INDICE

INSTALLATION OF SLY-INJECTION SYSTEM ELECTRICAL WIRING

The e-G@S INJECTION system is comprised of general wiring with standard automotive connectors and has been conceived to allow mechanics who perform installation to make the electrical connections of the system without problems or uncertainty regarding the position of the wires.

The wiring is made up of a series of connectors that are distinguishable by their shape and number of contacts so that the number of errors that could be made are drastically reduced, allowing even the most inexperienced user to perform his first installation of the system.

Type and Functions of Connectors in the Electrical Wiring

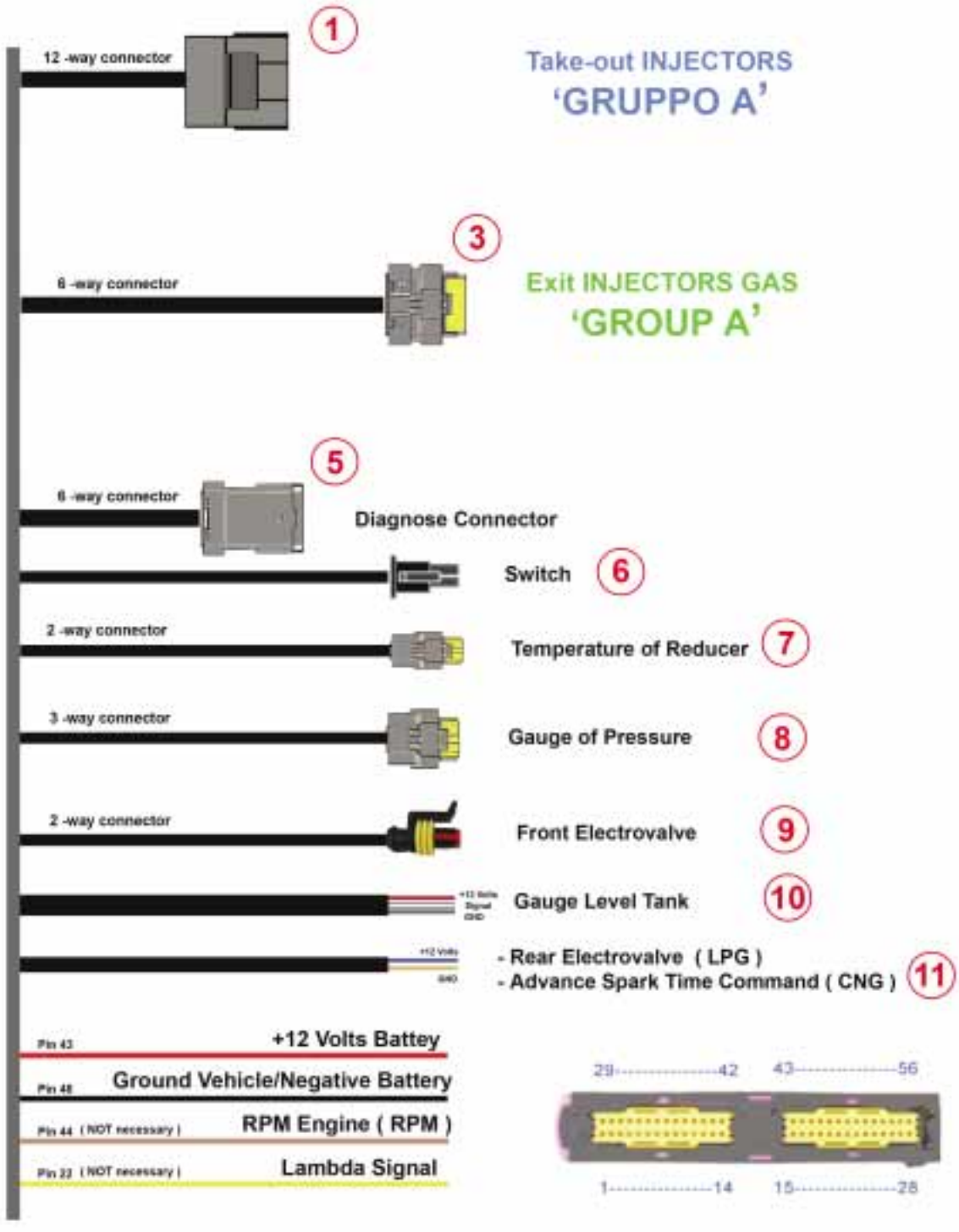
In Figure 2 there is a diagram of the wiring: beside each connector we have highlighted reference numbers that are used to identify the functions associated with each connector. The first step is to identify if the wiring chosen is the right type to install in the vehicle, and this distinction in made on the basis of the number of cylinders the vehicle has.

Electrical Wiring Connector Table. **Table 1**

TABELLA CONNETTORI		
1	**Injector detachment Connector A**	The connector is attached to the wiring of the injector detachment via its 10-pin complementary connector.
2	**Injector detachment Connector B**	The connector is attached to the wiring of the injector detachment via its 10-pin complementary connector.
3	**GAS Injector connector A**	The 6-pin connector is attached to gas injectors installed in Group A engines.
4	**GAS Injector connector B**	The 6-pin connector is attached to gas injectors installed in Group B engines.
5	**ECU Diagnostic Plug**	Via this 6-pin connector you can diagnose the ECU with a PC or with an e-G@S Tester.
6	**Commutator**	The 4-pin connector is inserted into the rear of the commutator supplied in the e-G@S system.
7	**Temperature Reducer**	The 2-pin connector allows you to connect to the temperature sensor located in the body of the reducer.
8	**Pressure Sensor**	The 3-pin connector allows you connect to the pressure sensor installed in the system.
9	**Front Electrovalve**	The 2-pin connector is connected to the front electrovalve.
10	**Level Sensor**	It allows you to have a connector to the e-G@S level sensor or to use the colours in order to connect a generic level sensor.
11	**Rear Electro-Valve**	This electrical plug allows you to connect it to the rear LPG valve when we are on LPG installation and when we are on the Methane installation is the command line for the advance spark time processor. Be careful: blue wire +12 volts.

LPG - CNG ELECTRICAL CABLE cod. 425.380

(engine: 3 → 4 cylinders)

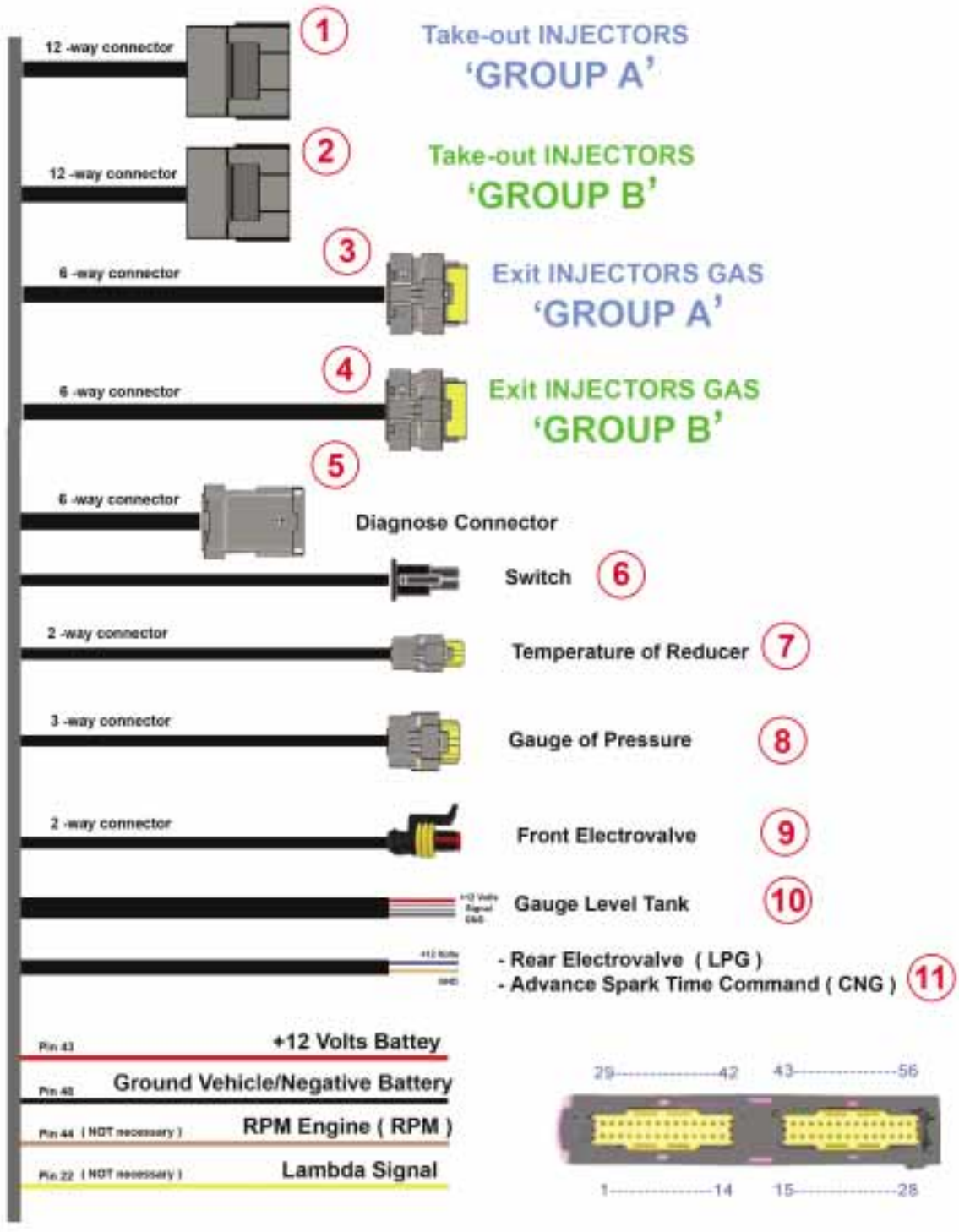


SLY-INJECTION SYSTEM

Figure 1: Connector 3 → 4 Cylinders. (cod. 425.380)

LPG - CNG ELECTRICAL CABLE cod. 425.381

(engine: 5 ➞ 8 cylinders)

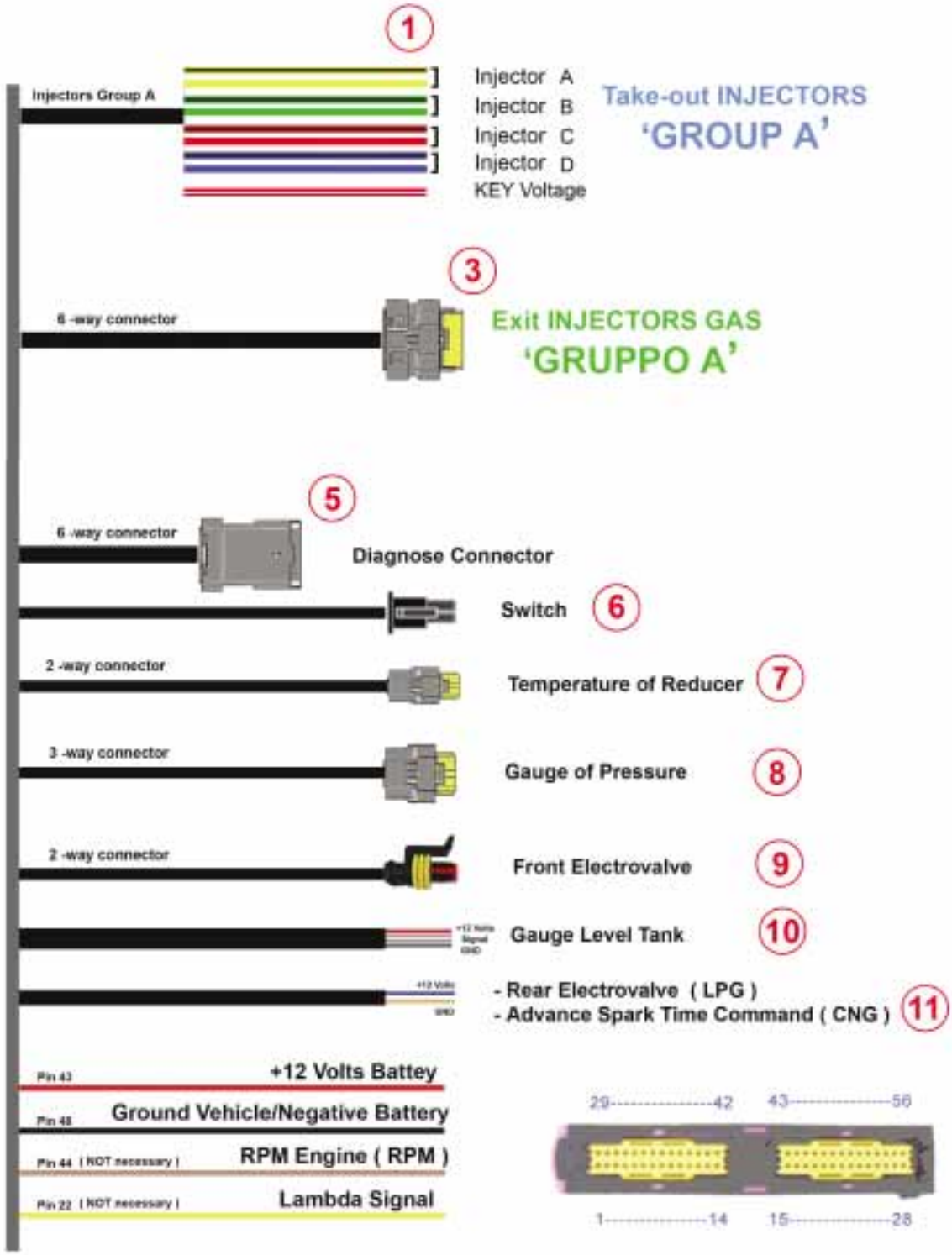


SLY-INJECTION SYSTEM

Figure 2: Connector 5 ➞ 8 Cylinders. (cod. 425.381)

LPG - CNG ELECTRICAL CABLE cod. 425.382

(engine: 3 ⟶ 4 cylinders)

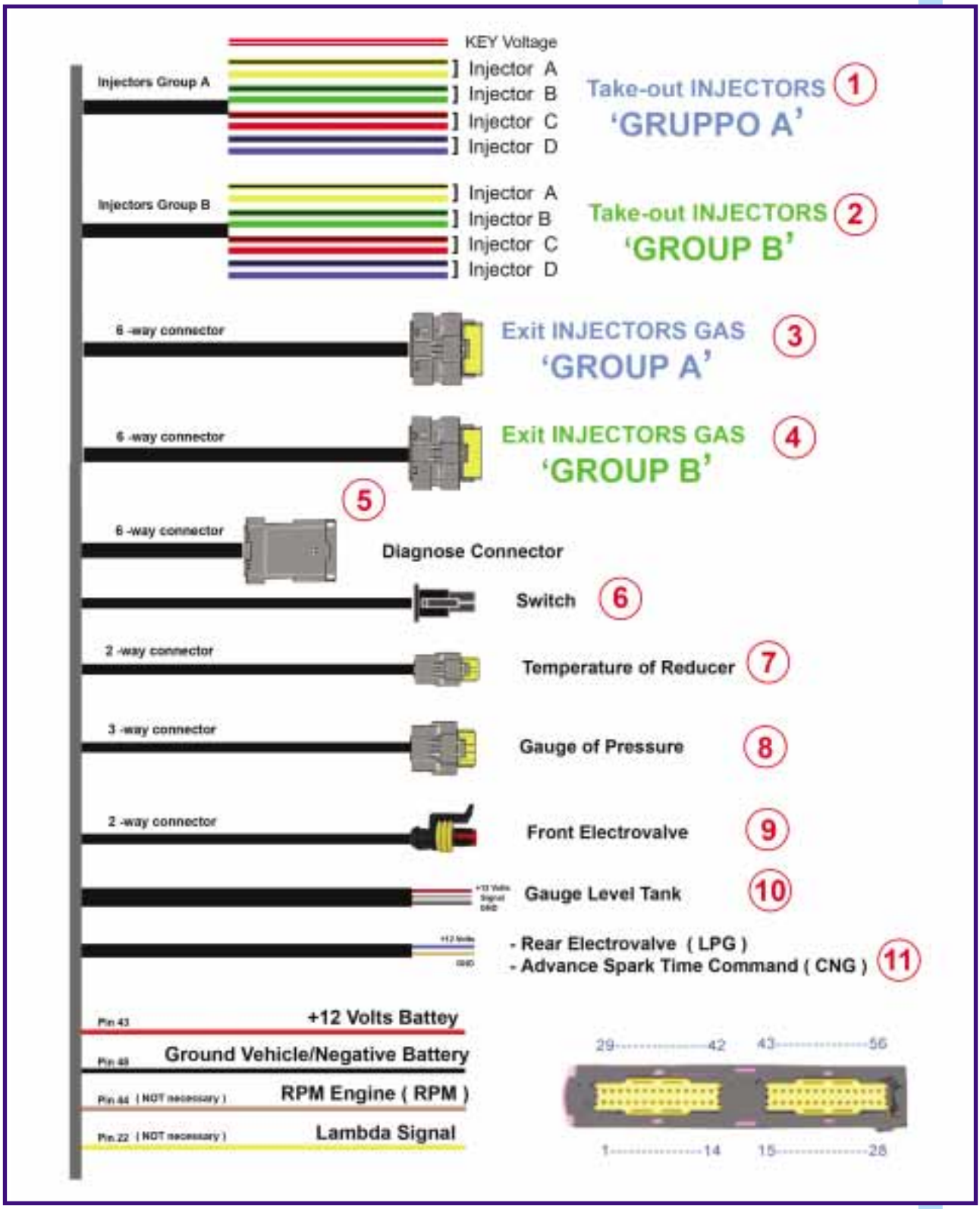


SLY-INJECTION SYSTEM

Figure 1: Connector 3 ⟶ 4 Cylinders. (cod. 425.382)

LPG - CNG ELECTRICAL CABLE cod. 425.383

(engine: 5 ➞ 8 cylinders)



SLY-INJECTION SYSTEM

Figure 4: Connector 5 ➞ 8 Cylinders. (cod. 425.383)

WIRING 4 CYLINDERS AND 8 CYLINDERS (LPG\METHANE).

E-G@S wiring allows you to manage engines from 2 to 8 cylinders. For the same wiring there are two different versions – the first for engines with 3 to 4 cylinders and the second for engines with 5 to 8 cylinders..

There is little difference between the two versions: in the first, with respect to the second, connectors (3,4) are missing whilst the second in some ways represents the full version of the wiring with all connectors included, essential for managing engines up to a maximum of 8 cylinders.

The first piece of information during installation is thus related to the type of engine on which the GAS system (LPG o Methane) is to be installed. On the basis of the number of cylinders the engine has you can find the most suitable wiring to use. The table below is useful for identifying the right wiring.

NUMBER CYLINDERS	TYPE OF WIRING TO INSTALL	
3 → 4	Wiring	cod. 425.380
5 → 8	Wiring	cod. 425.381
3 → 4	(Universal) Wiring	cod. 425.382
5 → 8	(Universal) Wiring	cod. 425.383

Wiring cod. 425.380:
Wiring with standard connectors to be used in engines with 3 and 4 cylinders.

Wiring cod. 425.381:
Wiring with standard connectors to be used in engines with 5 to 8 cylinders.

Wiring cod. 425.382:
Wiring without standard connectors with the exception of the connector on the injector detachment side for petrol Group A. This has been substituted by an electrical connection with universal ends to be used in 3 and 4 cylinder engines.

Cablaggio cod. 425.383:
Wiring without standard connectors with the exception of the connector on the injector detachment side for petrol Group A and Group B. These have been substituted by an electrical connection with universal ends to be used with 5 to 8 cylinder engines.

LPG and METHANE wiring

Whether you have chosen an LPG or a methane conversion, the E-G@S INJECTION wiring allows you to use either type of fuel: there's no need for different connectors or special configuration. In practice, the same wiring is used both for LPG and METHANE.

The differences that you find in the electrical installation have very little impact: it should be noted, in fact, that the connections that carry the command signal to the rear valve placed on the LPG tank become, in the case of methane, the electrical connection that commands the advance regulator needed in METHANE systems. Due to the fact that the rear valve does not exist in METHANE tanks, the electrical connection is used for commanding the advance regulator**,** if fitted.

CONNECTION: TANK LEVEL SENSOR

In the following lines we will simplify the use and installation of level sensors models different from those produced by e-G@S. The e-G@AS type differs from its competitors by the fact that it has a standard connector and is simple to insert into the general wiring without having to use special tools o complicated instructions for connecting it to the general wiring provided in the KIT.
Identify the cable in the wiring that contains the wires used to connect up the level sensor located on the GAS tank (LPG / METHANE) and which indicates the quantity of fuel present inside it. It has 3 wires (red, white, black).
There are essentially two types of level indicators on the market, one defined as '***resistive'*** and another defined as '***powered'***.

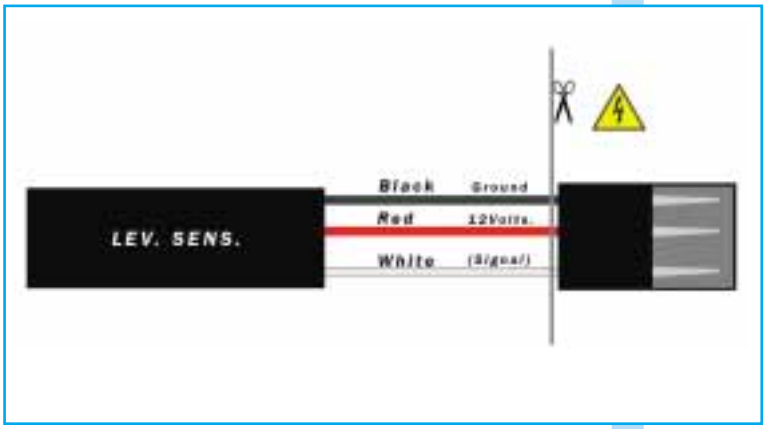
Resistive level indicators use only two of the three wires present in the cable of the main wiring, whereas powered sensors which need external power use all three of the wires inside the cable.
Now lets distinguish these two cases separately by moving through the connection instructions for the sensors, trying to be general at the same time in the description of this phase of installation, so that they can be applied order to apply all sensors available on the market.

Resistive Sensor

In all types of wiring (cod. 425.380, cod. 425.381, cod. 425.382, cod. 425.383) there is an electrical terminal which unites the three wires to the level sensor. The cable has a special label to make it easier to identify. Once the cable has been identified, proceed and connect your generic level indicator or use the connector terminal if it is a level sensor produced by e-G@S. If you use an e-G@S level sensor it will have the right connector for the general wiring, whilst if you possess a generic level sensor you'll have to use the electrical connections present in the general wiring just remove the specific connector with a cutting tool (see figure below).

Be careful!: **Do not cut the wires with scissors without having turned off the power to the wiring and without having taken out the 56 wire cabling from the ECU – this action could otherwise damage the electronic board and cause a short circuit.**

If the level indicator chosen by you, on the basis of our instructions, needs two wires for the connection it will certainly be a resistive type sensor. For the connection with the e-G@S general wiring identify the two wires in question, black and white according to the electrical scheme above (Earth, Signal) and attach them to your sensor.



Powered Sensor

The powered level sensor needs, in order to function properly, a power supply that is able to supply voltage to it. In the e-G@S system we have made prevision for a +12 volt external power supply suitable for powering the most common level sensors present on the market.
In the cable which contains the three wires dedicated to the e-G@S type level indicator, we can find the power supply present in the connection: the red colored wire.
Obviously, for each type of level indicator, on the basis of the experience of the mechanic, the connections to the level indicator chosen must be clear. The follow colors are, in any case, a point of reference:

CONNECTION:
TEMPERATURE SENSOR (LPG / METHANE)

The temperature sensor located in the LPG and METHANE reducer allows us to measure the operating temperature of the aluminum body which substitutes the reducer itself; the operating temperature is constantly monitored with a 0.5 degree centigrade margin. You need only identify the 2-pin connector placed on the electrical connection (it has a identity plate for the pressure sensor) to connect the temperature sensor to the general wiring.

Installation Phase: In the main wiring (cod. 425.380 , cod. 425.381, cod. 425.382 , cod. 425.383) identify the 2-pin male connector (female plug) and insert it into the connector located at the end of the temperature sensor that is inserted in the reducer body (see Figure 5). The operation is the same for both LPG and METHANE systems - the only variable is the reducer which for methane is a different type with respect to an LPG reducer. The temperature sensor, however, is exactly the same for both types of system.

Figure 5: Installation of the temperature sensor (LPG / METHANE).

CONNECTION:
PRESSURE SENSOR (LPG / METHANE)

The pressure sensor (Figure 4) used by the SLY-INJECTION system is a differential type, which allows it to efficiently measure the positive entry pressure at the gas injector rail and to measure at the same time, the negative pressure present in the inlet collector of the engine. Both of these measurements are considered by the algorithm of LPG or METHANE gaseous injection systems. The presence of the pressure sensor in the injection system allows it to provide accurate carburetion for the gas system and to be able to utilize, at any time, specific characteristics of the injection system such as automatic commutation to petrolin the absence of LPG or METHANE.

Figure 6: Pressure sensor (LPG / METHANE).

Installation phase:

In the main wiring (cod. 425.380 , cod. 425.381, cod. 425.382 , cod. 425.383) identify the 3-pin male connector (female plug) and insert into the relative connector located on the pressure sensor following the visual instructions in Figure 6.

CONNECTION:
COMMUTATOR (LPG / METHANE)

The connector of the commutator shown in Figure 7 allows you to connect , without having any doubts, the commutator placed inside the vehicle to the ECU of the e-G@S system.
The connector is easily inserted in a correct manner thanks to the small tab that provides a safe and practical connection to the commutator itself.
In this way it ensures the commutator has a firm grip on the electrical terminals and guarantees it a longer on board the vehicle

Figure 7: Detail Commutator Connector.

Installation Phase:

In the main wiring (cod. 425.380 , cod. 425.381, cod. 425.382 , cod. 425.383) identify the 4-pin microfit type connector; identify the tab placed on the connector and the relative socket on the commutator (see Figure 8).

Figure 8: Commutator Connector.

Commutation button:

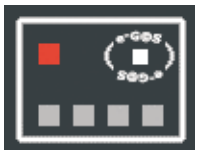
The commutation button is near the center of the commutator. The pressure zone has a special sign that indicates its location on the surface of the commutator. By pressing on this zone the vehicle is predisposed for GAS commutation or in alternative switches from running on GAS to running on petrol..
Pressing this button allows you to switch to GAS at any time you are running on petrol and to switch to petrol when running on GAS.

Be careful!: If the commutator model used in your system is mod. 425.375 every time the commutator is pressed an audible signal tells you the operation has been completed, whilst this function is not present in mod. 425.374.

Luminous signals and state of function

Running on PETROL:

The red light in the top left of the commutator is illuminated and indicates that the state of function is on petrol.



Running on GAS:

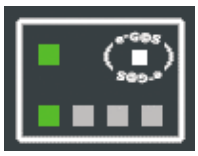
The green light in the top left of the commutator is illuminated in addition to the following combinations, indicating the level of GAS present in the tank.

GREEN LED COMBINATIONS
whilst running on GAS:

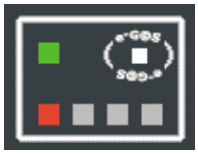
4 green leds:
Running on GAS with a full tank.

3 green leds:
Running on GAS with tank at 3/4.

2 green leds:
Running on GAS with tank at 2/4.



1 green led:
Running on GAS with tank at 1/4.



1 1 flashing red lrd:
Running on GAS with tank in RESERVE.

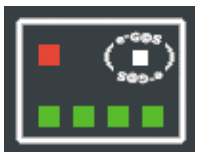
functioning Commutation

During the commutation phase you see alternating lighting of the LEDs on the commutator in a sequential mode. This depends on certain important conditions (see below).
Together with the red LED lit (that indicates running on petrol) certain sequences of LEDs flash on the commutator, as shown in the figure on the left.

- 1 red led
- 1 green flashing led:
Waiting for Commutation temperature.

- 1 red led
- 2 green flashing leds:
Waiting for time preset by installation mechanic to pass.

- 1 red led
- 3 green flashing leds:
Waiting to reach commutation revs set by the software interface default value 1400 rpm.



- 1 red led
- 4 green flashing leds:
Waiting for accelerator to be released after reaching commutation rpm.

Automatic Commutation following end of gaseous fuel.

The software present in the ECU allows you to set up automatic commutation after finishing all gas in the tank. This action also is visualized on the commutator with corresponding luminous signals.

The software, after having perceived the lack of pressure in the fuel supply circuit of the engine, switches to petrol use automatically **if it has been enabled. The commutator shows the change to petrol by lighting the LED to indicate running on petrol and, as well as this, the red LED that normal indicates gas in reserve also flashes.**

This indication aims to underline the fact that the system has commutated to petrol (red LED) as there was no gas in the circuit (RED flashing LED).

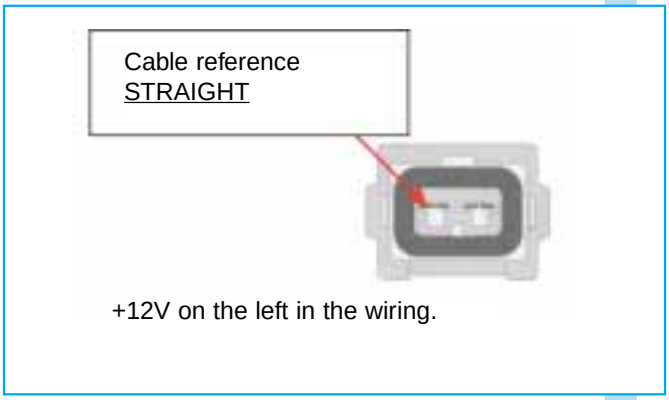
Forced starting on GAS.

With the Sly injection system you can start directly on GAS (both LPG and METHANE), taking care to keep the vehicle at minimum revs to allow the engine to reach ideal operating conditions.

Procedure:
Before starting the vehicle with the key press and hold the button and start the vehicle with the key just like normal starting. Continue until the engine starts and then release the commutation button located on the commutator.

INJECTOR SIGNALS

Figure 9: Cable reference Straight



Thanks to the injector emulator present inside the ECU, with its own specific wiring, the functioning of the injectors is interrupted and substituted by a fake load, eliminating in this way annoying problems such as lighting of the check-engine signal

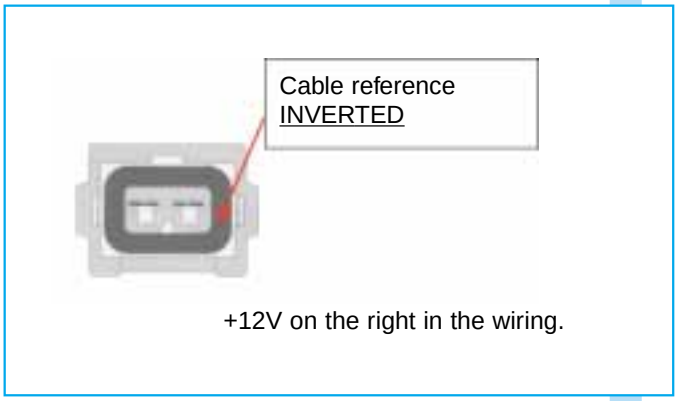


Figure 10: Cable reference Inverted

Capturing the injector signal of the vehicle is a very important operation and must be performed with the maximum care and skill by all mechanics.

The capture of the signal occurs through the use of a particular cable supplied in the e-G@S SLY-INJECTION KIT; this cable allows the system to receive the injector signal through the original connectors of the vehicle and then send the signal received back to the ECU.
The ECU is able to interpret the injection signal of the care and, when required, fuels the engine of the vehicle interrupting the flow of petrol and supplying the engine of the vehicle with gaseous fuel (LPG/METHANE).

Only one element is thus necessary in order to receive the injection time signal:

INJECTOR DETACHMENT WIRING

There are two types of INJECTOR DETACHMENT WIRING:

Direct Wiring.
Inverted Wiring (Identification: Red stripe on Connector).

The following procedure is used to distinguish which of the two wirings is suitable:

I - Disconnect ALL connectors from all injectors.

II - Turn the key to ignition on position (engine OFF).

III - On the female connectors you've just disconnected identify, according to the figures shown beside, on which side there is +12 volts, be it on the right or the left of the connector. In this case, if the voltage is on the left side you must use Direct Wiring otherwise (if it is on the right) you should you the Inverted wiring.

Connection wiring side (cod. 425.380 , cod. 425.381).

In Figure 11 you can find the details of the electrical connection between the connector of the injector detachment cable and the relative connector (1,2) located in the wiring of the ECU. (cod. 425.380 , cod. 425.381).
As you can see the connection is simplified by these special automotive connectors that stop you from making mistakes. If you quickly wish to check correct installation, an intuitive and easy method is to check that wires of the same color connect at the ends with their relative connectors: yellow to yellow, green to green and so on.

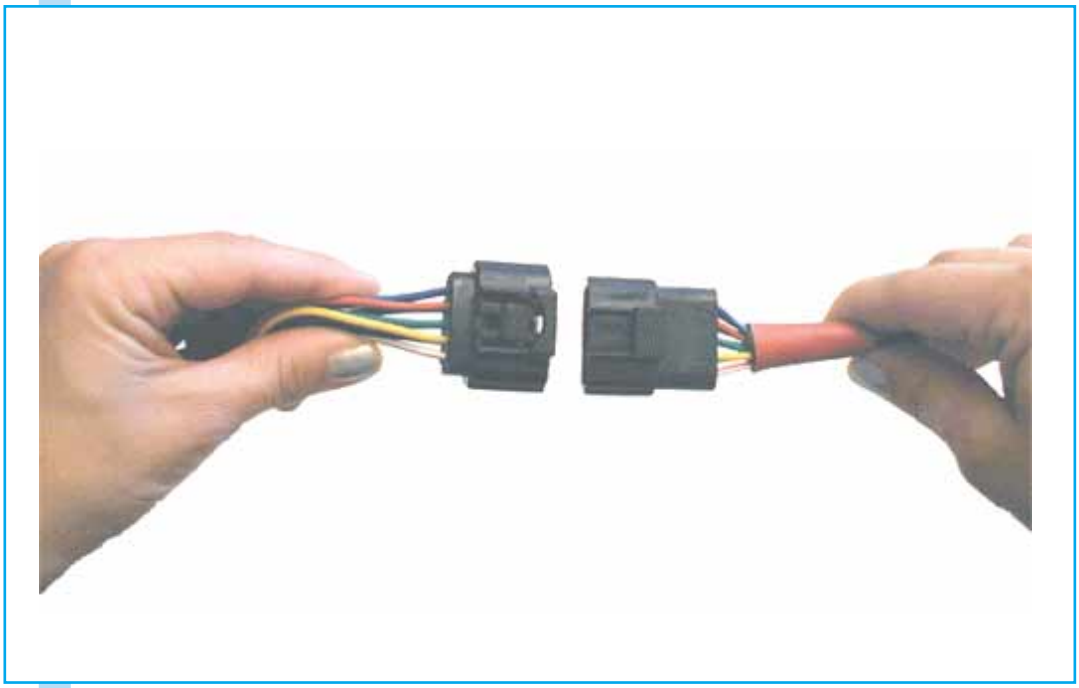


Figure 11: Detail Injector Detachment Connector.

425.382 WIRING (UNIVERSAL 4 CYLINDER)

The main difference in the wiring is the absence of the two connectors at the ends for each injector of the original control unit. Not having a connector, the wires are loose and you need to identify the installation sequence to understand which of these wires represent injectors A, B, C, D.

The first thing you must do is to find out, by detaching the original connectors of the vehicle, where the command signal of the injectors is and where you can find the supply voltage of the injector. In short, you have to understand whether it is direct or indirect wiring, as this allows you to perform the other connections correctly.
As you can see, the universal injector detachment wiring has in total 9 wires to be attached as follows:

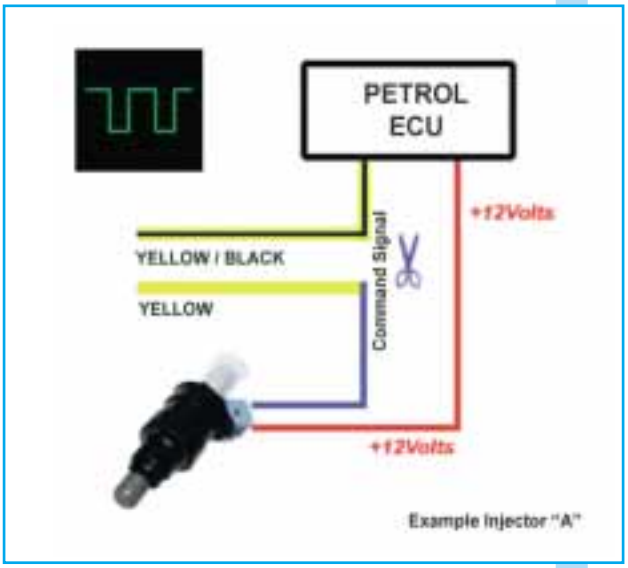
N° 8 INJECTORS

INJECTOR A	Yellow	Signal pick up on the injector
	Yellow / Black	Return signal towards the ECU
INJECTOR B	Green	Signal pick up on the injector
	Green / Black	Return signal towards the ECU
INJECTOR C	Red	Signal pick up on the injector
	Red / Black	Return signal towards the ECU
INJECTOR D	Blue	Signal pick up on the injector
	Blue / Black	Return signal towards the ECU

In the figure on the right you can see a diagram which describes the connection of injector “A” in the general wiring to the original petrol injector of the vehicle.

You proceed by identifying the injector command signal. Once you have found the cable you must cut it and connect the two ends left after cutting with the two wires in the general wiring.

The YELLOW/BLACK wire has to be connected to the cut wire which returns towards the original petrol control unit, while the yellow wire has to be connected to the wire that returns back towards the original petrol injector.



BE CAREFUL!!

N° 1 IGNITION SIGNAL WIRE (KEY TURNED ON)

The igntion signal can be taken both from a power signal of one of the original injectors of the vehicle (+ 12 Volts) or from a typical point, such as the fuse box, as long as this supplies voltage when the igntion is on (key turned on).

Ignition ON	White / Red	

INJECTOR DETACHMENT WIRING (UNIVERSAL)

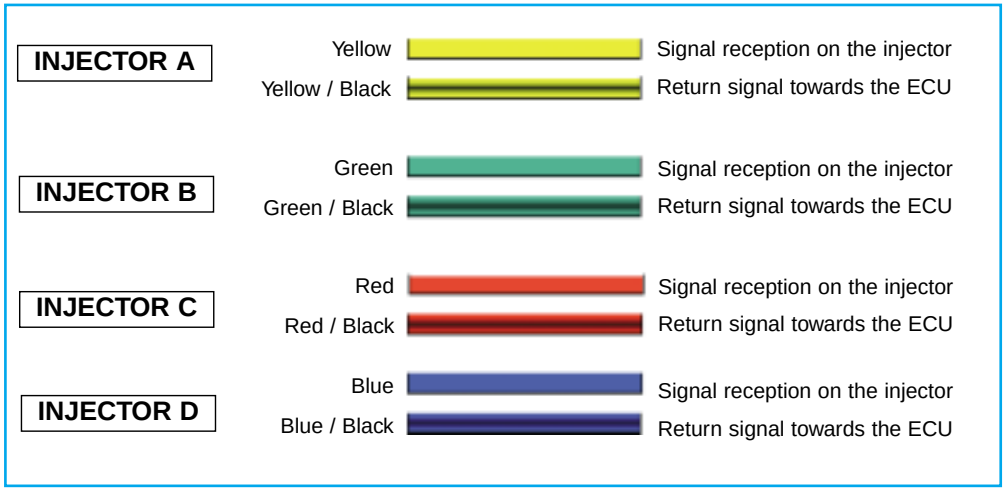
Injector Detachment 4 Cylinders	Universal	Cod. e-G@S	**425.518**
Injector Detachment 3 Cylinders	Universal	Cod. e-G@S	**425.519**

In the injector detachment wiring installation phase the mechanic can decide to install the universal cables. The main difference in this cabling is that it does not have the two connectors at the ends for each injector to the ECU. Not having the connector, the wires are single so you must understand the sequence of installation to ascertain which of these wires represents injector A, B, C, D.

By detaching the original connectors of the vehicle you must first discover where the command signal of the injector is and then find the voltage supply to the injector. Identifying if it is direct wiring or inverted wiring allows us to make the connection that follows correctly.

As you can see, the universal injector detachment wiring has 9 wires in total and should be matched as follows:

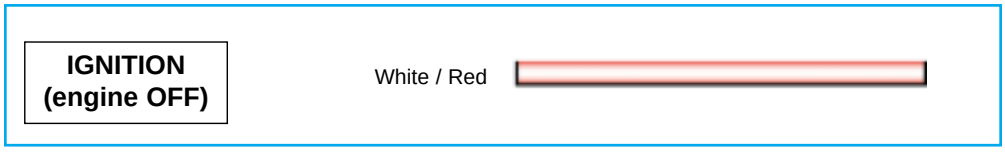
N° 8 INJECTOR WIRES



BE CAREFUL!!

ON THE UNIVERSAL WIRING FOR THREE CYLINDERS IT IS VERY IMPORTANT NOT TO ATTACH THE CONNECTION FOR INJECTOR C; CONNECT THE REMAINING ONES.

N° 1 SIGNAL VOLTAGE WIRE



If you wish to connect the ignition signal in a different place from the injector wiring, cut the red/white wire located before the connector **(CONNECTOR A)** in wiring cod.425.380 e cod.425.381 and connect it to the ignition source chosen in the vehicle.

See Connector 1 page 6 and page 7.

Connection GAS Injector side (LPG / METHANE)

In **Figure 12** we can see the detail of the connector in question located in the injector detachment wiring. This connector is identified by a protective label with the letter “A” and indicates that the connector must be inserted in correspondence to the GAS injector chosen as injector “A” (see ID plate on the injector rail). In the injector block there is, in fact, a label that specifies this reference.

BE CAREFUL! **The other connectors present in the injector detachment wiring are not labeled with identification letters. This operation is not necessary as, starting from connector A, the other injectors follow directly as B, C and so on.**

Product Code Table.

INJECTOR DETACHMENT WIRING			
3 Cylinder Injector Detachment	***Diritto***	Cod. e-G@S	**425.514**
3 Cylinder Injector Detachment	***Invertito***	Cod. e-G@S	**425.515**
4 Cylinder Injector Detachment	***Diritto***	Cod. e-G@S	**425.516**
4 Cylinder Injector Detachment	***Invertito***	Cod. e-G@S	**425.517**
4 Cylinder Injector Detachment	***Universale***	Cod. e-G@S	**425.518**
3 Cylinder Injector Detachment	***Universale***	Cod. e-G@S	**425.519**
Temperature Sensor		Cod. e-G@S	**425.370**
Pressure Sensor		Cod. e-G@S	**425.114**
GENERAL WIRING			
Wiring 4 Cylinders CSG		Cod. e-G@S	**425.380**
Wiring 8 Cylinders CSG		Cod. e-G@S	**425.381**
Wiring 4 Cylinders Universal CSG		Cod. e-G@S	**425.380**
Wiring 8 Cylinders Universal CSG		Cod. e-G@S	**425.381**

MECHANICAL COMPONENT INSTALLATION

RG10 LPG Reducer/Vaporizer

The RG10 vaporizer/reducer was designed for use in the Sly-Injection injection system.

The special form and the geometry of the internal channels allow it to produce effective thermal exchange, thus allowing it to fuel high-powered engines and ensure the temperature stability of outgoing gas.

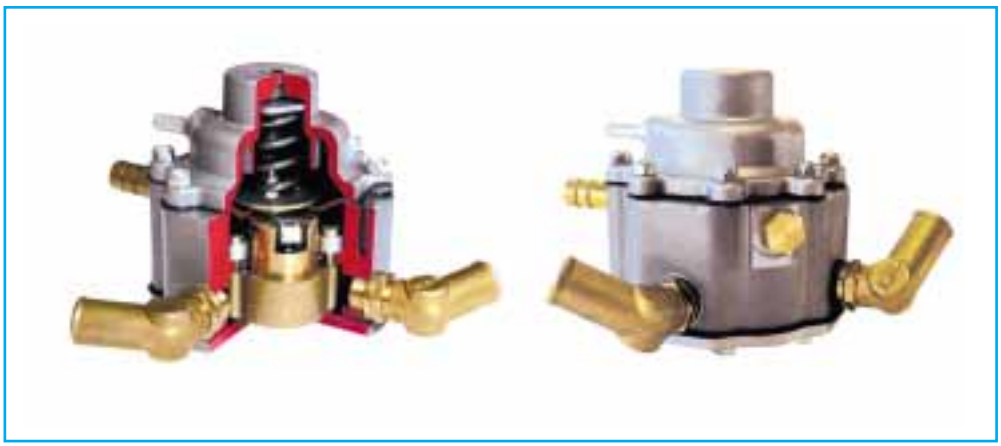
The LPG flows through a channel directly in the vaporizer body and is then transformed from the liquid state to the gaseous state before pressure reduction, guaranteeing stable and continuous output flow.

The vaporizer/reducer's seals in "viton", working with gas in a completely gaseous state and at temperatures above 0°C, allow a noteable reduction in manufacturing costs and are less subject, at the same time, to deterioration.

The operating pressure can vary from 0,6 bar at 1,8 bar assuring, in all engine operating conditions, precise supply pressure.
Installation is easier in engine compartments with limited space thanks to its reduced dimensions and compact form. The RG10 vaporizer/reducer can fuel engines with up to 150 Kw.

In brief:
Reducer with only one membrane stage for pressure reduction.
Heating and gasification of the LPG via a coil located in the fusion prior to the high pressure valve.
Outgoing LPG pressure can be regulated from 0,6 to 1,8 bar.
Internal circulation of engine cooling liquid to allow thermal exchange with the gas.
Incorporated temperature sensor.
Can fuel engines with up to 150 Kw.

RM10 METHANE reducer (CNG)



The RM10 type methane gas pressure reducer was designed for used in the Sly-injection injection system.

Operating pressure can be regulated and can vary from 0,6 bar to 1,8 bar assuring, in all engine operating conditions, precise supply pressure.

Thanks to its sophisticated piston balance system, it produces constant and reliable running with a single reduction stage in the entire range of entry pressure variability, from about 200 bar (full tanks) to 0 bar (full tanks). The advantages which derive from this are: a great reduction in load losses, consequent increase of methane range and related improvement in engine power erogation at high revs.

The engine cooling water circulates inside the pressure reducer allowing correct operating temperature in all running conditions.

Installation is easier in engine compartments with limited space thanks to its reduced dimensions and compact form. The RM10 pressure reducer can fuel engines with up to 130 Kw.

In brief:
Reducer with only one membrane stage for pressure reduction.
Piston balancing on the **A.P** lever. Outgoing methane pressure can be regulated from 0,6 to 1,8 bar.
Internal circulation of engine cooling liquid to allow thermal exchange with the gas.
Incorporated temperature sensor.
Can fuel engines with up to 130 Kw.

DIAGRAM INSTALLATION OF LPG COMPONENTS

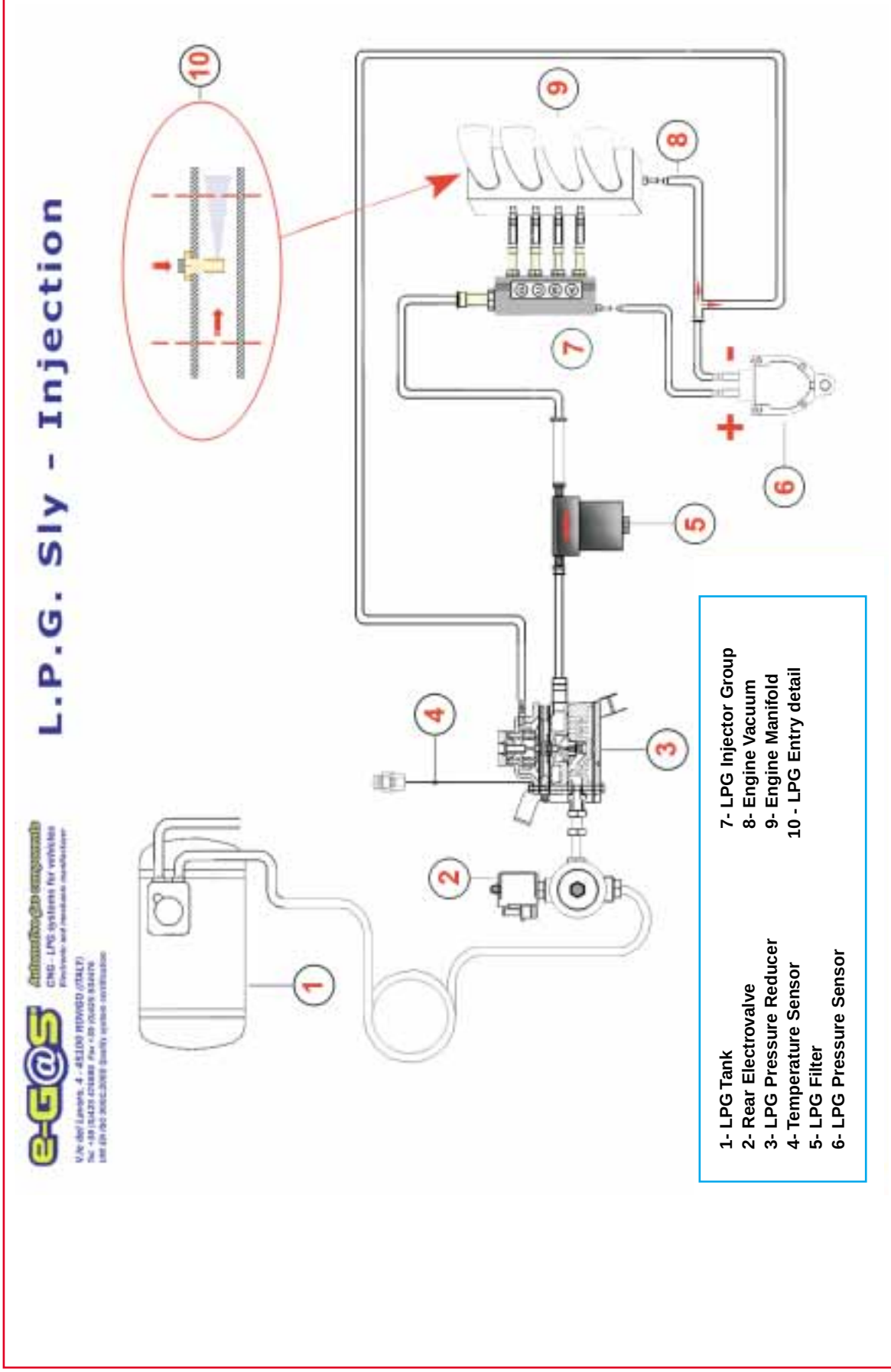
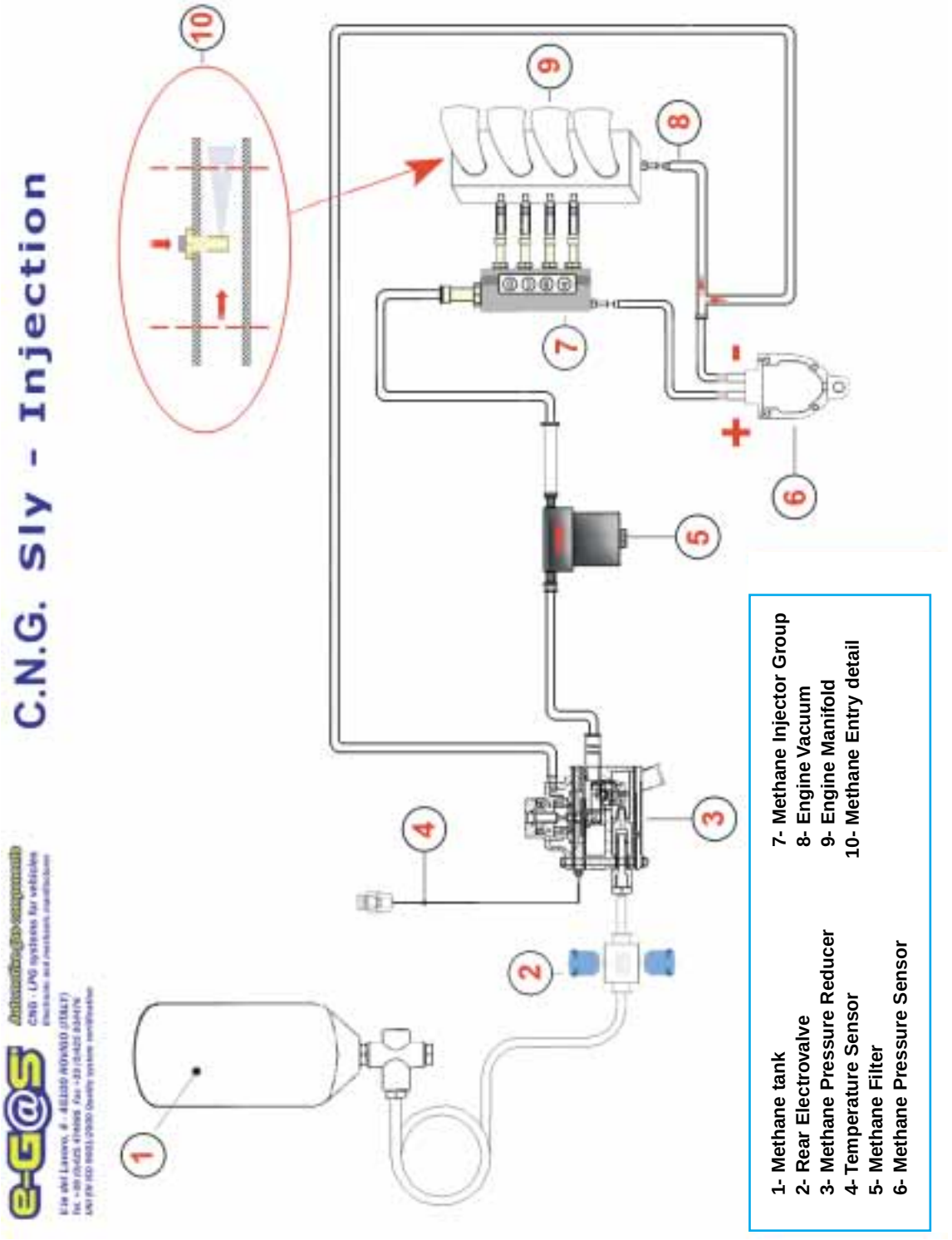
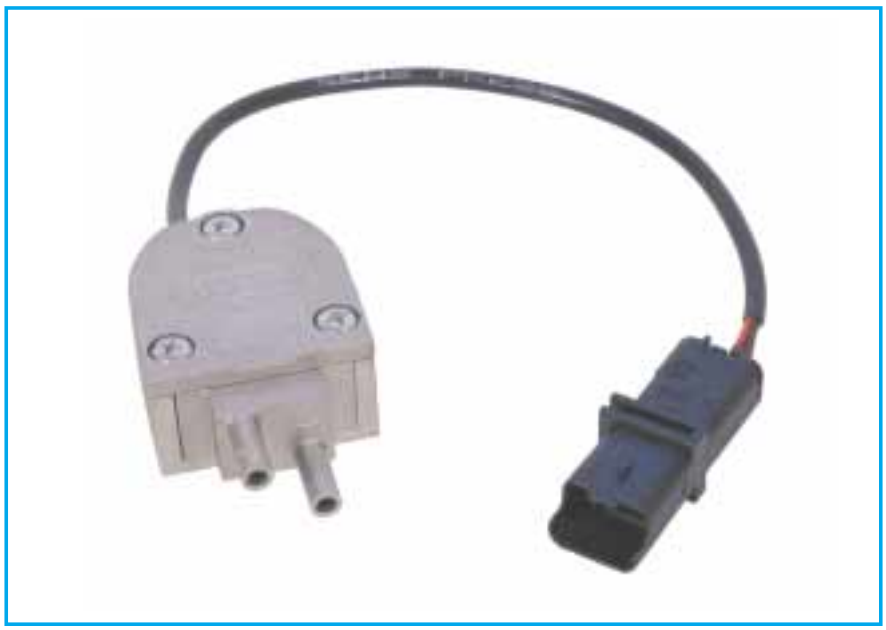


DIAGRAM INSTALLATION OF METHANE COMPONENTS (CNG)



PRESSURE SENSOR FOR INJECTION SYSTEMS

(e-G@S SLY INJECTION injection system)



The e-G@S SLY INJECTION system uses a differential pressure sensor. The sensor is situated inside a special aluminium container specifically designed to be impact resistant and resist mechanical stress.
The container hass two cylindrical ends (one of which is smaller) on one side and an electrical connector on the other.
The two cylindrical ends allow the electronic device housed inside the aluminium casing to measure both positive pressure through the "+" entry and negative pressure through the "-" entry.

The two cylindrical ends that protrude from the aluminium case are called "Acquisition Tubes" and are connected to the tubes used for pressure monitoring. The electrical wiring (equipped with a special connector that has three wires) is inserted into the special CN5 connector located in the control unit side of the CAB01 wiring.
The container and the pressure sensor are shown in Figure 10 we can see the internal part of the aluminium casing where the differential pressure sensor is located. It is closed with an aluminium lid that seals the box completely and only the electrical connection protrudes from it.

Pressure References on the Pressure Sensor

On the pressure sensor box there are two marks: each one refers to a particular cylindrical nozzle. These two marks bear the signs "+" and "-" with reference to Positive Pressure (P1) and to Negative Pressure (P2).
These pressures are collected via the special tubes in the installation kit which converge towards the pressure difference collection points situated respectively:

P1 = “+” = MATRIX INJECTOR GROUP (11)
P2 = “-” = MANIFOLD VACUUM

“FITTING” Phase

The pressure sensor must be mounted according to the following simple precautions:

- If possible, install the pressure sensor higher than the exit union of positive pressure taken from the GAS injector.
- In a vertical position and with the pressure tubes turned downwards (figure 13) so that any impurities will not flow into the sensor collection points.

RIFERIMENTI SUL SENSORE DI PRESSIONE

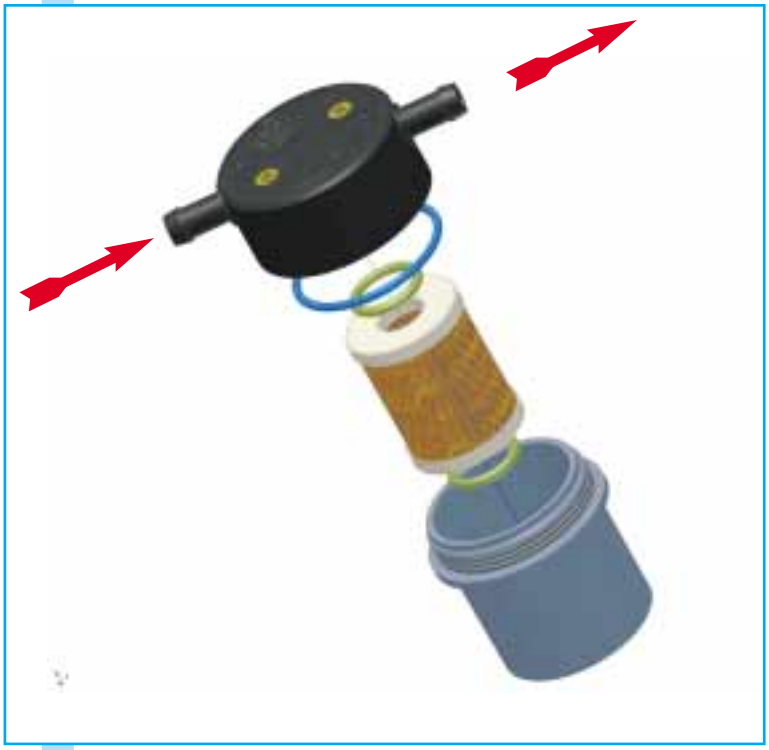
INDICATIONS: If pressure equal to zero is shown on either a PC calibration interface or on a Tester, make sure you have not accidentally swapped the entry of positive pressure with that of negative pressure.

LPG FILTER

The filter located between the LPG/METHANE reducer blocks any impurities present in LPG or METHANE fuel.
Impurities can be of various kinds and sizes,
such as the small metal fragments produced during installation of the tubes of the system or the metal residue present in the refuelling system. This simple device allows you to increase the safety margin of the GAS injector which can thus work in absolute safety.

"FITTING" PHASE

The filter does not generally need to be mounted strongly to the vehicle and does not even need to be in a position to prevent water splashes or avoid eccesive heat sources. The natural place for the filter in the system is between the LPG/METHANE reducer and gas injector rail. It is very important, however, to place the filter in a vertical position in relation to the ground whilst maintaining the upper and lower parts of the filter in their correct positions. The lower part is, in fact, formed by a cylindrical unit containing the filter element.

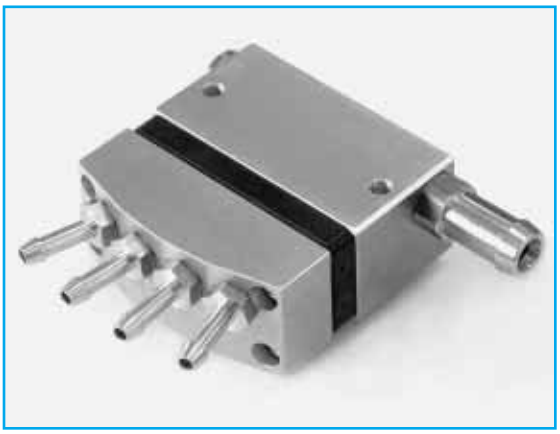


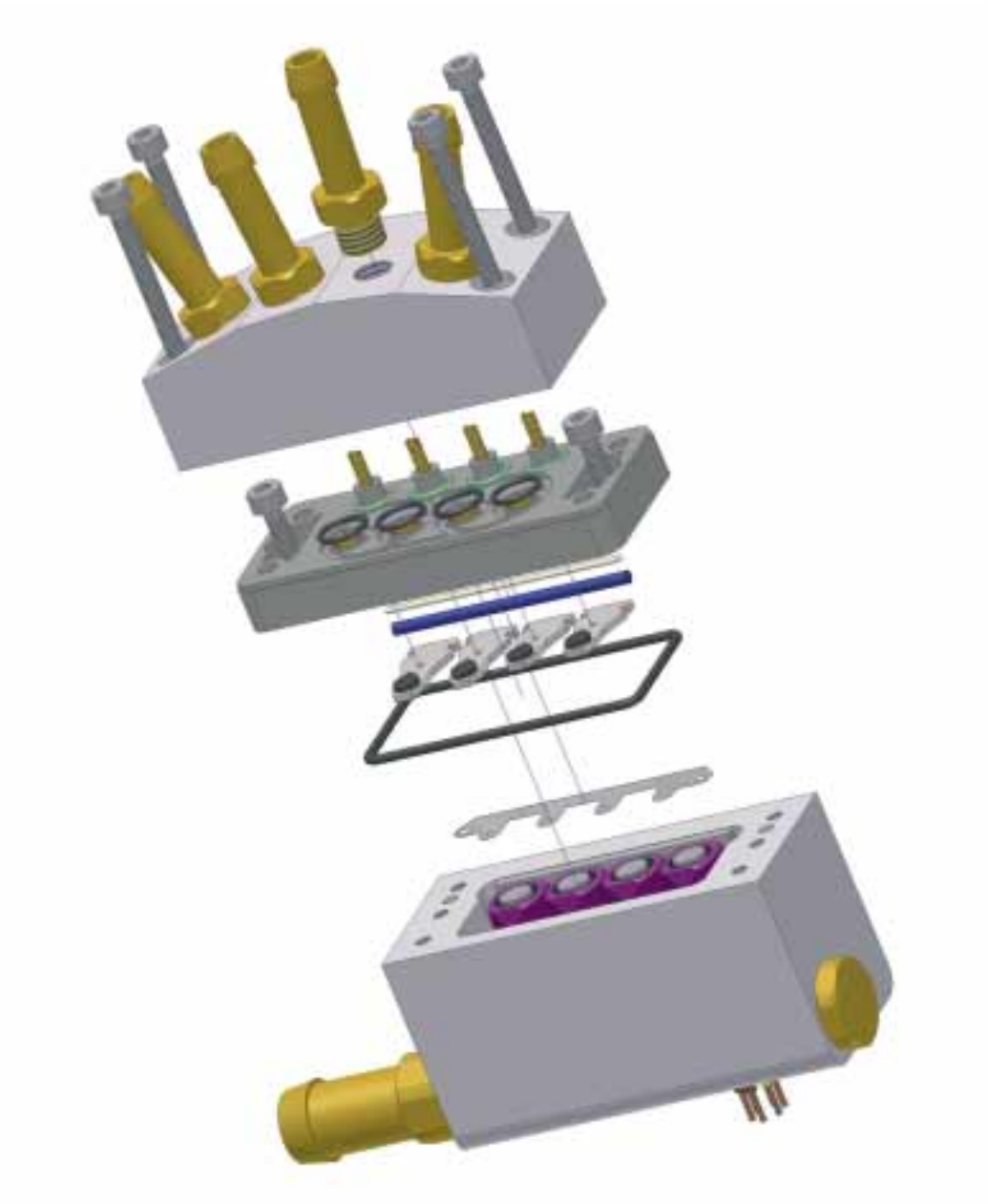
The gas enters from the upper part and flows into the lower cylindrical section which also acts also as an expansion tank The filter element withholds larger impurities while oils or gaseous residues remain deposited in the bottom of the cylindrical section. This dual action allows you: to ensure the gas is free from large elements when leaving the filter (otherwise they might damage the injector rail) and, in addition, to be sure the gas is free from oily elements or non-combustible impurities.

The references shown in the figure above indicate the direction of GAS entry. The GAS enters via the filter INPUT point and leaves the filter via the OUTPUT point and is then channeled through a specific tube towards the electronic GAS injectors.

INJECTOR GROUP

The **Injector Group** is comprised of several injectors, precisely one for each cylinder. The opening time and opening sequence of the injectors is established by the CDC which elaborates the data supplied by the original petrol ECU in real time through complex algorithms.





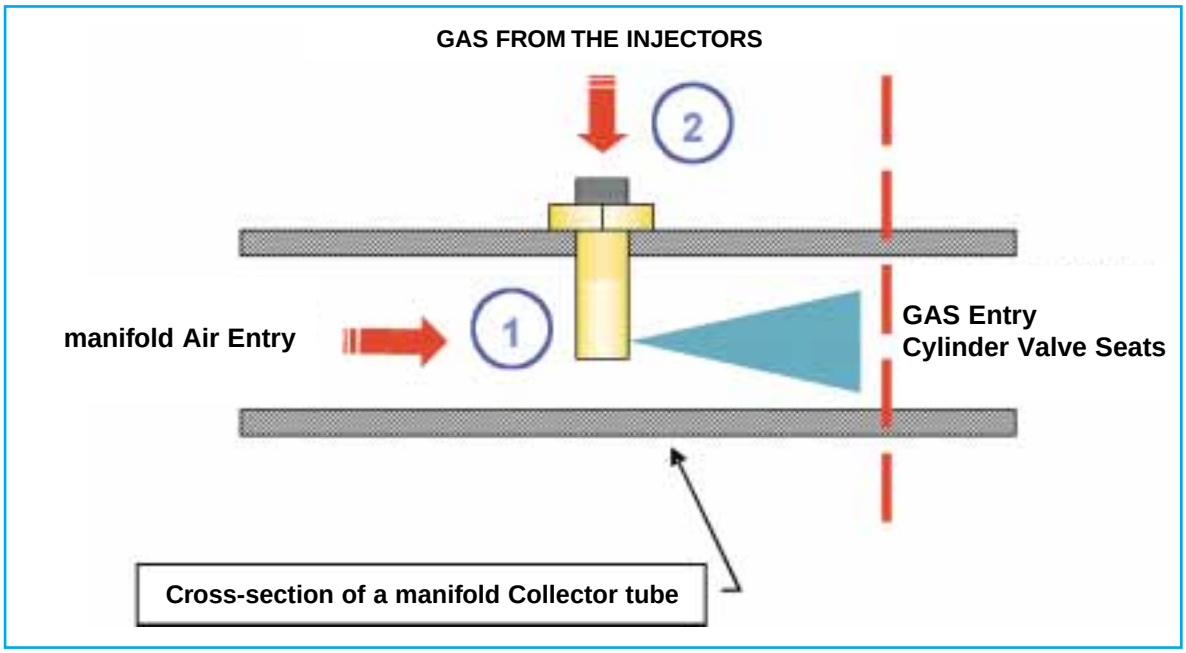
PASSIVE INJECTORS FOR INJECTION SYSTEMS

The passive injectors are special types of metal nozzles which are inserted into the plastic or aluminium manifold near the petrol injectors.
Their function is to direct the gas into the aspiration manifold as close as possible to the engine head, where the air/fuel mixture enters for combustion inside the cylinders.

The positioning of these special passive injectors is one of the most important actions in all of the installation phases of the GAS system. You must be careful where you position them in the manifold. The ideal position is this: the GAS injection point in the manifold should be as close as possible to the original position chosen for the petrol injectors. In this way, engine reactions after GAS injection are similar to or the same as those of petrol injection with the vehicle running on petrol.

You must furthermore remember that this is the main (or at least the most characteristic) difference between a gaseous LPG or METHANE injection system and a traditional LPG or METHANE system for combuston engines. The gas is, in fact, distributed through these injection ducts into the manifold in a calibrated manner.
The fuel is mixed with air in a measured way via the entry dynamics in the manifold and on the basis of the timing required by the original injection system of the vehicle.
In a traditional system the manifold is instead filled continuously and exhaustively with GAS via an entry placed upstream and generally a long way away from the valve entry. Saturation of the aspiration tubes of the manifold with combustion material is therefore unavoidable and favours backfiring in the manifold, causing serious damage to the manifold especially if this is made of plastic.

In figure (X) we can see a diagram representing a cross-section of a hypothetical aspiration collector of a traditional injection engine in which we installed passive injectors in the most appropriate place.
The choice of injector position is extremely important and, in any case, their correct positioning not only optimizies system performance but also reduces to a minimum possible complications in the e-G@S Injection KIT installation phase.



- Find the thickest zones of the walls and as close as possible to the point of petrol injection in plastic or aluminium manifolds. The arrangement of the passive M6 injectors is extremely important both on a technical and functional level. Once you've identified the point in which you want to drill, be careful that the piercing operation does not damage the original fittings of the vehicle, for example the moving parts or the original petrol injectors of the vehicle.

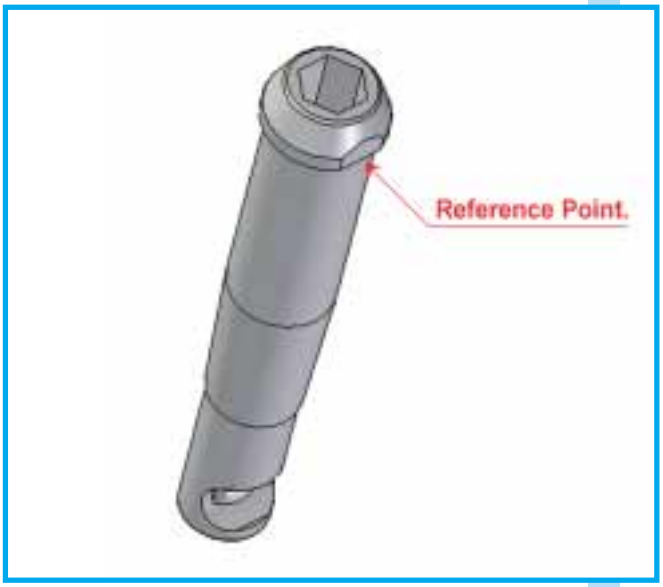
- Identify the point you want to drill for each GAS injector and drill in the place you've chosen with a Ø 5 mm drill applying a light layer of grease on the tip before the operation. This way the shavings formed when drilling are gathered by the grease on the tip of the drill bit and are not dispersed inside the manifold.

- Thread the hole made in the previous point with a 6MA tap and after cleaning shavings or residue away from the hole insert the passive injector. During the insertion phase pay attention to the direction of the passive injectors abd be sure that the direction of gas exit coincides with the injection direction of the original petrol injectors. A small notch on the rim of the passive injector makes it easy to identify the exact position of the gas exit hole.

- Be careful of the possible shavings produced in the previous points when piercing and threading. In fact, if these accumulate inside the manifold they could damage the engine. Attention: to get round this problem we recommend using some grease on the tip and frequently removing the shavings in both threading and piercing phases.

- Screw in the passive injectors and make sure you use a thread-blocking products. Use a 3.5 mm allen key and insert it into the top of the passive injectors.

- Be very carfeul that the exit hole of the passive injectors is aligned exactly towards the inlet valves (see figure below).



LAMBDA PROBE CONNECTION

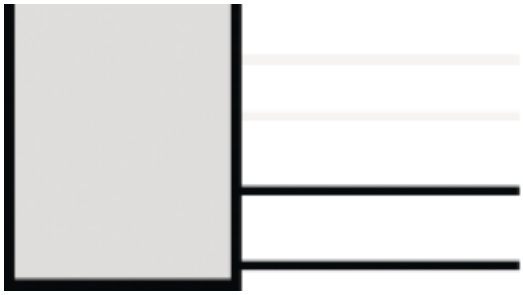
We must make clear that connecting the lambda probe to the SLY-INJECTION system is merely an “OPTIONAL” operation and is not required for correct running of vehicles powered by GAS or METHANE

The reason for attaching it to the system via the special yellow cable in the wiring (see document “Electrical Installation Manual” pin_22 pages 4 & 5) lies in the fact that it is often useful to observe the dynamic behaviour of the LAMBDA with the special PC or terminal interface. both during calibration and while running on the road.

Now we’ll briefly illustrate the two most common connectors that are currently installed in vehicles, independently of their form or of the connector colour:

3 PIN CONNECTOR:

Attach the black wire “LAMBDA signal” of the connector to the yellow cable in the wiring (see document “Electrical Installation Manual” pin_22 pages 4 & 5).



4 PIN CONNECTOR:

The 4-pin connector is a connector (as shown above) and the LAMBDA signal wire can be of three different colours, depending on the manufacturer of the vehicle. In any case (indepedently of the colour), as long as it is the right one, this is the terminal that needs to be connected to the yellow cable in the wiring (see document “Electrical Installation Manual” pin_22 pages 4 & 5).

BE CAREFUL! **The yellow wire must be attached to the wire of the original connector of the vehicle without interrupting the electrical continuity of the vehicle’s original wire: you simply need to pick up the signal without interrupting it. In this way there is still a signal return towards the original ECU of the vehicle and does not compromise ECU functioning.**

CALIBRATION OF THE E-G@S SLY-INJECTION.

Calibration of the vehicle is performed via a special graphical user interface for PC. The calibration program is installed with the installation disk that can be ordered from your local SLY-Injection system distributor.
Insert the CD-ROM of the program and the installation automatically begins, according to the model of PC you have, within a few seconds and a simple guided operation will help you to complete the operation requested.
During the installation phase it is possible to choose between two guide languages for the wizard that helps you to complete all of the operations.
Once you have installed the program, there are several communication languages available inside that will definitively personalize the installation of the program in your PC.

CALIBRATING a vehicle requires only five simple steps that we will describe (in order) during the following pages.
Refer to the software installed on your PC and carefully follow all the phases described afterwards. Be careful! During the execution of the first three steps (steps one to three), it is of vital importance that the vehicle is running on petrol with only the red light lit on the commutator.

Step 1: *Calibration of the engine revs (RPM).*

Step 2: *Calibration of the maximum injection times of the engine of the vehicle.*

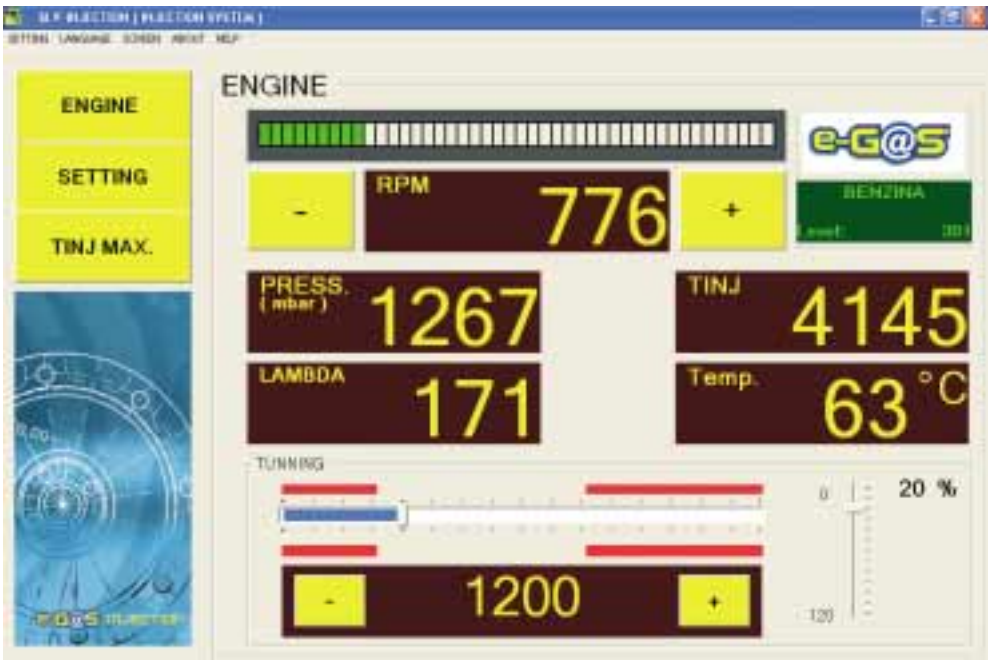
Step 3: *Choice of the fuel installed in the vehicle from the setup (ADVANCED), be it LPG or Methane.*

Step 4: *Calibration of the GAS/PETROL conversion constant of the vehicle.*

Step 5: *Calibration of the transitions of the GAS vehicle.*

It is important for the calibration of the vehicle that from **Step 1** to **Step 3** the vehicle is running on PETROL.

Figure 1:
"Engine" Screen .



Step 1: CALIBRATION OF THE RPM

In the “Engine” interface which is opened when the program starts or by pressing the MOTORE button situated in the top left in the program, the engine data of the vehicle, such as the GAS pressure, injection time of the injectors, the temperature of the reducer, the level of fuel etc. etc. is visualized. A representation of the graphics of the window “Engine” can be found in **Figure 1**:

In the “Engine” interface which is opened when the program starts or by pressing the MOTORE button situated in the top left in the program, the engine data of the vehicle, such as the GAS pressure, injection time of the injectors, the temperature of the reducer, the level of fuel etc. etc. is visualized. A representation of the graphics of the window “Engine” can be found in **Figure 2:**

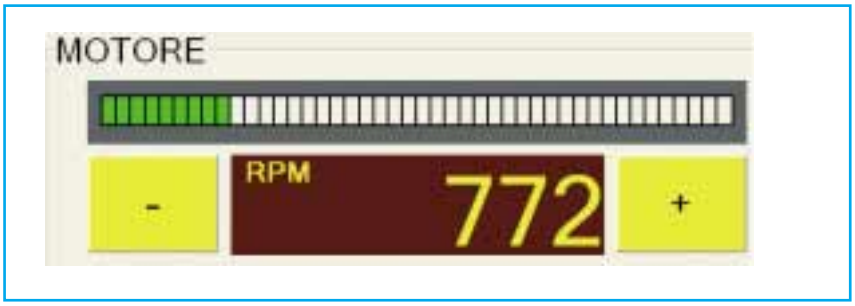


Figure 2: RPM ENGINE

During the first moments of operation of the vehicle (around ten seconds), the system evaluates if the engine RPM must be reconstructed from the “brown” wire of the general electrical wiring or if it has to be reconstructed from the injection time of the vehicle.
If, in fact, the brown wire has been connected to a useful RPM signal such as the signal from the coils of the vehicle or from the petrol ECU, through a special pin, then the software will automatically reconstruct the signal from such a connection. Otherwise it will use the information from the injection signal.

***Attention:* Be careful: if you decide not to use the” brown” wire at the end of the electrical installation, cut the brown wire near the large 56-pin connector in the general wiring.**

Suggestion:
Often in modern vehicles there is no reference for engine RPM in the dashboard of the vehicle so idle speed of the engine visualized in the interface should be around a value between 700 and 900 RPM. If the dashboard features an indicator for engine RPM, you need only bring this value in line with the revs indicated on the calibration interface.

Step 2: CALIBRATION OF THE MAXIMUM INJECTION TIMES OF THE ENGINE OF THE VEHICLE.

From the window “ACQUISITION OF INJECTION TIMES” that it is displayed by pressing the yellow button TINJ MAX in the top left, you gain access to the calibration of maximum injection times. This operation allows you to understand the type of injection of the car you are working on: the base algorithm, in fact, is modified according to the different type of injection.
The base algorithm takes on a different configuration on the basis of the engine injection type: FULL GROUP, SEMISEQUENTIAL or Sequential.

In this way, the algorithm is able to gain an optimal result from the existing engine configuration.

***Attention:* the button will flash alternatively between yellow and red until this phase of calibration has been performed. Once the maximum time has been ascertained and you press the “Save” key, the button will stop flashing and will remain yellow.**

The screen you see after pressing the TINJ. Max ' is the following:

Figure 3:
Maximum Injection Time

Once you enter the “TINJ. Max” screen you will see two text boxes with black backgrounds: in the first one (top) the instant injection time (TINJ box), while in the one underneath (MAX box) the maximum injection time is memorized at any given time (See Figure 3).
Gently accelerating the engine with the accelerator pedal, you can note how the maximum injection time of the vehicle is memorized in the MAX box.
The system of acquisition allows you, with a low margin of error, to obtain the maximum time even after a single rapid acceleration, or with the vehicle on the road; the same result can be obtained starting from low rpm with the vehicle in motion and accelerating heavily.

Once it has obtained the maximum injection time press the button "Save" to memorize the result in the ECU. If you don’t wish to save the result in the MAX box, you need only press the key "CLOSE" to close the current window and return to calibration (ENGINE) without having saved any data
The "RESET" key allows you only to reset the value in the MAX box, but not the value present in the ECU. This key can be used to recheck the calculation of maximum injection time several times, afterwards pressing the key "Save" to memorize it.

***Attention:* pressing the "Save" key saves the value and closes the program window.**

Step 3: CHOICE OF FUEL FROM SETTINGS (ADVANCED) LPG OR METHANE.

From the program window “Settings”, which you open by pressing button located in the top left, you pass onto the interface represented in Figure 4: System Settings. Figure 4:

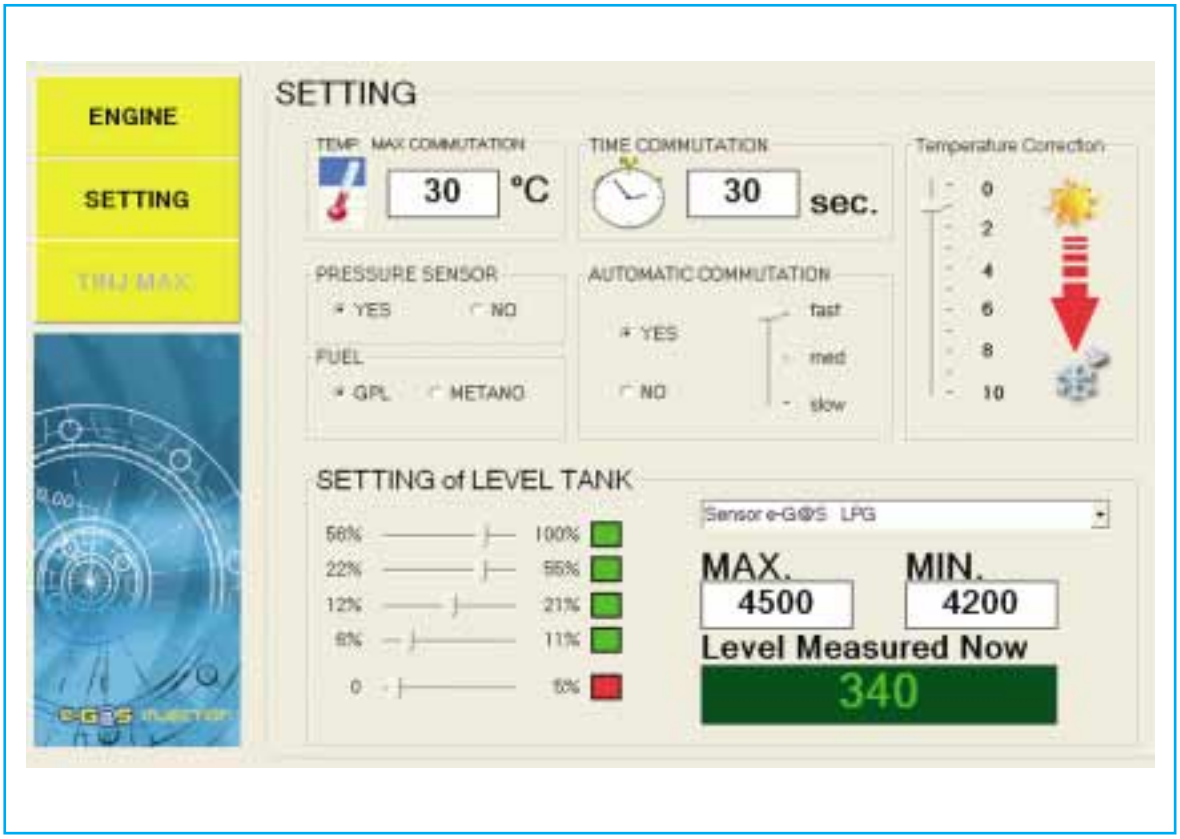


Figure 4: System Settings.

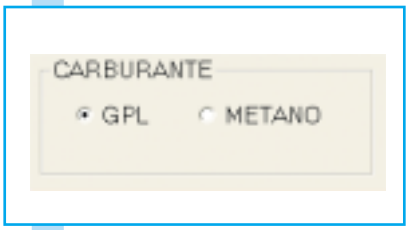


Figure 5: Fuel Type.

In the central part of this interface there is a section that allows you to select the type of fuel (default value LPG); with a simple click you can, in fact, select LPG or Methane fuel as you wish.
The algorithm of the SLY-Injection system allows you to get good performance by selecting the right fuel. Wrong fuel selection with respect to the vehicle’s correct fuel will not allow you to optimize the system.

Step 4: CALIBRATION OF THE GAS / PETROL CONVERSION CONSTANT OF THE VEHICLE.

Step four represents a fundamental step in calibrating the vehicle. It is extremely important to read the following paragraph carefully. Within its lines we can find many concepts of primary importance and also a description of the most efficient technique for setting the vehicle.
Before starting calibration it is important to set the system to petrol operation, then visualize the following section located at the bottom (see Figure 6) of the “**ENGINE**” interface (see Figure 1).

The calibration window, as you can see here on the left, features two keys: the and keys respectively allow you to increase and to decrease the calibration constant by 100 points with every keys stroke. In this case the value of the calibration constant is 1200.

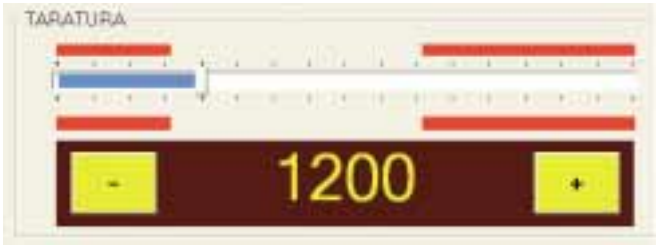


Figure 6: Calibration SLY-INJECTION System.

1) Put the vehicle in PETROL mode: wait a few minutes for the engine to reach stable idle speed and until it has reached operating conditions. "Regimate" is the mechanical term that indicates optimal engine temperature and that the injection time of the vehicle, as well as the engine RPM, are stable. You should also wait until the temperature of the reducer has reached at least 50°C.

2) Run the engine at idle speed: turn off all engine loads: Air conditioning, lights... this, in fact, makes the comparison between injection time GAS/PETROL easier.

3) Mentally **Memorize** the PETROL injection time in these conditions.

4) Commute to GAS: to perform commutation you need only press the space bar of the computer once and the system will commute directly to GAS, or use the commutator by pressing the special key on its surface. After pressing the key on the commutator green LEDs will begin flashing. When there are three flashing green LEDs, accelerate and decelerate and the system commutes, and in the top right of the screen of the computer, “LPG” or “METHANE” will appear to point out that commutation has occurred. **Engine at idle speed**.

5) Check the Gas injection time of the vehicle and act accordingly by setting the calibration. If the vehicle, once commuted to GAS, is running "LEAN" and therefore the injection time is greater than that which was memorized for “Petrol” under the same load conditions (without electro-fan or sudden loads), you need to increase the calibration constant using the + key or if it is too rich press the - key. We recommended initially using the "+" and "- " keys that allow rapid variations of 100 points with every keystroke and then the joystick of your keyboard with the directional arrows for more precise variations. It is advisable read the lines of Chart 1 carefully so you can understand how to move the constant calibration with respect to “lean” or “rich” conditions noted during calibration. You should use a rapid commutation between GAS and PETROL and vice versa to check the injection time. For this operation use the space bar of your PC.

REFERENCE CHART:

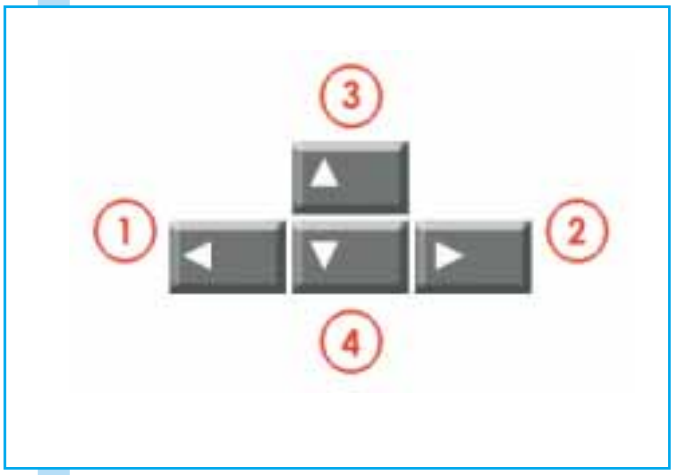
(Time GAS) < (Time Petrol)	**RICH** Engine	Decrease the Constant
(Time GAS) > (Time Petrol)	**LEAN** Engine	Increase the Constant

Table 1: Reference Injection Time for the Tuning.

Optimal calibration of the system is obtained when, in any condition of operation, the injection time of the vehicle during GAS operation is equal to the injection time during PETROL operation.
To obtain equivalence you must adjust the calibration constant by increasing or decreasing, with the more or less keys, when the vehicle is running on GAS, or by using the joystick of your PC's keyboard (the use of which is described in Figure 6).

Latest generation tools such as a practical tester EOBD can be used as a test of effective calibration. With this tool you are able, in fact, to verify the auto-adaptive changes in the vehicle and compare the reactions of GAS and PETROL operation so that their variations are similar.
Commute several times between GAS and PETROL and vice versa for accurate calibration, checking the correspondence of the injection time between GAS and PETROL and regulating the calibration constant with the methods already described.

HOW TO USE THE JOISTICK INTERFACE ON YOUR COMPUTER FOR THE TUNING.



The joystick of a keyboard of a laptop computer or otherwise usually has the form shown on the left in Figure 7.
The joystick used together with the SLY-Injection system during visualization of the "ENGINE" window (see Figure 1) allows you to finely calibrate the system using the keys 1 and 2. These keys allow you to increase or to decrease the calibration constant by more or less 10 points every time a key is pressed.

Figure 7: Joistick Calibration.

Step 5: CALIBRATION OF THE TRANSITIONS OF THE GAS VEHICLE.

With the SLY-Injection system it is possible to set the transitions in terms of engine response through the use of the vertical slide shown in Figure 8.
It is expressed in percentage terms and a higher percentage corresponds to an attenuation in terms of supply of the gaseous fuel

Figure 8: Attenuation SLY-INJECTION.

This parameter is useful to improve the response of the vehicle to an abrupt acceleration when the vehicle is on the road. Changing the value of the vertical on the right of the calibration interface allows you to increase the attenuation of the response of the GAS injectors to a value of 120% and to a minimum of 0%.
In fact, the more you increase this value, the lower the gas you supply in the transitions and only in these. Use the 3 and 4 keys of the joystick keyboard and the attenuation will move by 5 points at a time, respectively more and less.

As a rule you should note that this variable can easily be configured with the vehicle on the road by pressing the accelerator hard, starting from low revs.
The optimal value cannot be found in automatic mode: an operator that continually observes the lambda and the “drivability” of the vehicle or uses an EOBD tester will discover the optimal value.
Be careful of all vehicles: in case of an abrupt acceleration they normally react with a “RICH” lambda, so do not set the vehicle excessively lean with this parameter in such conditions.

LPG	**0% - 20%**
METHANE	**40% - 60%**

ENGINE PARAMETRS INTERFACE

GAS pressure in the system:

This useful viewer allows you to monitor the pressure of the system both when the vehicle runs on GAS and when the vehicle runs on PETROL.

Be Carefull:
You have the possibility of disabling the pressure sensor if this has not been inserted in the system as it is an optional. It is removed via the software interface in the section "SETTINGS" with the appropriate button. Once the modification has taken place four lines appear on the interface "----".

Engine Injection time:

This viewer allows you to monitor the injection time of the vehicle in all operating conditions. Its value is expressed in micro-seconds.

Engine Lambda Signal:

This viewer allows you to monitor the changes in the lambda signal, obviously only if it is connected to the system via the special wire. If it is not connected, its value will be zero.

Be Carefull:
Pleas also remember that the connection of the lambda to the vehicle influences neither the calibration nor the operation of the vehicle. It is a connection that facilitates the operator in certain calibration conditions.

Reducer Body Temperature:

This viewer allows you to monitor the temperature of the reducer body via a special thermal probe inserted into the body. The measurement is shown in degrees centigrade.

Level Signal Sensor placed on the Tank:

This viewer allows you to monitor the signal level in mVolts supplied by the level sensor on the tank. This indication supplies a value for sensor level as well as maximum and minimum level.

INTERFACE SETTING PARAMETERS

MAXIMUM COMMUTATION TEMPERATURE

The commutation temperature of the engine indicates the temperature that the system has to reach before being able to commute to GAS. temperature of commutation is set.
The temperature is measured by the special sensor on the reducer. With a double click on the white window, which displays commutation temperature, you can insert a numerical value with the keyboard. If you press the ENTER key on the keyboard the

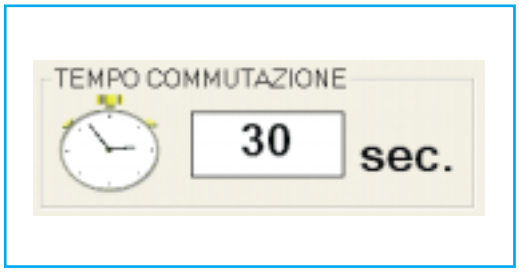
Default Value: 30°C.

INSERTING A VALUE:

With a double click of the left button of the mouse in the white window with the actual temperature value, the background will assume a red color. It will then be possible, via the keyboard, to insert the desired numerical value.
Once the value has been inserted press the “ENTER” button on the keyboard to confirm the insertion.

SWTCH TIME:

Varying this value it is possible to preset the number of seconds that must pass after starting before the vehicle commutes to GAS. Naturally, if in waiting for commutation temperature (see preceding point), the time indicated has already gone by, the system does not wait any longer.



Default Value: 30 s.

INSERTING A VALUE:

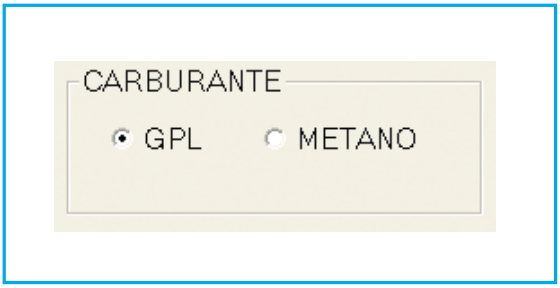
With a double click of the left button of the mouse in the white window with the value in seconds, the background will assume a red color. It will then be possible, via the keyboard, to insert the desired numerical value.
Once the value has been inserted press the “ENTER” button on the keyboard to confirm the insertion.

PRESSURE SENSOR

If you have just installed the system and have also inserted the pressure sensor (optional) then you will have to enable this window and select “**YES**”; otherwise select “**NO**”.

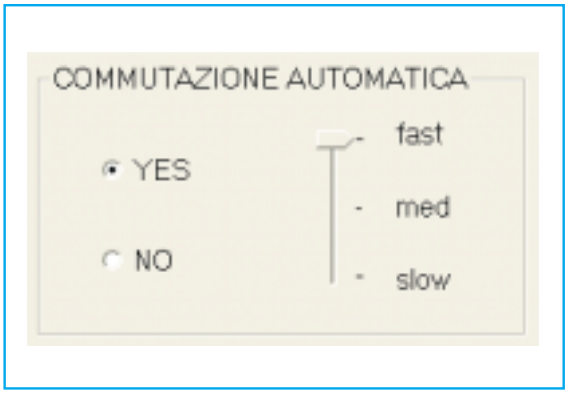
Default Value: YES.

FUEL TYPE



This option allows you to select the right type of fuel for your installation.
Obviously, if you are using METHANE fuel, select the METHANE option. Otherwise select LPG.

AUTOMATIC COMMUTATION OPTION

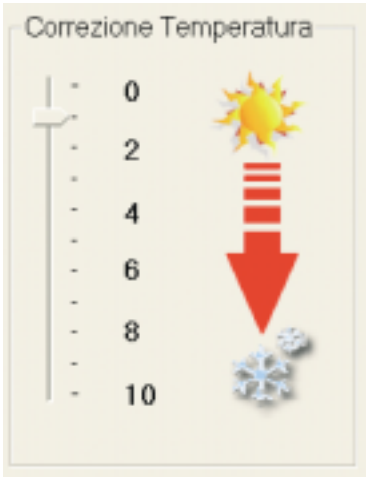


With this option you can make your system automatically commutate to PETROL when the GAS tanks is empty. Successful commutation is signaled on the commutator by a fixed red light and another flashing red one.

Obviously you select “YES” if you wish to activate this option. Otherwise select “NO” if you do not want automatic commutation.

It is advisable for vehicles with generation Euro3 and Euro4 engines to select this option, so as not to degrade the original petrol system in case of lack of fuel. The vehicle in such conditions, in fact, would run “LEAN.”
We also suggest, if you select the automatic commutation option, to activate the FAST position to guarantee that the system commutates immediately as soon as there is a lack of fuel in the tank.

TEMPERATURE CORRECTION



It is well known that in the first moments of operation of GAS vehicles (in particular when running on METHANE) engines tend to have a richer carburetion until the temperature of the reducer reaches optimal conditions and can guarantee a correct gasification of the GAS.

- 0 to set up no temperature correction.

- Default Value: 2

The configuration of the LEDs on the commutator and of the maximum/minimum levels acquired by the indicator located on the tank deserve particular attention.
The e-G@S system works both with powered and non-powered indicators, both with direct indicators and inverted ones. As is logical and obvious from the panel "Actual Level", the fuel level in the tank is measured at the same time, whilst in the panels "MAX" and "MIN" respectively display the maximum and minimum levels of the indicator for the particular indicator chosen.
The picture also indicates, next to each LED (red or green), the percentage of fuel in the tank relative to the lit LED.

Example:
When the tank is full then there are four green lights on the commutator, and when the level goes down under 56%, the fourth light on the commutator turns off leaving three green lights on to show that the level of fuel present in the tank is equal to 56% of the total capacity. In turn, the third light in the commutator stays on until the level goes down under 22% and so on until reaching reserve.
GAS system is empty.
The reserve value indicates that total fuel is under the threshold of 5% of the total value in the tank and on the commutator you notice that the red light is intermittent in correspondence with such a situation.
To complete the configuration of the tank we need to set the maximum and minimum values of the level of the tank that can (as all technicians know) vary from model to model and also for models of the same type. The electrical signals of maximum and minimum are not always equal.
To avoid this problem e-G@S has implemented a software package that is "auto-learning": it is able to acquire, during operation of the vehicle, the maximum level pointed out by the tank sensor and also the minimum, respectively at the first full tank and the first time the
During the life of the vehicle, at the first empty tank and the first full tank, the system auto-configures itself according to the optimal values.

Manual Setup of max and min values:
To set up the values, obviously, after having clicked with your mouse on the white window of min. or max., the background will take on a red color and it will be possible via the keyboard to insert the desired numerical value. Once the value has been inserted press the "ENTER" button on the keyboard to confirm the insertion.

APPENDIX 1

LevelSensor Setting (LPG or METHANE):

The level sensor both for LPG and METHANE must be regulated after having installed the system. This operation allows you to visualize correct information regarding the quantity of fuel contained in the tank on the commutator located inside the vehicle.

REGULATING MINIMUM AND MAXIMUM MANUALLY:

Figure 1: Eletrical sensor level.

Turn on the vehicle and switch it to either PETROL or GAS. Open the software interface of the program and go to the ENGINE PAGE from which you can read the pressure, engine revs and injection time.
In this interface “ENGINE” is in the top right of the screen of your computer and from this you can read, at any time, the electrical value generated by the level indicator ‘**LEVEL**’ at that time. This level indicates how much fuel is contained in the tank electrically. Following this, when necessary, you will be asked to observe this value and memorize it, associating it each time with the maximum and minimum values given later.

MINIMUM

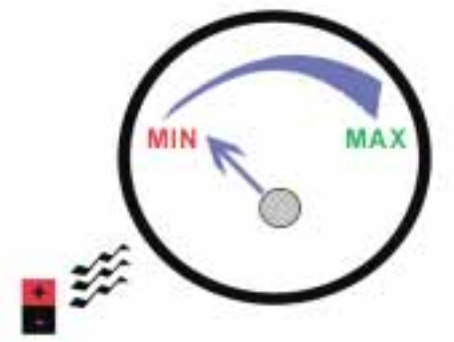


Figure 2: MINIMUM Value

Place a magnetic object (a normal magnet) above the indicator on the tank. Move the dial of the indicator using the effect of the magnet until it reaches the MINIMUM value in Figure 2. At this point observe the electrical value in the top right of the LEVEL indication with your computer’s software interface turned on.

Either mentally memorize this value or write it on a piece of paper. This will be the electrical **MINIMUM** value of your indicator for the particular type of multivalve installed.

MAXIMUM

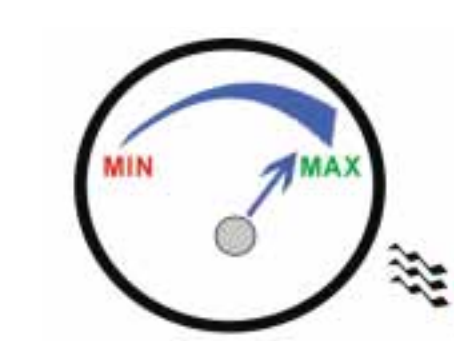


Figure 3: MAXIMUM Value

Place a magnetic object (a normal magnet) above the indicator on the tank. Move the hand of the indicator using the effect of the magnet until it reaches the MAXIMUM value. See Figure 3: MAXIMUM value.
At this point observe the electrical value in the top right of the LEVEL indication with your computer’s software interface on (see Figure 1).

Either mentally memorize this value or write it on a piece of paper. This will be the electrical **MAXIMUM** value of your indicator for the particular type of multivalve installed.

Once you've obtained the minimum and maximum electrical levels insert them into the correct fields located in the software interface on the SETTINGS page.

How to set MAX and MIN levels manually:

To set the values use your computer's mouse. After clicking in the white MIN or the MAX windows with the right button of your mouse, the background will turn red and, with the help of your keyboard, you'll be able to insert the minimum and maximum electrical values found.
Once you've inserted the value press the "ENTER" button to confirm the data entry and the window will assume its original white colour.

In the diagram above we can also note, next to each LED (green or red), the percentage of fuel in the tank that these lights refer to.

Example:

When the tank is full all four green lights are lit on the commutator, and when the level is under 56% the fourth light on the commutator turns off, leaving three green lights on to indicate that the fuel level present in the tank is equal to 56% of the total capacity. In turn, the third light on the commutator stays on until the level falls under 22% and so on until it reaches reserve.
The reserve value indicates that total fuel is under the 5% threshold of tank total capacity and a red light flashes on the commutator in accordance with this situation.