M.T.M. s.r.l.

Via La Morra, 1
12062 - Cherasco (Cn) - Italy
Tel. +39 0172 4860140
Fax +39 0172 488237

BRC GAS EQUIPMENT

Installer's handbook - 1/3

Types of installation - 2/3

Software guide - 3/3

TA010976EN - N. 10 - 25.01.2006

INDEX

USEFUL REFERENCES

Sequent is a control system family for carburation control with sequential injection in gaseous phase and groups 5 different systems satisfying the more and more technological requirements for the present and future car generations.

SEQUENT STANDARD
The first born Sequent system for the LPG or CNG conversion of 3 up to 8 cylinder vehicles.

SEQUENT FAST
Faster and simpler calibration and maps for this “fast” version Standard Sequent version.

SEQUENT FASTNESS
The system dedicated for the CNG conversion of 3 up to 8 cylinder vehicles

SEQUENT 24
For 3 and 4 cylinders vehicles to be converted to LPG, it introduces a new philosophy for components integration with easier and faster connections and maps.

SEQUENT 56
The system dedicated for LPG conversion of 5, 6 and 8 cylinders vehicles.

For further information on “SEQUENT” systems please refer to this guide and the other guides and documentation distributed by BRC.

More guides for Sequent Systems

• Types of installation 2/3

Versions:
- LPG Standard/Fast Sequent
- CNG Standard Sequent
- Sequent Fastness
- Sequent 24
- Sequent 56

These guides contain electrical and installation plans for the various installation you could carry out. The listed ones are mainly divided according to cylinders’ number, their position and the vehicle power.

• software guide 3/3

Versions:
- LPG and CNG Standard/Fast Sequent
- Sequent Fastness
- Sequent 24
- Sequent 56

These are the absolutely necessary guides for who wants to learn how to manage the system through PC, prepare maps, programme the ECUs, make diagnosis and modify operation parameters. These describe the operation of “SEQUENT” software on PC and guide the user during the steps for each operation.

The modular Common Rail for gas

1. INTRODUCTION

Dear installer,

while thanking you for choosing BRC we wish to give you full information on "**SEQUENT**", the gaseous **LPG or CNG** multipoint sequential injection system. It is a highly advanced injection system, result of the experience and continuos BRC'S research in the gaseous injection field, **that can be installed on vehicles with sequential multipoint petrol injection**. Thanks to its high level of integration, SEQUENT can assure higher performances without giving up simplicity of assembly.

Thanks to the high integration of the system, SEQUENT can assure higher performances without compromising the simplicity of the installation. Indeed inside the ECU there are several functions which allow, in most cases, avoiding fastidious and cumbersome devices that, by this time, each installer is used to assemble, as Modular, electronic timing advance processor, crankshaft sensor adapter, Memory, etc.

From the functional and performance point of view SEQUENT has the same basic characteristics of all BRC injection systems as a reduce power loss, no mixer, very small reducer, no backfire risk but also adds some new important ones such as:

- Sequential Injection obtained by using an electronic injector in each cylinder;
- High precision for gas dosage thanks to very precise injectors;
- Auto-diagnosis on ECU inlet/outlet;
- Protection against short-circuits of the ECU inlet/outlet;
- Communication on K line and on CAN bus;

Differences compared to other systems are not only these ones: some conventions you were used to have been radically changed. For this reason please read carefully the installation guides even if you are a very skilful technician in gas injection systems.

To convert a vehicle, the installer will have to use a basic kit and a standard one. Then he will have to buy a two-position built-inn change-over switch, place the components inside the engine compartment as indicated in this guide and personally realise the fixing brackets.

1.1 SEQUENT CONVERSION KITS DESCRIPTION

1.1.1 SEQUENT STANDARD AND SEQUENT FAST

The LPG basic kit includes:

- 1 FLY SF ECU without configuration,
- 1 harness (studied for BRC or Keihin Injectors),
- 1 roll of copper pipe ø 6 or ø 8,
- 1 Water pipe 16x23.
- 1 GENIUS or GENIUS MAX SEQUENT LPG pressure reducer with gas temperature sensor with thermistor,
- 1 "FJ1 HE" high efficiency filter
- 1 P1 - MAP or P1 - MAP Turbo pressure sensor,
- 1 LPG "ET98 Normal WP or ET98 Super WP" solenoid valve,
- 1 bag containing screws, nuts and various fittings,

The CNG basic kit contains:

- 1 FLY SF ECU without configuration,
- 1 harness (studied for BRC or Keihin Injectors),
- 1 auxiliary harness
- 1 roll of copper or steel pipe,
- 1 Water pipe 8x15
- 1 GENIUS SEQUENT CNG pressure reducer with gas temperature sensor with thermistor,
- 1 "FJ1 HE" high efficiency filter
- 1 P1 - MAP CNG pressure sensor 2,5-4 bar
- 1 "VM A3/E WP classic" CNG electro-assisted valve,
- 1 CNG pressure gauge with resistive pressure sensor
- 1 bag containing screws, nuts and various fittings,

The BRC standard kit contains:

- 3 (or 4,5 or 6 depending on the n. of cylinders) BRC gas injectors with nozzles,
- 1 injectors rail for BRC injectors with findings,
- Gas pipe 10x17,
- Gas pipes 5x10.5 to be used on the injectors and pressure points
- A bag containing: manifold pressure nozzle, nylon Y piece, nuts, junctions and "click" clamps for gas pipe 5x10.5 and 10x17, "click" clamps for the pressure points, cap M8x1 for possible RAIL closure.

The Keihin standard kit contains:

- 3 (4, 5 or 6 depending on the n. of cylinders) Keihin gas injectors with nozzles
- 1 injectors rail for Keihin injectors with findings,
- Gas pipe 10x17,
- Gas pipes 5x10.5 to be used on the injectors and pressure points
- A bag containing: manifold pressure nozzle, nylon Y piece, nuts, junctions and "click" clamps for gas pipe 5x10.5 and 10x17, "click" clamps for the pressure points, cap M8x1 for possible RAIL closure.

1.1.2 SEQUENT FASTNESS

The CNG basic kit – Fastness version – contains:

- 1 FLY SF ECU without configuration,
- 1 harness (studied for BRC Injectors),
- 1 auxiliary harness
- 1 roll of copper or steel pipe,
- 1 Water pipe 8x15.
- 1 CNG Zenith pressure reducer with water temperature sensor with thermistor,
- 1 MAP sensor,
- 1 "VM A3/E WP classic" CNG Electro-assisted valve,
- 1 CNG pressure gauge with resistive pressure sensor
- 1 bag containing screws, nuts and various fittings,

The BRC standard kit (Fastness version) contains:

- 3 (or 4,5, 6 or 8 depending on the n. of cylinders) BRC gas injectors with calibrated nozzles and pressure and gas temperature sensor
- 1 injectors rail for BRC injectors with findings,
- Gas pipe 10x17,
- Gas pipes 5x10.5 to be used on the injectors and pressure points
- A bag containing: manifold pressure nozzle, nylon Y piece, nuts, junctions and "click" clamps for gas pipe 5x10.5 and 10x17, "click" clamps for the pressure points, cap M8x1 for possible RAIL closure.

1.1.3 SEQUENT 24

The SEQUENT 24 front kit contains:

- 1 Sequent 24 ECU without maps
- 1 LPG GENIUS SEQUENT 24 pressure reducer with water temperature sensor
- 1 LPG "ET98 NORMAL or SUPER WP" solenoidvalve
- 3 or 4 BRC injectors with calibrated nozzles according to cylinders number
- 1 injectors rail for BRC injectors with temperature and gas pressure sensor with findings for Normal or Turbo version
- 1 "FJ1 HE" high efficiency filter
- 1 Sequent 24 changeover switch
- 1 harness (studied for Sequent 24 BRC injectors)
- roll of copper pipe ø 6 or ø 8,
- water pipe 16x23,
- 1 bag containing screws, nuts and various connections
- gas pipe 10x17
- Gas pipes 5x10.5 to be used on the injectors and pressure points
- A bag containing: manifold pressure nozzle, nylon Y piece, nuts, junctions and "click" clamps for gas pipe 5x10.5 and 10x17, "click" clamps for the pressure points,

1.1.4 SEQUENT 56

Front SEQUENT 56 kit contains:

- 1 Sequent 56 ECU without maps
- 1 LPG GENIUS SEQUENT 56 or GENIUS MAX SEQUENT 56 pressure reducer with water temperature sensor
- 1 LPG "ET98 SUPER WP" solenoidvalve
- 5,6 or 8 BRC injectors with calibrated nozzles according to cylinders number
- 1 injectors rail for BRC injectors with temperature and gas pressure sensor with findings for Normal or Turbo version
- 1 "FJ1 HE" high efficiency filter
- 1 Sequent 56 changeover switch

- 1 harness (studied for Sequent 56 BRC injectors)
- roll of copper pipe ø 6 or ø 8,
- water pipe 16x23,
- 1 bag containing screws, nuts and various connections
- gas pipe 10x17 or 12x19,
- Gas pipes 5x10.5 to be used on the injectors and pressure points
- A bag containing: manifold pressure nozzle, nylon Y piece, nuts, junctions and "click" clamps for gas pipe 5x10.5 and 10x17, "click" clamps for the pressure points.

Gas Injectors/reducers pairing allow to convert to LPG or CNG the vehicles as indicated in the table below (Please refer to Types of Installation 2/3 guide)

Tab.1

REDUCER	INJECTORS		SEQUENT BRC
	KEIHIN	BRC	
LPG Genius	LPG	LPG	SEQUENT STANDARD/FAST
LPG Genius MAX	LPG	LPG	SEQUENT STANDARD/FAST
LPG Genius SEQUENT 24		LPG	SEQUENT 24
LPG Genius SEQUENT 56		LPG	SEQUENT 56
LPG Genius MAX SEQUENT 56		LPG	SEQUENT 56
CNG Zenith		CNG	SEQUENT FASTNESS
CNG Genius	CNG		SEQUENT STANDARD/FAST

2. WHY CHOOSING SEQUENT

SEQUENT represents the most advanced level of evolution for what concerns the equipment of gas injection, **and it can be defined to all intents and purposes as a "COMMON RAIL" system**.

In fact it first introduces, in the gas propelled field, the winning evolution used for modern Diesel engines: a "rail-line" in pressure (rail) that supplies fuel to all injectors (true injectors) that are assigned to inject it in each cylinder of the engine.

SEQUENT in addition introduces the concept of modularity of the harness. This operation consists in the possibility to install the SEQUENT equipment on the vehicle through the connection of only three electrical wires and to add further electrical connections only and exclusively in case of particularly sophisticated vehicles.

In the SEQUENT system, unlike an injection at continuos flow (stream), the ECU calculates the opening times of the injectors, cylinder per cylinder, and it acts them separately on each gas injector with the highest precision and with the best timing if compared with the opening instant of the intake valve. The sequential injection control allows consequently obtaining the top timeliness and precision of the fuel dosage.

As per all electronic injection systems, a mixer does not aspirate the gaseous fuel, but the correct quantity is determined through the calculations made by the ECU. It allows obtaining the well known advantages of the injection systems, such as:

- No disadvantages in the performances on petrol, caused by the absence of a mixer,
- Maximum performances on gas, typical of the injection systems,
- No additional overall dimensions on the intake pipes,
- Elimination of the backfire risks, due to the injection near the intake valves and increased by the fact that injection is in a timed way with the opening of the intake valve.

The result is that the original sequential injection operation of the vehicle, the engine had been studied, built and optimised for, is absolutely unchanged, with the following practical results:

- Better driving fluidity,
- Consumption optimisation,
- Reduction of polluting exhaust emissions.

Other advantages of the system, which are typical of the "in series" working type and therefore already known by the BRC installers, are the following:

- There is no need of any specific emulation for the injectors. This is usually made by the same ECU,
- It is normally not necessary to delete the error codes in the petrol ECU, because they do not appear anymore,
- it is not necessary anymore to install the "Memory" devices on those vehicles provided by OBD diagnosis,
- all the petrol ECU functions remain perfectly efficient even while running on gas, assuring the respect of the OBD regulations,
- no particular adjustment is needed, if the configuration is available.

Moreover, thanks to the ECU high integration:

- it is not necessary to install external emulation devices and injectors stop ones as Modular LD are integrated in the system harness for Sequent Standard, Sequent Fast and Sequent Fastness while these are integrated in the Sequent 56 ECU. Modular LD are not present in Sequent 24 system.
- **you can read the crack shaft sensor rpm without using external devices**
- the ECU has **an internal spark timing advancer** suitable for most of the vehicles (except for Sequent 56 and Seqeunt 24)
- you can connect **two Lambda Oxygen sensor** without using adapters (except for Sequent 24),
- The Ecu has the main adapter for **"in need of power supply" and "fed" oxygen sensors**
- you can **convert vehicles till 8 cylinders** (except for Sequent 24).

3. UNDERSTANDING SEQUENT AND SEQUENT FASTNESS SYSTEMS

The evolution of SEQUENT system allows introducing new and more sophisticated components trying to obtain higher performance.

The system can be used in various configuration with different components (LPG Genius, LPG Sequent 56 Genius, LPG Sequent 24 Genius, Genius.M, LPG Genius Max, LPG Sequent 56 Genius MAX, Zenith, BRC or Keihin rail, etc)(table 1 page 7).

3.1 SEQUENT STANDARD

3.1.1 SEQUENT STANDARD STRUCTURE

The SEQUENT systems, starting from the gas tank to the reducer included, utilise components, which are already well known by the BRC installers. The pressure reducer, in particular, will be the GENIUS SEQUENT. It is the same little-sized reducer of simple installation already installed on the Flying Injection, with the difference that it will be provided with brass water elbows and a new temperature sensor, which is not compatible with the Flying Injection one. The differences if compared to the previous conception equipment start with the rail, connected through the proper pipe to the GENIUS SEQUENT outlet, which connects the gas injectors, supplying them heated and vaporised gas. A pressure sensor, that measures the absolute gas pressure and supplies injectors, is connected to the rail. If it is possible to say that the ECU is the brain of the system, the injectors represent its heart. They are electro-injectors, whose working principle is quite similar to the one of the petrol injectors, but they differ from these last ones for:

- Larger passage sections, suitable for the gaseous fuel
- Lower electric impedance, to have quick opening times,
- “Peak & hold” electric piloting, to have small piloting currents without disadvantaging performances.

At every injector outlet, the gas is directly introduced, through proper pipes, in the air-intake manifold, downstream the throttle valve.

The changeover switch with level gauge is of the two-position type, with buzzer. It allows carrying out the changeover functions from the petrol-gas and gas-petrol operations, indicating the gas quantity present in the tank and moreover displaying some diagnostic signals in case of malfunction, lack of fuel, not correct programming, etc.

Not least, there is the very powerful, extremely rugged, completely waterproof FLY SF ECU, complying with the EMC regulations, realised with electronic specific components for automotive use, which allow to install it even in the engine compartment. The ECU collects and elaborates full information and checks completely the various system functions; in particular the injectors, managing the instant when the injection happens and its duration with the precision of few microseconds (microsecond = 1/1000000 of second).

The ECU had been studied to bear short-circuits of unlimited duration on each of its inlet/outlet wires, both towards the ground and towards the battery positive. It had been subjected to stringent tests in order to verify its compliance with the regulations in the automotive field.

The SEQUENT system communicates with the outside through a computer, by means of which, with a valid and powerful interface program, it is possible to transfer any information to the ECU, program itself, calibrate the system, verify the correct operation, read and delete the possible error codes memorised and have information about the installation and about the memory contents of the ECU. The interface on the computer is therefore the instrument by means of which the installer interacts with the whole SEQUENT system and by means of which he could “shape” the gas equipment to fit it to the vehicle in the different driving conditions.

The tidy collection of all files related to the different installations made may constitute a very useful proper historic archive, both to keep under control the evolutions of equipment in the time, and to constitute a starting point for new installations.

The guide 3/3 has been entirely dedicated to the interface program on computer.

3.1.2 WORKING PRINCIPLE

SEQUENT is a system that is placed “in series” with the petrol system. While running on gas, the petrol ECU still determinates the fuel quantity to supply the engine. SEQUENT is a “passive system” or “slave”, SEQUENT works as an “interpreter” between the petrol system and the gaseous fuel control. The operation of the SEQUENT system is based on the fact that the Fly SF ECU is connected to the petrol ECU terminal/s piloting injectors (picture 1).

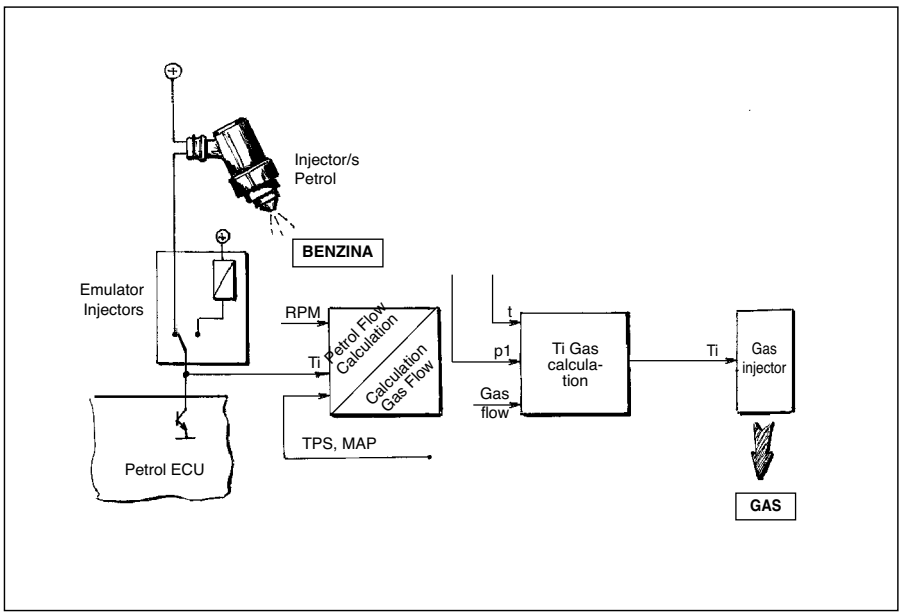
It recognises this way the petrol injection time (Ti). (While running

on gas, the injectors signal will be recognised due to the presence of the injectors integrated emulation inside the ECU).

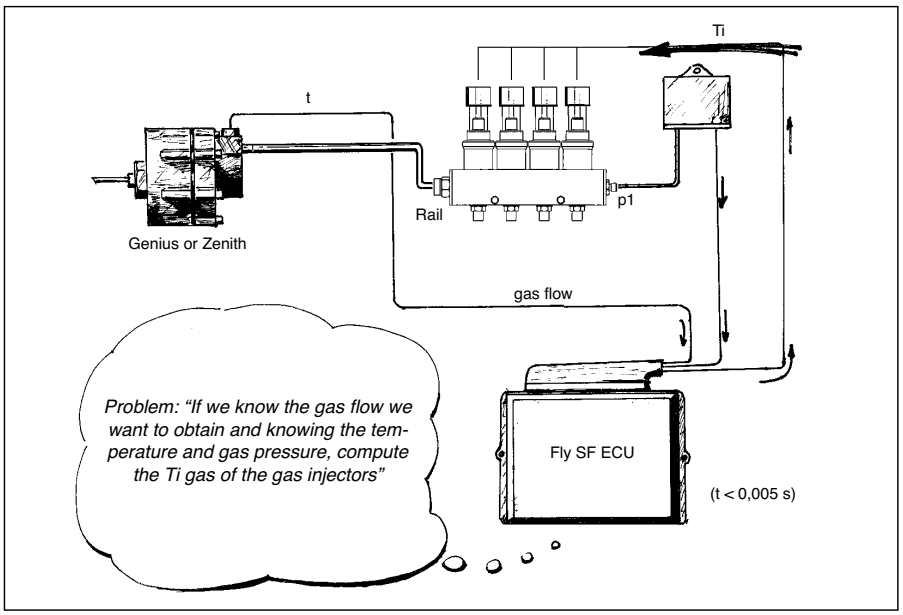
Due to the Ti and the engine rpm signal, the Fly SF ECU calculates the petrol flow that the original ECU tends to supply to the engine, then converts it into gas flow and realises it piloting opportunely the gas injectors. This choice is of the utmost importance, because the fact of enabling the petrol ECU to be constantly working and piloting the gas dosage, allows carrying out clearly and transparently functions such as stoichiometric control, enrichment in full load and cut-off following the criterions expected by the manufacturer, the restriction of the peak rpm, the coherent control of petrol vapours, the correct communication with the air conditioner equipment, etc. All this without the possibility that some counterfeit error codes could appear. For what concerns the petrol equipment, everything remains unchanged, that is why any error message, while running on petrol or on gas, has to be considered real and believable. Furthermore, if the vehicle shows some problems in the petrol operations, they will be maintained in the gas operation too. It is absolutely necessary when you want to comply with the more and more stringer OBD anti-pollution regulations, even in the gas operation.

The low impedance gas injectors are controlled in the peak & hold mode (see paragraph 4.12), keeping in mind the physical gas parameters (temperature and absolute pressure) read by the Fly SF ECU in real time (picture 2).

It is important to underline how the Ti is a precise and precious parameter, being the result of sophisticated calculating elaboration carried out by the petrol ECU on the basis of a complete and specific system of sensors.



Picture 01



Picture 02

Due to the fact that the temperature and pressure conditions can change depending on the conditions of use of the vehicle, the system has temperature sensors and suitable absolute pressure sensors placed on the gaseous supply of the injectors and on the air-intake manifolds. The Fly SF ECU can thus adjust in real time its calculus and, above all, can correctly operate even in the presence of strong drift of aforesaid parameters.

The SEQUENT reducers (GENIUS, GENIUS.M GENIUS MAX or ZENITH) tend to keep practically constant a differential of pressure between the gas outlet pressure and the air-intake manifold, exactly how it happens in many petrol systems. This helps optimising the system working, but it is not an indispensable fact, as the control electronics is quicker than the pressure steady state. For example, due to a sudden acceleration, the pressure in the reducer increases in a fraction of second. In this lapse of time, the ECU carries out several cycles of calculus and obviously compensates every delay of mechanical cause.

Another important aspect of the SEQUENT system is the gas injector. As it will be subsequently described, they are low impedance fuel injectors with large passage sections, able to obey, in a very quick way and with great repetitiveness, to the controls by the Fly SF ECU, enabling to supply even big engines.

The Fly SF ECU, in addition to the general program of the system working, has to contain the specific data for every vehicle (it is about a pretty complex whole of configurations and other calibration parameters). The calibration details can come from an archive that BRC will leave at your disposal, or they can be obtained directly from the installer through a proper self-calibration process, driven step to step by the PC program. The personal computer works also as a diagnostic instrument to verify the good working of the system or to spot any possible anomalies. Inside the ECU there is also a powerful self-organising software that, perceiving any possible changes in the vehicle operation, is able to rectify them automatically and without any external help.

3.1.3 CHANGE-OVER FUNCTION

The changeover switch (picture 3) has two positions, which allow the petrol operation and the petrol starting with automatic changeover to gas.

The latter one is to be used for the normal gas operation.

3.1.3.A Petrol operation

In this position, the two-colour LED turns red, the petrol injectors are working, while the gas ones are closed, likewise the gas solenoid valves and the spark advances go back to default values. The vehicle regularly runs on petrol, as if the system were not present (normal petrol operation).

Picture 03
Two-position changeover switch with buzzer and support

3.1.3.B Gas operation

In this position, the vehicle starts up on petrol, then, as soon as the temperature conditions of the reducer and the working conditions of the engine (rpm, manifold pressure, etc.) programmed are achieved, it changes over automatically on gas.

While the engine works on petrol, the two-colour LED turns red; during the changeover phase from petrol to gas the LED turns orange for an instant (red and green at the same time); last, when the changeover phase is over, the LED turns green and the engine works on gas (gas normal operation).

In case of accidental engine shutdown, the ECU re-changes automatically to petrol, independently of the position of the changeover button, and the two-colour LED turns red (this function is also called “Safety”). Such a function moreover prevents the on-off gas solenoid valves from being energised for a period longer than 5 seconds after the engine stop.

During gas operation, the ECU cuts off and emulates injectors, the gas solenoid valves are open and the gas injectors are controlled depending on the fuel demand and time calculated by the ECU.

3.1.3.C Fuel gauge: LPG operation

The changeover has moreover the function of fuel gauge through the four green LEDs. To know how much LPG is contained in the tank it is sufficient to see how many LEDs are turned on. Four LEDs turned on indicate the full filling of the tank (80% of the total tank capacity), three LEDs on indicate the 3/4 of the total filling, two LEDs on mean half tank, one LED on mean1/4 of tank.

The indication of fuel stock is obtained through the first LED flashing and is purely indicative. The correct signal is obtained when the vehicle is on a level surface and after a few seconds from the starting, even if the indication is immediately present. **It is recommended to use the partial trip odometer to control the fuel distance.** Four green LEDs flashing mean that there could be an excessive quantity of LPG in the tank. In this case it is suggested to run few kilometres until the flashing ends.

3.1.3.D Fuel gauge: CNG operation

To know how much CNG is contained in the cylinders it is necessary to connect the level sensor to

BRC manometer equipped with a pressure sensor.

Four green LEDs lit indicate the maximum pressure inside the cylinders; the gradual turning off of leds corresponds to lower pressures inside the cylinders. As per the LPG version, also in this case the indication of the fuel stock is obtained through the first LED flashing and is purely indicative.

It is recommended to use the partial trip odometer to control the fuel distance.

Precautions must be taken to ensure that the petrol tank is never allowed to become empty.

It is necessary to maintain a petrol quantity corresponding to 1/4 or 1/2 of the tank at all times and to renew it periodically both for the LPG and for the CNG versions.

3.2 SEQUENT FAST

3.2.1 Structure, Operation principles and Sequent Fast changeover

Description of structure, operation principle, changeover and level indication are the same indicated for Sequent Standard (§ 3.1).

Anyway Fast system difference is the calibration methods with faster and easier maps. It allows a fast installation too as rpm, TPS and oxygen sensor signals have not to be connected.

All software differences for calibration and mapping between Fast and Standard Sequent systems are described in the Software guide 3/3.

3.3 SEQUENT FASTNESS

3.3.1 Structure and Operation principles

Sequent FASTNESS is the sequential injection system in gaseous phase created by BRC for CNG installation.

Starting from SEQUENT consolidated structure, it includes important changes and updates thanks to BRC experience and recent experimentation with the aim to make the system stronger, easy to install and able to solve even the more serious problems.

Innovation and changes will be deeply described in the following paragraphs and refer to:

- system components (reducer, sensors, etc.)
- software and engine control (new strategies).

Both components and software have been studied for the best easy use.

3.3.2 Sequent Fastness change-over

Changeover switch and level indicator operations for Sequent Fastness are the same described for the Sequent Standard in § 3.1.3

3.4 SEQUENT 24

3.4.1 Structure and Operation principles for Sequent 24

SEQUENT 24 è is the sequential injection system in gaseous phase created by BRC for LPG conversion of 3 or 4 cylinders vehicles.

The installation is easier thanks to the sensors and emulators' new philosophy.

SEQUENT 24 does not need any additional device as emulators are integrated in the ECU while sensors are integrated in the main components (Genius and RAIL).

Connections are faster as for the dedicated connectors and TPS signal is no longer necessary while the Oxygen sensor one is only optional. For rpm signal you could use a standard rpm signal or the crank shaft sensor one.

SEQUENT 24 new programme on PC described in guide 3/3 is easier to use and completely independent from Standard and Fast Sequent for records and files, too even if the philosophy is the same.

3.4.2 Sequent 24 changeover

Similar to the classic two-position changeover switch with buzzer (used for Sequent and Sequent Fast) is substantially different from it.

This new changeover switch can be considered as a small ECU as this is not only a switch for the petrol-gas passage but dialogues with the ECU and manages the tank gas level indication on the 4 green leds.

3.4.2.A Changeover switch in petrol position

When the changeover switch is in petrol position, the vehicle will operate with petrol (as in previous systems). The user is aware of this because the red rectangular led is on while the gas level information is not available so that the 4 green leds are off.

3.4.2.B Changeover switch in gas position

In this position the vehicle starts with petrol (led off) and as soon as the set changeover conditions are reached the system automatically changes to gas operation. The user is aware of the change because the rectangular led is orange and then turns to green (gas operation). Only during gas operation the level indication is displayed on the 4 green leds.

3.4.2.C Error signal

As already underlined, this changeover switch is “clever” and talks with the ECU.

When the changeover is not working, the user is informed through the lighting of the blinking green central leds and the orange rectangular one. In these conditions it is possible to force petrol operation by switching to petrol position as well as it is possible to run with gas only with the changeover switch in gas position but without level indication. In these cases we suggest to carry out a system diagnosis and a possible repairing or replacement of the changeover switch.

3.4.2.D Fuel indicator for LPG and CNG

Please refer to Sequent Standard § 3.1.3.C.

3.5 SEQUENT 56

3.5.1 Structure and Operation principles

Sequent 56 is the sequential injection system for LPG supplementing the already known and appreciated BRC gaseous injection systems for automotive use and improving performance, easiness and economic.

Sequent 56 is an easy and fast system to install with the most powerful software strategies for the set up, paired to a fast and easy software to use, thanks to the new PC interface improvements.

The structure is similar to Sequent Standard that means it has a reducer with a rail with BRC injectors and a Sequent 56 ECU. All components are new concept ones so that from the electrical and mechanical point of view Sequent 56 has been studied to allow the installers an easy work with always more reduced overall dimensions.

3.5.2 Sequent 56 changeover and Fuel indicator for LPG and CNG

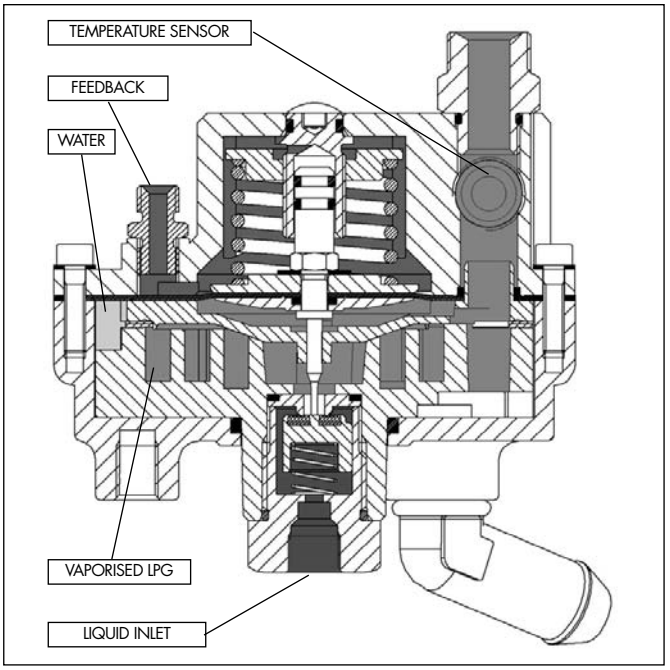
Same functions as for the Sequent 24 changeover switch described in § 3.4.2.

4. DETAILED DESCRIPTION OF THE COMPONENTS

Picture 01
Sequent Standard/Fast Genius Reducer

4.1 LPG STANDARD/ FAST SEQUENT GENIUS REDUCER (800-1200-1500 mbar)

In the LPG version, the SEQUENT GENIUS reducer (picture 1) only consists of one stage, with a variable outlet pressure, which stands approx. 1,2 bar higher than the air-intake manifold pressure. Inside the SEQUENT GENIUS room the LPG evaporation takes place due to the heat exchange with the engine coolant liquid, as in a common reducer. The gas outlet pressure is controlled by a spring-diaphragm-shutter system, equipped with proper vibration-damping systems.



Picture 02
Sequent Genius Reducer – Sectional view

You should observe that (picture 2), a room opens onto the surface of the diaphragm opposite to the 11\one on which the gas pressure acts. This room is connected to the air-intake manifold through a pipe. The gas outlet pressure is therefore not constant, but follows the intake manifold pressure course. For example, in idling conditions, the manifold pressure if compared with the ambient could be - 0,6 bar and the reducer outlet pressure could be + 0,6 bar.

Picture 03
Temperature sensor

On the other hand, with a complete acceleration, the manifold pressure will be around 0 bar (atmospheric pressure) and the gas pressure around +1 bar. Despite the particular compact dimensions, the reducer guarantees high gas flows, to satisfy powers up to 140 kW (190 CV). As it only consists of one stage, it does not need any draining operations. There is a temperature sensor (picture 3) near the gas outlet hole which gives full requisite information to the Fly SF ECU for a correct flow control. The petrol-gas changeover is also affected by temperature, to avoid the passage of not completely vaporised LPG.

4.2 LPG STANDARD/FAST SEQUENT GENIUS MAX REDUCER

Genius Max reducer has been studied and studied for being installed on motor vehicles with elevated powers motor and for LPG applications. The outer aspect of the reducer is different from the Genius Sequent one, while the working principles are similar.

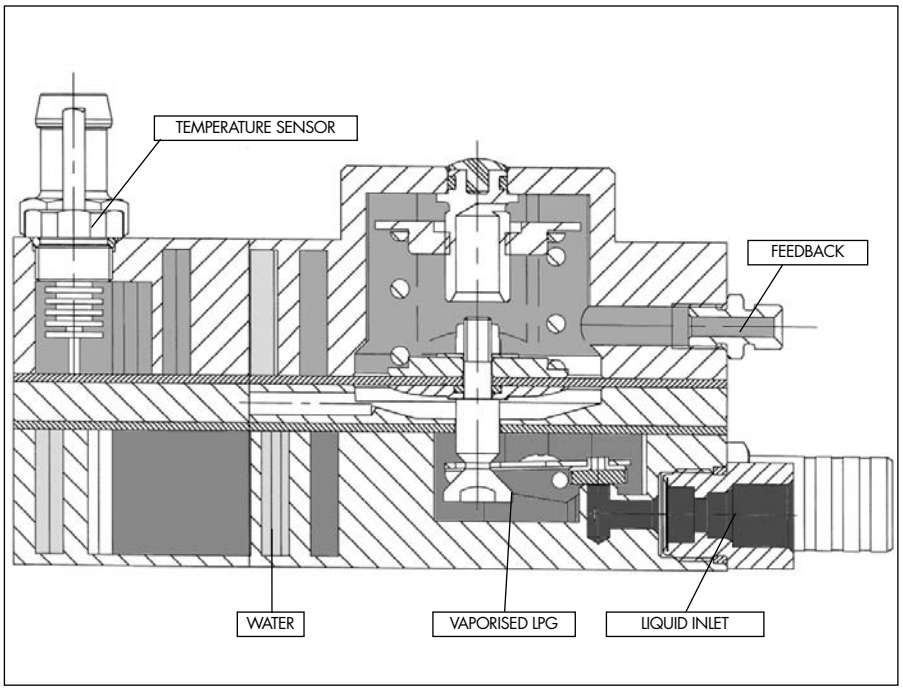
The reducer is constituted from a single stage with a variable outlet pressure that is maintained approximately 1.2 bar more than the pressure of the induction manifold. The status change of the LPG is obtained through a system shutter-lever-spring-diaphragm.

The reducer also contains a circuit where the engine cooling liquid allows the thermal exchange necessary to make the LPG completely gaseous. A temperature sensor is on the reducer, too.

This allows the ECU to acquire the necessary information on Gas conditions for a correct dosing. Check the possible cases described in the Types of installation - 2/3 guide.

Picture 04
Sequent MAX
Genius Reducer

Picture 05
Sequent MAX
Genius Reducer –
Sectional view



Picture 06
Temperature sensor

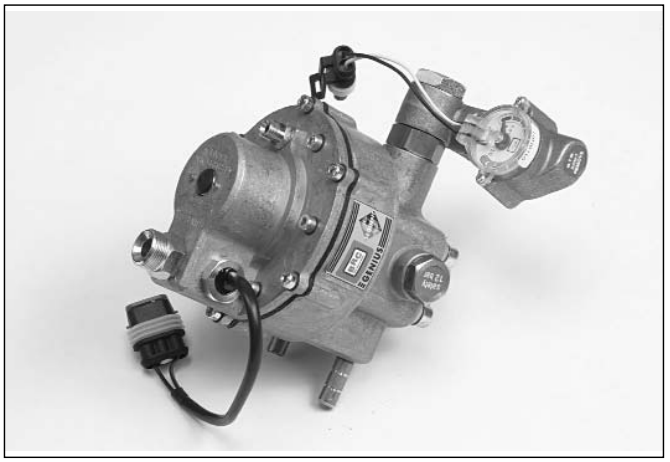
4.3 CNG STANDARD/FAST SEQUENT GENIUS.M REDUCER (2500 mbar)

In the CNG version the reducer, called SEQUENT GENIUS.M (picture 7), consists of two reduction stages, which have the following operations:

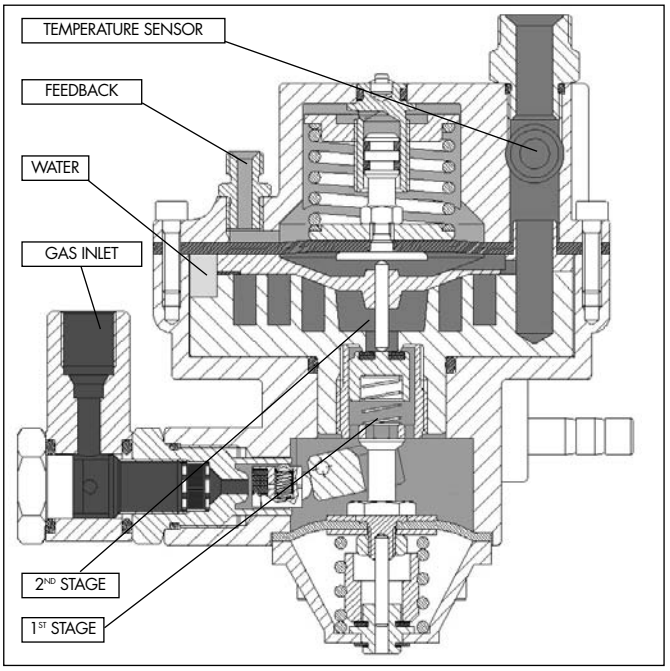
- to face every CNG pressure level coming from the tank (load pressure around 22 MPa corresponding to 220 bar),
- to spread the CNG at the intermediate pressure, of 500 - 600 kPa (5 - 6 bar) in a first stage,
- to bring the heat necessary to avoid an excessive cooling of fuel due to a sudden expansion,
- to spread the CNG further on at the requested pressure, of 200 kPa (2 bar), useful to supply the injection system. Such a value of outlet pressure is conditioned by the pressure signal of the air intake manifold: in practice, the differential pressure is kept constant between the CNG pipe at the outlet of the reducer and the air-intake manifold.

As can be seen from picture 8, the second stage of the SEQUENT GENIUS.M CNG reducer is very similar to the first and only stage of the SEQUENT GENIUS LPG reducer version.

Despite the particular compact dimensions, the reducer guarantees high gas flows, in order to satisfy powers up to 140 kW (190CV).



Picture 07
Sequent M. Genius Reducer



Picture 08
Sequent M. Genius Reducer – Sectional view

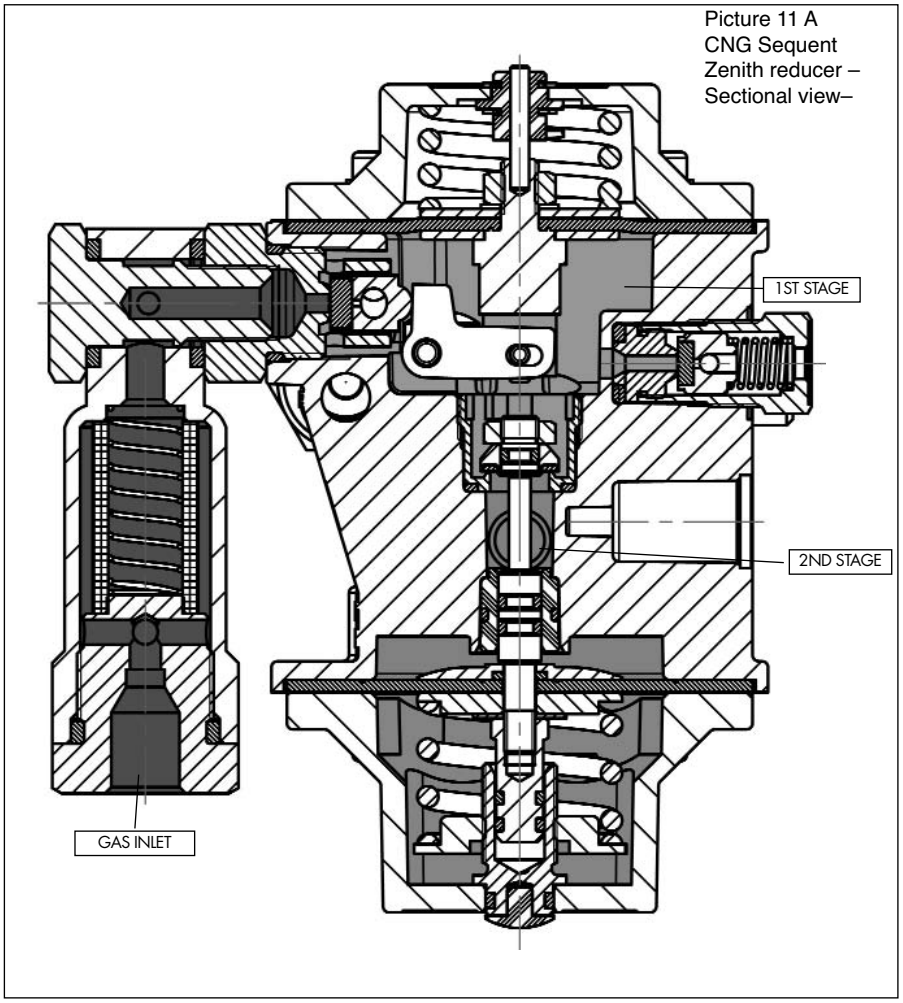
Picture 09
Temperature sensor

4.4 CNG SEQUENT FASTNESS ZENITH REDUCER (1600-2000-2500 mbar)

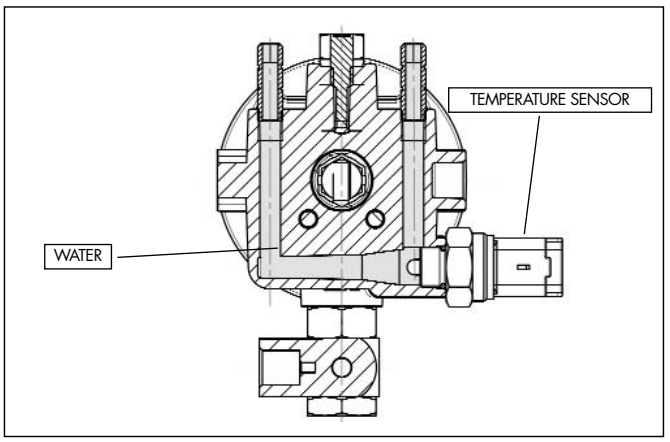
This is the new reducer for CNG installation and for **Sequent Fastness** system only and has important innovation and improvement.
The reducer consists of two reduction stages with the following aim:
- to face every CNG pressure level coming from the tank (load pressure around 22 MPa corresponding to 220 bar),
- to spread the CNG at the intermediate pressure, of 500 - 600 kPa (5 - 6 bar) in a first stage,
- to bring the heat necessary to avoid an excessive cooling of fuel due to a sudden expansion,
- to spread the CNG further on at the requested pressure, of 200 kPa (2 bar), useful to supply the injection system. Such a value of outlet pressure is conditioned by the pressure signal of the air intake manifold: in practice, the differential pressure is kept constant between the CNG pipe at the outlet of the reducer and the air-intake manifold.

In spite of the compact dimensions, the reducer assures high gas flow able to satisfy engine up to 230 kW.
Zenith pressure reducer is supplied with a Delta p (**Δp**) adjustment equal to about 2000 mbar.
If necessary, this value can be changed between 1600 and 2500 mbar by the technician by acting on the suitable screw.
Among the improvements we point out:
- Swivel-connection with integrated high efficiency filter (*).
- 1st reduction stage with lever.
- Safety valve on the 1st stage
- 2nd stage reduction with direct and DESMODROMICO connection.
- Water circuit built inside the aluminium body (no washers).
- Temperature water sensor placed on the reducer (no need to adjust it)

Picture 10
CNG Sequent
Zenith reducer



Picture 11 A
CNG Sequent
Zenith reducer –
Sectional view–



Picture 11 B
CNG Sequent
Zenith reducer –
Sectional view–

– picture 12.
- Fixing thanks to two M6 holes.
- Pressure compensation system adjusted according to the flow.
- Connection on the outlet to the 12x19 pipe rubber holder.

Advantages are the following: more precise and stable adjustment, faster response time, possibility to feed more powerful vehicles (with equal injectors and basic Delta P adjustment).
As for its installation and the indications for the power, please refer to Sequent 2/3 “TYPES OF INSTALLATIONS” guide.
(*) The use of the Zenith reducer excludes the use of the filters described in paragraphs 4.7, 4.8 and 4.9

4.5 LPG SEQUENT 24 GENIUS REDUCER (800-1200-1500 mbar)

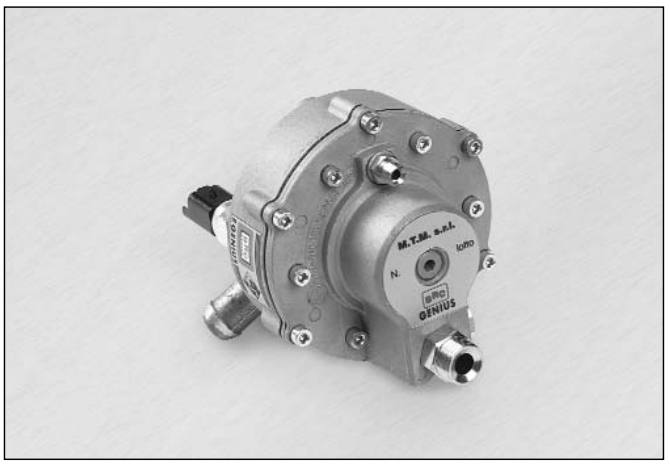
The pressure reducer has the same characteristics of the LPG Sequent Genius (§ 4.1) with the difference this has a new and specific sensor for the water temperature (picture 16 page 20) that is not compatible with previous ones.

4.6 LPG SEQUENT 56 GENIUS REDUCER (1500 mbar)

The reducer is the same as Sequent 24 one (§ 4.5)

4.7 SEQUENT 56 GENIUS MAX REDUCER

This pressure reducer has the same characteristics of the LPG Sequent Standard Genius Max reducer described in § 4.2 with the difference this has a new and specific sensor for the water temperature (picture 16 page 20) that is not compatible with previous ones and is used for LPG Sequent 24 and 56 as well.



Picture 12
Sequent 24 reducer

Picture 13
Sequent 56 reducer

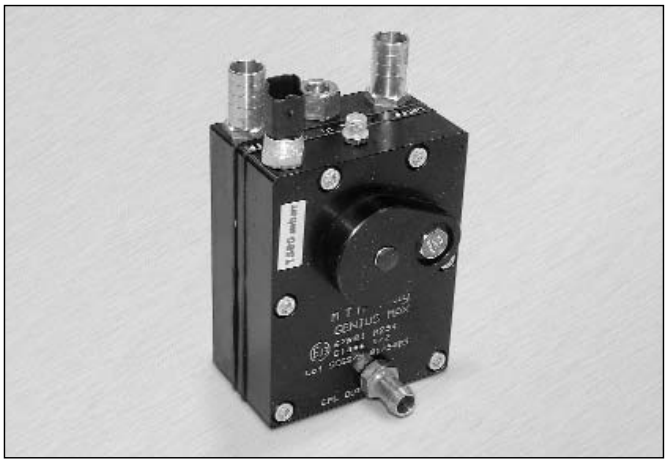


Fig. 14
Reducer Genius MAX Sequent 56

4.8 GAS TEMPERATURE SENSOR

As mentioned in the previous paragraphs, a temperature sensor is installed on LPG and CNG GENIUS and GENIUS MAX reducers. The sensor (picture 3,6 and 9) is resistive, with two wires, based on NTC thermistor.
All the gas changeover strategies of the system as well as the calculus of the gas injection times are based on the temperature measured by the sensor.
The sensor is different from the one used in the Flying Injection equipment. Confusing the two sensors and installing the wrong one, the ECU will not be able to determine the correct gas temperature, to carry out correctly the programmed changeover strategies and to make the corrections in the injection

times that depend on gas temperature, during gas operation.

4.9 WATER TEMPERATURE SENSOR (FOR ZENITH REDUCER)

Temperature sensor illustrated in picture 15 is exclusively installed on Zenith reducer in CNG Fastness system.
This is a resistive type, with three wires based on NTC thermistor. The system gas commutation strategies are all based on the water temperature measured by the sensor. This latter is different from previous ones for mechanic structure: it is more compact and sensor and connector are integrated inside it.

Picture 15
Water temperature sensor on the Zenith reducer

4.10 WATER TEMPERATURE SENSOR (FOR SEQUENT 24 AND 56 REDUCERS)

The temperature sensor illustrated in picture 16 is exclusively installed on reducer for Sequent 24 and Sequent 56.
This is a resistive type, with three wires based on NTC thermistor. The system gas commutation strategies are all based on the water temperature measured by the sensor. This latter is different from previous ones for mechanic structure: it is more compact and sensor and connector are integrated inside it.

Picture 16
Water temperature sensor on Sequent 24 and Sequent 56 reducers

The different temperature sensors can not be installed on reducer models different from teh indicated ones for which they have been studied.

4.11 “FJ1 HE” HIGH EFFICIENCY FILTER

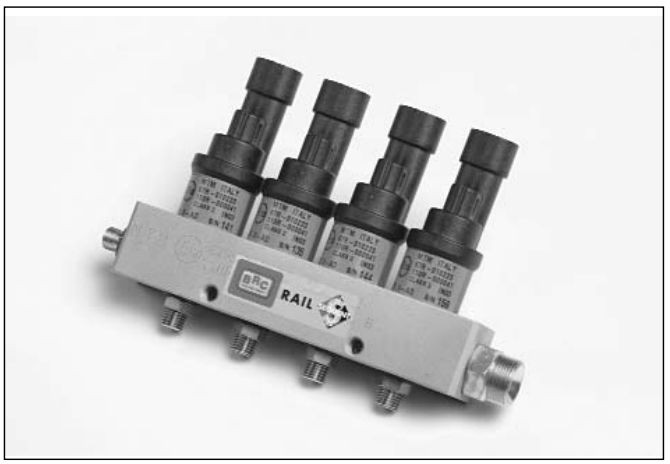
“FJ1 HE” filter replaces “FJ1” and “FJ1 TWIN” one. This is a very small cartridge filter but he has an inside cartridge with innovative filtering elements allowing to have an higher filtering power with regards to previous ones (picture 17).
We suggest you to replace the cartridge each 20,000 km.
FJ1 HE filter is not use for CNG Sequent Fastness system.

Picture 17
“FJ1 HE” filter with rubber-holder connections

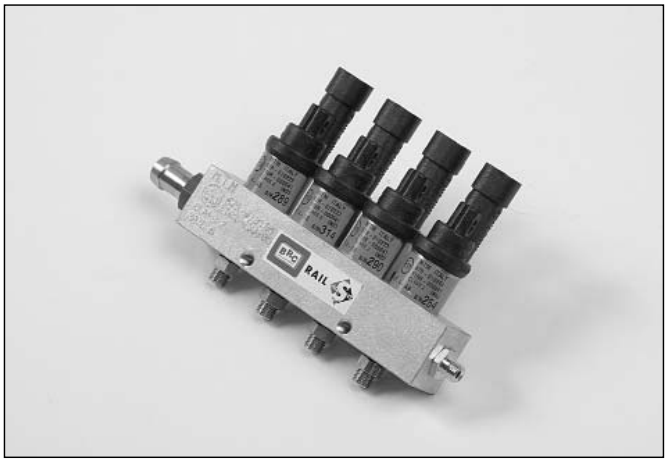
4.12 RAIL

It is the part where the injectors are assembled on; it enables the gas distribution to every injector at the requested pressure.
Available in the following versions:
- for BRC injectors - gas outlet with threaded union (picture 18) or with rubber holder one (picture 19),
- for BRC injectors – gas outlet with rubber holder union and gas temperature and pressure sensor inside the rail body. This configuration is available in two versions: the first for NG Sequent Fastness (picutre 20) and the second one for LPG Sequent 24 and 56 (picture 21).
- for Keihin injectors – gas outlet with threaded connection (picture 22) or with rubber holder one (picture 23).

The first and third rail described have a threaded connection for the pipe direct to P1 pressure sensor while the second (for application with Zenith reducer) is without and has a tap to close the hole.
Two threaded holes allow an easy installation of the fixing bracket to the vehicle.



Picture 18
Version with BRC injectors and threaded connection

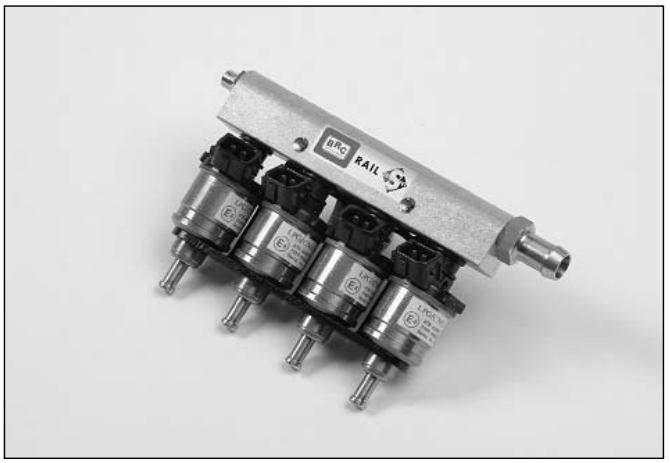


Picture 19
Version with BRC injectors and rubber holder connection

Picture 20
Version with BRC injectors, pressure and gas temperature sensor and rubber-holder connection for Sequent Fastness Applications.

Picture 21
Version with BRC injectors, pressure and gas temperature sensor and rubber-holder connection for Sequent 24 and 56 applications.

Picture 22
Version with Keihin injectors and threaded connection



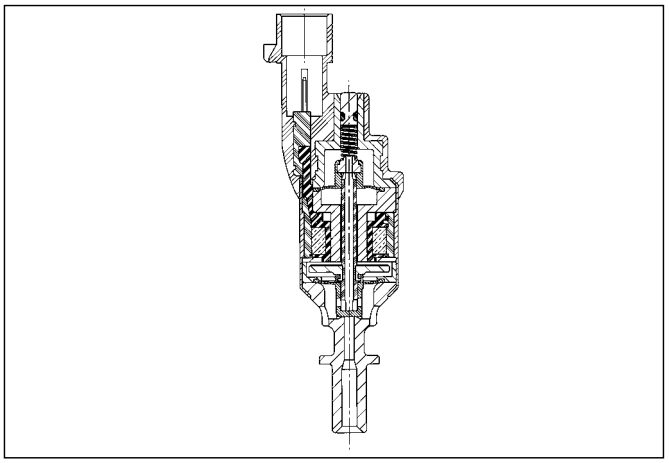
Picture 23
Version with Keihin injectors and rubber holder connection

4.13 INJECTORS

4.13.1 BRC INJECTOR

A patent that protects its constructive details covers BRC injector.

It is a “bottom feed” injector type (supplied from the bottom). Referring to picture 24, the gas contained inside the rail goes into the lower side of the injector and is injected in the air intake manifold when the shutter, moved by the electromagnet, frees the passage section.

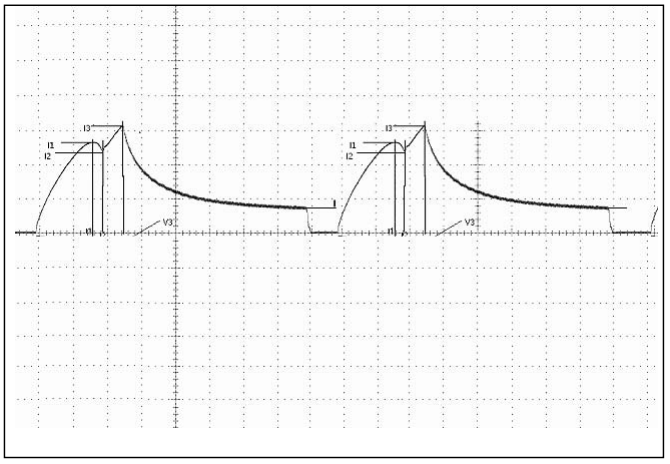


Picture 24
BRC injector - Sectional view

The tightness is assured by the rubber final part of shutter, which presses on a volcano.

The pressure differential acting on the shutter enables it remaining in the closure position when the coil is not energised, and prevents gas from being discharged in the air intake manifold.

The injector is expressively studied



Picture 25
Trend of the current inside BRC injector

to have a long life in extreme conditions of use:

• The diaphragms insulate the very delicate zone of the magnetic circuit, preventing any gas residual products from modifying its geometry.

• Working temperature: from –40 °C a +120 °C.

• 15 g accelerations.

It is a low impedance injector (2,04 ohm / 2,35 mH a 20 °C) and therefore requires a peak & hold piloting.

Picture 25 shows the typical trend of current in the injector. The shutter is opened by applying all the battery voltage during the peak phase; then the voltage which supplies the injector becomes the one called “hold”, as it is sufficient to keep it open for the necessary time. The shutter opening time is very short; it allows having a good control on the injected gas even in small dosages, like in idling conditions. The gas passage sections allow a correct supply even in the more powerful vehicles nowadays available on the market.

To better meet the needs of a fine idling control and a good supply at high r.p.m. there are two kinds of injectors, with different passage sections. The injectors (picture 26) are distinguishable by a coloured label, that can be Blue for the BRC injectors Normal type and Orange for the BRC injectors Max type.

The table of picture 27 shows the powers that can be supplied by the BRC injectors depending on the reducer used*.

Picture 26
BRC Injectors type “Normal”, “Max” and “Super Max”

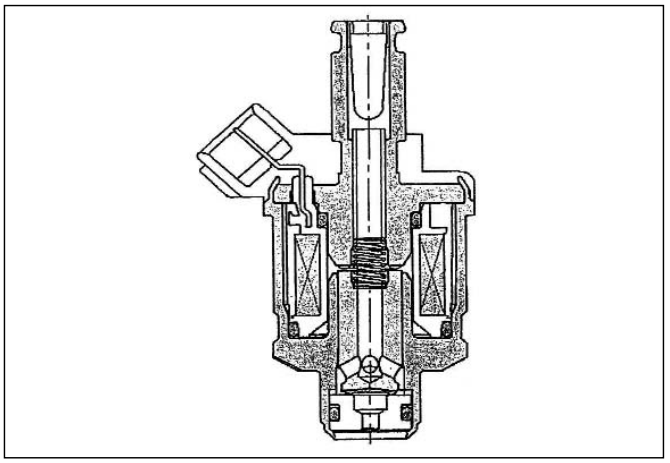
LPG feeding capabilities

Genius		800	1200	1500	MAX	MAX 56
Inj. **Normal Type**	Asp.	17 kW/cil.	21 kW/cil.	23 kW/cil.	-	-
	Superch.	22 kW/cil.	26 kW/cil.	28 kW/cil.	-	-
Inj. **Max Type**	Asp.	-	26 kW/cil.	30 kW/cil.	30 kW/cil.	30 kW/cil.
	Superch.	-	32 kW/cil.	36 kW/cil.	36 kW/cil.	36 kW/cil.
Inj. **Super Max Type**	Asp.	-	-	35 kW/cil.	35 kW/cil.	35 kW/cil.
	Superch.	-	-	42 kW/cil.	42 kW/cil.	42 kW/cil.

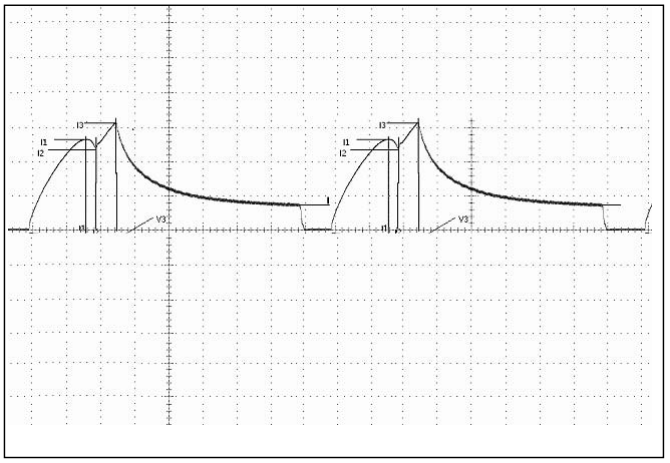
CNG feeding capabilities

		Zenith Δp.1600	Zenith Δp.2000	Zenith Δp. 2500
Inj. **Normal Type**	Asp.	15 kW/cil.	17 kW/cil.	20 kW/cil.
	Superch.	18 kW/cil.	20 kW/cil.	23 kW/cil.
Inj. **Max Type**	Asp.	19 kW/cil.	22 kW/cil.	25 kW/cil.
	Superch.	22 kW/cil.	25 kW/cil.	29 kW/cil.
Inj. **Super Max Type**	Asp.	22 kW/cil.	25 kW/cil.	29 kW/cil.
	Superch.	27 kW/cil.	31 kW/cil.	34 kW/cil.

Picture 27
• The data in the following chart are merely indicative. For the selection of the type of injectors please refer to “Types of Installation” guide.



Picture 28
Keihin injectors – sectional view



Picture 29
Trend of the current inside Keihin injector

4.13.2 KEIHIN INJECTOR

It is a “top feed” injector. Referring to picture 29, the gas enters from the top and axially goes through the shutter to reach the lower room. When the shutter opens, attracted towards the top by the electromagnet, the gas is injected in the air-intake manifold.

The pressure differential that acts on the shutter enables it remaining in the closure position when the coil is not energised, and prevents gas from being discharged in the air intake manifold. The vulcanised rubber on the bottom of the shutter guarantees both the seal and the low noise of the injector (< 90 dB).
The injector has been expressively studied to withstand more than 290 million of cycles, equal to 100.000 km, in extreme conditions of use:
• The shutter is covered by teflon so that the injector can work with no problems of wear with LPG and CNG.
• Working temperature: from –35°C to +120°C.
• 15 g accelerations.

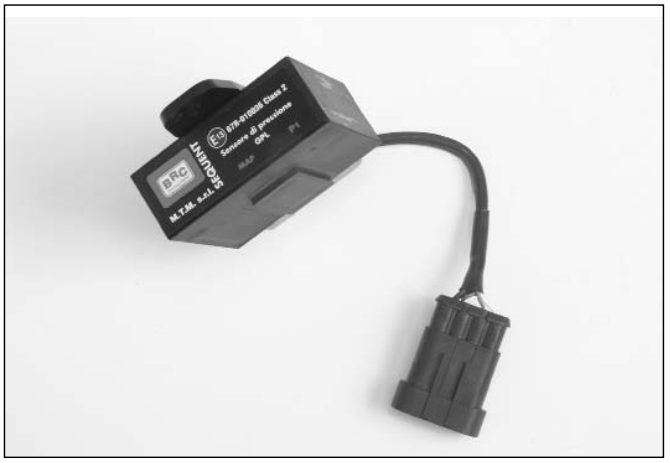
It is a low impedance injector (1.25 ohm/ 3,5 mH a 20 °C) and therefore requires a peak & hold piloting.
Picture 29 shows the typical trend of current in the injector. The shutter is opened by applying all the battery voltage during the peak phase; then the voltage which supplies the injector becomes the one called “hold”, as it is sufficient to keep it open for the necessary time.
The shutter opening time is very short; it allows having a good control on the injected gas even in small dosages, like in the idling conditions. The gas passage sections allow a correct supply even in the more powerful vehicles nowadays available on the market.
To better meet the needs of a fine idling control and a good supply at high r.p.m. there are two kinds of injectors, with different passage sections. The injectors (picture 30) are distinguishable by a coloured mark, placed on the label, that can be Blue for the Keihin injectors Normal type, Orange for the Keihin injectors Max type and Yellow for Keihin Super Max ones.
Picture 31 depicts the powers that can be supplied by the Keihin injectors depending on the used reducer**.

Picture 30
Keihin injectors type “Normal”, “Max” and “Super MAX”

LPG feeding capabilities					
		Genius 800	Genius 1200	Genius 1500	Genius Max
Inj. **Sup. Max Type**	Aspirated	-	-	35 kW/cil.	35 kW/cil.
	Supercharged	-	-	42 kW/cil.	42 kW/cil.
Inj. **Max Type**	Aspirated	-	26 kW/cil.	30 kW/cil.	30 kW/cil.
	Supercharged	-	32 kW/cil.	36 kW/cil.	36 kW/cil.
Inj. **Normal Type**	Aspirated	17 kW/cil.	21 kW/cil.	-	-
	Supercharged	22 kW/cil.	26 kW/cil.	-	-

CNG feeding capabilities			
		GeniusM 2000	GeniusM 2500
Inj. **Super Max Type**	Aspirated	-	27 kW/cil.
	Sovral.	-	29 kW/cil.
Inj. **Max Type**	Aspirated	20 kW/cil.	23 kW/cil.
	Sovral.	23 kW/cil.	26 kW/cil.
Inj. **Normal Type**	Aspirated	18 kW/cil.	20 kW/cil.
	Sovral.	20 kW/cil.	23 kW/cil.

Picture 31
** The data in the following chart are merely indicative. For the selection of the type of injectors please refer to “Types of Installation” guide.



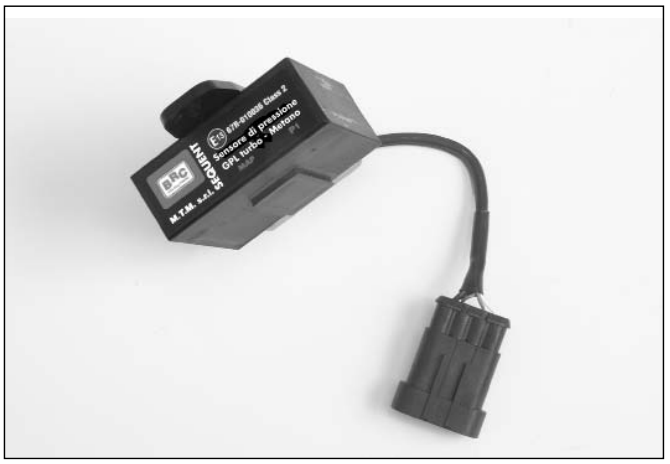
Picture 32
P1-MAP sensor for aspirated LPG applications

4.14 GAS PRESSURE AND MANIFOLD ABSOLUTE PRESSURE (MAP) SENSORS

P1-MAP device (picture 32 and 33) contains two sensors: the P1 sensor that measures the absolute pressure present in the injectors rail and the manifold absolute pressure (MAP) that gives to the Fly SF ECU the information on the absolute pressure present inside the air-intake manifold.
The device is pre-amplified so that the signal is not easily disturbed. The pre-cabled connection makes the installation very simple.
This is used for Sequent Standard and Fast.

4.15 GAS TEMPERATURE AND PRESSURE SENSOR

This new concept sensor (picture 34) is light, very small and integrated with the connector and includes the P1 pressure sensor and the gas temperature one.
Available for vacuum and CNG turbo vehicles, as indicated in § 4.12, it is directly installed on the injectors' rail for Sequent Fastness, Sequent 24 and Sequent 56 applications.
In this position the pressure and gas temperature value is more precise and allows to make faster interventions for the gas carburation corrections.



Picture 33
P1-MAP sensor for Turbo LPG and CNG applications

Picture 34
Pressure and gas temperature sensor inside the Sequent Fastness, 24 and 56 rail body.

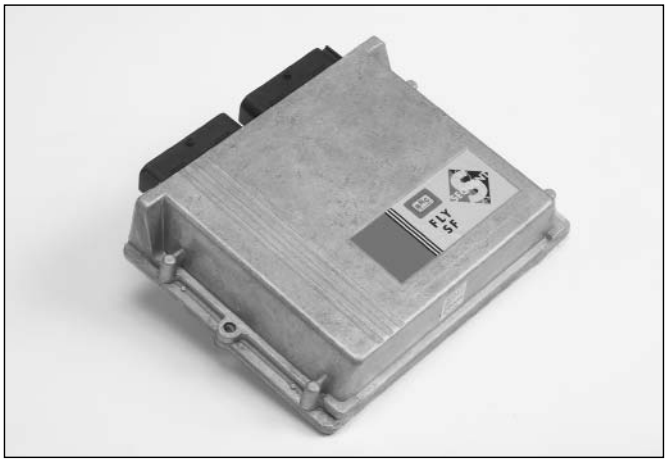
4.16 MANIFOLD ABSOLUTE PRESSURE SENSOR

This sensor (picture 34) is light, small and easy to fix to the bodywork. It already integrates the connector and a pressure sensor suitable for both vacuum and CNG turbo engines allowing a precise set up of every type of vehicle.
This sensor is contained in Sequent Fastness kits but not in Sequent 24 and 56 (separately sold) because if it is used to calibration and selfmapping phases.

Picture 35
MAP sensor for Sequent Fastness applications and used to calibration and selfmapping phases in Sequent 24 and 56

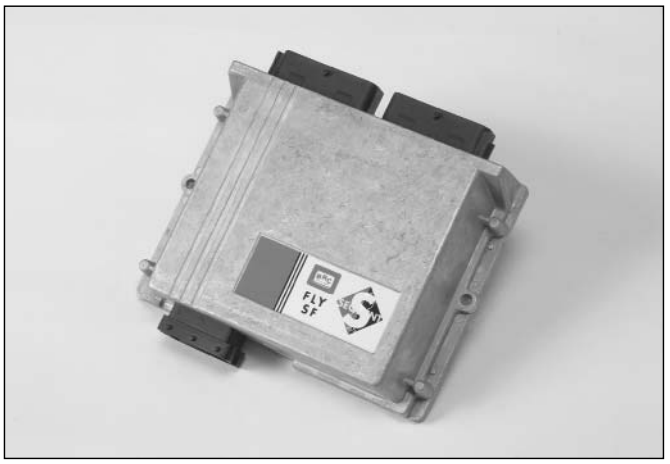
4.17 "FLY SF" ECU (SEQUENT AND SEQUENT FASTNESS)

A detailed description would lie outside the purposes of this handbook. What is important is to know that it is the operating unit controlling the whole system. It is completely made by automotive components, being therefore suitable to bear the temperature inside the engine compartment, even though precautions must be taken to ensure that it is not assembled near red-hot devices such as the exhaust manifold. It is waterproof and is in compliance with the EMC standards. It incor-



Picture 36
Fly SF ECU

porates components of the latest conception (Motorola 32 bit microprocessor), with a data processing speed higher than most original petrol ECUs. The memory that contains calibration program and data is not volatile, so, once programmed, the Fly SF ECU (picture 37) can be disconnected from the battery with no loss of data. It can be programmed more times without problems, for example it can be transferred from a vehicle to another and re-programmed.
Some data acquisition channels are shared to be connected to different signals according to the various vehicles (e.g. TPS, MAP, etc.).



Picture 37
Fly SF ECU: two connectors' version

Picture 38
Sequent 24 ECU

The task of the ECU consists in collecting and processing full information and, as a consequence, controlling the various functions of the system; in particular the injectors, controlling the injection time and its duration, with a precision of few microseconds (microsecond = 1/1000000 of second).
The ECU is contained in an aluminium rugged waterproof case, able to bear very high temperatures and to protect the inside electronic parts, both from external atmospheric agents and from mechanical stresses it is subjected to, and from electromagnetic radiation irradiated by the electrical components of the engine or other sources (transmitter, repeater, mobile phones, etc.).
The ECU has been studied to withstand prolonged short-circuits, both towards the ground and the battery positive contact, on each of its proper inlet/outlet wires (naturally except for grounds and supplies). This allows not ruining the ECU even when in presence of the more common harness errors (inversion of polarity, wrong connection of one or more wires, etc).
The harness connection takes place through a unique 56-way connector, which contains all the necessary signals for the various functions, as regards the piloting of 4 injectors at most.
In the two-connector version (picture 37), a 56-way and a 24-way, two additional types of Fly SF ECU are available: one for vehicles up to 6 cylinders and the other for vehicles up to 8 cylinders.

The ECU incorporates the following functions that were previously obtained through the installation of external various components:
• "modular" function to interrupt and emulate injectors,
• crankshaft sensor adapter function, more and more useful on new vehicle models,
• timing advance processor function, particularly useful for CNG applications (this function can not be used for Sequent Fly SF and Sequent Fastness ECUs for 8 cylinder vehicles)
• it is possible to connect 2 Lambda oxygen sensors with no need of adapters,
• the ECU contains the main adapters for "UEGO" and "in need of power supply" oxygen sensors, to be assembled externally in other systems.

4.18 SEQUENT 24 ECU

As the previous ones, this is compatible with automotive norms for electromagnetic compatibility and it is waterproof.
The difference is the plastic support and the very small dimensions allowing an easier installation in the vehicle.
The connection to the harness is made with a 24 poles connector containing all necessary signals for the different functions. For the installation please follow the already known procedures for Sequent Standard and Fast.

4.19 SEQUENT 56 ECU

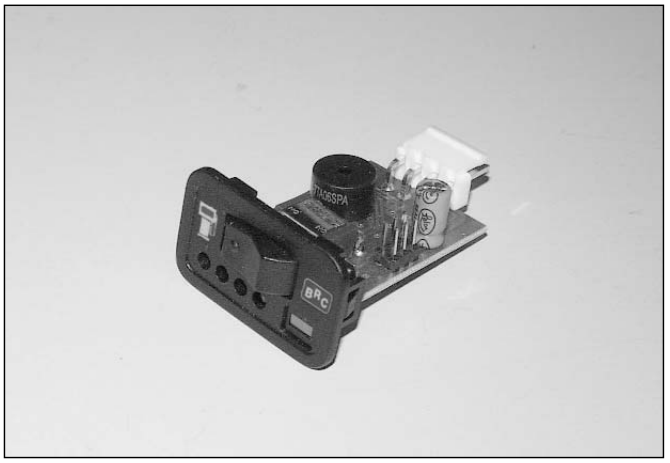
The completely new designed Sequent 56 ECU integrates the most update components and a new microprocessor able to execute the necessary calculations to control the engine in short time with precise and prompt answers.
The system is able to assure the best integration at electronic and communication level (through K and CSN BUS serial line) keeping unchanged the petrol control strategies and “translating” the petrol ECU injection time in gas ones, precisely and fast, adapting itself to gas pressure and temperature changes.
It satisfies OBD norms through an efficient diagnosis system on each sensor and actuator.
The ECU also includes other operations such as the automatic and sequential changeover from petrol to gas in whatever driving condition (acceleration, deceleration, idle) and at whatever rpm (BRC patent).

Picture 39
Fly SF ECU:version for 5-68 cylinders

Picture 40
Two positions changeover switch with buzzer and without body for Sequent Standard, Fast and Fastness

4.20 CHANGEOVER SWITCH WITH LEVEL GAUGE FOR SEQUENT STANDARD, FAST AND FASTNESS

This is the BRC two-position changeover switch (standard or built-in version) with buzzer (acoustic signal) and level indication led.
As already told before, the changeover switch (picture 40) for Sequent Standard, Fast and Fastness, allows to carry out changeover, gas level indication and diagnosis and also signals anomalies such as gas shortage, failure, petrol automatic changeover, etc. both through the leds and the buzzer.



Picture 41
Two positions changeover switch with buzzer and without body for Sequent 24 e 56

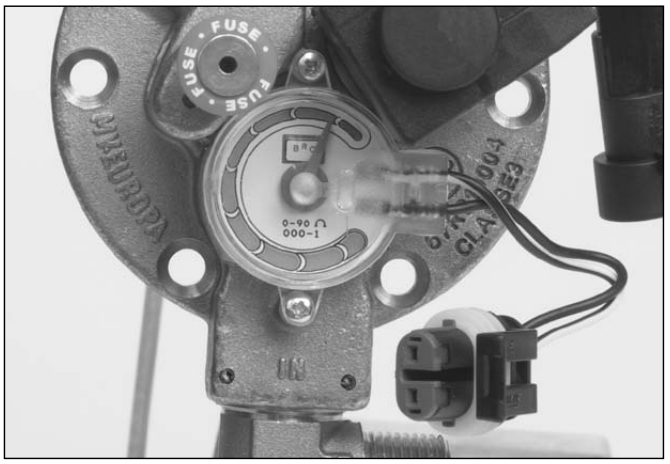
4.21 CHANGEOVER SWITCH WITH LEVEL GAUGE FOR SEQUENT 24 AND 56

Similar to the standard BRC two-position changeover switch with buzzer (acoustic signal) used for Sequent and Sequent Fast, it anyway has some substantial differences. As described in § 3.4.1 this new changeover switch can be considered a small ECU. It is not only a switch to control petrol-gas flow but also to indicate the gas level and signal anomalies such as gas shortage, failure, petrol automatic changeover, etc. through the leds.

4.22 LEVEL SENSOR

The FLY SF ECU controls the indication of gas level by means of a signal on the GREEN LEDs of the

changeover switch. To do that, the ECU is able to elaborate the signal coming from the BRC resistive level sensor (picture 42) located on the multivalve of the tank (LPG equipment), or from the BRC resistive pressure sensor (picture 43) of the CNG equipment. LED lighting thresholds are freely set up with the PC (see Software Guide 3/3 for each system) to allow a precise indication.



Picture 42
Resistive level sensor for BRC Europa Multivalve

4.23 INJECTORS' EMULATION IN SEQUENT SYSTEMS

The function to stop petrol injections is completely carried out by Sequent ECU in charge to emulate injectors too thanks to an internal resistive load.
Stop means to interrupt the electrical connection between petrol ECU and injectors and avoid to introduce the petrol flow inside the engine cylinders during gas operation.
In this phase the SEQUENT system has the aim to feed the engine with gas and to avoid the contemporaneous petrol injection that will be dangerous for both engine and catalyst. Obviously the petrol ECU diagnosis has been studied to "understand" if a connection is not working, especially injectors one.
This is the reason why it is necessary to emulate the load that was before represented by the petrol injectors that is to replace the petrol injectors as for an electrical point of view with "fake" injectors the ECU is not able to understand are not the original ones.
As already said, the resistive emulation is still present on Sequent ECUs nevertheless some petrol ECU also need a resistive-inductive load. For this purpose the SEQUENT STANDARD, FAST and FASTNESS harness includes the Modular LD able to give the inductive load required by the petrol ECU

Picture 43
Resistive pressure sensor for BRC CNG reducers

Picture 44
Fly SF ECU main harness for Sequent Standard and Fast

Picture 45
Fly SF ECU main harness for Sequent Fastness applications

during gas operation when petrol injectors are “disconnected” by FLY SF ECU. For further information, please refer to § 6.2.17.B.
In Sequent 56 system the Modular LD are directly contained in the ECU.
In Sequent 24 the petrol injectors’ emulation is made with suitable coils contained in the ECU and similar to the ones used in Modular LD.

Picture 46
5-6-8-cylinder FLY SF ECU connection harness for Sequent Standard, Fast and Fastness

4.24 SEQUENT STANDARD, FAST AND FASTNESS HARNESS

The harness is one of the new components launched with Sequent Standard system.
In this paragraph we will analyse two types with different characteristics according to the used configuration.
The first (picture 44) is the usual harness for Sequent applications while the second (picture 45) is the one for Sequent Fastness.
This innovative modular harnesses allow the installation in “easy” vehicles by only connecting 3 wires (rpm, + after key contact and TPS: grey, brown and white/violet wires) in addition to battery positive and negative.
For more sophisticated vehicles that usually require more connections, the harness can be integrated with other connections allowing to optimise the set up and vehicle driving conditions.
Both SEQUENT main harnesses have a 56 poles connector used by some of the most important European car manufacturers. In case you have a two-connector ECU, it is necessary to use a second part of the harness where a 24 poles connector will be introduced (picture 46).
There are two types of 5-6-8 cylinders harnesses to feed vehicles up to 6 cylinders and another one up to 8 cylinders. The used conductors

Picture 47
Sequent 24 harness

Picture 48
Sequent 56 harness

are shielded to comply with the electromagnetic compatibility norms. The connectors on the harness are all water proof except for the changeover switch that is anyway placed inside the car so it is protected from water. As for the harness wires and connectors please refer to § 6 of this guide.
NOTE: as the 56 poles connector used for SEQUENT is the same one already used for Flying Injection and considering the similar ECU external structure of the two systems you could mistake the ECU and install it with the wrong system.
This mistake has to be avoided or the car original components will be damaged.
The main harness (picture 44) and the 5-6-8 cylinder harnesses (picture 46) are available for both BRC or Keihin injectors. Pay attention not

to reverse those harnesses.
The main harness for Sequent Fastness is available only for BRC injectors so that it will be paired to the suitable 5-6-8 cylinder harness with BRC injectors.

4.25 SEQUENT 24 HARNESS

SEQUENT 24 harness is thinner compared to previous systems' one. Instead of being a 56 poles harness, it is a 24 poles one, To make installation easier, the system main components are connected through a dedicated connector and the number of wires to be welded is reduced to minimum. To comply with the electromagnetic compatibility standards the system has shielded conductors. The connectors on the harness are all water proof except for the changeover switch that is anyway placed inside the car so it is protected from water. Pay attention to the injectors "cut" that is the main change in the system and harness.

4.26 SEQUENT 56 HARNESS

SEQUENT 56 harness has been simplified to offer the technician an easy and fast installation of the system.
All above described harnesses will be analysed in details in chapter 6.

4.27 NORMAL WP "ET98" LPG SOLENOID VALVE

The LPG solenoid valve used in the SEQUENT system is a waterproof type (with watertight connectors) and is an evolution of the well-known LPG BRC ET98 solenoid valve, from which it can be externally distinguished for the white galvanising (picture 49). Inside the LPG solenoid valve, the filtering system has been improved, in particular for the iron-magnetic particles.
Due to the precise working of the injectors, it is compulsory to use this kind of solenoid valve, in the whole assembly of SEQUENT.

Picture 49
LPG "ET98" WP solenoidvalve

	NORMAL WP SOLENOID VALVE		SUPER WP SOLENOID VALVE
SYSTEM	Sequent Standard Sequent Fast Sequent 24	SYSTEM	Sequent Standard Sequent Fast Sequent 24 Sequent 56

Tab. 4

Picture 50
"ET98 SUPER" WP LGP solenoidvalve

4.28 SUPER WP "ET98" LPG SOLENOID VALVE

The Super WP "ET98" solenoid valve is an interception device for LPG necessary and designed to grant higher performances compared to previous ones. An improved coil allows a more efficient opening power with the same current. This permits to have bigger passage sections and a higher LPG flown. Even in this case the solenoidvalve has been conceived to allow the feeding of high power engines keeping a high filtering grade. With waterproof connectors, the solenoidvalve body is brass colour without external covering while the coil is red (picture 50).

4.29 “VM A3/E” CNG ELECTRO-ASSISTED VALVE

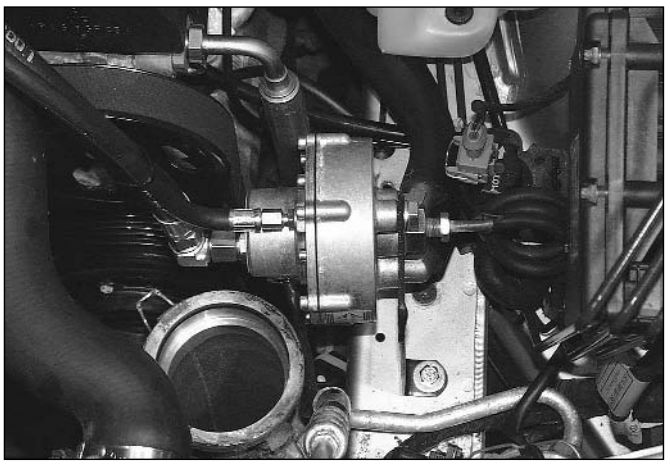
The “VM A3/E” CNG electro-assisted valve used in the SEQUENT system is of the waterproof type (with watertight connectors) and is an evolution of the well-known CNG VMA3/E solenoid valve (picture 51)

The valve, that is usually installed inside the engine compartment along the pipes connecting the CNG cylinder/s to the reducer, if combined to the IM series CNG filling adapter, allows refuelling and, at the same time, the free passage of fuel supply.

The use of this kind of refuelling solenoid valve, in the SEQUENT system context, has a very important role as the solenoid valve is controlled and operated by the electronic control system. It opens when the starting up begins and closes in case of shutdown, even if the driver does not turn off the ignition key (i.e. as it can happen in case of accident).

Picture 51
“VMA3/E” WP CNG electro-assisted valve

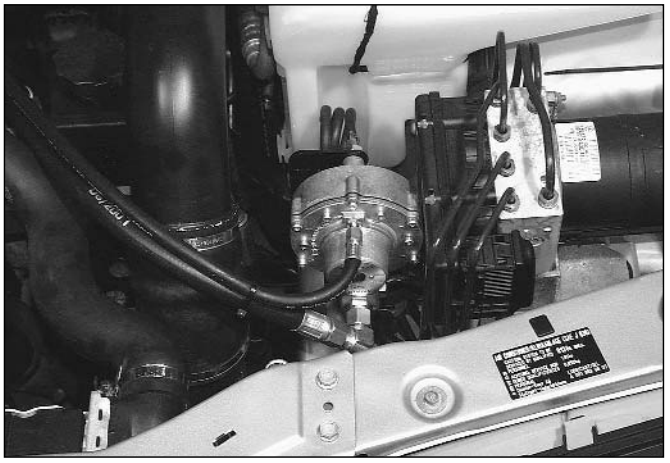
5. MECHANICAL INSTALLATION



Picture 01
Sequent Genius reducer installation with diaphragm parallel to the driving direction

The following installation rules are to be considered as general.

Before installing the various components of the Sequent system it is recommended to check the petrol operation of the vehicle. In particular, it is necessary to carefully check the state of the electronic ignition equipment, the air-filter, the catalyst and the Lambda Oxygen sensor.

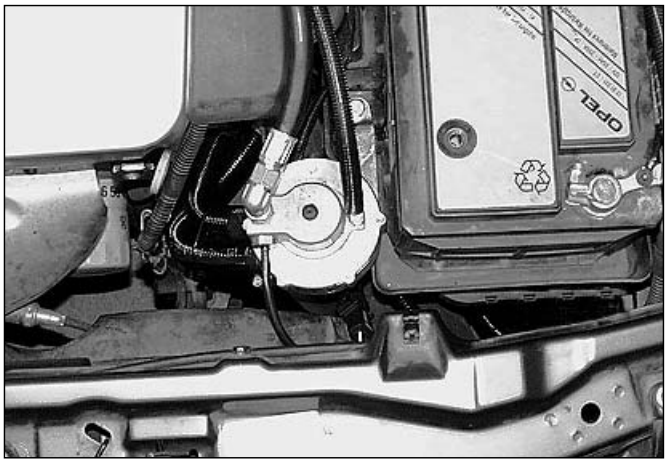


Picture 02
Sequent Genius reducer installation with diaphragm perpendicular to the driving direction

5.1 SEQUENT GENIUS REDUCER

The following general installation rules are to be considered effective both for the LPG version and CNG.

The reducer must be firmly fastened to the bodywork so that it is not subjected to vibrations during its operation. With the engine under stress, the reducer must not hit any other device. The SEQUENT GENIUS may be installed with any orientation (picture 1,2 and 3); it is not important that the diaphragm is parallel to the running direction.

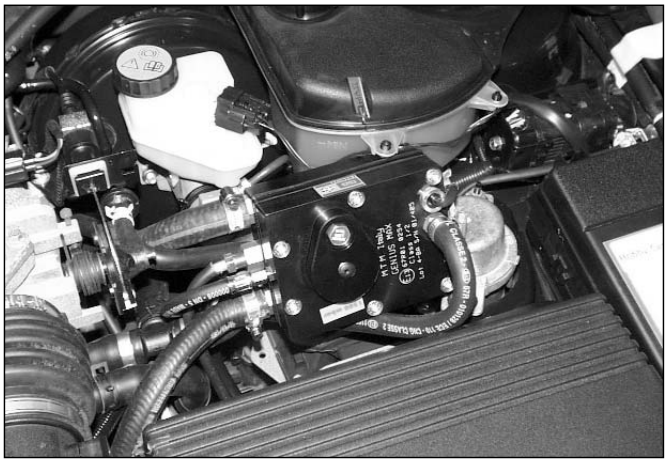


Picture 03
Sequent Genius Reducer: further installation position

The pipe that connects the reducer to the filter should not be longer than 200-300 mm. For the connection see paragraphs 5.10.

If you need to tighten or loosen the gas inlet fitting or any other fitting, we recommend to always use two spanners, in order not to move the component screwed on the reducer body.

The temperature sensor wire should not be too tight or twisted, it should nor make sudden folds at the outlet of the sensor.



Picture 04
LPG Sequent Genius MAX: possible installation position

The copper pipe that goes from

the solenoid valve to the SEQUENT GENIUS must not go through too hot areas of the engine compartment.

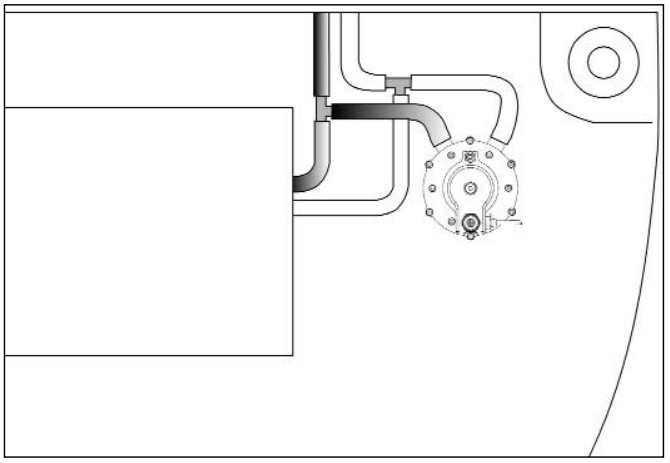
As no adjustment is programmed on the SEQUENT GENIUS, it is not essential it is assembled in an easily accessible area. However the installer should avoid uneasy places, in order to make any maintenance operations without too many difficulties.

For what concerns the LPG version it is important to note that there are rubber-holders connections for 17x23 pipes on the water side; they are quite large pipes because LPG needs to be vaporised and therefore needs a good water flow. The water connection can be made in series or in parallel as regards the passenger compartment heating circuit (picture 6 and 7). In phase of functional inspection of the equipment installed it is important to check that the gas temperature will not reach low values particularly after a long use in power.

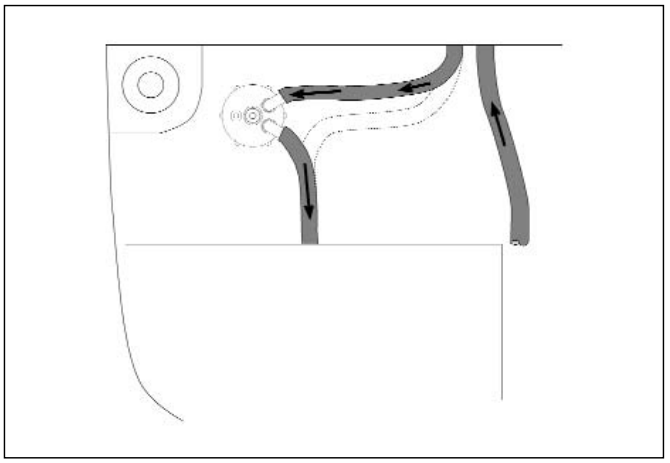
The CNG Sequent Genius, as it does not have to perform the vaporisation function, is equipped with rubber-holders for 8x15 water pipes. **The connection must be necessarily parallel:** indeed a connection in series made with pipes of such dimensions would strongly decrease the passenger compartment heating.

It is suggested, in this case, to carefully follow the indications of water inlet "IN" and water outlet "OUT" placed on the reducer.

Picture 05
CNG Sequent Zenith Reducer: example of installation



Picture 06
Reducer heating circuit – parallel type



Picture 07
Reducer heating circuit – series type

5.2 SEQUENT LPG GENIUS MAX REDUCER

General installation criteria described in the previous paragraph have to be applied for the SEQUENT LPG GENIUS MAX reducer. Unlike Sequent Genius reducer, the Genius Max has rubber-holders connections on the outlet so that pipes have to be tightened using the suitable supplied click clamps.

5.3 ZENITH CNG REDUCER

General installation criteria described in § 5.1 have to be applied for the Zenith reducer, too. As for Genius MAX, the Zenith reducer has rubber-holders connections on the outlet so that pipes have to be tightened using the suitable supplied click clamps.

5.4 LPG SEQUENT 24 GENIUS REDUCER

Installation criteria described in § 5.1 are valid for the LPG SEQUENT 24 GENIUS version.

This reducer is available only with rubber-holder connections so

that you will have to use click clamps for the fixing.

5.5 LPG SEQUENT 56 MAX GENIUS REDUCER

Installation criteria described in § 5.1 are valid for the this reducer version, too.

This reducer is available only with rubber-holder connections so that you will have to use click clamps for the fixing.

5.6 "FJ1 HE" HIGH EFFICIENCY FILTER

The filter may be fastened to the vehicle's structure or to the engine with any orientation; but it would be better to position it with the cartridge turned downward (picture 8).

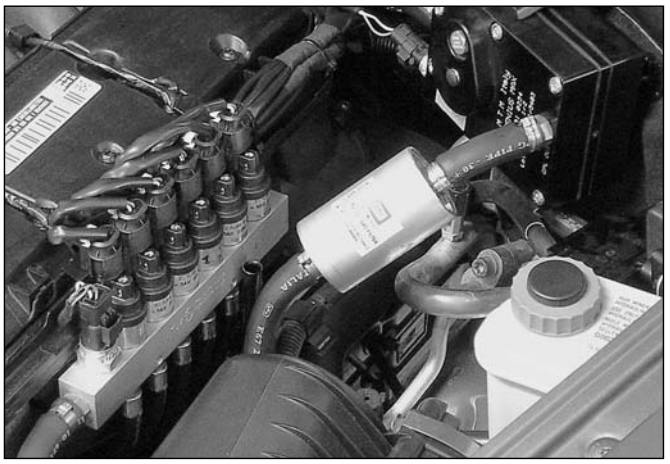
The pipe that connects the filter to the rail should not be longer than 200-300 mm. If you need to tighten or loosen the fittings, we recommend to use always two spanners, in order not to move the component that is screwed on the filter body.

It is recommended to place the filter in an accessible area in order to be able make its programmed replacement.

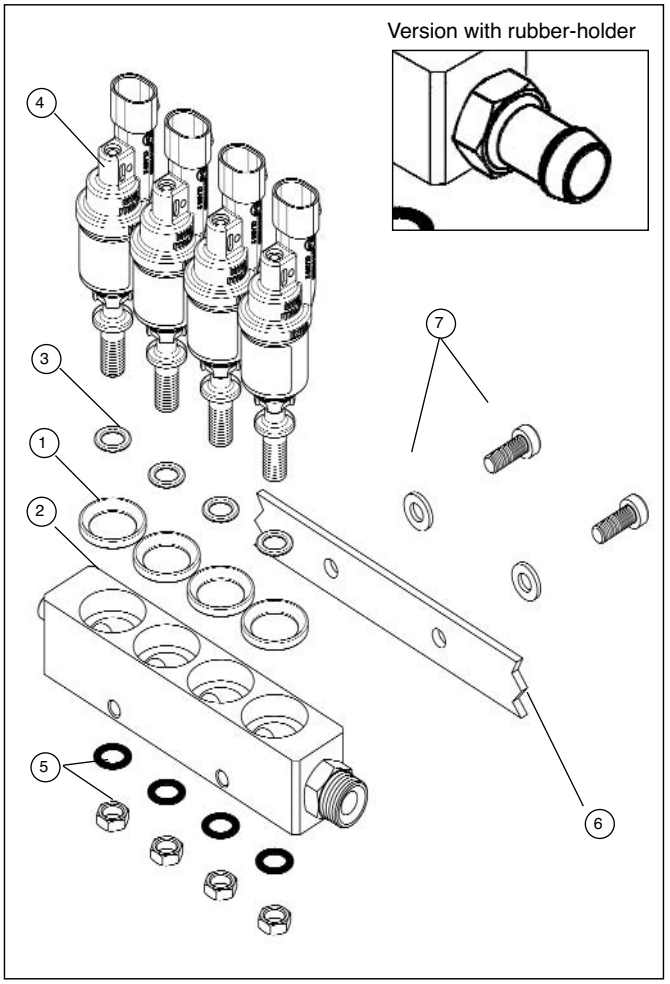
Attention: During the installation of the filter we strongly suggest you to respect the direction indicated on the filter label as this shows the gas flow direction from Genius reducer to injectors rail.

The described filter is available with rubber-holder connections only.

FJ1 HE filter is not used for Sequent Fastness.



Picture 10
"FJ1 HE" gaseous phase filter



Picture 11

5.7 RAIL AND INJECTORS GROUP

5.7.1 BRC INJECTORS INSTALLATION ON RAIL

The rail always has a connection to fix the pipe going to the P1 pressure and it is available is two versions as for the gas inlet that is with threaded connection or with rubber-holder one (see picture 11 page 30).

BRC injectors has to be installed as follow:

- Introduce the O-Ring (1) on the rail seat (2).
- Introduce the O-Ring (3) on the injector threaded part (4).
- Introduce the injector (4) in the rail seat (2).
- Fix the injector to the rail with the washer and nut (5). During the tightening block the injector in the desired position with one hand avoiding its rotation.
- Do not use pliers or spanners to block the injector as they can damage the steel body or the plastic covering. Use a maximum torque of 8 ± 0,5 Nm.
- Place the fixing bracket in the

car using the screws and the washers.

Please pay attention to the cleaning during assembly to avoid dirtiness damage the injector.

The injector ends with a threaded part to which you have to connect the pipe as indicated in § 5.10.

5.7.2 KEHIN INJECTORS INSTALLATION ON RAIL

The rail always has a connection to fix the pipe going to the P1 pressure and it is available is two versions as for the gas inlet that is with threaded connection or with rubber-holder one (see picture 10).

Keihin Injectors must be assembled as indicated below (picture 30A):

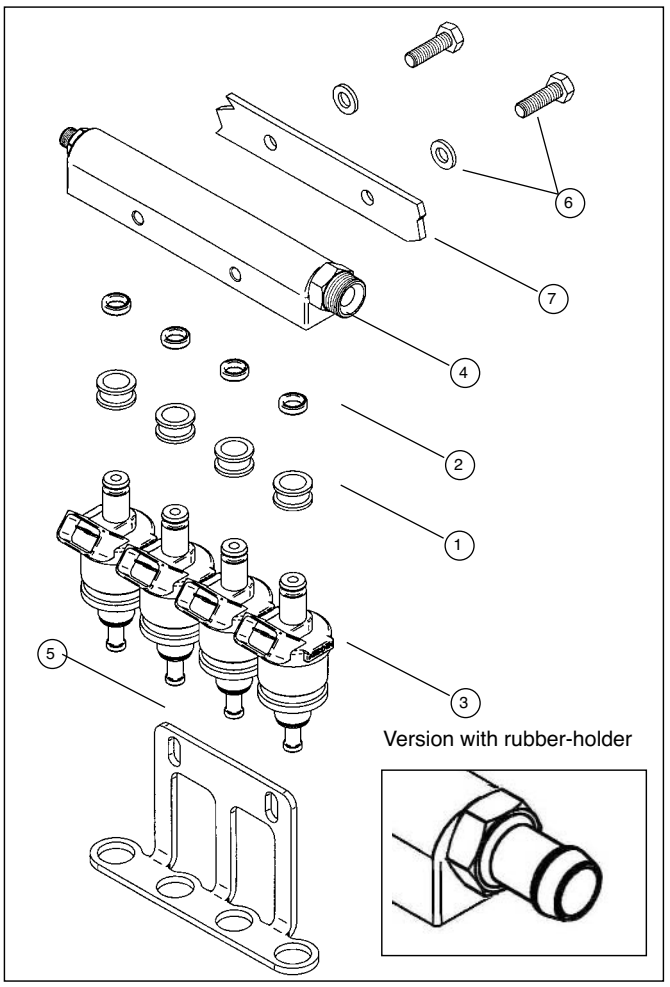
- Mount the rubber ring (1) and the O-Ring (2) in its seat on the injector (3),
- Fit the injector on the rail (4) without cutting or damaging the O-Ring (2). It is suggested to apply a minimum quantity of grease on the O-Ring before the installation. Do not apply too much grease that may overflow and go inside the injector while working.
- Once the injectors are mounted they are fastened to the rail through a suitable bracket (5). Two screws and two washers (6) fix the supporting bracket to the vehicle (7) and the bracket (5).

After installation, the injectors should not have endplay.

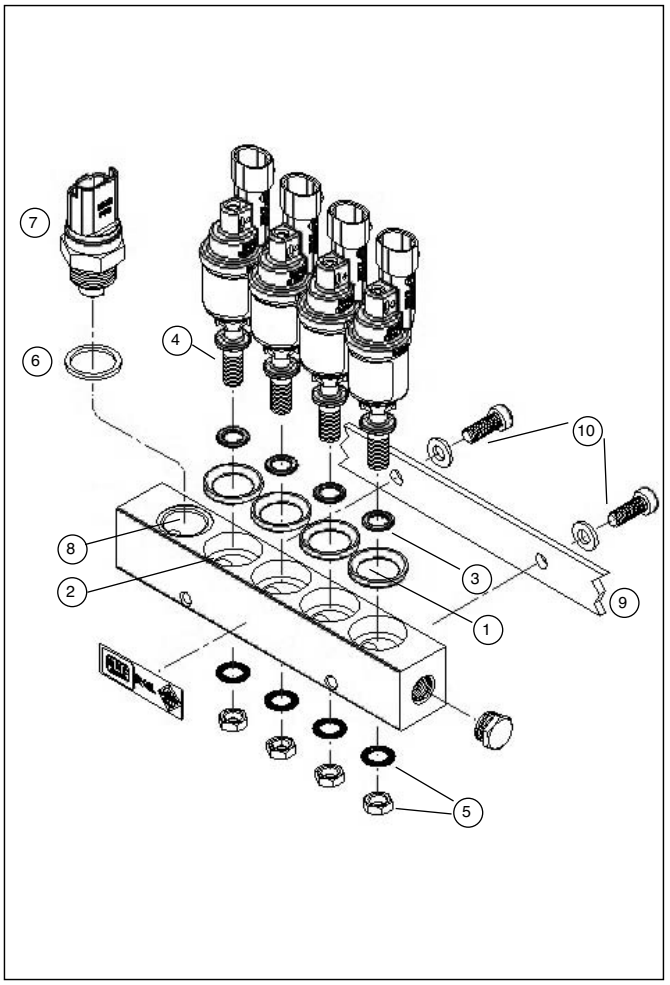
It is recommended to clean carefully during this installation, to prevent any dirties from obstructing the filter placed in the injector inlet, or even worst, damaging the same injector.

The injector ends with a rubber-holder on which the pipe fixed through the supplied click clamp is assembled (see § 5.10).

Picture 10



Picture 11



5.7.3 BRC INJECTORS INSTALLATION ON RAIL WITH PRESSURE SENSOR AND GAS TEMPERATURE (SEQUENT FASTNESS, 24 AND 56)

The difference between this rail and the previous ones is the introduction of the new pressure and gas temperature sensor (described in § 4.11) directly placed on the rail body (picture 12).

The rail has not the connection with the P1 pressure sensor (a cap closes the hole) and always has the rubber-holder connection on the gas outlet.

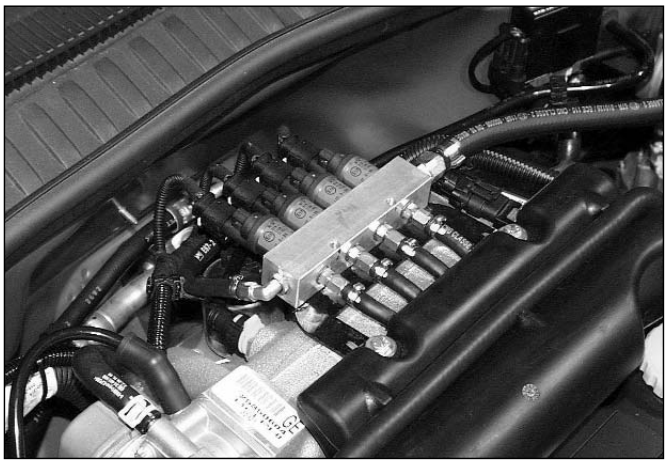
The rail always has a connection to fix the pipe going to the P1 pressure and it is available is two versions as for the gas inlet that is with threaded connection or with rubber-holder one.

BRC injectors has to be installed as follow:

- Introduce the O-Ring (1) on the rail seat (2).
- Introduce the O-Ring (3) on the injector threaded part (4).
- Introduce the injector (4) in the rail seat (2).
- Fix the injector to the rail with the washer and nut (5). During the tightening block the injector in the desired position with one hand avoiding its rotation.
- Do not use pliers or spanners to block the injector as they can damage the steel body or the plastic covering. Use a maximum torque of 8 ± 0,5 Nm.
- Introduce the washer (6) on the sensor threaded part (7)
- Introduce the sensor (7) in the rail seat (8)
- Place the fixing bracket (picture 9) in the car using the screws and the washers.

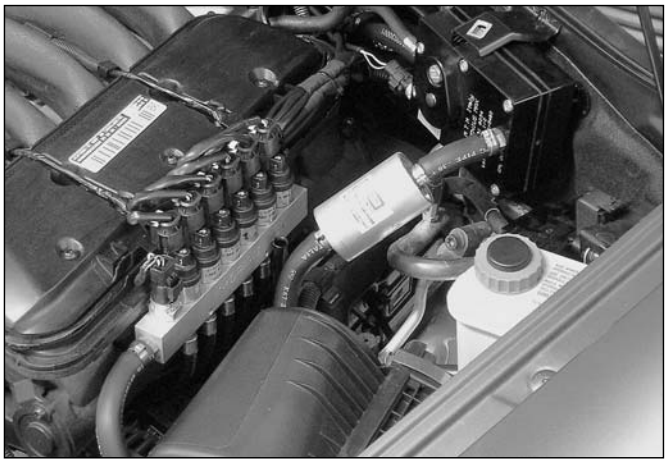
Please pay attention to the cleaning during assembly to avoid dirtiness damage the injector.

The injector ends with a threaded part to which you have to connect the pipe as indicated in § 5.10.



Picture 12
Example of the rail installation with BRC injectors

Picture 13
Example of the rail installation with Keihin injectors



Picture 14
Example of the rail installation with BRC injectors and temperature and pressure sensor gas

5.7.4 INJECTORS' RAIL INSTALLATION IN THE VEHICLE

The rail with the injectors can be fixed both to the vehicle and to the engine; the orientation is not important (picture 12 and picture 13).

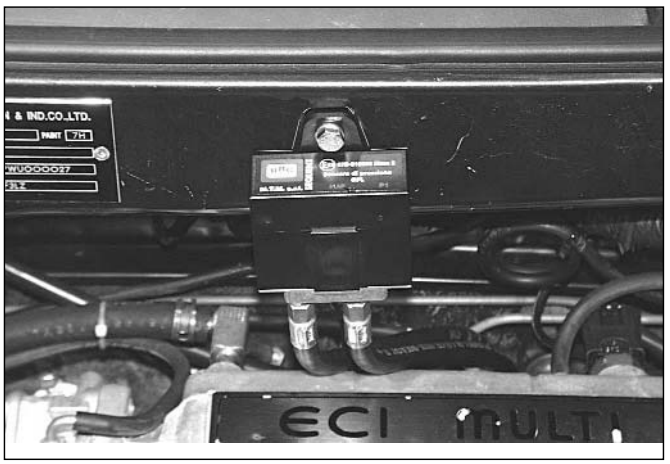
The fixing must be stable; it is necessary to place the injectors as close as possible to the engine head so that the air-intake manifold connecting pipes are as short as possible. They should not be longer than 150 mm.

In case of BRC the suitable connection nut has to be assembled on a pipe end as indicated in the § 5.10.

In case of Keihin injectors, pipes must be fixed to the rubber-holder through the click clamp and using the suitable pliers.

Follow the installation criteria for pipes and electric wires indicated in § 5.10 and chapter 6.

As the injectors are not noiseless, it is better not to fix them to the bulkhead that divides the engine from the passenger compartment, because it may become a resonance box that would amplify the noise. In case you are compelled to choose this position, it is necessary to equip the fixing bracket with suitable damping systems (silent-block).



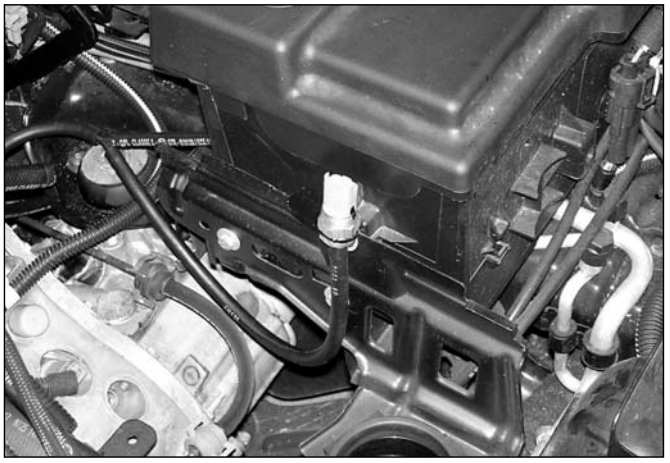
Picture 15
Example of the P1-Map sensor installation

5.8 PRESSURE SENSOR (P1-MAP, P1-MAP TURBO)

The P1-MAP sensor has to be used in LPG applications for aspirated engine while the P1-MAP TURBO sensor must be always used in LPG applications for boosted engines and in all CNG applications.

The sensor has to be fixed to the vehicle's bodywork (picture 15) avoiding high heat irradiation areas. It is better than pipes are as short as possible and anyway no longer than 400 mm. For the connection see paragraphs 5.10.

Electrical wires should not be too stretched, or twisted and they should not make sudden folds at the sensor outlet.



Picture 16
Example of the Sequent Fastness MAP sensor installation

5.9 MANIFOLD ABSOLUTE PRESSURE SENSOR

As already told before, this sensor is included in Sequent Fastness kit while it is not supplied for Sequent 24 and 56 ones (sold separately) because it is used only for calibration and set-up phases.

For installation please follow the indications described in the previous paragraph.

Picture 17
gas pipe ø10x17 to be used in all kits where the rail gas outlet is with threaded connection

5.10 PIPES

The pipes (picture 17,18 and 19) belonging to the Sequent system are realised by BRC. The pipes ø 10x17 mm supplied in the Sequent kit have a fitting on each ends (picture 17) and pipe ø 5x10,5 mm has the fitting on one end only (picture 18).

The applications for the P1 sensor and for BRC injectors you have to use the ø 5x10,5 mm pipe that must be cut at the desired length to allow installing a rubber-holder with a fitting-nut. In such cases installation will be as follows (picture 19):

- Mount the fitting with rubber-holder (1) on the suitable nut (2).
- Fit the click clamp (3) on the pipe (4).
- Fit the pipe on the previously assembled rubber-holder.
- Tighten the pipe on the rubber-holder with the click clamp and the suitable pliers.

In case of Keihin injectors, use the ø 5x10,5 mm pipe to be fixed

on the free end with the click clamps without using the rubber-holder and the connection nut.

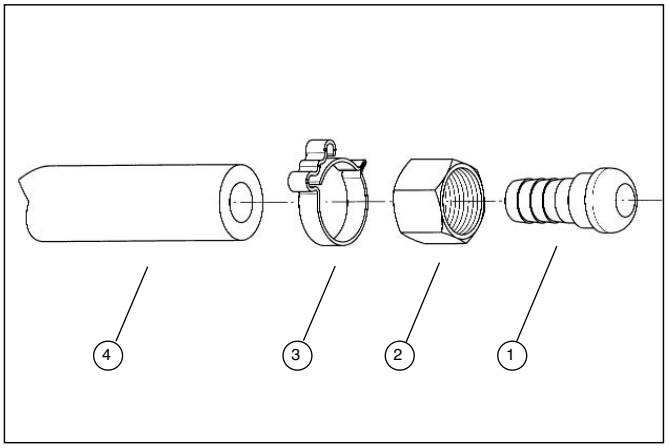
Do not leave any rubber residuals while cutting the pipe or fitting the rubber-holder; these chips could obstruct the pipes or other components of the equipment, prejudicing its working.

Before mounting the pipe it is recommended to blow it with compressed air, in order to expel any impurities or residuals. Verify that the clamp guarantees tightness.

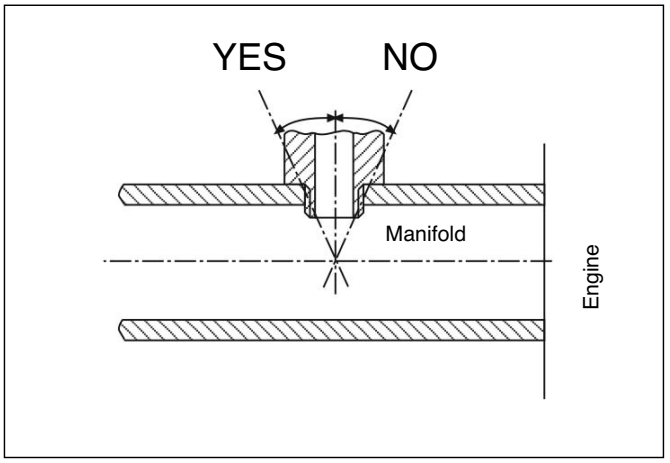
We recommend not to use pipes that are different from the ones supplied and to always mount them using high-quality wrenches in order to avoid damaging the hexagons. Each time it is needed to remove a fitting, use two wrenches, in order to hold firmly the component which is not be unscrewed. The fittings are tight and they seal on conical-spherical surfaces. Do not apply excessive torque wrenches to avoid damaging the fittings.

Do not use any dope. The usual criteria related to the correct installation of pipes should be always respected, without any relative motions on running to avoid rubbings and wears, contacts against sharp edges or driving belts, etc. Once mounted, the pipes should not be too stretched, they should not make any folds or be positioned in such a way to have the tendency to make folds in the future.

Picture 18
Gas pipe ø 5x10,5 mm



Picture 19
Pipe-holder assembly



Picture 20
Inclination of the drilling on manifolds

5.11 NOZZLES

The installation of the nozzles is one of the most important operations of the whole installation.

We recommend to clearly spot all the points that will be drilled, before beginning to drill.

Use the specific tools included in the tool-case for the installation of the Flying Injection components code 90AV99004028.

The drill should be quite near the cylinder head, but preserving the same distance on all manifold branches and the same nozzle orientation. Each nozzle has to be perpendicular to the intake-pipe axis, or at least, shape an angle such to convey the flow towards the engine and not towards the throttle-body (picture 20 and 21).

On the plastic manifolds, spot the areas whose walls are as less thin as possible.

After having marked properly the drilling points with a felt-tipped pen, before starting to drill, verify with the drilling-machine equipped with a helicoidal bit, that there are not overall dimensions such to avoid the correct drilling of all branches following the direction wanted. Make a chasing and drill

Use a correctly sharpened 5 mm helicoidal bit, and then thread with an M6 screw tap (picture 23).

While drilling and threading, take all necessary measures to prevent the chips from going into the

manifold.

In particular, we recommend to frequently remove the chips while drilling and to grease the bit during the breaking last phase of the wall, in order to stick the chips to the bit. The last part of wall should broken slowly so that the chips are very thin: this way the chips stick better to the bit and, if any of them falls inside, it would cause no damages. Even during the M6 threading, it is necessary to grease, extract and often clean the screw tap.

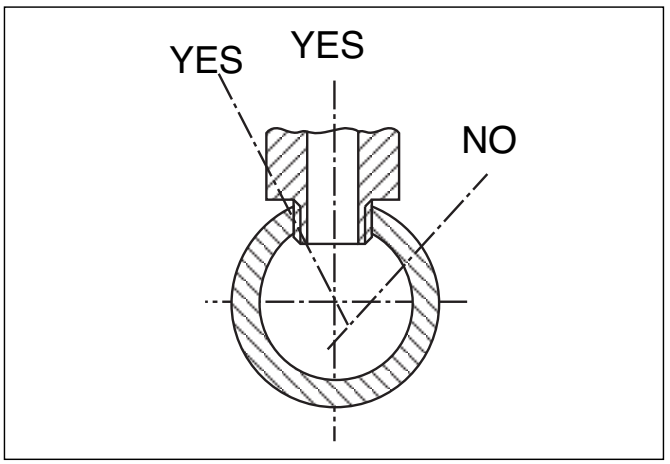
By using the two 10-mm wrenches, screw every single nozzle to the fitting of the 10x17 pipe.

By using two 10 mm wrenches (picture 24) screw each nozzle to the used ø 5x10,5 mm pipe connection. Using some Loctite 83-21 (picture 25) screw the nozzle and the pipe on the manifold hole. Fit the nozzles correctly in order to avoid tightening them excessively and stripping them.

During the clamping phase it is recommended to always use a proper wrench, as the one contained in the tool-case code 90AV99004028.

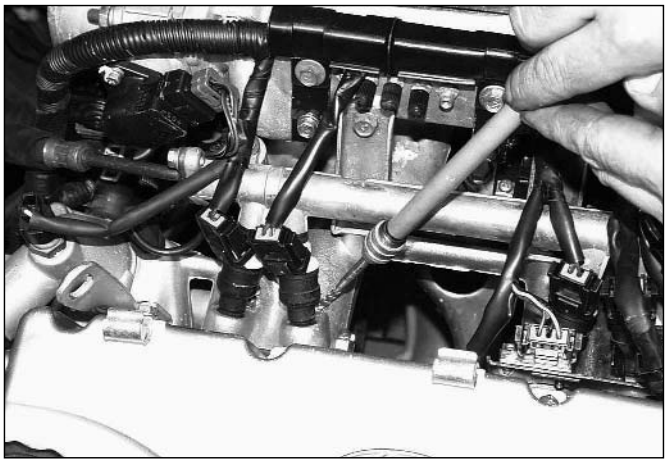
Do not change either the inside diameter of the nozzles or their outside shape.

N.B. In presence of small diameter air-intake manifolds, it can be necessary to mount some special nozzles, shorter than the standard ones.

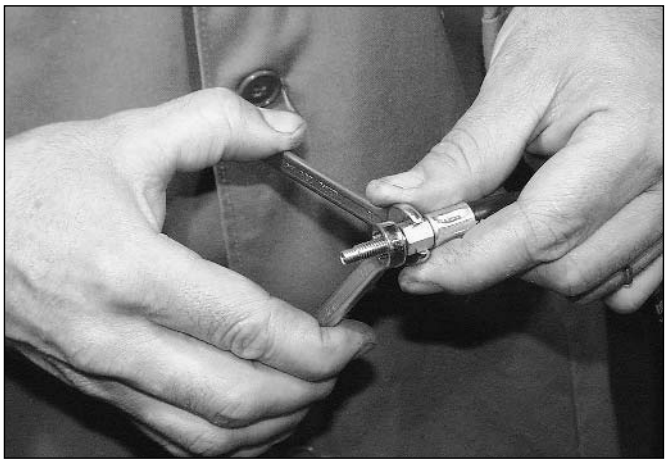


Picture 21
Orientation of the holes on the manifolds

Picture 22
Drilling of manifold



Picture 23
Threading of manifold



Picture 24
Nozzle clamping on pipe-fitting
Solo per injectors BRC

5.12 ECU (ELECTRONIC CONTROL UNIT)

It can be fixed both inside the passenger and in the engine compartment (picture 27 and 28 page 36). Use the fixing holes on the aluminium body avoiding to subject the structure to excessive stresses (e.g.: do not fix the ECU on a convex surface, thinking you can tighten the bolts thoroughly and level everything). If available, use always the suitable fixing bracket.

Avoid too hot areas or subjected to high thermal radiation. Even though the ECU is waterproof, avoid installing it in areas subjected to continuos dripping water in case of rain, so that the water does not penetrate and stagnate in the harness or sheaths.

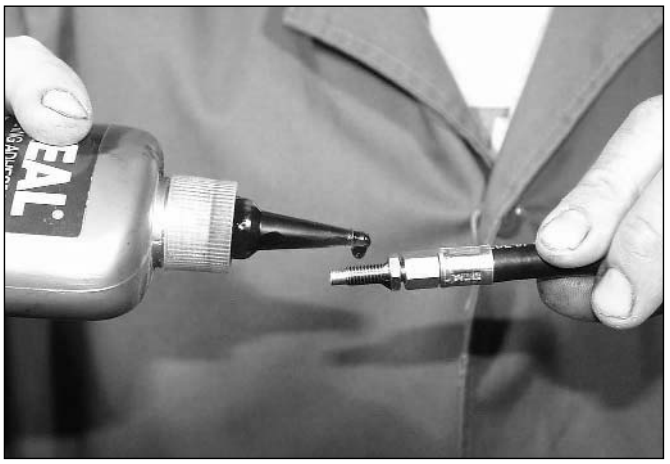
No adjustment is programmed on the ECU; it is therefore not important it is easily accessible. It is more important, instead, that the cable going from the ECU with the computer connection is placed in a very accessible area and protected by the cap from possible water infiltration.

5.13 CHANGE-OVER SWITCH

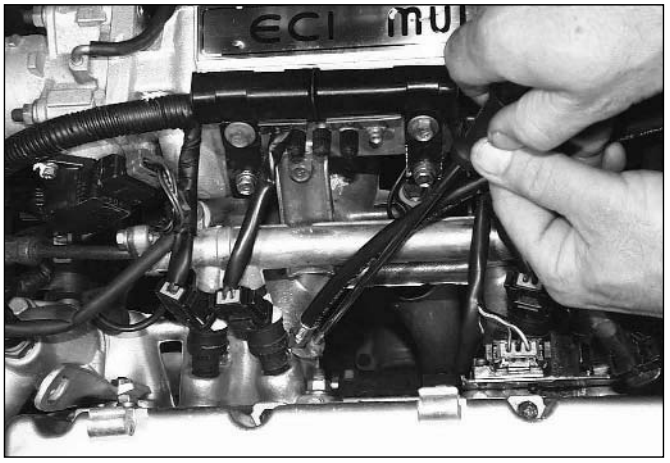
Choose an easily accessible and visible place for the driver and fix the device with the screws supplied. Substituting the label with the spare one, the changeover switch can also be installed in vertical position. Eliminating the external body, the changeover switch can be directly built in the vehicle's dashboard using the special tool to drill, code 90AV99000043.

Specific built-in changeover switches are also available for every single vehicle; they are to be positioned in place of the original switch-cover plates. Please refer to the price list in force to know the available models.

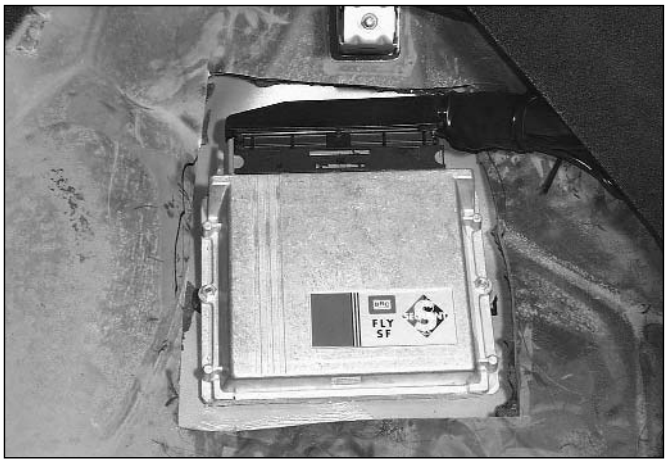
Make anyway sure it is always a



Picture 25
Threads-blocker product
Only for BRC injectors



Picture 26
Nozzle clamping with pipe on manifold



Picture 27
ECU installation inside passenger compartment

Picture 28
ECU installation in the engine compartment

specific changeover switch in the two-position version with buzzer.

5.14 HARNESS

The harness of the Sequent system guarantees the correct transmission of every inlet and outlet signal of the ECU. From a “mechanical” point of view, it is recommended to place the harness very carefully and to avoid forcing on the connections (never pull the wires to let the connector go through a hole or to disconnect it!!!). Avoid making too remarked folds, too strong clamping, sliding against moving parts, etc. Avoid certain pieces of wires from being too stretched when the engine is under stress. Fix opportunely the pieces of wire near the connectors, to prevent their dangling from wearing them out in the future. Avoid any contact with sharp edges (burr the hole rims and mount some wire-leads). Avoid placing the wires of the Sequent system too close to the spark plug cables or to other parts subjected to high voltage.

Each connector is polarised, for this reason it is fitted without stress only in the right direction.

Important: all not pre-cabled connections should be carried out through electric brazing (soft soldering) and opportunely insulated. The soldering should not be “cold” and should not risk coming off in the future. Any unused wire of the harness should be shortened and separately insulated. Never use welders that are connected to the battery of the same vehicle, or welders of the quick type.

5.15 INSTALLATION TYPES

For various mechanical and electrical installation types, please refer to the specific handbook 2/3.

6. ELECTRICAL CONNECTIONS

The following general installation rules are to be considered indispensable for a good understanding of the system.

The FLY SF ECU must be connected with the electric equipment of the SEQUENT system (supplies, grounds, signals, sensors, actuators, etc.) through a 56-poles connector that contains all the necessary signals for the various operations, as regards the piloting up to 4 injectors.

The two-connector (56-way connector and 24-way connector) version, the ECU can control vehicles up to 8 cylinders. Most of the harness wires end on pre-cabled connectors, therefore it becomes very easy to connect the components of the system to the ECU. Furthermore, the conductors are divided into more sheaths, in order to simplify the installation and the identification of the various wires.

All the connections of the wires that do not end on a connector should be executed by well-done and duly insulated soft soldering. Avoid any connections by simply twisting the wires or using other scarcely reliable systems. For the mechanical assembly and the location of the harness, make reference to the paragraph 5.14 of the present handbook.

6.1 CAUTIONS AND DIFFERENCES COMPARED WITH PREVIOUS SYSTEMS

The SEQUENT system differs from other BRC systems in some essential points. It is fundamental to take note of the cautions contained in this paragraph to avoid installation mistakes that can cause the breaking of the gas equipment components or even damages to the vehicle's original equipment. All the Sequent ECU harness terminals are waterproof in compliance with the latest European regulations.

The following paragraphs will describe in details all Sequent systems in this order:

Sequent Standard and Fast, Sequent Fastness, Sequent 24 and Sequent 56.

6.2 SEQUENT STANDARD AND FAST MAIN HARNESS

6.2.1 56 POLES CONNECTOR

As the 56 poles connector for SEQUENT system **is the same used for Flying Injection** and considering the similar ECU external structure of the two systems, pay attention not to use the wrong ECU in the wrong system.

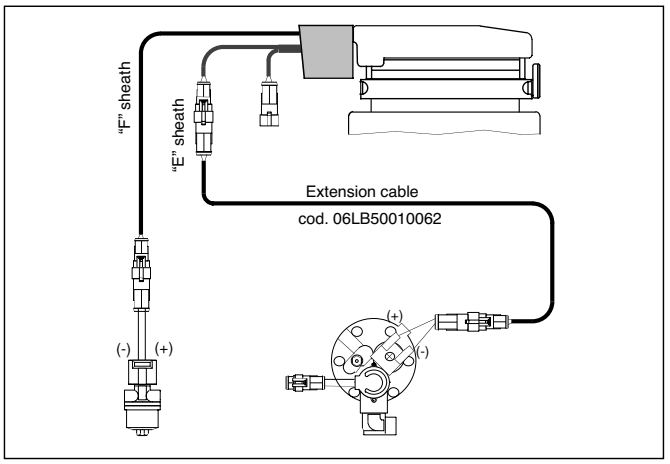
This mistake has to be avoided or ECUs and/or the original vehicle system could be damaged. If, after the system and ECU installation the vehicle does not start, a good suggestion is to control the ECU before trying again.

6.2.1 CONNECTION OF THE SOLENOID VALVES

An important difference compared to other BRC systems, that can cause mistakes if it is not taken into consideration, is the connection of the solenoid valves. In the previous systems, a terminal of the solenoid valve was perpetually connected to the ground (usually to the vehicle's body, near the solenoid valve itself), while the other terminal was coming from the gas equipment ECU. In the SEQUENT the philosophy is different and is similar to the one used to pilot the injectors and other actuators on the original petrol equipment. No solenoid valve terminal is connected perpetually to the ground, but a wire comes from the +12V battery (through fuse and relay), while the FLY SF ECU controls the other.

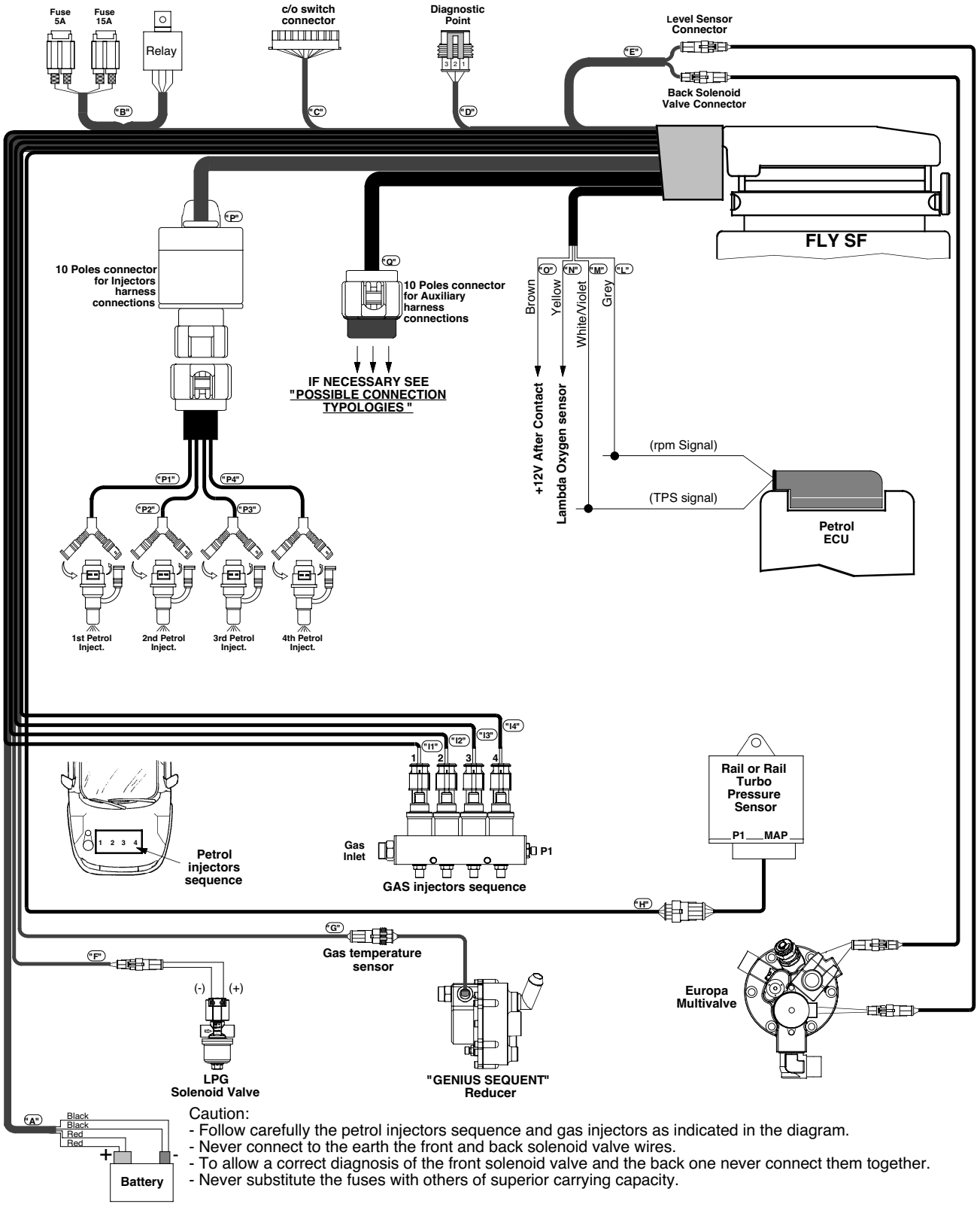
Do not connect directly the solenoid valve terminals to the ground: that may cause a short-circuit and will burn the fuses on the harness and/or prejudice the correct operation of the equipment.

Another difference is that there are piloting wires, separated for the front and back solenoid valve. This separation allows the FLY SF ECU understanding whether and, in case, which of the two solenoid valves is burnt or in short-circuit. It is therefore necessary to avoid con-



Picture 01
Connection of front and back solenoid-valves

Picture 02
General Sequent
Standard/Fast wiring diagram
Extension cable



Caution:
- Follow carefully the petrol injectors sequence and gas injectors as indicated in the diagram.
- Never connect to the earth the front and back solenoid valve wires.
- To allow a correct diagnosis of the front solenoid valve and the back one never connect them together.
- Never substitute the fuses with others of superior carrying capacity.

necting the two solenoid valves in parallel: this may prejudice the ECU diagnosis function (picture 1).

6.2.2 56-POLES HARNESS

As the 56-poles connector used by the SEQUENT system is the same already used for the Flying Injection, even considering the similarity of the external structure of systems, it is possible to confuse the ECU of a system with the other one, fitting it in the wrong equipment.

Such an error must be avoided, as it can damage the ECUs and/or the original equipment of the vehicle. If, after the installation of the equipment and the ECU, the vehicle does not start up, it is a good tip not to insist, before having checked that the ECU is of the correct type.

6.2.3 SEQUENT GENIUS AND GAS TEMPERATURE SENSOR

The temperature sensor contained in the Genius Sequent, Genius M and Genius Max is different from the one used for the Flying Injection. Confusing the two sensors and mounting the wrong one, the ECU will not be able to determine the correct gas temperature, to act correctly the programmed changeover strategies and to make the corrections in the injection times that depend on the gas temperature, while running on gas.

6.2.4 SUPPLIES AND GROUND FROM BATTERY

Sheath “A” in figure 2 contains two red and two black wires to be connected to the car battery: the red wires to the positive and the black ones to the negative. It is important to connect the wires as they are, allowing that they reach separately the terminals of the battery, without joining the wires of same colour in an only wire or joining them along the harness.

The grounds must be always connected to the battery negative and not to the vehicle’s structure, engine ground or other grounds present on the vehicle.

6.2.5 FUSES AND RELAY

At the outlet of the sheath “B” (see picture 2) there are the two 15A and 5A fuses of the SEQUENT equipment. The harness is supplied with the two fuses with correct amperage, fitted in the right place. It is recommended not to substitute the fuses with others of different amperage and not to invert their position. The 5A fuse will be fitted in the fuse-holder with the smaller section wires, while the 15A fuse will be fitted in the fuse-holder with the larger section wires.

At the outlet of the sheath “B” there is also a relay that the SEQUENT utilises to interrupt the battery positive coming from the actuators.

After finishing the connections, it is recommended to properly fix and protect both the fuses and the relay.

6.2.6 CHANGEOVER SWITCH

The 10-poles multipolar cable “C” inside the harness, ending on the 10-way connector, is used for the connection of the ECU to the changeover switch placed in the passenger compartment (picture 2). In order to make easier its passage across the wall openings, it is suggested to bend the connector by 90° to make it parallel to the wires.

The SEQUENT equipment uses the BRC two-position changeover switch with buzzer (see BRC Price List for sale codes).

6.2.7 DIAGNOSTIC POINT

The PC connection to the FLY SF ECU is based on a diagnostic point, directly coming from the harness. It is the 3-way connector diagnostic point (female-holder on the harness), equipped with a protection cap. The diagnostic point is usually placed near the 56-poles connector of the ECU. The connecting cable “D” differs from the one used for the connection of the PC on the Flying Injection system, for the type of connector. For the PC connection it is necessary to use the suitable cable code DE512114.

6.2.8 LEVEL SENSOR

The resistive type level sensor has to be connected directly to the harness through the 2-poles connector, pre-cabled (Sheath “E” on drawing of picture 2). There is no error possibility, because the connector of the level sensor is the only one of this type. The connection between the ECU and the sensor can be made through the special extension cable (06LB50010062) ended on the special connector of the resistive sensor for the Europa Multivalve. The sheath “E” also contains the 2-poles connector for the back solenoid valve connection (see par. 6.2.8).

6.2.9 SOLENOIDVALVES

The solenoidvalves has to be connected to the harness through the pre-cabled connectors connected to the wires contained in the sheaths “E” and “F”. The front solenoid valve will be connected to the connector of the sheath “F”, while the rear one (“Europa” multivalve) will be connected to the connector of sheath “E” through a suitable extension cable code 06LB50010062 (picture 1 page 37 and 3 page 40).

The sheath “E” also contains the connector for the resistive level sensor described in par. 6.2.8.

6.2.10 Gas temperature sensor

The temperature sensor, placed on the pressure reducer, is of the two-wire resistive type, based on NTC thermistore. It is a sensor, which is different from the one used in the Flying Injection equipment. By confusing the two sensors and mounting the wrong one, the ECU will not be able to determine the correct gas temperature, to act correctly the programmed changeover strategies and to make the corrections in the injection times that depend on the gas temperature, while running on gas. The connection with the harness comes through the special 3-way connector (male-holder on the harness) on which the 2 wires contained in the sheath “G” of the harness end.

6.2.11 Rail P1 pressure sensor and Manifold absolute pressure sensor (MAP)

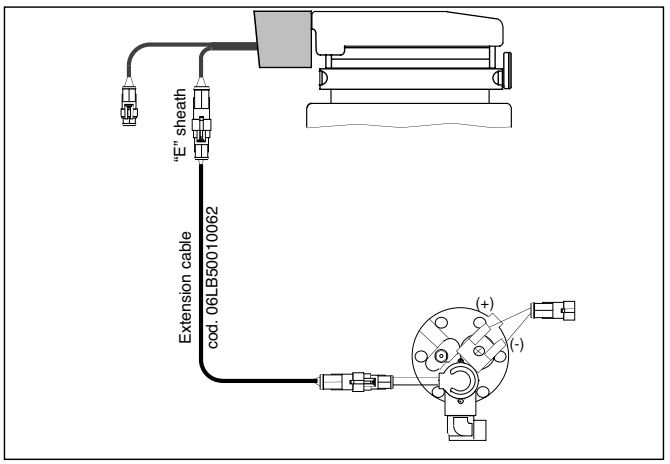
The P1-MAP pressure sensor is connected to the harness through a suitable pre-cabled connector, which is connected to the wires, contained in the sheath “H”.

The P1-MAP pressure sensor is a device containing two sensors in the same box: one to measure the gas pressure inside the injector supplying rail and the other one to measure the air-intake manifold pressure.

6.2.12 Gas injectors

The gas injectors are connected to the harness through the wires with pre-cabled connectors contained in the sheaths “I1”, “I2”, “I3”, “I4” (see picture 2).

The connectors of the gas injectors are numbered from 1 to 4 (or from 1 to 8 with the two-connector ECU); the same for the sheaths of the wires that will be connected to the petrol injectors.



Picture 03

It is very important to maintain the correspondence between gas and petrol injectors.

In practice, the gas injector connected to the connector n° I1 should correspond to the cylinder containing the petrol injector to which we will connect the injector connection Sequent plug (or the Orange and Violet wires of the universal injector connection Sequent harness) marked with the n° P1, and so on. In case there is no correspondence, you will note a worsening in the equipment performances, such as, for example: worse driving conditions, higher unsteadiness of the lambda control, less “clean” petrol/gas changeover, etc.

The number that distinguishes the gas injectors’ connectors is stamped on the harness wires coming to the same connector.

6.2.13 RPM signal

The SEQUENT system is able to acquire the engine speed signal (often indicated as “rpm signal”) by connecting directly to the rpm indicator.

It is sufficient to connect the Grey wire contained in the sheath “L” to the original equipment rpm indicator signal wire going from the petrol ECU to the revolution counter in the dashboard. This wire is not to be cut but only stripped, welded with the wire of the SEQUENT harness and insulated (picture 2).

6.2.14 TPS signal

In the sheath “M” there is the White/Violet wire to be connected to the TPS wire (throttle valve position sensor) of the original equipment; this wire should not be cut, but only stripped, soldered with the wire of the SEQUENT harness and insulated. The TPS wire, if not correctly connected, can enable the SEQUENT system to work nevertheless in a sort of steady condition but it can deteriorate the driving conditions, in particular in sudden accelerations and tip-outs.

6.2.15 Oxygen sensor signal

In the sheath “N” there is the Yellow wire to be connected, **if necessary**, to the wire of the Lambda Oxygen sensor, placed before the catalyst. This wire is not to be cut but only stripped, welded with the wire of the SEQUENT harness and insulated.

The connection of the Yellow wire allows a quicker self-learning by the FLY SF ECU and is therefore very useful in the event of the self-learning phase requiring a further configuration refinement

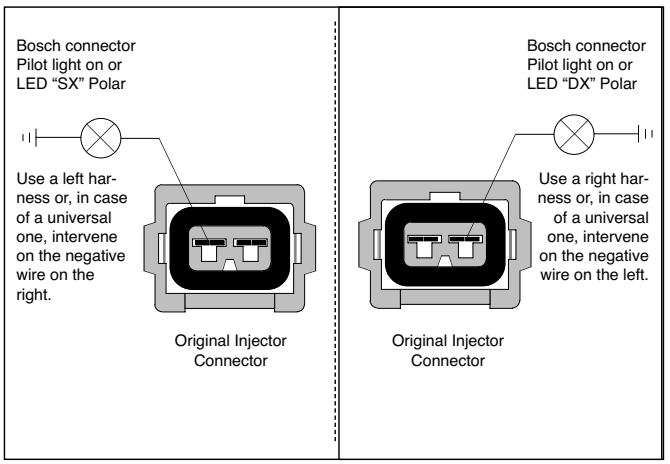
(refer to the software hand-book).

6.2.16 Positive Key contact

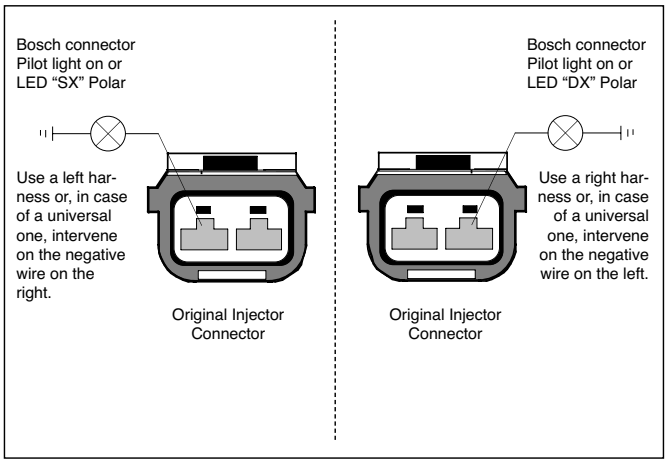
The Brown wire of the SEQUENT equipment, contained in the sheath indicated with the letter “O” in picture 2, has to be connected to the key contact positive signal of the original equipment. This wire has not to be cut but only stripped, welded with the wire of the SEQUENT harness and insulated.

6.2.17 10-Poles-connector for petrol injectors harness connection

The interruption of the petrol injector is possible by using the “P” sheath ending with a 10-poles-connector. You only have to connect one of the specific harnesses for the petrol injectors’ stopping according to the type in the vehicle (Bosch or Sumitomo).



Picture 04a



Picture 04b
Connector type Sumitomo

List of the harnesses codes with **Bosch** connector sold separately from the kits.

- code 06LB50010102 Right (DX) Sequent connection harness for 4 petrol injectors
- code 06LB50010103 Left (SX) Sequent connection harness for 4 petrol injectors,
- code 06LB50010105 Right (DX) Sequent connection harness for 2 petrol injectors,
- code 06LB50010106 Left (SX) Sequent connection harness for 4 petrol injectors,
- code 06LB50010101 Universal Sequent connection harness for 4 petrol injectors,
- code 06LB50010104 Universal Sequent connection harness for 2 petrol injectors,

to be chosen according to the petrol injectors’ polarity.

List of the harnesses codes with Sumitomo connector sold separately from the kits.

- code 06LB50010113 Right (DX) Sequent connection harness for 4 petrol injectors,
- code 06LB50010114 Left (SX) Sequent connection harness for 4 petrol injectors,
- code 06LB50010115 Right (DX) Sequent connection harness for 2 petrol injectors,
- code 06LB50010116 Left (SX) Sequent connection harness for 2 petrol injectors,

to be chosen according to the petrol injectors’ polarity.

The connection is very easy and the philosophy is the same BRC used from the beginning.

To select the right harness you only have to follow the instructions inside the single packages.

It is important to keep the same injection sequence we have during the petrol operation while operating with gas. It is necessary to stop the petrol injectors’ signals with the same order you will follow to connect the gas injectors.

You could pair a consecutive number to each cylinder (i.e. from 1 to 4 in case of a 4-cylinder engine and note that this order only help to carry out the SEQUENT installation so that it could be different from the one the car manufacturer assigned). Generally in case of a transversal engine you will indicate as number 1 the cylinder placed on the cam belt side (see picture 2)

The petrol injector sprinkling in the first cylinder will be stopped with the group 1 of the Sequent petrol Injectors’ Connection Harness (or with the Orange and Violet wires identified with the number 1 of the Universal Petrol Injectors’ Connection Harness) and so on.

The numbers identifying both gas and petrol injectors are prin-

ted directly on the harness connection wires.

6.2.17.A POLARITY OF THE INJECTORS

For the selection of the correct injectors' interruption harness **(Right or Left)** or to precisely know what is the negative wire (in case you prefer to use the **Universal harness**) it is important to know the injector's polarity that is where the positive wire is placed in order to intervene on the Negative one.

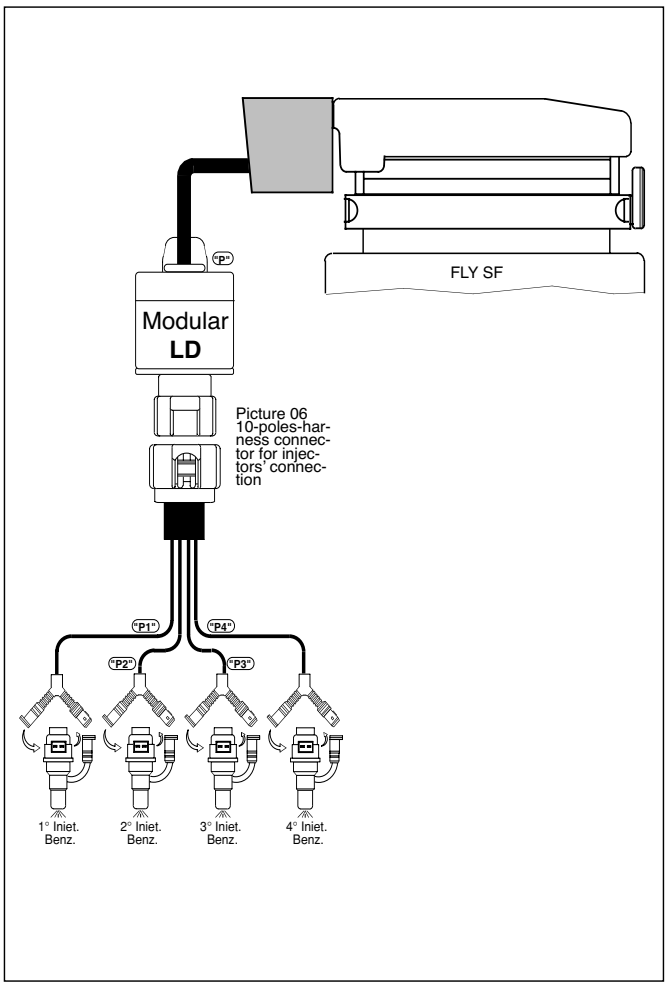
Referring to the picture number 4 it is necessary to:

- Disconnect the connectors of all the injectors and, if necessary, all other connectors if installed upstream (before doing this, please contact BRC technical Assistance Service)
- Switch the dashboard on
- Find out which pin of each female connectors just disconnected has a +12 V voltage (use the POLAR device code 06LB00001093 or a pilot-light. [Check all of them!!]
- If watching the connector as indicated in the picture 4 (pay attention to the reference teeth) the +12V wire is on the right you have to use a RIGHT Harness. If you are installing a Universal harness you will have to stop the negative wire (on the left).
- If the feeding is on the left use the LEFT Harness. If you are installing a Universal harness you will have to stop the negative wire (on the right).

6.2.17.B MODULAR LD

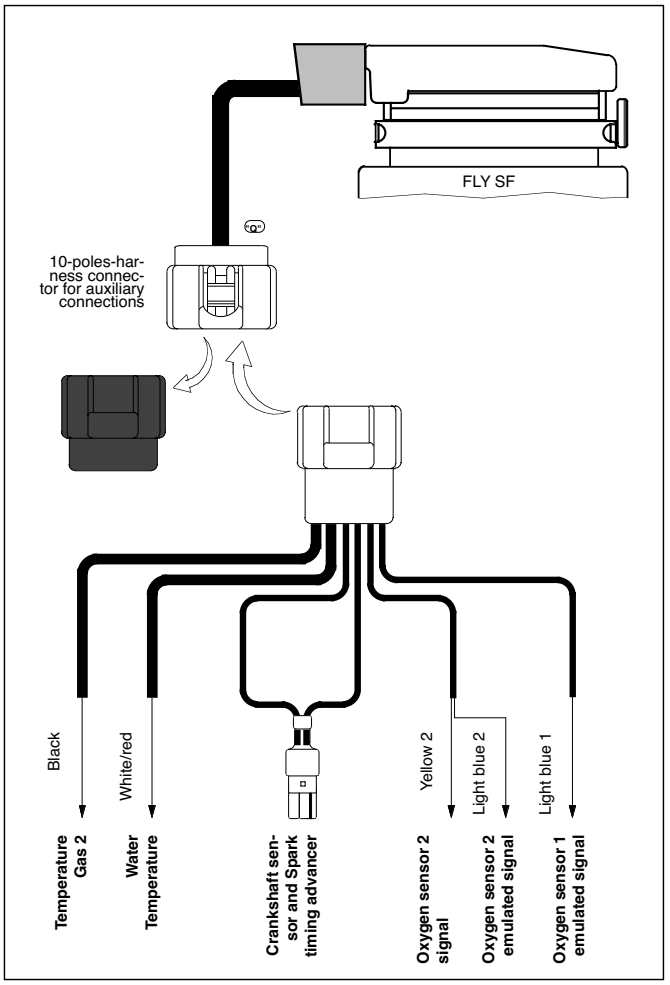
As can be seen from paragraph 4.23, even when you should use an additional resistive-inductive load, it is not necessary to add any outside modules but simply to connect the male of the Sequent harness with the female connector of the DX/SX

Picture 05



Picture 06 10-poles-harness connector for injectors' connection

Picture 06



or universal injectors harness. This connection enables to supply a resistive-inductive load to the original petrol ECU.

6.2.18 10-POLES CONNECTOR FOR AUXILIARY HARNESS CONNECTION

In case of “particular” vehicles, SEQUENT offers the possibility, through the sheath “Q” ending with a 10-poles connector, to take other signals that are not usually necessary in most vehicles converted.

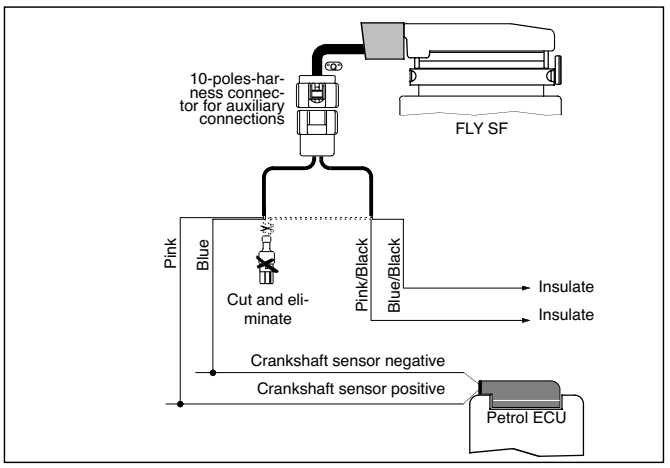
In this connector it is sufficient, after having removed the protecting cap, to fit the specific auxiliary connection Sequent Harness code 06LB50010100, from which 5 wires and 1 connector are shunted to realise the auxiliary connections (picture 6).

The further possible connections, due to the 5 wires and the connector of the auxiliary connection Sequent harness are the following:

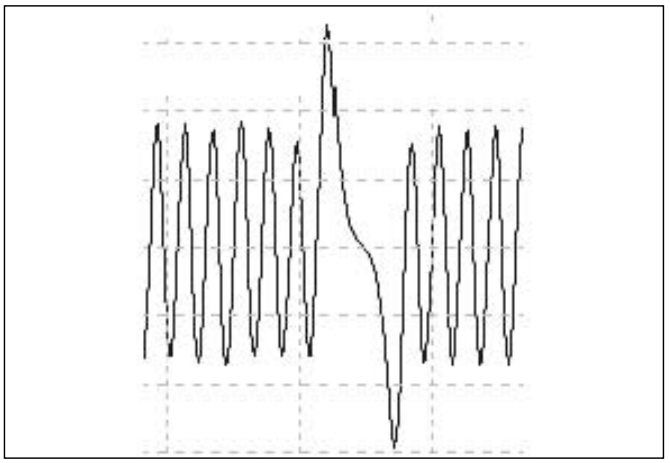
Connector:
Crankshaft sensor signal and Timing Advance Processor
Black wire:
Gas Temperature 2
White/Red wire:
Water Temperature
Light blue wire (Gr. 1):
Emulated Lambda Signal Sensor 1
Yellow wire (Gr. 2):
Lambda Signal Sensor 2
Light blue wire (Gr. 2):
Emulated Lambda Signal Sensor 2

Warning: for the possible connection of the Auxiliary Harness wires, please refer to the instructions inside the package, to the specific wiring diagrams of every single vehicle or ask the BRC after-sales service.

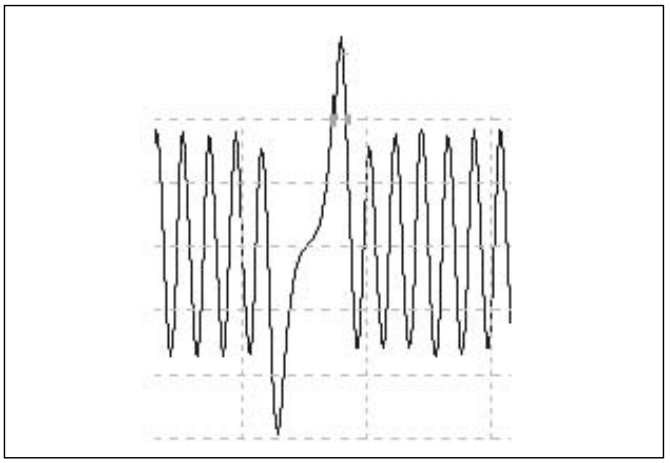
It is recommended to insulate the unused wire terminals and connector.



Picture 07



Picture 08
Negative



Picture 09
Positive

6.2.18.A CRANKSHAFT SENSOR SIGNAL

The SEQUENT system is able to acquire the rpm speed signal by connecting the Grey wire directly on the rpm indicator signal.

If this signal is not available or does not have such operations to be interpreted by the FLY SF ECU, it is possible to take the Crankshaft sensor signal through the Connector present on the Auxiliary Connection Harness.

First it is necessary to remove this connector to obtain the following 4 wires:
Blue
Pink
Blue/Black
Pink/Black

These last two wires (along with the remaining 5 wires of the Auxiliary Harness) should be insulated singularly.

It is sufficient to connect the Sequent Auxiliary Harness Blue and Pink wires respectively to the negative and positive of the crankshaft sensor (picture 7), without interrupting them. The negative and positive of the crankshaft sensor are recognisable by the signal present on the wires that, if it is displayed by a cathode-ray oscilloscope, in correspondence with the reference “hole”, has the trend illustrated in pictures 8 and 9.

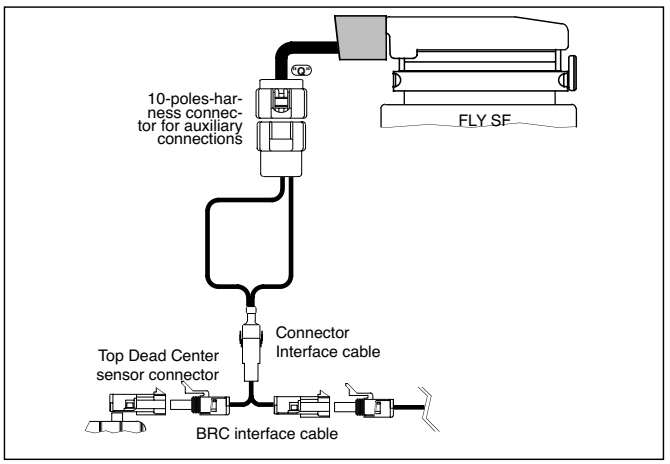
If you do not have the cathode-ray oscilloscope, you can connect the wires to the signal without worrying about the polarity, and then verify that, in all the working conditions of the engine, the r.p.m. are correctly read; if not, or in case you have an irregular gas operation of the vehicle, you have to try to invert the polarity.

If you use this connection, cut and insulate the “L” grey wire (§ 6.2,13)

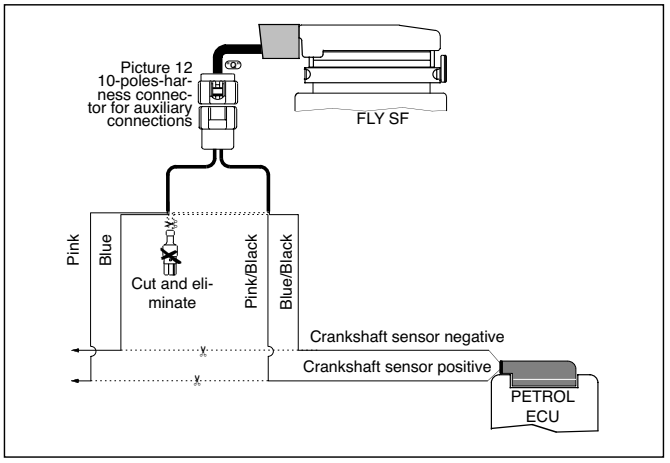
6.2.18.B Signal for the Ignition Timing Advance Variation

If you want to use the “timing advance” function, the FLY SF ECU is equipped with, and the connector of the vehicle Top Dead Center sensor is plug-compatible with one of the specific interface cables supplied by BRC, the diagram to be followed is represented in picture 10.

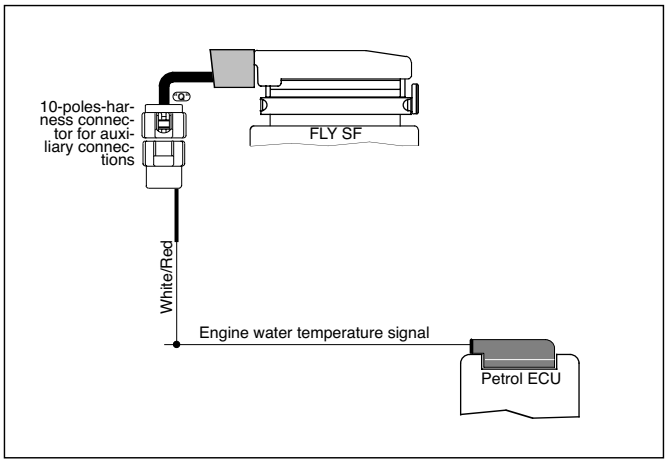
In this case it is **NOT** necessary to remove the connector of the Auxiliary Connection Harness, but it is possible to connect it to one of the Timing Advance Processor Harnesses normally used for the Aries electronic Advance Processor (for the correct choice refer to the specific wiring diagrams of the single vehicles or to the BRC Price List: Timing Advance Processors - Different Devices -).



Picture 10



Picture 11



Picture 12

If you want to use the “timing advance” function, the FLY SF ECU is equipped with and the connector vehicle of the Top Dead Center sensor is **NOT plug-compatible** with one of the specific interface cables supplied by BRC, the diagram to be followed is represented in picture 11.

In this case it **is necessary to remove** the connector of the Auxiliary Connection Harness, obtaining thus the following 4 wires:

Blue
Pink
Blue/Black
Pink/Black

The wires going from the crankshaft sensor to the petrol ECU should be interrupted. The Pink and Blue ones have to be connected to the side that goes towards the crankshaft sensor, while the

Blue/Black and Pink/Black wires will have to be connected to the side going to the petrol ECU. As regards to the polarity of the Pink and Blue wires, see the previous paragraph.

For what concerns the connection of the Blue/Black and Pink/Black wires, the Blue/Black wire should be connected to the Petrol ECU side of the wire to which the Blue wire has been connected on the crankshaft sensor; the same for the Pink and Pink/Black wires.

Pay Attention to the fact the Spark timing function is not available for 8 cylinder vehicles ECUS.

In case you use this type of connection, cut and insulate the "L" grey wire indicated in the electrical plans on the "Types of Installation 2/3" Guide.

6.2.18.C Engine Water Temperature Signal

This signal is sometimes useful to compensate the cold enrichment programmed by the carmaker that can be counterproductive in the gas operation. This kind of connection is normally for CNG applications.

For its correct use it is recommended to refer to the BRC indications. The signal is taken on the wire of the engine water sensor of the original equipment of the vehicle. This wire should not be cut, but only stripped and soldered with the White/Red wire of the SEQUENT Harness for Auxiliary connections (picture 12).

6.2.18.D Lambda Oxygen Sensor Signal

In the SEQUENT system the Lambda oxygen sensor signal is not normally taken and emulated.

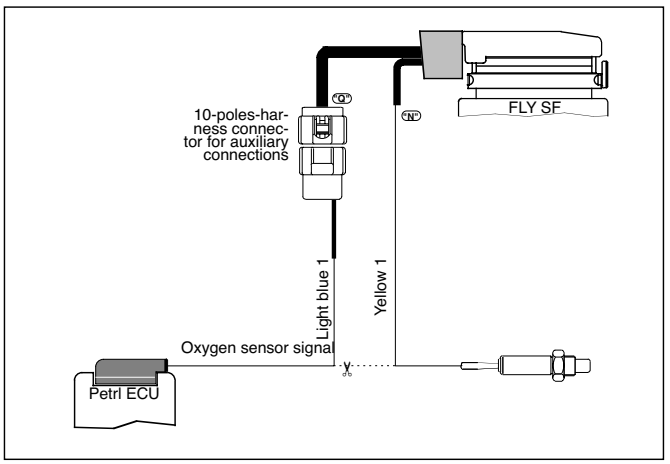
The possible connection of the Yellow wire going out from the main harness allows a quicker vehicle self-learning. In case of emulation of the Lambda oxygen sensor signal, it is necessary to cut the wire going from the ECU to the Lambda oxygen sensor, connect the Light blue "1" wire of the Auxiliary Harness from the ECU side to the Yellow "1" wire of the Lambda oxygen sensor side (picture 13).

These connections should be realised only on particular vehicles, on the BRC after-sales service's advice.

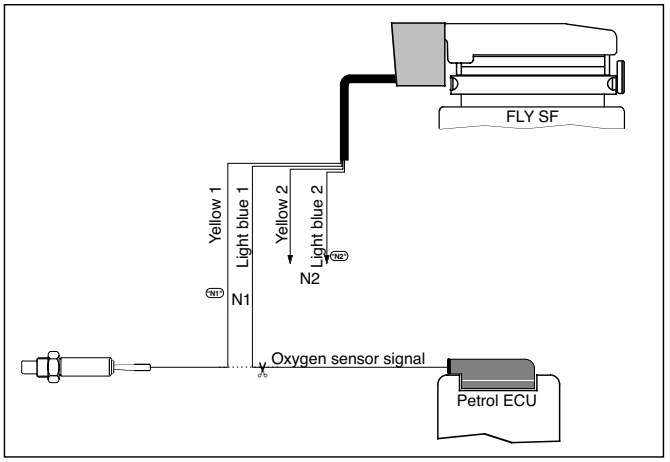
In case of two-bank vehicles, Sequent offers the possibility to act on the second Lambda oxygen sensor, through the Yellow "2" and Light blue "2" wires present on the Auxiliary Harness.

These last connections too should be only realised on particular vehicles, on the BRC after-sales service's advice.

Picture 13



Picture 14



6.3 SEQUENT FASTNESS MAIN HARNESS

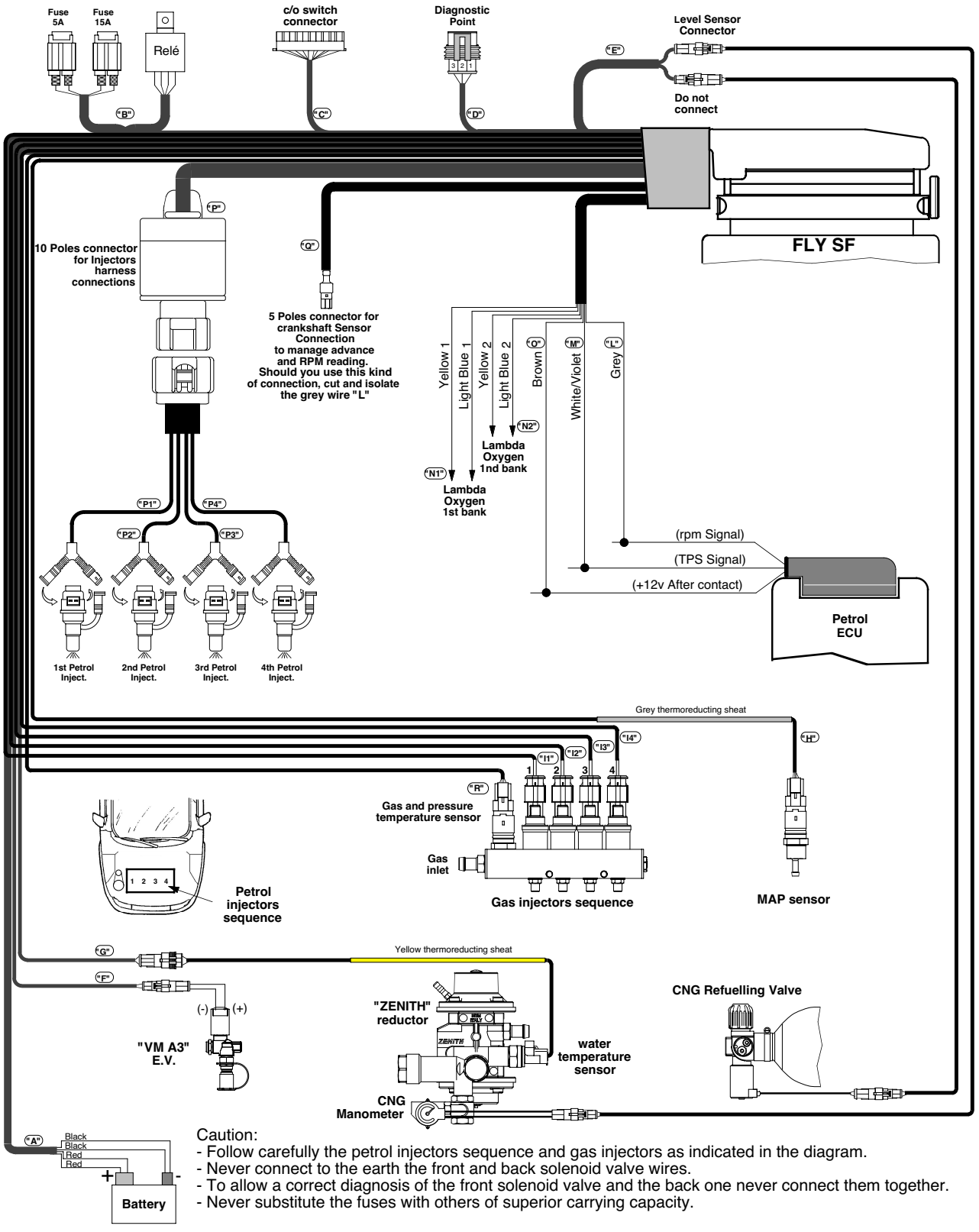
The following paragraphs will describe the differences compared to the previously described Sequent harness to avoid unnecessary repetitions.

As you may note from the general connection plans (picture 2 picture 15) differences are substantial.

The Sequent Fastness general connection plan (picture 15) does not include the auxiliaries 10 poles connector and adds a 5 poles one for the crankshaft sensor connection to be able to manage the advance and/or rpm reading.

Moreover the Black wire (gas 2 temperature) and the White/Red one (water temperature) have been eliminated as they are incorporated in the sensor on Zenith reducer.

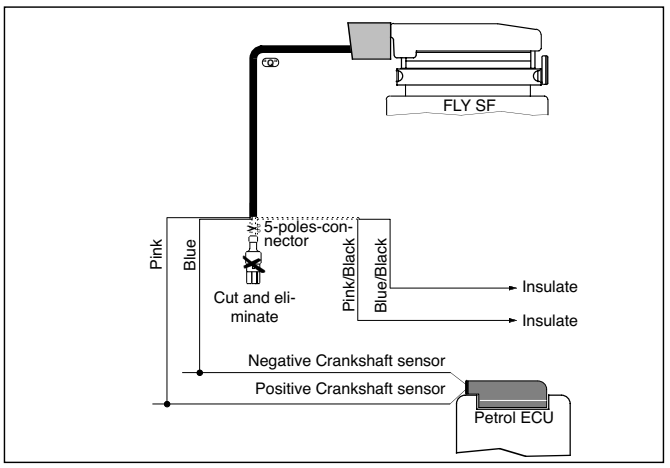
Picture 15
Sequent Fastness General wiring diagram with Zenith Reducer



Caution:
- Follow carefully the petrol injectors sequence and gas injectors as indicated in the diagram.
- Never connect to the earth the front and back solenoid valve wires.
- To allow a correct diagnosis of the front solenoid valve and the back one never connect them together.
- Never substitute the fuses with others of superior carrying capacity.

6.3.1 Zenith Sequent fastness and water temperature sensor

The connection to the harness is made with the suitable 4-poles connector (male holder on the harness) where the 3 wires contained in the harness “G” sheath end. **In the final part about 10 cm of yellow thermo-narrowing is introduced to avoid confusion with other connectors.**

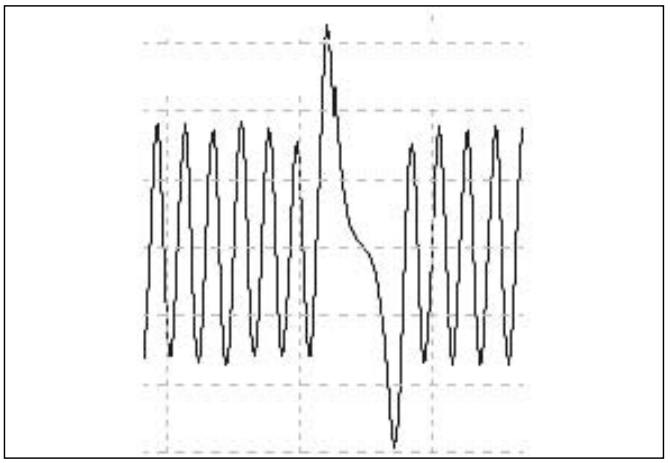


Picture 16

6.3.2 Pressure and Gas temperature sensor

The pressure and gas temperature sensor as described in paragraph 4.12 is placed directly on the rail (dedicated for BRC injectors). The connection to the harness is made through the suitable 4-poles connectors (male holder on the harness) where the 4 wires contained in the harness “R” sheath of the harness end.

Also in this case as before, in the final part of the harness, about 10 cm of grey thermo-narrowing are introduced.



Picture 17
Negative

6.3.3 Absolute pressure sensor MAP

The new conceived MAP pressure sensor is connected to the harness through suitable precabled connector, joint to the wires contained in the “H” sheath.

6.3.4 Oxygen sensor signal (Row 1 and Row 2)

The SEQUENT system does not usually include the picking up and emulation of the Lambda Oxygen sensor signal.

The possible connection of the Yellow wire coming out from the “N1” sheath (picture 15) allows a faster self-learning of the vehicle. In case of emulation, it is necessary to cut the wire going to the Oxygen sensor, connect the Light Blue wire on the ECU side and the Yellow wire on the Oxygen sensor side (picture 13 page 45)

These connections have to be carried out only on particular vehicles and on advice of the BRC Technical Assistance Service.

In case of two-bank vehicles, Sequent offers the possibility to act on the second Lambda oxygen sensor, through the Yellow and Light blue wires present in the “N2” sheath.

These last connections too should be only realised on particular vehicles, on the BRC after-sales service’s advice.

We underline that the row 1 and 2 number is printed on the N1 and N2 harnesses wires.

6.3.5 5-poles-connector for crankshaft to manage advancing and/or rpm reading

In case of particular vehicles, Sequent offers the possibility through the sheath “Q” ending with a 5-poles connectors to carry out the connection for crankshaft sensor for the timing advancer management and/or rpm reading.

Pay attention: for the possible connections of the 5-poles harness wires please refer to the indications contained in the following paragraphs. We recommend you to insulate the wires’ ends and the connector if not used.

6.3.5 A Crankshaft Sensor signal

The SEQUENT system is able

to acquire the rpm speed by connecting to the Grey wire directly on the rpm indicator signal.

If this signal is not available or does not have such operations to be interpreted by the FLY SF ECU, it is possible to take the Crankshaft sensor signal through the Connector present on “Q” sheath connector.

First it is necessary to remove this connector to obtain like that the following 4 wires:

Blue

Pink

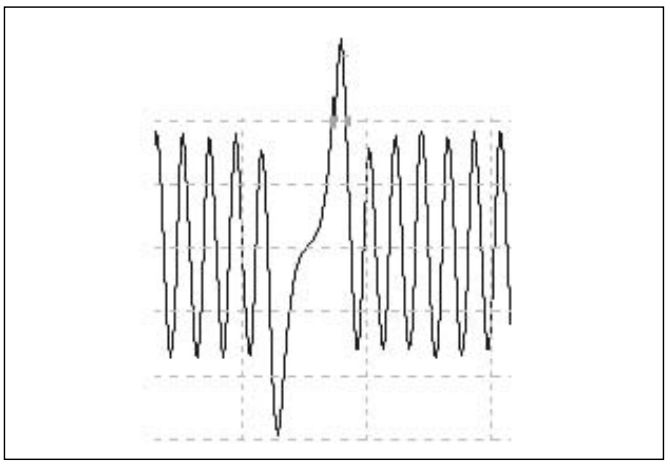
Blue/Black

Pink/Black

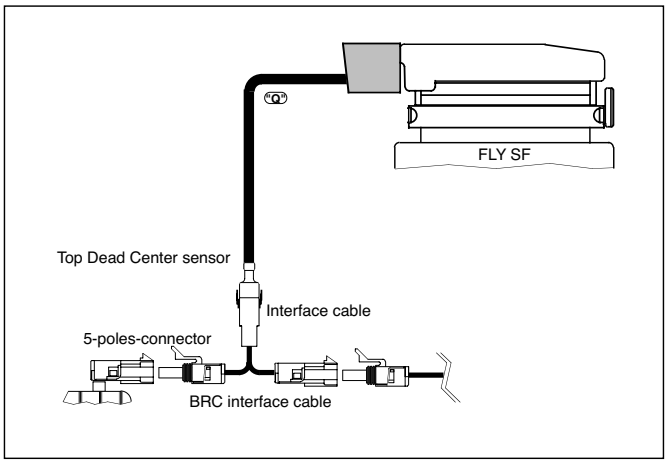
These last two wires should be insulated singularly.

You only have to connect the Blue and Pink wires of the %-poles harness respectively to the negative and positive of the crankshaft sensor (picture 20), without interrupting them. The negative and positive of the crankshaft sensor are recognisable by the signal present on the wires that, if it is displayed by a cathode-ray oscilloscope, in correspondence with the reference “hole”, has the trend illustrated in pictures 17 and 18.

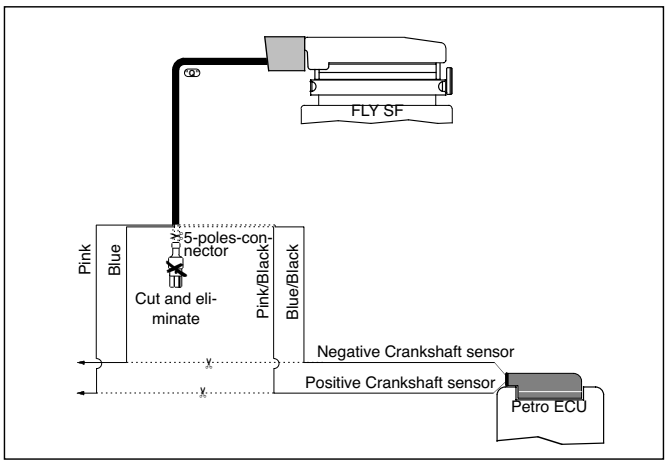
If you do not have the cathode-ray oscilloscope, you can connect the wires to the signal without worrying about the polarity, and then verify that, in all the working conditions of the engine, the r.p.m. are read correctly; if not, or in case you have an irregular gas operation of the vehicle, you have to try to invert the polarity.



Picture 18
Positive



Picture 19



Picture 20

6.3.5 B Signals for the ignition timing Advance Variation

If you want to use the “timing advance” function, the FLY SF ECU is equipped with, and the connector of the vehicle Top Dead Center sensor is **plug-compatible** with one of the specific interface cables supplied by BRC, the diagram to be followed is represented in picture 19.

In this case it is **NOT** necessary to remove the 5-poles connector, but it is possible to connect it to one of the Timing Advance Processor Harnesses normally used for the Aries electronic Advance Processor (for the correct choice refer to the specific wiring diagrams of the single vehicles or to the BRC Price List: Timing Advance Processors).

If you want to use the “timing advance” function, the FLY SF ECU is equipped with and the connector vehicle of the Top Dead Center sensor is **NOT plug-compatible** with one of the specific interface cables supplied by BRC, the diagram to be followed is represented in picture 20.

In this case **it is necessary** to

remove the 5-poles harness connector, obtaining thus the following 4 wires:

Blue
Pink
Blue/Black
Pink/Black

The wires going from the crankshaft sensor to the petrol ECU should be interrupted. The Pink and Blue ones have to be connected to the side that goes towards the crankshaft sensor, while the Blue/Black and Pink/Black wires will have to be connected to the side going to the petrol ECU. As regards to the polarity of the Pink and Blue wires, see the previous paragraph.

For what concerns the connection of the Blue/Black and Pink/Black wires, the Blue/Black wire should be connected to the Petrol ECU side of the wire to which the Blue wire has been connected on the crankshaft sensor; the same for the Pink and Pink/Black wires

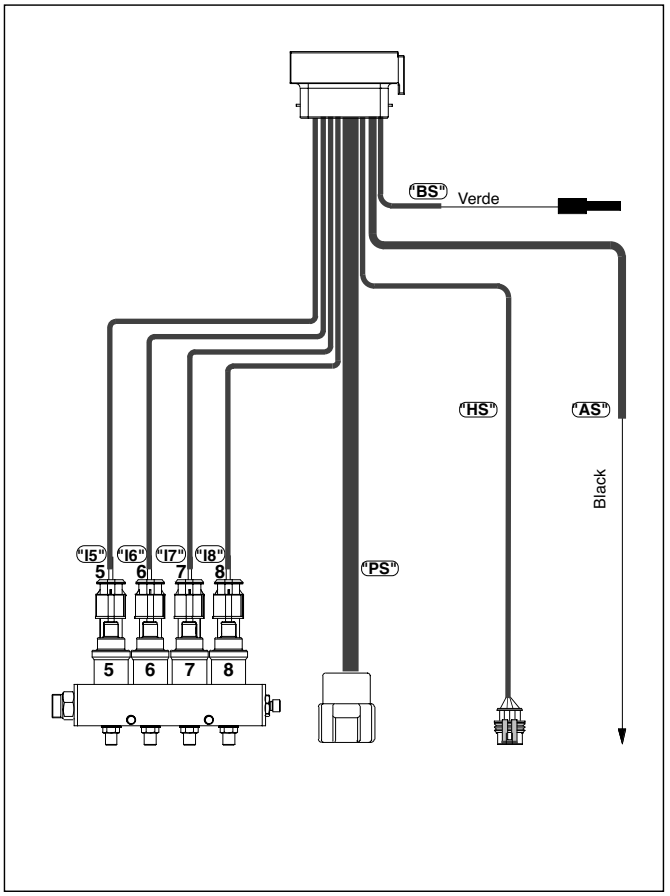
Pay Attention to the fact the Spark timing function is not available for 8 cylinder vehicles ECUS.

In case you use this type of connection, cut and insulate the "L" grey wire indicated in the electrical plans on the "Types of Installation 2/3" Guide.

For all other connections not described in this paragraph, please refer to the previous one 6.2.

6.4 DESCRIPTION OF THE 5-6-8 CYLINDER HARNESS (FOR ALL SEQUENT CONFIGURATIONS)

As mentioned in paragraph 4.19, in addition to the main harness, ending with a 56-way connector, used for the conversion of 4-cylinder vehicles, another harness is available to be used **on two-connector FLY SF ECUs,** ending with a 24-way connector (picture 20).



Picture 20
5-6-8-cylinder harness

This harness therefore allows realising, with only one two-connector FLY SF ECU, the conversion of 5-6-8 cylinder vehicles, without needing two standard FLY SF ECUs.

Obviously two different types of 5-6-8 cylinder harnesses are available: one is for vehicles up to 6 cylinders, and the other for vehicles up to 8 cylinders.

The main difference between the two harnesses is the quantity of "I" connectors for the gas injectors connection.

The 5-6-cylinder version of harness is equipped with only two "I" connectors (specific for 5 and 6-cylinder vehicles).

The 8-cylinder version of harness is equipped with four "I" connectors (specific for 8-cylinder vehicles).

6.4.1 GROUND FROM BATTERY

The sheath "AS" in picture 21 contains a Black wire that will be connected to the vehicle's battery with one of the Black wires of the main harness.

Please refer to the cautions reported in paragraph 6.2.4.

6.4.2 SUPPLY

The sheath "BS" in picture 21 contains a Green wire that will have to be connected to the free central terminal of the relay belonging to the sheath "B" of the vehicle's battery main harness (picture 2 and 15).

6.4.3. RAIL "P1" PRESSURE SENSOR AND MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP)

The possible second P1-MAP pressure sensor can be connected to the 5-6-8-cylinder harness through the proper pre-cabled connector

of the wires contained in the sheath “HS” (picture 21).

Attention: in the Sequent Fastness applications this connector is not used but cut and insulated.

6.4.4 Gas Injectors

The Gas Injectors (from the 5th to the 8th) are connected to the harness by means of the wires with pre-cabled connectors contained in the sheaths “I5”, “I6”, “I7”, “I8” (see picture 21).

If it is a 5-6-cylinder harness the sheaths indicated with “I” will obviously be only two.

The connectors of the gas injectors are progressively numbered and in the same way as the sheaths of the wires that will be connected with the petrol injectors.

It is very important to maintain the correspondence between the gas injectors and the petrol ones.

Practically, the gas injector to which the n° 15 connector will be connected, should correspond to the cylinder containing the petrol injector, where we will connect the plug P5 of the Injectors Connection Sequent Harness (or the Orange and Violet wires of the Universal Injectors Connection Sequent Harness) and so on. In case the correspondence is not respected, it is possible to note a worsening in the equipment performances such as, for example: worse driving conditions, greater instability of the Lambda control, less “clean” petrol/gas changeover, etc.

The number that distinguishes the connectors of the gas injectors is stamped on the harness wires going to the same connector.

6.4.5 10-Poles connector for petrol injectors harness connection

The interruption of the petrol injectors (from the 5th to the 8th) is possible by using to the sheath “PS” ending with a 10-poles connector.

It is sufficient to connect it to one of the specific injectors interruption harnesses described in paragraph 6.2.17.

While running on gas, it is important to keep the same injection sequence you have during petrol operation. It is therefore necessary to interrupt the signals of the petrol injectors with the same order of the gas injectors’ connection.

The numbers that distinguish both the gas injectors’ connectors and the petrol ones are printed directly on the corresponding wires of harness connection.

6.5 SEQUENT 24 MAIN HARNESS

6.5.1 24 POLES HARNESS

SEQUENT 24 harness is thinner compared to previous systems' one. Instead of being a 56 poles harness, it is a 24 poles one. To make installation easier, the system main components are connected through a dedicated connectors and the number of wires to be welded is reduced to minimum. To comply with the electromagnetic compatibility standards the system has shielded conductors. The connectors on the harness are all water proof except for the changeover switch that is anyway placed inside the car so it is protected from water. Pay attention to the injectors "cut" that is the main change in the system and harness.

6.5.2 CONNECTION OF THE SOLENOIDVALVES

Please refer to § 6.2.2

6.5.3 SUPPLIES AND GROUND FROM BATTERY

Please refer to § 6.2.4.

6.5.4 FUSES AND RELAY

Please refer to § 6.2.5.

6.5.5 CHANGEOVER SWITH

The 4-poles multipolar cable "C" inside the harness, ending on the 4-poles connector, is used to connect the ECU to the changeover switch placed in the passenger compartment (picture 22). In order to make easier its passage across the wall openings, we suggest to bend the connector by 90° to make it parallel to the wires.

The SEQUENT 24 system uses the BRC two-position changeover switch with buzzer (see BRC Price List for sale codes).

6.5.6 DIAGNOSTIC POINT

Please refer to § 6.2.7.

6.5.7 LEVEL SENSOR

Please refer to § 6.2.8.

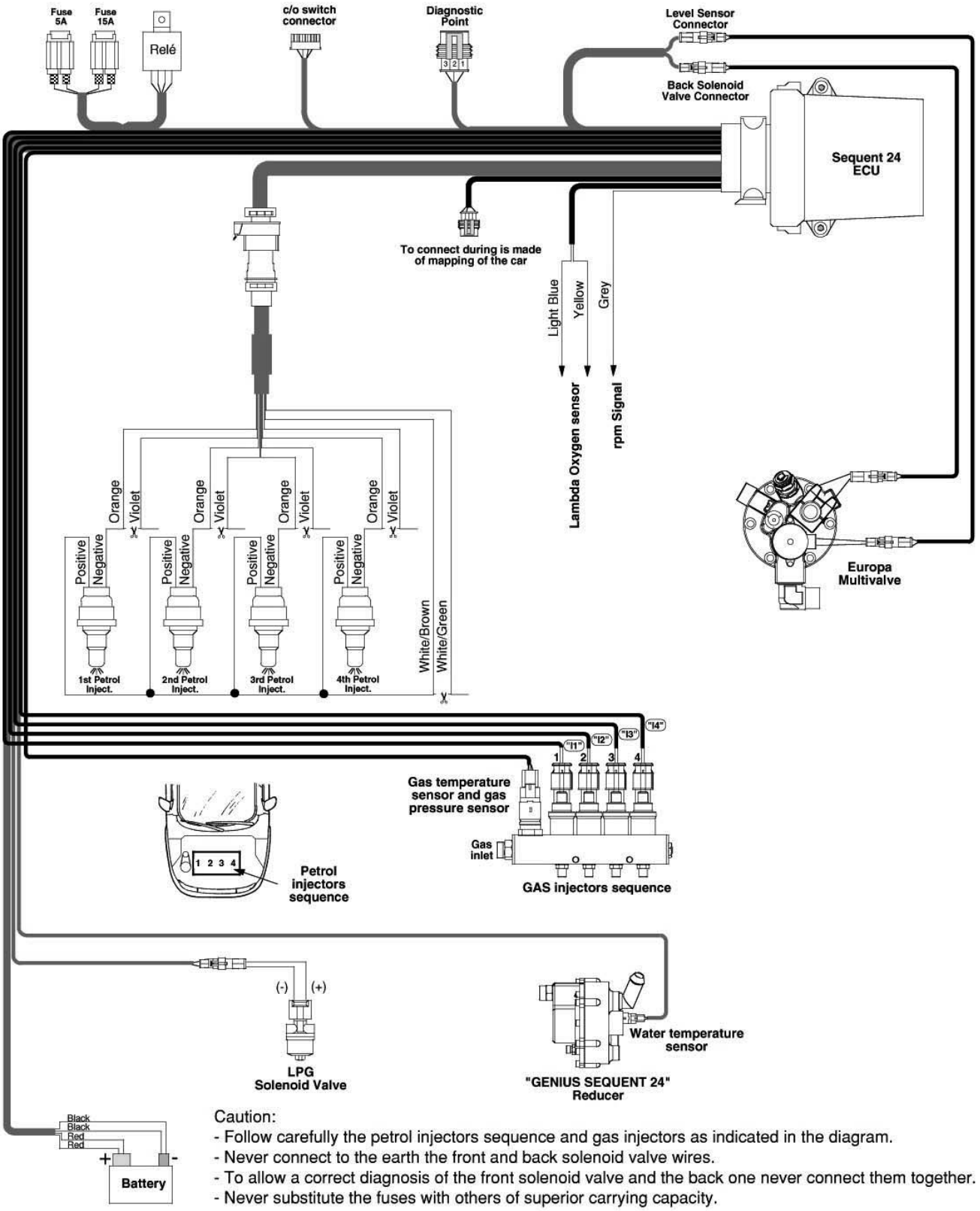
6.5.8 SOLENOIDVALVES

Please refer to § 6.2.9.

MAIN DIFFERENCES BETWEEN STANDARD SEQUENT / SEQUENT FAST AND SEQUENT 24

	SEQUENT/SEQUENT FAST	SEQUENT 24
Sensors	• P1-MAP (case) • Tgas on the reducer	• P1-Tgas integrated on rail • T water integrated on the reducer • MANIFOLD PRESSURE ONLY WHILE SELF-MAPPING
Injectors Cut	• Cut on the negative inside the ECU • Emulation with the Modular LD	• Cut on the POSITIVE inside the ECU and simultaneous for the 4 injectors (the orange wires do not enter the ECU)
Key contact and Petrol Injectors Positive	• To connect to the key contact positive (brown) and to the petrol injectors positive (white-green)	• The key contact positive becomes petrol injectors positive that goes into and out from the ECU. ECU ignition only if the petrol injectors positive is active
Communication	• Active with key contact positive ON	• Active with the engine switched on; once it is connected it remains active even disconnecting the key contact (if the PC/ communication is not disconnected)
Changeover switch	• 10 pins connected with the ECU	• 3 pins connected with the ECU + one for the level on the changeover switch
Screen	• Connected with the ECU case with a specific pin	• Connected with the battery ground
TPS connection	• Necessary or Optional	• Not connected
RPM Connection	• Necessary or Optional	• It is possible to use the RPM counter signal, the crankshaft position sensor signal (only one wire) or the coils negative)
Filing of the mappings	• FSF+AAP file or only FSF for vehicle parameters and mapping	• File FLS per parametri vettura e mappatura. • Separato dai Sequent precedenti
Advance variator	• Inside	• Outside

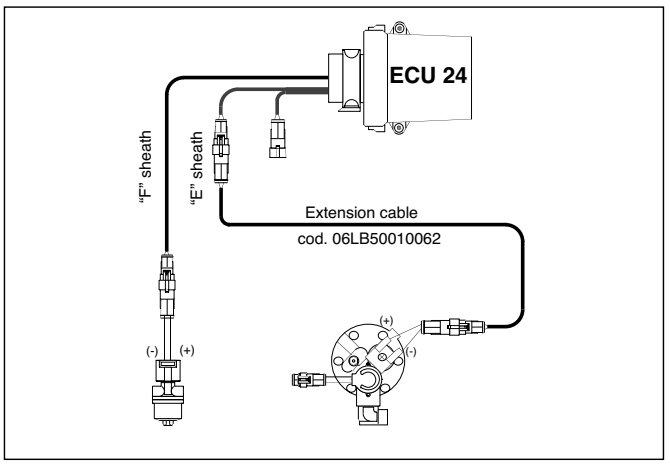
Fig. 22
General wiring diagram Sequent 24



Caution:
- Follow carefully the petrol injectors sequence and gas injectors as indicated in the diagram.
- Never connect to the earth the front and back solenoid valve wires.
- To allow a correct diagnosis of the front solenoid valve and the back one never connect them together.
- Never substitute the fuses with others of superior carrying capacity.

6.5.9 GENIUS SEQUENT 24 GENIUS AND WATER TEMPERATURE SENSOR

The connection to the harness is made with the 4 poles connector (male holder on the harness) where the harness three wires of the sheath G end (picture 22).

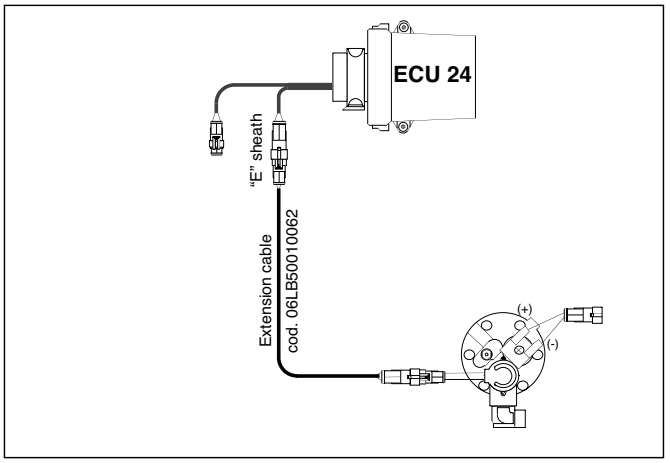


Picture 23
Connection of front and back solenoid-valves

6.5.10 MAP ABSOLUTE PRESSURE SENSORS

This sensor is not included in Sequent 24 kit but separately sold because it is used for calibration and self-mapping system only.

The connection is through the harness "M" connector (picture 22)



Picture 24

6.5.11 GAS INJECTORS

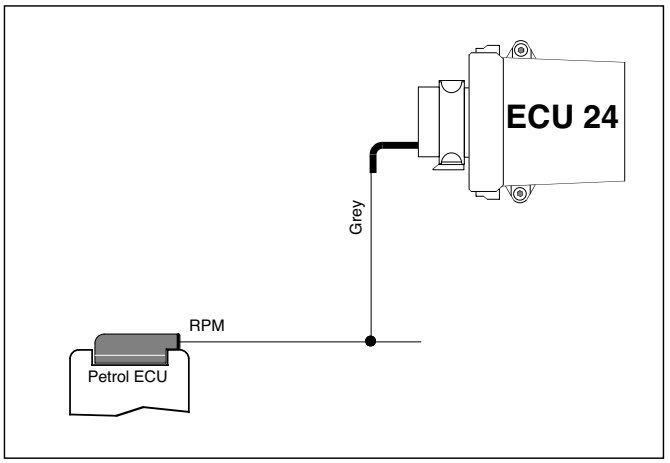
The Gas Injectors are connected to the harness by means of the wires with pre-cabled connectors contained in the sheaths "I1", "I2", "I3", "I4" (see picture 2).

The connectors of the gas injectors are progressively numbered from 1 to 4 and in the same way as the sheaths of the wires that will be connected with the petrol injectors.

It is very important to maintain the correspondence between the gas injectors and the petrol ones.

Practically, the gas injector to which the n° I1 connector will be connected, should correspond to the cylinder containing the petrol injector, where we will connect the plug P1 of the Injectors Connection Sequent 24 Harness (or the Orange and Violet wires of the Universal Injectors Connection Sequent 24 Harness) and so on.

In case the correspondence is not respected, it is possible to note a worsening in the equipment performances such as, for example: worse driving conditions, greater instability of the Lambda control, less "clean" petrol/gas changeover, etc.



Picture 25

The number that distinguishes the connectors of the gas injectors is stamped on the harness wires going to the same connector.

6.5.12 RPM

SEQUENT 24 system is able to acquire the engine rpm signal ("RPM") by connecting directly to the counter signal or to the crankshaft one.

As for the rpm signal the Grey wire of the "L" sheath has to be connected to the original installation rpm wire (the one going from the petrol ECU to the dashboard rpm counter)

The wire has not to be cut but only peeled, welded and insulated with the Sequent 24 harness grey wire (picture 25).

When the crankshaft sensor is acquired, you have to verify if the crankshaft sensor is Hall or

Resistive. Pictures 26 and 27 show the connection to carry out in the two cases.

6.5.13 OXYGEN SENSOR SIGNAL

"N" sheath contains the Yellow and Light Blue wires. The yellow one has to be connected to the Oxygen sensor wire before the catalyst. This wire has not to be cut but peeled, welded with the Sequent 24 harness wire and insulated.

The Yellow wire connection allows a faster self-adaptability of Sequent 24 ECU and it is very useful when the self-mapping phase requires a further improvement of the map itself (see software guide)

In case of oxygen sensor signal emulation, it is necessary to cut the wire going to lambda oxygen sensor, connect the Light Blue wire on the ECU side and the Yellow one on the oxygen sensor one (picture 28).

The above connections have to be carried out only on particular vehicles after BRC Technical Assistance indications.

6.5.14 6 POLES CONNECTORS FOR HARNESS PLUG TO PETROL INJECTORS

6.5.14.A injectors Cut and positive after turning the key

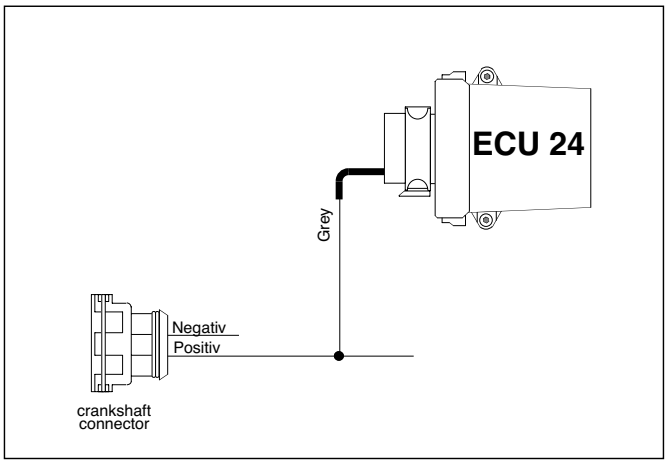
Differently from previous Sequent systems, here the injectors are cut on the positive so that there are few wires going to the ECU.

In fact the two wires of the "P" sheath are enough to stop all injectors: the White/Green wire (injectors positive, original installation side) and the White/Brown (injectors positive, injectors side) (picture 30).

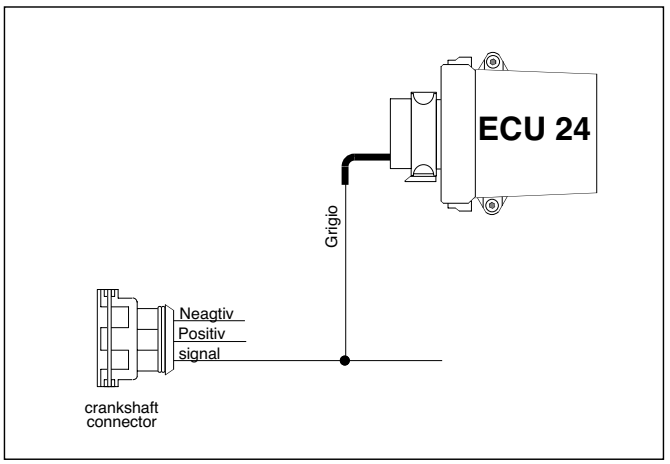
On the other hand, it is not possible to changeover from petrol to gas and viceversa injector after injector so that the changeover could be a little bit abrupt so that for some vehicles it should be necessary to change only during deceleration.

The White/Green wire has the function of positive after turning the key that means it is the wire feeding the gas ECU. At this purpose it is better to remember that some vehicles do not activate the injectors' positive till the vehicle is operating so that the key contact is not enough. In this case please start the engine to fee the gas ECU. As during programming, the gas ECU needs this wire is with high potentials, the programming has to be carried out during engine operation.

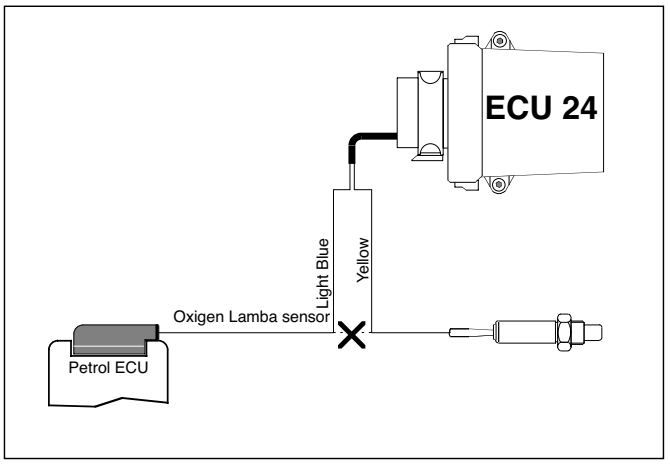
Usually the injectors' positive does not reach a low potential when both engine and key contact are off but it can stay high for some



Picture 26
Connection grey wire with the resistive crankshaft sensor.



Picture 27
Connection grey wire with the Hall crankshaft sensor.



Picture 28

seconds when the vehicle is not on. In this case the ECU will stay on for some seconds too.

The White/Brown wire is directly connected to petrol injectors. It gives tension on injectors' positive during petrol operation while it does not allow the feeding during gas one in order to cut injectors.

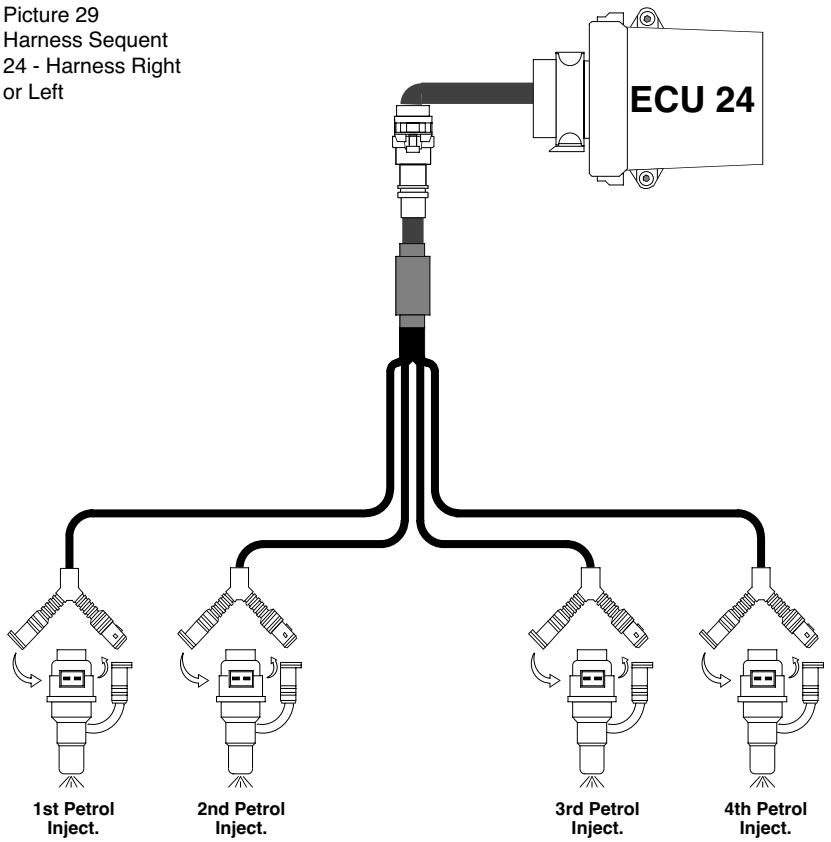
We strongly suggest the use of Sequent 24 right and left harness whenever is possible.

By using them all connections to injectors are fast, avoid welding and possible mistakes (picture 29).

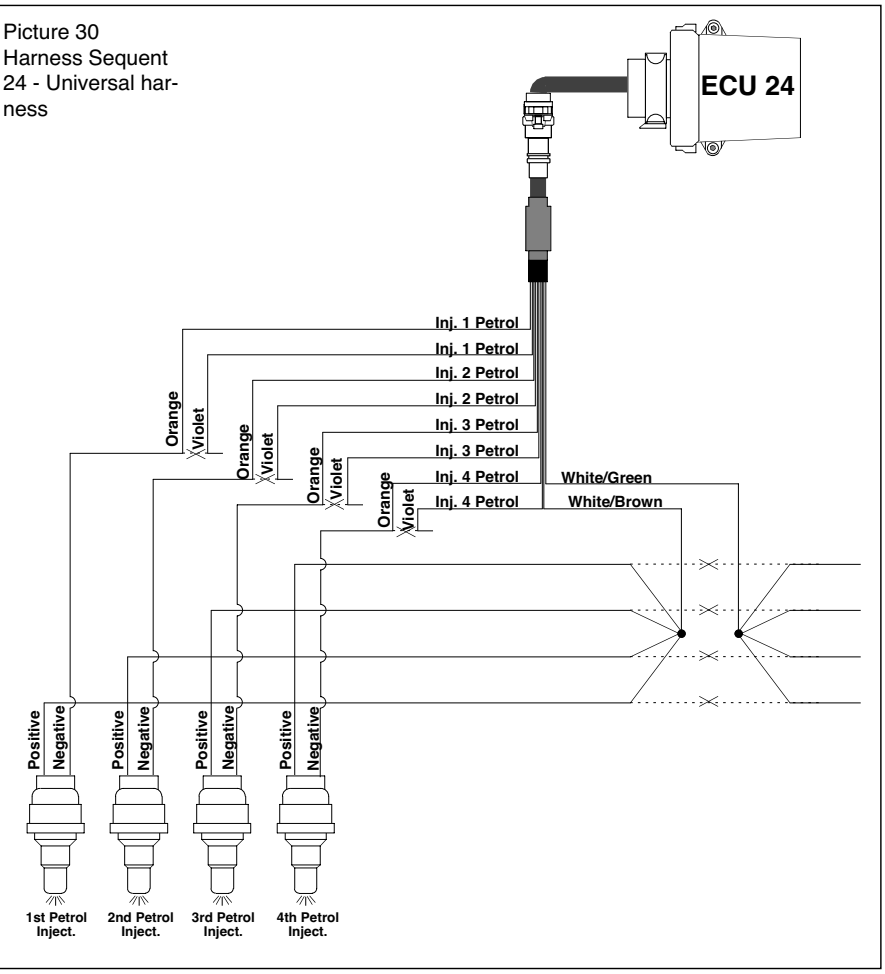
In case right and left harnesses can not be used, you can install the Universal one. Pay anyway attention to carefully follow the attached indications. Particularly consider that:

- The White/Green wire can be connected to one positive wire only coming from the original petrol ECU even if it is better all injectors' positives end to one wire only (ECU side) to avoid to overload one only petrol harness wire.
- All petrol injectors' positives have to be cut, disconnected from the original positive and connected with the White/Brown wire only. In fact, if a petrol injector receives the original positive, the injector will operate even while running with gas causing bad combustion of its cylinder.
- The petrol injectors' positive has to be cut as nearest as possible to the petrol injectors themselves. By cutting the positive far from the injectors you could cut also other actuators or sensors that are fed with the same original wire.
- Injectors' negatives have to be cut and connected as before to violet wires (petrol ECU side) and orange (injectors' side) and have to be connected in the same order of the gas injectors from 1 to 4

Picture 29
Harness Sequent 24 - Harness Right or Left



Picture 30
Harness Sequent 24 - Universal harness



For a correct installation please refer to picture 30.

List of the harnesses codes with **Bosch** connector.

• code 06LB50010122 DX (right) Sequent 24 harness for 4 Petrol Injectors connection

• code 06LB50010123 SX (left) Sequent 24 harness for 4 Petrol Injectors connection

• code 06LB50010121 Universal Sequent 24 harness for 4 Petrol Injectors connection

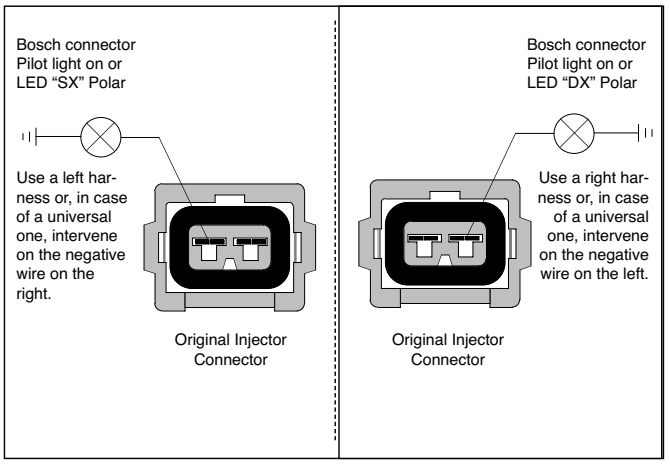
to be chosen according to the petrol injectors' polarity

List of the harnesses codes with **Sumitomo** connector.

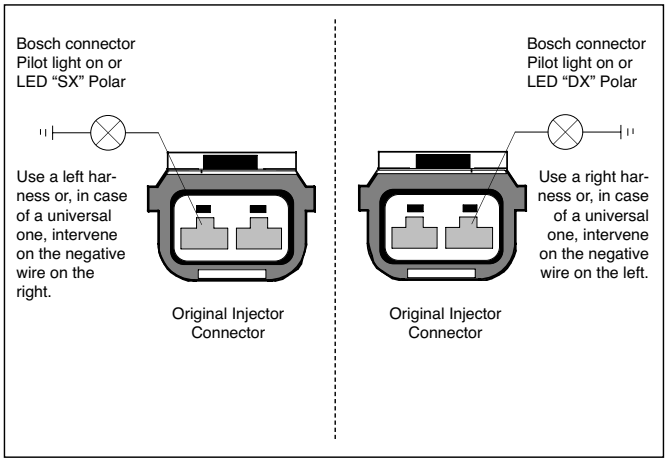
• code 06LB50010124 DX (right) Sequent 24 harness for 4 Petrol Injectors connection,

• code 06LB50010125 SX (left) Sequent 24 harness for 4 Petrol Injectors connection

to be chosen according to the petrol injectors' polarity



Picture 31a
Connector type Bosch



Picture 31b
Connector type Sumitomo

The connection is very easy and the philosophy is the same BRC used from the beginning.

To select the right harness you only have to follow the instructions inside the single packages.

It is important to keep the same injection sequence we have during the petrol operation while operating with gas. It is necessary to stop the petrol injectors' signals with the same order you will follow to connect the gas injectors.

You could pair a consecutive number to each cylinder (i.e. from 1 to 4 in case of a 4-cylinder engine and note that this order only help to carry out the SEQUENT installation so that it could be different from the one the car manufacturer assigned).

Generally in case of a transversal engine you will indicate as number 1 the cylinder placed on the cam belt side (see picture 22)

The petrol injector sprinkling in the first cylinder will be stopped with the group 1 of the Sequent petrol Injectors' Connection Harness (or with the Orange and Violet wires identified with the number 1 of the Universal Petrol Injectors' Connection Harness) and so on.

The numbers identifying both gas and petrol injectors are printed directly on the harness connection wires.

6.5.14.B Polarity of the injectors

It is necessary to pay attention not to confuse right and left harnesses and carefully follow the supplied instruction leaflet. In case of possible inversion of the harnesses, the vehicle will not start nor with petrol or gas and the injectors piloting outlets from the petrol ECU to the positive could be short-circuited. the injectors piloting could be short-circuited.

This short-circuit affects the petrol ECU only when the engine runs (but anyway it is not possible to start the vehicle). Moreover the petrol ECU is generally protected against this type of short-circuit. Please pay attention. Particularly we suggest not to excessively insist if the vehicle does not start after having reconnected the injectors but to immediately the connection harness is correct.

For the selection of the correct injectors' interruption harness (**Right or Left**) or to precisely know what is the negative wire (in case you prefer to use the **Universal harness**) it is important to know the injector's polarity that is where the positive wire is placed in order to intervene on the Negative one.

Referring to the picture number 31a abd 31b it is necessary to:

• Disconnect the connectors of

all the injectors and, if necessary, all other connectors if installed upstream (before doing this, please contact BRC technical Assistance Service)

• Switch the dashboard on

• Find out which pin of each female connectors just disconnected has a +12 V voltage (use the POLAR device code 06LB00001093 or a pilot-light. [Check all of them!!]

• If watching the connector (pay attention to the reference teeth) the +12V wire is on the right you have to use a RIGHT Harness. If you are installing a Universal harness you will have to stop the negative wire (on the left).

• If the feeding is on the left use the LEFT Harness. If you are installing a Universal harness you will have to stop the negative wire (on the right).

Connection harness codes for the 4 injectors are the following (these are not included in the kit and have to be separately ordered):

06LB50010121– UNIVERSAL HARNESS

06LB50010122 - RIGHT HARNESS

06LB50010123 – LEFT HARNESS

The petrol injectors' emulation is managed through suitable coils, similar to the ones used for Modular LF in Sequent Standard systems and are contained inside the ECU

6.6 SEQUENT 56 MAIN HARNESS

The following paragraphs describes the novelties for Sequent 56 harness. For all other connections please refer to previous paragraphs and previous Sequent standard and Sequent 24 systems to avoid useless repetitions.

6.6.1 56 POLES CONNECTOR

as the 56 poles connector used for SEQUENT **is the same one already used for Flying Injection** and considering the similar ECU external structure of the two systems you could mistake the ECU and install it with the wrong system.

This mistake has to be avoided or ECUs and/or the original vehicle system could be damaged. If, after the system and ECU installation the vehicle does not start, a good suggestion is to control the ECU before trying again.

Please refer to the labels for Sequent 56 system to avoid possible confusion as for harness and ECU.

6.6.2 SOLENOID VALVES CONNECTION

For "E" sheath connection please refer to § 6.2.2

6.6.3 SUPPLIES AND GROUND FROM BATTERY

Sheath "A" in figure 22 contains two red and three black wires to be connected to the car battery: the red wires to the positive and the black ones (all three) to the negative. It is important to connect the wires as they are, allowing that they reach separately the terminals of the battery, without joining the wires of same colour in an only wire or joining them along the harness.

The grounds must be always connected to the battery negative and not to the vehicle's structure, engine ground or other grounds present on the vehicle.

6.6.4 FUSES AND RELAY

For "B" sheath connection please refer to § 6.2.5.

6.6.5 SEQUENT 56 CHANGEOVER SWITCH

Sequent 56 changeover switch is the same used for Sequent 24. For "C" sheath please refer to § 6.5.5

6.6.6 DIAGNOSTIC POINT

For "D" sheath connection please refer to § 6.2.7

6.6.7 LEVEL SENSOR

For "E" sheath connection please refer to § 6.2.8

6.6.8 SOLENOIDVALVES

For solenoidvalves connection please refer to § 6.2.9 for "E" and "F" sheaths (picture 01).

6.6.9 SEQUENT 56 GENIUS AND WATER TEMPERATURE SENSOR

The connection to the harness is through the suitable 4 poles connector (male holder on the harness) where the 3 wires of the harness "G" sheath end.

6.6.10 MAP ABSOLUTE PRESSURE SENSOR

This sensor is not included in Sequent 56 kit but separately sold because it is used for calibration and self-mapping phases only.

During self-mapping phase, MAP pressure sensor is connected to the harness through the suitable pre-cabled connector attached to the "H" sheath wires.

The harness end also has 10 cm of grey thermo-narrowing.

6.6.11 PRESSURE AND GAS TEMPERATURE SENSORS

Pressure and gas temperature sensor is placed directly on the rail (dedicated for BRC injectors)

The connection to the harness is through the suitable 4 poles connector (male holder on the harness) where the 4 wires of the harness “R” sheath end.

6.6.12 Gas injectors

The Gas Injectors are connected to the harness by means of the wires with pre-cabled connectors contained in the sheaths “I1”, “I2”, “I3”, “I4” (group 1) and “I5”, “I6”, “I7”, “I8” (group 2).

The connectors of the gas injectors are progressively numbered from 1 to 8 and in the same way as the sheaths of the wires that will be connected with the petrol injectors.

It is very important to maintain the correspondence between the gas injectors and the petrol ones.

Practically, the gas injector to which the n° I1 connector will be connected, should correspond to the cylinder containing the petrol injector, where we will connect the connector of the Injectors connector Sequent 56 Harness (or the Orange and Violet wires of the sequent 56 Universal Injectors Connection Harness P1) and so on.

In case the correspondence is not respected, it is possible to note a worsening in the equipment performances such as, for example: worse driving conditions, greater instability of the Lambda control, less “clean” petrol/gas changeover, etc.

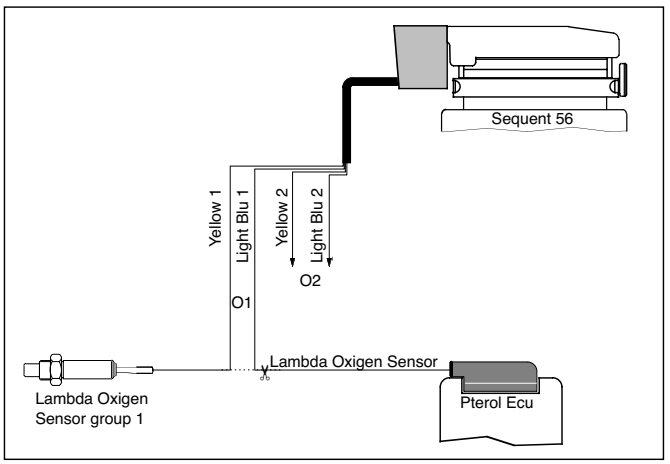
The number that distinguishes the connectors of the gas injectors is stamped on the harness wires going to the same connector.

6.6.13 RPM

For the connection of the Grey wire of “L” sheath, please refer to § 6.2.13

6.6.14 Positive Key contact

For the connection of the Brown with of “M” sheath please refer to § 6.2.16.



Picture 32

6.6.15 TPS signal

For the White/Violet wire of the “N” sheath please refer to § 6.2.14.

6.6.16 Group 1 and Group 2 Lambda Oxygen sensor Signal

SEQUENT 56 system does not usually allow to take and emulate the Oxygen sensor signal.

Anyway, if necessary, the system gives the possibility to carry it out for the two oxygen sensors of the two groups.

The possible connection of the Yellow wire 1 contained in the “N1” sheath of the main harness (picture 32) to the group 1 oxygen sensor, allows a faster vehicle self-adaptability. In case the group 1 oxygen sensor has to be emulated, it is necessary to cut the wire from the ECU to the oxygen sensor, connect the main harness Light Blue wire 1 on the ECU side and the group 1 Yellow wire on the oxygen sensor side. Those connections are valid for the group 2 second oxygen sensor through the Yellow 2 and Light Blue 2 wires contained in the “N2” sheath.

The above connections have to be carried out on particular vehicles and only after BRC Technical Assistance indication.

Please note the group 1 and 2 number is stamped on N1 and N2 harnesses wires.

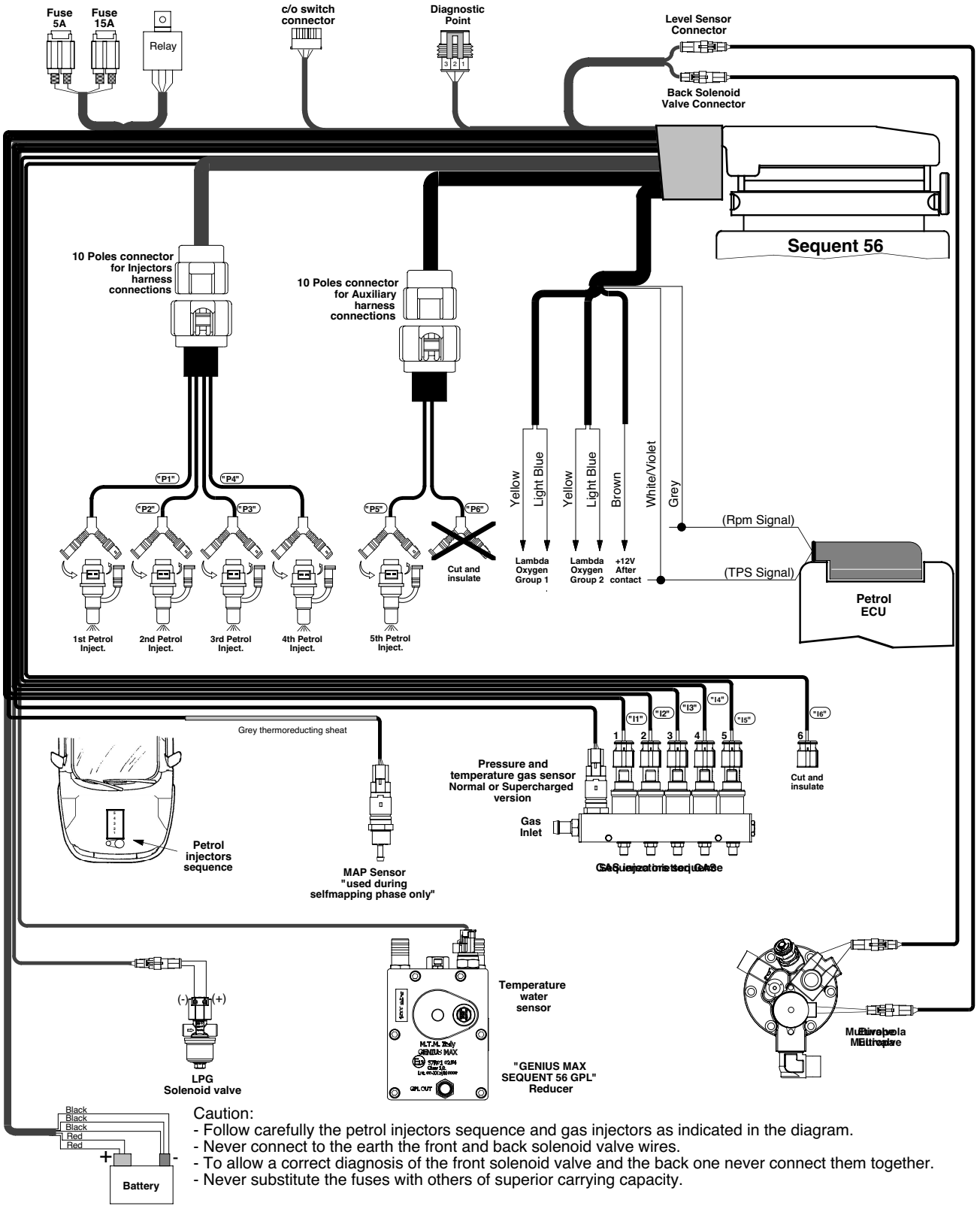
6.6.17 10 Poles connectors for the petrol injectors harness

For the connection of “P” shaeaths please refer to § 6.2.17.

6.6.17.A Polarity of the injectors

For the correct injectors polarity identification, please refer to § 6.2.17.A.

Picture 33
General wiring diagram
Sequent Fastness



Caution:
- Follow carefully the petrol injectors sequence and gas injectors as indicated in the diagram.
- Never connect to the earth the front and back solenoid valve wires.
- To allow a correct diagnosis of the front solenoid valve and the back one never connect them together.
- Never substitute the fuses with others of superior carrying capacity.

7. GLOSSARY OF TERMS AND ACRONYSM USED IN THE HANDBOOK

Terms or Acronyms	Meaning
Absolute Pressure	It is the pressure measured with reference (zero value) to the perfect vacuum.
Battery Positive (+12 V Battery)	It is the poles with greater electric potential of the vehicle's battery. Normally it is with a tension included between 8 and 16 V as to the ground.
Bottom Feed	Literally supplied by the bottom. Compare with "Top Feed". It is a particular kind of injector, in which the fuel path only covers the lower side of the injector.
CAN Bus	It is a communication system between the ECUs and the devices assembled on the vehicle.
Catalyst	See "Mapping"
Crankshaft position (sensor)	It is a sensor that is assembled near a gearwheel, integral with the driving shaft that produces an electrical signal which represents the driving shaft position.
Changeover Switch	In this handbook it is the device assembled in the passenger compartments that enables the driver to choose the kind of feeding (gas or petrol). See also paragraph 4.9
Connector	It is the device that has the duty to connect parts of harnesses with other parts of the harnesses or with electrical devices.
Cut-Off	It is a particular working condition of the engine in which the injectors do not supply fuel to the cylinders, which therefore sucks up pure air. Typically we are in cut-off during a tip-out of the accelerator, with possible deceleration of the vehicle (engine brake), starting from not too slow running conditions.
Diagnosis	It is the identification process of a problem cause or nature, breakdown, or particular condition or situation to be detected or signalised as malfunction.
Differential Pressure	It is the difference of pressure between two areas, as for example between the air-intake manifold and the atmospheric pressure.
Duty Cycle	In a rectangular waveform it is the ratio between the duration of high level and the period of the same waveform. In formula, if Ton is the high level duration and Toff is the low level duration, then Tp = Ton + Toff is the period and DC = Ton / Tp = Ton / (Ton+Toff) is the Duty Cycle.
ECU (Electronic Control Unit)	In this context it is the Electronic Control Unit of the engine or of the gas carburation.
Electro-injector	See Injector
EOBD	See "OBD". Vedi "OBD". European On Board Diagnostics. OBD system implementation at European level, regularised by institutions like ISO.
Flow	It is a physical quantity that defines the quantity of a fluid material that passes through a particular section in the time unit. The mass flow defines, for example, how many grams of a material pass in a second in a certain section.
Ground	It is the electrical potential of reference (voltage equal to zero Volt). By "ground" we

	mean the whole of cables and electrical conductors connected to this potential. The ground potential is present on the negative poles of the vehicle's battery, that by extension it is called "ground" of the battery.
Harness	In this handbook it is the whole of wires coming from the connector which the ECU is connected to reach all the other points of the electric equipment of the system
Injector	It is the device that has the duty to supply fine precision-metered quantities of pressured fuel, by injecting them in the air-intake manifold.
Injectors Rail	It is the part where the injectors are assembled; it enables gas distribution in every injector at the wanted pressure.
K Line	Communication line of the engine ECU towards the external diagnostic instrument.
Key contact	It is the voltage or the electric node downstream the switch powered by the vehicle's ignition key. It is normally at low potential; it reaches the potential of the positive battery when the switch turns off.
LPG	Liquefied petrol gas. It is a fuel obtained from the distillation of petrol. It mainly consists of butane and propane in very variable proportions. It is in gaseous phase at ambient pressure and temperature, while it is mostly liquid inside the tank.
LED	Light Emission Diode. They are electronic semiconductor devices able to give light off, if crossed by electric current.
Magnetic Circuit	It is where the magnetic flux concentrates, usually made in iron or other ferromagnetic material. It is a part of an electromagnetic device (solenoid valve, injector, electric engine, etc.).
Mapping/Map	It is the whole of data that defines the fuel quantity to be dosed depending on the working conditions of the engine.
MAP (Manifold Absolute Pressure)	It is the absolute pressure of the air-intake manifold of the engine (see absolute pressure). By extension it even indicates the sensor that measures it.
Multivalve	It is the device, placed on the tank, that performs several functions, superintending refuelling, measuring the fuel level, safety protections, etc.
OBD (On Board Diagnostics)	See also "Diagnostics". It is the monitoring system of all or some inputs and control signals of the ECU. If one or more signals are out of the programmed limits, a malfunction of the system or of the related systems detected, signalised and stored.
OR (O Ring)	Guarnizione costituita da un anello di gomma.
PC	Personal Computer
Peak & Hold (piloting)	See also "Piloting". It is the particular driving of the injectors that supplies a greater starting current to the coil in the opening phase, in order to reduce the opening times of the injector (peak); the current is later reduced to a lower value, sufficient to keep the injector open (hold).
Piloting	In this handbook, it indicates the action and the way the electric actuators are controlled by the ECU or other electric device, through electrical power signals.
Rail iniettori	See Injectors Rail
Relay	It is an electromechanical device that is able to open and close one or more electrical contacts following the proper electrical piloting.
Relative Pressure	It is the pressure measured with reference (zero value) to the atmospheric pressure.

RPM (Revolutions per minute)	is the English acronym that means “revolutions per minute”. Usually it is used to indicate the revolution speed of the driving shaft.
Self-diagnosis	See Diagnostic
Sensor	It is the device that detects the value of a physical quantity like: temperature, pressure, speed, and converts them into an electrical signal that can be used by the ECU or by any electrical circuit.
Sequential Injection	Injection control system in modern electronic injection vehicles. In every cylinder the injection phase starts and ends in independent times from the other cylinders and controlled by the engine ECU so that they are mapped with the cylinder phase and position.
Solenoid valve	It is the electromechanical device that has the duty to interrupt the flow of a fluid. In the present handbook, the solenoid valve interrupts the gas flow when it is not powered on, while it lets the gas flow when it is.
Oxygen Sensor	It is a sensor that detects the concentration of oxygen in the exhaust gases. It enables the ECU to determine if the air/fuel mixture is too rich or too lean of fuel, allowing the working of the system in closed loop.
Top Feed	Literally Supplied from the top. Compare with “Bottom Feed”. It is a particular kind of injector in which the fuel path crosses axially the whole length of the same injector, arriving from the top and being injected in the lower side of the device.
Throttle Valve	It is the valve that regulates the air load aspirated by the engine. Normally the accelerator pedal controls it but it is more often controlled directly by the petrol ECU.
TPS (Throttle Position Sensor)	It is a throttle valve position sensor. It supplies an electrical signal that indicates the opening of the throttle valve (see throttle valve).
Trivalent Catalyst	It is the catalyst that reduces the HC, CO and NOx values.