α ALPHA ANTENNA®

Manual
for the
DX-Mil (Model 2-30MHZ)
HF Antenna

Manufactured by:
Alpha Antenna
1.888.482.3249

Website: http://AlphaAntenna.com

User Guide Version 1.7

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Table of Contents

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS
If you find any mistakes in this document, or if you know of a way to improve the procedures, please let us know. Mail or email us a marked copy to the contact information on the last page of this manual.

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)
If the antenna needs improvement, let us know. You, the user, are the only one who can tell us what you would improve. Mail or email us an EIR to the contact information on the last page of this manual.

Safety Information

When installing or operating this antenna or any other antenna/tower, please observe the following safety tips. High voltages are present when transmitting, no matter how much or little power is applied. Do not touch any part of the antenna while transmitting.

NOTE – Never Loosen any of the Bolts, Washers, Nuts, or Caps on the match

WARNING: INSTALLATION OR OPERATION OF THIS PRODUCT NEAR POWER LINES IS DANGEROUS! FOR YOUR SAFETY, FOLLOW THE ENCLOSED INSTALLATION DIRECTIONS. THOUGH THIS ANTENNA IS CONSTRUCTED WITH INSULATEDMATERIALS, PROPER CARE MUST BE TAKEN DURING INSTALLATION. INSTALLER ASSUMES ALL LIABILITY FOR PROPERTY AND LIFE SAFETY.

YOU, YOUR ANTENNA, AND SAFETY
Each year, hundreds of people are killed, mutilated, or receive severe and permanent injuries when attempting to install an antenna. In many of these cases, the victim was aware of the danger of electrocution, but did not take adequate steps to avoid the hazard. For your safety, and to help you achieve a good installation, please **READ** and **FOLLOW** the safety precautions below. **THEY MAY SAVE YOUR LIFE!**

1. If you are installing an antenna for the first time, please, for your own safety as well as others, seek PROFESSIONAL ASSISTANCE.
2. Select your installation site with safety, as well as performance, in mind. **REMEMBER:** ELECTRIC POWER LINES AND PHONE LINES LOOK ALIKE. FOR YOUR SAFETY, ASSUME THAT ANY OVERHEAD LINES CAN KILL YOU.
3. Call your electric power company. Tell them your plans and ask them to come take a look at your proposed installation. This is a small inconvenience, considering **YOUR LIFE IS AT STAKE.**
4. Plan your installation procedure carefully and completely *before* you begin. Successful raising of a mast or tower is largely a matter of coordination. Each person should be assigned a specific task, and should know what to do and when to do it. One person should be designated as the leader/coordinator of the operation to call out instructions and watch for signs of trouble.
5. When installing your antenna, **REMEMBER: DO NOT USE A METAL LADDER. DO NOT WORK ON A WET OR WINDY DAY. DO DRESS PROPERLY:** shoes with rubber soles and heels, rubber gloves, long sleeved shirt or jacket.
6. If the assembly starts to drop, get away from it and let it fall. Remember, the antenna, mast, cable and metal guy wires are all excellent conductors of electrical current. Even the slightest touch of any of these parts to a power line completes an electrical path through the antenna and the installer – **THAT'S YOU!**
7. If ANY PART of the antenna system should come in contact with a power line, **DON'T TOUCH IT OR TRY TO REMOVE IT YOURSELF. CALL YOUR LOCAL POWER COMPANY.** They will remove it safely. If an accident should occur with the power lines, call for qualified emergency help **IMMEDIATELY.**

Excess RF Exposure Warning

In the United States, the Federal Communications Commission has established guidelines for human exposure to Radio Frequency (RF) electromagnetic fields. The commission's requirements are detailed in parts 1 & 2 of the FCC's rules and regulations {47 CFR, 1.1307(b), 1.1310, 22.1091, 2.1093}. It is the responsibility of the owner/operator of this device to follow all applicable warnings and precautions regarding human exposure to RF fields.

The FCC Office of Engineering Technology (OET) Bulletin 65, Supplement B, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields directly concerns the use and operations of all Alpha Antenna systems. This bulletin establishes safe operating distances from antennas associated power levels in order to permit the operator and persons who may be impacted by operation to exist in a safe environment. Guidelines for Maximum Permissible Exposure, or MPE, are defined in Supplement B of the bulletin.

IMPORTANT NOTE:
Refer to the above mentioned Supplement B along with FCC OET Bulletin 65, Version 97-01. The information in the supplement provides additional details that are used for evaluating compliance of amateur radio stations with FCC guidelines for exposure to radio frequency electromagnetic fields. Supplement B users should, however, also consult Bulletin 65 for complete information on FCC policies, guidelines, and compliance related issues. Definitions of terms used in this document appear in Bulletin 65. Bulletin 65 can be viewed and downloaded from the FCC's Office of Engineering and Technology's web site at: http://www.fcc.gov/oet/rfsafety

SECTION 1 – Concept of Operation

The Model DX-Mil is a limited space transportable base antenna that operates over the 2 to 30 MHz bands to link wideband HF communications equipment using short range (ground wave), medium range (sky wave), and long haul RF patterns as shown in the Appendices. Rather than using only horizontal polarization, the DX-Mil utilizes both Vertical and Horizontal polarizations to achieve uniform patterns without the need for a ground screen. To enable the wide band operation in a confined space, the DX-Mil reduces gain to eliminate the need for a tuning unit or coupler. Thereby, eliminating unnecessary equipment and reducing risk by reducing points of failure, resulting in an antenna system that is rugged, reliable, and which can be erected by one person in 10 minutes.

Many HF communication systems use vertical whip antennas that are not directional. With these antennas, communications are achieved on very short ranges by ground-wave (surface-wave propagation), and longer paths are achieved by sky-wave propagation. An inherent characteristic of radio-wave propagation, using whip antennas, is the zone of silence (skip zone) between the point where the ground-wave signal becomes unusable and the sky-wave signal starts to become usable (Ref. Radio Amateur's Handbook, Ionospheric Propagation, most editions). Depending upon terrain, ground conductivity, operating frequency, noise levels, etc., ground-wave signals are usable up to about 70 miles over average soil. Also, minimum distances for sky-wave paths, using whips, are generally 200 miles (E-layer) during the day and 400 miles (F-layer) at night.

While the skip zone, described above, severely limits the usefulness of vertical antennas for short-range communications, conditions become even worse in an adverse environment, such as a hilly or forest-type terrain. This occurs because of the restricted range of ground-wave signals in these environments.

The inverse distance field is the field that would be present if there were no attenuation due to the surface over which the signal is propagated. The strongest practical signals occur over seawater.

As the soil conductivity decreases or as the foliage increases, the signal strength at a distance decreases rapidly. The important consideration for communications is not the value of signal level, but the signal-to-noise ratio.

Good ground-wave communications are expected at 25 miles at any time of the day for good ground conditions, and the range may be as much as 100 miles for a couple of hours at midday. However, if the environment is dense forest instead of good ground, the maximum ground-wave communication range may be 1 mile or less.

From the above discussion, it is clear that a skip zone is present when vertical antennas are used. The extent of the skip zone is dependent upon soil conditions. For average environments, the skip zone lies between 70 and 200/300 miles; however, in extreme environments, it may include the range from 1 to 200/300 miles. The skip zone is of a very critical range for most tactical communication systems including man-pack, vehicular, and shelter equipment. If HF communications are to be effective in this range, different antennas and propagation modes are necessary. The DX-Mil addresses those requirements necessitating good communications in the 0 to 300-mile range.

The solution to the short-range communication problem is the use of sky-wave instead of ground-wave propagation on the short paths. This requires radiation from the antenna at very high elevation angles NVIS (near vertical incidence sky-wave). This is accomplished by deploying the DX-Mil vertical element simultaneously with the horizontally sloped elements. Radiation characteristics of the vertical element enhance DX, while radiation characteristics of the NVIS type are achieved through the use of the NVIS element mounted above ground. Such radiation characteristics are omni directional in azimuth and provide an l-hop range of about 300 miles. The antenna gain varies mainly with the ground conditions below the antenna system.

Because it is highly desirable to have minimum height and weight for transportable or tactical antennas, the immediate problem becomes one of determining the minimum effective antenna height required. In order to determine the required antenna height, a minimum acceptable level of performance is established as necessary to permit communications.

The required effective height of the antenna is found by considering the following; when a horizontal antenna is close to ground, energy is radiated in two modes. The desired NVIS mode produces radiation with a maximum in the vertical direction. The undesirable Beverage mode creates a vertical electric field between the conductor and ground, producing vertically polarized ground-wave signal with a maximum pattern in the direction off the NVIS wire end. Due to the proximity of the antenna to ground, this latter mode has an efficiency that is generally poorer than a whip. To negate the undesirable mode, the vertical element is deployed simultaneously with the NVIS element.

The shape of the radiation pattern of the horizontally sloped NVIS element is essentially constant for heights not exceeding one-quarter wavelength. For a fixed height above ground, the amount of the input power radiated proportionately in each of these modes is a function of the relative percentage of the antenna input resistance characterizing each mode. Each of these, in turn, is a function of the height above ground. The total input resistance is that portion due to the NVIS mode as the NVIS height is varied. As the height increases, a larger part of the input signal is radiated in the NVIS mode. These resistances are typical of these encountered over average ground.

For example, an antenna at an effective height of 0.070 wavelengths, places it at about 5 feet at 7.000 MHz. The result of this example enables an effective height for a signal at 0.070 wavelength to be achieved by elevating the horizontal NVIS element so that is mounted between two 5-foot supports where the NVIS element is horizontally mounted, or by a sloping the NVIS element so that it is connected on the top bolt of the Alpha Match and sloped down to the ground in the same manner that a guy wire would be deployed. An advantage of the sloping NVIS configuration is a polarized component that becomes slightly vertical, which produces desired affects at low frequencies and also permits compatibility with the vertical component where DX propagation conditions permit.

Using the above examples, you will be able to derive then that optimum characteristics are exhibited when the DX-Mil is placed at a height of between 5-7 feet. Adding or retracting from the default configuration of this balanced antenna system will change the performance characteristics for the frequencies it is designed to operate.

SECTION 2 – System Overview

Physical Description

Physically this antenna consists of:
1 –Padded Black Case,
1 – 6 foot Anodized Black Steel Tripod (NOTE – Guying the tripod is recommended, and for permanent deployments, a user supplied mast that is 6 feet high can be used),
1 – 2-30MHz antenna.

Equipment Characteristics

Low noise receive characteristics occur due to the entire antenna system being placed close to the earth. This balanced system requires no additional components be added to achieve a gain of -21 dBi at 2 MHz, gain which increases to -3.4 dBi at 15 MHz and above. The VSWR is 2.5:1 or less over the 2 to 15 MHz band, peaking at 3:1 on 19MHz, and less than 2.5:1 from 21 to 30 MHz. At the lower frequencies, the maximum radiation is toward the zenith and the azimuth patterns are essentially omni directional. The antenna is designed for 100 W average and 250 W PEP.

SECTION 3 – Technical Data

Leading Specifications

Leading Specifications and equipment for the Alpha DX-Mil antenna are listed in Tables 1-2 to 1-4. Personnel should become thoroughly familiar with data and procedures contained in the entire technical manual before working on or using the antenna. The antenna system should be guyed when winds are present and a user supplied mast that is 6 feet high is required for permanent deployments.

Table 1-2 Leading Specifications

ITEM	SPECIFICATIONS
Electrical Characteristics:	
Frequency range	2-30 MHz
Polarization	Horizontal and Vertical polarization
RF power capacity (watts)	250 W PEP, 100 W Average
Input impedance	50 ohms
VSWR	3.0:1 Maximum when measured at the antenna, no coax insertion.
Radiation Pattern:	
Azimuth	Omnidirectionnel/Semi-Directionnel
Elevation	Ground wave, NVIS & DX
Physical Characteristics:	
Wind and ice	Antenna survives 100 MPH wind with no ice, when properly mounted on a user supplied 6 foot high mast that is secured in concrete.
Maximum Height erected	24 feet
Minimum foot-print required	60 foot by 60 foot
Minimum Weight	14.00 pounds
Input Connector	Type N

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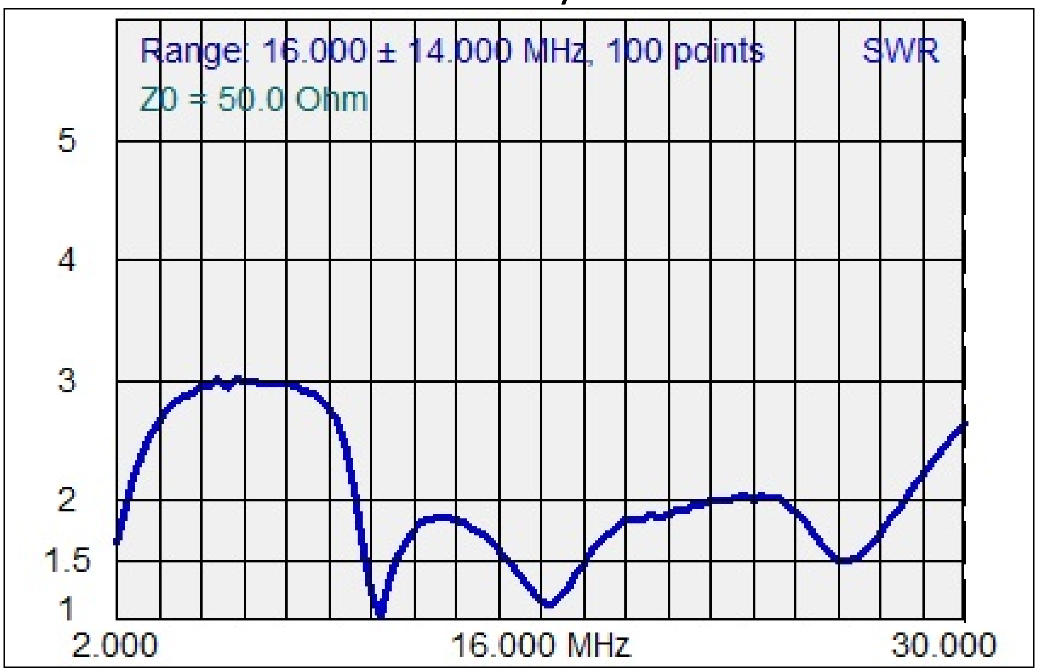
SWR

The following analysis is certified as accurate using a calibrated AIM 4300 from Array Solutions and is checked for redundancy using a calibrated Rig Expert AA-54. Equipment is connected via a barrel connector with no coax. Once coax is connected, operators may find that a choke balun is needed.

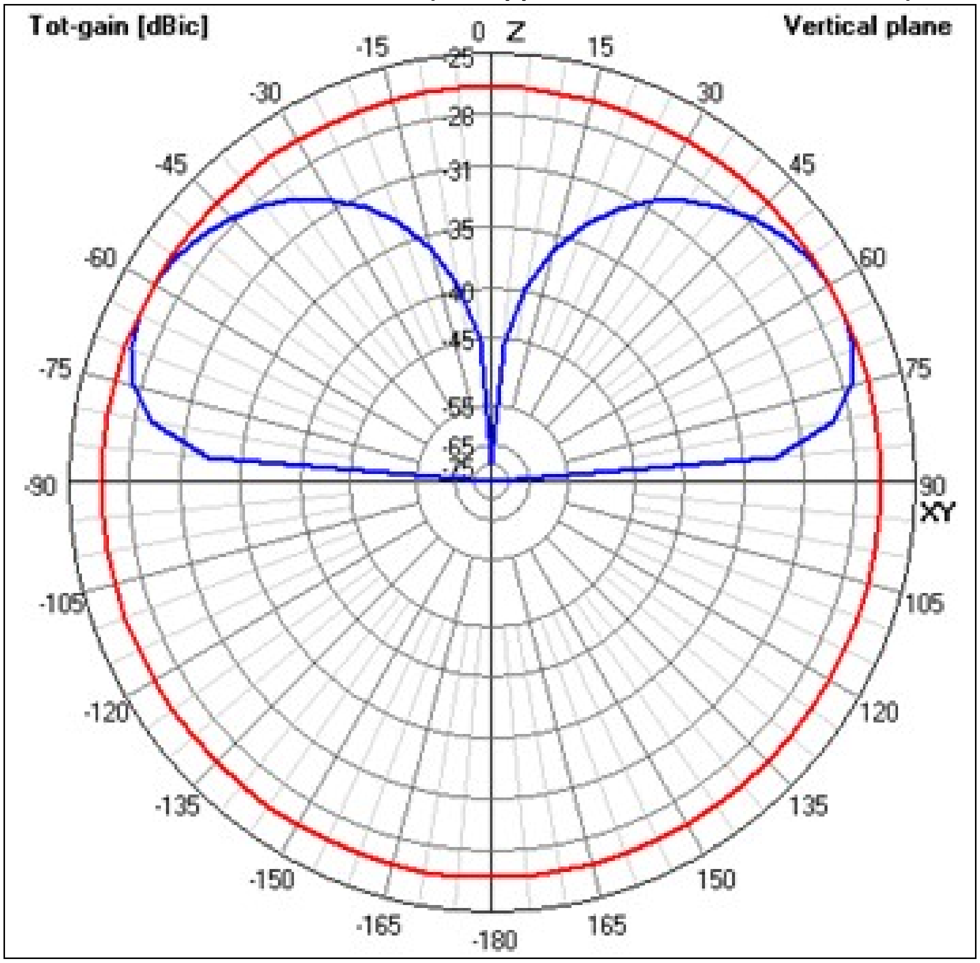
SWR Analysis



Pattern

After deployment, the DX-Mil has four sloped Horizontal wire NVIS element placed at 90 degrees from each other. This placement enables a take off angle that is sloped towards each horizon, and that in turn enables long haul signal patterns. Then the placement of these same elements closer to the ground enables the sky wave pattern when the signals are reflected off the ground that by design is close to the Horizontal elements. The Vertical element then provides the ground wave pattern for the short range component pattern. The Grounded Counterpoise then completes the circuit, by providing a path to ground at the feed-point.

Elevation/Azimuth Pattern (See appendices for additional details)

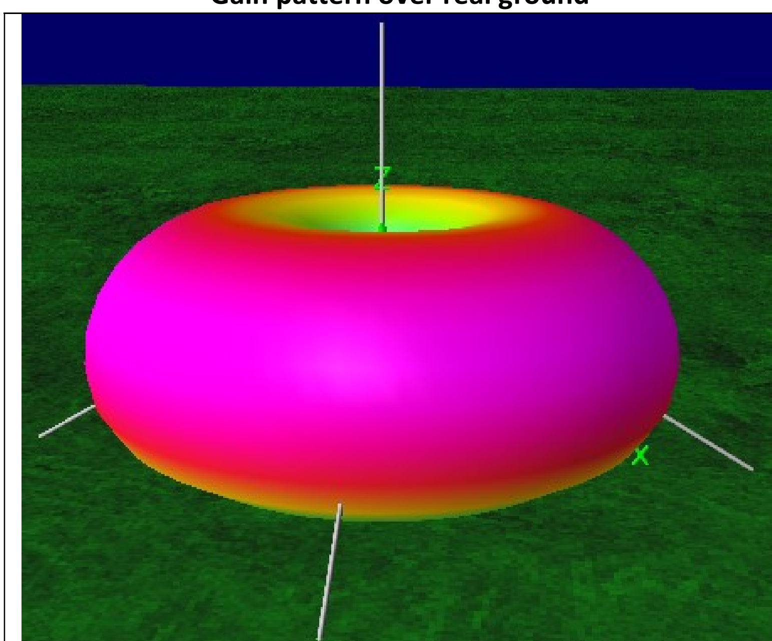


Gain

Gain (directivity) is realized by the placement one Vertical element above the four NVIS elements close to the ground. This enables the combined output to form an onmi-directional pattern. As the antenna has equal gain in all directions, the aggregate results in a negative gain pattern over a dipole. Fortunately, gain does not only come from antenna design. There is also “ground gain”, which can add up to 6 dB of additional gain. Ground gain is signal reflection that is transformed into gain. By rule, horizontal elements achieve a lower radiation take off angle with increased height over the ground, where at great heights the ground conductivity has little influence on gain.

By design, the DX-Mil places both its’ Horizontal and Vertical elements close to the ground to take advantage of ground gain. The results are the gain figures that occur above the Brewster angle, which is where no signal is present and where the ground gain has come from. This angle, and the associated gain, is dependent of the conductivity of the reflecting ground. For example, a greater amount of ground gain would be realized when the antenna is placed over a salt marsh than a desert floor.

Gain pattern over real ground



Frequency (MHz)	Gain (dBi)
2	-27 + 6 = -21
7.5	-15 + 6 = -9
15	-9.4 + 6 = -3.4
22.5	-8.2 + 6 = -2.2
30	-6.5 + 6 = -.5

SECTION 4 – Site Selection

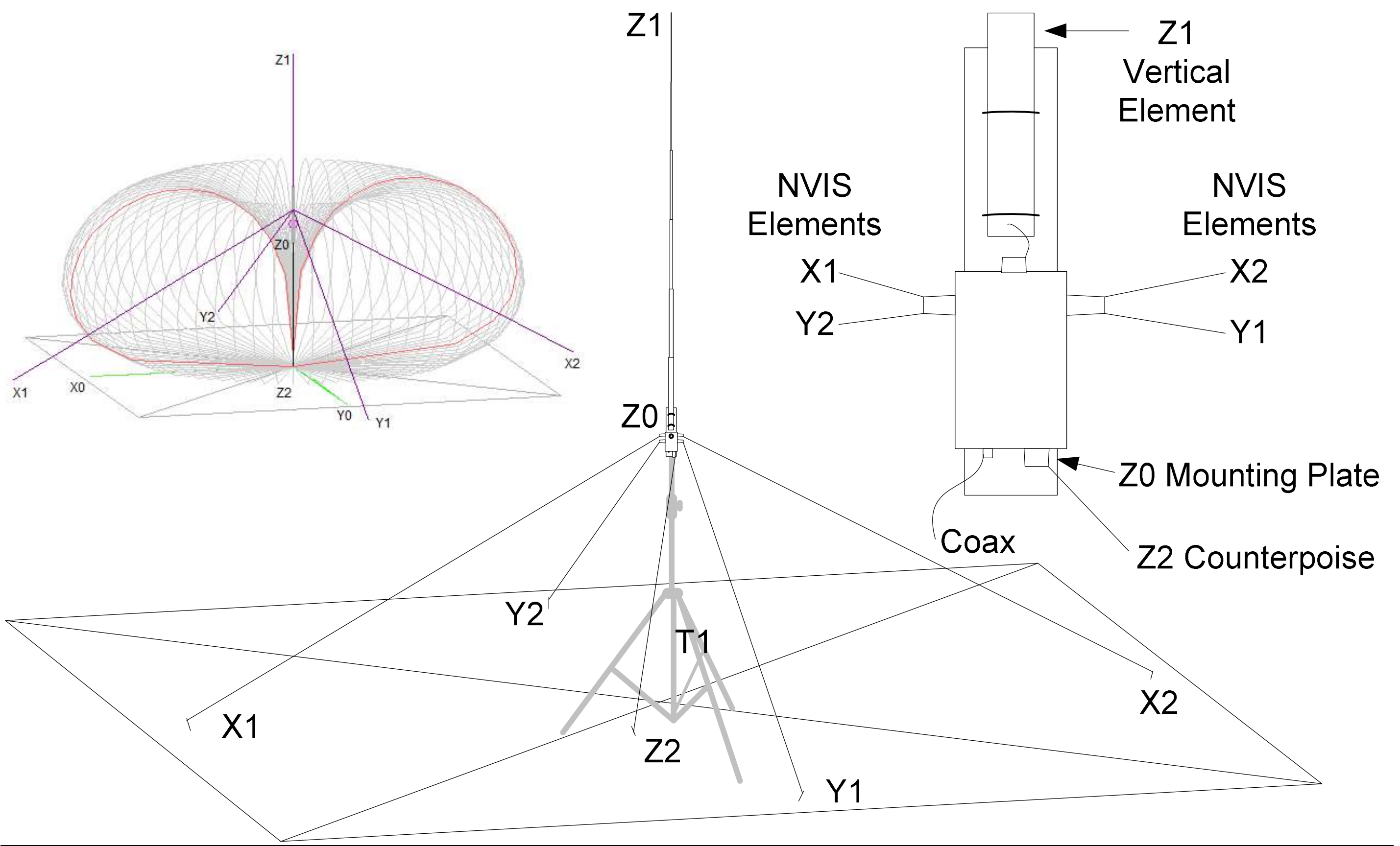
Antenna Placement

For maximum antenna operating efficiency, the Alpha DX-Mil antenna should be placed in the center of a clear area. Installation of the antenna near any tall metal object or under heavy foliage should be avoided. Under no circumstances should structures come in contact with the antenna. A user supplied mast that is 6 feet high is required for permanent deployments.

Appendices

Appendix A – Installation

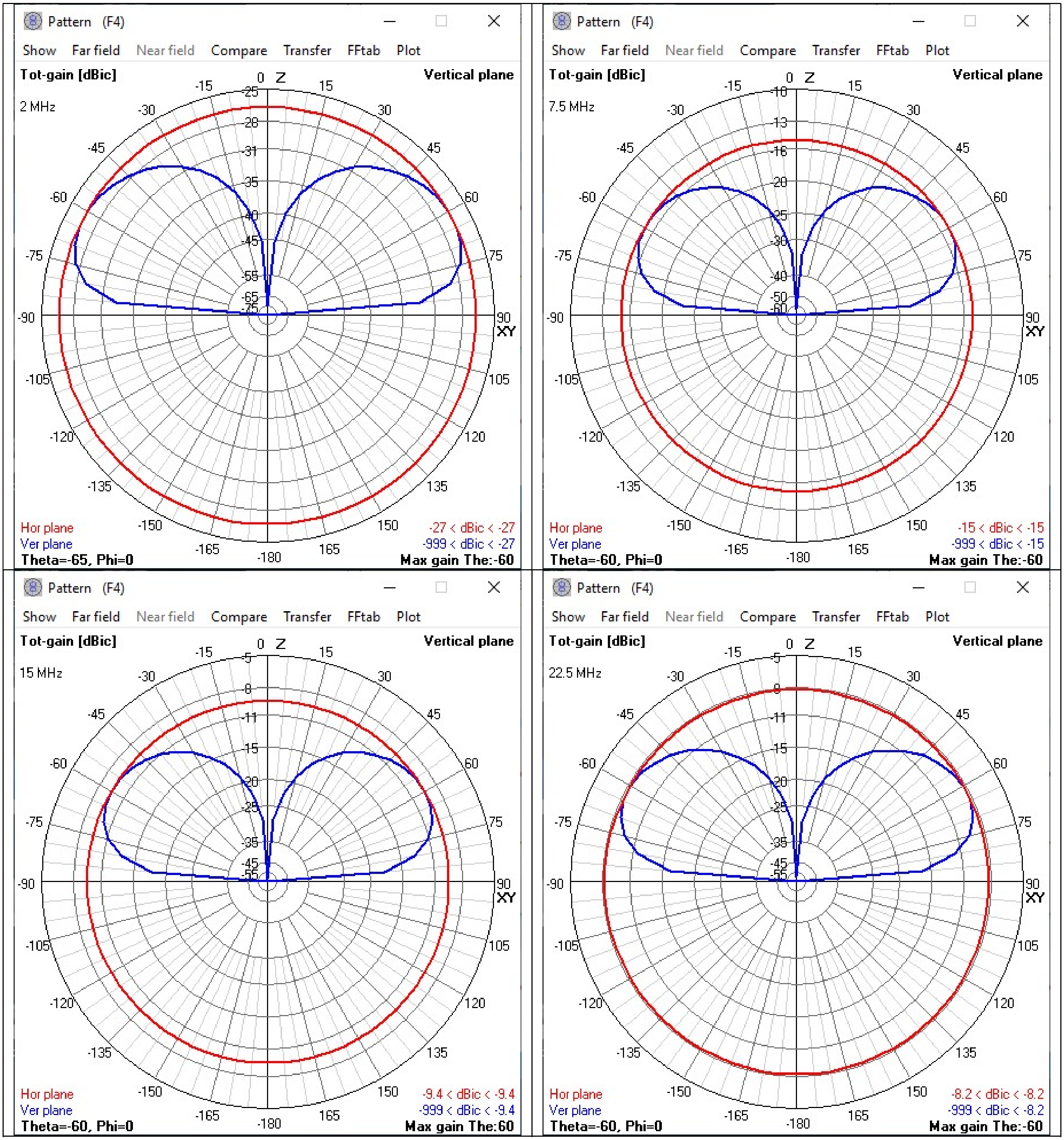
Appendix A.1 – Antenna Fully Assembled

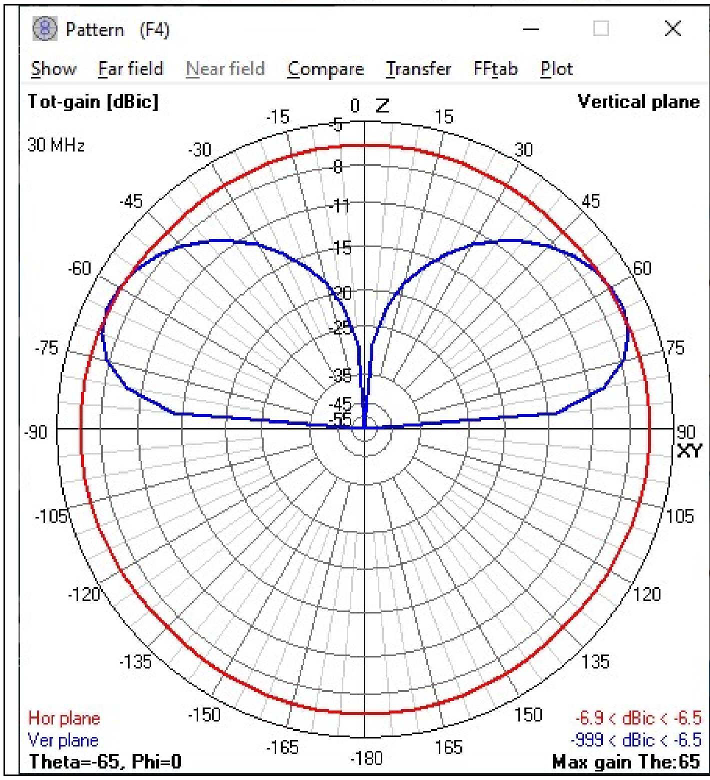


Component Measurements	Components Assembly
Axial radius = 30 x 30 feet Footprint = 60 feet x 60 feet Height = 24 feet Specifics Z0 – Z1 = 18 feet Z0 – Z2 = 6 feet Z1 – Z2 = 24 feet Z0 – X1 = 35 feet Z0 – X2 = 35 feet Z0 – Y1 = 35 feet Z0 – Y2 = 35 Feet Z2 – X0 = 30 feet Z2 – Y0 = 30 feet	T1 = Tripod for temporary or a user supplied mast that is 6 feet high is required for permanent deployments. Y1 = NVIS Element Y2 = NVIS Element X1 = NVIS Element X2 = NVIS Element Z1 = 6 sections of 3 foot each vertical element Z2 = Grounded Counterpoise Z0 = Mounting Plate

Appendix B – Patterns

Appendix B.1 – Elevation/Azimuth Patterns





Stop Patterns

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Support

If you have any questions or problems with your Alpha Antenna, please contact us.

You can reach us via:
Email – support@AlphaAntenna.com
Phone – 1-888-482-3249
Web – www.AlphaAntenna.com

Our mailing address is:

Alpha Antenna
112 East Commercial Street
Pleasant Hill, MO 64080