## C – Steve Randall Correspondence

Hi UKHAS guys,

I plan to launch a high altitude balloon for my final year project on 10th March 2019 (Telford or Wolverhampton, TBA)

I have done a fair amount of research, and have written a parts list which you can find attached. (It is not complete, yet, hence the ? and £0.00 in various cells)

You can use the 'Available at' column to navigate to the website I plan to purchase certain devices from.

Can anyone give me advice on whether the SDR dongle I have selected would be suitable. I thought the specs/build quality looked better than the tested ones on the SDR\_TRACKER ukhas guide, namely more so than the NEWSKY and EZCAP dongles. It appears to have the required Realtek chip and same tuner as the one the ukhas guide ones have and it also comes with a bunch of antennas (good or not I don't know), and the reviews seem very good.

But since I want to chase the landing location of balloon I will need a competent passenger to operate my laptop with cigarette light inverter to keep it charger with SDR dongle with SMA extension cable going to a powerful antenna magnetically mounted on the roof.

It's worth noting than I am way to poor to purchase a yaesu-817 and I have no chance of getting the university to fund it, so I will have resort to the "not recommended" SDR method as I have no choice.

However the antenna information is extremely vague online about what I would need and I have very limited knowledge of antennae and there is countless choices online to choose from. I have seen the keywords "70cm band",  "164mm" "2m" floating about online, but there there is no solid information on it, at least not from what have found. Can someone give me a definitive answer on this?

Thanks,

Riccardo Geraci

Hi Riccardo

Comments:

    The 8L box seems way too large.  1L or 2L is probably enough.

    Helium - you might be able to get this at the Uni themselves - or click4balloons.  You will need to make a fill tube - see <https://ukhas.org.uk/guides:fill_tube>

    BMP280 suffers problems at low pressure IIRC.

    Handwarmers - don't bother - the electronics will keep themselves warm and standard handwarmers (tea bag type) give off moisture (bad for lens condensation).

Since you seem to be aiming to use 434MHz the mag-mount antenna needs to be cut to tune to the 70cm band (70cm wavelength = 434MHz) - i.e. the length of the vertical element is cut in length to resonate about 434-435Mhz.  The antennas are usually supplied much longer so that they can be cut for 2m (144MHz) or VHF or UHF taxi use.  I personally use a cheap taxi antenna cut to size.  If you plan to use the antenna to transmit you will need to tune it with an SWR meter or antenna analyzer.   If you are just planning on using it to receive, then length is less critical and cutting it to about 164mm will probably do (164mm = about a 1/4 wavelenth on 434.5MHz allowing for "radio stuff").  Personally I always tune my magmounts as the magnetic base coupling, spacing of the vertical element holder and even the size of car roof itself all seem to have an effect.

        Steve

Hi Steve,

Sorry for the delay in response I have been sidetracked with other responsibilities...

***The 8L box seems way too large.  1L or 2L is probably enough.***

Regarding your comment of the 8L box, I got this size from a previous launcher website's guide, and thought if they did it, I could do the same. I have attempted to find a smaller 1-2L polysterene box, but there doesn't seem to be any at this size. I have since researched your name and found some of the BBC work you have been involved in. In the pudsey bear video, you appear to used that light blue foam board/prototyping foam to make a custom size container for the cameras you were using. I think about doing this too.

However I met up with Heather Lomond Ph.D ([myorangedragon.com](http://myorangedragon.com/)) who recommend this google group, and she educated me on a lot of things, such as purchasing balloons from Random Engineering ltd, but said she used a plastic PET bottle and used solar heating/raspberry pi self heating to keep the internal temperature within operating range. With this logic, could I just use a 1-2L clear plastic lunch box sort of container and use the same concept of keep the electronics warm?

***Helium - you might be able to get this at the Uni themselves - or click4balloons.  You will need to make a fill tube - see***[***https://ukhas.org.uk/guides:fill\_tube***](https://ukhas.org.uk/guides:fill_tube)

Thanks for the fill tube link. I will probably have to invest in the helium myself, from say the website you have recommended.

***BMP280 suffers problems at low pressure IIRC.***

Though I independently found the BMP180 and thus the successor BMP280, I have since seen launchers use the same module without mentioning anything about pressure related problems. Is there a module you would recommend that you would/have used?

***Handwarmers - don't bother - the electronics will keep themselves warm and standard handwarmers (tea bag type) give off moisture (bad for lens condensation).***

The handwarmers was, even for me, a unlikely required item. I included it in the list as I saw it being used on youtube launch videos, but thought it contradicted the idea that the solar heating/self heating would be enough to keep things warm enough. I also read that, while true the stratosphere is -55C+, the air is so thin that it is difficult for the heat to be "wicked" away. I cannot remember where I read this, but it sounds reasonable.

***Since you seem to be aiming to use 434MHz the mag-mount antenna needs to be cut to tune to the 70cm band (70cm wavelength = 434MHz) - i.e. the length of the vertical element is cut in length to resonate about 434-435Mhz.  The antennas are usually supplied much longer so that they can be cut for 2m (144MHz) or VHF or UHF taxi use.  I personally use a cheap taxi antenna cut to size.  If you plan to use the antenna to transmit you will need to tune it with an SWR meter or antenna analyzer.   If you are just planning on using it to receive, then length is less critical and cutting it to about 164mm will probably do (164mm = about a 1/4 wavelenth on 434.5MHz allowing for "radio stuff").  Personally I always tune my magmounts as the magnetic base coupling, spacing of the vertical element holder and even the size of car roof itself all seem to have an effect.***

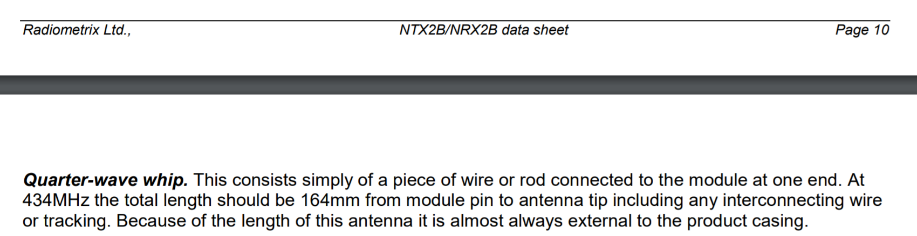
I require one for the magnetic mount on top of the car capable of receiving 1/4 wave 434MHz. Now I understand that I have to cut the element to 164mm which I didn't know was a thing until you mentioned it.

Can you tell me if the antenna at this link would be suitable, to me it appears to be.

|  |
| --- |
| <https://www.ebay.co.uk/itm/HAM-Antenna-Kit-Magnetic-Mount-Antenna-DUAL-BAND-2m-70cm/122953868791> |

You say ***(164mm = about a 1/4 wavelenth on 434.5MHz allowing for "radio stuff"),***but the description on that link says 70cm 5/8? Is this incorrect?

The radiometrix NTX2B states the antenna can be:



<http://www.radiometrix.com/files/additional/ntx2bnrx2b_0.pdf>

so both the transmitting antenna and receiving antenna need to be 164mm in length? - Though I may need to factor in the length of the pcb trace that runs from the TXD pin to the sma/bnc antenna connector. Though using a SWR, as you suggest, would probably be the easiest way to tune it, by snipping off bits of antenna until the frequency is about 434.075MHZ

Thanks again for the help,

Riccardo

Hi Riccardo

    The Raspberry Pi kicks out 0.4 to several W of heat depending on model and how you are using it.  I almost exclusively use the pi zero (without wifi) so are down at the low end of that range - 0.4W is plenty enough to keep itself warm if inside a small polystyrene box.

I've sent a separate email for some references to a source of materials - but another source of small boxes suitable for a raspberry pi is HobbyCraft : <https://www.hobbycraft.co.uk/polystyrene-flat-lid-box-13cm/591590-1000>  - but that's probably a bit small if you want to get an action camera in it too.

I don't tend to use the blue foam much these days - I mostly use small polystyrene boxes (a bit bigger than the HobbyCraft ones) - or clusters of small boxes in a sort of modular system.

IIRC the BMP180 output values wrap round below its stated pressure range (i.e. suddenly output values equivalent to a higher pressure low pressures) - the device only goes down to 300hPa (equivalent to about 20,000ft). I'm pretty sure the BMP280 is the same.   I'm told the BME280 (which also measures Relative humidity) doesn't suffer the same problem - but I have no experience of that device myself - the BME280 range also only goes down to 300hPa.   The MS5611 is the pressure sensor I have used - that goes down to 10mbar (10hPa = 100,000ft) - although with limited accuracy at that pressure - but at least the output values are monotonic.

Even though the air temperatures go down to -55C (Ive seen as low as -70C at night) - the air is so thin that little convection is taking place - so the only methods of heat transfer are conduction and radiation.  Its surprising, but equipment can often overheat - esp small cameras with close polystyrene packing.

"Radio Stuff" can be confusing to the uninitiated - 70cm refers to the 70cm wavelength (circa 434MHz) - 5/8 means is a five eighths wave on 70cms (so 70 \* 5 / 8  = about 43cm long).

5/8 wave antennas are a particular technology where the 5/8 wavelength element combined with a suitable coil presents an impedance about 50 ohms (matched to the co-ax) - the advantage being more low angle gain.  The linked antenna also works at the 2m wavelength (where I suspect it is more like a 1/4 wave).  I'm sure it will work - but IMO you would be better off with a straightforward single band 1/4 wave magmount antenna.

There are a couple of guides on making payload antennas here:

<https://ukhas.org.uk/guides:payload_antenna>

<https://www.youtube.com/watch?v=xemKyV1H6Xs>

The lengths of PCB tracks (and any co-ax) should not affect the antenna element lengths - because the tracks and coax should be transmission lines (and hence not radiate any RF power).

Regards

    Steve

Hi Steve,

Thanks again for the reply, and again sorry for the delay in response.

Cheers for the link for the box, I had a look, but because of you said may be a bit small I found one at 2.4L which seem fairly middle of the road of your previous suggestion. of 2-3L

This one: [ebay.co.uk/itm/233207982930](http://ebay.co.uk/itm/233207982930), hopefully this is okay.

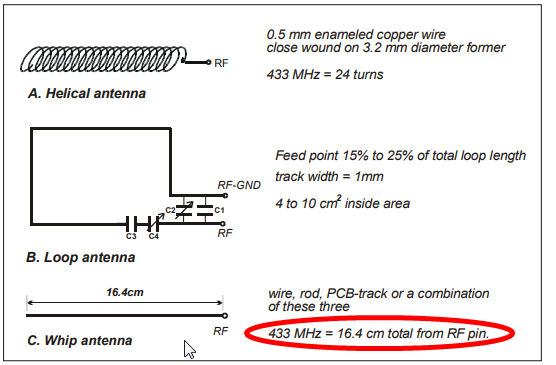
I have looked into the BMP180 etc, and agree with you, it seems to cut off at 30,000ft because of the 100hPa lower limit. This was further confirmed by articles explaining that the BMP280 etc will not give accurate data after this altitude. I was about to say I couldn't find any purchasable MS5661's but now I am finding lots of results on ebay, etc. Reason: I wrote MS5561, not MS5611. Fool.

I will definitely look into one combined with the acc, gyr, magno in a breakout board form.

It's crazy to think that overheating could ever occur in extreme cold temperatures, but I suppose it has a little micro climate in the box. Hopefully my internal sensor will show this!

Thank you for the info about the antennas. I watched the video and made notes on the payload with antenna with great attention to detail. I have added the equipment wire, pigtail etc to my shopping list. Now I know the function of the radials (simulating a ground plane)!

The reason I had the concern about the traces is because of read in the NTX2B datasheet. Maybe I misunderstood.



But I'll take your word for it, both your video and the guide say the same thing, that the 16.4cm is from the intersection of radials and coax shield.

Many thanks again for the help,

Riccardo.

Hi Riccardo  - I think your concern about track length comes from the NTX2B datasheet which says:

"Quarter-wave whip. This consists simply of a piece of wire or rod connected to the module at one end. At 434MHz the total length should be 164mm from module pin to antenna tip including any interconnecting wire or tracking."

This text is talking about the situation where the PCB track is not a transmission line. Under these circumstances the track becomes part of the antenna (i.e. it starts radiating RF energy) - and hence the track length becomes part of the antenna length calculation.

Ideally instead the NTX2 output should be directly connected to a transmission line (PCB and/or co-ax) which transports the RF energy to the antenna.

If your new to radio electronics its worth reading up on transmission lines, co-ax, RF connectors, antennas etc.

    Steve

## D – Heather Lomond PhD Correspondence

Hi Heather,

No worries, that sounds interesting!

Thanks for the answers!

I've acknowledged/asked additional questions below.

Thanks,

Riccardo

**From:** Heather Lomond <heather@myorangedragon.com>  
**Sent:** 06 November 2019 10:33  
**To:** Riccardo Geraci <ricci07@hotmail.co.uk>  
**Subject:** Re: High Altitude Balloons

Hi Riccardo,

   Sorry, my turn to delay - been in Scotland for a few days playing with big dishes and microwaves.

   Some answers below, do keep the questions coming and I'll do my best to reply.

Heather

On 30/10/2019 19:31, Riccardo Geraci wrote:

Hi Heather,

Sorry for the delay in getting back to you, hope you are well. I wrote some of the questions I would like to get an experienced answer for.

1. What receiver did you use?

- I have seen the common receiver is the Yaesu 817 these days

- How would I go about acquiring such an expensive device for a one time launch?

- I heard you can use an inexpensive radio receiving dongle

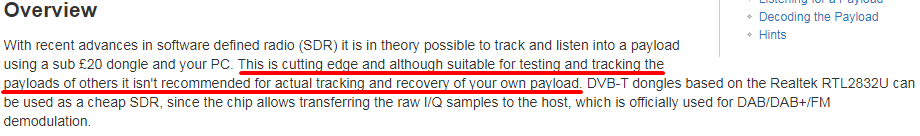
Paul and I used my FT857 which works well with a roof mounted vertical antenna.

The FT817 will be pretty good as well, If you need one I can lend you one for the day. I only have one though and you will need to find an antenna - can make them pretty cheaply but if you want a magnetic mounted one to go on the roof of the car that might be a little more expensive. I can ask around to find someone who can lend you one if you would like?

The alternative is to use a DVB-T dongle. They work well and can be got from ebay for less than 10 pounds. They need an adaptor cable to attach to a decent antenna. The antenna that comes with them isn't great for 434 MHz.

[https://www.ebay.co.uk/itm/USB-2-0-Digital-DVB-T2-T-DVB-C-FM-DAB-SDR-Tuner-Receiver-Stick-Dongle-Useful-HS/183988448884](https://www.ebay.co.uk/itm/USB-2-0-Digital-DVB-T2-T-DVB-C-FM-DAB-SDR-Tuner-Receiver-Stick-Dongle-Useful-HS/183988448884?_trkparms=ispr%3D1&hash=item2ad690ee74:g:4~gAAOSwuaJdndAi&enc=AQAEAAACQBPxNw%2BVj6nta7CKEs3N0qXrKOVNeJik16Yp5i5267zYzDDD%2BuqQ2odhmiYNfC83Fi7tGzxQ3Ry3lrS97PQ1E9t5azHdWdFPMtf1EAkz5x5tXoU3WOn3UFbcVyL%2BbSFZo8lp562UPSaXRdyxJnwxTOBtAoSDvcKDns3enGeM8bBxjjJXG48EAjRnA%2BHDyy2hDTQUjygdUBScSdnYAcyqQgSLMW5HaQNneekO46PFuJVQduVzLpr6DBCNKy0auPDG6AOKFQ7fTWBcbbd0Zgw4kSSc5e%2BXIT9VUSI9YDss8msCmAKAn%2BKfJAQD3er7ZklZNf4IVEji14oG9%2Bw8bsPJ6BUey33amc6YKq8MSQ12bJqBMNuv4rbX3gM01irnXss4%2FJXSZI8GaCOqsGhI0fX119h%2FD0hmOxsTEGWcEUVBENHt9qjW9%2Bc%2BUmZB7VaJHPiN326mOvtqsbSb3d5vhahJbC2xrR7RxlLk1ZsnvAqsI6onm5Af57XDybhRWJ9xCN%2FCdxCo%2Bc0tj9GBdt8FBA1vT1A5W9IwvW1L4VDMWey9GkL6F0bm9Pq9WW9LFPNDrMqKLfXSk6HZK6AsTQ0aeLkMogJdjcNqdJNJSQQVyoNYRMlFNig0ObhLCixHBB4jYtNvBF5AXgfdiaZnDJnR%2BxWSBsvWI15nztBmSSnzT%2Fa0ifpkXcjHl4la2CLBaW7YTye3l5hj8bvc697gkstmzGDAi6F%2BTIQ75yA16JtfXdQTbJ0DRiu3jvlX9ZZ8AvaXc5AMWg%3D%3D&checksum=183988448884c408068edaa0498f96ffd29edf7f399a&enc=AQAEAAACQBPxNw%2BVj6nta7CKEs3N0qXrKOVNeJik16Yp5i5267zYzDDD%2BuqQ2odhmiYNfC83Fi7tGzxQ3Ry3lrS97PQ1E9t5azHdWdFPMtf1EAkz5x5tXoU3WOn3UFbcVyL%2BbSFZo8lp562UPSaXRdyxJnwxTOBtAoSDvcKDns3enGeM8bBxjjJXG48EAjRnA%2BHDyy2hDTQUjygdUBScSdnYAcyqQgSLMW5HaQNneekO46PFuJVQduVzLpr6DBCNKy0auPDG6AOKFQ7fTWBcbbd0Zgw4kSSc5e%2BXIT9VUSI9YDss8msCmAKAn%2BKfJAQD3er7ZklZNf4IVEji14oG9%2Bw8bsPJ6BUey33amc6YKq8MSQ12bJqBMNuv4rbX3gM01irnXss4%2FJXSZI8GaCOqsGhI0fX119h%2FD0hmOxsTEGWcEUVBENHt9qjW9%2Bc%2BUmZB7VaJHPiN326mOvtqsbSb3d5vhahJbC2xrR7RxlLk1ZsnvAqsI6onm5Af57XDybhRWJ9xCN%2FCdxCo%2Bc0tj9GBdt8FBA1vT1A5W9IwvW1L4VDMWey9GkL6F0bm9Pq9WW9LFPNDrMqKLfXSk6HZK6AsTQ0aeLkMogJdjcNqdJNJSQQVyoNYRMlFNig0ObhLCixHBB4jYtNvBF5AXgfdiaZnDJnR%2BxWSBsvWI15nztBmSSnzT%2Fa0ifpkXcjHl4la2CLBaW7YTye3l5hj8bvc697gkstmzGDAi6F%2BTIQ75yA16JtfXdQTbJ0DRiu3jvlX9ZZ8AvaXc5AMWg%3D%3D&checksum=183988448884c408068edaa0498f96ffd29edf7f399a)

If you don't mind letting me borrow your FT857, that would be great (for the actual launch). I have been researching into SDR dongles, and think I can use one for testing purposes, but I think using something such as your FT857 would be much more safe. Take for example below from <https://ukhas.org.uk/guides:sdr_tracker>, though they don't seem to be able to make up there mind, as in some other pages they advocate the use of an SDR dongle for tracking.



Ref: <https://ukhas.org.uk/guides:sdr_tracker>

I would like to use a magnetically mounted antenna on the car, but at the moment I am unknowledable about which I would need for the magnetic mount. If you do ask around that would be fantastic!

2. Do you use the Radiometrix NTX2 10mW Transmitter (£21)

- I believe I don't require the matching reciever if I am using a Yaesu 817, is that correct?

We used the PITS radio board from Dave Ackerman. This has a radiometrixs transmitter on it but I don't off hand know the model number. You are correct that you only need the transmitter.

If you are going to write your own software then I would recommend looking at the RF PIC micros. I just bought a couple to play with. There is also a thing called HABDUINO that I have also not used but seems pretty good and low cost. Lots of stuff available from Dave Ackerman's site:

<https://store.uputronics.com/>

​I'll have a look at his site. I had planned to use the Raspberry Pi, though I have very little knowledge of it right now so I will have to look into it. Most of my knowledge is of the ST32 Nulceo. I assume the PITS radio board is just the necessary circuitry that utilises the radiometrix NXT2 transmitter and provides a connector for the payload transmitting antenna?

3. The datasheet for the Radiometrix NTX2 10mW states 500m range, but I know from ukhas research this can be extended to a few hundred miles with high line of sight, but as the line of sight reduces during the landing phase, the signal may not be pickup unless within 500m (chasing the balloon). You suggested using a secondary balloon and a gateway to locate the landing location. At the time I don't know exactly what this meant, but I have seen you can use a backup cheap GSM phone in the payload to send a SMS message of the landing location to your smartphone, what are your thoughts on this and how I would go about triggering a sms message to be sent containing the GPS coordinates?

The problem with GSM triggering is a little complex and I have not done it. I do have a GSM modem board (cheap from China on ebay) but haven't got as far as putting a SIM card into it and making it do stuff.

I think it is quite likely that you will be OK with tracking it, as long as you are reasonably close to it when it lands. If you have a couple of position points you can extrapolate to get a roughly accurate landing site and then you can drive around a bit in the general area until you get the tranmission again.

We haven't used our second balloon yet, both of our flights have been recovered without the need for it. The idea is to deploy a second, tethered balloon at the last know location of the landed balloon. This has a gateway that receives LoRa (our second transmitter on the payload) and relays this onto wifi in the form of a web page. I then use my smartphone to look at this web page and see what the lat and long are, then it is a matter of walking!

There is another, more expensive tracker that people have used - called th4e SPOT tracker. I have tracked a balloon with this on it and it seemed to work very well.

​The diagram I had based the idea used a classic nokia-type phone in it, which I was thinking to myself, how do I make it send periodic text messages with such an ancient phone, but I saw a video with a old smart phone and they used a app such as Tasker to send the SMS message periodically. But I'm not too motivated to but a smartphone in a untethered balloon for obvious reasons. I'll probably be doing the driving around until I regain transmission as you say. I'll have to ponder about this some more.

4. You said something about renting helium, but I don't remember exactly what it was. Can I not just buy a large cylinder of helium? - Or does renting allow you to obtain more helium for free if you require it? - e.g pay for the cylinder, and have free refills/new full cylinders.

What we found was helium per m^3 is more expensive than hydrogen (we got it from M&M gasses in Shrewsbury). However, the bigger helium bottles have a 50 pounds deposit on them (refundable as many years later as you like) and no rental, whereas the Hydrogen bottles have a monthly rental for the bottle, plus deposit. For us it worked out cheaper to buy the helium, keep the bottle for 3 months for our different launches and then return it and get our deposit back rather than pay 3 months rental on the hydrogen bottle.

​It seems it would be easier just to stick with helium based on the pros and cons you gave me. However, I'm not sure if I will be launching again within a 3 month period though.

5. Most guides I have seen use a software called dl-fldigi, is this 'the' software to use, or is there something you used instead?

yes dl-fldigi is "the" wy to go!

​I keep that in mind then.

6. I couldn't find rocket engineering's high altitude balloons, would any purpose designed latex high-altitude balloons do?

- Is 600g the most common size balloon, did you use this or bigger? (I realize it depends on the payload's weight)

I might have given you the wrong name, here is the link, it is Random engineering:

<http://www.randomengineering.co.uk/Random_Aerospace/Parachutes.html>

this site has details of balloons and parachutes and (at the bottom of the pages) calculators so that you can work out balloon size and parachute size.

Note that the parachutes are rather expensive but you can make your own if you have access to a sewing machine.

I think we used a 600g and a 300g for our 2 launches. Balloon size affects the rise time, max height etc. Yes, all depends on payload weight.

​I'll look at the prices and compare them to the ones I've seen from Kaymont (Balloons). I think 600g will be the size I go for. I've asked my sister if she can make a parachute once I calculate the weight of my remaining payload after bursting. She works with sewing machines 24/7 so I think she should be able to if I give her a design. (size and materials, etc)

7. I read hydrogen is cheaper, and has more lift, but can be explosive if mixed with correct amount of air. Is it best to just stick with inert helium?

We decided to stick with Helium for the first 2 launches. Note it is also environmentally friendly to use Hydrogen.

I will do the same.

8. You invited us to a couple or so events, but I cannot remember what they were or when, can you reiterate what it was?

The main event is the Microwave Round Table is at Eaton Manor, Nr. Much Wenlock, on Dec 14th. All welcome - it is a a mixture of a couple of talks and people making and testing things to do with radio and Amateur TV.

I'll mention it to the guy who came with me last, and maybe some others to see if they would be up for coming or not.

9. I mentioned to Mo (The Lecturer) that I met up with you and he must have spoken with a fellow lecturer about it. That lecturer asked me to check if you would be interested in coming into the university for a talk. She didn't specify what about exactly, but possibly the projects you have worked on, including the weather balloons.

Yes, I would be happy to come over for a talk! Do pass on my details (email and phone).

I'll mention this next time I see her, to see what exactly she had in mind and pass your contact details on.

10. How much helium is required? - Just enough that it wants to rise up? (Without overfilling and reducing the burst altitude)

No, this is where we went wrong on the first launch.

You need to get the right amount of neck lift. The way it works is that you fill in your details on one of the payload websites and then it tells you the free lift you need. this is the amount of lift that you need to have to make it go up at the correct rate.  What you need to do it build a filler system that allows you to have all the bits attached (parachute, balloon, payload etc, and also a water bottle filled with water. The weight of this bottle you set to be the free lift weight. You then fill the balloon until it is just lifting the bottle off the ground. When you are ready, you disconnect the bottle and the whole thing then shoots off up into the sky!

I have a bit I wrote on this, I'll dig it out for you, but here is an online guide that might help.

<https://ukhas.org.uk/guides:fill_tube>

​So, if I understand correctly, I need to inflate my balloon at the time of my launch, and have everything attached but with an additional water bottle full with water tethered to the bottom of the payload weighing the free lift weight, so that it hovers off the ground, so that when it is detached it rises at the desired rate? Also, If you find it please forward it :)

11. You said you used a thermocouple without the need for linearisation, could I use a thermistor since one I looked at has a working range of -85 deg C. I believe the peak temperature is about -55 deg in near-space

Yes, -55 is about the min we got, thermistor would be fine I am sure.

​Okay, great.

12. Can you list the types of sensor data you collected with your payload sensor board. I remember, ex temp, int temp, acceleration, gyro, humidity?

External temp, atm pressure, internal temp, 3 axis gyro, 3 axis accelerometer, 3 axis magnetometer, ambient light level, UV light level, GPS time, location, speed, and camera.

Some people put go-pro's on but that is a little too expensive for me to risk losing.

​

That's alot more than I expected! I hope to make to pcbs for these myself (as I need to design some part I guess) but what boards were they that you used that contained these sensors. I remember something about a Bosch chip or something. I have seen a BMP180, that has some sensors in a Bosch chip, GY-955 that has magno, accel, gyro, euler angle. Did you have separate boards that had a few or so sensors each or one that had all the ones you listed?

13. My research says x4 energizer lithium disposable batteries are the most resilient batteries to send up, are these the ones you used?

yes, lithiums cope with the cold.

​

Okay, those are you ones I will get.

14. Did you find the need for a YAGI antenna, or did you get by with just with whip antenna(s)?

For the payload we used a small whip antenna, for the car tracker we used a large magmount antenna on the roof, for the portable handheld tracker we used a small yagi.

So it seems the size of the receiving antenna is the most important. (A large one) - What handheld tracker was this?

15. What type of lines (material wise, e.g paracord) that connects the balloon to the parachute and payload did you use?

You need to get something with a suitable breaking strain, the CAA define that it can't be too strong. We used some cord I got from ebay.

<https://www.ebay.co.uk/itm/1-Hank-30-Metres-Nylon-Braided-Braiding-Cord-Thread-1mm-Kumihimo-PICK-COLOUR/400559282398?ssPageName=STRK%3AMEBIDX%3AIT&var=671341439532&_trksid=p2057872.m2749.l2649>

I recall that braided is best, and nylon copes with the cold well.

​I will likely use the same!

16. I think I'm going to use polystyrene, as most people do, for its many positive properties for this application. Is a polystyrene cooler with lid enough to keep the electronics warm enough, or do I need to include extra steps to prevent frozen electronics?

What about the antenna, does that need to be exposed out of the polystyrene cooler?

There are specific designed polystyrene boxes for this sort of thing. I would look at the websites and see if your cooler is similar. We used a clear plastic bottle to provide solar heating. A lot of systems , including ours, uses a raspberry Pi and this generates quite a bit of heat which helps keep things warm.

​

The solar heating was a great idea. The main reason I am using a box is because i want to to mount knockoff go pros. Not sure how many at the moment but the ones I looked at are £29 each excluding the sd card. But that will require external batteries to keep them alive, which will add more mass, which because of my 600g balloon limit, it may not be feasible. But I will need to look into this some more.

17. How do I make my balloon appear on HABHUB? - is it the output of the dl-dldigi software?

You need to register it with habhub before it will appear but, one done, yes, the dl-fldigi sends data to the habhub.

In order to register you have to tell it about the payload data format and the flight details and then go onto the IRC channel and get it authorized. This can only be done once you have done a successful trial so you need to full transmitter and receiver system to be working. Details here:

<https://ukhas.org.uk/guides:documents>

​Okay, thanks for the information. I will have a look.

I really appreciate your contributions in to my high-altitude balloon project

Thanks,

Riccardo