Which is Better--The Quarter Wave Sloper or the Inverted-V Dipole?
A paper by Alpha Delta Communications, Inc.

Introduction

A question that seems to be asked nearly everyday is, “which is best, the quarter wave sloper or the inverted-V dipole”? But, a check of the literature and internet sites reveals very little definitive data. There is a lot of information on propagation, sunspot cycles, wave angles, DX performance, height above ground and data on yagi (beam) antenna stacking. Including which beam heights are best for certain band openings on given bands and propagation conditions.

However, little of it relates to quarter wave slopers vs. inverted-V dipoles. It is obvious of course that an incoming wave impinges on ANY antenna in its path, whether it’s a beam, dipole, mobile whip, vertical or the proverbial “wet noodle”! Also, the characteristics of this wave (elevation angle/polarization) change by the minute, hour, season, global location of the transmitting station from your site (distance) and the sunspot cycle, with regard to which antenna design and site/height above ground is favored at a given moment. It continuously changes. This is true regardless of which antenna type you’re using.

This phenomena is best stated in the 19th edition of the ARRL Antenna Book, Chapter 23, page 25. “You should always remember that it is the ionosphere that controls the elevation angles, not the transmitting antenna. The elevation response of a particular antenna only determines how strong or weak a particular signal is, at whatever angles (or angles) the ionosphere is supporting at that particular instant for that propagation path and for that frequency”.

The foregoing is worth thinking about seriously because in a few words it explains some of the unexplainable frustrations about why your antenna seems better or worse than your friend’s across town at a given time/band, or with the other antenna you just put up. It also reveals why certain antenna heights and designs are not always best for various conditions, bands and distances. In other words, neither the highest nor the lowest height is always best for all signals. A single antenna can’t do that!

The old belief the “highest is best” does not always hold true. It is variable for all the reasons stated above. Now don’t get us wrong---we’re not saying a horizontal antenna 6 to 10 feet off the ground will ever work particularly well. We’re talking about “reasonable” heights on a given band as discussed in the antenna literature.

Test/Site Conditions for our Quarter Wave Sloper vs Inverted-V Dipole

Because of the above stated variables we wanted to test these antennas over the period of many months through different seasons. Indeed, we found that propagation conditions change as predicted.

Our Alpha Delta antenna test site is on a small mountain ridge at 5500 feet above sea level in central Arizona. It is fairly free of surrounding objects except for some Ponderosa pines. The distant horizon can be seen for almost 360 degrees. The ground slopes down for several hundred feet and out for several miles in the foreground.

The antennas were mounted at a height of 40 feet, not because this is optimum, but because it represents a typical “home” type installation for many hams. The sloper was an Alpha Delta Model DX-B quarter wave sloper (sloping to the north) and the inverted-V was a model DX-DD dipole (broadside north and south)---typical of a home based station. We used 80 and 40 meters since those are the most difficult bands for the average ham with a modest station to work DX. It does not represent the height of a “big gun” or contest type station because most hams don’t have that. Those heights and installations are in a whole different world.

When testing any two antennas, there are several things that must be taken into account for the tests to be meaningful. The antennas must be tuned to the same portion of the band, or one will be down compared to the other. They must be oriented so one is not in the field of the other. At the same time, differences in directivity must be taken into account. Not an easy task! In the real world, there will be some interaction, but it must be held to a minimum. Also, quarter wave (half slopers) slopers have very unique installation requirements that must be followed. Check our Web site for that. (Also Chapter 6, pages 30-31, 19th edition ARRL Antenna Book).

Because we wanted to simulate the typical ham environment, we used “s” meter results and transmitting results from various stations. “S” meters are the most meaningful to many hams because that’s what they’re used to. Also, we switched antennas using a Model DELTA-4C coaxial switch console. Hams typically don’t have lab gear. Sure, “s” meters are relatively inaccurate and results vary with QSB and the subjective comments of others. However, over a long period of time (months, years), comparative results will reveal themselves. Antenna purists will have a fit, but this paper is not directed to them. (We know the tech stuff too).

Test Results for the Sloper vs Inverted-V Dipole on 80/40 meters

Slopers are generally known to be good low angle DX antennas, while the inverted-V dipole is generally known to respond to higher angle, regional type signals. This is particularly true at our fairly low 40 foot test height. In order to select the better antenna for your particular needs, you need to consider asking the following three questions. 1. Where you want to talk (distance)? 2. In what direction? 3. At what time of day?

Here is where some unplanned and very interesting results unfolded. From our test site, the inverted-V beat the sloper (with a few exceptions) all the way across the U.S. by one to two “s” units. What we didn’t expect was it also beat the sloper into the Caribbean area as evidenced by many stations in the CQ WW SSB contest during October, 2001(local evening operation). It shows that the higher incoming wave angles from there and the U.S. were favoring the response of the inverted-V. As stated earlier, these wave angles will change based on time of day and distance. You’ll see this when we get into DX results vs time of day.

Just before and during local sun up, many Japan, China and Pacific stations were logged and worked. Here was another surprising result---the sloper this time was exactly the same as the inverted-V. It turns out the incoming signals were multi-hop higher angle signals apparently favoring both antennas equally. During the same period, Caribbean stations were better on the V as before. We could tell it was multi-hop because we could hear and work closer-in Pacific stations who were working the same Asian stations. As further evidence, a Hawaiian station confirmed both our antennas were the same strength at that time.

At sundown and into the evening, things changed dramatically in favor of the sloper. Low angle incoming signals from Europe, Africa and Asian Russia were favoring the characteristics of the sloper---by a wide enough margin to sometimes make the difference of hearing them or not, and the ability to work them. It was fascinating to watch stations from Europe through north Africa kick the “s” meter up a full “s” unit in favor of the sloper. This was a big difference in weak signal, noisy conditions, and was consistent with stations in Belgium, Russia, north Africa, Spain. Portugal, Poland, Finland, France and particularly EA9LZ in Spanish Sahara. He was worked with ease with the sloper showing a consistent 5 dB improvement over the V. The foregoing results were similar on both 40 and 80 meters during the same times of day.

As pointed out in Chapter 6 of the ARRL Antenna Book referenced above, slopers are known to have some directivity in the direction of the down slope with a broad pattern. We observed this with stations in Australia who reported better performance with the V. Australia is pretty much “off the back” of the sloper. When DX stations were within the pattern of the sloper, the sloper was always the same or better than the V as pointed out above.

We have used the DX contest because it’s a convenient example. However, the important thing to know is these results track accurately with our long term comparisons and experiments.

As a result of our research, the next thing to decide is whether you have the room to put up and use both antenna types. If you have a tower with a beam on it and some room in the back yard, it shouldn't be too difficult to do. An inverted-V only requires a single support, as does the sloper. This will add a great deal of versatility to your station.

Conclusions and Bibliography

Even with the exceptions that do occur in antenna testing due to the capricious nature of the ionosphere, there are long term "feelings" derived from testing these antennas. These feelings are found to be fairly consistent over time. Remembering that the antennas at our test site were only 40 feet high we came to these conclusions:

A. Quarter wave slopers are excellent DX antennas when dealing with long haul, low angle signals (typically beyond 3000 miles), and can often make the difference in working a weak DX station. Keep in mind that a sloper is small, being only half the length of a half wave dipole and is easy to install. However, their unique installation requirements must be adhered to with references as stated in this paper. Even with certain higher wave angles, they will "keep up" with the V.

B. The inverted-V half wave dipole is an excellent all around antenna, doing its best work at higher installation heights (40 to 60 feet, or higher). Its response to high incoming wave angles is such that its performance for "stateside" type distances (out to approximately 2500 miles) is excellent. Its directivity at 40 feet didn't seem quite as noticeable as stations "off the back" of the sloper.

C. Keep in mind that the conditions of the ionosphere can change instantaneously favoring a different antenna design at a given moment. It has been said many times, there is no one best antenna, no one best antenna height for all conditions during all seasons and all periods of the sunspot cycle. This is what makes antenna experimentation so much fun, and brings so much enjoyment to the hobby.

Bibliography

Many stations, stateside and DX, were logged and worked over the months during this testing. The results corresponded with the predictions and explanations made in the ARRL Antenna Book, 19th edition. Particular reference is made to Chapter 3, page 14, Chapter 6, pages 30-31 and Chapter 23, pages 13 through 38, particularly pages

23-25. The entire section on propagation is a very worthwhile read for a better understanding of this subject.

Many stations were logged and/or worked during this series of tests. To give you an idea of the regions and some (but not all) of the stations we used for comparison, we thought you would find the following to be of interest.

Central America/Caribbean Area

PJ2/N8V W; AA4V/KP2; CM8WAL; TI4CF; VP2EMS; VP5/WR4K; VP5/K4ISV; 9Y4TBG

European Area

OT1C; RU1A; EA1COZ; CQ7A; SP2FAX; OH2U; RW2F; TM5C

Asian/Pacific Area

T88XE; BA4RF; B4R; JA3AZD; JH5FXP; JA6ZPR; JE4VVM; JH7MQD; JH1RFM; JA3YBK; JR1AIB; JA3YBK; JJ3YBB; JF6OJX; UA0FDX

African Area

CQ9K; IG9A; CT9L; EA9LZ

The above stations were worked and noted for the test purposes. Both 80 and 40 meters were used and the results were similar for both bands in terms of sloper vs inverted-V responses.

Many other stations in Japan, Europe, Australia, Pacific and Indonesia were used for comparative purposes over the months. During the summer months, most Japanese stations favored the sloper by several “s” units. However, with the coming of fall, the two antennas were rated the same, or nearly the same, by Japanese stations.

Again, this shows the changeable nature of the ionosphere and wave angles and the fact that no one antenna at a given height will always produce the best results. Indeed, propagation presents one of the great and fun mysteries of the hobby. Put on your detective hat and go after it!

1/4 Slopers---Here's How To Install It RIGHT!

GENERAL PRODUCT USE
Alpha Delta designs and produces a line of high performance 1/4 wave slopers for limited space installations. For extra reliability, these antennas do not use traps of the traditional type with coils and capacitors but ISO-RES inductors that serve a trapping function. There is no separate capacitor therefore to break down under high RF voltages. All models use stainless steel hardware to accommodate extreme weather conditions. When our antennas are properly installed, tuners are usually not required.

APPLICATION: 1/4 WAVE SLOPERS
Alpha Delta slopers are designed for users who desire effective low band DX performance, but who have limited space installation capabilities. These slopers can be easily attached to existing towers and masts without the need for additional supports. However, please note the unique installation requirements explained in the following sections. While 1/4 wave slopers are only about half the size of regular 1/2 wave dipole, their installation requirements are very different than a dipole for proper SWR and operational performance. The 1/2 wave dipole when mounted in the clear is essentially a self resonant antenna and relatively easy to tune. However, a 1/4 wave sloper relies on three important additional factors for proper "no tuner" operation and lowest SWR.

1. A 1/4 wave sloper is essentially an "up side down" vertical where the traditional radials are up in the air over the high feed point with the radiating element sloping downward. In actual practice, these "radials" are actually the elements of a HF beam antenna and this beam is referred to as the "capacity hat" for the sloper. In addition, the sloper feedpoint must be at least 4 to 5 feet below the beam for proper decoupling. The tower or support must be clear of unbroken guy wires, other wire antennas or near by metal objects such as gutters, rooftops, or metal fascia.

   If a 1/4 wave sloper is put on a tower without the "capacity hat" on top, tuning will usually be difficult and will exhibit high SWR. In this case, a sloper can perform well but a wide range antenna tuner will be required.

2. Since a 1/4 wave sloper is essentially one half the size of a regular 1/2 wave dipole, the "missing part" of the sloper is made up by the ground return path through the tower or metal mast. If a nonmetallic support or a crank-up tower is used, it will be necessary to provide a " down lead" wire from the sloper bracket to the ground. This "down lead" wire should be 12 gauge or better and attached to a ground rod. Also, to decouple RF currents from the coax you should wind six or eight turns of the coax at a diameter of approximately 6 inches at the feedpoint. A common practice is to secure these turns with electrical tape.

3. Sometimes when a sloper is installed in what seems like an ideal situation, the user still finds a relatively high SWR. Our Customers have reported that to correct this situation it has been necessary to install additional ground rods or radials at the base of the tower due to poor RF ground condition. After doing this, they report normal SWR bandwidth results.

PRODUCT DESCRIPTION: 1/4 WAVE SLOPERS
Alpha Delta provides two 1/4 wave slopers---the model DX-A twin sloper and the model DX-B single wire sloper. Both models are designed to meet varying installation space requirements.

Model DX-A Twin Sloper
This model is designed to provide broad band characteristics by having two separate slopers driven from a common feedpoint. One sloper wire is about 67 feet long and resonates on 75/80 meters.

The other sloper wire utilizes an ISO-RES inductor and resonates on both 40 and 160 meters. The 40/160 wire has an overall length of about 55 feet. The two wires should have an included angle of 90 degrees or more. When installed, this configuration looks like and inverted “V” dipole but must meet the installation requirements noted in the previous sections. Broadband characteristics are accomplished by dividing the ham bands across two separate sloper wires. This model can be used at installation heights of 35 feet to 40 feet or more.

Model DX-B Single Wire Sloper
When dimensional and space limitations do not permit the use of the model DX-A twin sloper, the model DX-B provides a space saving option. The antenna is a single wire utilizing two ISO-RES inductors and an under slung parallel wire with stand-offs for operation on 160, 80, 40 and 30 meters. The overall length of the model DX-B is about 60 feet. Since the ham bands are divided by ISO-RES inductors instead of separate sloper wires, the antenna is more narrow band than the model DX-A and should be used with a tuner. Our customers report excellent DX performance with this antenna at heights of 35 feet to 40 feet or more above the ground. This model must also conform to the installation requirements outlined in previous sections.

FEATURES AND BENEFITS: 1/4 WAVE SLOPERS
When installed properly, a 1/4 wave sloper provides a significant antenna solution for those desiring excellent DX performance on the low bands where space does not allow for full size 50 OHM antennas. Sloper lengths are typically 60 to 67 feet long for bands covering 160, 80 and 40 meters. You will recall that a full size 160 meter dipole is 260 feet long, an 80 meter dipole is 130 feet long and a 40 meter dipole is 66 feet long. These compact small size slopers perform with an excellent DX punch across all these bands. The primary reasons for excellent sloper performance are:

1. The current lobe which defines the radiation efficiency is up high at the feedpoint and away from surrounding objects such as trees, bushes and buildings which could attenuate the signal. Comparatively, vertical antennas have a feedpoint at ground level and the current lobe therefore, can be attenuated by surrounding objects.

2. The angle of the sloper wire provides a favorable propagation angle for DX signals. It is generally thought that a dipole would have to be up in the air much higher than a sloper to provide the same level of DX performance.

3. The effect of the “capacity hat” above the sloper provides an efficient loading and SWR characteristic for a small physical size.