Boulder Amateur Television Club
TV Repeater's REPEATER

June, 2020
3ed Edition

BATVC web site: www.kh6htv.com

ATN web site: www.amateurtelevisionnetwork.org

Jim Andrews, KH6HTV, editor - kh6htv@arrl.net www.kh6htv.com

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/ ATV nets on Thursday and Sunday afternoons at 3 pm MDT. ATV nets are streamed via: https://batc.org.uk/live/kh6htvtvr

MICROWAVE ATV FEVER

The Boulder microwave ATV hams were out again. Each new time out, they are pushing the distance envelope. On Thursday, June 11th, Don, N0YE, headed to NCAR, Bill, AB0MY, headed to Lookout Road, north-east of Boulder, and Debbie, WB2DVT, & Pete, WB2DVS, headed to CO-128 & McCaslin, Blvd. west of Broomfield. The band and mode this time was again 5.8 GHz (5685 MHz) and FM-TV. All three rigs were essentially the same. They were using the low cost drone gear with the TS832 (+28dBm) transmitter and the RC-832 receiver. Bill also had a 2 watt (+33dBm) after-burner amplifier. They were all using dish antennas with about +23dBi gain. They were all able to have two way QSOs with P5 pictures and Q5 audio. OK, now that you have proved these distances work -- next time 20 miles ? ? ?


Bill has worked up a nice setup for his 5 GHz rig. He mounted everything on a piece of plywood, including the BBQ dish antenna and it all mounts on a camera tripod.

P5 pictures received by AB0MY. Left from N0YE. Right from WB2DVT & WB2DVS

Bouncing Microwave Signals Off of Mountains

Don, NOYE

SSB signals have been bounced off of the Front Range, Rocky Mountains for years. SSB signal on 2304 MHz and 10368 MHz have been bounced off of the Flatirons and other rock structures on a weekly basis for a multitude of QSOs.

So why not try to do microwave signal bounces for other modes and frequencies? On June 15, 2020 such an exercise was conducted in Boulder Colorado between hams at three locations in and near Boulder. The rocks used as a reflector were the Flatirons formations on nearby Green mountain. The signals used in the test were FM modulated ATV signals at a frequency of 5678 MHz.


Don's roving microwave ATV setup with dishes for receive and transmit (left) and view of Green mountain Flatirons (right)

KH6HTV, Jim, was east of Boulder nominally 5 miles east of the Flatirons. WB2DVS, Peter, and WB2DVT, Deb, were together in Boulder at a parking lot about 1.5 miles from the Flatirons. N0YE, Don, was also in Boulder at Fairview High parking lot about 2 miles from the Flatirons. The spots chosen for this exercise were done so no player could receive a direct signal from any other player. The Flatirons were visible to every player without neither any obstruction nor any reflecting surface other than the Front Range Mountains.

All players had 5 GHz dish antennas with a gain of 23 dBi. Don was transmitting about +23 dBm of rf power. Pete & Deb were transmitting about +24 dBm. Jim was transmitting a signal with +33 dBm of power.

5 GHz, FM-TV images received by N0YE from WB2DVS/WB2DVT (left) & KH6HTV (right)

There was a very modest amount of success in the exercise. Don received P2 signals from both Pete/Deb and Jim. Pete/Deb on the other hand received only a P0 signal from Don and nothing from Jim. Jim unfortunately received no signals.

The power output levels of each player can help explain what signals were received and what was not received. Jim had the strongest signal and the greatest distance to reach a

reflector. The greater distance and the greater power help explain why Jim's signal was just slightly better than Pete/Deb's signal for Don. The P0 signal and P2 signal received respectively by Pete/Deb and Don may be explained by the greater signal loss Pete/Deb had in front of their receiver. They had a longer coax cable in front of their receiver while Don had a very short coax. Jim receiving nothing could be explained by the lesser power from Pete/Deb and Don.

For my 5760 MHz, SSB contacts in the past, I have used the same dish antenna and my SSB transmitter's output power was +26 dBm (400mW pep). Thus essentially the same as we used for our recent FM-TV experiment. Why were the SSB contacts so much stronger? Well, the answer thus is in the relative noise floors for the bandwidths of the different modes. The thermal noise floor for a 2.4 kHz SSB receiver is a low -140dBm. FM-TV requires a 16 MHz bandwidth. Thus it's noise floor is a much higher -102 dBm. This is a whopping 38dB difference. Our P2 picture reception was thus just a bit above the noise floor limit.

So what is the take away from this exercise? Simply put, we can bounce microwave ATV FM signals off the Rocky Mountains as we have done with SSB microwave signals. The reality is that the signal loss, because of the scattering off of the random surfaces, are quite significant. The estimate for this exercise is that the signal loss was in the neighborhood of 30 dB. "Your mileage will vary". Depending on the nature of the reflecting surface, the angle of the transmitter and receiver to the surface, and the distances from the surface of both the transmitter and receiver, the loss can vary.

5 GHz, FM-TV -- How Far ?

Jim, KH6HTV

The above report has pushed our 5. GHz, FM-TV experiments out to > 11 miles. This was done using high gain, dish antennas. I wanted to see what could be done with simple antennas. I set up my TS-832 transmitter (+28dBm) in my driveway driving a simple 1/2 λ dipole mouted vertically at a 6ft. height. I ran a prerecorded vacation video to have live motion and audio. I used the simple rubber duck antenna supplied with the RS-832 receiver and my Haier, 7" monitor to receive the test signal. I then proceeded to walk away from my house while watching the monitor. I got about 0.2 miles away before I started to lose the signal. At that point I was no longer able to see my QTH as it was blocked by other structures and trees.

5.7 GHz Antenna Range Measurements

Don, N0YE

An antenna range was set up from my garage to across the street for a distance of about 70 feet. The source was a 1 kHz modulated 5678 MHz signal of about +18 dBm. The source antenna was a 13 inch dish with a home brew feed identical to one of the dishes measured. The h1 at the source antenna was about 8 inches off the ground. The h2 at the antenna under measurement was about 72 inches off the ground.

The HP 415B was the SWR meter used. Other than the rubber duck measurement, the other measurements were made close to the full-scale portion of the log periodic scale where the sensitivity was the greatest. Therefore the observed accuracy of the three measurements close together were believed to be within fractions of a dB. The accuracy of the rubber duck measurement may be off by a few dB because different scales on the meter were used and the dB accuracy between scales may be as much as a couple of dB.

The reference antenna for the test was a Radiowaves model SP1-2/5 dual band antenna that is 12 inches in diameter. The published gain for the lowest measured frequency of 5750 MHz is 23.2 dBi. The antenna gain for the test will be assumed to be 23.0 dBi.

Antenna	Meter Reading	**Gain**
Radiowaves, model SP1-2/5 dish	-31 dB	23 dBi (reference)
L-com model HG-5822 dish	-30.8 dB	23 dBi
13 inch home-brew dish	-31 dB	23 dBi
Rubber duck antenna	-54 dB	0 dBi

Receiving DVB-T ATV Signals on a Raspberry Pi

Bill, AB0MY & Don, N0YE

The Raspberry Pi OS (once called Raspian operating system) for the Raspberry Pi with applications included contains an application called VLC. VLC is a widely used video application on many platforms from PCs, tablets, and smart phones to the Raspberry Pi. The functioning and personality of VLC, from my observation, are identical to how it functions on PCs.

When a software-defined radio (SDR) dongle, with a USB plug, is plugged into a Raspberry Pi (RPi), the RPi software automatically recognizes the presence of the dongle,

and the VLC application will allow the user to tell the dongle to receive DVB-T signals on a given frequency and with a given bandwidth. VLC documentation will give the user the details of how to make the software work. .

The VLC application has been demonstrated to work with both a Raspberry Pi 2 running the Raspian operating system and a Raspberry Pi 3 running the Raspian operating system. It also has been verified for a Raspberry Pi 4.

Live 70cm, DVB-T video image being received with RPi-3 using a Nooelec model NESDR Mini 2 SDR (spare in foreground.)

Some notes:

1. The USB connectors on the RPi are close packed, so an extender of some sort is needed to connect the SDR device to the RPi.

2. VLC uses the operating system's built-in support for the RTL-SDR chips, and as such the maximum frequency is limited to around 860 MHz by the Linux drivers. (If you have used one of these devices at higher frequencies [they will function up to around 1700 MHz] with some SDR package, you were able to do that because your SDR software uses its own set of drivers.) If you want to use VLC at higher frequencies, there is a workaround for this described by Clayton Smith, VE3IRR, at the following link (described near the bottom of his page): https://irrational.net/2014/03/02/digital-atv/
He also describes using the "BladeRF" for transmitting digital ATV.

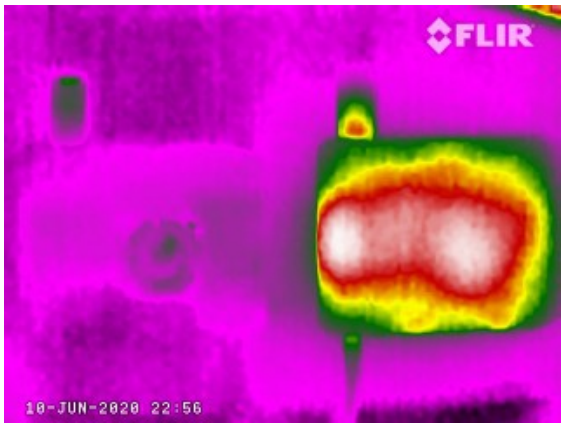
3. The following link is the best way to get the Raspberry Pi OS:
https://www.raspberrypi.org/downloads/

4. Method
   - ! Once you have your RPi up and running and your SDR dongle connected, start the VLC (it is under "sound and video").
   - ! Select: Media > Open capture device.
   - ! Select tab Capture Device.
   - ! Select Capture Mode (drop down) TV-digital.

- ! Select DVB-T.
- ! Enter frequency and use the bandwidth drop down and select 6 MHz. (The default "automatic" sometimes hasn't worked for me.)

5. Links for the Nooelec SDRs:
https://www.nooelec.com/store/sdr/sdr-receivers/nesdr-mini-2.html
https://www.nooelec.com/store/sdr/sdr-receivers/nesdr-mini-2-plus.html

6. Reply to my email to VE3IRR requesting permission to reference his work: *"You're certainly welcome to quote or paraphrase that part, or use whatever else you like from my blog. 73, Clayton (VE3IRR)"*



ATV Repeater Video ID Issue Resolved

Dave, AH2AR, Dayton, Ohio

There are many applications where additional cooling may provide overall better system performance and component life. Case-in-point is when hams will install additional cooling on linear amplifiers and transmitters, especially when the units may be operating continuous duty cycle. To that end, we recently developed an intermittent problem with a Western Digital Media Player down at the ATV repeater site. It was immediately suspected that thermal issues could likely be causing the problem.

As you may have noticed, the W8BI ATV ID that provides the "full motion" ID loop had been stuck on a still frame during last week's DARA/ATN ATV net, between ATV transmissions. This particular media player has been running continuously for three years. A reboot of the player worked for about a week, but the glitch occurred once again. I went ahead and installed a cooling fan in the player, as these units get quite hot after running continuously. I centered the cooling fan over the microprocessor, the primary source of heat.. The cooling fan has brought the external temperature of the unit down 40 degrees and this simple modification will obviously allow for cooler operation.

The thermal image below shows the difference in operating temperature between two identical media players; one with the fan and one without. It is interesting to note that heat also was propagating from the PC board of the media player into the external thumb drive via the metal USB connector. The fan modification markedly decreases the player's operating temperature, as illustrated by the thermal image (both units had been operating for three hours for the bench test). This particular media player has vent holes on the bottom of the case, so the 12vdc fan that has been installed now pulss the air through the unit.

Test Monitor for on-site NTSC Composite Video Testing

Dave, AH2AR, Dayton, Ohio

A good source for NTSC composite video test monitors are available. The e-bay seller is listing them for $34.95 (shipping is extra), but he will entertain "best offers". Admittedly not a bargain at this price, the units are still in new condition and they also operate from internal 8 AA battery power or a 12 to 24 VDC external power source. The TFT display provides excellent color video for the resolution display size, and can be used as a means to test analog cameras and also these units will accept a tripod for support if necessary. (The live video being inputted into the monitor in the photo below is an NTSC automotive backup camera). No, this particular unit does not have an HDMI input. The e-bay link is as follows:
https://www.ebay.com/itm/Portable-3-5-TFT-LCD-NTSC-Composite-Color-Monitor-320x234-Resolution/311506378919?hash=item48873a20a7:g:dnUAAOSwCQNWcuLx

ATV HAM ADS

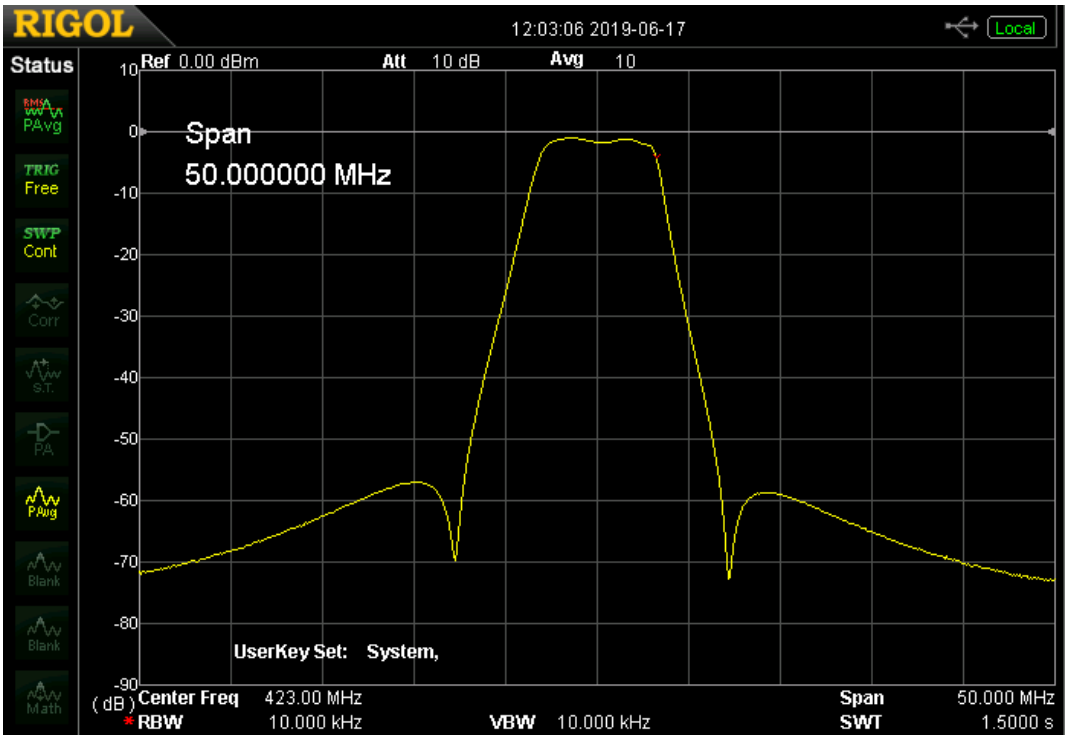
Free advertising space is offered here to ATV hams, ham clubs or ARES groups. List here amateur radio & TV gear **For Sale - or - Want to Buy.**

FILTERS for ATV REPEATERS

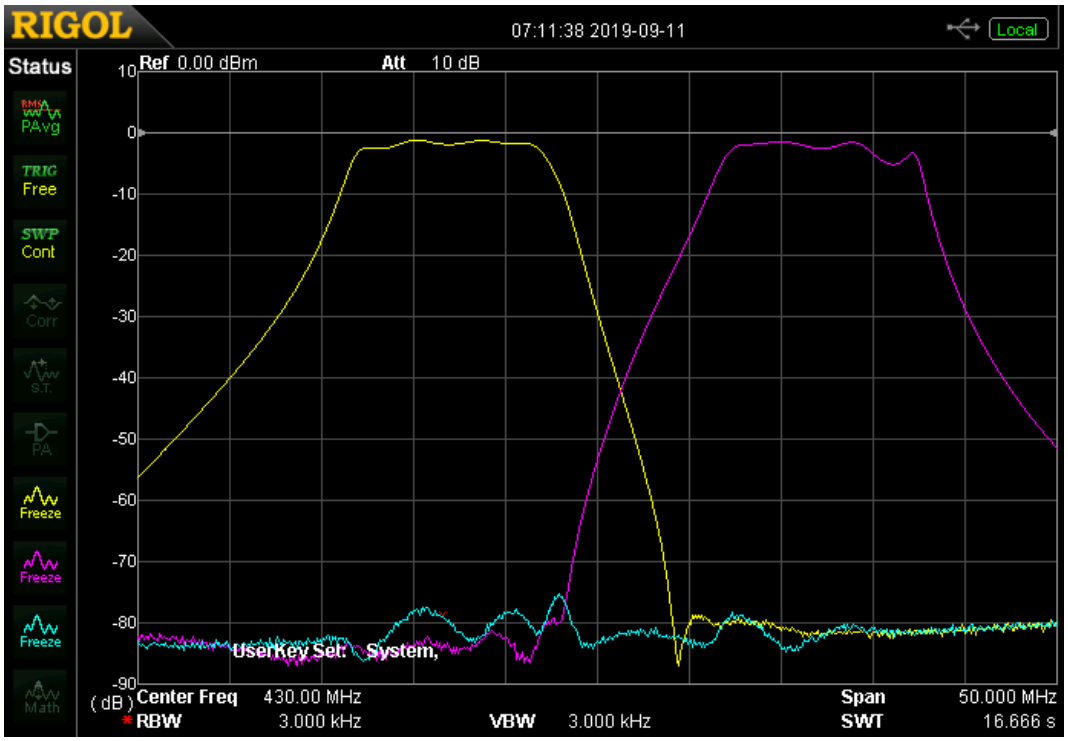
70 cm, 6 MHz, Band-Pass Filter

70cm, ATV / DTV Duplexer

KH6HTV VIDEO is pleased to announce the availability of filter products which will make it possible for radio/TV amateurs to easily build 70cm Television Repeaters. They are the model ATV-BPF-xxx, Band-Pass Filter and the model ATV-DPX, Duplexer. With the duplexer, it is now possible to construct a TV repeater using a single antenna. Detailed specification sheets are available on the web site: www.kh6htv.com Also check out new, revised, application note, AN-23e, entitled "DVB-T Television Repeater" plus AN-48 & AN-49.



S21 insertion loss of band-pass filter tuned for a center frequency of 423 MHz and 6 MHz bandwidth. 10dB/div & 5 MHz/div



Insertion loss of Ch 57 (423MHz) & Ch 60 (441MHz) ATV Duplexer. S21 = Ch 57 (yellow), S31 = Ch 60 (magenta) and S32 (cyan). Center frequency = 430 MHz, span = 50 MHz (5 MHz/div). Vertical = 10dB/div. Noise floor of measurement is -83dB