# Electric Diesel Injection Analyzer

# EDIA-PRO

**User manual**


DeltaTech Electronics ®

# Table of contents

## Contents of included software package

The software can be downloaded at:

https://dte.com.pl/download/software/ediapro/

| ***Folder*** | ***Items*** |
|---|---|
| *Manual* | Manual in PDF. |
| *Examples* | Waveform interpretation guides,<br>Example waveforms |
| *Driver* | Device driver |
| *Sys* | EDIA-PRO software installer. |

## Registration

If you want to receive free updates and additional materials concerning EDIA-PRO – register by sending us the following data:

- company name
- address
- phone number
- serial number (if it is present – see sticker under the device)

at the registration e-mail: *edia-pro@dte.com.pl*. Use this address also if you have any technical questions about the EDIA-PRO system.

# 1 Introduction

EDIA-PRO Analyzer is designed for quick, non-invasive diagnosis of Common Rail systems. Connected to computer with USB port allows measuring waveforms of four injectors current changes and rail fuel pressure.

Recorded waveforms can be used for accurate diagnosis and failure detection of injectors, sensors, high pressure pump and other components of Common Rail system.

With innovative probes it is possible to track injection signal with minimum interference, without removing the injectors or damaging wire insulation.

EDIA-PRO allows accurate measurement of injection signal times for four injectors at the time and enables to precisely observe rail pressure changes caused by working injectors. This gives very good diagnostic capabilities. An important advantage of the analyzer is small size and simplicity of use.

Guidelines on waveform interpretation can be found on the included CD in *Examples* folder.

# 2 EDIA-PRO analyzer requirements

For proper operation of the device and PC software the following conditions should be met:

- minimum 1GHz processor
- minimum 1024x600 screen resolution.
- Windows 7/8/8.1/10/11 (32 or 64-bit) operating system
- 512 MB RAM
- 15 MB hard drive space
- USB 1.1/2.0 port
- CD-ROM drive (for software installation)

# 3 Software installation

After decompressing software package run *Start.exe* from the main folder.
Click *Install* button to run the installer. Please follow the instructions on the screen – accept the license agreement, select destination folder and specify whether you want to create desktop icon. Click *Next* each time to go to a next step. The successful installation is confirmed by the message.

## 3.1 EDIA-PRO program installation

- After inserting the CD into the drive the installation program window should appear (if not, run *Start.exe* from the CD-ROM (or from other location that contains installation files).

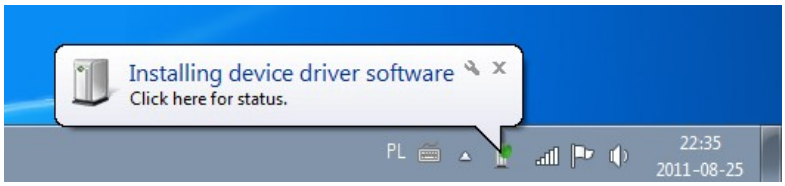
- After clicking *Install,* a dialog will appear – click *Yes* to continue.

- After clicking *Yes* the installation wizard will pop up. In the next steps you must accept the license agreement, specify the destination folder, and choose whether you want to create a desktop icon. Each wizard step should be confirmed by clicking *Next*.

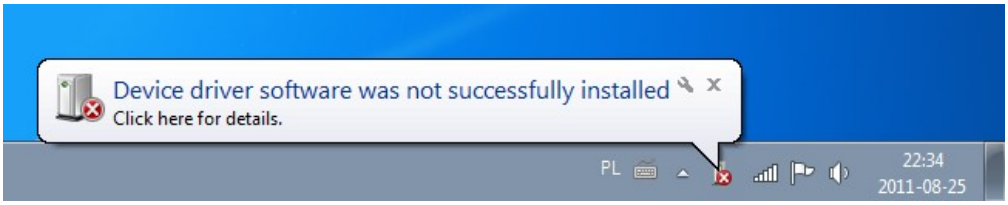
## 3.2 Driver installation (Windows 7)

**Warning!**
Users of 64-bit versions of Windows should make additional step before proceeding. Restart system and press F8 ahead of system loading begins. On the list that should appear select *Disable Driver Signature Enforcement* and press ENTER. Then perform the following steps just as in case of 32-bit version of operating system.

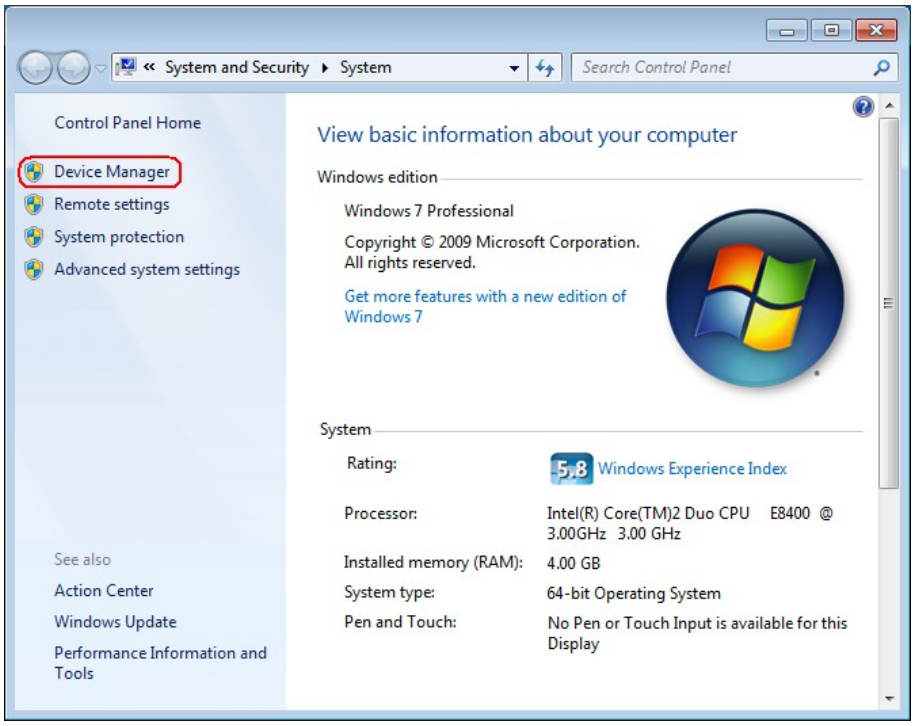
Connect the device to the USB port. Notification will appear in the lower right corner of the screen.



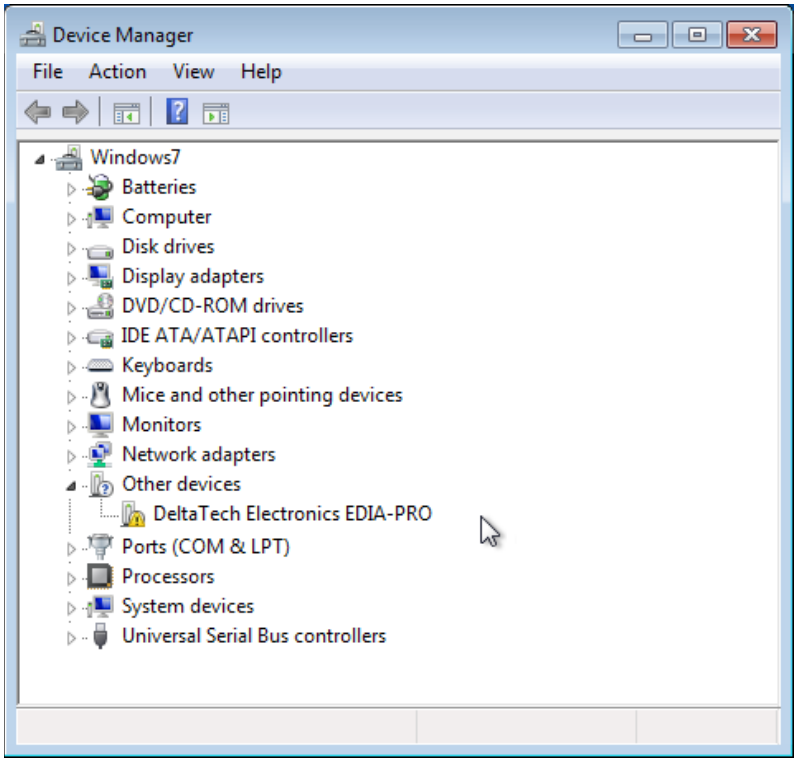

After a while the warning will display as the driver will not install automatically:




Right-click the *Computer*:

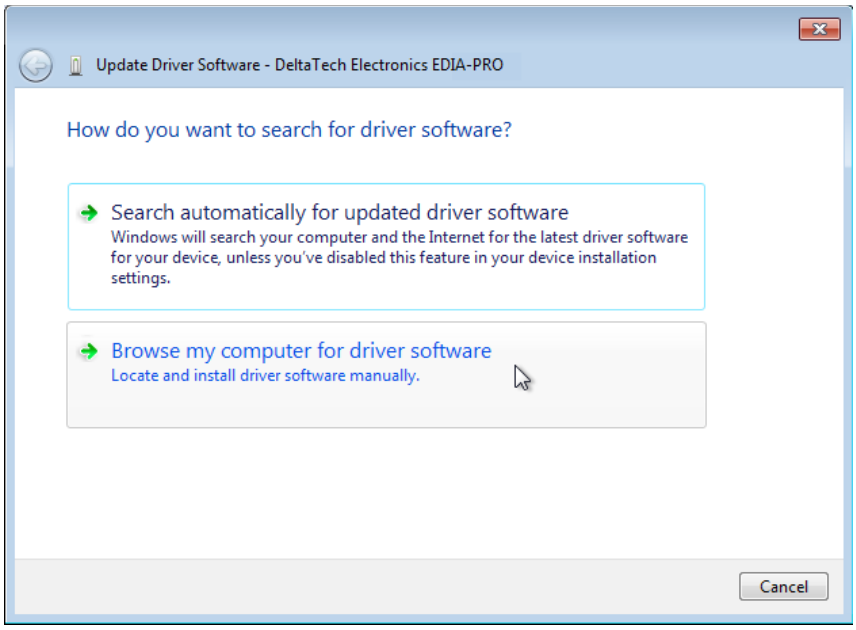



Click *Device manager*, this will invoke the list of devices. Among others there should be *DeltaTech Electronics EDIA-PRO* on the list.

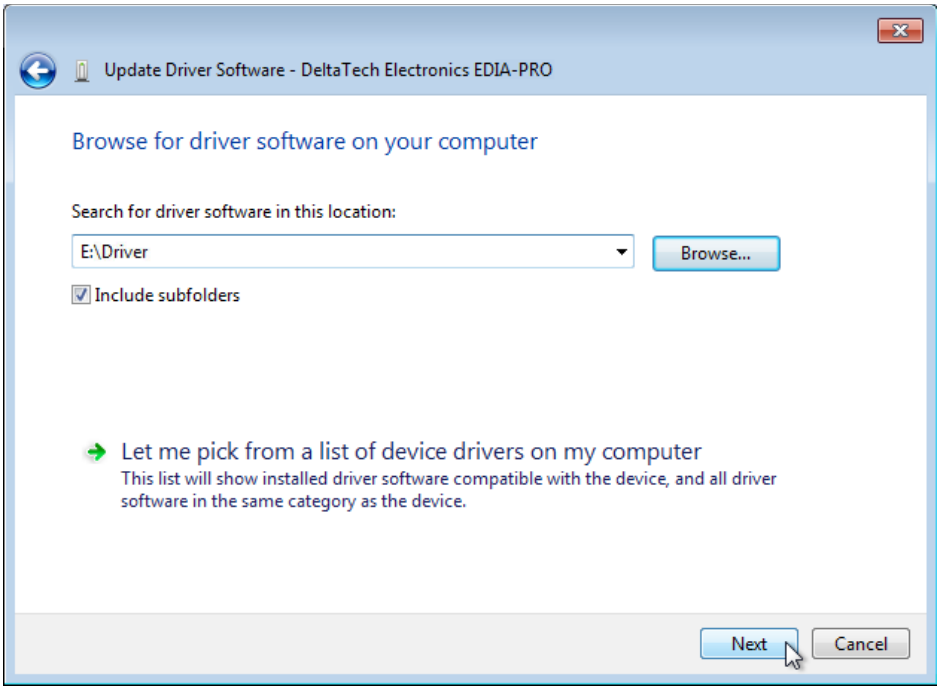



Right-click *DeltaTech Electronics EDIA-PRO* and select *Update device driver* from the pop-

up menu. The following window will appear:

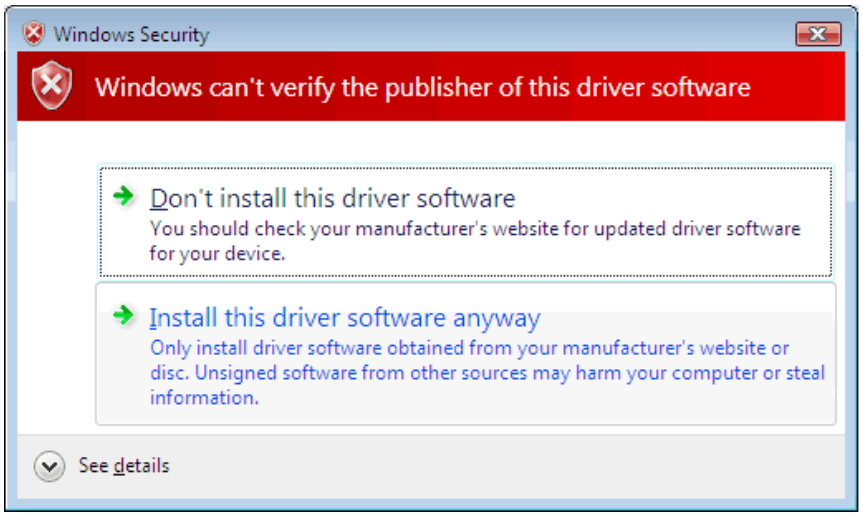



Choose *Browse my computer for driver software* and specify driver path:




Select *Driver* folder on the installation folder (drive letter may differ) and click *Next*.

The system will display untrusted publisher warning:




Select *Install this driver software anyway.*

After a while installation should be completed: *Windows has successfully updated your driver software*.

## 3.3. Driver installation (Windows 8/8.1/10)

To install driver properly in Windows 8/8.1/10 64 bit, it is necessary to start the computer in special mode.
Perform the following steps:

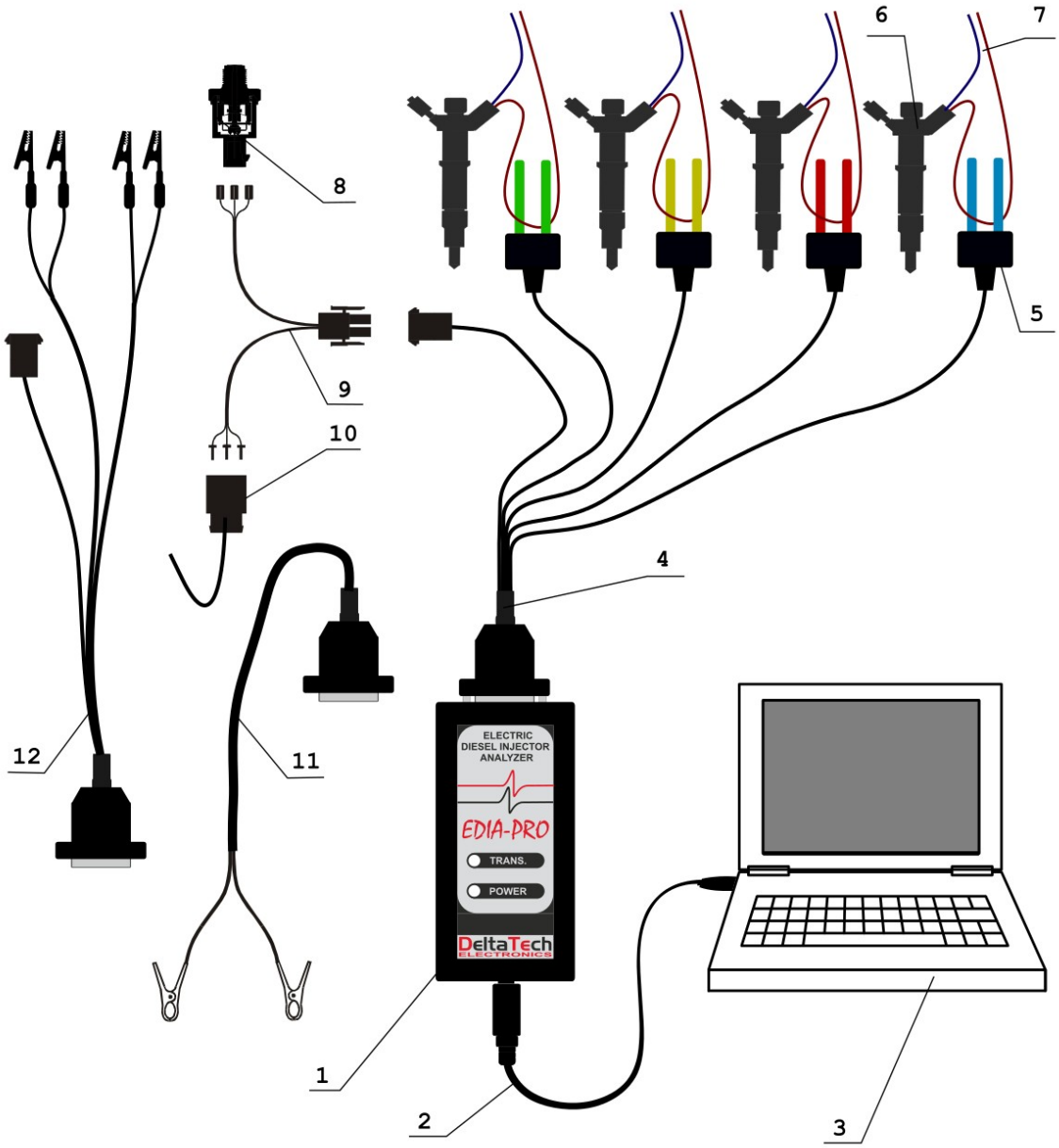
1. Display power options:
    1. Windows 8/8.1: Move cursor over the top or bottom right corer of the screen and the Charm Bar will appear. Click *Settings* (gear icon) and then click *Power*.
    2. Windows 10: Click *Menu Start* and then *Power*.
2. While holding *SHIFT* key click *Restart* button.
3. When an option screen will display, click *Troubleshoot*, then *Advanced options*, and then, *Startup settings*.
4. The system will display list of options available. Click *Restart*.
5. System will restart into startup settings mode. On the list displayed select number 7 (Disable driver signature enforcement) by pressing F7 key.

After performing all the steps run Device manager. The fastest way to do this is to press *WinKey + X* on the keyboard and select *Device manager*.

After opening device manager proceed as in Windows 7 (see previous section of this Manual).

# 4 Connecting the device

The device set up is shown in Figure 4.1:




1 - EDIA-PRO device
2 - USB cable
3 - computer
4 - probe cables
5 - injector probe
6 - injector
7 - injector wires
8 - rail pressure sensor
9 - pressure sensor cable
10 - pressure sensor car plug
11 - voltage and compression ratio measurement cable
12 - cable for measuring control valves signal

*Figure 4.1. Device connection diagram*

## 4.1 Connecting to PC computer

EDIA-PRO analyzer is connected to PC computer using provided USB cable (standard USB A-B cable). The device is powered directly from USB port.

**Warning! During measurement the computer running EDIA-PRO software should not be powered by tested car electrical system. This may lead to erroneous pressure readings. If using laptop computer we suggest disconnecting it from a power supply during measurement (when possible).**

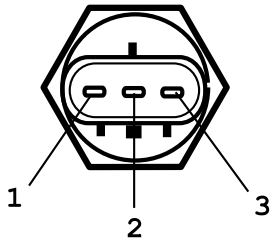
**Pressure waveform in unfavorable conditions may be susceptible to harmful mains interference. In such situation appropriate warning should appear after the measurement.**

## 4.2 Connecting to a Common Rail system

### 4.2.1 Connecting pressure sensor

Most high pressure sensors require connecting three signals:
- GND,
- sensor output,
- +5V power supply

The device is connected to the pressure sensor in the way that provide parallel connection to the engine controller unit (otherwise the ECU will not allow engine to start and will generate error codes). The analyzer can be wired to the pressure sensor using adapters or universal cable (provided). The sensor must be connected carefully to avoid short circuit or reversing cables.

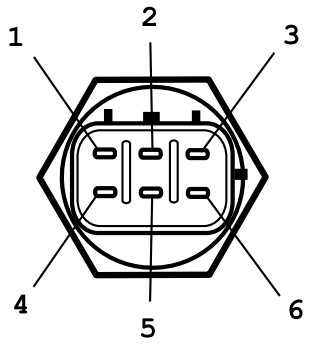



There are two most common variants of signals distribution in the sensor connector. These variants are presented in the table below:

*Table 4.1*

| signal name | wire color | pin number, variant 1 | pin number, variant 2 |
|---|---|---|---|
| GND | brown | 1 | 1 |
| output | yellow/green | 2 | 3 |
| +5V | blue | 3 | 2 |

Some of the Denso Common Rail pressure sensors have six terminals. These sensors have doubled measuring units.




| pin number | signal name |
|---|---|
| 1 | ground 2 |
| 2 | output 2 |
| 3 | power supply 2 |
| 4 | power supply 1 |
| 5 | output 1 |
| 6 | ground 1 |

The two signals (output 1 and output 2) should differ by 0.5V. To get correct pressure reading specify correct variant: *Denso* or *Denso-2*

To identify signal range of doubled Denso sensor make the first measurement with engine stopped, enabled ignition, and *Denso* sensor selected. If measured waveform is moved by one line from zero (about 31,3 MPa) select *Denso-2* pressure sensor.

Always check pinout variant of the sensor in the service manual provided by the sensor manufacturer. Incorrect wiring or short circuit may cause damage to the sensor and engine controller.

### 4.2.2 Injectors

Four provided probes allow observing changes of current in injector circuits. These probes should be placed on one of two cables connecting the injector to ECU. The most convenient way is to slide the shield and push the probe between wires so that on wire is located between two rods sticking out of probe. Correct probe placement is depicted in Figure 4.3.

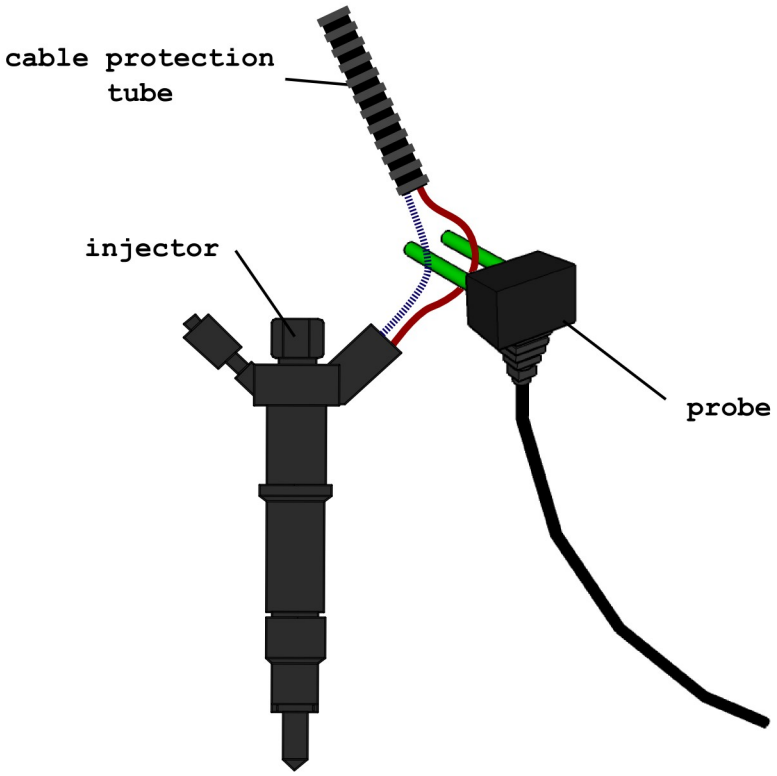



*Figure 4.3. Injector probe placement*

Probes need to be safely placed, possibly deep, the same wire color and the same position in all cases. If the probe is mounted as in figure above: on the positive wire, the recorded waveforms will have proper polarity. The probes can be also placed on the wires near ECU if injector access is difficult.

If all or some of the waveforms are reversed after the measurement, reverse the corresponding probes.

Color coding allow for differentiating the waveforms on the common graph. The recommended probe mounting sequence corresponds with injector numbers in PC program.

1. Green
2. Yellow
3. Red
4. Blue

When examining Common Rail system with greater number of injectors (eg 8), the test can be performed in two steps. Please note that this make some parameters of *Automatic analysis are* not valid in this situation.

Always place the probes carefully, without the use of force. Careless handling may cause probe damage.

Recorded waveforms of current change for electromagnetic injectors are similar to voltage waveforms. This is a result of injector coil inductance according to the following dependence: $\varepsilon = -L\frac{di}{dt}$ .

### 4.2.3 Car battery

When it is necessary to use *Compression analysis* or *Battery & alternator analysis* connect EDIA-PRO device to car battery using dedicated cable with crocodile clips included.

### 4.2.4 Control valves (DRV, SCV)

To be able to measure DRV and SCV control signals use measurement cable with banana connectors / crocodile clips and pressure adapter connector. One or both of channels can be used. First channel is marked with green band, the second with yellow. It in not needed to observe polarity (+/-). The program will automatically recognize control signal as a PWM duty cycle. Use pressure sensor adapter as described in 4.2.1.

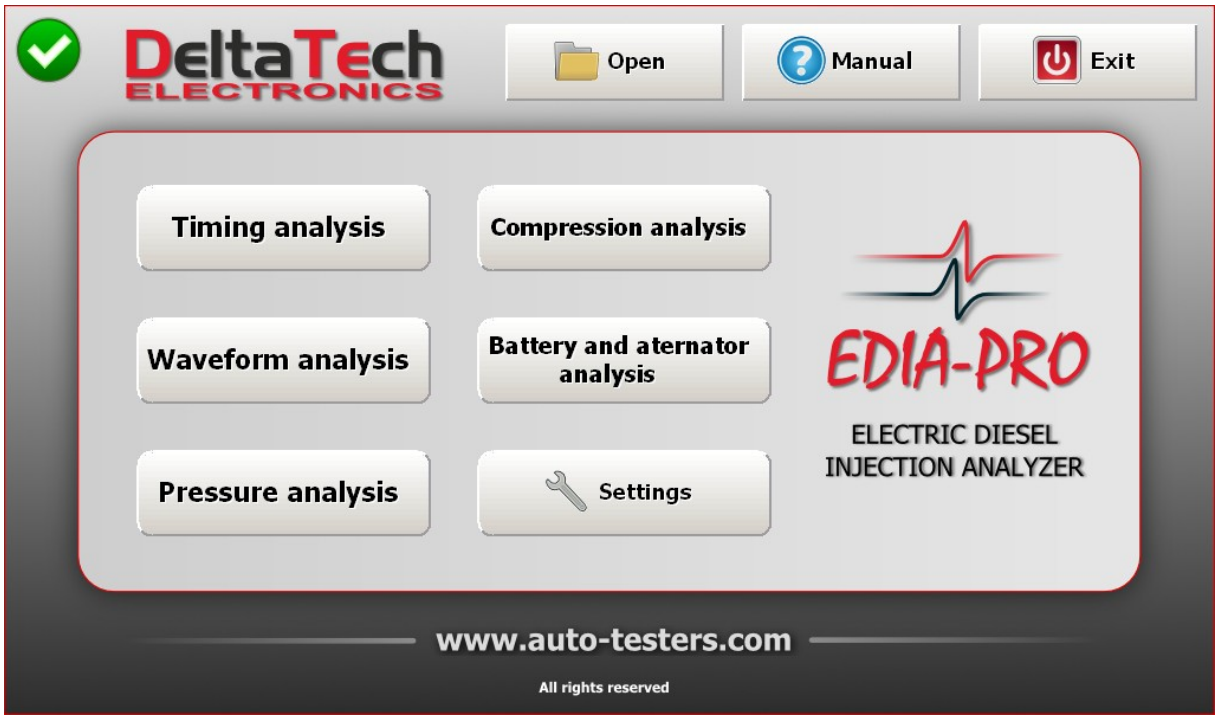
# 5 Operating EDIA-PRO software

Working with the is based on working with the EDIA-PRO software installed on the computer. Application window has size of 1024x600 so it is convenient to use it not only on desktop PC, but also on laptop, netbook or tablet (with Windows operating system). For the program window to display correctly we suggest using default system font size.

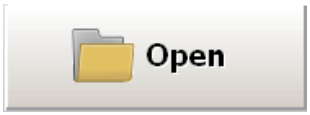
Before running the program and making any measurements it is recommended to close all unnecessary applications.

There are five operating modes available: *Timing analysis*, *Waveform analysis*, *Pressure analysis*, *Compression analysis* and *Battery and alternator analysis*.

View of the main window is shown below:




Description of individual buttons:




Enables opening the recorded waveform saved to file.


Invokes this manual in PDF format (Adobe Reader required).


Closes application.


Starts *timing analysis* mode – simultaneous recording of four injection waveforms and rail pressure. This is the main program operating mode.


Starts *waveform analysis* – records independently four injection waveforms with maximum speed and displays on the common graph. This enables visual comparison of waveforms and timings of injection signals.

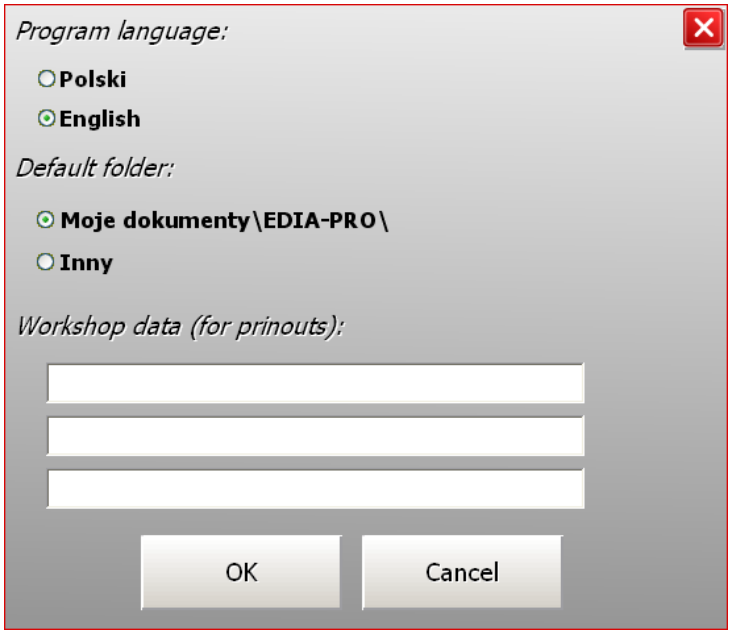

This mode records pressure waveform with optional control valve signals with reduced sample speed. The program can record up to 10 minutes of continuous waveform.


Enables relative cylinder compression measurements.


Starts voltage measurement mode – enables recording up to 120 seconds of continuous waveform for diagnosis of electric system.


Settings button allows the user to set the following: program language, default folder and workshop data.

After clicking *Settings* the following window will appear:




When selecting default folder the user may choose between EDIA-PRO folder in Documents folder or any other location. To select different folder click *Other* and select another location. Confirm settings by clicking OK.

*Workshop data* fields can be used to place any contact data such ass address, phone, email that will be placed on all printouts.

During program operation in the upper left corner of the window there is an indicator showing

device connection status.

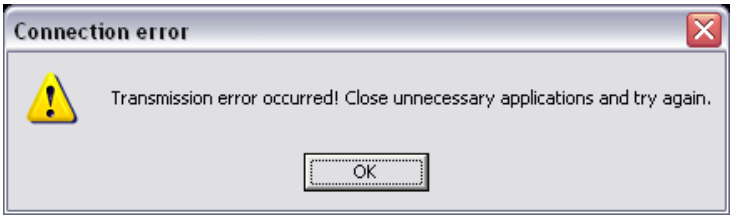
Indicates correct connection. The EDIA-PRO device is ready to transmit data.

Indicates no connection. Check whether the device is correctly connected to the USB port (the POWER indicator should light up) and the drivers are properly installed. If the problem persists – disconnect and reconnect the device.

When trying to start the measurement without device connected the application will display error message:


If the device is properly connected to USB port, the *POWER* indicator is active and the drivers are installed, and the device still fails to run, please disconnect and then reconnect the device.

If computer is under heavy load due to other applications using USB transfer or having high CPU usage an transmission error may occur. If this happen the error message will pop up:

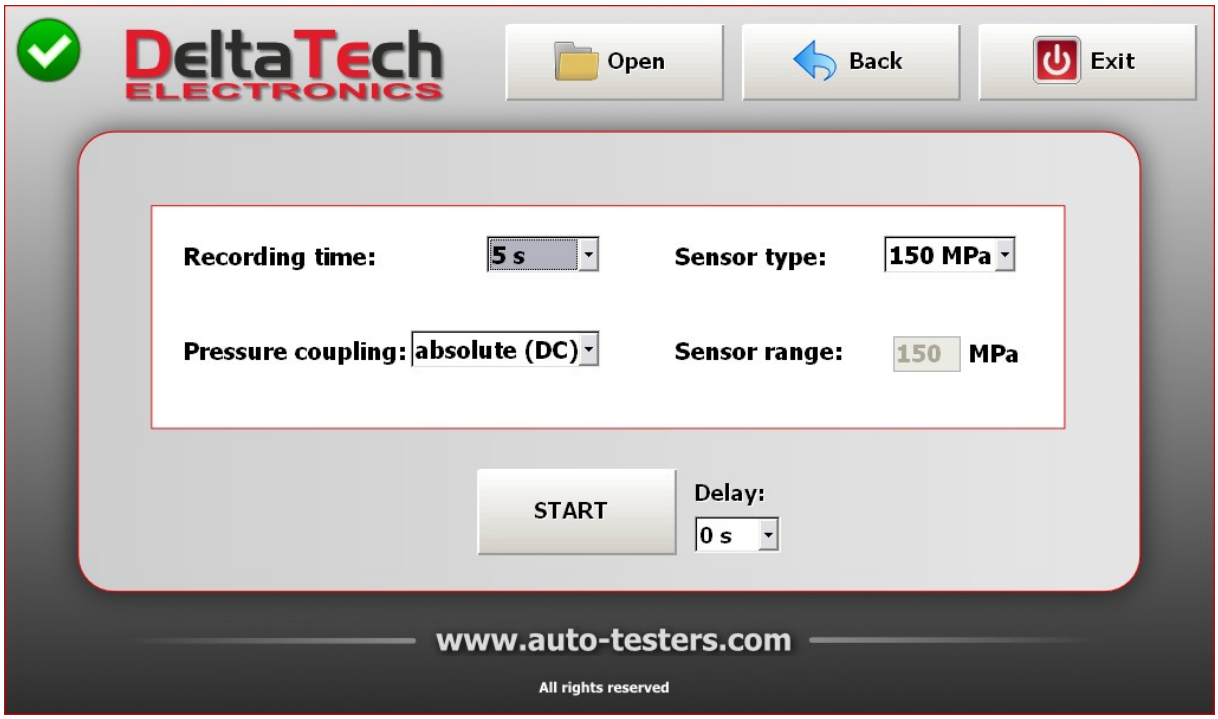



Please make sure that all unnecessary application are closed.

## 5.1 Timing analysis

This is the main device mode – it enables simultaneous recording of 5 signals: 4 injector probe signals and rail pressure. Duration of measurement can be set to one of predefined values from 1 to 15 seconds. The user may select between pressure DC input coupling (real pressure value) or pressure AC input coupling (enables easier observation of small pressure fluctuations).

After clicking '*Timing analysis*' the parameters screen will appear where user can select required options before running the measurement.




The user can select between the following presets:

**Recording time:** *1 s*, *2 s* , *5 s* (default), *10 s* or *15 s*.

This enables selecting measurement duration. The recorded waveforms can be fully viewed or/and saved to file.

**Pressure coupling**: *absolute* (default) or *pulsation (AC)*

Default setting is *absolute* (DC) pressure input measurement. The voltage values are converted to pressure according to selected type of sensor. The measurement covers the entire range of the rail pressure sensor. The user will be able to scale the graph so that even small changes in narrow range of pressure will be revealed..
In *pulsation (AC)* mode the device filters the DC component and displays only variations in pressure value. Slower changes, such as those associated with moderate increasing or decreasing engine speed are also filtered out. The waveform is extra amplified to enhance small fluctuations. This mode allows quick visualize of the pressure drop caused by injection – without having to scale the graph.

**Sensor type**: *14 MPa, 25 MPa, 150 MPa* (default), *180 MPa*, 200 *MPa*
*250 MPa*, *Denso*, *Denso-2*, *Other.*

Select the type of sensor that matches with the sensor fitted in car. In the case of the most

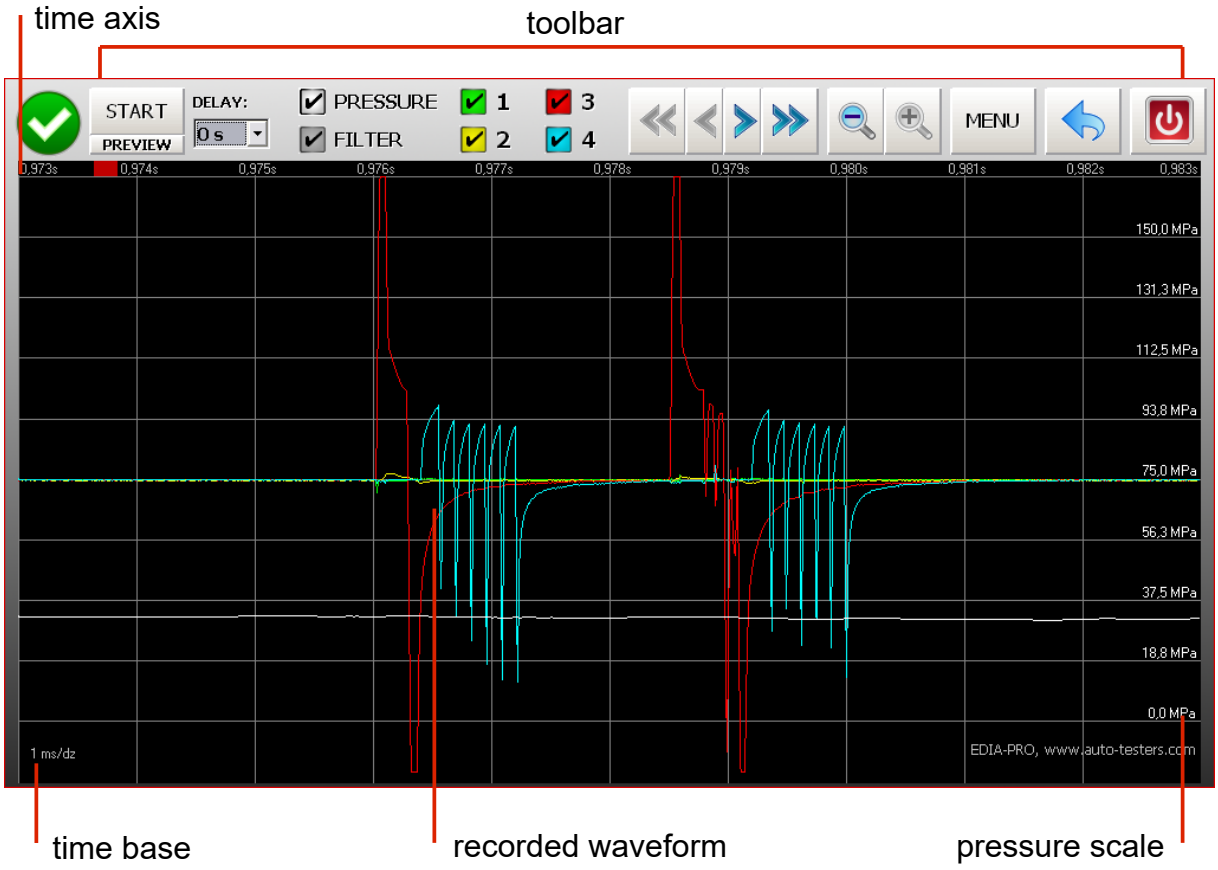
common sensors (BOSCH, SIEMENS) the user need to specify the maximum pressure value selecting it from the list. If the given sensor has different maximum value, select *Other* and manually enter the maximum value of the sensor (in MPa) in the *Sensor range* field. The correct choice of sensor type allows accurate measurements of pressure.

After clicking ***START*** button the program starts measurements in *Timing analysis* mode.

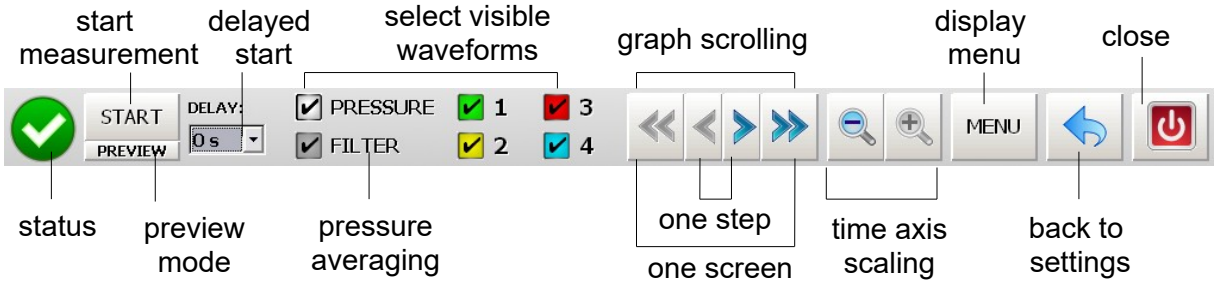
*Delay* value allows delayed measurement. The user can select required delay from list: *3 s*, *5 s*, or *10 s*. Selecting '*0 s*' means starting the measurement immediately after clicking *START*.

*Back* enables returning to main program screen.

'Timing analysis' mode window:




The following description discusses window control elements:



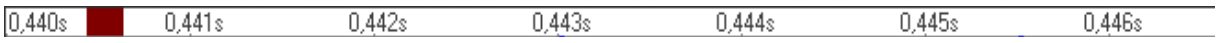

S*TART* button starts measurement. Ongoing recording can be stopped by clicking *ABORT* button displayed during the measurement:


When the measurement is complete, the user may browse the result.

If new recorded data is not saved yet, the floppy symbol will appear under the *MENU* button:


Clicking this symbol opens file save window.

Use arrow buttons to move the waveforms. Single arrow moves the graph by one step and the double arrow by one screen. Holding down one of the arrow buttons allows quickly moving the graph.The graph can be moved also by placing the cursor on the time axis and using the mouse to drag.




Red rectangle on the time axis indicates current view location in relation to whole file.

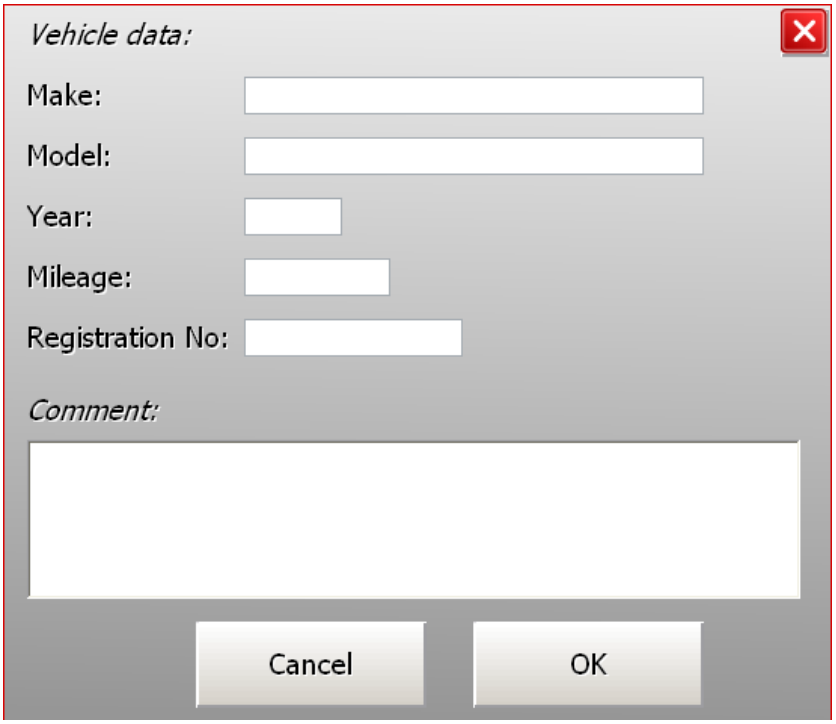
With the help of a magnifying glass buttons, you can scale the time axis. By default, the time base is 1 ms/div. Clicking the '-' makes a longer piece of waveform appear on the graph. The '+' button increases accuracy and lowers time base. The time base can be set in range from 1 ms to 30 ms/div.

By right-clicking one of the zoom buttons the user will display *Zoom range* slider. This slider

enables fast adjustment of displayed time base.


***MENU*** button displays list of available commands.

***Comment*** – allows adding or displaying a comment which will be included in file. In addition the vehicle data can also be saved. This data will appear both in file and on the printouts. After clicking *Comment* button the following window will appear:




After making required changes confirm changes using *OK*. We suggest placing in comment such data as time values corresponding to interesting phenomena (eg, lack of expected injection). This will greatly simplify the subsequent search after opening the file.

***Save*** – enables storing the measurement data in file. The file save window will open. After specifying file name and optionally changing file destination, click 'Save' to save the file.

Each data file is stored along with graph position at the time of saving the file. When opening the file, the graph is automatically restored to that position.

***Open*** – opens measurement data file. The file selection window will appear. Select the file to open and click *Open*.

***Save screen (bitmap)*** – saves application window contents as a bitmap. After selecting this command the file save window will appear. Bitmap files are saved in BMP format.

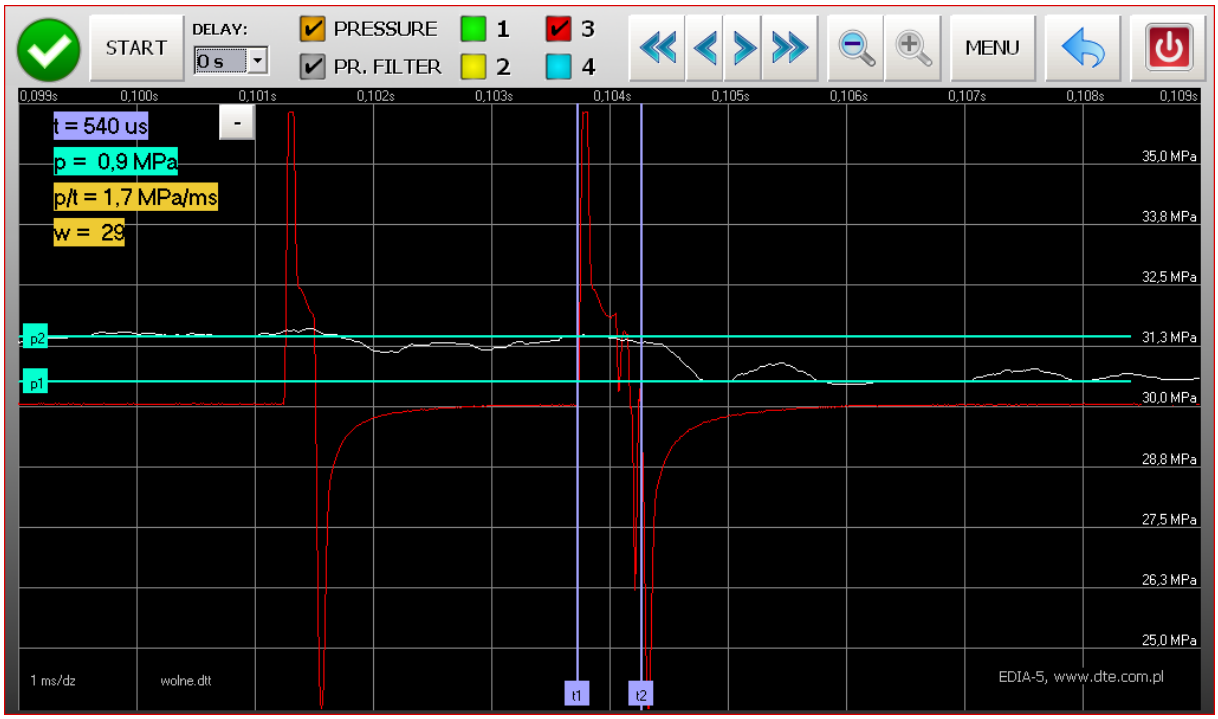
***Print*** – allows printing the graph. When clicked, the two buttons will appear that enables black-white or color printing:


After selecting one of two options, the print dialog will show up. Printed graph will have white background instead of black (to save printer ink or toner).

After clicking *OK* the contents of application window along with the graph will be printed on selected printer.

***Measurements*** – this function allows to measure the waveform values on the chart with markers moved by a mouse. In the upper left of the graph there are values that displays the difference between two sliders. To hide the markers click the *MENU>Measurements* command again.


If *t1* and *t2* markers indicates injection time and *p1* and *p2* pressure drop after injection then additional injection parameters can be displayed. To do this click '+' button and additional labels should appear.

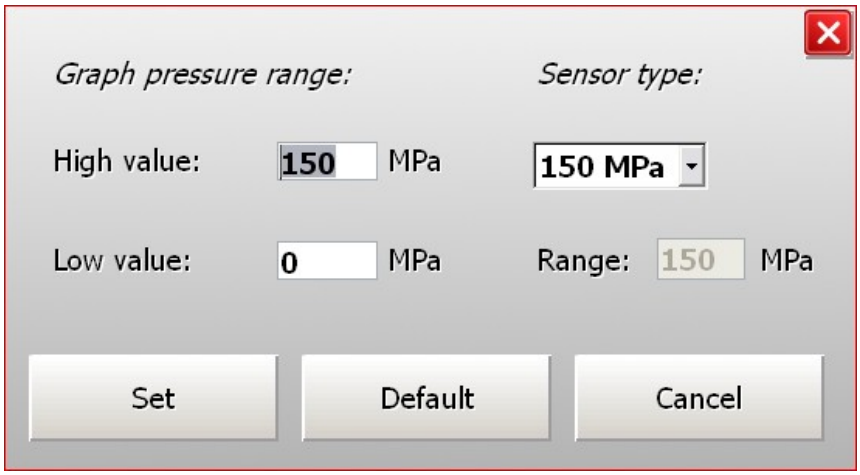



The first, *p/t* means pressure drop speed during injection, and the second – *w* is fuel expense

during injection in arbitrary units. Fuel expense means sum of fuel dose and leak from injector during the injection. This vales can help in comparing different injectors performance, but to make them reliable the user should average a few measurements.

To measure the absolute pressure value set the first slider (p1) on 0 MPa line, and the second (p2) in a required position (see above).

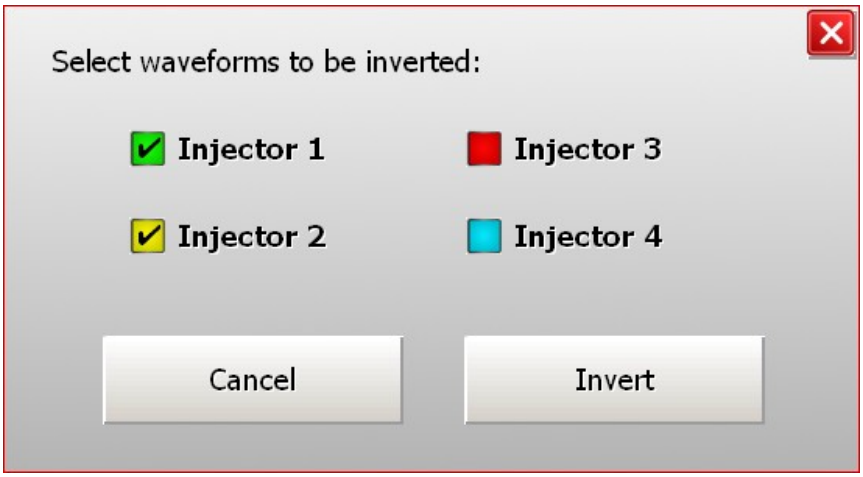
***Pressure range*** – offers scaling of the graph so that only certain range of pressure is visible. .




Specify low and high value and click *Set* to scale the graph. By selecting appropriate values it is possible to visualize even small variations in pressure such as those associated with single injections. Both the low and the high values can be set to integer values only.
If the current value of the pressure waveform is outside of specified range, there will be visible horizontal line only on the top or at the bottom of the graph. The user can return to default pressure sensor range at any time by selecting *Default*.
In the right part of the dialog a type of pressure sensor can be specified. This allow changing pressure sensor type after the measurement. To made changes click *Set*.

Setting pressure range is very helpful in determining the rail pressure drop delay or reading the pressure drop value after each injection..

**Invert waveforms** – enables inverting one or more waveforms if one or more injector probes was placed incorrectly.



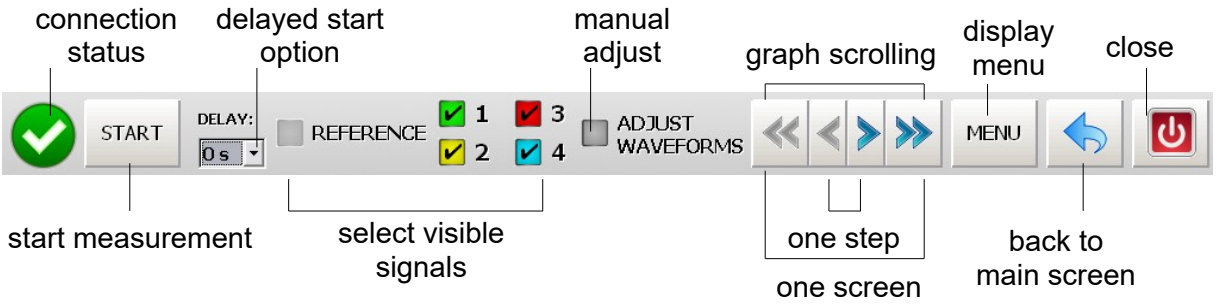

After selecting one or more injector signals and clicking *Invert* the corresponding waveforms will be inverted.

## 5.2 Waveform analysis

In this mode, the waveform recording is not simultaneous, but greater sampling speed is applied. The signal is sampled individually for each of the injectors and later displayed on a common graph. Pressure signal is not recorded. The purpose of this mode is to compare the shape of the injection signal waveforms in stable operating conditions (eg idling).
By overlapping all four waveforms it is easy to see differences such as lower signal amplitude (faulty coil or circuit continuity problem) or different injection time (significant increase may indicate insufficient flow through the injector and the ECU tries to compensate for it). The recording takes 4 seconds to complete (1 second sample for each injector). Correct waveforms can be saved as templates – they can be later displayed on the same graph with other measurement data.

'Waveform analysis' mode window:


Window control elements:




The 'Waveform analysis' toolbar is similar to that in 'Timing analysis' mode. The differences relate to lack of pressure waveform and ability to add the reference waveform instead.

*START* allows starting the measurement. The ongoing recording can be stopped at any time by clicking *ABORT* button visible during the recording.

*ADJUST WAVEFORMS* automatically position recorded waveforms and enables the set of controls that allows to move of all four (or five) waveforms. In this way the user may visually distinguish any differences. The set of additional arrow buttons is shown below:


Colors of arrows corresponds with colors of signals on the graph.

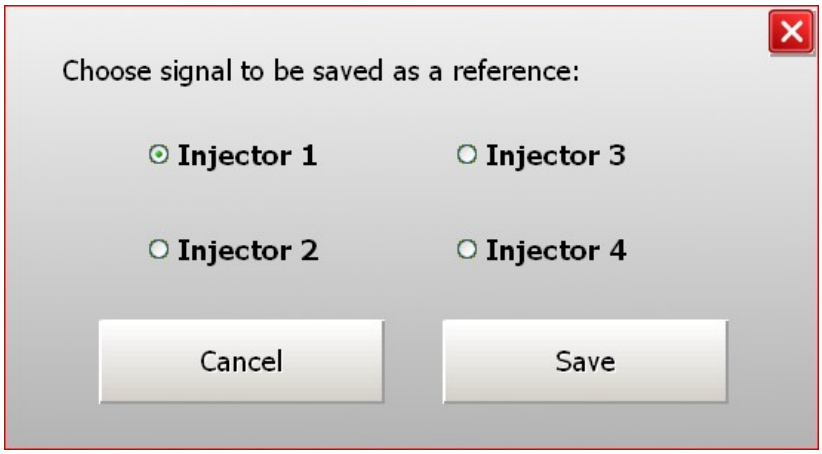
The user can also move the waveforms up and down that allow comparing multiple signals.

'Waveform analysis' graph has constant time base (0.4 ms/div). To accurately measure duration of waveforms the user may use markers (*MENU>Measurements*).

Inactive arrow buttons are associated with reference waveform – they become active after opening reference file..

***MENU*** button displays list of available commands. The menu is almost the same as in 'Timing analysis' mode (additional description available in 5.1). Exceptions include two new options:

***Save reference*** – allows storing one of four waveforms in reference file. This file can be accessed later and displayed on the common graph with currently recorded waveforms of 'Waveform analysis' mode. The following window will pop-up:




***Open reference*** – opens file open dialog. Select required reference file and click *Open*. The reference will appear on the graph along with other signals. The reference waveform is marked with other color (violet).

## 5.3 Pressure analysis

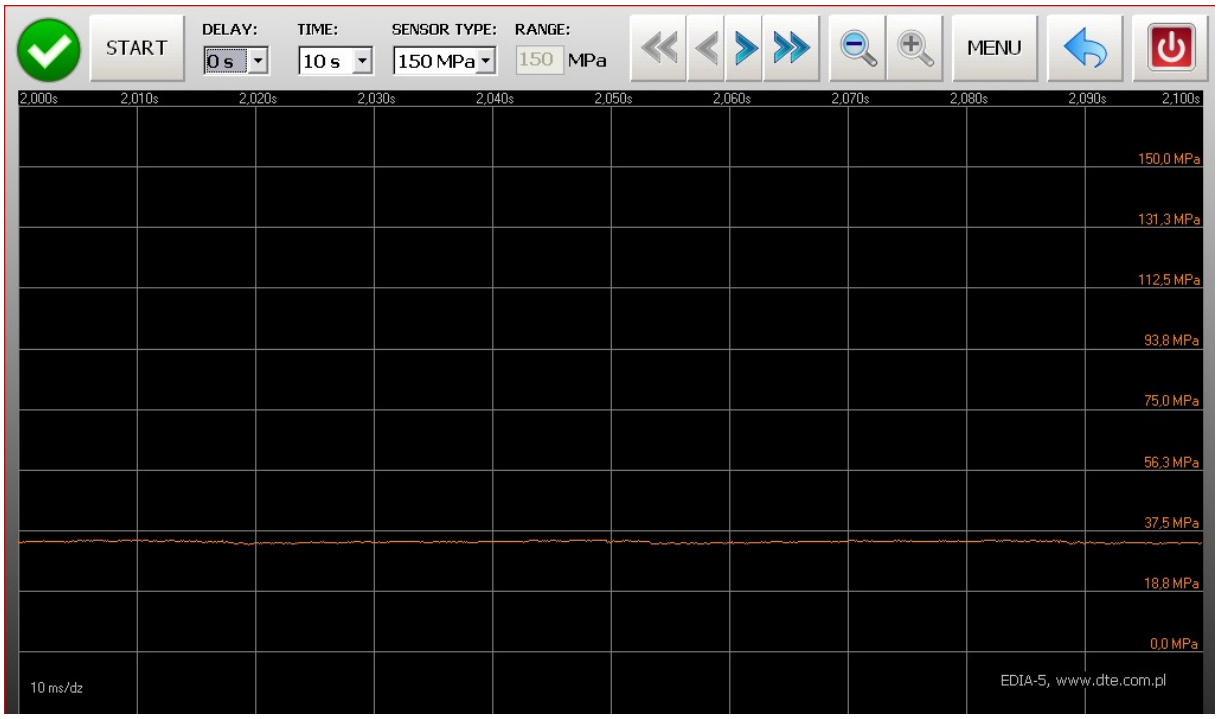
If there is need to obtain longer pressure recording (eg. operating the engine under different situations), and the injection signals are not important the user may want to use this mode. The pressure signal is sampled 10 times slower than normal (time base 10 ms/div) and recording time can be set from 10 to 60 seconds. There is only absolute measurement (DC coupling) available. 'Pressure analysis' mode can be useful in high pressure pumps diagnosis. For this purpose it is advised to record pressure waveform during engine starting and to evaluate pressure rise speed and shape of slope. The user may additionally measure control signals of DRV and SCV valves to make pump and valve diagnosis easier.

### 5.3.1 Pressure only measurement

To make initial diagnosis it is usually convenient to take only pressure waveform. It is advised to start the measurement before engine starting to observe pressure increase rate during cranking. It is also important to check pressure response to rapid RPM increase. When evaluating pressure regulation performance check pressure fluctuation on constant RPM – if it is too high and also there is noticeable RPM fluctuation, it may indicate problem with pressure control valve. Pressure recordings from a car with similar pump type may be helpful in evaluating state of pump.

If the measurements are taken out with cable with injector probe, it is recommended to remove the probes before proceeding (there is possibility of erroneous detection of control valve signals form injector probes).

*Pressure analysis* window:



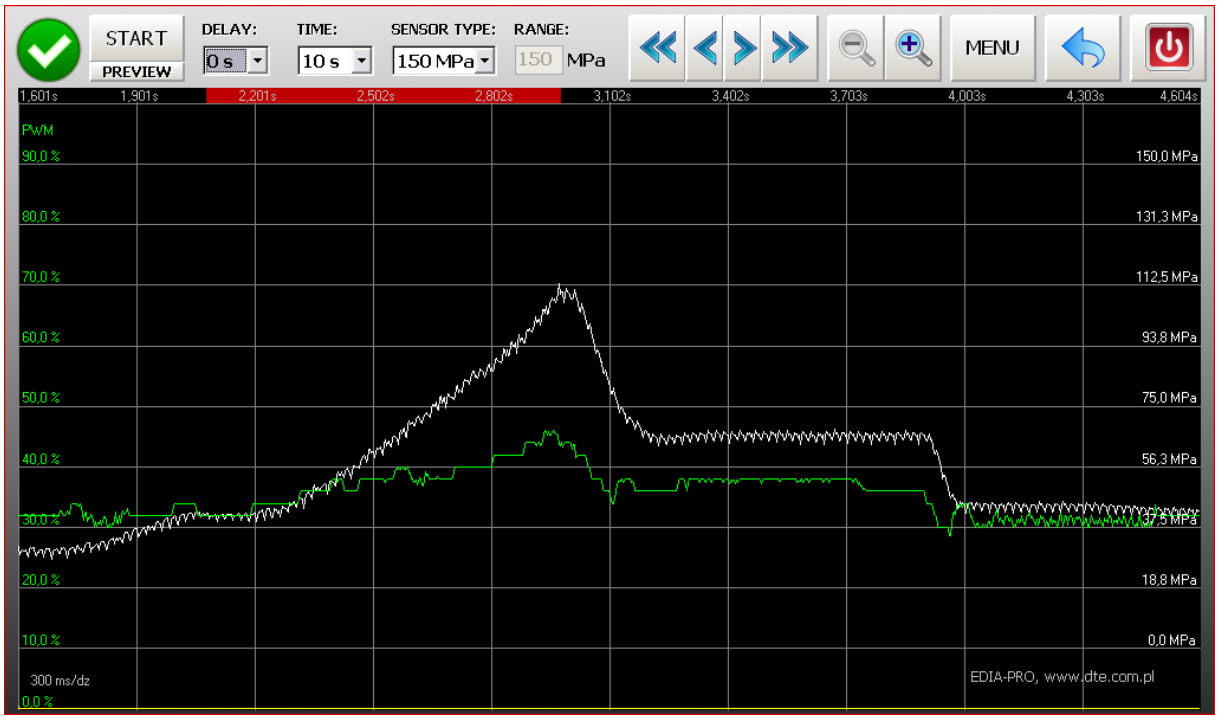

### 5.3.2 Pressure measurement with DRV/SCV

Connecting simultaneously pressure sensor signal and DRV and/or SCV control signals offers more detailed insight into pressure regulation system.

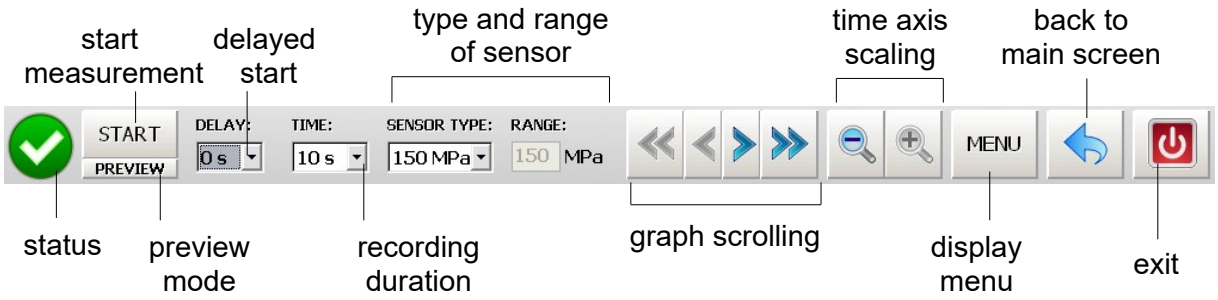
The software can detect two types of control valve signal:

- **PWM** – continuous square waveform with a frequency of 250Hz or greater. Found mostly in pressure control valve used at high pressure side, allowing smooth valve opening. The software will display a duty cycle waveform scaled in %.
- **On/Off** – waveform are similar in shape to injector signals. They are characterized by a much lower frequency of pulses. These signals are mostly found in pump metering valves, working on low pressure side. The program will display value in % as in PWM signal as long as pulses will have sufficient frequency.

*Pressure analysis* window – pressure waveform with DRV signal:




*Pressure analysis* toolbar:




**Time** (recording duration) – select from predefined values:
*10 s* (default), *15 s, 30 s, 60 s, 2 min, 10 min.*

**Sensor type**: *14 MPa, 25 MPa, 150 MPa* (default), *180 MPa, 200 MPa, 250 MPa, Denso, Denso-2, Other*.

Select the type of sensor that matches with the sensor fitted in car. In the case of the most common sensors (BOSCH, SIEMENS) the user need to specify the maximum pressure value selecting it from the list. If the given sensor has different maximum value, select '*Other*' and manually enter the maximum value of the sensor (in MPa) in the '*Sensor range*' field. The correct choice of sensor type allows accurate measurements of pressure.

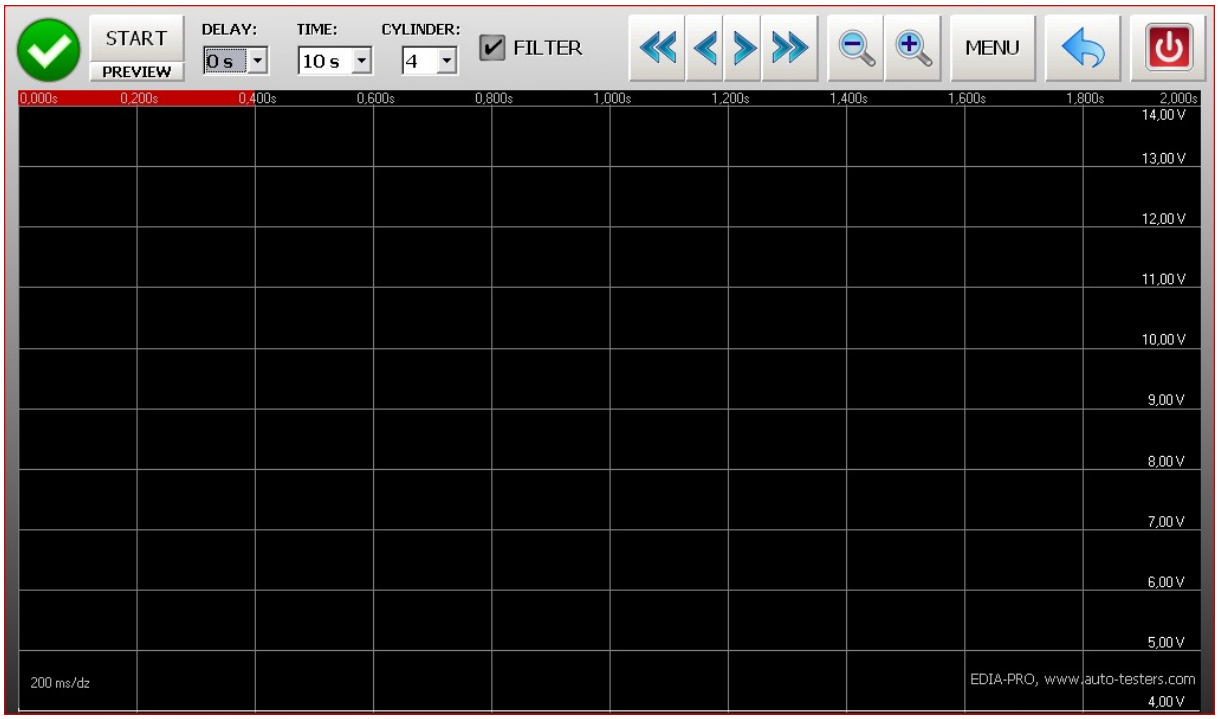
*START* enables starting the measurement. Ongoing recording can be stopped at any time using *ABORT* button which is visible only during recording process.

*MENU* button displays list of available commands. The menu is the same as in 'Timing analysis' mode (additional description available in 5.1).

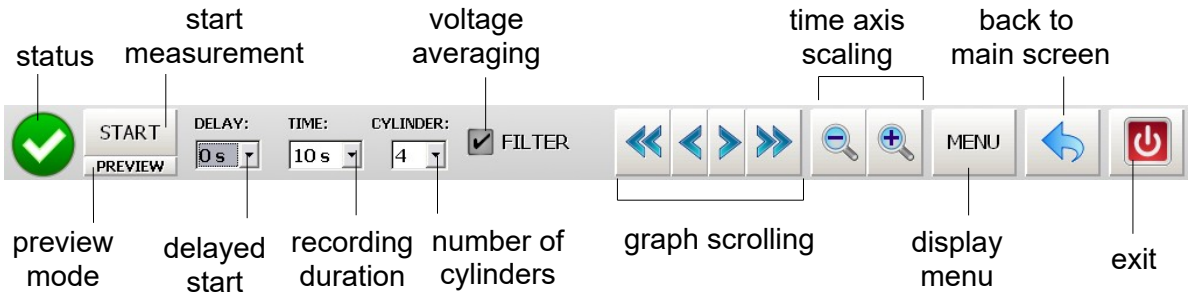
## 5.4 Compression analysis

This function of EDIA system allows assessment of cylinder compression using a indirect measurement method. This type of measurement does not replace direct measurement done using pressure gauge, however it gives a good indication of overall engine condition. The measurement may be performed on both Diesel and gasoline engines.
Due to the ease and speed of measurement *Compression analysis* is recommended as a preliminary test of engine compression if the cause of problems is not certain.

*Compression analysis* mode window:




*Compression analysis* mode toolbar:



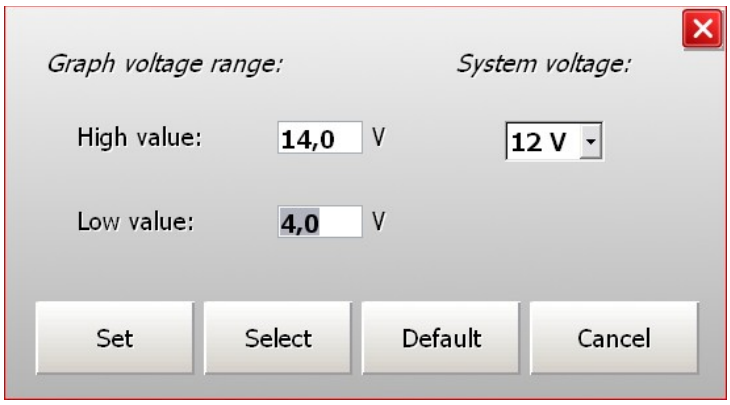
**Time** (recording duration) – select *10 s* (default) or *20 s*.

**Cylinders**: – specify number of cylinders in engine, select one of predefined values: *2*, *3*, *4*, *5*, *6* or *8*. This parameter can be changed either before or after the measurement.

*START* enables starting the measurement. Ongoing recording can be stopped at any time using *ABORT* button which is visible only during recording process.

*MENU* button displays list of available commands. The menu is almost the same as in 'Timing analysis' mode (additional description available in 5.1). The exception is *Voltage range*.

**Voltage range** – enabled scaling of the graph so that only certain range of voltage is visible.

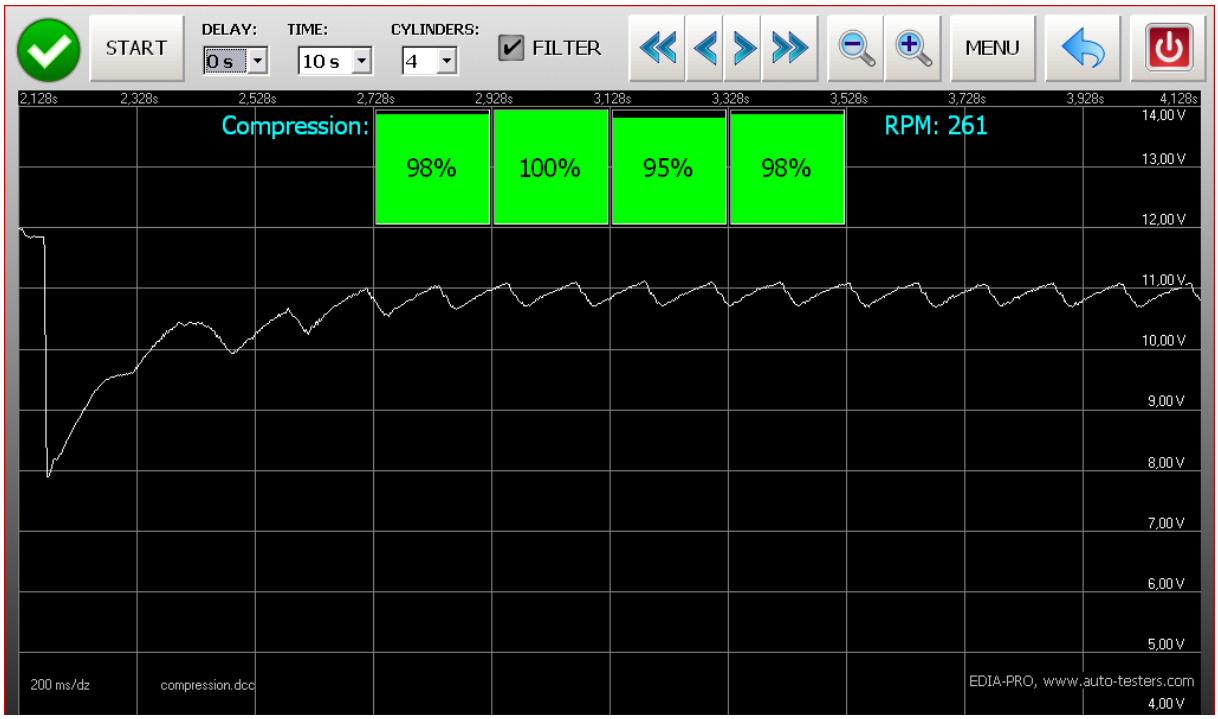



Specify *High value* and *Low value*. Click *Set* to made changes.
If the current value of the voltage waveform is outside the specified range, there will be visible horizontal line only on the top or at the bottom of the graph. The user can return to default voltage range at any time by selecting *Default*.

On the right part of window there is vehicle voltage selection box. When using appropriate measurement cable (marked with red band) it is possible to diagnose also vehicles with 24V electric system.

To perform measurement:

1. Connect measurement cable to car battery connectors (see 4.2.3).
2. Prevent the engine from starting by removing ECU fuse (recommended).
3. Enable ignition without starting the engine.
4. Begin the recording using *START* button .
5. During the recording make a starting attempt for at least 5 second.
6. After finishing the recording, the program will display results:




The graph would be scaled to show 4 – 14V and moved to the moment of enabling the starter. In addition, an average engine speed during starting would be displayed in the upper right part of the screen.
Bars displayed indicate the relative compression value as a percentage of the maximum value associated with the best cylinder. The values should be considered as approximate. In case of significant differences, cylinder compression values should be measured using pressure gauge.

Bars order does not correspond to car cylinder numbers, it preserves firing sequence only.

The recommended method to prevent engine from starting is to disconnect the engine controller (ECU) from power by removing ECU fuse. This will avoid fault codes. Alternatively, the user may choose do disconnect injectors or crankshaft position sensor.

## 5.5 Battery & alternator analysis

This mode allows to record vehicle electrical system voltage waveforms. This waveforms are useful in diagnosing of electrical system and its main components.

*Battery & alternator analysis* mode window:


**Time** (recording duration) – select one of predefined values: *20 s* (default), *60 s*, *120 s*.

**Measurement type**: - *Voltage*, *Ripple* – The first is absolute DC voltage measurement 0-20V, the latter is AC-coupled voltage measurement -0,5 – 0,5V.

### 5.5.1 Voltage measurement

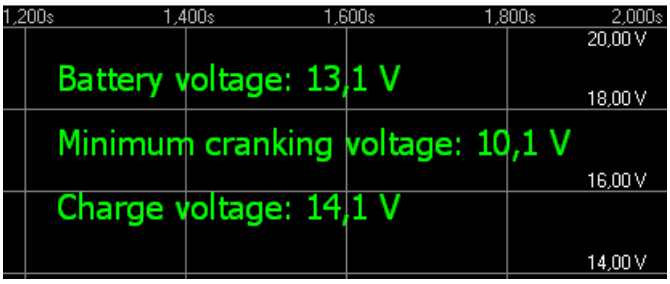
Setting *Voltage* type of measurement will be suitable for most of measurements. This enables voltage measurement on a DC coupled input. The measured voltage range is 0-20V for vehicles with 12V electrical system or 0-40V for vehicles with 24V electrical system. *Ripple* setting allows AC coupled measurement.

*START* allows starting the measurement. The ongoing recording can be stopped at any time by clicking *ABORT* button visible during the recording.

Suggested procedure for making *Voltage* measurements.

1. Connect test leads to vehicle battery terminals.
2. Set measurement type: *Voltage*.
3. Start recording by clicking *START*.
4. During the recording enable the ignition and start the engine.
5. Leave engine running till the end of measurement.

After completing the measurement the result will display in the upper right part of the graph.




Displayed values refer to:

*Battery voltage* – vehicle battery voltage when starting the measurement.
*Minimum cranking voltage* – minimum value of voltage during engine starting.
*Charge voltage* – final voltage value.

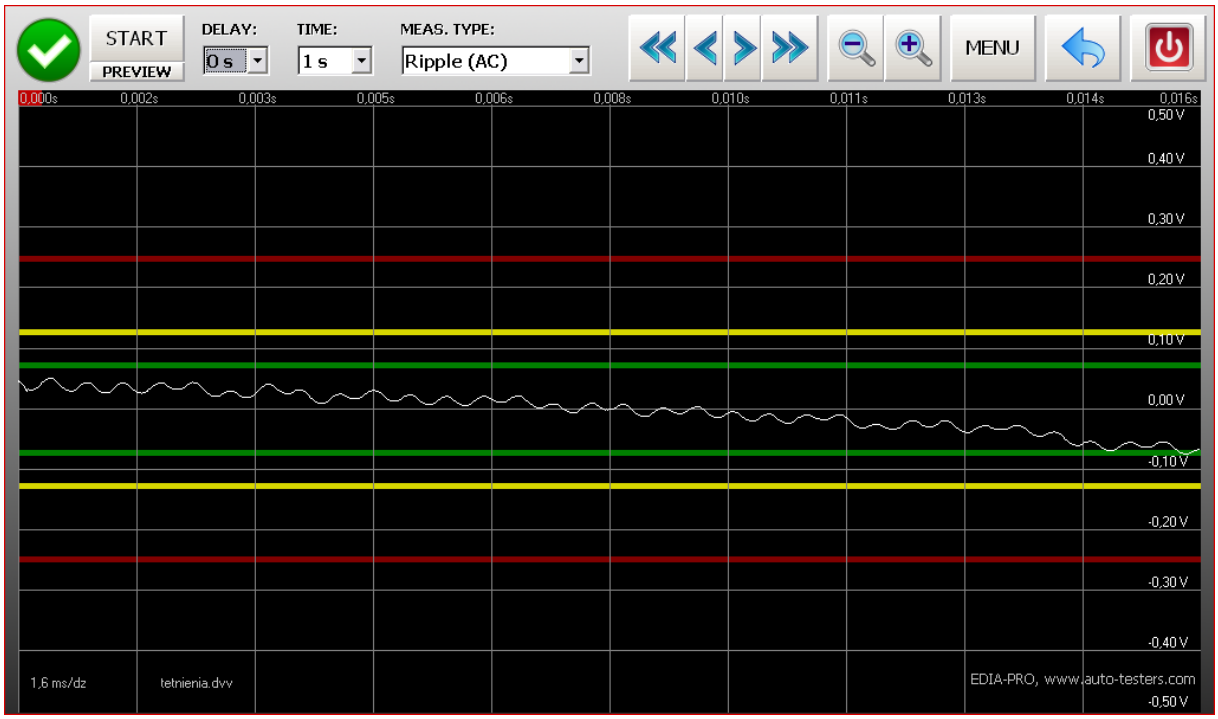
The menu is the same as in *Compression analysis* mode (additional description available in 5.4).

### 5.5.2 Ripple measurement

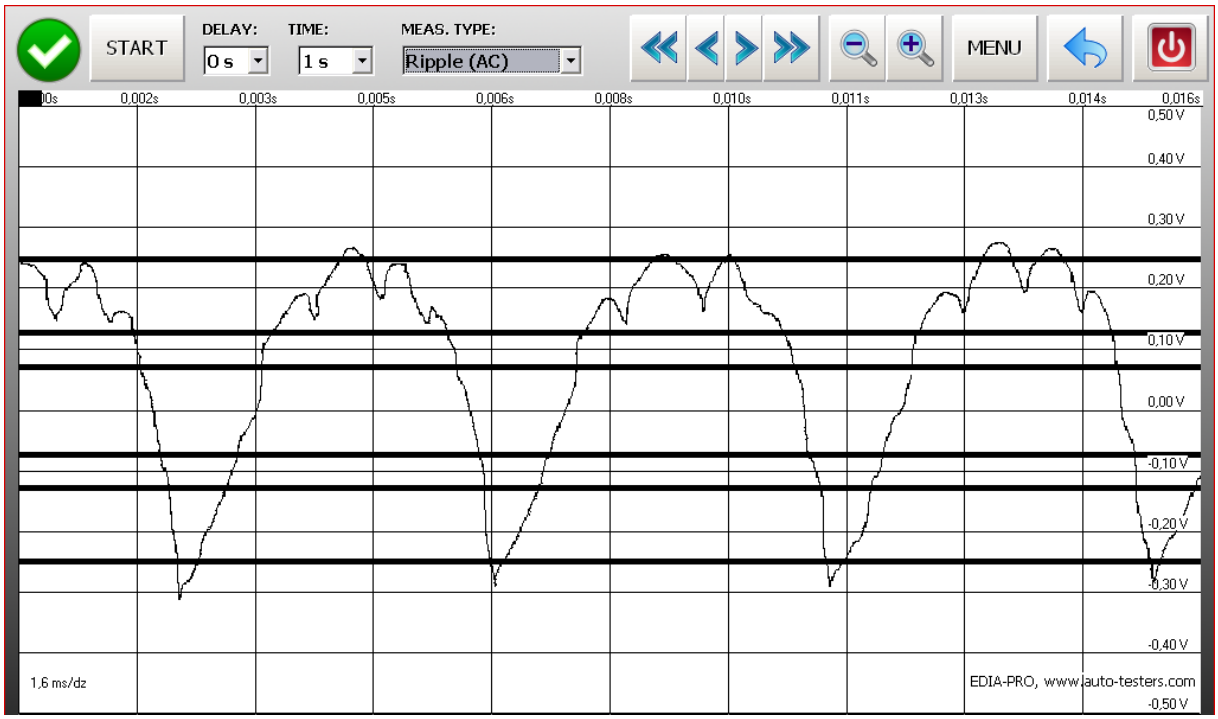
Ripple measurement enable recording of ac coupled amplified voltage signal. The recording takes 1 second and the sampling rate is more than ten times higher than in *Voltage* mode. Waveform obtained is useful especially in alternator diagnosis.

After making a measurement the user may compare obtained signal amplitude with color lines on the graph. This allows simple check if the measured ripple is in the norm. Due to large spread of individual alternator good values and significant battery impact it is difficult to judge alternator condition on the basis of ripple amplitude only.

Much more information can be get from ripple waveform shape observation. Correct ripple come from rectifier output (three phase in most cases). This waveform is influenced by voltage regulator operation and impulse loads of some vehicle equipment (eg. injectors, ignition coils). Below there is an example of good voltage ripple:




The next example shows bad waveform – one of the alternator rectifier diodes was damaged:



## 5.6 Keyboard shortcuts

For user convenience, there are keyboard shortcuts available for frequently used functions.

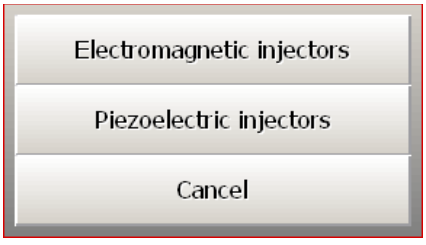
| *shortcut* | *function* |
|---|---|
| F1 | Display User manual |
| F2 | Default pressure/voltage range |
| F3 | Select pressure/voltage range |
| F4 | Preview mode |
| F5 | Start the measurement |
| F6 | Display markers for waveform measurements |
| F7 | Increase time scale ('Zoom –' ) |
| F8 | Decrease time scale ('Zoom +' ) |
| Ctrl+S | File save |
| Ctrl+O | File open |

# 6 Automatic analysis

The automatic analysis function is enhancement of *Timing analysis* mode by enabling to automatically evaluate basic injection system parameters.

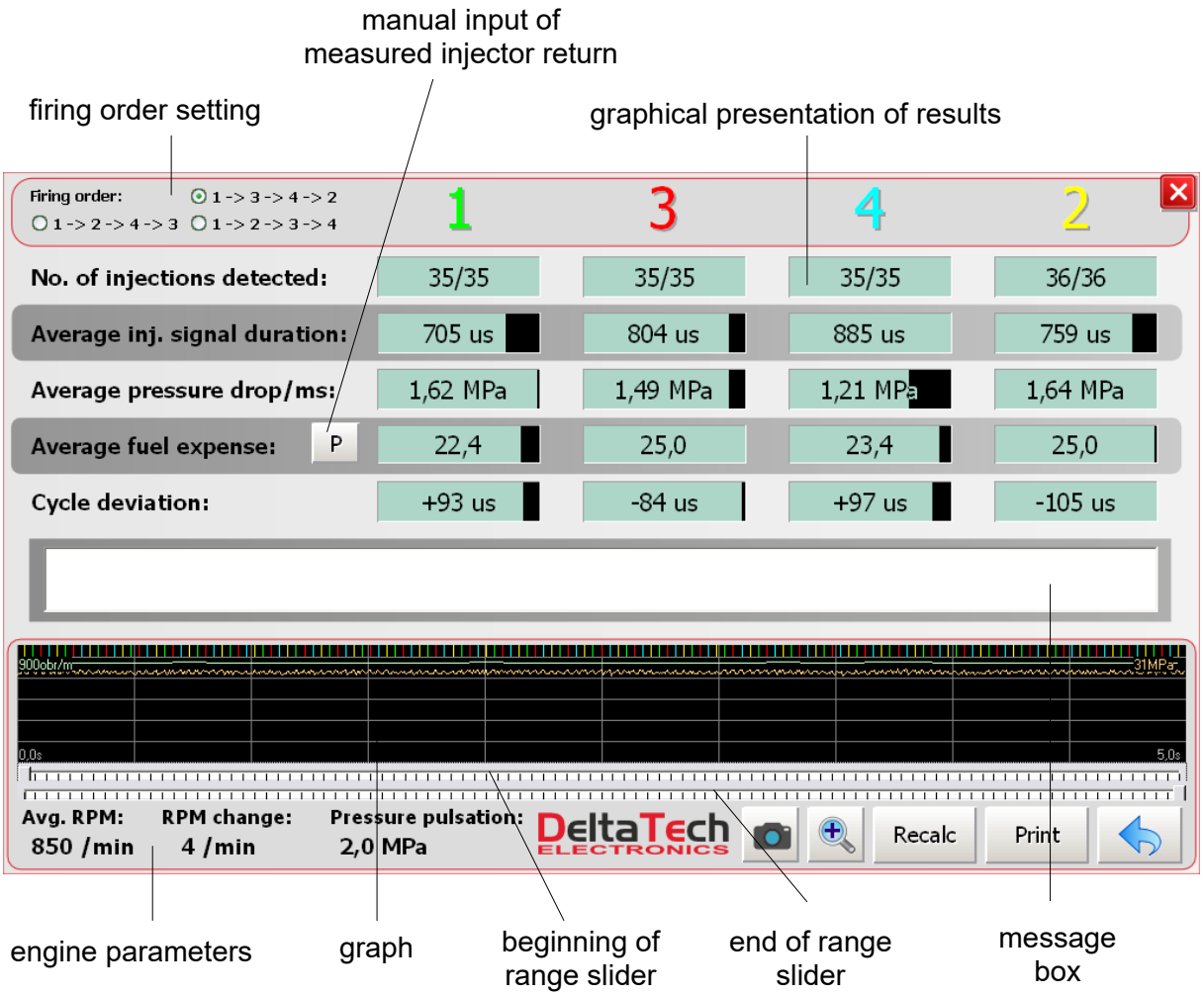
To make use of automatic analysis follow this guidelines:

1. Enter *Timing analysis* mode
2. Take *Timing analysis* measurement of 10 or 15 seconds a idling. If possible make measurement on pre-heated engine.
3. Click *MENU* button, and select *Automatic Analysis*. Then injector selection menu will appear:




4. After selecting injector type the program will calculate and display results.

Below there is a description of *Automatic Analysis* mode window:




**Firing order**

During automatic analysis the program selects appropriate firing order. As a result the results will be displayed in the columns corresponding to subsequent engine operating cycles. If there is need to display results in a different order (for example when making diagnosis of more than 4 cylinders engine in few steps) the order may be changed manually.

**No. of injections detected**

This parameter determines the number of injection signals detected by an automatic algorithm along with the number of cycles predicted on the observation of other injection signals. This information allows us to detect missing injection signals or improper detection. Difference of single injection is acceptable.

When waveform includes rapid change of engine RPM, the lacking injections may come from the ECU disabling injections for quick deceleration.

If the difference between detected and predicted injection signals is greater (by about 10%) the other parameters should be considered not reliable. If this happens, check manually on the graph if and what injection signals (if any) were detected.

The cause of incorrect detection can be improper placement of injector probes. If distance between probe casing and injector wire is too large, the signal cannot be detected properly. If we exclude bad measurement, the user should suspect injector circuit problem, faulty injector or faulty ECU output.

If the cause of incorrect signal detection was incorrect probe placement, the resulting values is not reliable.

**Average inj. signal duration**

This parameter indicates average injection signal duration for given injector. This is a sum of all injection stages. For Common Rail systems this is important parameter for engine diagnosis.

The actual injection signal times can vary quite significantly for each cylinder. This is due to several factors:

- performance differences at the manufacturing stage which are compensated by injector coding that affect dosage calculated by the ECU;
- uneven injector wear resulting in dosage change.
- efficiency and performance of individual cylinders, caused by e.g. different compression pressure. Most ECUs for Common Rail system measures crankshaft angular acceleration and adjusts injection doses in order do achieve most uniform engine movement;

The ideal situation is when the injection timing is the same for all cylinders which in practice is rare.

One important thing is relation of signal duration to a *cycle deviation.* If signal durations vary considerably but cycle deviation is small (less than 100us) that means engine operates evenly, and the ECU was able to fit in adaptation range. High deviations of about 100us at idling mean that ECU failed to compensate injector and cylinder differences. This will indicate possible injector or compression problem, or problems relating to improper injector coding or outdated adaptation values.

**Average pressure drop/ms**

This value specifies the average pressure drop in the rail per one millisecond of injection signal duration. It allows to determine 'throughput' of individual injectors. A greater value indicates greater injector throughput – the more fuel will flow through the injector in the same time and the lover value indicates lower throughput – the less fuel will flow through the injector in the same time.

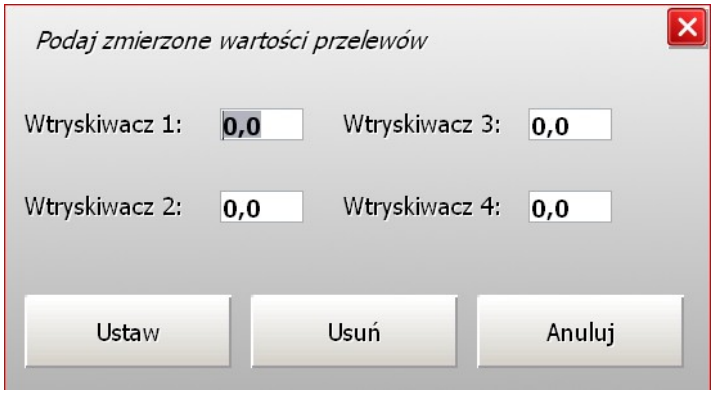
This parameter tells us how the fuel expenses (dose + return) differ for each injector assuming identical injection signal time. For example, this parameter will be greater for leaky injectors, and lesser for clogged ones.

In real conditions the differences can be very significant. It should be remembered that manufacturing tolerances as well as significant differences in fuel return performance has major impact on this parameter.

**Average fuel expense**

Although it is not calibrated to ml or cm3, it maintains proportionality between individual

injectors which allows for comparison.
In more complicated cases there is a possibility to enter measured return volume that will allow for more adequate dose estimation. After clicking *P* button the user may enter manually measured values. This values should be measured in the same conditions, during engine idling.





After entering the data (in any units) and accepting by clicking *Set* button the program will split *Fuel expense* bars into two: *Average fuel dose* and *Measured injector return*. *Average fuel dose* obtained in this way is estimate value, expressed in arbitrary units. The accuracy of dose estimation diminishes when measured on leaky injectors with excessive return value.

**Cycle deviation**
This parameter represents small but significant differences of crankshaft speed after each cylinder operation. If one cylinder is accelerating, cycle deviation value will be lesser (negative). If the cylinder is slowing down, the deviation value will be greater (positive).
Deviations of tens of microseconds at idling are normal and indicate good uniformity of engine operation. Larger values may come from improper injector operation or poor cylinder compression and indicate that ECU failed to compensate cylinder differences. Extreme value corresponding to non operating cylinder is typically 1000 – 2000 us at idling.

**Avg. RPM:**
This is the average engine rotational speed during measurement. The value is computed from detected injections.

**RPM change**
This parameter value describes the irregularity of engine speed. Ideal value is 0 that means most stable operation. In practice, idling speed fluctuations should be not more than 10 RPM. Larger irregularities indicate malfunction of injection system, uneven cylinder compression or other malfunction resulting in fluctuating engine speed.

**Pressure pulsation**
Pressure pulsation is the value of rail pressure change recorded during measurement at idling.

If the automatic analysis was applied to waveform with variable RPM, this will show the difference between minimum and maximum pressure during recording.
If this parameter is high at idling, it may indicate problems with high pressure pump, pressure regulator or injectors. To find the cause of malfunction it is necessary to observe on the graph when exactly pressure changes happen and make diagnosis on this basis.

**Graph –** is a collective and simple illustration of the injection system and engine operation in time. It includes individual injection signals, RPM line (light green) and rail pressure line (light orange). Ideal condition if engine is idling are flat lines of RPM and pressure.
If automatic analysis is applied to waveform with varying engine speed, this graph shows relation of speed and pressure. This is especially helpful when diagnosing high pressure pump and valves. Slow pressure rise during acceleration and/or small changes when fully pressing accelerator pedal indicate possible problem with pump or control valves.

**Messages –** the message box is used to display warnings and advices concerning automatic analysis results.

**Sliders –** allow to select part of the waveform for automatic analysis or for changing waveform range visible on the graph. By default, set to beginning and end of the waveform. Using the sliders allow for obtaining reliable results for waveforms with variable engine speed – to do that select part of the waveform with engine idling and click *Recalc*.

**Recalc** – starts automatic analysis for a waveform range specified by sliders and updates displayed results.

**Zoom** – use this button to narrow range of the graph to the waveform range specified by sliders.

**Print** – allows the user to print the results screen along with current date, vehicle and workshop data.

DeltaTech Electronics has made every effort to ensure that the results of the automatic analysis was accurate. Please note that all evaluated parameters rely on proper injection detection and in unusual versions of injection system may not be accurate.

# 7 Recommendations on measurement making

Below there is a suggested set of measurement to be taken to get comprehensive diagnosis of the Common Rail system. We suggest keeping this schedule if you want to send your results to DeltaTech Electronics for consulting. Having all these files will help in determining the cause of malfunction.

1. *Timing analysis* mode, recording time 10 or 15 s. Start a measurement about 1 s before starting the engine (recording should capture a moment of start-up). If possible, the best results can be obtained on pre-heated engine, unless there are signs of fault on

a cold engine only.

2. *Timing analysis*, recording time 10 s, on idling, engine warmed up.
3. *Waveform analysis*, on idling, engine warmed up.
4. *Pressure analysis*, recording time 60 s. Start a measurement about 1 second before starting the engine. During recording, wait until engine idling speed stabilizes, then press the acceleration pedal, wait until engine returns to idling speed and then finally turn off the engine. If possible, the best results can be obtained on pre-heated engine, unless there are signs of fault on a cold engine only.
5. *Compression analysis*. Start the measurement shortly before cranking. Then crank the engine for at least 5 seconds. During that time the engine cannot start.

# 8 Troubleshooting

| *Problem* | *Suggested actions* |
|---|---|
| No communication with the computer. Power indicator lights up but the software shows no connection (red icon in the upper left corner of the window) | Make sure proper driver is installed – see sections 3.2 – 3.4 of this Manual.<br>Pay special attention to run the computer in special mode for driver installation (64-bit systems).<br>Connecting the device to a USB port different that during installation may require to reinstall the driver. |
| No pressure waveform. Waveform is visible as a single line at the top or bottom of the display. | Check pressure sensor connection. Possibly the signal polarity is reversed (line at the bottom of the screen) supply voltage is measured (line at the top of the screen). Use multimeter to check voltages.<br>If there is suspicion of incorrect measurement – please check it. Use typical AA battery or similar with 1,5V voltage and connect it using universal adapter (brown –, yellow +) and start measurement. The device should show a flat line corresponding to battery voltage. |
| After measurement a warning displays: *Mains hum detected*... | Disconnect the laptop power supply for the duration of the measurement.<br>This problem can be caused also by battery chargers, jump starters and other diagnostic tools connected to a car. In this case disconnect any other devices for the duration of the measurement. |
| Invalid or doubtful measurement of control valve signals in *Pressure analysis* mode. | Check wiring. To verify presence of valve signal go to *Timing analysis* with valve connected. and make measurement. Voltage waveforms of the control valves should appear as a waveforms of injector 1 and 2. |
| When using *Pressure analysis* additional valve PWM waveform | Measurements are taken with a cable with injector probes put on injector wires. Under certain conditions, the |

| | |
|---|---|
| appears, despite the fact no valve is connected. | injection signal can be detected as a control pulse of metering valves.<br>Remove injector probes or use valve measurement cable for making this type of measurement. |

If the above list do not contain your problem or you ran out of possible solutions, please contact manufacturer.

If you detect any error in the software please contact us at edia-pro@dte.com.pl and report your problem. Please contain the following information:

- problem description
- version of edia-pro software (displayed during start-up)
- waveform file if the problem relates to specific measurement.
- version of your operating system

**Warning !!!**

***The device is covered by 24 month limited warranty. The warranty do not cover any damage caused by incorrect use.***

***DeltaTech Electronics company is liable up to the amount paid for the device and is not responsible for any damage and consequences of misuse.***

***DeltaTech Electronics Company has do their most in order to write this manual properly, but can not guarantee that it does not contain any errors. During any workshop activities please always refer to vehicle service manuals, local regulations and laws, workplace and fire safety rules.***