Portable Near Vertical Incidence Skywave (NVIS) Antenna (CHA NVIS) Operator's Manual

Nevada - USA
WWW.CHAMELEONANTENNA.COM

MADE IN U.S.A.

VERSATILE – DEPENDABLE – STEALTH – BUILT TO LAST

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Be aware of overhead power lines when you are deploying the CHA NVIS. You could be electrocuted if the antenna gets near or contacts overhead power lines.

Photographs and diagrams in this manual may vary slightly from current production units due to manufacturing changes that do not affect the form, fit, or function of the product.

Introduction

Thank you for purchasing and using the Chameleon Antenna™ Portable Near Vertical Incidence Skywave (NVIS) Antenna (CHA NVIS). Chameleon Antenna™ has taken the world's most popular NVIS antenna, the U.S. Army's AS-2259/GR, and made it better by making it lighter, more portable, and with increased frequency coverage--while not sacrificing the ruggedness needed for hard field use. It was built for the jungles of Vietnam--but is now ready for the harshest EMCOMM environment.

The CHA NVIS is a specialized antenna designed primarily for NVIS propagation and for use by serious Emergency Communication (EMCOMM) operators. The typical use case for the CHA NVIS would be for use inside a disaster area where communications with emergency aid providers, who are located just outside the affected area, is required.

The CHA NVIS antenna will operate from 1.8 – 54.0 MHz (including 160m – 6m Amateur Service bands) without any adjustment when used with an antenna tuner. This antenna requires one center support, approximately 15 feet in height, and is self-guying. Setup is quickly and easily accomplished in the field by two personnel. Although primarily designed for NVIS propagation, this antenna will also provide satisfactory medium range portable HF communication, particularly on higher frequencies.

The CHA NVIS is the perfect portable antenna for military, government agencies, non-governmental organizations (NGOs), Military Affiliate Radio System (MARS), Civil Air Patrol (CAP), Amateur Radio Emergency Service (ARES) / Radio Amateur Civil Emergency Service (RACES), Salvation Army Team Emergency Radio Network (SATERN), and almost any emergency or preparedness operation where NVIS propagation is required to establish and maintain a sub-regional communication network.

Plate 1. CHA NVIS Antenna.

This antenna requires an antenna tuner or coupler for most frequencies. Antennas built by Chameleon Antenna™ are versatile, dependable, stealthy, and built to last. Please read this operator's manual so that you may maximize the utility you obtain from your CHA NVIS.

HF Propagation

HF radio provides relatively inexpensive and reliable local, regional, national, and international voice and data communication capability. It is especially suitable for undeveloped areas where normal telecommunications are not available, too costly, or scarce, or where the commercial telecommunications infrastructure has been damaged by a natural disaster or military conflict.

Although HF radio is a reasonably reliable method of communication, HF radio waves propagate through a complex and constantly changing environment and are affected by weather, terrain, latitude, time of day, season, and the 11-year solar cycle. A detailed explanation of the theory of HF radio wave propagation is beyond the scope of this operator's manual, but an understanding of the basic principles will help the operator decide what frequency and which of the CHA NVIS's configurations will support their communication requirements.

HF radio waves propagate from the transmitting antenna to the receiving antenna using two methods: ground waves and sky waves.

Ground waves are composed of direct waves and surface waves. Direct waves travel directly from the transmitting antenna to the receiving antenna when they are within the radio line-of-sight. Typically, this distance is 8 to 14 miles for field stations. Surface waves follow the curvature of the Earth beyond the radio horizon. They are usable during the day and under optimal conditions, up to around 90 miles, see table (1). Low power, horizontal antenna polarization, rugged or urban terrain, dense foliage, or dry soil conditions can reduce the range very significantly. The U.S. Army found that in the dense jungles of Vietnam, the range for ground waves was sometimes less than one mile.

Sky waves are the primary method of HF radio wave propagation. HF radio waves on a frequency below the critical frequency (found by an ionosonde) are reflected off one of the layers of the ionosphere and back to Earth between 300 and 2,500 miles, depending upon the frequency and ionospheric conditions, HF radio waves can then be reflected from the Earth to the ionosphere again during multi-hop propagation for longer range communication. The most important thing for the operator to understand about HF radio wave propagation is the concept of Maximum Usable Frequency (MUF), Lowest Usable Frequency (LUF), and Optimal Working Frequency (OWF).

Frequency	Distance	Frequency	Distance
2 MHz	88 miles	14 MHz	33 miles
4 MHz	62 miles	18 MHz	29 miles
7 MHz	47 miles	24 MHz	25 miles
10 MHz	39 miles	30 MHz	23 miles

Table 1. Maximum Surface Wave Range by Frequency.

The MUF is the frequency for which successful communications between two points is predicted on 50% of the days of in a month. The LUF is the frequency below which successful communications are lost due to ionospheric losses. The OWF, which is somewhere between the LUF and around 80% of the MUF, is the range of frequencies which can be used for reliable communication. If the LUF is above the MUF, HF sky wave propagation is unlikely to occur.

The HF part of the Radio Frequency (RF) spectrum is usually filled with communications activity and an experienced operator can often determine where the MUF is, and with less certainty, the LUF by listening to where activity ends. The operator can then pick a frequency in the OWF and attempt to establish contact. Another method is using HF propagation prediction software or an online service, such as the *Voice of America Coverage Analysis Program (VOACAP)*, which is available at no cost to download or use online at www.voacap.com. The operator enters the location of the two stations and the program shows either a chart or wheel with the predicted percentage of success based on frequency and time. ALE, which is the standard for interoperable HF communications, is an automated method of finding a frequency in the OWF and establishing and maintaining a communications link.

Even under optimal conditions, there is a gap between where ground waves end (around 40 to 90 miles) and the sky wave returns to Earth on the first hop (around 300 miles). NVIS propagation can be used to fill this gap. NVIS was first employed tactically by the German Army in WWII by reconnaissance units, who were too far forward for groundwave communication with HQ, but too close for normal sky waves. Plate (2) shows a WWII German Army Sd.Kfz.263 (6-rad) armored car with an NVIS antenna on top.

Plate 2. NVIS Equipped WWII Armored Car.

The U.S. Army discovered the need for NVIS in Vietnam, where groundwave communication was ineffective due to the dense foliage mountainous terrain -- their solution was to use NVIS propagation and the antenna they used was the AS-2259/GR, shown in plate (3).

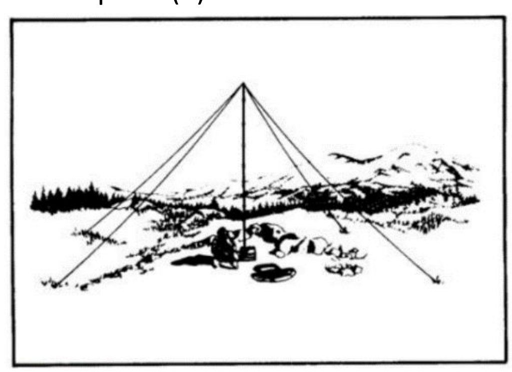


Plate 3. U.S. Army AS-2259/GR Antenna.

To use NVIS propagation, the frequency selected must be below the critical frequency. Therefore, NVIS propagation can normally only be used on frequencies from around 2 to 10 MHz. Frequencies of 2 – 4 MHz are typical at night and 4 – 8 MHz during the day.

CHA NVIS Components

The CHA NVIS antenna is comprised of the following components, see plates (4) – (6).

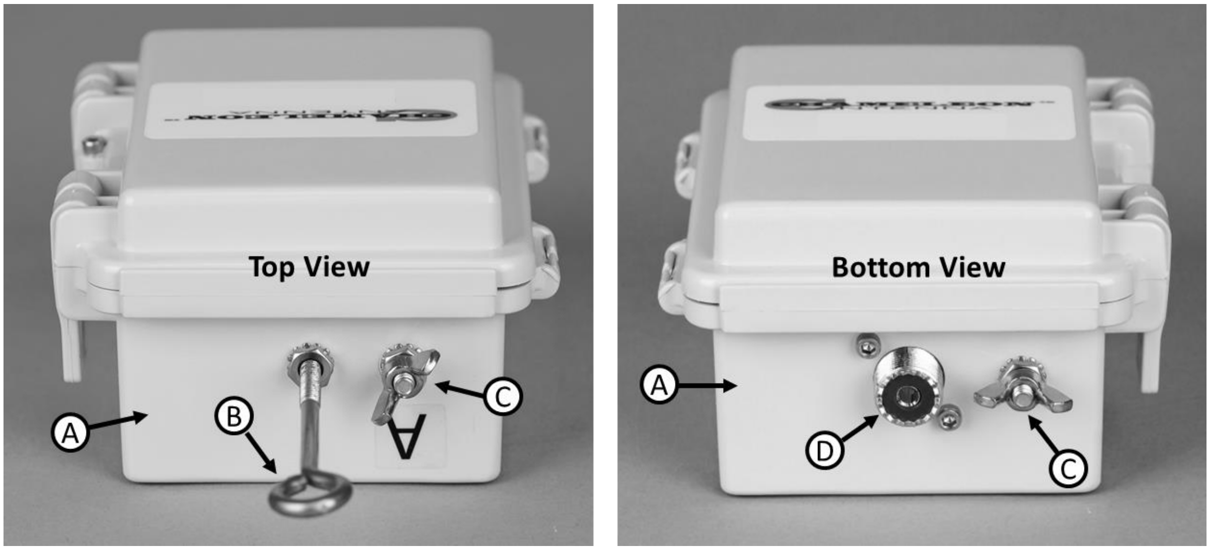


Plate 4. Matching Transformer.

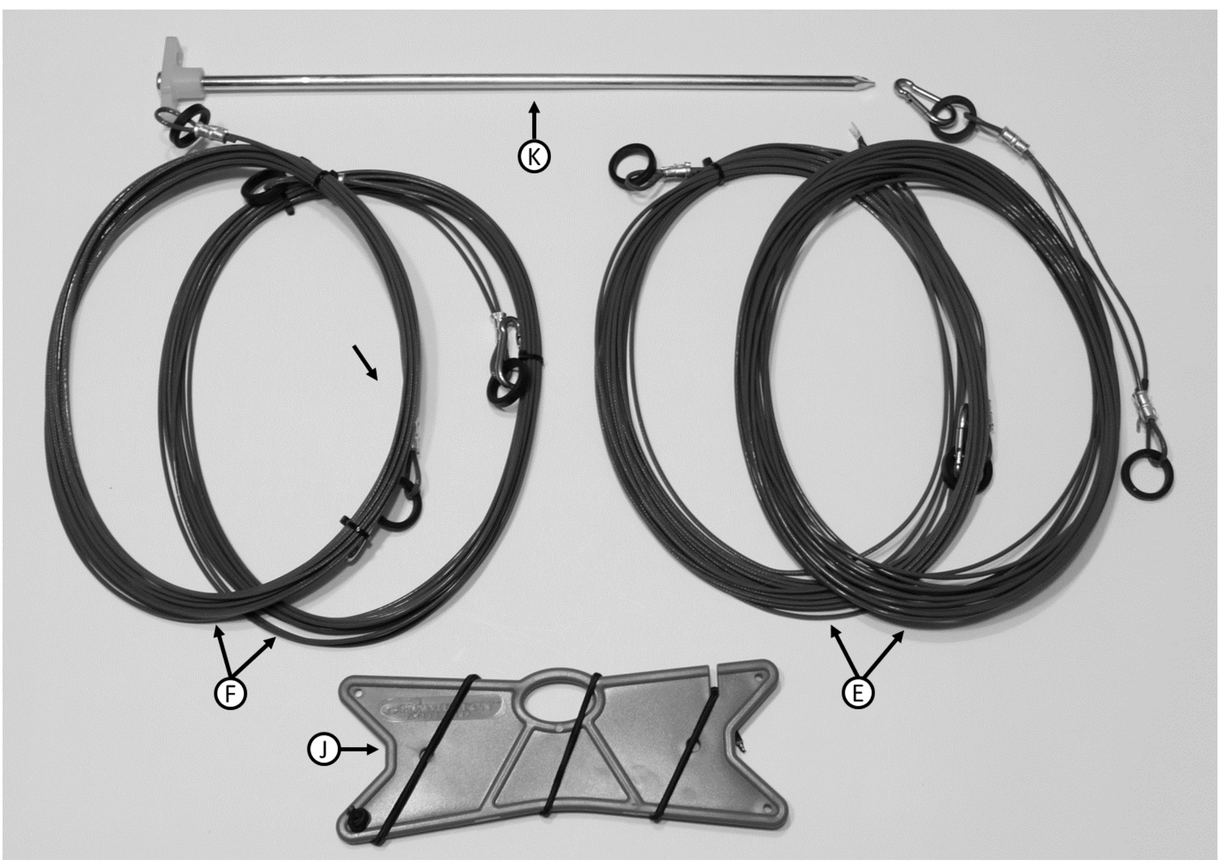


Plate 5. CHA NVIS Components.

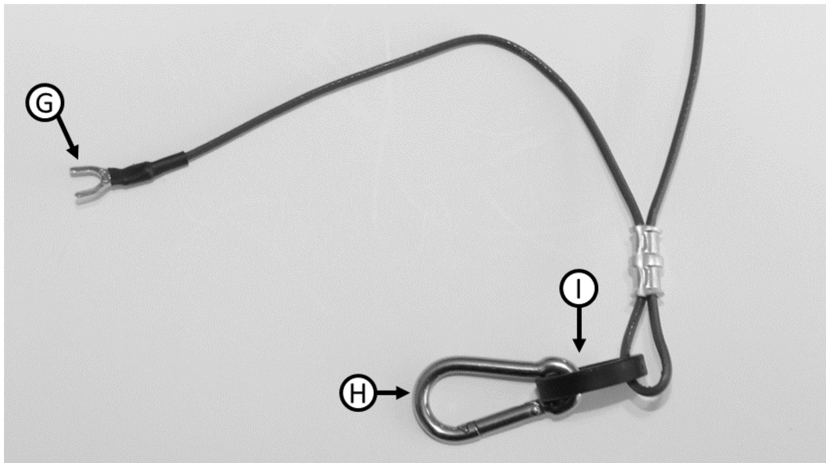


Plate 6. Wire Details.

A. Matching Transformer. The Matching Transformer is used to match the dipole antennas to the 50 Ohm coaxial cable.

B. Suspension Eyebolt. The Suspension Eyebolt is located on top of the Matching Transformer and is used to suspend the center of the antenna and for strain relief for the Long Wire and Short Wire antenna elements.

C. Wire Terminals. The Wire Terminals are located on the sides of the Matching Transformer and are used to electrically connect the Long Wire and Short Wire antenna elements.

D. Coaxial Connector. The Coaxial Connector is an SO-239 socket used to connect the Coaxial Cable to the Matching Transformer.

E. Long Wire. The lower frequency dipole is comprised of the two Long Wire antenna elements, each of which is 38 feet long.

F. Short Wire. The higher frequency dipole is comprised of the Short Wire antenna elements, each of which is 25 feet long.

G. Wire Lugs. The Wire Terminals are located at the end of the Long Wire and Short Wire antenna elements and electrically connect them to the Matching Transformer.

H. Carabiner. The four Carabiners are used to mechanically attach the ends of the Long Wire and Short Wire antenna elements to the Suspension Eyebolt.

I. Insulating Rings. Insulating Rings are located at the ends of the Long Wire and Short Wire antenna elements and are used for electrical isolation and mechanical connection.

J. Line Winder. Four Line Winders *(not pictured)* are included for storing the Long Wire and Short Wire antenna elements, when not in use.

K. Ground Stake. Four Ground Stakes *(not pictured)* are used to anchor the Mini-Paracord ends of the antenna elements to the ground making the antenna self-guying.

L. Mini-Paracord. Mini-Paracord *(not pictured)* is attached to the ends of the Long Wire and Short Wire antenna elements and is used to make all elements a uniform 45 feet in length.

M. Coaxial Cable. Coaxial Cable *(not pictured, available as an option)* is used to connect the CHA NVIS to the Radio Set.

Antenna Description

The CHA NVIS antenna is a set of crossed sloping dipoles positioned at right angles to each other, see figure (2). It is designed to provide high-angle radiation enabling short-range skywave propagation from beyond the radio horizon out to around 300 miles. Although primarily designed for high-angle radiation, the CHA NVIS antenna will provide good medium-range communications capability—like other Inverted V antennas installed at a low height. Also, on frequencies above 16 MHz, the antenna produces more medium-angle radiation and the horizontal pattern changes from predominantly omni-directional to bi-directional.

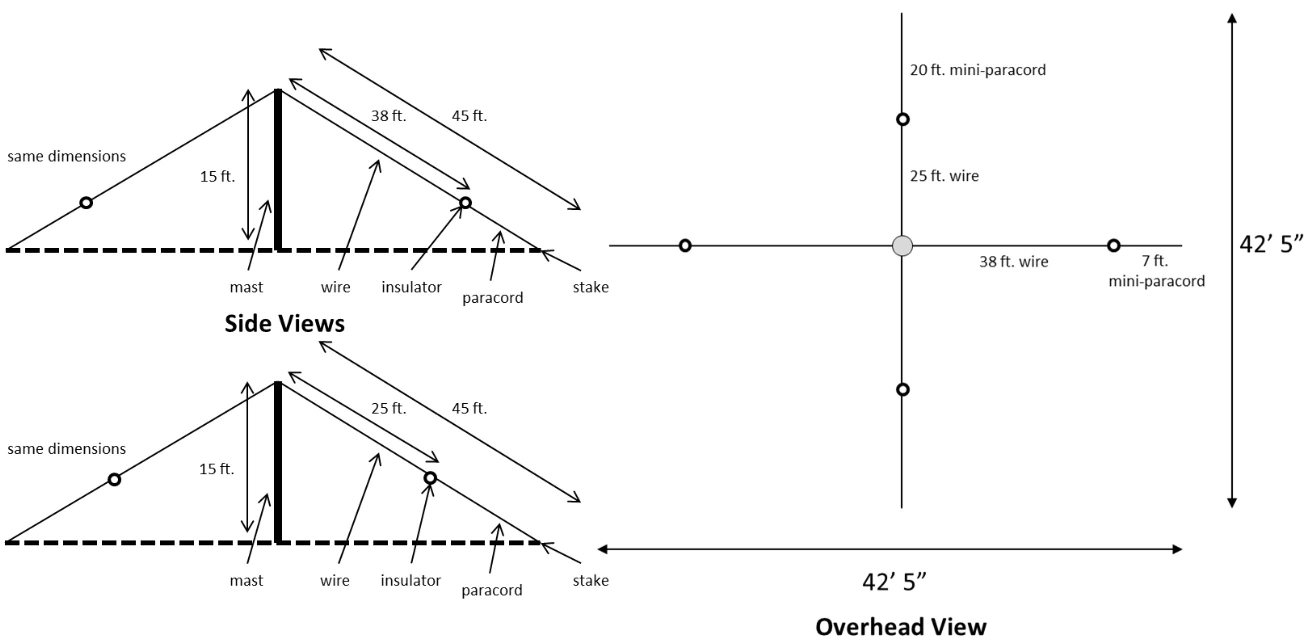


Figure 2. CHA NVIS Antenna Side and Overhead Views.

As shown in figure (2), the CHA NVIS can be deployed in two ways: mast mounted, using a portable 15 foot mast *(available as an option)* or suspended from an existing support, such as a tree, that is 15 feet or greater in height. The CHA NVIS is self-guying, meaning, when used with a mast, no additional guy wires or mast tripod are required because the antenna elements themselves serve as guys.

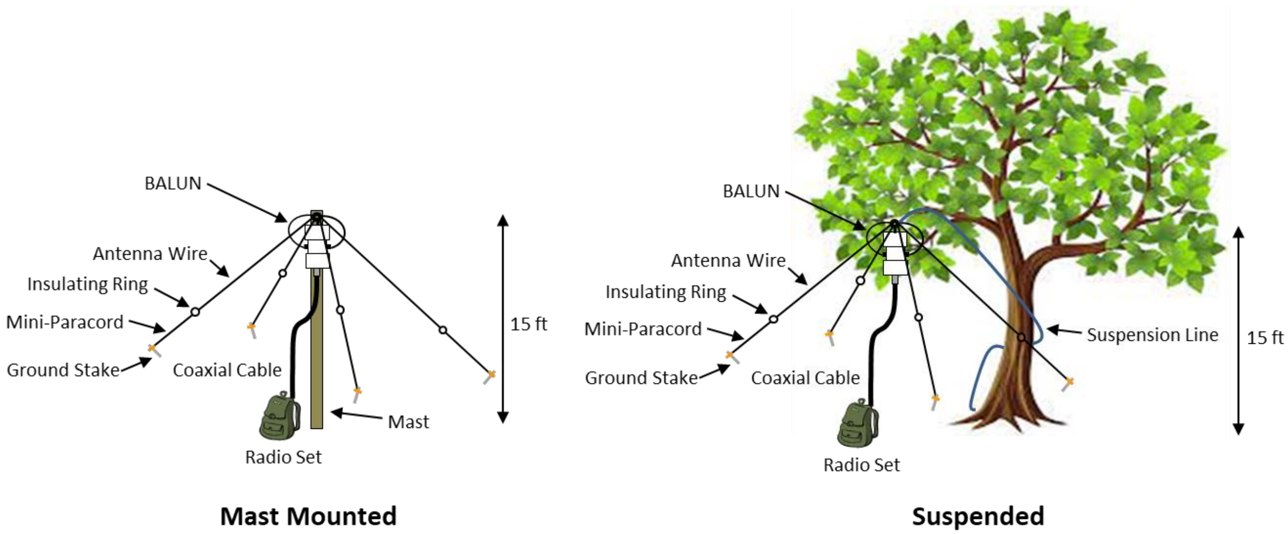


Figure 3. CHA NVIS Setup Options.

Deployment Procedure

Use the following procedure to deploy the CHA NVIS antenna. Refer to plate (7) for Matching Transformer connections.

1. Select a site large and clear enough to permit setup of the antenna, see figure (2). *You will need a mast or tree at least 15 feet in height for the center support.*
2. Using a Bowline or similar knot, attach a suspension line to the Matching Transformer (A) Suspension Eyebolt (B).
3. Connect Coaxial Cable to the Matching Transformer Coaxial Connector (D).
4. Attach the Carabiner (H) from the end of one of the Short Wires (F) to the Suspension Eyebolt.
5. Connect the Wire Lug (G) from the Short Wire to the Wire Terminal (C) on one side of the Matching Transformer.
6. Attach the Carabiner from the end of one of the Long Wires (E) to the Carabiner from step 4.
7. Connect the Wire Lug from the Long Wire to the same Wire Terminal.
8. Tighten the Wire Terminal wing nut until finger tight. The assembly should look like that shown in plate (3).
9. Attach the Carabiner from the other Short Wire to the Suspension Eyebolt.
10. Connect the Wire Lug from the Short Wire to the Wire Terminal on the other side of the Matching Transformer.
11. Attach the Carabiner from the other Long Wire to the Carabiner from step 9.

12. Connect the Wire Lug from the Long Wire to the same Wire Terminal.

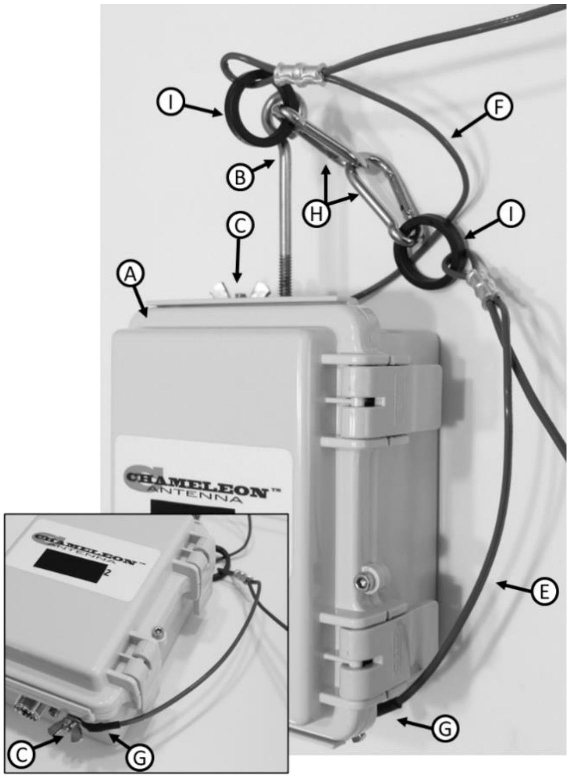


Plate 7. Matching Transformer Antenna Wire Connection ***(only one side shown).***

13. Tighten the Wire Terminal wing nut until finger tight.
14. Using a Bowline or similar knot, tie a 7 foot length of Mini-Paracord (L) to the Insulating Ring (I) at the end of both of the Long Wires.
15. Using a Bowline or similar knot, tie a 20 foot length of Mini-Paracord to the Insulating Ring at the end of both of the Short Wires.
16. Raise the Matching Transformer to a height of 15 feet. If using a portable mast, have one operator hold the mast in position for the remaining steps of the procedure.
17. Extend a Short Wire to its full length away from the center of the antenna.
18. Drive a Tent Stake (K) into the ground at the end of the Short Wire and Mini-Paracord.
19. Tie the Mini-Paracord from the Short Wire to the Tent Stake using a Round Turn and two Half Hitches or similar knot.
20. Extend the other Short Wire to its full length in the opposite direction of the first Short Wire, as shown in figure (2).
21. Drive a Tent Stake into the ground at the end of the Short Wire and Mini-Paracord.
22. Tie the Mini-Paracord from the Short Wire to the Tent Stake using a Round Turn and two Half Hitches or similar knot.
23. Extend a Long Wire to its full length perpendicular from the Short Wires, as shown in figure (2).
24. Drive a Tent Stake into the ground at the end of the Long Wire and Mini-Paracord.
25. Tie the Mini-Paracord from the Long Wire to the Tent Stake using a Round Turn and two Half Hitches or similar knot.
26. Extend a Long Wire to its full length in the opposite direction of the first Long Wire, as shown in figure (2).
27. Drive a Tent Stake into the ground at the end of the Long Wire and Mini-Paracord.

28. Tie the Mini-Paracord from the Long Wire to the Tent Stake using a Round Turn and two Half Hitches or similar knot.

29. Perform an operational check.
    Note: This antenna requires an antenna tuner on most frequencies.

Accessories

The following accessories are available for purchase from Chameleon Antenna™. Go to www.chameleonantenna.com for current prices and availability.

- **CHA 50' COAX** – 50 foot of Coaxial Cable with integrated RFI Choke and PL-259 connectors on each end.
- **CHA PORTA MAST 15 HD** - 15 foot portable, telescoping mast that measures 59 inches when collapsed. It is the perfect height for the CHA NVIS antenna.
- **CHA DPACK** – A small to medium bodied/shoulder pack that is perfect to store the components of the CHA NVIS.

Recovery Procedure

To recover the CHA NVIS, perform the following steps:

1. Disconnect the Coaxial Cable from the radio set.
2. Lower the antenna to the ground.
3. Pull the Stakes from the ground.
4. Disconnect the Coaxial Cable from the Matching Transformer.
5. Carefully roll (do not twist) the Coaxial Cable.
6. Detach the Short Wires and Long Wires from the Matching Transformer.
7. Wind the Short Wires and Long Wires onto their individual Line Winders. *Leave the Mini-Paracord tied to the antenna wires.*
8. Check deployment area for misplaced antenna components.
9. Remove dirt from antenna components and inspect them for signs of wear.
10. Store components together in a tactical pack.

Troubleshooting

1. Ensure Antenna, Counterpoise and Loop connections are properly and securely connected.
2. Inspect Antenna, Counterpoise, and Loop Wires for breakage or signs of strain.
3. Ensure UHF Plugs are securely tightened.

4. Inspect Coaxial Cable assembly for cuts in insulation or exposed shielding. Replace if damaged.
5. If still not operational, connect a Standing Wave Ratio (SWR) Power Meter and check SWR.
6. If SWR is greater than 10:1, check antenna tuner or coupler using the technical manual or manufacturer's procedure. Be sure to check the Coaxial Patch Cable that connects the radio set to the antenna tuner or coupler. Also Check any adapters used.
7. If still not operational, replace Coaxial Cable assembly. *Most problems with antenna systems are caused by the coaxial cables, connectors, and adapters.*
8. Connect a Multi-Meter to the Antenna Wire to check continuity. Replace assemblies that do not pass a continuity check.
9. If still not operational, contact Chameleon Antenna™ for technical support.

Specifications

- **Frequency Range:** 1.8 MHz through 54.0 MHz continuous. Requires an antenna tuner on most frequencies (including Amateur Radio Service frequencies).
- **Power Handling:**
  100W intermittent Duty Cycle (SSB Phone); 50W medium Duty Cycle (CW, FM); 25W continuous duty cycle (AM, RTTY, FT8 and other High Duty Cycle digital modes)
- **Length:** Each element has a combined length of 45 ft. for a total space required of 85 ft.
- **Height:** 15 ft.
- **SWR:** Typically, less than 3:1, except for 5.5 and 9.8 MHz (±1.2 MHz), see figure (4).
- **Weight:** X.X lbs.
- **Setup Time:** Two personnel, approximately 15 minutes.

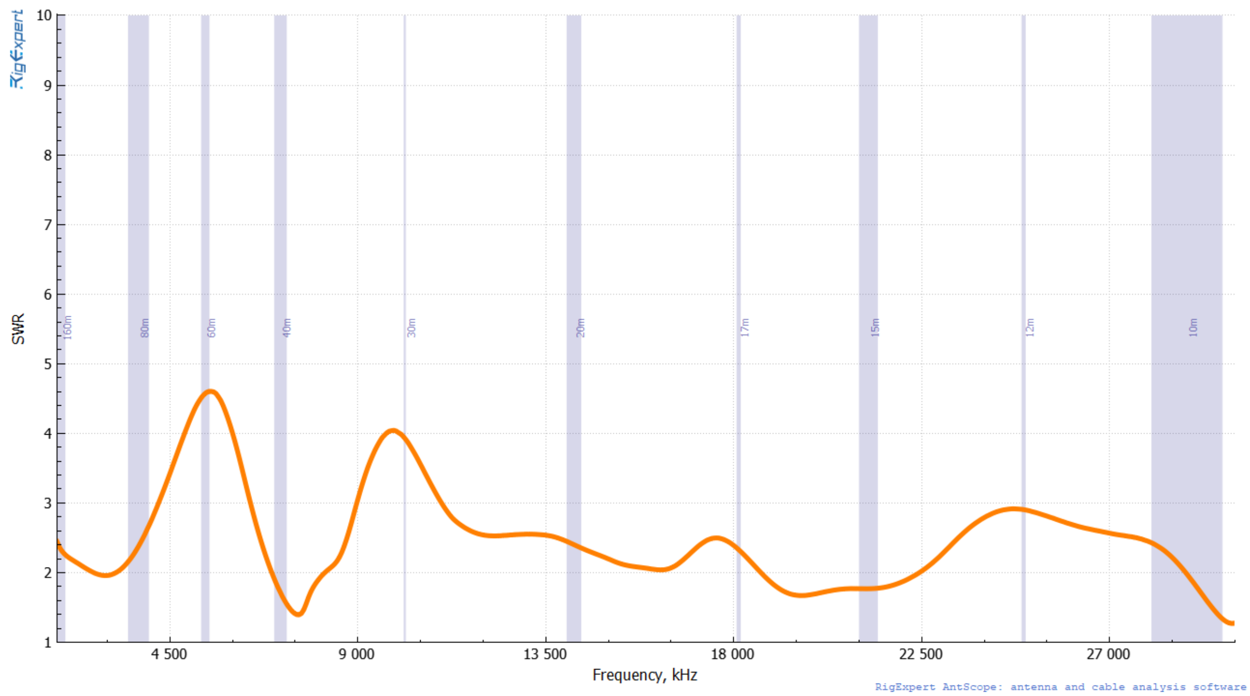


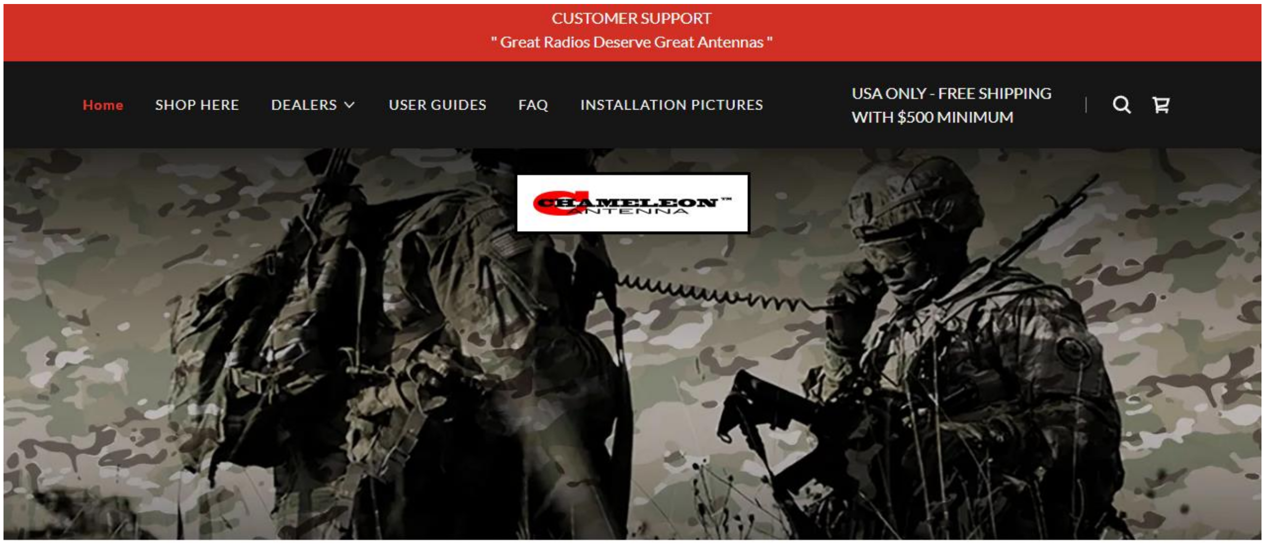
Figure 4. CHA NVIS Antenna Measured SWR.

References

1. Silver, H. Ward (editor), 2013, *2014 ARRL Handbook for Radio Communications*, 91st Edition, American Radio Relay League, Newington, CT.
2. 1987*, Tactical Single-Channel Radio Communications Techniques (FM 24-18)*, Department of the Army, Washington, DC.
3. Turkes, Gurkan, 1990, *Tactical HF Field Expedient Antenna Performance Volume I Thesis*, U.S. Naval Post Graduate School, Monterey, CA.

Chameleon Antenna™ Products

Go to http://chameleonantenna.com for information about quality antenna products available for purchase from Chameleon Antenna™ – The Portable Antenna Pioneer.



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