ALTERNATIVE FUEL SYSTEMS

Prins

VSI-3 DI

Installation manual

General

PART 1/2

SYSTEM VERSION	VSI-3 DI / AFC-3.0 DI
DATE	03-03-2022
Revision version:	1.3

1 TABLE OF CONTENTS

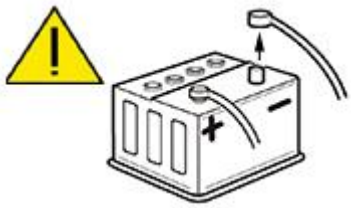
2 Manual updates / revision

Rev. nr	Rev. Date	Subject update
1.0	27-08-2020	First official release
1.1	12-10-2020	Text modifications, Added CAN Gateway details, added PSA fuel gauge reset details.
1.2	15-02-2021	Various updates added Cylinder tanks GZWM
1.3	03-03-2022	Added CNG Ventrex system overview Added chapter information Fuel Pressure Control Valve Added Instructions Connection Multiple LPG tanks Various modifications

3 General instructions

The installation of the system shall be done in accordance with the installation manual provided by Prins Autogassystemen.

- This manual is based on Dutch regulations; always install the system in accordance with local regulations.
- Fitting and maintenance is only allowed by LPG/ CNG engineers.
- Failure to follow the instructions in this manual can result in a poor or non-working LPG/ CNG-installation or a dangerous situation.
- For maintenance instructions and filter registration also see the Driver's Guide.
- Prins Autogassystemen is not responsible for any damages to people or objects as a result of changes to Prins products.
- Power and fuses:
  - Make sure the ignition key is outside the car / windows open.
  - Be aware of central door locking, radio / telephone memory code and alarm system.
  - Always disconnect the battery when installing the LPG/ CNG system.



  - Do not place the main fuse into the fuse holder before having completed the installation of the system.
- AFC-3.0 DI
  - The AFC-3.0 DI has to be activated with the Prins AFC Software V2.
  - In the unlikely event the AFC-3.0 DI fails, it will automatically switch over to petrol.
  - Never disconnect the AFC-3.0 DI connectors, unless you have removed the main fuse.
  - When +ignition or a 5V wake-up is connected, the engine always can run on petrol. Also without software or installed main fuse.
- Harness and wiring:
  - The wires in the loom are provided with numbers and text.
  - The text on the wire explains the function of the wire.
  - The wire harnesses are mainly not model specific. Therefore it may be necessary to adjust the wire length.
  - Ensure maximum care is taken when connecting the wiring.
  - Ensure that it does not run near any of the ignition components.
  - Make sure there is no stretch on the wire harness.
  - Solder and insulate all electrical connections.
  - Make professional joints using solder and shrink sleeve.

- Hardware installation:
  - Always use the DEDICATED MANUAL (part 2/2) for detailed installation instructions.
  - No component of the LPG/ CNG -system shall be located within 100 mm of the exhaust or similar heat source, unless such components are adequately shielded against heat.
  - Remove any internal burrs after having shortened the copper LPG/ CNG pipe. (This guarantees the maximum flow through the pipe without pollution.)
  - Threat all drilled holes with an anti-corrosion agent, after removing the chips.
  - Check components for gas leakage with a gas leak detection device after the installation. Also check for air and fluid leakage.

- Up to date information:
  - Regularly check our website the latest for diagrams, certificates, updates, info-bulletins and product information.

- Contact your local distributer for:
  - Homologation information.
  - Technical information
  - Sales information

- Warranty:
  - Register the components for warranty period after installation.

- Work safe:
  -  = WEAR SAFETY GOGGLES

4 About this manual

This manual describes:

- Operation of the VSI-3 DI system
- System and components description
- General diagnostics
- Service and maintenance
- General installation instructions

4.1 Abbreviations and terms

4.1.1 Abbreviations

Abbreviations	Out written	Explanation
AD	Analog digital	Sensor input.
AFC	Alternative Fuel Controller	LPG/ CNG computer.
CAN-bus	Controller Area Network	High speed communication; 2 twisted wires most used for drive line and vehicle communication.
DAC	Digital analog converter	Simulated signal output.
DI injector	Direct injection	Fuel injection in combustion chamber.
DI (AFC)	Digital Input	Input of on / off signal (high / low)
LED	Light Emitted Diode	
LIN-bus	Local Interconnect Network	Low speed communication. 1 wire 0-12V Most used for switches.
LPG	Liquefied Petroleum Gas	
MPI	Multi Point Injection	Fuel injection in inlet manifold.
OBD	On Board Diagnostic	OBD systems gives access to the status of the various vehicle sub-systems and reports errors of these system.
PWM	Pulse Wide Modulation	Proportion of 'on' time with a regular interval or 'period' of time.
VSI-3 DI	Vapour Sequential Injection third generation Direct Injection	Next generation gas conversion systems for DI-engines.

4.1.2 Terms

Terms	Explanation
Dedicated kit	Complete engine and trunk side conversion kit; with all brackets and accessories included.
Free calibration parameters	Calibration parameters which can be changed by the dealer / technician.
Hall sensor	A sensor that is used to measure the magnitude of a magnetic field. Its output voltage is directly proportional to the magnetic field strength through it.
Prins AFC Software V2	Name of the calibration, service and diagnostic program.
Semi-dedicated kit	Engine conversion kit; with injector brackets and accessories included.
Switch back	Switch back from GAS to petrol modes.
Switch over	Switch over from petrol to GAS modes.
Universal VSI-3 DI kit	Engine conversion kit; without injector brackets, accessories and reducer bracket.

5 General engine features

5.1 Ignition coil

Important factors for a proper combustion include:

- Correct compression final pressure
- Optimal conditions for ignition

During gas mode the spark plug and will become warmer. According to measurements, the central electrode will be at least 50 °C warmer than during petrol mode. This is caused by the differences in chemical composition between LPG/ CNG and petrol.
The electrical resistance of the L LPG/ CNG /air mixture is higher than of the petrol/air mixture. Therefore, igniting a LPG/air mixture requires a 15-20% more power, i.e. the spark tension must be higher. When the ignition capacity is insufficient, driveability problems will arise immediately. Since the ignition of the LPG/ CNG /air mixture is more critical than of the petrol/air mixture, driveability problems will occur sooner while driving on LPG/ CNG.

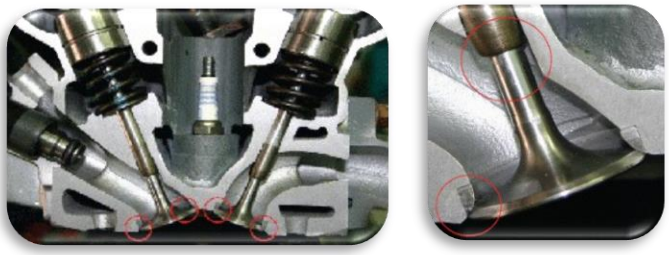
Often worn or bad spark plugs are the source of the failure of the ignition system.

5.2 Spark plugs

Since LPG/ CNG is harder to ignite than petrol, the requirements for the spark plugs are higher. In addition, LPG/ CNG is more aggressive than petrol, requiring the use of materials with extremely high load-bearing capacity. When using OEM spark plugs the replacement interval will have to be shortened, in some cases. Prins recommends using OEM sparkplugs.

Recommendation! In case of ignition problems Prins recommends OEM spark plugs.

5.3 Valves and valve seats



LPG/ CNG contains no additives, so increased wear may occur to the valves and valve seats. The extent of wear strongly depends on the materials used by the manufacturer and the use of the vehicle. High engine speeds

and loads will cause rapid wear. To prevent valve wear Prins advices to install the ValveCare-DI adaptive system.

Since LPG/ CNG contains neither additives nor sulphur, it has bad lubricating qualities. For some engines it is recommended to use an additive to lubricate and cool the valves.
For this reason Prins has developed ValveCare-DI. ValveCare-DI is an additive dosing system compatible with the Prins VSI system. It is suitable for all combustion engines using alternative fuels such as LPG and CNG. ValveCare-DI is used for the correct dosage of additives which prevent excessive valve and valve seat wear.

Insufficient valve clearance will cause burnt valves. If the valve clearance is too small, the valve will be closed for a shorter period of time, which does not allow the valve enough time to discharge its heat through the valve seat. So the most obvious solution would be to increase the valve clearance.

Attention! When the valve clearance is too large, it will cause the camshaft load to double, which will have far-reaching consequences.

Recommendation! If possible, always adjust the valve clearance according to the instructions of the car manufacturer. In some cases it is advisable to check the valve clearance more frequently.

5.4 Engine oil

In some cases it may be seen that engine oil is increased during driving on petrol. During driving on gas, the engine oil is no longer diluted with petrol. Therefore, the actual oil consumption is determined while driving on gas.

6 VSI-3 DI approval numbers

Reducer eVP-500: E4-67R-010358

Injector rail: LPG E4-67R-010093
CNG E4-110R-000021

Filter unit T1 / T2 Prins : LPG E4-67R-010096
CNG E4-110R-000028

Filter unit Keihin: LPG E4-67R-010177
CNG E4-110R-000091

Injector Keihin KN9: LPG E4-67R-010310
CNG E4-110R-000295

Prins AFC-3.0 DI: LPG E4-67R-010098
CNG E4-110R-030083
E4-10R-050507 (EMC)

WinLas: LPG E37-67R-010140
CNG E37-110R-000012

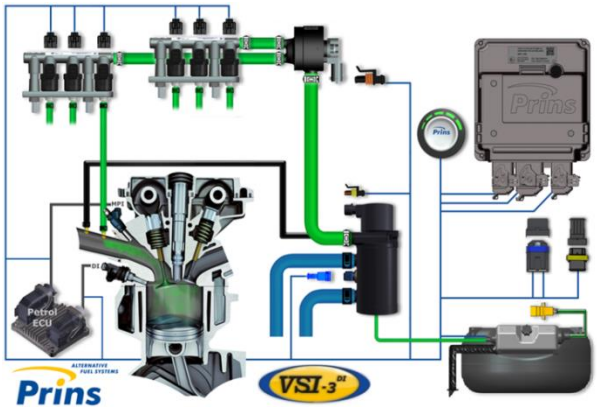
Thunderflex: LPG E24-67R-010018
CNG E24-110R-000040

Fuel supply hose XD E4-67R-010247

Regulator CNG
Ventrex E1-110R-000186

7 VSI-3 DI introduction

7.1 Highlights VSI-3 DI

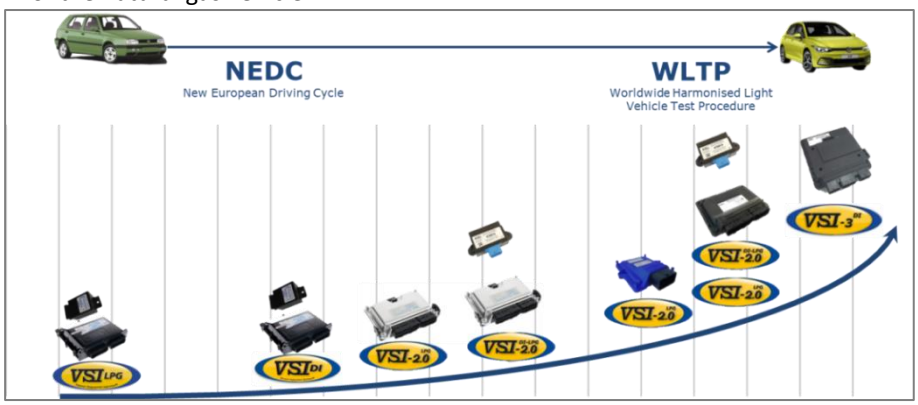


VSI-3 DI system
Unique and future proof LPG/ CNG system for latest DI engines up to Euro 6D emission standards. The system is equipped with AFC-3.0 DI computer and eVP-500 LPG reducer.

AFC-3.0 DI computer
Advanced ECU with integrated DI injector emulation and full limp-home functionality.

eVP-500 LPG reducer
Compact full electronic LPG reducer for low to high power engines which gives smooth and optimal driveability performance.

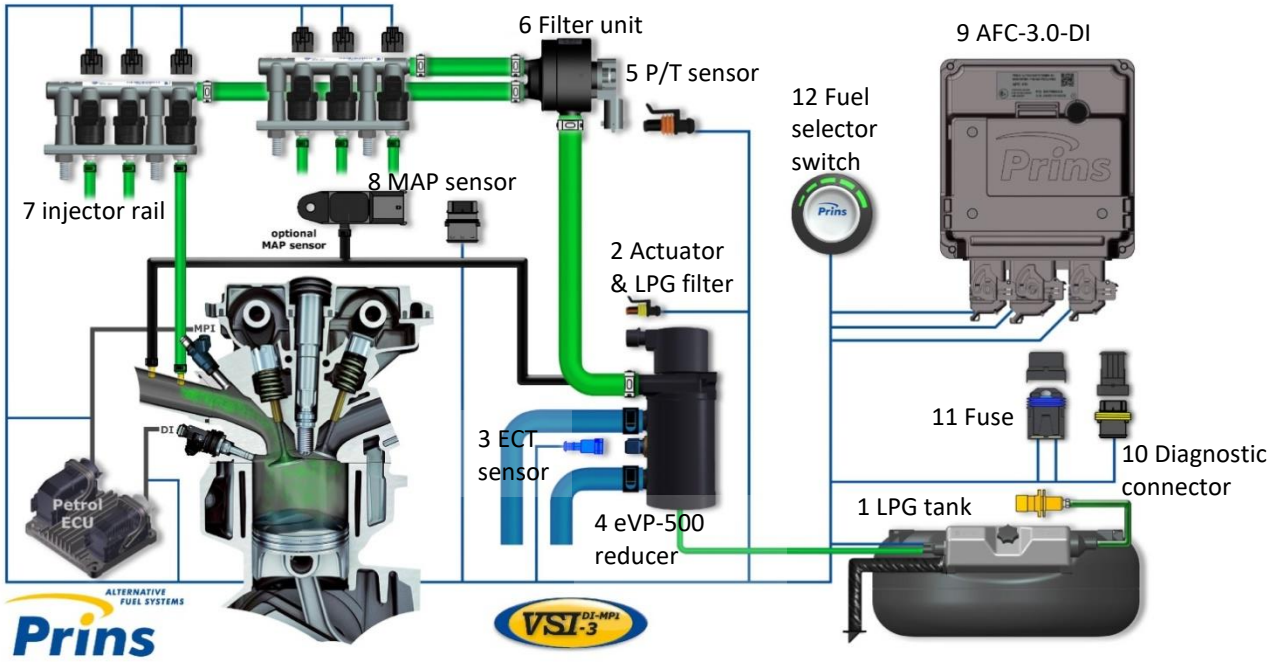
Ventrex Evo 3.1 reducer
State of the art electro-mechanical valve to continuously adjusting the gas pressure demanded by the AFC-3.0 DI of the natural gas vehicle.



7.2 VSI-3 DI Unique Selling Points

- For DI and DI-MPI engine technology
- Minimal petrol consumption (<5%)
- Maximum performance, lowest emissions
- For vehicles including latest Euro 6D WLTP technology
- New AFC-3.0 DI computer
- Single AFC for 3 - 6 cylinder
- Master-Slave for 8 - 12 cylinder
- OEM quality LPG/ CNG components
- R115/EPA R110/R10 certified
- Plug & Play wiring harness (optional)
- ValveCare-DI (optional)

7.3 Description



VSI-3 DI is the third VSI-DI generation. VSI-3 DI stands for '**V**apour **S**equential **I**njection third generation **D**irect **I**njection'.

VSI-3 DI has been introduced to run modern vehicles flawlessly on LPG and CNG. Advanced engine controls, emission requirements and engine management diagnostic functions require a new generation of gas systems.

VSI-3 DI uses both existing and latest new developments. New techniques, such as the eVP-500, the AFC-3.0 DI and proven techniques such as the Keihin KN-9 LPG/ CNG injector, the Prins filter and the switch.

Pressurised Liquid LPG is stored in the tank / LPG fuel tank (1). The tank contains a number of tank accessories for safe storage of LPG. A fuel level sensor is mounted on top of the tank to measure the fuel level and send this information to the AFC-3.0 DI (9). The tank indication LED's on the fuel switch (12) informs the driver about the fuel level.

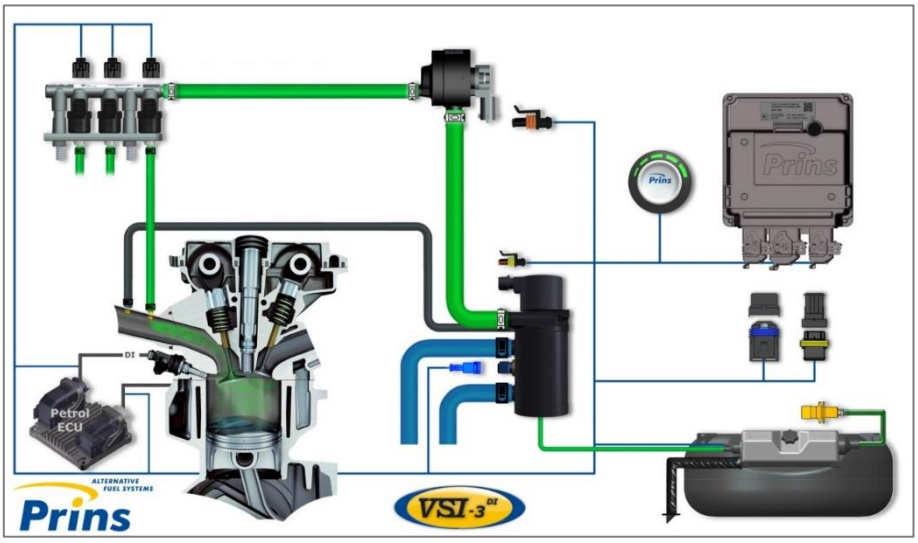
When LPG mode is selected, the tank lock-off valve will be supplied with 12V or a PWM. By activating the tank lock-off valve, the liquid LPG flows to the eVP-500 reducer (4).
The engine coolant warms up the liquid LPG inside the eVP-500 reducer. The LPG will become vapour. The vaporized LPG will flow through a filter to the electronically controlled plunger which controls the system pressure.

A filter unit (6) is placed between reducer and injectors. It filters the vaporous LPG to prevent contamination of the gas injectors. A combined PT-sensor (5) is installed in the filter unit. This sensor measures the gas temperature and system pressure. These signals are processed by the AFC-3.0 DI (9) to obtain the proper mixture.

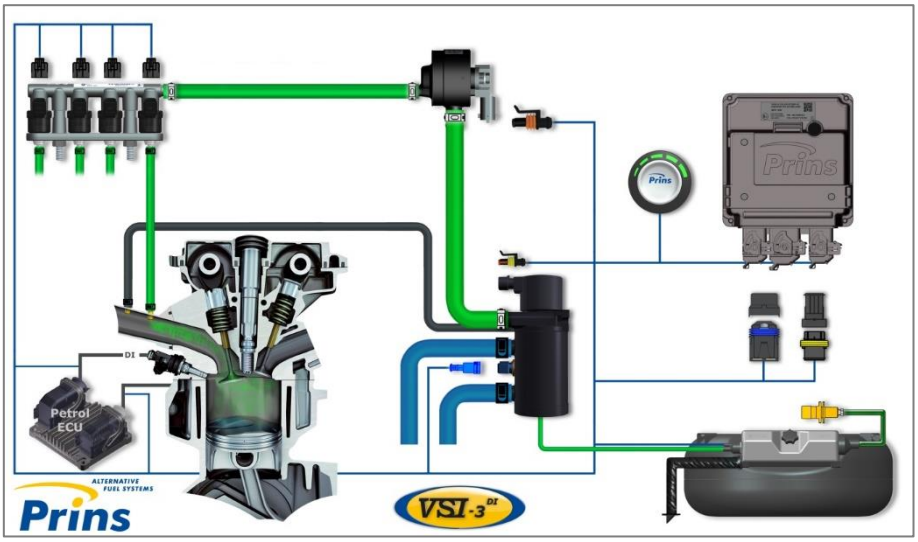
The gas injectors (7) inject the vaporous LPG sequentially into the inlet manifold.
During LPG mode all petrol injectors must be switched off and simulated. All DI and MPI petrol injectors are directly connected to and simulated by the AFC-3.0 DI.

7.4 General system overview VSI-3 DI

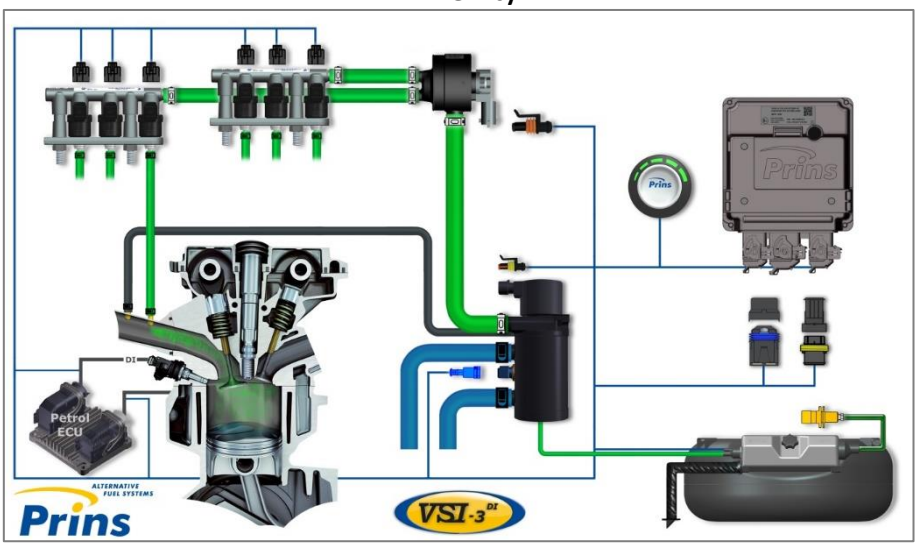
7.4.1 LPG DI-engines



DI LPG 3-cyl

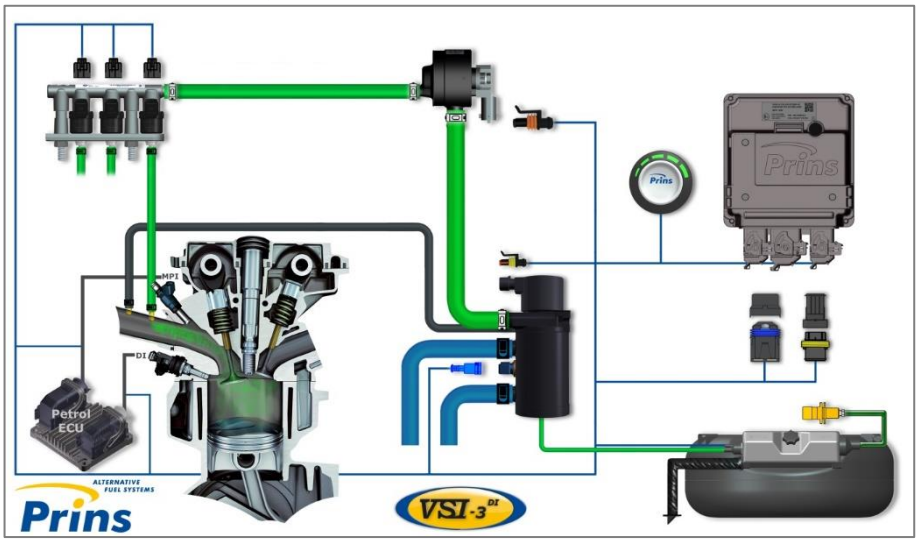


DI LPG 4-cyl

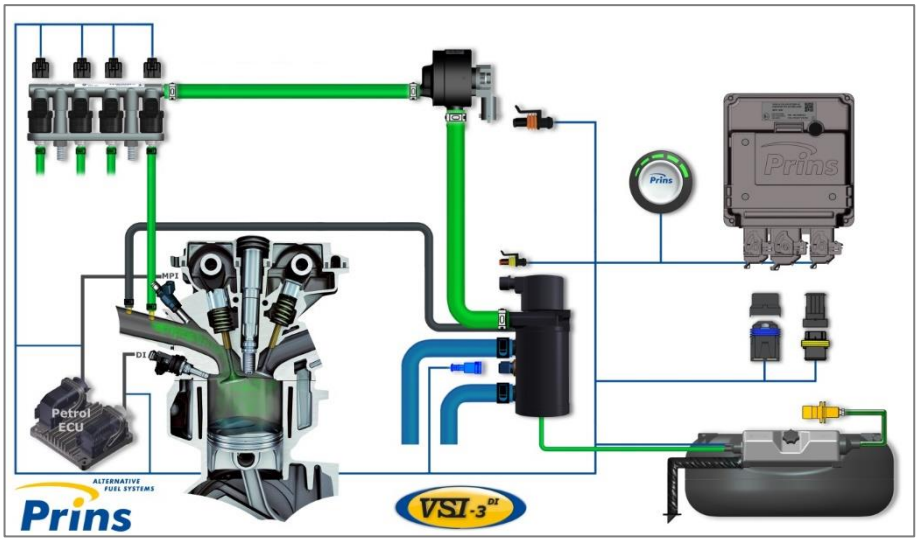


DI LPG 6-cyl

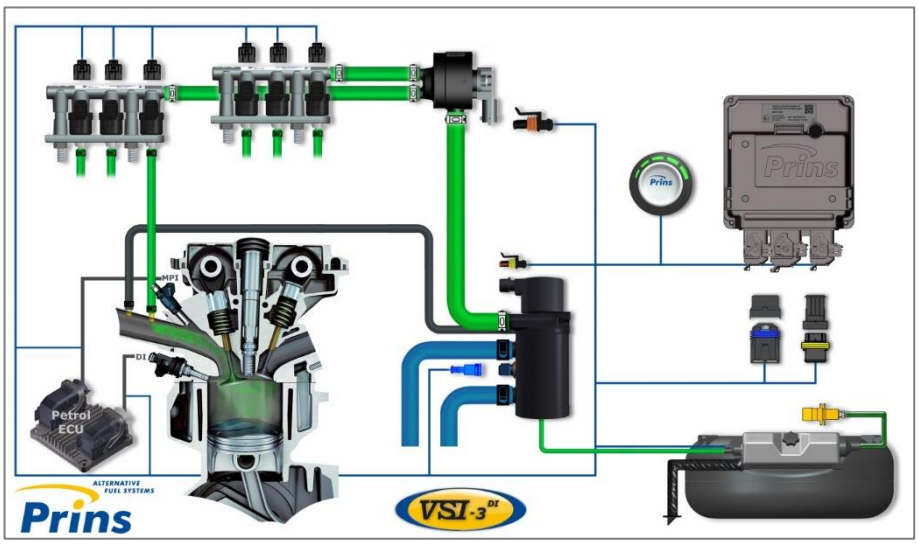
7.4.2 LPG DI-MPI -engines



DI-MPI LPG 3-cyl

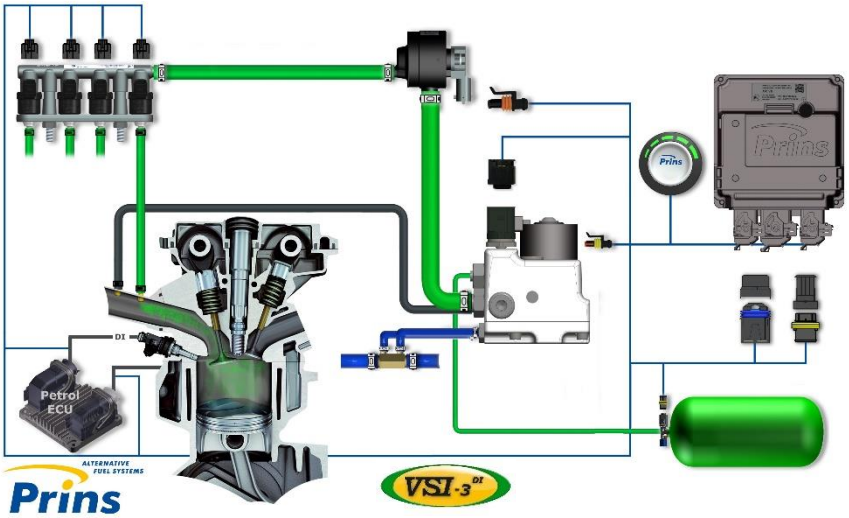


DI-MPI LPG 4-cyl



DI-MPI LPG 6-cyl

7.4.1 CNG DI-engines



DI CNG 4-cyl

8 VSI-3 DI Components

8.1 AFC-3.0 DI

8.1.1 Highlights

- 3 Versions:
  - 3 Cylinder DI-MPI [180/700044]
  - 4 Cylinder DI-MPI [180/700040]
  - 6 Cylinder DI-MPI [180/700041]
- DI-MPI compatibility
- Full limp-home functionality
- Future proof I/O design
- OBD-CAN gateway
- Flexible 2-way mounting system

8.1.2 Function

- Measures and processes all input signals
- Simulates various OEM sensors
- Controls two tank lock-off valves and the eVP-500 reducer
- Controls the LPG/ CNG injectors
- Interrupts/simulates the DI and MPI petrol injectors
- Control fuel switch
- Monitors the gas system and generates trouble codes in case of errors
- Communicating with Prins AFC Software v2 application

8.1.3 Specifications

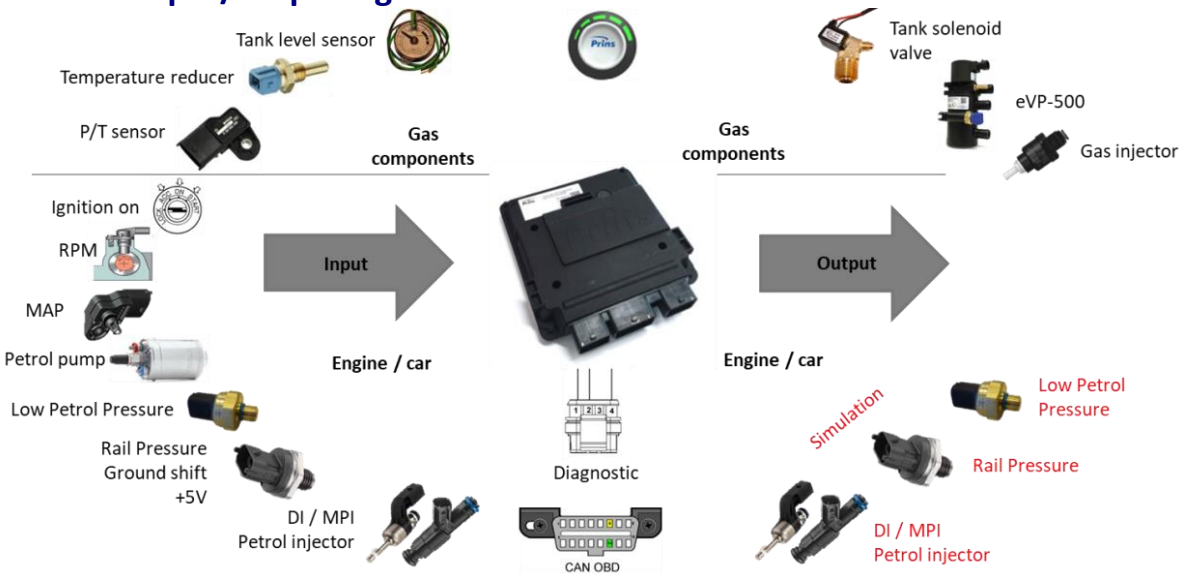
Item	AFC-3.0 DI
Types	4 Cylinder & 6 Cylinder
Colour	Black
Environment	Engine compartment or interior, -40˚C to +120˚C
Homologations	R67, R110, R10
Housing	Plastic top with ventilation plug - Aluminium bottom with cooling fins covers - IP69K
Dimensions box (mm)	208 x 180 x 44
Weight (gr)	1200
Operating voltage	7,5V to 15V, reverse voltage and ISO pulse protected (limp home 5V)
Connector	3 Connectors - Molex
Inputs	Analog sensors - Digital OEM sensors - Digital inputs
Petrol injectors	DI and MPI 2-3-4 or 5-6 cylinder
MPI petrol injector types - simulator	High impedance saturated – Internal Emulation
DI petrol injector - simulator	Coil - Integrated Variable GDI Emulation
Outputs	High powered outputs - 6x Gas Injectors - 3x Tank / Regulator
Gas injector drivers	6 Amp(max) Peak mode - 1.5 Amp hold mode with current feedback and plunger movement detection
Current consumption	Standby current 27 mA @ 12V - sleep current < 0,50 mA @ 12V
Communication Interfaces	2 or 3 CAN, 1x LIN-bus
Flexibility	ECT sensor or OEM - analog or digital OEM sensors - selectable RPM input range - multi colour fuel switch

8.1.4 Description

The AFC-3.0 DI computer is the heart of the VSI-3 DI system.
The housing is made of plastic cover and aluminium back plate with heat ridges. For heat dissipation it's important to place it in the relative cool location in the engine compartment with unblocked heat ridges.

The AFC-3.0 DI is one of the key components to run the engine on an alternative fuel. It ensures that the petrol injectors are interrupted and gas is injected. Injection of gas must not affect the functioning of the engine and the engine management. Trouble-free operation on alternative fuel functions is an increasing challenge for modern engines. Especially interrupting the petrol injectors and the petrol pressures deviate while driving on an alternative fuel. When driving on gas, the sensors of the petrol system react differently than expected by the engine management.

8.1.5 Input/output signals



Various signals are measured to calculate the correct amount of the fuel and flawless drivability without engine management errors. The AFC can manage analogue, digital and communications signals.

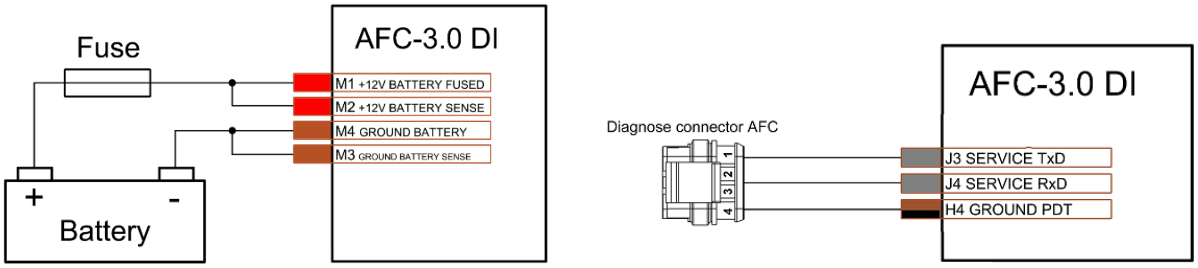
All engine components connected to the AFC-3.0 DI are explained in the chapter 'Engine Sensors and Actuators'.

Input signals:	Explanation
DI-MPI Injector signals	Basic information to calculate the gas injection timing
Petrol high rail pressure	To measure the actual pressure and simulations strategy
Petrol Low pressure	To measure the actual pressure and simulations strategy
Petrol pump signal	Measure the petrol pump load for simulations strategy
RPM signal	Activate lock-off valves and calculations
Manifold pressure (MAP)	Create MAP related dynamic gas system pressure
Coolant temperature	Switch over temperature
Lambda sensor	Correct fuel mixture
+ Ignition	Wake up and for simulations strategy
5V Wakeup ECM	Wake up and shut down at same time as ECM
LPG System pressure	Correct gas injection time
LPG System temperature	Correct gas injection time
LPG Tank level	Tank level information

Output signals:	Explanation
Gas injector timing	Activate the gas injectors
LPG tank lock-off valve	Supply the coil and open the tank lock off valve
eVP-500 reducer actuator	Variable voltage for coil to manage the gas system pressure and flow
DI-MPI Petrol injector	To simulate the interrupted petrol injectors
Simulation of engine sensors	Pressures deviate on gas. simulation ensures correct values for ECM
5V sensor supply	Supply gas system sensors

Communication signals:	Explanation
OBD CAN-Bus	Extra information for calculations and strategies
Fuel selector switch [LIN-bus]	Switch over/back and inform driver
Prins AFC Software v2 [TXD&RXD]	Flash, change setting and diagnose

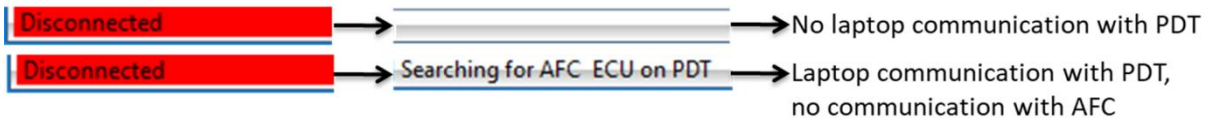
8.1.6 Electrical connection



8.1.7 Diagnostics

Engine does not run on gas, Fuel selector switch does not lit, and no communication with the Prins AFC Software V2
Check / insert the main fuse. The fuse is not installed when the wiring harness is delivered.

No communication with Prins AFC Software V2
Check the main fuse and +12V ignition.
Check if the Prins Diagnostic Tool (Communication interface) is active.
The Blue LED of the PDT flashes during communication with between PDT and laptop.



8.1.8 Prins AFC Software v2

Process parameters

	Term	Explanation	Expected values	unit
183	Battery voltage	Actual Battery voltage measured via BAT-sense wires	10-15	V
340	ECU Voltage	Actual ECU power supply voltage		
184	Board Temperature 1	Actual temperature of the circuit board of the internal injector module	-20 +120	°C
343	Board Temperature 1 Max	Maximum archived temperature of the circuit board	-20 +120	°C
1060	Master ECU		0: Yes 1: No	-
110	Selected Fuel	Selected fuel with switch	Gas / Petrol	-
2	Status VSI-2.0	Indicates the system status	Different statuses	
4269	LSS2 actual	Ground output active	0: not active 1: active	-
368	Engine State	Engine running or shut down	On/Off/FCO	-
624	Actual Fuel	Actual injected fuel	Gas/Petrol	-
102	Ignition Plus	+12V signal present	0: not active 1: active	-
428	Active Critical Trouble Code	Critical Trouble Code present in AFC	Yes / No	-

8.2 VSI-3 DI System Status

Different AFC statuses are possible. The most common statuses will be described:

- Sleep mode
- Engine off [1]
- Petrol Selected [2]
- Switch over solenoid valve closed [16]
- Pre-opening [15]
- Switching over to gas [6]
- Gas [7]
- Gas not Allowed [11]
- Tank empty [9]
- Tank empty retry [22]
- Error [10]

These statuses are shown in the lower right side of the Prins AFC Software v2 and in the log files in column 'STATUS VSI'.

Sleep mode
In order to minimize the power consumption when the car is not used, the AFC is switched to sleep mode. The AFC goes to sleep mode shortly after ignition + and the 5V sensor wake up signal are not present any more. The communication status bar will be coloured red.

Engine off [1]
Engine off [1] is active when + contact and/or the 5V wake-up is active without running engine. Normally this is during ignition on and when the engine management is active. The communications start between the AFC and Prins AFC Software v2. The communication status bar will be coloured green.

The fuel selector is supplied and communicates with the AFC. The 5V for the P/T-sensor and reducer temperature is active. The tank level is read, and all connected engine inputs are read and simulated.
When the computer detects an RPM, it switches over from engine off to 'Petrol selected [1]', 'Switching over to gas [6]', 'Gas [7]'or 'Gas not allowed [11']. This depends of the fuel selection and status of the engine, like coolant temperature, engine run time or settings of the calibration.

When the wake-up signals are not available anymore, the AFC will go to sleep mode after a certain time. This time is depends on the settings in the calibration. Also the communications stops between the AFC and Prins AFC Software v2. The communication status bar will be coloured red.

The Engine off status is numbered by 1 in the log file.

Petrol Selected [2]
The engine runs on petrol and the fuel status LED is off. All petrol injectors are active and engine signals are read by the AFC and unmodified send to the engine management.
The gas tank level can be monitored on the switch.
The Petrol selected status is numbered by 2 in the log file.

Switch over solenoid valve closed [16]
The fuel selector switch has been pressed to select gas. This signal is send to the AFC and it starts the switch over to gas procedure/
The Switch over solenoid valve closed status is numbered by 16 in the log file.

Pre-opening [15]
The tank solenoid valve will be active and the reducer pressurizes the gas injectors. During pre-opening
The Pre-opening status is numbered by 15 in the log file.

Switching over to gas [6]
The system switches over from petrol to gas when all . The engine can run on both fuels for a few injections. Often the switch over is managed per cilinder. The simulation of the connected engine sensors starts.
The Switching over to gas status is numbered by 6 in the log file.

Gas [7]
The engine runs on gas. The status LED of the fuel selector switch is active. The gas injectors are active. The petrol injectors are inactive and simulated. The petrol rail pressure is read and simulated to the engine management. The low petrol pressure can also be simulated when needed. This depends on the strategy of the engine management.
The Gas status is numbered by 7 in the log file.

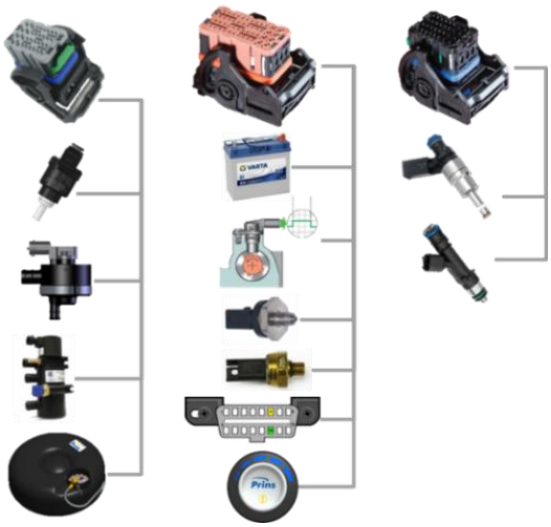
Gas not allowed [11]
The system can switch back to petrol automatically.
When a device is connected to the OBD-system, the system will switch back to petrol and with the system status 'Gas not allowed'.
Gas not allowed will also be active when the hardware of the AFC gets too hot.
Some applications use 'Gas not allowed' during, manoeuvring or other situations for the best drivability, comfort and performance.
The Gas not Allowed status is numbered by 11 in the log file.

Tank empty [9]
The system monitors the gas system pressure with the P/T sensor in the filer unit between the reducer and the gas injector rail. When the system pressure becomes too low, the system will switch back to petrol. This pressure is called the Tank empty pressure. This tank empty pressure is calibration depended and the value can be found in the Prins AFC software V2.
The Tank empty status is numbered by 9 in the log file.

Tank empty retry [22]
During a Tank empty status the engine runs on petrol. Within a minute the system tries to twitch over to gas to check if the system pressure is really too low. The system pressure can be too low during different circumstances, like cold weather, to small tank valve or other blockage. With sufficient system pressure, the system switches to over gas to gas. With insufficient system pressure, the engine will continue to run on petrol.
The Tank empty retry status is numbered by 22 in the log file.

Error [10]
During a critical fault the system will switch back to petrol.

8.3 Wiring harness



8.3.1 Highlight

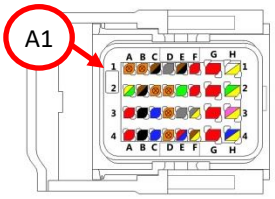
- 3 Connectors – 112 pin header
- GAS injectors / Reducer / Tank -> Grey [1]
- Supply / Ground / OEM sensors -> Brown [2]
- DI - MPI Petrol injectors -> Black [3]
- Simple – clean – efficient routing
- Modular wiring harness system

8.3.2 Description

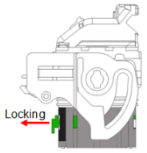
The AFC-3.0 DI is equipped with three Molex connectors, grey [1], brown [2] and black [3].
Each connector has its own main function.
All wire numbers correspond with the position numbers on the connector (see wiring diagram).
Example: wire number L3 can be found on connector position number L3.
The wires have a colour, a number and text description. The text refers to the function of the wire and is identical as the description in wiring diagram.

Detailed wiring harness information is explained in chapter ‘Electrical installation instructions’

LPG system components	Grey [1]
Gas injectors	
System Pressure & Temperature sensor	
eVP-500 reducer actuator	
eVP-500 coolant temperature sensor	
Tank lock of valve)s)	
Tank level sensor(s)	
NOT the fuel selector switch	



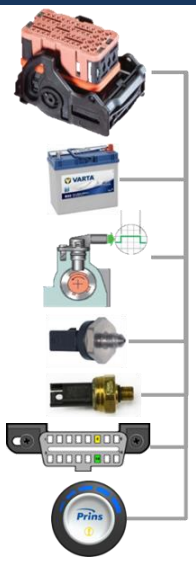
A1 upper left corner

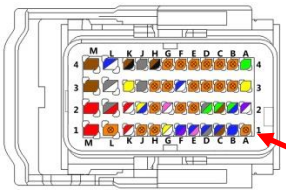


Attention!

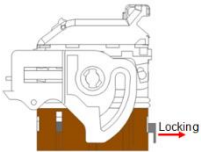
Numbering of grey connector pinning rotated 180 degrees.

Supply / ground / engine	Brown [2]
Battery voltage and ground	
Fuse	
Ignition +	
Engine management wake-up	
Fuel selector switch [LIN-bus]	
OBD CAN-bus	
Diagnostic connection [TXD&RXD]	
Inlet manifold pressure	
High pressure petrol rail pressure sensor input and simulated output	
Low pressure petrol pressure sensor input and simulated output	
Petrol pump signal	
Lambda sensor	
Various optional signals	

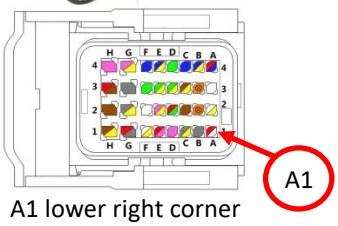




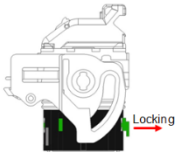
A1 lower right corner



DI-MPI Petrol injectors	➢ Black [3]
DI Petrol injectors interruption	
DI Petrol injectors simulation	
MPI Petrol injectors interruption	
MPI Petrol injectors simulation	



A1 lower right corner



8.3.3 Variants

Universal and dedicated (tailor made) wiring harnesses
Universal and dedicated (tailor made) wiring harnesses are available. This depends of the layout and complexity of the conversion. More complex engine systems, like a DI-MPI system, prefer a tailor made wiring harness to reduce conversion issues and log diagnostic times. A universal wiring harness is sufficient for basic 4 cilinder DI engines.

Dedicated harness; example Ford 3.3 DI-MPI

OPTIONAL WIRING MODULES
The standard harnesses support basic functions / wires. Optional wiring modules are available when extra options are needed; for example, a second tank or an OBD gateway.
Use the Webshop to order the extra needed features.

Wiring loom 2nd CAN module for PSA Fuel gauge reset

Picture soon
3rd CAN wiring
Yellow/red – Green/red

Wiring loom OBD Gateway wiring

Wiring loom OBD Gateway Connectors (without CAN wires, order separately)

Second tank module

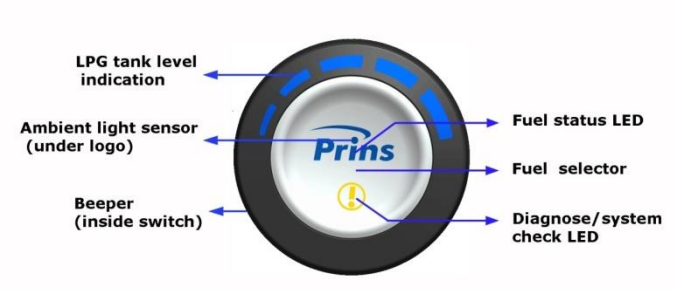
Additional wire

8.4 Fuel selection switch

8.4.1 Features

- Small and compact design suits all interiors
- Fuel selection via smart touch control
- Informs operator on tank content
- Audible buzzer to alert for an empty tank or fault codes
- Illuminated fault code warning with LED
- Fully programmable LED colors

Attention! Ensure that the correct tank gauge is programmed!



8.4.2 Description

The multi-colour fuel selection switch is controlled by a touch control button. When pushing the button, the computer receives a switch-over signal. The computer will change the actual fuel selection.

The switch also features five tank indicator LED's that indicates the current tank level.
It's possible to change colours using the diagnostic software to meets the customer wishes.
The switch is controlled by the AFC through LIN communication.

When the gas system pressure is too low (empty gas tank), the system will automatically switch back to petrol mode. A beep signal informs the driver of empty tank and switch back to petrol mode.

8.4.3 Operation mode

Normal operation modes

Switch operation mode Normal	Fuel selection	Active fuel	Status LED	Tank level LED	Beeper	Diagnose LED
Engine off					Off (delay	
Ignition+ on /engine off	Petrol	-	Off	On	Off	Red 3 sec.
Ignition+ on /engine off	Gas	-	On	On	Off	Red 3 sec.
Petrol mode	Petrol	Petrol	Off	On	Off	Off
Gas mode	Gas	Gas	On	On	Off	Off
Switch over to Gas	Gas	-> Petrol to Gas	Flashing [1 Hz]	On	Off	Off
Tank empty (switched back to petrol)	Gas	Petrol	Flashing [1 Hz]	LED 1 [Red]	3x [0,5 Hz]	Off
Tank empty (confirm by pressing switch)	Petrol	Petrol	Off	LED 1 [Red]	Off	Off

ValveCare-DI

Switch operation mode ValveCare-DI	Fuel selection	Active fuel	Status LED	Tank level LED	Beeper	Diagnose LED
ValveCare reserve	Gas	Gas	On	On	Off	Blue 1 Hz
ValveCare empty	Gas	Petrol	Flashing [1 Hz]	On	Beeping [1 Hz]	Blue
ValveCare empty (confirm by pressing switch)	Petrol	Petrol	Off	On	Off	Blue

Fault situations

Switch operation mode Fault codes	Fuel selection	Active fuel	Status LED	Tank level LED	Beeper	Diagnose LED
Non critical fault (gas mode)	Gas	Gas	On	On	Off	Yellow 1 Hz
Non critical fault (petrol mode)	Petrol	Petrol	Off	On	Off	Yellow 1 Hz
Critical fault (gas mode)	Gas	Petrol	Flashing [1 Hz]	On	Beeping	Red 1 Hz
Critical fault (confirm by pressing switch)	Petrol	Petrol	Off	On	Off	Red 1 Hz
OBD related fault / External OBD tester / device	Gas	Petrol	Flashing 2 Hz	On	Off	Off

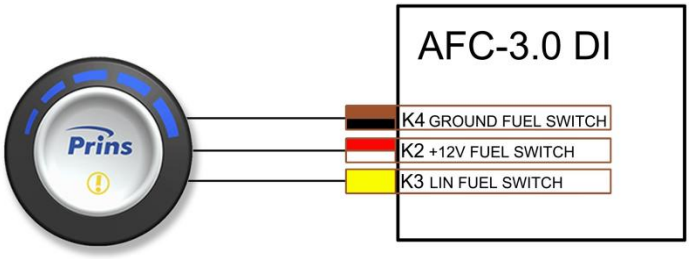
Emergency start

A special procedure is available to start direct on gas.

- Turn on the ignition
- Press on the Prins switch until the lock off valves open.
- Start the engine

After 5 emergency starts, the system will not switch over to gas anymore. The AFC-3.0 DI needs to be reset by a Prins certified installer.

8.4.4 Electrical connections



Grey connector Electrical connection	AFC
Supply	K2
Ground	K4
LIN-bus data	K3

8.4.5 Diagnostics

Inactive switch
When the switch does not light up, check the fuse and small three pole connector..

Fast flashing white
The AFC is not activated. Activate it with the Prins AFC Software V2.

8.4.6 Prins AFC Software v2

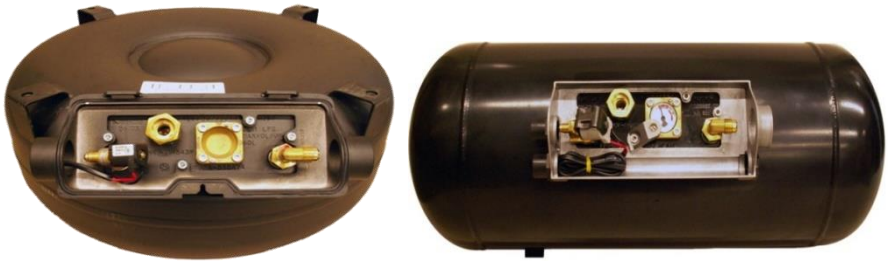
Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	unit
215	Power Switch/Acc	Fuel selector switch supplied	Yes No	-
600	Tank Level Status	Tank 1 level percentage	0-100	%
11263	Tank Level 2 Status	Tank 2 level percentage	0-100	%
197	Daylight Sensor	Light intensity	0-100	%
1568	Daylight Correction	Correction of LED power	0-100	%

Advanced – Calibration parameters

	Term	Explanation	Values	unit
2276	Tank Indicator LED Strategy	**Always on**: LED's active during Petrol and Gas mode **Only when active fuel is gas**: LED's active during gas mode. **Only when gas is selected**: LED's active during gas mode, switch over and petrol start.	Always on / Only when actual fuel gas / Only when gas selected	-
155 Table	Tank Indication LED Color	The LED color can be modified for the tank level indication. The diagnostic tool will display the chosen color as an indication.	Table	-
157 Table	Tank Indication LED Tank Empty Color	The LED color can be modified for the tank empty situation. The diagnostic tool will display the chosen color as an indication.	Table	-
4152	Tank Level Refuse Rise During Wake	Tank level may rise during dynamic driving conditions. **Yes**: The tank level indicator may not rise during engine on. It only rises during ignition on. **No**: The tank level indicator may rise during engine on.	Yes/No	-

8.5 LPG fuel tank



8.5.1 Function

- Safe storage of liquefied LPG
- Providing housing for all fittings

8.5.2 Description

LPG tanks are available in various shapes and sizes. LPG tanks have been tested up to 30 bar.
Production date and homologation information can be find on the tank.

For homologation, legislation and installation information, refer the Chapter ‘General installation instructions trunk side’ and the Prins website.

8.5.3 Variants

Various tank brands, types, volumes and dimensions are available. Visit the Webshop for more product information.

Attention! Always refer to the installation instructions of the tank manufacturer and local installation regulations

8.6 LPG Lock-off valve (tank)

8.6.1 Function

- Stops the LPG flow from tank to reducer
- Limits the LPG flow in case of a broken pipe

8.6.2 Specifications

- Coil with water-proof housing
- Complies with R67-01 regulations

8.6.3 Description

The lock-off valve is a legally required component which shuts off the LPG flow in case the engine speed/ignition signal is missing.
The LPG lock-off valve is mounted on top of the tank.
The LPG lock-off valve is activated by the AFC when LPG is selected as fuel and no system errors are present.
The supply from the LPG tank to the other LPG components is shut off when switching back to petrol mode, when stopping the engine and in case of system errors.

8.6.4 Variants

Different types of tank valves can be found on the tank.

Tank valves

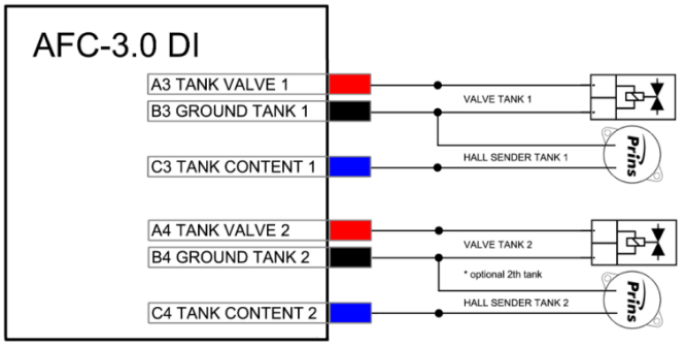
- Standard vale
  - not suitable for VSI-3 DI
  - Big Flow Capacity
  - Increased bore from 3.2 to 5.2mm
  - Pilot operated
  - 135 kW [>180HP]
  - XD4 high pressure fuel line
  - Only compatible for eVP-500

- When a standard valve has been used, a tank empty can occurs due to the limited fuel supply form the gas tank.

Tank solenoid valve

Various tank valve coils are available on the market. Some of them consume a lot of power. The maximum current supplied by the AFC is 2A (24W).

8.6.5 Electrical connection



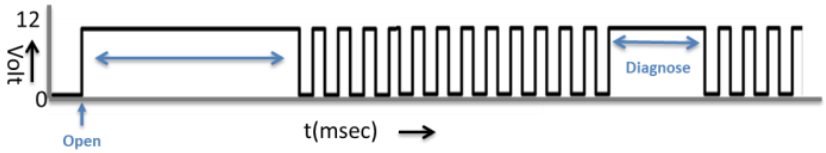
Grey connector Electrical connection	Tank 1	Tank 2
Supply	A3	A4
Ground	B3	B4
Level sensor signal	C3	C4

Coil	Min.	Max
Current (A)	0,5	2
Power (W)	6	24

The solenoid valve for tank 1 is standard wired on the grey connector. An optional 2nd tank wiring module can be ordered via the Webshop.
The ground is also used for the tank level sensor(s).

The AFC supplies the solenoid of the tank lock off valve, connected to the Grey connector A3. To reduce the temperature of the solenoid valve is powered with a Pulse Width Modulation voltage (PWM) as default. During opening of the valve a constant 12V is supplied. After a few seconds, the constant 12V is changed to a PWM supply. Sequence will be repeated after 60 seconds. The current through coil is diagnosed during 12V constant. When it get too high a fault code will be generated.

Some solenoid valves do make some noise when supplied with a PWM. Change the free parameters with Prins AFC Software v2 to a constant 12V supply.



The solenoid valve of a second tank can be directly connected to the grey connector. Change the free parameters with the Prins AFC Software v2.

8.6.6 Diagnostics

Whispering buzzing noise
The solenoid valve may produce a buzing noise due to the 12V PWM supply. Set calibration parameter 4335 Power Tank SO PWM Enable to [No]

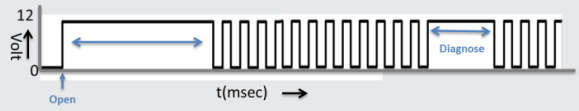
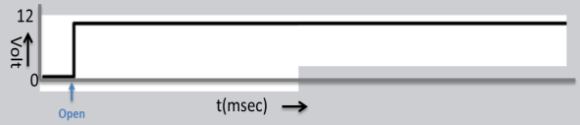
Tank 2 valve inactive
Check the calibration parameters of the 2nd tank and strategy.

8.6.7 Prins AFC Software v2

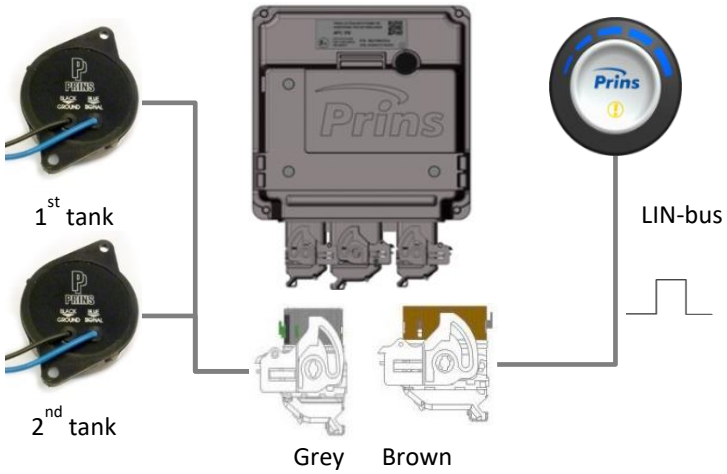
Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	unit
209	Power SO Valve Tank	Solenoid valve tank supplied	0: inactive 1: active	
356	Tank Solenoid Current	Current through solenoid	1-1,2 A no PWM 0,8A with PWM	A
6379	PowerOutputTank2Actual	Solenoid valve tank supplied	0: inactive 1: active	
11251	Multiple Tank Valve Separate Mode Active Tank	Tank valve 1 or 2 active	1: Tank 1 active 2: Tank 2 active	

Advanced– calibration parameters

ID	Name	Value	Unit	Default (min/max)	Explanation
2403	Output 1 function Tank 1	Disabled / Tank valve / Tank valve relay	-	Tank valve	**Disabled**: No Valve connected / manual valve **Tank valve**: Tank valve 1 supplied
6363	Output 3 function Tank 2	Disabled / Tank valve / Tank valve relay		Disabled	**Disabled**: No Valve connected / manual valve **Tank valve**: Tank valve 2 supplied
4335	Power Tank SO PWM Enable	Yes/No	-	Yes	**Yes**: To reduce the voltage and power through the solenoids [1 and 2]. The temperature of the solenoid will increase less. The first few seconds switched with 12V, then PWM switched. After each 60 second the sequence will be repeated. **No**: Some valves can't handle PWM. They remain in a closed position or the valve produces a whistling sound.
					Yes: Average supply voltage < 12V
					No: Supply voltage > 12V
11248	Multiple Tank Valve Strategy	Disabled / Separate / Simultaneously	-	Disabled	**Disabled**: multiple tank strategy not active (default) **Separate**: Tank valve 1 opened until empty -> Tank valve 2 opened. **Simultaneous**: Both valves opened (Not allowed in some countries. Check this before activating this function)
11613	Tank 1 Volume	Value	l	0	Enter the gross tank volume (100%)
11614	Tank 2 Volume	Value	l	0	Enter the gross tank volume (100%)

8.7 Tank level sensor



8.7.1 Function

- Measures the LPG fuel level of the tank(s)
- Sends voltage signal to AFC3.0 DI
- AFC-3.0 DI sends total tank level via LIN-bus to fuel selector switch

8.7.2 Specifications

- AFC supports Hall sensors and low resistance level sensors
- AFC supports two level sensor simultaneously

8.7.3 Description

The fuel level is measured by a sensor mounted to the tank. This sensor informs the AFC-3.0 DI the actual fuel level with a voltage. The fuel selector switch receives the tank level information via LIN-bus from the AFC. To prevent a nervous tank indication, a damping / delay is applied.
Only low resistive and Hall level sensor types are supported.

Two tank level sensors can be connected directly to the AFC-3.0 DI. The actual volume of both tanks is calculated and is send to the switch. Both sensors need to be the same type.
Refer to the diagrams for the relation between the tank level and tank level sensor voltage generated by the tank level hall sensor.
Order the ‘Second tank wiring module’ via the Webshop.

8.7.4 Variants


Livello 0-95Ω


AEB 1090 10-90Ω


AEB CARTESIO


Prins Hall


Rochester Hall

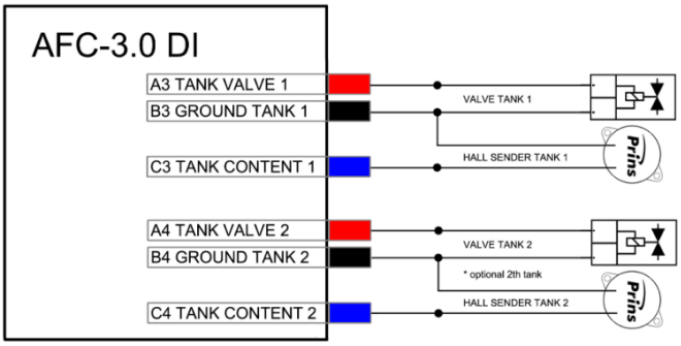

75K-0.1K not supported

Most common tank level sensors are supported by the AFC-3.0 DI.

- Low resistive [10-90Ω – 0-95Ω pre selectable]
- Hall
- User defined Low resistive [0-10V]
- High resistive level sensors are not supported. [75K-0.1K – 0-KΩ]

Attention! Set the parameters with the Prins AFC Software v2.

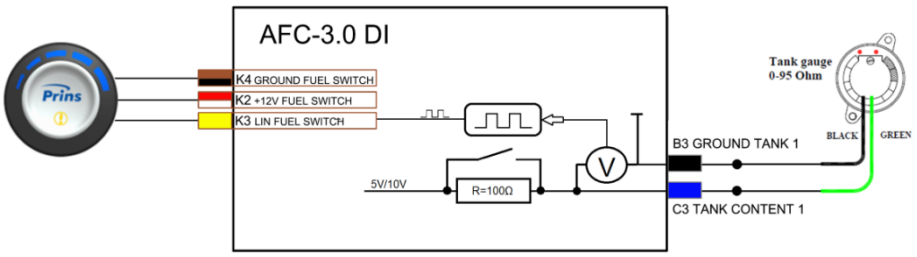
8.7.5 Electrical connection



Grey connector Electrical connection	Tank 1	Tank 2
Supply	A3	A4
Ground	B3	B4
Level sensor signal	C3	C4

Both tank level wires are located on the grey connector.
The ground is also used for the tank solenoid valves.

Pull-up



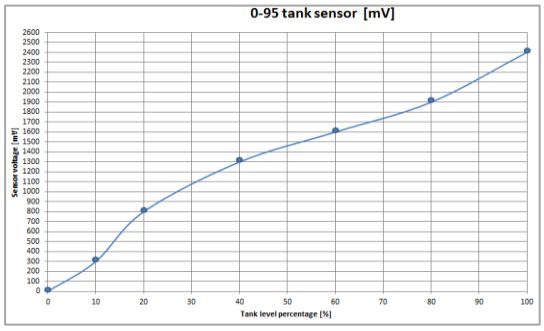
The fuel level is measured by a sensor mounted to the tank. This sensor informs the AFC-3.0 DI the actual fuel level with a voltage. The fuel selector switch receives the tank level information via LIN-bus from the AFC.

Low resistive and Hall level sensor types are supported. High resistive level sensors cannot be used; 20K or 75K level sensors. The internal pull-up resistor in the AFC has a value of 100Ω. Only use level sensors with a value of less than 1K (1000Ω).

The sensor of a second tank can be directly connected to the grey connector. Change the free parameters with the Prins AFC Software v2.

Resistive Livello 0-95Ω

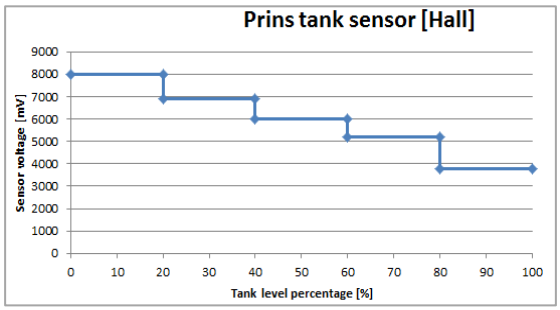
- Resistive type
- 6 level indication levels on fuel selector switch
- Analog signal
- 2 wire – 3 wire support
- AFC Internal pull-up 100Ω



Tank level (%)	Sensor voltage (mV)
0	0
10	300
20	800
40	1300
60	1600
80	1900
100	2400

Prins Hall sensor

- Operation according to Hall sensor principle
- Long life span / no wear
- 100% water-resistant
- 5 indication levels
- 2-wire 0-10V
- 3-wire 5V



Tank level (%)	Sensor voltage (mV)
0 – 20	8000
20 – 40	6950
40 – 60	6000
60 – 80	5100
80 – 100	3800

8.7.6 Diagnostic

Wrong indication

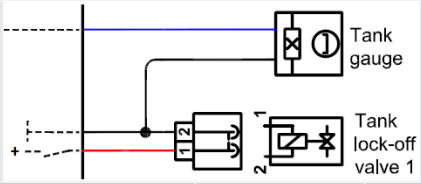
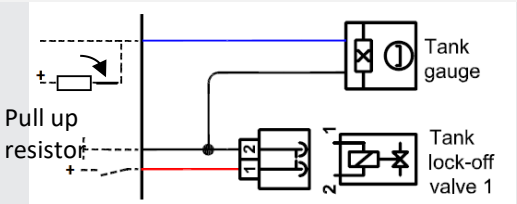
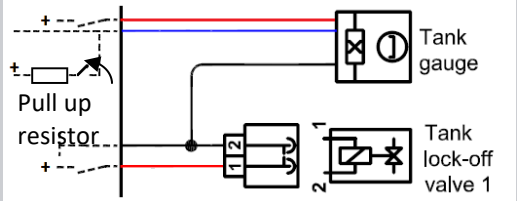
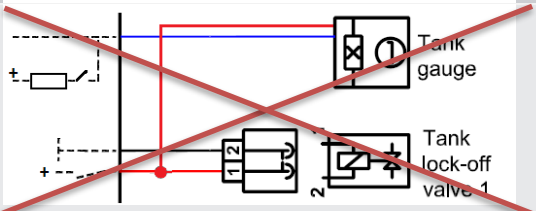
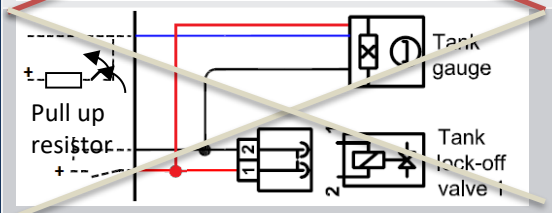
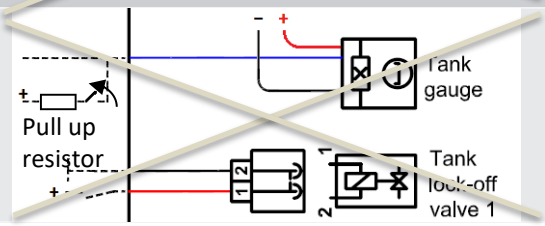
Different pre-defined sensors can be selected by the calibration parameters. Always check the settings and voltage of the sensor signal.

8.7.7 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	unit
190	Tank Level Voltage	Voltage of the tank level sensor	0-10	V
600	Tank Level Status	Percentage of tank level	0-100	%
5511	Tank Level Status Unfiltered	Indication without delay	0-100	%
11598	Tank Level 2 Voltage	Voltage of the tank level sensor	0-10	V
11263	Tank Level 2 Status	Percentage of tank level	0-100	%

Diagnostics – calibration parameters

ID	Name	Value	Unit	Default (min/max)	Explanation
444	Tank Level Sensor	Disabled / Hall / 0-95Ω / 10-90Ω / 90-3Ω / User defined	-	0-95 Ohm	Select <User defined> if the correct value is not available. If <User defined> then also parameter <616>, <617> and Table <User defined tank level sensor> may set.
					Connect the tank level sensor to the AFC as shown, when the value <Hall / 0-95Ω / 10-90Ω / 90-3Ω> has been selected.
616	Tank Level Sensor Voltage	10V / 5V	-	5V	Select the supply voltage according the specifications of the sensor. *Only change this parameter if parameter <444 Tank Level Sensor> has been set to <User defined>
76 Table	User defined tank level sensor	Table	-	Default Prins values (0-95Ω)	Tank Level Status versus Sensor Signal Voltage.
617	Tank Level Sensor Pull Up Enable	Yes/No	-	Yes	Set to <No> when the tank level sensor has an external power supply. The Pull up resistor will be disabled. *Only change this parameter if parameter <444 Tank Level Sensor> has been set to <User defined>
					Yes; Switch close -> Resistor enabled Sensor type: 2 wire sensor, Connected: Ground – Signal
					NO, Switch Open -> Resistor disabled Sensor type: 3 wire sensor, Connected: AFC internal power supply – Signal, Ground
					Does not function, AFC and gauge could be damaged Sensor type: 2 wire sensor, Connected: 5V/10V/12V Supply – Signal
					Avoid this situation NO, Switch Open -> Resistor disabled Sensor type: 3 wire sensor, Connected: 12V Supply, 12V(PWM) – Signal, Ground
					Avoid this situation NO, Switch Open -> Resistor disabled Sensor type: 3 wire sensor Connected: 5V/10V/12V Supply – Signal, Ground

8.8 LPG high pressure line and fittings

XD-line

Fittings

8.8.1 Function

- The line transports LPG in a safe way from the tank to the reducer
- Fittings ensure gas-tight connections

8.8.2 Specifications

- According ECE R067.01
- Reinforced Light weight thermoplastic
- 30% more flow compared to copper pipe
- Environment temperate range -40°C – 120°C [-40°F – 248°F]
- Maximum operation pressure 30bar
- Maximum burst pressure 200bar
- Easy to install and assemble
- Cut to length
- Standard fittings for LPG tanks
- Custom Prins fittings for eVP-500 reducer

8.8.3 Description

The LPG high pressure line is called the XD-line. It transports the LPG from tank to reducer in a safe way. The reinforced thermoplastic line is easy to bend and install. Always use the Prins mounting parts to avoid damaged XD-lines. Avoid mounting the XD-line in a hot area. Use a heat shield to protect it.
Cut the XD-line to the required length and install the fittings like described in the 'Installation chapter'.

8.8.4 Variants

XD-lines
Three different XD-lines are available, each with a different diameter and max flow; XD-4, XD-5, XD-6. Prins delivers the correct XD-line in the ordered kit. It's not needed to make your own diameter selection. Check if the standard length of the line is suitable for your application. Beware of the minimum radius during assembly

LPG XD-line	Inside diameter (mm)	Application
XD-4	6,5	Engine power →200kW
XD-5	8	Engine power 200kw→
XD-6	10	Filling line

Fittings
A straight eVP-500 fitting is standard supplied in the kit. Order a 90° fitting when needed.

Flare M12x1 straight
(XD-4 and XD-5)

Flare M12x1 90°
(XD-4, XD-5)

8.8.5 Diagnostics

Too low system pressure or lack of power can be caused by a kink in the line.

8.9 eVP-500 reducer

8.9.1 Function

- Vaporizing liquid LPG
- Absorbing sufficient heat to vaporize the required amount of LPG
- Create a Flow and Pressure regulation
- Providing the engine with sufficient vaporous LPG across its entire load range

8.9.2 Specifications

- Unique, next-generation concept
  - High performance (>370kW / 500hp)
  - No diaphragm
- Housing
  - Compact and light weight design
  - Lock-off valve integrated
  - Integrated safety pressure relief valve
- System pressure
  - Fully dynamic output pressure
  - Pressure adjustment by software
  - No pressure loss even at higher flows
  - No pressure drift over time
  - No pressure peaks during fuel cut-off
- Service and Maintenance
  - Replaceable filter
  - Easily accessible from top
- Installation / calibration
  - MAP connection not required / Via optional MAP sensor
  - Special calibration parameters
  - Standard coolant temperature sensor
  - Regular Prins two pole Superseal connector for actuator

8.9.3 Technical Specifications

- Single stage full electronic LPG pressure reducer
- Liquefied Petroleum Gas (LPG)
- Engine compartment installation
- 800g total weight
- Ø56mm x 142mm dimensions
- 300-2500 kPa input pressure (Abs.)
- 0- 550 kPa adjustable output pressure (Abs.) (software limited between 50-380kPa)
- >100 kg/h Max Fuel flow rate [at 60°C ECT]
- 585 ±50 kPa pressure relieve valve (acc.to R67-01)
- -40 to +120°C operating temperatures
- M12x1 Gas inlet
  - Various adapter ¼ NPT available)
- 16 mm gas outlet
- 16mm coolant connections
  - no flow direction specified
- Standard Prins Temperature sensor
  - R-ntc at 20˚C is 2500Ω
  - IP 54A Connector
- Software controlled MAP Reference

8.9.4 Description

eVP-500 is the abbreviation of electronic Variable Pressure 500Hp
It is a state-of-the-art full electronic reducer for the LPG market. It does not only surpass competitors in terms of capacity (500hp), it also extends the benefits of an electronic controlled LPG system with the possibility to fully control the system pressure.
The actuator has two functions, to stop the gas flow (lock off valve) and to manage the gas flow and pressure . The coil is supplied by a PWM.

The system pressure is managed by the calibration settings. The gas system pressure can be set by different strategies

1) Constant pressure
2) Pressure related to the inlet manifold (Delta pressure)
3) Related to engine load / speed
4) Combination of delta pressure and engine speed / load

The target pressure can be read out with the Prins AFC Software v2.

When the system pressure is related to the inlet manifold, the electronic MAP signal is used to manage the system pressure. The hose connection to the inlet manifold is used for the Pressure Relief Valve. No extra connection to the inlet manifold is needed to manage a Delta pressure.

8.9.5 Parts description

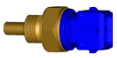
eVP-500

Actuator

Filter
type 2

Body

PRV
(pressure relief valve)

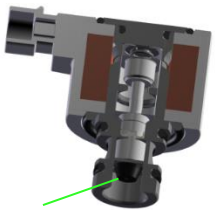


ECT

Standard fitting Screw
Flare M12x1 straight

Fitting Screw Flare
M12x1 angled

Heat exchanger

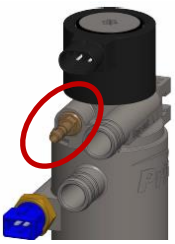


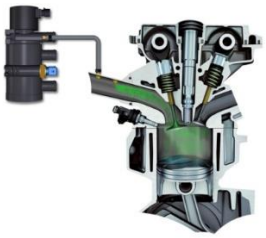
Plunger
(O-ring above the
thread)

8.9.1 LPG lock-off valve / Actuator (reducer)

The lock-off valve is integrated in the actuator of the eVP-500 reducer. The actuator completely closes during engine off, driving on petrol and during fuel cut off.

8.9.1 Pressure relief safety valve (PRV)





Reducers must be equipped with a pressure relief valve to prevent excessive pressure, according to the 67R-01 regulations. The pressure relief valve lowers the system pressure when it gets too high.
The pressure relief valve is integrated next to the LPG outlet. It has to be connected to the inlet manifold of the engine with a 5mm hose. The gas is relieved directly into the engine. It's not allowed to relief the gas into engine compartment or into the environment.

The maximum relief pressure is 2.25 x 'maximum system pressure' =>. 2.25 x 2.8 bar = 6.3 bar ± 0.5bar

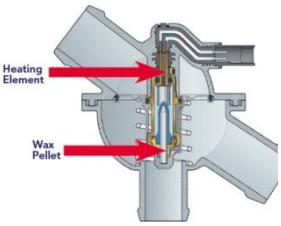
When the PRV is connected to MAP the opening pressure may be variable. This depends on the pressure in the inlet manifold.

8.9.1 Coolant connections

The reducer is connected to the coolant system with two 16mm heater hoses.

Modern heating systems are getting more complex. They can be equipped with a thermal engine management. The temperature of different engine parts and heater are controlled by an electronic thermostat, valves or electrical coolant pumps. The warmup time can be longer than expected.

Electronic coolant pump



Electronic thermostat

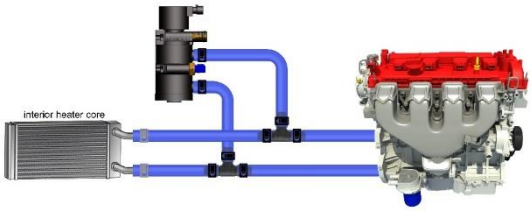
Schaeffler Thermal Management Module

Coolant valves

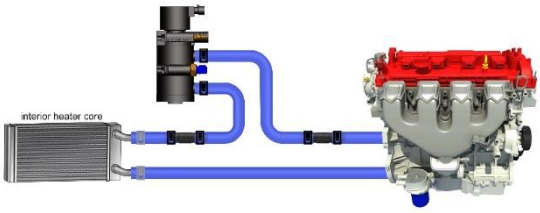
Use the (semi-) dedicated installation instructions for the correct coolant connections. When the information is not available, connect the reducer parallel to a constant coolant flow hose.

8-10-12 Cylinder engines can have an extreme high coolant flow. For example, a RAM 5.7v8 and 6.4v8 has a coolant flow of surpassing 2000 l/hr direct from the coolant pump. Connect the reducer parallel to a constant coolant flow hose.

2-3-4-5-6- cylinder engine

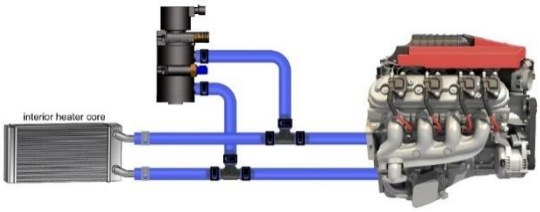


Parallel connection

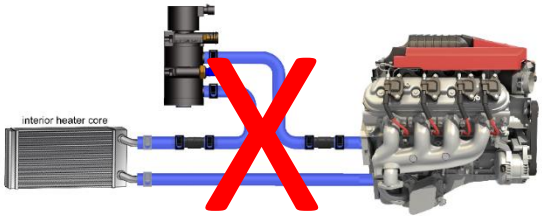


Serial connection

8-10-12- cylinder engine



Parallel connection



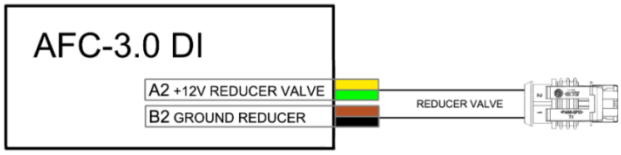
Serial connection

8-10-12 Cylinder engines can have an extreme high coolant flow. For example, a RAM 5.7v8 and 6.4v8 has a coolant flow of surpassing 2000 l/hr direct from the coolant pump.

8.9.2 Variant

At the moment of writing, only one variant is available.

8.9.3 Electrical connections



Grey connector Electrical connection	eVP-500
Supply (PWM)	A2
Ground	B2

Coil	Min.	Max
Current (A)	-	4
Power (W)	0	48

8.9.4 Diagnostic

Fluctuation of system pressure during gas mode
The system gas pressure is measured with the P/T-sensor. The eVP-500 actuator is controlled depending on the deviation of the system pressure from the target pressure. This deviation depends on the gas flow. Use the process parameter SystemEPR_PressureErrorIAbsAvg6s [17396] to monitor the deviation.
SystemEPR_PressureErrorIAbsAvg6s (17396)

- Idle <25 [mbar]
- Part load <50 [mbar]
- Full load <100 [mbar]

Internal leakage Actuator valve DTC 236
When the AFC wakes up, the system gas pressure is measured. When this pressure is much higher than the pressure during engine shutdown, a DTC 236 can become active.
Switch back to petrol and the system pressure may not rise

Tank empty / Performance of the eVP-500
The tank pressure can be a limiting factor (summer OK / Winter NOK)

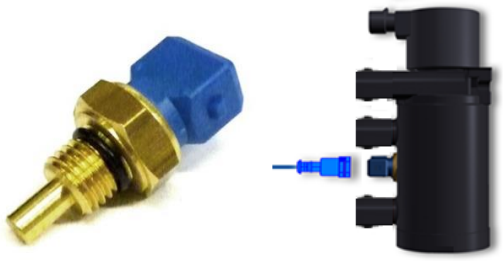
Heat capacity of evaporation
Heat capacity limit 100 kg/h @ ECT > 60c
ECT < 40c heat capacity is limited
(Depending on fuel propane content)

8.9.5 Prins AFC Software V2

Diagnostics – Process parameters

	Term	Explanation	Expected values	unit
17396	SystemEPR_PressureErrorIAbsAvg6s	Difference between expected value and real value.	Idle <25 Part load <50 Full load <100	mbar
15317	SystemEPR_TargetPressureLookUp	Expected pressure	500-3800	mbar
15303	SystemEPR_ActuatorVoltageCorrected	Supply voltage	0-12	V
76	Manifold Absolute Pressure (MAP)	Inlet manifold pressure	350-1000 (n.a.) 350- >1000 (super charged)	mbar
73	Gas Absolute Pressure	System gas pressure measured in the filter unit	500-3800	Mbar
487	Delta pressure	Pressure difference between Gas Absolute pressure and MAP pressure	800-1700	Mbar

8.10 eVP-500 Reducer Coolant Temperature sensor (ECT)



8.10.1 Function

- Measures the coolant temperature inside the LPG reducer
- Reducer temperature / flow monitoring
- Switch-over strategy based on this temperature

8.10.2 Specifications

- The NTC thermistor has a negative temperature coefficient; the electrical resistance lowers when the temperature rises
- The sensor is equipped with a rubber sealing ring

8.10.3 Description

A coolant temperature sensor has been integrated in the coolant section of the body of the reducer. The signal is used to monitor the reducer temperature and to control the switching over timing from petrol to LPG. The switch over moment is reached as soon as the coolant temperature reaches the minimum switch over temperature (adjustable). This temperature normally varies from 30 to 50°C.
The engine runs on petrol at temperatures below the minimum switch over temperature and switches over to LPG when the coolant has heated up. When a hot engine is started, the engine will run on LPG almost directly from the start.

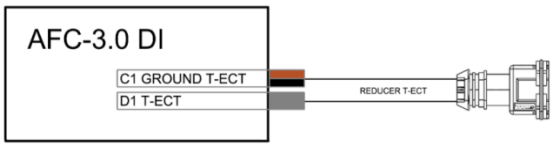
The coolant temperature sensor measures the temperature based on changes in resistance.
A NTC resistor is applied. The higher the temperature of the coolant, the lower the NTC resistance will become.

Most applications / calibration make use of the reducer temperature to switch over. In rare cases, the OBD engine temperature is also used for the switch over strategy.

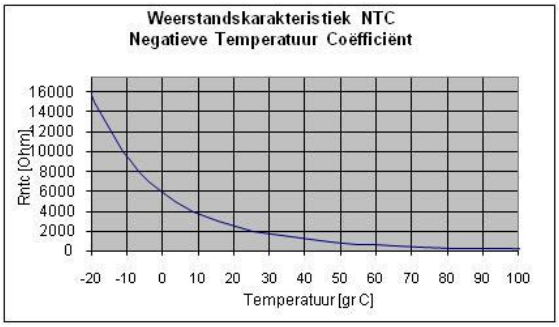
8.10.4 Variants

The eVP-500 is equipped with a sensor with rubber ring.

8.10.5 Electrical connections



Grey connector Sensor	AFC
Signal	C1
Ground	D1



R NTC [Ohm]	Temperature [C]
9400	-10
2500	20
325	80

ECT sensor resistance values at various temperatures

8.10.6 Diagnostics

Reducer does not heat up

Compare the OBD temperature with the reducer temperature. Check the used coolant hose temperature of the engine.

8.10.7 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	unit
70	ECT	Coolant temperature	Engine temperature	°C
16013	ECT	Engine ECT sensor	Engine temperature	°C
590	OBC_ETC	Coolant temperature OBD	Engine temperature	°C
11522	Regulator Coolant Temperature	Regulator coolant temperature	80 – 105 Operating temp	°C

8.11 Ventrex Evo3.1 Electronic CNG Pressure Regulator

8.11.1 Function

- Reducing tank pressure (200 bar) to system pressure (2-5,5 bar)
- Absorbing sufficient heat to prevent ice formation
- Create a Flow and Pressure regulation
- Providing the engine with sufficient CNG across its entire load range

8.11.2 Specifications

- New-generation concept
  - 110kW / 150hp)
  - No diaphragm
- Housing
  - Lock-off valve integrated
  - Integrated safety pressure relief valve
- System pressure
  - Fully dynamic output pressure
  - Pressure adjustment by software
  - No pressure loss even at higher flows
  - No pressure drift over time
  - No pressure peaks during fuel cut-off
- Service and Maintenance
  - No maintenance needed
- Installation / calibration
  - MAP connection not required / Via optional MAP sensor
  - OEM coolant temperature sensor?
  - Special two pole Superseal connector for actuator
  - Special three pole high pressure sensor

8.11.3 Technical Specifications

- Dual stage full electronic CNG pressure reducer
- Compressed Natural (CNG)
- Engine compartment installation
- 890g total weight
- 122,55 x 94,4 x 79,4 dimensions
- 20 to max. 260 bar input pressure (Abs.)
- 2 to max. 12 bar electronically adjustable output pressure (Abs.)
  (software limited between 2 – 5,5 bar)
- >30 kg/h Max Fuel flow rate [at 5 bar]
- 8 bar pressure relieve valve
- -40 to +125^{o}C operating temperatures
- Double ferrule 6mm Gas inlet
- 16mm Hose pillar gas outlet
- 8mm coolant connections
  - no flow direction specified
- Software controlled MAP Reference

8.11.4 Description

The Ventrex Evolution 3.1 is a state-of-the-art full electronic reducer for the CNG market.
It is designed for the usage in the supply system of CNG powered engines. The mechanic stage and the electronic proportional valve ensures the regulation of the working pressure. At the same time, the proportional valve acts as a shut-off valve.

The EPR contains two stages: a mechanical first stage and an electro-magnetic second stage (proportional valve). Additionally, a heat exchanger is part of the pressure regulator.
The proportional valve is controlled by a PWM signal (defined voltages), external from AFC.
The shut-off function is integrated in the electro-magnetic pressure regulation unit (proportional valve) as it is “normally closed”.

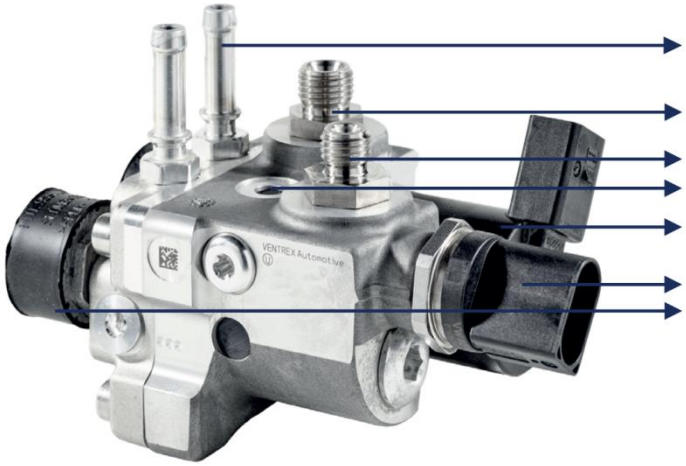
The system pressure is managed by the calibration settings. The gas system pressure can be set by different strategies

1) Constant pressure
2) Pressure related to the inlet manifold (Delta pressure)
3) Related to engine load / speed
4) Combination of delta pressure and engine speed / load

The target pressure can be read out with the Prins AFC Software v2.

When the system pressure is related to the inlet manifold, the electronic MAP signal is used to manage the system pressure. The hose connection to the inlet manifold is used for the Pressure Relief Valve. No extra connection to the inlet manifold is needed to manage a Delta pressure.

8.11.5 Parts description



Coolant connection – ø 8 mm

Outlet – low pressure, max. 8 bar,

Inlet – high pressure, max. 260 bar,

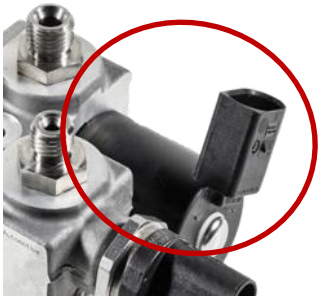
Pressure relief valve 8 bar ± 10%

Proportional valve, 2 pin

High pressure sensor, 3-pins

2 fixing connection M8 x 10

8.11.6 Proportional valve lock-off valve / Actuator (reducer)



The lock-off valve is integrated in proportional valve. The proportional valve completely closes during engine off, driving on petrol and during fuel cut off.

8.11.7 High pressure sensor (tank pressure)

The pressure indicates the amount of CNG in the CNG tanks. The high pressure sensor measures the tank pressure between 0-260 bar. It's a 3-pole connector

8.11.1 Pressure relief safety valve (PRV)

Reducers must be equipped with a pressure relief valve to prevent excessive pressure. The pressure relief valve lowers the system pressure when it gets too high. It is not connected to the inlet manifold of the engine.
The maximum relief pressure is 8 bar ± 0.8bar

8.11.1Coolant connections

The reducer is connected to the coolant system with two 8mm heater hoses.

Use the (semi-) dedicated installation instructions for the correct coolant connections. When the information is not available, connect the reducer to a constant coolant flow hose.

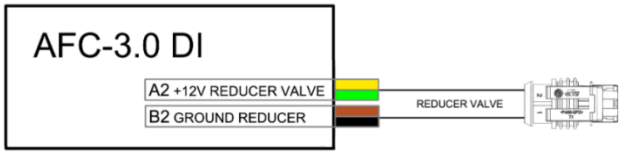
8.11.1Coolant temperature

The coolant temperature is measured from the OEM coolant temperature sensor. No temperature sensor is mounted in the Ventrex Evolution 3.1 CNG regulator.

8.11.2 Variant

At the moment of writing, Prins uses a dedicated Prins Ventrex Evolution 3.1 version. This reducer is equipped with Prins dedicated connections.

8.11.3 Electrical connections



Grey connector Electrical connection	Ventrex
Supply (PWM)	A2
Ground	B2

8.11.4 Diagnostic

Fluctuation of system pressure during gas mode

The system gas pressure is measured with the P/T-sensor inside the Prins filter. The proportional valve is controlled depending on the deviation of the system pressure from the target pressure. This deviation depends on the gas flow. Use the process parameter SystemEPR_PressureErrorIAbsAvg6s [17396] to monitor the deviation.

Coil	Min.	Max
Current (A)	-	4
Power (W)	0	48

SystemEPR_PressureErrorIAbsAvg6s (17396)

- Idle <25 [mbar]
- Part load <50 [mbar]
- Full load <100 [mbar]

Internal leakage Actuator valve DTC 236

When the AFC wakes up, the system gas pressure is measured. When this pressure is much higher than the pressure during engine shutdown, a DTC 236 can become active.
Switch back to petrol and the system pressure may not rise

Tank empty / Performance of the CNG reducer

The tank pressure can be a limiting factor (summer OK / Winter NOK)

Heat capacity of evaporation

Heat capacity limit 30 kg/h @ 5bar
ECT < 40c heat capacity is limited
(Depending on fuel propane content)

8.11.5 Prins AFC Software V2

Diagnostics – Process parameters

	Term	Explanation	Expected values	unit
17396	SystemEPR_PressureErrorIAbsAvg6s	Difference between expected value and real value.	Idle <25 Part load <50 Full load <100	mbar
15317	SystemEPR_TargetPressureLookUp	Expected pressure	500-3800	mbar
15303	SystemEPR_ActuatorVoltageCorrected	Supply voltage	0-12	V
76	Manifold Absolute Pressure (MAP)	Inlet manifold pressure	350-1000 (n.a.) 350- >1000 (super charged)	mbar
73	Gas Absolute Pressure	System gas pressure measured in the filter unit	500-3800	Mbar
487	Delta pressure	Pressure difference between Gas Absolute pressure and MAP pressure	800-1700	Mbar

8.12 Prins filter unit

8.12.1 Function

- Filters the vaporized LPG/ CNG
- Housing for the combined pressure/temperature sensor
- Distributes the vaporized LPG/ CNG over several injector rails

8.12.2 Specification

- Lightweight nylon housing
- High pressure resistance [max.25bar]
- Filter material special glass fiber [3µm]
- Max. oil trap [4-5gr]
- Light weight [110gr]
- 16mm gas inlet
- 11mm outlet

8.12.3 Description

The filter unit protects the gas injectors against pollution. It filters the vaporized LPG/CNG supplied from the reducer. A Pressure / Temperature sensor (P/T-sensor) measures the actual gas temperature (Tgas) and gas system pressure (Psys). The internal filter cannot be replaced, replace the complete filter unit

8.12.4 Variants

Two brands and two versions of filter units are available:

- Prins filter unit: standard filter suitable for most applications.
- Keihin filter unit: specially designed for much polluted LPG fuel.
- Single outlet: for vehicles with 3-4 or 5 cylinder engines with one single VSI injector rail.
- Double outlet: for vehicle with 4 cylinder boxer, 6 or 8 cylinder engines with two VSI injector rails.

Outlet / engine	Single 3-4-5 cylinder	Double 4 boxer-6-8 cylinder
Prins filter unit		
Keihin filter unit		

8.12.5 Diagnostics

A clogged filter may cause a too low system pressure and / or lack of engine power.

8.13 Combined pressure / temperature sensor

8.13.1 Function

- Measures
  - Gas system pressure
  - Gas temperature
- Pressure feedback to control the eVP-500 actuator

8.13.2 Features

- P/T sensor
- Temperature range: -40 ˚ C and 130 ˚ C.
- Standard pressure range: 0.5 and 4.0 bar
- Ensure a tight seal between the sensor and filter housing

8.13.3 Description

The temperature / pressure sensor has been integrated into the filter unit to measure the gas system pressure and the gas temperature.

The gas system pressure has to be measured to:

- Adapt the GAS injection times.
- Detect an 'Empty tank'; low gas system pressure detection.
- Control the actuator of the eVP-500 to manages the system pressure.

The gas temperature has to be measured to:

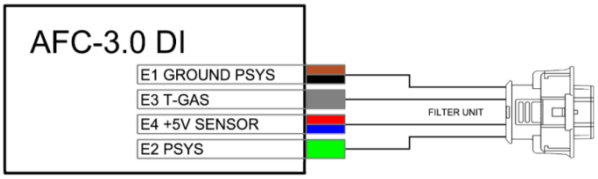
- Adapt the GAS injection times.
- The GAS density (energy) varies to the GAS temperature; the colder the GAS is, the higher the density of the GAS. The energy flow (gas volume) to the engine varies 49ebshop. 12% over a temperature range from 20 to 60°C.

The combined Pressure and Temperature (P/T) sensor measures the gas pressure and temperature inside the filter unit, after the filter element.
The sensor is directly supplied with 5V from the AFC and also has its own ground connection on the AFC.

8.13.4 Variants

- 4 bar sensor: Standard sensor for LPG applications
- 5,5 bar sensor: Standard sensor for CNG applications and engines with high system and MAP pressure

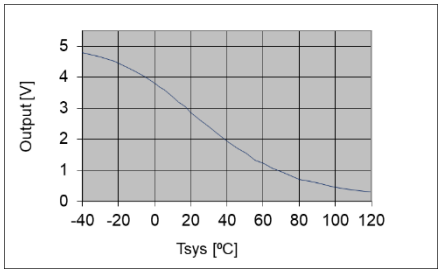
8.13.5 Electrical connections



Grey connector Electrical connection	AFC	P/T Sensor
Ground	E1	1
Gas temperature	E3	2
Supply (PWM)	E4	3
Gas pressure	E2	4

4 bar sensor

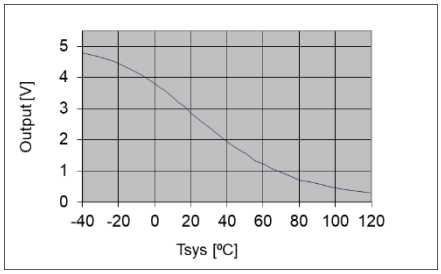
Absolute system pressure



System Temperature

5.5 bar sensor

Absolute system pressure



System Temperature

8.13.6 Diagnostics

Fault	P system DTC	T gas DTC
Ground interrupted	17 system pressure too high (5V) (2200mbar)	21 Gas temperature signal too high (5V) (40˚C)
Ground sort circuit to +5V	18 system pressure signal too low 20 Regulator temperature too low 32 Sensor Power Supply voltage to low (0,2V) (2200mbar)	(119.4˚C)
+5 volt interrupted	18 system pressure signal too low (~0,02V) (2200mbar)	No DTC (normal range)
Psys interrupted	18 system pressure signal too low (~0,03V) (2200mbar)	-
Psys sort circuit to ground	18 system pressure signal too low (~0,02V) (2200mbar)	-
Psys sort circuit to +5V	17 system pressure too high (5V) (2200mbar)	-
T-gas interupted	-	21 Gas temperature signal too high (5V) (40˚C)
T-gas sort circuit to ground	-	22 Gas temperature signal too low (0V) (40˚C)
T-gas sort circuit to +5V Pin 9	-	21 Gas temperature signal too high (5V) (40˚C)

8.13.7 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	unit
76	Manifold Absolute Pressure (MAP)	Inlet manifold pressure	350-1000 n.a. 350-2200 super charged	mbar
73	Gas Absolute Pressure	System gas pressure measured in the filter unit	500-3800	Mbar
487	Delta pressure	Pressure difference between Gas Absolute pressure and MAP pressure	800-1700	mbar
72	System Pressure Voltage	Sensor voltage system pressure	500-4500	mV
192	System Tank empty	Tank empty detected	0: No 1: Yes	-
81	Gas Temperature	Gas temperature measured in the filter unit	15-80	°C
82	Gas temperature Voltage	Sensor voltage gas temperature	800-3500	mV
188	Sensor Supply Voltage	5V supply for the P/T sensor	~5000	mV

8.13.8 VSI Injector rail

Function

- Compact assembly of gas injectors
- Distributing the gas over the various injectors
- Fixing the injectors in the various cylinder configurations
- Proper mounting onto the engine

Specification

- R67-01, R110 & CSA homologated
- PA6 Glass fiber “reinforced” nylon
- Light weight and compact
- Available in 2, 3, 4 en 5 cylinder versions

Description

The GAS injectors are mounted in a common rail.
The injectors are held in the rail by two studs and M8 bolts to clamp the injectors between the strip and the common rail.
The injectors can be rotated in the rail (180 degrees) for left or right gas inlet configuration.
The injector rail can be mounted to the engine by an injector rail bracket.
The hose between Prins filter unit and GAS injector rail provides all injectors with sufficient GAS. 5mm hoses are connected between injector outlets and intake manifold nipples.

Variants

Four different gas injector rails are available; 2, 3, 4 and 5 cylinder versions.
Prins delivers the correct injector rail(s) for the engine in the ordered kit. It’s not needed to make your own selection.

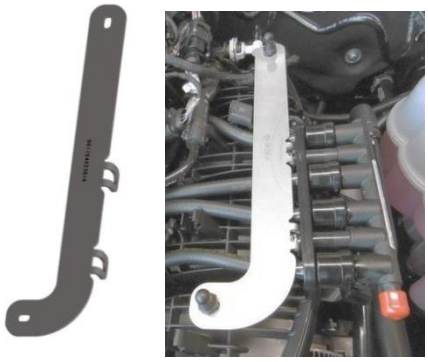
2 cylinder (2-C)

3 cylinder (3-C)

4 cylinder (4-C)

5 cylinder (5-C)

8.14 VSI Injector rail brackets



8.14.1 Function

- Mounting plate of the gas injectors on the engine
- Perfect fit and time saving

8.14.2 Specification

- Stainless steel (Prins brackets)
- Universal or tailor made for specific engines

8.14.3 Description

For a perfect installation of the injector rail, VSI Injector rail brackets are designed by Prins.
These brackets are supplied as standard with a semi dedicated kit. Order a bracket separately when ordering a universal kit.

8.14.4 Variants

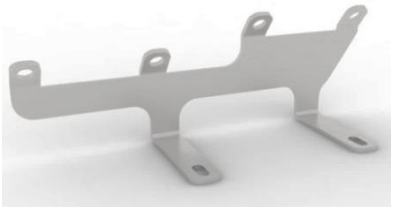
Prins can supply many different injector brackets.
Tailor made rail brackets are delivered in a dedicated and semi-dedicated kit.
Order an injector rail of make your own when ordering a UNIVERSAL VSI-3 DI-kit. Visit the Webshop for the best option.

Example of universal brackets:

001/040262

001/040084

Example of dedicated brackets:



001/040298
Ford Explorer 3.3 Ti-VCT 2020

001/040230
VAG 2.0
CNCD/CZPA-B/CVKB/DKZA/DNUA

More brackets available at Prins Webshop.

8.15 Keihin KN-9 Injector

8.15.1 Function

- Inject vaporized gas into the inlet manifold
- Ensure the quick opening and closing of the injector plunger
- Shut off the gas supply, when deactivated

8.15.2 Specification

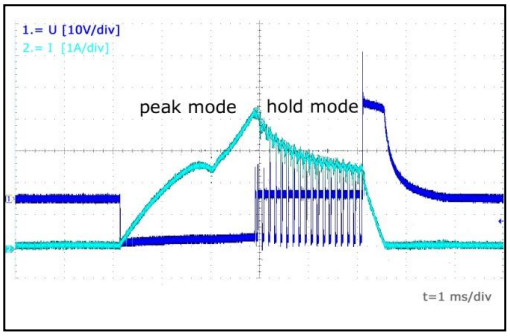
- Developed by Keihin Corp. Japan
- Excellent linear 'flow range'
- Linear flow starting from 2,6 msec.
- 2% accuracy from min. to max. flow
- 7 injector sizes
- Engine capacities from 9 kW up to 50 kW/cyl
- Lifespan >290 million cycles or 240.000 km
- Low coil resistance (1,25Ω)

8.15.3 Description

The functioning of the GAS injectors can be compared to the functioning of the petrol injectors. The dosing of the injected GAS during the four stroke cycle is adapted by controlling the injection time for each of the gas injectors. Consequently, the activation time of the injector varies from idle to full load and thus the amount of gas that is injected.

The gas injectors have to deal with a far higher flow than petrol injectors. This requires a bigger injector plunger and an increased lifting height.
To guarantee a fast open and close behaviour of this injector, the injector power must be very high. The coil has a low resistance (1.5 Ω), resulting in a fast current build up and a strong magnetic field.
The current is reduced as soon as the injector is fully open, to prevent the injector from overheating. This control is also known as 'peak and hold'.

Refer the diagram for the **peak and hold phases** in the GAS injection cycle.



VSI-3.0 DI control

With VSI-3.0 DI the ground of the gas injector is controlled. During the peak mode ground is switch on. During the hold mode, the ground is switched (PWM controlled) I. The scoop view shows that the signal is PWM controlled by power supply.

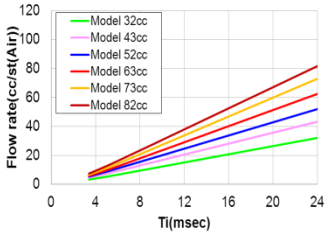
The petrol injector will be deactivated by the AFC during GAS mode and the GAS injectors will be active. The AFC-3.0 DI monitors the petrol injector control strategy and calculates the gas injection duration and injection timing. It is possible that the gas injector will start earlier than the petrol injector would actually do.
At the moment the petrol injectors are switched off (end TI petrol) the AFC calculates the active time and timing for gas injector.
In this calculation, different corrections are taken into account:

- difference in injector flow size
- injector opening and closing behaviour
- engine speed
- engine load
- calorific value difference
- gas system pressure
- gas temperature
- reducer temperature
- battery voltage
- etc.

8.15.4 Variants

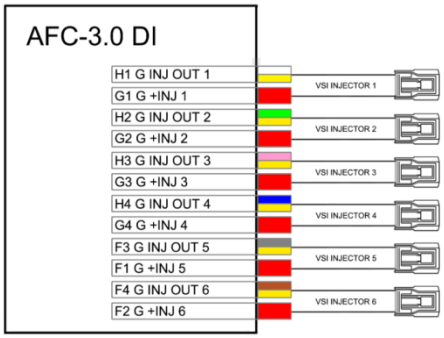
Six different gas injector types are available, each with a different output volume. The higher the power per cylinder, the higher the volume output is needed.
Prins delivers the correct injector for the engine in the ordered kit. It's not needed to make your own selection. The correct injector is already set in de firmware which you need to load into the AFC-3.0 DI
The injector size can be recognized from:

- Number of grooves at the output side.
- Flow rate number.
-



Idenitification [@24ms/2,55bar/AIR]						
Max. flow (cc/st)	32	42	52	63	73	82
KN-9 ID.	32	42	52	63	73	82
Grooves	0	1	2	3	4	5

8.15.5 Electrical connection



Black connector injector	Supply (peak hold)	Ground
1	G1	H1
2	G2	H2
3	G3	H3
4	G4	H4
5	F1	F1
6	F2	F4

The gas injector number corresponds to the cilinder of the engine. Respect the cilinder numbering of the engine. These cilinder order and firing order orders can deviate per brand, model and engine series.

8.15.6 Diagnostic

Gas injection time
The gas injection time should not be less than 2.8ms. During high idle the lowest injection time can be found. Often the gas injections time is longer than the petrol injection time.
Check the system pressure and compare it with the target pressure.

Check correct connection
Run the Injector – Actuator test to check if the relation between the petrol injectors and gas injectors. This test deactivates the petrol injector and activates the gas injector. When the engine runs smooth, the gas injector and petrol injector are paired well. With an irregular running engine the connectors can be installed incorrect. Other cause are also possible, like blocked hoses, incorrect soldered wires, incorrect drilled injector couplings or hardware failure.

8.15.7 AFC Software Prins v2

Diagnostic – Actuator Test – Injector
Check the correlation with the actuator test – Injector

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	unit
73	Gas Absolute Pressure	System gas pressure measured in the filter unit	500-3800	Mbar
487	Delta pressure	Pressure difference between Gas Absolute pressure and MAP pressure	800-1700	mbar
213	Power Gas Injectors	Gas injectors +12 supply active	0: No 1: Yes	

Gas injector times

	Term	Explanation	Expected values	unit
134	GasPulseWidthCyl1	Gas injection time 1 -6	2,8 – 20	ms
141	GasPulseWidthCyl2			
142	GasPulseWidthCyl3			
143	GasPulseWidthCyl4			
144	GasPulseWidthCyl5			
145	GasPulseWidthCyl6			

Gas injection duty cycle

	Term	Explanation	Expected values	unit
367	GasInjectorDutyCycleCyl1	Percentage of injection time vs injection cycle time	0,1 – 120	%
697	GasInjectorDutyCycleCyl2			
698	GasInjectorDutyCycleCyl3			
699	GasInjectorDutyCycleCyl4			
700	GasInjectorDutyCycleCyl5			
701	GasInjectorDutyCycleCyl6			
13584	Gas Inj DCY Max	Maximum duty cycle for all injectors	0,1 – 120	%

8.16 Inlet couplings

8.16.1 Function

- Inject gas into the engine

8.16.2 Description

The GAS injectors are connected to the inlet manifold by 5 mm hoses. Nylon hoses or PTFE hoses are applied when the inlet coupling are not close to the petrol injector or inlet valve. The gas needs to be injected as close to the inlet valve.

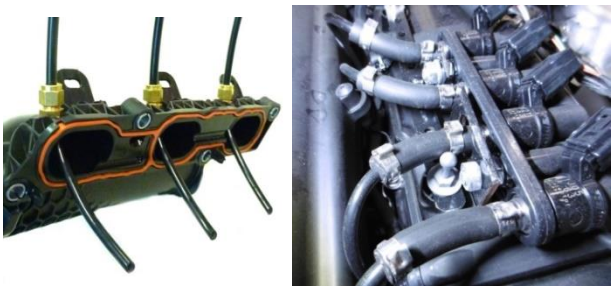
8.16.3 Variants

This can be done in various ways:

1. M6x1 – Rubber hoses
   Applied when the inlet coupling are located nearby the original petrol injector or inlet valve.
2. M10x1 – Nylon hoses
   Applied with limited installation space.
3. M10x1 – PTFE hoses
   Applied with enough installation space.

M6x1 – Rubber hoses

M10x1 – Nylon hoses



M10x1 – PTFE hoses

8.16.4 Diagnostics

Deviating fueltrims / misfire / bad response / bad idle / lack of power

- False air -> use brake cleaner to find the leakage
- Kink in the hose(s) -> Use the actuator test – Injector
- Swapped injector hoses. (exp. Cilinder 1 switched with 2) -> Check the correlation with the actuator test – Injector
- Injector hose wrong in manifold (direction throttle instead of the inlet valve) – Inspect the manifold internally

8.16.5 AFC Software Prins v2

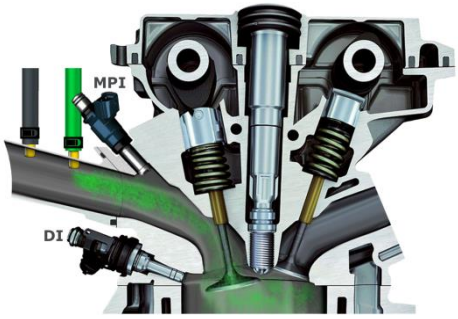
Diagnostic – Actuator Test – Injector
Check the correlation with the actuator test – Injector

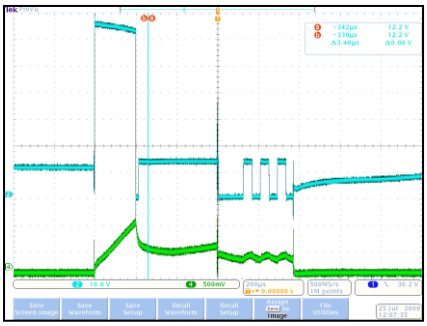
Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	Unit
526	OBD_ShortTermFuelTrimBank1	Percentage to make the fuel mixture balanced	-10 / +10	%
527	OBD_LongTermFuelTrimBank1	Long term percentage to make the fuel mixture balanced	-10 / +10	%

9 Engine Sensors / actuators

9.1 DI Injector signals





9.1.1 Function

- Stops petrol injection
- Measuring the DI petrol injection time and timing
- Connected directly to the AFC-3.0 DI
- Prevents EOBD trouble codes during GAS mode

9.1.2 Specifications

- Only coil type DI injectors
- Petrol injectors active when AFC power supply is missing
- Connected in the black connector

9.1.3 Description

The interruption of the coil type Direct Injectors is integrated inside the AFC-3.0 DI and is used to deactivate the DI petrol injectors. The gas injectors can take over the fuel injection. Since the engine management system detects whether any injectors are controlled, the injectors cannot be disconnected physically. A dummy coil is used to simulate the DI petrol injector. A special strategy is needed to simulate the voltage and current trough the dummy coil. The programmable simulation strategy will limit the current through the injector coil. As a result, the DI petrol injector needle will not open.
The simulation strategy is set in the firmware.

Engine management systems will apply trouble code detection to the voltage levels and current trhoug the DI petrol injectors.

Attention! The simulation strategy is set in the firmware. Always select the correct online firmware.

DI injector can be in-active with MPI-DI engines during normal running mode

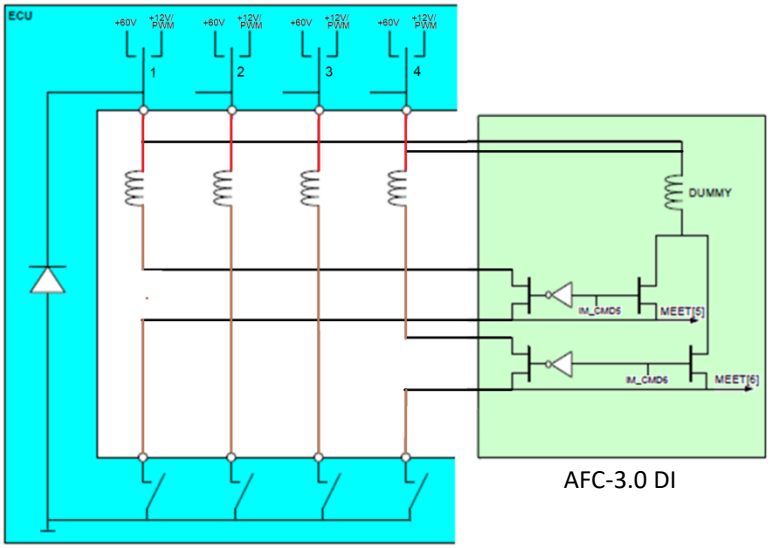
- MPI in general during lower load
- MPI in general during warmer engine conditions
- DI during higher load
- DI during colder engine conditions

9.1.4 Variants

Endless variant have been used by engine manufacturers. The AFC-3.0 DI can handle most of the DI petrol coil injectors.

9.1.5 Electrical connections

Engine management



AFC-3.0 DI

For detailed wiring diagram information please used chapter ‘Basic wiring diagram’.

Unlike the MPI injectors, a real coil is used as a dummy for the DI injectors. Therefore it is necessary to connect the + 65V / 12V and the mass of all injectors. Due to the hardware layout in the AFC, it is necessary to connect all +65V / 12V injector wires.

Normally a dummy injector simulates 2 DI petrol injectors, except a 3 cilinder engine.

- 3 cilinder engine
  - Each DI injector has an own dummy injector motor.
  - 3 and 6 cylinder AFC can be used.
  - Injector 3 is connected to row G.

- 4 cylinder engine with firing order 1-3-4-2.
  - Dummy injector 1 simulates DI petrol injector 1 and 4.
  - Dummy injector 2 simulates DI petrol injector 3 and 4.
  - 4 and 6 cylinder AFC can be used.

- (V)6 cilinder engine,
  - Dummy injector simulates two DI injectors.
  - Different DI petrol injector groups possible with a six-cylinder engine. This depends on the cylinder sequence and on the ignition sequence.
  - For example or firing orders:
    - 1-4-2-5-3-6
      Dummy injector 1 -> cilinder 1 and 5.
      Dummy injector 2 -> cilinder 4 and 3.
      Dummy injector 3 -> cilinder 2 and 6.
    - 1-2-3-4-5-6
      Dummy injector 1 -> cilinder 1 and 4.
      Dummy injector 2 -> cilinder 2 and 5.
      Dummy injector 3 -> cilinder 3 and 6.
  - Normally a dedicated wiring harness is delivered and installed in a 6 cilinder engine. No injector wires need to be soldered.

Attention! All ‘injector high’ wires need to be connected to the AFC-3.0 DI.

9.1.6 Diagnostics

Check the firing order with the Prins AFC Software v2 and compare it with the firing order described in the (semi-) dedicated installation manual.
Run the actuator test for correlation check.

9.1.7 Prins AFC Software v2

Diagnostic – Actuator test
Check the correlation with the actuator test – Injector

Diagnostics – Monitor – Process parameters

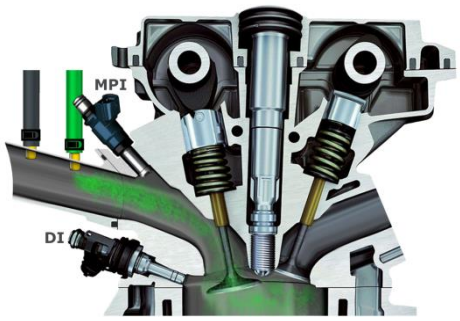
Firing order

	Term	Explanation	Expected values	unit
11126	Engine Firing order	Firing order of the DI injectors	Only a value when injector is active. Info on front page of installation instruction	-
14636	Engine Firing Order Secondary Detected	Firing order of the MPI injectors		-

DI Petrol injection time

	Term	Explanation	Expected values	unit
85	Petrol Inj Time Cyl 1	Injection time of the DI injectors	0,8 – 20	ms
88	Petrol Inj Time Cyl 2			
103	Petrol Inj Time Cyl 3			
104	Petrol Inj Time Cyl 4			
105	Petrol Inj Time Cyl 5			
106	Petrol Inj Time Cyl 6			
1719	Post Inj Counter Cyl 1	Pre injection of DI injector cil 1	0: Yes 1: No	-

9.2 MPI Petrol injector



9.2.1 Function

- Stops petrol injection
- Measuring the MPI petrol injection time and timing
- Connected directly to the AFC-3.0 DI
- Prevents EOBD trouble codes during GAS mode

9.2.2 Specifications

- Petrol injectors active when AFC power supply is missing
- Connected in the black connector

9.2.3 Description

The internal injector module is used to deactivate the MPI petrol injectors so the gas injectors can take over the fuel injection. The engine management system detects whether any injectors are controlled. During gas mode power resistors or coils are connected in series with the petrol injectors. This will limit the current through the injector coil. As a result, the petrol injector needles will not open.

MPI injector can be active with MPI-DI engines during normal running mode

- MPI in general during lower load
- MPI in general during warmer engine conditions
- DI during higher load
- DI during colder engine conditions

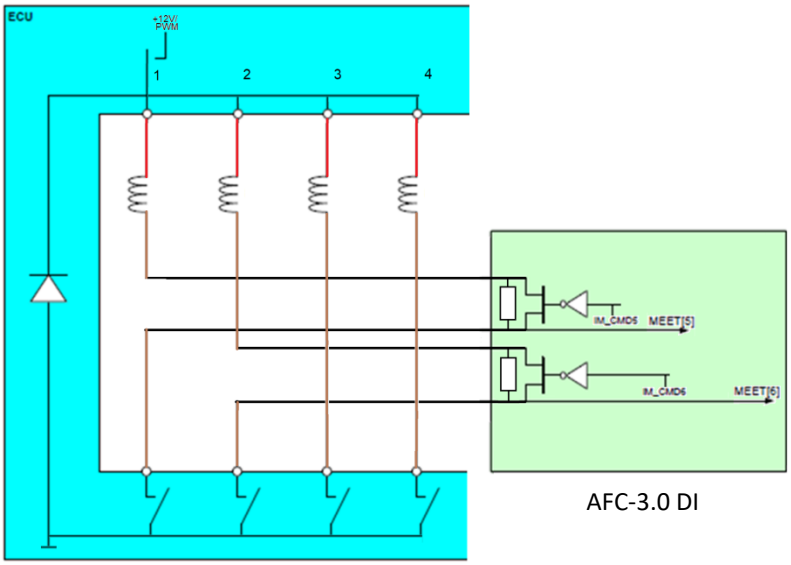
DI-MPI engines use in most cases combines a variable low pressure fuel system to prevent vapor lock.

9.2.4 Variants

Endless variant have been used by engine manufacturers. The AFC-3.0 DI can handle most of the MPI petrol injectors.

9.2.5 Electrical connections

Engine management



AFC-3.0 DI

For detailed wiring diagram information please use chapter 'Basic wiring diagram'.

A resistor for each MPI injector is used to deactivate the petrol injection. It is switched in series, therefor it is only needed to interrupt and connect the ground wires to the AFC. The MPI injector wiring text corresponds with the actual cilinder of the engine.

9.2.6 Diagnostics

The MPI injectors are called secondary injectors in the diagnosis tool.
Check the secondary firing order with the Prins AFC Software v2 and compare it with the firing order described in the (semi-) dedicated installation manual.

Engine behaviour
Irregular running engine
Stalling engine

9.2.7 Prins AFC Software v2

Diagnostic – Actuator test
Check the correlation with the actuator test – Injector

Diagnostics – Monitor – Process parameters

Firing order

	Term	Explanation	Expected values	unit
11126	Engine Firing order	Firing order of the DI injectors	Only a value when injector is active. Info on front page of installation instruction	-
14636	Engine Firing Order Secondary Detected	Firing order of the MPI injectors		-

MPI Petrol injection time

	Term	Explanation	Expected values	unit
20014	Petrol Inj Time Secondary Cyl 1	Injection time of the MPI injectors	3-20	ms
20015	Petrol Inj Time Secondary Cyl 2			
20016	Petrol Inj Time Secondary Cyl 3			
20017	Petrol Inj Time Secondary Cyl 4			
25461	Petrol Inj Time Secondary Cyl 5			
25462	Petrol Inj Time Secondary Cyl 6			

9.3 RPM signal

9.3.1 Function

- Safety Signal to switch over to gas.
- Used for calculations and strategies.

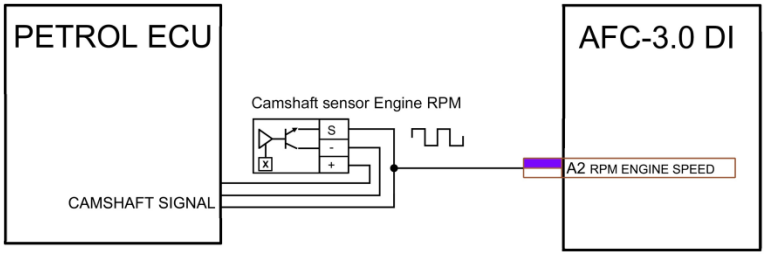
9.3.2 Description

The AFC uses the engine speed (RPM) to switch over to GAS, for calculations and strategies. Based on this signal the AFC detects a running engine. When the engine runs and all switch-over conditions have been met, the AFC activates the tank lock-off valve, the eVP-500 actuator and starts GAS injection. When the engine speed signal is missing, the system will switch to petrol; the LPG lock-off valve and eVP-500 are no longer activated.

9.3.3 Variants

In most cases the engine speed signal is derived from the camshaft sensor or ignition coil signal.

9.3.4 Electrical connections



Brown connector Electrical connection	AFC
RPM Engine signal	A2

9.3.5 Diagnostics

Hall sensor

A hall sensor is often used to measure the camshaft signal. This has 3 connections on the connector.

1) + 5V (measures 5V relative to battery mass)
2) Block signal (measure relative to sensor mass)
3) Ground (measure 12V to battery)

Ignition coil signal

Sometimes the ignition of the ignition coil is used. The connection of the ignition coil can have 2 or three connections on the connector.

1) + 12V (measure 5V relative to battery mass)
2) Controlled mass (measure frequency relative to battery)
3) Ground (measure 12V relative to battery)

No engine speed signal or wrong value

Check the wiring and terminals. Check with an advanced multi the voltage and the frequency of the signal. Use the Prins AFC Software v2 to read out and compare the engine RPM and the OBD_engineSpeed. When all connections are good, contact the technical helpdesk via the Support System

9.3.6 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	Unit
101	RPM	Engine speed direct from engine sensor	550-max rpm	rev/min
9863	OBD_EngineSpeed	Engine speed read from OBD	550-max rpm	rev/min
957	Engine running	Engine revs >450 RPM	0: No 1: Yes	-
140	Engine Run Time	Time of running engine		sec
368	Engine State	Engine running or shut down	On/Off/FCO	-

9.4 Manifold pressure (MAP)

9.4.1 Function

- Measures the engine load
- For calculation and strategies
- Input for MAP related gas system pressure
- Input for engine load related gas system pressure
- Analog and digital sensor supported

9.4.2 Description

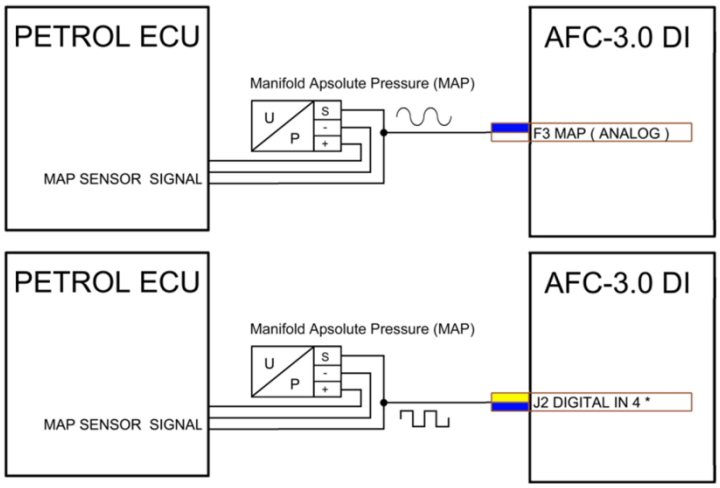
The manifold absolute pressure sensor provides manifold pressure information to the engine management system. The data is used to calculate air density and determine the engine's air mass flow rate, which in turn determines the required fuel metering for optimum combustion and influence the advance or retard of ignition timing.
The AFC-3.0 DI measures the engine load via the original MAP sensor from the engine. It is used for manage strategies, calculation and variable gas system pressure.

9.4.3 Variants

Analog and digital sensors
For a long time analog sensors have been used in the automotive industry. They provide the engine management with an analog signal between 0,5 and 4,5 Volt. An analog sensor requires a separate wire to the ECU for each reading. A digital sensor is equipped with microelectronics and communicates with the ECU via a data line. It can transmit multiple measurements across the data line. Fewer wires are needed despite the transmission of multiple signals. Another advantage of the digital sensor is that it self-diagnoses.

The correct settings are programmed in the online firmware for the engine / AFC-3.0 DI.

9.4.4 Electrical connections



Brown connector Electrical connection	AFC
Analog MAP signal	F3
Digital MAP Signal	J2

9.4.5 Diagnostics

Analog sensor
The analog MAP sensors can have 3 or 4 wires.

- 3 wires:
  - +5V sensor supply
  - Pressure signal (0,5V – 4,5V)
  - Ground
- 4 wires:
  - +5V sensor supply
  - Pressure signal (0,5V – 4,5V)
  - Temperature (0,5V – 4,5V)
  - Ground

Digital sensor
The digital sensor has 3 wires

- +5V sensor supply
- Data line (0V – 5V)
- ground

No signal or wrong signal
Check the wiring and terminals. Check with an advanced multi the voltage and the frequency of the signal. Use the Prins AFC Software v2 to read out and compare the engine MAP and the OBD_MAP. When all connections are good, contact the technical helpdesk via the Support System.
Normally the analog signal voltage becomes higher when the pressure rises. Normal voltage range is 0,5V to 4,5V.

9.4.6 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	Unit
76	Manifold Absolute Pressure (MAP)	Inlet manifold pressure	350-1000 (n.a.) 350- >1000 (turbo / super charged)	mbar
531	MAP Voltage	Measured voltage on the sensor	0,5 – 4,5	Volt
591	OBD_MAP	MAP read from OBD	350 -	mbar

9.5 Ignition + (12V)

9.5.1 Function

- Signal wakes up and shuts down the AFC-3.0 DI
- Start of simulation strategies

9.5.2 Description

The AFC-3.0 DI wakes up and becomes active when 1 of the 2 wake-up signals is present.
The two wake-up signals are:

1) Ignition +
2) Wake up (5V sensor supply rail pressure petrol)

The Ignition + needs to be a 12V signal during ignition on cranking.
The wake-up signals are also used for limp home mode. If these signals are present, the motor can run without loaded firmware and / or main fuse.

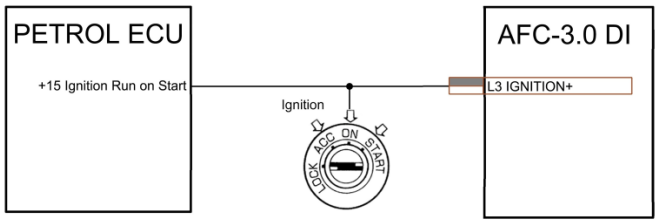
9.5.3 Variants

Different Ignition + signals can be used to wake up the system.

- Supply of the ignition coil
- +12V ignition switch
- +12V engine management supply
- Other +12V source during 68ebshop68 on and cranking

Attention! Always connect the Ignition + according the (semi-) dedicated installation manual..

9.5.4 Electrical connections



Brown connector Electrical connection	AFC
+12v ignition signal	L3

9.5.5 Diagnostics

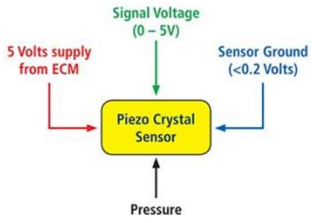
No signal of intermitted signal
Check the wiring and terminals. Check the voltage with a multi meter.
Disconnect the wire from the car wire and make a temporary connection to the car battery. The status of the value in the Prins AFC Software v2 needs to change to 1. Also AFC needs to wake-up by car battery signal.
Otherwise the wiring or terminals are suspected.

9.5.6 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	Unit
102	Ignition Plus	+12V signal present	0: not active 1: active	-

9.6 Petrol high rail pressure sensor



9.6.1 Function

- To measure the actual petrol fuel rail pressure
- Input for simulation strategy
- Analog and digital sensor supported

9.6.2 Description

The petrol rail pressure is measured from the petrol rail pressure sensor. While driving on gas, no petrol is injected and the pressure in the rail will increase. Normally, the engine management system would generate an error code and the engine would go into limp home mode. The AFC-3.0 DI simulates the correct petrol pressure to prevent fault codes. Hence an interruption of the signal wire is necessary. The AFC reads the signal and sends the desired signal to the engine management system.
During petrol modes, the original pressure is sent to the engine management system.

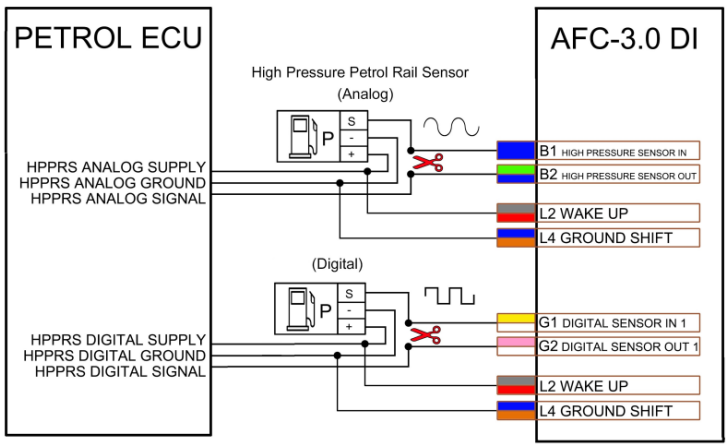
The +5V wake-up and the ground is also measured from the sensor. These signals are explained in the next chapters.

9.6.3 Variants

Analog and digital sensors
For a long time analog sensors have been used in the automotive industry. They provide the engine management with an analog signal between 0,5 and 4,5 Volt. An analog sensor requires a separate wire to the ECU for each reading. A digital sensor is equipped with microelectronics and communicates with the ECU via a data line. It can transmit multiple measurements across the data line. Fewer wires are needed despite the transmission of multiple signals. Another advantage of the digital sensor is that it self-diagnoses.

The correct settings and sensor are programmed in the online firmware for the engine / AFC-3.0 DI.

9.6.4 Electrical connections



Brown connector Electrical connection	AFC
Analog sensor pressure in	B1
Analog sensor pressure out	B2
Digital sensor pressure in	G1
Digital sensor pressure out	G2
+5V wake up	L2
Ground shift	L4

9.6.5 Diagnostics

Respect

- Wire connections located in installation manual
- OEM pin position in installation manual
- Correct sealing of battery / ground connections

Analog sensor

The analog sensors can have 3 or 4 wires.

- 3 wires:
  - +5V sensor supply
  - Pressure signal (0,5V – 4,5V)
  - Ground
- 4 wires:
  - +5V sensor supply
  - Pressure signal (0,5V – 4,5V)
  - Temperature (0,5V – 4,5V)
  - Ground

Normally the signal voltage becomes higher when the pressure rises. Normal voltage range is 0,5V to 4,5V.

Digital sensor

The digital sensor has 3 wires

- +5V sensor supply
- Data line (0V – 5V)
- ground

No signal

Check the wiring and terminals. Check with an advanced multi the voltage and the frequency of the signal.
When all connections are good, contact the technical helpdesk via the Support System

Wrong signal

Check the sensor pressure and OBD pressure during petrol mode. These signals need to be the same.
Often the sensor wires are mixed up or the wrong signal wire is cut through and connected to the AFC.
Normally the analog signal voltage becomes higher when the pressure rises. Normal voltage range is 0,5V to 4,5V.
Check chapter How to connect petrol emulation for the procedure to connect sensor wires.

Common conversion issues

- HPP rattle due to too high pressure
- OEM rail pressure DTC's
- Prins sensor DTC's

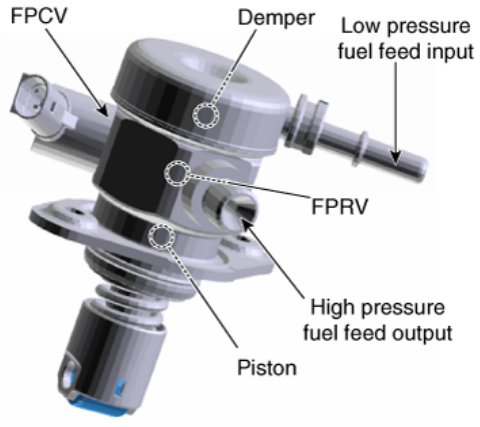
OEM Injector DTC's

- Engine behaviour
- Irregular running engine
- Stalling engine
- Deviation of injection time

Check

- State of power/ground connections
- According to manual
- Water intrusion in harness / AFC

9.7 Fuel Pressure Control Valve



9.7.1 Function

- To measure (in-)active time of the Fuel Pressure Control Valve
- Input for petrol rail pressure simulation strategy

9.7.2 Description

For some applications the signal of the Fuel Pressure Control Valve needs to be connected.

The fuel rail pressure in a DI engine is provided by a cam-driven variable stroke high pressure fuel pump. In typical designs, the volume of fuel pumped is controlled by a Flow Pressure Control Valve (FPCV) located on the inlet of the pump. The valve is electronically controlled by the engine control unit to regulate fuel rail pressure. The operation of the FPCV is unique because its control must be synchronous with the crankshaft position. Typical GDI fuel pumps have three lobes per camshaft revolution that stroke the pump. Fuel pressure is regulated by controlling the FPCV during the stroke of the pump to regulate how much of the stroke is allowed to draw fuel into the pumping chamber.

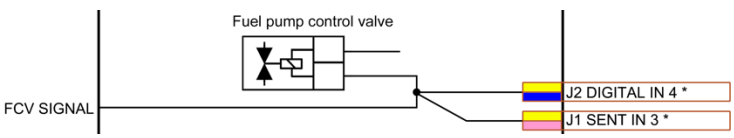
The quantity of fuel delivered by the GDI fuel pump can be adjusted by controlling the exact moment in the upward plunger stroke that the FPCV solenoid is energized. The earlier the valve closes, the higher the quantity of fuel delivered to the fuel rail.

9.7.3 Variants

1) Energized -> Pressure buildup.
   If the FCV solenoid is energized during the upward stroke of the cam and plunger, the valve closes and the pump develops pressure. The GDI fuel pump thus delivers fuel to the fuel rail.
2) De-energized -> Pressure buildup.

9.7.4 Electrical connections

Not all applications do need this connection.



Brown connector Electrical connection	AFC
DIGITAL IN 4;	J2
OR	
Sent IN 3	J1

* Depends on other connections, for example the Petrol low pressure pump signal for the petrol tank

9.7.5 Diagnostics

Respect

- Wire connections located in installation manual
- OEM pin position in installation manual

Rail pressure simulation 0 bar/ 0mV

When the signal wire is not connected, the emulated pressure will be 0 bar / 0mV.

Common conversion issues

- Extreme low pressure when wire is not connected
- Stalling engine
- OEM rail pressure OBD DTC's
- Deviation in fueltrims

OEM Injector DTC's

- Engine behaviour
- Irregular running engine
- Stalling engine
- Deviation of injection time

Check

- State of power/ground connections
- Location of pins according to manual (beware of deviation between manual and automatic transmissions)
- Water intrusion in harness / AFC

9.7.6 Prins AFC Software v2

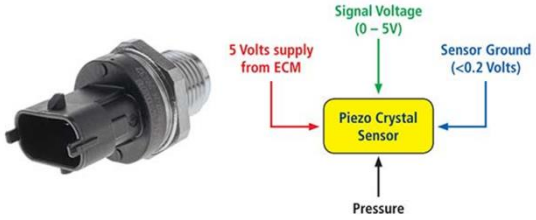
Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	Unit
29052	SystemHighPressureActuator CommandedAngle	The angle of the HP pump's actuation	1.5 ->	°
532	Petrol High pressure 1 Voltage	Analog sensor voltage (only for analog sensor)	0.5 – 4.5	V
537	Petrol High Pressure Absolute	Petrol rail pressure measured on the sensor	5-300	bar
805	Simulation Table Feedback Voltage	Simulated signal voltage to the engine management (only for analog sensor)	0.5 – 4.5	V

Diagnostics – OBD – Live data

	Term	Explanation	Expected values	Unit
	Fuel Rail Pressure	Rail pressure from engine management	500-30000	V

9.8 Wake up (+5V)



9.8.1 Function

- Signal wakes up and shuts down the AFC-3.0 DI
- Start of simulation strategies
- Sensor voltage value correction

9.8.2 Description

The AFC-3.0 DI wakes up and becomes active when 1 of the 2 wake-up signals is present.
The two wake-up signals are:

1) Ignition +
2) Wake up (5V sensor supply rail pressure petrol)

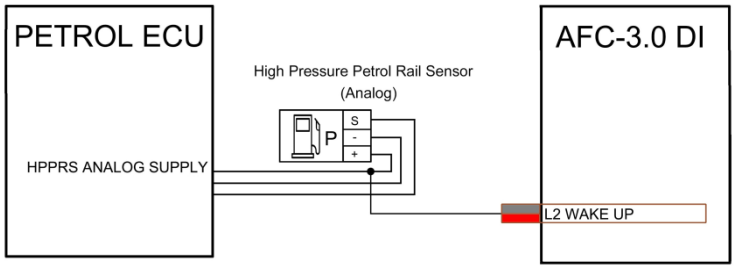
The Wake up is always connected to the +5V of the petrol rail pressure sensor.

The wake-up signals are also used for limp home mode. If these signals are present, the motor can run without loaded firmware and / or main fuse.

9.8.3 Variants

The Wake up is always connected to the +5V of the petrol rail pressure sensor.

9.8.4 Electrical connections



Brown connector Electrical connection	AFC
+5V wake up	L2

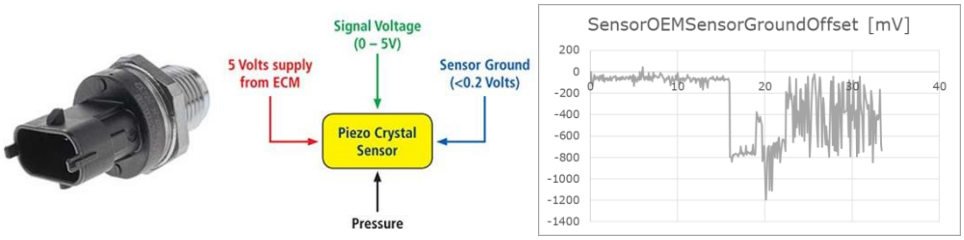
9.8.5 Diagnostics

No signal of intermitted signal
Check the wiring and terminals. Check the voltage with a multi meter.
Disconnect the wire from the car wire and make a temporary connection to the car battery. The status of the value in the Prins AFC Software v2 needs to change to 1. Also AFC needs to wake-up by car battery signal.
Otherwise the wiring or terminals are suspected.
Often the wrong sensor wire is connected to the AFC.
Check chapter How to connect petrol emulation for the procedure to connect sensor wires.

9.8.6 Prins AFC Software v2

	Term	Explanation	Expected values	Unit
6299	Spare Input 1 Status	+5V sensor power supply signal present	0: not active 1: active	-

9.9 Ground shift



9.9.1 Function

- Eliminate ground difference between engine management and AFC-3.0 DI

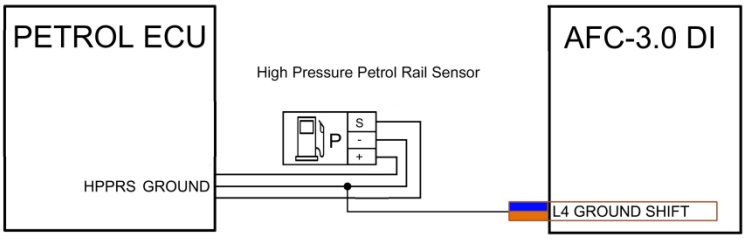
9.9.2 Description

The AFC-3.0 DI measures various engine sensor signals, like MAP, fuel rail pressure and petrol low pressure. These sensors are connected to the engine management with its own ground connection to the vehicle. The ground of the AFC-3.0 DI is often connected to the vehicle battery. This causes a small voltage difference between the measured signals. Normal value with a running engine is +/- 0-100 mV. Failures in Ground shift signal have extra effect negative effect on emulated signals
For example, a voltage difference of 0.1V is a difference of 7.5 bar petrol rail pressure. Therefore, it is necessary to eliminate the mass difference.

9.9.3 Variants

The Ground shift wire is always connected to the sensor ground of the petrol rail pressure sensor.

9.9.4 Electrical connections



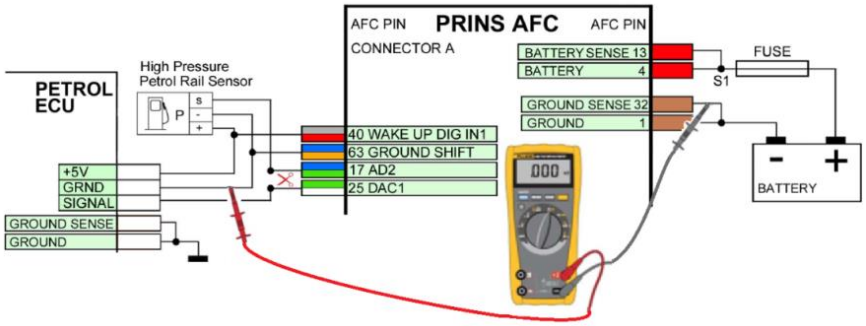
Brown connector Electrical connection	AFC
Ground shift	L4

9.9.5 Diagnostics

No signal or wrong signal
Check the voltage with the Prins AFC Software v2.
Check

- Wiring connection and terminals.
- Ground shift connection
- Supply / grounds

Check chapter How to connect petrol emulation for the procedure to connect sensor wires.

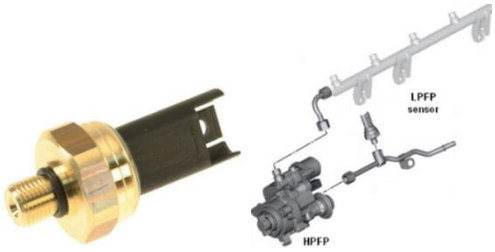


Always respect the ground locations as described in the (semi-) dedicated installation manual.
Wrong locations of ground connections can cause an irregular running engine or drivability issues.

9.9.6 Prins AFC Software v2

	Term	Explanation	Expected values	Unit
3708	OEM Sensor Ground Offset	Difference between the AFC ground and the sensor ground voltage	-100 - +100	mV

9.10 Petrol Low pressure



9.10.1 Function

- To measure the actual low petrol pressure from the petrol ltank
- Input for simulation strategy
- Analog and digital sensor supported
- Petrol low pressure emulation with the Prins AFC
- Best hardware solution
- No fuel line modification needed
- Provide a normal mixture during high loads (otherwise too lean)
- The best drivability

9.10.2 Description

While driving on gas, no petrol is injected and the low petrol pressure from the petrol tank will rise.
When the engine management generates and error during gas mode, the pressure sensor needs to be simulated.
The petrol tank pressure is measured from the petrol low pressure sensor of the vehicle. The AFC-3.0 DI simulates the correct petrol pressure to prevent fault codes. Hence an interruption of the signal wire is necessary. The AFC reads the signal and sends the desired signal to the engine management system.
During petrol modes, the original pressure is sent to the engine management system.
When the tank pressure needs to be simulated, also the signal of the tank petrol pump (driver) needs to be read out.

The petrol low pressure simulation prevents

- Vapour lock in the petrol line and rail
- Invalid petrol fuel pressure during gas and petrol mode
- Invalid learning of petrol pump driver
- Invalid fuel trims during petrol mode

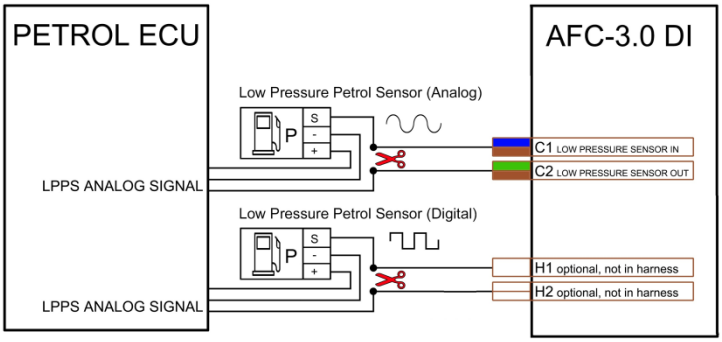
For some applications, reading the pressure is sufficient.
The location of the sensor can differ per brand and type. Often it can be find in the engine bay or under the vehicle.

9.10.3 Variants

Analog and digital sensors
For a long time analog sensors have been used in the automotive industry. They provide the engine management with an analog signal between 0,5 and 4,5 Volt. An analog sensor requires a separate wire to the ECU for each reading. A digital sensor is equipped with microelectronics and communicates with the ECU via a data line. It can transmit multiple measurements across the data line. Fewer wires are needed despite the transmission of multiple signals. Another advantage of the digital sensor is that it self-diagnoses.

The correct settings and sensor are programmed in the online firmware for the engine / AFC-3.0 DI.

9.10.4 Electrical connections



Brown connector Electrical connection	AFC
Analog sensor pressure in	C1
Analog sensor pressure out	C2
Digital sensor pressure in	H1
Digital sensor pressure out	H2

9.10.5 Diagnostics

Analog sensor
The analog sensors can have 3 or 4 wires.

- 3 wires:
  - +5V sensor supply
  - Pressure signal (0,5V – 4,5V)
  - Ground
- 4 wires:
  - +5V sensor supply
  - Pressure signal (0,5V – 4,5V)
  - Temperature (0,5V – 4,5V)
  - Ground

Normally the signal voltage becomes higher when the pressure rises. Normal voltage range is 0,5V to 4,5V.

Digital sensor
The digital sensor has 3 wires

- +5V sensor supply
- Data line (0V – 5V)
- ground

No signal
Check the wiring and terminals. Check with an advanced multi the voltage and the frequency of the signal.
When all connections are good, contact the technical helpdesk via the Support System

Wrong signal
Check the sensor pressure and OBD pressure during petrol mode. These signals need to be the same.
Often the sensor wires are mixed up or the wrong signal wire is cut through and connected to the AFC.
Normally the analog signal voltage becomes higher when the pressure rises. Normal voltage range is 0,5V to 4,5V.
Check chapter How to connect petrol emulation for the procedure to connect sensor wires.

9.10.6 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	Unit
1171	Petrol low Pressure Absolute	Petrol rail pressure measured on the sensor	2-10	mbar
1170	Petrol low pressure 1 Voltage	Sensor voltage (only for analog sensor)	0.5 – 4.5	V
806	Simulation Table2 Feedback Voltage	Simulated signal voltage to the engine management	0.5 – 4.5	V

9.11 Petrol pump signal

9.11.1 Function

- To control fuel pressure
- Measures the load of the tank petrol pump
- Input for petrol pressure simulation strategy
- Direct signal from pump or signal to pump driver supported

9.11.2 Description

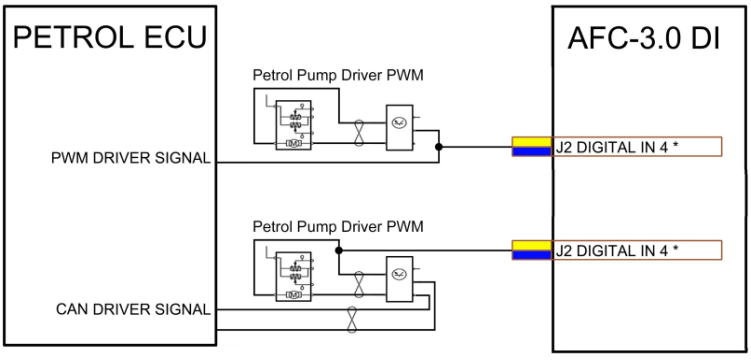
The load of the petrol pump is needed, for a correct simulation of the petrol pressures. The PWM control of the pump is measured by the AFC-3.0 DI.

9.11.3 Variants

PWM control between engine management and pump driver
Most of the applications use this signal. The engine management sends a PWM signal to the pump driver. When the duty cycle gets higher, the current through the pump will be higher.

PWM control direct on petrol pump
When the pump driver communicates via CAN-bus with the engine management, the PWM signal is measured direct on the petrol pump.

9.11.4 Electrical connections



Brown connector Electrical connection	AFC
PWM petrol pump	J2

Frequency:

- Engine management to pump driver: <400Hz
- Direct on petrol pump: 10-30 kHz

9.11.5 Diagnostics

No signal

Check the wiring and terminals. Check with an advanced multi the voltage and the frequency of the signal. Whe the flow increases, the duty cycle will get higher.

Frequency:

1) ECM to pump driver [<400Hz]
2) Direct on petrol pump [10-30 kHz]

When all connections are good, contact the technical helpdesk via the Support System

Engine behaviour

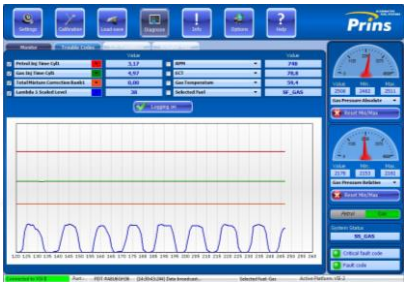
- OBD-DTC's
- Extreme rich or lean mixture
- Vapour lock complaints (High pressure fuel rail DTC's)
- Stalling

9.11.6 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	Unit
6277	Spare Input 4 Duty Cycle	Duty cycle of measured signal	10-80 [pump driver] 10-100 [Fuel pump]	%
6278	Spare Input 4 Frequency	Frequency of measured signal	>400Hz ECM -> pump driver 10-30kHz Petrol pump	

9.12 Lambda



9.12.1 Function

- Monitors the mixture
- Corrects the mixture when needed

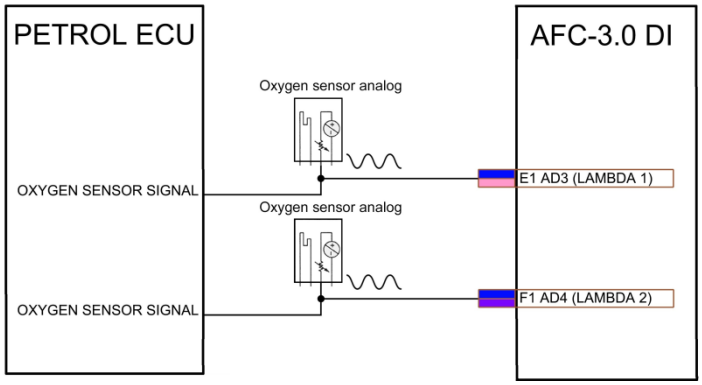
9.12.2 Description

The system uses the lambda signal to monitor the fuel mixture. It monitors during high load (open loop control) whether and how long the mixture is lean.
When the mixture is too lean for too a too long period, it may cause damage to the catalytic converter and engine. If this situation is detected, a trouble code will be generated and the system will automatically switch to petrol.
The system can also use the lambda signal for emission corrections.
Some engines have more than one bank. In this case, one or more lambda probes per bank will be used. The AFC-3.0 DI can process two small band lambda signals.

9.12.3 Variants

Only small band lambda sensors are supported by the AFC-3.0 DI.
Wideband lambda sensors cannot be readout by a wiring input.

9.12.4 Electrical connections



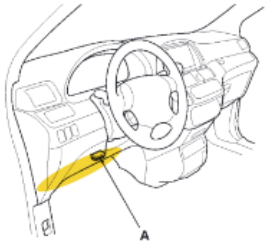
Brown connector Electrical connection	AFC
Lambda 1 signal AD3	E1
Lambda 2 signal AD4	F1

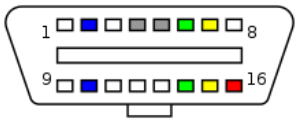
9.12.5 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	Unit
1716	Lambda 1	Lambda sensor bit signal bank 1		-
560	Lambda 1 Voltage	Lambda sensor voltage bank 1	0 – 5	V
1180	Lambda 1 Status	Mixture status bank 1	Lean Rich	-
1717	Lambda 2	Lambda sensor bit signal bank 2		-
561	Lambda 2 Voltage	Lambda sensor voltage bank 2		V
1183	Lambda 2 Status	Mixture status bank 2	Lean Rich	-

9.13 OBD CAN-Bus





9.13.1 Function

- Readout OBD information for calculations and strategies
- Information for diagnostics
- Reset fuel gauge level (PSA models)

9.13.2 Description

On-board diagnostics (OBD) is the term referring to the vehicle's self-diagnostic and reporting capability. Modern OBD implementations use a standardized digital communications port to provide real-time data in addition to a standardized series of vehicle information and diagnostic trouble codes (DTC).
The AFC CAN wires need to be soldered to the vehicles OBD CAN-bus wires. It uses the OBD information for calculation and system strategies.

Prins AFC Software v2 OBD reader

An OBD reader is integrated in the Prins AFC Software V2. Use the software instead of an external OBD-tester. When an external OBD tester is connected to the OBD socket, the system will switch back to petrol and the engine will not run on gas anymore.

9.13.3 Variants

OBD connection
All VSI-3 DI systems need the standard OBD CAN-bus connections for a best performance and smooth running engine.

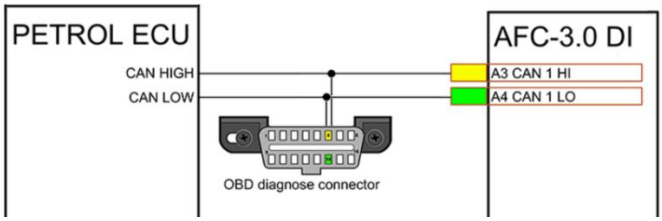
PSA Petrol fuel gauge reset
With the PSA applications a second CAN-bus needs to be connected, used to reset the fuel gauge.
Use parameter 'PSA Petrol Gauge CAN Reset counter' [22309] to check the functionality.

OBD CAN Gateway
When an extra OBD device is a must, install the extra OBD Gateway wiring module. The external tester/device will communicate through the AFC with the vehicle. It is no longer parallel connected to the AFC and vehicle. And the engine will run on gas with a connected OBD device. Hardware modifications need to be made.
Order the CAN-gateway wiring module via the Prins Webshop.

Attention! When a vehicle system needs an OEM software update always disconnect the CAN Gateway and use the original OBD connector to flash a vehicle system.

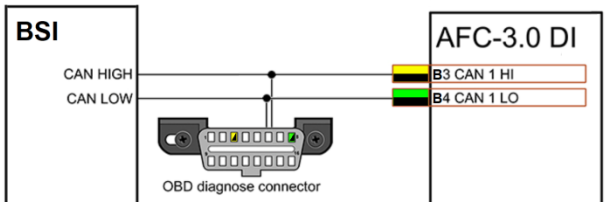
9.13.4 Electrical connections

Standard



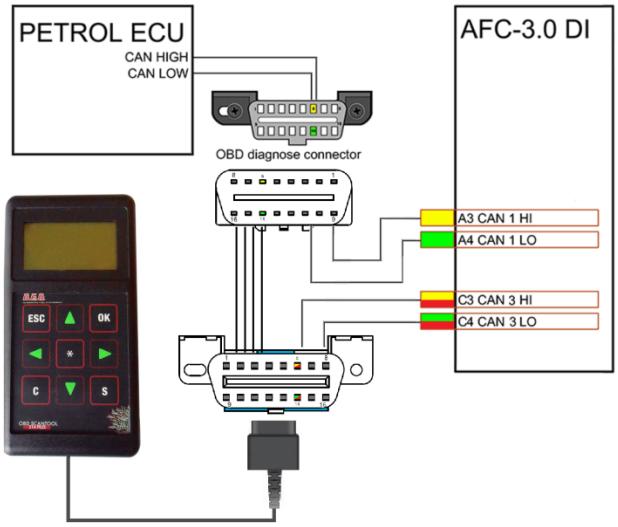
Brown connector Electrical connection	AFC	OBD Pin
CAN 1 High	A3	6
CAN 1 Low	A4	14

PSA Petrol Gauge CAN Reset



Brown connector Electrical connection	AFC	OBD Pin
CAN 2 High	B3	3
CAN 2 Low	B4	8 Opel 11

OBD Gateway



Brown connector Electrical connection	AFC
CAN 1 High	A3
CAN 1 Low	A4
CAN 3 High	C3
CAN 3 Low	C4

9.13.5 Diagnostics

External tester present
It is not possible to connect an external tester, dongle or GPS tracking device onto the vehicle OBD-connector during gas modes. When the AFC detects an extra device on the OBD CAN-bus, the system status 'GAS_NOT_ALLOWED' will be active and the Prins logo on the switch will flash with 2Hz. The engine will only run on petrol then.

AFC DTC 81 CAN 1 communication lost
No communication with vehicle CAN-bus. Check CAN wiring and connections.
This fault may occur when the CAN wires are not connected / soldered correct.
When the CAN1 and CAN2 wires are soldered to the correct OBD Pin, contact your local distributer.

AFC DTC 209 Essential OBD data not received
Try other VAG firmware with identical engine code

AFC DTC 210 Essential OBD data implausible
Missing OBD data. Check CAN wires for incorrect connection, open or short circuit.
Contact Prins

9.13.6 Prins AFC Software v2

Diagnostics – Monitor – Process parameters

	Term	Explanation	Expected values	Unit
4650	OBD External Tester Present	Diagnostic tool or other device connected to the OBD network	Yes / no	-
570	OBD_FuelSystemStatus	Engine management system status	Open loop (warm-up / failure) / Closed loop (warm-up / failure) / transient open loop	-
526	OBD_ShortTermFuelTrimBank1	Percentage to make the fuel mixture balanced	-10 / +10	%
527	OBD_LongTermFuelTrimBank1	Long term percentage to make the fuel mixture balanced	-10 / +10	%
22309	PSA Petrol Gauge CAN Reset counter	Counter increases after each 'ignition on' and acknowledge of the BSI. Above 255, this counter starts again with 1.	1-255	-

Diagnostics – OBD – Live data

	Term	Explanation	Expected values	Unit
	Fuel Rail Pressure	Rail pressure from engine management	500-30000	V

10 Hardware installation instructions engine kit

10.1 Required equipment / tools / materials

- Complete workshop toolbox (wrenches, screwdrivers, cutters, pliers, ratchet, sockets)
- Car lift
- Portable computer
- Vehicle fuel system scan tool or OBD scan tool Prins (part no. 099/99928)
- Exhaust gas analyser
- Multi-meter
- Oscilloscope
- Prins diagnostic software
- Prins Diagnostic Tool
- Torque wrench (5-50Nm)
- Torque wrench (200-250Nm)
- Portable light
- Assortment drill bits Ø4 to 12 mm
- Assortment cutters (Ø20, 30, 50, 70 mm)
- Portable drill or pneumatic drill
- Thread cutting device (male M6x1, M8x1, M10x1)
- Air gun
- Vacuum cleaner
- Safety goggles
- Hot air gun
- Soldering iron, soldering tin
- Wire-stripping pliers
- Adhesive tape
- Adhesive sealant
- Thread locking compound (for example WURTH Pipe Sealant 0893 577 050)
- Anti-corrosion agent / black body coating
- Gas leak detection device or foam leak spray
- Shrink sleeves

10.2 Tightening moments

Connection	Nm	Spanner mm
M5 x 0,8	6.5	8
M6 x 1,0	11.3	10
M8 x 1,25	27.3	13
M10 x 1	52	15-16-17
M10 x 1,5	54	15-16-17
GAS manifold nipple	1	3.5 Allen / 12
P/T sensor filter unit	2.5	10
eVP bolts – bracket	10	10
Fuel line nut	20	13
Fuel line Banjo bolt / seals	10	14
Fuel line tank – lock-off	20	16
Filling hose connections	50	22

10.3 Conversion kit variants

Prins delivers three kind of alternative fuel kits, dedicated, semi-dedicated and Universal VSI-3 DI-kits.

10.3.1 Universal VSI-3 DI-kits

The Universal VSI-3 DI-kit contains only the main parts of the GAS system. Like AFC, wiring harness, switch, reducer, filter, injectors, inlet couplings and hoses. No engine brackets, extra relays or other parts are included. Always check the vehicle installation manual if extra parts are needed.

Content:

AFC-3.0 DI

Wiring harnesses (Grey-Brown-Black)

Fuel selector switch

LPG high pressure line and fittings

eVP-500 reducer

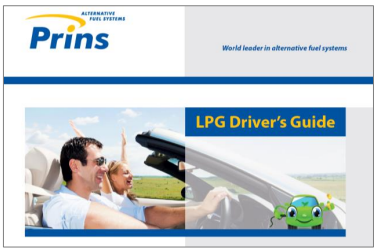
Filter unit

Injector rail

Inlet coupling

Map sensor (when needed)

Various hoses GAS11-16mm – coolant



Driver's Guide

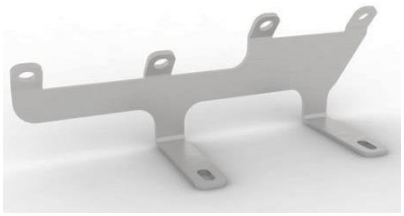
Warranty card

Various mounting material

10.3.2 Semi-dedicated kits

Semi-dedicated kits do not contain filler and tank components. The high pressure hose and most components used in the engine bay are supplied. Including the gas injector bracket for the specific engine type. The reducer bracket is not supplied.

Content -> Universal kit + injector brackets and additional electric parts:



Injector bracket(s)

Additional electrical parts
(when needed)

10.3.3 Dedicated kits

Dedicated kits are complete conversion kits which contain all components to convert a vehicle to LPG or CNG.

Content -> Semi dedicated kit + vehicle specific brackets, gas tank and/or harnesses:

eVP-500 bracket

Dedicated wiring harness (if applicable)

Optional: LPG tank and filling hose material

10.4 AFC-3.0 DI

10.4.1 Hardware

The ACF can be installed in 2 different ways.

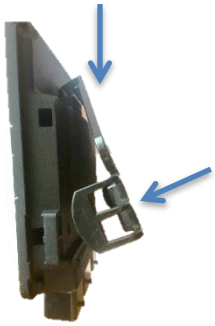
- Plastic bracket wit 3 plastic AFC clips
- Steel bracket with 3 plastic AFC clips

For heat dissipation it's important to place it in the relative cool location in the engine compartment with unblocked heat ridges.

Attention! Install the AFC at a location with least heat build-up. If the AFC reaches an internal temperature of more than 90 degrees, it will automatically switch back to petrol.

Plastic bracket wit 3 plastic AFC clips

The plastic bracket is default supplied in the engine kit.



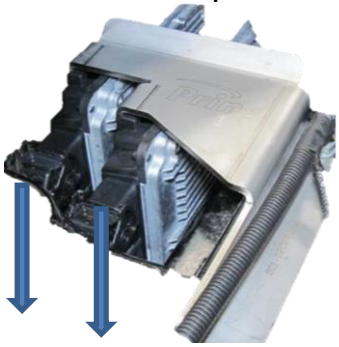
Stainless steel bracket with 3 plastic AFC clips

Create your own bracket or order one from Prins to install the AFC-3.0 DI into the engine bay.

001/020220/A
BRACKET AFC-3 UNIVERSAL

Example of dedicated bracket

Preferred installation positions

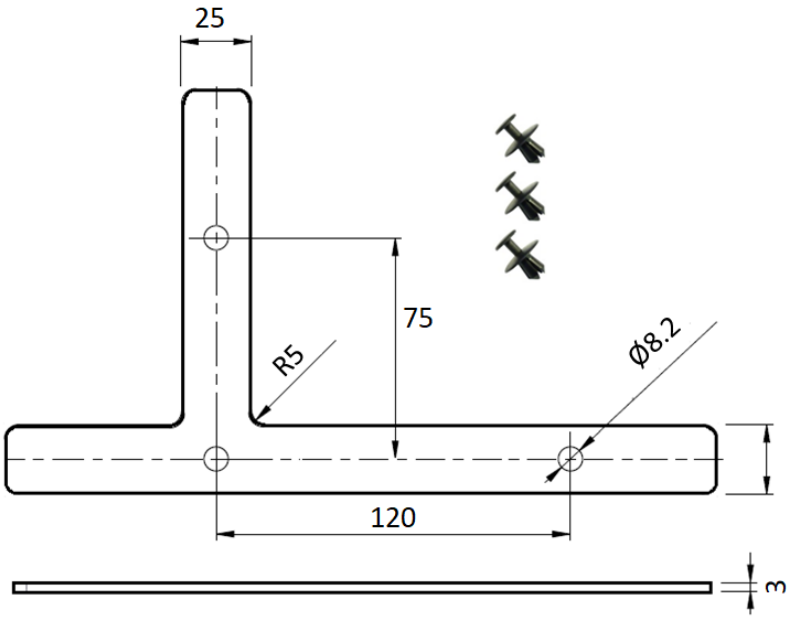


Wiring downwards

Connectors downwards

Heat plate up

Dimensions



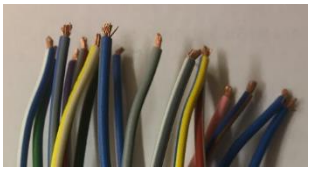
Dimensions

10.5 Wiring harness

10.5.1 Description

Universal harnesses or dedicated harnesses are supplied in the universal engine kits. Most (engine) connections need to be soldered with universal harnesses.

10.5.2 Installation of wiring harness



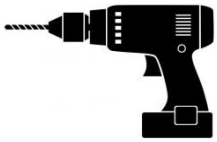
- Use the (semi-) dedicated installation instruction for the correct electrical connections.
- Use the correct electric connections:
  - Solder connections
  - Wire clamps.
- Isolate all the connections with
  - The supplied shrink-sleeves, or
  - Moisture sealing electrical tape
- Install the connected wires at a suitable place. This includes fixation at sufficient places and positioning out of the reach of heat sources, e.g. EGR supply lines;
- Ensure that the wires are not stressed when the engine tilts
- Try to integrate the GAS wires into the petrol wiring as much as possible.
- Mount the system fuse according to the instructions at a place which can easily be accessed.
- Respect the ground position as described in the (semi-) dedicated installation instruction. A deviation can create drivability issues and engine management errors.

10.6 Fuel selection switch

10.6.1 Hardware installation

Standard
Drill a hole Ø8.3mm for the switch. Mount the switch.
Beware of any electrical wiring or other components when locating the hole

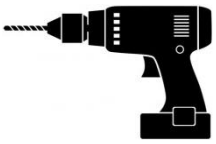
Standard switch



Ø 8.3mm

Recessed
Prins offers an option for recessed installation of the switch. Order the 'Ring aluminium switch recessed' via the Prins Webshop.

091/020020/A

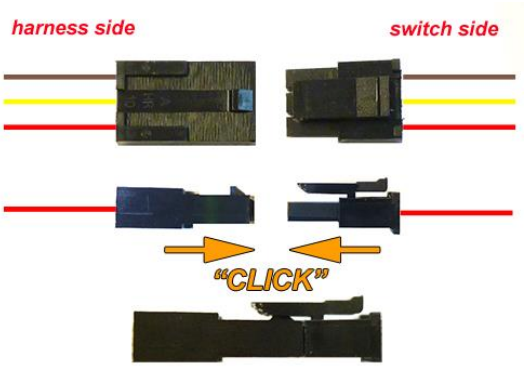


Ø 32mm

10.6.2 Electrical installation

AFC-3.0 DI Brown connector

K4	Ground fuel switch			Brown-black
K2	+12V fuel switch			Red-white
K3	LIN-bus			Yellow



Connect the 3-pole connector to the Prins fuel selection switch and the wiring harness.

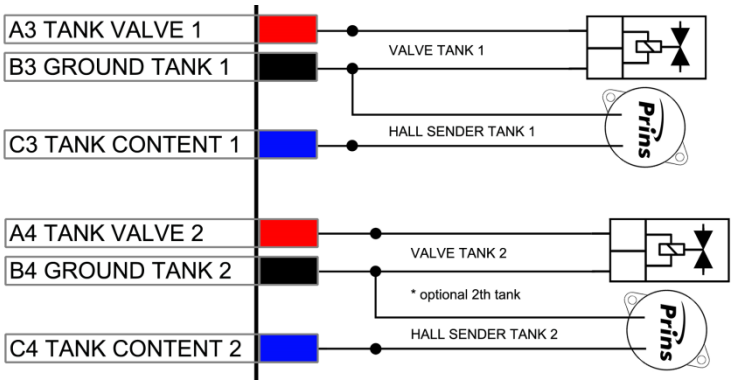
10.7 LPG fuel tanks

10.7.1 Hardware installation

Use the information in the chapter “General installation instruction trunk side – Installation of LPG fuel tank”

10.7.2 Electrical installation

Standard one tank can be connected to the harness of the AFC-3.0 DI. When a second tank needs to be connected, order the second tank module via the Webshop. Use the same type of level sensor for both tanks.



10.8 Fuel supply hose XD

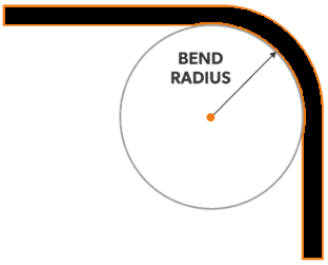
10.8.1 Hardware installation

Mounting the XD-hose

- Use the supplied clamps and mounting hardware
- Maximum distance of 400mm between each clamp
- Temperature min -40°C max 120°C.
  - Prins advices to use a heatshield when the distance between the hose and exhaust is less then 100mm. (or other heat source)
- Follow your local installation regulation for proper mounting.
- It is not permitted to have GAS tubes routed through the passenger compartment or a closed cargo space.
- Note the jack supporting points and moveable parts when mounting the GAS line.
- Remove the inner burrs after shortening the GAS line (to prevent the flow from being reduced).
- The number of joints shall be limited to a minimum.
- In a passenger compartment or enclosed luggage compartment the gas tube or hose shall be no longer than reasonably required; this provision is fulfilled when the gas tube or hose does not extend further than from the fuel LPG fuel tank to the side of vehicle.
- There shall be no gas-conveying connections in the passenger compartment or enclosed luggage compartment with the exception of:
  - The connections on the gas-tight housing;
  - And the connection between the gas tube or hose and the filling unit if this connection is fitted with a sleeve which is resistant against GAS and any leaking gas will be discharged directly into the atmosphere.

Bend radius

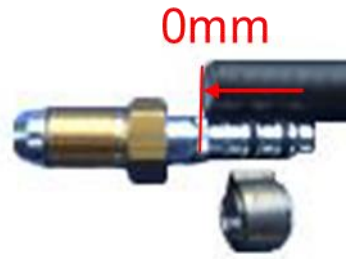
Hose	Minimum bend radius (mm)
XD-500-3	60
XD-4	85
XD-5	105
XD-6	120

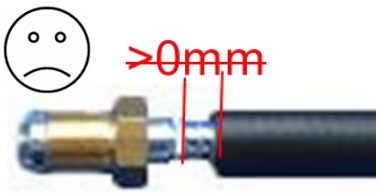


Clamp work instruction

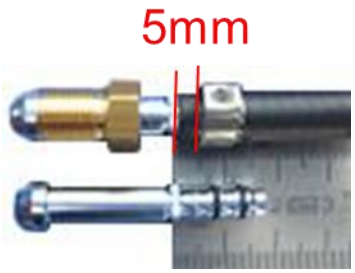
1. Cut the XD hose with a special hose cutter.

2. Increase the bore of the XD hose.

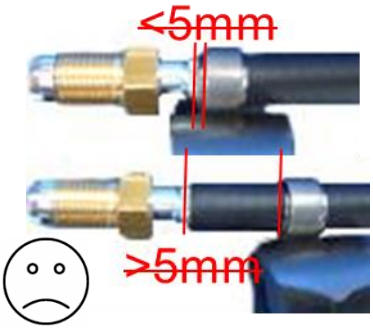




3. . Insert the coupling into the hose and evaluate position.



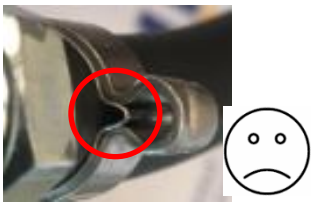
4. Clamp position 5mm from marking on fitting.



5.

6. Squeeze the clamp with a proper tool.

7. Check Squeezed clamp



8. Slave ring also squeezed.

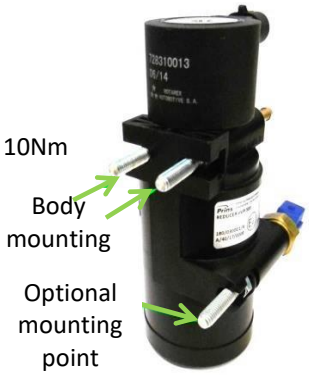
9. Maximum width 2,5mm

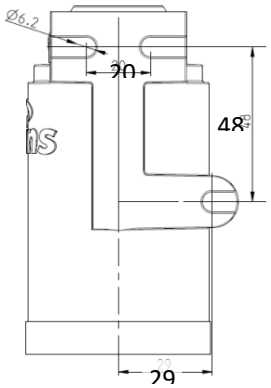
10.9 eVP-500 reducer

10.9.1 Hardware installation

Mount the eVP-500:

- In the engine compartment as shown on the images below
- According to local regulations.
- With use of the two upper mounting points.
  Use the third mounting point if the reducer suffers from vibration.
- With use of the M6 bolts, nuts and spring lock washers delivered in the kit.





10Nm Do not Exceed torque, this may cause damage

Use spring lock washer

Design your own bracket according the dimensions or order a bracket separately via the Prins 96ebshop.

Basic strip eVP: 001/999040

Bracket universal zinc plated steel: 001/080131

Tightening torques	Nm
Body mounting bolts	10
Actuator	15
Banjo bolt / LPG hose	10
Pressure Relief Valve	4
ECT sensor	4

10.9.2 Electrical installation

Connect the black 2 pole connector to the actuator

Connect the blue 2 pole connector to the bleu regulator coolant sensor

- Standard Prins sensor
- NTC resistor
- R20˚C ≈ 2500Ω
- IP 54A Connector

10.9.3 Hoses installation

Coolant

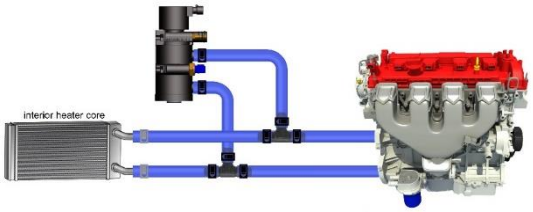
Connect the coolant hoses to the coolant system of the vehicle.

- Fast temperature rising vehicle coolant hose
- No flow direction specified

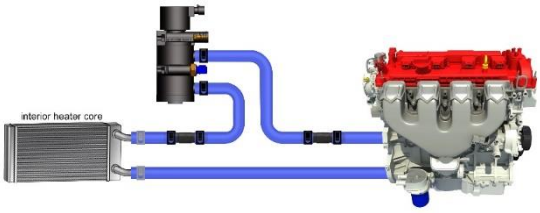
Use the (semi-) dedicated installation instructions for the correct coolant connections. When the information is not available, connect the reducer parallel to a constant coolant flow hose.

8-10-12 Cylinder engines can have an extreme high coolant flow. For example, a RAM 5.7v8 and 6.4v8 has a coolant flow of surpassing 2000 l/hr direct from the coolant pump. Connect the reducer parallel to a constant coolant flow hose.

2-3-4-5-6- cylinder engine

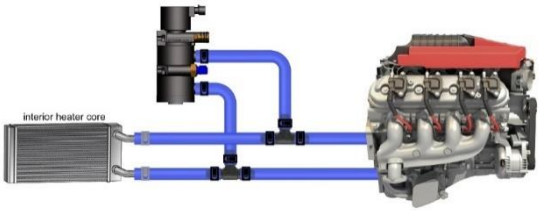


Parallel connection

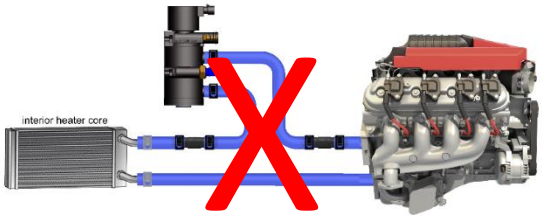


Serial connection

8-10-12- cylinder engine



Parallel connection



Serial connection

8-10-12 Cylinder engines can have an extreme high coolant flow. For example, a RAM 5.7v8 and 6.4v8 has a coolant flow of surpassing 2000 l/hr direct from the coolant pump.

LPG supply from tank

Connect the XD fuel supply hose at the bottom of the eVP-500.

- XD4, XD5 flare straight / flare 90°

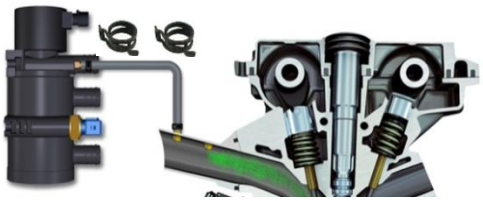
Gas output to filter

Connect the gas hose to the Gas-out and the inlet of the filter. Use the supplied clamps.

Try to install the filter unit as close as possible to the injector rail.

Pressure Relief Valve

Connect the gas hose to the Pressure Relief Valve and the inlet manifold



Attention!

Ensure a kink-free routing of the coolant hoses
Make sure hose clamps are properly tightened
Check the coolant level, top up if necessary and bled the coolant system
Check after the installation if the reducer and interior heater heats up quickly (normal operating temperature of motor is 85 ±5°C)
The coolant temperature must be 55°C within 10 minutes.

10.10 Ventrex Evo3.1 Electronic CNG Pressure Regulator

10.10.1 Hardware installation

Mount the CNG Pressure Regulator:

- In the engine compartment as described in the (semi-) dedicated installation instructions.
- According to local regulations.
- With the delivered bracket.
- With use of the two rubber dampers.
- With use of the M8 bolts, nuts and spring lock washers delivered in the kit.

Tightening torques	Nm
Body mounting bolts	24

10.10.2 Electrical installation

Connect the black 2 pole connector to the actuator

Connect the black 3 pole connector to the pressure sensor

10.10.3 Hoses installation

Coolant

Connect the coolant hoses to the coolant system of the vehicle.

- Fast temperature rising vehicle coolant hose
- No flow direction specified

CNG supply from tank

Connect the XD-500 fuel supply hose at the bottom of the eVP-500.

Gas output to filter

Connect the gas hose to the Gas-out and the inlet of the filter. Use the supplied clamps.

Try to install the filter unit as close as possible to the injector rail.

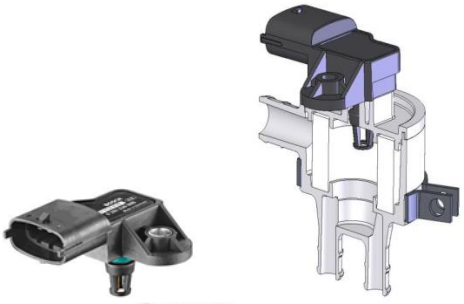
Attention!

Ensure a kink-free routing of the coolant hoses
Make sure hose clamps are properly tightened
Check the coolant level, top up if necessary and bled the coolant system
Check after the installation if the pressure regulator and interior heater heats up quickly (normal operating temperature of motor is 85 ±5°C)
The coolant temperature must be 55°C within 10 minutes.

10.11 Filter unit

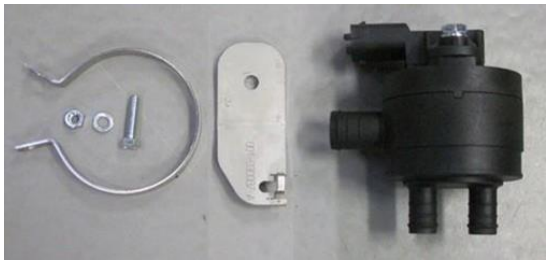
10.11.1 Hardware installation

The round filter clamp is delivered in all kits.
The vehicle specific brackets are only delivered in dedicated kits.



Install the P/T sensor.
(Gas system pressure and temperature sensor)

Use the bracket to install the gas filter in a proper way.



Create your own bracket or order one from the Prins Webshop to install the filter unit into the engine bay.

10.11.2 Electrical installation

Connect the black 4 pole connector to the P/T sensor.
(Gas system pressure and temperature sensor)

10.11.3 Hoses installation

Connect the gas hose to the Gas-out and the inlet of the filter. Use the supplied clamps.

Try to install the filter unit as close as possible to the injector rail.

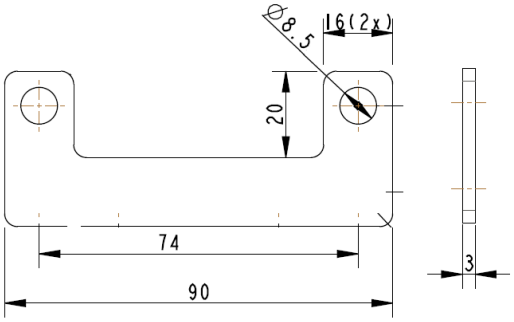
Connect the gas hose(s) to the outlet and the injector rail. Use the supplied clamps.

10.12 Injectors / rail

10.12.1 Hardware installation

Use the (semi-) dedicated installation instruction for correct installation.
Create your own injector rail bracket or order one from Prins to install the injector rail onto the engine.

Always install the injector rail in a positive angle.



Dimensions

10.12.2 Electrical installation

Gas injector wire / connector identification

Connect the black 2 pole connector to the injector according the (semi-) dedicated manual.

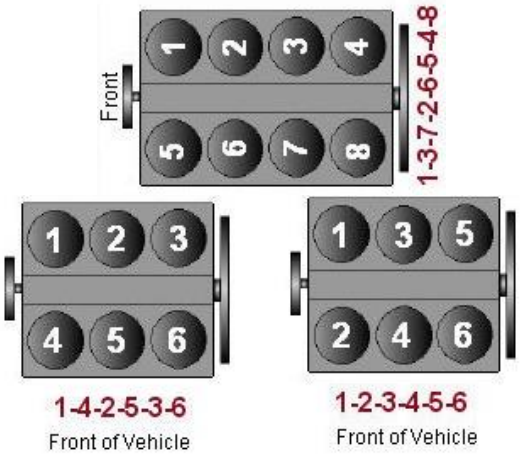
	Connector / color	Wire color	
Gas injector 1	2-pole Black	White	yellow
		Red	
Gas injector 2	2-pole Black	Green	yellow
		Red	
Gas injector 3	2-pole Black	Pink	yellow
		Red	
Gas injector 4	2-pole Black	Blue	yellow
		Red	
Gas injector 5	2-pole Black	Grey	Yellow
		Red	
Gas injector 6	2-pole Black	Brown	Yellow
		Red	

Numbering of cilinders and firing order

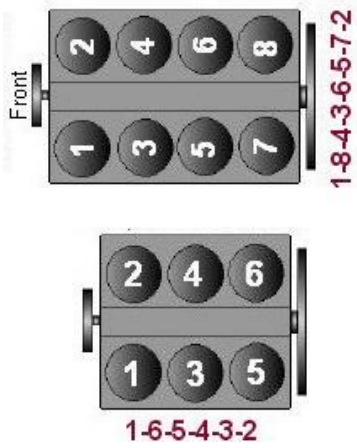
Respect the cilinder numbering of the engine. These cilinder order and firing order orders can deviate per brand, model and engine series.

Common 4 cilinder numbering

Example of PSA cilinder numbering
Beware: First cilinder at gearbox side.

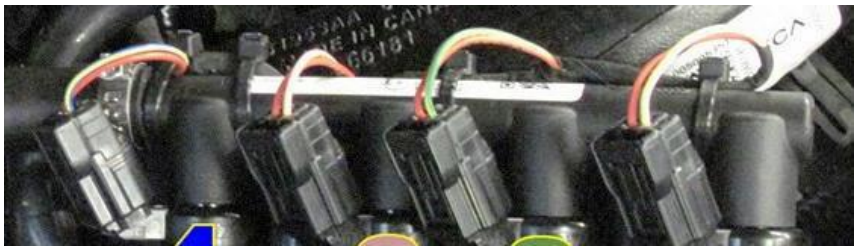


Example of Ford cilinder numbering



Example of GM cilinder numbering

Strap wiring



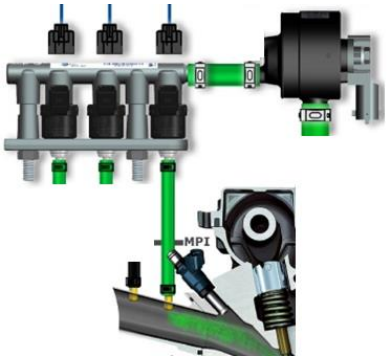
Strap the wires to prevent wear through and excessive vibrations.

10.12.3 Hoses installation

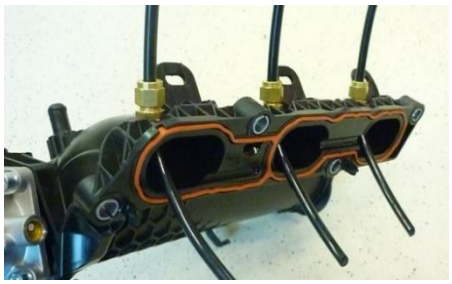
Connect the gas hose to the inlet of the injector rail. Use the supplied clamps.

Connect the gas hose(s) to the gas injector and the corresponding inlet coupling of hose. Use the supplied clamps.

Make sure that the gas hoses between the intake manifold nipples and the gas injectors have the length mentioned in the (semi-) dedicated manual.



M6x1 - Rubber hoses



M10x1 – Nylon hoses

M10x1 – PTFE hoses

10.13 Inlet couplings

10.13.1 Hardware installation

Use the (semi-) dedicated installation instruction for correct installation

Attention!

Work very carefully while installing the couplings
Always use hose clamps
If installed wrongly, leaks may occur (air and gas)
After installation always check for gas or air leaks and whether the 5mm hoses are mounted properly without jams or bends
Make sure that hose lengths do not exceed 40 cm
Make sure that the hoses have the same lengths according the (semi-) dedicated manual

10.13.2 General tools and material

WURTH Pipe Sealant
0893 577 050

Drill

Hand cutting tool

Vacuum cleaner

Air gun

Ratchet set

Clamps

Hose clamp pliers

5mm hose

Oetiker clamp pliers

2x Wrench 12

Basic workshop equipment/tools

10.13.3 M6x1 - Rubber hoses 5mm

TOOLS AND MATERIAL

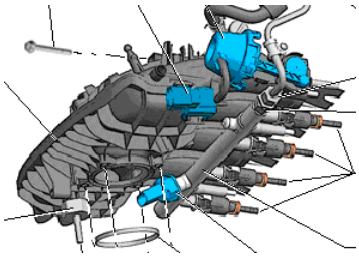
Long cutter M6x1

Long drill Ø5mm

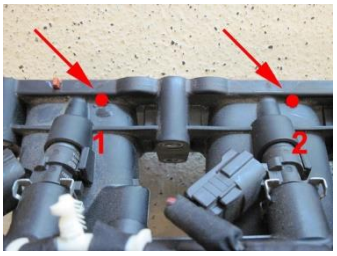
Allen torque wrench

Inlet nipples

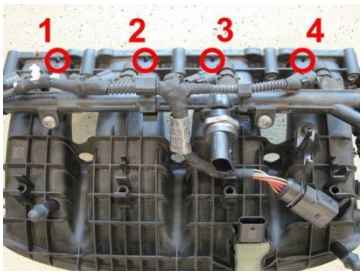
Installation process M6x1 - Rubber hoses 5mm



1. Always remove the inlet manifold.

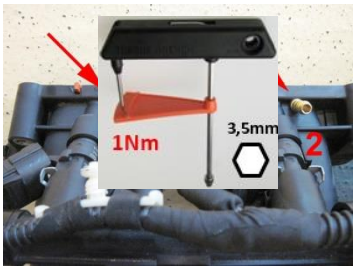


2. Mark and drill 5 mm holes according the (semi-) dedicated installation manual.

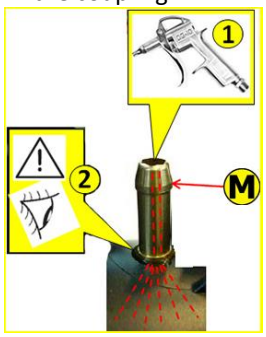


3. Cut **M6** thread in these holes.
4.

5. Add locking compound to the coupling

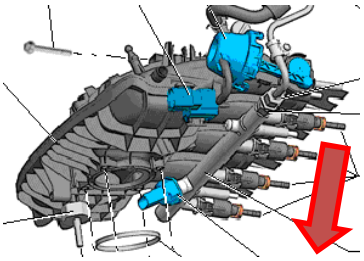


6. Place the VSI couplings in the inlet manifold.
7. Tightening to 1Nm



8. Make sure NO sealant blocks the coupling.

9. Install the hoses Ø5mm with supplied clamps



10. Clean and
11. Install the manifold

10.13.4 M10x1 – Nylon hoses

TOOLS AND MATERIAL

Long cutter M10x1

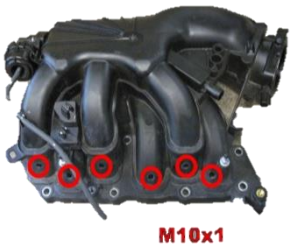
Long drill Ø8,5mm

Nylon Inlet nipple set

Installation process M10x1 – Nylon hoses

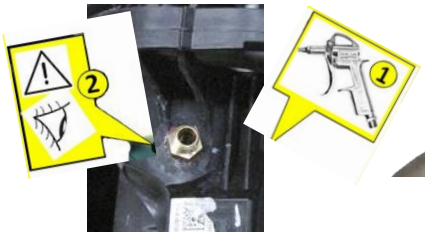
1. Always remove the inlet manifold.

2. Mark and drill 8,5 mm holes according the (semi-) dedicated installation manual.



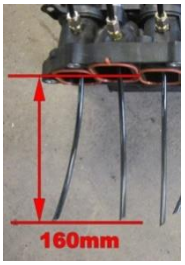
3. Cut **M10x1** thread in these holes.
4.

5. Add locking compound to the coupling

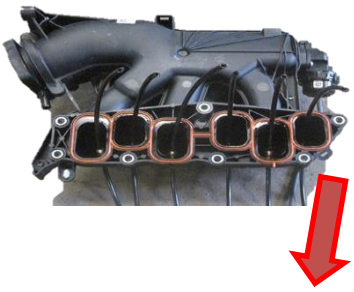


6. Place the couplings in the inlet manifold.
7. Make sure NO sealant blocks the coupling.

8. Mount the nylon hose with the nut to the manifold couplings



9. Cut the hose diagonally to the length as mentioned in the (semi-) dedicated installation manual.



10. Clean and
11. install the manifold

12. Install the hoses Ø5mm with supplied clamps over the nylon hose.

M10x1 – PTFE hoses

TOOLS AND MATERIAL

Long cutter M10x1

Long drill Ø8,5mm

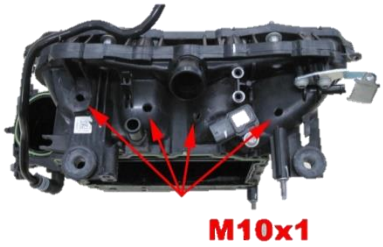
PTFE Inlet nipples

PTFE hose

Installation process M10x1 – PTFE hoses

1. Always remove the inlet manifold.

2. Mark and drill 8,5 mm holes according the (semi-) dedicated installation manual.



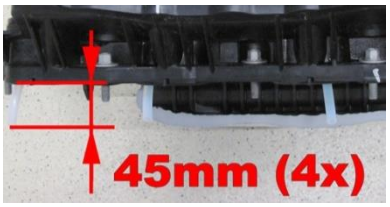
3. Cut **M10x1** thread in these holes.

4. Add locking compound to the coupling

5. Place the couplings in the inlet manifold.
6. Make sure NO sealant blocks the coupling.

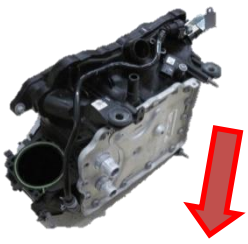
7. Cut the hose to the length described in the (semi-) dedicated installation manual.
8. Install the PTFE hose over the hose-coupler

9. Mount the PTFE hose with the nut to the manifold couplings



10. Cut / Check the described length as mentioned in the (semi-) dedicated installation manual.

11. Install the hoses Ø5mm with supplied clamps over the PTFE coupling.



Clean and
12. Install the manifold

11 Electrical installation instructions

This chapter describes the wiring diagram, connector layout and installation of the electrical parts. For harness routing use the chapter Hardware installation instructions engine kit.

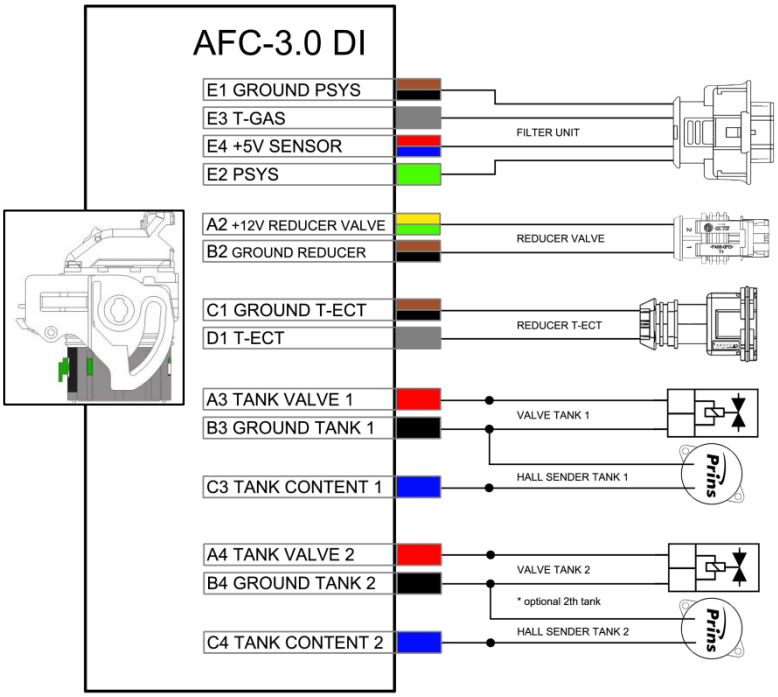
11.1 Basic wiring diagram

11.1.1 Grey connector

The Grey connector contains most of the GAS related in- and outputs. It can be divided into 2 parts.

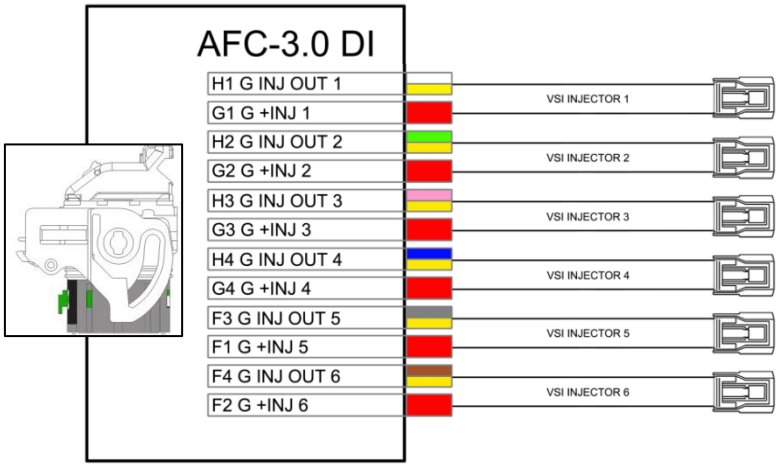
1) Gas sensors and actuators
2) Gas injectors

Gas sensors and actuators



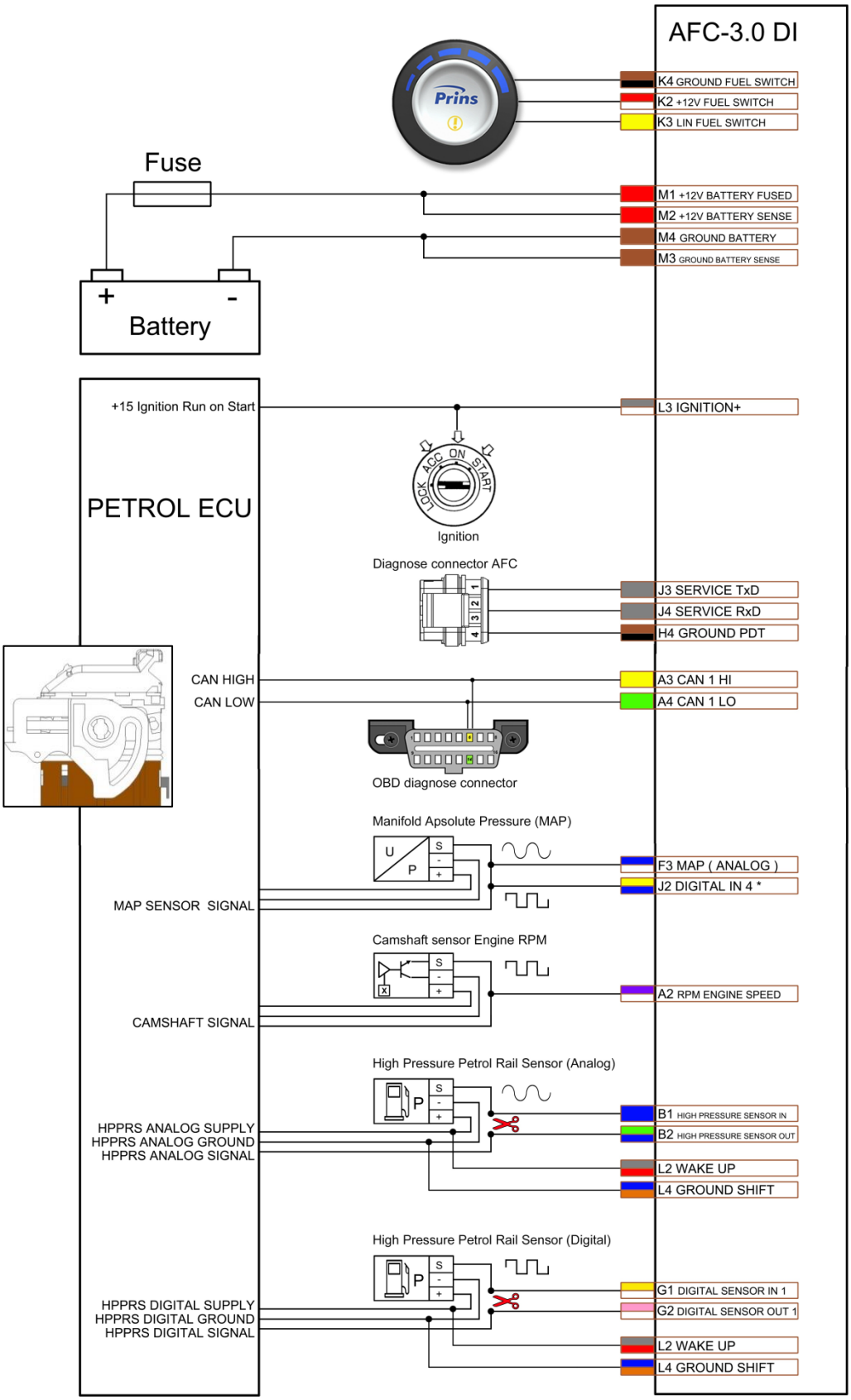
Gas sensors and actuators

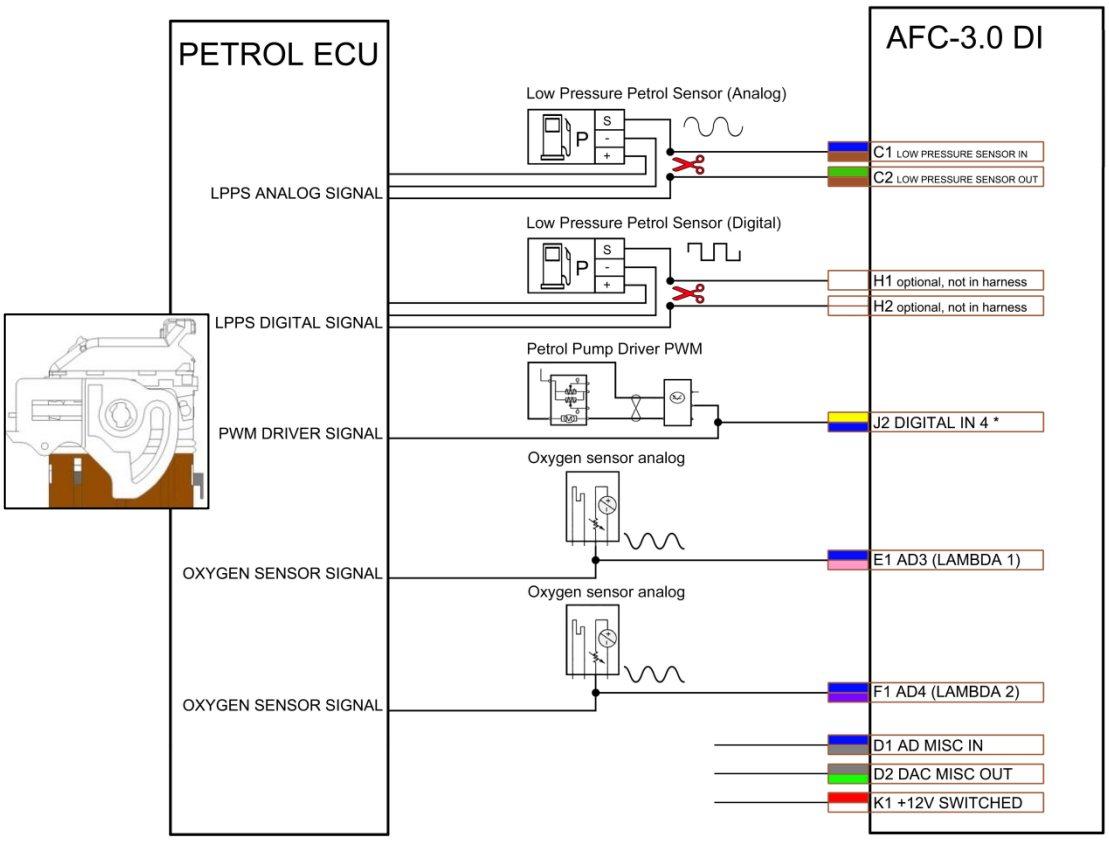
Gas injectors



Gas injectors
(injector numbering corresponds with the actual cilinder)

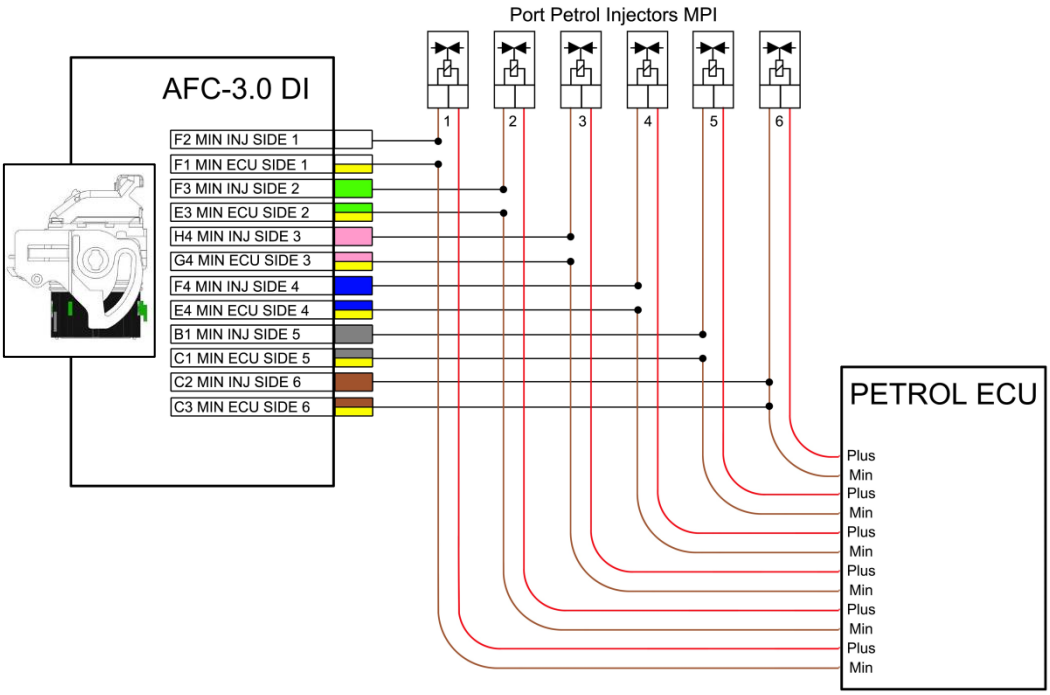
11.1.2 **Brown connector**





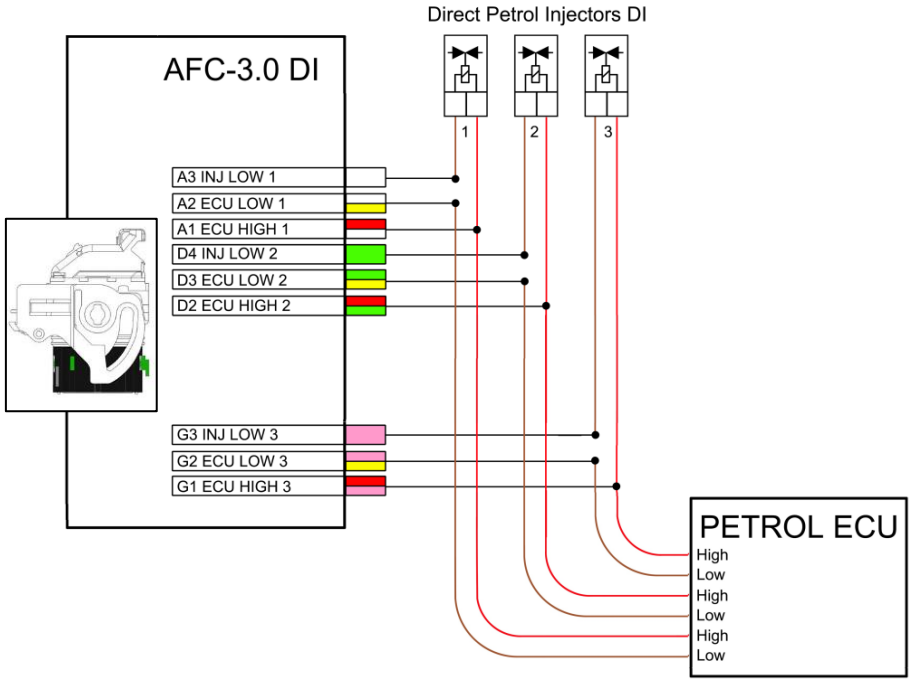
11.1.3 Black connector

MPI injectors



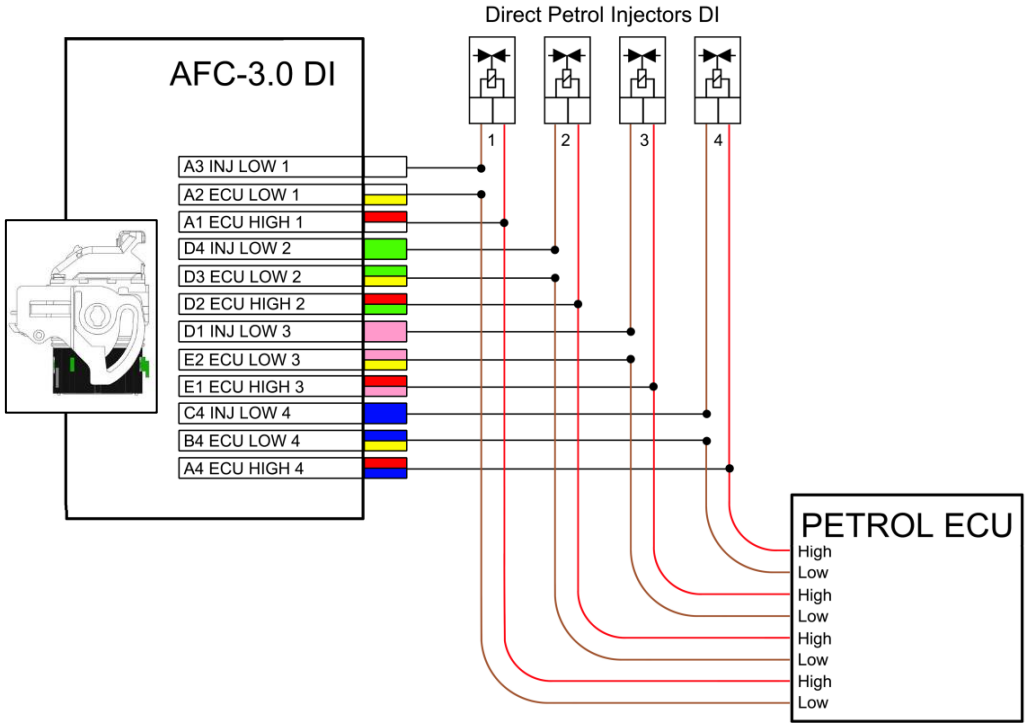
MPI injector
Injector numbering corresponds with the actual cilinder

DI injector 3 cilinder

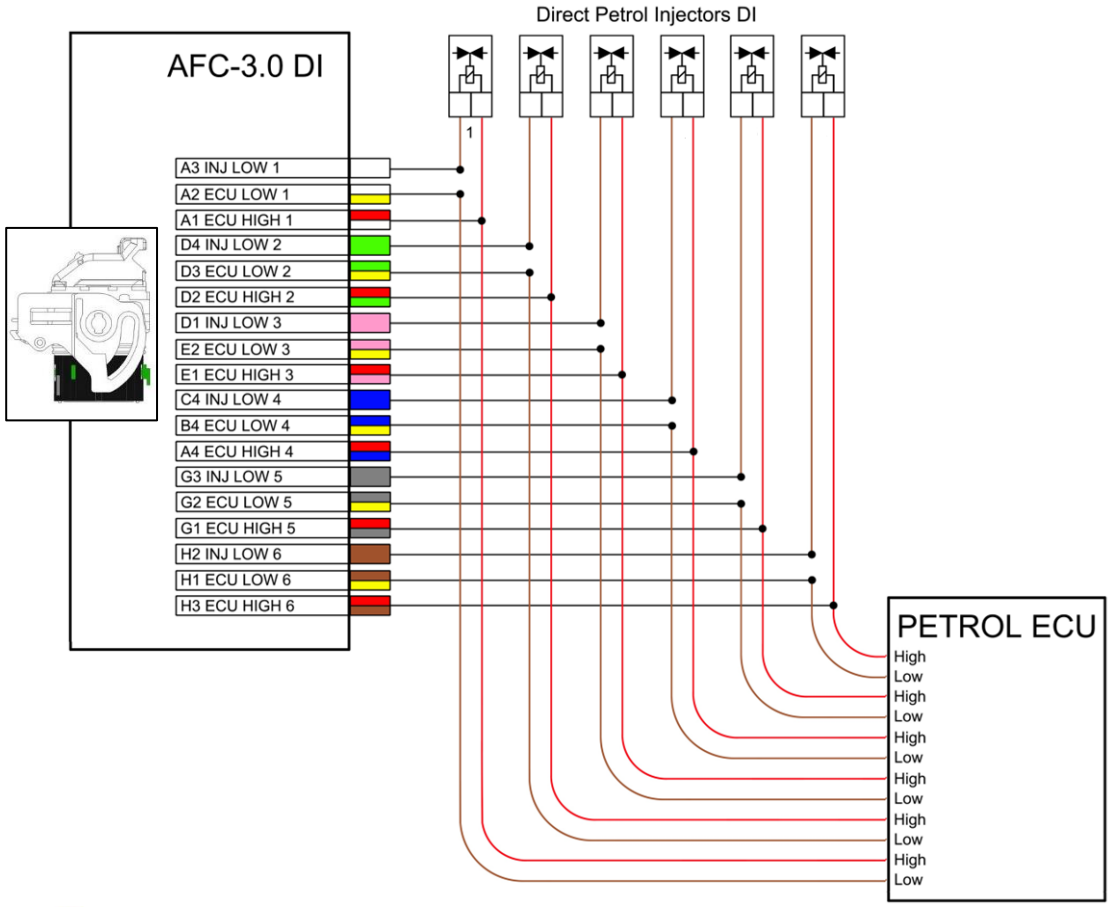


Attention! The 3rd DI injector pinned in row G.

DI injector 4 cilinder



DI injector 6 cilinder



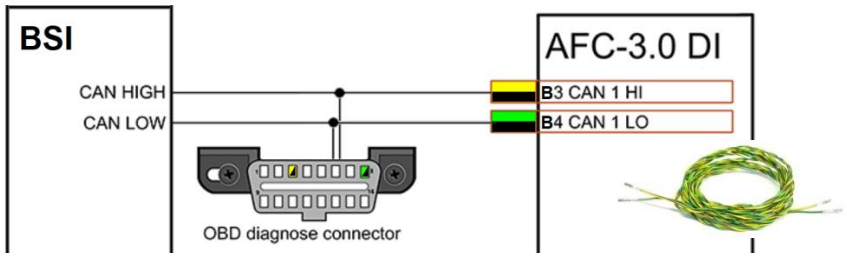
Attention!

For a 6 and 8 cilinder: The numbering and text on the wires does not correspond with the numbering of the actual engine cilinders.

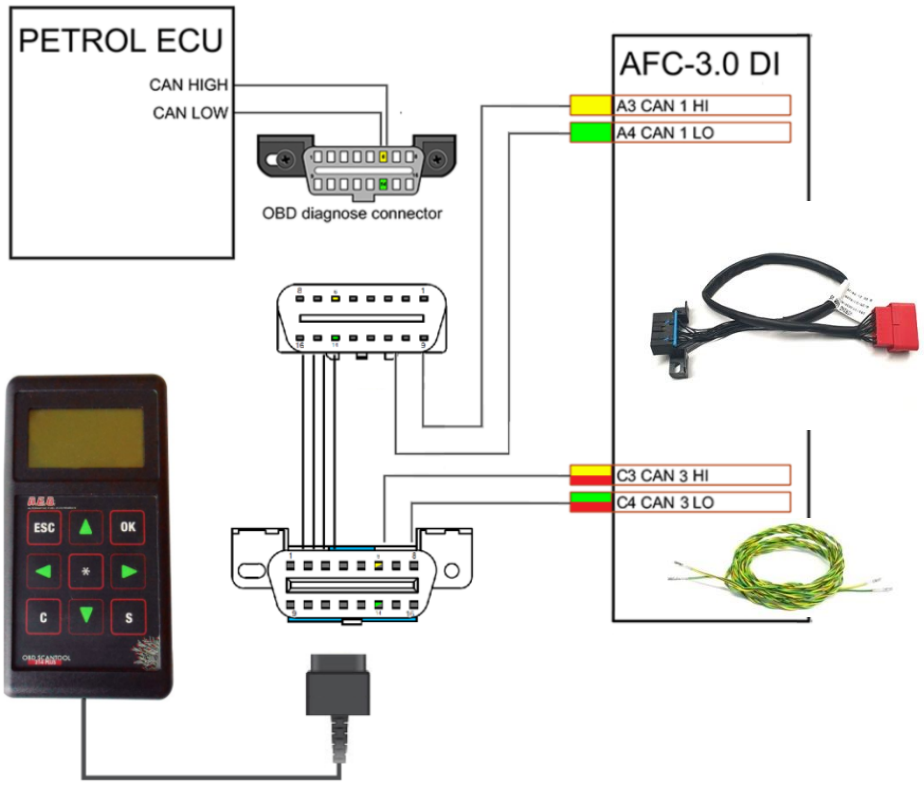
11.1.4 Optional wiring modules

The standard harnesses support basic functions / wires. Optional wiring modules are available when extra options are needed.
Use the Webshop to order the extra needed features.

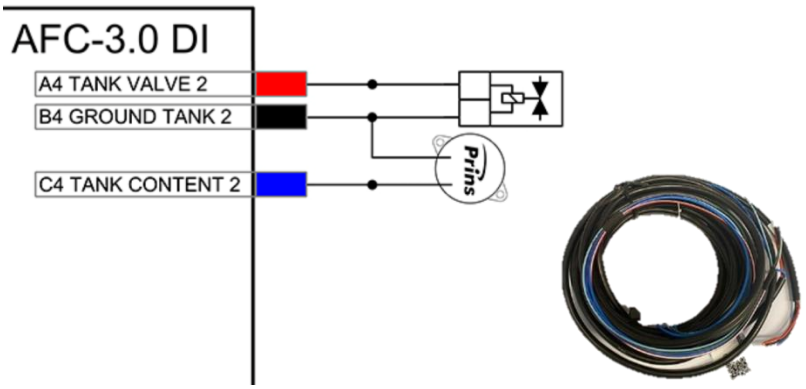
PSA Petrol Gauge CAN Reset



OBD Gateway

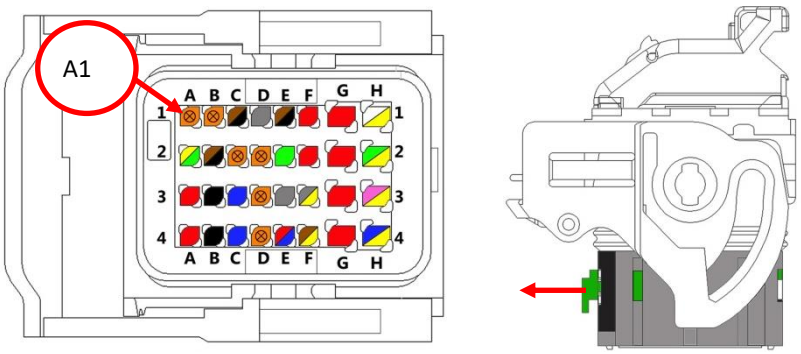


Second tank module

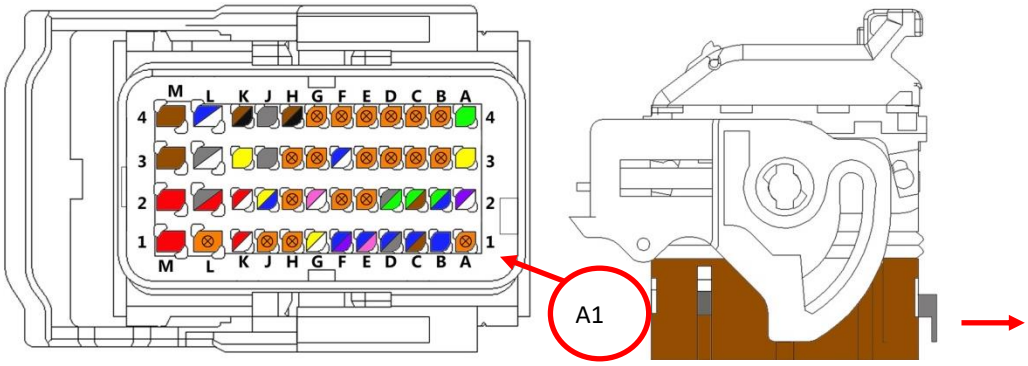


11.2 Connector

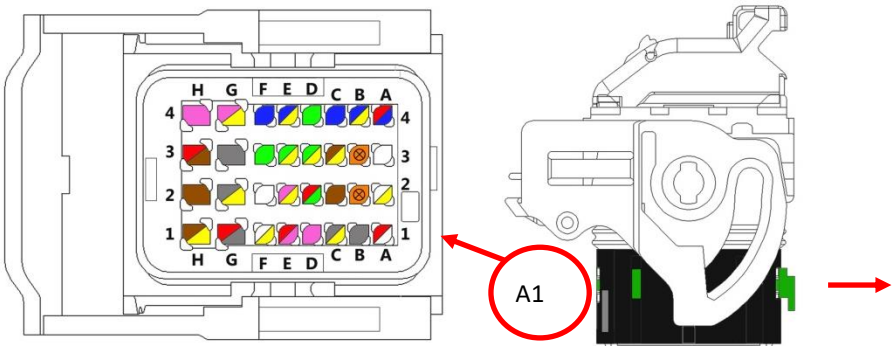
11.2.1 Pinning AFC-3.0 DI harness



Top View 32P Grey connector
Gas system components excluding the fuel selector switch

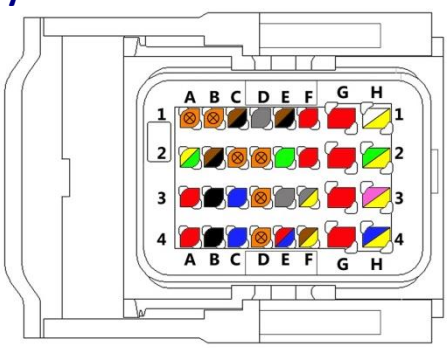


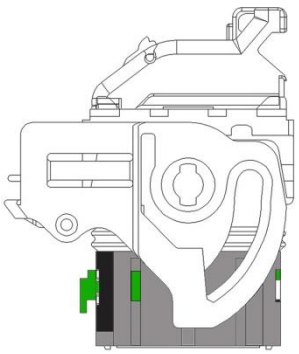
Top View 48P Brown connector
Ground, supply, communication & switched output



Top View 32P Black connector
Petrol injectors DI-MPI interruption and signals

11.2.2 Grey 32P connector

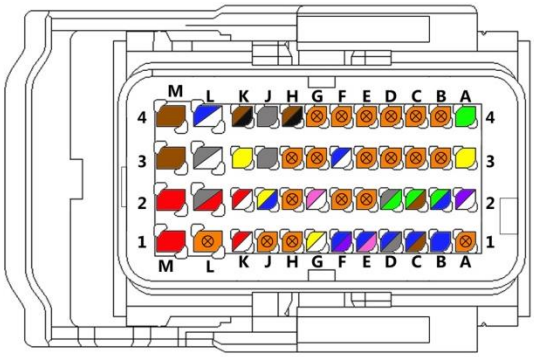


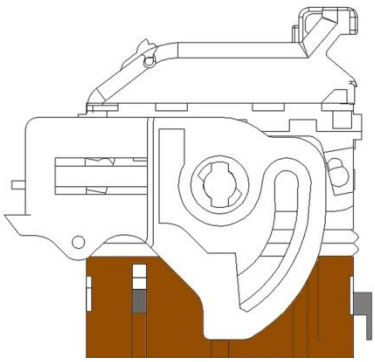


Gas system components excluding the fuel selector switch

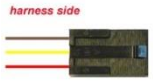
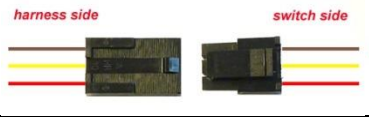
Component	Connector / color	Pos	Wire color	Wire code		Comment
Gas injector 1			White yellow	H1	G INJ OUT 1	
			Red	G1	G + INJ 1	
Gas injector 2			Green yellow	H2	G INJ OUT 2	
			Red	G2	G + INJ 2	
Gas injector 3			Pink yellow	H3	G INJ OUT 3	
			Red	G3	G + INJ 3	
Gas injector 4			Blue yellow	H4	G INJ OUT 4	
			Red	G4	G + INJ 4	
Gas injector 5			Grey Yellow	F3	G INJ OUT 5	
			Red	F1	G + INJ 5	
Gas injector 6			Brown Yellow	F4	G INJ OUT 6	
			Red	F2	G + INJ 6	
Reducer temperature sensor		1	Brown	C1	Ground T-ECT	
		2	Grey	D1	T-ECT	
eVP-500 reducer actuator		1	Brown	B2	Ground reducer valve	
		2	Yellow green	A2	+12V Reducer valve	
Gas system pressure and temperature	Loose wire	1	Brown	E1	Ground Psys	
	Loose wire	2	Grey	E3	T-Gas	
	Loose wire	3	Red blue	E4	+5 Volt sensor	
	Loose wire	4	Green	E2	Psys	
Lock-off valve 1	Loose wire		Red	A3	Lock-off valve	
Tank 1 Ground	Loose wire			B3	Ground tank	
Tank 1 level	Loose wire		Blue	C3	Tank content	
Lock-off valve 2	Loose wire		Red	A4	Lock-off valve	Optional wiring module 191/150004/A
Tank 2 Ground	Loose wire			B4	Ground tank	
Tank 2 level	Loose wire		Blue	C4	Tank content	

11.2.3 Brown 48P connector



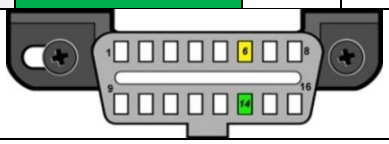


Ground, supply, communication & switched output

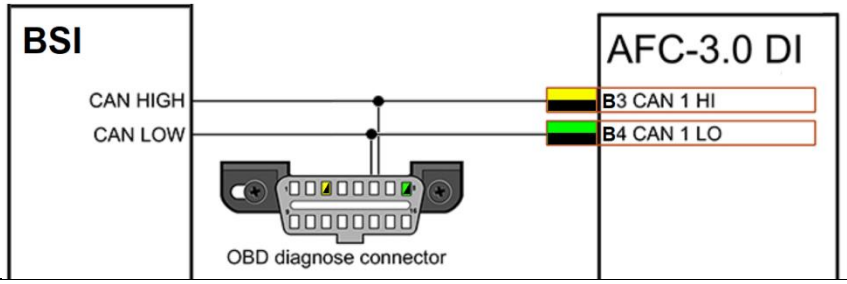
Component	Connector / color	Pos	Wire color		Wire code		Comment
+12V Battery	Loose wire		Red		M1	+12V Battery	Connect battery +
			Do not place the fuse in the holder before having completed the installation of the GAS system.				
Ignition +	Loose wire		Grey	White	L3	IGNITION+	12V switched input
Ground AFC-3.0 DI	Loose wire		Brown		M3	Ground battery sense	Connect to battery -
	Loose wire		Brown		M4	Ground battery	
Fuel selector switch			Red	white	K2	+12V fuel switch	
			Yellow		K3	LIN fuel switch	
			Brown		K4	Ground fuel switch	
  							
Prins Diagnostic Tool		1	Grey		J3	Service TxD	
		2	Grey		J4	Service RxD	
		3					Seal
		4	Brown	black	H4	Ground PDT	
Output 12V switched	Wire		Red	White	K1	+12V SWITCHED	Output 12V switched

CAN-bus connections

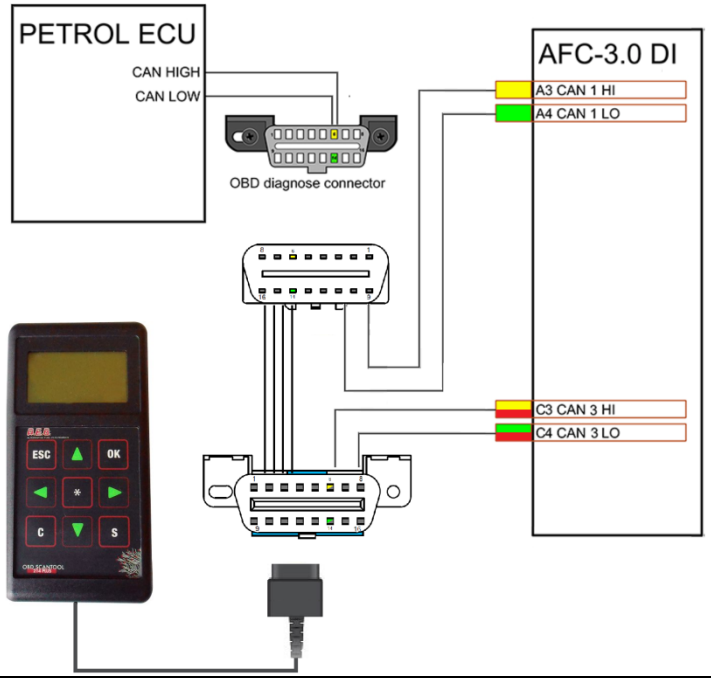
EOBD diagnose connector	Loose wire		Yellow	A3	CAN1 High	OBD Pin : 6
	Loose wire		Green	A4	CAN1 Low	OBD Pin : 14



PSA Petrol Gauge CAN Reset	Optional wire		Yellow	black	B3	CAN2 High	OBD Pin : 3
	Optional wire		Green	black	B4	CAN2 Low	OBD Pin : 8 (Opel Pin: 11)



CAN OBD Gateway	Loose wire		Yellow	red	C3	CAN1 High	OBD Pin : 6
	Loose wire		Green	red	C4	CAN1 Low	OBD Pin : 14

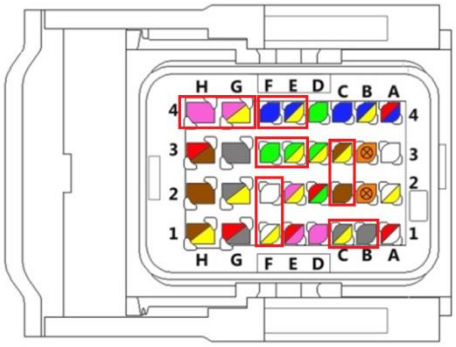


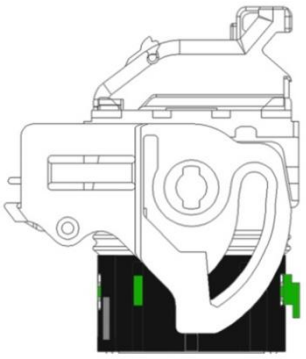
Engine signals

Component	Connector / color	Pos	Wire color		Wire code		Comment
Camshaft sensor / Ignition coil	Loose wire		Purple	white	A2	RPM ENGINE SPEED	
Petrol high pressure sensor analog (rail pressure)	Loose wire		Blue		B1	HIGH PRESSURE SENSOR IN	Sensor side
	Loose wire		Green	blue	B2	HIGH PRESSURE SENSOR OUT	Ecu side
	Loose wire		Grey	red	L2	WAKE UP	5V sensor supply
	Loose wire		Blue	orange	L4	GROUND SHIFT	Sensor ground
Petrol low pressure sensor analog	Loose wire		Blue	brown	C1	LOW PRESSURE SENSOR IN	Sensor side
	Loose wire		Green	brown	C2	LOW PRESSURE SENSOR OUT	Ecu side
MAP signal analog (OEM engine)	Loose wire		Blue	white	F3	MAP	Sensor signal
Petrol pump tank or MAP signal digital	Loose wire		Yellow	Blue	J2	DIGITAL IN 4 Tekst wordt anders in def kabelboom	Digital signal
MAP (Prins sensor)		1	Red	Blue	G4	+5V SENSOR	
		3	Blue	white	F3	MAP	Sensor signal
		2	Brown	black	F4	GROUND	
Sensor signal analog	Loose wire		Blue	pink	E1	AD3 (LAMBDA 1)	Spare input for analog sensor
Sensor signal analog	Loose wire		Blue	purple	F1	AD4 (LAMBDA 2)	Spare input for analog sensor
Spare digital sensor interruption	Loose wire		Yellow	white	G1	DIGITAL SENSOR IN 1	Sensor side
	Loose wire		Pink	white	G2	DIGITAL SENSOR OUT 1	Ecu side
Spare analog sensor signal interruption	Loose wire		Blue	grey	D1	AD MISC IN	Sensor side
	Loose wire		Grey	green	D2	DAC MISC OUT	Ecu side

11.2.4 Black 32P connector

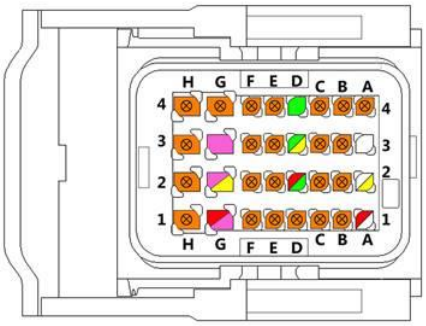
MPI-injectors



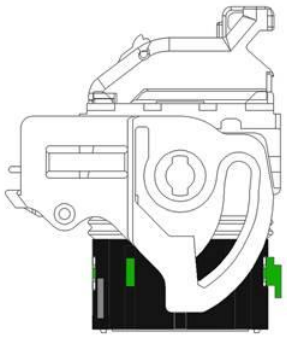


Component	Connector / color	Pos	Wire color		Wire code		Comment
MPI Petrol injector 1	wires or connectors		White		F2	INJ LOW 1	Injector side cil. 1
			White	yellow	F1	ECU LOW 1	ECU side cil. 1
MPI Petrol injector 2	wires or connectors		Green		F3	INJ LOW 2	Injector side cil. 2
			Green	yellow	E3	ECU LOW 2	ECU side cil. 2
MPI Petrol injector 3	wires or connectors		Pink		H4	INJ LOW 3	Injector side cil. 3
			Pink	yellow	G4	ECU LOW 3	ECU side cil. 3
MPI Petrol injector 4	wires or connectors		Blue		F4	INJ LOW 4	Injector side cil. 4
			Blue	yellow	E4	ECU LOW 4	ECU side cil. 4
MPI Petrol injector 5	wires or connectors		Grey		B1	INJ LOW 5	Injector side cil. 5
			Grey	yellow	C1	ECU LOW 5	ECU side cil. 5
MPI Petrol injector 6	wires or connectors		Brown		C2	INJ LOW 6	Injector side cil. 6
			Brown	yellow	C3	ECU LOW 6	ECU side cil. 6

3-cylinder connector



Top view 32P black connector

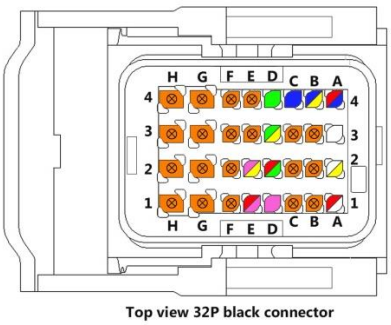


DI-injectors 3-cylinder

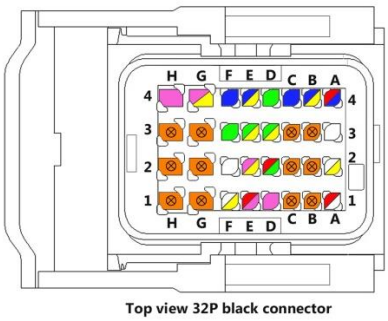
Component	Connector / color	Pos	Wire color		Wire code		Comment
DI Petrol injector 1	Loose wires or original connectors		White		A3	INJ LOW 1	Injector side cil. 1
			White	yellow	A2	ECU LOW 1	ECU side cil. 1
			Red	white	A1	ECU HIGH 1	Injector high 1 65/12V 1
DI Petrol injector 2	Loose wires or original connectors		Green		D4	INJ LOW 2	Injector side cil. 2
			Green	yellow	D3	ECU LOW 2	ECU side cil. 2
			Red	green	D2	ECU HIGH 2	Injector high 2 65/12V 2
DI Petrol injector 3	Loose wires or original connectors		Pink		G1	INJ LOW 3	Injector side cil. 3
			Pink	yellow	G2	ECU LOW 3	ECU side cil. 3
			Red	pink	G1	ECU HIGH 3	Injector high 3 65/12V 3

Attention! The 3rd DI injector pinned in row G. This is a separate high group

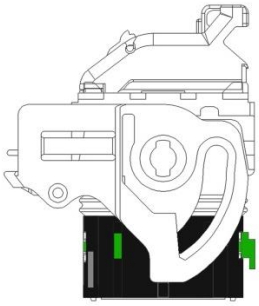
4-cylinder connector



DI lay-out



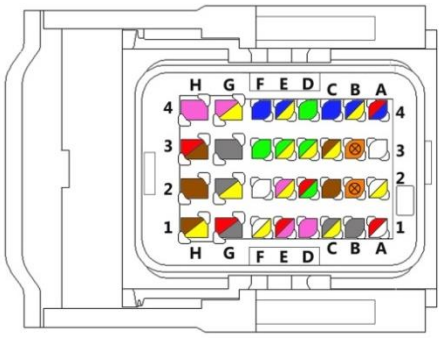
DI-MPI lay-out

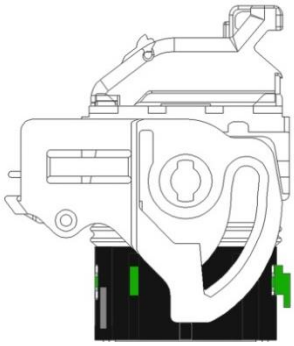


DI-injectors 4-cylinder

Component	Connector / color	Pos	Wire color		Wire code		Comment
DI Petrol injector 1	Loose wires or original connectors		White		A3	INJ LOW 1	Injector side cil. 1
			White	yellow	A2	ECU LOW 1	ECU side cil. 1
			Red	white	A1	ECU HIGH 1	Injector high 65/12V cil. 1
DI Petrol injector 2	Loose wires or original connectors		Green		D4	INJ LOW 2	Injector side cil. 2
			Green	yellow	D3	ECU LOW 2	ECU side cil. 2
			Red	green	D2	ECU HIGH 2	Injector high 65/12V cil. 2
DI Petrol injector 3	Loose wires or original connectors		Pink		D1	INJ LOW 3	Injector side cil.3
			Pink	yellow	E2	ECU LOW 3	ECU side cil. 3
			Red	pink	E1	ECU HIGH 3	Injector high 65/12V cil. 3
DI Petrol injector 4	Loose wires or original connectors		Blue		C4	INJ LOW 4	Injector side cil.4
			Blue	yellow	B4	ECU LOW 4	ECU side cil. 4
			Red	Blue	A4	ECU HIGH 4	Injector high 65/12V cil. 4

6-cylinder connector





DI-injectors 6-cylinder

Component	Connector / color	Pos	Wire color		Wire code		Comment
DI Petrol injector 1	Loose wires or original connectors		White		A3	INJ LOW 1	Injector side cil. 1
			White	yellow	A2	ECU LOW 1	ECU side cil. 1
			Red	white	A1	ECU HIGH 1	Injector high 65/12V
DI Petrol injector	Loose wires or original connectors		Green		D4	INJ LOW 2	For 6 or 8 cilinder not always cilinder 2
			Green	yellow	D3	ECU LOW 2	
			Red	green	D2	ECU HIGH 2	
DI Petrol injector	Loose wires or original connectors		Pink		D1	INJ LOW 3	For 6 or 8 cilinder not always cilinder 3
			Pink	yellow	E2	ECU LOW 3	
			Red	pink	E1	ECU HIGH 3	
DI Petrol injector	Loose wires or original connectors		Blue		C4	INJ LOW 4	For 6 or 8 cilinder not always cilinder 4
			Blue	yellow	B4	ECU LOW 4	
			Red	Blue	A4	ECU HIGH 4	
DI Petrol injector	Loose wires or original connectors		Grey		G3	INJ LOW 5	For 6 or 8 cilinder not always cilinder 5
			Grey	yellow	G2	ECU LOW 5	
			Red	grey	G1	ECU HIGH 5	
DI Petrol injector	Loose wires or original connectors		Brown		G3	INJ LOW 6	For 6 or 8 cilinder not always cilinder 6
			Brown	yellow	G2	ECU LOW 6	
			Red	Brown	G1	ECU HIGH 6	

Attention!

For a 6 and 8 cilinder: The numbering and text on the wires does not correspond with the numbering of the actual engine cilinders.

11.3 Molex connector

11.3.1 Wire module installation

Tools and material

Wire module

Wire cutter

Strap

Instructions

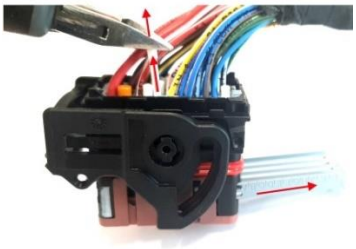
1. VSI-3.0-DI Molex connector

2. Remove strap

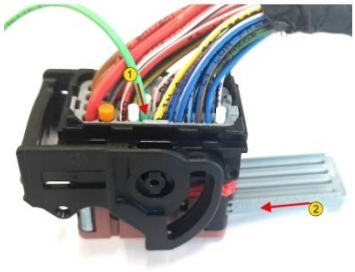
3. Push outside

4. Push outside

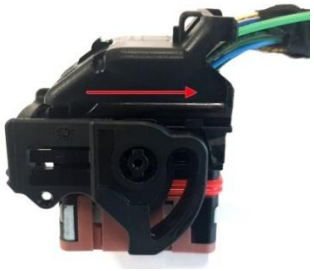
5. Slide cover



6. Pull out locking and plug



7. Insert wire with terminal
8. Slide back locking



9. Slide on cover

10. Secure wire with new strap

11.3.2 Remove wire and add blind plug into connector

Tools and material

Removal tool: 099/520010/A (Bosch)

Wire cutter

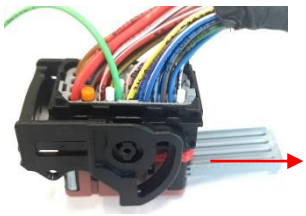
Strap

Blind plug small (white)

Blind plug large (orange)

Instructions

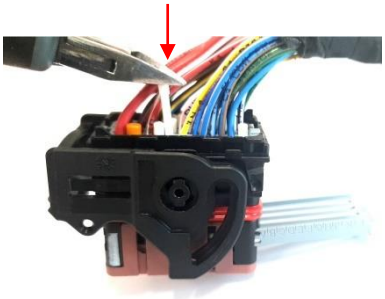
1. Remove cover as described in previous chapter



2. Pull out locking

3. Use the removal tool to remove the wire

4. Use the removal tool to remove the wire



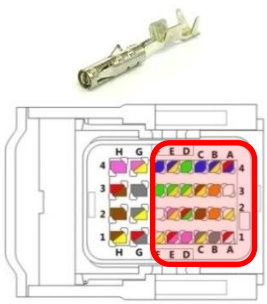
5. Insert the blind plug

6. Slide on cover and secure wire with new strap

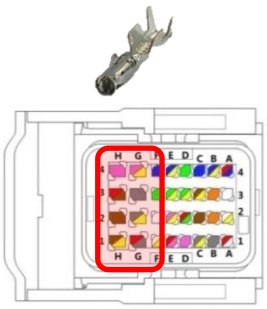
11.3.3 Add terminals to wire

Prins advises to order wiring modules direct from the Webshop. Crimping terminals to a single wire is a delicate and precise procedure. An assembly fault is made very quickly.

Tools and material



Small terminal
0.5mm² 080/000058
0.75mm² 080/000059



Large Terminal 080/000060

Wire stripper

Hand crimper
Small terminals 638119200

Hand crimper
Large terminals 638118900

Wire cutter

Instructions small terminal

1. Strip wire for 3 mm

2. Crimp terminal

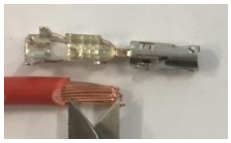
OK

Not OK

Inspect crimping

Instructions large terminal

1. Strip wire for 5 mm



2. Crimp terminal

OK

Not OK

Inspect crimping

11.4 Soldering and shrinking wires

Conductor splices and connections are an essential part of the electrical circuit. When conductors join each other or connect to a load, splices or terminals must be used. Therefore, it is important that they be properly made. Any electrical circuit is only as good as its weakest link. The basic requirement of any splice or connection is that it be both mechanically and electrically as sound as the conductor or device with which it is used.

Quality workmanship and materials must be used to ensure lasting electrical contact, physical strength, and insulation. The most common methods of making splices and connections in electrical cables is explained in the discussion that follows.

Without good sealant, moisture will penetrate into the wiring. This will harm the harness and affect the connections, with a result of malfunction of the VSI-3 DI system.

After soldering or scrimping eye terminals, the connections need be insulated with adhesive lined heat shrink tubing. Also not-used wires need be insulated with adhesive lined heat shrink tubing, to prevent moisture into the wires. The adhesive lined heat shrink tubing is delivered in the kits.

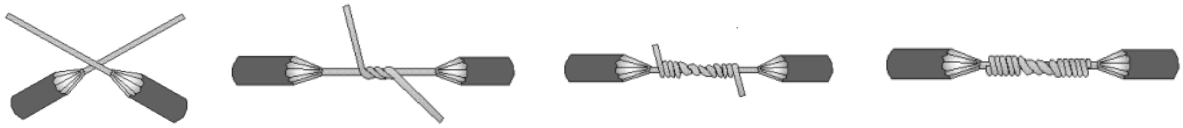
When it's not possible to heat shrink the wires, apply vulcanization sealing tape to seal the connection.

It's not recommended to use solder splice connectors. The connection cannot be checked very well.

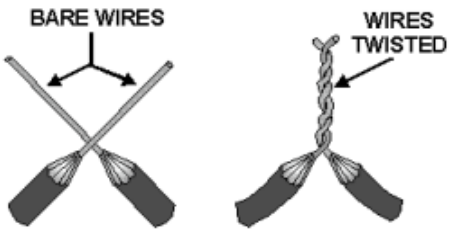
11.4.1 Splices and joints

Three different types of splices are recommended.

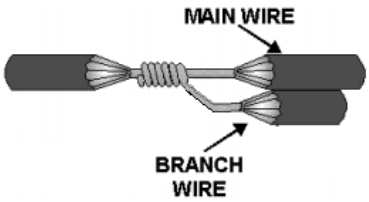
Western Union Splice



Rattail Joint



Tap Joint



11.4.2 Soldering and shrinking wires

Tools

Wire cutter

Wire stripper / crimper

Solder torch / gun

Electrical solder

Heat gun

Heat shrink

Eye terminal

1. Strip the wire

2. Crimp the eye terminal

3. Cut and install the tubing

4. Shrink the tubing until glue comes out of both ends.

5. Cool down the tubing until the glue is solidified.

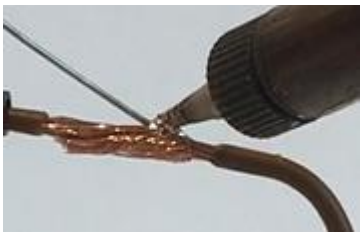
6. Detail of correct insulation.

Solder wires



Clean the surface of the solder torch

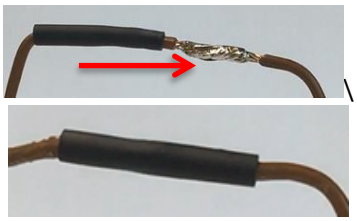
7. Slide over the shrink tubing



8. Hold the iron tip and solder together on the wire until the solder begins to flow

9. Move the soldering iron to the opposite side.

10. Make sure the tin has completely flowed through

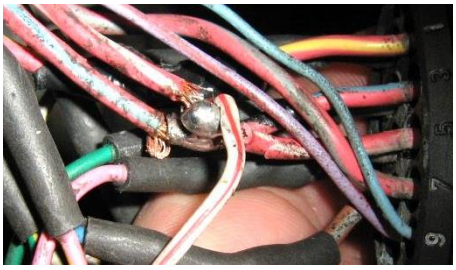
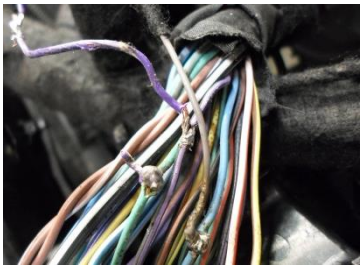


11. Slide over the shrink tubing over soldered wires

12. Shrink the tubing until glue comes out of both ends.

Bad soldering connections



Bad soldering connections

11.4.3 Vulcanized connections

Always resect the instructions of the supplier of the vulcanization tape. In this example Scotch® Rubber Mastic Tape 2228 is used.

Tools and material

Wire cutter

Moisture sealing electrical tape

vinyl electric tape

Vulcanize soldered wires

1. Solder the wires

2. Stretch the tape to 3/4 of its original width during application

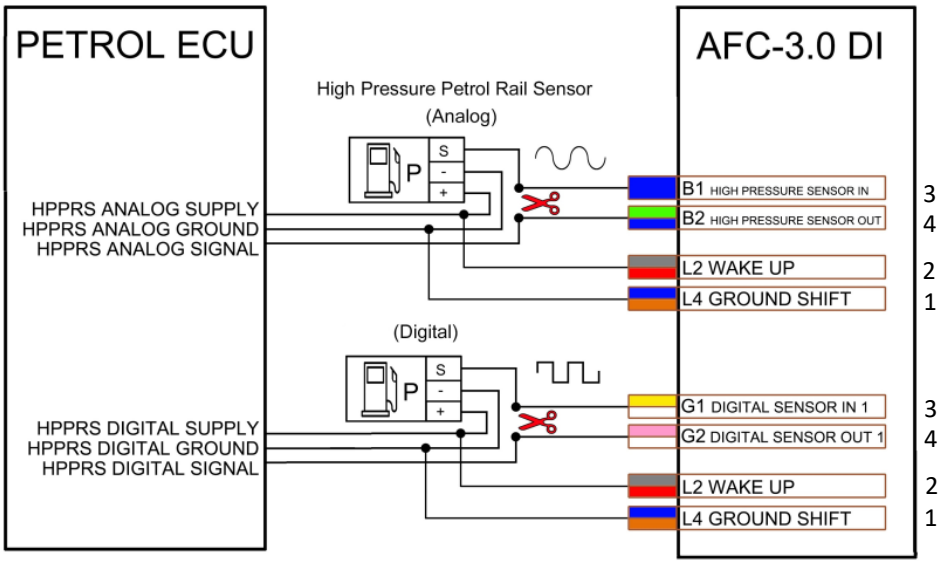
3. Applied 4 half–lapped layers

4. Apply 2 half lapped layers of vinyl electric tape for mechanical protection

5. End result

11.5 How to connect petrol pressure emulation

11.5.1 Petrol High Pressure emulation



1) Find sensor ground with Ω multi meter
    a. Connect wire L4 Ground shift (brown connector)

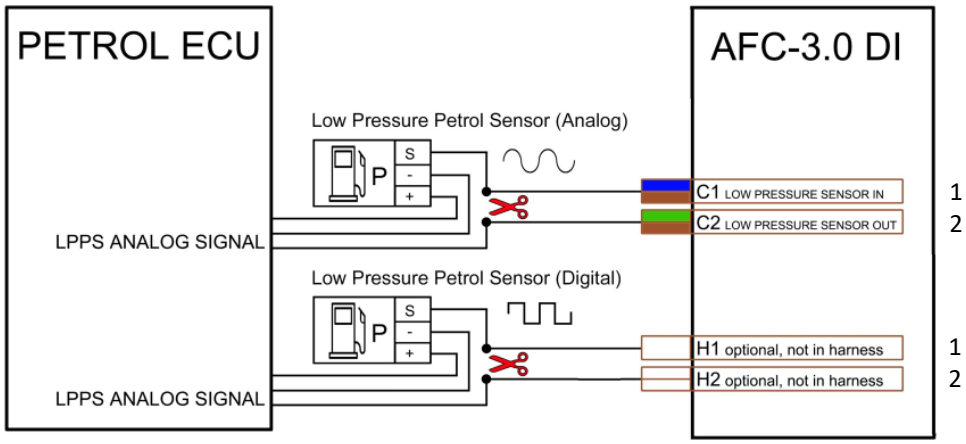
2) Use the multi meter to find the 5V sensor supply
    a. connect wire L2 (brown connector)

3) Find the signal wire of the sensor. Start the engine and read out the pressure.
    a. Analog: [1,5 -3,5V] Use wire B1 (brown connector)
    b. Digital: Use wire G1 (brown connector)

4) Cut sensor wire at ECU side and connect to:
    a. Analog: B2 (brown connector)
    b. Digital: G2 (brown connector)

5) Test drive with recording a log file
    a. On petrol mode
    b. Different loads and RPM

11.5.2 Petrol Low Pressure emulation



1) Find the signal wire of the sensor. Start the engine and read out the pressure.
   a. Analog: [1,5 -3,5V] Use wire C1 (brown connector)
   b. Digital: Use wire H1 (brown connector)

2) Cut sensor wire at ECU side and connect to:
   a. Analog: C2 (brown connector)
   b. Digital: H2 (brown connector)

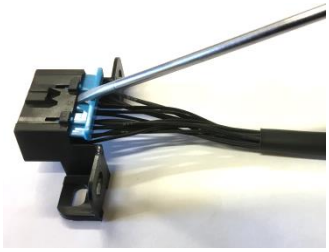
3) Test drive with recording a log file
   a. On petrol mode
   b. Different loads and RMP

11.6 How to connect OBD Gateway connection

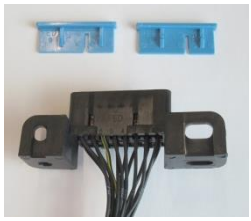
1. Order the Wiring loom OBD Gateway Connectors

Picture soon
3rd CAN wiring
Yellow/red – Green/red

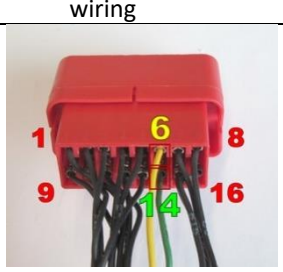
2. Order the Wiring loom OBD Gateway wiring



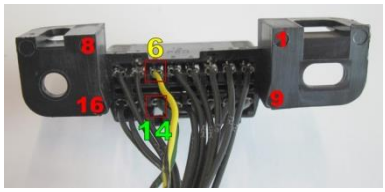
3. Use a small screwdriver to unlock and remove the two locking.



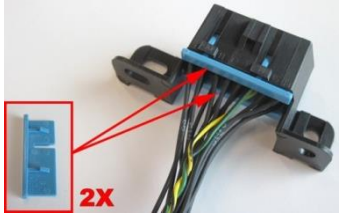
4. Two locking



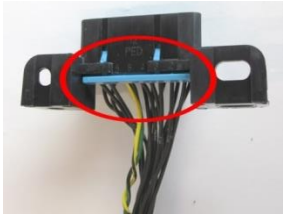
5. Add the CAN11 wiring into the red connector



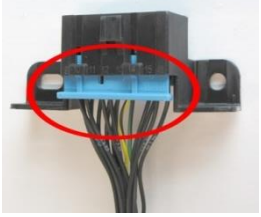
6. Add the CAN3 wiring into the red connector



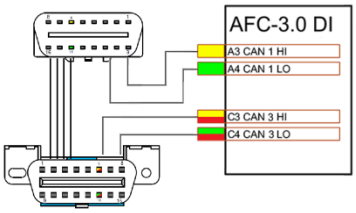
7. Mount both lockings into the black connector



8. OK



9. NOT OK



10. Add the CAN3 wires into the brown AFC-3.0 connector

11. Connect the red connector into the vehicles OBD connector

12. Mount the black OBD connector at a good accessible place

Attention!

When a vehicle system needs an OEM software update always disconnect the CAN Gateway and use the original OBD connector to flash a vehicle system.

12 General installation instruction trunk side

The requirements of Regulation No. 67-01 series, concerning the fixation of the LPG fuel tank(s) shall be deemed to be met if the LPG fuel tank is secured to the vehicle by at least:

- The LPG fuel tank shall be installed
  - permanently in the vehicle
  - not in the engine compartment.
  - in the correct position, according to the instructions from the LPG fuel tank manufacturer.
  - such that there is no metal to metal contact, other than at the permanent fixing points of the LPG fuel tank.
  - with permanent fixing points to secure it to the vehicle or the LPG fuel tank shall be secured to the vehicle by a LPG fuel tank frame and LPG fuel tank straps.
  - not less than 200 mm above the road surface, unless:
- The LPG fuel tank is adequately protected, at the front and the sides and no part of the LPG fuel tank is located lower than this protective vehicle structure.
- No component of the LPG installation shall project beyond the external surface of the vehicle for more than 10 mm.
- No component of the LPG installation shall be located within 100 mm of the exhaust or a similar heat source, unless such components are adequately shielded against heat.
- No component of the LPG installation, except the LPG fuel tank, may extend beyond the lower edge of the vehicle unless another part of the vehicle, within a radius of 150 mm, is situated lower.
- If more than one LPG fuel tank is connected to a single delivery tube each LPG fuel tank shall be fitted with a non-return valve installed downstream of the remotely controlled service valve and a tube pressure relief valve shall be installed in the delivery tube, downstream of the non-return valve. An adequate filter system has to be placed upstream of the non-return valve(s) to prevent fouling of the non-return valve(s).
- The LPG-system shall be installed such that is has the best possible protection against damage, such as damage due to moving vehicle components, collision, grit or due to the loading or unloading of the vehicle or the shifting of those loads.
- All electrical connections shall be soldered and insulated.
- The LPG-system shall show no leaks.
- Certificates LPG fuel tanks can be downloaded at www.prinsautogas.com

12.1 Filling Units

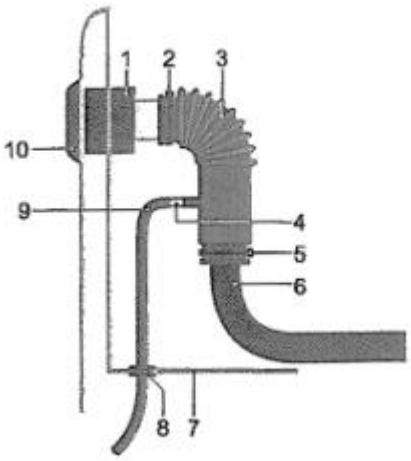
12.1.1 Hardware installation

- The filling unit shall be secured against rotation and shall be protected against dirt and water.
- The filling unit is connected to the LPG fuel tank by a hose or pipe.
- When the LPG fuel tank is installed in the passenger compartment or an enclosed (luggage) compartment, the filling unit shall be located at the outside of the vehicle.
- The filling unit shall be secured against rotation and shall be protected against dirt and water.
- When the LPG fuel tank is installed in the passenger compartment or an enclosed (luggage) compartment, the filling unit shall be located at the outside of the vehicle.
- The filling unit shall be equipped with at least one soft-seated non-return valve and it shall not be dismountable by design.
- The filling unit shall be protected against contamination.
- The outside filling unit is connected to the LPG fuel tank by a rubber hose, XD hose or copper pipe.
- There shall be no gas-conveying connections in the passenger compartment or enclosed luggage compartment with the exception of: (i) the connections on the gas-tight housing; and (ii) the connection between the gas tube or hose and the filling unit if this connection is fitted with a **sleeve** which is resistant against LPG and any leaking gas will be discharged directly into the atmosphere.

EN **The purpose of the rubber sleeve is to get rid of eventual leaking gas**

1	Filler housing	6	Filler hose
2	Cable tie	7	Bodywork
3	Rubber sleeve	8	Grommet in hole Ø14
4	Hose adaptor	9	Hose
5	Cable tie	10	External filler

- Slide the rubber sleeve over the filler hose
- Assemble the filler hose at the external filler
- Drill a hole Ø14mm in the area of the external filler and fit the grommet inside
- Slide the hose covering over the filler coupling
- Assemble the 4mm hose with the hose adapter
- Bring the hose to size and feed it through the grommet
- Use the Ø30mm grommet as an inspection gap in the covering panel. To make sure the connections can be checked easely (for in case the filler housing is assembled behind a difficult to remove panel)



12.1.2 Bayonet filling unit

90° connection

straight connection

E8-67R-011329

12.1.3 ACME filling unit

90° connection

straight connection

E8-67R-011329

Homologation no.

12.1.4 Dish filling unit (Italian)

Flat 90° connection

Flat straight connection

E8-67R-012481

Homologation no.

12.1.5 Euro filler

90° connection

straight connection

E8-67R-010077

Homologation no.

12.1.6 Flat filler

90° connection

straight connection

E8-67R-010023

Homologation no.

Bayonet

ACME

Dish

Euro

Adaptors

Korean / Japanese

Eurasian

12.1.7 Mini filler Ceodeux

straight connection

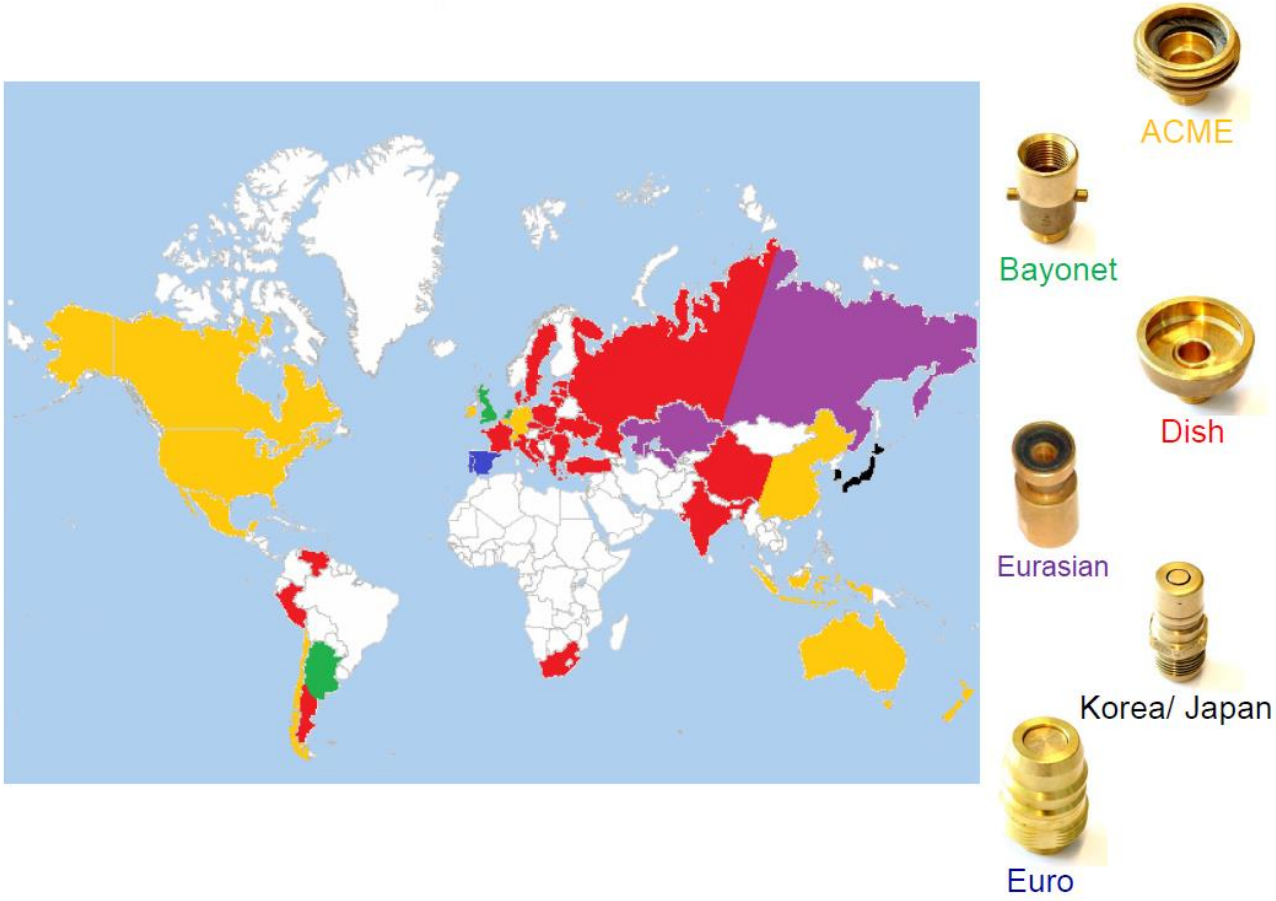
E13-67R-010300

Homologation no.

Bayonet ACME Dish Euro Korean / Japanese Eurasian

Adaptors

12.1.8 Adapters per region



12.2 Filling hose XD-6

12.2.1 Variants

90° connection

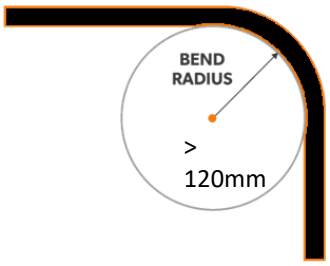
straight connection

E4-67R-010247

Homologation no.

12.2.2 Bend radius

Hose	Minimum bending radius (mm)
XD-6	> 120



12.4 LPG fuel tank

12.4.1 Installation of LPG fuel tank

Cylindrical transverse installation

- If the LPG fuel tank is secured to the vehicle by a LPG fuel tank frame and LPG fuel tank straps, the LPG fuel tank shall be secured to the LPG fuel tank frame by at least two LPG fuel tank straps (diagram 1).
- Install the frame with a minimum of four bolts (diagram 1).
- Appropriate washers or plates if the body panels at that location are single thickness (diagram 1).
- If the LPG fuel tank straps also carry the mass of the fuel LPG fuel tank, at least three LPG fuel tank straps are necessary.
- The LPG fuel tank straps shall ensure that the fuel LPG fuel tank will not slide, rotate or be dislodged.
- A protective material such as felt, leather or plastic shall be interposed between the fuel LPG fuel tank and the LPG fuel tank straps.
- Locate the tension straps in such a way that the identification stickers remain visible.
- A tension strap has to be in contact with the tank over at least half the tank diameter, with a minimum of 15 centimetres.
- Assuming that the material grade is Fe 370, the fixing bolts shall be of class 8.8, and have the dimensions specified in diagram 1 below:

LPG fuel tank content [litres]	Minimum dimensions of the washers or plates [mm]	Minimum dimensions of the LPG fuel tank straps [mm]	Minimum diameter of bolts Class 8.8 [mm]
up to 85	round: 30 x 1.5 round: 25 x 2.5	20 x 3 30 x 1.5	8
85 - 100	round: 30 x 1.5 round: 25 x 2.5	30 x 3 20 x 3 */	10 8 */
100 - 150	round: 50 x 2 round: 30 x 3	50 x 6 50 x 3 **/	12 10 **/
more than 150	shall meet the provisions of Regulation No. 67, 01 series of amendments, for LPG fuel tanks, or Regulation No. 110 for CNG LPG fuel tanks		

Diagram 1

*/ In this case the LPG fuel tank shall be secured by at least three LPG fuel tank straps.
**/ In this case the LPG fuel tank shall be secured by at least four LPG fuel tank straps.

Cylindrical longitude installation

When the LPG fuel tank is installed behind a seat, a total clearance of at least 100 mm, in the longitudinal direction of the vehicle, shall be provided. This clearance may be divided between the LPG fuel tank and the rear panel of the vehicle and between the seat and the LPG fuel tank (diagram 2).

If the cylindrical LPG fuel tank is installed longitudinally to the vehicle, a transverse connection shall be present at the front of the LPG fuel tank frame which is:

- at least of the same thickness as the LPG fuel tank frame
- at least 30 mm high and its top is at least 30 mm above the bottom of the LPG fuel tank
- as close as possible, or even within, the domed end of the LPG fuel tank

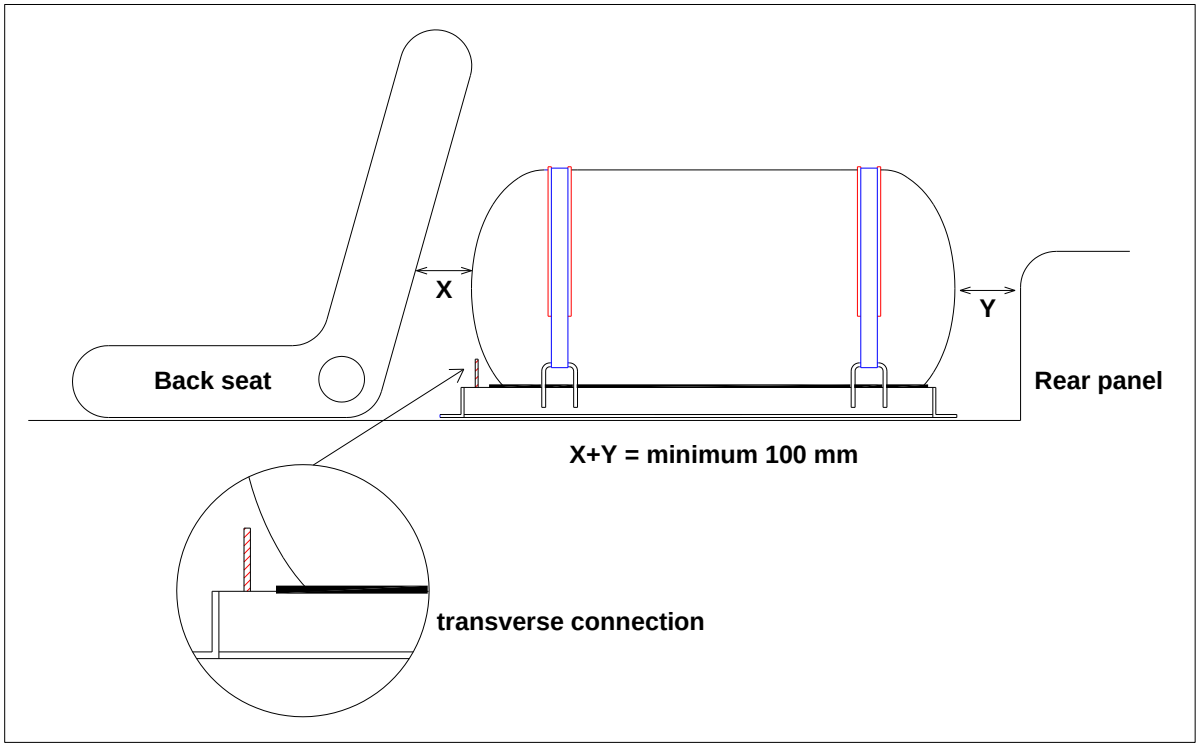


diagram 2

By "installed longitudinally" it is meant that the axis of the cylindrical fuel LPG fuel tank makes an angle of no more than 30 degrees with the longitudinal centre plane of the vehicle.

Toroidal LPG fuel tank

Into the spare-wheel room (flush-mounted):

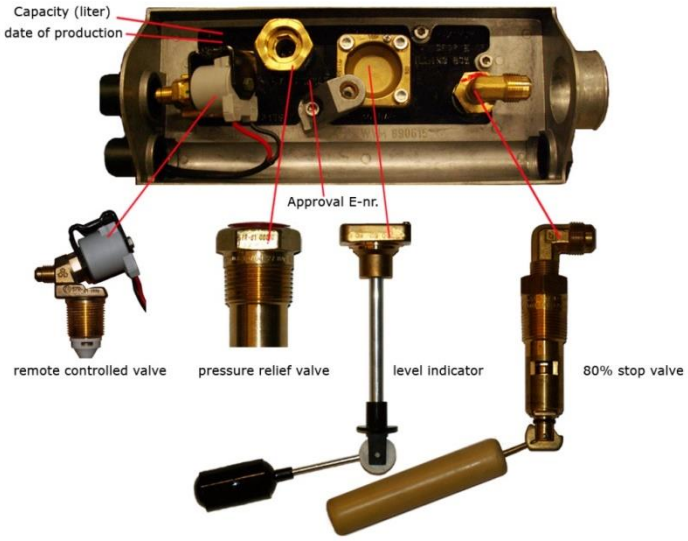
- The LPG fuel tank shall be installed such that there is no metal to metal contact, other than at the permanent fixing points of the LPG fuel tank.
- Installation of the LPG fuel tank:
- with frame or brackets (mounting points on top of the LPG fuel tank).
- Frame/bracket material: minimum 4mm thick x 40mm wide.
- Use of Prins M8 certified M8 brackets
- (Prins Autogassystemen B.V. declares that the threaded ends, that have been delivered with a toroidal tank, are fitted with a threaded end M8 or M10 with strength class 8.8.)
- Other kinds of threaded ends may not be used with these mountings.
- directly to the vehicle floor with bolts and washers / plates
- (with tank mounting points on the underside of the LPG fuel tank) see diagram 1.

Example of brackets inside the vehicle

Under the vehicle (sub-structure):

- The LPG fuel tank shall be installed such that there is no metal to metal contact, other than at the permanent fixing points of the LPG fuel tank.
- When the vehicle is ready for use the LPG fuel tank shall not be less than 200 mm above the road surface, unless:
- the LPG fuel tank is adequately protected, at the front and the sides and no part of the LPG fuel tank is located lower than this protective vehicle structure.
- the LPG fuel tank is installed in place of the original petrol tank and keeps at least the same height above the road.
- No component of the LPG installation shall be located within 100 mm of the exhaust or a similar heat source, unless such components are adequately shielded against heat.
- Installation of the LPG fuel tank:
- with a frame or brackets (mounting points on top of the LPG fuel tank)
- Frame/bracket material: minimum 4mm thick x 40mm wide.
- directly to the vehicle floor with bolts and washers / plates (mounting points on top of the LPG fuel tank) see diagram 1.
- Treat the LPG tank when mounted with a black body coating.

12.4.2 Accessories of the LPG fuel tank



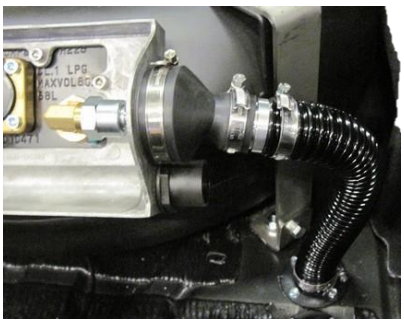
Remote controlled valve with excess flow valve on the LPG fuel tank
The remotely controlled service valve with excess flow valve shall be installed directly on the fuel LPG fuel tank, without any intervening fittings.
The remotely controlled service valve with excess flow valve shall be controlled such that it is automatically closed when the engine is not running, irrespective of the position of the ignition switch, and shall remain closed as long as the engine is not running.

Spring-loaded pressure relief valve in the LPG fuel tank
The spring-loaded pressure relief valve shall be installed in the fuel LPG fuel tank in such a manner that it is connected to the vapour space and can discharge to the surrounding atmosphere. The spring-loaded pressure relief valve may discharge into the gas-tight housing if that gas-tight housing fulfils the requirements of paragraph

80 % stop valve
The automatic filling level limiter shall be suitable for the fuel LPG fuel tank it is fitted to and shall be installed in the appropriate position to ensure that the LPG fuel tank cannot be filled to more than 80 per cent.

Level indicator
The level indicator shall be suitable for the fuel LPG fuel tank it is fitted to and shall be installed in the appropriate position.

Gas-tight housing on the LPG fuel tank
A gas-tight housing over the LPG fuel tank fittings shall be fitted to the fuel LPG fuel tank, unless the LPG fuel tank is installed outside the vehicle and the LPG fuel tank fittings are protected against dirt and water.



The gas-tight housing shall be in open connection with the atmosphere, where necessary through a connecting hose and a lead-through.
The ventilation opening of the gas-tight housing shall point downwards at the point of exit from the motor vehicle. However, it shall not discharge into a wheel arch, nor shall it be aimed at a heat source such as the exhaust.

Any connecting hose and lead-through in the bottom of the bodywork of the motor vehicle for ventilation of the gas-tight housing shall have a minimum clear opening of 450 mm^2. If a gas tube, other tube or any electrical wiring is installed in the connecting hose and lead-through, the clear opening shall also be at least 450 mm^2.

12.4.3 **Stako**

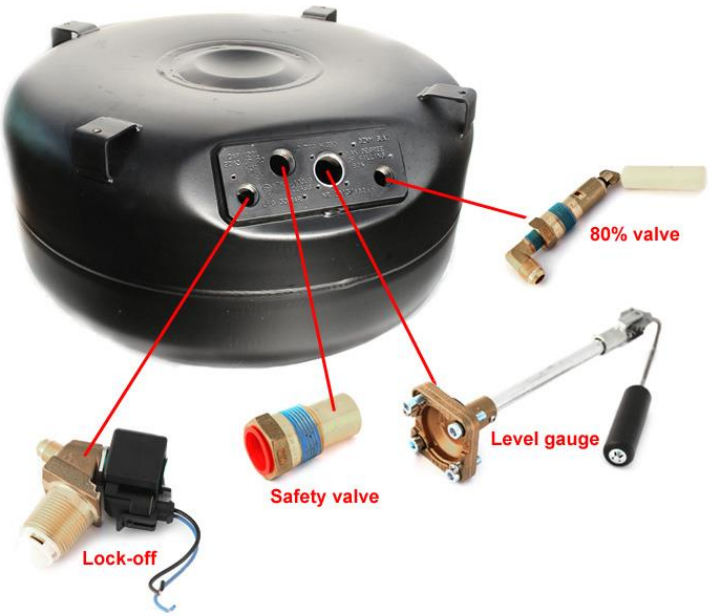
Approval numbers Stako toroidal LPG fuel tank

Stako Toroidal LPG container E20-67R-01****

E20-67R-010447 :	54/60 litre	E20-67R-010473 :	67 litre
E20-67R-010466 :	54/60 litre	E20-67R-010475 :	66/72/77 litre
E20-67R-010470 :	51/61 litre	E20-67R-010570 :	66/72/77 litre
E20-67R-010472 :	55 litre	E20-67R-010598 :	86 litre
E20-67R-010474 :	60/66 litre	E20-67R-010599 :	95 litre

Approval numbers Stako cylindrical LPG fuel tank

12.4.4 GZWM LPG fuel tank



E20-67R-011009

122 Litre:

Approval number GZWM tank accessories

Lock-off Valve	Ceodeux 071307	E20-67R-010711
	Ceodeux 071307 - option	E8-67R-011330
	Valtek 74 - option	E4-67R-010043
	OMB B3 - option	E8-67R-014449
Safety Valve	Ceodeux 070770	E2-67R-0100010
Level Gauge	Shramifa (Livello) L1	E4-67R-0193020
	SRG (497 serie) - option	E4-67R-010038
80% Valve	Ceodex 070116	E8-67R-011328
	OMB Type 4B - option	E8-67R-010216

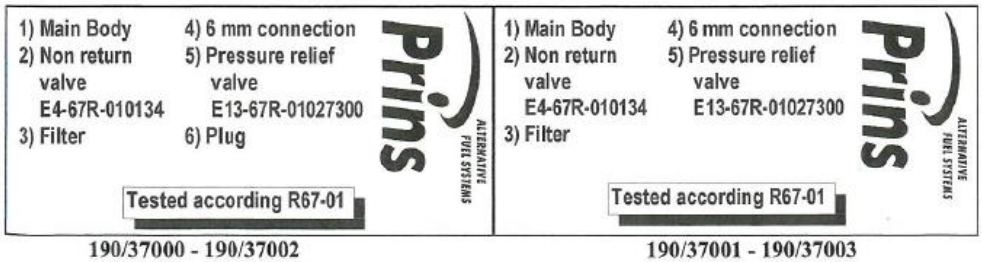
Approval number GZWM tank accessories (optional) gas tight housing

GZWM OP-280 E20-67R-010711
Del Al Type D – option E4-67R-010103

12.5 Tank connection block

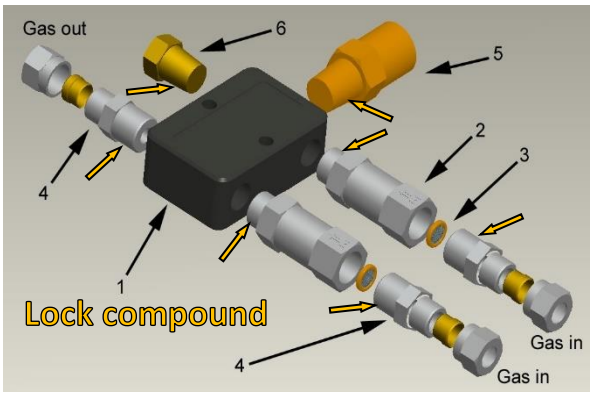
12.5.1 Function

This unit is specially designed and tested according R67R-01 (chapter 17.5) test procedures to connect multiple tanks.

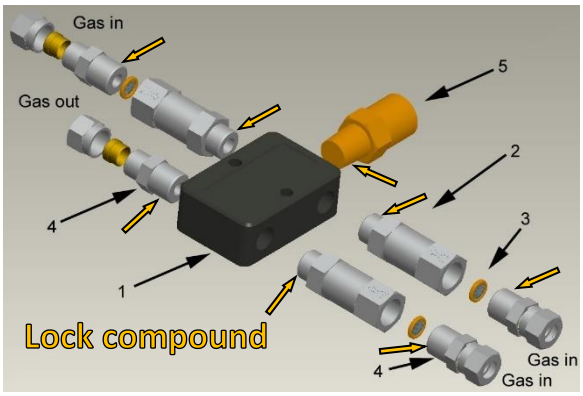


190/37000 - 190/37002 190/37001 - 190/37003

12.5.2 Description



190/37000 - 190/37002 – 190/37004
Connection 2 LPG tanks



190/37001 - 190/37003
Connection 3 LPG tanks

1. Main body
2. Non-return valve E4-67R-010134
3. Filter
4. 6 mm fuel line connection / 8 mm line out
5. Pressure relief valve E13-67R-01027300
6. Plug. Necessary when connecting 2 tanks. When connecting 3 tanks, substitute part 6 with parts nr. 2, 3 and 4
7. Label

Attention! Make sure lock compound is used for assembling the parts to the main body. Respect regulations for mounting the unit. After installation, check unit for leakage.

12.5.3 Part nr.:

- 190/37000: 6 mm fuel line connection, 2 LPG tanks
- 190/37001: 6 mm fuel line connection, 3 LPG tanks
- 190/37002: 8 mm fuel line connection, 2 LPG tanks
- 190/37003: 8 mm fuel line connection, 3 LPG tanks
- 190/37004: 6 mm fuel line connection, 2 LPG tanks, 8 mm Gas out

Commissioning

12.6 Checklist after installation

1) When working on the car, beware of moving, rotating parts and hot parts.

2) Fill-up the tank to a minimum tank level of 20%

3) Install the main fuse; turn the ignition key in the ON position.

4) Prins AFC Software V2 program
   a) Connect and run the Prins AFC Software v2 program.
   b) Flash the correct firmware into the AFC
   c) Activate the AFC.
      When the AFC has not been activated, the switch blinks white.
   d) Start vehicle on petrol (system status “SS_Petrol_selected”)
   e) Check the engine signals, petrol injection time, RPM, ECT, MAP signal and petrol pressure signals.
   f) Activate and set the service interval time (50km/h)
   g) The system may switch over to LPG as soon as the temperature of the coolant becomes higher than parameter 62 - Switch over ECT.

5) Check all components and connections for any gas and fluid leakage (use a GAS leak detector device or a fluid detection like soap).
   Caution for moving and rotating parts in the engine compartment!

6) Let the engine run warm on petrol >80°C.
7) Check if the reducer heats up.

8) Check the vehicle and gas system for error codes and solve these, if required.

9) Create a log file during the test drive and judge the drivability on GAS and petrol.
   a) Switch over behaviour Petrol -> GAS -> Petrol
   b) Engine behaviour running cold and warm.
   c) Shifting / changing gears.
   d) The engine behaviour during and after a “fuel cut off”, especially when falling back to idle rpm.
   e) Stable idle, when pushing power steering to maximum limit and when shifting from park/neutral to gear and backwards.

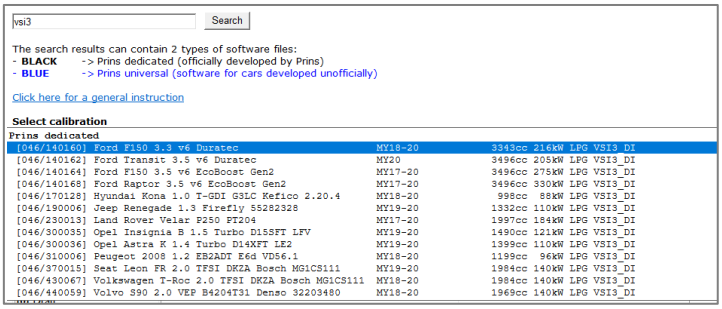
10) Final check:
    a) OBD- and AFC fault codes.
    b) All installed components [hoses, wirings components].
    c) Coolant level and the coolant connections, reducer and T-splices.
    d) Gas & petrol leakages.
    e) Disconnect the Prins AFC V2 software and place the protection connector on the VSI diagnostic connector.

11) Fill in Warranty Portal.
12) Fill in the Drivers Guide.

13) Handover the car, Drivers Guide and warranty certificate.

12.7 Flash AFC-3.0 DI

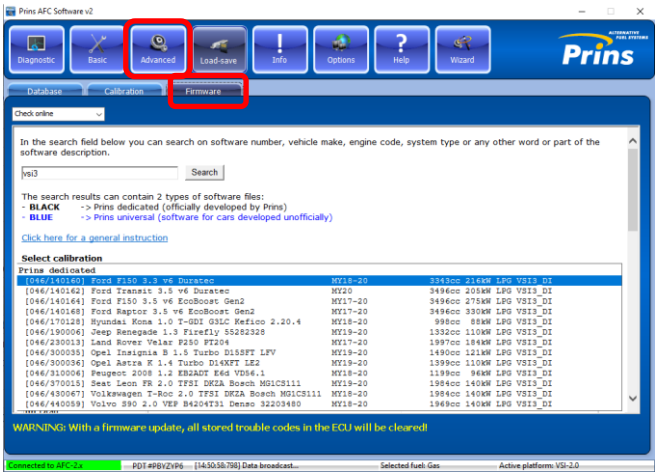
Make use of the Prins AFC Software v2 and Prins Diagnostic tool to flash the AFC-3.0 DI with the correct Firmware.
Available online VSI-3 DI firmware can be identified with 046/…. and with VSI3_DI at the end of the line.



1) How to select the correct firmware for the vehicle?
Always check this vehicle information

- Car brand and model type
- Engine Manufacturer
- Engine displacement
- Engine code / Number - Output
- Firing order
- Transmission
- Petrol ECU manufacturer / Code
- Model Year: (10th digit of the VIN)

1. Select the menu Load-save / Firmware.
2.
3. Use the Search box or scroll trough the calibrations to find the correct calibration.



4. Activate the AFC after flashing

12.8 Calibration parameters

Calibration parameters are described at the components in chapter 'VSI-3 DI Components'.

13 Service and maintenance

The VSI-3 DI system uses 2 filters which need to be replaced according the service interval to assure the performance of the VSI-3 DI system. One filter is mounted inside the eVP-500. The filter is installed in the filter unit. The filter unit needs to be replaced completely. The interval depends on the gas quality and the amount of pollution inside the GAS tank. The time may be set with the Prins AFC Software V2.
Always replace the eVP-500 filter and filter unit at the same time.

13.1 Interval and filter change

	Every 25.000 km, 500hr or after 2 years*
 eVP-500 filter	X
 Filter unit	X

* Depends on local conditions and gas quality.

13.2 Service items

Filter change:

- eVP-500
- Filter unit.

Prins InjectorCare

- Add a bottle (200 ml) Prins InjectorCare in petrol tank

Check:

- Hoses:
  - Damage
  - Gas leaking
  - Engine coolant leakage
  - Petrol leakage
- Fastening of components.
- Electrical connections and wiring.
- VSI system error codes.
- Engine:
  - Error codes
  - Exhaust emissions.
  - Valve clearance
  - Ignition plugs
  - Ignition cables

13.3 Parts Replacement kit eVP-500 filters

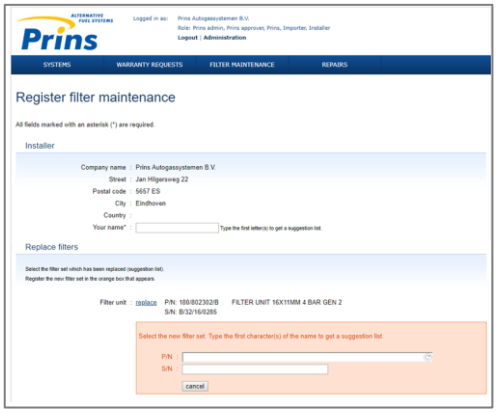
Type	Picture example	Replacement filters eVP-500 and filter unit	1x	Box 50X
Type 2		PRINS 16X11 MM	180/800505/A	180/800053/A
		PRINS 16X11X11 MM	180/800506/A	180/800054/A
		KEIHIN 16X11MM	180/800507/A	180/800055/A
		KEIHIN 16X11X11MM	180/800508/A	180/800056/A

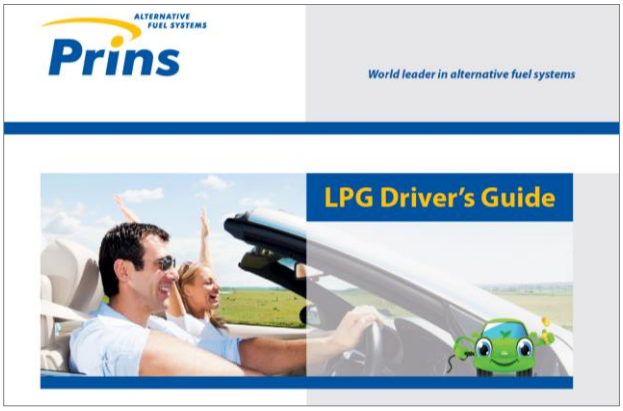
13.4 How to replace the eVP-500 filter

- Use the eVP-500 general manual for the correct instructions
- View the video on the YouTube Prins Autogas site

13.5 Warranty portal and LPG Driver's Guide

- The dealer has to sign / stamp the Driver's Guide when the filters have been replaced.
- Register filter replacement in the warranty portal

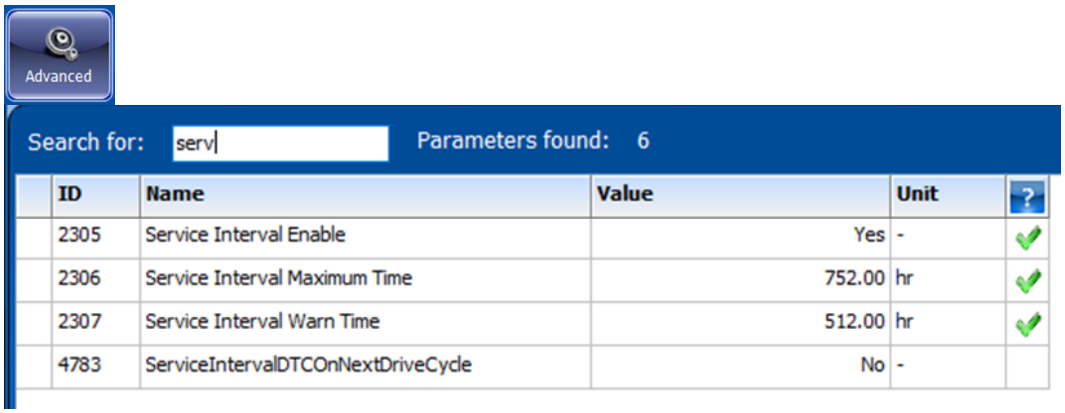




13.6 Service time

13.6.1 Set service time

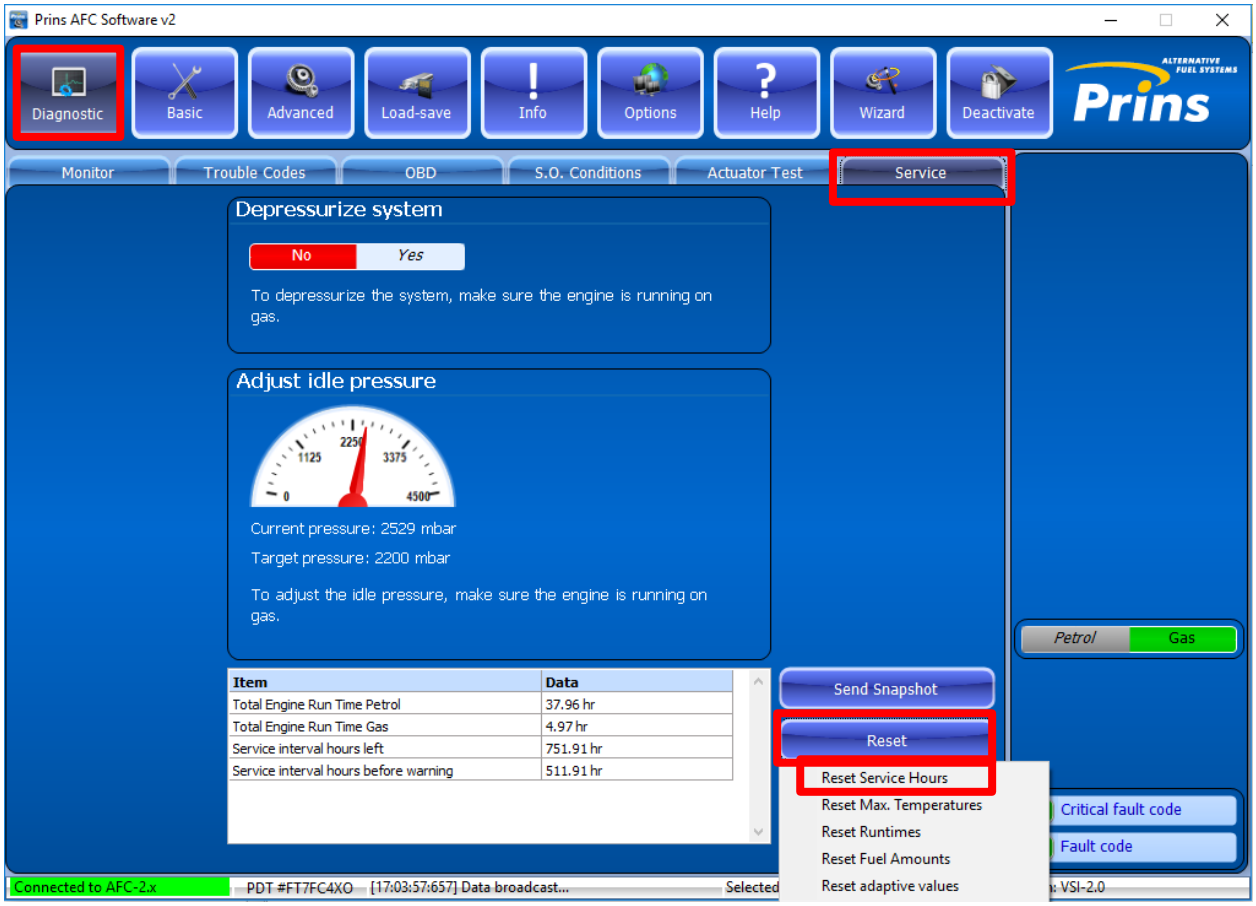
While driving on gas, the filters will collect impurities. After a certain time, the filters will need to be replaced. This time can be set with the Prins AFC software V2. The duration of saturation depends on the pollution of the gas and depends on the region. Prins handles 50km/h. 1000 hours => 50.000 km.
After the Service Interval Time has elapsed, the engine will only run on petrol.



ID	Name	Value	Unit
2305	Service Interval Enable	Yes	-
2306	Service Interval Maximum Time	752.00	hr
2307	Service Interval Warn Time	512.00	hr
4783	ServiceIntervalDTCOnNextDriveCycle	No	-

13.6.2 Reset time

Reset the service time with the Prins AFC V2 Software.



14 Trouble shooting

14.1 Way of working

The installer contacts the Prins importer when support is needed. The Prins importers have their own way of working with the installers.
Prins importers make use of the Prins Support Center. It's an online helpdesk application for communication between the importer and Prins HQ.

14.2 General

- If you can't solve the problem perform the basic checks
- Create log files with marks
- For complex diagnose:
  - 'Planning with customer, Installer, importer and Prins is needed'
  - 'Drive-in and solve problem, often not feasible or realistic'
  - Provide useful information
    - Customer complain
    - Good description of engine / vehicle behaviour
    - Log files of test drive
      - Reproduce behaviour - Mark
      - Gas & petrol modes
    - Deviating fuel trims
  - Check for new firmware

14.3 Basic checks

14.3.1 Engine does not run

1) Visual check :
   a) Main fuse
   b) Prins switch behaviour
   c) Software in Master and Slave AFC?
      -
2) Check with diagnostic tool
   a) Diagnostic Trouble Codes AFC
   b) OBD faults
   c) Diagnostic parameters (Inputs)
      i) Spare Input 1 Status [6299]
      ii) Firing order [See installation manual]
         (1) DI Engine Firing Order [11126]
         (2) MPI Firing Order [14636]
      iii) Petrol Injection time
      iv) + ignition wire 112 [102]
      v) RPM signal [101]
      vi) Petrol High Pressure Absolute [537]
      vii) Petrol Low Pressure Absolute [1171]
      viii) Petrol Low Pressure Absolute Simulated [1317]
      ix) OEM Sensor Ground Offset [3708]
      x) OBD rail pressure (OBD page)

14.3.2 Engine does not run on GAS

1) Check with diagnostic tool
   a) Switch over conditions not met
      Diagnostic S.O. Conditions
   b) System status
      i) Switch over
      ii) RPM, ECT, runtime, …
      iii) Firing order; not all injector present [DI-MPI]
         (1) DI Engine Firing Order [11126]
         (2) Secondary (MPI) Firing Order [14636]
   c) GAS NOT ALLOWED
      i) Main board temperature too high
      ii) OBD External Tester Present [4650]
      iii) Specific conditions ex. Idle, Reverse, …
   d) Empty Tank
2) Diagnostic Trouble Codes AFC
3) + ignition [102]; value 0 (or blinking 0-1-0-1)
4) RPM signal [101]; No signal