2019 United States Air Force Marathon

Wavelengths

Xenia Weather Amateur Radio Net
XWARN (W8XRN)

Oct 2019

147.1650+ (123.0) (Analog Only)
443.1000+ (123.0) (Analog + System Fusion)

Meetings: 2nd Monday, 7:30PM, Greene Memorial Hospital (1141 N Monroe Dr, Xenia, OH) Herman Menapace Auditorium

President's Message

Happy October fellow XWARNers! Fall seems like it is finally here. We have lots of public service events in which to help out. There are new and upgraded license classes to attend. And don't forget the multitude of contests and special event stations to contact!

Our best wishes go out to Janese Brooks, KD8DGB, and her family on the loss of her mother. Her mom was one of the founding members of this club.

Sheriff Fischer, KX8GCS, has been working very hard to help us get our own space. He will have some very exciting news

(Continued on page 2)

DIY Lithium Battery

I follow a couple of YouTube channels that keep me up to date on the latest solar polar technologies as well batteries for the DIY'er. The first is DIY Solar (http://bit.ly/325jBUx) and the second Jehu Garcia (http://bit.ly/2LWvoi9). A few months ago, I saw a battery project (http://bit.ly/35hHEkM) that really piqued my interest about the same time the robotics club that we support was gearing up for parade season.

Unlike matches, which last about 3 minutes, parades and the Walk for Life they participated in can last anywhere from 20 minutes to several hours albeit with less stress on the battery. The way we approach this now is to connect two of our regulation lead acid batteries in parallel.

Each is about 18Ah, but you certainly don't get 18Ah out of the battery. At best, you get 50% of that if it's a deep cycle

(Continued on page 3)

Club Contacts

- Liz Klinc, KE8FMJ
  President@xwarn.net
- Vice President, Bob Baker, N8ADO
  Vicepresident@xwarn.net
- Secretary, Jason Bowman
  secretary@xwarn.net
- Treasurer, Steve Mackey, N8ILR
  Treasurer@xwarn.net
- Repeater Guru, Jim Simpson, WB8QZZ
  Technical@xwarn.net
- Web Master Josh Long, W8KDL
  webpresence@xwarn.net
- Membership, Phil Verret, KA8ZKR
  membership@xwarn.net
- XWARN Trailer / Public Service,
  Mike Crawford, KC8GLE
  trailer@xwarn.net or
  publicservice@xwarn.net
- Newsletter, Jason Bowman, WG8B
  newsletter@xwarn.net

(Continued from page 1)

to share at our next meeting - at which time all our repeater work is promised to be completed!

I will see you all at our next meeting on Monday October 14th where we be taking nominations for office.

73,

Elizabeth Klinc KE8FMJ

XWARN and DARA trailers at the 2019 USAF Marathon

Public Service Events

Sunday, October 13, Dayton River Corridor Classic Half Marathon and 5k

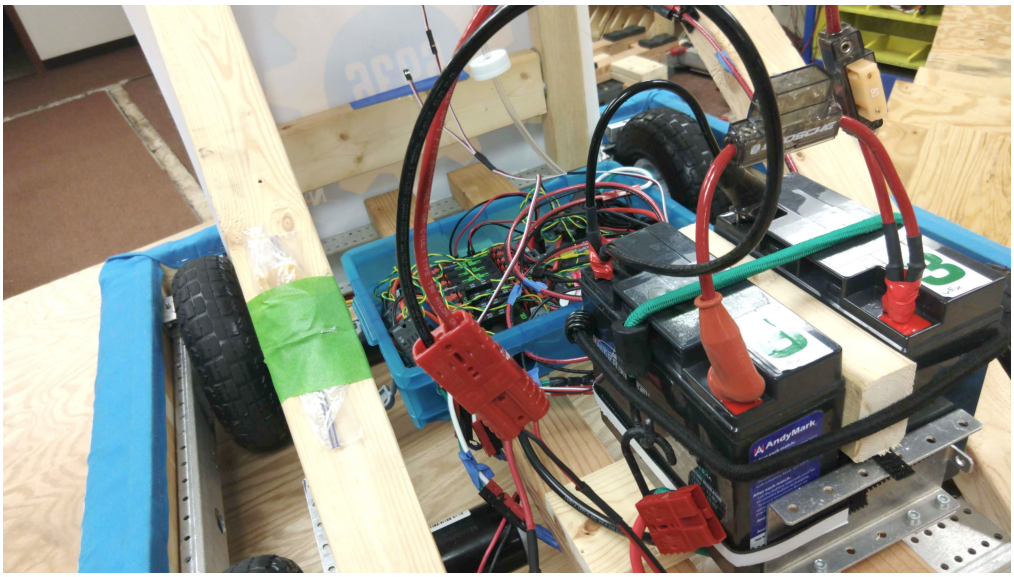
Start/Finish is at Welcome Stadium and the course runs along theriver-side paths. Event starts at 9:00 and the course closes at 1:00. That means some positions would need to be in place starting around 8:30 and that some positions would begin to close at roughly halfway through (11:00). We need about a dozen volunteers to cover key locations, such as water stops and it would be great to have several bicycle mobiles to patrol the paths along the river. If you are able to help with this, please contact n8ado@arrl.net and

include your shirt size in your reply.

Saturday, October 19, Dayton District Cross Country Meet; Cedarville OH. First Race is 10:00. Six races every 45 minutes with a half hour break in the middle. Should be done before 3:00. We need nine volunteers to cover the course and report time splits to the announcer. Lunch is provided. If you are able to help with this, please contact n8ado@arrl.net.

Saturday, November 16, Mid-East Cross Country Championships; Indian Riffle Park, Kettering Girls Race 11:00; Boys Race 11:30. This event features invited elite high school runners from several states around Ohio. Fast paced. We usually join together for breakfast before this relatively short event. If you are able to help with this, please contact n8ado@arrl.net.

Bob Baker, N8ADO



Two 18Ah lead acid batteries in parallel on the Vault 6936 robot. Note the fuse between the two positive terminals in addition to the fuse going out to the load. That first fuse is there to keep the batteries from having a "thermal event" should one cell go dead and the other battery tries charging it.

battery. And, if you run the robot hard (high current draw), you'll get even less, maybe 25%, due to the battery's internal resistance. Because there are no regulations requiring the use of lead acid batteries outside of FIRST-sanctioned competitions, I decided we should investigate using a lithium iron phosphate (LiFePO4 or LiFe for short) battery to power the parade robot.

Just a little refresher on why use LiFe. The biggest reason is that it has much higher energy density than lead acid. Second, it is the lithium chemistry closest to a nominal 12V system (12.6V-13.8V) running between 12V at depletion to 14.4V at full charge and staying at roughly 12.8V for most of the discharge cycle for a 4-series or 4S configuration. 12V lead acid is a 6S configuration, by the way. Third, of all the lithium chemistries, it is by far the safest. You can hit them with a hammer and cut them open and they'll smoke but won't catch fire.

Like any battery chemistry, you can formulate LiFe for high energy density or high power density. If you select high energy density LiFe, don't expect to pull a lot of current out due to higher internal resistance. If you select high power density (high current), don't expect a high amp-hour rating. The batteries I purchased are definitely high power density rated for 12C continuous and 25C peak. These cells are 8Ah each, so you can pull 100A (8Ah * 12C) continuous and 200A peak (8Ah * 25C) per cell! LiFe batteries made for backup systems for data centers are typically only 1C to 3C.

If we assume that we're getting, at best, about half of the energy out of the lead acid batteries, which would be 2*9Ah = 18Ah, then I would need at least a 3-parallel or 3P configuration to have more energy than the lead acids. Not knowing what battery boxes were available, I decided to purchase 16 cells to allow a for a 4S4P configuration if space permitted.

XWARN Mission

The mission of the Xenia Weather Amateur Radio Net (XWARN) amateur radio club is to conduct weather spotting nets during severe weather and other communication services for the City Of Xenia and all other Greene County communities.

In this capacity, we are set up to provide communication services as required to the Greene County Ohio Public Service Agencies and other local government entities. The communications services provided to the supported agencies may be for emergency purposes or to simply enhance their communications abilities. On an as needed basis XWARN provides similar services to various government entities of our surrounding counties.

Additionally, XWARN provides communications support to various community organizations in support of marathons, 5K runs, 10K runs, bicycle events, etc. to provide health and safety assistance to the participants and sponsors of said events.

In support of these goals, XWARN operates and maintains amateur radio repeaters and other equipment in Greene County.

Minutes: September 9, 2019

The meeting was called to order at 7:32 by President Elizabeth Klinc and opened with the usual Pledge of Allegiance and introductions.

Mike Crawford shared during Cracker Barrel that he had found a supply of XWARN decals during a garage cleaning and that they were available to anyone who wants one.

Jim Beller moved and Jim Simpson seconded a motion to accept last month's minutes as published in the newsletter. Motion passed.

Steve Mackey presented the treasurer's report for the month of August. Richard Weis moved and Jim Simpson seconded to accept the report. Motion passed.

Public Service Committee report:

Two training sessions are being provided for the volunteers signed up to help with the Air Force Marathon. Both are on Saturday, September 14. The first will be at the Air Force Museum at 3:00 and the second at Beavercreek Fire Station 61 at 6:00.

Bob Baker reported that besides the Air Force Marathon on September 21, there are several events coming up in October. Further information will be communicated over the usual email reflectors. Also, XWARN has been invited to display the Communications Support Trailer at the Make It Dayton Festival at Carillon Park on October 5.

Trailer Report: Mike Crawford reports that the trailer needs to be prepped for the Air Force Marathon. He also reported that one of the APRS trackers stored in the trailer and marked "W8XRN-2" actually belongs to his brother KF4KWW.

Repeater Report: Jim Simpson reports that one of the Mastr III repeaters is up and running and that the programming for it is in progress. An antenna test is needed at the Clifton site. He estimates that one should be ready to be put on line within the next 30 days. Available features should include Echolink, All-Star Network, and future enhancements may include connectivity to D-Star and Fusion networks.

Membership Report: Phil Verret reports 58 members.

MESH Report:

Bob Baker reports that a demonstration was held to show what services could be provided to Greene County emergency response agencies. They expressed no interest in using this resource. Bob recommended that we suspend the committee until there is a reason to reactivate it.

Old Business: Jim Simpson reported that the shirt people are preparing a quote for club shirts. (Some discussion) Salient points—embroidered logo red with blue print; a preference for dark gray was stated, name & call over pocket, logo on right side. Bob Baker reported that Karen has booked TJ Chumps for the Christmas party. 6:00 PM on December 9. We did not get the party room, but the manager promises a suitable area that will permit us to have the usual social atmosphere.

New Business: Bob Baker asked if we should plan to display the trailer at the Make It Dayton Festival on October 5 and asked if anyone was available to tow it. Rick Brooks will check.

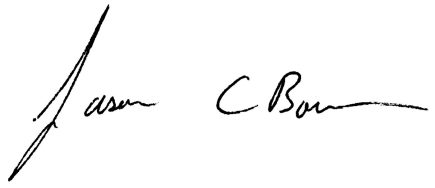
October 5 is the Simulated Emergency Test. As this is written, the scenario for the test is still pending, but XWARN has been asked to provide several volunteers. Three members responded: Jim Beller will cover the Xenia EMA / EOC, Danielle Edgington will cover the Greene County Public Health Center, Travis Lansing will cover Greene Memorial Hospital. (access to these locations may be limited, so the appropriate cover is likely to be making contact from the parking area using a mobile radio).

Bob Baker showed the documentation package that the organizers of the Pan Ohio Hope Ride assembled for the command group that controlled the support activities for the ride.

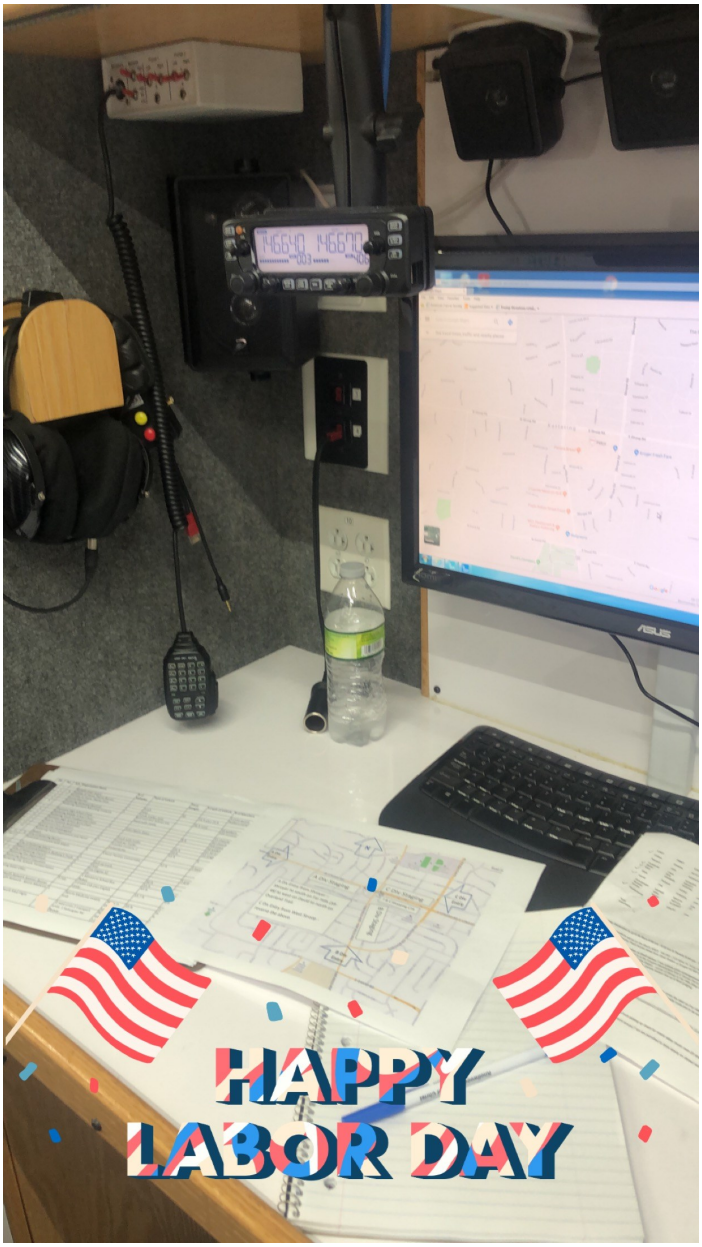
Next month, Danielle Edgington KE8JNU will present her "fair" project.

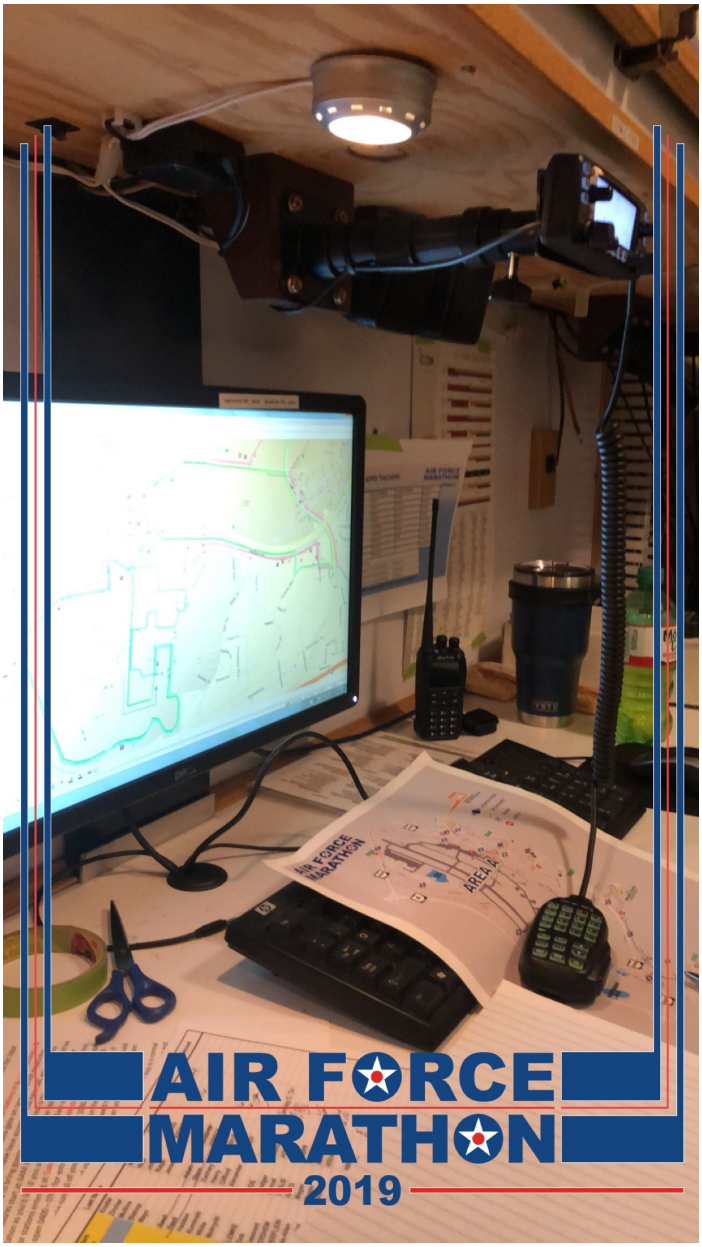
Meeting adjourned at 8:47.

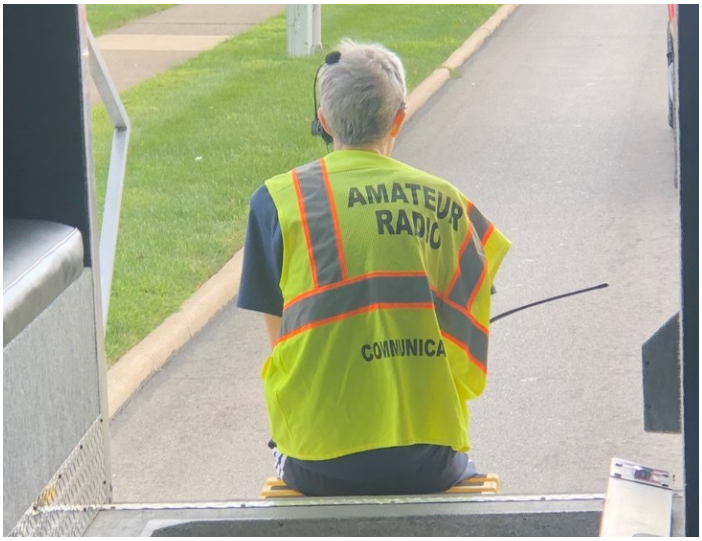
Submitted by Bob Baker N8ADO

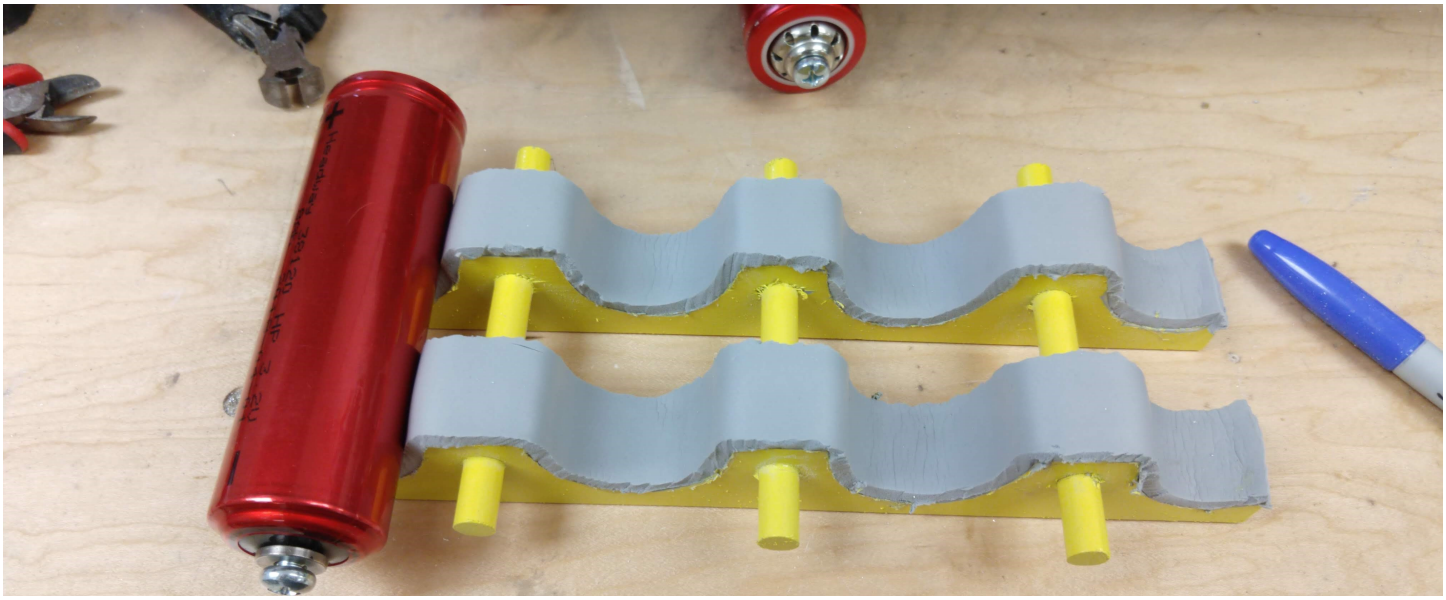


Jason Bowman, WG8B, Secretary


HAPPY
LABOR DAY


AIR FORCE
MARATHON
2019


AMATEUR
RADIO



DIY Lithium Battery

(Continued from page 3)

So why did I pick the high power density cells? The answer is very simple – I got them fairly cheap (http://bit.ly/2AQht75) at $10 per 8Ah cell. The same 38120 (38mm by 120mm) cell made by the same company but with a 3C / 10C rating costs at least $15. Also, if you look at cost per watt-hr, the high power density cells were still cheaper. This means the battery is going to bigger than I would like, but it's a good first prototype to learn how to build a lithium battery from scratch.

As a rule-of-thumb, all cells in a battery should be balanced before assembly and re-balanced at least once in a while. Balancing means that each cell in a series configuration should have the same voltage within a certain tolerance. Usually 0.05V is a good tolerance, and balancers will get that to 0V initially.

Why balance cells? Battery performance and safety is going to be impacted by the weakest cell. Total series voltage may read within tolerance while the weakest battery may be below its cutoff voltage. To charge the weakest cell, the other cells will end up over-charged! Definitely not safe. Balancing ensures that each cell has a similar state-of-charge and extends the run-time and life of the battery.

What happens after that depends on other choices involving the battery management system (BMS). BMS typically provide over-discharge protection, over-charge protection, and balancing. However, in some systems, especially high current systems, it is beneficial to separate these functions. When the functions are separated, there is a choice whether to provide continuous balancing. If the per cell current is well within its C-rating, the cells will remain balanced for a very long time and continuous balancing isn't required. However, balancers are so cheap now that it doesn't make a lot of sense to not install a continuous cell balancer. And most BMS for small systems have all the functions built in.

One question that people new to making batteries ask frequently is, is it better to parallel the cells first and then series them, or series them first and then parallel them? The answer is almost invariably, parallel them first. Otherwise it is nearly impossible to balance the cells due to the number of leads required. If you parallel them first, each group of parallel cells will self-balance, and then all you have to worry about is balancing between the parallel groups. Also, BMS will only provide enough leads for a 1P battery configuration. They assume if you have a 2P or higher configuration that you will just parallel them first.

Rather than hide the cells in a boring and opaque battery box, I thought it would be interesting to show them off as well as the BMS and other stuff. This is, after all, about learning and showing off. To do this, I purchased a polycarbonate (Lexan) dry box. Polycarbonate is a lot tougher than acrylic (Plexiglass). Unfortunately, this dry box forces the cells to lay flat rather than standing on end. If on end, you can use the cell buss bars to also mount the battery to the box.

Instead, I had to make a cradle that is then secured to the

(Continued on page 7)

(Continued from page 6)

bottom of the box. The cradle consists of two wood bases connected by wood dowels. The dowels are there to secure the cells to the cradle with Velcro. The wood bases are two pieces of 0.5-inch plywood glued together. The cutouts for the cells were radiused 0.125 (1/8) inch larger than the cell to accommodate foam padding. The padding is required to provide friction against the cells to hold them in place when the battery is not lying flat, e.g. being carried by the handle. The foam rubber also helps prevent damage to the cells from vibration and bumps experience by the robot.

Securing the wood cradle to the bottom of the box involves 6x ¼-20 machine screws and a trick I learned when I used to build RC airplanes. Appropriately sized holes are drilled into the wood, then a ¼-20 tap is used to make threads. Thin CA glue (Basically superglue or cyanoacrylate, thus the "CA", but thinner than what you can buy at the local hardware store so it really soaks into the wood. You can buy it at any RC hobby shop.) was then dripped onto the threads and allowed to harden and dry. This makes the wood threads stronger and better able to take a machine screw. Then I ran the tap through again to clean up the threads.

The only issue is that the threads still aren't as strong as a machine screw. So you have to be very careful torqueing them. I also bought nylon bolts, but I don't know if they will hold the weight, about 12lbs, if someone drops the box. On the other hand, you don't have to worry about stripping the wood threads because the nylon bolt will typically shear off before that happens.

Battery buss bars are availability from various sources (http://bit.ly/33eT1Im), but I decided to make my own because I have a bunch of 0.063" (1/16 inch) aluminum laying around. Because I don't have a CNC machine or laser cutter – you want the holes to have a consistent spacing – to make the buss bars I simply sketched everything out in Powerpoint like you would do in CAD. I then printed off the templates and used contact cement to adhere them to the sheet aluminum.

Rather the use a template for each buss bar, I simply stacked similar buss bars, again holding them together with contact cement, to ensure uniformity for the next step. I then used a small benchtop bandsaw, drill press, and belt sander to do all the cutting, drilling, and smoothing of the edges.

(Continued on page 8)

Plano Guide Field Box (https://amzn.to/2Ivnom6) for the battery

(Continued from page 7)

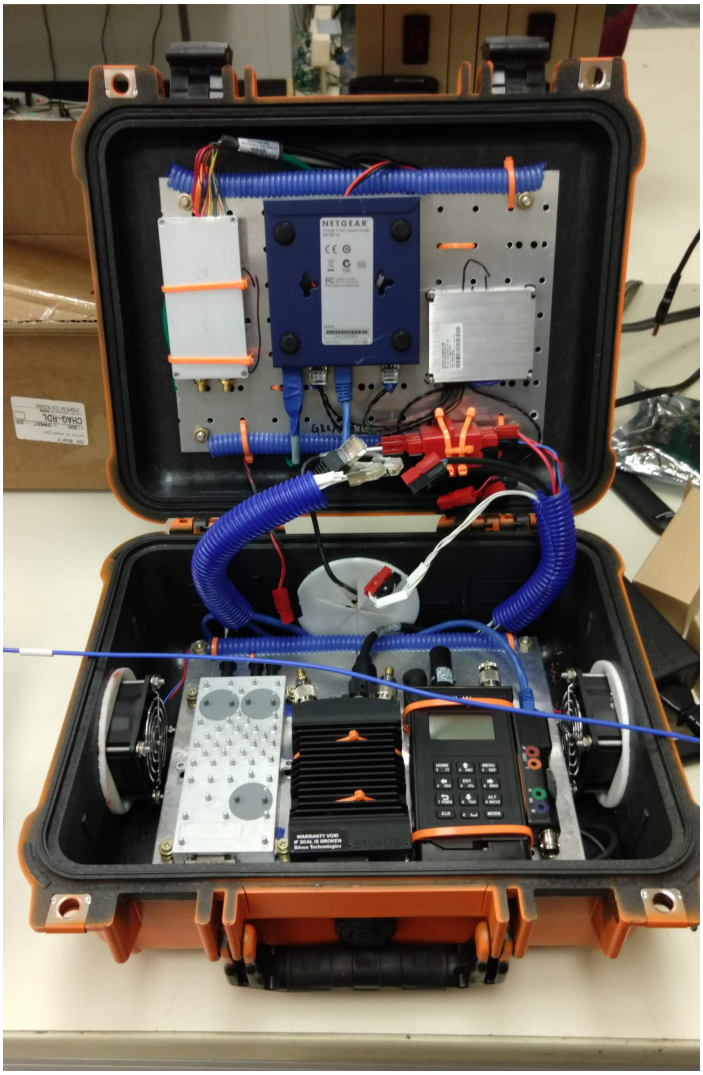
Drilling started with 1/16-inch pilot holes followed by drilling with a step bit. The pilot holes are there to simply keep the step bit in the right spot when the drilling starts. Step bits are much smoother going through sheet metal – they don't grab – and if you ever so gently engage the step bit to the next size, it will chamfer the hole for you. Just don't go all the way into the next size and make a bigger hole!

I bought two different BMS, one made for 60A continuous (180A peak) and the other 120A continuous. The 120A one arrived from China first, so that's the one I included in the design. Also, these robots are fused for 120A even though we typically don't get anywhere near that kind of current. So I thought this would give us the most flexibility in the future. But, when I finally received everything I needed, a quick fit check led to disappointment – there was no way to mount the 120A BMS to any of the sides of the box without interfering with the box lid latching mechanisms. So I remade one of the buss bars to be slightly oversized compared to the others so that I could use it to mount the BMS. Then I just needed 4x 13mm nylon standoffs to hold the BMS away from the cell terminals. I wanted nylon to avoid any concerns over stray voltage and shorts, but the nylon ones are harder to find than you think. DigiKey came to the rescue yet again as they usually do.

I've been able to get as far as roughly assembling the cells into a pack with the BMS installed without blowing myself up. But it was pretty sporty for a little bit getting comfortable around all that potential current ready to be unleashed by an absent-minded short. However, I haven't gotten the holes drilled through the box to attach the cradle.

I also haven't figured out how I'm getting power out of the box. The choices are small bulkhead battery posts or just fish the cables through some rubber grommets. I'm leaning towards small battery posts, which will allow me to quickly disconnect the cables without tearing into the box. I can also

(Continued on page 9)



DIY Lithium Battery

(Continued from page 8)

seal the box better against water intrusion by using battery posts.

I am considering adding a voltmeter to give a visual indication of battery state-of-charge rather than being surprised when the BMS turns the battery off. While I am partial to the old analog gauges for their Steam Punk value, there are entirely too big for this box. I am also considering adding cooling fans, but I want to better understand how hot it gets in there first so that I can choose the smallest fan possible, again due to fitment considerations. It may turn out I don't need cooling at all, but since the box is sealed even small amounts of waste heat are going to build up.

Jason Bowman, WG8B

Amazing Radios for Military Drones

Way back when I presented some of my day job to the club. If you don't recall, part of what I do involves radios for small drones or small unmanned aerial systems (SUAS) as we call them. We need to get targeting quality video from the SUAS to a host platform about 15 nautical miles away. What this boils down to is a 15Mbps MP4 stream with H.264 encoded video. The hard part is doing this at frequencies authorized to the Department of Defense with 5-10MHz of bandwidth available (L, S and C bands or roughly 1.8GHz through 6GHz) and through weather. Remember, to make this work with cell phones, we literally litter the landscape with cell phone towers. I don't have that benefit.

When we first started this program, there really wasn't a radio capable of doing this that could meet our size, weight, and power requirements to fit into the SUAS.

Then came along Trellisware. Trellisware is a mobile adhoc network (MANET) waveform utilizing 802.11 (WiFi) waveforms that actually fits in the SUAS and meets my performance requirements. Interestingly, it about the size of a cell phone with about the same power output (2-3W out with about 20W going in).

Fast forward a few years and the radio market for SUAS has exploded. So we felt the need to go characterize the new waveforms while rebaselining the ones we already had looked at. To the left you can see a dry box full of 5 radios—Trellisware, Silvus (used for transmitting video at NASCAR and NFL events), Bandit II, Aeronix' EDL Nano, and an industrial WiFi radio made by Doodle Labs that uses the 900MHz ISM band — that we flew on a Cessna Cardinal.

We essentially proved that Trellisware is still the best radio for our program even if it didn't have the best range. That title went to the Bandit II radio. Whereas the Trellisware is something like a 20nm radio in an airborne environment when passing 1.5Mbps, the Bandit II radio is more like 30nm. And all of this is happening in L and S band!

But don't think you can just go out and buy these radios. While you can call their sales office, the cheaper end of the scale is about $2000, and the upper end of the scale is about $15,000! I think you can get the Doodle Labs radio for about $1000 off of Mouser.

Jason Bowman, WG8B

Club Call: W8XRN

XWARN
P.O. Box 562
Xenia, Ohio 45385

Email: info@xwarn.net
Website: XWARN.NET

«FNAME» «LNAME» - «CALL»
«ADDRESS»
«CITY», «STATE» «ZIP»

Wavelengths

Wavelengths is published monthly by the Xenia Weather Amateur Radio Net. Our meetings are currently held on the 2nd Monday of each month at **7:30 pm** at the Greene Memorial Hospital Auditorium. You can find additional information about our organization at www.xwarn.net . We welcome new and experienced Amateur operators and those interest in becoming an Amateur operator to attend our meetings.