

# Boulder Amateur Television Club TV Repeater's REPEATER

February, 2023  
issue #122

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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## REMEMBER the Days of FM-TV ?

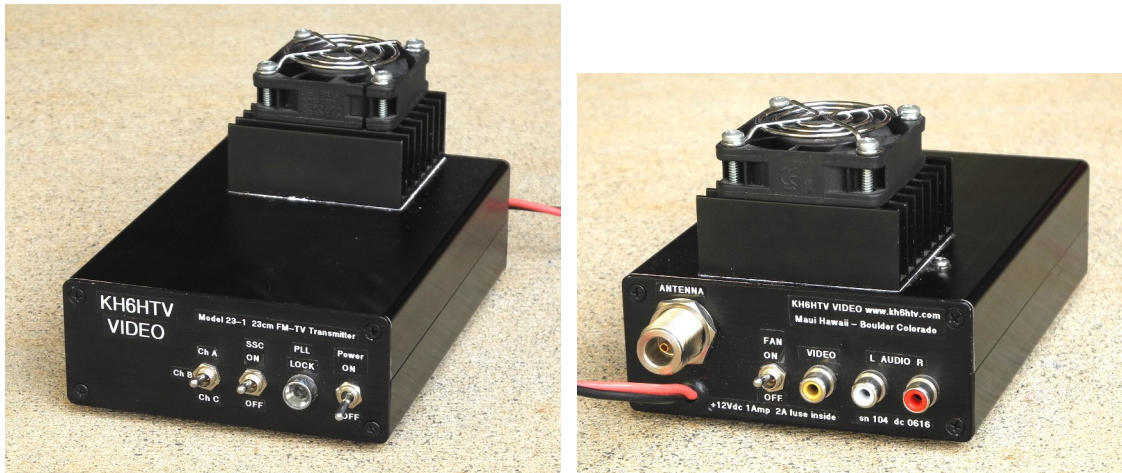
**Jim Andrews, KH6HTV**

Much of the emphasis of this ATV newsletter has been on current day usage of digital TV for our Amateur Television (ATV) readers. However, there are still ATV hams and repeater groups out there using the older analog systems of AM-TV, the commercial, band-width saving variation of Vestigial Sideband (VUSB-TV), or FM-TV. Because of the wide band of spectrum consumed with FM-TV, we never used it on the 30 MHz of our crowded 70 cm band. It was the dominant mode used to transmit video on our higher microwave bands. However, with the advent of Digital TV, the sources of supply for FM-TV equipment have almost completely disappeared. The sole exception presently is on the 5.8 GHz band where good quality, in-expensive, FM-TV gear for the drone market is available. We have written about this equipment in several issues of this newsletter. Sources of FM-TV gear for all of our other amateur bands, 900 MHz, 1.2 GHz, 2.4 GHz and 10 GHz have essentially disappeared.

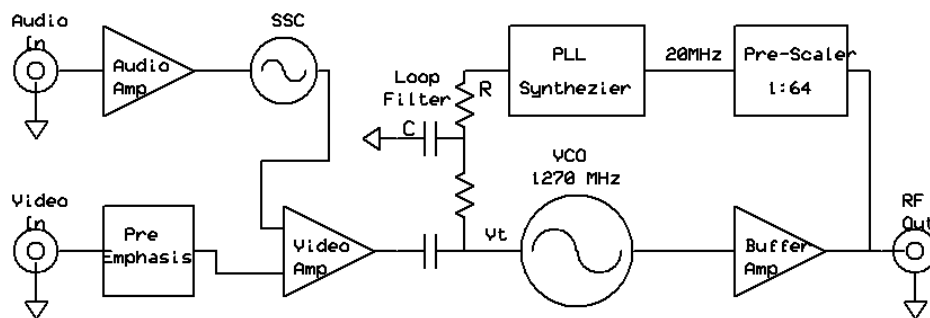
10-12 years ago, prior to my discovery of low cost Hi-Des DVB-T products, I was focused on VUSB-TV and FM-TV. Even then, it was very difficult to find any quality FM-TV gear for us ATVers. So I set out the goal to design my own and offer it to the ATV market. I designed for the 23 cm band a 3 Watt transmitter and also a companion receiver. The receiver consisted of two separate units. First a low noise, down-converter with an IF output of 70 MHz. The second unit was a 70 MHz IF amplifier and FM-TV demodulator. The IF amp/demodulator could then be used for any other microwave band with a suitable down-converter. With the exception of the 23 cm down-converter, the ATV market for the other items has been a bust. So, after the disastrous fire a year ago, I decided to drop all of these items from my catalog.

Now in December, along comes Dave, AH2AR. The Dayton, Ohio ATV repeater, W8BI, includes a 23 cm FM-TV receiver and transmitter. (see previous issue #120 ) Dave wanted to improve their

transmitter by replacing the old Comtech exciter in it. Dave talked me into building for him a new 23 cm FM-TV Modulator. As a result, I have decided to share with our readers what is involved in generating FM-TV. Hence this article.



**KH6HTV Model 23-1, 23 cm, 3 Watt, FM-TV Transmitter front & rear panel views**



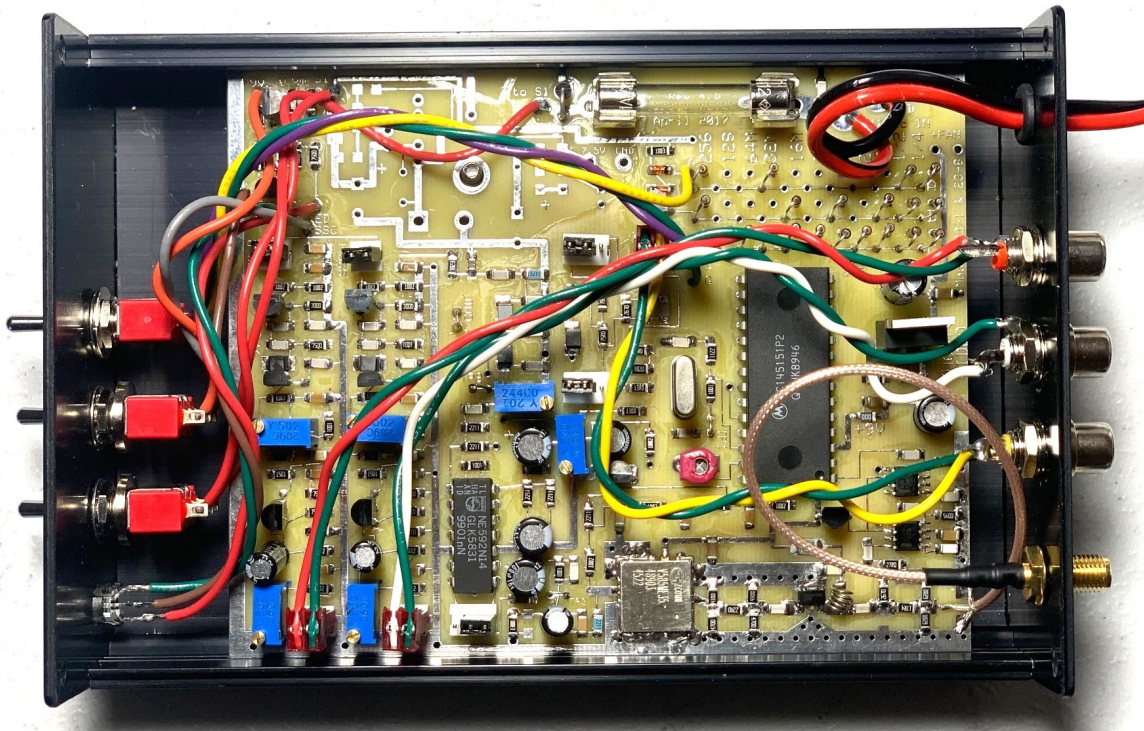
The above is the block diagram of the FM-TV modulator. The FM-TV transmitter is identical with the addition of the final rf power amplifier. The actual schematic diagrams are on the following pages. We start off with a frequency synthesizer using a Voltage Controlled Oscillator (VCO), U1. The PLL synthesizer IC, U6, operates at about 20 MHz input and includes an 8 MHz reference crystal oscillator. The 20 MHz signal is obtained by a pair of divide by 8, ECL, pre-scalers, U3 & U4, working from a sample of the VCO output. U2 is used as a buffer amplifier to isolate the VCO from load changes, etc. U6 is programmed via a diode matrix on a set of parallel programming pins. U6 generates the dc tuning voltage,  $V_t$ , for the VCO. A low pass network on the  $V_t$  line controls the PLL loop band-width.

We create FM by ac coupling into the  $V_t$  port of the VCO our desired video and audio. The input composite video signal is amplified by differential video amplifier, U7. The FM modulation polarity is selectable using jumper J5 to select either the + or - differential output from U7. The audio, either mono or stereo as desired, is FM modulated onto a Sound Sub-Carrier(s) (SSC). Typical SSC frequencies are between 5 to 7 MHz. Transistors Q6 & Q8 generate the SSC(s). Varactor diodes, D6 & D7 are used to FM modulate the SSC(s). Transistors Q5 & Q7 are audio amplifiers to drive the varactors. The two SSCs are added together and then low pass filtered before being added to the video signal in U7.

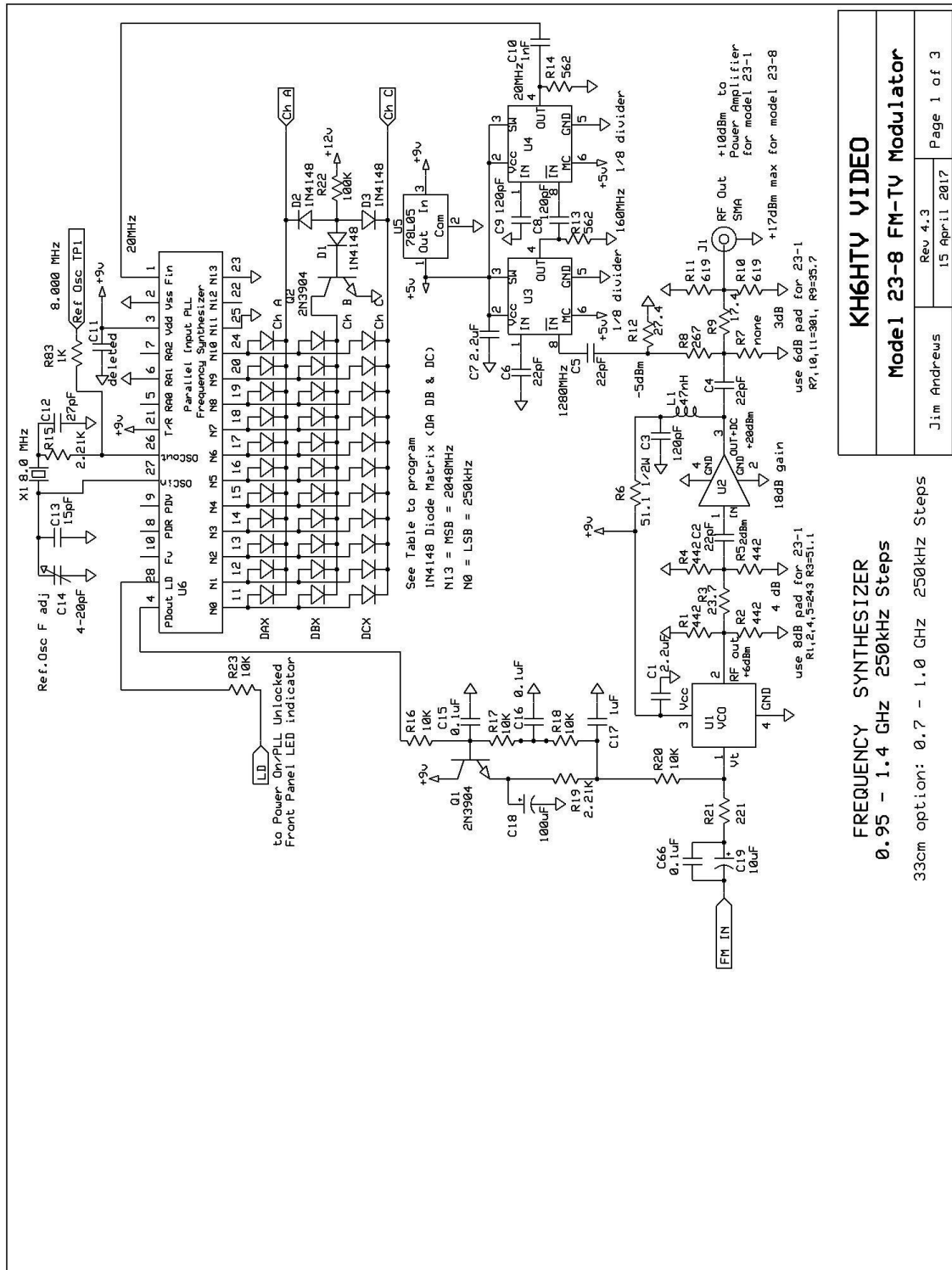
Often times, Pre-Emphasis is used with FM-TV modulation. When used it needs to adhere to the CCIR standard 405-1. This calls for a 13.4 dB boost in the high frequencies of the video signal with a 762 kHz cross-over. This is an optional feature in the transmitter and selected using the jumpers J3 & J4. When pre-emphasis is used, then the FM-TV receivers must also use the matching De-Emphasis. Pre-emphasis is also used on the FM audio SSC(s). Standard audio pre-emphasis is a simpler RC network with a 75  $\mu$ s time constant.

Building FM-TV gear has become more difficult as many of the specialized ICs required are no longer produced and are considered obsolete. They are no longer available from our normal electronics parts distributors, such as Mouser, Digi-Key, etc. One has to search the internet and contact lots of companies, mostly in Asia, stocking obsolete parts. They can also be quite costly as many of these firms require large minimum purchases or processing fees.

For this project, there were several difficult to find ICs. For the FM-TV transmitter, they include: the frequency synthesizer, U6, a Motorola MC145151 and the video amplifier, U7, a Phillips NE592, and the varactor diodes. Fortunately, the VCO is still in production. I was able to purchase it from Z-Comm. It is their model V585ME35. I might note that when I was originally designing the transmitter, I tried to use a VCO from Mini-Circuits, but I was quite disappointed in it's performance. For the 3 Watt transmitter, the modulator output drives a separate pc board with a Mitsubishi brick amplifier module, the M67796A. Fortunately, while being obsolete and out of production, it is still available from RF Parts.



**Interior View of the Model 23-8, 23cm, FM-TV Modulator**



Frequency Synthesizer for 23 cm, FM-TV Modulator

**KH6HTV VIDEO**

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**Model 23-8 FM-TV Modulator**

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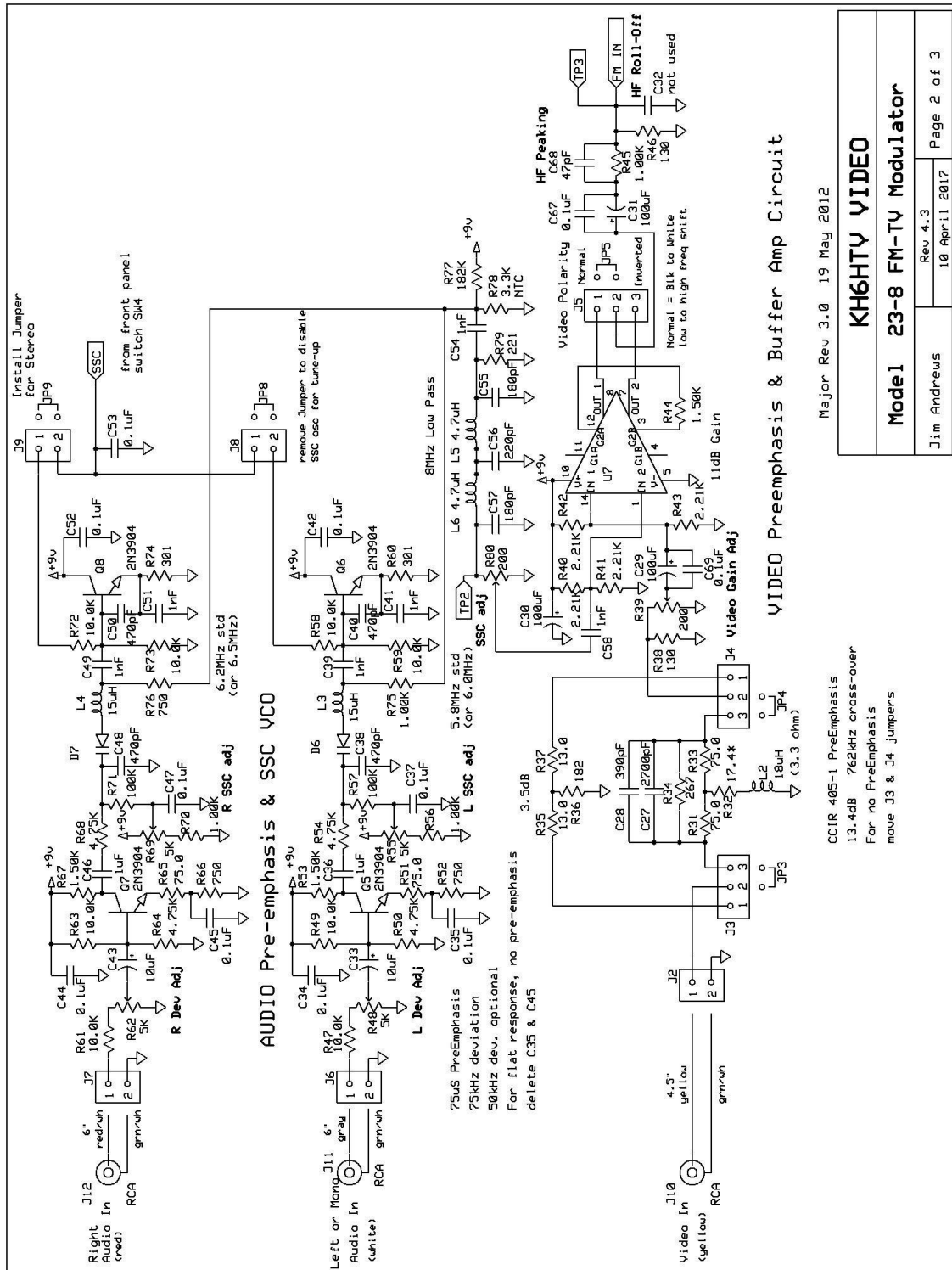
Jim Andrews      Rev 4.3      Page 1 of 3  
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**FREQUENCY SYNTHESIZER**  
 0.95 - 1.4 GHz 250kHz Steps

33cm option: 0.7 - 1.0 GHz 250kHz Steps

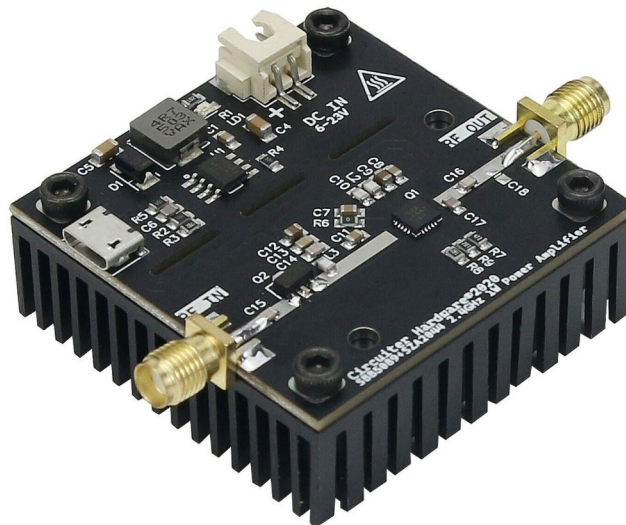




## 2.4 GHz Amplifier - Product Review

Jim, KH6HTV

The Chinese keep pumping out several versions of this heat sink mounted, open pc board, amplifier. In our Oct. issue #114, we reviewed several amplifiers for the 5 cm (5.8 GHz) band, including one similar to this one for the 13 cm (2.4 GHz) band. They all are from China and selling for about \$15. They all seem to be the same basic design, except for the final MMIC amplifier used.



This amplifier is advertised to work from 700 MHz to 2.4 GHz with Max. RF output of 1 Watt and gain of 34 dB. The MMICs require +5Vdc, but an on-board switcher allows it to be powered with +6 to +23Vdc. It is advertised to use two MMICs which are the SBB-5089 driver and SZA-2044 as the final amplifier. Dollar Value? The prices at Digi-Key & Mouser for the 5089 & 2044 MMICs alone are about \$6 ea.

**13 cm:** If you check the data sheets from Quovo/RFMD for these MMICs, the gain at 2.4 GHz of the 5089 is 20 dB and the 2044 is 25 dB. Thus the total expected gain could be of the order of 45 dB. For the unit I purchased, I measured it to be 38 dB. Less than the RFMD estimate, but more than the Chinese spec. The RFMD spec. for the -1dB gain compression rf output power was +28.5 dBm. On my unit, I measured +26.4 dBm, about 2 dB lower. The Chinese spec. for output power was 1 Watt (+30 dBm). I measured the max. saturated output power to be +28.5 dBm, 0.7 Watts. At +12Vdc input, the amp draws 280 mA at low rf output and 320 mA at saturated rf output.

**23, 33 & 70 cm:** Because this amplifier was also advertised to work down to 700 MHz, I also measured it's performance on lower ham bands. At 1270 MHz, I found the gain to be higher at 43 dB, with P(-1dB) of +25 dBm and P(sat) of +27 dBm. At 915 MHz, I found the gain to still be 43 dB with P(-1dB) of +24.5 dBm and P(sat) of +26.5 dBm. At 435 MHz, the gain had dropped to 38 dB with P(-1dB) of +23dBm and P(sat) of 25 dBm.

**Digital TV Amp:** I also tested this amplifier to see how well it would work with DVB-T. I used a Hi-Des HV-320E modulator as the test source. I looked at the output spectrum on my Rigol Spectrum Analyzer. I adjusted the rf drive from the modulator to set the shoulder break points to the normal setting used for DTV transmitters of -30 dB. I did this on all four bands 70 cm through 13 cm. I then measured the resultant average rf output power with my HP 432 thermistor power meter. The results were: +16 dBm (70 cm), +19 dBm (33 cm), +19 dBm (23 cm) and +20 dBm (13 cm). Thus, this amplifier will serve as a good "After-Burner" for use directly with the Hi-Des modulators. It will boost their outputs up to the 100 mW level (40 mW on 70 cm). Not bad for only a \$15 investment!

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## FEED-BACK:

**Media Player Feed-Back:** Thanks Jim for newsletter. I have been using the same “blue” media player that you reviewed at my home station. It has worked just fine now for couple years. I am getting ready to order another one for our ATV repeater.

Also enjoyed reading about the microwave ATV work being done by the Japanese hams. Rain scatter is quite popular here in Midwest during summer/spring. Quite a few stations work it. Now, if we can get them interested in ATV. Maybe with the new IC-705 will help.

73, Mel, K0PFX, St. Louis, MO

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Jim ---- Believe it or not, I have been using the Mini-1080 media player for the “endless loop” video ID for the last three years at the DARA ATV repeater. It has worked well, with no glitches. The nice thing about it, is that it will automatically restart the MPEG file if power is interrupted. We run a 2 minute long “motion” video ID. See this You-Tube video --- <https://youtu.be/SrsNFGGPbHs>  
This is the endless loop video ID I am running at the DARA repeater site. I changed out the older media player three years ago at the site for the mini-1080 player. This media player has worked well for the purpose of supplying the “motion” video ID we are using. My son Michael produced the video that is being used. (*Note that we installed a slightly different version of this video clip when we updated some of the wording that appears, regarding the on-site receivers*).

Cheers, Dave, AH2AR, Dayton, Ohio

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Thanks Jim --- Great newsletter ! I love that little video player. Great solution. That’s the kind of creativity members love to see.

Very 73, David, NA2AA, CEO - ARRL

## What is Happening to Ham Radio ? ( an Editorial )

A recent issue (Jan. 2023) of the NEVARC News has a quite long article ( 9 pages, small type) by Ian Jackson, VK3BUF. It is entitled "***The Changing Nature of Amateur Radio***". The newsletter is published by the North East Victoria (Australia) Amateur Radio Club ( [www.nevarc.org.au](http://www.nevarc.org.au) ) Ian makes some very good points which I feel should be passed on to our readers. I will try to summarize them here by just listing his main points. Some of his article was mainly relevant to Australia, so I have left them out of my list.

1. Loss of Magic in Communications:
2. The Total Penetration of Mobile Phone Technology
4. Amateur Radio is Increasingly Irrelevant as a Back-Up Emergency Service Provider
5. Availability of Cheap and Highly Sophisticated Radio Equipment
6. The Internet as a Communications Medium
7. The Rise of Broad-Band Electrical Interference
8. Limitations on Antenna Height and Size with Higher Density Housing
9. The Availability of Disposable "Hobby Time" for the Average Worker

10. The Passing of the Older Generation of Operators
11. The Lack of Native Curiosity in How Things Work
12. Potential Amateur Operators Are Being Steered Away from the Hobby
18. A Lack of Knowledge About "What Amateur Radio Is" by most of the Population

I am in total agreement with Ian about how all of the above is leading to our ham radio hobby being that of the older, graying generation and unlikely to survive as we know it going into the 21st century. I myself have encountered personally several of the issues that he discusses.

your editor, Jim, KH6HTV

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**WOBTV Details:** Inputs: 439.25 MHz, analog NTSC, VUSB-TV; 441MHz/6MHz BW, DVB-T & 1243 MHz/6MHz BW, DVB-T  
Outputs: Channel 57 --- 423 MHz/6MHz BW, DVB-T, or optional 421.25 MHz, analog VUSB-TV. Also, secondary transmitter, FM-TV output on 5.905 GHz (24/7).  
Operational details in AN-51a      Technical details in AN-53a.      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 about 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/>*

## 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.***



# ATN-AZ WINTER MEETING

Attend our ATN-AZ WINTER MEETING AND POTLUCK LUNCH at 10am on this coming **Saturday February 4th** at my home in East Mesa. The address is 8334 E Culver St, Mesa AZ 85207.

The Mesa Marathon will close many roads in the area so check the attached route map to plan a good way to get here. You ought to have no problem if you take the 202 to McKellips, drive east to Hawes and north to Culver. **DO NOT TRY TO TAKE MCDOWELL!**

There ought to be plenty of food and soft drinks provided for lunch at noon but feel free to bring a side dish or dessert to share.

Stay for the 1pm Mesh Workshop following our ATN-AZ meeting and lunch.

This is the planned agenda...

10:00am - Social Time and Story-Telling

10:30am - Welcome and Introductions

10:45am - Officer and Site Reports

11:00am - Election of Officers

11:15am - Discussion About Incorporation and 501(c)(3) Status

11:30am - Discussion About Constitution and Bylaws Changes

11:45am - Other Business

12:00pm - Potluck Lunch and Social Time

1:00pm - Mesh Workshop (and ATV Workshop)

5:00pm - Conclude Until Next Time

Please send an email to me at [wb9kmo@gmail.com](mailto:wb9kmo@gmail.com) if you plan to attend so I can plan ahead.

Hope to see you there,

Rod Fritz WB9KMO

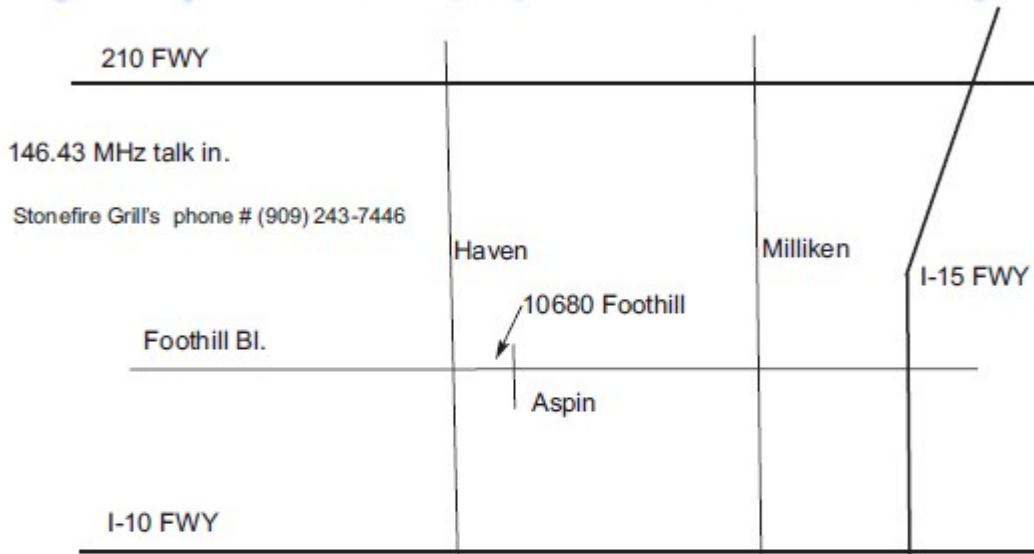
Amateur Television Network - Arizona Vice President

Arizona Mesh Organization Director



## ***ATN-CA WINTER MEETING 2023 ANNOUNCEMENT***

***Saturday, February 18 at Noon at Stonefire Grill, 10680 Foothill, Rancho Cucamonga, CA***



Please join us for lunch about 11:30 in Stonefire Grill's private dining and meeting inside patio room. We have the room reserved between 11:30 AM until 2 PM. ATN winter business meeting will start at 12 noon.

1. 12:00 Nathan AG6AV, our president will open the meeting
2. 12:05 The technical committee will update us with the latest news about our repeaters
3. 12:30 Mike WA6SVT will give the financial report
4. 12:40 Roland KC6JPG will discuss DMR radio & our new ATN talk group
4. 12:50 Discussion of promotion of ATN
5. 01:00 Discussion of converting Mt. Wilson's output to DVB-T
6. 01:20 Break and renewing your dues
7. 01:35 Nominations followed by election of officers followed by any new business
8. 2 PM wrap up the meeting