

# Boulder Amateur Television Club TV Repeater's REPEATER

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BATVC web site: [www.kh6htv.com](http://www.kh6htv.com)

ATN web site: [www.atn-tv.com](http://www.atn-tv.com)



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## W0BTV is Back on the Air !!!

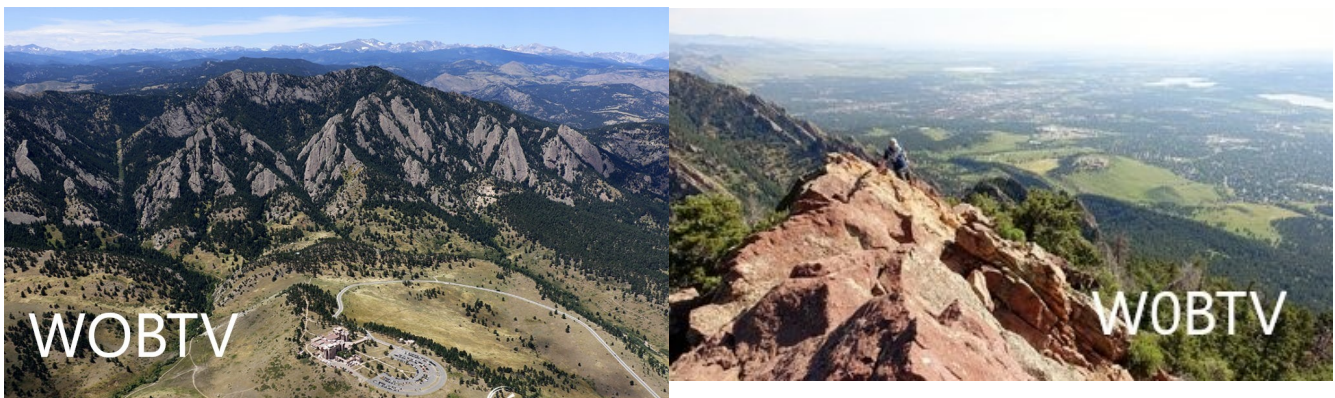
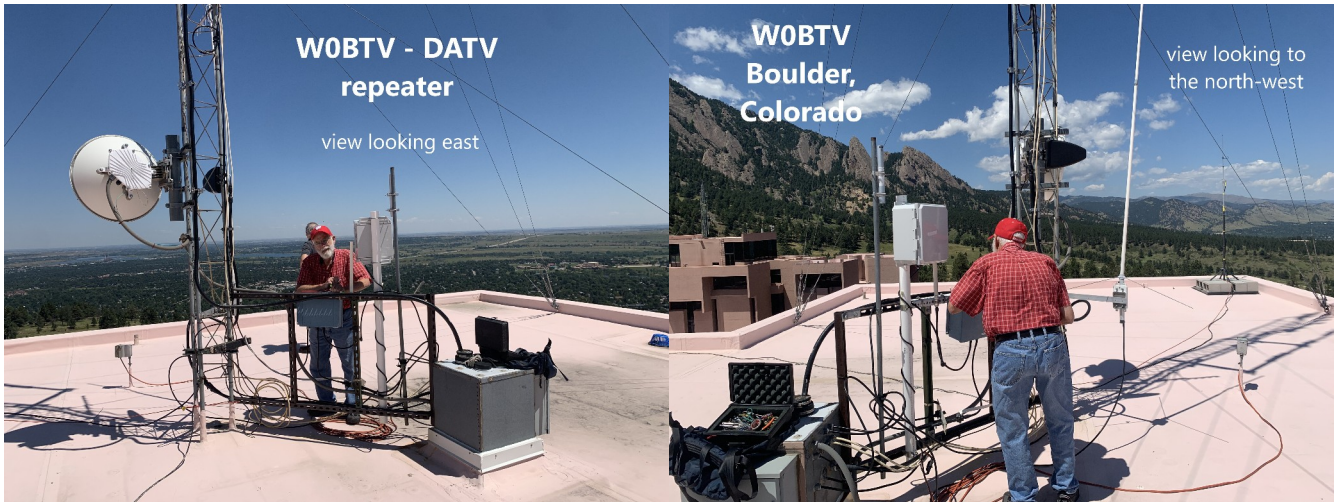
Finally ! -- On Wed, Sept. 13th, trustees Don, N0YE, & Jim, KH6HTV, were finally able to reinstall our Boulder, Colorado, DATV Repeater. It is once again, back in it's home on the mesa south-west of the city of Boulder. We welcome all ATV users back again and hope it sees a lot of usage.

The basic repeater is all digital running DVB-T. The main transmitter is on 70cm with DVB-T. It is on 423 MHz with a 6 MHz band-width signal on channel 57. The transmitter puts out 5 Watts (+37dBm) (avg) to a DB-Products, DB-411, four element co-linear antenna (+11dBi gain with a cardioid pattern). We share the antenna with the Boulder Amateur Radio Club's 70cm FM voice repeater.

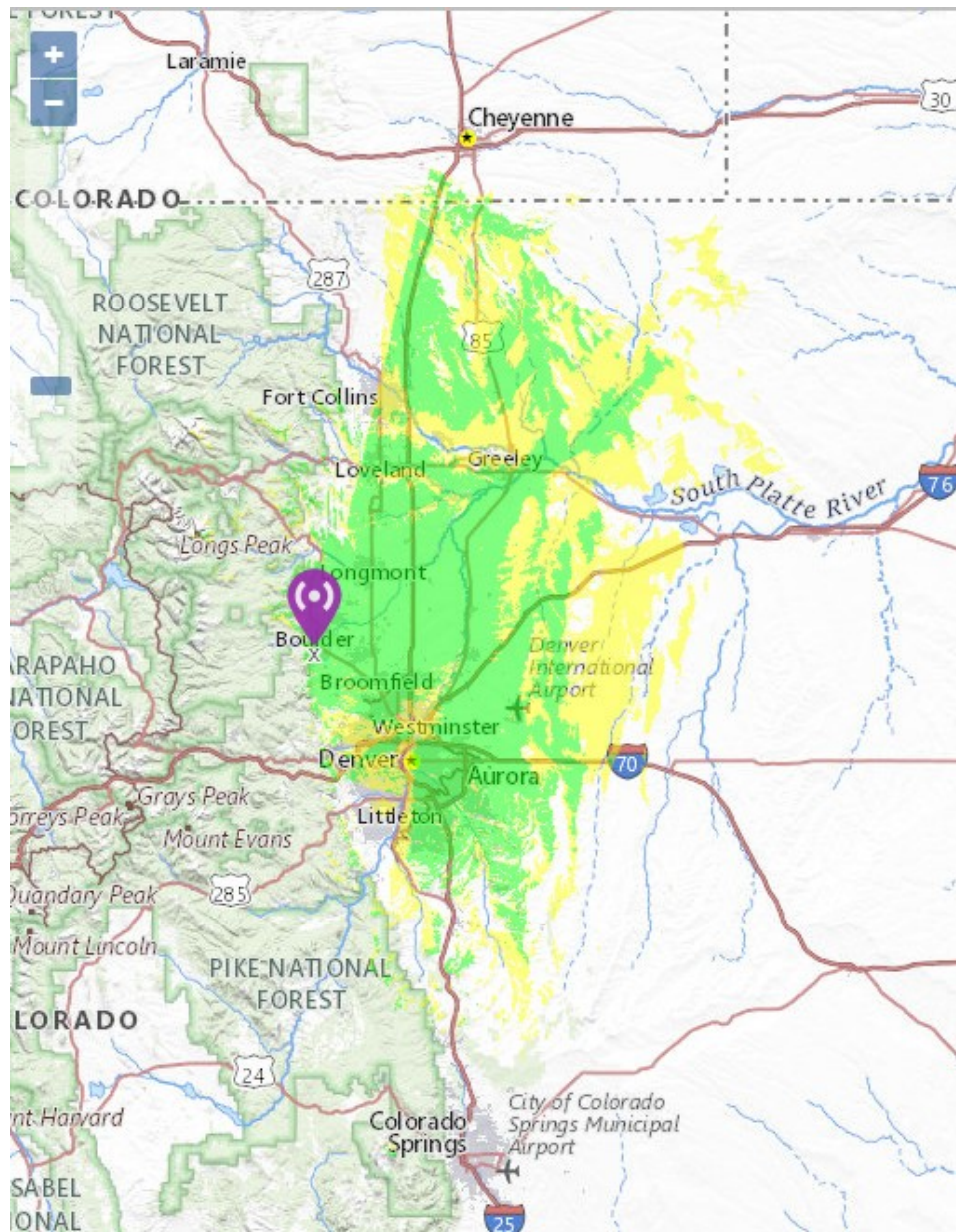
The repeater is a cross-band repeater (23cm in / 70cm out). The input frequency is 1243 MHz, again with 6 MHz BW, DVB-T. Our receive antenna is a Diamond X-6000, tri-band (2m/70cm/23cm) with +10dBi, omni-directional gain on 23cm.

We also have a secondary, analog, FM-TV transmitter on the 5 cm band. It's frequency is 5.905 GHz. It puts out 2 Watts to a Laird model OC515010H, omni-directional, horizontally polarized antenna with 10dBi gain. This transmitter runs 24/7 as a microwave beacon.





Full details about the W0BTV - DATV Repeater can be found in application notes, AN-51 & AN-53, on our web site at: [www.kh6htv.com](http://www.kh6htv.com)



The above map shows the predicted RF coverage area for our WOBTV, 70cm, Transmitter. This map was calculated using the on-line rf prediction program, **Radio Mobile**. The receiving stations are assumed to be using a 6 element, yagi antenna with 11dBi gain and mounted at 10 meters elevation. 50 ft. of LMR-400 coax was assumed. Also assumed was the receiver is using a good low noise figure pre-amp. Plus the antenna is in a good location with no RFI and minimal multi-path. Under these ideal conditions, the ultimate receiver sensitivity is of the order of -99dBm. The yellow shaded areas are predicted really weak signals of -99 to -90 dBm. The green shaded areas are for stronger signals > -90 dBm. TV signals reach all the way to the Wyoming border, just south of Cheyenne. The repeater covers a good portion of the prairie portion of the northern front range, but with zero coverage into the mountains to the west.

**BUGS Remaining:** Unfortunately, all is still not perfect with the repeater. On our next ATV net after reinstalling the repeater, we discovered still yet another Arduino code "*bug*". After the repeater has been on the air continuously for 10 minutes, to meet FCC requirements, we switch over to the quad display for a few seconds and then back to full screen. Using the quad screen allows us to ID the repeater because the lower right quadrant always displays our continuously running ID slide show. So the "*bug*" is after doing this switch, we then lose the audio from the incoming TV signal. Bummer ! So, Don, N0YE, will be making yet another trip back up the hill to the repeater site. This time he will be lugging along his PC laptop and try to modify the Arduino code to kill what we hope is the last and final "*bug*" ! Wish him LUCK !

**HDMI QUAD VIEWER FEED-BACK:** As a result of our article in the previous newsletter, we received this e-mail and interesting article from Dave, G8GKQ.

"Hi Jim --- I was interested to read about your use of a 4-way HDMI switch for a basic repeater. We have done the same thing, and it is now in use at GB3HV (currently off-air due to site change) and GB3DO which sometimes streams here <https://batc.org.uk/live/gb3do>  
We used a Raspberry Pi to provide full control, and to emulate the IR codes to switch the HDMI. It has proved to be a very easy way to control the switch."

## BATC ATV Repeater Controller

Dave Crump, G8GKQ & Noel Matthews, G8GTZ

Over the last 10 years, the ATV community has successfully migrated to digital transmission standards which have enabled transmission of greater resolutions than the 720 x 576, PAL standard and the Ryde receiver has enabled this high quality video to be available in HDMI format.

However, most ATV repeater systems are still using PAL based video switching and logic systems with the resulting loss in video quality. In order to encourage repeater groups to upgrade their systems, BATC has developed a simple repeater controller enabling the use of consumer HDMI switches as a repeater video switch.

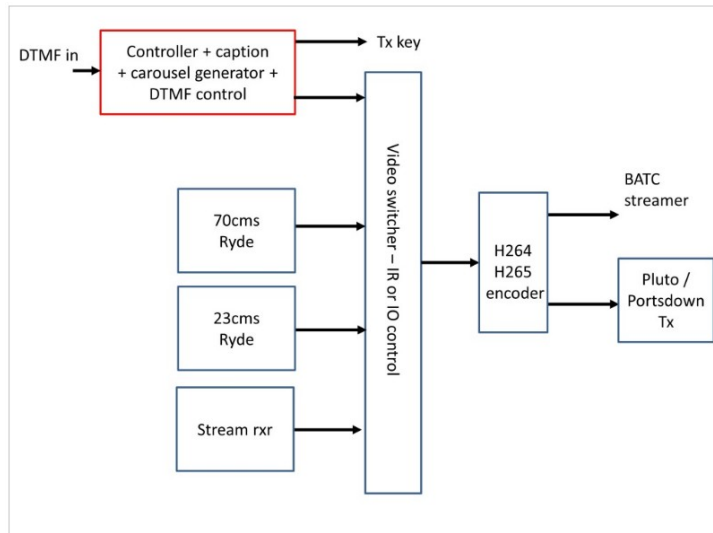
The controller provides a flexible way to display captions and images and can be used to replace existing controllers. In order to provide backwards compatibility and enable to controller to be fitted to an existing repeater, an analogue switcher can be controlled using the GPIO outputs and the controller's HDMI caption output can be converted to composite video.

Inputs from existing analogue receivers can be converted to HDMI for use in the system using the HDMI converter described in another article in this issue.

**OVERVIEW:** The core of the system is a consumer IR controlled HDMI switch – these are readily available for Multimedia home systems from the normal sources and come in 2 / 4 / 6 / 8 input configurations.

The switch will be fed with HDMI outputs from Ryde receivers, BATC streaming receiver, Analogue to HDMI converters and graphics generator.

The switched HDMI output is fed to a video encoder / modulator and also to provide streaming on the BATC live streaming service.



Every repeater is different and the controller is designed as a core logic that can be used as the basis for an ATV repeater. The design is flexible with a large number of parameters in a text editable configuration file so that users can configure it to meet their own needs.

**TYPICAL OPERATION:** The BATC repeater controller controls single or multiple video switchers either by InfraRed, I2C, webhooks or GPIO pins. It also generates a carousel of scenes and has an on-board DTMF decoder. The carousel can be configured to show up to 99 scenes. The content and duration displayed of each scene is set in the configuration file and the scene can be one of the following:

The carousel can be configured to show up to 99 scenes. The content and duration displayed of each scene is set in the configuration file and the scene can be one of the following:

1. Status screen generated by the controller
2. jpg or png images played out by the controller
3. Video files (in future release).
4. Any input on the video switcher, so can display inputs such mast cams, weather stations or Quad video displays.

The still images are read each time before display so can be regularly updated by an external source.

**VALID SIGNAL INPUT:** On receipt of a valid signal from, for example, a Ryde receiver, the controller will key the transmitter, play an image for .5 seconds indicating which input has been activated and then switch to that input. When the receiver closes, the logic will play a "K" image and optional "K" in Morse and go back to the carousel.

The receiver input switching line can be directly from a Ryde receiver or an external source such as a sync detector on an analogue source. Note do NOT exceed 3.3 volts on the GPIO input.

**IDENT SIGNAL:** In order to comply with licensing regulations, a video and/or audio ident can be generated at an interval set in the config file.

**DTMF CONTROL:** An on-board DTMF decoder will allow input selection by remote control and also enable GPIO pins to be toggled to enable the control of external equipment.

**POWER SAVING:** To enable power saving by turning the repeater transmitter off during quiet periods, a number of options are available such as, only key the transmitter when in repeat mode, do not key the transmit during the night time and only key the transmitter to display the carousel for the first 30 minutes of every hour.

**REPEATER CONTROLLER:** The BATC repeater controller runs on Raspberry Pi4 (2 GB memory) which has several functions:

**CONTROL of the VIDEO SWITCHER:** The preferred method of control is via Infra-Red commands sent by an IR diode, recovered from an old remote control, connected to pin 12 on the RPi GPIO port. The IR commands sent are totally programmable in the config file.

To increase the number of inputs available, 2 separate IR transmitters can be connected to enable a second HDMI switch to be controlled.

The controller can also control a video switcher using the RPi GPIO lines – these lines are 3.3v logic and the outputs must be buffered.

At the request of Justin G8Y TZ, Dave G8GKQ (author of the controller software) has added the ability to controller an external video switch such as the ATEM mini using webhooks – see the separate article on the Alternative Repeater controller in CQ-TV.

**GRAPHICS GENERATION:** The RPi generates captions and plays out carousel images using the HDMI port which should be connected to an input on the video switcher. A future update of the controller may enable the composite video port to be used for playout or alternatively an HDMI to composite converter can be used to output to an analogue switcher.

**DTMF DECODER:** The on board DTMF decoder is fed via the mic input on a standard USB audio dongle. All DTMF command sequences are programmable and can be set to select video inputs, toggle GPIO output pins, send i2c commands and several keeper only commands such as turn the transmitter on / off and reboot the controller.

**GPIO CONNECTIONS:** The repeater controller uses the RPi GPIO port for the following:

1. Accepts up to 8 signal detect inputs
2. IR / I2C drive output
3. GPIO outputs to control video switchers.
4. Auxiliary equipment control outputs

The exact pins used for each function are set in the configuration file.

**CONFIGURATION FILE:** The controller is designed as a core logic with a large number of parameters in a text editable configuration file so that users can configure it to meet their own needs. For full details on the controller configuration see this wiki page:

[https://wiki.batc.org.uk/Repeater\\_Controller\\_configuration](https://wiki.batc.org.uk/Repeater_Controller_configuration)

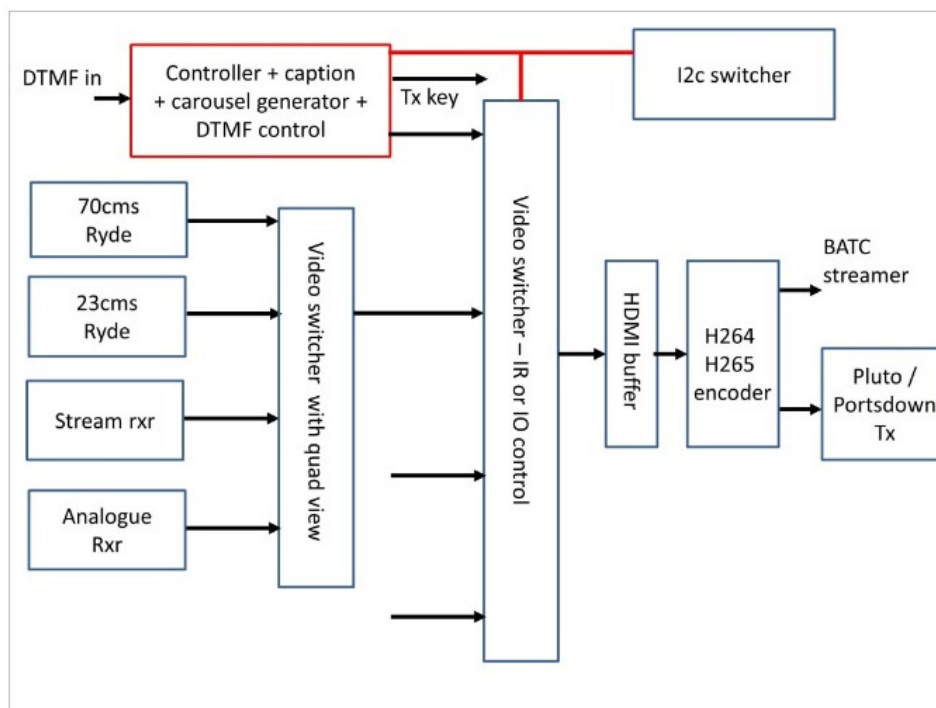
**AUDIO SWITCHING:** Whilst HDMI switchers will switch any audio carried in the HDMI signal, a repeater system may require additional control over the audio such as talkback audio insertion and multiple audio mixing when in quad mode.

The Ryde receiver and the BATC composite to HDMI converter do provide selectable analogue audio outputs via the RPi multi pin jack socket.

To enable this to be used, the BATC controller can control an optional i2c audio switcher – see the separate article in this CQ-TV for more details.

**HDMI BUFFERING:** Experience has shown that although the switches are advertised as seamless, the switch between sources is not truly seamless.

This glitch is enough to cause any encoder following the switch to hang up. This problem could possibly be solved by using another HDMI seamless switch as a buffer between the main switch and the encoder. This may seem extravagant but is cheaper than a designed HDMI buffer!



**SOFTWARE AVAILABILITY:** The controller software is available for download from the BATC Github page <https://github.com/BritishAmateurTelevisionClub/atv-rptr>

We believe that whilst this is a very important project for the ATV community the actual number built will be relatively low and so do not intend to put the pre-programmed SD cards in the shop. However, if you would prefer to buy a pre-programmed SD card, please send an email to [chair@batc.tv](mailto:chair@batc.tv)

**MORE INFORMATION:** More information, including a comprehensive guide to configuring all the options available, GPIO pin outs and DTMF control is available on the BATC wiki at [https://wiki.batc.org.uk/Repeater\\_Controller](https://wiki.batc.org.uk/Repeater_Controller)

There is also a forum thread <https://forum.batc.org.uk/viewtopic.php?f=82&t=7750> where you can get support from the community of users and details of the latest updates will be published.

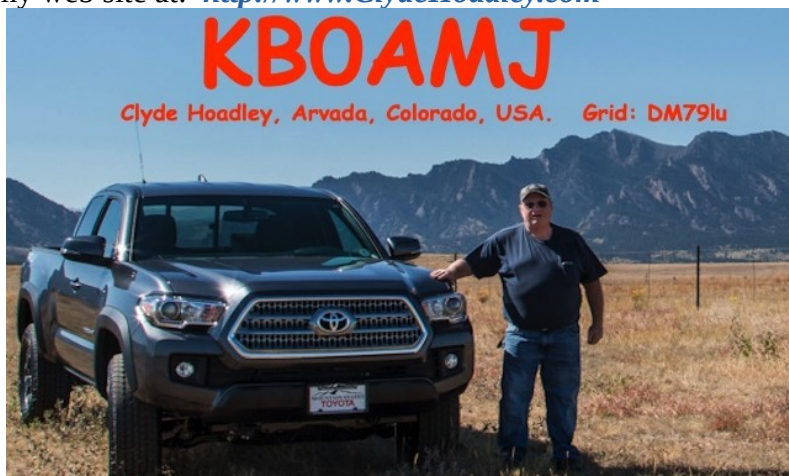
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## CLYDE - KB0AMJ - ATVer

Apartment dwellers can also participate and have fun with ATV. Our own Clyde, KB0AMJ, is a classic example. A couple of years ago, Clyde read about the Boulder ATV repeater in the Denver Radio Club's newsletter. It picqued his interest. Even after we did an RF path profile from the Boulder ATV repeater to Clyde's apartment QTH in Arvada and said it would be impossible to get a signal to/from there, that didn't stop Clyde.



Clyde says --- "I've been in ham radio off & on since 1987. My interests include photography, art, birding, ham radio (KB0AMJ), science, and motorcycling. I have over 30 years experience in computing and information processing. I am now retired and enjoying life. I blog and post photos on my web site at: <http://www.ClydeHoadley.com>"



Clyde also said to himself -- "Well if I can't do ATV at home, maybe I can do it mobile instead." Clyde has proved that is possible. He is a regular check-in to our weekly Boulder ATV net. His favorite mobile ATV location is north of Arvada on state highway, CO-128 near the giant windmills at the National Renewal Energy Labs. From there, he has a 9 km, direct line of sight path to the Boulder ATV repeater.



Clyde outfitted himself with a "To Go" ATV kit which installs rapidly in his Toyota pick-up truck. With it he is able to transmit hi-def, 1080P video on 23 cm band while simultaneously watching the hi-def, digital ATV repeater's output on the 70 cm band. Most all of the various electronic components are all mounted on a wooden board which sits nicely on the passenger seat in his truck. He powers it all with a battery packaged in an ammo carrier box. Every thing works off of +12Vdc. He only needs a single antenna which is a magnetic mount, tri-band (2m/70cm/23cm) mobile whip antenna. Here is the list of the gear Clyde uses. He also has sent us some photos of the setup.



#### **DVB-T Transmitter / Receiver:**

1. Hi-Des, model HV-320E, DVB-T Modulator
2. KH6HTV Video, model 23-11A, 4 watt, 23cm RF Linear Power Amplifier
3. Combo DVB-T & DVB-S, DVB-T receiver
4. Lilliput model A7S, 7" full HD video monitor
5. Zoom Q2n-4K Handy Video Recorder / Camera

#### **Antenna System:**

1. Diamond model NR2000NA, 2m/70cm/23cm, mobile whip antenna
2. Diamond model DPK-4NM-N, 4" dia. magnetic mount base, N connector + coax
3. Diamond model MX3000N, antenna triplexer, 2m/70cm/23cm

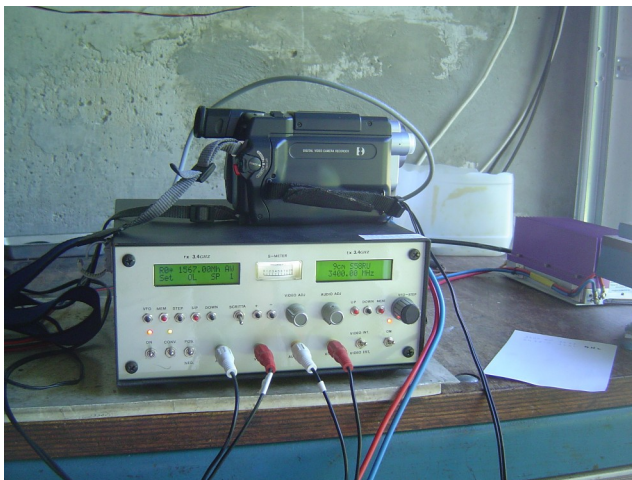
#### **Battery System:**

1. Hardened Power Systems model Pilot G2 --- LiFePo4 battery, 33 Amp-hour, in ammo can
2. Powerwerx, model PD-8 power distribution block





Clyde's battery box & video camera



**ATV in Slovenia** Rudi, S58RU, has sent us some photos of his 9cm (3.4 GHz), ATV gear

**NEWS from San Diego:** Our membership team is still very active and still with the STEM Science Programs through JPL, NASA and the NSF. Membership holds steady with our senior group and younger team' seventy one total. Systems are working well with no outages nor equipment failures. 2024 will bring new upgrades to our site(s) with antenna replacements ,system computers and management software. CubeSat Team reports progress in project funding and development.

73 de Mario, KD6ILO

**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/>

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