Dealer Information SGI, type 1

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Introduction.

The emission requirements have been tightened considerably over the last few years. In the present generation engines the DGI system, which is used at the moment, meets the emission requirements. However, in the years to come the maximum permissible exhaust emissions will be lowered substantially.
AG foresees that LPG-supply systems will have to become fully sequential for modern multi-point injection engines, in order to continue to meet these future requirements.

Sequential LPG injection is realised by AG's latest invention:

The SGI system is an ultramodern Multi-point Vaporous Sequential LPG injection system, developed in-house by AG. The system allows the LPG or CNG vapour to be regulated and injected separately for each cylinder by using the management strategy of the engine-management computer, already present in a vehicle.

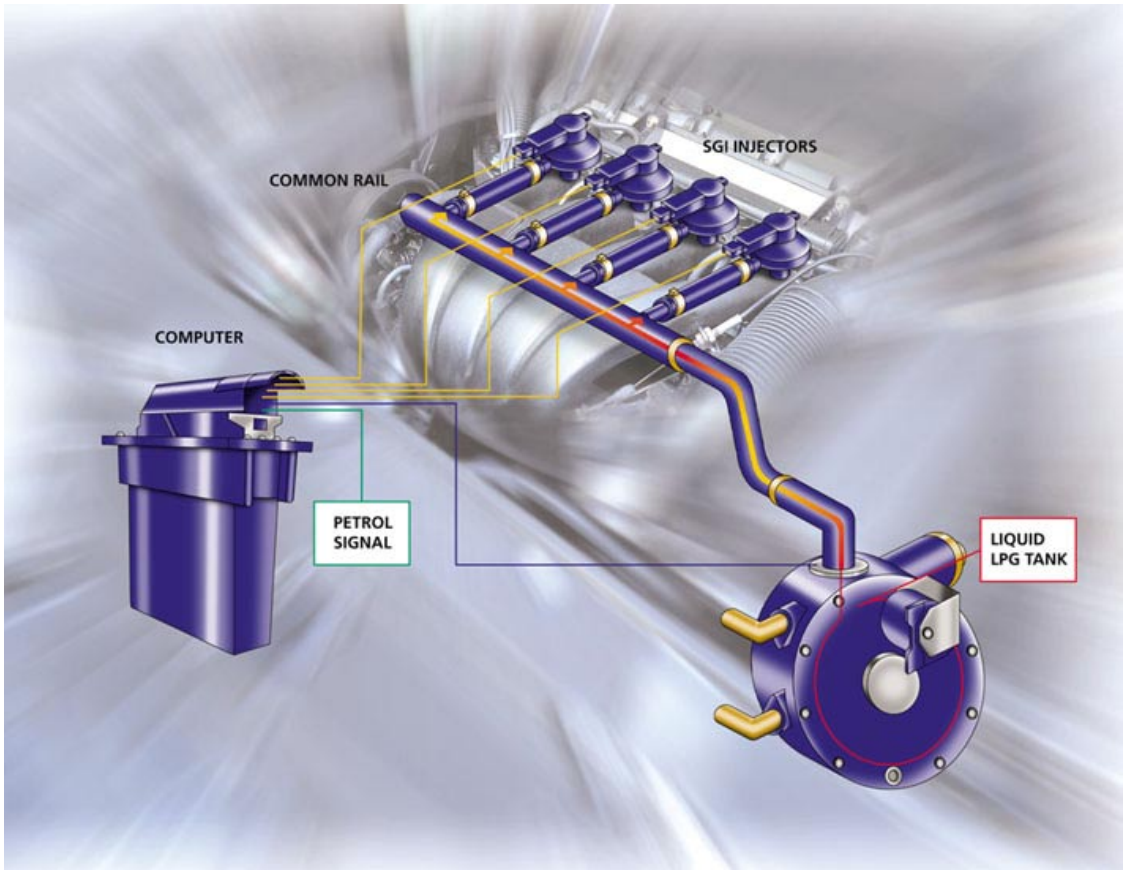
This results in an optimal price / performance ratio of the SGI system with the following advantages:

- No risk of backfire
- Very clean exhaust emissions (below the Euro-4 standard)
- Minimal difference in engine power between petrol and LPG (1 to 2%)
- More effective use of LPG, resulting in lower fuel consumption when compared to present LPG systems
- The system can be used in all modern multi-point petrol-injection engines
- It takes little time to develop new packages because of the simplicity of the system
- On-board diagnosis and modem communication have been further developed as compared to the present systems (DGC and DGI)
- No fuel pump required for LPG supply
- All the SGI components meet the European 67R-01 requirements
- Optimum mating between fuel injection, speed control and ignition

- The diagnostic system, which is part of the engine-management system, is maintained (no simulation required)

1. The LPG system.

The figure below shows an overview of the SGI system and its components:



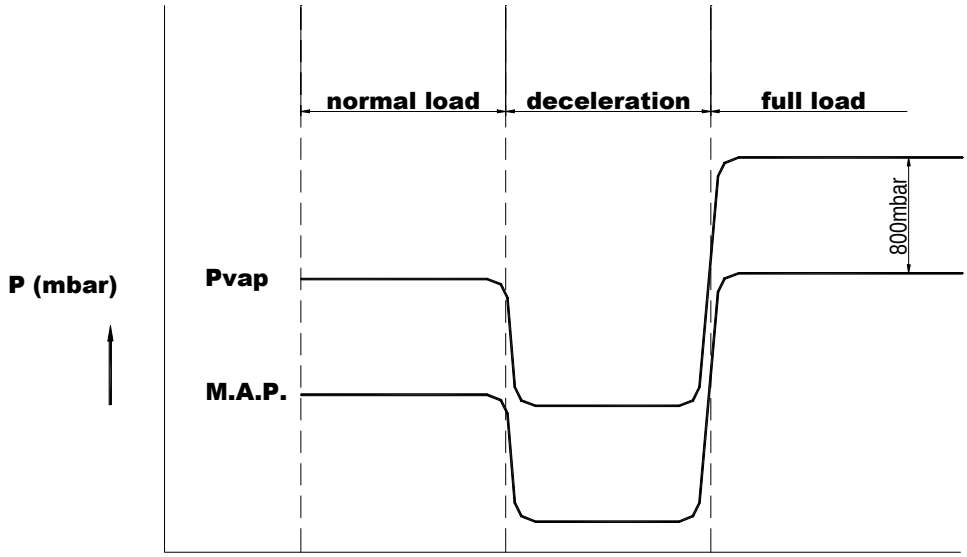
The parts in the engine compartment are:

- The SGI vaporiser/pressure regulator for the vaporisation of the liquid LPG (or CNG) from the tank and for regulation of the pressure across the injectors.
- The SGI fuel rail for the distribution of the gas supply from the vaporiser to the injectors.
- The SGI injectors for the delivery of the required amount of fuel for each cylinder separately.
- The SGI computer for the conversion from the opening periods of the petrol injectors to the opening periods of the SGI injectors and for the regulation of the LPG shut-off valves.
- The Interface Unit for the interruption and simulation of the petrol injectors by connecting the petrol-injector control wires to the SGI computer. The interface unit also measures the pressure in the inlet manifold by means of the integrated MAP sensor.

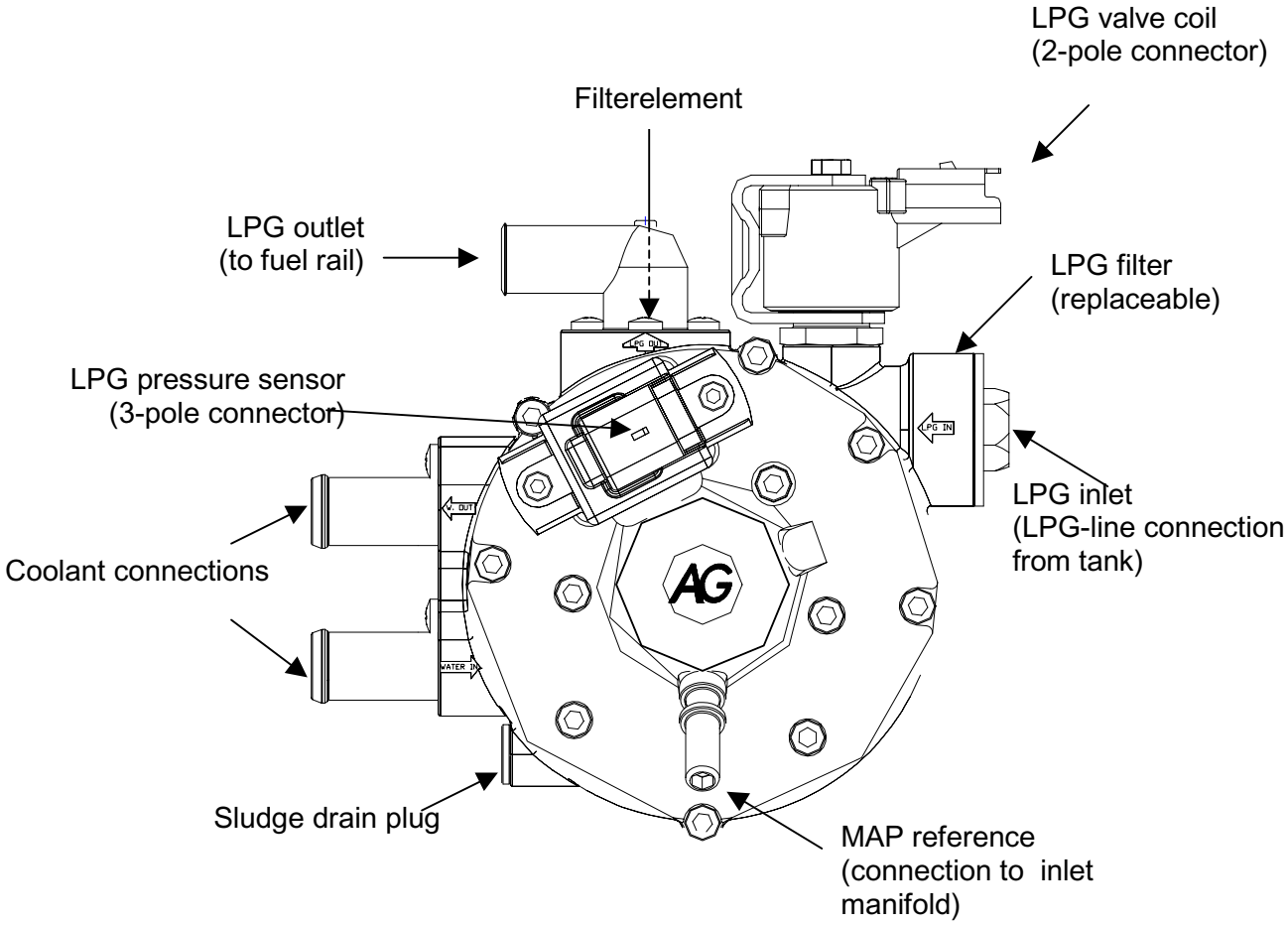
In this dealer information the mechanical and electrical components are described separately.

1.1. SGI vaporiser.

Liquid LPG (or gaseous CNG through a high-pressure regulator) is supplied from the tank to the SGI vaporiser (AG 600.001). The LPG shut-off valve is integrated into the vaporiser. When this valve is open, the pressure in the vaporiser is pressurised to a value that depends on the engine load. To this end a vacuum hose has to be connected between the inlet manifold and the vaporiser. In this way the pressure across the injectors is maintained at a constant value (see the drawing below).

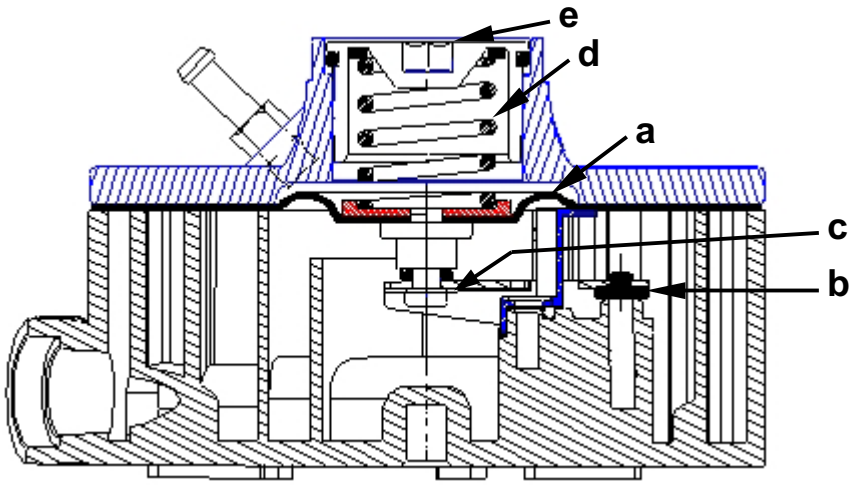


The SGI-vaporiser connections are shown on the next page.



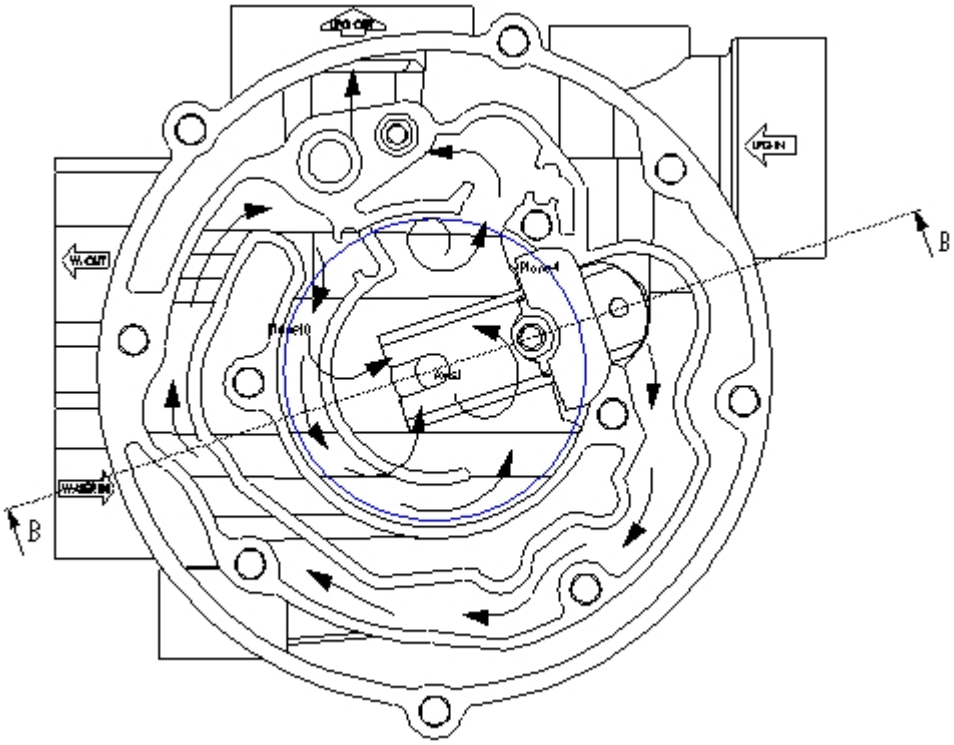
The absolute pressure in the vaporiser is gauged by means of a pressure sensor, so that the SGI system does not suffer any adverse effects from pressure fluctuations in the vaporiser. The absolute pressure varies between 950 mb. (when decelerating) and 1800 mb. (at full load).

The sectional drawing of the SGI vaporiser below will further explain its operation.



As shown, underneath the membrane (a) LPG is allowed to enter the vaporiser along the valve (b) , which is fitted onto the lever (c); when the shut-off valve is open.
The pressure of the LPG is referenced to the manifold absolute pressure (map), because the upper side of the membrane is connected to the intake manifold by a vacuumhose.
Because of this reference, the differencial pressure in between the LPG and the intake manifold is controlled at appr. 800 mbar constantly by the tension of the spring (d). The tension of this spring is adjustable via the adjustment screw (e) by using a 6mm Allen screw wrench.

To clarify the way the LPG and the engine coolant flow through the vaporiser, a sectional drawing is shown below:



As shown above by the arrows, the velocity of the LPG is kept as high as possible during which the heat exchange in between the engine coolant and the LPG is optimal.
A turbulance is created by the swirl-wall in the middle of the vaporiser. In this way, the internal heat-exchange is further optimized and the accumulation of sludge inside the vaporiser is minimized.

TIPS:

1. **It remains necessary to drain sludge from the vaporiser with each major service.**
2. **Behind the gas inlet of the vaporiser there is a filter element, which must be checked or cleaned after every 60,000 km.**

1.2. Fuel rail.

The fuel rail has the same function as the fuel gallery in multi-point petrol engines i.e. it only regulates the distribution of the LPG supply from the vaporiser to the SGI injectors. In addition to the present 4-splitter rail (AG 600.090), various versions will become available for 5- and 6-cylinder engines when required (8-cylinder engines are fitted with two 4-splitter rails).

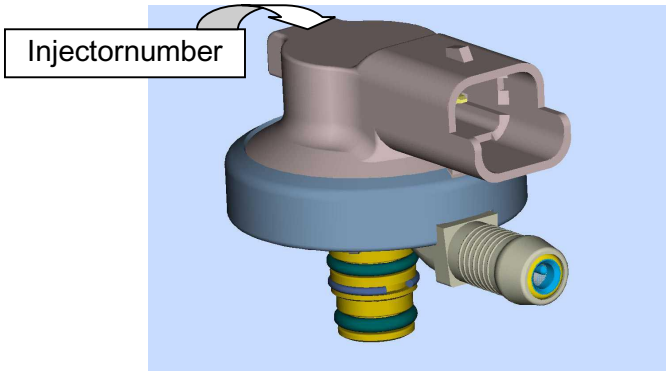
1.3. Injector.

The computer gauges the petrol-injector opening periods separately and converts them to the SGI-injector opening periods. This is possible because the characteristic of the SGI-injector, like that of the petrol injectors, is linear. The management computer of the engine itself therefore regulates the LPG-supply control.

A 2-pole water-resistant connector is fitted onto each injector. It is important that the connections are not interchanged.
At the moment 3 SGI injector types are available:

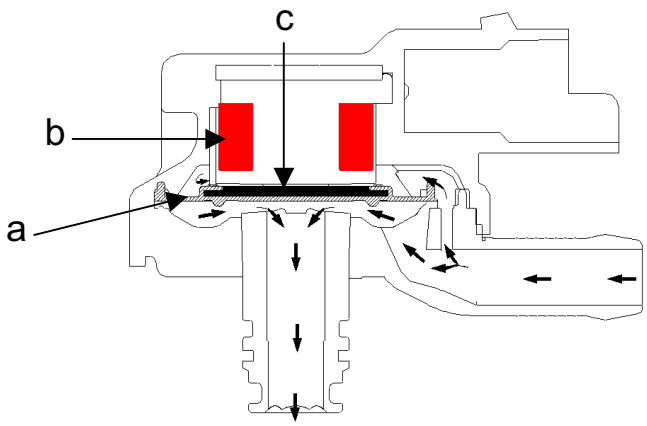
- **4mm. Injector** **(AG 600.040)**, used up to 300cc. per cylinder (*indication only)*
- **5mm. Injector** **(AG 600.050)**, used from 300 to 500cc. per cylinder (*indication only)*
- **6mm. Injector** **(AG 600.061)**, used from 500cc. per cylinder (*indication only)*

The right type of injector is supplied in the complete set. The type can be identified by the part number on the injector-coil housing (see the figure below).

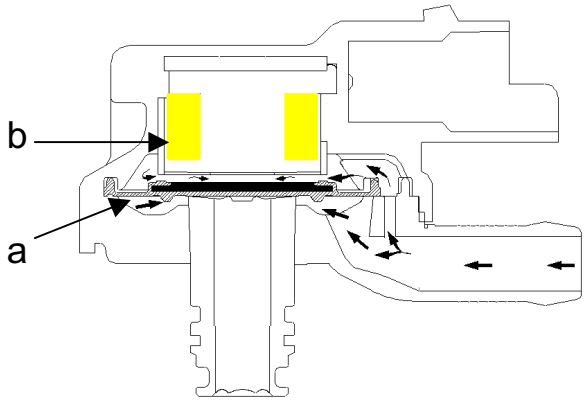


The operation of the injectors is based on a diaphragm instead of a plunger principle. Two conditions are possible:

1. The injector opens electrically by tightening the steel core (c) on the diaphragm (a) by means of a magnetic field that is generated in the injector coil (b) during the opening period.

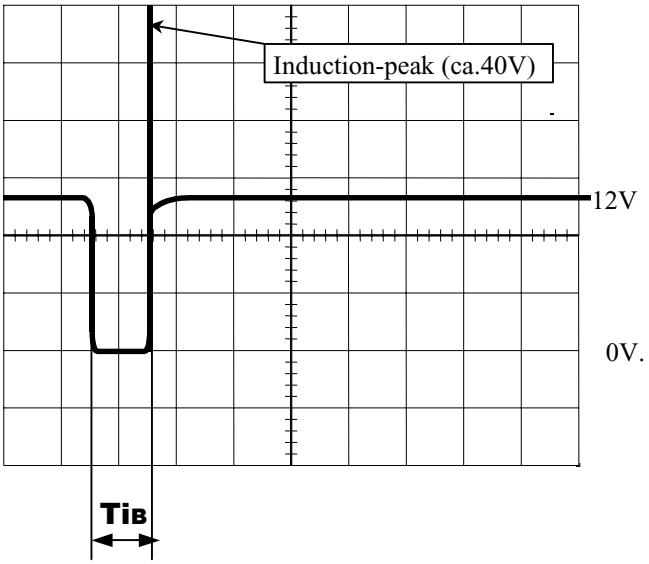


2. As soon as the magnetic field in the injector coil (b) drops the injector closes after the opening period, under the influence of the LPG pressure across the diaphragm (a), which is delivered by the vaporiser.



2. The electrical system.

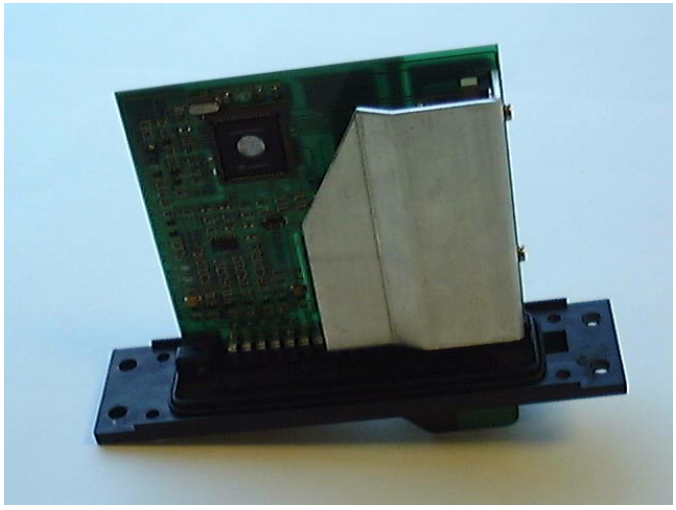
The SGI system reads in the opening periods of the petrol injector and converts them to the exact opening periods for the SGI injectors. This principle is also referred to as the conversion strategy.
It is of course of importance to know how the petrol injectors are actuated.
In 99% of the present engine management systems the injectors are opened by switching the injector coil to earth while feeding the other side of the coil with 12V. The time during which the petrol injector is held open is the opening period TiB. The resulting scope picture is shown below.



In most contemporary engines the petrol injectors are actuated separately (fully sequentially), but the injectors can also be actuated simultaneously. A hybrid form, in which the injectors are actuated in groups of two (half sequential), is also possible. In each case the injection strategy of the engine-management system will be followed completely.

2.1. The SGI computer.

The SGI computer converts the opening periods of the petrol-injectors to the opening periods for the SGI injectors.
The computer housing is identical to that of the DGC and the DGI computers and installation can be carried out in the same way. By the end of 2001 an aluminium housing, such as that for the Interface Unit, will be used. This will simplify installation of the SGI computer even further.

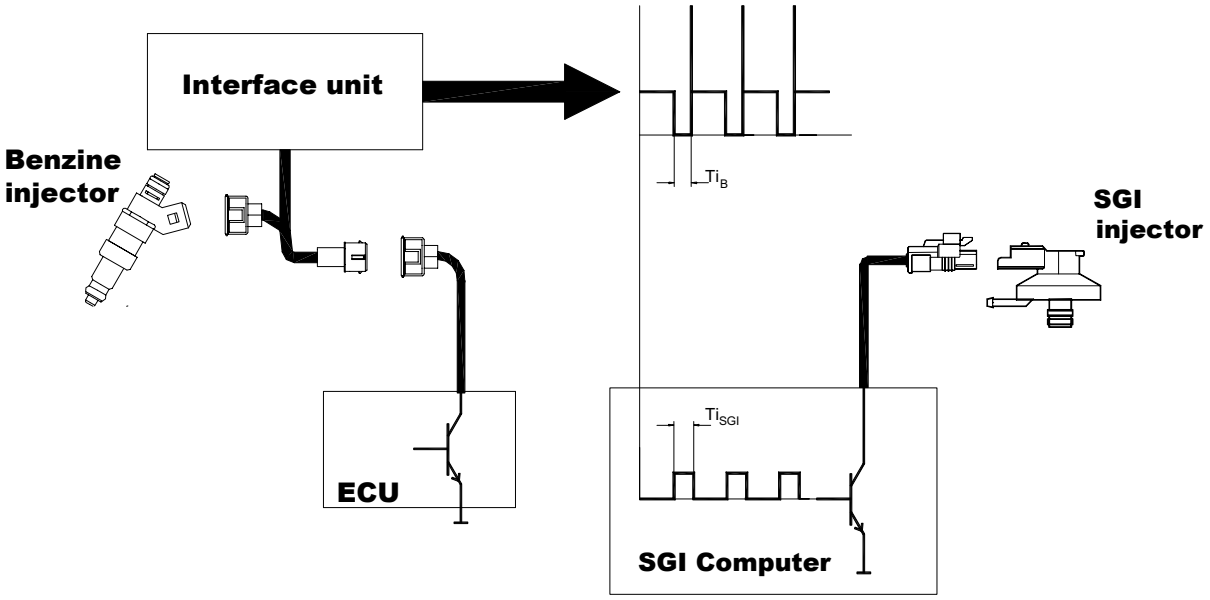


The SGI print (type AG)

The present computer is fitted with the well-known 35-pole connection onto which the 35-pole plug of the standard cable tree can be connected.
The input and output signals of the SGI computer are described in the chapter called “The Required signals”.

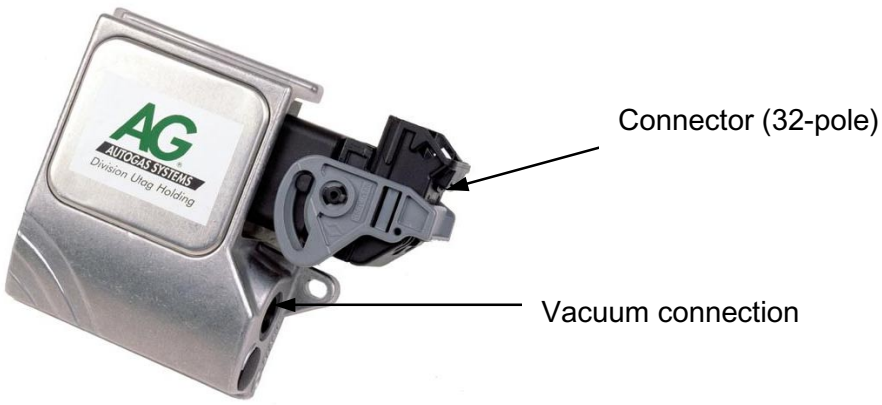
2.2. The SGI conversion strategy.

Actuation of the SGI injectors is fully based on copying the opening periods of the petrol injectors, in the way they are controlled by the engine-management computer. Therefore it is ultimately the engine-management computer that determines the opening periods of the SGI-injector, as these are converted by the SGI computer.
The scope picture of the SGI injections is therefore identical to that of the petrol injectors, because the actuation takes place by means of the opening period of the SGI injector coils.
The following page shows a graphic presentation of the conversion strategy.



2.3. The Interface Unit.

Interruption of the petrol injectors is realised by the so-called Interface Unit. This unit consists of an interruption unit with a number of transistors with integrated simulation resistances. Each petrol injector is interrupted by means of soldered joints or by supplied shrunk connections. When driving on LPG the petrol injectors are simulated. The opening period of the petrol injectors can be measured by reading in the simulation signals. Each simulation-resistance wire is therefore branched off and connected to the SGI computer.
The SGI computer actuates the Interface Unit when change-over from petrol to LPG takes place.
A pressure sensor is integrated into the Interface Unit. With this sensor the pressure in the inlet manifold of the engine (MAP) is measured, for which a vacuum hose needs to be connected directly in the unit.
The chapter “The Required signals” will further explain how and why the pressure in the inlet manifold is measured.



The Interface Unit

2.4. The Required signals.

The required signals for the SGI computer are:
1. Opening period of petrol injectors (4 maximum)
2. Coolant temperature
3. Pressure in inlet manifold (MAP)
4. LPG pressure in vaporiser
5. Optional signals

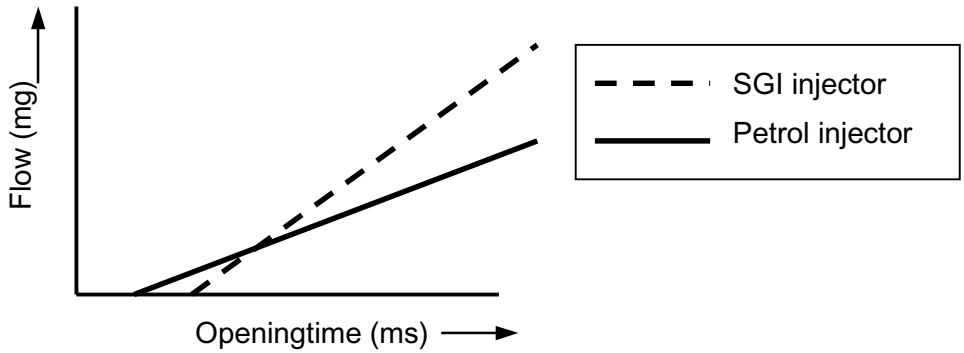
The following paragraphs will deal with these signals successively (sequentially).

2.4.1. Opening period of petrol injectors:

As the SGI computer is no more than a conversion unit to control the petrol injectors, the information on the opening periods of the petrol injectors is of greatest importance.
This considerably simplifies the SGI computer software, as the petrol computer has in fact already calculated the actuation.
The characteristic of the SGI injector, like that of the petrol injector, is linear. The differences are determined by two factors:

- the amount of flow in relation to the opening period;
- the minimum required opening period before the injector actually opens.

The differences in factors for the petrol injector and the SGI injector are determined during development of the application, so that the SGI computer exactly converts the opening period for each petrol injector to the opening period for each SGI injector.
The principle of the differences in characteristics between the petrol injector and the SGI injector is shown below.



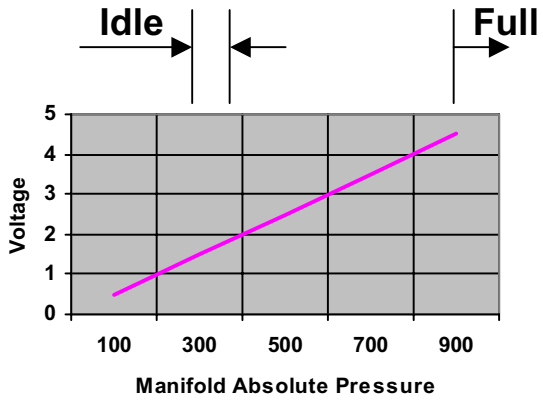
To be able to measure the opening period of the petrol injectors, they are simulated by the interface unit when driving on LPG. This simulation signal communicates the opening periods separately to the SGI computer. The computer then converts these periods to the exact opening periods for each SGI injector separately.

2.4.2. Coolant temperature:

When driving on petrol at low engine temperatures a considerable enrichment is required to compensate for condensation of petrol.
LPG is vaporous so there is no condensation. The actuation of petrol injectors can therefore not be copied completely. With a cold engine and driving on LPG it is in principle possible to directly regulate the mixture stoichiometrically.
In that case it is important to measure the engine (i.e. coolant) temperature so that the degree of correction to the petrol opening periods can be calculated.
Below an example is given of the characteristic of a temperature sensor (type NTC):
It is thus necessary to connect the coolant-temperature sensor signal wire, using the appropriate cable-tree wire.
However, in an engine-management computer, fitted with so-called double (internal) pull-up resistances for the coolant-temperature sensor, the voltage of the original sensor cannot be used by the SGI computer. In that case an external temperature sensor will be included in the SGI engine set. This sensor can be fitted in the feed tube of the SGI-vaporiser coolant connections.
All this is clearly indicated in the installation manual in question.

2.4.3. Pressure in the inlet manifold (M.A.P.)

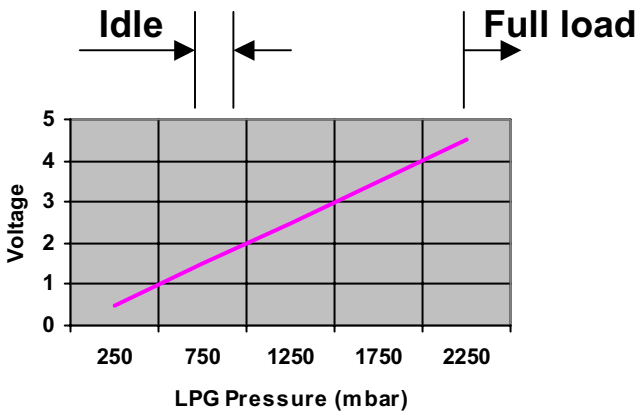
As described before it is important to measure the differential pressure across the SGI injectors. This is done indirectly by means of measuring the pressure in the inlet manifold, among other things.
As the MAP sensor is integrated into the Interface Unit, the connections are integrated into the cable tree, which means that they need not be connected separately.
The characteristic of this signal is shown below:



ⓘ When the SGI system is used in engines equipped with boost pressure (turbo), the reach of the MAP sensor integrated into the Interface Unit is not sufficient.
In that case the original MAP sensor of the engine concerned must be branched off. In case the engine-management system is not fitted with a MAP sensor, a separate MAP sensor will be included in the SGI engine kit. Both situations are clearly explained in this installation manual.

2.4.4. LPG pressure in the vaporiser:

To determine the differential pressure across the SGI injectors, the LPG pressure supplied from the vaporiser as well as the pressure in the inlet manifold need to be measured. This is done by means of a pressure sensor, which is integrated into the SGI vaporiser. Its signal is shown below:



The differential pressure across the SGI injectors is equal to the difference between the pressure measured in the inlet manifold and the LPG pressure in the vaporiser. Any variation in the differential pressure can be corrected by means of the software.
The SGI system is therefore not sensitive to differences or variations in LPG pressure.
The LPG-pressure sensor is connected by means of a 3-pole plug. Its connections will be described in the following chapter.

2.4.5. Optional signals:

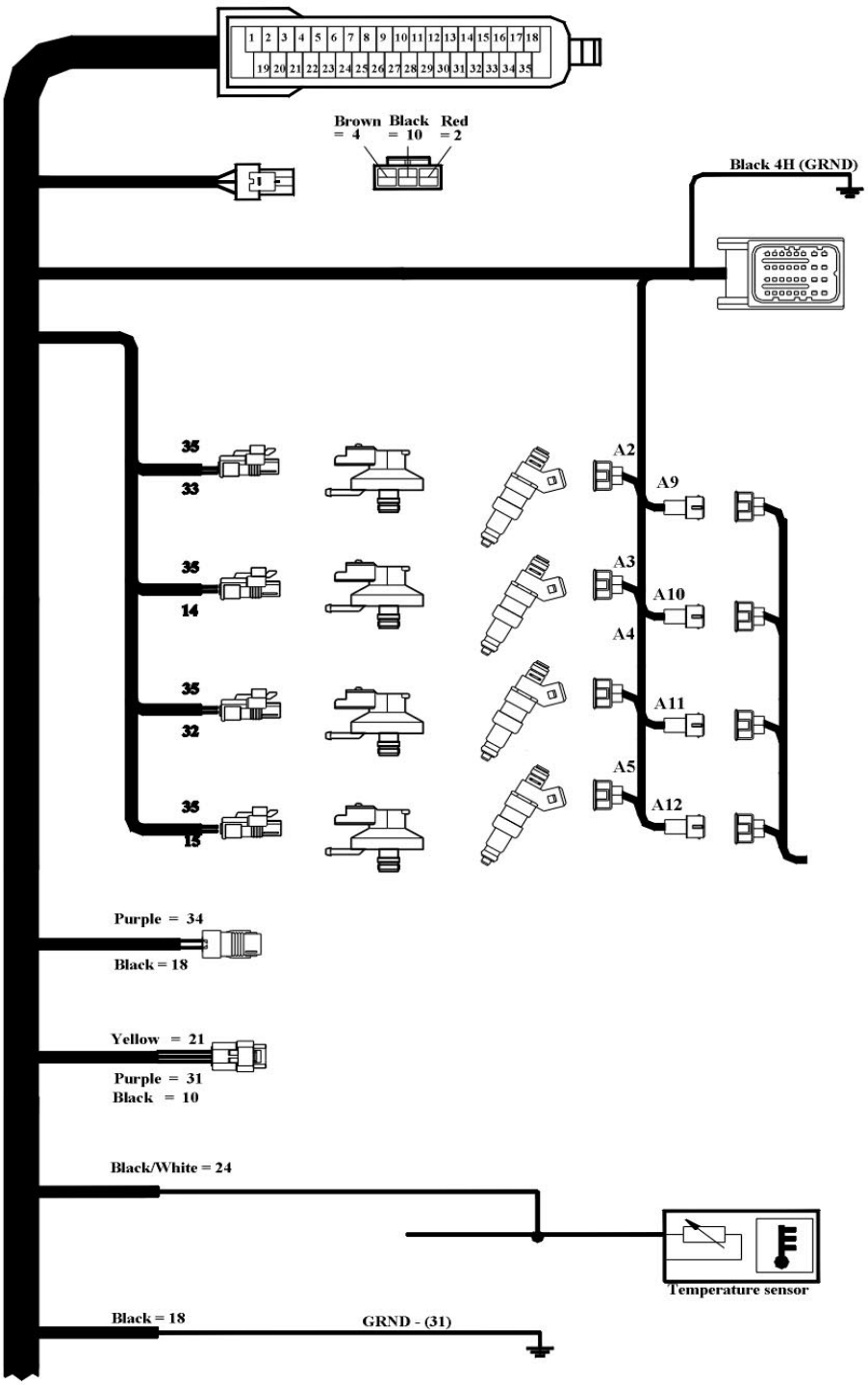
It may be necessary to read in one or more sensor signals in addition to the usual signals, because the exhaust emissions can be further optimised in this way.
The SGI computer can e.g. read in an analogue signal, such as the lambda signal. Then the lambda signal will have to be branched off (NOT interrupted!).

Apart from reading in optional signals, such as the lambda signal described above, the system can also be connected as a stand-alone system. This means that the SGI system, like the DGI system, can operate completely independently. The conversion strategy, however, is far more complicated in that case, and this function is only used in specific projects.

2.5. Wiring diagrams.

2.5.1. SGI computer (conversion strategy); type AG.

The wiring diagram, together with all the connections for the SGI computer in the engine compartment, is shown below:



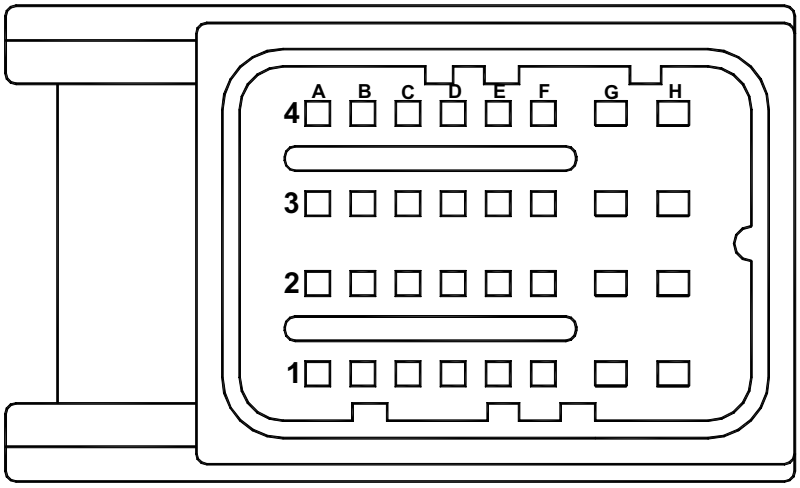
As an addition to the cable-tree diagram of the conversion version of the SGI computer, an overview of all the connections is shown below:

Pole number:	Wire colour:	Function:
1	Orange	Diagnostic LED
2	Red	Diagnostic plug (communication)
3	Black/Brown	Earth
4	Brown	Diagnostic plug (communication)
5	-	Not used
6	Brown	Pulse signal (from LPG switch)
7	Purple	Petrol-injector input signal 4
8	Black *	Common connection relay group 2
9	White *	Lambda-signal input
10	Grey *	Sensor earth
11	Yellow	Petrol-injector input signal 1
12	Red	Normally closed connection, relay group 1
13	Red *	Normally closed connection, relay group 2
14	Brown	Actuation SGI injector 2
15	Purple	Actuation SGI injector 4
16	-	Not used
17	Blue	Buzzer actuation (near switch)
18	Black	Earth
19	Green	MAP-sensor signal input (interface unit)
20	White	Petrol-injector input signal 2
21	Purple	LPG pressure sensor signal input (vaporiser)
22	-	Not used
23	Blue	Interface unit ambient temperature input
24	Black / White	Coolant temperature input
25	Black	Common connection relay group 1
26	-	Not used
27	Red	Petrol-injector input signal 3
28	Brown	Interface unit actuation
29	Blue *	Normally open connection relay group 1
30	Grey *	Normally open connection relay group 2
31	Yellow	+5V output (LPG-pressure sensor feed)
32	Red	Actuation SGI injector 3
33	Black	Actuation SGI injector 1
34	Purple	LPG-valve actuation (LPG+)
35	Red	15+ feed of SGI computer (+12V) from interface unit

*: optional connection (no wire available in standard cable tree)

2.6 SGI Interface Unit.

The Interface Unit, which provides both interruption and simulation of the petrol injectors, is fitted with a 32-pole “Molex” plug connector. The bottom view of the plug with all the pole numbers is shown below:



Interface Unit Plug Aspect

The connections are numbered as follows: first the row number is mentioned and then the column letter. For example: the connection at the top left is row 4, column A and is therefore called: connection **4A**.

TIP:

NEVER measure the 32-pole plug connection of the Interface Unit by means of a metering pin or a paperclip as this may immediately result in contact problems!!

To be able to check the Interface-Unit connections properly a special breakout box has been developed, which can be connected between the Interface Unit and the 32-pole Molex plug. This box will also become available to dealers.

The Interface-Unit wiring is integrated into the SGI-computer wiring. The connection diagram of the Interface Unit (in tabular form) is shown on the next page.

Pole number:	Wire colour:	Function:	Connection:
1A	Red *	Interruption injector 5, input	Injector side
1B	Black *	Interruption injector 5, output	ECM side
1C	Red	Interruption injector 4, input	Injector side
1D	Red	Interruption injector 3, input	Injector side
1E	Red	Interruption injector 2, input	Injector side
1F	Red	Interruption injector 1, input	Injector side
1G	Yellow	Feed + 5 V	Pin no. 31 (SGI comp.)
1H	Red	Feed + 12 V (to SGI computer)	Pin no. 35 (SGI comp.)
2A	Red *	Interruption injector 6, input	Injector side
2B	Black *	Interruption injector 6, output	ECM side
2C	Black	Interruption injector 4, output	ECM side
2D	Black	Interruption injector 3, output	ECM side
2E	Black	Interruption injector 2, output	ECM side
2F	Black	Interruption injector 1, output	ECM side
2G	*	+5 V output	-
2H	*	+15 V output	-
3A	Red *	Interruption injector 7, input	Injector side
3B	Black *	Interruption injector 7, output	ECM side
3C	Purple	Output petrol injector signal 4	Pin no. 7 (SGI comp.)
3D	Red	Output petrol injector signal 3	Pin no. 27 (SGI comp.)
3E	White	Output petrol injector signal 2	Pin no. 20 (SGI comp.)
3F	Yellow	Output petrol injector signal 1	Pin no. 11 (SGI comp.)
3G	Black / Brown	Earth	Pin no. 3 (SGI comp.)
3H	Red / White	+12 V input	Petrol-injector feed
4A	Red *	Interruption injector 8, input	Injector side
4B	Black *	Interruption injector 8, output	ECM side
4C	Brown	Switch wire (5 V actuator)	Pin no. 28 (SGI comp.)
4D	Blue	Measurement of ambient temperature	Pin no. 23 (SGI comp.)
4E	Grey	Earth (sensors)	Pin no. 10 (SGI comp.)
4F	Green	MAP signal	Pin no. 19 (SGI comp.)
4G	Black	Earth	Pin no. 18 (SGI comp.)
4H	Black	Earth	Separately to Earth

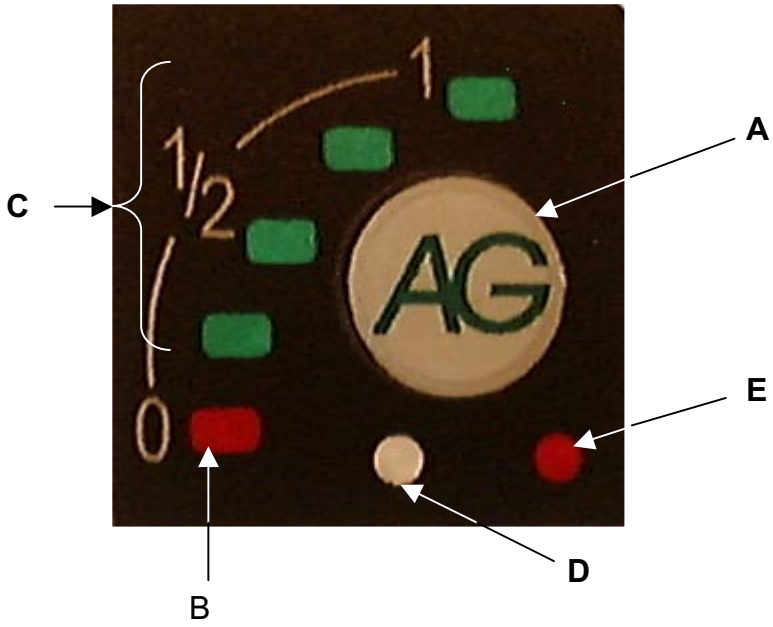
* : optional connection (no wire available in standard cable tree)

3. The LPG switch.

3.1. Operation.

A pulse switch is supplied together with the AG Autogas Systems Sequential Gas Injection (SGI) system. Because the operation of this switch differs from that of the traditional one, a description of the operation of the so-called pulse switch is given in this chapter.
The photograph below shows the front of the pulse switch, as it is visible on the dashboard.

The photograph shows that the switch has a number of functions.



A: pulse-switch
B: indication tank empty
C: fuel-level indication
D: light-sensitive photocell
E: Diagnosis LED

A is the switch to change over from LPG to petrol. Because it is a pulse switch, it only needs to be touched slightly to switch between petrol and LPG.
When the ignition is switched on, the pulse switch automatically returns to the last-used condition. The diagnostic LED (**E**) flashes in the LPG position; in the petrol position all the LEDs are off.
When the engine is started in the LPG position it will initially run on petrol before actually changing over to LPG. The LPG shut-off valves will be opened first, with the engine still running on petrol (flushing). In this condition tank indications (**B** and **C)** light up and the diagnostic LED (**E**) flashes. As soon as the supply lines have filled up with LPG, the SGI injectors are opened. In this way a smooth change-over is realised.

B and **C** are the LEDs indicating the LPG tank level. When the LPG tank is full all four green LEDs (**C**) light up when driving on LPG. As the LPG tank gets empty the LEDs will gradually go out from top to bottom. When the last green LED goes out the red LED (**B**) will light up, to indicate that only a limited distance can be driven on LPG.
When the SGI computer detects an empty tank, it will automatically switch back to petrol and a pulsating signal can be heard. The signal can be stopped by pressing the switch (the car will continue to run on petrol).

D is not an indication but a photocell to regulate the light intensity of the indication LEDs **B** and **C**. This intensity depends on the intensity of ambient light; in sunlight the LEDs will light up brighter than in the evening, when it is dark.

E is the diagnostic indication. This red LED will flash when the SGI computer recognises the LPG position and the engine is still running on petrol (for example when the engine temperature is too low or when the LPG tank is empty (together with an audible signal)).

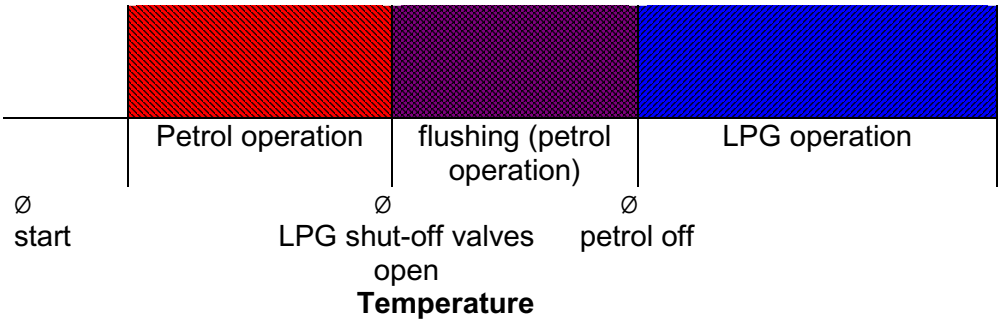
In case a fault is detected when driving on LPG, this LED will also flash (in combination with tank indication LEDs that light up) to alert the driver that he should contact the dealer so that the fault can be eliminated.

3.2. Change-over strategy.

After starting the engine it will first run on petrol; shortly after that the LPG injectors are opened and then they take over the injection of fuel from the petrol injectors. The coolant temperature determines the time for change-over to LPG. The lower the temperature, the longer it takes for change-over to LPG.

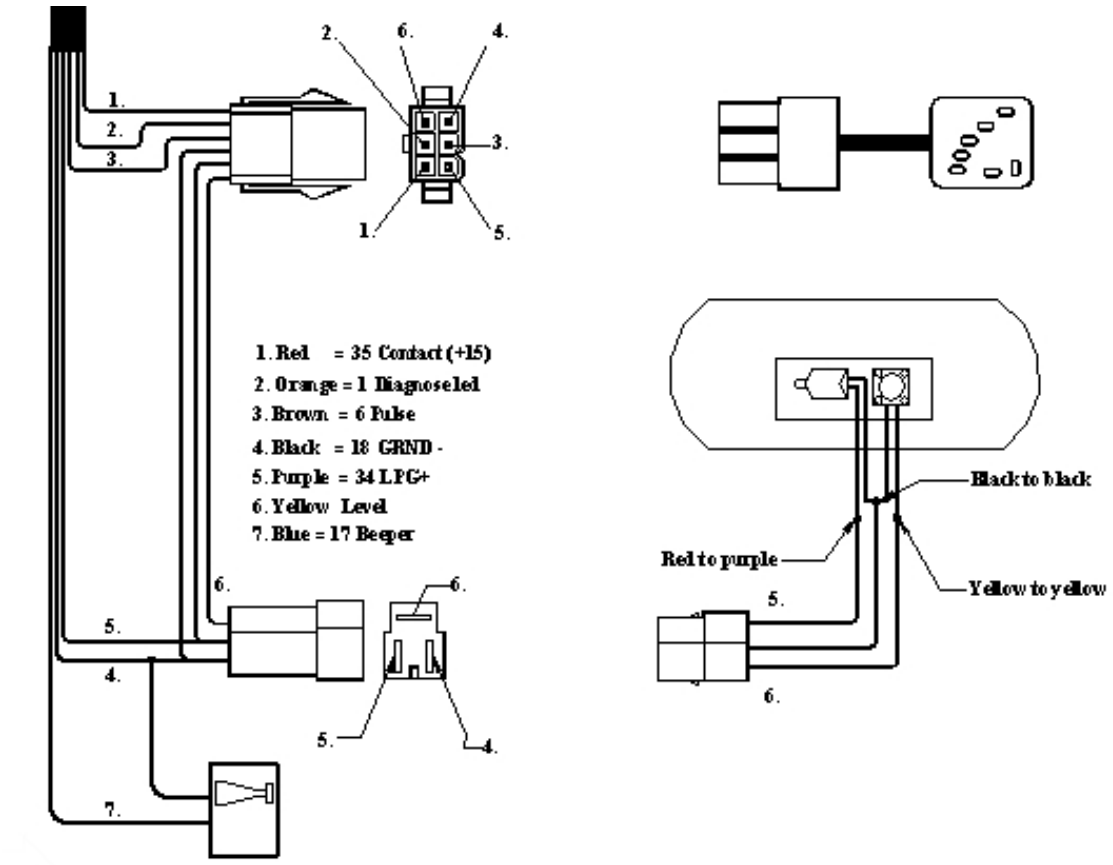
As was described before, the SGI system uses the actuation of the petrol injectors when driving on LPG. When the LPG tank is running empty this is compensated for by the actuation of the SGI injectors. As this is the task of the engine-management computer, this correction may be stored in the memory, in which case the mixture will be too lean when change-over to petrol takes place. This results in temporary bad performance of the car. It is also possible that (especially when the engine-management system is fitted with E-OBD) error codes are stored in the engine-management computer memory, which will cause the check-engine light to light up.

To prevent situations as described in the previous paragraph the computer will change over to petrol when it detects that the LPG tank is nearly empty. An empty LPG tank is detected on the basis of the injection periods of the SGI injectors in combination with the vaporiser pressure. When the injection periods exceed the value specifically programmed for each engine type and the vaporiser pressure is too low for that condition, the SGI computer will automatically change back to petrol.
To indicate this condition to the driver, an audible signal will be given and the lights on the LPG switch will go out. (It would be inconvenient for the driver to notice this condition when the petrol tank was completely empty.)



3.3. Electrical connections.

The electrical diagram of the switch connections is shown on the next page.
This diagram also shows that the SGI-system buzzer is connected separately from the switch, behind the dashboard.



Below you can find the connections in tabular form once again:

Colour	Pin no. (SGI comp.)	Function	Signal
Red	35	Feed	+12 V (connected)
Orange	1	Diagnostic LED	+12 V (flashing)
Brown	6	Pulse (of switch)	+12 V (pulse when pressed)
Black	18	Earth	0 V
Purple	34	LPG shut-off valve feed	+12 V (running on LPG)
Yellow	-	Tank-sensor signal	Inductive
Blue	17	Buzzer actuator	+12 V (pulsating)

Because all the wires have already been provided with the necessary plug connections, they only need to be plugged into the 6-pole plug during installation. (It is important, however, to plug in equal colours opposite to each other.)

4. Diagnostic equipment.

Introduction.

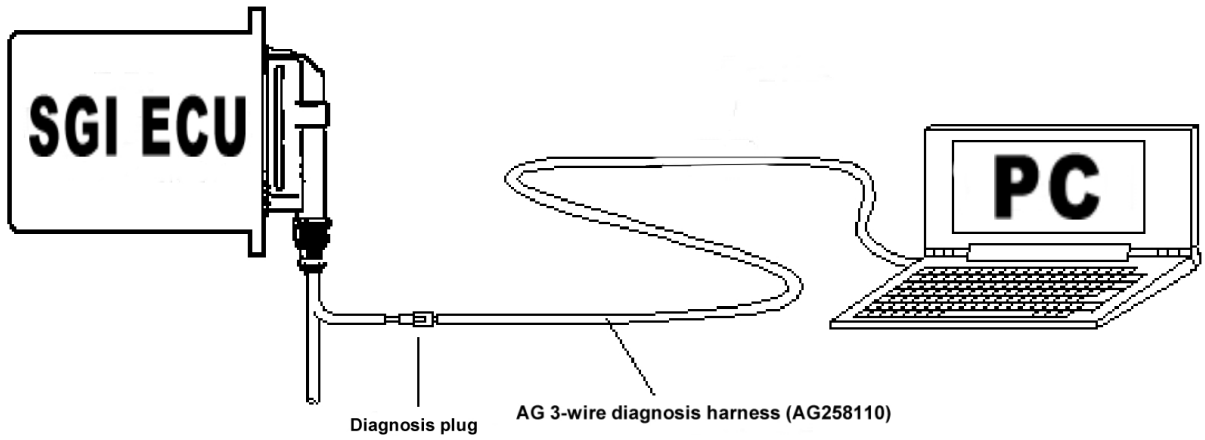
The AG test kit, used for the DGC and DGI systems, can also be used as a diagnostic kit for the SGI system.
In addition to this diagnostic equipment more extensive diagnostic features will be developed. One of these features will be a kind of scope function with approximately 8 channels to give an overview of all the injector pictures simultaneously. Then it will be necessary to use a laptop computer in combination with a breakout box.
For the SGI system direct diagnosis, using the Psion or a laptop computer, and modem communication are carried out in the same way as for the DGC and DGI systems.
Both diagnostic features will be described in the following paragraphs.

Making a diagnosis on the SGI system is limited, because fuel supply is actuated by means of the original engine-management computer. It is therefore very important to make a diagnosis on the car itself, before reading out the LPG installation.
The same diagnostic equipment as that used for the DGC and the DGI systems can be used for the SGI computer when making a diagnosis and when reading out the input and output signals.
As with the DGC and DGI systems a distinction can be made between:

4.1. Direct diagnosis
4.2. Indirect diagnosis

4.1. Direct diagnosis.

To make a direct diagnosis with the Psion from the test kit, a connection needs to be made via the diagnostic cable.
To do so, the diagnostic cable must be connected to the 3-pole diagnostic socket, which is located close to the SGI computer plug in the engine compartment.



When using a PC or a laptop computer instead of the Psion, the “AGT” communication program must first be started from the MS-DOS prompt. This program can be found on the diskette supplied with the test kit. After that, making a diagnosis is exactly the same as when using the Psion..

Communication is only possible when the SGI computer receives input. As it gets input when running on LPG and on petrol (petrol-injector feed), communication is possible in both conditions. Because petrol-injector input is often the same as petrol-pump input, communication may only be possible with a running engine.

First type “AG” after which the main menu shown on the next page will appear on the screen. Four submenus can be selected within the main menu:

```
AG Autogas Systems

1. Identification      3. Diagnosis
2. System Info         4. Calibration
```

4.1.1. Identification

When the digit “1” is typed in the main menu, the screen shown below will be displayed. This screen shows the type of engine for which the SGI software was developed.

```
IDENTIFICATION

PSA 6FZ 1.8i-16V
Version: 6FZ___v1.108(108)
Date: 09-03-01
Injector: 600.050
```

PSA 6FZ 1.8i-16V:
The first line shows the car make, in this case PSA (= Peugeot and Citroën), and the engine code. This implies that this software was developed for all cars fitted with this engine type.
Version:
The second line shows the software version that is programmed in the SGI computer. To be able to assess this information an overview is given below of the types of microprocessor memory in the SGI computer:

Temporary memory	**RAM**	Variable data (measured signals, error codes, etc.)
Reprogrammable memory	**EEPROM**	Engine-type specific software
Fixed memory (cannot be altered)	**EPROM**	SGI main program (identical for each type of car)

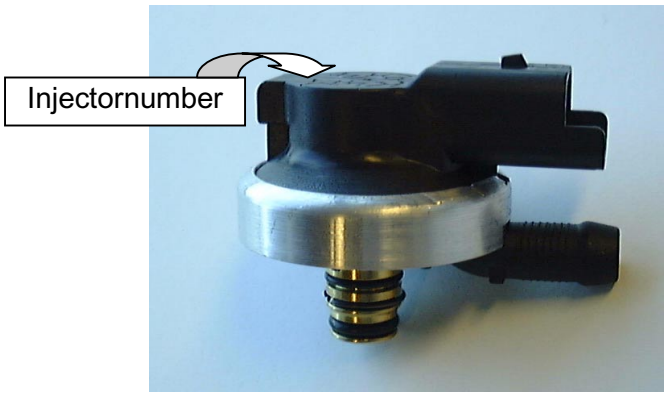
In the second line of the Identification menu, the SGI main-program version is shown in brackets (here: **(108)**). It is NOT possible to alter the main program later on (not even by way of modem).

The first 8 characters indicate the engine type for which the specific software is developed, here: **6FZ___v1**. When an alteration/modification is carried out, which is specific for this engine type, **v1** (version 1) will be altered into **v2** (version 2), etcetera. This alteration can be made by means of the modem or by the dealer by means of modification loaders (AGModify), which will become available at a later stage.

Date:
The third line shows the date on which this software was developed.

Injector:
This shows the SGI-injector type, which may vary between:
- 600.040 smallest type of injector (4mm)
- 600.050 medium-sized injector (5mm)
- 600.061 largest type of injector (6mm)

These various types can be identified by the part number on top of the injector coil.

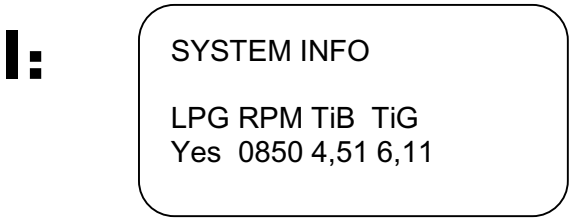


In case this number does not correspond to the part number referred to, the opening period of the petrol injector will not be converted exactly. The engine-management computer will have to correct the mixture to such an extent that this may cause problems, such as hesitation, stalling and the computer becoming deranged (check engine).

By pressing the “delete” (Psion) or “backspace” (PC) function key one returns to the main menu.

4.1.2. System Info

After typing “2” in the main menu the System Info menu as shown below will appear.
The following SGI-computer input and output signals are shown:



LPG:

The SGI computer supplies a 12V feed to the LPG shut-off valves (on the vaporiser and on the tank) to open them.
Before change-over to LPG takes place “No” is shown under “LPG”. When the LPG shut-off valves are actuated to the open position, the SGI injectors will not immediately change over from petrol injection to LPG injection. In this way the dry-gas part is pressurised first.
As soon as the engine actually runs on LPG “Yes” will appear under “LPG”.

TIP:

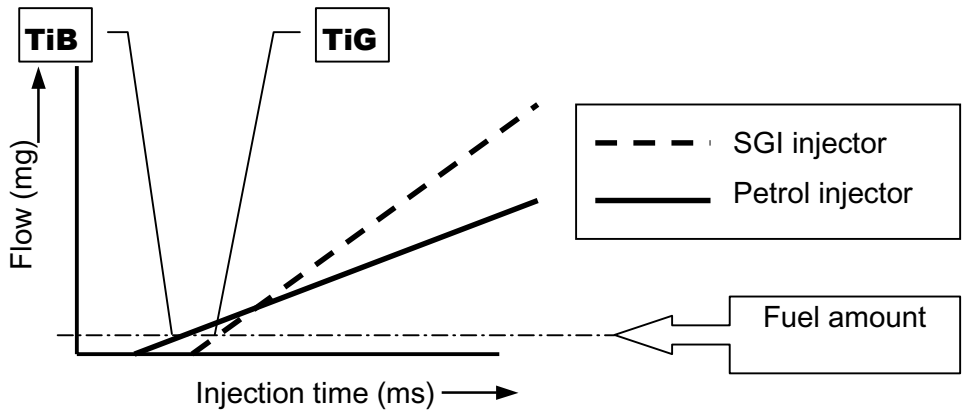
As with the DGC and the DGI systems: NEVER connect 12V voltage from the outside to the feed wire of the shut-off valves!!!

RPM:

As no engine-speed signal is connected to the SGI computer, the engine speed is calculated on the basis of the injection frequency of the petrol injectors. During deceleration no petrol is injected (fuel cut-off) and “----“ is shown. When the engine speed is not displayed correctly, it is possible that the wrong software has been loaded in the SGI computer (see identification menu).

TiB:

This is the opening period in milliseconds of the first petrol injector, which is read in via the Interface Unit. The purpose of the conversion strategy is that this period remains unchanged when driving on LPG and on petrol. It is obvious that this applies to identical specific circumstances (engine speed, constant engine load, etc.).
If this is not the case the conversion from the opening period of the petrol injector to the opening period of the SGI injector is not correct. This may be caused by incorrect software for the specific engine or by the wrong type of SGI injectors.



TiG:

As was described in paragraph 2.2., a conversion takes place from the opening period of the petrol injectors to the opening period of the SGI injectors, whereby the difference in characteristic between both periods is compensated for. The average SGI-injector opening period is shown under “TiG”.

When the space bar is pressed, the second System Info screen is shown.

II:

SYSTEM INFO

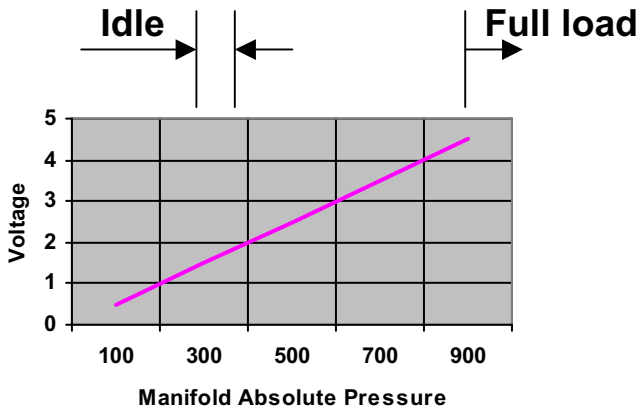
MAP Pvap DelP Vbat MT
374 1168 794 13.85 +81

MAP:

The internal MAP sensor in the Interface Unit measures the pressure in the inlet manifold. This pressure is presented in millibars. The characteristic of this sensor is shown below.

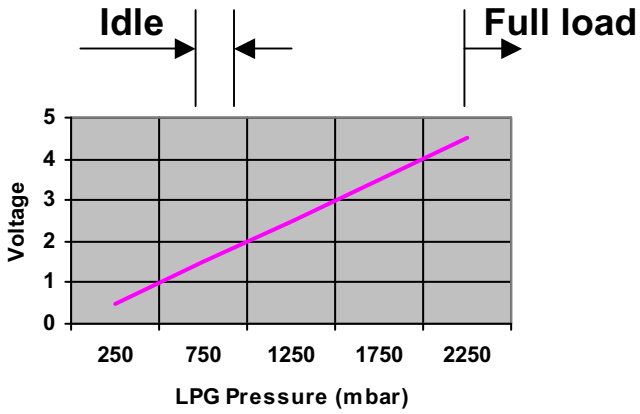
When the engine is idling, the pressure will be approximately 350 mb.; at full load the pressure in atmospheric engines will be approx.1000 mb.; with a supercharged engine this pressure may exceed this atmospheric value.

Because the internal MAP sensor has a measuring range of up to 1000 mb., the pressure in turbo engines is measured by means of an external MAP sensor (either an original sensor or one that is included in the set).



Pvap:

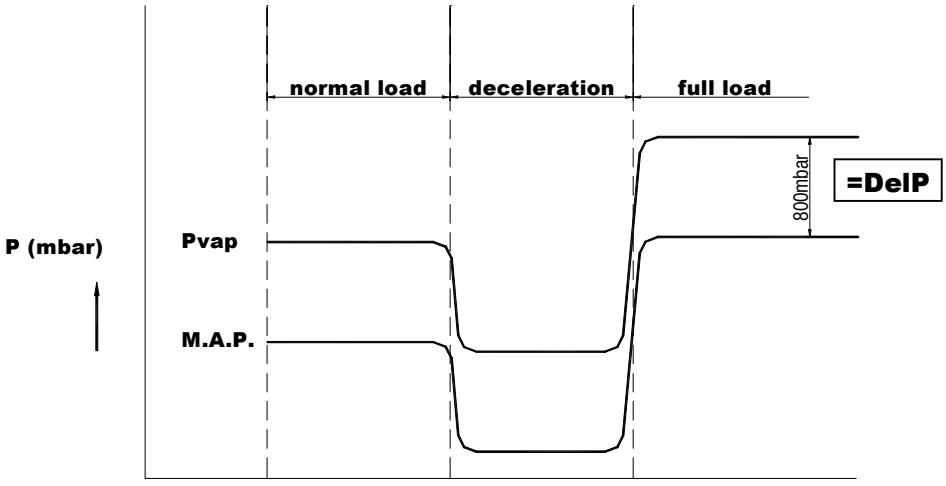
The LPG pressure in the SGI vaporiser is shown, also in millibars, under “Pvap”. As this pressure is relevant to the pressure in the inlet manifold, it varies together with the “MAP” value. The LPG-pressure sensor in the vaporiser measures the LPG pressure. The characteristic is shown below:



DelP:

It is possible to calculate the pressure across the SGI-injector plungers because both the MAP signal and the LPG pressure are measured in the vaporiser. For this calculation the value of “MAP” is subtracted from “Pvap”.
This differential pressure across the SGI injectors (Delta P) is shown here (also in millibar):

ⓘ **Recommended values are: 700 < DelP > 900 mbar.**



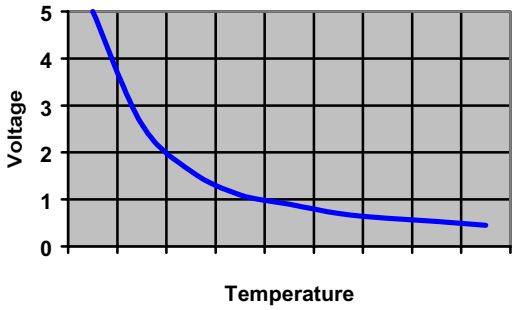
Vbat:

As the supplied voltage level strongly influences the characteristic of the injectors (both petrol and SGI), this is important information for the conversion strategy of the SGI system. The measured voltage on the branched off feed wire of the petrol injector is shown here.

MT:

The engine-coolant temperature is shown here in degrees Celsius. This signal is branched off from the original coolant-temperature sensor of the engine, as a result of which the characteristic may vary.

An example of the characteristic of a coolant-temperature sensor is shown below.
In cases where the signal of the original temperature sensor cannot be used for the SGI computer, a signal as shown above is provided by means of a temperature sensor that is supplied additionally.



However, when the original engine coolant temperature signal is not useable to the SGI computer, the temperature signal will be provided by an additional sensor, which is supplied in the engine kit. The signal will be similar to the signal like shown above.

When the space bar is pressed once again all the petrol injector opening periods are shown one next to the other. The screen only shows opening periods (in milliseconds) of four petrol injectors separately, for example:

III:

SYSTEM INFO

TiB1	TiB2	TiB3	TiB4
4.11	4.15	4.10	4.12

This figure therefore shows the four SGI-computer input signals that are branched off from the interruption groups of the Interface Unit. When these signals are not visible (--,--) it is probably the result of (incorrect) interruption of the wiring of the petrol-injector control wires.

The fourth System Info screen becomes visible when the space bar is pressed again. Now all the SGI-injector opening periods are shown one next to the other:

IV:

SYSTEM INFO

TiG1	TiG2	TiG3	TiG4
7.11	7.17	7.09	7.13

These four values are the SGI-injector opening periods as calculated by the SGI computer. When a connector of one of the SGI injectors is pulled off, this will not show any change in this fourth System Info menu.

4.1.3. Diagnosis

It is ultimately the engine-management computer that determines the strategy by which the SGI injectors are actuated and the self-learning functions of the engine-management computer are also used. This means that the SGI computer does not need to be self-learning. It is therefore only possible to read error codes. These error codes only refer to the signals that are read in when driving on LPG.
To find out whether any error codes have been stored in the SGI-computer memory, a “1” must be typed in the Diagnosis menu below:

DIAGNOSIS

2. Show error codes
3. Reset error codes

The error codes mainly relate to the temperature-sensor signal, which is branched off separately from the original coolant-temperature sensor of the engine.

ⓘ ***In view of the limited diagnostic features of the SGI computer it is essential to always read out the engine-management computer in case of a failure!!***

When a “2” is typed in the above menu, any stored codes will be erased from the SGI-computer memory.

4.1.4. Calibration

It is in principle not necessary to program the SGI system after installation. The software, however, provides for an option to calibrate the conversion from the opening periods of the petrol injector to the opening periods of the SGI injector.
Normally speaking this option is not used, but should it be necessary in the future, the following screen will be displayed after typing a “4” in the main menu:

CALIBRATION

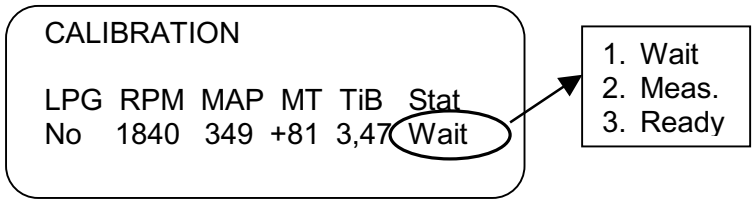
1. Idle adjustment

Typing “1” will first give a summary of the running conditions of the engine needed to carry out calibration.

```
MT>70, RPM: 1500-2000
MAP<400, Constant throttle
System will switch between
petrol and LPG.
Continue? y/n
```

Summarising, the following points have to be taken into account:
- Engine temperature higher than +70ºC;
- Engine speed between 1500 and 2000 min^{-1};
- Pressure in the inlet manifold (Load) lower than 400 mb.;
- Throttle position has to be constant during calibration.

After typing “y” the programming procedure is started and the following screen appears:



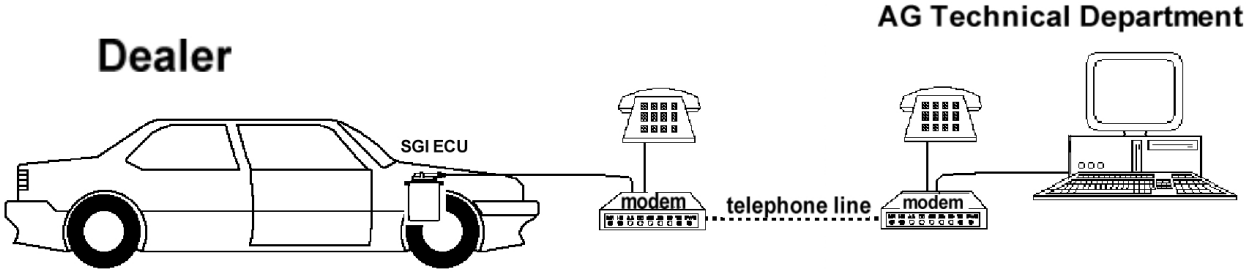
The SGI computer will first wait until a stable condition is reached, which is necessary for calibration. This waiting condition is indicated under status (“Stat”) (“**Wait**”).
When a constant condition is measured, the computer measures the opening period of the petrol injectors when running on petrol (LPG=”No”). After that it will automatically change over to LPG (LPG=”Yes”), and the opening period of the petrol injectors is measured again. During both measurements the status “**Measure**” is shown on the screen.
The conversion of the opening period of the petrol injectors is correct when the period remains the same both on petrol and on LPG (under constant conditions).
If this is not the case, the setting for conversion of the opening period when running on petrol will be adjusted in the SGI-computer software.
Calibration is ready when the status “**Ready**” is shown.

In actual practice, however, this calibration only needs to be carried out when there is a noticeable difference in the opening periods of the petrol injectors between driving on petrol and on LPG. It is very likely in such a situation that incorrect software or the incorrect type of SGI injector is being used, so it is always important to check this first.

4.2. Indirect diagnosis.

Comparable with the DGC and DGI systems it is now also possible to make a connection with the relevant AG Technical Department by means of an (analogue) telephone line.
To do so the DGC or DGI test kit can be used, because it is provided with the necessary telephone, modem and wiring (see picture below).

Modem communication is possible because a connection can be made (by means of the modem in the test kit) between the SGI computer and a computer located at the relevant Technical Department (see picture below).



When all the necessary connections have been made, the switch should be set to LPG and the ignition off. Then the so-called modem line (see appendix) can be contacted, using the telephone in the test kit.
When a contact has been established the complaints and findings concerning the vehicle can be discussed. As soon as everything is clear, the employee of the Technical Department will ask the mechanic to start the engine, following which a connection with the SGI computer is established. Speech contact is not possible then. The employee of the Technical Department will switch back to speech contact (light on telephone lights up again) as soon as he has finished the necessary operations.

For further details we refer to the manuals provided with the test kit.

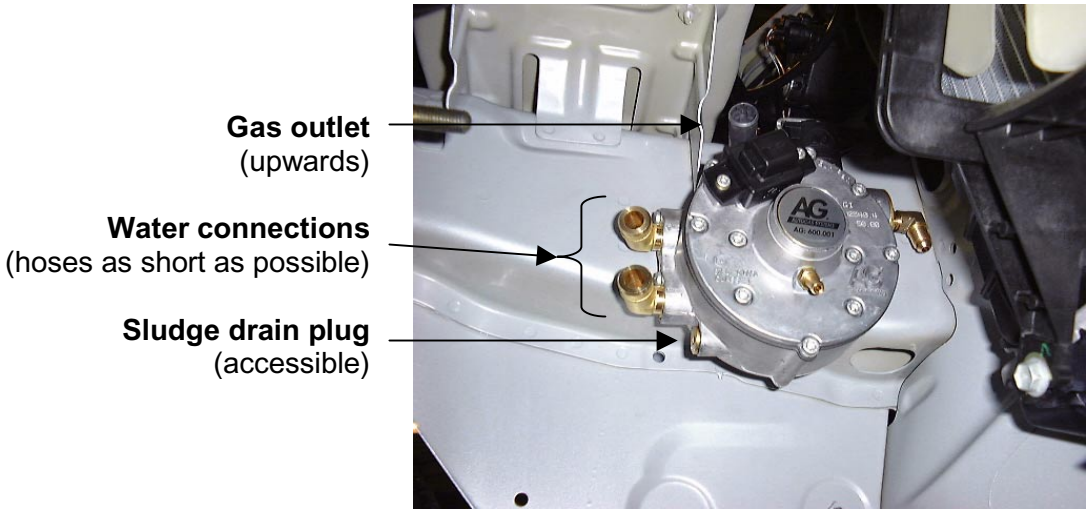
5. Installation of the SGI system.

This chapter deals with a number of general matters that have to be taken into account when installing an SGI engine set.
When installing an SGI engine set in a car, it is essential to closely follow the instructions of the installation manual for that particular car.
It is possible that one or more components cannot be installed at the location indicated in the manual, because an air-conditioning installation or an alarm installation has already been fitted there. In that case an alternative location will have to be found. To make sure that the performance of the SGI system is not influenced by this alternative location, the specific criteria for each component will be dealt with separately.

5.1. SGI vaporiser.

The SGI vaporiser can be fitted either parallel or transversal to the travel direction. Every engine set is supplied with a standard vaporiser bracket and when this bracket is used the vaporiser can be fitted properly in most cases.
It is advisable to fit the vaporiser with the gas outlet facing upwards and the drain plug for sludge facing downwards. Make sure this plug is easily accessible.

The SGI-vaporiser coolant hoses should be as short as possible to prevent too much cooling of the coolant water (and freezing of the vaporiser).
To avoid rattling as a result of resonance vibrations, it is advisable not to fit the vaporiser against the cowl panel.

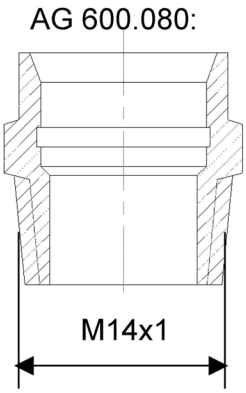


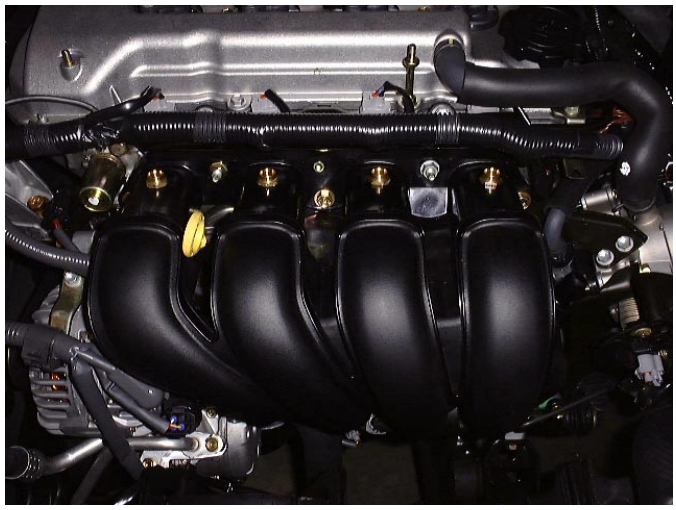
5.2. SGI Injectors / Fuel Rail

Like the zero-pressure regulators of the DGI system, the SGI injectors are also fitted into the inlet manifold of the engine. In accordance with the installation instructions the nipples, into which the injectors are fitted, are usually fitted equally spaced and as close to the inlet valve as possible.

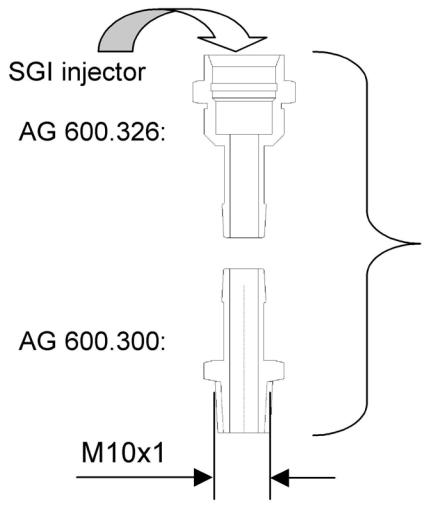
Two types of nipples are possible:

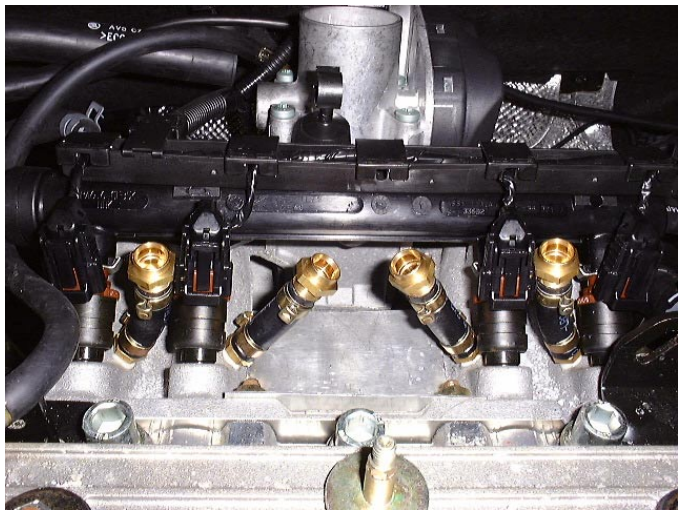
- AG 600.080, to fit the SGI injectors directly into the inlet manifold (see photographs below). To do so Ø13mm holes have to be drilled into which M14 x 1 screw thread is cut.
  Plastic requires careful drilling (ascending from Ø5 mm) and it is advisable to use a special drill with a sharp nose angle (to prevent irregular holes in the manifold).





- AG 600.300 in combination with AG 600.326, to fit the SGI injectors indirectly into the inlet manifold by means of an 8 mm hose (see photographs below). These nipples are used when the injectors cannot be fitted sufficiently close to the inlet with the standard nipples.





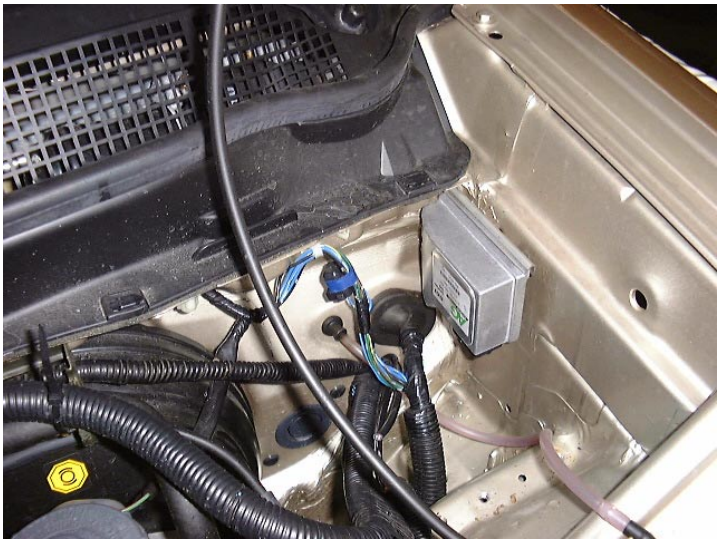
The length of the LPG hose between the SGI vaporiser and the Fuel Rail is not really important for the performance of the system (it is a good starting point to keep it as short as possible).
To eliminate differences in flow, however, the LPG hoses between the Fuel Rail and the SGI injectors have to be of equal length, as indicated in the installation manual.
The same applies to the hose lengths between the special nipples AG600.300 and AG600.326.

5.3. SGI computer / Interface Unit.

The criteria for the installation of a DGC and DGI computer also apply to the SGI computer:

- Do not position the computer in the part of the engine compartment where temperatures can become high;
- Do not position it where the engine compartment gets damp;
- Make sure that the wires do not touch hot or sharp components.

In most cases a specially developed bracket is supplied to fit the SGI computer. If (for reasons mentioned above) such a bracket is not supplied, it is advisable to use the universal computer bracket AG 202001.



The criteria mentioned above also apply to installation of the Interface Unit. In this case it is also important to:

- Fit the Interface Unit with the plug connection facing downwards.

The wire length makes it possible to fit both components anywhere in the engine compartment; in most cases, however the wires will be too long. If this is the case, it is advisable not to shorten the wires, as this may cause errors. It is best to lead the wires alongside the original wires in the engine department.

5.4. Checkpoints after installation.

There are a number of matters that always need to be checked after installation.
It is obvious that the rules and regulations for checkpoints after installation (such as checking for LPG leakage) are of primary importance. These points will not be discussed in the present dealer information manual.
A number of (electrical and mechanical) points, however, are of specific importance after installation of the SGI system.

5.4.1. Mechanical checkpoints after installation.

The following mechanical points have to be checked after installation of the SGI system:

✓1 Coolant leakage (on vaporiser and connections to coolant system);

✓2 Vacuum leakage on connections of vaporiser and Interface Unit;

✓3 Vacuum leakage of injector nipples in inlet manifold;

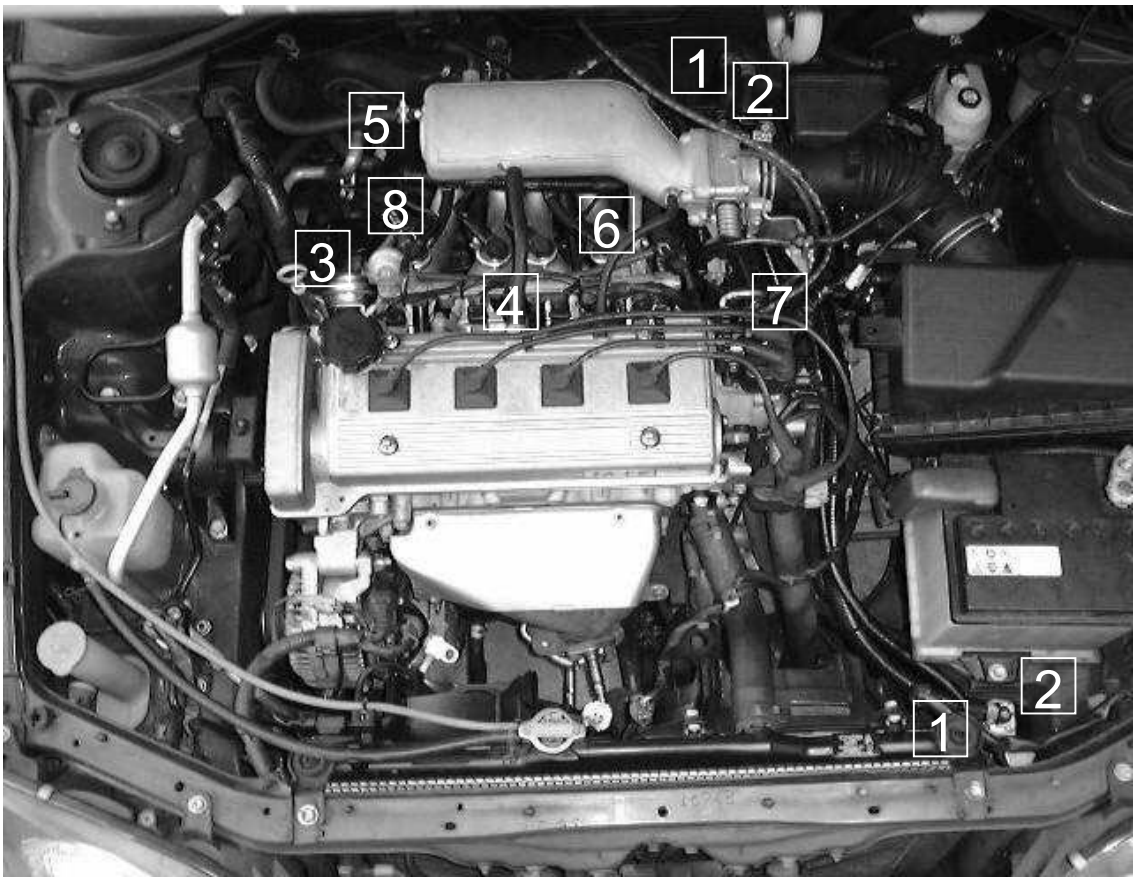
✓4 Vacuum or coolant leakage between inlet manifold and cylinder head;

✓5 No vibration of Fuel-rail attachment;

✓6 Equal (correct) length of all 8 mm hoses between the Fuel Rail and the SGI injectors;

✓7 Use of correct types and sizes of hose clamps (in accordance with 67R-01);

✓8 Attachment of the SGI injectors in the nipples (clicked in properly).



5.4.2. Electrical checkpoints after installation.

The following electrical points have to be checked after installation of the SGI system:

✓1 Does order of interruption groups correspond with SGI injectors?

✓2 Have electrical connections been insulated properly (no tension load possible)?

✓3 Has correct temperature wire been connected (see System Info menu)?

✓4 Does wiring not touch hot (e.g. EGR) or sharp components?

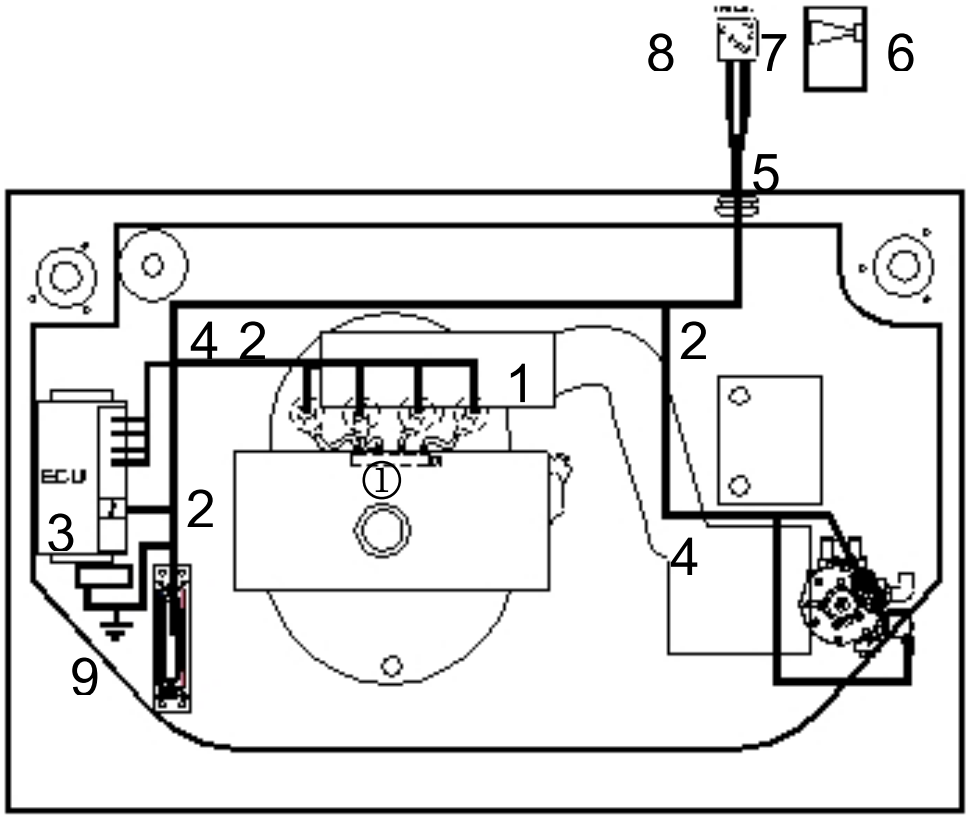
✓5 Is passage through cowl panel properly protected?

✓6 Has buzzer been fitted with tension relief?

✓7 Does diagnostic LED operate when engine is running on petrol (before change-over)?

✓8 Do indication LEDs for tank level on switch operate?

✓9 Have all the earth connections been connected properly and tightly?



Obviously it is also important to assess the incoming and outgoing signals of the SGI computer by means of communication with the diagnostic equipment (see System Info menu).

TIP:

*It is **always** important to take a test drive after installation, in order to check the mixture for LPG and for petrol by means of a lambda tester. It is advisable to connect a branched off wire from the lambda-probe signal wire, using an extra wire with a plug during installation, as it is not easily accessible after installation.*