**Application Note
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web = www.kh6htv.com   email = kh6htv@arrl.net

Evaluation of SatLink
WS-6990, DVB-T Modulator

Jim Andrews, KH6HTV

Fig. 1   SatLink model WS-6990 DVB-T Modulator

For several years now, USA ATV hams have been experimenting with the European digital TV broadcast standard called DVB-T.   Our primary supplier of equipment has been the Hi-Des company in Taiwan (www.hides.com.tw).   Recently it has come to our attention that a Chinese manufacturer called **SatLink** now has a low cost modulator available for sale on the internet. The FuJian Satlink Electronics company web site is: www.sat-link.com.cn   I have purchased their model WS-6990 for evaluation.   This application note is a summary of my observations.

Unlike Hi-Des, which sells directly to the consumer for a fixed price, the SatLink model WS-6990 is not sold directly by the company. Instead it is sold by many on-line retailers via the internet most of whom are in China.   A google search for it will come up with a lot of "hits".   The prices range all over the place from a low found of $130 to a high of $265.   It is sold on E-Bay, Alibaba and Aliexpress.

The **key major difference**, aside from price, between the SatLink and Hi-Des DVB-T modulators is **Band-Width**.   Hi-Des offers selectable band-widths from 1 to 8 MHz. The SatLink only offers the commercial broadcast standards of 6, 7 or 8 MHz.   Thus for those ATV repeater groups using band-widths narrower than 6 MHz, the SatLink modulator is not an option.

SatLink Model WS-6990 Specifications

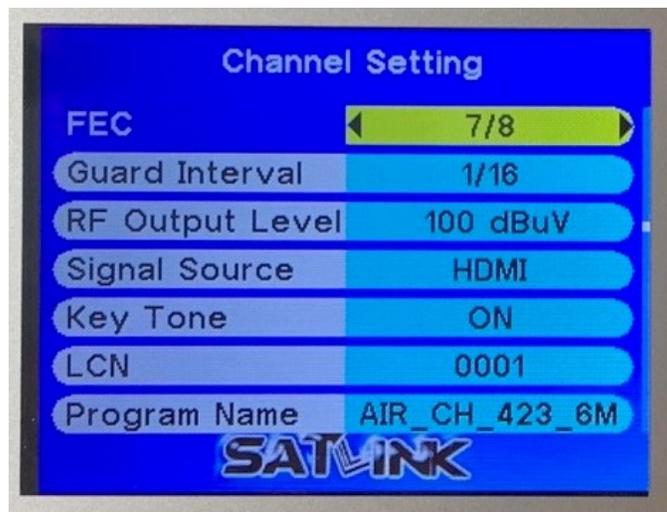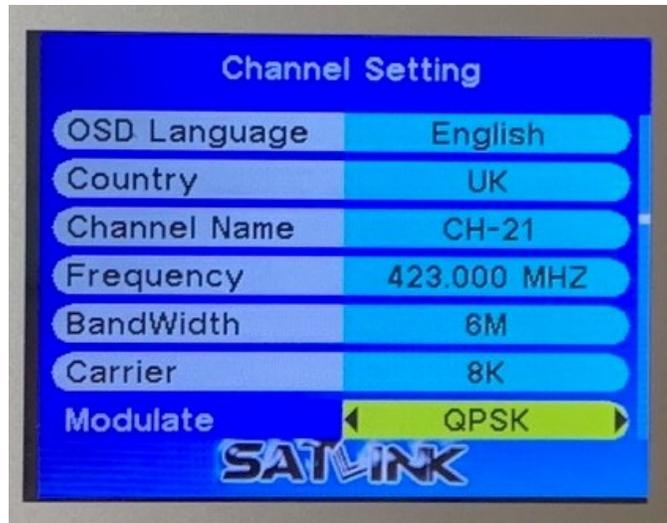|	
Modulation Standard	DVB-T (COFDM)
Constellation	QPSK, 16QAM or 64QAM
Band-Width	6, 7 or 8 MHz
Carriers	2K or 8K
Guard Interval	*1/4 1/8 1/16 1/32*
Code Rate	1/2 2/3 3/4 5/6 7/8
MER	35 dB
Frequency Range	50 MHz to 860 MHz
Output Level	70 dBμV to 100 dBμV
Output Impedance	75 Ω
Video Compression	H.264 bit rate 5 to 15 Mb/s
Video Resolution (CVBS)	576i PAL or 480i NTSC
Video Resolution (HDMI)	1280 x 720P (50/60) to 1920 x 1080 i or P (50/60)
A/V Inputs	HDMI or Composite Video plus line level stereo audio
Power Source	12Vdc @ 1.5 Amps

Fig. 2   WS-6990 Menus

VIDEO ENCODING: The WS-6990 only does H.264.   It does not support the older MPEG-2.

AUDIO ENCODING: The manual for the WS-6990 does not mentioned what encoding standard is used.   The Hi-Des units supported ACC,   AC3, and MPEG-2. Searching the internet, I found one site which said the WS-6990 used MPEG-1, audio layer II.

HDCP: The WS-6990 manual cautions -- "HD program which contains HDCP agreement protection will not play normally, such as Blu-Ray disc and so on."   I found the 6990 would not accept any video input from a DVD player on it's HDMI input.   It will accept video from a camcorder.   The work around for this issue is to use the analog, composite video output from your DVD player.

INITIAL SET-UP: The photos on the previous page show you the 3 pages of the WS-6990's menu structure.   When you first turn on the new WS-6990, it will come up with the initial Factory Settings.   They will probably be: language = English, country = UK, channel = Ch-21, frequency = 474 MHz, band-width = 8 MHz, etc.   It is well before making any changes to note what all of these settings are.   Now assuming you plan to use the modulator for amateur digital TV on the 70cm band, you will need to change some of these settings before testing.   In particular, the frequency.   You are able to enter any arbitrary frequency between 50 and 860 MHz.   The resolution is to 1 kHz.

You navigate around the menu and make data entries into it using the six push-button keys to the right of the LCD display screen.   They are: Up, Down, Right, Left, OK and Return.   When the unit is initially powered up the screen will light up.   After the unit has been on for awhile with no data entry, the screen will power down and go black.   Don't worry, this is normal.   Simply push the OK button to activate the screen again.   Then use the Up/Down buttons to select the menu item desired.   To change a menu setting, use the Right/Left buttons to scroll to the desired value, then hit the OK button to enter it. For menu line items which require numerical entry, such as Frequency, you will use the Right/Left buttons to select the desired digit and then the Up/Down buttons to scroll through the numbers 0 to 9.   For menu line items which require alpha-numeric entry, you will be presented with a table of letters and numbers to select from with the Up/Down, Right/Left buttons.

When you are finished making data entries in the menu and you want to save them, push the Return button.   The unit will then ask you "Settings were changed.   Do you want to save?" You then must select either Yes or No and push OK.   The display will then show the same as in Fig. 1

DOES IT WORK ?   When I first setup my new WS-6990 to use with our Boulder W0BTV, ATV repeater, I used our normal settings of: 441 MHz, QPSK, 8K, 5/6 code rate (FEC), 1/16 guard.   My home "combo" DVB-T receiver immediately said it was receiving a strong signal, but **NO video nor audio, just a black screen**.   What was the issue ?   Well the issue was improper settings for the various IDs found on page

3 of the menu. They are NID, ONID, TSID and SID. The factory settings were set to: 12289, 0918, 50804, & 13374.   So just what did these numbers represent?   I thus went to my Hi-Des HV-320E modulator and examined the various settings on it.   In particular on the AV-Sender application, I examined the TS page.   See Fig. 3.   It had a great number of parameter settings, and they included NID, ONID, TSID and SID.   They were all Hex numbers and had the same identical value of "1A7".   The values in the WS-6990 menu didn't look like hex numbers, so I went to the internet and found a Hex/Decimal converter.   Converting 1A7 in hex gave 493 in decimal.   So I entered the value 00493 into the WS-6990 ID menus and tried the modulator again.   Bingo, it worked and put out a usable DVB-T signal which I was able to receive on my "combo" DVB-T receiver.   However, it did NOT work with my Hi-Des HV-110 receiver.
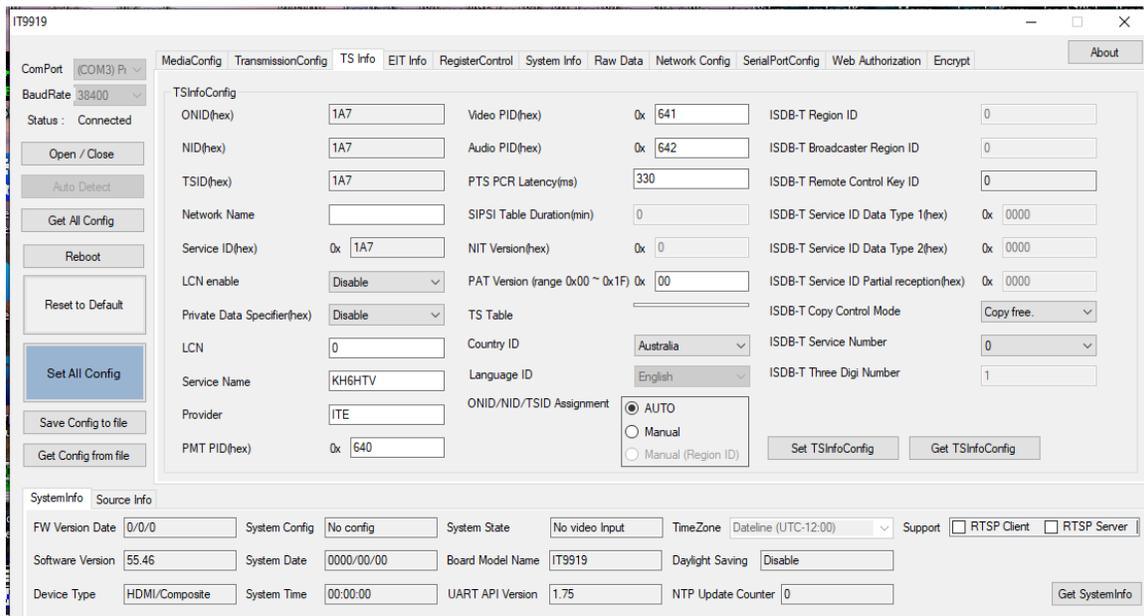

Fig. 3   AV-Sender program for the Hi-Des modulators.   TS Info page showing the settings for the various IDs.

As seen in Fig. 3, in addition to ONID, NID, TSID and SID, there are also PMT PID, Video PID and Audio PID.   All of these IDs can be programmed in the Hi-Des modulators.   The SatLink WS-6990 does not provide in it's menu the ability to program the PIDs.   The "info" button on the Hi-Des HV-110 receiver gives diagnostics on the incoming signal. It showed all of the parameters of the WS-6990 to be correct as set. But it also showed that all of the PIDs were set to hex 0 x 7d1.   I next tried to retrain the HV-110 receiver.   I deleted it's channel memory and tried to retrain it on the WS-6990's DVB-T signal. No Luck !   It wouldn't accept it.

BOTTOM LINE: *If your ATV repeater group is already using Hi-Des equipment, you will not be able to integrate the SatLink WS-6990 into your group.   If your group is just getting started and considering various options, then the lower cost, SatLink modulator and the consumer grade*

"combo" receiver are an acceptable pair which will work together, but not with Hi-Des equipment. But you must use 6 MHz band-width. You can not use any narrower band-width.
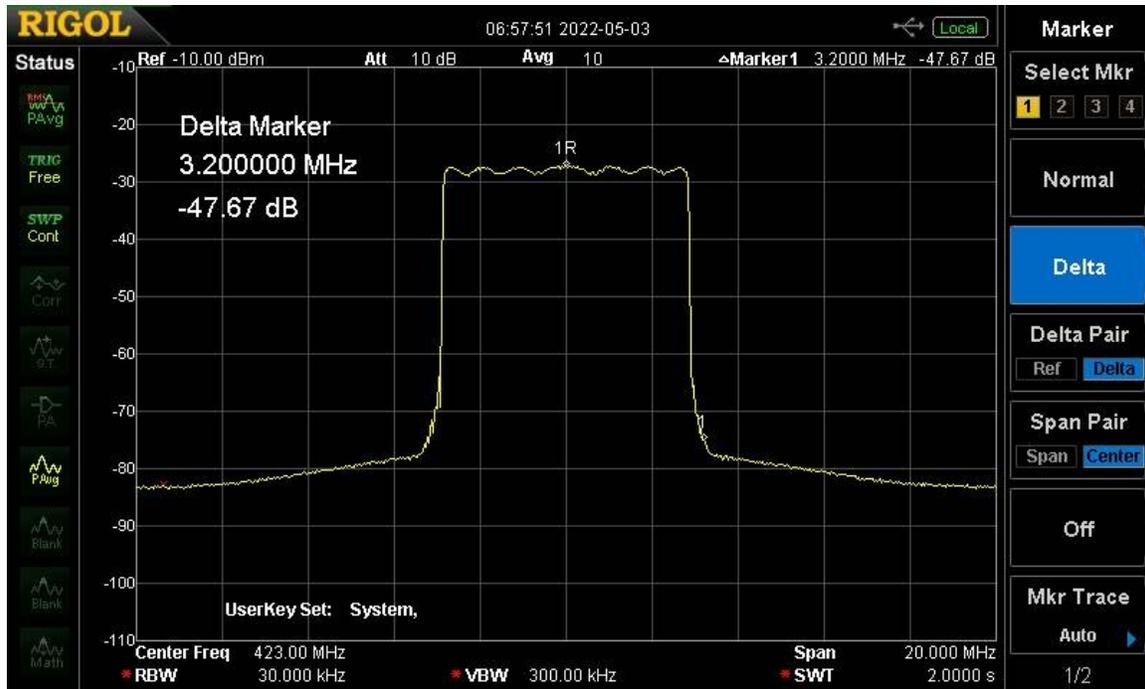

Fig. 4 RF spectrum of SatLink model WE-6990 Modulator.   Center frequency = 423MHz, span = 20 MHz,   10dB/div & 2MHz/div.   RF output set to 100dBµV

RF PERFORMANCE: The modulator was set to 423 MHz center frequency with 6 MHz band-width.   It's spectrum was measured using a Rigol DSA-815 spectrum analyzer. See Fig. 4.   The spectrum was found to be quite acceptable. The spectrum shoulders were measured to be -47dB down.   The second harmonic was -32 dB down, while the third harmonic was -50 dB down.

The RF output is specified to be adjustable from 70 to 100dBµV into 75 Ω..   It was measured with an HP-432A RF power meter with an HP-478A thermistor power sensor head.   When set to 100dBµV, the rf power into 50 Ω was -4.6dBm.   The rf power output was found to be adjustable in 1dB steps over a 31 dB range.