# Boulder Amateur Television Club
# TV Repeater's REPEATER


**December, 2019**
**2ed edition**

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

**Future Newsletters:** If you have contributions for future newsletters, please send them to me. We love to also include news from other ATV groups.
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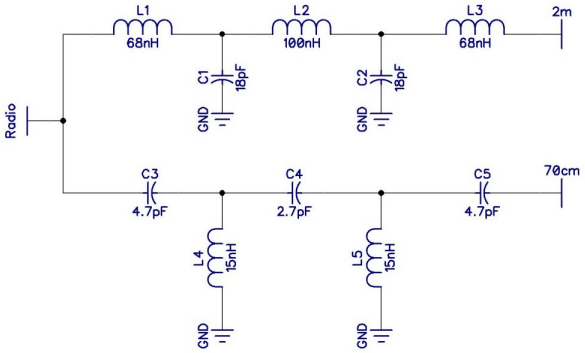
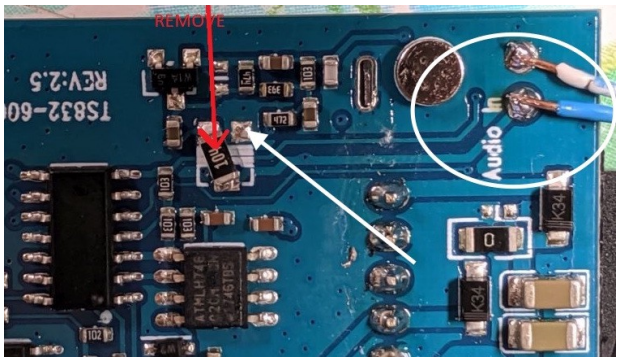
**DECEMBER BARC MEETING:** Most BATVC members are also members of the Boulder Amateur Radio Club (BARC). The next BARC meeting will be Tuesday, Dec. 17th at 7pm. The meetings are held in the terminal building of the Boulder municipal airport where BARC also has it's club room and remote HF base station. BATVC members Don, N0YE, and Jim, KH6HTV will be giving the evening's technical presentations. Jim, KH6HTV, was discuss the equations for VHF/UHF radio propagation and the free computer program, Radio Mobile for calculating point-to-point rf paths and also to generate rf coverage maps. Don, N0YE, will then follow telling about some recent Summits-On-The-Air (SOTA) expeditions for long distance DX, digital ATV, two way QSOs on the 70cm, 23cm & 3cm bands.


**TINY 23cm/70cm DUPLEXER:** A new project of Mario's, KD6ILO, included an intriguing part. It was a tiny, pc board antenna duplexer for 23cm / 70cm. So, off to google for it. Bingo ! Here is what I found at Shelby, KW4FB's web site: http://kw4fb.com/ http://kw4fb.com/micro-diplexer/ The Chebyshev design came from our own, local boy, Chuck Duey, KI0AG in 1997 AMSAT Journal ! Shelby's web site includes a link to purchase the pc board along with a bill of materials.

## TS-832 FM-TV Transmitter Modification - Correction

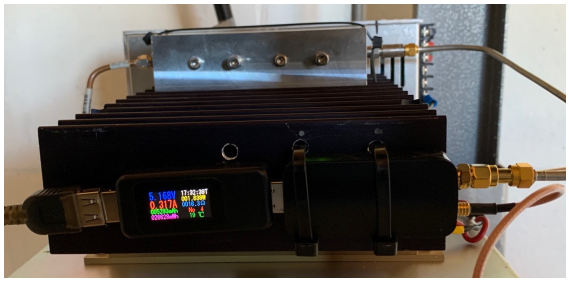



In the Dec. issue (#27) of this newsletter on page 2, we included Bill, AB0MY's modification to the TS-832, 5.8GHz, FM-TV transmitter to disable the on-board microphone and instead inject external, line audio. I (kh6htv) have tried Bill's modification of simply removing the resistor. I found that it did disable the microphone, but I did not get any injection of external line audio, just "sync buzz". Bill said to remove the 100K 1206 chip resistor shown by his red arrow. What I found was that another 100K resistor then needed to be installed on the opposite diagonal pad, which I have indicated with a white arrow. The line level audio is then connected to the pads labeled Audio In and shown with a white oval in the photograph.

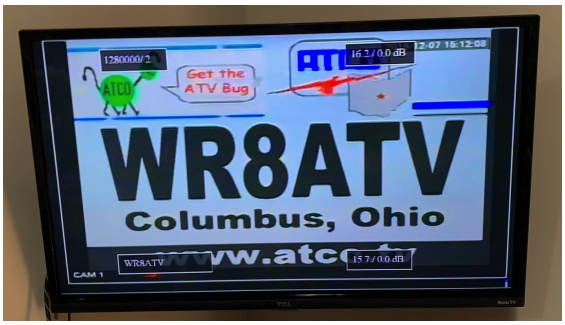
## NEW ATV MICROWAVE BEACON

There is now a new ATV, 5cm, beacon on the air transmitting 24/7. KH6HTV now has a 5cm, FM-TV signal on and is looking for contacts and/or signal reception reports. The frequency is 5.685 GHz. The transmitter is TS-832 with output power of 750 mW. The transmitter is mounted directly onto the antenna, thus no feed line loss. The antenna is an L-Com model HF5822EG, BBQ grill parabolic dish with 23dBi. Polarization is horizontal. The antenna is pointed towards the city of Boulder and the Flatirons on Green mountain and should give good reflections. This is not a digital signal, but an analog, NTSC signal with 480i resolution. The video source material is a continuously looping slide show with various slides all displaying the KH6HTV call sign. There is no audio with the slides, but with a live camera, both video and audio can be transmitted.

**MIXING HDMI AUDIO & VIDEO:** Both Ed, K0JOY, & Bill, AB0MY, have been working up more exotic video presentations from their ham shacks on our Thursday afternoon ATV nets. Both have been using the OREI model HD-401 Quad Viewer / Switch which we discovered last spring and are now using in our W0BTV-TV Repeater. They also wanted to insert a separate audio stream onto their ATV signal, independent of whichever video they were presenting. But, how to break into the HDMI A/V signal path ? Bill says, "I'm using a "Monoprice Blackbird 4K Series HDMI Audio Inserter. It provides HDMI audio pass-thru or digital optical or analog stereo inputs. I have it connected between the HD401 output and the HV 320 modulator input.."



Gapfiller Link Repeater




ATCO rptr signal rebroadcast by DART rptr

# DAYTON, OHIO ATV NEWS: ON GOING DARA/ATCO LINK LEG TESTING WORKING WELL

Bruce, K8FIX & link rptr

Bruce K8FIX and I installed the DARA/ATCO "Gapfiller" leg at Jones Rd, South Vienna, Ohio on Saturday 7 December 2019, and as of 4:25 pm Wednesday, the DAYTON/Columbus 60 mile test link has been working flawlessly. The HiDes Gapfiller at South Vienna is receiving the 423 MHz DVB-T ATCO repeater output and re-transmitting it on 1280 MHz. An HV122A receiver is in-turn receiving the link at the DARA site in Huber Heights,Ohio, and the signal is being re-transmitted over the DARA repeater. Signal quality is excellent and the link appears to be experiencing only about a 1/2 second delay. What the HiDes manufacturer states about no-data-loss during re-transmission appears to be true, as received signal quality is excellent. This test will continue throughout the month to see whether the 70cm and 1280 MHz signal path changes as environmental conditions change. So far, heavy rains between Dayton and Columbus have not affected signal quality.

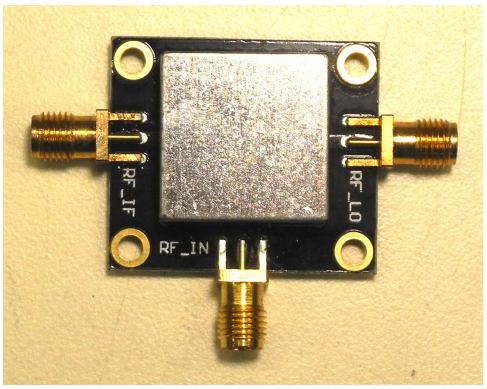
73 de Dave, AH2AR

# CHINESE MICROWAVE COMPONENTS - contd.

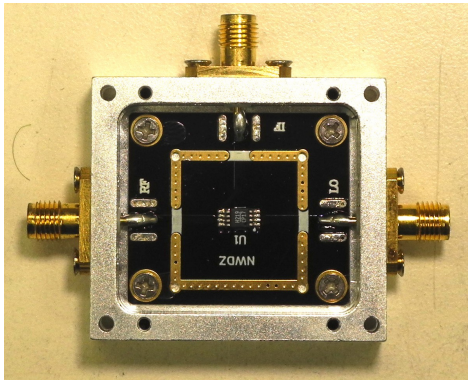
**Jim, KH6HTV**

In the December issue (#27), I talked about starting a project of evaluating some of the really low cost, microwave components now available over the internet from China. Unfortunately, most of them have long lead times of 1 to 2 months because they are shipped via container on the proverbial "slow boat from China." Some of them have started to trickle into the ham shack here in Boulder. In this issue, I discuss the recent arrivals.

**CONCLUSION:** *Don't expect to get accurate (if any) specs. nor quality stuff -- if you are buying it from China on the internet ! Cheap -Yes, Quality - No. If you want quality items, such as we have gotten in the past from Hewlett-Packard / Agilent, Tektronix, or Picosecond Pulse Labs, then expect to pay an appropriate, stiff price for them, and buy USA.*




RF/LO 5MHz - 2.5GHz & 9-15GHz mixers



RF/LO 4.5 - 9GHz mixer

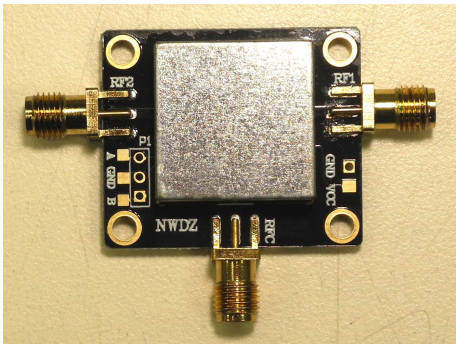
**MIXERS:** A key component for up or down-converting rf signals is a mixer. These are most typically diode mixers. Three mixers were found on Amazon that looked interesting and at attractive prices. The packaging is typical of all the various Chinese parts I have received so far. Those sold as simple pc boards all have the same rectangular size and four mounting holes and come with SMA connectors attached. When they are in a metal enclosure, the same identical pc board is mounted in a common, aluminum machined housing with SMA connectors on the outside. The two photos above show this. For the photo on the right, I removed the metal top cover to show the interior. The basic pc board versions seem to be quite fragile as the pc board thickness is only 0.02". Thus, when possible, one should always pay a bit more for the component to be in the rugged, machined metal housing.

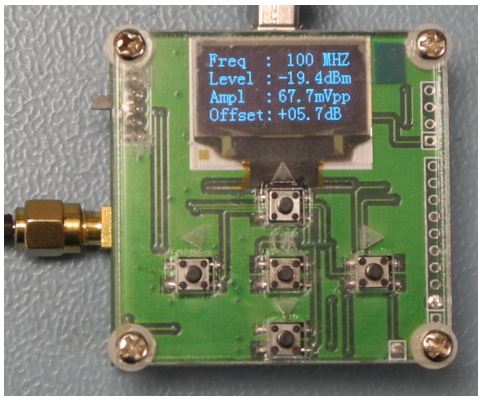
Typical of most Chinese internet offerings, the specs. were very minimum. The only specs given for these mixers were basic frequency ranges. 1. RF/LO 5 MHz to 2.5 GHz & IF dc to 1.5 GHz.- $14 2. RF/LO 4.5 to 9 GHz & IF dc to 2.5 GHz - $19. & 3. RF/LO 9 to 15 GHz & IF DC to 2.5 GHz, $11. There was also another number identifier in the advertising which didn't mean anything to me at the time I ordered the parts. However, it turned out to be very significant. The numbers were actually semiconductor manufacturer's part numbers of the device used in the mixer. For the first mixer, it was actually a Mini-Circuits model ADE-25. For the second mixer, it was actually an Analog Devices model HMC219. The third mixer was an Analog Devices HMC412M. Thus going to these manufacturers web sites and downloading a .pdf file of their data sheets gave the full details on these parts. I did run some rf tests on these mixers of conversion loss and found that the first two basically did meet the specs. on the semiconductor manufacturers' data sheets. The third one for X-band had a horrible conversion loss of -34dB and was obviously defective.

The only draw-back for a typical ham radio, microwave experimental project with these three mixers was the LO power required for proper operation. All of these mixers required +13dBM of LO power. If less LO power than 13dBm was used, then the conversion loss rose rapidly. At microwaves, with ham budgets, rf power is difficult to come by. There are other rf diode mixers that use lower LO drive power of +7dBm and

as a result are more attractive for ham usage. The LO drive power required is a key spec. and unfortunately, it was missing from the Chinese advertising. So again, the warning -- "Buyer Beware". Otherwise, these mixers are good buys and do work.

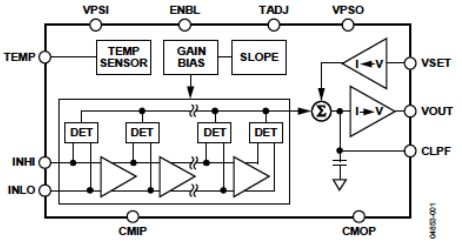
**GaAs SPDT RF SWITCH:** This was another intriguing part from China. It had very deceptive advertising. It was billed as an RF LNA amplifier with SPDT switch. Amazon price was $12. When it arrived in the mail, the package was labeled as HMC336. A google search turned up that this was an Analog Devices HMC336 part. It was in fact NOT an LNA. It was a semiconductor RF SPDT switch with no gain. The Analog Devices' specs said the insertion loss should be 1.2dB up to 2GHz and 1.6dB up to 6GHz with better than 40dB isolation. It should also handle up to +20dBm of power for -1dB compression. I tested it on my Wiltron 5447A, 20GHz network analyzer. What I found was it was really only useful for up to the 23cm band. It meet insertion loss spec. up to 1 GHz only. It had -3dB loss at 2.4 GHz and -5dB at 3.5 GHz. Conclusion: Totally useless for microwave work as a coax switch due to it's high loss.





## AD8318 - 8GHz RF POWER METER




The next Chinese item evaluated is actually a test instrument on a pc board. There are a really large number of offerings on E-Bay, Amazon, etc. of this item. They all contain the Analog Devices model AD8318 log amplifier / detector IC. Prices typically are in the $10 - $25 range
What I purchased was a module that contained the basic AD8318 board, plus another board stacked on top with a digital readout of rf power. It cost about $50. The AD8318 is a string of log amplifiers, each with a detector. It provides a dc output from 0 to 4.9V with a slope of -25mV/dB. It is specified to work from 1MHz to 8GHz with a dynamic range of 60dB and ±1dB accuracy. The max. input power is typically about 0dBm. Most of the low cost, single pc board units offered for sale, simply have a dc output and you need to do the math yourself after reading the dc output voltage.

For the unit I purchased with the extra digital readout (shown in above photo), it also included a micro-computer to convert the dc voltage to power in dBm. It apparently also included a frequency correction table, as the top line of the display is frequency. There is not a built-in frequency counter, but the user is supposed to enter with the 5 push buttons the frequency of the rf input signal.

I have tested the calibration of this rf power meter using calibrated HP signal generators and an HP thermistor power meter. I tested it from 100 MHz to 5.8GHz. I have found that it definitely does NOT meet Analog Device's specs for accuracy. The indicated noise level ranged from -48dBm (100MHz) to -42dBm (5.8GHz). The dynamic range was not 60dB, but more like 45dB. At 100MHz, it read correctly at about -20dBm. At 430 & 900MHz, it read correctly at about -10dBm. At 5.8GHz, it read correctly at about -5dBm. For input powers below these points it read too high, while for powers above these points, it read too low in increasing errors.

I also tested the AD rf power meter to see how it handles non-sinusoidal signals, such as digital TV. Using a Hi-Des DVB-T modulator to generate a 70cm DTV signal, I first measured it with my HP thermistor power meter. I then set up the HP signal generator to put out a sine wave of the same rms power. I measured both with the AD rf power meter. I did this measurement at power levels ranging from -32dBm to -2dBm. In all cases, the AD power meter read the DTV power about -2dB low.

CONCLUSION: This is a useful device to have on the test bench, but only as a relative signal strength meter, not as an accurate rf power meter.

**BAND-PASS FILTERS:** While looking for low cost, microwave parts, including band-pass filters, I also found a couple of items, that may - or -may not be from China. They were SMA filters for 2.4 & 5.8GHz from a firm called Taoglas. They are listed on Amazon, but also for a much lower price ($25) at the USA electronic distributors, Mouser & Digi-Key. Unlike most Chinese stuff, complete specs. are available from the Taoglas web site. https://www.taoglas.com/ Unfortunately, like many items intended for FPV drone usage they have reverse polarity (RP) SMAs. I have tested these BPFs on my Wiltron 5447A, 20 GHz network analyzer. I found that they do meet Taoglas' specs. For the 2.4 GHz BPF, the in-band insertion loss was about -1dB and the -3dB bandwidth was about 230MHz. For the 5.8GHz BPF, it measured better than specs. It had less than -1dB insertion loss from about 5.72 to 6GHz with better than -15dB return loss. It's -3dB bandwidth was about 700 MHz.

# CHARACTERISTIC IMPEDANCE -- How to Measure it

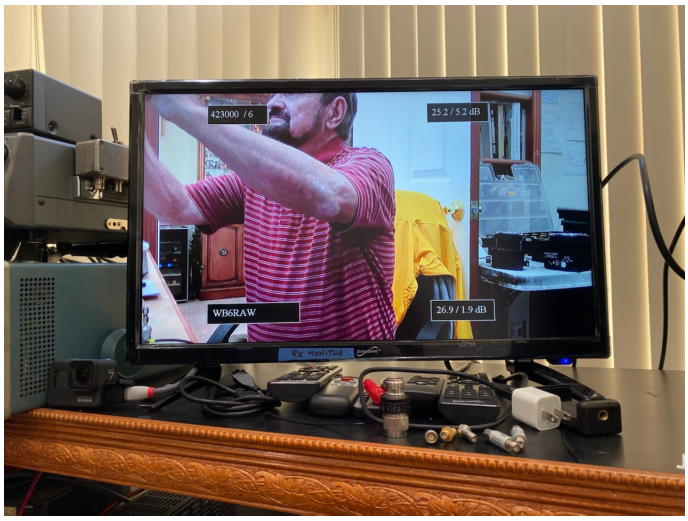
Recently on the Thursday afternoon ATV net, Don, N0YE, posed the question, "How can I measure the characteristic impedance of a coax cable?" Don said he had a lot of surplus 0.141" semi-rigid coax cables with SMA connectors, but he found (the hard way) that some of them caused very high VSWR because they were not 50 Ω, but were 75 Ω cables. From outside appearances, they looked identical. Now he is worried about his stockpile of surplus bits & pieces. How can he sort them out?

Well Don's question, triggered our local Georgia Tech EE professor and antenna expert, Ed, K0JOY, to come up with a great lecture on the ATV net the following week. Ed presented about half a dozen, relatively easy ways to measure and determine the impedance of an unknown cable. Ed had all the necessary equations and gave a very informative lecture on our ATV repeater. Unfortunately, no one was prepared ahead of time to video tape Ed's lecture.

As a result, of Ed's lecture, Jim, KH6HTV, then volunteered to give a demonstration on a future weekly ATV net of how to use Ed's "Surge Impedance" concept to measure characteristic impedance. Jim will do a live, on the air, demo of TDR. TDR stands for Time Domain Reflectometry. Ultra high resolution TDR was one of the products of Jim's company, Picosecond Pulse Labs (PSPL). Most hi-res, commercial TDRs had a resolution of about 35 ps. PSPL's TDR pushed the resolution down to about 10ps. At 10ps, one was able to resolve discontinuities in coax and microstrip line down to about 1.5mm in air dielectric or 0.5m in alumina substrates. *(Note: PSPL was purchased by Tektronix in 2014 and Tek has since closed the PSPL facility and discontinued all of the PSPL products.)*

Jim's demo will not get down to 10ps, as he does not have in his ham shack the really high res, (and very $$$$) gear. He will instead be using a very old, antique, HP 18GHz sampling oscilloscope along with a 25ps risetime, PSPL tunnel diode pulse generator for his TDR demo.

Want to learn more about TDR and what you can do with it ? ---- then download from Jim's web site, his PSPL application note, AN-15 on TDR. https://kh6htv.com/pspl-app-notes/





# Analog Days ATV Ham - Now on Digital !

We have a new convert to DTV. Werner, WB6RAW, in Temecula, California recently contacted me (kh6htv) and expressed an interest in getting back into ATV after a 40 year absence. He is a retired RF engineer who was very active with fast scan TV back in the 70s. Werner told me "Back in the 70s, I designed an ATV repeater. I even designed and manufactured an ATV transceiver for a short time. I sold about 20 of them at the Dayton hamfest under my company name of XTRONIX. It was short lived business - just for fun ! " I gave Werner a glowing endorsement of the Hi-Des, DVB-T gear and encouraged him to give it a try. In the meantime, Werner ordered an rf linear power amplifier from me. Tonight (12/11, 5pm), just as I was ready to put this issue of the newsletter to press and distribute it -- I got an excited text message from Werner with the above photo and he said "Hi Jim -- Good news! I just got a chance to configure the HV-320E modulator & HV-122 receiver for the first time using your excellent AN-18C ! ! ! Thanks for writing such a great App. Note. It was exciting to see my transmitted signal for the first time on 423MHz with 6MHz bandwidth."

**How NOT to adjust your antenna !**