



CONNECTION AND PROGRAMMING INSTRUCTIONS

STAG-TAP-03

Timing Advance Processor

E₈ 10R-03 4945

(the manual is also accessible via diagnostic software or www.ac.com.pl)

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1. Set includes:

1. STAG-TAP-03/1 or STAG-TAP-03/2 - timing advance processor
2. Wire harness
3. Wiring diagram
4. Quick Start Manual
5. STAG TAP-03 processor hardware

2. Before purchasing

Before purchasing the device is important to check the type of crankshaft position sensor mounted in the car, based on which you can select the type of Time Advance Processor (TAP-03/1 – for inductive sensors, TAP-03/2 – for electronic sensors). TAP-03/1 and TAP-03/2 support up to 2 digital signals from the camshaft position sensors.

3. Intended use

Timing advance processor is a microprocessor based device for changing the spark lead angle of engines powered with LPG or CNG. Due to the higher octane number of gas fuel, the combustion time of the air and gas mix is longer than in the case of air and petrol mix. Therefore, ignition of the air and gas mix should occur earlier than in the case of petrol. Timing advance processor improves response of an engine powered with gas, reduces gas fuel consumption and reduces the risk of back-fire in the case of previous generation systems. STAG-TAP-03/1 timing advance processor has been designed for installation in cars equipped with an induction crankshaft position sensor, whereas STAG-TAP-03/2 has been designed for installation in cars equipped with an Hall effect or optical crankshaft position sensor.

4. Principle of operation

Timing advance processor is incorporated in the engine crankshaft position sensor circuit and additionally into the camshaft position sensor circuit (optionally). It generates a signal sent to the petrol controller advanced in comparison to the signal from the sensor by a few or more degrees. Modification of the ignition advance has a direct impact on the ignition (spark in the cylinder). Timing advance shift results in earlier ignition of the air and fuel gas mixture in the cylinder to optimize the conditions for combustion.

The following signals are used to control the operation of the processor:

- signal from the gas electro-valve (detecting the type of fuel),
- engine load sensor (MAF/MAP/TPS),
- ignition coil signal (optional).

5. Wiring diagram and installation instructions

Before installation, ignition system should be checked carefully.

Depleted elements of this system can prevent proper working of Timing Advance Processor, which can appear a number of inadvisable situations, such as unexpected stopping of the engine, misfire, OBD faults of the crankshaft and the camshaft recorded by on-board computer of the vehicle ("check engine").



Special inspections should be subjected to spark plug and ignition wires.

Spark plug, in which will be revealed wear electrodes must always be replaced with new one.

- Used spark plug



- Spark plug not used yet



Fig. 1. Quality control of spark plugs.

Install the timing advance processor in the engine compartment, so that it is not exposed to high temperature, water, oil or fuel.



Install the controller vertically by the installation eye, using a screw; the socket must be positioned downward to protect it from water.

Rubber gaskets protecting the bundle socket should be installed carefully in order to seal the whole casing.

The original harness used for connection of the crankshaft position sensor with the ECU should be shielded. Otherwise, replace it with a shielded wire!

Electric connections should be soldered, carefully insulated and protected against short circuits and moisture.

The method of determining the sensor type:

- 2-pin connector – inductive sensor:
 - resistance for a typical sensor is approximately 1000 ohms.
- 3-pin connector – inductive sensor (two pins – sensor, the third pin – GND):
 - resistance between the two pins of the sensor should be approximately 1000 ohms, while the third pin from the ECU side should be connected to GND.
- 3-pin connector – Hall effect or optical sensor (GND, power supply, signal):
 - one wire from the ECU side is connected to GND, the second to the ignition switched-on voltage, while the third one is a signal wire.

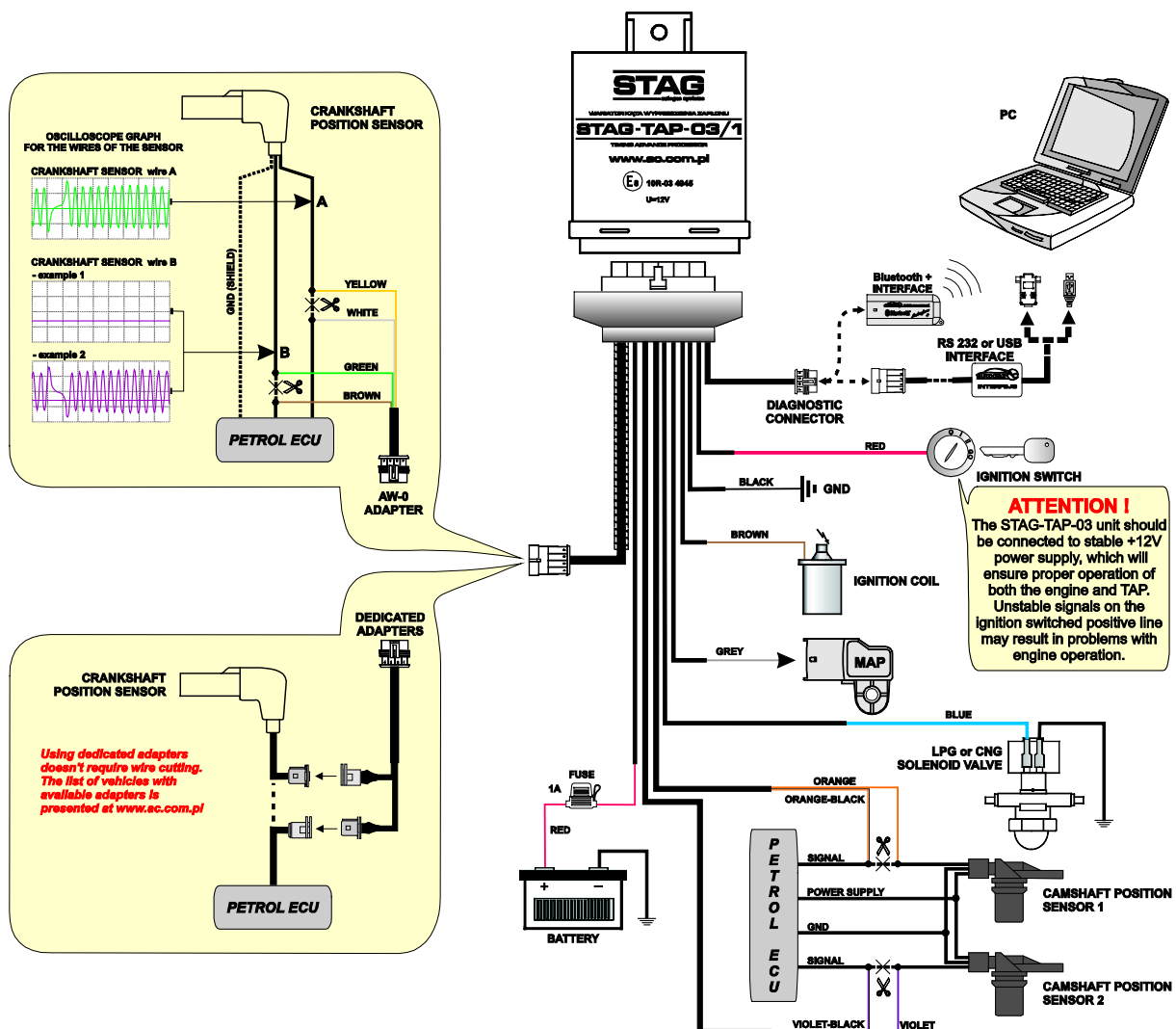


Fig. 2 STAG-TAP-03/1 wiring diagram (inductive crankshaft position sensor).

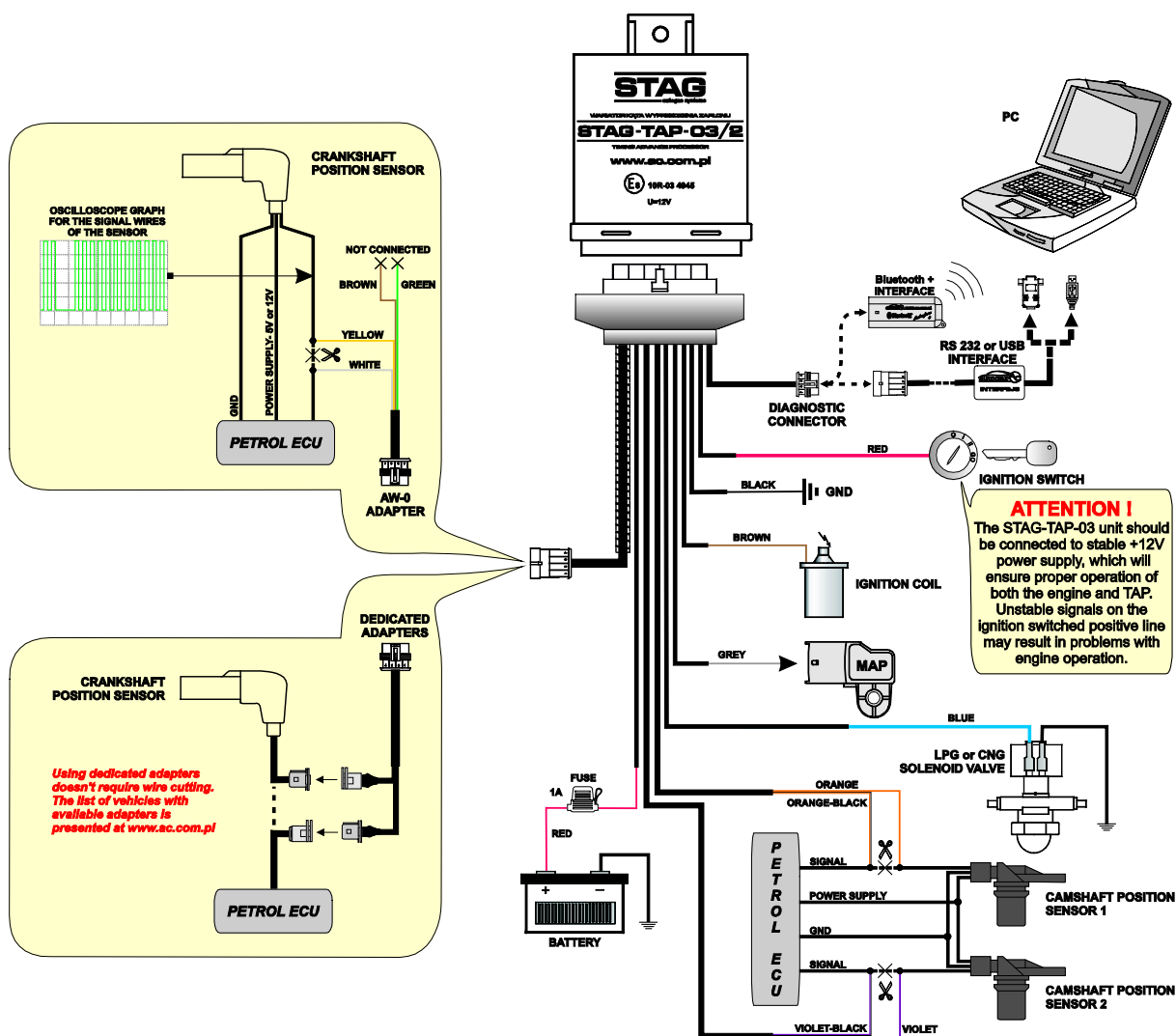


Fig. 3 STAG-TAP-03/2 wiring diagram (Hall effect or optical crankshaft position sensor).

6. Harness leads

No.	CONNECTION DESCRIPTION	COLOR OF THE WIRE	TYPE
1	GND	Black	Power supply
2	Ignition switch	Red	Signal
3	RXD	White	Signal
4	TXD	Blue-Black	Signal
5	-	-	-
6	-	-	-
7	Camshaft ECU 2	Violet-Black	Signal
8	Camshaft ECU 1	Orange-Black	Signal
9	Crankshaft ECU B	Brown	Shielded
10	Crankshaft ECU A	White	Shielded
11	+12 LPG or CNG	Blue	Signal
12	Battery	Red (fuse 1A)	Power supply
13	Ignition coil	Brown	Signal
14	Engine load sensor	Grey	Signal
15	-	-	-
16	-	-	-
17	Camshaft sensor 2	Violet	Signal
18	Camshaft sensor 1	Orange	Signal
19	Crank shaft sensor B	Green	Shielded
20	Crank shaft sensor A	Yellow	Shielded

7. Operation status indication

LED diodes inform about the operation status of the STAG-TAP processor.

LED		Status
Red and green	On	Advance processor started, the condition kept for 2 sec. after power up the processor.
Petrol fueling		
Red	On	Missing rpm signal
Red	Pulsing	Rpm signal detected, waveform unknown
Red	Off	Rpm signal detected, waveform detected
Green	Pulsing	Autocalibration in progress
Autogas fueling		
Green	On	Rpm signal detected, TAP processor is shifting the pulses
Green	Pulsing	The time advance processor (TAP) does not shift the pulses (it is operating below the threshold of idle speed detection, missing Rpm signal or waveform unknown)

8. Configuration via switches



Configuration of the timing advance processor via switches and potentiometer must be performed while the **SW4** switch is **OFF**.

1) The switch controls the operation mode and basic settings:

<u>Autocalibration:</u>	Turn on autocalibration ON	Turn off autocalibration OFF		
SW5				
<u>Operating mode:</u>	MANUAL (switches) OFF	PC (RS232 interface) ON		
SW 4				
<u>TPS type:</u>	Normal	Reverse		
SW 3	OFF	ON		
<u>Ignition advance:</u>	6 degrees	8 degrees	10 degrees	12 degrees
SW 2	OFF	OFF	ON	ON
SW 1	OFF	ON	OFF	ON

2) Engine load sensor threshold adjusting potentiometer is used for setting the limit of idle run detection.

Position of the idle speed detection threshold potentiometer (trigger potentiometer) should be adjusted after auto-calibration in the manual mode. Before auto-calibration is started, turn the idle speed detection threshold potentiometer to the max. left position. It should be adjusted so that the processor does not shift the pulses on idle. Changing the timing advance while idling may cause rev oscillations in some cars.

Stages of adjusting the idle speed detection threshold:

- The process should be performed after auto-calibration and with gas-fueling activated (green LED of the timing advance sensor is on).
- Turn on the air-conditioning, ventilation fans and wait until the engine reaches the operating temperature level.
- Slowly turn the potentiometer right until the green LED starts pulsing. This will mean that the TAP processor detects idle speed and does not shift any pulses.
- Verification of the correct adjustment of idle speed detection threshold involves increasing engine load, e.g. by increasing rpm, which is confirmed by continuous light of the green LED, which means that the pulses are shifted.

<i>Load sensor type</i>	<i>Setpoint range</i>
Normal	0 – 2.5 [V]
Reverse	5 – 2.5 [V]

9. Configuration via PC (see description of ac stag software)



Configuration of the timing advance processor via PC must be performed while the **SW4** switch is **ON**.

9.1. Controller connection to the PC

Following correct installation, connect a computer with installed AC STAG software to the STAG-TAP-03/1 or STAG-TAP-03/2 processor using RS232, USB or Bluetooth next (system developed by AC S.A.). Switch on the ignition before initiating the software. This is necessary, as the controller is switched to stand-by mode 30 seconds after post ignition voltage (switched positive) is cut out (communication is not possible).

After initiation of the application, if correct serial COM port is selected, the controller should communicate with the software, which is confirmed with the following messages "Status: Missing ignition signal", "Status: Petrol", "Status: Gas" in the bottom left corner. The parameters window is presented on Fig. 4.

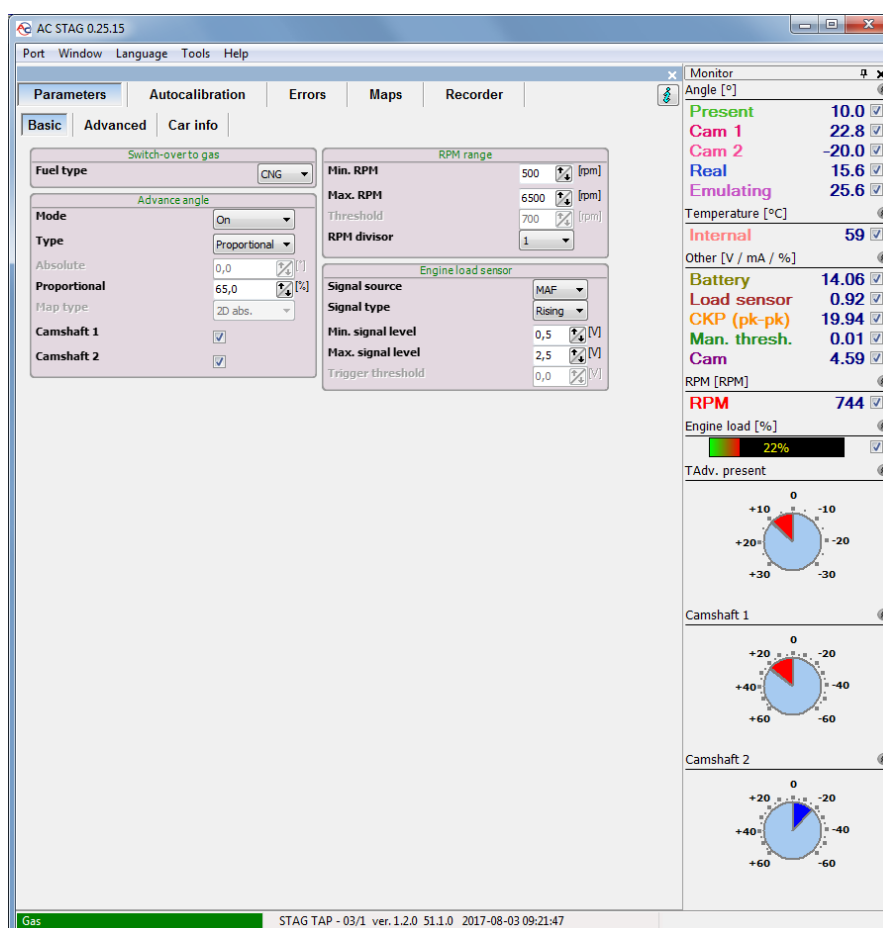


Fig. 4. Basic parameters

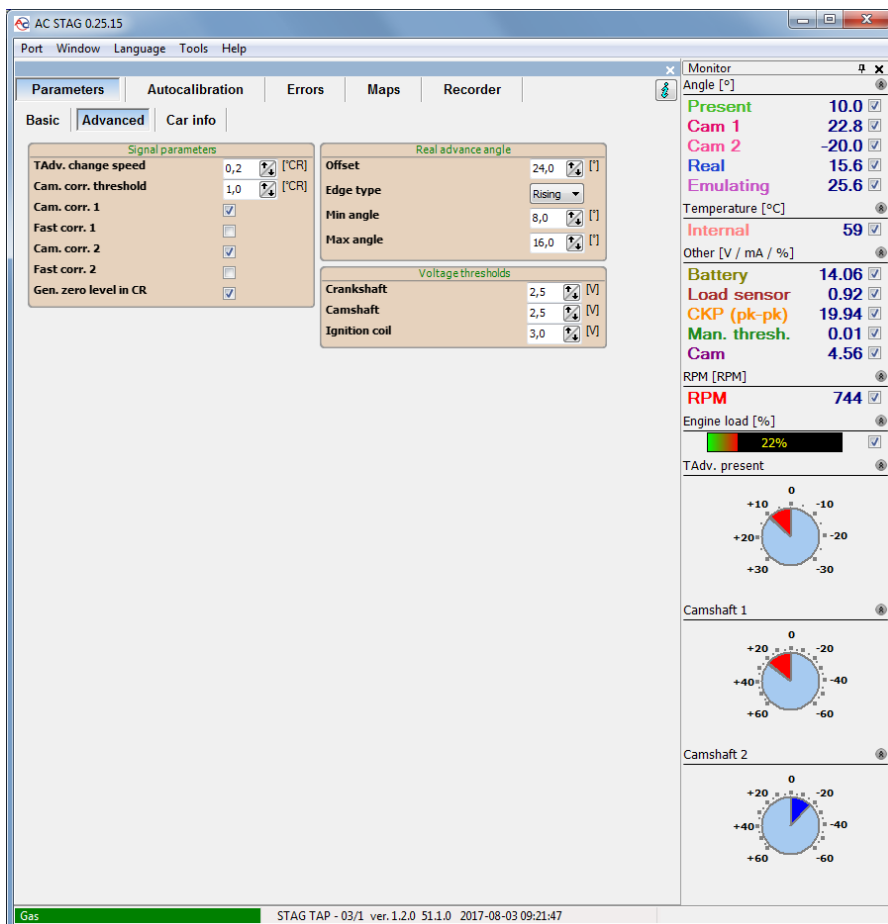


Fig. 5. Advanced parameters

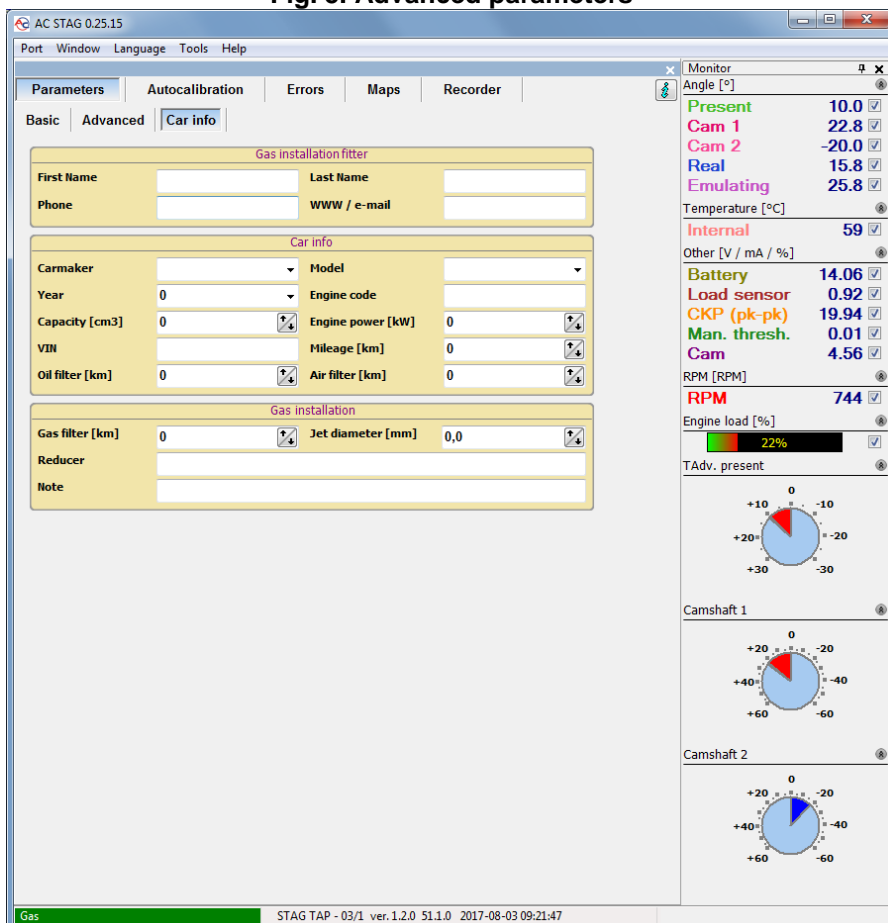


Fig. 6. Car information

If the application displays “No LPG controller” window with “No connection” message in the bottom left corner, select a different port from the Port menu on the screen top.

9.2. AC STAG software version

Software version is displayed on the left side of the top bar.

9.3. Main menu

The following options are presented in the main menu:

- **Port** – choosing a communication port, controller connection and disconnection.
- **Window** – selecting windows screens.
- **Language** – selecting desired language version.
- **Tools** – update hardware devices, setup program settings, load stored settings, store modified settings, restore default (factory) settings.
- **Help** – display info on the controller and documentation.

To bring up the About gas controller window, select “Gas controller info” in the Help menu.

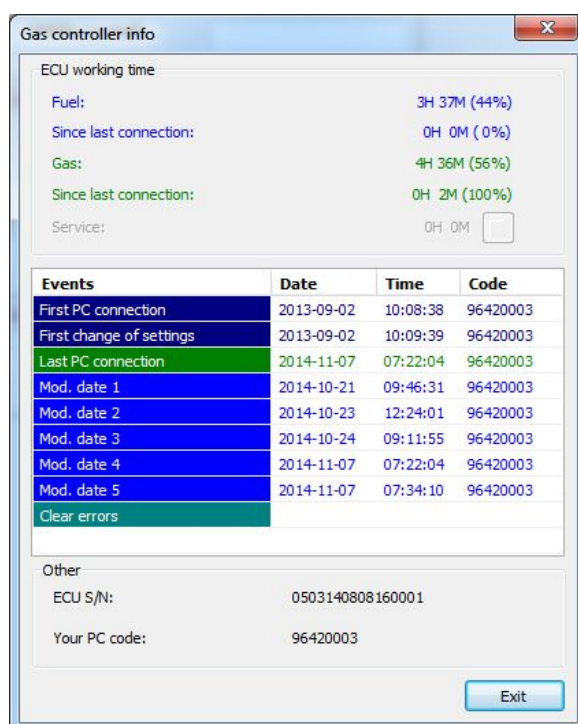


Fig. 7. Gas controller info

The gas controller info window (Fig. 7) shows the following parameters:

Controller working time:

- **Fuel** – total working time of the controller using petrol listed in the following format: H – hours, M – minutes, S – seconds.
- **Since last connection** – working time of the controller using petrol since its last connection with a PC.
- **Gas** – total working time of the controller using LPG.
- **Since last connection** – working time of the controller using LPG since its last connection with a PC.

Below the working times, the Controller Info lists the following types of recorded events:

- **First PC connection** – date of the first controller-PC connection.
- **First change of settings** – date of the first modification of the controller settings.
If these fields do not show dates but instead the “???” symbols, it means an error occurred in the Controller Info. Time information has been lost and the controller will start counting the times from the beginning.
- **Mod. date 1 ÷ Mod. 5** – a list of controller settings modifications. From the most recent ones to the oldest.
- **Clear errors** – Time stamp showing when some controller error was cleared.

Each event is also accompanied by a “code” linked to the PC on which the modification was made. Thus knowing the modification date as well as the PC code, it is easy to determine whether any modifications have been performed by anyone else.

The bottom of this window shows additional information:

- **ECU S/N** – the serial number of the controller.
- **Your PC code** – The code of the PC on which the AcStag software is currently used.

9.4. Controller parameters

The controller firmware version is shown at the bottom of the screen (Fig. 4); text presented on the exemplary figure means the following:

STAG-TAP-03/1 – controller model

1.2.0 – controller firmware version number

51.1.0 – controller version number

The Parameters window lists a number of basic parameters that need to be set individually for each vehicle:

Engine load sensor group – settings related to the type of sensor based on which the actual engine load is calculated.

- **Signal source** – selection of the sensor connected to the advance processor based on which engine load is calculated (MAF/MAP/TPS).
- **Signal type** – selection of characteristics of the engine load sensor (rising/falling edge).
- **Min. signal level** – signal level representing the lower limit of the value indicated by the connected engine load sensor.
- **Max. signal level** – signal level representing the upper limit of the value indicated by the connected engine load sensor.
- **Trigger threshold** – engine load sensor signal level that triggers (when exceeded) a change of the actual timing advance by the set value.



The settings belonging to the group “Engine Load Sensor” serve for indicating the range of sensor voltage used for engine load computation. After setting the minimum and maximum signal values, the load indicated by the processor varies from 0 to 100%. By using the setting “Signal Type” it is declared whether the sensor has a rising characteristics (signal voltage increases with increasing load), or falling characteristics (sensor voltage decreases with increasing load). The correctness of engine load readings depends on the accuracy of “Min. Signal Level” and “Max. Signal Level” settings. The engine load is used as a 3D map parameter.

The setting "Trigger threshold" is used if the parameter "Mode" is set to Auto in the Setting Group: Timing Advance. The processor is then switched off for load sensor voltages below the trigger threshold and shifting is activated only when the load sensor voltage exceeds the set Trigger threshold.

Advance angle – settings related to the generated advance angle and selection of signals to be shifted by the set value.

- **Mode** – managing processor operation (On/Off/Auto).
 - Off – the processor does not shift the signals.
 - On – the processor shifts the signals by the set angle if the following conditions are met:
 - the processor has been synchronized with all signals recognized in autocalibration
 - rpm threshold (RPM range group) has been exceeded
 - rpm value is kept within the range specified in the RPM range setting group
 - Auto – the processor shifts the signals by the set angle if all conditions specified for the switched-on mode are met, and, additionally, engine load sensor voltage exceeds the activation threshold set in the Engine Loading Sensor setting group.
- **Type** – selecting the type of waveform shifting:
 - Absolute – the waveform is shifted by a fixed advance angle value set in the "Absolute" field.
 - Proportional – the course is shifted with a proportional value calculated based on the real advance angle as set in the "Proportional" field (correct operation requires that the Real Advance Angle setting group is correctly configured).
 - Map – the course is shifted by a value that is defined on the map; map selection is made in the "Type of map" field.
- **Crankshaft, Camshaft 1, Camshaft 2** – selection of waveforms to be shifted.



By using the settings in the "Advance Angle" Group it is declared which signal should be shifted by the processor (crankshaft position sensor/camshaft position sensors), by which value and when the signals are to be shifted. The setting "Mode" allows the processor to be switched on/off. When the processor is switched off with the setting "Mode", the output signals from the crankshaft sensors and camshaft position sensors correspond to the original signals. When the processor is switched on ("Mode" set to "On" or "Auto."), the processor generates an offset of selected signals by a declared angle.

After auto-calibration is completed, a default signal which is to be shifted is the crankshaft position signal and this setting cannot be changed. In addition, if camshaft positions signals are connected to the processor, when "Camshaft 1/ Camshaft 2" settings are selected, these signals will be shifted along with the crankshaft position signal.

The setting "Type" provides the three options for Timing Advance determining. The first of them is Absolute mode that enables Timing Advance values to be generated by the processor in the whole range of variation. The Timing Advance values vary in the range from -30 [°CRANKSHAFT ROTATION] to +30 [°CRANKSHAFT ROTATION] with the resolution of 0,2 [°CRANKSHAFT ROTATION]. The second option is Proportional mode that allows defining which fraction of Real advance angle should be an additional timing advance. This option is active provided that the brown wire is connected to the engine ignition coil control signal and the Setting group: Real advance angle is set properly. The setting varies within the range from 0 to 100% and functions as follows. The setting "Proportional" defines a fraction (percentage) of the Real advance angle which should be an offset generated by the processor. For example, if Real advance angle is 20

[°CRANKSHAFT ROTATION] and the “Proportional” setting value is 65%, then the ignition will be advanced by the processor by $20 \times 0,65 = 13$ [°CRANKSHAFT ROTATION]. It is important that the minimum and maximum allowable values of timing advance have to be set before enabling proportional mode. The third option is “Map” and after activation the processor will generate Timing Advance based on one of maps: “2D Absolute”, “3D Absolute” or “2D Proportional”.

RPM range group – a group for defining processor operating rpm range.

- **Min. rpm** – minimum rpm for which timing advance shift should be still generated.
- **Max. rpm** – maximum rpm for which timing advance shift should be still generated.
- **Threshold** – rpm threshold that needs to be exceeded to start timing advance angle shifting.
- **RPM divisor** – option adjusting the processor to work with crankshaft signals with multiple repetitions of waveform sequence in a single crankshaft turn. If rpm levels observed after autocalibration twice as high as the actual rpm, set the rpm divider to “2” and repeat the autocalibration.



The setting belonging to the “RPM Range” Group defines the engine speed range in which the processor should work. The processor begins to shift signals when the “RPM Threshold” is exceeded. If RPM values displayed by the processor after auto-calibration are many times greater than the actual values, the setting “RPM Divider” should be adjusted so that RPM values indicated by the processor correspond to actual RPM values in the car. If the setting “RPM Divisor” has been changed, auto-calibration should be carried out once again.

Switch-over to gas group – parameters related to switching from petrol to autogas.

- **Fuel type** – type of fuel in the LPG system (LPG or CNG).



The Group “Switch-over to gas” contains only one setting “Fuel Type”. This setting informs the processor about the type of gas fuel powering the combustion engine. The value of this setting should be entered prior to auto-calibration – this allows the processor to enter some initial settings during auto-calibration, thus improving and speeding up the processor start-up process.

The “Advanced” tab in the Parameters window lists a number of settings that need to be set individually for each vehicle:

Voltage thresholds group – threshold values for TAP working voltage levels:

- **Crankshaft** – voltage threshold to detect crankshaft signal..
- **Camshaft** – voltage threshold to detect camshaft signal.
- **Ignition coil** – voltage threshold to detect ignition coil signal when the value is exceeded.



The Group “Voltage Thresholds” is responsible for selection of voltage thresholds above which the processor begins to recognise signals. For digital signals the voltage value of 2,5V is recommended. When an inductive crankshaft position sensor is used and its voltage at idle speed is lower than 10V, once the processor is installed some troubles with car engine start-up may occur demonstrated by longer time required to start up with the starter. To eliminate this undesired effect the value of voltage detection threshold for the crankshaft should be reduced to approx. 1V.

Signal parameters group – managing the method of generating emulated waveforms.

- **TAdv. change speed** – setting the rate of generated timing advance.
- **Camshaft correction threshold** – option activated when camshaft correction is selected; it sets the maximum allowed deviation of the camshaft emulated waveform, which is corrected when exceeded.
- **Camshaft correction 1 / Camshaft correction 2** – activated option starts correction of emulated camshaft signals (option used when camshaft variable timing adjustment is used in the engine).
- **Fast correction 1 / Fast correction 2** – launching a fast correction of emulated camshaft signals. The option should be used when the distance between two signal edges is at least 60° of the crank shaft turn.
- **Generate zero level in CR** – the setting defines if the TAP processor should generate the zero level in the waveform based on the inductive crankshaft position sensor signal. The option is only active for TAP-03/1. The function should be activated only if there are problems with engine stalling when TAP makes a signal shift.

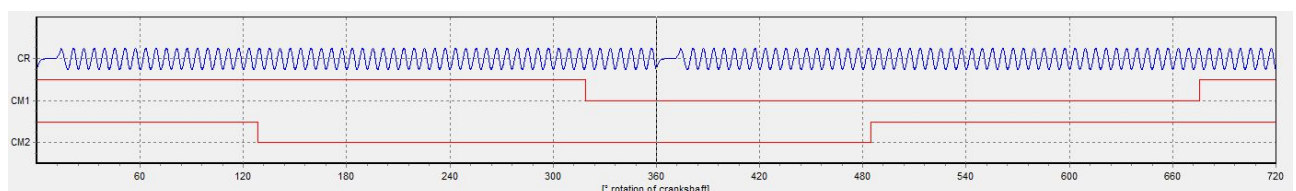


The Setting Group “Signal Parameters” has an effect on the way how emulated signals are generated, i.e. signals from crankshaft position sensors and camshaft position sensors. The setting “TAdv. change speed” defines how quick Timing Advance is changed by the processor. For example, if present Timing Advance is 0 [°CRANKSHAFT ROTATION], Timing Advance Rate is 0,2 [°CRANKSHAFT ROTATION] and the set Timing Advance is 4 [°CRANKSHAFT ROTATION], the change of Timing Advance from 0 [°CRANKSHAFT ROTATION] to 4 [°CRANKSHAFT ROTATION] will be performed after 20 crankshaft rotations. Too high Timing Advance rate may in some cars cause misfire so this option should be used carefully!

If there is Variable Valve Timing in the car engine you should activate options “Crankshaft correction 1” / “Crankshaft correction 2” that ensure proper signal generation on camshafts when variable valve timing is present. These options are directly connected with the setting Camshaft correction threshold that defines an allowable valve timing deviation acceptable by the processor and if valve timing exceeds the “Camshaft correction threshold”, the processor will make a correction to camshaft signals to maintain correlation between the crankshaft and camshaft signals.

For example, if the camshaft changes momentarily its position by 2 [°CRANKSHAFT ROTATION], and the value of the Crankshaft correction Threshold is 1 [°CRANKSHAFT ROTATION], then the processor will make a correction in Valve Timing in the generated run to maintain correlation between the crankshaft and camshaft signals.

When the option “Crankshaft correction 1” / “Crankshaft correction 2” is activated, a new option “Fast correction 1” / “Fast correction 2” is enabled. When the option “Crankshaft correction 1” / “Crankshaft correction 2” is activated and the car jerks when speeding up, please consider the use of the option “Fast correction 1” / “Fast correction 2” if camshaft timing changes very quickly. This option can be used only if the camshaft position sensor signal contains a single wide pulse shown in the Figure below:



Rys. 8. An example of auto-calibration

Another possibility for using the above option is when the narrowest pulse present in the camshaft position sensor signal is wider than 60 [°CRANKSHAFT ROTATION]. If the width of the narrowest pulse present in the working signal of the camshaft position sensor is shorter than 60 [°CRANKSHAFT ROTATION] at significant camshaft timing variation, some errors may occur in the emulated camshaft position signal.

Real advance angle group – group correcting the reading of the actual advance angle and allowing the user to set the range of advance shifts if the signal is generated automatically in the “Proportional” advance mode.

- **Offset** – a setpoint for the offset required to obtain a correct actual advance value read by the processor. If autocalibration detects the ignition coil signal, the value will be set roughly. Value may be in range of -180 deg. to 180 deg., depending of the number of ignition coil connected.
- **Edge type** – signal edge type (rising/falling) following which the processor should set the timing advance.
- **Min. angle** – minimum angle to be generated by the processor while shifting the waveform, when the “Proportional” advance shift is selected.
- **Max. angle** – maximum angle to be generated by the processor while shifting the waveform, when the “Proportional” advance shift is selected.



In the Setting Group “Real advance angle”, the parameters are modified so that the processor could properly interpret the ignition coil control signal based on which the Real advance angle is displayed. The setting “Offset” corrects the Timing Advance indication displayed by the processor. For example, if after auto-calibration the processor displays the Real advance angle of 5 [°CRANKSHAFT ROTATION], and the Real advance angle value in the engine is 7 [°CRANKSHAFT ROTATION], then the “Offset” should be 2 [°CRANKSHAFT ROTATION] to display the correct Real advance angle value. The value of Real advance angle can be read out, for example by using the AC SXC1011 scanner (see the illustration below).



The setting “Edge Type” establishes the edge of ignition coil control signal (rising/falling) on which

the processor should determine the Real advance angle. If the Real advance angle indicated by the processor at idle speed is correct, but at increased engine speed some differences occur between the Real advance angle in the engine and that determined by the processor, it is necessary to change the Edge Type in the current setting group and correctly adjust the Offset to display the correct Real advance angle.

The settings "Min. Angle" and "Max. Angle" define the range of Timing Advance variations generated by the processor in the Proportional or 2D Proportional Map modes.

The **Car info** window lists the following groups of parameters:

- **Gas installation fitter** – contact details of the fitter.
- **Car info** – car data, for cars with gas installation.
- **Gas installation** – general information about the components of the gas installation.

9.5. Monitor.

On the right side of the application screen there is a "Monitor" window. The window presents the following signals measured by the controller:

Angle:

- Present – value of the TAdv additionally generated by TAP03 (represented by the "TAdv. present" indicator).
- Camshaft 1/Camshaft 2 – camshaft position – camshaft phase (parameters represented by "Camshaft 1/Camshaft 2" indicators).
- Real – actual timing advance generated by the ECU (parameter displayed when signal from the ignition coil during auto-calibration is detected).
- Emulating – value of TAdv actually generated in the combustion chamber. The sum of Real TAdv generated by ECU and Present TAdv generated by TAP03 (parameter displayed when signal from the ignition coil during auto-calibration is detected).

Temperature:

- Internal – internal controller temperature.

Other:

- Battery – supply voltage to the processor.
- Load sensor – voltage of the engine load sensor connected to the advance processor (MAP/MAF/TPS).
- Crankshaft position (pk-pk) – voltage on the crankshaft position sensor.
- Man. threshold - voltage on the timing processor potentiometer.
- Camshaft – voltage on the signal line of the first camshaft.

RPM:

- Rpm – engine speed value.

Engine load:

Engine load expressed in percentage. It is calculated based on the voltage value from the engine load sensor and min./max. level values set in the "Engine load sensor" group.

All described signals are also displayed on the oscilloscope. It is possible to switch off any signal on the oscilloscope display.

The user can click a signal to change its display color.

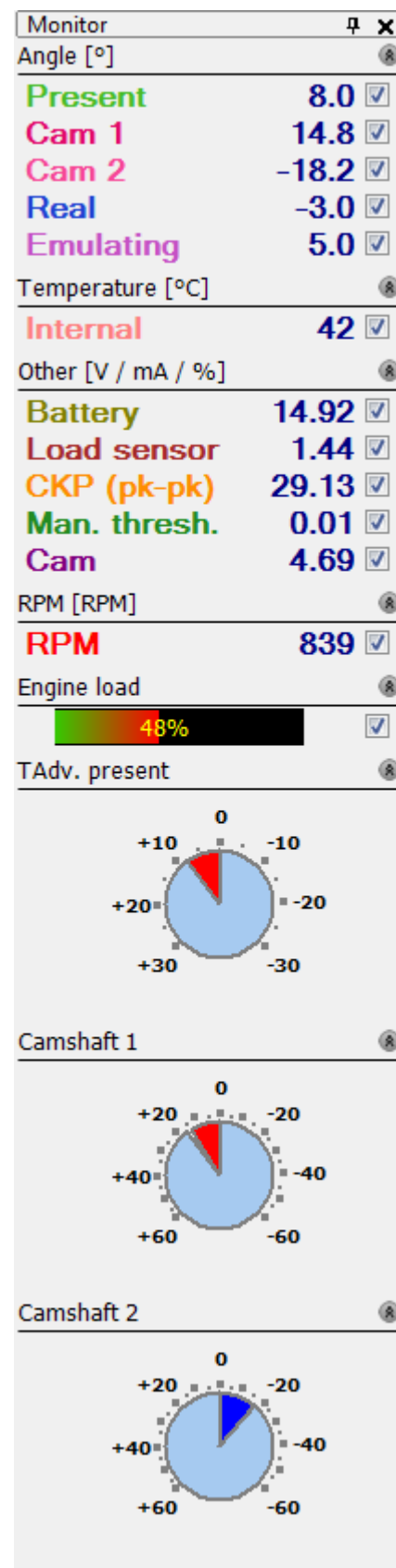


Fig. 9 Monitor window

9.6. Autocalibration

The STAG TAP-03 timing advance processor allows two types of autocalibration:

- **Quick calibration** – the processor adapts to the curves of signals from the crankshaft and camshaft sensors.
- **Full calibration** – the processor adapts to the curves of signals from the crankshaft and camshaft sensors and to the range of voltage of the respective engine load sensor (MAF/MAP/TPS). Additionally, after the analysis, an ignition coil control signal is specified in order to display the actual ignition advance angle and an optimum ignition advance angle for gas-fueled idle run is selected.



If autoadaptation option use is to be used (automatic adjustment of the ignition timing advance on the "3D Absolute" map), make sure that:

- MAP line (gray wire) is connected as the engine load signal source,
- ignition coil control signal has been connected (brown wire) to the TAP.

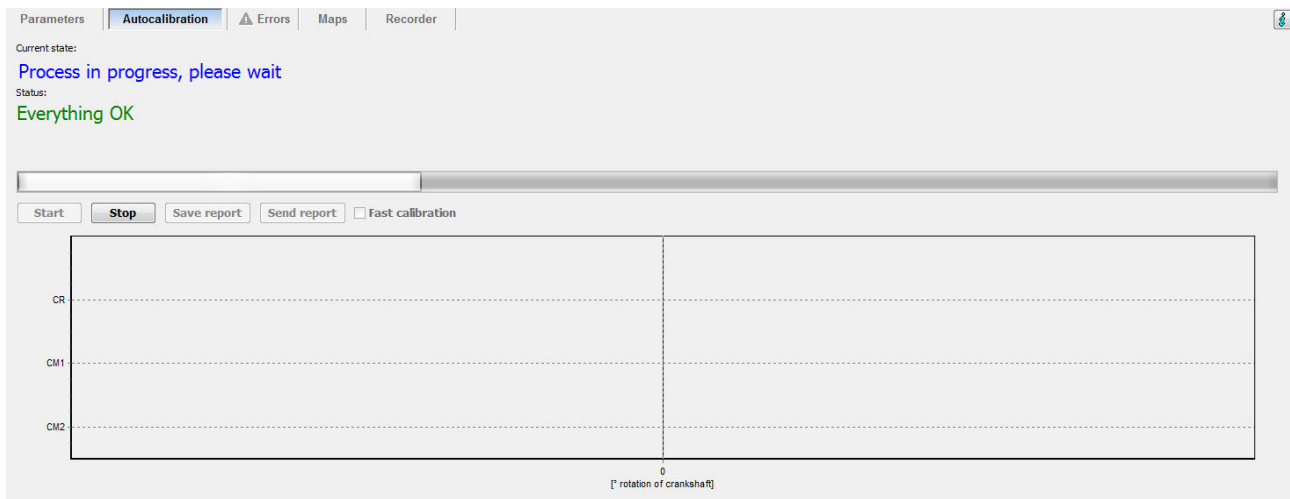


Fig. 10. Autocalibration window.

During the autocalibration process, the engine should run on idle speed and be fuelled by petrol. When the procedure is completed, the controller displays the waveforms of the crankshaft and camshafts.

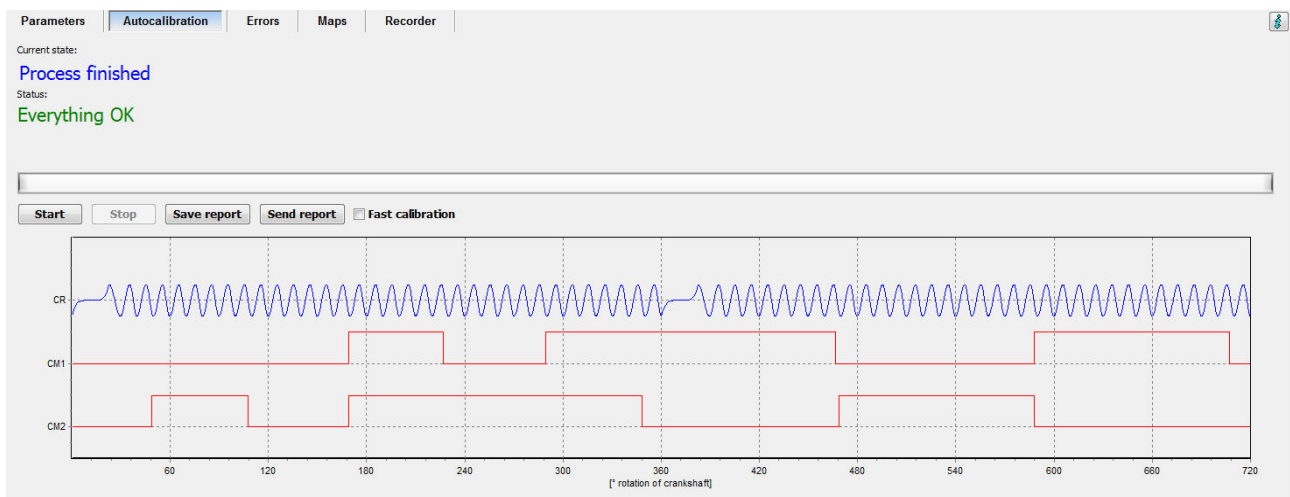


Fig. 11. Autocalibration results

The following messages can be displayed during calibration:

- **Engine rpm: high** – rpm too high.
- **No signal correlation** – the processor is not able to detect the correlation of crankshaft and camshaft signals.
- **Unstable engine operation** – engine operation is unstable, which inhibits correct calibration.
- **Crank shaft pulses are too short, camshaft signal shift is not possible!** - the processor is able to handle the crankshaft signal only.
- **Insufficient number of pulses per crankshaft rotation.** – the processor is not able to adapt to the crankshaft signal curve, as the number of notches on the crankshaft position disc is not sufficient. The minimum number of notches per crankshaft rotation is 13.
- **Process error.** - the processor is not able to detect the crankshaft waveform.

Results of the successful or failed calibration process can be sent to AC S.A. and will be used for further product development. Fill the required fields and press the “Send report” button.

Fig. 12. Report details

9.7. Oscilloscope

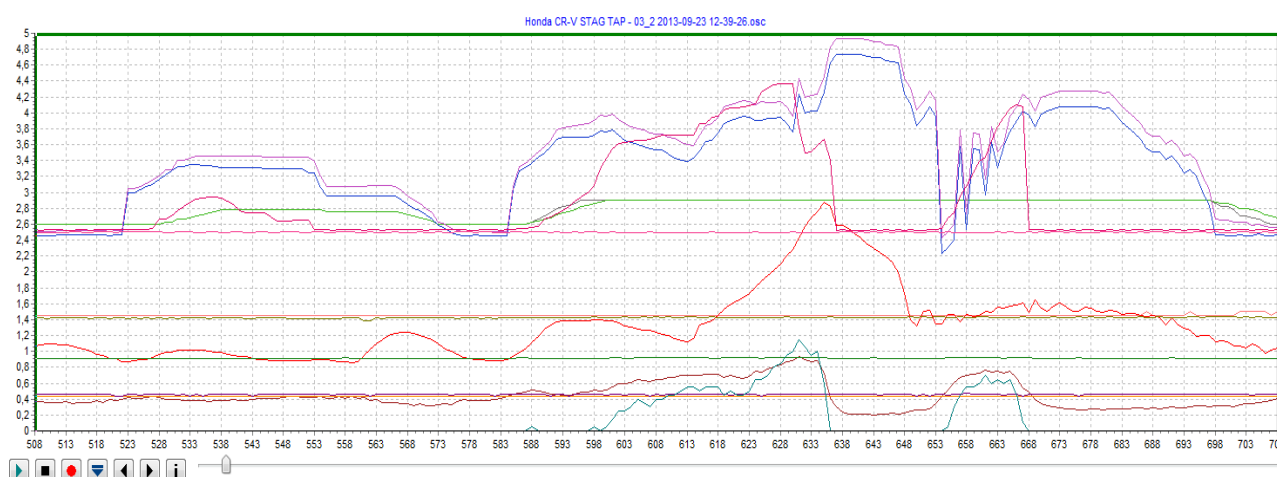


Fig. 13. Oscilloscope

The Autocalibration/Maps/Recorder tabs contain an oscilloscope window. The oscilloscope displays all signals described in 9.5.

There are control buttons with the following functions (from the left):

- *Start the oscilloscope*
- *Stop the oscilloscope*
- *Save current oscilloscope display*
- *Load saved oscilloscope display (file)*
- *Reduce the number of displayed points (only for loaded graphs)*
- *Increase the number of displayed points (only for loaded graphs)*
- *Display oscilloscope file information (data logging start/stop, total number of stored samples, application version, controller version, controller serial number).*

9.8. Errors and messages

The window tab is split into the following sections based on the type of displayed alarm messages:

- Gas controller errors and messages:
 - actual
 - registered

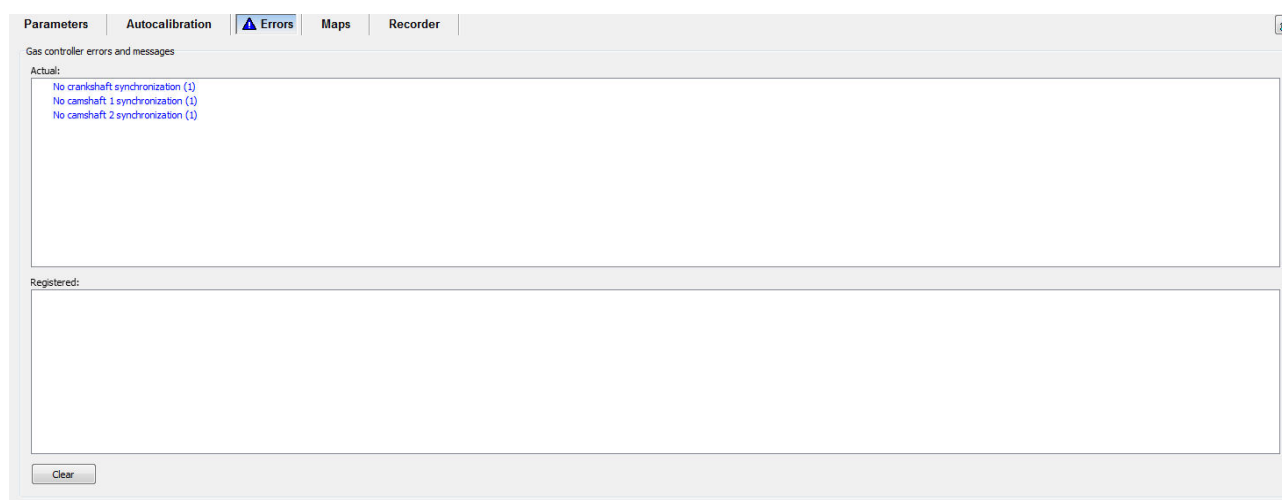


Fig.14. Errors and messages window

System status is continuously monitored by the controller. Upon detection of a condition that disturbs correct operation, the controller informs the fitter about the problem by displaying a respective message in the “Actual errors” section. When the conditions causing such error are eliminated, the error message will be automatically cleared.

The following errors can be reported during operation:

Description in AC STAG application	Meaning
Crankshaft synchronization failure (0)	A curve for the crankshaft position sensor has been loaded, but synchronization fails.
Crankshaft synchronization failure (1)	The controller detects a crankshaft position sensor signal, but it does not receive information on the curve profile (autocalibration has not been performed).
Crankshaft synchronization failure (2)	The controller has not detected crankshaft position sensor signals during engine operation.
Camshaft 1 synchronization failure (0)	A curve for the camshaft 1 position sensor has been loaded, but synchronization fails.
Camshaft 1 synchronization failure (1)	The controller detects a camshaft 1 position sensor signal, but it does not receive information on the curve profile (autocalibration has not been performed).
Camshaft 1 synchronization failure (2)	The controller has not detected camshaft 1 position sensor signals during engine operation.
Camshaft 2 synchronization failure (0)	A curve for the camshaft 2 position sensor has been loaded, but synchronization fails.
Camshaft 2 synchronization failure (1)	The controller detects a camshaft 2 position sensor signal, but it does not receive information on the curve profile (autocalibration has not been performed).
Camshaft 2 synchronization failure (2)	The controller has not detected camshaft 2 position sensor signals during engine operation.
Unstable ignition switch signal	the processor has detected lost ignition switch signals during engine running.
Missing ignition switch signal	Ignition switch signal has not been detected during engine running.
Crankshaft sensor signal disturbance detected	check the ignition system - During operation, the processor has detected temporary disturbances in the crankshaft position sensor signals. The probable cause is wearing of sparkplugs and/or ignition coils.

9.9. Maps

The “Maps” tab displays 3 types of maps used to define the timing advance.

– Timing advance map 2D (absolute):

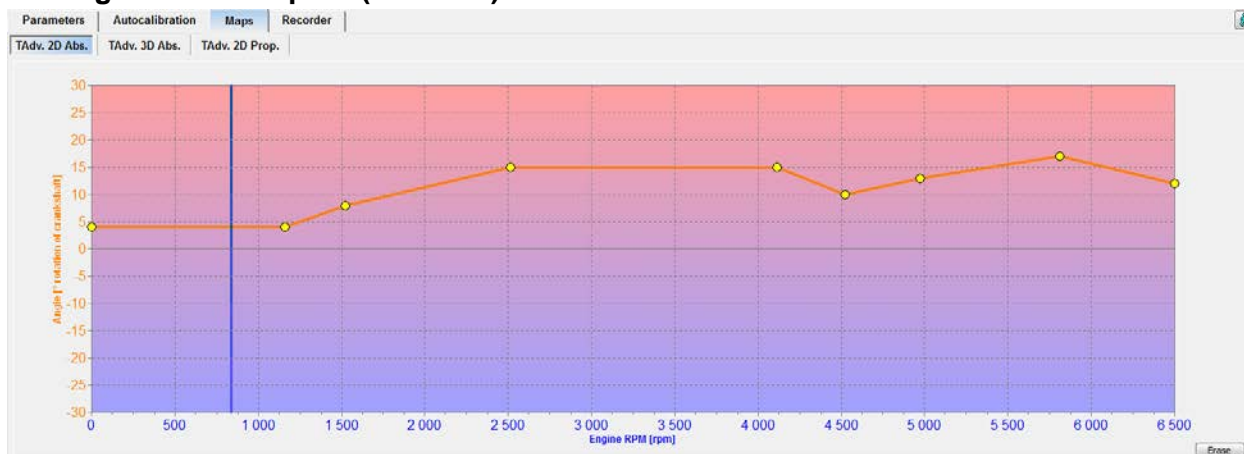


Fig. 15. Timing advance map 2D (absolute)

The 2D map defines the timing advance based on the engine rpm. This is the simplest type of a map. The multiplier is set with yellow curve points on the map. Select a point by clicking and proceed with moving. The value of the selected point is displayed on the right side in the bottom of the map.

To move the points on the map, use the following keys:

- ← - left arrow moves the point to the left (change of the injection time for a given point)
- → - right arrow moves the point to the right (change of the injection time for a given point)
- ↓ - down arrow decreases the multiplier for given injection times
- ↑ - up arrow increases the multiplier for given injection times
- “Insert Insert” (when a point is active) or right mouse button – add a new point
- “Delete” – delete a selected point on the map
- “Page Up” – moving the map curve up
- “Page Down” – moving the map curve down
- “Ctrl” + ← , or “Ctrl” + → change the active point

When the „Shift” key is pressed in, the map movement speed is multiplied by 10 (fast movement). When no point is selected, the ↑ ↓ arrows move the entire map.

– Timing advance map 2D (proportional):

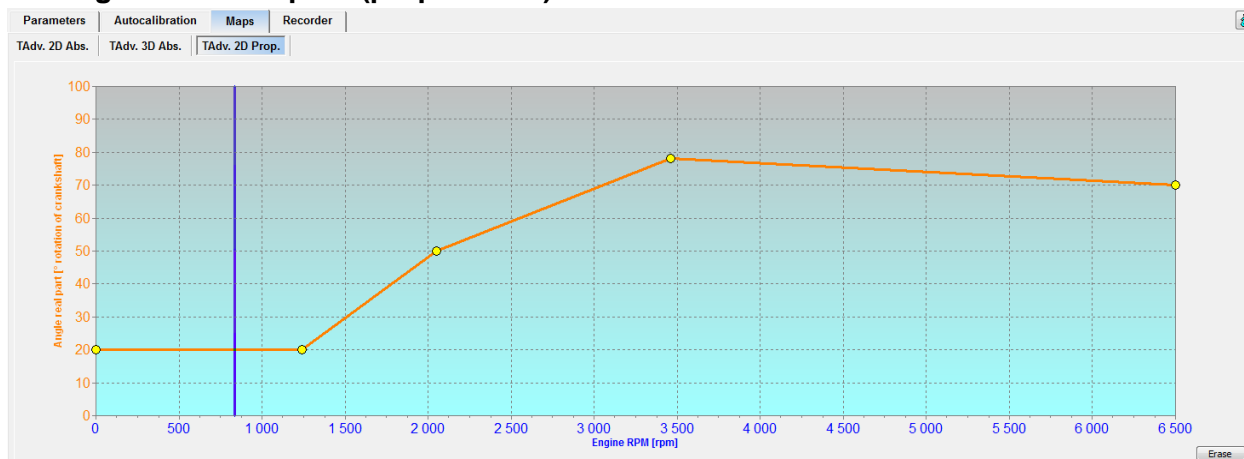


Fig. 16. Timing advance map 2D (proportional)

This 2D map sets the timing advance based on the current reading of the timing advance. The map is used to set the proportion ratio based on the engine speed. Navigation on the map as described above.

– **Timing advance map 3D (absolute):**

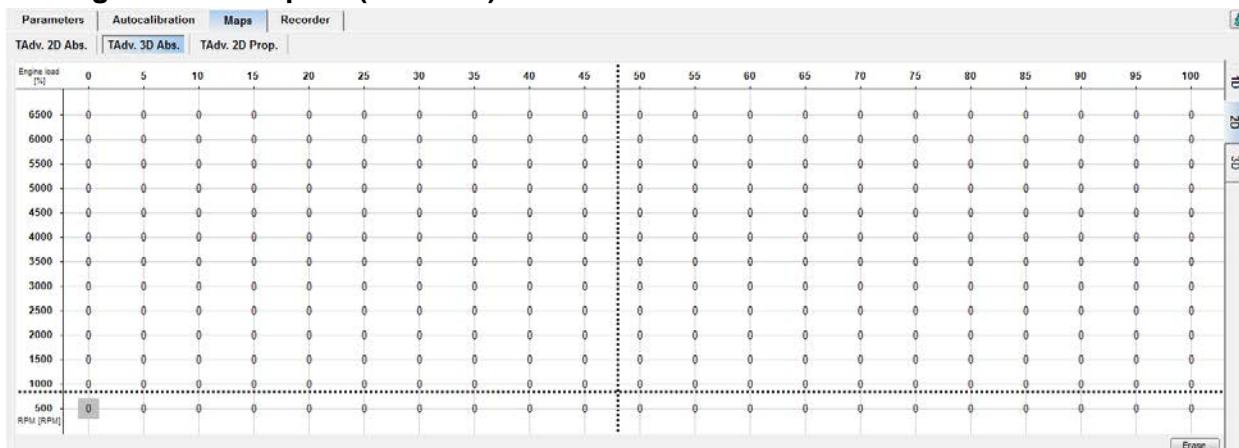


Fig. 17. Timing advance map 3D (absolute)

The Timing advance map 3D forms a plane. One axis of the plane represents engine speed (rpm), while the other represents engine load. This map allows setting the timing advance value for each engine operation curve point.

The cursor shows the point in the engine operating curve. Cursor position depends on the current rpm and engine load values.

In order to change the angle on the map, the area which is to be calibrated must be selected by moving the mouse with the left button pressed over this area. Another method is to press the SHIFT key and, while holding it, to select the appropriate area by pressing arrow keys:

- ← Arrow left
- ↑ Arrow up
- Arrow right
- ↓ Arrow left

Having selected the area which is to be calibrated, specified actions can be performed by using the combination of the CTRL key and one of the keys below:

- ↑ Up arrow (add correction / rich ratio)
- ↓ Down arrow (reduce correction / lean ratio)

Pressing the SHIFT key in the course of the multiplier calibration will multiply the required step by 10.

If full calibration is performed (item 9.6), it is possible to enable autoadaptation option that will automatically enter timing advance (ITA) values on the 3D map.

9.10. Autoadaptation

After full autocalibration, it is possible to enable the autoadaptation option. The autoadaptation configuration window is presented on the figure below.

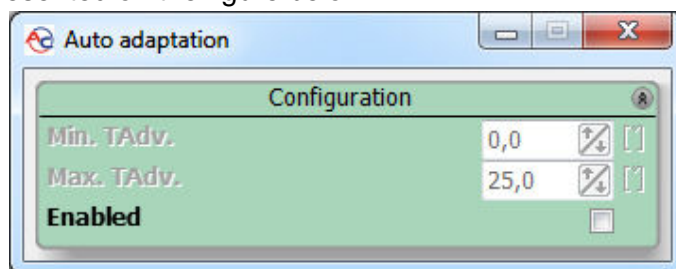


Fig. 18. Autoadaptation option configuration window.

The autoadaptation process enters the timing advance values on the absolute value 3D map, which makes setting TAP operating parameters faster and easier. As a standard, the "3D Absolute" map is fully user-editable, which makes it possible to shift the timing advance for any rotation and load value. With the autoadaptation option, the processor can determine timing advance for individual map cells. It should be noted that completing the 3D map with autoadaptation enabled is started directly after autocalibration and it does not require acquisition of the basic petrol map signals – autoadaptation works when the engine is fuelled with gas. After autoadaptation is enabled, the user can specify the range of timing advance modifications allowed for the autoadaptation (fig. 19).

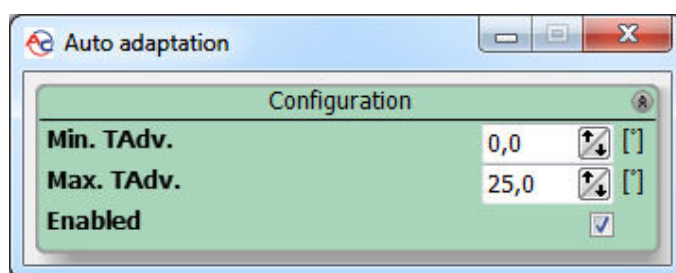


Fig. 19. Active window of autoadaptation configuration.

- Min. TAdv. – minimum ignition timing advance entered to the "3D Absolute" map of the processor
- Max. TAdv. – maximum ignition timing advance entered to the "3D Absolute" map of the processor

It is recommended to leave the default settings of the processor autoadaptation configuration.

After autoadaptation enabling, individual cells of the processor absolute 3D map will be colored as follows.

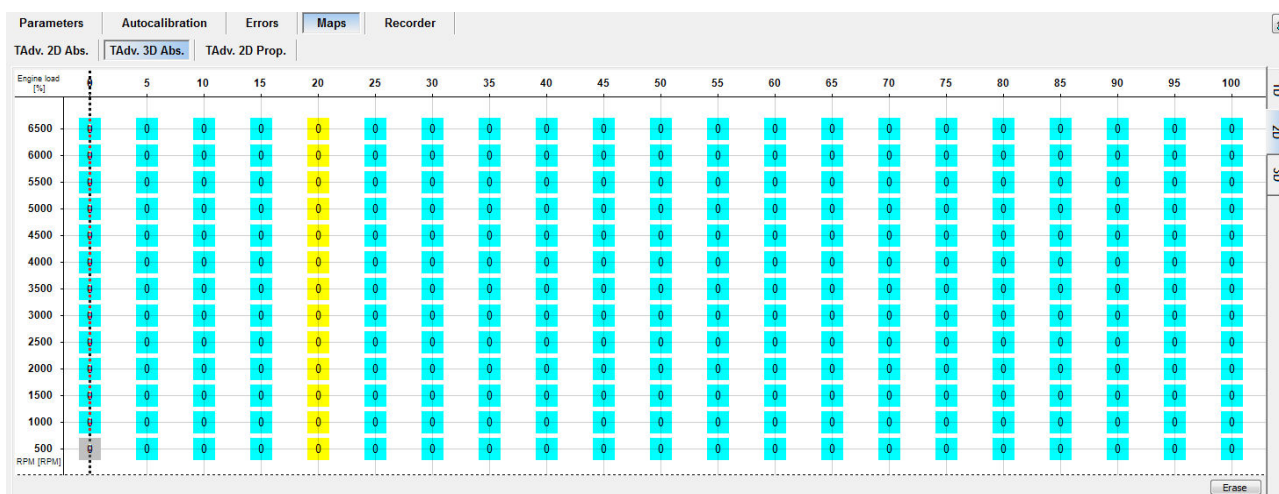


Fig. 20. Absolute 3D map with autoadaptation enabled.

Identification of cell colors:

- Map element from the main column of processor autoadaptation that has not been read.
- Map element from the main column of processor autoadaptation that has been unlocked, but not read.
- Map element that is locked and cannot be currently read, as its corresponding point from the main column has not been read.
- Map element that is unlocked to allow data acquiring (reading).

After autocalibration and selection of map type for generating the shift to the "3D Absolute" map, it must be noted that the ITA value in empty cells (not completed by the autoadaptation) is calculated automatically, proportionally to the settings of the proportional signal source (item 9.4). Before driving, make sure that the engine load and the actual ITA value is displayed by the processor correctly. After making sure that the signals read by the processor are correct, perform the test drive.

During the test drive, adjust the speed and load so that the points from the main column - yellow - are read first, as this column unlocks further adaptation of lines on the 3D map (fig. 21).

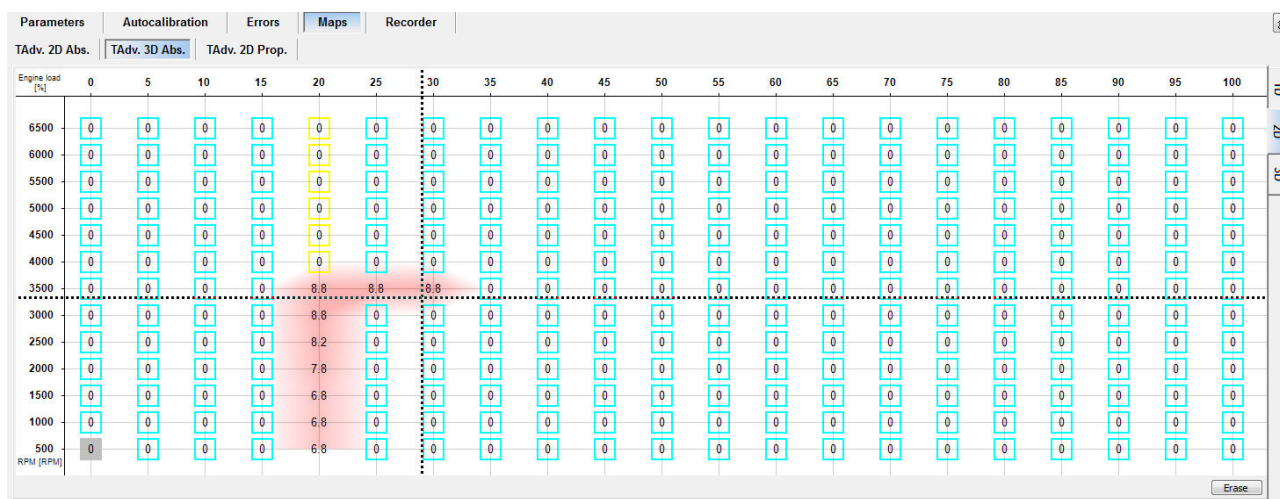


Fig. 21. Absolute 3D map after reading the basic points of the processor main column.

After reading the basic points from the processor main column, autoadaptation is able to complete all elements of the "3D Absolute" map. On this stage, ITA value adjustments on the "3D Absolute" map are handled by the autoadaptation. Autoadaptation results in an LPG-fueled engine are presented below.

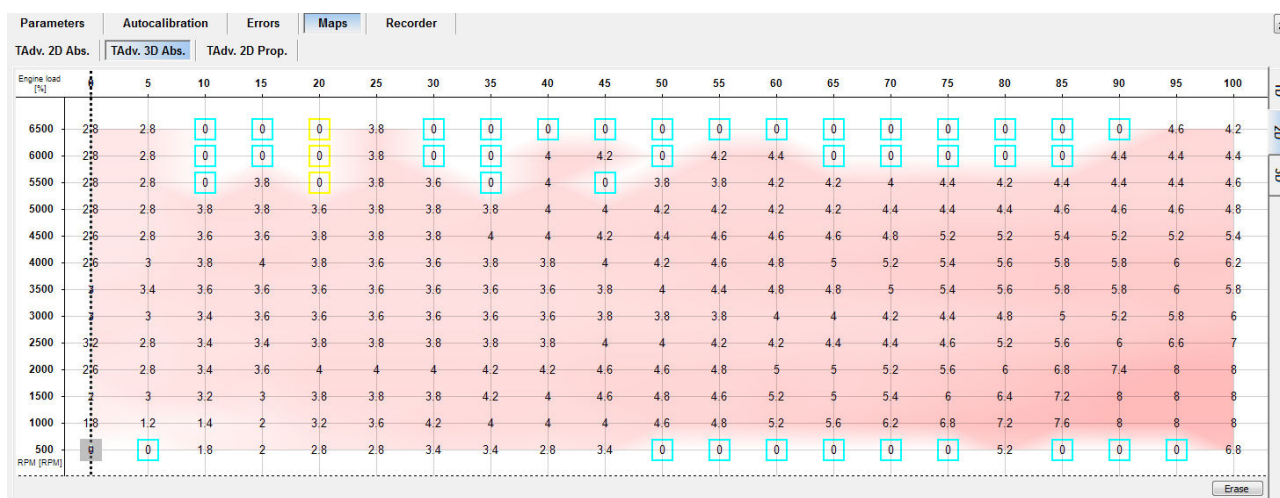


Fig. 22. Autoadaptation results on the "3D Absolute" map.

At any moment during processor operation, adaptation of selected cells can be locked for manual ITA configuration. Cell-specific adaptation locking is performed when adaptation is disabled:

- Check the cells to be locked on the "3D Absolute" map.
- Right-click and select the "Lock adaptation" option.

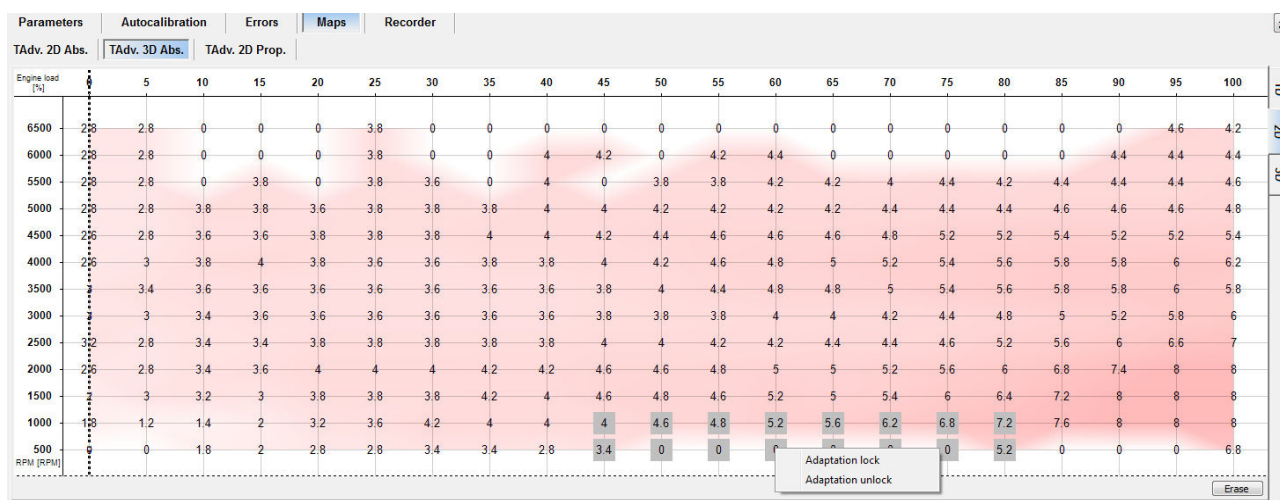


Fig. 23. Adaptation locking in selected cells of the "3D Absolute" map.

When adaptation is re-enabled, the locked cells will be grayed-out and excluded during adaptation (figure below).

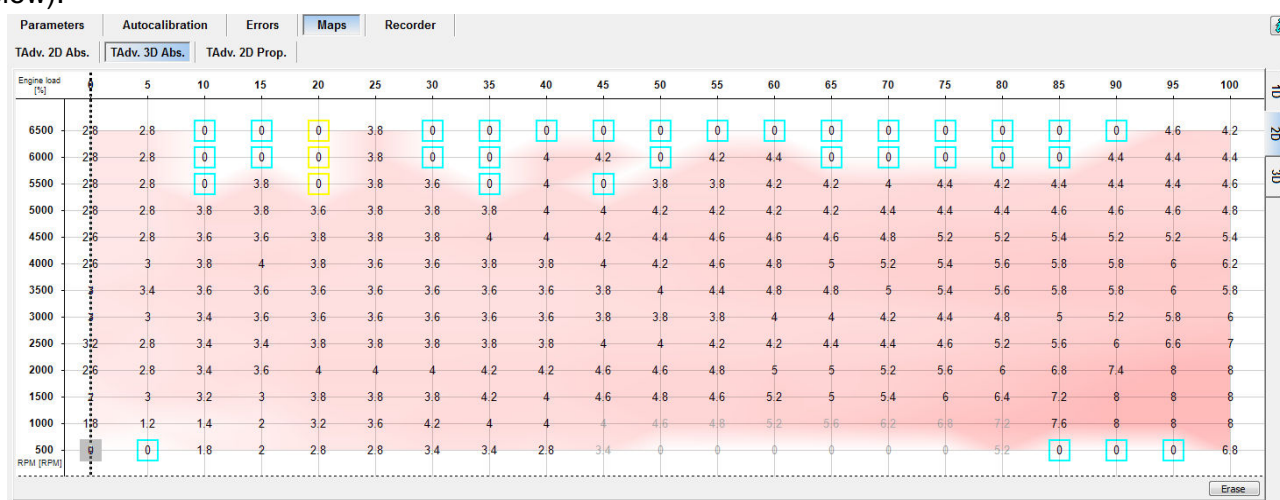


Fig. 24. Locked cells of the "3D Absolute" map with autoadaptation enabled.

9.11. Program settings menu.

In the "Tools" – "Program settings" menu, the user can define the port used for communication with AC Stag application, type of map and oscilloscope display lines.

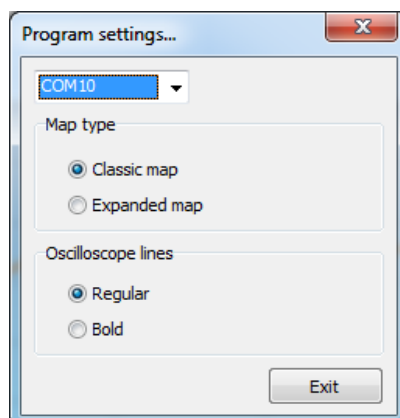


Fig. 25. Program settings menu

9.12. Controller update

In order to update the controller, connect the controller with the application and stop the engine. Select “Tools” – “Devices update” from the main menu. The application automatically searches for the available devices. A window for “Devices update” is displayed. “Devices parameters” window shows the information about the controller firmware version. “Available updates” window shows the list of available updates for the connected controller. To load an update file from a folder, press the “Read Update” button and browse for the file. The loaded update file will be added to the list of available updates. Select the update from the list and press “Update”. When the progress bar reaches 100 %, the controller will be disconnected for a while and then reconnected. On the bottom of the screen, the new firmware version number should refer to the loaded update file.

If an error occurs when connecting with the controller after an update, the update window will be displayed automatically. Repeat the update procedure.

10. Technical specification:

Supply voltage	12[V] -20% ÷ +30%
Maximum supply current	<200mA
Stand-by mode current consumption	<10mA
Working temperature	-40°C ÷ 110°C
Protection class	IP53

11. Warranty / exclusions

The warranty does not cover:

1. Damage resulting from the failure to follow the applicable wiring diagram.
 - particularly connection of signal wires in non-approved locations.
2. Defects resulting from the fitting in non-approved locations and positions exposed to moisture, high temperature and battery vapors.
3. Non-authorized modifications or attempted repairs.
4. Mechanical defects caused by the customer, in particular:
 - damaged connections,
 - connection defects caused by the use of chemical cleaning products,
 - housing damage,
 - electronic board damage.
5. Electrical defect resulting from the failure to follow the instructions for communication interfaces.