

Migration guide from firmware V2 to V3

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Preface

EMU BLACK V3 is a new firmware designed for EMU BLACK devices, enhancing their capabilities. This software can be installed on any EMU BLACK device, regardless of its version.

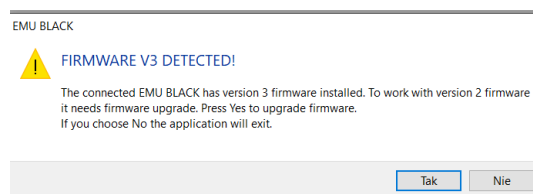
EMU BLACK is directly derived from EMU Classic software and hardware. Over the years, this software has been continuously improved, but due to the need to maintain compatibility, creating new functionalities was limited. Currently, V2 software no longer allows for further expansion. To not disappoint existing users, we decided to reorganize the architecture, redesign key strategies, and provide them with a superior product. As most of you know, over the past few years, we've created a new hardware platform called EMU PRO, where the software was built from scratch. When developing V3 software, we drew from our experience with EMU PRO, aligning some strategies with those of EMU PRO. This will give you more advanced strategies, making future migration to the PRO platform easier.

Due to the fact that many strategies have been rewritten and have completely different parameters, they won't be compatible with V2 maps by parameters. However, we will make efforts to create an importer that will transfer as many parameters as possible from V2 maps. I can guarantee that the most time-consuming aspects of fuel and ignition map creation will be smoothly transferred to V3.

This document describes the fundamental conceptual differences and things to pay attention to when transitioning between V2 and V3 software.

Upgrading to V3 / Downgrading to V2

To update the software to version V3, you need to run the EMU BLACK Windows Client V3. When connected to a device with V2 software, a message will appear informing you about the possibility of upgrading the firmware to V3. The same process applies if you want to revert to V2 software. In that case, you should run the EMU BLACK Windows Client V2, and upon connection to a device with V3 software, a message about the possibility of downgrading to V2 will appear.



DBW

Using the experience gained from designing the EMU PRO, we have developed the electronic throttle control (DBW) support in the V3 software from scratch.

The primary difference is the increase in throttle position resolution from 0.25% to 0.1% and a twofold increase in the frequency of the throttle electric motor control strategy. Since the DBW strategy is based on the throttle model, we have also simplified the PID controller, which now consists of two sets of coefficients for movement above and below the limp home position.

An important change compared to V2 is the reorganization of nomenclature. TPS always refers to the physical throttle position, while PPS represents the accelerator pedal position. In the case of a mechanical throttle,

these values are equal. Additionally, to avoid requiring users to change wiring, you can assign the TPS input as an input for the accelerator pedal position sensor.

Another feature is the 2D CLT limit table, which allows for limiting the throttle position based on the coolant temperature to restrict torque for a cold engine.

We have also improved the diagnosis in the case of throttle error detection as well as during its proper operation. By checking the throttle status, you can identify the source of errors and the strategy actively controlling the throttle at any given moment (such as Idle, Blip, Override, etc.)

A significant change has occurred in the automatic electronic throttle calibration. The algorithm of operation has been completely revised, resulting in the automatic calibration being shortened to less than 40 seconds, with significantly improved results compared to the V2 version.

During the initial electronic throttle calibration, we recommend not configuring the "check" sensors (analog inputs should be set to "None"). While using the DWB tuner, if an error related to the Check sensor occurs, the calibration process cannot be completed.

WBO calibration

The WBO sensor support has been rewritten from scratch, offering better precision compared to V2. There is an option to calibrate the WBO circuit. To do this, disconnect the LSU 4.9 connector and select "Calibrate WBO sensor" from the Tools menu.

Before calibration, ensure that the Sensor type in the Oxygen Sensor configuration is set to LSU 4.2 or 4.9!

Functions

As mentioned earlier, firmware V3 has been largely rewritten. One of the significant changes is the functions that replace parametric outputs from version V2. The new system is very similar to the system known from EMU PRO, ADU, and PMU.

In V3 software, the user has access to 12 functions, within which they can utilize 32 operators. The available operators are: IsTrue, IsFalse, Equal, Not Equal, Less, Less or Equal, Greater, Greater or Equal, And, Or, Xor, And Bitwise, Xor Bitwise, Flash, Pulse, Toggle, Set-Reset-Latch, and Changed.

The parameters of operators can be any logging channels (in V2, there was a limited set of predefined channels). Each function has its name, which is then displayed in the strategy parameters, making it easier to use them.

Logging system

In the case of V2 software, the channel logging frequency was fixed at 25Hz. V3 software introduces 50Hz logging for selected channels (such as RPM, MAP, TPS, PPS, etc.), 100Hz logging for Analog inputs 1,2,3,5,6 and 250Hz logging for Analog input #4.

For many strategies, a status channel has been introduced, which indicates the state of the strategy and, for example, the reason why the strategy did not activate. This significantly simplifies diagnostics and configuration.

Help

Recognizing the imperfections of the help system in EMU BLACK V2 software, we have created an entirely new help system, first introduced with the EMU PRO premiere. The most significant feature of this system is the ability to create content directly within the software. This allows developers to create help content while

developing or modifying existing strategies. This system has also been implemented in EMU BLACK V3 software.

Our goal is to create comprehensive help that describes every aspect of the implemented strategies, making device usage easier, especially for less experienced users.

In EMU V3 software, the Help system is located on the right side and can be summoned or hidden at any time using the keyboard (H key) or the help window icon.

Help is context-sensitive, and by changing the current selection in the Tree View, the content of the help window also changes.

Scope

A new enhanced Scope tool has been implemented. In addition to displaying crankshaft/camshaft signal waveforms, it also shows waveforms from ignition coil outputs and injectors.

Corrections

In V2 software, for most correction tables, a value of 100% indicated no correction. However, in V3 software, this has been unified with the EMU PRO concept, where 0% denotes no correction.

Ignition / Fueling

The main difference between V2 and V3 lies in the way the firing order is defined and in assigning coils/injectors to cylinders. In the new version, the firing order is defined in a firing order table, while in the coil and injector configuration, we assign which ignition output/injector is assigned to which cylinder. Such an approach greatly simplifies configuration. The trigger system has also been improved, allowing for faster engine startup (we can generate spark and fuel delivery earlier than in the V2 software).

User CAN

In V3 software, the Userdefined CAN functionality can operate independently of other CAN options (i.e., it can receive and send data)

PID

A completely new, highly precise PID controller has been implemented. Now, in every strategy, when configuring the controller coefficients, their units are displayed, which facilitates understanding of the control.

DSG support

Starting from version 3.024, when the DSG option is enabled, a VW CAN stream is automatically sent. This allows selecting a different vehicle's CAN stream in the CAN configuration, enabling the use of the DSG gearbox in such a vehicle (provided there are no CAN ID conflicts). Additionally, a Torque Losses table has been introduced. However, we suggest leaving the values at 0 for now, as we are still working on practical utilization of this table.

Password protection

To secure the device with a password, you need to go to the Tool menu and select the Device password option.

After entering the password, the device will be secured, and this will be visible on the status bar in the form of a padlock. Upon restarting the device, to connect to it, you need to enter the password. Entering the correct password will unlock the device, and it will remain in this state until it is restarted again.

The client software remembers the password during runtime, so subsequent turning on/off of the device will not require re-entering the password.

When the device is password protection the Quick save during Make permanent process is disabled.

During connection to the encrypted device, there are 4 options to choose from:

1. **Quit** - exit the program
2. **Enter password** - enter the password.
3. **Load package** - allows loading an encrypted package with settings. If the password with which it was saved is identical to the password in the ECU, firmware, and calibration, it will be saved on the device. This allows sending clients new calibration versions without revealing their contents. This function is not yet available.
4. **Restore to default** - restores the device to factory settings. It removes all data and the password.

Missing features:

1. Organizing logging channels (groups, names, etc)
2. Implement all the triggers present in Black V2
3. Paddle shifts strategy
4. 2nd fuel rail
5. Staged injection
6. Nitrous
7. Help (finishig text, replace hand drawn images with the final ones)
8. Feedback from users
9. Windows client user interface improvements
10. Support for loading encrypted projects to locked ECU
11. Partial locking of the project
12. EMU BLACK V2 project importer
13. Fuel composition calculations are still tested
14. Electronic wastegate support