WINTER 2015

Volume 28-No 1

ISSN 1042-198X
USPS 003-353

SINGLE ISSUE
$6.00 USA
$7.00 CANADA
$9.00 ELSEWHERE

Amateur Television Quarterly

Building an ATV Controller

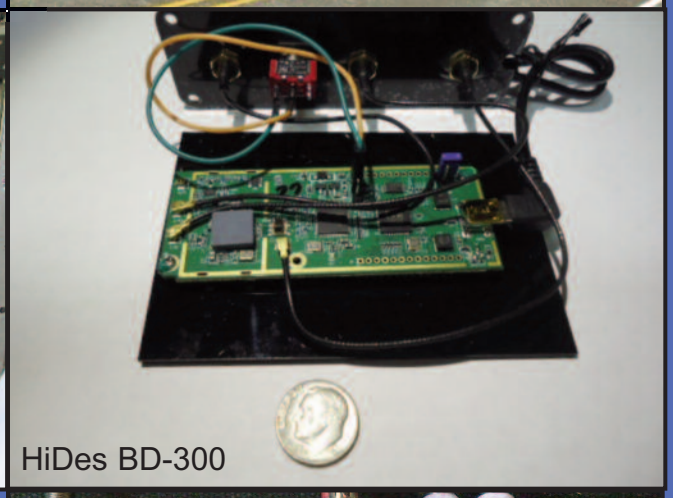
How To Receive Amateur Digital TV

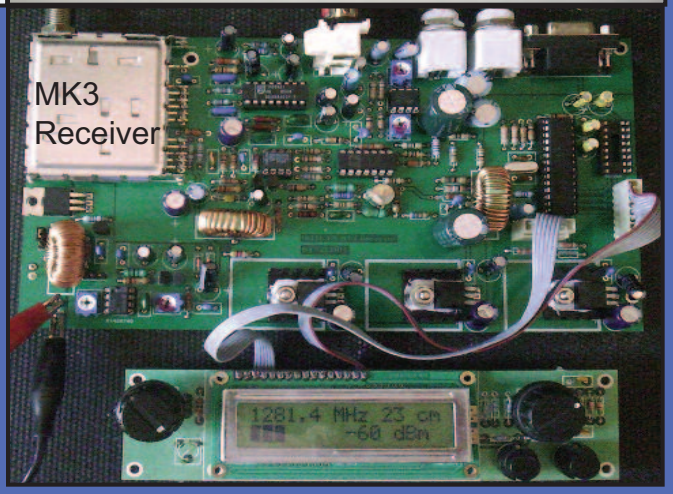
HiDes BD-300 Product Review

MKIII Receiver Project

Early Involvement with Television


ATV Controller


HiDes BD-300



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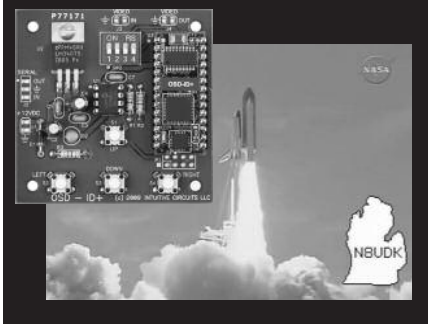

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ATV Quarterly

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Amateur Television Quarterly (ISSN 1042-198X) is published quarterly, in January, April, July, and October for $22.00 per year by ATV Quarterly Magazine, P.O. Box 1594, Crestline, California 92325. Periodicals Postage Paid at Crestline, CA and additional mailing offices. POSTMASTER: Send address changes to: Amateur Television Quarterly, P.O. Box 1594, Crestline, CA 92325.

Amateur Television Quarterly is available by subscription for $22.00/yr in the USA; $25.00/yr in Canada; $35.00/yr elsewhere. Single issues $6.00/USA; $7.00/Canada; $10.00 elsewhere. Cyber version $15.

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Sync Buzz Editorial

-Mike Collis WA6SVT

In this issue

We have a number of articles to help you get started with digital ATV and highlight some new DATV products. We'd also like to welcome several new authors. We encourage anyone to submit articles to us and can be any topic relating to Amateur Television ranging from the Good Old Days to the new.

We would particularly like to see some more ATV in Action stories. Also, if you have a weekly (or daily) ATV net on-the-air or via the Internet, please let us know the details and we would like to get the word out.

Dayton Activities

The annual ATV Dinner during the Dayton Hamvention will be at Roush's restaurant in Fairborn Ohio on Friday evening. Great food and a great group of ATVers from around the county and sometimes from outside the country are in attendance each year.

There will be a high altitude balloon launch on Friday afternoon after the BalloonSat Forum that will be carrying SSTV this year on 2 meters. ATV Forum chaired by Art Towslee WA8RMC will be held on Saturday at the Hamvention. We look forward to seeing you all at the ATN booth at the Hamvention. We have a Dayton special for new subscribers and renewals at the hamvention.

On a lighter note

One of our subscribers in the Pacific Northwest sent in this photo of an 18 wheeler with the ATCO club sign on the side of the trailer. We knew ATCO was looking for new members but what an interesting advertising method.

In the next issue

We will have articles about Raspberry Pi video ID, FM voice intercom receiver, DATV expedition, and ATN news. We will have the Dayton Hamvention ATV Forum schedule and map to the ATV Friday night dinner.

Stay tuned - Bill & Mike

Building an ATV Repeater Controller using Intuitive Circuits' Boards

-Mike Collis WA6SVT

Building an ATV Repeater controller can be fun and easy using PC boards from Intuitive Circuits with a couple of modifications for added functionality. In the photo above left is the front panel with an added audio amplifier and speaker, to the right is Steve WA6EJO holding the controller to provide a look inside.

The boards used are the ATVC-4 Plus controller, DTMF-8 decoder, and the OSD-ID Plus with Carrier Board. A Velleman model K4001 audio amplifier kit and a 3" 4 watt speaker adds local audio while on site. A small perf board is used to hold two relays and their drivers that adds a TX link transmitter mute and camera control audio switch. Plenty of room is left in the chassis for expansion.

The controller needed to provide the following functions:

1. 2.4415 GHz FM ATV input 1st priority
2. 434.00 MHz AM ATV input 2nd priority
3. Tower camera plus control 3rd priority
4. Link input from another repeater 4th priority
5. TX link mute upon switching the RX link to air
6. Hear the TV audio via the front panel
7. Graphics ID overlay
8. Unified command protocol system

The heart of the controller is the ATVC-4 controller board, it provides the audio and video switching and with a small modification, unified command of the DTMF-8 decoder to control the camera and TX link muting. Graphics overlay of the camera video is used for video identification. This controller is used in a linked repeater network known as Amateur Television Network.

Many repeaters in this network are tied together via microwave over a three state system in the southwest part of the country covering hundreds of miles allowing QSO's over long distances. Some of our sites have larger controllers with eight inputs of our own design and they are usually located at the hub repeater sites. Due to cost and time to build such a large controller, we did not want to use them for the smaller repeaters. Thanks to Chris's design of the four input ATVC-4, we can build up a great working mid size controller with all the key controls we are used to at our hub sites.

The ATVC-4 uses prioritized inputs and the usual configuration we use is 2.4 GHz FM input having the highest priority, 434 MHz next, if the camera is turned on, then that will override the RX link input. The RX link is last. This allows all local activities to have priority.

With all repeaters set up this way you can either have a QSO in each local area or join in for a QSO across the network without having to enter control codes to change configuration. Because linking is bidirectional a need exists to only allow the sites local activities to be transmitted back to the other site (s). In other words the programming from the far site shall not be allowed to transmit back to that site via the TX link (video feedback). The ATVC-4 has two ways to control its A/V switches: video is controlled via binary coding (BCD) and the audio via individual control lines, one for each input.

The easiest way to use the existing switching signal is use the audio switch control line from the pic chip. When input four (RX link video and audio) is switched into the output of the controller and transmitted over the air, that high (5 volts) level is used to drive an NPN transistor relay driver. The normally closed relay now opens and disconnects the video line to the link transmitter avoiding the undesired video feedback.

Upon local repeater activity having higher priority, the link transmitter will now send that activity to the far site. Pin 18 on the Pic chip provides the connection needed. Pin 18 is active when the input 4 RX link has video present.

The Max 454 chip is a 4 input, 1 output chip with an op amp Video driver built in. To provide a video output for the link transmitter, I tapped into the output via a series 75 ohm resistor (2 volts P-P here), and the 75 ohm load on the link TX brings the video back to 1 volt p-p. The relay is in series with this line to provide the muting function. Pin 18 on U1 is used to drive the relay (see Fig 1)

The output of the Max 454 chip also feeds an on board relay used to switch between inputs 1-4 and video ID (input 5). The board also provides CW audio ID that will satisfy the ID requirements on the link transmitter (we do not mute the link transmitter audio).

The DTMF-8 has it's own control with a choice of momentary or latched decode of DTMF tones.

In the case of camera control you usually need all eight functions for moving the camera and controlling zoom and focus. This requires the DTMF eight to run in the momentary mode. I used the ATVC-4's command for input 3 to turn on the camera video to be transmitted and switch off a mute relay to allow control audio to be routed to the DTMF-8. I used the normally open contacts. Pin 17 on U1 is used to operate the relay driver (See Fig 1).

The Velleman 7 watt audio amplifier kit's audio input (repeater audio) is fed via a 50k audio taper level pot and is connected to a 2 to 4 watt small speaker with a 1 watt 3 ohm series resistor to reduce the output power to the speaker as well as allow the amplifier will run cooler. The connections are on the back panel via DB-9 connectors for each input and output. This allows one cable for each receiver or exciter with power, audio and video on the same cable for a clean layout.

DB-9 pin outs:

1. Audio
2.
3.RX AGC or TX PWR monitor (optional)
4.
5. Switched 13 volts on to TX
6. Ground
7.
8. Video
9. 13 volts all the time

Pins 2,3,4 and 7 are used for other functions on our larger ATN controllers for PTT, COS etc on voice repeaters and remote base VHF intercom.

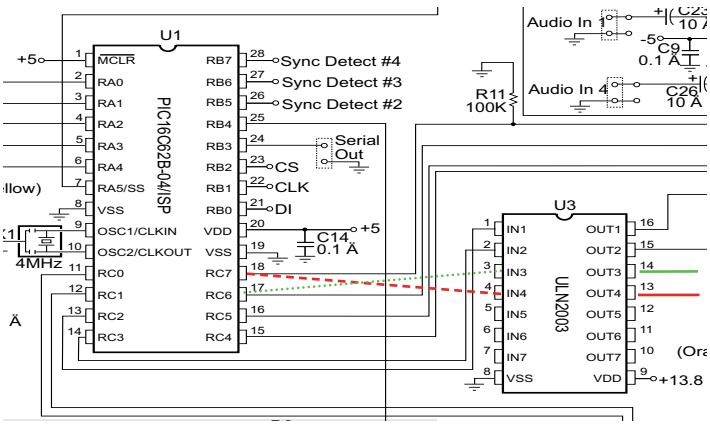


Fig-1 Pic U1 & Driver U3 Modification

There are two methods of driving the relays thanks to Bob W6KGE reminding me of the unused drivers on U3 that could be used. Bob also took my hand drawings and provided clean professional schematics (Fig 2 & 3). I had already built up the external relay driver circuit for the Snow Peak repeater and used one of U3's drivers on the Mt. Wilson repeater controller.

Fig-2 Using external relay drivers

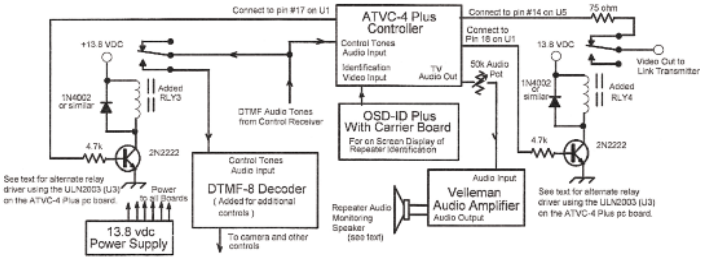
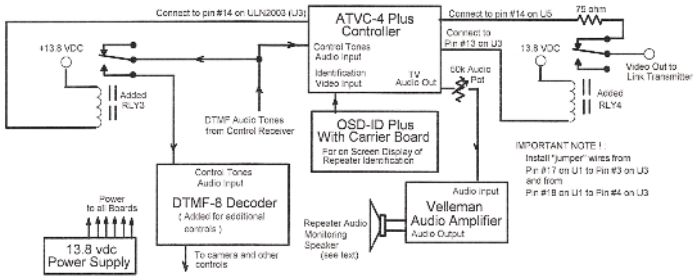
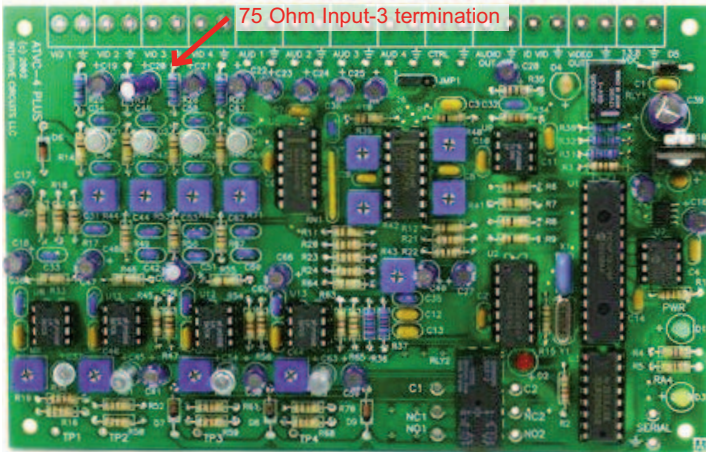
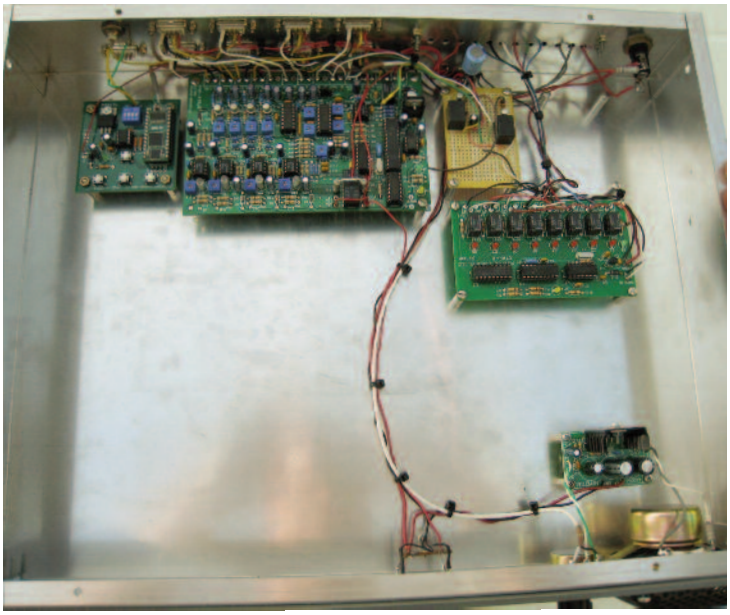


Fig-3 Using spare U3 drivers



Each driver inside U3 includes a driver transistor circuit with a back EMF diode protection. The Camera video is connected to both input 3 on the ATVC-4 and the OSD board. Both have a 75 ohm termination on their inputs. You must remove one of the terminations. The easiest to remove is the termination resistor on input 3 of the ATVC-4. This will allow you to drive a camera input and an ID video source with call sign over camera video.





Inside of controller chassis

The OSD board is in the upper left hand side, ATVC-4 upper center, perf board with driver circuit and relays are on top right, DTMF-8 center right and speaker and amplifier board lower right. The back side of the DB-9s connections are seen from the back side of the chassis. A lot of spare space is provided for future expansion.

Earl KJ6DQR & Mike WA6SVT at Snow Peak

If you want to expand past a single ATV repeater to a network of linked ATV repeaters, this project is for you! I want to thank Steve Noll WA6EJO for the photos Bob Miller W6KGE for the schematics and Earl KJ6DQR help for installation.

73,
Mike WA6SVT

ATCO FALL EVENT 2014

-C. Mark Cring N8COO

ATCO held it's Fall Event on October 26, 2014, our first order of business was lunch! Attendees enjoyed nice food selections from City Barbecue along with drinks and desert. Thanks to Art WA8RMC for ordering and picking up the food, no one should have left hungry!

After eating, Art kicked things off with a welcome, and each person around the room introduced themselves. There were 18 in attendance. Art brought up the subject of encouraging participation in the events. A brief discussion followed. Thanks were given to Ken, W8RUT, for the use of the facilities at ABB. In addition, thanks were given to KEN for donating the Baofeng HT to be raffled at the end of the meeting, before the other door prizes. Thanks were given to Dale WB8CJW, for maintaining the bulletin board.

Art congratulated Charles WB8LGA, on setting a record land distance and winning an ATV digital contest sponsored by BATC! Congratulations Charles! While speaking of Charles, Art had the list of members and dues status, and a number of members went ahead and paid their dues. The downtown repeater now has operational a DVB-T input and output - receive is on 438 MHz, 2 MHz bandwidth and transmit on 424 MHz, 4 MHz bandwidth. Just a mention that the digital receiver holds the last image received - some other issues to be worked out but overall a successful roll out of the 70cm system. Seems that things are standardizing on DVB-T digital mode for 70cm - right now, main options are HiDes equipment or DATV-Express board.

Art mentioned we still need to replace the 70cm antennas as the radomes are deteriorating - a couple of people mentioned they could help. Jones Road (Between Dayton and Columbus) - going to replace/repair antenna in South Vienna. This is 439 analog in and 1280 out when it gets fixed. Other discussion ensued regarding a few technical topics and further discussion of the possible future of analog and digital (on 70cm).

After the main part of the meeting, the Baofeng radio was raffled off, and Phil Morrison, W8MA was the winner. Congratulations Phil! After the main prize, the remaining door prize tickets were drawn and everyone got to go home with "something" of their choosing...as always, thanks to the donors for giving to the club and fellow members!

C. Mark Cring, N8COO ATCO Secretary

How to Receive Amateur Digital Television

-Jim Andrews, KH6HTV & Don Nelson, N0YE

By now Boulder Amateur Radio Club (BARC) members are probably quite aware of some of their fellow club members', high-definition, digital television (DTV) activities We have been using the club's 146.70 MHz, NCAR repeater for our TV intercom frequency for our weekly Thursday afternoon TV nets and also for DTV propagation experiments lately. We have also been publishing articles here in BARC's Bark. Plus Don, N0YE, and Jack, K0HEH, have given live DTV "demos" at the club's November "Show and Tell" evening and also at the recent Boulder County Amateur Radio Emergency Services (BCARES) annual meeting. This has generated interest among members that have inquired "How can I also see your DTV pictures?"

The DTV system adopted by local, Boulder and Colorado Front Range hams is called DVB-T, or Digital Video Broadcast - Terrestrial. It is NOT the system used in the USA for commercial TV broadcast over the air, nor for transmission in cable TV (CATV). It is the system developed in Europe and used by most of the rest of the world for broadcast DTV. Thus, you can NOT use directly your home TV receiver to receive DVB-T. The reasons, we have adopted a European standard rather than an American standard are primarily based upon cost and availability of transmitting equipment and also on the superior performance. In the USA, DTV is called ATSC, Advanced Television Systems Committee. TV receivers sold in the USA will only receive ATSC signals.

Over the air, USA broadcast DTV uses the 8-VSB modulation method. CATV uses either 64-QAM or 256-QAM modulation. Both use standard 6 MHz bandwidth TV channels. The ATSC technology is patented and very difficult to obtain without paying very high license fees. The cost of an 8-VSB modulator is extremely expensive and well beyond most hams' budgets. In 2011, Jim, KH6HTV, found a digital CATV modulator for $1,200 (the cost of a decent HF rig). It produced 64-QAM or 256-QAM for up to 1080i video. Note: modulators only put out low power, typically about 0dBm or less, and need a high power linear amplifier to make a complete DTV transmitter. Over the air, propagation experiments with the CATV modulator showed that it could be used, but only in situations where multi-path was essentially non-existent (almost never ! !). Also DTV receiver sensitivity for 64-QAM was very poor at about -80dBm and even worse for 256-QAM. Thus, the use of 64-QAM never really took off for amateur DTV.

A year ago, the amateur TV magazine, ATV Quarterly, (www.atvquarterly.com) published some articles about DVB-T and also had an advertisement from a new company, Hi-Des Technology, (www.hides.com.tw) *see their ad is on page 10, ed.* in Taiwan which was offering for sale reasonably priced DVB-T modulators and receivers. Jim, KH6HTV, purchased a modulator and receiver set and immediately found the performance to be far superior to that of CATV 64-QAM Soon thereafter other local TV amateurs got their own DVB-T equipment and started experimenting also. At present, there are Colorado DVB-T amateurs in Boulder County, Douglas County and El Paso County. Most all of the DVB-T activity has so far been on the amateur 70cm band. The longest DVB-T DX here in Colorado has been 77 miles from Cheyenne, Wyoming to Boulder.

DVB-T was designed particularly for the multi-path issues always found in terrestrial RF propagation. Multi-path is not an issue for satellite paths nor especially in cable systems, thus other DTV methods are used for these services. DVB-T includes special digital algorithms to characterize the time varying channel and eliminate the delayed multi-path signal. The result is perfect, digital quality, ghost free, pictures even under extremely strong multi-path conditions. DVB-T also offers a choice of modulation methods of QPSK, 16-QAM and 64-QAM. 64-QAM supports the highest data bit rate, especially important mainly for video with a lot of extremely fast ming

events, such as sports. We have found that the simplest QPSK adequately supports high-definition, 1080P video with ordinary video scenes with some motion.. Using QPSK gave an almost 20dB (3 S units) improvement in receiver sensitivity over 64-QAM.

Broadcast DVB-T stations use bandwidths of either 6, 7 or 8 MHz depending upon the various country's historical channel allocations. Here in the USA, the FCC fixed TV channel bandwidths at 6 MHz. Therefore, all of our DTV activity has been done using 6 MHz. The Hi-Des DVB-T equipment supports 6, 7 and 8 MHz and also supports using lower bandwidths of 2, 3, 4 & 5 MHz. Some DTV hams elsewhere have been experimenting using narrower bandwidths down to 2 MHz. High-Definition TV (720p or 1080) will not work at 2 MHz. However, standard-definition, 480i video will work with 2 MHz bandwidth. So back to the original question ***"How can I see the local DTV pictures?"*** There are a couple of easy solutions. Either with a "turn-key" $169, set top box -- or -- a really inexpensive (**$10**), USB, TV tuner dongle.

EASY SOLUTION: The easiest solution is to buy from Hi-Des, their Model HV-110, DVB-T Receiver. It costs $169. It has an SMA antenna input connector. Video output is either via digital HDMI or analog, composite (480i only). It requires +5Vdc power. An AC power supply is included. It is controlled via a supplied IR remote control. The HDMI or composite video can then be connected directly to your home TV receiver/monitor via the rear panel video input connectors. The receiver is frequency synthesized to any frequency between 170 and 950 MHz. It works with all bandwidths from 2 MHz to 8 MHz.

LOW COST ($10) SOLUTION: The really low cost approach is to buy a DVB-T TV Tuner USB dongle for your PC computer. They are found from several sources on www.ebay.com It should be mentioned that Hi-Des also sells USB dongles, but they are quite expensive, in the $150-$250 price range. The model RTL2832 PC dongle (the $10 ebay special) comes with a modest antenna, remote control and a CD containing the software. The antenna is not used because it is too small. The antenna jack is a MCX connector. This unit came with software by Blaze Video. www.blazevideo.com Hopefully there are other options for software to run this dongle. The good news is this dongle and associated software works for DVB-T, 6 MHz bandwidth, amateur DTV purposes. The picture and audio are quite good. The picture can be sized to fill the screen. The picture quality will depend on the PC monitor. There are controls for adjusting color, brightness and other video properties. The side by side comparison of the receiver sensitivity with the Hi Des receiver is comparable. Most hams are not using MCX connectors. We have made our own adapters by simply cutting off a connector pigtail from the supplied mini antenna and installing another connector of our own choice on the other end of the pig-tail.

The PC software that came with the dongle receiver is a teaser. It works but would not be acceptable for a normal TV viewing experience. An upgrade software version is available online for $50. The supplied software is acceptable for ATV purposes. The price is right. The driver and the feature software need to be loaded from the CD, in that order.

It should be noted that not every ham trying to use these dongles was able to successfully make them work. It did not work on computers with Windows 8. It works on most XP machines, but we have encountered a couple of older XP computers that wouldn't work. These tuner dongles will only work with standard broadcast bandwidth of 6 MHz.

DIGITAL TV RECEIVER "GOTCHA" There is a "Gotcha" for all digital TV receivers, whether it is a new SONY that you buy at Best-Buy, the Hi-Des receiver, or the USB dongle. Unlike the old analog TV receivers, we can not simply enter on the remote control any arbitrary channel number and the receiver will automatically tune to that frequency and start working. Due to unfortunate, poor human interface design by DTV engineers, they require that DTV receivers must be "taught" each and every new channel by exposing it to the actual rf signal. This is typically done once when unpacking your TV, connecting it to the cable system or outside antenna and doing an "Auto-Scan". The TV receiver scans all frequencies and memorizes only those on which it found a valid signal. Thus whether you are using the Hi-Des set-top receiver box or the USB tuner dongle -- you will have to teach it first to find and memorize a specific frequency (channel). This means you need to either (1) own your own DVB-T modulator, (2) carry your receiver to another ham's house and train it on his modulator, or (3) if you have a really good RF path, have the other ham point his antenna at you and transmit a DTV signal on each frequency of interest.

ANTENNAS: Most all present DTV activity is on the 70cm band. Thus, use the best 70cm antenna you have and put it up as high as possible. All DTV activity is using vertical polarization in the Boulder area.

DETAILED SETUP PROCEDURE: For the USB DVB-T Tuner Dongle, this is the detailed procedure Don, N0YE, has developed. When scanning for 70cm DVB-T channels do the following:

1. Push the scan button in the lower right of the control panel. A separate box appears with options to select.
2. Set the Country to Universal
3. Enter the Frequency range from 423000 to 447000. Set the starting frequency to the frequency of the channel to be trained. For example if 435 MHz is to be trained, set the range to start at 435000.
4. Set the Bandwidth to 6 MHz
5. Leave the Advanced settings to NOT SET.
6. Push the OK button to begin the scan.
7. The scan will go to completion.

It is probably best to let the scan go to completion. If for some reason you want to stop the scan you can do so without losing any channels found to that point.

8. The channels found are listed in a Play List. The Play List can be displayed by pushing the small box in the upper right of the control panel. This button has an arrow pointing northwest.
9. Channels found are listed in the order found. The frequency of the found channel is listed along with the call sign. By clicking on a channel in the Play List, that channel will be tuned in. There are options displayed for managing the Play List.
10. New channels found are added to the Play List. It is not clear how to manage channels listed in the Play List. This version of software does not allow channels in the list to be deleted or moved although those options are listed in light grey.
11. To scan an additional channel, the application program has to be terminated and restarted. When the program is restarted, the Play List is remembered.
12. It appears the Play List cannot be deleted.
13. Sometimes the application is slow to very slow. To change channels for example takes over 5 seconds. Some other actions take longer. On occasion the response is much quicker. Blaze Video has probably done this intentionally as an inducement for you to pay $50 for their advanced software.
14. The remote control works but the software appears to always be slow. Only the obvious buttons on the remote were tested. Interestingly the remote has an ON/OFF button that turns off the software. This button did not turn the software on.

73, Jim KH6HTV & Don K0YE

DVB-T Range Test January 18, 2015 Colorado

-Gary Sutton WB5PBJ

View from WB5PBJ's location

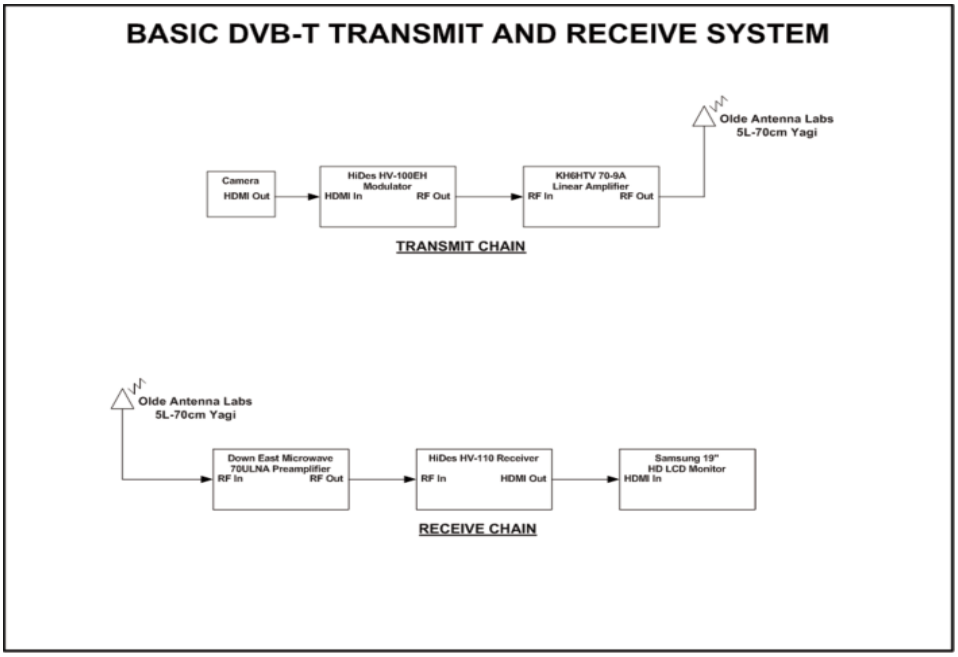
Having recently acquired the basic components to transmit and receive DVB-T, I was anxious to test the range of my system. I initially did solo range testing with the transmitter at the home QTH and driving in the local area with a receive setup in the car. The results were promising, however I was wanting to see if I could make successful transmissions much further away. Fortunately, we have about a dozen hams in the Front Range area of Colorado who have acquired the equipment necessary to transmit and receive DVB-T. I was assuming that I would have to wait for warmer weather before conducting any portable DVB-T range testing, as January can be rather cold in Colorado. However, we happen to get a nice forecast for an upcoming weekend and Don, N0YE in Boulder, CO, asked if I wanted to run a test with him on Sunday morning. That sounded like a great idea, so we established a time and announced where we would setup our stations.

Since this was our first attempt at conducting a two-way DVB-T QSO, we wanted to assure ourselves that we had topography working in our favor, so we picked locations that have good line-of-sight to each other. I was located in Daniels Park in Douglas County and Don setup 33 miles (53 km) to the northwest of me near the old Rocky Flats nuclear weapons facility. Both locations are high spots with the intervening land being at a lower elevation, so we had no topographical obstructions to deal with.

The weather was fantastic for our morning QSO attempt, and from my operational location, I could easily see the area where Don was going to setup his station. His chosen spot was near the National Renewable Energy Laboratory's National Wind Technology Center, which has test wind generators that are visible on a clear day from my setup location at Daniels Park, so knowing where to point the Yagi was very easy.

We had a liaison repeater in Boulder where we were coordinating our activities, and as soon as Don said via the repeater that he was pointing his antenna in my direction, a beautiful HD image of the wind generators showed up on my LCD display. There was no pixelation at any time during Don's transmissions and the built-in microphone on his camera gave me much better audio from their end than what I heard from them on the liaison repeater.

Don started out using a 70 cm 5 element Yagi, as did I, so neither one of us had a large antenna setup to deal with. Don wanted to try an omnidirectional antenna as well, and I had no problem receiving his signal when he switch to the omni antenna. This was turning out to be an easy trans-



mission path, which is understandable when you have such good line-of-sight conditions.

It turned out that Don had company at his location. George, N0RUX, and Doshia KB0NAS, were also setup and when they transmitted towards my direction, I had no problem receiving their signal. Don was running about 10 Watts with his transmitter and George and Doshia were running about 3 Watts with their transmitter. The 3 Watts was plenty for covering the 33 mile path, so that was a good bit of knowledge to learn for future tests.

With such good reception on my end from the transmitters up north, the reverse path worked equally well. I was running 10 Watts on my end to a 5 element Yagi and they had no problem receiving my signal.

Don was adventuresome and wanted to try repeating my transmission to other hams who were located at their QTHs in Boulder. The city of Boulder is behind a ridge from my setup location, so it isn't line-of-sight. Therefore, Don wanted to see if he could receive my signal and repeat it to those folks in Boulder. That proved to be successful, so a portable DVB-T repeater is somewhat easy to accomplish by simply taking the HDMI output of the receiver and feeding it to the HDMI input on the transmitter. However, I say "somewhat easy" because Don said he does have to have filters in place on both the receiver and the transmitter to keep the transmitter from desensing the receiver. Since they were using 70 cm for both the receive (423 MHz.) and transmit (441 MHz.) frequencies, filters for each of the respective frequencies were necessary.

All in all, it was a very successful first test of DVB-T. I look forward to future tests where we can accomplish greater DX and test more repeater setups. The video and audio quality from the HD transmissions is phenomenal, and while analog ATV served us well in the past, it does seem like the future lies in digital.

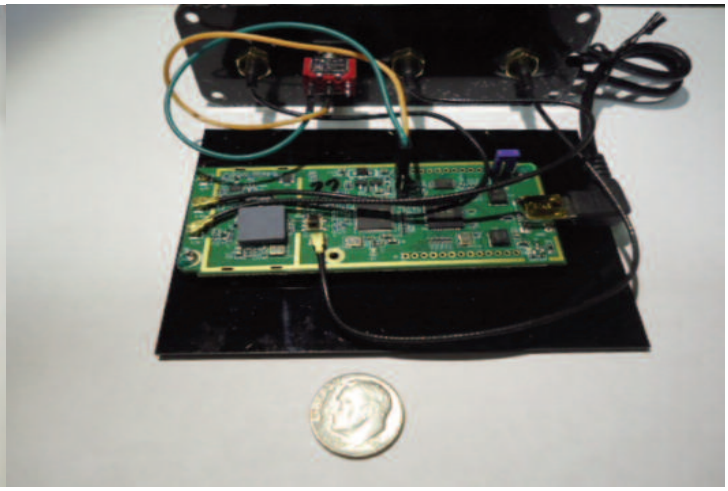
EQUIPMENT SETUP AT WB5PJB

Camera: Sony camcorder
Modulator: HiDes HV-100EH
Power amplifier: KH6HTV Model 70-9A
Antenna: Olde Antenna Labs 5L-70cm Yagi
Coax: 50 feet of LMR-400
Antenna height: 6 feet
Receive preamp: Down East Microwave 70ULNA
DVB-T receiver: HiDes HV-110
LCD TV: Samsung LN19B360C5D
Power source: Kirkland deep cycle 110 AH battery with inverter for 110 VAC devices

Gary Sutton
WB5PJB

Product Review: HiDes BD-300 Dual Band 1.2 GHz & 2.4 GHz Downconverter

-ATVQ Staff



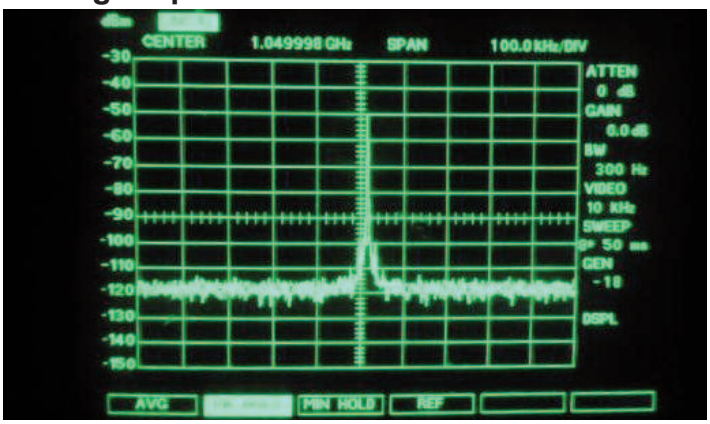
HiDes has just release their two band downconverter the BD-300 that brings both the 1.2 GHz and 2.4 GHz bands within range of their DVB-T receivers. It should be noted that the BD-300 converter can also be used for other DATV modes as well as analog ATV!

The package was received in a few days time in great shape thanks to a sturdy shipping box. Included is a CD with the user's manual and programming software, a 100-240 volt universal USB power supply. The BD-300 is housed in a nice looking black box and all RF connections are SMA female chassis jacks. Power is via either the USB jack or 12 volts from a bias tee (not supplied) into the RF output SMA connector (only one power source can be connected at a time).

The BD-300 is programmed with the following default LO frequencies, 1050 MHz for the 1.2 GHz band and 1800 MHz for the 2.4 GHz band. Using the supplied programming software the LO frequency can be set anywhere from 1050-2300 MHz independently for each band. The BD-300 has separate SMA input connectors for each band feeding a Maxim 2691 LNA (developed for use for GPS L2 band receivers) with a 1dB noise figure. on the 1.2 GHz band. The 2.4 GHz band has a Maxim 2644 LNA at 1.8 dB noise figure.

A switch on the BD-300 switches between the LNAs and LO frequency. The LO is stabilized via a 20 MHz TCXO. A very low phase noise VCO is used to provide superior performance needed for DVB-T and other digital modes.

Fig-1 Spectrum of the LO at 1050 MHz



The RF output is wide band allowing multiple LO, RF and IF combinations to be used. LO leakage on the output is -48 dBm at 1050 MHz and -53 dBm at 1800 MHz. Better than expected for a wide band output.

It should be noted that when you switch bands or reprogram the LO via a computer, the power needs to be reset to obtain the frequency change. The manual does mention turning off the power then turning it back on when reprogramming the LO. My test setup for this review is an IFR-930A spectrum analyzer and a HP-8660C signal generator. This was used to measure the conversion gain, Image, and frequency range of the converter. Not having a noise figure bridge, I was not able to test that parameter however comparison of the BD-300 to a known receiver was tested.

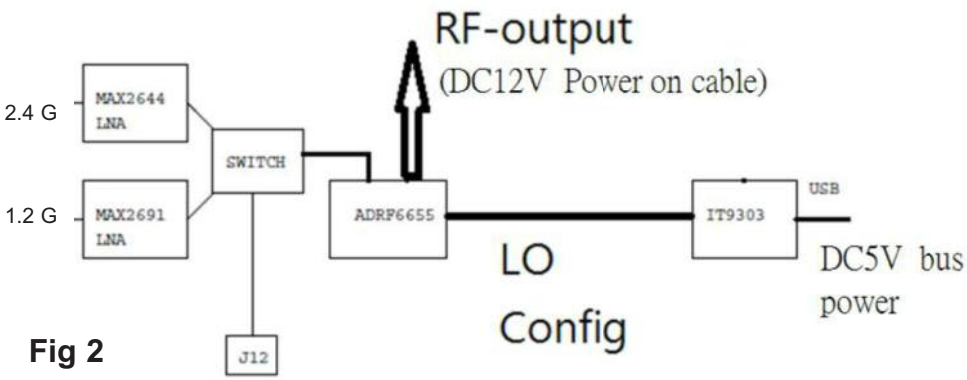


Fig 2

Internal RF switching allows either LNA to be connect to the converter. The 12 volt connection via the output connector uses a switching supply that can generate some objectional noise below 300 MHz on the output and HiDes recommends using the USB 5 volt supply when lower output frequencies are used. Perhaps future units will add more power supply filtering to the 12 volt input line.

Specifications

Parameter	Condition	Min	Typ	Max	Measured	Unit
Pwr Consumption	USB 5V	240		310	271	mA
Frequency Range	2.4 GHz LNA	2200		2600	Exceeds	MHz
Image Response	2400 MHz	Not listed	(Image at 1200 MHz*)		-19	dBc
Input P1	2.4 GHz		-6		5.9	dBm
Noise Figure	2.4 GHz	1.5		2.5	Not Measured	dB
Frequency Range	1.2 GHz LNA	1100		1350	Exceeds	MHz
Image Response	1250 MHz	Not listed	(Image at 850 MHz*)		-6	dBc
Input P1	1.2 GHz		-8.5		8.5	dBm
Noise Figure	1.2 GHz	1		1.5	Not Measured	dB
LO		1050	1800	2300	Meets	MHz
TCXO Freq			20		20.00007	MHz
Phase Noise LO at 1840 MHz	100 KHz offset		-111		-111	dBc/Hz
LO at 1330 MHz	100 KHz offset		-114		-114.3	dBc/Hz
Operating Temp		-20		+80	Meets	Deg C
Price	$169					USD

* Image is 2 times the IF (RF out) frequency below desired input frequency (low side LO injection for the desired signal and high side LO injection for the Image signal). As tested, the IF on the 1.2 GHz band is 200 MHz, LO at 1050 MHz, IF on the 2.4 GHz band is 600 MHz, LO is 1800 MHz.

Performance

Stability of this converter is excellent, I was unable to cause either band configuration to go unstable by changing input impedance or output impedance.

Phase Noise is excellent, see figure 1, I offset the center frequency of the analyzer slightly to show the LO carrier just outside of the analyzer's center graph. Microphonics are also low.

Selectivity is low and mostly due to the wide band performance of the Maxim LNA chips and no external filtering was seen in the circuit.

Image Response could be better as noted above there doesn't appear to be any external filtering between the LNA and RF switch (LNA selection to the mixer). I did try an external simple filter and LNA in front of the filter and retested the combination and image rejection was excellent. Image response was better at 2.4 GHz most likely to the higher IF (RF out) output frequency pushing the image frequency much further outside the 2.4 GHz LNA's frequency response.

Sensitivity

Not having a noise figure bridge, I was not able to properly test for noise figure. I was able to compare the BD-300 to known receivers and checked the demodulated signal to noise ratio. The 2.4 GHz band was about the same as my best receiver. The 1.2 GHz band was about a 1.5 dB short, however I am of the opinion that this is not due to the LNA in the BD-300 but rather due to the -6 dBc image noise at 850 MHz mixing with the 1250 MHz signal. To confirm this, I added an external filter and LNA (padded to the same noise figure as the Maxim chip) and the combination slightly exceeded rated sensitivity.

Using the converter for analog ATV on 1.2 GHz band (VSB), I would suggest programing the LO frequency to 1060 MHz to allow 1241.25 MHz to fall on channel 8, 1253.25 MHz will be on channel 10 etc. I would also recommend adding an external filter to reduce the cellular 800 MHz band signals that are in the image response area.

Programing the local oscillator is easy and the supplied software and user manual is well laid out. HiDes has examples of each step along the way with examples shown in the manual as it will appear on your computer.

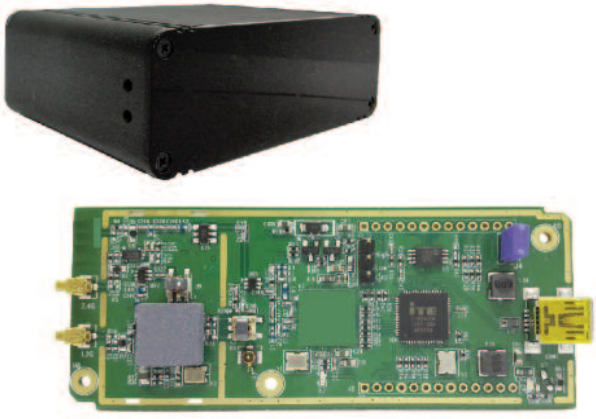
Summary

I have on air tested the BD-300 with QAM-64 DATV on the 1.2 GHz band with excellent results. VSB analog reception was also excellent (An external filter and LNA was used for on the air testing). Circuit board layout and quality of parts is commercial grade or better. Good quality RF connectors are used as well.

Another great use of this converter with it's extra wide bandwidth, programable and stable LO. is to extend the range of low frequency spectrum analyzers and radio receivers up to 2.6 GHz.

A good downconverter for the money that works on all modes not just DVB-T. See their ad on page 10.

BD-300



73, Mike WA6SVT

MKIII Receiver Project

-Grant ZL1WTT

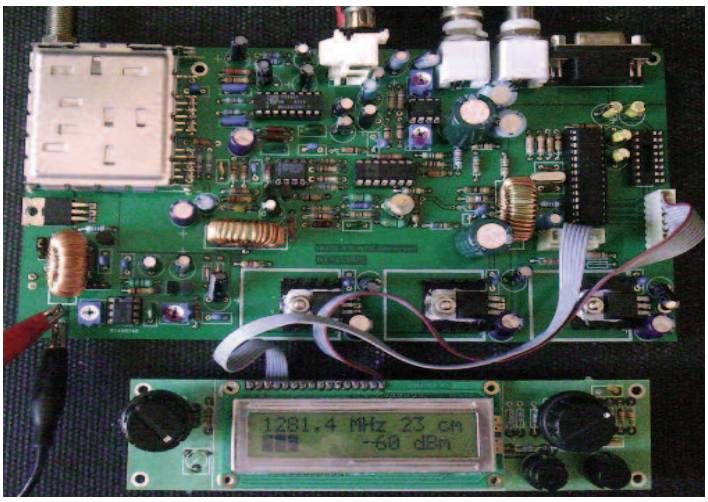


Image showing my new receiver board

History

In the 1960's early days of Satellite Television they had the problem of how to get good carrier to noise and also provide broadcast quality pictures. This is how the 54MHz Satellite transponder standard came about. More and more Satellite services where required to share a single transponder became common place. To minimize the drop in broadcast quality video pre-correctors where used with post-correctors on the receiver side, this is where 36MHz and 18MHz standards came about.

Background

I started working on my MK1 design 20 years ago after finding short comings with available Satellite receivers. In the beginning I found a suppler in the UK where I could get L-band tuners at the right price. Over the intervening years I have improved the design and performance. This has been done alongside my development of the MK1 and 2 modulators. Now I have very good all around performance from LC-2 modulator and this new MK3 receiver design.

Back in the 1990's I can remember visiting TVNZ studios and seeing what a broadcast video picture can look like. They had a studio camera to broadcast monitor and I notice everyone was asking if that was HD. No, was the reply, it is an uncompressed video signal. Being involved with ATV I needed to find out more about analog video compression. It turnout out that they had to run RGB directly from the studio camera to monitor both bits of equipment were about to work up to 20 MHz of video bandwidth. This is how the HD effect was done. I knew then I needed to find a way to send much higher video bandwidth via ATV.

Introduction

There is still a lot of misunderstanding about how AM and FM TV works, I will leave the subject of AM for another article. In this article I will cover the areas of carrier to noise and the importance of video bandwidth. As part of this I will need talk a bit about the FM modulation and key things to look for.

Carrier to Noise

This can be affected by two things: Carrier level and the noise floor whereby noise figure is the amount of noise that is generated from within the front end RF device. Another factor is the IF bandwidth of the receiver itself. This is why it's so important to align the modulator to IF response of the receiver as a matched pair.

For example a common mistake that is where an analog Satellite receiver is used that has an IF bandwidth of 18MHz and someone decides to set up their modulator to use only 12MHz. By doing this you have degraded your carrier to noise performance. The correct way to do this is to set up the receiver that is being used to an IF of 12MHz also.

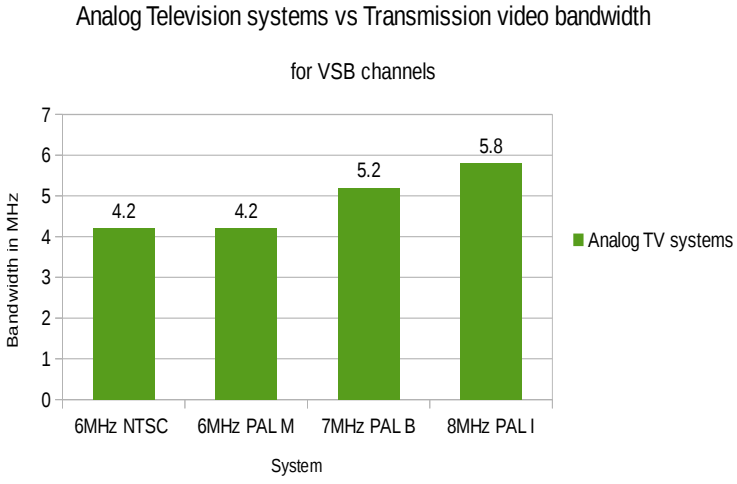
Bandwidth

There is always a trade off of RF bandwidth being used vs video frequency response. For ATV applications 54MHz channels comes with a few problems. This is where 27 and 18MHz bandwidths (1/2, 1/3 of a transponder) are somewhat more useful. With years of experimentation and untold hours of testing, here in Auckland we have gone with 18MHz bandwidth. The trade off between carrier to noise performance and video frequency response was acceptable at this bandwidth.

Whereby going down to 12MHz of RF bandwidth, video bandwidth has been rolled off making the picture looking more like VHS quality. Other things to think about is what affect the modulator has on video bandwidth, again you need to check-out both sides. A lot of FM TV modulators currently been used for ATV are nothing more then low cost video senders. Therefore video frequency response is poor and they have low sub-carrier injection levels. This is s problem when the video,and audio is resent out via an ATV repeater this is when these issues tend to show up. If you are interested to find out more about FM TV modulators, take a look my article on the LC-2 design. Now you understand why I spend so much time testing and retesting equipment to make sure it always up to best possible standard.

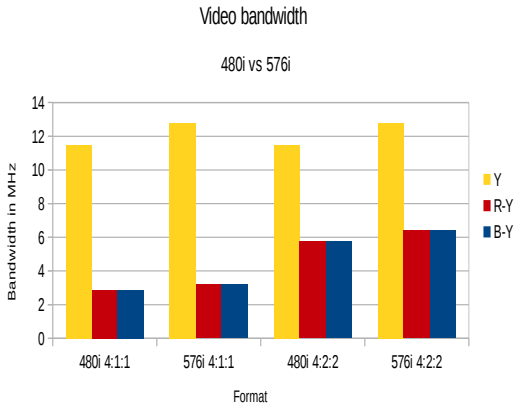
Video formats

Analog composite video bandwidth can very on the VSB OTA standard used, such as PAL, SECAM and NTSC. Alongside these different transmission formats you also have a range of sub-carrier frequencies from 4.5 up to 6.5MHz. This was done to fit them into one of three RF bandwidths, 6, 7 and 8MHz channels. All these factors have an effect on the amount of fine detail that can be displayed. As in graph below, I keep it simple by just showing PAL and NTSC formats.



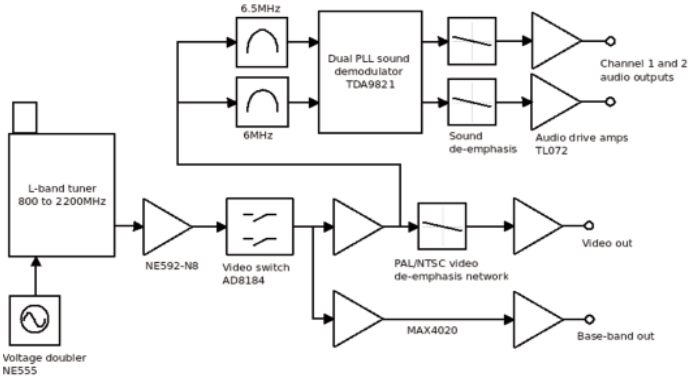
With newer digital technology like DVD players and media playout boxes. I have noticed they have analog Y/C S-Video (luminance and chrominance) and composite video outputs, they can be higher in frequency response than you would normally expect. For example when white text is displayed you sometimes can hear vision buzz coming back via the demodulated sound. No matter what you do with S-video or composite video there will always will be a high amount of colour compression involved. Now lets look at component video, with this level there is no colour sub-carrier, therefore it's not PAL nor NTSC at this point. This is where the terms 576i and 480i are used to explain the difference. Component video has three outputs compared to the one used for composite video. You normally find component video on the back of DVD players and all kinds of media set top boxes. They can be identified by three RCA sockets red, green and blue (R-Y, Y, B-Y) this is one step away from RGB level.

This is where we talk about colour pull down ratios such as 4:2:2 and 4:1:1. You can look at this like this, 4 is the number of luminance pixels to each of the colour pixels. This is how colour compression is done as shown below.



As you can see a component video output has much higher bandwidth than compressed composite, providing much higher level of information within the picture. How does this apply to ATV? I hope by displaying all the information above you have greater understanding of the importance of video bandwidth and it's impacts to image detail. Another thing to think about is how a received analog signal will look through a DATV repeater. Again I will leave this subject for another article, there are many factors that can effect the performance of an ATV repeater. This is why I wanted to rework my MK2 receiver to improve the video bandwidth response. The limitation is set by 6 and

6.5MHz sound sub-carriers. To get around this I added a base-band output to provide wider frequency response.



Receiver Features

1. Wide tuning 800 to 2200 MHz
2. Wide and narrow IF settings
3. Variable low threshold demodulator
4. Dual IF sound demodulators 6 and 6.5MHz
5. Local oscillator offsets for different bands
6. +/- video output
7. Baseband output
8. 22kHz LNB drive (if required)
9. Wide video bandwidth up to 10MHz (at 27MHz bandwidth without threshold)
10. 12 volts DC powered
11. Designed for ATV applications (set up for 18MHz bandwidth)
12. Can be driven via RS-232 for remote use (ATV repeater sites with a software change)

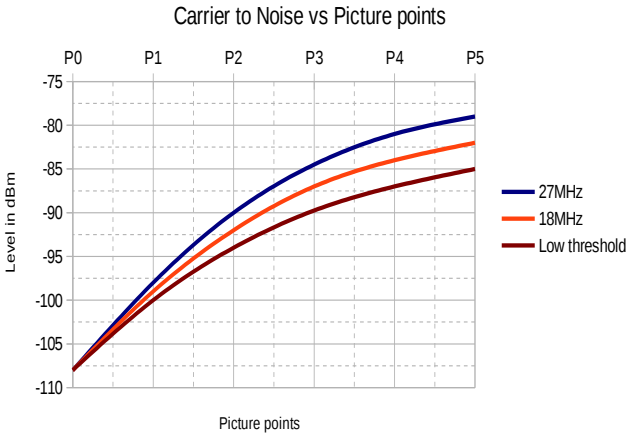
RX Circuit description

The L-band tuner takes the incoming RF and mixes it down to an IF of 480MHz, with two IF filters that are switchable. One is wide (27MHz) and the other is narrow (18MHz). This tuner is arranged around a Mitel SP5055 PLL chip. This PLL is driven with an I2C serial interface that is controlled via a PIC 16F876A Micro-controller. The FM demodulator runs at the IF frequency and uses PLL for demodulation. In the loop filter of this PLL the time constant can be increased by varying the low threshold pot. The AGC line is connected to the A to D input of the Micro and is converted in software to a signal readout on the LCD display. IC1 Is a NE555 timer oscillating at 22kHz, this drives two transistors in a Totem pole configuration.

This feeds D1 and D2 these Diodes set out as a voltage doubler, this part of the circuit provides the tuning voltage. IC2 The incoming baseband signal is DC coupled into pin 1 of the NE592-N8. This is where the gain is controlled via TR3 (MPF102 JFET) across pins 2 and 7 whereby the bias is set from the Micro in the form of a PWM output. The common pin is the pick off point for a dual sound demodulator. IC3 is a TDA9821 dual PLL sound demodulator. This takes the outgoing signal from the relay from the NE592 stage. Through two ceramic filters (6 and 6.5MHz) which then feeds the two inputs of IC3 pins 1 and 15. The audio gain has been set by the use of two 1.2k resistors and two 2.2 uF caps. The audio output pins 7 and 8 are connected to the 50uS sound de-emphasis networks. IC4 is a TL072 op-amp used as a dual channel line amp. The pins 2 and 6 are the two inputs. The audio gain is set by VR3 and VR4. The output pins 1 and 7 are coupled to the outputs which then provide the two audio output channels.

IC5 is the PIC, a 16F876A Micro-controller that drives all parts of this receiver plus a 2 x 16 LCD display. It reads the push buttons and the rotary encoder from the display PCB. I have written the software and laid out the menu in the same structure that Kith (ZL1BQE) did for the MKII ATV modulator. IC6 is a MAX232 RS-232 level converter. I have added this component to provide remote access to software settings, this could be from a PC or a repeater controller. For example changing receive frequency or even displaying the signal level. This IC can be left out if you are just using the rotary encoder from the display board. To use this receiver in remote mode requires a software change. IC7 is a AD8184, a high speed video switch that is used to select between positive and negative modulation. This is connected to the two drive output of the NE592 and switched via TR5 MPF102 JFET from the L-band tuner. IC8 a MAX4020 is a quad video op-amp, where two of these op-amp sections are connected from the output of IC7. Next is the PAL or NTSC video de-emphasis network, the output side feeds on to the output driver op-amp with a sound trap in the feedback path.

The second output driver is used for the base-band output. REG1, 2 and 3 are the on board regulators. REG1 is 9 volts supplying the video and sound stages. REG2 and 3 are 5 volt regulators to drive the analog parts of the circuit whereby REG3 does the same for the digital side. The PCB layout has two ground planes one on each part of the circuit board. The digital ground is connected to analog ground via L3 100uH choke reducing any unwanted noise between each part of the circuit. The TR10 (IFR9540N) P-channel MOSFET switches on and off the LNB volts. This N-channel device is biased in depletion mode. Therefor you need to take the gate negative to turn it off. This is done via TR9 (BC548).



As you can tell using threshold will only provide an extra 3dB carrier to noise performance. By doing this it will affect the output waveform at the higher video frequencies. A noise floor at -108dBm makes this receiver ideal for ATV DX work. To give some Idea how this compares to AM modulation a home aerial installer aims for a signal level of –54 dBm (55 dBuV) as a reference for the same P5 picture.

The operating AGC range is from -30 down to the noise floor of -108 dBm. I have added a table in software to display readings in dBm as well as in a bar graphical format. Audio bandwidth was tested from 20 Hz to just above 20 kHz with a small amount of phase shift at the top end, full deviation is set at 0dB on both sub-carriers.

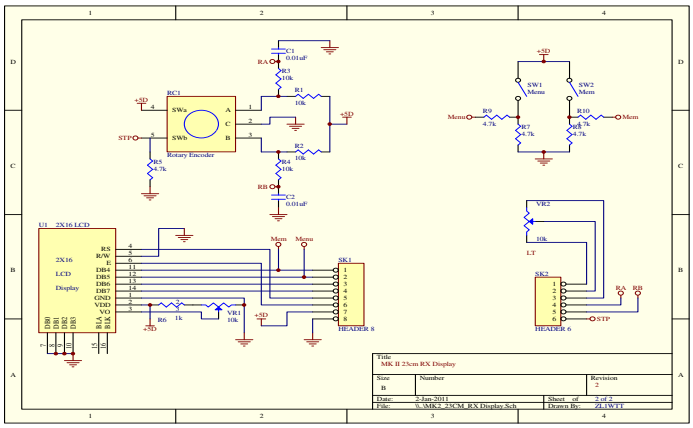
Setting up 22kHz

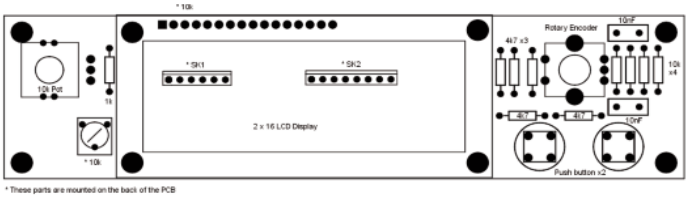
There is very little to do here, adjust VR1 with a frequency counter and set to 22kHz. Set VR2 to an output of one volt peak to peak to set the 22kHz injection level.

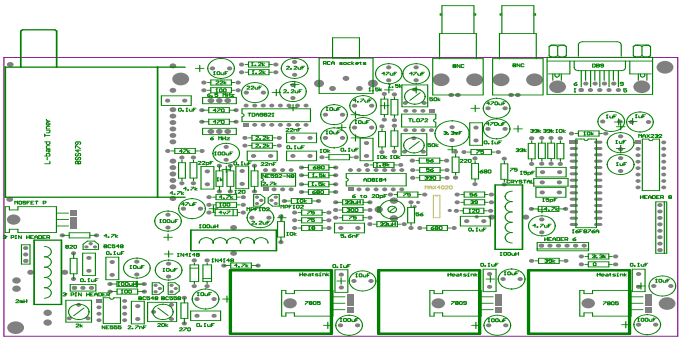
MK3 RX Menu Layout

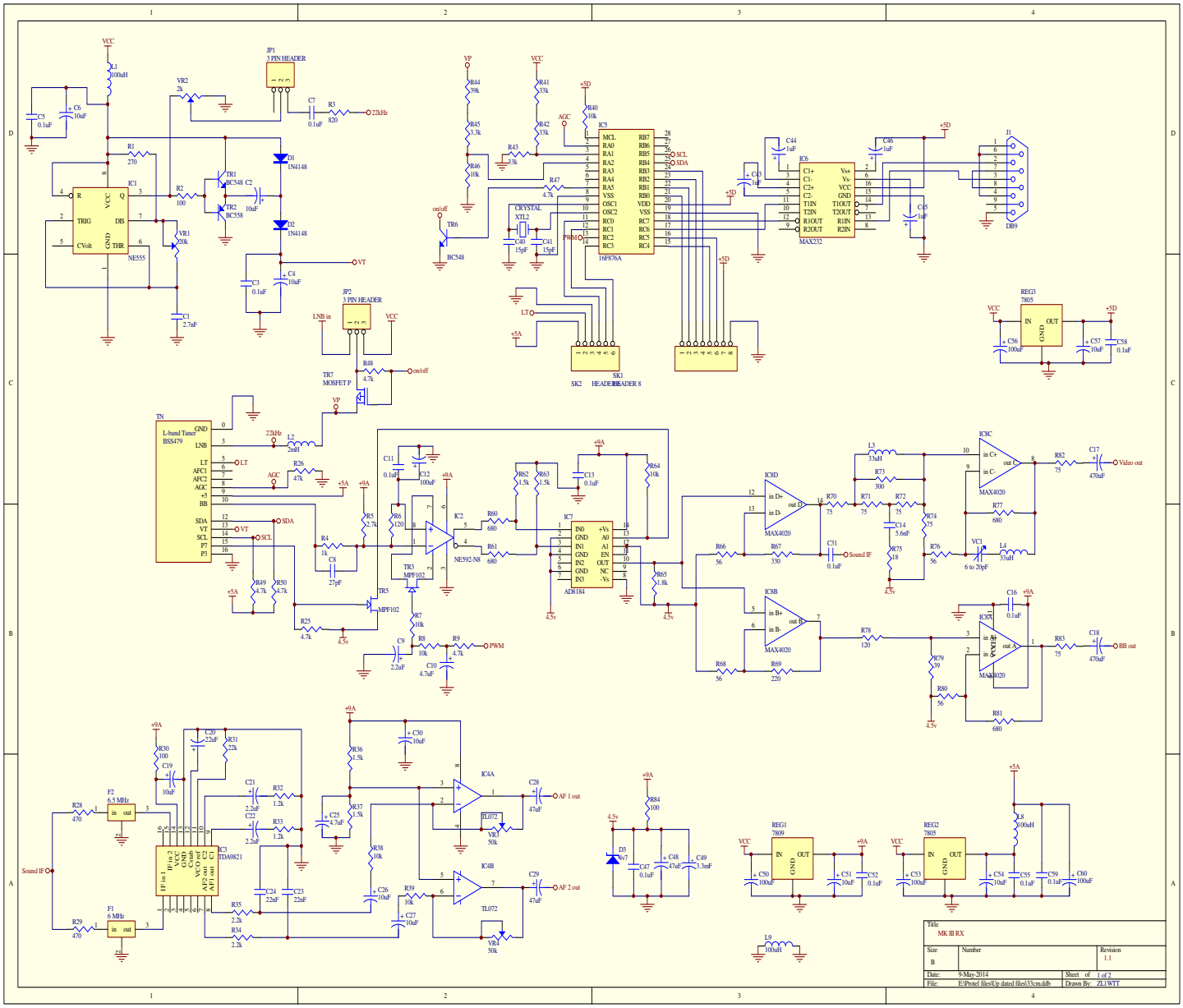
The code within PIC16F877A has not changed that much from the older MK2 software. From the VFO display the left button goes into the menu. By re-pushing this button you are able to move through the various parts of the menu. The rotary encoder changes the values as required. When storing the data the left button will exit without saving and the right button will rewrite the information to memory location selected.

When in VFO mode the steping sizes are 100 kHz or you can jump to 10 MHz steps by pushing the button in on the rotary encoder and holding it in. The right button from the VFO will take you into memory mode where you can load data out of any one of 40 locations.









ATVQ

DATV on 2 meters in UK

-ATVQ

OFCOM has opened 146-147 MHz for experimental digital medium bandwidth communications. The existing 2 meter band in Europe and UK is 144-146 MHz. This band extention is for full license hams that apply for a NoV and must not cause QRM to other countries outside the UK. Power is limited to 25 watts ERP, a height restriction of 20 meters above ground and some geographical limitations. DATV transmission have taken place with Arthur Turner G4CPE transmitting 4 watts DATV MPEG-2 at 543KS on 146.5 MHz to Don Saunders G0WFT over a 3.7 km path. G1LPS has also received DATV on 146.5 MHz and has a short video clip on YouTube.

The NoVs will expire on October 31, 2015. If things work out with no QRM to other services outside the UK from this new experimental band, OFCOM may renew the NoVs. This may be the first time Amateur Television has taken place on VHF frequencies.

Early Involvement with Television

-Roger Salaman K0IHX

Television gained its major start after World War II. From 1946 to 1950, my brother, Roy, and I build, sold and installed television sets, and became the New England distributor for Transvision Television Kits (produced in New Rochelle, New York). I was 14 years old, my brother 16. New York television

stations were on the air only three days a week. (WABD, standing for the television pioneer, Allen B. Dumont, and WNBC-TV). The broadcast industry felt that people did not have time to watch television during the evening or on the weekends. In fact, our mother sent a letter to the New Haven Register asking them to carry the television schedule for the New York Stations, and received the reply that there was not sufficient demand for television.

So that we could sell television sets around New Haven, I designed, built, and installed guyed rooftop antennas to receive the distant television signals from New York. My brother and I also repaired older (1930's model) television sets, and converted them to receive the channel 3 when the FCC eliminated channel 1 (because of interference with other radio services).

In December,1947, our parents invited a full living room of friends over to watch the Joe Louis, Jersey Joe Walcott boxing match on two 10 inch black and white television sets that my brother and I built. The 10 inch tube was the largest available at that time.

The New Haven Connecticut television station, WNHC-TV, went on the air on June15, 1948, 6 days after WBZ-TV in Boston, thus just missing being the first operational television starting in New England. In 1948 and 1949 I worked for the WNHC-TV chief engineer Vincent deLaurentis. My brother, Roy, and I visited the WNHC-TV transmitter in 1948 after reading in the New Haven Register about the Elm City Broadcasting Company building of the television station for New Haven. We talked to Mr. deLaurentis who said my brother (who was 18 years old) could work a TV camera in the studio, and I (who was 16 years old and attended New Haven High School) was hired to run the Oxford Hill relay station which relayed television signals from New York City to the New Haven transmitter located on Gaylord Mountain, 8 miles from New Haven. Since I didn't have a First Class Radio Telephone License, Mr. deLaurentis said I should obtain a Third Class Radio Telephone License, and inform anyone that I was supervised by a First Class License.

The Oxford Hill Relay station had a Microwave transmitter at the bottom of a wooden pole, with a parabola pointed straight up to a reflector which allowed the microwave signal to be beamed to the microwave parabola receiving antenna on a tower at the Gaylord Mountain transmitter station. We received the New York signals from WABD, CBS, and NBC on a yagi antenna mounted at the top of the wooden pole. The signal was fed inside the relay station to a fixed frequency crystal receiver tuned to receive the WABD signal on Channel 5. The signal from the antenna was also fed to an RCA 630 television set to receive the signals from CBS and NBC (on Channels 2 and 4). My job was to assure the relay station operated correctly to receive the WABD, WCBS and WNBC signals, convert the correct signal (according to the schedule of which station was to be carried by WNHC-TV at that particular time) to microwave, and beam it to the WNHC-TV transmitter on Gaylord Mountain.

The WNHC-TV transmitter personnel and I established communications by normal telephone calls. Besides switching to the correct network signal on

the hour or half-hour, I needed to maintain a quality signal for transmission to Gaylord Mountain. For pickup of the off-the-air signals for CBS and NBC, I had to switch the RCA 630 television signal to the correct channel, and tune the RF section of the receiver for the best quality signal according the video signal on an oscilloscope. Since the off-the-air signal had some noise, the synchronization signal (which was most important) had to be regenerated and adjusted to the correct level. Therefore I ordered a Sync-Stretcher for this purpose. During the 30 second station break, I fine-tuned the RF signal for best quality, and adjusted the synchronization signal to meet the FCC standard. More times than not, I finished making these adjustment while WNHC-TV was on the air carrying the appropriate television signal. Not being satisfied with the quality of the signal we were receiving off-to-air, I built a Sloping-V antenna and erected it toward New York City.

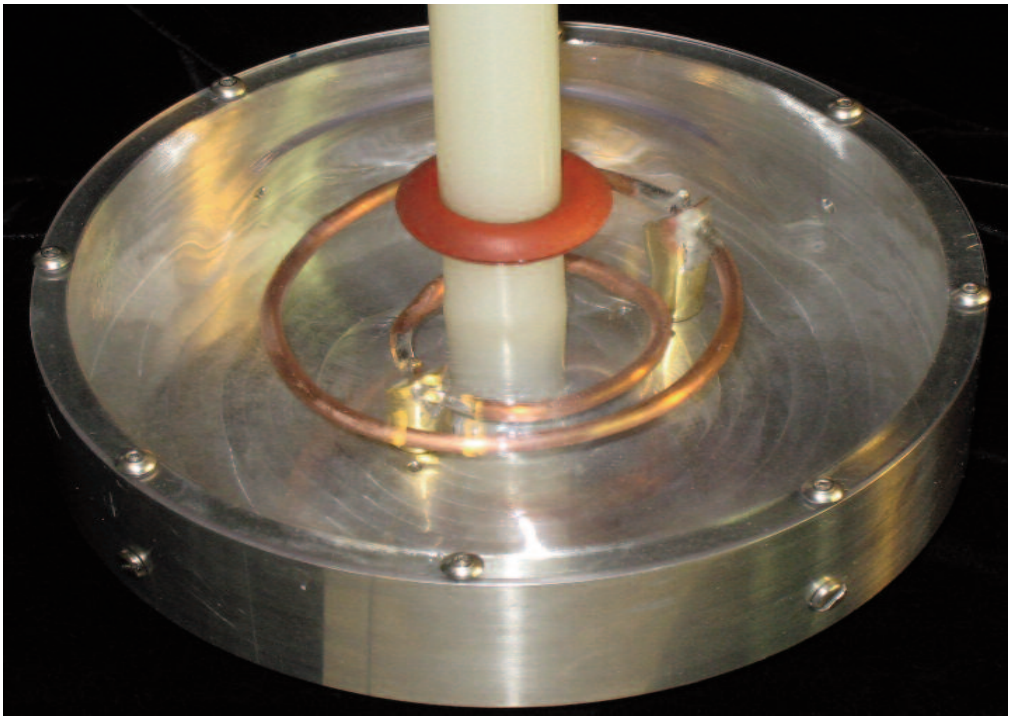
This significantly improved the signal we were receiving from the New York Networks. There were other externalities associated with this job. Hurricanes Edna, Carol and Hazel pounded New England, and knocked the relay station (and WNHC-TV) off the air. To get the Oxford Hill relay station on the air as soon as possible, I drove around debris-littered roads, and activated an emergency power generator at the relay station. We were quickly on the air, providing the New Haven area with information concerning the hurricane.

I obtained my first ham license, Advanced Class W1UDF, just before enrolling in Rensselaer Polytechnic Institute in 1951. My current call, K0IHX was acquired when I moved to Colorado in 1957.

Roger Salaman
1/31/2015

Manufacturing a tri-Band Dish feed, addendum

-Steve Noll WA6EJO



Background

After construction of the tri-band feed for Oat Mountain, two 2-band feeds (each 13 cm and 23 cm) were built for Ord Mountain and Cathedral City ATV repeaters. These feeds were to be mounted using a coaxial Nylon rod identical to that used by Kevin Jacobson, AD7OI, for his Phoenix Arizona dish feed.

Construction

A different technique was employed to form the radomes.

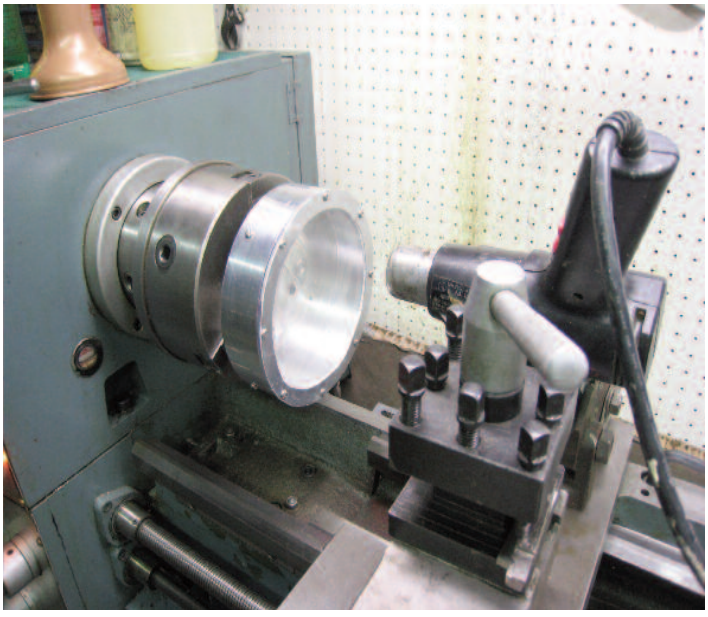
Fig-1 Vacuum pump connected to the lathe

Polycarbonate (a.k.a. Lexan) was again used for its superior strength and crack resistance compared to acrylic (a.k.a. Perspex.) As the 23 cm loop is close to the height of the rim of the reflector the proximity of even the thin 0.0625-inch (1.6 mm) plastic affects the tuning.

The radomes were bowed to provide added clearance by using vacuum forming. After the reflector was machined, but before the loop supports were installed, a 3/8”-16 fiberglass hex head cap screw with a hole drilled through its axis was installed in the central hole that would later be used to fasten the ¾-inch (19 mm) Nylon rod to the reflector.

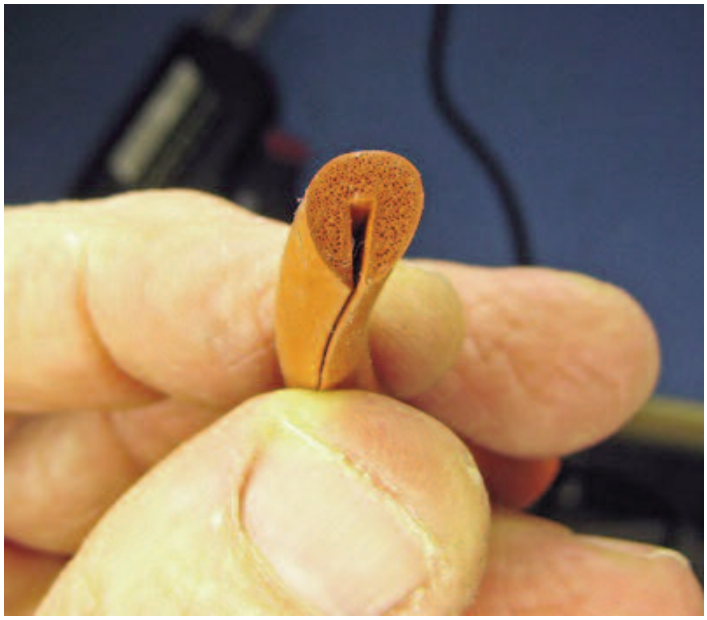
A high vacuum hose connects this screw to a vacuum pump with the hose running through the hollow chuck and lathe spindle. A swivel at the vacuum pump allowed the hose and reflector to rotate. The loop support holes were sealed with tape and a polycarbonate disk was mounted to the front of the reflector. The lathe rotated the reflector mounted disk while directed heat from a heat gun

Fig-2 Heating the polycarbonate disk t



softened it enough to be sucked into the reflector. The softening point of polycarbonate is quite critical and it took a couple tries to get a useable radome. After the radome cooled it was re-mounted on the reflector, now with the sucked-in portion sticking out, and a 1" (25.4 mm) hole drilled through the center while still in the lathe. This hole was lined with weatherproof silicone rubber edge trim (McMaster-Carr 4869A681) to provide a tight seal for the Nylon rod.

Fig-3 Photo of the rubber seal



The nylon rod allows this version of the dish feed to be used with surplus grid dish antennas by cutting off the old feed about 4 inches away from the focal point, pulling out the center conductor from the old feed horn mounting pipe-feedline, and inserting the nylon rod into the open end of the mounting pipe.

Fig-4 Side view of the completed dish feed

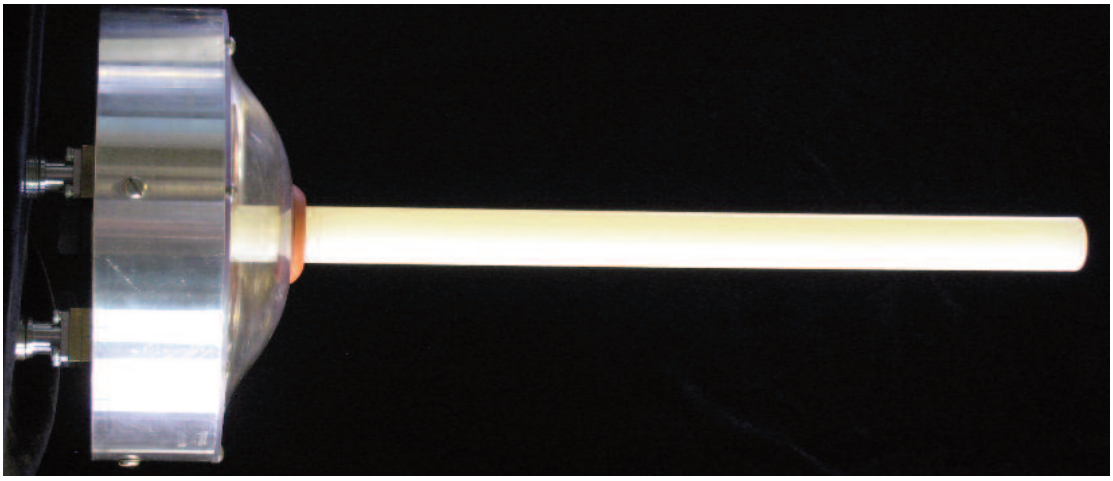
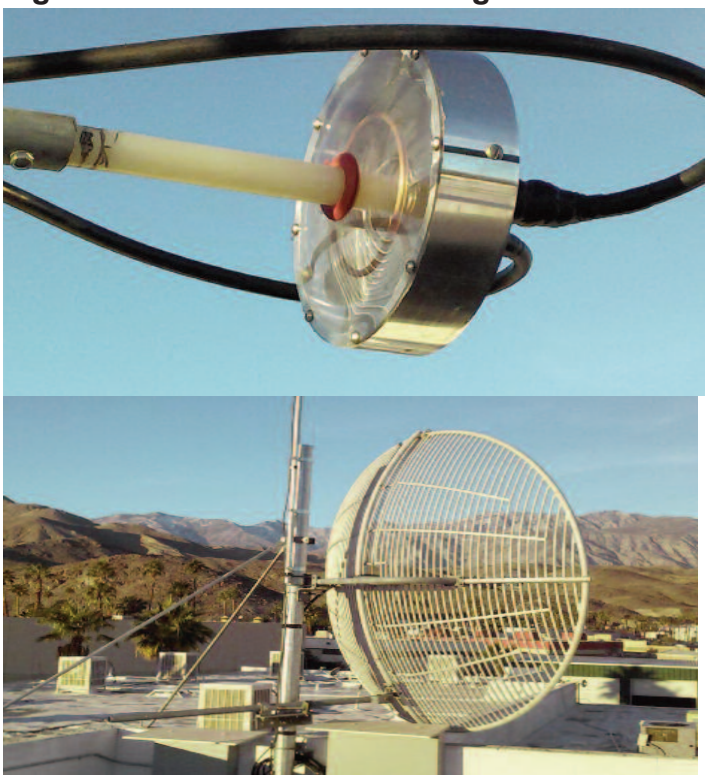


Fig-5 Feed mounted on a 8 ft. grid dish

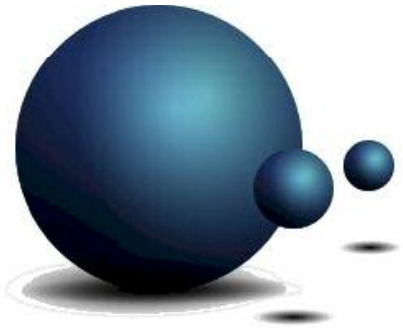


Performance

In the photo above Earl Holtman KJ6DQR replaced a dipole feed for 1.2 GHz RX with the new feed and he obtained a 5 dB improvement and using the same dish for 2.4 GHz TX allowed removing a 2nd smaller dish from the rooftop. The combination of the feed and larger dish gave a substantial improvement in ERP.

This site is used as a boosting station to fill in coverage in Cathedral Canyon 1.5 miles distance for the W6ATN Snow Peak ATV repeater. Amateur Television Network has been replacing simple dipole dual band dish feeds with this new dish feed and consistently obtaining 4 to 5 db improvement at each. Isolation of 18 to 22 db between bands will require that a filter be used on the RX side to filter out the TX signal used on the other band of the feed from brute force overloading the receiver.

73,
Steve WA6EJO



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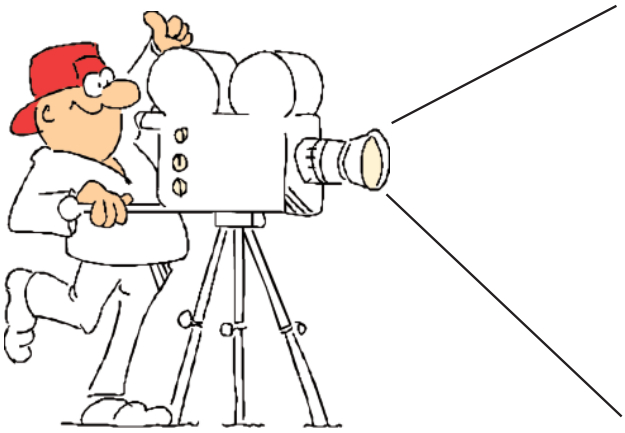

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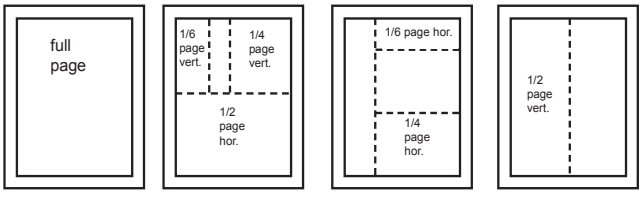

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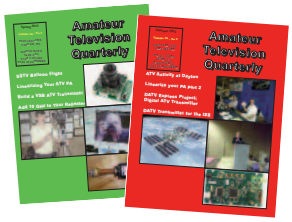

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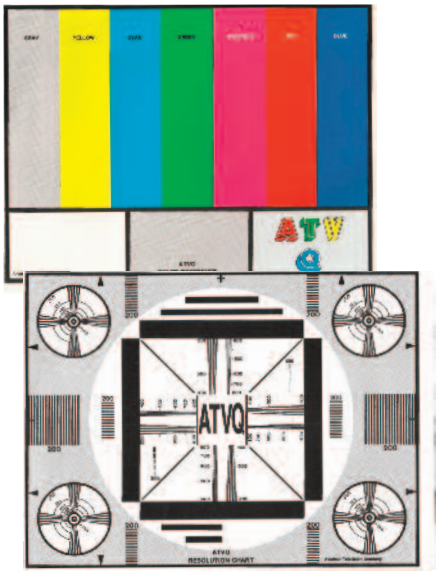

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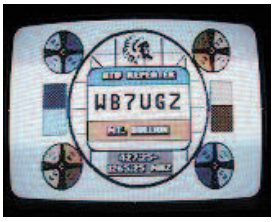

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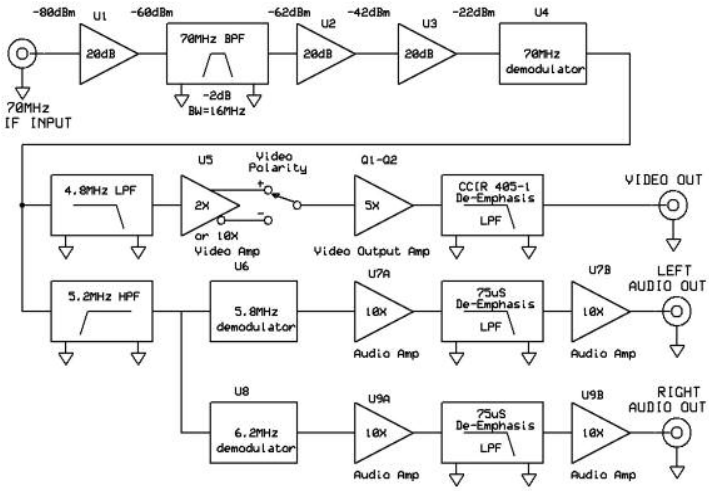

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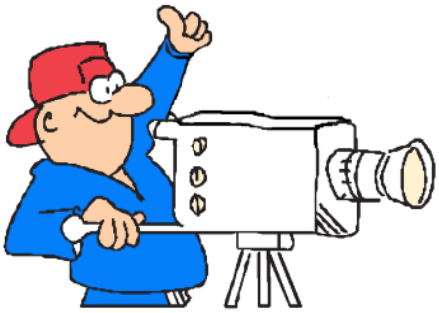

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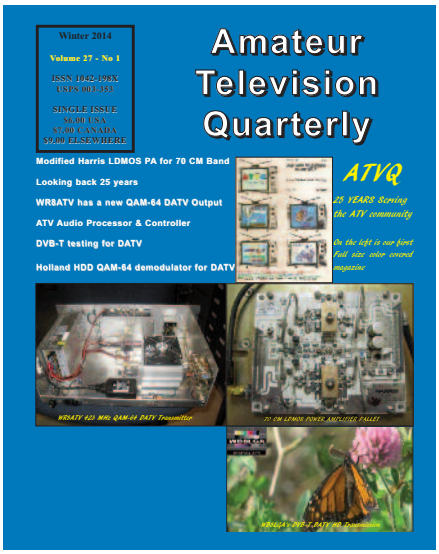

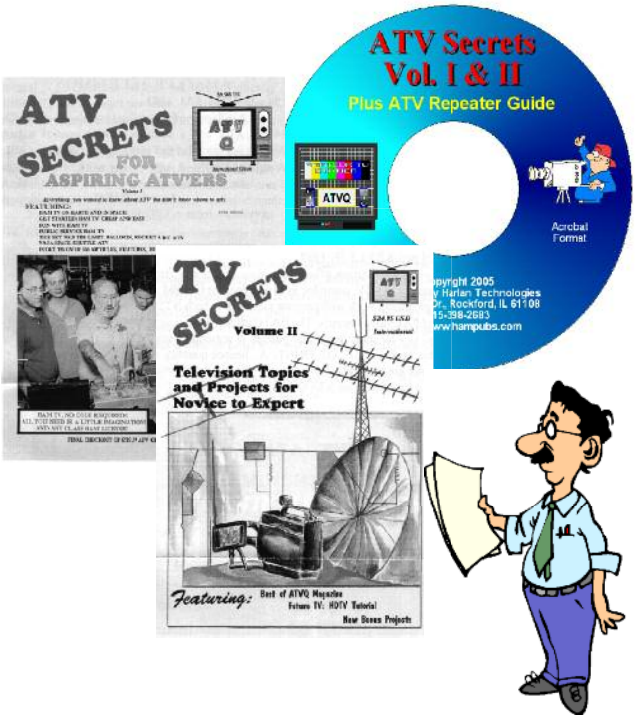

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