Seriously Pro

Racing F3 EVO Flight Controller

Thank you for directly supporting the Cleanflight project with your purchase.

About

The Seriously Pro Racing F3 EVO Flight Controller (SPRacingF3EVO) was designed to give awesome flight performance in a stackable race-ready package. It has the latest sensors, race timing & logging technology backed by excellent connectivity options at a wallet-friendly price.

Featuring a race timing transponder system the SPRacingF3EVO is truly designed for racers. Analyze your race and flight telemetry/blackbox logs using the built-in MicroSD card socket.

The SPRacingF3EVO gives you all the features you need for the heart of your aircraft, whether you're into FPV racing, acrobatic flying or aerial photography it's perfect.

Features

- Next-generation STM32 F3 processor with hardware floating point unit for efficient flight calculations and faster ARM-Cortex M4 core.
- MicroSD-Card socket for black box flight log recorder - optimize your tuning and see the results of your setup without guesswork.
- Race transponder built in - just turn up at a race and have your lap times recorded.
- Features the latest Accelerometer, Gyro and Mag/Compass and Baro/Altitude sensor technology.
- Wire up using using pin headers for all major connections for excellent crash-durability. Use either right-angled or straight pin-headers.
- No compromise I/O. Use all the features all the time; e.g. Connect your USB + OSD + SmartPort + SBus + LED Strip + Battery Monitoring + 8 motors - all at the same time!
- 8 PWM output lines for ESCs and Servos. Arranged for easy wiring on standard pin headers.
- Supports direct connection of SBus, SumH, SumD, Spektrum1024/2048, XBus receivers. No external inverters required (built-in).
- Supports direct connection of 3.3v Spektrum Satellite receivers via 3 pin through-hole JST-ZH connector.
- Dedicated PPM receiver input.
- 3 Serial Ports - NOT shared with the USB socket.
- Telemetry port
- Micro USB socket.
- Dedicated output for programmable LEDs - great for orientation, racing and night flying. (Currently mutually exclusive with the Transponder).
- Dedicated I2C port for connection of OLED display without needing flight battery.
- Battery monitoring for voltage and current.
- RSSI monitoring (analogue or PWM).
- Buzzer port for audible warnings and notifications.
- Developer friendly debugging port (SWD) and boot mode selection, unbrickable bootloader.
- Symmetrical design for a super tidy wiring.
- JST-SH sockets only for I2C, UART2 and SWD. UART2 also on through-hole pins.
- Flashing via USB or serial port.
- Stackable design - perfect for integrating with OSDs and power distribution boards.
- Standard mounting - 36x36mm with standard 30.5mm mounting holes.
- LEDs for 3v, 5v and Status for easy diagnostics.
- Copper-etched Cleanflight logo.

Software

The SPRacingF3EVO runs the open-source Cleanflight flight control (FC) software which has an ever-growing community of friendly developers and users. Being open-source means that you too can contribute to the system.

Cleanflight comes with a detailed manual that is reviewed and maintained by the Cleanflight developers and community. No more out-of-date wiki pages and second-hand information.

See http://cleanflight.com for links to the manual. PDF copies can be downloaded from the github releases pages. Ensure you reference the manual that is appropriate to your firmware version.

History

The hardware was designed by the lead developer of Cleanflight to be more capable than the previous-generation STM32F1-based boards and to set the benchmark for a wallet-friendly STM32F3 based board.

The EVO uses a similar layout to the SP Racing F3 Acro & Deluxe boards; the stack-pins, ESC/Servo outputs and connectors are in the same location on the F3 EVO as they are on the Acro and Deluxe boards for maximum mounting compatibility with existing products.

Compared to the F3 Acro/Deluxe the EVO uses newer sensor technologies, adds MicroSD and Transponder functionality and drops PWM receiver (1 wire per channel) support.

WARNINGS

Failure to adhere to these warnings will void your warranty and destroy your flight controller.

- When using ESCs that support active braking or battery regenation ensure the FC is protected with a power supply filter. Damage to the FC caused by lack of protection is not warrantable.
- Observe polarity at ALL TIMES. Check and DOUBLE CHECK before applying power. Do not rely on wire color-coding alone.
- POWER OFF before unplugging, plugging in or making any connections.
- Connect only one 5.0v SOURCE of power to the VIN pins / Do not connect more than one SOURCE of power to two or more of the VIN pins. e.g. If you are using ESCs with BECs then remove the center RED wire from all but one ESC connector.
- Do not connect SOURCES of power to the pins marked with 5v. They are OUTPUTS for supplying power to other devices.
- Do not connect a LiPo to the 5.0v VIN pins.
- The 3.3v supply is for low-current use only. 100mA MAX.
- Do not use a VIN voltage source higher than 5.0v. Check your 5v supply is actually outputting 5.0 volts, check it before powering the FC via VIN. - do not just assume it is 5v.
- Do not connect GND, 5v, VIN or 3.3v to each other (short circuit).
- Do not connect GND, 5v, VIN or 3.3v to any inputs or outputs unless specifically stated.
- Do not connect any input or output to any other input or output unless specifically stated.
- Do not allow dirt/dust/glue/etc into the pressure sensor (barometer).
- Keep magnets away from the flight controller.
- Do not use excessive force when inserting or removing MicroSD cards.
- Always align USB plug and socket when inserting/removing USB cables to prevent damage to the USB socket.

GENERAL ADVICE

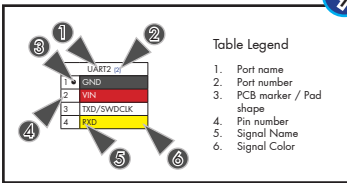Follow the advice below for best performance and long-life of your flight controller:

- Apply resin/glue to reinforce JST-SH connectors - helps if you crash your aircraft.
- To further protect the board from crashes you can add a some additional solder to the edges of the JST-SH and USB sockets to reinforce them.
- Support JST connector sockets when inserting cables.
- Using an enclosure/box for the flight-controller is recommended.
- Install open-cell foam on the pressure sensor.
- Do not cover the hole in sensor (e.g. with glue, resin, etc) or allow foreign object to enter it.
- Route motor/battery wires as far away from the compass sensor (magnetometer) as possible.
- Using color-coded pin headers is recommended (not supplied), especially for BATTERY connections.
- For optimum performance do everything you can to prevent vibrations reaching the accelerometer/gyro sensor. e.g. balance motors, props use rubber isolation grommets and secure everything.

TOP

1. UART2 socket.
2. I2C socket.
3. UART3 headers.
4. UART1 headers.
5. Spektrum Satellite JST-ZH socket holes.
6. IR LED headers.
7. UART2 / PPM/TLM headers.
8. Current/RSSI headers.
9. Battery headers.
10. BUZZER headers
11. PWM 1-8 headers.
12. BOOT Pads.
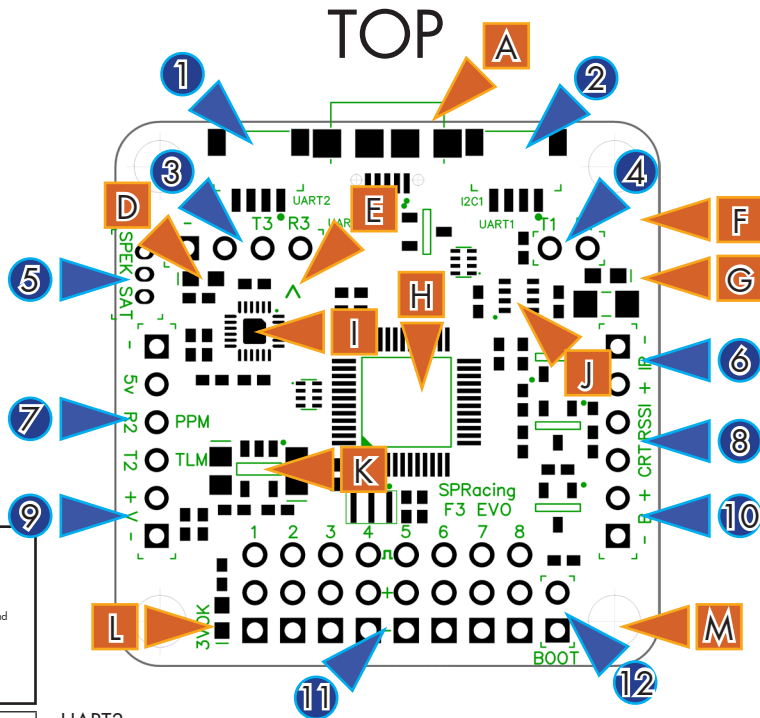
A. MicroUSB socket.
D. STATUS LED.
E. Orientation indicator.
F. Cleanflight copper-etched Logo
G. 5V OK LED.
H. STM32F303 processor with FPU.
I. Accelerometer, Gyro and Magnetometer (Compass) sensor.
J. Air pressure sensor (Barometer).
K. 3v3 Voltage Regulator.
L. 3V3 OK LED.
M. M3 mounting holes.

Table Legend
1. Port name
2. Port number
3. PCB marker / Pad shape
4. Pin number
5. Signal Name
6. Signal Color

UART3 (3)	
1 ■	GND
2 ●	VIN
3 ●	TXD (T3)
4 ●	RXD (R3)

UART1 (4)	
3 ●	TXD (T1)
4 ●	RXD (R1)

Spektrum Satellite (5)	
1 ●	RXD (R3)
2 ●	GND
3 ●	3.3v

IR LED (6)	
1 ■	IR -
2 ●	IR + / LED Strip

UART2/PPM (7)	
1 ■	GND
2 ●	5v
3 ●	RXD (R2 / PPM)
4 ●	TXD (T2 / TLM)

CURRENT / RSSI (8)	
1 ●	CURRENT (CRT)
2 ●	RSSI

BATTERY (9)	
1 ●	+V
2 ■	V-

PWM 1-8 ESC/SERVO OUTPUTS (10)	
1 ●	PWM/ONESHOT125
2 ●	VIN
3 ■	GND

UART3
Use for GPS, Spektrum Satellite RX, SmartPort Telemetry, HoTT telemetry, etc.

IMPORTANT: 3.3v ONLY signals.

UART1
Use for connecting to OSD/GPS/BlueTooth. 5v signals OK.

Spektrum Satellite socket holes.
Holes ready to install a top-mount or side-mount through hole JST-ZH 3 pin socket for connecting to a Spektrum Satellite receiver - UART3. PIN 1 faces towards the bottom of the board.

IR LED
IR + (Pin 2, ROUND) is used to connect either:
a) to a single IR LED - either direct-solder the LED or attach the LED via a cable. The LONG leg of the LED goes in the ROUND hole. The SHORT leg of the LED goes in the SQUARE hole.
b) to the DIN (Data DIN) on a WS2812 RGB LED strip.

The IR + / LED Strip pin is disabled until the IR/LED select pads (bottom) are set.

UART2/PPM - Serial RX or PPM RX + Telememetry
Use a standard 3 pin cable on pins 1-3 to attach to either a Serial RX receiver or a PPM receiver. Use pin 4 as telemetry output when using PPM.

5v is also supplied when connecting via USB.

Note: When using a Serial RX receiver the TXD (T2) pin cannot be used for telemetry. Use UART3 TXD instead.

Note: UART2 TXD (T2) cannot be used when using the SWD port.

CURRENT / RSSI
Current - 0 - 3.3v input from external current sensor for current monitoring.

RSSI is for 0 - 5v PWM RSSI or 0 - 3.3v Analog RSSI - Disabled until RSSI select pads (bottom) are set.

BATTERY - IMPORTANT: DOUBLE CHECK and TRIPLE CHECK POLARITY!
For connecting a 2-6S LiPo battery (25V MAX). Used for voltage monitoring ONLY. Will NOT power the board or accessories.

ESC/SERVO OUTPUTS.
8x3 Pin headers for connecting servos/motors. ALL VIN holes are connected to each other. VIN can be used to power the board. When VIN-5v Pads are bridged only connect OUTPUTs to VIN holes.

BUZZER (11)	
1 ■	BUZZER- (B-)
2 ●	BUZZER+ (B+) / 5v

BUZZER

Use 5V and BUZZER- to connect to an external buzzer.

5.0v is also supplied when powering via USB.

BOOT (12)	
1 ■	3.3v
2 ●	BOOT

Boot Headers - Used for recovering firmware

No connection = Boot Normally
Bridged = STM32 Bootloader

UART2 socket (1)	
1 ●	GND
2	5v
3	TXD/SWDCLK
4	RXD

UART2 connector - Used for 5.0v Serial IO. (GPS, etc.)

TXD MUST NOT be used when SWD port is in use.

5.0v is always supplied via the on-board voltage regulators, even when powering via USB.

I2C1 socket(2)	
1 ●	GND
2	5v
3	SCL
4	SDA

I2C1 connector - Used for external sensors and OLED displays.

The SCL and SDA are 3.3v signals.

5.0v is also supplied when powering via USB.

IMPORTANT: logic level converters are REQUIRED if your sensors use 5.0v signals.

NOTE:

You can check the transponder LED is working by using a mobile phone camera pointed straight at the LED when the transponder is enabled via the board and in the software. The LED will pulse an infrared signal which usually shows up purple via a mobile phone camera.

BOTTOM

1. SWD debugging socket.
2. IR / LED select pads.
3. RSSI Analog/PWM select pads.
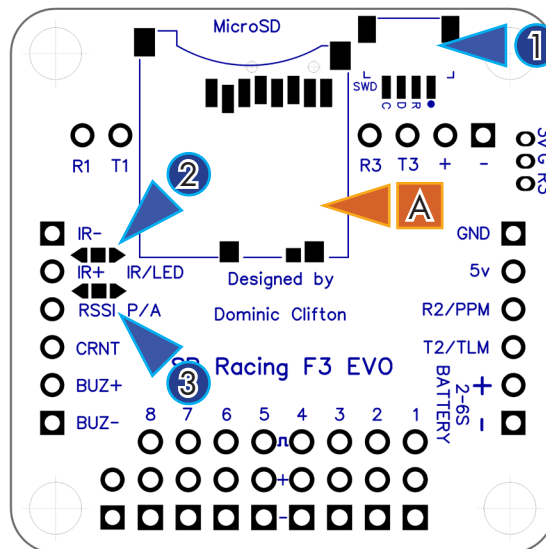
A. MicroSD card socket

SWD/DEBUG (1)	
1 ●	GND
2 R	NRST
3 D	SWDIO
4 C	SWDCLK

SWD/DEBUG connector - Used for software development or flashing via SWD

Cannot be used when UART2 is enabled. Use an ST-Link debugger with OpenOCD or a J-Link debugger.

If for some reason you cannot flash using USB DFU or UART1 you can reinstall firmware using this port.

IR/LED STRIP SELECT (2)	
1 ◄	IR
2 ■	OUTPUT
3 ►	LED STRIP

IR / LED STRIP Select Pads

Create a solder bridge between TWO PADS ONLY to select the function of the OUTPUT pad.
a) bridge ◄ and ■ to use the "IR+" pad for TRANSPONDER.
b) bridge ■ and ► to use the "IR+" pad for LED_STRIP.

RSSI PWM / ANALOG SELECT (3)	
1 ◄	PWM RSSI
2 ■	INPUT
3 ►	ANAGLOG RSSI

RSSI PWM / ANALOG Select Pads

Create a solder bridge between TWO PADS ONLY to select the function of the INPUT pad.
a) bridge ◄ and ■ to use the "RSSI" pad for PWM RSSI - for 0 - 5v PWM signals.
b) bridge ■ and ► to use the "RSSI" pad for ANALOG RSSI - for 0 - 3.3v Analog Signals.

NOTE:

When bridging select pads with solder, put a small blob of solder on two pads, then bridge them together with a little more solder.

IMPORTANT: DO NOT CONNECT ALL THREE PADS TOGETHER.

Soldering

The flight controller is supplied with a bag of pin-headers. Some are straight, some are right-angled. Choose very carefully which ones you want to use. You can solder headers to top or the bottom of the board.

Once you have soldered pin headers in place DO NOT attempt to remove them unless you are highly skilled in de-soldering and have the correct tools. Overheating the board or components will destroy it.

Cables

The flight controller is not supplied with any cables. There are sockets for 3 4-pin JST-SH plugs/cables.

IMPORTANT: Ensure that you leave some slack in your cable routing as this will help if you crash your aircraft.

Cables are available from your retailer.

Do not rely on cable color-coding due to manufacturer variations. Always check before applying power.

MicroSD Card

The MicroSD socket allows MicroSD/SDHC/SDXC to be inserted.

HOWEVER, Currently only MicroSD and MicroSDHC are supported. MicroSDXC is NOT currently supported by Cleanflight.

For full details on how to enable logging, SD card speed requirements and how to view logs please see the Cleanflight software manual.

Your aircraft will fly better if you analyze your logs and tune accordingly.

Getting started

Verify flight controller operation via the configuration software.

- Disconnect the flight controller from your computer.
- Disconnect ALL connectors and headers from the flight controller.
- Install latest STM32 Virtual COM Port Driver
  http://www.st.com/web/en/catalog/tools/PF257938
- Install and launch the Cleanflight Configurator tool
  https://chrome.google.com/webstore/detail/cleanflight-configurator/enacoimjcgeinfnnnpajinjgmkahmfgb
- Connect flight controller to computer via USB cable.
- Select the correct COM port if it is not automatically detected.
- Click connect, verify that communication is established. (Fig 3)
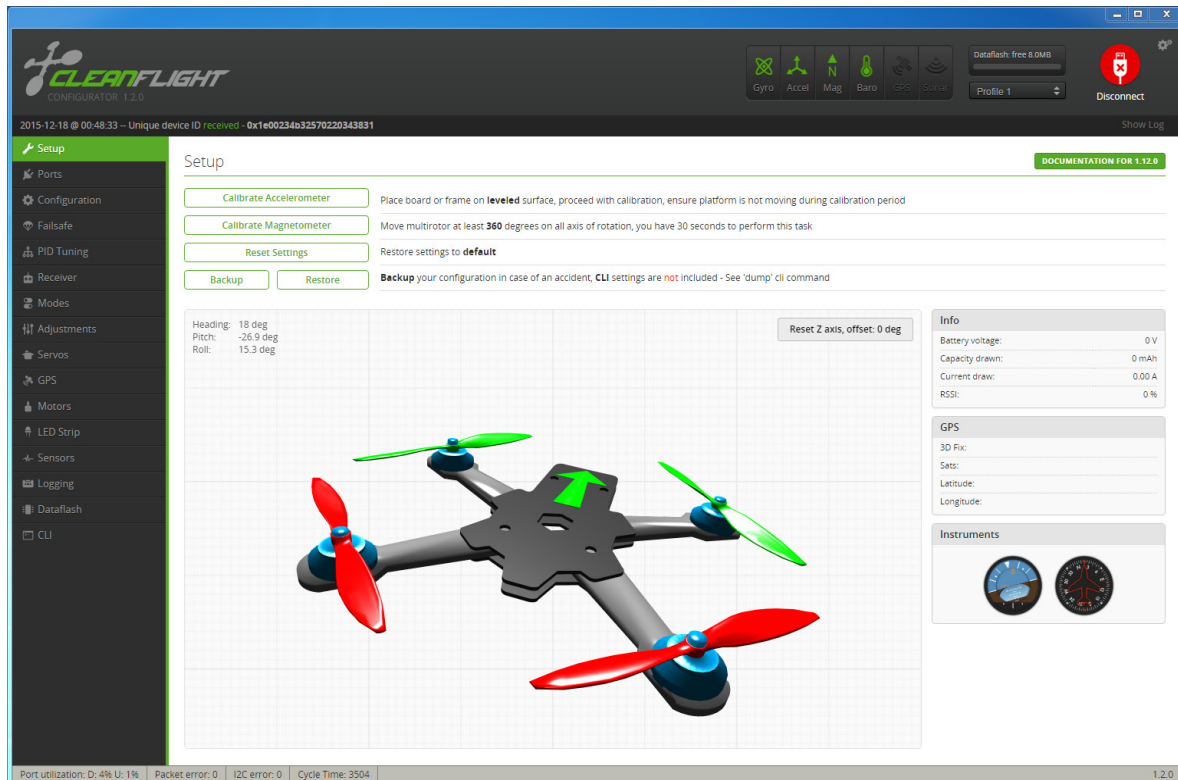
[Figure 3 - Setup tab after connection established]

- Verify all sensors on your board are giving correct readings. (Fig 4)

[Figure 4 - Sensors tab showing all sensors.

Disconnect and upgrade the firmware using the Cleanflight configurator tool. (See Firmware Upgrade section)

For further software configuration see the getting started guide in the Cleanflight manual.

The basic steps, after firmware upgrade, are as follows.
- Choose board alignment - you can mount it in any orientation, not just with the arrow facing forwards.
- Calibrate sensors.
- Configure serial ports.
- Choose model/mixer (default is Quad X)
- Enable features.
- Configure receiver, set channel mapping.
- Configure channel mid and endpoints (1000-2000) and trim channels on transmitter.
- Configure voltage monitoring.
- Configure outputs (servos/ESCs)
- Ensure ESC calibration matches ESC configuration, recalibrate ESCs if needed.
- Learn about flight modes and configure channels/switches to activate them as required.
- Learn how to arm/disarm.
- Bench-test failsafe.
- Read safety notes.
- Learn how to download and view your flight logs to help tune your aircraft.
- Insert correctly formatted MicroSD/SDHC Card before your first flight (so you have a log).
- Learn how to recognise un-tuned flight characteristics and the effects of a PID controller. (Watch some videos).
- First flight should be in Acro/Rate mode (the default mode when no other modes are active).
- Tune PIDs.
- Backup settings.
- Contribute to the Cleanflight project with feedback, suggestions, code, etc.

Firmware Upgrade

IMPORTANT:

It is REQUIRED that you immediately upgrade the firmware of the flight controller so that you have the latest features and bug fixes. DO NOT ATTEMPT TO FLY until you have installed the latest CLEANFLIGHT firmware.

On Windows USB DFU drivers must be installed. See the Cleanflight manual for latest installation instructions.

1. Click the Firmware Flasher tab.
2. Select the correct COM port and speed, use the default speed unless you have changed it on the FC.
3. Select the latest "SPRACINGF3EVO" stable release. (Do not use "SPRACINGF3" or other targets). If no firmware is currently available do NOT attempt to flash. NOTE: Flashing the wrong firmware can cause the FC to be permanently damaged.
4. Click 'Load firmware [Online]' and wait for firmware to download and read release notes before flashing.
5. Click 'Flash Firmware'. At this point the FC will reboot into DFU mode. DFU will appear in the list of ports and flashing via DFU will proceed. After flashing the virtual COM port will re-appear.
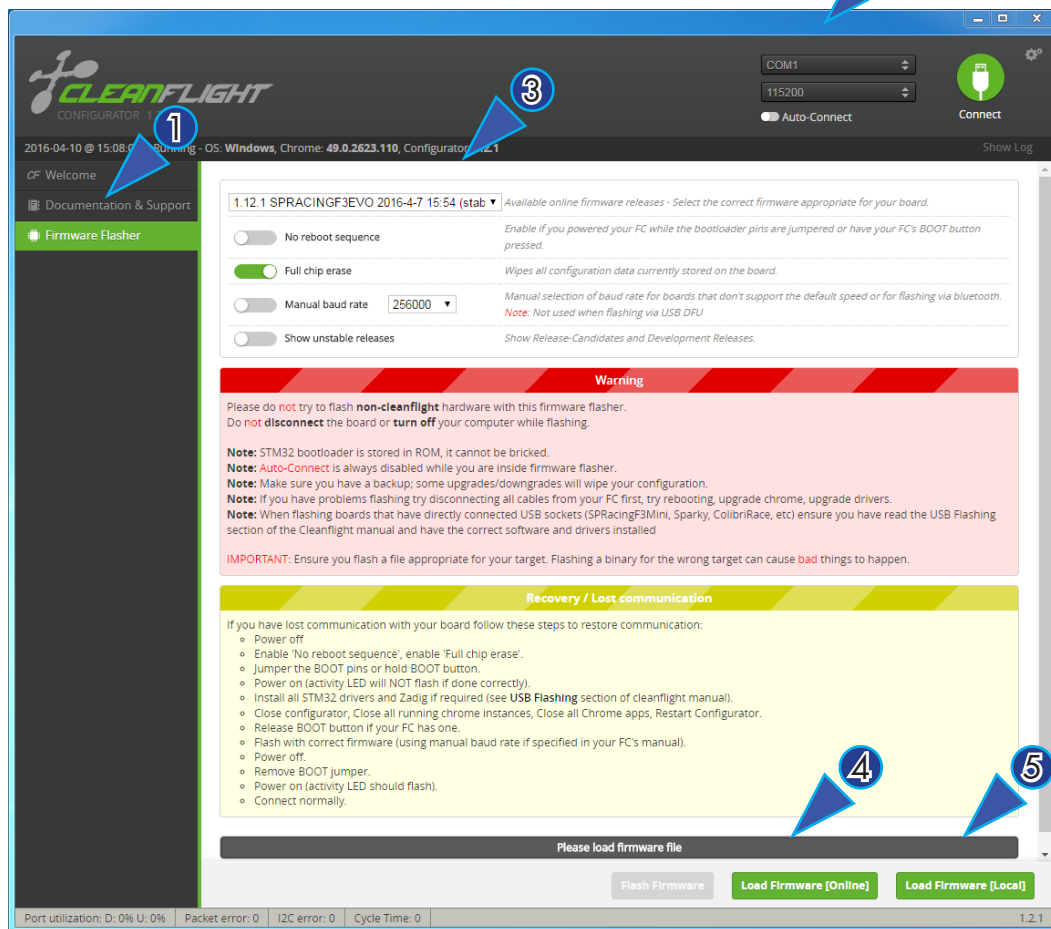
IMPORTANT: Verify operation using latest CLEANFLIGHT firmware before attempting to use alternative firmware. Not all features may be supported by alternative firmware.

Troubleshooting

Q: Unable to flash firmware via DFU.
A: Likely the correct DFU drivers are not installed. Put the board in BOOTLOADER mode (jump boot pins, connect USB cable). Then update DFU drivers. See USB Flashing section of Cleanflight manual for details.

Q: The COM port does not show up.
A: Ensure latest USB STM VCP (Virtual Com Port) drivers are installed.

Q: It beeps continually.
A: Verify your RX is receiving data and your battery voltage monitoring is configured correctly, verify that the board is aligned correctly and is not at an angle.

Q: I have no LEDs on at all.
A: Check 5v supply. (Battery Charged?, USB cable damaged?)

Q: The status LED never lights or is always on.
A: Follow recovery procedure in the configurator. Likely caused by flashing wrong firmware.

Q: Unable to connect and a repeating light sequence occurs on the activity LED.
A: Check the Cleanflight manual for how to interpret the error code (count the long flashes).

Q: Unable to connect to the board (and status LED shows non-repeating pattern at boot-up).
A: Close all Chrome browsers and Chome apps, retry. COM Port drivers not installed? Try connecting via different UART OR Reset the board to defaults using buttons OR reflash firmware using 'full chip erase'. (Likely caused by mis-configuration of ports).

Q: Transponder code not recognised by receiver.
A: Check transponder enable bridge. Check IR LED orientation and light beam exit path. Ensure transponder feature enabled in software. Ensure transponder code correctly configured.

Q: The COM port does not show up after flashing firmware.
A: Wrong firmware was flashed; Use SPRACINGF3EVO target and follow recovery steps in the Cleanflight Configurator firmware flasher to restore the firmware.

Q: The receiver tab does not show any activity.
A: Check configuration tab - receiver mode. Center sticks, configure endpoints and trim on transmitter. Check ports tab if using Serial RX. Check wiring.

Q: You have a problem not listed here.
A: Reset and/or upgrade the firmware, try again, report issues via the forums - links are in the configurator on the 'Documentation & Support' tab. Before contacting your retailer reflash with latest CLEANFLIGHT and double check - perhaps the firmware you are using is old or incorrect?

Transponder

The SPRacingF3EVO features a IR LED transponder system. For optimum performance ensure you read the following section.

Mounting - Ensure that the IR LED can shine light from its installed location onto the track-side receiver, unobstructed. e.g. ensure that props, motors, arms, etc, are not in the way of the light shining from the LED.

Orientation - Ensure the LED points outwards from the aircraft towards the track-side receivers. The more receivers you use the better the code reception will be.

Verifying operation - Ensure that the TRANSPONDER feature is enabled in Cleanflight. Ensure that the correct pads of the IR/LED SELECT solder pads are bridged with solder. Ensure that the TRANSPONDER code has been configured via the Race Transponder configuration section in the Cleanflight Configurator. Once this is done you can use a CMOS/CCD camera without IR block pointed directly at the IR LEDs and you should see them pulsing. A mobile phone camera works well for this, your FPV camera and screen/goggles may be OK if it doesn't block IR light.

Once you have verified that the IR LED pulses IR light then you can scan your SPRacingF3EVO past one of the iLAP receivers. The iLAP receiver just needs power, no software configuration is required to verify that the code is working.

The first time the iLAP receiver can read the transponder code the LAP light will pulse once, while the iLAP receiver can read the code then the activity light (ACT) will be flashing.

Each time the LAP light flashes the receiver transmits transponder code and timing information via it's COM port to the computer it is attached to.

By default the iLAP receivers will not transmit the transponder code to the PC twice in a row unless the transponder code has not been received for over one second.

For further iLAP receiver configuration and setup advice refer to the iLAP documentation.

Hardware Specifications

- 36x36mm board with 30.5mm mounting holes
- Weight ~5 grams
- STM32F303 CPU, 72Mhz inc FPU
- MicroSD card slot (SD/SDHC, upto 32GB)
- MPU9250 accelerometer/gyro/compass (connected via SPI)
- BMP280 barometer
- 1 IR LED and unique code for race transponder
- MicroUSB socket for configuration and ESC programming
- 3 LEDs for 5V, 3V and STATUS (Green, Blue, Red)
- Supplied with straight and right-angled pin headers.
- Copper-etched Cleanflight logo
- 8x 3pin though-holes for pin headers for ESC/Servo connections
- 1x 2pin though-holes for pin headers for UART1 RX/TX
- 1x 6pin though-holes for pin headers for UART2/PPM/Telemetry/LiPo (for standard SerialRX/SBus/PPM lead)
- 1x 4pin though-holes for pin headers for UART3
- 1x 6pin though-holes for pin headers for IR LED/LED Strip, RSSI, Current Monitoring, and Buzzer connections
- 1x 3pin though-holes for JST-ZH connector for Spektrum Satellite receivers (connector supplied).
- 1x 4pin top mounted, JST-SH socket for I2C
- 1x 4pin top mounted, JST-SH socket for UART2/PPM
- 1x 4pin bottom mounted JST-SH socket for SWD debugging
- 1x 2pin though-holes for BOOT jumper.

Credits and acknowledgements

Hardware design by Dominic Clifton.
Manual by Dominic Clifton.
Seriously Pro website by Dominic Clifton.
Cleanflight firmware and GUI tools are maintained by Dominic Clifton.
Blackbox flight logging component, tools and SD Card support by Nicholas Sherlock.

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The GUI tool was based on software by cTn.

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https://www.youtube.com/user/Painless360/playlists

Thanks to everyone who provided feedback on the SPRacingF3 Acro/Deluxe/Mini boards.

Software support and contributions from many, many authors. For a complete list see github contributors.
https://github.com/cleanflight/cleanflight/graphs/contributors

Community

Thanks to everyone from the AWESOME Cleanflight community for code, artwork, support, ideas, feedback, and everything else. Without you all this product would not exist.