The VK9GMW SpiderPole Antenna

A Simple All-band Antenna for DXpeditions

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Introduction

VK9GMW, operating from Mellish Reef from March 28 to April 13, 2009, put good signals into both NA and Europe on all bands, including 160 meters. With only a modest solid-state amplifier, the reason for the good signals was the antenna. (It usually is.)

Background

DXpeditions to small islands, or amateurs living on the water-front, can take advantage of the surrounding salt-water to create vertical antennas with impressive performance. The salt water provides an almost perfect ground and allows for very low take-off angels.

The VK9GMW antenna was specifically designed to take advantage of the excellent conductivity of sea-water. The design overcomes the problems caused by the changing tides (which change the feed-point impedance) and it uses light wires that are easily held by a pair of SpiderPoles. The antenna performs well from 160 to 10 meters. The antenna is easy to erect and does not require any adjustments. Dimensions are not critical either.

There is no reason why this antenna could not be installed on land. Adding 32, preferably more, approximately 20 meter long radials to the base of each pole and tying the two bases together, will provide an acceptable ground and an antenna that will work well on all bands. It will not have the low angle radiation that the sea-water based antenna has, but it will work.

Feeding the Antenna

The central component of the antenna is a home built, water-proof, dual output automatic antenna coupler (the coupler has two antenna ports with an internal ANT select relay). The coupler solves the problem of the constantly changing feed-point impedance caused by the changing tides (1.8 meter tides on Mellish). It allows operation on any band, and it provides total freedom of antenna geometry. The same function, or course, could be fulfilled by any weather resistant commercial automatic antenna coupler and an external relay.

In amateur practice, antenna geometry is often dictated by the desire for a given feed-point impedance, such as 50 ohms. A lot of sacrifices are made to obtain this impedance. The use of coupling devices (such as antenna tuners or couplers) is seen as undesirable because of losses and complexity (and cost). I believe that for a portable multi-band antenna the situation is the opposite: a low loss antenna coupler makes things simple and easy! Simple and easy are good things on a DXpedition.

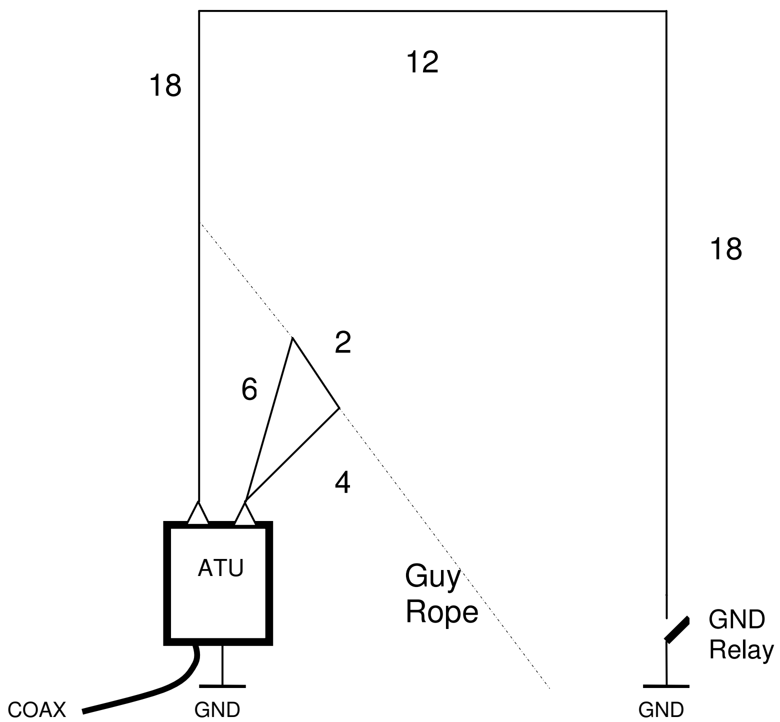
Indeed, there is no reason why the above concept could not be applied to permanent antennas: a low loss, automatic or remotely controlled antenna coupler will give the user a lot of freedom and will match the antenna to the coax on all frequencies. The key is low loss! Especially with short vertical antennas, where the radiation resistance is low, coupler losses can become a significant percentage of the overall loss.

Antenna Configuration

The antenna consists of two arrays of wires held aloft by the two 18 meter SpiderPoles. One array, which consists of three wires, is used on the 160 to 30 meter bands. The other array, which is used on 20 to 10 meters, also uses three wires, which form a triangle.

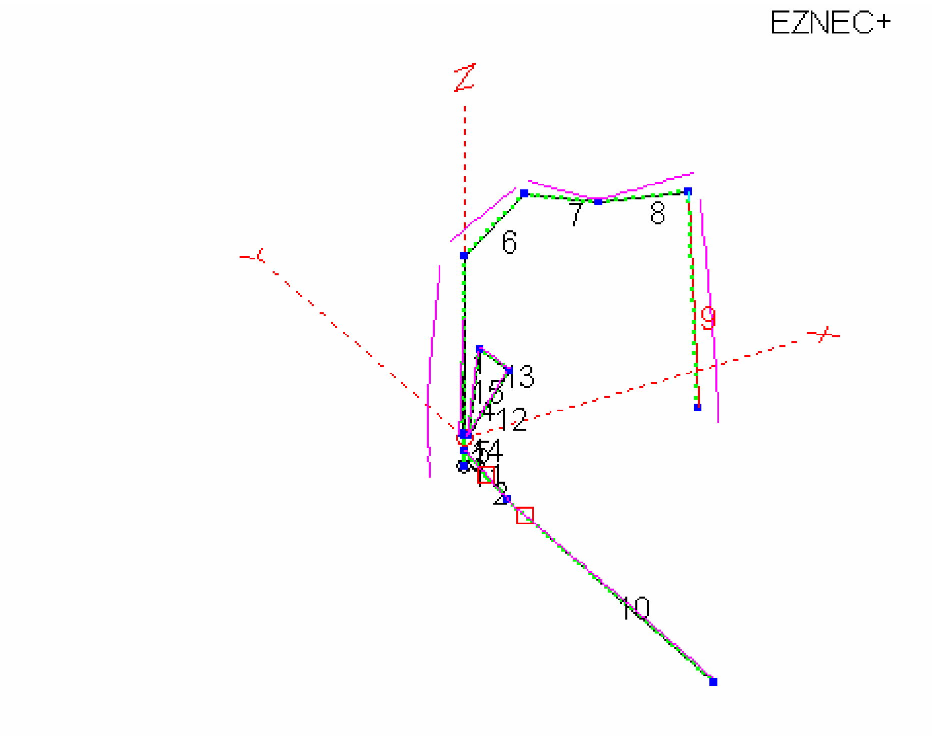
When standing in salt-water, the antenna does not require radials. Grounding is directly into the salt-water via the large metal base of the antenna. Add radials if the antenna is erected on the beach.

The following diagram shows the antenna wires and the dual output antenna coupler unit (ATU). Note that there is nothing sacred about the wire lengths shown. The vertical wires are 18 meters long because the SpiderPoles are 18 meters tall. The length of the horizontal wire connecting the two 18 meter long vertical wires should be around 12 meters, but anything between 11 to 15 meters will work almost as well. The dimensions of the triangle forming the high band radiator are again not important, they are dictated by the desire to have wires that are around 0.3 wavelengths long on 20 and 15 meters (6 and 4 meter long wires, respectively). The third wire (the 2 meter long wire) is there to provide some capacitive loading to keep voltages both at the tuner's output and the wire-ends down. The angle of the wires is dictated by the desire to keep them away from the 18 meter vertical wire and the angle of the guy rope, which holds these wires aloft.



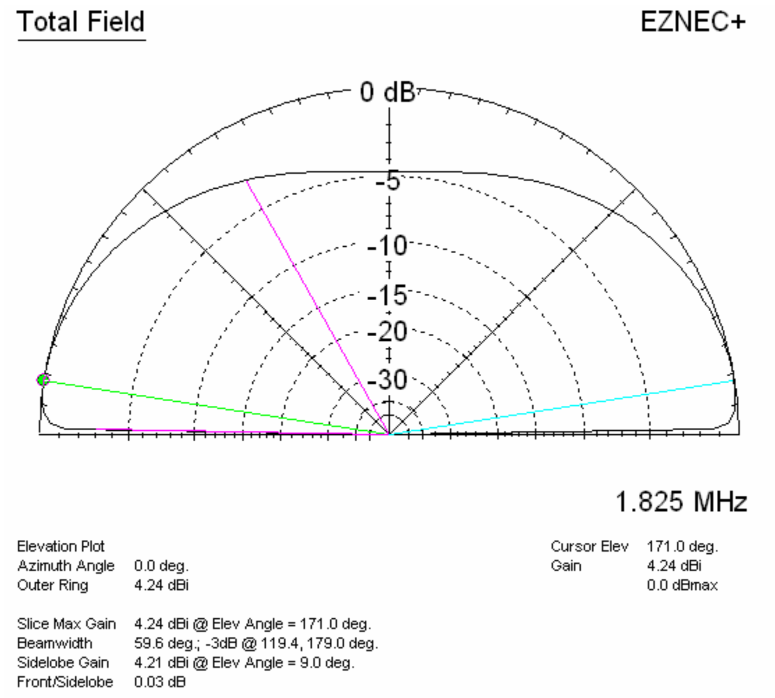
Wire lengths in meters

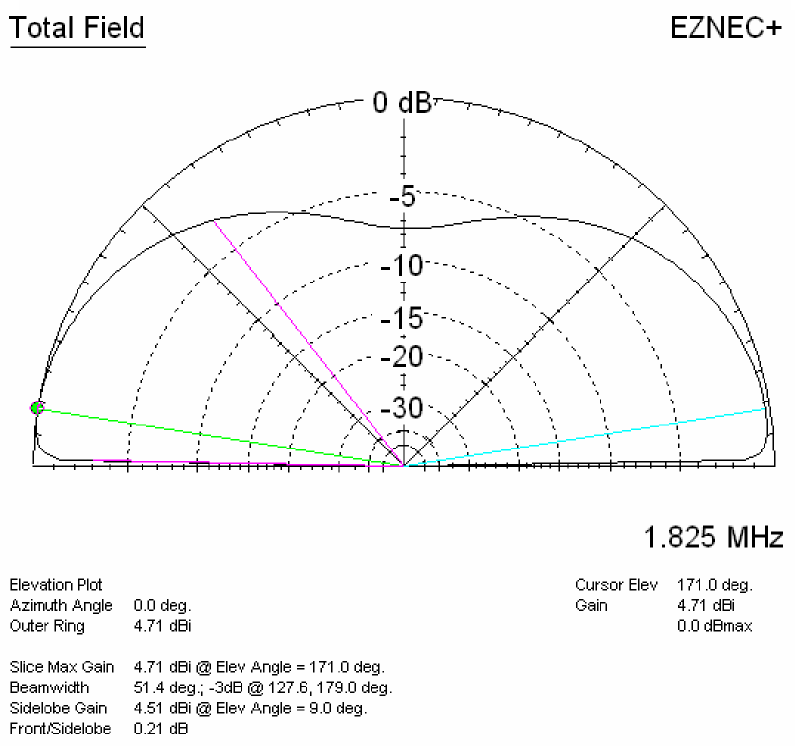
The low band wires are derived from an inverted L. For 160 meters a full size inverted L would consist of an 18 meter vertical wire and an approximately 24 meter long horizontal wire. The problem with this configuration is that on 80 meters it will have very high angles of radiation. This is avoided by adding a second vertical wire (bending “down” the horizontal wire) – and adding between the lower end of the “down” wire and the ground a remotely controlled grounding relay. On 160 meters the relay is open. There will be very little current flowing in the “down” wire and it will have little effect on the overall radiation pattern of the antenna. On 80 meters the relay is energized and it grounds the lower end of the “down” wire. This will result in greatly reduced high angle radiation. (See plots on Page 7.)



Antenna currents at 3.5 MHz with GND relay closed

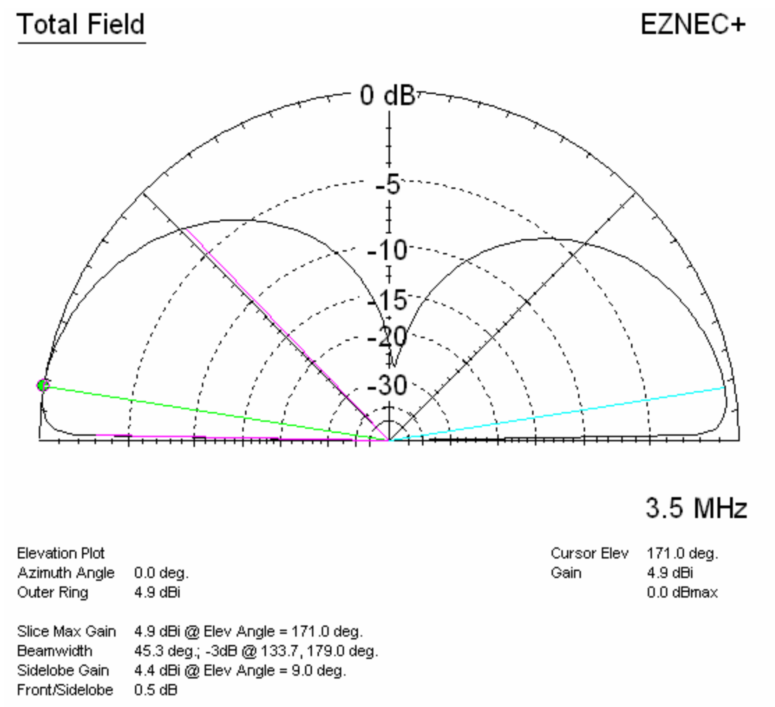
160 meter radiation pattern is very similar to a good inverted L:



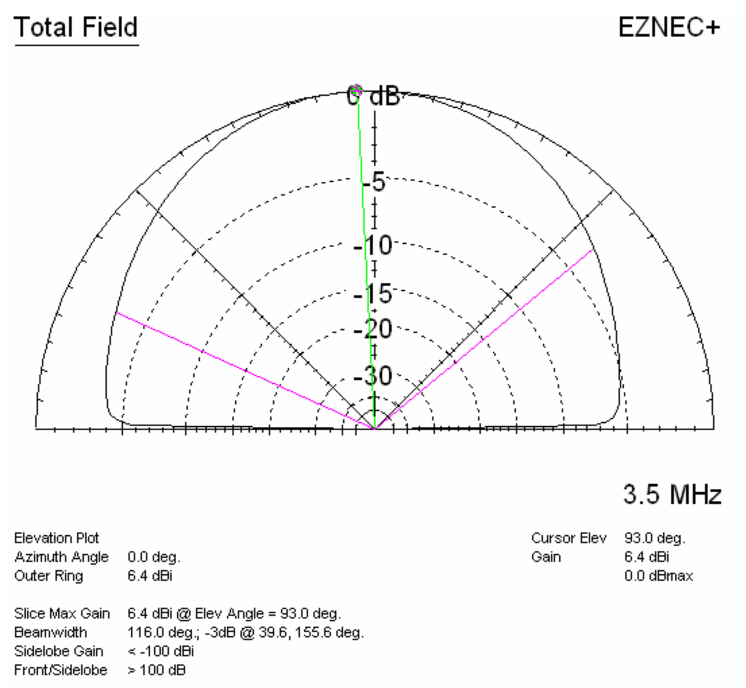


The same antenna with the GND relay closed. Unfortunately, this configuration results in a very high feed-point impedance and extremely high voltages.

The following plots show the antenna’s 80 meter vertical radiation pattern with the GND relay closed and open.

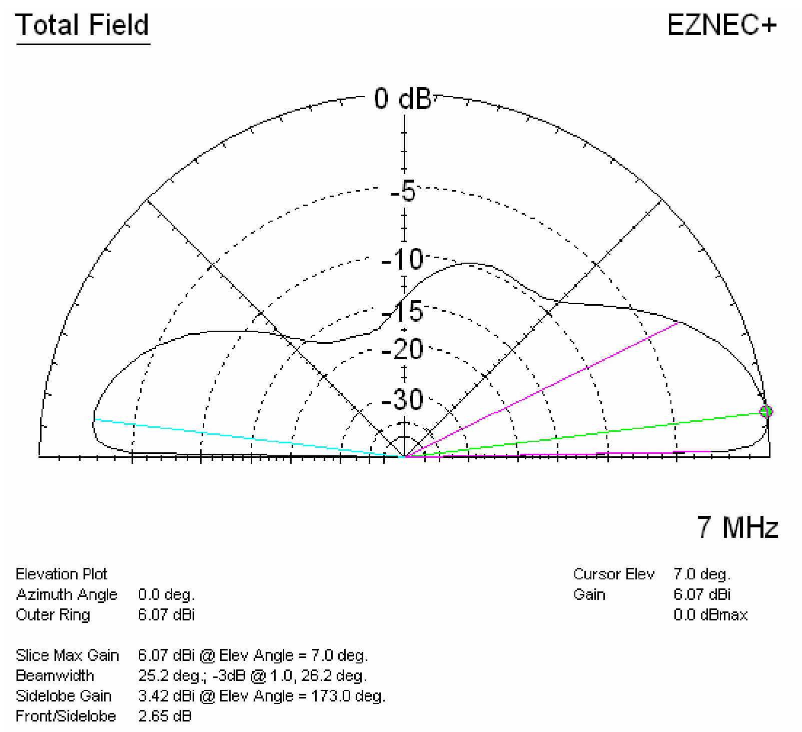


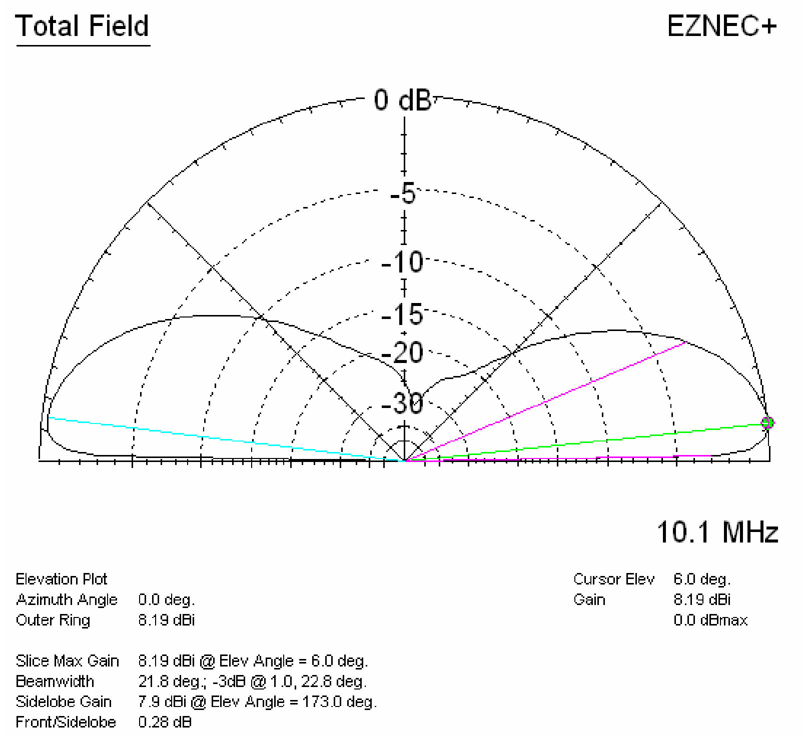
Vertical radiation pattern with relay closed



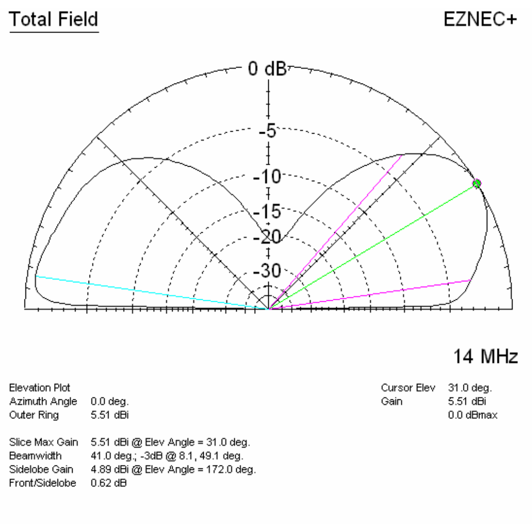
Vertical radiation pattern with relay open

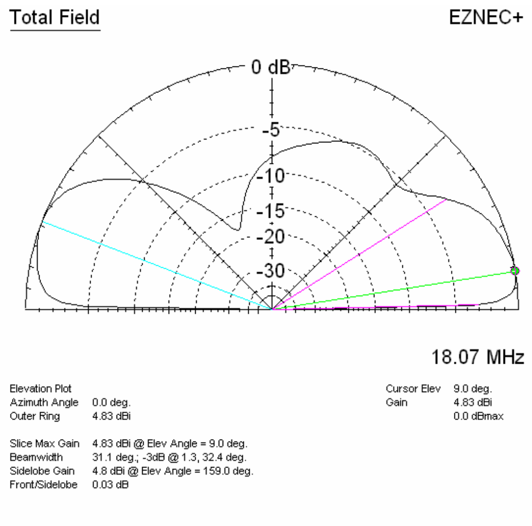
The antenna also performs well on 40 and 30 meters:

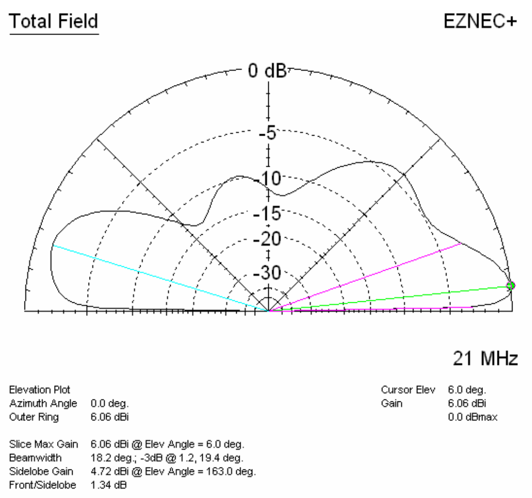


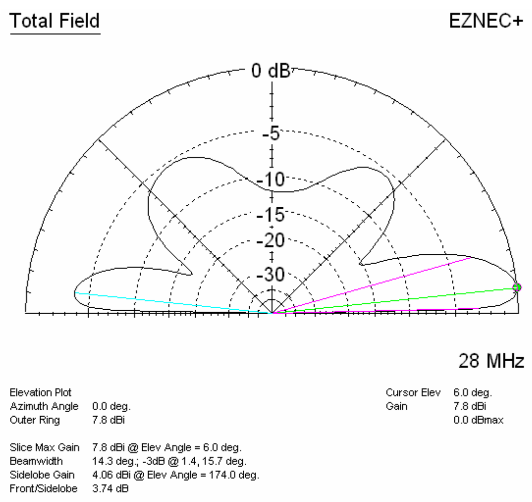


For the bands above 30 meters the antenna coupler output is switched to the second antenna port, feeding the second wire array:





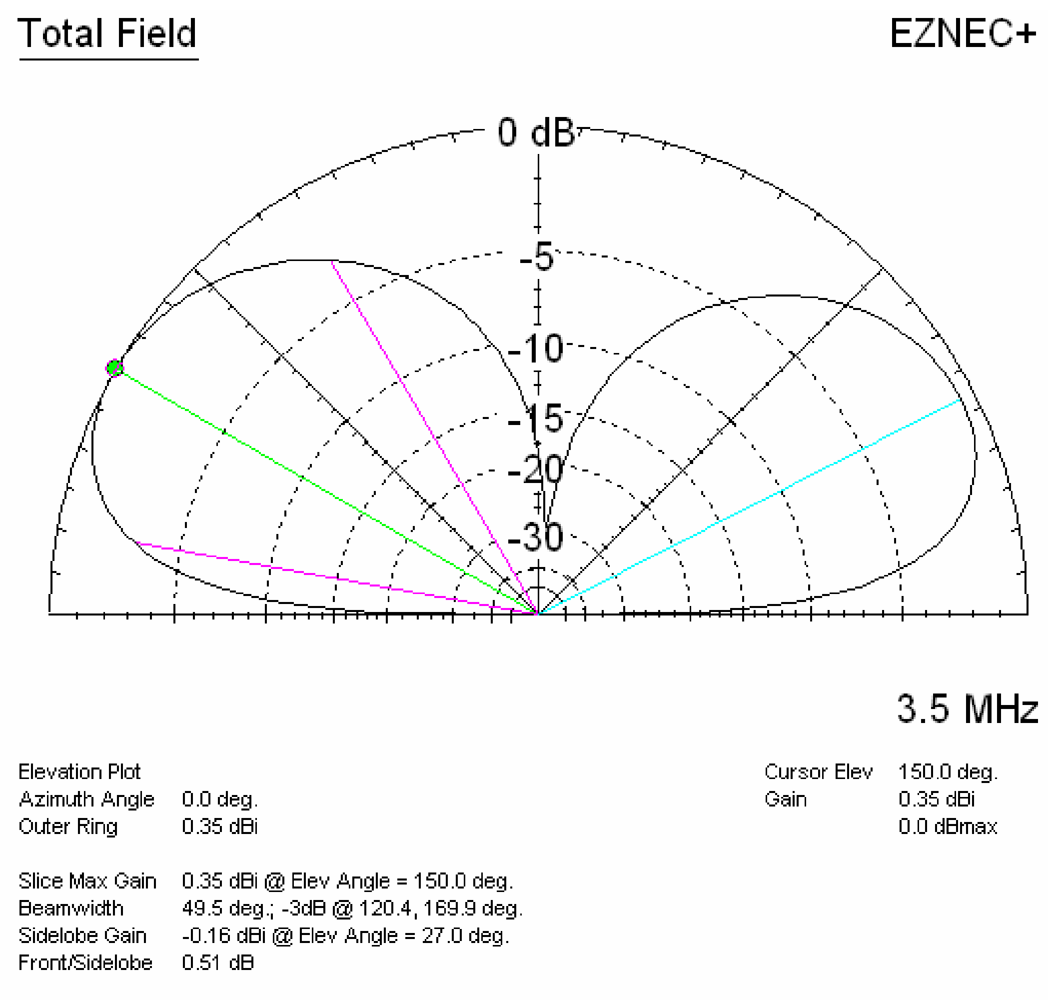




The above patterns were obtained with the GND relay closed. Note that antenna orientation is somewhat important and should favor the areas of interest. (The radiation maximums are towards the X axis, i.e. from the mast with the tuner towards the mast with the GND relay.)

Land Based Installation

The radiation plots in this paper show an antenna of substantial performance on all bands. This is mainly possible because of the sea water it is intended to stand in. On land, with a good radial system, the antenna will still work, albeit with higher vertical radiation angles and gains that are lower by 3 or 4 dB. The diagram below shows the 3.5 MHz vertical radiation pattern with 32 twenty meter long radials.



Vertical radiation plot with 32 x 20 m radials over average ground.

Mechanical Considerations

You can not take an 18 meter SpiderPole and just stick it into the sand! The pole requires some king of a base to stand on. At VK9GMW we used an easy to assemble stand made of aluminum pipes. In addition to providing a stable base, the stand also acted as a ground connection to the sea-water.

18 meter SpiderPole with aluminum base before erection. Note that the fourth leg of the base has not been inserted yet.

The 18 meter SpiderPoles require guying. Three guy ropes should be attached somewhere around the 10 meter point (from the bottom). Set up at a 45 degree angle, they will provide ample support. Do not put tension on the guys! They should be straight but should not exert a force on the pole under calm wind conditions.

Conclusion

The antenna described in this paper is a compromise antenna. When installed over salt water, however, it will perform very well. Although installing an antenna in the sea is made difficult by the changing tides, waves, salt-spray and sometimes difficult access; it is worth it! It is well worth doing the extra work, making thing corrosion resistant and water-tight.