

GRATEC: ALTERNATIVE FUELS DIVISION

INSTALLATION MANUAL

VERSUS GAS Premium Sequential Systems

VERSUS GAS USA

1/1/2013

This manual will guide you step by step through the installation process of your new VERSUS GAS system.



VERSUS Installation manual

Contents:

1.	INTRODUCTION - SGI THE VERSUS ECU	2
1.1.	Initial recommendations	2
1.2.	Scheme no 1: General scheme of VERSUS system installation (4 cyl. engine sample).....	3
2.	THE VERSUS ECU installation	5
2.1.	Fitting position	5
2.2.	Scheme no 2: Harness installation	6
2.2.1.	General rules.....	7
2.2.2.	Bare wires connection	7
2.2.3.	“Plug and play” connections	10
3.	Regulator installation.....	11
3.1.	Regulator selection	11
3.2.	Regulator’s fitting method	11
3.3.	Adjusting the regulator’s pressure	13
4.	FH02 CNG/LPG INJECTORS installation.....	14
4.1.	Inlet manifold nozzles installation.....	14
4.2.	GAS injector nozzles size selection	16
4.3.	GAS Injection fitting position.....	16
4.4.	GAS Injectors – GAS Inlet manifold Nozzles hoses installation	17
5.	MAP-SENSOR: vacuum and pressure measurement connection	19
5.1.	Map-sensor vacuum connection	19
5.2.	Map-sensor pressure connection.....	20
6.	TEMPERATURE SENSORS	20
7.	FILTER.....	21
8.	GAS LEVEL SENSORS installation.....	22
8.1.	LPG VERSUS 1050 LPG Level sensor installation	22
8.2.	CNG VERSUS VR-C 01 manometer (gauge) installation.....	22
9.	CHANGE OVER SWITCH display modes and buzzer installation	23
9.1.	Switch signaling modes	23
9.2.	Leak test procedure – steps.....	24
9.3.	Buzzer installation and signalization	24
10.	OTHER Diagrams.....	25
10.1.	Diagram 3: general connections for 6 cyl. engines up to 200 HP	25
10.2.	Diagram 4: general connections for 6 cyl. 200-300 HP	26
10.3.	Diagram 5: general connections for 8 cyl. engines over 300 HP	27
10.4.	Diagram 6: general connections for 4 cyl. engines with FH02 1-cyl injectors.....	28
10.5.	Diagram 7: general connections for 8 cyl. engines over 300 HP with FH02-2 injectors.....	29
10.6.	Diagram 8: general connections for 8 cyl. engines over 300 HP with FH02-1 injectors.....	30

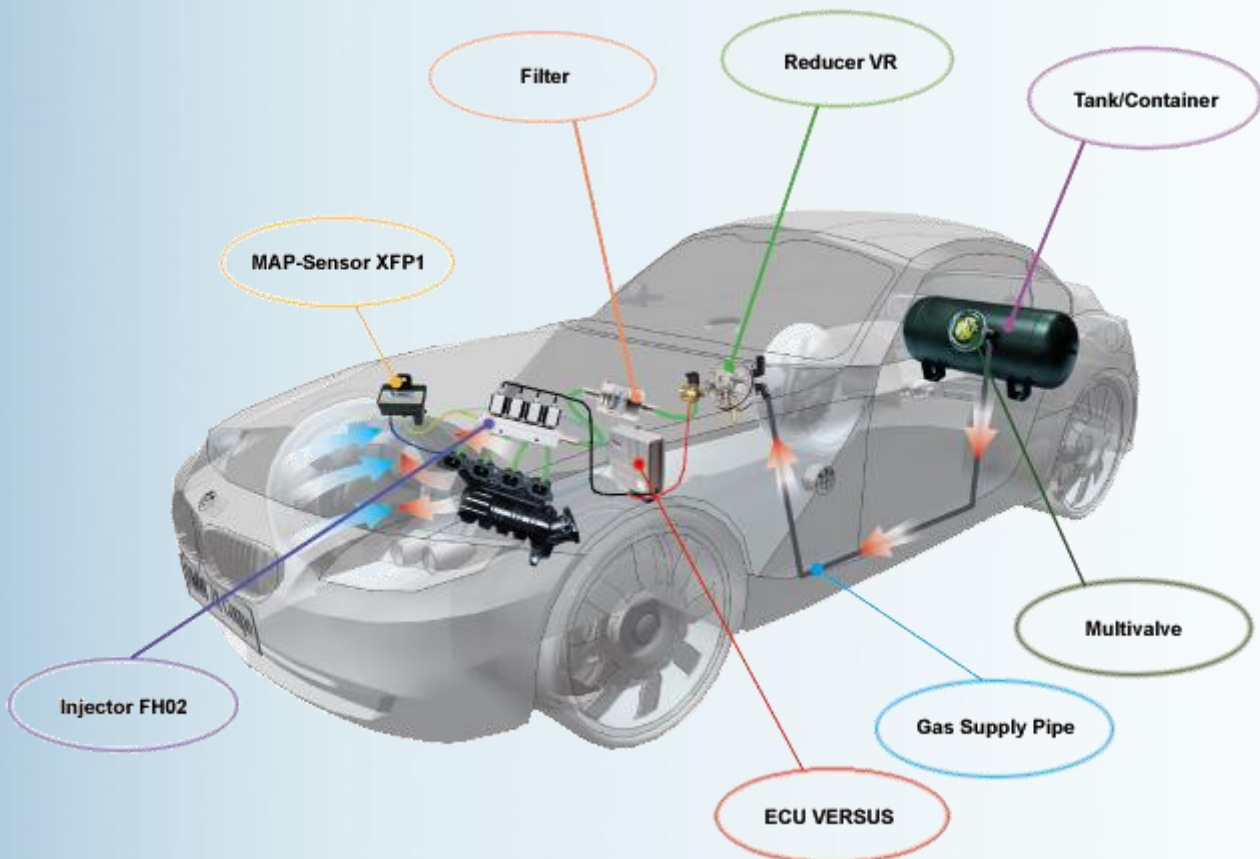
1. INTRODUCTION - SGI THE VERSUS ECU

VERSUS is a sequential injection gas conversion system designed for gasoline fuel injected vehicles supplying propane or natural gas as the primary fuel source. Thanks to its superior integration features, VERSUS guarantees high performance as well as an easy, user-friendly installation process. Versus Sequential gas system is the right solution, it represents the most advanced level of evolution for gas injection equipment. In the Versus gas system, the ECU (Electronic Control Unit) calculates the opening times of the injectors, individually required by each cylinder, it operates each gas injector separately with the highest precision and with perfect timing to the opening instant of the air intake valves. Consequently the Versus Sequential injection system delivers correct fueling requirement at the precise time for your particular vehicle.

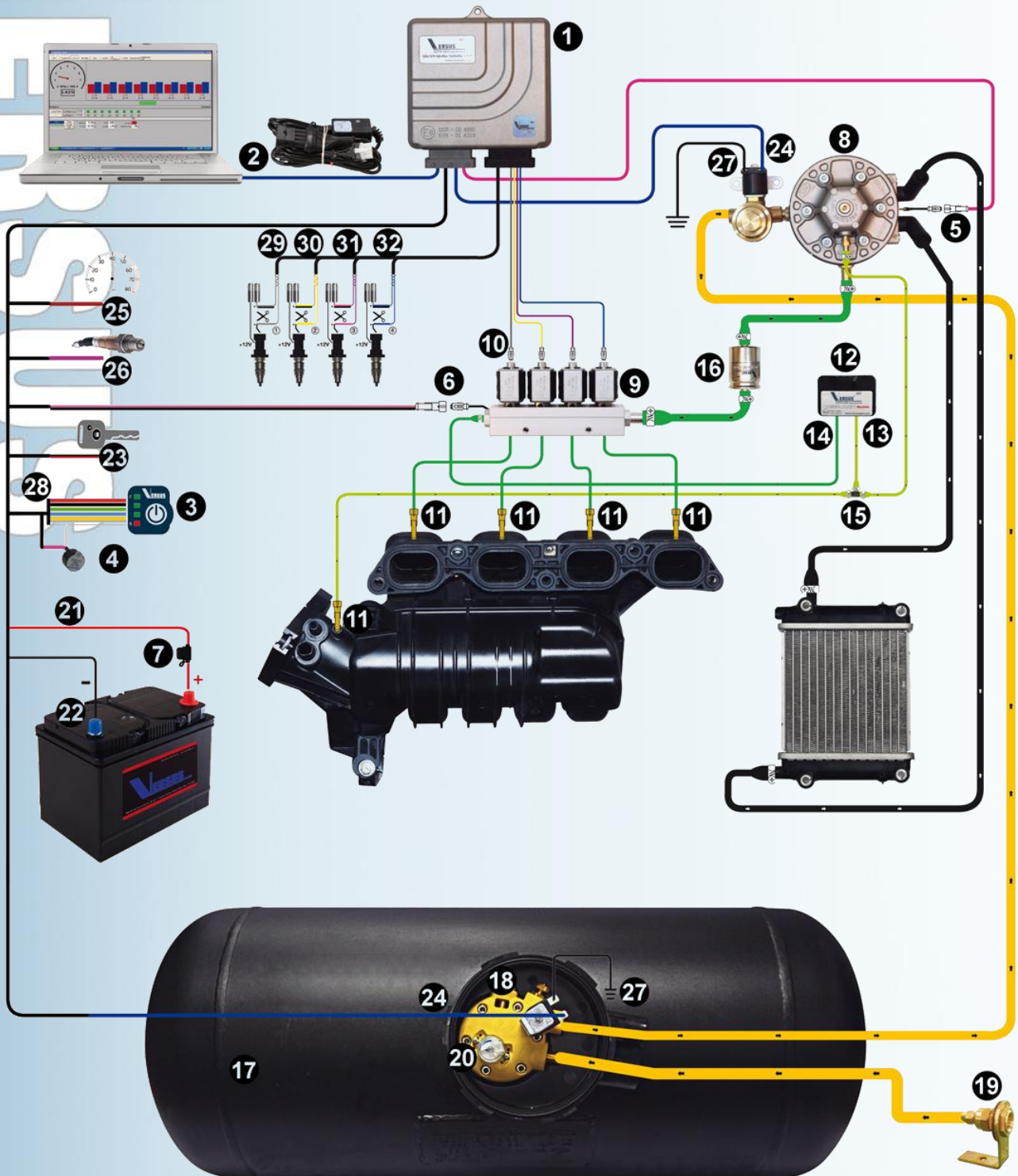
The following manual is designed to guide you through the installation process along with providing clear and detailed information about the installation of VERSUS system.

1.1. Initial recommendations

- The key to correct installation is to pre-define which type of the KIT would fit the requirements of your engine (description of the KIT can be found on the bottom of each page of the catalogues). Pay special attention in order to choose the correct reducers and injectors it is important to take into consideration engine type, capacity, and horsepower.
- Every installation should be completed by qualified personnel only. Please check with your local and state laws guaranteeing you are in compliance with all regulations.
- Before starting installation, please read this manual carefully and follow the instructions.
- Before starting the installation of the propane or natural gas conversion system in your car, first check its condition. A car with a malfunctioning engine will never function properly when running on the alternative fuel. When your vehicle is running on the alternative fuel your ignition system will need to be in good working condition. It is recommended to perform all necessary regular maintenance change prior to installation: i.e. change spark plugs.
- The latest version of software, wiring diagrams, and installation manuals are always available on the website at www.versusgasusa.com.



1.2. **Diagram 1: General diagram of VERSUS system installation (4 cyl. engine sample)**



LEGEND:

Liquid gas supply line	-	
Evaporated Gas supply line	-	
Vacuum connection	-	
Coolant connection scheme	-	

1. THE VERSUS ECU
 2. VERSUS Interface Cable USB (plug & play)
 3. Change-over Switch
 4. Horn (Buzzer)
 5. Reducer's Temperature Sensor
 6. GAS Temperature Sensor
 7. Fuse Case with Fuse 10 A inside
 8. VR-L Standard Reducer
 9. Injector FH02 type
 10. Plugs for GAS Injectors (plug & play)
 11. Inlet manifold nozzles "IM"
 12. MAP-sensor XFP01 type
 13. Map-sensor vacuum nozzle ("V" mark)
 14. Map-sensor pressure nozzle ("pressure" mark)
 15. T-fitting for Vacuum
 16. Gaseous phase Filter F1
 17. Cylindrical Tank
 18. Multivalve/valve
 19. Filling point
 20. Gas level indicator
- Harness:
21. +12V power supply wire – red wire
 22. Ground wire – black
 23. Red/black wire - +12V when ignition in "on" position
 24. Valve power supply connection – blue wire
 25. RPM signal – brown wire
 26. Lambda/oxygen sensor (violet wire) (Not Required)
 27. Ground wire for valves: multivalve and VR-L Reducer's valve
 28. Red, black, green, blue, yellow, white and pink wires in one bench – switch and horn connection
 29. Grey, grey/black set of wires – 1st cylinder (grey to the side of GASOLINE Injector, grey/black to the side of GASOLINE ECU)
 30. Yellow, yellow/black set of wires – 2nd cylinder (yellow to the side of GASOLINE Injector, yellow/black to the side of GASOLINE ECU)
 31. Violet, violet/black set of wires – 3rd cylinder (violet to the side of GASOLINE Injector, violet/black to the side of GASOLINE ECU)
 32. Blue, blue/black set of wires – 4th cylinder (blue to the side of GASOLINE Injector, blue/black to the side of GASOLINE ECU)

2. THE VERSUS ECU installation

VERSUS Sequential ECU is a sophisticated computer controlled unit which controls the entire alternative fuel system. The ECU operates by interfacing with the vehicle's gasoline ECU so performance and emissions control are maintained. The VERSUS ECU is equipped with a safety feature which cuts the natural gas supply in the event of an accident. The VERSUS ECU and software is continually being updated and should be applied during routine maintenance on your VERSUS system.

THE VERSUS ECU can be installed:

- THE VERSUS ECU "V4" (any type) - in 3,4 cylinders engines
 - ECU MINI – in 3,4 cylinders engines
 - ECU MV4 (any type) – in 3,4 cylinders engines
 - THE VERSUS ECU "V6" (any type) - in 3,4,5,6 cylinders engines
 - THE VERSUS ECU "V8" (any type) - in 3,4,5,6,8 cylinders engines
- Before beginning the wiring process, it is strongly recommended to disconnect your car battery.

2.1. Fitting position

The ECU controller should be mounted as far as possible from the sources of high temperature; such as cylinder head and exhaust manifold. Guaranteed working temperature range of the VERSUS controller is from -40 to + 125 °C. If the maximum temperature is exceeded, the controller may switch to gasoline in emergency.

Correct position of ECU fitting:

- Inside drivers cabin (picture 2a)
- In engine chamber (plug downwards- picture 2b)

Picture 2a: ECU inside vehicle



Picture 2b: ECU in engine chamber



Picture 2c: ECU incorrectly fitted



2.2. Diagram 2: Harness installation

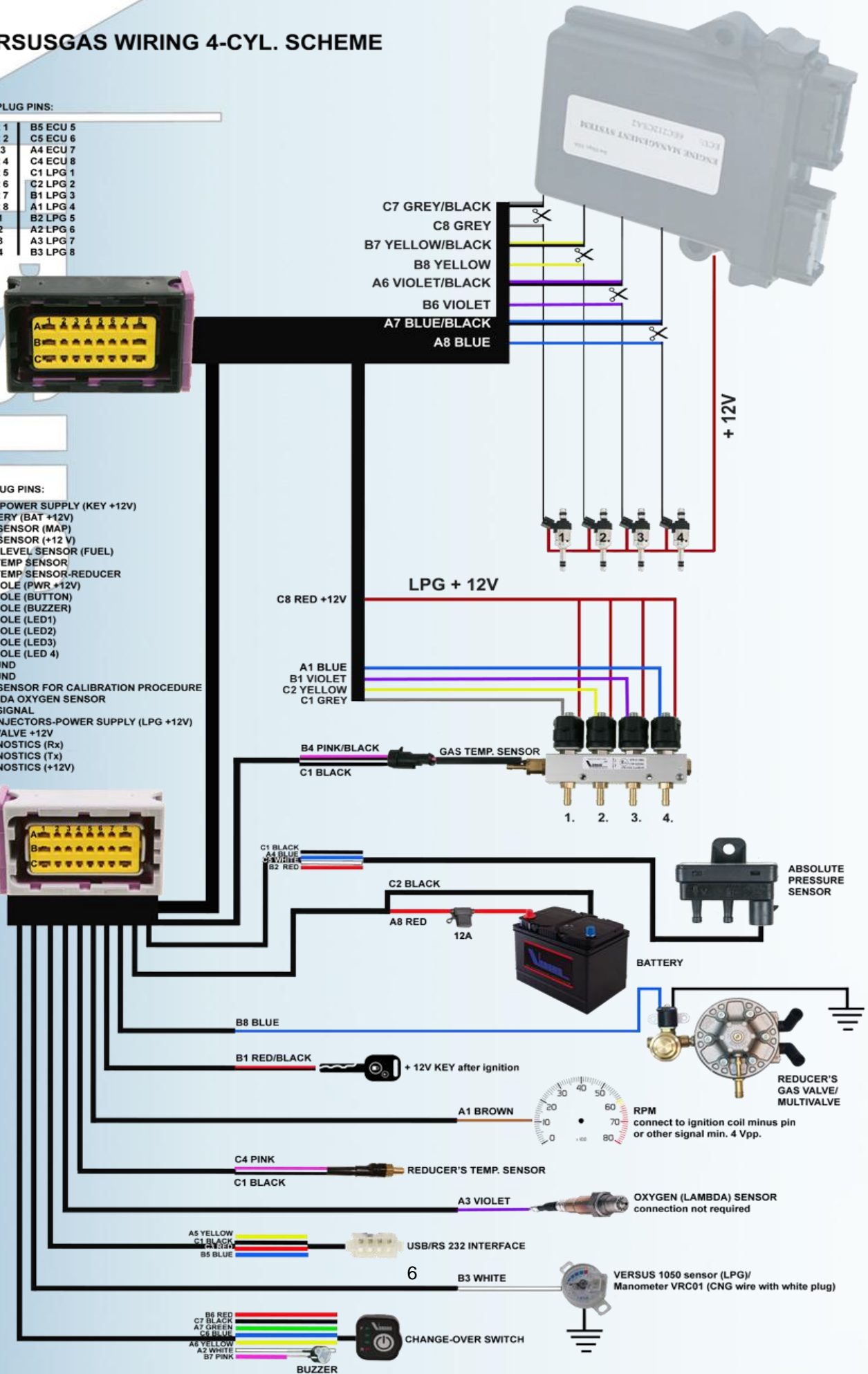
VERSUSGAS WIRING 4-CYL. SCHEME

BLACK PLUG PINS:

C8 PETR 1	B5 ECU 5
B8 PETR 2	C5 ECU 6
B6 PETR3	A4 ECU 7
A8 PETR 4	C4 ECU 8
A5 PETR 5	C1 LPG 1
C6 PETR 6	C2 LPG 2
B4 PETR 7	B1 LPG 3
C3 PETR 8	A1 LPG 4
C7 ECU 1	B2 LPG 5
B7 ECU 2	A2 LPG 6
A6 ECU 3	A3 LPG 7
A7 ECU 4	B3 LPG 8

GREY PLUG PINS:

B1 MAIN POWER SUPPLY (KEY +12V)
A8 BATTERY (BAT +12V)
A4 MAP-SENSOR (MAP)
B2 MAP-SENSOR (+12 V)
B3 FUEL LEVEL SENSOR (FUEL)
B4 LPG TEMP SENSOR
C4 LPG TEMP SENSOR-REDUCER
A2 CONSOLE (PWR +12V)
C7 CONSOLE (BUTTON)
B7 CONSOLE (BUZZER)
A7 CONSOLE (LED1)
C6 CONSOLE (LED2)
A6 CONSOLE (LED3)
B6 CONSOLE (LED 4)
C1 GROUND
C2 GROUND
C5 MAP-SENSOR FOR CALIBRATION PROCEDURE
A3 LAMBDA OXYGEN SENSOR
A1 RPM SIGNAL
C8 LPG INJECTORS-POWER SUPPLY (LPG +12V)
B8 LPG VALVE +12V
A5 DIAGNOSTICS (Rx)
B5 DIAGNOSTICS (Tx)
C3 DIAGNOSTICS (+12V)

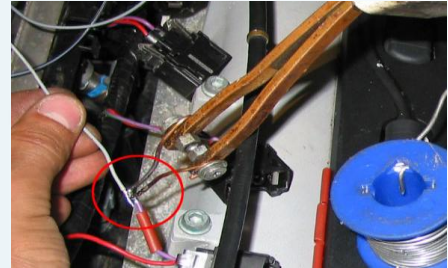


2.2.1. General rules

- Connecting the harness wires should be performed when the VERSUS ECU controller main plugs are disconnected.
- Black wire (negative/ground) should be connected first.
- All connections that are not “plug and play” have to be properly connected, soldered and then the connections are to be properly insulated.
- Avoid putting the VERSUS ECU controller harness wires next to high voltage wires and/or ignition coil.
- Mounting the VERSUS ECU controller wires next to high temperature sources should also be avoided.

All bare wires coming from the VERSUS ECU harness have to be soldered (picture 2d).

Picture 2d: wires soldering



After soldering all wires must be insulated (picture 2e).

Picture 2e: wires insulated



Picture 2f: incorrect wire fitting

Incorrect wiring method – wires not soldered or not insulated (picture 2f).

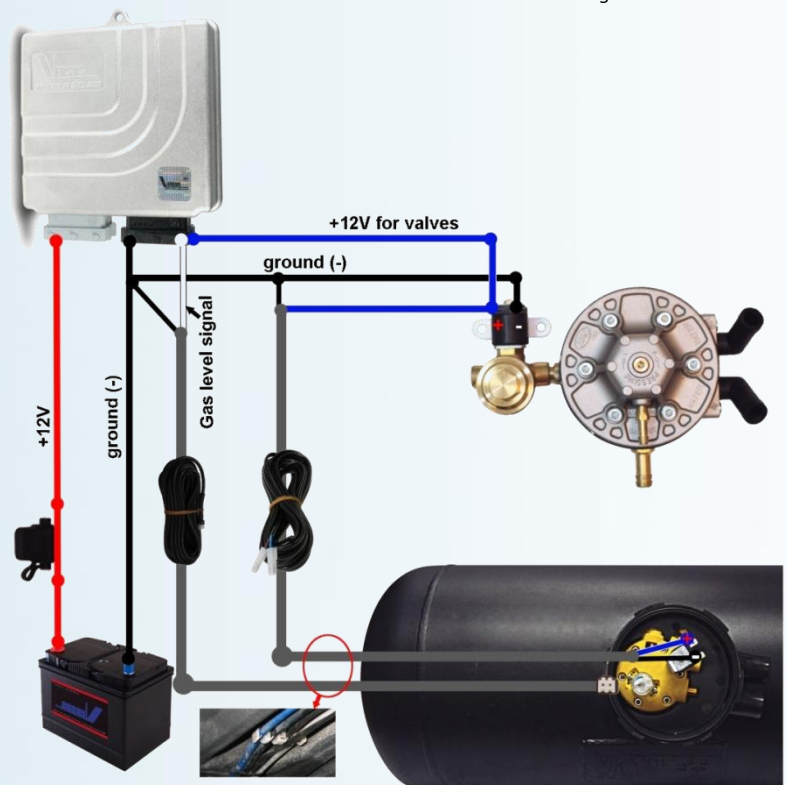


Picture 2g: black wire

2.2.2. Bare wires connection

Black wire should be connected to the negative pole of the battery or chassis grounding point (picture 2g). The ground wires of all the CNG or LPG tank solenoid valves and gauge level sensor are also recommended to be connected to the negative pole of the battery or the black wire of the VERSUS ECU harness (see picture 2g).

It is also reminded that in accordance with applicable regulations (ECE) all electrical connections must NOT be connected to the metal parts that are in contact with propane or natural gas component. The ground connection cannot be connected to the following: the body of the reducer, tank valve, CNG/ LPG solenoid valve, or high pressure supply line. The ground connections should be made with cables connected together and permanently connected in one place to the chassis or negative pole of the battery.



Red wire must be connected to the positive pole of the battery (picture 2g). If the battery is not in the engine compartment, a point at which a constant voltage of 12 V, with a current capacity of at least 10A, should be selected. The rule is to connect to a thicker wire in the car than the wire on the VERSUS ECU controller harness. The cable must be protected by a fuse included in the kit. Failure to install the fuse may cause damage to the controller, and can cause a fire in extreme cases.

Blue wire signal opens the solenoid valves located on the CNG/ LPG tank and the reducer(s) (picture 2g). When installing, pay attention to the connection of all solenoid valves in parallel. Current efficiency is about 8A (depends on the value of the main fuse installed on THE VERSUS ECU harness red wire). The 12V appearance on this wire does not mean that the engine is now running on the alternative fuel. This is caused by delay defined in the software and warming up time of the injectors.

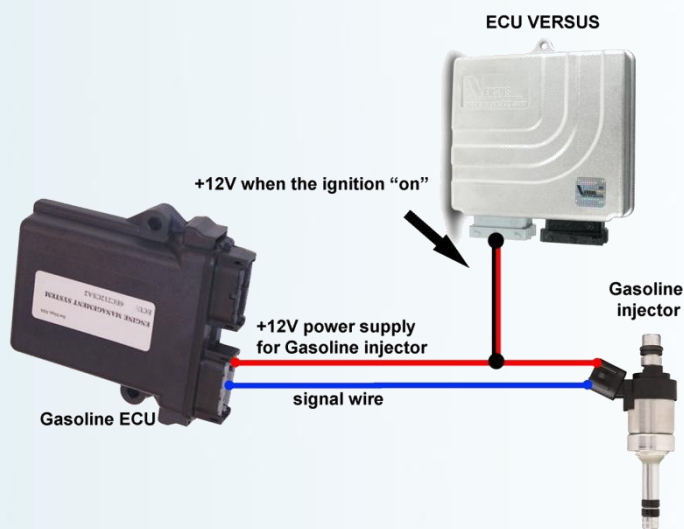
White wire gas level sensor in the tank (picture 2g) - LPG dedicated harness only (for CNG – manometer plug). The gauge, CNG level sensor, originally supplied with SGI VERSUS KIT is a resistive type. On the CNG system, the gauge is plug and play. Just simply plug the designated plug into the gauge. This gauge is to be located in the high pressure line. On the LPG systems, the white wire shall be connected to the sensor signal wire (black wire coming from the sensor wires shall be attached to the ground). This gauge is connected on the tank multivalve.

Red/black power wire (picture 2h). This wire is connected to a 12V ignition source. This source must only have a power voltage when the ignition key is turned to "ignition on" or "run" position. When selecting the place to connect this wire, it should also be checked to make sure the power is not lost when the engine is in "start" position (this will prevent an emergency run on gasoline).

It is recommended to connect this wire to the positive power supply of the gasoline injectors (picture 2h). In this case, communication with the VERSUS ECU will be possible only when the engine starts and when engine is running.

It is not recommended connecting the wire to the ignition coil, especially in vehicles with one coil per every cylinder. This combination results in large fluctuations in power supply and may cause the VERSUS ECU to malfunction. The power consumption of this wire does not exceed 0.3 A (CPU power), so using a fuse is not required.

Picture 2h: THE VERSUS ECU power cord

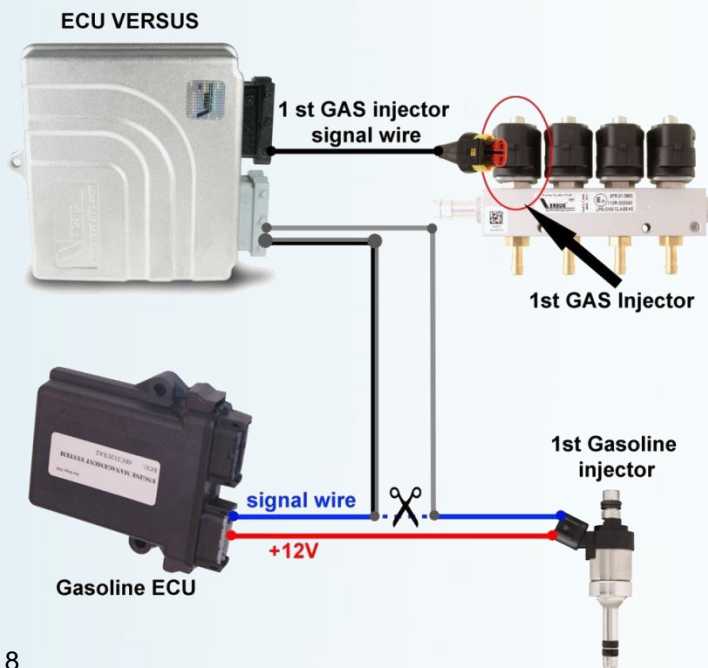


Grey & Grey/black pair of wires - the first cylinder connection

Grey cable should be connected to the negative wire of the gasoline injector (picture 2i), this will be the wire that comes from the gasoline ECU to the injector that controls the pulse. When running on gasoline, the negative impulses appear on this wire at 12V (Gasoline injector power supply wire) with a duration corresponding to the time of the gasoline injection. The signal wire needs to be cut. The Grey wire must always be connected with the direction to the Gasoline injector NOT in the direction of the gasoline ECU.

Grey/black wire should be connected to the same negative wire of gasoline injector, however must always be connected with the direction to the Gasoline ECU (picture 2j, point no 1).

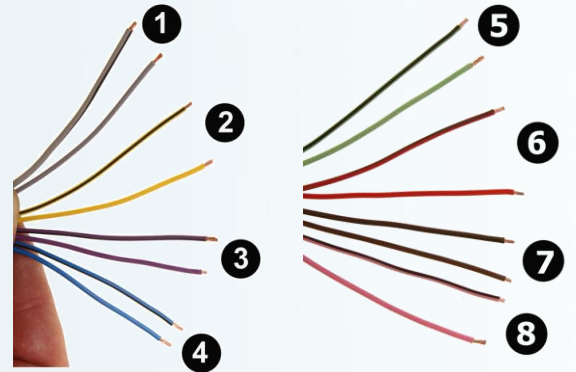
Picture 2i: Grey wire scheme



Analogously other pairs of injector wires shall be connected:

- a) Yellow & yellow/black wires – 2nd cylinder (picture 2j, point no 2)
- b) Violet & violet/black wires – 3rd cylinder (picture 2j, point no 3)
- c) Blue & blue/black wires – 4th cylinder (picture 2j, point no 4)
- d) Green & green/black wires – 5th cylinder (picture 2j, point no 5)
- e) Red & red/black wires – 6th cylinder (picture 2j, point no 6)
- f) Brown & brown/black wires – 7th cylinder (picture 2j, point no 7)
- g) Pink & pink/black wires – 8th cylinder (picture 2j, point no 8)

Picture 2j: Injectors wires



Notice:

- When the grey & grey/black set of wires are connected to the first cylinder injector, the plug for CNG/ LPG injector channel and its fitting should always be done to the first cylinder as well. It is possible to select other cylinder for this connection, however in such a case it is necessary to install the plug for CNG/LPG Injectors to the same injection channel to which the wires were attached.
- Please note that it is recommended to install the wires according to the order they were counted by the engine's producer. The original engine producer's numeration of the cylinders can differ. This have no influence on the engine operation, however in case of some Gasoline ECU errors like misfire in the "X" cylinder it may be problematic to match the CNG/ LPG injection channel with its connection to the problematic cylinder.
- Make sure when splicing the wires you splice the correct wire to the correct cylinder via vehicle manufacturers specs. When you are hooking up CNG/ LPG injectors make sure they follow the same pattern.

Brown RPM signal wire (picture 2k) should be connected to the negative wire of the ignition coil. In case of an engine ignition system with individual coils per every cylinder, the connection should be made to the signal wire (from gasoline ECU) on one of the coil packs. If the ignition coil is integrated with a power stage, the ignition coil signal will be weak so be sure to change the programming instructions input sensitivity RPM from 12V to 5V (advanced options of the software – please refer to the software manual). In the VERSUS ECU firmware above version 2.11 there's an additional option of selecting "RPM signal from petrol injectors." In such case the VERSUS ECU collects RPM signal from petrol injectors impulses. This option is dedicated to be used in the engines in which RPM signal coming from the coil is disrupted or the signal coming from one coil is infiltrated with another coil signal. It is always recommended to connect brown wire to RPM source such as: coil, crankshaft sensor, camshaft sensor, other. RPM signal from gasoline injectors shall be treated as final solution for some problematic cars with problematic RPM signal. If you result in using signal from gasoline injectors you will not attach brown wire.

Picture 2k: Brown wire



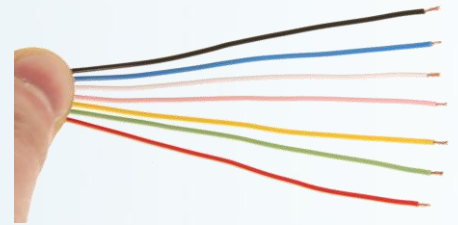
Violet optional cable used to connect the signal from the lambda (oxygen) sensor (picture 2l). The oxygen sensor (O2 sensor) signal is not used by the VERSUS ECU to adjust the mixture of fuel but may facilitate the installation regulations especially without EOBD tester. If the vehicle is equipped with two lambda sensors, the lambda sensor connection should be made to the first sensor (before catalytic converter) to enable observation of the mixture composition during adjustment. For vehicles with multiple exhaust manifolds, you may use either lambda sensor as long as it is upstream of the catalytic converter (closer to engine). The most common type is the zirconium lambda sensor that can be easily identified by the colors of four wires leading directly from the body: two white, grey and black which is the signal. Connection should always be done to the original car harness plug, never on the steel wires (the section from the body of the connector to the plug). If the car has a different type of sensor, specifically the wideband lambda sensor (such as an air/ fuel ratio sensor) then its connection is forbidden.

Picture 2l: Violet wire



Red, black, green, blue, yellow, white, pink bench wires connection method: wires should be connected according to “color to color” method. Remember that white wire should be connected BOTH to the switch and the buzzer.

Picture 2m: Change over switch wires connection

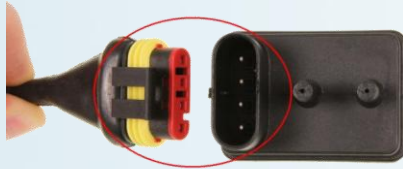


2.2.3. “Plug and play” connections

Picture 2n: Tuning cable plug



Picture 2o: XFP01 Absolute pressure sensor plug



Picture 2p: GAS temperature sensor plug



Picture 2r: Manometer plug



Picture 2s: Reducers temperature sensor plug



Picture 2t: GAS injectors plugs



3. REDUCER installation

3.1. Reducer selection

This is an important device located in the engine compartment. It allows the CNG or LPG to be delivered to injectors at the correct pressure and temperature. The alternative fuel is delivered to the reducer in a gaseous state (CNG), or in liquid phase (LPG), that becomes gaseous at constant pressure at the output. This device is connected with your vehicle's cooling system to prevent freezing up of the regulator.

It is always necessary to select proper reducer's type according to the power of the engine. Recommendations are given below:

LPG:

Engine power/type:	up to 200 HP naturally aspirated	turbo charged engines up to 300 HP	200-300 HP naturally aspirated	over 300 HP (also turbo charged with such a power)
Reducer's type to be selected:	VR-L Standard	VR-L SUPER or VR-L LUX	VR-L SUPER or VR-L LUX	2xVR-L Standard
Remarks:	KIT can be composited with 1-1 type of filters (filter gas flow capacity up to 200 HP)	KIT must be composited with two separate 1-1 filters (total gas flow capacity 400 HP). 6 mm internal diameter GAS supply pipe is recommended	KIT must be composited with two separate 1-1 filters (total gas flow capacity 400 HP).	KIT must be composited with two separate 1-1 filters (total gas flow capacity 400 HP). 6 mm internal diameter GAS supply pipe is required

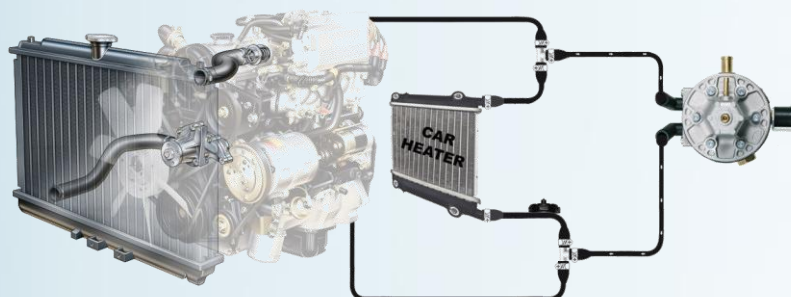
CNG:

Engine power/type:	up to 200 HP naturally aspirated	turbo charged engines up to 250 HP	200-300 HP naturally aspirated	over 300 HP (also turbo charged with such a power)
Reducer's type to be selected:	VR-C	VR-C	VR-C or 2xVR-C	2xVR-C
Remarks:	KIT can be composited with 1-1 type of filters (filter gas flow capacity up to 200 HP)	KIT must be composited with two separate 1-1 filters (total gas flow capacity 400 HP)	KIT must be composited with two separate 1-1 filters (total gas flow capacity 400 HP). Depends on the instantaneous engine fuel consumption.	KIT must be composited with two separate 1-1 filters (total gas flow capacity 400 HP)

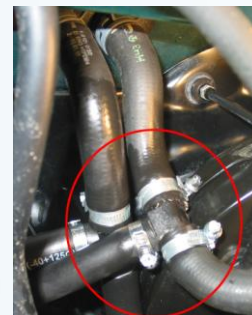
Practical note: the selection of the regulator's type should always be done taking into consideration some power reserve (the reducer should always have slightly more power capacity than the engine).

3.2. Reducer's fitting method

- The reducer (regulator) must be stable and fitted to fixed elements of the car. It is forbidden to bolt the reducer to the engine or any of its components.

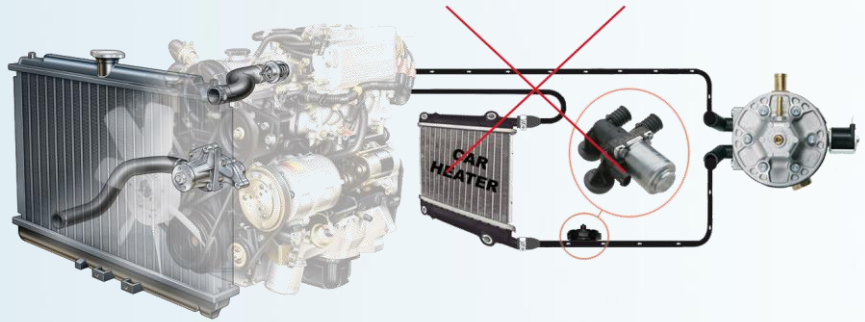


Picture 3a: Correctly fitter reducer



FRS

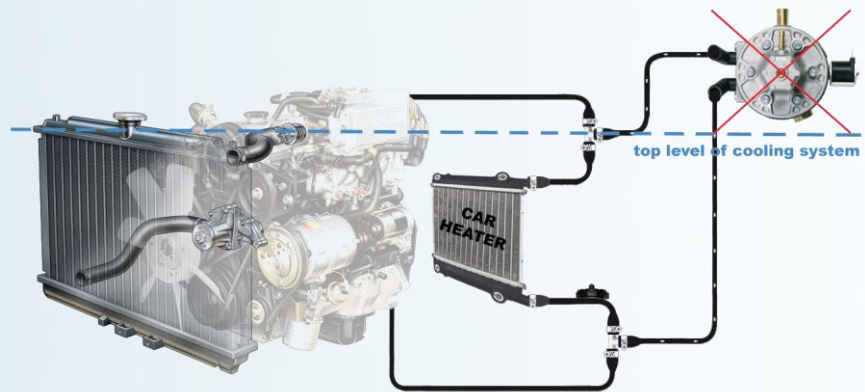
- It is necessary to install water fittings of the reducer in parallel between the engine block and the car heater core (see picture 3a). It is forbidden to install water cooling pipes to the reducer that may limit the flow of the engine coolant (see picture 3b).



Picture 3b: Incorrectly fitter reducer in serial way

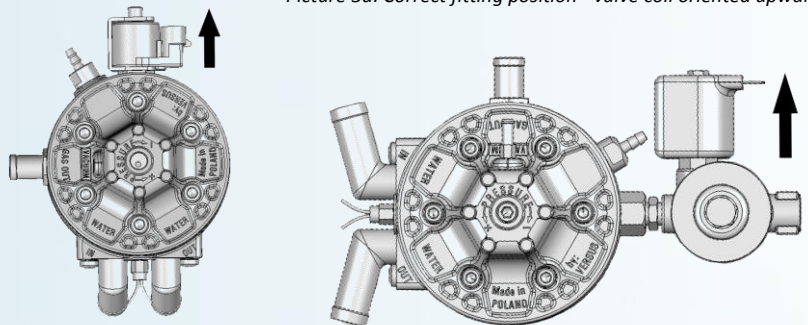
Picture 3c: Incorrectly installed reducer above top level of car cooling system

- It is necessary to fit the reducer below the highest level of the engine cooling system for optimum circulation (picture 3a - correct, 3c - incorrect).



- The regulator should not be installed in a place where there is too much heat (like exhaust manifold) and should not disturb other engine components service.

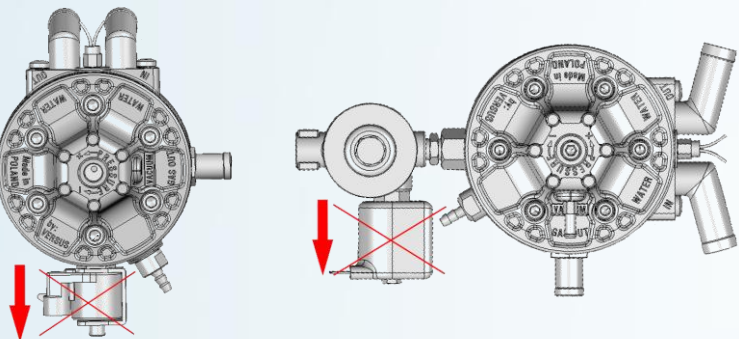
Picture 3d: Correct fitting position - valve coil oriented upward



- The regulator shall not be installed in places where the surrounding temperature falls during driving and should not be installed at the lowest location in the engine compartment.

Picture 3e: Incorrect fitting position- valve coil oriented downward

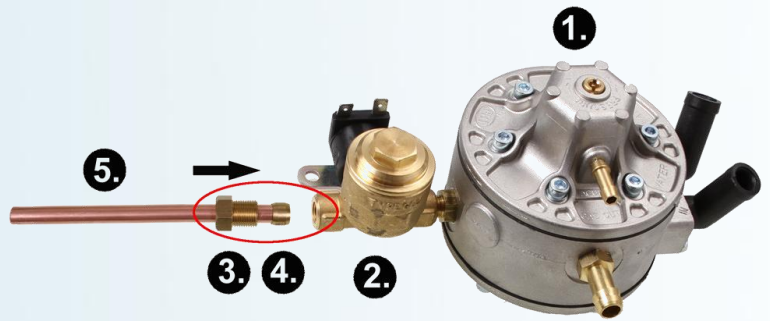
- The regulator shall always be installed with the valve solenoid oriented upward (see picture 3d). Incorrect fitting position has been marked on the picture no 3e.



Gas inlet connection method:

1. Regulator.
2. Filter set/unit.
3. Inlet nut.
4. Copper o-ring (LPG) or Metal o-ring (CNG). Attention: the o-ring is a disposable part. It is forbidden to use the same o-ring in case the nut was unscrewed once.
5. High pressure supply pipe coming from the CNG/ LPG Tank.

Picture 3f: Sample reducer connection scheme



Practical note:

- The place of the pressure regulator assembly should permit easy access to e.g. change the filter or pressure regulation.

Picture 3g: Gas reducer's outlet hose and its clamp(12-22)

- It is always recommended to use CNG/ LPG application dedicated hoses and tubing only.



Picture 3h: Cooling liquid hose:
LPG (16 mm inside diameter)

CNG (10 mm inside diameter)



- It is recommended to use only original cooling system T-fittings for the regulators coolant connection.



Picture 3i: Original cooling liquid T-fitting and clamps 12-22

3.3. Adjusting the reducer's (regulator) pressure

Recommended outlet pressure of the reducer should be as follows:

- VR-L Reducers (LPG): 100 kPa/1bar/14.5 psi (+/- 20%)
- VR-C reducer (CNG): 160 kPa/1,6 bar/23.2 psi (+/- 20%)

Pressure regulation screw of a reducer has been marked on the picture 3j.

Picture 3j: reducer's pressure regulation nozzle



Picture 4a: FH02 4-cyl Injector

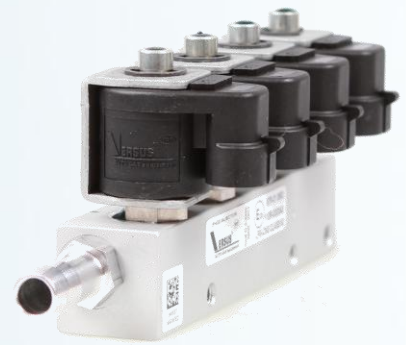
4. FH02 CNG/ LPG INJECTORS installation

The injectors are electromechanical devices that precisely control the gas supply to be delivered to the engine. Injectors are controlled by the VERSUS ECU which utilizes signals from a variety of vehicle sensors. THE VERSUS ECU operates properly with several kinds of CNG/ LPG Injectors (different Brands, impedance). If you are using the VERSUS injectors it will be preselected in the software. However, if other injectors are used, it is essential to choose the correct type of installed injectors in the software.

When choosing CNG/ LPG injectors of impedance 1 oHm or lower, it may be necessary to use a fuse (located on the red wire) with a value higher than the standard provided in the kit - over 10A.

One CNG/ LPG injector is used for each cylinder on your vehicle.

- In case of 4-cyl engine it is possible to use: 1x FH02-4cyl Injector set, 2x FH02-2cyl Injectors set or 4x FH02-1cyl Injectors set.
- In case of 6-cyl engine – 2x FH02-3cyl Injectors set. Other possibilities are 3x FH02-2cyl or 6x FH02-1cyl.
- In case of 8-cyl engine – 2x FH02-4cyl, 4x FH02-2cyl, 8x FH02-1cyl.



4.1. Inlet manifold nozzles installation

The hole diameter for the collector nozzle should be 4.8mm while the screw tap is a typical M6. It is always recommended to remove the inlet manifold from the engine to install the inlet manifold nozzles to prevent shavings falling into engine.

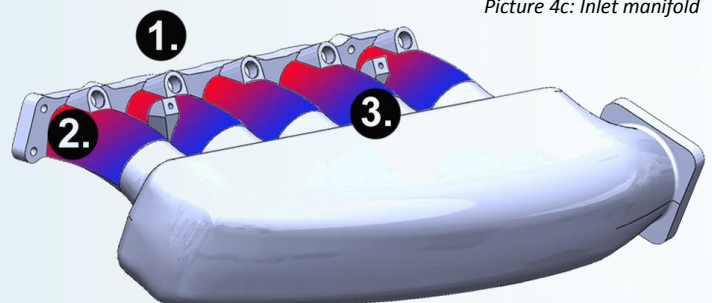
Before dismantling the manifold it is recommended to make note of spaces to drill the holes that will be free from other vehicle parts. After the hole is drilled and tapped, before fitting the inlet manifold nozzles it is necessary to apply a thread locker to threads that will protect them from unscrewing and provide perfect tightness. After cleaning the manifold of the filings, it can be refitted. It is also forbidden to drill accidental holes in the inlet manifold.

Picture 4b: Inlet manifold nozzles



While installing the inlet manifold nozzles it is essential to follow the rules:

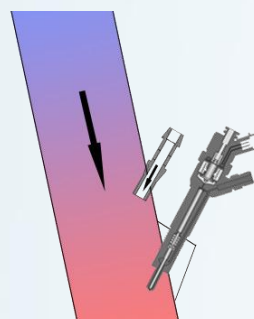
- 1) Gasoline injectors installation place.
- 2) Ideal place to install CNG/LPG inlet manifold nozzles (2-3 cm from gasoline injectors – red field)
- 3) Wrong placement of CNG/LPG inlet manifold nozzles installation (over 5-6 cm from Gasoline injectors – blue field)



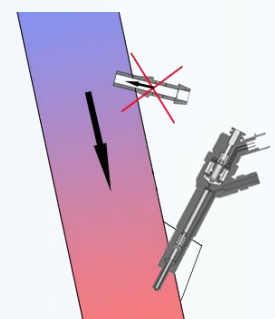
Picture 4c: Inlet manifold

Inlet manifold nozzles should be installed as close to the petrol injectors in such a manner that the injection of the alternative fuel is directed toward the intake valves.

correct fitting position



incorrect fitting position



Picture 4d:

The holes of the CNG/LPG inlet nozzles need to be drilled the closest to cylinder head. It is essential to keep the same distance and angle for every separate nozzle.

Every separate inlet manifold nozzle should be installed in the same way.

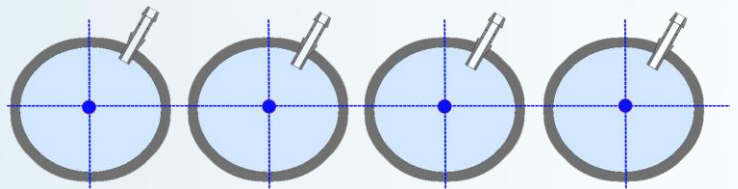
The nozzle shall be slanting to the central point of inlet manifold channel.

When installing the inlet nozzles to an engine equipped with a system of variable charge of air turbulence (SWIRL, TSCV), be sure to install the nozzles so that at any engine operating mode, the gas can be supplied to the engine smoothly. The presence of turbulence changes can be easily identified by the presence at the end of the inlet manifold (next to the cylinder head) flaps, which by rotation or displacement cause a change of the channel cross-section of the collector. In this case, it is recommended to install the nozzle in such a way that the CNG/LPG can always flow into the engine. Improper nozzles installation will result in the engine shaking during large load changes that cannot be eliminated by the VERSUS ECU controller mixture adjustment system.

Practical note:

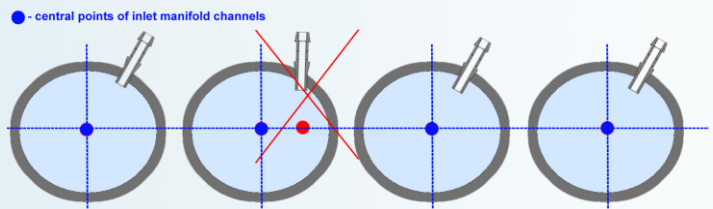
To avoid drilling the holes in inlet manifold it is possible to install the injector adaptors. These inserts allow for a time saving, clean installation. There are multiple variations of injector adapters to guarantee the correct application for your vehicle. Some vehicles do not have adequate room for these injector adapters. For more information please contact your dealer.

Picture 4e: Inlet manifold nozzles installed in the same way



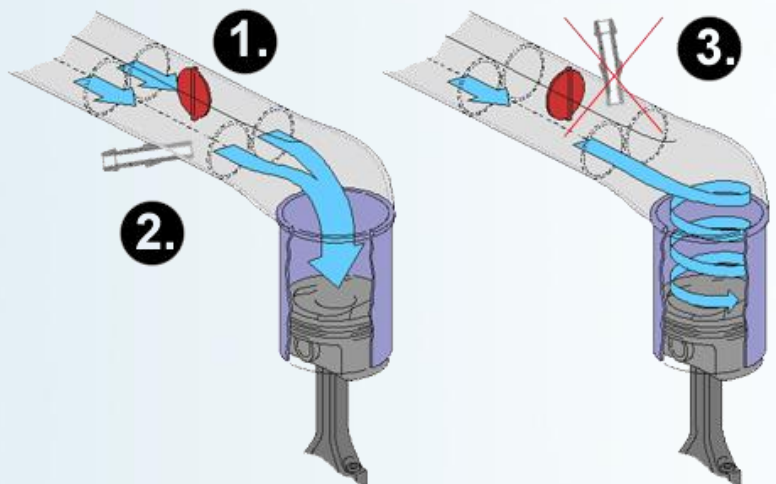
Picture 4f: Sample of typical mistake (2nd cylinder):

1. Inlet manifold nozzle not oriented to the central point of the channel.
2. One inlet manifold nozzle installed in different way than the others



Picture 4g:

1. Inlet manifold flaps (red marked)
2. Correct place of inlet manifold nozzle installation
3. Incorrect place of inlet manifold nozzle installation (air flow limited by flap)



Picture 4h: Injector adapters



4.2. CNG/LPG injector nozzles size selection

Picture 4i: Calibration nozzle diameter

The calibration nozzles must be sized according to the capacity of the car being converted (engine power and number of cylinders) according to the formula:

$$\text{nozzle size (mm)} = \frac{\text{engine power (HP)}}{\text{number of cylinders} * 25} + 1$$

Explanations to the formula:

- The result should be rounded to one decimal place.
- Nozzle size is correct for sequence control and pressure of gas (LPG = 100kPa, CNG = 160kPa).
- For the semi-sequential or non-sequential types of the engines the nozzle size should be smaller than calculated by about 15%.
- The size calculated according to this formula shall be treated as general idea of the size. Finally, the most optimal size may differ in the range of +/- 15% from the calculated value.
- If you need help with the correct calculation for your vehicle please contact our FREE technical support hotline.

Practical note:

- In case the size of the calibration nozzle is correctly selected the engine shall smoothly pass the THE VERSUS ECU system calibration on idle. Finally the software "corrections" value oscillate in the range between 0.5 – 2.5 ms.
- Make sure that the size of all calibration nozzles installed in the CNG/LPG injector rails are the same.
- If the size of the nozzles are too small there is a possibility please locate a larger size nozzle that was included in your KIT. Replace all the smaller nozzles with the larger ones. Make sure you perform the auto calibration again once new nozzles are installed.
-

Picture 4j: Drilling the injectors nozzles

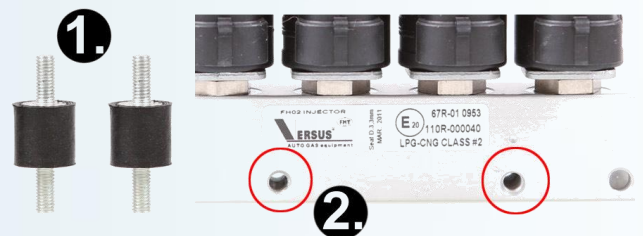


4.3. GAS Injection fitting position

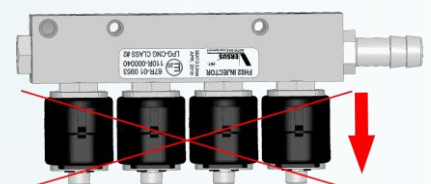
Injectors regardless of housing type (single, double, triple, quadruple) must be installed calibration nozzles facing down. Otherwise, despite the applied filters, oily substances will embed that lead to improper operation of the injectors. The injectors must be mounted to a rigid element of the engine that is capable to support them. It is recommended to use the anti-vibration dumpers (picture no 4k) supporting their fitting that are originally supplied with the injector mounting KIT. It is not recommended installing the injectors in a location exposed to cooling down while driving especially in winter.

Picture 4k:

1. Anti-vibration dumpers
2. Injectors dumpers fitting place

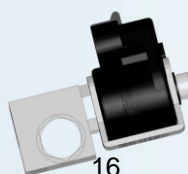
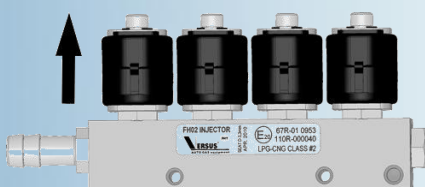


Picture 4n: Incorrect position of installation

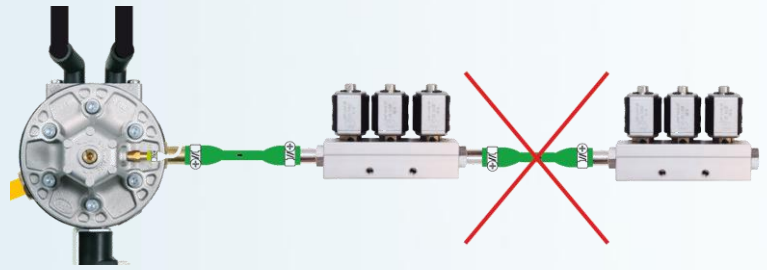


Picture 4l: Correct position of installation

Picture 4m: Acceptable position of installation



Picture 4o: Injectors matched in serial way



In case there are (two) 2x FH02 3-cyl Injectors installed it is forbidden to join such a pair of injectors in serial way (see picture 4o). Correct installation method is illustrated on "Scheme no 3" and "Scheme no 4".

In case there are (two) 2x FH02 4-cyl Injectors and two reducers installed:

- It is also forbidden to join such a pair in serial way.
- they should be joined together with an additional rubber hose to equalize the pressure between them. For better understanding see "Scheme no 5".

Picture 4p: FH02 4-cyl injector installed correctly in the engine chamber



Location of the CNG/LPG injectors should always strive to minimize the length of the gas supply hoses to the collector nozzles.

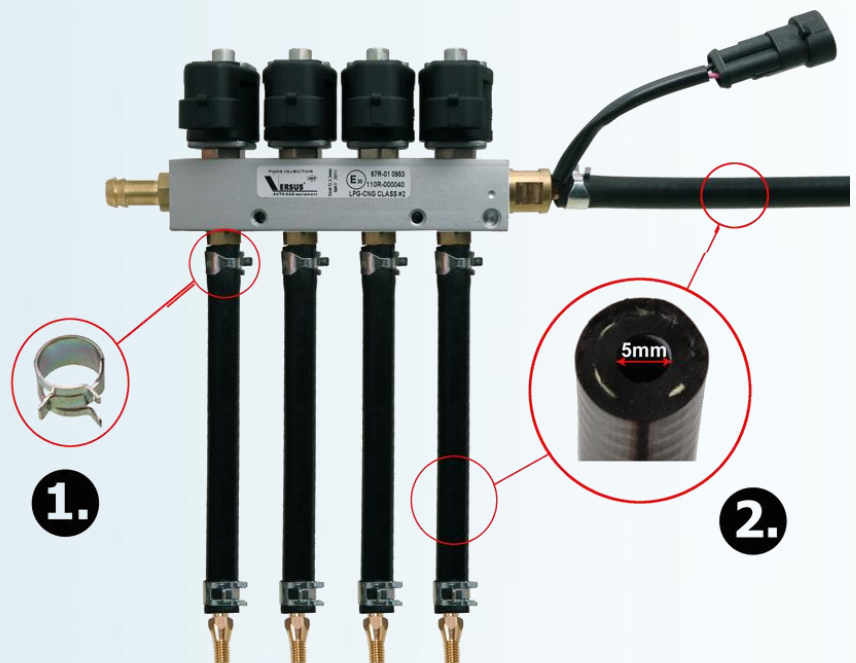
4.4. CNG/LPG Injectors – GAS Inlet manifold Nozzles hoses installation

Picture 4q: Pressure hose clamps used for nozzles connections:

1. Pressure hose clamps AML12 type
2. GAS dedicated hose $\varnothing 5$ mm (nylon inside)

High pressure rubber hose shall be used for connection from injector rail to injector nozzles. Each hose must be secured with tight metal clamps (picture 4q – "1"). It is forbidden to use vacuum connection dedicated clamps for pressure hoses for security protection.

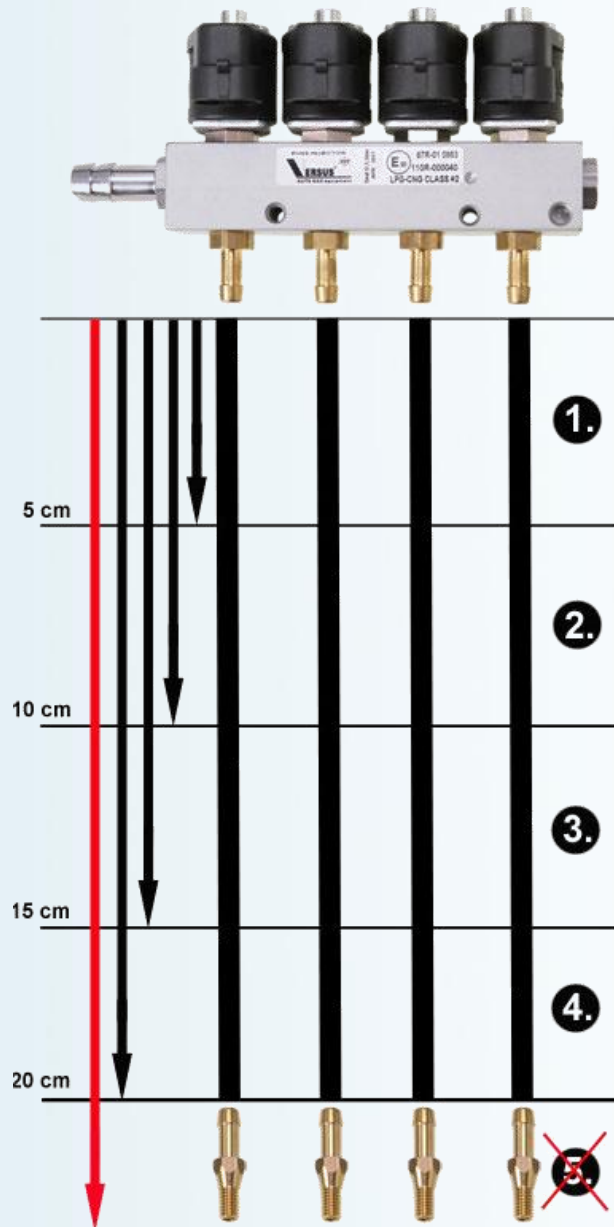
Hoses must not be bent or pressed; that will allow for inadequate flow to engine



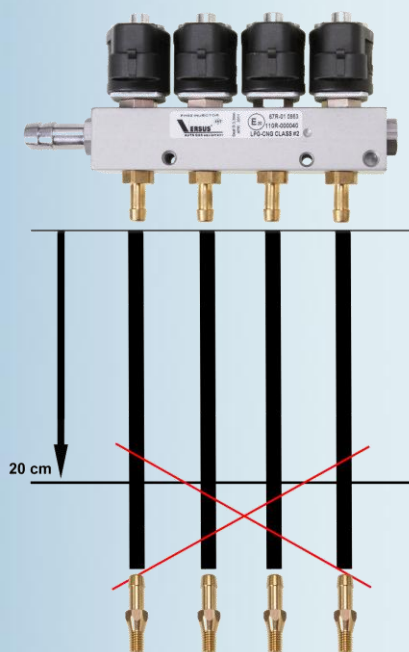
It should be noted that it is more important have the length of the hoses similar (as close to the same as possible). Maintaining symmetry between these hoses (from injector to engine) allows for the vehicle to operate under ideal conditions. When you switch fuels it will also allow for a seamless switch.

- 1) up to 5 cm (2 in) - ideal length.
- 2) up to 10 cm (4 in) – correct.
- 3) up to 15 cm (6 in) – acceptable.
- 4) 15 - 20 cm (6-8 in) not recommended but allowed.
- 5) over 20 cm (8 in) - forbidden

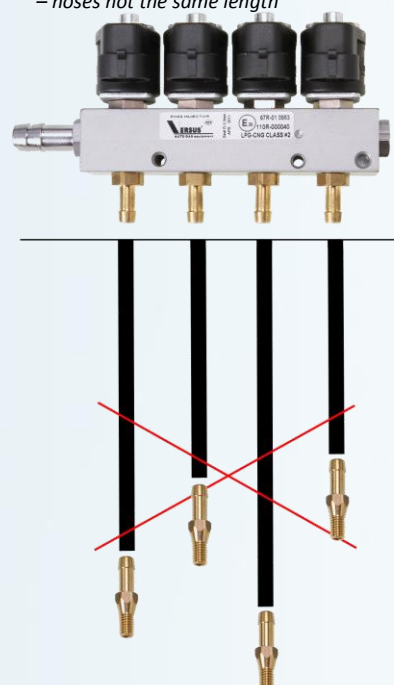
Picture 4: the length of the hoses



Picture 4s: incorrect length of injection hoses – hoses too long



Picture 4t: incorrect lengths of injection hoses – hoses not the same length



5. MAP-SENSOR: vacuum and pressure measurement connection

The Map-sensor is used to measure CNG/LPG pressure, after the regulator, in the system. It fulfills an additional role which is vacuum measurement in the intake manifold (measurement of engine load).

5.1. Map-sensor vacuum connection

Vacuum should be connected to:

- "V" marked nozzle of map-sensor
- "Vacuum" marked nozzle of the reducer
- Inlet manifold nozzle that must be installed the closest to the throttle (butterfly) on the intake manifold side NOT on the side leading to air filter.

Description:

- VACUUM hose is to be fitted by T-Fitting to:
 - VR Reducer's nozzle
 - Inlet manifold nozzle
 - "Vacuum" marked nozzle of the VERSUS map-sensor

Picture 5b: Inlet manifold vacuum fitting nozzle



Picture 5a: MAP sensors vacuum




Picture 5c: Reducer's vacuum nozzle



Picture 5d: Vacuum T-fitting



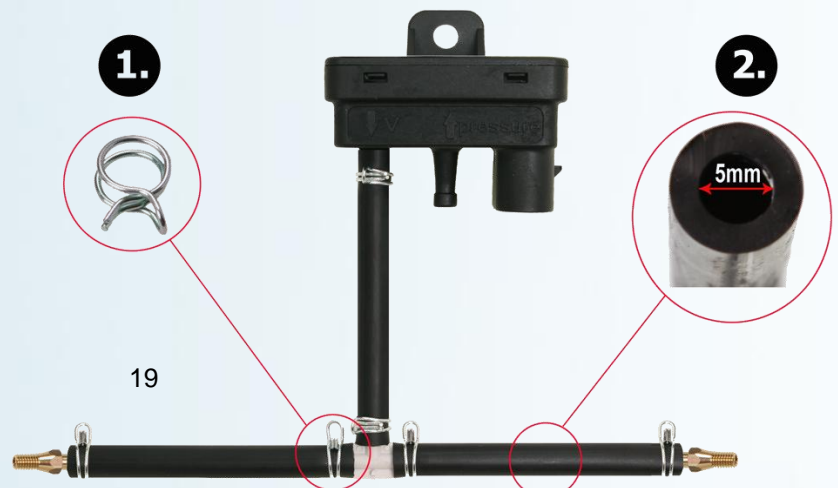
The connections should be integrated by using vacuum "T-fitting" (picture no 5d).

Detailed connection scheme is illustrated with light green line() on:

- "Diagram 1: General scheme of VERSUS system installation (4 cyl. engine sample)" – chapter 1.2 of this manual
- "Diagram 5: general connections for 8 cyl. engines over 300 HP" – chapter no 10 of this manual

Picture 5e: Vacuum hose and its dedicated clamp

Vacuum dedicated hose (no nylon reinforcement inside – picture 5e – "2") and clamps (picture 5e – "1") shall be used for vacuum connection. During the installation make sure that the hose is not bent, pressed or obstructed.



5.2. Map-sensor pressure connection

CNG/LPG temperature pressure outlet nozzle should be integrated with “pressure” marked nozzle of map-sensor. High pressure hose shall be used for the connection. The hose must be secured with the dedicated pressure clamps.

Picture 5f: GAS temp. sensor pressure outlet nozzle



Picture 5g: Map-sensor pressure nozzle



It is forbidden to use vacuum connection dedicated clamps for pressure hoses for security protection.

Hoses must NOT be bent, pressed or obstructed to restrict flow.

Note:

- In case of FH02 1-cyl Injectors it is necessary to use “T” type of CNG/LPG temperature sensor. In that case the “pressure” nozzle of map-sensor should be integrated with pressure outlet nozzle on the CNG/ LPG “T” Sensor. There is also a dedicated filter with 4 (four) outlet nozzle to supply the gas to every injector that must be used.
- In case of the installation with two reducers, the pressure connection should be made by using the “T” type of CNG/LPG temperature sensor as per “Diagram 5: general connections for 8 cyl. engines over 300 HP” – chapter no 10.3 of this manual.

Picture 5h: Gas pressure hose and its dedicated clamp



6. TEMPERATURE SENSORS

Reducer’s temperature sensor is to be connected to reducer’s body.

Picture 6a: Reducers temperature sensor

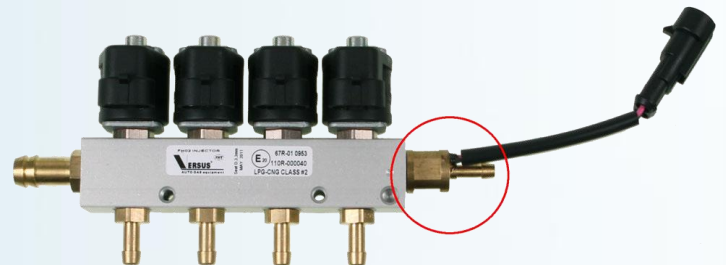


Picture 6b: GAS temperature sensor

GAS Temperature sensor should be fitted to GAS Injectors outlet. If a “T” type sensor is being used please see note below.

Practical note:

- In case of the installation with “Filter 1-4” type or the installations with two reducers it is necessary to use “T” type of the temperature sensors. For more details please see “Diagram 5” and “Diagram 6” (chapter 10.3, 10.4 of this manual)



If you every need to replace, it is recommended to use original VERSUS temperature sensors (others can indicate false temperature and their type need to be selected in the software).

7. FILTER

CNG/LPG filter has an important task of filtering the GAS impurities and preventing them passing into the injectors, which are delicate devices. The VERSUS filter is located between Regulator and Injectors. It is very important that the filters are replaced with genuine VERSUS parts at specified service intervals.

The filter is marked with a red arrow indicating the direction of the assembly (in the direction to injectors).

Picture 7a: Filter 1-1 type



Considering the amount of output nozzles – there are several types of filters (with one, two, three or four outputs). The gas flow efficiency of one filter (regardless of the number of output nozzles) is limited to 200 horsepower. If the engine power is greater than 200 HP it is necessary to use two filters with “Y-fitting”.

Picture 7b: T-fitting for filters and filters 1-1 (set for engine over 200 HP)

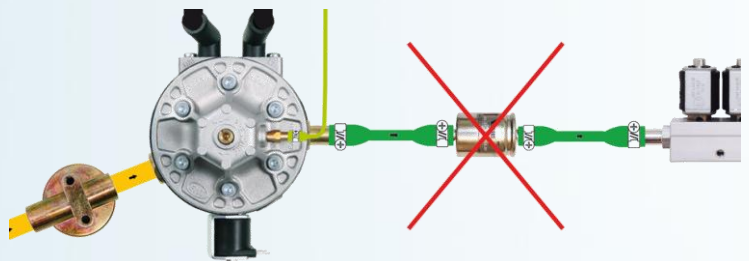


Detailed schemes of filters connections are illustrated in Chapter 10 of this manual:

- 10.1 Diagram 3: general connections for 6 cyl. engines up to 200 HP
- 10.2 Diagram 4: general connections for 6 cyl. engines up to 200-300 HP
- 10.3 Diagram 5: general connections for 8 cyl. engines over 300 HP with FH02-4 injectors
- 10.4 Diagram 6: general connections for 4 cyl engines with FH02 1-cyl injectors
- 10.5 Diagram 7: general connections for 8 cyl engines over 300 HP with FH02-2 injectors
- 10.6 Diagram 8: general connections for 8 cyl engines over 300 HP with FH02-1 Injectors

It is forbidden to use a only one filter with regulators in versions above 200 HP. Such use may cause a drop in gas pressure flow through the filter. This will cause the regulator to not be able to withstand your vehicles horsepower needs. Both filters (2) must be used in these applications.

Picture 7c: Forbidden connection method: SUPER reducer (300 HP) and one filter (200 HP)



Picture 7d: Gas dedicated hose and clamp 12-22

Only gas dedicated hoses and high pressure clamps shall be used in the filter connection.



8. GAS LEVEL SENSORS installation (High Pressure Gauge)

8.1. LPG VERSUS 1050 LPG Level sensor installation

Picture 8a: VERSUS LPG level sensor 1050 type

The sensor's wiring should be connected according to the diagram (picture no 8b)

The sensor itself should be fitted to the Multivalve (see picture no 8c)

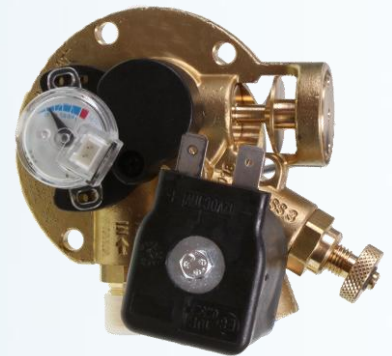
- There is a possibility to turn the indicator left or right in order to achieve adequate LPG Level indication on the Switch (If LPG Tank is full all diodes should shine).



Picture 8b: VERSUS LPG level sensor 1050 type installation scheme



Picture 8c: VERSUS LPG level sensor 1050 type already fitted



8.2. CNG VERSUS VR-C 01 manometer installation (High Pressure Gauge)

CNG VERSUS VR-C 01 Level indicator:

Picture 8d: CNGVERSUS VR-C 01 level indicator correct fitting method

The role of the manometer is to measure the pressure of the CNG tank. The results of this measurement are displayed on the switch assembled in the cab.

The manometer should be connected to the T-fitting with metal nuts. Also, the metal O-ring should be used to seal the connections.

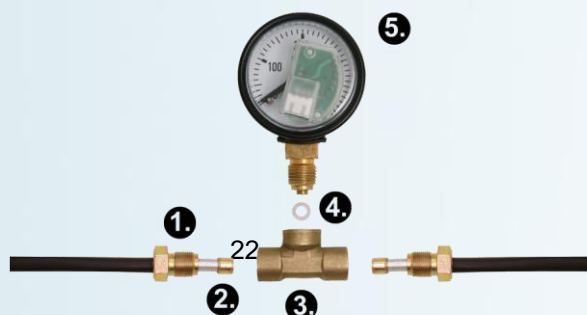
It is forbidden to screw the manometer by grabbing its cover with a wrench (picture 8f). THIS WILL VOID THE WARRANTY.



Picture 8e: VR-C 01 fitting scheme

Picture 8f: Incorrect fitting method

- 1) Metal nut
- 2) Metal o-ring
- 3) T-fitting
- 4) Aluminum seal
- 5) VR-C 01 sensor/manometer



9. CHANGE OVER SWITCH display modes and buzzer installation

The switch allows you to select the type of the fuel: Gasoline or CNG/LPG. The switching from one fuel to another can be done by pressing the switch button. Both the switch and the buzzer shall be installed in the driver's cabin.

9.1. Switch signaling modes

Picture 9a: "GASOLINE" mode display

"GASOLINE" mode – no lights shining in the switch (picture 9a):



- Gasoline fuel is supplied to the engine.
- When the switch button is pressed the controller switches to "AUTO" mode.

"AUTO" mode – all diodes (lights) flashing on the switch (picture 9b):

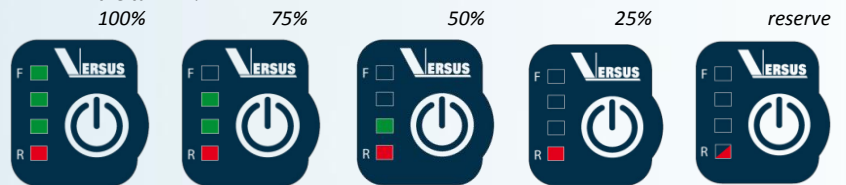
Picture 9b: "AUTO" mode display



- Gasoline fuel is supplied to the engine, however the VERSUS ECU system is ready to switch the fuel to the alternative fuel when the switching conditions are met (RPM level, temperature, delay level).
- As soon as the conditions are met the VERSUS ECU switches to the alternative fuel automatically.
- When the switch button is pressed the VERSUS controller switches to "GASOLINE" mode again.

"CNG/LPG" mode – lights are shining constantly (picture 9c): *Picture 9c: "GAS" mode display – 5 types of display possible depending on the Gas level in the tank in %:*

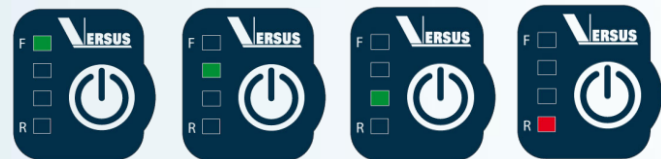
- The alternative fuel is being supplied to the engine
- The amount of CNG or LPG in the tank is displayed on the switch (picture 9c)
- When switch button is pressed the controller switches back to "GASOLINE" mode.



"EMPTY" Tank mode – diodes light up one after the other (picture 9d):

Picture 9d: "EMPTY" Tank mode display

- the mode activated only when there is no CNG/LPG pressure recognized by the system.
- Gasoline fuel is supplied to the engine.
- As soon as the system recognizes that the CNG/LPG tank was filled over 50% - the controller switches automatically to "AUTO" mode after 1-3 minutes.
- In case the tank was filled less than 50%, switch button needs to be pressed to switch to "AUTO" mode.
- Pressing the switch button changes the mode to "AUTO".



"EMERGENCY" mode start the engine with "GAS" (CNG or LPG) fuel:

There is a possibility to start the engine with the alternative fuel without using GASOLINE in emergency mode, however it is recommended only in emergency situations.

Procedure:

- Press and hold pressed the switch button
- Start the engine when the button is pressed
- The engine is supplied with CNG/LPG, and the VERSUS ECU controller switches to "GAS" mode directly with no delay.

"CALIBRATION" mode – top diode blinking and some other diodes shining (picture 9e):

Picture 9e: "CALIBRATION" mode display

- For more information see "Fully-automatic mapping" chapter of the software manual.



9.2. Leak test procedure – steps

1. The engine should be started, running on gasoline (“AUTO” mode with the diodes on switch blinking or “GASOLINE” mode with no diodes shining/blinking)
2. Press and hold the switch button for about 10sec.
3. After this time one beep signal can be heard and the switch start to indicate the process of testing with two extreme diodes blinking (see picture 9g).
4. Release the button and wait for calibration end.



Picture no 9f: Leakage test start from

A) “AUTO” mode



B) “GASOLINE” mode



Scenarios:

a) Test positive – no leakage:

For the next 15 seconds measurements of pressure are made and if there is no drop of pressure (there is not a leak), the controller completes the procedure that is confirmed with:

- Two top diodes shining for 3 seconds and
- One beep signal can be heard

After this time the controller switches the mode to “AUTO” mode.

b) Test negative – leakage detected:

If within 15 seconds, the controller registers a pressure decrease of more than 15kPa the controller completes the procedure that is confirmed with:

- Two bottom diodes shining for 3 seconds and
- Triple beep signal can be heard

After this time the controller switches the mode to “Gasoline” mode.

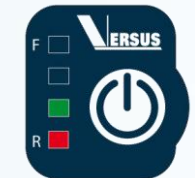
Picture no 9g: leakage test in progress



Picture no 9h: leakage test positive



Picture no 9i: leakage test negative



Notes:

- In case a tank is empty, the leakage test will not be performed correctly, the result will be negative. Please make sure that the tank is at least ¼ filled.
- Please note that this procedure can only check for leakage of the output section of the regulator, gas hose with filter, injection rail and Pressure sensor/Map-Sensor. Other leaks are not detected.
- The efficiency of the procedure also depends strongly on the type of regulator (solenoid valve must be attached close to the regulator). In case the solenoid valve is located far away from the regulator and there is a pipe full of gas between the devices, the potential pressure falls of the evaporated gas pressure will be compensated by CNG/LPG coming from this intermediate pipe. In such special cases (gas solenoid away from the regulator), medium and small leaks are not being detected.
- It is unacceptable to check the leaks just by using the above procedure. Leak test always must include all pressure connections with the use of an appropriate leak tester.

9.3. Buzzer installation and signalization

The buzzer should be installed in the driver’s cabin.

After the device installation make sure the security label is taken off.

Horn signals always indicated:

- “EMPTY tank mode beginning – 3 beep signals

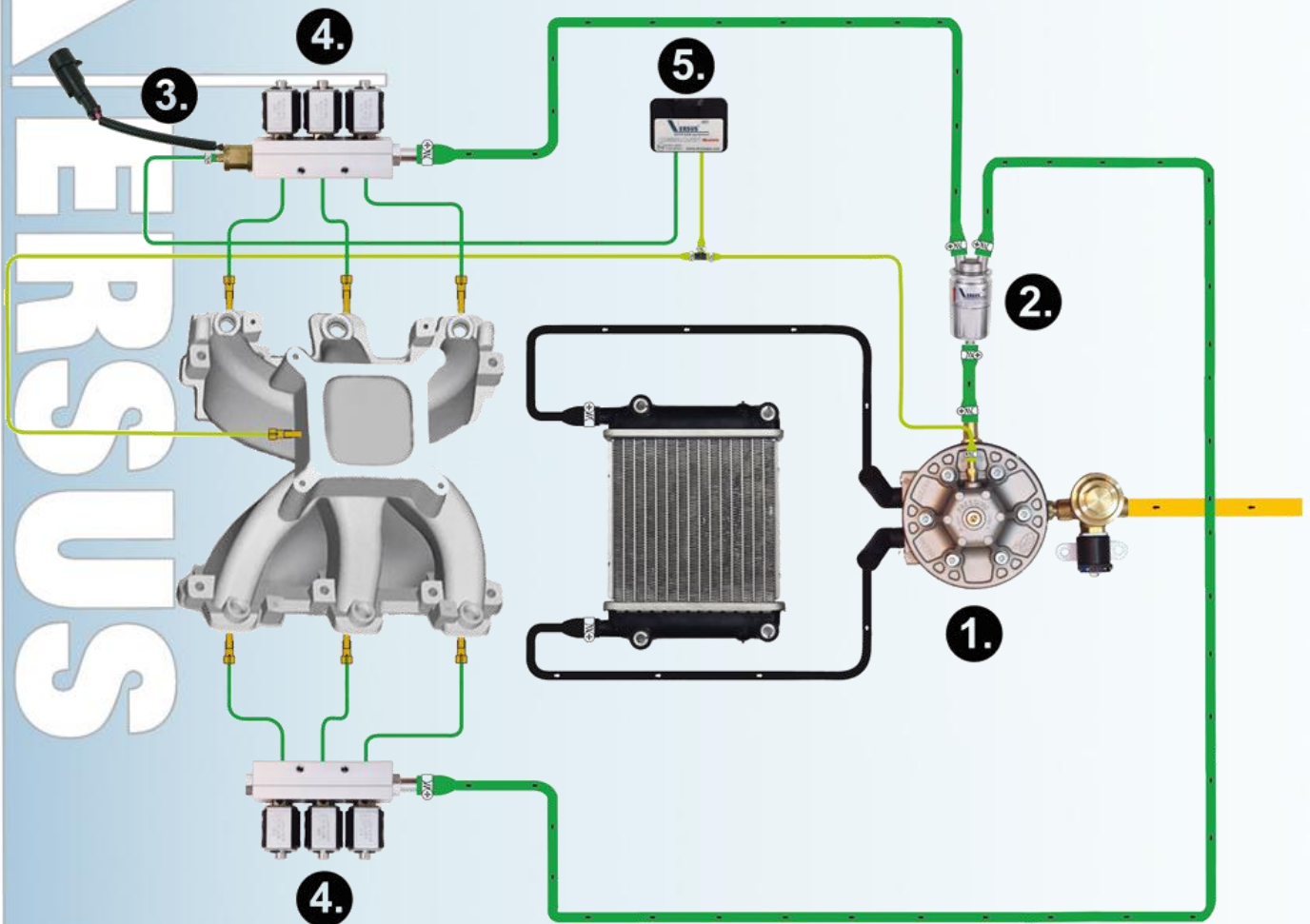
More signaling modes are widely described in the software manual.

Picture no 9j: Buzzer security label to be removed



10. OTHER DIAGRAMS

10.1. Diagram 3: general connections for 6 cyl. engines up to 200 HP

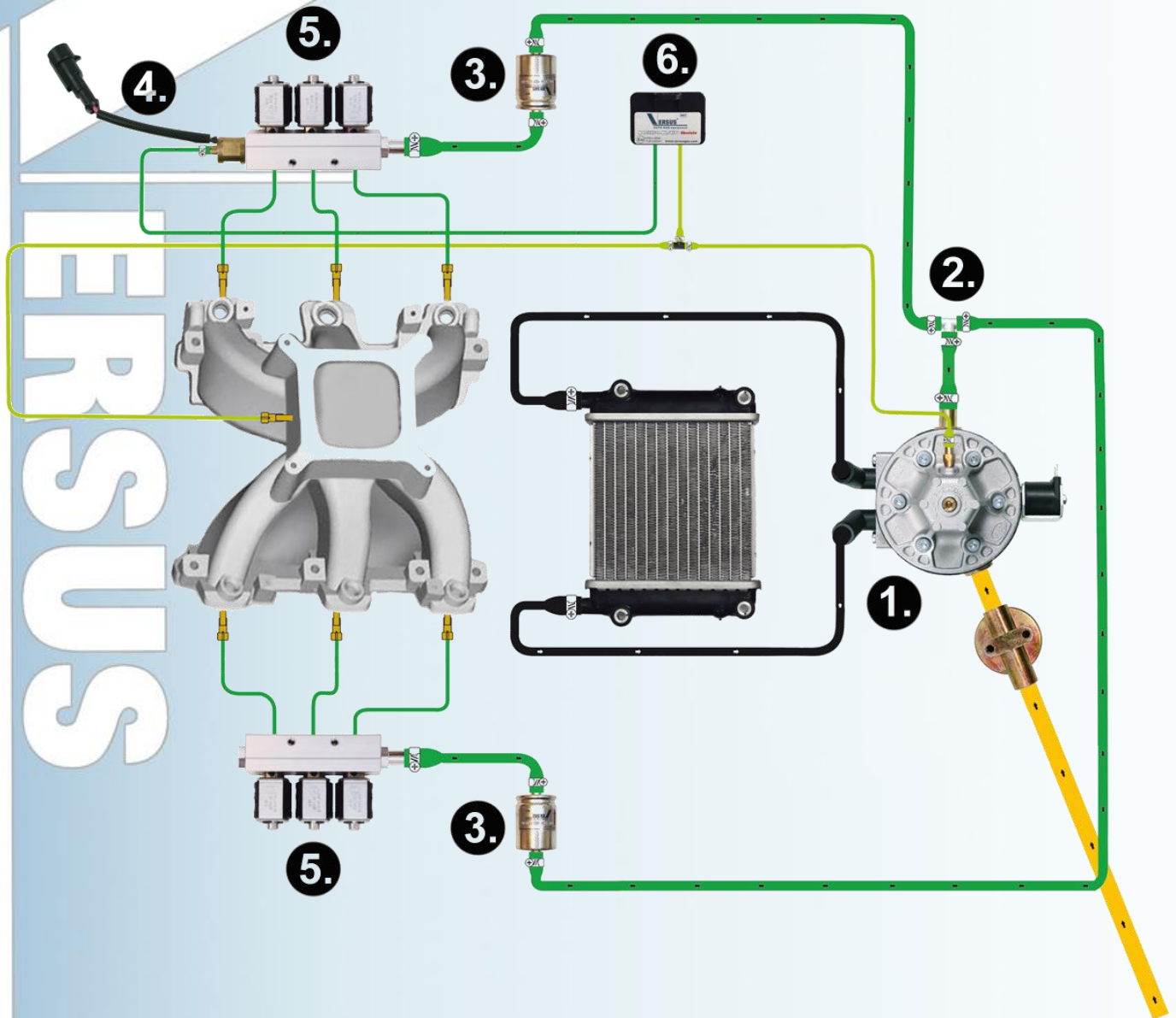


LEGEND:

Liquid gas supply line	-	
Evaporated Gas supply line	-	
Vacuum connection	-	
Coolant connection scheme	-	

1. VR-L Standard reducer
2. Filter 1-2
3. Gas Temperature Sensor
4. FH02 3-cyl Injectors
5. MAP-sensor XFP01 type

10.2. Diagram 4: general connections for 6 cyl. Engines 200-300 HP



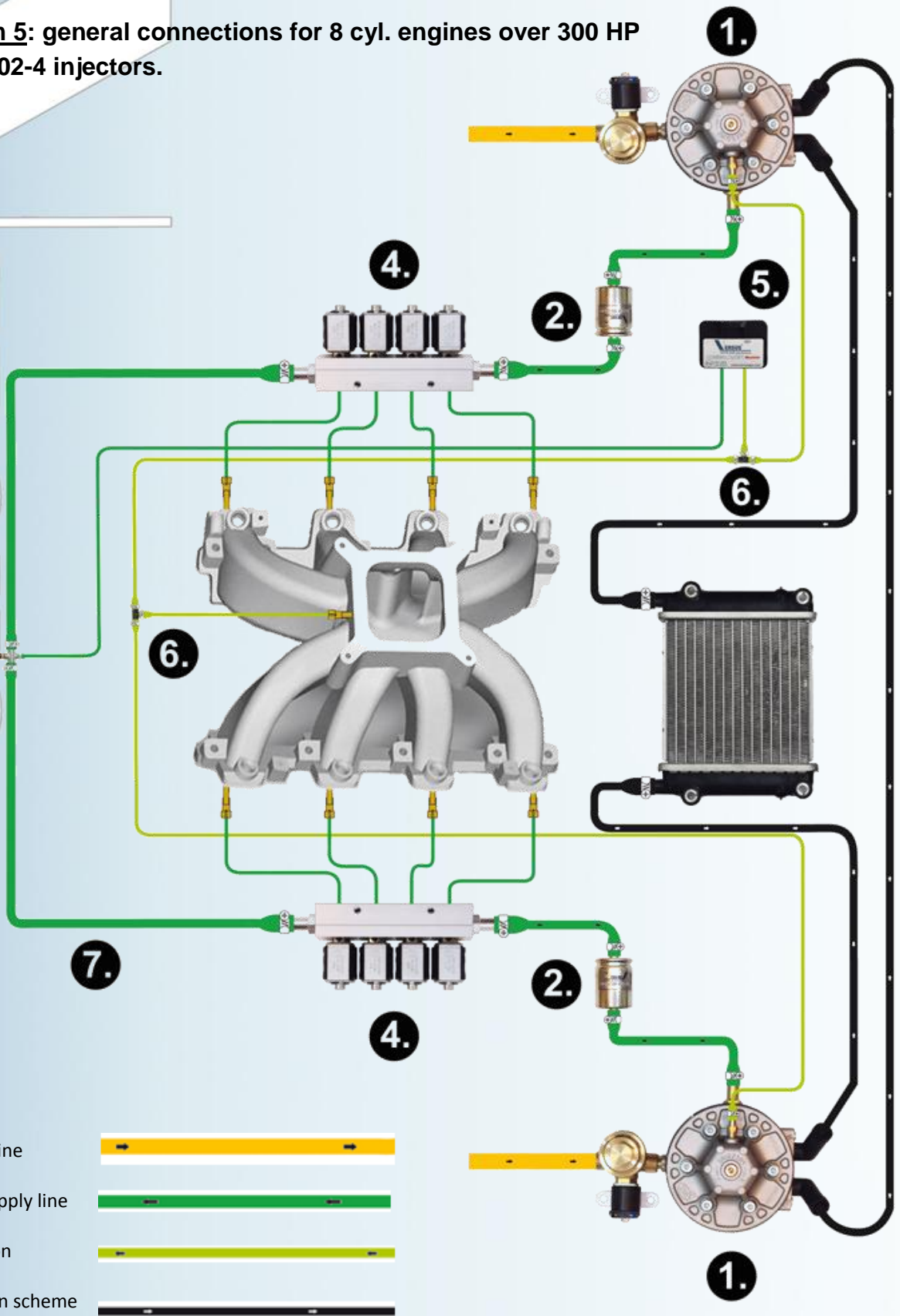
LEGEND:

Liquid gas supply line	-	
Evaporated Gas supply line	-	
Vacuum connection	-	
Coolant connection scheme	-	





1. VR-L SUPER reducer
2. T-fitting for filters
3. Filters 1-1
4. Gas Temperature Sensor
5. FH02 3-cyl Injectors
6. MAP-sensor XFP01 type

10.3. **Diagram 5: general connections for 8 cyl. engines over 300 HP with FH02-4 injectors.**

ERSUS



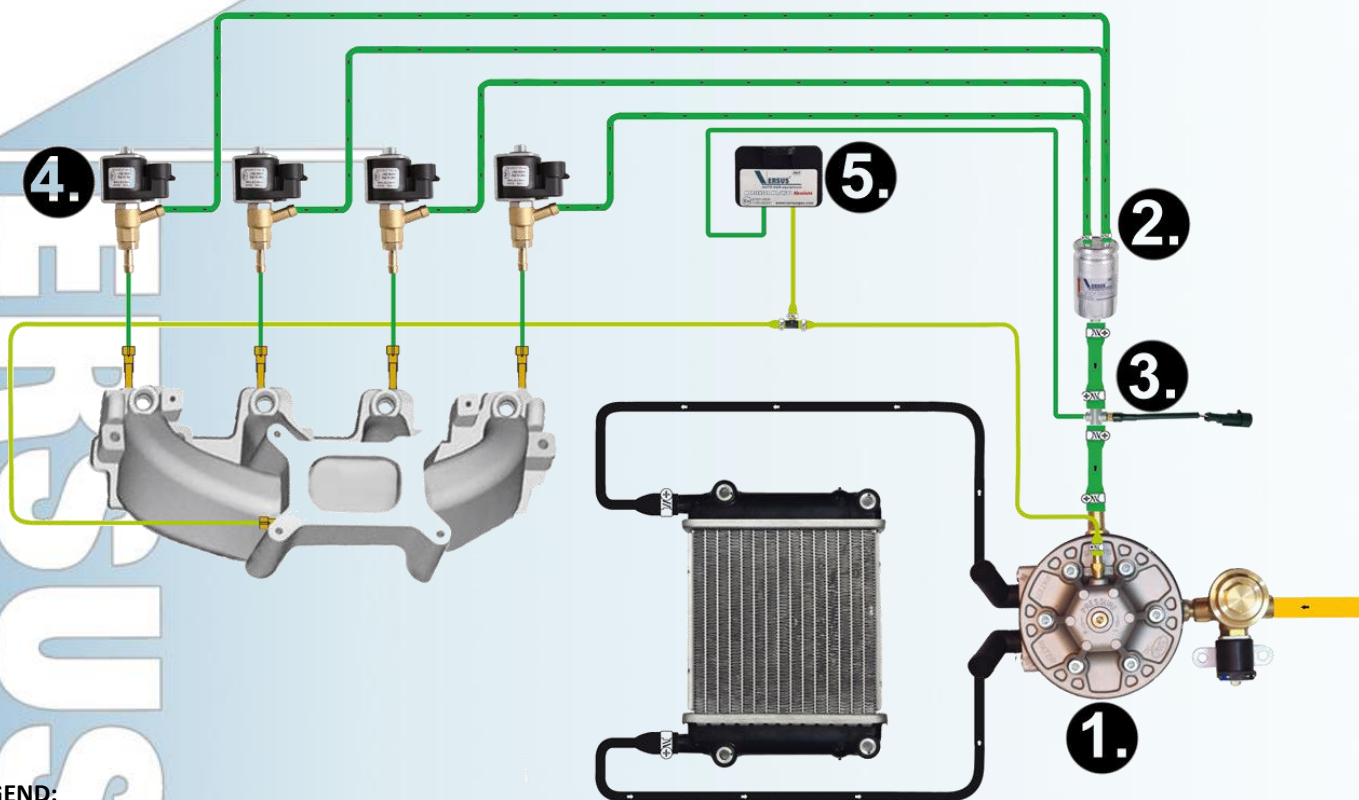
LEGEND:

- Liquid gas supply line 
- Evaporated gas supply line 
- Vacuum connection 
- Coolant connection scheme 

1. VR-L Standard reducers
2. Filters 1-1
3. Gas Temperature Sensor
4. FH02 4-cyl Injectors
5. MAP-sensor XFP01 type
6. Vacuum T-fittings

7. Gas pressure equalization hose

10.4. Scheme no 6: general connections for 4 cyl. engines with FH02 1-cyl injectors



LEGEND:

- Liquid gas supply line -
- Evaporated Gas supply line -
- Vacuum connection -
- Coolant connection scheme -

1. VR-L Standard reducer
2. Filter 1-4
3. Gas Temperature Sensor "T" type
4. FH02 1-cyl Injectors
5. MAP-sensor XFP01 type

For more advanced technical explanations please visit restricted area of our website:

www.versusgas.com

Thanks for studying the manual to the end!

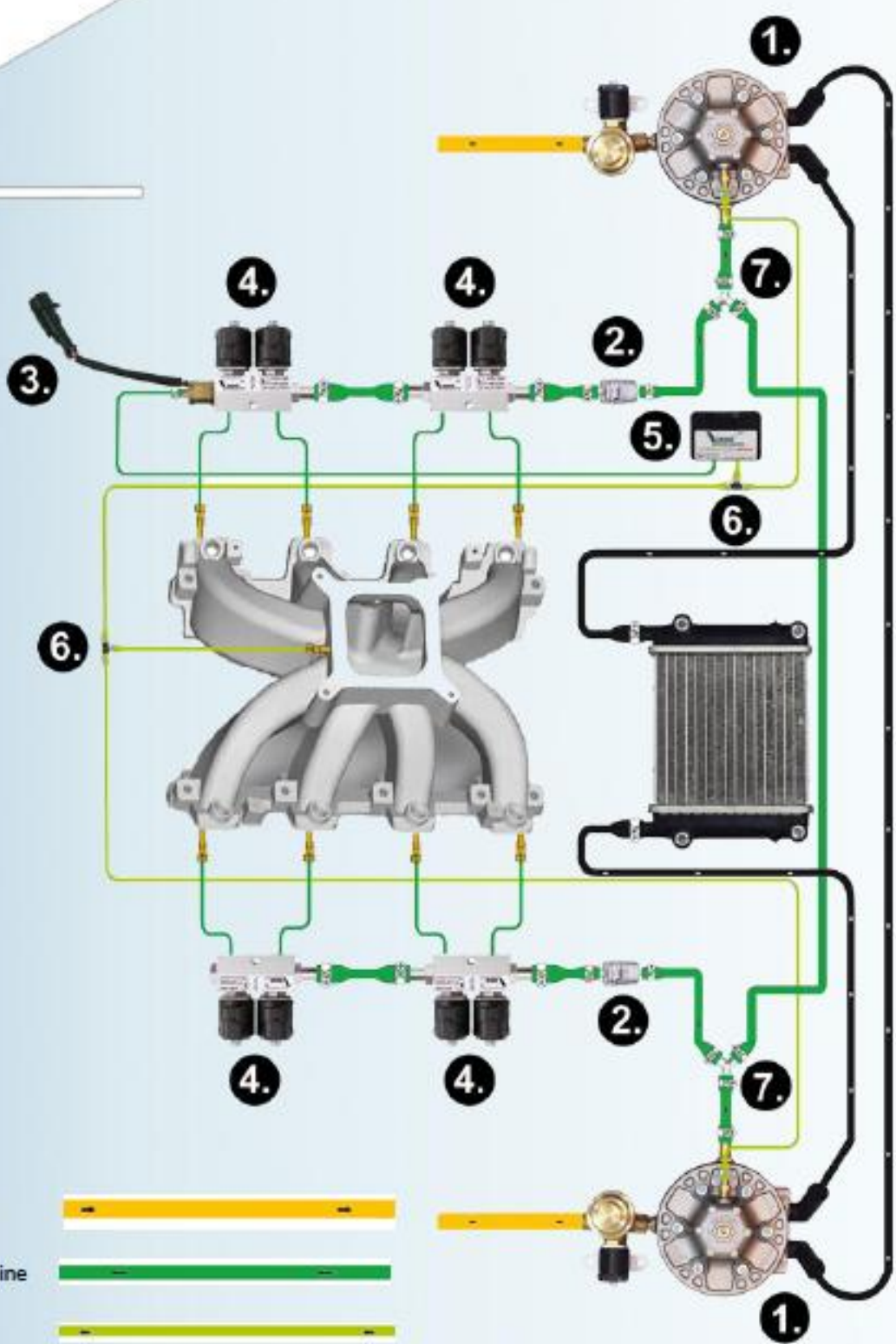


The pictures, text description, nameplates, technical data that is contained in this manual are the property of FHT VERSUSGAS. Copying of this property without FHT VERSUSGAS prior written permission is prohibited.



ISO 9001:2008
ISO 15500-9:2001

ERSUS



LEGEND:

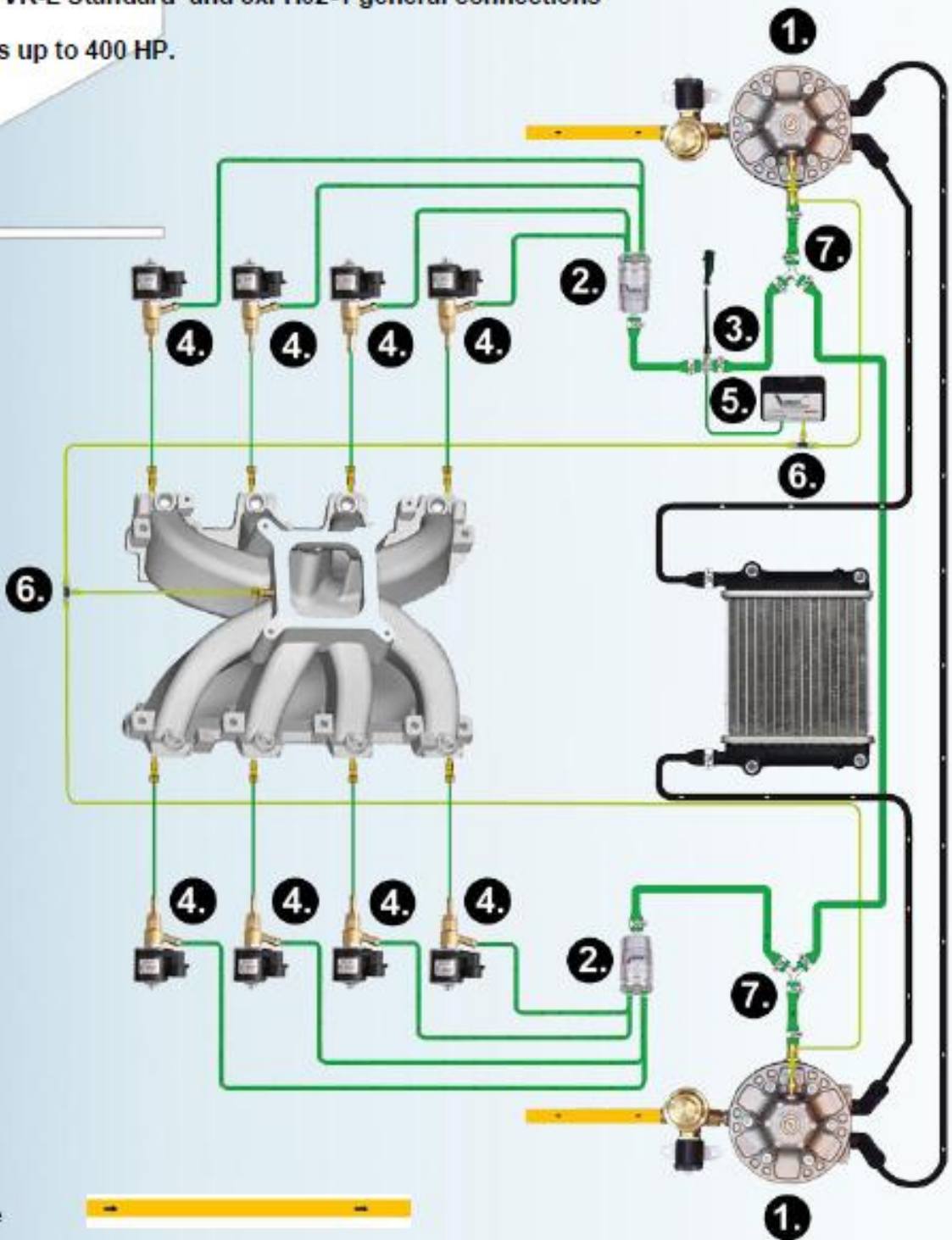
- Liquid gas supply line
- Evaporated gas supply line
- Vacuum connection
- Coolant connection scheme

- 1. VR-L Standard reducers
- 2. Filters 1-1
- 3. Gas Temperature Sensor STD
- 4. FH02 2-cyl Injectors
- 5. MAP-sensor XFP01 type
- 6. Vacuum T-fittings
- 7. Gas Y-Fitting

10.6 Diagram 8 2 x VR-L Standard and 8x FH02-1 general connections

for 8 cyl. engines up to 400 HP.

ERSUS



LEGEND:

Liquid gas supply line 

Evaporated gas supply line 

Vacuum connection 

Coolant connection scheme 

1. VR-L Standard reducers
2. Filters 1-4
3. Gas Temperature Sensor "T"
4. FH02 2-cyl Injectors
5. MAP-sensor XFP01 type
6. Vacuum T-fittings
7. Gas Y-Fitting

Technical Support

For more advanced technical explanations please contact our technical support department:

- Website: www.versusgasusa.com/technical-support
- E-mail: support@gratec-cng.com
- Phone: 209-6VERSUS (209-683-7787)

Thanks for studying the manual to the end!



The pictures, text description, nameplates, technical data that is contained in this manual are the property of FHT VERSUSGAS. Copying of this property without FHT VERSUSGAS prior written permission is prohibited.



ISO 9001:2008
ISO 15500-9:2001