

# Boulder Amateur Television Club TV Repeater's REPEATER

March, 2024  
2ed edition, issue #157



BATVC web site: [www.kh6htv.com](http://www.kh6htv.com)

ATN web site: [www.atn-tv.com](http://www.atn-tv.com)



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## *Silent Key - Naomi, KDOPD3*

It is with great sadness that we report the passing of one of our fellow Boulder ATVers. On Friday, March 2ed, Roger, K0IHx, informed us ---

"Aloha Jim and Janet. With much sadness, Naomi died this afternoon from the effects of the stoke. I appreciate your friendship."

This photo of Roger & Naomi was taken live off the air on 70 cm ATV in 2018 with them sitting in their ham shack.



The next photo of Roger & Naomi was taken from a recent TV news broadcast feature story about Marshall Fire survivors rebuilding problems. It was aired by Denver TV station, KDVR, on almost the two year anniversary of the fire.

Pete, WB2DVS, shares some memories of Naomi. "She was a teacher at Boulder High since 1982. She was closely involved with the expansion of Boulder high including a technology lab and three computer labs. Here is a clip from an article in the Denver Post:



Roger and Naomi Salaman as construction continues on their property lost in the Marshall Fire

*Naomi Salaman, computer teacher and coordinator at Boulder High, said it cost \$1.7 million to upgrade the school this past summer, when construction was completed on a new wing to the building. The new wing includes a technology lab and three computer labs. In addition, every classroom in the school was equipped with telephones, video equipment and two connections for Internet access.*

I also remember that she was a judge in in the "First Robotics" competitions. She also was recognized by Microsoft along with 47 other teachers by their curriculum grant program in 2000. Here is a clip from the article:

*Microsoft Corp. today announced that 48 middle- and high school teachers nationwide will receive more than \$1.3 million in software licenses as part of the Microsoft® Curriculum Grant Program, an initiative designed to help educators create leading-edge information technology curricula and courses that will help prepare students for college and the technology-driven work force.*

I also remember that the computer labs in Boulder High were dedicated to her with a plaque.

I remember Roger and Naomi talking on our weekly ATV net about how they built their house on Davidson Mesa in the early 60s and Naomi did the roofing!

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### **FEED-BACK on Amp Overdrive Impact:**

Jim -- A little nit-pick about the latest newsletter:

On page 2 you state "QPSK being purely phase shift keying is independent of amplitude variations, is much more like FM.". I do not believe this to be true and if you look at the trajectories on the Real/Imaginary constellation they are not constant amplitude and the diagonals actually go through 0. The improved performance comes from the decreased theoretical carrier to noise requirement for QPSK (15dB) vs. 16QAM (22.5dB) and 64QAM (28.5dB). [ reference: Advanced Digital Communications, Dr. Kamilo Feher, Editor, Prentice-Hall, 1987 ]

Another way to look at it is from the point of error vector magnitude (EVM) tolerance. Since the QPSK states exist within a bigger "box" they can allow for much higher levels of noise and distortion before the EVM indicates an error.

I'm sure you know all of this and were probably just checking to see if we read all of it!! Thanks for all your work in creating these great newsletters.

73 de Steve, WA0TQG, Boulder, Colorado

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## **More on Required S/N for DATV**

With the comments above from Steve, WA0TQG, I decided to dig into the text books to share with our readers what the design engineers for DTV have to say about the subject. I don't have the reference book Steve used, but I do have a copy of what I consider the "Bible" for me for DTV.

**"Digital Video & Audio Broadcasting Technology -- A Practical Engineering Guide"**, by W. Fischer, 3ed edition, 2010, published by Springer. W. Fisher was a TV engineer for Rohde & Schwarz, Munich, Germany.

The following is lifted directly from Fischer's book in chapter 20 on DVB-T. Required reading for those interested in the "gory" details of the modulation methods for DTV. Section 20.7 deals with interference on the transmission link. For over the air, rf propagation experts describe the different channels as Gaussian, Ricean or Rayleigh. See drawing from p. 402. Page 405 shows the effects of S/N on bit error rate (BER) with table 20.14 giving the required S/N for various parameters. Bottom line to get a signal through under the worst possible conditions -- use QPSK with a code rate (Forward Error Correction) of 1/2.

73 de Jim, KH6HTV

The theoretical minimum carrier-to-noise ratios for quasi error-free operation depend on the code rate both in DVB-T and in DVB-S. In addition, the type of modulation (QPSK, 16QAM, 64QAM) and the type of channel (Gaussian, Ricean, Rayleigh) have an influence. The theoretical minimum C/Ns are listed below for the case of non-hierarchical coding.

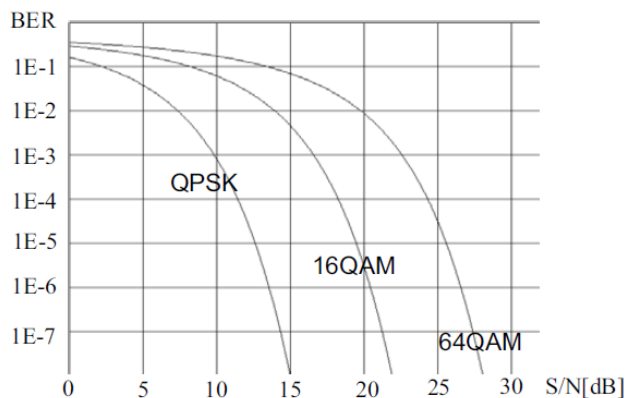


Fig. 20.22. Bit error ratio in DVB-T as a function of S/N in QPSK, 16QAM and 64QAM with non-hierarchical modulation

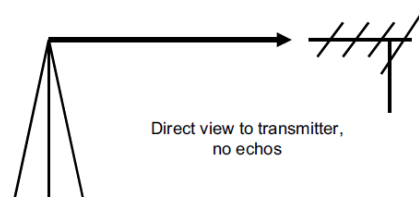


Fig. 20.17. Gaussian channel

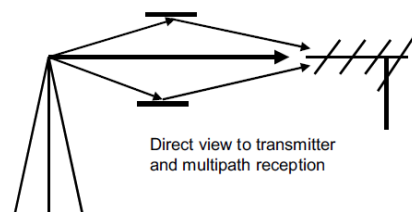


Fig. 20.18. Ricean channel

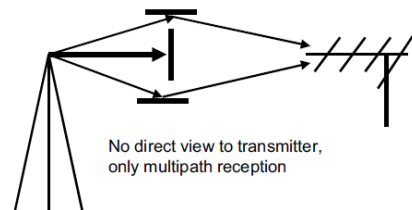


Fig. 20.19. Rayleigh channel

**Table 20.14.** Minimum C/N required with non-hierarchical modulation

| Modulation | Code rate | Gaussian channel | Rice channel | Rayleigh channel |
|------------|-----------|------------------|--------------|------------------|
|            |           | [dB]             | [dB]         | [dB]             |
| QPSK       | 1/2       | 3.1              | 3.6          | 5.4              |
|            | 2/3       | 4.9              | 5.7          | 8.4              |
|            | 3/4       | 5.9              | 6.8          | 10.7             |
|            | 5/6       | 6.9              | 8.0          | 13.1             |
|            | 7/8       | 7.7              | 8.7          | 16.3             |
| 16QAM      | 1/2       | 8.8              | 9.6          | 11.2             |
|            | 2/3       | 11.1             | 11.6         | 14.2             |
|            | 3/4       | 12.5             | 13.0         | 16.7             |
|            | 5/6       | 13.5             | 14.4         | 19.3             |
|            | 7/8       | 13.9             | 15.0         | 22.8             |
| 64QAM      | 1/2       | 14.4             | 14.7         | 16.0             |
|            | 2/3       | 16.5             | 17.1         | 19.3             |
|            | 3/4       | 18.0             | 18.6         | 21.7             |
|            | 5/6       | 19.3             | 20.0         | 25.3             |
|            | 7/8       | 20.1             | 21.0         | 27.9             |

## 406 20 Terrestrial Transmission of Digital Television Signals (DVB-T)

Thus, the demands for a minimum C/N fluctuate within a wide range from about 3 dB for QPSK with a code rate of 1/2 in a Gaussian channel up to about 28 dB for 64QAM with a code rate of 7/8 in a Rayleigh channel. Practical values are about 18 to 20 dB (64QAM, code rate 2/3 or 3/4) for stationary reception and about 11 to 17 dB (16QAM, code rate 2/3 or 3/4) for mobile reception.

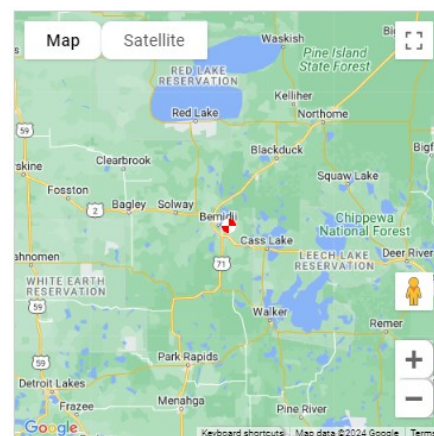
## HAMS in Northern Minnesota -- Take Notice !!!

We have recently been contacted by Roger, WA0IUJ, in Bemidji,, Minnesota, asking advice on how to receive the 2.4 GHz, DVB-S, transmissions from the ISS. We were not able to help much. Are there any readers out there who can help Roger ?

But, also in the conversations, Roger said *"Ham DVB-T TV is new to me and I'm learning as I go. Next, I want to get something TV started in my area. I own several 600 ft. towers for FM broadcast and a Ham TV repeater could be rent free at 500 ft."*



**Roger, WA0IUJ**



Hey, Minnesota hams -- wake up. Don't let this opportunity slip by you ! Check out Roger's bio on [www.qrz.com](http://www.qrz.com) --- Then get cracking and put up a DATV repeater on Roger's 600 ft. tower.



**Doshia, KB0NAS & hubby, George, N0RUX**

## **SUCCESS on 23 cm DVB-T**

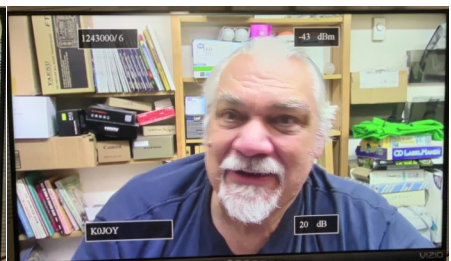
The above photo is our "Hero Photo" for the week. On the Boulder ATV Net on Thursday, March 7th, we welcomed Doshia, KB0NAS, and George, N0RUX, to our W0BTV repeater. They have been absent from our ATV nets for a really long time. Welcome Back ! This was their first successful DVB-T transmission on 23 cm band. In our previous newsletter (#156, pp. 3-4) we showed their new 70cm/23cm DATV transmitter. They are seen standing out in the middle of an open field shivering due to the cold weather. They live in the Heatherwood area north-east of the city and 7 1/2 miles from the repeater. But due to the urban environment, they have difficulty accessing the repeater from their QTH, hence the trip to a nearby open space with a clear line-of-sight path to the repeater.



Don, NOYE



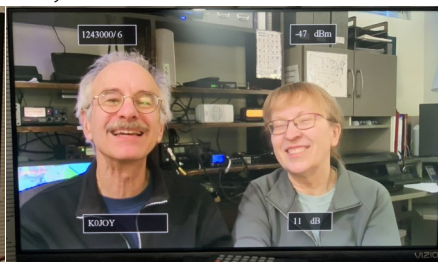
Bill, AB0MY



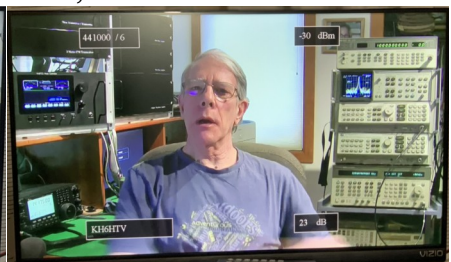
Chris, K0CJG



Ed, K0JOY



Pete, WB2DVS & Debbie, WB2DVT



Steve, WA0TQG

These were some of the other smiling faces seen on the March 7th ATV net in Boulder. Several regulars were absent that day. We will share their TV images in future issues.

Don, N0YE, is our ATV net controller. He talked about the recent trip to the repeater. He also showed us a new antenna bracket he fabricated for the next trip up to repeater. Plus he also showed us the new 2 watt, 23cm amplifier he just built. It even had a GR-874 output connector on it ! How many old hams remember the GR-874 ? Jim, KH6HTV, next discussed the receive problems we have been having with the repeater and our unsuccessful efforts so far to resolve them. Bill, AB0MY, talked about his solar panel system and showed us a graph of his solar energy generation and useage. Chris, K0CJG, continued with his on-going troubles with his new solar system and his fighting with Xcel Energy. Ed, KOJOY, showed off his new pride-n-joy 2 kW, HF linear amplifier he just got from Germany. It is seen in the lower left corner installed in his HF operating desk. Steve, WA0TQG, told us about his experiences repairing his defective HP signal generator. As seen in his shack photo, he has quite a tall stack of HP gear. Pete & Debbie updated us on their weekly activities, including their most recent walks around town. Pete also told us about he and Allen, KOARK, giving a talk and live ATV demo the previous weekend to a ham club in Lakewood, Colorado.

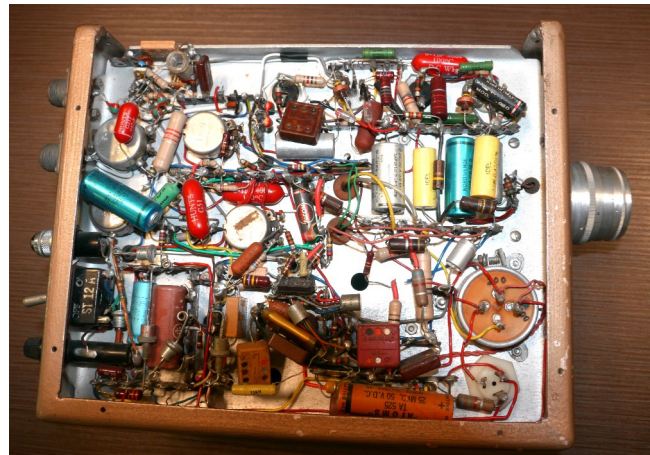
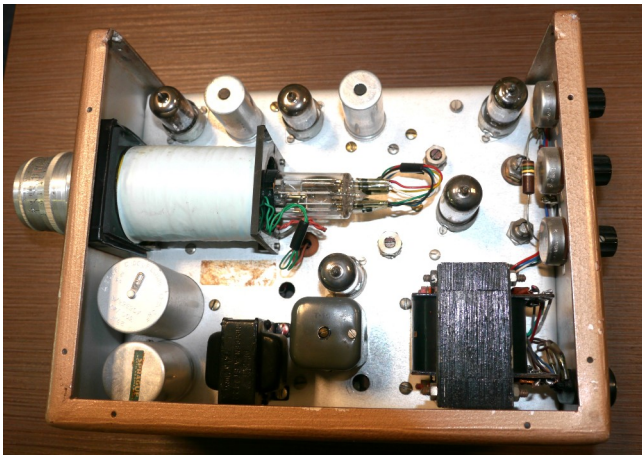
Our ATV nets typically run for about 1 to 1 1/2 hours in length. We stream them over the inter-net via the BATC server in the U.K. ( <https://batc.org.uk/live/> ) Both Bill and Don stream the video. In general, Bill's (AB0MY) stream is more reliable. We also have some regular viewers, both locally over the air, and elsewhere via the BATC stream. We encourage our local viewers to check in on our 2 meter FM voice net and add their comments to the nets. Our nets are every Thursday afternoon, starting at 3 pm local time (Mountain time zone).

## **The Beginnings of ATV in Slovenia, Yugoslavia**

**Rudi Pavlic, S58RU**

I spent a lot of time trying to find out when the ATV appeared here in Slovenia or even in Yugoslavia. There is very little data on this, although we RAs (*radio amateurs*) are required to keep logs of our RA bonds. The Serbs claim that they were the first to establish an ATV connection in Yugoslavia in 1976 between Šabec and Belgrade on 432 MHz. In Slovenia, RK (*radio club*) Murska Sobota has the TV symbol in its title. This club "Radio TV Club MS" was broadcasting on the RA frequency in 1974, but I have not found any QSOs anywhere. I may have managed to obtain information about the first ATV broadcast, certainly in Slovenia - Yugoslavia or even in Europe.

Everything took place in 1963/4. Polič Vlado, a member of RK Jadran Koper, assembled various RTX for the needs of the club. I remember UKV RTX with lamp probably QQE06/40... I can't be more precise, because he was born an "electronics engineer", I was just learning to be a machinist.



Vlado bought a Philips (55850AM) lamp in Germany. Because it had defects, he got it significantly cheaper than the regular price. The regular price was over 2000 marks, he bought it for 400 marks (400 marks in 1963). Around this lamp, he started trying to make a video camera. He didn't have any instruments then. He set up a home TV for work. It has created a video input and a video output. For recording, he drew a circuit to see how the signals changed as the gains were changed, on the TV.

When the camera was working in the home premises, Vlado arranged with RA Marjan (S58O) to watch it on his converted home TV. They modified the "tuner" to receive on the RA frequency of 144 MHz. The connecting frequency is the bull's KV frequency. This was Vlad's first television station. 25 years later, he founded "Kanal A".

I equip my writing with pictures of this first RA TV camera (not professional - purchased TV camera).  
73 de Rudi, S58RU, Koper, Slovenia

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## NEWS from DAYTON, OHIO ATV HAMS

**STATUS OF DARA ATV Repeater Re-Install: BACK RACK NEARLY COMPLETE**

Bruce K8FIX and Dave, AH2AR, continued with the ATV repeater system replacement on Saturday and Sunday. The "back" rack is nearing completion (See photo). It mainly contains the ATV receivers, voter, and distribution amplifiers for the audio and video lines. A stiffening U-channel brace was also installed that will also contain the 10 audio/video/PTT cables extending between the two racks. Different patch lines had to be ordered since the equipment is positioned in different configurations due to the taller rack dimensions and the significant separation of the two racks. The work will continue.



## NEWS from SAN DIEGO, CALIFORNIA --- ATV HAMS



San Diego DATV Society Weekly Programs.

23cm / 70cm DVB | IPTV | FSOC |

As of January 2024

### LIVE from QO-100 Transponder:

- DATV WW Net with host, ZS6YI.
- BATC QO-100 Net with host, GB3GKQ.
- Net ITALIA DATV

Special thanks to our sponsors for providing us with the **LIVE**, rtsp feeds from the UK, South Africa, Netherlands, and Italy.

### From Australia:

VK3RTV DATV Repeater Network

VK2MB-TV Network

### From the United Kingdom:

GB3HV BATC President's Net

GB3SQ Technical Net with Colin, G4KLB

### From the United States:

W0BTV - Colorado

W6ATN - Southern California {and affiliates}

WW7ATS - Washington

W6CX - Northern California

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### **San Diego DATV Society Channels**

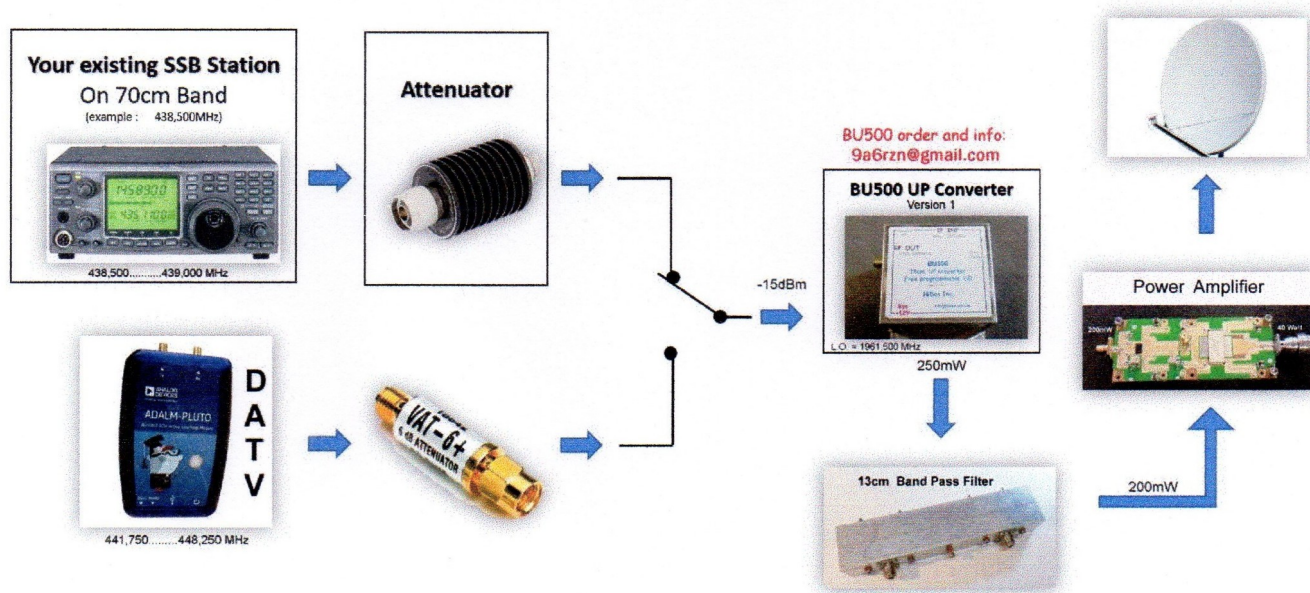
Weekly:

- **Science & Technology Workshop** {STEM Programing}, channels 20,21.
- **Amateur Radio Study Hour** {Licensing Exam Preparation}, channel 22.
- **What's in your Shack** {Projects, Equipment reviews, and repairs}, channel 23.
- **RAVEN** – eCom Group Meeting Room, channel 24.
- **NASA-TV** via transponder 15 [NTV-1 – the Public/Education Channel DVB-S2/8PSK] Channel 25.
- **QO-100 DATV** Transponder {rtsp live feeds}, channel 26.
- **SDATV Membership**, channel 01

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editor's note: For more info about the San Diego ATV group and all their various activities, contact Mario, KD6ILO, at [kd6ilo.labs@gmail.com](mailto:kd6ilo.labs@gmail.com)  
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## TX hardware for successful SSB and DATV QO-100 connection



Thanks to Rudi, S58RU, for sharing this with us.

## Boulder ATV Repeater -- Do we have receive issues ?

Recently there has been discussion and concern on our weekly ATV net about the 23 cm receiver for the WOBTV, Boulder, Colorado, ATV repeater. This is in addition to our degraded 70 cm receivers' capabilities due to RFI. Field strength measurements from a mobile at many locations around Boulder and in the eastern part of the county have been made and they tend to show the received signal at the repeater is down 10dB or more than predicted by Radio Mobile rf propagation program. There however is a wide spread in the data.

Don, N0YE, and Jim, KH6HTV, have made a trip to the repeater site to test out the receivers and coax cables. No problem was found with them. They even swapped out the old Diamond X6000 antenna for a new one. But no improvement was noted. They also did try moving the location of the antenna a few feet horizontally on the roof, and found that resulted in losing another 10dB on Bill, AB0MY's test signal. So they put the antenna back in it's original location. Discussion among members is continuing as to what possibly is happening? It could be multi-path from the tall mountains immediately to the west of the repeater? Or what? This is a topic -- "To Be Continued".

In the meantime, while digging thru the archives of my old computer files relative to our repeater, I found a report to the members dating back to 2017 when our repeater was located at the previous site in

Chautauqua Park. I think other readers might find this of interest as it was a comparison of the relative merits of analog NTSC, VUSB-TV, analog FM-TV and the new (New for us in 2017) digital TV, DVB-T. I might add that the analog capability of the repeater tested then is no longer on the current configuration of the repeater. After our last hold-out member stopped using analog ATV, those features of the repeater were removed. Today, it is strictly a DVB-T repeater.

73 de Jim, KH6HTV, Boulder, Colorado

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## **TV Repeater Propagation Tests**

*(report to BATVC members in June, 2017)*

Don Nelson, N0YE, Jim Andrews, KH6HTV

Colin Bradley, WA2YUN & Jack Quinn, K0HEH

During the past month, we have been doing a series of tests to determine the coverage area of the Chautauqua Park TV repeater and also the effectiveness of it's various modes of operation. The repeater is capable of receiving on both the 70cm and 23cm bands in either analog or digital modes. On 70cm, it receives the old USA, NTSC, analog standard, VUSB-TV modulation (480i). On 23cm, it receives analog, 4 MHz deviation FM-TV modulation (480i). On either band, it can receive the European digital TV broadcast standard, DVB-T with video resolution up to 1080P.

The DVB-T transmission parameters can be manipulated to optimize various characteristics as the propagation channel requires. We use mainly two dramatically different settings. For the highest resolution of 1080P, our normal settings are: 1080P resolution, 6 MHz bandwidth, QPSK modulation, 8K FFT, 1/16 Guard (sync) Interval, 5/6 Code Rate ( Forward Error Correction ) and 6 Mbps data rate. For difficult propagation conditions with lots of multi-path, etc. we use much more aggressive settings with a lower resolution of 720P, 1/2 Forward Error Correction and 3.5 Mbps data rate. Note: an FEC of 5/6 means for every 5 bits of real data transmitted, an additional bit is devoted to forward error correction. 1/2 means for every bit of real data, an additional bit is used for FEC.

The first set of tests of all modes, plus both 1080P(5/6) & 720P(1/2) DVB-T parameters consisted of driving a mobile transmitter around the city of Boulder and the nearby Boulder Valley over a fixed, 30 mile route. The route was chosen to test many different environments of rural, residential, light industrial, urban canyons (i.e. downtown), university, etc. For each trip a different transmitter/mode was used. A TV camera was sat in the passenger seat looking out the windshield thus providing a live image of the actual location of the vehicle. The relayed audio/video from the TV repeater was received on a 70cm DVB-T receiver and recorded on a DVD. This provided a permanent record of the quality of the picture received by the repeater. Later reviewing of the DVDs allowed us to draw the following conclusions about the relative usefulness of the various bands and modes. They are ranked from best to worst.

1. 70cm, digital, DVB-T, 720P resolution, 1/2 FEC aggressive digital parameters.
2. 70cm, digital, DVB-T, 1080P resolution, 5/6 FEC, normal digital parameters
3. 70cm, analog, VUSB-T, 480i resolution
4. 23cm, digital, DVB-T, 720P resolution, 1/2 FEC, aggressive digital parameters
5. 23cm, analog, FM-TV, 480i resolution
6. 23cm, digital, DVB-T, 1080P resolution, 5/6 FEC, normal digital parameters.

Clearly, the best performance was found using DVB-T on the 70cm band with a lower 720P resolution and the best possible, most aggressive, Forward Error Correction (FEC) of 1/2. Perfect reception by the repeater was achieved from well over 90% of the total 30 mile route tested. None of the other modes/bands came anywhere close to this performance. The 23cm coverage was particularly poor with coverage over much less than 50% of the route. A separate test ran by Colin, WA2YUN, and Jim, KH6HTV on 23cm, DVB-T using loop yaggi antennas on a clear, line of sight, 5.6 mile path showed a 10dB improvement in weak signal reception using the 720P, 1/2 FEC over the 1080P, 5/6 FEC parameters.

On Monday, June 12th, we ran an additional set of tests over a very long distance, 35 mile path from the fringe area of the repeater. Don and Jack drove out to the Denver International Airport (DIA) and set up a portable TV station with 70 cm and 23 cm yaggi antennas on an extendable mast. They set up on a high spot at the north end of DIA on Powhatan Road, just north of 114th Ave. They again tested all of the modes and bands. For DTV, they only used the more aggressive digital coding of 720P, with 1/2 Forward Error Correction. On 23cm, they used 3 watts of power for DTV and 25 watts for FM-TV. On 70cm, they used 6 watts for DTV and 15 W(PEP) for VUSB-TV. The first tests were run at an antenna height of 15 ft. and were successful. They then lowered the antennas to 10 ft. and repeated the tests. They were still able to successfully send perfect pictures and audio to the repeater on DVB-T and FM-TV. They then dropped the 23cm DVB-T power to a low 1/2 watt and the FM-TV to 3 watts and were still putting a perfect picture into the repeater. On 70cm, VUSB-TV, the picture quality was not perfect, but a very useable P3+ with full quieting audio. They then tried to use a lower gain, tri-band, mobile mag. mount antenna at an even lower height. This was not successful.

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**DVB-S Band-Width, etc.** Roger, WA0IUJ, has called our attention to an old, but still very relevant, excellent article on DVB-S. It was written by Ken, W6HHC, and Hans, DC8UE. It was published by TAPR in their issue #111, Spring, 2010. It is available still to be down-loaded from the TAPR web site. ( [https://www.qsl.net/n9zia/tapr\\_psr/index.html](https://www.qsl.net/n9zia/tapr_psr/index.html) ) It does a great job of discussing band-width and amplifier non-linearity.

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**ATV - Public Relations:** On Saturday, March 2ed, fellow ATVers, Allen, K0ARK, and Pete, WB2DVS gave a talk and live demo to the 285 Tech Connect Radio Club, in Lakewood, CO. It is a club which focuses on technology. Allen demonstrated the 70cm, DVB-T, portable transmitters he has assembled for BCARES along with his drone video. Pete demonstrated the microwave IP network which BCARES is hoping will be installed in the various EOCs up and down the Colorado Front Range. Pete reported there were about 20 hams in attendance and the presentation went well. Folks were interested in what they presented and had lots of questions.

On Wed, March 6th, Jim, KH6HTV, was invited to present a zoom talk about ATV to the White Mountain Amateur Radio Club ( W1MWV ) in Conway, NH.

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**HackRF Inquiry:** Jim -- I'm reaching out to sign up to the BATVC newsletter and also had a question regarding DVB-T RX/TX hardware options.

I'm currently looking to see if anyone in your group or yourself has had any luck using the HackRF for DVB-T operations? I have a HackRF + Portapack on order and looking to see if could be used for digital ATV.

A little about myself, I have been in Ham Radio for the better part of 7 years, and currently the vice president of the WWATS, ATV group in Seattle WA.

73, Wade Marshall - W7ITL w7itl.usa@gmail.com

( Anyone out there had any experience with HackRF and can help Wade ? )

**ATN - Arizona Winter Meeting:** The Arizona chapter of ATV will hold their winter meeting on Saturday, March 30th at noon. The meeting location will be at DeVry University, 2149 W. Dunlap Ave. in Phoenix. It will also be a Hamfest and Electronic Swap meet. For more info, contact Ed Olague, K5OLA, k5ola@usa.com

**WOBTV 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/>

**WOBTV 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 700+. 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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