

# Boulder Amateur Television Club TV Repeater's REPEATER Sept., 2019

Jim Andrews, KH6HTV, editor - [kh6htv@arri.net](mailto:kh6htv@arri.net)



## NEW TV REPEATER

The big news for August is our club has a NEW TV repeater. Jim and Don have spent the summer, redesigning and rebuilding our old TV repeater. It retains the basic features from before, but with refinements and is more user friendly. It still is capable of receiving either analog or digital TV signals on either 70cm or 23cm bands. It is also capable of transmitting either analog or digital TV signals on 70cm band. For receive, it will accept 23cm DVB-T, 70cm DVB-T, 23cm FM-TV, or 70cm VUSB-TV. On transmit, it will put out on Ch. 57 (420-426MHz), either DVB-T (423MHz) or VUSB-TV (421.25MHz). On 70cm, it receives on Ch 60 (438-444MHz). On 23cm, it receives DVB-T on 1243MHz and FM-TV on 1247MHz.

The previous repeater was built by Jim & Don in 2016. What made the new design possible was finding this past spring a much improved HDMI switch. The old, 2016 design used what was available then, but that HDMI 4 in / 1 out switch could not be computer controlled. Thus, the repeater design was very complex and unwieldy. We had to have a lot of "work-arounds" to



even make it work remotely. We suffered from intolerably long delay times when we switched receive bands/modes or lost an incoming TV signal. The new HDMI switch is basically a Quad Viewer, but with the added feature of a RS-232 computer control port. After Don was able to figure out how to use an Arduino micro-computer to control the Quad Viewer via RS-232 -- it became very obvious that we should thus redesign and rebuild our TV repeater. Jim, KH6HTV, did the hardware rebuild. Don, N0YE, wrote the new computer code for the Arduino controller.

The NEW, W0BTv, TV repeater was first made operational for the BATVC club members on the August 22ed, Thursday afternoon ATV net. It was operating from a temporary location at Jim's QTH, south-east of Boulder. Jim has the same antennas on his tower as are used at our TV repeater site on the mesa south-west of Boulder. For receive, a Diamond X-6000 (2m/70cm/23cm) omni antenna is used. For transmit, a DB Products DB-411, 70cm, 4 element co-linear antenna is used. The test was successful. We hope to re-install the TV repeater on the mesa during the last week of August.

Having the computer controlled Quad Viewer allowed us to add new features. First is the ability to actually see a quad display. This does however require one to command over the 2m control frequency the repeater to shift to quad display and turn on the transmitter. In the quad display mode, the 23cm DTV receiver's video is in the upper left quadrant. The 70cm DTV receiver's video is in the upper right quadrant. The analog TV receiver's video is in the lower left quadrant. The repeater's ID slide show is displayed in the lower right quadrant. The quad display is also presented whenever the repeater is first keyed up. The quad display comes on for about 5 seconds and then switches to whichever receiver is picking up a valid TV signal. To meet FCC ID requirements, for long duration (> 10 minutes) transmissions, the repeater automatically switches to the quad display for ID for a few seconds every 9 1/2 minutes. With the ID slide show in the lower right quadrant, we are always able to ID with the club's call sign, W0BTv.



At the end of each TV transmission, the repeater also automatically IDs with an ID trailer. The quad viewer, thus switches to a full screen display of the ID slide show. This trailer runs for 25 seconds after the incoming TV signal drops. The trailer is long enough for a user to try to "kerchunk" the TV repeater and then watch the output to see if he was successful. If a new, valid TV signal comes on during this trailer, the trailer is instantly terminated and the repeater automatically switches to the new TV signal. The BEACON mode was retained. If the Beacon command is sent on the 2 meter control frequency, the transmitter is turned on and transmits in full screen mode the ID slide show. There is no

audio with the slide show. The slide show is a continuously looping video provided by a Raspberry-Pi micro computer reading an .mp4 video file stored on a USB memory stick.

A key improvement in the repeater operation is that now any valid TV signal appearing on either the 23cm or 70cm band will automatically key up the repeater. One no longer needs a control operator to reconfigure the TV receiver inputs. A priority hierarchy was however established in the event of multiple TV signals being on the air simultaneously. A digital TV signal will always take immediate priority over an analog TV signal. If two digital TV signals are on the air simultaneously, then the 23cm signal will have priority over the 70cm signal. Turning on either the Beacon or Quad Display will override any incoming TV signal. However, in quad display, if there is any valid incoming TV signal, analog or digital, it will be displayed in it's respective quadrant.

The following table lists the new control codes to select the various features of the TV repeater. The confidential control frequency and password remain the same as before. Note: codes 2, 3 & 6 are new.

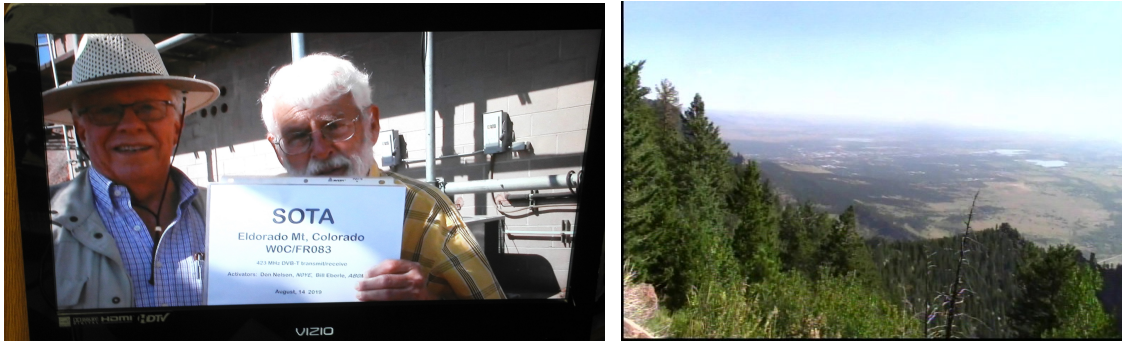
**NEW TV REPEATER CONTROL FUNCTIONS**

<b>Control Code</b>	<b>Function</b>	<b>( * )</b>	<b>( # )</b>
1	BEACON (xmit on)	ON	OFF
2	Analog Receiver	23cm FM	70cm VUSB
3	Not Used	-- na --	-- na --
4	Transmitter Mode	VUSB-TV	DVB-T
5	Transmitter	ON	Stand-By
6	QUAD Display (xmit on)	ON	Stand-By
7	Transmitter Disable	OFF	Enabled
8	RESET (reboot all digital eqpt)	Reset to # state	--- na ---

The receiver uses Hi-Des, model HV-120A receivers for DVB-T. These have been programmed to continuously display the On-Screen-Display (OSD). The OSD parameters displayed are Frequency/Bandwidth (upper left), received station Call Sign (lower left), S meter Power in dBm (upper right) and Signal/Noise ratio in dB (lower right). It should be noted that the S meter reading is not true. It has a significant offset (it reads too high). However, it is accurate for relative changes, i.e. 1dB change in input power causes a 1dB change in the S meter reading. The S meter and S/N can be used as a tuning aid for antenna alignment.

The transmitter has been programmed to output full 1080P, 16:9, high-definition video. The digital modulation parameters have been set to "normal" settings of: QPSK, 8K FFT, 5/6 FEC, 1/16 Guard, and 6 Mbps code rate. The transmitter's output power to the antenna is +37.5dBm (5.6 Watts, rms) for DVB-T. In analog mode, it puts out +41.5dBm (14 Watts, pep).

The NEW TV repeater will be fully documented in a forthcoming KH6HTV Video Application Note to be published in Sept. 2019. It will be available from the web site: [www.kh6htv.com](http://www.kh6htv.com)



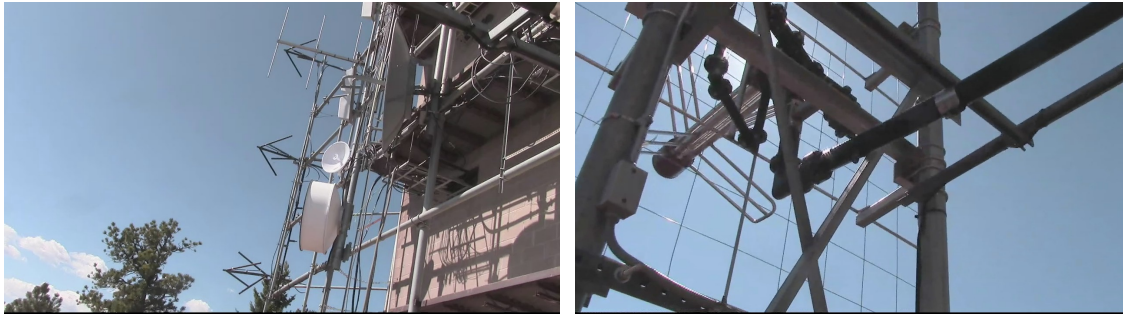
Bill, AB0MY, & Don, N0YE -- 70cm DVB-T signal from the top of Eldorado mtn. photos taken by KH6HTV from his home receiver.

### **ANOTHER SOTA -- Mountain Topping DTV DX-Pedition:**

After Don & Jack's DTV DX-pedition last month to the top of Pike's Peak, Debbie, WB2DVT, was excited enough, she said "Great ! -- Let's do that again soon." So this month, on 14th of August, Don, N0YE, Bill, AB0MY, and Bill's wife, Mary, drove to the top of nearby Eldorado mountain for another DTV SOTA outing. Eldorado mtn. is on the front range, just south of Boulder and on the Boulder / Jefferson county line. It is a great commercial radio site for covering the Denver metro area. They were able to drive directly to the transmitter / antenna site and sat up their gear directly in front of the transmitter building. No great, heroic distances this time. Spitting distance to Boulder ! With their TV camera and telephoto lens, they were able to see individual buildings in Boulder.

Don & Bill exchanged two way ATV contacts with several ATV hams, some as rovers, others at their home stations. All TV transmissions were done simplex, without the TV repeater, on 423MHz, using DVB-T modulation. Voice coordination was on 2 meter FM simplex on 144.33MHz. Participating stations included from home, Colin, WA2YUN, Jack, K0HEH, and Jim, KH6HTV. There were two husband & wife rover teams. Pete, WB2DVS & Debbie, WB2DVT, were on CO-93 just south, up the hill from Marshall road. George, N0RUX, and Doshia, KB0NAS, were on Gunbarrel Hill, north-east of Boulder. All stations were able to copy each other's DTV transmissions.





Here is Don's after-action report: *"We had a great session on Eldorado Mt this morning doing ATV on a summit. Here are two antennas observed around us when we were on the east side of the equipment building up there. These pictures were extracted from a video taken during our summit activation. Antenna 1 maybe could be called a co-linear set of crossed Vs. What is it and how does it work? Antenna two is also a different kind of antenna to me. It is interesting because it is different and it is interesting because there is a 3.5 inch coax feeding to. What kind of power requires a 3.5 coax?"* 73 de Don, N0YE

Gary, WB5PJB answered Don's antenna question. *"Don, the "crossed Vs" are circularly polarized antennas for the FM broadcast station. The second antenna may be another transmit antenna for an FM broadcast station. Sometimes they use panel antennas for circular polarization (the metal grid hints at it being a panel antenna.) And, the panel antennas can usually handle higher power than the crossed V antennas, so the thicker coax might be a good indicator of that."*

## **ATVers Itching to Rove:**

The recent ATV SOTA activities seem to have kindled an interest in getting out in the field with portable ATV gear. Just got this e-mail from Gary, WB5PJB, from down in Castle Rock.

Don, well, I am itching to rove also once I get a few more things buttoned up on the transmitter and receiver. I have got to get out with a portable setup before the cold weather moves in :). I am close, I think, and I will start throwing some RF your direction from down south here. It may be just short transmissions during a lunch break or on my way home from work, so maybe keep an eye on the repeater output during those times, hi. I might have time to do a test run this Sunday, but that just depends on how the weekend chores work out. Otherwise, Tuesday or Wednesday next week would be the next earliest time I could attempt some transmissions . I will try and send out an email ahead of time so maybe some folks can monitor the repeater or you can start up the BATC stream so I can see if I am getting into the repeater. My past experience with analog ATV is that de-sense of a receiver on 70 cm from a nearby transmitter on 70 cm was a challenge. We would have to separate the two antennas by quite a distance to make it work, and I may not be able to find that much space in the select places where I can setup. So, operating duplex may not be possible with both the TX and RX on 70 cm.

You probably recall a couple years ago that you setup near W. 120th Ave. and Indiana and I was at Daniels Park, and we were able to easily send video between us. So, that 120th Ave. location is a good spot that isn't too far from Boulder. I think you were able to work back into Boulder from there, as well. Of course, there are some good spots out by DIA that might do well back to Boulder and perhaps to Douglas County. I had no problem getting into your mesh node from near the hotel row along Tower Rd. out by DIA, so I wouldn't think 70 cm would do worse than 2.4 GHz.

73, Gary, WB5PJB

----- Sat, 17 Aug report from Don, N0YE -----

10 GHz went well. We had 4 stations: K0RZ, W0BA, W6OAL, and WB5PJB.

Gary, WB5PJB, transmitted to me at CO128 well but at that time did not get into the repeater. He and Bill, AB0MY, worked while I drove home. Gary got thru the repeater fine for Bill. When I got home (Bill had to leave) , I put a signal thru the repeater and Gary after some struggling, changing antenna and adding a preamp, did intermittently receive the output of the repeater. Gary asked how much more power out does the real repeater have. I guessed at 3 -5 dB.

**ARRL - QST:** ATV got some good publicity in the Sept. issue of QST. Check out pages 40-41 for an article on "Digital ATV Repeaters" Let's hope it generates more interest in our branch of the amateur radio hobby. I do have some statistics to judge some increase in interest. The QST article did include references to application notes on my web site, [www.kh6htv.com](http://www.kh6htv.com) It is hosted on WordPress.com I am able to get statistics on the number of hits, etc. daily on my own web site. On a normal day, my site gets visited by about 4-5 visitors. On the 9th of August, when ARRL sent out an e-mail notice of the availability of the digital, on-line version of the Sept. issue of QST, this jumped to 14. On the 20th of August, when most ARRL members received in the mail, their copy of QST, the number of visitors peaked at 21, with most of these looking at the referenced application notes, then looking at other parts of my web site. Eleven of these also downloaded my ATV book, AN-45, "Introduction to Amateur Digital Television"

**ADAMS County ARES:** Also no doubt related to the DTV repeater article in QST, I just received an invitation to give a talk about digital TV to the Adams County, Colorado, ARES group. I will be giving this talk on Sept. 12th at the Cherry Creek high school. They have also invited the Adams county OEM / EOC people to attend.

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Figure 3 shows a 70-centimeter DVB-T repeater built by Matt Holday, K0DVB. It is small and compact, and all the components fit within a rugged container for portable operation. This DVB-T repeater is used by the Boulder, Colorado, ARCS group (BCARES) in support of the local sheriff's police and fire agencies. It is stored in the BCARES equipment trailer and is used by the Boulder Operations Center 911 dispatch center, along with portable DTV transmitters and TV cameras.

**Notes**

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2. J. Andrews, K6HTV, "DVB-T: A Solution for Portable DTV Repeater Stations," QST, June 2015, pp. 42–44.
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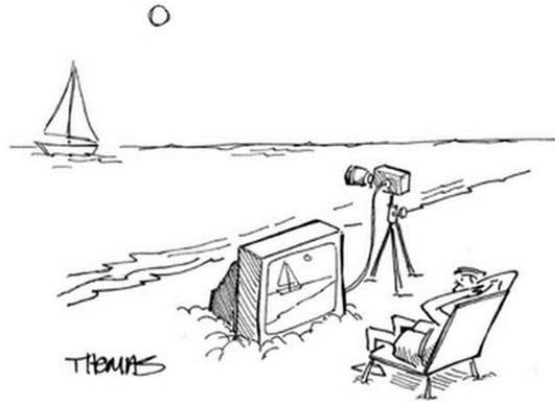
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**Future Newsletters:** If you have contributions for future newsletters, please send them to me. Jim Andrews, KH6HTV, email = [kh6htv@arrl.net](mailto:kh6htv@arrl.net)

**Andrews Family News:** Being a proud grandpa, I have to share with you the successes of my kids & grandkids. -- Jim A, KH6HTV

**Grace - Volleyball:** My granddaughter, Grace Andrews, will be a senior at Fairview High this year. She has been on the Fairview varsity volleyball team since being a sophomore. Last year as a junior, she was the team captain. This past year, Grace has decided to concentrate on beach volleyball. She will still be playing this fall on Fairview's team. As opposed to regular indoor volleyball, beach volleyball is played outdoors on a sand surface and only two players on a team. Grace is very good. You do not want to be her opponent. She will take your head off with her spikes ! (or at least give you a real bad headache) She participated in a lot of national tournaments this summer in southern California for beach volleyball. As a result she got an offer from the University of Utah to play on their beach volleyball team after she graduates from Fairview. Utah is a division 1 school and part of the Pac-12 along with other big schools in the western USA. Grace has accepted Utah's offer.

**Baja Motorsports Races:** My son-in-law, Mike McMynn, is also planning to race in the Baja-1000 in November. Check out <https://youtu.be/Sv3a-VgOUWc> (Cindy Racing 2019 SCORE Baja 500) for a good video of Mike driving in the Baja-500 race earlier this summer.