The Building of my Blitzortung Lighting System

The building of my Blitzortung lightning detection system was the culmination of many tips and tricks I read on the WXForum website, and some ideas of my own. In order to help others, I’ve decided to document as much as I can about the building of my system.

Before the build

There are a few things before the build you might want to purchase. I have a degree in Electronic Technology, so I have experience with soldering. I had many of the items that others may not have. I had a nice variable temperature soldering iron, anti-static matt to put on a workbench, multi-meter for verifying the resistors and capacitors. But here are some of the things I would recommend buying as they will help in the build.

1. **Illuminated Binohead Magnifier**: Some of the chips and diodes have very small labels. Even at age 40, I couldn’t read most of the labels on chips. This unit was nice because it has a LED to light up what I was working on, and had a flip down extra magnifier for inspecting the very small SMD chip solder work I needed to do. For $9, it’s a good investment.

2. **Liquid Rosin Flux**: You will need this for the surface mounted chip soldering. Just using a Q-Tip and swiping the contacts on the board beforehand makes the solder flow well into the small areas. I don’t think my SMD solder would have been nearly as clean without this. For another $9, it was worth not having to fix bad solder joints.

3. **Discover Board**: order this before you start your project. When final assembly of the controller board is reached, you will need the Discovery to finish the last bit of soldering. I bought mine from Mouser.

4. **The actual boards and parts**: Personally, I bought all of my parts directly from the Blitzortung “Cover your Area” page. I also bought the antenna system from there as well. I may have been able to source the parts from the US cheaper, but it would probably have taken a lot of man hours researching all the specs to make sure I got the right parts. I just found it easier to pay the Euro conversion and get the direct from Egon in Germany.

Starting the Actual Board Build

I started first with the amplifier board. This has fewer parts and less chip work. Since it’s been close to 20 years since I did this intricate of soldering work, I thought I would get my feet wet on this board first.
To keep this part of my documentation short, I mainly followed the directions that were posted on a WXForum posting.  [http://www.wxforum.net/index.php?topic=20037.0](http://www.wxforum.net/index.php?topic=20037.0) The “Step by Step Build” instructions were spot on, except for the controller board. The controller board had some resistors changed as well as a group of capacitors. Look at page 30 of the official Blitzortung web documentation at the capacitor and resistor values compared to the assembly directions above.  [http://www.blitzortung.org/Documents/TOA_Blitzortung_RED.pdf?t=1399831107](http://www.blitzortung.org/Documents/TOA_Blitzortung_RED.pdf?t=1399831107) (You will need to be logged into the Blitzortung Services area to get to this document)

I didn’t compare that parts list and ended up with “spare” parts and I put some capacitors in the wrong place. I was able to de-solder and fix most parts with the exception of one ceramic capacitor that I broke. Since I didn’t get around to ordering my Discovery board, I was able to buy another capacitor from Mouser with the board.

It took me probably 10-12 hours’ worth of soldering to complete both boards. Knowing what I know now, I could do it again in probably 8. The preparation of inventoring the parts labeling all of your resistors and capacitors helps a lot. But as I said, I also have a lot more experience than most people with soldering. So your mileage will vary.

**Antenna assembly with shields**

Even though I bought the magnet core wire wound antennas from Germany, I wanted to install them in a shielding housing system shown on the WXForum. I wanted to eliminate as much possible noise as I could. Also, by putting the system in PVC, it gave me the option of putting antenna assembly outside, should I need to.

I used the standard 1 inch grey PVC pipe that others have been using. I made mine about 22 inches long with a junction box in the middle. That is longer than I needed, but it allows me to put in some longer homebuilt antennas should I decide to down the road. I found a center junction unit that not only had the 90 degree angle needed for the two antenna tubes, but it also had an option for a third angle. For now, I just have my wires coming out there. But if I should move my assembly outside, it would serve as the location for a mounting pole that the wire could still come down.

I put three sections of outdoor weather stripping around each antenna. One loop at each end of the antenna and one in the middle. This served as a way to slide the antennas into the tubes and give some friction and gap to keep the antenna in the center of the PVC. In the junction box, I brought the enameled wires in there. I then used some light sandpaper to take the enamel off the ends of the antenna leads. Some have used a screw terminal to attach the wires to insulated wires leading to the amplifier. I decided to solder my antenna leads to some CAT 6 wires, since I already had bought some CAT6 shielded wire. I just personally prefer to use solder where possible.

Shielding of the antennas is accomplished by wrapping the PVC tubes with a copper foil. The foil does not entirely wrap the whole tube. You want to leave a gap roughly the thickness of a nickel. If you fully wrapped the tube, it would totally shield all signals from reaching the antennas inside.
I bought my Copper Shielding Tape from Amazon. I had to trim some of the foil so it didn’t fully wrap the tube. Personally, I found it best to just wrap it entirely. I then took a razor blade and trimmed the one side back. The foil comes with an adhesive on one side. Cutting the foil strip in half length-wise, yields just the right amount to cover each PVC side. I took the paper backing off and slowly worked the foil around the pipe. I got some crinkles in it, but that shouldn’t matter.

The next issue is how to ground that chunk of foil. Grounding of the foil is the essential piece to shielding the antennas from the unwanted signal noise. Trying to solder onto the foil I think would be problematic, so I went a different route. I found my local Menards hardware store had a 4 foot piece of brass rod. Using 4 zip ties, I attached the brass rod to the side of the PVC. It should get plenty of contact with the copper foil. I bent the end of the brass rod outward to attach grounding wire. Here is a close-up of the end result of the foil wrap and brass rod. It’s hard to see the brass rod, but it is on the right side of the PVC shown below. But you can see the bend coming out at the top and the ground wire attached.

I will have more pictures of the entire system at the end of the documentation so you can see the antenna system as a whole.
Housings for the electronic boards

I have a fairly new house built in 2008 with a large 3 stall garage. To get the system away from some of the electrical noise that occurs in a house, I decided to mount the system out in the garage. Plus, that location gave me easy access to the roof for the GPS antenna. Even though my garage is fairly clean, the electronic boards really needed to be put in housings to keep the dust away from the boards.

On the WX forum, two housings were recommended that I used. The larger board is for the controller, the smaller board is for the amplifier. When I add the new E-Field system, I will be using this same smaller housing again.

These boxes have screws to hold the cover down. But I felt that would make accessing the boxes cumbersome. I had a big box of 2 inch wide “industrial strength” Velcro strips from previous projects that I used extensively on the whole system. For these boxes, I put one single strip at an end or side of the box to serve as a hinge. On the other side, I put both strips down, with one cut down the middle, to serve as a fastener to close the box. I used a Dremel tool to cut notches into the boxes for the cables to run through. I then used more strips of Velcro with slits in them to cover these holes to keep dust and bugs from getting in the box.

To mount the electronic boards nicely in the box, I bought a kit that computer building would typically use. The parts are made from nylon. The kit has some longer standoffs that have threads on the bottom. These are the ones I used. These required me to drill a hole and use a metric tap to thread the holes. But if you don’t have a tap, there are some other stand offs you can use instead. These have threads at both ends. So you would just drill a hole in the box and use the nylon screws on the back of the box to hold the standoff to the box. Then lastly, you mount the board to the standoffs using the supplied screws. The kit was $10. But it helped make a secure mounting that looks good as well.

GPS antenna

The typical GPS antenna used for these systems is what I would call a “puck” style antenna. These work well, but I needed one with a longer antenna wire. My garage has 12 foot ceilings. So by the time I went up the wall, and out my soffit up to the GPS antenna outside, the typical antenna was too short. I originally went with a larger Larsen model GPS0015-C and added a long cable. I’m not sure if I got a bum antenna or if that antenna isn’t compatible, but it didn’t work.

So I was back to Amazon again for more shopping. What I ended up with was a GlobalSat AT-65SMA antenna. It had the longer cable that was just the right length. I’ve been getting good signals and no issues. If you need a GPS antenna with a longer cable, it’s worth the few extra bucks.
### Cables

You will need quite a few various cables for the build. 2 USB cables will be needed with the Mini-B ends to power each of the electronic boards. The network cable for the controller and the cable that connects the controller to the amplifier board are regular 8 wire network style cables. It is highly recommended that the connection board be a shielded cable. It is also recommended that the network cable be shielded as well. CAT6 style cable has more twists in the cable pairs to eliminate cross talk between the wires. So that style will be better for noise than CAT5.

Since my garage didn't have any network connections, and my basement has ceiling tiles that could allow me to run cables, I ran two CAT6 shielded wires out to my garage for the network connection. I bought both the bulk CAT6 shielded cables and a set of shielded CAT6 ends from [Cables4Sure.com](http://www.cables4sure.com). Even if you have never made your own cables, the company was easy to order the cables from. If you decide to not use custom bulk cables, they have plenty of pre-made cables to choose from.

If you've made CAT5 cable ends before, be aware that CAT6 ends are different. I had difficulty at first trying to put the ends on. [Belden](http://www.belden.com) has a nice PDF on the proper end installation. This video from [TekSyndicate.com](http://www.teksyndicate.com) shows how to install ends. The CAT6 section starts about 6 minutes in. The big difference is that CAT5 wires go straight across. CAT6 are in a staggered up/down pattern. The individual wires also have thicker insulation on CAT6, so I couldn't get them into CAT5 ends well. After watching the video, I realized I needed to strip back a longer section of the outer sheath before trying to install the wire guide. With short leads, it's real tough to get that little piece needed to align CAT6 wire into the ends. But my CAT5 crimper worked fine on CAT6 ends. I custom made both network and connection wires all in CAT6.

### Power

There was a lot of talk on the WXForum about what USB power supply to use. I found a “brick” on Amazon that I decided to try. Hopefully this unit will deliver clean power at the proper voltage. The thing I liked about it was there are 5 USB ports on it. Two ports labeled for iPads with 2.1 amps, one port labeled for a Samsung Tab at 1.3 amps, and two more ports labeled for Android devices at 1 amp. I plan on connecting both amplifier and controller to the iPad ports, but I don’t think either will need that much amperage. The brick is made by Anker. [Model AK-71AN25W-W5A](http://www.anker.com).
Final Assembly

I live in a rural subdivision outside of town. All of our property lots are about 2 acres. So in theory, I should have less electronic noise than in town. But as we all know, that doesn’t always happen. So in case I needed to move things around, I didn’t want to restrict myself to where all the devices were mounted.

I decided I wanted the power supply and controller board mounted to one single chunk of plywood. Then I would mount the antennas and amplifier board to another chunk of plywood to my ceiling. I planned on just using two screws to mount them to the 2x4’s in the wall/ceiling. After going out to my shop where my wood is, I found some sheets of peg board. So my initial thought was “Hey, I have this board with pre-drilled mounting boards”. Peg board is thin and light and has a pretty smooth surface. Each housing box I mounted to the peg board again with my 2 inch Velcro. I went with 22x22 inch pieces of pegboard. That was large enough to hold the antenna assembly PVC, and long enough for the usual 16 on center spacing of my studs in the walls.

After I started working with the peg board, I realized that I could mount the PVC antenna assembly easily to the peg board with zip ties. All I needed was a little spacer at the ends since the caps were a smaller diameter than the junction box. I just used some folded cardboard since this will be hanging upside down. But I should have plenty of holes in the pegboard to secure the assembly to the board.

After I started on the controller box that I will be mounting to the wall, I realized that I could use a series of zip ties going through the pegboard as cable guides. Being the OCD natured person, I quickly started using tons of zip ties for cable guides. This should keep the wires neat and less likely to get snagged while anyone walks by it in the garage. I didn’t snug up the zip ties to the board. This should allow me to remove and re-install cables easily, while keeping everything neat.

If you look at my controller board, I also set it up so that this box opens with the hinge at the bottom. This allows me to easily take the top Velcro holding strip off the top and the door hinges downward, allowing gravity to keep it open. That way I can easily work on this board without the clear door in the way. The hinge side of the housing ended up covering the network cable inlet for the box. So I had to cut a decent sized hole through the Velcro to allow a network cable end through. But the majority of the connections at the top would be covered well.

The amplifier box was going on the ceiling. So gravity would hold that open well too. I put that one on the side where there would be no connections getting in the way.

I also mounted on each board a ground block. This way I could run one ground wire to the amplifier section, then one to the controller board where I had another grounding block. Again, I just used zip ties to mount these to the boards.
And finally, here are some finished pictures of the two boards as I had them put together in the house. This was before I mounted them to the wall in my garage.

**Amplifier board Assembly**

Board in the box, antenna connected. CAT6 cable coming out the bottom of the housing, heading to the controller board. Grounding wires coming from the rods to grounding block on the bottom right.

You can also see the third PVC pipe hole where the antenna wires are coming out the junction housing. If for some reason I decided to mount the antenna assembly outside, I would insert another 1 inch pipe here four holding the system up.
Amplifier board housing close up

Here you can see the Velcro hinge piece on the right and closure on the left. Incoming CAT6 wires at the top for antenna. CAT6 shielded cabled to the controller board at the bottom with Velcro over the holes.
Controller Board Assembly

Shielded CAT6 network cable coming down from the top left. USB power looping from center and around to the left. GPS antenna was in the garage, so that isn’t pictured. I already made the short CAT6 wire to connect the secondary detection system when I get that down the road. Plenty of room on the board assembly for the second detection system. The only reason my USB power cord is so long is because I bought it in a 2 pack of 15 footers. I needed a long 15 foot cord to power the amplifier board that will be mounted on the ceiling above this assembly.
Controller housing

Close-up of the controller board with the door open. White Anker power brick in the middle.

Amplifier Door Open
Side by side before mounted

Both boards before mounting them in the garage.
Controller Board mounted:

Amplifier board

Mounted to the ceiling about 8 feet above my controller unit
**GPS Antenna Mounted.** - I've since removed this antenna and have a “puck” style antenna mounted on this same plate.

![Antenna Mounted](image)

**Addendum:**

I have since this spring, added the new E-Field amplifier system. I mounted the amplifier down next to my controller in the same smaller Bud Box the H-Field amplifier is in. I also used CAT6 shielded 1 foot cable to connect the amp to the controller. Even though it isn’t needed, I used one of the ports on the 5 port USB brick to power the E-Field amplifier.

To mount the antenna, I used some standard plastic conduit. The pre-amp is inside the junction box. Be careful of mounting the 15” antenna, as I broke that connector and had to soldering in a wire fix.

I mounted my antenna outside on the same side of the house as my GPS antenna. I didn’t have an extension ladder tall enough to go to my peak. But the antenna is a good 20 feet off the ground. Since I have no trees or other places around the yard within reach, this is as good as I can do. I used RG6 cable from Menards labeled “quad shielded” and “for digital use”. It was a 100 ft. cable, which is longer than I needed. But it got the job done. I ran my cable inside my soffit and into my garage attic. Not as hidden as I would like. But given the heights, that was as good as I could do.
Controller and E-Field amp in Garage:

E-Field Antenna:
E-Field Antenna:

You can see the E-Field on the left, and my GPS antenna just to the right of my gutter.

To help with Interference, someday I will mount my H-Field antennas outside in the general vicinity of the GPS antenna.

Feel free to email me with questions! I’m happy to help any way I can.

Dale Z.
Station 1002
Bismarck, ND USA