TechTalk123
- The MiniTiouner Receiver/Analyzer for Digital-ATV

by Ken W6HHC

Jean-Pierre F6DZP has been modifying Digital-ATV receivers for DVB-S protocol with software for years - in order to allow the tuner to provide information that hams need. The main problems with commercial DVB-S receivers are (a) that if the signal is not good enough - they show only the "blank screen of death" and (b) they do not work with smaller Symbol Rates that some hams want to use. The MiniTiouner receiver/analyzer solves these two problems.

The MiniTiouner unit

The MiniTiouner is a second-generation DATV receiver/analyzer for hams and is USB2based. **Figure 01** shows a block diagram of the MiniTiouner Receiver/Analyzer connected to a PC desktop or portable.

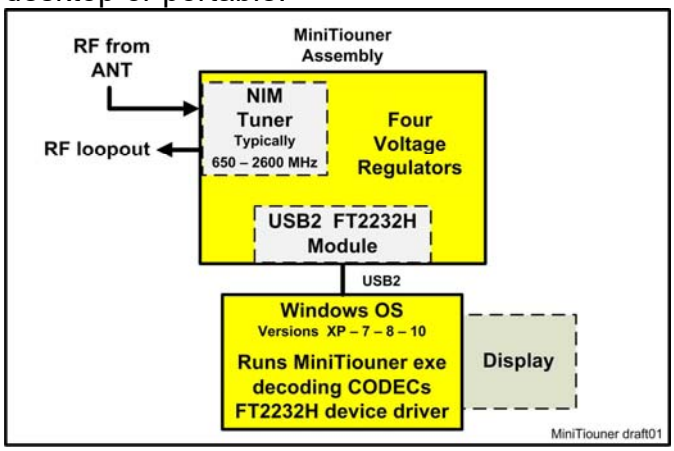

Fig01 – Block Diagram of MiniTiouner set-up for receiving DVB-S and DVB-S2 protocol

The MiniTiouner makes a great receiver for receiving and displaying ham DATV signals, including from the International Space Station (ISS) broadcasts from Ham-TV transmitter.

Figure 02 shows the construction and main components of the MiniTiouner assembly. The NIM-tuner, assembled FT2232H USB module, a hard-to-find 1 V regulator, and blank board can be purchased from the BATC online store. Other components can be ordered individually from an on-line electronic distributor like Digi-Key (some soldering is necessary).

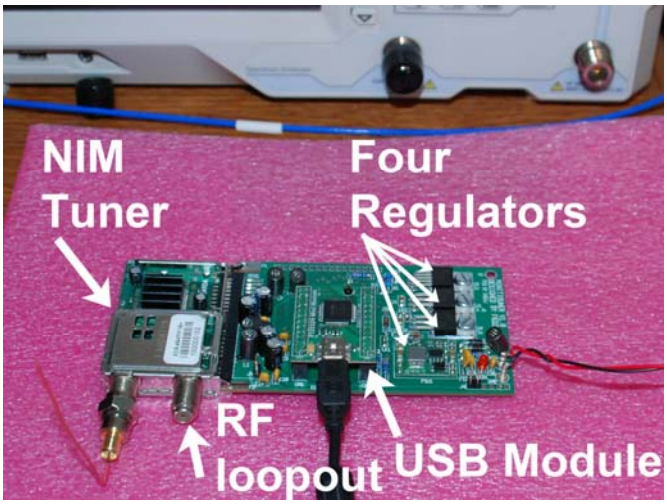

Fig02 – Main Components of the MiniTiouner Analyzer/Receiver

The USB-2 module is a preassembled module and plugs onto the main PCBA by a pair of dual-inline connectors.

The MiniTiouner Receiver

The MiniTiouner makes a great DVB-S and DVB-S2 receiver. **Figure 03** shows the uncluttered video display on your Windows PC.

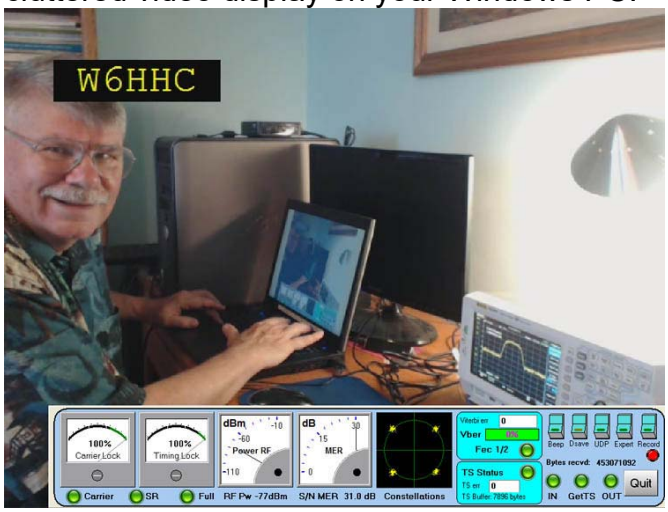

Fig03 - The MiniTiouner shown in receiver-mode for DVB-S. The Measurement-Panel at bottom can also be removed.

The MiniTiouner can accept NIM-tuners manufactured by different companies. Typically the "direct

frequency range" of these TV tuners is from around 650 MHz to 2600 MHz. By adding the appropriate "up-converter" or "down-converter" in front of the receiver's antenna connector, hams can receive DATV signals from 50 MHz to 10 GHz (and above). Video can be displayed in the video aspect ratio of 4:3 or 16:9 or even square (1:1).

The MiniTiouner Analyzer

The MiniTiouner is also a ham-radio analyzer tool for DVB-S protocol and DVB-S2 protocol. As Jean-Pierre F6DZP clearly explains: ***"On commercial receivers the DATV video is either good or missing…perhaps only with a signal strength reading to guide you. With MiniTiouner, Digital transmissions are not really 'all or nothing', in between there are many things that can happen; it's important to be able to observe and define the various stages."***

The MiniTiouner as an analyzer can be switched into the "expert-mode" to:

- measure signal strength directly in –dBm units
- look at encountered FEC error rates,
- measure MER (Modulation Error Rate)
- visualize noise on modulation "constellation"
- deviation of frequency received
- deviation of Symbol Rate received
- display PIDs for video and audio
- confirm selection of H.262 H.264 or H.265
- enable/disable "anti-rotation"

…and the list goes on.

Figure 04 shows a typical the control panel display for the "expert mode analyzer" mode of the MiniTiouner for a DVB-S2 transmission. **Figure 05** displays a typical weak-signal modulation "constellation" for inspection (QPSK modulation in this screen-capture). There is a lot of noise being seen compared with the received DATV signal.

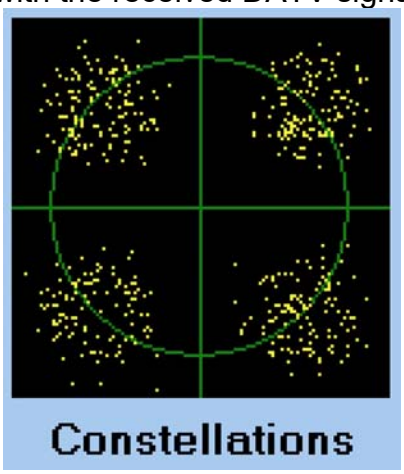

Fig05 – The MiniTiouner analyzer permits observing the "constellation" of the received DATV modulation (weak-signal QPSK in this case).

This "constellation" display also allows you to observe the quality of the modulation constellation being transmitted by your station (especially if your I and Q modulator gains have not been balanced).

Reduced-Bandwidth DATV

In 2015, hams in England were provided with a newly opened, but temporary, segment of 2 Meters (from 146.0 through 147.0 MHz. The challenge made to the hams in England was to use

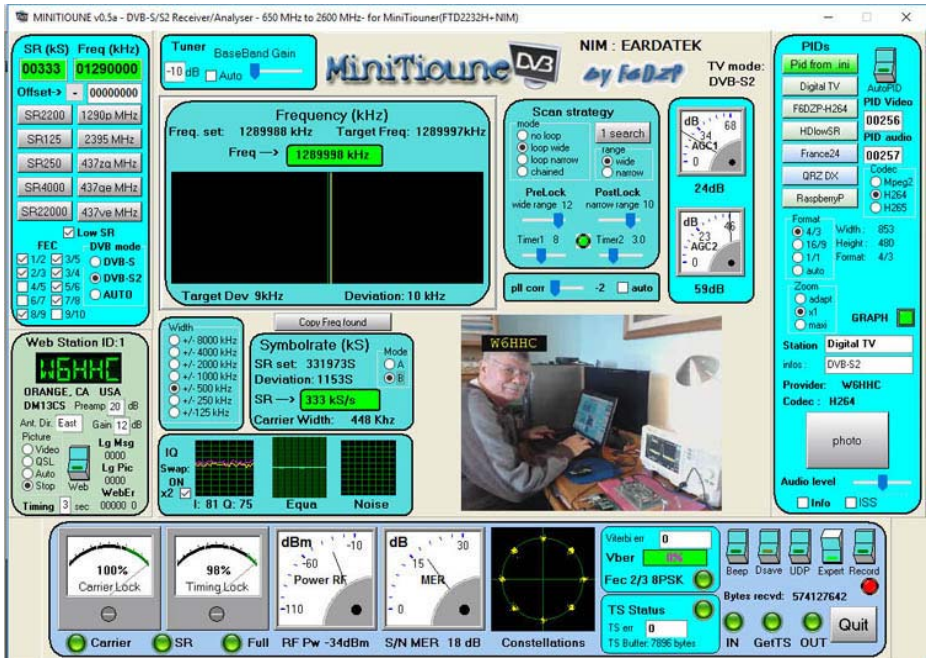

Fig04 - The MiniTiouner design by F6DZP is an excellent analyzer for DVB-S and DVB-S2. Shown in analyzer-mode (AKA "Expert" mode) looking at 8PSK modulation "constellation".

this new segment only for digital forms of communications (not just more FM repeaters) and to perhaps also invent a way to produce DATV in 0.5 MHz RF bandwidth…instead of just using the more typical 2 MHz RF bandwidth for DVB-S!! This is called RB-DATV.

Hams in England and France responded with enthusiasm and clever work to make this happen. The DATV-Express software was changed by Charles G4GUO to lower the Symbol Rates to 333 kSymb/sec (and lower) with changes to the anti-alias filters (all in software) to produce low-SR transmissions. Jean-Pierre F6DZP looked at the software of the older TuTioune design and the newer MiniTioune design and with much perseverance was able to allow the MiniTioune RB-DATV reception to work down to less than 125 kSymb/sec (RF bandwidth around 170 KHz). Hams in England started setting distance records on the 2M band with DATV QSO's. These pioneering hams also observed that transmitting H.264 encoding with DVB-S protocol (instead of the normal MPEG2) provided a better (smoother) low SymbolRate video. Noel G8GTZ explained to me that the significantly better low-SR video quality seen on the receiver is due to the H.264 design using a more suitable macro block size.

Then even more benefits were confirmed (or better understood) from using RB-DATV than just reducing RF bandwidth to meet regulations. Reducing that bandwidth of the DATV transmission also increased the signal/noise (aka C/N) performance at the receiver. If you use the same transmitter power…but cut the signal bandwidth by one-half (perhaps going from 2 MHz to 1 MHz) then the receiver is looking at less noise (power) and therefore the signal/noise ratio is doubled (3 dB better)

Power required vs dish size vs bandwidth					
	8MHz	4MHz	2MHz	1MHz	0.5MHz
2.4m	100	50	25	12.5	6.25
1.7m	200	100	50	25	12.5
1.2m	400	200	100	50	25
0.85m	800	400	200	100	50

Fig06 – Comparing power required at transmitter as channel-bandwidth of RX gets smaller.
(courtesy of Rob M0DTS)

Figure 06 shows that the power required at transmitter gets smaller as the channel-bandwidth of receiver is reduced: 25W for 2 MHz BW, 12.5W for 1 MHz BW and 6.25W for 0.5 MHz BW. Conversely, the same transmitter power will go further as the channel-bandwidth of the receiver gets smaller (and the signal S/N at receiver gets improved). [Note - this table was originally created by Rob M0DTS as he planned for groundstations transmitting on 2.4 GHz band to the future DATV satellite.]

Noel G8GTZ also pointed out to me that use of the RB-DATV approach is NOT limited to the 2M band. Creating a more robust signal on 440 MHz, 1.2 GHz and even 10 GHz band by using RB-DATV communications theory also stretches the ability to work DX.

Receive DATV from ISS

Receiving DATV from the HamTV transmitter on the International Space Station (ISS) consists of dealing with three "hurdles" for hams:

- The ISS Is a moving target and you need a tracking antenna rotator.
- The ISS moving in orbit creates Doppler shifts in frequency.
- The DATV transmitter on ISS contains issues that prevent the video and audio PIDs from being inserted in the signal normally.

The MiniTioune can overcome the last two ISS challenges in software.

The MiniTioune software package also include a tool called Tioune Data Reader.

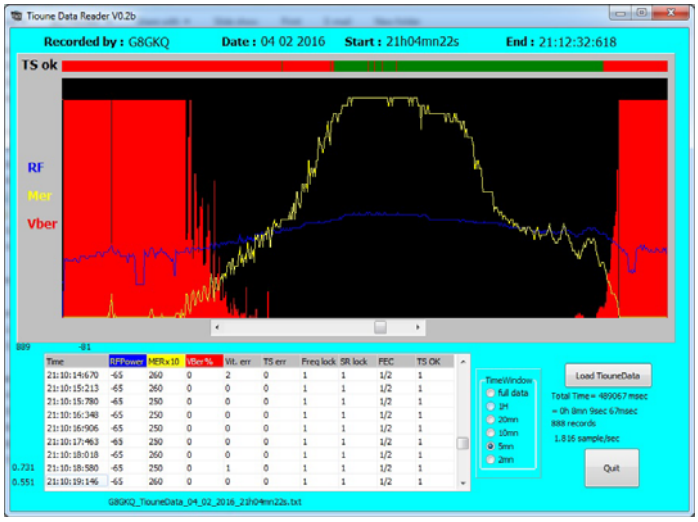

Fig07 – The Tioune Data Reader tool allows plotting the receiver DATV parameters during ISS pass.
(Courtesy of Dave G8GKQ)

In **Figure 07**, the green bar at the top shows where a "solid DATV lock" occurred on this pass of ISS.

Noise Power Measurement Tool

The VivaDATV website for MiniTioune software also contains another software package tool called NPM_USB.zip. The NPM tool can be used for (a) measuring the Sun noise, (b) sweeping their antenna dish around the good value, to be sure their antenna rotator tracking is set correctly (see **Figure 08**) or (c) for observing the noise/interferences.

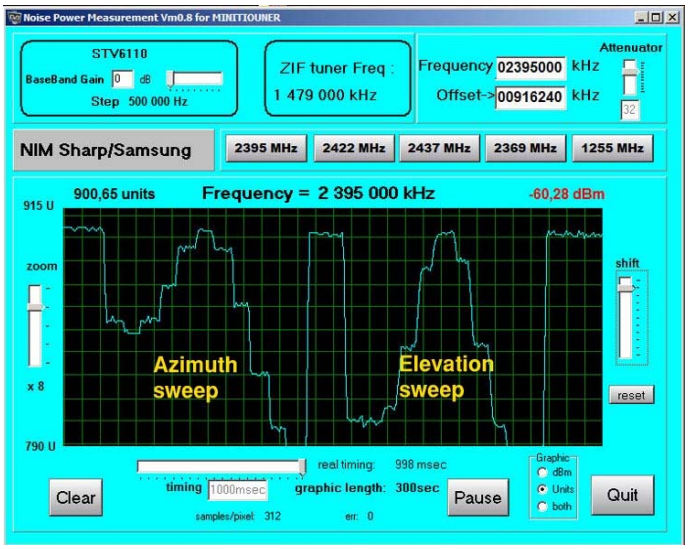

Fig08 - Display of Noise Power Measurement tool sweeping the Sun with antenna rotator
(Courtesy of Jean-Pierre F6DZP)

In the example shown in **Figure 08**, we are tracking the Sun, sweeping the antenna at -10°, -8°, -6°, -4°, -2°, 0°, +2°, +4°, +6°, +8°, +10° in azimuth and in elevation. At 0° we must have the top of the pyramid. If we obtain a symmetric pyramid, then our antenna is set well.

Specifications (with MiniTioune v0.5a software)

- NIM-tuner frequency range – typically 650-2600 MHz
- DATV Protocols – DVB-S and DVB-S2
- Modulation constellations – QPSK, 8PSK
- Symbol Rate – 100 k –to– 22000 kSymb/sec
- Decoder CODECs - H.262 (MPEG2), H.264, H.265
- O/S – Windows XP, 7, 8, 10
- PC interface - USB-2
- Windows device driver – FT2232H from FTDi-chip
- Board power input voltage – 9–16 VDC.
- Assembled board size - approx **5.625** x **2.25** inches

Software and Hardware

The BATC organization for ATV and DATV has created a terrific wiki site to place useful information in one (repository) web location. Included in the BATC wiki is a section devoted to the MiniTiouner details for hardware and software. (See the BATC wiki URL at the end.) The wiki info on MiniTiouner is organized as five areas:

1) Hardware overview
2) Hardware parts-list and Assembly
3) Software Downloads
4) Software Installation
5) Receive up-converters and RF BP filters

Note that you must be registered on the VivaDATV.org website in order to download the MiniTioune software.

Plans

Jean-Pierre has discussed on DATV forums that he is interested in using a new NIM-tuner manufactured by Serit in Korea. The advantage of this Serit model FTS-4335 NIM-tuner is that the frequency range goes from 144 MHz up to 2450 MHz. That means that the up-convertors would no longer be needed in order to receive on the 2M band and the 70cm band. Note that the pin assignments on the SERIT NIM-tuner are different than the first batch of NIM-tuners by SHARP and EARDATEK. So changes to the current MiniTiouner PCB board or an adapter cable may be necessary to use the SERIT NIM-tuner?

On the current v0.5a software for DVB-S2, only demodulators for QPSK and 8PSK are operational via the current SHARP and EARDATEK NIM-tuners. In the future, the use of SERIT NIM-tuner can provide demodulation implementations for the other DVB-S2 modulation technologies of 16APSK and 32APSK.

Conclusions

Jean-Pierre F6DZP has provided hams with a very useful DATV analyzer. In addition, his design produces a DATV receiver that has capabilities that hams want…but are not provided by commercial DVB receivers. It is my favorite DVB-S/S2 receiver…so easy to use compared to commercial Set-Top-Box receivers!! I also want to give a very large "Thank You" to F6DZP for his help to me whenever I had difficulties or questions with my installing/testing of MiniTiouner.

Useful URLS

- British ATV Club - Digital Forum – see www.**BATC.org.UK/forum/**
- BATC wiki site for ATV information ranging from "getting started" to MiniTiouner installation
  – see **https://wiki.batc.tv/MiniTioune**
- CQ-DATV online (free monthly) e-magazine – see **www.CQ-DATV.mobi**
- Orange County ARC entire series of newsletter DATV articles and DATV presentations
  – see **www.W6ZE.org/DATV/**
- Yahoo Group Forum for Digital ATV - see **https://groups.yahoo.com/neo/groups/DigitalATV/info/**
- VivaDATV forum for many French DATV efforts including TuTioune and MiniTiouner
  – see **http://www.vivadatv.org/viewforum.php?f=80** (English section)
  – see **http://www.vivadatv.org/viewtopic.php?f=60&t=365** for Noise Power Measurement page