

TechTalk #77
Digital-ATV – Testing Report – Part 1
 by Ken W6HHC
 &
 Robbie KB6CJZ

In the May 2009 OCARC newsletter, TechTalk presented an introduction to D-ATV. In the June newsletter, Robbie-KB6CJZ and I teamed-up to present a top-down approach for planning a DATV Station that resulted in selecting the DVB-S standard. The July TechTalk explained how Symbol-rate and FEC affected the RF Bandwidth on DVB-S. In this article, Robbie and I team up to test and share the initial test results of the DATV station we had planned

Configuring the DATV Transmitter

A “breadboard” for testing the DATV transmitter for the DVB-S standard is shown in **Fig 1**. These boards were purchased from SR-Systems located in Germany (...see links at the end). **Fig 2** shows a block diagram of the entire DATV station and how the two boards fit into the station. Note that we have not yet



Figure 1 – MPEG2 and DVB-S 1.2 GHz Exciter Boards from SR-Systems on the Test “Breadboard”

added an RF power amplifier to the test set up, so we tested with only 1 mW output on 1.290 GHz.

Choosing the transmitter frequency and all other set-ups and adjustments with the DVB-S transmitter and the MPEG2 compressor are made through an RS232 interface connected on the DVB-S Exciter board. I used a RS232-to-USB adapter to plug the RS232 cable into the notebook computer. By running a WindowsXP application called “Hyper-Terminal”, I can read out the settings on the boards and make changes to the settings. **Fig 3** is a typical display of the settings menu as seen on the notebook computer.

DVB MiniMod Firmware V54.34 LOWDVBT
 (c) 2009 maintech GmbH

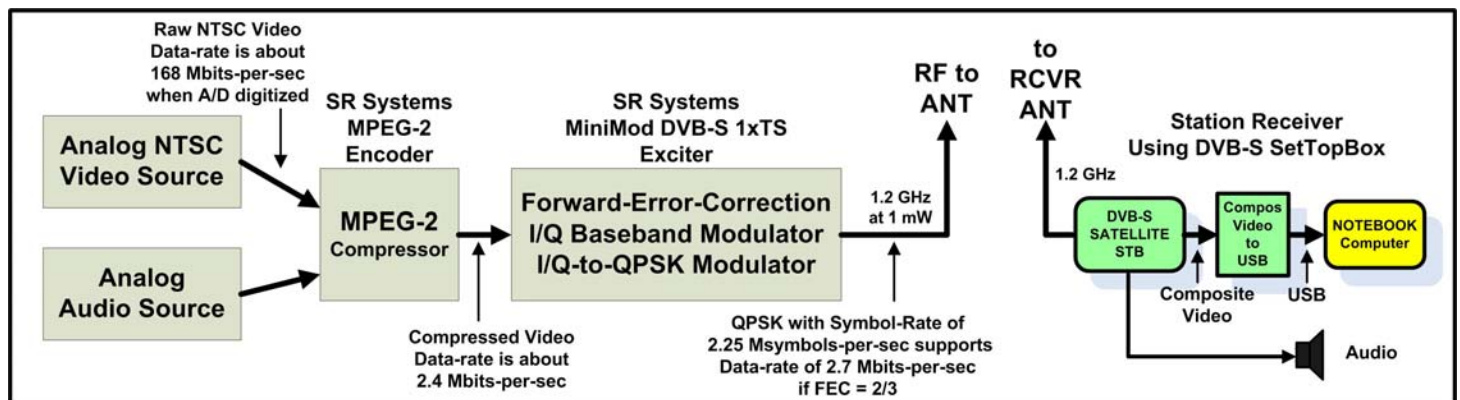
OnBoard VCO: ADF4360-0
 Real HF output range from 575000 to 1425000 kHz.
 FPGA firmware v042.
 Encoder firmware upload done (tvp5146, 0x01600425).

MiniMod Mainmenu
 1) show status
 2) Input Settings
 3) Modulation Settings
 4) Video Settings
 5) Audio Settings
 6) PSI Settings
 7) PID Settings
 > 3

Modulation Settings
 1) TX Enable (ON AIR)
 2) Output Frequency (1290000 kHz)
 3) Spectrum (normal)
 4) Carrier Only (no)
 5) Output Gain (12)
 6) Symbolrate (2500 ksym/s)
 7) Coderate (FEC) (3/4)
 0) exit menu
 >

Figure 3 – Typical Hyper-Terminal Menu Display of the DVB-S XMTR Settings

Figure 2 – Block Diagram Showing DATV Station being Tested



TechTalk – DAVT cont'd from pg 8

Fig 5 also shows how the configuration menu looks like on the notebook computer when no DATV pictures are being displayed. For the test set-up, a very simple $\frac{1}{4}$ wavelength wire was inserted into the RF SMA connector and used to provide a 1.2 GHz vertical antenna on the XMTR, as shown in **Fig 4**.

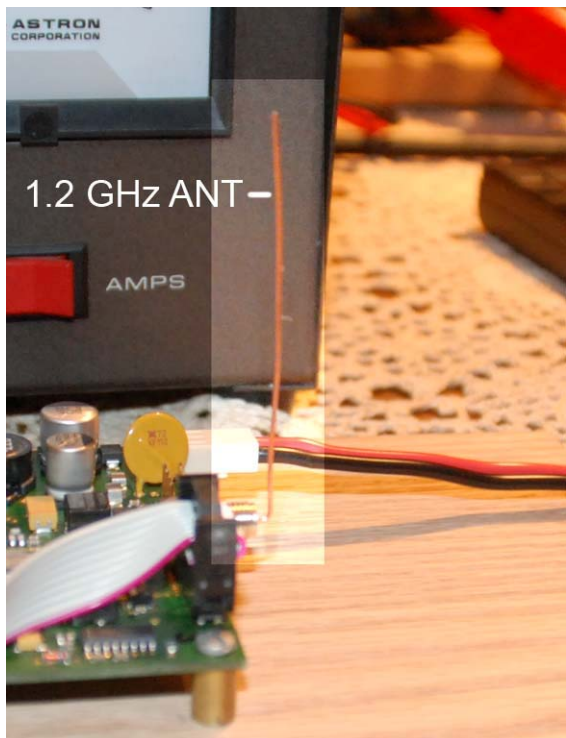


Figure 4 – Simple $\frac{1}{4}$ -wave Vertical Antenna used for Testing the DVB-S Exciter

I used my trusty Kenwood TM-741A FM receiver to confirm that there was a nice strong RF signal centered around 1.290 GHz when the DVB-S exciter was turned on.

Configuring the DATV Receiver

The heart of the DATV receiving station is a ViewSat Model VS2000 Xtreme DVB-S SetTopBox (aka FTA or Free-to-Air) that I bought used on e-Bay. The price was right; less than \$75, including cost of shipping.

As the block diagram in **Fig 2** shows, the output of the STB sends Composite Video to the USB port on the Dell notebook computer via Composite-Video-to-USB converter that costs about \$50 on the internet. I bought a Startech.com USB 2.0 converter (new) via Amazon. **Fig 6** shows a photo of the Startech.com USB 2.0 converter. Note that this model does not send the audio to the computer, only composite-video or S-video. The Startech.com product is primarily



Figure 6 – The Composite-Video-to-USB converter Sends the Video to the Computer USB Port

designed to capture video files to a disk on a computer and to take “snap shots” of video streams. It includes a software program called GrabBee that

See TechTalk – cont'd on Page 10



Figure 5 – Photo of the Entire DATV Station – Satellite STB receiver is on right, Notebook for configuring Transmitter in the middle, and DVB-S Transmitter on left.

TechTalk – DAVT cont'd from pg 9

allows the USB data to be displayed on the computer screen. The computer screens in **Fig 7** and **Fig 8** are being displayed by the GrabBee application software and device drivers.

The hardest part of our first testing session was to determine how to use the SetTopBox receiver to tune in the frequency we wanted, 1.290 GHz. This was not easy. Robbie determined from inspecting the STB menus that the STB local oscillator was 10,600 MHz. So, on this particular brand of STB:

STB Search Freq = XMIT Freq + 10,600 MHz

STB Search Freq = 1290 MHz + 10,600 MHz

STB Search Freq = 11890 MHz

Because each brand of STB has a different user's interface...we could never determine how to command our STB to search-and-find our signal on a frequency of 11,890 MHz. So we tried a different approach and added a "new transponder" to the GALAXY 10R Satellite settings already on the STB. Now we could edit the frequency for the new transponder to 11890. **Fig 7** shows the settings for new 'transponder 33' is configured to 11890 with a Symbol-Rate (S/R) of 2500 (Ks/sec).

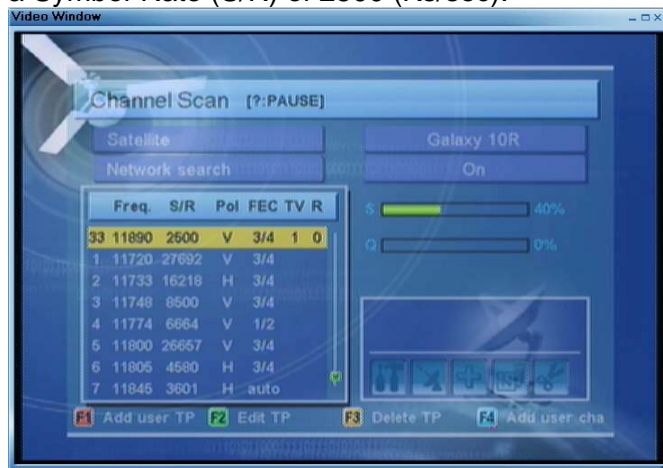


Figure 7 – The STB Configuration Menu for Editing Received Frequencies and other Settings

Robbie explained there are two cautions hams need to take on the antenna connector of satellite STB's:

1) The center conductor of the antenna connector has a DC voltage present that is normally intended to power a remote LNB (low noise block) converter box near the satellite dish antenna. Do not short the center conductor to ground. The fuse is normally soldered down to the PCBA inside the STB (not an easy task to replace). Robbie installed a "DC Block" adapter to the antenna F-connector to prevent an accidental short circuit.

2) The STB receiver RF amplifier is quite sensitive and designed to receive tiny microWatt signals (-20 dBm to -70 dBm). We could blow out the STB amp if the received signal is too strong. For initial testing, Robbie inserted some 50 dB of attenuators on the antenna...knowing we could always remove the attenuators once we knew the signal strength

First DATV Test Pictures Received

Once we determined how to correctly configure a "transponder" setting for our frequency on the STB, the picture magically appeared on the notebook screen....crystal clear!! A photo of our first test pictures is shown in **Fig 8**. To add a little professional touch to the received pictures, Robbie-KB6CJZ inserted his text generator in series with the video input to the MPEG2 encoder board. You can see "**W6HHC ORANGE**" show up in the upper-left corner of the DATV picture in **Fig 8**.



Figure 8 – First DATV Test Pictures (of Ken W6HHC) are Displayed on Dell Notebook Computer

The first thing that we noticed was that the audio had very little latency (delay) from real time. Probably about 1 second. For the first test trial, we had set the Symbol-Rate on the transmitter menu to 2.5 Msymb/sec and the MPEG2 data-bit-rate setting to "MANUAL" and 2.5 Mbits/sec, while FEC was set to 3/4. There was noticeable latency in the picture motion and also a noticeable "jerking" to the motion. We were confused to understand what was going on?? Why were we seeing so much video motion jerking??

The answer appeared with a little more testing at higher Symbol-rates. When the GrabBee software was set for default 720 pixel wide picture, the jerking was gone. When the GrabBee was set for a 1024 pixel wide picture (full screen), the jerking was extreme. The settings on the transmitter were **NOT incorrect**, but the receiving notebook computer and its display lacked the processing speed to convert the NTSC video pixels into a full display screen at 1024 pixels wide at the frame rate. The notebook computer was probably dropping five frames (or more?) to process one frame at 1024!!

See TechTalk – cont'd on following Page

TechTalk – DAVT cont'd from pg 10

Inspecting RF Bandwidth

Robbie used a HP Model 8559A Spectrum Analyzer 0.01-to-21 GHz plug-in (installed in a HP 182T display) to determine the quality of the transmitted QPSK RF signals.



Figure 9 – Robbie-KB6CJZ Inspects RF Bandwidth with an HP Spectrum Analyzer

The spectrum analyzer was set to 1.290 GHz - not centered, @500 KHz per /div (horizontal) and a bandwidth at 30 KHz. RF input was set at 0 dB with a two inch sniffer. Robbie checked the signals bandwidth which was reading about 3.5 MHz.

The earlier TechTalk#76 article explained that bandwidth for QPSK (DVB-S) is predicted as:

RF Bandwidth = 1.33 x Symbol-Rate
RF Bandwidth = 1.33 x 2.5 Msymbols/sec
RF Bandwidth = 3.33 MHz signal

So our measured bandwidth looked as expected. The signal looked clean and did not drop out when the video was removed. No out-of-band testing

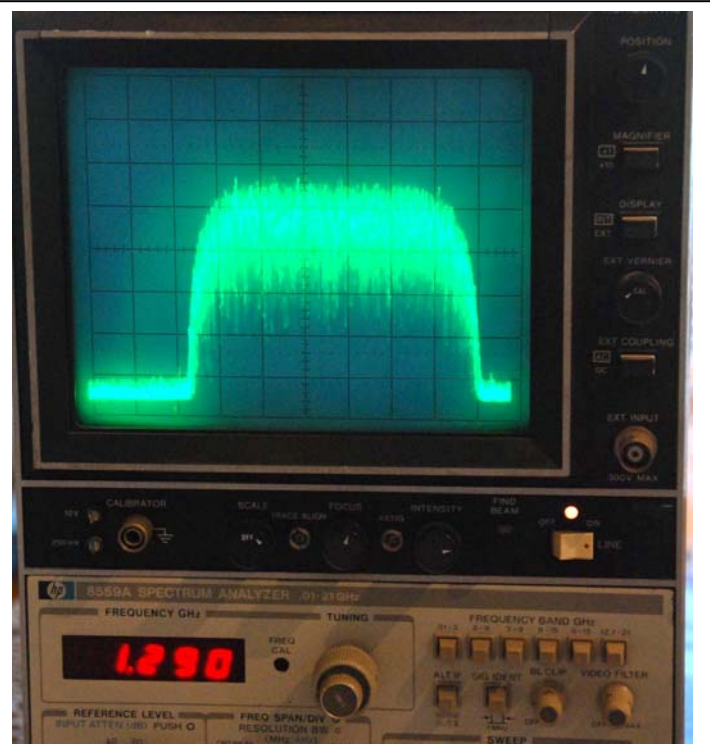


Figure 10 – A Close-up of the 1.290 GHz Signal RF Bandwidth on the Spectrum Analyzer Display

or other testing was performed. More test reports will come in later OCARC TechTalk articles.

Findings and Plans

The DATV station works like we had hoped it would work. The picture really is crystal clear. But, we need to still better understand computer display-density processing limitations when displaying DATV video.

We will do more testing at various Symbol-rates and data-bit-rates. Then as a next step, we plan to amplify the RF output from 1 mW to around 10 W. Then we will do some cross-town distance testing.

Useful DATV Links

- AGAF D-ATV components (Boards) – see www.datv-agaf.de and www.AGAF.de
- SR-Systems D-ATV components (Boards) – see www.SR-systems.de
- British ATV Club - Digital Forum – see www.BATC.org.UK/forum/
- Amateur Television of Central Ohio – see www.ATCO.TV
- OCARC newsletter DATV introduction article “ATV – the Digital Fork in the Road” – see www.W6ZE.org/DATV/TechTalk74-DATV.pdf
- OCARC newsletter article “Planning a Digital-ATV Station” – see www.W6ZE.org/DATV/TechTalk75-DATV.pdf
- OCARC newsletter article “Understanding Symbol-rate, FEC, and RF Bandwidth for DVB-S” – see www.W6ZE.org/DATV/TechTalk76-DATV.pdf
- Darren-G7LWT site for “DATV Primer” – see www.G7LWT.com/datv.html
- Rob-MØDTS D-ATV site including details of F4DAY-design – see www.MØDTS.co.uk/datv.htm
- Ultimate Resource for Digital Amateur Television – see www.D-ATV.com