



# OLHZN Circuit Boards

Assembly Instructions

Arduino Mega Compatible | Revision 5



# What is Overlook Horizon?

Overlook Horizon Inc. (OLHZN) is a 501(c)(3) non-profit charitable organization with the goal of educating and inspiring the next generation of scientists and engineers to shape our world. We fly high altitude weather balloons for science and fun! We hope to inspire students into careers involving science, technology, engineering and mathematics! Learn more at: [www.OverlookHorizon.com](http://www.OverlookHorizon.com)

## What is this circuit board?

The OLHZN circuit boards are experimental bare circuit boards intended for data logging and radio position tracking for high altitude weather balloons using the Arduino platform. You will need to purchase the electronic components separately and assemble the board using some basic soldering skills. The Arduino Mega Revision 5 board is our 5<sup>th</sup> revision to our tracking system and contains fixes and improvements from our 4<sup>th</sup> revision.

## What is the success rate?

The revision 5 board has not yet been flown onboard an actual flight. Its first flight is scheduled for March 2018. We cannot confirm the success rate of this board yet. A backup tracking method is recommended in the event that there are undiscovered errors or technical deficiencies.

## What software do I need?

For this model, you can run our “**OLHZN\_Track**” software on Arduino Mega which can be downloaded from <http://github.com/OverlookHorizon>. Feel free to make any modifications, improvements or upgrades to the code and let us know if you find any errors by contacting us at [Info@OverlookHorizon.com](mailto:Info@OverlookHorizon.com)

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# PCB Parts List

You will need to purchase the following parts to assemble this circuit board:

Component	Qty	Source
3 Pin SPDT Toggle Switch	1	<a href="http://amzn.to/2BpK94r">http://amzn.to/2BpK94r</a>
5.5mm x 2.1mm Female DC Power Jack	5	<a href="http://amzn.to/2E47uvq">http://amzn.to/2E47uvq</a>
2 Pin JST Female Connector	2	<a href="http://amzn.to/2E5V3PY">http://amzn.to/2E5V3PY</a>
3 Pin JST Female Connector	1	<a href="http://amzn.to/2E5V3PY">http://amzn.to/2E5V3PY</a>
DS18B20 Temperature Sensor	1	<a href="http://amzn.to/2DCTTxz">http://amzn.to/2DCTTxz</a>
5mm LED Red	1	<a href="http://amzn.to/2Dw0E0K">http://amzn.to/2Dw0E0K</a>
5mm LED Yellow	1	<a href="http://amzn.to/2Dw0E0K">http://amzn.to/2Dw0E0K</a>
5mm LED Green	1	<a href="http://amzn.to/2Dw0E0K">http://amzn.to/2Dw0E0K</a>
0.1uF 50V Ceramic Capacitor	2	<a href="http://amzn.to/2Dxqy4g">http://amzn.to/2Dxqy4g</a>
100uF 25V Polarized Capacitor	2	<a href="http://amzn.to/2BqkoRN">http://amzn.to/2BqkoRN</a>
3mm 3 Pin SPDT Slide Switch	3	<a href="http://amzn.to/2Bpmlhi">http://amzn.to/2Bpmlhi</a>
USB Female Type A 4-Pin Right Angle Connector	3	<a href="http://amzn.to/2DzgasY">http://amzn.to/2DzgasY</a>
2N3906 PNP Transistor	1	<a href="http://amzn.to/2DvZ9j6">http://amzn.to/2DvZ9j6</a>
2N2222 NPN Transistor	1	<a href="http://amzn.to/2DByeGN">http://amzn.to/2DByeGN</a>
SMA Female Right Angle Connector	1	<a href="http://amzn.to/2E7NpEM">http://amzn.to/2E7NpEM</a>
1/4W 20K $\Omega$ Resistor	1	<a href="http://amzn.to/2DARcNN">http://amzn.to/2DARcNN</a>
1/4W 10K $\Omega$ Resistor	4	<a href="http://amzn.to/2DARcNN">http://amzn.to/2DARcNN</a>
1/4W 2K $\Omega$ Resistor	1	<a href="http://amzn.to/2DARcNN">http://amzn.to/2DARcNN</a>
1/4W 1K $\Omega$ Resistor	2	<a href="http://amzn.to/2DARcNN">http://amzn.to/2DARcNN</a>
1/4W 4.7K $\Omega$ Resistor	1	<a href="http://amzn.to/2DARcNN">http://amzn.to/2DARcNN</a>
1/4W 15K $\Omega$ Resistor	2	<a href="http://amzn.to/2DARcNN">http://amzn.to/2DARcNN</a>
1/4W 150 $\Omega$ Resistor	2	<a href="http://amzn.to/2DARcNN">http://amzn.to/2DARcNN</a>
1/4W 68 $\Omega$ Resistor	1	<a href="http://amzn.to/2DARcNN">http://amzn.to/2DARcNN</a>
6-Pin Stackable Shield Header	1	<a href="http://amzn.to/2F8WJYg">http://amzn.to/2F8WJYg</a>
8-Pin Stackable Shield Header	5	<a href="http://amzn.to/2F8WJYg">http://amzn.to/2F8WJYg</a>
18-Pin Stackable Shield Header	2	<a href="http://amzn.to/2DH3J1g">http://amzn.to/2DH3J1g</a>
U-blox NEO-6M 5 Pin Active GPS Breakout	1	<a href="http://amzn.to/2GdOnzG">http://amzn.to/2GdOnzG</a>
BME280 (or BMP180) Pressure, Temp, Humidity Breakout	1	<a href="http://amzn.to/2GFzfLN">http://amzn.to/2GFzfLN</a> <a href="http://amzn.to/2DuQCwN">http://amzn.to/2DuQCwN</a>
Adafruit PowerBoost 1000 Basic Breakout	3	<a href="http://amzn.to/2DvYv5i">http://amzn.to/2DvYv5i</a>
Radiometrix HX-1 Radio Transmitter	1	<a href="http://olhzn.com/HX1">http://olhzn.com/HX1</a>



# External Parts List

The following parts are not necessary to assemble the circuit board, but the circuit board is designed to work with these external components to complete the full setup. Many of these components can be omitted or replaced, if desired. These are the components we use.

Component	Qty	Source
<b>Orbtronic 3400mAh 18650 Li-ion batteries</b>	5	<a href="http://amzn.to/2GcfxqK">http://amzn.to/2GcfxqK</a>
<b>5.5x2.1mm Male DC Power Plug</b>	5	<a href="http://amzn.to/2GfsRLc">http://amzn.to/2GfsRLc</a>
<b>HYD-4218 Active Piezo Alarm</b>	1	<a href="http://amzn.to/2DDyOTM">http://amzn.to/2DDyOTM</a>
<b>18650 Single Battery Holder</b>	3	<a href="http://amzn.to/2DImS3b">http://amzn.to/2DImS3b</a>
<b>18650 Double Battery Holder</b>	1	<a href="http://amzn.to/2Du36F3">http://amzn.to/2Du36F3</a>
<b>DS18B20 Waterproof Temperature Sensor</b>	1	<a href="http://amzn.to/2E6pZ2i">http://amzn.to/2E6pZ2i</a>
<b>Low Voltage Battery Alarm (LiPo)</b>	1	<a href="http://amzn.to/2DBzUjE">http://amzn.to/2DBzUjE</a>
<b>AM2302 DHT22 Digital Temperature/Humidity Sensor</b>	1	<a href="http://amzn.to/2F79KRS">http://amzn.to/2F79KRS</a>
<b>USB 2.0 Type A-Male to Micro B Cable</b>	3	<a href="http://amzn.to/2Dw4elc">http://amzn.to/2Dw4elc</a>
<b>Lightdow LD4000 Action Camera</b>	3	<a href="http://amzn.to/2DGPfyk">http://amzn.to/2DGPfyk</a>
<b>SMA Male to Male Connector</b>	1	<a href="http://amzn.to/2Dw1GKg">http://amzn.to/2Dw1GKg</a>
<b>Nagoya NA-771 15.6 Inch Whip Antenna 144MHz</b>	1	<a href="http://amzn.to/2Ge6zsY">http://amzn.to/2Ge6zsY</a>
<b>Arduino Mega 2560 R3</b>	1	<a href="http://amzn.to/2Dznetm">http://amzn.to/2Dznetm</a>
<b>RTC Data Logging Shield</b>	1	<a href="http://amzn.to/2DzKyY9">http://amzn.to/2DzKyY9</a>
<b>16GB Class 10 SD Card</b>	1	<a href="http://amzn.to/2DzKzvb">http://amzn.to/2DzKzvb</a>
<b>USB 2.0 Type A Male to Type B Male Cable</b>	1	<a href="http://amzn.to/2E6AAAdF">http://amzn.to/2E6AAAdF</a>
<b>Dupont Cable Crimper</b>	1	<a href="http://amzn.to/2DxJ10C">http://amzn.to/2DxJ10C</a>
<b>18650 Battery Charger</b>	1	<a href="http://amzn.to/2GcjoEt">http://amzn.to/2GcjoEt</a>
<b>Extra Straight Single Row Header Pins</b>		<a href="http://amzn.to/2E5VZny">http://amzn.to/2E5VZny</a>
<b>Copper Shielding Tape</b>	1	<a href="http://amzn.to/2BqIL2J">http://amzn.to/2BqIL2J</a>

## Camera Warning

The Lightdow LD4000 action cameras create a large amount of electromagnetic interference. The active GPS antenna we recommend resolves much of this, but we still recommend wrapping the LD4000 cameras in copper tape to create a faraday cage around the cameras to contain as much of the electromagnetic interference as possible. Too much interference will cause the GPS to lose signal and can lead to the Arduino randomly crashing or freezing.

# PCB Assembly Order

We recommend starting with the small and inexpensive parts, first in case you make a mistake.

Desoldering these boards can be tricky. You can assemble in any order, but we follow and recommend this assembly order:

1. Resistors
2. Transistors
3. Capacitors
4. SMA Female Connector
5. Female DC Connectors
6. USB Female Connectors
7. SPDT Slide Switches
8. SPDT Toggle Switch
9. JST Female Connectors
10. LEDs
11. DS18B20 Temperature Sensor
12. BMP180 Breakout
13. U-blox GPS Breakout
14. Radiometrix HX-1 Radio Transmitter
15. Adafruit PowerBoosters
16. Stackable Headers

# PCB Assembly Tips

- **BMP180 Breakout Board**

When mounting this component, we recommend mounting it flat against the board. To do this, solder on the header pins to the breakout board. Next, use pliers to remove the plastic spacer on the header pins. Finally, solder the breakout board so it lays flat against the circuit board. The board has room for a 5-pin breakout board, but many of the BMP180 breakout boards only have 4-pins. Be sure the 3V power pin of the breakout board lines up with the 3.3V labeled pin.

- **Adafruit PowerBoost 1000 Basic Breakout Boards**

These breakout boards should also be mounted flat, like above. Note, that these breakout boards should be mounted on the **BOTTOM** of the circuit board. Be sure that the 5V labeled pin on the circuit board matches the 5V output pin on the breakout board.

- **U-blox NEO-6M GPS Breakout Board**

This breakout board is designed to be mounted perpendicular to the circuit board so that the breakout board sticks straight up from the circuit board. When looking at the circuit board picture below, the breakout board should be to the right of the through holes (within the bracket) and the pins should be mounted so they stick out the left side of the breakout board. This allows enough space to stack an Arduino Uno sized shield on top of our circuit board. Be sure the 5V labeled pin on the circuit board matches the VCC pin on the GPS breakout board.

- **Radiometrix HX-1 Radio Transmitter**

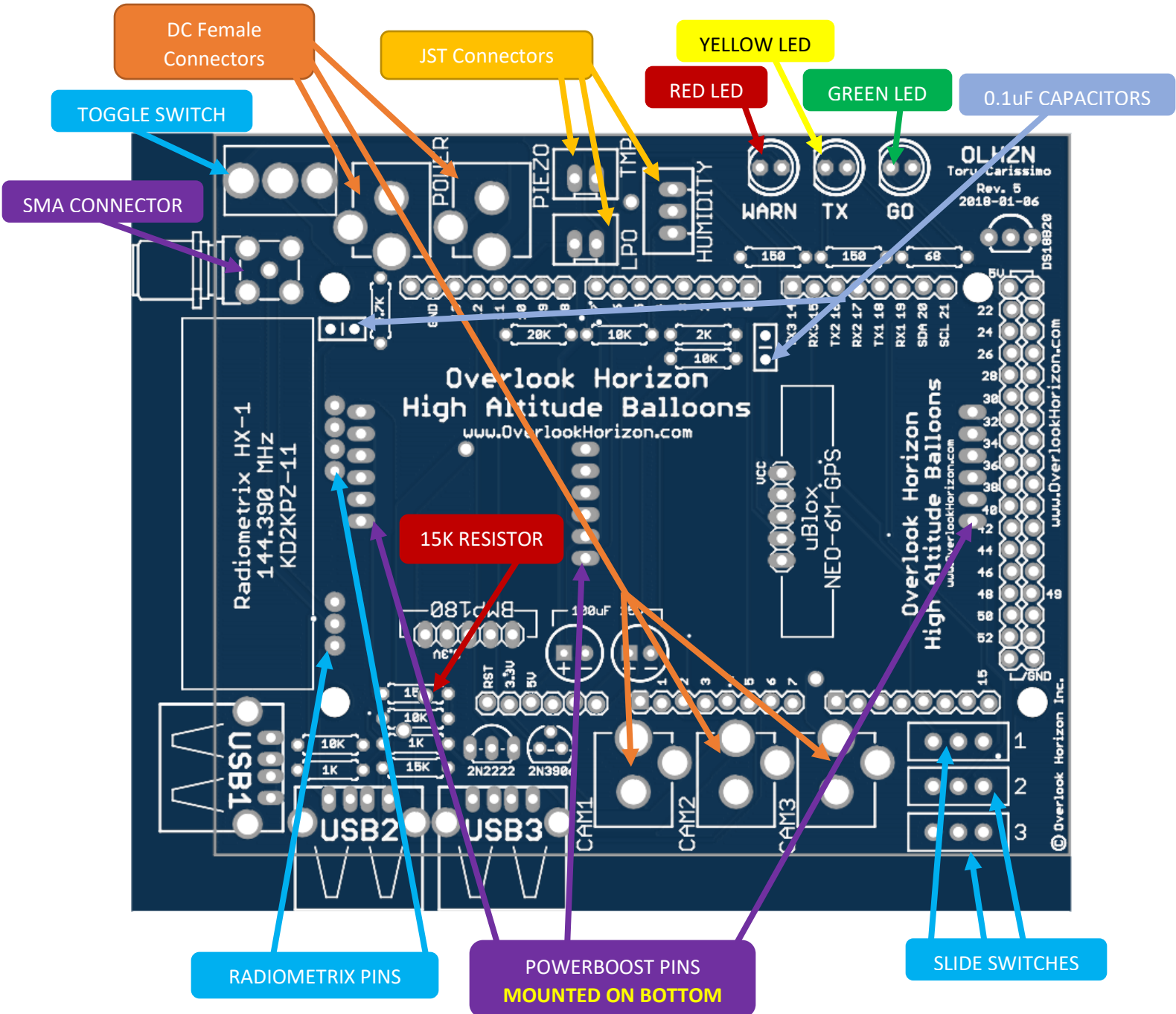
This breakout board is designed to also lay flat against the circuit board, but it comes with its own pins. When soldering the transmitter, place the pins in the through holes and bend/fold the transmitter so it lays flat within the rectangular bracket printed on the board. Once the transmitter is in place, you may then solder the pins. This will ensure the transmitter body is out of the way of the Power Booster pins which are very close to the Radiometrix pins.

- **Double Row Stackable Headers**

If you can find an 18-pin stackable header, fantastic! If you're not able to locate an 18-pin stackable header, you can use adjacent 8 and 10 pin stackable headers. If you do this, we recommend alternating the pins for better stability so that one row is 8, then 10 pins and the other row is 10 then 8 pins. This ensures the break between segments is not in the same spot on both rows.

# Components Map

Most of the components are labeled directly on the circuit board itself, but here are some helpful clarifications:



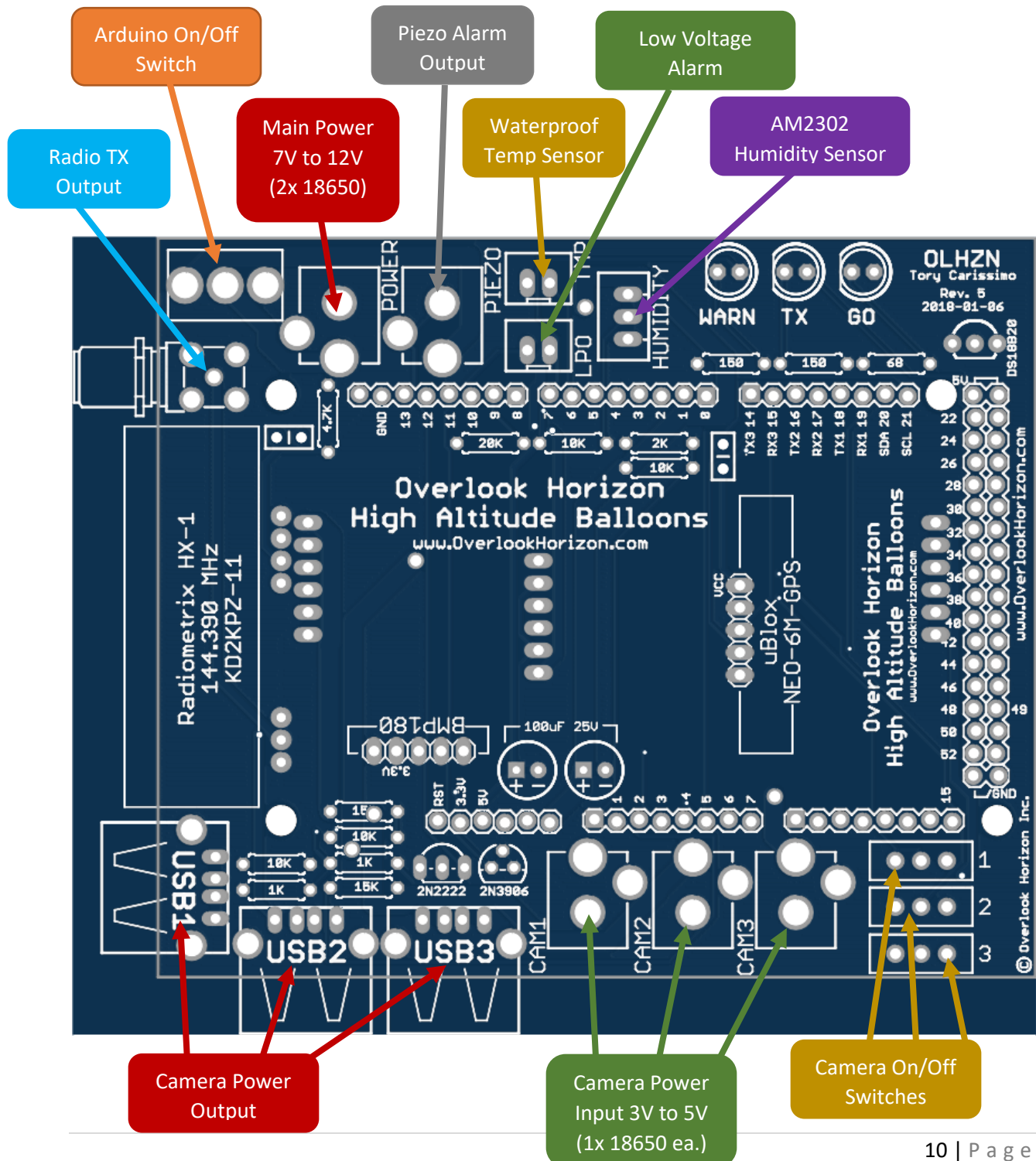


# Known Issues

- Use a genuine Arduino Mega (<http://amzn.to/2FBr4yQ>), not a knock-off brand. The genuine Arduino has higher quality components and is better protected from brownouts.
- Be sure the coin-cell battery on your data logging shield (if used) is not depleted. We've seen strange behavior from the onboard real-time clock (RTC) in isolated instances. Using the Adafruit Data Logging Shield (<http://amzn.to/2E4r8aE>) may provide better results since it has a better RTC, but we've not tested that yet. If using the Adafruit Data Logging Shield, you'll need to short the solder jumpers closed on the back of the board for compatibility, per their instructions.
- The **OLHZN\_Track** software utilizes the NewTone library to control the Piezo speaker/alarm. This library utilizes Timer 2 on the Arduino which directly conflicts with our APRS operations that also utilizes Timer 2. We intend to replace/correct this by Spring 2018.
- The mini slide switches on the Revision 5 circuit boards are placed too close together. They will work as-is, but future revisions will add more space for these so they're not so crowded.
- There is a 15K resistor on the board that had its screen printed label cutoff by a through hole. See the image on **Page 8** for the location of that resistor (in red).
- The 2-pin JST connector for the external temperature sensor should really be a 3-pin connector to make easier work creating the connectors, but it will work fine as-is. When crimping the DS18B20 waterproof temperature sensor, both the VCC and DATA wires should be crimped to the same pin. The GND pin will be the other pin of the JST connector. See **Page 11** below.

# Post Assembly Operations Map

Once assembled, there are a number of external components that connect to the circuit board. Only the main power is absolutely required. Others can be included or omitted, as desired. If omitted, you'll need to comment/adjust the software code as necessary.



# External Components Wiring Guide

Below explains how the board expects the external components to be wired to their respective connectors.

- **Male DC Barrel Plugs**

These follow standard wiring. The GND pin will be the outside of the barrel. The powered pin will be the inside of the barrel. Using a soldered connector, GND would be soldered to the longer pin connected to the outer part of the barrel.

- **Low Voltage Alarm (LiPo)**

The GND pin will be wired to the first pin.  
The VCC pin will be the 3<sup>rd</sup> pin from the left.  
See the diagram to the right for wiring map,

- **JST Connectors**

Note: The 2-PIN temperature JST will have DATA & VCC on the same pin.  
See the diagram below for wiring maps.

