Dealer Information
SGI ECU, type 2

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Introduction.

Like already pronounced in the first version of the Dealer Information SGI, Teleflex*GFI* Europe (formerly: AG Autogas Systems) has introduced the second generation SGI ECU at the start of 2003. The second type of SGI ECU has more capabilities in terms of speed, capacity and diagnostics, compared to the first type of SGI ECU. The second type of SGI ECU is produced in almost the same housing as the SGI Interface Unit (as shown below), because of which the installation of the unit itself has been facilitated.

The SGI ECU, type 2

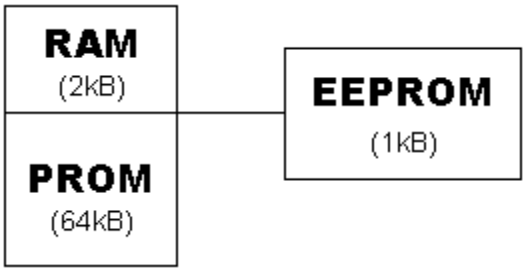
Because the introduction of such an ECU brings several changes about in the SGI system, Teleflex*GFI* Europe made this supplement to the Dealer Information SGI. In this supplement the changes of the unit itself as well as its connections and diagnostic possibilities are described.
The below mentioned matters have successively been described in the following paragraphs:

- Function SGI ECU
- Connections SGI ECU (inputs and outputs)
- Wiring schematics SGI ECU and Interface Unit
- Connections SGI switch
- Direct communication with the SGI ECU
- Indirect (modem-) communication with the SGI ECU

1. Function SGI ECU.

Just like the previous version of the SGI ECU, the way of controlling of the SGI injectors has been fully based on the translation of the opening times of the petrol injectors, which are controlled by the Motor management computer (ECM). Thus it is still the ECM, which controls the opening time of the SGI injectors, converted by the SGI ECU.

The composition of the memory of the SGI ECU, type 2 has been shown below:

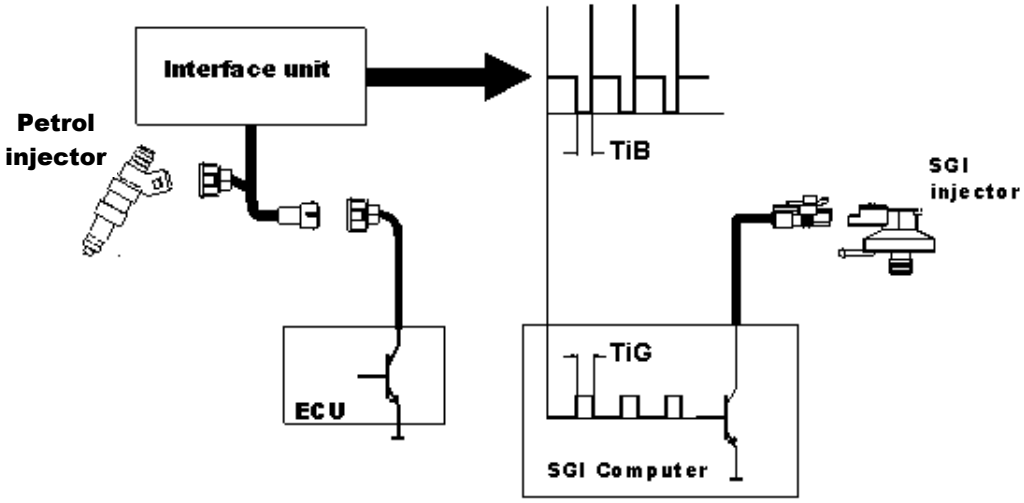


RAM: The RAM memory of the microprocessor is a kind of "read and write" memory, which read the incoming signals all the time. The measured values are used to execute calculations to be able to determine the correct opening time of the SGI injectors. In this way, possible errors will be detected and written into the memory of the microprocessor.
The RAM memory is maintained by the constant power supply of the SGI ECU.

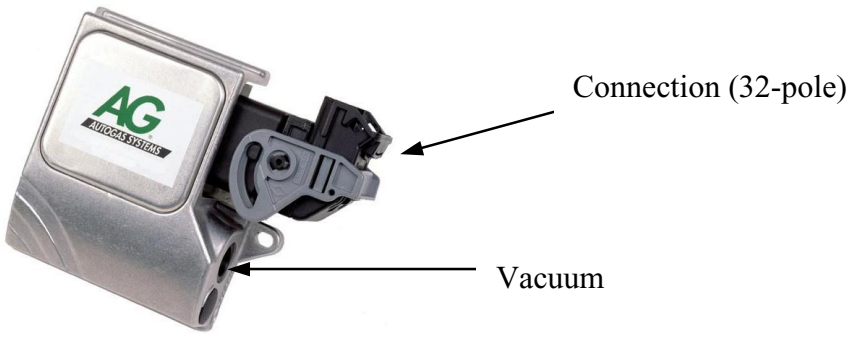
EEPROM: In contradiction to the first type, the second type of SGI ECU makes use of a separate EEPROM memory, in which engine specific calibrations are being stored. Also the unique software and hardware identification is stored in the EEPROM memory for the benefit of possible warranty issues.
In case the RAM memory detects any errors, these will be saved in the EEPROM memory after the ignition is switched off.

PROM: Just like the RAM memory, the PROM memory has been integrated inside the microprocessor. The basic SGI program is stored in this part of the memory, which is basically the same for each type of application. This program executes all calculations and functions of the SGI translation system.

For a more detailed description of the translation strategy, please consult chapter 2.2. of the general “Dealer Information SGI”. The translation principle has been depicted below:



The disconnection of the petrol injectors is taken care of by the same Interface Unit as with the first system set-up. This is mainly a disconnection unit, in which transistors are placed with integrated simulation resistors.



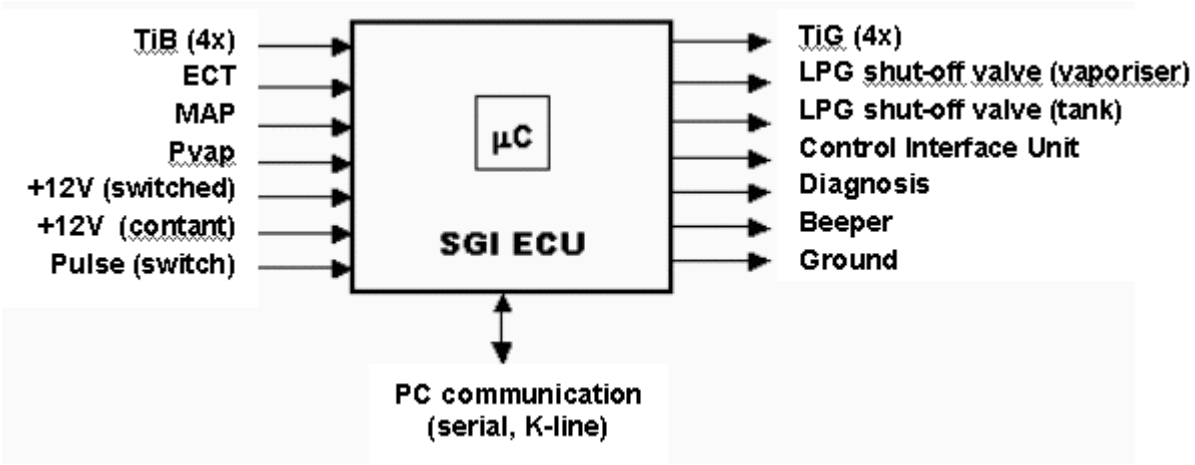
The Interface Unit

The Interface Unit has been undergoing some internal changes before the introduction of the second type of SGI ECU. Because of these changes, the partnumbers of the Interface Units have changed, as listed below. The first and second type of Interface Unit are interchangeable.

First type:	Second type:	Characteristics:
AG 600.130	AG 600.131	4 disconnections, simulation 120 Ω, including zener diodes
AG 600.135	AG 600.136	4 disconnections, simulation 120 Ω, without zener diodes
AG 600.140	AG 600.141	8 disconnections, simulation 240 Ω, without zener diodes

2. Connections SGI ECU, type 2.

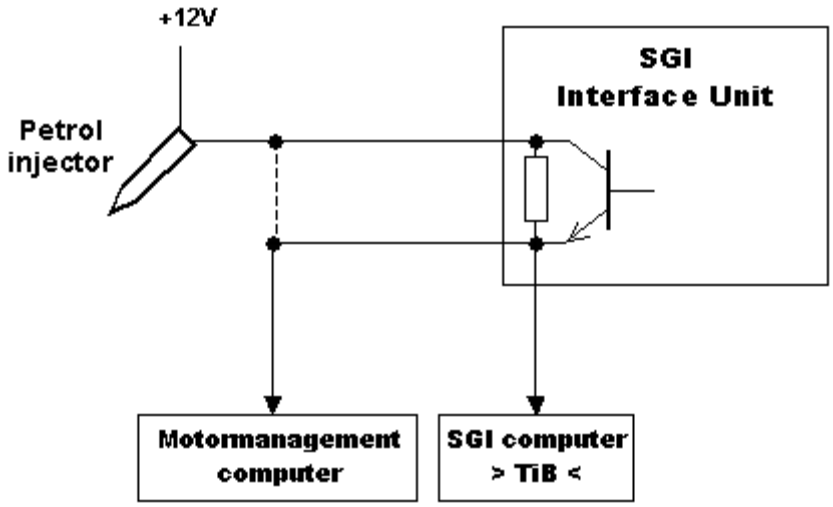
The in and outgoing signals of the SGI ECU, type 2 are shown below schematically:



The in and outgoing signals of the SGI ECU have been explained in the next paragraphs.

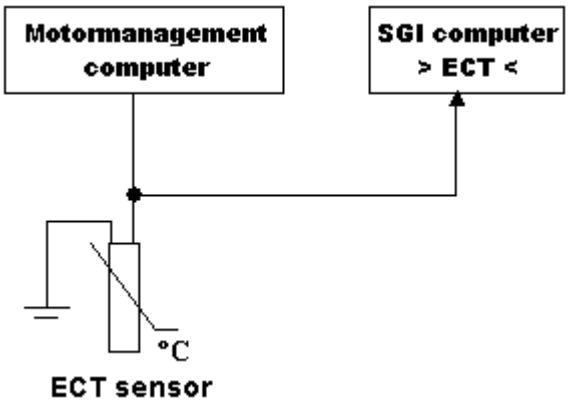
2.1. The inputs of the SGI ECU:

2.1.1. Opening time petrol injectors (TiB):



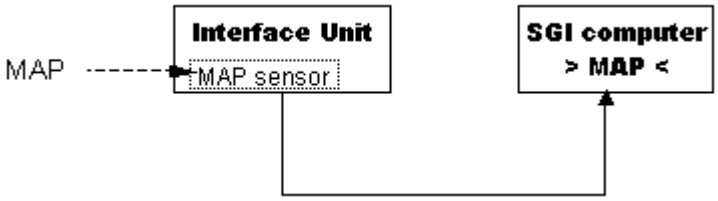
Equally to the first type of SGI ECU, the SGI ECU, type 2 has 4 digital inputs to measure the opening time of the petrol injectors.
These signals are coming from the Interface Unit and are still used to be able to calculate the opening times of the petrol injectors.
Compared to the first version of the SGI ECU, no change has been made regarding these inputs.

2.1.2. Engine Coolant Temperature (ECT):



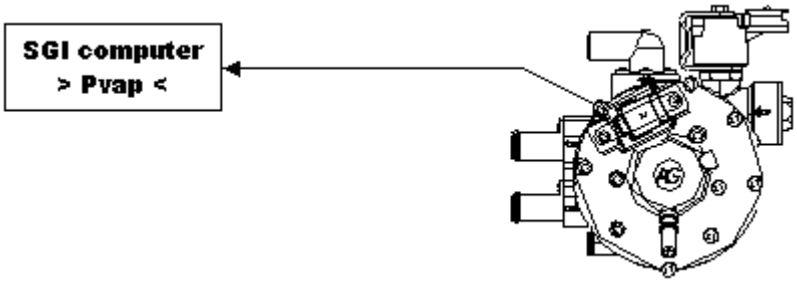
The analogue input that monitors the Engine Coolant temperature has not changed as well compared to the previous situation. As yet, the signal of the already present ECT sensor of the motor management system is branched off and measured by an analogue input of the microprocessor.
In case the original ECT sensor of the engine cannot be read, an external ECT sensor will be fitted inside one of the coolant connections of the SGI vaporizer.

2.1.3. Pressure in the intake manifold (MAP):



As described earlier, the internal map sensor of the Interface Unit measures the pressure in the intake manifold. The signal is measured through the wiring in between the Interface Unit and the SGI ECU.
The map sensor signal of a turbo charged engine needs to be measured on a different (high-pressure) map sensor.

2.1.4. LPG vapour pressure (Pvap):

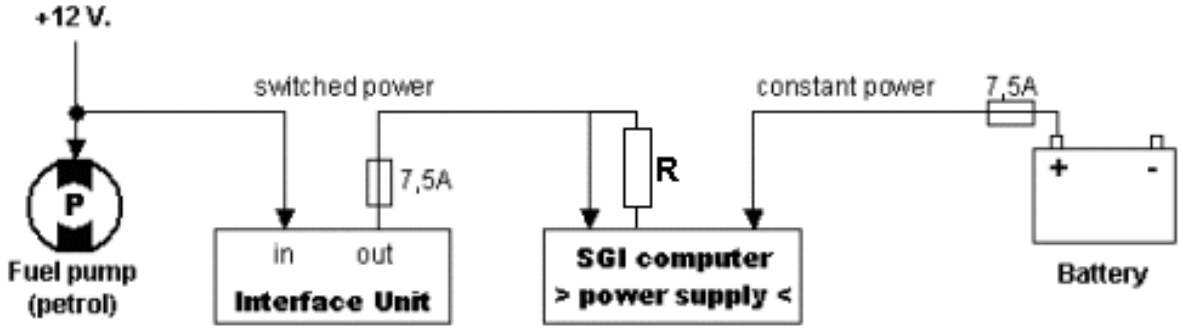


To be able to determine the differential pressure over the SGI injectors, next to MAP, the pressure of the vapour LPG is measured inside the vaporiser. This has remained the same because of using the LPG pressure sensor, which is fitted in the outlet of the SGI vaporiser. The SGI ECU supplies +5V and ground to the sensor. Its signal is read by an analogue input of the SGI ECU.

2.1.5. Power supplies:

In contrast to the first type of SGI ECU, it is necessary to connect two power supplies, instead of one:

- +12 Volt, switched
- +12 Volt, constant

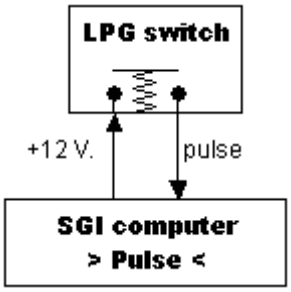


The switched power supply is in fact the main power supply of the SGI ECU. This power supply must be connected, either to the power supply of the petrol pump or the petrol injectors for safety reasons. These are normally switched off automatically when the engine stalls.

To prevent that the SGI program does not shut-off properly, the switched power supply is kept internally for a maximum of 17 seconds. Regularly, the incoming +12 Volt power supply is connected to ground via an external resistor. Because of this, the SGI program will always be shut-off properly after the ignition has been switched off. During 17 seconds, it is possible that the diagnosis led is on (after the ignition is turned off).

The constant power supply is necessary because of certain additional functions, which have been implemented in the program of the second type of SGI ECU. An example is that all detected errors will be written into the EEPROM memory after the ignition has been turned off.

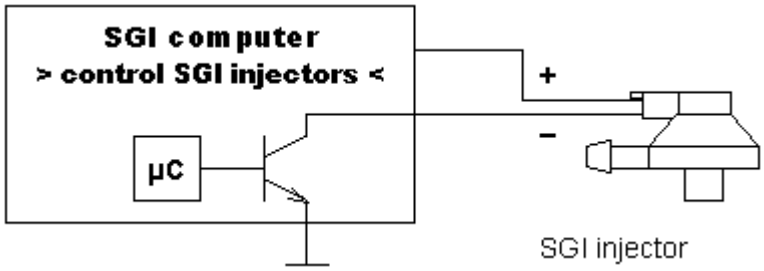
2.1.6. Pulse (from the LPG switch):



Just like the first type of SGI ECU, the second type switches over from petrol to LPG (and oppositely) when a digital input of the microprocessor is connected to +12 Volt momentarily. The +12 Volt pulse is switched by pressing the button on the LPG switch.

2.2. *The outputs of the SGI ECU:*

2.2.1. The SGI injector drivers:



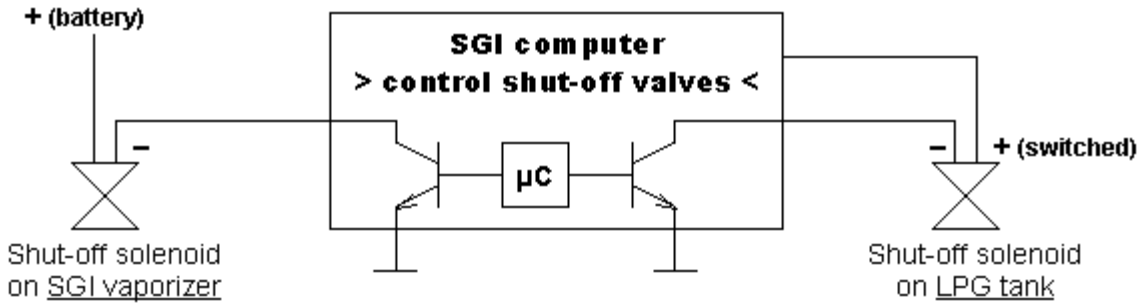
The SGI injectors are controlled open in the same manner as with the second type of SGI ECU. The injectors are connected to a +12 Volt power supply (switched). The other side of each injector is connected to a low side driver inside the SGI ECU. The time of switching the SGI injectors to ground (= opening time) determines the amount of fuel injected into the intake manifold. This opening time is calculated by translating the opening time of the petrol injectors, as described in chapter 1.

2.2.2. The drivers of the LPG shut-off valves:

The first type of SGI ECU controls the opening of the LPG shut-off valves simultaneously by an internal high-side driver. Both solenoids (on the SGI vaporizer and on the tank) are both opened by a +12 Volt power supply; the other side is connected to ground continuously.

The second type of SGI ECU has two separate drivers to control the shut-off solenoids:

- For the shut-off valve on the vaporizer
- For the shut-off valve on the tank

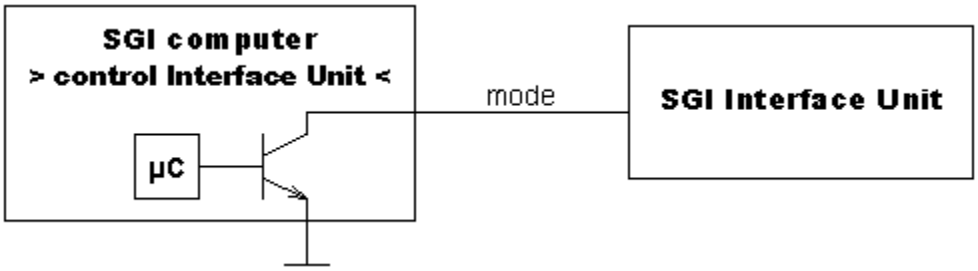


The shut-off valves are opened in the same way as the SGI injectors: one side is connected to +12 Volt, whilst the other side is controlled to **ground** (by two low-side drivers inside the SGI ECU).

The shut-off solenoid on the tank is connected to the switched power supply of the SGI ECU; the other side is connected to ground when the SGI ECU is in LPG mode (also before running on LPG). After switching off the engine or switching over to petrol operation, the shut-off valve will close directly.

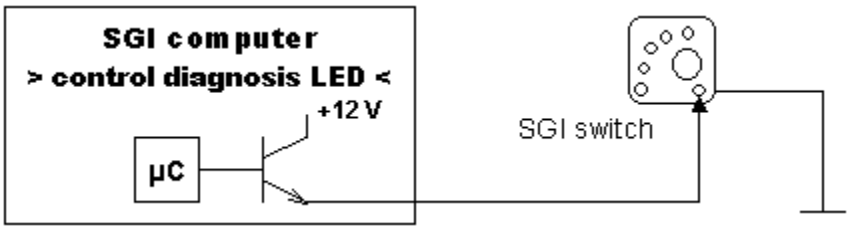
The shut-off valve on the SGI vaporiser is connected to a constant power supply; the other side is connected to ground when the engine is running on LPG. After switching off the ignition, the shut-off valve on the vaporiser does not close directly with the shut-off valve on the tank. After switching off the ignition the shut-off valve on the vaporiser stays open for approximately two seconds. The reason for this is, that the differential pressure over the SGI injectors remains 800 millibar, because of which the injectors close off more effectively. The result will be a better starting behaviour of the engine.
This is the reason why the shut-off solenoid needs to have a constant power supply instead of a switched one. To be able to control this solenoid to ground, the SGI ECU needs a constant power supply as well, which is different to the first type of SGI ECU.

2.2.3. Control of the Interface Unit (mode):



The moment of disconnecting the petrol injectors is determined by the SGI ECU according to the measured ECT signal. Since the Interface Unit takes care of the injector breaks, the SGI ECU controls the Interface Unit to connect or to disconnect the petrol injector wires. This is done by the so-called “mode” output of the SGI ECU. This is a low-side driver, which connects the input of the Interface Unit to ground to disconnect the petrol injectors.
During running on petrol this mode signal will be +12 Volt, because of which the petrol injectors are connected. The Interface Unit will disconnect the petrol injectors when the voltage on the mode input is lower than 1,2 Volt, which is the case when running on LPG.

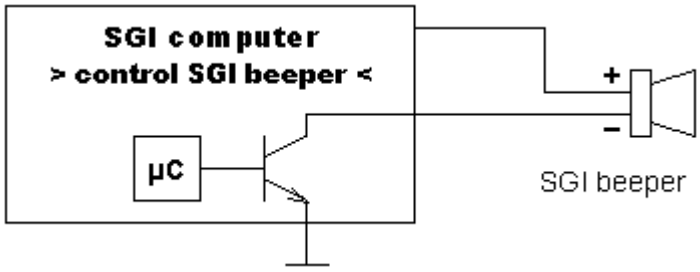
2.2.4. Control of the Diagnosis LED:



The SGI ECU controls the diagnosis LED on the switch on. The LED will be on when a +12 Volt power is switched on (via a high-side driver inside the SGI ECU).
When the LPG tank becomes empty during driving, the SGI ECU will take care that the system switches back to petrol. I this situation, the diagnosis LED will be flashing, which is the same for the first and for the second type of SGI ECU.
Compared to the first type of SGI ECU, the second type has much more diagnostic capabilities. In case an error is detected by the ECU while running on LPG, the diagnosis LED will be controlled on continuously by the output of the SGI ECU (in combination with the indication LEDS on).

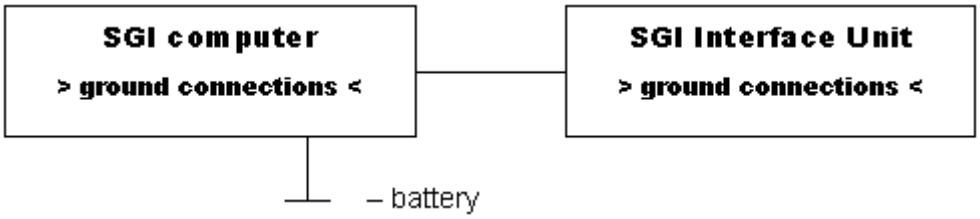
In case the error is detected continuously, the diagnosis LED will be kept on after switching the ignition off and on; if the error is temporarily, the diagnosis LED will be off again.

2.2.5. Control of the beeper:



The beeper (behind the dashboard) is controlled by a low-side driver inside the SGI ECU when the system has switched back to petrol because of an empty LPG tank. Also the diagnosis LED will be flashing in this situation. Both the beeper and the diagnosis LED will be off when the switch is pressed once. This procedure is described in paragraph 2.2.4. more in detail.

2.2.6. Ground connections:



The ground connection of the SGI ECU is considered as being an output, because the direction of the current is to the outside. The wiring harness of the first type of SGI ECU had two separate ground wires, one for the ECU and one for the Interface Unit. The wiring harness of the second type of SGI ECU only has one central ground wire for the whole SGI system.
This wire is normally connected directly to the battery ground.

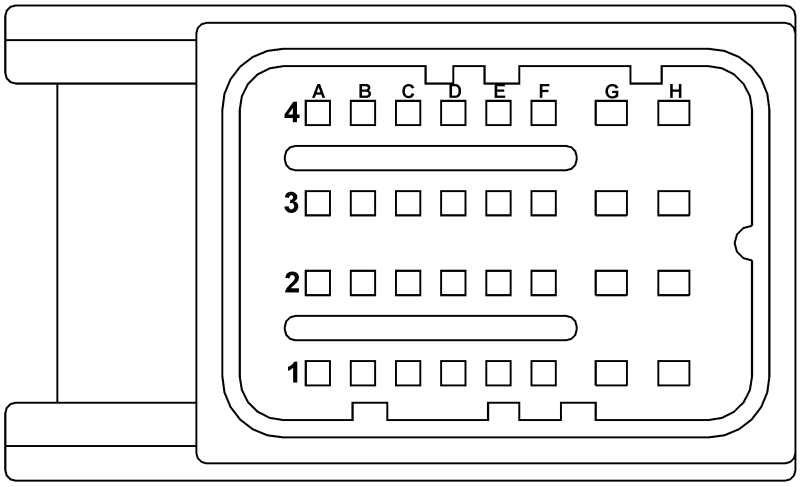
3. Wiring diagrams SGI

3.1. Wiring diagram SGI ECU.

Just like the Interface Unit, the second type SGI ECU has a 32-pole “Molex”-connector. These are however not interchangeable because of the different mechanical blocking inside. Also the colour of both connectors is different:

- SGI ECU : Brown
- Interface Unit : Black

The bottom view of the connector with all the pole numbers is shown below:



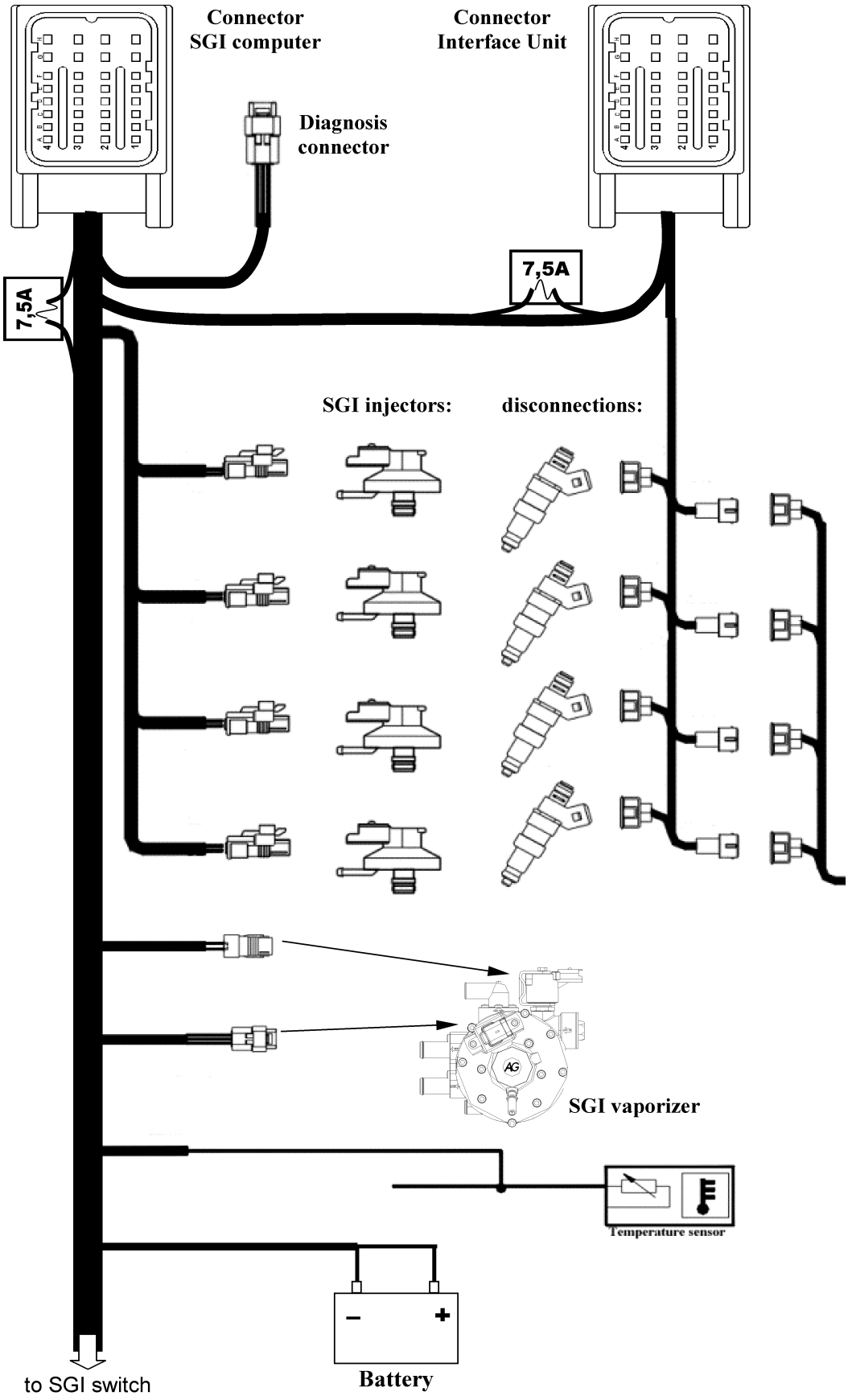
Connector view SGI ECU, type 2

The numbers are numbered in the same way as for the Interface Unit: 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: **4A**.

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

To be able to check the SGI ECU connections properly a special Breakout box has been developed, which can be connected in between the ECU and the 32-pole Molex connector. This box has also become available for dealers.

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



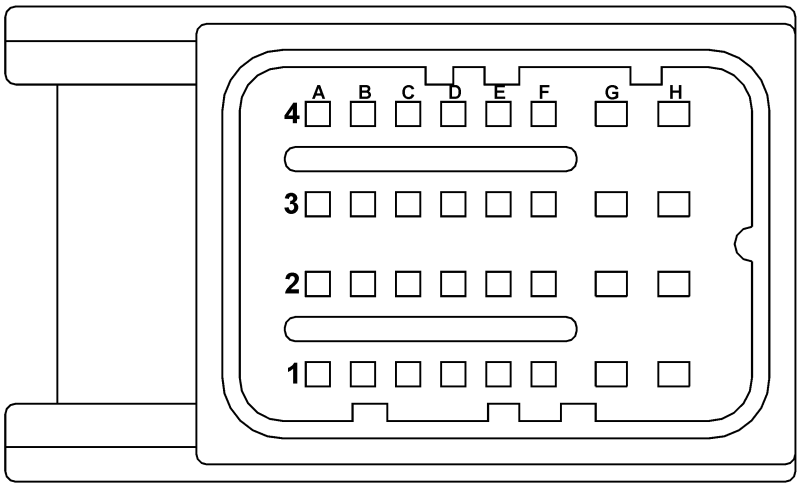
As an addition to the wiring diagram of the SGI ECU, an overview of all connections is shown below:

Pin nr:	Wire colour:	Function:
1A	*	CAN-L
1B	Red	Input petrol injector signal 3
1C	Brown	Pulse signal (from LPG switch)
1D	Orange	Control diagnosis LED (LPG switch)
1E	Purple	Control beeper (near switch)
1F	*	Spare digital input
1G	Black	Ground (battery)
1H	Black	Ground (Interface Unit)
2A	*	CAN-H
2B	Pink	Input petrol injector signal 4
2C	Red	Switched power +12 Volt (via Interface Unit)
2D	Black/white	Input Engine Coolant Temperature (ECT) sensor
2E	*	Input Ambient Temperature sensor Interface Unit
2F	*	Spare digital output
2G	Black	Control LPG shut0off solenoid on SGI vaporizer
2H	Red	Control SGI injector 3
3A	Yellow/purple	Power supply +5 Volt
3B	Grey	Sensor ground
3C	*	Spare analogue input
3D	Green	Input MAP sensor signal (Interface Unit)
3E	*	Spare analogue input
3F	Brown	Control Interface Unit (mode)
3G	Black	Control SGI injector 1
3H	Purple	Control SGI injector 4
4A	Yellow	Input petrol injector signal 1
4B	Blue	Communication connection (K-line diagnosis plug)
4C	Purple	Input LPG pressure sensor signal (vaporiser)
4D	White	Input petrol injector signal 2
4E	Black	Control LPG shut-off solenoid on tank
4F	> Resistor <	Pull-down delay (connected to pin 2C)
4G	Brown	Control SGI injector 2
4H	Black (> red)	Constant power +12 Volt (battery)

*: Optional connection (no wire available in standard harness)

3.2. Wiring diagram 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:



Connector view Interface Unit

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.
Aside from a few exceptions, the connections of the Interface Unit have not changed compared to the first type of SGI ECU.

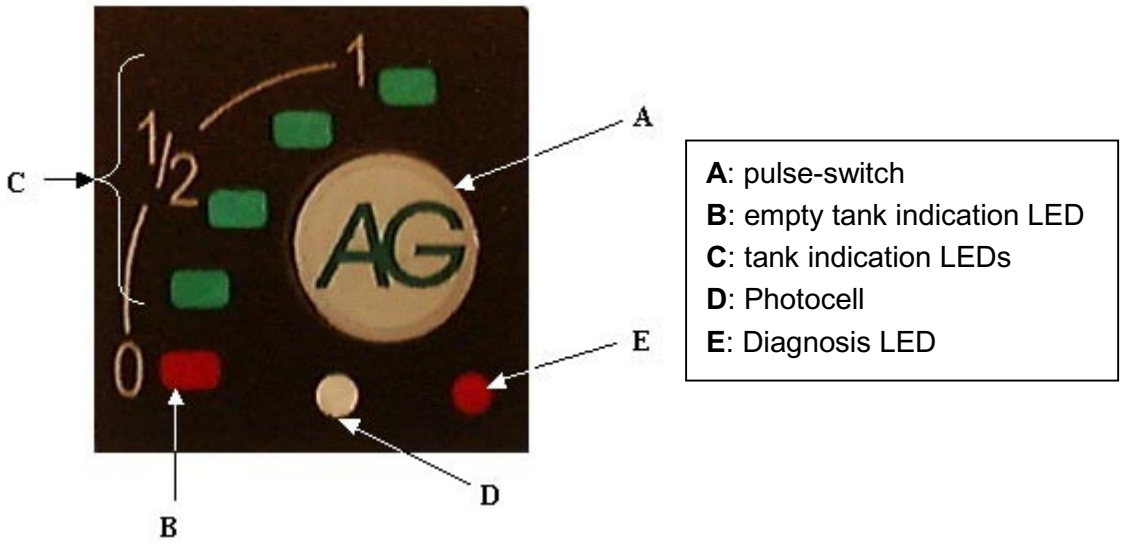
Pin nr.	Colour:	Function:	Connection:
1A	Red *	Disconnection injector 5, input	Injector side
1B	Black *	Disconnection injector 5, output	ECM side
1C	Red	Disconnection injector 4, input	Injector side
1D	Red	Disconnection injector 3, input	Injector side
1E	Red	Disconnection injector 2, input	Injector side
1F	Red	Disconnection injector 1, input	Injector side
1G	Yellow/purple	Power supply + 5 Volt	Pin nr. 3A (SGI ECU)
1H	Black (> red)	Power supply + 12 Volt (to SGI ECU)	Pin nr. 2C (SGI ECU)
2A	Red *	Disconnection injector 6, input	Injector side
2B	Black *	Disconnection injector 6, output	ECM side
2C	Black	Disconnection injector 4, output	ECM side
2D	Black	Disconnection injector 3, output	ECM side
2E	Black	Disconnection injector 2, output	ECM side
2F	Black	Disconnection injector 1, output	ECM side
2G	-	-	-
2H	-	-	-
3A	Red *	Disconnection injector 7, input	Injector side
3B	Black *	Disconnection injector 7, output	ECM side
3C	Pink	Output petrol injector signal 4	Pin nr. 2B (SGI ECU)
3D	Red	Output petrol injector signal 3	Pin nr. 1B (SGI ECU)
3E	White	Output petrol injector signal 2	Pin nr. 4D (SGI ECU)
3F	Yellow	Output petrol injector signal 1	Pin nr. 4A (SGI ECU)
3G	-	-	-
3H	Red / White	+12 V input	Power petrol injectors
4A	Red *	Disconnection injector 8, input	Injector side
4B	Black *	Disconnection injector 8, output	ECM side
4C	Brown	Mode / Switch wire (low-side)	Pin nr. 3F (SGI ECU)
4D	*		
4E	Grey	Ground (sensors)	Pin nr. 3B (SGI ECU)
4F	Green	MAP signal	Pin nr. 3D (SGI ECU)
4G	Black	Ground	Pin nr. 1H (SGI ECU)
4H	-	-	-

* : Optional connection (not present in standard wiring harness)

4. The SGI switch.

4.1. General Information.

Physically, the switch has not changed in combination with the SGI ECU, type 2. However, since the connections to the switch have changed, the differences made are being explained in the coming paragraph.
The photograph below shows that the functions of the SGI switch on the dashboard have not changed.



4.2. Working principle SGI switch:

For the sake of completeness, the working principle of the SGI switch is explained, together with its different functions.

- **Switch:**

A is the switch itself, with which it is possible to switch over from LPG to petrol and back. Since this is a pulse-switch, a short touch is sufficient to switch between LPG and petrol.

- **Switch-over procedure:**

After the ignition is turned on, the ECU will use the fuel which has been used the latest. In petrol mode all LEDs are off, as usual in combination with the first type of SGI ECU.
In LPG mode, the tankindication LEDs (**B** en **C**) will be on directly after starting the engine. At the same time, the shut-off valve on the tank is opened directly.
In LPG mode, the engine will first run on petrol before switching over to LPG. The diagnosis LED (**E**) flashes during this situation until the engine is actually running on LPG.

When the switchover temperature has been reached, the shut-off valve on the SGI vaporizer is first opened, whilst the engine is still running on petrol ("flushing period"). It is not possible to recognise the flushing period on the indications of the SGI switch.

⇒ With some engine types the SGI ECU will only switch over above a certain opening time of the petrol injectors. Therefore, it is possible that in certain cases the system will not switch over to LPG when idling.

- **Tank indication LEDs:**

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.

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.

- **Automatic switch-over to petrol:**

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).

- **Diagnosis LED:**

E is the diagnosis LED. This red LED will be controlled on by the SGI ECU in the following situations:

1. The engine is running on petrol whilst LPG is the selected fuel (diagnosis LED flashes, in case of an empty LPG tank with the beeper on)
2. An error is detected (diagnosis LED is on continuously)

The above-mentioned situations are listed in order of priority. This means, that when an error is detected, together with the recognition of an empty LPG tank, the diagnosis LED will only be flashing.

In case an error is detected while running on LPG, the diagnosis LED will be on continuously (in combination with tankindication LEDs on) as a sign for the driver to contact the dealer to solve the problem immediately.
In this case, there are two different kinds of errors which can be detected; present errors and incidental errors:

- Present errors:

  This type of error is detected by the SGI ECU, and takes place at the moment of running; the diagnosis LED will be on continuously. The error code will be memorised by the SGI ECU.

- Incidental errors:

  When the ignition is turned off, possible error codes are stored in the EEPROM memory of the microprocessor. If the error is not detected anymore after switching the ignition on, the present error will be recognised as an incidental error.

The diagnosis LED will be off; the error code can still be read from the memory of the microprocessor, using the diagnostic equipment.

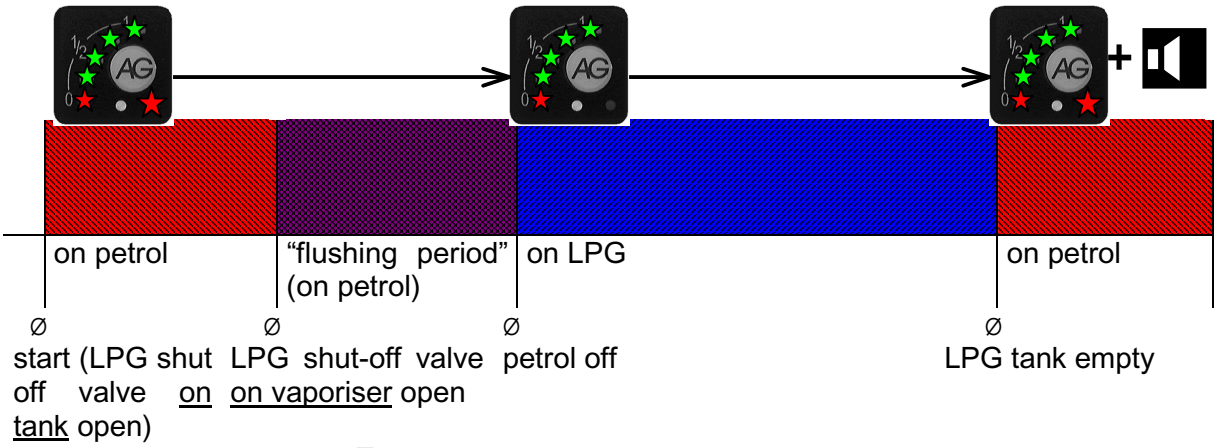
4.3. Switchover strategy:

After starting, the engine will run on petrol first. In this situation, the shut-off solenoid on the LPG tank will be activated directly after starting. Shortly after, the LPG shut-off valve on the SGI vaporiser will be opened, after which the SGI injectors take over injecting fuel from the petrol injectors. The time until switching over to LPG is determined according to the Engine Coolant Temperature (ECT); at a lower temperature, it takes more time before the SGI ECU switches over to LPG.

As described before, the opening time of the petrol injectors is measured to calculate the opening time of the SGI injectors. When the LPG tank becomes empty, the LPG vapour pressure to the injectors will decrease, which is compensated for by increasing the opening time of the SGI injectors. Of course, there is a certain limit to this, when the pressure becomes too low. This could result in a lean mixture while driving on LPG. Considering the ECM is monitoring the mixture by reading the signal of the lambda sensor, it can happen that the ECM is going to learn away. This can be noticed after switching back to petrol; the engine will not run properly. It is conceivable that certain motor management systems (especially E-OBD), will store certain error codes in its memory, whilst the engine check light on the dashboard will come on.

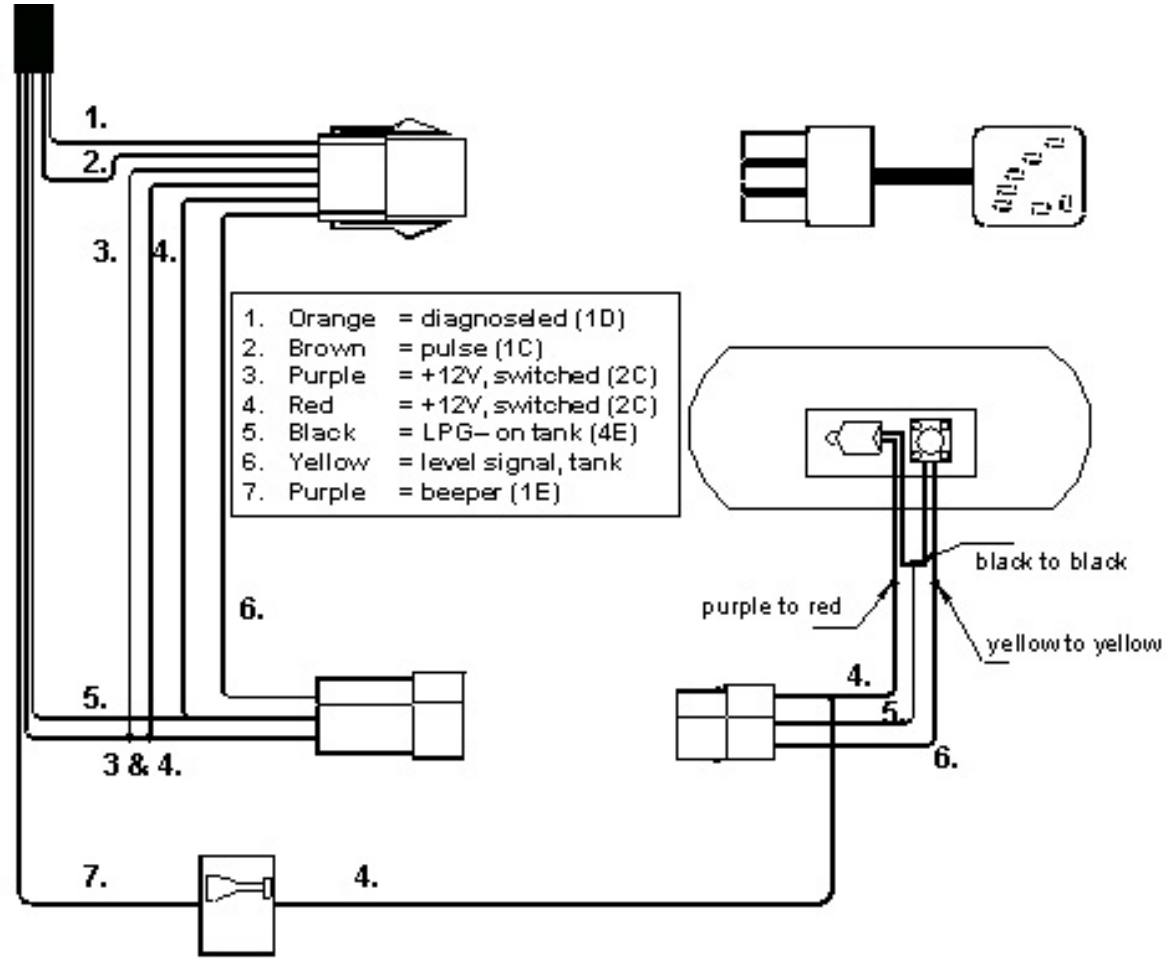
To prevent this situation, the SGI ECU is able to recognise an empty LPG tank; it will then switch back to petrol mode before any problem can occur. An empty LPG tank is recognised according to the measured vapour pressure (under a certain value) in combination with the opening time of the SGI injectors (above a certain value).

To notify the driver, the beeper will go on, together with a flashing diagnosis LED (tank indication LEDs are off). This will prevent the driver to unintentionally empty the petrol tank.



4.4. Electrical connections.

The electrical diagram of the switch connections is shown below.
This diagram also shows that the SGI-system buzzer is connected separately from the switch, behind the dashboard. The control wire for the beeper is no longer a separate wire in combination with the SGI ECU, type 2, but has now been joint in the 5-wire harness towards the switch.



All connections of the SGI switch are listed below:

Colour	Pin nr. SGI ECU	Function	Signal
Orange	1D	Diagnosis LED	+12 Volt (switched or intermittent)
Brown	1C	Pulse from switch	+12 Volt (pulse, pressing the switch)
–		Spare	
Red	2C	Power +12 Volt	+12 Volt (engine running)
Black	4E	Ground LPG shut-off v.	Ground (running in LPG mode)
Yellow	–	Signal tank sensor	Inductive
Purple	1E	Control beeper	Ground (intermittent)

Since all wires have already been accommodated with terminals, these only need to be connected into the 6-pin connector during installation. (It speaks for itself that all wires have to be facing equal colours.)

5. Diagnostic equipment.

The diagnostic equipment for the SGI ECU, type 2 has not changed much compared to the first type. Considering that the diagnostic possibilities have been extended considerably, its functions are being explained in the next paragraph (5.1.).

The equipment has only changed partly; instead of the Psion, a PC (or better: a laptop) is required to be able to read out the SGI ECU.
The reason for this is that all data from the SGI ECU are sent encoded. To be able to actually see the data of the SGI system, a special program is required which decodes all the data. This program is called "DiagnoseTool SGI (DTS)" (partnumber 640.020) and can be used with a PC or a laptop.
The user manual for the DTS program is described on the following pages.

Next to the communication equipment a Breakout box has been developed for the second type of SGI ECU. This unit works in exactly the same way as described in the manual "Trouble shooting SGI" regarding the Breakout box of the Interface Unit.
This is an essential piece of equipment to be able to measure all connections from and to the SGI ECU.

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

Because the motor management computer (ECM) is still in control of the fuelling strategy of the engine, the diagnostic possibilities of the SGI ECU, type 2 are limited. Thus it is still essential to perform a diagnostic check of the motor management system before a diagnosis is carried out of the SGI system
The diagnostic possibilities are described in the following paragraphs.

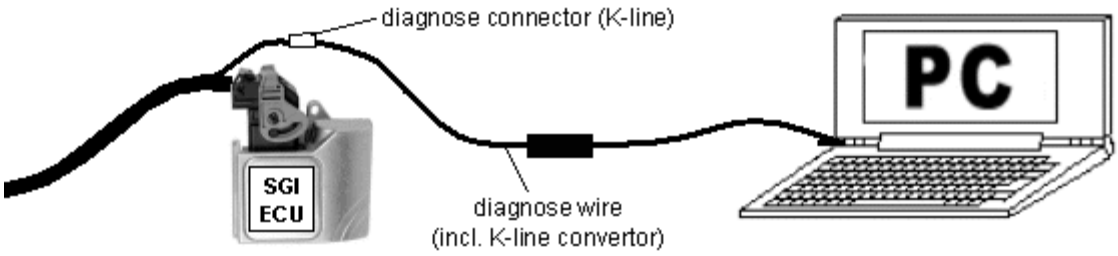
5.1. User manual DiagnoseTool SGI (DTS):

To be able to perform a diagnosis by using a PC or laptop, a connection needs to be made with a diagnostic cable, which is connected to the 3-pole diagnosis plug of the SGI wiring harness in the engine compartment.
The diagnostic cable is made in two parts:

1. Diagnostic cable to serial COM port
2. "K-line converter"

The K-line converter is taking care that the way of communication takes place in the correct way (in terms of transmission speed etc.) between the SGI ECU and the PC or laptop.
Both parts for communication are listed below:

Description	Part number
AG diagnostic cable for PC	AG 258110
AG K-line converter	AG 258111



It is only possible to communicate when the switched power supply to the SGI ECU is on. Since this is the case when running on LPG as well as on petrol, it is possible to communicate when running on each fuel. In most cases it is only possible to communicate when the engine is running, because the switched power is normally shut down when the engine stalls.

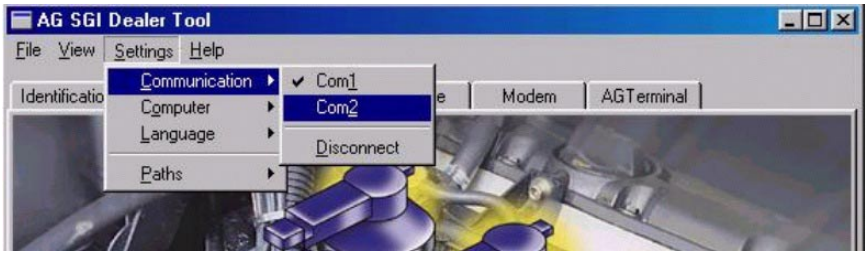
The DiagnoseTool DTS has been developed to make it possible for dealers to communicate with the second type of SGI ECU in case any after sales is required. First, the program needs to be installed on the hard disk of the PC with which the communication is to be performed. It is necessary to have a Windows 95, 98, NT or 2000 operating system working on the PC.

5.1.1. Installation DiagnoseTool DTS:

The DiagnoseTool SGI can be installed on a PC easily by starting the “setup.exe” program by a simple mouse-click. This will start up the installation process. The DTS program is normally installed in the following directory: “C:\Program Files\ AG \ DiagnoseTool SGI”. It is however also possible to specify another location on the hard disk. After the installation is complete, you will find a short cut to the DTS program on your desktop (SGI logo). When double-clicking on the short cut, the DiagnoseTool SGI program is started like shown below.

5.1.2. *Selection COM-port:*

The software has been developed to communicate via a serial COM 1 or COM 2 port with the SGI ECU. COM 1 is normally selected after the installation of the DTS program, but it is also possible to select COM 2 instead for communication with the SGI ECU. The preferred COM-port can be selected by choosing the option “Communication” under “Settings” (see below).



5.1.3. *Adding a new data-file:*

In contrast with the first type of SGI ECU, it is no longer possible to use one program to communicate with all software versions of the SGI ECU, type 2. To be able to communicate with the second type of SGI ECU, it is necessary to have a specific data file which corresponds with the type of basic SGI software. The type of data file must have the same identification as the basic software of the SGI ECU, like shown below:

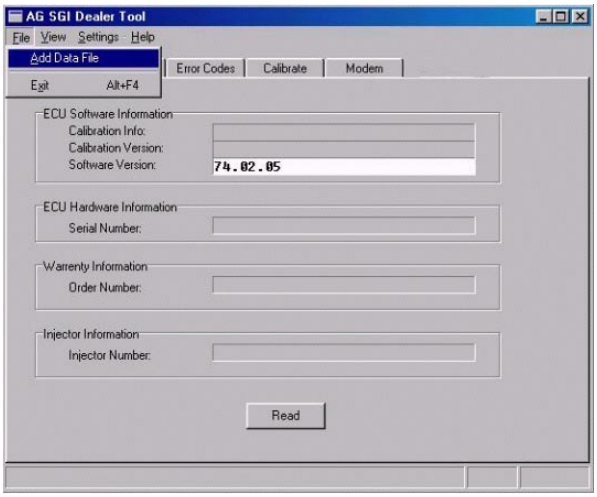
Software version	Data file name
74.03.03	740303.dat

When reading the data from the SGI ECU, the DTS program will automatically search for the correct type of data file, which can normally be found in the directory:

… \ AG DiagnoseTool SGI \ Data \ Software

In case a communication is required with an SGI ECU, which has a new version of the basic software, it can happen that the corresponding data file has not been installed yet in the DTS program. In that case, the data file concerned will have to be added to the installation directory of the DTS program.

Selecting the button “File” and subsequently “Add data file”, as shown in the image below can actualise this. The specific data file can be found on the website www.agautogas.com.



5.2. Functions DiagnoseTool SGI (DTS):

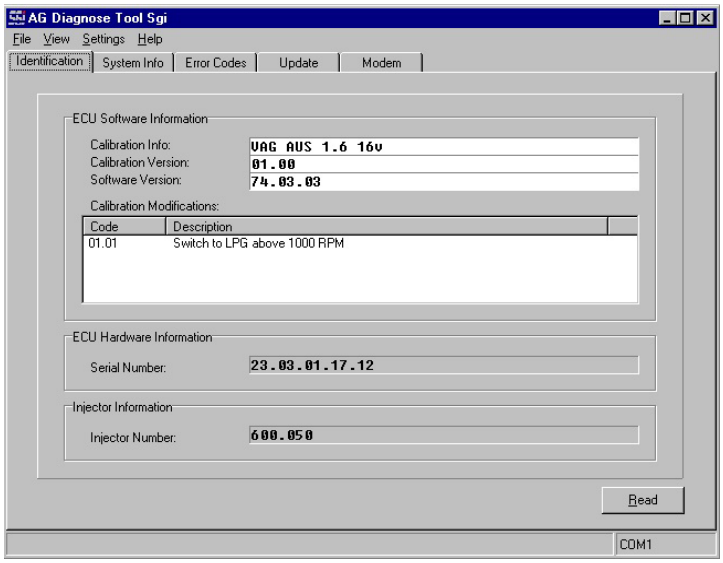
The DiagnoseTool SGI has the following menu structure:

- § Identification
- § System Info
- § Error codes
- § Updates
- § Modem communication

The menu structure has been made in the same way as for the first type of SGI ECU. Clicking on its tab can open each menu, of which an explanation is given in the next paragraphs.

5.2.1. Identification menu:

By clicking the tab "Identification", the screen as shown below will become visible. The DTS program will start communicating when clicking on the "Read" button.



The following data are shown in the Identification menu:

ECU Software Information (see also chapter 1: Function SGI ECU):
Calibration info : Information about the brand and type of vehicle with its engine code
Calibration version : The specific EEPROM software used for this type of vehicle
Software version : The version of the basic software of the SGI ECU (PROM)

Calibration modifications:
Code : Specific identification code of the modifications in the calibration
Description : Description of the modifications in the calibration

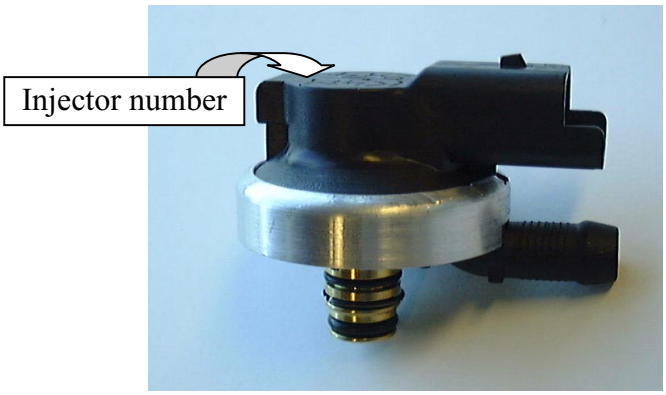
> A "Calibration Modification" is a general change of the engine specific software that can be programmed in by a dealer or installer who has access to the DiagnoseTool SGI. How to perform a modification of the calibration, is being described in paragraph 5.2.4. The type of modification is shown in the Identification menu to be able to recognise which specific changes have been made in the calibration. In the figure above, the modification programmed in the ECU is that switching over from petrol to LPG will not take place below 1000 RPM.

ECU Hardware Information:
Serial Number : Unique serial number of the hardware of the SGI ECU

Injector Information:
Injector Number : Part number of the correct type of SGI injector;
> This number can be:

- 600.040 small capacity type SGI injector (4mm)
- 600.050 medium capacity type SGI injector (5mm)
- 600.062 large capacity type SGI injector (6mm)

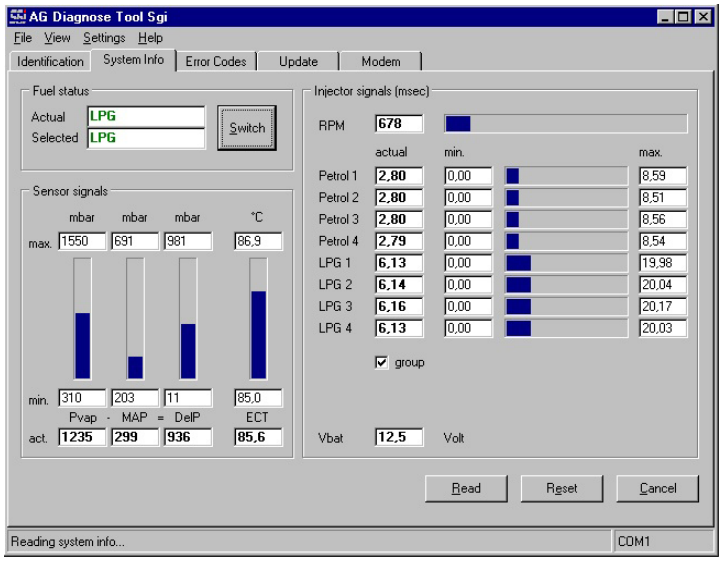
The type of SGI injector fitted can be recognised by its part number as mentioned on top:



If the part number does not correspond with the number mentioned in the Identification menu, the opening time of the petrol injectors will not be translated correctly by the SGI ECU, because of which the mixture will have to be corrected too much by the lambda correction of the motor management computer. This will result in problems like hesitation, stalling and learning away (check engine).

5.2.2. Read in and outgoing signals (System Info):

When opening the tab “System Info”, the in and outgoing signals of the SGI ECU will appear on the screen, as shown below:



- *Status:* (also see § 2.2.2. en 2.2.3.)

Actual Fuel : the actual situation in which the engine is running; possibilities:

Status:	Situation:
Petrol	Engine runs on petrol
Petrol – heat up	Engine runs on petrol; SGI injectors are controlled open
Petrol – flush	Engine runs on petrol; LPG shut-off valve on vaporiser open
LPG	Engine runs on LPG

Selected Fuel : the fuel, which has been selected by the driver (petrol or LPG).

- *Sensor signals:* (measured signals of the sensors, as mentioned in § 2.1.)

  All signals are shown in numeric values as well as graphically (vertical bar); the minimum and maximum values measured are shown behind "min." and "max.", so it is possible to afterwards judge the values in an easier way.

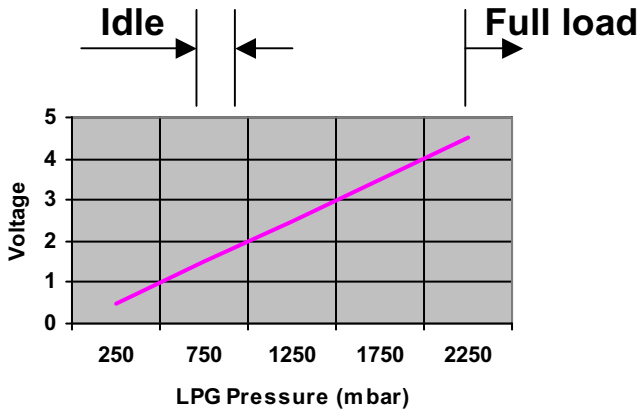
RPM : engine revolutions per minute (= injection frequency of INJ.1)

The engine speed is calculated from the injection frequency of the petrol injector, which has been disconnected by disconnection group 1 (INJ.1). Since no fuel is injected during deceleration (fuel cut-off), the engine speed as shown on the System Info screen will become "0000" in this situation.

Using the wrong software, which can be checked in the Identification menu, normally causes wrong reading of the engine speed.

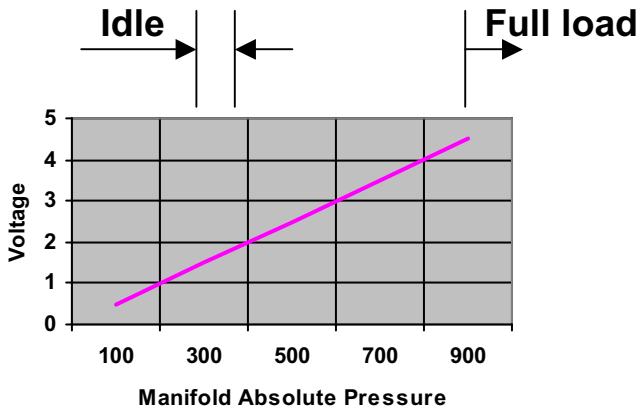
Pvap : LPG vapour pressure in millibar (measure inside the outlet of the vaporiser)

Pvap represents the pressure of the LPG, as supplied by the SGI vaporiser (in a vapour stage). This pressure is also displayed in millibar. Since the vapour pressure is referenced to manifold pressure, its value varies with the value of "MAP". The pressure of the LPG is measured by the LPG pressure sensor, which is fitted onto the SGI vaporizer. Its characteristics are shown below:



MAP : pressure in the intake manifold in millibar (measured by the Interface Unit)

The internal MAP sensor of the Interface Unit measures the pressure in the intake manifold of the engine. The pressure is displayed in millibar. The characteristics of the sensor are shown below.



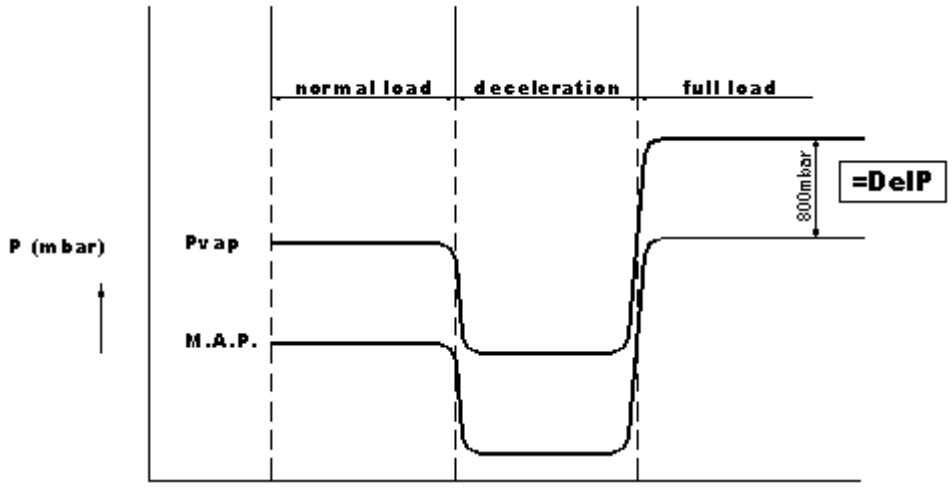
When running at idle, the pressure is normally around 350 millibar; during full load, the pressure will become approximately 1000 millibar with a normally aspirated engine; the manifold pressure will become higher than atmospheric with turbo charged engines.

Since the maximum range of the MAP sensor inside the Interface Unit in up to 1000 mbar, the signal needs to be read from an external MAP sensor (original or additionally supplied in the SGI kit).

DelP : differential pressure over the SGI injectors (= Pvap – Load)

The differential pressure over the SGI injectors is equal to the input LPG vapour pressure minus the pressure in the intake manifold. Because the LPG pressure and the manifold pressure are both measured, it is possible to calculate the differential pressure of the SGI injectors (DelP = Pvap – MAP).

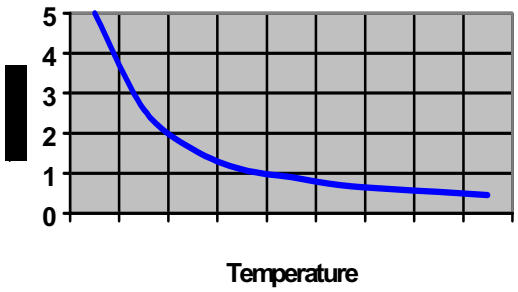
Just like Pvap and MAP, DelP is displayed in millibar.



ⓘ Tolerances are: 700 < DelP < 900 mbar (measured statically).

ECT : measured Engine Coolant Temperature (original sensor)

The Engine Coolant Temperature is measured in degrees Celsius. Since this analogue signal is normally branched of the signal wire of the original ECT sensor on the engine, the characteristics can vary per engine type.
An example of the characteristics of an ECT sensor is shown below:



Nevertheless, in case the SGI ECU cannot use the original ECT sensor signal, the signal will be monitored from an auxiliary sensor, which is supplied with the SGI kit.

Vbat : voltage of the power supply (measured by the SGI ECU)

Considering that the voltage level of the power supply influences the characteristics of both the petrol and SGI injectors, this is an important measurement for the translation strategy of the SGI ECU. The voltage of the power supply to the petrol (and SGI) injectors is displayed on the screen.

- *Ti Injectors:* (Petrol and LPG; separated into 4 groups)

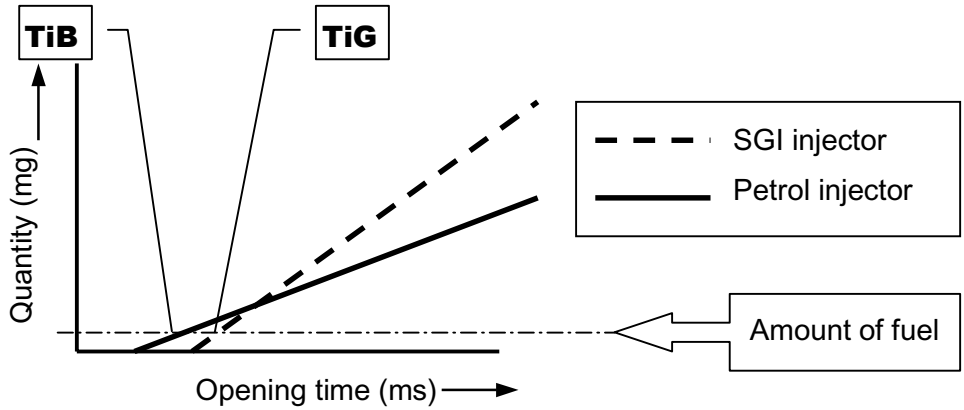
  Also, the opening times of the are shown in numeric values as well as graphically (horizontal bar); the minimum and maximum values measured are shown behind "min." and "max.", so it is possible to afterwards judge the values in an easier way.

Inj.1 : Injector group 1 (INJ.1):
Petrol: opening time petrol injector in milliseconds (measured via the Interface Unit)
LPG : opening time SGI injector in milliseconds (calculated by the SGI ECU)
Inj.2 : Injector group 2 (INJ.2):
Petrol: opening time petrol injector in milliseconds (measured via the Interface Unit)
LPG : opening time SGI injector in milliseconds (calculated by the SGI ECU)
Inj.3 : Injector group 3 (INJ.3):
Petrol: opening time petrol injector in milliseconds (measured via the Interface Unit)
LPG : opening time SGI injector in milliseconds (calculated by the SGI ECU)
Inj.4 : Injector group 4 (INJ.4):
Petrol: opening time petrol injector in milliseconds (measured via the Interface Unit)
LPG : opening time SGI injector in milliseconds (calculated by the SGI ECU)

Petrol:

This is the opening time of the petrol injector (in milliseconds), which is measured from the corresponding disconnection group of the Interface Unit. The basis of the translation strategy is to keep the opening time of each petrol injector unchanged, either driving on petrol or on LPG. This only counts when the circumstances (i.e. RPM, MAP, etc.) remain equal, of course.

If this is not the case, the translation of the opening time of the SGI injectors will not take place properly. The reason for this to happen could be that either the software is incorrect or that the wrong type of SGI injectors has been fitted.



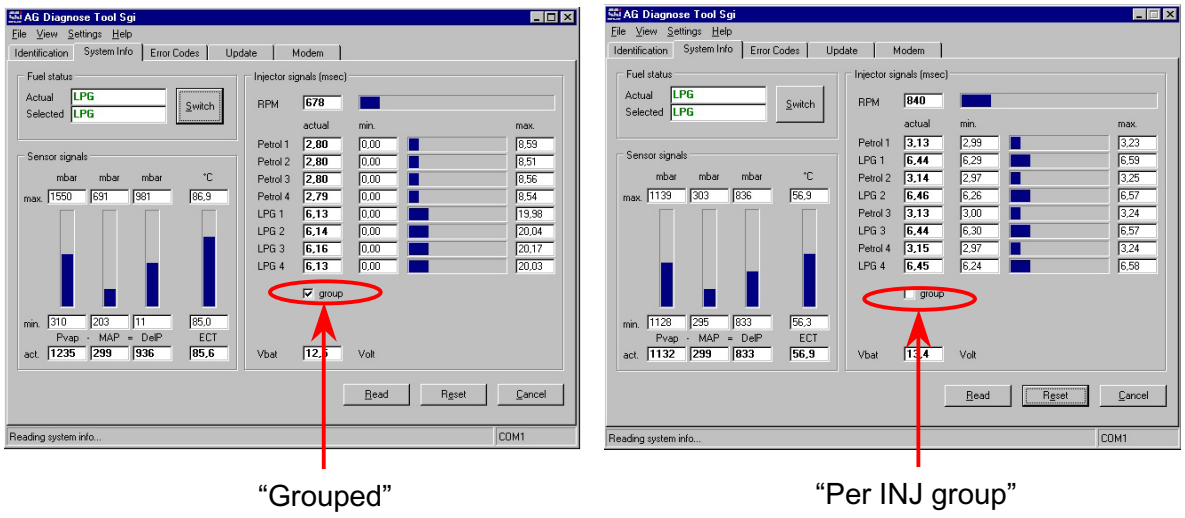
LPG:

As described in chapter 1, the SGI ECU translates the opening time of the petrol injectors to the opening time of the SGI injectors. This strategy is mainly based on the mechanical differences in between both injector types.

The four values shown are the opening times of the SGI injectors, which have been calculated by the SGI ECU. In case a connector of one of the SGI injectors is taken off, this will not make any difference to the value as displayed on the screen.

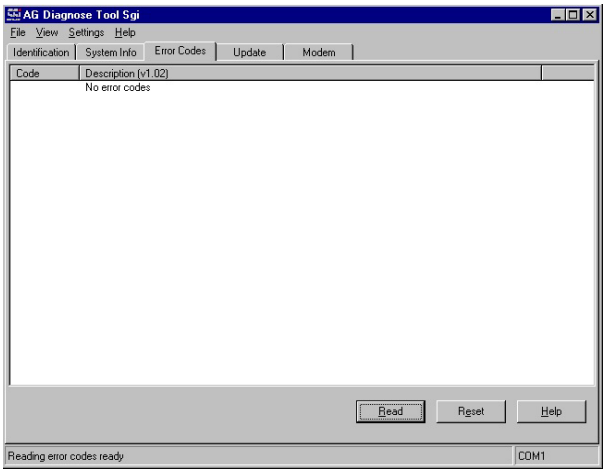
The opening times of the petrol and SGI injectors can be displayed in two ways, standard and grouped (marked "**V**" by a mouse-click):

Standard : Opening time of petrol and SGI injector alternately (per INJ group);
Grouped : Opening time of petrol injectors together and SGI injectors together (per fuel).

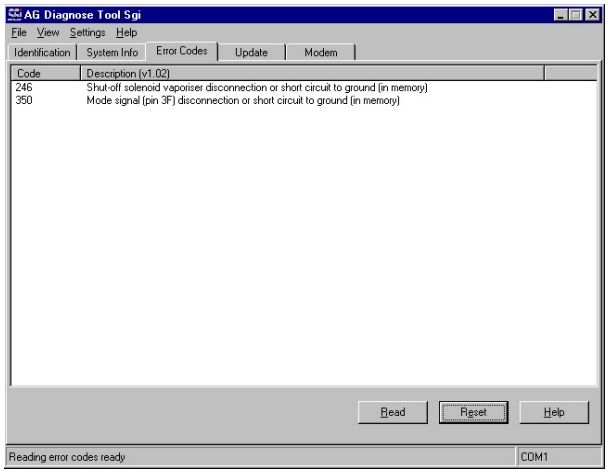


5.2.3. Diagnosis (Error codes):

The ECM determines the strategy in which the SGI injectors are controlled. In this way, the self-learning capabilities are utilised, also when running on LPG, meaning that the SGI ECU does not have to be self-learning itself.
Thus it is sufficient to be able to read out possible error codes. These error codes only concern the in and output signals, which are read by the SGI ECU while running on LPG.
To check the memory of the SGI ECU for possible error codes is a matter of clicking on the tab "Error Codes", after which the screen below will be shown:



No error codes detected



Two errors memorised (code & description)

Since the reading of diagnosis menu is a snapshot, the display will not change when the SGI ECU detects another error. The new error will be shown after clicking on the button "Read", after which the screen will be reloaded.
The error codes shown can be selected separately; by clicking on the button "Reset", the error codes, which have been selected in the screen, will be removed from the memory of the microprocessor of the SGI ECU.

The error codes have been classified into two different types:

- Actual error : This error is present at the moment of reading (diagnosis LED is on continuously);
- Memorised error : This error has been stored by the SGI ECU, but is not present at the moment of reading the error codes (in case no actual error code is present).

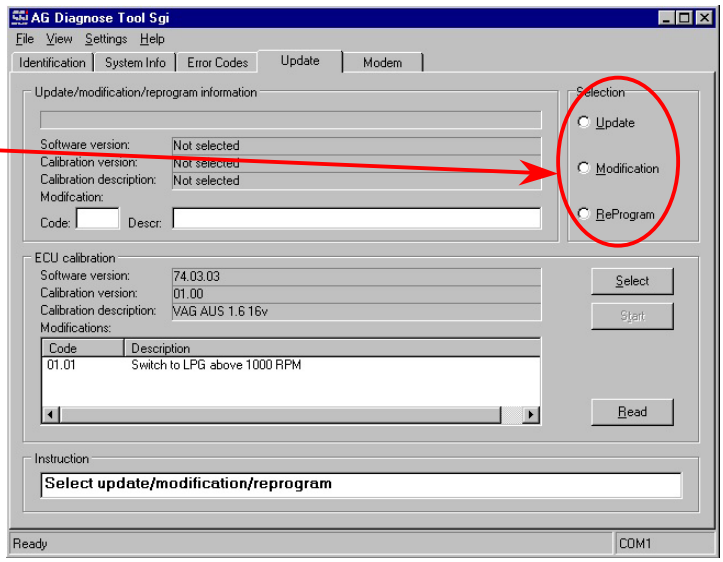
In annex 1 all possible error codes of the second type of SGI ECU are listed.

ⓘ ***In case any problem occurs, it remains essential to always read out the error codes of the motor management computer FIRST (also with the SGI ECU, type 2) !!***

5.2.4. Software Update:

With the second type of SGI ECU, the calibration possibility has been leaved out. Instead of this, three new features have been implemented into the DealerTool SGI, behind the tab "Update" (see figure below). These features are:

1. Update
2. Modification
3. Reprogram



1. *Update*:
   With this option it is possible to upgrade the calibration version to a newer version, which has been developed for a specific type of engine (as long as the basic software version is the same).
2. *Modification*:
   A modification is generally applicable for different types of engines, and can be used for all kinds of vehicles, if necessary (as long as the basic software version is the same).
3. *Re-program ECU*:
   It is possible with the DiagnoseTool SGI to completely reprogram the calibration of an SGI ECU, type 2 (as long as the basic software version is the same). It is, for example possible to change to calibration for a different type of engine.

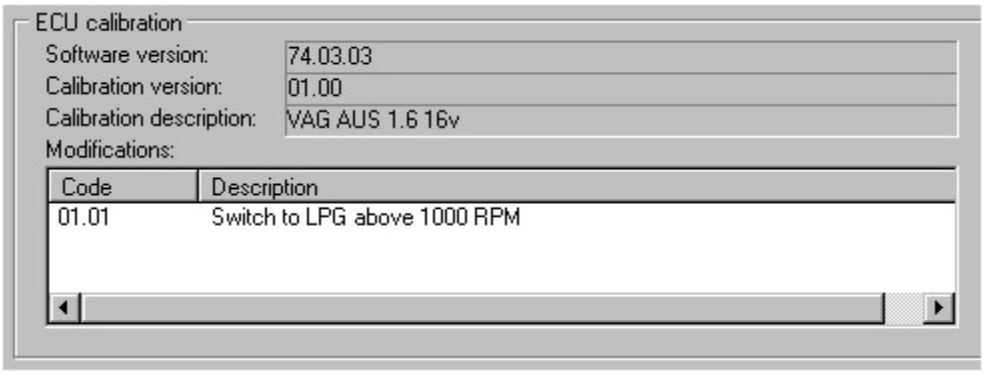
To be able to carry out any update, modification or to reprogram the engine specific software of the SGI ECU, the basic software (="software version") must be the same as the version mentioned in the file !! (In case the needed file is missing, this can be downloaded from the website www.agautogas.com .)

> Procedures to change the calibration of the SGI ECU:

The procedure works mainly the same for an update, a modification or reprogramming the calibration of the ECU. The descriptions of the procedures have been split vertically by a dotted line. For example, when carrying out a modification, the procedure can be followed according to the middle column from the next page on.

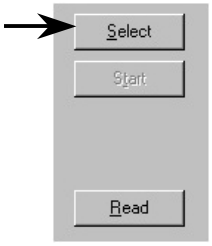
Update:	Modification:	Reprogram:

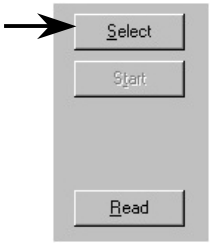
1) First make contact with the SGI ECU; the current identification of the ECU will be shown below “ECU calibration” (the same for all options; see below);

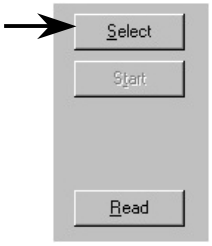


2) Choose the option wanted by a mouse click on the small round frame in front of the selection (update, modification or reprogram) as shown below;

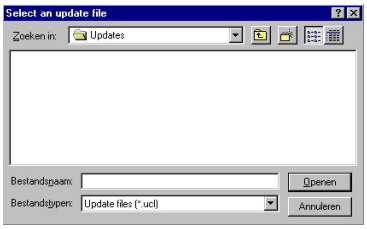
3) Then click on the “Select” button to start looking for the necessary file to change the calibration of the ECU;

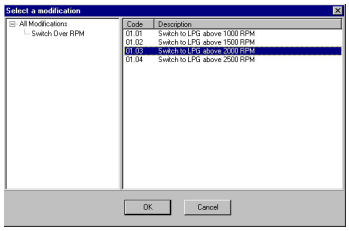


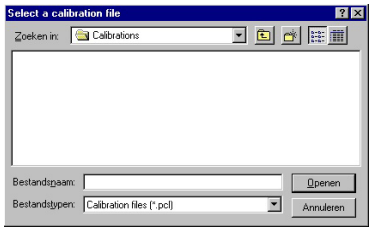




4) The available update, modification or reprogram files will then be shown on the screen:



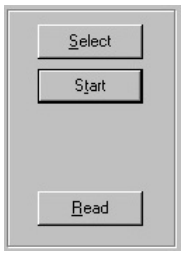




5) Choose the needed: Update-file (.ucl),	Modification file	or Calibration file (.pcl)

Note: Check whether the software version is the same as the version the files are meant for !

6) Confirm the selection and acknowledge changing the calibration of the ECU by clicking on the “Start”-button, which has been enabled by the program (see below).



7) Follow the instructions underneath the Update screen (in the white message box);

The instructions are successively:

- Please turn off ignition key and wait until Contact+ is off
- Please wait for the ECU to shut down
- Please start the engine
- Update / Modification / Reprogram successful !

After this, the Update / Modification / Reprogram has been performed successfully.

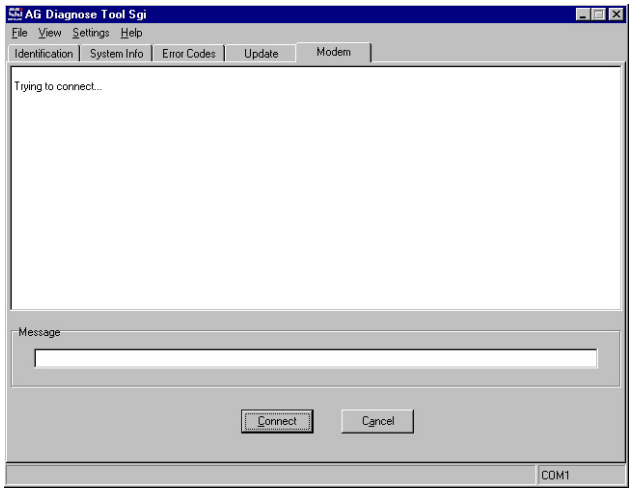
The notation of the change in the calibration software is as follows:

- The Update can be recognised behind the identification “Calibration version”;
- The Modification can be recognised in the separate screen below the software identification (“Modifications” with a code and a description);
- Reprogramming the calibration will result in a different identification of the engine type (“Calibration description”).

In Annex 2, 3 and 4, all available Updates, Modifications and Reprograms have been respectively listed.

5.2.5. Modem communication:

With this menu (see below) it is possible to make a modem connection with the second type of SGI ECU. In this way, a diagnosis can be performed by the technical helpdesk of the representative of Teleflex*GFI* Europe.



The procedure for having a modem connection with the SGI ECU, type 2 has changed. With the first type of SGI ECU, a direct connection was made between the SGI ECU and an external modem via a special modem cable. In the new situation, the modem communication is taking place via the PC (using the same diagnostic cable).
Therefore, the modem communication can take place in mainly two ways:

a. Via an external modem (from the existing AG test suitcase);
b. Via an internal modem of the PC or Laptop.

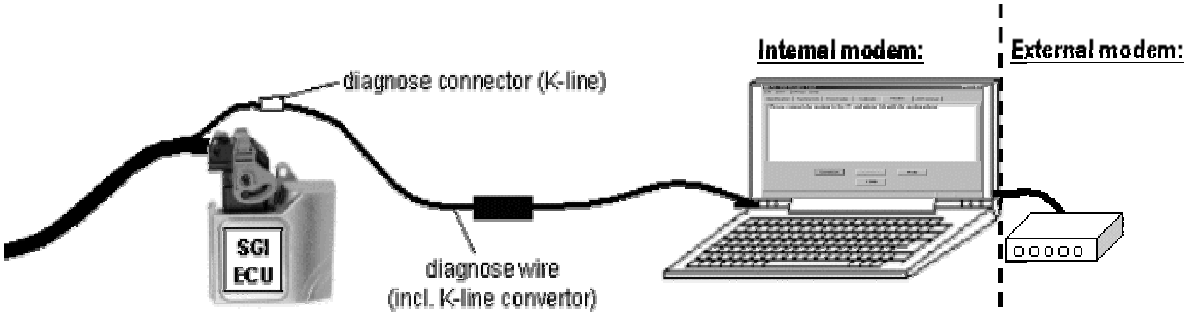
a. Via an external modem (from the existing AG test suitcase):

   The external modem is connected to the PC, which is used for having communication with the SGI ECU. The modem will have to be installed properly in the operating system of the PC first, of course, before any communication can take place.
   The modem of the AG test suitcase can be used for communication.

b. Via an internal modem of the PC or Laptop:

   Considering that mot PC's are already equipped with an internal modem, a feature has been developed in the DiagnoseTool SGI to be able to have a modem connection with this modem. With this possibility, the connections for a modem have been simplified, and therefore, is has become more convenient for the dealers to prepare a modem communication.
   The principle of the modem communication remains the same as when using an external modem; the communication is taking place through the PC itself by using the Modem menu of the DiagnoseTool SGI.

As mentioned before, in both cases the communication takes place using the same diagnostic cable (together with the K-line converter). Because of this, the connections are being connected according to the picture on the next page.



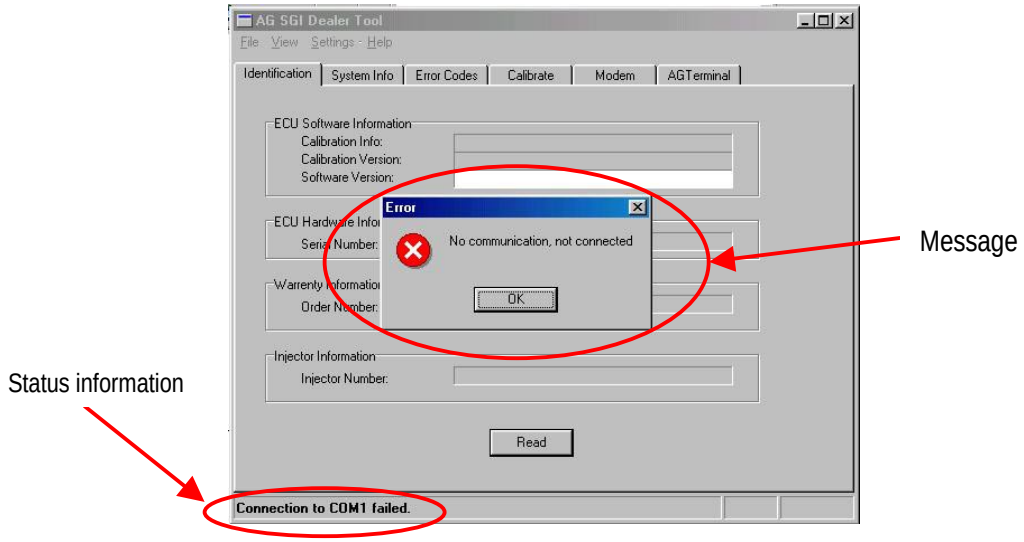
At present many dealers are only using digital phone lines (ISDN), which may complicate having a modem connection. In case only digital phone lines are available, a special converter needs to be used to transform the transmitted signals into an analogue communication. In this way it is still possible to communicate with the SGI ECU by modem.

The operation for a modem communication is as follows:

1. Connect the PC (or laptop) to the SGI diagnostic connector with the cable AG 258110 and the K-line converter AG 258111;
2. In case of using an external modem, connect the modem to the PC and to the power supply;
3. Connect the phone connection of the PC, and also connect the phone itself (with an external modem to the “phone” connection of the modem);
4. Start up the DiagnoseTool SGI and make a connection with the SGI ECU (with the engine running);
5. Open the tab “Modem” and call the phonenumber of the modem helpdesk;
6. When having the connection with the helpdesk, it is possible to explain the need for the modem communication;
7. After this, the technician at the helpdesk will ask to click on the button “Connect”;
8. The modem communication will be started and a diagnosis is carried out;
9. It may happen that a message appears on the screen from the helpdesk. In that case it is necessary to follow the instructions as mentioned.
10. After the helpdesk is ready communicating with the SGI ECU, the helpdesk will switch back to normal communication. This will also be notified on the screen of the PC. In this way the findings during the modem communication will be explained, together with possible actions to be taken by the dealer.

5.3. Trouble shooting

In case it is not possible to communicate with the SGI ECU, a message box appears on the screen with the text “No communication, not connected” (see figure below).



Below the screen, more detailed information is shown about the status of communication. Possible errors have been listed below, together with the possible cause and solution:

Message status information	Cause / solution
Connection to COM 1/2 failed	Has the correct COM port been selected? Select the correct COM port acc. to §5.1.2., COM port selection Does the engine run? Check the power supply to the SGI ECU. Check the connection PC – SGI ECU
Error init COM 1/2	The COM port selected is already in used by another application; close the other application. COM port not present; use another COM port
Error reading data file	Missing data-file; add this file according to §5.1.3., Add Data-file.

Annex 1

Error codes SGI ECU, type 2:

Error code	Description fault
204	Power supply to sensors (in memory)
205	Power supply to sensors (present)
212	Constant power supply +12 Volt too low (in memory)
213	Constant power supply +12 Volt too low (present)
217	Constant power supply +12 Volt too high (in memory)
218	Constant power supply +12 Volt too high (present)
225	Short circuit switched +12 Volt power supply (in memory)
226	Short circuit switched +12 Volt power supply (present)
232	Interference on switched +12 Volt power supply (in memory)
233	Interference on switched +12 Volt power supply (present)
241	Checksum RAM memory (in memory)
242	Checksum RAM memory (present)
246	Shut-off solenoid vaporiser disconnection or short circuit to ground (in memory)
247	Shut-off solenoid vaporiser disconnection or short circuit to ground (present)
251	Shut-off solenoid vaporiser short circuit to power supply (in memory)
252	Shut-off solenoid vaporiser short circuit to power supply (present)
259	Short circuit injector 1 (in memory)
260	Short circuit injector 1 (present)
264	Disconnection injector 1 (in memory)
265	Disconnection injector 1 (present)
272	Short circuit injector 2 (in memory)
273	Short circuit injector 2 (present)
277	Disconnection injector 2 (in memory)
278	Disconnection injector 2 (present)
285	Short circuit injector 3 (in memory)
286	Short circuit injector 3 (present)
290	Disconnection injector 3 (in memory)
291	Disconnection injector 3 (present)
298	Short circuit injector 4 (in memory)
299	Short circuit injector 4 (present)
303	Disconnection injector 4 (in memory)
304	Disconnection injector 4 (present)
311	Diagnosis LED, disconnection or short circuit to power supply (in memory)
312	Diagnosis LED, disconnection or short circuit to power supply (present)
337	Pull-down delay (pin 4F) disconnection or short circuit to ground (in memory)
338	Pull-down delay (pin 4F) disconnection or short circuit to ground (present)
342	Pull-down delay (pin 4F) short circuit to power supply (in memory)
343	Pull-down delay (pin 4F) short circuit to power supply (present)
350	Mode signal (pin 3F) disconnection or short circuit to ground (in memory)
351	Mode signal (pin 3F) disconnection or short circuit to ground (present)
355	Mode signal (pin 3F) short circuit to power supply (in memory)
356	Mode signal (pin 3F) short circuit to power supply (present)
363	MAP sensor, short circuit to ground (in memory)
364	MAP sensor, short circuit to ground (present)
368	MAP sensor, disconnection or short circuit to power supply (in memory)
369	MAP sensor, disconnection or short circuit to power supply (present)
376	Sensor LPG pressure (vaporiser) short circuit to ground (in memory)
377	Sensor LPG pressure (vaporiser) short circuit to ground (present)

▼	*continued* ▼
Error code	**Description fault**
381	Sensor LPG pressure disconnection or short circuit to power supply (in memory)
382	Sensor LPG pressure disconnection or short circuit to power supply (present)
397	LPG shut-off solenoid tank disconnection or short circuit to ground (in memory)
398	LPG shut-off solenoid tank disconnection or short circuit to ground (present)
402	LPG shut-off solenoid tank short circuit to power supply (in memory)
403	LPG shut-off solenoid tank short circuit to power supply (present)
454	ECT sensor, signal too low (in memory)
455	ECT sensor, signal too low (present)
459	ECT sensor, signal too high (in memory)
460	ECT sensor, signal too high (present)
467	Beeper, disconnection or short circuit to ground (in memory)
468	Beeper, disconnection or short circuit to ground (present)
472	Beeper, short circuit to power supply (in memory)
473	Beeper, short circuit to power supply (present)

Annex 2

Available Updates for the SGI ECU, type 2:

Vehicle Identification:	Version software:	Version calibration :	Remarks :
No Updates available			

Annex 3

Available Modifications for the SGI ECU, type 2:

Code Modification :	Description Modification:	Version software:	Remarks :
01	*Group: Switchover RPM:*		
01.01	Switch to LPG above 1000 RPM	74.03.03	
01.02	Switch to LPG above 1500 RPM	74.03.03	
01.03	Switch to LPG above 2000 RPM	74.03.03	
01.04	Switch to LPG above 2500 RPM	74.03.03	

Annex 4

Available Calibrations for reprogramming the SGI ECU, type 2:

Vehicle Identification:	Version software:	Version calibration :	Remarks :
No Reprograms available			