HOW-TO

How-to Use VE Tuner in EMU PRO

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Client: 102.0
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1. Introduction

VE Tuner is a tool, which is helpful to build or improve the *Volumetric efficiency* table by analysing logged data.

The process consists of the three main steps:

1. Gathering data (log)
2. Processing data
3. Analysing data and applying changes

1.1. Gathering data

Gathering data is a crucial step in the process. It is important to keep the engine in a steady state in many load / RPM setpoints. The algorithm will ignore any data gathered during transient condition (e.g. acceleration). It is essential to build Lambda target table before running the VE Tuner.

To collect data, ensure the engine coolant reaches its normal operating temperature. Gather data using various gears and throttle positions. The goal is to cover as large *Volumetric efficiency* table area as possible.

1.2. Processing data

To process data in VE Tuner, project and log must be loaded.

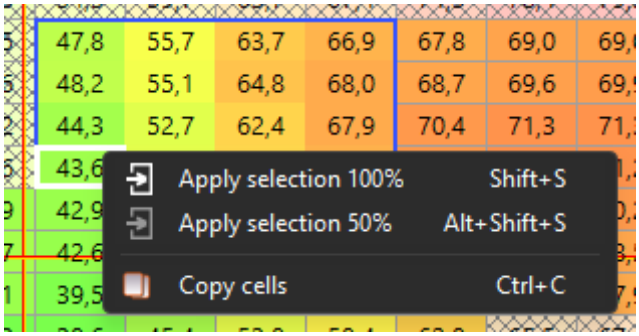
It uses log to calculate corrections for the *Volumetric efficiency* table. VE Tuner performs data validation to reject samples during transients and specified time afterwards (recovery delay).

Corrections are calculated after opening settings window or changing any condition. A VE Tuner table will be filled with calculated values.

1.3. Analysing data

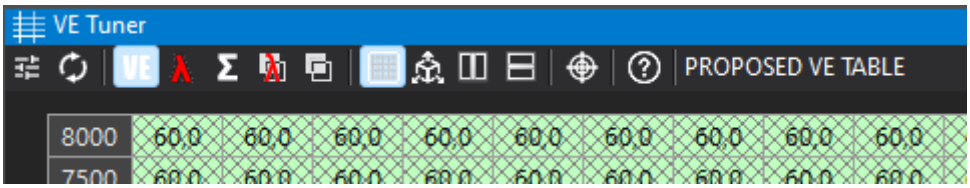
The base view is Proposed VE table. All the highlighted cells contain values calculated from a log which meets the requirements, the rest are masked (cross-hatched).

To apply the changes to the *Volumetric efficiency* table, select cells of interest and choose *Apply selection 100%* or *Apply selection 50%* from a context menu (right mouse button). Apply 100% means that Proposed VE values will be copied to VE table, apply 50% means that the average value of *Volumetric efficiency* table and Proposed VE table will be set.



2. How to use

By default VE Tuner panel is located on FUEL desktop. It can also be found in menu *Tools / VE Tuner* or can be manually added to any desktop. The panel contains a toolbar and a table of the same size and axes as *Volumetric efficiency* table.



VE Tuner table shares common functionalities with other standard tables, however it has enhanced toolbar with dedicated buttons:

- VE Tuner settings – shows settings of log data conditions
- Recalculate – updates graph selection and recalculates corrections

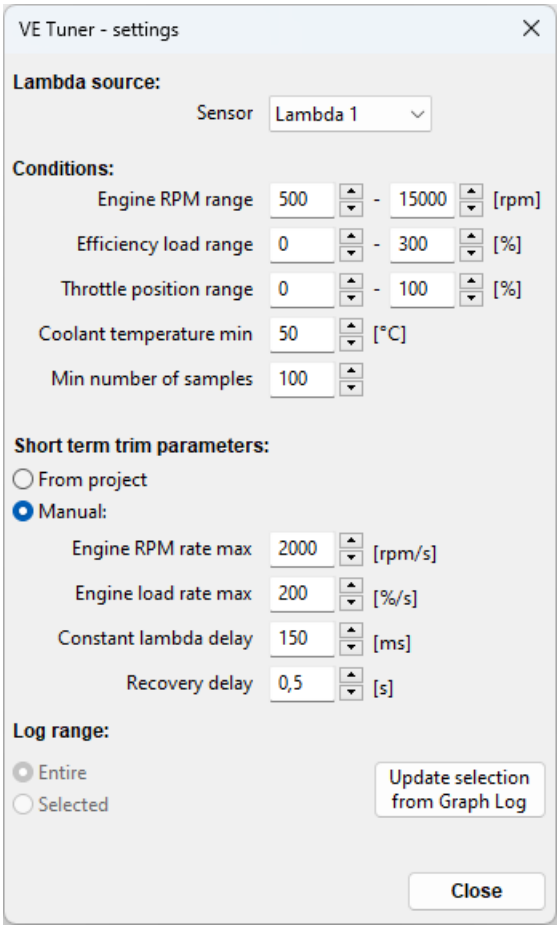
There are five views of results:

- VE Proposed VE table – proposed corrected *Volumetric efficiency* table
- λ Lambda – measured lambda values
- Σ Number of samples – number of collected valid samples
- Lambda difference – difference between lambda target and measured lambda values
- VE difference – difference between current and proposed *Volumetric efficiency* table

The label on the toolbar shows the currently selected view.

3. Settings

Settings window contains all the conditions which are used to validate log data. Corrections would only be calculated from data which meets specified requirements. After each value change followed by Enter key or by using up/down arrow buttons next to values, the corrections will be recalculated.



Conditions description

Parameter	Description
Engine RPM range	range of analysed RPM from log
Efficiency load range	range of analysed *Efficiency load* from log
Throttle position range	range of analysed TPS values from log
Coolant temperature min	minimal coolant temperature to calculate corrections
Min number of samples	minimal number of samples in each cell to use corrections
Sensor	choice of lambda sensor 1 or 2, or average of both sensors

Manual parameters – use the following parameters when *Short term trim* is not configured

Parameter	Description
Engine RPM rate max	maximal rate of change of RPM
Engine load rate max	maximal rate of change of *Efficiency load*
Constant lambda delay	time delay of exhaust fumes reaching lambda sensor. It is dependent on the distance from exhaust manifold to lambda sensor and exhaust gas speed. It is advised to configure the delay in *Short term trim* section
Recovery delay	delay of recovery from transient state

Short term trim parameters – use of rate and delay parameters configured in *Short term trim* section in the *Smart Grid* panel

Log range

Entire – entire log is used to calculate corrections

Selected – only selected range of log is used to calculate corrections. Log can be selected by left mouse button with Shift key pressed or by left / right arrows with Ctrl+Shift keys pressed.

Update selection from Graph Log button applies current *Graph Log* selection.

4. Fuel trims

Short term trim

If *Fuel Short term trim* is enabled, it is important to set logging of appropriate correction channel to at least 25 Hz. Its values would be taken into consideration. Depending on chosen sensor, different channel would be used:

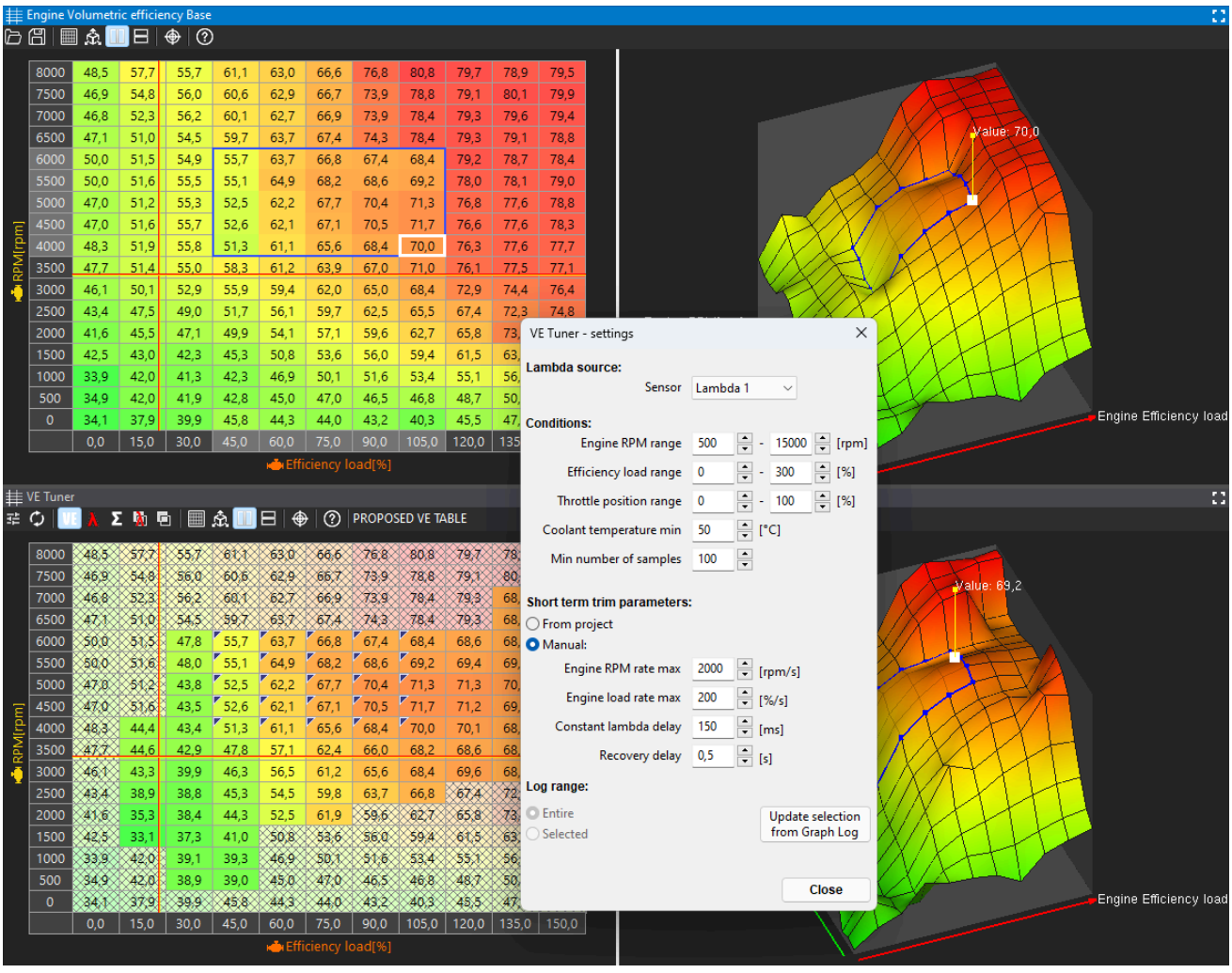
- Lambda 1 – Short term trim Correction 1
- Lambda 2 – Short term trim Correction 2
- Average 1&2 – Short term trim Correction average

Long term trim

For best results it is recommended to apply or clear Long term trim corrections before gathering data for VE Tuner calculations.

5. Step by step Volumetric efficiency table tuning procedure:

1. Prepare *Volumetric efficiency* table that allows the engine to run and assure that in high engine load the mixture is rich
2. Prepare *Fuel Lambda target* table
3. For precise lambda delay value configure *Fuel Short term trim Lambda Delay*
4. Drive the car under different load / RPM conditions
5. Run the VE Tuner tool
6. Apply changes in desired *Volumetric efficiency* table cells
7. Correct unmodified (not visited during test drive) VE table cells manually to fit them to corrected ones. You can use Equalize function (E button on selected cells)
8. Clear the log
9. Repeat the procedure from point 3 until achieving satisfactory results



6. Channels used for data validation and calculations

- Engine Cylinders Cut
- Engine Efficiency load
- Engine Efficiency load Rate
- Engine RPM
- Engine RPM Rate
- Fuel Film State
- Fuel Lambda target
- Fuel Rail 1 Injectors Pulse width Average
- Fuel Rail 2 Injectors Pulse width Average
- Fuel Rail 3 Injectors Pulse width Average
- Fuel Rail 4 Injectors Pulse width Average
- Fuel Short term trim Correction average
- Fuel Short term trim Correction 1
- Fuel Short term trim Correction 2
- Resources Lambda controller 1 Heater state
- Resources Lambda controller 2 Heater state
- Sensors Coolant temperature
- Sensors Lambda 1
- Sensors Lambda 2
- Sensors Throttle 1 position

7. Document history

Version	Date	Changes
1.0	2023.09.14	Initial release
1.1	2024.02.01	Adjusted to changes from software version 102.0