ADVANCED POWER DRIVES

USER MANUAL

APD F3[x]-120 and F3[x]-100

F_SERIES

ADVANCED POWER DRIVES

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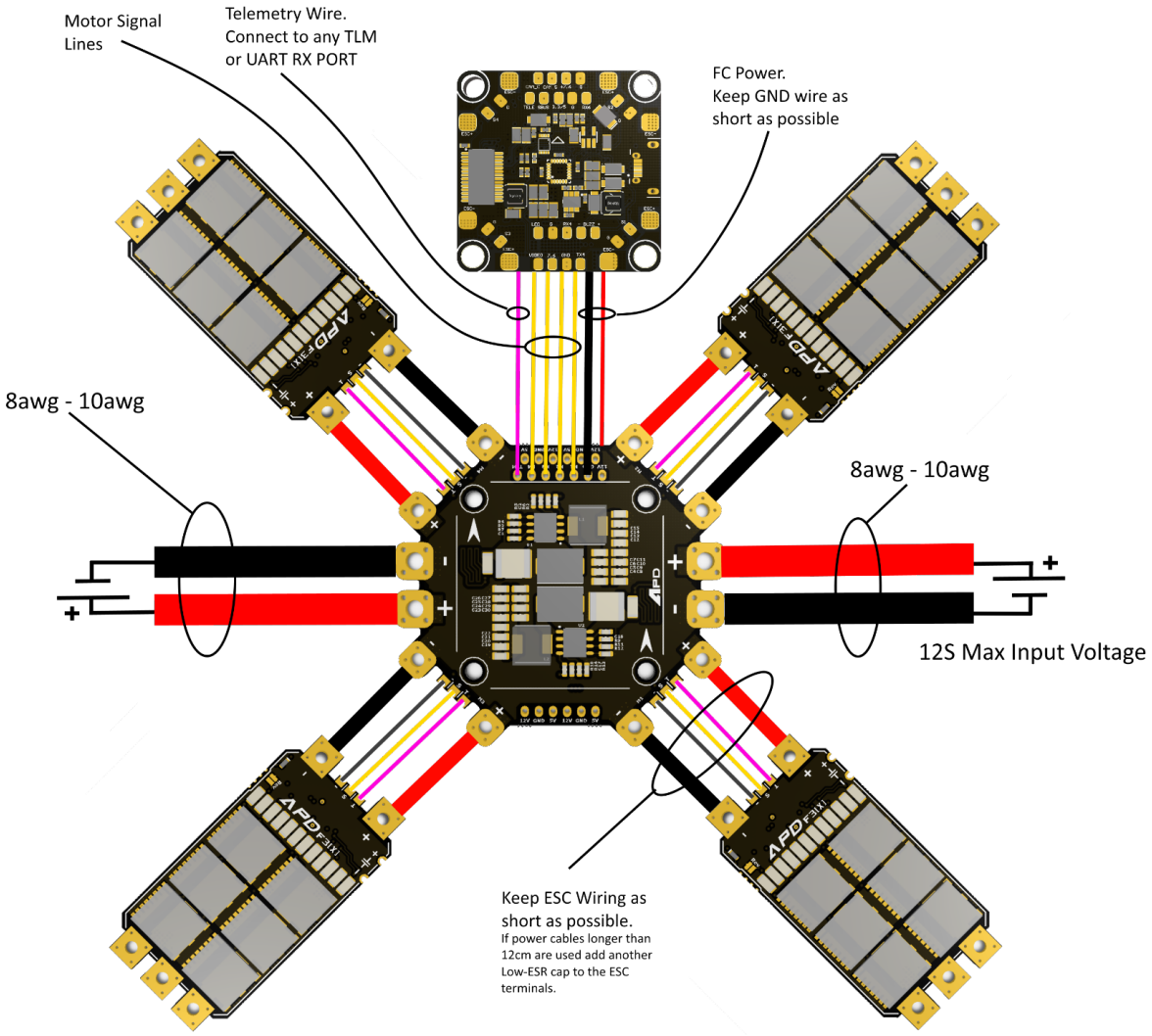
Before Power Up

- Ensure the supplied capacitor is soldered to the capacitor mounting location, with correct polarity. Refer to image (Cap mounting – on page 3).
- Ensure the ESC receives good airflow.
- Ensure you are using the correct motor and prop combination. Please refer to motor and prop size tips.
- Ensure all input power wires are kept to minimum length. Long wires will cause spikes during regenerative braking. - Ensure signal wires are wired as a twisted pair along with the corresponding signal GND wire.
- Ensure the motor phases are not shorting to the motor's stator. (Check with a multimeter)
- Make sure there is no cold solder joints.
- Ensure the FC GND is connected to the PDB GND
- After installation... Power up with a low-voltage battery and a smoke stopper to ensure wiring is correct.

Wiring Diagram –
For typical setup **using the PDB500**



- Ensure there is enough mechanical relief on all wiring so you don't rip pads off in the event of a crash/vibrations.
- Twisted pair signal and GND wires are recommended for maximum performance.

Note –
If a *wiring harness* is used instead of the PDB, **you must ensure the following:**

- All the ESC's Power **GND wires are connected to a single 'Star' node (common GND point)**.
- The **FC GND** must also be connected, with a short wire, to the **above 'star' GND point.**
- **Signal GND wires must be used.** They provide the FC with the ESC's GND reference for maximum signal integrity.
- **FC power must be supplied via a regulator** that can sustain high-ripple/high-noise environments, or a separate battery.
- **Additional capacitors**, Low-ESR 330uF-1000uF must be used on the ESC inputs if your wiring is longer than 12cm.

Capacitor mounting

- Capacitor should be installed as shown in the following image. Ensure all solder joint are soldered correctly with correct polarity. The Supplied capacitor is a Panasonic FS series 330uF.
- The following capacitors are recommended:

    - Panasonic FM or FS series.

    - Rubycon ZLJ series.

Motor and prop size:

For a MAS 13x12x3 Prop, the following motor KV is recommended:

Cell Count	Recommended KV
6S	500-700Kv
8S	400-600Kv
10S	350-450Kv
12S	300-400kv

For larger props, reduce motor Kv or cell count.

If your prop and motor combination draw more than 120A at full throttle @ static load, they are not recommended.

For reference -

Running the MAS 13x12x3 prop:

The below configurations **will exceed the 120A ESC spec:**

- 500Kv motor on 12S will draw 180A.

- 675Kv motor on 8S will draw 170A.

- 600Kv motor on 10S will draw over 200A.

Tuning

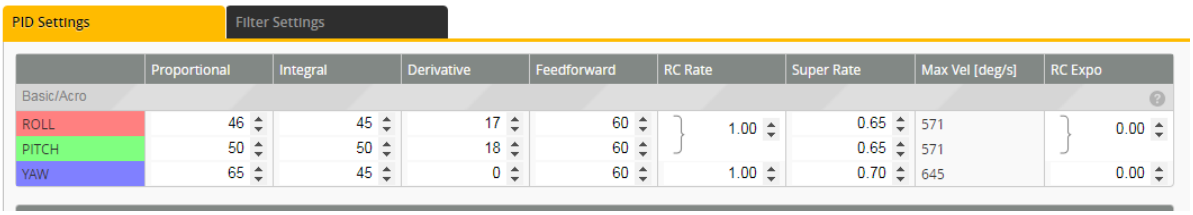
MPU6000 series recommended, ICM gyros are low-power and more susceptible to noise.

PID rule of thumb:

If increasing frame size by X%, the increase your P value by X%.

If increasing your prop size or rpm by X%, then reduce your P value by X%. Start with lower I and D, and gradually increase them.

The below PIDs are known to work well for a 1 meter frame running 350Kv motors on 12S with MAS 13inch props.



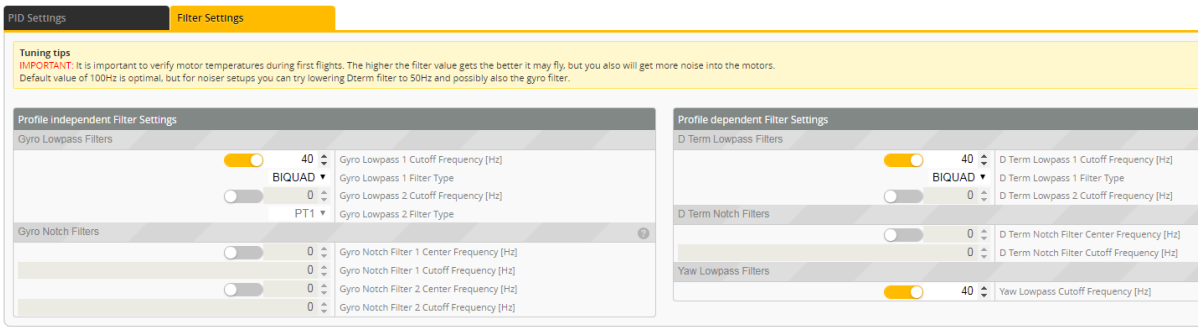
	Proportional	Integral	Derivative	Feedforward	RC Rate	Super Rate	Max Vel [deg/s]	RC Expo
Basic/Acro								
ROLL	46	45	17	60	1.00	0.65	571	0.00
PITCH	50	50	18	60		0.65	571	
YAW	65	45	0	60	1.00	0.70	645	0.00

Filters

Filters are really important on large frame. They need to be low.

The ESCs update loop-time is much higher than the frequency that the arms on larger machines vibrate at. As a result, any vibrations the flight-controller sees will pass through to the motors. Therefore, it is critical that the vibrations are filtered out.

The default Betaflight filters are set to 100Hz and tuned for a 5inch quad. They will need reducing for larger frames. The following filter settings are known to work well for a typical aluminium and carbon 1000mm frame.



Correct filters will allow for higher PID's, and result in a more locked in feel.

Usual check-ups & Maintenance:

After any crash:

- Inspect for any broken or chipped components on both top and bottom sides.
- Power using a smoke stopper and low-voltage battery to ensure the electronics are not damaged
- The no-load current draw of the 120A ESC is 40mA. You can easily check this by unsoldering the ESC from the PDB, and powering using a 3S LiPo and a multimeter. If the ESC is drawing less than 38mA or more than 45mA, then something has likely broken.
- Inspect the top and bottom sides of the ESC for any broken or chipped componets.
- It's a good idea to always check your capacitor for swelling/bulging. Excessive heat and high-current will reduce your capacitors life. Capacitor performance drops over time, so change them every 20-30 flights, even if they look ok.

The following capacitors are recommended:

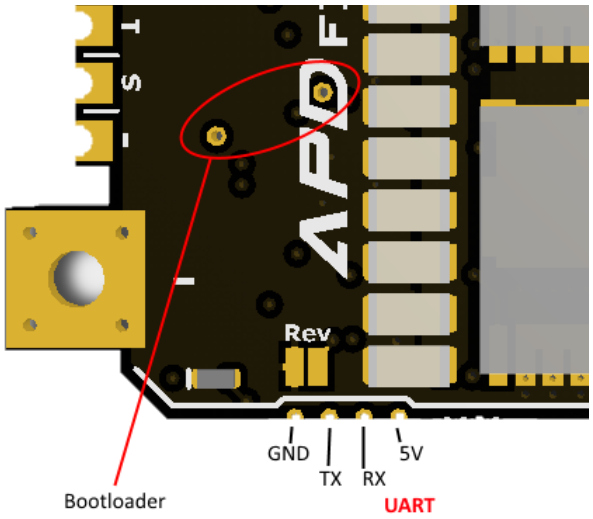
- Panasonic FM or FS series.
- Rubycon ZLJ series.

50V 330uF is recommended for mounting to the ESC. The same capacitor can be used as an additional capacitor to mount externally.

Firmware updates

Firmware updates are done through a USB-UART bridge. All FTDI and Silabs UART-USB bridges are known to work.

The UART PADs are located on the bottom edge of the PCB. Due to a 1K Pull-down resistor on the signal input (for noise suppression), pass-through cannot be used.



Protection Mechanisms

3 stage bus current limiting	The ESC will limit current to 60A when below 30% throttle, 120A when between 30-60% throttle and 200A when over 60% throttle.
Phase Current limiting	Motor phase current is limited to 200Amps
Over-temp protection	Set to 110°
Over-voltage protection	The ESC will reduce regenerative braking response when it detects a voltage rise on the bus whilst braking.
Current Sense methodology:	Impedance controlled GND plane

Tones

Types

High Beep Tone ——— high pitch (high freq)

Low Beep Tone ——— low pitch (low freq)

On Power-Up

Tone sequence:		Indicates:
3 high, 1 low, 1 high	———	Proshot detected + Armed
2 low, 1 high	———	Dshot Detected + Armed
6 fast high tones (Every 5 seconds)	———	Incorrect signal detected on power-up
1 low tone (Every 2 seonds)	———	Waiting for input signal / no input signal detected

After Arming

Tone sequence:		Indicates:
1 high (Every 5 seconds)	———	Normal operation, waiting for throttle
3 low (Every 5 seconds)	———	Thermal limit exceeded last flight

_ SERIES

APD F3[x]-120 and F3[x]-100

APD F3[X]

The APD F3[x] Series ESCs bring forward a ground-breaking new design, utilising a powerful 32bit F3 processor, running application specific firmware developed from the ground up.

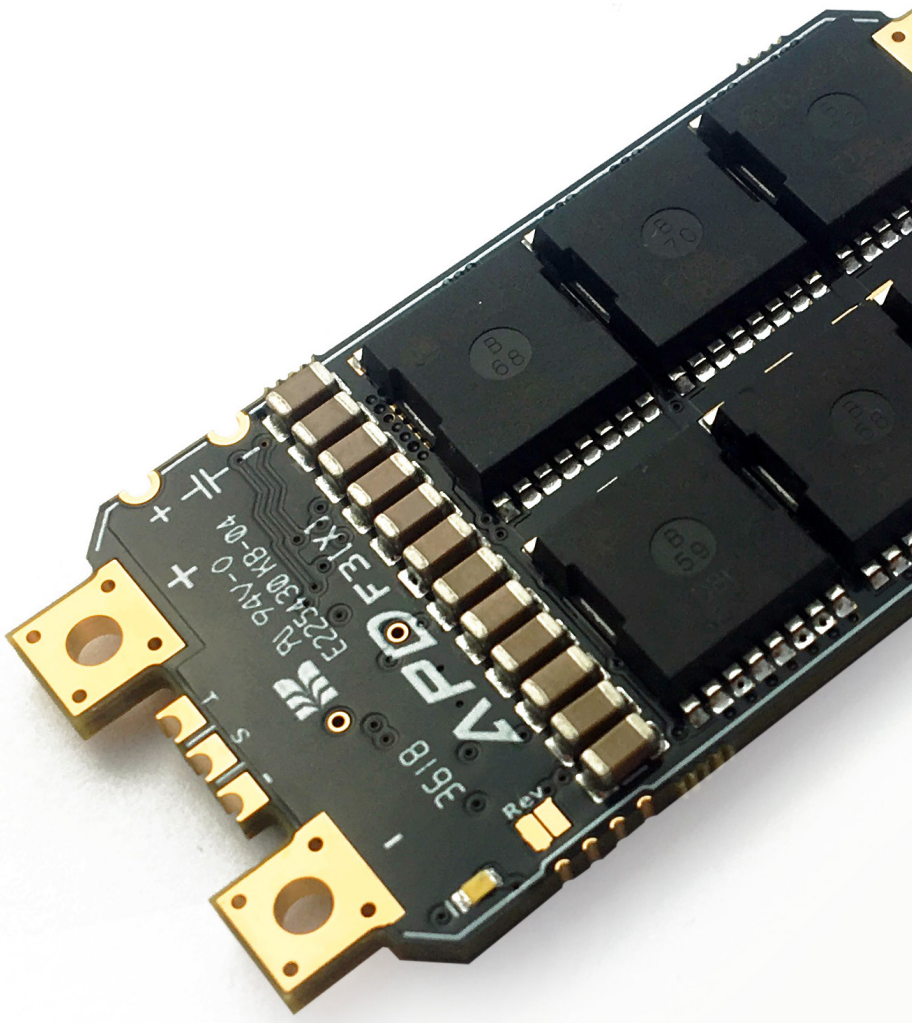
The high-speed F3 processor ensures no input commands are missed, whilst delivering unmatched input to output transient response, linearity and resolution, to ensure the smoothest flying characteristics are achieved without compromising PID performance.

The firmware and hardware are designed with a heap of protection features that include:

- **Current limiting** - both bus current and phase current
- **Thermal Protection** – 110°C (50% power reduction)
- **Intelligent Regen** (active braking) control, with over-voltage protection
- **Motor stator saturation protection** (reducing the possibility of de-sync)

SPECIFICATIONS

- Voltage: 4S – 12S
- Current: 120A with direct airflow (200A active bus and phase current limiting)
- Protocols: Proshot1000-3000 and Dshot300-2400
- RPM Limit: 750,000 eRPM
- Commands: Full Proshot/Dshot Commands include anti-turtle mode, motor beacon, and LED flash. Weight: 12.4grams
- Firmware: APD Proprietary
- Telemetry: Full Betaflight telemetry
- Protection: Active bus and phase current-limiting



ADVANCED POWER DRIVES APD

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ABOUT APD

Advanced Power Drives is Australian based electronics engineering company specialising in Power Electronics design for a wide range of industries. We offer a comprehensive range of electronics design services ranging from initial product specification through all stages of engineering including research and development, prototyping, manufacturing and certification.

We focus on high quality and high reliability.

Our designs comply to (but not limited to) IPC-2220 to IPC-2225, ACMA A-Tick, C-Tick, AS/NZ3000, DO-160, MIL-STD-429 and are currently used in commercial, military and aerospace sectors.

Areas of expertise include –
Motor control (High Power BLDC and DC), Battery management systems, DC-DC converters, high-speed FPGA, CANBus, ARINC429 and Embedded Systems Design.

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For further enquires and pricing, contact:

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