Application Note AN-57c

August, 2020

rev. a, Sept. 2020

rev. b, Dec. 2021

rev. c, March 2022

web = www.kh6htv.com email = kh6htv@arrl.net

Comparison of Hi-Des DVB-T Receivers

Jim Andrews, KH6HTV

HV-110 Receiver (170 - 950 MHz)

HV-120A Receiver (100 - 950 MHz & 1.15 - 2.65 GHz)

HV-122A, Diversity Receiver (0.17 - 2.7 GHz)

The major supplier of DVB-T equipment for USA, ATV hams is Hi-Des in Taiwan (www.hides.com.tw). They supply both modulators and receivers. App. note, AN-42 reviewed the most popular modulator, the model HV-320E, and compared it to the older HV-100EH [1]. App. note, AN-27a, reviewed the HV-120 receiver and compared it to the original HV-110 [2]. Since then Hi-Des has dropped the HV-120 and added a newer receiver featuring dual-diversity, their model HV-122. This application note reviews the

Hi-Des models HV-110, HV-120A, HV-122 & HV-122A. It also discusses in more detail the HV-122 & 122A.

Comparison Table for the 4 Hi-Des Receivers

Parameter	HV-110	HV-120A	HV-122	HV-122A
List Price	$99	$209	$269	$299
Frequency Coverage	170-950MHz	100-950MHz & 1.15-2.65GHz note: 2 separate SMA antenna inputs	170-862 MHz dual antenna inputs	170 MHz - 2.7GHz dual antenna inputs
ATV Amateur Bands covered	70cm & 33cm	70cm, 33cm, 23cm & 13cm	70cm only	70, 33,23 & 13cm
Measured Sensitivity, ** see note	-95dBm, 70cm -93dBm, 33cm	-95dBm, 70cm -96dBm, 33cm -91dBm, 23cm -92dBm, 13cm	-95dBm, 70cm	-88dBm, 70cm -96dBm, 33cm -94dBm, 23cm -86dBm, 13cm
Measured Sensitivity -- with low noise preamp	-98dBm, 70cm	-98dBm, 70cm -97dBm, 23cm	-98dBm, 70cm	-98dBm, 70cm -98dBm, 23cm
Bandwidths supported	2, 3, 4, 5, 6, 7 & 8 MHz	2, 2.5, 3, 4, 5, 6, 7 & 8 MHz	1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, & 8 MHz diversity, 2.5 MHz or higher	1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, & 8 MHz diversity, 2.5 MHz or higher
Inverted Spectrum supported	Yes, Automatic	Yes, Automatic	NO	NO
Diversity Reception	NO	NO	YES, 2 antenna inputs	YES, 2 antenna inputs
Video Coding Formats supported	MPEG-2, MPEG-4 H.264	MPEG-2, MPEG-4 H.264	MPEG-2, MPEG-4 H.264	MPEG-2, MPEG-4 H.264
A/V Outputs	HDMI & composite video + stereo line level audio	HDMI & composite video + stereo line level audio	HDMI & composite video + stereo line level audio	HDMI & composite video + stereo line level audio
Control	IR remote control only	IR remote control & Up/Down channel push buttons	IR remote control & Up/Down channel push buttons	IR remote control & Up/Down channel push buttons
Front Panel Display	2 digit Channel #	2 digit Channel #	2 digit Channel #	2 digit Channel #
On Screen Display S meter in dBm	Yes	Yes	No	No
On Screen Display Signal/Noise dB	Yes	Yes	Yes	Yes
DVR	Yes	Yes	Yes	Yes
Cooling Fan	No	Yes	Yes & No	Yes
DC Voltage	+5 V	+12 V	+12 V	+12 V
DC Current	600 mA	390 mA	450 mA	450 mA

** Note: The sensitivity was measured using "Normal" ATV digital parameters. They are: QPSK modulation, 1080P resolution, 5/6 code rate (i.e. FEC), 1/16 guard, 6 Mbps.
For detailed comments on the earlier models HV-110 & HV-120A, see AN-27a, reference [2].

Other Hi-Des Receivers: Hi-Des sells several other options for the receivers reviewed here along with several other receiver products.

HV-110: There are no other options. The 110 was Hi-Des' original, stand alone, DVB-T receiver. The original version ran off of +5Vdc only. Current production units can be run off of +12Vdc.

HV-120: Besides the "A" version reviewed here, Hi-Des also previously offered two other options (-1.2G & 2.4G) which included a SAW band-pass filter on the front end of the High Band SMA input. With the SAW filter, the high band, frequency coverage range was thus limited to only the 23cm or 13cm band. Hi-Des has now discontinued the 120 in favor of the 122.

HV-122: The standard HV-122 & A versions were reviewed here. The -2.4G version includes a SAW filter and only works on the 13cm band (2.1 - 2.55GHz).

USB TV Tuner Dongles: Hi-Des also sell several USB dongles with model numbers of UT-100, UT-120, UT-130 & UT-160. The USB dongles all require a supporting PC computer. Thus, I feel they are only useful for ATV service in the ham shack. They are not as generally useful as the stand alone units. Plus they are quite expensive, compared to the garden variety of TV tuner dongles, which can be purchased for $25 or less.

Other Receivers: We have found other DVB-T, set-top box receivers that are less expensive than the Hi-Des receivers. The big difference between these consumer grade receivers and Hi-Des is bandwidth. The consumer grade receivers will only do 6, 7 or 8 MHz channel bandwidth. Whereas the Hi-Des receivers can cover from 2 to 8 MHz bandwidths. Doing a Google search for "DVB-T Receivers" will result in a large number of hits from vendors such as Amazon, E-Bay, Alibaba, etc. However, care must be taken as many of them advertise frequency coverage from 50 to 860 MHz, but will not tune the amateur 70cm band (420-450MHz). We have found a few which will however easily tune 70cm frequencies. The specific units we found which definitely do work were:

GT-Media model V7 Plus It typically is selling for $40 to $60. It is a combo receiver for both DVB-T and also DVB-S. On DVB-T it covers both the 70cm and 33cm bands. For DVB-S it tunes L band from 950 to 2150MHz, thus covering the 23cm band. See reference [3]. It runs off of +12Vdc. A wall wart power supply is included.

GT-Media model V7 TT It typically is selling for $25 to $30. It only works on DVB-T, or -T2. It covers both the 70cm and 33cm ham bands. It uses the same menu setup procedure as the V7 Plus [3]. It runs off of +12Vdc. A wall wart power supply is included.

Pantesat model HD99 It typically is selling for $15 to $30. It is only for DVB-T. It too covers both the 70cm and 33cm bands. The tuning procedure described for the GT Media works for it also [3]. It has an attached AC power cord and runs off of 120Vac.

GENERAL COMMENTS on Hi-Des RECEIVERS

Low Latency Mode: The Hi-Des receivers are capable of working in a low latency mode. This feature is important if one is using the equipment to actually fly an R/C aircraft, such as a drone, using the on board camera to actually pilot the aircraft. Otherwise, the typical DTV long latency is a major safety issue. Thus Hi-Des has included this option. One needs to go into the setup menu to activate this feature in the receiver firmware. However, it only works when used with a matching Hi-Des modulator (Hi-Des calls them transmitters) in which the same low latency mode in the firmware has been activated. For general ATV activity with multiple transmitters being used by various ATV hams, one should stay with standard, broadcast DVB-T coding and not use the low latency mode. This allows compatibility with other ATVers.

A word of caution --- Recently, Hi-Des has been shipping their equipment with the special low latency firmware installed. It is **NOT COMPATIBLE** with standard broadcast, DVB-T standards and such signals can not be received on DVB-T receivers from other manufacturers. If you want to be compatible with your other DATV ham friends and their local repeater, you definitely need to be using the standard modulation, not the low latency version.

Thus, when you place your order to Hi-Des via their E-Bay web store, you need to immediately follow-up with an e-mail to Hi-Des. Send the e-mail to Calvin Yang (calvin@hides.com.tw). Inform Calvin that you have just placed an order and request that they not install the low latency firmwave, but instead the standard broadcast firmware.

Digital Video Recorder: A DVR is a nice feature in all of these Hi-Des receivers. There is a slot in the front panel to accept a micro-SD memory card. Pushing the RED button on the provided remote control turns on and off the recording. While recording there is displayed in red in the upper left corner on the monitor screen Rec and a running clock. The DVR requires that there be present a valid TV signal before you turn on the DVR. If you turn on the DVR, as evidenced by the red timer in upper left corner, with no signal present, it will act like it is recording, but no valid data file will result. If you are recording a valid signal, and the incoming signal drops out, to give you a freeze frame, it will not be recorded, even though the red timer keeps running. When the signal returns, it will then be recorded. The resultant video file will thus be of shorter duration than indicated by the on screen, running timer. The recording on the memory card is in .TS format. This is the same as used in conventional DVDs. Each recorded file is up to 262 MB in size. The recordings can be played back on a PC using the VLC program.

Thermal Issues: I found early on dealing with Hi-Des products that they often times had thermal issues. The early units, both receivers and modulators all used the same

enclosure. They did not provide any ventilation holes, etc. They worked OK in a normal room temperature environment, but quickly overheated and shut down if used outdoors in a hot ambient temperature or exposed to bright sunlight. I solved this on my own Hi-Des gear by drilling holes in the top of the extruded housing and adding a small 40x40mm cooling fan. I documented this in my app. note, AN-37 [4]. Since publishing AN-37, Hi-Des then added a tiny cooling fan and some vent holes in the front panel on some of their products. For the HV-122, I put in the table (page 2) the note for the HV-122 "Yes & No". This is because when I tested two recent production (summer 2020) HV-122s for fellow ATV hams, I found that one had the fan while the other one did not. If you happen to get one without a cooling fan, you are advised to add a fan.

Encryption: The Hi-Des modulators and receivers are capable of having their DVB-T transmissions encrypted. This feature should never be activated as it is illegal for USA radio amateurs to use encrypted transmissions.

H.264 vs. MPEG-4 issue: An issue had been discovered in Hi-Des receivers which did not appear in other DVB-T receivers. Normally, any transmission parameter could be changed in an incoming rf signal and the receiver would automatically track it and continue receiving. For example a switch from QPSK to 16QAM would track seamlessly. The issue discovered was if the video encoding was changed H.264 to MPEG-4, the Hi-Des receivers would lock up, if it had originally been trained with H.264. In the fall of 2021, this issue was brought to Hi-Des' attention and they promptly rewrote the HV-110 firmware to resolve it. Updated firmware is available from Hi-Des.

Care When Ordering: Hi-Des offers several different options for the various receivers and modulators. They mainly deal with optimization for a particular frequency band. Be careful to read their E-Bay store listings to be sure you are ordering the version you want. The units Hi-Des ships are unfortunately not labeled as to which option they are.

Comments on the HV-122 Series

In December, 2021, a local ATV ham recently purchased the model HV-122A from Hi-Des. That model was not reviewed in the earlier version of this app. note. He kindly loaned it to us to run an evaluation. The major difference between the 122 and the "A" version is the advertised frequency coverage. 170 to 860 MHz vs. 170 MHz to 2.7 GHz. Thus, with the testing of this "A" version, I decided to revise this app. note. With the exception of frequency coverage, the two versions were identical.

Frequency Coverage: The HV-122 worked at the low spec. limit of 170MHz, but would not work at the high spec. limit of 862 MHz. It did function properly at 850 MHz. The HV-122 only covers the amateur 70cm band for ATV. The HV-110, HV-120A & 122A cover more amateur bands.

Sensitivity: The HV-122 was found to have the same identical sensitivity on the 70 cm band as the HV-110 & HV-120A. The measurements were made using "normal" DATV digital parameters of: 1080P, H.264 encoding, 6 MHz BW, QPSK, 8K FFT, 5/6 FEC & 1/16 Guard. "Live" video with plenty of motion and audio from a DVD was used as the A/V source material. Digital threshold was defined as the lowest possible signal with perfect P5 video and Q5 audio. Dropping another -1dB gave freeze framing and/or total loss of signal [5].

For the "A" version, the sensitivity was very poor on the 70cm and 13cm bands. Here are the results.

70cm band = -88dBm
33cm band = -96dBm
23cm band = -94dBm
13cm band = -86dBm

It should be noted that Hi-Des warns in a small footnote on their web site, the "A" version has very poor sensitivity, down -20dB, from 170 to 700MHz.

If the "A" version is to be used on the 70cm band, I highly recommend that a good, low noise preamplifier be used in front of it.

Low Bandwidths: The HV-122 did work all the way down to 1 MHz bandwidth. I used the HV-320A to generate low bandwidth, DVB-T test signals. At 1 MHz, I was only able to use 360x480 resolution video at 400 kbps. 2 MHz bandwidth worked with 720x480 video at 2 Mbps. 4 MHz bandwidth worked with 1280x720 video at 4 Mbps.

Spectrum Inversion: There is no Hi-Des specification given on the ability to work with inverted sideband DVB-T signals. The HV-122 was tested and found that it **would not work** with an inverted sideband. Both the HV-110 and HV-120A work fine with inverted sideband spectrum and they do it automatically. This can be a project killing issue if using it with some microwave transverters. For details on the measurement to test spectrum inversion, see AN-50a, [6]

dBm S Meter: The HV-122 does not have an On-Screen-Display (OSD) capability for displaying the RF input power level in dBm. Both the HV-110 and HV-120A do have this capability. What the HV-122 does have is a relative signal strength bar graph which can be activated, via the remote control, along with a lot of other digital parameters. This appears as a semi-transparent, gray over-lay on the video image. A calibration curve was run on the HV-122 bar graph. The bar graph has values ranging from 0 to 100%. With no input signal, the background, residual noise level indicated 9%. When performing the sensitivity measurements, the P5 picture digital threshold indicated 15% (at -95dBm, 70cm). From that point on upward, I found that for each 10dB increase in input power level, the bar graph increased 10%. It maxed out at 100% with -4dBm input. Thus, with this calibration curve, one could easily calculate the actual rf input power in dBm.

Diversity Reception: I set up an experiment to verify if the diversity feature really worked on the HV-122. Using the same setup as I used to measure sensitivity, I split the DVB-T test signal into two paths using a 6dB resistive power divider. I put a 20dB, SMA attenuator in one path and connected that to one of the two antenna inputs. In the other path, I put a rotary step attenuator (0-69dB in 1 dB & 10dB steps) and connected it to the other antenna input. I intentionally used different cable lengths to alter the incoming phase between the two antenna inputs. I set the overall test signal level so that the max. input signal to the receiver was about 10dB above the digital threshold. I then rapidly switched the step attenuator through it's range. At 0dB setting, it's signal was the strongest input. When it was 20dB, both antenna signals were equal. When the step attenuator was set > 20dB, it's signal was weaker. As I changed the attenuator settings, the HV-122 receiver never lost lock on a signal. However, I noted that the switching back and forth from one antenna receiver to the other was not seamless. There was always a jerkiness in the displayed video when switching between antenna inputs.

CONCLUSION: *I do not recommend the HV-122 receiver as a 1st choice for amateur radio/TV (ATV) usage, especially for the 70 cm band.* It is more suitable for use with remote control (R/C) aircraft, such as drones. In that environment, the diversity reception is an important feature to be able to track a moving aircraft with constant doppler shift and fading rf signals. Other reasons for my conclusion include: Cost -- it is the most expensive of the 3 receivers. Frequency Coverage -- it only covers the 70cm amateur band. Spectrum Inversion -- For ATV use at microwave frequencies, it restricts the options on available local oscillators. S Meter -- the other receivers have a direct reading dBm S meter.

REFERENCES:

1. "Second, Re-Evaluation of Hi-Des, Model HV-320E, DVB-T, Modulator", Jim Andrews, KH6HTV Video Application Note, AN-42, Dec. 2017, 7 pages

2. "Evaluation of New Hi-Des, Model HV-120A, DVB-T, Receiver", Jim Andrews, KH6HTV Video Application Note, AN-27a, March 2016, 5 pages

3. "Programming for ATV the GT Media V7+, DVB-T, Receiver" Jim Andrews, KH6HTV Video Application Note, AN-58, October 2021, 5 pages

4. "Thermal Issues with Hi-Des, DVB-T, Equipment", Jim Andrews, KH6HTV Video Application Note, AN-37, March 2017, 3 pages

5. "Measuring ATV Receiver Sensitivity & Received Signal Strength", Jim Andrews, KH6HTV, -- Boulder Amateur TV Club -- TV Repeater's REPEATER, club newsletter, issue #46, June, 2020, pp. 6-9. available at: https://kh6htv.com/newsletter/

6. "Is DVB-T Sideband Sensitive ?", Jim Andrews, KH6HTV Video Application Note, AN-50a, July, 2020, 3 pages