Boulder Amateur Television Club
TV Repeater's REPEATER

July, 2023
issue #134

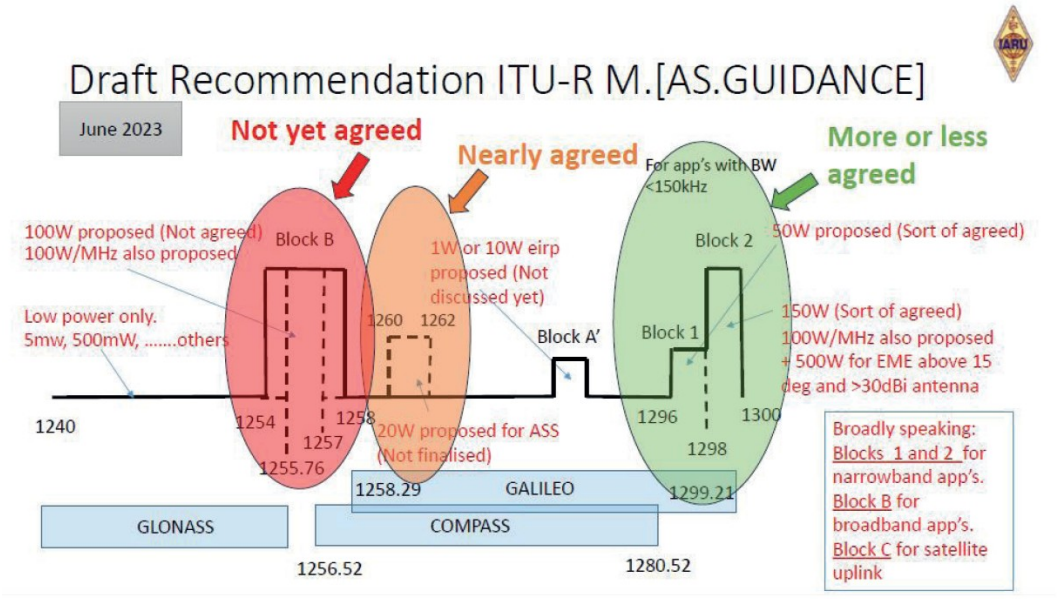
BATVC web site: www.kh6htv.com

ATN web site: www.atn-tv.com

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

The future of 23cms – update

Noel Matthews - G8GTZ



As hopefully everyone is aware major changes to amateur access to the 23cms band are set to be agreed at WRC-23 in October. Barry, G4SJH, is leading the IARU negotiation team and gave an update at the

RAL microwave roundtable on Sunday June 18th. For the full background to the changes watch the video of Barry's presentation at the Martlesham microwave roundtable. ***https://www.youtube.com/watch?v=0DnixRmJ0Hk***

The changes are significant and there will be a stringent power limit (less than 1 watt) to the majority of the band apart from 4 segments seen below. Negotiations are still ongoing and nothing will be decided until after the WRC. ---– It is hoped there will be a segment centered around 1256 MHz to accommodate digital repeater inputs and simplex operation.

It is important that everyone prepares for these changes so they do not come as a surprise when Ofcom updates your license - we will try post the latest updates on the BATC forum here: ***https://forum.batc.org.uk/viewtopic.php?f=91&t=8436&p=33718#p33718***

Whatever agreement is made, FM ATV operation will no longer be possible below 1300 MHz and it is likely the IARU and BATC contest rules will be amended before the end of 2023 to exclude FM entries on 23 cms.

Reprinted from the latest Summer, 2023 issue of the BATC's CQ-TV magazine. issue #280, page 9

BARC FIELD DAY -- 2023

Once again the Boulder Amateur Radio Club (BARC) set up their field day operation on Boulder County mountain parks open space, Betasso Reserve. A prime mountain top setting. Normally no overnight stays are allowed. But each year BARC gets special permission from the county to use the picnic shelter house and stay overnight for the weekend. Allen, K0ARK, once again brought his complete portable HF station. The key element in Allen's station is his trailer mounted, electrically driven crank-up tower and a Step-IR tunable yagi beam antenna on a rotator. It is used for BARC's SSB station. The BARC CW station this year used a horizontal wire, delta loop antenna fed with ladder line. The above photo on the left shows the Step-IR antenna, the CW (white) and SSB (yellow) tents. Plus in the foreground was a BARC member getting ready to use the air gun to shoot a tennis

ball with a pull line over a tree to then be used to pull up a leg of the delta loop. The photo on the right shows the SSB station rapidly logging lots of 20 meter contacts. The mountain top location and Step-IR antenna configuration put out such a strong signal that W0DK was able to command their own frequency, call CQ Field Day and just sit back and let the "hunt-n-pouncers" find and call us. This was the first year that BATVC, ATVers did not participate with any ATV demo at the BARC field day operation.

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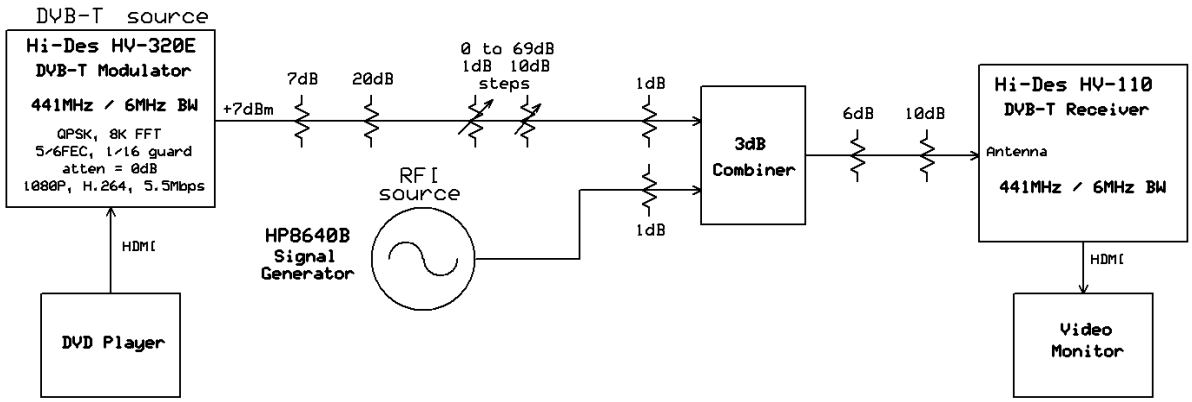

DVB-T RFI Experiment

Jim Andrews, KH6HTV

Many years ago (2014), when we first started working with digital ATV, I made experiments to determine the RFI susceptibility of DVB-T receivers. At the time, the concern was for the Boulder ARES (BCARES) operations running four simultaneous, 70 cm, ATV transmitters covering the University of Colorado football games for the CU police dept. Could we run then several DVB-T transmitters on adjacent channels, and / or a mix of analog and digital TV transmitters. I also included a few tests using CW interfering signals. The results were documented in my application note, AN-19, entitled "Analog & Digital TV Co-Channel & Adjacent Channel RFI Measurements". (available at www.kh6htv.com)

With our current issues of a whole lot of RFI on our 70 cm input to our Boulder W0BTV, DATV repeater, I decided to once again perform some measurements on the susceptibility of a DVB-T receiver to an interferring CW signal.

The above block diagram shows the test set I assembled to perform the tests. The tests were run using a DVB-T test signal on 441 MHz with a band-width of 6 MHz. The various digital signal parameters are shown on the block diagram. The RFI source was an HP-8640B signal generator producing an unmodulated CW sine wave of known frequency and level. The DVB-T and CW signals were added together in a passive, 3 dB Wilkerson power divider/combiner. "Live" video with lots of

motion and audio was provided by a DVD player. Having continual motion in the video is important to be able to detect when freeze framing occurs indicating RFI interference. The Red/Green signal status LED on the Hi-Des receiver is also a great indicator of when RFI occurs. If it is flickering red/green or turns red, the DVB-T signal is being interfered with.

The first test was to determine the digital threshold sensitivity of the HV-110 receiver. This was the minimum signal level at which solid video and audio was obtained with no freeze framing. Also the red/green LED glowed a solid green. The receiver sensitivity was found to be -92 dBm. At this level, the on screen display showed a signal/noise ratio of 8 to 9 dB.

CW RFI tests were then run with the DVB-T test signal into the receiver being set to +3 dB and also +10 dB above digital threshold. i.e. -89 dBm and -82 dBm. At these levels the S/N read 11 dB and 18 dB respectively. I performed the tests over a range of ±8 MHz from the center frequency. i.e. from 433 MHz to 449 MHz in 1 MHz increments, except at the channel band-edges. In each case, I started with a very low level CW RFI signal of -130 dBm. I brought it up in 10 dB steps until I got freeze framing. I then backed off the signal by -10 or -20 dB and using the vernier amplitude control slowly increased the signal level until I reached the threshold of freeze framing. It was also indicated by flickering of the HV-110's red/green LED. Then backed off to again have solid video. I then recorded the signal generator setting. Corrected it for the additional 20 dB loss in the test set and calculated the difference between the interfering RFI signal and the average power of the DVB-T signal.

RESULTS: So what were my findings? I found that a single interfering CW signal anywhere within the 6 MHz channel (i.e. from 438 to 444 MHz) needed to be about +23 to +30dB stronger than the average power of the DVB-T signal to cause interference. On the band edges, ±500 kHz beyond the channel edges (i.e. 437.5 & 444.5 MHz), there was starting to be additional rejection. The RFI signal needed to be about +35 dB stronger. Beyond ±1 MHz from the channel edges, the RFI rejection was considerably better. RFI signals there needed to be 40 to 60dB stronger than the DVB-T signal. I obtained similar results from both tests at +3 dB and +10 dB above digital threshold.

I also noticed some variablity in my measurements. Not always repeatable. Also, the receiver at times seemed to be able to correct and eliminate the RFI. I sometimes observed it initally being momentarily having a freeze frame for a second or two, but then correcting for it and then allowing me to increase further the RFI signal level without freeze framing.

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W0BTV, 70 cm, 2 MHz BW Experiment - a Bust

Recently, we modified the Boulder, Colorado ATV repeater by removing the unused 439.25 MHz, analog TV receiver and replacing it with a 439 MHz, 2 MHz BW, DVB-T receiver. The hope was to

be able to minimize the RFI which was clobbering all but the strongest of our 70 cm, 441 MHz, 6 MHz BW, DATV signals. Nope -- didn't make any appreciable improvement. Warning, the following is a tale of disappointments.

What we found was that we got similar results with both the 441/6 MHz receiver and 439/2 MHz receiver. Our measurements, using the repeater's on-screen-displays of signal strength and s/n showed that we needed very strong signals to overcome the unknown RFI. If the input DVB-T signal dropped down to -60dBm or weaker, it started being clobbered with freeze frames from the RFI.

So, after the fact, we then did some spectrum studies to see what is happening at our repeater site. We don't have ready 24/7 access to the government building where our W0BTV-DATV repeater is located. We have to schedule a visit appointment several days in advance to gain access to the radio room or the roof top. The building itself sits way above the city of Boulder, by 800-900 feet, on a mesa, nestled up against the front range of the Rocky mountains. So we did our measurements sitting in our car in the parking lot. The repeater's antennas are another 120 feet above the parking lot. From either location, we see a really long way to Denver and out onto the eastern Colorado prarie. At the repeater's location, it is exposed to all the RF signals coming out of Denver and all of north-eastern Colorado.

We used the new, really low cost, TinySA-Ultra spectrum analyzer. The mobile antenna used was a Diamond NR2000NA (2m/70cm/23cm). We tried lots of different settings and looked at various portions of the ham 70cm band, plus above into the business band. The band below 445 MHz was fairly quiet. We did see the occasional ham FM voice signal pop up now and then. We also noted activity around 434 MHz. Above 445 MHz, it was a totally different story. Lots of signals in the 445-450 region which for the most part were FM voice repeater outputs. Then above 450 MHz, in the business band, it was painted almost wall-to-wall with signals. Careful monitoring however showed that the most likely culprit was perhaps a signal at 445.050 MHz. So punching that frequency into an HT and listening to it, we found it was not voice, but was intermittant bursts of data. There were also very strong FM voice repeater signals in the 447 MHz area.

So back to the drawing board. Our repeater configuration was set with a 70 cm, ATV channel filter tuned to a center frequency of 441 MHz with a -3dB band-width of 6.3 MHz. Our next step was to try QSYing down a few MHz. Don, N0YE, had another home-brew, ATV channel filter so he retuned it for a center frequency of 439 MHz. The hope was to put more of the BPF skirts onto the signals at 445 and above.

OK, back to the repeater site on Wed, June 21st. Don swapped out the 441 for the 439 MHz ATV channel filter. In the meantime, Jim retuned the Hi-Des HV-120 receiver from 441 down to 439. While we were at the repeater site and had the repeater's receive antenna disconnected from the repeater, we had it attached to a TinySA-Ultra spectrum analyzer. We wanted to see what signals were actually being picked up for it. The below plot is what we saw. The green trace was the peak signals recorded over the 25 minute time interval we were in the radio room. We didn't see anything significantly different from earlier observations in the parking lot.

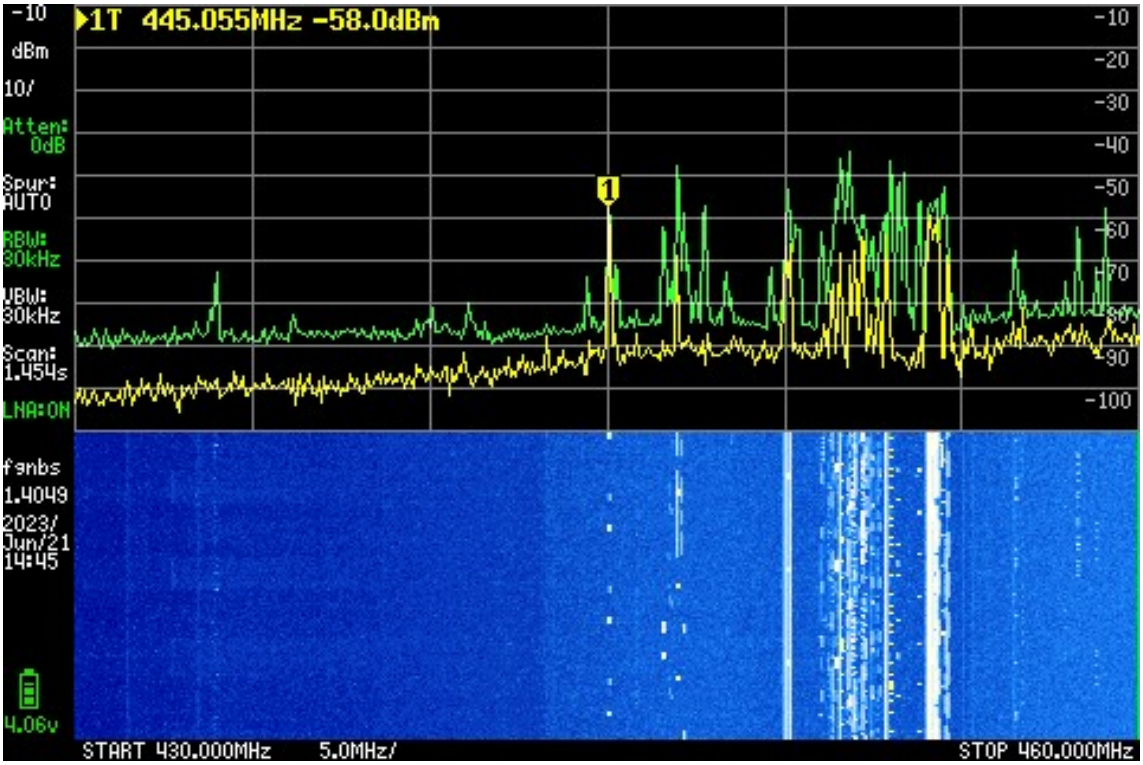
Now, back home that evening, Don was able to run some controlled experiments at 439/6 MHz from his home QTH. He put a step attenutuator between his Hi-Des modulator and the rf power amplifier.

He was also able to monitor the repeater's output and note the repeater receiver's on-screen S meter & s/n meter displays. He was able to drop his signal strength down to as low as -85dBm into the repeater before seeing any freeze framing. It appeared we had solved the problem.

Wrong ! The next morning Jim tried the same experiment, but was unsuccessful. There were times when the s/n hit max. of 23dB, but then would be clobbered again by something causing the repeated pictures to freeze up. On our Thursday, June 22ed, afternoon weekly net, we had a brief period for about 5 minutes before the net when Don's 439/6 MHz signal came through great. But then once the net started, everyone trying out 439/6 was clobbered with lots of freeze framing, even when running high power.

We returned to the NCAR parking lot again on other days with both the spectrum analyzer and also a DVB-T receiver to simultaneously video monitor the repeater's output signal and look for any strong RFI signal(s) we could correlate with the freeze framing we were observing. No luck.

Bottom Line for us is at present --- our cross-band repeater configuration of 23 cm input and 70 cm output works best. Where do we go from here ? Big Question ? ? ? Do we just kiss off 70cm as an input ? ? ? Jim is voting to say "I have had it and want to just go back to 441/6 MHz and rip out the 439/2 MHz receiver." But Don is saying "No way, I want to continue experimenting and hopefully find a solution." Guess Don wins for the present. So we will make some more hardware adjustments at least. 73 de Don, N0YE, & Jim, KH6HTV, trustees



70 cm RFI at the W0BTV repeater site

We used the W0BTV's Diamond X-6000 receive antenna. Sweep 430 MHz to 460 MHz, 5 MHz/div. Vertical: 10dB/div. Top level = -10dBm. Resolution band-width set to 30 kHz. Yellow trace is single "live" sweep. Green trace was in peak hold mode for 25 minutes. Bottom 1/2 with blue background was waterfall display of green trace.

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5 cm FM-TV Transmitters -- How do they compare ?

Noel, G8GTZ, of BATC demoing new IC-905 in You-Tube video

ICOM IC-905: With the recent introduction of the new ICOM IC-905 Microwave Transceiver, we hear that it includes FM-TV capability. Will it be compatible with other existing amateur FM-TV gear ?

In our May issue #130, we said that Mike, WA6SVT, and Gary, W6KVC, had recently tested a new IC-905 and posted their tests on YouTube. (***https://www.youtube.com/watch?v=4ymjoAxIpnw***) Their 1/2 hour video included comments about testing the FM-TV performance. They reported (1) the video modulation level was a bit low, (2) the HF video response rolled off a bit and (3) the sound sub-carrier frequency was not adjustable. As a result, it was not on what ATN-CA uses. But it did work for ATV.

Dave, G8GKO, of the BATC in the U.K. has informed us that he is working presently on an evaluation of the IC-905. It will be published by RadCom. He then plans to publish the results he finds for ATV in the BATC's CQ-TV magazine. We will be anxiously awaiting to read those articles of Dave's.

There is another **NEW** (as of May 30th) **You-Tube** video evaluating the IC-905. This 18 minute video devotes 1/2 of it to a field test demo of the ATV capability of the 905. The video was put together by

BATC members, Dave Crump, G8GKO and Noel Matthews, G8GTZ, along with Bob McCreadie, G0FGX. They include a live demo of a 5.8 GHz, FM-TV QSO using a pair of IC-905s. Noel makes the statement in the You-Tube video that the video standard used by the 905 is compatible with the video system used for 5.8 GHz drones. The URL link is: ***https://www.youtube.com/watch?v=0yLnjeEGx2s***

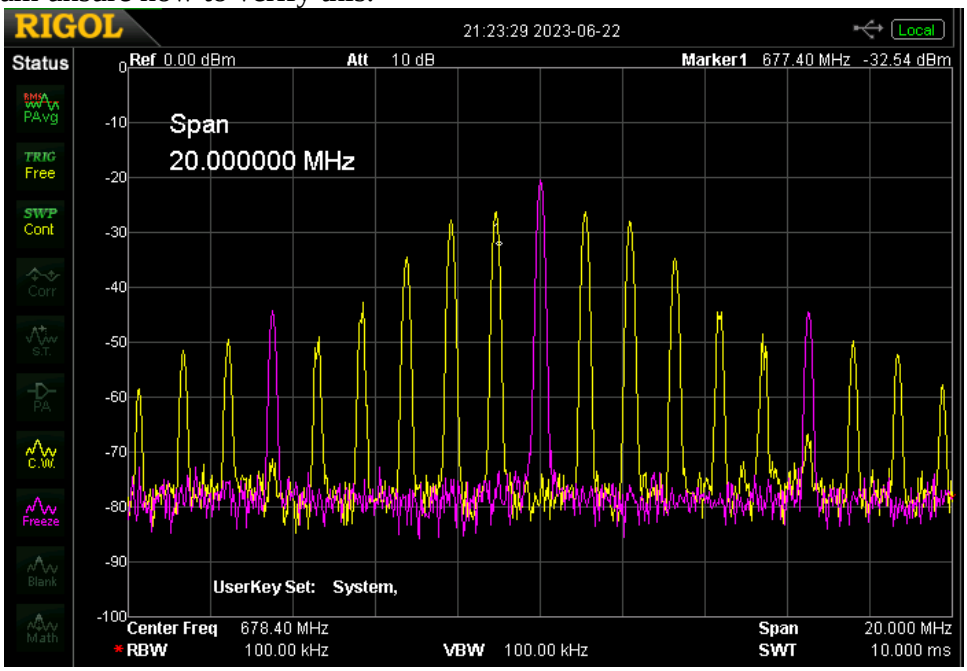
DRONE 5.8GHz FM-TV: I have been pushing ATV folks to continue using analog ATV, especially on the 5cm (5.8 GHz) band using the extremely low cost ($30) drone video kit from Amazon of a complete FM-TV transmitter and receiver. I have written about it in several previous newsletters. We ATV hams here in Boulder, Colorado have also done some DX-peditions with them and gotten some really long distances for ATV contacts. In addition, we added one of the transmitters to our W0BTV, ATV repeater to serve as a 5 cm, FM-TV Beacon running 24/7.

So, all this new excited talk about the IC-905 got me to wondering, just what were some of the performance specs. of the Amazon 5.8 GHz, drone FM-TV gear. The gear has no manufacturer's name on it. Just model numbers. They are TS832 for the transmitter. RC832 for the receiver. Their instruction manuals tell us very little. The only relevant specs. for the TS832 are the channel frequencies (40 channels from 5645 to 5945 MHz), modulation type of wideband FM, output power of 600mW, Sound Sub-Carrier frequency of 6.5 MHz, Video format NTSC/PAL, Video input of 1 Vptp into 75 Ω, video bandwidth of 8 MHz, audio input of 1 Vptp into 10 KΩ, 12Vdc @220mA.

Key relevant specs. missing are: What is the Deviation ? Does it use Pre-Emphasis / De-Emphasis ? and if so, to what spec. ? We here in Boulder have used the gear successfully, but without inquiring about these parameters. Guess we weren't bothered at the time as there was nothing else to compare it with and try to operate interchangablity with. Now with the new IC-905 coming on the market, we do need to be concerned.

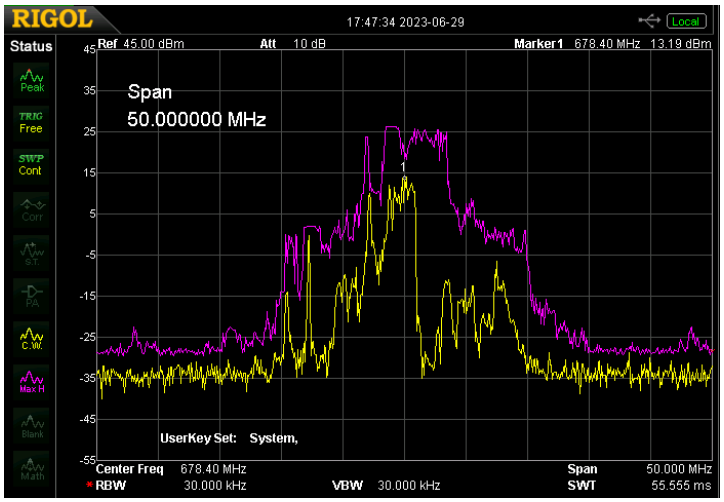
So, I decided to at least try to answer some of our questions. I lashed together a test setup to measure the video deviation. I used the system documented in my application note, AN-14 "FM Transmitter Deviation Adjustment & Calibration". The easiest technique to measure deviation is the Bessel method shown there. It consists of putting a 1 Vptp sine wave into the video transmitter and looking at it's rf spectrum. The spectrum consists of a large number of sidebands of diminishing amplitude. Of particular interest is to watch the zero carrrier frequency. Slowly bring up the frequency and watch for when the carrier is nulled out for the first Bessel function null. Equation (1) is the modulation index $\chi = D / m$ where D is the deviation and m is the modulation frequency. The first Bessel null occurs when $\chi = 2.405$.

This spectrum analyzer screen grab photo shows the results of the deviation measurement. The span is 20 MHz. The scales are: 10dB/div & 2 MHz/div. The magenta trace is the spectrum with no video modulation applied. All we see is the carrier at 5.905 GHz and the upper and lower sound sub-carriers ± 6.5 MHz on either side of the carrier. The yellow trace is now with a 1 Vptp sine wave into the video input connector. The frequency of this modulating sine was adjusted to find the first null in the Bessel function. It was measured to be m = 1.086 MHz. Thus putting this value in the above equation, I found the deviation of this FM-TV transmitter to be 2.6 MHz. Not 4 MHz as in commonly used for ATV. However, I did make the assumption that pre-emphasis was not being used in the transmitter. I am unsure how to verify this.



Deviation Measurement

This plot shows a typical spectrum obtained from this same drone transmitter, but the input video signal was typical "live" video obtained from a DVD player playing a movie file. The span is now 50 MHz (5 MHz/div & 10 dB/div), 30 kHz BW. Yellow trace is capture of a single sweep. Magenta trace was peak hold mode for 3 minutes of video.

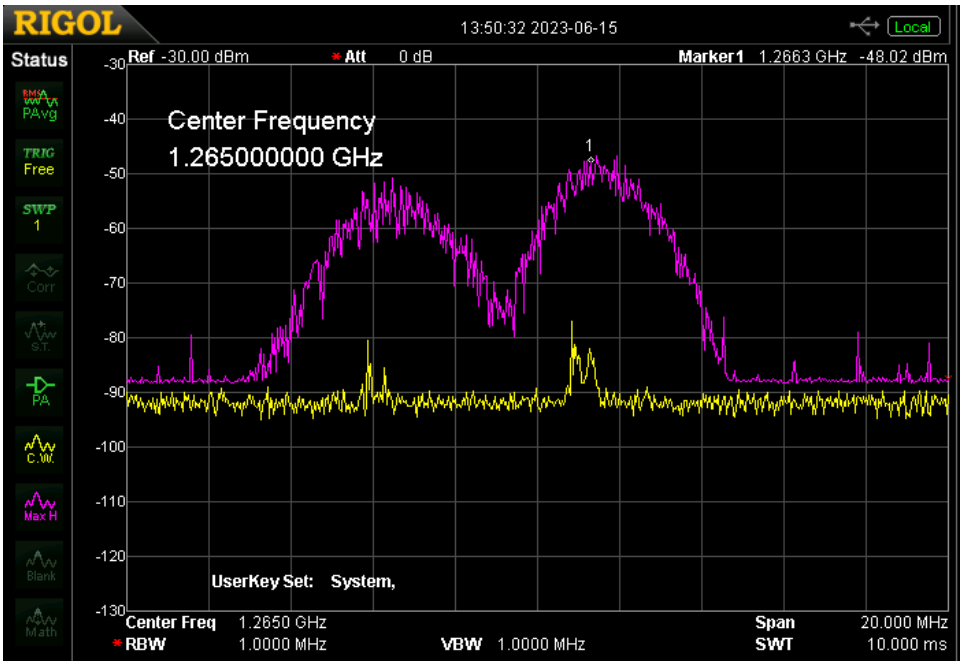


"Live" Video Spectrum

The next test I performed was to check the overall video frequency response of a drone transmitter / receiver pair. The transmitter was the TS-832. The companion receiver was the model RC-832. I attenuated the 600mW output of the transmitter with 90dB of SMA attenuators before inserting the signal into the receiver. I input a test sine wave of 200 mV (ptp) into the 75Ω input of the transmitter. Looking at the receiver output on a Siglent digital oscilloscope, terminated in 75Ω, the output signal was also 200 mV (ptp). Thus 0 dB insertion gain for the combo. I then put the RC-832 video output into a Rigol spectrum analyzer. I measured the swept frequency video response. I found it was flat from 100 Hz up to 1 MHz. It then peaked a bit rising 1 dB at 1.5 MHz and flattening out at +2dB from 2.3 to 5.0 MHz. It then rolled off to help eliminate feed-thru of the 6.5 MHz sound sub-carrier (SSC). It was -3dB down at 5.7 MHz, -10dB at 6.1 MHz and -20dB at 6.3 MHz.

Conclusion ? -- Well, if your only objective is to do microwave FM-TV on the 5cm band, then there is a very significant 20dB $$ advantage to sticking with the drone gear (i.e. $30 vs. $3,000 for the IC-905). Essentially identical performance, both from an rf and video perspective.

73 de Jim, KH6HTV, Boulder, Colorado



FAA, 23 cm RADAR Spectrum

FAA RADAR SIGNATURE

What does our Denver, 23 cm, FAA radar look like on a spectrum analyzer ? Recently, I connected my 23 cm, loop yagi antenna to my Rigol spectrum analyzer and tuned to 1265 MHz. This is what I saw.

The resolution bandwidth was set to the widest possible of 1 MHz. The center frequency was 1265 MHz with a 20 MHz span. The yellow trace is a "live" single sweep. The magenta trace was set to peak hold. It took several minutes to build up the magenta trace. The FAA radar is located in Parker, Colorado, about 35 air miles from our W0BTV repeater site. My home antenna was pointed due west

at our repeater site, about 12 air miles away. The radar was on the side of my beam. What I was really looking at was the reflection of the radar pulses from the Flatiron mountain directly to the west and behind our repeater. As the radar dish rotated, I could see the intensity of the radar pulses go dramatically up and down. Ony the highest peaks were captured on the magenta trace. I measured as a weak reflection a strong -50dBm signal. One can only imagine how strong the radar must be at our TV repeater and why it was clobbering our 23 cm receiver before Dan, K0DGS, designed for us a great band-pass, band-notch filter. It is a direct line-of-sight path from our repeater to the Parker radar.

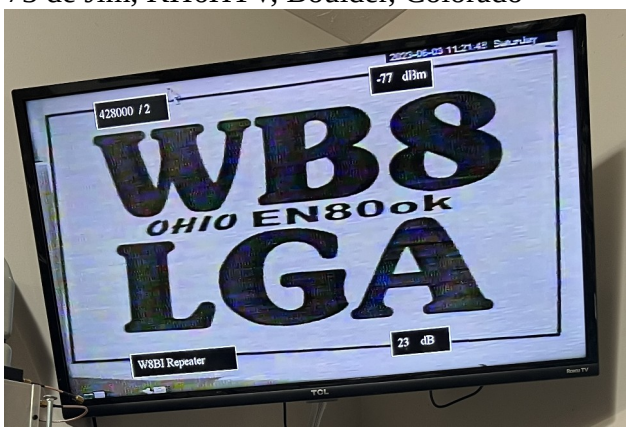
As a side note -- I also tried the same experiment using my new TinySA-Ultra spectrum analyzer. I used the same settings as my Rigol. It was worthless for measuring the radar signal. It gave almost no indication of the presence of the radar signal.

73 de Jim, KH6HTV, Boulder, Colorado

DATV DX !

(CORRECTION)

Another Mid-West Band Opening
Saturday, 3 June, 7am



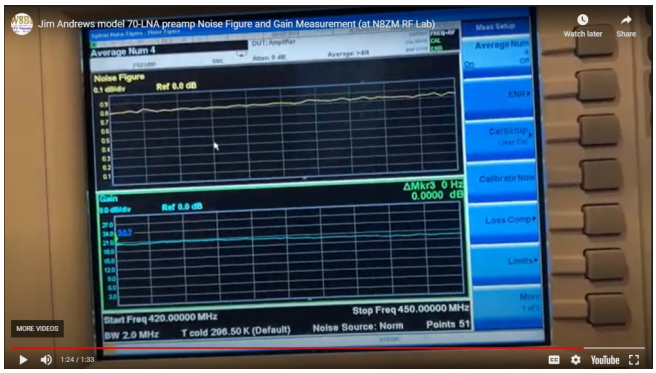
photos tnx to Dave, AH2AR

This is an an A5 signal from Charles Beaner in Morrow County, Ohio passing through the W8BI repeater in Dayton, Ohio on its DVB-T output…at 85 miles…

Hi Jim --- Just wanted to mention that you got it a little wrong, do appreciate you running the photo of the incoming ATV DX signal from WB8LGA through the repeater, but you might want to ask when you add information to the photos I send you. The OSD information displayed on the monitor is NOT the OSD that the ATV repeater is receiving. Those OSD values are from the receiver at my home QTH from the incoming DVB-T signal from the W8BI repeater. The repeater will only display the OSD if the HV110 at the repeater site is receiving a digital signal. As the signal that the ATV repeater was receiving was an A5 signal, the repeater will not be retransmitting the OSD display. Confusing, ain't it!!! It was quite remarkable that the ATV repeater was receiving Charles' A5 video P5…. Closed-circuit, rare to experience that kind of analog video from 80+ miles distance…

Cheers, Dave P. , AH2AR, DARA, Dayton, Ohio

p.s. Here is another photo from Dayton Hamvention. It shows a group of hams checking out some of the ATV gear on display at the ATN booth.



YouTube links to N8ZM "RF Lab" Noise figure and Gain on 70 cm preamps

AirSpy 70cm Preamp (unmodified, 434 MHz filter in-place), $11 Amazon Commercial off-air TV preamp: ***https://youtu.be/Gekwf6SgM8k***
AirSpy Modified 70cm Preamp (434 filter removed): ***https://youtu.be/oj9HnFOhg8w***
VHF Designs Ukranian 70cm LNA preamp: ***https://youtu.be/jJPy22VyKUs***
Jim Andrews', KH6HTV, model 70-LNA, 70cm Preamp: ***https://youtu.be/SEaJLeB_rnA***
Thanks to Dave, AH2AR, for sharing these with us.

CORRESPONDENCE:

SatLink Issues:

Fran, PAFEX, in Holland writes ---- "Hello Jim. Thanks for your newsletter.
I've read that you have tested the Satlink WS-6990 modulator. I've just received that same Satlink and I'm trying to get it work with HDMI input, also tried CVBS and that gives me a picture on my Satlink satfinder dvb-t/s/c but no picture from HDMI. Do you know if the modulator is critical at setup??
I have set it at 430 Mhz both modulator and satfinder at dvb-t and on the screen I can read the same value's for PID….as set on the modulator, so I think it's getting the correct info but no picture."

Editor's Comment: *We too encountered the same problem with our WS-6990. Could only get it to work with analog composite video input, but even then the analog audio didn't work. Now glad to hear our's was not a unique problem. Fran is seeing the same issue. Thus it must be a built-in defect in the SatLink box. We had written about the WS-6990 a year ago. Now wish we hadn't. Our conclusion now is it is a piece of JUNK ! Do Not Buy ! It is too bad, as we all were really wishing we could find a low cost supplier for DVB-T modulators.*
Perhaps others have gotten them to work? If so, then please share with our readers your experience and solution.
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ARES & ATV: Hi Jim --- Always a great newsletter. Thanks for keeping me in the loop. I thought I wouldn't be "involved" with any ARRL type duties when I moved here but I was "enlisted" by the New England Division Director whom I believe you know, Fred Kemmerer, AB1OC. (*also an ATVer*) Because of my past experiences with ARES in Colorado, I am now an Assistant Director for the New England Division, responsible for emcomm communications! Yikes! What did I sign up for?... LOL.

Handling a one-state ARES group is one thing but now being responsible for the six states ARES groups plus the Hudson Valley of NY state is certainly a whole different world. Fortunately, there are a some really good SECs and SMs but there is missing the situational awareness aspect of any emergency as we were so good at with BCARES and ATV.

73 de Jack Ciaciaa, WM0G, Nashua, New Hampshire

Editor's Note: *Jack formerly lived in Boulder, Colorado for many years. He was extremely active in ham radio here. He is an avid HF DXer. Over the years he had served as the president of our ham club, the chairman (EC) of our local ARES group, a SWAT team volunteer (for ATV video), and more recently the ARRL section manager for Colorado. In 2020, Jack and his wife Mary retired and moved back to his original home area of New England.*

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W0BTV Details:

Inputs: 23 cm Primary (CCARC co-ordinated) + 70 cm secondary all digital using European Broadcast TV standard, DVB-T 1243 MHz/6 MHz BW (primary), plus 441 MHz/6 MHz BW and 439 MHz/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/***

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*.**

No, I am not selling this old TV receiver. I recently saw it while shopping in the Longmont, Colorado Flea Market & Antique Store. The sign says it is a 1949 Motorola TV receiver. Asking price was $150.