. Input from reservoir (direct connection to reservoir)

Oil reservoir with filter
A detail of the oil level present in the reservoir is shown in the following illustration.

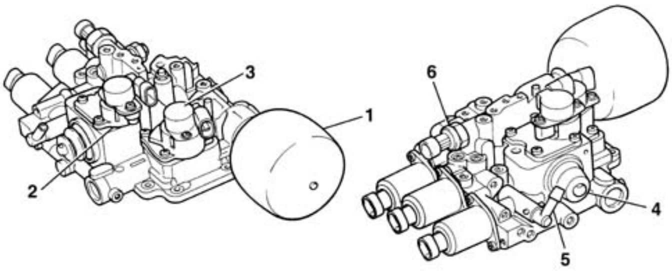


Key:
1. Oil recovery connection
2. Low pressure return connection
3. Bracket connection eyelet
4. Electric motor connector support
5. Pump connection

Note: Hydraulic oil, TUTELA CAR CS SPEED specific with "ATF Dexron III" type additive (viscosity 1800 cPs at -40 [˚C]; 6.5 cPs at 100 [˚C])

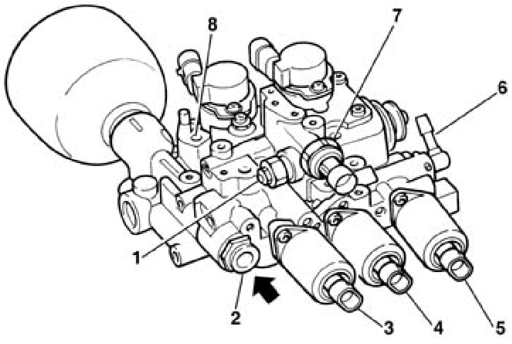
SOLENOID VALVE BODY
The functions of this subsystem include:
- Control and actuation of the clutch position
- Forced control of gear shifts and range selection
- Accumulation of hydraulic energy/power for controlling the actuators.

The components of the solenoid valve unit are:
- Clutch actuator (simple acting piston)
- Flow rate proportioning solenoid valve for clutch actuator control
- Gear shift actuator (dual acting piston)
- Two pressure proportioning solenoid valves for controlling the shift actuator: even gear pressure proportioning solenoid valve (2 - 4 - R) and odd gear proportioning solenoid valve (1 - 3 - 5)
- Two potentiometer sensors for detecting the shift position and the clutch stroke position
- Accumulator
- Line pressure sensor (0-80 bars)
- Check valve.



Key:
1. Accumulator
2. Clutch stroke potentiometer
3. Shift stroke potentiometer
4. Clutch lever strut
5. Low pressure oil relief port
6. Pressure sensor

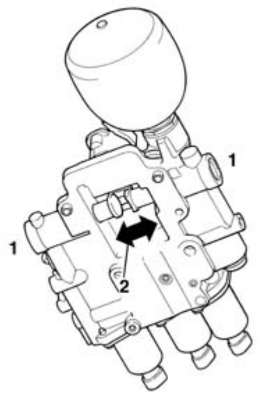
Hydraulic unit rear view



Key:

1. Maximum valve
2. High pressure deliver tube quick coupling
3. Clutch flow rate proportioning solenoid valve (sv0)
4. Even gear shift pressure proportioning solenoid valves (sv2)
5. Odd gear shift pressure proportioning solenoid valves (sv2)
6. Low pressure oil discharge rubber tube attachment
7. Pressure sensor
8. Earth point on kit

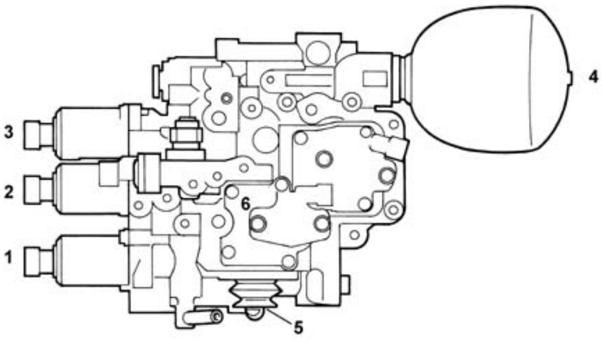
Bottom view of the hydraulic unit: observe the dual-acting actuator (1) with fork coupling (2) to the control shaft.



Pressure proportioning valves sv1 and sv2

These valves control the oil pressure in the two dual-acting gear shift actuator ports to two stabile mechanical positions according to the control combination (even gears, odd gears).
The maximum flow rate is 7l/min with a pressure differential of 10 bars.
The control current is from 0 to 2.5 A controlled directly by the C.F.C328F unit.
The electrical resistance of the winding is 2.5 ohm ± 6% at 20˚C.

Valve unit top view

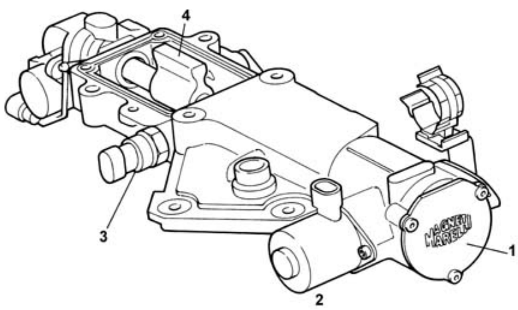


Key:
1. Odd gear shift pressure proportioning solenoid valves (sv2)
2. Even gear shift pressure proportioning solenoid valves (sv2)
3. Clutch flow rate proportioning solenoid valve (sv0)
4. Accumulator
5. Self-adjusting clutch strut
6. Pressure sensor

Mechanical unit
The mechanical unit interfaces with the gearbox to shift gears and change range.

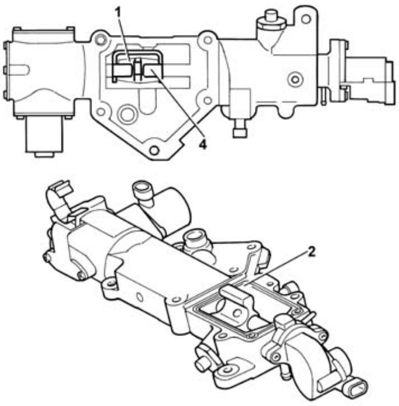
It consists of:
- Gear selection system ("S" cam)
- Control shaft
- Connecting finger to shift pistons and gear holding system
- Engagement finger
- On-off electromagnet for controlling the gear selection system (brake)
- Reverse switch
- Selection potentiometer

Mechanical unit view

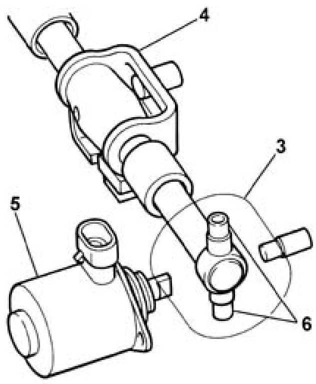


Key:
1. S-shaped cam containing port cover
2. Range change cam lock on-off electromagnet
3. Reverse switch
4. Engagement piston connection finger

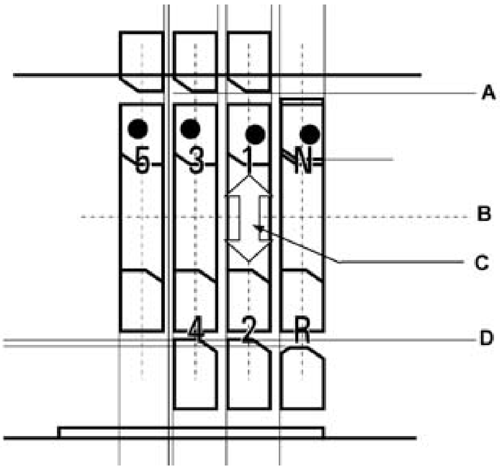
The mechanical system consists of a shaft which integrally carries a control finger (1),and an interface element (2) to the pistons obtained in the hydraulic unit. A drum (3) (on which two "S"-shaped profiles and three grooved seats are made) and a bolt (4) (whose task is to keep the gearbox control fork dogs aligned and static) are connected in the shaft in a non-rigid manner. Both elements (3) and (4) are kept in position by means of steel pins connected to the casing.
Mechanical unit view: the gearbox control finger (1), the piston interface element (2) and the bolt (4) are shown.



Diagrammatic view of the mechanical unit: the bolt (4), the drum (3) with the fastening pins to the aluminium casing are shown. The brake (5) and the spider (6) may be seen.

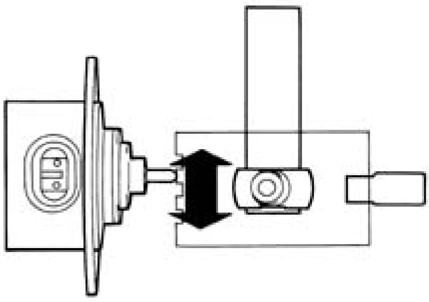


The operating principle is based on the transformation of the linear motion of the hydraulic pistons into rotary or rotary-translation motion of the shaft and thus the elements rigidly connected to it.
The purely rotary motion of the shaft (which corresponds to the disengagement of a gear and the engagement of a gear in the same range) is implemented by means of the following steps:
1. One of the two hydraulic pistons moves by translation motion.
2. The shaft is turned by means of the connecting element (2).
3. The electromagnetic brake is not active and allows the sliding of the drum (3) which is moved by the spider (6).
4. The bolt (4) does not move and keeps the forks non involved in the gear shift aligned.

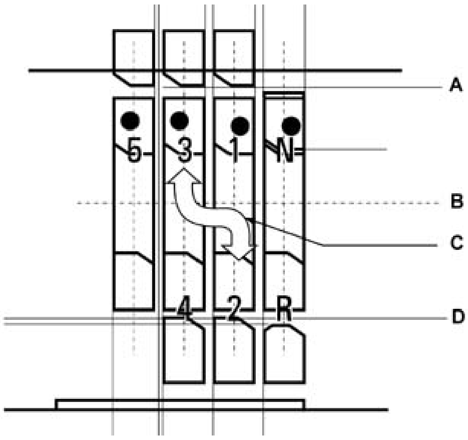


Key:
A. Odd gear engagement position
B. Neutral position
C. Gear shift in same range
D. Even gear engagement position

For gear shifts in the same range, the brake is not active and consequently does not engage the grooved profiles on the drum. In this manner, the shaft describes a purely rotational movement about its axis. The spider feeds the drum in the direction shown by the arrow (see figure).



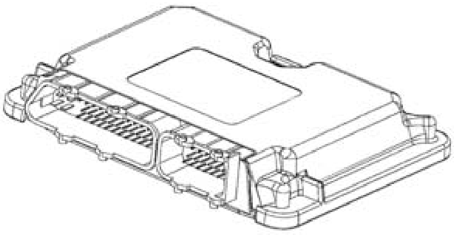
The purely rotary-translation motion of the shaft (which corresponds to the disengagement of a gear and the engagement of a gear in an adjacent range) is implemented by means of the following steps:
1. One of the two hydraulic pistons moves by translation motion.
2. The shaft is turned by means of the connecting element (2).
3. The electromagnetic brake is activated: the spider (6) is forced to follow the "S"-shaped profile on the drum which in this case is fixed to the aluminium casing. In this manner, the shaft, and thus the control finger (1), is forced to rotate by an angle, translate and rotate again by an angle.
4. The bolt (4) slides being drawn by the translating shaft. It is responsible for ending the dog recall of the gear being disengaged to home position and keeping it aligned with the others not involved in the gear shift.



Key:
A. Odd gear engagement position
B. Neutral position
C. Adjacent range gear shift
D. Even gear engagement position

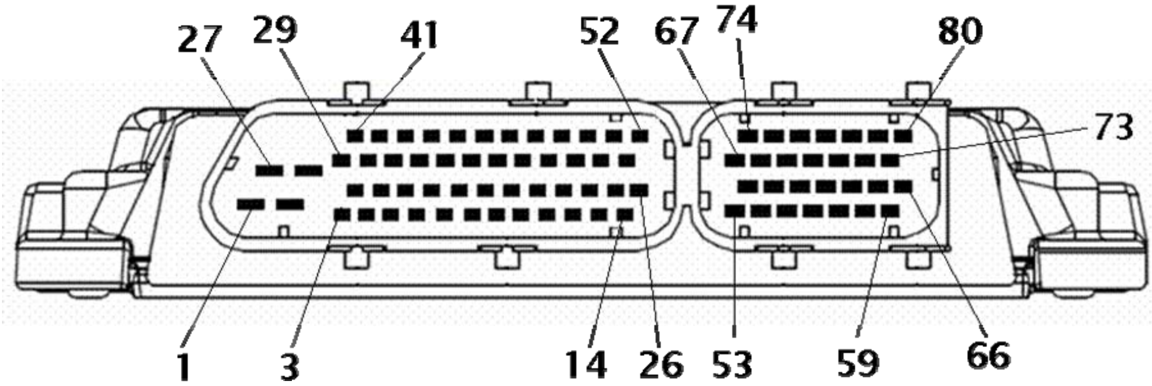
When shifting to gears in different ranges, the brake is active and consequently engages the grooves on the drum making it integral with the casing. In this manner, the shaft describes a rotary-translation motion above its axis because in this case the spider is forced to follow the "S"-shaped profile on the drum.

ELECTRONIC CONTROL UNIT
The ECU is accommodated on a metal bracket and ensured in turn with a further bolted bracket. The front wiring reaches the ECU via two male 80-pin sub-D Siemens connectors.



Communication lines:
C-CAN diagnostic line (500 kbyte)
An identification plate is applied onto the upper surface showing fundamental identification data, such as ECU number, part number, SW version and calibration.

Robotised gearbox ECU pinout



Pin	Signal description	Signal features
1	Power earth	Power
2	Power earth	Power
3	Not connected	
4	Not connected	
5	Not connected	
6	Not connected	
7	(L) C-CAN	from ECM
8	Not connected	
9	Not connected	
10	Not connected	
11	Not connected	
12	Not connected	
13	Not connected	
14	Not connected	
15	Not connected	
16	Not connected	
17	Not connected	
18	Not connected	
19	(H) C-CAN	from ECM
20	Not connected	
21	Not connected	
22	Not connected	
23	Not connected	
24	Not connected	

25	Not connected	
26	Lever signal	Input
27	+ 30	Power
28	+ 15	NCR and lever power
29	SV 3 control - Gear selection	Output
30	Not connected	

Pin	Signal description	Signal features
31	Pump relay command	Output
32	SV 1 command - Gear engagement	Output
33	C-CAN L line	from NBC
34	Not connected	
35	Not connected	
36	Not connected	
37	Not connected	
38	Clutch speed signal (positive)	Input
39	Gear engagement sensor signal	Input
40	Pressure sensor signal	Input
41	Not connected	
42	Starter relay enabling	Output
43	SV 0 command - clutch	Output
44	SV 2 command - Gear engagement	Output
45	C-CAN H line	from NBC
46	Not connected	
47	Not connected	
48	Not connected	
49	Not connected	
50	Clutch speed sensor signal (negative)	Input
51	Gear selection sensor signal	Input
52	Clutch position sensor signal	Input
53	Not connected	
54	Not connected	
55	Not connected	
56	Not connected	
57	Not connected	

58	Not connected	
59	Clutch position sensor earth (GND)	Power
60	Not connected	

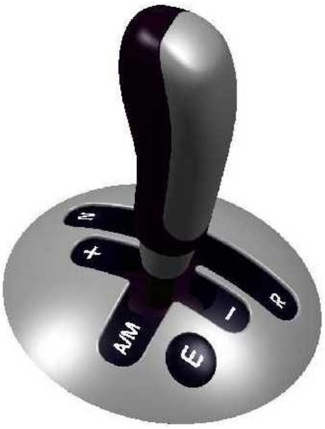
Pin	Signal description	Signal features
61	Not connected	
62	Not connected	
63	Not connected	
64	Not connected	
65	Gear lever command earth from NCR	Output
66	Potentiometer earth from NCR	Output
67	Lever signal	Input
68	Lever signal	Input
69	Brake pedal signal	Input
70	Not connected	
71	Not connected	
72	Not connected	
73	Potentiometer power from NCR	Output
74	Lever signal	Input
75	Steering wheel levers (OPT) (**note 1**)	Input
76	+ 50 ignition	Input
77	ECO button signal	Input
78	NBC port signal	Input
79	Clutch position sensor power	Output
80	Not connected	

Note:
1. The signal from pin 75 is univocal for shifting up and down. The steering wheel levers (opt) actually control a resistive divider. They are always active.
2. The NCR receives/sends the following signals on the CAN :

- Vehicle speed signal (RX)
- Engine speed (RX)
- Buzzer control (TX)

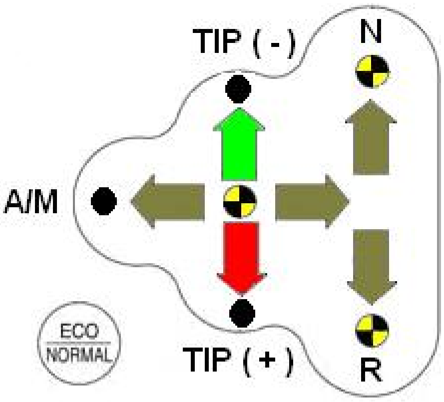
LEVER UNIT

Lever unit description
The robotized gearbox is equipped with a multistable gear selection lever with three stable positions and two unstable positions.



The lever positions are illustrated with reference to the following figure:

- **Stabile positions:** (black/yellow dots) These positions correspond to NEUTRAL (N), REVERSE (R) and TIP [between two unstable positions TIP (+) and TIP (-)].
- **Unstable positions:** (black dots) These positions are kept for as long that the lever is held and then released. These positions correspond to shift up request TIP (+), shift down request TIP (-) and automatic mode request (A/M). Tip the lever back to A/M to return to manual mode.



A button for selecting the operating mode is found on the lever panel:

- Economy (E). The indication (E) will appear in Automatic mode only.
- Normal (no indication).

Steering wheel levers
Two (optional) levers on the steering wheel may be provided for better safety and sportier use in combination with the lever unit. The steering wheel levers are always active for shift up and down requests.

SYSTEM BEHAVIOUR AT KEY-OFF

OPENING OF DOOR

When the vehicle is parked, the instrument panel is activated and various information on the vehicle is displayed when the door is opened: the engaged gear is not shown. The Selespeed® oil pump is activated to pressurise the circuit and allow the system to be active at key-on.

MISUSE BEFORE KEY-ON

The lever can be moved with or without pressing the brake pedal at key-off (vehicle stationary and ignition-switch devices not powered). The system will not activate any function when the lever is operated in this condition. Consequently, the gear engaged before key-off will remain engaged.

KEY-ON (+15)

When the vehicle is standing at key-on (ignition-switch devices powered), the engaged gear will appear on the instrument panel along with the operating mode (automatic = AUTO or manual = NO INDICATION) and the logic (economy = E or normal = NO INDICATION). The indication "E" will appear in Automatic mode only.

Only 1st, N and R may be engaged by pressing the brake pedal.

The system will not implement the gear shift request if the lever is operated **without pressing the brake pedal**.
The following cases of inconsistency may occur **if the lever is operated without pressing the brake pedal**:

Engaged gear	Display	Final lever position	Message on panel	Buzzer	Yellow GENERIC FAILURE warning light
NEUTRAL	[N]	TIP	PRESS PEDAL AND REPEAT THE OPERATION	No	No
REVERSE	[R]	TIP	PRESS PEDAL AND REPEAT THE OPERATION	No	No
REVERSE	[R]	NEUTRAL	PRESS PEDAL AND REPEAT THE OPERATION	No	No
1st	[1]	NEUTRAL	PRESS PEDAL AND REPEAT THE OPERATION	No	No
NEUTRAL	[N]	REVERSE	PRESS PEDAL AND REPEAT THE OPERATION	No	No
1st	[1]	REVERSE	PRESS PEDAL AND REPEAT THE OPERATION	No	No

Important:
Select the gear shown in the "engaged gear" column (making sure that the corresponding gear is shown on the display) and shift the lever to the position shown in the "Final lever position" column **without pressing the brake pedal**.

Repeating the operation consists in returning the lever to the position coherent with the actually engaged gear (i.e. simply shift the lever back to the position prior to the request). Then press the brake pedal and repeat the operation: the gear shift request will be accepted by the system in this manner.

Furthermore, TIP position, i.e. the central stable position between TIP (+) and TIP (-), corresponds to first gear if the request is made with the brake pedal pressed from lever in NEUTRAL position and transmission in neutral or from lever in REVERSE position and reverse gear engaged.

ENGINE RUNNING AND/OR VEHICLE MOVING

CRANKING (+30)

If the vehicle was stopped with transmission in "N":
Cranking is allowed with the brake pedal either pressed or not.
Neutral [N] indication will appear on the display in addition to the operating mode and the logic which appear at key-on when the cranking request is made.

If the vehicle was stopped with transmission in other than "N":

- *Without brake pedal pressed:*
  The system informs the driver by showing the message "PRESS BRAKE" on the display and cranking is not allowed. To start the engine, simply either repeat the operation pressing the brake pedal or press the brake pedal with the key at AVV.
  The message will appear for as long as the key is at AVV or until the brake pedal is pressed (for up to 4 cycles).
- *With brake pedal pressed:*
  The engine is started and the system automatically engages "N".

Neutral [N] indication will appear on the display in addition to the operating mode and the logic which appears at key-on.

After ignition, the system will inform the driver of the inconsistency between selected gear (neutral = "N") and lever position by means of the buzzer until the lever is returned to the "N" position with the brake pedal pressed.

START-OFF

After cranking, engine running, speed V = 0 km/h, transmission in neutral (N) and selector at N or TIP/R.
The driver may choose either to start-off forward or in reverse.
Neutral [N] will appear on the display in addition to the operating mode and the logic.

Regardless of the mode (Auto/Manual) or operating logic (Eco/Normal):
to engage first or second gear, press the brake pedal and:

- take lever to TIP to start-off in first gear or keeping the brake pedal pressed request first gear by moving the lever to TIP+ if the lever was taken to N position following the request illustrated in the paragraph above; remember than the lever in TIP position corresponds to 1st gear when shifting from N;

- take the lever to TIP and move the lever towards TIP+ (always pressing the brake pedal) to start-off in second gear on surfaces with poor grip.

ENGINE STARTED

The car will start-off only when the accelerator is pressed.

Only 1st, 2nd and R may be engaged when the engine is running. *The brake pedal must be pressed to engage the gears.*

NOTE: The buzzer will not sound when "R" is engaged.

NOTE: TIP position corresponds to 1st gear from "N" or "R" position. TIP- requests will be ignored because the request is not plausible.

Gear shift requests made by the driver with the vehicle standing without pressing the brake pedal will be rejected by the system and the driver will be informed by means of a message on the display to "PRESS THE BRAKE PEDAL AND REPEAT THE OPERATION" along with the buzzer (the buzzer is deactivated when consistency between lever position and engaged gear is re-established). The message only will appear (no buzzer) if a gear shift is requested by tipping the lever to up/down position.

Requests to shift to 3rd gear with the vehicle standing will be rejected by the system even *if the brake pedal is pressed*. The system will inform the driver by showing the message "OPERATION NOT ALLOWED" on the display (for the timeout of 8.7 seconds) and the buzzer will sound (the buzzer will be switched off when a further gear shift request is made).

GEAR SHIFTS WHILE VEHICLE IS MOVING

Gear shift in manual mode

Take the lever to "TIP (+)" position to **shift up**.
The requests are accepted only if the engine speed at the end of the shifting operation as such to prevent stalling.

If the request is accepted by the system:
the new, currently engaged gear will appear on the display after the gear shift.

NOTE: The actually engaged and not the gear requested by the driver is shown on the display.

If the request is not accepted by the system:
the gear engaged before the request will remain on the display, the message "OPERATION NOT ALLOWED" will appear and the buzzer will sound.

Similarly, the driver may **shift down** by taking the lever to "TIP (-)" position. In this case, the system will accept the request only if the engine rpm after gear shift does not exceed the maximum engine speed.

The system will automatically shift down if the driver holds the current gear to engine stalling limits (AUTODOWN function).
The lever is in TIP position for the operations described above.

Note 2: The auto up/down function is a performance function not a protective function because engine protection is provided only by the speed limiter.

GEAR SHIFTS IN AUTOMATIC MODE

The message AUTO will appear on the display over the currently engaged gear indication.

To start the vehicle off (forward or reverse) also in automatic mode, the driver must request one of the two possible gears for start-off (1st or 2nd) or reverse with the brake pedal pressed (obviously the system will remain in automatic mode).

The system will accept requests made using the lever (TIP+ or TIP-) also is automatic mode without switching to manual (AUTOMATIC GEAR SUGGESTION strategy).

After accepting the driver's request, the system will continue to work in fully automatic manner.

The **kick-down** function is also available: the system recognises the action of pressing down the accelerator pedal very rapidly to end of stroke as the request for maximum torque and shifts down one, two or three gears if the conditions so allow.

ECO/NORMAL LOGIC

- When the system is running in automatic mode, indication "E" appears on the display when button E is pressed. Economy logic is deactivated when button E is pressed again (indication "E" disappears from the display: Normal logic is established).
- When the system is running in manual mode, pressing the E/N button will have no effect (no indication on the display).
- If the system is in automatic mode (Economy or Normal logic), take the lever to A/M to engage Manual mode; the indications "AUTO" and "E" will disappear from the display.
- When the system is running in manual mode, take the lever to A/M to select Automatic mode and the message "AUTO" will appear on the display: the system will return to the logic stored before Manual mode was selected.

NEUTRAL REQUEST WITH VEHICLE MOVING

If Neutral is requested with ACCELERATOR PEDAL RELEASED, regardless of the brake pedal state:
- the system will accept the request:
  N will appear on the display in addition to operating mode and logic.

If Neutral N is requested with ACCELERATOR PEDAL PRESSED, regardless of the brake pedal state:
- the system will reject the request:
  the current gear is maintained because the lever position is not consistent with the gear actually selected by the gearbox. The message "OPERATION NOT ALLOWED" will appear on the display and the buzzer will sound.

Take the lever to the stable TIP position in either AUTOMATIC or MANUAL mode to return to neutral "N": THE BRAKE PEDAL DOES NOT NEED TO BE PRESSED.

The operation will return the gearbox to the most suitable gear.

REVERSE REQUEST WITH VEHICLE MOVING

Reverse may only be engaged in the following conditions:
- brake pedal pressed
- vehicle speed close to 0 km/h.

If an attempt is made to engage reverse (R) without pressing the brake pedal and with vehicle speed slower than approximately 10 km/h: the system will automatically engage neutral (N) and the message "PRESS BRAKE PEDAL AND REPEAT OPERATION" will appear. The buzzer will sound.

If an attempt is made to engage reverse (R) regardless of the action on the brake pedal and with vehicle speed faster than approximately 10 km/h: the system will not allow any action and the message "OPERATION NOT ALLOWED" will appear on the display. The buzzer will sound.

NOTE: with the brake pedal pressed, reverse can only be selected if the vehicle is expected to stop within approximately 3 seconds.

Disengaging reverse (i.e. engaging first gear)
The system engages first gear when the lever is taken to the TIP position. Consequently, with the brake pedal pressed and vehicle speed close to 0 km/h, the system will accept the gear shift.

<u>If an attempt is made to engage first gear without pressing the brake pedal and with vehicle speed slower than approximately 10 km/h:</u>
the system will automatically engage neutral (N) and the message "PRESS BRAKE PEDAL AND REPEAT OPERATION" will appear on the display. The buzzer will sound.

<u>If an attempt is made to engage first gear with the brake pedal pressed and with vehicle speed faster than approximately 10 km/h:</u>
the system will not shift and the message "OPERATION NOT ALLOWED" will appear on the display. The indication "R" (currently engaged gear) will appear and the buzzer will sound.

SAFETY SYSTEMS

A <u>VEHICLE STATIONARY, ENGINE RUNNING, GEAR ENGAGED (typically 1st, 2nd or R):</u>

Press the brake and/or the accelerator pedal and open the driver's door:
the system will hold the current gear. The instrument panel will display the current mode, logic and gear. The buzzer will not sound.

B <u>VEHICLE STATIONARY, ENGINE RUNNING, GEAR ENGAGED (typically 1st, 2nd or R):</u>

DO NOT press the brake and/or the accelerator pedal and open the driver's door:
the system will select N (neutral) after approximately 1.5 seconds.
The mode, logical and N will appear on the instrument panel.
Since the lever may be either at TIP or at R, the shift to N (neutral) controlled by the system causes an inconsistency between the lever position and the engaged gear. Consequently, the operation will be accompanied by an acoustic indication of inconsistency (use of the buzzer is contemplated all cases when N is automatically engaged).

C <u>VEHICLE STATIONARY, ENGINE RUNNING, GEAR ENGAGED (typically 1st, 2nd or R):</u>

Perform no action for longer than 3 minutes (do not press either the brake pedal or the accelerator pedal and do not shift the lever (e.g. while stopping at the traffic lights):
the system will automatically select N (neutral).
The mode, logical and N will appear on the instrument panel.
Since the lever may be either at TIP or R, the switch to neutral (N) controlled by the system will cause an inconsistency between the position of the lever and the engaged gear. The operation will consequently be accompanied by the buzzer.

D <u>VEHICLE STATIONARY, ENGINE RUNNING, GEAR ENGAGED (typically 1st, 2nd or R):</u>

Hold the brake pedal pressed and do not perform any action for longer than 10 minutes (parking):
the system will automatically select N (neutral).
The mode, logical and N will appear on the instrument panel.
Since the lever may be either at TIP or R, the switch to neutral (N) controlled by the system will cause a situation of inconsistency between the position of the lever and the engaged gear. The operation will consequently be accompanied by the buzzer.

E <u>VEHICLE STATIONARY, ENGINE RUNNING, NEUTRAL (N): KEY-OFF PROCEDURE:</u>
Stop the engine:
the mode and logic will continue to be displayed on the instrument and N will blink for approximately 4 seconds. The buzzer will sound and the vehicle will be parked in neutral (N).

F VEHICLE STATIONARY, ENGINE RUNNING, GEARBOX NOT IN NEUTRAL (N): KEY-OFF PROCEDURE:
Stop the engine: no information on the gearbox will be shown.

System input signals
For logic operations, the system uses the following signals from specific sensors or other vehicle systems:

- Specific robotised transmission sensors
- Clutch speed sensor (the value is read on the gearbox primary shaft)
- Position sensors: clutch, engagement and selection actuator (potentiometers).

Signals from other vehicle systems:

- Engine speed (frequency signal from engine ECU on C-CAN line)
- Brake pedal switch (duplicated and discretionary on C-CAN line)
- Driver's side door switch (discretionary)
- Ignition key (stable position and ignition position, discretionary).

Other main signals from the vehicle system via CAN are:

- Accelerator pedal position
- Engine torque
- Vehicle speed
- Coolant temperature

User-system interfaces
The driver interfaces with the system by means of the following commands:

- Accelerator pedal, this signal is transmitted by the system on the CAN and comes from the engine ECU;
- Brake pedal, directly from the brake switch (dedicated signal) via CAN;
- Gear shift or mode selection request reaches the TCU though a specific electro-mechanical lever with three stable positions and three unstable positions by means of four signals which convert the electrical signal of the 10 Hall-effect sensors positioned within the lever itself (the signals must be read by the ECU as analogue inputs for safety reasons);
- "ECO/NORMAL" logic (the signal is a switch directly connected to the TCU).

The system provides the following information to the driver by means of the reconfigurable multifunctional display:

- Gear engaged (the display is located/integrated in the panel and connected via the CAN);
- "AUTO" mode selected (information to the panel-display via the CAN);
- "ECO/NORMAL" logic in use: the information is shown near the engaged gear indication by means of indication "E";
- System faults are indicated by a warning light (connected to the panel by via the CAN).

Buzzer indication via CAN for informing the drive in the event of:

- Vehicle misuse (associated to warning messages)
- Potential critical system/vehicle situations
- System failures
- R engagement

Note: The system shows the gear actually engaged during automatic operation.

SYSTEM OPERATION (not failures)

Hydraulic circuit pressure
The hydraulic circuit is pressurised when the pressure drops under the minimum running threshold, in two different manners:

- When the driver's door is opened, the system automatically pressurises the hydraulic system to reach a pressure allowing to open the clutch and engage neutral without needing to wait for the hydraulic circuit to charge after key-on.

Cranking
This is performed by turning the ignition key: the engine is started by controlling the ignition relay directly by the system.
When the driver turns the key to the unstable cranking position, the TCU checks whether the driver has pressed the brake pedal or not. If so, the system positions the gearbox at "N" and allows cranking by energising the relay (<0.5s).

Note: An emergency cranking procedure is possible. If the battery cannot start the engine but the system is correctly pressurised, push the vehicle (with clutch open) until a sufficient speed is reached and them request engagement of a gear by means of the gear lever. The system will engage a gear (lower than or equal to second gear) so as to start the engine (the driver will have to request gear engagement when the speed is sufficient to start the engine).

Engine off operation
For safety reasons, gear shifts (including neutral) are only accepted when the brake pedal is pressed.

Start-off
- The gears which may be engaged to start off (engine running) are:
  - 1st, 2nd and R. These gears in these conditions may only be requested by moving the lever.
- For safety reasons:
  - The brake pedal must be pressed
- To engage R, in addition to the conditions above:
  - the vehicle must be stationary (speed measured at gearbox input under a certain threshold).
- The car starts off only if the driver:
  - presses the accelerator pedal
  - releases the brake pedal
  - At this point the system will gradually engage the clutch to start off.
- The driver can control the torque transmitted by the clutch by modulating the position of the accelerator pedal.
- By releasing the accelerator pedal and with vehicle speed over a certain value, the clutch is gradually engaged until the minimum engine speed is reached. Otherwise it is reopened.
- The clutch is completely opened when the system detects synchronism between the engine speed and the clutch speed.
- A specific clutch engagement map is provided for each of the three start-off gears.
- The driver may request gear shifts during start-off: the system will manage the request if the necessary conditions are met.
- Automatic clutch engagement downhill when accelerator pedal is released.
- Automatic clutch engagement is interrupted when the vehicle moves in direction opposite to that of the engaged gear.
- If the vehicle with gear engaged, accelerator released and engine running picks up speed because it is going downhill, the clutch is automatically closed again when a predetermined speed is reached to provide engine braking effect.
- During this step, if the driver presses the accelerator pedal, the driver returns to controlling the torque transmitted by the clutch.

Slowing down
When slowing down, e.g. with gear engaged and accelerator pedal released, the system will automatically release the clutch to avoid stalling the engine when:
- Minimum engine speed is approaching.
- When slowing down, if the engaged gear is higher than 2nd gear, the system automatically shifts down.
- 1st gear is automatically engaged when the vehicle is standing.
- Gear shift using lever (semi-automatic mode).
- With vehicle moving and clutch fully engaged, shift up and down requests made by the driver will cause a gear shift.
- Requests are only accepted by the system if compatible with the engine speed limits.

Generally, only one gear is shifted at a time by operating the lever. However, in some conditions, more gears may be shifted is so required by the driver by means of two commands in rapid sequence.

- A shift up required by the driver without releasing the accelerator pedal after being accepted by the system will start an automatic sequence of operations to follow the driver's request:
  - Motive torque reduction by means of a command sent from the system to the engine ECU and clutch release at the same time.
  - Modulated clutch engagement and gradual return to maximum engine torque at the same time. The clutch is fully engaged when the system detects synchronism between engine speed and clutch speed.
  - Release, selection and engagement of the new gear, during gear shifts. The engine is controlled to forecast the speed that the clutch will have after engaging the new gear (shift down).

- The new gears is engaged according to:
  - Performance required by the driver
  - Estimated hydraulic system temperature.

- A gear shift may be interrupted at any time by driver by making another acceptable request (i.e. compatible with the engine speed limits).

Automatic gear shifts ("Auto" mode)
The robotised gearbox is provided with an automatic operation mode which is very similar to that of a conventional automatic transmission.
The gear shift points are determined on the basis of two functional maps:
- ECO logic to reduce consumption and pollution.
- NORMAL logic for a sportier driving style.

The system correlates the accelerator pedal position, the operating speed of the accelerator pedal, the vehicle speed and the optimal running conditions.

- The system may shift down in certain conditions when the accelerator pedal is released to maintain engine braking effect.

The shifting method is identical to that in semiautomatic mode using the lever and the same gearbox/engine actuator control parameters are employed.

Automatic mode is selected by tipping the lever to the specified position and deselected by repeating the same operation.

Neutral request
This request has a higher priority over all the other gear shift requests and may only be performed by means of the lever.
As mentioned, the brake pedal must be pressed when the engine is not running.
- The neutral request is accepted by the vehicle is moving.

Stopping engine and system
The engine is stopped and the system holds the engaged gear when the key is turned to STOP.
The system is switched off only after checking that the following quantities are equal to zero:

- engine speed
- gearbox input
- gearbox output

and after saving functional and diagnostic data in the non-volatile memory of the ECU (EEPROM).

The system will be shut down approximately 5s after stopping the engine.
The system will inform the driver that the gearbox is in neutral by operating the buzzer for one second when the key is turned off.

Information to driver (display and buzzer)
The system provides information to the driver by means of:

- **Display:** "Manual" mode and engaged gear, "Auto" mode, ECO mode, NORMAL mode and engaged gear, system failures;
- **Buzzer:** misuse, potentially unsafe conditions, system failures.

Some examples of buzzer indications are:

- start-off with overheated clutch
- when the system is shut down and the gearbox is in neutral to indicate that parking gear has not been engaged.

FUNCTIONAL SYSTEM AND DRIVER INTERFACE STRATEGIES

Diagnostics
The system diagnoses:

- ECU (TCU) inputs/outputs (I/O)
- consistency between system commands and actuations in potentially dangerous situations
- diagnostic tool functions (C-CAN line)
- main microprocessor failures
- TCU inputs and outputs (I/O).

The following input/output signals are not diagnosed:

- Brake pedal
- Automatic and door open switches
- All engine control signals on CAN
- Key signals, +30 ignition, power, +30 battery, all ECU earthing points, electrical connection to CAN.

Analogue signals are diagnosed on the basis of the following fault types:

- Electrical signal out of range
- Dynamic signal out of range

The ECU diagnostic outputs related to:

- the three proportioning solenoid valves;
- the two on-off solenoid valves;
- the two pump and engine ignition relays.

System diagnostics are:

- Gear not engaged
- Opposite gear engaged
- Incorrect selection during gear shift
- Unexpected closing of the clutch during gear shifts
- Runaway clutch during gear shift
- Rapid clutch closing (< 0.05 s) during start-off or just before start-off.

Diagnostic tool procedures
The ECU interfaces with the diagnostic tool via the C-CAN.

Diagnostic procedures are:

- **"passive",** display of functional variables/parameters according to a predetermined menu
- **"active"**, activation of end-of-line self-calibration procedures and open-loop engagement test of all gears for all service diagnostics.

Main microprocessor failure diagnostics
The ECU is provided with a second microprocessor which has the function of monitoring that the main microprocessor is working. In actual fact, the second microprocessor monitors the number of pulses sent by the main microprocessor in a predetermined time and in the case of errors informs the driver and secures the system (see paragraph on safety strategies).

SAFETY STRATEGIES
These strategies manage incorrect commands in the event of potentially dangerous or critical operative conditions for the transmission and the car.

Incorrect commands

- Reverse engagement: cannot be accepted when the vehicle is moving.
- Gear shifts with vehicle moving and clutch closed: the driver's request cannot be accepted if it may cause the engine speed to exceed the maximum or minimum limit.
- Gear shift with vehicle standing and engine running: only the start-off gears (1st and R) may be accepted.
- Key-off with vehicle moving: the system must control the transmission until all monitored speeds (engine, gearbox input and gearbox output) are equal to zero.
- Cranking: must not be allowed if a gear is engaged and the brake pedal is not pressed.
- Cranking with engaged gear: only possible with the vehicle standing, the accelerator pedal released, the brake pedal pressed and absence of faults.

The system needs to automatically shift to neutral and then enable cranking.
With the vehicle stationary (or nearly stationary), the gear shift requests must be accepted only if the brake pedal is pressed.
This avoid dangerous situations if the steering wheel levers are operate by a passenger or by a person standing outside the car (e.g. through the window) or if the driver accidentally operates the control when the car is parked on a gradient.

Neutral inhibit over a predetermined speed
This eliminates the risk of incorrect commands by the driver in critical situations (e.g. downhill) or improper operation of the control by a passenger.
The transmission is automatically put in neutral and the buzzer sounds (for 1s) when:

- When the oil pressure is insufficient to manage the clutch (only if the clutch conditions allow when the car is travelling a slow speed, approximately 5 km/h).

- When the engine is running if the driver opens the door to leave the vehicle (starting off with the door open is however allowed because the driver's action on the brake pedal and accelerator is detected: transmission is put into neutral 1 second after the door is opened.
- With engine running, gear engaged and vehicle stationary, if no operation of either the accelerator pedal or the brake pedal is observed for at least three minutes; with engine running, gear engaged, accelerator released and brake pedal pressed for at least 10 minutes.
- Automatic shift up when the driver keeps the accelerator pressed and the engine speed exceeds the regulator threshold: this function is called AUTOUP (4850 rpm).
- Limitation of full vehicle functions in the presence of faults which reduce the safety level of the system (e.g. gears limited to 1st, 2nd and R when a speed sensor fault or an engaged gear sensor fault is detected).

Visual/acoustic indications to driver
Information relates to:

- The functional state of the traction/vehicle system (gear display, fault warning light, buzzer).

Acoustic indication by means of buzzer and continuous visual indication means of fault warning light (associated to specific messages) is activated if an I/O signals fault is detected; the safety level is decreased as a consequence.

Information to driver by means of engaged gear display
Indication if the driver has stopped the engine (key-off) with transmission in neutral and therefore the car could move unexpectedly: acoustic and visual warning ("N" blinks on the display) for at least 4 seconds.
Acoustic and visual warning (display) if the system automatically puts the transmission in neutral.
Overheated clutch indication (limited to start-off): specific warning on reprogrammable multifunctional display and buzzer.
Acoustic and visual indication (display) if transmission is in neutral following a failed engine cranking attempt.
Supplementary information to driver when transmission is in reverse: specific acoustic indication ("polite" intermittent buzzer).

Note: The gear shift required may not always be accepted by the system (brake pedal not pressed, R request with vehicle travelling faster than 2 km/h, etc.).

FUNCTIONAL INTERACTION LOGICS WITH OTHER SYSTEMS
The system must be capable of interacting with other vehicle systems according to the logics shown below.

Interaction with engine control
While travelling, the two systems do not interact because the system is not working and therefore only information and signals are exchanged.
When a gear shift is in progress, the transmission system because the master system with regards to the engine control system, i.e. the transmission system must ask the engine (via the CAN) in relation to motive torque (decrease when opening the clutch and increase when the gear shift has been completed and the clutch is closing).
If the system reads a engine speed or clutch speed fault when the engine is being stopped, the system (in recovery mode) will allow the engine to be restarted also with a gear engaged. The strategy is not applied if the fault relates to both signals.

Interaction with Cruise Control (CC) (versions/outfits where fitted)
The Cruise Control works regardless of the transmission control system:
when the Cruise Control is on and the transmission system is in manual mode, the Cruise Control will be switched off when a gear request is made.
When the Cruise Control is on and the transmission system is in automatic mode, gear shift requests made either by the system or by the driver ("gear shift suggestion") will not cause the Cruise Control to be switched off.

Interaction with ABS (versions/outfits where fitted)
There is no functional interaction logic.

Interaction with VDC-ASR-MSR (versions/outfits where fitted)
The system must inhibit "fast" start-off when the ASR is on.

Interaction with NBC (Body Computer)
The Body Computer node sends the external temperature signal from the sensor on the external rearview mirror to the robotised transmission node (NCR) via the CAN.
This signal is used by the robotised transmission system to calculate the (estimated) temperature of the gearbox oil.

WIRING DIAGRAM

Wiring diagram key

1. Robotised transmission ECU
2. Clutch position potentiometer sensor
3. Gearbox input speed sensor
4. Solenoid valve 1 - Gear engagement
5. Solenoid valve 2 - Gear engagement
6. Solenoid valve 3 - Gear selection
7. Solenoid valve 4 - Clutch
8. Gear engagement position potentiometer sensor
9. Gear selection position potentiometer sensor
10. Hydraulic circuit pressure sensor
11. Engine ECU
12. Gearbox lever unit
13. Normal/Economy function selection button
14. Body Computer node
15. Driver's door open switch
16. Brake light switch
17. 3rd brake light connection
18. Ignition switch
19. Supplementary fusebox
20. Reversing light control
21. Front earth - G9
22. Reverse light switch
23. Key sense - Engine ECU
24. Starter motor command (+50).
25. Battery voltage (power)
26. Robotised gearbox front connection (vehicle side)
27. C-CAN - Twisted wires
28. Earth
29. Robotised gearbox hydraulic oil pump

Suspension

Overview

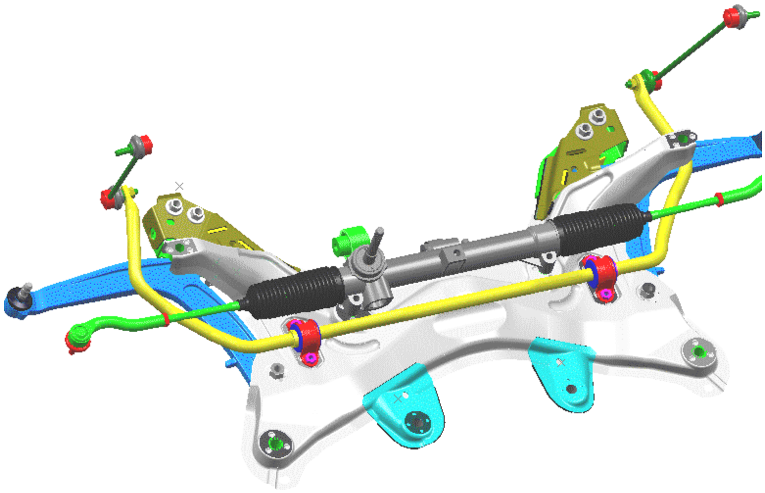
The purpose of the suspension is to allow the vehicle to take on any type of road surface without transmitting vibration from the wheels to the passenger compartment, reducing lateral (roll) and longitudinal (pitch) of the body, and dampening vertical oscillation, while maintaining maximum ground adherence of the wheels.
It is therefore capable of assuring passenger comfort, drivability and road-holding sufficient to safely pass through any critical situations.

The front suspension is McPherson type, with the following components:

- The mechanical traverse consists of two spot-welded half-shells complete with brackets for attaching the front wishbone and lower MTP tie bar, spacers for fastening the steering box and nut screws for fastening the torsion bar. There are four body shell anchor points (rigid), two front and two rear.
- The shock absorbers are structural type with stem diameter 20 mm, complete with lower brackets for attachment to stanchions, spring plate, brake cable and ABS sensor fastening bracket (optional).
- The upper shock absorber attachment is not doubled. It is elliptical to assure the possibility of adjusting the longitudinal inclination of the suspension between manual and power steering.
- The spiral springs are positioned such as to compensate the lateral load on the shock absorber and rest on upper and lower spring plates without rubber rings.
- The limit stop buffers are in cellastio, coaxial with the shock absorbers, and have a stem guard boot.
- The wishbone is in cast iron. It is fastened to the traverse by elastic bushes. The rear bush is vertical, whereas the front bush is horizontal (x-axis), with characteristics capable of realizing the best compromise between handling and comfort. The wishbone incorporates the ball joint head with rubber boot.
- The stabilizer bar (present only on versions with EPS power steering), is in full steel with diameter 20 mm. It is fastened to the traverse by u-bolts consisting of a single steel plate and rubber element. It is connected to the shock absorber by a tie rod with ball joints.
- The stanchion is in cast iron. The holes for fastening the heat shield are separated from the ones for fastening the brake caliper. The seat of the union pin with the steering box links is tapered 1:6

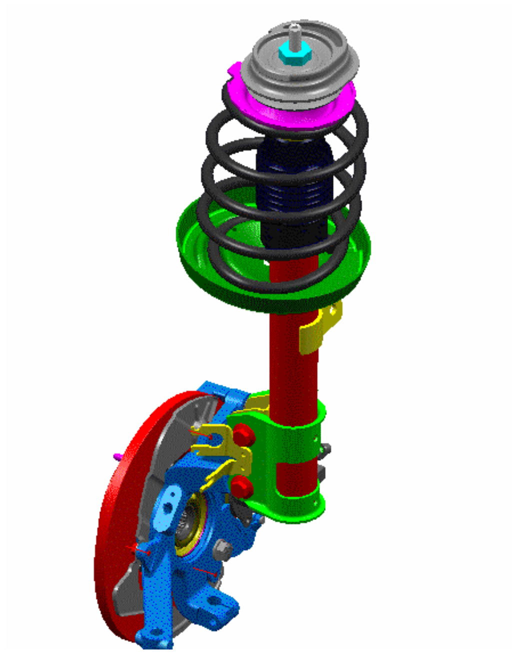
The module is in forged steel.

FRONT SUSPENSION
McPherson type independent suspension with wishbones in nodular cast-iron anchored to an auxiliary traverse.
Offset spiral springs and dual-effect telescopic hydraulic shock absorbers. Torsion roll bar.



The front suspension traverse is realized in galvanized sheet metal to assure greater corrosion resistance, and has been braced by boxing the sections attached to the body shell, in order to assure greater filtering of vibration reaching the passenger compartment.
Wishbones, in spheroid cast-iron with new vertical bushes mounted to the rear to improve vibration absorption and holding on curves.

“Side-load” type spiral spring that permits better reduction of tangential forces on the stem, with consequent better absorption of road surface roughness.
Dual effect telescopic hydraulic shock absorbers.
Upper shock absorber section with optimized axial rigidity to improve comfort.
Wheel stanchion with transverse inclination angle increased to optimize camber angle when turning (wheel perpendicular to road).



REAR SUSPENSION
The rear suspension is “torsion axle” type (semi-independent wheels).
Spiral springs and dual-effect telescopic hydraulic shock absorbers.
The modules of the front and rear wheels of versions with ABS have an instrumented bearing for the active sensors, which replaces the phonic wheel used in previous systems.

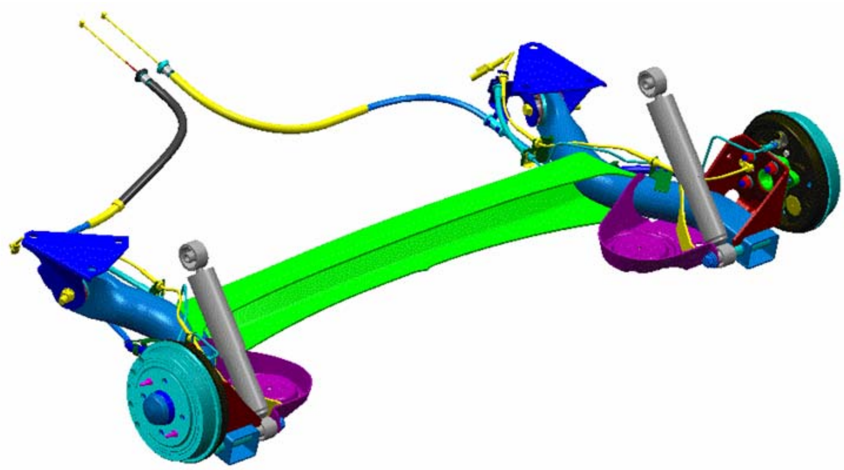
The advantages of this system are:

- Similar kinematic behavior to system with independent wheels with corresponding functional advantages.
- Traverse stabilizing function.
- Reduced weight.
- Suspension pre-assembly prior to mounting on vehicle.

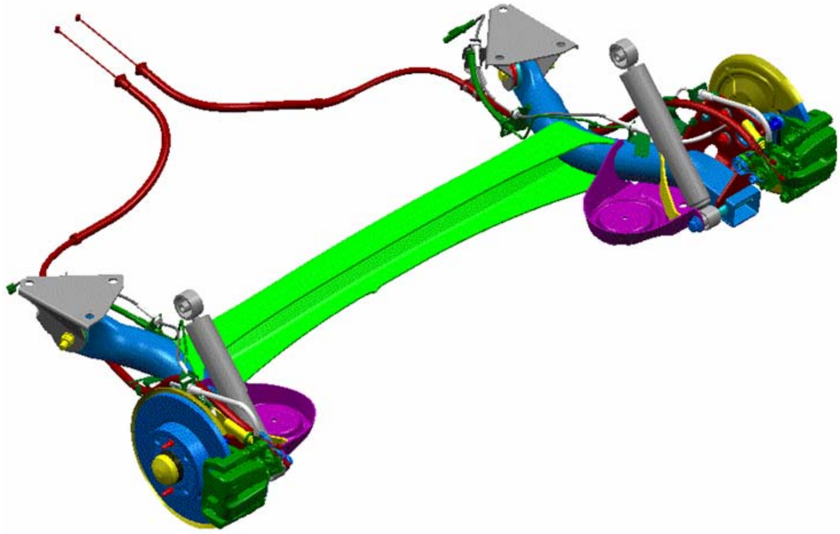
There are two rear axle versions according to engine type. In the figure below it can be seen that the structure of the rear axle is similar for both versions, the difference being:

- Drum brakes for the 1.2 8V petrol and 1.3 Multijet versions
- Full disk brake for the 1.4 16V petrol version.

1.2 8V petrol / 1.3 Multijet version



1.4 16V petrol version



The “torsion axle” suspension is fastened to the body shell by:

- Brackets in metal plate fastened to the shell by 3 bolts.
- Twin-tube non-structural type shock absorbers with horizontal lower bush (y-axis) and upper bush, also horizontal, for fastening to the rear spar.

The spiral springs sit between the lower plate on the axle and the upper support welded to the spar. A rubber element is fitted between the upper support and the spring.

The limit stop buffers are in cellastio. For this reason, due to the shape, they are fastened to a support welded to the rear spar, the same one that serves as the upper spring support.

Braking system

General
The braking system employs sophisticated, state-of-the-art electronic and mechanical components installed today only on the most recent cars belonging to higher segment models, namely:

- ABS: Antilock Braking System;
- EBD (Electronic Braking Distribution): electronic brake distributor acting between the front and rear wheels;
- ESP (Electronic Stability Program): stability electronic control;
- Hill-holder (with ESP): automatism allowing to brake and start off on gradients without using the handbrake;
- HBA (Hydraulic Brake Assistant): electro-hydraulic braking assist for automatically increasing pressure in the braking circuit during panic braking (with ESP).

The following ABS ECU versions may be installed:

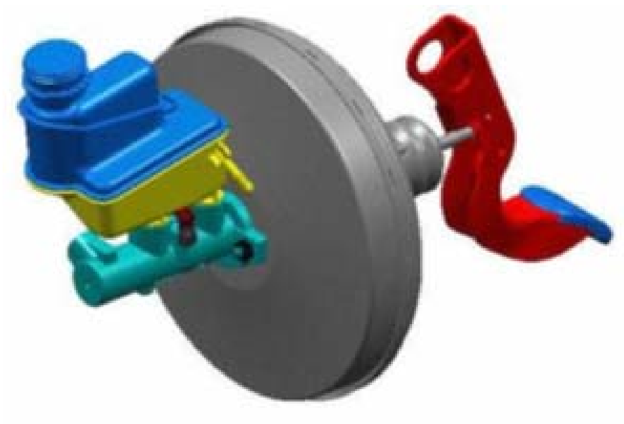
- with EBD
- with EBD and EPS (Electronic Stability Program) integrating the ASR/MSR/HBA/HHC functions.

The ABS is the most advanced available today: the system has a hydraulic control unit with eight solenoid valves, four active sensors and four channels with brake corrector (or distributor); in versions with ESP, the electro-hydraulic unit fits twelve solenoid valves; the steering angle sensor is installed on the steering column, while the yaw sensor is arranged on the central floor near the central console unit (for detecting lateral acceleration, yaw speed and vehicle inclination, the latter of the Hill-Holder function).

The servo-hydraulic braking system consists of two independent crossed circuits. Each circuit works on a front wheel and the diagonally opposite rear wheel to ensure braking and stability also in the event of a failure to one of the circuits. The entire range is equipped with:

- ventilated brake discs on the front wheels
- solid brake discs on the rear wheels
- ABS with EBD
- standard ESP for Sport versions.

A wide diameter (9”) Bosch brake booster is fitted with aluminium master cylinder and extra stroke to ensure good pedal stroke reserve also in extreme overheating conditions caused by intensive use. The pedal is collapsible.

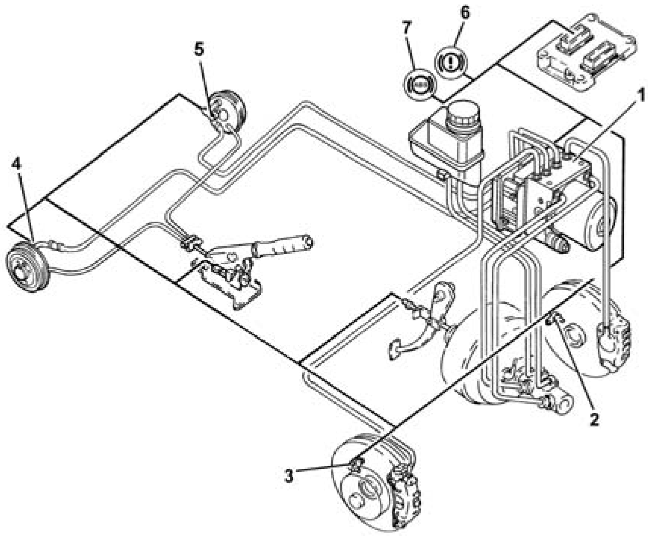


ABS 8.1 (EBD only)

Introduction

The car is equipped with a Bosch 8.1 ABS/EBD system.
The ABS is fitted in parallel with the hydraulic brake system so that braking is ensured also if the system fails.
The ABS integrates a EBD (Electronic Braking Distribution) system for adjusting and splitting the brake force between the axles.

OVERVIEW



Key:
1 - ABS/EBD ECU
2 - Front left wheel sensor
3 - Front right wheel sensor
4 - Rear right wheel sensor
5 - Rear left wheel sensor
6 - EBD warning light
7 - ABS warning light

The Bosch ABS 8.0 HCU is connected to the C-CAN line and is called 'Brake Node' in the aboard electrical system.

Operation

The ECU processes the signals from the active sensors and the brake light switch and by means of the implemented logic identifies the wheel or wheels which are about to lock (maximum slip between wheel and road surface). The ECU consequently modulates the braking system fluid pressure in a selective manner on the front wheels and in tandem on the rear wheels (select low function).

The ABS modules the brake pressure in three fundamental steps:

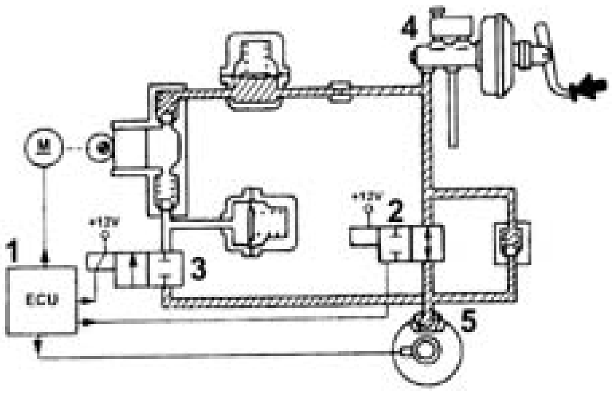
- pressure increase
- pressure hold
- pressure reduction.

Pressure increase step without ABS operation

With the brake pedal pressed, the ECU (1):

- does not power the charging solenoid valve (NO) (2)
- does not power the relief solenoid valve (NC) (3).

The pressure generated by a master cylinder (4) reaches the brake callipers (5) without variations.

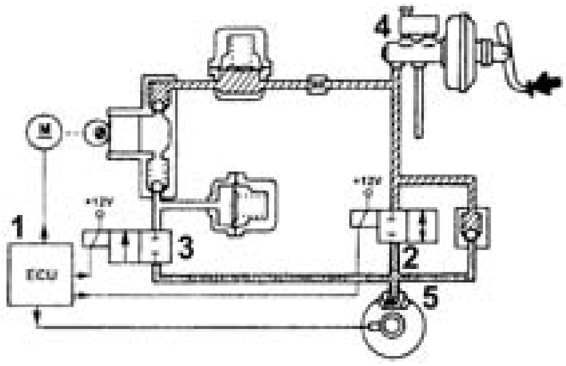


Pressure hold step

The ECU (1):

- powers the charging solenoid valve (NO) (2)
- does not power the relief solenoid valve (NC).

The line between the master cylinder (4) and the brake callipers (5) is interrupted.
The pressure in the brake callipers (5) remains constant also if the pressure on the brake pedal is increased.

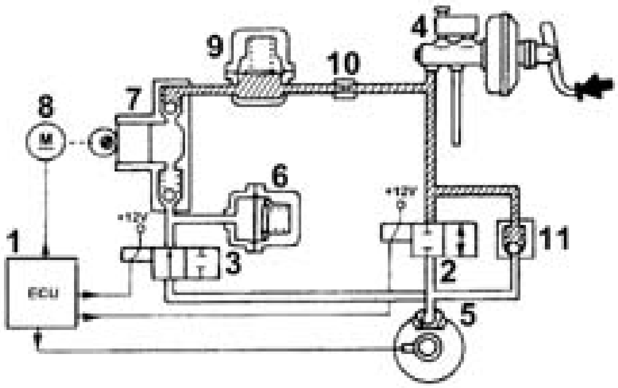


Pressure reduction step

The ECU:

- powers the charging solenoid valve (NO) (2)
- powers the relief solenoid valve (NC) (3).

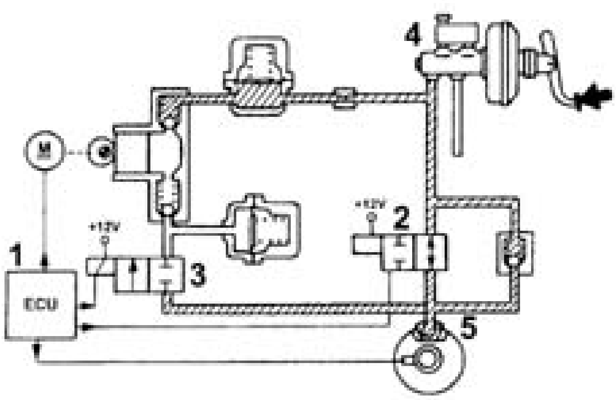
The hydraulic connection between the master cylinder (4) and the brake callipers (5) is interrupted and the relief solenoid valve (3) opens and puts the master cylinder (5) into communication with the low pressure accumulator (6) and the recovery pump (7).
The ECU (1) also powers the motor (8) of the recovery pump (7) to re-introduce the fluid subtracted from the brake callipers (5) into the main circuit.
The fluid crosses the high pressure accumulator (9) and the bottleneck (10) which is used for damping purposes.
The system is equipped with a check valve (11) mounted in parallel to the charging solenoid valve (2) which allows a rapid pressure reduction on the brake callipers (5) during brake pedal release.



Pressure increase step
The ECU (1):

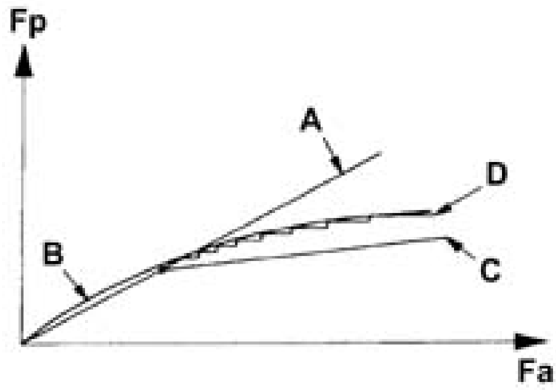
- does not power the charging solenoid valve (NO) (2)
- does not power the relief solenoid valve (NC) (3).

The fluid is thus re-introduced into the main circuit and free to return to the brake callipers (5) thus increasing the pressure on the brake callipers.



EBD (Electronic Braking Distribution)
The EBD function controls brake force distribution and consequently replaces the traditional mechanical brake corrector. The system:

- operates on the rear wheels only
- improves brake force distribution
- operates optimally in all load conditions (static or dynamic), running conditions (on straights or bends) and vehicle wear conditions (tyres, brakes and suspensions) actuating a strategy which follows the ideal brake force distribution curve.



Fa - Brake force on front axle
Fp - Brake force on rear axle
A - Distribution curve actuated by the braking system
B - Ideal curve distribution
C - Curve distribution actuated by traditional hydraulic brake corrector
D - Distribution curve actuated by EBD function

EBD system faults are indicated by the simultaneous lighting up of the:

- ABS warning light
- low brake fluid and/or handbrake warning light.

In this condition, the driver must proceed with the utmost care and drive the car to the nearest dealership to have the system checked.

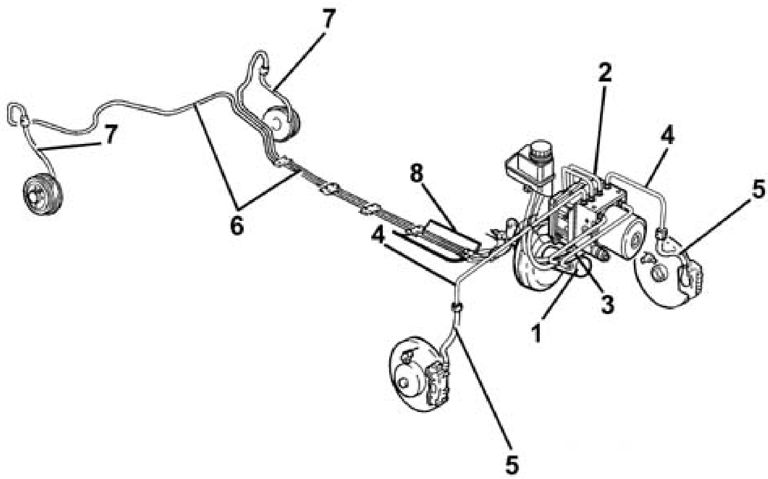
ABS SYSTEM COMPONENTS

ABS system lines

The ABS system lines are divided into three parts:

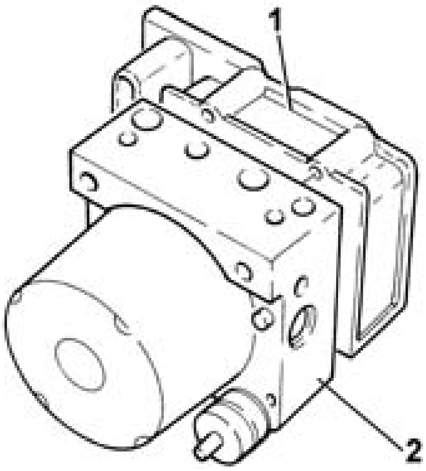
- pipes from the master cylinder to the ABS ECU (of larger diameter and with a flexible segment in versions with ESP),
- pipes from the ABS ECU to the hoses (front and rear) connecting to the brakes; the rear brake pipes are split into two parts for assembly reasons and their most exposed part is protected by a specific guard,
- hoses connecting the rigid pipes to the brake callipers.

The brake lines (pipes and hoses) are anchored to the body by means of brackets and/or fastening pegs.



Key:
1 - Master cylinder
2 - ABS ECU
3 - Pipes from master cylinder to ABS ECU 4 - Pipes from ECU to front brake hoses
5 - Front calliper hoses
6 - Pipes from ECU to rear brake hoses
7 - Rear brake hoses
8 - Rear brake hose guard

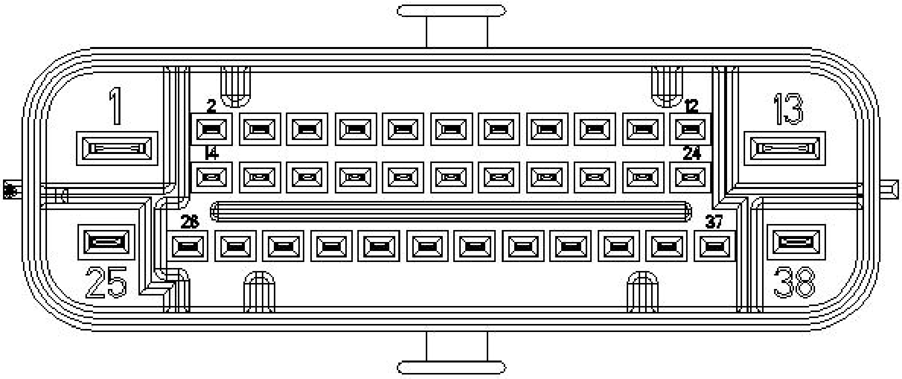
ECU
The unit consists of an electronic control unit (1) and a hydraulic control unit (2).



Feature
The ECU has the following functions:

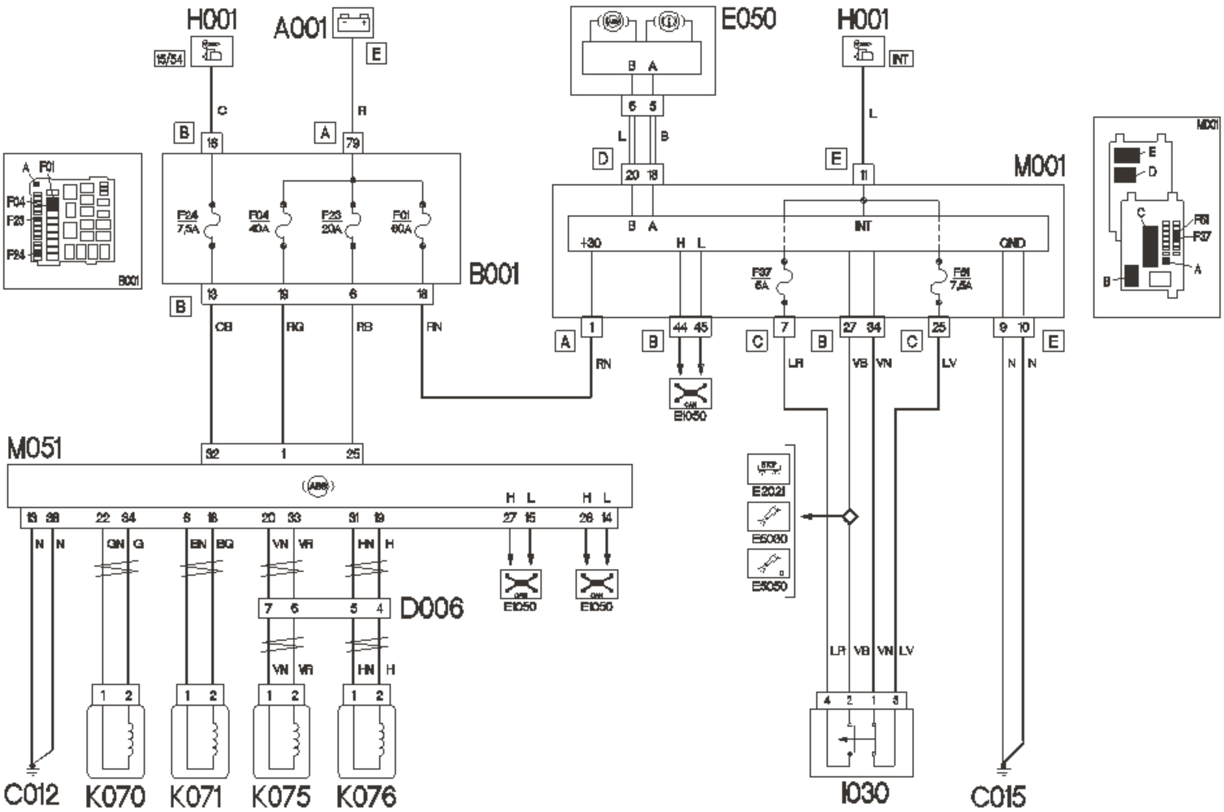
- to acquire data from the wheel speed sensors
- to store vehicle setup control parameters
- to store software
- to process acquired data
- to monitor the braking process
- to detect ABS system component faults and failures
- to store fault codes and operate the ABS and EBD warning lights
- to transmit and receive data via the C-CAN line (where fitted)
- to transmit and receive data via the diagnostic socket.

ABS/EBD PINOUT



Pin	Description	Pin	Description
1	+ 30	**20**	K075 wheel sensor signal
	Not connected	**21**	Not connected
3	Not connected	**22**	K070 wheel sensor signal
4	Not connected	**23**	Not connected
5	Not connected	**24**	Not connected
6	K071 wheel sensor signal	**25**	+ 30
7	Not connected	**26**	C CAN (H)
8	Not connected	**27**	C CAN (H)
9	Not connected	**28**	Not connected
10	Not connected	**29**	Not connected
11	Not connected	**30**	Not connected
12	Not connected	**31**	K076 wheel sensor signal
13	Earth	**32**	+ 15
14	C CAN (L)	**33**	K075 wheel sensor power
15	C CAN (L)	**34**	K070 wheel sensor power
16	Vehicle speed signal (not connected)	**35**	Not connected
17	K line (not connected)	**36**	Not connected
18	K071 wheel sensor power	**37**	Not connected
19	K076 wheel sensor power	**38**	Earth

WIRING DIAGRAM (with EBD)



Key:

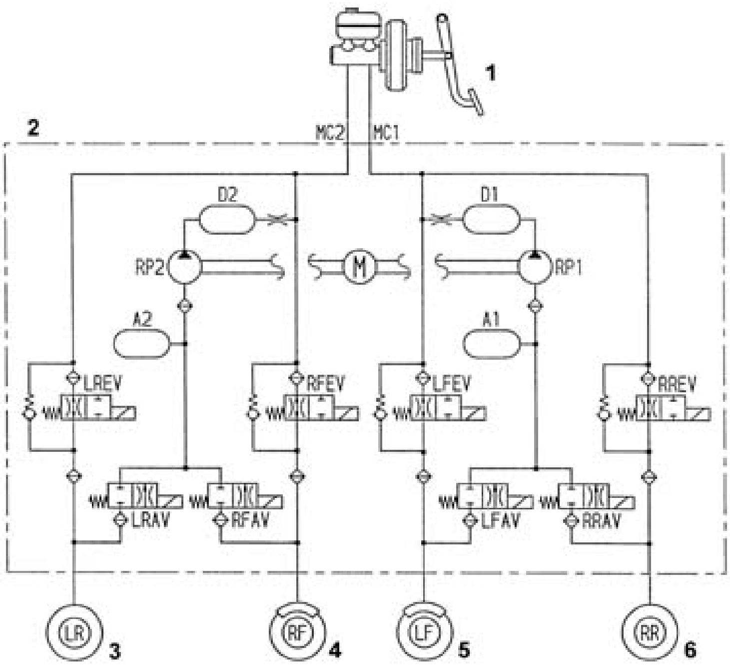
A001: Battery
B001: Ignition switch
C012: Earth
C015: Earth
E050: Instrument panel
H001: Fusebox
I030: Brake pedal switch
M001: Body Computer
M051: ABS ECU
K070: Left front wheel sensor
K071: Right front wheel sensor
K075: Left rear wheel sensor
K076: Right rear wheel sensor

Hydraulic control unit
The unit modulates the fluid pressure to the brake callipers by means of solenoid valves and implements the following steps:

- brake fluid pressure increase
- brake fluid pressure hold
- brake fluid pressure release

The hydraulic control unit consists of:

- eight two-way solenoid valves
- one double circuit recovery pump
- two low pressure accumulators
- two high pressure accumulators



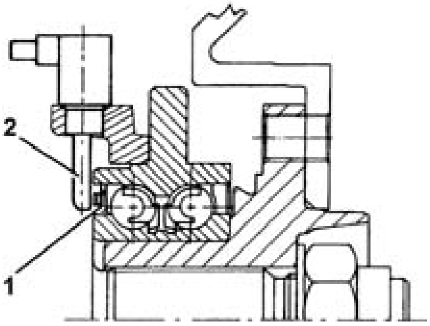
1 - Master cylinder-brake booster unit
2 - Hydraulic control unit
3 - Left-hand rear wheel
4 - Right-hand front wheel
5 - Left-hand front wheel
6 - Right-hand rear wheel

Wheel speed sensors
The advantages offered by the adoption of active sensors are:

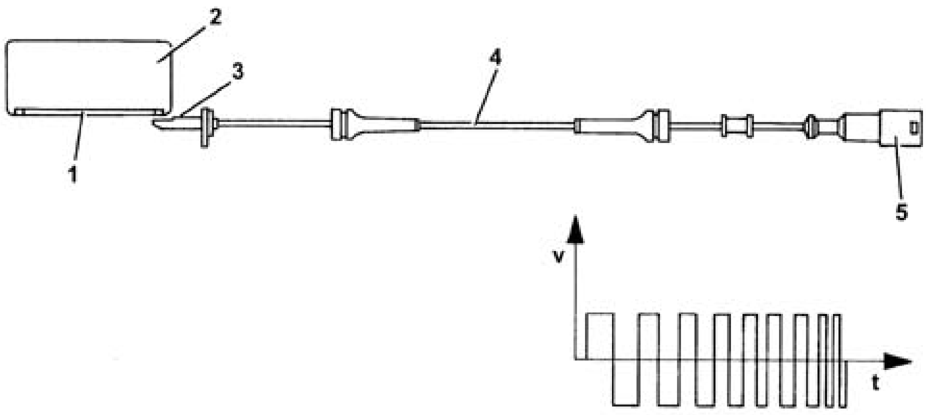
- less sensitivity to distance between sensor and magnetic ring (gap)
- less sensitivity to electromagnetic interference
- an active sensor can measure wheel speed down to zero (instead of a minimum speed of 2.5 km/h detectable by a passive sensor)
- less weight and compacter dimensions
- simplified transmission connections because there is no phonic wheel.

Active sensors consist of two basic components:

- a multipolar magnetic encoder (1) integrated in the wired wheel hub bearing
- a magnetoresistive sensor (2) facing the encoder.



The operation of the active sensor is based on the variation of internal electrical resistance according to the intensity and orientation of external magnetic field force lines (multipolar magnetic encoder). A square wave signal is generated whose amplitude is constant and whose frequency varies according to the revolution speed of the wheel.
The active sensor is thus an integrated electronic proximity sensor connected by a wire to ABS ECU (power supply) which receives vehicle speed input.
The phonic wheel is a multipolar ring formed by an elastomer provided with a certain quality of magnetic particles which by means of a special magnetising technique are oriented so as to form various magnets with alternative north or south polarity in the circumferential direction.



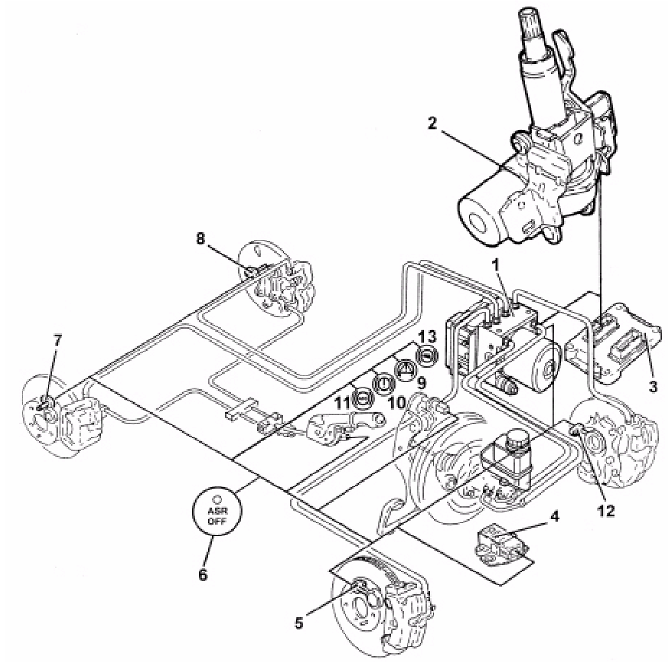
Key:
1 - Magnetised ring
2 - Bearing
3 - Sensor head
4 - Active sensor
5 - Sealed connector

ABS 8.1 (with EBD + ESP)

The main technical innovation of this system is an efficient control method of the return pump by an electrical motor whose speed may be adapted to driving conditions. In this manner, a smaller motor may be used, thus making the assembly more compact (smaller and 20% lighter with respect to the previous version).
Furthermore, the variable speed control of the electrical motor reduces noise and vibrations generated during operation. The valve and pump control was optimised during product development.

The ABS/EBD with ESP integrates the following functions:

- ASR (traction control operating on brakes and engine)
- MSR (engine braking torque control when shifting down)
- HBA (automatic braking pressure in the event of panic braking)
- HHC (providing assistance to driver when starting off on a hill)



Key:
1 - ABS/ESP ECU (NFR)
2 - Steering angle sensor integrated in NGE electrical steering
3 - NCM
4 - Yaw/lateral acceleration and longitudinal acceleration sensor (under parking brake)
5 - Right front wheel sensor
6 - ASR button
7 - Right-hand rear wheel sensor
8 - Left-hand rear wheel sensor
9 - ESP warning light
10 - EBD warning light
11 - ABS warning light
12 - Left-hand front wheel sensor
13 - HHC warning light

Operation

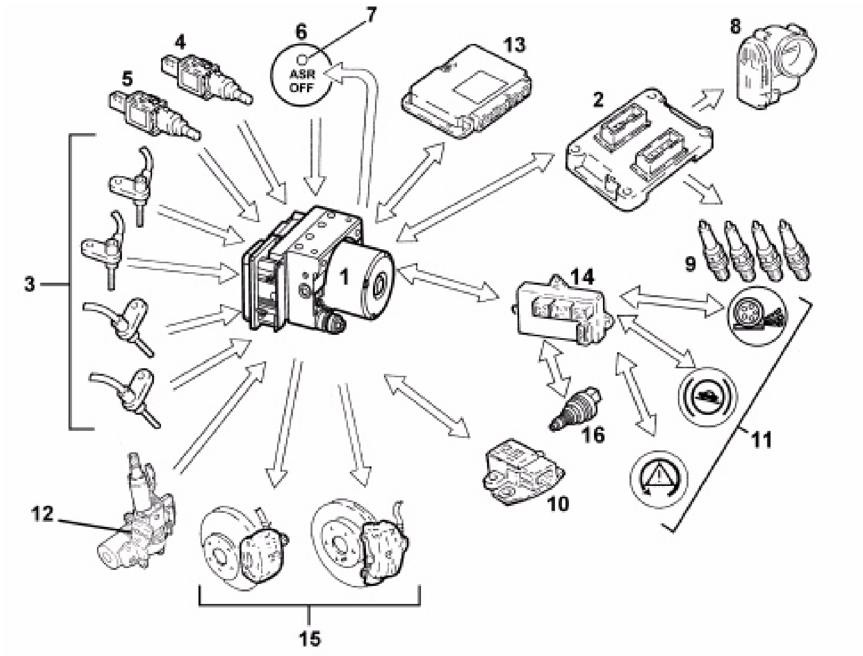
The ABS ECU processes the following signals:
- steering angle/speed sensor on the steering wheel
- yaw/lateral acceleration and longitudinal acceleration sensor
- motorised throttle position
- wheel speed sensor
- hydraulic brake system pressure sensor.

The system interprets the actual vehicle dynamics from these values. The values are used to identify critical conditions due to environmental factors (e.g. poor road grip) or possible errors by the driver (e.g. panic situations) consequently operating on the brakes and the engine torque to restore good handling conditions.

Information is exchanged between the various components of the system (NCM, NBC, NYL, NFR) on the CAN. The system is diagnosed via the CAN.

The system is combined to a specific master cylinder power unit. The lines between the master cylinder and the ABS ECU are larger in diameter (6mm) with respect to the normal lines (4mm) to prevent negative effects on ESP operation at low engine oil temperatures.

Input/output signals:



	Description
1	Hydraulic system pressure sensor (direct line)
2	NCM
3	Wheel speed sensors
4	Brake pedal sensor (normally open)
5	Brake pedal sensor (normally closed)
6	ASR off button (direct line)
7	ASR off LED
8	Engine power management throttle angle position (NCM)
9	Ignition advance reduction control
10	Yaw sensor: lateral acceleration (Y), longitudinal acceleration (X) and rotation (Z)
11	ABS/ASR/ESP/HHC warning lights on panel control
12	Steering angle/steering wheel rotation sensor integrated in electrical steering
13	Robotised gearbox ECU (in version where fitted, gear engaged status)
14	Vehicle speed signal for VSO speed indicator and odometer (NBC)
15	Brake pressure modulator control
16	Reverse sensor

ABS/EBD operating logic

The ABS calculates normal vehicle behaviour so as to control the influence of lateral forces and thus limit yaw. The following signals are monitored:
- steering angle sensor
- accelerator pedal position
- brake pedal pressure.

The ECU compares these parameters with the actual vehicle behaviour determined by monitoring the following signals:
- vehicle speed sensor (active sensors on the wheels)
- yaw/lateral acceleration sensor

If the values differ from normal, the ECU is capable of:
- perceiving the driver's actions
- perceiving the actual behaviour of the car given by the environmental variables.

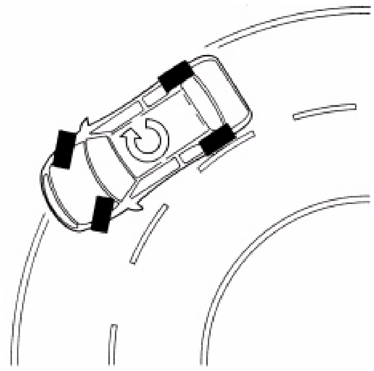
These operations are needed to compare the numerical model mapped in the ECU with the actual vehicle performance in order to identify its state (understeering or oversteering) and determine the action on the brakes and/or engine management system.

ESP operation display

Operation of the ESP is indicated by blinking of the specific warning light on the instrument panel (5 Hz d.c. 50%).

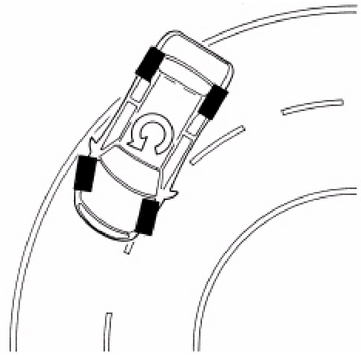
UNDERSTEERING:

An understeering vehicle tends to go straight (to turn out).
Given constant lateral acceleration, the slip angle of the front axle will increase more than that of the rear axle.

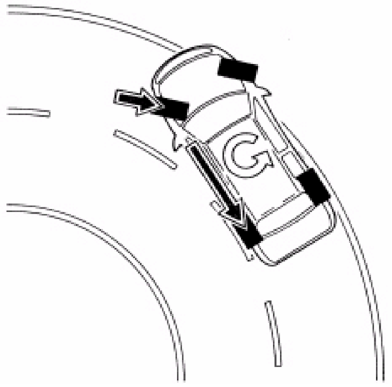


OVERSTEERING:

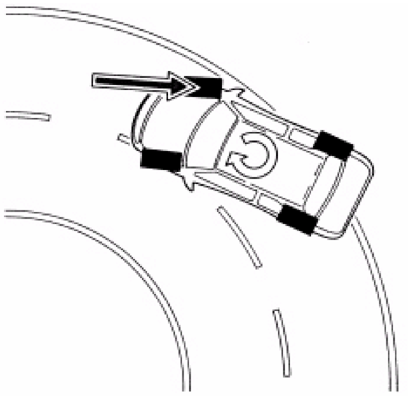
An oversteering vehicle will tend to slew round (the rear axle will tend to go straight and as a consequence the car will turn in). Given constant lateral acceleration, the slip angle of the rear axle will increase more than that of the front axle.



Understeering on bends (prevalence of slip on front axle)
The ECU detects the presence of understeering and corrects the vehicle behaviour by applying the brakes on the front and rear wheels inside the bend. This creates an opposite momentum and turns the car in towards inside of the curve. Motive torque may be reduced.



Oversteering on bends (prevalence of slip on rear axle)
The ECU detects the presence on oversteering and corrects the vehicle behaviour by applying the brakes to the external front wheel to create an opposite yaw momentum.
In certain cases, the speed of the wheel inside the bend may be increased in addition to applying the brakes.



The system intervenes before excessive oversteering or understeering occurs so as to prevent the need for countersteering which may be difficult to manage.

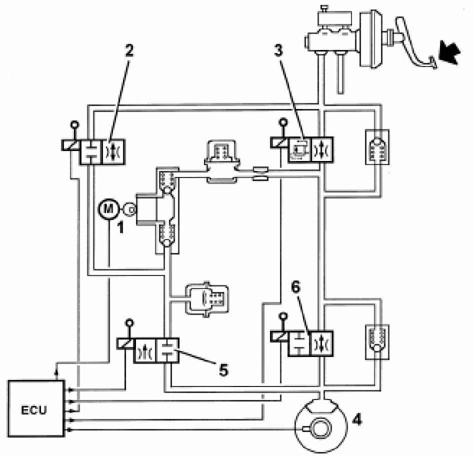
Sudden deviations from straight line (slalom, overtaking)
In the case of sudden deviations from a straight line (e.g. overtaking, slalom, gusts of wind), the ECU can detect the condition and the prevalence of slip on the axles and consequently correct the line by appropriately operating the brakes and the engine.

Hydraulic system operation
The hydraulic control unit in the version equipped with ESP has four supplementary solenoid valves.
The suction solenoid valve (normally closed) is activated to receive the amount of supplementary fluid needed to increase pressure and brake the wheel(s).
The pilot solenoid valve (normally open) when activated maintains the modulated pressure generated by the recovery pump needed to ASR intervention in the cylinder-calliper circuit.
With the brake pedal pressed, the ECU:

- does not power the suction solenoid valve (NC) (2)
- does not power the pilot solenoid valve (NO) (3).

In this manner, the system implements the steps of:

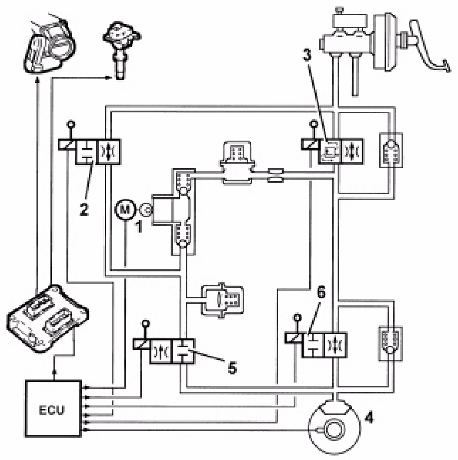
- pressure increase
- pressure hold
- pressure reduction
- supply re-establishment and pressure increase
- ABS/EBD system functions.



When the ECU detects the actuation conditions of the ESP, it:

- powers the hydraulic assembly pump (1)
- powers the suction solenoid valve (NC) (2)
- powers the pilot solenoid valve (NO) (3).

Consequently, when the pressure generated by the pump (1) reaches the brake calliper and is modulated (upon request of the ECU) by the relief (5) and loading (6) solenoid valves.



The ESP system increases driving safety but there are limit situations which cannot be controlled by the ESP. As a consequence, the system must be considered as a device for increasing vehicle safety not as a device for increasing vehicle performance.

HBA function

It is a proven fact that in panic situations not all drivers are capable of obtaining top performance from their car's braking system. Indeed, in many cases, drivers tend to limit the load they apply although they are quick to react.

The HBA ensures the same vehicle deceleration with a load three times lower than that of normal braking. As it is known, the stopping distance of a vehicle depends on the braking distance and the space covered during the reaction time and the brake system response time. This device reduces the stopping distance, particularly at faster speeds, by reducing the brake system response time.

Operation

The HBA (Hydraulic Brake Assist) function is implemented by the ABS ECU with the use of ESP software which monitors the oil pressure ramp-up while braking.

A panic situation is recognised when the gradient exceeds the set threshold. The device threshold is programmed so as to intervene only in real panic situations without affecting pedal modularity during normal vehicle use.

HHC function

The HHC (Hill Holder Control) function assists drivers when starting up in forward gear or reverse on a hill with a gradient of more than 2%. The HH automatically provides the braking torque needed to hold the vehicle until the clutch is fully released and the engine torque is sufficient to start the car off comfortably.

Features include:

- automatic operation at zero speed and vehicle gradient higher than 2%
- NQS warning light management
- pressure holding time equal to 1+15 sec
- automatically shut-down after acceleration
- clutch release or brake pedal release timeout.

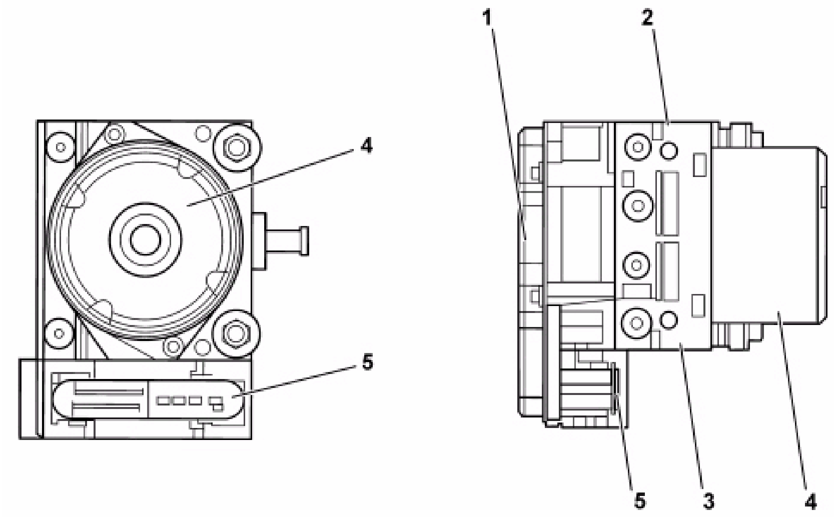
ABS EBD warning light operation

The ECU operates the warning lights according to the following logic:

		Warning light:				
Event	System status	button	NQS			
		ASR	EBD	ABS	ESP	HHC
Check (4s)	EBD / ABS / ASR / ESP HHC Not active for the first 500 ms	On	On	On	On	On
While travelling	EBD / ABS / ASR / ESP / HHC Active	Off	Off	Off	Off	Off
ASR off from button (1)	EBD / ABS / HHC ESP(2) Active ASR Not active	On	Off	Off	Off	Off
EBD failure	EBD / ABS / ASR / ESP HHC Not active	On	On	On	On	On
ABS failure	EBD Active ABS / ASR / ESP Not active HHC Any status	On	Off	On	On	On
ASR failure	EBD / ABS Active ASR / ESP Not active HHC Any status	On	Off	Off	On	On Off (Note 3)
HHC failure	EBD / ABS / ASR / ESP Active HHC Not active	Off	Off	Off	Off	On
ESP failure	EBD / ABS / ASR Active ESP Not active HHC Any status	Off	Off	Off	On	On Off (Note 3)
Low brake oil or handbrake applied	EBD / ABS / ASR / ESP HHC Active	Off	On	Off	Off	Off
ASR/ESP failure	EBD / ABS / ASR / ESP HHC Active	Off	Off	Off	Blinking 4Hz d. c. 50%	Off
HHC working	EBD / ABS / ESP HHC Active	Off	Off	Off	Off	On

(1) The system is shut down at key-off and automatically started up at key-on.
(2) ESP operation limited to brakes.
(3) According to type of failure: if the relief valves, the speed value and C-CAN communication are available, the function is maintained and the warning light is off.

Hydraulic control unit
The hydraulic control unit consists of: twelve two-way solenoid valves, one double circuit recovery pump, two low pressure accumulators, two high pressure accumulators, one brake liquid pressure sensor.

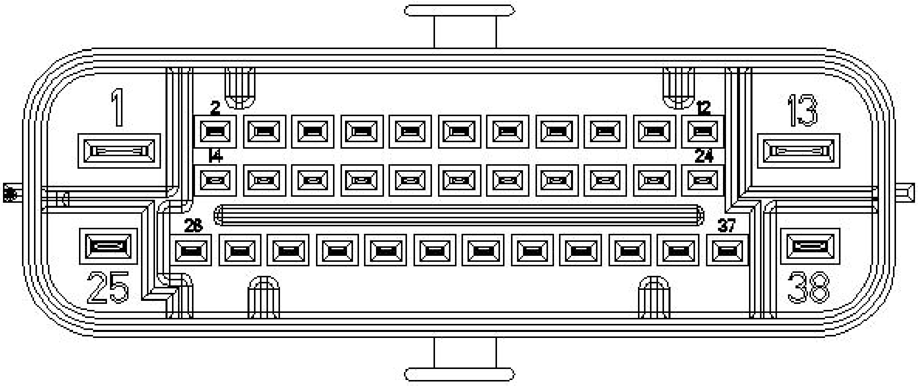


Key:
1. ECU
2. HCU
3. Brake oil pressure sensor
4. Recovery pump
5. 38-pin connector

The hydraulic control unit with ESP integrates a sensor for monitoring the brake pressure and cannot be separately replaced.

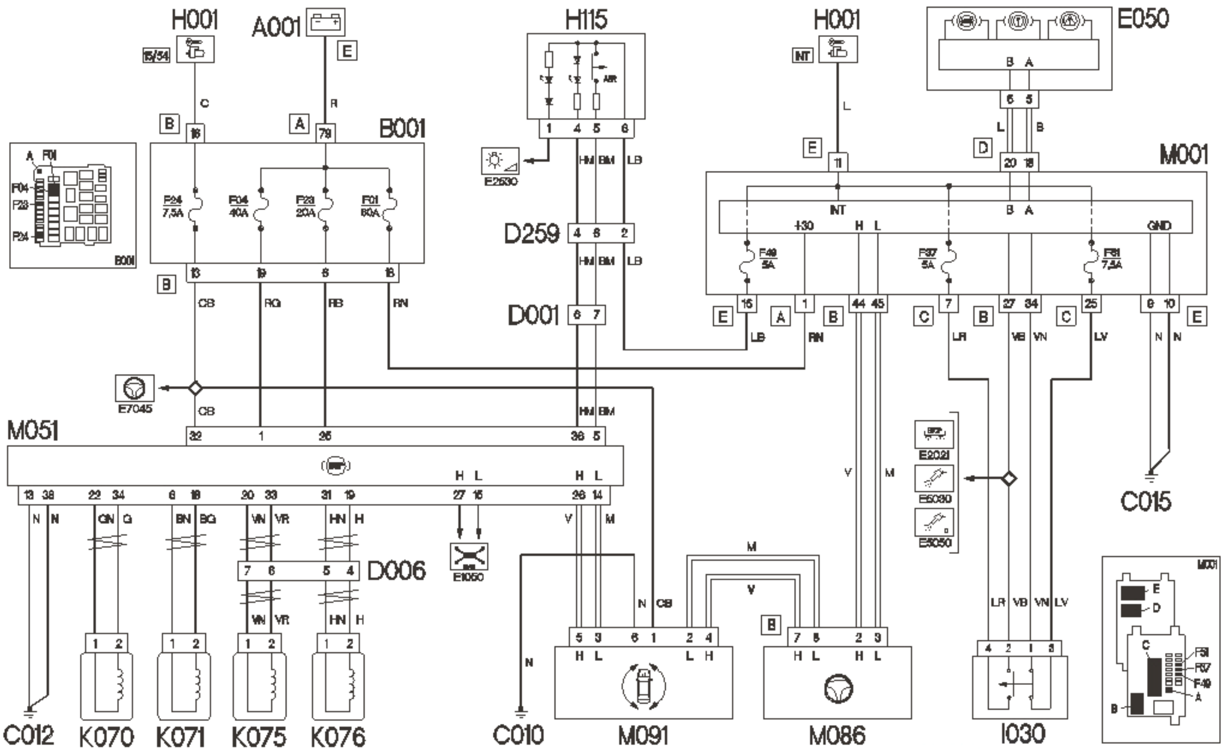
ECU (version with ESP)
The ECU:
- acquires data from the wheel speed sensors
- store control parameters defined in the vehicle setup
- stores the software and processes the acquired data
- controls the braking process
- detect ABS system component failures
- transmits and receives data via the diagnostic socket
- stores failure codes and operates the ABS/EBD/ASR/ESP/HHC warning lights on C-CAN
- transmits and receives data via the C-CAN (interface with other nodes)
- controls the ASR, ESP, HHC activation process.

PINOUT (version with ESP)
The ECU is connected to the electrical system via a 38-pin connector.



Pin	Description	Pin	Description
1	+ 30	20	K075 wheel sensor signal
2	Not connected	21	Not connected
3	Not connected	22	K070 wheel sensor signal
4	Not connected	23	Not connected
5	Input 12 Volt - ASR off	24	Not connected
6	K071 wheel sensor signal	25	+ 30
7	Not connected	26	C CAN (H)
8	Not connected	27	C CAN (H)
9	Not connected	28	Not connected
10	Not connected	29	Not connected
11	Not connected	30	Not connected
12	Not connected	31	K076 wheel sensor signal
13	Earth	32	+ 15
14	C CAN (L)	33	K075 wheel sensor power
15	C CAN (L)	34	K070 wheel sensor power
16	Vehicle speed signal (not connected)	35	Not connected
17	K line (not connected)	36	ASR off LED control
18	K071 wheel sensor power	37	Not connected
19	K076 wheel sensor power	38	Earth

WIRING DIAGRAM (with ESP)

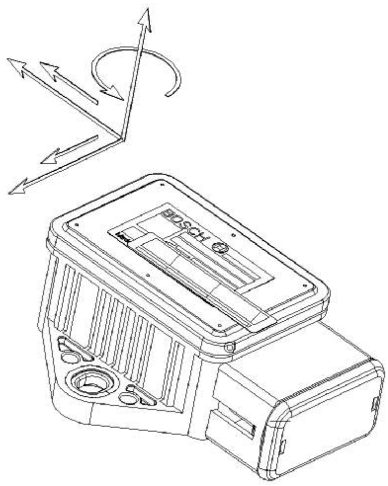


Key:
A001: Battery
B001: Ignition switch
C010: Earth
C012: Earth
C015: Earth
E050: Instrument panel
H001: Fusebox
H115: ASR off button
I030: Brake pedal switch
M001: Body Computer
M051: ABS ECU
M086: Steering angle sensor (inside power steering)
M091: Yaw sensor
K070: Left front wheel sensor
K071: Right front wheel sensor
K075: Left rear wheel sensor
K076: Right rear wheel sensor

Steering angle sensor
The steering angle sensor is integrated in the NGE (electrical steering node) and detects the angular degrees and the rotation speed of the steering wheel. The signals are made available on the CAN line.

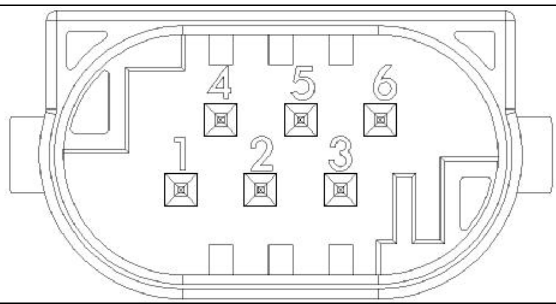
Yaw/lateral acceleration and longitudinal acceleration sensor
The yaw and lateral/longitudinal acceleration sensor is called the NYL (Yaw lateral) node. It is used to detect vehicle rotation about the vertical axis (yaw or centrifuge force) and to detect lateral and longitudinal accelerations (the latter to evaluate vehicle inclination for HHC function).

The connection between the ABS/ESP ECU is achieved on the C-CAN. The corresponding diagnostics is performed by the NFR.



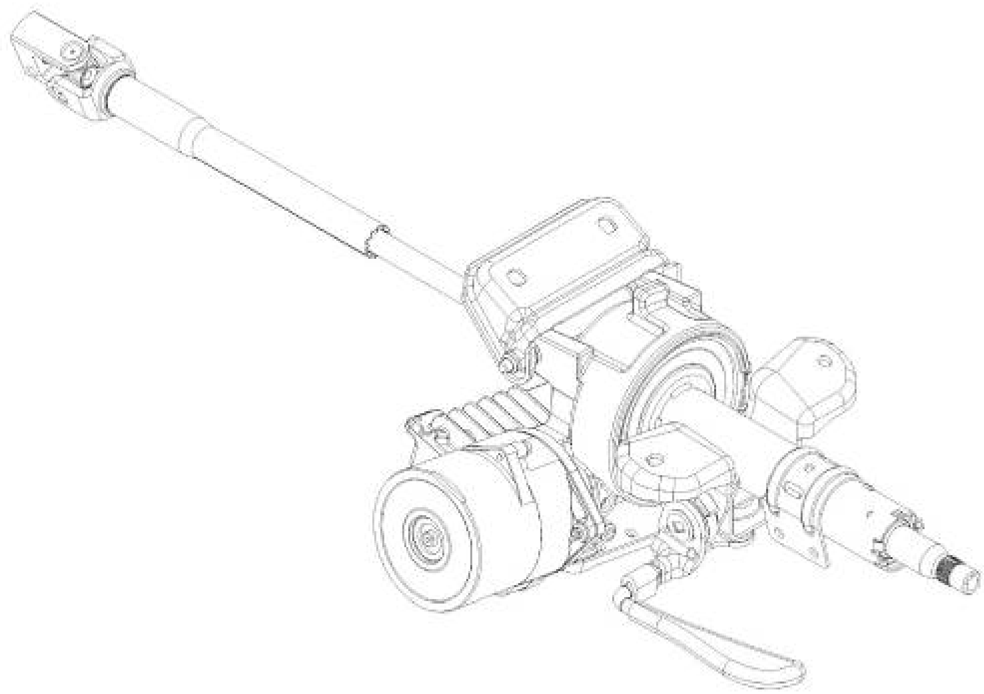
The sensor is located in the central position with respect to vehicle weight (near the NAB) under the heater. Assembly is univocal and the sensor is provided with six pins, all connected.

Yaw sensor pin-out



Pin	Description	Pin	Description
1	Power	**4**	C-CAN High 1
2	C-CAN Low 1	**5**	C-CAN High 2
3	C-CAN Low 2	**6**	Earth

EPS Electric power steering



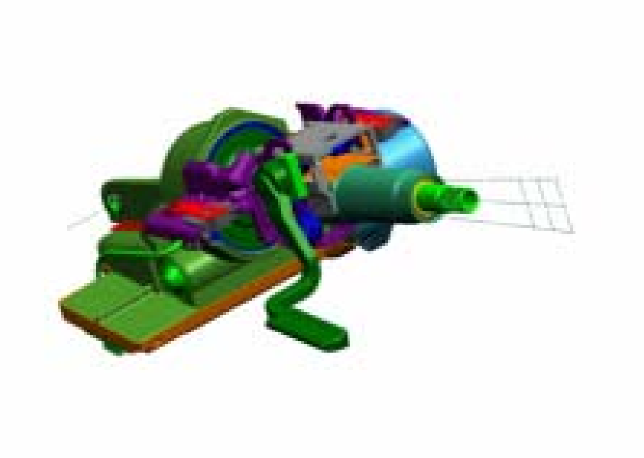
The Electrical Power Steering, or EPS system manufactured by DELPHI, is a servo steering system designed to reduce the force necessary for maneuvering the vehicle at low speed, although without rendering steering too light at higher speeds.
With respect to hydraulic power steering, electrical power steering offers the following advantages:

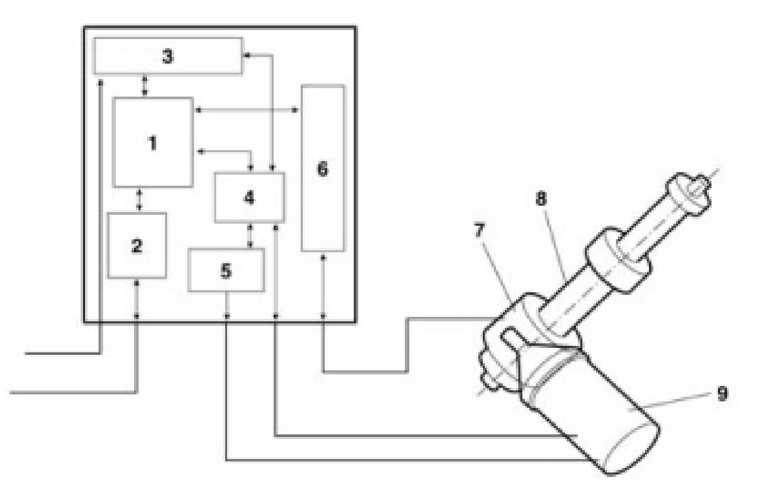
- The system has fewer components and is thus lighter and less complex.
- Installation and/or servicing are quick and more simple.
- The power steering system absorbs power from the internal combustion engine only when required, improving vehicle performance and reducing consumption and emissions.
- Less noise, improved driving comfort.
- Less pollution, using electrical energy.
- Power steering modulated to vehicle speed.
- Steering wheel "active return" to centre
- Steering wheel return oscillation dampening
- Power steering settings (Normal / City/Sport)

Components

Steering column

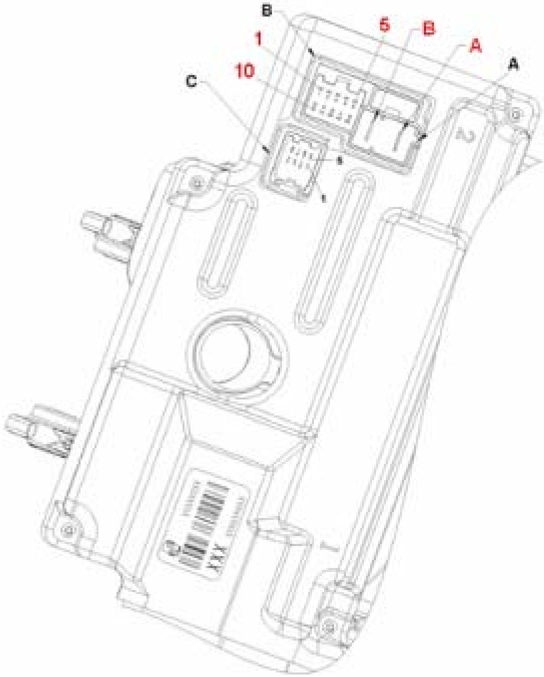
The electric steering columns have adjustable inclination, with total excursion of 5 degrees. Manual columns are not adjustable, as on the Panda.





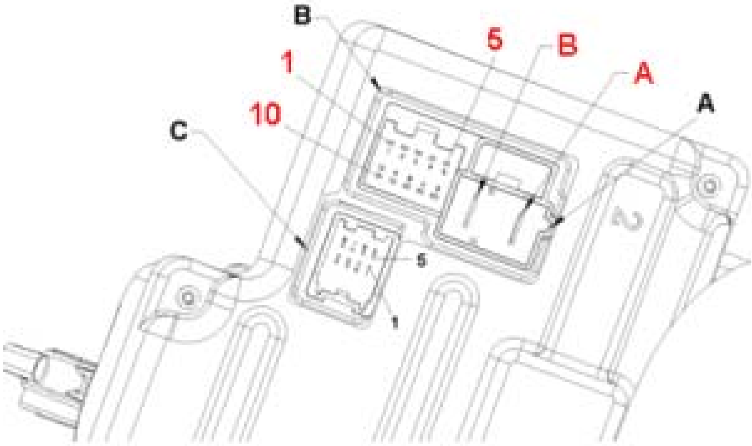
Key
1. Microprocessor
2. CAN interface
3. Power supply circuits
4. Engine timing circuit (EBMD)
5. Power electronics (FET)
6. Analogue signal interface.
7. Position and torque sensor
8. Servo mecanism
9. Electric motor (with motor position sensor)

EPS control unit



The electronic control unit processes the signals received as input from the sensors and pilots the electric motor, delivering the current necessary to obtain the required servo torque. It also manages communications over CAN network and carries out continuous system self-diagnosis, to assure correct function. It manages communication with diagnosis instruments via CAN network.
The values related to vehicle speed, alternator, City/Normal/Sport mode and the type of tuning are read over CAN line.
The position and torque signals from the sensors are the base values with which the microprocessor processes the output data in terms of current delivered to the motor.
The power steering control unit is fastened to the power steering box itself and interfaces with the harness through two separate connectors: one 10-pin and the other 2-pin.

Pin - out



Key

Connector A:
A - Battery +
B - Battery -

Connector B:
1 – power +15
2 - CAN HI 2
3 - CAN LO 2
4 - N.C.
5 - N.C.
6 - N.C.
7 - CAN HI
8 - CAN LO
9 - N.C.
10 - N.C.

Connector C:
1 - P 3 (ESP only)
2 - P 1
3 – Sensor reference power
4 - T2
5 - N.C.
6 - P2
7 - Ground
8 – T1

Description of signals

Driving mode selection signal "Normal / City /Sport"

The "Normal / City" function serves to vary power steering torque according to vehicle speed. A button on the instrument switches from the base configuration ("Normal"), to "City" or "Sport" mode.
The NGE receives the "Normal / City / Sport" signal via C-C.A.N. and implements the required strategy.
The Body Computer Module receives the analogue signal that varies when the button is released, activating the signal and with torque applied by the driver greater than 1 Nm.
During the key to STOP / key to RUN cycle, the Body Computer Module maintains the previous setting.
Steering is always assisted, and decreases as speed increases.

C-C.A.N. Line
The control unit can receive / transmit information over the CAN network. The network interfaces is enabled from key-on to key-off.

Signals received / sent via C-CAN network
The signals received via CAN network by the NGE control unit are:

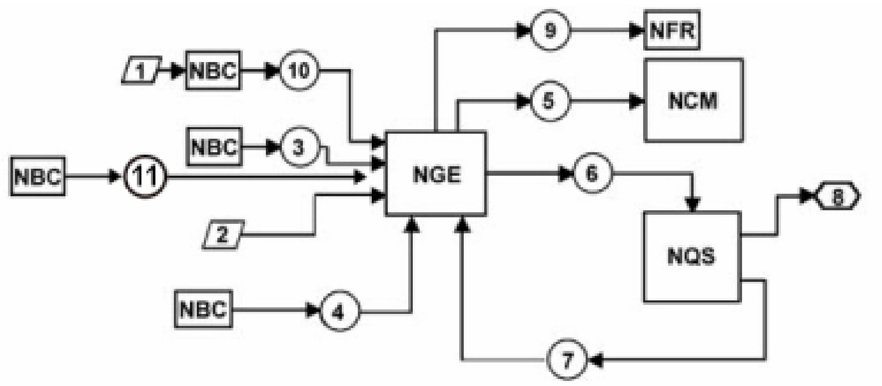
- Vehicle speed
- Warning light status
- Engine running signal (D+)
- Diagnosis
- Vehicle speed signal error
- Normal/City/ Sport mode
- Type of tuning (calibration)

The signals sent via CAN network by the NGE control unit are:

- System status (fault)
- Power steering enabled signal (EPS Active)

Diagnosis
Absolute steering wheel position (only for NGE version for applications with ESP)

Functional diagram



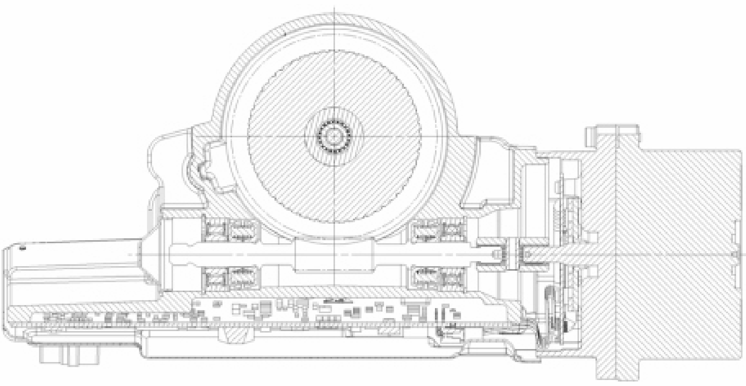
Legenda
1. City/Sport selector
2. Ignition key
3. Alternator voltage
4. Vehicle speed
5. Steering load
6. Warning light state send
7. Warning light state return
8. Warning and/or City/Sport light activate
9. Steering angular position signal (only with ESP)
10. City / normal/ Sport signal from NBC
11. Tuning type (calibration) signal from NBC

Functional behavior
The following table offers a schematic of system functional behavior.

INPUT	OUTPUT
Vehicle speed indication (4) (via CAN network)	Regulates power steering according to vehicle speed and required steering wheel torque.
Alternator D+ indication (3) (via CAN network)	Through this indication the control module recognizes engine running.
System error	Fault light on via CAN network.
Normal/City/Sport selection (included in system)	According to driver command by button, system activates corresponding strategy (soft/hard).

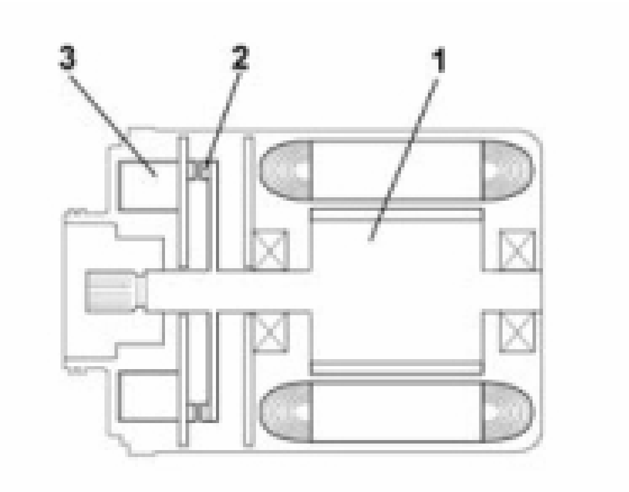
System electrical load (system indication)	The system transmits this information to the engine control module through the CAN network, and the module in turn executes the appropriate strategies to regulate engine idle speed. The NGE module control panel is able to identify timed variations in current absorbed by the module during operation. The control panel recognizes passing of the positive and negative thresholds and retransmits this information over the CAN network.

Motor gear



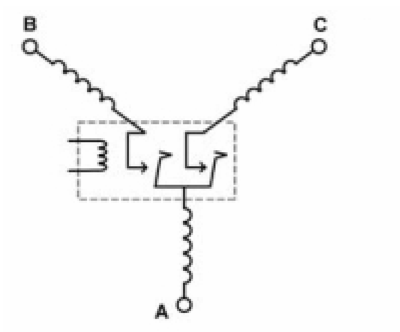
The reduction gearing group consists of an aluminum cast anchored to the vehicle chassis.
To the side of the gear casting, the servo motor delivers torque through a worm screw to the servo gear at ratio 22:1.
The gear motor cog, coaxial with the steering column, is in steel, while the outer crown wheel is in co-molded plastic material. The worm screw and pinion are designed such that the angles assure coupling reversibility.
The metal part of the gear is shrunk onto the output shaft, which transmits the summed steering forces (servo motor plus driver).
The input and output shafts are linked together via a calibrated torsion bar that permits angular movement from +8° to -8° (mECManical limit stops prevent torsion increasing further).
With resistance at the wheels, the input shaft twists the torsion bar thereby offsetting the input and output shafts by an angle proportional to the torque applied to the steering wheel.
A torque sensor, mounted in the motor gear, detects angle offset between the input and output shafts and provides an electrical signal to the control unit proportional to shift.
The reduction gear group also serves to retain the outer part of the “torque and position” sensor, and lastly, the input shaft support sleeve is fastened to the box, where the steering wheel is mounted, housing the ignition switch and combiswitch stalk.
In the adjustable steering column version, the angle and axial position of the steering wheel can be adjusted in the vehicle.
It is strictly forbidden to dismantle the steering reduction gearbox, as it would NOT be possible to reassemble it as in the factory

Electric motor

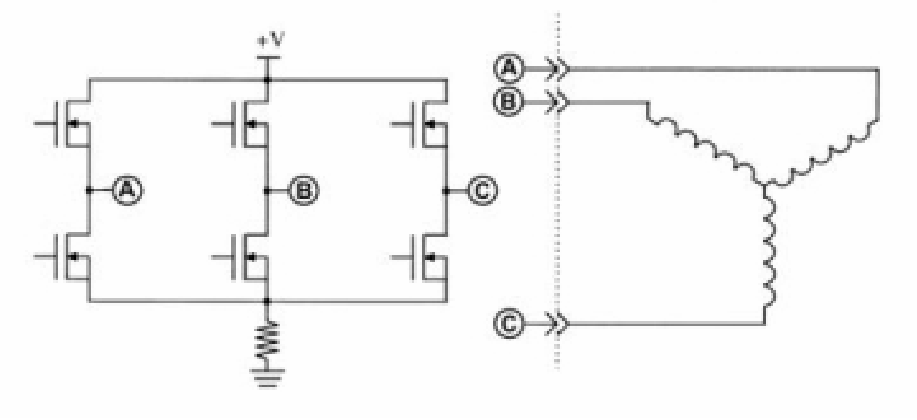


Specifications and function

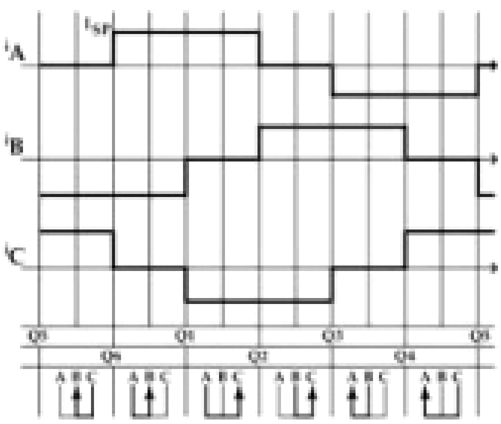
The electric motor is a three-phase synchronous self-commutating (brushless) type, with permanent magnetic rotor.
Power distribution and phase control are regulated by the EPS control module.
The rotor is made with permanent magnetic material.
A disk is fastened to the rotor, bearing two small magnets (2), while the fixed side on the crankshaft output side, has three Hall effect semiconductors (3), that serve to indicate lower shaft angular position to the control unit. Therefore the position of the rotor (orientation) is measured by the position sensors built-in to the casing (Hall-effect sensors), allowing the control unit to power the appropriate phases.



To reduce noise and vibration in the steering column, the motor is mounted with three silent blocks for the stator and one for the motor.



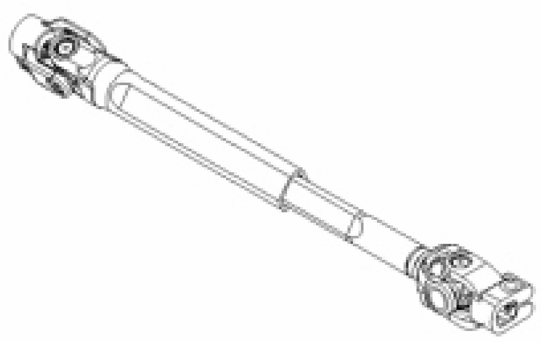
Motor current absorption ranges from 1 A to 80 A. Maximum absorption condition is when carrying out evasive maneuvers at high steering wheel turning speed.
The motor is designed to deliver torque as required, or to aid the driver according to the force required to move the wheel.
The wheels offer resistance to the steering column that differs according to whether they are on gravel or asphalt, for example.
As a consequence, the motor delivers torque according to that required.
The control unit controls each individual winding (three-phase) in current. Being permanent magnets, the rotor tends to follow and reach the centre of the magnetic field.
The control unit controls rotor position through the signals sent to it through the Hall effect semiconductors.
The exact position of the rotor serves to allow the control unit to power the coils concerned thereby maintaining the motor always under torque
The action of the individual coil is realized using an FET bridge as shown above. Working frequency is 18 kHz using the PWM (Pulse Width Modulation) method for each individual coil.



The figure also shows how, when current is delivered to a winding, another will demand it, while the third winding is without current. On commutation the current flows through the windings change.
The synchronous self-commutating motor always operates are the torque required by the force exerted on the steering wheel, and as torque demand increases, the current in the windings increases proportionally: this value will be around zero when no torque is demanded.

The sensor
The sensor that measures position and torque is mounted in a single box fastened to the reduction gear casting, while the input and output shafts are free to rotate, driving the moving parts.
The sensor has two functions: to measure torque and output shaft position.
To measure torque, it may be compared to a potentiometer, where the support is fastened to the output shaft and the cursor to the input shaft. The torsion moment on the torsion bar between the two shafts determines the torque value applied between the steering wheel and the steering wheels.
Through this potentiometer signal the control unit is able to recognize the effort the driving is exerting on the steering wheel, and the direction of the torque. The angular position of the output shaft in relation to centre (wheel straight) is measured on the same principle (potentiometer). Through this signal the control unit is able to recognize by how many degrees the steering wheel is turned with respect to centre.
For versions with ESP the sensor in question also serves as steering angle sensor, and so to calculate how many turns of the steering wheel for how many degrees per turn.
The information provided by the torque/position sensor is transmitted over C-CAN network by the NGE module for optimal electronic stability control managed by the NFR.
Note: it is strictly forbidden to carry out tests with any instruments on sensors: any diagnosis MUST be carried out through the electrical power steering control unit

Lower shaft



The connection between the steering column output shaft and the pinion on the steering box is realized through a telescopic intermediate shaft, attached to the pinion by a splined fork and a screw.

Functional logic

Basic function
According to driver requirements (torque at steering wheel) and vehicle speed, the electrical power steering module (EPS) commands the servo motor that assists the steering column in its rotation. Through a worm screw mECManism, the motor applies a torque to the steering column itself, making the steering maneuver lighter for the driver.

Power steering variation according to vehicle speed.
As vehicle speed increases, the system proportionally increases the force to apply to the steering wheel, since as speed increases, the resistance offered by the wheels decreases.
Consequently, using the vehicle speed signal, the EPS applies a lesser degree of servo assistance.

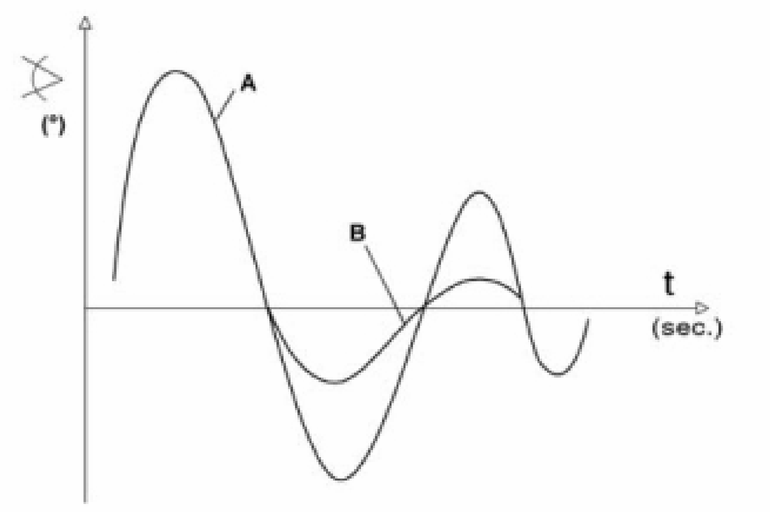
Active return
The return phase is understood as the realignment normally generated by the geometry of the fore carriage when the steering wheel is released after a turn.
This information serves to make realignment more rapid, by inverting the servo motor to assist the normal geometric effect.

Active return correction varies according to vehicle speed:

- It is maximum at low speeds
- It is minimum at high speeds.

The servo motor carries out active steering wheel return according to the steering angle with respect to centre. The larger the steering angle, the greater the energy delivered by the motor for realignment.

Steering return oscillation damping.



After releasing the steering wheel after a turn, the vehicle chassis generates oscillations (A) which, persisting for a certain time may be uncomfortable.
The servo motor reduces the amplitude of the oscillations (b) during return to straight travel and intervenes to a greater degree at higher speeds.

Selectable power steering

Using the buttons on the control panel, the driver can select two driving modes:

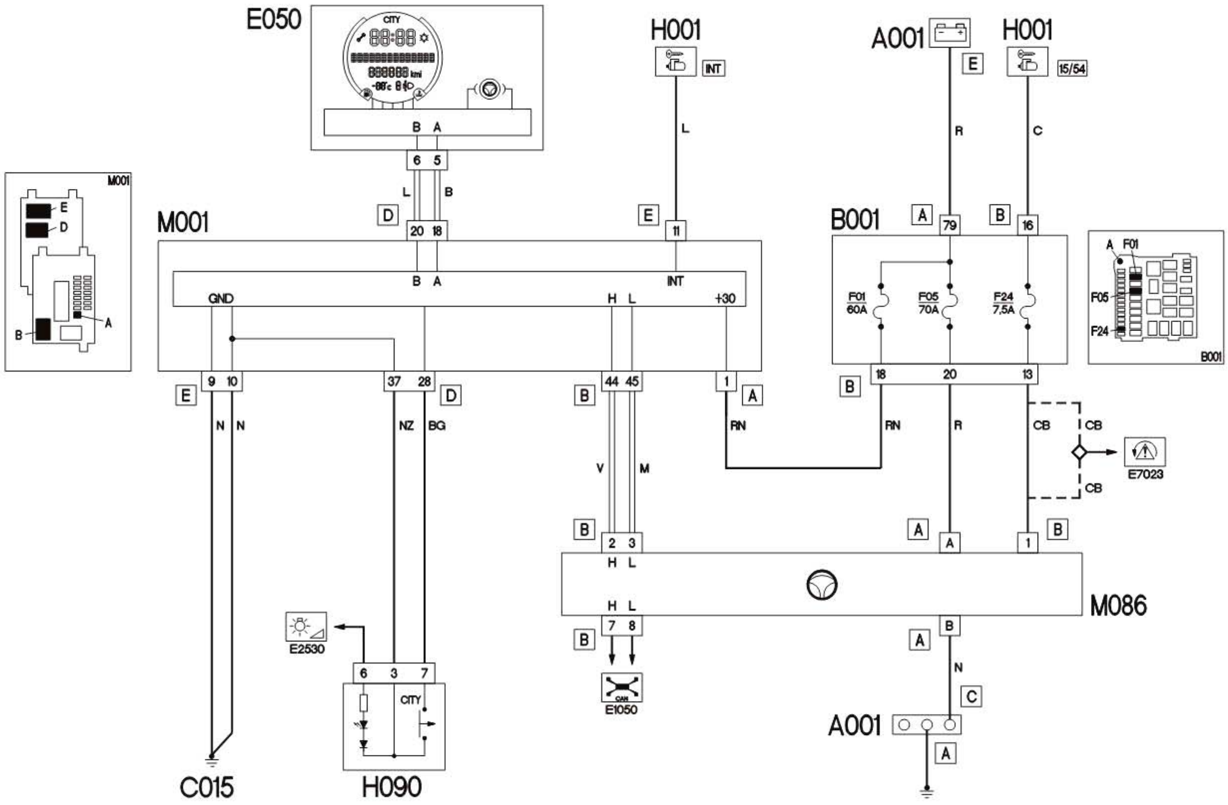
- “Normal” for normal power steering at medium to high speeds,
- “City” for lighter driving at low speeds and facilitating parking, thanks to increased servo power.
- “Sport” for versions with the SPORT function, there is a reduction is power steering at high speeds, rendering the drive harder, and steering wheel movements more precise.

Note: if the City function is present the Sport function is not, and vice versa, if the Sport function is present, the City function is not.

NGE Calibrations

The system manages 5 drive settings. The NGE receives the vehicle information (engine and steering box type) from the Body Computer through the CAN network and selects the correct settings from its memory.

EPS Electric Power Steering circuit diagram
Diagram E7045

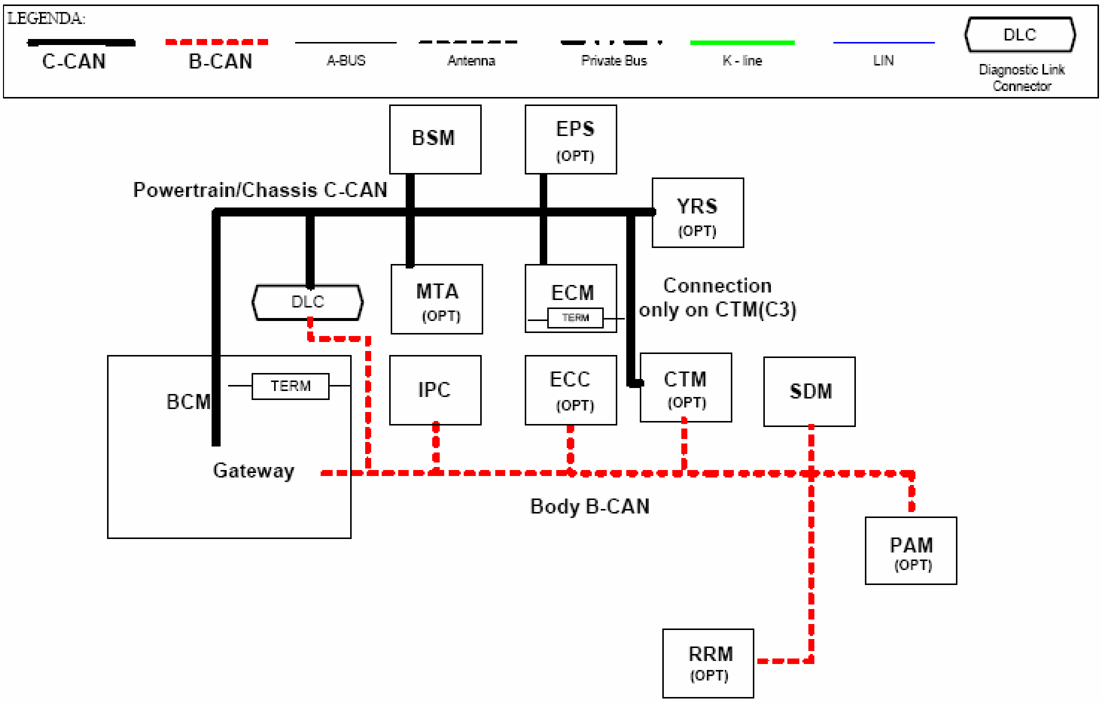


Legenda

A001 BATTERY
B001 ENGINE BAY JUNCTION BOX
C015 GROUND
E050 INSTRUMENT PANEL MODULE
H001 IGNITION SWITCH
H090CITY/SPORT BUTTON
M001 BODY COMPUTER MODULE
M086 ELECTRIC POWER STEERING MODULE

ELECTRIC SYSTEM

Communications network architecture



Module	Description	Nodo corrispondente	Descrizione
BCM	Body computer module	NBC	Nodo body computer
BSM	Braking system module	NFR	Nodo freni
EPS	Electric power steering	NGE	Nodo guida elettrica
YRS	Yaw rate sensor	YRS	Sensore imbardata- Hill holder
MTA	Manual transmission automated	NCR	Nodo cambio robotizzato
ECM	Engine control management	NCM	Nodo controllo motore
IPC	Instrument panel cluster	NQS	Nodo quadro strumenti
ECC	Electronic climate control	NCL	Nodo clima
CTM	Convergence telematic module	NCV	Nodo convergence
SDM	Sensing and diagnostic module	NAB	Nodo air bag
PAM	Parking aid module	NSP	Nodo sensore parcheggio
RRM	Radio receiver module	NRR	Nodo radioricevitore
DLC	Diagnostic link connector	EOBD	Connettore di diagnosi

For the Fiat 500, the communications line architecture envisages:

- A 50 kbit/s B-CAN network,
  Specifications:
  - ✓Two network cables, B-CANb and B-CANa,
  - ✓Resistance to network faults;
  - ✓29 bit standard

- A 500 Kbit/s C-CAN network.
  Specifications:
  - ✓Two twisted cables, C CANH and C-CANL,
  - ✓Not resistant to network faults;
  - ✓29 bit standard

Not present:
- K com line for C-CAN component diagnosis;
- Discrete line for command of ECM Mil warning light;
- W com line for CODE function recovery

Components

The components connected to the C-CAN network are:
- BCM (NBC) (Body Computer Module);
- BSM (NFR) (braking System Module);
- MTA (NCR) (Manual Transmission Automated) (OPT);
- EPS (NGE) (Electric Power Steering) (OPT);
- ECM (NCM) (Engine Control Module);
- YRS (Yaw Rate Sensor) (OPT).

The components connected to the B-CAN network are:
- BCM (NBC) (Body Computer Module);
- IPC (NQS) (Instrument Panel Cluster);
- ECC (NCL) (Electronic Climate Control) (OPT);
- CTM (NCV) (Convergence Telematic Module) (OPT);
- SDM (NAB) (Sensing and Diagnostic Module);
- PAM (NSP) (Parking Aid Module) (OPT);
- RRM (NRR) (Radio Receiver Module) (OPT).

Types of module

The B-CAN network has the following types of module.
B-CAN Master +30:
- BCM (NBC) (Body Computer Module);

B-CAN Slave +30
- IPC (NQS) (Instrument Panel Cluster);
- RRM (NRR) (Radio Receiver Module) (OPT).

B-CAN Slave +30 (non critico al tempo)
- CTM (NCV) (Convergence Telematic Module) (OPT);

B-CAN Slave +15
- ECC (NCL) (Electronic Climate Control) (OPT);
- PAM (NSP) (Parking Aid Module) (OPT);
- SDM (NAB) (Sensing and Diagnostic Module).

Whereas for the C-CAN
C-CAN Terminal module (primary)
- BCM (NBC) (Body Computer Module);
- ECM (NCM) (Engine Control Module);

C-CAN Terminal module (secondary)
- CTM (NCV) (Convergence Telematic Module) (OPT);

C-CAN modules that permit network transit
- BSM (NFR) (braking System Module);
- EPS (NGE) (Electric Power Steering) (OPT);
- MTA (NCR) (Manual Transmission Automated) (OPT);
- YRS (Yaw Rate Sensor) (OPT).

The module that permits the Gateway function, meaning transit of information between one network and the other and vice-versa, is the BCM (NBC) (Body Computer Module);

PROXY Alignment

The electronic units requiring PROXY alignment in case of after-market substitution are::

- BCM (NBC) (Body Computer Module)
- IPC (NQS) (Instrument Panel Cluster);
- CTM (NCV) (Convergence Telematic Module) (OPT);
- SDM (NAB) (Sensing and Diagnostic Module).

Diagnosis and diagnostics connector

As can be seen from the diagram, the DLC (Conn. EOBD) (Diagnostic Link Connector), is external to the Body Computer Module and unites the two CAN networks, so module diagnosis is carried out exclusively via diagnostics messages exchanged between the communications networks. **For this purpose it is essential to have the A16HS diagnosis connector ion order to dialogue with the various electronic control units.**

The control units that can be diagnosed with the EXAMINER are:

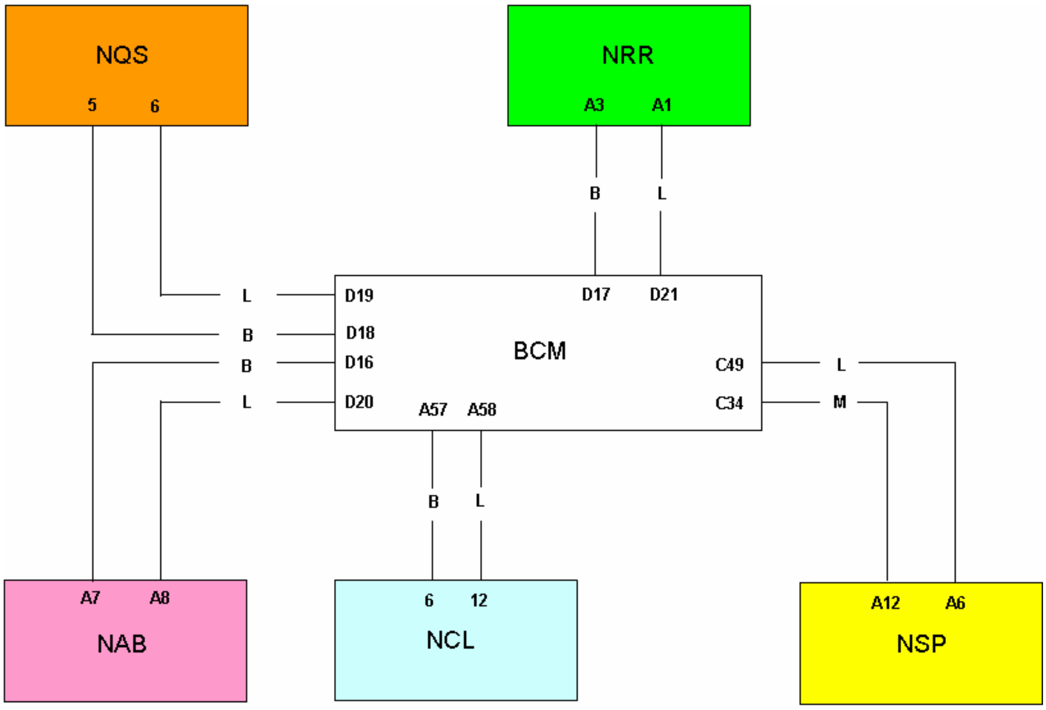
- BCM (NBC) (NBC) (Body Computer Module);
- BSM (NFR) (braking System Module);
- ECM (NCM) (Engine Control Module);
- EPS (NGE) (Electric Power Steering) (OPT);
- IPC (NQS) (Instrument Panel Cluster);
- CTM (NCV) (Convergence Telematic Module) (OPT);
- MTA (NCR) (Manual Transmission Automated) (OPT);
- PAM (NSP) (Parking Aid Module) (OPT);
- SDM (NAB) (Sensing and Diagnostic Module).

Summary table

Module	**Mod (commercial name)**	**BUS**	**Module type**	**Diagnosis**	**Diagn. line**	**Proxy**	**Programmabe**
BCM (NBC)	Body computer	B-CAN C-CAN	B:+30 master C:+15 terminal	YES	B-CAN	**YES**	YES
ECM (NCM)	Engine control	C-CAN	C:+15 terminal	YES	C-CAN	NO	YES
EPS (NGE)	Electric steering	C-CAN	C:+15 passage	YES	C-CAN	NO	YES
IPC (NQS)	Instrument panel	B-CAN	B: +30 slave	YES	B-CAN	**YES**	YES
RRM (NRR)	Radio receiver	B-CAN	B: +30 slave	**NO**	/	NO	**NO**
BSM (NFR)	ABS/ESP	C-CAN	C:+15 passage	YES	C-CAN	NO	YES
ECC (NCL)	Climate control	B-CAN	B: +15 slave	YES	B-CAN	NO	YES
MTA (NCR)	Robotic gearbox	C-CAN	C:+15 passage	YES	C-CAN	NO	YES
YRS	Yaw	C-CAN	C:+15 passage	**NO**	/	NO	**NO**
PAM (NSP)	Parking aid	B-CAN	B: +15 slave	YES	B-CAN	NO	**NO**
SDM (NAB)	AIR BAG	B-CAN	B: +15 slave	YES	B-CAN	**YES**	YES
CTM (NCV)	BLU & ME	B-CAN (C1/C3) C-CAN (C3)	B: +30 slave C: +15	YES	B-CAN	**YES**	YES

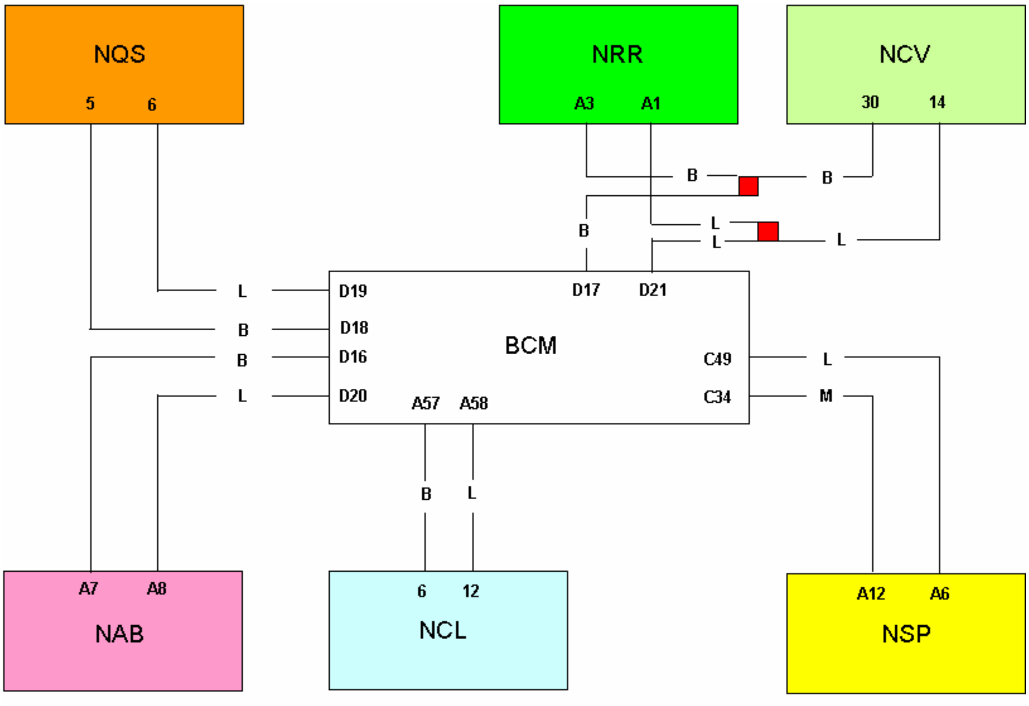
Network configuration

B – CAN network



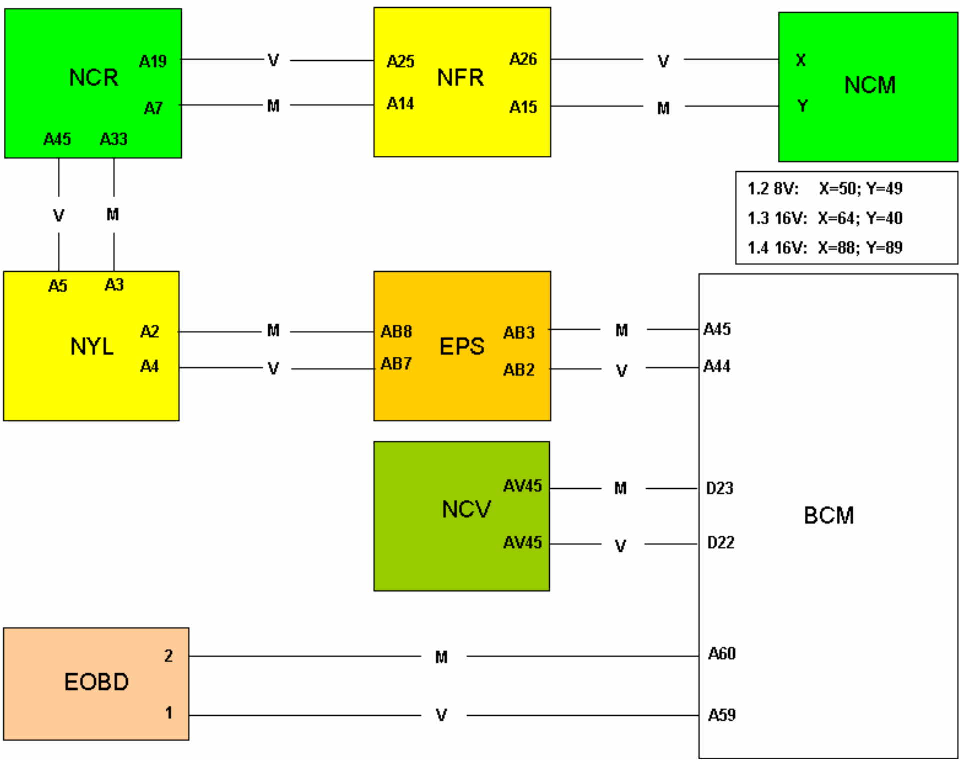
B - CAN

B – CAN with Convergence

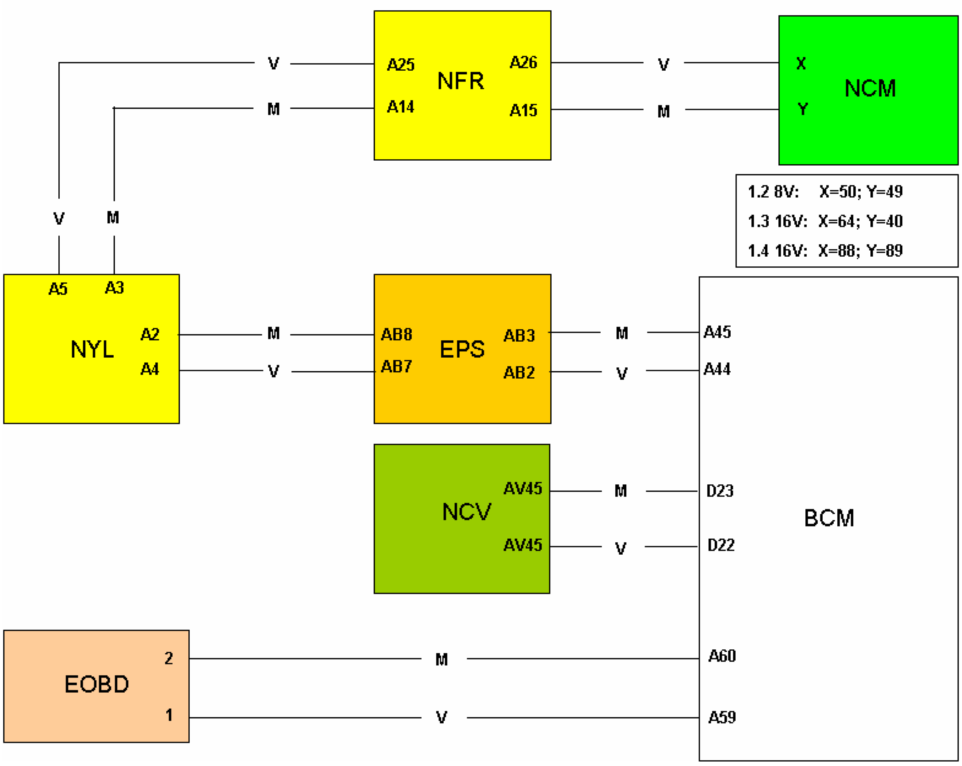


B – CAN - convergence

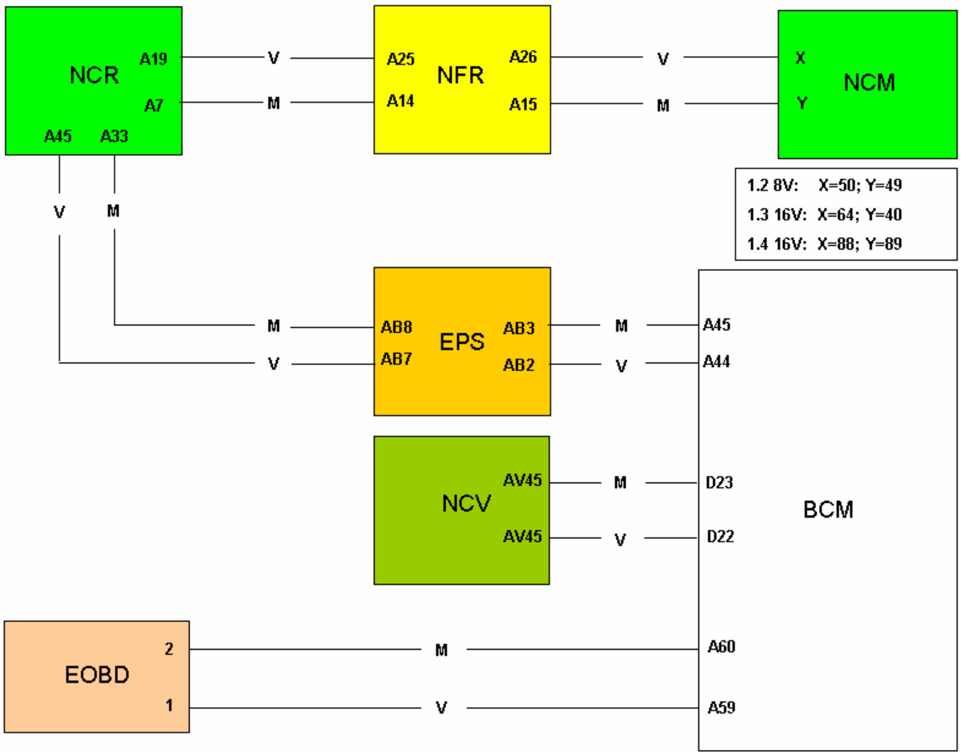
C – CAN 1 (FULL)



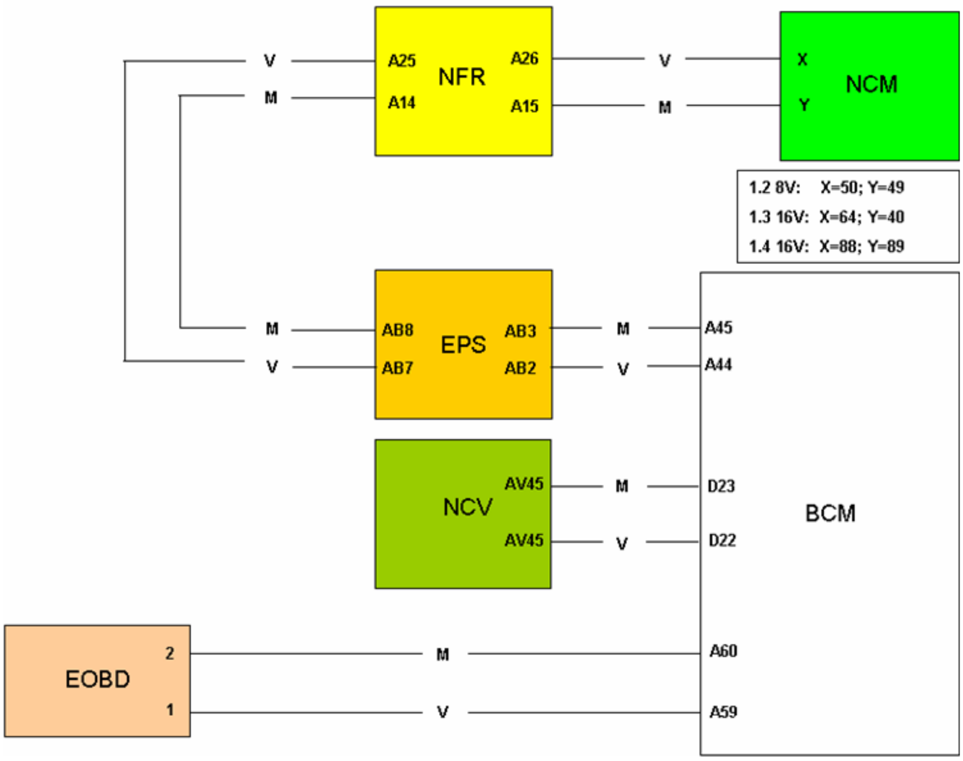
C – CAN 2



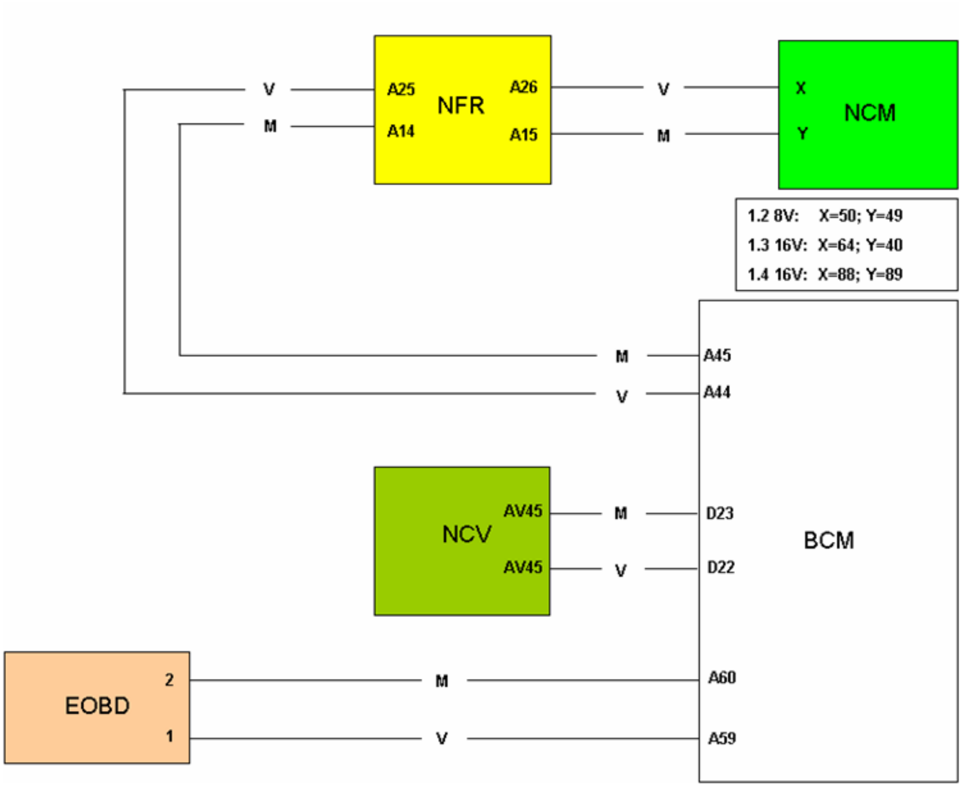
C – CAN 3


NCR
A19
A7
A45
A33
V
M
NFR
A25
A14
A26
A15
NCM
X
Y
1.2 8V: X=50; Y=49
1.3 16V: X=64; Y=40
1.4 16V: X=88; Y=89
EPS
AB8
AB7
AB3
AB2
NCV
AV45
AV45
BCM
A45
A44
D23
D22
A60
A59
EOBD
2
1

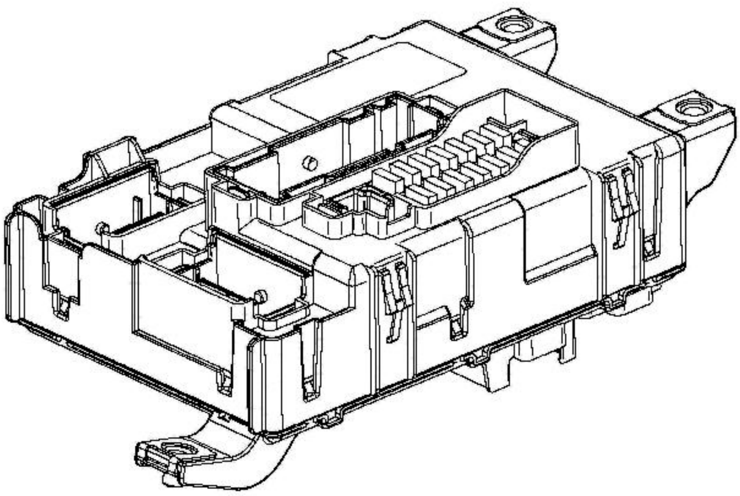
C- CAN 4


NFR
A25
A14
A26
A15
V
M
NCM
X
Y
1.2 8V: X=50; Y=49
1.3 16V: X=64; Y=40
1.4 16V: X=88; Y=89
EPS
AB8
AB7
AB3
AB2
NCV
AV45
AV45
BCM
A45
A44
D23
D22
A60
A59
EOBD
2
1

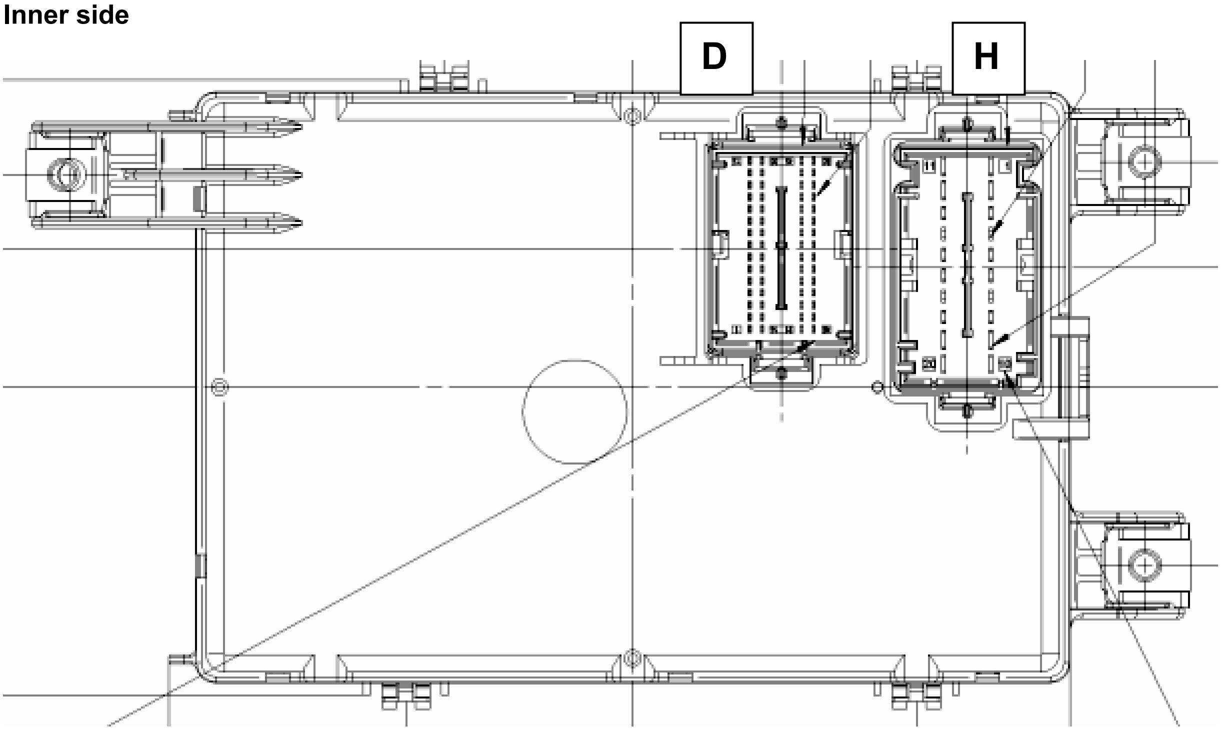
C – CAN 5



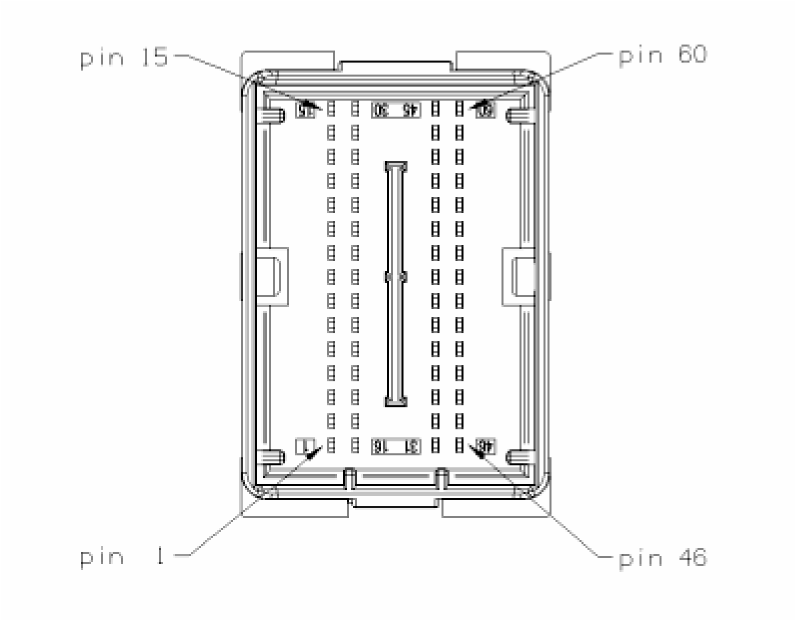
BCM (NBC) (NBC) (Body Computer Module)



PIN-OUT
Inner side



Connector D

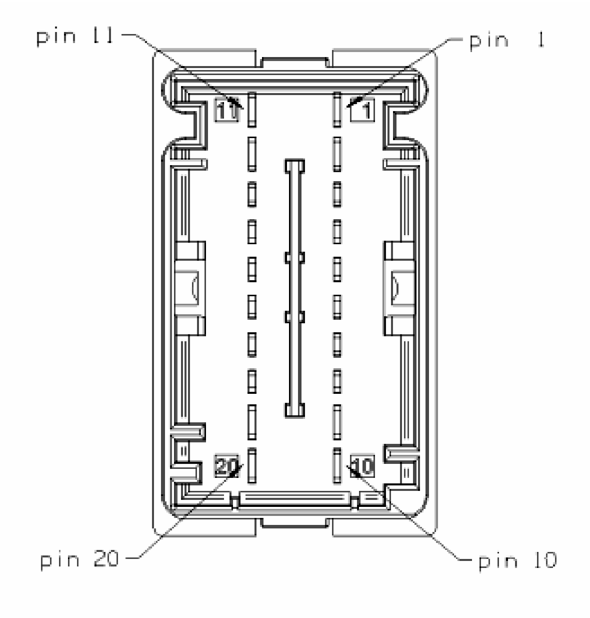


Pin	Pin OUT function	Funzione da disegno
1	Horn relay command	Comando relè avvisatore acustico
2	KL 15 relay command (T6) (the Low side driver must be drived directly by Key INT signal)	Comando relè KL15 T6 (low lato guidatore deve essere comandato direttamente dal segnale chiave
3	WLM comfort closing	WLM alzacristalli
4	Front fog relay command/Bending right with fog lamp	Comando relè fendinebbia anteriori / piegato a DX con lampada nebbia
5	Front driver door ajar signal to MTA (NCR) control unit	Segnale porta guidatore aperta all'unità di controllo MTA (NCR)
6	Rear window defroster relay command	Comando relè lunotto termico
7	Front puddle lights	Luci pozzanghera anteriori
8	Front Right flasher	Lampeggiante anteriore DX
9	Side Right flasher	Lampeggiante laterale DX
10	Front Left flasher	Lampeggiante anteriore SX
11	Side Left flasher	Lampeggiante laterale SX
12	Night lighting 58d	Illuminazione notturna 58d
13	Rear right fog light command/reverse gear ligth command	Comando luce retronebbia destra/comando luce retromarcia
14	Comfort enable supply	Alimentazione comfort enable
15	Front right Parking Light (LEFT/RIGHT)	Luce di posizione anteriore DX (SXe DX)
16	KL 15a relay command (T5)/Bendig right with specific lamp	Comando relè KL15a (T5) piegato a destra con lampada specifica
17	Doors status led command	Comando Led stato porte
18	Hazard switch signal	Segnale luci d'emergenza
19	VSO Output generation	Generazione uscite VSO
20	Hazard led command	Comando luci d'emergenza

21	Rear defroster led command	Comando LED lunotto termico
22	High beam relay command	Comando relè fari abbaglianti
23	Headlamp washer pump relay command	Comando relè pompa lavafari
24	Front Passenger door Limit switch	Interruttore limite porta passeggero
25	Tachometer sensor/TPMS Ground (GND)	Sensore tachimetrico / TPMS massa (GND)
26	Front brake pad wear sensors signal	Segnale usura guarnizioni freni anteriori
27	Stop light switch signal (normally open)	Segnale interruttori luci stop (NA)
28	Rear right fog light command/reverse gear ligth command	Comando luce retronebbia destra/comando luce retromarcia
29	Front left Parking Light (FRONT/REAR or LEFT/RIGHT)	Luce di posizione anteriore sinistra /fronte retro/ SX o DX
30	Front right Parking Light (FRONT/REAR)	Luce di posizione anteriore destra /fronte retro/ SX o DX
31	KL 15a relay command (T30)	Comando relè KL15 (T30)
32	Front driver window UP switch signal	Segnale interruttore “SU” finestrino guidatore
33	Brakes oil level signal	Segnale livello olio freni
34	Stop light switch signal (normally closed)	Segnale interruttore luci stop (NC)
35	TPMS signal 1	Segnale TPMS 1
36	TPMS signal 2	Segnale TPMS 2
37	External temperature sensor (signal)	Segnale sensore temperatura esterna
38	Front passenger window UP switch signal	Segnale interruttore “SU” finestrino passeggero
39	Front wiper parking contact signal	Segnale contatto stop tergicristallo anteriore
40	Front driver window DOWN switch signal	Segnale interruttore “GIU” finestrino guidatore
41	Rear defroster switch signal	Segnale interruttore lunotto termico
42	LS CAN-A	LS CAN-A
43	LS CAN-B	LS CAN-B
44	High Speed CAN-H	High Speed CAN-H
45	High Speed CAN-L	High Speed CAN-L
46	Low beam relay command/Bending left with fog or specific lamp	Comando relè faro anabbaglianti/piegato a SX con lampada da nebbia o specifica
47	Front passenger window DOWN switch signal	Segnale interruttore “GIU” finestrino passeggero
48	Bonnet ajar switch signal (normally open)	Segnale interruttore cofano aperto (NA)
49	A/C request signal	Segnale richiesta A/C
50	Tachometer sensor signal	Segnale sensore techimetrico
51	Front Driver door Limit switch	Interruttore limite porta guidatore
52	External temperature sensor (GND)	Sensore temperatura esterna (GND)
53	Front passenger door ajar switch signal	Segnale interruttore porta passeggero aperta
54	Front driver door ajar switch signal	Segnale interruttore porta guidatore aperta
55	Serial line F for ABS/Doors Lin	Lina seriale per ABS doors LIN
56	Roof LIN _ A-bus for Rain sensor	Linea A-BUS per sensore pioggia

57	LS CAN-A	LS CAN-A
58	LS CAN-B	LS CAN-B
59	High Speed CAN-H	High Speed CAN-H
60	High Speed CAN-L	High Speed CAN-L

Connector H

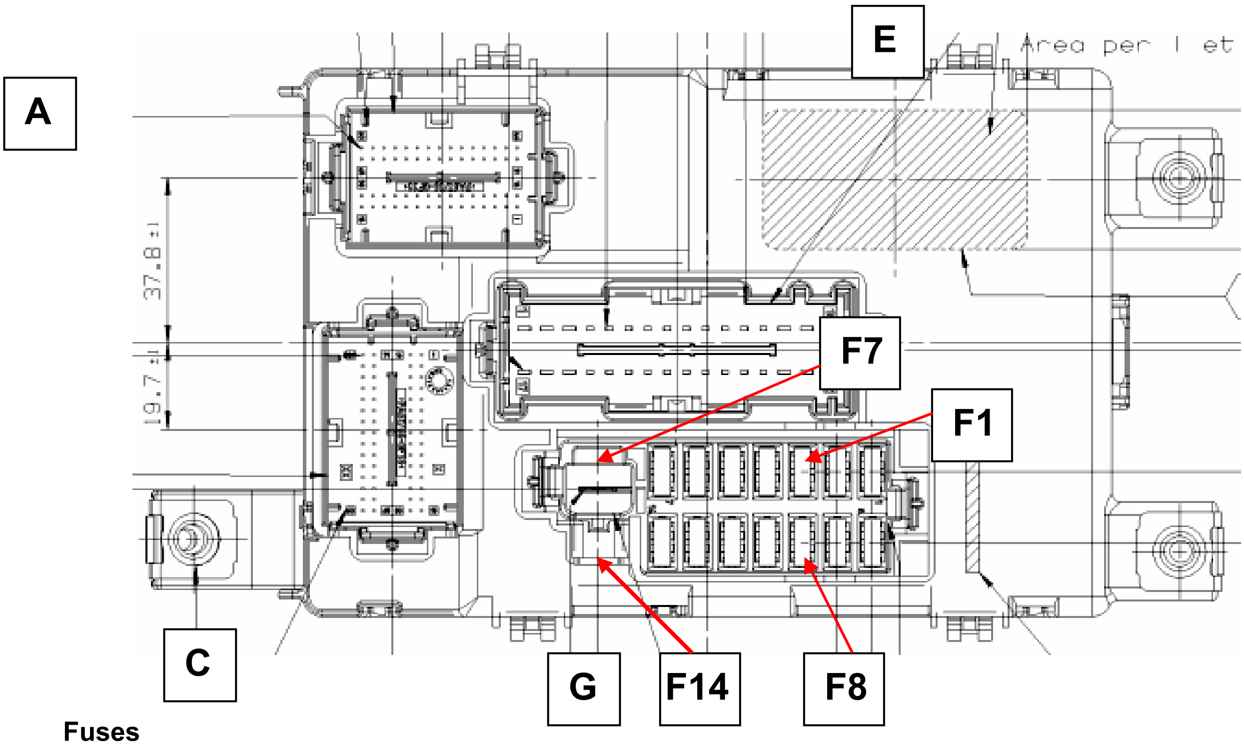


1	External immo GND	IMMO esterna GND
2	Immobilizer antenna (Signal)	Segnale antenna immobilizer
3	Rear defroster switch signal	Segnale interruttore lunotto termico
4	Serial line F for ABS/Doors Lin	Linea seriale F per ABS / Doors LIN
5	Roof LIN _ A-bus for Rain sensor	Lin A- bus per sensore pioggia
6	Turn right light negative command (DEV)	Comando negativo di direzione destro (DEV).
7	Hazard switch signal	Segnale interruttore luci di emergenza
8	Front driver window UP switch signal	Segnale interruttore “SU” finestrino guidatore
9	VSO Output generation	Generazione segnale VSO
10	Hazard led command	Comando LED luci d’emergenza
11	Doors status led command	Comando LED stato porte
12	Rear defroster led command	Comando LED lunotto termico
13	Front driver window DOWN switch signal	Segnale interruttore “GIU” finestrino guidatore
14	Front passenger window UP switch signal	Segnale interruttore “SU” finestrino passeggero
15	Front passenger window DOWN switch signal	Segnale interruttore “GIU” finestrino passeggero
16	LS CAN-A	LS CAN-A
17	LS CAN-A	LS CAN-A

18	LS CAN-A	LS CAN-A
19	LS CAN-A	LS CAN-A
20	LS CAN-B	LS CAN-B
21	LS CAN-B	LS CAN-B
22	LS CAN-B	LS CAN-B
23	LS CAN-B	LS CAN-B
24	High Speed CAN-H	CAN-H alta velocità
25	High Speed CAN-L	CAN-L alta velocità
26	High Speed CAN-H	CAN-H alta velocità
27	High Speed CAN-L	CAN-L alta velocità
28	City mode	Modalità City
29	Spare input	Ingresso di riserva
30	Front fog switch signal	Segnale interruttore fendinebbia anteriore
31	A/C request signal	Segnale richiesta A/C
32	Not connected	Non connesso
33	Reference GND signal to Cruise Lever	Segnale riferimento massa a leva cruise
34	Reference GND signal to DEV	Segnale riferimento massa a DEV
35	Steering wheel command ref (GND)	Segnale riferimento massa volante
36	High Beam/Flash to pass negative command (DEV)	Comando negativo abbaglianti/lavaggio (DEV)
37	ELC commands reference GND	Riferimento a massa comando ELC
38	Low beam negative command (DEV)	Comando negativo anabbaglianti DEV
39	Lock/ unlock switch signal	Segnale interruttore apertura/chiusura
40	Trunk internal switch signal	Segnale interruttore interno baule
41	Rear washer negative command (DEV)	Comando negativo lavavetri posteriore (DEV)
42	ELC commands reference GND	Riferimento massa comandi ELC
43	Steering wheel command 1 (horn command)	Comando volante 1 comando clacson
44	Rear/Front fog switch signal	Segnale interruttore fendinebbia posteriori/anteriori.
45	Rear/front fog switch signal	Segnale interruttore luci nebbia anteriori / posteriori
46	Not connected	Non connesso
47	Not connected	Non connesso
48	Not connected	Non connesso
49	Center Stack Switch reference GND	Riferimento massa CSS
50	Steering wheel command 2 (left side infotainment commands: vol-; vol+; mute; voice)	Comandi 2 volante comandi radio VOL- ; VOL+ ; Mute ; Voice
51	Parking light negative command (DEV)	Comando negativo luci di posizione (DEV)
52	Steering wheel command 3 (right side infotainment commands: scan-; scan+; source; tel)	Comandi 3 volante comandi radio SCAN - ; SCAN + ; Source ; TEL

53	Not connected	Non connesso
54	Front wiper first speed negative command (DEV)	Comando negativo prima velocità tergicristallo anteriore (DEV)
55	Front washer negative command (DEV)	Comando negativo lavavetri anteriore (DEV)
56	Front wiper second speed negative command (DEV)	Comando negativo seconda velocità tergicristallo anteriore (DEV)
57	Front wiper interval adjust negative command (DEV)	Comando intervallo regolazione tergicristallo anteriore (DEV)
58	Not connected	Non connesso
59	Rear wiper negative command (DEV)	Comando negativo tergicristallo posteriore (DEV)
60	Night lighting 58d	Illuminazione notturna 58d

Outer side

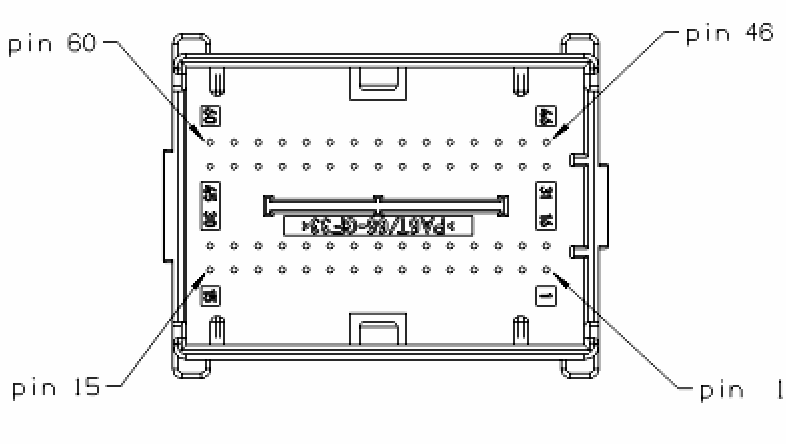


Fuses

Index	ID	Type	Function	Rating	312 L1	312 L2
1	F12	A0 (mini)	Right headlight power	7.5 A	X	X
2	F13	A0 (mini)	Left headlight power and CAF	7.5 A	X	X
3	F31	A0 (mini)	+ INT/A for SDM (NAB) (air bag)	5 A	X	X
4	F32	A0 (mini)	Front ceiling, rear, boot and puddle light.	7.5 A	X	X
5	F36	A0 (mini)	Diagnosis socket NRR/Cell/ECC (NCL)/EOBD (DLC (Conn. EOBD)))	10A	X	X
6	F37	A0 (mini)	Stop lights switch, IPC (NQS)	5 A	X	X

7	F38	A0 (mini)	Central door locking	20 A	P2	X
8	F43	A0 (mini)	Rear window washer pump	15 A	X	X
9	F47	A0 (mini)	Driver windown winder	20 A	P2	X
10	F48	A0 (mini)	Passenger window winder	20 A	P2	X
11	F49	A0 (mini)	Parking sensor, Backlighting switches, spECC (NCL)hi electric	5 A	X	X
12	F50	A0 (mini)	Airbag (SDM (NAB))	7,5 A	X	X
13	F53	A0 (mini)	IPC (NQS)	5 A	X	X
14	F51	A0 (mini)	+INT per NRR/NCV/NCL/Stop lights switch (NC)/ clutch switch	7,5 A	X	X

Connector A

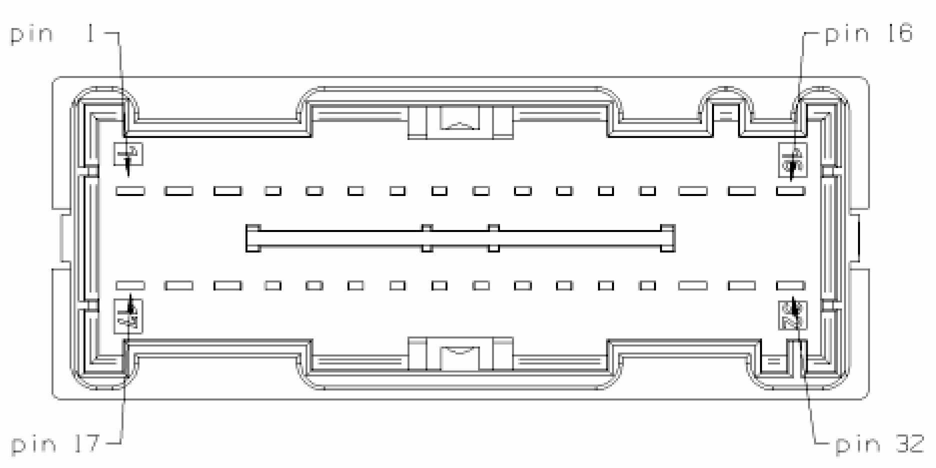


Pin	Pin OUT function	Funzione da disegno
1	Horn relay command	Comando relè avvisatore acustico
2	KL 15 relay command (T6) (the Low side driver must be drived directly by Key INT signal)	Comando relè KL15 T6 (low lato guidatore deve essere comandato direttamente dal segnale chiave
3	WLM comfort closing	WLM alzacristalli
4	Front fog relay command/Bending right with fog lamp	Comando relè fendinebbia anteriori / piegato a DX con lampada nebbia
5	Front driver door ajar signal to MTA (NCR) control unit	Segnale porta guidatore aperta all'unità di controllo MTA (NCR)
6	Rear window defroster relay command	Comando relè lunotto termico
7	Front puddle lights	Luci pozzanghera anteriori
8	Front Right flasher	Lampeggiante anteriore DX
9	Side Right flasher	Lampeggiante laterale DX
10	Front Left flasher	Lampeggiante anteriore SX
11	Side Left flasher	Lampeggiante laterale SX
12	Night lighting 58d	Illuminazione notturna 58d
13	Rear right fog ligth command/reverse gear ligth command	Comando luce retronebbia destra/comando luce retromarcia
14	Comfort enable supply	Alimentazione comfort enable

15	Front right Parking Light (LEFT/RIGHT)	Luce di posizione anteriore DX (SXe DX)
16	KL 15a relay command (T5)/Bendig right with specific lamp	Comando relè KL15a (T5) piegato a destra con lampada specifica
17	Doors status led command	Comando Led stato porte
18	Hazard switch signal	Segnale luci d'emergenza
19	VSO Output generation	Generazione uscite VSO
20	Hazard led command	Comando luci d'emergenza
21	Rear defroster led command	Comando LED lunotto termico
22	High beam relay command	Comando relè fari abbaglianti
23	Headlamp washer pump relay command	Comando relè pompa lavafari
24	Front Passenger door Limit switch	Interruttore limite porta passeggero
25	Tachometer sensor/TPMS Ground (GND)	Sensore tachimetrico / TPMS massa (GND)
26	Front brake pad wear sensors signal	Segnale usura guarnizioni freni anteriori
27	Stop light switch signal (normally open)	Segnale interruttori luci stop (NA)
28	Rear right fog light command/reverse gear ligth command	Comando luce retronebbia destra/comando luce retromarcia
29	Front left Parking Light (FRONT/REAR or LEFT/RIGHT)	Luce di posizione anteriore sinistra /fronte retro/ SX o DX
30	Front right Parking Light (FRONT/REAR)	Luce di posizione anteriore destra /fronte retro/ SX o DX
31	KL 15a relay command (T30)	Comando relè KL15 (T30)
32	Front driver window UP switch signal	Segnale interruttore "SU" finestrino guidatore
33	Brakes oil level signal	Segnale livello olio freni
34	Stop light switch signal (normally closed)	Segnale interruttore luci stop (NC)
35	TPMS signal 1	Segnale TPMS 1
36	TPMS signal 2	Segnale TPMS 2
37	External temperature sensor (signal)	Segnale sensore temperatura esterna
38	Front passenger window UP switch signal	Segnale interruttore "SU" finestrino passeggero
39	Front wiper parking contact signal	Segnale contatto stop tergicristallo anteriore
40	Front driver window DOWN switch signal	Segnale interruttore "GIU" finestrino guidatore
41	Rear defroster switch signal	Segnale interruttore lunotto termico
42	LS CAN-A	LS CAN-A
43	LS CAN-B	LS CAN-B
44	High Speed CAN-H	High Speed CAN-H
45	High Speed CAN-L	High Speed CAN-L
46	Low beam relay command/Bending left with fog or specific lamp	Comando relè faro anabbaglianti/piegato a SX con lampada da nebbia o specifica
47	Front passenger window DOWN switch signal	Segnale interruttore "GIU" finestrino passeggero
48	Bonnet ajar switch signal (normally open)	Segnale interruttore cofano aperto (NA)
49	A/C request signal	Segnale richiesta A/C
50	Tachometer sensor signal	Segnale sensore techimetrico
51	Front Driver door Limit switch	Interruttore limite porta guidatore

52	External temperature sensor (GND)	Sensore temperatura esterna (GND)
53	Front passenger door ajar switch signal	Segnale interruttore porta passeggero aperta
54	Front driver door ajar switch signal	Segnale interruttore porta guidatore aperta
55	Serial line F for ABS/Doors Lin	Lina seriale per ABS doors LIN
56	Roof LIN _ A-bus for Rain sensor	Linea A-BUS per sensore pioggia
57	LS CAN-A	LS CAN-A
58	LS CAN-B	LS CAN-B
59	High Speed CAN-H	High Speed CAN-H
60	High Speed CAN-L	High Speed CAN-L

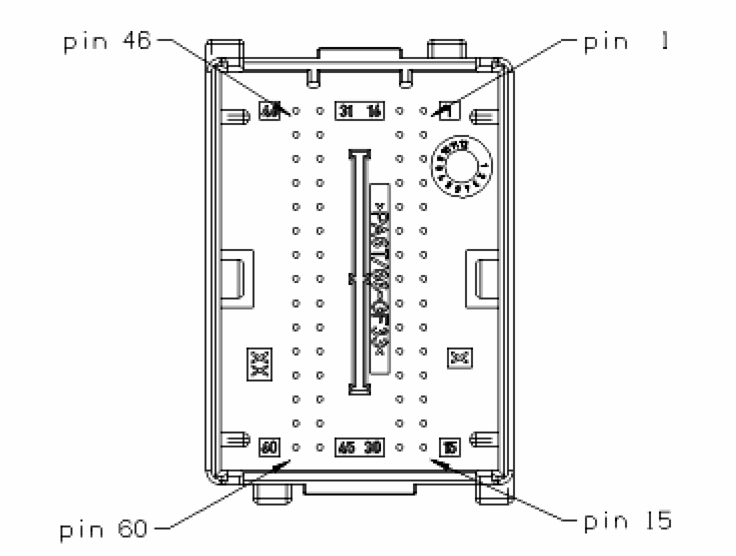
Connector E



1	Front left window lifter command down	Comando “GIU” alzacristalli anteriore sinistro
2	Bi-directional washer pump command (rear)	Comando posteriore pompa do lavaggio bidirezionale
3	Front Wiper motor (low speed command)	Motore tergicristallo anteriore (comando bassa velocità)
4	?	?
5	Predisposizione (KL15)	Predisposizione (KL15)
6	Supply for door mirror command lighting	Alimentazione per i comandi dello spECC (NCL)hio retrovisore
7	Brake pedal switch normally open (Kl 15)	Interruttore pedale freni normalmente aperto (Kl 15)
8	Predisposition (Kl15)	Predisposizione (Kl15)
9	Predisposition (Kl15)	Predisposizione (Kl15)
10	Supply for left Low beam bulb	Alimentazione per lampadina anabbagliante sinistra
11	Supply for left HeadLamp levelling	Alimentazione per plafoniera sinistra
12	Predisposition (Kl30)	Predisposizione (Kl30)
13	Supply for rear wiper	Alimentazione per tergicristalli posteriore
14	Front Wiper motor (high speed command)	Motore tergicristallo anteriore (comando alta velocità)

15	Bi-directional washer pump command (front)	Comando anteriore pompa di lavaggio bidirezionale
16	Central doors locking (lock/ unlock command)	Chiusura centrale porte CHIUSURA/APERTURA
17	Front right window lifter command down	Comando “GIU” alzacristalli anteriore destro
18	Front right window lifter command up	Comando “SU” alzacristalli anteriore destro
19	Front left window lifter command up	Comando “SU” alzacristalli anteriore sinistro
20	Puddle light (SBMT)	Luce pozzanghera (SBMT)
21	INT/A for SCM	INT/A per SCM
22	?	?
23	Predisposition (Kl15)	Predisposizione (Kl15)
24	Supply for HVAC (Kl15)	Alimentazione per HVAC (Kl15)
25	Supply for Stop sw (NO)/ Clutch sw (NO) (Kl15)	Alimentazione per interruttore STOP normalmente aperto
26	Supply for right HeadLamp levelling	Alimentazione plafoniera destra
27	Supply for right Low beam bulb	Alimentazione per lampadina anabbagliante destro
28	Supply for EOBD diagnosis (+30)	Alimentazione per diagnosi EOBD
29	Supply for ECC (NCL) (+30)	Alimentazione per ECC (NCL) (+30)
30	Trunk release command	Comando sblocco baule
31	Central doors locking (common)	Chiusura centrale porte (comune)
32	Central doors locking (dead-lock command)	Chiusura centrale porte (comando DEAD-LOCK

Connector C

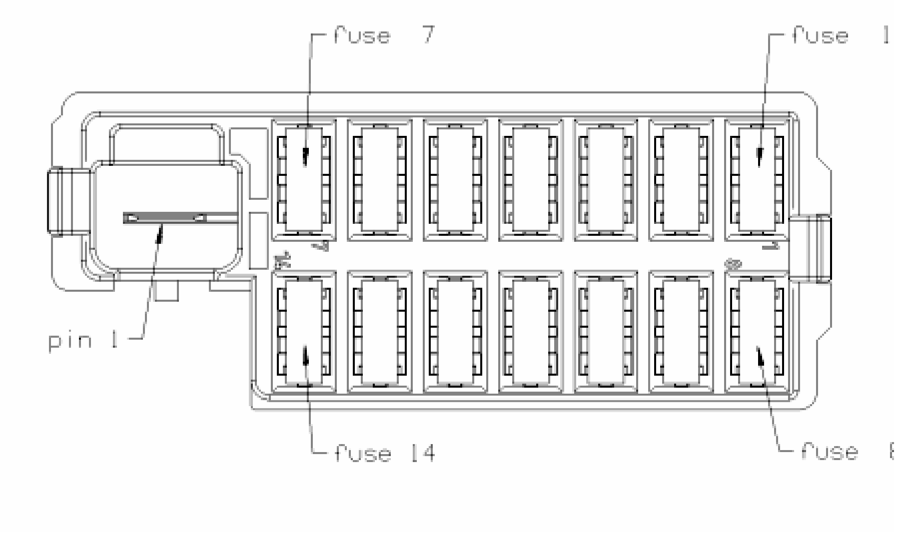


	Rear Left flasher	Lampeggiante posteriore sinistro
	Side Left flasher	Lampeggiante laterale sinistro
	Rear Right flasher	Lampeggiante posteriore destro
	Fuel level sensor (signal)	Segnale sensore di livello
	Rear right parking light (FRONT/REAR or LEFT/RIGHT)	Luce posizione posteriore destra (Fronte/retro o SX/DX)

	Rear left parking light (LEFT/RIGHT)	Luce posizione posteriore sinistra (SX/DX)
	Rear parking contact signal	Segnale contatto luci di posizione
	Right stop light	Luce stop destro
	Front ceiling light command	Comando luce plafoniera anteriore
	Rear left fog light command	Comando retronebbia sinistro
	Trunk light command	Comando luce baule
	Rear ceiling light command	Comando luce plafoniera posteriore
	Front ceiling light (SBMT)	Luce plafoniera (SBMT)
	Supply for Parking sensor (Kl 15l)	Alimentazione per sensore parcheggio
	License plate lights	Luce targa
	Center High Mounted Stop Light	Luce stop alto centrale
	Fuel level sensor (GND)	Sensore livello carburante
	Side Right flasher	Lampeggiante laterale destro
	Hand brake switch signal	Segnale interruttore freno a mano
	Rear left parking light (FRONT/REAR)	Luce posizione posteriore sinistra (fronte retro)
	Pin not present	Pin non presente
	Front ceiling light switch signal	Segnale interruttore luce plafoniera anteriore
		?
		?
	Rear left fog light signal	Segnale luce fendinebbia sinistra
	Trunk light (SBMT)	Luce baule (SBMT)
	Rear ceiling light (SBMT)	Luce plafoniera posteriore (SBMT)
		?
	INT/A for SCM	INT/A per SCM
	Night lighting 58d	Illuminazione notturna 58b
	RF antenna (GND) - coaxial cable	Antenna RF (GND) cavo coassiale
	Rear window defroster relay command	Comando relè lunotto termico
	Serial line F for ABS/Doors Lin	Linea seriale F per ABS /doors LIN
	LS CAN-A	LS CAN-A
	Pin not present	Pin non presente
	Pin not present	Pin non presente
	LS CAN-A	LS CAN-A
	Trunk external handle open switch signal	Segnale maniglia apertura esterna baule
	Trunk door switch signal	Segnale interruttore portellone posteriore
	Left sliding door switch signal	Segnale interruttore porta scorrevole laterale sinistra
	Fire prevention switch (normally open) signal	Segnale interruttore prevenzione incendio (normalmente aperto)
	Pin not present	Pin non presente
	Pin not present	Pin non presente
	Rear right fog light command/Reverse gear light command	Comando retronebbia destro/comando luce retromarcia

	Rear right fog light command/Reverse gear light command	Comando retronebbia destro/comando luce retromarcia
	RF antenna (signal) - coaxial cable	RF segnale antenna (cavo coassiale)
	WLM comfort closing	WLM Confort closing
	Roof LIN _ A-bus for Rain sensor	Lin A-BUS per sensore pioggia
	LS CAN-B	LS CAN-B
	Pin not present	Pin non presente
	Pin not present	Pin non presente
	LS CAN-B	LS CAN-B
	After market antitheft system signal	Segnale antifurto After market
	Spare imput	Ingresso di riserva
	Pin not present	Pin non presente
	Right sliding-door switch signal	Segnale interruttore porta scorrevole destra
	Pin not present	Pin non presente
	Pin not present	Pin non presente
	Pin not present	Pin non presente
	Left stop light	Luce stop sinistra

Connector G



1	+30 BCM (NBC) (NBC) from SCM	+30 BCM (NBC) (NBC) per SCM

Functions controlled by the BCM (NBC) (NBC) (Body Computer Module)

New
***"Fuel cut off"* control function**

This vehicle is not fitted with an inertia switch; the "fuel cut off" function control logic is as follows:
1) the Air Bag control unit detects the impact and transmits the FPS (Fire Prevention System) activation signal via CAN network.
2) after receiving the FPS activation signal the Body Computer Module:
- activates the hazard lights
- switches on the ceiling light
- unlocks the doors
- transmits impact via CAN network (B and C)
3) the instrument panel indicates Fuel Cut Off
4) the engine control module interrupts fuel supply.

Reset
To reset the fuel cut off function, proceed as follows **using the combiswitch stalk:**

- KEY OFF (starting condition)
- KEY ON
- Right indicator on
- Right indicator off
- Left indicator on
- Left indicator off
- Right indicator on
- Right indicator off
- Left indicator on
- Left indicator off
- KEY OFF

Key recognition
When the ignition key is turned to run, the BCM (NBC) dialogues with the ECM (NCM) to recognize the key CODE. The dialogue is over the C-CAN network. There is not "W" recovery line.
In case of fault, the BCM activates the MIL warning light on the Instrument Panel Cluster via B-CAN network.

Fuel level
Thel BCM (NBC) receives the signal from the sensor in the fuel pump, and the number of engine revs, then processes the fuel level information and sends messages on: fuel level, reserve warning light and fault status via B-CAN to the IPC.
It also transmits fuel level information for the ECM via C-CAN network.

"Comfort" function
When the key is turned to stop the BCM activates the comfort function for approximately 3 minutes, which maintains certain functions, such as window winders, for that time.
The comfort function is disabled when the doors are opened, or if the key is turned to stop with the doors open.

Alternator signal control
The alternator is connected to the ECM, to which it transmits its status message via C-CAN network, the BCM (NBC) processes this information and renders alternator charge status over both networks, and any fault messages to the electronic control units concerned.

Battery voltage acquisition

The BCM (NBC) is directly connected to the battery and monitors its charge status, transmitting this information over the B-CAN network

Minimum engine oil pressure
The minimum oil pressure sensor is directly connected to the ECM, which detects its status and transmits this information over the C-CAN network. The BCM (NBC), through the GATEWAY function, renders it over the B-CAN network for the IPC to command the minimum oil pressure warning light.

Fuel consumption
The ECM (NCM) transmits fuel consumption information over the C-CAN network. Through the GATEWAY function the BCM transmits this message over the B-CAN network for the TRIP COMPUTER function

EOBD/MIL warning light control
The ECM (NCM) transmits MIL/EOBD light status over the C-CAN network. Through the GATEWAY function the BCM transmits this message over the B-CAN network.
The IPC (NQS) reads status and comands the warning light accordingly.

Glowplugs warning light control (Diesel only).
The ECM (NCM) controls the glowplug control unit and transmits active state or error state over the C-CAN network.
Through the GATEWAY function the BCM (NBC) transmits the messages rendered by the ECM over the B-CAN network
The IPC (NQS) acquires the messages and commands the glowplug warning light accordingly.

Rear fog light control
The BCM (NBC) acquires the on command from the corresponding switch and, if the headlights are on, activates the rear fog lights directly.
The fog lights on message is transmitted over the B-CAN network. The IPC acquires the message and activates the lights on or fault message or light.

Front and rear fog lights control
The BCM (NBC) acquires the on command from the switch (there is only one switch) and, if the headlights are on, and according to driver selection, activates the front fog lights only or both front and rear fog lights.
Rear fog lights on state is transmitted over the B-CAN network. The IPC acquires the message and activates the corresponding warning lights and messages on the panel.
When starting the fog lights are disabled.

Key status

The BCM (NBC) acquires key status (Stop, INT/ INT/A) from the ignition switch and transmits position status over the C-CAN and B-CAN networks.

Direction indicator control

The direction indicators are directly commanded, without external relays, by the BCM, through the following commands:
- LH or RH direction indicator command from stalk;
- Door open function command.
- Hazard warning switch
- Immobilizer system command (After Market)
- FPS function activation command.
- Stop lights control function command (see “hazard light activation on braking”)

When commanded, the BCM transmits the corresponding message via B-CAN network to allow the IPC to command the corresponding indications on the panel.
The same message is transmitted over the C-CAN network

Direction change function
In case of direction change, shifting the indicator stalk, the BCM commands the direction indicators from the selected side, LH or RH.

Lane change function
In case of lane change, for example, overtaking on motorway, flicking the stalk (less and 500 ms), the BCM commands three flashes of the selected indicator.

Lane change function stop
The lane change function can be stopped by flicking the stalk in the opposite direction.
This way it is possible to activate lane change (three flashes) or direction change.

Hazard lights
Hazard lights with key to stop or run
The hazard lights are commanded directly by the BCM, when the button on the centre dashboard is pressed.
Turning the key to stop and vice-versa has no effect on the hazard lights.

Hazard lights active with direction change command.
If direction change is commanded with the hazard lights on, or if the hazard lights are turned on during a direction change, the hazard lights have priority.

New

ESS (Emergency Stop Signaling)
In the case of braking with deceleration rates greater than 7(+/-0.5)m/s^2, vehicle speed over 50 kph, hazard lights off and speed signal not in error, the BCM (NBC) estimates deceleration level and activates the hazard lights, until it estimates that deceleration has dropped to below 2.5 (+/-0,5)m/s^2.
Note: the lights are commanded with a higher flashing rate than in normal hazard warning conditions

Hazard lights on in case of FPS function activation (Fire Prevention System)
If the fire prevention strategy is activated (EX inertia switch), when the key is turned to run the hazard warning lights come on immediately. In the first phase of system reset, shifting the indicator stalk will activate the indicators on the selected side to confirm receipt of the command.

Hazard lights on for vehicle access function
The hazard lights are activated by the BCM through the door lock function in the following way:
- Doors locked, hazard lights 1 second
- Doors unlocked, hazard lights three seconds.
- The lights flash for two seconds when the doors are unlocked.
- The lights flash for 1 second on opening the boot.

Hazard lights for immobilizer function
On receiving the command from the immobilizer system , the BCM activates the hazard lights, deactivating them when the corresponding command is received.

Recovery and diagnosis
The front and rear lights are controlled by the BCM, which transmits the corresponding commands over the B-CAN network. If one of the bulbs is blown, the BCM doubles the flashing frequency.

Brake switch position function

Through a direct connection the BCM (NBC) receives the status of the Normally Open and Normally Closed switches on the brake position sensor and transmits status of the Normally Closed switch over the C-CAN network.

The ECM (NCM) receives the status of the Normally Open switch via a direct connection and the status of the Normally Closed switch via C-CAN network.
The BSM (NFR) receives the status of the Normally Open switch through a direct connection and the status of the Normally Closed switch via C-Can network.
This function permits acquisition of pedal position and plausibility control by the electronic control units involved.

Stop lights activation

The BCM (NBC) acquires the brake pedal “Pressed/Released” status from the Normally Open pedalò switch, and activates the RH and LH STOP lights directly, the third stop light is activated directly by the “Normally Open” switch.
In case of fault, the BCM (NBC) transmits the error message via B-CAN network, which is received by the IPC (NQS) which in turn activates the corresponding warning light/message.

Backlights without dimmer

The backlights, consisting of the various LED’s that illuminate the various buttons, are activated when:

- There is a transition from key to stop to key to run (+15). The backlights activated in this way are:
  - ✓LH and RH window controls
  - ✓ECO/SPORT button
  - ✓Centre dashboard controls
  - ✓Auxiliary dashboard controls
  - ✓Steering wheel controls
  - ✓ECC controls and electric window controls
- By the BCM (NBC), with key to run through the “backlights without dimmer” command. The lights involved with this command are:
  - ✓Cigar lighter illumination
  - ✓Power point light
  - ✓Ashtray light,
  - ✓Heater controls

The BCM (NBC) receives status of instrument panel lights via B-CAN network and transmits, again over the B-CAN, the status of backlights without dimmer activation.

Interior lights

The interior lights present on the vehicle are:

- Ceiling light
- Visor light
- Trunk light

The BCM (NBC) enables activation of these lights via the corresponding switches with key ON, through the “voluntary lights on” signal.
This signal may also be present with key OFF in the following conditions:

- Door unlocked with remote control
- Door opened manual
- Trunk opened.
- Pressing the visor switch.
- Pressing the courtesy light switch

In this case the activation time of the “voluntary lights on” signal is 15 minutes.

Ceiling light
The ceiling light is operated from the switch on the fitting. The possible settings are:

- Ceiling light on
- Ceiling light on/off by BCM:

The BCM (NBC) can command the courtesy light directly in the following conditions:

- On opening a door (activation time approx 3 minutes)

- On closing a door (activation time circa 10 seconds)
- On removing the key with comfort function active (activation time approx 10 seconds)
- In case of FPS function activation (activation time approx 15 minutes) in this case the timer can only be reset after resetting the FPS function).

Note: the position of the key, e.g. passage from OFF to ON switches the ceiling light on or off.
On versions without centralized door locking, the BCM may activate the front ceiling light when:

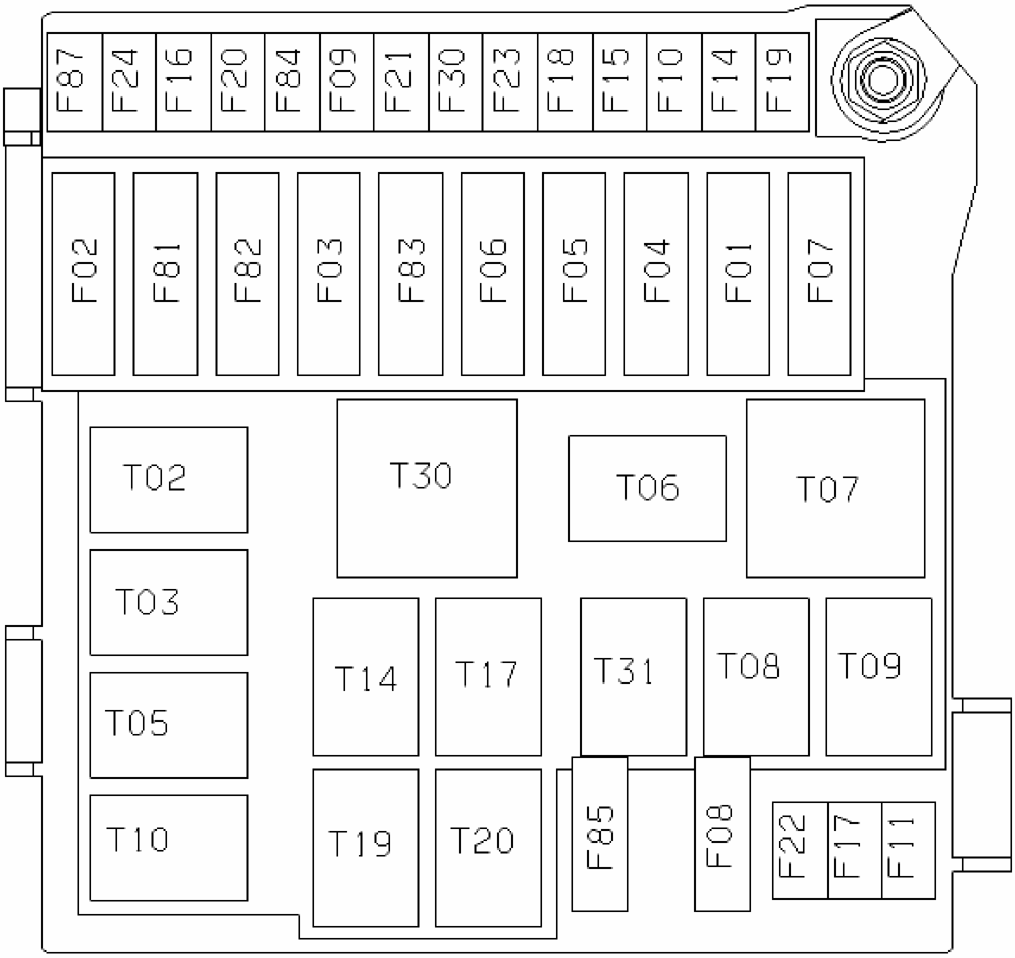
- A door is opened
- FPS intervention

Brake wear control

The BCM acquires the brake wear signal via a direct connection to one of the front left brake pads.
As the brake pad wears beyond a certain level, a metal inserted embedded in the material is uncovered and comes into contact with the disk, grounding the cable it is connected to.
The ground signal is transmitted to the BCM. The BCM sends a message via B-CAN to the IPC that activates the brake wear warning light.

Engine compartment control unit

The engine compartment control unit is embedded in the engine bay harness and cannot be singularly replaced.



Fuses and relays

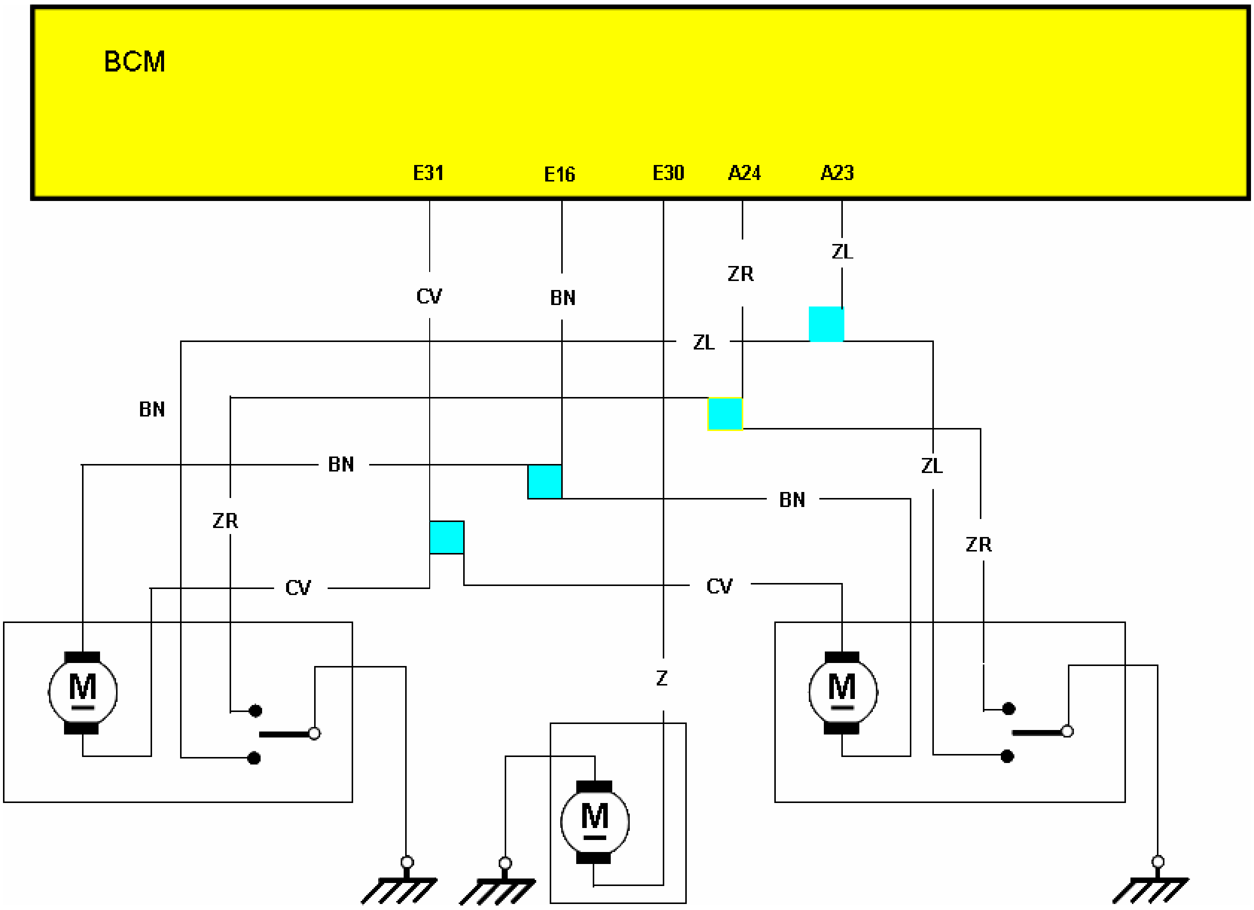
ID	I(A)	bus-bar	Connection	Protected users	Cable color
			Fusei		
F01	60	1	+ 30	BCM (NBC) (NBC)	**RN**
F02	20	1	+ 30	Subwoofer, hi-fi amplifier	**RB**
F03	20	1	+ 30	Ignition switch	**RV**
F04	40	1	+ 30	BSM (NFR)1 (pump)	**RG**
F05	70	1	+ 30	EPS (NGE)	**R**
F06	20	1	+ 30	single speed engine cooling fan	**RL**
F06	30	1	+ 30	Engine cooling fan low speed	**RL**
F07	40	1	+ 30/ T07	Engine cooling fan high speed	**M**
F08	30	3A	+30/ T08	Climate control fan	**HB**
F09	-	1	+ 30	free	
F10	15	1	+ 30	Horns	**RG**

F11	10	4	+30/ T09	Engine control system (secondary loads)	LV
F14	15	1	+ 30	Headlights	RV
F15	20	1	+ 30	Electric sunroof servo	RZ
F16	7,5	5	AC1	+15 ECM (NCM), MTA (NCR), robotic trans control, relay coil T20	CN
F17	10	4	+30/ T09	ECM (NCM)	LN
F18	7,5	1	+ 30	ECM (NCM), (1.2 8V)	RN
F18	7,5	1	+ 30	ECM (NCM), relay coil T09 (1.3 SDE)	RN
F19	7,5	1	+ 30	Conditioner compressor	RM
F20	30	1	+ 30	Heated rear window, demister spECC (NCL)hi	L
F21	15	1	+ 30	fuel pump	ZG
F22	15	4	+30/ T09	ignition coil, injectors (1.2 8V)	LR
F22	20	4	+30/ T09	ECM (NCM) (1.3 SDE)	LR
F23	20	1	+ 30	BSM (NFR)2 (ECU, valves)	RB
F24	7,5	5	AC1	+15 BSM (NFR), EPS (NGE), YRS	CB
F30	15	1	+ 30	Fog lights	ZB
F81	50	1	+ 30	Glowplug control unit (1.3 SDE)	RH
F82	-	1	+ 30	free	
F83	30	1	+ 30/ T30	Selespeed servo pump	
F84	10	1	+ 30	MTA (NCR) (control unit, solenoid valves)	RH
F85	15	3B	+30/ T31	Front power point (with or without cigar lighter)	HR
F87	7,5	5	AC1	+15 for reversing lights, debimeter, water in fuel sensor, relay coils T02, T05, T14 and T19	CL

			Relays		
T02	20	-	Free	Headlights	V
T03	20	-	Free	Horns	Z
T05	20	-	Free o	Conditioner compressor	MN
T06	30	1	+ 30 (86)	Single speed engine cooling fan Engine cooling fan low speed	B
T07	50	1 - 2B	bus bar 1 (86), bus bar 2B (30)	Engine cooling fan high speed	M
T08	30	1	+ 30 (30), bus-bar 3A (87)	Climate control fan	
T09	30	1	+ 30 (30)	Engine control system (main relay)	
T10	20	-	Free	Fuel pump	VC
T14	20	-	Free	Fog lights	VB
T17	30	-	Free	Free	
T19	30	-	Free	Demisting	MB
T20	30	-	Free	Start disable with robotic transmission	M

T30	50	2A	bus-bar 2A (30)	Selespeed servo pump	H
T31	30	1	+ 30 (30), bus-bar 3B (87)	Front power point (with or without cigar lighter)	

Door lock function



For control of the door locking function the BCM (NBC) acquires the signals from the switches present on the locks. These signals identify the following states:

- Door closed
- Door open
- Door locked
- Door open command by key or internal handle
- Door unlocked
- Door lock command by key or internal handle
- Trunk open
- Trunk closed
- Trunk open command from switch on handle

Through internal function it receives:

- Door and boot lock/unlock command via remote control
- FPS activation
- Vehicle speed
- Transponder CODE recognition
- Door lock/unlock command and Trunk unlock

It also receives door lock active status with vehicle speed greater than 20 kph from IPC (NQS)

Having received the various commands the BCM commands the door and trunk lock servo motors, activates the hazard lights, and transmits door status over the B-CAN and C-CAN networks.
As can be seen in the diagram, the commands are direct.

Door lock function details

Door status recognition
The BCM (NBC) recognizes door and trunk open/closed status through the various switches, and transmits this information over the CAN networks

My Car personalization
Via the B-CAN network the BCM (NBC)receives door lock function activation status with vehicle speed greater than 20 kph. With function active over the speed threshold, it commands doors/trunk locked.
The function only activates if the doors are closed and if the speed threshold is exceeded for a time of less than 200 ms.
The doors are not unlocked if the vehicle drops below the speed threshold.
If after being locked the doors and unlocked, the function re-activates on exceeding the speed threshold.

Lock/unlock status recognition by switch in lock

The door lock contains a switch that recognizes lock status. This switch also serves to command lock/unlock by the key in the barrel mechanism.
On recognizing the change in switch state, the BCM commands unlocking of all locks

Lock/unlock by remote control

On receiving the signals from the remote control the locks are activated as defined in the following table.

Type of command	Type of pressure on button	Action
Unlock button	One click	Unlock command Hazard lights flash
	Double click	Unlock command
Lock button	One click	Unlock command Hazards lights flash
Trunk button	One click	Trunk release Hazard lights flash

Command from immobilizer module (After Market)

On receiving signals from the immobilizer, the locks activate as defined below.

Type of command	Type of pressure on button	Action
Unlock command from immobilizer remote	One click	Unlock doors Hazard lights flash
Lock command from immobilizer remote	One click	Lock doors Hazard lights flash
Trunk release command from immobilizer remote.	One click	Trunk release Hazard lights flash

Lock/unlock action indications (only with remote control).

The hazard lights flash to indicate doors/trunk lock/unlock (see paragraph).

Door lock with one door or trunk open
If one or more doors are open the lock command is refused for all doors.
If the trunk is open the doors are locked normally.

Trunk lock control
The trunk is controlled as a third door, so when the doors are locked the trunk is also locked, and when the doors are open the trunk opens as well.
When the trunk is released, it can be opened by means of the button on the external handle, vice-versa when locked it cannot be opened.
If the trunk is mechanically opened, it's logic state does not change, and when closed again it automatically aligns with the status of the other doors.
The trunk cannot be opened with vehicle speed over 20 kph, to prevent accidental trunk opening.

Doors unlock with FPS
On recognizing FPS active state, the BCM immediately unlocks all the doors,

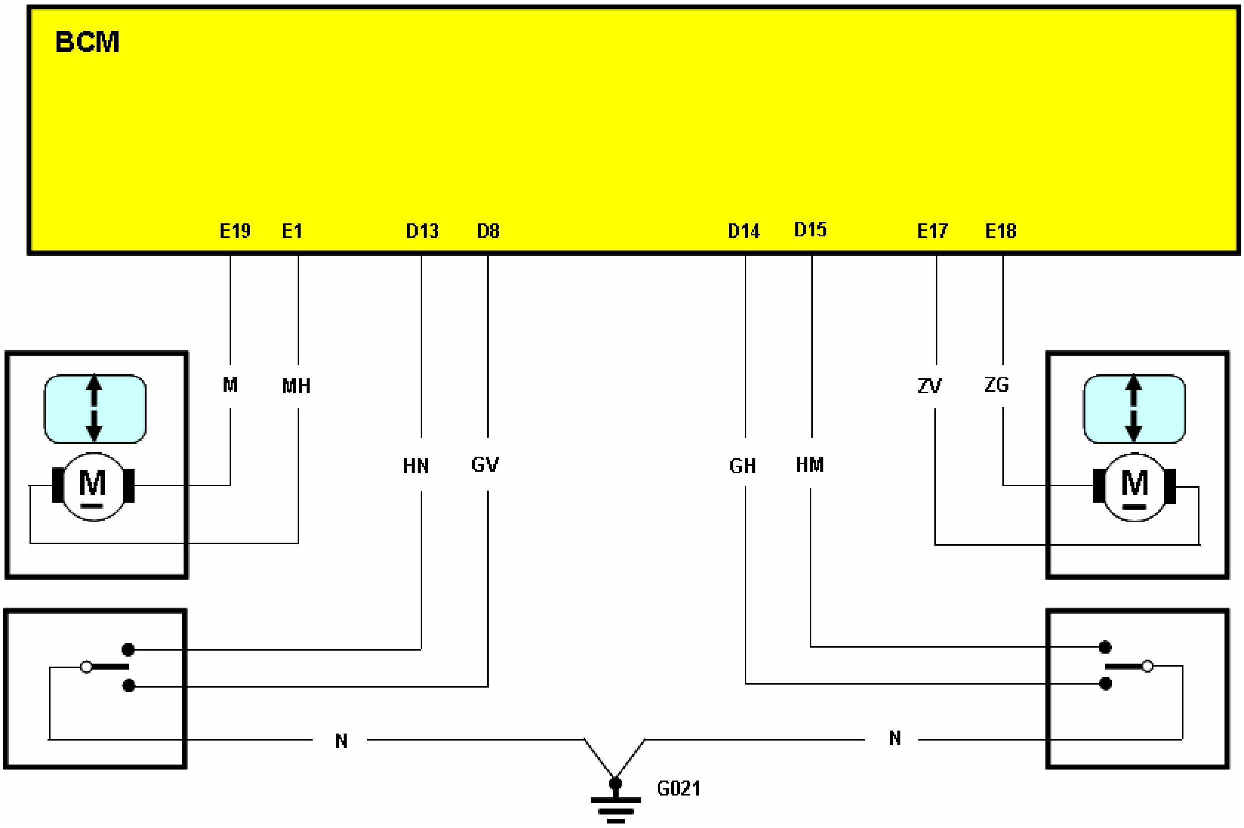
Disable after several lock/unlock commands

After 10 commands repeated in 25 seconds, the BCM disables the lock/unlock commands as follows:
- If the last contact was door unlock, the BCM disables a further unlock command for 30 seconds.
- If the last command was a door lock, the BCM disables a further lock command for 30 seconds, during this disable time the BCM only accepts a door unlock command.

In case of FPS intervention the doors unlock in any case.

Connection to +30
On connection of the +30 the BCM will not accept commands for at least 2 seconds, moreover the BCM (NBC) does not recognize door status until a centralized key command is given by the remote control, immobillizer remote or FOPS function.

Window winder command with automatic function



To command the window winder servos the BCM receives the signals from the switches on the central dashboard panel, furthermore, to control the servos it checks the status of the comfort function in case of key-OFF, as can be seen in the diagram, the servos are commanded directly by the BCM.

Function modes

The BCM (NBC) can command the servos in two modes:

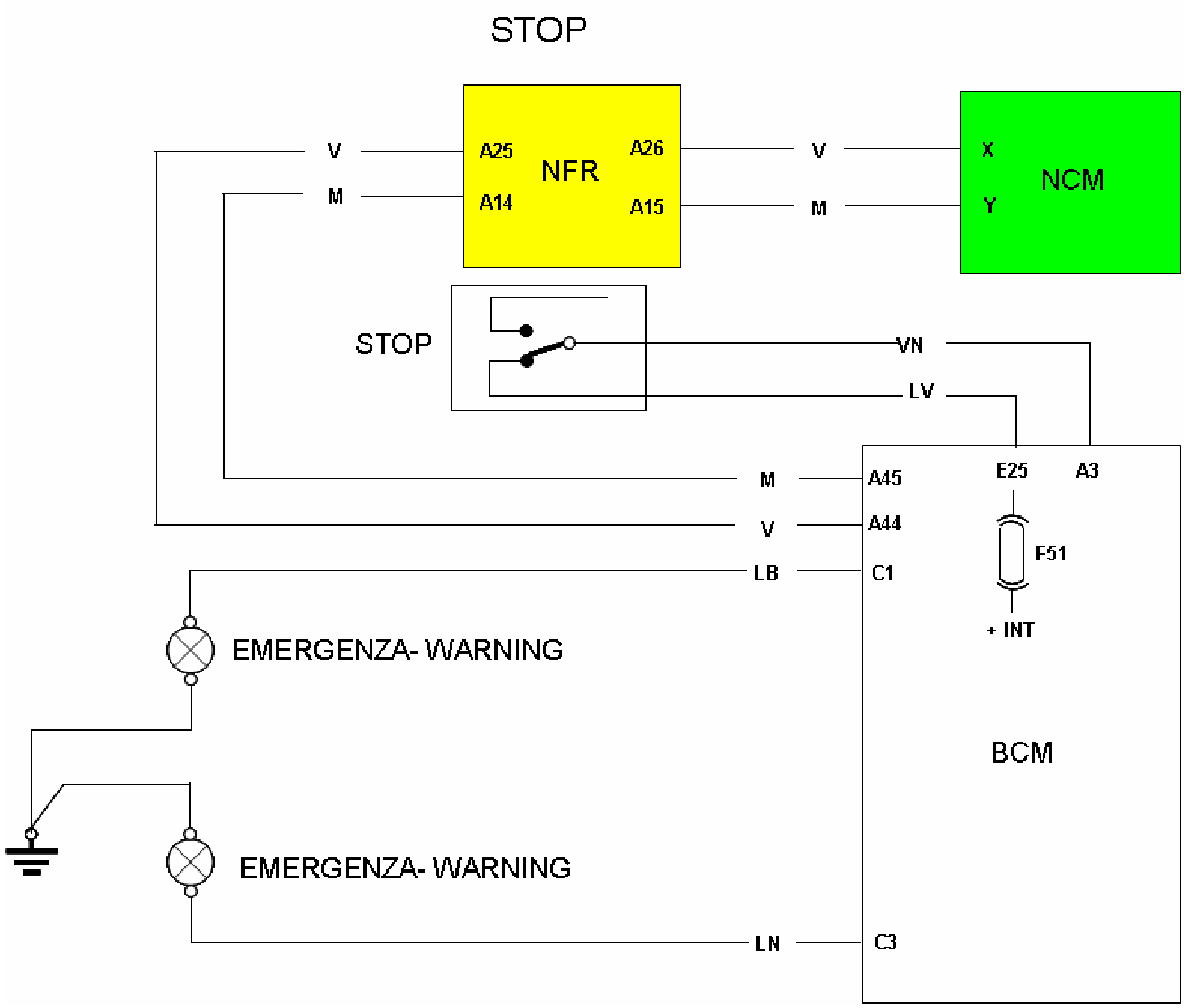
- Manual mode, activated by button pressure for 50 to 300 ms.
- Automatic mode, activated with button pressure longer than 300ms

The BCM interrupts the servos when the command is inverted e.g. from raise to lower, or when the upper or lower limit is reached.

There is no anti-pinching function.

Emergency Stop Signaling function

In the case of braking with deceleration rates greater than 7(+/-0.5)m/s^2, vehicle speed over 50 kph, hazard lights off and speed signal not in error, the BCM (NBC) estimates deceleration level and activates the hazard lights, until it estimates that deceleration has dropped to below 2.5 (+/-0,5)m/s^2.
Note: the lights are commanded with a higher flashing rate than in normal hazard warning conditions



Instrument panel

The instrument panel of the new Fiat 500 is divided into two macro families:
- COMFORT
- DOT-MATRIX (coordinated with Blue&Me Nav or richer versions).

Specifically, the two families (Comfort and Dot-matrix) differ in terms of the technology of the circular display situated at the centre of the Instrument Panel.

Comfort version
The image below shows the comfort version:

Sport version
The sports version of the Fiat 500 is fitted with the Sport instrument panel, which has different graphics for the speedometer and rev counter. Available also for COMFORT and DOT-MATRIX versions.
The figure below offers a graphic illustration:

Functional zones

The Instrument panel is essentially subdivided into four functions zones, and specifically:

1. Warning lights zone
2. Electronic speedometer zone
3. Electronic rev counter zone
4. Central zone reserved for alphanumerical display

ALPHANUMERICAL DISPLAY

Comfort display

The Comfort and Sport alphanumerical displays display the following functions:

FUNCTIONS	Always present	With key-ON	On event	On request
Clock	X	-	-	-
Date	X	-	-	-
Odometer	X	-	-	-
Headlight trim adjuster (lights on)	-	-	-	X
External temperature	X	-	-	-
“Ice” warning signal	-	-	X	-
Function activation message	-	-	-	X
Fault / warning messages	-	-	X	-
“CITY” function	-	-	-	X
“SPORT” function	-	-	-	X
Automatic transmission info (OPT – specific version)	X	-	-	-
Trip Computer	-	-	-	X
Service (Scheduled maintenance)	-	-	X	X
AUDIO info repeat	-	-	X	-
Blue&Me (status bar)	-	-	X	-
SMS (reception)	-	-	-	-
Pictogram browsing	-	-	-	-
Destination info	-	-	-	-
Route info	-	-	-	-
Position info	-	-	-	-
Setup menu functions	-	-	-	X
AGENDA / MEMORANDUM function	-	-	-	-
Follow me	-	-	-	X

Note: Enabling the “SPORT” function by means of the button on the dashboard sets sports operation for the following systems:

- Engine control
- Robotic gearbox
- Electric power steering

Comfort version alphanumerical graphic display (without dual logic gearbox)

Key:

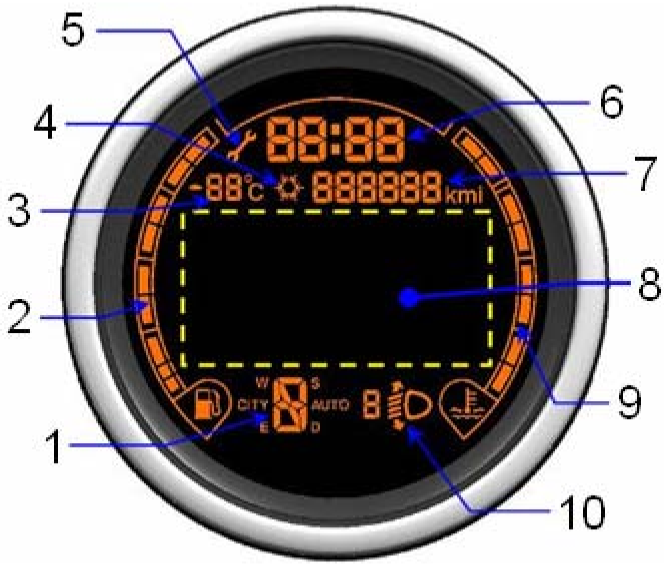
1. External temperature indication
2. 9-segment bar graph fuel gauge
3. Odometer
4. Spanner icon (SERVICE)
5. Clock
6. CITY/SPORT mode
7. Ice warning
8. 14 characters used for messages (pseudo dot-matrix)
9. 8-segment bar graph engine coolant temperature indicator
10. Headlight trim adjuster indication

Comfort version alphanumerical graphic display (with Dual logic gearbox)

Key:

1. External temperature indication
2. 9-segment bar graph fuel gauge
3. Odometer
4. Spanner icon (SERVICE)
5. Clock
6. Robotic gearbox indication, SPORT mode (S), CITY and AUTO
7. Ice warning
8. 14 characters used for messages (pseudo dot-matrix)
9. 8-segment bar graph engine coolant temperature indicator
10. Headlight trim adjuster indication

Sport version circular alphanumerical display

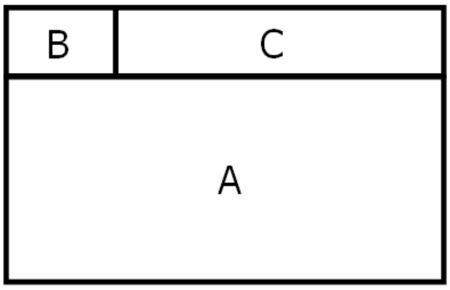


Key:

1. Robotic gearbox indication, SPORT mode (S), CITY AND AUTO
2. 9-segment bar graph fuel gauge
3. External temperature indication
4. Ice warning
5. Spanner icon (SERVICE)
6. Clock
7. Odometer
8. Central dot-matrix area
9. 8-segment bar graph engine coolant temperature indicator
10. Headlight trim adjuster indication

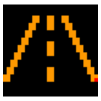
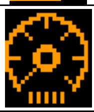
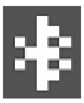
Sport version central dot-matrix area
At the centre of the Sport version display there is a 128x64 pixel dot-matrix.
The central area is split into theme zones as shown in the figure below:

- A – Message / information / settings display area etc …
- B – Displayed function identification symbol
- C – Displayed function title

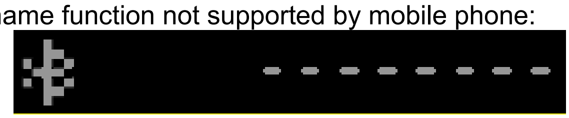


- **Information displayed in area A:**
- Audio repeat
- Trip
- Menu
- Dimming
- Feedback
- Blue&Me
- “Other messages”

Information displayed in areas "B" and "C"

	Symbol (area B)	Function title (area C)	Notes
1		**Audio**	Radio display repeater
2		**Audio**	CD display repeater
3		**Audio**	CD MP3 display repeater
4		**Audio**	CD Changer display repeater
5		**SMS**	SMS message received from navigator.
6		**Navigation**	Navigator message repeater
7		**Trip Computer**	Trip display
8		**Menu**	Main setup menu display
9		Note 1	Displays: ● main menu option if at settings level in main menu or sub-menu.
10		**Illumination**	Dimmer
11		**Info**	Feedback and "other messages" display
12		**Phone operator name** (Note 2)	Telephone message repeater from Blue&Me and Bluetooth status.

Nota 1: The title varies according to the submenu displayed. In practice, the bar displays the selected menu option, which before selecting was displayed in the lower part of the screen.
Note 2: The name of the phone operator is sent from the phone paired with the Blue&Me system. Not all mobile phones have this function.
Display with send operator name function not supported by mobile phone:



Standard video page at key-on

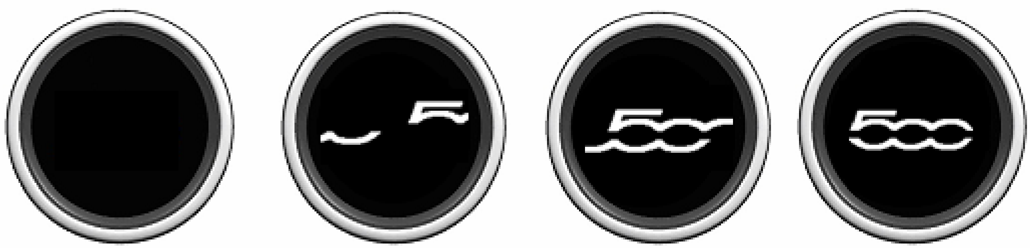
The information present on the standard display at key-on includes:

- Audio or Blue&Me logo or date (on Sport display and with Blue&Me). 2 seconds after key-on, the trip computer can be automatically displayed is it was active at the previous key-off.
- clock
- Total odometer
- Headlight trim adjuster info
- External temperature
- "Snow" symbol (ice warning)
- Spanner symbol (if Service required)
- "CITY" symbol (if enabled)
- "S" sport symbol (if enabled)
- Robotic gearbox info (where fitted)

This remains on the display until another function that requires the display is activated.

Only on dot-matrix instrument panels and with the "Blue&Me" or "Blue&Me NAV" OPT, at key-on, the display will only show the "Blue&Me" logo for 2 sec as in the following example.
Subsequently, the check phase continues normally with activation of the remaining info as described above and the logo display ends. For more information, refer to the states-event matrix.

The **"Sport"** version starts a graphic animation of the "500 logo" after approx. 4 seconds of opening or closing the doors with key-off, as illustrated in the sequence below:



WARNING LIGHTS

The figure below illustrates the “WARNING LIGHTS”.

Important: the rheostat adjustment for panel illumination does not affect the warning lights (intensity always at 100%). The dimming value is transmitted to the Instrument Panel over the CAN network.

Note: 33.Menu (+); 34. Menu (-); 35. Menu/ESC

The table below describes the various warning lights present on the instrument panel:

N°	DESCRIPTION	Comfort	Sport	COLOR
1	Setting (luminosity sensor)			
2	General fault ***(Note 3)***	X		amber
3	Fog lights	X	X	green
4	Rear fog light	X	X	amber
5	High beams	X	X	blue
6	Side lights	X	X	green
7	LH direction indicator	X	X	green
8	Fuel reserve	X	X	amber
9	Airbag fault	X	X	red
10	Passenger airbag disabled	X	X	amber
11	Seat belt reminder	X	X	red
12	Alternator fault	X	X	red
13	Power steering fault (Servotronic)	X		red
14	Not used			
15	Not used			
16	Not used			
17	Not used			
18	Not used			
19	robotic gearbox fault	X		red
20	Water in fuel filter	X		amber
21	DPF particulate filter	X		amber
22	Glowplugs active	X	X	amber
23	Minimum oil pressure	X	X	red
24	EOBD and engine control system fault	X	X	amber
25	Engine coolant max temperature	X	X	red
26	RH direction indicator	X	X	green
27	Handbrake / low brake fluid / EBD fault	X	X	red
28	Brake pads worn	X		amber
29	ABS fault	X	X	amber
30	ESP cut-in / fault	X	X	amber
31	Door open warning	X		red
32	Immobilizer fault	X	X	amber

Note 3: The general fault warning light (2) indicates the followings faults/events:

- FIS cut-in
- Engine oil pressure sensor fault
- External lights fault
- Parking sensor fault
- Engine oil pressure sensor fault
- Robotic gearbox safety warning
- Fuel cut-off enabled
- Fuel cut-of unavailable
- ABS, ASR and ESP fault

Luminosity sensor

The instrument panel is equipped with a luminosity sensor that serves to distinguish between day and night in order to adjust instrument panel illumination (see fitting n°1 on Instrument Panel).

Use of KEY signal (+15)

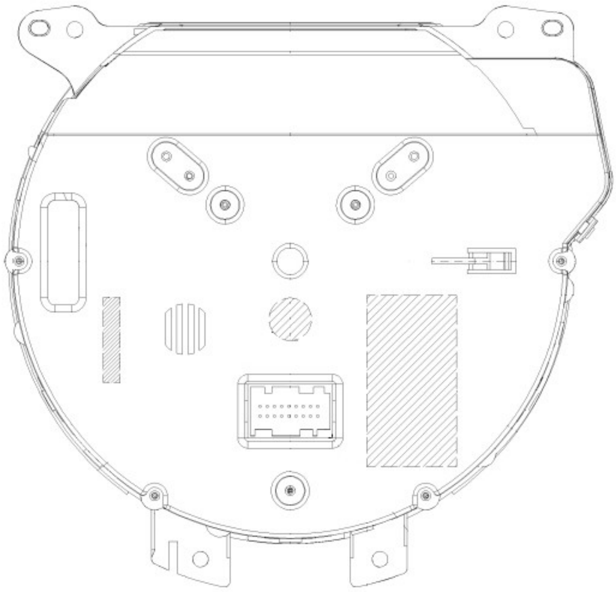
The instrument panel receives:

- Network key (+15 from BCM, CAN “KeySts” signal)
- Physical key

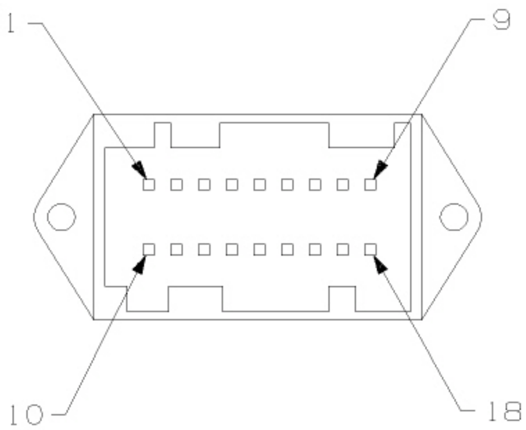
The instrument panel only uses the network key signal to switch off, whereas it also needs the physical key signal to start.
All the modules of the Instrument Panel system (Network, Wakeup, Diagnosis) use only the physical key.
The BCM recovery conditions, the instrument panel no longer considers the network key and manages its functions with only the physical key.

INSTRUMENT PANEL BACK VIEW

The figure below shows the back view of the Instrument Panel, with the connectors for connecting to the vehicle wiring harness.



View of connector



Pin Out

Pin	Pin	Description	Pin
1	Ground - GND	10	n.c.
2	+ 30 Batt (from NBC)	11	n.c.
3	+ 15 – Key on (from NBC)	12	n.c.
4	n.c.	13	n.c.
5	B-CAN (A)	14	n.c.
6	B-CAN (B)	15	n.c.
7	Headlight trim adjuster control signal	16	n.c.
8	+ Headlight from NBC (headlight icon activation on display)	17	n.c.
9	TRIP command from combi switch stalk	18	n.c.

Note: The signal from pin 7 is a percentage of the power on pin 8.

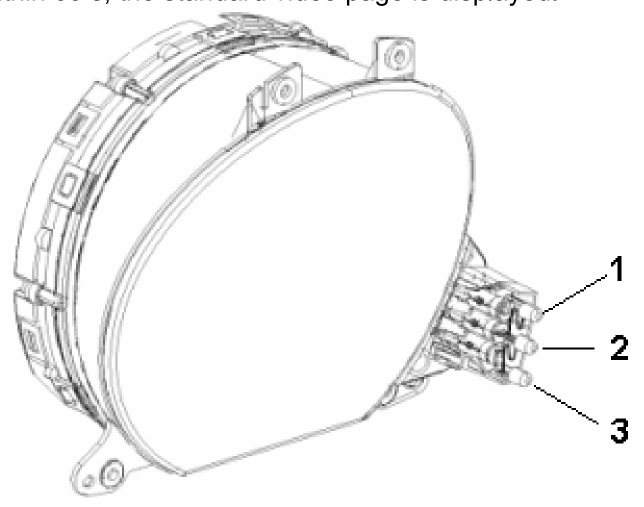
MENU FUNCTION

There are three buttons on the Instrument Panel, one to enter the menu or confirm menu selection, and two for browsing in the menu.

The setup menu can be activated by short pressure (< 1s) on button (3), in two different modes:

- Complete menu (with vehicle speed less than 4 kph)
- Compact menu (with vehicle speed greater than 4 kph)

Note: pressure longer than 1s on button (3) memorizes the modifications made with the short pulse. If no operation is carried out within 60 s, the standard video page is displayed.



Key: 1.Menu (+) ; 2. Menu (-); 3. Menu/ESC

Menu

The table below lists the items available on the menu:

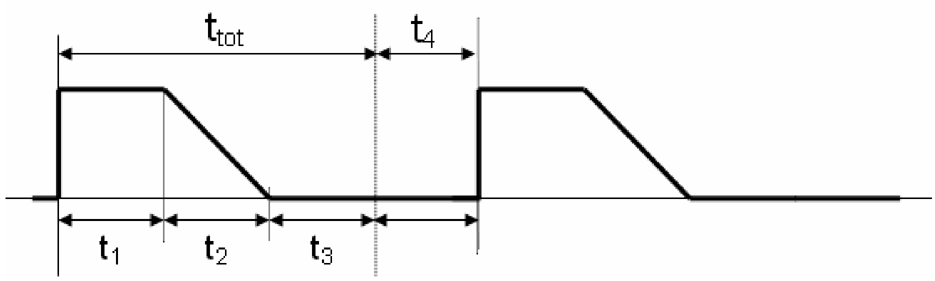
	Level 1	Level 2
1	**Illumination**	
2	**Beep speed**	On - Off
3	**Trip B activate**	On - Off
4	**Set time**	
	- Time	hh:mm
	- Format	24h – 12h
5	**Set date**	dd.mm.yy
6	**See radio**	On – Off
7	**Autoclose**	
	- Moving	On – Off
	- Remote	On – Off
8	**Units**	
	- Distance	Km – mil
	- Consumption	Km/l – l/100Km - mpg
	- Temperature	°C / °F
9	**Language**	
	Italian	
	English	
	German	
	Portuguese	
	Spanish	
	French	
	Dutch	
	Polish	
10	**Info vol**	7 led bar
11	**Key vol**	7 led bar
12	**Seat belt beep**	On – Off
13	**Service**	
14	**Passenger air-bag**	On – Off
15	**Day lights**	On - Off
16	**Quit menu**	

Note: Seat belt beep: the customer cannot disable the seat belt beep, but only restore it if it has been disabled by the authorized service network using the diagnosis instrument.

Buzzer

The instrument panel has a buzzer to warning the driver of piloted events.
The acoustic signals are given according to the table below:

Signal	*Adjustable*	*Disable*	*Description*	*Frequency / duration of individual beeps*					
				Frequency					**Freque ncy**
ALL	YES	YES	*1 beep*	*2000 Hz*	*700 ms*	*700 ms*	*0 ms*	*0 ms*	*0 ms*
Automatic / robotic gearbox (selespeed)	NO	NO	*1 beep repeated*	*2000 Hz*	*700 ms*	*350 ms*	*200 ms*	*150 ms*	*0 ms*
Parking sensor	YES	NO	*1 beep repeated with interval proportional to distance*	*2000 Hz*	*Proportional to distance*	*75 ms*	*0 ms*	*Proportional to distance*	*0 ms*
Seat belt reminder (SBR)	NO	NO	*6s initial constant beep, followed by 1 beep repeated (1)*	*2000 Hz*	*500 ms*	*250 ms*	*250 ms*	*0 ms*	*2 sec.*
Direction indicators/hazard	NO	NO	*Tick* *Tock*	*2000 Hz* *2000 Hz*	*Established by BCM, synchronous with flashing light on IPC*	*2,5 ms* *1,5 ms*	*0 ms* *0 ms*	*Established by BCM, synchronous with flashing light on IPC*	*0 ms*
Memory Roger Beep	YES	YES	*1 beep*	*2000 Hz*	*75 ms*	*75 ms*	*0 ms*	*0 ms*	*0 ms*



DIAGNOSIS
If it is substituted, the Instrument Panel requires a “Proxi Alignment”.

The panel memorizes and transmits (via CAN network) the ON/OFF status of the following warning lights (if present), indicating an eventual fault:

- Handbrake on / low brake fluid / EBD fault
- ABS fault
- ESP cut-in/fault
- Power steering fault
- AIR-BAG fault
- Passenger AIR-BAG disabled
- Seat belt reminder

ODOMETER RESET
If the letter “H” in the Odometer is on and distance travelled less than 200 km, the Odometer can be zeroed with the following procedure:
- Press and hold the “TRIP” button on the combiswitch stalk until the letter “H” disappears from the odometer display, and the odometer simultaneously zeroes.

Climate control system

Introduction

The new Fiat 500 may fit either a heating system or one of two different types of climate control systems, namely:

- Heater
- Manual climate control system
- Automatic climate control system

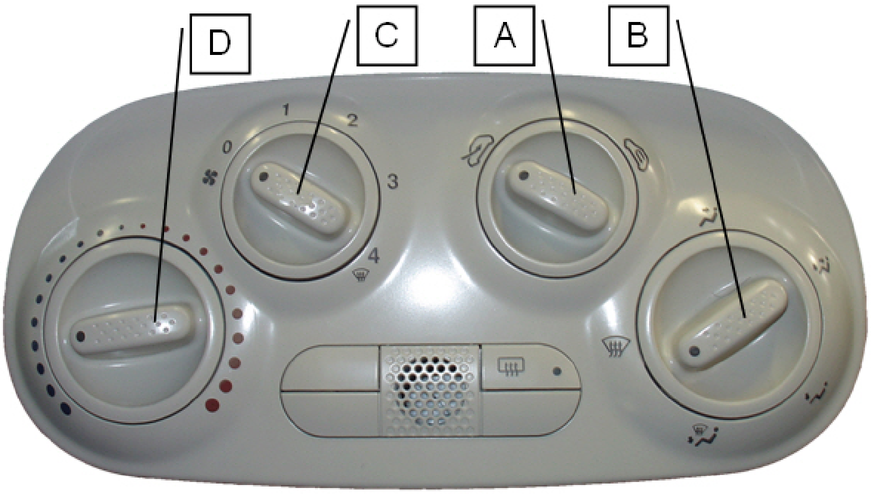
The climate control system and heater controls are located conveniently within reach in the middle of the dashboard.

The two climate control systems are used to change the features of the air introduced into the passenger compartment (temperature, humidity).
The difference between the two climate control systems is exclusively in way the system is managed:

- ***Manual climate control system:*** the user can adjust certain temperature, air distribution and air flow settings; the settings will remain unchanged until the user changes them again.
- ***Automatic climate control system:*** the user can set the parameters and let the system manage the controls automatically. The user may manage the system manually, if so required

HEATER

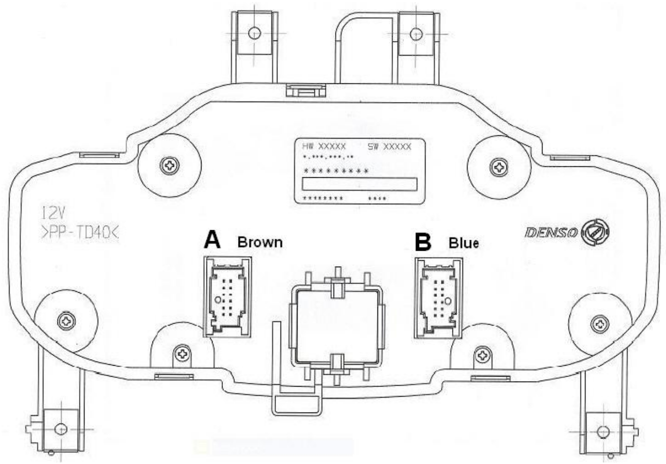
Front view
The manual heater control panel is shown in the figure below:



Key:
A. Air recirculation control knob (2 positions).
B. Air in passenger compartment distribution selector knob (5 positions).
C. Air flow speed control knob (4 positions).
D. Air temperature mixing control knob (22 positions).

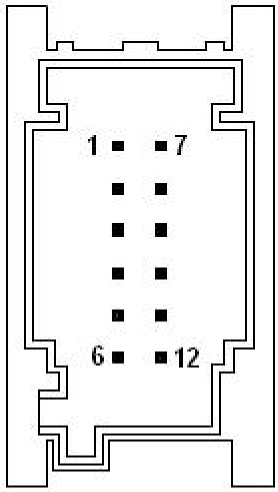
Rear view

The figure shows the back of the unit with the connections to the electrical system. The connector pinout is shown below.



Heater pinout

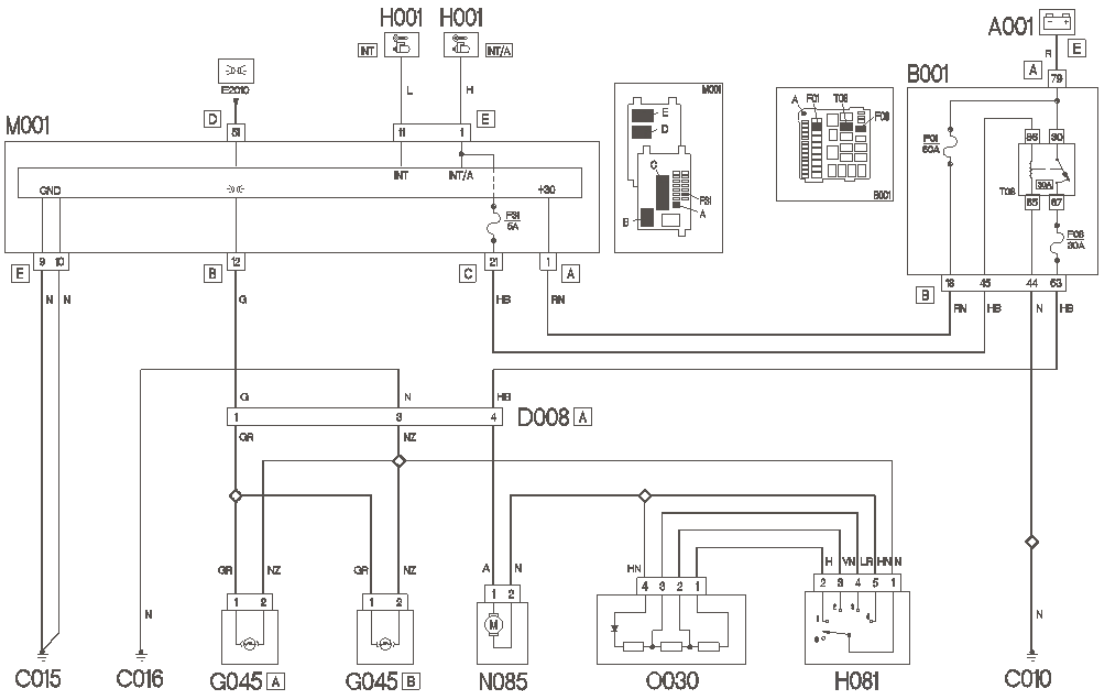
Brown 12-pin connector A



PIN	FUNCTION
01	Earth (GND)
02	Speed 1
03	Speed 2
04	Speed 3
05	Speed 4
06	Not connected
07	Not connected
08	Not connected
09	Not connected
10	Not connected
11	Not connected
12	Not connected

Blue 12-pin connector B
Connector not used by the heater.

CIRCUIT DIAGRAM (Heater)



Key:
A001: Battery
B001: Fusebox
C010: Earth
C015: Earth
C012: Earth
G045A: Heater control lights
G045B: Heater control lights
H001: Ignition switch
H081: Climate control system fan control
M001: Body Computer
N085: Passenger compartment air fan
O030: Passenger compartment air fan control resistor

MANUAL HEATER OPERATING LOGIC

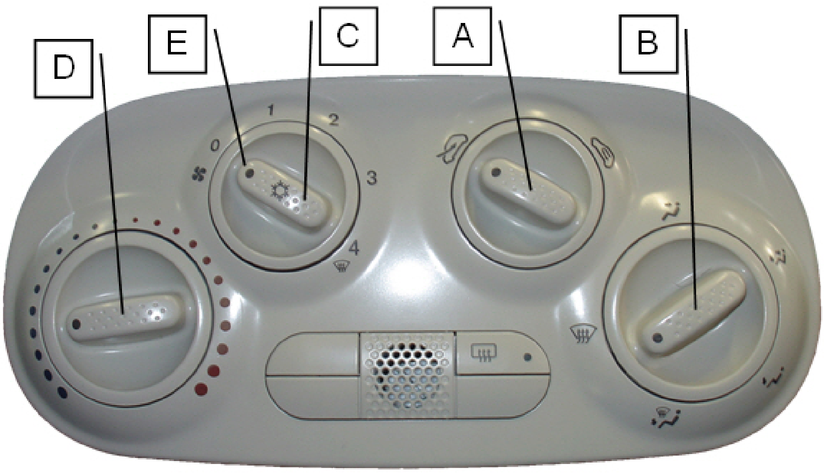
The following functions are available to the user:

- heating of air in the passenger compartment
- manual recirculation
- flow rate of air let into the passenger compartment
- incoming air flow orientation.

The air mixing, air distribution and recirculation controls are connected to the various knobs on the heater unit by means of flexible cables (Bowden cables).
The heater unit mounted on the dashboard crossmember is identical to that of the climate control unit, except for the specific air cooling and dehumidifying circuit components.
The heater simply consists of a radiator in which the engine coolant circulates and the corresponding pipes in addition to the flaps and the pollen filter.

MANUAL CLIMATE CONTROL SYSTEM

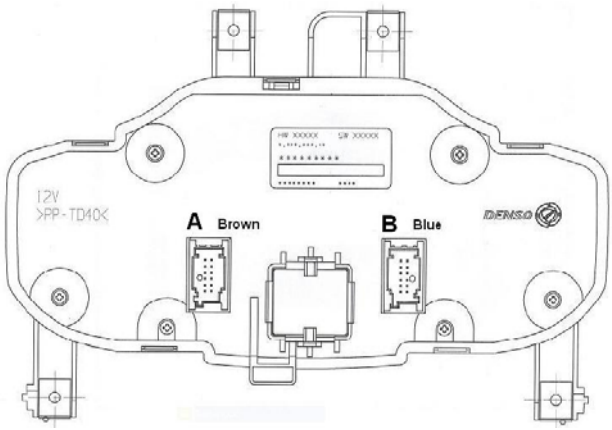
Front view
The manual climate control panel is shown in the figure below:



Key:
A. Air recirculation control knob (2 positions).
B. Air in passenger compartment distribution selector knob (5 positions).
C. Air flow speed control knob (4 positions) and gas compressor control.
D. Air temperature mixing control knob (22 positions).
E. Compressor state indicator LED (on/off).

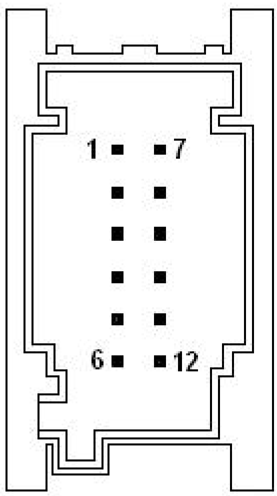
Note: Press knob (C) to operate the gas compressor.

Rear view
The figure shows the back of the unit with the connections to the electrical system. The connector pinout is shown below.



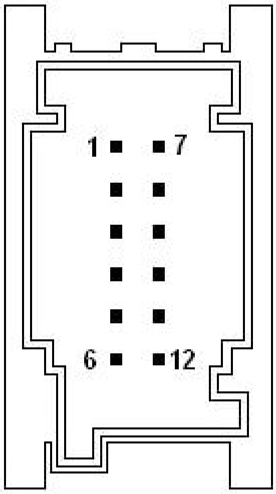
Manual climate control system pinout

Brown 12-pin connector A



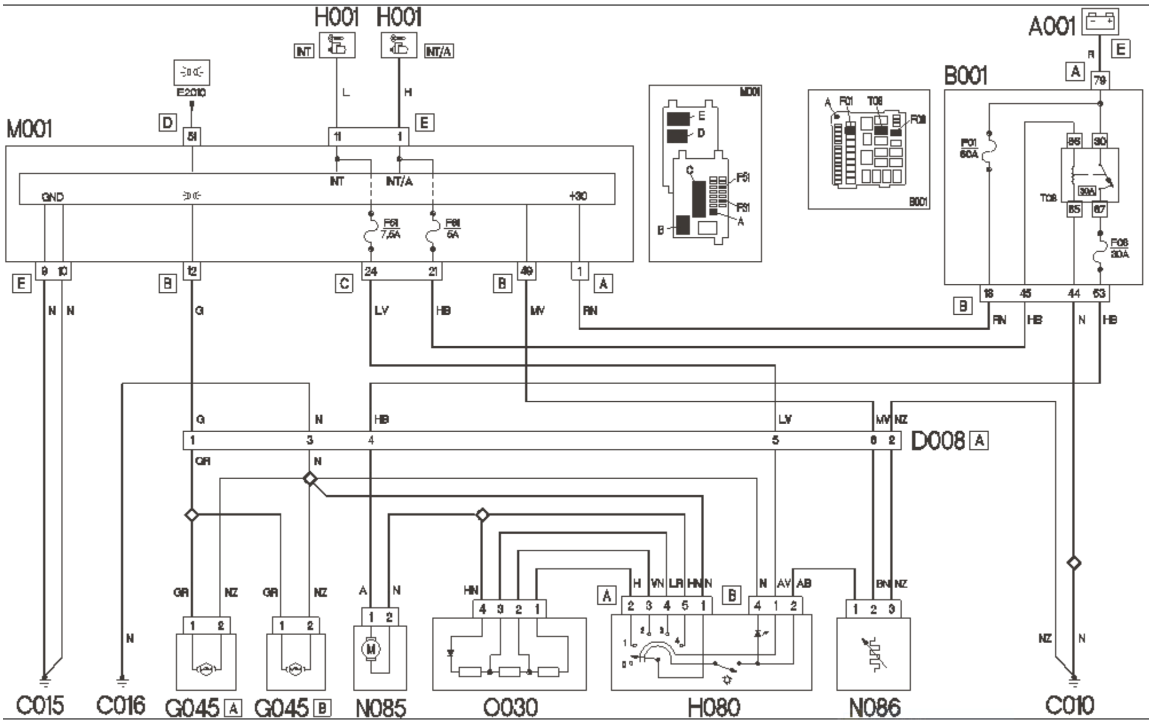
PIN	FUNCTION
01	Earth (GND)
02	Speed 1
03	Speed 2
04	Speed 3
05	Speed 4
06	Not connected
07	Not connected
08	Not connected
09	Not connected
10	Not connected
11	Not connected
12	Not connected

Blue 12-pin connector B



PIN	FUNCTION
01	+15
02	? N086 pin 1
03	Not connected
04	Earth
05	Not connected
06	Not connected
07	Not connected
08	Not connected
09	Not connected
10	Not connected
11	Not connected
12	Not connected

CIRCUIT DIAGRAM (manual climate control system)



Key:
A001: Battery
B001: Fusebox
C010: Earth
C015: Earth
C012: Earth
G045A: HVAC control lights
G045B: HVAC control lights
H001: Ignition switch
H080: Climate control system controls
M001: Body Computer
N085: Passenger compartment air fan
N086: Electronic thermostat (frost sensor)
O030: Passenger compartment air fan control resistor

MANUAL CLIMATE CONTROL SYSTEM OPERATING LOGIC

The manual climate control system can be used to adjust the temperature and air flows let into the passenger compartment using various knobs.
The following parameters/functions can be adjustment manually:

- Temperature
- Air distribution (five positions)
- Fan speed
- Compressor enabling
- Defrosting/demisting
- Recirculation

The air mixing, air distribution and recirculation controls are connected to the various knobs on the climate control unit by means of flexible cables (Bowden cables).

The compressor on knob is designed so that the user cannot switch off the fan (by turning the knob to zero position) while the compressor is running (this to keep the evaporator from freezing).

There are some restrictions determined by the outside temperature (measured by the outside temperature sensor integrated in the external left rearview mirror) on compressor operation:

- if outside temperature < -1°C the compressor is switched off
- if outside temperature > 1°C the compressor may be switched on

A further restriction is given by the front sensor (N086) whose purpose is to avoid the formation of ice on the evaporator. Operation of the compressor is not possible to prevent freezing of the evaporator.

Compressor control
The compressor is controlled according to the following strategy:

- Compressor on/off signal (12Volts) from H080.
- N086 electronic thermostat activation which in the absence of ice on the evaporator sends a signal to the body computer to confirm that the compressor may be started.
- The body computer, in turn, sends the compressor activation request on the CAN line.
- The engine ECU receives the compressor on/off information on the C-CAN and activates the compressor after checking that the operating conditions are within safety parameters.

AUTOMATIC CLIMATE CONTROL SYSTEM

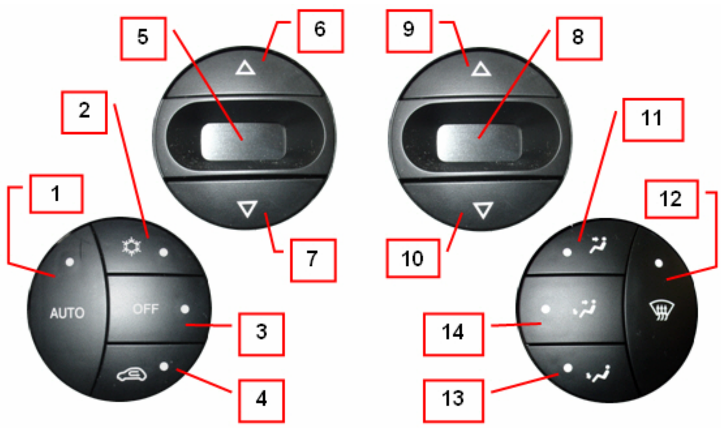
Front view

The automatic climate control panel is shown in the figure below

This is a one-zone automatic climate control system with pollen filter.
This system may be managed automatically by an ECU (called NCL) which keeps the climate control conditions determined by the user constant.
The NCL is connected to the vehicle B-CAN.
The NCL is integrated in the climate control panel installed in central position on the dashboard.

AUTOMATIC CLIMATE CONTROL UNIT

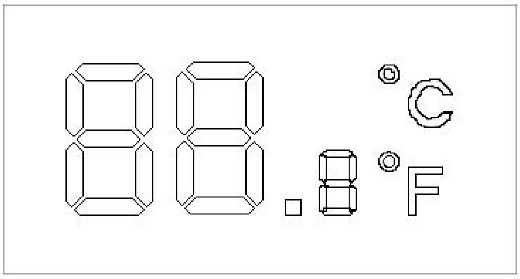
The automatic climate control functions are shown in the figure below:



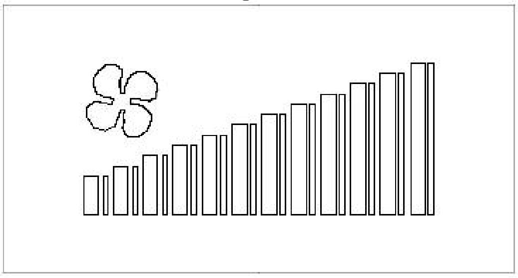
Key:

1. AUTO (automatic) mode button
2. Compressor on request button (via CAN)
3. Off button
4. Recirculation button
5. Set temperature display
6. Temperature control button (+)
7. Temperature control button (-)
8. Set air flow display
9. Air flow control button (+)
10. Air flow control button (-)
11. Air distribution button (FRONT)
12. MAX DEF button
13. Air distribution button (FLOOR)
14. Air distribution button (BI-LEVEL)

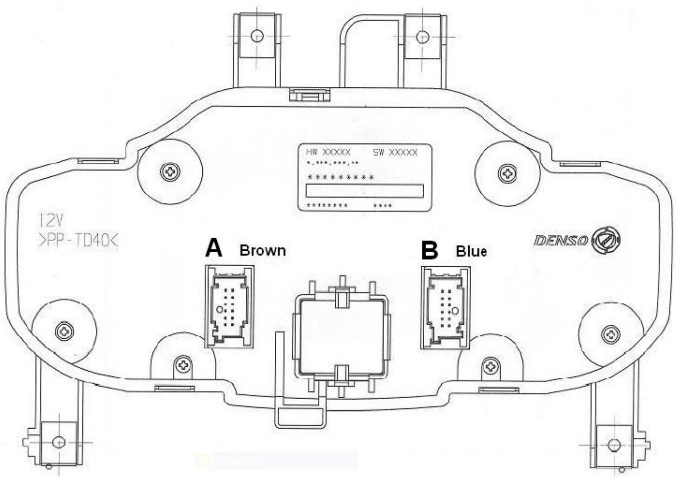
Set temperature display graphics
The set temperature display graphics are shown in the figure below.



Set air flow display graphics
The set air flow display graphics are shown in the figure below.

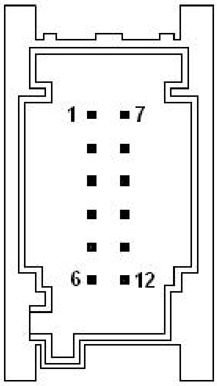


Rear view (automatic climate control system)
The figure shows the back of the unit with the connections to the electrical system. The connector pinout is shown below.



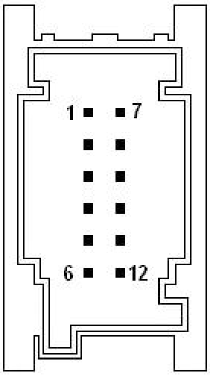
Automatic climate control system pinout

Brown 12-pin connector A



PIN	FUNCTION
01	+30 (Battery)
02	+15 (INT)
03	Electronic earth
04	Not connected
05	Analogue earth
06	Frost sensor
07	Fan feedback
08	Fan control
09	B CAN (B) (High)
10	B Can (A) (Low)
11	Low temperature sensor
12	High temperature sensor

Blue 12-pin connector B



PIN	FUNCTION
01	Mixer actuator feedback
02	Potentiometer power (+ 5 volts)
03	Not connected
04	Not connected
05	Recirculation control (+)
06	Recirculation control (-)
07	Distribution actuator feedback
08	Not connected
09	Mixer control (+)
10	Mixer control (-)
11	Distribution control (+)
12	Distribution control (-)

Nota: In seguito alla sostituzione della centralina o di uno degli attuatori è necessario eseguire la procedura di autoapprendimento della posizione portelle utilizzando Examiner.

Nota: La richiesta di Attivazione /disattivazione compressore è inviata sulla rete CAN.

CIRCUIT DIAGRAM (automatic climate control system)

Diagram A

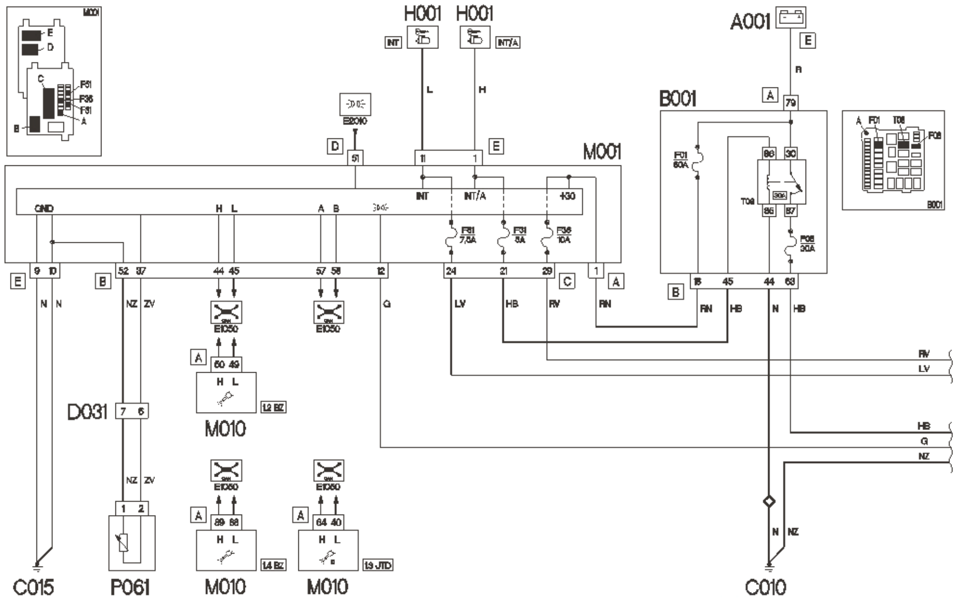
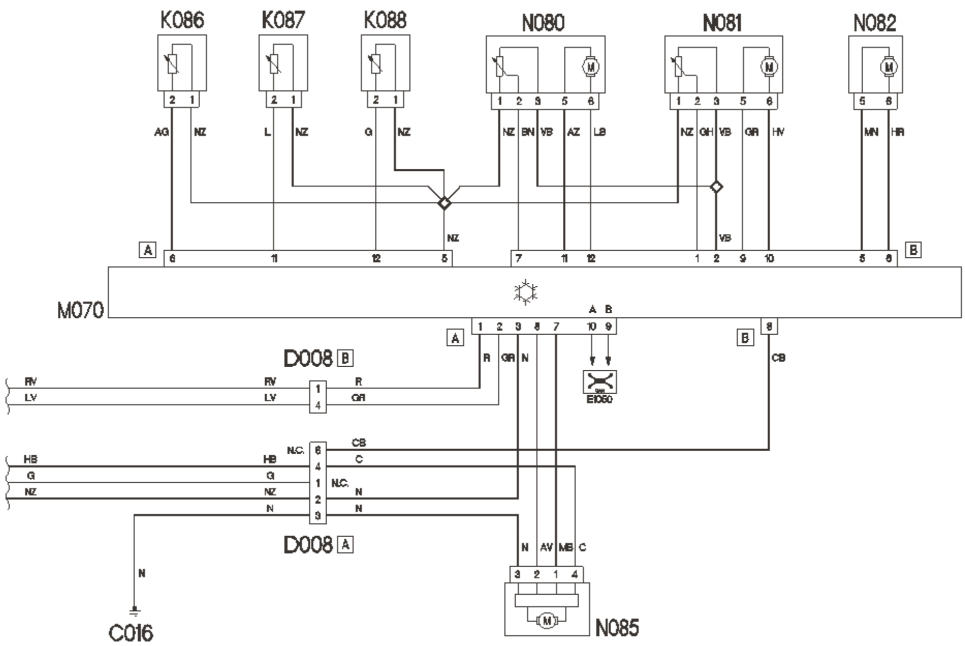
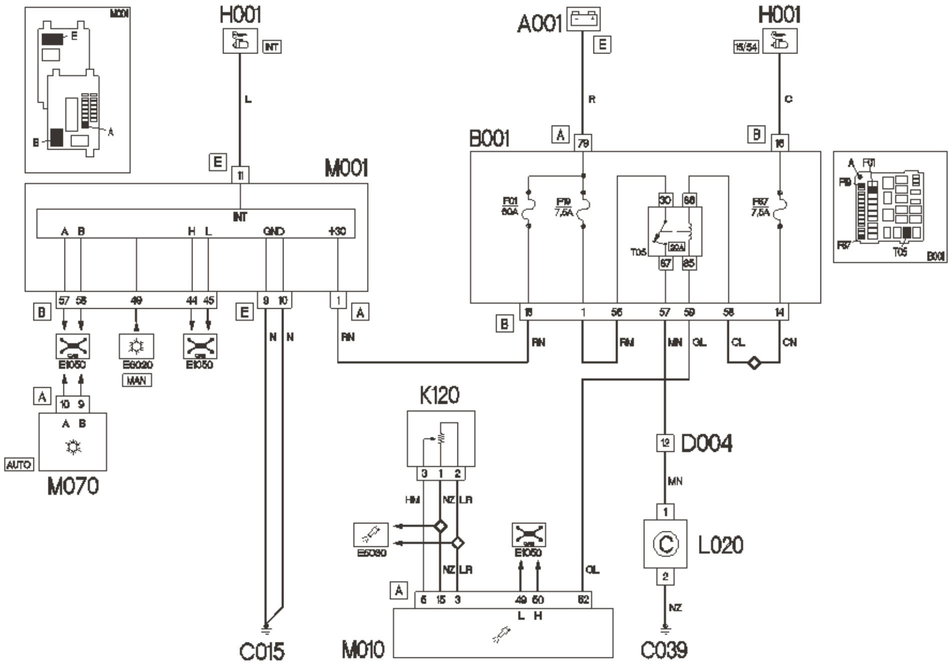


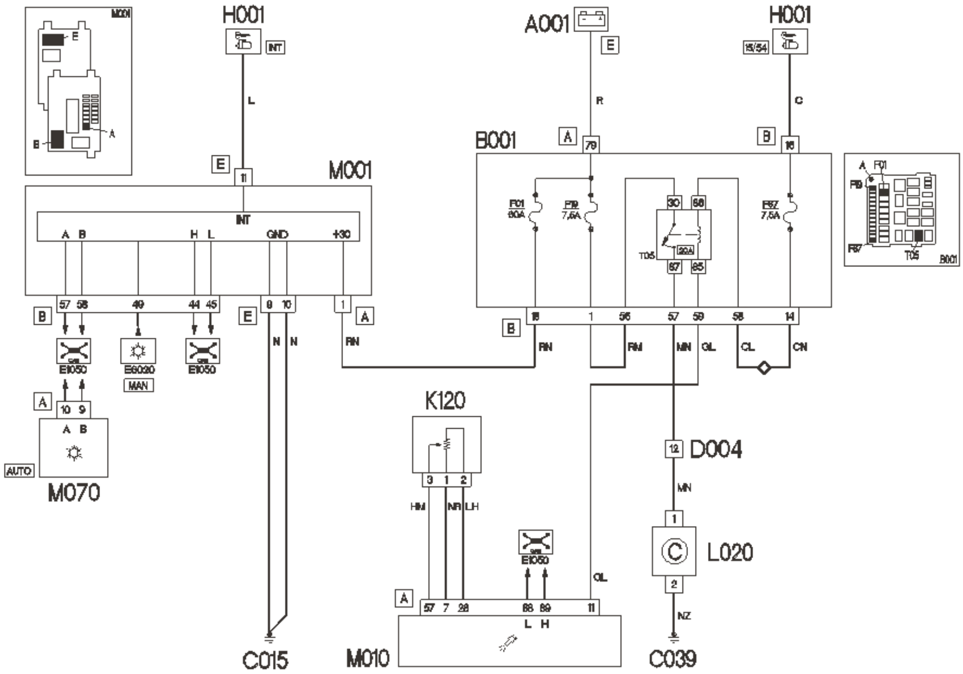
Diagram B



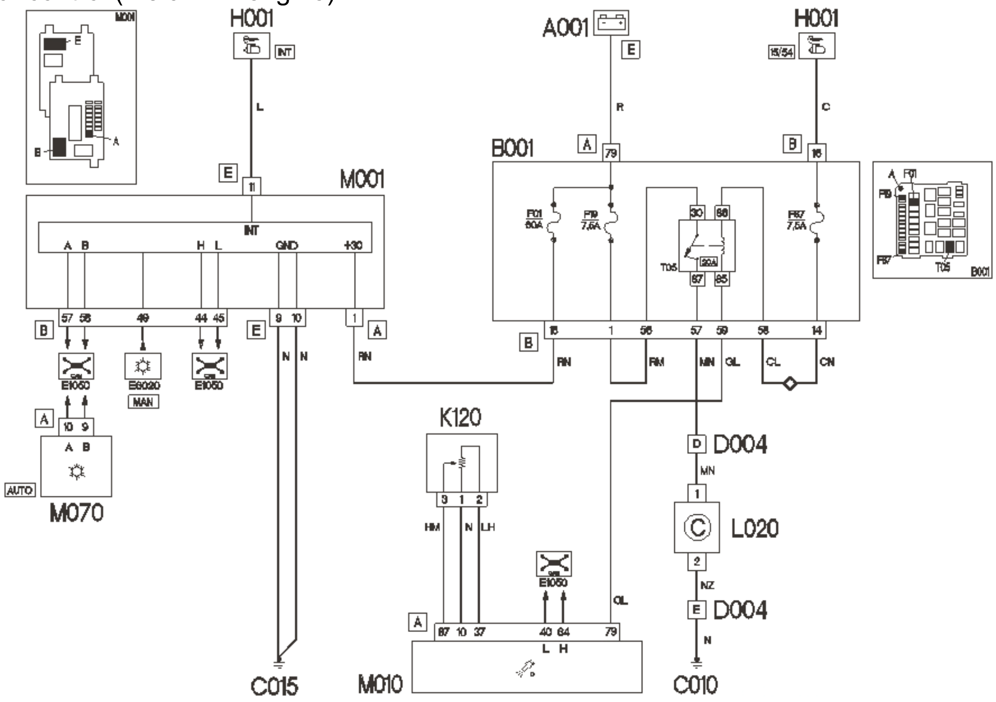
Compressor control (1.2 engine)



Compressor control (1.4 engine)



Compressor control (1.3 JTDM engine)



Key:
A001: Battery
B001: Fusebox
C010: Earth
C015: Earth
C012: Earth
C039: Earth
H001: Ignition switch
H080: Climate control system controls
L020: A/C compressor power electromagnet
M001: Body Computer
M010: Engine control module
M070: Climate control module
N085: Passenger compartment air fan
N080: Air distribution flap actuator
N081: Air mixer flap actuator
N082: External air/recirculation flap actuator
P061: External right-hand rearview mirror (external air temperature sensor)
K086: Frost sensor
K087: Low mixed air temperature sensor
K088: High mixed air temperature sensor
K120: Linear sensor (for climate control system)

OPERATING LOGICS (automatic climate control system)
The same parameters as the manual system may be adjusted by hand, namely:

- Temperature
- Air distribution (five positions)
- Fan speed
- Compressor enabling
- Defrosting/demisting
- Recirculation

Manual selections always have a higher priority than the automatic functions and are stored until the user cancels the command by returning control of the concerned function to the automatic system (by pressing AUTO).
The other functions may continue to be controlled automatically when one function is controlled manually.
Specifically, the temperature is always controlled automatically when the system is running.
All buttons (except adjustment controls) are of the on/off type, including the recirculation button.
The function is deactivated after pressing the button.
Other operation of the button is only acknowledged after releasing the previous button.

General information on functional state display
The functional state of the climate control system is displayed by means of LEDs and a display:

- RECIRCULATION function: button with the car profile and amber LED indicating that the recirculation function is on.
- Compressor on LED: button with the snowflake icon and amber LED indicating when the compressor is on.
- AUTO LED: button with the word AUTO and amber LED indicating that all the functions are managed by the control system. The AUTO LED will go out in the presence of at least one manual control (flow rate, distribution, compressor and recirculation).
- MAX DEF function LED: button with amber LED indicating when the MAX DEF function is on.
- REAR WINDOW DEMISTER function LED: yellow indicating when the rear window demister is on.
- DISPLAY: of the NEGATIVE TRANSFLECTIVE type indicating the fan speeds by means of bars and set temperatures (in °C or °F).
- OFF function LED: button with word OFF and amber LED indicating that the unit is on.
- Distribution state LED: amber indicating air distribution state in the passenger compartment.

Power-on after stopping the car
The various parameters controlling either in manual or automatic mode before key-off are presented again at key-on.
Therefore, all the manual interventions made before key-off are stored and kept for the next start-up, except for some safety related functions (demisting, etc.) whose operating strategies are described below.
This also applies to the OFF function: if the system was off when the engine was stopped, it will be off again when the system is restarted.
If MAX DEF was selected at key-off, the system will return to the conditions before MAX DEF was selected at key-on.
.

Temperature control

Set temperature selection
The temperature in the passenger compartment is set to a 22 ºC by the ECU whenever the battery is reconnected [MM1].
The user may modify the set temperatures by means of the corresponding buttons.
The temperatures are adjusted in 0.5°C steps.
The temperature range is from 16 to 32 ºC; under 16 ºC the set temperature is "LO", while over 32 ºC the set temperature is "HI".
The set temperature shown on the display is stored and re-presented at the next key-on when the unit is shut down.

Winter start-up transient
The system activates the "WINTER START-UP TRANSIENT" strategy in order to prevent annoyance to the user (such as jets of cold air and/or misting up of the windscreen) in certain temperature conditions.
The following conditions must exist at the same time for this strategy to be implemented:

- Engine coolant temperature lower than -4°C
- Outside temperature lower than 19°C

If these conditions are present, the ECU starts the "winter start-up transient" procedure by setting:

- air flow to the first bar
- distribution to Def
- mixing to AUTO.

The compressor may be automatically started in winter start-up transient mode to dehumidify the air.
The winter start-up transient strategy is stopped if the outside temperature is higher than 21°C of if the engine coolant temperature has reached 50°C.
All manual functions stored at key-off are represented at the end of the winter start-up transient.

LO condition
Maximum air cooling is obtained by setting a temperature lower than 16°C.
The following actions occur when the setting is made:

- Mixer: the air mixing flap is set to ALL COLD position.
- Distribution: the distribution flap is positioned (by default) to the VENT position and the corresponding LED lights up (visible by the user).
- Fan: air flow (by default) is 10 bars.
- Recirculation: previous setting according to the recirculation rules.
- Compressor: on (LED will light up if it was off before).

All manual settings are accepted in LO conditions: requests made by the user have a higher priority with respect to automatic control conditions operated by the system in LO state.
Maximum cold management is interrupted following one of the following functions which have a higher priority with respect to LO state:

- +KEY OFF status management
- OFF status management
- MAX DEF status management

HI condition
Maximum air heating is obtained by setting a temperature higher than 32°C.
The following actions occur following the user's request:

- Mixer: the air mixing flap is set to ALL HOT position.
- Distribution: the distribution flap is positioned (by default) to FLOOR position with XX % leakage to DEF and the corresponding LED lights up (visible by the user).
- Fan: air flow (by default) is 10 bars (with limitations determined by winter transient conditions).
- Recirculation: previous setting according to the recirculation rules.
- Compressor: user's previous setting.

All manual settings are accepted in HI conditions: requests made by the user have a higher priority with respect to automatic control conditions operated by the system in HI state.
HI management is interrupted following one of the following functions which have a higher priority with respect to HI state:

- +KEY OFF status management
- OFF status management
- MAX DEF status management

AUTO function
The following functions are controlled automatically when the AUTO button is pressed (the corresponding LED will light up):

- Air distribution
- Fan speed
- Compressor
- Recirculation

Consequently:

- The AUTO LED will light up.
- The compressor LED (HI request to engine ECU) will light up.
- The distribution LED (Front, Bi-level, Floor) will go out.

Particular situations:
the AUTO LED will go out when at least one of the following functions is set manually:

- Distribution
- Flow
- Recirculation
- Compressor

Important: The system will return to AUTO after a manual setting (distribution, air flow, compressor or recirculation) only by pressing the AUTO button.

Fan speed and corresponding display
The air flow rate may be adjusted manually to 12 levels shown on a display by 12 bars.
If there are no manual interventions, the fan speed will be constantly controlled by the automatic system and the bars corresponding to the set fan speed will be shown on the display.
AUTO function is stopped when the user manually adjusts the fan control.

Press the corresponding buttons to increase or decrease the fan speed.
Hold one of the two buttons (up/down) pressed for longer than 0.8 seconds to activate the "repeat" function which increases/decreases the air flow rate by one step every 0.4 seconds.

With the air flow at AUTO or during HI, LO and MAX DEF functions, the flow is limited to one bar (minimum flow) if the engine speed is slower than 200 rpm or the battery voltage is lower than 10.5 Volts. It is always possible to control the fan manually during this limit.
The flow rate is not limited when engine speed is faster than 250 rpm and battery voltage is higher than 11.5 volts.

When the compressor is off, the fan speed may be adjusted until no bars are shown on the display (no air flow).

When the compressor is on and the engine is running, manual ventilation cannot be less than one bar (minimum flow) on the display because with the compressor running a minimum air flow is needed to prevent the evaporator from freezing.

Air distribution control
The air distribution may be set to five positions (VENT, BI_LEVEL, HEAT, FLOOR, DEF).
The system shows the selected distribution by lighting up the LED on the control button.

Distribution setting
One of five positions may be manually selected by means of the corresponding buttons according to the combination logic shown below.
The main distributions are managed in three groups:

- "Main" distributions: DEF (windscreen), VENT (frontal), FLOOR (feet)
- "Combined" distributions: BI_LEVEL, FLOOR_DEF
- "Banned" distributions: all OFF, DEF-VENT, DEF-VENT-FLOOR

With a main distribution running (one LED on), the following occurs when the same button is pressed:

- Distribution remains unchanged
- The system switches to manual (the Auto LED will go out).

The distribution set at the time will remain unchanged if a button which generates an "All off" banned distribution pattern is pressed or if two or three distribution buttons are pressed at the same time.

Compressor management
The compressor button is of the on/off type and is provided with a LED.
Pressing the button will enable compressor operation. The corresponding LED will light up.
The LED on the compressor button indicates that the compressor operation request has been forwarded to the engine control module via the CAN.

The LED will light up if the request has been sent.
From this instant, if the outside temperature so allows, the system will generate the refrigeration needed to control the temperature inside the passenger compartment with the dehumidifying effect proper of the evaporator.
This functional state is maintained also after the next key-off/on.

There are some limitations for compressor operation determined by the outside temperature:

- If Text <= 3°C, the compressor is disabled
- If Text = 5°C, the compressor is enabled
- Enabled by frost sensor
- If the temperature is 35°C at key-on, the compressor is enabled.

Set temperature blinking logic
The following occurs when the user switches the compressor off:

- The button LED will go out
- The AUTO LED will go out (if it was on).

The ECU will check whether the system is capable of reaching the set temperature given the current outside temperature:

- *In the affirmative case:* the system will run normally and is capable of meeting the request without using the compressor.
- *In the negative case:* the system cannot meet the user's request and the set temperature will blink to indicate this fact. A temperature blinking cycle will be repeated at the next key-on if the compressor is not enabled again.

Recirculation management
The recirculation button is an on/off button.
There are three possible types of operation:

- Automatic recirculation (managed by the specific rules shown below and activated by pressing the AUTO button).
- Closed forced recirculation (passenger compartment air) (RFC)
- Open forced recirculation (outside air) (RFA)

The following are used to display the various recirculation operating states:

- Button (with LED) and AUTO (the LED will light up when recirculation is controlled automatically)
- Button (with LED) and car profile (the LED will light up when forced recirculation is selected)

Note: Recirculation will return to closed forced at key-off/on.

Automatic recirculation
Recirculation is controlled automatically (opening/closing of the flap) considering the following rules shown in decreasing order of priority:

- Air exchange rule: after 25 minutes of recirculation in closed position, the system open the flap for one minute to exchange the air inside the passenger compartment. After this time, the system will return to the conditions before opening.
- Temporary dynamic rule: when the user either deactivates the compressor manually or the compressor is switched off by the automatic system due to low outside temperature, the ECU controls opens the recirculation flap to prevent misting up which would affect visibility.
- Heat regulation transient rule to favour cooling in the passenger compartment: the system either opens or closes the recirculation flap according to the outside temperature letting in the air where is it coolest and thus cooling the passenger compartment down by accelerating when cooing the passenger compartment.

Manual recirculation
Recirculation (opening and closing of the flap) is managed considering the following rules:

- Forced recirculation closed: in this type of manual operation the recirculation flap is closed (LED on the recirculation button on).
- Forced recirculation open: in this type of manual operation the recirculation flap is open (LED on the recirculation button off).

MAX DEF function
The MAX DEF function is a procedure activated by pressing the corresponding button.
This procedure causes the activation of the following operations:

- The LED corresponding to the DEF air distribution position will light up.
- Conditions before MAX DEF button was pressed are stored.
- The AUTO and recirculation LED and messages will go out.
- The LEDs corresponding to DEF, compressor, recirculation open and rear window demister will light up.
- HI temperature setting is shown on the display.
- Ventilation will appear on display.

If the MAX DEF function is activated after a winter start-up transient:

- Air flow is limited to 80% the nominal rate
- MAX DEF timer is set to three minutes

If the MAX DEF function is activated during a winter start-up transient:

- The air flow remains that of the transient, if the engine coolant temperature is lower than 35°C.
- The flow rate is 80% of the maximum rate, if the engine coolant temperature either reaches or exceeds 35 °C.
- The system waits for the engine coolant temperature to either reach or exceed 50°C to start the MAX DEF three minute timer.
- Distribution flap in Def position
- Mixing flaps in HI position
- Recirculation flap in forced open position
- Compressor enabled
- Rear window demister enabled.

During MAX DEF the following actions are possible without shutting the procedure down:

- the air flow may be changed as required
- the rear window demister may be switched off.

The MAX DEF function is interrupted if any of the buttons/controls of the climate control system are operated (recirculation, compressor on, auto, off, max def, temperature and distribution) causing the system to revert to the condition prior to MAX DEF except for the pressing of the button.

The MAX DEF procedure has a higher priority over the LO and HI procedure management. These will be interrupted (if in progress) when the MAX DEF function is selected.

Switching the unit/system off
The following actions occur when the off button is pressed:

- The current state is stored.
- Forced closed air recirculation is selected and the corresponding LED lights up.
- The OFF LED will light up and all the other icons will go out.
- The compressor is switched off.
- The fan is switched off.
- The mixer flap is taken to LO position
- The distribution flap is taken to Vent position.

The recirculation button can still be controlled (on/off) without the automatic functions when the system is off.
The system will be switched on again when any button is pressed (except for recirculation and temperature). The required function will be implemented and the system will restore the operating conditions prior to switch-off.
By increasing the air flow, all the conditions prior to switch-off will be restored and manual flow rate will be selected at the same time.
Only the required main distribution will be implemented when the system is switched on by pressing a distribution button.
The conditions prior to switch-off will be restored when the system is off and the OFF button is pressed again.

CLIMATE CONTROL SYSTEM COMPONENTS (MANUAL AND AUTO)

The climate control casing, i.e. the plastic structure fastened to the dashboard crossmember, is the same for both the manual and the automatic versions.

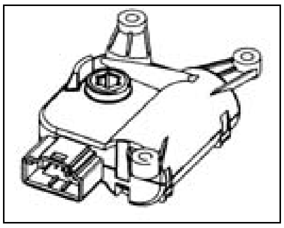
The difference between manual and automatic versions (in relation to the casing) is only in the actuating method of the mixing, distribution and recirculation flaps: flexible cables are used to control the flaps in manual systems, electro-mECManical actuators are used in automatic systems.

The components according to type of system are shown in the table below:

COMPONENTS	Manual climate control system	Automatic climate control system
Climate control module (NCL)		X
Electro-mECManical actuators		X
Compressor	X	X
Expansion valve	X	X
Radiator - heater	X	X
Evaporator	X	X
Condenser	X	X
Linear sensor	X	X
Frost sensor	X	X
Outside air temperature sensor	X	X
Passenger compartment air temperature sensor		X
Mixed air temperature sensor		X
Pollen filter	X	X
Fan in passenger compartment	X	X
Dehydrator filter	X	X

ACTUATORS
The flaps inside the automatic climate control casing, i.e. the mixing, distribution and air circulation flaps, are actuated by means of electro-mECManical actuators controlled by the NCL.
Inside the actuators, a 12V motor controls the rotational movement of a pin which acts directly on the flaps.
A potentiometer detects the actual position of the flap and provides feedback to the ECU.
The actuators are only present in the automatic version of the climate control system.

NOTE: The flap position self-learning procedure must be run with Examiner after replacing either the ECU or an actuator.



AIR DISTRIBUTION ACTUATOR
The air distribution actuator rotates the distribution flaps.
It is powered at 12 volts and may turn either clockwise or anticlockwise by reversing the polarity. A potentiometer detects the position and provides feedback to the ECU checking the complete stroke between limit positions.
It is fitted on the climate control casing on passenger side.

AIR MIXING ACTUATOR
This actuates the rotation of the air mixing flaps.
It is fitted on the climate control casing on passenger side.
It is powered at 12 volts and may turn either clockwise or anticlockwise by reversing the polarity. A potentiometer detects the position and provides feedback to the ECU checking the complete stroke between limit positions.

RECIRCULATION ACTUATOR
The actuator rotates the flap to the two extreme positions: dynamic air (external) and recirculation, without intermediate positions.
It is fitted in dynamic air vent zone.
It is powered as 12 volts and may turn either clockwise or anticlockwise by reversing the polarity.

MIXED AIR TEMPERATURE SENSORS
Two temperature sensors which provide a signal related to the air at vent outlet are present on the automatic climate control system casing. One sensor is positioned at the FLOOR outlets and the other is positioned at the outlet of the vents in the middle of the dashboard.
The sensors are of the NTC type and characterised by a resistance of 10000 Ohm +/- 5% at a temperature of 25 °C.

FROST SENSOR
The gas flow control system is controlled by the climate control ECU which acts on the compressor electromagnetic coupling according to the temperature of the evaporator detected by means of a NTC type sensor.
This sensor, called a frost sensor, is of the NTC type and has the function of measuring the temperature of the evaporator.
It is arranged inside the distributor unit and fitted directly on the evaporator.
It is capable of detecting in certain conditions that the temperature of the evaporator is dropping to values which could cause the condensation which is deposited on the surface of the evaporator itself to freeze. The efficiency of the climate control system would be severely compromised in these conditions because the evaporator coated with frost would loose its heat exchanging capacity with the air.

In order to avoid this condition, if the signal generated by the frost sensor indicates the risk of freezing, operation of the compressor and consequently circulation of the refrigerating fluid is interrupted:

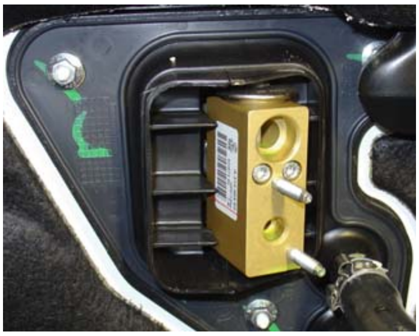
- For temperature < 3.5˚C the compressor is deactivated,
- For temperature > 5˚C the compressor is reactivated.

In manually controlled systems, the sensor is connected to a thermostat connected to the Body Computer, which sends the compressor activation/deactivation command via the CAN network. The Engine control module in turn directly controls the compressor.
In automatic systems, the sensor is connected directly to the Climate control module which, through the Body Computer Module, communicates with the engine control module via CAN network, which activates/deactivates the compressor.

EXTERNAL AIR TEMPERATURE SENSOR
This NTC sensor is mounted on the lower side of the right-hand external rearview mirror.
It is found on both manual and automatic versions.
It provides a signals proportional to the outside air temperature.
The sensor sends its signal to the NBC which sends it onto the CAN for the NCM. The NCM by means of the frost sensor thermostat enables activation/deactivation of the compressor

PASSENGER COMPARTMENT AIR TEMPERATURE SENSOR
This NTC type sensor has the task of informing the climate control ECU on the temperature of the passenger compartment, making the system capable of correcting the climate control parameters to respect the temperature selected by the user.
This sensor is present on automatic climate control system only.
It is integrated in the climate control unit and is provided with a fan to avoid stagnation of air and to make the temperature reading and coherent as possible.

EXPANSION VALVE
The assembly position in the engine compartment is shown in the following figure.



A cross-section of the expansion valve is shown in the following figure along with its main parts.
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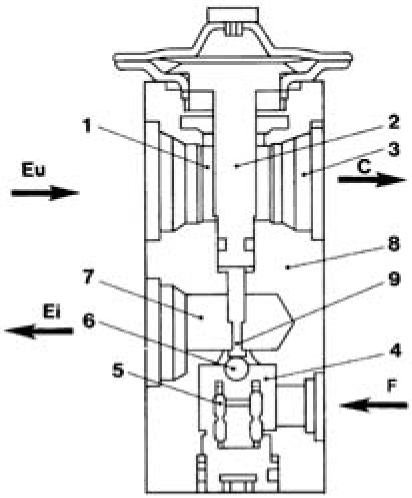


Key:
1. Fluid passage outlet from evaporator
2. Heat sensitive element
3. To the compression suction fitting
4. Pressurised fluid
5. Contrast spring
6. Ball and calibrated hole
7. Expanded fluid (to evaporator inlet fitting)
8. Valve body
9. Rod

C. To the compressor
F. From the dehydrator filter
Ei. Evaporator inlet
Eu. Evaporator outlet

Operation
The tasks of this valve are:

- To separate the high pressure circuit from the low pressure circuit.
- To expand the refrigerant (passage from liquid to gas state).
- To regulate the evaporation process (flow rate).
- To regulate the evaporation temperature.
- To protect the compressor for liquid refrigerant.

The thermostatic expansion valve fitted on the evaporator inlet/outlet is used to adjust the flow and expansion (pressure drop) of R134a refrigerant prior to being let into the evaporator.
Automatic adjustment of the gas passage section within the expansion valve is obtained by means of a sensitive bulb which detects the temperature of the refrigerant fluid and according to this appropriately adjusts the gas passage hole section by means of a specific spring which shifts a shutter determining the entity of the expansion.
The increased temperature at evaporator outlet detected by the sensitive bulb causes the valve to open with consequent increase of the refrigerant flow rate in the evaporator.
On the contrary, a low temperature will cause a reduction of the gas passage hole section determining a reduction in the gas flow.

Important: The valve regulation screw is calibrated at the factory and must never been tampered with to prevent compromising the efficiency of the A/C system.

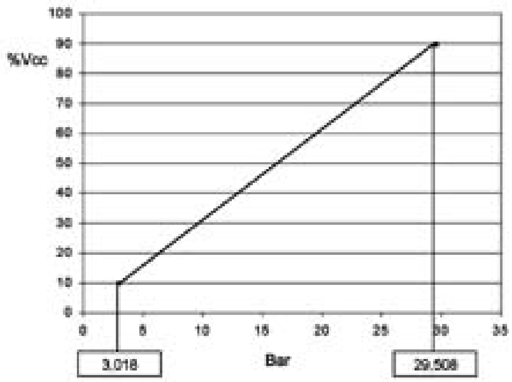
The expansion valve is directly accessible in the engine compartment.
This type of expansion valve has two different refrigerant fluid passages:

- The lower passage from point (4), gas from the dehydrator filter, to point (7) gas outlet towards the evaporator, contains the overheating spring (5) and the modulating element, which in this case is the ball (6) accommodated in the calibrated pipe.
- The upper passage, from point (1), gas from the evaporator, to point (3), gas outlet towards the compressor, contains the thermostat sensor (2) which is connected to the upper part of the diaphragm and to the ball (6).

The flow rate control function is exerted by shifting the ball (6) connected through the rod (9) to the thermostat sensor (2).
The action of the ball (6) is contrasted by the appropriately calibrated spring (5) causes the refrigerant fluid in the evaporator to be in gassy state, without presence of liquid which could damage the compressor it is were aspirated.
The position of the ball (6) depends on the pressure difference acting on the diaphragm inside the sensor (2); this in turn depends on the outlet temperature of the refrigerant gas from the evaporator (upper passage of the valve).
High temperature of the gas released from the evaporator (1) corresponding to conditions in which a large amount of heat is dispersed increase the pressure inside the thermostatic sensor (2); this causes a shift of the rod (9) and of the ball (6) connected to it so as to increase the passage section and consequently the refrigerant flow rate (7).
The opposite occurs when low temperature of the gas at evaporator outlet (1).

LINEAR PRESSURE SWITCH

The linear pressure switch continuously and uniformly controls the correct operation of the climate control circuit and sends the pressure variations in real time to the engine control unit to make activation thresholds more flexible.
Each pressure variation corresponds to a voltage signal used by the engine ECU to activate the fan and switch the compressor off if the pressure rises or drops over or under the permitted thresholds (safety function).
The range of use of the linear sensor spans from 3.018 bars to 29.508 bars according to the following curve illustrating the characteristic pressure (Bar) - in relation to output voltage (% Vdc).



Operation of the compressor is enabled and the fan speed is adjusted according to pressure variations in this pressure range. Under or over these values, the compressor is off to prevent possible damage to the system itself.

COMPRESSOR
By using the mECManical energy taken from the engine through the pulley and the electromagnetic coupling, this machine allows the circulation of coolant fluid in the circuit by changing its pressure level.
The compressor is the same for both manual and automatic models.
DENSO SCS06 compressor specifications:

- Orbital rotation radius: 4.58 mm
- Lubricant capacity: 50 cm[sup3].

The compressor is of the orbiting spiral type with connected system which switches the compressor off when the temperature of the evaporator reaches values close to freezing. The deactivation signal is controlled by the front sensor fitted on the evaporator.
Orbiting spiral compressors consist of a fixed scroll 1 (body) and a mobile scroll 2.
The movement of the cam shaft (3) connected to the pulley creates a chamber whose volume is reduced during rotation allowing compression.
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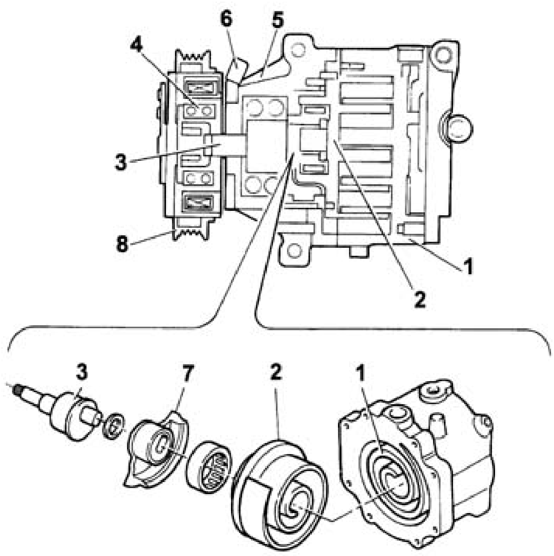
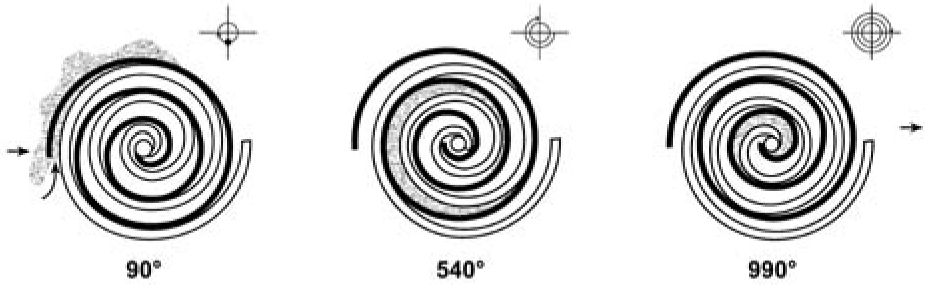


Key:
1. Fixed scroll (body)
2. Orbiting scroll
3. Cam shaft
4. Ball bearing
5. Guard
6. Compressor power electrical connection
7. Balancing mass
8. Pulley

Compressor construction
The contact between the fixed scroll and the orbiting scroll of the compressor creates a chamber whose volume is progressively reduced as the scroll rotates.
The compression chamber is alternatively opened to feed the gas, closed to convey the gas and then opened on outlet side to evacuate the pressurised gas.
The pressure of the stored gas defined by the volume formed by the two scrolls (one fixed and the other mobile) progressively increases until the gas is pushed into the central zone where it reaches running pressure. From here the gas is released through the outlet fitting towards the condenser.

The sequence shows the three compression steps of the gas. Compression occurs after three complete turns of the orbiting scroll.



The adoption of these compressors, formed by only two parts, has provided the following advantages:

- No need for seals.
- No radial or axial loss.
- Low load loss because there are no internal valves or pipes.
- Spiral scroll wear improves tightness on the sides of the scrolls.
- No valves, splashing, or pulsing; quieter operation.

On the other hand, the presence of the frost sensor is required to prevent freezing of the evaporator because the compressor is not of the variable displacement type.

Note: The cycle is continuous. Therefore, a gas suction step starts and the pressurised gas is released at the same time during compression..

In manual systems: the enabling request is forwarded by pressing the air speed button, the signal reaches the body computer module through the frost sensor that puts it on the CAN network. The engine control module reads the request from CAN network and starts the compressor if conditions so allow.

In automatic systems: the enabling request is forwarded by pressing the button on the control panel. The signal reaches the climate control module which sends the activation request on the CAN. In turn the engine control module switches the compressor on if the conditions for correct operation exist.

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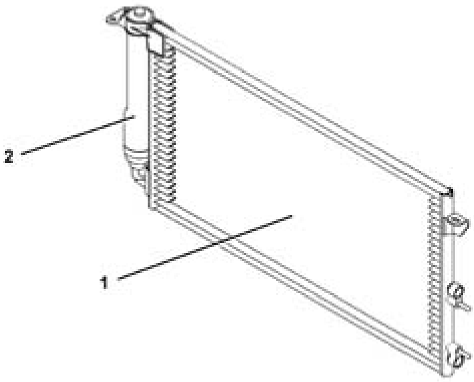
CONDENSER WITH INTEGRATED DEHYDRATOR FILTER

The condenser is a heat exchanger arranged in front of the engine cooling radiator.
Its task is to condense the refrigerant, i.e. to transform it from the gassy to the liquid state.
The refrigerant fluid at the gassy state crosses the condenser tubes and liquefies (in average at a temperature of 60°C).
The condenser is lapped by air. When the vehicle is standing or travelling in a queue, the flow of air is generated by the engine radiator fan.
An insufficient heat exchange in the condenser increases the pressure in the system and causes incomplete condensation of the fluid, thus reducing the system efficiency.

A seat for the dehydrator fluid is obtained on the left-hand side of the condenser. This solution allows to optimise the system layout.



Key:
1. Condenser
2. Integrated dehydrator filter

FAN

- In manual systems, the fan is operated by the air speed selector, which sends a signal to a resistive divider which generates the various speeds. The resistive divider is inserted in the conveyor between the dynamic air vent and the unit for cooling it.
- In automatic systems, the fan is operated by pressing the buttons on the control panel which send the signal to the climate control module and which generates the various voltage values for the various speeds.

POLLEN FILTER

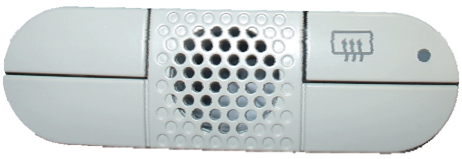
The pollen filter is use to filter the dust from the outside air let into the passenger compartment.
It is located on the outside of the A/C casing and may be replaced from inside the vehicle by removing the hatch accessible in passenger zone.
It is found on both manual and automatic versions.

CENTRAL CONTROLS ON HEATER/CLIMATE CONTROL SYSTEM UNIT

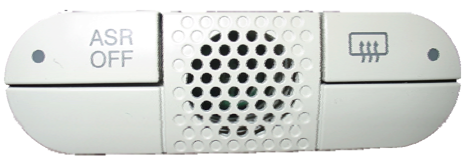
A control panel containing the following controls is the heart of the heating and manual climate control system:

- rear window demister button
- ASR on/off button
- passenger compartment air temperature sensor (in the middle).

Basic version



Top-of-the-range version



COOLANT CIRCUIT PIPES

The manual and automatic climate control system refrigerant coolant pipes are present in the engine compartment.

The circuit components are:

- Evaporator (passenger compartment)
- Expansion valve (engine compartment)
- Gas compressor (engine compartment)
- Gas condenser and dehydrator filter (engine compartment).

<u>The gas capacity is: 450 g ± 40 g.</u>

In the event of interventions requiring replacement of system components, add oil (**ND8**) before assembly in the quantities shown below:

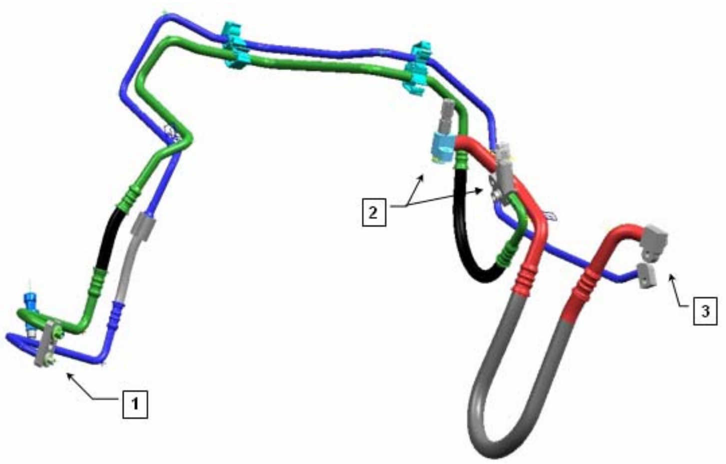
- Dehydrator filter:15 cm^3;
- Pipes:5 cm^3/m;
- Evaporator: 40 cm^3;
- Condenser: 40 cm^3;
- Condenser with integrated filter: 50 cm^3,
- Compressor: Pour oil from the compressor being replaced into the graduated jug **A**. Repeat the same operation on the compressor pouring new oil into jug **B**. Pour the same amount of oil as that removed from the oil compressor (jug **A**) into the new compressor taking the new oil from jug **B**.

ENGINE COMPARTMENT PIPE LAYOUT

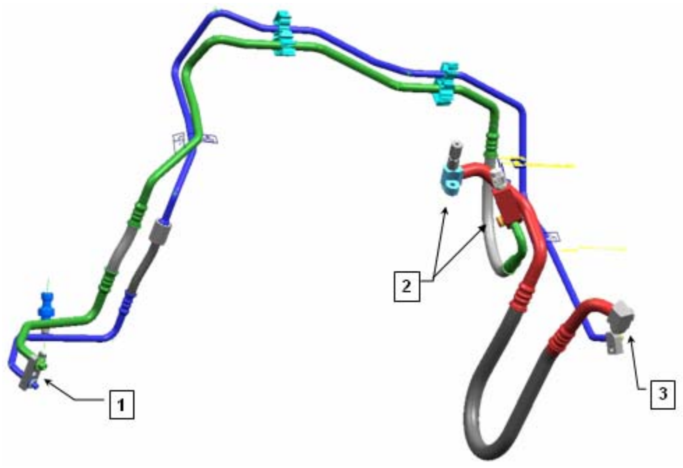
The configuration of the gas circuit in the engine compartment is shown, specifically:

- 1. Connection of the condenser unit
- 2. Connection to gas compressor
- 3. Connection to expansion valve/evaporator unit.

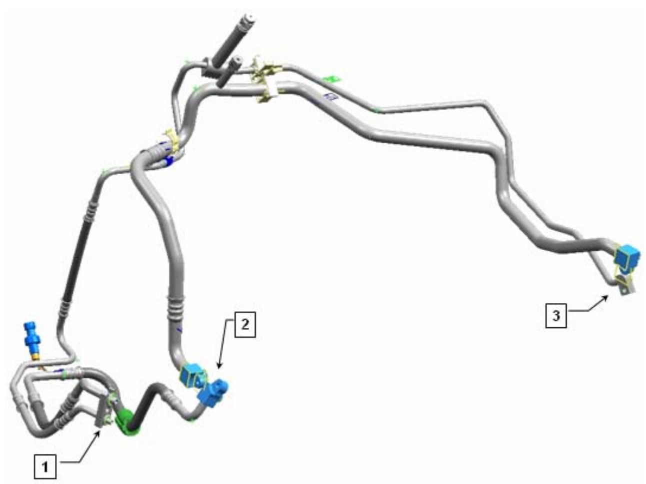
1.2. petrol version



1.4 petrol version.



1.3 MJET version.



Audio system

Overview
The audio system essentially consists of a radio with single CD-ROM player compatible with MP3 format compressed audio files.
According to the vehicle version (Base or sport) the radio front panel is either light or dark to match the color of the dashboard.

Light front panel version:

Dark front panel version:

TECHNICAL SPECIFICATIONS
The main technical specifications of the audio system are:
- Music audio power: 4x40W.
- 7-band graphic equalizer (only CD and CD MP3).
- Built-in large size alphanumerical display (20 characters for RDS functions + control flags) with negative contrast for radio CD and CD MP3.
- Connection for hands-free phone (external phone).
- User-friendly menu for radio settings and external interfaces (CD-Changer, telephone).
- Remote controls on steering wheel.
- Possibility of interfacing with external CD-Changer via ASCI-BUS line.

CONTROL FUNCTIONS ON FRONT PANEL.
The figure below shows the markings on the radio front panel, describing the corresponding functions.

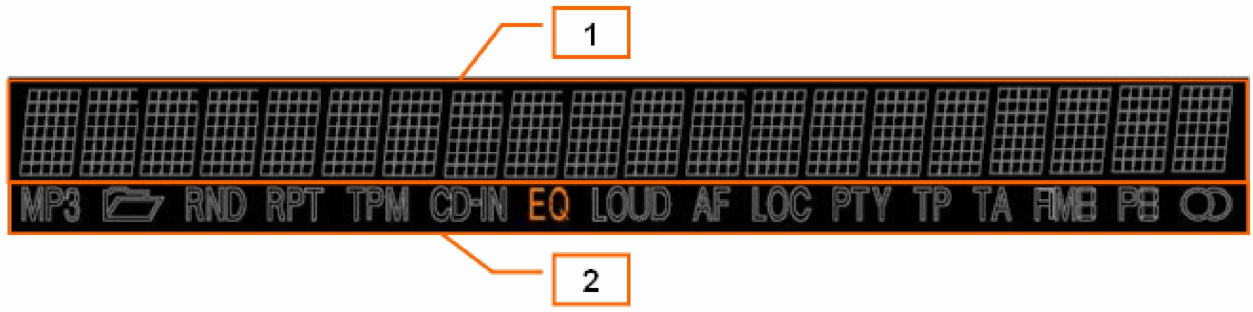
Key:

1. FM1, FM2, FM frequency reception enable button.
2. AM frequency enable.
3. Radio station memory button. Memory 1.
4. Radio station memory button. Memory 2.
5. Radio station memory button. Memory 3.
6. Radio station memory button. Memory 4.
7. Radio station memory button. Memory 5.
8. Radio station memory button. Memory 6.
9. Audio settings key (Bass, Treble, Fader, Balance, Loudness).
10. Plug for radio extraction tool hole.
11. Automatic radio search backward.
12. Manual search backward/forward.
14. Automatic search forward.
15. Settings menu button.
16. Plug for radio extraction tool hole.
18. Manual search backward.
19. CD-ROM slot.
20. Display.
21. CD-ROM eject button.
22. Audio volume increase button (+).
23. Plug fro radio extraction tool hole.
24. Radio on/off button.
25. Mute button.
26. Audio volume decrease button (-).
27. CD-ROM enable button.
28. Plug from radio extraction tool hole.

RADIO DISPLAY

The radio display is split into two areas:

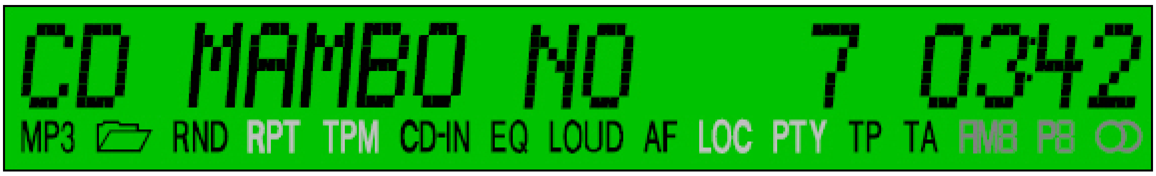
1. Information display area.
2. Active function symbols (icons) display area.



Area 2 displays the following symbols (icons):

1. MP3.
2. Folder.
3. RDN.
4. RPT.
5. TPM.
6. CD-IN.
7. EQ.
8. LOUD.
9. AF.
10. LOC.
11. PTY.
12. TP.
13. TA.
14. FM1, FM2, FM, AM.
15. Selected memory (P1…P6).
16. Stereo station symbol.

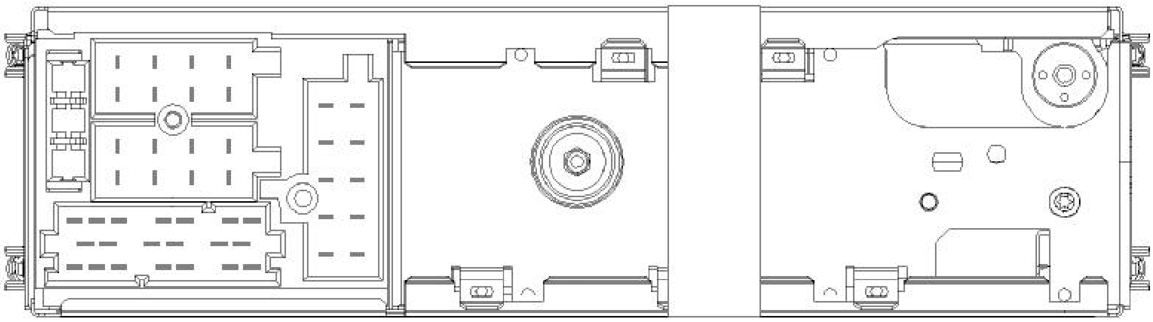
Example of display



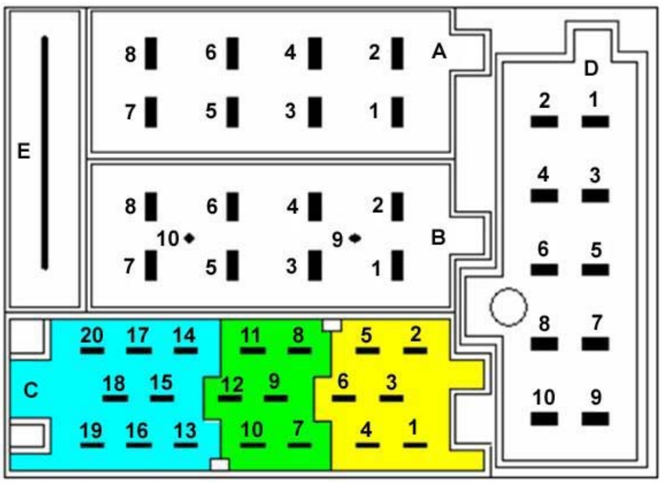
RADIO BACK PANEL

The following connectors are present on the back panel of the radio for connection to the vehicle wiring harness:

- N° 2 8-way connectors respectively for powering the radio and piloting the speakers.
- N° 1 20-way connector (consisting of 3 elements, yellow, green and blue) for connection of the steering wheel controls (if present as OPT) and for enabling the sub-woofer box (only present on Hi-Fi versions).
- N° 1 radio antenna connector.



RADIO PIN-OUT



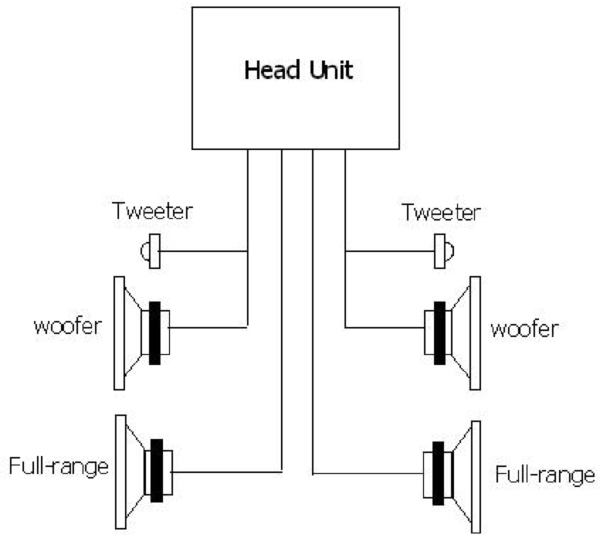
PIN	DESCRIPTION	PIN	DESCRIPTION	PIN	DESCRIPTION
A 1	B CAN (B) - H	C 1	Aux AF (L)	D 1	n.c.
A 2	Sub-woofer (input)	C 2	Aux AF (R)	D 2	n.c.
A 3	B CAN (A) - L	C 3	Aux AF (GND)	D 3	n.c.
A 4	+ 30	C 4	n.c.	D 4	n.c.
A 5	Automatic antenna	C 5	n.c.	D 5	n.c.
A 6	n.c.	C 6	Sub-woofer (12V)	D 6	n.c.
A 7	n.c.	C 7	Telephone AF in +	D 7	n.c.
A 8	Ground (GND)	C 8	Telephone AF in -	D 8	n.c.
		C 9	Telephone mute	D 9	n.c.
B 1	LS RR +	C 10	n.c.	D 10	n.c.
B 2	LS RR -	C 11	n.c.		

B 3	LS RF +	**C 12**	Mute (GND)
B 4	LS RF -	**C 13**	CDC Data (input)
B 5	LS LF +	**C 14**	CDC Data (output)
B 6	LS LF -	**C 15**	+ 30 CDC
B 7	LS LR +	**C 16**	+ 15 CDC
B 8	LS LR -	**C 17**	CDC Data (GND)
B 9	Maus Bus (output)	**C 18**	CDC AF (GND)
B 10	Maus Bus (input)	**C 19**	CDC AF (L)
		C 20	CDC AF (R)

BASE AUDIO SYSTEM

The base audio system has the following architecture:

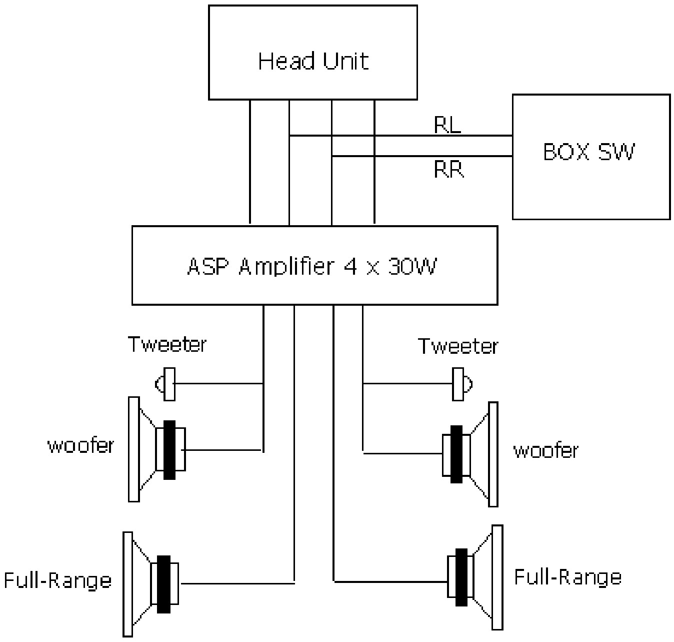
- 2 front tweeters, installed on pillars. (15.000 Hz; ≤ 5 ohm).
- 2 front woofers, installed in door panel. (200 Hz; ≤ 7 ohm; 165mm).
- 2 rear full-range, installed in side panels. (200 Hz; ≤ 7 ohm; 165mm).



HI-FI AUDIO SYSTEM (OPT)

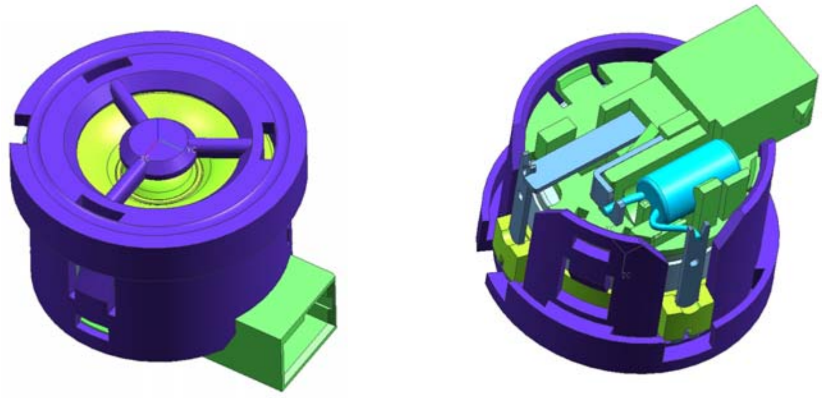
The base system has the following architecture:

- 2 front tweeters, installed on pillars (10.000 Hz; 2V rms; ≤ 5 ohm;).
- 2 front woofers, installed in door panel (500 Hz; 2V rms; ≤ 7 Ohm; 165mm).
- 2 rear full-range, installed in side panels (500 Hz; 2V rms; ≤ 7 Ohm; 165mm).
- 1 sub-woofer box under front right seat (80 Hz; 2V rms; ≤ 7 ohm; 30+30 Wrms):
  - 2 channel 2X13,75Wrms (6+6 Ohm) with ASP
  - Frequency range: 31,6 – 96,1 Hz (- 3 dB)
- Audio amplifier, 4x 30Watt, installed in rear right side panel.

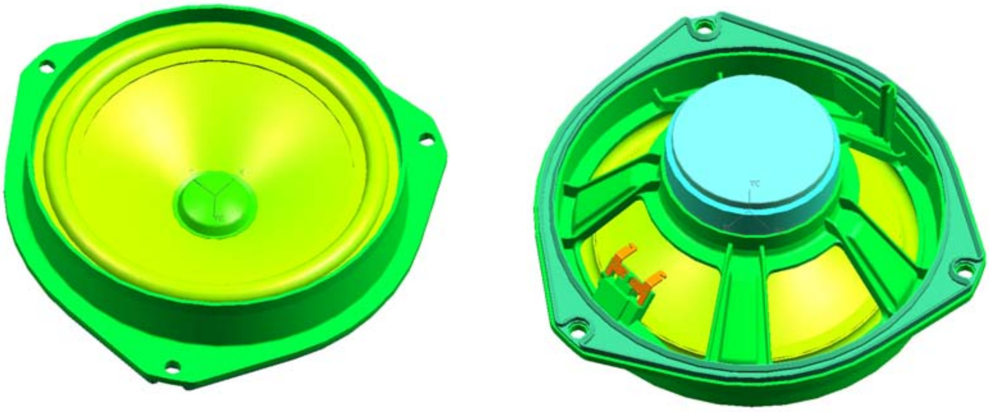


AUDIO SYSTEM COMPONENTS

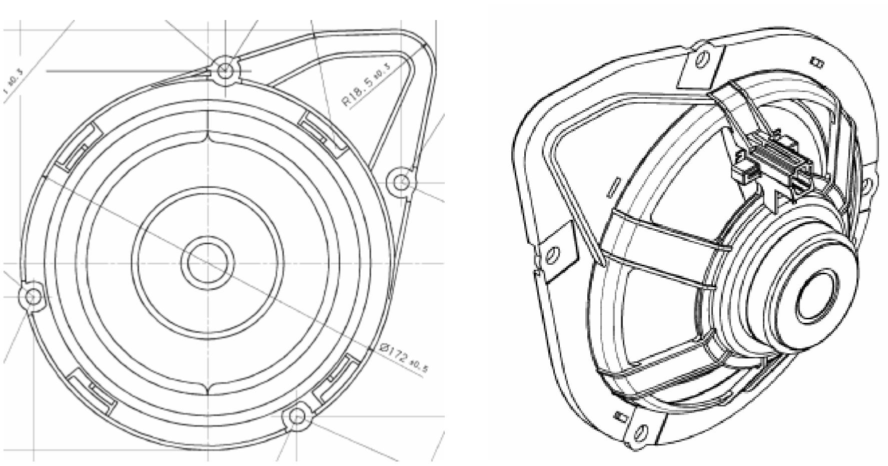
Tweeters



Woofers

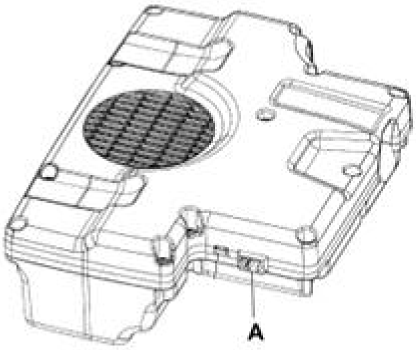


Full-Range



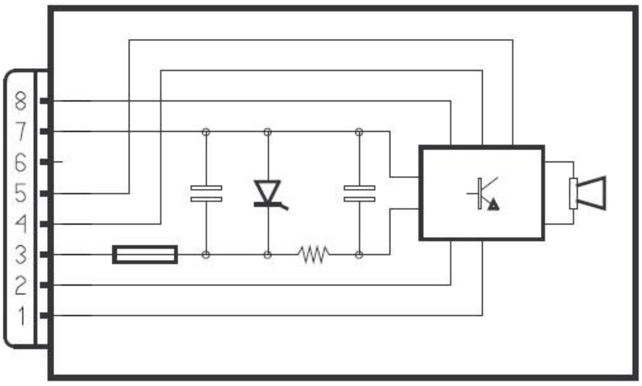
Sub-woofer box (HI-FI version)

The SubWoofer is located under the front right seat. It enhances low frequencies.

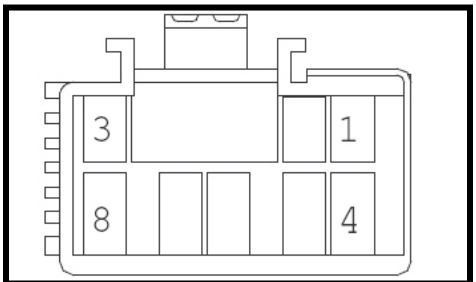


Sub-Woofer functional outline

The figure below gives and internal functional outline of the SubWoofer.



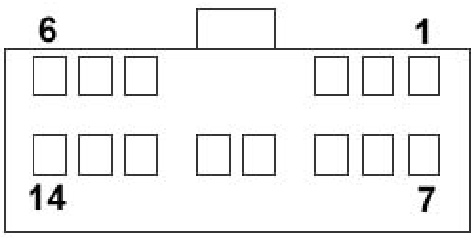
Sub-Woofer PIN-OUT

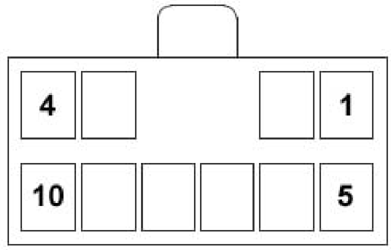


PIN	DESCRIPTION
A 1	Left audio input +
A 2	Right audio input +
A 3	+13.5 Vdc power supply
A 4	Left audio input -
A 5	Right audio input (-)
A 6	n.c.
A 7	Ground
A 8	+15

Audio amplifier (HI-FI version)
4x 30 Watt audio amplifier, installed on rear right side panel, serves to amplify the audio signal from the radio for the front and rear speakers, whereas the sub-woofer has its own built-in amplifier.

Amplifier Pin-out





Connector A		Connector B	
Pin	**Description**	**Pin**	**Description**
1	Front right speaker input (-)	**1**	+30
2	Front left speaker input (-)	**2**	Ground (GND)
3	n.c.	**3**	Rear right speaker input (-)
4	Rear left speaker output (+)	**4**	Rear left speaker input (-)
5	Rear left speaker output (-)	**5**	n.c.
6	Front left speaker output (+)	**6**	n.c.
7	Front right speaker input (+)	**7**	n.c.
8	Front left speaker input (+)	**8**	SubWoofer enable
9	n.c.	**9**	Rear right speaker input (+)
10	Front right speaker output (-)	**10**	Rear left speaker input (+)
11	Front right speaker output (+)		
12	Rear right speaker output (-)		
13	Rear right speaker output (+)		
14	Front left speaker output (-)		

STEERING WHEEL CONTROLS (OPT)

Certain radio functions can be controlled by means of the buttons on the steering wheel


Key:

1. Blue & Me voice controls.
2. Mute/ESC function selection button.
3. Volume UP button UP (+).
4. Volume DOWN button (-).
5. Station scan UP / CD track scan UP;
6. Audio source selector button: FM1/FM2/FMT/MW/LW (not available for South American market) / single CD / CD Changer (if present as OPT);
7. Station scan DOWN / CD track scan DOWN;
8. Blue&Me main menu activate.

ANTENNA

There are two antenna versions according to whether the vehicle has the optional sun roof.

Antenna (without sun roof)

Antenna stem 36 cm

Antenna support, inclined 75°

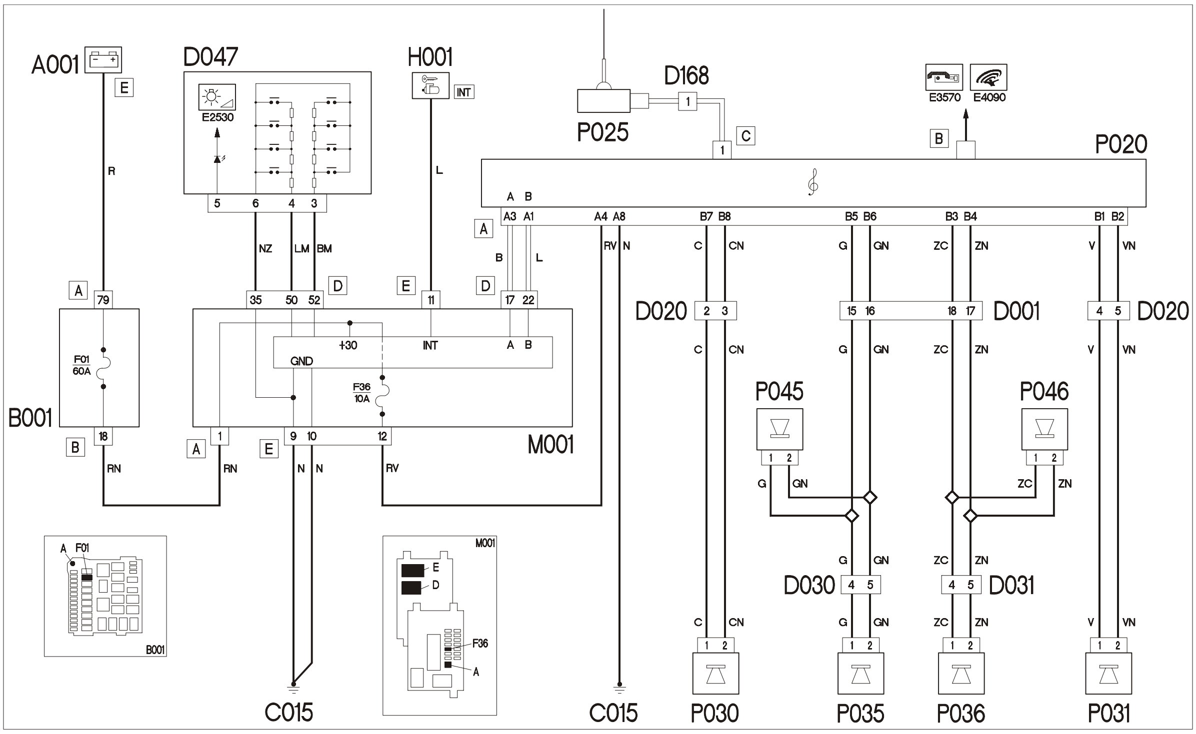
Antenna (with sunroof)

Antenna stem 36 cm

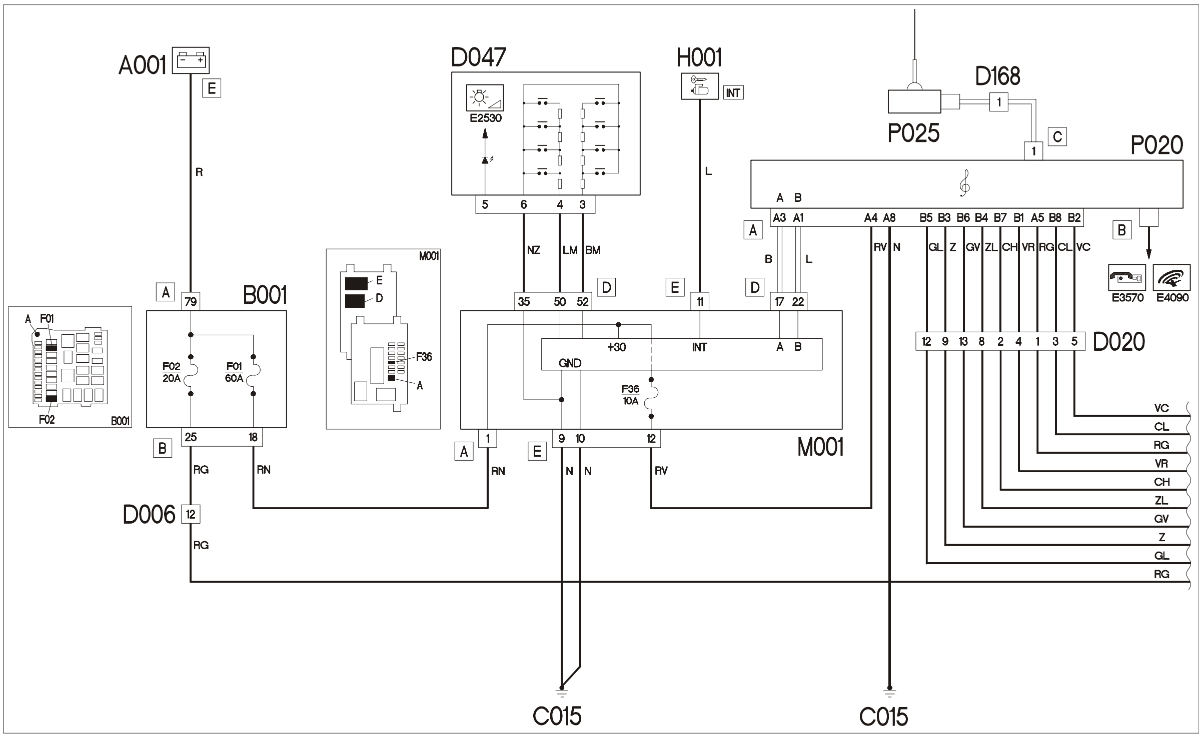
Antenna support, inclined 60°

CIRCUIT DIAGRAMS

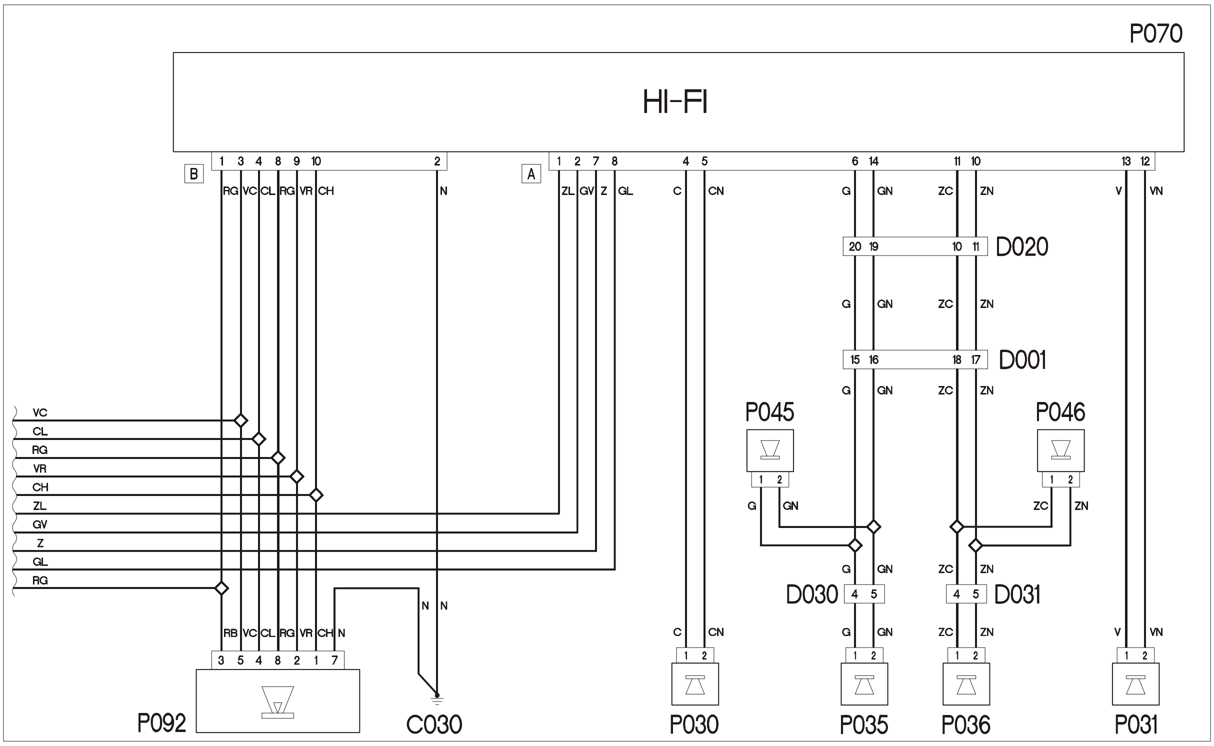
Base version



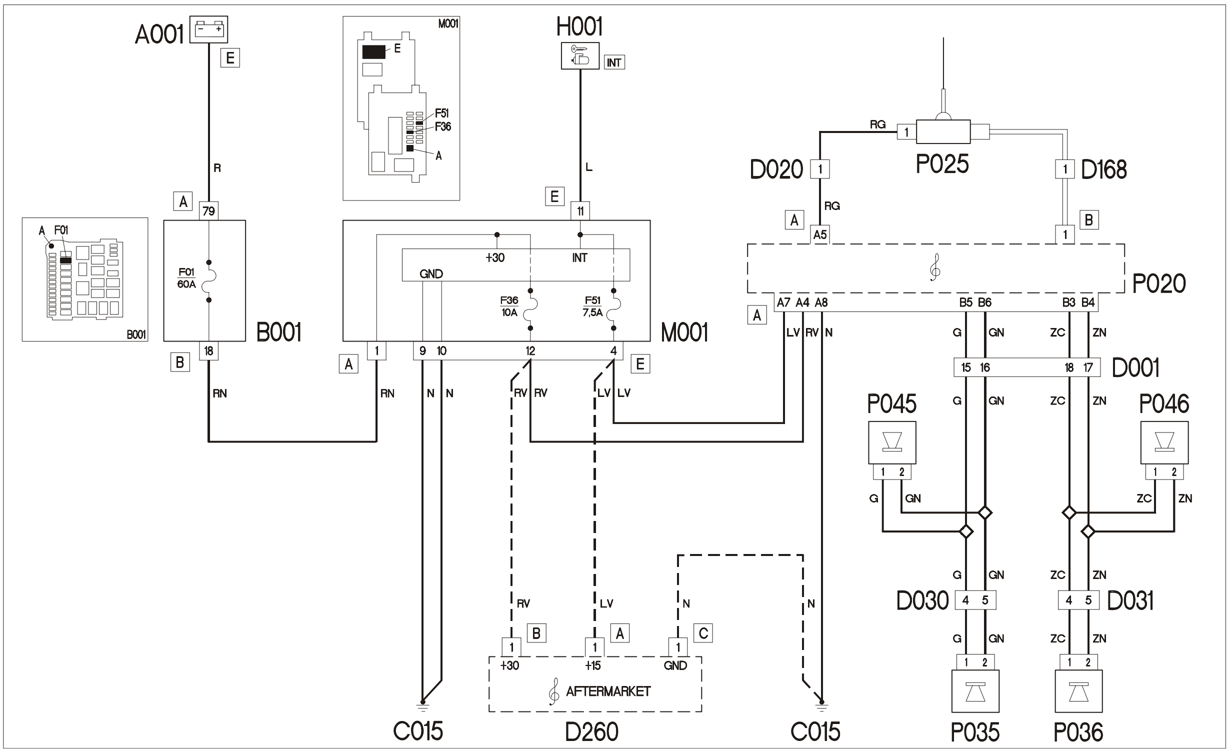
HI FI version (diagram A)



HI FI version(diagram B)



Predisposition



Key to diagram

A001: Battery.
B001: Junction box (fuses).
C015: Ground.
C030: Ground.
D047: Spiral contact junction (steering wheel controls)
D260: ?
H001: Ignition switch.
M001: Body Computer.
P020: Radio.
P025: Power supply/antenna amplifier.
P030: Rear left speaker)on rear shelf).
P031: Rear right speaker (on rear shelf).
P035: Front left door speaker.
P036: Front right door speaker.
P045: Front left tweeter.
P046: Front right tweeter.
P070: Radio / CD amplifier.
P092: Subwoofer.

E3570 : Circuit diagram reference.
E4090 : Circuit diagram reference.

Telematics

Blue&Me

This telematics system is Fiat's answer to the ever-increasing market demand for systems that permit the use of the cell phone in the vehicle, protecting the safety and operation of the user, and offering a range of multi-media services.
The support proposed is called "**Blue&Me**" and is incorporated in the vehicle dashboard.
Two types of "Blue&Me" are available:

- Version C1V2
- Version C3

The main difference between the two versions is that version C3 integrates the functions:

- Navigator with pictograms and voice messages.
- GSM Dual-Band telephone (only for communication with the service provider).
- Services.

SERVICES

SOS Emergency: On the road/health assistance with localisation upon request (SOS button) or automatic if the air bag explodes..
INFO Service: pressing a dedicated button, a variety of information (hotels, restaurants, weather, etc....) can be obtained live from a service operator. The service has no fixed charge, but is pay per use.
Insurance : Connection via computer with insurances and use of discount Internet policies .
Intelligent Maintenance : Detection of Wear and Expiry dates; Channelling on Fiat Auto after-sales service network.
Fleet Management : Vehicles localisation/visibility; KM control and report; Consumption and diagnostic.
Regarding insurance and fleet services, the Blue&Me system, after authorisation from the user, collects the information concerning vehicle use and transmits the data to the service provider and, after certain agreements, to the insurance companies. Through these indications the insurance companies can prepare policies on the real use of the vehicle and therefore significantly cheaper.

Future services
Drive Me: possibility of obtaining an SMS with your required destination from the INFO services operator, to automatically load destination into navigator.
Off Board: possibility of receiving a route toward a destination even if not present in on-board maps.

The Fiat **Blue&Me™** system, based on Windows Mobile™ is a latest generation computerised system incorporated in the car dashboard, that allows the use of applications for communication, entertainment and navigation specifically designed for use in the car.

The **Blue&Me™** system installed in the car includes the following functions:

- Hands-free telephone
- SMS messages reader
- Media player
- Navigator (version C3)

The **Blue&Me™** system**,** with its complete integration with voice commands, steering wheel controls and information on the car panel multifunction display, allows the client who has a cell phone with Bluetooth technology to use it, even if it is in a jacket pocket, or in a bag, without ever moving the hands from the steering wheel.
To use the voice commands, there is no need for voice learning by the voice commands system. The system is able to recognise the voice commands given, regardless of sex, tone of voice and pronunciation inflections

Furthermore it is possible to listen to your favourite music, stored on a USB device, selecting the pieces and playing mode either with the keys on the steering wheel or with voice commands.

On dot-matrix displays, and with the “Blue&Me” or “Blue&Me NAV” OPT, when the key is turned the displays shows the “Blue&Me” as shown below logo for per 2 seconds.

After this, the check phase proceeds as normal, displaying all other information while the logo disappears.

COMPONENTS AND LOCATION

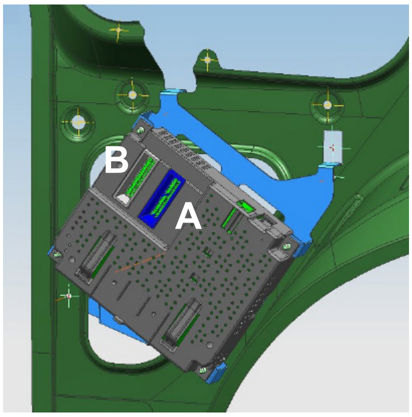
The Blue&Me system has the following components:

- Blue&Me control unit
- GSM module and SIM board (version C3)
- Radio with Tel-IN and Tel-MUTE inputs
- Microphone in ceiling light
- Panel on roof with **NAV, INFO (i), SOS** key. (version C3)
- Controls on steering wheel
- Display on car panel
- GPS/GSM aerial (version C3)
- USB key with preloaded map of a country/geographical area (version C3)
- USB socket (central tunnel)

BLUE&ME CONTROL UNIT

The Blue&Me control unit is connected to the B-CAN network with the radio node and the Body Computer, in turn connected to the controls on the steering wheel.

The picture below shows the location of the Blue&Me control unit on the car, mounted on a special bracket and secured to the rear side frame (LH side).



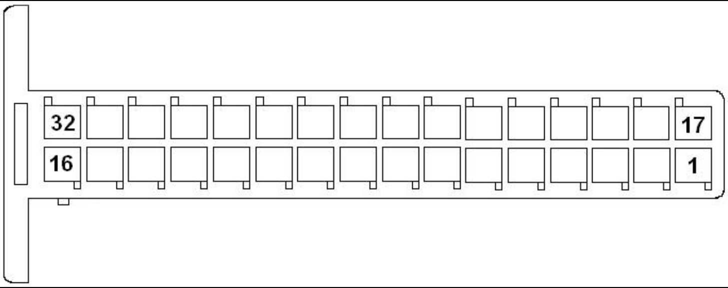
Blue&Me control unit electrical data:
Operating voltage range : 6 – 16 Volt.
Nominal power supply voltage : 13.5 Volt.
Voltage limit for 1 min. : 24 Volt.
Current draw Max: 220 mA (C1V2) 500 mA (C3).
Current draw in standby: 1.7 mA.

CONNECTORS (Blue&Me control unit)
On the control unit there are two 32-pin connectors, which, according to the Blue&Me version, can be used or not. The table below shows the combination of connectors use, according to the Blue&Me version:

	Connectors		
	A	**B**	**USB**
C1V2	X	O	X
C3	X	X	X

Key:
X: Present.
O: Not present.

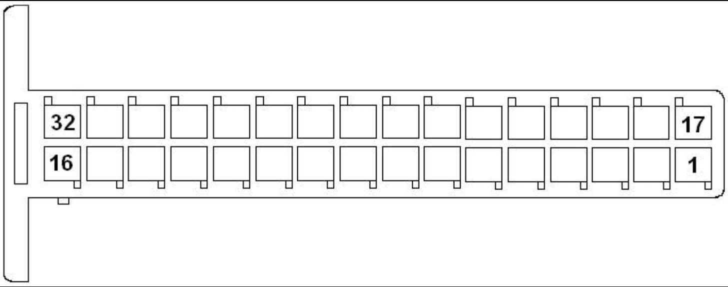
PIN-OUT



CONNECTOR A			
PIN	**Description**	**PIN**	**Description**
1	n.c.	**17**	n.c.
2	n.c.	**18**	n.c.
3	USB D (+)	**19**	USB D (-)
4	USB Signal ground (GND)	**20**	USB Signal
5	Output Audio (L)	**21**	Output Audio (ground)
6	USB cable shield	**22**	Output Audio (R)
7	TEL out (+)	**23**	TEL out (-)
8	MIC (+)	**24**	MIC. shield
9	n.c.	**25**	TEL (mute)
10	n.c.	**26**	n.c.
11 *	n.c.	**27**	n.c.
12 *	n.c.	**28 ***	n.c.
13	n.c.	**29 ***	n.c.
14	B CAN (A)	**30**	B CAN (B)
15	Ground	**31**	n.c.
16	+ 30	**32**	+ 15

Note: (*) Pins active in C3 version.

- Pin 11: **SOS, INFO, NAV** (GND) keys – Voltage splitter.
- Pin 12: No GSM signal LED command.
- Pin 28: **SOS, INFO, NAV** (Input)keys – Voltage splitter.



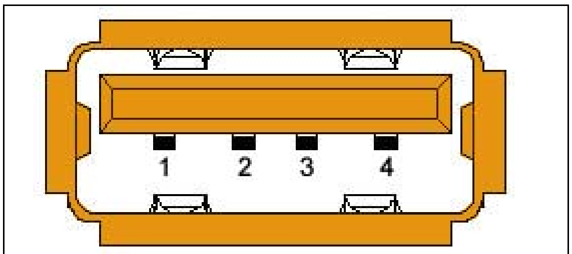
CONNECTOR B			
PIN	**Description**	**PIN**	**Description**
1	C CAN (H) Input	**17**	C CAN (H) Output
2	C CAN (L) Input	**18**	C CAN (L) Output
3	n.c.	**19**	n.c.
4	n.c.	**20**	n.c.
5	n.c.	**21**	n.c.
6	n.c.	**22**	n.c.
7	n.c.	**23**	n.c.
8	n.c.	**24**	n.c.
9	n.c.	**25**	n.c.
10	n.c.	**26**	n.c.
11	n.c.	**27**	n.c.
12	n.c.	**28**	n.c.
13	n.c.	**29**	n.c.
14	n.c.	**30**	n.c.
15	n.c.	**31**	n.c.
16	n.c.	**32**	n.c.

Microphone in ceiling light
The microphone is mounted on the roof panel near the front ceiling light.

GPS / GSM aerial (C3 version)
The two aerials are inserted in the FM aerial base.

USB SOCKET
The picture below shows the location of the USB socket, on the central tunnel near the parking brake lever.

PIN OUT USB



Pin	Description
1	Signal (BUS)
2	Power supply (+)
3	Power supply (-)
4	Ground (GND)

CONTROLS ON STEERING WHEEL

Through the steering wheel controls, Blue&Me and radio share the control source and each appliance responds to its own commands according to the pushbutton pressed and the operating mode active at that moment (in this case Blue&Me prevents the radio from executing commands from the steering wheel when the Hands-Free function is active).

List of steering wheel control functions

Key	Brief pressure (< 1s)	Long pressure (> 1s)
1	- Activates voice recognition - Interrupts voice message, so as to send a new voice command .	Repeats last voice message emitted by the system.
2	- Deactivates voice recognition. - Interrupts voice message. - Interrupts SMS message reading. - Exits from Blue&Me Main Menu. - Exits from a sub-menu and returns to previous menu option. - Exits from current selection without saving. - Deactivates/reactivates microphone during a telephone conversation - Resets call tone volume for incoming call. - Activates/Deactivates media player pause.	
3 - 4	- Regulation of Blue&Me audio volume functions : hands-free, SMS messages reader, media player, voice announcements.	
5 - 7	- To scroll Blue&Me menu items. - To select excepts from media player. - To scroll SMS messages in the list.	
6	- Confirms menu option selected during manual interaction. - Transfers phone-call in progress from hands-free to cell phone and vice-versa. - Selects audio sources (Radio, CD, CD Changer, Media player). - To select displayed SMS messages .	
8	- Activates Blue&Me Main Menu. - Confirms selected menu option. - Accepts incoming phone call. -Switches from one telephone conversation to another in second-call mode (call waiting service). - To select displayed message.	- Refuses incoming call . - Closes telephone call in progress.

Note: For many functions, the steering wheel controls (6) and (8) are interchangeable, therefore it is possible to choose the key which is preferred.
For both modes to activate steering wheel controls (brief or long pressure) the function is actuated when the key is released

BLUE&ME MENU

The Blue&Me Main Menu displays the options in a list that is shown on the multifunction display of the car panel. Options can be used to activate Blue&Me system functions or change the settings .

To activate the Blue&Me Main Menu, press the TEL/MAIN key, after which you can start to interact with the system using the controls on the steering wheel.

- To navigate among the items of a menu, press keys ▲ or ▼.
- To select the option shown on the display, press keys SRC/OK or TEL/MAIN .
- To exit from the displayed item or from a sub-menu, press MUTE/ESC.
- To answer an incoming call while another telephone call is in progress, press TEL/MAIN. The system will switch to the incoming call and leave the current call in standby.
- To transfer a telephone conversation from hands-free to your cell phone, press SRC/OK.

Note: When viewing the names in the phone book, if the number of characters is more than the maximum allowed, the name is sliced.

- **LAST CALL** – with this sub-menu you can see a list of recent calls, made or received. This list is downloaded from the memory of your cell phone, updated during the use of hands-free or obtained from both operations.

- **PHONEBOOK** - with this sub-menu you can see the telephone numbers in your phone book and select one to make a call. If your phone book contains many numbers, they will be grouped in alphabetic sub-menus. The number of persons in a sub-menu depends on the number of names in your phone book.

- **SMS MESSAGES READER** – with this sub-menu you can read the last SMS message received, call the SMS sender or delete the last SMS message received. Up to 20 SMS messages can be stored in a specific list to be listened to later, call the sender or delete. It is also possible to choose the notification mode of SMS messages received.

- **MEDIA PLAYER-** with this sub-menu you can scroll the digital audio excerpts in the library according to folder, artist, type, album or playing lists. Still with this sub-menu you can select and play the pieces.

- **NAVIGATION** - with this sub-menu you can access the Blue&Me™ navigation functions. It is possible to enter a new destination, use one of the last destinations, change the navigation settings, access information on the vehicle GPS position, or simulate a previously calculated route (only version C3).

- **SETTINGS** - with this sub-menu you can manage the names in your phone book, record a new device or have access to the identity code of the hands-free system .

EXTENDED BLUE&ME MENU

- **SMS MESSAGES READER:**
  - **Read message** – Reads last message received.
  - **Messages reader** – Activates messages reader menu.
    - **Read last message** – Reads last message received.
    - **Messages received** – Accesses list of received messages .
      - **Read** – Reads selected message from those contained in the list of messages.
      - **Call** – Activates call to number.
      - **Delete** – Deletes selected message from the messages list.
      - **Forward –** Passes to next message.
      - **Backward –** Passes to previous message .
    - **Delete messages** – Deletes all the messages in the messages list.
    - **Type of notification** – Activates notification settings function.
      - **Deactivate reader** – Deactivates SMS messages reader.
      - **Visual and acoustic** – Visual indication on car panel display and acoustic indication by a beep, that a new message has arrived .
      - **Visual only** – Only visual notification on the car panel display that a new message has arrived .

- **MEDIA PLAYER:**
  - **Media player**– Activates media player menu
  - **Sound** – Activates digital audio playing.
  - **Stop** – Stops digital audio playing.
  - **Next** – Moves to next menu option or next musical excerpt.
  - **Previous** – Moves to previous menu option or previous musical excerpt .
  - **Start random playing** – Activates function to play pieces in random order .
  - **Stop** – Deactivates function to play pieces in random order .
  - **Start continuous playing –** Activates function for continuous playing of musical pieces.
  - **Stop continuous playing -** Deactivates function for continuous playing of musical pieces.
  - **Music information** – Displays information regarding the piece being played.
  - **Folders** – Activates the Folders menu of the media player.
  - **Artists** – Activates the Artists menu of the media player.
  - **Types** – Activates the Types menu of the media player.
  - **Album** – Activates the Album menu of the media player.
  - **Playlist** – Activates the Playlist menu of the media player.
  - **Start automatic playing** – Activates the function for automatic audio playing when car USB device is inserted.
  - **Stop automatic playing** – Deactivates the function for automatic audio playing when car USB device is inserted.
  - **Any** – Activates automatic playing of all digital audio pieces present .
  - **Multimedia file settings** – Activates Media player menu .

- **NAVIGATION :**
  - **Next move** – Repeats last voice message during navigation.
  - **Resume navigation** – Resumes a navigation session.
  - **Arrival Information** – Gives an estimate on the time of arrival and the distance to be covered
  - **Suspend navigation** – Interrupts a navigation session.
  - **New destination** – Accesses the menu to enter a destination.
    - **Address** – To enter a destination address.
      - **Town centre** – Starts navigation toward town centre.
      - **Enter Street** – To enter the name of the destination street/square .
        - **Enter number** – To enter the civic number of the destination address.
        - **Start** – Starts navigation toward the displayed destination.
    - **Points of interest** – To select a point of interest as destination.
      - **Town centre** – Starts navigation toward town centre.
      - **Elsewhere** – To select a point of interest in the vicinity of the chosen address. See "Environs" sub-menu .
      - **Environs** – To select a point of interest in the environs of the car.
        - **List** – Gives a voice list of groups of available points of interest.
        - **Airport** – Airports group selection.
        - **Bus station** – Buses group selection.
        - **Ferry station** – Ferries group selection.
        - **Hospital** – Hospitals group selection.
        - **Park and ride** – Park&Ride. group selection
        - **Car park** – Car parks group selection.
        - **Police** – Police group selection.
        - **Car Hire** – Car Hire group selection.
        - **Lay-by** – Lay-by group selection.
        - **Railway station** – Railway station group selection.
        - **Authorised workshops** – Authorised workshop group selection.
        - **Service station** – Service station group selection (Petrol station).
        - **Pharmacies** – Pharmacies group selection.
        - **Restaurant** – Restaurants group selection.
        - **Hotel** – Hotels group selection
  - **Last destinations** – Calls up one of the last destinations set.
    - **Start** – Starts navigation toward displayed destination .
    - **Forward** – Displays the next destination on the list.
    - **Backward** – Displays the previous destination on the list.
    - **Delete** – Deletes the destination displayed .
    - **Delete all** – Deletes all the destinations contained in the list.
  - **Navigation settings** – To enter the preferences on the type of route to follow.
    - **Type of route** – Starts navigation toward the displayed destination .
    - **Set motorway** – to include, or not include motorways in the calculation of the route.
    - **Set ferries** – to include, or not include ferries in the calculation of the route.
    - **Set toll roads** - to include, or not include toll roads in the calculation of the route.
    - **Dictate destination** – Enable or not voice completion of the destination.
  - **Car position** – Supplies an indication regarding latitude, longitude and number of GPS satellites .
  - **Route simulation** – Simulates the set route.

❖ **SETTINGS :**

- **Settings** – Activates Settings menu.
  - **User data** – Activates USER DATA menu.
    - **Delete users** –Deletes recorded data of all users.
    - **Delete phone book** – Deletes current phone book.
    - **Copy phone book** – Transfers phone book of connected cell phone to hands-free system.
    - **Add contacts** – Transfers phone book of connected cell phone to hands-free system (management of single contacts).
    - **Delete All** – Deletes recorded data and the entire phone book of all recorded telephone numbers.
  - **Register** – Activates the procedure to register a new cell phone . (* Note).
  - **Update** – Activates the Blue&Me update function.
  - **Hold** – Temporary suspension of update procedure in progress.
  - **Resume** – Continues the previously suspended update procedure.
  - **Advanced options** – Activates the Advanced options menu.
    - **System code** – Displays identity code of hands-free system.
    - **Connection code** – Activates GPRS CODE menu.
- **Media file settings** – Activates media player random playing of audio excerpts.
- **Random playing** – Activates/Deactivates random track reproduction
- **Continuous playing** – Activates/deactivates continuous reproduciton of audio tracks
- **Automatic playing** – Activates/deactivates automatic playing of audio tracks when USB device is inserted

*** *Note:*** To download and manage Blue&Me updates, make sure that a GPRS Data Plan is active on your telephone number. If it is not, ask for it from your telephone service provider.

VOICE COMMANDS (TELEPHONE)

- **Call number** – Activates voice entry of a telephone number.
  - **One** – To enter digit “1”.
  - **Two** – To enter digit “2”.
  - **Three** – To enter digit “3”.
  - **Four** – To enter digit “4”.
  - **Five** – To enter digit “5”.
  - **Six** – To enter digit “6”.
  - **Seven** – To enter digit “7”.
  - **Eight** – To enter digit “8”.
  - **Nine** – To enter digit “9”.
  - **Zero** – To enter digit “0”.
  - **Plus** – To enter “+” symbol.
  - **Asterisk** – To enter “*” symbol..
  - **Hatch key** – To enter “#” symbol..
  - **Delete** – To delete last set of digits entered.
  - **Start again** – To delete all the sets of digits entered with possibility to enter a new number.
  - **Repeat** – To repeat telephone number entered and recognised by free-hands system.
  - **Call** – To send a call to the number entered by voice
- **Call name** –Activates the call of a name in the phone book of the cell phone and copied on hands-free system.
  - **Name** – The voice Name command is the name under which the number is memorised in the phone book of the cell phone .
- **Last call received –** Composes the telephone number of the last person who called.
- **Last call made –** Composes the telephone number of the last person called.
- **Recall** – Access to last call.
- **Made –** Composes last phone number of last person who was called .
- **Received –** Composes phone number of last person who called.

VOICE COMMANDS ALWAYS AVAILABLE

- **Help** – Activates the "HELP" function that gives a list of the voice commands available at the current level.
- **Cancel** – Cancels the voice interruption and deactivates the voice recognition system.
- **Repeat** – Repeats the last message given by the hands-free system.

LANGUAGES AVAILABLE

The following languages are available, for the texts displayed (menus) and for "voice recognition" and "text to speECM" messages :
French
English
German
Italian
European Spanish
Dutch
European Portuguese
Polish

The change of language and any software updating of components is to be carried out by the dealer.

Instrument panel display

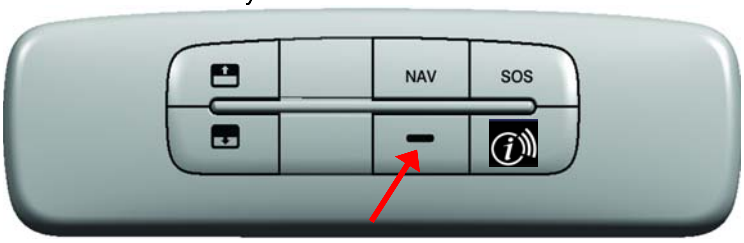
- Bluetooth attivo
- Cellulare
- Nome operatore
- Menù
- Radio
- Navigazione

ADDITIONAL CONTROL PANEL

The panel applied on the roof (front ceiling light zone) is pre-set for:

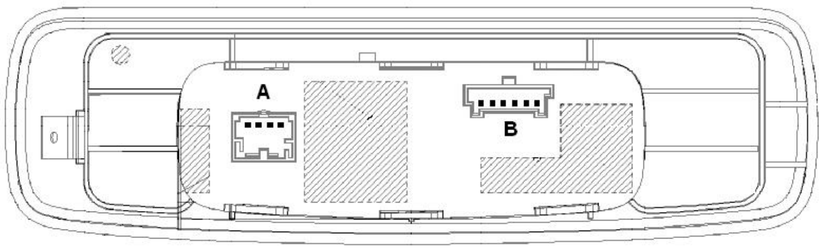
- NAV Quick connection to navigation menu.
- SOS Road or Health Assistance with localisation of car.
- INFO Concierge service for live information regarding points of interest along the route: dealers, workshops, service stations, pharmacies, restaurants, hotels, cinemas, discos, as well as information about traffic, weather, events.
- Sunroof opening and closing (OPT).

IMPORTANT NOTE the SOS and INFO keys will not be active if there is no service contract

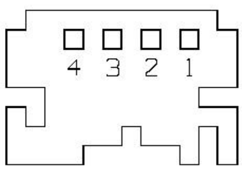


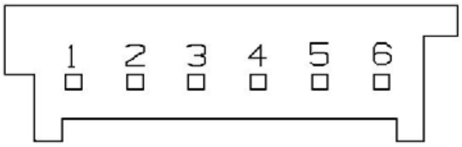
The control panel has an LED (see arrow) that comes on to indicate the absence of GSM coverage. The SOS and INFO applications will not function in areas without GSM cover.

Rear view of additional control panel



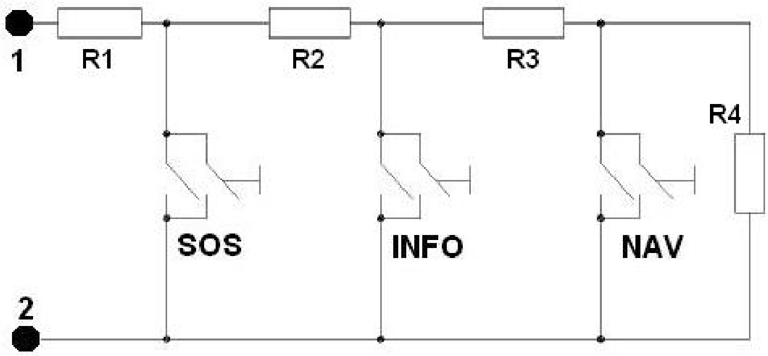
PIN OUT of additional control panel

	**Connector A**
Pin	**Description**
1	Ground (GND)
2	Close roof (OPT)
3	Open roof (OPT)
4	Lighting



	Connettore B
Pin	**Description**
1	SOS, INFO, NAV. key signal (+) Voltage divider.
2	SOS, INFO, NAV key signals (-) Voltage divider.
3	n.c.
4	LED control by Blue&Me. (NAV active)
5	Ground (GND).
6	+15 – key lighting.

Keys voltage splitter circuit diagram (SOS, INFO, NAV)



Resistance values:
R1: 4 KΩ ± 1%
R2: 261 Ω ± 1%
R3: 127 Ω ± 1%
R4: 46 Ω ± 1%

System functions (C1V2 and C3)

The following system functions are available:
Automatic phone connections via bluetooth.
Manual interaction from menu or with synthesis and voice recognition.
Phone book complete transfer to system.
Display on car panel of caller's number or name (if already in phone book).
Possibility to compose a number by voice, digit by digit, or to call a number stored in the user phone by pronouncing the name.
Search for a number in the phone book scrolling it on the panel display using the steering wheel keys.
Possibility to set the communication in "mute" through the steering wheel controls.
Copying the "personal" telephone radio into the radio system.
Compatibility with 90% of telephones on the market and upgradeability to remain compatible with new standards and future telephones.

Up to 5 users can be stored in Blue & Me, but only one phone at a time can be connected.
With several phones memorized, at Key-on the Blue&Me automatically connects with the last phone that made or received a call.
In any case, only one cell phone can be connected to Blue&Me via BlueTooth.

Connection with bluetooth telephone
The system that connects to a cell phone with Bluetooth and Hands Free Profile interface.

The first connection between cell phone and Blue&Me device (called Pairing) is regulated by a password; The user connects by means of the password that is displayed on the instrument panel after activating the related Bluetooth connection procedure from the relevant menu, and entering it on his/her cell phone,.

Bluetooth Hands Free Profile in detail
- The Bluetooth system switches on autonomously at Key On and immediately starts the search for Bluetooth devices (cell phones) to connect to.
- the appliance switches off autonomously at Key Off possibly leaving the Bluetooth connection active: there is a delay of 30 seconds (preliminary value) to compensate for accidental shutting off of the engine (in traffic jams, at traffic lights, etc.) .
- if a phone-call is in progress, the conversation is kept active (except for the display on the car panel) even after key-off; the control unit and the radio shut down after the conversation finishes .

List of compatible cell phones
The current hands-free system with Bluetooth tECMnology is compatible with all cell phones that support Bluetooth 1.1 specifications and HandsFree profile 1.0 (see Bluetooth connection characteristics indicated in the cell phone owner's handbook).

Because of the possible different software versions available on the market for different cell phone models, some auxiliary functions (for example call waiting service, call transfer from hands-free to cell phone and vice-versa, etc.) may not correspond exactly to what is written in the cell phone owner's handbook. In any case the possibility to converse with hands-free is not compromised.

The table below contains cell phones that, at the time of updating this handbook, have been fully tested for functioning with Bluetooth hands-free system; also indicated are models for which complete functioning has not been verified.

Make	Models compatible with Blue&Me	Other potentially compatible models
Asus		P505
Audiovox	SMT 5600/Orange (HTC) C500	
BlackBerry		7100, 7290, 8700i
Hewlett Packard	iPAQ 63xx, iPAQ 6515	
i-Mate	SP3, SP5/SP5m	JAM, Jamin, Jasjar, K-Jam, PDA2K, Smartphone 2, SP3i
LG	U880, U8550	U8210, U8360, Chocolate
Motorola	A830/A835, E398, Razr K1/Capri, MPX 220, V3 Razr, V500, V501, V525, V535, V600, V635	A780, A1000, E550, E680, E1000, PEBL V6, ROKR E1, V80, V545, V547, V557, V600i, V620
Nokia	3230, 3600/3620/3650/3660, 6230/6230i, 6280, 6310/6310i, 6600, 6620, 6630, 6680/6681, 6810/6820/6822, 7600, 7610, 8800, 8910/8910i, 9500, N70, N-Gage	3250, 6021, , 6260, 6650, 6670, 7280, 7710, 9300, N90, N-Gage, N-Gage QD
Palm		Treo 650
Panasonic		P341i, X11, X70, X88
Qtek	8010, 8300/8310, 9100, S200	8080, 8020, 8100, 8200, 9000, 9090, S100
Sagem		MYX-8, MYV-76
Samsung	SGH-D600, SGH-D820, SGH-E770, SGH-i300, SGH-i750	SGH-D500, SGH-E340, SGH-E620, SGH-E720, SGH-E860, SGH-E880, SGH-S500i, SGH-Z130, SGH-Z140/SGH-140V, SGH-Z500
Sendo		X, X2
Sharp		GX15/GZ100, GX25, GX30i/GX31/GX32, TM 200
Siemens	SL75	CX75/M75, S65, S66, SX1, SK65, SL55
Sony Ericsson	K700/K750i, P910i, T68/T68i, T606/T608/T610/T616/T618/T628/T630/T637, V800, Z600/Z608, Z1010	K600i/V600i, K608i, S700/S700i/S710, W800/W800i, Z520i, W600i
SPV	C500, C600	
Telit		Neo

Note: On the official FIAT website **(www.fiat.com)**, selecting the "Blue&Me" window, there is an updated list of cell phones that are compatible with Blue&Me

Note: It is pointed out that because of possible different software versions available on the market for different cell phone models, some functions may not correspond exactly to what is described.

Navigator function

Blue&Me™ Nav to reach the selected destination quickly and safely through the navigation function, using the voice synthesis and the pictograms shown on the reconfigurable car panel multi-function display. With the navigation system you can navigate to a destination address, call up destinations already programmed or points of interest (such as: hotels, restaurants, pharmacies, airports, railway stations, authorised workshops, etc.). The position of the vehicle is determined by the GPS (Global Position System), with the processing of signals coming from GPS satellites and from the car odometer signals .

Blue&Me™ Nav, according to where you are, it uses the digital maps preloaded on your USB device to guide you to your destination by the best route.

Navigation display on instrument panel
On the reconfigurable multifunction display of the car panel (see **fig. xx**), the instructions are shown with pictograms (turn right, turn left, circle round, continue straight ahead or reverse).

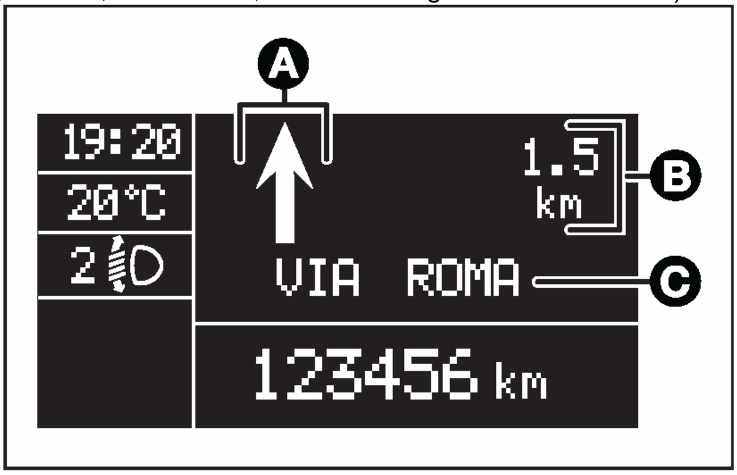
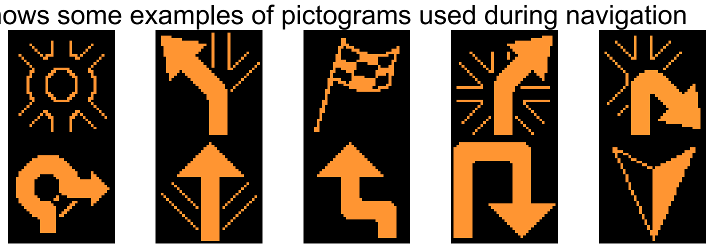


fig. xx

Key:
A – Navigation pictogram
B – Distance before next move
C – Name of street

Navigation pictograms
The table below shows some examples of pictograms used during navigation



NAVIGATION START-UP
To start using **Blue&Me™ Nav** navigation, proceed as follows:
Connect your USB device with the preloaded maps to the USB port on the car.
Set the car ignition key on **MAR**.

Note: In compliance with the highway code, some functions, such as, for example, entering a new destination, are only enabled when the vehicle is stationary.

To activate the **Navigation** menu in manual mode, proceed as follows:
Press the **NAV** key in the front ceiling light zone.
Or activate the Main Menu by pressing **MAIN**, select **Navigation** and press **SRC/OK** or **MAIN**.

Voice indications
The voice indications of the system give timely advice regarding all the moves to be made: in particular a warning message is first announced regarding the move that is to be made, followed by the detailed indications when the actual manoeuvre is made.
To have the repetition of the last voice indication given, press the (logo windows) key and say “Next move”

Warning: The indications given by Blue&Me™ Nav do not relieve the driver of full responsibility for manoeuvres made in traffic when driving the car, and compliance with the highway code, as well as any other regulations concerning road traffic.
It is always the car driver who is responsible for safety on the road.

Operating procedure

Incoming calls
- when the signal of an incoming call reaches the telephone: the radio switches to mute, the speakers emit the cell phone users ring tone and on the instrument panel display the number/name of the caller is shown (if available)
- at this point the user accepts or refuses the call
- during the conversation the user listens to the remote user on the radio audio system, and talks through the microphone
- at the end of the conversation the radio returns to its previous condition before the call (volume, mode)

While the conversation continues, the user can carry out these operations:
- change the volume of the conversation with the Radio Vol + and Vol - keys. The level set is reset at the end of the conversation the next will have the default volume of the radio.
- pass the conversation in progress from the Bluetooth control unit to the cell phone (and vice versa) to speak with more privacy (local privacy)
- interrupt the conversation with the remote user for a moment (keeping it in hold) to speak privately with another passenger in the car without being heard by the user on line (remote privacy)
- answer another incoming call and pass from one conversation to the other
- refuse another incoming call

For the last 2 functions listed, the necessary characteristics and authorisations are required on the GSM network, on the user profile and on the cell phone to manage 2 calls simultaneously.

Outgoing calls
The user can make a call in 4 ways
- using the cell phone keypad
- using the list of the last calls
- using the phone book of the cell phone
- dictating the number of who is to be called.

Media player
With the Blue&Me media player you can play, through the car radio system, the digital audio memorised on a USB device, just by connecting it to the USB port of the car at the base of the central console, next to the current socket/cigar lighter.

The following operations are possible with the media player:
play digital audio: all digital audio files can be played (.mp3 - .wma - .wav) or a personal playlist (in .m3u or .wpl format);
select the audio according to category: it is possible to play all the audio of a certain category, for example an album, an artist or a type of music;
use the play functions : while playing the pieces, certain functions can be used, such as Play, Stop, Next piece, previous piece, random play and continuous play.

Note: The media player cannot be used with compressed audio files with other formats (such as .aac files downloaded from itunes for ipod players) and protected DRM files (Digital Right Management).
If there are audio files on the USB device that are not compatible, they will be ignored.

Compatible digital audio files: the media player can play audio files with these formats:
:

Extension	Audio extension
.wma	- Supports standard WMA version 1 and WMA version 2.(WMA2 = 353, WMA1 = 352). - Supports audio formats WMA Voice
.mp3	- File MPEG-1 Layer 3 (sampling frequency 32 kHz, 44.1 kHz e 48 kHz) and MPEG-2 layer 3 (16 kHz, 22.05 kHz e 24 kHz). - The following bit rates are supported: 16 kbps, 32 kbps, 64 kbps, 96 kbps, 128 kbps, and 192 kbps. - Supports also the Fraunhofer extension MP2.5(sampling frequency 8 kHz, 11.025 kHz e 12 kHz).
.wav	Audio in digital format without data compression .

SMS voice player
If the telephone can support this function, the system includes the “SMS messages voice player”. This is an application that allows the Client to listen to the automatic reading of the incoming messages on his/her cell phone through the car audio system.

With the Blue&Me SMS message player the Client can:

- be informed, by a warning message on the car panel multifunction display, that a new SMS message has arrived on the cell phone, with indication of the sender’s number/name, Blue&Me also proposes the playing of the message.
- manage the list of SMS messages received on the cell phone connected with Blue&Me
- re-read the SMS messages already read and stored.
- make a voice call to the sender of the SMS message received using the steering wheel controls or voice commands.
- delete single SMS messages or the entire list of received SMS messages using the steering wheel controls or the voice commands.

Note: The Blue&Me system is also able to recognise and read any abbreviations and interpret the more common emotions (example :-) will be read as “Smile") that are used today i SMS messages

Warning : Some cell phones on the market may not support the transmission of linked SMS messages (more than 160 characters). See the cell phone owner’s handbook.
.

BLUE&ME SYSTEM ASSISTANCE SERVICE

Control unit replacement
Before removing the old control unit, disconnect the battery terminals.
Order a new control unit through Spare Parts dept who will send a “blank” component: after assembly, it will be necessary to transfer the initial default data, carrying out the "ALLINEAMENTO PROXI" (alignment) procedure with Examiner .
After the new control unit has been installed it is necessary to:
- update the software;
- check and if necessary correctly set the language of the voice messages;
- proceed with the "pairing" operations of the telephones to be connected.

Operations with Examiner
To carry out the operations to change the language for the voice messages and to update the software. it is necessary to temporarily install a special operating system on Examiner, using the specific CD-ROM ""WINDOWS MOBILE FOR AUTOMOTIVE EXAMINER CD" supplied together with the normal Examiner software updates
Furthermore, as already mentioned, it is necessary to have a USB “pen” to transfer the data on the system control unit.
The pen is to have these characteristics : USB version - standard 1.0, 1.1, or 2.0 with minimum memory of 256 MB and compatibility with "WINDOWS XP" or "WINDOWS 2000".

Note: When using this pen for the above operations , this is “formatted” and therefore loses any data that was previously contained in it !
Note: Never disconnect the car battery terminals while carrying out the operations indicated here.

Always work (regardless of the operation) in the following sequence:
- switch on Examiner in the normal functioning mode
- insert the "WINDOWS MOBILE FOR AUTOMOTIVE EXAMINER CD"
- swish off Examiner
- insert the USB pen in the specific port on the rear of Examiner

Warning: the pen is NOT recognized if it is inserted when Examiner is powered on.

- restart Examiner.

Examiner will now function for the moment with the special operating system and is able to arrange on the USB pen the data needed to carry out these operations:
- single language setting
- multi language setting
- software update

Note: Only one of these three operations can be carried out at a time, to carry out two operations on the same system (change language and update software) it is necessary to separately repeat twice the operations described.

- follow the operations until the pen preparation operations are completed (Examiner notifies this)
- remove the USB pen
- remove the WINDOWS CD
- switch off Examiner

Note: AS AN ALTERNATIVE THE SAME OPERATIONS CAN BE CARRIED OUT USING A PERSONAL COMPUTER WITH "WINDOWS XP" OPERATING SYSTEM INSTALLED

- take the USB pen on the car
- with the key on STOP , insert the USB pen in the USB port of the control unit, or i the external port at the base of the central console , next to the current socket/cigar lighter.

- brig the key to MAR

The control unit will now carry out the required operation (change language or update software):

- at the end a message on the car panel display will inform that the operation has terminated

check the operation has been successful (for example, check the language of the voice messages giving an instruction).

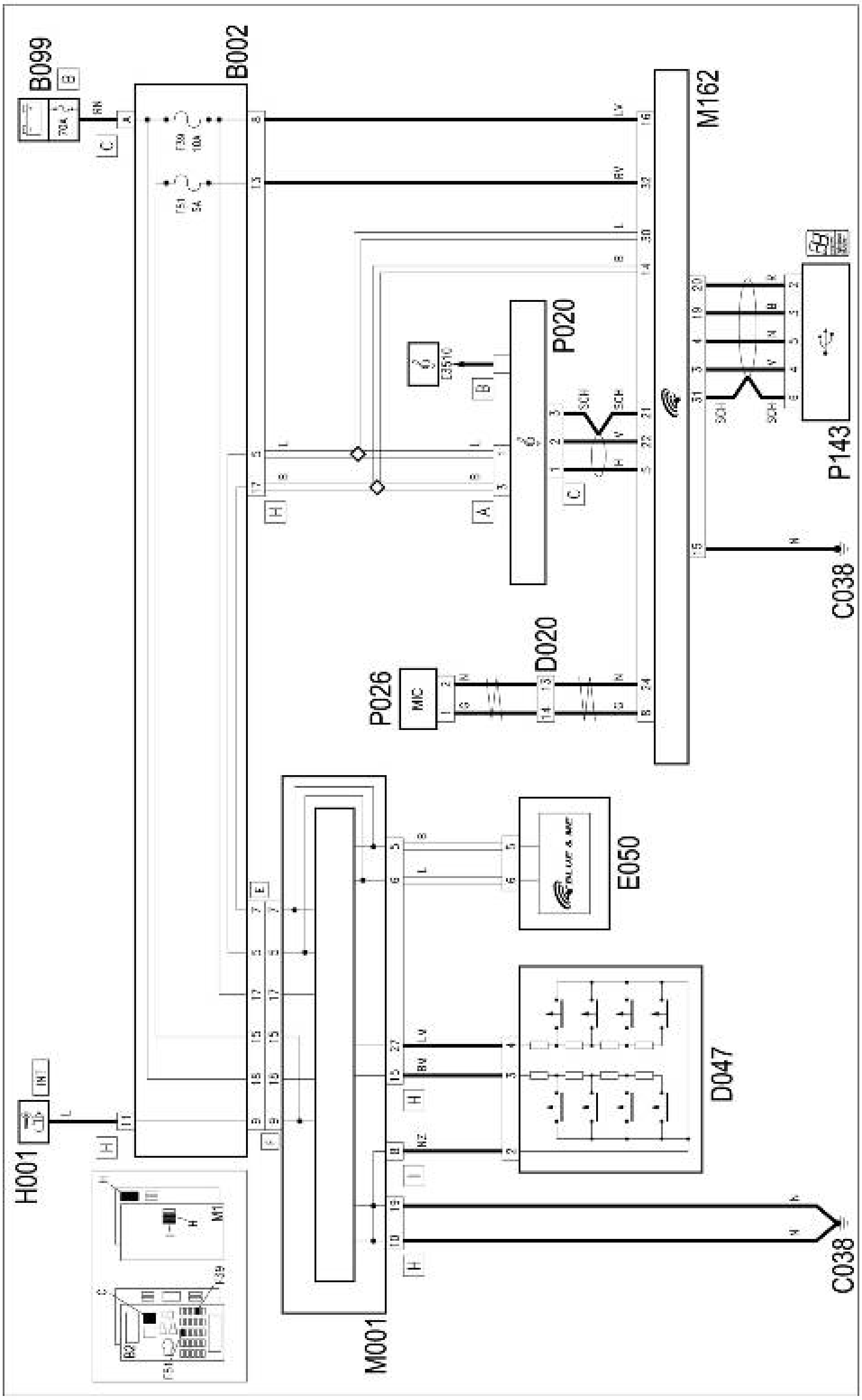
Note : Never disconnect the car battery terminals while carrying out the operations indicated

NAVIGATION KIT

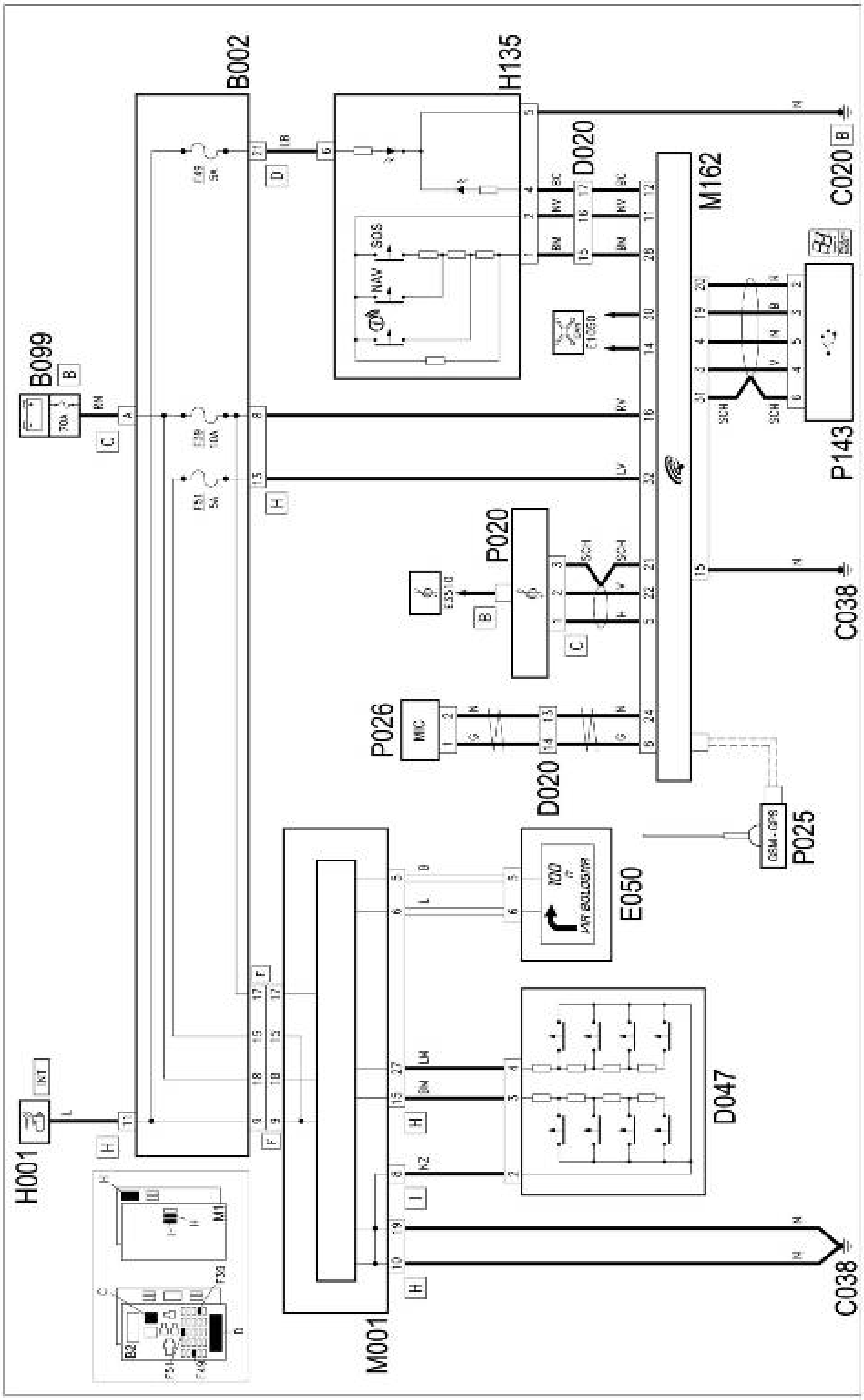
On purchasing a Blue&ME NAV system the customer receives a navigation kit consisting of

- USB stick with maps of country of residence.
- A back-up CD with the same map for transferring the map via PC (following the instructions provided) onto a larger memory that also contains your music (stick, media player, even iPod….) This makes it possible to use both NAVIGATION and MEDIA functions simultaneously.
- Possibility, with the same system, to of loading maps of other countries and navigate from country to country without interruption (1 GB contains Western Europe).
- Additional maps can be purchased from dealers (P&S).

Blue & Me circuit diagram (C1V2) Version without navigator.



Blue & Me circuit diagram (C3) Version with navigator.



Key to circuit components

B002. Derivation control unit under dashboard
B099. Maxi-fuse box on battery
C038. Ground on central tunnel
D020. Dashboard/rear connection
D047. Coiled contact connection
E050. Instrument panel
H001. Ignition key
M001. Body computer
M162 Bluetooth control unit
P020. Radio
P025. GPS/GSM aerial
P026. Free-hands microphone
P143. USB socket

Diagnostics

The control unit is connected via B-CAN network with the radio module and the Body Computer; therefore diagnostics are carried out, as for all the other “modules” of the CAN network, through the specific standard diagnostics socket and Examiner.

Passive safety system (AIRBAG)

The vehicle is equipped with an electronic control system that activates the retaining system in the event of a frontal or side impact:

The frontal protection system includes:
- frontal driver and passenger two-stage air bags;
- front seat belts with dual pre-tensioner and load limiter;
- frontal satellite impact sensor;

The side protection system consists of:
- two side bags on the front seats;
- two drop-down air bags housed in the roof spar;
- two impact sensors on the central pillar.

The frontal protection system operates according to “Air-Bag Smart 2” logic, which is capable of automatically adapting activation parameters according to impact severity.
The driver and passenger front air-bags indeed have two-stage activation:
- when the impact is of medium severity the control unit commands first stage activation and, with a certain delay, second stage such that the energy discharged onto the occupant is not harmful;
- for very severe impact, the control activates first and second stages with a fractional delay to absorb the maximum possible kinetic energy from the occupant before impact with the steering wheel or dashboard.

In addition, an ECS or “Early Crash Sensor” mounted on the front cross member near to the bonnet catch helps the control unit activate the air bags earlier than in a conventional system, such that they are activated even before the occupant has started to move toward the steering wheel or dashboard.

Warning:

- The components of the Air Bag system are designed to operate on a specific vehicle. Therefore they MAY NOT be tampered with, adapted or installed on any other vehicle.
- For safety reasons, repairs to wiring are NOT permitted.

The electrical connection between the components of the Air Bag system is realized by specific harness, built-in to the dashboard harness, and the rear harness.
The control unit is connected via two connectors, one for the dashboard cable and one for the rear cable.
The control unit is connected to the vehicle CAN network through which it exchanges information with the other modules, lights the warning lights on the instrument panel and performs diagnostics.

Since the control unit is a module on the B-CAN network, the Air Bag system connects:
- to the standard diagnostics socket via CAN
- to the instrument panel, again via CAN, to pilot the “air bag system”, “seat belt reminder” and “passenger air bag disabled warning lights, and the “seat belt reminder” buzzer,
-to the Body Computer for possible line end personalization (Proxi), and consequent reduction in number of parts.

NOTE:

- FATAL HAZARD! Before installing a baby chair on the front seat, the front Air Bag module MUST BE DISABLED.
- THE MODULE CAN BE DISABLED FROM THE FUNCTION SETUP MENU ON THE INSTRUMENT PANEL.
- If the vehicle is fitted with side bags, disabling the passenger front air bag also disables the side bags.

COMPOSITION
According to version, the system is made up of the following components.

-Basic version:
- electronic control unit;
-two front air bags, passenger and driver, with dual stage activation;
-a “single stage activation” driver knee bag, optional.
-a supplementary satellite ECS (Early Crash) sensor;
-two double electronic pre-tensioners placed respectively in the winders of the front belts and the buckles.

-Full version
-electronic control unit;
-two front air bags, passenger and driver, with dual stage activation;
-a “single stage activation” driver knee bag, optional.
-a supplementary satellite ECS (Early Crash) sensor;
-two double electronic pre-tensioners placed respectively in the winders of the front belts and the buckles.
-two side bags on the front seats;
-two window bag modules for side impact protection;
-two lateral impact sensors mounted on the pillars;

For status indications, the system has:
- system fault warning light (red) on the instrument panel;
- Passenger air bag disabled indicator on instrument panel;
- Seat belt reminder warning on instrument panel;
- connection via B-CAN to diagnostics socket for functional checks using EXAMINER.

ELECTRONIC CONTROL UNIT

The electronic control unit is the central processor for the occupant protection system. It is solidly anchored to the floor near the central tunnel. It controls all sensors and retainer systems, processing the signals received from the various sensors distributed throughout the vehicle.

NOTE:
- The control unit must be mounted with the arrow printed on the label facing in the direction of travel.
- Always check that there are no foreign bodies between the unit and the body shell, and tighten the crews to the specified torque.
- If the control unit is dropped or suffers damage it MUST BE REPLACED.

The control unit is fitted with a deceleration sensor that enables safety system activation. This sensor consists of two-way accelerometers that supplement the front ECS sensor and side impact sensors.

FUNCTION

Frontal impact:
If the impact is of medium severity, the control unit commands first stage activation of the air bags and then second stage with a certain delay, such that the inflation energy is not potentially harmful.
Vice-versa, for severe impacts, the control unit commands activation of the two stages almost simultaneously, to absorb the kinetic energy of the occupant before impact against the steering wheel or dashboard.
Furthermore, the supplementary ECS or “Early Crash Sensor” mounted on the front cross member near to the bonnet catch helps the control unit activate the air bags earlier than in a conventional system, such that they are activated even before the occupant has started to move toward the steering wheel or dashboard

Side impact:
Similarly, in the event of a side impact the control unit is capable of recognizing both direction and intensity, consequently activating the two side bags on the side involved in the collision. To give total cover against side impact, two satellite sensors are mounted in the central pillars.
The satellite sensors detect the impact signal along the transverse axis of the vehicle and transmit this to the control unit. After processing, the signal gives the severity of the side impact and the control unit decides whether or not to activate the side bags on the side involved, only is the control unit safety sensor gives consent.
The side bags (Window Bag and Side Bag)are activated simultaneously and independent of the frontal safety systems.
After each activation of the piloted systems (pre-tensioners, frontal air bags, side bags) the control unit memorizes activation in its permanent memory and lights the fault warning on the instrument panel.

The control unit assures, before replacement, activation of the individual systems for a maximum number of:
-3 impacts with activation of front belt pre-tensioners only;
-3 impacts (right or left) with activation of side bags;
-1 impact with activation of pre-tensioners and front air-bags;

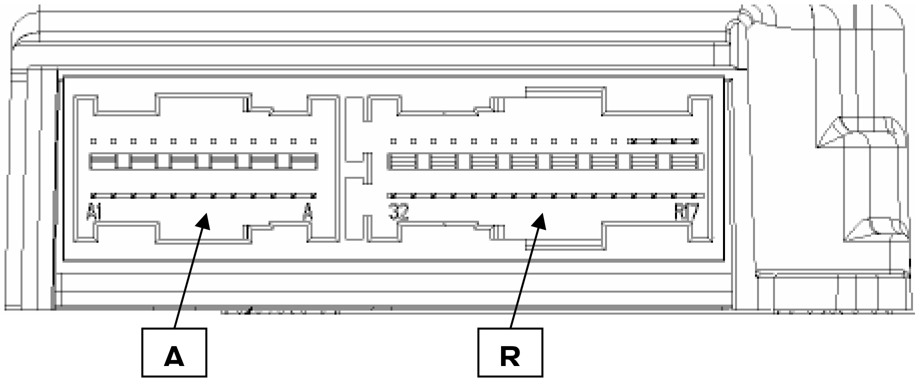
or any combination of the above until reaching the maximum number.

If the maximum number is not reached, after restoring system operative conditions, it is possible to use the control unit again after carrying out a RESET using the EXAMINER. Once the maximum number is reached, a further reset is not possible.

FPS intervention
In case of impact, the control unit send the BCM a specific message, which is then sent to the ECM that disables the electric fuel pump.
For this reason the inertia switch is no longer used.

FPS system reset
To reset the system, refer to the BCM functions section – Electrical System.

Control unit pinout



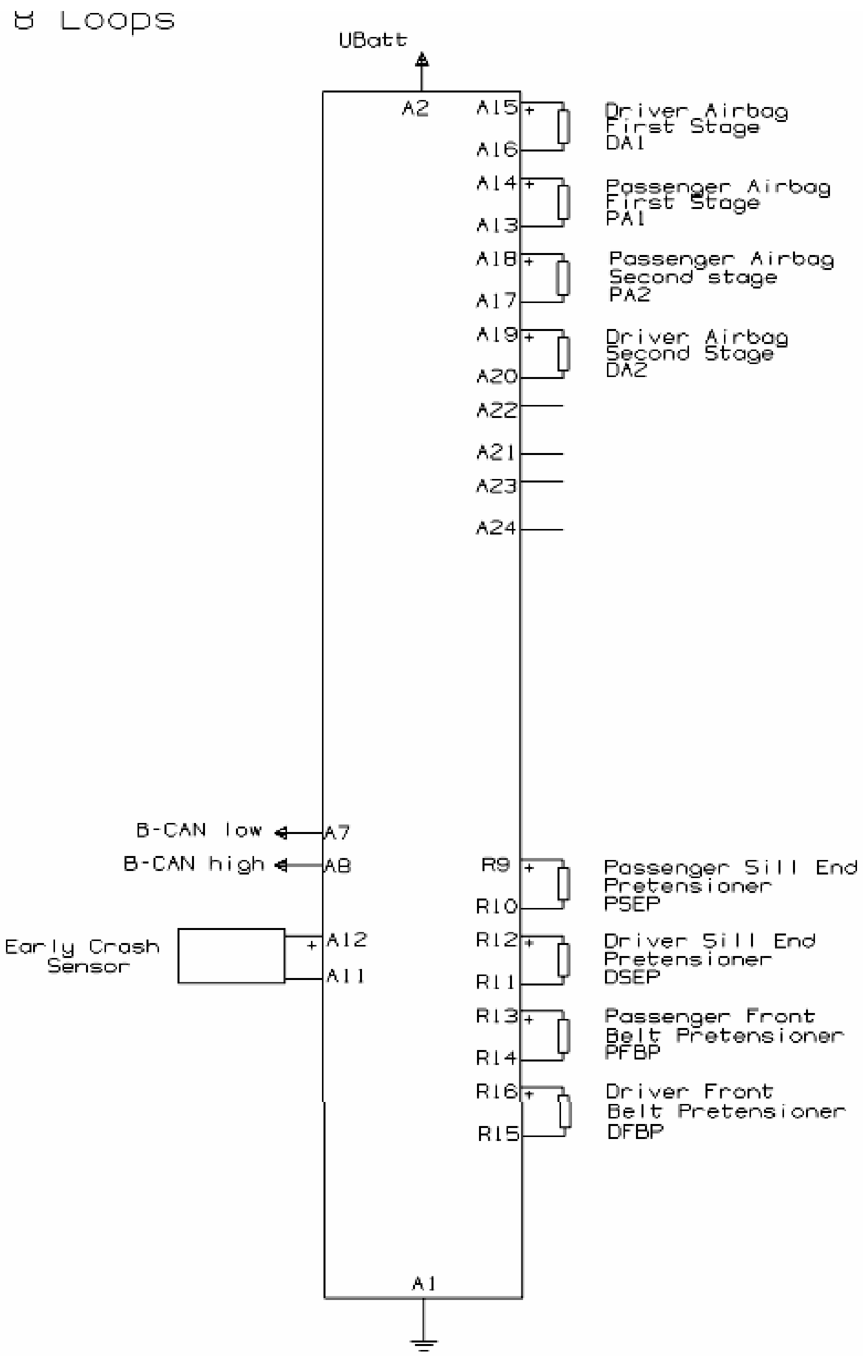
A – FRONT CONNECTOR

R – REAR CONNECTOR (BLACK).
(version without side and drop-down bags)

1	Ground	1	N.C.
2	+ 15	2	N.C.
3	N.C.	3	N.C.
4	N.C.	4	N.C.
5	N.C.	5	N.C.
6	N.C.	6	N.C.
7	B – CAN L	7	N.C.
8	B – CAN H	8	N.C.
9	N.C.	9	Pre-tensioner on buckle Passenger +
10	N.C.	10	Pre-tensioner on buckle Passenger -
11	ECS (early crash sensor) -	11	Pre-tensioner on buckle driver -
12	ECS (early crash sensor) +	12	Pre-tensioner on buckle driver +
13	Passenger air bag 1st stage -	13	Pre-tensioner on belt Passenger +
14	Passenger air bag 1st stage +	14	Pre-tensioner on belt Passenger -
15	Driver air bag 1st stage +	15	Pre-tensioner on belt driver -
16	Driver air bag 1st stage -	16	Pre-tensioner on belt driver +
17	Passenger air bag 2nd stage -	17	N.C.
18	Passenger air bag 2nd stage +	18	N.C.
19	Driver air bag 2nd stage +	19	N.C.
20	Driver air bag 2nd stage -	20	N.C.
21	N.C.	21	N.C.
22	N.C.	22	N.C.
23	N.C.	23	N.C.
24	N.C.	24	N.C.
		25	N.C.
		26	N.C.
		27	N.C.
		28	N.C.
		29	N.C.

		30	N.C.
		31	N.C.
		32	N.C.

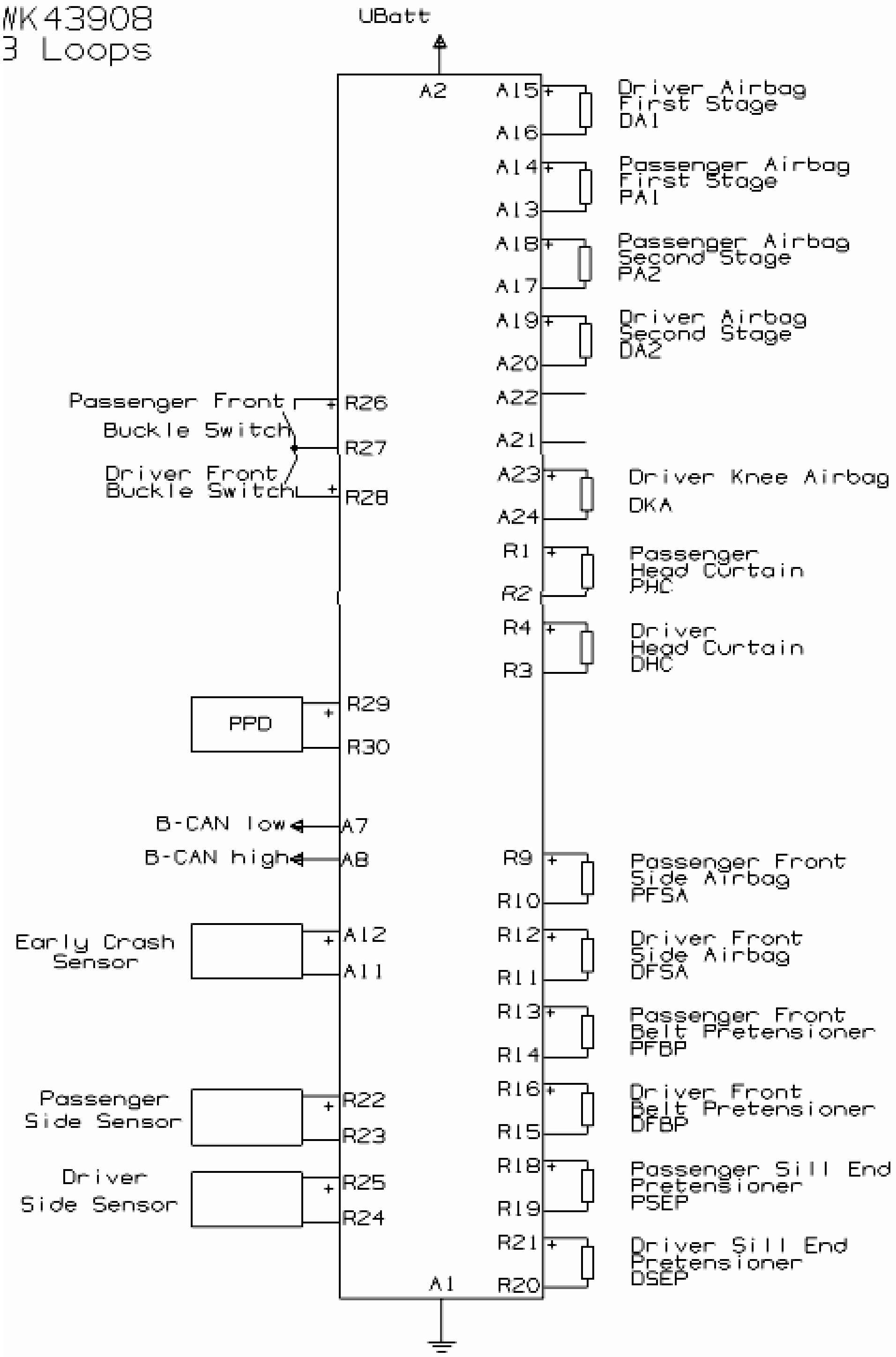
Circuit diagram for version without side bags



A – FRONT CONNECTOR full version   R - REAR CONNECTOR- (BROWN) full version

1	Ground	1	Drop-down bag passenger side +
2	+ 15	2	Drop-down bag passenger side +
3	N.C.	3	Drop-down bag driver side -
4	N.C.	4	Drop-down bag driver side +
5	N.C.	5	N.C.
6	N.C.	6	N.C.
7	B – CAN L	7	N.C.
8	B – CAN H	8	N.C.
9	N.C.	9	Side bag passenger side +
10	N.C.	10	Side bag passenger side -
11	ECS sensor (early crash sensor) -	11	Side bag driver side -
12	ECS sensor(early crash sensor) +	12	Side bag driver side +
13	Passenger air bag 1st stage -	13	P Pre-tensioner on belt Passenger +
14	Passenger air bag 1st stage +	14	Pre-tensioner on belt Passenger -
15	Driver air bag 1st stage +	15	Pre-tensioner on belt driver -
16	Driver air bag 1st stage -	16	Pre-tensioner on belt driver +
17	Passenger air bag 2nd stage -	17	N.C
18	Passenger air bag 2nd stage +	18	Pre-tensioner on buckle Passenger +
19	Driver air bag 2nd stage +	19	Pre-tensioner on buckle Passenger -
20	Driver air bag 2nd stage -	20	Pre-tensioner on buckle driver -
21	N.C.	21	Pre-tensioner on buckle driver +
22	N.C.	22	Side impact sensor passenger side +
23	Knee bag +	23	Side impact sensor passenger side -
24	Knee bag -	24	Side impact sensor driver side -
		25	Side impact sensor driver side +
		26	Switch on buckle passenger side +
		27	Switches on buckle driver side and Passenger -
		28	Switch on buckle driver side +
		29	Passenger present detector + (PPD)
		30	Passenger present detector - (PPD)
		31	N.C.
		32	N.C.

Full version circuit diagram.



Self-diagnosis

The control unit runs continual self-diagnosis of system function. In particular:

- It detects and memorizes any faults;
- It diagnoses the connections with system components and the type of fault;
- It indicates the fault by lighting the warning light on the instrument panel.

Faults memorized in the control unit can be deleted only after repair, using the EXAMINER diagnosis instrument

DRIVER'S SIDE AIR BAG MODULE

Features

The driver's side air bag is a passive safety device consisting of a cushion that inflates between the driver's body and the frontal structure of the passenger compartment in the event of a frontal collision. The air bag module is installed at the centre of the steering wheel, and also serves as the horn button.

Composition

The module consists of:

- a plastic cover, that breaks at predetermined points in case of activation, to permit correct cushion inflation;
- a cushion, with volume of circa 60 liters, made of nylon fabric to reduce skin abrasion to a minimum in case of contact, and folded such as to render inflation gradual and not directly aimed at the driver;
- two pyrotechnic gas generators;
- a container.

Function

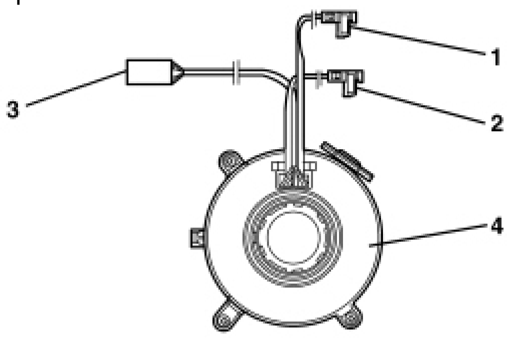
The air bag is inflated by a gas generator that has two cut-in stages, which activate separately according to the severity of the collision.

The gas generator is activated by two electric elements that burn the propellant inside the generator, causing the cushion to expand.

After full inflation, the cushion is in an optimal position to perform the function of retaining the occupant. Air bag deflation is immediate, due to the hole present in the lower part of the cushion. This hole also serves to "soften" the contact of the passenger with the cushion, preventing any risk of abrasion.

SPIRAL CABLE

The figure below illustrates the spiral cable.

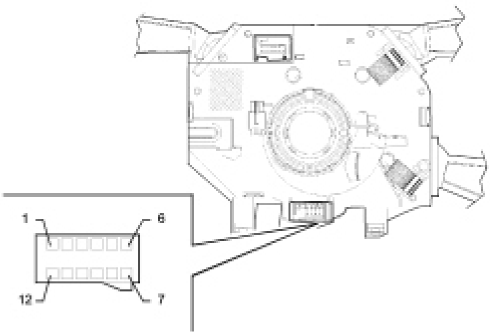


1 – Air bag first stage electrical connector
2 – Air bag second stage electrical connector
3 – Steering wheel electrical functions cable
4 – Spiral cable

Features

The spiral connector serves to transfer the steering wheel electrical control signals (horn and other optional controls) and to connect the air bag module, without the risk of breaks or disconnections.
This device consists of two plates, the lower plate fastened to the combiswitch and the upper plate anchored to the steering wheel by means suitable fittings. Between the two plates, the module connector cable is spiral wound to permit steering wheel movement.

Spiral cable pinout



PIN	SIGNAL
1	Robotic gearbox commands ground
2	Robotic gearbox commands signals
3	Steering wheel radio controls
4	Steering wheel radio controls
5	power "with key-on " for lights
6	N.C.
7	Ground
8	negative signal from horns button
9	Air bag 2nd level (+)
10	Air bag 2nd level (-)
11	Air bag 1st level (-)
12	Air bag 1st level (+)

Make up

The steering wheel end of the spiral cable has three wires, two for connecting the air bag module (first and second stage) and one for the steering wheel electrical functions (horn, radio controls).
On the upper plate, steering wheel side, there is a ring that automatically locks rotation between the two plates when the device is removed from the steering wheel.
The replace is fitted with a transport safety lock, to be removed after fitting.

Function

The connector cables for the air bag and other electrical functions are spiral wound between the two plates, with a sufficient number of coils to follow the turns of the steering wheel. The upper plate is turned by the teeth in the locking ring that engage with the grooves in the steering wheel hub. In operating position the steering wheel presses on the ring, freeing it from the teeth, permitting rotation between the two plates. If the steering wheel is removed, a spring pushes on the ring that locks rotation between the two plates. This function prevents the upper plate, no longer engaged, from rotating freely, causing the cable inside to wind or unwind with consequent possibility of damage.
During operations that require removal of the steering wheel and the device, it is mandatory to:
- Always work with the wheels aligned straight;
- For safety, lock the two plates together with a clamp before removing the device from the combi switch.

NOTE:
If for any reason the upper plate rotates with respect to the lower one, by an amount that then means that the starting position cannot be determined with absolute precision, the spiral cable MUST be replaced with a new one

PASSENGER SIDE AIR BAG MODULE

Features
The passenger side air bag is a passive safety device that protects the front passenger in the event of a collision by means of a bag that inflates between the occupant and the vehicle dashboard.

Composition
The module consists of:
- a plastic container/support;
- a cushion guard in paper that when activated breaks at predetermined points to allow the cushion to expand;
- a cushion with volume of approximately 120 liters, realized in nylon to reduce skin abrasion to a minimum in case of contact, and folded to prevent it expanding directly toward the passenger;
- two pyrotechnic gas generators;
- mounting brackets on the “cushion guide” bracket.

Function
The passenger bag activation logic is identical to that of the driver’s side bag.
Cushion expansion opens the panel in the dashboard, along the predefined grooves. When fully inflated the cushion is in the optimal position for protecting the passenger.
Deflation is immediate, due to the vent hole in the end of the cushion.

The straps in the air bag and their means of deployment are designed to permit maximum aperture, in order to prevent injury to the passenger.
Deflation is immediate due to the vent holes in the end of the cushion.
Passenger air bag disable
The user can disable the passenger air bag, making it possible to safely fit a baby seat, which on front seats must be facing backward.
This function can be activated from the “setup” menu on the instrument panel as follows:
- with vehicle stationary, press MENU ESC to access the setup memory;
- using the + or – buttons select the “BAG-P” function;
- press MENU ESC and, with the + o – buttons select the message “BAG P OFF” (to disable) or “BAG P on” (to enable); then press MENU ESC again;
- the message “Conf” appears on the display;
- using the + o – buttons select “YES” (to confirm enable/disable) or “no” (to quit confirmation);
- press MENU ESC again to return to the set-up menu.
When disabled, the corresponding warning light lights on the instrument panel.

KNEE BAG

Features
On request, it is possible to install an air bag module in the lower part of the dashboard, in front of the driver's knees. In addition to protecting the lower limbs, this module enhances driver protection especially in preventing the driver slipping forward, the main cause of injury to legs and chest.

Composition
The knee air bag module consists of a metal container housing the gas generator and the nylon cushion. The container is fastened to a support plate and a safety that anchors it to the lower part of the dashboard.

Function
The gas generator is activated electrically by a signal from the electronic control unit. This signal triggers a pyrotechnic charge that causes the gas in the generator to expand. The expanding gas exits through the holes provided and inflates the cushion. When fully inflated the cushion is in the ideal position for protecting the occupant. The bag has a vent hole, so deflation is immediate.

SIDE BAG MODULE

Features
To enhance the protection offered by the body itself in the event of a side impact, two side air bag modules are provided, installed under the seat cover.
This arrangement is designed to inflate and position the air bag optimally with respect to the occupant, regardless of how the seat is regulated or the size of the passenger.

The side bag provides protection to the chest and pelvic zone and assures, along with the door panels, protection of critical parts of the body such as the ribs or abdomen.
Its position on the seat always assures maximum effectiveness, independent of seat position, even if the passenger in the seat is not correctly seated, since the dynamics with which the bag opens minimizes the risk of injury caused by impact against the vehicle body.

NOTE:
- Do not cover the back of the front seat with covers or linings.
- Do not wash the back of the seat with water or pressurized steam

Composition
The side air bag module consists of a metal container housing the gas generator and a nylon cushion, with volume of circa 12 liters.
Inside the container the module has a paper protective cover that permits inflation of the bag by tearing along section of stitching designed to yield, on the outer sides of the lining itself.
The module is connected to the electrical system by two cables with yellow sheath, which run with the ground wire in a protective cloth sheath fastened to the seat structure. The two cables terminate with a yellow connector. The connectors are anchored to an extractable support present on the base of the seat

Function
The gas generator is activated electrically by a signal from the electronic control unit. On receiving the signal, a pyrotechnic charge is triggered that causes the gas contained in the generator to expand. The expanding gases exit through the openings provided causing the cushion to expand. Deployment of the cushion breaks the special stitching on the seat back that permits correct deployment of the cushion itself. After inflating, the cushion is in an optimal position to protect the occupant. The cushion deflates immediately due to the presence of a vent hole.

NOTE:

- No maintenance is possible on seats fitted with air bags, other than simple removal or replacement..
- Dismantling seat fitted with air bags is strictly forbidden..

DROP-DOWN SIDE BAG MODULE (WINDOW BAG)

Features

The window bags activate along with the side bags, inflating between the occupant and the vehicle to prevent to protect the head from impact with the windows or pillars.
Since it extends from the front pillar to the boot, the window bag protects both the front passengers and the rear passengers. The drop-down system offers the best performance thanks to its large surface area and self-supporting capacity even if the windows are open.

Composition

The window bag consists of:
- A gas generator fastened by supports to the vehicle rear pillar;
- A flexible pipe in permeable fabric, fastened by a clamp to the gas generator, that diffuses the gas uniformly over the entire length of the cushion;
- A cushion with a volume of circa 30 liters, fastened to the gas generator along with the flexible pipe. The cushion is made out of permeable nylon and folded away inside a container sleeve. When deployed, the cushion is designed to correctly absorb the energy of a collision while maintaining the occupant's head at a safe distance from the impact zone. Once inflated, the bag immediately deflates due to the porosity of the nylon fabric.
- Clips fastening the cushion to the roof spar
- Plastic fasteners for mounting the bag on the vehicle;
- A retainer strap fastened to the front pillar that holds the cushion in position once inflated;
.

Function

The gas generator is activated electrically by a signal from the electronic control unit. On receiving the signal, a pyrotechnic charge is triggered that causes expansion of the gas contained in the generator. The expanding gases exit through the openings provided and are distributed along the entire length of the cushion through the flexible pipe, inflating the cushion. The increase in cushion volume breaks the container, causes stitching in the sleeve to yield and the opening of the upholstery trim, which is fitted specially to permit correct downward deployment of the cushion. Correct deployment is assured by a retainer strap, at the front end of the cushion. When deployed, the cushion is in an optimal position for protecting the occupant. The cushion deflates immediately after inflation due to the porosity of the nylon fabric.

FRONT IMPACT SATELLITE SENSOR

Features
The supplementary ECS or “Early Crash Sensor” mounted on the front cross member near to the bonnet catch helps the control unit activate the air bags earlier than in a conventional system, such that they are activated even before the occupant has started to move toward the steering wheel or dashboard.
.

SIDE IMPACT SATELLITE SENSORS

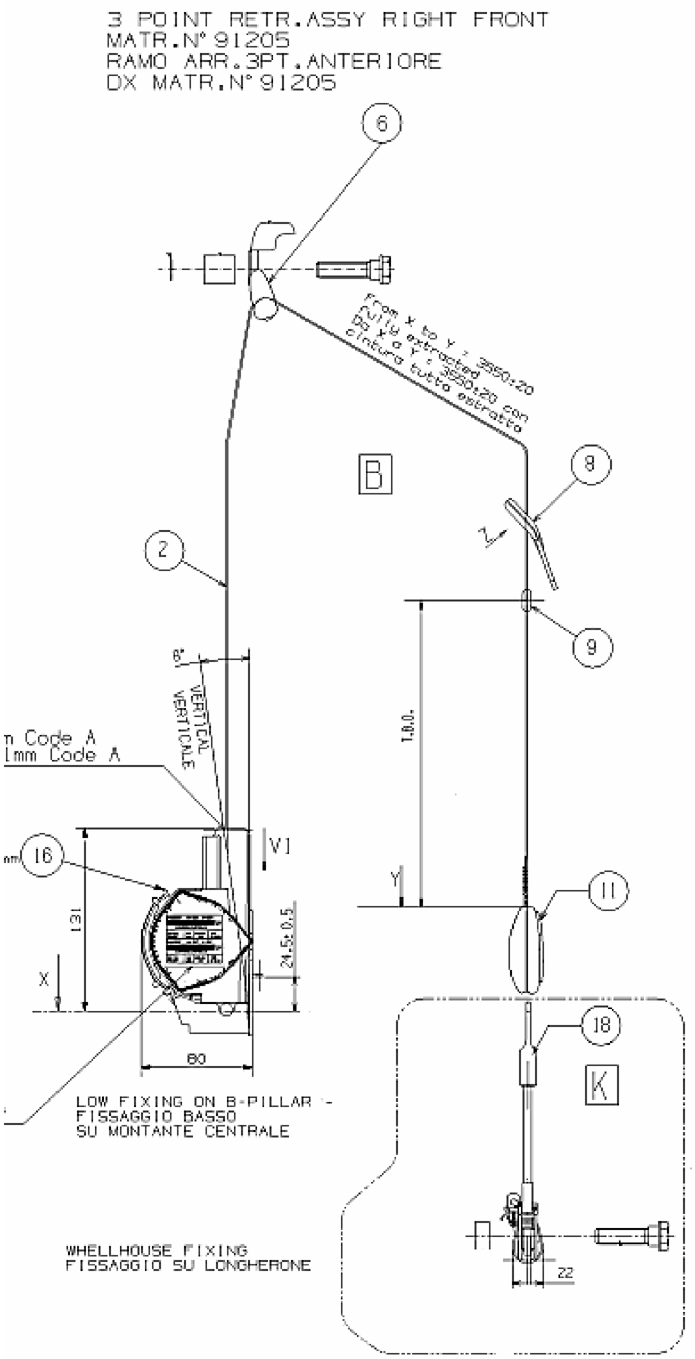
Features
In addition to the air bags, the side impact protection system also includes the electronics required for its correct function. To measure the acceleration caused by a side impact, the system is equipped with two satellite sensors each containing an accelerometer.

Function
If the acceleration value measured by the sensor exceeds a certain threshold, the information is compared with the measurements made by the air bag system control unit safety sensor. If the values measured are congruent, the control unit commands deployment of the side air bags only on the side involved in the collision

SEAT BELT PRE-TENSIONERS

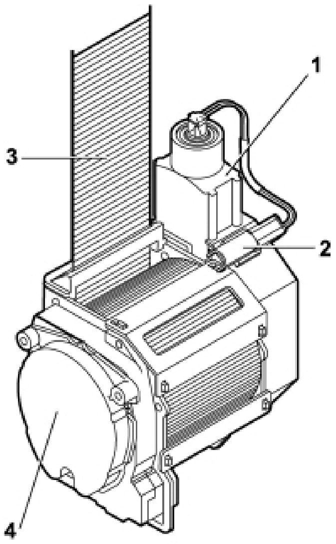
Features
The pre tensioners are pyrotechnic devices that are electrically triggered by a signal from the electronic control unit. They are built-in to the front seat belt winders. The pre-tensioners are controlled by the same logic as the air bags.
The pre-tensioners serve to recover any looseness in the belt such as to retain the occupant firmly against the seat back during the collision, reducing possible forward movement.
The belts are also fitted with load limiters that reduce the force transferred from the belts to the chest: the level of force at which the limiters intervene considerably reduces the risk of shoulder blade or rib fracture, even for people with fragile bone structure (e.g. the elderly).
The vehicle is fitted with dual pyrotechnic pre-tensioners for the occupants of the front seats:
One, conventional type, installed in the belt winder and one on the buckle anchored to the floor.
The pre-tensioners intervene simultaneously on both ends of the belt permitting uniform distribution of the recovered length with consequent reduced injury to the occupant.

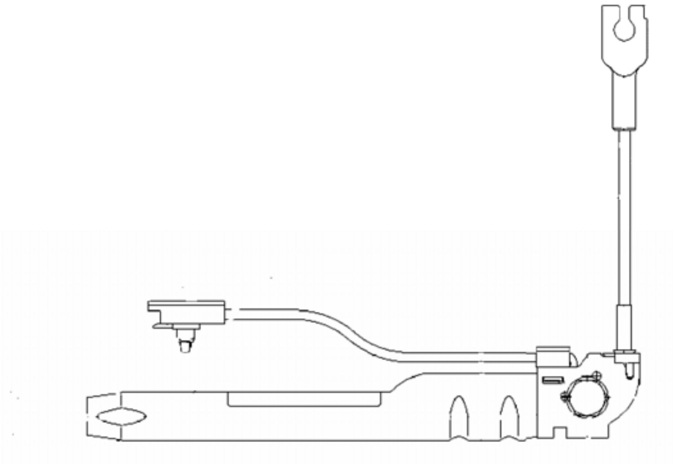
Diagram of a seat belt with dual pre-tensioner



Key
16 belt winder with pyrotechnic pre-tensioner
2 belt
5 belt anchor to pillar
8 belt buckle
9 buckle stop
11 belt fastening to spar
18 re-tensioner on fixed buckle

Function
The diagram below details the pre-tensioners on winder and buckle.



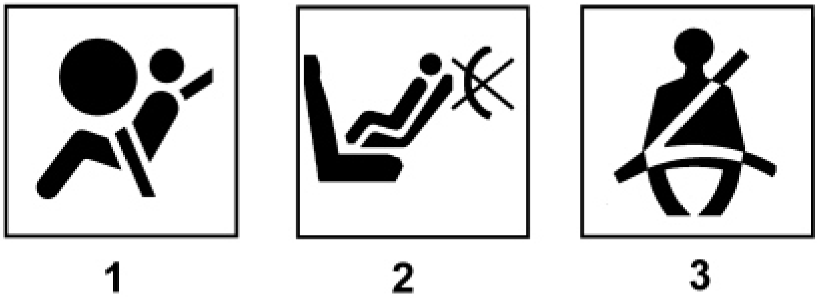


1 – Gas generator
2 – Electrical connection
3 – Seat belt
4 - Winder

As soon as a sufficiently high deceleration is detected by the system's accelerometers, the electronic sensor on the control unit sends a signal that triggers the pyrotechnic charges in the gas generators. Combustion of the propellant forms an inert gas, the pressure of which generates a force that pushes the piston upwards, which winds-in the belt by a number of centimeters.
The pre-tensioners on the buckle are triggered simultaneously. The combined action of the two systems permits uniform distribution of the length of belt to recover, and consequently more uniform distribution of the retaining force on the occupant.

NOTE:
Once triggered, the belt pre-tensioners remain locked and must be replaced.

AIR BAG SYSTEM WARNING ICONS



1 – Air-Bag system fault warning
2 – Passenger Air-Bag disabled
3 – Seat belt reminder

Air bag system fault warning light

With key on, the Air-bag system warning light (red), comes on for circa four seconds (initial self-diagnosis phase) and then goes off. If the control unit detects a fault, it memorizes the corresponding fault code.

If no faults are detected with key on and there are no faults in the control unit memory, after these four seconds the warning light switches off. Otherwise it remains on until key off.

The warning light remains on, or comes on while driving the vehicle in the following situations:
- The control unit detects a fault in the air bag system;
- The control unit detects an impact with system activation;
- When there is a fault in the warning light connection circuit.

Following an impact with activation of only the pre-tensioners or side bags, the warning light will remain on until the system is restored to an operative condition (replacement of components triggered and resetting of the control unit by EXAMINER).

If the impact also triggers the front air bags, the warning light remains on permanently, since the control unit cannot be reset in this case, and must be replaced with a new one.
If functional errors arise during the life cycle of the control unit, which cannot be reset by EXAMINER, these are indicated by the warning light, which remains on permanently.

Passenger air bag disabled warning light
With key on, the passenger side air bag disabled warning light, which is yellow, comes on for circa four seconds (initial self-diagnosis phase), and flashes for the following four seconds.
If the control unit detects a fault, it memorizes the corresponding fault code, activates the warning light and disables the passenger side air bog module disabled. To enable system function, use the EXAMINER in the same way as for the warning lights.

NOTE:
The passenger side air bag may only be disabled with the key OFF or removed, as this operation is recorded as a fault in the control unit).

Seat belt reminder
"First reminder cycle": indication by warning light.
The "seat belt reminder" warning indicates "seat belts not fastened", according to the following logic:
- the warning lights steady at key-on if the belts are not already fastened;
- the waning light steady if with key on the belts are unfastened (unless in the conditions described later, in which the light flashes);
- if the belts are previously fastened, the light remains off;
- the warning lights if, with key-on, the belts are unfastened;
- with key-off the warning is always off.

NOTE:
The indication cannot be disabled.

"warning cycle" : warning light plus buzzer
The warning cycle is activated for 90 seconds if, with belt unfastened and key-on, at least one of the following conditions arises:
- 50 s time elapsed and vehicle speed greater than 10 kph
- vehicle speed greater than 20 kph
- distance travelled greater than 400 m.

The "warning cycle" consists of warning light flashing (frequency 2 Hz D.C. 50 %) coupled with a buzzer.

NOTE:
The cycle will stop if reverse is engaged (warning light remains on).

Function during the 90 second cycle
- if the belts are fastened, the warning cycle stops immediately (light off and buzzer stopped) and the system stands by for the next cycle;
- if one of the three events that activated the cycle ceases, the warning will in any case complete the 90 second cycle.
- if it is necessary to signal the presence of another warning, the warning light indicates the new event, interrupting the current reminder cycle (buzzer stopped and "seat belts not fastened" changes from flashing to steady on)and activating the new warning. After this the cycle prior to the new event is resumed.

Naturally, if during the new event warning the belts are fastened, the reminder cycle is stopped.
- with key-off the reminder cycle stops immediately.

Function after 90 seconds
If the seat belts are not fastened:
- The buzzer is disabled
- the flashing warning light cycle is interrupted and the light comes on steady.

The reminder cycle is only run once, and so once ended (after 90 s) if the belts are still not fastened, the cycle does not repeat.

New warning
The warning cycle is only repeated again if the belts are unfastened (transition from belts fastened to unfastened) or in one of the three previously described conditions.

“Warning cycle” disable (warning light / buzzer)
The user can disable the warning cycle temporarily, proceeding as follows:
- fasten the driver and passenger side seat belts.
-turn key-on.
- keep the belts fastened (together) for a minimum of 20s after key-on.
- unfasten at least one seat belt.

The warning cycle is automatically enabled again every time the key is turned on.

The user can only disable the “warning cycle” permanently at a Service Centre.

The disable procedure requires the diagnosis tool (Examiner) to dialogue with the instrument panel.

NOTE:
It is not possible to disable the reminder, which will remain active (on steady) until the belts are fastened.

BODY

Body shell

The body shell of the New Fiat 500 is realized with the greatest attention to passenger safety, thanks to the application of the most advanced design techniques.
This has allowed us to obtain the following specifications:

Torsional rigidity - 81000 dNm/rad, without windshield - 71000 dNm/rad

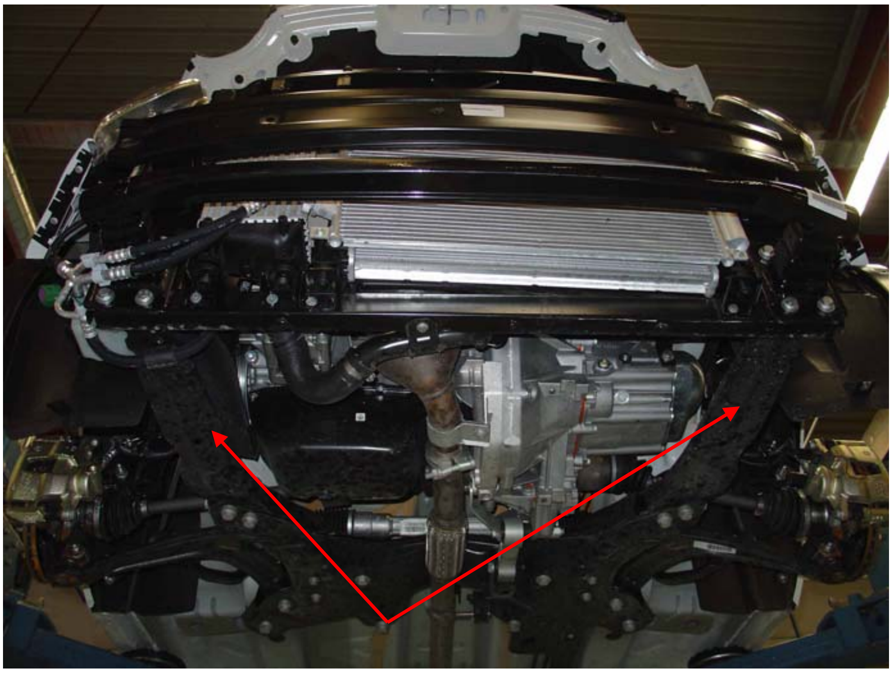
Flexional rigidity: 1150 dN/mm

Prime Torsional Mode: 38 Hz

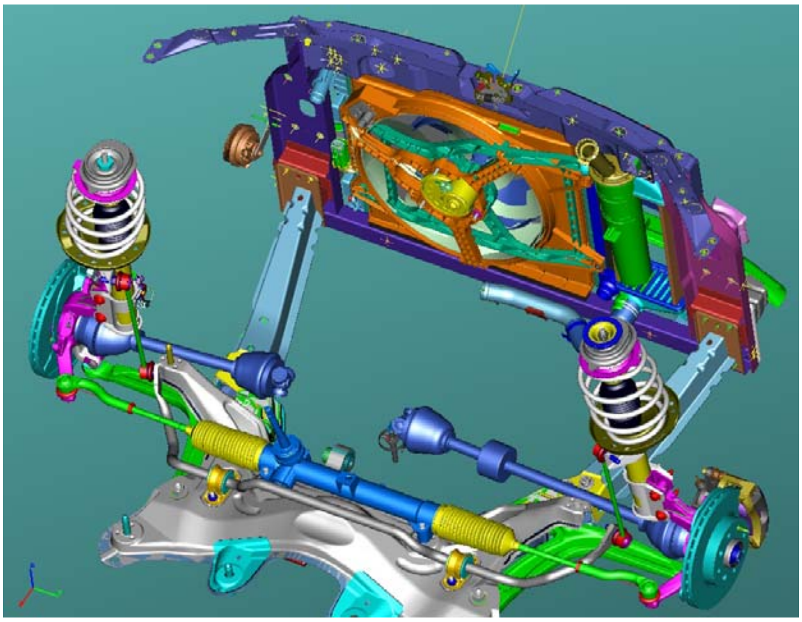
Pedestrian impact

The lower front of the Fiat 500 body shell is fitted with a pedestrian impact bar that allows the body design to meet the most stringent of pedestrian safety standards

Third Load line



To achieve body shell rigidity in order to assure optimal dynamic vehicle performance, two connecting braces have been fitted between the front suspension traverse and the pedestrian impact bar itself. This system consists of two longitudinal links under the vehicle spar, referred to as the “third load line”.



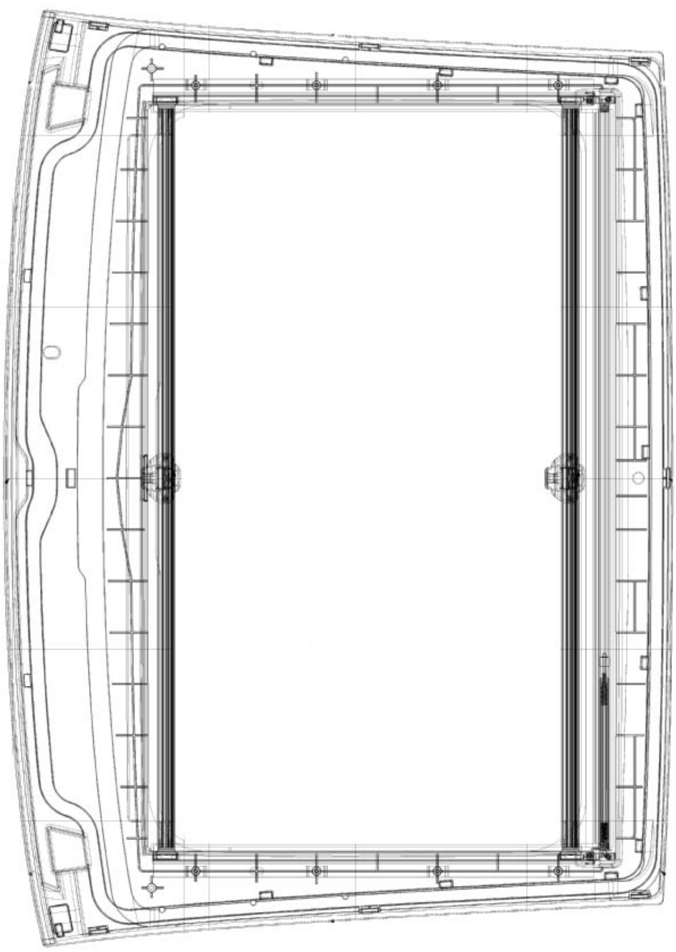
SUNROOF

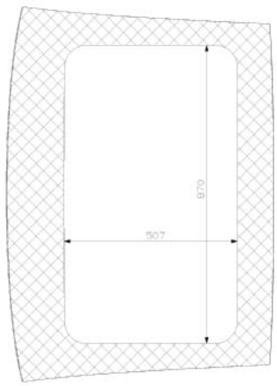
A glass sunroof (optional) is available for the new Fiat 500.
There are two versions of the sunroof:

- Fixed sunroof
- Electric opening sunroof

Fixed sunroof

The Fiat 500 can fit a fixed sunroof as shown below. The thickness of the glass is around 4 mm, with 16% light transmission and energy transmission lower than 19%
It has a manually operated roller blind.





ELECTRIC SUNROOF

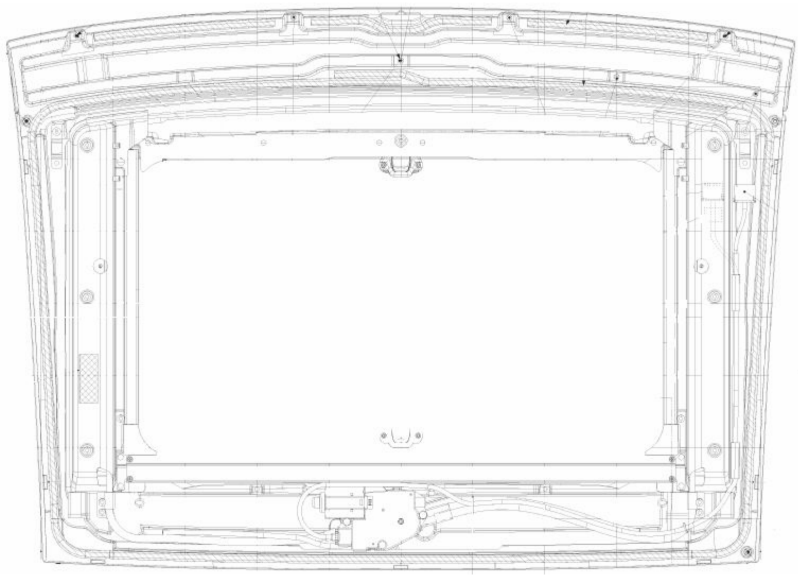
Overview
The electric sunroof (Webasto) is a specific system consisting of a moving glass panel and a front deflector.
When closed, the glass allows light to enter, and the passengers to see out.
When opening, the moving panel runs on top of the roof ("spoiler" position).

The opening sunroof consists of:

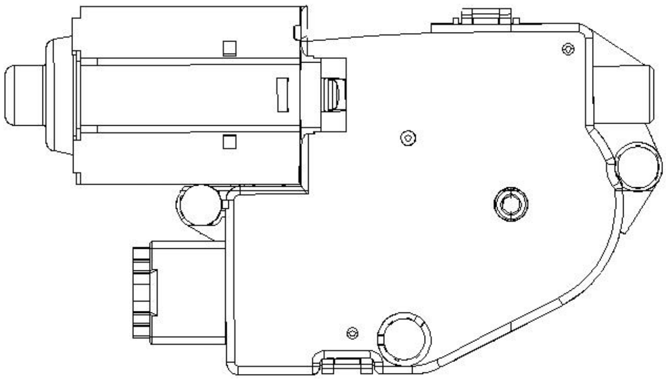
- A frame that carries the other components;
- A mechanical system to the left and right, fastened to the frame, for moving the glass panel, driven by an electric motor via a spiral metal cable;
- A panel of tempered glass,
- The front roof section in painted sheet metal.
- A manually operated roller blind.

Technical specifications
Tempered glass – Thickness 4 ± 0.2 mm.
Light transmission: TL 19 ± 2 %.
Energy transmission: TE 19 < 19 %.
Roller blind operating force 30N max.
Opening/closing time: 5 ± 2 sec.
Peak motor absorption: 30 Amp. max.
Motor opening/closing absorption: 12 Amp.

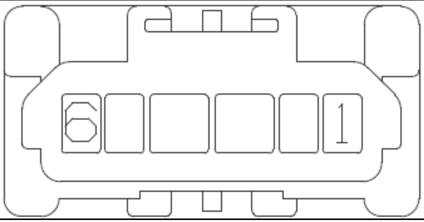
Frame group
The frame group carries all the mechanical and electrical components of the sunroof.



Control unit
The electric sunroof control unit also includes the electric servo motor.



Pin-out

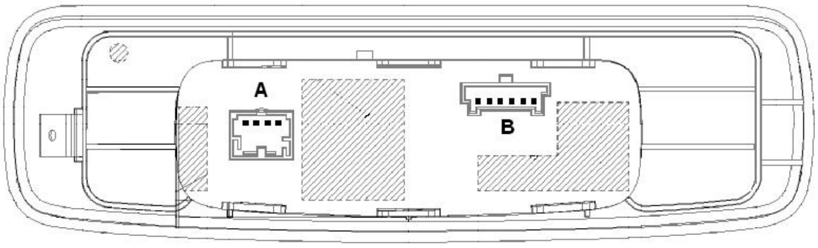


Connector – Electric sunroof control unit

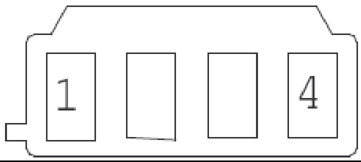
Pin	Description
1	+15 from Body Computer
2	VSO – vehicle speed signal from Body Computer
3	+ 30 – from engine junction box
4	Ground (gnd)
5	Open command (ground - gnd)
6	Close command (ground - gnd)

Control panel (on ceiling)
The control panel contains the two buttons for opening and closing the sunroof.

Control panel back view
The back of the control panel has the two connectors for connecting to the vehicle wiring harness.

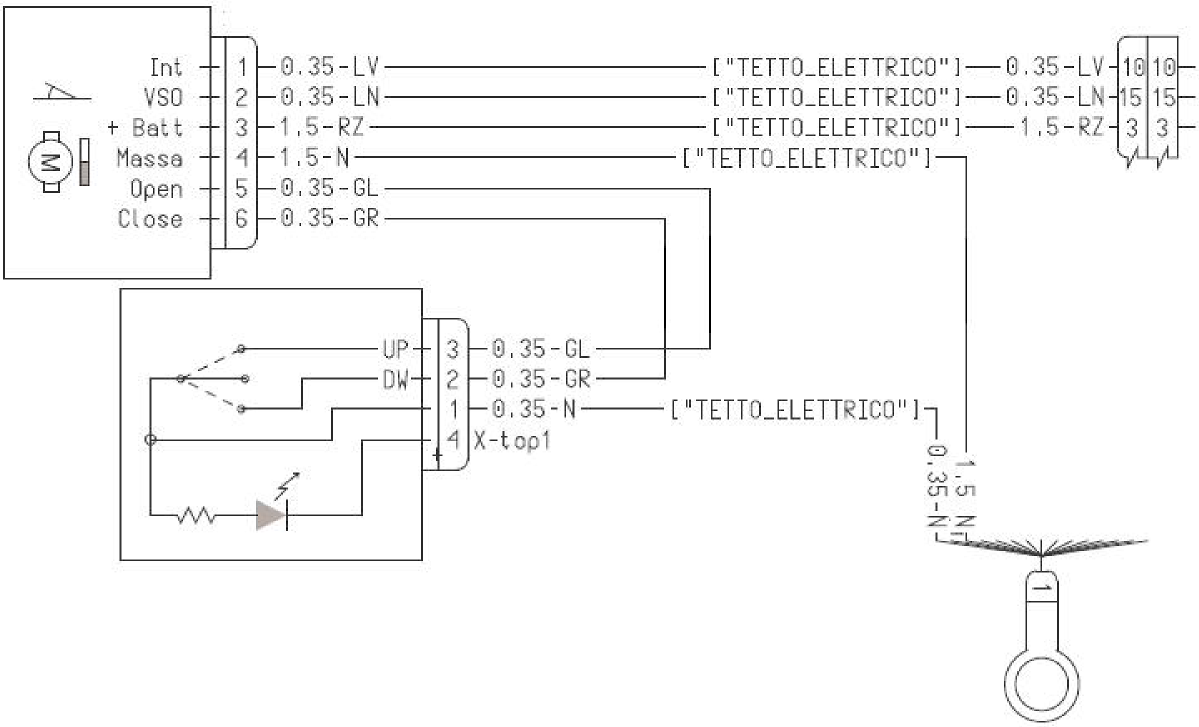


Pin-out



Connector A – Control panel	
Pin	**Description**
1	Ground (gnd)
2	Sunroof close control
3	Sunroof open control
4	LED ideogram on command

CIRCUIT DIAGRAM



Operation
The sunroof is operated by means of the open/cklose buttons on the centre front ceiling panel.
The sunroof is effectively driven, as described below, by an electric servo motor controlled by an electronic control unit.
The sunroof can only be operated with the instrument panel switched on (key-ON)..

Roof open
Pressing the button (opening side) with key-ON allows for two sunroof opening modes.

Automatic opening
Pressing the “open” button normally (for a time >300 ms), from completely closed, moves the sunroof to “tilt” open. Pressing the button again moves the sunroof to fully open. After the first open command, the sunroof can be stopped in any position simply by pressing the button again.

Manual opening
Pressing the “open” button briefly (for a time 60<T<300 ms), from fully closed, moves the sunroof proportionally to the time the button is pressed (T) and stops it at the position it is in when the button is released. Pressing various times on the same side of the button and always within time T of 60<T<300 ms, the panel will open push-by-push up to fully open position. This function allows the user to manually adjust sunroof aperture.

ROOF CLOSE
Like opening, pressing the button (close side), only with key-ON, allows for two operating modes, automatic or manual, exactly as for the open button.

Automatic closing
Pressing the “close” button normally (for a time >300 ms), from completely open, moves the panel to “tilt” open. Pressing the button again moves the sunroof to fully closed. After the first open command, the sunroof can be stopped in any position simply by pressing the button again.

Manual closing

Pressing the “close” button briefly (for a time 60<T<300 ms), from fully open, moves the sunroof proportionally to the time the button is pressed (T) and stops it at the position it is in when the button is released. Pressing various times on the same side of the button and always within time T of 60<T<300 ms, the panel will close push-by-push up to fully closed position. This function allows the user to manually adjust sunroof aperture.

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Sun blind

Light inside the passenger compartment can be regulated by means of a sun blind.
This is a polyester roller blind with “Y” shaped runners to prevent it slipping out of the guides.
It is manually operated and can only be fully open or closed. The blind can be closed regardless of the sunroof position.

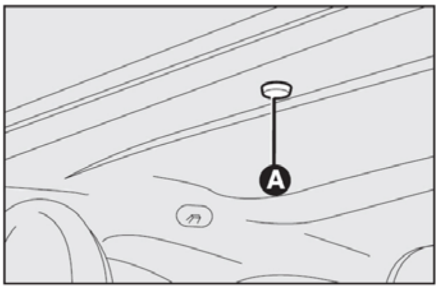
Sunroof safety features (anti-pinching)

In addition to conforming to Directive 2000/4/CE, the electronically controlled anti-pinching system stops horizontal movement if the panel encounters an obstruction (fingers, hand,...):

- This system is active throughout the closing cycle (if open by more than 4 mm).After encountering the obstruction, the control system assures reverse motion for 100 mm from the point of inversion;
- The inversion load is <100 N, as required by Directive 2000/4/CE.

Emergency operation

In emergency, or for maintenance without power, the electric motor can be manually forced to open or close the glass sunroof , as follows:



1. Remove the plug (A) on the roof lining behind the roller blind;
2. Take the Allen key from the standard toolkit in the boot;
3. Insert the key into the seat and turn:
   – clockwise to open the roof;
   – anticlockwise to close the roof.

System initialization

If the battery is disconnected, or a fuse blows, or the servo motor is replaced, the sliding sunroof system has to be initialized, following the procedure given below:

- Press the sliding sunroof button, in closed position, and hold it down until the sunroof is fully closed, then without releasing it wait for the metalic click of the servo motor (around 5 seconds after closing).
- Release the button, then press it again within 5 seconds and hold it down for a complete opening/closing cycle. After complete closure, release the button.
- This completes the initialization cycle.

Stickers

The Fiat 500 is designed to distinguish itself and certainly not pass unnoticed. For this reason a series of Stickers are available to render the vehicle unique, to apply on purchase or in after market.

OPT: 5H0

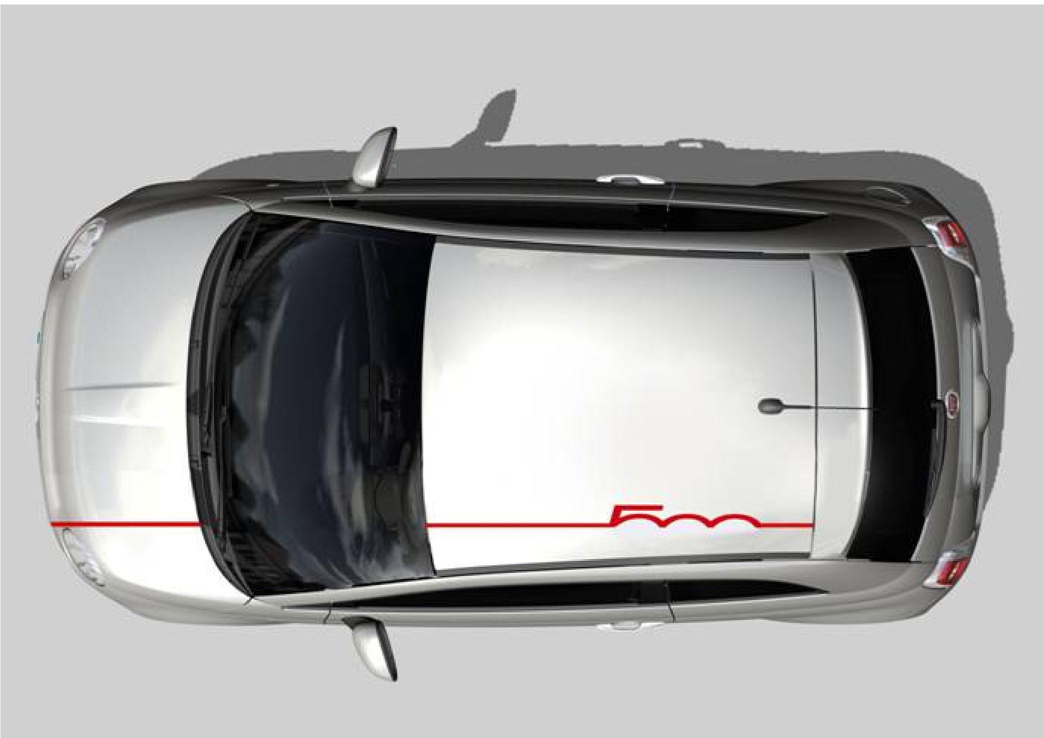
OPT: 5H1

OPT: 5H2, 5H3

OPT : 5H4, 5H5, 5H6

OPT: 5H7, 5H8, 5H9

OPT: 5HA, 5HB



OPT: 5HC, 5HD

OPT: 5HE

Sticker application

Stickers must be applied in a clean, closed area, so as not to pollute the adhesive with any dust or dirt present in the air. The polymerization time is 72 hours, and once applied, the vehicle can be used after 12 hours, though it may only be washed after at least 24 hours.

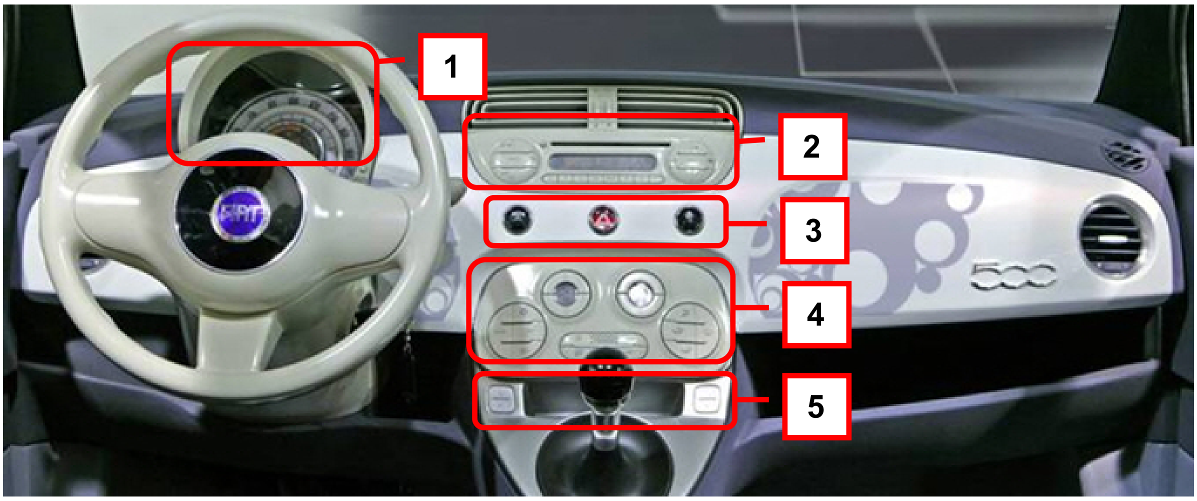
The application procedure is as follows:

- Wash the vehicle prior to applying the stickers
- Body shell temperature must be around 15 – 16 °C
- Clean and degrease the parts where the stickers are applied with heptane or equivalent product
- Lay the sticker on the body and remove the liner while pressing the sticker against the metal
- Remove any air bubbles trapped under the sticker by pressing the sticker with the special spatula provided
- Remove the protective film and run the spatula over the sticker again, increasing pressure applied

Dashboard

Overview
In the realization of the dashboard and instrument panel, a special technique has been used to give the components a soft, "yielding" feel.
The chosen finish ("velvety") contributes to optimizing this feel.

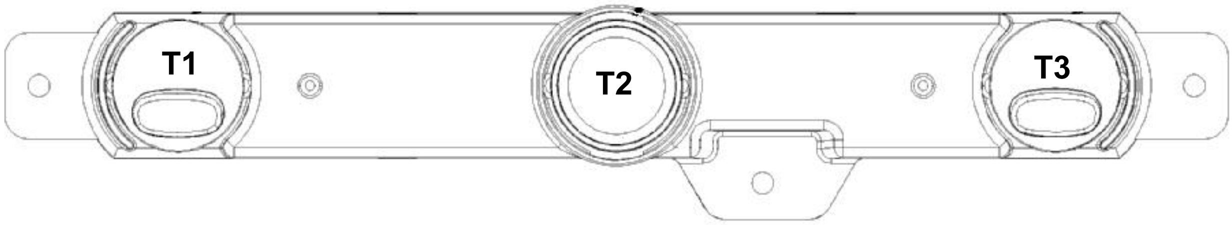
The dashboard has the following devices:
- 1. Instrument panel.
- 2. Radio/CD.
- 3. Central control group.
- 4. Heater or manual/automatic air-conditioner.
- 5. Window winder controls.



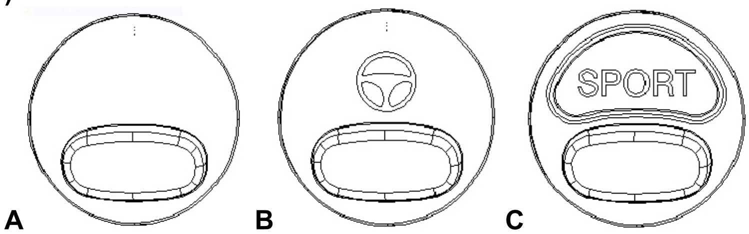
Materials
The dashboard lining material is the result of an important innovation. All the internal linings of the vehicle, developed to meet stringent international inflammability standards, are slow burning, do not ignite by accidental contact (for example, a cigarette), do not develop flames though when severely heated do generate heavy, dense smoke.
The design and conformation of the linings is aimed toward achieving a high level of acoustic comfort and passive safety, by eliminating all protrusion that could be considered hazardous for the occupants in the event of a collision.

CENTRAL CONTROLS GROUP
There are three buttons in the central area of the dashboard, which according to the vehicle version/series may be configured in different ways.

Central dashboard controls, front view

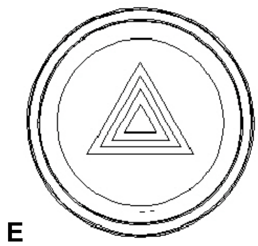


Driver side keys (T1)



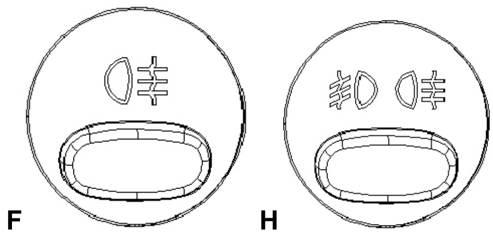
Key:
A. Plug
B. Electric steering City button.
C. Sport button.

Centre button (T2)



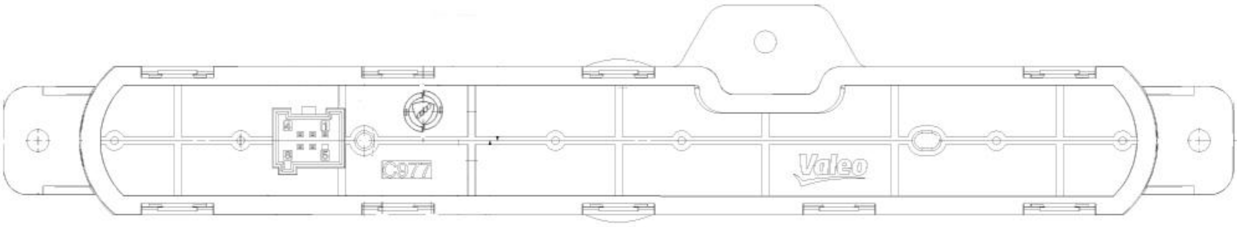
Key:
E. Hazard warning lights

Passenger side keys (T3)

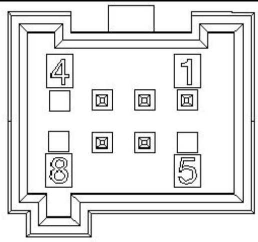


Key:
F. Rear fog warning lights button.
H. Front/rear fog lights button.

Central controls group back view



Central control group pin – out



Pin	Description
1	Hazard warning lights
2	Front/rear fog lights
3	Ground (GND)
4	n.c.
5	n.c. (hazard lights fitting)
6	+15 – ideogram power supply
7	City / Sport
8	n.c.

WINDOW WINDER CONTROLS

The right and left window winder controls are located under the air-conditioner or heater group.

Interior trim

7005E10 – FRONT SIDE DOOR INTERIOR PANEL - S.R.

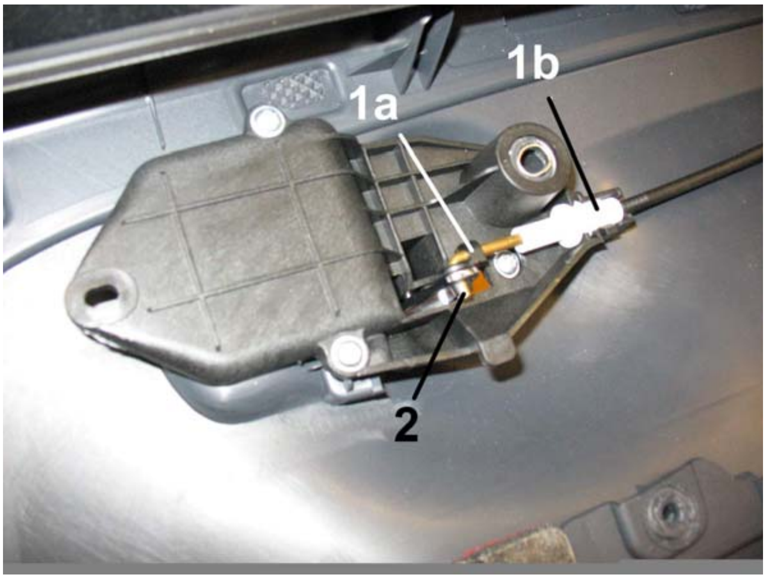
Removal

1. Detach and remove the protective cover on the door handle.
2. Detach and remove the door panel molding.

1. Unscrew the inner door panel screws.

- Using a detacher lever (1.878.077.000), remove the inner door panel by separating the corresponding push-fasteners.

1. Open the safety device (1a) and free the door opener connector rod bush (1b) from its seat on the panel.
2. Disconnect the rod from the door handle assembly.



- Remove the inner door panel.

Replacement

- Connect the door opener rod to the door handle assembly and fasten the safety device.
- Fasten the rod bush to the panel.
- Fit the door panel, carefully aligning and fastening the corresponding push-fasteners.
- Insert and tighten the door panel screws.
- Fit the molding on the door handle
- Fit the protective cover to the handle.