



USER MANUAL

Migration Guide to EMU Black V3 Software

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1. Introduction

EMU Black V3 is a new software developed for EMU Black devices, significantly expanding their functionality. It can be installed on any EMU Black unit, regardless of its hardware revision.

The original EMU Black platform was based on the EMU Classic architecture — both in hardware and software. Over the years, the software evolved continuously, but due to the need to maintain full compatibility, the ability to introduce major new features became increasingly limited. At this point, the V2 software architecture has reached the end of its expansion capabilities.

This document outlines the key conceptual differences between V2 and V3 software and highlights important considerations during the migration process.

To ensure continued development without compromising the experience of existing users, we decided to modernize the architecture, redesign key control strategies, and deliver a more advanced product. In parallel, we developed a new hardware platform — **EMU PRO** — with a completely new software foundation. While creating V3, we leveraged experience from EMU PRO and aligned several strategies across both systems. This approach provides more powerful features today and makes future migration to the PRO platform straightforward.

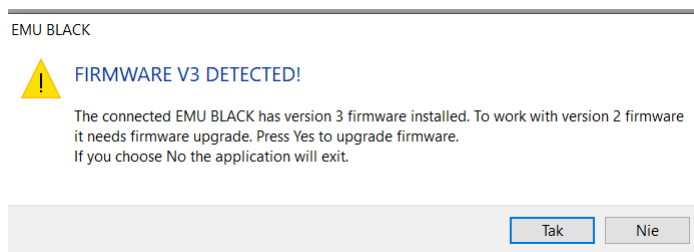
A V3 firmware version for **EMU Classic** is also planned. This will allow shared base maps between EMU Classic and EMU Black (with consideration for hardware limitations).

Because many control strategies were rewritten and re-parameterized, V3 is not fully backward-compatible with V2 calibration files. However, we have implemented an importer that transfers as many settings as possible. All major fuel and ignition maps — typically the most time-consuming elements of calibration — are migrated automatically.

Upgrading to V3 / Downgrading to V2

To update your EMU Black to firmware V3, simply launch the **EMU Black Windows Client V3**. When you connect to a device running V2 firmware, the software will automatically detect it and display a prompt offering to upgrade the ECU to V3.

The process works the same way if you wish to revert back to V2. Launch the **EMU Black Windows Client V2**, connect to a device running V3, and you will see a notification with the option to downgrade the firmware to V2. *Required version 2.163 or later.*



Importer

To simplify the conversion of existing V2 projects to the new V3 format, the application includes a built-in import tool (*File → Import EMU BLACK V2 file*). Despite extensive efforts, this importer has limited capabilities due to the fundamental architectural changes introduced in version V3. For this reason, it is essential to carefully review all importer messages and verify all data after the import process.



Warning:

After starting the engine, it is strongly recommended to check the ignition timing with a timing light to ensure proper trigger configuration.

2. General improvements

User interface

In version V3, the user interface has been significantly improved. A Dark Mode has been introduced (requires Windows 10 or newer). New keyboard shortcuts have been added (e.g., **F5** toggles *Scope*, **F6** toggles *Graph Log*, **F7** toggles *Tune Display*), along with an interactive help panel on the right side of the window.

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.

Our goal was to create comprehensive help that describes every aspect of the implemented strategies, making device usage easier, especially for less experienced users. Currently, all elements of the software and parameters are described.

Additionally, all help is available in 7 languages (English, French, German, Italian, Japanese, Polish, Spanish).

In EMU V3 software, the Help system is located on the right side and can be summoned or hidden at any time using the help window icon in top right corner of the software.

Help is context-sensitive, and by changing the current selection in the *Tree view*, the content of the help window also changes. With this new help system, the developers can create and modify content more easily when changing the strategies. Our goal for the future is to keep the help always up to date.

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.

Tree view panel

The Tree view panel can be dynamically resized by dragging its border. It features a search bar at the top of the panel, which helps you find parameters within the tree structure.

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.

EDL-1 two way communication

The new firmware introduces bidirectional communication with the EDL-1 module (requires both Rx and Tx connections). This enables diagnostics of the logger status, such as the number of write errors, SD card state, and other parameters.

Additionally, when using the eDash mobile application (available soon for Android and iOS) <https://www.ecumaster.com/products/edash-pro/>, it is now possible to control ECU parameters via Bluetooth switches and Bluetooth rotary switches.

CAN

In V3 software, the **User Defined CAN** functionality can operate independently from other CAN options (i.e., it can both receive and transmit data).

The **OBD** protocol support has been expanded, and it is now possible to define the vehicle VIN number directly in the software.

Additionally, several vehicle-specific CAN streams have been extended (e.g., Renault Clio 3, Mitsubishi Lancer EVO X, and others).

Password protection

A new calibration encryption method based on cryptography has been introduced. Due to the nature of this encryption, if the password is lost there is absolutely no way to read the contents of the ECU. The only option in such a case is to restore the device to factory settings.

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.

3. Strategies

DBW

Using the experience gained during the development of EMU PRO, we redesigned the electronic throttle control (DBW) system in V3 from scratch. The key improvements include an increase in throttle position resolution from 0.25% to 0.1% and a two-fold increase in the actuator control strategy frequency. Since the new DBW system is based on a physical throttle model, the PID control strategy has been simplified and now consists of two sets of coefficients – above and below the limp-home position.

A major change compared to V2 is the revised nomenclature. **TPS** always refers to the physical throttle position, while **PPS** refers to the accelerator pedal position. For a mechanical throttle body, these values are identical. Additionally, to avoid wiring changes, the TPS input can now be reassigned to operate as a PPS input.

A completely new method of detecting TPS and PPS sensor faults has been implemented. By using a mapping table that correlates TPS/PPS position with sensor voltage, it is now possible to define virtually any dual-channel TPS or PPS sensor configuration.

Another new feature is a 2D coolant-temperature-based throttle limit table, allowing torque reduction when the engine is cold.

Diagnosis and monitoring have also been improved. By using the *DBW Target Source* log channel, users can identify the cause of errors as well as determine which strategy is currently controlling the throttle (Idle, Blip, Override, etc.).

In V3, the opening and closing speed of the throttle can be controlled independently as a function of engine RPM, improving drivability during rapid throttle movements.

The automatic throttle calibration procedure has also been significantly revised. The algorithm has been completely redesigned, reducing calibration time to **under 40 seconds** while providing improved accuracy and repeatability compared to V2.



Note:

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

Ignition

The main difference between V2 and V3 lies in how the **firing order** is defined and how coils/injectors are assigned to cylinders. In the new version, the firing order is configured using a dedicated firing order table, while in the coil and injector configuration, users assign which ignition output or injector corresponds to each cylinder. This approach significantly simplifies the configuration process.

The trigger system has also been enhanced, allowing for faster engine startup, as ignition and fuel injection can be activated earlier than in the V2 software.

A new **Trigger Wizard** has been added, which automatically configures trigger and coil parameters for many popular engines (with more engines to be added over time).

The camshaft signal decoding system has been expanded – through the use of factors, it is now possible to define virtually any signal pattern available on the market.

Additionally, trigger error diagnostics have been improved, and a new logging channel, Trigger error count, has been introduced to record all occurrences of trigger errors.

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.



Warning:

This is a very common mistake made by users transitioning from V2 to V3.

Fuel model

The **fuel model in version V3** has been expanded to include **automatic fuel dose correction based on ethanol content** (e.g., using a **Flex Fuel sensor**), which simplifies operation with different fuel types.

Additionally, the model now takes into account the **type of fuel pressure regulator** and provides **automatic compensation of the fuel dose** with changes in rail pressure (only when a **fuel pressure sensor** is used).

Four configuration modes are available:

- **MAP Referenced** - the pressure in the fuel rail changes relative to the pressure in the intake manifold in a 1:1 ratio. If the pressure in the intake manifold increases, the fuel pressure increases. The effective fuel pressure should have a constant value defined by the Base pressure parameter.
- **MAP Referenced + Fuel Pressure Sensor** - the pressure in the fuel rail changes relative to the pressure in the intake manifold in a 1:1 ratio. If the pressure in the intake manifold increases, the fuel pressure increases. The effective fuel pressure should have a constant value defined by the Base pressure parameter. If the measured fuel pressure, adjusted for MAP value, differs from the Base pressure, a fuel dose correction is applied. The pressure difference is visible in the Fuel pressure error channel.
- **Baro Referenced** - the pressure regulator maintains a constant pressure defined by the Base pressure parameter. The effective fuel pressure changes along with the pressure in the intake manifold (MAP) and influences the calculated fuel dose.
- **Baro Referenced + Fuel Pressure Sensor** - the pressure regulator maintains a constant pressure defined by the Base pressure parameter. The effective fuel pressure changes along with the pressure in the fuel rail and the intake manifold (MAP) and influences the calculated fuel dose.

Extended fuel dose correction tables, including three 3D Custom Correction tables with fully configurable axes. These corrections can affect either the Lambda Target or the Injector Pulse Width directly.

The Injector Dead Time table has been converted into a 3D table, with an additional axis representing Effective Fuel Pressure.

The injector assignment process has also been simplified. In version V3, injectors are assigned directly to individual cylinders, while the firing sequence is defined through the Firing Order settings in the ignition configuration.

Idle control

The **Idle Control** strategy has been completely redesigned and differs significantly from the V2 version.

The most important change is in the operation of the PID controllers. The primary controller is the ignition timing controller, which is used for fast and precise RPM control.

The PID controller managing the airflow to the engine is based on the error between the desired ignition angle (**Idle ignition target**) and the actual ignition timing. In addition to standard actuators controlling airflow (such as DBW, PWM solenoids, stepper motors, etc.), a **Cycling Idle** strategy (using fuel cut) is available and can be activated independently of the selected actuator.

Furthermore, for engines not equipped with any idle airflow control mechanism, an idle speed control strategy using the **rev limiter** (ignition or fuel cut) is also available.

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.

Knock sensors

The main improvement in the **Knock Detection** strategy is the ability to control ignition timing independently for each cylinder — ignition is retarded only for the cylinder where knock has been detected. Additionally, individual knock signal gain can be defined per cylinder, allowing signal level equalization caused by sensor mounting position differences.

It is important to note that in V3, the ignition timing correction applied by the **Knock Control** strategy is not reflected in the **Ignition Angle** channel, but in separate channels **Knock Ign. Retard 1–8**. This is because **Ignition Angle** represents the base ignition advance for the engine, while the Knock Control strategy operates independently for each cylinder.

Boost

The **Boost Control** strategy has been completely redesigned. It supports both standard PWM-controlled solenoids as well as electronic wastegate and CO₂-based systems. The new strategy allows for precise boost control under all conditions and ensures the fastest possible boost buildup.



Note:

A very important difference compared to V2 is that the strategy now operates on **BOOST** (pressure relative to atmospheric pressure) instead of **MAP** (absolute pressure). This is a very common mistake made by users transitioning from V2 to V3.

Additionally, an **Overboost Protection** strategy has been implemented to safeguard the engine from malfunction of the boost control system (e.g., a broken hose) or incorrect controller configuration.

Acceleration enrichment

The **Acceleration / Deceleration Enrichment** strategy has been completely redesigned. It allows both **synchronous fuel corrections** applied over subsequent engine cycles and **asynchronous additional fuel injection** during rapid load transients.

The enrichment calculation can be based on either Throttle Position Sensor (**TPS**) change or Manifold Absolute Pressure (**MAP**) change.

Overrun

A new feature in V3 is the enhanced Overrun strategy. It allows for smooth torque reduction before injector cutoff, as well as a very aggressive setup that can produce flames from the exhaust system. Additionally, the strategy enables configuration of two independent overrun settings, which can be switched using an external switch or a function.

Sensors

The concept of calibrating analog sensors such as temperature, pressure, and position sensors has been redesigned in V3. Each sensor now has a dedicated status channel in the logs (e.g., Fuel press. status), allowing quick and clear diagnostics. Sensor status values include:

- **OK** – sensor is operating correctly
- **Short to ground** – sensor voltage is below the defined minimum threshold
- **Short to 5V** – sensor voltage exceeds the defined maximum threshold
- **Unassigned** – the sensor is not assigned to an analog input
- **CAN-BUS** – the sensor value is being overridden by a user-defined CAN stream

All analog inputs now support optional low-pass filtering with selectable cutoff frequencies of 1, 2, 5, 10, 25, 50, or 500 Hz, which is especially useful when using sensors prone to signal noise (for example, an oil pressure sensor where pressure fluctuations must be smoothed).

The configuration of digital inputs (Primary trigger, Cam 1, Cam 2, VSS) has also been moved to the sensor section to improve configuration consistency.

The vehicle speed processing strategy has been completely redesigned, greatly increasing flexibility and allowing more advanced use cases.

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.

Outputs

In the **Outputs** section, support has been added for several new features:

- **EKP fuel pumps (CAN)** – allows control of the pump flow rate as a function of engine load.
- **Electric water pumps (EWP)** – control strategy added.
- **Volvo EHPS power steering pumps (CAN)** – enables control of the steering assist level based on vehicle speed.

Additionally, for **PWM tables**, the number of available logging channels that can be assigned to table axes has been increased.

WBO sensor

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.



Note:

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

Switches

In the V3 software, the concept of **Switches** used for activating or modifying strategy parameters has been completely redesigned.

In V2, an analog or digital input could be assigned directly to a strategy. In V3, a switch must first be configured and then linked to the desired strategy. The same principle applies to rotary switches.

The following types of switches are available:

- **Built-in switches 1–3** – ground-activated switches built into the ECU, available on terminals 10, 23, and 36 of the black connector
- **User switches 1–8** – configurable switches that can use analog or digital inputs. Additionally, the Flex Fuel input and RS232 Rx input can be assigned as switch sources
- **Mux switches** – use one analog input to connect up to three independent switches via a resistor ladder
- **Latching switches 1–4** – switches with up to four states, changeable via an external switch or function. Switches 2–4 are set through vehicle-specific CAN streams
- **CAN switches 1–20** – switches activated by CAN bus data (vehicle-specific CAN, user CAN, or CAN switch board)
- **Rotary switches 1–5** – rotary switches based on voltage from analog inputs or CAN analog channels
- **Rotary switches CAN 1–5** – rotary switches based on CAN bus data (user CAN or CAN switch board)
- **Functions 1–12** – logical functions that can be used in the same way as switches

Additionally, with a new eDash PRO Mobile app (for iOS and Android) <https://www.ecumaster.com/products/edash-pro/>

- **Rotary switches BT 1–4** – rotary switches controlled via Bluetooth
- **BT switches 1–8** – switches controlled via Bluetooth

Rev limiters

In the V3 software, the implementation of rev limiters has been redesigned for both ignition cut and fuel cut modes. Thanks to integration at the trigger decoding level, RPM control is significantly faster, resulting in **high limiter stability and an attractive engine sound**. The same mechanism is also used in the Launch Control strategy.

The rev limiter configuration can be found in the Ignition category.

DSG support

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, support for the **MQB** platform has been implemented, which enables the use of newer DSG gearboxes. The emulation

of modules such as ESP/Gateway/ABS has been expanded. Additionally, gear lever emulation using the Ecumaster CAN keyboard has been implemented.

Close loop gear shift + paddle shift support

In V3 software, an advanced gear shift strategy (Gear Cut + Blip) has been added, enabling closed-loop operation. This ensures very fast gear changes while maintaining gearbox safety. A load cell in the gear lever, switches, or a gearbox position sensor can be used as the shift signal source.

Additionally, an enhanced paddle-shift strategy has been implemented, which uses the closed-loop gear-shift logic. Besides traditional gearboxes, it is also capable of operating motorcycle gearboxes where the shift pattern is 1-N-2.

Sport functions

In the motorsport functions, several major enhancements have been introduced:

- Added support for **Trans-Brake**.
- A completely new Anti-Lag System (**ALS**) strategy has been implemented.
- The **Launch Control** strategy has been fully redesigned with a strong focus on flexibility and ease of configuration. It now allows on-the-fly adjustment of target RPM and boost pressure using rotary switches (or the eDash app) and provides high precision in engine speed control.
- A new Prestage function has been added, which, when combined with the **Nitrous** strategy, enables rapid buildup of the desired boost pressure before launch.

Drag racing features

In the V3 software, drag-oriented features have been added, such as **Trans Brake**, fast adjustable **Launch Control**, advanced **Nitrous** control, and improved injection angle, boost, and fuel delivery management based on timers. Combined with the capability to control boost using CO₂, this enables optimal and repeatable passes.

4. Document history

Version	Date	Changes
1.0	2025.11.12	Initial release
1.1	2025.11.17	Corrected software version