Amateur Television Journal

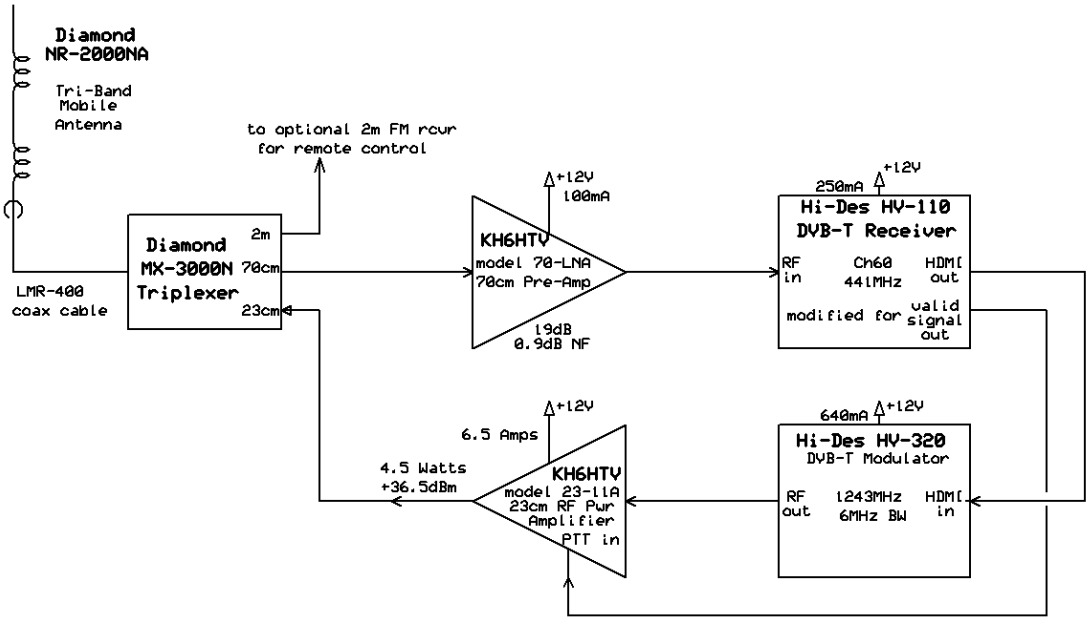
April, 2025
issue #184

BATVC web site: www.kh6htv.com

ATN web site: www.atn-tv.com

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

A Simple, Low-Cost Cross-Band, Digital ATV Repeater



Does your local ATV group need a TV repeater? Are you debating should it be an in-band 70cm repeater, or instead perhaps a cross-band repeater? Tight budget? Technically complex or KISS (Keep It Simple Stupid) ?

70cm In-Band Repeater: This will be complex to make work right and costly. Why? You need really great, ATV channel band-pass filter for both the receiver and transmitter to make it function properly without serious de-sense. These filters are not easy to come by, nor in-expensive. KH6HTV app. note AN-22b discusses such filters. Most builders of ATV repeaters are using ATV channel filters from DCI in Canada (***www.dcifilters.com***). Note: DCI has been purchased recently by the Kavveri Telecom Products in Bangalore, India and communications with them now need to be addressed to mktg@kavveritelecoms.com For 70cm, ATV, DCI offers a 6 MHz filter in either 8 or 10 pole configuration. The price tag is not inexpensive. They are currently quoting $850 for the 8 pole filter and $1,050 for the 10 pole. A 70cm TV repeater will need two filters.

70cm to 23cm Repeater: A cross-band repeater is much simpler to build and less expensive. The exotic, $$$ BPFs are not required. The block diagram on page 1 shows the basic elements. Such a repeater could even be patched together in a few minutes in an emergency. Simply taking the HDMI output from a 70cm DVB-T receiver and patching it directly into the HDMI input of a 23cm transmitter. Attach appropriate antennas and bingo, you are on the air with a cross-band repeater. Cost? The repeater shown would cost $1,300 (not including taxes & shipping)

DVB-T Receiver and Modulator: I recommend using the specified Hi-Des units, the HV-110 receiver and HV-320 modulator. For an automatic controlled repeater, it is necessary to have a "Valid Signal" detector to key on/off the transmitter. A simple modification to the HV-110 receiver provides this logic signal for the PTT line. For details on this modification, see KH6HTV app. note, AN-23.

Antenna: We have found an excellent antenna for this purpose is simply a tri-band (2m/70cm/23cm) mobile antenna from Diamond. Their model NR200NA. We have run antenna range tests on this and other antennas for ATV service and documented our findings in KH6HTV app. note AN-67. On 70cm band, the gain is specified to be 6.3dBi. Over the whole band we found it ranged from 3.6 to 6.6dBi. On 23cm band, the spec. is 9.7dBi. Over the whole band we measured it to be from 6.9 to 9.4dBi.

Triplexer: A key element in making the arrangement shown in the block diagram work as a repeater with a single antenna is the Diamond MX-3000 triplexer. It consists of all in one common unit a low pass filter for 2m, a band-pass filter for 70cm and a high-pass filter for 23cm. The Diamond specs. are for at least 55dB isolation between the various filters and very low in-band insertion loss. Our April, 2024, newsletter issue #159 included a product review of the MX-3000. The 70cm BPF was found to have a -3dB BW from about 290 to 500 MHz. The 23cm HPF has a -3dB cutoff at about 550 MHz. The 2m LPF's -3dB cutoff was about 180 MHz.

Pre-Amp: A low noise preamplifier is also shown in the block diagram. While the basic Hi-Des is receiver is quite sensitive, a good low noise pre-amp will improve it by 2-3dB. But for the repeater purposes, the pre-amp is extra important for it's added band-pass filtering. The 70-LNA is a 70cm only pre-amp and includes a good BPF on it's output. The filter gives about -60dB rejection to the 23cm

transmitter signal, plus provides additional protection against other strong rf signals outside of the 70cm band.

RF Power Amplifier: The amplifier shown is the model 23-11A which produces a 4.5 Watt (+36.5dBm) DVB-T signal. Another suitable amp would be the model 23-12 with 2 Watts (+33dBm) output.

Performance? So what performance can be expected. The 70cm receive sensitivity is of the order of -95dBm (measured with "normal" DVB-T signal [1080p, 5.5Mbps, H.264, 6 MHZ BW, QPSK, 5/6 code, 1/16 guard]). RF output power of 4.5 Watts. ERP of approximately 35 Watts.

DC Power Required: The repeater is designed for +12Vdc operation (10-15V). At 13.8Vdc, the stand-by current draw is 1 Amp. When transmitting, it is 7.5 Amps with the 23-11 amplifier or 2 Amps with the 23-12 amplifier.

Cost Break-Down: The total list price cost is about $1,300. The various items included are: HV-110 ($120), HV-320 ($400), 70-LNA ($90), 23-11A ($450), MX3000N ($90), NR-200NA ($85) and 50ft. LMR-400 coax cable ($65).

Extra Features: As the basic amplifier, it will operate independent of human direct control with the automatic Valid Signal detector driving the amplifier's PTT line. If for FCC control purposes, a separate control capability is required this could be accomplished by adding a 2 meter FM receiver to the third port of the triplexer. This receiver could then drive a DTMF touch-tone decoder / relay driver to add remote control capability. An additional nice feature is to have a local video monitor to look at the incoming signals. This could be added for an additional $100. In addition to a small flat screen video monitor ($60), an HDMI 1 in / 2 out splitter ($20) would be required.

This photo shows a proto-type 70cm to 23cm cross-band repeater built similar to the above block diagram. All the components were assembled onto a single 1U, 19", 14" deep, relay rack shelf. This proto-type used the 23-12, 2 Watt, rf power amplifier. It also included a 2m FM receiver, ABOMY -

Aruduino DTMF decoder / relay, video monitor and +13.8Vdc power supply. We recently used this as a mobile repeater to do the site surveys around Boulder County for BCARES as reported in the previous issue #183 of this newsletter.

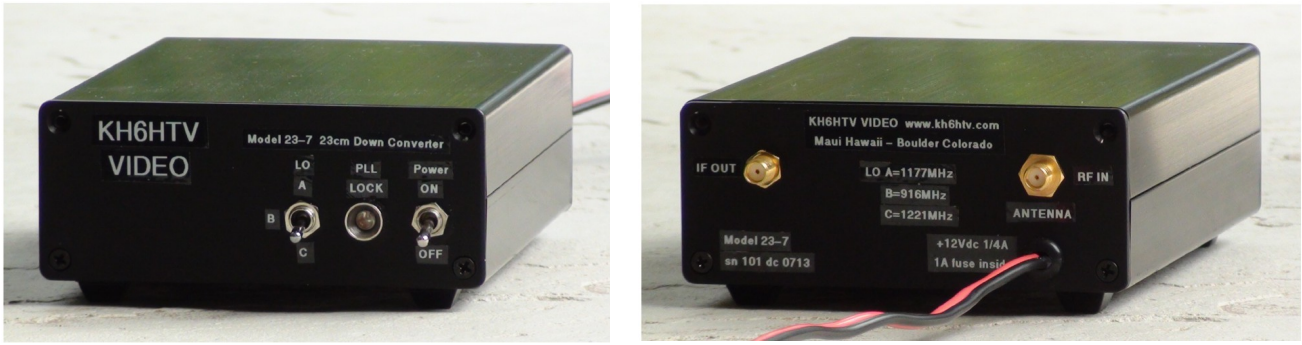
73 de Jim Andrews, KH6HTV, Boulder, Colorado

==========

Where to Obtain 23cm band DVB-T Receivers ?

This is a very similarly related issue. Co-incidently with writing the above article on the 70cm to 23cm DATV repeater, I got several inquires from readers wanting to build 23cm to 70cm DVB-T repeaters, but they were all stymied by the unavailability of the Hi-Des, model HV-120. All commercial DVB-T receivers only cover the commercial DTV broadcast bands and typically top out at about 950 MHz. The sole exception being the Hi-Des model HV-120. (*also some USB TV tuner dongles will go up to 23cm band, but they are not stand-alone units, but require a dedicated PC*) At present, the HV-120 is not available on their E-Bay web site. Availability is very hit or miss and most often miss.

So what is the solution ? --- Use a good down converter for RF to a suitable IF frequency where you can receive it on the Hi-Des HV-110, or other suitable receiver. This has been a subject of much discussion over the years here in our ATV newsletter. The new INDEX for the newsletter lists over 15+ issues with discussions on this very subject.



Model 23-7, 23cm Down-Converter

Back in the "Good Ole Days of FM-TV" I had developed a complete 23cm FM-TV station package for sale with separate modules for a 3 Watt transmitter, 23cm down-converter, and 70MHz IF Amplifier/ FM-TV detector. While there is no longer any interest in the transmitter nor the 70MHz IF amp/detetor, the down-converter design is still extremely relevant. I can still build it and actually do still have one unit sitting on the shelf and available for sale. It is my model 23-7.

More recently, I tried to come up with lower cost, DIY down-converter solutions for you our fellow readers. But none of them have lived up to the high performance I got with the 23-7. It has much better sensitivity due the the excellent low phase noise performance of it's frequency synthesizer.

73 de Jim Andrews, KH6HTV, Boulder, Colorado

Feed-Back on --
"ATV Has Way Too Many Choices - or Does It?"
(letter from Rudi, S58RU)

Michelle, W5NYV, writes -- "Thank you so much for another great issue! ---- It is sad to hear about AD0I. His contributions were presented so well in this issue. Deeply appreciated.

It is true that there's a dizzying array of ways to do ATV. I think it's accurate to say we have a "fragmented market". Thank you for letting all of us hear from Rudi, S58RU on this. I hope you spark more conversation on this topic. We are supposed to experiment, and I think those experiments need to lead to usable and useful modes. Those modes don't need to be exclusionary or permanent, but they need to be easily available enough for us to actually operate.

Sigi, DG9BFC, writes ---

About Signal Levels and Bandwidth for Digital ATV

"Hi Jim -- on QO100 we have signals at about 6 to 8 db .. max 10 db over the noise and we have a clean picture in full hd 25 Fps ... with only 333 k bandwidth ... in DVB-S2 and H.265 coding. Narrow bw means less power needed!! so why stick on 6 megs?? (you can tx from repeater out on 6 megs for the user to have any normal set-top box usable but with a narrow bw the s/n goes up (and there exist also a Pluto firmware that can tx DVB-S and DVB-T) ... noooo not in 6 megs bw!!

So you need either a sat receiver with modified firm-ware (to lock on those narrow signals) or .. just use a software decoder like dvbs gui... or a minituoner, picotuner or similar ham datv gear. Simon, G4ELI, is working on a complete software solution for rx and tx receive only works also with an rtl dongle .. rx an tx now on a Pluto or Libre sdr ..

More hardware will follow soon. I hope that sooner or later Simon will add also DVB-T2 and DVB-S (not S2 because that's aready working) on out local repeater (DM0MAX) we have analog FM in (on 13 and 3cm) and DVB-T on 70 ... and DVB-S on 23 and analog FM out on 3cm and 23cm (we had also 9cm out but since 5G internet was built up here in Germany we switched it off .. it did not work

anymore on longer distances)

With digital ATV very few level is needed. Just some thoughts.
73 de Sigi, DG9BFC, Barenburg, Germany

PS It's so sad that QO-100 footprint is not covering North America. As far as I know there is a new geostationary sat planned on 43 west ...fingers crossed it will come soon
---

Sigi writes more in a second email: The software is pre beta. Nice thing is .. no special Evariste firmware needed .. and no Minituoner needed (all solved in software). It is NOT out in the wild yet (in a few weeks maybe?!?) There are a lot of possible narrow-band RX solutions .. the Minituoner (and all of its brothers and sisters) is maybe the best option .. besides some sat receivers that may be "hacked" (ham radio friendly fw)

Using "Hi-Des" hardware is too costly in my view (for narrowband DVB-T) ... there are cheaper solutions out now

For bigger bw .. instead of a Pluto take a "LIBRE-SDR " (with Ethernet it's easy to have much wider bw than the Pluto supports via its USB port) ...

We are getting more and more options what to use for "terrestrical or sat datv" ... and some just need a few db over noise for a clean picture and there is no need to stick on 6 MHz BW.

==========

News from ATVer Mike, WA6SVT, -- Pitcairn Island

Aloha Jim and Jon,

I am living on Pitcairn Island. I have an Icom IC-706 MK-II Antenna is an inverted V for 20 meters up about 35 feet and a whip antenna with the tin roof as a counterpoise, this is tuned with an AH-4 tuner. This gives me the other bands as well as a 2nd 20 meter antenna. The inverted Vee works better than the whip on 20 meters. The Icom can work six meters but have not heard any activity on six meters. I have heard activity on 10 meters during the day. I work stateside during the gre zone times and the EU and mid east about 9 to 10 PM. My time zone now is the same as the west coast (pacific standard time). Glad you liked the article. BTW, The rights to the article belong to QST and not me. This is my first time writing an article for QST. I did 73 magazine in 1980 or 81 with an article "Coax comes alive".

No ATV on Pitcairn, one other active ham Mirelda VP6MW, she is not that interested in ATV. I did install a 10 watt DVB-T channel 25 TV station back in June of 2023 and last month a channel 80 marine band repeater at the top of the island. We now have HT coverage all over the island and out to sea 70 miles to ships. Top of the island is 1140 ft. Antenna is on a 30 ft mast.
73de Mike VP6MC AKA WA6SVT

==========

DVC-S

DVB-T

Mario's Reccomendations for Modulators

Mario, KD6ILO

I've used these THOR units in my portable, mobile and fixed-base operating systems for years with no problems or disappointments on deployments. *{I am not associated with THOR}* Note that other components such as pre-amps/rf power amplifiers etc of your preference will work, to include Jim's, KH6HTV, products as they have never fail me in operation especially with the PETIT. I'm not promoting these products to any organization, it's just I(we) the SD.DVB Society have great success, no failure, disappointments but awesome support. Also I made some personal modifications at my own risk {invalidates warranty}.

I leave it up to the individual or groups and respect their options. This group has a lot of intelligent minds in the field of image communications like my Society has the choice is yours to move on and explore.

DVB-S Modulator: THOR model H-AV-DVBS2, $???, complete detailed specs at:
https://thorbroadcast.com/product/satellite-sng-encoder-dvb-s2-modulator.html
DVB-S & DVB-S2 modulation, Video inputs of SDI, HDMI, CVBS or Y PbPr up to 1080P60, Video Codecs of MPEG-2 HD & H.264, Symbol Rate 0.05 to 20Msps, RF Frequency 950 to 2150 MHz (10kHz steps), optional IF output 50-200 MHz, RF power out -10 to -41.5dBm, 12Vdc
Editor's Note: Unfortantely, following up with inquires to THOR and they say it is a discontinued model. Then they offer to sell me their replacement for a measly $6,000 ! ! ! Thanks, but no thanks.

DVB-T Modulator: THOR model H-HDNI-RG-PETITm **$470,** complete detailed specs at:
https://thorbroadcast.com/product/petit-hdmi-rf-modulator.html
DTV modulations are: DVB-T (Europe), ISDB-T {Japan), DVB-C J83.A (Europe cable), DTMB, ATSC (USA), DVB-C J83B (USA cable also called QAM); HDMI.1 Video in/out up to 1080P, Video encoding is only MPEG2 (*note: does NOT include more efficient H.264*), bit rate 2-24Mbps, DVB-T band-width 6,7, or 8MHz, 6MHz for ATSC & QAM, RF Frequency 50-950 MHz in 1KHz steps, RF level 70-100dB (units?), 12Vdc

==========

Sources for Analog NTSC Transmitters?

I keep getting inquires about how to get on the air with the older analog, NTSC, ATV signals. Aaron, AD5JK, has called our attention to still another product from China which might work. Called a TV-TX200. $70 on Amazon. But typical of most every piece of electronics from China, little or no specs. Anybody know anything about this box ? If so, please share it with our readers.

Plus Amazon also lists this analog PAL/NTSC modulator for $32. Tangxi model HDM-69. Again essentially ZERO info given about it's specs. Anybody got anything to share about it?

==========

Old Age is Not for Sissies !

My Mother-in-law, Betty, used to remind her kids and grand-kids of this. Now at age 83, I am realizing the wisdom of many of Betty's quotes. For the past month I have been really laid up. First of the month I went in the hospital for pancreas / spleen surgery. Surgeons warned me it would be long slow recovery process. After about a week in the hospital I was close to being discharged to go home. Ops Major Relapse -- I developed severe internal bleeding. Two quick emergency trips that night back to the operating room before the leak was stopped. Now finally back home in Janet's good care, but don't see any recovery progress. Slowly creeping around with a walker and lots of time horizontally polarized. Somedays I occasionally feel like writing a bit on this newsletter. I will try to keep them coming to you our faithful readers. Hopefully at least once a month.

73 de Jim Andrews, KH6HTV, Editor

==========

W0BTV Details: **Inputs:** 23 cm Primary (CCARC co-ordinated) + 70 cm & 3 cm secondary all digital using European Broadcast TV standard, DVB-T with standard 6 MHz wide TV channels. Frequencies listed are the center frequency of the TV channel.
23 cm = 1243 MHz (primary), 70 cm = 441 MHz & 3 cm = 10.380 GHz
Outputs: 70 cm Primary (CCARC co-ordinated), Channel 57 -- 423 MHz with 6 MHz BW, DVB-T
Also, secondary analog, NTSC, FM-TV output on 5.905 GHz (24/7 microwave beacon).
Operational details in AN-51d Technical details in AN-53d. 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. 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 newsletter was started in 2018 and originally published under the title "*Boulder Amateur Television Club - TV Repeater's REPEATER*" Starting with issue #166, July, 2024, we have changed the title to "*Amateur Television Journal.*" This reflects the fact that it has grown from being simply a local club's newsletter to become the "de-facto" ATV newsletter for the USA and overseas hams. 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

Colorado Ham Radio Swap-Fest:

Set the date, Saturday, April 5th, aside on your calendar for the annual Longmont Amateur Radio Club's LARCFest - 2025.
Location is the Boulder County Fairgrounds, 9505 Nelson Rd. in Longmont.
Hours are 9am to 1pm, Admission is $7, with kids 16 and under free.

For Sale: 2m/70cm, 20 Watt, Mobile FM Transceiver

QYT brand (China), model KT-8900D - New, in original carton. I just purchased it for $80 from Amazon. I am now offering it for sale for 1/2 price, at a very low **$40**. **Local Boulder, Colorado area sale only. Will not ship. You need to pick it up.**

Why am I selling it? I purchased it for use as a 2m, FM control receiver for a future BCARES DATV repeater. But I found it to be unsuitable for that application. I was unable to program the memories using CHIRP on either a Windows 10 or 11 computer. Otherwise the radio works fine in VFO mode. I have not tried to program the memories from the mike buttons.

This is a very small rig and designed to work from the cigarette lighter in your car. I have tested it on professional test equipment. It does meet specs. It puts out 22 Watts on both 2m and 70cm bands. Current draw is 0.1 A in squelched receive mode. Draws 3.9 A (2m) and 4.4 A (70cm) on full power transmit. The receiver sensitivity is 0.12uV (2m) and 0.15uV (70cm).

Interested ? --- contact Jim Andrews, KH6HTV, kh6htv@arrl.net -- 303-594-2547