Power Distribution Conceptual Design

Team C: Column Robotics

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Power Needs of the System

We are using a 3DR Iris+ as our system. It comes with a LiPo battery and connectors for the Pixhawk flight controller connected. We need to grab the power supply from the battery and direct it to our on board computer. From the onboard computer, we will be connecting a USB Camera and USB RGB-D sensor. Because the camera and the RGB-D sensor will be run off of USB from the on board computer, we just need to be able to get power with enough amperage to run the single board computer that is also giving power to the two sensors.

Electrical Sources

The 3DR Iris+ comes with a battery pack that we will be using to power the single board computer. The power to the motors and the flight controller (Pixhawk) are all taken care of within the package of the Iris+.

Figure 1 shows an image of the battery and Table 1 shows the specs for the battery.

Figure 1) Battery Pack Included with the Iris+ [1]

Spec	Value
Chemistry	Lithium Polymer (LiPo)
Number of Cells	3
Capacity	5100 mAh
C Rating	8C
Max Voltage	12.6V
Low Battery Voltage	10.5
Max Current Output	40.8 A
Continuous Current Output	5.1 A

Table 1) Iris+ Battery Pack Specs

The maximum current output was calculated by using:

$$\text{Max Current Output} = \text{Capacity} \times \text{C-Rating}$$

$$5.1\text{Ah} \times 8\text{C} = 40.8\text{A}$$

The continuous amperage was calculated assuming that the battery discharges with a rate of 1C:

$$\text{Continuous Current Output} = \text{Capacity} \times 1\text{C}$$

$$5.1\text{Ah} \times 1\text{C} = 5.1\text{A}$$

The connector to the battery is an XT60 connector and JST-XH charging connector. Shown in FIgure 2 and 3 respectively.

Figure 2) XT60 Connector [2]

Figure 3) JST-XH 3S Charging Connector [3]

Subsystems

The only subsystem that we are connecting to the power distribution circuit is the single board computer we are using, The Minnowboard Max. We will also be connecting a USB camera and USB RGB-D sensor to the Minnowboard Max which we have to account for in extra current powered to the single board computer.

Figure 4 shows the Minnowboard Max and Table 2 shows the power specifications for the Minnowboard Max.

Figure 4) Minnowboard Max [4]

Spec	Value
Input Voltage Range	4.7V to 5.3V
Regulation Require	Down from 12V
Peak Input Current Draw	2.2A
Nominal Input Current Draw	1.75 A

Table 2) Minnowboard Max Specifications

The peak input current draw was calculated using the peaks for the three systems running from the single board computer: the processor, the USB camera, and the RGB-D sensor. Table 3 shows the peak input current draw calculation

System	Peak Current Draw
Processor	1.2 A
USB Camera	0.5 A
RGB-D Sensor	0.5 A
Total:	2.2 A

Table 3) Peak Current Draw of System

The continuous input current draw was calculated using the nominal current draw of the same three systems running from the single board computer. Table 4 shows the continuous current draw calculation.

System	Peak Current Draw
Processor	1.05 A
USB Camera	0.2 A
RGB-D Sensor	0.5 A
Total:	1.75 A

Table 4) Continuous Current Draw of System

The power connector to the Minnowboard Max is a 5.5x2.1mm barrel 5V power plug. This connector is shown in Figure 5.

We will be connecting the male 5.5mm x 2.1mm barrel 5V plut to a C-GRID SL connector soldered to the floor.

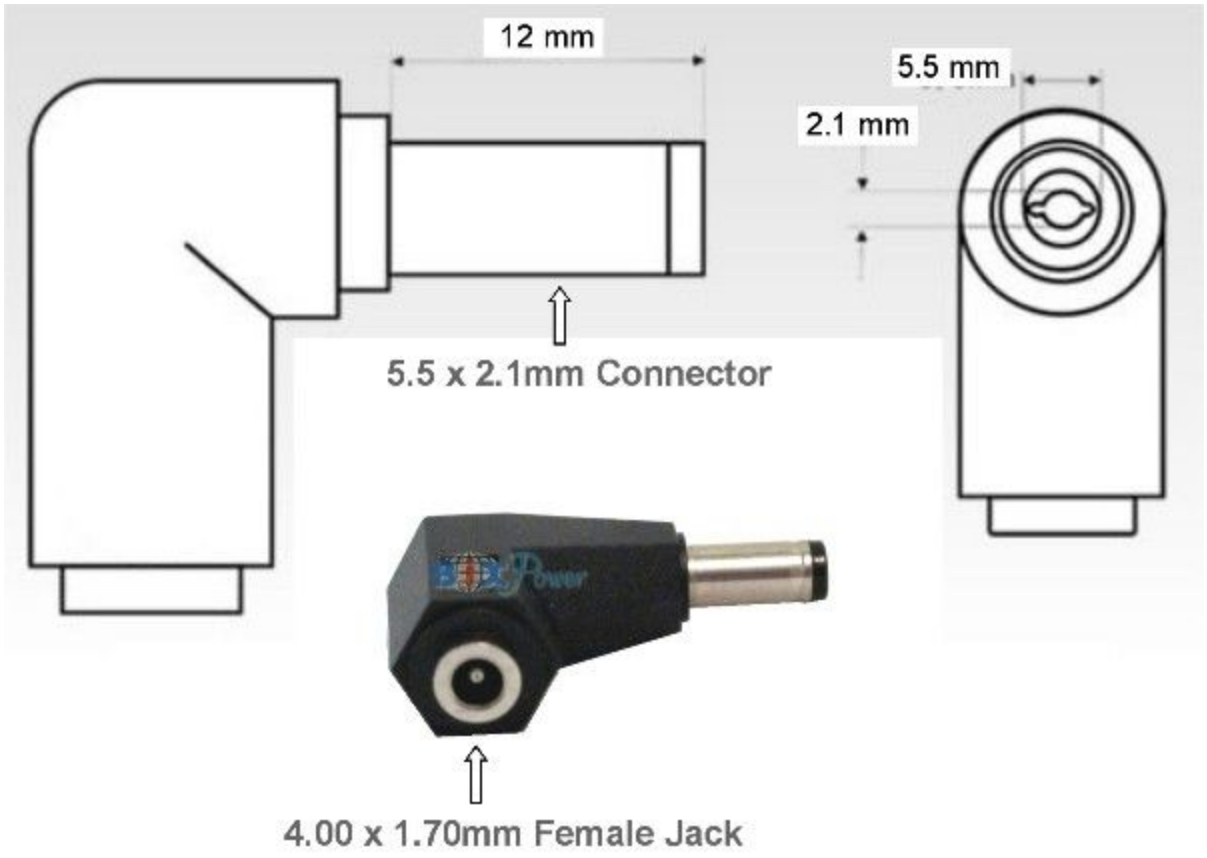

Figure 5) 5.5x2.1mm Barrel Jack (Male and Female shown) [5]

The current capacity is 3 A.

Voltage monitoring will be done by the Iris+ electronics, and will not be needed in our power distribution circuit.

No manual switch is required. The Iris+ has a manual abort system that can be leveraged for this use.

The overvoltage/reverse voltage protection will be taken care of by a 7.5V TVS Diode after the voltage regulator and a 16V TVS diode on the input from the battery.

The system will require a voltage regulation circuit from the 12 V of the battery to the 5 V that the Minnowboard Max requires.

The efficiency of our voltage regulation desired using a linear voltage regulator:

$$\text{Efficiency} = \frac{4.7V}{12.6V} = 37\%$$

So here we will say that the efficiency should be less than this at around 35%.

The peak output current should be around 2.5 A so as not to get close to the current capacity of the power connector to the Minnowboard Max.

Overcurrent protection will be handled by a fuse rated for 3A.

Overcurrent from the input power will be handled by an 8A rated fuse.

Control of the power to the system will be handled by the Iris+ which already has a system in place to control power to the system.

We plan to monitor the input voltage to the Minnowboard Max and input to the regulator with LEDs to aid in debugging.

We will be adding a second XT60 with diodes after both in order to facilitate easier hot swapping.

Resources

[1] Battery Pack
[2] XT60 Connector
[3] JST-XH 3S Charging Connector
[4] Minnowboard Max
[5] 5.5x2.1mm Barrel Jack