Boulder Amateur Television Club
TV Repeater's REPEATER

December, 2023
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BATVC web site: www.kh6htv.com

ATN web site: www.atn-tv.com

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News Flash ! - 8 December

WRC-23 Reaches Acceptable Conclusion on 23 cm Issue

IARU President Tim Ellam, VE6SH, said “This is a very good result for the amateur services. The decision reached at WRC-23 on this agenda item makes **NO CHANGE** to the table of allocations nor incorporates by reference M.2164 into the Radio Regulations. The addition of a footnote that provides guidance to administrations in the event of interference to the RNSS is a good regulatory outcome for amateurs and the primary users of this band.”

IARC-WARC team - 2023

To read more about this issue: ***https://www.iaru.org/recommendation-on-ai-9-1b-approved-at-wrc-23/***
also -- ***https://www.arrl.org/news/wrc-23-reaches-acceptable-conclusion-on-23-centimeter-issue***

Special Issue on
ATV Antennas

The bulk of this issue of our ATV newsletter is devoted to antennas for ATV. The key word for such antennas is -- **"BROAD-BAND"**. Our TV signals are broad, 6 MHz typically, plus when we transmit on several TV channels, we need to be able to cover the entire band. Our two most popular bands for ATV are #1 - 70cm & #2 - 23cm. The required antenna band-widths are thus at least 30 MHz (420-450) and 60 MHz (1240-1300).

Any article on antennas will always be insufficent. There are so many choices out there, it is darn near impossible to try to test all of them. Here in Boulder, we have some favorites used by most. For a 70 cm Base Station, most prefer the 7.2 dBi, Diamond X-50NA. For a 70cm Yagi, the favorite is the 11 dBi, 6 element, M-Squared 440-6SS. For a 23 cm Yagi, the favorite is the 15 dBi, 14 element, Directive Engineering DSE2414LYRMK. For our W0BTV repeater's receive antenna, we use the tri-band (2m/70cm/23cm) Diamond X-6000A For our current Boulder ATV antenna testing, we are using what antennas we can borrow from other hams. Definitely a very small sample of what is available. All the more reason why we want to hear from other ATV ham groups.

Each ATV repeater group has their own favorite antennas. Please write to us with your list and tell us why. We will then pass the info on to our readers. In this issue, Mario, N2JWP, an ATV pioneer on Long Island, New York shares with us his favorite. What are yours ?

Antenna Tests: In years past we have run a couple of major testing sessions to evaluate antennas for ATV service. The first was in 2011 and was documented in KH6HTV app. note AN-4, "Antennas for Ham TV". The second was in 2017 and documented in KH6HTV app. note AN-40, "70cm Antennas for ATV". Once again, here in 2023-24, we are now doing some more antenna testing. We will report our results in a future newsletter. In none of the tests are the results totally accurate. They are never performed on high quality antenna ranges nor using the methods employed by organizations such as Georgia Tech Univ., FCC or NIST. So, gain figures from our tests are really not absolute, but in reality comparisons between various antennas of their performance on our particular test range.

Polarization: Boulder uses Vertical for both 70 cm & 23 cm bands. Why? It was a historical decision dating back to the early 90s. To support in the field ARES operations, both back-pack portable and mobile, vertical antennas were deemed the most suitable. Other ATV groups have elected to go horizontal. They typically are the out growth of weak signal SSB/CW DXers choice of horizontal. What does your group use ? One advantage of using horizontal is the extra 20 dB of isolation between the dominant vertical polarization used by the FM voice crowd and their multiple repeaters.

Mario, N2JWP's Favorite ATV Antenna:

Marios says his favorite is one he has used successfully for many years. It is a 22 element, K1FO Yagi antenna. He presently owns five of them. He writes "It appears that the gentleman who designed it originally may have passed and the design rights were possibly purchased." A search on qrz.com shows the K1FO call sign is now held by the North-East Weak Signal Group club.

A further web search for K1FO antennas reveals that they are now being built and sold by Directive Systems & Engineering in Haymarket, Virginia. (***www.directivesystems.com***). They list the 22 element, K1FO Yagi as their model # DSEFO432-22. Their specs. are: freq. range = 432-435MHz, 15.8dBd Gain (i.e. +18dBi), 24º beam-width, 22dB F/B, vswr = 1.14:1 at resonance, It is a BIG antenna with a 14 ft. long boom, center mount. DSE's price is $260 (kit).

How well does it perform away from the CW/SSB frequency of 432 MHz ? That is an unknown. Hopefully, some of you ATVers out there will enlighten us. But Mario has put it to use on ATV frequencies some distance away from 432 MHz. Here is what he has to say about it. --- "An aged gentlemen in my ATV group in the early nineties had recommended it to me. Our receive frequency was 421.25 MHz, transmit frequency was 434 MHz for the ATV repeater. My 7-Pole Inter-digital Band-Pass filters were cut for those frequencies I have always been very satisfied with it since way back in time. It performed stellar with the right weather conditions in tropical ducting with my 4 beam array. My best QSOs were with W3PHL in PA, some 125 miles away. Our ATV transmissions to the World Trade Center ATV repeater (pre 9/11 !) were reliable from 45 miles away with the analog format. We would upon occasion experience sea coast radar interference only, but that was it." Are you happy with it? --- "Yes, for the length of time that I had it, no damage apparent when taken down." What can you tell us about it ? --- "The only shortcoming it had when taken down were the insulated standoffs were cracked, but the stiffness of the copper used in the Gamma match held its proper spacing intact on the boom."

Mario's K1FO, 22 element Yagi

Mario used his Comet VSWR meter recently to look at his ATV antenna. He wasn't able to get directly to the antenna, but some distance back in the ham shack. This is what he measured. It definitely shows the antenna works best at the top end of the 70cm band.

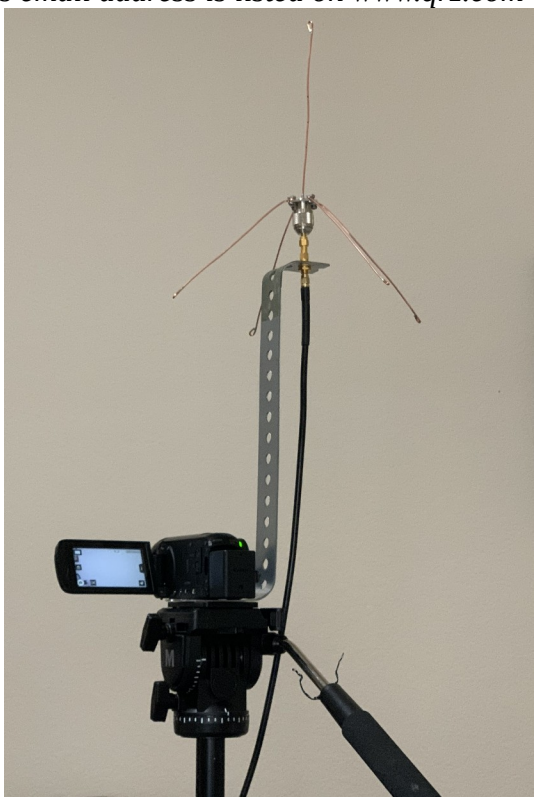
"DVB-T is a new game for me, hence I never dismantled my rack mount Analog TV Transmitter and PC Electronics Receiver, which has a 35 Watt pre-driver amp and a 100 Watt final and GaAs FET preamp in the garage before leaving the house for the tower and can be substituted by throwing a coaxial switch."

73 de Mario Klas, N2JWP, Deer Park, New York

Editor's Note: *Mario is anxious to rejuvenate ATV activity in the New York City area. It has been dorminant for a long time now after their ATV repeater on the World Trade Center went down on 9/11. Other NYC area hams are encouraged to contact Mario. His email address is listed on www.qrz.com*

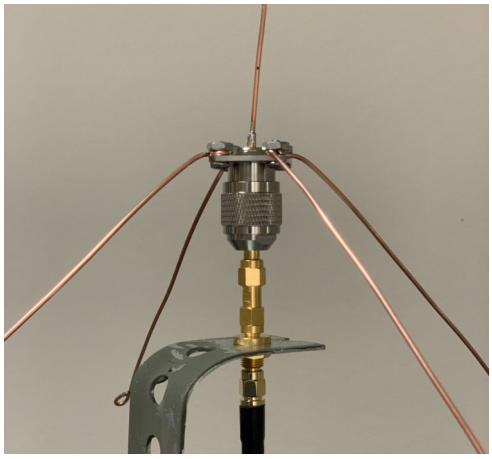
Inexpensive Antenna Mount for Camera Tripod

Jim, KH6HTV



Ten years ago, I published my app. note, AN-15, "Simple Camera Tripod Antenna Bracket". I think it is worth while to again bring it to the attention of you ATVers. It is extremely simple to build and very low cost.

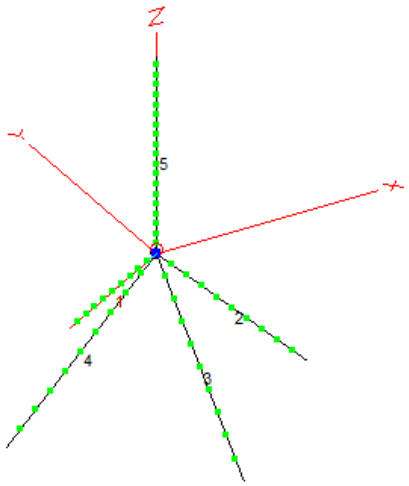
The antenna bracket is fabricated from a piece of 1 3/8", 14 gauge, perforated, steel flat bar. The steel bar is pre-drilled with 3/8" holes. These bars are readily available from your hardware or home improvement store. The thickness of the bar is ideal to fit between the camera tripod mounting plate and the camcorder. Only one or two holes need to be drilled. An extra, small, #12 (0.189") hole is drilled next to an existing large hole to accommodate the base plate alignment pin. The camera mounting screw is typically either a 1/4"-20 (small consumer cameras) or 3/8"-16 (large professional cameras). Either screw will go through one of the pre-drilled 3/8" holes. To mount the antenna, I use either a BNC or SMA jack/jack (f/f) bulkhead adapter. For a BNC another existing hole on the top of the bracket is enlarged to 1/2" for mounting the BNC bulkhead adapter. The bracket is then bent in two locations as seen in the photo. The exact length of the bar and location of these bends depends upon the size of the camera used and the desired antenna height above the camera. A 50 Ω, coax cable is used to attach the antenna to the TV transmitter.



REFERENCE GAIN -- 1/4 λ Ground Plane Antenna

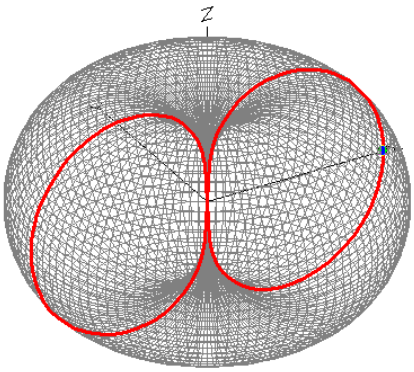
Jim, KH6HTV

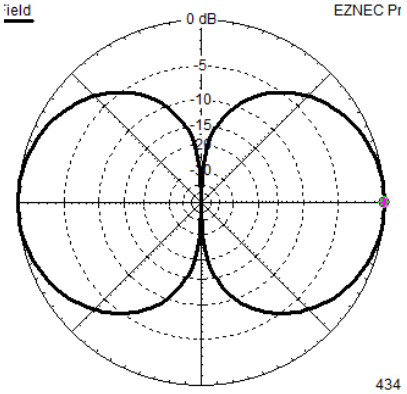
We could just simply do comparison tests between various antennas and rate them accordingly. However, it would really be nice if we could assign an absolute gain value in dBi. To do this, we need to have some reference antenna to compare our other antennas to. For microwaves, we typically use a standard gain, flared waveguide horn antenna. For HF & VHF measurements, the classical 1/2 wave (λ) dipole antenna is typically used. For vertical polarization on VHF/UHF, we typically use a 1/4 λ ground plane antenna. It consists of a single 1/4 λ vertical radiator rod plus four, 1/4 λ radials drooping down at a 45° angle.

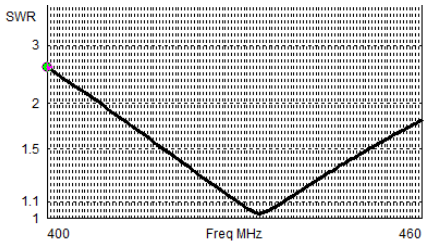


Using the EZNEC antenna modeling program, it is straight forward to determine this antenna's predicted performance.

I designed on EZNEC such an antenna for the 70 cm band. It was designed for a center frequency of 434 MHz and used #14 gauge, solid copper wires for the elements. The lengths of both the vertical radiator and the four radials were optimized on EZNEC. The final design was with a vertical radiator of 6.2". The four radials were 6.7".







EZNEC calculations: Free Space Gain = 2.1 dBi flat across 70 cm band. Omni directional performance in the azimuth (X-Y) plane. min. VSWR = 1.03:1 at 434 MHz, 1.5:1 vswr limits (-14 dB return loss) = 418 & 452 MHz

An actual antenna was then built using a bulkhead mount, square flange, type N (f) connector. This antenna is shown on the previous page mounted on the camera/antenna bracket. For eye safety, I looped the ends of all the 14 ga. copper wires back on themselves and soldered the loop to the wire. The lengths were then measured and cut to the tips of these loops. I then measured the vswr with a Nano-VNA. The results were: min. vswr = 1.05:1 at 430 MHz, < 1.5:1 (417-463), < 2:1 (409-470)

& < 3:1 (396-481 MHz) This antenna is thus a very good match to 50 Ω over the entire 70 cm amateur band.

So, can we use the calculated **Gain of +2.1 dBi** as our reference antenna ? Well yes and no. It is a starting place. It is the theoretical gain for the antenna out in free space with nothing else to perturbate the EM fields. With EZNEC, we can then start to add disturbances and see their effects on both the far field patterns and the gain on the horizon. First off, we have the coax cable feed line, plus the support mast dropping down vertically. A metal rod of various lengths can be tried with EZNEC to simulate these. It causes some dimpling in the pattern. It remains omni-directional, but now adds some uncertainty of ±1 dB or so to the +2.1 dBi gain figure. A major disturbance is to then simulate in EZNEC the effects of using the antenna over real earth. We now have ground reflections to deal with. They can get to be much more serious in distorting the far field pattern and cause greater variations in the gain.

But, being real "amateurs", not true antenna scientists, I guess for lack of better tools, we might as well go ahead and use the +2.1 dBi figure for our inter-comparisons of our various ATV antennas.

73 de Jim, KH6HTV

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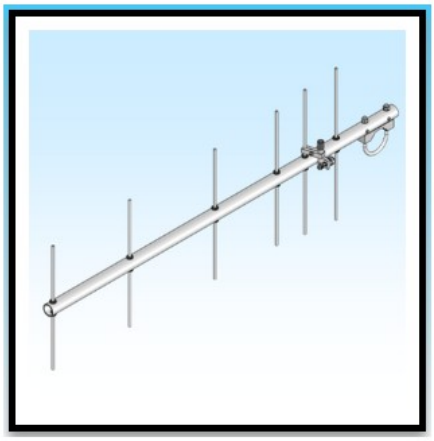
DIY - your own 70cm Yagi Antenna

Jim, KH6HTV



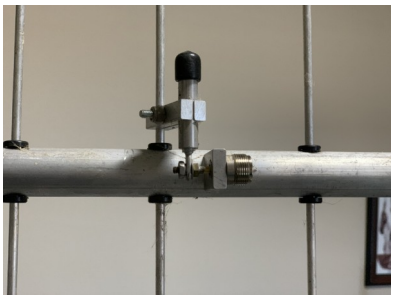
440-6SS Yagi

While the M-Squared 440-6SS Yagi is my personal favorite, broad-band, Yagi for 70 cm, it has recently gotten quite expensive at $169. It previously sold for many years at $100. The construction of it appears to be quite simple and could be duplicated in your own garage work shop. The yagi consists of a total of six elements. They are a driven element, one reflector element, and four director elements. The elements are 3/16" dia., solid aluminum rods appropriately spaced on a 3 ft, 1" dia. boom. I have measured them on my own antenna.

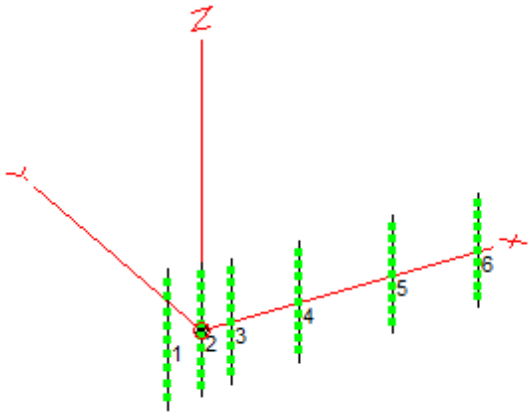
Here are the lengths and their respective positions relative to the driven element.

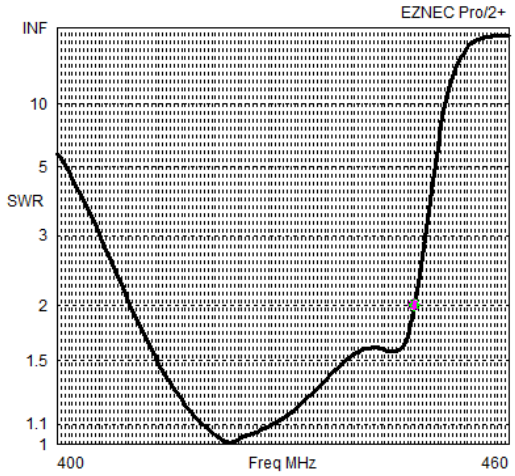
#1 Reflector: 34.7cm (-8.3cm) #2 Driven Element: 33.1cm (0 cm ref)
#3 Director: 30.7cm (7.4cm), #4 Director: 29.6cm (23.7cm)
#5 Director: 28.8cm (46.3cm) #6 Director: 28.2cm (66.7cm)

M^2 does not electrically attach the rod elements to the support boom. They pass through the boom and are held in place with insulating plastic spacers.



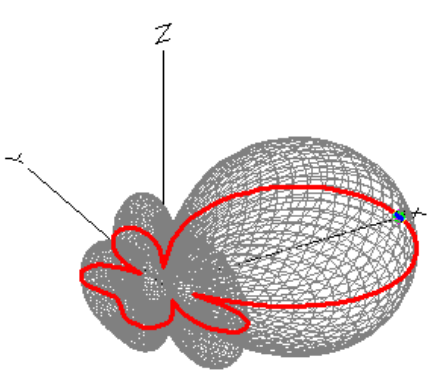
Here is a close-up photo of the construction of their Z - matching Gamma match and the UHF coax connector showing how they are attached to the boom and the driven element.

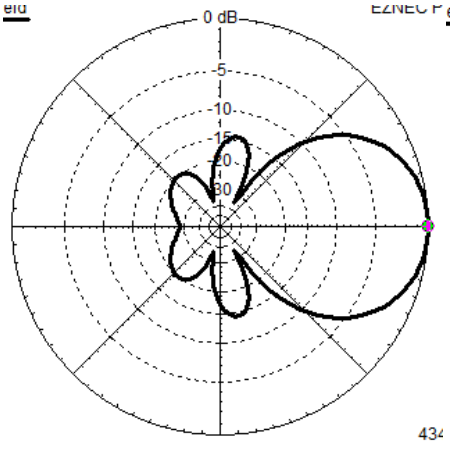




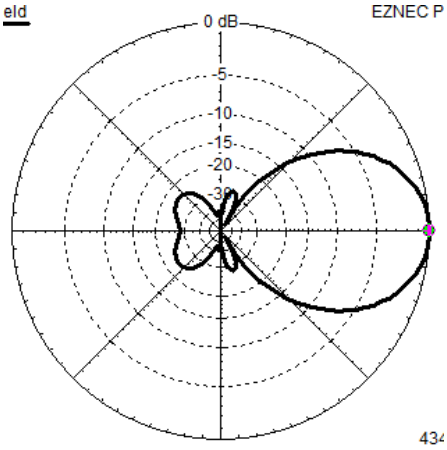
EZNEC Modeling: The M^2 yagi is an easy one to model. Simply enter the above data into the wire table for a total of 6 wires. Place the excitation source in the middle of wire #2.

The following is the predicted performance in Free Space. The VSWR plot shows the min. of 1.41:1 (-15.3dB RL) at 425 MHz with an impedance of about 35-36 Ω. Thus showing the need for the Gamma Match. If we then assume a gamma match is used and then replot the vswr using a ref. Z of 35 Ω we get this plot with a min. vswr of 1.006 at 423 MHz. The < 1.5:1 BW is 413-439 MHz. The < 2:1 BW is 410-448 MHz. The free space far field calculations show the below plots. The max. theoretical, free space gain is +11.5dBi, essentially the same as the M^2 specs.





Azimuth Field Pattern



Elevation Field Pattern

On my real M^2 Yagi, I measured a vswr min. of 1.2:1 at 436 MHz, < 1.5:1 (416-446) & < 2:1 (410-453 MHz) & < 3:1 (408-457). My measured < 2:1 band-width very closely matches the EZNEC calculations. These indicate that it should be a good antenna over the whole 420-450 MHz, 70 cm amateur band.

BOULDER ATV ANTENNA TESTING

We have started this winter a project to test various 70 cm antennas for possible use for ATV. We are looking to test four categories of antennas. They are: (1) Base Station, Omni-Directional (2) Directional Yagis, (3) Mobile Antennas & (4) Hand-Held HT Antennas. All with vertical polarization. We plan to test all antennas on all five, 6 MHz, ATV channels in the 70 cm band.

View from Lowell Blvd. test site to W0BTV-ATV repeater, 13 miles west

A "dry-run" was done on Dec. 6th on a single frequency (423 MHz) using the W0BTV repeater's Beacon mode as the test source. A few antennas were tested that day. For a receiver we used a pre-amp followed by a 3dB power splitter. One arm of the splitter went to a Hi-Des HV-110 receiver. The other went to a TinySA-Ultra spectrum analyzer. Actual signal strengths in dBm were recorded. We also recorded s/n.

Legionaire's Hill - Receive Test Site

Don, N0YE, & Larry, N8GGG

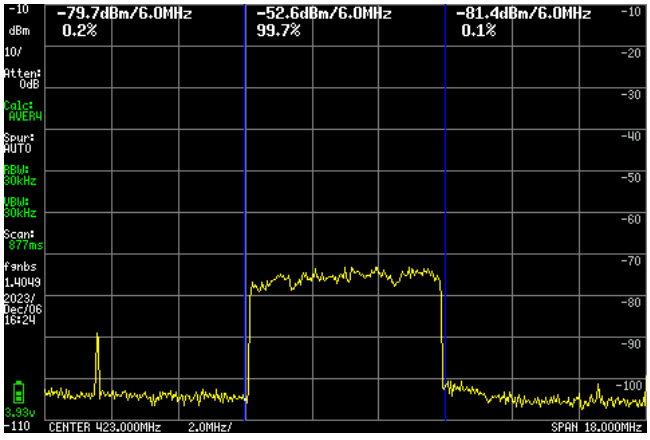
Then on Saturday, Dec. 16th, we tried to do a major test session with lots of participants and antennas to be tested. We set up our receivers on Legionaire's Hill county park, east of the City of Boulder. It is on high ground overlooking Boulder Valley and the Rocky mountains to the west. It is remote from any other structures. The terrain immediately to the west of the parking lot slopes down hill rapidly

which should reduce the effects of ground reflections and clutter from our measurements. Steve, WA0TQG, from his home on Sugar Loaf mountain, 11 miles to the west, provided our DVB-T test signal on all five ATV channels. Things did not go well this time. We had technical glitches and then after only about an hour the wind started blowing really hard. So we abruptly terminated the test session. To be continued sometime in the future.

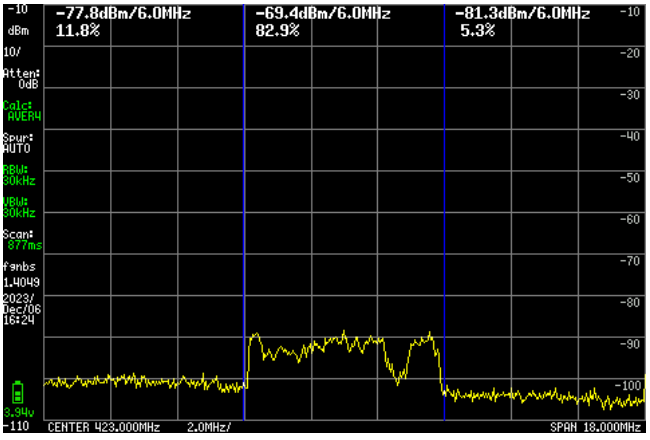
Rick, KK0COP, taking data

George, N0RUX & Doshia, KB0NAS

While the Dec. 16th test was a "Bust", we did get some useful data to be shared on Dec. 6th. The results that day were strictly on a single frequency, 423 MHz at the bottom of the 70 cm band. The two Yagis tested that day came in close to the anticipated +11 dBi gain. They were a very old, 6 element KLM (unknown model #) and an M-Squared 440-6SS. The KLM tested out at +9 dBi. The M-Squared tested out at +10 dBi.



Diamond X-50



Diamond X-6000

We also tested two Diamond base station omni, vertical antennas. They were the X-50NA and the X-6000A. Tests in previous years had shown the X-50 to be broad-band and worked well across the entire 70 cm band,. The X-6000 only worked, but worked quite well at the top end of the band, but had

negative gain at the bottom end of the band. The Dec. 6th tests confirmed this at 423 MHz. We measured +6 dBi (spec. 7.2 dBi) for the X-50. The X-6000 showed -11 dBi. See the above measured spectrums.

73 de Jim, KH6HTV, Boulder, Colorado

W0BTV Details:

Inputs: 23 cm Primary (CCARC co-ordinated) + 70 cm secondary all digital using European Broadcast TV standard, DVB-T 23cm, 1243 MHz/6 MHz BW (primary), plus 70cm (secondary) on 441 MHz with 2 receivers of 6 & 2 MHz BW
Outputs: 70 cm Primary (CCARC co-ordinated), Channel 57 -- 423 MHz/6 MHz BW, DVB-T
Also, secondary analog, NTSC, FM-TV output on 5.905 GHz (24/7 microwave beacon).
Operational details in AN-51c Technical details in AN-53c. Available at: ***https://kh6htv.com/application-notes/***

W0BTV ATV Net:

We hold a social ATV net on Thursday afternoon at 3 pm local Mountain time (22:00 UTC). The net typically runs for 1 to 1 1/2 hours. A DVD ham travelogue is usually played for about one hour before and 1/2 hour after the formal net. ATV nets are streamed live using the British Amateur TV Club's server, via: ***https://batc.org.uk/live/*** Select ***ab0my or n0ye***. We use the Boulder ARES (BCARES) 2 meter FM voice repeater for intercom. 146.760 MHz *(-600 kHz, 100 Hz PL tone required to access*).

Newsletter Details:

This is a free newsletter distributed electronically via e-mail to ATV hams. The distribution list has now grown to over 500+. News and articles from other ATV groups are welcomed. Permission is granted to re-distribute it and also to re-print articles, as long as you acknowledge the source. All past issues are archived at: **https://kh6htv.com/newsletter/**

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