

# Seriously Pro

SP Racing F3 OSD/PDB On-Screen Display & Power Distribution Board



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

## About

The Seriously Pro Racing F3 OSD/PDB was designed to stack with the SP Racing F3 ACRO/DELUXE and EVO flight controllers. When the two boards are stacked they create a unique and very tidy core for your aircraft.

The Cleanflight OSD software is all new and supports a variety of features with more to come. The USB socket on the OSD allows configuration and firmware flashing via the cleanflight configurator. No additional software, other than drivers, is needed.

The OSD also has race timing transponder components. The LED that comes with an EVO can be used to allow the OSD to perform transponder duties thus allowing the switichable IR/LED STRIP on the EVO to be set to LED STRIP.

## Features

- Next-generation STM32 F3 processor with hardware floating point unit with a fast ARM-Cortex M4 core.
- Race transponder built in - just turn up at a race and have your lap times recorded. (LED + CODE sold seperately, or use the one from an EVO)
- Current monitoring - know how much power you're using and when your battery is going flat.
- Battery monitoring.
- 12V and 5V supply monitoring.
- Configurable display of FC status, RSSI, modes, motors, voltages, etc.
- Automatic PAL/NTSC camera support with auto-adjusting OSD layout.
- Simple easy to wire stackable design.
- Configure using Cleanflight configurator via USB socket.
- LC Filter.
- Buzzer socket (FC controlled).
- High-Current 12V and 5V regulators.
- Designed for future expandability - Features UART and I2C sockets.
- Developer friendly debugging port (SWD) and boot mode selection, unbrickable bootloader.
- Micro USB socket.
- Flashing/Firmware Upgradable via USB socket (in DFU mode)
- Symmetrical design for a super tidy wiring.
- Standard mounting - 36x36mm with standard 30.5mm mounting holes.
- LEDs for 3v, 5v, 12v and Status for easy diagnostics.
- JST-ZH sockets for camera and VTX connections.
- Copper-etched Cleanflight logo.

## Software

The SPRacingF3OSD/PDB runs the open-source Cleanflight OSD 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 No more out-of-date wiki pages and second-hand information.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 the first brand-new open-source OSD system available to replace the ageing 8-bit MWOSD system and to pave the way for future OSD systems that build on the Cleanflight codebase.

# WARNINGS

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

- Observe polarity at ALL TIMES. **Check** and **DOUBLE CHECK** before applying power. Do not rely on wire color-coding alone.
- Perform a continuity test between Battery + and Battery - terminals on the OSD before powering up for the first time. A short circuit can start a FIRE!
- **POWER OFF** before unplugging, plugging in or making any connections.
- Connect only 3S or 4S LiPo batteries to the OSD/PDB. (4.2v per cell)
- Ensure the 3S/4S selection jumper is set correctly. If all three pads are bridged your board and attached equipment will be destroyed - only connect the center pad SQUARE to a single TRIANGLE pad..
- Ensure the two 5V/12V selections jumpers are set correctly for your VTX and Camera. If all three pads are bridged your board and attached equipment will be destroyed - only connect the center pad SQUARE to a single TRIANGLE pad.
- Do not connect SOURCES of power to the any pin marked with **5VO**. They are OUTPUT for supplying power to the FC.
- Do not connect a LiPo to any **5.0v** VIN pins.
- Do not connect GND, **5v**, **VIN**, **BATTERY+** or **3.3v** to each other (short circuit).
- Do not connect GND, **5v**, **VIN**, **BATTERY+** 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.
- Always align USB plug and socket when inserting/removing USB cables to prevent damage to the USB socket.
- Always use a current limiter when powering on for the first time - this can help save your equipment in case you wired something incorrectly. (This applies to all builds, not just with this product!).

# GENERAL ADVICE

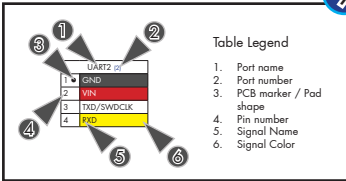
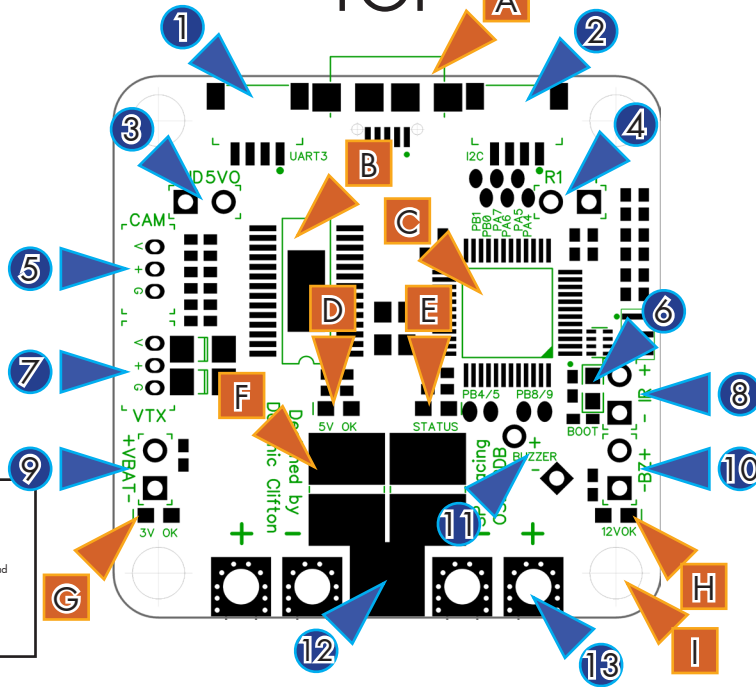
Follow the advice below for best performance and long-life of your product:

- Apply resin/glue to reinforce JST-SH connectors - helps if you crash your aircraft.
- To further protect the board from crashes you can add some additional solder to the edges of the JST-SH and USB sockets to reinforce them.
- Support JST connector sockets when inserting cables.
- Ensure all wires are tinned correctly, make sure there are NO loose strands of multi-core cable sticking out - This is VERY IMPORTANT FOR THE BATTERY CONNECTIONS.
- Ensure the board is the right way up when soldering the header pins.
- The header SOCKETS go in the TOP OSD. The header pins go in the BOTTOM of the FC.
- 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.
- If direct-soldering XT60, T-plug or other connectors to the board ensure that the XT60/T-Plug assembly is protected in a crash - too much leverage on the PCB will break it! Cable connections preferred.

TOP

1. UART3 socket.
2. I2C socket.
3. POWER-to-FC headers.
4. UART1-to-FC headers.
5. CAMERA JST-ZH socket holes.
6. BOOT pads.
7. VTX JST-ZH socket holes.
8. IR LED headers.
9. VBAT-to-FC headers.
10. BUZZER-from-FC headers.
11. BUZZER headers.
12. BATTERY + pad.
13. ESC power pads (+, - and -, +)

- A. MicroUSB socket.
- B. Video processor.
- C. STM32F303 OSD processor.
- D. 5V OK LED (Green)
- E. STATUS LED (Red)
- F. Current Sense parts.
- G. 3V OK LED (Blue)
- H. 12V OK LED (Yellow)
- I. M3 mounting holes.



POWER-to-FC (3)	
1	GND
2	5V

POWER-to-FC

For connecting to the GND and 5V pins on the FC PCB directly above the OSD PCB.

UART1-to-FC (4)	
3	TXD (T1)
4	RXD (R1)

UART1

For connecting to the USART headers on the FC PCB directly above the OSD PCB.

VTX/CAM (5/7)	
1	VIDEO
2	POWER (12V or 5V)
3	GND

VTX/CAM

Holes for installing a top-mount or side-mount through hole JST-ZH 3 pin socket for connecting to camera and video transmitters. Center pin is POSITIVE, VIDEO pins are towards the USB sockets.

**CHECK YOUR CAMERA/VTX WIRING BEFORE POWERING.**

Set each port to either 5V or 12V using the 5V/12V selector pads underneath.

Avoid direct-soldering cables if possible, removing a broken cable due to a crash is hard on these holes.

BOOT (6)	
1	3.3v
2	BOOT

Boot Headers - Used for recovering firmware

No connection = Boot Normally - USB VCP mode.

Bridged = STM32 Bootloader - USB DFU mode - Allows USB DFU driver installation for flashing.

IR LED (8)	
1	IR -
2	IR +

IR LED

IR + (Pin 2, ROUND) is used to connect an 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.

BATTERY (9)	
1	+V
2	V-

BATTERY

For connecting to the VBAT headers on the FC PCB directly above the OSD PCB.

**Do NOT directly connect a battery to these headers.**

BUZZER (10)	
1	BUZZER- (B-)
2	BUZZER+ (B+) / 5v

BUZZER-from-FC

For connecting to the BUZZER headers pins on the FC PCB directly above the OSD PCB.

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

BUZZER

Use 5V and BUZZER- to connect a buzzer.

Buzzer is controlled directly by the FC. The OSD board cannot control the buzzer.

BATTERY + (10)	
1	BATTERY POSITIVE +

BATTERY +

Single large pad for connecting to a battery. The BATTERY - pad is underneath, on the bottom of the board.

**READ SOLDERING TIPS BEFORE SOLDERING**

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

UART3 - Currently unused.  
**IMPORTANT: 3.3v ONLY** signals.

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

I2C1 connector - Currently Unused  
 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.

ESC Power (10)	
1	● ESC 1 POSITIVE + (Left)
2	● ESC 1 GND
3	● ESC 2 GND
4	● ESC 2 POSITIVE + (Right)

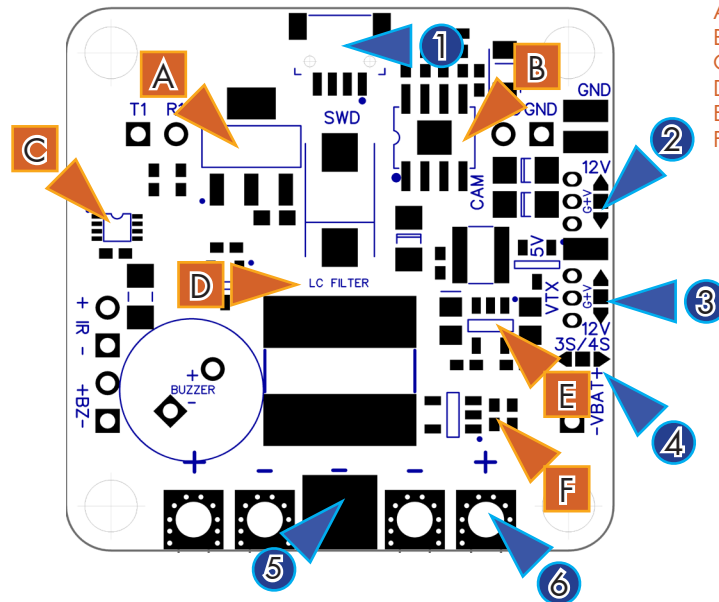
ESC Power  
 4 pads for connecting to 2 ESCs. Connect ESC GND from OSD to BATTERY - on ESC. Connect **ESC POSITIVE** from OSD to **BATTERY +** on ESC.  
**DO NOT ACCIDENTALLY BRIDGE ANY OF THE ESC OR BATTERY PADS WHILE SOLDERING - CHECK!**

**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. CAMERA 5V/12V selector pads.
3. VTX 5V/12V selector pads.
4. 3S/4S selector pads.
5. BATTERY - pad.
6. ESC power pads (+, - & -, +)



- A. 12V regulator
- B. 5V regulator.
- C. UART1 bus switch.
- D. LC FILTER.
- E. 3.3V regulator.
- F. Current Sensor.

**TIP**  
 The 5V bridge pad arrows point to the center of the board.  
 The 12V bridge pad arrows point outwards from the board.

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  
 Use an ST-Link debugger with OpenOCD or a J-Link debugger.  
 If for some reason you cannot flash using USB DFU you can reinstall firmware using this port.

CAMERA 5V/12V SELECT (2)	
1	▲ 12V
2	■ OUTPUT
3	▼ 5V

CAMERA 5V/12V select pads  
 Create a solder bridge between **TWO PADS ONLY** to select the voltage of the OUTPUT pad.  
 a) bridge ▲ and ■ to use 12V.  
 b) bridge ■ and ▼ to use 5V.

VTX 5V/12V SELECT (3)	
1	▲ 5V
2	■ OUTPUT
3	▼ 12V

VTX 5V/12V Select Pads  
 Create a solder bridge between **TWO PADS ONLY** to select the voltage of the OUTPUT pad.  
 a) bridge ▲ and ■ to use 5V.  
 b) bridge ■ and ▼ to use 12V.

3S/4S SELECT(4)	
1	◀ 3S
2	■ OUTPUT
3	▶ 4S

VTX 5V/12V Select Pads  
 Create a solder bridge between **TWO PADS ONLY** to select the voltage of the OUTPUT pad.  
 a) bridge ◀ and ■ to use 3S - 12V voltage regulator **DISABLED**. All 12V sources supplied at battery voltage.  
 b) bridge ■ and ▶ to use 4S - 12V regulator **ENABLED**.

BATTERY - (5)	
1	BATTERY NEGATIVE -

#### BATTERY -

Single large pad for connecting to a battery. The BATTERY + pad is above, on the top of the board.

**READ SOLDERING TIPS BEFORE SOLDERING**

ESC Power (6)	
1	ESC 4 POSITIVE + (Left)
2	ESC 4 GND
3	ESC 3 GND
4	ESC 3 POSITIVE + (Right)

#### ESC Power

4 pads for connecting to 2 ESCs. Connect ESC GND from OSD to BATTERY - on ESC. Connect ESC POSITIVE from OSD to BATTERY + on ESC.

**DO NOT ACCIDENTALLY BRIDGE ANY OF THE ESC OR BATTERY PADS WHILE SOLDERING - CHECK!**

#### 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.**

### 3S WARNING

When using 3S the 12V regulator is DISABLED and the battery is used for all 12V sources. If you later connect a 4S battery with 3S/4S jumper in 3S mode then you will send 16.8v to your camera or VTX when 12V selectors are used!

If you need to use both 3S and 4S batteries you are advised to use a 5V camera and VTX with a wide voltage input range (e.g. 5V - 20v). Or a 5V camera and a 5V VTX.

## Soldering

#### IMPORTANT:

- Use a high quality soldering iron and good solder.
- Tin/Lead solder is **MUCH** easier to use than other Lead-free solder.
- Use solder with flux and remove any flux residue after soldering. **AVOID CORROSIVE FLUX!**
- Check for and remove solder balls you may have created after soldering - use a magnifying glass.
- Ensure you have sufficient fume extraction when soldering.
- Pin headers that connect to the GND signal will be more difficult to solder because the PCB will sink the heat from your soldering iron. Solder the signal pins, then the VIN pins, then the GND pin - by the time you get to the GND pins you will have heated the board and it will be easier to solder them.
- If you have never soldered before then **DO NOT** attempt to solder the OSD, practice on something else first.
- 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.

## Installation.

**IMPORTANT:** Verify the board is functioning as much as possible via the USB socket BEFORE soldering.

1. Fit and solder supplied round header pin SOCKETS to the TOP of the OSD board. 1 pair in each corner - a) VBAT + and -, b) 5VO and GND, c) UART R1 and T2, d) BUZZER + and -.
2. Carefully push header pins into the header sockets that you just soldered.
3. Gently place the flight controller onto the other end of the header pins, solder each pair from the TOP of the FC so that the header pins face DOWNWARDS from the FC.
4. Take note of how much space there is in the stack for connections from the FC to your accessories.
5. Carefully, a little at a time, remove the FC from the OSD + FC stack. Taking care note to bend the header pins.
6. Install the JST-ZH sockets for the CAM and VTX sockets if you are going to use them - recommended.
7. Set the 3S/4S jumper to EITHER 3S OR 4S - **DO NOT BRIDGE ALL THREE PADS.**
8. Set the CAMERA 5V/12V jumper to EITHER 5V OR 12V - **DO NOT BRIDGE ALL THREE PADS.**
9. Set the VTX 5V/12V jumpers to EITHER 5V or 12V - **DO NOT BRIDGE ALL THREE PADS.**
10. Fit a BUZZER if you have one (supplied FOC with OSD/PDB when available). If you do not have a buzzer that fits in the space provided on the PCB then you can solder header pins, etc to the BUZZER OUT +/- pads and connect an external buzzer to them.
11. Attach Transponder IR LED (not supplied, available separately) as required.
12. Either:
  - A) Use wires for battery - Tin BATTERY + and BATTERY - wires. Tin BATTERY + and BATTERY - pads. Solder BATTERY + wire (RED) to BATTERY + pad. Solder BATTERY - (BLACK) wire to BATTERY - pad.
  - B) Use XT60 plug (male pins), T plug (male pins) and solder POSITIVE + connection to the BATTERY + pad and solder the NEGATIVE - connection to the BATTERY - pad.
13. Double check there is no short circuit between BATTERY + and -. Use a multimeter even if you think you've soldered it correctly.
14. Connect VTX or a screen to VTX output. Do NOT connect camera yet. Turn on VTX receiver, screen/goggles and tune to correct VTX channel.
15. Power up the board via battery (use a current limiter). Ensure Yellow (12V), Green (5V) and Blue (3.3V) LEDs are ON.
16. Ensure the OSD image is displayed on the screen.
17. Power off. Connect camera and FC.
18. Power on, ensure OSD and camera images are displayed on the screen.
19. Power off, disconnect camera, vtx, FC.
20. Tin ESC +/- wires. Tin ESC +/- pads. Solder the ESC wires to the BOTTOM side of the PCB first, then solder the TOP side. Ensure you do NOT cut your ESC wires too short. Allow a little cable slack to allow easier maintenance and to prevent damage in a crash. Allow the solder on an ESC pad to cool before soldering the next ESC pad as it will be easier.
21. Solder any remaining wires to the FC as per the FC manual.

## Cables

The OSD is supplied with two 3 pin JST-ZH cables for camera and VTX connections.

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

Additional or replacement cables are available from your retailer.

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

## Configuration.

Verify OSD operation via the configuration software.

- Disconnect the OSD from your computer.
- 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/enacoimjcgiefnnpajinigmkahmfgb>
- 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.

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

For further software configuration see the Cleanflight manual.



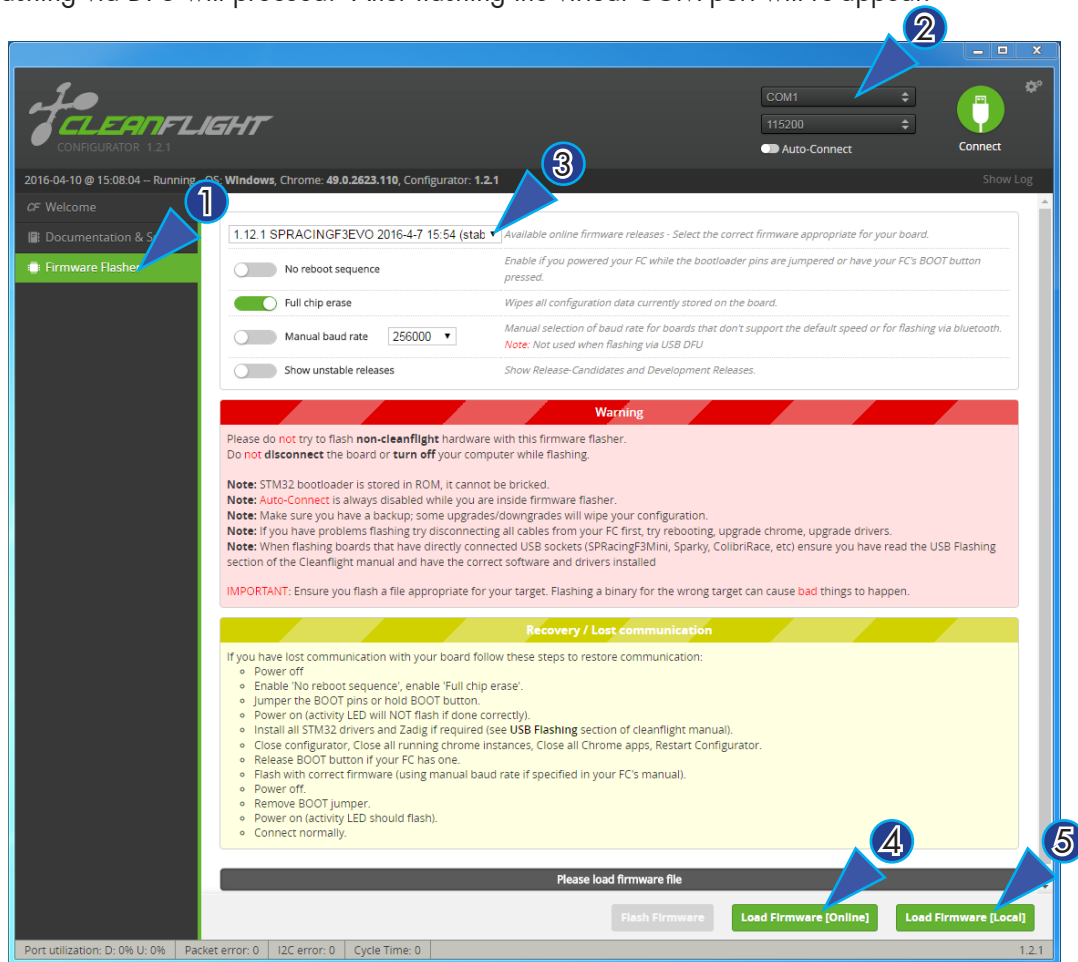
## Firmware Upgrade

### IMPORTANT:

It is **REQUIRED** that you immediately upgrade the firmware of the OSD 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, the device needs to be in bootloader mode for the DFU driver to 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 OSD.
3. Select the latest "SPRACINGF3OSD" 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 OSD 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: DFU does not appear in the PORT selection when flashing.

A: The correct DFU drivers are not installed. Put the board in BOOTLOADER mode (jump boot pads, connect USB cable). Then update DFU drivers. See USB Flashing section of Cleanflight manual for details. Watch YouTube videos of the process.

Q: The COM port does not show up.

A: Ensure latest USB STM VCP (Virtual Com Port) drivers are installed.

Q: Green LED not ON when connected via USB.

A: Check USB cable.

Q: Green LED not lit when powered by battery.

A: 5V regulator damaged. Check board for short circuits/debris/solder-balls.

Q: Blue LED not lit.

A: 3.3V regulator or CPU damaged. Check board for short circuits/debris/solder-balls.

Q: Yellow LED not lit.

A: 12V regulator damaged. Check board for short circuits/debris/solder-balls.

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 Chrome 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'.

Q: Transponder code not recognised by receiver.

A: Check IR LED orientation and light beam exit path. Ensure transponder enabled in software. Ensure transponder code correctly configured.

Q: The COM port does not show up after flashing firmware or resetting the firmware.

A: Wrong firmware was flashed; Use SPRACINGF3OSD target and follow recovery steps in the Cleanflight Configurator firmware flasher to restore the firmware.

A: FONT UPLOAD is in progress - connect camera to monitor the progress. 5 second pause, font upload, 5 second pause, normal operation.

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 SPRacingF3OSD/PDB 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 SPRacingF3OSD/PDB 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
- 4 LEDs for 12V, 5V, 3V and STATUS (Green, Blue, Red)
- Supplied with header pin sockets and plugs.
- Supplied with two 3pin JST-ZH sockets and two cables with JST-ZH plugs.
- Copper-etched Cleanflight logo.
- See website for further details.

## Credits and acknowledgements

Hardware design by Dominic Clifton.

OSD software by Dominic Clifton.

Manual by Dominic Clifton.

Seriously Pro website by Dominic Clifton.

Cleanflight firmware and GUI tools are maintained by Dominic Clifton.

The GUI tool was based on software by cTn.

Thanks to Painless360 / Lee Schofield for ideas and tutorial videos.

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

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.