Portable HF Antenna
(CHA EMCOMM II)
Operator's Manual

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VERSATILE – DEPENDABLE – STEALTH – BUILT TO LAST

Table of Contents

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

Introduction

Thank you for purchasing and using the Chameleon Antenna™ Portable High Frequency (HF) Antenna (CHA EMCOMM II). The CHA EMCOMM II Antenna has been specially designed for backup emergency HF systems or permanent installation. The integral broadband impedance matching network transformer allows broadband antenna tuning. The antenna will operate from 1.8 - 54 MHz (including 160m – 6m amateur bands) without any adjustment with a wide range antenna tuner. The CHA EMCOMM II is the perfect backup 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), First Responders and especially for Emergency Preparedness. It is also the ideal antenna for hams living in apartments and condominiums or developments with homeowners associations, deed restrictions, or CCRs (Covenants, Conditions & Restrictions). The CHA EMCOMM II is configurable to facilitate Near-Vertical Incident Sky wave (NVIS) communication and is totally waterproof. The CHA EMCOMM II does not required any ground plane, but will perform better with one (a ground terminal is available for that purpose). This antenna requires a wide range antenna tuner or coupler. 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 EMCOMM II.

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 EMCOMM II'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.

Frequency	Distance	Frequency	Distance
2 MHz	88 miles	**14 MHz**	33 miles
4 MHz	62 miles	**18MHz**	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.

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 multihop 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). 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 loses. 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, 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 show a 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. The frequency selected must be below the critical frequency, so NVIS is 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.

Parts of the Antenna

The CHA EMCOMM II is comprised of the following components, see plate (1):

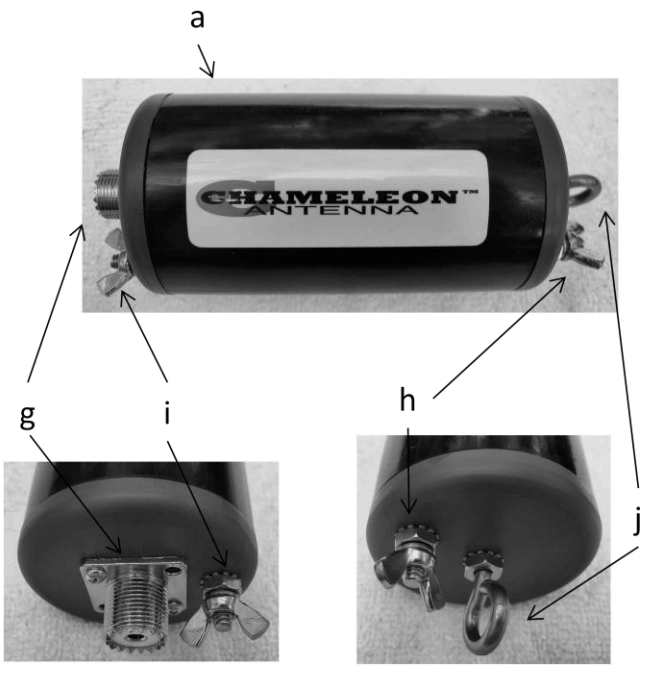

Plate 1. Matching Transformer, Side View (top), Bottom View (left) and Top View (right).

a. Matching Transformer, EMCOMM II

The EMCOMM II Matching Transformer, see plate (1), provides impedance matching for the CHA EMCOMM II.

b. Antenna Wire

The Antenna Wire, see plate (2), is a 60 foot length of black insulated wire.

c. Isolation loop

One Isolation loop is permanently attached to the Wire Connector (f) end the Antenna Wires (b).

d. Carabiner

The Carabiner is a removable pear-shaped stainless steel hooks with a spring-loaded gate.

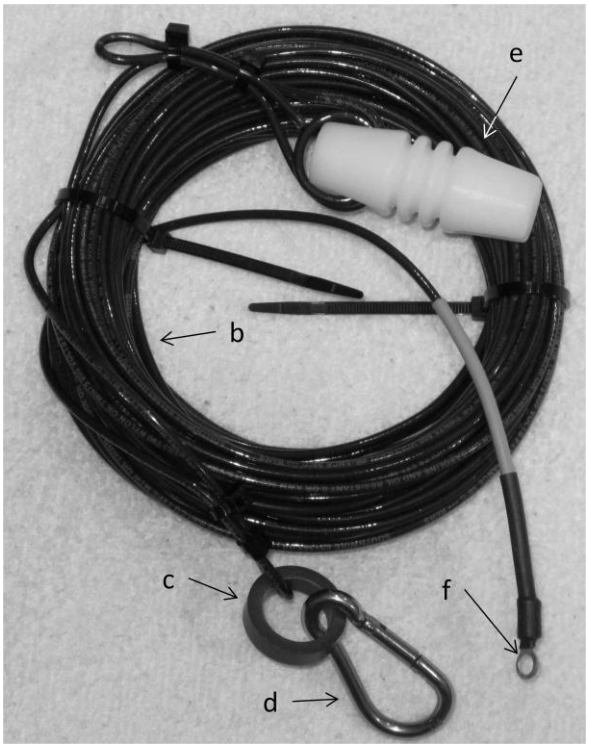

Plate 2. Antenna Wire.

e. Insulator

The Insulator is permanently attached to the far end of the Antenna Wire (b).

f. Wire Connector

The Wire Connectors are located at one end of the Antenna Wires (b).

g. UHF Socket

The UHF Socket, SO-239, is located on the bottom of the Matching Transformer (a).

h. Top Transformer Connection

The Top Transformer Connection is located on the top of the Matching Transformer (a).

i. Bottom Transformer Connection

The Bottom Transformer Connection is located on the bottom of the Matching Transformer (a).

j. Transformer Eyebolt

The Transformer Eyebolt is located on the top of the Matching Transformer (a).

Antenna Configurations

Using the supplied components, the CHA EMCOMM II can be deployed into a number of configurations. Three configurations, see table (2), are described in this manual, each with unique performance characteristics. The table can assist the operator to quickly select the most appropriate antenna configuration to meet their operational requirements.

Configuration	Ground	Short	Medium	Long	Directionality
Horizontal NVIS		↓	↑		Omnidirectional
Sloping Wire	↓		↕	↑	Omnidirectional
Inverted "L"	↓		↕	↓	Unidirectional

Table 2. Antenna Configuration Selection.

To use the table, decide which distance column (Ground = 0 to 90 miles, Short = 0 - 300 miles, Medium = 300 – 1500 miles, Long > 1500 miles) best matches the distance to the station with whom you need to communicate. Then, determine if the OWF is in the lower (↓ = 1.8 – 10 MHz) or upper (↑ = 10 – 30 MHz) frequency range. Finally, select the CHA EMCOMM II configuration with the corresponding symbol in the appropriate distance column. All CHA EMCOMM II configurations provide some capability in each distance category, so depending upon the complexity of your communications network, you may need to select the best overall configuration. The directionality column indicates the directionality characteristic of the antenna configuration. When using NVIS, all the configurations are omnidirectional. Most configuration and frequency combinations will require a wide range antenna tuner or coupler.

Horizontal NVIS

The CHA EMCOMM II Horizontal NVIS configuration, see figure (1), is a special configuration designed to provide good NVIS propagation on lower frequencies. It is predominately omnidirectional and also provides medium range sky wave propagation on frequencies above 10 MHz. It requires two supports that will enable the antenna to be raised to a height of 10 – 12 feet. A counterpoise wire with a length of 50 to 55 feet is recommended. If a counterpoise wire is not used, the coaxial cable must be 25 to 100 feet in length, as the shield of the coaxial cable provides the counterpoise.

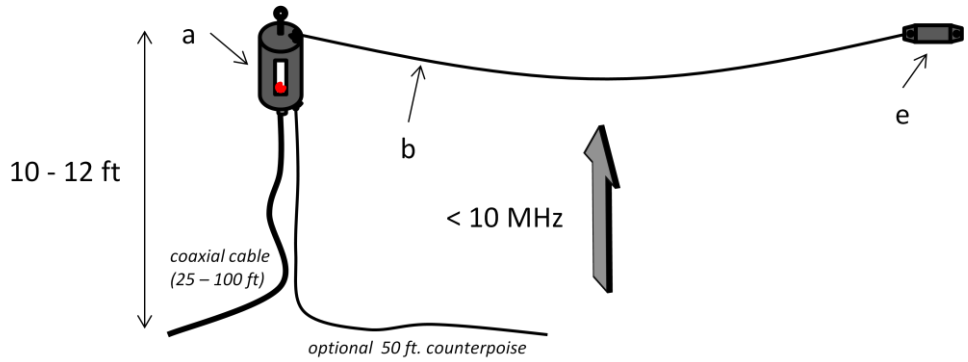

Figure 1. Horizontal NVIS Configuration.

Site Selection and Preparation.

1. Select a site to deploy the CHA EMCOMM II Horizontal NVIS configuration. The site must have two supports that will position the Matching Transformer and the end of the Antenna Wire to be at a height of between 10 and 12 feet and 60 feet apart. Higher or lower heights may be used, but may reduce NVIS performance.
2. If not already attached, connect a Carabiner (d) to the Wire Connector (f) end of the Antenna Wire.

Connect the Matching Transformer. Refer to figure (2) for steps (3) – (6).

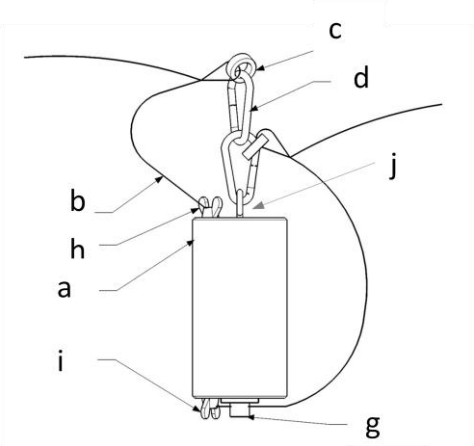

Figure 2. Matching Transformer Electrical and Mechanical Connections.

3. Connect the Carabiner from the Antenna Wire to the Transformer Eyebolt (j).
4. Connect the Wire Connector from the Antenna Wire to the Top Transformer Connection (h). Tighten the wing nut finger tight.
5. If using a counterpoise wire, connect it to the Bottom Transformer Connection (i). Tighten the wing nut finger tight.
6. Connect a CHA RFI CHOKE and coaxial cable or the Integrated RF Choke end of the CHA Coaxial Cable assembly to the UHF Socket (g) on the Matching Transformer.

Raise the Antenna.

7. Using a Bowline or similar knot, tie the end of a long length (25 feet or more) of Paracord to the Carabiner from step (3).
8. Using a throw weight or other method, loop the Paracord over the support that is closest to where the radio set will be located.
9. Raise the Matching Transformer end of the antenna to a height of 10 to 12 feet and secure it to the support using a Round Turn and two Half Hitches, or similar knot.
10. Using a Bowline, or similar knot, tie another long length of Paracord to the Insulator (e) at the end of the Antenna Wire.
11. Using a throw weight, or some other method, loop the Paracord over the other support.
12. Raise the end of the Antenna Wire to a height of 10 to 12 feet, such that the Antenna Wire is not quite taut, and secure it to the support using a Round Turn and two Half Hitches.

Extend the Counterpoise.

13. If using a counterpoise, extend it along the ground under the raised portion of antenna.
14. Perform operational test.
15. This completes deployment of the CHA EMCOMM II Horizontal NVIS configuration.

Sloping Wire

The CHA EMCOMM II Sloping Wire configuration, see figure (3), is a broadband short to long range HF antenna. It is designed to provide acceptable ground wave and sky wave propagation. This configuration is predominately omnidirectional, becoming slightly bidirectional towards both ends as the frequency increases. The Sloping Wire requires one support and should be mounted at a height of 25 to 40 feet for best performance. A counterpoise wire, with a length of 20 - 40 feet, is recommended. If a counterpoise is not used, the coaxial cable must be 25 to 100 feet in length, as the shield of the coaxial cable provides the counterpoise. The "Half Sloper" is an alternate version of this configuration, where the antenna is attached to a metal tower and the antenna is fed from the top.

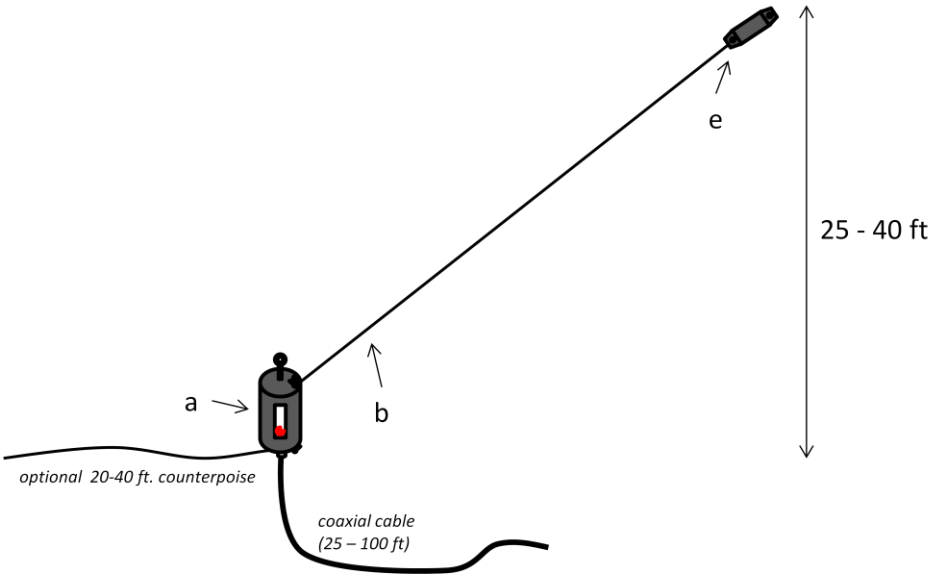

Figure 3. Sloping Wire Configuration.

Site Selection and Preparation.

1. Select a site to deploy the CHA EMCOMM II Sloping Wire configuration. The site must have a supports that will position the end of the Antenna Wire at a height of 25 to 40 feet. If the right support is unavailable, any convenient object, such as a fence post or the top of a vehicle, may be used as a field expedient support with reduced performance.
2. If not already attached, connect a Carabiner (d) to the Wire Connector (f) end of the Antenna Wire.

Connect the Matching Transformer. Refer to figure (2) for steps (3) – (6).

3. Connect the Carabiner from the Antenna Wire to the Transformer Eyebolt (j).
4. Connect the Wire Connector from the Antenna Wire to the Top Transformer Connection (h). Tighten the wing nut finger tight.
5. If using a counterpoise wire, connect it to the Bottom Transformer Connection (i). Tighten the wing nut finger tight.
6. Connect a CHA RFI CHOKE and coaxial cable or the Integrated RF Choke end of the CHA Coaxial Cable assembly to the UHF Socket (g) on the Matching Transformer.

Raise the Antenna.

7. Using a Bowline or similar knot, tie the end of a short length (around 4 feet) of Paracord to the Carabiner from step (3).
8. Drive a Stake into the ground closest to the location of the radio set and tie the Paracord from the Matching Transformer to the Stake using two Half Hitches, or similar knot.
9. Using a Bowline, or similar knot, tie a long length (50 feet or more) of Paracord to the Insulator (e) at the end of the Antenna Wire.

10. Using a throw weight or some other method, loop the Paracord over the other support.
11. Raise the end of the Antenna Wire to the desired height, such that the Antenna Wire is not quite taut, and secure it to the support using a Round Turn and two Half Hitches, or similar knot.

Extend the Counterpoise.

12. If using a counterpoise wire, extend it along the ground in any convenient direction away from the Antenna Wire.
13. Perform operational test.
14. This completes deployment of the CHA EMCOMM II Sloping Wire configuration.

Inverted "L"

The CHA EMCOMM II Inverted "L" configuration, see figure (5), is a broadband short to long range HF antenna. This configuration tends to be unidirectional, favoring the horizontal end of the antenna. It is also provides effective ground waves communication during the day time on frequencies between 1.8 – 4.0 MHz without using sky wave propagation. The Inverted "L" requires two supports and should be mounted at a height of 25 feet for best performance. Though, it will provide good performance at a height of 10 to 20 feet, and is usable when mounted as low as three feet. One counterpoise wire, with a length of 20 - 40 feet, is recommended. If a counterpoise is not used, the coaxial cable must be 25 to 100 feet in length, as the shield of the coaxial cable provides the counterpoise.

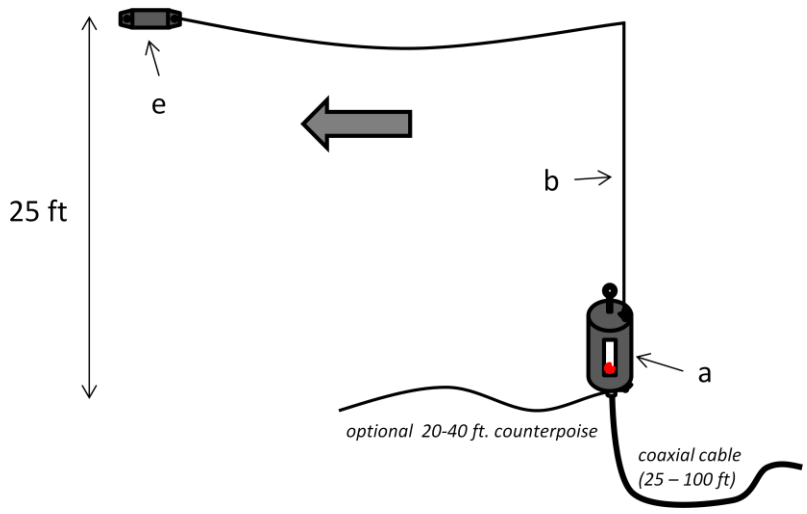

Figure 5. Inverted "L" Configuration.

Site Selection and Preparation.

1. Select a site to deploy the CHA EMCOMM II Inverted "L" configuration. The site must have two supports that will position the corner of the "L" and the end of the Antenna Wire at a height of 25 feet. If the right supports are unavailable, any convenient objects, such as fence posts or the tops of vehicles, may be used as a field expedient supports with reduced performance.
2. If not already attached, connect a Carabiner (d) to the Wire Connector (f) end of the Antenna Wire.

Connect the Matching Transformer. Refer to figure (2) for steps (3) – (6).

3. Connect the Carabiner from the Antenna Wire to the Transformer Eyebolt (j).
4. Connect the Wire Connector from the Antenna Wire to the Top Transformer Connection (h). Tighten the wing nut finger tight.

5. If using a counterpoise wire, connect it to the Bottom Transformer Connection (i). Tighten the wing nut finger tight.
6. Connect a CHA RFI CHOKE and coaxial cable or the Integrated RF Choke end of the CHA Coaxial Cable assembly to the UHF Socket (g) on the Matching Transformer.

Raise the Antenna.

7. Using a Bowline or similar knot, tie the end of a short length (around 4 feet) of Paracord to the Carabiner from step (3).
8. Drive a Stake into the ground closest to the location of the radio set and tie the Paracord from the Matching Transformer to the Stake using two Half Hitches, or similar knot.
9. Using a Bowline or similar knot, tie a long length (50 feet or more) of Paracord to the Insulator (e) at the end of the Antenna Wire.
10. Using a throw weight or some other method, loop the Paracord over the support closest to the radio set.
11. Pull the Paracord and end of the Antenna Wire over the support.
12. Using a throw weight or some other method, loop the Paracord over the other support.
13. Pull the Paracord, such that the Antenna Wire is not quite taut, and secure it to the support using a Round Turn and two Half Hitches, or similar knot.

Extend the Counterpoise.

14. If using a counterpoise wire, extend it along the ground under the antenna wire.
15. Perform operational test.
16. This completes deployment of the CHA EMCOMM II Inverted "L" configuration.

Recovery Procedure

To recover the CHA EMCOMM II, perform the following steps:

1. Disconnect the Coaxial Cable from the radio set.
2. Lower the antenna to the ground.
3. Disconnect the Coaxial Cable from the Matching Transformer (a).
4. Carefully roll (do not twist) the Coaxial Cable.
5. Untie the Paracord from the Matching Transformer and Antenna Wire (b), as applicable.
6. Disconnect the Antenna Wire and counterpoise wire, if used, from the Matching Transformer.
7. Roll (do not kink) the Antenna Wire and secure with a short length of Paracord.
8. Pull the Stakes from the ground.
9. Remove dirt from antenna components and inspect them for signs of wear.
10. Store components together.

Troubleshooting

1. Ensure Wire Connector is securely connected.
2. Inspect Antenna Wire (b) 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.

7. If still not operational, replace Coaxial Cable assembly. *Most problems with antenna systems are caused by the coaxial cables and connectors.*
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, replace Matching Transformer (a).

Specifications

- Frequency: 1.8 MHz through 54.0 MHz continuous (including all Amateur Radio Service bands 160m to 6m). Wide range antenna tuner or coupler required.
- Power: 250 W continuous duty cycle (CW, AM, FM, RTTY), 500 W intermittent duty cycle (SSB and SSB-based digital modes)
- SWR: Subject to frequency and configuration, see red (bottom) line in figure (6).

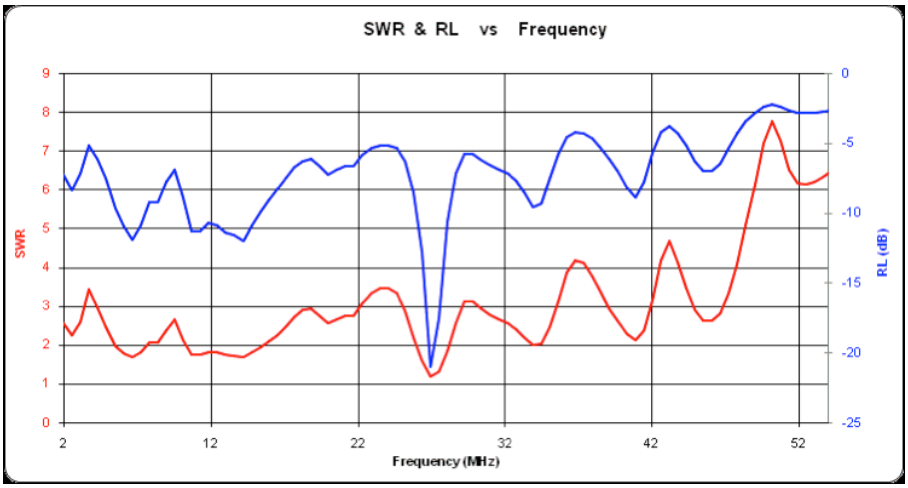

Figure 6. SWR vs Frequency Graph.

- RF Connection: UHF Plug (PL-259)
- Length: 60 ft (maximum) and around 35 ft (minimum)
- Weight: 1 lbs
- Personnel Requirements and Setup Time: one operator, less than 15 minutes.

Accessories

The following accessories are available for purchase from Chameleon Antenna™. Please contact us at support@chameleonantenna.com for current prices and availability.

- **Counterpoise Kit.** The Counterpoise Kit is ideal for portable antenna deployment. The system will create the ground-plane needed to any vertical antennas and will also play the role of guy wires. It contains four 25 foot wire radials secured around plastic wire winders and four steel tent stakes.
- **50' Paracord and Line Winder Assembly.** One assembly is recommended to enable installation of the CHA EMCOMM II.

- **Coaxial Cable Assembly.** 50 feet of RG-58 with integrated RFI Choke. Used to connect the CHA EMCOMM II to the radio set. This is a highly recommended accessory if you are not using a CHA RFI CHOKE.
- **RF Choke Assembly.** The CHA RFI CHOKE will prevent, greatly reduces or totally eliminates the RFI carried by the coax cable. It can be installed either at the antenna feed point or right behind the antenna tuner. This accessory is highly recommended if you are not using the Chameleon Antenna™ Coaxial Cable Assembly.

Recommended non-supplied accessories:

- Wide range antenna tuner or coupler. Required for most configurations.
- Flashlight.
- Multi-tool.
- Throwing weight and string.
- SWR Power Meter.
- Multi-Meter.
- One Tent Peg *(if not purchasing optional counterpoise kit)*
- Mallet.
- 20 – 50 ft. 18 gauge insulated stranded wire to be used as a counterpoise *(if not purchasing optional counterpoise kit)*
- #10x24 stainless steel wing nut. Recommend one for use as a spare.
- Small canvas or nylon bag to store antenna components.

Chameleon Antenna™ Products

The following products are available for purchase at Chameleon Antenna™.
Go to http://chameleonantenna.com *for ordering and more information.*

CHA Zepp - The CHA Zepp Antenna has been specially designed for apartments, condominiums, homeowners associations, deed restrictions and CCRs (Covenants, Conditions & Restrictions), ARES, RACES, MARS, EMCOMM, NVIS, First Responders, Emergency Preparedness and attic antenna installation. It's a true base station or portable stealth antenna.

CHA SKYLOOP - The CHA SKYLOOP is a 250' full wave loop antenna cut for 80M. With the help of an antenna tuner, the CHA SKYLOOP will cover all the bands between 80M and 6M.

CHA HYBRID Vehicular Base - The CHA HYBRID Vehicular Base is designed to enhance the capabilities of the common HF radio application by allowing faster tuning operation across the HF bands including MARS/CAP frequencies. This antenna base has an integral broadband impedance matching network allowing broadband antenna tuning. The CHA HYBRID can be used mobile with the CHA V1L and V2L mobile antennas or stationary with the provided 30' wire.

CHA V1 Mobile Antenna - The CHA V1 antenna is our first and classic broadband HF mobile antenna that we designed. It has been updated from fiberglass to 7075 alloy and stainless steel.

CHA V1L Mobile Antenna - The CHA V1L antenna is a rugged multiband HF mobile antenna that can be erected in a minimum of time and space.

CHA V2L Mobile Antenna - The CHA V2L is a rugged multiband HF antenna designed for smaller vehicles.

CHA VHF/UHF Magnetic Mount Mobile Antenna - The CHA VHF/UHF is a simple but great dual band antenna for 2M and 70CM.

CHA HYBRID-MINI Base - The CHA HYBRID-MINI Base is the portable version of the regular HYBRID. The unit can be differentiated by the color of the lid and the base connector, which is black instead of gray. The HYBRID-MINI is also smaller and about 50% lighter than the regular HYBRID. The CHA HYBRID-MINI Base and a CHA MIL Whip perfectly complements the capability of the CHA EMCOMM II.

CHA HYBRID-MICRO Antenna - The CHA HYBRID-MICRO is a lightweight highly portable broadband HF antenna system designed to offer maximum portability and performance. The antenna weights about 1 lb. The antenna will operate at all frequencies in the 1.8-54 MHz band without any adjustment with most modern external antenna tuners. No masts or guying are required. The CHA HYBRID-MICRO is a great quick deployment backup for the CHA EMCOMM II. The CHA HYBRID-MICRO and a CHA MIL Whip perfectly complements the capability of the CHA EMCOMM II.

CHA MIL Whip - The CHA MIL whip is a broadband (28 to 54 MHz) monopole antenna designed for portable or man-pack radios requiring compact but rugged antenna systems. Its design has been borrowed from similar antennas utilized by many armies all over the world. The CHA MIL is very hardy, sturdy and portable (being collapsible). Un-mounted the entire antenna length is less than 29". The 5 aluminum sections are hold together by a piece of 1/8th inch US GI MIL SPEC shock cord. The CHA MIL Whip and a CHA HYBRID-MINI Base perfectly complements the capability of the CHA EMCOMM II.

CHA MIL EXT Whip Extension - The CHA MIL EXT whip has been designed to offer maximum portability and performance for those already using the portable CHA MIL whip for man-pack antenna system. This collapsible antenna extension needs to be used with the CHA MIL to create a 17'4" long portable antenna. When combined with any HYBRID series antenna bases the CHA MIL EXT will operate at all frequencies in the 1.8-54 MHz band without any adjustment with most modern external antenna tuners.

CHA TD Tactical Dipole - The CHA TD (Tactical Dipole) Antenna has been designed as an add-on for the CHA EMCOMM II. The CHA TD is a HF broadband antenna specially designed for portable HF communication where rapid deployment and simplicity of operation is essential. The antenna will operate at all frequencies in the 1.8-30 MHz band without any adjustment with most modern internal antenna tuners. It is ideal for use in conjunction with modern, digitally configured, HF communication transceivers where features such as ALE and frequency hopping require true broadband capability. No masts or guying are required. The CHA TD can also be used without antenna tuner, as the SWR will stay under 2.5:1 between 10M and 80M and under 2.75:1 on 160M.

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.