Compendium of Cushcraft Six Meter Antenna Modifications
Some History and A Mystery - by W3CMP

One of the oldest manufacturers of six meter antennas that I am aware of is Cushcraft, now MFJ/Cushcraft. When I held a Novice class license in the dark ages of the 1960s, the Cushcraft six meter yagis were among the most popular on the band. At that time, Cushcraft manufactured six meter antennas of three, five, six, and 10 elements. (**Figure 1 sales brochure**).

A hallmark of the Cushcraft antennas was, and remains the use of standard .058" wall aluminum tubing sizes that telescope into each other. Boom and element section ends were slotted and fastened by hose clamps. The element to boom and boom to mast clamp brackets were stamped aluminum. The brackets were mounted to the boom with U-bolts, which although perhaps unintended, allowed for easy modification of element position and spacing. Antenna assembly was quick and simple. The feed was a simple 50 ohm gamma match with an SO-239 connector, known as the "Reddi match." Repairs were easy. If you twanged an element or boom, no problem. A quick trip to the hardware store or tubing supplier for some .058" tubing fixed that. Whatever couldn't be sourced locally could be purchased at a reasonable price from Cushcraft.

Dave Olean, K1WHS, who worked at Cushcraft for a number of years, mentioned in a recent email that "[t]he [A]50-3, 50-5, 50-6, and 50-10 were all Lester Cushman designs and all were cookbook creations from his days making TV yagis in his chicken coop in the 1950s. He used 0.2WL spacing and a 5540/f DE with a taper of maybe 1/4 to 1/2" depending on the bandwidth he needed. He always said that the 50-10 was a DOG but hams liked lots of elements. That had closer spacing and was discontinued before I started work there in 1979…. [T]he 50-5 was only 12 ft. and not so hot. The 10 element monster had been retired well before the Boomers appeared."[1] Joe Reisert, W1JR, a consultant to Cushcraft who later followed K1WHS as chief engineer, added "the 50-10 [was] based on his old 10 element 2 meter series and was on a 24 foot boom. That's lots of aluminum"[2]

In the late 1960s, six meters was generally thought of as a local band. AM was the predominant mode. Only a few sophisticated stations had SSB or CW capabilities. E skip openings were rare, confined to the summer months, and usually single hop. Many hams chose the A50-3 three element antenna. (**Figure 2 A50-3 diagram**). Finding space for the antenna with its six foot boom length was fairly easy. It was adequate for local work, and displayed some front to back. (**Figure 3 A50-3 E plane**). For those who wanted more oomph, a modest but noticeable improvement in performance resulted from the conversion of a three element CC to five elements. You just lengthened the boom from 6' to 12', purchased a couple element brackets and U-bolts, some hose clamps, cut some tubing, put it together and adjusted the Reddi match. (**Figure 4 A50-5 gamma match detail**). If you were lucky enough to have a friend with a 5 element CC, the A50-5, you could get the measurements for the gamma match and elements from him or her; otherwise you asked CC to send a five element manual with the brackets. If you wanted to go full bore, you could opt for the six element model on a 20' boom.

As a Novice class licensee with the call WN3HMK, my VHF activity was confined to six and two meter operation with Heathkit lunchboxes. I bought an A50-5, the first of several Cushcraft six meter antennas, to go with my Heathkit Sixer. It worked well for local contacts, and occasionally for E openings before the big local

[1] Email correspondence K1WHS
[2] Email correspondence W1JR

stations with 5894 or 6146 finals got on and swamped the Sixer's front end. When I went to college and my parents moved, the antenna got taken down.

In 1976 NBS Technical Note 688[3] was published. Shortly afterwards, Cushcraft began marketing a new long boom six meter antenna, the 6-617 Boomer. The Boomer used the same element and bracket material as the earlier A50 designs. Although a number of hams assumed the antenna was based on the NBS work, it wasn't. As K1WHS, described it, "The 6 meter boomer was a direct copy of the Chen & Cheng yagi that was published in the IEEE transaction pages. It was in the spring of 1979 and Joe Reisert had been working on a Cushcraft project to design some NBS yagis for VHF. I had started work there after Joe got the job. He brought the 3219 and the 214B yagis, the 19 el NBS 3.2 and the 2.2 wl 14 el both with trigonals for final testing. Glenn Whitehouse, the VP, wanted trigonals. It must have been in April of 1979. At the same time, Joe had cobbled together a copy of the six element Chen & Cheng yagi cut for 144 MHz. The gain it exhibited was fantastic, being almost as good as the 2.2 wl NBS, but it had no F/B ratio. I think it was only 12 dB F/B or something like that. He had no idea how it would play as he had no antenna range at his house, so he was as surprised as I was. The group got together and we all decided there was no room in the line for a 2 meter yagi like that. I came up with the idea to clone it to six meters. I made up a version at that time and shortened the last director so the F/B got much better at about a 0.5 dB gain penalty and that became the 617-6B. At that time there were no readily available computer programs for yagi analysis. Around that time, [w]e were starting to play with computer designs, and had access to an Ohio State program that was on a main frame at Avco in Massachusetts. We had to rent CPU time to use it. I did an IEEE paper in 1980 about computer optimized yagis for commercial uses and had some six and 10 element wideband yagis with great patterns at 150 MHz and 10 MHz bandwidths. The only way I could do it was with a computer program. That same program produced the Cushcraft Skywalker 4 element yagis for 20, 15, & 10 meters."[4,5]

An article about NBS Note 688, authored by W1JR, appeared in August 1977 *ham radio* magazine[4]. One of the antennas featured in the Note was a 1.2λ 50MHz model. For me, that design provided the motivation to build a six element 1.2λ yagi out of Cushcraft parts. The specifications for the antenna included 10.2 dBd gain, and what was then thought of as a reasonably clean pattern (**Figure 5 NBS 1.2 λ 50MHz pattern**). I still had the old A50-5 lying around, so decided to make a 1.2λ six meter antenna from that and some other Cushcraft parts. I modeled the antenna using the charts and other information in the *ham radio* article, and the antenna tuned up easily using the Cushcraft gamma match. This 24 foot long antenna served me very well - I worked many DXCC with 10 or 150 watts from 1989 when I installed it until 1991 or 1992 when I went to a bigger antenna. When I replaced this antenna I loaned it to another local ham who used it for many years afterwards.

[3] https://tf.nist.gov/general/pdf/451.pdf

[4] Email correspondence K1WHS

[5] In a later email, Joe added that after designing the 32-19 two meter Boomer, he was asked to come up with a shorter two meter antenna. He submitted a six element yagi on a 12 foot boom based partially on the Chen & Cheng paper. The antenna did well on gain and the F/B was just over 12dB. Bob Cushman immediately rejected the design, saying "No one would buy an antenna since it has so few elements on 2 meters." Joe then submitted a two meter antenna with more elements and a trigonal reflector which became the Cushcraft 214B. Dave K1WHS, who was now at Cushcraft, asked Joe about modifying the antenna for six meters. Dave built it and made some tweaks with the last director to improve the F/B ratio. It became the 617-6B 6 element 6 meter Yagi.

The NBS note also spawned a four element design for portable use, using Cushcraft parts[6], which W1JR described in his June 1987 h*am radio* VHF column. The antenna was based on an unpublished 0.6 wavelength NBS design, and at 12 feet long produced gain of just under 10 dBi (**Figure 6 W1JR 4 element antenna**). The construction was not critical, and the 12 foot length allowed for use in many locations.[7]

The 6-617 Boomer was the first and only Cushcraft six meter antenna to use a T match balanced feed. Although it was initially a huge improvement over earlier designs, as antenna design and optimization and design programs became available its shortcomings became evident. However, the Boomer didn't die. Its rugged construction and ability to be modified easily allowed it to become the basis for a number of excellent antennas.

About 20 years ago, Fred Stefanick N1DPM, used a couple scrap 6-617s to construct a seven element yagi on the original 34' boom. He used YO to look at the Cushcraft design and greatly improved the pattern. Fred used the original CC element material and driven element. The element spacing and lengths are shown below (**Figure 7 N1DPM Dimensions**). The final design showed 10.75 dBd gain, a front to back ratio of 30dBd, and a first vertical side lobe of -18dB (**Figure 8 N1DPM Antenna Pattern E and H plane**). The SWR was under 1.25:1 from 50.025MHz to 50.33MHz. Fred noted that in designing this (or any) antenna, "[w]hen optimizing a Yagi for best pattern it's best to look at the vertical (H plane) pattern. If you create a clean H plane pattern the E plane (horizontal or azimuth) will by default be a clean one. The reverse of this is NOT true."[8] Comparison patterns for the 6-617 and N1DPM modified antenna are telling. (**Figure 9 Comparison patterns 6-617 and N1DPM modification**).

A few years later, at the 2007 Northeast VHF Conference in Enfield, Connecticut, Dave Olean, K1WHS, described a seven element optimized version of the 6-617 that formed the basis of a four antenna contest array that was phase adjusted for varying propagation. Dave's design goals included trying to get the H plane pattern better than -16 dB for the side lobes, which is important when stacking in the H plane. The K1WHS antenna was 31 feet long, had 11 dBd gain, and a F/B ratio greater than 25 dB. The pattern was clean in both the H and E planes (**Figure 10 K1WHS Contest Antenna E plane**)(**Figure 11 K1WHS Contest Antenna H plane**). It also used standard Cushcraft parts. (**K1WHS Contest Antenna Diagram).** A full description of the antenna and the array can be found at *https://directivesystems.com/wp-content/uploads/sites/2/2014/04/50-MHZNEWS.pdf.*

Clarke Greene K1JX, also modified the Boomer. As he tells the story: "Sometime in the last century (I can say that now), W1XX and a few other guys, including me, occasionally went on VHF contest expeditions to various places in the Northeast. One year we went to a location at the top of Blue Knob in Western Pennsylvania (FN00) for the September contest. I thought that was a really great location and we did really well, all things considered. So, I leaned on John to go back there the next year but with a better station and larger group. I offered to take the responsibility for the gear. Up to that point John had always used a 6M Boomer from Cushcraft. I had the sense that we could do better, so I set upon doing two things. One was to rethink the Boomer design by using K6STI's Antenna Optimizer (AO) software. AO was a superb DOS based program that really did the job well and was quite advanced, especially for its time. In fact, I still use it routinely in a DOSBox window on my pretty new iMac.

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[6] Email correspondence W1JR

[7] Reisert, Joseph, W1JR, "VHF/UHF World", h*am radio* vol. 20, no. 6, June 1987, pp79-80

[8]Email correspondence N1DPM

What I eventually came up with was to add two elements to the original Boomer design. The boom stayed the same length, but I moved the elements around and optimized the element lengths. This gave a much cleaner pattern and provided some other benefits I thought important. I wanted a medium feed point impedance and low side and rear lobes. These seem to be available in a bunch of commercial and hobbyist designs these days, but that wasn't really true back in the 1980's. Probably that was largely because software based antenna design was still new and had previously been unaffordable for hams. It had been largely unaffordable for many antenna businesses, too.

Plus, it's always hard for companies to throw off their existing designs and philosophies in favor of a new direction. Of course, I didn't have those constraints and AO was very affordable. This eight element design evolved again a little later….. My late friend W3ZZ wanted to modify his 6M Boomer, too. But, he wanted the boom to be shorter. So, he prevailed on me to design it for him. It ended up being seven elements on about a 29 foot boom…."[9]

Clarke's design is now marketed by Directive Systems as the DSEJX7-50. https://directivesystems.com/. The combined pattern for the antenna is show here (**Figure 12 K1JX Modified Boomer combined pattern**).

Improvement of Cushcraft six meter antennas wasn't limited to the Boomer or to outside parties. In the early 1990s W1JR redesigned the A50 series to use all stainless hardware, and the "S" designation was added to the antennas. As part of his work, using YOC Joe created the A50-6S, a six element model on a 20' boom. Here are the E and H plane patterns for the A50-6S. (**Figure 13 Cushcraft A50-6S E plane**)(**Figure 14 Cushcraft A50-6S H plane**). These antennas are still sold today by MFJ/Cushcraft.

The A50-5 also provided the basis for several interesting antenna designs. In October 1993 *Six News*, Brian Beesley K6STI, creator of YO (Yagi Optimizer) described an optimized five element six meter beam he built using Cushcraft six meter antenna parts, including the gamma match. Brian had designed the antenna using an early version of YO, and created a 23' antenna with "an unusual combination of performance characteristics."[10] The free space forward gain of the antenna was more than 10 dBd, and the rear lobes of the antenna were all 20 dB down. To achieve this performance, Brian had to "to optimise the design over a narrow frequency range, 50.000 to 50.250MHz."[11] Today this antenna would not be practical, but the exercise of designing an antenna using the then relatively-new optimization programs was fascinating. The article describing the antenna can be viewed at: https://www.dxzone.com/dx6582/optimised-six-metre-yagi.html or https://www.uksmg.org/content/yagi.htm.

In 2003, William Van Alstyne W5WVO developed what is perhaps the most popular and widely copied modification and improvement to the A50-5. Bill modeled the antenna with K6STI's Yagi Optimizer software, v7.58. The boom was stretched from 12' to 17.5', which improved gain and front to back, and cleaned up the pattern. The element lengths and locations were changed as shown here: (**Figure 14 W5WVO A50-5 Mod. Diagram**), and the gamma match was retuned. Gain of the long boom A50-5 increased from 7.59 dBd to 9.14 dBd, and the front to rear ratio increased by 10 dB. (**Figure 15 W5WVO H plane**). Full documentation of the modification, including cookbook directions to make the changes, is available at: https://www.bigskyspaces.com/w7gj/A50-5S_w5wvo.pdf

[9]Email correspondence K1JX
[10]Beezley, Brian K6STI, "Optimised Six-Meter Yagi", UKSMG *Six News* October 1993.
[11] Ibid.

A slightly shorter stretch of the A50-5 was published by Justin Glasener K9MU. Charlie Betz N0AKC used YO to run the modification. The antenna length was extended from 12' to 16' by replacing one of the 4' boom pieces with an 8' piece of the same diameter. The gamma match was only slightly adjusted, if at all. The rear sidelobes are almost 30 dB down and the gain is increased to about 8.8 dBd. Dimensions for the elements and spacing are listed below (**Figure 16 K9MU A50-5 Mod. dimensions**). Details about the modification is available at: https://www.k9mu.com/a50-5.html.

Using Cushcraft parts, Justin has also built a pair of four element 15 ½' long boom antennas which he uses in a stacked array. As he described it: "I had a couple old Cushcraft 50 Mhz yagis laying around and an assortment of old aluminum tubing I used to make the booms longer. Each yagi has a 50 degree 3 dB beamwidth. For contesting, I split the yagis to cover nearly 100 degrees of azimuth (ME down to FL for me!). I used the DOS based Yagi YO modeling program to optimize Cushcraft's element length and spacing."[12] The element lengths and spacings can be seen here: (**Figure 17 K9MU A50-5 4 Element Mod dimensions**).

For feeding the stack Justin uses a homebrew phasing harness using two pieces of 3/4 wavelength of 75 ohm coax from a T-connector mounted midpoint between the yagis. The antennas are mounted directly on the legs of his Rohn 45G tower at about 28 and 40 feet, or 5/8 λ. More information about the stack and antennas can be found at: https://www.k9mu.com/4elementstack.html.

Another upgrade to the A50-5, which did not involve lengthening of the boom, was made by K1JX for his previously mentioned contest work. "The other thing I thought we needed was a high gain antenna that had a broad horizontal beam width. It seemed to me that covering a very wide swath of the country without turning the antenna was just what you wanted from FN00. I already owned a stock A50-5 that I'd used for operating QRP from a local hilltop for the various contests, so I started with that as a base. Why not? I never much liked drilling or sawing aluminum tubing. Same design approach as before. I was able to buy some "spare parts" from Cushcraft that let me convert the driven element from a gamma match to a balanced T-match. The rest just involved moving the elements around and adjusting their lengths. This worked well enough that I bought two more A50-5's so that we'd have a three high stack.

John had always used some military surplus mast sections to support all his antennas for these operations. I think each section was just about five feet in length. (Side note - John found a toothbrush holder at the local hardware store that was a perfect fit on the mast. Those became the guy rings.) The plan was to use ten sections of the masts so that the top antenna was at 50 feet, with the other two at 10 feet and 30 feet. The rotator was at the base. It was an interesting adventure to get that system in the air, but we did. We had the three high fives on one mast and the eight element modified Boomer at 30 feet on another mast. (Also interesting to put up) …. [N]ot long after, Gene [W3ZZ] and a bunch of others guys decided that they were going to operate from Spruce Knob with a serious effort in the contests. They asked if I could provide the dimensions for the 5 element Yagi because that would be easier to manage up on that hill. So, I did. I guess it worked out for them.

Sometime later, Terry (now W8ZN) and Owen (then K6LEW, later K3CB) decided that they wanted to go into the antenna business. This was to be an extension of Owen's consulting company C3i. They asked if they could use the designs for their product line. "Sure, why not?" sayeth me. Later they asked me to design a couple other models, a six element yagi and a 13 element Yagi. More on the history

[12] Email correspondence K9MU

here: https://www.qrz.com/db/W8ZN. Along the way Owen had one of the designs measured at a professional antenna range. It matched the AO design almost perfectly."[13]

The K1JX modification is now sold by Directive Systems as the DSEJX5-50. The element dimensions and spacings are shown below. (SN1 -). Undoubtedly the A50-5 gamma match will have to be adjusted if it is retained. The K1JX modification increases the antenna's gain by about .5 dB, and significantly improves its pattern (**Figure 18 K1JX 5 Element Mod. diagram**).

Everyone likes a mystery and there is one commercial six meter antenna, no longer available as a stock item, that *may* have Cushcraft origins. In the 1980s Tom Rutland K3IPW, began selling K1FO antenna designs for 2 meters and 432MHz. He also sold a couple of six meter designs, the four element RA50-4 and the seven element RA50-7. The RA50-4 design looks suspiciously similar to the Cushcraft A50-5. It uses a gamma match like the Cushcraft and the elements are mounted to the boom using a single U-bolt and bracket just like the Cushcraft. It used the same length (48") center sections, and the same hose clamp method of joining boom sections.

Was it prototyped from Cushcraft parts or was Cushcraft construction adapted to an entirely new design? There are some differences between the two. The RA50-4 element center and ends diameters are 1/8" smaller than the Cushcraft. The RA50-4 is a little longer than the Cushcraft at 146 inches and the boom pieces are different length. Emails to Bill K1DY and K1WHS, who later sold the antenna as a Directive Systems DS50-4HP, did not give any insight into the origins of the antenna. Bill, who sold the antenna as the DEM50-4HP, noted "[t]he Rutland 6 meter antennas were designed by Tom Rutland. I'm not sure what design software he was using at the time. I would say the mechanical design was probably influenced by what was around at the time….I rep'ed the RA line for Tom for a while. I know I have the Rutland Arrays manual here somewhere but can't lay my hands on it right now. When Tom died I offered the same beam with a Gamma match instead of a t-match. The element spacing and lengths were all the same. In fact, that antenna is what I am using right now."[14] Dave K1WHS also wrote: "I do remember that some folks had VSWR problems with it, so I looked at it on the antenna range and was horrified to discover that the original Rutland design was low in frequency. Bill, K1DY came down and we worked on it and modified the elements to improve it quite a bit…."[15] So, none of Bill's or Dave's emails, could shed any light on the origins of the RA50-4/DS50-4HP. The current Directive Systems owner, Terry Price W8ZN, was also unable to provide any information, However, Terry was able to provide an old Directive Systems manual for the antenna, and the dimensions are shown here: (**Figure 19 DSE4-HP Element diagram**).

Lionel Edwards VE7BQH, author of the antenna comparison tables for six and two meters, and 432MHz - https://www.bigskyspaces.com/w7gj/6mTable.htm – has included the DS50-4HP in his six meter table for a number of years. For a four element design, it has good gain, and the pattern is good. The E and H plane patterns are shown here: **(Figure 18 DSE4-HP E and H plane**). Curiously, Lionel's table shows the match as a T match; both the DEM50-4HP and DS50-4HP yagi manuals show a gamma match.

Lionel recently ran an optimization of the antenna which tightened up the pattern a bit and increased the gain slightly. The results of his work use the same element spacing as the RA-50-4/DS50-4HP. In his email with his work, Lionel stated: "I took and older Directive design and tweaked it a bit. That is the easy part. The

[13] Email correspondence K1JX
[14] Email correspondence K1DY
[15] Email correspondenceK1WHS

biggest problem I have is a T match. The NEC programs do not like wires at right angles to each other. Therefore, I give you my best opinion on what the T match should be but no guarantees. The element mounting uses the Cushcraft bracket you show in the Email you sent me. All elements use 48" of .625 with .5" tips. As you know the center sections are 48" the only measurement you need from below is the .5" Tips. The T match with a 2" spacing has T bar of 12.75" long."[16]

Directive Systems DS50-4HP 50 MHz
50.000 50.150 50.300 MHz
4 elements, inches

	0.9872	**0.6250**	**0.5000**
0.0000	0.7500	23.2500	35.2027
38.0000	0.0000	24.0000	32.7632
83.0000	0.7500	23.2500	30.9309
145.0000	0.7500	23.2500	28.5529

Match: 4 0.2500 2.0000 12.7500 0.0000 0.0200.0 0.0000
Bracket: 5 1.5000 1.5000 0.0000 1.7600

E and H plane patterns for the VE7BQH optimization are shown here: (**Figure 19 VE7BQH Optimized 4 Element E and H plane**). The gain is a little higher, and the patterns in both planes are a little tighter than the RA50-4 /DS50-4HP. Both look to be pretty good for relatively simple and short antennas.

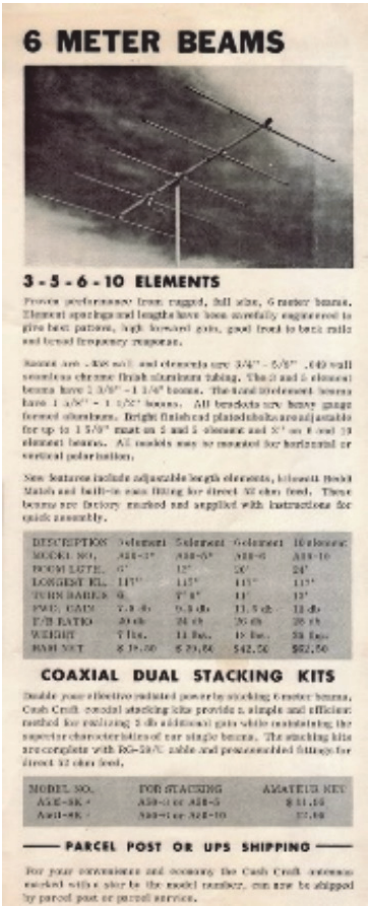
Even though there may be (and probably are) a bunch of other six modifications for six meter Cushcraft antennas floating around, the antennas shown above represent the majority of proven designs that have been put together and tested, and certainly what have been published. They include a number of lengths and elements and should allow the easy assembly of a six meter antenna that will fill almost any need. So now you have a reason to look for the Cushcraft parts you squirrelled away and put them to use.

Acknowledgement

In putting this article together, I had the pleasure of corresponding with Lionel Edwards VE7BQH, Justin Glasener K9MU, Clarke Greene K1JX, Dave Olean K1WHS, Bill Olsen K1DY, Terry Price W8ZN, Joe Reisert W1JR, and Fred Stefanick N1DPM. The historical and design information they provided was invaluable. Without their help, it wouldn't have happened. Thank you very much.

Chris Patterson W3CMP

[16] Email correspondence VE7BQH



6 METER BEAMS

3 - 5 - 6 - 10 ELEMENTS

Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

Boom are .058 wall and elements are 3/4" - 5/8" - .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The final 6 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finished plated bolts and gamalok for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

Now features include adjustable length elements, Telescoping Gamma Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

DESCRIPTION	3 Element	5 Element	6 Element	10 Element
MODEL NO.	A36-3*	A36-5*	A36-6	A36-10
BOOM LGTH.	6'	12'	16'	24'
LONGEST EL.	111"	113"	113"	113"
TURN RADIUS	6'	7' 8"	11'	13'
FWD. GAIN	7.5 db	9.3 db	11.5 db	12 db
F/B RATIO	20 db	24 db	26 db	26 db
WEIGHT	7 lbs.	11 lbs.	15 lbs.	23 lbs.
HAM NET	$ 39.50	$ 59.50	$ 72.50	$ 92.50

COAXIAL DUAL STACKING KITS

Double your effective radiated power by stacking 6 meter beams. Cush Craft coaxial stacking kits provide a simple and efficient method for realizing 3 db additional gain while maintaining the superior characteristics of our single beams. The stacking kits are complete with RG-58/U cable and precut cable fittings for direct 52 ohm feed.

MODEL NO.	FOR STACKING	AMATEUR NET
A36-6K*	A50-6 or A28-6	$ 31.95
A10-6K*	A50-6 or A28-10	$ 37.95

PARCEL POST OR UPS SHIPPING

For your convenience and economy the Cush Craft antennas marked with a star in the model number, can now be shipped by parcel post or parcel service.

Figure 1

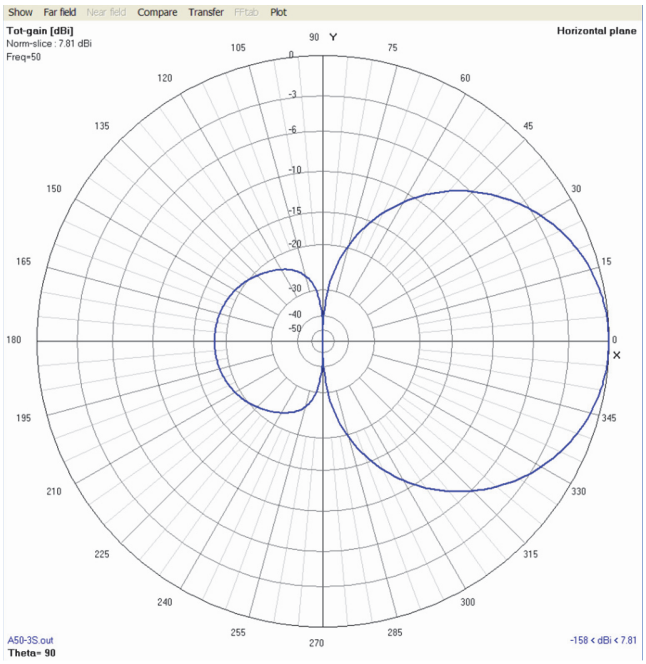
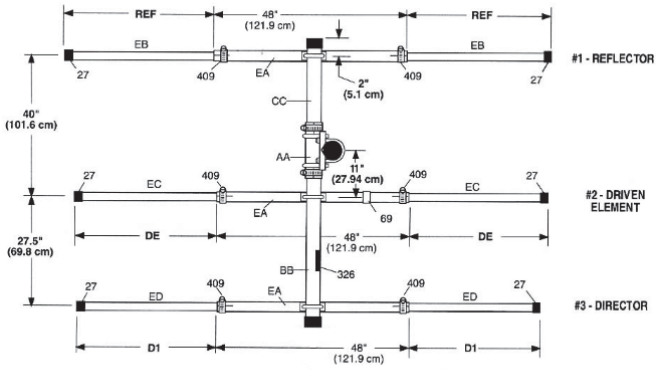


Figure 3

Cushcraft A50-3 Dimensions



Horizontal Polarization					
	50 MHz	51 MHz	52 MHz	53 MHz	54 MHz
REF in.	34-1/2	34-1/2	32-1/2	32-1/2	30-1/2
(cm)	(87.63)	(87.63)	(82.55)	(82.55)	(77.5)
DE in.	31-1/4	30-1/4	29-1/4	28-1/4	27-1/4
(cm)	(79.37)	(76.83)	(74.29)	(71.75)	(69.21)
D1 in.	28-1/2	26-1/2	26-1/2	26-1/2	24-1/2
(cm)	(72.39)	(67.31)	(67.31)	(67.31)	(62.23)
Set in.	17	15-5/8	15-3/8	15-1/4	15-1/4
(cm)	(43.18)	(39.69)	(39.05)	(38.73)	(38.73)
X in.	4-3/4	4-3/4	4-3/8	4-3/4	4-3/4
(cm)	(12.06)	(12.06)	(11.11)	(12.06)	(12.06)

Figure 2

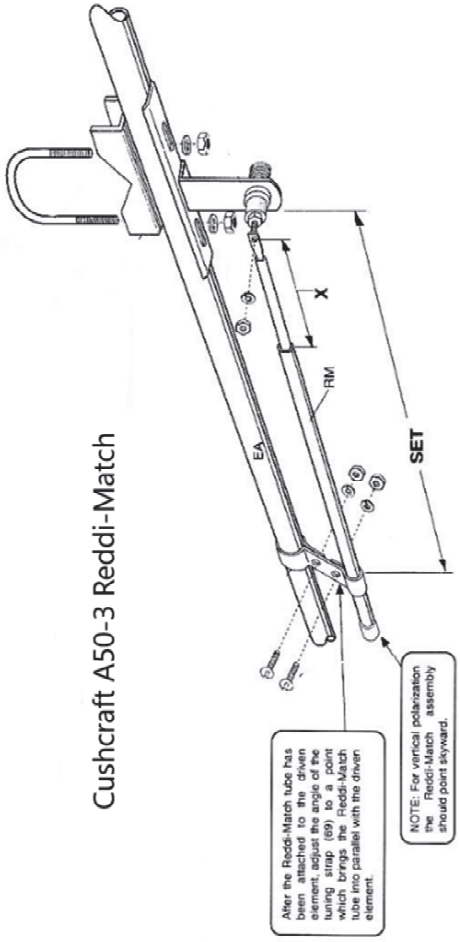


Figure 4

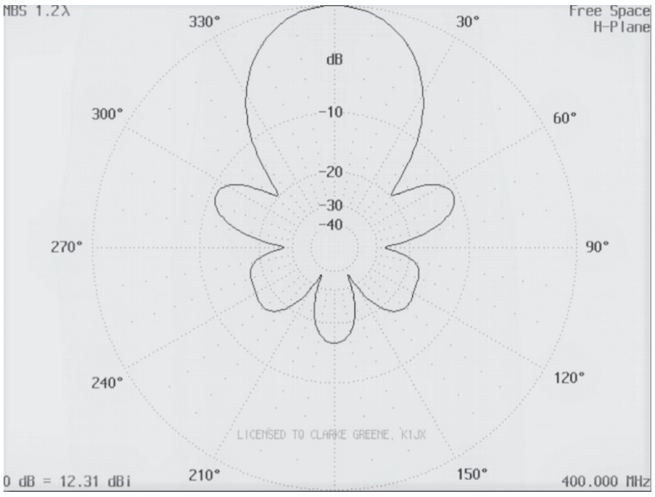


Figure 5

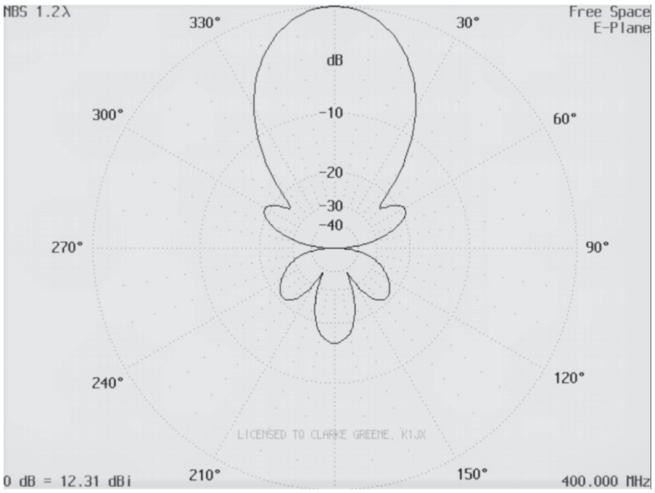


Figure 6

W1JR Four Element 50MHz NBS Yagi

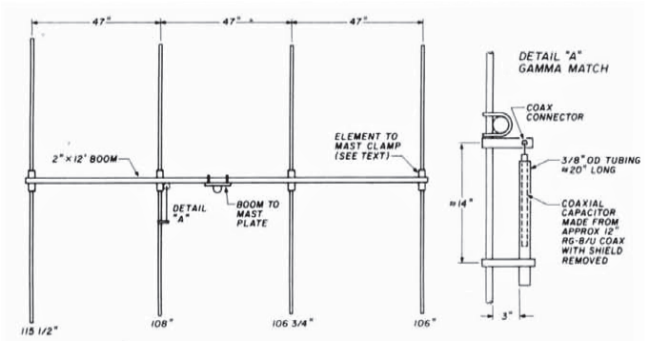


Figure 7

N1DPM Modified 6-617B Dimensions

ELEMENT	POSITION	SPACING	ELEMENT LENGTH	CENTER LENGTH	END LENGTH
REF	0.000	N / A	116.500	48	34.250
DRIVEN	54.695	54.695	113.000	48	32.500
DIR 1	95.237	40.542	109.500	48	30.750
DIR 2	157.532	62.295	106.250	48	29.125
DIR 3	226.779	69.247	104.250	48	28.125
DIR 4	308.821	82.042	102.375	48	27.187
DIR 5	398.125	89.304	98.500	48	25.250

The match was accomplished with the original Cushcraft parts. The antenna was tuned up with a signal generator and a return loss bridge / SWR meter. With the dimensions shown the match was -38.5dB return loss at 50.150 or a 1.025:1 SWR. An SWR curve is shown below.

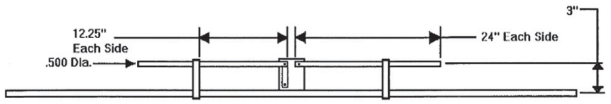


Figure 8

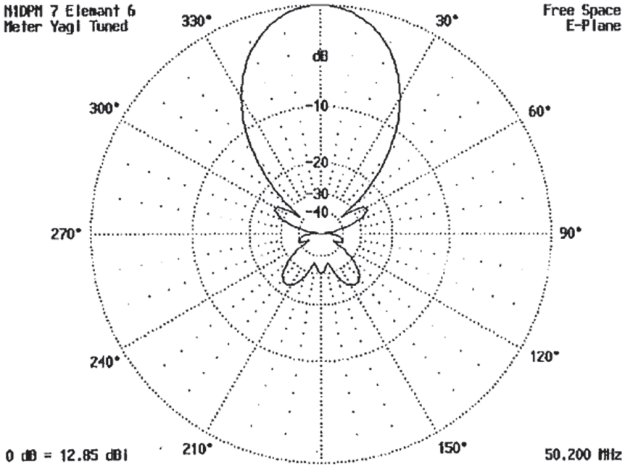


Figure 9

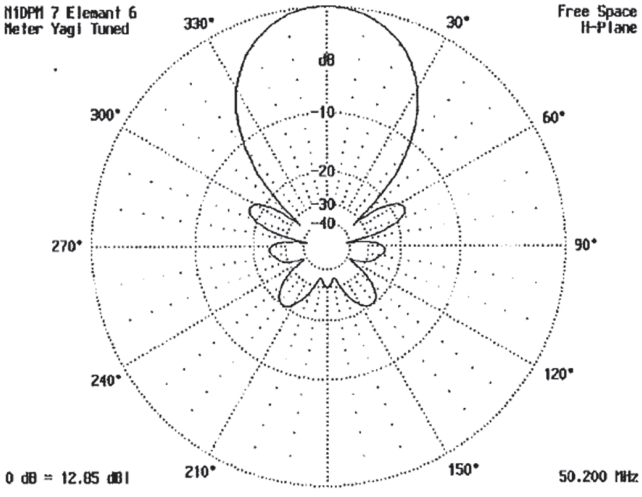
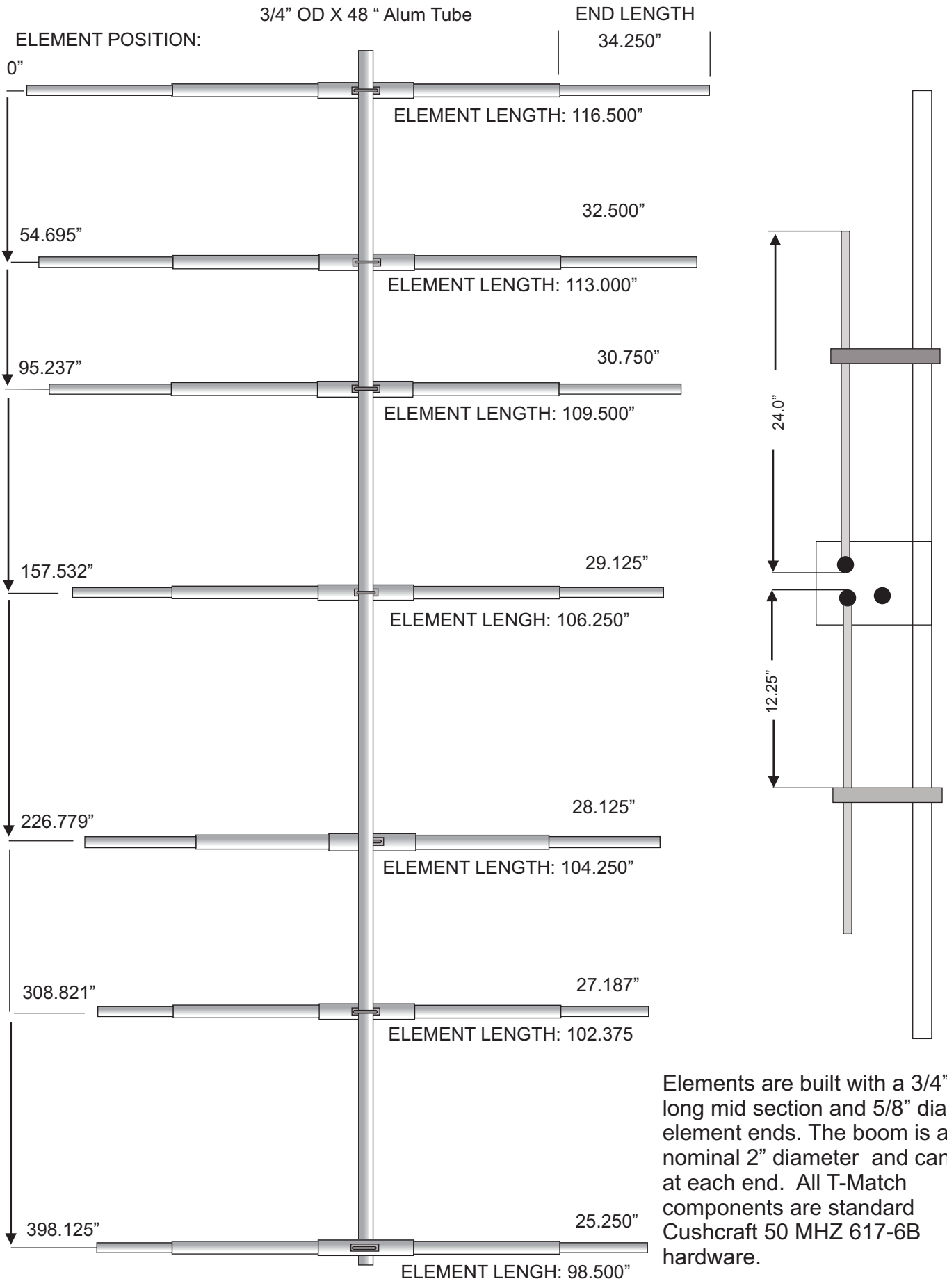


Figure 10

N1DPM 7 ELEMENT 50 MHZ YAGI



Elements are built with a 3/4" X 48" long mid section and 5/8" diameter element ends. The boom is a nominal 2" diameter and can taper at each end. All T-Match components are standard Cushcraft 50 MHZ 617-6B hardware.

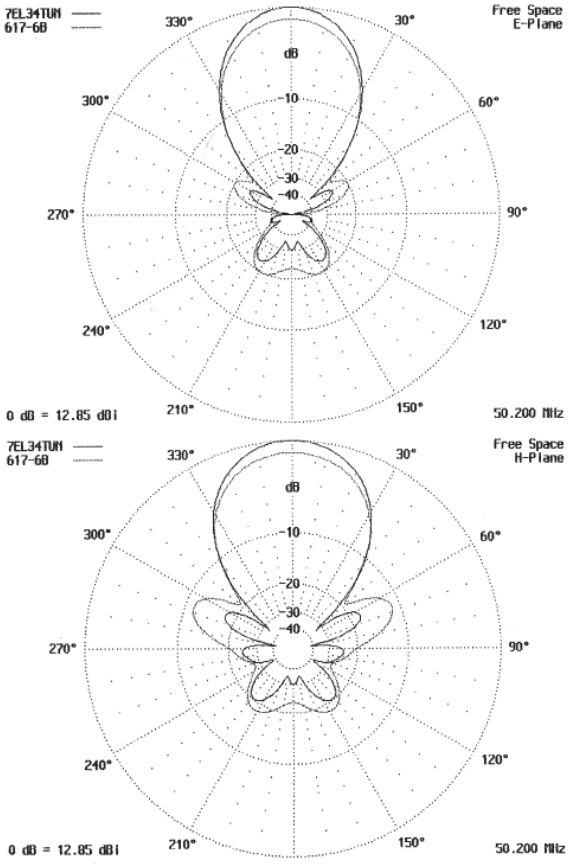


Figure 11

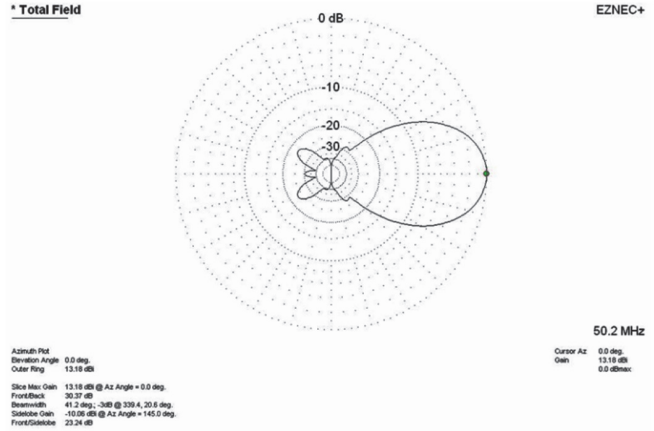


Figure 12

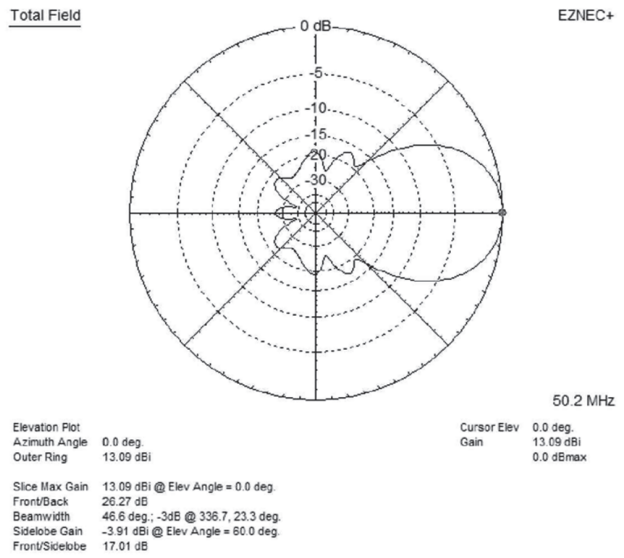


Figure 13

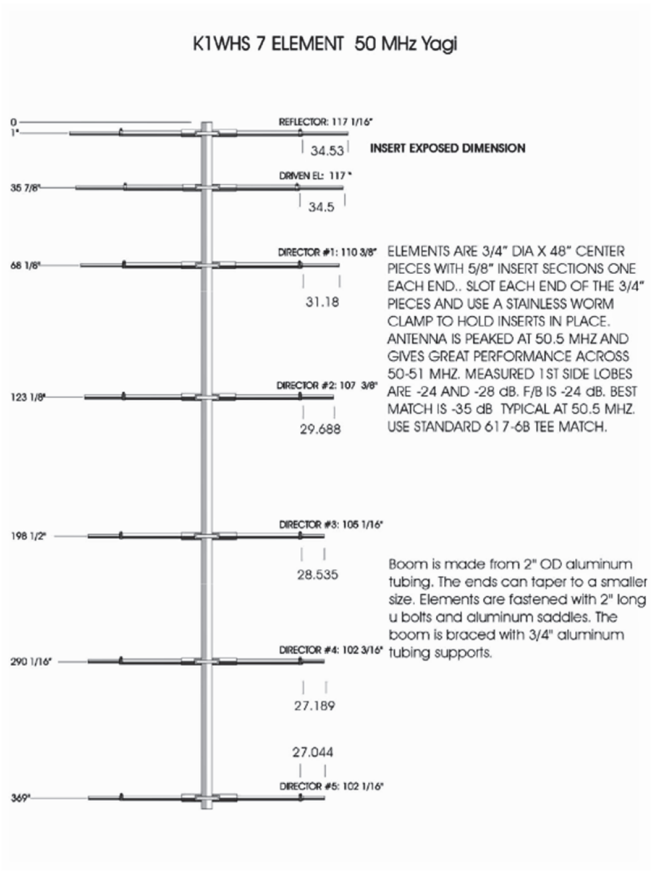


Figure 14

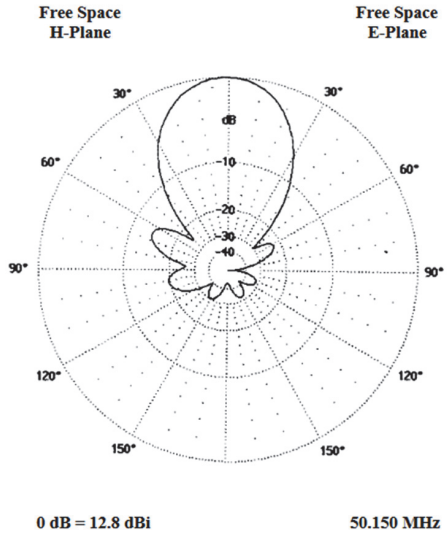


Figure 15

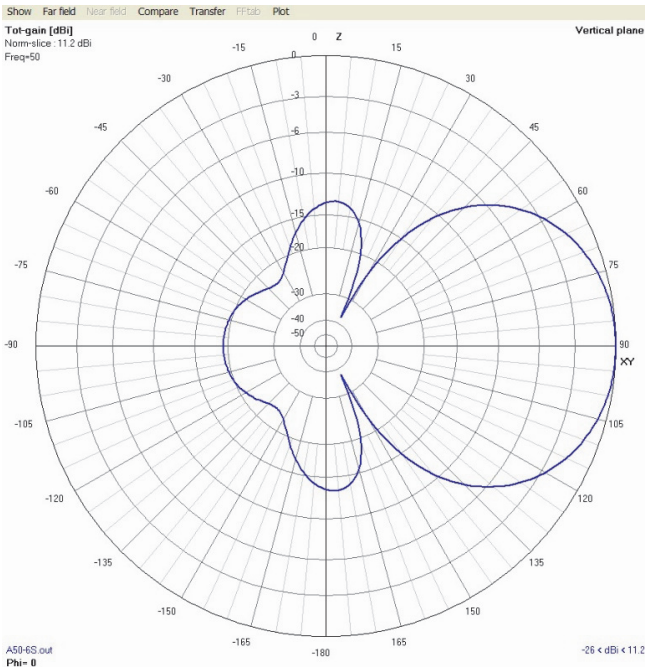


Figure 17

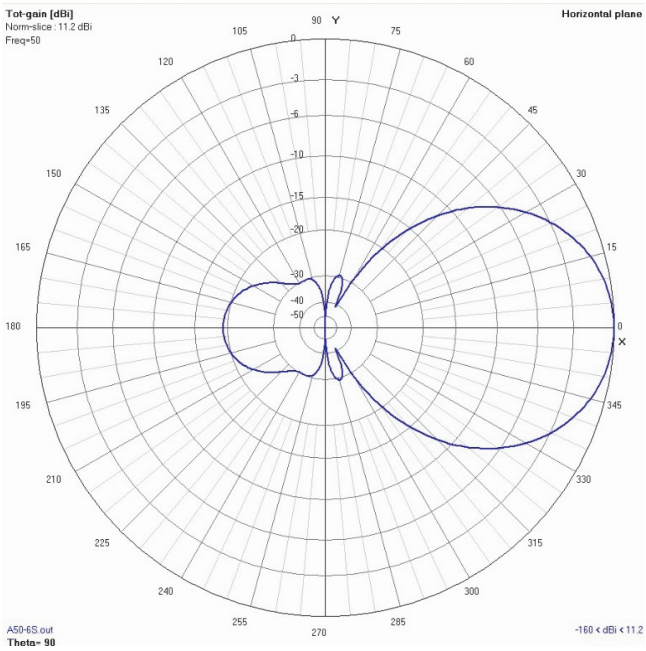


Figure 16

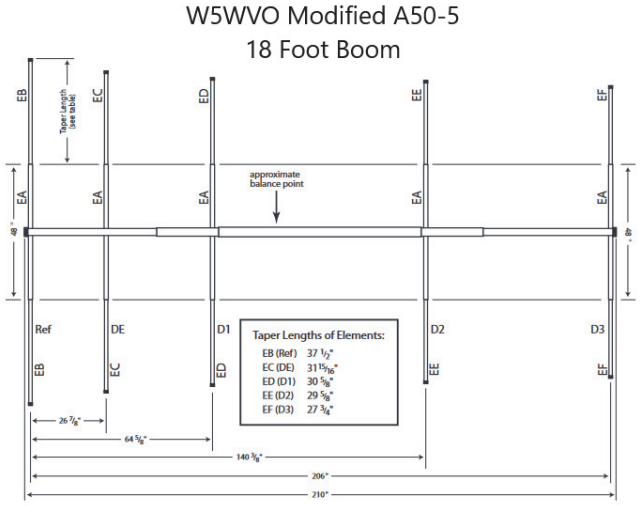


Figure 18

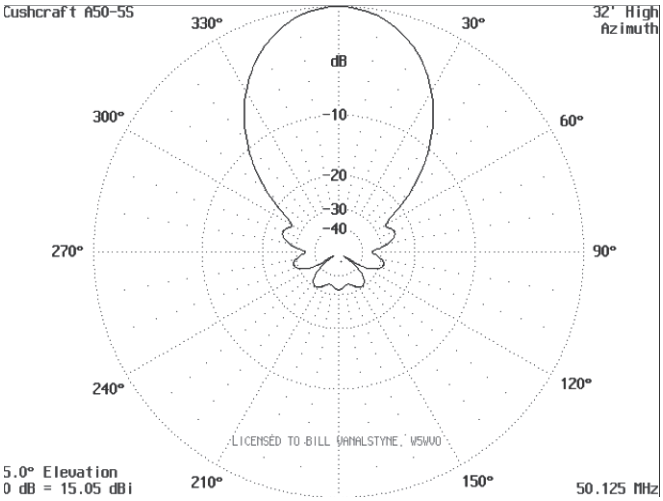


Figure 19

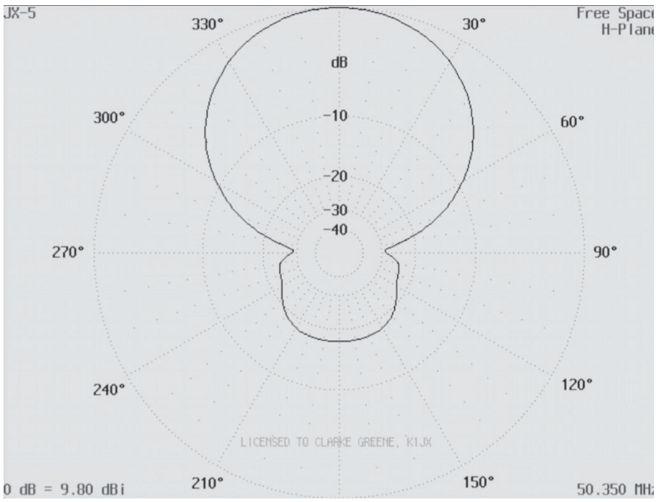


Figure 22

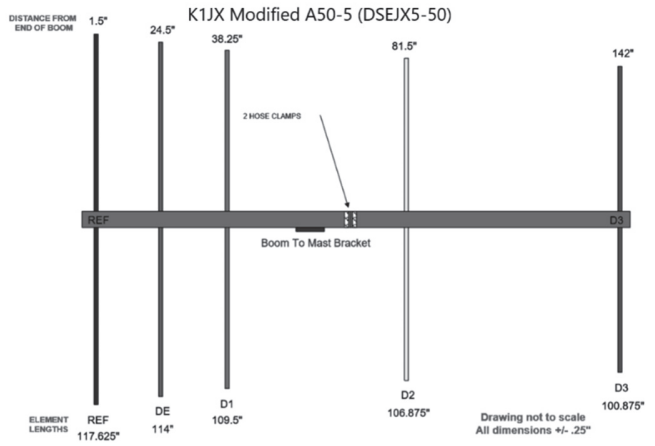
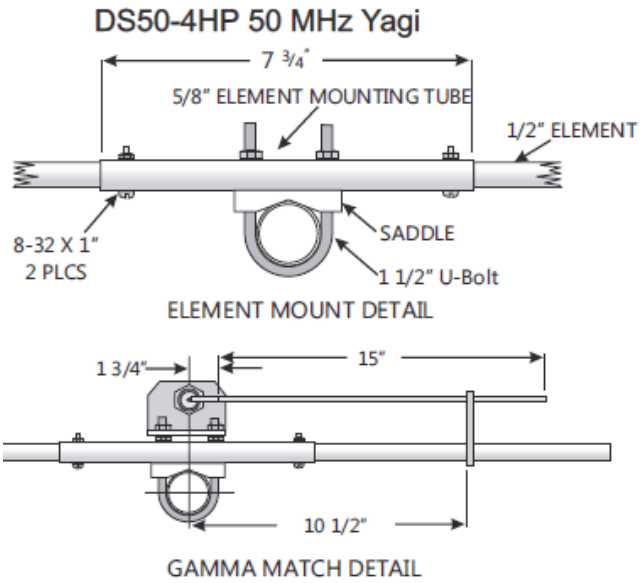


Figure 20



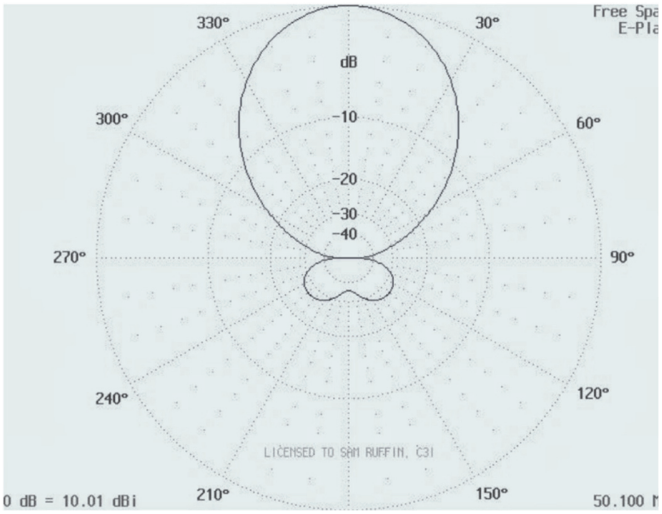


Figure 21

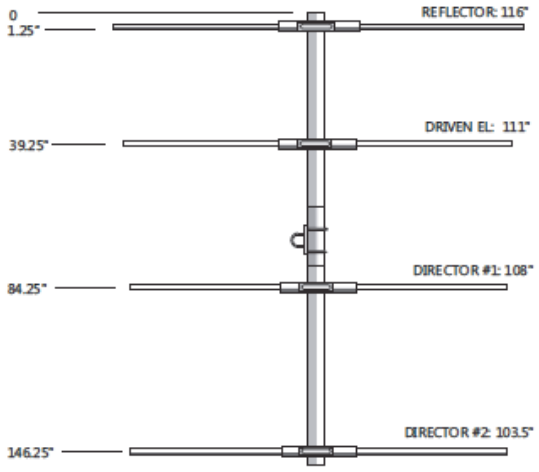


Figure 23

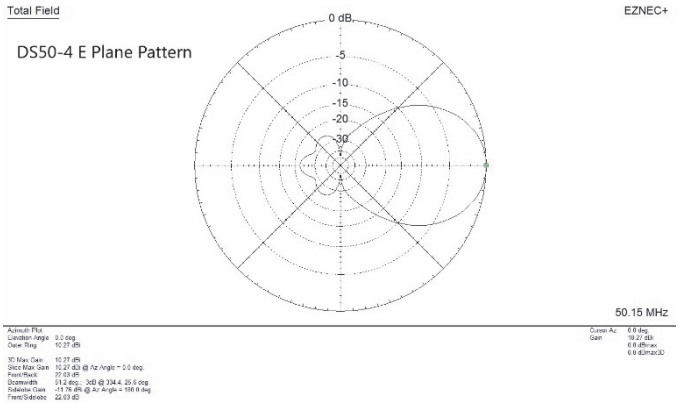


Figure 24

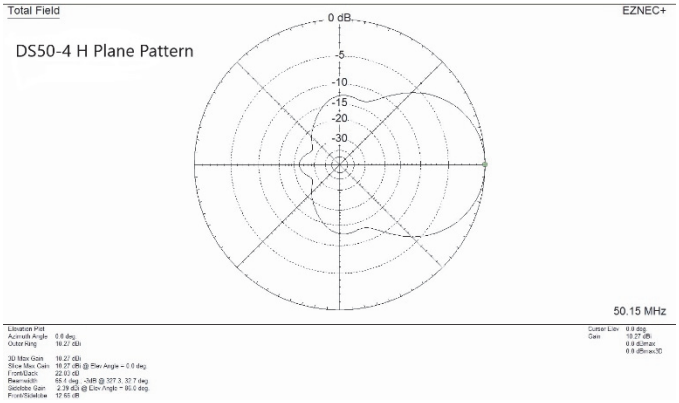


Figure 25