# Water Injector System

# Ecomax-3

## User Manual

sdsauto.com

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## Introduction

The proposed ***Ecomax!*** Water Injector System is designed, basing on modern technologies with the use of the micro computer and is a complete device installed either under the hood of a vehicle or into its interior (as agreed upon delivery).

The use of the micro computer renders the Water Injector System simple at operation and adjustment. Furthermore, the application of the computer allows precise calculation and dosing of the required amount of water and fuel which is related to the operation modes of the vehicle, its temperature, crankshaft rpm, throttle plate position, etc.

***Water Injector System enables the following:***

- to reduce fuel consumption;
- to eliminate detonation;
- to reduce the shock stress of the crank gear;
- to reduce scale in the combustion chamber;
- opportunity to use petrol with the lower octane number;
- opportunity to modify the chip tuning parameters without re-flashing the control unit of the vehicle, which may be done in a process of operation even by a non-experienced user with their PC;
- Fuel consumption indication.

## 1. Complete set

| No. | Name | Quantity | Note |
|---|---|---|---|
| 1 | Control | 1 | |
| 2 | Pump | 1 | |
| 3 | User Manual | 1 | |
| 4 | Hose | 2m | |
| 5 | Nozzle | 1 | |
| 6 | Crinkled hose for electric wiring | 2m | |
| 7 | Wire set with the connector | 1 set | |
| 8 | Tank fitting | 1 | |
| 9 | Software CD | 1 | |
| 10 | Bluetooth module | 1 | optional |
| 11 | USB adapter for PC connection | | |
| 12 | Filter | 1 | |
| 13 | Absolute pressure probe | 1 | For the carburettor |
| | | | |

## 2. Operation principle of the device

Water flows from the tank into the filter pump, and further, under pressure, to the injection nozzle. The nozzle is installed on the intake collector following the throttle plate in such a way as to generate a fine suspension of water and air. The pump and nozzle receive controlling signals from the Ecomax-3 Unit, the brain of which is the microcomputer. The microcomputer calculates the water portion individually for each engine stroke according to the parameters set in a setting process.

The control unit receives and processes the control signals delivered from the nozzles dosing the fuel supply. The control unit also receives and processes the signals of the sensors of engine temperature, air consumption and water in the tank. The controlling signals generated by the Ecomax-3 Unit are delivered to the pump and the nozzle responsible for water supply. System's maximum efficiency is achieved by direct adjustment of fuel intake time. In order for the computer of the vehicle to treat the intervention in a normal way, the lambda probe signal is generated by the **Ecomax-3**.

## 3. System installation

1. Determine a place for the control unit, pump unit and tank under the vehicle hood. At that, the pump must be located lower than the water level in the tank and not more than 0,5m away from the tank. The control unit must be installed far from the heat generation sources and places of rainwater entry. The water injection nozzle must be connected to the intake collector in a way as to provide the best spray. The nozzle must be installed after the throttle plate.
2. Drill an opening with d = 10mm in tank 1. The opening must be located in the lower tank part. Insert the fitting which is included in the set into the opening. *The tank fitting may be pulled through the opening with a rod. Set the fitting with its gasket on the rod and pull the rod through the tank neck into the opening.*
3. After selecting a place, install all system units: the control unit, pump, tank, and nozzle.
4. Connect the hoses included in the set (see figure 3.1., 3.2.). Connect the hose from the nozzle to the pump outlet. Do not tighten the clamp in the place of hose-to-nozzle connection yet. The pump is connected to the tank fitting through a filter. In case of using a simple pump, the filter is installed between the pump and the nozzle. IT IS NOT DESIRABLE TO USE THE ORIGINAL WASHER TANK. IT MAY CAUSE INOPERABILITY OF THE SYSTEM (due to the cleaning agents that may be contained in the washer tank)! The length of the tube from the pump to the nozzle must be at least 1,5m.
5. Connect the wiring as shown in figure 3.3. *Lambda probes will be connected after the self-training process. If you want to use 4 nozzles for injection of water, perform the connection according to figure 3.5.*
6. Install the temperature probe on the engine cylinder head.
7. Wire up the LED indicator in vehicle's interior in a way as to make the indicator visible by the driver. Connect (if it is still not connected) the connector to the control unit.

Figure 3.1. Diagram of hose connection in the automatic pump system.

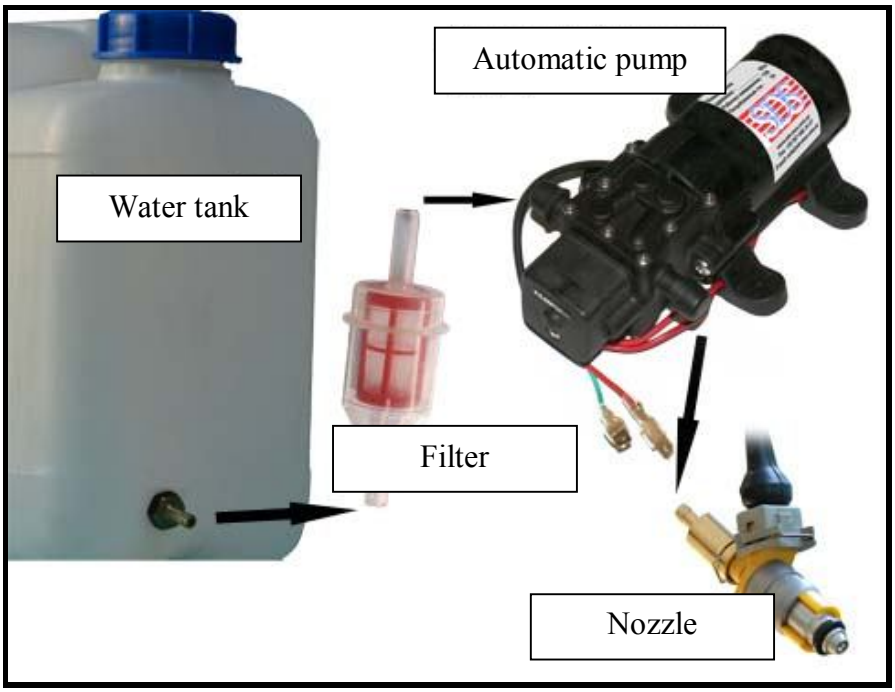



Diagram 3.2. Diagram of hose connection in the simple pump system.

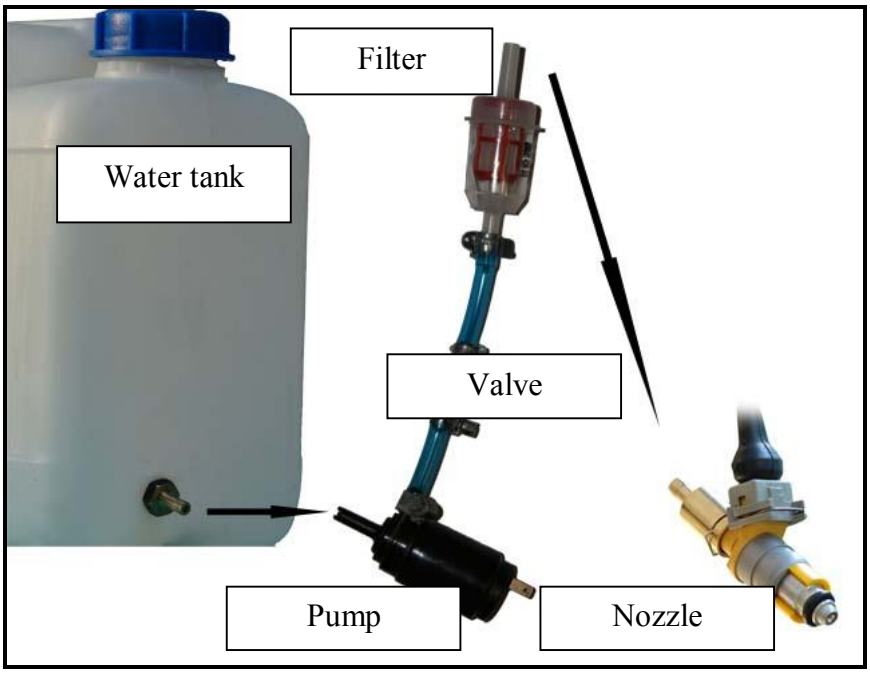


*Figure 3.3. Connection of patching cords. Standard connection.*

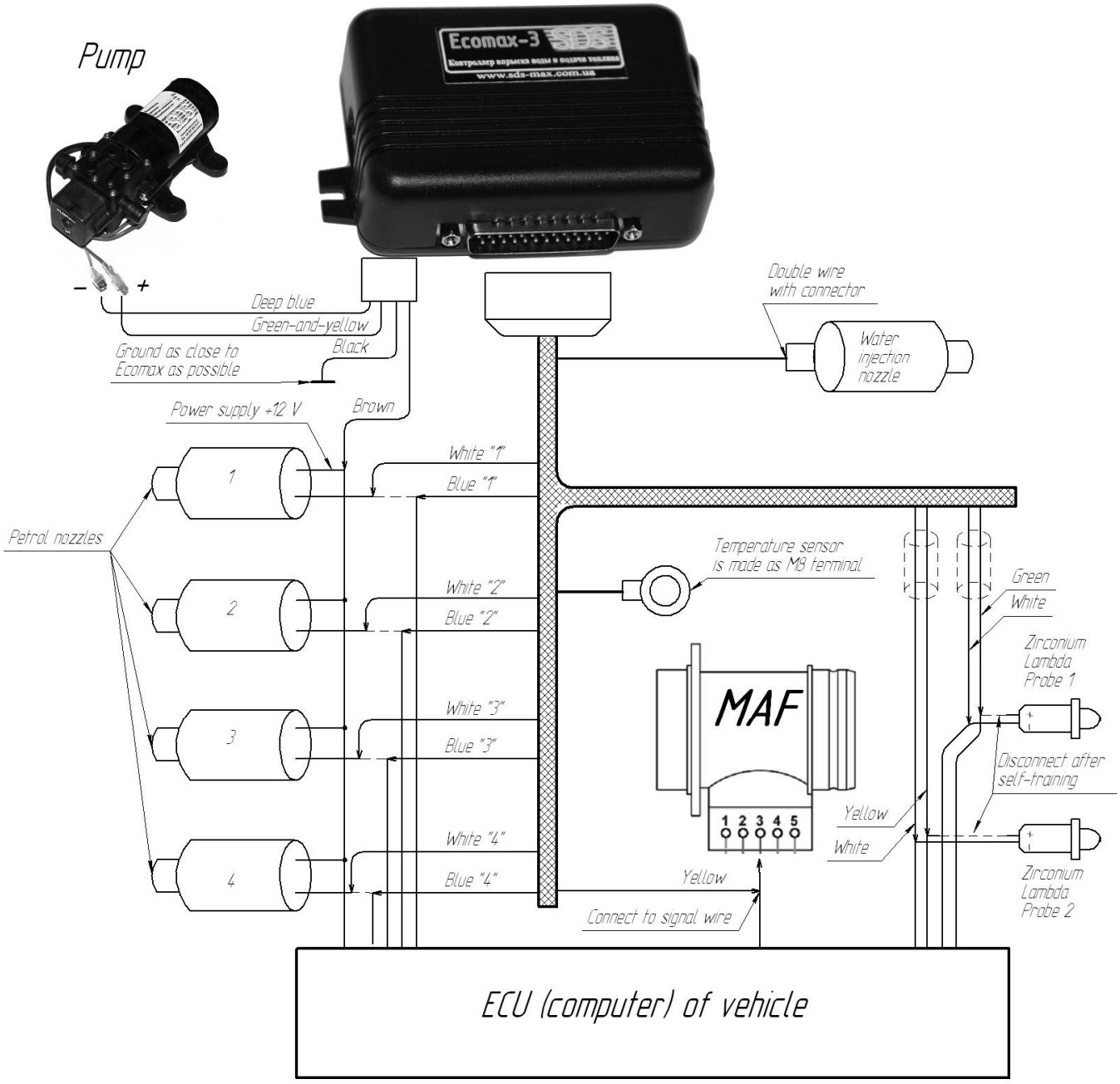
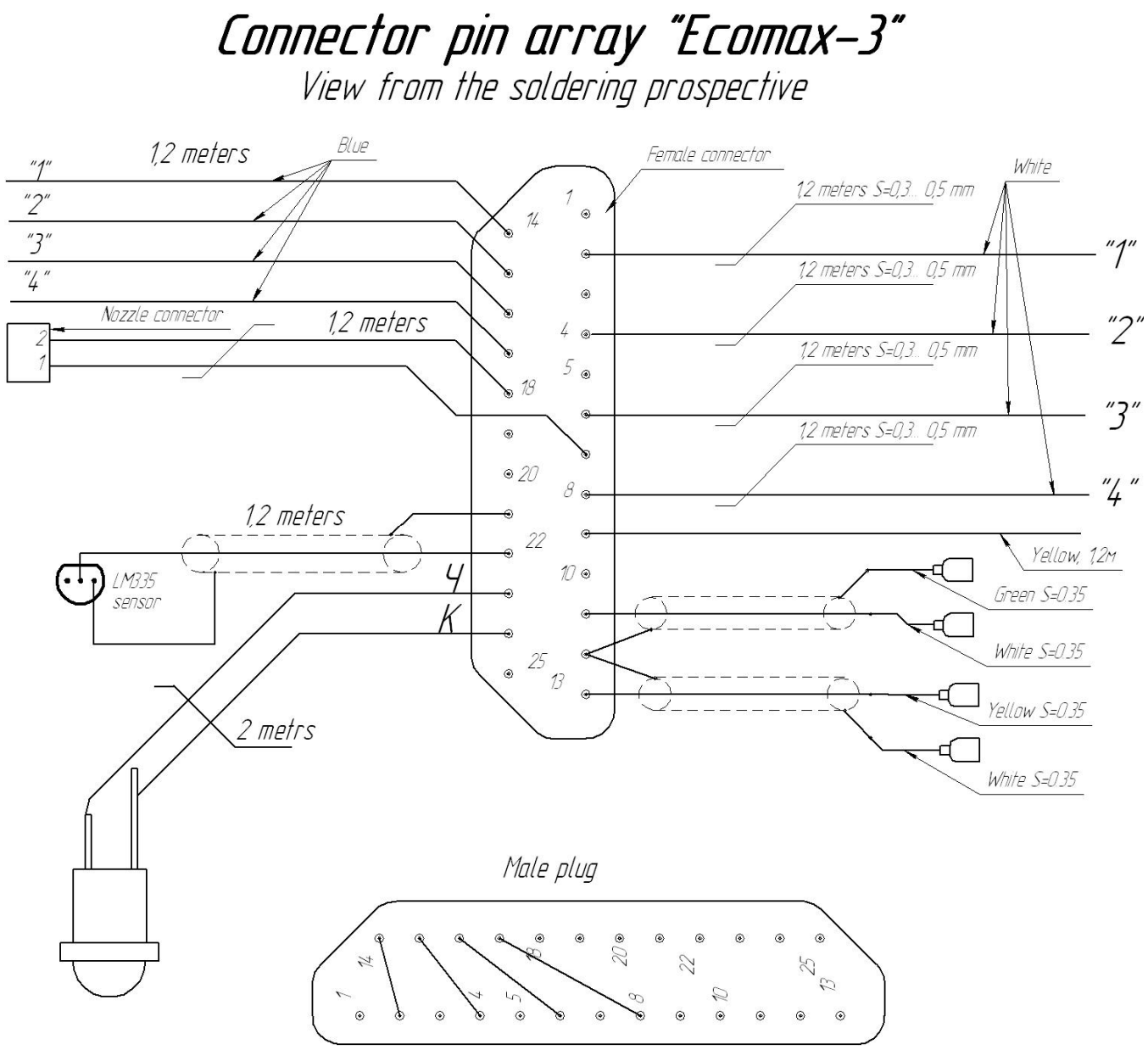
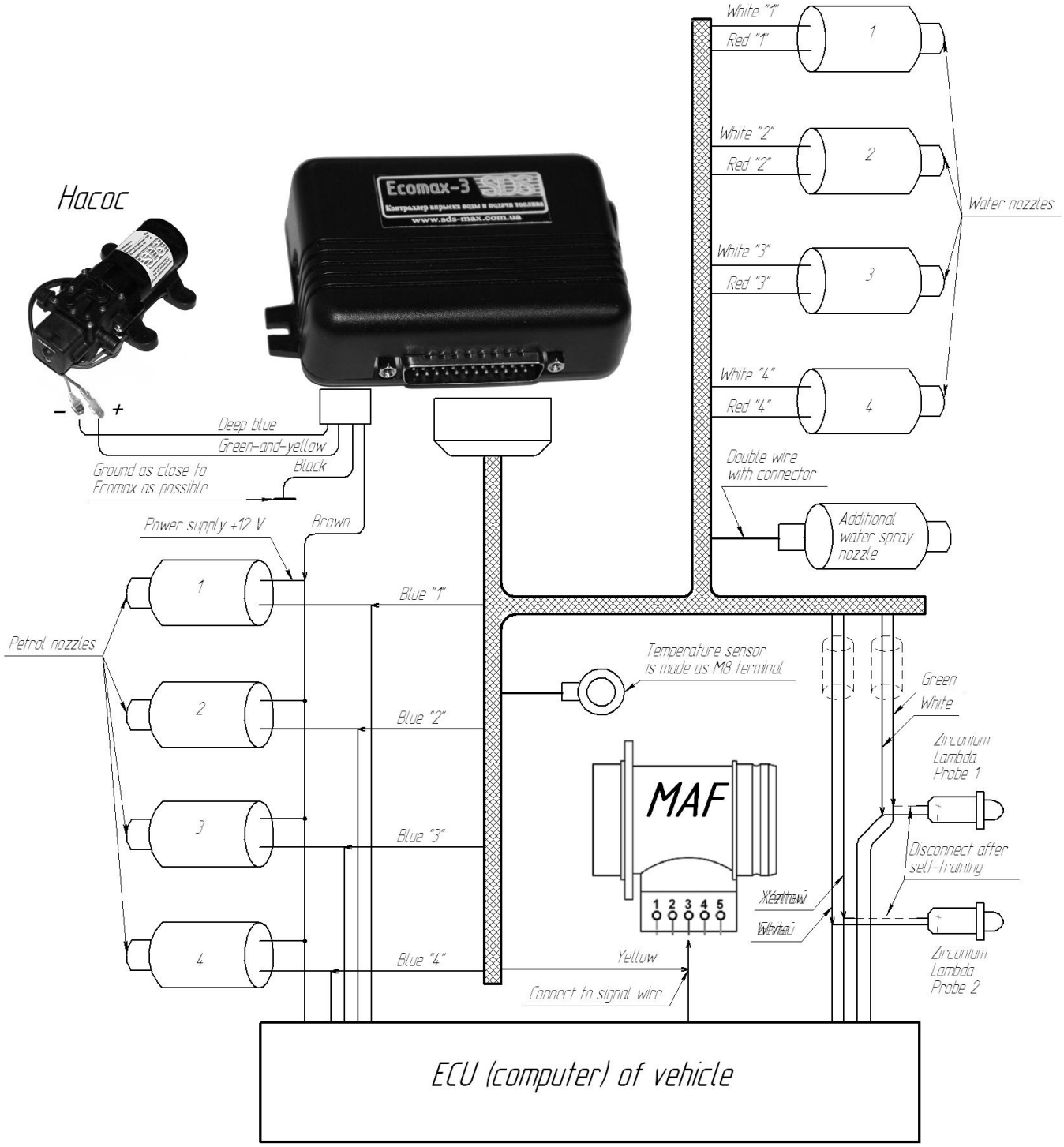


*Figure 3.4.*




**Prior to setting the system, you must review item 4 hereof!**

Figure *3.5. Connection of patching cords according to the scheme of 4 water nozzles.*



## 4. PC connection and software

The device has the USB connector for connection to the PC USB port.

The device is an autonomous device, therefore PC is required only for configuring the device. Self-training may be performed without PC.

The device enables to save, review and record all data on the computer. There are a number of special buttons for this purpose:

 - Upon pressing this button, the data from the device are read and represented in a table or diagram. Old data will be replaced with the new one.

 - Upon pressing this button, the data from the table will be recorded on the device.

 - Open the table or diagram which was previously saved on your computer. It may be subsequently recorded on the device.

 - Save the table on your computer. It may be further recorded on other device.

### 4.1. Getting started with software

Software (SW) is provided along with the device. SW enables to read and save the signal parameters of the sensors on a real-time basis as well as perform the system adjustment. It includes the feature of visualizing the parameters in a form of diagrams and graphs. You may read, edit and record the tables on the device and save them on your computer as well as create the table patterns.

Table 4.1. List of editable parameters and functions.

| No | Name of parameter | Purpose |
|---|---|---|
| 1 | Fuel consumption calculation factor | The parameter is required for calculating the fuel consumption |
| 2 | Number of fuel nozzles, pcs | The parameter is required for calculating the fuel consumption |
| 3 | Engine volume, l | The parameter is required for calculating the fuel consumption |

| | | |
|---|---|---|
| 4 | Switch-on delay time, seconds | After starting-up the ignition, the lambda probe signal is not displayed, and water is not supplied to the engine, and fuel injection time is not adjusted. |
| 5 | Option of applying the channel of the Lambda Probe No. 2<br>– for the first or second lambda probe (as a catalyst emulator) | It enables to use the channel of the 2nd lambda probe to emulate the catalyst operation. |
| 6 | System: “on/off” | It deactivates the system. When it is in the deactivated mode, the engine operates in the same way as it does without the system. |
| 7 | Temperature threshold | Minimum engine temperature, at which water injection is possible. |
| 8 | Sensor type: «MAP/MAF» | It is the switch of the connected sensor type (air consumption or pressure). It is required for the correct emulation of the lambda probe. |
| 9 | Lambda probe training: “on/off” | It starts the process of training which is required for the subsequent reproduction of the lambda probe signal. |
| 10 | Nozzles application: “petrol/water” | It changes the purpose of the basic 4 injector outputs. |
| 11 | Pump type: “automatic/simple/ignored” | It is required for the correct determining of water availability in the tank. |
| 12 | Determination of the transient mode | For the proper operation of the system, it is required to determine the sharp throttle pedalling. The parameter determines the pedalling speed to determine the transient mode |
| 13 | Asynchronous injection different/similar | The method for the estimation of fuel injection. It enables to increase the |

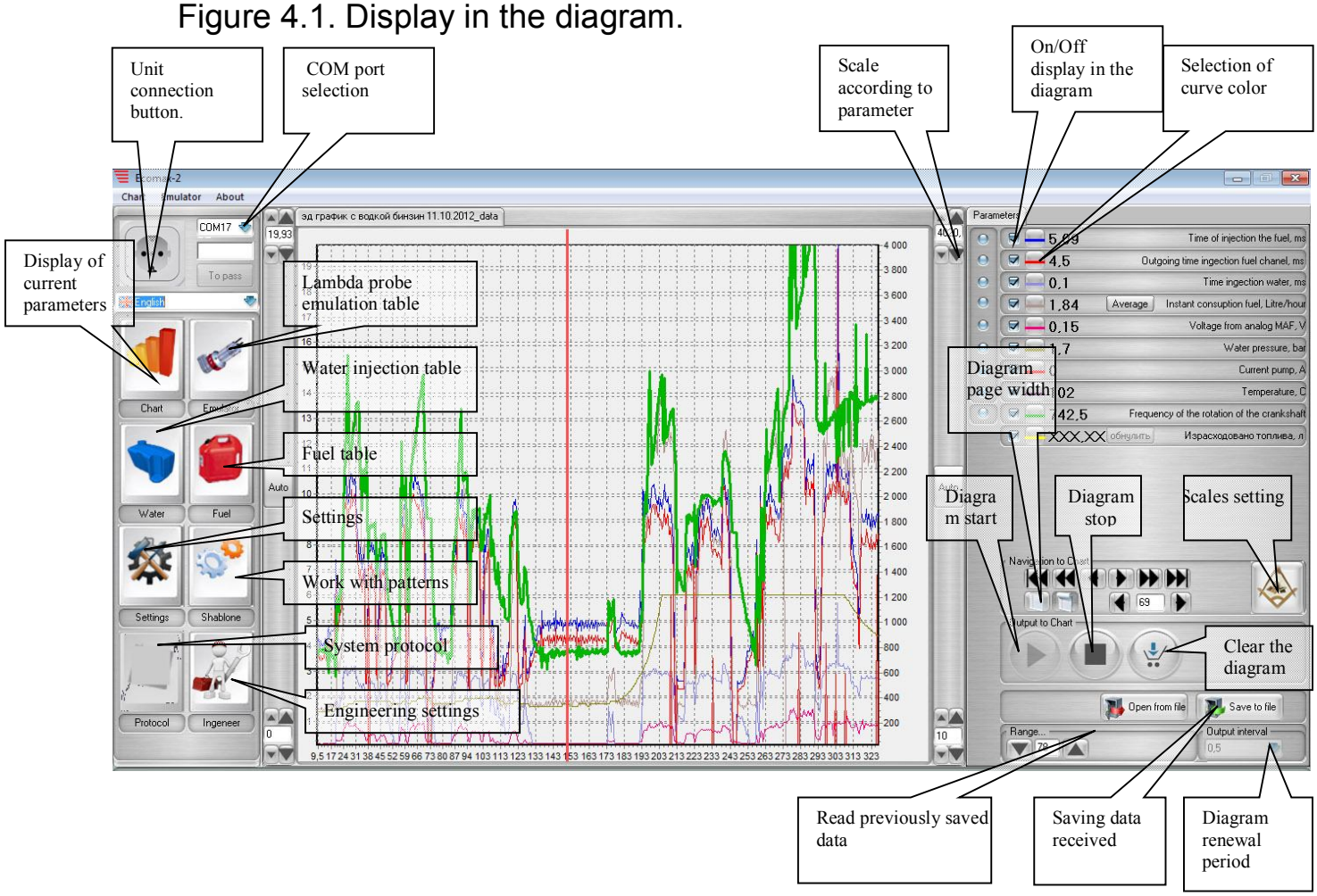
| | | |
|---|---|---|
| | | speed of system's response to the change of injection parameters. |

### *4.2. Display of current data in the table*

For the purpose of illustrating the processes, the feature of display of engine parameters received from the connected sensors in a diagram with their subsequent saving on the computer is provided.

By selecting the required area with the left mouse button, you may zoom in and out the diagram. In order to scroll the diagram, move it with the right mouse button.

Figure 4.1. Display in the diagram.




- ***Ecomax-2 Connection Button***.

  Start working with the program by selecting the COM port and pressing this button. Upon pressing this program, the program establishes the connection with the unit and reads its settings. Upon pressing the “Connect module” button, connection of the program with the COM port that you indicated is performed. If the connection succeeds, the deep-blue-coloured stripe elongating as the reading of data from the unit proceeds and the text “Module connected” will emerge in the lower part of the window. In the event of unavailability of connection with the optimizer, the text “Connection failed” will emerge 5 seconds after. You need to check the entire connection chain and retry the connection. The program remembers the COM port used. The “Disable Module –

X" button is not compulsory, as the module is disabled automatically upon closing the program.

- ***COM Port Selection Window*** 

indicates the program which connector of the computer the optimizer is connected to. Before starting the work, it is imperative to indicate the COM port number, or otherwise the program will not be able to connect with the optimizer.
- ***Diagram Renewal Period (polling interval).*** It means the interval of display of values in the diagram. For instance, "0, 25" means that the values are displayed in the diagram with the interval of 0, 25 seconds.
- **"X Axle Range"**. It is designated for choosing the way of diagram formation. "Auto" means that the whole diagram fits into the window, and it shrinks as new values are added. "Pages" mean that the diagram is displayed fragmentally in pages.
- **"Diagram Page Width, Sec"**. It is designated for choosing the interval of one page from 5 to 120 sec in case of page-to-page display. The details of the selected page width are saved until the next work session.
- **"Asynchronous Injection Different/Similar"** upon calculating the fuel dose, the last fixed injection time for a particular nozzle is used. If the parameter of asynchronous injection is selected as "similar", then the data from the neighbouring nozzles may be used. In the settings, "Different" means that in case of asynchronous injection, when a few nozzles are open at the same time, opening time of such nozzles is different. This parameter only allows or disallows the use of injection data time from the neighbouring nozzles and influences only the response speed of the injection time change.

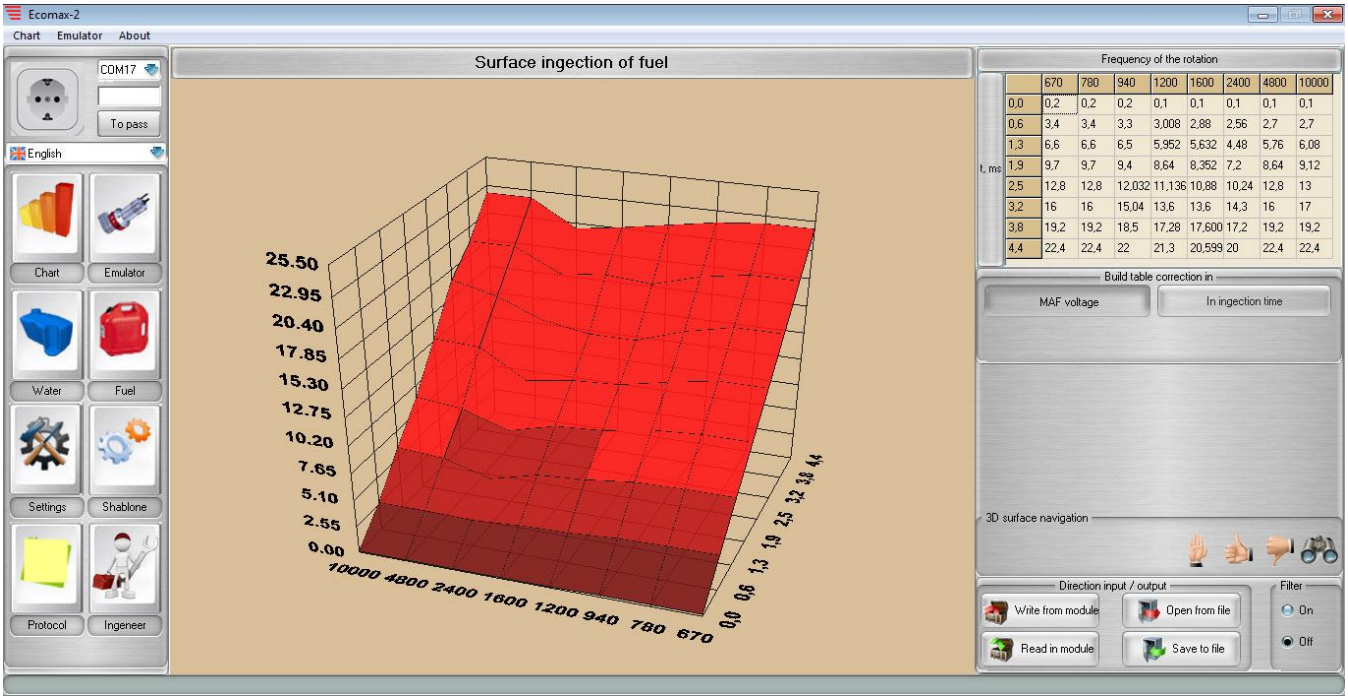
### 4.3. Working with injection tables

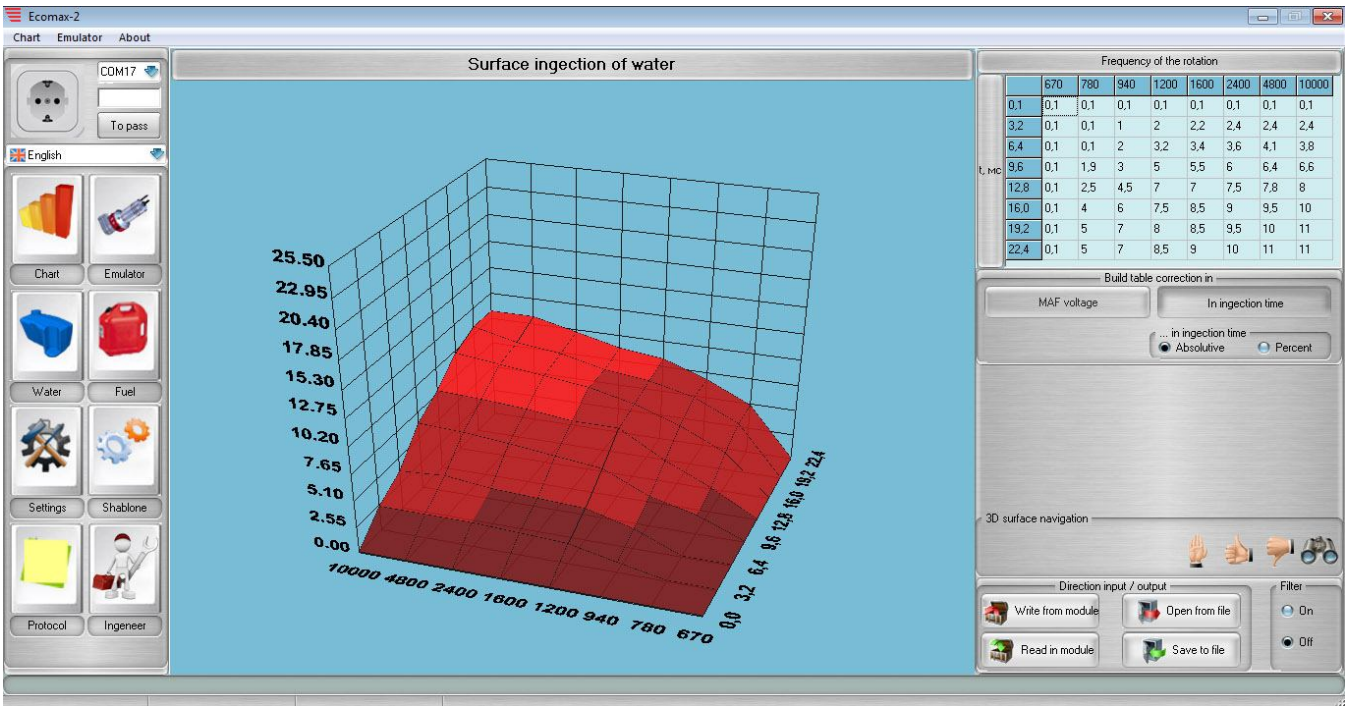
The fuel and water injection time is determined by the 3-dimension table.

The 3-dimension table contains fixed values of crankshaft rotation speed and fuel injection time or voltage from the Mass Airflow Sensor, optionally (see figure

4.3). Consequently, the user may link the engine operation mode (crankshaft speed, injection time, air consumption) to a specific value of the output signal.

Figure 4.2. Graphical view of the tables in the window program.



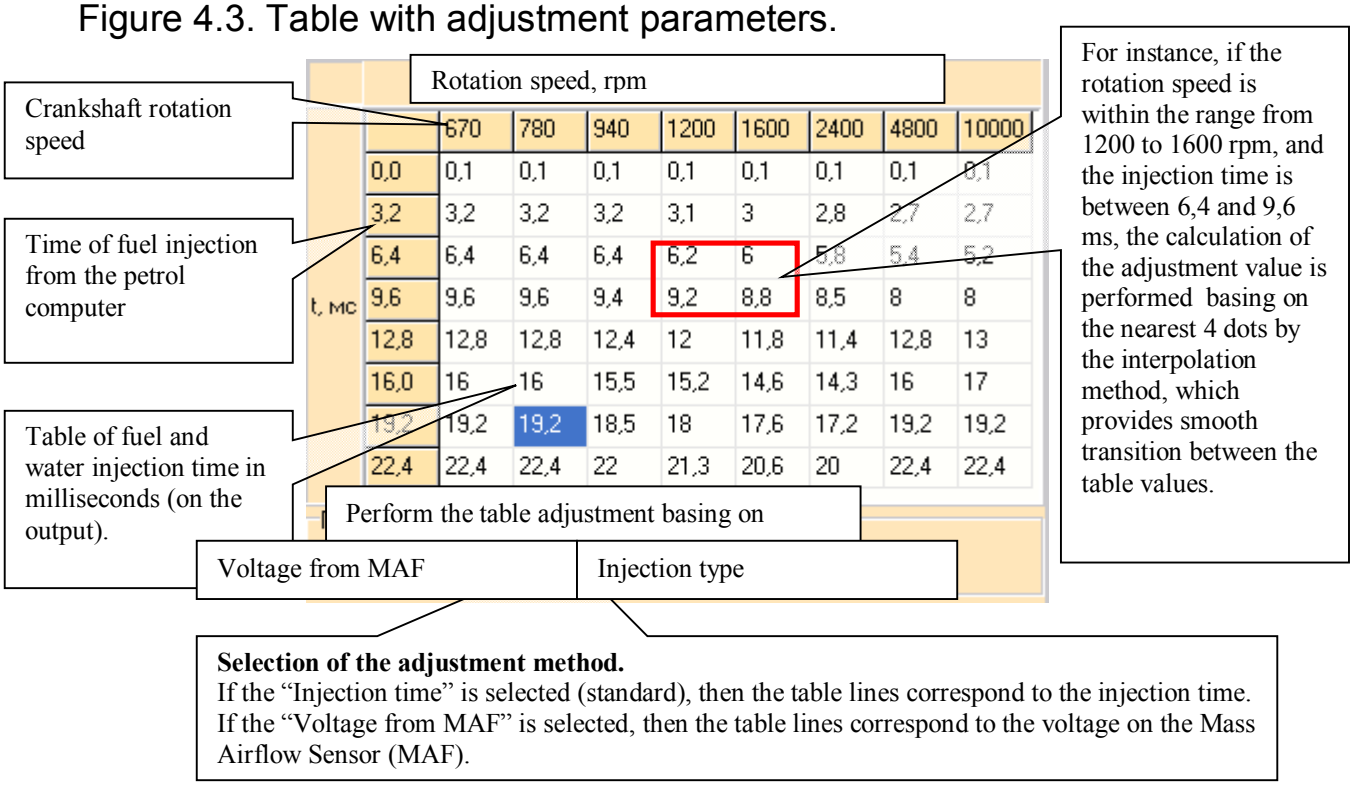




There is an opportunity to perform the adjustment of signals, depending on the crankshaft speed, injection time, and air consumption. The adjustment table is built in a form of the 8x8 matrix. The matrix columns always correspond to the rotation frequency. The matrix lines correspond to the fuel injection time or air consumption (voltage from MAF (Massive Airflow Sensor)). The selection of the

lines mode is performed with the switch (see figure 4.3.). ***For the diesel or carburettor engine, the adjustment basing on the "Voltage from MAF" must be installed.***

The adjustment level basing on the neighbouring points of the time is averaged by the optimizer program, if the injection time and rotation frequency do not precisely match the table ones. Thus, it results into "smooth" recalculation of adjustment (interpolation), if the rotation speed and injection time are between the table values.

Figure 4.3. Table with adjustment parameters.




The graphical table data is displayed in a form of the 3-dimension model which is shown in figure 5.3.

The 3-dimension panel may be rotated with the mouse or control keys.

👁 is a zooming button (the left mouse button is for zooming in, and the right one is for zooming out).

To turn and rotate the surfaces, buttons ↩↪↥↧ ↶↷ are used.

Buttons 👍 and 👎 are intended for storing and recovering the dimensional orientation of the surfaces.

Restoration of the custom surface view is done with the "Initial view" button.

### 4.4. Saving the settings pattern

In order to simplify the setting procedure in future, you may save a settings pattern from the unit which is already configured to the computer. The settings pattern includes all settings and tables.

It is recommended to apply the pattern which was previously saved for the same vehicle from which it was read. That is due to the possible difference of settings for other vehicles.

In order to save the settings pattern, press the button “Settings pattern – Save into file”. Select the saving path, and then all required data will be read from the Ecomax-3 unit and saved on the computer.

In order to record a ready pattern into the Ecomax-3 unit, press the button “Settings pattern – Open from file” and indicate the path to the saved pattern. The window with the main settings which you may edit, if necessary, will be displayed. In order to record the pattern into the unit, press the “Record into module” button located on the top of the window.

## 5. System setting

Before system setting, one should make sure that the device is connected correctly and fill the tank with water.

***Remember that the system does not supply water at engine temperature lower than 50°C (it is set in the settings) and for the first 30 seconds after the ignition is started up (it is set in the settings).***

Afterwards, it is necessary to perform the following actions:

1. Disconnect the hose from the nozzle, start up the ignition. Immediately after starting up the ignition, the pump will be enabled for 2 seconds and will press air out from the hoses. In the event that water has not flown from the hose, stop and then start up again the ignition. After successful pumping, connect the hose to the nozzle and tighten the clamp;
2. If the engine works instable at idle, try to switch the “Asynchronous injection – different/similar” setting;
3. Train the lambda emulation according to item 6.1. If there is emulator table available for a specific vehicle, one may use it without the performance of training;
4. Connect lambda probes according to the scheme in figure 3.3. And perform the adjustment according to item 6.2.;
5. Select the “Transient mode determination” parameter so that in the event of sharp gas pedalling there are no abrupt engine failures. The values of this parameter of less than 0,1 are not desirable;
6. Configure and load the water and fuel injection tables into the Ecomax-3. It is desirable to configure the water injection table as to prevent the water supply at idle engine operation.
7. Water consumption must be approximately 12 … 20% of fuel consumption (in the event of standard settings).

The water dose for each engine stroke is indicated in the table. The water dose is indicated in milliseconds. When the injection time is less than 1 ms, the nozzle fails to open timely and water injection is not performed.

## 6. Lambda probe emulation setting

The emulation is used to reproduce the zirconium lambda probe signal so that vehicle's control unit does not notice the intervention into the fuel system. For the purpose of reproduction (emulation) of the signal, the data concerning the amount of air delivered to the engine (from MAF, for instance), amount of fuel injected and data obtained in a training process are used. In order to obtain the predetermined mix content, this data is further treated and presented in a form of the lambda probe signal.

*The system may be applied without lambda probe emulation by using the signal from the original lambda probe. The efficiency of the system in this case will be probably lower.*

In the training mode, the optimizer forms the table of relation between the MAF voltage (amount of air) and injected fuel amount. The table is available for editing and you may adjust the fuel mix content.

If MAF is not installed on your vehicle, you may use the signal from the absolute pressure probe. In this case, it is necessary to indicate the probe type "MAP" in the settings.

The "Emulator" mode is compatible with the catalytic converter emulator mode (only for the lambda probe channel No. 2).

### *6.1. Lambda probe emulation training*

In order to use the emulator mode, first perform the optimizer training. To do this, in the "Settings" tab, select the lambda channel mode "emulator", then press the button "Start lambda training" which is located below. The training process takes approximately 3 hours and may terminate automatically, and throughout the entire training period, the "correction" indicator blinks. In the process of training, the engine works in the standard mode, and water is not supplied.

***In the training process, Ecomax-3 must be disconnected from the lambda probe.***

After completion of the process of training, checking and smoothing the emulator table, the standard lambda probe must be disconnected, and the corresponding wire from the Ecomax Unit (if it is still not connected) must be connected instead in the manner showed in figure 3.3.

### *6.2. Lambda probe emulation settings*

You must embark on the setting after the training process is completed.

Prior to setting, set the parameter “Lambda table shift” = 0 on the Ecomax-3 Unit.

The emulator setting window is launched with the “Emulator” button.

In course of the setting, the fuel injection table must not modify the fuel injection time (at zero offset of fuel injection, the mix must be the same as the one with the standard lambda probe). Therefore, at the time of the setting, it is necessary to switch the system into the “Off” state, and in this state the lambda probe signal is still emulated.

Prior to the setting, remove the table formed by the unit in a training process. To do this, press the button “Receive from the module”, and further the green-coloured dots determining the dependence of voltage from MAF (amount of air) on the amount of fuel will be rendered on the screen. It is desirable to the save the read out table on the computer. If there are spikes of the curve obtained in a training process, they must be adjusted by dragging the dots, and then the table must be saved in the optimizer.

The dots may be adjusted in the semi-automatic mode by using the program options. To do this, click the corresponding dot with the right mouse button. The proposed smoothing option in a form of a yellow line will be displayed on the screen, and if it is suitable for you, press the “Accept” button.

Afterwards, it is necessary to check the correctness of filling the table. To do this, press the yellow button  on the engine started, with the standard lambda probe connected. There will be appearing and disappearing yellow dots on the screen, which must coincide with the curve (green dots).

Connect the lambda probe emulation according to figure 3.3.

At first, it is necessary to configure the lambda probe emulation within the idle operation area so that the engine operates without interruption. The injection time at idle operation must be the same as it is with the standard lambda probe.

Should it be necessary to compare the obtained curve with the actual values of the engine, press the yellow button  . There will be yellow dots appearing and disappearing on the screen, which correspond to the current engine operation mode. To stop the display of yellow dots, press “Stop dots”. Owing to this function, you will be able to understand in which direction the adjustment must be performed.

The yellow dots must be situated on the curve. If they are slightly aside, you must wait for 1…5 minutes so that ECU is adapted. If the dots remain beside the curve, then you must press “Stop” and move the curve towards the dots, and save the changes on the Ecomax unit.

The sign of normal operation is the yellow dot position on the curve and fluctuation of the voltage on the lambda probe wires coming from the Ecomax-2 Unit within a range of approximately 0,1 ... 0,9V. It should be controlled with a tester.

If you want to change the content of the fuel and air mixture, drag the dots up and down (see figure 6.2). The upward movement of the dot causes mixture leaning and the downward one causes the enrichment. ***Warning: the position of dots must provide the same content of the fuel and air mixture as the one with the standard lambda probe at the zero offset of the injection time.***

For the purpose of suitable perception, the colour of moved dots changes to green. The previous position of a dot is displayed as a deep blue curve.

After the performance of necessary adjustment, the table with values obtained must be recorded on the optimizer once more. To do this, press the button  (see figure 6.1).

In a process of operation, you may adjust the fuel mixture by the Ecomax-2 Unit within narrow limits with the parameter “Lambda table shift”. It is sometimes necessary for the adjustment for particular fuel or other factors. The increase of the value leads to the fuel mixture leaning (see more details in item 7).

If it is required to shift the dots within a low range, click the corresponding table cell. By pressing the emerging buttons  , adjust the value. The changes are immediately applied upon pressing the emerged button.

Figure 6.1. Approximate view of the diagram obtained as a result of training.

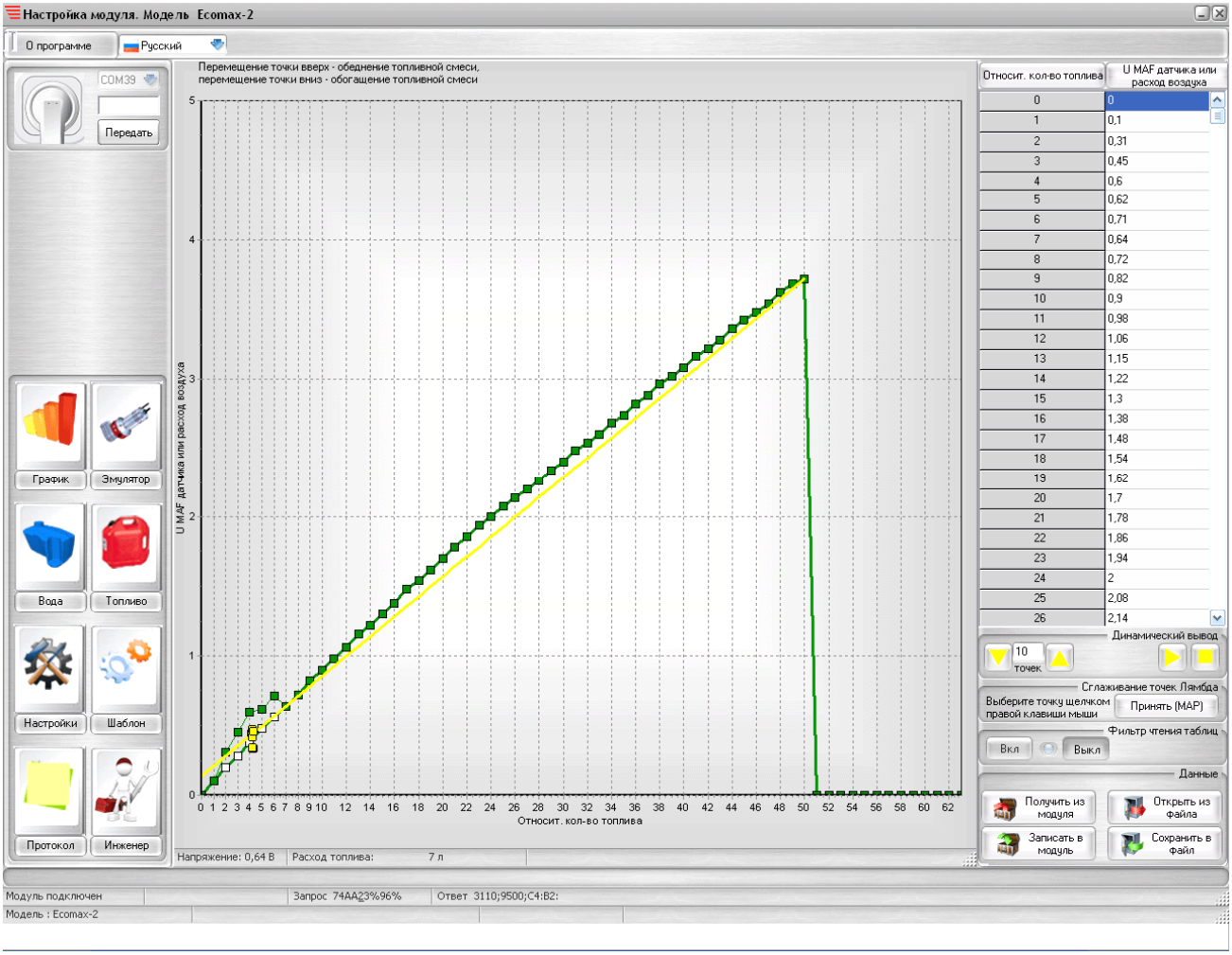
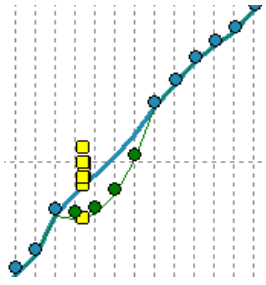



Figure 6.2. Dots and curves presented in the emulator diagram: yellow – *current data; deep blue – data recorded in the optimizer in a process of training; green – data edited by the user.*



In order to smooth the obtained diagram, click on the most dominant area of curve flex. If you are satisfied with the result, press the “Accept” button and save the table.

### 6.3. Setting on the carburettor or diesel engine

In these vehicles, one should switch on the adjustment according to “Voltage from MAF” (figure 4.3.).

If the probe type “MAF” is selected in the tab “Setting”, then the values of the axle “V” of the water injection table will correspond to the voltage from the pressure probe.

For diesel vehicles, it is imperative to install the probe type “MAF”, if the boost pressure probe is connected.

In carburettor vehicles, if the probe type “MAP” is selected, then the calculation of air consumption is performed. At that, the value of air consumption is conventionally presented in the diagram in volts and corresponds to the axle “V” of the water injection table. In such mode, the normal voltage readings at idle operation are equal to 0, 15…0, 3 volts approximately.

At adjusting the water supply, it is necessary to avoid water injection at idle operation or at low air flow in order to prevent water accumulation in the collector.

The water dose is indicated in the table for each stroke of the engine. The water dose is indicated in milliseconds. At injection time lower than 1 ms, the nozzle cannot open timely and water injection is not performed.

The water consumption for the carburettor engine must be equal to 15% approximately of fuel consumption on the road.

In order to increase the water injection efficiency, it is recommended to change the ignition angle to 5$^{o}$ towards ignition advance and adjust the fuel supply towards slight leaning, by 10-15% approximately.

**7. Calibration of fuel consumption representation**

For the correct representation of fuel consumption, it is necessary to adjust the accounting ratio (adjustment). Before the setting is started, make sure that the accounting ratio is equal to 100, or otherwise, set the value of 100.

**Setting:**

Fill the tank with particular amount of fuel, and spend the fuel in a riding process. Adjust the fuel accounting ratio. This value may be calculated as follows:

$$Accounting\_ratio = \frac{100 \bullet Correct\_consumption}{Consumption\_values\_on\_the\_control\_unit}$$

To adjust the ratio, press the button “Mod”, until the “Accounting ratio” is displayed on the screen, and adjust the ratio with the buttons “+” and “-“. If the fuel consumption values are slightly different from the actuality after the first setting, adjust the accounting ratio by one or two units.

In other words, it is necessary to change the accounting ratio by the difference of indications between the real and actual consumption.

## 8. System maintenance

The system maintenance consists in filling the tank with distilled or purified water. The indicator installed in the interior alarms of the minimum water level in the tank by red colour. At the water level lower than the minimum, the system is automatically blocked, and the operability is restored after filling in the tank.

For normal and long-term operation of the system, one should pour only pure or distilled water.

In order to use the system at the surrounding air temperature lower than zero, a specific amount of spirit or ethanol must be added to the tank. The ratio of water and spirit is indicated in table 9.1.

If you are not going to use the device in cold time of the year, drain water, pour pure spirit, then let the engine work under the load in course of five minutes. Holding the “Mod” button, wait until the “System disabled” indication is enabled. At stopping and subsequent starting of ignition, the system remains in the disabled condition. The system is put into operation in the same manner, by pressing and holding the button “Mod”.

***Do not drain water (spirit) from the tank completely, even when the system is disabled! The liquid level must be not lower than the tank fitting.***

*Table 9.1. Water-to-spirit ratio in relation to the surrounding air temperature.*

| Air temperature | Spirit 96% | Spirit 40% |
|---|---|---|
| -6 | 1:10 | 1:4 |
| -8 | 1:7 | 1:2,5 |
| -15 | 1:4 | 1:1,5 |
| -20 | 1:3 | 1:1 |
| -25 | 1:2 | 0:1 |
| -40 | 1:1 | - |

## 9. Possible failures and ways of their elimination

| Failure | Possible reason | Way of elimination |
|---|---|---|
| The system does not work, the red indicator lights up | The tank ran out of water | Pour water |
| | The pump is not connected | Connect the pump |
| The device does not work, the engine has warmed up, the green indicator does not light up | The temperature probe is improperly installed | Install the probe on the engine cylinder head |
| | The wire is improperly connected to the fuel nozzle | Check the connection pursuant to item 3 of this Manual |
| The device does not work, the engine has warmed up, the green indicator lights up | The pump is improperly connected | Check the polarity, the red terminal must be connected to the "+" of the pump |
| | The filter is clogged | Replace the filter in the pump unit |
| | The nozzle or pump is broken | |
| The settings cannot be saved, the diagram is not recorded | No connection between the optimizer and the computer | 1. If you use the adapter, check whether the drivers for it are installed. The program start must be performed only after the adapter is connected.<br>2. Possibly, there is no power supply of the optimizer, or the ignition is switched off.<br>3. Did you not forget to press the **"Connect module"** button?<br>4. If the connection of the computer and emulator is established, then in the top part of the program you should see the model of the Emulator, for instance, SK-04_v1.<br>5. The COM port is improperly selected in the corresponding window (see figure 4.2).<br>6. In a setting process, it is not desirable that the notebook is supplied with power from the vehicle's network.<br>**Remember, whenever the connection is available, in moments when you modify the settings on the computer or record the diagram, the indicator "PC connection" blinks on the optimizer** |
| Injection time and rotation speed are not displayed | The deep blue wire is improperly connected | Reconnect the deep blue wire to another wire of the nozzle. |
| Fuel consumption is not presented | The diagram is not recorded | Fuel consumption is refreshed only when the diagram is launched. |

## 10. Warranty liability

The Manufacturer guarantees the operability of the device, provided that the operation rules set forth in the Operation Manual are complied with.

The warranty period of the *Ecomax-3* system is ___ months from the day of setting into operation.

Throughout the warranty period, the owner, in the event of system's failure, is entitled to free repair.

Throughout the warranty period set for the *Ecomax-3* system, the repair must be performed at owner's cost in the event of their failure to operate the set in compliance with this Operation Manual or to fulfil the manufacturer's recommendations aimed at maintaining the normal operation of the *Ecomax-3* system.

The *Ecomax-3 system,* meets the technical conditions and is deemed fit for operation.

Date of manufacture _____ 201__ .

The system warranty shall cease in the following events:

- Upon opening the control unit;
- If the washer tank is used as a tank;
- Presence of mechanic damages;
- If the operation is not in compliance of this User Manual.