Amateur Television Journal

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2ed edition, issue #181

BATVC web site: www.kh6htv.com

ATN web site: www.atn-tv.com

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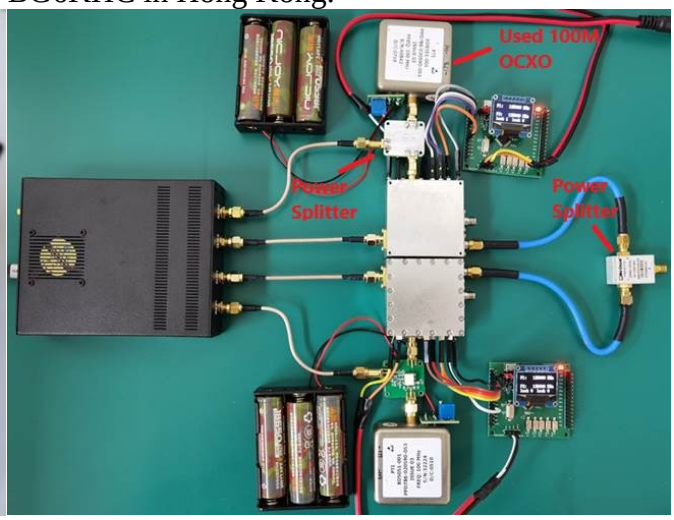
LO Phase Noise -- Feed-back:

Hi All --- The issue of phase noise of oscillators is mentioned in the story on the 5.8 GHz (ATV Journal, Dec. 2024, 3ed edition).

I have written several blog posts on an inexpensive measure of phase noise using the PN2060a and later using an improved version, PN2060c made by BG6KHC in Hong Kong.

PN-2060c Phase Noise Analyzer $849



Typical Test Set-Up

https://qsl.net/bg6khc/pn2060c_phase_noise_analyzer.htm
URL link to Phase Noise Store is: ***https://qsl.net/bg6khc/Payment.html***

I started with oscillators at 100 MHz and below, as they are within the measurement range of the instrument. I then progressed to using a down-converter to measure GHz oscillators. I originally used a pair of inexpensive Chinese oscillators that had good performance and relatively low phase noise. However, I have recently obtained a couple of down-converters from the analyser's maker that have superior performance. The down-converters can also be used as up-converters for DATV or as general-purpose oscillators or local oscillators.

Regards, Drew Wollin, VK4ZXI, Queensland, Australia

Editor's note: Check out Drew's blog ***https://vk4zxi.blogspot.com/*** He has several posts there of interest, including:
"An improvised 9 GHz real-time spectri, analyser with 64 MHz bandwidth using RX888, SDR Console and a down-converter."
"PN2070A GHz phase noise measurement using only reference OCXOs"
"Measuring GHz phase noise using a dual-channel down-converter with the PN2060A phase noise analyzer"
"Why the phase noise of a U-Blox GPS module at 10 MHz is terrible"
"Have PN2060A phase noise analyser, will measure"
"An economical way to measure phase noise using the PN2060A cross-correlation Phase Noise Analyzer"
"Measuring phase noise"
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BG7TBL WB-SG2, Signal Generator

Main Parameter List					
Model	CH1 Frequency	CH1 Amplitude	CH2 Frequency	CH2 Amplitude	Note
WB-SG2-4.4G	1Hz-250M	3.3Vpp	9K-4.4G	-40dBm to +13dBm	CH2 amplitude 0.5dB step
WB-SG2-6.4G	1Hz-250M	3.3Vpp	13M-6.4G	64 levels	-40dBm to +7dBm at 1GHz
WB-SG2-8G	1Hz-250M	3.3Vpp	35M-8G	0dBm	fixed CH2 amplitude
WB-SG2-9.5G	1Hz-250M	3.3Vpp	20M-9.5G	32 levels	-10dBm to +5dBm at 1GHz
WB-SG2-15G	1Hz-250M	3.3Vpp	10M-15G	32 levels	-10dBm to +5dBm at 1GHz
WB-SG2-20G	1Hz-250M	3.3Vpp	10M-20G	32 levels	-10dBm to +5dBm at 1GHz

While looking at Drew's blog, I became aware of a signal generator with very impressive specs. Apparently designed by a Chinese ham, BG7TBL. Googling his call sign doesn't reveal his identity, but he has apparently designed several other interesting pieces of microwave test equipment. It appears there are now several models of this signal generator available with max. frequencies from 4.4 GHz all the way up to an astonishing 20 GHz. Google searching, I found the 8 GHz model selling on E-Bay for as low as $180. I found the 20 GHz model selling for $551. Do any of our ATV Journal readers out there own any of these generators ? If so, we would love to hear from you and publish your observations on their performance. In particular, what do you think about their phase noise performance for use as potential microwave Local Oscillators ? --- Jim, KH6HTV

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An Impressive, Low Cost LNA

I also noted in Drew's blog another Chinese product which looked interesting. It was a very nicely packaged LNA with impressive specs. Checking it out on Amazon, I was amazed at the very low price I found of only **$14 !** At that price, I had to buy one to evaluate it.

SPECs: Amazon's advertised specs. were: Band-width 100kHz to 6 GHz, 20dB gain, +22dBm, 50 Ω in/out, +5Vdc (70mA)

OK, can you really believe them ? Well yes and no. They are typical Chinese specs. I did proceed to very carefully evaluate this LNA. While it didn't meet all their specs., it is definitely a winner and a Must Buy at this price.

The model number stamped on the case is TQP3M9037-LNA. It turns out to be the part number of the MMIC used. It is a TriQuint (now Qorvo) part. The detailed spec. sheet is available on-line. Qorvo only claims 0.7 to 6 GHz operational bandwidth, 20dB gain and 0.4dB noise figure at 1.95 GHz, +22dBm output power, +3 to +5V supply at 70mA. The actual MMIC is packaged in a very tiny, 8 pin, 2 x 2 mm, DFN package. That package is much too small for me to ever consider using it in my own preamp designs with my old eyes and shaky hands for hand assembly ! Qorvo's spec. sheet

includes a table of S parameters from 50 MHz to 5 GHz. The table shows the gain S21 to be 28.7dB (50 MHz), 24.5dB (1GHz), 19dB (2.4GHz) and 11.3dB (5GHz). They also show noise figure ranging between 0.3dB to 0.5dB from 1.5 to 2.7 GHz.

The evaluation unit which I purchased from Amazon worked well for most ham bands, but did not completely live up to all of Amazon or Quorvo's specs. In particular, it was not useable above 3.5 GHz and it did not put out the max. advertised power. But otherwise, it was a great LNA. And definitely well worth the $14 price. So here tabulated are my measured results.

DC Power: This has the very nice feature of an included, internal Li-Ion battery for stand-alone operation. The +5V USB port is only for recharging the battery. Provision is made to also power the LNA remotely via a Bias Tee to apply DC voltage via coax on the rf output connector. When +5Vdc is applied to the USB port, the amp draws 280mA, but only while re-charging the internal battery. The spec. for the MMIC is it pulls 70mA.

S21 vs. Frequency: Measured from 0 to 1.5 GHz, 5 dB/div & 150 MHz/div. Yellow trace is at instant of power turn-on. Magenta trace is after 15 seconds. Cyan trace is steady state reached after 30 seconds.

S21 Gain: The gain is not flat across the specified frequency range, but it is similar to what is listed on the Quorvo spec. sheet. However, I did note an instability during the initial turn-on period. See the above S21 plot. The dip in the gain curve first started at about 850MHz and then slowly drifted down to stabilize at around 600 MHz. The max. gain measured was 30 dB at 0.5 to 3 MHz. At 100 kHz, the gain had rolled off to 26 dB and fell rapidly at lower frequencies.

Band	80 m	20 m	6 m	2 m	70 cm	33 cm	23 cm	13 cm	9 cm	5 cm
Gain (dB)	29.7	27.7	27.2	27.2	26.1	22.1	20.4	15.5	8.0	-2.5

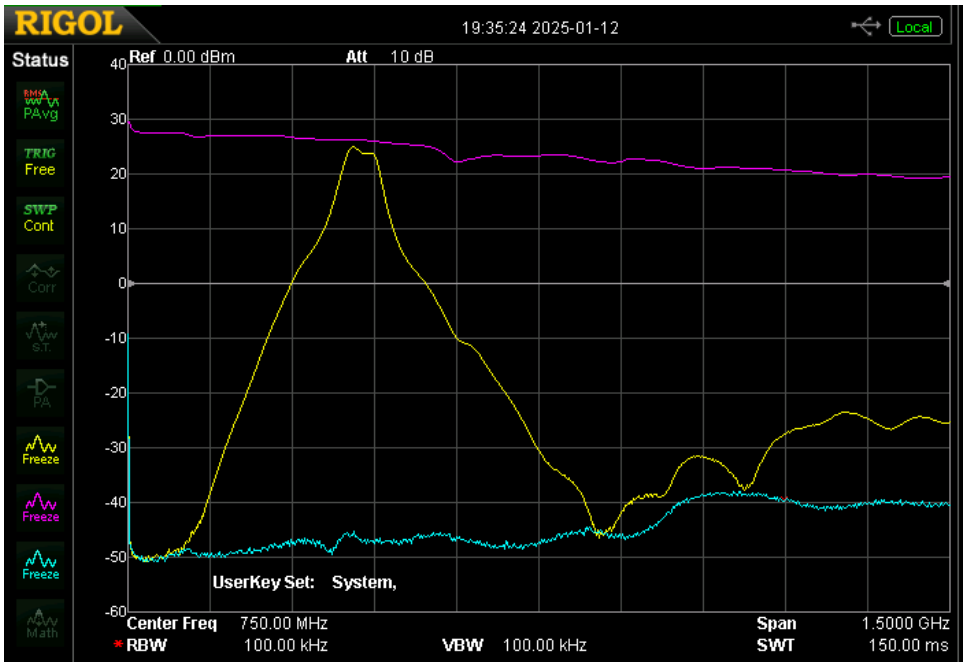
Obviously, this unit tested never came close to working at 6 GHz. It had marginal gain of only 8 dB on the 9 cm (3.4 GHz). Totally useless, -2.5dB for the 5 cm (5.8 GHz) band. But very useful gain for LF, HF, VHF & UHF bands.

Max. RF Power: I also ran linearity tests to determine the -1dB gain compression point along with the the max. saturated rf output power on various bands. The unit tested did not quite meet Quorvo's specs of +22dBm. But it still put out considerable rf power. For the 70 cm and 23 cm bands, P(-1dB) was +19dBm and P(max) was +20dBm. For the 13 cm band, P(-1dB) was +17dBm while P(sat) was +18dBm.

Noise Figure: The noise figure (NF) was measured using an HP-8970A Noise Figure Meter. The noise head was a Noise Com model NC346B. The basic NF meter covers the frequency range from 10 MHz to 1.5 GHz. To make the measurement at 2.4 GHz, required using an external down-converter. I assembled a temp down-converter using several discrete SMA components. The LO was a MAX-2870 frequency synthesizer with booster amp driving +14dBm into a Mini-Circuits 25MH mixer. On the RF input to the mixer I used a KH6HTV, UWBA-103 amplifier followed by an Amazon $10 pcb 2.4 GHz band-pass filter. The LO was set to 2.0 GHz with the IF at 400 MHz.

Band	20 m	10 m	6 m	2 m	70 cm	33 cm	23 cm	13 cm
NF (dB)	1.16	1.22	1.09	0.54	0.43	0.80	0.62	1.30

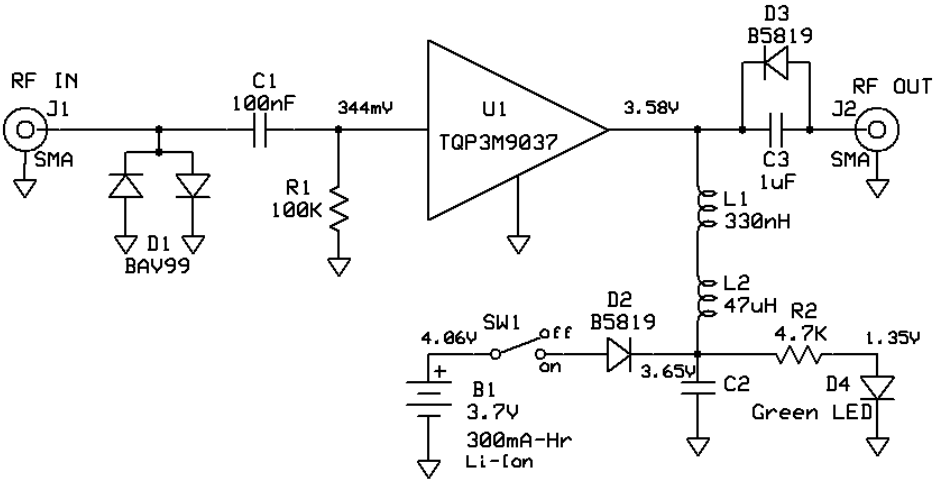
The measured noise figures were very impressive. They make this LNA a real contender for actual ham use in the ham shack.



LNA with added 70 cm Band-Pass Filter: S21 vs. Frequency, sweep 0 to 1.5 GHz, 10dB & 150MHz/div.

Band-Pass Filtering: It is usually not a good practice to use an ultra-wideband amplifier as your pre-amp. Doing such exposes your receiver to every signal out there in the real world. Some of them are strong enough to overload your receiver and cause lots of havoc. Band-Pass filters are always recommended on our ham receivers. So, I also tested this $14 LNA with a 70 cm band-pass filter on it's output. The filter I used was a KH6HTV Video, model 70-BPF ($60). The above plot of S21 shows the resulting dramatic improvement in signal rejection outside of the desired 70 cm band. The magenta trace is the S21 of the LNA alone, the cyan trace is the spectrum analyzer's noise floor for S21 measurement. The yellow trace is for the LNA + BPF. The resultant 70 cm gain and noise figure was 25.5dB and 0.5 dB. The -3 dB band-width was 67 MHz.

Actual Circuit: Naturally, I was curious as to what was inside the box. Here is what I found. There was a 3.7 V, 300mA-Hr, Li-Ion battery mounted on the bottom side of the pc board. All of the components were clearly labeled on the pc board. Here is the schematic diagram I was able to draw from what I found. There was also a TP5056 battery charger IC on the board which I didn't include in the schematic.



Lousy Microwave Performance: So why is the gain so poor at the higher frequencies ? We discussed this issue on the Boulder ATV net. The consensus is that first the presence of the input limiting diode, D1, is no doubt adding significant capacitive loading. Also the design of the dc power feeding network of L1 and L2 may be less than desirable at microwave frequencies. Checking the

specs for D1, BAV99, diode shows that the capacitance of each diode is 1.5pF (@0V). Thus the input is being loaded with a significant (at microwave frequencies) 3 pF of capacitance. A quick R-C low pass filter calculation shows this adds -3.6dB (2.4 GHz), -5.5dB (3.4 GHz) and a whopping -9.3dB (5.8 GHz). Obviously a deal killer for the 5 cm band !

Potential Modification: OK, so let's try a little surgery on the actual amplifier. I removed D1 and retested the gain. Voila ! The gain at 5.8 GHz jumped up 7.5dB from -2.5 to +5dB. 5 dB is still not a useful amount of gain for a 5.8 LNA. At 3.4 GHz, the improvement was 3dB from 8 to 11dB. But in the process, we messed up the lower frequency performance. The gain dropped most everywhere about 1 dB, but what was worse was a degradation in the noise figure. At 70 cm it went from 0.4 to 0.7 dB and at 23 cm it went from 0.6 to 1 dB. So, except for perhaps using this LNA at 3.4 GHz, we really do not want to be removing D1. Best to leave this Amazon LNA unmodified and use it as is.

1 Off - or Repeatable? So, at that point having messed up the first amplifier's low frequency performance -- I decided to order another LNA from Amazon to replace the modified one. How well did the second sample work ? Well the good news is they perform identically. I got the same gain and shape of the S21 vs. frequency response curve testing S21 on the Rigol out to 1.5 GHz. The same turn-on instability was noted. I then tested the noise figure. For the 2ed unit, the results were encouraging: 70cm = 25.4dB gain and 0.39dB NF. 23cm = 19.8dB gain and 0.57dB NF. Bottom line -- this is a good LNA and well worth the $14 price tag.

73 de Jim Andrews, KH6HTV, Boulder, Colorado

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Another Low Cost DATV Receiver

(But Do NOT Buy !)

Ops, it looks like in the previous issue, I reported on this new receiver from China too soon. After using it now for awhile to monitor our Boulder, Colorado DATV repeater, I have found it has a new quirk which makes it totally unacceptable for such monitoring service.

After leaving the system running overnight, I discovered that each morning when I came into the ham shack, the receiver had gone dead and needed to have the power recycled. Then one day while sitting at my desk, I noticed the receiver suddenly displayed on the video monitor this warning notice. "***If no button is pushed within the next two minutes, the receiver will turn off.***" I waited the two minutes, and sure enough it shut itself off. Obviously not suitable for long term monitoring purposes.

73 de Jim, KH6HTV, Boulder, Colorado

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More HDMI Issues !

There seems to be a recurring problem with the HDMI output for several brands of DVB-T receivers.

I had recently purchased (3) of the model HD-99 (mfgr. unknown) DVB-T receivers from E-Bay (China). I bought them for use in DATV repeaters because they included a front panel red/green Valid Signal LED indicator. From that LED I was able to pick off a useful logic signal to indicate "Valid Signal". All three receivers worked initially. However, after a brief time, all three of them have since died. All the same death. Their HDMI outputs have failed. I certainly will not be buying any more HD-99s ! ! !

If you recall, a year ago we were reporting similar issues with the HV-110 receivers from Hi-Des. I have also had a few of the GT-Media V7 Pro receivers I have been selling fail on me. All the same issue, no HDMI output. Bummer ! No doubt, all of them are using the same failure prone HDMI output IC chip.

73 de Jim, KH6HTV

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2024 Year End Summary from San Diego ATV

Greetings --- Great Boulder ATV net this afternoon. Nice to see you all on the air over the BATC stream. (***https://batc.org.uk/live/*** *click on AB0MY*)

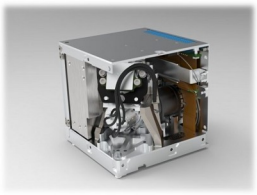
[1] And hopefully a great 2025 for the rest of the WOBTV family. We ended 2024 with a meeting of the board, STEM advisory committee and membership teams. We are holding strong with the current members with additions of the young members of our STEM students.

[2] 2024 goals were met with our RF/Optical upgrades and integration to our community zone gateway hubs which of course receive low power RF 70cm T2 into each zone's hub to the FSO backbone network, then to the output on 23cm S2. We had no outages to report last year.

[3] We had credit for exchanging out our old THOR components for the optical systems integration packages. The Ramona site has internal fiber optics installed between components which make connectivity of RF and optical components operate flawlessly. The audio is clear,the video very sharp. When linking our SRT traffic to the UK and Europe it's noticeable by the viewers.

[4] I've completed my part of my task for our second CubeSat FSO2, the transceiver 1U module. G8KOE {Martin} has set up a SRT Repeater Hub which he uses to link members together like myself who don't have a direct connectivity to repeaters in the UK and to QO-100 he's the control operator. It works very well.

Just sharing an update on our number two (2) CubeSat FSO-2. I did my section's responsibility for the assembly of the 1U optical transceiver module [3U spacecraft] set for full assembly in the fall of this year. Also the machine housing unit for the OGS - Optical Ground Station. my responsibility is the optics.



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[1U FSO-2] CubeSat Optical transceiver unit for the San Diego DVB Society set for launch

In late 2026 onboard SpaceX share ride program.

CubeSat will be a 3U Spacecraft.

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Portable Laser module with integrated optics with its' machined aluminum housing.

Best to all, cheers! Mario, KD6ILO, Oceanside, California

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W0BTV Details:

Inputs: 23 cm Primary (CCARC co-ordinated) + 70 cm & 3 cm secondary all digital using European Broadcast TV standard, DVB-T with standard 6 MHz wide TV channels. Frequencies listed are the center frequency of the TV channel.
23 cm = 1243 MHz (primary), 70 cm = 441 MHz & 3 cm = 10.380 GHz
Outputs: 70 cm Primary (CCARC co-ordinated), Channel 57 -- 423 MHz with 6 MHz BW, DVB-T
Also, secondary analog, NTSC, FM-TV output on 5.905 GHz (24/7 microwave beacon).
Operational details in AN-51d Technical details in AN-53d. 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. 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:

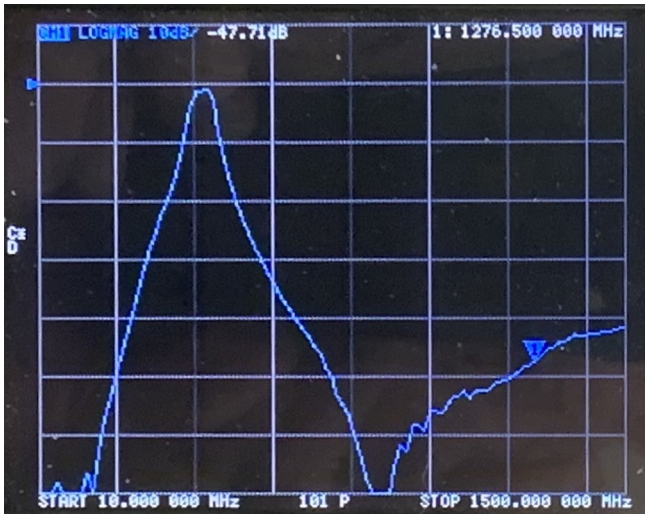
This newsletter was started in 2018 and originally published under the title "*Boulder Amateur Television Club - TV Repeater's REPEATER*" Starting with issue #166, July, 2024, we have changed the title to "*Amateur Television Journal.*" This reflects the fact that it has grown from being simply a local club's newsletter to become the "de-facto" ATV newsletter for the USA and overseas hams. This is a free ATV newsletter distributed electronically via e-mail to ATV

hams. The distribution list has now grown to over 800+, both in the USA and overseas. 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/

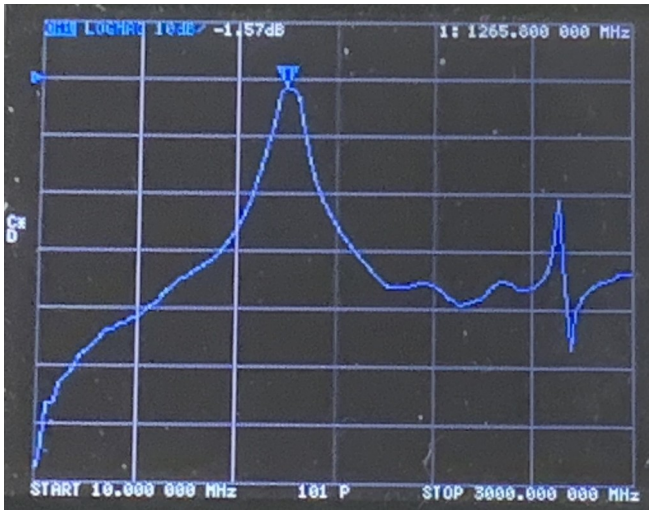
ATV HAM ADS -- *Free advertising space is offered here to ATV hams, ham clubs or ARES groups. List here amateur radio & TV gear*

For Sale - or - Want to Buy

Ham Ads Testimonial: They really work ! In the previous issue I advertised several items for sale and to give away. Most all of them were gone within two days. -- Thanks! Jim, KH6HTV



Model 70-BPF, sweep to 1.5GHz



Model 23-BPF, sweep to 3GHz

BAND-PASS FILTERS -- for Sale

KH6HTV Video offers new, 70cm & 23cm band-pass filters for use with your wide-band LNAs. Check out their detailed specs. at the web site: *www.kh6htv.com*
Price is $60 each.
To order send email to: kh6htv@arrl.net or call 303-594-2547