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*This ATV electronic newsletter was formerly entitled **"TV Repeater's Repeater"** for issues #1 through 165. It is a publication of the Boulder Amateur Television Club, Boulder, Colorado. It started six years ago in July, 2018 strictly as a club newsletter for it's own 20 some members. Since then it has grown in popularity to become the "de-facto" ATV Journal for a large number of ATV ham through out the USA. Plus it now has a sizeable base of readers, plus contributing authors from overseas. Hence the new name of **Amateur Television Journal**.*

Adapting an Offset-Fed Parabolic Satellite Dish for 5.8 GHz ATV Operations

Chris Grund, K0CJG

Local ATV'ers in the Boulder, CO area, including myself, have been using inexpensive 600 mW drone transmitters/receivers coupled to high gain antennas, and sometimes 1.5W PA's, to hold FM-TV QSO parties at ~5.8 GHz over 10's of km distances with P3-P5 picture quality. Recently, we have been discussing extending the range for these parties to much greater distances, perhaps 100 km or more. Distances increases 3X or 4X come with the expectation of additional path losses of >10dB, suggesting a similar increase in Rx and Tx gain will be needed to maintain similar quality contacts. The best way to achieve the needed improvements in both Rx and Tx performance is by increasing antenna gain The down sides of increasing already high antenna gain are the need for higher pointing precision and deploying a physically larger antenna.

Figure 1. Center: small parabolic dish antenna (0.36m dia), Left: feed for small dish, Right: Large offset feed parabolic dish antenna (0.68m X 0.84m) showing final corner reflector feed and support arm.

Currently, I am using a 14" (0.36m) diameter parabolic dish fed by a dipole element with a reflector plate (Fig. 1). This dish and feed were given to me by Don Nelson, N0YE, and have served me very well for ATV activities over the past few years. A year or so ago, another ham, Colin WA2YUN gave me a somewhat larger offset feed satellite dish typically used for commercial satellite reception ~12 GHz (Fig. 1). These dishes are ubiquitous and inexpensive, and are oblong sections geometrically defined from a side of a larger parent parabola. Since these sections exclude the center of the parent parabola, they have the advantage that the focus, and hence the feed location, is typically outside the boresight of the dish. But, without full specifications on the dish (as was the case here), this geometry also makes feed positioning a 5 degree-of-freedom geometric problem, with the critical primary focus occurring at some location along a non-obvious line at some unknown angle to an unknown point on the dish. Fortunately, this dish did come with a rigid arm meant to hold a 12GHz LNB and feed horn, so I had some general notion about where the focus might be found. Geometric challenges notwithstanding, it looked like a fun project to make this dish work for extending my ATV DX activities.

Determining the offset dish parameters was my first task. For this, I found invaluable the Microwave Antenna Book available on the W1GHZ.org site. Most useful was the section on offset dishes, and the link on that site to an online Windows application HDL_ANT from W3SZ (comprises a great set of calculators for feed horn and dish problems). Using HDL_ANT, I plugged in my carefully measured dish parameters: Long axis 833mm; Short axis 760mm; Deepest point 70mm; and, Bottom edge to deepest point 305mm. HDL_ANT then dutifully returned: Focal length 472 mm; f/D of segment 0.31; f/D of parent dish 0.7; Feed illumination angle 78.7°; Recommended feed horn 3dB beam width 45.7°; and estimated 50% efficiency gain 32dBi. Using the calculated geometric parameters, I tied together 3 strings from convenient existing holes in the dish rim to indicate the calculated focal point for future reference.

I also used HDL_ANT to generate a sheet metal stretch out pattern for a feed horn of the suggested 3dB beam width parameters to an existing WR159 coax to waveguide transition (another gift, from Bill McKay K0RZ). The resulting horn antenna, shown in Fig. 2, was constructed in 0.019" aluminum.

Another app in HDL_ANT allowed me to calculate the expected gain for my small dish as well: 24 dBi. Thus, the benchmark goal for a good implementation of the offset dish should yield a gain improvement of ~8dB (or slightly more if feed efficiency can also be increased). A comparison of the theoretical performance of the antennas is given in Table 1.

Table 1. Comparison of calculated gain and Rayleigh Range for the antennas.

Antenna	D (m)	R_r (m)	Area (m^2)	Best Expected Gain
Small Tx feed horn	0.05 X 0.065	1.6	0.0033	10.6 dBi
Small Parabolic	0.36	4.9	0.1	50% efficiency → 24 dBi
Large Offset	0.68 X 0.84	27	0.45	65% efficiency → 32 dBi

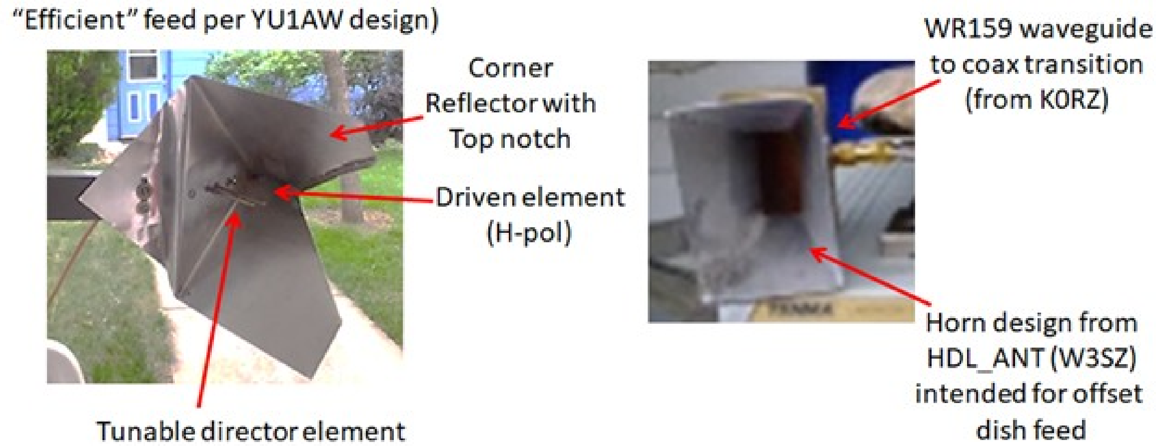


Figure 2. Feed antennas. Right: Implementation of HDL_ANT suggested feed horn for matching WR159 coax-to-waveguide transition for the offset dish. Left: Implementation of the YU1AW corner reflector feed for "efficiently" feeding offset dishes.

First attempt to feed the offset dish employed the feed horn design from HDL_ANT. The initial test signal source was the W0BTV 5.8GHz FM-TV beacon as received at my QTH, ~5miles distant. Although the beacon is on a high plateau, my location is in a shallow depression with houses and trees all around so signals at the ground are weak, typically resulting in a P2 picture using the small dish. With the larger offset dish, I was able to get a P3 signal. I'm guessing from this that the large dish produced only ~3dB gain over the small dish with this feed horn. Disappointing ! I found it extremely difficult to align the dish with the beacon and simultaneously find the best position of the feed horn using only the subjective judgement of the noise in the picture received from the beacon. Consequently, I attempted to use a Rigol DS815 spectrum analyzer to view the signals directly from the antenna, but found I could not resolve the small received signal above the noise floor of the SA with either the small or large dish. Lacking a good LNA for this frequency band to use as a pre-amplifier for my SA, I, instead, set up a short test range in my backyard using the highly attenuated drone transmitter and waveguide feed horn antenna as a test source.

The test range setup is shown in Fig 3. The signal source is the carrier generated by an unmodulated TS832 drone transmitter that is attenuated by 33dB and then transmitted by the horn antenna previously described. The 3dB attenuator was added ahead of the 30 dB attenuator to spread heat dissipated in the transmit path. The signal from the antenna under test is down-converted into the frequency range accessible by the Rigol spectrum analyzer (<1.5 GHz) by a Magnum Microwave MC44T-P mixer. The "Brick" oscillator is a very stable microwave source using a temperature controlled crystal oscillator, a cavity multiplier, and band-pass filter in this case producing a clean 6498 MHz LO resulting in a 593 MHz product from the received carrier from the Tx source that was set to 5905GHz to match the beacon frequency.

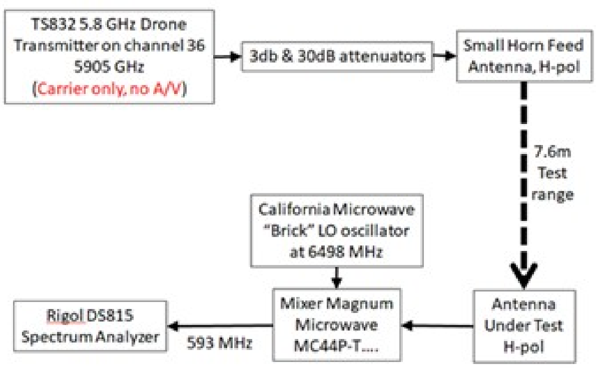


Figure3. Antenna test range and measurement setup.

Figure 4. 5.9 GHz loop antenna focus probe.

For the most accurate measurement of antenna pattern characteristics, the source and receiving antenna should be spaced so that they are in the "far field". The cross-over distance from near to far-field is called the Rayleigh Range, $R_r = 2*D^2 f / c$ (D = major dia. (m), f = frequency (s^{-1}), c = speed of light $3*10^8$ m/s). Typically, measurements at a distance >2 Rr is the best practice rule of thumb, to minimize the effects of interference between various parts of the finite-sized antennas, but there are so many real world variables for most of us amateurs that 1 R_r suffices. R_r for the antennas discussed here is shown in Table 1. Note that the test range is ~7.6m due to backyard limitations, and the large dish tests were definitely done in the near field. Accuracy of those measurements will be in question until a longer range field test can be performed. Unfortunately, the ATV repeater and therefore the 5.905 GHz beacon, is offline for repairs at this time, so that will have to wait.

Test range measurements were performed for the large offset dish with several feeds and compared to the small dish. Initially I measured the carrier to noise ratio (CNR) received by the small dish to establish a reference. This measurement is shown in Fig. 5, left.

Small Parabolic Dish w/ reflected dipole feed   Large, Offset Parabolic dish w/corner reflector feed

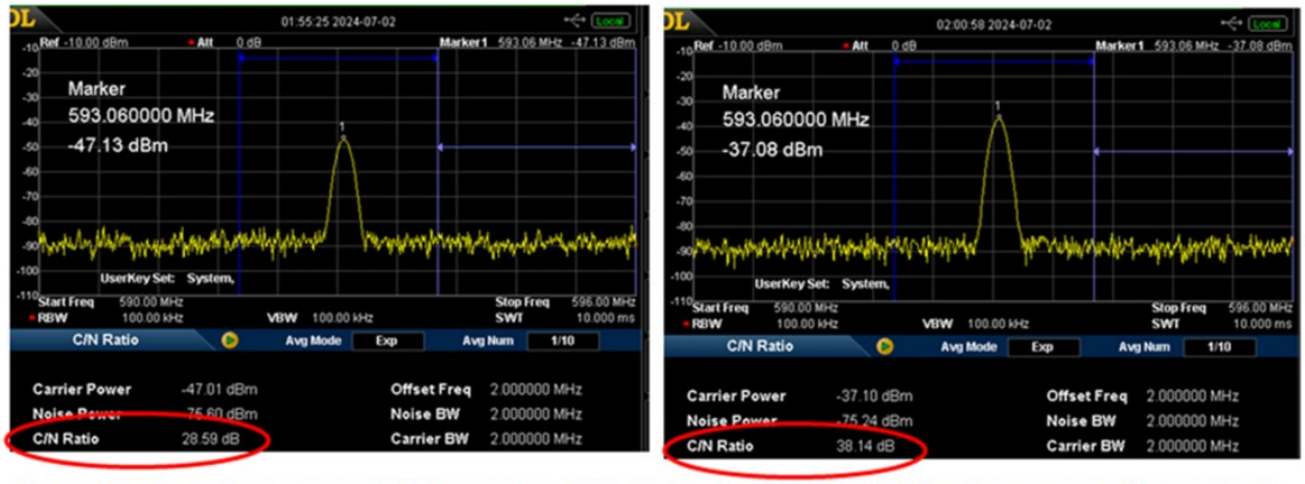


Figure 5 Left: Reference small dish antenna CNR. Right: Final result CNR for the corner reflector feed illuminating the offset parabolic dish showing 38.15 dB – 28,59dB = 9,6 dB gain over the reference.

Because of the alignment difficulties encountered in the first beacon tests, a small loop antenna, shown in Fig 4, was built to act as a probe to locate the focal point. Once convinced I'd found the optimal dish pointing direction and focal point judged by peaking the CNR on the spectrum analyzer, I compared that to the geometrically determined location. They were within 1.5cm of each other. I readjusted the locator nut on the strings to the experimentally determined optimal focal point.

The loop alone as a feed for the offset dish produced ~2dB gain over the small dish reference. Then I tried sliding a small flat aluminum plate perpendicular to the loop plane, back and forth along the axis toward the center of the dish segment to see how much improvement could be gained from a reflector at this feed. At the best reflector position, this configuration produced ~5dB gain over the reference.

I then tried the reflector dipole shown in Fig 1 resulting in a 2dB relative *loss* of gain! Evidently, this design of feed does not match well with the offset dish requirements.

By calculation, I expected to be able to achieve ~8dB relative gain. Now that the geometry issue was apparently solved, it was clear a more efficient feed was needed. I found a paper by Dragoslav Dobričić, YU1AW, entitled: *3 D Corner Reflector Antenna as an efficient feed for offset parabolic antennas for 5.8 GHz*. The design looked intriguing and promised higher efficiency for dishes like mine. Unique features of this feed are a slot to make the feed pattern more symmetric, and a passive director element (that, in my version, is tunable in length using a screw). I built this feed, shown in Fig. 2 left, in 0.019" thick aluminum sheet soldered at the corner seam. I soon discovered that aluminum solder has a melting point very close to that of aluminum when I blew a small hole through the adjacent sheet metal with my propane torch. Beware if you use this stuff. I was able to salvage the corner reflector using thin aluminum tape over both sides of the burn hole.

By observing the transmitted test signal directly with the corner reflector, I was able to independently tune the director element for maximal gain. I found the director element needed tuning to longer than specified length (director has ~4 dB effect on gain). Then, by carefully placing the phase center of the corner reflector feed (location given in YU1AW's paper) at measured offset dish focus location, and with a little adjustment of the corner reflector pointing angle to symmetrically fill the dish, 9.6 dB relative gain was achieved as shown in Fig 5 right, exceeding the relative gain goal of +8dB.

SUCCESS!

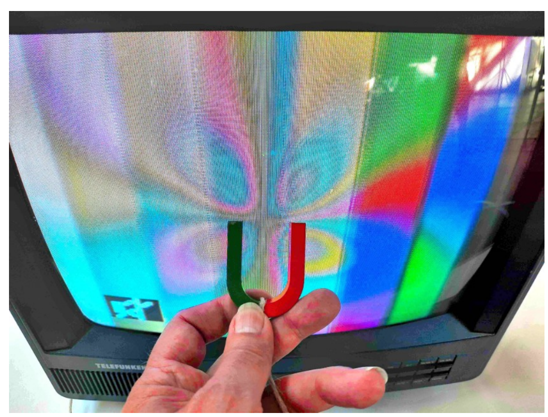
One last note on using this antenna configuration: by convention, our local microwave ATV operations use horizontal polarization. The design of the corner reflector feed was intended for vertical polarization. For this reason, and because I was unsure how rotating the feed might affect dish fill efficiency, the entire dish assembly is mounted 90 deg. to the usual satellite orientation.

The main downside of offset feed parabolas is that the pointing geometry is non-intuitive. It turns out for my antenna; the long straight section of the feed support arm is aligned exactly with the optimal pointing direction. Kudos to the designer if this was intended! This may not always be the case for other antennas. Pointing precision is also an issue for high gain antennas because the primary gain lobe is narrow. In this case, I observed two deep (20dB) nulls either side of the main lobe that appeared to be only a few degrees wide. Field experience with a distant source signal will resolve whether the nulls are an artifact of near-field effects in the test setup, or inherent to the offset dish and feed geometry. By comparison, the small dish had a very smooth main lobe without major nulls.

In any event, this has been a fun and challenging project, and I look forward to roving with the new antenna for the next 5.8 GHz ATV outing.

73 de Chris Grund, K0CJG, Boulder, Colorado

An individual HAM RADIO visit. Or criminal...



I can't provide a full trade fair report from HAM RADIO 2024 in Friedrichshafen at this point. This year I was almost exclusively in the two flea market halls.

Last but not least, I took a look into the main hall to greet ATV friends. On the way back, the past caught up with me - but really and completely unexpectedly! And it happened like this:

I crossed the exhibition stand of the "Elektronikmuseum Tettnang". Oh no, there was an old, small color TV with a real cathode-ray tube (CRT) right at the front.

Careful, dear readers, now it's getting criminal!

During my training as a television technician at the end of the 1960s, my master told me the following: When orders were low, the children in the neighborhood were encouraged to play around with permanent magnets on the screen of the color TV at home. They were even given magnets as gifts. The children were told that they could "mix up the colors so nicely". As the shadow mask retains some of the magnetization, it is no longer a pleasure to watch TV afterwards. The repair service had to be called to the rescue. They earn easy money and come with a so-called demagnetizing choke.

Both a permanent magnet in the shape of a horseshoe and a coil for demagnetization - a ring with an estimated diameter of 30 cm (12 inches) - were lying on the stand right next to the TV set. So now I acted as once inspired by the master! What a story after 55 years.

73 de Klaus Welter, DH6MAV, Upper Bavaria

10m ATV/DATV New update

Grant, VE3XTV

I made more improvements the video compression process, with the key frames and the motion frames. I now looking doing the audio compression in hardware, as it a lot easier do work at this level for what I want to do. I plan to go with a R+L, R-L process where 3/4 are information is with the sum of the two and 1/4 is the difference information. I also looking at some of the ways that NiCAM worked with digital audio bit streams. As the video and audio information has no error correction, only noise reduction is used, which is major limitation for the mixable usable bandwidth.

As I have made a lot more progress with the SDR steps, I now working with GNU Radio within Linux, using an UDP IP interface to go between the video compression software and the SDR block. I have a simple UDP loop-back working in the in GNU Radio and now building up the multi-carrier OFDM modulation using 256FSK or 256PSK not sure yet, which could take a few months of work to do. As with learning DSP with FPGA's, I am starting all over again working out how use GNU Radio with it's SDR blocks. If anyone has done development work with GNU Radio? I would be interested in getting some feedback, in ways to get the modulator and demodulator stages to work. I plan make the Linux software publicly available some time next year based on testing I am doing at the moment.

The software has two parts on the video compressor and de-compressor written in Gambas3 and the other SDR done in GNU Radio, I hope soon to order in a 192kHz PCIe sound card to provide a base-band output. As 48kHz is too low to fit all the video and audio digital information into as a modulated waveform. Therefore progress is been made, but very slowly and I hope to have the modulator and the demodulator working by the end of the year with loop-back testing.

As for the signal processor it is working in hardware using PWM, but I am looking ways get to converted into SDR blocks as it important part to filter out sky-wave phase jitter. I will need see what is involved in coding in Python, to convert the signal processor across to SDR blocks, as this approach has not been done before. I can code in BASIC and VHDL, I hope Python is going to be more like BASIC to work with and not like C coding which I am not good at. A simple hardware ATV project, now become more of software development project, all to keep the cost down to a minimal level. Good news is I can see the end in site within the next few years, if I do not get pulled away on other things.

I have not looked at the SDR hardware yet, but I am still thinking of using the HackRF, as it is very common these days and GNU Radio will support it.

73 de Grant Taylor, VE3XTV, North York, Ontario, Canada

Another Forest Fire !

Mid-day on Friday, July 12th, still another forest fire broke on the mountain side just west of the city of Boulder, Colorado. This one was close to our W0BTV-ATV repeater site. It was a very hot day with the temperature around 100°. But fortunately without a lot of wind. The firefighters jumped on it right away with some aircraft slurry dumps. After a few hours, they were able to extinguish it without it spreading far. Don, N0YE, provided some excellent video of the fire as seen from the Fairview High parking lot in Table Mesa. He broadcast his video via W0BTV.

BullsEye - LNB

Thanks to Claudio, I2NDT, for calling our attention to this attractive device. Claudio was watching our weekly ATV net via our BATC stream. He heard us discussing our plans to add a 10 GHz receiver to our Boulder ATV repeater. So, he suggested we consider the BullsEye LNB. He said "It is used by many QO100 users and microwavers in Europe." He also said there is more info on using it on the BATC web site.

So, a couple of us Boulder ATV hams have already purchased a BullsEye for evaluation. Whow ! Low cost - only $30 on E-Bay, and great performance ! The manufacturer claims "The Bullseye LNB is the world's most precise and stable Ku-band down converter." Believe it. Our measurements showed it to be dead on frequency.

The key specs. are: model number is BE01; LO Frequencies = 9.750 & 12.750 GHz, RF Frequency Coverage = 10.489 - 12.750 GHz (really useable for whole ham 10 GHz band), IF Frequency = 739 - 2150 MHz (really works ok below 739), Noise Figure = 0.5 dB, Conversion Gain = 50 to 60 dB They also say the LO frequency is factory calibrated to within 1 kHz. A second F connector provides access to the 25 MHz reference oscillator.

Initial bench tests showed the unit works over a wide range of DC voltages. At +12Vdc, it pulled 90 mA of current. It worked fine down to +7.5Vdc (150mA). When the DC voltage exceeded +14.5Vdc, the unit automatically switches polarization from vertical to horizontal. At 16Vdc, it pulled 60 mA. The normal LO frequency is 9.75 GHz which is ideal for ham 3 cm, 10 GHz band use. If a 22kHz tone is injected onto the IF+DC line, then the LNB is supposed to then switch the LO to the higher frequency.

We hope to report in future issues of this newsletter our operational experience using these BullsEyes out in the field for 10 GHz, DVB-T DX-peditions.

W0BTV Up-Date

The Boulder, Colorado, W0BTV, DATV repeater is still "limping along". It has not yet been repaired after the most recent second failure of an Intuitive Circuits DTMF-8 decoder/relay board. We have had since then a failure of the audio circuits. Don, N0YE, was able to correct that by calling our contact person at NCAR and asking him to go to the radio room and power cycle the repeater to do a complete computer re-boot, reset.

Bill, AB0MY, is presently working on building and programming an Arduino DTMF decoder and relay board with eight relays. We will replace the defective DTMF-8 with Bill's new Arduino.

We are also considering replacing the current HDMI quad viewer / switch in the repeater. It has some "funky" behaviour and does not give us instantaneous switching. Bill, ABOMY, has recommended we consider a newer OREI product, the model HDS-402MV. It has four HDMI inputs and two HDMI outputs. It is capable of quad displays in several different modes. Of particular interest, is it also now includes a PIP (Picture-In-Picture) capability. Seamless switching. It also can be computer controlled. It has a USB port for RS-232 control. Price is also very attractive at only $99.

An HDS-402MV has been purchased for evaluation. Initial tests with the remote control and front panel buttons show that it works very nicely. The next step will be for Don, N0YE, to learn how to control it with an Arduino micro-computer. If successful, then we may very well use it in W0BTV.

We have also previously mentioned adding a 10 GHz receiver to W0BTV. Don is providing a home-built, X-band waveguide slot antenna with a 180 deg beam-width. We decided upon the Hi-Des model

3LNC70-ATV down-converter. The key reason for it's selection over LNBs like the BullsEye was the fact that the RF input connector is an SMA rather than an antenna horn. We needed a coax connection to be able to use Don's waveguide antenna. The Hi-Des unit has been ordered but not received yet. In the meantime, Bill, K0RZ, and Don, N0YE, have discussed and decided upon using 10.380 GHz as the input frequency to the repeater for 10 GHz DVB-T signals. We will be using a standard 6 MHz TV channel band-width. This frequency is close to the 3 cm, SSB frequency of 10.368 GHz to allow using dual-mode transverters, but still should be far enough away to avoid causing RFI to SSBers.

When we have all the various components, etc. on hand, we will then jerk the repeater out and take it home for some bench work modifying it. Plans are to install a "dumb" 23cm in / 70cm out temporary repeater in it's place for the duration.

MORE Hi-Des Issues ! ! ! -- Ugh !

In addition to recurring problems with HDMI compatibility at times with some HV-110 receivers, some of us are now having UART issues with our HV-320 modulators. The modulators work ok, until you try to change some parameters using your PC and AVsender program. Then the PC doesn't want to recognize it has anything connected to a COM port. Bummer. Very frustrating !

W0BTV 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/***

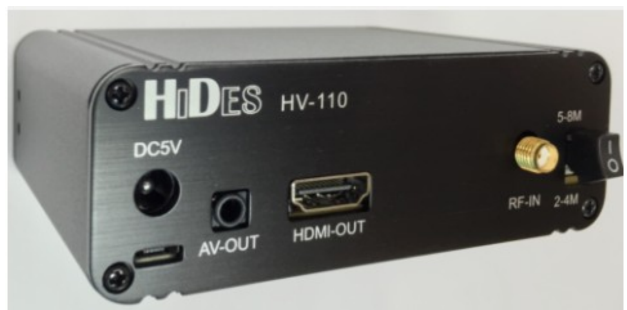
W0BTV ATV Net: We hold a social ATV net on Thursday afternoon at 3 pm local Mountain time (22:00 UTC). The net typically runs for 1 to 1 1/2 hours. A DVD ham travelogue is usually played for about one hour before and 1/2 hour after the formal net. ATV nets are streamed live using the British Amateur 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 ATV newsletter distributed electronically via e-mail to ATV hams. The distribution list has now grown to over 800+, both in the USA and overseas. 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

For Sale: Hi-Des HV-110 DVB-T RECEIVER



NEW - in original carton with all accessories. Programmed for 70 cm, ATV channels. Hi-Des sells these for $119. My price is 1/2 at $60, including shipping via USPS.

Why am I selling it? It does work, but has an HDMI compatibility issue. It works with some monitors, but not with others. I can't guarantee it will work on your monitor. The 480i composite A/V works OK. Note: Hi-Des' photo shows 5V input. It actually works on 12Vdc.
Interested ? -- contact Jim, KH6HTV, kh6htv@yahoo.com or 303-594-2547
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FREE ! EPSON Color Ink Jet Printer

Model ET-3700 with refillable ink tanks. Includes a complete, unopened set of refill ink bottles. I don't use it anymore. I now use a laser printer. Free to the first taker. But you need to pick it up at my QTH. No shipping.
Interested ? -- contact Jim, KH6HTV, kh6htv@yahoo.com or 303-594-2547
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