



# **STAG-50, STAG-100, STAG-150**

## **LAMBDA SENSOR CONTROLLER**

***INSTALLATION & PROGRAMMING MANUAL***

***version : V1.77 -V1.79***



**Manufacturer:**  
AC Spółka Akcyjna.  
15-182 Białystok, ul. 27 Lipca 64, Poland  
tel. +48 85 7438148, fax +48 85 653 8649  
[www.ac.com.pl](http://www.ac.com.pl), e-mail: [autogaz@ac.com.pl](mailto:autogaz@ac.com.pl)



## **SET COMPONENTS**

1. STAG-50 or STAG-100 or STAG-150 - lambda sensor controller
2. Actuator (stepping motor) & base plate
3. A group of wires
4. Installation set:
  - control panel
  - fastening screws
  - temperature sensor
  - connectors, screws
5. Programming & operation manual

## **APPLICATION OF THE CONTROLLER**

The STAG-50/100/150 lambda sensor controller has been designed for controlling of operation of engines adapted for LPG and fitted with a lambda sensor. The control panel enables manual, automated or emergency switching over working mode (gasoline / LPG) as well as visual monitoring of LPG quantity.

	INJECTOR EMULATOR	LPG LEVEL INDICATION
STAG-50	-	only LPG reserve indication (1 LED)
STAG-100	single-point emulator	full indication (5 x LEDs)
STAG-150	four-point emulator	LPG reserve or full indication

## **CONTROLLER OPERATION**

After starting of the engine and reaching of required rpm (in the automatic mode green LED blinks) LPG supply is switched on (green LED shines constantly). The LPG output is controlled with a actuator and depends on lambda sensor indications. All STAG-50/100/150 parameters are set with an external tester or a PC (AcLpgWin software).

## **CONTROL PANEL FUNCTIONS**

The control panel contains:

- working mode switch (gasoline / LPG) - B/G key
- working mode indicator - green LED
- LPG quantity indicator: five LEDs

After switching on the ignition switch (without starting the engine) LPG supply may be switched on in the normal (automatic) mode or emergency mode (starting up of the engine with LPG). Next functions are switched on by pressing the working mode selector.

- green LED does not shine - running with gasoline
- green LED blinks - automatic mode (LPG supply begins after starting the engine, reaching required rpm and, alternatively, reaching the temperature set at the pressure regulator).
- green LED shines constantly - emergency mode (starting up the engine with LPG). The function is available only with switched ignition switch but without starting up the engine.

The last working mode is stored and recalled automatically during next engine start-up.



## **WIRING DIAGRAM AND INSTALLATION MANUAL**

The STAG-50/100/150 controller should be mounted within the engine room in the place, which is not exposed to high temperature, water and fuel.

### **CAUTION!**

**It is recommended to install the controller vertically using its mounting eye and a screw, placing sockets downward to avoid water penetration. Install bundle protecting rubbers carefully to seal the entire housing.**

Electrical connections should be soldered, carefully insulated and protected from humidity to avoid shorting.

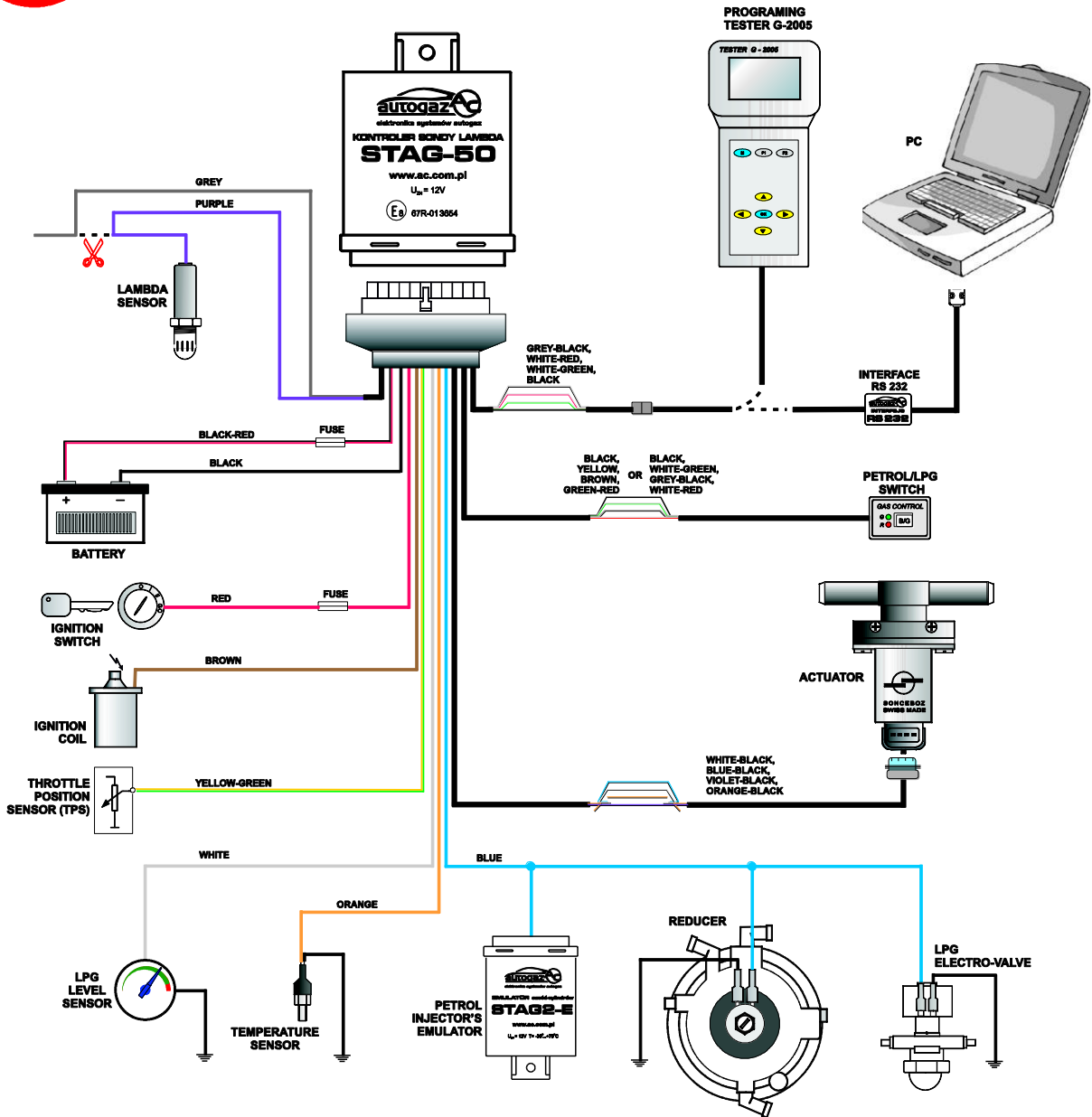
## **CONTROL PANEL FIXING & INSTALLATION**

The control panel should be mounted within the driver's cab in the range of driver's sight.

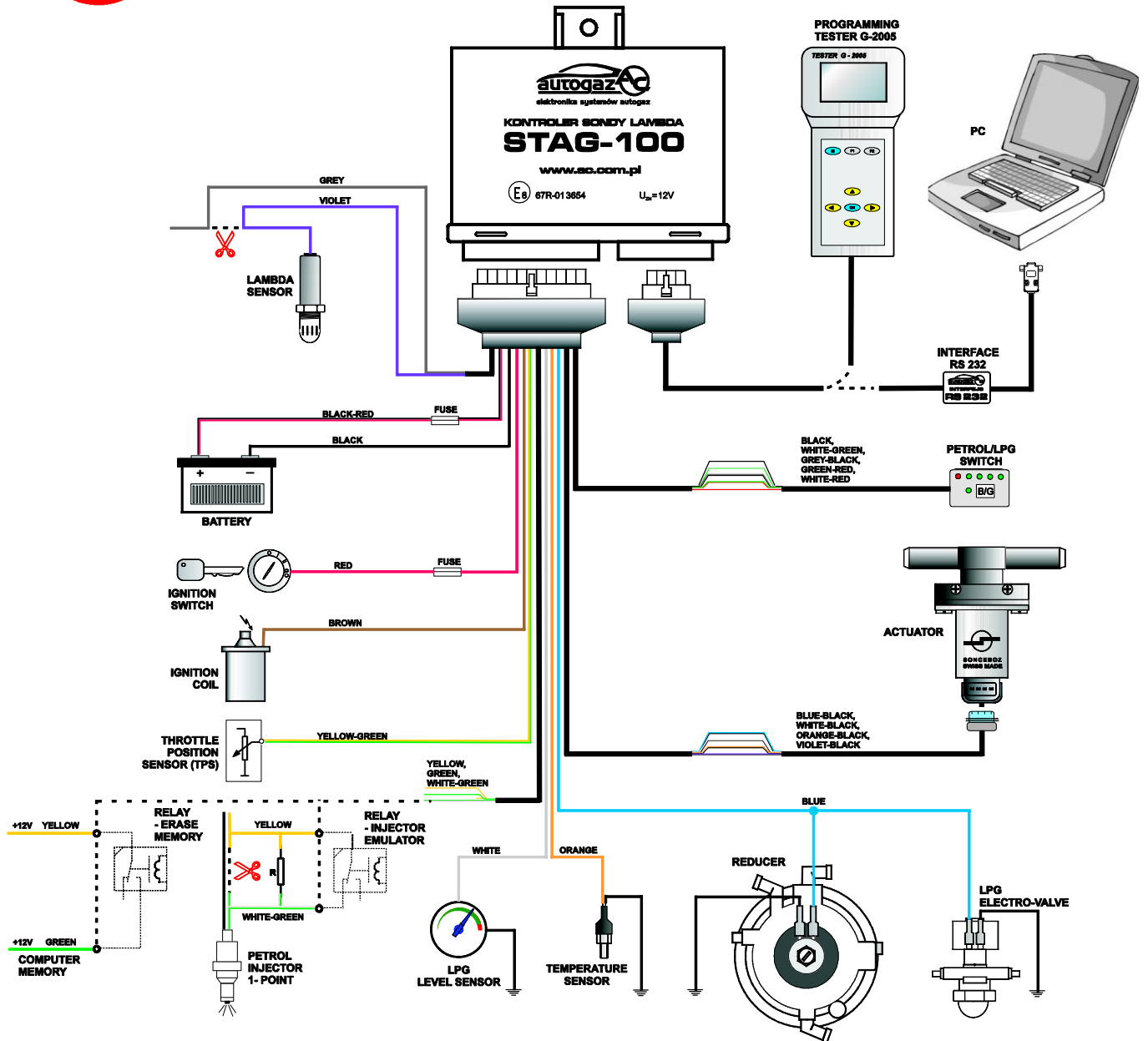
First check fitting of the lower panel part, then drill two openings  $\varnothing$  1,8 mm for fastening the panel and one  $\varnothing$  5 mm for the bundle. Fix the lower part of the panel (together with a plate) with screws (installation set) in the chosen place and cover it with panel's upper part. Check the working mode switch function.

50	100	150	CABLE COLOUR	DESCRIPTION
11	15	11	BLACK	GND
1	2	1	BLACK-RED	+12 V BATTERY
15	13	15	RED	+12 V IGNITION SWITCH
19	14	19	BROWN	RPM - 5/12 V PULSES
14	1	14	BLUE	LPG SWITCH ON
12	8	12	YELLOW-GREEN	TPS
18	10	18	WHITE	LPG LEVEL SEN SOR
20	9	20	ORANGE	TEMPERATURE SENSOR
-	16	-	YELLOW	EMULATOR RELAY ( SWITCHING OVER )
-	17	-	WHITE-GREEN	EMULATOR RELAY ( CLOSED )
-	18	-	GREEN	EMULATOR RELAY ( OPEN )
10	15	10	BLACK	SWITCHBOARD LED-100 or LED-50 ( new ) * (GND)
8	6	8	WHITE-RED	SWITCHBOARD LED-100 or LED-50 ( new ) *
4	5	4	WHITE-GREEN	SWITCHBOARD LED-100 or LED-50 ( new ) *
9	4	9	GREY-BLACK	SWITCHBOARD LED-100 or LED-50 ( new ) *
-	3	14*	GREEN-RED	SWITCHBOARD LED-100 (+12V)
10	-	-	BLACK	SWITCHBOARD LED-50 ( old ) (GND)
8	-	-	GREEN-RED	SWITCHBOARD LED-50 ( old )
4	-	-	YELLOW	SWITCHBOARD LED-50 ( old )
9	-	-	BROWN	SWITCHBOARD LED-50 ( old )
5	12	5	PURPLE	LAMBDA SENSOR
13	11	13	GREY	CAR COMPUTER ( SIMULATION )
-	7	-	option – WHITE-BLACK	RESERVED CONNECTION
-	23	-	option – BLUE-BLACK	RESERVED CONNECTION
6	19	6	BLUE-BLACK	ACTUATOR
7	20	7	WHITE-BLACK	ACTUATOR
17	21	17	ORANGE-BLACK	ACTUATOR
16	22	16	VIOLET-BLACK	ACTUATOR

\* STAG-50 only LED-50 , STAG-100 only LED-100 , STAG-150 - LED-50 or LED-100



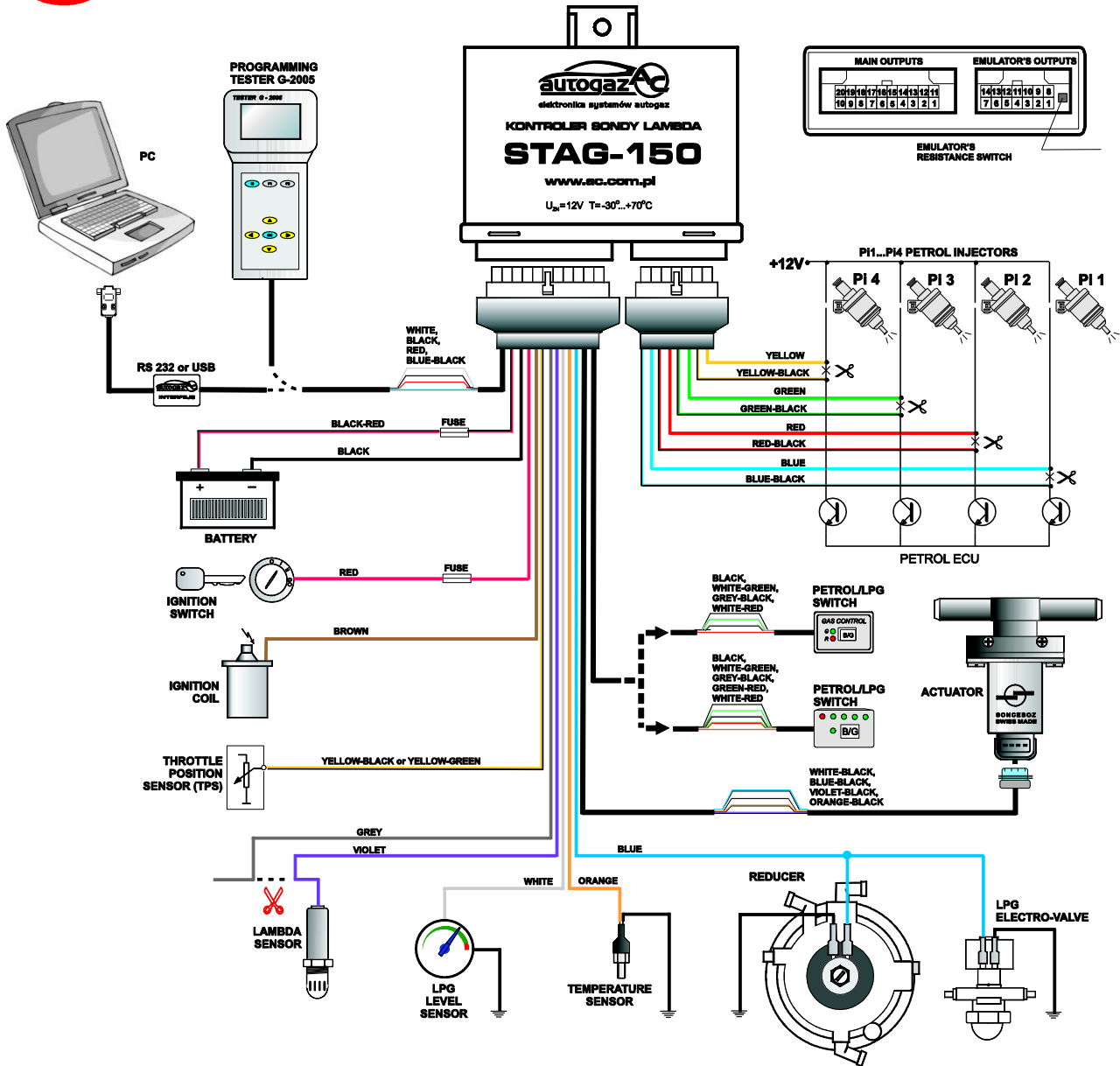
STAG-50 installation diagram



STAG-100 installation diagram

**RELAY FUNCTIONS IN STAG-100**

	Connect wires	Cut/Connect	Connect resistor	"Relay" parameter
<b>Emulation of single-point injector</b>	yellow white-green	Injector power supply point	~20Ω	Emulation of injections
<b>Emulation of multi-point injector</b>	yellow white-green	+12 power supply of all injectors	~100Ω	Emulation of injections
<b>Fuel pump cutoff</b>	yellow white-green	Pump power supply circuit		Emulation of injections
<b>External emulator controlling</b>	yellow green	+12V Emulator		Emulation of injections
<b>Error erasure</b>	yellow green	+12V Computer		Memory erasure



STAG-150 Installation diagram.

**OUTLETS OF STAG 150 EMULATOR WIRE SET**

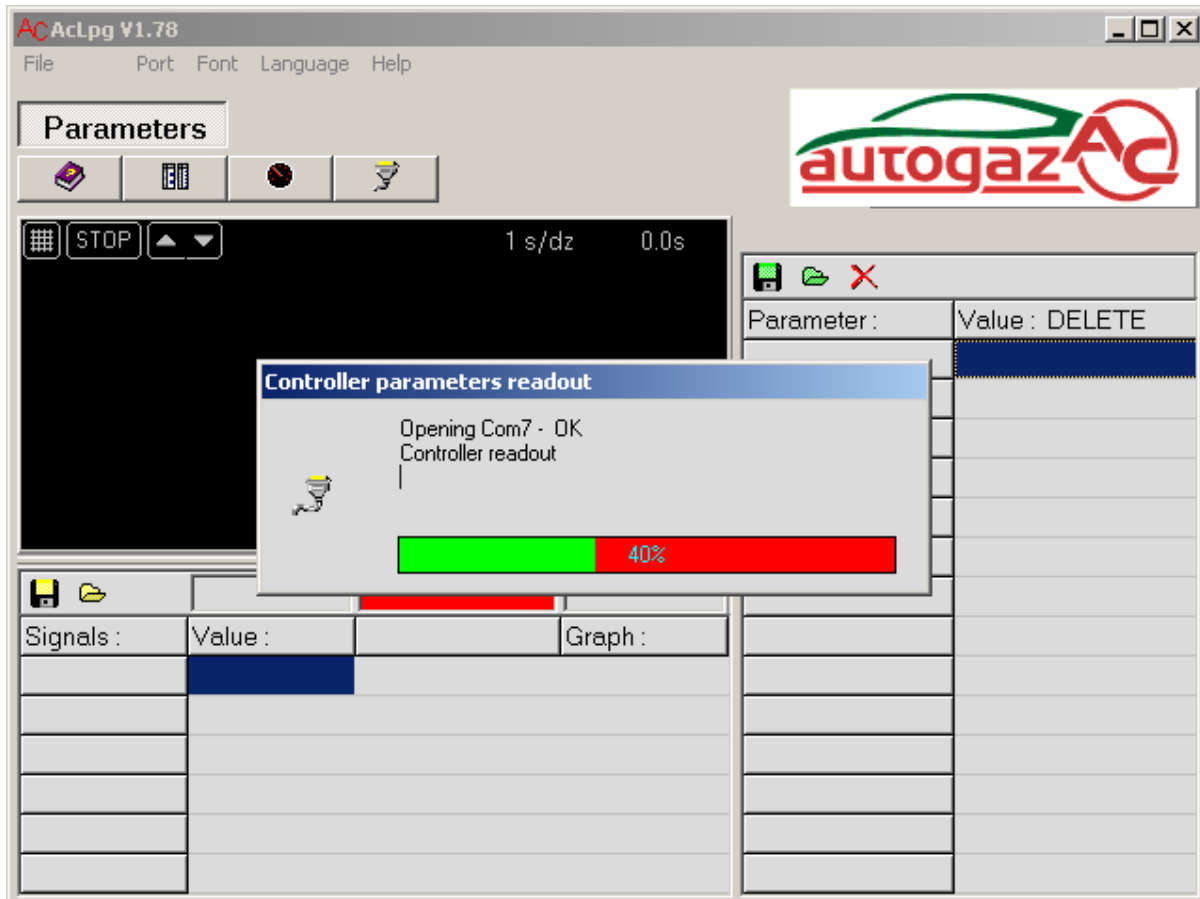
No.	WIRE COLOUR	DESCRIPTION
1	(option) BLACK	FRAME POWER SUPPLY OF EXTERNAL EMULATOR
8	(option) BLUE	+ 12V POWER SUPPLY OF EXTERNAL EMULATOR
2	YELLOW	INJECTOR 1 - POWER SUPPLY
9	YELLOW-BLACK	INJECTOR 1 - COMPUTER
3	GREEN	INJECTOR 2 - POWER SUPPLY
10	GREEN-BLACK	INJECTOR 2 - COMPUTER
4	RED	INJECTOR 3 - POWER SUPPLY
11	RED-BLACK	INJECTOR 3 - COMPUTER
5	BLUE	INJECTOR 4 - POWER SUPPLY
12	BLUE-BLACK	INJECTOR 4 - COMPUTER
14	(option)	RESERVED CONNECTION

Near the STAG 150 emulator socket, there is an emulator resistance switch. When the switch is not pressed, the resistance is **100Ω**, and when it is pressed the resistance is **50Ω**.



## **STAG-50/100/150 - PROGRAMMING WITH A PC AND AcLpgWin SOFTWARE**

To set STAG-50/100/150 parameters using a PC it is indispensable to connect the PC through a RS socket and a RS-232 interface to the STAG-50/100/150 programming socket and start the AcLpgWin.exe software.



During communication appears the screen **PARAMETERS** and transmission percentage indicator . If after a few trials the software cannot establish communication with the controller then instead of the transmission percentage indicator appears the window **CONNECT**, which should be activated to renew communication. If there is no communication check RS-232 connection, change the serial port number or activate auto-search (V1.76 only).

If the communication is established appears the window **PARAMETERS**, oscilloscope function is on.



ACAcLpg V1.78 - LPG controller STAG100 V1.77

File Port Font Language Help

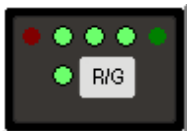
Parameters Configuration Version

STOP 1 s/dz 109,1 s

Parameter :	Value :
Coil type	Coil for 1 cyl.
Coil signal	0-5V
TPS type	0-5V
TPS threshold	0.38 [V]
Adjustment from T	Yes
TPS Hysteresis	0.06 [V]
Enrichment	50
Weakening	30
Actuator speed	250
Opening option	No
Option CUT-OFF	No
Lambda sensor type	0-1V
Lambda sensor	Standard
Adjustment from l	Yes

Signals :	Value :	Graph :
Lambda sens	0.00 [V]	<input checked="" type="checkbox"/> <span style="color: green;">■</span>
Simulation	0.80 [V]	<input checked="" type="checkbox"/> <span style="color: red;">■</span> <span style="color: green;">■</span>
Rpm	1400 [rpm]	<input checked="" type="checkbox"/> <span style="color: red;">■</span>
TPS	0.00 [V]	<input checked="" type="checkbox"/> <span style="color: yellow;">■</span>
Actuator	110 [pos]	<input checked="" type="checkbox"/> <span style="color: cyan;">■</span>
LPG level	0.00 [V]	<input type="checkbox"/> <span style="color: lightgreen;">■</span>

Lambda weak LPG



or



-control panel - working mode change (mouse click)



- open help file



- window layout



- open gauges window



- controller parameters readout



- grid on



- start / stop oscilloscope



- oscilloscope time base change



- save visualisation file



- open visualisation file



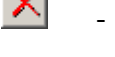
- oscilloscope on / off; graph colour change



- save controller configuration file



- open controller configuration file



- restore manufacturer's parameters

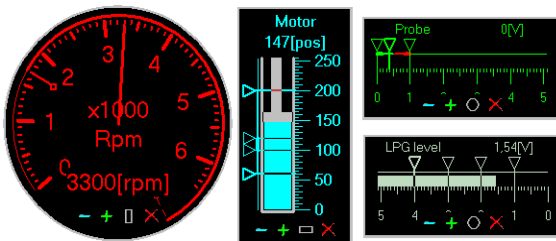


On the oscilloscope you can see basic STAG controller signals: lambda sensor, lambda simulation, TPS and actuator positions .

Below the graph, there is a signal table.

You can enable each graph and select its colour in the “Graph” column.

Apart from the oscilloscope, signal values are displayed in the “Values” column and visualised as line graphs.



Gauge windows – display signals, it is possible to change their position, size and shape ([-][+][O] buttons)

Additionally, in V1.77 version the windows of additional gauges are also accessible. They are displayed by clicking a list below the “Gauges” button or by double-clicking relevant line in the signal table. It is possible, separately for each such window, to change its position (using left mouse button), size ([-] [+]) buttons), shape ([O] button) and close ([X] button).

### KEYBOARD SHORTCUTS

- F1** - full function switch names / abbreviations
  - F2** - screen SETTINGS
  - F3** - screen PARAMETERS
  - F4** - screen CONFIGURATION
  - F6** - screen VERSION
  - F7** - parameter table activation for the screen PARAMETERS
  - F8** - working mode change GASOLINE / AUTO / LPG
- NOTE: working mode change is possible also with mouse
- F9** - font change
  - F10** - start of communication with the controller

### QUICK CHANGE OF PARAMETERS

To change parameters and their values it is possible to use mouse buttons through clicking on selected parameter as well as keyboard keys:

- UP / DOWN** - parameter change
- RIGHT / LEFT** - parameter value change



## **STAG-50/100/150 ADJUSTMENT PARAMETERS**

**IGNITION COIL** - according to the connection of rpm pulse and ignition type it is indispensable to choose such type of coil to obtain the same rpm indication at the tachometer and software window. In certain vehicles it is indispensable to use an ignition pulse adder.

**COIL SIGNAL** – change of the rpm detection voltage threshold. Set suitable detection level depending on rpm pulses voltage value.

**TPS** - after connection of a throttle opening sensor choose its type and voltage range.

**TPS THRESHOLD** – voltage level, which causes switching over from idle operation to operation with load

**ADJUSTMENT FROM TPS** - adjustment from TPS on / off

**TPS HISTERESIS** - removal of voltage noise from the TPS sensor

**ENRICHMENT** - number of actuator steps proportional to accelerator's pressing

**WEAKENING** - number of actuator steps proportional to accelerator's loosing

**ACTUATOR SPEED** - actuator speed during enrichment / weakening

**OPEN** - additional opening of actuator after reaching of TPS level

**TPS LEVEL** - TPS voltage level causing mixture enrichment – additional opening of the actuator

**ACTUATOR AT THE POSITION** - number of actuator steps during additional opening

**ACTUATOR SPEED** - actuator speed during opening

**CUT OFF** - additional closing of actuator during accelerator's loosing and reaching TPS level downward. This function works if rpm falls to the set level.

**RPM LEVEL** - rpm level activating CUT OFF function

**ACTUATOR AT THE POSITION** - number of actuator's steps during CUT OFF execution

**ACTUATOR SPEED** - actuator speed during CUT OFF

**LAMBDA SENSOR TYPE** - lambda sensor operation range

**LAMBDA SENSOR** - lambda sensor type:  
STANDARD – zirconium  
RESISTIVE (-) – load from the frame



RESISTIVE (+) – load from the positive pole (+)

**ADJUSTMENT FROM LAMDBA SENSOR** - adjustment from sensor on / off

**LAMDBA SENSOR THRESHOLD** - a voltage causing mixture weakening

**ACTUATOR SPEED ABOVE TPS THRESHOLD**- actuator speed during LPG – air mixture adjustment set by the sensor during idle operation

**ACTUATOR SPEED BELOW TPS THRESHOLD**- actuator speed during LPG – air mixture adjustment set by the sensor during idle operation

**LAMDBA SENSOR COLD** - theoretical time of sensor heating. At each switching of LPG supply the controller ignores sensor indications maximally for the set time period and awaits sensor's proper operation. Until the parameters become stable, the controller uses internal map.

**SIMULATION** - during running with LPG vehicle's computer receives simulated signal with adjustable parameters instead of lambda sensor signal

TYPICAL - square wave 08 / 08 s.

AUTO - simulation of the sensor regarding petrol engine characteristics

FRAME - vehicle's computer input connected to the frame

USER - square wave adjusted freely

TIME HI - duration of simulation pulse upper course

TIME LO - duration of simulation pulse lower course

TIME OFF - total time of pauses between pulses' groups, 0 = no pause

PULSE NUMBER - number of pulses within a group, 0 = no groups

DISCONNECTED - vehicle's computer input disconnected from the sensor

**RELAY** – switchover of additional relay function, which can operate as a injection emulator or switch off of car computer (erase car computer errors)

**CAUTION! Function available only for STAG – 100**

**SWITCH-OVER TIME** – time of fuel “overlapping” during switching on the LPG (function RELAY – emulator)

**SWITCH OFF TIME** – time of relay switch off after the ignition switch is off (function RELAY – memory erase)

**SWITCH-OVER TYPE** - LPG supply switch on according to rpm

RPM UP - LPG supply on during rpm increase

RPM DOWN - LPG supply on during rpm decrease

RPM + TPS - additional TPS voltage check at rpm (driver opens / closes throttle)

**SWITCH OVER RPM** - rpm causing LPG supply on

**SWITCH OVER POSITION** – position of controller actuator during switching on the LPG

**SWITCH OVER TEMPERATURE** - temperature causing LPG supply on if the pressure regulator temperature sensor is connected

**MAX rpm for LPG** - rpm level causing switchover to gasoline. Rpm decrease causes switchover to LPG.



**ACTUATOR MAX LEVEL** - number of steps for max. actuator opening.

**3000 RPM LEVEL** - number of steps of actuator at 3000 rpm (sensor cold or off).

**900 RPM LEVEL** - number of steps of actuator at 900 rpm (sensor cold, off or damaged).

**ACTUATOR MIN LEVEL** - number of steps for min. actuator opening.

**LEAKAGE** – actuator opening just after switching on the ignition switch (while working with gasoline)

**LPG LEVEL SENSOR** – depending on LPG level sensor, voltage thresholds for activation of relevant LEDs indicating LPG level

### **FAULTS DETECTED BY THE STAG-50/100/150 CONTROLLER**

**VOLTAGE SUPPLY FAULT** - to big voltage drop or disconnection of battery, which causes controller's reset

**DATA FAULT** - faults within controller's memory (damage or improper assembly)

**LAMBDA SENSOR FAULT** - long-lasting lack of voltage from the sensor

**TPS FAULT** - long-lasting lack of TPS voltage change



## CONFIGURATION

Parameter :	Value :	Graph :
Rpm	3300 [rpm]	<input checked="" type="checkbox"/>
Lambda sens	0.88 [V]	<input checked="" type="checkbox"/>
TPS	1.92 [V]	<input checked="" type="checkbox"/>
Actuator	111 [pos]	<input checked="" type="checkbox"/>

Parameter :	Value :
Coil type	Coil for 2 cyl.
TPS type	
TPS threshold	0.24 [V]
Lambda sensor typ	
Lambda sensor thr	0.46 [V]
Level for 900 rpm	
Level for 3000 rpm	

To match controller parameters to the individual vehicle type choose **CONFIGURATION** menu; software detects petrol engine parameters and automatically adjusts LPG mode parameters.

**CONFIGURATION** is activated with the key **GASOLINE**.

Dialog windows shows commands to execute to configure the controller for a LPGpowered vehicle.

During check of gasoline mode parameters individual parameters will be displayed within a table; during LPG mode configuration revolutions of actuator will be added for individual rpms.

### **CONFIGURATION – GASOLINE**

Start controller configuration for gasoline with the key **GASOLINE**.

According to dialog window commands proceed as follows:

- start the engine
- set working mode **GASOLINE** (control panel key or mouse)
- keep idle rpm - gasoline mode parameters will be checked
- increase rpm to 3000 - gasoline mode parameters will be checked once again

At this moment all parameters indispensable for LPG controller operation will be stored to the parameter table - match them to the engine type.

**NOTE:** sensor type (standard / resistive +, -) is not recognised automatically. Insert sensor parameters manually to the window **PARAMETERS** after **CONFIGURATION** (e.g. OPEL OMEGA, lambda sensor



5 V, resistive +).

Finish the gasoline configuration pressing one of following keys:

**NEXT** - LPG mode configuration

**OK** - save gasoline mode settings

**SKIP** - skip settings

### **CONFIGURATION – LPG**

**NOTE: LPG MODE CONFIGURATION SHOULD BE MADE AFTER PRELIMINARY PRESSURE REGULATOR ADJUSTMENT! (SEE QUICK START P. 12)**

LPG mode configuration may be activated with **LPG** or **NEXT** - if gasoline configuration has been performed previously.

According to dialog window commands proceed as follows:

- set **AUTO** working mode (control panel key or mouse)
- increase rpm to ca. 2000 to switch over to LPG
- leave idle rpm - actuator position will be adjusted
- increase to 3000 rpm - actuator position will be adjusted
- 

Finish the configuration with:

**OK** - save LPG mode settings

**SKIP** - skip settings

Other controller settings as e.g. sensor simulation, LPG mode on level etc. may be adjusted with menu **PARAMETERS**.

### **QUICK START, FIRST PRESSURE REGULATOR ADJUSTMENT**

First pressure regulator adjustment must be done before use of **CONFIGURATION -LPG** function.

Adjustment should be done using menu **PARAMETERS**.

- start the engine in gasoline mode and wait for proper lambda sensor operation
- set the controller for **GASOLINE** mode.
- Check lambda sensor operation for idle and 3000 rpm (sensor indications should be between upper and lower voltage value).
- Set the controller for **AUTO**
- Increase rpm to ca. 2000 to switch over to LPG
- Watching lambda sensor graph at the oscilloscope adjust LPG output (with an adjustment screw located on the pressure regulator) so that the actuator works in the range 50 - 100 steps (idle engine rpm)
- Check sensor balancing at 3000 rpm
- If the sensor shows long return time to balancing during rpm change check pressure regulator membrane tension and adjust it with a screw, if necessary.

NOTE: if during pressure regulator adjustment it is impossible to obtain sensor balance at high rpm and the mixture is weak, it means that the system pressure regulator - mixer does not work properly, thus before adjustment of electronics some mechanical components must be adjusted. If the pressure regulator has been adjusted and works properly, proceed with **LPG CONFIGURATION**.



## **CALIBRATION OF LPG LEVEL INDICATOR**

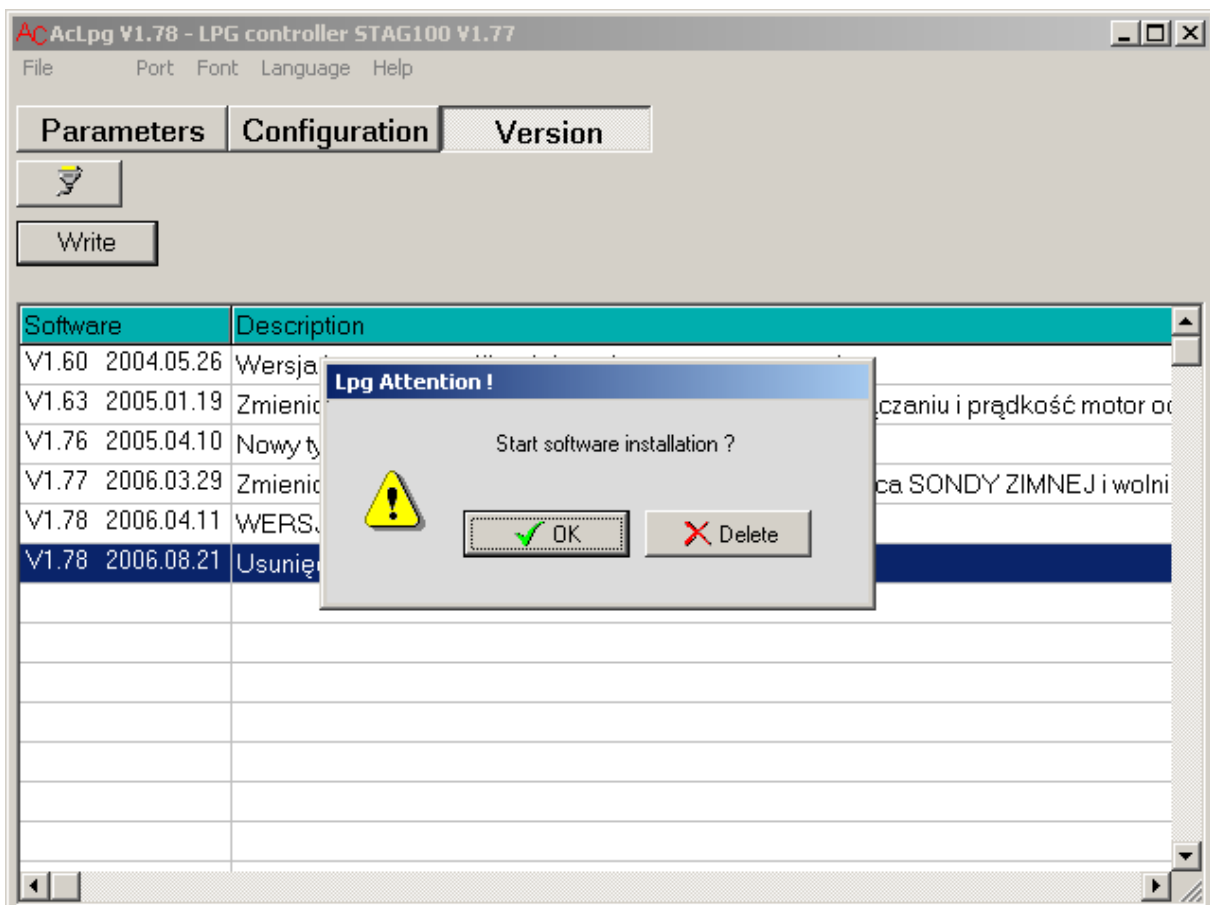
LPG level indicator calibration should be performed with ignition switch on without starting the engine. Displayed voltage will be quickly responding to changes in float position.

## **VERSION**

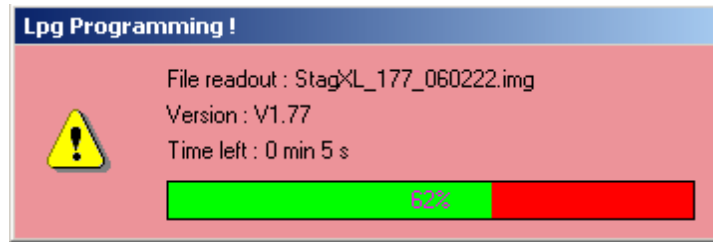
The STAG-50/100/150 controller from the version 1.60 on is provided with the option of user-made software modification.

After connecting the controller to a PC the new window VERSION appears.

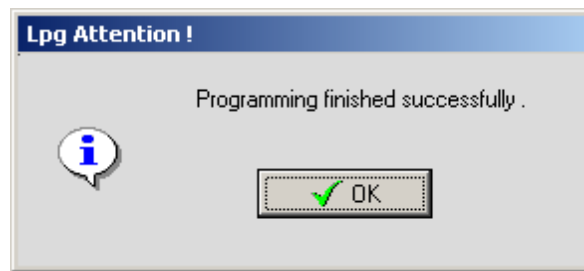
If the folder containing the program AcLpgWin.exe includes also a batch program of the STAG 50/100/150 controller marked with the wildcard .img, the batch program will be also displayed after activation of the VERSION window; this enables controllers software exchange.



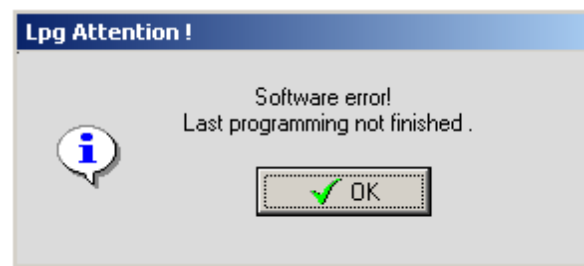
Click with the mouse on the program, which should be copied into the controller software  
Click the button Write  
When the question "Start software installation?" appears, press OK.



⌚ wait until the installation progress bar reaches 100%



⌚ when the message "Programming finished successfully" appears, press OK. The controller performs restart and begins to work with the new version of the software.



If the programming process is interrupted or there are some errors, diagnostic software will display the "Software error ..." message. Press OK and repeat the controller programming procedure.



## **TECHNICAL DATA**

Operation voltage	12V ( +30% - 25% )
Max current consumption	0,3 A
Max current supplied to LPG control system	6,5 A
Max injection emulator current	5 A
Ignition pulse input voltage	3 – 12 V

## **FUNKCJE PROGRAMOWALNE**

Number of cylinders and ignition type.....	3, 4, 5,6, 8 cylinders, single or double coil
Type of throttle position sensor.....	0-5 V, 5-0V linear, switch 0-12/12-0 V
Lambda sensor type.....	0-1V, 0-5V, 5-0V, 0.8-1.6V, standard or resistive
Lambda sensor emulation.....	square wave, disconnected, frame
Type of changeover gasoline / LPG.....	rpm up, rpm down, rpm + TPS
Time of simultaneous operation gasoline + LPG.....	0 - 1,020 s
Temperature of switchover gasoline / LPG.....	60 - 185°C
Switchover rpm.....	1000 - 10000 rpm
Max rpm for LPG mode.....	5000 - 10000 rpm
Fuel level sensor STAG-100/150.....	0-90 Ω, 90-0 Ω, 0-50 kΩ, 50-0 kΩ
Actuator operation range.....	0 - 255 steps
Actuator speed.....	0 - 255
Option of automated actuator opening during acceleration.....	on / off
Option of additional actuator opening during acceleration.....	on / off
Option CUT OFF.....	on / off
Emulator relay operation mode STAG-100.....	1 point emulator / erase vehicle computer memory
Default parameters option .....	yes
Fault recognition.....	power supply (reset), TPS, lambda sensor