DIY for Near Vertical Incident Skywaves (NVIS) Antennas

NVIS Antenna Working Group
Alexandria Radio Club

June 9, 2023

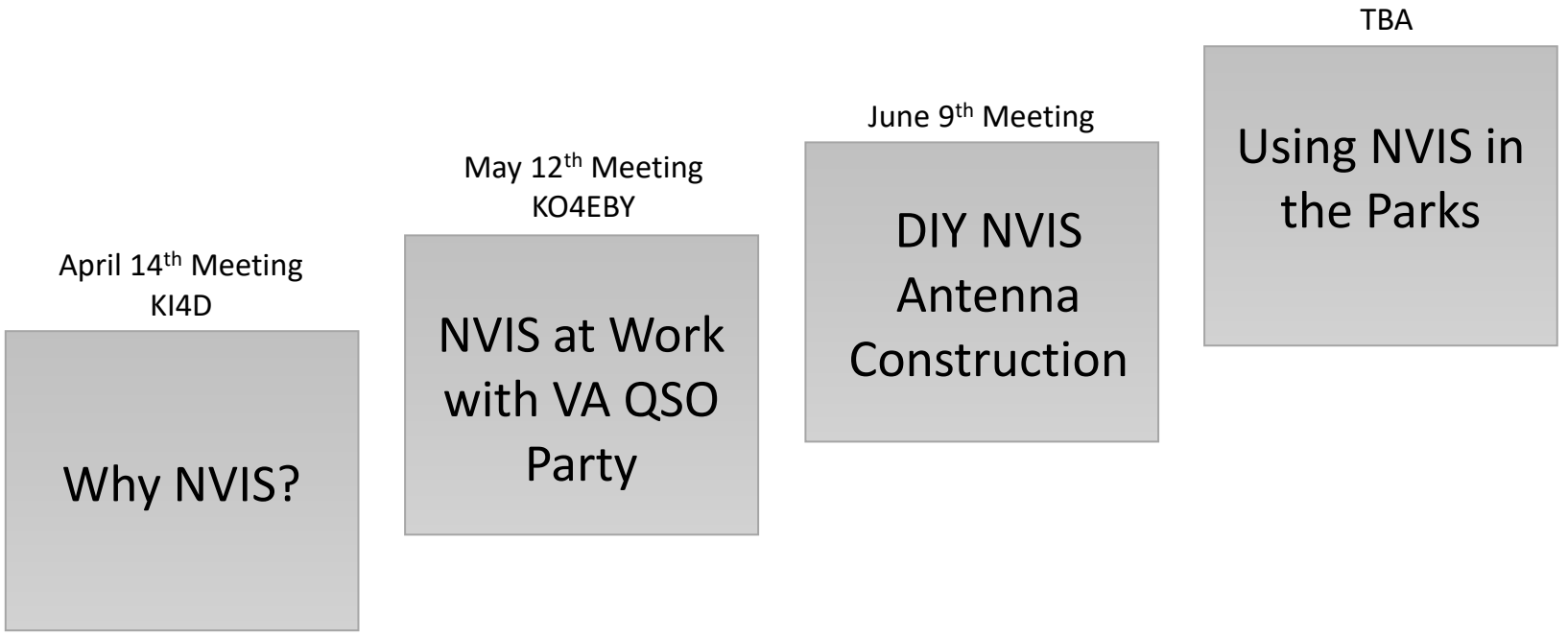
Overview

- NVIS, What is it?
- Building Blocks of This Project
- Overall Working Group Progress To Date
- Individual NVIS Antenna Presentations
- Summary

NVIS, what is it?

- Near-Vertical Incidence Skywave (NVIS) radio propagation is a communications technique useful for beyond line-of-sight (LOS) communications.
- NVIS can be used for short range communications out to about 200 to 300 miles.
- Use of NVIS propagation is common, but it is especially useful for military communications and emergency communications (EMCOMM).

Beyond Line of Sight (LOS) with NVIS
Building Blocks



Working Group Essential Considerations

- Band Coverages
    - **40 meters** for daylight hours
    - **80 meters** for after dark
- Portability (weight & ease of carry)
- No tuner preferred
- Ease of installation
- Quick installation
- Limited deployment space required

Some Antennas Considered

- DIY Center-fed Dipole, or shortened version
- DIY End-fed Halfwave Dipole, or shortened version
- DIY Off-Center-fed Dipole or shortened version
- DIY AS-2259, or modified shortened version
- DIY Random Length Wire Antennas
- DIY Vehicular counterpoise NVIS antenna
- Commercial NVIS Antennas
  - Buddipole System
  - Hamsticks/Hustler Radiator
  - Other commercial Antennas, including Antenna Kits

Sourcing of Antenna Parts and Components

Antenna Parts – KT3I, Joe

For $25.00 Joe can provide these parts

- 3D Printed Parts
- ~3' 16 awg magnet wire
- SO-239 or BNC connector
- FT240-43 Toroid
- 100pF 15KV ceramic capacitor
- 70' Polystealth 26 awg wire & Hardware to put it all together

Antenna Parts Info – KO4EBY, Ryan

- Newark Electronics and Mouser Electronics sell FT240-43 and FT140-43 toroids. The FT140-43 can handle 100w SSB with no problem. If you plan on running high power, use multiple FT240-43s stacked in your transformer.
- Ebay has 100pF, 10kV rated capacitor for the 49:1 transformer
- AutomationDirect has good prices on spools of hookup wire, especially 20 AWG. Usually free shipping too.
- Amazon for almost everything else (18 or 14 gauge magnet wire, solid core wire, ring terminals, etc. Look for the brand name BNTECHGO on Amazon for wire.

Sourcing of Antenna Parts and Components

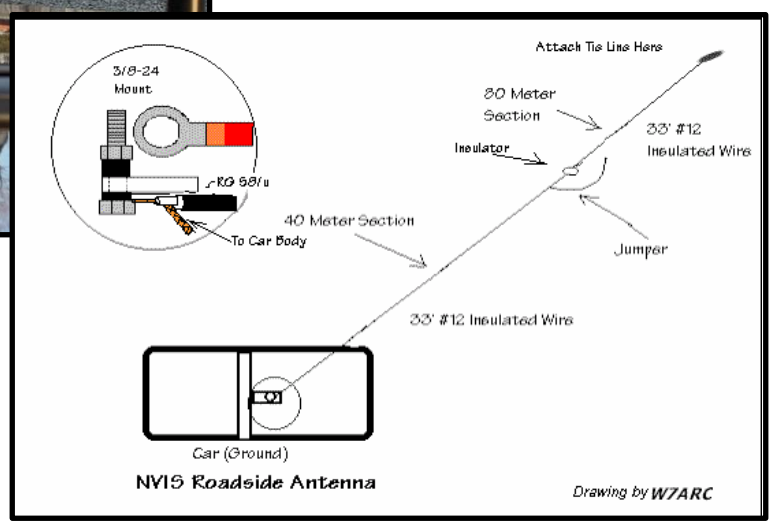
Antenna Kits Info – KI4D, Don

- EFHW 49:1 UnUn HF Kit – ARRL website URL: https://home.arrl.org/action/Store/Product-Details/productId/133267, also available from http://www.hfkits.nl
- Long Wire (Random Length) 9:1 UnUn HF kit from http://www.hfkits.nl
- Portable 49:1 EFHW antenna kits from KM4ACK
- Center-fed dipoles and inverted-V antennas -- "HF kits" offers Baluns for 150W and 800W versions.

DIY NVIS Antenna Projects in Progress

- Todd (KO4IJH) - Vehicular NVIS antenna
- Alex (KO4ZMC) - AS-2259 NVIS Antenna
- Ryan (KO4EBY) - Alpha Delta DX-DD hack
- Don (KI4D) - End Fed Long Wire (kit)
- Joe (KT3I) - EFHW DIY Antenna ($25.00)

Vehicular NVIS antenna

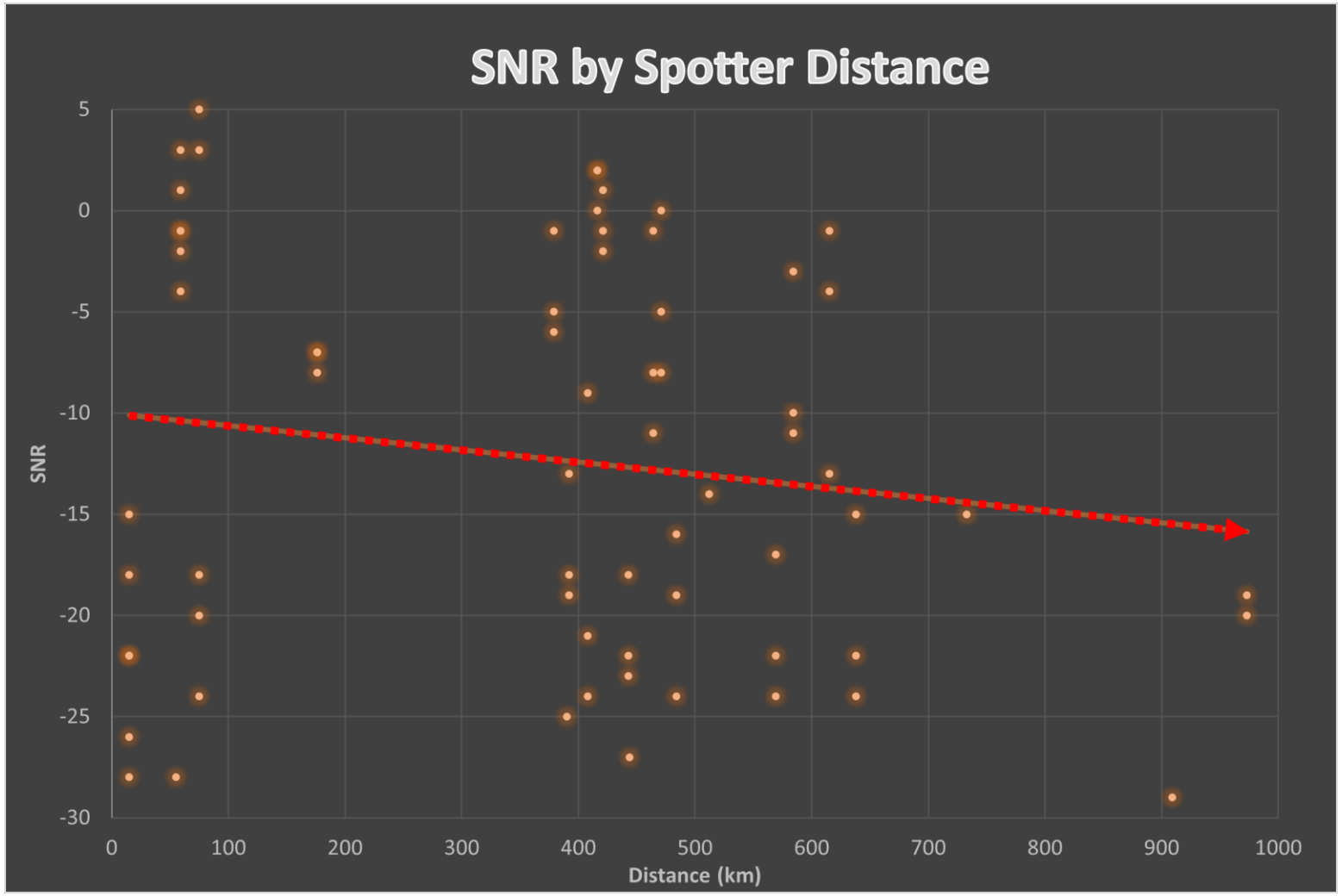


WSPRnet Spots Log (40m) (within 300mi)

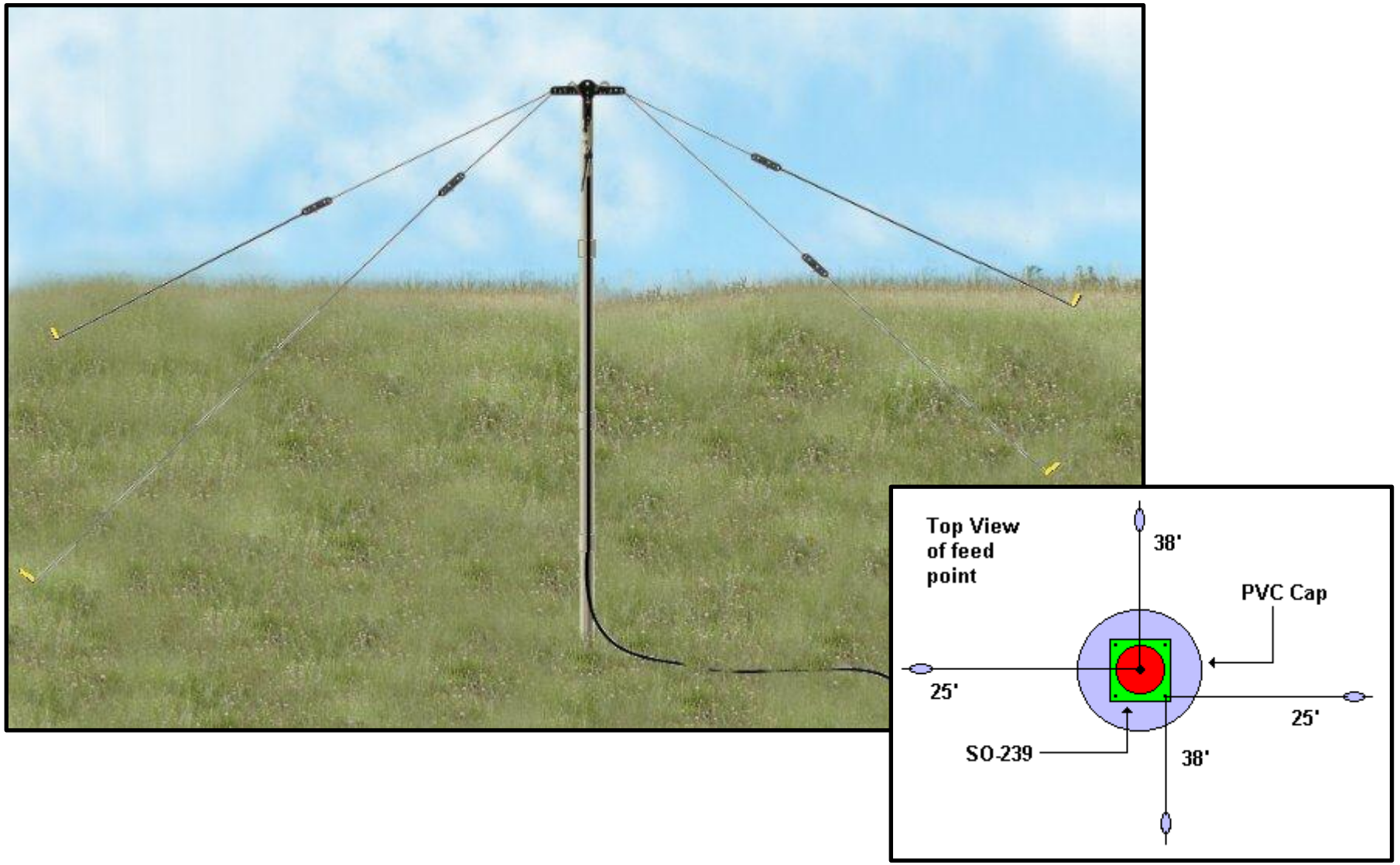
Timestamp	Pwr	Reporte	RGrid	km	SNR
5/29/2023 18:36	5	WS3W	FM19ng	55	-28
5/29/2023 18:32	5	KW4EP	FM18iu	15	-28
5/29/2023 18:36	5	KC2STA4	FN22	444	-27
5/29/2023 18:30	1	KW4EP	FM18iu	15	-26
5/29/2023 18:36	5	N4JJS	FM05on	390	-25
5/29/2023 18:30	1	KB3EDF	FM18rh	75	-24
5/29/2023 18:30	1	WA2ZKD	FN13ed	484	-24
5/29/2023 18:30	1	K5MO-1	FM05	408	-24
5/29/2023 18:32	5	WB7OND	FM05mc	443	-23
5/29/2023 18:36	5	KW4EP	FM18iu	15	-22
5/29/2023 18:32	5	N4TVC/4	FM18is	15	-22
5/29/2023 18:30	1	WB7OND	FM05mc	443	-22
5/29/2023 18:32	5	K5MO-1	FM05	408	-21
5/29/2023 18:36	5	KB3EDF	FM18rh	75	-20
5/29/2023 18:32	5	WA2ZKD	FN13ed	484	-19
5/29/2023 18:30	1	N4TTN	FM05pm	392	-19
5/29/2023 18:36	5	WB7OND	FM05mc	443	-18
5/29/2023 18:32	5	N4TTN	FM05pm	392	-18
5/29/2023 18:30	1	K1HTV-4	FM18ap	75	-18
5/29/2023 18:30	1	N4TVC/4	FM18is	15	-18
5/29/2023 18:36	5	WA2ZKD	FN13ed	484	-16
5/29/2023 18:36	5	N4TVC/4	FM18is	15	-15
5/29/2023 18:36	5	N4TTN	FM05pm	392	-13
5/29/2023 18:32	5	KD2OM	FN12gx	464	-11
5/29/2023 18:36	5	K5MO-1	FM05	408	-9

Timestamp	Pwr	Reporte	RGrid	km	SNR
5/29/2023 18:30	1	W3ENR	FM28jh	176	-8
5/29/2023 18:30	1	KD2OM	FN12gx	464	-8
5/29/2023 18:30	1	N2HQI	FN13sa	471	-8
5/29/2023 18:36	5	W3ENR	FM28jh	176	-7
5/29/2023 18:32	5	W3ENR	FM28jh	176	-7
5/29/2023 18:32	5	WD4ELG	FM06be	379	-6
5/29/2023 18:32	5	N2HQI	FN13sa	471	-5
5/29/2023 18:30	1	WD4ELG	FM06be	379	-5
5/29/2023 18:32	5	K1RA-4	FM18cr	59	-4
5/29/2023 18:32	5	K1RA-PI	FM18cr	59	-2
5/29/2023 18:30	1	WA2RKN	FN31ar	421	-2
5/29/2023 18:36	5	WD4ELG	FM06be	379	-1
5/29/2023 18:36	5	KD2OM	FN12gx	464	-1
5/29/2023 18:32	5	WA2RKN	FN31ar	421	-1
5/29/2023 18:30	1	K1RA-4	FM18cr	59	-1
5/29/2023 18:30	1	K1RA-PI	FM18cr	59	-1
5/29/2023 18:36	5	N2HQI	FN13sa	471	0
5/29/2023 18:36	5	WA2TP	FN30lu	416	0
5/29/2023 18:36	5	WA2RKN	FN31ar	421	1
5/29/2023 18:36	5	K1RA-4	FM18cr	59	1
5/29/2023 18:32	5	WA2TP	FN30lu	416	2
5/29/2023 18:30	1	WA2TP	FN30lu	416	2
5/29/2023 18:36	5	K1RA-PI	FM18cr	59	3
5/29/2023 18:32	5	K1HTV-4	FM18ap	75	3
5/29/2023 18:36	5	K1HTV-4	FM18ap	75	5

WSPRnet Spots Map (40m)



AS-2259 Antenna



AS-2259 NVIS Antenna

By Alex Lammers KO4ZMC
Antenna donated by Ryan KO4EBY

HF Bands Covered

The AS-2259 SWR was measured, and found low SWR points at 80 & 60m, with a small dip at 40m. 80m measured 1.25 without an external tuner, 60m at 1.22, and 40m at 1.45. An MFJ tuner was able to compensate and bring SWR to 1.2 or lower.

Portability

The DIY AS-2259 antenna was able fit and be transferred in a standard West Marine paper bag. However, my telescopic umbrella and umbrella stand required more careful transit.

Space Required

The AS-2259 antenna was able to be placed across a flat area similar that of a small table. It required a vertical space of 10-15 feet.

Installation

Installation of the antenna at my QTH was fairly simple and very crude. All loading coils and antenna strands were mounted with duct tape to a telescoping umbrella pole, and antennas were deployed and adjusted using the umbrella canvas controls. Depending on time of day, this provides some much needed shade while operating.

DIY Issues

The primary issue with this kind of antenna was limited repair space. When operating, a full cleanup was required to access areas that could be repaired. Physical materials were also a hazard due to the close proximity of potentially heat-sensitive materials. These required some thermal mitigation that could only be done in a home shack.

Possible Development

Due to the ability to fit and operate on a large telescopic antenna, such installation techniques could be done on a handheld umbrella as well. I will be testing designs for handheld umbrella options in the near future and will notify whoever is interested in the results.

Testing

A majority of the testing was completed between live and monitor FT8 stations to measure signal reception change in relation to a SA-MP1CDX vertical antenna.

Results:

Long range stations were slightly fainter with the AS-2259 and contact could not be established as easily as the vertical.

Short range stations were much clearer, and I was consistently able to establish contact with R-2 or higher signal reception. Some SSB contacts were also completed at S9+ signal reports, compared to S6-S9 on the vertical.

Future testing

I will be testing different antenna arrangements at my QTH over the coming weeks. I will also be testing the antenna in a POTA setting either with the working group session and/or POTA sites VE-5095 and VE-4882 sometime in mid-July as VE3YOTA, KO4ZMC/VE3, or VB3LIGMA.

Alpha Delta DX-DD “Hack”

Single dipole, 80, 40 meters, 82 ft. long

Matching Unit

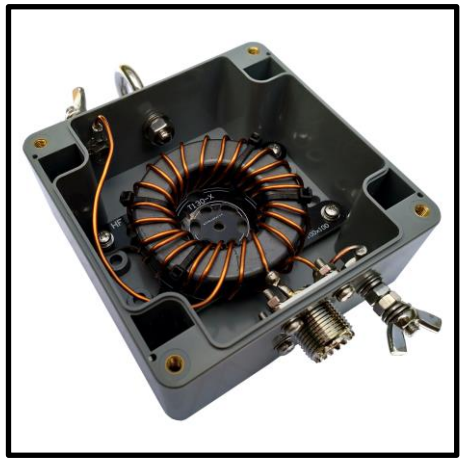
Loading Coil

NVIS Antenna Comparisons

End Fed Half Wave vs. Random Wire End Fed	EFHW	Random End Fed
Length	Must be exact multiple of 1/2 wavelength	Must NOT be any multiple of 1/2 wavelength
Feed Point Imp (Z)	Very High. 2000 to 4000 ohms depending on surroundings	Much Lower. In the order of 400 to 600 ohms
Feed Point Current	Very Low	Much Higher
	Note that counterpoise requirements are proportional to feed point current!	
RF Gnd. Required	Minimal counterpoise Required	Requires much more extensive RF ground for reasonable efficiency
Typical Impedence Matching Required	64:1 or 49:1 UnUn Transformer	9:1 UnUn Transformer

Source: https://www.reddit.com/r/amateurradio/comments/tget3f/differences_between_endfed_have_wave_and_endfed/

End Fed Long Wire (Hfkits.com)

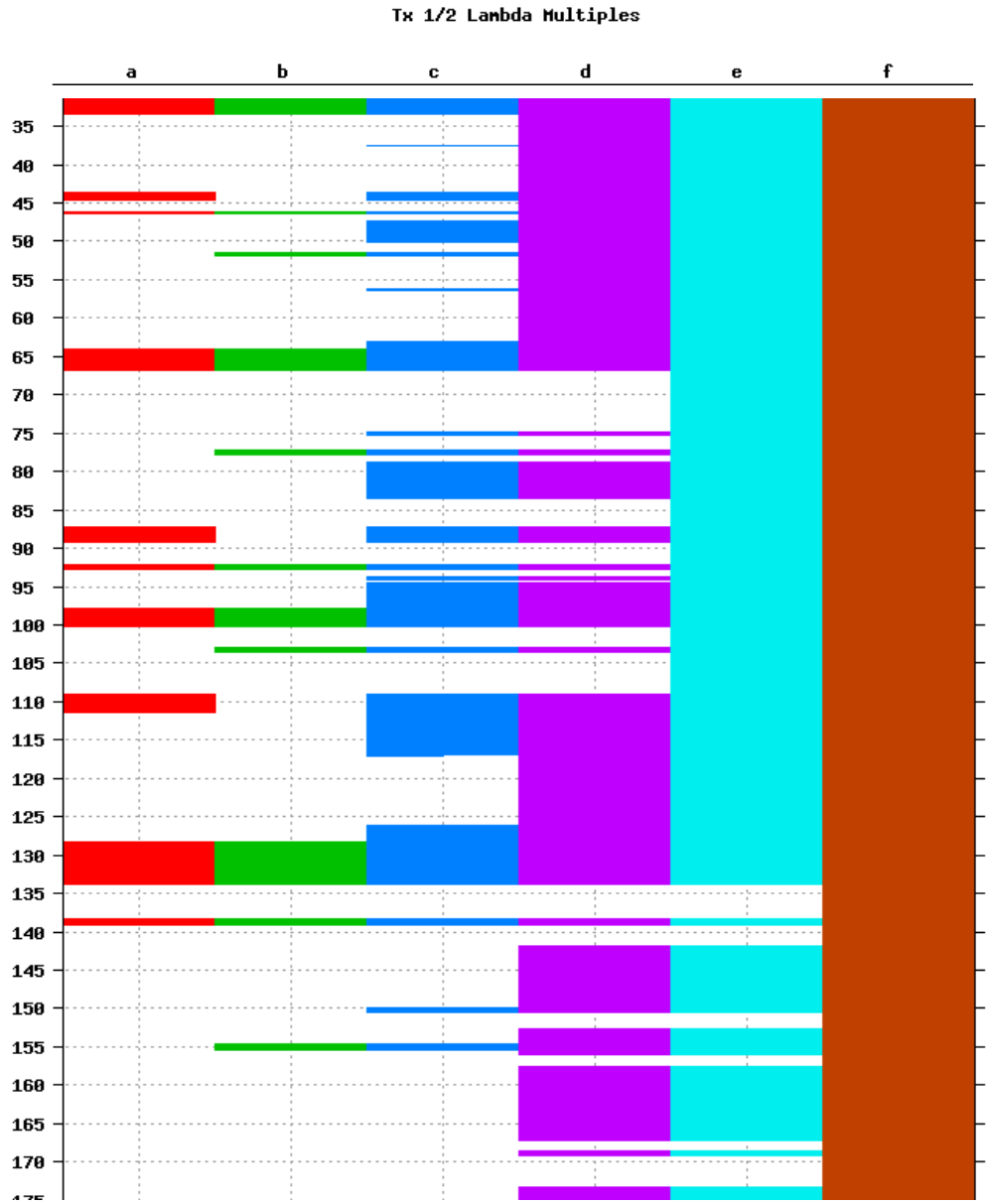


9:1 UnUn

Core Mount

Random Wire Lengths for Various Band Combinations

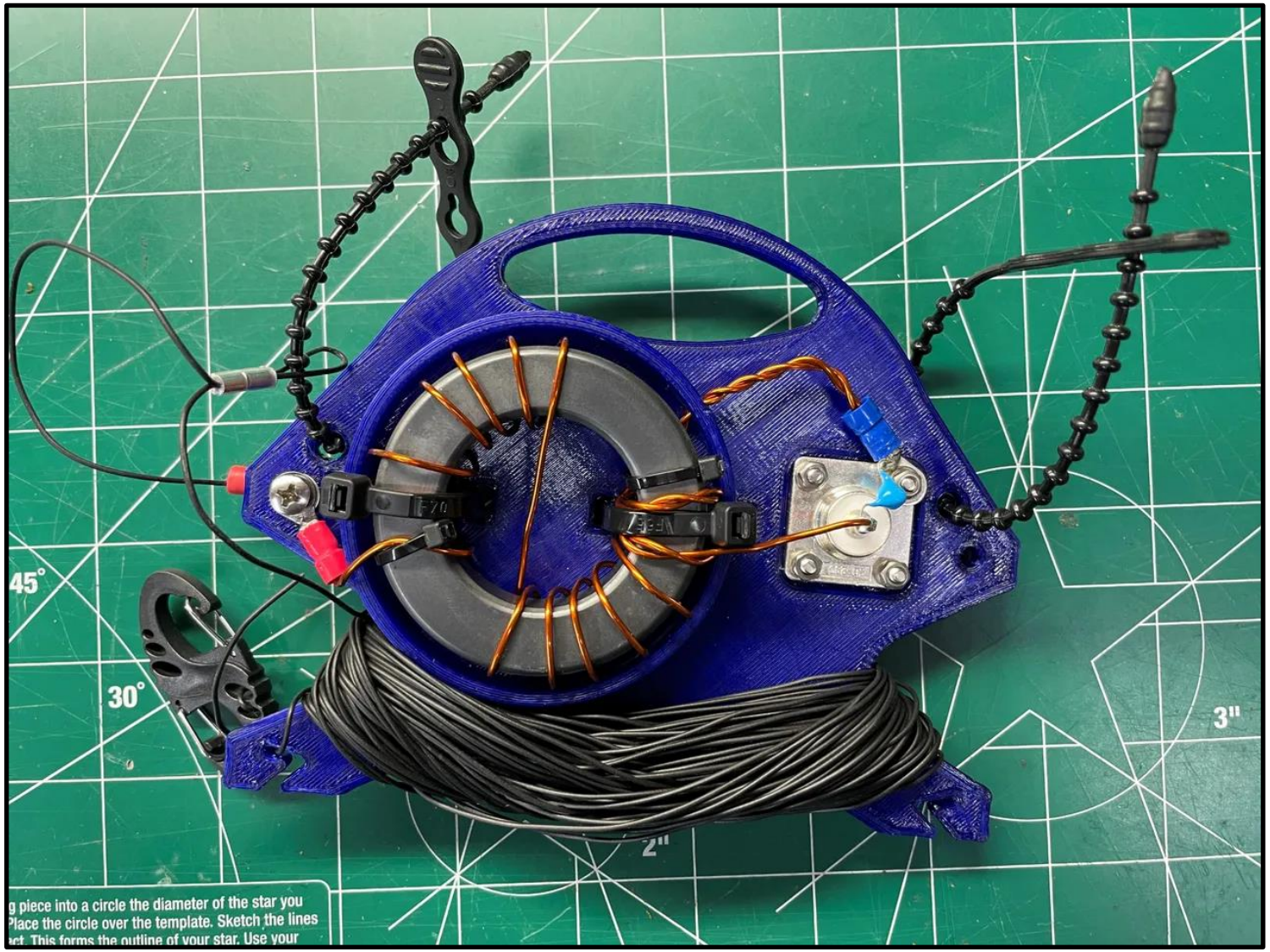
Group	USA Bands
a	40-30-20-15
b	40-30-20-17
c	40-30-20-17-15-12-10
d	80-40-30-20-17-15-12-10
e	160-80-40-30-20-17-15-12-10
f	160-80-60-40-30-20-17-15-12-10-6



Source: https://udel.edu/~mm/ham/randomWire/

EFHW DIY Antenna

Parts available from Joe, KT3I ($25.00)



Summary

- The purpose of this project is to enhance club member knowledge of and appreciation for NVIS propagation while having some fun
- More experience with NVIS operations is the main objective
- Overall, successful Implementation of this NVIS framework will promote development of stronger capabilities to aid in case of emergencies or disasters
- The next block in this framework is a deployment to a park in mid-July to field test antennas in a POTA configuration

- Comments or Questions?