Boulder Amateur Television Club
TV Repeater's REPEATER

October, 2019

2ed Edition

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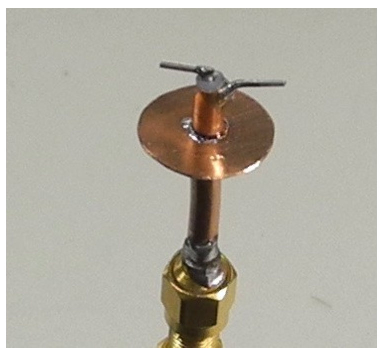
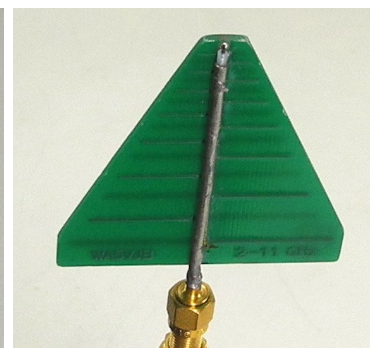
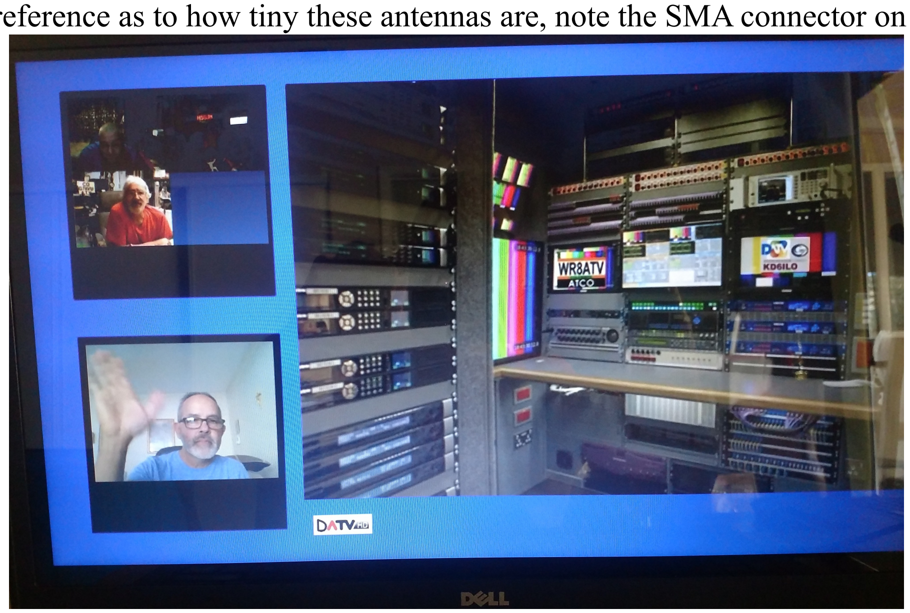
Future Newsletters: If you have contributions for future newsletters, please send them to me. Jim Andrews, KH6HTV, email = kh6htv@arrl.net

3 cm - 10 GHz ANTENNAS

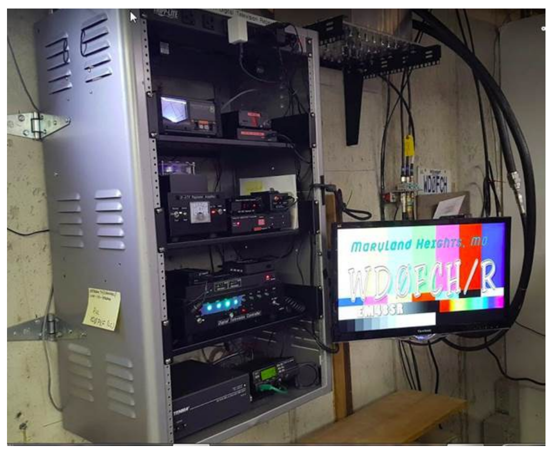
1/4 λ vertical dipole with reflector 2-11 GHz log-periodic

For reference as to how tiny these antennas are, note the SMA connector on each



What the inside of a very well equipped ATV ham shack should look like !
tnx de Mario, KD6ILO

ATV NEWS from St. Louis



Mel, K0PFX, reports - Here, I now have the repeater on one antenna 10 foot+ higher (a Hustler/Spirit 9db) with DCI, 8 pole, BP filters. I am looking to buy or build a higher power amplifier. Our club SLATS (St Louis Amateur Television Society) received a new call, W0ATN and will use it for repeater when I get it in the state coordinator's data base.

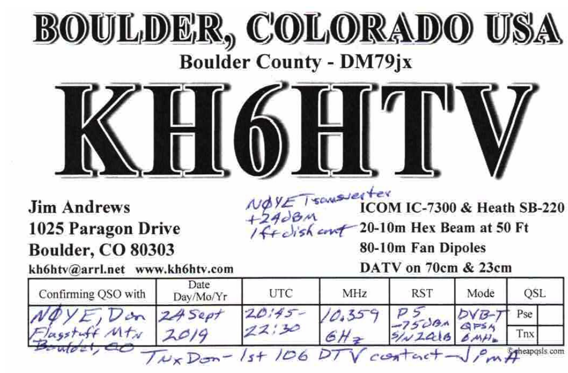
I had a good Turnout for my DATV presentation at the ARRL/TAPR Digital Communications Conference (DCC) held in Detroit last week. The 40th Anniversary of this conference will be in Tucson Oct 2022.My talk at DCC was more of an introductory talk with info on building interface and repeater. Much of it was from previous talks but I find the "locals" where ever I go are looking for this kind of info vs. "how it works tech details." I had three handouts one was a one sheet DVB-T tutorial another on the many acronyms and references. Phil Karn KA9Q attended and supported me with a few comments. By the way, most of the players from ARDC were there. ARDC received **52 million dollars !** for some 44.x IP addresses "hams had" and Amazon was glad to get them. It was a good time to sell as they will be near worthless when IP6 is finally implemented. As a result, we'll see those dollars put to good use for ham radio. They sponsored a number of students to attend the DCC and most of them were at my talk. SO good to see something besides gray beards in the audience.

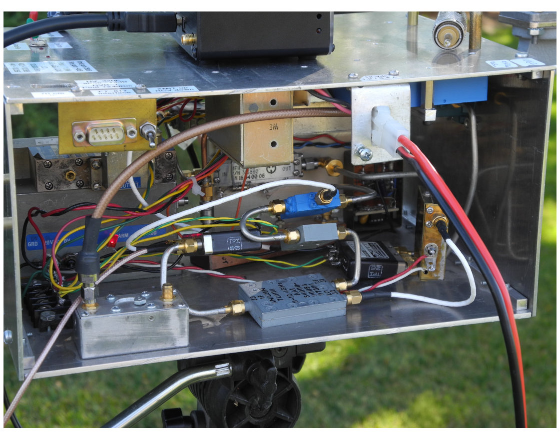
10 GHz DVB-T Progress in Boulder

KH6HTV as received by N0YE

N0YE as received by KH6HTV

On Tuesday, 24th of Sept, Don, N0YE, and Jim, KH6HTV, were successful in making a 2 way DVB-T QSO on the 3cm, 10 GHz band. Jim was at his QTH south-east of Boulder while Don was at Panorama Point on Flagstaff mountain. The distance covered was 6.2 miles (10 km). Jim was using an N0YE, 3cm Transverter running +24dBm into a 1 ft. dish antenna. Don was running +18 dBm, also into a 1 ft. dish. Perfect, P5, digital pictures and CD quality audio were received. Jim's HV-110 receiver showed Don's signal to be -75dBm at the antenna with a 20dB S/N.

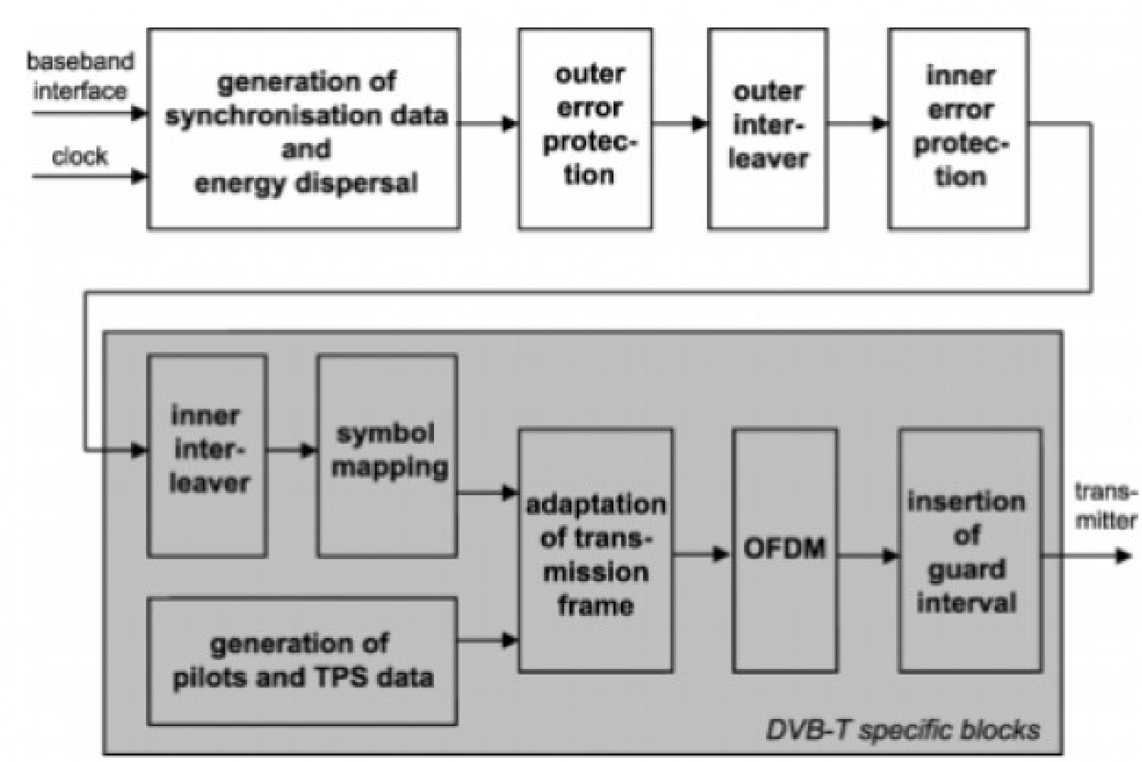




Interior View of N0YE 10GHz Rig

N0YE on Flagstaff Mtn.

DVB-T (**D**igital **V**ideo **B**roadcasting-**T**errestrial) is the DVB European-based standard for the broadcast transmission of digital terrestrial television. DVB-T is more complex and robust than DVB-S because it must cope with a different noise and bandwidth environment and multi-path. The system has several dimensions of receiver 'agility', where the receiver is required to adapt its decoding according to signaling. The key element is the use of OFDM. There are two modes: 2K carriers plus QAM, 8K carriers plus QAM. The 8K mode can allow more multi-path protection, but the 2K mode can offer Doppler advantages where the receiver is moving.



The DVB-T system transmits audio, video, and data through MPEG-2 streaming, using COFDM modulation. The DVB-T Standard is published as EN 300 744, "Framing structure, channel coding and modulation for digital terrestrial television". This is available from the ETSI website, as is ETSI TS 101 154, "Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream", which gives details of the DVB use of source coding methods for MPEG-2 and, more recently, H.264/MPEG-4 AVC as well as audio encoding systems. Many countries that have adopted DVB-T have published standards for their implementation. DVB-T has been further developed into newer standards such as DVB-H (Handheld), now in operation, and DVB-T2 now fully implemented.. The MPEG-2 video formats include:

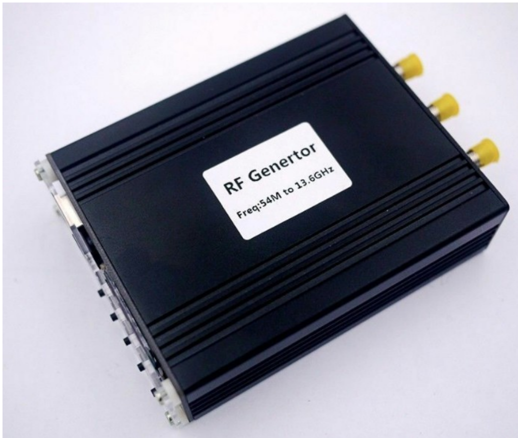
HDTV 1920x1080i/p, 1440x1152p, etc. in 16/9, SDTV 720x576 4/3 or 16/9, and Audio MPEG-2 or Dolby AC-3. Moreover, other types of data-stream can be transported as generic data or MPEG-4. It supports interactive contents by using return paths such as Internet, cellular or telephone.

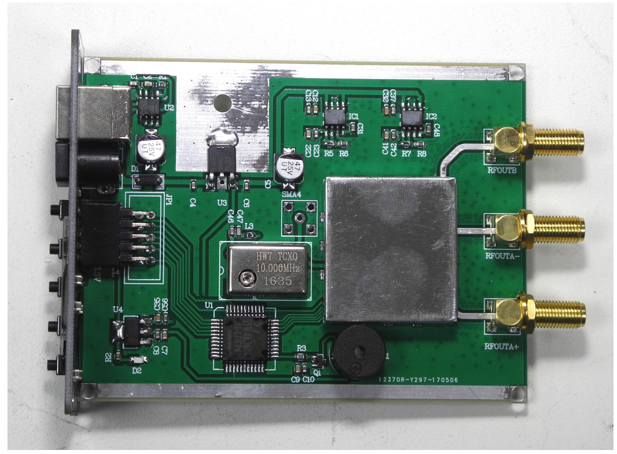
The DVB-T signal is an Orthogonal Frequency Division Multiplexed (OFDM) signal with either 2k or 8k subcarriers depending on the operating mode. Symbols are organized into frames, with each DVB-T frame consisting of 68 OFDM symbols. A super-frame consists of four frames and is used to match the OFDM signaling with the framing for the error control coding in the system. The OFDM symbols carry data belonging to three different types: 1) the MPEG- 2 video data stream, 2) the DVB-T transmission parameter signal (TPS), and 3) pilots.

1. **Data:** The MPEG-2 stream first passes through a series of stages including bit-randomization, outer-coding, and inner-coding before being mapped into the signal constellation. This process results in the information appearing on these carriers as random data. This also leads to the flat spectrum of the signal. The data carriers are modulated with Quadrature Phase Shift Keying (QPSK), 16-Quadrature Amplitude Modulation (QAM), or 64QAM depending on the operating mode.

2. **Transmission parameter signal (TPS):** The TPS carriers convey information about the parameters of the transmission scheme. The carrier locations are constant and defined by the standard and all carriers convey the same information using Differential Binary Phase Shift Keying (DBPSK). The initial symbol is derived from a Pseudorandom Binary Sequence (PRBS).

3. **Pilots:** The pilot symbols aid the receiver in reception, demodulation, and decoding of the received signal. Two types of pilots are included: scattered pilots and continual pilots. The scattered pilots are uniformly spaced among the carriers in any given symbol. In contrast, the continual pilot signals occupy the same carrier consistently from symbol to symbol. The location of all pilots carriers are defined by the DVB-T standard.



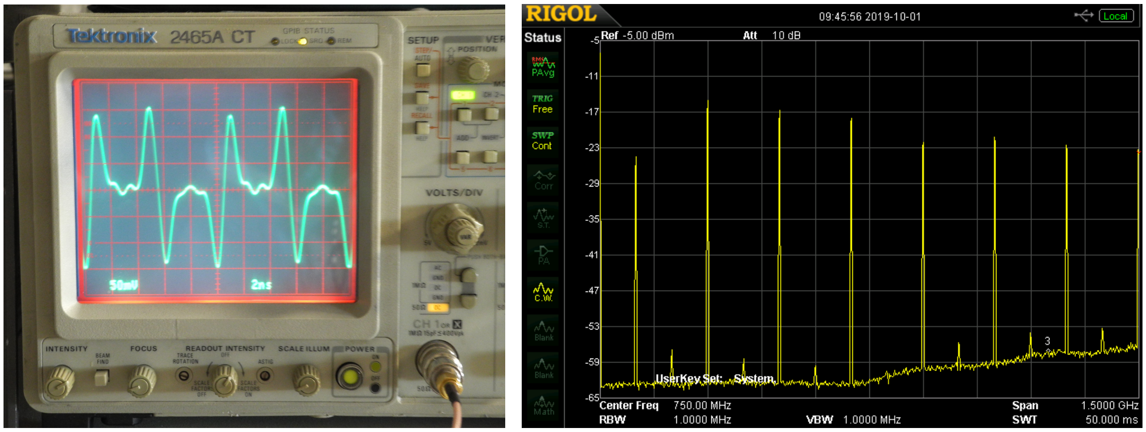


PRODUCT REVIEW --- ADF-5355
54 MHz - 13.6 GHz, SIGNAL GENERATOR

In my Feb. 2017, application note, AN-36, "Microwave TV Transmitters & Receivers", I discussed using the new Analog Devices, model ADF-XXXX, microwave, frequency synthesizer chips as local oscillators. AD offered the ADF-4351 (up to 4.4GHz), ADF-4355 (up to 6.8GHz) and the ADF-5355 (up to 13.6GHz). Several Chinese companies were offering the 4.4 and 6.8GHz versions in complete packages with the necessary support boards to easily program the frequency along with an display panel. AN-36 reviewed their performance. In 2017, the 13.8GHz version was not available in a turn-key, packaged version. Now here in 2019, it is finally available in an easy to use package. They can be found online on E-Bay. I just purchased the one shown above to evaluate. It came from Hong Kong for $156 + $10 postage.

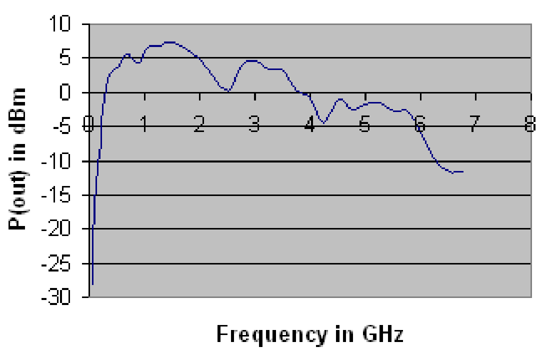
The RF generator is shown in the above photos. It is packaged in a nice, all metal, extruded enclosure. A 12Vdc wall wart was supplied to power the generator. It has 3 SMA outputs on the rear panel. The two labeled A+ & A- output the same signal with a range from 54 MHz to 6.8 GHz. The ADF5355 is basically a 6.8 to 13.6GHz oscillator followed by programmable digital dividers. Thus the RF-B output is direct from the VCO. While the RF-A outputs are from the dividers. The frequency is programmed directly from the front panel. There are 5 push buttons on the front panel. They are left, up, OK, down, and right. You only can enter Frequency A (lower line) up to 6.8 GHz. Whatever VCO Frequency (B) is required to give Frequency A is internally calculated and then displayed as the upper line. If you want to generate a specific frequency above

6.8 GHz and use the B SMA output, you enter on the lower line, a frequency of 1/2 the desired B frequency. For example to get 10 GHz (B), enter 5.00 GHz (A).

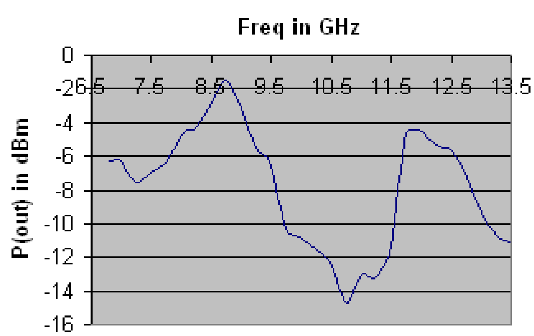


RF Output - A waveform (2ns/div) & spectrum (1.5GHz span) Freq = 100 MHz

The RF-A output has an unusual waveform. It is not the normal sine wave or square wave. It instead is a positive doublets followed by a negative doublet. A doublet is a positive going impulse followed immediately by a negative going impulse. An impulse is generated by the first derivative, dV/dt, of a step function. A doublet is the second derivative. Thus it appears that the RF-A output waveform is being generated internally by taking the second derivative of an internal logic square wave. Such a waveform is extremely strong in all odd order (3ed, 5th, etc.) harmonics as shown in the measured spectrum.



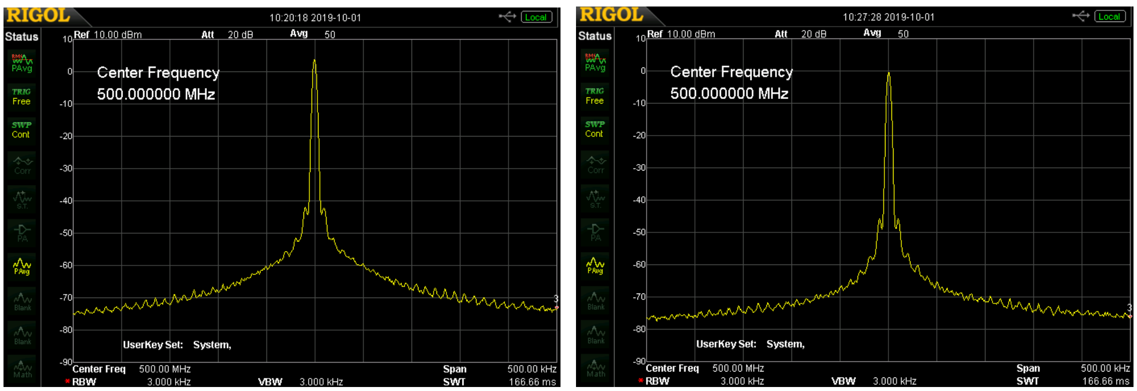
RF Output A



RF Output B

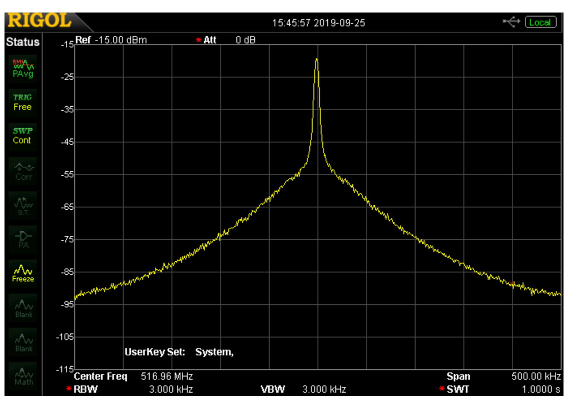
I found the RF output power to be somewhat disappointing. There were no specs. given on E-Bay for what to expect. The power, except from 1-2 GHz, was too low to directly drive a diode mixer. Thus to drive a mixer, one would need to use an external amplifier on the output of this generator. Also I found the rf power to vary dramatically over the frequency range. It dropped like a rock below 300 MHz. The above plots show my measured results. Caution should be taken when measuring the RF output-A power due to the unusual waveform and strong harmonic content. For example measuring the 100 MHz output shown above with an HP thermistor (rms) power meter gave a reading of -3.2dBm while measuring only the 100 MHz signal on a Rigol spectrum analyzer, it was found to give a very low -18dBm strength. Only when setting the generator to frequencies > 1.4 GHz were the HP power meter and spectrum analyzer readings found to be essentially the same. This indicated that the harmonic content for f > 1.4GHz was quite low.

I also measured the frequency accuracy of the generator. To do this, I took it to Bill, K0RZ's ham shack. Bill has a very precise, 18 GHz HP frequency counter with an external HP-107 reference quartz oscillator. Bill says he can measure a signal to 1 part in 10^{10}, roughly 10 Hz at 10 GHz. We set the ADF-5355 to the amateur band, SSB calling frequency of 10,368 MHz. We found the ADF-5355 to be very accurate as it was only 10 kHz low ! ! ! It was also very stable and didn't drift. Thus, it could be used as a good frequency marker. Bill also listened to the signal on his 10 GHz SSB receiver and said it was a very pure tone. It should be noted that this generator's internal standard is an HWT, 10.0 MHz, TCXO which does also include an accessible trimmer capacitor. It can be seen in the above internal view photo.



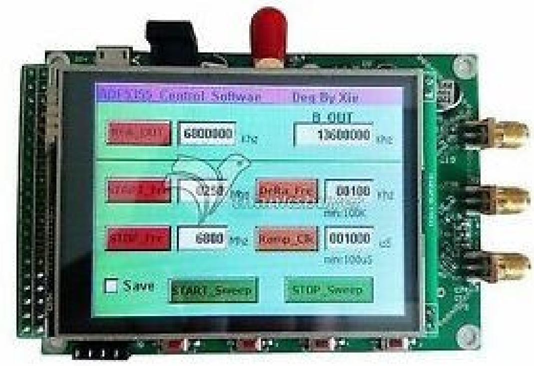
Phase Noise measurement at 500 MHz: 3kHz BW, 500 kHz span, 10dB/div
left is ADF-5355 and right is HP-8656A

I then set up to measure the phase noise of the ADF-5355. The first measurement was at 500 MHz (RF-A output). Also shown is a 500 MHz signal from an HP-8656A for reference. They are very comparable.



Phase Noise measurement at 10.368 GHz: 3kHz BW, 500 kHz span, 10dB/div

I next measured the phase noise at 10 GHz. To do this, I used my Frequency West, brick oscillator and a mixer. My FW oscillator is on 10.885 GHz. I used it to drive an Anzac MDC-171 mixer. I observed the IF on my Rigol DSA-815 spectrum analyzer with the same 3 kHz narrow band-pass filter. More phase noise is shown, but it is not possible to say if it came from the ADF-5355 oscillator - or the Frequency West oscillator.



ADF-5355 basic board with touch-screen display - available on E-Bay $150

The ADF-5355 can also be purchased as a basic pc board as shown in the above photo. Colin, WA2YUN, has found an article on-line from 2018 Microwave / EME symposium in Poland.

http://www.dd1us.de/Downloads/A%20low%20cost%20signal%20generator%202018-06-09%201v0.pdf

It is a paper presented by Matthias Bopp, DD1US, on the ADF-5355 using this basic board. Matthias found severe phase noise on his board and his paper discusses his improvements. They were mainly in replacing the board's voltage regulators with very low noise regulators. For the unit I tested which was packaged differently, I found that it used as voltage regulators, a 78M06 for 6 Vdc and an AMS-1117 for 3.3 Vdc.