Bravo-5K

5 Amateur Band Vertical Dipole

20-17-15-12-10 meter bands

Manually Tunable to any frequency 13.7–30 MHz

www. n6bt .com
P.O. Box 1859 Paso Robles, CA 93447
e-mail to: tom@n6bt.com

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OVERVIEW and PRODUCT HISTORY

Congratulations on your purchase of a next generation antenna by N6BT. In this case, it's a next generation vertical dipole, the Bravo-5K.

The Bravo series has some important, fundamental improvements over older antennas. One is that it is designed to be the lowest cost to you, the customer. There are no "frills", such as powder coating (besides, its an insulator), no anodizing (its also an insulator) and no added cost for a balun – use what you already have, such as your own 1:1 balun, ferrite beads, or coaxial RF choke. Keeping it simple, it uses easy-to-find compression clamps for section coupling, designed to be mostly field-repairable if need-be, coax attachment is easily accessible, basically "plug and play" and the highest efficiency possible. In simple economic terms, "The most bang for your buck!"

The Bravo series is another development by Tom Schiller, N6BT, who founded Force 12, Inc. back in 1992. He brought about a whole new generation of antennas back then, including the

first trap-less tri-band Yagi, multi-band Yagis of many variations without traps, new verticals and vertical dipoles. After producing about 24,000 antennas, he took a break and started a new venture in 2010 – n6bt.com – and the next generation of antennas was begun. After designing about 200 production antennas over the years, holding several radio patents, being an active DXer and contester with more than 20 world records individually and with Team Vertical, one would expect something new. Here it is.

Team Vertical began in 1997 and re-wrote the book on vertical antennas using creativity, empirical testing, plus building and using in competition more than 300 verticals. Much of the Team's history is contained in N6BT's latest book, Array of Light Third Edition 2010. One of the antennas that was developed with the Team and used to set many records on 40 and 20 meters was the called "Sigma" vertical dipole. It was given that name because it was the sum of what N6BT knew about verticals at that time. Now after a break of a couple years to distil thoughts, the Bravo-7K is the next generation – a vertical dipole that is not only improved mechanically and visually, but also performance-wise.

The Bravo-5K is capable of being tuned to any frequency between about 13.700 MHz and 30 MHz and the materials provided will do most of that. It can be loaded more heavily to operate farther down in frequency and can also be physically shortened to operate above 30 MHz. This range covers 5 amateur bands: 20, 17, 15, 12 and 10 meters. You might also find that when set for 10 meters, it might also operate on 6 meters, too. The Bravo-5K is close to being physically and electrically full size on 15 through 10 meters. The word, "close" is used because the radials are loaded slightly for 10, 12 and 15 meters, although the vertical section is not. The antenna is overall physically short for 17 and 20 meters, so it is loaded using high-Q coils in both the radials and the vertical section for these two (2) bands.

BASIC DESIGN PRINCIPLES and FEATURES

How to describe the Bravo series has been a bit of a challenge and the best description is that it is a vertical dipole with asymmetric feed and compressed length tubing radials. The last part first: vertical dipole.

A full size, straight vertical dipole is basically a half-wave dipole turned vertically and fed in the center, just like it would be as a horizontal dipole. In the horizontal configuration, it has a feed impedance of about 70 ohms, depending on its height above ground. In the vertical position, it has a feed impedance of around 90 ohms, giving a VSWR to 50 ohm coax of about 1.8:1. Nobody likes that very much, as the VSWR isn't that coveted 1:1, so we shorten the length to move the feed impedance down to around 50 ohms. This is done in collaboration with the vertical section and the radials. Since there is no end loading at the top (no cross bar at the top of the vertical portion), the Bravo vertical section is made longer than one that is top loaded. This new Bravo vertical section is mechanically and visually superior, while maintaining the performance characteristics of the top loaded vertical dipole.

The two (2) tubing radials are shorter than full size and the appropriate length to have a 50 ohm feed impedance on the higher bands for the vertical dipole is made up in the vertical

length selection. The tubing radials are loaded on all bands, although very slightly on 10 and 12 meters. The feed point is, therefore, not at the center; therefore, it is asymmetric. The loading in the radials and the loading in the vertical section are also not identical.

Putting the above together into the next generation, the Bravo-5K has these improvements over the previous designs:

a) mechanically
   __single vertical element without the top end loading bar, making this antenna easier to build and erect, with less wind loading and, therefore, stronger in bad weather, without the tendency to rotate in the wind (as often happens with the top end loading cross bar);
   __safety-tilt radials slope downward from the main hub. The slight slant catches one's eye, so it is easier to see and less likely to bump in to;
   __the tri-pod was always an option, but not any more – it comes with the antenna
   __box containing the loading coils has a weather-sealing gasket
   __box cover is easily removed to change bands and friction can hold it in place
   __stainless hardware is used where it should be used
b) electrically
   __feed point is at the bottom, right where you want it
   __the feed line can now be dropped straight down – no more sloping off at a 45° angle
   __all loading is right at the bottom, within easy reach
c) performance
   __efficiency is a on the order of 92% on 20 meters, increasing rapidly on 17 and being about 98-99% on the higher bands
   __actually has slightly more gain than the older series with the top end loading bar.
d) cost – low cost and field repairable are major design goals
   __the "most bang for your buck"
   __use your own 1:1 balun, ferrite beads, or coaxial RF choke at the feed point (no need to pay for what you probably already have available)
   __simple, easy to get compression clamps
   __no need for powder coated or anodized parts
   __keep it simple

The Bravo-5K is set up close to full size (slightly loaded radials) on 15-12-10 meters. Some loading is via a coil in the radial line on 10 and 12, plus stray inductance from the leads in the coil box. For 15 meters, the inductance used on 10-12 meters is in the radials and an additional coil is inserted for 15 meters in the radial section. For 17 meters, another small coil is added in the radial line (total 3 coils: 10/12 + 15 + 17) and a coil is also placed in the vertical line. On 20 meters, another coil is added in the radial line, plus another pair (one very small, one larger) in the vertical line.

There is one, common matching device for all bands. There is a hairpin matching coil placed across the feed point terminals. This is mainly for the lower bands (e.g. 20 and 17), but remains across the feed point for the higher bands. When it is adjusted for 20, it has some affect on 17, but minimal affect on the higher ones.

SPECIFICATIONS:
Overall height will all vertical sections = ~11'
Overall radial length with all sections = ~6.5'
Weights: vertical sections = 2.0#, radials (2) = 2#, hub = 1.5#; tri-pod = 2.5# Total = 8#
VSWR on all bands is 1.3:1 or less at resonance
Power rating = 1500w CW

Computed efficiency:

	Efficiency %	Total Loss in the Antenna
10 meters	99+%	-0.01dB
12 meters	99+%	-0.01
15 meters	99 %	-0.03
17 meters	98 %	-0.07
20 meters	95+ %	-0.19dB

Please be aware that there are emission exposure limits set by the FCC. All ground-based antennas will emit more energy at "people" level than elevated ones. Since this antenna is probably going to be used at ground level and possibly close to people, be careful to keep the power level as low as practical.

It is rare that a fixed-size antenna can cover more than 1 octave with reasonable efficiency. An octave means a doubling or halving of a particular frequency, such as 14-30 MHz, or 7-14 MHz. In general, a multi-band antenna will be full size at its highest frequency and then loaded from there on down. This antenna has adjustable lengths to get it close to full size on 15 meters and, along with its various loading coils, can maintain excellent efficiency over one octave: 14-30MHz.

Some might like to add more inductance to the antenna to reach another octave lower, namely 40 meters, or possibly 30 meters. This can certainly be done, although the efficiency will drop considerably on 40, especially since it will be extremely difficult to maintain high Q in the coils. The calculated results for coil Q's of 600 (doubtful) and 300 (more likely) are as follows:

		Coil Q	Efficiency %	Total Loss in the Antenna
30 meters	10.110 MHz	600	86%	-0.62dB
30 meters	10.110 MHz	300	76%	-1.15dB
40 meters	7.200 MHz	600	68%	-1.67dB
40 meters	7.200 MHz	300	51%	-2.85dB
40 meters	7.025 MHz	600	66%	-1.79dB
40 meters	7.025 MHz	300	50%	-3.02dB

The above is to point out that if this is tried, the low efficiency and resulting loss will be dissipated primarily in the coils. Since 3dB is half power, the minimum power going up in heat

will be at least half of the power to the antenna when the calculated loss is 3dB (7.025); therefore, is it suggested to run at reduced power. The feed impedance will also be very low and a hairpin matching coil will be required across the feed point connections. A coil of perhaps 4 turns, 2" in diameter would be a place to start. The dimensions are not critical. If the best VSWR is obtained with the turns compressed, then add a turn. If the best VSWR is obtained with the coil expanded to maximum, remove a turn. Note: if you wind other loading coils and a hairpin coil for this antenna, wind them in the same direction as the existing coils.

Let's put it together……..

ASSEMBLY

1. TOOLS and PARTS REQUIRED

____ A. Tools required:

1) blade screwdriver for compression clamps
   a) can also use nut drivers on the compression clamps
   b) they will be the #6 (1/4" dark red) and #8 (3/16" orange)
2) nut driver for #10 nuts (3/8" – blue handle)

____ B. Other

1) tape measure

__Note – for portable use, a tri-pod leg or the first section on the radial (the .625" section) can be calibrated for the various measurements you will need. The maximum is measurement anywhere is 33" and either of these is longer and handy.

____ C. Hardware

1) The majority of the hardware is stainless steel, except possibly for some of the components in the compression clamps. They are available in all stainless steel for harsh environments.
2) The tri-pod contains screws and nuts that are plated, not stainless.

____ D. Coax and feed point balun of some kind

1) Coax should be 50-ohm, such as RG-8X, RG-58, RG-8
2) To keep the product cost as low as possible, this antenna is shipped without an included balun, without ferrite beads to go on coax cable, or a pre-wound coaxial RF choke, as many customers already have one of these.
3) The coax can be attached to the two (2) feed point screws in several ways:
   a) carefully split the coax into the shield and center conductor and attach the shield to the left-hand screw and the center conductor to the right-hand screw. There are lugs provided.
   b) the coax can have several ferrite beads on it for a balun
   c) the coax can be wound into a coil of about 4 turns, close to the feed point, which is a coaxial RF choke

SET-UP

2. ANTENNA AND TRI-POD

____ A. This antenna has been fully assembled and tested before shipping
1) all the compression clamps are in place on the sections of tubing
2) the tubing sections are telescoped inside each other
3) the coils inside the coil box have been pre-set
4) the hairpin matching coil is already across the feed point screws

____ B. Please follow the tuning chart that gives the tubing length settings and coil box jumper positions for the band you want to operate on
1) Snug the compression clamps to secure the sections – just enough so the section(s) won't slide, or turn
2) No need to "crunch" the clamps.
3) Nut drivers are the best method for managing the compression clamps
4) Using a spray lubricant, such as WD-40 or Tri-Flo will aid in keeping the sections easy to move. WD-40 will disappear over time and needs to be replenished.
5) if you are in a salt air environment, spraying the entire antenna with WD-40 can protect it from the salt deposits. WD-40 is not a conductor. "WD" stands for "water displacement."

____ C. Your particular installation is most likely not like our test facilities, so the antenna might not be exactly on frequency using the included chart.
1) Please follow the frequency adjustment procedure later in this manual and use the lower portion of the chart to write your own section lengths.

____ D. Insert the three (3) tri-pod legs into the tri-pod.
1) The legs are not secured, as gravity will normally keep them in place.
2) If desired, the legs can be taped – remember to make a "flag" as the last part of the tape so you can easily pull the tape off and not have to search for the end.

____ E. Loosen the compression clamp on the tri-pod and slide the antenna into the tri-pod.
1) The compression clamp can be left loose, or tightened.
2) Tighten the clamp just enough so that the antenna won't swing around.
3) On the other hand, perhaps allowing the antenna to swing in a slight breeze would be useful. Remember that the antenna is not directional.

____ F. The antenna is now ready to be set for the desired band of operation.

3. CHANGING BANDS, SETTING THE ANTENNA ON A BAND

____ A. The compression clamps can be loosened at the first vertical section to easily insert or remove the vertical portion.

____ B. Follow the chart to set the tubing lengths for the vertical and radials, plus the

jumper(s) inside the coil box

____ C. The hairpin matching coil across the feed point screws is primarily used for matching 20 meters to 50 ohms. It has much less affect on 17 meters and almost none on the higher bands.

1) The hairpin can be compressed or expanded to improve the match on 20/17 meters.
2) On other frequencies other than the antenna is set for, the hairpin coil will probably still do a reasonable matching job.

____ D. The coil box cover can be left off if desired

1) there is a gasket for the coil box cover to assist in weather-sealing
2) there are (4) screws for the coil box cover for permanent installations
3) place the gasket and screws in a safe place you can find when you want them

____ E. There are many combinations of radial lengths and vertical lengths that will "work" for the bands. The ones provided are those that have given a good match and efficiency.

____ F. If the frequency of lowest VSWR on the band in use is not where it is desired

1) If the VSWR is low enough for the equipment (usually less than 2:1), use it as is
   a) just because the VSWR is not the ideal 1:1 does not mean the antenna is not working efficiently. All it means is that the Bravo 5K is not matched on the desired frequency – unless it is on the wrong band, of course.
   b) to the other side, just because an antenna (not this one) has an ideal 1:1 does not mean it is working efficiently, as inefficient antennas and dummy loads give "great" VSWR's.
2) to move the frequency of lowest VSWR UP, one can either:
   a) shorten either the vertical portion (preferred), or the radials; or,
   b) if there is a coil associated with the band, expand the turns on the coil
      1. be careful on changing a coil, as they are in series and might affect other bands that are lower in frequency
3) to move the frequency of lowest VSWR DOWN, one can either:
   a) lengthen either the vertical portion (preferred), or the radials; or,
   b) if there is a coil associated with the band, compress the turns on the coil
      1. be careful on changing a coil, as they are in series and might affect other bands that are lower in frequency
4) remember to update the settings on the drawing for future use.

4. WHAT IF

____ A. What if the VSWR is way high, like 3:1 when I hook it up?

1) Most likely this is a coax feed line problem. Check for continuity through the coax connectors and be sure the shield and center conductor are not shorted somewhere.

____ B. What if when I use a meter to check tuning, I can't get it to work right?

1) Meters, like the popular MFJ, can have a couple conditions where they are not useful.
2) Meters send out their own, very low power signal and read the "return." If there happens to be additional RF nearby, such as from AM broadcast, the meter might be completely ineffective, as it will also receive the Rf from the broadcast station. This is because the meters normally have a wide-open front end and receive everything.
3) On the MFJ dual meter device, people will sometimes use the righthand meter that is calibrated in ohms to tune an antenna. They will move the tuning knob until the meter reads 50 and then read the frequency, plus reading the VSWR on the lefthand meter. The lefthand meter will more often than not, read a high VSWR. This is an incorrect procedure.

   a) Use the lefthand meter only to tune an antenna. Tune the knob carefully and slowly, looking for the dip in the lefthand meter. Set the tuning for the lowest point in the meter's reading and you will have both the frequency of the antenna and its associated VSWR at that frequency.

5. COMMONLY ASKED QUESTIONS

____ A. Do I need to change the antenna to go on another band?

To listen on another band, you can use the antenna on whatever band it is tuned for. It will not be as effective (i.e. sensitive) as when it is properly tuned.

____ B. Can I use a tuner with the antenna?

Sure – on receive it is fine.

On transmit, you can use a tuner, but please do not run high power, as the expected high voltage points in the antenna will not be as designed.

Using a tuner on either receive and transmit will not be as efficient as when the antenna is properly tuned.

6. HOW CAN I USE THE BRAVO 5K ON FREQUENCIES OTHER THAN THE AMATEUR BANDS?

There are three (3) frequency adjustments on the Bravo 5K:

1) the radial lengths
2) the vertical portion length
3) the coils inside the coil box

All the above can be used together to move the frequency of the antenna up or down. Changing the vertical portion will move the antenna a fair amount. Changing the radial lengths (equally) will not change as much as the vertical portion. Changing the coils for 20 can move the antenna a long way. If you want to move below the bottom of a band for MARS work, the antenna might already be fine and well within the VSWR handling capabilities of your equipment.

Extending the tubing sections on the vertical and radials (both radials equally) can move the antenna lower on a given band; however, if they are already extended, then adding more coil to move farther down will need to be used. Changing the jumpers on the coils for radials and the vertical can also be used to move the frequency up or down.

Shortening the tubing sections on the vertical and radials (both radials equally) can move the antenna much higher and probably not require changing coils.

The "K" in the product name implies an antenna "kit" that can be utilized by you for many purposes. As mentioned previously, there are many combinations of radial and vertical lengths that can be "discovered." Add to that the loading possibilities for the radials and the vertical and this is an incredibly versatile antenna.

WHAT CAN I EXPECT IN TERMS OF PERFORMANCE?

Vertical antennas installed not far above ground will have a single energy lobe coming off at about 20 degrees. If the vertical antenna is installed over salt water, or very close to it, this energy lobe will be lowered considerably, with energy now down to about 1 degree, which is as good as it gets. Horizontal antennas, even stacked Yagis, cannot compete with verticals and vertical arrays over salt water. This antenna has a small footprint and will perform quite well when properly installed. It is the product from almost 20 years of using vertical antennas in world-wide competition by Team Vertical. As mentioned earlier, the Team has set more than 20 world records and re-wrote the book on verticals.

The ground under the vertical can be improved, especially when it is installed over sand or rock (granite is quite poor). Laying wire down underneath the antenna in length as long as practical and as many wires as practical, will improve the ground conductivity in what is called the ""near field." This is the area closest to the vertical and is where the most loss in the ground will occur. Improving the ground will reduce these ground losses, with improved system performance and even a lowering of the lobe. "System performance" includes the antenna and the ground. The efficiency of the antenna itself will be constant, so improving the ground conductivity pertains to the ground portion of the system.

Q: How is a vertical compared to a horizontal antenna, such as a full size dipole (e.g. not a Windom, which is more of a top loaded wire vertical)?

Vertical antennas over ground will do a good job, especially considering their small footprint. A good, full size dipole at a reasonable height and in the clear will often be more effective than a vertical. The dipole will favor the stations off to the sides, because the dipole is directional. A vertical is omni-directional, meaning it emits and receives energy equally in all directions.

Q: How can I get more gain, or can I make this into a beam?

You most certainly can. The Bravo 5K is ideal for making into a phased array, or a parasitic

array. Please contact us for details.

SHORT EXPLANATION OF ANTENNA PRINCIPLES

Verticals over ground will lose some energy into the ground, which is why the ground should be as good as possible; good = electrically good and a metal roof is quite nice for this purpose. Salt water is incredible. In a different manner, the horizontal antenna will gain energy from ground effects, called "ground reflection gain." In practical terms, a horizontal dipole will achieve about 2dB gain compared to the isotropic source (properly stated 2dBi) due to the pattern being made into a figure 8 when the dipole is above ground. The side energy of the dipole, however, is reduced in order to achieve this 2dBi improvement.

If we begin with what is called the "isotropic radiator" (strictly theoretical), it is a sphere, with a single point source of energy located exactly at the center. It is emitting energy equally in all directions until it runs out – which is the skin of the balloon. It is also located out in "free space" and looks like this photo:

The horizontal antenna is, of course, not located in free space, but over ground. This causes the energy in the balloon to be redistributed like the next photo. As you can see, the balloon has been reformed, with more of it in 2 directions, which are broadside to the dipole. There is less energy where Tom's fingers are squeezing the balloon, which is in the direction of the ends of the dipole. By the ground effect of redistributing the energy, the dipole has 2dB gain over the isotropic source. This is known as 2dBi – 2dB compared to the isotropic source.

The horizontal will also benefit from ground reflection gain on the order of 5dB. This is the effect of reflected energy combining way out, in the "far field." If the vertical were perfect, in terms of not losing any energy to the ground, but still being over ground, the vertical will be about 7dB behind the dipole (2dB + 5dB). The take-off angle of the antennas comes into play here and although a single vertical will typically be less than a good horizontal antenna, adding a second element to the vertical will improve its performance by about 4dB and make it a directive array, as well.

ANTENNA PLOTS

There are several pages of computer antenna models in this manual. Each page contains much information concerning the probable performance of the Bravo 7K vertical.

If you are interested in adding a second element for an array, or making a larger array, please send off an e-mail. We will be glad to assist you.

We can also provide information for you on your DXpeditions.

Thank you for selecting our product and let us know how it performs for you!

----------NOTICE----------

BE SURE THIS ANTENNA DOES NOT COME NEAR TO, OR IN CONTACT WITH POWER LINES, AS YOU CAN BE SERIOUSLY INJURED OR KILLED.
BE AWARE OF OTHER DANGERS AND ALWAYS CHECK THE AREA MORE THAN ONCE BEFORE ERECTING ANY ANTENNA.

Supplier: www. n6bt. com Warranty and Limitation of Liability

The supplier warrants its products for a period of one year from date of purchase. This warranty covers defects in manufacturing and workmanship. The supplier has the discretion of honoring the warranty if the product appears to have been abused, used in a manner that exceeds the specifications of the unit, or a use for which the product was not designed. This warranty does not cover transportation, installation, punitive, or other costs that may be incurred from warranty repair, or installation. The supplier must be notified and warranty repair authorized (only by the supplier who will issue a return material authorization, an RMA) before the supplier will accept any product returns. Please advise the date of purchase, model number, serial number if there is one and a brief description of the problem. There is a 30% restocking fee on products returned unused with an RMA issued by the supplier, at its sole discretion.

The customer, installer and user of these products individually and collectively acknowledge that these products can cause injury or death and individually and collectively accept full responsibility and liability for any and all personal and property damage (direct, indirect and punitive) caused during installation and/or use of these products and hold the supplier harmless for such damage.

(warranty notice date 4/1/2010)

The Bravo Series

How it got here.
(page 1 of 2)

What makes the Bravo the "Next Generation"?
One item is low cost -- it is easy to add cost into a product and very difficult to keep it low while maintaining performance. For example -> no expensive powder coating, which is an insulator and impossible to repair in the field.
Another is the basic design -- it is a new one, developed from more experience with Team Vertical over the past 2 years (2008-2009). It might be mistaken for what looks like a ground plane type vertical. A ground plane, of course, is a 1/4 wavelength vertical radiator fed against a pair of 1/4 wavelength radials. A quick look at the Bravo will show this is not the case. A ground plane vertical also has a feed impedance in the low 30-ohm range and the Bravo design is much higher, in the 50-65 ohm range for the full size Bravo's.

The vertical portion on the Bravo is fed at the bottom and the "radials" are fed at their common junction. If this were a typical, full size 1/4 wavelength vertical, the unmatched (native) feed impedance would give a VSWR of about 1.6:1. A full size Bravo, on the other hand has a native impedance over 50 ohms. It also has a vertical portion longer than a 1/4 wavelength and has a pair of "radials" that are much shorter than 1/4 wavelength. They are loaded at their center, with the result that the Bravo requires much less installation space. I Put the word, "radials" in quotes, as they are not the best words to describe them, but they are the most convenient. They are not, however, a conventional type, as they are loaded, sloped and made of tubing. Maybe we should invent a new word for them in the Bravo design.

Let's take a couple steps back --
The previous generation before the Bravo was the "I" style and it was developed to be mechanically simpler to build than the "ZR" series vertical dipole. The original ZR specification was to have a high efficiency vertical without radials. It was composed of a vertical section and loaded at both ends using tubing in the shape of a square - an open-ended loop. It was built in single band designs and also a 20-15-10 meter model. They looked like this:

A single band ZR for 20 meters that is 6' tall. The feed is less than 50 ohms and is matched with a simple hairpin.

A original 20-15-10 mtr ZR at is 6' tall. This is 1500 watts mobile in the CQP sitting in Butte County.

A set of (4) 40 mtr ZR's are assembled and ready to be set up in Jamaica for Team Vertical who set a multi-op CQWW CW World Record.

The ZR's were built for amateur and commercial, with long term commercial testing documenting their high efficiency. Unfortunately, they were very difficult to manufacture, so over the years, more design work and experimentation led to the testing by Team Vertical of a new that we later called the "Sigma" series. It also was a center-fed vertical dipole, but the upper and lower loading square tubing loops were replaced by single horizontal bars, later dubbed, "T-bars." The full size models were set for 50 ohms and the shortened, loaded ones were matched with a simple hairpin. The photo at the right is the first set used, once again, in Jamaica and another record was set. The Sigma series was also built for amateur, commercial, plu smilitary applications. Frequencies covered from HF through UHF. Survival ratings were to 200mph and power ratings were to 10KW CCS.

The large size of the Sigma for 80/75 meters is what began the development of the asymmetric feed. This was about 36' tall, plus the base, making the center feed and loading point a long way up in the air. The feed point was moved downward, making it within reach on a tall ladder, but it created a small current imbalance of about 5% for the balun/RF choke to handle; it was a fair trade.

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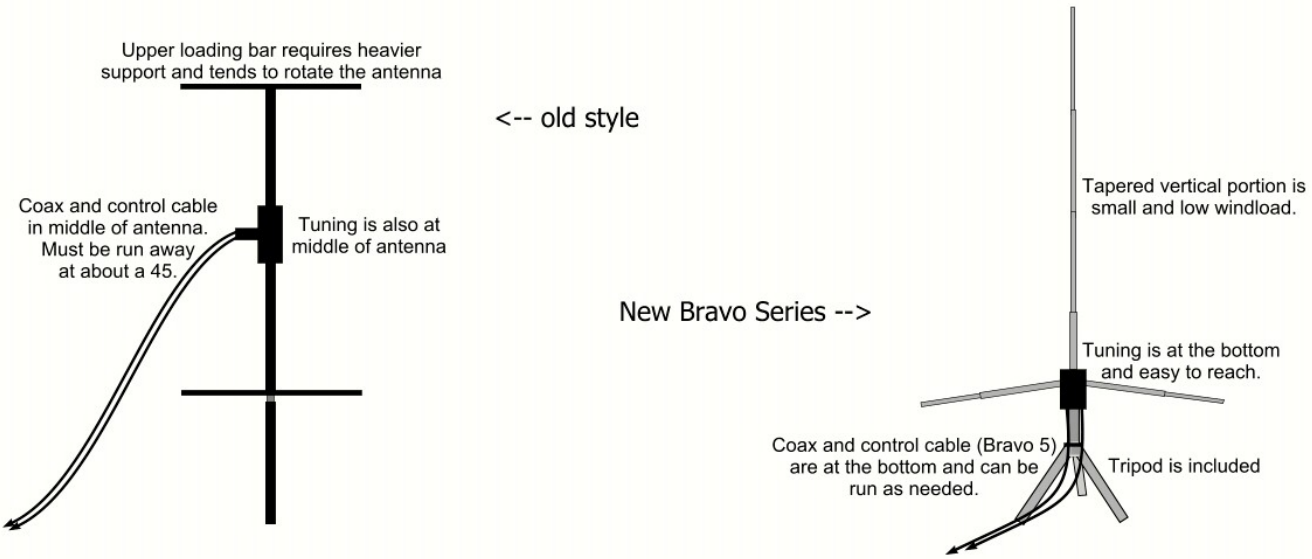
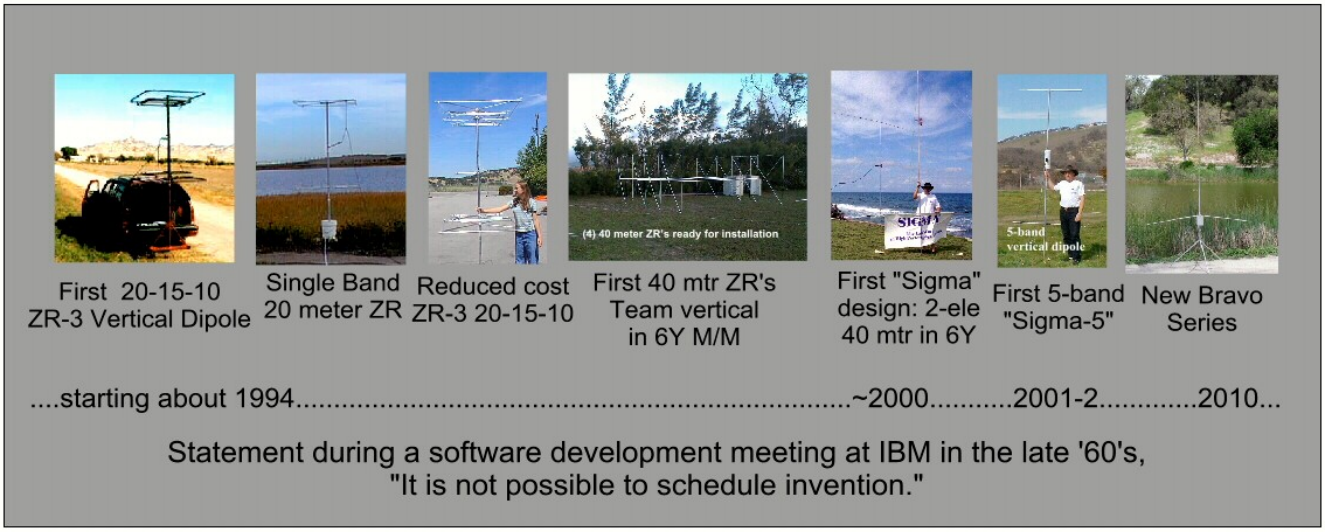
The Bravo Series

How it got here.
(page 2 of 2)

The next couple of years (2008-2009) were used to further experiment with ways to improve the Sigma series. Several antennas were built and tested, particularly with Team Vertical again and all their expertise. These efforts were focused on improving it mechanically (mainly getting rid of the center feed), electrically and also achieving a visually smaller footprint, particularly for neighbors. Along with these criteria, the new design had to retain at least the same efficiency and overall performance. Enter the Bravo Series.



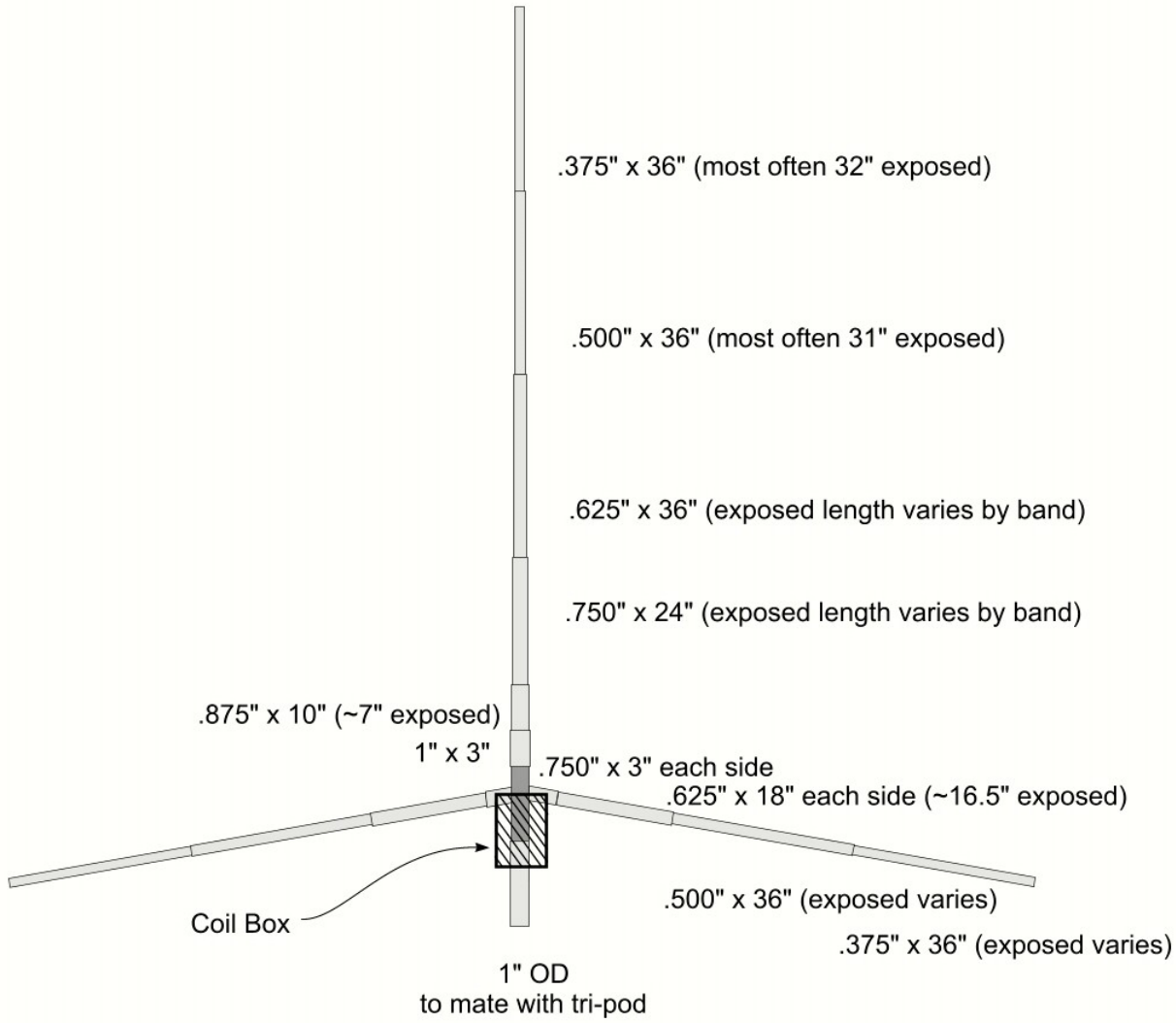
How long does it take to develop a new product? The visual below is a consolidated time line and through all these years, Team Vertical built and tested in competition more than 300 verticals and set more than 20 World Records. Many thousands of verticals were manufactured for the amateur and commercial marketplaces. Over the 16 years of founding and running Force 12, Inc., we built more than 24,000 antennas and developed many innovations and patented features. The new operations of founder N6BT will continue following the original goals of providing excellent products with accurate, true specifications. Enjoy the Bravo antennas !!



Bravo 5K

5-band vertical dipole, manually switched

Covers the amateur 20-17-15-12-10 meter bands
(and most all frequencies inbetween)



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Bravo 5K

5-band vertical dipole, manually switched

Covers the amateur 20-17-15-12-10 meter bands
(and most all frequencies inbetween)

Hub Detail

Bravo 5K

5-band vertical dipole, manually switched

Covers the amateur 20-17-15-12-10 meter bands
(and most all frequencies inbetween)

Coil Box Detail
coils on
left side are radial coils ------ right side are vertical coils

50 ohm coax input attachments
(coax/ferrite bead pigtail shown)

Bravo 5K

5-band vertical dipole, manually switched

Covers the amateur 20-17-15-12-10 meter bands
(and most all frequencies inbetween)

Coil Box Detail
jumper attachments

Radial and Vertical jumper connections for each band
Set radial and vertical tubing sections to match band selection.

50 ohm coax input attachments
(coax/ferrite bead pigtail shown)

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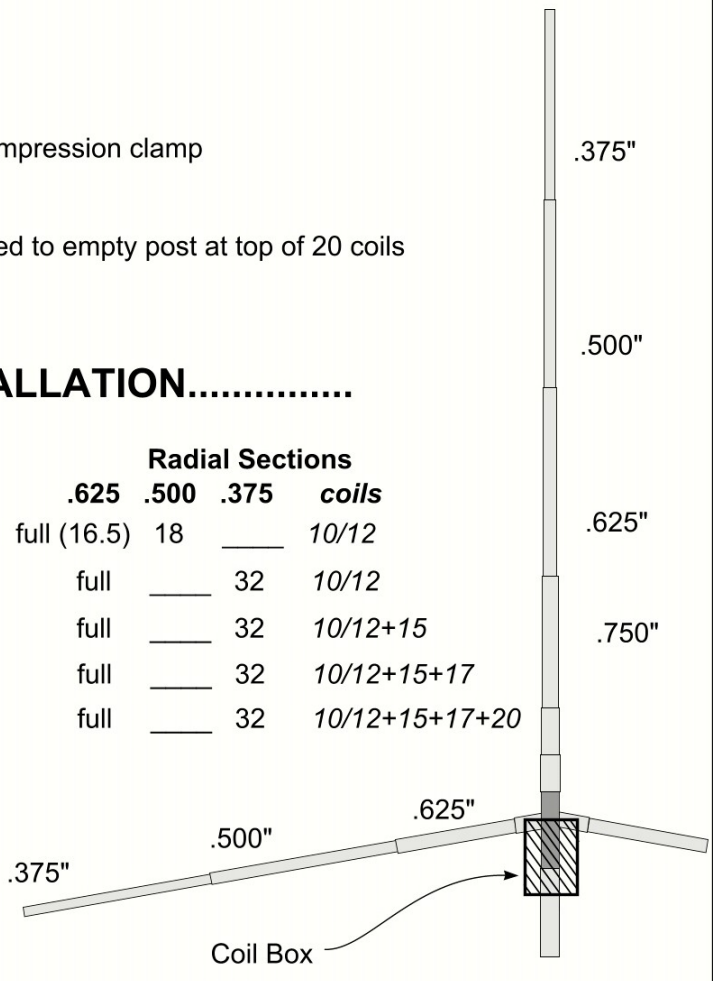
	Vertical Sections					Radial Sections			
	.750	.625	.500	.375	*coils*	.625	.500	.375	*coils*
10m	14.5	18	31	32	*n/a*	full (16.5)	18	14	*10/12*
12m	14.5	31	31	32	*n/a*	full	18	32	*10/12*
15m	17	31	31	32	*n/a*	full	26	32	*10/12+15*
17m	20.5	31	31	32	*17*	full	18	32	*10/12+15+17*
20m	20.5	31	31	32	*17+20*	full	30	32	*10/12+15+17+20*

Key:
n/a = not applicable (none)
full = full length
comp = compressed, only enough showing for compression clamp

Notes:
a) all coils are used for 20 mtrs - jumper is attached to empty post at top of 20 coils
b) see diagram for other band attachment points

.....YOUR INSTALLATION.....

	Vertical Sections					Radial Sections			
	.750	.625	.500	.375	*coils*	.625	.500	.375	*coils*
10m	14.5	____	31	32	*n/a*	full (16.5)	18	____	*10/12*
12m	____	31	31	32	*n/a*	full	____	32	*10/12*
15m	____	31	31	32	*n/a*	full	____	32	*10/12+15*
17m	____	31	31	32	*17*	full	____	32	*10/12+15+17*
20m	____	31	31	32	*17+20*	full	____	32	*10/12+15+17+20*



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5-band vertical dipole, manually switched

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Tri-Pod

with base tube for antenna and 3 slide-in legs

Base Tube - antenna slides in here

tri-pod leg slides in here

tri-pod leg slides in here

tri-pod leg slides in here

Usually, the weight of the antenna is sufficient
to keep the legs in place. They can be taped.
In windy conditions, the antenna can be guyed with
non-conductive line just above the relay box; or,
a weight can be tied to the welded plate on the tri-pod.

Bravo Series

Compression Clamp Information

Tubing ends have either (2) or (4) slots.

The photo shows tubing with (2) slots. On this type of tubing end, postition the clamp body on the portion of tubing without a slot.

On tubing with (4) slots), the clamp position isn't as important; however, try to still place the clamp body *not* on a slot.

Bravo 5K

5-band vertical dipole, manually switched

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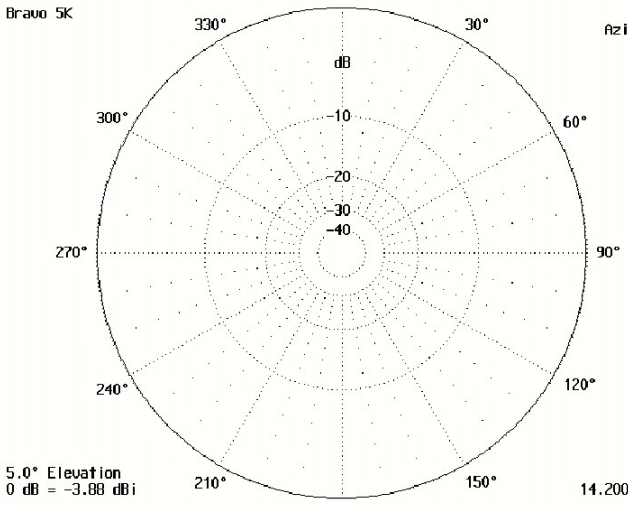
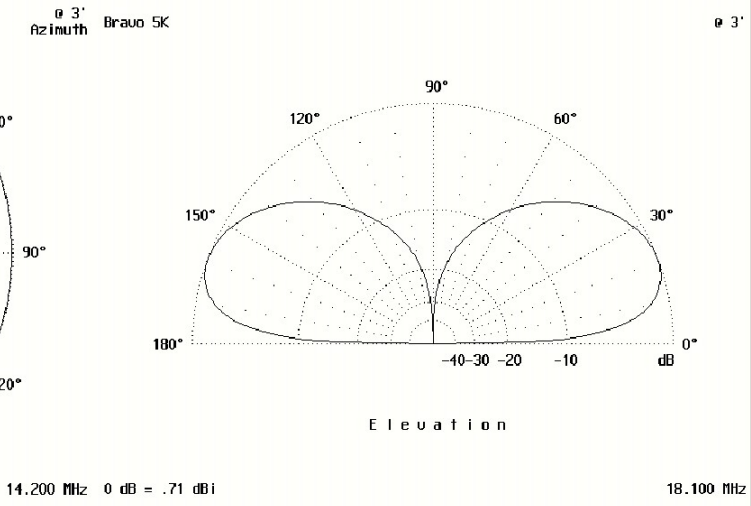
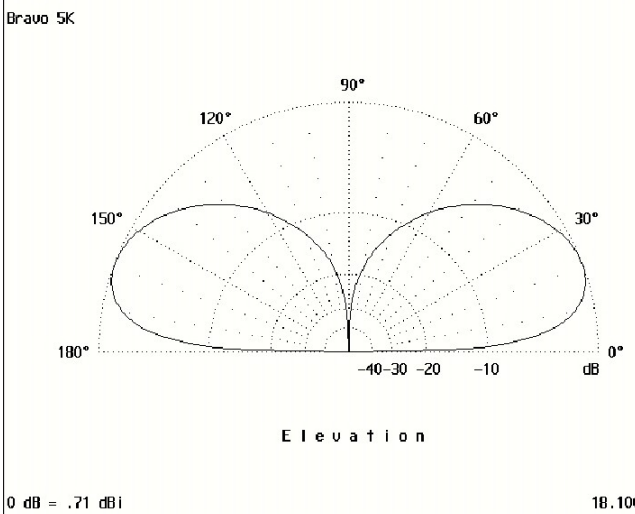


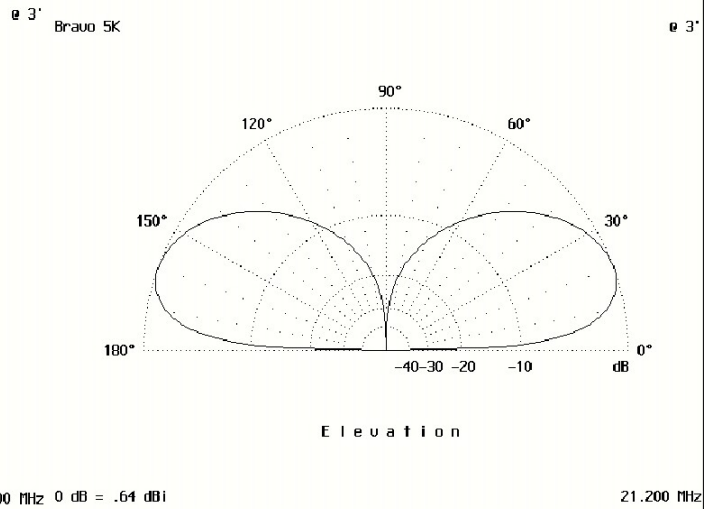
Typical omni-directional pattern
looking down on the vertical



Elevation pattern for 20 meters,
over ground, looking from the side.



Elevation pattern for 17 meters,
over ground, looking from the side.



Elevation pattern for 15 meters,
over ground, looking from the side.

Bravo 5K

5-band vertical dipole, manually switched

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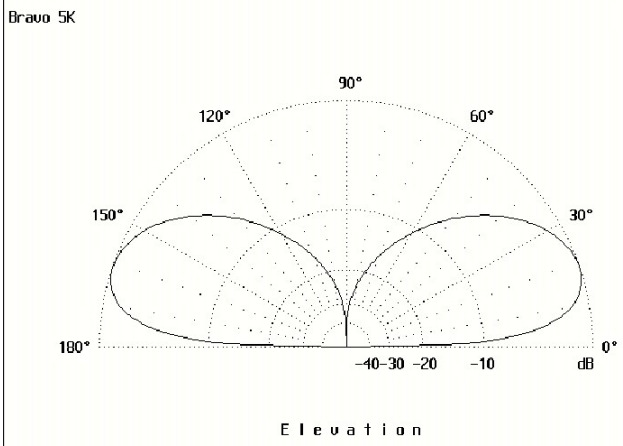
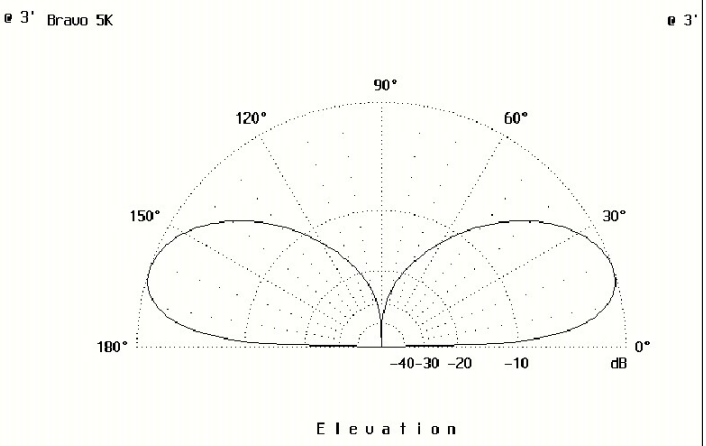
(and most all frequencies inbetween)

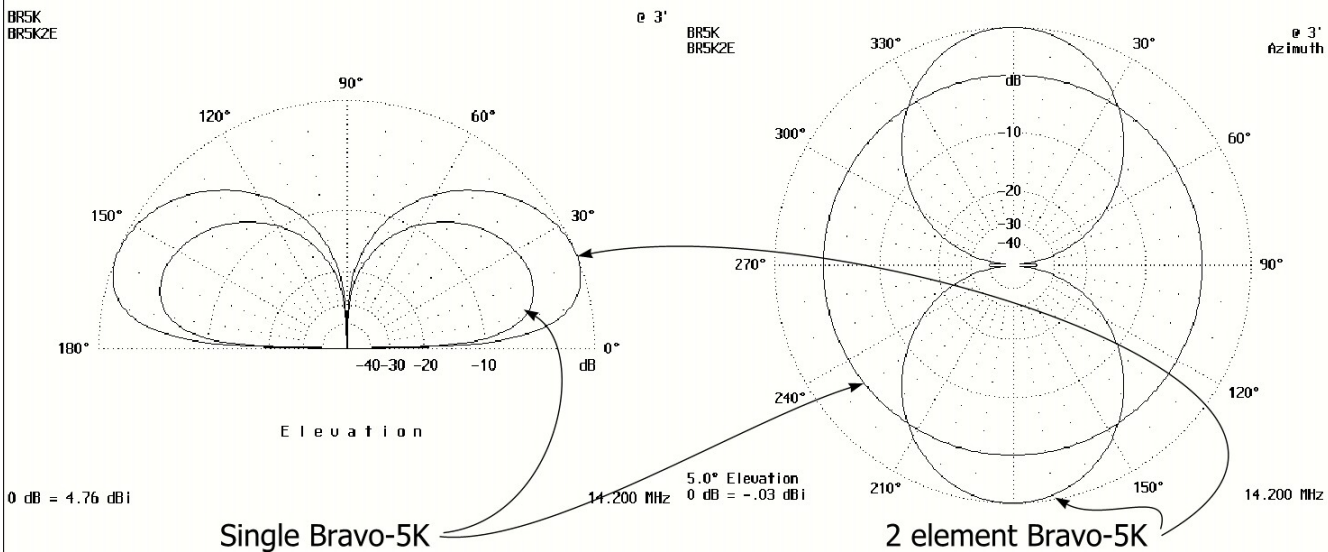


Elevation pattern for 12 meters,
over ground, looking from the side.



Elevation pattern for 10 meters,
over ground, looking from the side.

A great way to get almost 4dB of gain on 20 meters:
space a pair of Bravo-5K's at 35' and feed them in phase.



Single Bravo-5K

2 element Bravo-5K

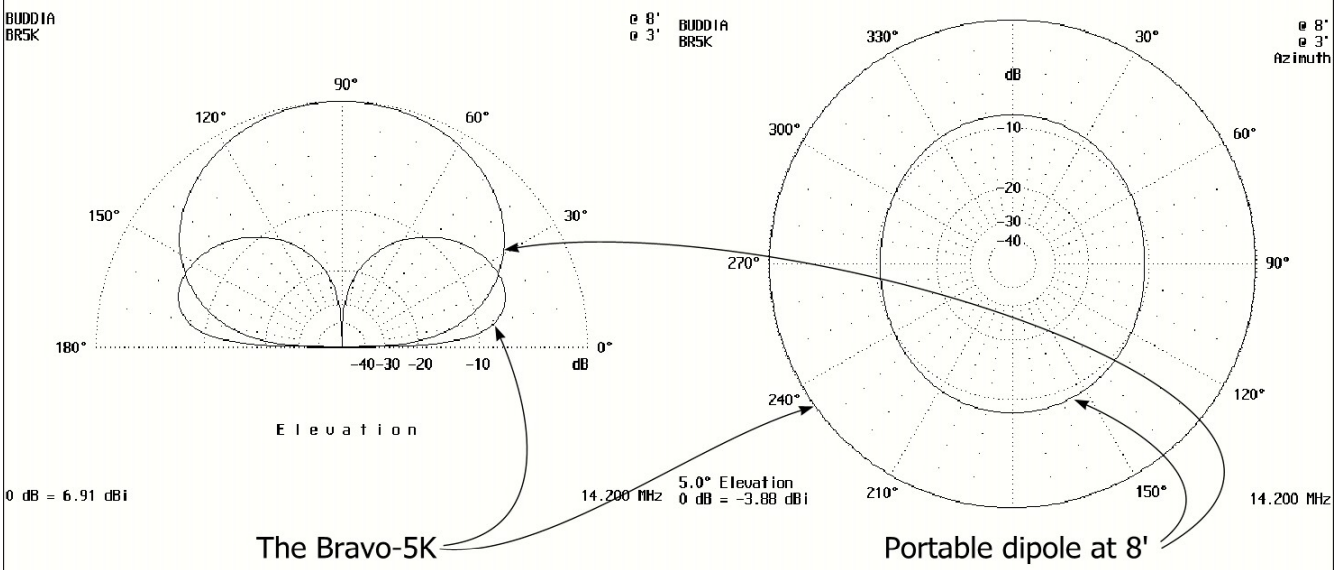
The 2 element has a 1/2 power beamwidth (-3dB from peak) of about 60 degrees.
This means the array needs to be aimed where you want it to go!
Note that it has gain in 2 (opposite) directions.

Bravo 5K

5-band vertical dipole, manually switched

Covers the amateur 20-17-15-12-10 meter bands
(and most all frequencies inbetween)

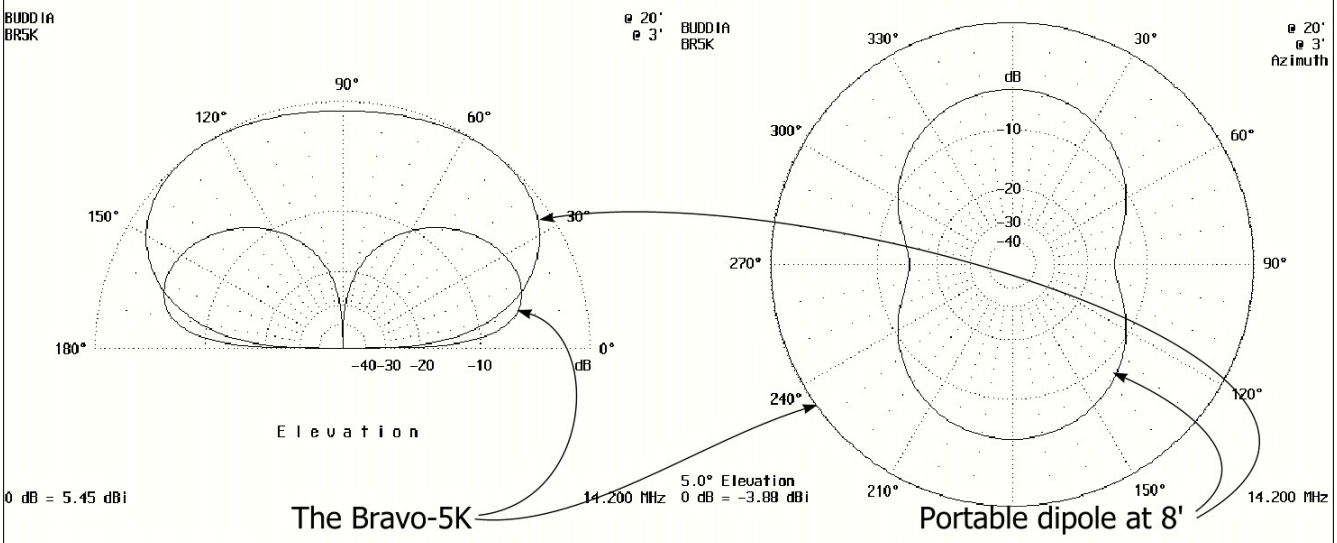
Comparison of Bravo-5K on 20 meters to popular, portable short dipole at its provided mast height of 8'



The Bravo-5K — Portable dipole at 8'

The Bravo-5K is way ahead. The right-hand plot is energy at 5 degrees.

Comparison of Bravo-5K on 20 meters to popular, portable short dipole at 20', 12' higher than its provided mast height of 8'



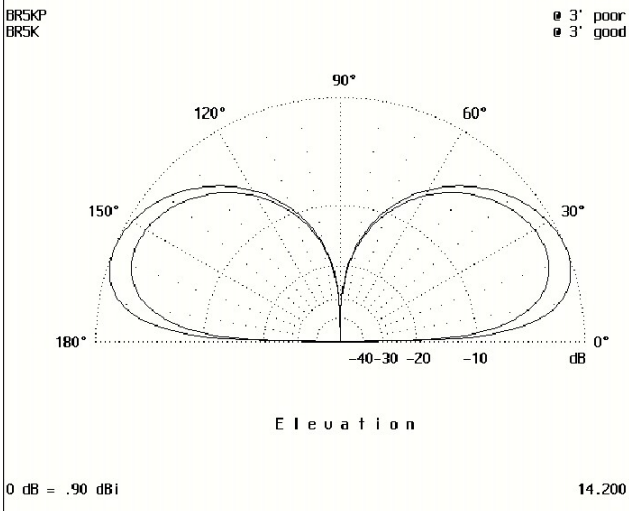
The Bravo-5K — Portable dipole at 8'

The Bravo-5K is still ahead. The right-hand plot is energy at 5 degrees.

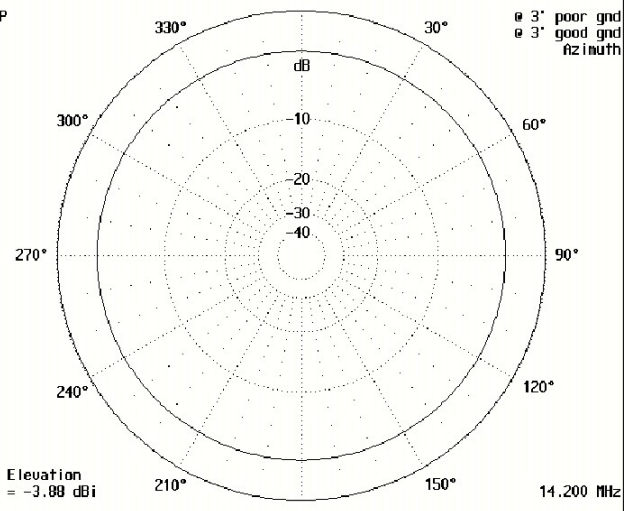
Bravo 5K

5-band vertical dipole, manually switched

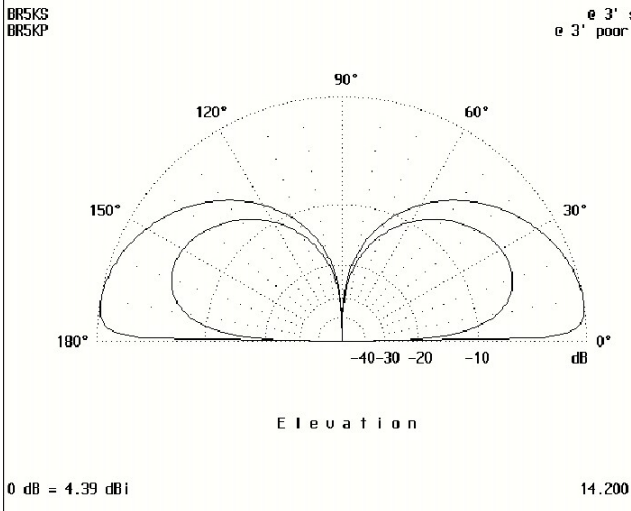
Covers the amateur 20-17-15-12-10 meter bands
(and most all frequencies inbetween)



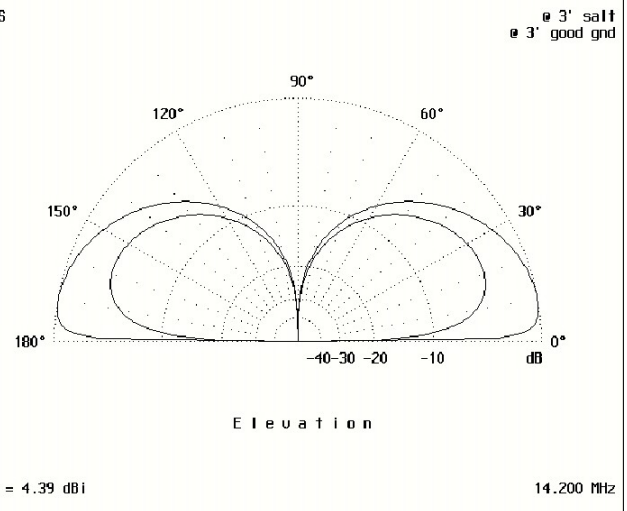
Elevation comparison of Bravo-5K over
poor ground and good ground = +3dB



Azimuth comparison of Bravo-5K over
poor ground and good ground = +3dB



Comparison of Bravo-5K over
poor ground and salt water = +12dB @ 5 degs



Comparison of Bravo-5K over
good ground and salt water = +8dB at 5 degs

n6bt-bravo-5k-d10-rev1.0

Last page for notes……

