

Boulder Amateur Television Club TV Repeater's REPEATER

September, 2023
issue #140



BATVC web site: www.kh6htv.com

ATN web site: www.atn-tv.com



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Boltzmann Constant -- Thermal Noise

The latest September issue of QST has an excellent article in it by Adrian Ryan, 5B4AIY. It is entitled "*Understanding the Boltzman Constant*". He describes what it is and how we hams can use it to understand the fundamental laws of physics which determine the ultimate sensitivity of our receivers. He also discusses the origin and definition of "S" units. Definitely recommended reading.

The basic equation to describe thermal noise power, P_t , is:

$$P_t = k * T * B$$

where k is the Boltzman constant = 1.380649×10^{-23} Joules/degree Kelvin

T is the absolute Temperature measured in degrees Kelvin (room temperature = 290° K)

and B is the Band-Width measured in Hertz

To make this equation easy to use, check out the on-line calculator tool at:

<https://www.everythingrf.com/rf-calculators/noise-power-calculator>

Ryan works through some typical ham radio bandwidths for CW and SSB and then expresses the results in dBm. The thermal noise floor is thus:

1 Hz => -174dBm, 500 Hz (CW) => -147 dBm, 2.4 kHz (SSB) => -140 dBm

He further states that the typical amateur operator needs about 10dB s/n to copy reliably. Thus these numbers come up 10 dB to -137 dBm (500 Hz) & -130 dBm (2.4 kHz).

Then with a noisy front-end receiver, the receiver's noise figure (NF in dB) needs to also be added to these numbers. He gives an example of a typical HF receiver (IC-7610) with a noise figure of 9dB, the resultant numbers are now up to -128dBm (500 Hz) & -121dBm (2.4 kHz).

So what is the impact for us ATV hams ? For ATV, we use much wider band-widths than the typical HF ham on CW or SSB. Using these examples and going to higher band-widths should give you an appreciation of the smallest signal you can expect to receive with your ATV gear. Let's start with our **typical 6 MHz wide TV channel**. Now using the above equation our residual thermal noise floor is a really big number of **-106dBm !** This is just the noise floor, it doesn't account for the required S/N of our video detector, nor the front-end noise figure of our receiver. They only make it worse. .

So how does this compare with some real world measurements? I have made lots of sensitivity measurements over the years of various digital (DVB-T) receivers. For what I considered my standardized digital parameters (H.264 encoding, 1080P, 5.5Mbps - 6MHz BW, QPSK, 8K FFT, 5/6 Code Rate (FEC) & 1/16 Guard), I almost always ended up measuring a receiver sensitivity of about -94 or -95dBm. Then adding a good low noise (< 1dB NF) pre-amp, these numbers improved to about -99dBm. When performing these tests on a Hi-Des receiver which includes a built-in accurate dBm S meter and S/N meter, the digital threshold always came out at about 8dB S/N.

So what does that tell me. -99dBm (sens) - 8dB (s/n) ==> -107dBm
Whow! -- that number comes damm close to the computed -106dBm for 6 MHz thermal noise ! So we must be in the ball park with our measurements and calculations.

So what can we do to improve on this -99dBm value ? For starters, we can use more aggressive forward error correction encoding. I have found going to 1/2 FEC lowers the required S/N from 8 to 5dB. Remember to also lower the video encoding rate accordingly. Plus we can go to a lower band-width. If we go to a typical narrower band-width of 2 MHz, this improves the theoretical noise level a bit from -106dBm to -111dBm.

73 de Jim, KH6HTV, Boulder, Colorado

W0BTv - ATV Repeater Status Update:

Our regular Boulder ATV repeater, W0BTv, is presently out of service. It is in KH6HTV's ham shack for repair and modification. The control receiver's touch tone decoder has been repaired. The 5.9 GHz, FM-TV transmitter is again functioning. Don, N0YE, is modifying the Arduino's firmware to correct some issues, including audio routing. A new 7", hi-res, flat screen monitor has been added to replace the 10+ year old Haier, low-res (240 line) monitor. Based upon Colin's (WA2YUN) spectrum observations and recommendations, we will be moving the input frequency of the 70cm receivers back to the original 441 MHz. We had recently moved to 439 MHz in an unsuccessful attempt to get away from the RFI. A new, 70cm, 2 MHz band-width, channel filter has been on order for quite some time now from a ham radio store in Hong Kong. When it arrives it will be installed in front of the Hi-Des HV-110, 441MHz, 2 MHz BW receiver. We hope it arrives soon. USPS tracking shows it has arrived at US Customs in Los Angeles.

In the interium, we have installed the BCARES, portable, W0BCR, DVB-T repeater. It is strictly a 70cm in/out, in-band repeater. Our W0BTv is primarily a cross-band repeater with 23cm input and 70cm output. It also has a pair of secondary 70cm receivers for 6 MHz and 2 MHz band-widths.

However, due to the extremely high level of 70cm RFI at the site, the BCARES 70cm receivers have very limited usefulness. The RFI is so strong that an incoming 70cm DVB-T signal needs to be stronger than -60dBm to override the RFI. We are taking at least a 30dB hit in sensitivity. Thus, currently only 2 or 3 members are able to access the repeater.

We were considering moving the W0BTV repeater to a different, quieter location. We had a good mountain top site in mind, but were unable to gain access to it. We thus will continue to keep the repeater at it's current location on the noisy mesa south-west of the city of Boulder. We will continue to encourage all ATV users to only use the 23cm input (1243 MHz) and forget about the 70cm inputs. The 23cm input is RFI free. We had the 70cm inputs on the repeater historically dating back to the early 1990s. When the Boulder ATV repeater was first frequency coordinated with the CCARC in early 90s, it was even then as a cross-band (23cm in / 70cm out) repeater. The 70cm inputs were put there mainly to be able to support BCARES. All of the BCARES, ATV gear was then and is still now on the 70cm band. In the next issue, we will discuss how we might implement some remote 70cm, DVB-T receive sites for W0BTV to still be able to support BCARES.

73 de Jim, KH6HTV, trustee for W0BTV

11th Annual International ATV QSO Party

Peter Cossins, VK3BFG, once again organized and moderated this ATV QSO party. Thanks to Mick, VK3CH, editor of NEVARC-NEWS for this summary and the photos of participants.

The annual Digital ATV QSO Party was scheduled for Friday August 25 starting around 0930 UTC with mainly VK stations with Saturday morning/afternoon on August 26 being our link with USA. It was their Friday night. Stations acting as local Anchors were Bevan VK5BD in Port Pirie, Gary VK2CRJ in Sydney, Art WA8RMC in Columbus Ohio, Bill AB0MY in Boulder Colorado and Roland KC6JPG in Los Angeles. Also participating this year was Claudia, I2NDT, our first European participant for quite a while.

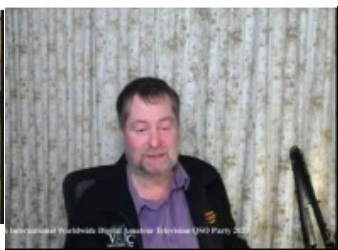


Peter, VK3BFG

BATVC: This year the Boulder, Colorado ATVers didn't participate, except for Bill. This was because our W0BTV, cross-band (23cm in / 70cm out) DVB-T repeater was out of service for repair and modification. As described in the above article, only 2 or 3 members are presently able to key up the temporary BCARES, 70cm portable repeater.



VK7OTC



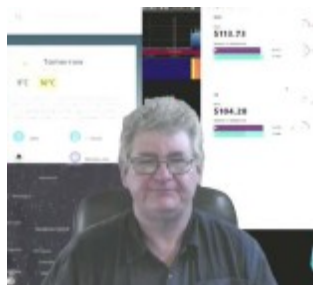
VK3CH



VK3ATV



VK3BCU



VK5BD



VK5YYY



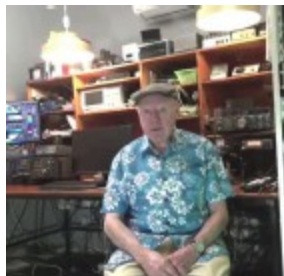
VK5KJG



I2NDT



VK2CRJ



VK2ATU



VK3CSJ



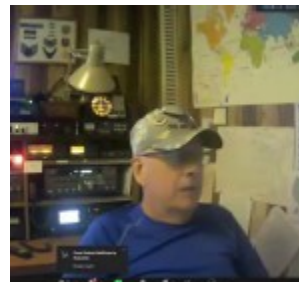
VK3VRS



VK3WV



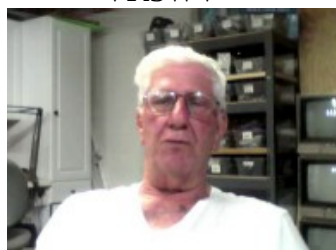
VK3QL



W8MA



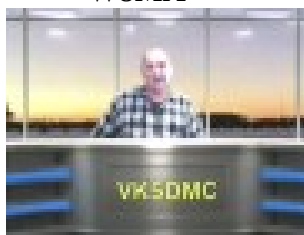
WA6NUT



WA8RMC



AB0MY



VK5DMC



VK3YLH



K6JPG



WB6KYH



N6GKB



AF7PA



N2MJF



K0CCU



WB9KMD



WA6SVT



W6KVC



KK4YZE



K6SOE



G7JTT

New Microwave Antenna Supplier

The latest, Sept. issue of QST had a small ad on page 118 for microwave antennas for the IC-905. I was unaware of this company before and it was the first time they advertised in QST. Technical Antennas

www.technicalantennas.com

14-27 dBi
600-6500 MHz

Ultra Wide Band Grid
High Gain Cellular Antenna

SHOP NOW

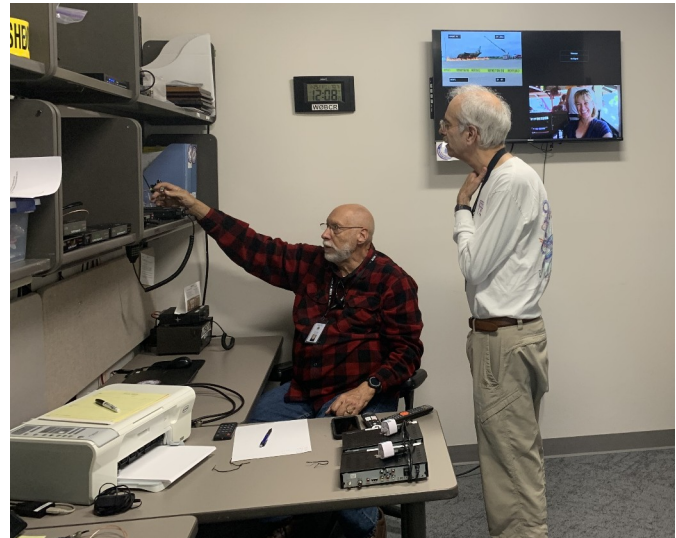
The ad featured two dish antennas with very broad frequency coverage, so I decided to at least check out their web site. The dish shown here with 0.6-6.5 GHz coverage appears to be the classical BBQ grill, grid parabolic dish we have seen for many years for 2.4 GHz, but with a different feed assembly. The feed assembly looks to be a log-periodic antenna thus accounting for the broad frequency coverage. The BBQ grill measures 24"x39". They are asking \$189 for it. Amazon offers on it's web site what appears to be the same antenna, with same specs., for \$200 with two day prime shipping.

Their ad also featured an even larger 48" dia. circular mesh dish with coverage up to 10 GHz. They are quite proud of it as they are asking \$979 for it.

If anyone has any microwave experience with this company and these antennas, we would like to hear from you and pass on your observations to our readers.



New 70cm, DVB-T receivers



Allen, K0ARK, EC (left) and Pete, WB2DVS, Equipment Officer (right) at work installing the new DVB-T receivers in the BCARES office at the EOC.

BCARES has New DVB-T Receivers

The Boulder County ARES (BCARES) emergency coordinator, Allen Bishop, K0ARK, has instituted a new effort to enhance our ATV capability for serving the public safety agencies in Boulder County. As a first step, he asked Jim, KH6HTV, to provide a quad set of 70cm DVB-T receivers. Previously, BCARES only had the capability to receive and display a single ATV channel. The new receivers were installed on August 29th in the BCARES office in the Boulder County Emergency Operations Center (EOC). The BCARES office is immediately adjacent to the master Command & Control situation room. The Boulder County 911 dispatch center is also located in the same building.

The new GT-Media receivers were programmed to receive all of the 6 MHz, 70cm, ATV channels. Their 1080P hi-def HDMI outputs are then sent to an HDMI quad processor. The quad video output is then routed to a large screen video monitor seen in the above photo. It is also piped directly into the EOC building's video distribution network where it can be displayed on any other large screen monitor throughout the building, including in the master situation room. Don, N0YE, provided a test signal via the ATV repeater for initial testing as seen in the above photo.

The RF circuit starts with a Diamond model X-50 (2m/70cm) vertical antenna on the roof of the EOC. In the BCARES office, the signal is then split with a Diamond 2m/70cm duplexer. The 2m signal goes to a 2 meter packet radio. The 70cm signal goes first to a KH6HTV model 70-LNA, low noise, 20dB, pre-amplifier. The output of the pre-amp is then split four ways with a Narda SMA power splitter (-6dB loss). These four outputs then go to the four GT-Media receivers. All of the receivers and the pre-amp are powered from a common +12Vdc power supply.

September, QST - Trivia: Their cover photo is a "hookey" posed group photo. It shows a group of high school students gathered around a table with an HF ham rig. One student is holding the mike and talking into it while another is tuning the radio. Everyone else is watching the "excitement". So what is "hookey" about it? No cables attached! AC power cord is missing from the power supply. Power supply not connected to the transceiver. No antenna coax connected to the rig. Obviously a staged photo op.

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 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/>

ATV HAM ADS

Free advertising space is offered here to ATV hams, ham clubs or ARES groups. List here amateur radio & TV gear For Sale - or - Want to Buy.

Boulder Amateur Radio Club (BARC)
BARCfest Hamfest

Ham Radio and Electronics
Sunday, October 8, 2023, 9 am to 1 pm

Boulder County Fairgrounds -- Exhibit Building
(Just north of the Hover Rd. & Nelson Rd. intersection in Longmont, Colorado)

Admission \$5 – Under 18 Free with Paid Adult
(Correct Change Appreciated to Avoid Delays at Door)

Lots of Great Treasures
Awesome Door Prizes Hourly with
Grand Prize at Noon
(Must be Present to Win)



ARRL V.E. License Testing, 10 am



Pre-registration strongly recommended – walk-ins possible. Go to BARCfest session at hamstudy.org
Direct registration link: <https://ham.study/sessions/644d313ebb47dd7a44566a04/1>
For questions write to: barc70@arrl.net

Main Hamfest Doors Open to the Public at 9:00 am
Vendor Doors Open for Set-up at 7:30 am

For more information contact write to barc70@arrl.net or call Debbie (WB2DVT) 303-447-3183



Combo
DVB-T2/T & DVB-S2/S
Receiver

KH6HTV VIDEO offers for sale a consumer grade, digital TV receiver which we have pre-programmed for DVB-T operation on the amateur **70 & 33cm** bands. Price is \$50 + shipping. For details -- see web site www.kh6htv.com

