

# **Preparing and programming of ESGI 2 LPG supply system manual**



## **Part II**

### **Instruction of preparing and programming the ESGI system**

## Technical data of the central unit

Vs	Power supply voltage	0...16V
V i_an	Analog input voltage	0...5V
Vi-dgt	Digital input voltage	0..16V
Vo	Output voltage	0..Vs
Io	LPG rectifiers current	4,5A
Iinj	Injector current	4,5A
I_st-by	Quiescent current	0,048 A
Is	Readiness current	0.060 A
Is-p	Max programmer current	14A
T	Temperature range	-20°C / +125°C
Ts	Safety activation delay	<1s

## Main window



The main window is always visible irrespective of chosen setting or readouts and allows to control constantly all the necessary engine parameters during the change of setting or adaptation.

### 1. File

- read parameters from the file
- save parameters to the file
- RESET – restore setting
- exit the program

### 2. Ports

- connecting communication (auto detection)
- disconnecting communication with the controller
- computer's COM port manual selection

### 3. Language

- Selection of the interface language

### 4. Lambda probe 1

### 5. Lambda probe 2

- The window activates after connecting lambda probe, range 0...5V and allows the system to visualize all available lambda probe models

6. Connecting communication (auto detection)

- the button can be used to connect or disconnect communication with the computer for example in case of changing the port, or in case of controller's sleep state (in case of lack of power supply signal, the controller will disconnect after 5 minutes and turn into sleep mode in order to minimize quiescent current consumption.)

7. Supply voltage display

- The display should be used to diagnose supply voltage drop, which may result in controller work instability caused, for example, by incorrect 12V supply connection or lack of ground.

8. Signal of the communication state between controller and the computer.

9. LPG temperature

- Indicates LPG temperature in the gas filter of volatile phase – numerical and graphical temperature readout in Celsius degrees

10. LPG reducer temperature

- Numerical and graphical temperature readout in Celsius degrees

11. PETROL/LPG switch

- The switch allows the user to manually change fuel type directly from the program
- Current fuel type is signalled by corresponding colour (petrol-red, gas-green)
- LPG level indicator is placed above the switch

12. Engine RPM indicator

- RPM values are shown numerically and by means of indicating needle.
- In case of improper indication, you should check the connection to the engine speed indicator and select correct setting in the PETROL panel.

13. Indicator of the LPG pressure on reducer output P1

- Numerical and bar readout

14. MAP suction manifold negative pressure indicator

- Numerical and bar readout

15. Selection of the correct setting panel

- PETROL panel
- LPG panel
- ADAPTATION panel
- MAP panel
- ERROR panel
- OSCILLOSCOPE panel
- SWITCH panel
- OBD II panel
- HELP panel
- INFO panel

16. Switches of gas injectors in cylinders

Enable to disconnect particular gas injectors. After disconnecting gas injector, the controller changes the particular cylinder fuel type to petrol. It enables to diagnose damaged gas injectors by observing changes in the parameters. The change of particular cylinder fuel type is signalled by the button colour change from green into red.

Disabled injectors are highlighted in grey (for example injectors 5-8 for 4 cylinder engine).

17. Selection of the visualization for particular cylinder parameters.

- After selecting required cylinder, indicators 18 and 19 will show parameters of this cylinder.

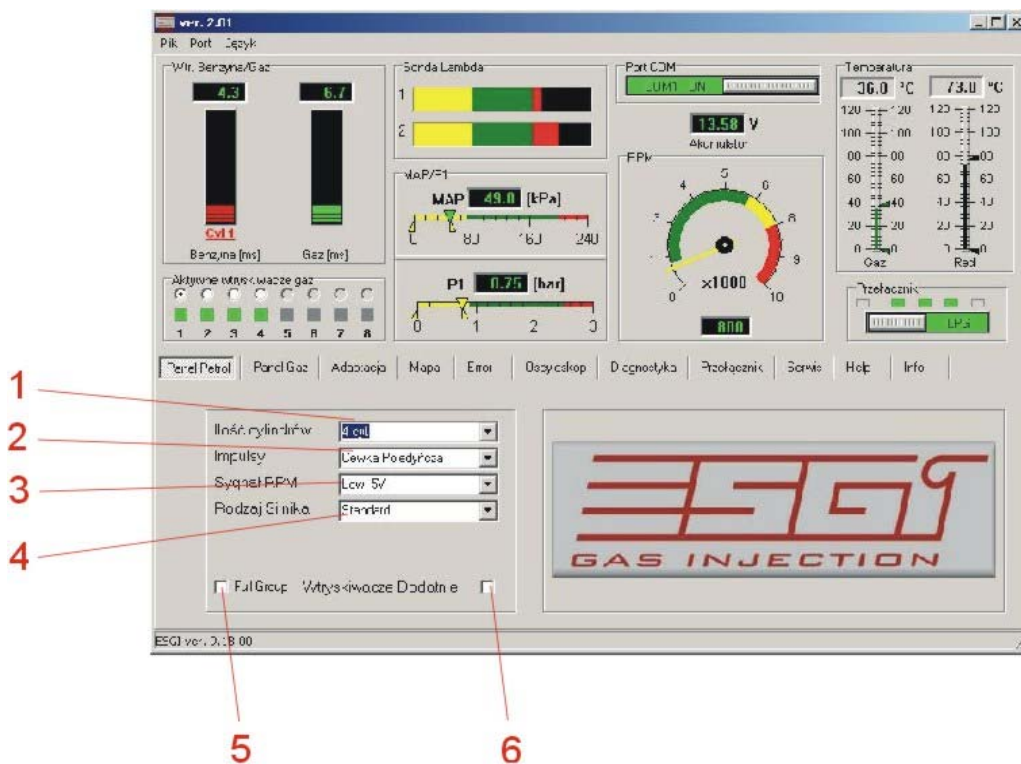
18. Gas injection time (in ms) for particular gas injector.

- The required cylinder might be changed by means of an option described under number 17.

19. Petrol injection time (in ms) for particular injector.

- The required cylinder might be changed by means of an option described under number 17.

## PETROL panel



1. Number of cylinders

- Selection of the engine cylinder quantity in which ESGI system has been installed

- Possible options: 3, 4, 5, 6, 8 cylinders

2. RPM signal impulse

- Possible options: single coil (a coil per cylinder), double coil, multi-cylinder system (distributor, ignition module)

- Correct parameter should be chosen in order to get correct RPM indication in accordance with the engine-speed indicator.

3. RPM signal

- Low 5V – signal from the sensors, for example engine-speed indicator signal from ECU

- High 12V - ignition coil signal

#### 4. Engine type

- For normally aspirated engine – standard option
- For supercharged engine – turbo option

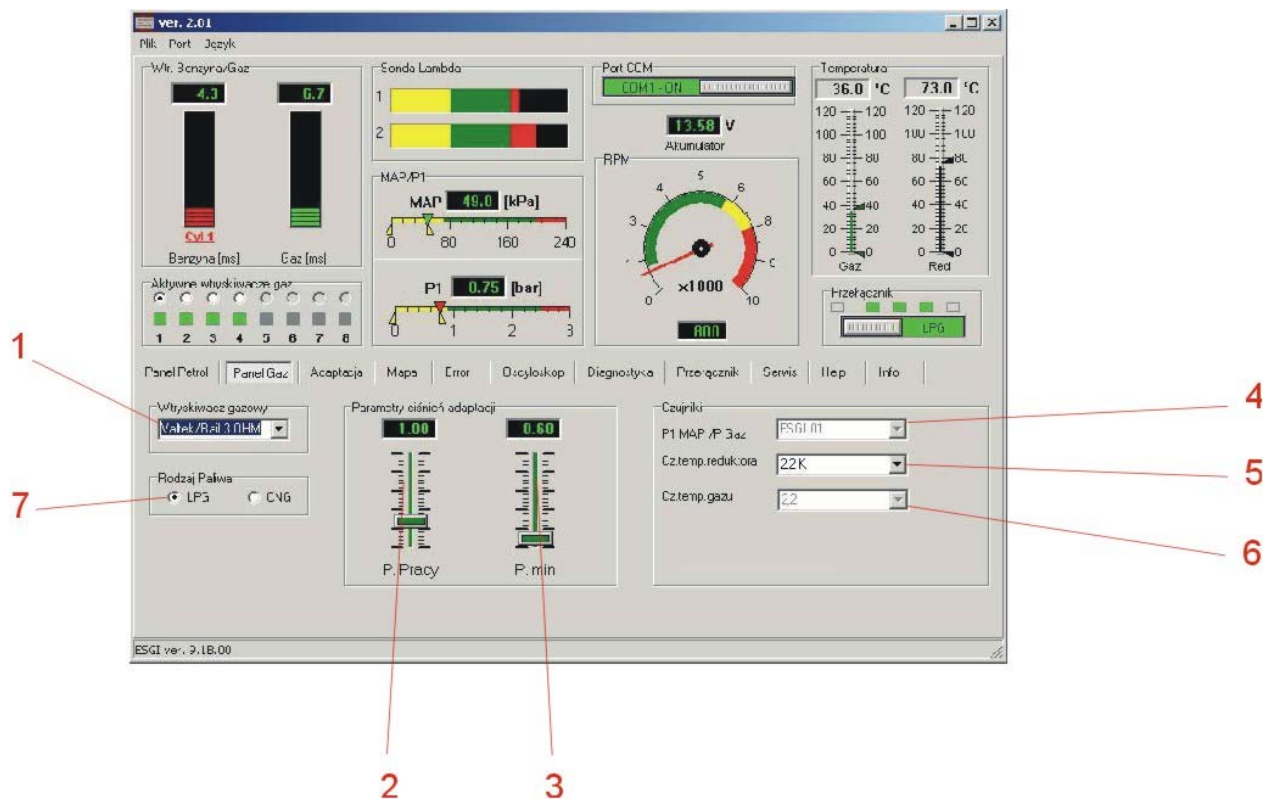
#### 5. Full Group

- Choosing this option results in shutting down cylinder switching sequence
- if there is possibility of disconnecting each injector separately, there is no need in choosing "Full Group" option;

#### 6. Positive injectors

- Choosing this option allows the controller to work with petrol injectors controlled by ECU with positive voltage (used for example in American cars)

## LPG panel



#### 1. Selection of the gas injector.

- Available injector types: Matrix, BRC, Keihin, Valtek/Rail in versions 3 Ohm, 2 Ohm and 1 Ohm
- It is essential to choose the correct type of the used injector in order to ensure correct system operation

#### 2. LPG work pressure – the pressure during the adaptation

- Manual correction can be made, but always bearing in mind that there is a possibility of error occurrence
- In case of manual correction, the correction of LPG injection time should be made as well.

3. Minimum pressure – if the minimum gas pressure is not reached, the system will change fuel type to petrol

- The change will occur if the pressure drop time is longer than the one set in the SWITCH panel.
- In case of reducer pressure correction, without another adaptation, the parameter should be revised in order to avoid unjustified fuel type change (effect of pressure variation)

4. Selection of the pressure sensor type

- After engaging, system detects the type of the sensor used.
- In case of incorrect indications or when replacing the sensor, select appropriate sensor type.

5. Selection of the reducer temperature sensor type

- After engaging, system detects the type of the sensor used.
- In case of incorrect indications or when replacing the sensor, select appropriate sensor type.

6. Selection of the LPG temperature sensor type

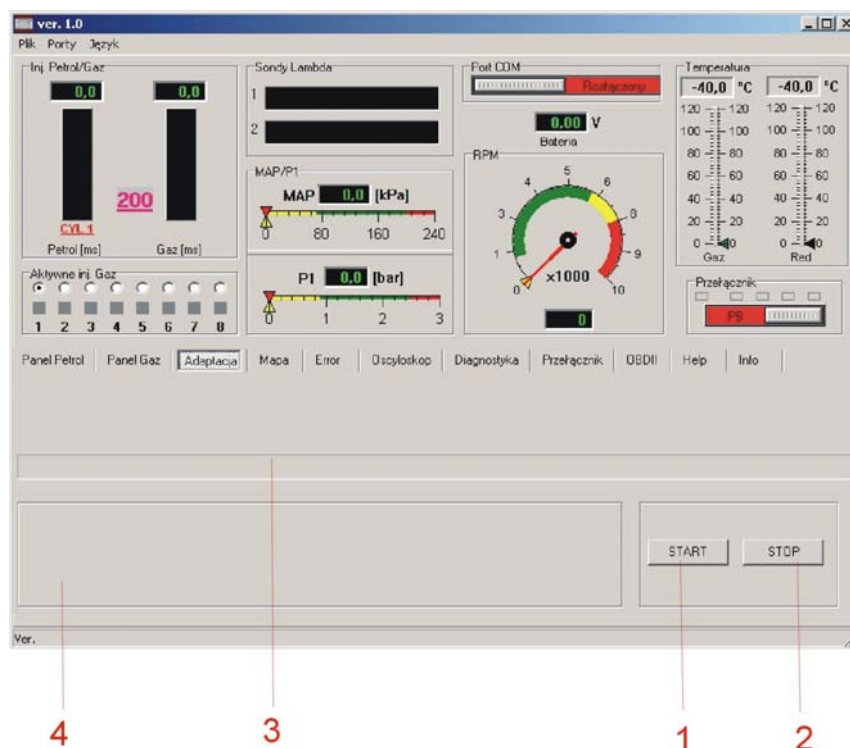
- After engaging, system detects the type of the sensor used.
- In case of incorrect indications or when replacing the sensor, select appropriate sensor type.

7. Selection of gas fuel type

- depending on the used gas correct option must be chosen: LPG or CNG, right selection guarantees correct selection of corrections dependant on features of the given gas;

**NOTE: LPG temperature sensor is sealed screwed to the gas filter of volatile phase. When replacing the sensor or the gas filter of volatile phase, screw the sensor in the filter casing sealing the connection with appropriate hermetic seal and check the place of connection with a tester for possible leakage.**

## ADAPTATION panel



1. Adaptation start button

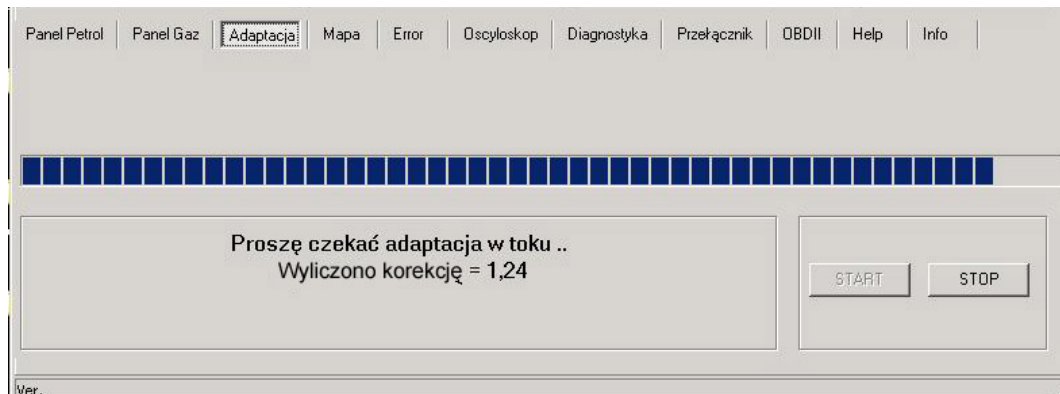
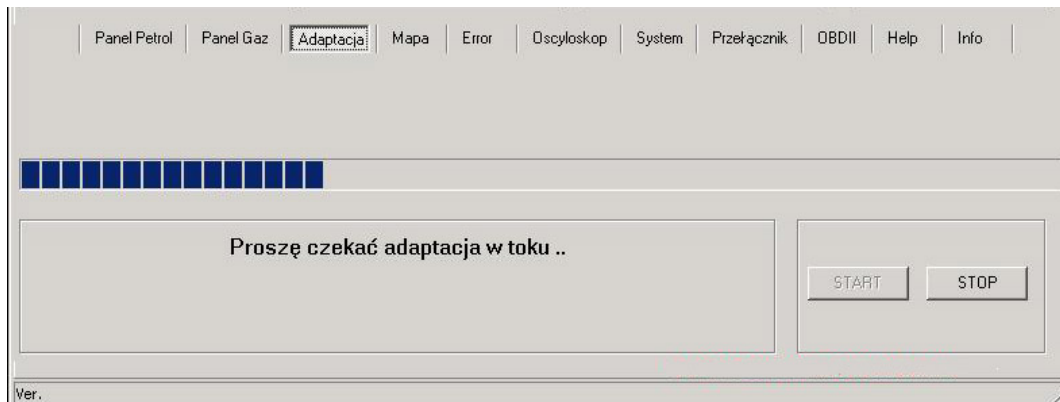
2. Adaptation stop button

3. Progress bar

- During the adaptation, progress bar shows approximate process time left. After the process completion, the controller displays information about adaptation success or failure.

4. Information window

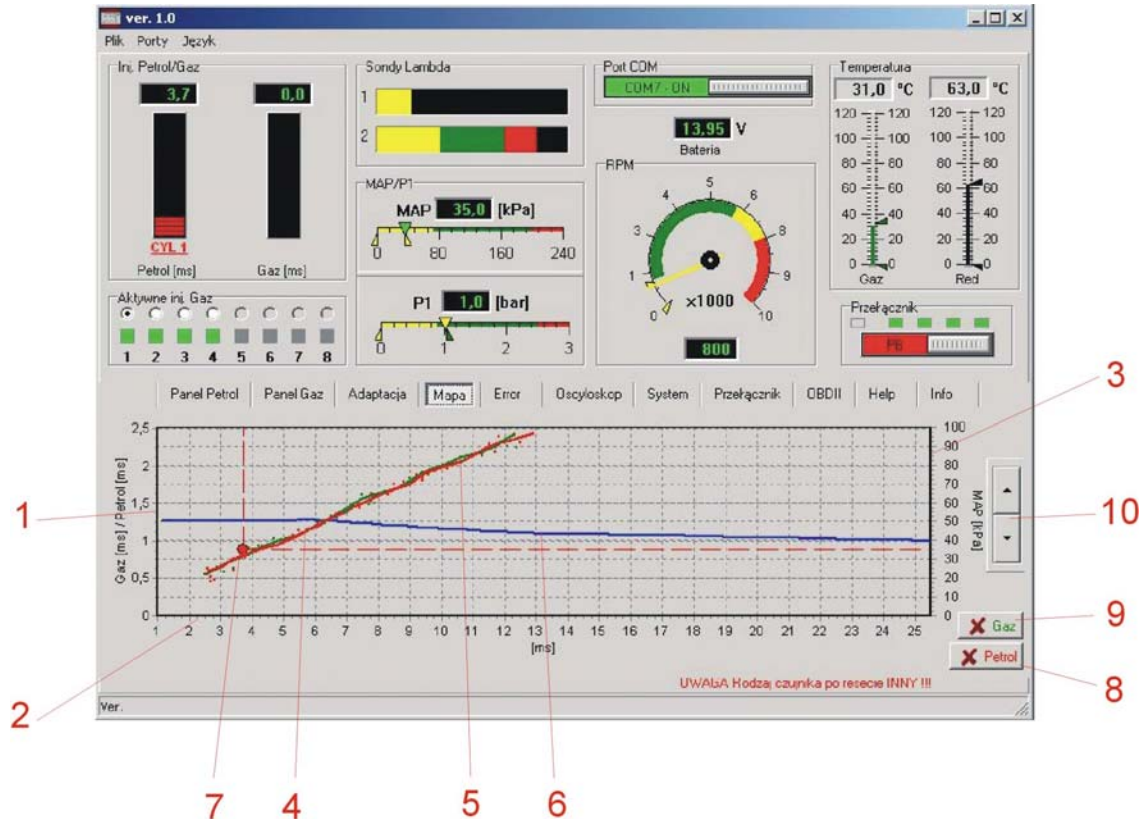
- In this window, the system displays information concerning the adaptation progress and completion.



**NOTE:** The optimum correction value should be in range 1.2-1.6. The system allows to finish the adaptation with different correction value, but it may result in other than optimum LPG injection time and incorrect engine work during LPG supply. In this case, the size of the holes in the injection nozzles should be corrected (Valtek, Rail) or proper injectors should be placed (ESGI, BRC, Keihin, OMVL). During the adaptation, the engine should be in idle run without any engine load (don't move the steering gear, turn off the lights and air conditioning) until the process finishes. If one of the parameters (RPM, pressure, temperature) is incorrect, the system displays corresponding information. During the adaptation, the controller sequentially changes fuel type in particular cylinders (in both ways petrol – LPG and LPG – petrol) establishing petrol injection time and correction for idle run. Correction value for higher RPM should be established during a test drive (MAP panel).



## MAP panel



1. Axis of the correction of LPG injection time values

2. Axis of injection time values (ms)

3. Axis of the MAP pressure values in the suction manifold (kPa).

4. Petrol map – diagram of the petrol injection time depending on the MAP pressure in suction manifold.

- While engine is running on petrol, the controller writes red points on the diagram. After gathering enough points, the system will connect them creating the petrol curve.

5. LPG map – diagram of the **petrol** injection time while running on LPG depending on the MAP pressure in suction manifold.

- While engine is running on gas, the controller writes green points on the diagram. After gathering enough points, the system will connect them creating the gas curve.

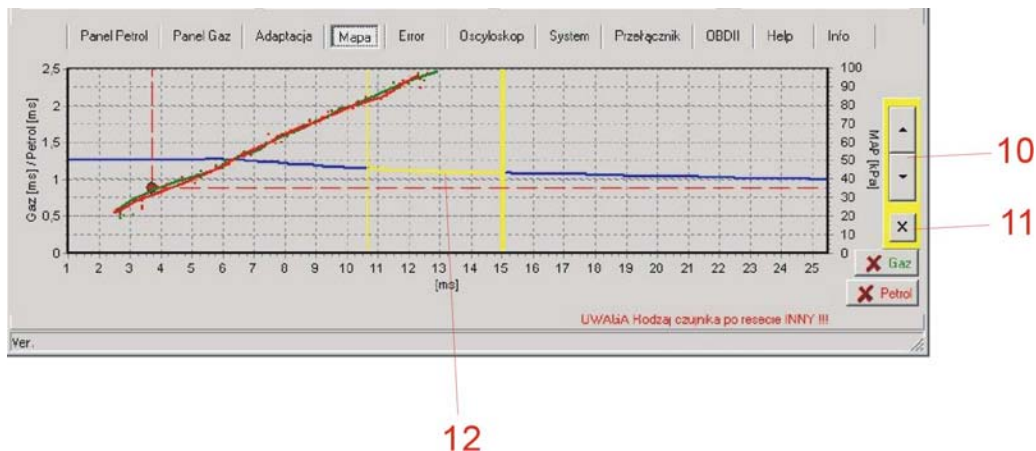
6. Diagram of the correction of LPG injection time values

- the diagram of the gas injection correction might be moved up and down by means of the buttons (10), changing the correction factor value for the whole range of petrol injection time.

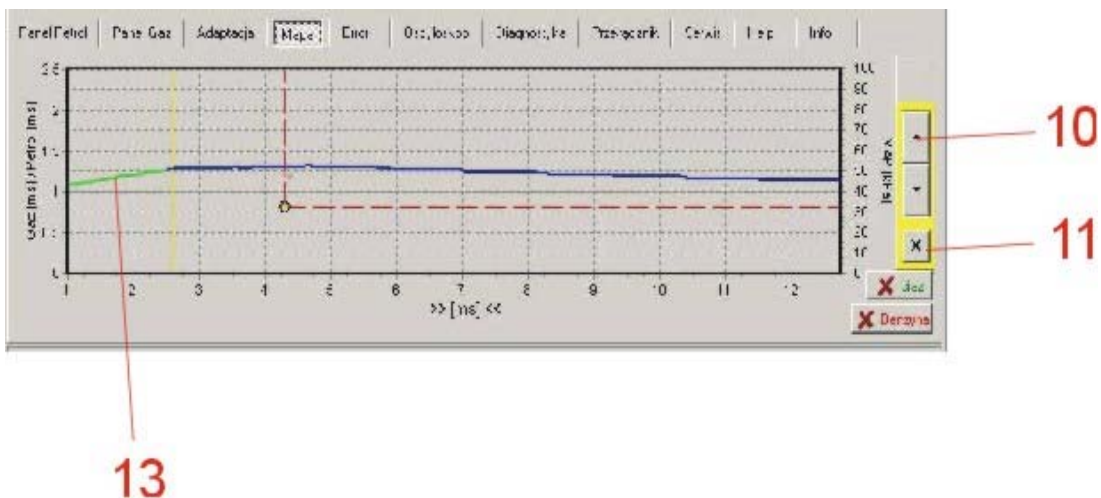
- After clicking the left mouse button in appropriate place of the correction curve, the beginning (1<sup>st</sup> click) and the end (2<sup>nd</sup> click) of the detailed correction will appear (12). In the marked area, the correction curve will change its colour into yellow.

- The buttons (10) are highlighted in yellow and allow parabolic deviation of the correction curve only in the marked area. It enables to choose proper correction in places of gas map deviation in comparison with the petrol map.

- The button marked in the graph with number 11 provides the function of deleting detailed correction (the same function is available by means of the right mouse button)
- **Proper correction depends on perfect match between petrol and LPG maps.** It is recommended to perform detailed correction during a test drive.



- if there is a need to move the beginning or the end of the correction curve one needs to mark by left key the chosen field (it is highlighted green – 13) and change the course of the beginning or the end of the correction curve by key 10



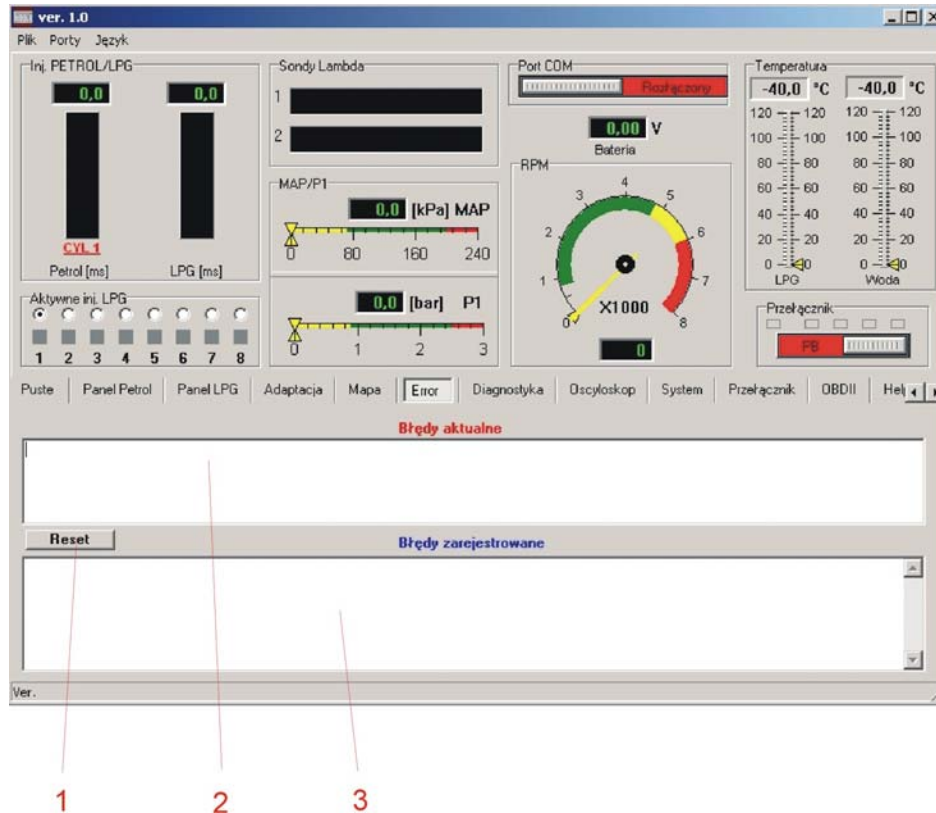
#### 7. Point of work

- Location of the point of work depends on actual injection time and MAP negative pressure. It allows the system to determine temporary engine load and injection time. While the engine is running, the point of work moves across the diagram and writes points of the petrol map.

8. The button for deleting points of the petrol map.

9. The button for deleting points of the LPG map.

# ERROR panel



## 1. RESET button

- It enables deleting current and registered errors in the LPG controller.
- It deletes current and registered errors.

## 2. The window of current errors.

- In case of malfunction, the controller signalizes the error with a sound signal and flashing diode on the switch, and changes the fuel type into petrol
- Switching into LPG is possible only after turning off and on again the ignition switch providing that the error does not occur again.
- It is possible to delete the error by means of the RESET button.

## 3. The window of registered errors.

- If, after another turning on the ignition switch, system does not detect any errors and starts running on LPG, the error that occurred previously will be moved and written in this window.
- Registered errors are important information for service concerning temporary system malfunctions, and they facilitate diagnosing possible inefficiencies.
- Registered mistakes do not have any influence on the controller operation.

## Displayed error messages

- **Injection error** – lack of injector connection or injector is damaged. System is testing injectors after turning on the ignition switch and during the system operation.
- **Voltage error** – quality of the contacts and power supply connection should be checked. Notice the voltage variation during the controller operation and eliminate the defect.
- **Control voltage too low** – incorrect power supply connection from the ignition
- **LPG pressure too high** – LPG pressure has exceeded by 100% value of the operating pressure. It may signal inappropriate corrector adjustment or its damage, pressure sensor

malfunction or selection of incorrect sensor.

- **LPG pressure too low** – LPG pressure dropped below the minimum pressure. It may signal lack of gas in the tank, malfunction or incorrect reducer adjustment. It may also signal disconnection of the pressure sensor or serious impurity in the gas filter of volatile phase.

- **Lack of petrol injection** – controller is not able to read petrol injection time on one or few petrol injectors. Bundle and the injector emulation plug should be checked.

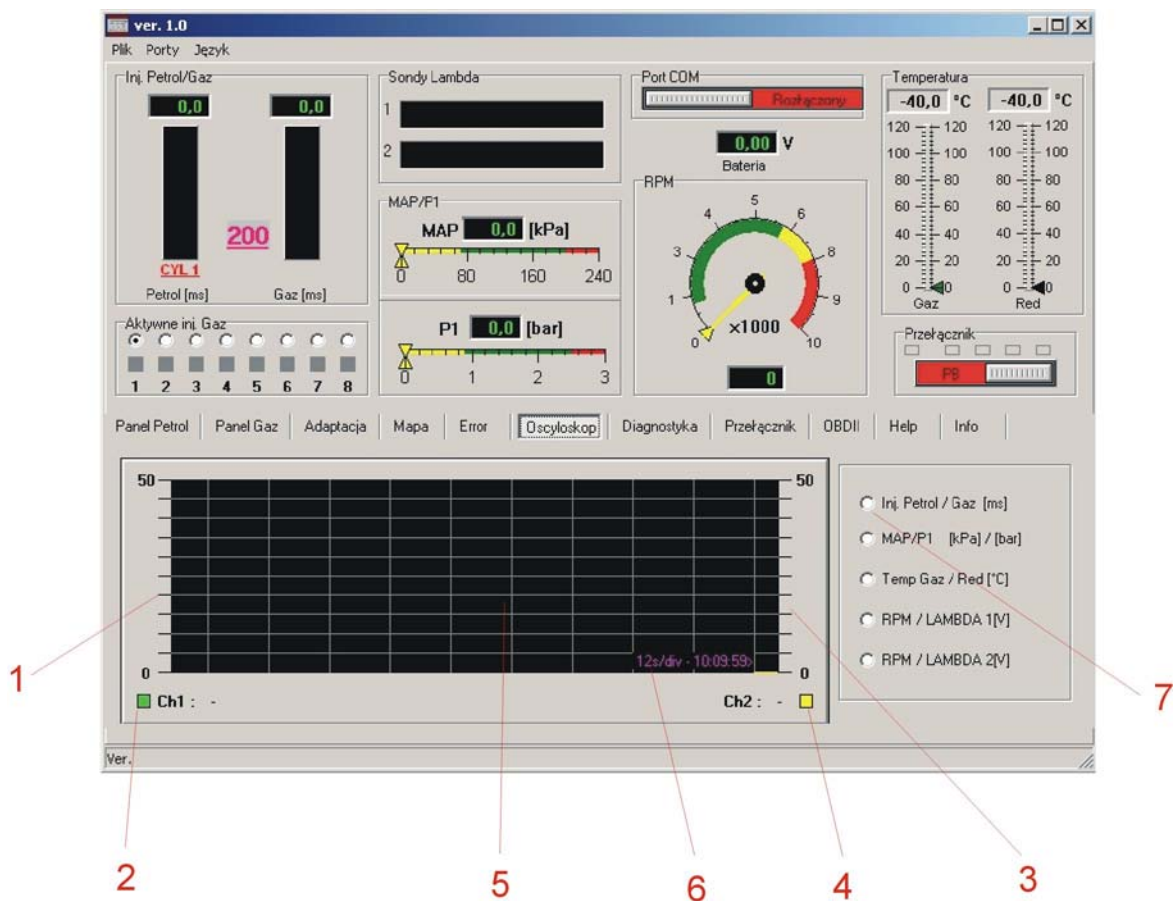
- **Incorrect setting** – incorrect data has been inserted. Settings in panels PETROL, LPG and SWITCH should be checked and corrected.

- **Incorrect operation of the petrol system** – the error signals incorrect operation of the petrol system or incorrect LPG installation.

- **LPG injection time too long** – accumulation of the injection times took place. It might be caused by inappropriate correction settings, too small injection nozzles or low reducer efficiency.

**NOTE: Too long opening of gas injectors might result in damage of the injector coils due to their overheating.**

## OSCILLOSCOPE panel



1. Value scale for channel 1 diagram

2. Type of visualized run for channel 1

3. Value scale for channel 2 diagram

4. Type of visualized run for channel 2

5. Oscilloscope graphic field

6. **Time/graduation** oscilloscope unit

7. Type of visual signals selection

- Simultaneously on the oscilloscope screen two runs might be observed depending on the position chosen in option number 7

- Possible signal pairs:

[Petrol injection time/LPG injection time] in ms

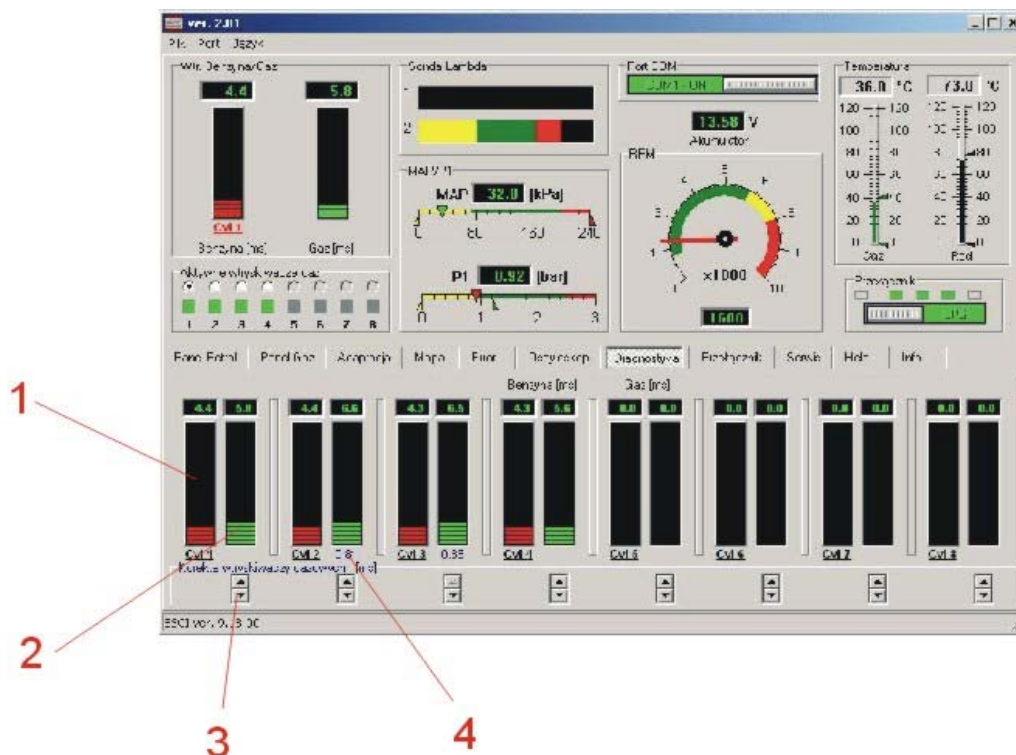
[MAP pressure in collector/gas pressure] in bar

[LPG temperature/reducer temperature] in Celsius degrees

[Engine RPM/Lambda 1 probe signal]

[Engine RPM/Lambda 2 probe signal]

## DIAGNOSTICS panel



1. Indicator of petrol injection time for particular cylinders

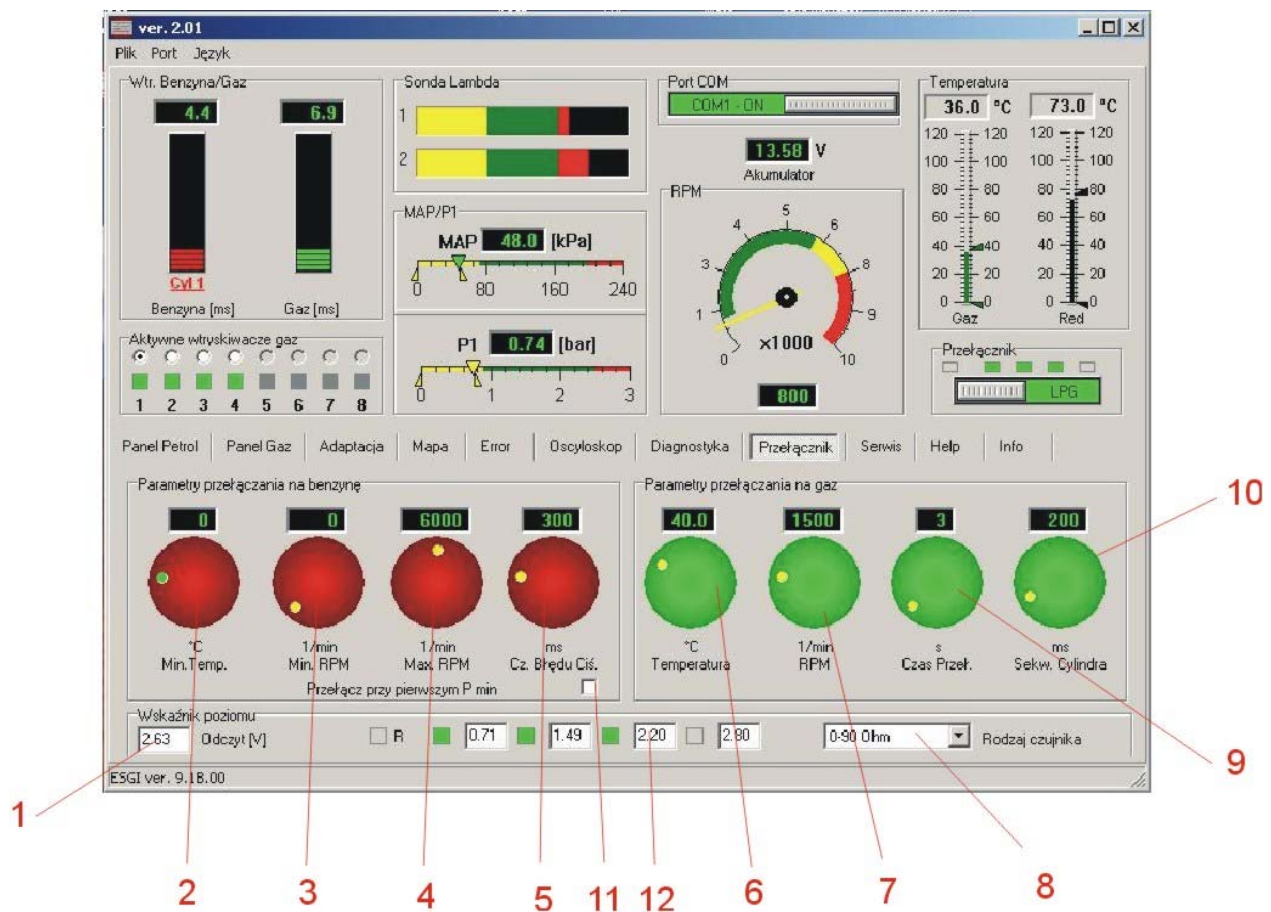
2. Indicator of gas injection time for particular cylinders

3. Keys allowing for individual gas injection correction for each gas injector (range of correction approx.  $\pm 20\%$ )

4. Readout of correction number for particular gas injector (correction number given in ms)



## SWITCH panel



1. Voltage readout from the LPG level gauge in the tank

2. Minimal gas temperature

- temperature value below which the system will change the fuel type back into petrol (system does not signalise petrol work)

3. Minimal RPM

- RPM value below which the system will change the fuel type back into petrol (system does not signalise petrol work)

4. Maximum RPM

- RPM value above which the system will change the fuel type back into petrol

5. Pressure error time

- Time (in ms) after which the system will change the fuel type into petrol due to the pressure drop below the minimum level. It should be remembered that too short error time may cause out-of-control switching into petrol. It may happen in case of momentary pressure drop caused by rapid demand for gas while the engine load is very big.

6. Temperature

- Reducer's temperature value in which the system allows to switch on LPG

## 7. Torque

After exceeding this RPM value, the system will change the fuel type from petrol to LPG. Temperature value set in 8 should be reached.

## 8. Selection of the level gauge indicator type

- After setting the type of the indicator, it is possible to manually correct indications by changing threshold voltage values 7.

## 9. Switch time delay

- Switch time delay after which the fuel type will change to LPG. In addition, parameters 6 and 7 have to be reached.

## 10. Cylinders' sequence

- Delay (in ms) of the switch between particular cylinders in order to obtain regular, steady change from petrol to LPG.

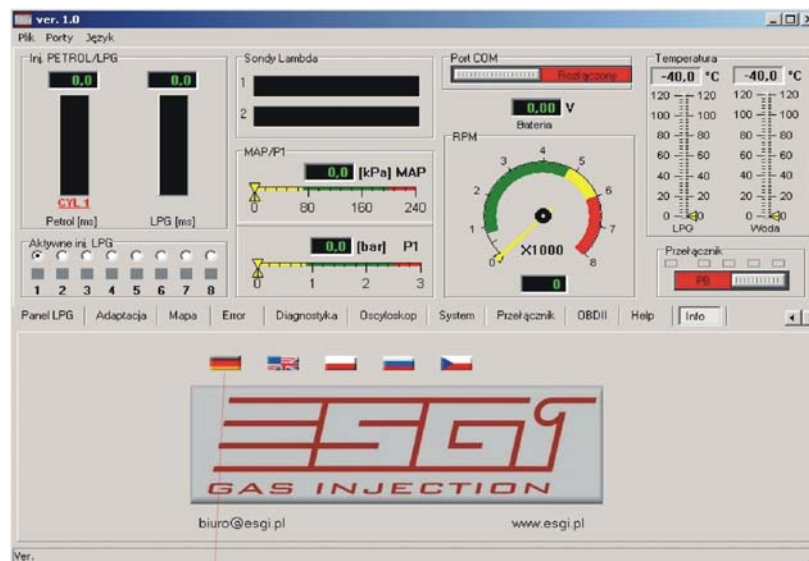
## 11. Switch in case of the first pressure drop

- Marking this option will result in immediate switching into petrol, even after the first momentary pressure drop below the minimum level

## 12. Threshold values of the LPG level gauge

- In case of the need for correcting indications of the LPG level gauge, or using level gauge of an unknown type, threshold values should be set in order to get linear characteristic of the LPG level gauge. Location of the indicating needle can be changed with a magnet.

## INFO panel



## 1. Language selection

- Available languages: German, English, Polish, Russian, Czech.