

# Hexapod Mark IV - How Not to Kill your Crawler

Before you use or charge any lithium battery you must read the [Lithium Battery Safety Instructions and Warnings](#) document.

1. Do not charge or use batteries if the battery ...
  - A. is punctured or damaged
  - B. is bloated, expanded, swelling or otherwise deformed
  - C. has any cell with a voltage of 3.3v. This means less than 9.9v for a 3-cell/11.1v battery.
2. Do not charge batteries unattended. Monitor batteries during charging for popping, hissing, smoke, sparks or fire. Also monitor the battery for any swelling or other deformities. Disconnect the battery from your charger immediately.
3. Do not charge batteries near flammable material. Charge batteries in a fireproof container. Do not charge batteries while they are in your robot.

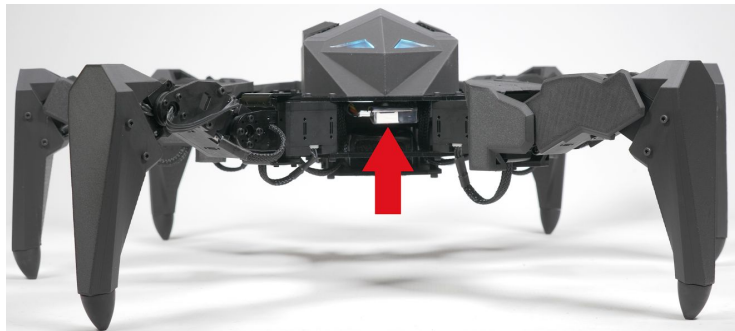
## POWERING YOUR HEXAPOD

The following is aimed to serve as a guide for how to take care of the LiPo battery used in your hexapod. For more general LiPo battery advice, such as how to charge it and more detailed descriptions of the battery and its connectors, please consult [this guide!](#)

Your Hexapod's Battery:

### 1. Battery Voltage Tester (BVT)

The following image shows the location of your Battery Voltage Tester (BVT) on your hexapod:



Your BVT can be found attached, by velcro, to the underside of the top base plate, near the front of the hexapod. It should be face down and connected - with cabling to the back of the hexapod - to the Battery's balance connector.

The purpose of the BVT is to let you know when you should charge your battery. This is important as letting your battery drop below 3.3V per cell (9.9V total) can affect the long term performance of the battery. **If you let the battery drop too low, the battery can become very dangerous!**

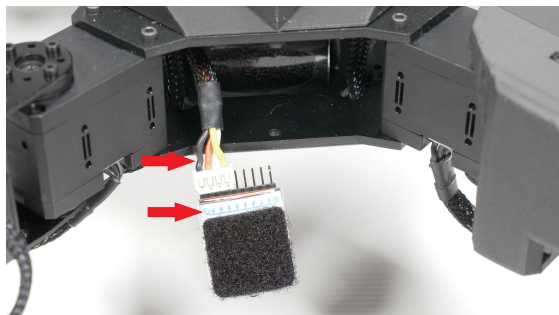
When the BVT is connected, it will cycle through displaying the Battery's individual cell voltages and that of the battery as a whole. When the Battery reaches a voltage value deemed to be too low, the BVT will start making an incredibly loud and annoying beeping sound. This means it is time to charge your battery. (The low voltage level is set to 9.9V - see [guide](#) to adjust at own risk).



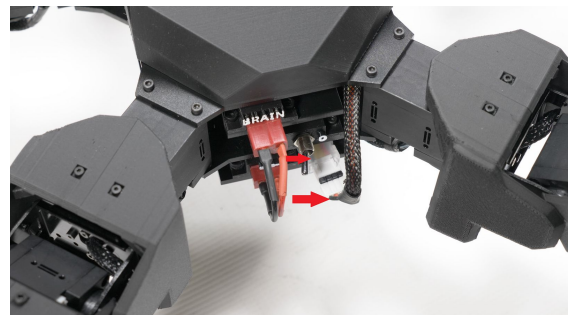
It is important to keep the BVT connected to the battery while your hexapod is being powered. **However, when the hexapod is not powered, keeping the BVT connected will slowly drain the battery. As such, please disconnect the BVT when the hexapod is switched off!** Furthermore, when charging the battery, you will need to disconnect the BVT.

The BVT is attached to the hexapod with velcro and therefore, can be removed for easier viewing of the BVT display. However, I would recommend leaving the cable connected to the BVT in place. Instead, I suggest disconnecting the cable from the battery's balance connector at the back end of the hexapod.

Whichever side of the cable you choose to disconnect it is important to remember the orientation of the connectors when reconnecting the BVT. Please remember to line up the Ground wires (shown with arrows) to their appropriate locations on the BVT and balance connector respectively.



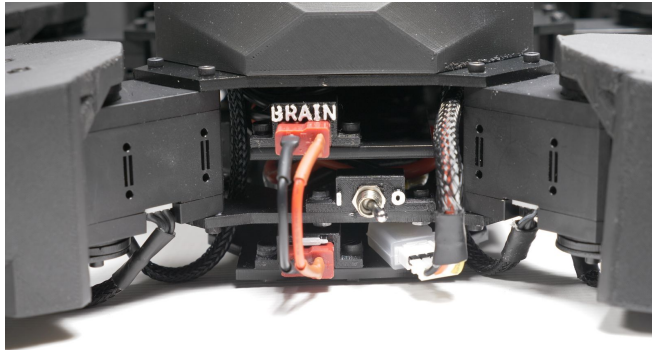
BVT Connection



Balance Connector Connection

## 2. Charging your Battery

The first step in charging your battery is to make sure the switch at the back of your hexapod is in the off position. As seen below, when the robot is off, the switch is switched towards the “O” symbol.

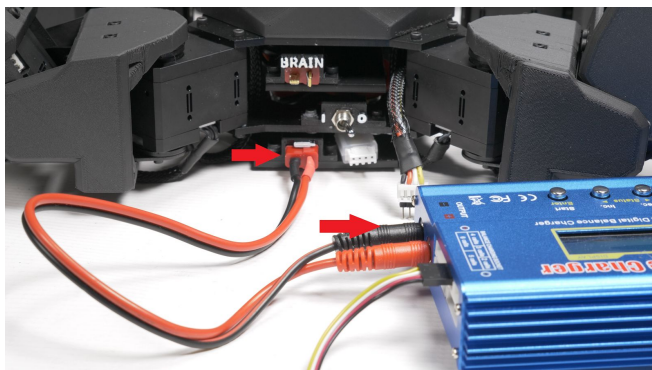


Next, disconnect the Battery of the hexapod from the Brains of the hexapod. This can be done easily, by removing the male to female Deans cable located at the back of the robot.



Next, you should disconnect the BVT from the battery's balance connector as described above.

Now, you should connect the Banana-Plug-to-Deans-Connector Cable to both your charger and the - now empty - “Battery port” on your hexapod.



Next, connect the battery's balance connector to the 3 cell port on your charger.

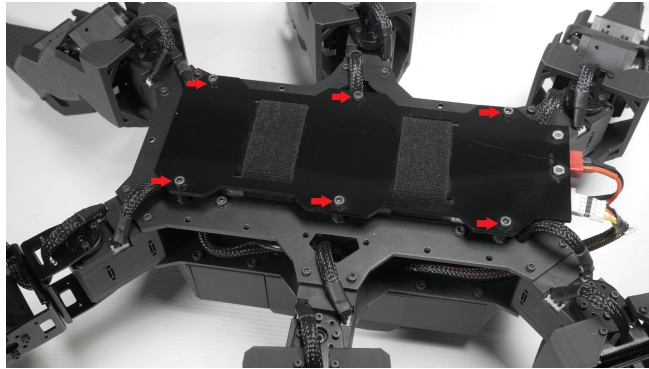


Now follow steps 3-9 under Charging your Battery in [this guide!](#)

When your battery is charged, please remember to reconnect the battery-to-brains connector as well as the BVT to the battery's balance connector - paying attention to the orientation of the connectors as described above.

### 3. Detaching your Battery

If you would like to remove the battery from your hexapod, this can be done simply by unscrewing the 6 M3X6mm screws located at the very bottom of the hexapod. This will result in detaching the battery plate from the rest of the hexapod.

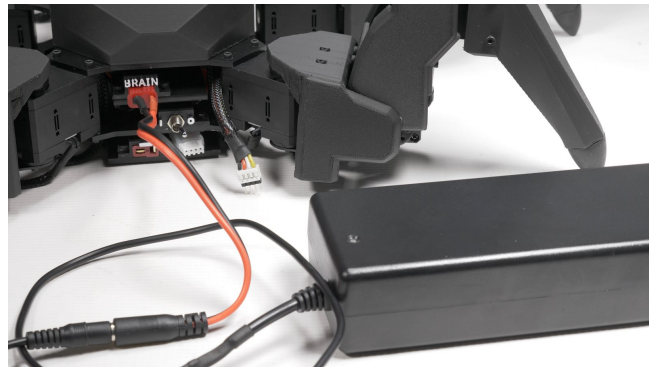


This can be useful when you would like to remove the battery or replace it. Please remember to disconnect the battery-to-brains connector before removing the battery plate.



#### 4. Tethered Operation

If you would like to operate the hexapod while tethered to a [12V 5A power supply](#), you can do so by disconnecting the battery-to-brains connector at the back of the hexapod. This will allow you to connect the power supply directly to the “Brains port” of the hexapod, with the DC-Power-Jack-to-Deans-Connector Adapter.



It is up to you if you would like to remove the battery plate from the hexapod, but it is not necessary for tethered operation.



## **SHELLING YOUR HEXAPOD**

When you receive your hexapod you will find that the shelling for the hexapod's legs are not yet attached (for distribution purposes). Further, you will notice that the shelling for the main body of the hexapod has been designed to be removable in the case that you would like to access the Raspberry Pi or any of the internal electronic components.

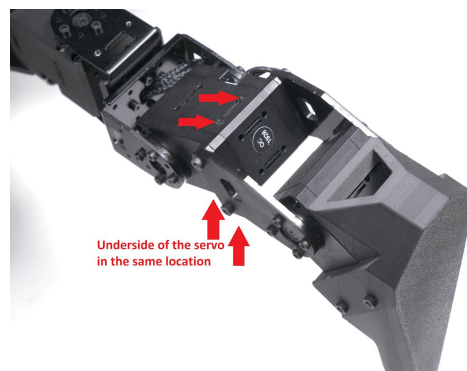
This section should serve as a guide for how to attach and detach the aforementioned shells:

### **1. Leg Shelling**

I recommend that you attach the Femur shells in their appropriate locations prior to attaching the Coxa shells as the Coxa shells overlap the Femur shells on the outside of the leg as you will soon find out!

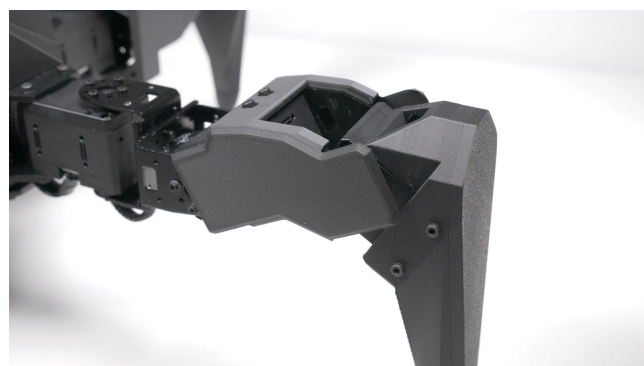
#### **a. Femur Shells**

The following image shows the location of the holes on the leg to which you should attach the Femur shells.



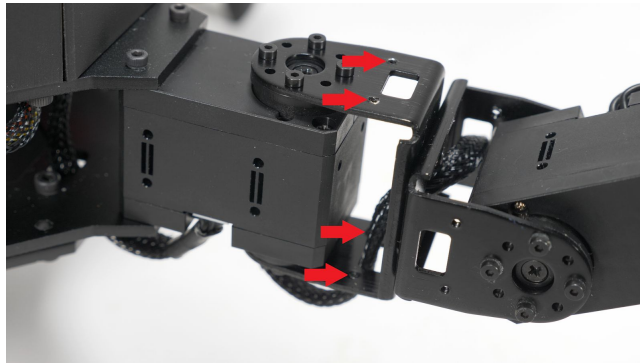
Each leg will require 4 M2.5X8mm screws in order to attach the Femur shell. My recommendation is to lightly screw in one side of the shell and then do the same for the other side of the shell before tightening the screws. This process is useful in order to ensure the shells line up correctly.

The final Femur shelling should look as follows:



b. Coxa Shells

The following image shows the location of the holes on the leg to which you should attach the Coxa shells.



Each leg will require 4 M2X8mm screws in order to attach the Coxa shell. My recommendation is to lightly screw in one side of the shell and then do the same for the other side of the shell before tightening the screws. This process is useful in order to ensure the shells line up correctly.

The final Coxa - and full leg - shelling should look as follows:

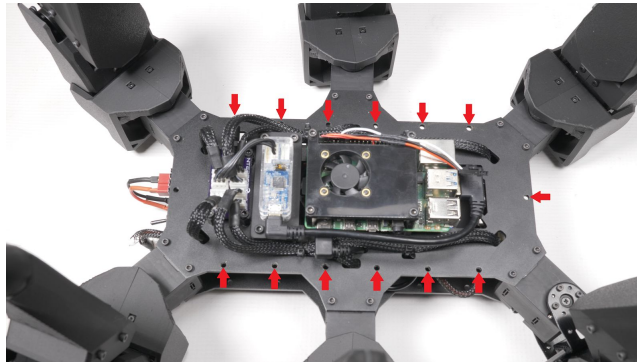




## 2. Body Shelling

If you would like to detach or reattach the base shelling of the hexapod, you can follow these steps:

The following image shows the holes in which the screws can be placed to attach the base shelling.



The base shelling is split into three sections, namely: Head Shell - placed at the front of the hexapod; Middle Shell- placed in the middle of the hexapod and Tail Shell - placed at the rear of the hexapod.



There are holes on the bottom plate of the hexapod that mirror those in the top plate. These are in place to provide access for your allen key to get to the holes in the top plate. The process of using these holes to screw in the shell is shown below:

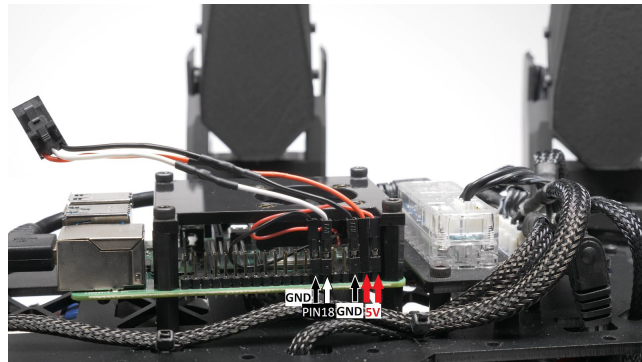


The final shelling should look like this:



## LED EYES AND GPIO PINS

The following image shows you the necessary connections to the GPIO pins of the Raspberry Pi. The Fan used to cool down the Pi is simply connected to both 5V (red) and GND (black) pins in order to power the fan. The LEDs are also powered with connection to 5V (red) and GND (black), however, the white cable is connected to GPIO pin 18 in order to send the necessary data to the LEDs.



On the inside of the face of the Head Shell, the LED connector cable is connected to the LEDs as shown below. **Pay careful attention to the orientation of the connector!** Note the black cable lines up with where the LED chip has “GND” written on it. Connecting 5V to the GND pin of the LEDs will permanently damage the LEDs.

