



Reference manual:

software

This manual is to be used for the V2.20 software/Firmware. This Firmware runs in the new TEC2 hardware only!



For the TEC1 the software/Firmware V1.19 remains to be valid.



Software

LiquidSI V2.20

Release date: 01-12-2014

Revision history

01-12-2014 : initial version released

1. The hardware for the TEC has been completely updated. There is a new die-cast housing with improved cooling performance and a generally more modern look and feel. Name is TEC2.

2. Software Version 2.20 released. Changes:

- Compatibility: for reasons of clarity, the TEC delivered so far, both in the plastic and aluminium housing, will be designated as TEC1. The newest software version (2.20) will not work in the TEC1. This has to do with the numerous hardware changes that were necessary to improve the OBD functionality.

The “older” TEC1 units will only work with software/firmware upto version 1.19. For Service or in case of defects, the “old” TEC1 can be replaced by the new TEC2. The wiring looms and pinning have not changed.

- OBD. The F6 error page has been completely overhauled. The new error page allows the detection, storage and action-definition for a large number of potential errors. For each reported error the user can now instruct the software when, how and what type of action to be taken in case of an error. Also the threshold values for each error can now be set. The auto-switch back mode in case of a faulty component or electrical connection can now be configured much more precise.

- Suspended petrol injections. A new feature has been added where the user can now instruct the software to prohibit (suspend) one or more petrol injections during the cranking phase. This gives the user an extra tool for automatic purging of the intake manifold with fresh air prior to starting the engine. An extra table has been added which allows the number of suspended petrol injection to be programmed against coolant temperature.

- The “brown wire” functionality has been extended considerably and now allows a much wider use of the “virtual RPM” feature. When choosing for “virtual RPM”, the brown wire can now be connected to any DC source which indicates that the engine is running. Voltage level and positive or negative trigger slope for this signal can now be defined by the user.
- One new wire is added to the wiring loom: the Yellow wire. This yellow wire can be used to power any external device/relais/emulator. The user can program the exact point in time where the yellow wire will be live (+12V) after the engine has switched over to LPG.
- PTS-70 automation. When the user selects the PTS-70 pump from the F2/Gas Pump drop down menu, automatically, several pump related parameters are changed to the correct values for this pump.

Reference manual **Software**

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Introduction to this Reference Manual Software

This reference manual software applies to software version LiquidSI v2.20

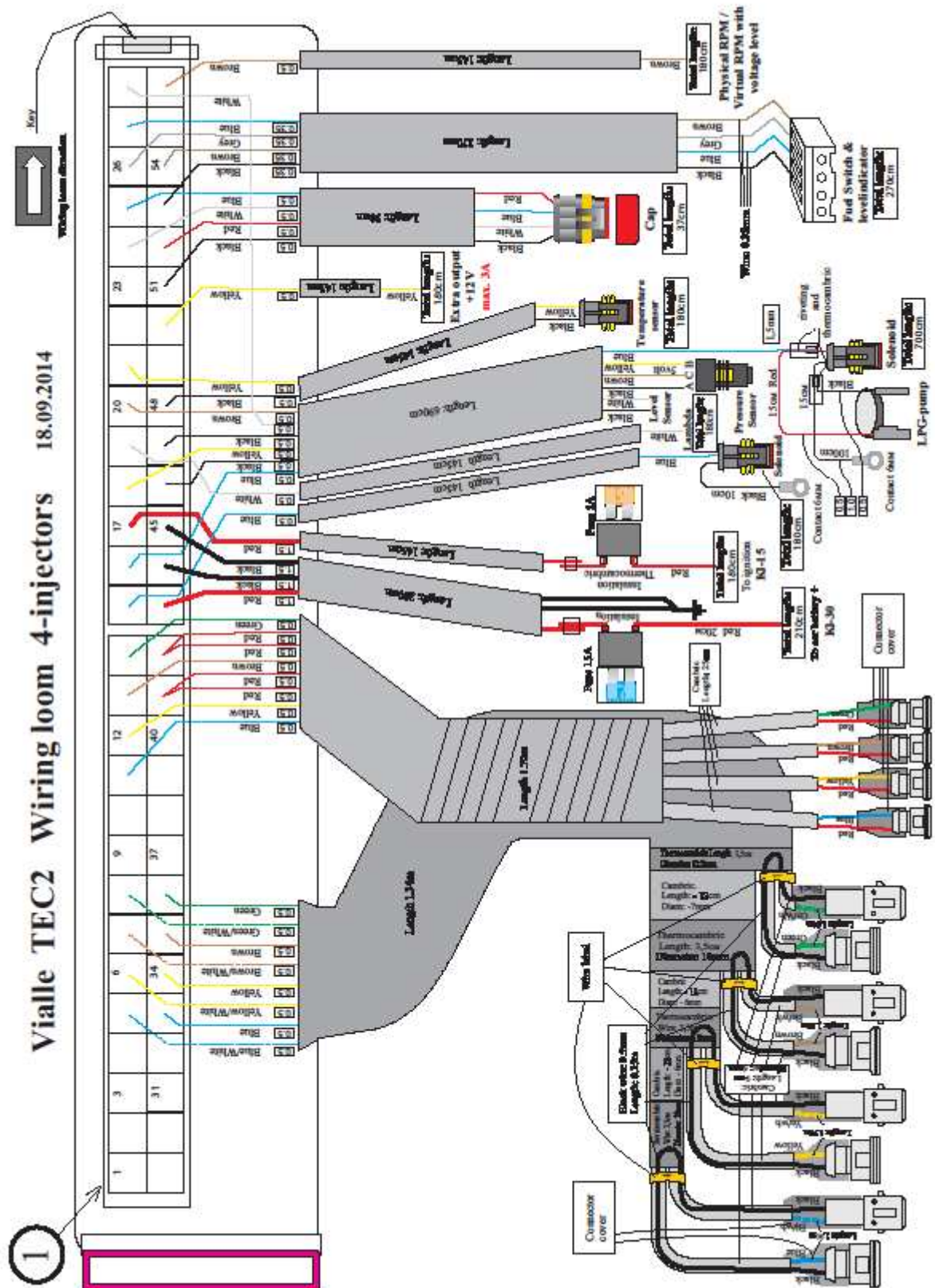
In this manual it is assumed that the reader already has a basic understanding of the operating principles and installation instructions for the LiquidSI system. A separate calibration manual is available from the download area of the LiquidSI website, describing the basic software installation and calibration process for LiquidSI.

Also a basic understanding how to check the car in Petrol operating mode before calibration starts, is assumed here.

Finally, a basic knowledge of how the calibration process is to be executed - mainly the calibration sequence as offered by the Step-by-Step button functionality – is very helpful when reading, studying or using this reference manual.

LiquidSi system description

1. **The LiquidSi computer** works on the master slave concept. Trade mark is **TEC**. It is available in three versions: 4 cilinder (TEC-4), 6 cilinder(TEC-6) and 8 cilinder(TEC-8) package. All packages use identical PCB's and electronic components. The output pins of the TEC are connected directly to the corresponding sensor or actuator. So, from an electrical point of view there are no other external electronic modules in the system. Also the LPG main relais is integrated into the TEC.
 - a. Operating principle is based upon the same philosophy that has made Vialle flag ship LPI such a lasting success. The petrol injectors are interrupted and these wires (2 per injector) are fed into the TEC. In petrol mode these wires are shorted through a NC relais. This allows the car to always run on petrol even in case of serious trouble with the LPG system. In LPG mode these relais are powered and the wires are interrupted, thus deactivating the Petrol injectors. The open ends of these wires are bridged constantly by a 100 Ohm resistor also located inside the TEC. This serves as a dummy load for the Petrol ECU in order to avoid diagnostic issues. The terminals of these resistors are directly connected to a Freescale microprocessor. The pulse produced by the Petrol ECU is therefore directly "captured" by the interrupt timers of the micro. The length of the pulse can thereby be measured and the required pulse length for the LPG injectors can be calculated.
 - b. I/O. See wiring diagram and wiring/installation instructions.
 - i. 8 Petrol injector interrupt wires (16 pins)
 - ii. 8 LPG injector driving wires (16 pins)
 - iii. Battery (+) (1 pin)
 - iv. Battery (-) (2 pins)
 - v. "KL-15" (ignition_on switched (+))
 - vi. Pressure sensor (3 pins)
 - vii. Fuel level sender (2 pins)
 - viii. Fuel selector switch (4 pins)
 - ix. Solenoid and LPG fuel pump (4 pins)
 - x. Serial interface for laptop (4 pins)
 - xi. RPM signal pick-up wire (1 pin)
 - xii. Aux temperature sensor wires (2 pins)
 - xiii. Lambda sensor wire (1 pin)



[illegible]

[illegible]

PIN description for TEC unit

TEC Pin Number	Connected wire leads to	Wire colours	comments
6	- petrol ECU cil 3	Yellow-white	Interrupt petrol injector control wire if supplied injector-connector does not fit.
34	+ petrol_inj cil 3	Yellow	
5	- petrol ECU cil 4	Blue-white	Interrupt petrol injector control wire if supplied injector-connector does not fit.
33	+ petrol_inj cil 4	Blue	
4	- petrol ECU cil 5	Green-white	Interrupt petrol injector control wire if supplied injector-connector does not fit.
32	+ petrol_inj cil 5	Green	
3	- petrol ECU cil 6	Brown-white	Interrupt petrol injector control wire if supplied injector-connector does not fit.
31	+ petrol_inj cil 6	Brown	
8	- petrol ECU cil 1	Green-white	Interrupt petrol injector control wire if supplied injector-connector does not fit.
36	+ petrol_inj cil 1	Green	
7	- petrol ECU cil 2	Brown-white	Interrupt petrol injector control wire if supplied injector-connector does not fit.
35	+ petrol_inj cil 2	Brown	
2	- petrol ECU cil 7	Yellow-white	Interrupt petrol injector control wire if supplied injector-connector does not fit.
30	+ petrol_inj cil 7	Yellow	
1	- petrol ECU cil 8	Blue-white	Interrupt petrol injector control wire if supplied injector-connector does not fit.
29	+ petrol_inj cil 8	Blue	
42	Battery + via fuse 15A	Red	Do not forget to solder fuse holder onto this wire! Also crimp supplied ring terminal to end of fuse holder.
42	+ LPG_inj cil 1	Red	Push connector onto LiquidSi injector for cylinder 1
14	- LPGinj cil 1	Green	
42	+ LPG_inj cil 2	Red	Push connector onto LiquidSi injector for cylinder 2
13	- LPGinj cil 2	Brown	
41	+ LPG_inj cil 3	Red	Push connector onto LiquidSi injector for cylinder 3
12	- LPGinj cil 3	Yellow	
41	+ LPG_inj cil 4	Red	Push connector onto LiquidSi injector for

11	- LPGinj cil 4	Blue	cylinder 4
40	+ LPG_inj cil 5	Red	Push connector onto LiquidSi injector for cylinder 5
38	- LPGinj cil 5	Green	
40	+ LPG_inj cil 6	Red	Push connector onto LiquidSi injector for cylinder 6
10	- LPGinj cil 6	Brown	
39	+ LPG_inj cil 7	Red	Push connector onto LiquidSi injector for cylinder 7
37	- LPGinj cil 7	Yellow	
39	+ LPG_inj cil 8	Red	Push connector onto LiquidSi injector for cylinder 8
9	- LPGinj cil 8	Blue	
44	Battery ground	Black	Crimp both black wires onto the supplied ring terminal and connect to battery ground terminal
45	Battery ground	Black	
15	+12V for engine bay solenoid valve	Blue	Push loom-side connector into coil-side female connector. Make sure to connect the black ground ring terminal to the chassis.
56	(-) minus terminal on ignition coil or other source for engine running/stalling	Brown	<p>This wire should pick up the low-side voltage pulses that are generated by the petrol ECU switching events. RPM is calculated from this signal. In case of Virtual RPM this wire should be connected to a source indicating if the engine is running or has stalled.</p> <p><u>IMPORTANT:</u> the signals picked up on this wire are not only used for displaying the correct engine speed, but the sustained absence of this signal immediately makes the Gas system shut down, even when ignition is ON.</p>
17	+12V from ignition_on ("KL-15")	Red	Connect this wire to the fuse holder first, then solder the red wire from fuse holder to Ignition+ or Contact+. IMPORTANT: this must be a switched 12V. "Bosch": KL15.
19	Lamba sensor	White	Connect wire parallel to lambda sensor.
21	+ engine coolant sensor	Yellow	(optional) temperature sensor clip can be connected to this 2P connector.
48	- engine coolant sensor	Black	
50	Yellow Wire	Yellow	Extra 12V output wire. Can be used for switching emulators or other external

			devices (max 3 Amps)
23	Not used		
46	LPG level sensor	Black	The (0...90 Ohm) LiquidSI level sensor is used in the multivalve. Wires must be connected by soldering.
28	LPG level sensor	White	
47	Pressure sensor ground	Black	Pressure sensor is mounted onto the multivalve. Just insert the 3-pole Packard connector into the female connector of the pressure sensor.
20	Pressure sensor OUT	Brown	
18	+5V Pressure sensor	Yellow	
16	+12V for multivalve solenoid and LPG pump	Blue	ECU has internal relay to switch this wire on or off. Make sure that the ground connection is made to the <u>car</u> chassis and <u>not to the tank or tank-frame</u> using the ring terminal crimped onto the black wire.
24	TXD	White	Connector for diagnostics and programming of ECU.
25	RXD	Blue	
52	+12V	Red	
51	Ground	Black	
26		Gray	Connector for fuel switch.
27		Blue	
54		Brown	
53		Black	

- c. **Safety related features** in TEC series computers.
- i. In case of extreme system pressures the fuelling automatically switches to Petrol (level can be set by user).
 - ii. If the engine stops or stalls unintentionally, the LPG system will be disabled. This will happen because the ignition(-) connected wire (brown, running to PIN 56 in TEC) will no longer see ignition pulses.
 - iii. In case of unexpected injection pressure drops, the fuelling changes over to Petrol and the LPG system is switched off.
 - iv. The new F6 error page allows exact configuration of the actions to be taken in case an error is detected.

d. **Feature list of the TEC2 series computers.**

Calibration/diagnostic Laptop SW runs on 32 and 64 bit Windows platforms (all)

Auto calibrating software to define the main multiplication factor

The calibration can be trimmed manually as function of pulse length

Automatic pump test at system start-up. This checks for programmable pressure rise within a programmable time period.

Programmable, coolant temperature dependent, system priming time before switch-over to Gas.

There is an option to invoke one simultaneous Petrol and Gas injection. This can further improve smooth switching from Petrol to Gas.

Can accept multiple RPM input sources for ignition signal, single coil, double coil, distributor type.

Accept back-up RPM signal through injector pulse measurement (virtual RPM).

Allows emergency start on LPG.

AutoSwitch Petrol Gas condition: RPM over threshold value

Autoswitch Petrol Gas can be executed in a sequential order, time delay for each cylinder is programmable.

Autoswitch Petrol Gas condition: when dry_run_test is passed successfully. Minimum pressure rise and test-period is programmable.

Autoswitch Petrol Gas condition: LPG pressure higher than threshold value.

Safety related Autoswitch Gas Petrol condition: LPG pressure higher than threshold value.

Buzzer integrated into switch.

The Petrol injections during cranking can now be suspended. This can help in cold starting conditions by purging the intake manifold with clean air.

An extra output wire is now added: the yellow wire. This can be used to power any kind of emulator. User can set the time after fuel switching when the yellow wire becomes live (+12V).

Automatic switching from Gas to Petrol if tank is empty. Parameters that are programmable:

- Maximum pressure drop before switching
- Hysteresis for this pressure drop
- allow for a pressure recovery (Y/N)
- set maximum time for this recovery

Automatic but temporary switching Gas – Petrol – Gas in following conditions:

- If RPM lower than threshold value
- If RPM higher than threshold value (fuel clipping)
- In case of fuel cut-off and pick up after fuel cut-off (tip-in)
- 2FUEL function to assist in cylinder head/valve protection

Able to handle Vialle DEKA-LPG injectors, low impedance.

Can handle 2,3,4,5,6,8 cilinder MPI engines (2,3,4cil = TEC-4, 5,6cil = TEC-6, 8cil= TEC-8)

Injector drivers are programmable to accommodate also alternative LPG injectors

- Peak current time limit
- Hold current switching frequency
- Duty cycle for holding current control frequency

Following injection strategies can be handled:

- Sequential mpi
- Parallel group mpi
- Mono(group) injection

Automatic handling of short Petrol pulses

LPG level indicator switching points are freely programmable.

LPG pressure sensor calibration data are freely programmable

Both absolute pressure and relative pressure reading can be set

Lambda sensors of following types are useable:

-0 -1 V

-0 – 5 V

-0,8 – 1,6 V

Main fuel formula is: $T_{gas} = (T_{petr} - T_{offset_ptrol}) \times Petrol_Factor \times corfac + T_{offset_gas}$

Offset_petrol is 2D table (offset = f(Ubat))

Offset_gas is 3D table (offset = f(Ubat, P_lpg))

Autocalibration can determine "Petrol_Factor" (just 1 number)(optional: 2D table).

Corfac shall be 3D table (corfac = f(P_lpg, Pulse_length))

Data for driver and car is stored onto hard drive and also in the calibration file, inside the TEC.

Software allows for "Petrol_Factor" in a wide range of 0,50 ... 1,50

Software has an integrated oscilloscope function.

Scenarios for autocalibration routine can be adapted by user

Software stores all accumulated errors during operation, to be accessed using the laptop software interface.

Communication with ECU is over USB adapter cable.

2. Sensors: **the only sensor in the LiquidSI system** used in calculating the correct fuelling is the (Keller) pressure sensor, mounted in the fuel return line, just upstream of the pressure regulator (orifice) inside the 48mm multivalve. It detects the "" INJECTION PRESSURE"". This is the pressure actually existing at the injectors. It consists of Tank Pressure + Pump Pressure. A good reference value is 12 bar(relative). (8 bar tank pressure + 4 bar pump pressure). LPG temperature and composition are compensated automatically. Therefore no additional sensors are required. This unlike any gaseous injection system in the market. There is 1 temperature input available on the TEC, this is used to calculate the minimum pump priming time. User configurable.
3. Sensors: **the LPG level sensor**. This is a resistive 0...90 Ohm sensor connected directly to the TEC. The data is however processed only for the purpose of powering the level indication LED's in the fuel switch. There is no interaction with the fuelling software.

4. Sensors: there is a **temperature sensor** integrated into a plastic clip which can be clamped onto one of the heater hoses. When connected, this information is used to set the required pump priming time.
5. Actuators: **Vialle injectors**: The injectors used are similar to the ones used for many years now in the LPi and LPfi systems. Vialle have 5 different injector flow rates available. They all have the same electrical characteristics. Since these injectors are designed and produced in an OEM manner, there is very little difference between the electrical characteristics of the Petrol and the Gas injectors. The linearity is excellent and allows a straightforward autocalibration algorithm whereby only 1 "Factor" needs to be determined. This means that there is just 1 main multiplier inside the fuelling formula. This is also very much unlike conventional gaseous injection systems. Because of the low impedance of these injectors (+/- 2 Ohm) a peak-and-hold driver strategy is implemented inside the TEC.

Identification: is moulded onto the injector-connector. VIALLE 12, VIALLE 15, VIALLE 17, VIALLE 20 or VIALLE 28. (The numbers correspond to the approximate standardised n-heptane flow rate. Also, each injector type has its own color.

6. Actuators: **Vialle solenoids and fuel pump**: as of the year 2014, there are 2 different pump types to choose from. The first is TYPE = PTS-40. The second one is TYPE=PTS-70. Make the correct choice in F2/Gas Pump.
7. The new PTS-70 pump has a much higher flow capacity, allowing the user to install the LiquidSi system also in very powerful cars. IMPORTANT: do not install the PTS-70 pump in small cars (power < 100 kW). This will possibly lead to heated tanks and possible failure to re-fuel! The solenoids and the pump are **always** operated simultaneously.
8. Two important differences between gaseous injection systems and LiquidSi.
 - a. One important issue is the protection of the LPG pump against dry-running. This condition will destroy the pump within minutes. The software needs to perform a check at system start-up: this is called the **dry-run test**. Algorithm: software monitors the system pressure during the first few seconds after system startup. If system pressure rise is below a user-defined threshold then dry run test has failed and consequently an empty tank condition is assumed. The system will not change to Gas.
 - b. The second major difference is the implementation of the AFS (automatic fuel switching) upon an (almost) empty tank condition while driving. When the fuel tank is nearly empty there is no "early warning" signal available. In conventional vaporiser based systems the regulated vapour pressure is monitored and in this way a gradual drop in outlet pressure is assumed to indicate an almost empty tank. In LiquidSi there is no vaporiser and the tank level sensor is by far not accurate enough. Resort has to be taken to a radically different approach: the LPG pressure sensor which monitors the injection pressure is watched meticulously and constantly by an advanced software algorithm looking for sudden drops of pressure. To make this work, two things are required: firstly a very solid and reliable fuel module with an integrated jet-pump providing a constant supply of LPG to the intake of the LPG pump. At any one time there is a buffer of more than 500CC of LPG available around

the inlet port of the LPG pump. Secondly, a highly user configurable, software module is available in the calibration software allowing for a tuned and accurate detection of an empty tank condition while driving. The result of this effort is a system which will allow the driver to consume the vast majority of the fuel contents. Typically no more than 1 .. 2 liters of LPG remain unused inside the fuel tank.

The main fueling formula used in the TEC looks like this:

$$t_gas [ms] = (t_petrol - offset_petrol) \times petrol_factor \times cor_fac + offset_gas$$

t_gas = pulse to LPG injector[ms]

t_petrol = pulse to petrol injector[ms]

Offset_petrol = dead time of petrol injector[ms] = f(Ubat) = 1D table

Offset_gas = dead time of LPG injector[ms] = f(inj_pressure, Ubat) = 3D table

Petrol_factor = main correction factor, result of autocalibration process[-] = 0D, just a number!

Cor_fac = factor that corrects for injection pressure and pulse time[-] = f(inj_pressure, t_petrol)=3D table

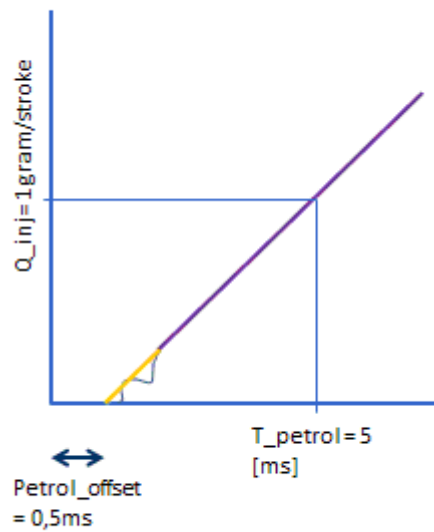
Very important:

It is only the **petrol_factor** that is determined during the autocalibration procedure. All other correction factors and tables are determined in our laboratories and should be OK for almost all applications.

All factors and tables in this formula can however be manipulated by the user, but this should only be done in extreme cases!

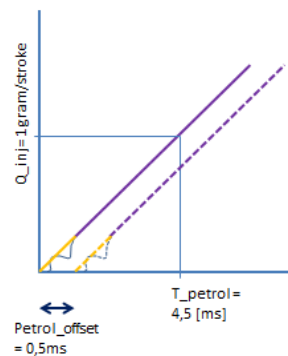
Here is a graphical representation of the calculation steps used in the fueling formula.

Step 1



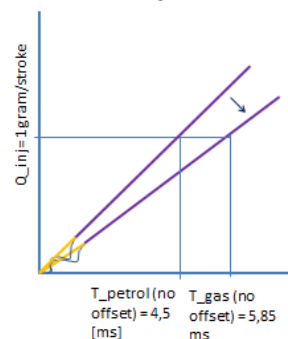
Step 1, the petrol pulse is measured

Step 2

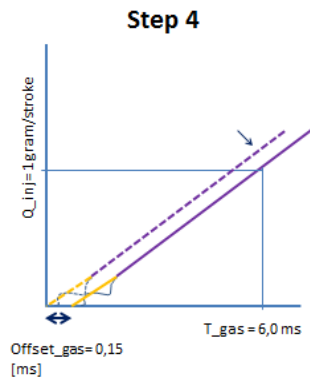


Step 2, the petrol_offset is deducted, this means that the line is moved 0,5 ms to the left and now crosses the origine of the graph.

Step 3



Step 3, the resulting t_{petrol} (no offset) is now multiplied by the Petrol_factor. Assume this factor is 1,30. the t_{gas} (no offset) now can be calculated to be $1,3 \times 4,5 = 5,85 \text{ [ms]}$.



Step 4, adding the gasinjector offset. Assume the $\text{offset}_{gas} = 0,15[\text{ms}]$, then the total pulse to the gasinjector, t_{gas} , can be calculated to be $5,85 + 0,15 = 6,0[\text{ms}]$.

This method is mathematically correct and can be used because the linearity of the Vialle injectors is just as good as the linearity of the petrol injectors.

These 4 steps follow exactly the main fuelling formula shown above.

The Software

The software consists of two parts. The first part is the LiquidSI Software which runs on your laptop or desktop computer (currently version v2.20) and allows the communication with the TEC and is also the calibration interface (only Windows operating systems are supported). The second part is named: Firmware (currently version Lpsi 4.20 for TEC-4, Lpsi 6.20 for TEC-6 and Lpsi 8.20 for TEC-8 units), this is the binary code which runs inside the TEC. this Firmware is uploaded to the TEC through the LiquidSI Software.

The current software v2.20 is not downwards compatible with the previous versions (upto v1.19). Also the newest software/firmware will not run on the TEC1 models. This has to do with the PCB modifications required for the updated functionality.

The “new” TEC’s have a die-cast aluminium housing with several cooling fins, making them very easy to identify. For service and repairs the TEC1 can be replaced by the “new” TEC2 since the connector pinning has remained identical.

Below a picture of the TEC2.



PC Software

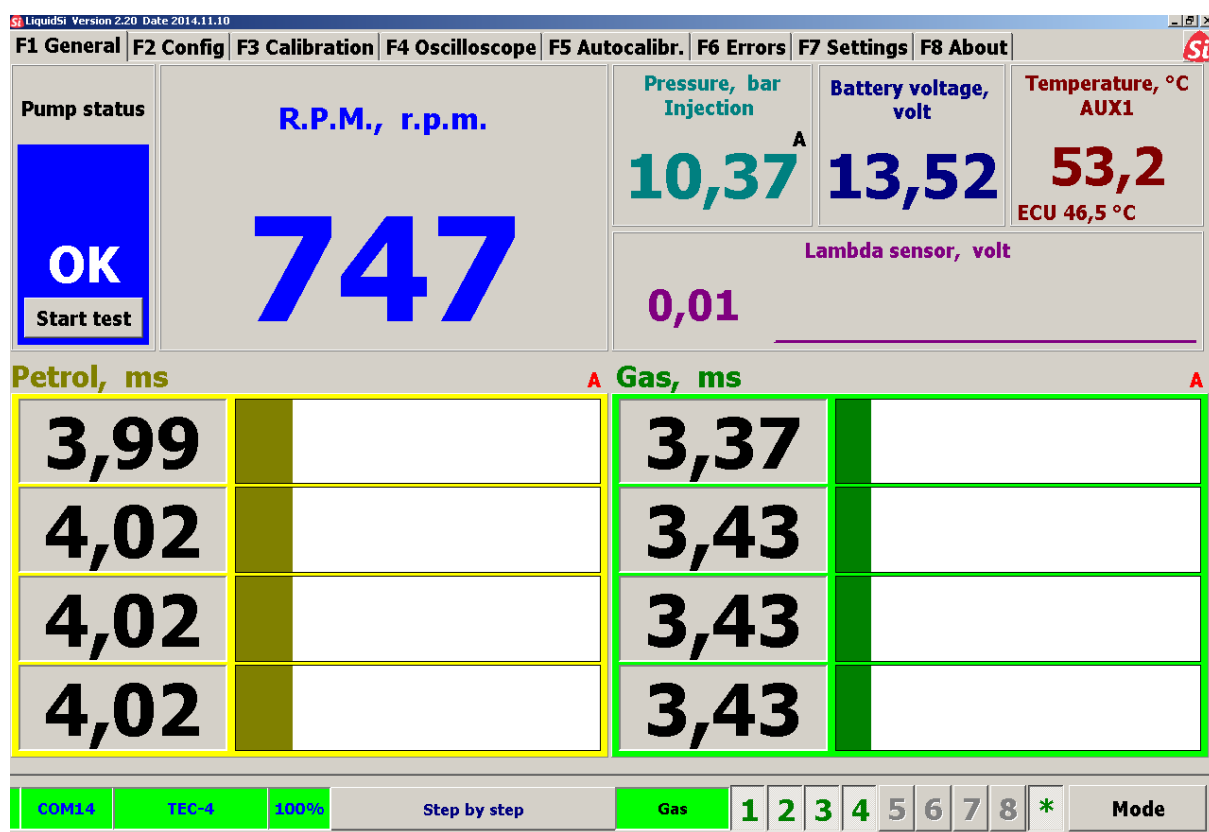
The software can be downloaded from the www.liquidSI.com website and contains the setup file which installs the liquidSI program onto your PC or laptop. This software also contains (integrated) the firmware which needs to be uploaded into the TEC unit. The TEC units come pre-programmed with the latest firmware. In case of a version update being available on the www.liquidSI.com website it is always necessary to download the updated software from the website and install it onto your PC or laptop and after that, load the (updated) firmware into the TEC unit. This updated firmware is inside the downloaded (updated) software and therefore does not need to be downloaded separately. The firmware upload function is available in the LiquidSI software program on the page: F8 ABOUT, using the “Loader” button.

The PC software consists of a Windows program consisting of 8 main pages (Tabs). When starting the program, the first Tab (F1) is always shown by default.

NOTE: the new V2.20 PC software can be used to service also the V1.19 and older firmware versions. The opposite however does not apply.

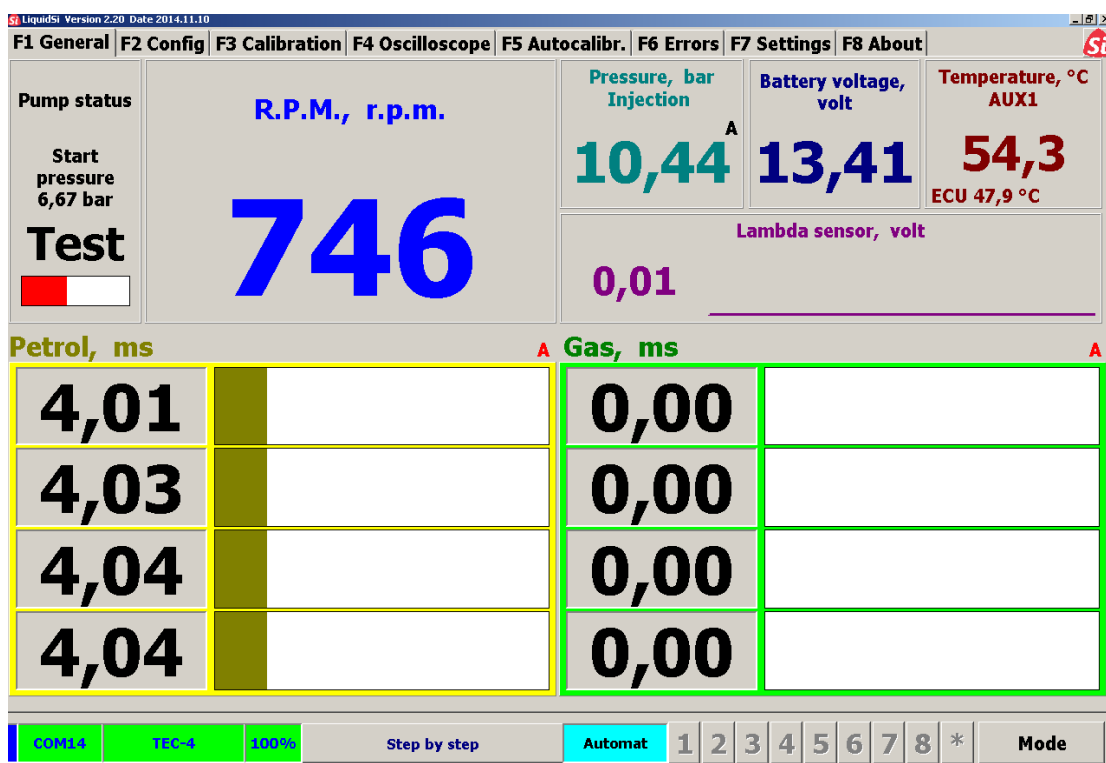
Compatibility: the software only works under the Windows operating system. It will work with the following versions of Windows: 2000/ME/XP/Vista/7/8. 32 and 64 bit versions.

F1 General



The first Tab is the F1 GENERAL page. This shows an overview of the current system performance and status.

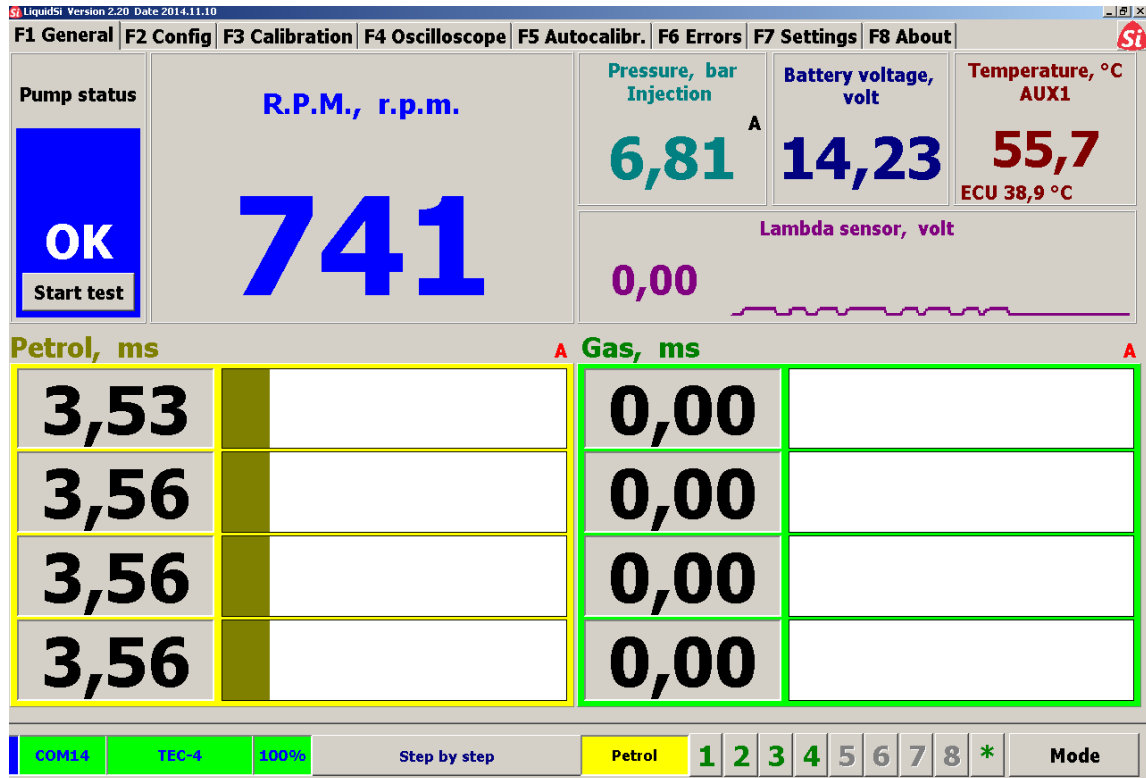
1. “Title bar”. This shows the version and release date of the software installed onto your laptop or desktop computer. Check www.liquidsi.com regularly for updates.
2. “Pump status” indicator field. The operating status of the LPG in-tank pump is this indicator field. If engine is started, this field is coloured RED. After several seconds the LPG solenoids are opened (one on the multivalve and one close to the engine) and the LPG pump is activated simultaneously for a few seconds, then stopped and started again. When the pump is started for the third time the actual “dry-run test” is executed: when the pressure sensor detects a pre-defined level of pressure rise within a certain period of time (default = 6 seconds) the TEC signals that the so called dry-run test is passed and the indicator field changes from RED to BLUE. (see: F2/GAS PUMP for details) if insufficient pressure rise is detected the TEC concludes that the fuel tank is empty and fuelling remains on Petrol and the indicator field stays RED.
3. After selecting “Gas” mode, the red progress bar inside this indicator field shows progress of the dry-run test.



The maximum test time and the minimum rise in injection pressure that needs to be achieved within this period of time can be adjusted in F2/GAS PUMP. The default values should normally be sufficient.

NOTE: while the dry-run test is in progress, the pressure recorded shortly after activation of the pump is shown inside the pump status field. This recorded pressure is a fair indication of the actual "tank" pressure. The user can monitor how much pressure rise is being created during the dry-run test because the Injection pressure output field shows the real time value of this pressure. The delay time between the start of pump activation and the recording moment of the "tank" pressure, can be set in F2/PETROL GAS.

After successful passing the dry-run test, there is a counter showing up in this indicator field.



This counter indicates the remaining fuel circulation time (priming time) before the Gas injectors are being switched on. If no temperature sensor is connected to the wiring loom, the default value for this circulation time is used. This default can be set in F2/PETROL -> GAS. Default is 40 seconds. In case the temperature sensor/clip is attached to the wiring loom and than clipped onto one of the heater hoses, this default value will not be used but instead a six element look up table is used, thereby making the priming time dependent upon engine coolant temperature. A certain amount of priming time is always required since any vapour bubbles residing in the Gas circulation system need to be transported back to the tank.

Lower status bar. From left to right this bar indicates/controls the following:

- Name of connection port (usually COM1..10). RED = no port found. GREEN = active port is found.
- Disconnected or Connected. Indicates an active or an inactive data connection to the **TEC**. RED when no TEC is connected through the interface cable, GREEN when there is a TEC connected to the interface cable. Also the type of TEC is indicated.
- Percentage indicator. Shows progress of the current operation.
- Dynamic indicator field. This field is used to display a short message, relevant to the actions you are performing.

29

Go idling RPM

Save data in memory

30

- Individual Gas injector switches 1,2,3,4,5,6,7,8. These buttons allow the immediate switching ON or OFF for the separate Gas injectors. You can click these buttons or use the following keyboard shortcuts:

- «1» "Z" . Nozzle 1 ON/OFF
- «2» "X" . Nozzle 2 ON/OFF
- «3» "C" . Nozzle 3 ON/OFF
- «4» "V" . Nozzle 4 ON/OFF

- Mode indicator field. This field shows which of the three possible Modes is active. The Mode is chosen by pressing the "Mode" button on the far right side of the lower status bar.

Mode 1: Petrol operation

Mode 2: Automatic. In this mode the software changes from Petrol to Gas automatically in the precise same manner as if you would press the "G" button on the selector switch while driving. So: solenoids are opened and pump is started. The dry-run test is performed and the programmed priming time is observed. If sequential change-over is activated in F2/P->G than this feature is also respected.

Mode 3: Gas. In this mode there is no dry-run test and there is also no priming time observed. Sequential change-over however is respected. Typically this mode is used if you want to quickly test a new setting or feature.

- Next to the Mode button is the "*" button. Pressing this button is similar to using the Mode 3, but sequential change-over is blocked and all injectors switch over simultaneously.

- Step-By-Step button. This button invokes the Step-By-Step function. This function consists of a series of pop-up screens asking the user to input the most important data that the program needs to operate the vehicle on Gas. Following is the sequence of pop-up screens:

STEP-BY-STEP function description.

Pressing the Step by Step button will display the following "Car data" window:

LegadSi Version 2.20 Date: 2014.11.10

F1 General F2 Config F3 Calibration F4 Oscilloscope F5 Autocalibr. F6 Errors F7 Settings F8 About

Pump status **OK** Start test

R.P.M., r.p.m. **743**

Pressure, bar Injection **6,54** A

Battery voltage, volt **14,21**

Temperature, °C AUX1 **55,8**
ECU 39,6 °C

lambda sensor, volt

Petrol, ms

3,52	
3,56	
3,57	
3,58	

0,00
0,00

Step by step

Car data

Number

Model

Engine power (kW)

Gas injectors type : Vialle Alternative Fuel System

Date

Current : 18-11-2014
Last Save : 18-11-2014
Installed 18-11-2014

< Back Next > Cancel

COM14 TEC-4 100% Step by step Petrol 1 2 3 4 5 6 7 8 * Mode

In this pop up window the user should enter a new or existing file name into which the calibration data will be stored. Press NEXT and a new window will pop up allowing the user to enter car and owner data.

LegadSi Version 2.20 Date: 2014.11.10

F1 General F2 Config F3 Calibration F4 Oscilloscope F5 Autocalibr. F6 Errors F7 Settings F8 About

Pump status **OK** Start test

R.P.M., r.p.m. **743**

Pressure, bar Injection **6,34** A

Battery voltage, volt **14,21**

Temperature, °C AUX1 **55,0**
ECU 40,1 °C

lambda sensor, volt

Petrol, ms

3,55	
3,56	
3,59	
3,57	

0,00
0,00

Step by step

Information Owner data

Name

Phone

Address

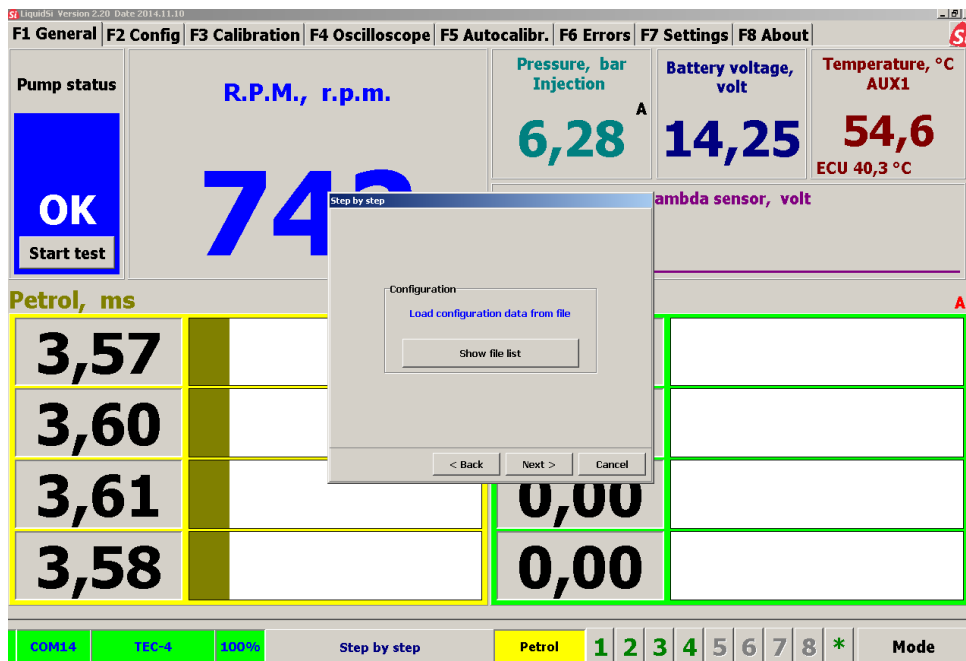
Comments

TEC2
V2.20

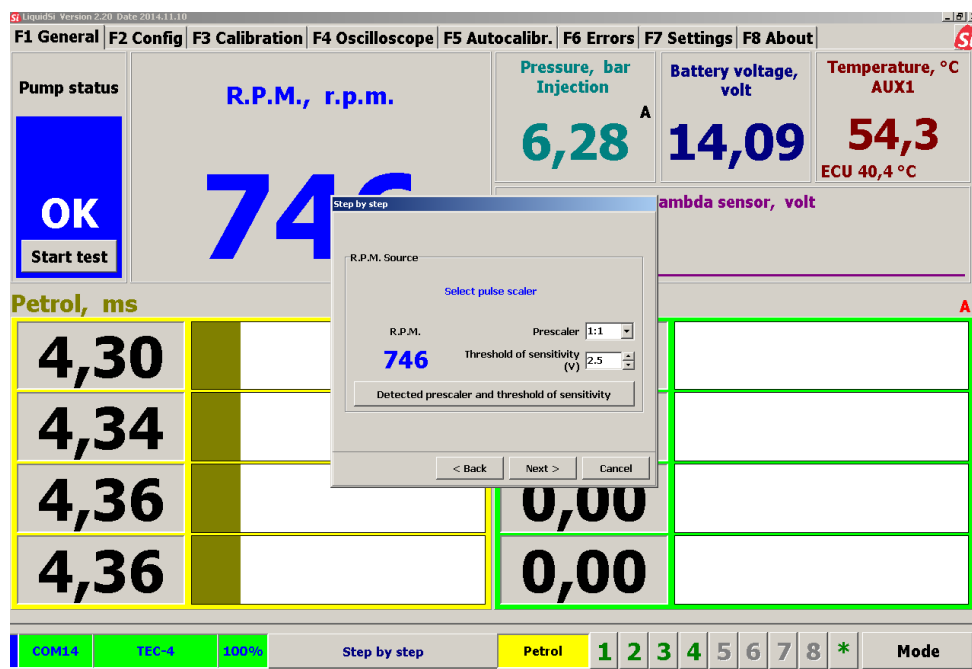
< Back Next > Cancel

COM14 TEC-4 100% Step by step Petrol 1 2 3 4 5 6 7 8 * Mode

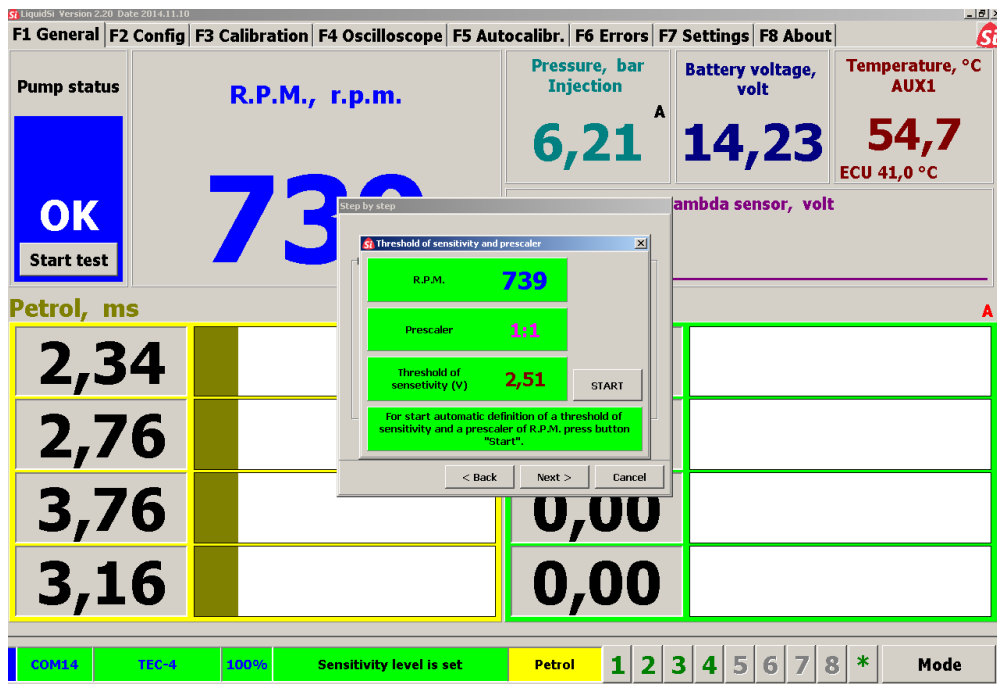
Press NEXT and again a new window will pop up asking the user for a calibration file to start with: in many cases the user will have accumulated a lot of calibration files from which he can choose one to use as a starting point for a new calibration. This window now offers the opportunity to choose a starting file from "config" directory on your hard drive.



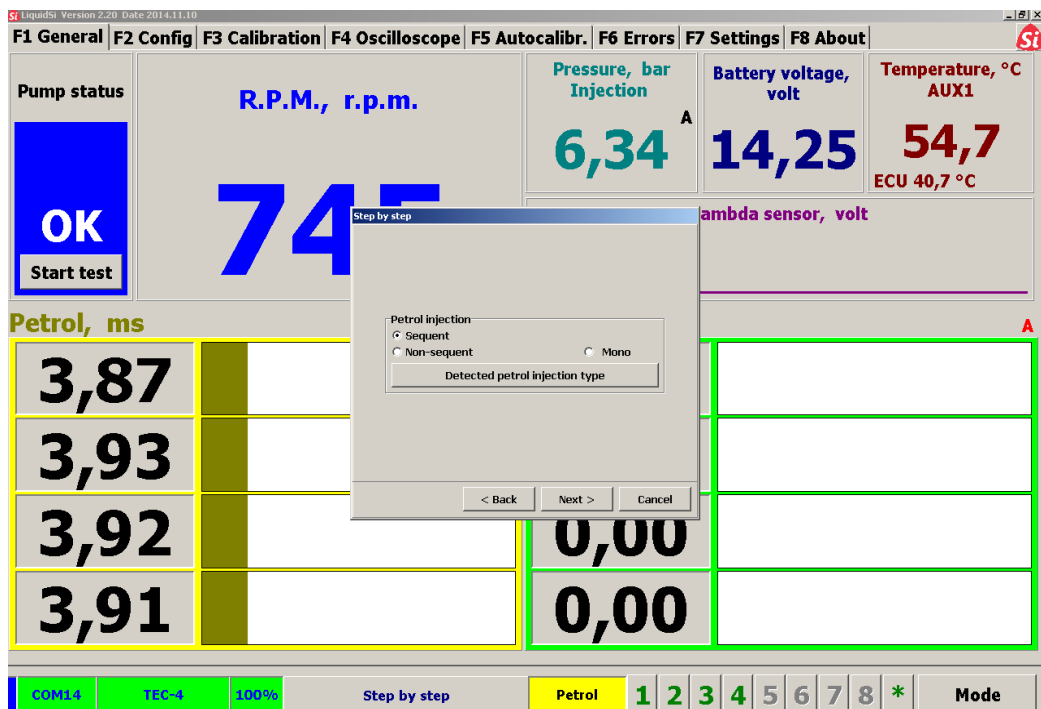
The next window is probably the most important one. It lists the data used for the calculation of engine speed. This parameter is used in many places inside the Software and inside the Firmware.



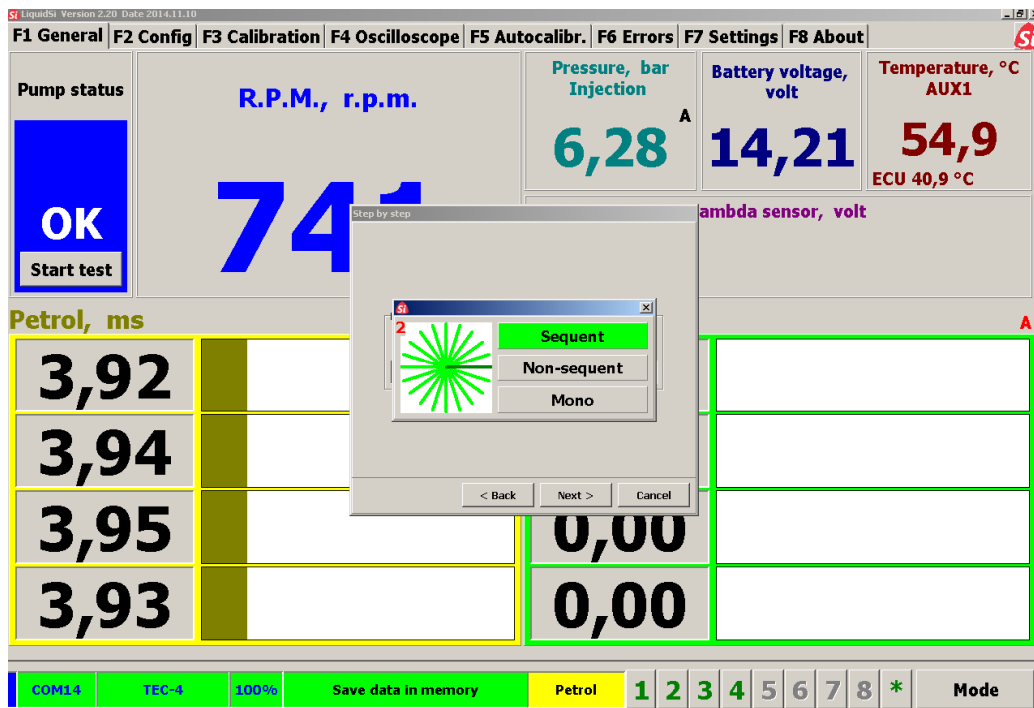
Luckily, pressing the button DETECTED PRESCALER AND THRESHOLD OF SENSITIVITY invokes an automated routine capable of determining the required data automatically. Press START to run the routine.



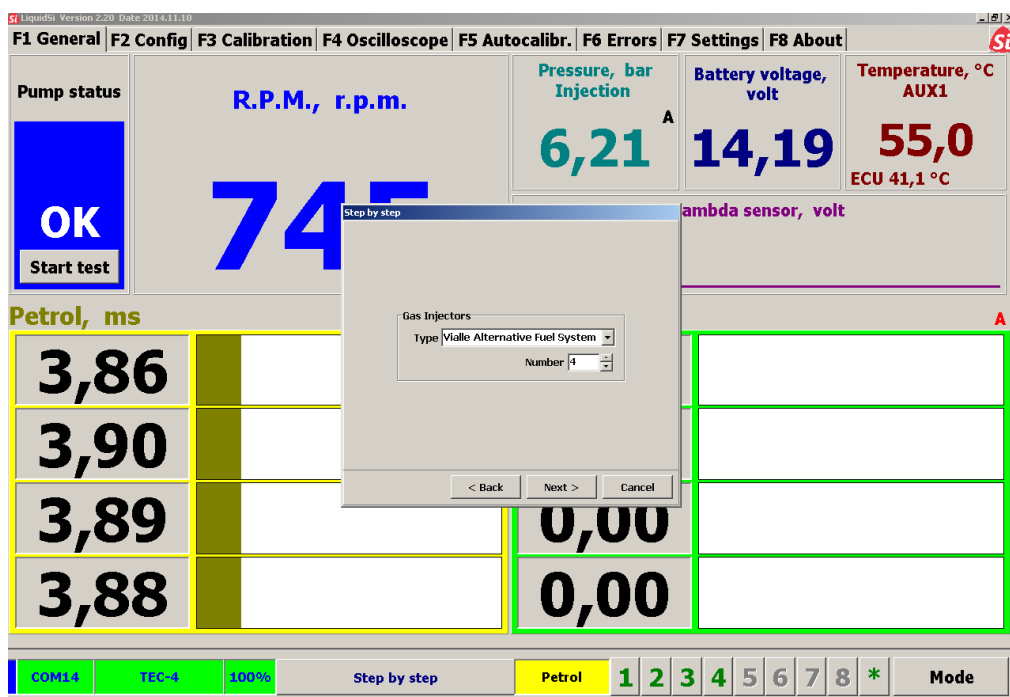
After several seconds the colour of the four text fields of the pop up window should turn GREEN. This indicates that the routine has finished successfully. Press NEXT.



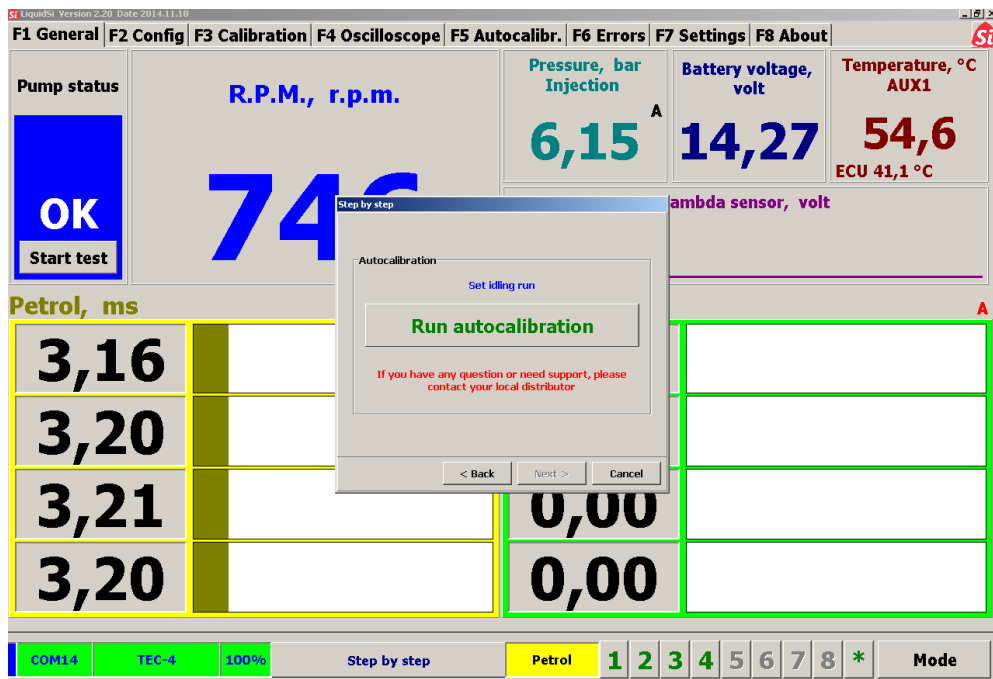
Again, pressing the button DETECTED PETROL INJECTION TYPE invokes a function capable of determining the type of Petrol injection system installed in the car you are working on:



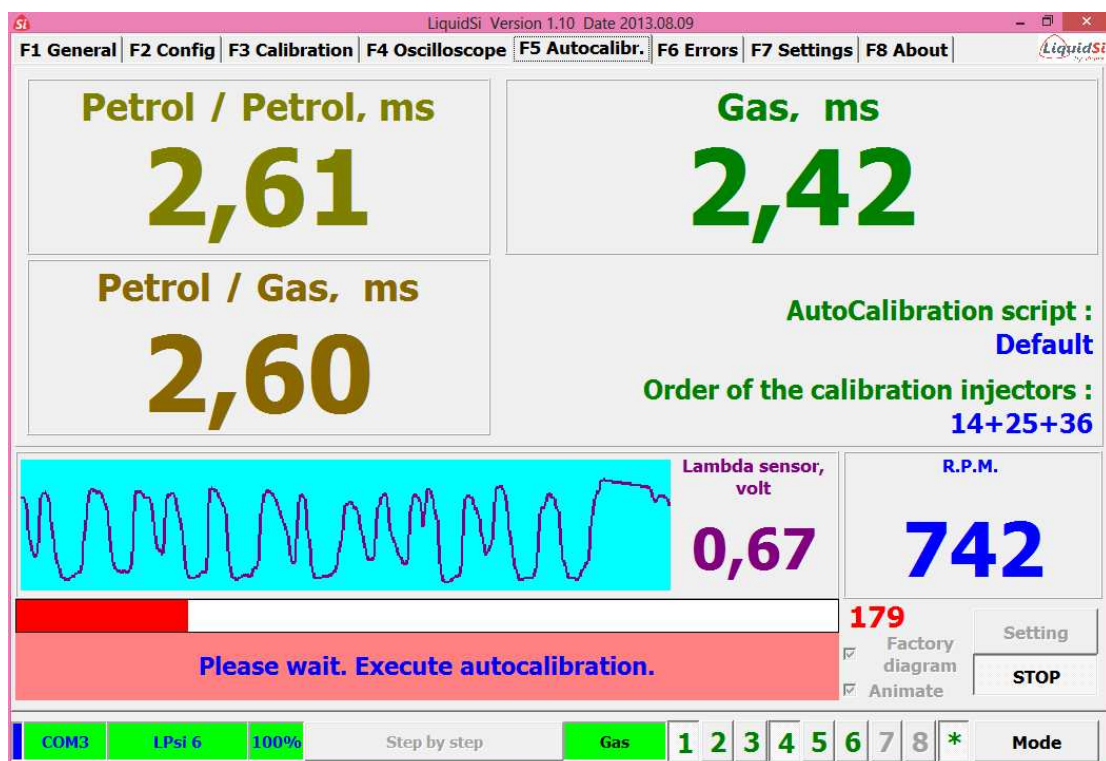
This usually takes a few seconds and the identified injection type is highlighted in GREEN. The small detection routine window closes automatically after 3 seconds. Then press NEXT.



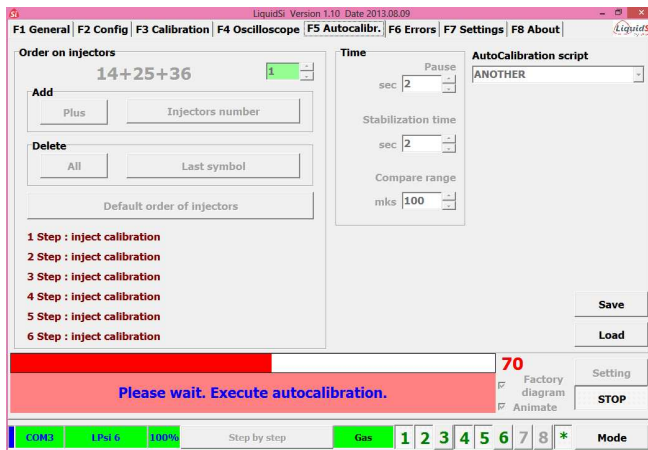
In the above pop up window it is important that you select the correct number of cylinders. This is important for screen lay-out purposes. When done, press NEXT:



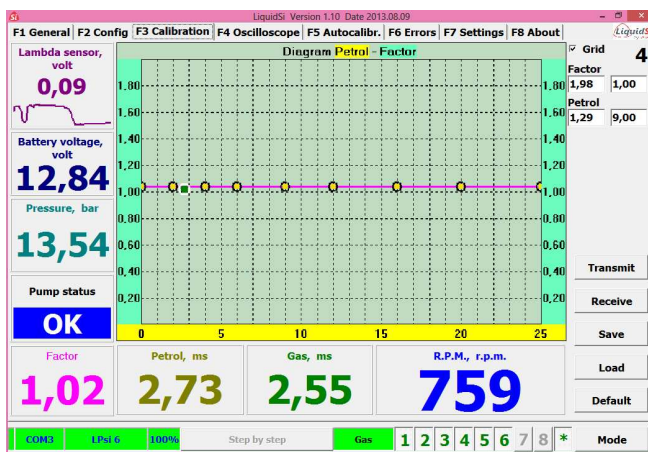
Finally, the last pop up window. Press the RUN AUTOCALIBRATION button and this routine will be started. Alternately, the engine will on Petrol and on Gas for short periods of time whereby the routine tries to minimise the differences between the Petrol pulse time in Petrol mode and the Petrol pulse time in Gas mode.



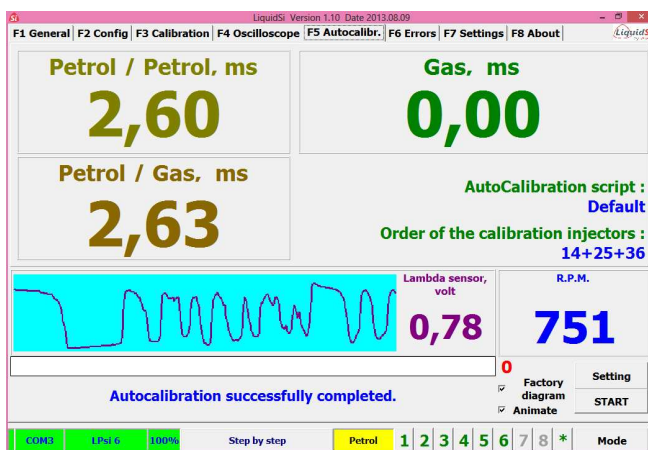
By pressing the button SETTING the user can toggle the display between the lay-out shown above, or the lay-out shown below:



When the checkbox ANIMATE is checked (default), the user will from time to time see the F3 page, showing the current value of the Petrol_factor. The current value of the Petrol_factor is shown in the lower left corner of the F3 CALIBRATION page:

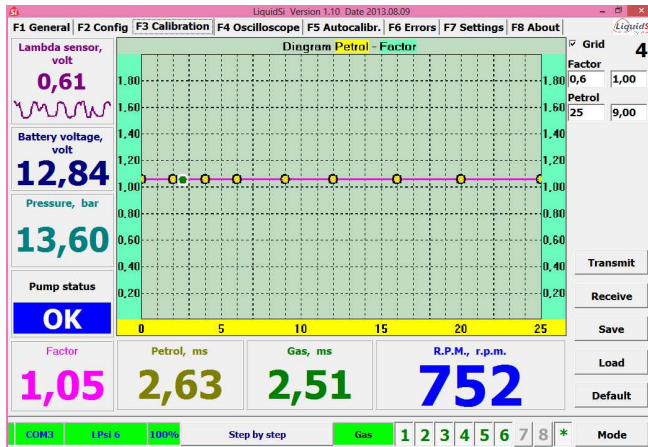


When the routine has finished, this can take several minutes, the display will look like this:



In this case, the final deviation between the Petrol pulse in Petrol mode and the Petrol pulse in Gas mode is indicated to be: 2,63 minus 2,60 equals 0,03 milliseconds. This result is very satisfactory. The resulting Petrol_factor is indicated in F3 window (see below). the value is 1,05. this value should be as close to 1,0 as possible. However, depending on injector flow rates available, the Petrol_factor can (roughly) be anywhere between 0,50 and 1,50. In case

you expect that the Petrol_factor will deviate substantially from 1, you can consider to uncheck the box FACTORY DIAGRAM in this screen: this will force the autocalibration routine to use the existing Petrol_factor line in F3 as a starting point for the calculations. So, first set the Petrol_factor line to the approximate position and then start the autocalibration routine.



NOTE: when the autocalibration has finished, the selected fuel is automatically set to PETROL. Do not forget to switch to GAS in case you are going to continue work on the GAS calibration.

Finally, a first quick check can be carried out by running the car on Gas mode first and then change to Petrol mode and vice versa a few times and observe the (if any) changes in the Petrol pulse time. Use the “*” button on the lower status bar to change over in the fastest possible way (there will be no priming time, no sequential change-over of injectors).

12. “Injection pressure” indicator field. This field indicates the real time value of the injection pressure. Since the pressure sensor is located in the return line connection on the multivalve, the entire fuel feed and return line have the same pressure.

13. “Battery voltage” indicator field. This field indicates the value of the battery voltage, as measured by the TEC. This is not necessarily identical with a voltage measurement across the battery terminals when using a high grade voltage meter.

14. “Temperature, AUX-1” indicator field. This field indicates : OFF in case no temperature sensor is connected to the wiring loom. The field will indicate a temperature in the range from -40 to + 110 in case the temperature sensor is connected to the wiring loom. In the latter case, the value of the temperature is used to determine the correct value for the pump priming time. The translation table for temperature to priming-time is accessible through F2/P->G page. The table values can be edited by the user, although this will normally not be required.

15. “R.P.M.” indicator field. This field indicates the real time engine speed. When starting a new calibration it is vital that this indication is correct: the RPM is determined by the software through processing of the ignition pulses arriving through the (dark brown) ignition(-) wire. This processing needs to be different for distributor type ignition systems, single coil ignition, double coil ignition system. Arriving at the correct setting for the RPM indication can be set by using the options available in the F2/RPM page.

F2/RPM

LiquidSI Version 2.20 Date 2014.11.10

F1 General F2 Config F3 Calibration F4 Oscilloscope F5 Autocalibr. F6 Errors F7 Settings F8 About

R.P.M.

Petrol/Gas

Gas/Petrol

Gas/Petrol/Gas

Gas injectors

Petrol injection

Gas pump

Gas level sensor

Pressure sensor

Lambda sensor

Pressure factors

Offset gas

Offset petrol

Car

Owner

Comments

R.P.M. Source

R.P.M. 753

☒ **Autofilter** **Filter (ms)** 1

Diagnostics **Prescaler** 1:2

Detected prescaler and threshold of sensitivity

Functions of the BROWN wire

Physical RPM Wire

Physical RPM Wire

Virtual RPM with voltage level

Virtual RPM, voltage level on the wire

Transmit

Receive

Save

Load

Default

When virtual RPM engine considered off if the voltage on the brown wire is less than the specified

COM14 TEC-4 100% Step by step Gas 1 2 3 4 5 6 7 8 * Mode

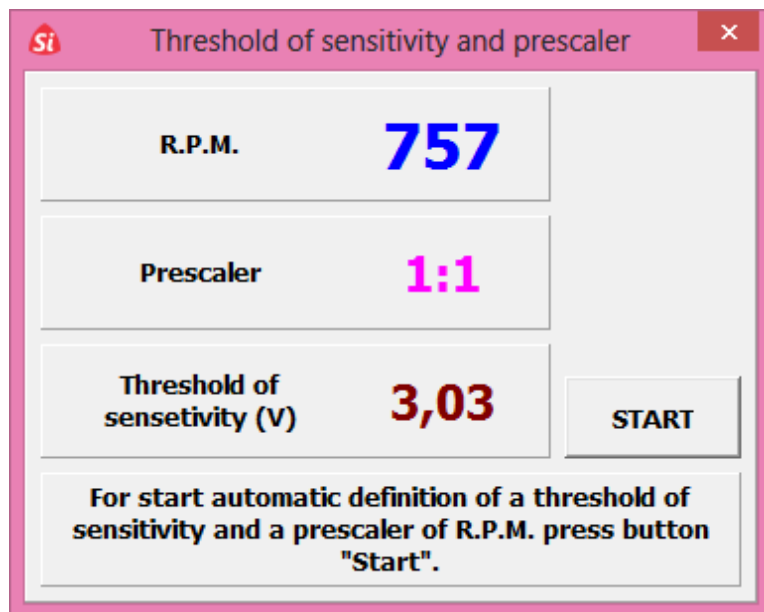
The F2 page consists of a large array of sub pages where a variety of options can be set and where parameters can be modified by the user.

The vast majority of these sub pages will not require any action by the user except in very extraordinary circumstances.

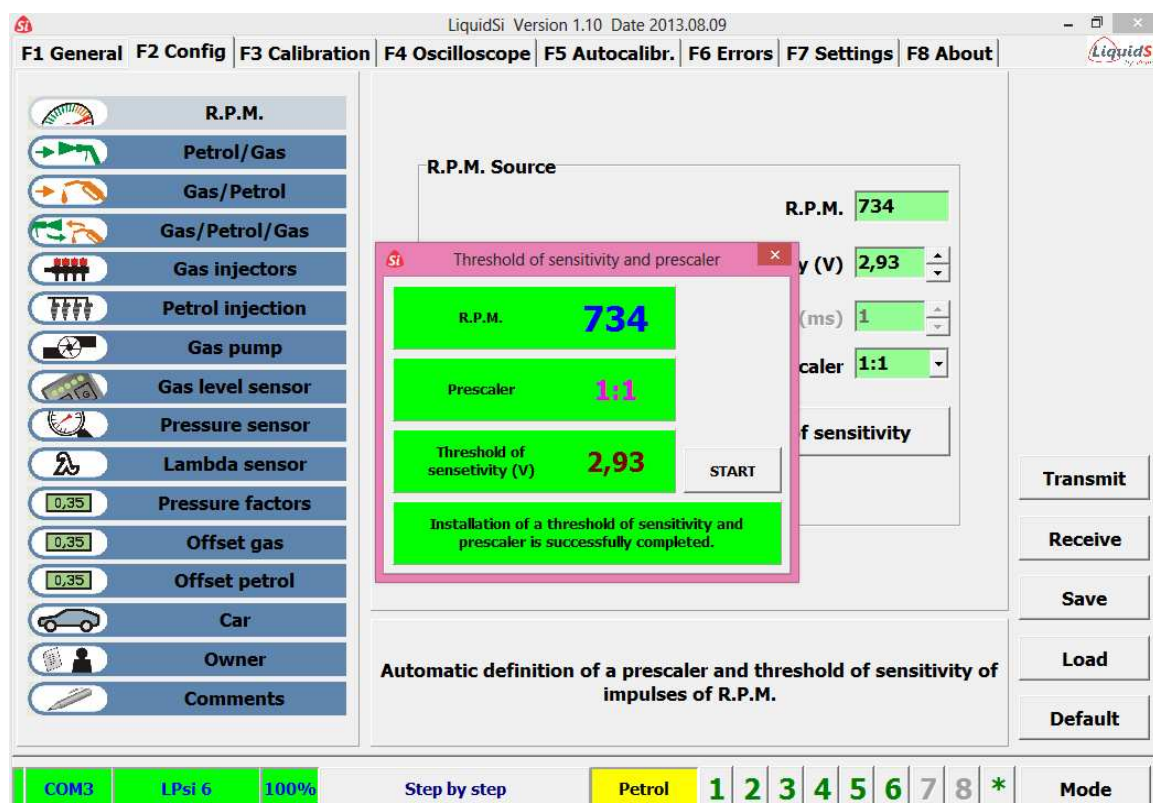
The F2/RPM sub page is vitally important since it needs to set the correct division factor for the ignition (-) pulses arriving in the TEC through the BROWN wire. Only then will the engine speed be presented correctly. This is typically a setting which needs to be made for each new calibration.

The value of the “Prescaler” is the most important one. Selecting 1:1 means that all recorded pulses will be used for RPM calculation. This is usually true for ignition systems whereby each cylinder has its own individual high tension coil. On the other end of the spectrum, if you have a one coil system, connected to a mechanical high voltage distributor, than, for a four cylinder engine, you need to choose the 1:4 Prescaler.

To help you in determining the correct Prescaler setting there is an automatic function available under the button “Detected threshold of sensitivity and prescaler”. It is usually a good idea to first use this function and see if it delivers a correct and stable engine speed indication. This function should be executed in idle condition. Pressing this button pop up the following window:



Pressing the START button makes all four text fields turn either RED or GREEN. When the routine has finished, all four text fields should be GREEN:

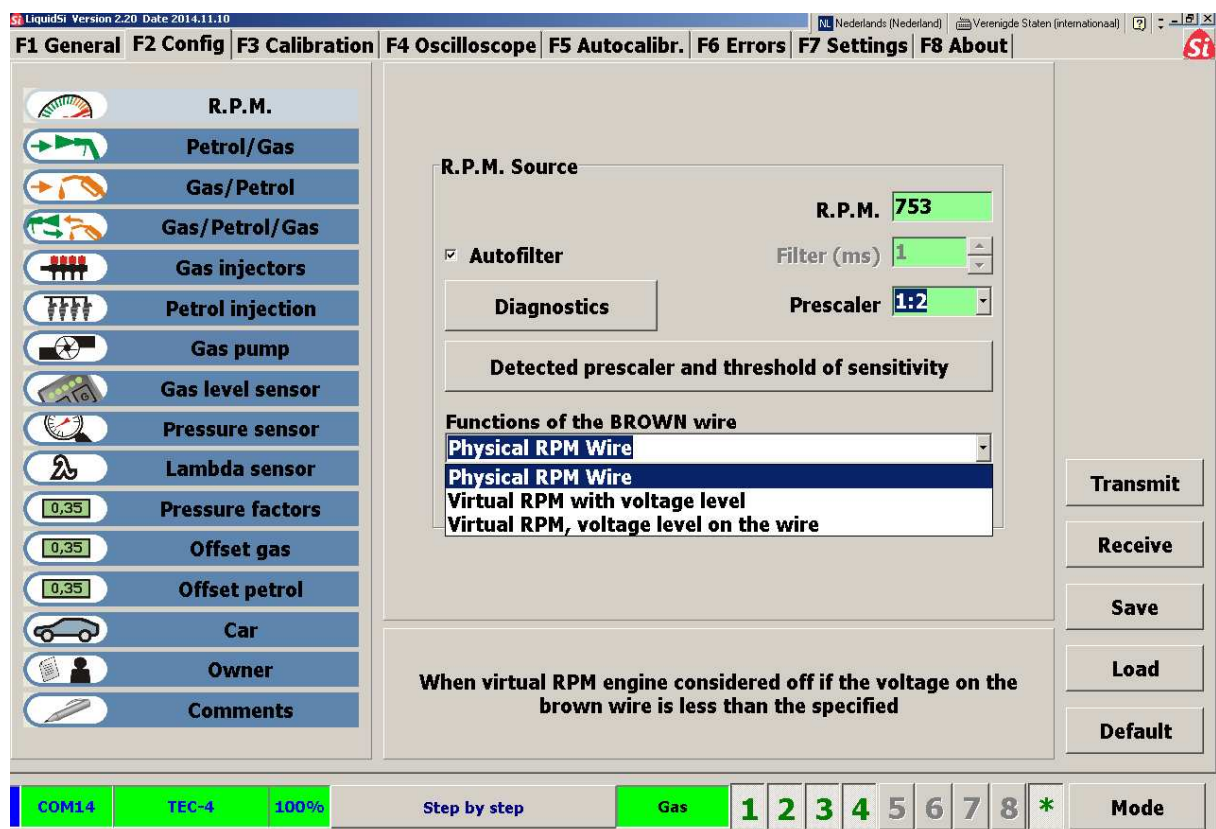


The pop up window can now be closed.

The checkbox “Virtual RPM” is unchecked by default. You can check this box if it is not possible to arrive at a stable RPM signal using any of the available pre-scalers or filters. When checked, the RPM is calculated indirectly by measuring the interval times between (Petrol) injections.

A new drop down menu is now available: “Function of the BROWN wire”. The BROWN wire refers to the wire connected to the TEC pin 56. in TEC1 this wire needs to be connected to the low side of the

ignition coil, serving two purposes: picking up the ignition pulses for RPM calculation and also as safety measure to determine if the engine is actually running or not. This became an issue in the TEC1 if the VIRTUAL RPM box was ticked: in case of FCO (fuel cut off) there are no injection pulses so the TEC1 had to conclude that the engine had stopped for some reason. When leaving the FCO condition the LiquidSi system had to restart completely. In the new TEC2 there are now possibilities for connecting the BROWN wire to any signal in the car which is a reliable signal indicating whether the engine is running or not. In some cases this can be the battery voltage for example, in other cases there can be a clear main relays signal available. Also, in some cases there is a MAP sensor signal available indicating a running engine or a stalled engine. To this end the user can set a threshold voltage level and also if the signal level must be higher or lower than the threshold.



Side bar Control buttons

- “Transmit” - keyboard shortcut “T”

Transmits data of configuration to the TEC. When the checkbox on “Data CFG and CLB together” in F7 SETTINGS checked, calibration data are transmitted to the TEC also. This option is checked by default.

- “Receive” – keyboard shortcut “R”

Receives from the TEC unit the current configuration data. When the checkbox “Data CFG and CLB together” in F7 SETTINGS is checked, calibration data are received also.

- “Save”- keyboard shortcut “S”

Saves the configuration data into the current xxx.CFG file on you hard drive. The standard Windows file/save dialog window appears. The default directory for saving configuration files is xxxx/program files/liquidsi/config.

- “ Load “ – keyboard shortcut “L”

Loads configuration data from .CFG file. The standard Windows file/save dialog window appears. The default directory for loading configuration files is xxxx/program files/liquidsi/config.

- “Default” – “D”

Resets all configuration data to Default.

For more detail on these buttons see the chapter on: F2/CAR.

F2/Tab: PETROL/GAS

LiquiSI Version 2.20 Date 2014.11.10

F1 General F2 Config F3 Calibration F4 Oscilloscope F5 Autocalibr. F6 Errors F7 Settings F8 About

R.P.M.

Petrol/Gas

Gas/Petrol

Gas/Petrol/Gas

Gas injectors

Petrol injection

Gas pump

Gas level sensor

Pressure sensor

Lambda sensor

Pressure factors

Offset gas

Offset petrol

Car

Owner

Comments

Switching Petrol -> Gas

☐ **Dual-fuel injection in switching**

Injection pressure (bar) > 3,0

R.P.M (rpm) > 600

Nozzle delay (sec) 2,0

Suspend petrol injection 8

Delay after ignition "on" (sec) 5

System priming time (sec) 16

Result of dry run test

☒ **Emergency start of the car with gas**

Countner 0 Clear Allowed 0

Functions of the YELLOW wire

Function is disabled

Transmit

Receive

Save

Load

Default

Switching Petrol -> Gas : Result of dry run test

COM14 TEC-4 100% Step by step Gas 1 2 3 4 5 6 7 8 * Mode

This page gives all parameters that control the automatic switching from Petrol to LPG after the car has been started. This automatic switching occurs only:

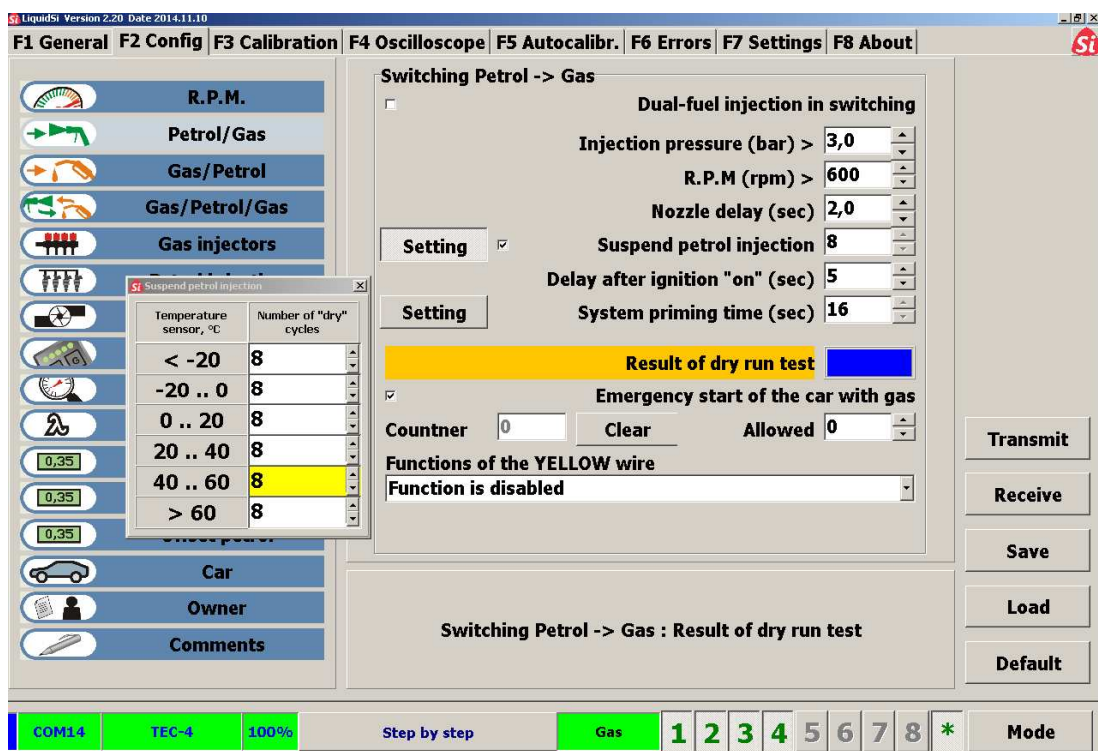
- When the fuel switch is in Automatic (= Gas) mode. This means that during the previous driving events, before engine shut down, the fuel switch was in Gas mode.
- When the engine is started and the necessary automated self tests are completed successfully
- When RPM is higher than a threshold value. Default value is 600 RPM.
- When injection pressure is over a certain threshold value. Default value is 3,0 bar.
- When the System priming time has elapsed. Default value is 40 seconds (if no temperature sensor is connected).

All five conditions must be met before switching takes place. These conditions are only checked once - after startup - not continuously.

1. Checkbox "Dual fuel injection in switching". Checking this box forces the software to generate 1 Petrol pulse and 1 Gas pulse simultaneously. This is a valuable tool if you find that the vehicle is not smooth in switching from Petrol to Gas. Default is Unchecked. In case the gas injectors are installed relatively far from the Petrol injectors (injection hoses > 5 cm), it is usually a good idea to check this box.

2. Injection pressure (bar). User can input a threshold value. Below this value the engine remains in petrol mode. The injection pressure is evaluated after the dry-run test. The dry-run test is explained in detail in F2/GAS PUMP. Range = 1 ... 30 bar. Default value = 3 bar.
3. RPM. User can set a minimum engine speed below which the fuel will not change from Petrol to LPG. Range = 600 ... 8000 RPM. Default = 600 RPM.
4. Nozzle delay(sec). This is the time interval that elapses between the change over of each set of injectors. Example: if set to 2 seconds, it takes a total of 8 seconds before fuelling has changed over completely from Petrol to LPG for a 4 cylinder engine. This function becomes active after the priming time has elapsed. Range = 0 ... 10 seconds. Default = 2 seconds.
5. Suspend petrol injections. This new feature makes it possible to disable the petrol injectors for a controlled number of injections during cranking. In the textbox you can enter the number of petrol injection to disable. This function is for example used in converting several Toyota models to Gas since these models sometimes use extremely long petrol injection pulses during cranking. Now you can disable one or more of these extreme injections. When you press the SETTINGS button next to this text field, you can enter the required number of suspended petrol injections as a function coolant temperature. This is helpful in case the cranking is to be improved in the morning with a cold engine, while there might be no need to suspend Petrol injection under hot start conditions. DEFAULT = unchecked.

IMPORTANT: this function only works when the ignition key has been turned into the "ON" position and is held there for more than 0,25 seconds before the key is turned further into the "START" position.

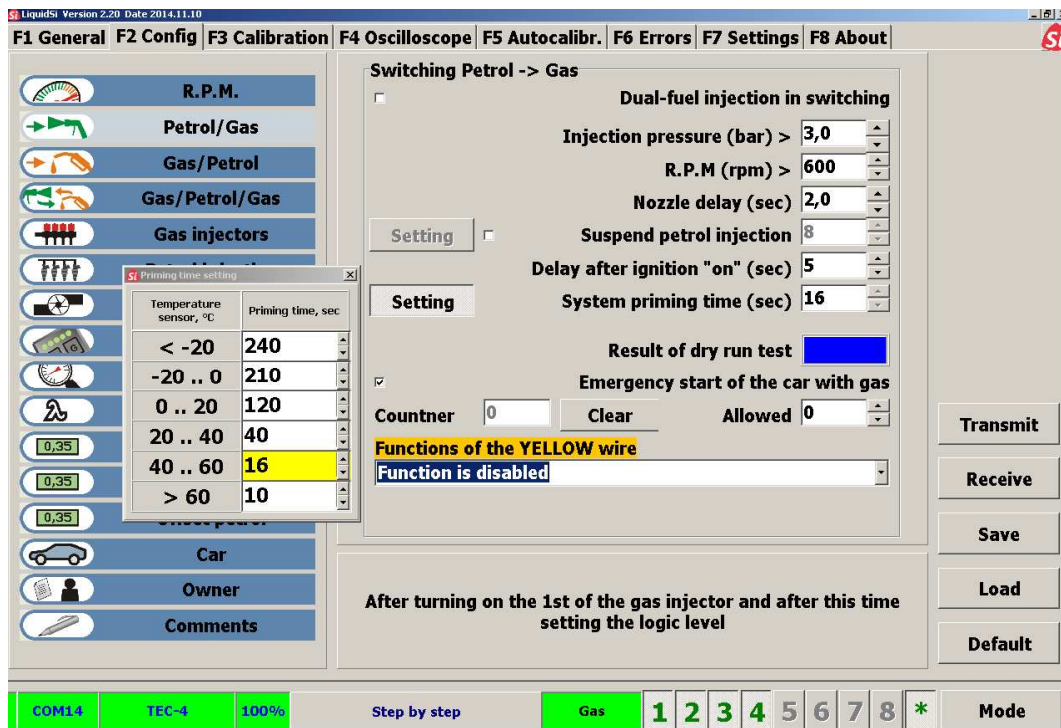


6. Delay after ignition on. This is a general pause time. Basically nothing happens during this period. Engine runs on Petrol, all LPG valves are closed. Range = 1 60 seconds. Default = 5 seconds.
7. Result of dry-run test. To protect the LPG pump against dry-run damage resulting from too low fuel level inside the tank, it is important that software checks if the pump activation results in a certain amount of pressure rise. This test is explained in detail in F2/GAS PUMP. This test is carried out each time there is a switch from Petrol to Gas. If result of this test is positive, then the indicator field changes from RED to BLUE.

NOTE: This test is **not** performed during temporary GAS → PETROL → GAS events.

It is important to note that there is no information on the fuel level inside the LPG tank available inside the TEC unit. The level indicator integrated into the fuel switch is only intended to give the driver an indication of the useable fuel content left inside the LPG tank. The advanced algorithms used together with the Jet buffer system make it possible to deplete the Gas tank almost completely.

8. System priming time(sec). The LPG pump needs time to purge the system so that no vapour is left inside the fuel Lines and injectors. This procedure is started directly after the dry run test has been completed. The solenoids and the pump have already been started prior to the dry-run test. After the priming time has elapsed, the LPG injectors are started. If no temperature sensor/clip is connected, the user can edit the duration of this priming time. Range = 0 ... 200 seconds. Default = 40 seconds. The remaining priming time is shown, real time, inside the (BLUE) pump status field in the F1 GENERAL page.
9. Button: SETTING (system priming time). If the pressure sensor/clip is connected, pressing this button pops up a window giving you the possibility to edit a 2D table (see below). This table outputs values for priming time based upon temperature readings as input. The temperature is measured by the AUX Temperature sensor which is connected to the wiring loom over a 2-pole connector. This sensor is integrated into a plastic clip which is clamped over one of the engine heater hoses.



10. Checkbox: “Emergency start of the car with Gas”. This box is checked by default. This function gives the customer the possibility to start the car on LPG, even if the Petrol tank is completely empty.

The correct procedure is as follows:

1. push and hold the “Si” button on the switch
2. turn the ignition key to the “ON” position
3. now wait for the five GREEN LEDs to simultaneously flash and the buzzer should give a repeating beep tone
4. now you can release the “Si” button and wait a few seconds for the Gas pump to circulate fresh fuel over the injectors (releasing this button opens the solenoids and starts the Gas pump)
5. Start the engine.

ATTENTION: for this procedure to work it is of the utmost importance that the RED wire (KL-15 or Ignition + (5amps fuse)) is connected to a voltage source which provides +12V when the ignition key is turned in the “ON” position and also during cranking. You can check this by observing the LiquidSi switch while turning the ignition key into the “ON” and in to the “cranking” position: if the light(s) of the switch remain lit while you are turning the key, then the RED wire is connected correctly.

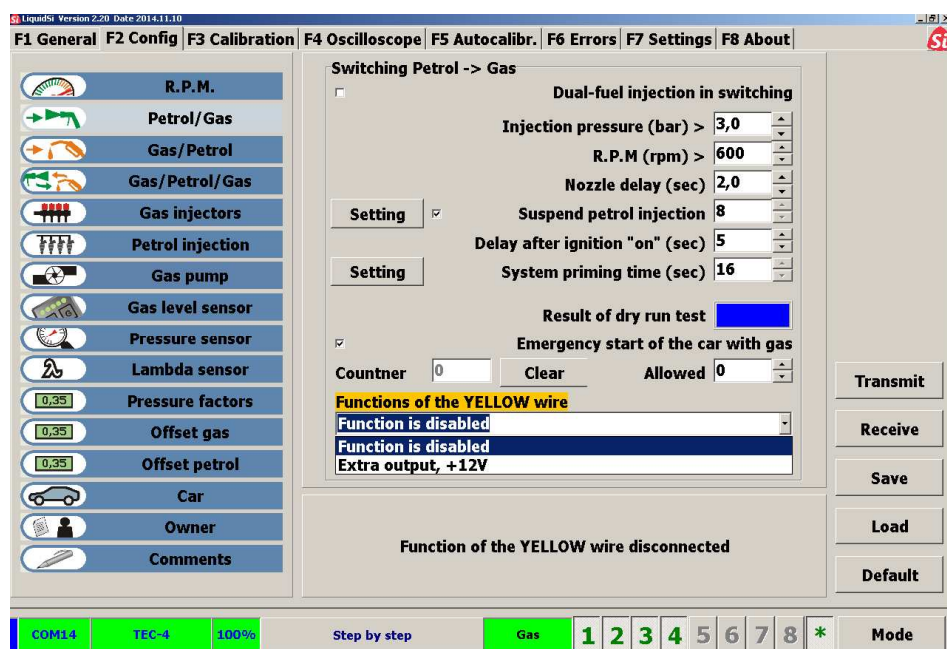
11. Textbox "Counter". This counter shows the number times that the driver has used the "emergency start on Gas" function. This number can be cleared by pressing the "CLEAR" button.
12. Textbox "Allowed". The installer can enter into this box the number of times that the "emergency start on Gas" function can be used by the driver. The purpose of the "Allowed" parameter is to give the installer a means of checking, or limiting, the number of times that this function can be used. This is used in cases where excessive damage is claimed for one or more components inside the Gas system. Using the emergency procedure there are no checks for gas pressure or vapour building inside the system. This could therefore result in damage to the injectors (if no liquid fuel inside the injectors) or to damaged Gas pump if this function is used when also the Gas tank is empty.

ATTENTION: by default the value for "Allowed" is "0". This means that an unlimited number of emergency starts are possible. Only when you enter a number > 0, the allowed number of emergency starts is being limited.

13. Pull down menu: "**FUNCTIONS OF THE YELLOW WIRE**". This new function allows the user to activate an external device such as an emulator when the engine has switched over from Petrol to GAS. The user can set the exact pause time. When "0" is entered, the yellow wire will go live immediately after the first Petrol injector has switched over to GAS. So, if you enter "10" into the textbox, the TEC2 will wait for the first Petrol injector to switch over to GAS, then wait an additional 10 seconds and then activate the yellow wire.

IMPORTANT: the yellow wire is capable of delivering +12Volt with a maximum current of <3 Amps.

IMPORTANT: when you install the TEC2 into a vehicle which was originally installed with the TEC1, there will be no Yellow wire in the wiring loom. In that case you can install the extra yellow wire yourself and connect it to PIN 50 of the TEC2 main connector.



F2/Tab: Gas/Petrol

Auto switching Gas -> Petrol

☒ **Endless beep**

☐ If injection pressure (bar) > 30

☐ If injection pressure (bar) < 3,0

After time period (sec) of 5

☒ If injection pressure drops (bar) > 2,4

If injection pressure rises (bar) > 2,0

Minimum restart pressure drop (bar) > 0,5

Min time for temporary petrol operation (sec) 5,0

Min time for temporary gas operation (sec) 1,0

Max time to allow temporary petrol operation (sec) 10,0

Injection pressure recording interval (sec) 1,0

Number of record interval to look back 6

Transmit

Receive

Save

Load

Default

For moving under the menu of a configuration use "mouse" or buttons of management of the cursor on the keyboard

COM14 TEC-4 100% Step by step Gas 1 2 3 4 5 6 7 8 * Mode

The F2 GAS/PETROL page has all the parameters which control the automatic switching from Gas to Petrol. There are two main conditions: first one is the out of range value of the injection pressure and the second one is the detection of a sudden drop in injection pressure resulting from an empty fuel tank condition. The system will automatically switch back to GAS after you have refueled the car. Of course this only works if you have not pressed the fuel switch in the mean time!

1. Checkbox "Endless beep". When checked, the buzzer inside the switch will be activated in case fuelling is automatically switched from Gas to Petrol. The buzzer is never activated in case fuel is switched to Petrol temporarily (deceleration cut-off, idling on Petrol, fuel clipping etc). When checked, the buzzer gives an endless beeping signal which only stops if you press "Petrol". Default = Unchecked.
2. Checkbox "If injection pressure(Bar) >". When this box is checked, the system will switch automatically to Petrol when the injection pressure exceeds a certain threshold value. This function can be used if local/national regulations demand such a feature. Range = 15 ... 35 bar. Default = 30 bar. This field is greyed out when a TEC2 is connected to this V2.20 software. This is because this function has been moved into the F6 ERROR tab.
3. Checkbox "If injection pressure(Bar) <". When this box is checked, the system will switch automatically to Petrol when the injection pressure drops below a certain threshold value. This function can be used if local/national regulations demand such a feature. Range = 0,1 ... 10 bar. Default = 3 bar. This field is greyed out when a TEC2 is connected to this V2.20 software. This is because this function has been moved into the F6 ERROR tab.

4. „After time period (sec) of“. Here a minimum duration can be prescribed during which the injection pressure has to be in accordance with condition 2. or 3. Range = 1 ... 20 seconds. Default = 5 seconds. This field is greyed out when a TEC2 is connected to this V2.20 software. This is because this function has been moved into the F6 ERROR tab.
5. Checkbox “ If injection pressure drop(Bar) >“. When checked, the system monitors the injection pressure for sudden drops in pressure, indicating an empty LPG tank. Sometimes, in case of service for example, it is advantageous to temporarily disable this function. Also, this function can be disabled if the vehicle has been shown to signal a pressure drop which was not traced back to an empty tank condition. Range = 0 ... 5 bar. Default = 2,4 bar for PTS-40 pump.

NOTE: Do not change this value. This function is designed to detect a shortage of fuel provided by the LPG pump. When a certain pressure drop is detected the gas injectors are immediately switched off and the petrol injectors are switched on (**solenoids and pump remain activated!!!**). See also F2 GAS/PETROL/GAS for more details.

6. “restore if injection pressure rises[bar]”. After a temporary switch over to Petrol as a result of the condition under 5) being active, the system will allow the return of the fuelling back to Gas if the injection pressure rises a certain amount within a specified period of time (see item 10). Range = 0 ... 5 bar. Default = 2,0 bar for PTS-40 pump.
If the pressure drop signalled in the previous function recovers within a specified period of time, then the software concludes that the fuel tank is not empty after all but the fuel pump had a temporary shortage of fuel (long, high speed cornering for example). In that case the software shall then turn the gas injectors back on. In case the injection pressure remains below the threshold value for longer than the time period defined in item 8), then the system switches back to petrol permanently (solenoids are closed and pump is stopped, buzzer is activated).

NOTE: this recovery option can be disabled by entering the highest possible value for item 6).

7. “Minimum restart pressure drop (bar)”. Do not change this value. Default = 0,5 [bar].
8. “Minimum time for temporary Petrol operation[sec]”. If the system switches back to Petrol because a certain pressure drop was signalled, this parameter sets the minimum time during which the fuelling shall remain on Petrol. This avoids unwanted rapid oscillations. Do not change. Range = 0 ...10 [sec]. Default = 5 [sec].
9. “Minimum time for temporary LPG operation[sec]”. If the system switches back from Petrol to LPG because a certain pressure rise was signalled, this parameter sets the time during which the fueling shall remain on LPG. This too avoids unwanted rapid oscillations. Do not change. Range = 0 ...2 [sec]. Default = 1 [sec].

10. “Maximum time to allow temporary Petrol operation[sec]”. A timer is started when the first LPG pressure drop has been signalled. With this parameter the duration of the timer is set. Do not change. Range = 0 20[sec]. Default = 10 [sec].
11. “Injection pressure recording interval[sec]”. The injection pressure is recorded into memory at a certain rate. The time interval between these records is given by this parameter. These stored values are used by the software to detect as accurately as possible the occurrence of a pressure drop or pressure rise. Do not change. Range = 0 ... 2 [sec]. Default = 1[sec].
12. “Number of recorded intervals to look back”. Pressure drops and pressure rises are detected by comparing the actual (real time) injection pressure with the recorded (historical) injection pressure. This parameter sets the number of elements (=time) to look back into the records of the recorded injection pressure. Do not change. Range = 1 ... 15. Default = 6.

F2/Tab: GAS/PETROL/GAS

Temporary switching Gas <-> Petrol

☒ **Run** Current **750**

To petrol, if R.P.M > **4000**

To gas, if R.P.M < **3900**

☒ **To petrol, if R.P.M. idle run < 500**

☒ **To petrol, to exit Cut-off (quantity cycles) 20**

☒ **2 Fuel on/off**

Delay time 2 fuel function (sec) **180**

Cycle time period (sec) **30**

	ms\rpm	2000	3200	R.P.M.
Petrol injection (ms)	4,20	1	1	
Gas injection (ms)	8,00	1	1	

2 Fuel time (sec)

1

1

Temporary switching Gas <-> Petrol : switch to petrol, if R.P.M. is less (idle mode)

Transmit

Receive

Save

Load

Default

COM14 TEC-4 100% Step by step Gas 1 2 3 4 5 6 7 8 * Mode

The F2 GAS/PETROL/GAS page controls the temporary switching from GAS to Petrol and back. This can occur in four different conditions:

- clipping of GAS fuelling above a certain RPM,
- temporary switching to Petrol in idle conditions,
- to use Petrol for the first injections when fuelling is reinstated after a FCO condition,
- when the 2FUEL function is activated.

NOTE: solenoids and pump remain activated in case of such a temporary GAS->PETROL->GAS switch.

1. Checkbox "Run"(fuel clipping). The default setting in F2 GAS/PETROL/GAS for Fuel Clipping is: ON. This function should ensure that engine Gas demand is never higher than the maximum Gas supply which the pump can deliver. When the engine demands more fuel than the pump can deliver, the fuel clipping kicks in and temporarily switches the fuelling from Gas to Petrol. This behaviour is controlled by two settings: the RPM where fuel clipping comes in (default = 5000 RPM) and the RPM below which the fuelling is switched back to Gas.
To not confuse the TEC, the pressure drop resulting from an increasing engine fuel demand must never be more than the 2,4 Bar (or a different value if you have changed the value in F2 GAS-PETROL field "If injection pressure drops >(Bar)") which is used as the threshold pressure-drop value for detecting an empty tank. This pressure drop monitoring is used to detect an empty tank situation.

So, the best way to avoid this confusion is to make a test drive and use the F4 SCOPE to monitor the drop in injection pressure while increasing the engine speed/load. If pressure drop is considerably smaller than the threshold value at the point of fuel-clipping, then you can increase the RPM threshold. Or, in case of a relatively small engine, you might disable fuel clipping all together. Again, you must observe the injection pressure trace in the F4 SCOPE to make sure.

Checking this box activates the fuel clipping function and the parameters for “To Petrol RPM” and “To GAS RPM” have to be set by the user. Default = checked.

2. “To Petrol RPM \geq ”. The engine speed above which fuelling has to change from Gas to Petrol needs to be set here. Range = 3000 ... 7000 RPM. Default = 5000.

3. “To Gas RPM \leq ”. The engine speed below which the fuelling is changed back to GAS needs to be set here. Range = 2000 ... 6000 RPM. Default = 4900. NOTE: you must make sure that there is sufficient hysteresis between the engine speeds set in 2. and 3. to prevent frequent changes in fuelling.

4. Checkbox “To Petrol if RPM idle run \leq ”. With this function it is possible to have the engine run idle on Petrol while using Gas in all other operating modes. This can be very useful if the engine you are working on will not show a satisfactory idling behaviour on Gas. Default = Unchecked.

5. “To Petrol if RPM idle run \leq ”. With this function it is possible to have the engine run idle on Petrol while using Gas in all other operating modes. This can be very useful if the engine you are working on will not show a satisfactory idling behaviour on Gas. Range = 500 ... 1500 RPM. Default = 500 RPM.

6. Checkbox “To Petrol to exit FCO”. With this function the user can force the system to use a certain number of Petrol injections before changing to Gas injections when leaving FCO operating mode. This can be used in case Gas injector are placed relatively far away from the intake ports or in case of extremely short Petrol injections when fuelling is reinstated. Default = Unchecked.

7. “To Petrol to exit Cut-Off (quantity cycles)”. With this function the user can force the system to use a certain number of Petrol injections before changing to Gas injections when leaving FCO operating mode. This can be used in case Gas injector are placed relatively far away from the intake ports or in case of extremely short Petrol injections when fuelling is reinstated. The number of crankshaft revolutions during which Petrol is injected can be set here. Range = 1 ... 255 revolutions. Default = 20.

8. Checkbox “2FUEL on/off”. This checkbox activates the 2FUEL function. This function is designed to help in minimising valve seat recession by periodically injection Petrol instead of Gas. The parameters you need to set are discussed below. The 2FUEL function can be used together with the “Dual fuel injection in switching” option in F2/Petrol/Gas. Combining these options can help in case you feel some irregularities while driving with 2FUEL activated. Most importantly the following conditions apply if you wish to use this option:

- since the fueling is alternating between Petrol and Gas in a very high frequency, it is of the utmost importance that the Gas injectors are positioned as close to the original Petrol injector location as possible

- The length of the injection hose between injector and nozzle must also be as short as possible (you might try to also check the box: "Dual fuel injection in switching").

The algorithm has as inputs the engine speed and the Petrol pulse width. You must set two engine speeds and two Petrol pulse widths. Below the lowest RPM there is no 2FUEL available. Below the lowest pulse width there is also no 2FUEL available.

Explanation of the 2FUEL table

See example screen shot below for the default 2FUEL configuration.

IF the engine speed is below 1500 OR the Petrol pulse is below 3,00ms THEN there is no 2FUEL activity.

IF the engine speed is between 1500 and 4000 AND Petrol pulse is between 3,00 and 6,50 THEN 2FUEL time is 1 second (so, there is a repeated sequence of 30 seconds of Gas operation followed by 1 second of Petrol operation).

IF engine speed is > 4000 AND Petrol pulse > 6,50 THEN the 2FUEL time is 4 seconds.

IF engine speed between 1500 and 4000 AND Petrol pulse is > 6,50 THEN 2FUEL time is 3 seconds.

IF engine speed is between 1500 and 4000 AND Petrol pulse is between 3,00 and 6,50 THEN the 2FUEL time is 2 seconds.

☒ **2 Fuel on/off**

Delay time 2 fuel function (sec) 120

Cycle time period (sec) 60

	ms\rpm	1500	4000	R.P.M.
Petrol injection (ms)	3,00	1	2	
	6,50	3	4	
				2 Fuel time (sec)

Example of 2FUEL configuration

9. Delay time 2FUEL function(sec). This parameter sets the time interval (in seconds) for the 2FUEL function to become active, AFTER the engine has switched to Gas. This means that there is the dry-

run test, the priming time, the actual switching over to Gas and only then the “delay time 2FUEL” starts to count down.

10 Cycle time period(sec). This parameter sets the time interval (in seconds) for the Petrol injection events to happen. Example: if this parameter is set to 30 seconds (=default value) then the engine will run on Gas for 30 seconds and will then change to Petrol for 1,2,3 or 4 seconds and then return to Gas and the sequence is started again. This fuelling change-over happens per cylinder and in a sequential manner. The duration of the Petrol injection events (in seconds) is determined by the settings in the 2x2 table as explained earlier.

11 setting the values in the 2FUEL table. Setting the optimum values in this table is not going to be easy. Much depends upon the experience of the installer. However, some general guidelines can be given:

- check the Petrol pulse RANGE of the vehicle you are working on. Some vehicles have a very wide range of Petrol pulses: 3 to 30ms is no exception. Other vehicles are in a much closer range like 1,5 to 9 ms. This might give you some clues for setting the two RPM break points in the table.
- the same concept obviously applies to settings for the RPM break points.
- the percentage of Petrol fuel consumption when using the 2FUEL function can be estimated as follows:

1. Calculate the sum of the values in the four cells (in the example: $1+2+3+4 = 10$)
2. Divide this number by 4 ($10/4 = 2,50$)
3. Divide the “Cycle time period” by this result and multiply by 50% ($2,50 / 30 \times 50\% = 4,2\%$)

F2/Tab: GAS INJECTORS

The screenshot shows the 'F2 Config' tab in the 'LiquidSI Version 2.20' software. The 'Gas Injectors' section is active, displaying a 'Type' dropdown menu set to 'Vialle Alternative Fuel System'. Below this, the 'Number' is set to 4 and the 'Range (ms)' is set to 32. To the right, three parameter fields are visible: 'Start pulse (mks)' set to 0, 'Duty Cycle (%)' set to 1, and 'Frequency (kHz)' set to 0. A 'PWM data' label is positioned to the left of these fields. On the far right, there are five buttons: 'Transmit', 'Receive', 'Save', 'Load', and 'Default'. At the bottom of the main panel, a text label reads 'Injectors number (always 4 in this version)'. The left sidebar contains various configuration options like 'R.P.M.', 'Petrol/Gas', 'Gas/Petrol', 'Gas/Petrol/Gas', 'Gas injectors', 'Petrol injection', 'Gas pump', 'Gas level sensor', 'Pressure sensor', 'Lambda sensor', 'Pressure factors', 'Offset gas', 'Offset petrol', 'Car', 'Owner', and 'Comments'. The bottom status bar shows 'COM14', 'TEC-4', '100%', 'Step by step', 'Gas', and a row of numbered buttons from 1 to 8, with 'Mode' on the right.

The F2 GAS INJECTORS page gives an overview of the gas injectors that can be used with LiquidSI. There is usually no need to edit any of the parameters on this page.

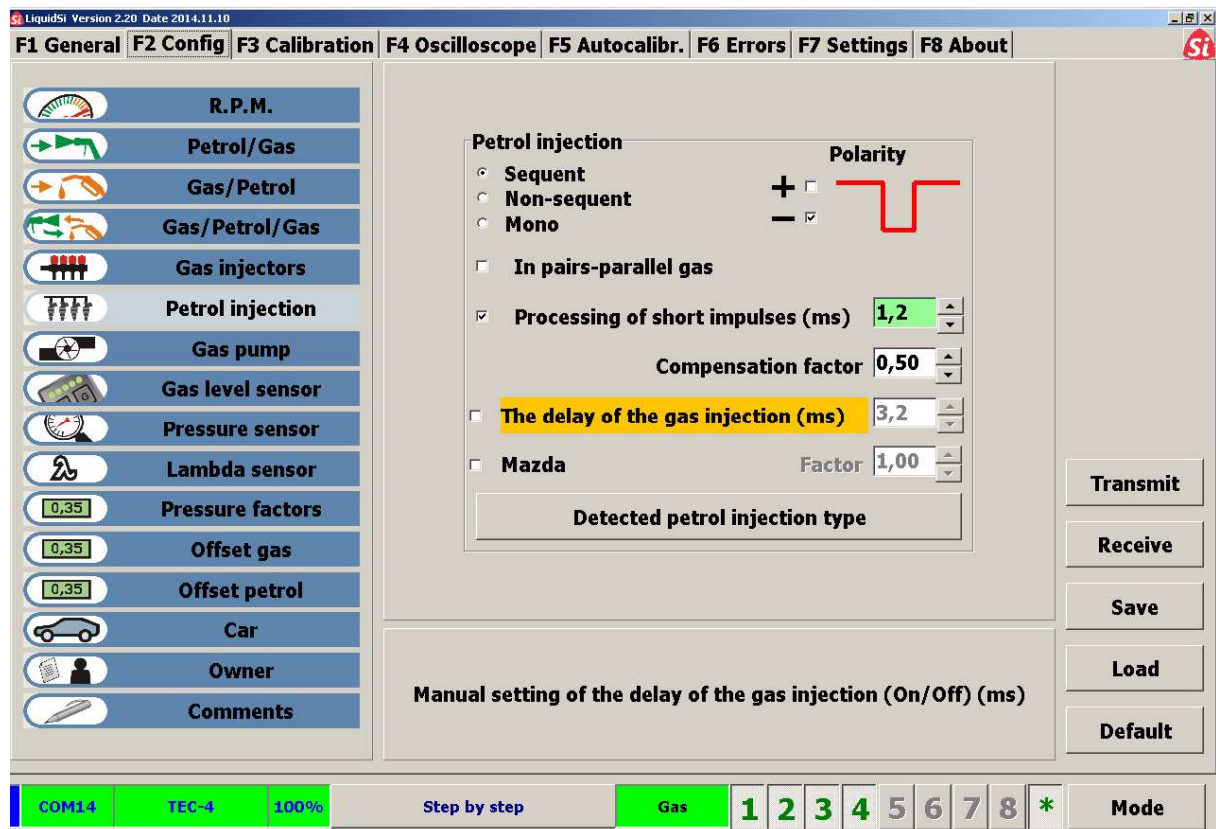
1. "Type". Currently, all Vialle LiquidSI injectors have the same electrical characteristics. This is true for the Vialle-12, Vialle-15, Vialle-17, Vialle-20 and Vialle-28 injector. The pull down menu has only 2 choices: ""Vialle 12/15/17/20/28"" and ""Another"".

The choice "another" activates the three parameter fields on the right hand side, normally these fields are greyed out.

NOTE: For information only: the settings in the three parameter fields on the right hand side for the Vialle injectors are - "Start pulse" = 1500 mks, PWM = 30%, "Frequency" = 20 kHz.

2. "Number". Here you should enter the correct number of cylinders. For the TEC-4 you can enter: 2,3 or 4. For the TEC-6 you can enter 5 or 6. For the TEC-8 it is always: 8. when you change this number, the lay-out of the relevant pages is updated accordingly. For instance, the F1 overview page will display just four injector output fields if you choose "4" in this page.

F2/Tab: PETROL INJECTION



The F2 PETROL INJECTION page gives you the possibility to edit some of the basic petrol injection characteristic of the car you are working on.

1. “Petrol injection type”. This parameter has three options. “Sequent”, this is the default option and fits all full sequential petrol injection systems. “Non-sequent”, this option can be used for parallel and semi-parallel petrol injection systems. “Mono”, this option is only to be used in case of single point petrol injection systems (not recommended).
2. “In pairs – parallel gas”. More options..
3. Checkbox “Processing of short impulses”. When checked, this function allows the handling of short Petrol impulses (and therefore also the handling of short GAS pulses) which would normally be too short to achieve a reliable opening of the Gas injector. Such short pulses are sometimes generated by the petrol ECU for no apparent reason. Default = Checked.
4. “Processing of short impulses”. This function works as follows: pulses longer than the value entered here, are treated by the TEC as working pulses. These pulses are translated into the corresponding Gas pulses and are being sent to the Gas injectors. Pulses that are shorter than the value entered here, are being treated in a different manner; these pulses are firstly multiplied by the factor which is entered in the field “Compensation factor” and then the result is not processed directly but is being saved in memory until the next Petrol pulse is recorded and the saved value is then added to this new pulse. Default = 1,2ms.

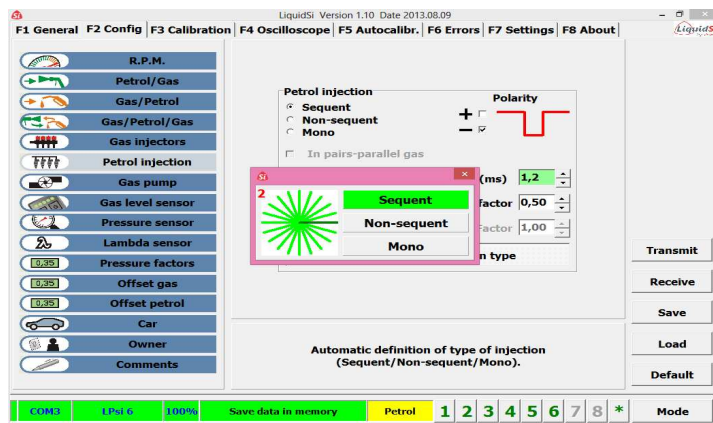
Example: let us assume that the “Processing of short impulses” is set to 1,2 ms, “Compensation factor” is set to 50%. Suppose a petrol pulse of 0,8ms is being received by the TEC. Since this pulse is shorter than the threshold value of 1,2ms, there will not be a Gas injection event. Therefore the 0,8ms is being multiplied by 0,5 and the result (0,4ms) is being added to the next upcoming Petrol injection pulse time.

Note: there is an additional importance to this function. The actual software algorithms that decide the precise timing of the next upcoming Gas injection use in their calculations, amongst others, the data for the most recent Petrol and Gas injection. Pulses that were treated as working pulses are used for this history, but pulses that were shorter than the value set in “Processing short impulses” are discarded for this history function. The result is that especially for very small Petrol factors (smaller than 0,75), where a lot of injection delay is required, it can become of significant importance to set these short impulses parameters with great care.

5. “Compensation factor”. For explanation see above. This factor can be set between 0 ... 1,99 (=200%). Default = 0,5 (=50%).
6. Checkbox “the delay of the GAS injection”. When checked, the delay between the start of the Petrol injection and the start of the GAS injection can be entered manually in the textbox on the right-hand side. Default is Unchecked. In this case the software will automatically calculate the best value for this delay time. When checked however, the user has absolute control over this delay time. This can be useful in cases where the Petrol-Factor is very small (typically $<< 0.70$). of course you must make sure that you installed the correct injectors, always use the smallest injectors possible. This way, the Petrol-Factor is as large as possible, this will improve system stability. Example: in a 1400CC VW Polo, the Petrol-Factor is 0,56 (Vialle 12 injectors are used). Engine dynamics and running was dramatically improved when this box was checked and a value of 10 ms was entered into the corresponding text field.

“Polarity”. This gives you the option to change the way that Petrol injectors are connected to the Petrol ECU. Default = (-) Polarity, this means that the injectors are connected to constant (+) and that these are switched to ground inside the Petrol ECU. This is by far the most common way of driving Petrol injectors. If you come across a care whereby the injectors are connected to constant (-) and the (+) is switched inside the ECU, than you can set the “Polarity” option to “+”.

7. “Detected Petrol injection type”. Pressing this button invokes an automatic function which determines the type of Petrol injection system that is fitted to the car you are working on. You can use this function to help you in determining the type of Petrol injection system installed.



F2/Tab: GAS PUMP

Gas pump

Type: **PTS-40**

☒ Dry-run protection and settings

Pressure measurement delay (ms): **25**

Minimum rise in injection pressure (bar) > **1,3**

in a time period (sek) < **9,5**

☒ Hydraulic conditioning

Pump run time ON (sec): **15,0**

Pump run time OFF (sec): **3,0**

Transmit

Receive

Save

Load

Default

Gas pump type

COM14 TEC-4 100% Step by step Gas 1 2 3 4 5 6 7 8 * Mode

F2 GAS PUMP page gives the settings for the turbine-type GAS pump mounted inside the tank. An important issue in any liquid injection system is the protection of the pump against dry-running. This condition would otherwise destroy the pump within minutes. The software therefore needs to perform a dry-run test at system start-up. Algorithm: software monitors the system pressure during the first few seconds after LPG solenoids have opened and pump has started for the third time; the pump and solenoids are activated two times before but this is only done to make sure that the pressure in the tank is equal to the pressure in the fuel lines. If the pressure rise is below a user defined minimum pressure rise after a user defined time-period, then dry-run (=empty tank) is expected and system will not change to Gas (Coloured pump status output field in F1 , F2 and F3 remains RED). Remember that the Gas solenoids and the Gas pump are electrically connected in parallel, they are always activated together.

1. **"TYPE"**, this pull down menu provides the user with two choices: PTS-40 and PTS-70. The PTS-40 is the standard turbine pump. For more powerful engines the PTS-70 can be selected. Default = PTS-40. IMPORTANT: do not use the PTS-70 for engines <100kW. If you do, there is a risk that the LPG tank gets overheated and the customer will complain about re-fuelling problems.

Some settings will change automatically if you change the pump selection. This goes for the pressure drop and pressure rise settings in F2/Gas->Petrol page and also for the minimum rise in injection pressure in the F2/Gas Pump page.

2. **Checkbox "Dry-run protection and settings:"**. This box is checked by default. Users can uncheck this box for several diagnostic reasons. If unchecked then there will be no dry-run

test carried out at system start-up. Function is as follows: at system start-up when the "delay after ignition on" time-period has elapsed, the solenoids are opened and the pump is started two times for a short period of time, this ON time and OFF time can be set by the user, also in this screen. The purpose here is to equalize pressures between the tank and the fuel lines before the actual dry-run test is being executed. After these two short opening events, the "system priming time" function is started (user setting in F2/Petrol→Gas). The software shall monitor the rise of the injection pressure immediately after the solenoids have opened and pump has started. User can input the values for the minimum rise in pressure that has to be reached in field 3) and the maximum time that it may take to reach this rise in pressure in field 4). If this test fails, the system will not change over to LPG.

3. "minimum rise injection pressure(Bar) >". User can input this value, for explanation see item 2. Default = 1,3 bar for the PTS-40 and 3.0 bar for the PTS-70. Do not change this value.
4. "in a time period(sec) of <". This is the time period during which the injection pressure needs to rise the amount specified in item 3. User can input this value, for explanation see item 2. Default = 9,5 seconds.

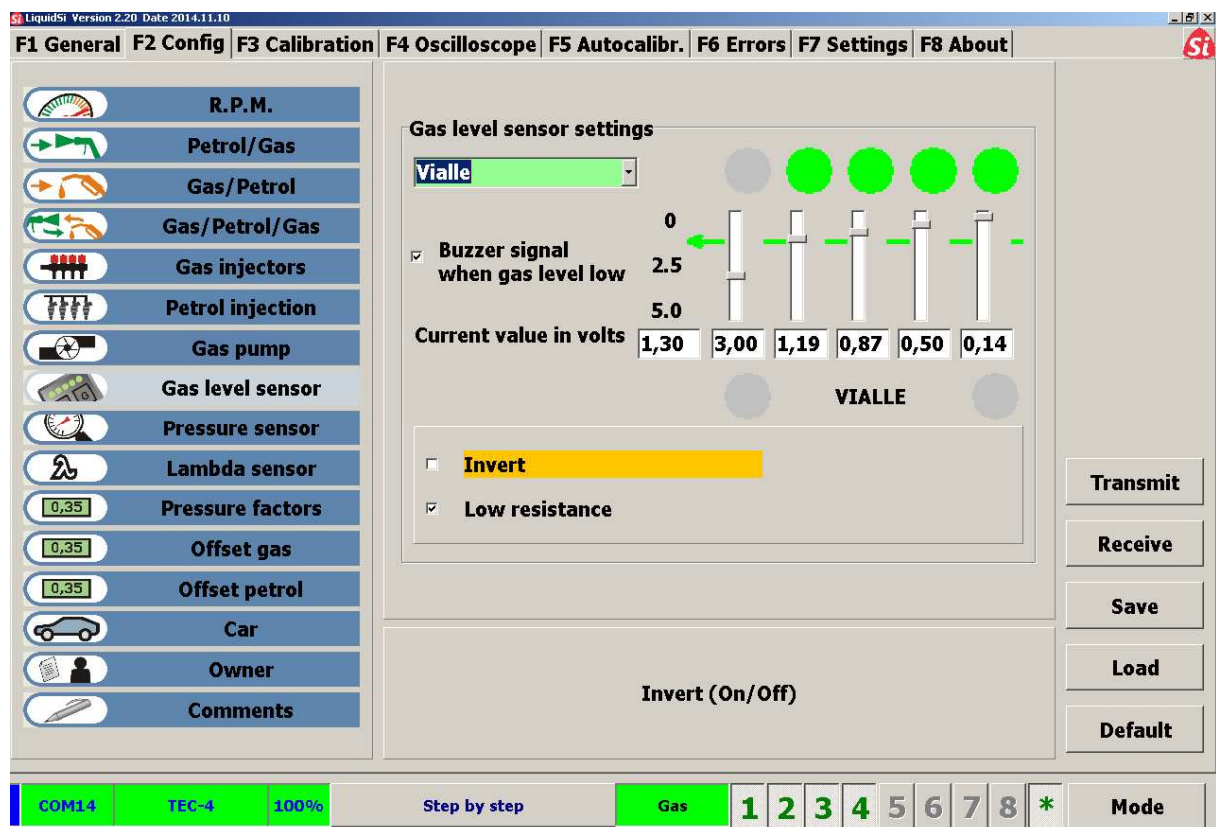
NOTE: a RED progress bar inside the Pump Status indicator field in F1 is showing the dry-run test progress time.

NOTE: also, the injection pressure which is measured immediately after opening of the solenoids is shown inside the F1 Pump Status indicator field, this value is a good approximation of the prevailing Gas tank pressure. While the dry-run test is in progress you can compare the real time injection pressure (which is shown inside the F1 Injection pressure indicator field, with the tank pressure which is shown inside the F1 Pump Status indicator field.

NOTE: the duration of this dry-run test will always be observed completely. The test will not be aborted once the required pressure rise has been reached.

5. Checkbox "hydraulic conditioning". Default is Checked. When checked the dry-run works as explained above, and the user can then modify the time periods for the Open time and for the Close time in the two text field below the checkbox. When you uncheck this box, there will not be the two short opening and closing events described earlier.
6. "Pump run time ON (sec)". this is the time during which the fuel pump and the solenoids will be activated before the actual dry-run test begins. Default is 15,0 seconds.
7. "Pump run time OFF (sec)". this is the time period during which the pump and solenoids are kept closed. Default is 3,0 seconds.

F2/Tab: Gas level sensor

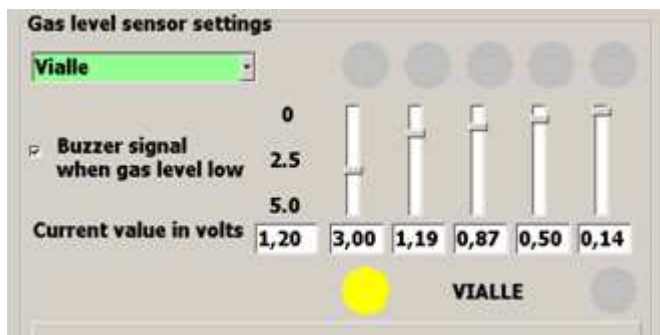


F2 GAS LEVEL SENSOR page contains setting for the LiquidSI level sensor. The sensor is designed specifically for the LiquidSI system but is electrically compliant with the standard 0...90 Ohm resistive sending unit that are found in many Gas systems. Tank Level Sensor has 5 steps. The upper right four LED's are used to indicate the tank contents, the lower right RED LED is the "Reserve" indicator. The buzzer beeps twice when red LED is turned on.

1. Pull down menu. From this pull down menu the user can choose a variety of sensors. The only option in this menu that is sensible to use is the "VIALLE" option. Therefore the default is also "VIALLE".
2. checkbox "buzzer signal". This box is checked by default. It means that the buzzer will give a signal (two short beeps) when so much Gas has been used that the 5 LED's in the top row of the switch are all "OFF" and the "Reserve" LED in the lower right hand corner of the switch has just been turned "ON".
3. "Current value in volts". There is an array of 6 parameter fields extending to the right hand side of this text label. The first field gives the real time voltage which is read from the resistive sending unit. This voltage obviously depends of the level of Gas currently inside the tank. Typically, if you fill the Gas tank completely, you can use sliders to trim at least the fifth LED switching point. In a similar manner, you could drive the car until automatic switch-over to Petrol takes place and you could then trim the switching point for the first LED and so on.

The second, third, fourth, fifth and sixth field allow the user to set the switching points (in volts) for each of the 5 LED's in the top row of the switch. The Default values should be OK.

4. Checkbox "Invert". Default unchecked. Do not change.
5. Checkbox "Low resistance". Default checked. Do not change.



F2/Tab: Pressure sensor

The screenshot shows the 'F2 Config' tab in the 'LiquidSI Version 2.20' software. The left sidebar contains a list of sensor types: R.P.M., Petrol/Gas, Gas/Petrol, Gas/Petrol/Gas, Gas injectors, Petrol injection, Gas pump, Gas level sensor, Pressure sensor (highlighted), Lambda sensor, Pressure factors, Offset gas, Offset petrol, Car, Owner, and Comments. The main area is titled 'Pressure sensor' and contains a dropdown menu for 'Type' set to 'KELLER 30 BAR'. Below this are input fields for 'Sensor output (volt)' (1,83) and 'Sensor output (bar)' (10,77). A formula box shows 'Pressure = C1 * (volt) + C2' with 'C1 = 6,600' and 'C2 = -1,307'. There are radio buttons for 'Absolute' and 'Relative' (selected). On the right are buttons for 'Transmit', 'Receive', 'Save', 'Load', and 'Default'. At the bottom, a status bar shows 'COM14', 'TEC-4', '100%', 'Step by step', 'Gas', and a row of numbered buttons (1-8, *) and a 'Mode' button.

The F2 PRESSURE SENSOR page gives information on the Gas pressure sensor. It has a measuring range from 0 ... 30 bar. You can use this page to check the output voltage of the pressure sensor for diagnostic purposes. The formula which is used by the software to calculate the pressure from the voltage is detailed on this page, although it will normally not be required to change any of the setting in this page.

The pressure sensor is the most important sensor in the LiquidSI system. In most cases the sensor is mounted onto the multivalve, just upstream of the pressure regulator (orifice). If the pump is not running, the sensor „sees“ the tank pressure. If the pump is running, the sensor “sees“ the “INJECTION PRESSURE”. This is the pressure actually existing at the injectors and also in the fuel lines connecting the fuel rail to the multivalve. It consists of Tank Pressure + Pump Pressure. A good reference value is 12 bar. (8 bar tank pressure + 4 bar pump pressure).

Keller sensor data:

- Type: absolute pressure sensor
- Range: 0 .. 30 Bar
- Supply voltage: 5V (4,5 .. 5,5V)
- Output (Uout): 0,2 .. 4,8 V analogue

1. “TYPE”. There are 2 options in the pull down menu. First option is „KELLER 30 BAR“, this is the standard sensor for LiquidSI and therefore also the default choice. The second option is „ANOTHER“.

2. "sensor output(Volt)". This is an output field. It shows the (real time) value for the sensor output voltage, as measured by the TEC.

NOTE: for the default sensor the output voltage is always a function of the supply voltage, therefore, if for any reason the voltage supplied to the sensor deviates from the standard 4.8 Volts (loose pins, contact resistance etc), then also the sensor output voltage will deviate.

This output field is especially suited for use as comparative measurement with the sensor output voltage as measured directly on the sensor.

3. "sensor output(Bar)". This is also an output field. It returns the (real time) pressure in bar from the formula defined under item 4.
4. The coefficients for the translation formula can be entered/changed in these 2 fields. For the KELLER sensor the default values are:

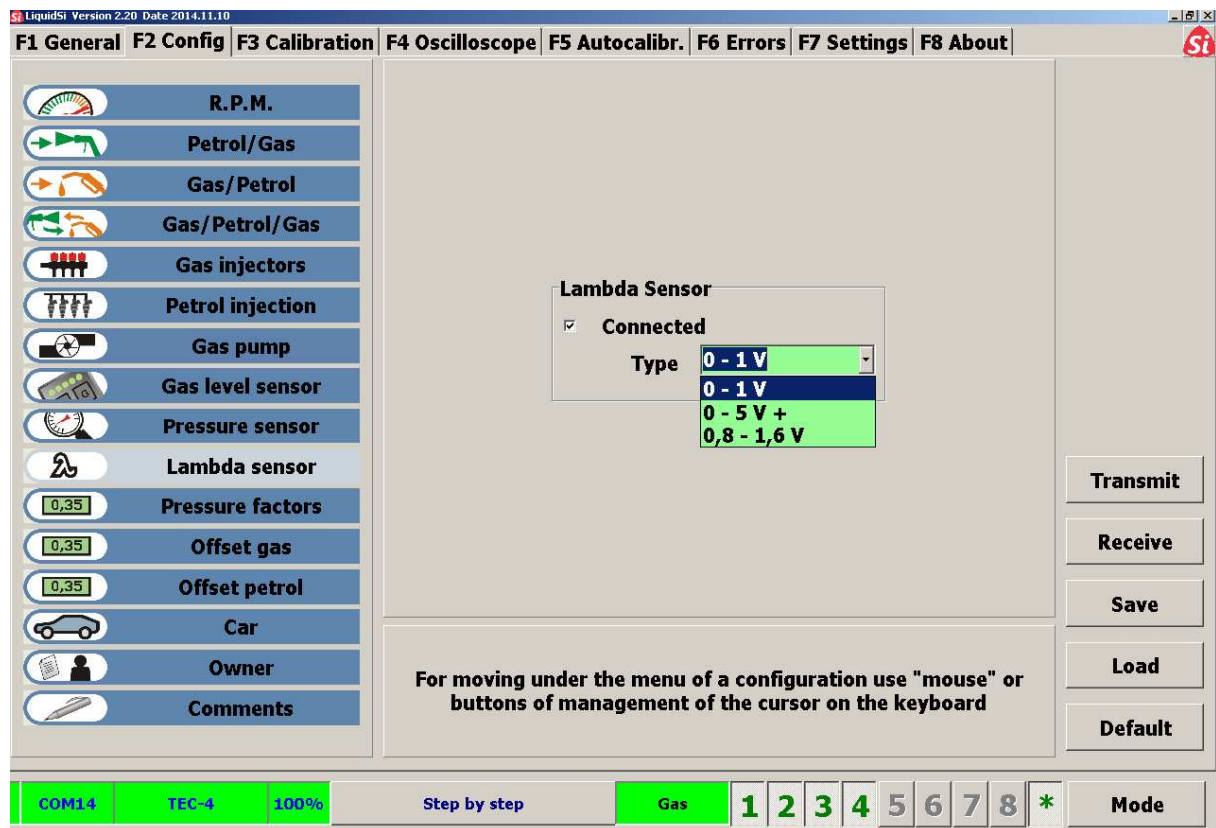
C1 = 6,600

C2 = -1,307

Do not change these values.

5. checkbox "Absolute/Relative". By default the box "Relative" is checked. Do not change.

F2/Lambda sensor



The F2 LAMBDA SENSOR page allows the user to choose between three most dominantly available types of lambda sensors.

1. Checkbox “Lambda sensor connected”. This option tells the software whether a lambda sensor is connected and can therefore be used in the (Auto) calibration functions. By default this box is checked.
2. “Type”. The pull down menu offers three choices: the (standard) 0..1 Volt sensor, 0..5 Volt sensor and the 0,8 ... 1,6 Volt sensor. Default is the 0 ..1 Volt type.

NOTE: the software does not use the lambda sensor signal for Gas pulse calculations. It is only displayed in a number of pages to give visual feedback to the user when making changes to the calibration.

NOTE: when the box is unchecked, also it will not be possible to display the lambda signal in the F4 OSCILLOSCOPE page.

F2/Tab: Pressure factors

LiquidSI Version 2.20 Date 2014.11.10

F1 General F2 Config F3 Calibration F4 Oscilloscope F5 Autocalibr. F6 Errors F7 Settings F8 About

ms\bar	5,00	6,25	7,50	8,75	10,00	11,25	12,50	13,75	15,00	16,25	17,50	18,75	20,00	21,25	22,50	23,75	25,00	26,25	27,50	28,75
0,0	1,35	1,25	1,09	1,05	0,98	0,95	0,91	0,88	0,82	0,80	0,75	0,70	0,70	0,70	0,66	0,63	0,63	0,59	0,57	0,56
1,0	1,35	1,25	1,09	1,05	0,98	0,95	0,91	0,88	0,82	0,80	0,75	0,70	0,70	0,70	0,66	0,63	0,63	0,59	0,56	0,63
2,0	1,35	1,25	1,09	1,05	0,98	0,95	0,91	0,84	0,82	0,80	0,75	0,70	0,70	0,70	0,66	0,63	0,63	0,59	0,57	0,63
3,0	1,35	1,21	1,09	1,03	1,00	0,95	0,91	0,84	0,80	0,78	0,77	0,74	0,70	0,70	0,66	0,63	0,63	0,59	0,57	0,63
4,0	1,41	1,27	1,14	1,07	1,02	0,95	0,91	0,84	0,80	0,78	0,77	0,77	0,74	0,73	0,71	0,70	0,66	0,63	0,63	0,63
5,0	1,41	1,27	1,14	1,09	1,00	0,98	0,95	0,89	0,88	0,84	0,82	0,78	0,75	0,74	0,71	0,70	0,66	0,63	0,63	0,63
6,0	1,41	1,27	1,14	1,09	1,00	0,96	0,95	0,91	0,88	0,84	0,82	0,80	0,77	0,74	0,71	0,70	0,66	0,63	0,63	0,63
7,0	1,41	1,27	1,14	1,09	1,03	0,96	0,95	0,91	0,88	0,84	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
8,0	1,41	1,27	1,14	1,09	1,05	0,96	0,95	0,91	0,88	0,84	0,82	0,78	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
9,0	1,41	1,27	1,14	1,09	1,05	0,96	0,95	0,91	0,88	0,84	0,82	0,78	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
10,0	1,41	1,27	1,14	1,09	1,05	0,96	0,95	0,91	0,88	0,85	0,82	0,78	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
11,0	1,41	1,27	1,16	1,09	1,05	0,96	0,95	0,91	0,88	0,85	0,82	0,78	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
12,0	1,41	1,27	1,16	1,09	1,05	0,96	0,95	0,91	0,88	0,85	0,82	0,78	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
13,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,78	0,77	0,75	0,73	0,70	0,70	0,66	0,63	0,63
14,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
15,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
16,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
17,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
18,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
19,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
20,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
21,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
22,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63
23,0	1,41	1,27	1,16	1,09	1,05	0,98	0,95	0,91	0,88	0,85	0,82	0,80	0,77	0,74	0,73	0,70	0,70	0,66	0,63	0,63

COM14 TEC-4 100% Step by step Gas 1 2 3 4 5 6 7 8 * Mode

Clear Default 0,91 0.01 .. 1.99 Transmit Receive Save Load Default

This page holds the Gas pressure correction data which is used as “cor_fac” in the main fuelling formulae:

$$T_{\text{gas}} [\text{ms}] = (t_{\text{petrol}} - \text{offset}_{\text{petrol}}) \times \text{petrol_factor} \times \text{cor_fac} + \text{offset}_{\text{gas}}$$

The “cor_fac” corrects the fuelling for variations in the Gas pressure (injection pressure). Horizontally is the injection pressure axis. Vertically there is the pulse length (ms) axis. The latter gives the possibility to correct the fuelling for drop in pump output pressure (head) when pulse duration gets longer (increased engine load).

NOTE: the values in this table should normally apply for all vehicles. There will very rarely be a need to changes the values in this table.

NOTE: when the engine is running, the currently active element in this table will be highlighted, so you can see which value/number is actually being used in the Gas pulse calculations.

NOTE: the software does not interpolate between table cells. So, a given cell value is used by the calculation routines from the injection pressure row value that the cell is in, upto the injection pressure value for the neighbouring column. The same applies for the horizontal rows.

F2/Tab: Offset Gas

LiquidSI Version 2.20 Date 2014.11.10

F1 General **F2 Config** **F3 Calibration** **F4 Oscilloscope** **F5 Autocalibr.** **F6 Errors** **F7 Settings** **F8 About**

v\bar	5,00	6,25	7,50	8,75	10,00	11,25	12,50	13,75	15,00	16,25	17,50	18,75	20,00	21,25	22,50	23,75	25,00	26,25	27,50	28,75
6,0	0,69	0,71	0,72	0,75	0,79	0,84	0,89	0,95	1,02	1,10	1,17	1,26	1,35	1,45	1,55	1,66	1,78	1,90	2,02	2,17
7,0	0,83	0,85	0,86	0,90	0,93	0,98	1,26	1,08	1,12	1,21	1,27	1,35	1,43	1,52	1,61	1,71	1,81	1,92	2,02	2,15
8,0	0,94	0,99	1,02	1,05	1,08	1,12	1,14	1,21	1,26	1,32	1,38	1,44	1,51	1,59	1,66	1,75	1,84	1,93	2,02	2,12
9,0	0,81	1,12	1,17	1,19	1,22	1,26	1,30	1,36	1,38	1,43	1,48	1,53	1,59	1,66	1,72	1,79	1,86	1,94	2,02	2,10
10,0	0,72	0,76	0,77	0,79	0,81	0,84	0,86	0,89	0,93	0,96	1,00	1,04	1,09	1,12	1,19	1,24	1,30	1,36	1,42	1,48
11,0	0,65	0,68	0,69	0,71	0,73	0,75	0,77	0,80	0,82	0,85	0,88	0,92	0,96	1,00	1,04	1,08	1,12	1,18	1,23	1,28
12,0	0,60	0,63	0,64	0,65	0,66	0,68	0,70	0,72	0,74	0,77	0,79	0,82	0,85	0,89	0,92	0,96	1,00	1,04	1,08	1,12
13,0	0,56	0,56	0,59	0,60	0,61	0,63	0,64	0,66	0,68	0,70	0,73	0,75	0,78	0,81	0,84	0,87	0,90	0,94	0,97	1,01
14,0	0,52	0,55	0,55	0,56	0,56	0,59	0,60	0,62	0,63	0,65	0,67	0,69	0,72	0,74	0,77	0,79	0,82	0,85	0,88	0,92
15,0	0,50	0,52	0,52	0,53	0,54	0,55	0,56	0,56	0,59	0,61	0,63	0,66	0,67	0,69	0,71	0,73	0,76	0,78	0,81	0,84
16,0	0,47	0,49	0,49	0,50	0,51	0,52	0,53	0,54	0,55	0,56	0,56	0,60	0,61	0,63	0,65	0,67	0,69	0,72	0,74	0,76
17,0	0,44	0,46	0,47	0,47	0,48	0,49	0,50	0,50	0,51	0,52	0,54	0,55	0,56	0,56	0,60	0,61	0,63	0,65	0,67	0,69

COM14 TEC-4 100% Step by step Gas 1 2 3 4 5 6 7 8 * Mode

Clear Default 0,64 0 .. 2.55 Transmit Receive Save Load Default

This page shows a table whereby the cells represent the Offset value (in ms) for the Gas injectors. These values are identical for all four types of Vialle injectors. The value retrieved from the table is the output whereby the inputs are the injection pressure (horizontal axis) and the battery voltage (vertical axis), as measured by the TEC. The corresponding active cell value is then used as “offset_gas” in the main fuelling formula:

$$T_{\text{gas}} [\text{ms}] = (t_{\text{petrol}} - \text{offset}_{\text{petrol}}) \times \text{petrol_factor} \times \text{cor_fac} + \text{offset_gas}$$

“offset_gas” corrects the fuelling for the variations in injector opening time and closing time when the battery voltage is changing or when the Gas injection pressure is changing.

NOTE: the way cell output changes when the axis value changes is similar to the behaviour described in the previous page: F2 PRESSUE FACTORS.

NOTE: the values in this table should normally not require any editing, unless you have a very specific reason for doing so.

F2/Tab: Offset petrol

U bat	OffSet
6,0	2,22
7,0	1,96
8,0	1,66
9,0	1,30
10,0	1,04
11,0	0,86
12,0	0,75
13,0	0,62
14,0	0,53
15,0	0,47
16,0	0,42
17,0	0,36

To stay in line with the main fuelling formula we must also provide numbers for the offset of the petrol injectors used in the car you are working on. Please note that for petrol injectors the only influence factor is the battery voltage. Petrol fuel pressure is usually a constant.

$$T_{\text{gas}} [\text{ms}] = (t_{\text{petrol}} - \text{offset_petrol}) \times \text{petrol_factor} \times \text{cor_fac} + \text{offset_gas}$$

Luckily, the offset values for most cars are quite similar. For this reason we have included a table whereby the average values found in many different petrol injectors are given.

This table can be edited and gives the user the possibility to optimize the calibration for a specific car. This can be useful typically when you find significant deviations in fuel trims when changing from very short pulses (very low load) to longer pulses. Alternatively, you could use the F3 CALIBRATION page to manipulate the Petrol_Factor near the low end of the diagram.

NOTE: also in this table there is no interpolation in between cells.

F2/Tab: Car

LiquiSI Version 2.20 Date 2014.11.10

F1 General F2 Config F3 Calibration F4 Oscilloscope F5 Autocalibr. F6 Errors F7 Settings F8 About

Car data

File : exists **Number** 6020_015

Model

Engine power (kW)

Gas injectors type : Vialle Alternative Fuel System

Date **Last Save : 12-11-2014**

Installed

Time to TS at work on a gas

☐ **Block work on gas**

Remains, h 0,00 **Mileage, km** 0

Refresh **Speed, km/hour** 25

Disable **Setting** **Assigned, h** 0

Setting password

Date of last record of a configuration in the controller. It is brought automatically with pressing button "Transmit".

Archive **New** **Again** **Find**

Transmit **Receive** **Save** **Load** **Default**

COM14 **TEC-4** **100%** **Step by step** **Gas** **1** **2** **3** **4** **5** **6** **7** **8** ***** **Mode**

This page allows the user to enter basic data on car owner and car characteristics.

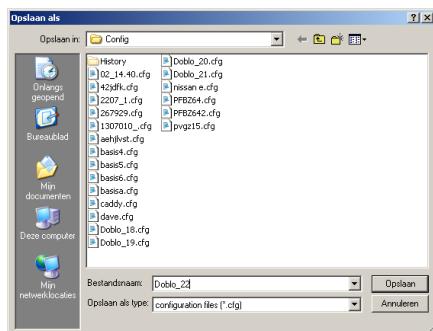
1. **"file:"**. This field indicates weather the file name in the text field: **NUMBER** is:
 - a. **NEW**, if you type a name of a file in the **NUMBER** field the system automatically checks your hard drive for matching file names. If no match is found, the message **NEW** is displayed. This means you can use the new file name without risking to overwrite an existing file.
 - b. **EXISTING**, if you type a name in the **NUMBER** field, the system checks automatically your hard drive for matching file names. If a match is found, then the message **EXISTING** is displayed.
 - c. **CURRENT**, this indicates that the name and the contents of the configuration data inside the **TEC** is identical to the name and the contents of the configuration file which is saved onto your hard drive. This is the optimal status. The text **CURRENT** therefore is displayed in color (**GREEN**). Example: if the current status is: **EXISTING** and you make some changes to the calibration and you press: **TRANSMIT**, then the status will change to **CURRENT** because the data transmitted to the **TEC** have become identical to the data on your hard drive (**TRANSMIT** also saves the configuration data to your hard drive).

Transmit

Pressing this button sends the most recent set of parameters and calibration data from the Software to the TEC. Also, the calibration data is stored into a file on your laptop/desktop. NOTE: in case you shut down the engine, all data changed in the software but not transmitted to the TEC, will be lost.

Save

The main difference with using the TRANSMIT button is that the calibration data is not being sent to the TEC and therefore the Firmware receives no new data. SAVE allows the user to store the currently displayed calibration data under a file name of choice.



Car data	
File : new	Number Doblo21B
	Model Doblo
	Engine power (kW) 47,5

Example: suppose you want to save your configuration in a new file, named: Doblo21B. While you are typing this name, the system indicates to you that this is a new name, not already in use by another file. When you then press SAVE, the files are being stored in the following location:
C:\Program Files\LiquidSi\Config\Doblo21B.cfg.

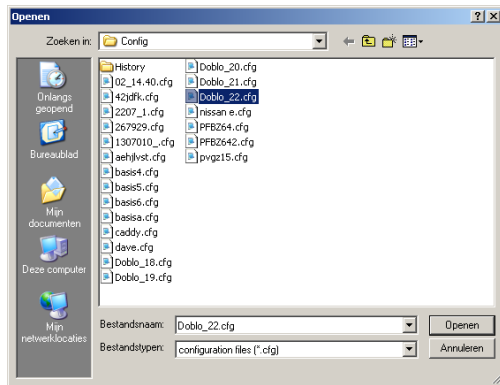
Also, a new directory is created inside the "history" directory. In this history directory a sub directory is created with the same name as the name you gave to the calibration file (in this example: Doblo21B.cfg): C:\Program Files\LiquidSi\Config\History\Doblo21B.

Also, in this sub directory another sub directory is created. Directory name is the current calendar date. C:\Program Files\LiquidSi\Config\History\Doblo21B\2013.08

Finally, in this new date-directory a copy of the calibration file you were working on (which is still Doblo21B.cfg) is being stored whereby the file name is composed of the day and time of creation. From now on, each time you make a change to the calibration and transmit this change to the TEC, automatically a copy of this changed calibration file, together with a date code, is saved into the C:\Program Files\LiquidSi\Config\History\Doblo21B\2013.08 directory.

Load

This button allows the user to load a previously defined calibration file into the Software. After the file has been loaded into the Software, the file status will be displayed as : EXISTING. This makes sense since the file already existed in the hard drive but it is not yet synchronised with the TEC. To accomplish that, you need to press TRANSMIT. After that, the status will change to CURRENT.



Default

Pressing the DEFAULT button returns all settings back to their default values.

NOTE: after pressing DEFAULT button, it is likely that crucial parameters such as engine speed are no longer displayed correctly! In that case it is advised to return to Petrol mode and first find the correct settings for RPM in F2 RPM. Alternatively you can use the “Step by Step” button in the lower status bar.

2. “Number”. Here the user can enter the name of the configuration file for the car he is working on. A maximum of 8 characters applies.
3. “Model” and “engine power”. These fields can be filled freely.
4. “Installed”. Here you can enter the date of installation.
5. “Time to TS (in hours..”. In this block the number of car running hours (on Gas) can be set by the user. When the car is back in the workshop for service the user can read from this block how many running hours (on Gas) have used up.
6. Checkbox “Block work on Gas”. When checked, the car will no longer work on Gas when the number on running hours on Gas is over the limit set in “Assigned, h”.
7. “Setting Password”. The use of a password is optional. It can be used by the dealer/installer who wants to make sure that no tampering has been done after the car was converted to LiquidSI. The protection works in the same way as a warranty which can find on many purchased products like CD’s or electronic devices: as long as the seal is not broken, the “seller” (= installer/dealer) can be sure that the car’s calibration has not been tampered with. But, as with any seal, it can be broken. This is however detectable for the installer/dealer when the car is returned for service or in case of warranty claims.

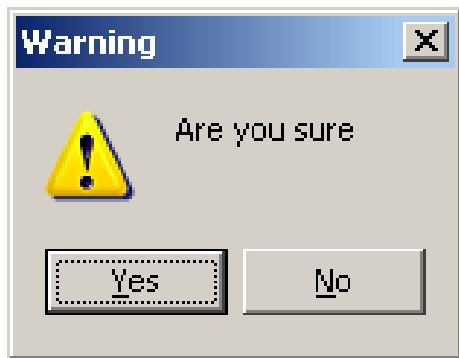
Pressing the “Setting password” button makes a number of popup screens appear. The first pop up confirms that there is no password set. Here you need to press the “Setting” button:



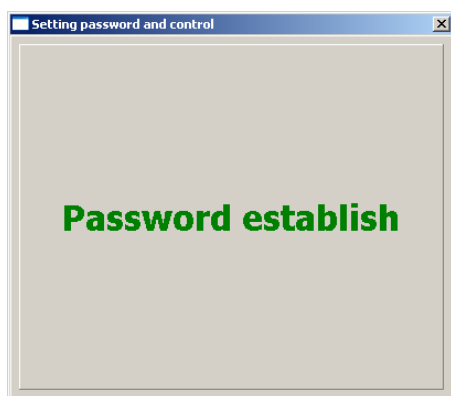
Next, a window pops up where you need to set the actual password of choice. Here is the empty version:

Here is an example of a fully filled out pop up window:

Next, press the ESTABLISH button:



If you now press YES, you are done!



After this confirmation message, the car changes over automatically from Gas to Petrol and there is some data transmission visible in the lower status bar. NOTE: the Password is stored inside the TEC unit but also inside the laptop or desktop that was used to create the Password settings!



Connecting a password protected TEC to a different computer

Remember: if you reconnect the password protected TEC to the laptop or desktop that was used to set the password, there will no issue: you can communicate with this TEC as if there was no password.

Connecting the password protected TEC to a different computer immediately makes the following window pop up:

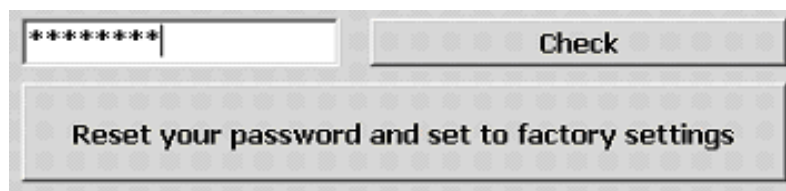


If you know the password, fill out the text field and press CHECK.

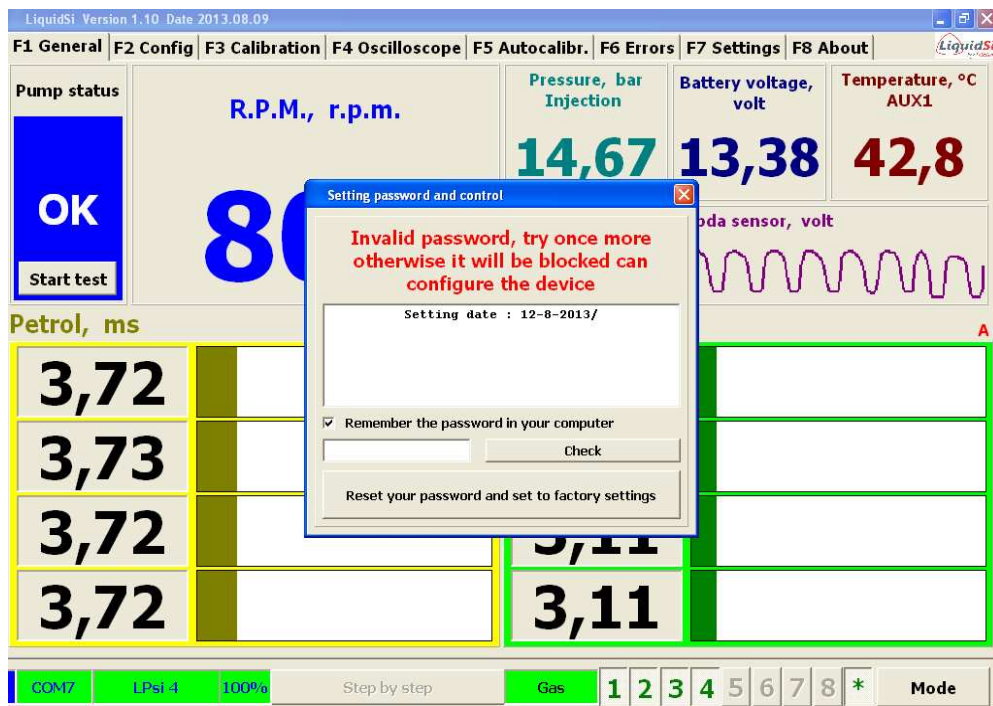


This reply obviously indicates that you have entered the correct password.

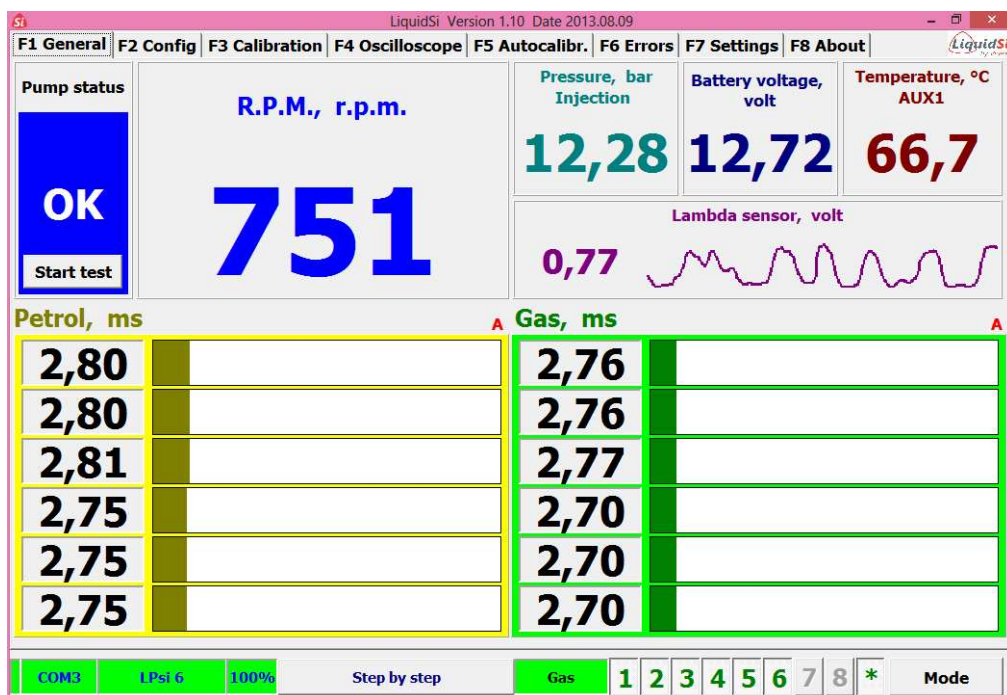
NOTE: be careful not to accidentally press the button RESET PASSWORD. If you do, the password lock is opened but all calibrations change to the defaults. The calibration process needs to be performed from scratch.



If you don't know the password or if you entered the wrong password, the following window pops up:



If you close this window, then only the F1 GENERAL page is available for monitoring the system:



NOTE: in Tab F7-SETTINGS it is possible to check or uncheck the box: "check password". This is however of no consequence for the way the password protection is handled.

LiquidSi Version 2.20 Date 2014.11.10

F1 General | **F2 Config** | F3 Calibration | F4 Oscilloscope | F5 Autocalibr. | F6 Errors | **F7 Settings** | F8 About

Language

English

Font, size, style, color

Setup Ports

Name COM14

☐ Auto search

Setup

Delay (ms)

60

Configuration file

☒ Taken together CFG and CLB information

☐ Transmit data CFG or CLB immediately after change

Averaging (only show)

☒ Petrol, Gas 20

☐ Pressure

☐ Hold in front

☒ Show hint

☐ Check password

Save

Load

Default

COM14 TEC-4 100%

Step by step

Petrol

1 2 3 4 5 6 7 8 *

Mode

Deleting the password is only possible through the F2 CAR page.

F2/Tab: Owner

LiquidSI Version 2.20 Date 2014.11.10

F1 General F2 Config F3 Calibration F4 Oscilloscope F5 Autocalibr. F6 Errors F7 Settings F8 About

Owner data

Name

Phone

Address

For moving under the menu of a configuration use "mouse" or buttons of management of the cursor on the keyboard

COM14 TEC-4 100% Step by step Gas 1 2 3 4 5 6 7 8 * Mode

Archive New Again Find Transmit Receive Save Load Default

Car owner information can be entered in the F2 OWNER page. It is not mandatory to fill this page out.

F2/Tab: Comments

LiquidSI Version 2.20 Date 2014.11.10

F1 General F2 Config F3 Calibration F4 Oscilloscope F5 Autocalibr. F6 Errors F7 Settings F8 About

R.P.M.
Petrol/Gas
Gas/Petrol
Gas/Petrol/Gas
Gas injectors
Petrol injection
Gas pump
Gas level sensor
Pressure sensor
Lambda sensor
Pressure factors
Offset gas
Offset petrol
Car
Owner
Comments

Comments

Clear

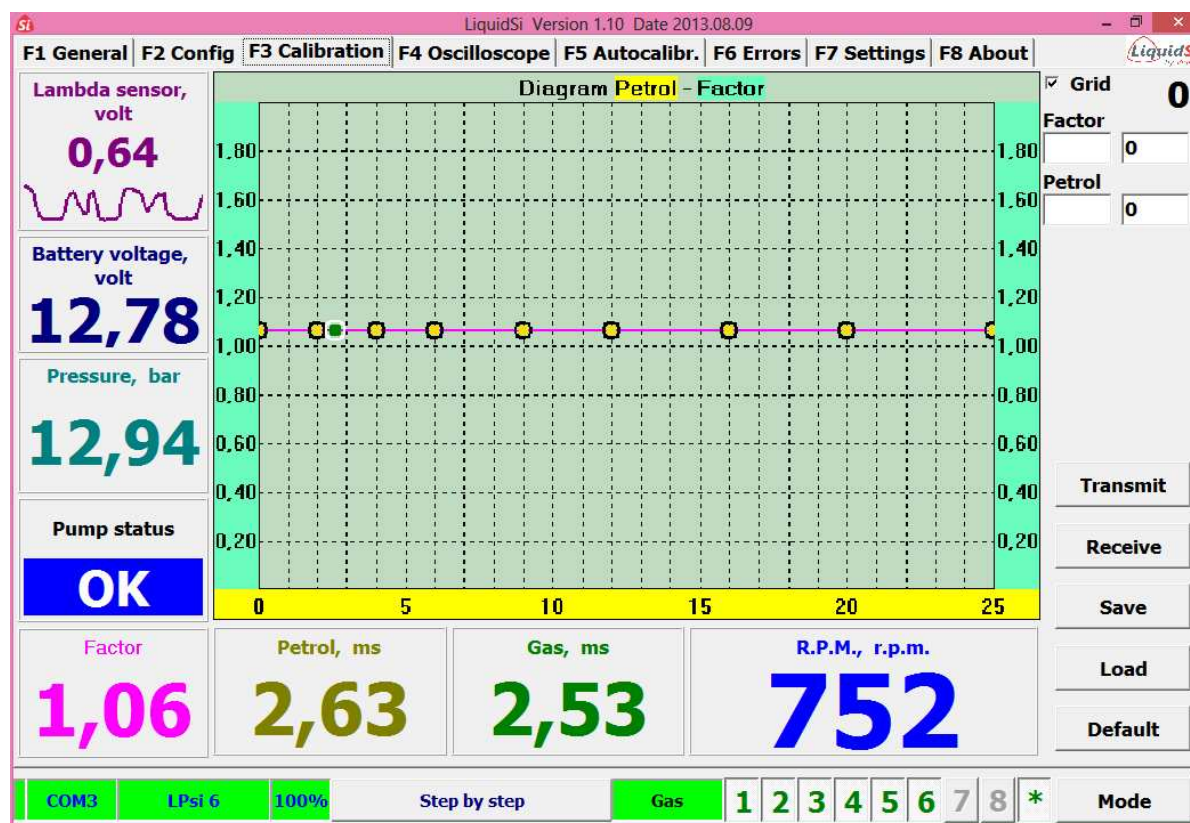
Comments of the installing (feature of the car, installation, adjustment, etc.)

Archive
New
Again
Find
Transmit
Receive
Save
Load
Default

COM14 TEC-4 100% Step by step Gas 1 2 3 4 5 6 7 8 * Mode

Add comments in the “Comments” text area.

F3 Calibration



This page shows the settings for the “Petrol factor”. This is the main multiplier used inside the main fuelling formula:

$$T_{\text{gas}} [\text{ms}] = (t_{\text{petrol}} - \text{offset}_{\text{petrol}}) \times \text{petrol factor} \times \text{cor_fac} + \text{offset}_{\text{gas}}$$

Theoretically, the petrol_factor is just a number, not a function or table. However, for practical purposes it is sometimes convenient to have the possibility to use slightly different petrol_factors at different (petrol) pulse times. Such manipulation is accomplished in the diagram on this page and will be explained in more detail below.

The page contains some obvious information fields in the left hand side bar, the bottom bar and the right hand side bar. These fields are explained elsewhere. The most important is the window in the center of the page displaying the petrol_factor. The vertical axis shows the magnitude of the petrol_factor and the horizontal axis shows the (petrol) pulse time.

1. “Lambda sensor” indicator field. This can be used to monitor the lambda sensor behaviour resulting from a change that you in the calibration on this page. When you, for example, switch individual injectors ON or OFF in the lower right of the bottom status bar, you can immediately see if there is any unwanted voltage response from the lambda sensor. However, you could also use the F4 OSCILLOSCOPE page for that purpose. When you are manipulating the petrol_factor diagram however, then you have no other way of monitoring undesired changes in lambda sensor output.
2. “Battery voltage” indicator field. Speaks for itself.

3. "Pressure, bar" indicator field. This shows the real time value for the injection pressure.
4. "Pump status" indicator field. This has similar functionality as the pump status window in F1. priming time is however not indicated here. The indicator field turns from RED to BLUE when the dry-run test has been passed successfully. This allows for a quick check on the status of the pump so that you are not wasting time on the calibration while pump function is not being adequate.
5. "factor" indicator field. This is clearly a very important field. It shows the actual value of the petrol_factor.

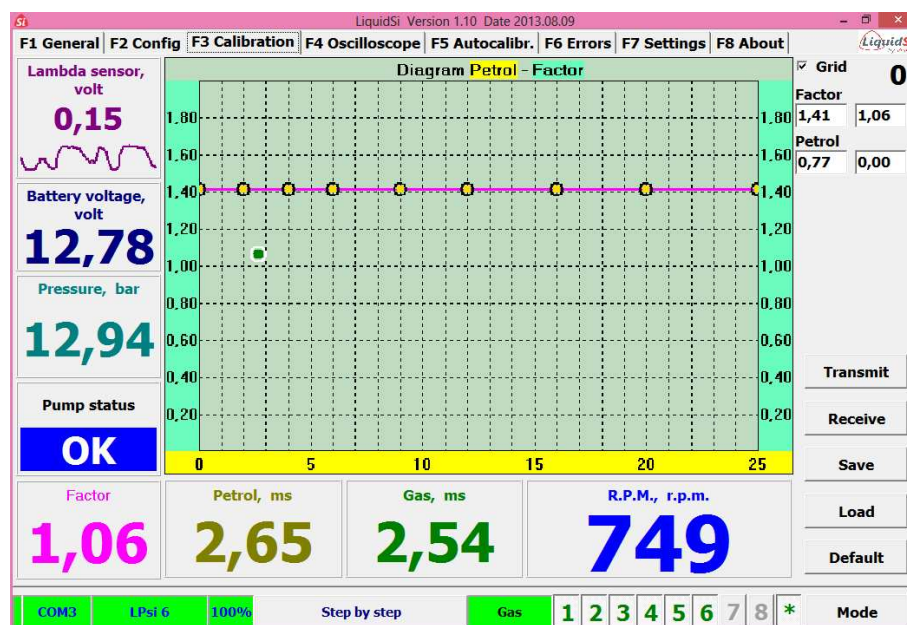
The autocalibration function in F5 always returns just one petrol_factor and therefore the calibration line is returned from the autocalibration function as a horizontal line (see: F5 AUTOCALIBRATION for details on how to change this behaviour). The complete horizontal line is merely moved up or down to the required value by the actions of the autocalibration function. The range for the petrol_factor is 0 ... 2 in the diagram. For practical purposes however, the limits are somewhere in the range of 0,5 ... 1,5. much depends upon the details of the car you are working on. There is no definitive rule here.

By default, the main calibration line is a horizontal line, with a value of 1,0 for all pulse times. The diagram however gives the user the possibility of setting the petrol_factor for 9 different levels of (petrol) pulse time.

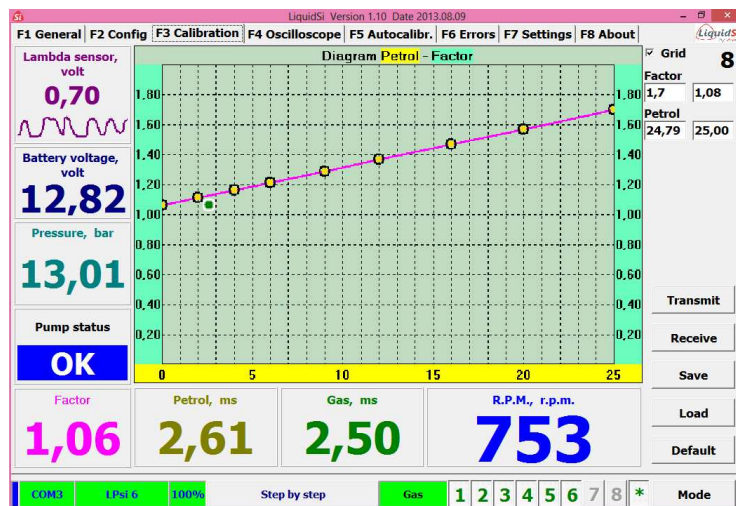
Selecting and moving the petrol_factor diagram dots.

By clicking and dragging the user can move the 9 dots individually, into any desired direction.

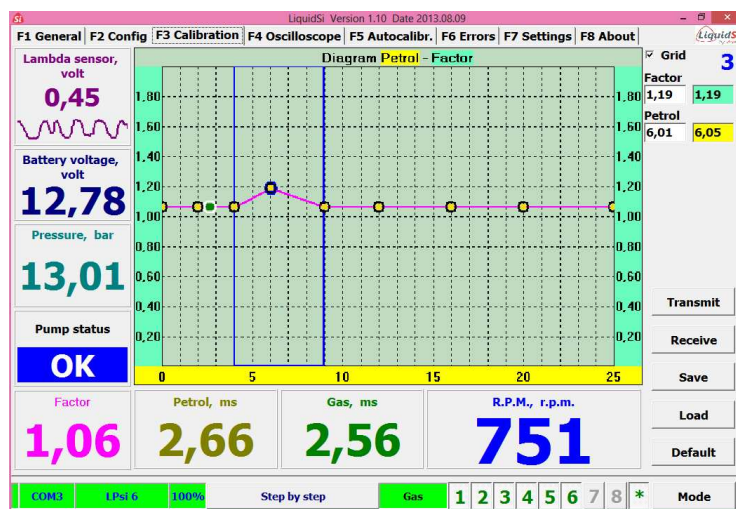
NOTE: User can move all dots simultaneously up or down by left-clicking and dragging of the left-most dot.



NOTE: User can tilt the complete line (pivotting) using the left most dot as pivotting center. To do this, move the mouse over the right-most dot and left-click/drag it vertically:

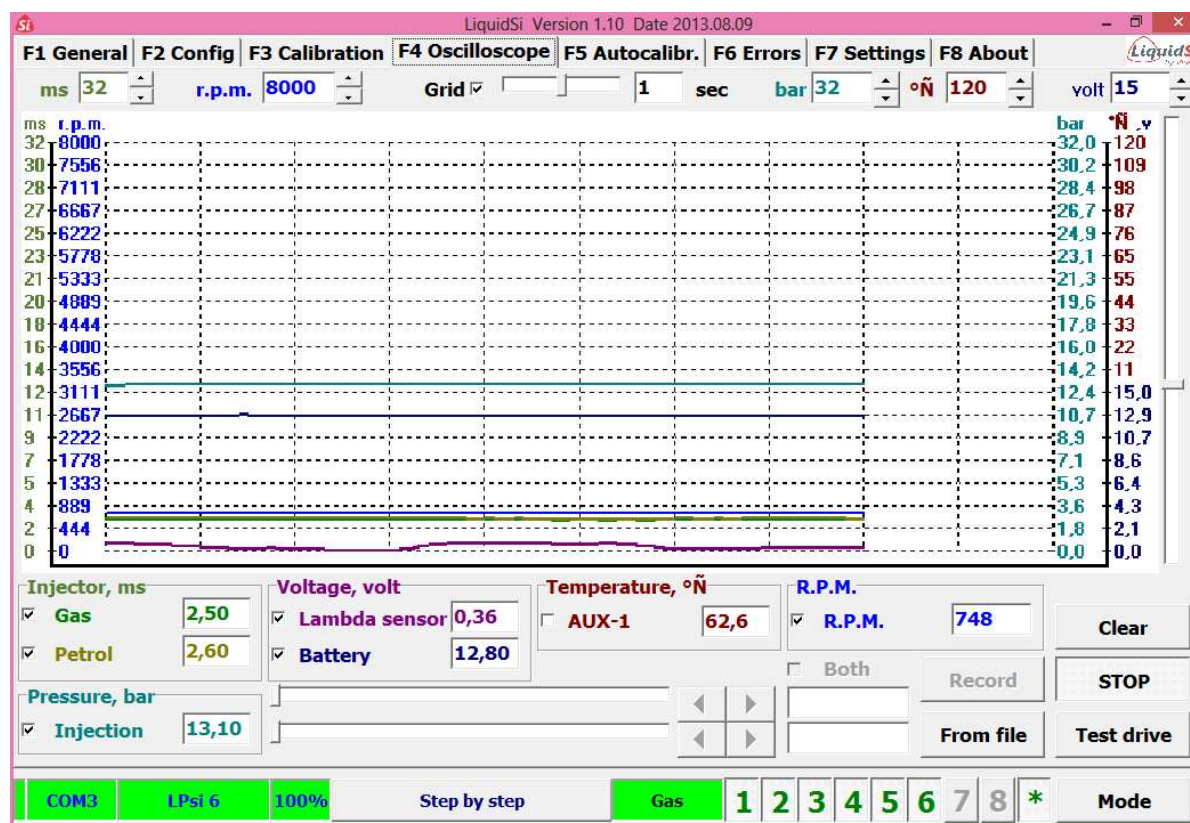


NOTE: By moving you mouse over any of the dots and then left-click and hold, you can move that dot in any desired direction.



NOTE: you can manually increment or decrement the value of the Petrol-Factor by clicking on the left-most dot and then use the UP or DOWN arrows.

F4 Oscilloscope



The F4 OSCILLOSCOPE page provides a very valuable tool when calibrating a car. Also for troubleshooting work this tool can come in very handy.

The parameters that you can track and/or record are fixed. You can not add other parameters except the parameters that are listed in the checkbox area below the graphics output area.

Top row buttons/indicator fields:

1. "ms" field. In this field you can set the range of the vertical axis for Gas pulse and Petrol pulses. Default = 32 ms. Range is 1 ... 32 ms.
2. "RPM" field. In this field user set the range for the vertical axis for engine speed. Default = 8000 RPM. Range is 500 ... 8000 RPM.
3. "checkbox "grid" . here you can turn ON or OFF the grid visible in the graphics area. The two input fields next to this checkbox allow the user to specify the spacing between the grid lines in both the vertical as well as in the horizontal direction.
4. "sec" field. The value in this field determines the "time base" for the scope: it sets the number of seconds that it takes for the traces to run in the graphics area from the far left to the far right. Default = 5 seconds. Range is 0,1 10 sec.
5. "Bar" field. Here the range for the vertical injection pressure range can be set. Default = 32 bar. Range is 0,01 ... 32 bar.

6. "T" field. In this field the maximum range for the vertical temperature axis can be set. Default = 120 degrees Celsius. Range is 0,01 ... 154 degrees Celsius.
7. "Volt" field. In this field the range for the voltage axis (on the right hand side of the graphics window) can be set. Default = 15Volt. Range is 0,01 ... 15 Volts.

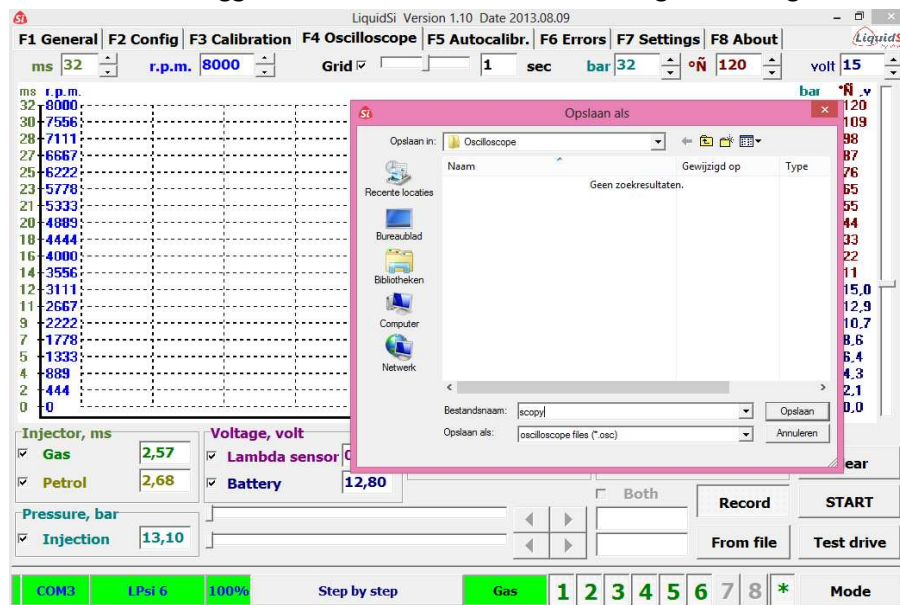
Lower row checkboxes/output fields, directly below graphics window.

8. Checkbox "Gas". When checked, duration of Gas pulses will be displayed in graphics window after the button "start" has been pressed.
9. Checkbox "Petrol". When checked, duration of the Petrol pulses will be displayed in graphics window after button "start" has been pressed.
10. Checkbox "Lambda sensor". When checked, the output voltage of the lambda sensor will be displayed in graphics window after button "start" has been pressed.
11. Checkbox "Battery". When checked, the battery voltage (as measured inside the TEC unit) will be displayed in graphics window after button "start" has been pressed.
12. Checkbox "Temperature". When checked, the temperature as measured by the temperature measuring clamp (if fitted) will be displayed in graphics window after button "start" has been pressed.
13. Checkbox "RPM". When checked, the engine speed in RPM will be displayed in graphics window after button "start" has been pressed.
14. "Clear" button. Pressing this button clears all output from the graphics window.

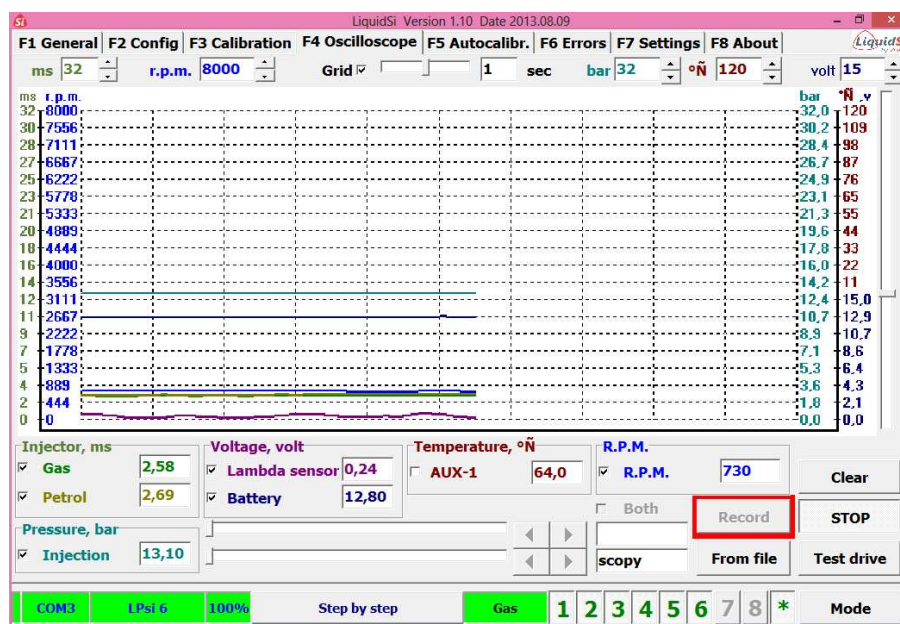
Bottom row of controls and buttons.

15. Sliders(2x). There are two sliders that each control which part of a previously recorded oscilloscope event is being displayed. You can use it to very quickly navigate through previously recorded oscilloscope files. Since there are two sliders, you can have two recorded files open at the same time. This gives you the possibility to compare two events that were each recorded into a separate file.
16. Vertical Slider. On the far right hand side there is a vertical slider allowing the user to change the resolution for Temperature and Battery voltage. When you move the slider, the resolution for the one parameter will improve at the expense of the other parameter.

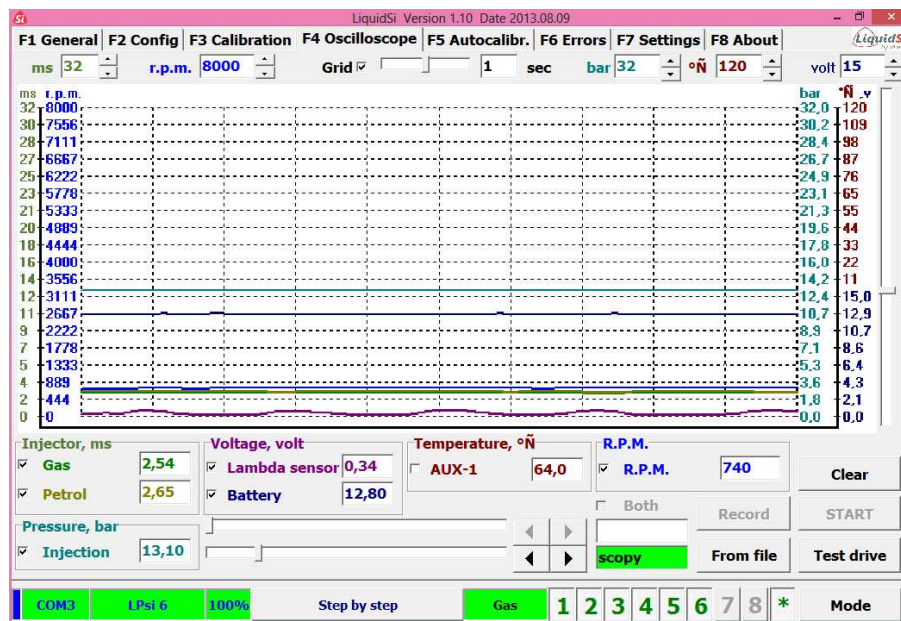
17. “Record” button. Pressing this button starts a recording session. All output visible in the graphics window will be logged. Software will first show a dialog box asking for a file name.



You can now save this file. If you now press the START button, the recording will actually start and the data will be stored in the saved file (in this example: scopy.osc) The RECORD button will show a RED border to remind you of the fact that data is being recorded into memory and onto disk. Also, the START button will change into a STOP button:



18. “From file” button. This button opens a dialog box allowing you to pick any of the previously recorded oscilloscope files for further investigations or analysis. In the example below we have selected the scopy.osc for examination:

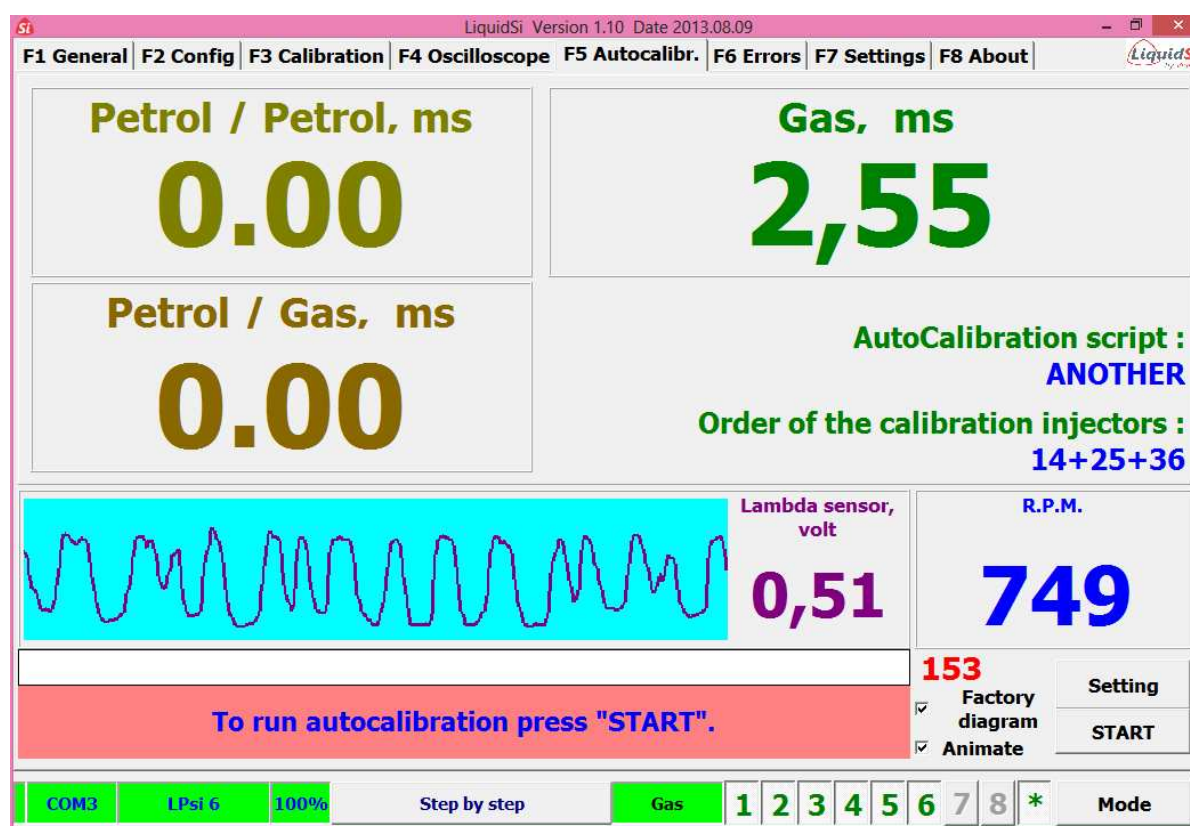


19. The two black arrows next to the loaded file name ("scopy" in the example above) allow the user to navigate through the data stored into the loaded file.

NOTE: you can load two stored files simultaneously. This a great tool for comparing two separate recordings.

NOTE: there is no way to export the oscilloscope data; you must analyse and examine the data inside the LiquidSi software.

F5 Autocalibration



The F5 AUTOCILBRATION page is where you can start the autocalibration function. This function determines the numerical value of the Petrol_factor inside the main fuelling formula:

$$T_{\text{gas}} [\text{ms}] = (t_{\text{petrol}} - \text{offset}_{\text{petrol}}) \times \text{petrol_factor} \times \text{cor_fac} + \text{offset}_{\text{gas}}$$

The autocalibration functions works basically through a repeated process of changing over one or more cylinders from Petrol to Gas and vice versa, until no difference in Petrol pulses is detected between the Petrol mode and the Gas mode.

This function works on most cars. The time that the function takes to complete depends heavily upon the value of the Petrol_factor that is anticipated. The starting point for the autocalibration function is a Petrol_factor of 1,0. if the Gas injector sizing is much different from the sizing of the Petrol injectors, then the resulting Petrol_factor can be very small (0,50). In such a case it can take more than 10 minutes to arrive at the final iteration steps.

Output fields.

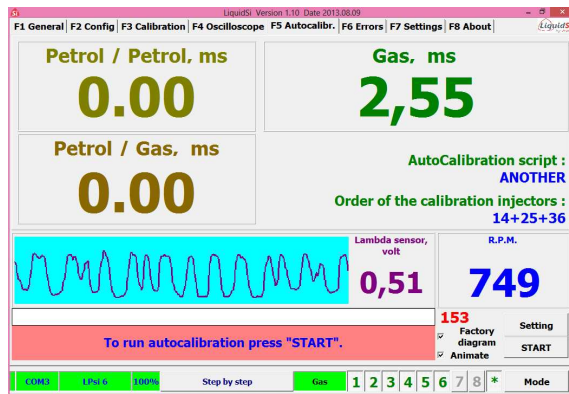
1. "Petrol/Petrol" field. This field gives the real time value for the Petrol pulse, while running on Petrol.
2. "Petrol/Gas field. This field gives the real time value for the Petrol pulse while running on Gas. As indicated earlier: the whole objective of calibration is that there is no change in Petrol pulse when changing over from Petrol to Gas. So, by monitoring these two field (1. and 2.) the user can immediately see how far the autocalibration has progressed.

NOTE: if for any reason you do not wish to use the autocalibration function, you can alternatively use the F4 SCOPE page and monitor the Petrol pulse (and lambda signal) when changing back and forth between Petrol and Gas.

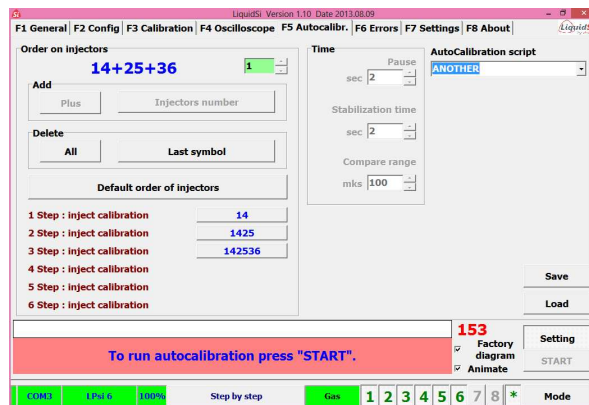
3. "Gas" field. This gives the real time value for the Gas pulse.
4. "Lambda sensor" field and graphics window. Also the lambda sensor trace can provide much insight into the progress of the autocalibration process. Especially very experienced users can retrieve a lot of important information from the lambda sensor trace shown in the graphics window.
5. Checkbox "Animate". When checked, this results in the Software displaying the progress of the Petrol_factor in the F3 CALIBRATION page, whenever the Autocalibration routine makes a change to the Petrol_factor. This box is checked by default.
6. Checkbox "Factory diagram". Checked by default. When this box is checked, the autocalibration function will use the default main calibration line from the F3 Petrol_factor diagram as a starting point for the iteration loops. Remember that the default Petrol_factor = 1,0.

NOTE: If you Uncheck this box, the Autocalibration routine will use the current value and shape of the Petrol_Factor calibration line from the F3 page. Use this option if you anticipate a Petrol_Factor located far away from the default value of 1,0. you can first, manually, set a indicative value for Petrol_Factor in F3 and then invoke the Autocalibration routine from F5 using the Unchecked "Factory diagram" option.

7. "Autocalibration script:". Below this label the name of the currently used autocalibration script is shown. By default this: Default. The user can define his own script by pressing the button "Setting" (on the same page). The order of injectors can be changed but more importantly the accuracy of the autocalibration routine can be adjusted through the three input fields: Pause, Stabilisation time and Compare range.
 - "Pause". Time (sec) of engine stabilization (default – 10 sec.) Time decreasing shortens autocalibration time but precision becomes worse.
 - "Stabilization time". Time of collection of petrol injection data (default – 10 sec.) . Time decreasing shortens autocalibration time but precision becomes worse.
 - "Compare range" . Difference between (Petrol) pulse duration in petrol mode and gas mode. The pulse difference is acceptable if it is less than set. The lower this value is set, the more precise the calibration result will be but the longer the autocalibration process will take (default = 50 usec.).
8. Button: "Setting". Pressing this button toggles the display between:



and:



The first option gives the user a good overview of how the deviations in Petrol pulses are getting smaller (or larger) while the Autocalibration is in progress.

9. "Start" button. Obviously, pressing this button starts the autocalibration process.

NOTE: the most important preparation that the user has to perform is finding a way to keep the engine load during the autocalibration process as constant as possible. This is not as easy as it sounds; when idling there is normally a quite large variation in engine load (pulse time!) due to engine auxiliaries being switched on and off automatically. For example: if the airco is activated the idle petrol pulses can vary upto 100 % depending on the current status of the airco compressor (ON or OFF). The best results are obtained by creating the highest possible engine loading at idle speed. This means that as many energy drawing functions should be activated (headlights etc.).

F6 Errors

LiquidSi Version 2.20 Date 2014.11.10

F1 General | **F2 Config** | **F3 Calibration** | **F4 Oscilloscope** | **F5 Autocalibr.** | **F6 Errors** | **F7 Settings** | **F8 About**

OBD on monitoring, ifgas pulse < (ms) CPU frequency 64 MHz

Thresholds	Component	Error Y/N, BLUE=OK RED=ERROR	Change G->P Y/N	Driver warning Y/N	Fault duration before error is set trip Y/N (sec)	Error reset at next (sec)	Start of monit., (sec)
< 0,10 > 5,00 v	LPG INJECTORS	<input checked="" type="checkbox"/> 0.95	No	No	1	No	0
< 0,20 > 2,00 v	PUMP/MV	<input checked="" type="checkbox"/> 0.62	No	Yes	1	No	0
< 0,10 > 2,00 v	SOLENOIDS	<input checked="" type="checkbox"/> 0.39	No	Yes	1	No	0
< 0,20 > 4,60 v	PRESSURE SENSOR	<input checked="" type="checkbox"/> 1,69	No	Yes	1	No	0
< 4.0 bar	SYSTEM PRESSURE TOO LOW	<input checked="" type="checkbox"/> 9,84	No	Yes	30	No	60
> 28.0 bar	SYSTEM PRESSURE TOO HIGH	<input checked="" type="checkbox"/> 9,84	No	Yes	30	No	60
< 9.0 volt	BATTERY VOLTAGE TOO LOW	<input checked="" type="checkbox"/> 13,52	No	Yes	1	No	0
> 16.0 volt	BATTERY VOLTAGE TOO HIGH	<input checked="" type="checkbox"/> 13,52	No	Yes	1	No	0
	NO RPM SIGNAL	<input checked="" type="checkbox"/> 745	Yes	No	1.0	Yes	0
< -40 > 110 °C	TEMPERATURE SENSOR	<input checked="" type="checkbox"/> 46,2	No	Yes	1	No	0

Default Save Load Error page last cleared : 2014-11-19 To reset the error, press button "Clear" Clear

COM14 TEC-6 100% Gas pump ON Gas 1 2 3 4 5 6 7 8 * Mode

The lay out of the error page has been completely overhauled and the functionality has been vastly improved and extended to be more in line with the formal requirements of the R115 regulations.

There are now 10 errors pre-defined, each occupying 1 line in the error page.

Definition#1: any input/output value which is exceeding the thresholds set in Column 1, is named: a **Fault**.

Definition#2: a **Fault** can become an **error** if the fault satisfies all the criteria and conditions:

- top row criteria: "OBD on" must be set to YES and gas pulse must be lower than the value entered in the "OBD monitoring" field, AND
- column 1 criteria, AND
- column 6 fault duration time is passed, AND
- column 9 criteria (obviously, the monitoring delay time must have elapsed first) must be satisfied.

Top row

The top row has two settings:

- "OBD on", this a small pull down menu with only two options: YES or NO. Default = YES.
- "OBD monitoring gas pulse < [ms]", here the user can enter a value so that OBD monitoring can be suspended/ignored when gas pulse is more than a threshold value, 18ms is the default.

First Column (thresholds)

The first column gives the parameter fields for the different fault thresholds. A **fault** is signaled when the parameter being monitored is either lower than the lower threshold or is higher than the upper threshold value.

Second Column (component)

The second column gives the name for the error/fault.

Third Column (error yes/no)

The third column lists the **error** output fields. These fields are coloured BLUE or RED. By default all fields are BLUE. They turn RED if a **fault** has become an **error**. When the car is running, the momentary value of the monitored parameter is being displayed within the BLUE or RED block.

Also, the coloured field has a checkbox which turns the OBD for this particular error ON or OFF.

Fourth Column (change G-> P yes/no)

The fourth column indicates what action to take in case of an **error**. User can choose for YES or NO from drop down menu. In case of YES, the system switches to Petrol as soon as the **error** field changes from BLUE to RED. Also, the driver receives a warning via the fuel switch if the fifth column is set to YES also.

Attention: in case of YES, the selected fuel changes to Petrol automatically in case of an error.

Fifth Column driver warning yes/no)

In the fifth column the user can indicate whether the driver should receive an audible/visible warning or not from the fuel switch in case of an **error** (remember: **error** = **error field changing from BLUE to RED**). For markets where the R115 is compulsory, this parameter should be set to YES (R115 requirement) for selected errors.

Attention: this warning shall be disabled when the driver presses any of the two switch buttons.

Here is a logic table for the columns 4 and 5:

<p>4=YES 5=YES</p> <p>In case of an error, the fueling changes to Petrol.</p> <p>The selected fuel is now Petrol.</p> <p>The switch beeps and flashes 4 times.</p> <p>If the driver presses any of the switch buttons, the beep and flash will stop. Petrol will still be indicated on the switch.</p> <p>The driver can not change to Gas, the switch is blocked.</p> <p>If column 9 is set to NO (no error reset at key on) then after a restart of the engine the selected fuel is still Petrol and switch is blocked, no more beeping/flashing after restart.</p> <p>Errors must be reset by the dealer in case of NO in column 9 before Gas operation is possible again.</p>	<p>4=YES 5=NO</p> <p>In case of an error, the fueling changes to Petrol.</p> <p>The selected fuel is now Petrol.</p> <p>The switch shows Petrol as selected fuel.</p> <p>The switch does not respond to the driver, it is blocked.</p> <p>If column 9 is set to NO (no error reset at key on) then after a restart of the engine the selected fuel is still Petrol and switch is blocked. No beeping/flashing.</p> <p>Errors must be reset by the dealer in case of NO in column 9 before Gas operation is possible again.</p>
<p>4=NO 5=YES</p> <p>In case of an error, the fueling remains on Gas.</p> <p>The switch beeps and flashes continuously.</p> <p>If the driver presses any of the switch buttons, the beep and flash will stop.</p> <p>After that, the driver can use the switch normal. Selected fuel remains Gas (if driver does not change the fuel selection).</p> <p>If column 9 is set to NO (no error reset at key on) then after a restart of the engine the selected fuel is not changed. Switch is not blocked, no more beeping/flashing after restart.</p> <p>Errors must be reset by the dealer in case of NO in column 9 before Gas operation is possible again.</p>	<p>4=NO 5=NO</p> <p>In case of an error, the fueling remains on Gas.</p> <p>There will be no beep/flashing.</p> <p>The driver can use the switch as normal.</p> <p>If column 9 is set to NO, then the error is remembered and can only be cleared by the dealer.</p> <p>If column 9 is set to YES, then the error is reset at engine shut down.</p>

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Sixth Column (fault duration before error is set)

In this column the user can set the required duration of the **fault** before the **error** is set (error field is turned to RED and action is to be taken). For example, the injection pressure must be lower than the threshold pressure for more than 5 seconds before this fault is to be recognized as an error. In that case enter "5" into the sixth column.

Seventh Column (error reset at next trip)

In this column the user can decide for each error whether this error shall remain in memory after engine shut down or not. It makes sense for some errors to be automatically reset after each trip. Others should be preserved in memory until these are cleared by the dealer/installer. In markets ruled by the R115 this is a requirement for selected errors.

If this parameter is set to YES, then after engine stop the corresponding error field is changed from RED into BLUE again.

Eighth Column (start of monitoring)

This last column dictates when the OBD monitoring shall be started: some faults can/should be monitored right from the beginning (key-ON), for some other faults it is maybe better to wait a number of seconds/minutes before the monitoring is started. The zero point for this pause timer is the change-over of the first Petrol injection to Gas injection. In case of manual switch-over from within the software program (using the bottom row of individual cylinder buttons), this timer will start, irrespective of which cylinder was chosen.

Bottom line: first there are the three standard buttons: DEFAULT, SAVE and LOAD. Next is a box showing the date and time for the last time that all errors were cleared. Finally there is a CLEAR button. Pushing this button immediately clears all errors from the page. It might be necessary to press this button twice to make sure that all errors fields are being reset.

NOTE: it is not necessary to use the TRANSMIT button when making changes in the new error page: any change made is transmitted automatically to the TEC. Each change you make is also automatically saved into the history file on your hard drive.

NOTE: the error line "No RPM signal" is for information only. The settings for this error can not be changed by the user.

NOTE: In case of sensor failure the LiquidSI software excludes faulty or missing sensor data and their correction factors from the main fuelling formula, therefore pulse duration correction is carried out only by using the calibration line visible in F3 CALIBRATION. The program checks sensor functioning continuously, this implies that errors which are resolved (automatically, randomised errors) automatically restore the full functionality of the main fuelling formula.

F7 Settings

LiquidSi Version 1.14 Date 2013.09.18

F1 General | F2 Config | F3 Calibration | F4 Oscilloscope | F5 Autocalibr. | F6 Errors | F7 Settings | F8 About

Language

English

Font, size, style, color

Setup Ports

Name

☒ Auto search

Setup

Delay (ms)

60

Configuration file

☒ Taken together CFG and CLB information

☐ Transmit data CFG or CLB immediately after chang

Averaging (only show)

☒ Petrol, Gas 20

☐ Pressure

☐ Hold in front

☒ Show hint

☐ Check password

Save

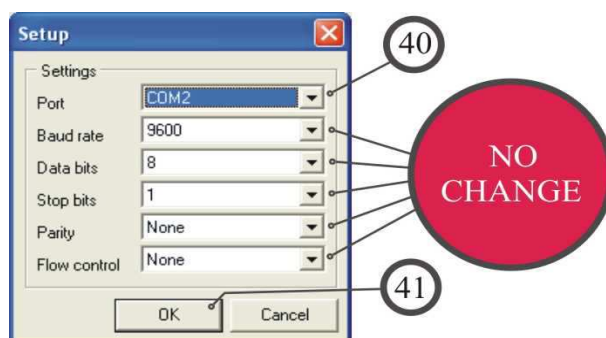
Load

Default

Disconnect 0% Step by step Automat 1 2 3 4 5 6 7 8 * Mode

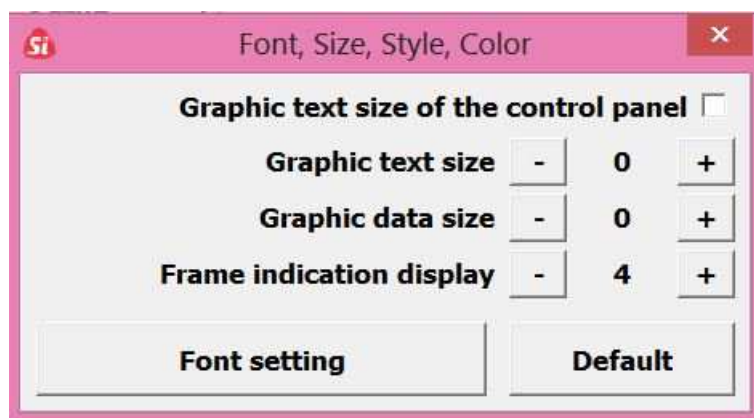
The F7 SETTINGS page allows the configuration of several important (global) parameters.

1. “Language”. This drop down menu shows a list of all the software languages which are installed in the hard disk directory xxx/program files/liquidsi/language. Choosing a different language results in the immediate changing of all of the software text into the newly chosen language. The language files are automatically stored into the correct hard disk folder when you download or install a (new) version of the LiquidSI program. Language files have the file extension: .lng.
2. “Setup Ports”. Here the name of the active computer port is shown.
3. “Setup” button. Block of port connection adjustment with LiquidSI TEC unit.



3. Checkbox “auto search”. By default this box is checked and therefore the software automatically searches for the port which the USB adaptor is connected.

4. "Delay (ms)". Determines the communication protocol delay. Do not change this setting. Default = 60.
5. "Averaging (only show)". Here you have the option to choose an averaging filter level for the graphical representation of:
 - a. Petrol and Gas pulse duration. This only applies to the representation in the F4 OSCILLOSCOPE. **It has no influence on the software internal handling speed for these signals.** By default this box is checked. Default = 20.
 - b. Pressure. The output of the pressure is highly important for many functions inside the software. For reliable diagnostics it is advised to use no averaging for this signal. By default this box is therefore Unchecked.
6. Checkbox "taken together CFG and CLB information". This box is checked by default. Do not change. Explanation: CFG is all the configuration data, which is basically all the data and parameters which can be edited under the F2 CONFIG pages (Tabs). CLB is all the calibration data which is largely the data which set in the F3 CALIBRATION page. It is usually not advantageous to treat these two data sets as separate entities.
7. Checkbox "Transmit data CFG or CLB immediately after changing". When checked, any change in configuration data (any modification made in an F2 page) or calibration data (any modification made in F3 page) is transmitted to the TEC unit immediately, i.e. there is no need to press the button "Transmit". By default this box is Unchecked.
8. Button "Font, size, style, color". With this button a pop up screen is launched, allowing the user to change size, font and color for the graphical text and data in the software.

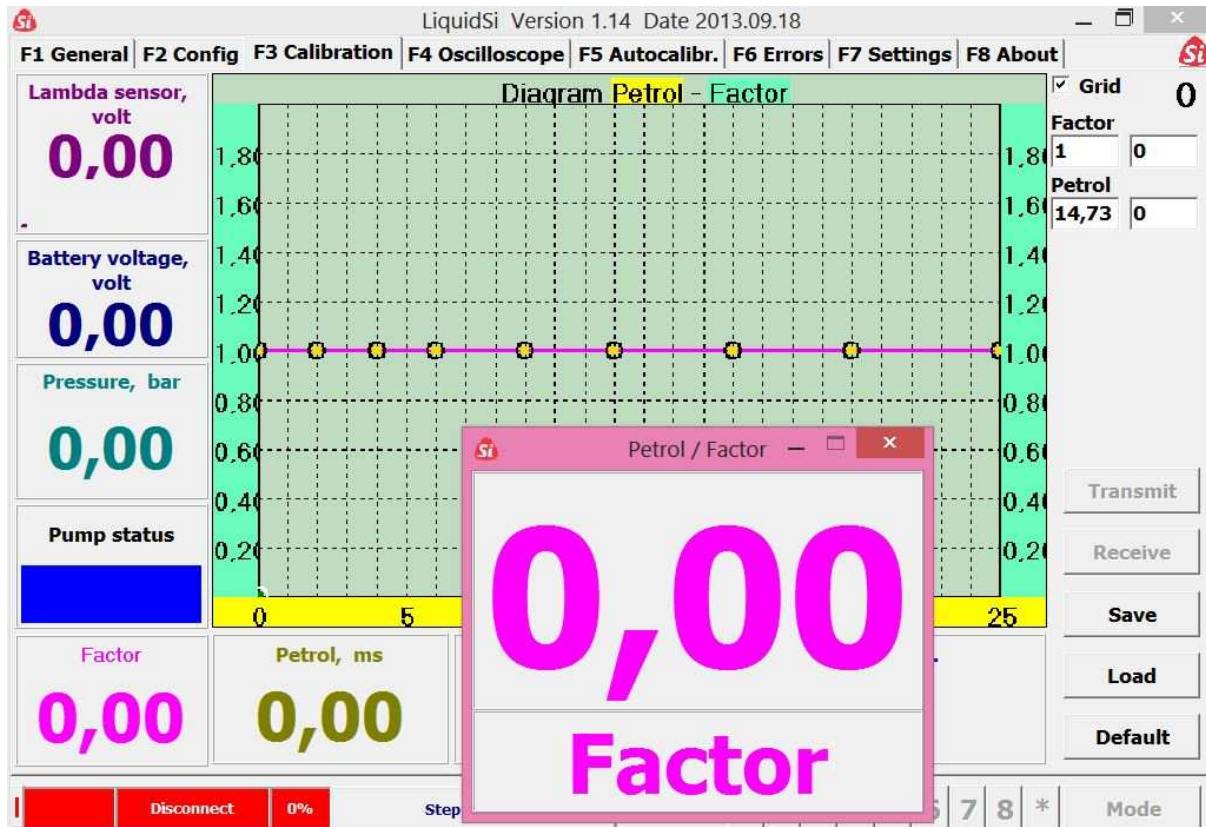


Checkbox "Graphic text size of the control panel". Checking this box gives you control over these parameters.

Graphic text size. Here you can increase or decrease the size of the displayed graphical text. This can be useful if you have a laptop display whereby a part of the text is "clipped" by Windows standard settings.

Graphic data size. This allows you to change the size of the large numbers shown in the many data fields such as: temperature, pressure etc.

Frame indication display. Here you can change the portion of the data frame that is used for actually displaying data and text. Remember that you can enlarge any data field by double clicking on it. This helps greatly when having to look at the display from a large distance.



F8 About

LiquidSI Version 2.20 Date 2014.11.10

F1 General **F2 Config** **F3 Calibration** **F4 Oscilloscope** **F5 Autocalibr.** **F6 Errors** **F7 Settings** **F8 About**

Hot Key

F1 - General	"Z" - Gas injector 1 (On/Off)	"I" - Installation diagram
F2 - Configuration	"X" - Gas injector 2 (On/Off)	"F" - Full screen
F3 - Calibration	"C" - Gas injector 3 (On/Off)	"T" - Transmit data to "TEC-4"
F4 - Oscilloscope	"V" - Gas injector 4 (On/Off)	"R" - Receive data from "TEC-4"
F5 - Autocalibration	"B" - Gas injector 5 (On/Off)	"S" - Save data in file, Start/Stop
F6 - Errors	"N" - Gas injector 6 (On/Off)	"L" - Load data of file
F7 - Settings	"M" - Gas injector 7 (On/Off)	"D" - Default data
F8 - About ...	"<" - Gas injector 8 (On/Off)	
F10 - Exit	"A" or "*" - All Gas injectors	

"F3" - Control calibration point

"0", "1", "2", "3", "4", "5", "6", "7", "8" - Select / unselect point	"Mouse right button" - Select break point
"Arrow key" - Move selected point and break point	"Mouse left button" - Push to select point and hold for move point and break point. Push and release button for unselect break point
"Esc" - Unselect point	
"P" + "point" - Select break point	
"O" + "point" - Unselect break point	

Program "TEC-4"

Version : Date :

Technical support

If you have any question or need support, please contact your local distributor

Vialle alternative fuel systems BV

Visit our website regularly for updates and documentation downloads

www.liquidsi.com

COM14 TEC-4 100% Step by step Petrol 1 2 3 4 5 6 7 8 * Mode

The F8 ABOUT page gives a listing of all the relevant keyboard short cuts.

1. "Program" textbox. This field gives the version name/number of the firmware inside the TEC unit (only shows up if there is an active connection between your laptop and the TEC unit). The version number always begins with a numeral indicating the TEC-type for which it is suitable. In the example above, the version "6.05" indicates 6 cylinder firmware of revision status 05.
2. "Technical support" text label. If you require assistance you should contact your distributor or importer. You can also check the www.liquidsi.com website for additional information.

NOTE: The LiquidSI program is designed for Windows 98/2000/XP/Vista/7/8. This program can be downloaded from the download section of the www.liquidsi.com website. The software version number is shown in the title bar (top), the firmware version is shown on the F8 page. Consult the "Software Installation and Calibration Guide" for details on how to install the Software and **upgrade** the Firmware. This guide is also available for download at the www.liquidsi.com website.