Boulder Amateur Television Club
TV Repeater's REPEATER

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BATVC web site: www.kh6htv.com

ATN web site: www.atn-tv.com

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

WA2YUN ISSUE !

Colin, WA2YUN, loves to surf the internet for interesting electronic toys. Many times he shows up on our weekly Boulder, Colorado ATV net and/or our weekly ham breakfast with a new find to share with his fellow hams. Recently, he has made some discoveries worth sharing with our readers. Here are three of them. He has kindly loaned them to your editor, KH6HTV, for evaluation.

13 Watt, 70cm AMPLIFIER

Colin recently discovered this amplifier on AliExpress from China for $41. Colin hoped it might prove useful for ATV service. So he bought one. What AliExpress claims are: 350-480 MHz, Pout = 13 Watts, DC power < 3 Amps @ 12Vdc.

Ali's photo shows the amplifier as an open pc board mounted on a heat sink with a cooling fan and temperature sensor.

So, we have tested this amplifier. What did we discover ? Well the biggest and most important discovery is this is definitely NOT a linear amplifier for ATV service. It does work on 70cm band. I tested it at 435 MHz. But, it is a class C amplifier. Only useful for FM/CW service. No RF output at all until the input rf power is greater than -8dBm. Then the rf output leaps up to about +35dBm (3 Watts). Very non-linear RF out vs. RF in power curve. At +10dBm input, the RF output is about 8 Watts. The no rf output idle current is 250 mA. At 8 W out, the amp pulls 2.5 Amps from +12Vdc. Boosting the dc input to +13.8Vdc gives about 10 Watts output pulling 3 Amps. Bottom Line: If you are looking for an amplifier for ATV, this one is a ***"DO NOT BUY !***"

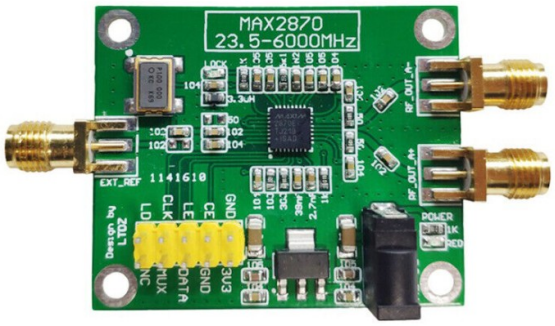
New Microwave Frequency Synthesizer

Our local Boulder internet sleuth, Colin, WA2YUN, has made another real valuable find. We have for some time now been aware of, and tried to use, the microwave frequency synthesizers from Analog Devices such as the ADF4350, ADF4351, ADF5350, etc. We have written about them in previous issues of this ATV newsletter. They have all give us grief when trying to use them as local oscillators, in particular for DATV. They have all had way too much phase noise.

The new synthesizer which Colin has discovered is the **MAX2870** made by Maxim Integrated Products (https://www.maximintegrated.com/en/products/comms/wireless-rf/MAX2870.html). It covers from 23.5 MHz up to 6 GHz. The fundamental VCO ranges from 3 to 6 GHz. It also includes binary dividers of 1/2/4/8/16/32/64 & 128. It

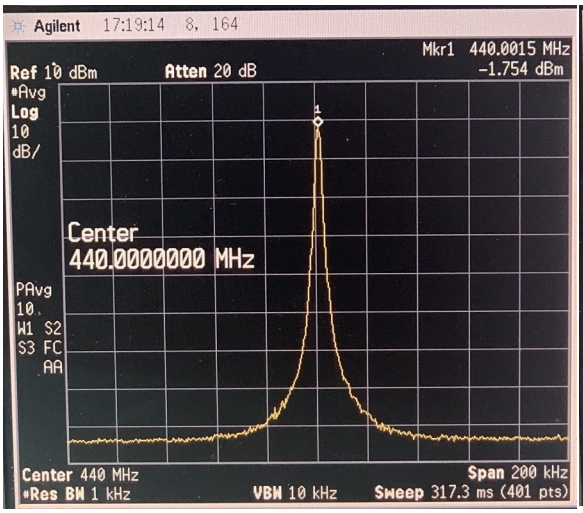
accepts reference frequencies from 10 to 200 MHz. The device also has dual programmable output with adjustable rf power levels from -4dBm to +5dBm. The MAX2870 is claimed to have much lower phase noise.

As with the Analog Devices synthesizers, the MAX2870 is now available on a pc board with a touch screen controller from China. Amazon Prime offers them for rapid delivery for $76. See photo above. You can also purchase it mounted on a pc board without the controller board from E-Bay, AliExpress, etc for $24-32 from China. See photo at right. You need to write your own control code with an Arduino, etc. to control this board.

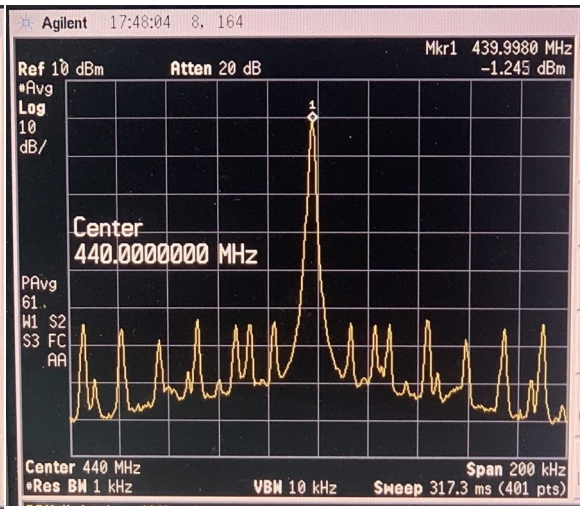


The rest of this article will give a demonstration of using a spectrum analyzer to measure the phase noise of the MAX2870 and compare it to some other oscillators.

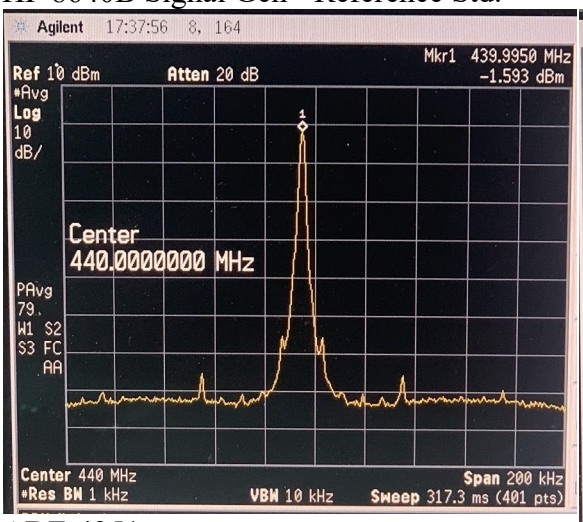
Phase Noise Measurements: Dan, K0DGS, has generously loaned your editor his Agilent model E4407B, 9kHz - 26GHz, Spectrum Analyzer to analyze these various oscillators. I already own several other frequency synthesizer boards which I had previously purchased, hoping to be able to use as microwave LOs for DVB-T transverters. So we will compare the new MAX-2870 to them. They all used Analog Devices synthesizer chips. ADF-4350, ADF-4351 and ADF-5350. The ADF-4350 tunes from 137 MHz to 4.4 GHz. The ADF-4351 tunes from 35 MHz to 4.4 GHz. The ADF-5355 tunes from 54 MHz to 6.8 GHz, plus it has a frequency doubler to extend on up from 6.8 to 13.6 GHz. I evaluated the phase noise at both UHF (440 MHz) and also microwaves of either 4.4 GHz or 5.2 GHz. As examples of "ideal" oscillators, I am including a Hewlett-Packard model 8640B (500 kHz - 512 MHz) for UHF. For microwaves, my "ideal" source is a brick oscillator made by California Microwave in the 1970s. My brick is on 5226.6 MHz. For looking at the phase noise, I used identical spectrum analyzer settings for all oscillators. I set the analyzer's resolution bandwidth to the minimum setting of 1 kHz. I set the span to 200 kHz. Every oscillator had an output of the order of 0dBm.



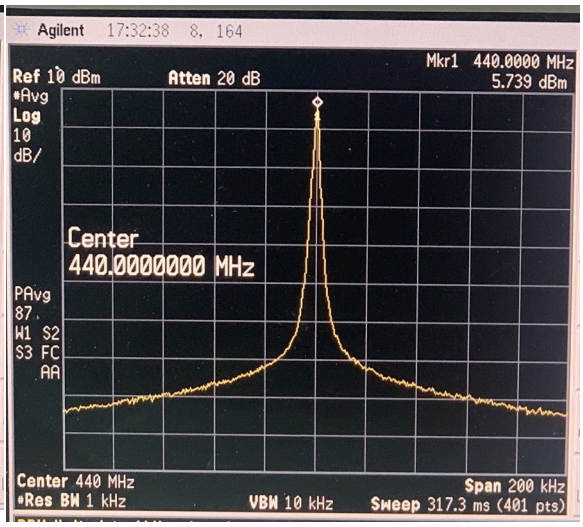
HP 8640B Signal Gen - Reference Std.



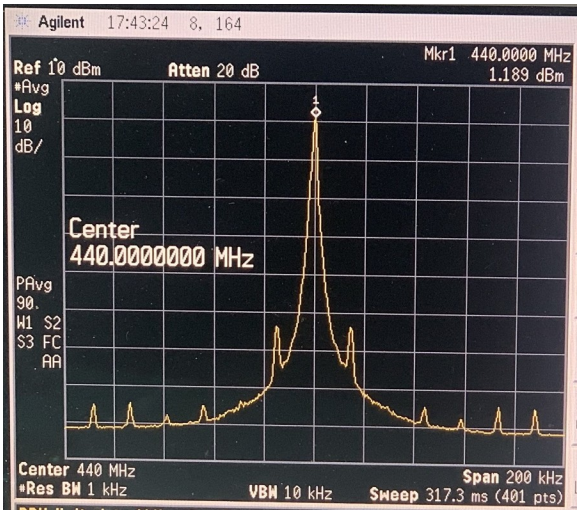
ADF-4350



ADF-4351

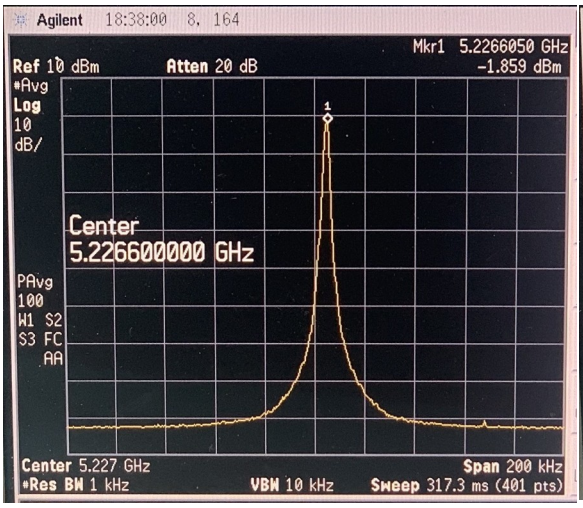


ADF-5355

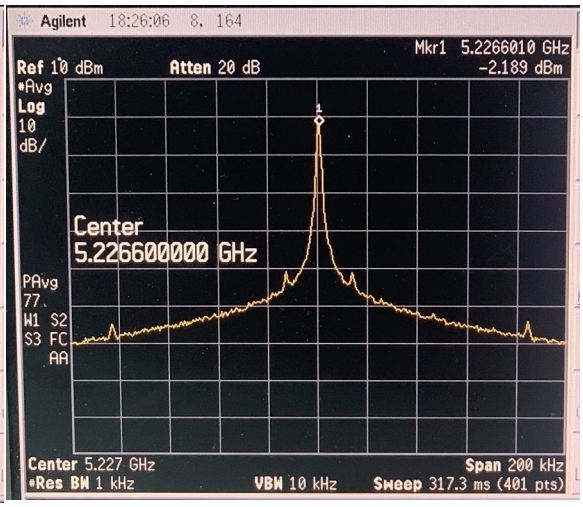


MAX-2870

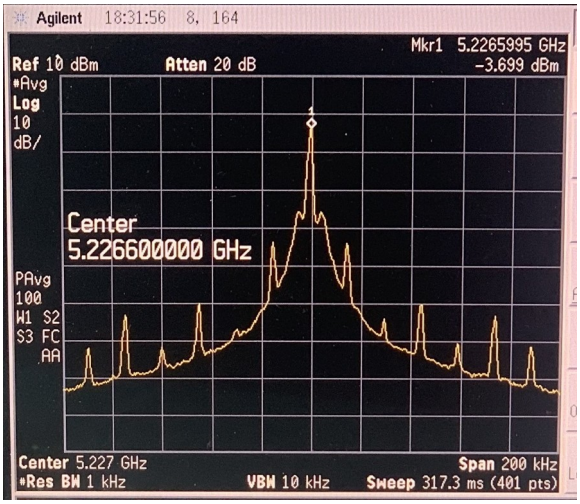
Phase Noise Measurements at UHF (440MHz) 200kHz span, 10dB/div & 20kHz/div, 1kHz BW. Reference, "perfect" oscillator is the HP signal generator.



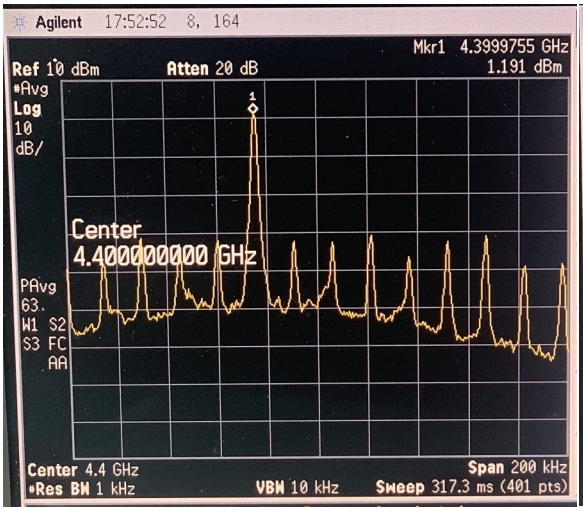
California Microwave "Brick" Ref. Std.



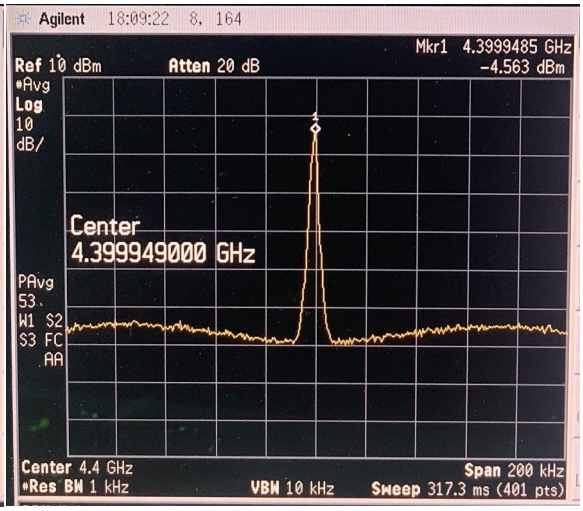
ADF-5355



MAX-2870



ADF-4350



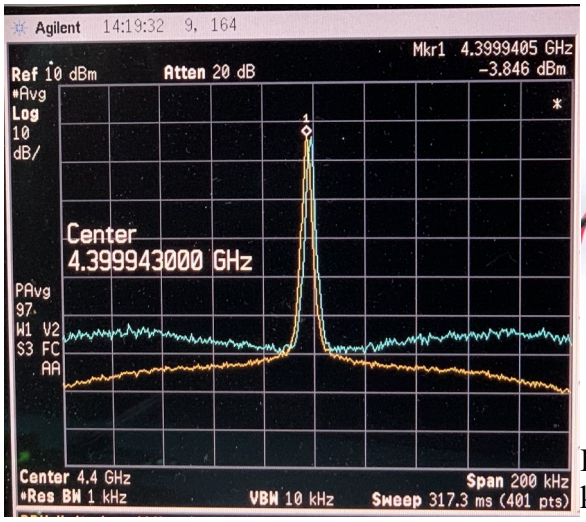
ADF-4351

Phase Noise measurements at microwave frequencies. 200kHz span, 10dB/div & 20kHz/div, 1kHz BW. Reference, "perfect" oscillator is the California Microwave brick at 5226.6 MHz. ADF-5350 & MAX-2879 set to same frequency. ADF-4350 & 4351 set to max. 4.4GHz

So what conclusions can we draw from these spectrum analyzer observations ?

1. The phase noise performance of all of them is much better at lower UHF frequencies, than at microwave frequencies up near the top end of their range.

2. The MAX-2870 did have very low phase noise at UHF, with the exception of a few low level spurs. But it's phase noise at 5.2 GHz showed quite a few spurs on much higher, broad-band noise skirts.



ADF-4351 before (cyan) & after (yellow) adding 2,200µFcap. to +3.3Vdc line

Low cost ($30-35) ADF-4351 with keyboard data entry. Amazon Prime.

In earlier issues of this newsletter, we had discussed these various Analog Devices frequency synthesizers. We had mentioned efforts to improve the phase noise. In some cases, adding much larger filter capacitors on the +5V and +3.3V voltage regulators gave some improvement. I have tried the same on this present batch of current production, 2022 generators. I saw no improvement on any of them with the sole exception of this $35, ADF-4351 generator. I powered it with a 7805, +5V linear regulator with 100uF cap. on the +5V line. Adding more capacitance to the +5V line gave no improvement. There is a +3.3V voltage regulator on the ADF-4351 pc board. No big caps. are obvious on the board. I tried adding successively bigger caps of 100µF, 1000µF and 2200µF to the 3.3V line. Each one gave a noticeable improvement in reducing the phase noise. See above photo.

A SENSITIVE PHASE NOISE TEST: The real "acid test" for an oscillator is how well it will perform as a local oscillator in a radio receiver. For a receiver to hear very low level signals, it requires a "quiet" LO. I have found this to be particularly important when trying to build a receiver for DVB-T, digital ham TV.

I have setup a down-converter for 5cm consisting of only an LO, 5.8 GHz band-pass filter and a mixer. I used a Watkins-Johnson M-14 mixer (RF/LO 4-8 GHz, IF DC-2 GHz). It required +7dBm of LO drive. I used a KH6HTV Video model UWBA-103

amplifier to boost the LO power plus SMA attenuators to then set the LO drive to +7dBm for each test. The IF output was on either the 70cm or 23cm band and went to a DVB-T receiver. For 70cm, I used a Hi-Des HV-110 receiver. For 23cm, I used a Hi-Des HV-120 receiver. The DVB-T signal source was on 5.678 GHz with 6 MHz BW, QPSK, 8K FFT, 5/6 FEC, 1/16 guard, 1080P and 5.5 Mbps. I used calibrated step attenuators to set the weak signal level into the LO/mixer down-converter under test. The digital threshold was measured at the lowest signal level with perfect P5 video and Q5 audio. This occurred typically at a S/N of 8 or 9dB. Dropping the signal level one more dB gave either freeze frames or total loss of signal. The following table lists the results obtained with the various LO oscillators.

Oscillator	Digital Threshold	LO Frequency	IF Frequency
California Microwave	-90 dBm	5226.6 MHz	451.4 MHz
MAX-2870	-81 dBm	5226.6 MHz	451.4 MHz
ADF-4350	-74 dBm	4399.0 MHz	1270 MHz
ADF-5355	-69 dBm	5226.6 MHz	451.4 MHz
ADF-4351*	-66 dBm	4399.0 MHz	1270 MHz

(*) the 4351 used had the modification of the added 2,200µF cap on the +3.3V supply.

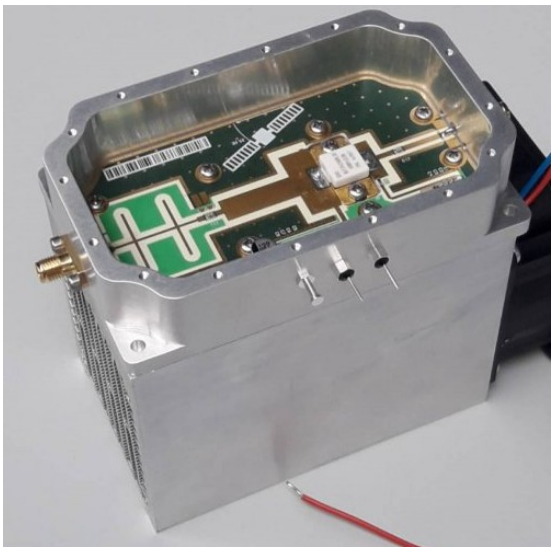
Conclusion: Yes, the new MAX-2870 is the winner with the best receiver sensitivity. But it is still 9 dB worse than our old work horse, the 1970s era California Microwave brick LO. But we are getting closer to finding a good replacement for the old bricks.

10 MHz Reference Standard

Our local Boulder internet sleuth, Colin, WA2YUN, has found another interesting "goodie". This time it is a 10 MHz ovenized, crystal reference standard. Available on Amazon for $24. It includes a switching voltage regulator to accept wide range of DC input voltages. It pulls 450mA (cold) and 220mA (warm) at +12Vdc. It provides two SMA outputs. One is TTL with a distorted square wave of about 3 Vptp (open circuit) or 1.5 Vptp (into 50 Ω). There is also an on board low-pass filter to provide a sine wave output of +7dBm (10 MHz). Also seen on the board is a pot, R5, to make minor "tweaks" to calibrate the frequency.

Your editor doesn't have the means of measuring the frequency with the required accuracy. We will take Colin's word that it is quite accurate.

ANOTHER AMPLIFIER SUPPLIER



Don, N0YE, has called our attention to still another supplier of amplifiers (and a whole lot more other goodies) for our UHF and microwave bands. Check out Makis Katsouris, SV1AFN's web site:

www.sv1afn.com

It is impressive. As just one example, here is one of his amplifiers for the 13cm band.

30 Watts of RF power at -1dB gain compression, 18dB gain, 2.4-2.5GHz, ultra-linear Class AB, works on +24 to +32Vdc, price 289 €. He says he also has models with output powers of 1, 2, 12, 100 & 300 Watts. Don cautions however that some chatter on microwave reflectors about this amplifier has warned that folks have had problems with them burning out if the VSWR > 2:1.

CURIOUS EXPERIMENTS

While trying to build a 23cm Down-Converter for DVB-T, I got some curious results. My objective was to down convert the 23cm band to the 70cm band using one of the low cost frequency synthesizer boards discussed elsewhere in this newsletter. I wanted to convert 1243 MHz down to 423 MHz, thus the LO frequency was to be 820 MHz.

I planned to use the Mini-Circuits MDE-25H mixer. The key specs. for the mixer are: double-balanced mixer, +13dBm LO power (range +10 to +16dBm), LO & RF 5 MHz to 2.5GHz, IF 5 MHz to 1.5 GHz, conversion loss = 6.9dB typical, LO-RF isolation = 34dB typical, LO-IF isolation = 32dB typical

A key criteria for success was good sensitivity. So I set up my sensitivity test set using a Hi-Des HV-320E modulator on one bench in the ham shack. I used a DVD player to provide "live" audio/video for the test. I set the HV-320 to 1243 MHz, 6 MHz BW with QPSK. I put a 20dB SMA attenuator on the output of the HV-320. I then used an 18 ft. coaxial cable to run the signal across the room to another test bench. This was to provide spatial rf isolation between the signal source and the receiver under test. On the second bench was a 30dB SMA attenuator and a rotary step attenuator (0-69dB, 1 & 10dB steps) to provide a controlled, low level test signal. Also on the bench was a video monitor for the receiver under test.

So what could go wrong ?

1st Issue: Well the first curious result was the Mini-Circuits mixer. In the initial tests, I got very disappointing results. Then on another day, trying it all again, I inadvertently

hooked up the mixer backwards. I did connect the LO to the LO port. But I, by mistake connected the 1243 MHz RF test signal to the IF port, not the RF port. And I connected the 423 MHz IF cable for the receiver to the RF port. So what happened ?
Well darned if I didn't end up measuring a far better sensitivity with the wrong connections. 10 dB Better ! Why ? Dammed if I know ! I even tried it again with a second mixer and still got the same results.

Second Issue: This one has me upset. It turns out to be a comparison of Hi-Des to other receivers. I have several DVB-T receivers. A couple of Hi-Des receivers, an HV-110 and an HV-120-1.2G. I also have a couple of consumer grade (6,7 or 8 MHz BW only) receivers. A Combo DVB-T & DVB-S and a Pansat HD-99. The HV-120 worked fine measuring directly the 1243 MHz test signal going into it's 1.2/2.4 Ant2 port. The combo receiver and the Pansat receiver worked fine with the 423 MHz IF signal from the mixer. What did NOT work were either of the Hi-Des receivers for the 423 MHz IF signal. Using their on-screen-display of signal statistics, they showed they were receiving the correct signal with a very strong signal strength and great signal/noise ratio. But both receivers refused to decode and display video nor give audio output. I find this to be totally unacceptable.

I should note that both Hi-Des receivers are new, 2022 production. I had purchased them recently to replace ones I had lost when my home burned down in the Dec. 2021 fire storm. I do recall that I did not have this problem with the older Hi-Des receivers which I lost in the fire.

Jim Andrews, KH6HTV, Boulder, Colorado

Ham TV to Return to the ISS

During the AMSAT-UK Space Colloquium on October 8th, AMSAT announced the Ham TV unit for the ISS is repaired and on the way to Houston for testing. The flight date dependent on testing. Ham TV has been inoperative since April 2018. It had been active since April 2014, having been launched to the ISS in 2013. It was returned to earth for diagnosis and repair in late 2018. The ARISS Ham TV transmitter is capable of down-linking DVB-S digital video of ARISS contacts and other activities on board the ISS to amateur ground stations in the 2.3 GHz amateur band. More information can be found at: https://www.ariss.org/hamtv-on-the-iss.html

FEEDBACK: Controversy over FCC Regulations for NB-DATV on 10 meters

Grant, VE3XTV's, initial posting on DigitalATV@groups.io about live video on HF really kicked off a flurry of comments, etc. on that internet group site. Most of it now is stirring up a lively debate among amateur "lawyers" on the interpretation of the FCC rules. Here are only a couple of letters with a sample of what is going on.

From M5AKA: The FCC Part 97 regulations cover these types of emissions that are used on HF: CW Telegraphy, RTTY, Phone, Image and Data. A TV emission using whichever modulation technique you choose is an Image emission. Only the regulations applicable to Image emissions apply. In the context of Part 97 an Image emission in Not a Data emission different regulations apply to each. A 300 kHz bandwidth DATV emission centered on 29.150 MHz is permitted by Part 97.

Part 97 defines Image emissions as:
"(3) Image. Facsimile and television emissions having designators with A, C, D, F, G, H, J or R as the first symbol; 1, 2 or 3 as the second symbol; C or F as the third symbol; and emissions having B as the first symbol; 7, 8 or 9 as the second symbol; W as the third symbol."

The 100 kHz restriction you mentioned only applies to Data emissions not Image. There are no FCC bandwidth restrictions specified for Image transmissions. Way back in 1976 the FCC's tried with Docket 20777 to introduce bandwidth restriction but this was strongly opposed by ARRL which succeeded in defeating the proposal.

Consider this: Part 97 doesn't allow Data emissions to take place in the Phone segments, so how is it Digital Voice (DV) transmissions are permitted in Phone segments e.g. 14.236 MHz? The answer is that DV transmissions are classed as Phone emissions despite their using Digital modulation. The same logic applies with Digitally modulated TV emissions they are still classed as Image emissions not Data.

73 Trevor M5AKA, Chelmsford, England

From K0ZAK: I dug into the part 97 regs for the US a little while ago. Here is what I found concerning allowed modes on 10 Meters in the US. under 97.305 Authorized emission types.

28.3-28.5 MHz - Phone, image
28.5-29.0 MHz - Phone, image
29.0-29.7 MHz - Phone, image
with the following note
2) No non-phone emission shall exceed the bandwidth of a communications quality phone emission of the same modulation type. The total bandwidth of an independent sideband emission (having B as the first symbol), or a multiplexed image and phone emission, shall not exceed that of a communications quality A3E emission.

So, unless someone can come up with some official documentation proving that 100kHz image bandwidths are allowed on 10 Meters here in the United states, I don't think we will be doing any 2 way video contacts on HF.

However, I will have an up-converter feeding my Knucker receiver shortly and looking for DVB-T signals from the UK shortly if anyone wants to try it! I don't have anything for DVB-S reception.

John Kozak : K0ZAK, Reisterstown, Maryland

EDITOR's Comments --- HF DATV: It is interesting what the communications authorities over in IARU region 1 have recently allowed regarding narrow-band, digital ATV. It would be nice to see something similar here in region 1 and the USA and Canada. But for this to happen, we would need to first convince, and then get the backing and support from the ARRL. Then, they as amateur radio's (& TV) spokesmen would present the case to the FCC and IC. But don't expect the FCC or the IC to act in a prompt, timely fashion.

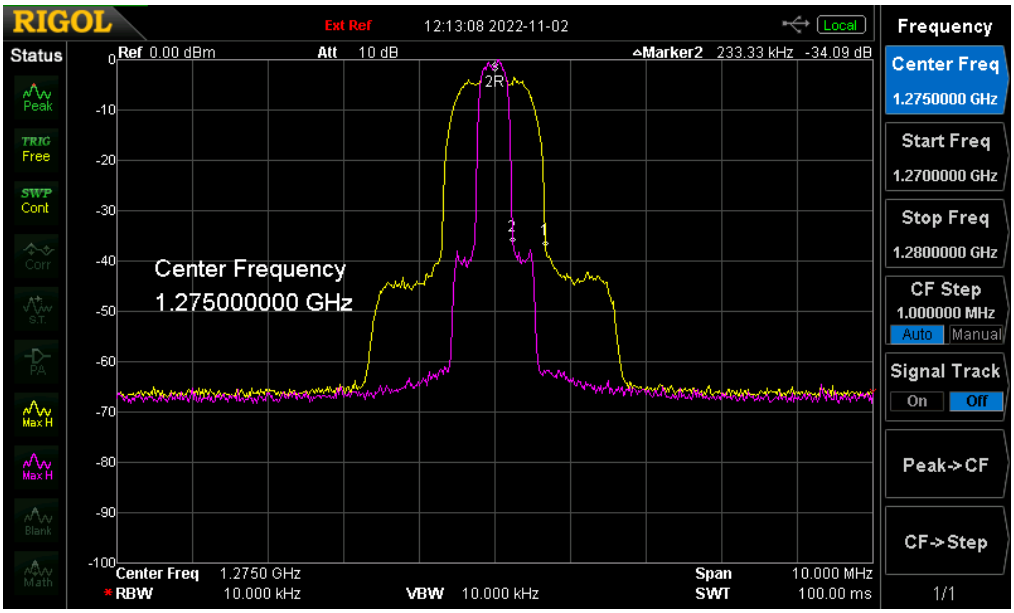
As I see it, the only bands where we could expect to get any support would be on 10 meters and 6 meters. 10 meters has 1.7 MHz total, 28 to 29.7 MHz. Almost as much as all the other lower bands combined (2 MHz). We might get away with asking for 100 kHz, 200 kHz at most, of that 1.7 MHz total. It would need to be below 29.3 MHz. Above there is the satellite band (29.3 to 29.51) and the FM voice band (29.52 to 29.7 MHz). The 500 kHz region of 28.8 to 29.3 is most promising.

6 meters is even more promising with it's really big 4 MHz (50 to 54 MHz). Most of it is virgin, unused, waste land. Granted the ARRL has all of it allocated in their band plan, but have you ever heard anything happening in most of it ? The current band plan does in fact have an interesting tidbit. 200 kHz at 50.6 to 50.8 MHz is set aside for "Non-voice Communications". Guess video would fall into that category. It would be nice, if the ARRL would revise their 6 meter band plan to provide 2 MHz, or at least 1 MHz for video.

The ATV hams in Europe are also experimenting with NB-DATV in their 2 meter band. Forget it here in the US. Our 2 meter band is our most used ham band and fully occupied. I don't see any hope for us doing DATV in it.

In the meantime, interested USA and Canadian ATV hams could help provide technical proof of concept to the ARRL and the FCC and IC by receiving and documenting NB-DATV transmissions on 10 meters from the U.K. and elsewhere in IARU region 1. With the solar cycle picking up now, we are suddenly again seeing signals appearing on 10 meters. Openings to Europe will now be available for these experiments.

73 de Jim, KH6HTV, Boulder, Colorado



FEEDBACK: ? About DVB-S Symbol Rate vs. Band-Width

Hi Jim --- To answer your question about DVB-S2 occupied bandwidth, please see the attached spectrum analyzer plot. Both plots were taken from the output of my transmitter via a -30dB coupler at 1275MHz. The span is 1MHz/div and the markers on the HF side are approximately -35dBc (peak). The yellow trace is at 1000kS/s and the -35dBc point is +666kHz. The purple trace is at 333kS/s and is -35dBc at around +233kHz. It's not quite symmetrical but that's not unusual to see. 333kS/s uses 467kHz and 1MS/s 1.37MHz, **so 1.35 to 1.4 times the symbol rate gives a good approximation**. The shoulders are 39dB down or better. The Tx is a Pluto SDR followed by a Mitsubishi RA18H1213G power module giving about 4W rms output. The Pluto is fed with F1EJP's DATV-Easy 2.08 software encoder using H.265. Content is supplied by OBS .

73, Clive, G3GJA, Hull, England

FEEDBACK: Cheap Chinese 5.8GHz Amplifiers

Hi Jim ---- Hi hi hi hi hi 8-) :'(my condolences ! You're not the first to notice that this PA doesn't work. I also bought 6 pieces for 2.4GHz and 4 pieces for 5.6GHz. I haven't tried a 2.4GHz yet, all the others work from very poorly to not at all. The only relatively good thing is switch down power supply.... the rest ended up in the trash. These PA's are built with fake China parts or chips discarded by manufacturers as not good enough. Unfortunately, we customers are still blinded by the price and buy it.

If anyone needs good all mode amplifiers for 2.4GHz, with throughput gain above 50dB, I have a few for sale. with 0,008mW input PA give 2,0 Watt output DVB-T
or with -14dBm input PA give 16 Watt output CW SSB ATV

Vy 73 de OE7DBH, Darko, Pians Austria

W0BTV 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/***

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. 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/kh6htvtvr* or *n0ye or ab0my*. 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).

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Model 23-LNA. 0.7dB noise figure, 14 dB gain, +21dBm (-1dB compression), $90

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