

Copy files to the root directory of the microSD card with FAT32 filesystem (how to format microSD to FAT32 on Windows and Mac you can read [here](#)), insert into On-board computer (contacts on top) and run the update process.



**Do not downgrade firmware that was installed by the manufacturer! You may get a brick**

Each device has its own firmware and is updated separately from different menus. It does not matter in what order you update the firmware of the devices. If you have older firmware, you can install the latest firmware at once, without having to install the firmware one by one.

If you already have firmware version **v0.75B** and higher installed in the On-board computer, then the order in which devices are updated does not matter, since in firmware **v0.75B** the ability to force the update of the controller and other devices connected to the CAN bus through the menu of the On-board computer was added. You can read more about **Forced update of devices** in this [section](#).

If your On-board computer has firmware **v0.60B** or lower and Controller **v.7.18** and lower, first, need to update all devices but display. Because menu protocol is new and old devices will not be visible in the menu. After the update is finished hold the left button few seconds to exit the updated device menu. If the button does not work you may need to reset the power supply or replug CAN cable in the On-board computer. After everything is updated — update the On-board computer. Make a controller reset (load defaults) after the update. We recommend running motor detects again on controllers. Detection of throttle/brake connected to display should be done in the On-board computer menu.

Instruction of update of firmware:

1. [Description](#) of the On-Board Computer update menu.
2. [Description](#) of the Controller update menu.
3. [Description](#) of the uLight update menu.

To check the current firmware version, go to the **Device Information** menu, each device has a separate menu.

1. [Information](#) about the firmware version of the On-Board Computer.
2. [Information](#) about the firmware version of the Controller.
3. [Information](#) about the firmware version of the uLight.

The list of actual firmware to be downloaded:

## 30 September 2023

Recommended to update display first! Export configurations before update and import after to save your settings.

**Controller v0.8.13** 

Added reset handlers  
Added quick battery voltage setup  
Fixed dc-dc mode for P24F

Added LR detect indication  
Throttle/brake error replaced with 'not connected'  
Added temperature sensor detect logic when sensor disabled  
Added access level selection  
Added boost mode duration  
Fixed active braking stutter  
Adjusted square control duty cycle


## **Display v0.82B**

Added access level menu support  
Fixed some freezes  
Fixed displayed mode with multiple motors


## ===== **21 July 2023** ===== **Controller v0.8.12**

Added MPPT solar logic  
Added throttle lock when brake pressed  
Fixed FOC 'square' noise  
The added neutral mode by timer  
The button now turns off without the need to release it  
Active braking fix when not enabled (stutter fix too?)  
Added motor gear ratio  
Speed kp changed the default to 0.1  
Added separate throttle mode power+torque  
Fixed storage erase when both banks are full  
Increased ampere offset at startup for plate  
Added power indication in the Converter menu  
Small parameter text fixes  
Added continuous logging mode  
Temperature calculation moved to a separate file  
Current calibration now only saved when the test finished  
Added error when current calibration out of range  
Battery min charge current can be set to 0 now  
Added NTC10k3500  
Added file flush when log rate slow  
Added ADC sample timetable  
Logger settings offset calculated automatically  
FOC ADC current sample for P24F changed from ADC3 to ADC1+2  
Remove low speed for changing HZ mode  
Added cruise-ready flag  
Added throttle lock when brake pressed  
Added low ripple PWM mode (for FOC)  
DMA removed, because of triple buffering (noise fix)  
Added throttle-locked flag  
SVM sector selection moved to a separate function

Added lock flags index by function name  
Increased default throttle response  
Advanced modes now have default throttle = torque

===== 1 July 2023 ===== **uLight v0.6.4** 

Added export/import  
Added kty84 tsensor  
Added hazard switch logic, works when everything is off  
Added brake strobe effect  
Added data that can be requested over LEVCAN


===== 7 May 2023 ===== **Controller v0.8.11** 

v0.8.10:  
Added Adaptive throttle mode (by default with 6%)  
Added Power throttle mode  
Added PAS scaling with buttons  
Added Torque sensor minimal pressure for insta-start  
Forwarded hall error to display flag  
Changed hall error detection logic  
DC-DC now shows current on each phase  
Added TF21904M potential driver fix  
PhaseResponse added phase selection  
Updated flag names for sensor errors  
Added phase currents and voltages for LR detect  
Added PAS voltage filter  
Added PAS voltage selection (throttle or vpas)  
Added new inputs (I1-I13)  
Inputs renamed  
Added checks to HWPort HAL  
Added t-sensor resistance compensation  
Added DAC current protection temperature correction, needs optimization  
Added 5V for FW  
VBUS calculation moved to RAM  
Added FreeRTOS-gcc workaround  
R detection now uses 50% pwm as offset  
New timer sync method for upcounter mode (R detect)  
Motor LR auto detect enabled  
Added AN brake input 'switch' detect by dV  
Added MTPA enable detect when inductance is 30% bigger  
Added hall input filter  
Added hall step forward filter with min step time  
Added fallthrough directives  
Added parameters size check as warning  
Fixed inputs array position

Motor LR moved to the last detection position  
Added local port input filter  
Added Enable Throttle function (opposite to Disable Throttle)  
Added Hall sensor minimal step time  
Added wait code for R detect  
Fixed voltage error on R detect  
Fixed negative flux linkage  
Disabled MTPA, FW, and other options for hall calibration  
Added Adaptive throttle to adv. modes  
Control structure optimized  
FOC FW improved, should not stuck  
Vq limit removed, now it is by default  
Added (by default) MTPA mode by real Q current  
Small FOC optimizations  
Added TIM1 as a variable to linker script  
Hall code moved to upcounter while FOC in down-counter (buzz fix #1)  
DMA is now in circular mode, it needs less code with same effect.  
Added noise suppression in vq vd to decrease sector change (buzz fix #2)  
Storage updated, improved reliability, and now with version system  
Fixed invisible fault flag in logger  
Updated logger defaults  
v0.8.11:  
Small optimizations  
Logger FOC parameters replaced to filtered values in fast mode  
Data Storage unit-test updated  
Fixed a few bugs in Data Storage  
LEVCAN updated with recent bugfixes  
Added additional tests for Data Storage  
Startup junk removed  
Logger fixed hang-on display disconnect  
Logger cache moved to SRAM2  
FOC pids rolled back to v0.8.9  
Speed max increased to 200%


**Display v0.80B** 

Changed voltage drop saving  
Fixes in LEVCAN  
Fixes in flash saving  
Fixed RPM in info lines  
v0.80B: Data Storage updated with latest fixes

==== 8 February 2023 ==== **Controller v0.8.9** 


You will need to run new motor detection after update!  
This update fixes issues with the reverse function of the previous release and also some problems with recently made controllers. There are known issues with starting under high currents that will be investigated later.

Added interrupt setup logic.  
Added High V ripple flag for plate controller.  
Added middle DAC offset from raw ampere calibration.  
Fixed EXTI-PR register reset in the main logger.  
Fixed Neutral for the master controller.  
DAC offset updated for the plate.  
Fixed square wave plate reverse.  
Fixed reverse sensorless startup logic.  
Added hall idle parameter.  
Hall angle fixed, now transition with offset, when not interpolated — no offset.  
Added fix in HW config for TF21904 drivers (shipped after Dec 2022 till Feb 2023).  
Added fault flag to the logger.  
FOC has removed the extra current at the start.  
FOC angle now has no offsets.  
FOC sectors moved to match the square wave.  
FOC added an additional dead time gap.  
Added load defaults by section.

==== 14 October 2022 ==== **Display v0.75B** 

Export configuration before the update, update the Display, and then import your config!  
Added menu for forced device update.


- Added passwords for devices menu and main menu.  
Configurable max visible speed in statistics.  
Fixed some SD card issues, and added exFAT support (not for display update).  
Added phase current bar min/max setting.  
Added menu for forced device update.  
Fixed brake voltage inversion.  
Fixed Wh calculator for high power.  
Removed info line scroll in info line theme.  
Phase current now showed as Ap.

==== 26 September 2022 ==== **Controller v0.8.8** 

Export configuration before the update, update controller, load default settings, and then import your config!


Added motor angle to logger  
Fixed errors in combined transition logic  
Fixed clutch negative current spike  
Added FOC vq limit parameter for QS165 motor  
Fixed reverse operation for vq limit  
Current calibration fix for shunt  
Levcan got an update on ParseParameterValue  
Fixed PWM minimum time for TF driver (FOC)  
DAC constant updated with calibrated value

Position sensor temporary fix for FOC when not interpolated  
Added remote throttle timeout (locked screen full throttle bug)  
Many small fixes for assembly testing

==== 8 August 2022 ==== **Controller v0.8.7** 

Fixed sensor logic for square wave  
Fixed adc issues but still should be improved  
ADC logic changed to more future-proof  
Added configuration import with button  
Added import lock when motor spinning  
Moved PLLs to separate file  
Fixed current spike on brake press (filter abs duty)  
Removed 'hall invalid' logic from interpolation start  
Improved speed control for reverse from forward movement  
Position sensor logic separated  
USB code deleted  
Stop PWM on debug added to pwm hal  
SQ have sensorless interpolation  
Interpolation logic improved  
Deleted global PositionSensor variables  
Fixed speed reference NaN  
Added diagnostic mode to state machine switch  
Fixed few diagnostic issues  
Live hall angle update in menu  
Added NaN checks for hall  
Adjusted detected angle for first step  
BEMF now have one extra step to skip spike, in case if it falls slowly  
Detection sensor state fixed, caused motor to stall  
Added frequency startup logic for sensorless square wave (yay!)  
Frequency control used for sensorless startup now, default changed to 2  
Added encoder position sensor  
Pullup control removed  
Added encoder menu  
Added encoder detection  
Updated position sensor logic, detection routed through it  
Added hall detect quick fail  
Swapped hall inputs to match timer index  
Speed calculation changed  
Rads calculation moved to Position sensor file  
ERPS counter upgraded with direction filter  
Encoder angle calibration added  
RCPWM disable-exit added  
Added pwm port assignment to encoder  
Torq sensor exit added  
ADC ports reassigned  
Few parameters live update fixed  
Added encoder info to device info menu

Added E suffix for Encoder  
 OV and UV flags separated  
 Test bench code moved to separate file  
 Includes optimised everywhere  
 Square wave current offset disabled on next step now  
 FW added better enable logic, to help avoid extreme brake power on FW  
 Added few FOC optimisations  
 Added FOC vq limit before vd-vq vector limit, to let vd do field weakening more (unlimited vq caused worse FW performance and sometimes it was stuck)  
 SQ added DC current dead time compensation  
 Added out of control detection logic  
 Added serial number  
 Added calibration constants  
 Added calibration logic when checking hardware  
 Added FreeRTOS stack monitor  
 Optimised testing procedure for faster test  
 Updated critical task enter routines  
 Fixed field weakening integral kick if foc is forced shutdown  
 Changed PWM Freq to constant  
 Position sensor menu updated  
 Over-Field weakening flag logic fixed  
 Fixed PAS menu parameter update  
 Moved foc square-boost to sector switch logic  
 Added PLL low speed smoother logic

==== 6 April 2022 ==== **uLight v0.6.3** 

Fixed T1/T2 settings menu.

Now possible to disable the turn signal blinking by setting 0 sec. ==== 23 March 2022 =====

**Controller v0.8.6** 

Field Weakening PID updated.  
 Added FW limit based on motor temp limit.  
 Decreased allowed FW vector size to 80%.  
 Config defaults decreased.  
 Added locks 10 seconds on temperature exceeding.  
 Small menu changes and export fixes.

==== 20 January 2022 ==== Critical update for new controllers and hotfix for controllers 6F/12F and old 24F. Export config before the update, load defaults after the update, and import your config.


### **Important!**

If your On-board computer has firmware **v0.60B** or lower and Controller **v.7.18** and lower, first, need to update all devices but display. Because menu protocol is new and old devices will not be visible in the menu. After the update is finished hold the left button few seconds to exit the updated device menu. If the button does not work you may need to reset the power supply or replug CAN cable in the On-board computer. After everything is updated — update the On-board computer. Make a controller reset (load defaults) after the update. We recommend running motor detects again on controllers. Detection of throttle/brake connected to display should be done in the On-board computer [menu](#).

## Controller v0.8.5

Save system updated, added unit tests.  
Added clutch shutdown when brake pressed.  
Added option to enable MTPA.  
USB for computers disabled by default, will be removed in the future Fixed P1 P2 PWM mode.  
Lifetime temperature now calculates only when motor powered.  
Added hall pullup disable option.  
Various save system fixes.  
Fixed NaN for resistance detection.  
Fixed import of 1st parameter in every section.  
  
Hotfix for 6F/12F and old 24F.

==== 18 October 2021 ==== First, need to update all devices but display. Because menu protocol is new and old devices will not be visible in the menu. After the update is finished hold the left button few seconds to exit the updated device menu. If the button does not work you may need to reset the power supply or replug CAN cable in the On-board computer. After everything is updated — update the On-board computer. Make a controller reset (load defaults) after the update. We recommend running motor detects again on controllers. Detection of throttle/brake connected to

display should be done in the On-board computer [menu](#). **Display v0.71B** 

Menu redesigned.  
All display settings moved to separate menu.  
Added port input state in port settings.  
Added port functions: disable backlight, lock screen.  
Added separate hotkeys while charging.  
Added option to use hotkeys with a short click.  
Added throttle/brake settings which are connected to display.  
Added global odometer setting.  
Global stats reset will not reset odometer now.  
Added parameters import/export.  
Added icons on the main screen (brake, brake limit, turtle mode, motor/controller fault, battery fault).  
With new controllers update speed is 6 times faster now.  
Logger speed should work faster too.  
Added text scroll in the menu.  
Logo updated.  
Added more informative messages for resets with a password request.  
Added parameters that could be requested from display on CAN bus. \\</WRAP> === v0.71  
Fixed some parameter editing.  
Updated import/export.  
Odometer now can be imported, value is not decimal now.  
Fixed button blinking while typing a password.  
Fixed charge screen, button blinking fixed.  
Fixed info-lines names.  
Fixed header for password message.



## Controller v0.8.2

Added glitchy USB to controller (needs a USB cable connected to PWM port).  
Completely new LEVCAN parameters protocol with more possibilities.  
Added trip statistics menu to controller:  
-Wh regen/used/total.  
-Ah regen/used/total.  
-Estimated motor efficiency realtime and average.  
-Calculated motor torque (on shaft).  
Temperature measurement now calculates t-sensor resistance.  
Improved kV detection.  
Fixed 'bug' with long brake response on slow current change speed for acceleration limit.  
Defaults for all ports now OFF.  
Added brake button % (percentage of brake phase current for button-brake).  
Added brake on released throttle (brake phase current).  
Motor inductance and resistance detection for MTPA.  
MTPA logic (works good only with IPM motors).  
Fixed FOC FW to be triggered at stop when braking.  
Added more control CAN commands.  
Added more parameters that could be requested from controller on CAN bus.  
Added more logger parameters.  
Added hall filter settings to debug stuttering.  
Added prefix selection for controller name.  
=== v0.8.2  
Added log header option.  
Added translation for some messages (RU).  
Added error messages for throttle/brake detection.

## uLight v0.6.1

New LEVCAN parameters protocol.  
Fixed PWM IO settings, now they do work.  
Added temperature sensor thresholds, they work as virtual button for functions.  
Added ability to send button inputs to CAN bus.  
Main program source code published on GitHub:  
<https://github.com/Nucular-tech/uLight>

===== 31 August 2020 ===== Use configuration export before update, reset defaults after update and import configuration.


## Display v0.60B


Fixed throttle drop.  
Small menu fixes.  
LEVCAN updated.

Button setup simplified, by default all set to CAN mode.  
 Added exFAT support (but display still can be updated only from FAT32).  
 Added charge screen.  
 Added fast statistics type selection.  
 Added wider event window.  
 Mph stats fixed.

**Controller v0.7.18** 

Experimental logger added.  
 Fixed many charger glitches, however still have few.  
 Added soft start to charger and more safe phase detect.  
 Completely reworked field weakening, now should not have any hard braking after release.  
 Added minimum speed reference for speed PID.  
 Added RC PWM control on P1 port (throttle/brake).  
 Added more logger parameters.  
 Few important FOC control fixes, DC current should be calculated better under field weakening.  
 Fixed one weird ultra-rare bug in square mode.  
 LEVCAN operates on queues now, log time 2x faster when display updated.  
 Decreased DCi Ki default from 500 to 200.  
 Slightly decreased FW start point.  
 Added full debug info export.  
 Added logger mode selection and tuned logger start.  
 Removed first line from log for easy datazap upload.  
 Throttle / brake curves added (8 point configuration) with presets.  
 PAS extra scale added for additional modes.  
 Soft acceleration for cruise added, more shutdown triggers.  
 Cruise logic updated - phase current limited by selected mode, not throttle position.  
 Minimum cruise speed - limits cruise activation.  
 Cruise increment/decrement - control cruise speed with buttons ( port = CR+/CR-)  
 Cruise restore - recovery last saved cruise speed with button, activated only above min cruise speed.  
 (port = CRr)  
 Power limit added to modes and battery configuration. 0 = power limit disabled.  
 Small menu fixes.  
 CAN inputs increased to 16.  
 Parameters export / import fixes.  
 12V shutdown fix.

==== 18 March 2020 ==== **Display v0.59B** 

HOTFIX for display speed sensor ==== 11 March 2020 ==== **Display v0.58B** 


Fixed 0V throttle issue.  
 Fixed charge statistics reset.  
 Added kmh/mpg switch.  
 Added more parameters to info. lines on main screen.

Added hotkey mode for compatibility with controller speed functions.  
Fixed contrast setting.  
Added driving range, calculated from WH usage.  
A lot of tiny fixes.

## Controller v0.7.12

Torque PAS fixes  
Fixed configuration import for advanced modes  
Added configuration selector from 1 to 9  
Import will show first line of configuration, you can put a comment here  
Fixed N mode  
Fixed motor wiggle at charger mode  
Added more debug information

==== 21 Nov 2019 ==== HOTFIX, fixed NaN error for analog inputs.

**Controller v0.7.9**  ==== 20 Nov 2019 ==== Export configuration (or make screenshots), after controller update do "Erase data storage" and reboot. Configuration will not be imported fully, some values will need to enter manually.

## Display v0.57B

CAN buttons setup  
Inverted inputs setup  
Statistics reworked  
Added filters for analog inputs

## Controller v0.7.8

Big menu update  
Control logic completely reworked for future compatibility with BMS  
New default values for PIDs  
DC-DC low voltage difference charge fixed  
Inverted brake input added  
Specific setup for 3 positional speed switch added (can work now as 1-2-3)  
Button/switch select for usual speed select input  
Save CRC calculation fixed  
New speed mode - neutral  
Speed increment and decrement added  
Added t-sensor NTC 10k B:3380  
Reboot command added  
Fixed field weakening over 126%  
Fixed VBUS measuring, now it is at PWM frequency, significantly improved overvoltage protection

Added median VBUS filter  
Added averaging of N-X ADC samples filter for throttle and brake  
Fixed brake glitches  
Current measuring fixes for better measuring on 6F board  
When enable button configured controller will not turn-on anymore when power applied  
Autodetect improved, more informative, short-circuit detect added and timeout fixed  
Added lock-at-turn-on, will lock throttle until password on-screen is entered  
Voltage on phases detect added, will lock controls  
UVLO added  
Added "Advanced modes" menu with more specific options per mode  
Personal throttle protection lock for CAN source or local  
Motor temperature limit for charger (DC-DC)

From:

<https://docs.nucular.tech/> - **Nucular Electronics**

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Last update: **2023/10/06 08:26**