Boulder Amateur Television Club
TV Repeater's REPEATER
August, 2020

BATVC web site: www.kh6htv.com

ATN web site: www.amateurtelevisionnetwork.org

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W0BTV Details:
Inputs: 439.25MHz, analog NTSC; 441MHz/6MHz BW, DVB-T & 1243MHZ/6MHz BW, DVB-T Output: 423MHz/6MHz BW, DVB-T Operational details in AN-51a Technical details in AN-53a. Available at: https://kh6htv.com/application-notes/ We hold an ATV net on Thursday afternoon at 3 pm MDT. ATV nets are streamed live using the British Amateur TV Club's server, via: https://batc.org.uk/live/kh6htvtvr or n0ye.

Another ATV Newsletter
Art, WA8RMC, puts out a great quarterly newsletter for ATCO, Amateur Television in Central Ohio. ATCO has more than 50 members. The latest issue includes news from several other ATV groups around the USA and also Australia. If you would like to receive future copies of their newsletter, send your request to Art at: towslee1@ee.net ATCO's web site is: www.atco.tv

ANALYSIS of 10 GHz, DVB-T DX-Pediton Results
Jim, KH6HTV

In the previous newsletter, we reported on the Boulder ATV hams, July 12th experiments with DVB-T video transmission on the 3cm (10GHz) band. In all cases, of successful reception, the S/N was usually just above the minimums required. So the question arises, how did these results compared with the theoretical predictions for each path ?? The free, on-line, RF Path Predicion program, Radio Mobile, was used to generate the predicted receive signal strengths for each rf path. The previous newsletter included a table of the site locations along with the transmitter power and antenna gains. These values were used in Radio Mobile.

For the receiver I (KH6HTV) used, I had previously measured it's sensitivity on my lab bench. For the "Agressive" digital transmission parameters everyone used (i.e. 720P, 1/2 FEC, etc.), my receiver's digital threshold was found to be -100dBm. At that level, the Hi-Des model HV-120 receiver's On-Screen-Display showed a S/N = 5dB. (Also of note, when using "Normal" parameters (i.e. 1080P, 5/6 FEC, etc.) the theshold was -96dBm with S/N = 8dB) I thus assumed the same values for the receivers used by the other ATV hams. During the actual exercise, each ham reported both the background, no signal, RF power and the best RF signal level observed on a signal. These were taken from the Hi-Des receiver's S meter in dBm. WB2DVS/DVT's receiver did not have an S meter.

Successful & Unsuccessful 10 GHz, DVB-T Contacts

Transmitter	Receiver	Distance	Best Signal above noise	Rcvd Signal (approx)	Radio Mobile Prediction	Difference
N0YE	KH6HTV	7.4 miles	15 dB	-90dBm	-61dBm	29dB
N0YE	WB2DVS	2.2 miles	P 5	> -100dBm	-67dBm	< 33dB
N0YE	AB0MY	22.3 miles	10 dB	-95dBm	-69dBm	26dB
KH6HTV	N0YE	7.4 miles	10 dB	-95dBm	-64dBm	31dB
KH6HTV	AB0MY	18.1 miles	5 dB	-100dBm	-76dBm	24dB
AB0MY	WB2DVS	22.1 miles	P 5	> -100dBm	-86dBm	< 14dB
WB2DVS	N0YE	2.2 miles	4 dB	-100dBm	-64dBm	36dB
KH6HTV	WB2DVS	5.6 miles	no go		-66dBm	
AB0MY	KH6HTV	18.1 miles	no go		-76dBm	
AB0MY	N0YE	22.3 miles	no go		-72dBm	
WB2DVS	KH6HTV	5.6 miles	no go		-60dBm	
WB2DVS	AB0MY	2.2 miles	no go		-80dBm	

The above table summarizes the results. The best result was actually for the longest path of 22 miles from Bill, AB0MY, to Pete & Debbie , WB2DVS/DVT. Radio Mobile predicted a weak signal of -86dBm, but Pete & Debbie easily received it. The difference in prediction and actual was less than 14dB. However, for all of the other situations, the differences between theory and reality was more of the order of 25-30dB. Why ? --- well one reason could very well be our in-ability to fine tune the respective pointing of both antennas. Hopefully, with experience, we can improve these results. If we expect to achieve greater distances in the future, we will have to be more accurate in our antenna pointing. -- Or, it could be some other equipment issue which accounts for the dramatic shortcomings ? ? --- Read further for more recent tests.

Antenna Beam Width

Jim, KH6HTV

So, if some of our issues relate to correct pointing of our dish antenas, then how narrow are their beamwidths ? I posed this question after our 10 GHz outing. Pete, WB2DVS, responded. "I found a couple of interesting websites regarding antenna beamwidth. The first one has an on-line calculator: https://www.satsig.net/pointing/antenna-beamwidth-calculator.htm "

This calculator is for parabolic dish antennas, the input data is the diameter of the dish, the frequency and the efficiency of the feed. The default value given for the efficiency was 0.65.

We are basically using two types of dish antennas for 10 GHz. The first is a 12" dia. dish with a waveguide feed. The second is an 18", offset feed dish salvaged from satellite TV installations. In the Nov. 2019, issue #25, of this newsletter, Don, N0YE, published the results of his antenna range measurements on these and other antennas for both 5 and 10 GHz. See pages 5-8. His results were 27.5dBi for the 12" dish and 32.5dBi for the 18" dish.

So, using Don's gain figures and adjusting the efficiency parameter in the satsig.net's on-line calulator, we come up with the following results for 10.359 GHz. The 5dB increase in gain resulted in halving the beamwidth from 8 to 4 degrees.

12" Dish: Gain = 27.5dBi, efficency = 0.515, **-3dB Beam Width = 8.0 degrees**

18" Dish: Gain = 32.5dBi, efficency = 0.72, **-3dB Beam Width = 3.9 degrees**

The wider 8 degree beamwidth of the 12" dishes may help to account for why the DVB-T contact between AB0MY and WB2DVS/DVT came the closest to the theoretical signal strength. Both stations were using 12" dishes.

I also posed the question to our resident antenna expert, Prof. Ed Joy, K0JOY. Ed is a professor emiritus from Georgia Tech where his speciality was antennas. Here is a portion of Ed's reply. Ed then also gave serveral examples.

Gain of Antennas Based on Principal Plane Beamwidths

For Rectangular (Including Square) Apertures or Effective Areas

$$G = \frac{52525\eta_{\Omega}\eta_{AZ}\eta_{EL}}{BW_{AZ}BW_{EL}}$$

For Ellipsoid (Including Circular) Apertures or Effective Areas

$$G = \frac{41253\eta_{\Omega}\eta_{AZ}\eta_{EL}}{BW_{AZ}BW_{EL}}$$

These equation ignore polarization.

η_{Ω} = Ohmic Efficiency $(0 \le \eta_{\Omega} \le 1)$

η_{AZ} = Aperture Efficiency in Azimuth Plane $(0 \le \eta_{AZ} \le 1)$

η_{EL} = Aperture Efficiency in Elevation Plane $(0 \le \eta_{EL} \le 1)$

$BW_{AZ} = -3dB$ Azimuth Plane Beamwidth in Degrees

$BW_{EL} = -3dB$ Elevation Plane Beamwidth in Degrees

$$G_{dB_i} = 10\log_{10}(G)$$

Ed Joy, KØJOY

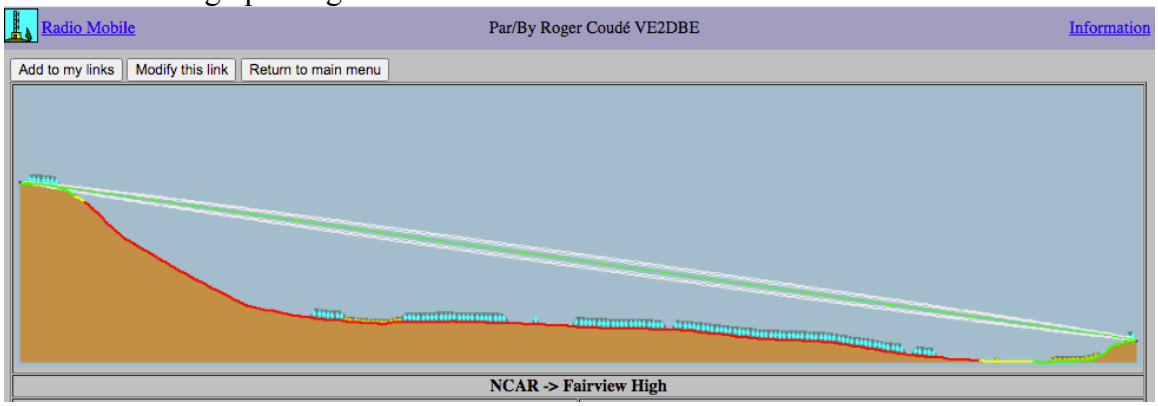
Pete, WB2DVS, & Debbie, WB2DVT (left) & Jim, KH6HTV, (right)
-- photo by Bill, AB0MY

10 GHz, DATV Equipment Test Session

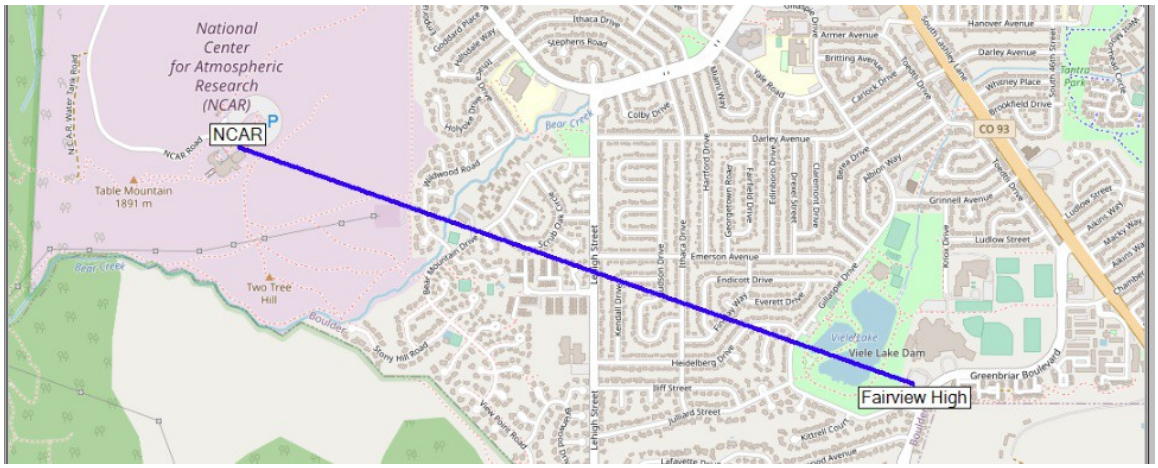
After the disappointing results on July 12th reported above, our microwave guru, Don, N0YE, decided to set up a more controlled experiment so everyone could check out their 10 GHz rigs. So, on the following Sunday, July 19th, several hams set up their 10 GHz, DVB-T rigs in the parking lot at Fairview High School, in Boulder. Don, N0YE, set up

his rig up the mountain side 1.5 miles away in the parking lot of NCAR. From there, Don had a direct, line-of-sight view of the Fairview High parking lot. His TV camera with it's zoom lens even was looking at the hams at Fairview.

10.359 GHz, DVB-T signal from Don, N0YE, at NCAR as received by Jim, KH6HTV, using an X-band, waveguide horn antenna. Don's camcorder is looking directly at us in the Fairview High parking lot. Distance = 2.46 km = 1.53 miles



RF path profile from NCAR parking lot to Fairview High parking lot



Transmissions were exchanged in both directions. Everyone took S meter readings to compare results. Don also used a step attenuator to drop his rf power in known increments to help in the calibrations. Here were Don's comments afterwards:

"Jim, Deb, Pete, Bill and I did a 10 GHz outing this morning as a shake down of our equipment. And there was a whole lot of shaken that went on.

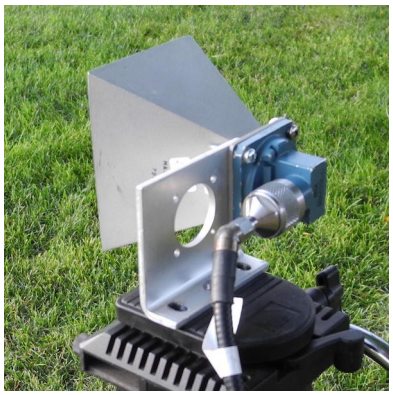
I had intermittent freeze frame on my receiver while monitoring my transmission. That turned out to be a loose SMA connector on my HV110 receiver. Pete and Deb's new Hi Des HV122 receiver refused to work. Jim has a dud satellite dish that essentially was nearly a dummy load. His 17 dBi horn worked quite well instead. Bill must have been too prepared because his stuff worked well. in fact Bill's system had a receive threshold 47 dB down from my maximum output level. We did some antenna pointing exercises to the benefit of the players. The higher gain antennas have to be carefully aimed to get maximum performance. We did some weak signal testing to show how sensitive a couple of the systems were. It would appear that the next outing should be with some significant distances". Don, N0YE

So, what were some of the numbers ? The best results were obtained by Bill receiving Don's signal. Don was transmitting +20dBm rms into an 18", offset feed, dish antenna with +32dBi of gain. He had -1.5dB of loss in his coax cable. Bill was receiving with a 12" dish antenna with a waveguide feed. The RF path prediction program, Radio Mobile, predicts that the received signal would be -63dBm. Don was able to drop his signal by 47dB to hit Bill's DVB-T receiver threshold. What was Bill's receiver sensitivity? It has not been bench tested, but my (KH6HTV) similar receiver measured on the bench a

AB0MY's 10GHz, DVB-T transverter with 12" dish antenna and waveguide feed

digital threshold sensitivity of -100dBm, with a s/n = 5dB, when using "aggressive" modulation parameters (1/2 FEC, etc.). So if we assume -100dBm, and Bill had a margin of 47dB, that would say his received signal strength was -53dBm, 10dB better than Radio Mobile predicted. Well looking at Radio Mobile's results, it said the free space loss was -121dB, but it added in 7dB for "obstruction loss", 1dB for "forest loss", 5dB for "urban loss" and another 7dB for "statistical loss" for a total path loss of 140dB. Well in this case, we had a true visual line of sight with no obstructions other than some tall grass, no trees, and no buildings. So if we throw those away from Radio Mobile's calculations, we end up just about at Bill's results. Conclusion, Bill and Don had it nailed right on !

Pete & Debbie had just purchased a new HV-122 receiver which they were trying for the first time. It didn't work. Pete later contacted Calvin at Hi-Des and discovered that the HV-122 will not work with an inverted spectrum. With the particular LO used in Pete's 10GHz rig, the spectrum gets inverted, i.e. upper sideband becomes lower sideband and vice versa. Calvin agreed to swap an HV-110 for the HV-122. *Editor's note: Guess this means I need to redo my app. note, AN-50 !*



So, Bill's rig was right on the money. That was the "Good" result. The "Bad & Ugly" result was Jim, KH6HTV's. Jim was able to pick up Don's signal with his 18", offset feed antenna, but with a much weaker S meter reading than Bill's, and way off of bore-sight. Jim then switched to using an X-band, reference standard, waveguide horn antenna with a calibrated +17dBi of gain. He immediately got a much stronger signal from Don. Based upon previous bench tests calibrating his S meter, with the waveguide horn, he received -68dBm. In this situation, Radio Mobile predicted the signal would have been -73dBm. In other words, Jim's horn antenna came in +5dB better than predicted. Taking these results with what Jim measured on the dish antenna, it said his dish antenna had a whopping -2dBi of gain ! ! ! Ops ! bad news. Jim had also noted that the aiming was way off on his dish. It was off by 7 deg. in azimuth and 4 deg. in elevation. Later, when Don looked at the dish, he said "Bad News, this Dish Network salvaged dish was intended for a totally different feed for 3 satellites and will not work with the current feed and it's location. This really demonstates the need to have the feed properly positioned at the focal point of a dish. Well, by now you can guess where this Dish Network dish has ended up -- In the Trash Barrel !

VK3RTV Repeater Now Active:

Peter, VK3BFG writes -- "VK3RTV is now active …. Pictures attached. 80% Homebrew and or assembled from Kits. Final is a W6PQL 70 cm 500 watt linear running 120 watts." For more details on their new ATV repeater, see the latest issue of the ATCO newsletter, Vol 37-3, pages 5 & 6.

Editor's Note: Check out all the great products from Jim, W6PQL at his web site: www.w6pql.com

Gary, WB5PJB - PVI Modulator ?

Gary asks -- "Has anyone checked out this modulator from PVI that does DVB-T, ATSC and just about any digital TV mode? https://www.provideoinstruments.com/hdmi-modulator
I wonder if the frequency entry can be any value in the VHF to UHF range, or do they force you to only use the standard broadcast channelized frequencies? The manual says it can do 6 MHz BW, but again, is that only in certain video standards and country settings?" Gary, WB5PJB, Castle Rock, CO

We carefully studied the PVI website and have downloaded the manual, but it is quite vague and leaves a lot of ?? unanswered. So, I sent an inquiry direct to PVI. Here is their answer. *"The Minimod-2 can support any frequency from 50-999 MHz up to the thousandths place. You can set an arbitrary frequency."* Thus, drawing from both the PVI and Hi-Des spec. sheets, I made up the following table comparing the PVI unit to the Hi-Des model HV-320E which is currently the most popular DVB-T modulator used by DATV hams.

Parameter	**Hi-Des HV-320E**	**PVI VeCoax MiniMod-2**
Price	$369	$495
DTV Standards supported	DVB-T	ATSC (USA), DVB-T (Europe), DVB-C (Europe), J.83B (USA digital cable), ISDBT-b (Latin America) & DMB-T (China)
Frequencies	100 - 2500 MHz	50 - 999 MHz
Bandwidths	1,2,3,4,5,6,7 or 8 MHz	6, 7 or 8 MHz
Modulations	QPSK, 16QAM or 64QAM	not specified
Max. RF Output	6.5dBm (100-700MHz) 5.5dBm (915-1250MHz) 0dBm (2450MHz) - 50 Ω	+40dBmV = -7dBm (75 Ω)
Video Compression	H.264	not specified
Audio Compression	MPEG or AAC	MPEG, ACC, or AC3
A/V Input(s)	HDMI or analog, composite video plus line level, stereo audio	HDMI (720p, 1080i, or 1080p)
Output Resolution	480i thru 1080P	1080i, or 1080p
Programable via USB to ext. PC?	Yes	Yes
Power Required	+12 Vdc, 500 mA	+12 Vdc, 1 Amp

PVI VeCoax MiniMod-2 -- menus relative to DVB-T

Editor's Conclusion: While I have not actually tested the PVI unit, but looking at the specs., I feel that the Hi-Des unit is superior, especially for DVB-T. The PVI's one advantage is that it supports ATSC for those USA ATV hams that would like to experiment with that mode. It is an economical solution for ATSC. While this unit does support many modes, it should be noted that it does not include DVB-S.

2 MHz Bandwidth, DVB-T in Midwest

The Dayton, Ohio DVB-T repeater, W8BI, uses 2 MHz-wide bandwidth with a QPSK constellation for the digital receive and transmit parameters. This configuration was chosen for two reasons. Employment of 2 MHz bandwidth/constellation coincides with the parameters used by all of the hams in the Ohio/Kentucky/Indiana area since these parameters are optimized for DX ATV contacts. Also, use of these same parameters extend the receiver footprint out to the hams that may be on the edge of coverage, within the greater Dayton area, when band conditions don't cooperate. Edge of coverage may be dictated by distance from the repeater, obscura, or antenna/mast limitations.

Frame Grab Showing the spectrum display of the Dayton DVB-T Repeater Link being received in Morrow County by Charles, WB8LGA's SDR Dongle (80 miles distance)

A number of hams within the Midwest region use RTL SDR dongles and APPs such as SDR Sharp and HDSDR to detect the presence of ATV signals. Normally, the spectral displays are set at very narrow bandwidths (as narrow as 312 KHz) to detect analog ATV video carriers and its sidebands. In this particular instance shown, WB8LGA in Marengo, Ohio, spanned out to 3 MHz to examine the 2 MHz-wide DVB-T signal being transmitted by the W8BI repeater in Dayton, Ohio (80 miles distance). Presented on the top portion of WB8LGA's HDSDR GUI is a 3 MHz span that indicates a signal that is 20 dB above the noise floor from W8BI's DVB-T waveform as being received at WB8LGA's QTH. Also note that on the lower right-hand display window are about 18 of the individual 2000 DVB-T carriers from a small segment of the overall bandwidth (the DVB-T COFDM modulation is spread over 2000 carriers). Lastly, note that SDR dongles are not used to demodulate the ATV signals in this application, rather they are used as a methodology to determine band conditions and for antenna orientation.

Thanks to Dave, AH2AR, of DARA for this article

Tony, VK7AX, in Tasmania, Australia is now re-broadcasting the weekly Boulder ATV net. The Ulverstone, Tasmania ATV transmissions are on 70cm band at 445.50 MHz, DVB-T, 1280x720 HD, MPEG-2.

For further information on this program and others, including all broadcast advices, 'on demand' Video Streaming & Audio streaming and file downloads... check out the....
Spectrum Tasmania Web Site: http://www.vk7ax.id.au/spectrum/
N/West Tasmania ATV Group Web Site: http://www.vk7ax.id.au/atvgroup/

PXO in QST ? I submitted an article on PXOs to QST. Here is their reply. "Dear Jim: Thank you for allowing our Editorial Committee to review "Replacement for Crystals - PXOs." Unfortunately, we are unable to accept your article for publication in QST, QEX, or On the Air." Guess, the ARRL & QST are not interested in helping hams find crystals anymore for their older rigs, etc. ---- Jim, KH6HTV

BUSTED ! ! --- FCC Fines HobbyKing Nearly $3 Million for Marketing Unauthorized Drone Transmitters The latest ARRL newsletter reports that the FCC has finally cracked down on illegal FM-TV transmitters marketed supposedly for the 23cm amateur radio band. The original complaint by ARRL to the FCC dates back three years to 2017. A lot of these illegal transmitters had widely seperated frquencies from 1 GHz up to 1.4 GHz. For example, one 23cm, FM-TV transmitter, BCARES had purchased, but never ended up using because of illegal frequencies, had four channels none of which were in the legal 23cm ham band. They were: 1080, 1120, 1160 & 1200 MHz.

Newsletter Details: This is a free newsletter distributed electronically via e-mail to ATV hams. The distribution has now grown to almost 350. 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. Past issues are archived at: https://kh6htv.com/newsletter/

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