



Application Note

AN-18d

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Notes on Setting Up Hi-Des DVB-T, Modulators & Receivers

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Programming Notes for Modulators -- start on page 3.

Programming Notes for Receivers -- start on page 10

Hi-Des Firmware Issues:

We have a major problem with equipment now coming from Hi-Des in Taiwan. Often times it is being shipped with Low Latency firmware installed. Hi-Des is trying to sell to the drone market and long latency (i.e. delay) with digital video is a major deterrent for drone pilots. Unfortunately the low latency firmware does not meet DVB-T commercial broadcast standards. Thus, a Hi-Des, low latency DVB-T signal will not decode in other manufacturer's DVB-T receivers, nor Hi-Des receivers with standard firmware. It can only be received by a Hi-Des receiver with the special firmware installed. Likewise a Hi-Des receiver with the low latency firmware will not decode a broadcast standard DVB-T transmission. This makes it incompatible with DVB-T Amateur TV repeaters which all try to adhere to broadcast standards. If you are experiencing such issues, contact Calvin Yang at Hi-Des (calvin@hides.com.tw) or customer support at sales@hides.com.tw and request he send you the proper firmware. You will need to follow the detailed instructions in the manual to install the correct firmware.

(note added 23 Sept. 2021)

If you are purchasing new equipment from Hi-Des via their E-Bay, then send an e-mail to Calvin immediately after you placed your order on E-Bay. Inform Calvin of your purchase and request that he make sure the proper firmware is installed in your equipment.

(note added 24 Nov. 2021)

Application Note, AN-17, introduced the reader to the DVB-T products from the Taiwan company, Hi-Des Technology (www.hides.com.tw) [1]. Hi-Des does supply good, detailed instruction manuals with their products. The purpose of this note is to give more details on how to initially set up the Hi-Des equipment for Digital Amateur Television service (DATV). Four Hi-Des models will be discussed in detail as they are the most often used for amateur TV. They are: Modulators, HV-320E & HV-100EH and

Receivers, HV-120 & HV-110. See Figures 1-4. The models HV-100EH & HV-110 were Hi-Des' original offerings and are still available in 2019, selling for \$560 & \$125 respectively. The models HV-320E and HV-120A are newer, improved versions, selling for \$369 & \$209 respectively. The setup for both the older and newer versions are similar.

Note added 9/2021: Hi-Des has discontinued the HV-120A, although it is still listed on their web site, but no longer available for sale on their E-Bay site. They are now pushing the HV-122 instead. For a comparison of the 110, 120 and 122, see AN-57a [9]



Fig. 1 Hi-Des model HV-320E, DVB-T Modulator (100MHz - 2.5GHz)



Fig. 2 Hi-Des model HV-100EH, DVB-T Modulator (50-950MHz & 1.2-1.35GHz)



Fig. 3 Hi-Des model HV-110, DVB-T Receiver (170-950 MHz)



Fig. 4 Hi-Des model HV-120A, DVB-T Receiver (100-950MHz & 1.15-2.65GHz)

KH6HTV Video has done exhaustive testing and evaluations of these modulators and receivers. See references [1-5 & 7] for more details on them.

Customer Support: Hi-Des in Taiwan is a very reputable supplier of quality DVB-T equipment. We highly endorse their products. Orders to Hi-Des can be placed via the E-Bay store and paid for by credit card. Their prices include shipping by air to the USA. Delivery times are usually much quicker than quoted by E-Bay. Hi-Des has excellent customer support via e-mail. If you have any issues, you are unable to resolve, then send an e-mail to Calvin Yang at calvin@hides.com.tw

Firmware: The Hi-Des firmware used in the examples shown in this app. note were: HV-110/120 Receivers = 5.72.156. HV-100/320 Modulators = AVSender 7/11/19



Fig. 5 Rear panel of the HV-320E Modulator

Notes on Programming the HV-100EH & 320E Modulators

The Hi-Des modulators are programmed over a USB cable from a Windows PC computer. For the HV-100, a type B USB port is on the rear panel. For the HV-320, the rear panel port labeled UART is used along with the special USB adapter cable supplied by Hi-Des. Hi-Des supplies the necessary software on a CD disc with the modulator. Copy the contents of the disc into a file folder on your PC. Open the file folder labeled HV-320 Tx User's Guide. Here you will find two .pdf files. One is the spec. sheet,

while the other is the instruction manual. First, always read the Hi-Des instruction manual. Comments here are supplemental to the manual. These notes apply to both the HV-100 & 320 models.

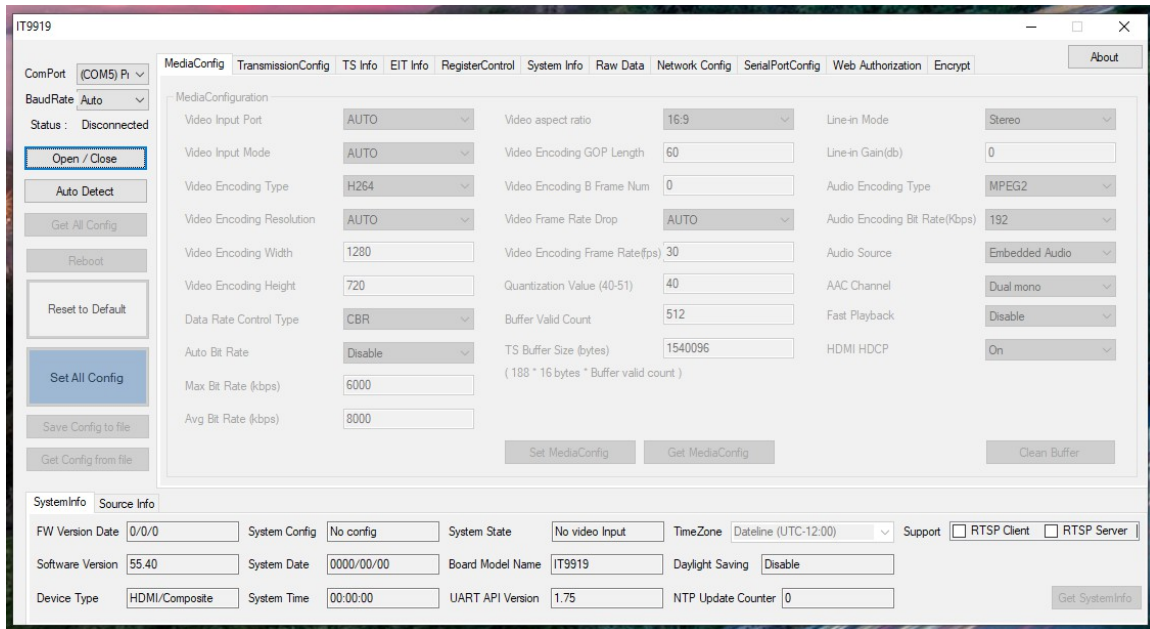



Fig. 6 Initial start-up screen for AVSender

With the modulator powered on, connect it to the PC via the USB cable. To program the modulator, the Windows program called "AVSenderUARTGUI" is used. It is found in the file folder labeled HV-320 Tx User's Guide. Click on the icon  to start the program. Fig. 6 shows what will appear on your PC monitor screen initially.

The screenshot shows the AVSender software interface. The top menu bar includes tabs: MediaConfig, TransmissionConfig, TS Info, EIT Info, RegisterControl, System Info, Raw Data, Network Config, SerialPortConfig, Web Authorization, Encrypt, and About. The left sidebar contains buttons: ComPort (COM5) P1, BaudRate 38400, Status: Connected, Open / Close, Auto Detect, Get All Config, Reboot, Reset to Default, Set All Config, Save Config to file, and Get Config from file. The main area is titled 'MediaConfiguration' and contains various settings for video and audio. The bottom section has two tabs: SystemInfo and Source Info, with fields for FW Version Date, System Config, System State, Time Zone, Daylight Saving, Device Type, System Date, Board Model Name, UART API Version, and NTP Update Counter.

Fig. 7 AVSender after "Get All Config"

The next step is to have AVSender connect to the modulator. First click on the "Auto Detect" button. It will search the various COM ports. If successful, it will then give a message "Found AVSender at Com X". Next click on "Open" button. You should then get a message saying you are connected to the modulator. The next step is then to read the current state/configuration of the modulator. To do this click on "Get All Config". After interrogating the modulator, all of its various parameters will now be displayed on AVSender, Fig. 7. There are actually a whole lot of page tabs which contain all of the data. They are labeled at the top as "Media Config, Transmission Config", "TS Info", etc. At the bottom there are two tabs. "System Info" gives the firmware version, etc. Clicking on "Source Info" will give you the various parameters of an incoming A/V signal. If this is the first time operation of your new modulator, it is highly recommended that before you do anything else, you save the initial factory settings. To do this, click the "Save Config to File" button. You can then give a name to the file which you save on your PC.

For normal amateur TV service, you will not be concerned with any of the various tab pages, except Media Config, Transmission Config, and TS Info. Do NOT change any of the factory preset parameters on any of the other pages.

Application Note, AN-39, gives a list of the "DVB-T Recommended Parameters" which we have found to work well for amateur DTV service. [6] It discusses in detail what these parameters are and their effects. Also recommended reading is AN-42, [7], which is a technical review of the HV-320E.

MediaConfiguration	
Video Input Port	AUTO
Video Input Mode	AUTO
Video Encoding Type	H264
Video Encoding Resolution	1920x1080
Video Encoding Width	1920
Video Encoding Height	1080
Data Rate Control Type	CBR
Auto Bit Rate	Disable
Max Bit Rate (kbps)	6000

Line-in Mode	Stereo
Line-in Gain(db)	0
Audio Encoding Type	MPEG2
Audio Encoding Bit Rate(Kbps)	96
Audio Source	Embedded Audio
AAC Channel	Dual mono
Fast Playback	Disable
HDMI HDCP	On

Fig. 8 Media Page -- important settings

MEDIA PAGE: Set the parameters shown above in Fig. 8. After making these changes, then click on the "Set Media Config" button. If you fail to click the "Set" button, any changes made on AVSender will not be entered into the modulator.

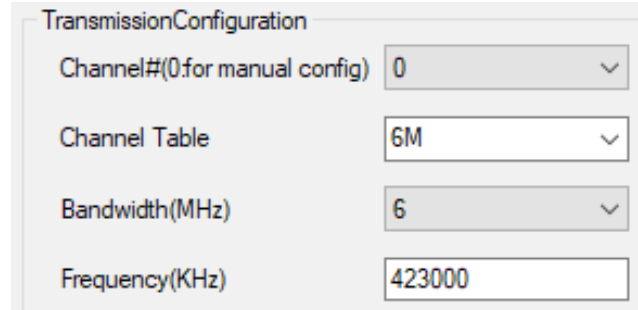
Note: sometimes when hitting the "SET" button to move data into the modulator, the spiraling 'circle of death' will run for awhile and then finally give a message "Set XX Time Out !". Don't worry about it, just click "OK". This is a bug in AVSender.

TS Info PAGE: Fig. 9
Next click on the tab for "TS Info" page. On this page, the only parameter to change is "Service Name". Enter here your own amateur radio call sign. Now click on the "Set TS Info Config" button.

LCN	0
Service Name	KH6HTV
Provider	Jim
PMT PID(hex)	0x 640

Transmission Config Fig. 10
Now click on the tab for the "Trans Config" page. We will change a lot of parameters on this page. First change the Constellation to QPSK, FFT to 8K, Code Rate to 5/6 and Guard Interval to 1/16. As you change these the Modulation Data Rate box will be automatically updated. Ignore the RF attenuation box for now. Now click on the "Set Trans Config" button.

Constellation	QPSK
FFT	8K
Code Rate	5/6
Guard Interval	1/16
RF Attenuation/Gain(db)	-14
Modulation Data Rate(Mbps)	7.32



The image shows a software window titled "TransmissionConfiguration". It contains four settings, each with a label and a control element:

- Channel#(0 for manual config)**: A dropdown menu showing the value "0".
- Channel Table**: A dropdown menu showing the value "6M".
- Bandwidth(MHz)**: A dropdown menu showing the value "6".
- Frequency(KHz)**: A text input field containing the value "423000".

Fig. 11 Setting Channel 0 Frequency

SETTING MODULATOR FREQUENCY (Channel 0):

For the first time operation of your modulator and receiver, it is important to be able to set both of them to a known frequency. Eventually we will install a table of various amateur TV frequencies (channels), but to first learn how to use the modulator, we will only focus on a single frequency. Even when using pre-programmed channel tables, it is always possible to input into the Hi-Des modulators a new, different operating frequency. This is always put into channel # 0.

To learn how to use the Hi-Des modulator and receiver, we will first program them to work on the lowest TV channel in the 70 cm amateur band. On the Transmission Configuration page, first set Channel Table to "6M". Set Channel # to 0. Set Bandwidth to 6 MHz and set Frequency to 423000 (kHz) (i.e. 423 MHz). Now click on the "Set Trans Config" button to enter the data into the modulator.

At this point, the modulator should now be outputting a valid DVB-T rf signal on 423 MHz with a 6 MHz bandwidth. The front panel LED display should show "00". You should also have a live video source connected to the modulator. It can either be a digital HDMI (preferably) or an analog composite video signal. Suitable sources are a TV camera, or DVD player, or the HDMI monitor output from your PC computer. If you have a valid incoming video signal to the modulator, a green LED will illuminate on the HV-320 front panel.

You should now skip forward in this application note to the section on setting up your Hi-Des receiver. You now have a valid RF signal to train your receiver to the first 70 cm TV channel at 423 MHz. After you are successful in receiving this 423 MHz DTV signal, then return back here to the next section on installing a Channel Table.

KH6HTV CustomChannelTable 8-2018 - Notepad

File	Edit	Format	View	Help
0, 423000, 6				
1, 423000, 6				
2, 429000, 6				
3, 435000, 6				
4, 441000, 6				
5, 447000, 6				
6, 909000, 6				
7, 912000, 6				
8, 915000, 6				

Fig. 12 Example of a custom channel table (partial list shown)

INSTALLING A CUSTOM CHANNEL TABLE

It is recommended that you next install in the modulator, a custom channel table with all of the frequencies (i.e. channels) which you would like to use. They should at least be the standard, five, 6 MHz, channels in the 70cm band (423, 429, 436, 441 & 447MHz). The table is created as a simple comma seperated, text (.txt) file with the format shown in Fig. 12. Each line contains the channel number, frequency in kHz, and bandwidth in MHz. The table must contain 100 entries starting at channel 0 and ending at channel 99. If you don't need that many, the table can be simply padded out by repeating the last entry.

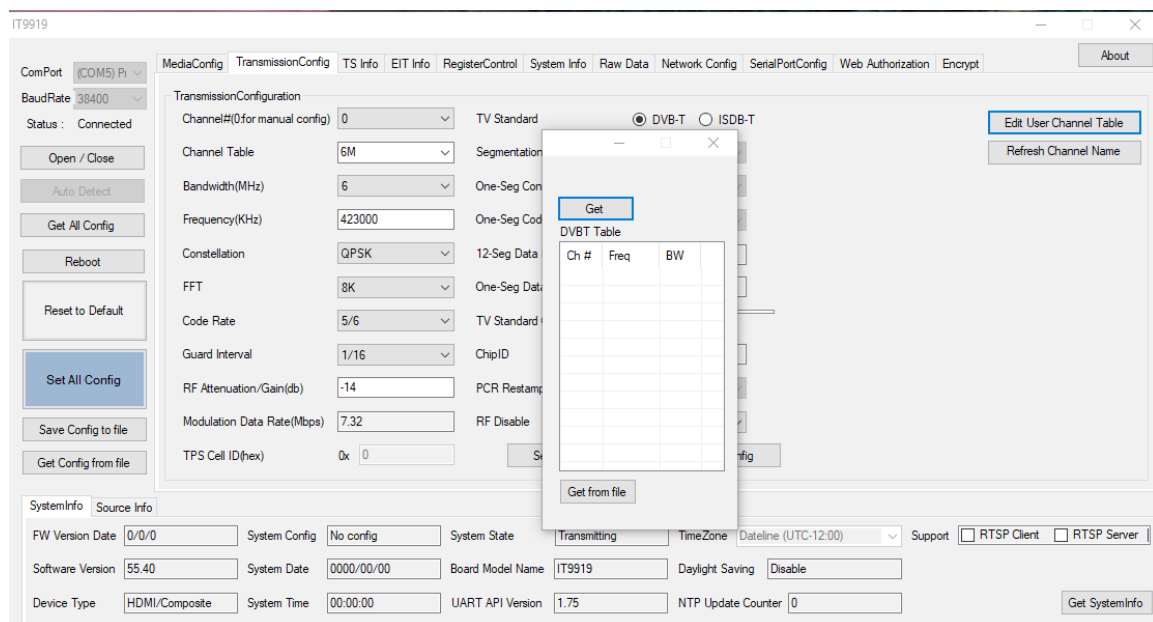
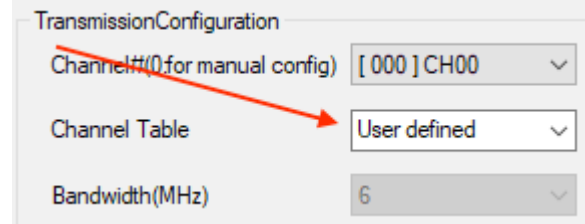


Fig. 13 First step to add a custom channel table

Fig. 14

In AVSender, open the Transmission Config page. For Channel Table, select "User Defined". Next click on the "Edit User Channel Table" button. (upper right corner). This will activate an



overlay page as shown in above Fig. 13. On this overlay, click the "Get from file" button. This opens up the finder menu where you enter the name of your previously created text file with your own custom channel table. The overlay will now contain your table, displayed in red type, as shown in Fig. 15. The last step is to click on the "Set" button on the overlay page. This loads the new custom channel table into the modulator's memory. You may now close out the overlay by clicking on the "X".

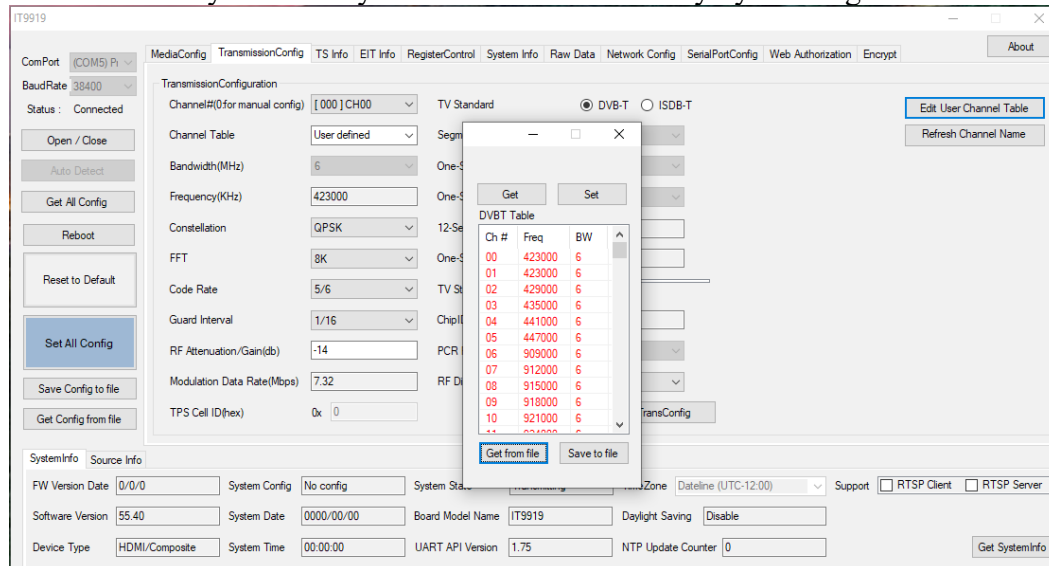
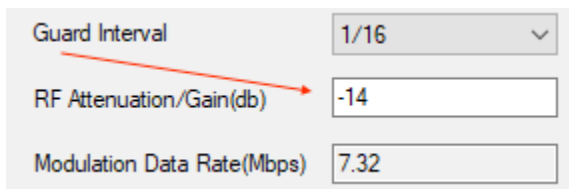


Fig. 15 Example of a custom channel table ready to be loaded into the modulator

RF Attenuation:

Fig. 16

The only last parameter to be set in AVSender is the internal rf attenuator in the modulator. This is an adjustment of the rf output power. This parameter does



not need to be set at this time. Later when the modulator is used with an RF linear power amplifier, you will need to set this for the proper drive level to the amplifier. Consult the test report which came with your amplifier to determine what the proper setting should be.

When you are finished programming the various parameters in the modulator, click on the "Open/Close" button on AVSender to disconnect from the modulator. You may then shut down AVsender and remove the USB cable from the modulator.



Fig. 17 Rear panel of an HV-120, DVB-T Receiver

Notes on Programming the HV-110 & 120 Receivers

First, always read the Hi-Des instruction manual. Comments here are supplemental to the manual.

Monitor: Connect your receiver to a video monitor using an HDMI cable. Turn on both the receiver and monitor. Note: there is no on/off power switch on the Hi-Des receiver. It is powered up simply by plugging in the 12Vdc wall wart. (5Vdc for the HV-110) All communication with the receiver is done via the supplied remote control.

Firmware: Make note of which version of firmware is installed in your receiver. On the remote push the *Menu* button. Then select in order *Tools --> System Information --> OK* to display the current installed firmware revision. To quit this screen, push the *Exit* button on the remote.

Settings: Before proceeding further, it is important to set up the display preferences. On the remote push the *Menu* button, then select *Settings --> Display Preference*. You will now be presented a table with many parameters to be set. For DATV service, I recommend you start with the following:

Display Mode = 1080P60
 Aspect Ratio = 16:9 Full Screen
 Video Output = CVBS
 PAT Mismatched = Disable
 Signal OSD = ON

RF Key = leave at factory default (00000000)

Low Latency Mode = OFF

Decrypt Mode = OFF

Decrypt Start Byte = leave at factory default (004)

Decrypt Key = leave at factory default (00000000-00000000-00000000-00000000)

Notes on above Settings:

1. Display Mode: If you will be using an older analog monitor with the composite video output rather than HDMI, you must set this to 480I60. Otherwise, set to match your HDMI monitor's resolution.
2. Video Output: CVBS enables the composite video output, with 480i resolution
3. PAT: If the Program Association Tables, i.e. PAT, are mismatched, then your receiver will not display any video. Thus, disable this feature.
4. OSD: i.e. On Screen Display of frequency/bandwidth, station call sign, received signal strength and signal/noise ratio. This can later be set to OFF, but it will be useful for initial work. You can also temporarily turn it off with the remote control. For more details on the OSD, see pages 15-16.
5. Low Latency: This must be OFF to work with all standard DVB-T transmitters. Hi-Des added this feature for flying drones. When activated, it requires using a matching Hi-Des transmitter.
6. Decrypt: Do NOT use encryption with your transmitter and receiver. Per FCC rules for the amateur service, encryption is illegal.

After making the above proper settings, do not forget to push the "OK" button to save your new settings before exiting.

Channel Programming: Unfortunately, like most modern digital TV receivers, the Hi-Des receivers are "dumb" to start with. Too bad, that modern digital TVs are not as easy to use as the the old analog sets, but we have to live with them. They must be trained to receive a DTV signal by being exposed to a real DTV signal on the proper frequency during the "set-up" process. If the receiver finds the real DTV signal, during setup, it then remembers it in it's channel table memory, for future use. If not, then you are out of luck -- the receiver will never tune to your desired frequency.

While Hi-Des' receivers come with an assortment of various channel tables for various countries, plus the ability to load a custom channel table using a micro SD card, I have not found them useful and trying to use them sometimes hoses the unit and I have had to completely reload the firmware, etc. The following is the procedure that I have found to always work. It is tedious if you want to load a large number of channels (frequencies), but it does work.

To train your new Hi-Des receiver, it is mandatory that you provide it with an actual, valid DVB-T, rf signal on the correct desired frequency, with the correct desired bandwidth. This is most easily done by having a DVB-T modulator (such as the HV-100 or HV-320) sitting on your test bench to be used as an rf signal source. A live video source with motion and audio should be connected to the modulator. A still, quiet image

can be confusing as you will not know when you have a freeze frame vs. a real active picture. I suggest using a DVD player to provide live action, for both video and audio. Use a coax cable to connect directly the modulator to the proper SMA antenna input on your receiver. I recommend you also use a 20 dB attenuator between the modulator and receiver to avoid overloading the receiver's input circuit. Lacking a suitable DVB-T modulator, you will need to find another DATV ham friend with one to program your receiver for you. The first part of this application note explained how to set up your modulator and put it on a known frequency.

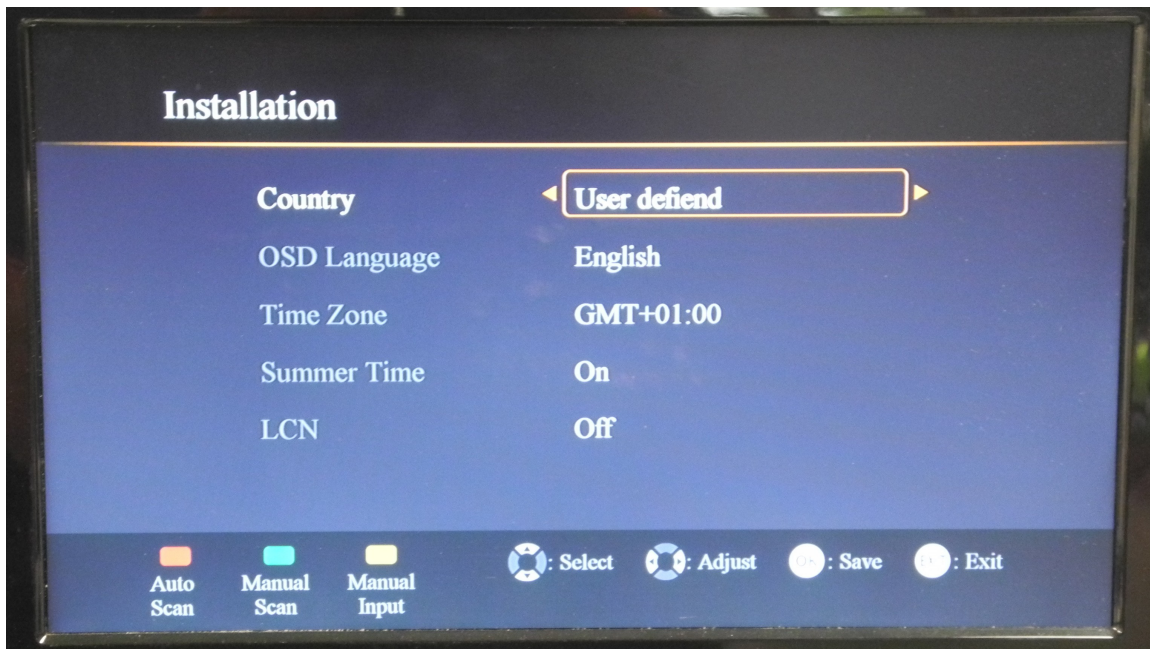
For your first time experience with DVB-T, I recommend you start out by programming your receiver to the most commonly used 70cm, amateur band, TV channels. These follow the USA commercial TV practice of 6 MHz wide channels and will be on cable TV channels 57 thru 60. So first install these

Channel #	Bandwidth in MHz	Center Frequency in kHz
1	6	423000
2	6	429000
3	6	435000
4	6	441000

Now with your modulator connected to the receiver and set to 423 MHz / 6 MHz BW -- follow exactly this procedure. Actual photographs were taken of an HV-110's monitor screen to visually demo the necessary steps in the procedure. All programming of the Hi-Des receivers is done using the supplied remote control.



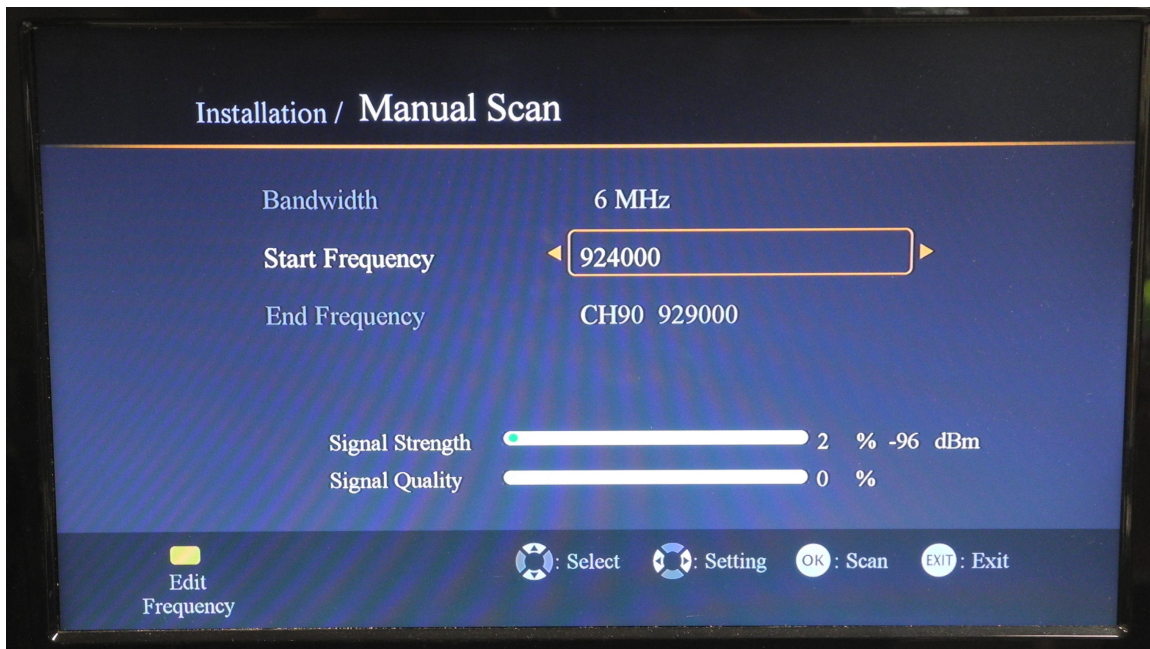
Step 1. On the remote control, push the *Menu* button. Select *Installation*. Push OK.



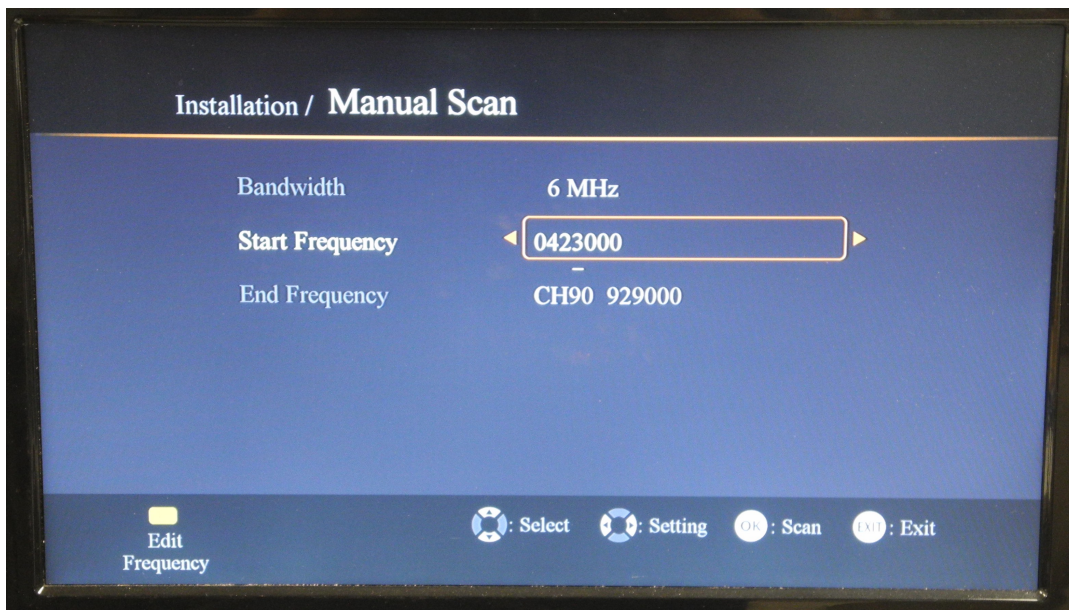
Step 2. For country, use the right/left buttons on the remote to display *User Defined*. Do NOT push the OK button. Now on the remote control, push the GREEN button for manual scan. This brings up a new screen



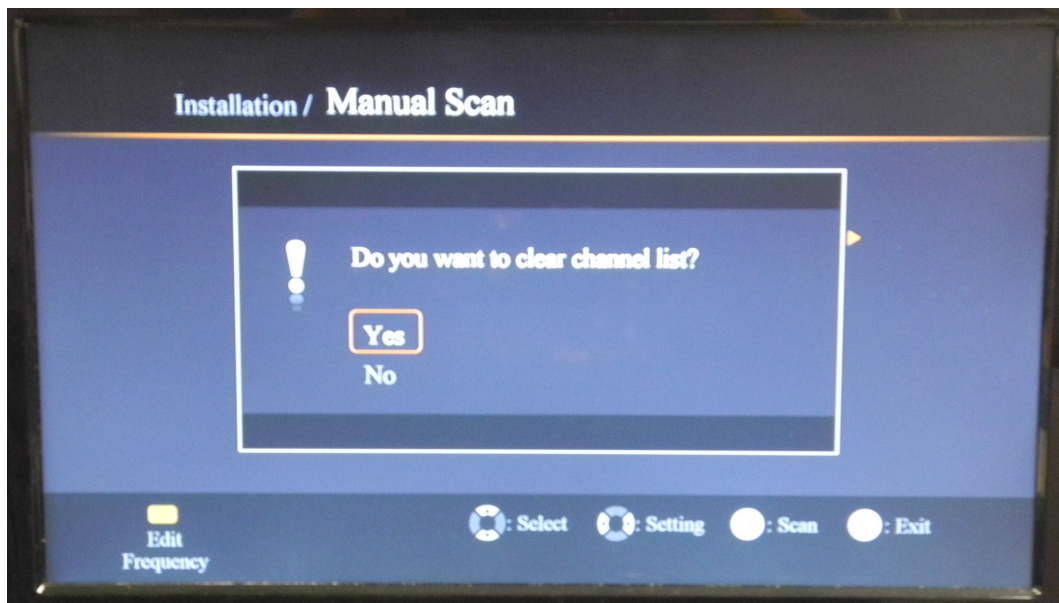
Step 3. With Bandwidth highlighted, use the right/left buttons to display 6 MHz as shown



Step 4. Next, use the down button on the remote to highlight Start Frequency. The frequency displayed will be arbitrary and will need to be changed. Now push the YELLOW button on the remote to Edit Frequency.



Step 5. After pushing the Yellow button to *Edit Frequency*, a cursor underscore will appear under one of the highlighted numbers. Use the left/right buttons to move the horizontal position of the cursor to the desired digit. Then use the up/down buttons to change the value of the desired digit. The center frequency of the channel to be programmed must be entered in kHz. For the example shown, we are entering the lowest, 70 cm TV channel of 423 MHz, i.e. in kHz, 0423000. When you have the correct bandwidth and frequency set, then and only then, push the OK button to scan. Ignore the End Frequency line.



Step 6. As soon as you hit the OK button, this screen will appear. When you are programming your very first channel, you will select YES and then hit OK. For all succeeding channels, # 2 and higher, **ALWAYS SELECT NO !** If you select Yes, it will wipe out all channels previously stored.



Step 7. If you were successful in storing your first channel, the receiver should then display on the monitor the live tv picture being received. Having the On Screen Display (OSD) activated will give you confirmation that you have the correct frequency and bandwidth. See the upper left corner box.

Programming Additional Channels: After you have successfully programmed Ch 01 into your receiver -- to add additional channels follow the above steps 1 through 7 again. But first set your modulator to the next desired frequency & bandwidth. It is very important that when you arrive at step #6 which asks "Do you want to clear channel list?" -- **you must answer NO.** If you answer Yes, then your whole previously stored channel table will be wiped out. On entering channels 2 and higher, after a successful scan, the receiver automatically returns back to channel (memory) #1. You will then need to use the remote control's Ch+ Ch- keys to go to your desired channel to verify you are receiving a valid picture. Always verify proper reception, before moving on to programming the next channel.



Fig. 18 HV-110 or HV-120 On Screen Display

ON SCREEN DISPLAY: A nice feature of both the HV-110 and HV-120 for determining your RF path propagation characteristics is the "Signal Statistics" On Screen Displays (OSD) which provide a lot of details about the incoming signal. Pushing the Green button on the remote control gives a lot of details. However, it overlays the desired picture and "grays" it out. Pushing the Yellow button on the remote gives a brief description of the signal, including: frequency, bandwidth, Signal Quality, Signal Strength, etc, but also grays out the screen image.

The most useful OSD diagnostic is to push the Yellow button on the remote control twice. This gives you the normal received picture, but also places four small boxes in the corners of the screen. See Fig. 18 above. In the upper left is the center frequency and bandwidth. In the lower left is the ID call sign of the station being received. In the upper right corner is the received signal strength in dBm. In the lower right corner is the received signal to noise ratio in dB. Pushing the Yellow button the third time turns off these OSD boxes.

The signal strength calibration of the HV-110 in a lab environment with only one signal present was found to be extremely accurate within ± 1 dB over a range from -10 dBm to -90 dBm. Signals weaker than -90 dBm were not accurately measured. In a typical field environment with multiple signals coming in from an antenna, the dBm reading tends to read the composite power of all the input signals.

The OSD signal strength display of the HV-120 was found to have a very large error. It's linearity was good. It tracked 1 dB change in input gave 1 dB change in the OSD. The actual OSD values displayed were found to have a large offset error. It reads +14 dB too high on 70 cm and +25 dB too high on 23 cm.

The S/N reading is useful for understanding the quality of the incoming signal and the amount of error correction needed. Under perfect conditions, the max. s/n reading is 23 dB, for QPSK. When the s/n drops down to 7 to 8 dB, the receiver can no longer decode the signal. (for QPSK, FEC = 5/8, Guard = 1/16). With more aggressive FEC and Guard Intervals, a worse (i.e. lower) s/n can be tolerated. For 16QAM, the max. s/n = 26 dB, while for 64QAM, the max. s/n = 29 dB.

REFERENCES:

1. "How to Receive Amateur Digital, DVB-T Television Signals", Jim Andrews, KH6HTV Video Application Note, AN-21d, May, 2018, 8 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. "Evaluation of New Hi-Des, Model HV-320E, DVB-T Modulator" Jim Andrews, KH6HTV Video Application Note, AN-28a, April, 2016, 14 pages
4. "DVB-T Receiver Sensitivity Measurements" Jim Andrews, KH6HTV Video Application Note, AN-29, June, 2016, 5 pages
5. "Thermal Issues with Hi-Des, DVB-T Equipment" Jim Andrews, KH6HTV Video Application Note, AN-37, March, 2017, 3 pages
6. "DVB-T Recommended Parameters" Jim Andrews, KH6HTV Video Application Note, AN-39, June, 2017, 9 pages
7. "Second, Re-Evaluation of Hi-Des Model HV-320E, DVB-T Modulator" Jim Andrews, KH6HTV Video Application Note, AN-42, Dec. 2017, 7 pages
8. "Introduction to Amateur Digital Television" Jim Andrews, KH6HTV Video Application Note, AN-45, Aug. 2018, 30 pages
9. "Comparison of Hi-Des DVB-T Receivers", Jim Andrews, KH6HTV Video Application Note, AN-57a, Sept. 2020, 6 pages

Note: All of the above application notes are available free for down-loading in .pdf format from the web site: <https://kh6htv.com/application-notes/>