Hardware Selection
for
Aeronova SDP V3

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1. Powerplant

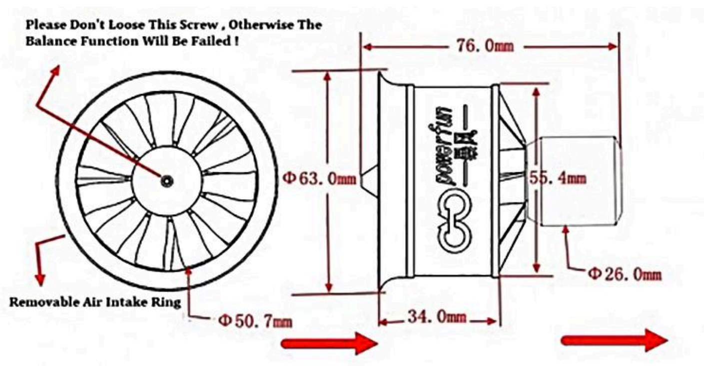
The Software Development Platform (SDP) is a tri-copter platform designed to help with flight control software development. For the SDP prototype, two types of propulsion methods are widely available:

- Brushless Motor Driven Propeller (Left)
- Electric Ducted Fan, or EDF (Right)

The propeller method provides more lift, a more linear throttle-thrust response, and better efficiency at low throttle. However, the propeller's required space is large and puts a minimum size constraint on SDP design.

The EDF however, is compact, making it the prime choice for the SDP prototype. Even in future developments, larger EDFs (or many small ones) remain a better choice than propellers due to compactness, less drag, and safety (ducted blades).

The SDP is 402[mm] by 340[mm] (engine-to-engine), with an estimated mass of 1.7[kg]. With the tri-engine configuration, each engine must sustain a thrust of at least 0.57[kgf] to lift the SDP. However, an overhead is required for conservativity. The 50 Millimeter class EDFs are great, their thrust range from 0.7[kgf] to 1[kgf] depending on brand and setup.



Static Thrust	950[gf]
Max Voltage	16.8[V]
Max Current	40[A]
OD	55.4[mm]

The chosen EDF is the Powerfun 50mm EDF, 4300KV-4s. This EDF provides the highest static thrust in its class when running on a 4 cell LiPo.

2. Electronic Speed Controller

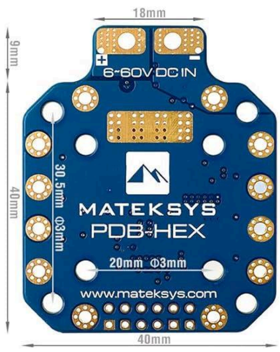
Electronic Speed Control, or ESC, is crucial as it takes in PWM throttle commands and provides the required power to the propulsion device. The chosen propulsion device is rated at 40 Amps when at max throttle. For conservativity, we select the 50A class ESCs, that way it can handle unexpected current bursts during operation.

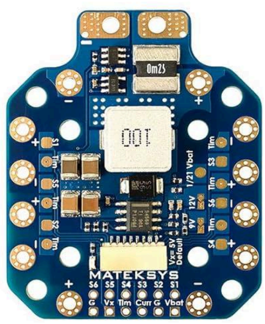
Since the flight control system and software are all proprietary, there is no need to purchase ESCs for multicopters. Instead, a standalone ESC is preferred:

The final choice is the SkyWalker 50A BEC, though the specific model does not matter. Any standalone 50A esc would suffice.

3. Power Distribution

The Power Distribution Module (PDM) manages the LiPo battery output and distributes the power to every component. We are primarily powering 3 EDFs, each running at 40 Amps when at max throttle. Therefore, the PDM should be rated for 120 Amps, preferably higher for conservativity. The LiPo battery itself has to also withstand the 120A current at peak usage, meaning its capacity and discharge rating must be sufficiently large to sustain the engines. The wires also must handle 120A.





Max Current	140[A] Cont.
Voltage	6-60[V]
BEC Output	5/9/12[V]

We chose the Mateksys HEX-X PDM as it qualifies all the requirements with significant overhead.

4. Data Transmission

Any generic transmitter-receiver set with PWM signal modulation would suffice. Considering cost, available support documentation, ease of use, and compatibility, we selected the FS-i6X transmitter. This model supports numerous receivers, and up to 10 channels for comms. It also supports telemetry.

5. Battery

Running 3 separate EDFs is a demanding task for all electrical systems, especially the battery, since it must handle the combined power draw of all systems onboard.

Finding a LiPo battery with high capacity and current rating for this project is difficult. Ideally, we want one that uses a high current socket and thick wires, such as 6 or 8 AWG. However, most LiPo are not designed for such high current draw. Those that do have thicker wires are often too heavy and are large.

Considering the likelihood of not needing to run at full power for extended periods of time, 10 AWG wires should do fine, though they are most certainly to heat up during use.

The current selection is the Youme 4S 6500 mAh 80c LiPo. If excessive heating is observed during testing, we shall explore safer options such as the Powerhobby Lipo.

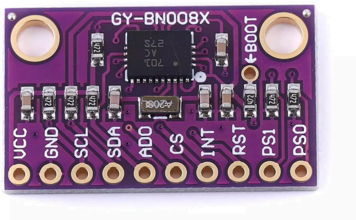
6. IMU

The SDP is a preliminary platform, it needs only the angular rates and axial acceleration. One of the most widely used and documented IMU is the MPU-6050. It is simple, robust, and well supported on the Arduino framework. Since we are using the Teensy 4.1 (which also runs on the Arduino framework) for flight control, the MPU-6050 is chosen.

In case higher precision, lower noise, and/or onboard sensor fusion is needed, below are two great alternatives:

For easiest implementation:

- BNO085/86 (Onboard sensor fusion)



For best performance and low-level flexibility:

- ICM-20948 (Raw data)

7. Flight Controller

Controlling flight vehicles with feedback-control require high control loop frequencies. This requires a very powerful processor. Generic Arduino boards will not meet this requirement due to their low clock rate. The Teensy 4.1 is chosen for flight control as it is one of the most powerful microcontrollers available. It is also ideal because it runs on the arduino framework, making it easy to program. Adding to the list of benefits is its low cost. Teensy 4.1 excels in our application.