VA7ILO Meshcore Repeater Build

Here is a little write up about the repeater I decided to build for Meshcore using a Heltec V4 board, I could have bought an off the shelf one, but I thought it would be more fun to build and design.

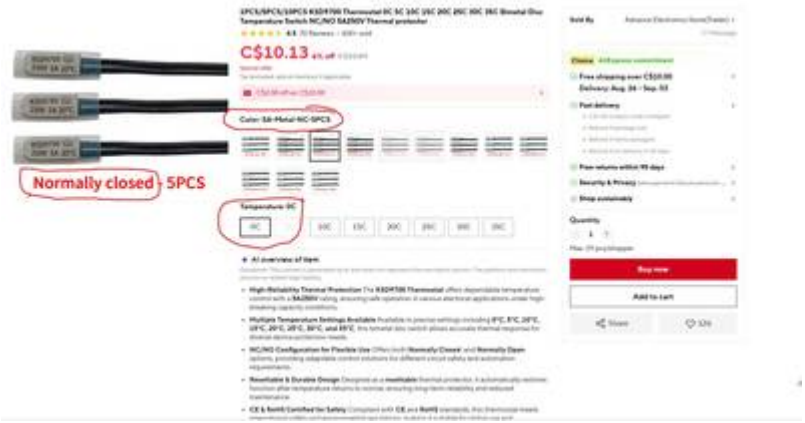
I am very new to Meshcore so there are still quite a few things I am learning about it and consequently after starting on this I revised a couple of things and also realized that there are a few things hardware wise I would have done differently. Some of the things I bought I wanted a shorter lead time so either bought more than I needed or paid more to get things in a timelier manner. The links are put there to illustrate what I used, not necessarily a suggestion to where to buy them from.

First off, the Heltec V4 has a built-in solar input so this could be used to interface it (using caution that the maximum voltage is 6 V) the downside of doing this is the charging current is maximum 500 mA and there is a risk that even a 5-volt panel might have an open circuit voltage that exceeds this 6 V maximum. In light of this I opted for a charge controller board rated at 3 amps, which takes advantage of the maximum charge that the solar panel can put out as well as over voltage protection etc.... The board has ntc pads on it for freeze protection and high battery temperature protection (by default on the variant I have this is bypassed with a surface mount 10K resistor, which could be removed and pads soldered to with the yellow or white wire from a battery that has an onboard 10K thermistor or alternatively adding a thermistor against the battery casing if it doesn't have this) this could be useful to use but I opted to not bother with it as I decided to use a separate freeze protection method, the charging board has overcharge and over discharge protection, the battery has its own high temperature and other protections too. The remaining consideration that is left is freeze protection (not sure if this is overkill or not if I insulate things somewhat but better safe than sorry) so I ordered some small temperature switches from Aliexpress that are normally closed 0 degree centigrade rating, these should open up if the battery temperature reaches 0 degrees and halt charging until it warms up again, I will open one of the lines from the solar panel and install it there and put it against the battery case with some Kapton tape. I chose this board originally for the NTC part but abandoned that idea as I preferred to have the freeze switch instead, I could have chosen a different board for my purposes due to this. I think it is better to go with minimum 3A board as I tested this one by plugging it into a usb charger and it drew 2.6A at first charging the battery so if you want to pre charge the battery good to know, as charging progressed it did switch to a much lower charging current.

Another thing worth noting, is using a custom firmware tuned to ultra low power consumption like EasySkyMesh, below is a link to a separate article I am writing (bit of a work in progress), an excellent way to go for a solar node to really bring the draw down incredibly. Actually EasySkyMesh has affected another hardware choice, I was going to put a voltage monitor circuit to ground out the RST pin when the voltage dropped too low to prevent brown out boot loops, but this firmware virtually eliminates this concern so another advantage.

EasySkyMesh Firmware for Meshcore

https://www.amazon.ca/dp/B0FFS9WXQG?ref=ppx_yo2ov_dt_b_fed_asin_title



To prepare the board I soldered a PH 2.0 connector to the battery terminals B+ and B- and then I soldered a JST 1.25 pigtailed connector to the J+ and J- pins on the charging board so I could plug directly into the Heltec V4 battery input connector. I decided since the solar panel has a USB C connector, I would just plug it directly into there and make a USB C adapter later on for the temperature switch. I also left the solar panel cable full length to give me the option of moving it around for the best sun location.

I used this for a case:

This for SMA to N connector (I should have used one a little shorter but not a huge problem)

The antenna I chose was this one, it was probably not the best value for what it was but I had it so I used it (got rid of the 20 foot cable) there are many similar or better outdoor antennas that are less expensive, so this is one of the things I would have done differently.

This is the solar panel I used:

This is the battery I used, 5200 mA with BOM protections, battery plugged in nicely to the PH connector I soldered to the board, I might opt for a larger capacity battery later on, will see how this works out first.

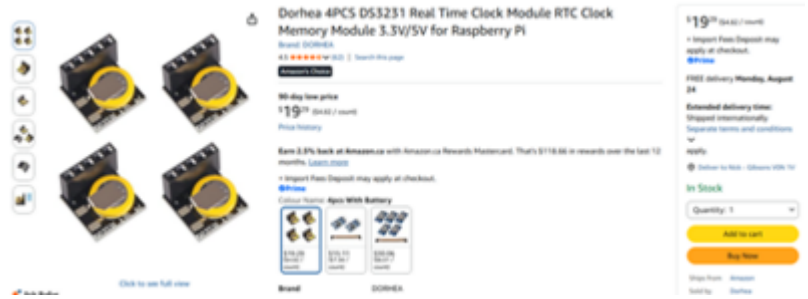
This is the Heltec V4 I used:

This was my first step, installing the N connector with SMA pigtail and the solar panel cable.

Next I mounted the charge controller board and battery:

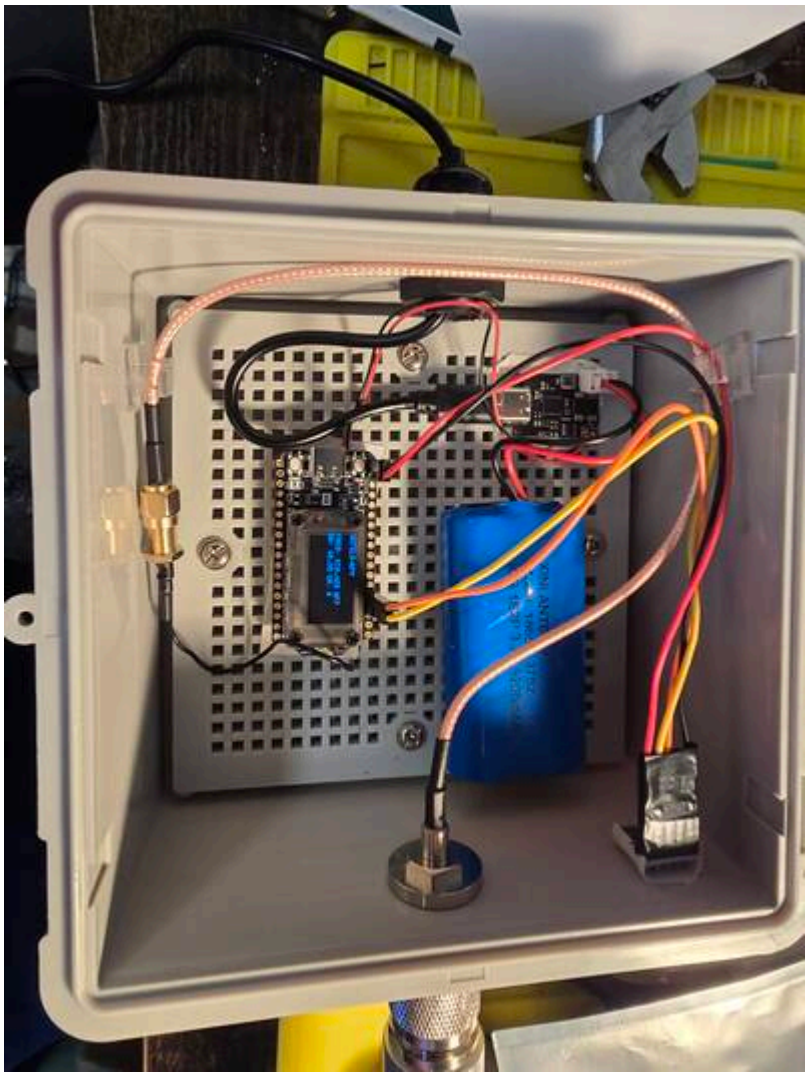
I didn’t want to put a GPS in it as it is fairly power hungry, so I set the coordinates manually and added a real time clock module to keep the time in synch. This is the module I used, doesn’t have indicator LEDs so that is helpful with power consumption too. The Power Win (99% Less Drain): A GPS module constantly pulls 24 mA to 30 mA to track satellites. The DS3231 RTC pulls a near-invisible 0.2 mA when updating, a huge power saving.

This is the module I used:



(I removed the details about installing this temporarily as I will need to give a better explanation on how to install it and with which firmware, GPIO3 and GPIO 4 work well for EasySkyMesh for instance after remapping but not the stock MC firmware, I will add this back with more details later). Latest update, I actually am going to remove the clock module as it doesn't seem to be capturing the time correctly anyways. Since I am using EasySkyMesh firmware, I will put the GPS module back as it is off something like 99% of the time with this firmware so the overall draw is miniscule.

Next, I mounted the Heltec board and clock module, plugged the connector from the battery terminal on the charging board into the Heltec onboard battery connector, the battery into the charging board connector and the solar panel USB C connector into the charging board.



For good measure sealed around the N connector and the strain relief for the solar panel wire, finally mounted the box on my roof and the solar panel on the sunny side.

The location I mounted it has a rectangular metal chimney cap, I worry that it might affect the radiation pattern too much so most likely will mount it a little above this, but for now it is getting out fairly well. I used high temperature double sided tape to mount everything and also adhesive clips to organize the wires better.

So as mentioned above I moved my antenna above the metal chimney flashing, using this hi-tech mounting pole (1 X 2 cedar board) and 10 feet of KMR240 low loss coax.

Update: I replaced this repeater with a hard wired RAK 1W kit, it has a 12v 3A power brick fed to 25 feet of 16 gauge cable, then a 12 v to 5 v buck convertor (was worried the buck convertor might add some noise but seems to be fine), the antenna and power cable are at the bottom of the box to reduce the chance of water ingress. My next trip up I will install a 5,000 ma backup battery with temperature switch and a schottky diode in parallel with it to prevent freeze charging the battery and allow current to flow from the battery to the board when the switch opens. So far this new repeater is a big improvement over the Heltec (which worked quite well, but hey this one goes to 11)

The Heltec V4.3 with EasySkyMesh power saving firmware worked really well, the battery never dipped much below 90% even on rainy/cloudy days, so it has proven that it should be suitable for deployment in the wild somewhere. The main reason I went to the RAK, is I had to turn off the external LNA for the Heltec to get the noise floor down sacrificing some range, the RAK also has a built in SAW filter so with that it has about a -110 noise floor with the LNA still turned on.

Here are some of the links, I am sure if you shop around, you can get much better prices on things if you are willing to wait a little for them to arrive.

Heltec V4: (cheaper on Aliexpress)

https://www.amazon.ca/dp/B0G3P28F1N?ref=ppx_yo2ov_dt_b_fed_asin_title

Enclosure:

https://www.amazon.ca/dp/B07KXSPRGC?ref=ppx_yo2ov_dt_b_fed_asin_title&th=1

Charging Module:

https://www.amazon.ca/dp/B0FFS9WXQG?ref=ppx_yo2ov_dt_b_fed_asin_title

Battery:

https://www.amazon.ca/dp/B0C2VFTDPY?ref=ppx_yo2ov_dt_b_fed_asin_title

Antenna:

https://www.amazon.ca/dp/B09N2H166D?ref=ppx_yo2ov_dt_b_fed_asin_title

N connector to SMA:

https://www.amazon.ca/dp/B0FDB2BN1R?ref=ppx_yo2ov_dt_b_fed_asin_title&th=1

Real Time Clock Module:

https://www.amazon.ca/dp/B08X4H3NBR?ref=ppx_yo2ov_dt_b_fed_asin_title&th=1

Temperature Switch:

https://www.aliexpress.com/item/1005007233738243.html?spm=a2g0o.order_detail.order_detail_item.4.83eb126a15Xgpz

These kind of clips are nice for arranging the wires in the box:

https://www.amazon.ca/Xetree-Cable-Adhesive-Transparent-Organizers/dp/B0H6X1JCVL/ref=sr_1_10?crid=3UCHVA81WV822&dib=eyJ2IjoiMSJ9.fTut_kH-4qwM99Dn_5CoABaRd8lb4TaQzRcnM3Z82PC0koK5gfiEi54jE1cfZEUX8i8kPdPgbKv1yTTlO4wCB9uxltRV_PK-1UzhPQ7GkP2DKUghHtCe7hrr7JEbIVw9zH9h9Q5dVIdCgt5FZaMLpQHi5MWHsW7CJl_WD1A770f65GAe2rqbynOESzunYzUOR2aIJonm__p-VL3ciYim7juKtMenmbcYvfZbYsCy5nNJSQF9mhNL3L3GqEOliztzdLO4xoT3JrzMUvBUd7cL3Vts5rplJHErdNmsAvXFWSE.kxa4dI1Yqi0_EDjx-75AmOzfLNqB6bqxngdtlsrJ844&dib_tag=se&keywords=adhesive+clips&qid=1787703074&refinements=p_85%3A5690392011&rnid=5690384011&rps=1&s=electronics&sprefix=adhesive+clip%2Celectronics%2C154&sr=1-10