The EMCOMM Easytenna

This document will detail how to build an easy to install multiband dipole type antenna for emergency communications using the NVIS propagation mode.

History

The NVIS mode is one in which the design goal is to enhance a HF antenna's radiation pattern in the vertical plane while minimizing low angle radiation. This is normally done by reducing the height of the antenna. When height is optimized for NVIS propagation the pattern becomes essentially an omni-directional with coverage from 200 miles to 400 miles radially from the transmitting station depending on the frequency in use. This makes this type of antenna exceptionally functional for Emergency communications at ranges beyond normal repeater coverage on VHF / UHF frequencies. This mode also excels in mountainous terrain since the signal is essentially returning to earth from directly overhead. It allows teams or groups to communicate even when hills or mountains intervene.

Project goals

1. Given that a standard dipole at the proper height is a proven NVIS performer it was chosen as the basic design for this project. Therefore, the project focused less on the actual antenna and more on the construction method.

2. Produce a coax feed center point module that allows easy exchange of radiating elements in the field without the need to disassemble the antenna completely. Allow for the use of any available coax without the need for attaching coax connectors in the field.

3. Design for dual band operation without the requirement of a tuner. (See Appendix A for more on this goal and tuners)

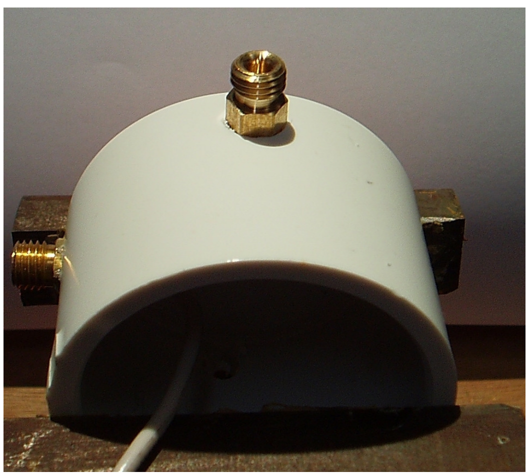
4. Design an easy method for fine tuning the antenna to suit variances in environmental or ground effects.

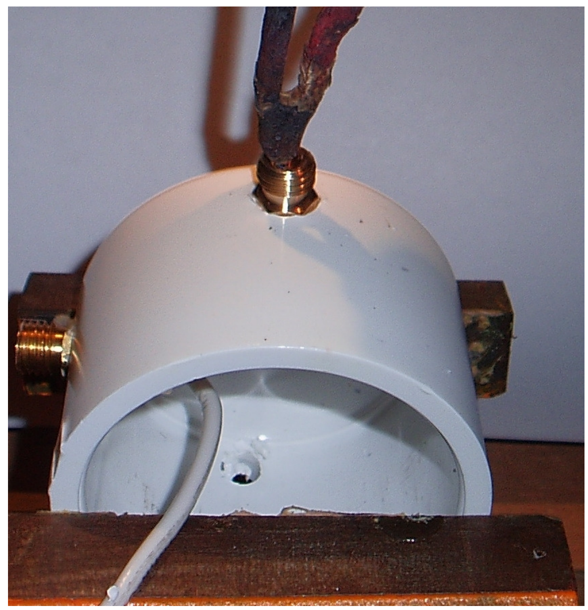
5. Design a system that can be deployed without the need for existing support structures. The design should allow for easy (<30 minute) assembly and deployment by one individual.

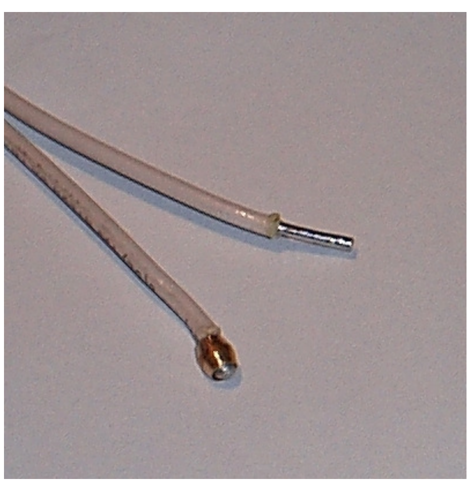
6. Achieve an overall package size that can be easily transported in even compact vehicles. This means no part can exceed a maximum length of 5 ft. The overall package should weight less than 20 lbs.

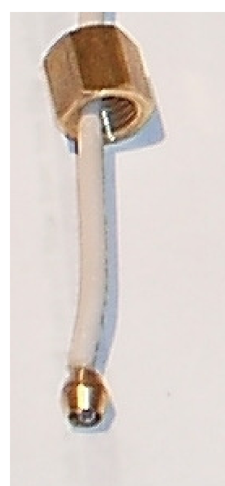
Construction

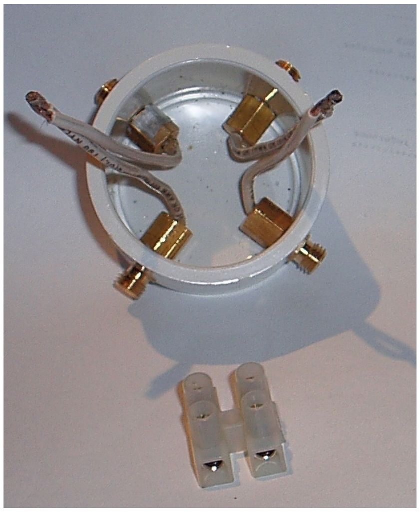
Assemble the center point from a PVC Pipe cap and 1/8 inch brass compression unions. I inserted the center part of the union from the outside of the cap into a tight hole that was drilled undersize and opened using a tapered reamer. I then used a soldering gun to embed the hex collar of the part into the PVC cap. This helps prevent the center part of the union from rotating when attaching the radiating elements. I provided for two bands but 3 should also be workable. I used 14 gauge THNN stranded house wire for the hookup. To make a strong joint I tinned the wire then bent the end over to form a nub that fits tightly in the compression collar. Then I solders the compression collar using adequate solder to form a secure fillet around both ends of the compression collar. Be sure to slip the compression nut onto the wire first. I then used a European style power bus connector to provide a secure connection for any type of available coax. This also allows easy assembly and disassembly.

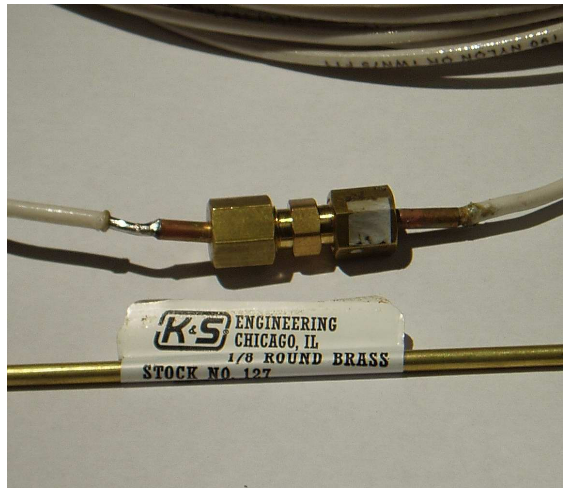










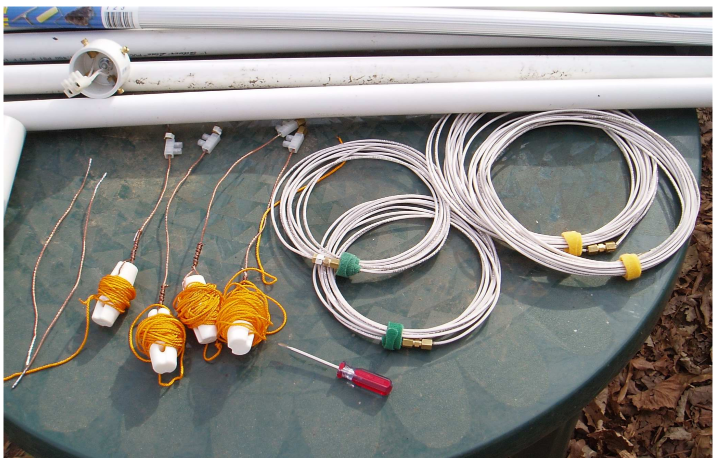


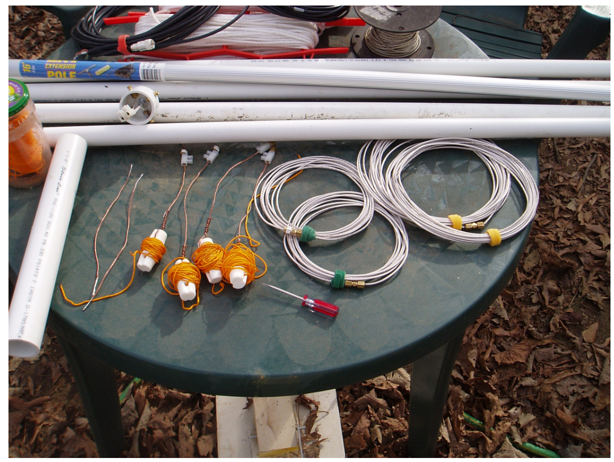
I used a 12 inch section of 1 1/2 inch schedule 40 PVC for the base part of the center piece. It is not cemented to the cap in order to provide for easy disassembly. I inserted an eye bolt in the cap to provide a means of hanging the center piece of there is an available support. [UPDATE] I added a small section of 1/8" brass tubing to keep the wire from being stressed at the union nut after I had a break in the field.

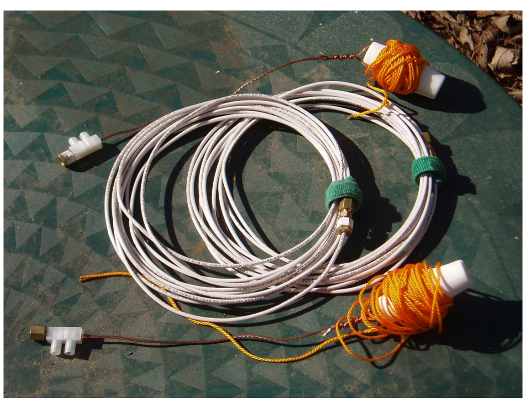
This is a complete set of 20 meter radiating elements. The Velcro wraps are color coded by band. The end insulators are attached to regular bare stranded 14 gauge antenna wire on which I have threaded a single section of European style power bus connector. This allows easy attachment of 6 to 24 inches of wire to allow tuning with in a given band to compensate for environmental differences. It can also allow for the easy attachment of a random extra length of wire to each end that can be trimmed to resonate the antenna on a lower band. For example the 20 meter elements can easily be extended to allow operation on 30 meters while 40 meters could be extended to allow 60 or 80 meter operation. Below is a close-up of the end assembly. The European style power bus connectors are perfect for this type of use since the large size can accept 2 14 gauge wires in parallel and uses 2 set screws to provide mechanical security and electrical connectivity. [UPDATE] If a nut breaks it is possible to strip the insulation and insert it into the end fitting and still work. Another thought is to have an extra set of forty meter radiating elements. At night simply lower the ends of the antenna and add the elements to move the antenna to 80 meters. The bare wire ends allow a short length of wire to be added to improve the match so the actual length of the elements is better too short than too long. 31-32 ft should work well for forty meter elements.

The center support of the antenna system consists of a 16 ft extendable painters pole. This was the most expensive part of the system and cost about $ 25. An alternative would be a third pole like the end supports which would drop the cost somewhat. The pole is installed in a folding wooden park on mount that includes clear PVC tubing on the U-bolts to prevent excessive tightening. The end of the pole has a section of 1/2 in Schedule 40 PVC that has been heat expanded and driven down over the end of the pole. This allows antennas to be easily slid on and off and allows attachment of a vertical VHF antenna if desired. I also have a 300 ohm Twinlead J-Pole that has been installed in 1/2 in PVC that attaches directly to the pole. Both antennas can be use at the same time if the HF antenna is attached with Hose clamps rather than slid directly over the stub.

The end supports are made from 10 ft long sections of 1 1/2 in schedule 40 PVC. To enhance portability I cut each section in half with a hacksaw and used PVC compression fittings to allow reassembly. These fittings are stronger than simple friction collars. It is also possible to glue a wooden dowel inside one section and bridge the connector but I have not found it to be necessary yet. I use a schedule 80 PVC pipe flange to make a foot for the base of each section. The holes could be use with large spikes or rebar to prevent slippage.   Each support is capped by a PVC tee fitting that is not glued. The support ropes are 100 ft long 3/8 th nylon although any rope will do. It has a large loop in the center that is slipped through the tee when it is off the pipe and then looped back around the pipe. This prevents the pipe from drifting sideways during erecting.







These shots show the entire system laid out on a table. The yellow wraps are 40 meter elements. The green ones are for 20 meters. The system can be installed in < 30 minutes by one person without any climbing or throwing ropes into trees. It does require some form of anchoring system for the end support ropes but even curb bumpers can be used if the rope is wrapped around them.

With a center height of 16 ft and ends at 10 ft the antenna is at near ideal NVIS height for most HF bands where this mode is an option. Furthermore, it places the antenna wire high enough that most cars and pedestrian traffic is not at risk. It is possible to assemble the system with the antenna at about a level 5 ft but this requires more care to isolate the antenna from casual contact. All of the parts with the exception of the poles are easily stored in a 2.5 gallon Ziploc bag. This includes 60ft of RG-8x with a PL-259 and pre-tinned ends and 100ft of RG-58. Below are some shots of the antenna system setup in my backyard. In this shot the center pole is at its lowest position. I also keep about 25 ft of ladder line in the kit for use with the SGC-237.

Appendix A

Tuners

While my original goal was to design an antenna that did not require a tuner I was ultimately not successful in that attempt.

After much testing I have come to the conclusion that a tuner is a good idea simply due to the extremely variable conditions that are often encountered in filed installations.

While it is possible to use the end sections to fine tune the antenna it is a very problematic process that takes a good deal of time and tweaking. When this is combined with the easy availability of relatively inexpensive auto-tuners it seems silly to waste the time.

I have experience with two common tuners and I will detail that experience here.

I have the SGC-237 and the LDG at-897. I can highly recommend both but given a choice of only one I would go with the SGC with no hesitation. The AT-897 requires remembering to push the button after changing frequencies and is best described as semi-automatic. It also has less matching range than the SGC-237.

Manual tuners will also work but are often about the same price range as the lower end of the auto tuners.

The SGC and the LDG represent the two most common types of auto tuners.

The LDG tuners are basically trimmer tuners designed to work only with coax fed antennas. These tuners tend to have less matching range and suffer from more power loss in the feed line at higher SWR levels.

The other type is the SGC that is an antenna coupler and is designed to be installed at the feed point or to feed the antenna with ladder line. This type of tuner can handle much higher SWR levels. With the negligible loss inherent in ladder line this type of tuner can often be installed at the base of the EMCOMM EASY ANTENNA and used with ladder line on 1ft standoffs made of PVC pipe. This does require a 12volt source at the antenna but this can be done easily with the MFJ power injectors.

This document is intended to suggest a method of construction not a final design. I hope it is helpful and can stimulate some construction projects.