

TechTalk97

Looking at the DigiLite Digital-ATV XMTR Project

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For several years, hams have recognized that the cost to buy ham-grade MPEG2 encoders boards and Digital-ATV exciter boards is too expensive. A ham-grade set of MPEG-2-and-DVB-S boards from Germany cost about US\$1,000. The cost of commercial-grade digital-TV boards is even higher. This high cost is known to prevent many hams from “trying Digital-ATV”. A group of hams in Europe with the backing of the British Amateur Television Club (BATC), have succeeded in designing a DVB-S board, called DigiLite, that will lower the cost of DATV considerably.

System Block Diagram for DigiLite

A system block diagram for a Digital-ATV DVB-S transmitter using the DigiLite board is shown below in **Fig 1**. The analog output of a video camera is sent to an MPEG2 encoder unit (made by Hauppauge) to compress the video stream. The video file is stored on a PC and a Windows-based PC does much of the “heavy lifting” to provide real time processing of the Program Stream from the MPEG2 Encoder into a Transport Stream to be used with the DVB-S protocol.

The Transport Stream on the PC is output via USB2 to the DigiLite project board where the 16-bit dsPIC33 microprocessor manipulates the data and sends an I-stream and a Q-stream to a QPSK (Quadrature Phase

Shift Keying) modulator. The operating frequency for the DATV transmitter is determined by a stand-alone commercially available Local Oscillator (L.O.) board that is connected to the DigiLite board by a short piece of coax. The Local Oscillator can be chosen for 70 cm band or for the 23 cm band.

The RF output level from the DigiLite board is very low, usually around -15 dBm to -10 dBm. So the typical DATV station will probably follow the DigiLite RF output with about three stages of RF amplifiers to get up to a normal transmitter power level. The DigiLite Project team also recommends using an interdigital band-pass filter.

The DigiLite Board

To obtain a DATV exciter you actually need three separate boards:

- USB2 Daughter-Board (commercially available)
- An assembled DigiLite board
- Local Oscillator Board (commercially available)

The basic structure of the three boards related to the basic DigiLite DVB-S exciter can be see in the Block Diagram in **Fig02** on the next page. The main DigiLite board is designed to provide all of the voltages needed from a single 12V connection. **Fig03** shows a photo of the actual assembled

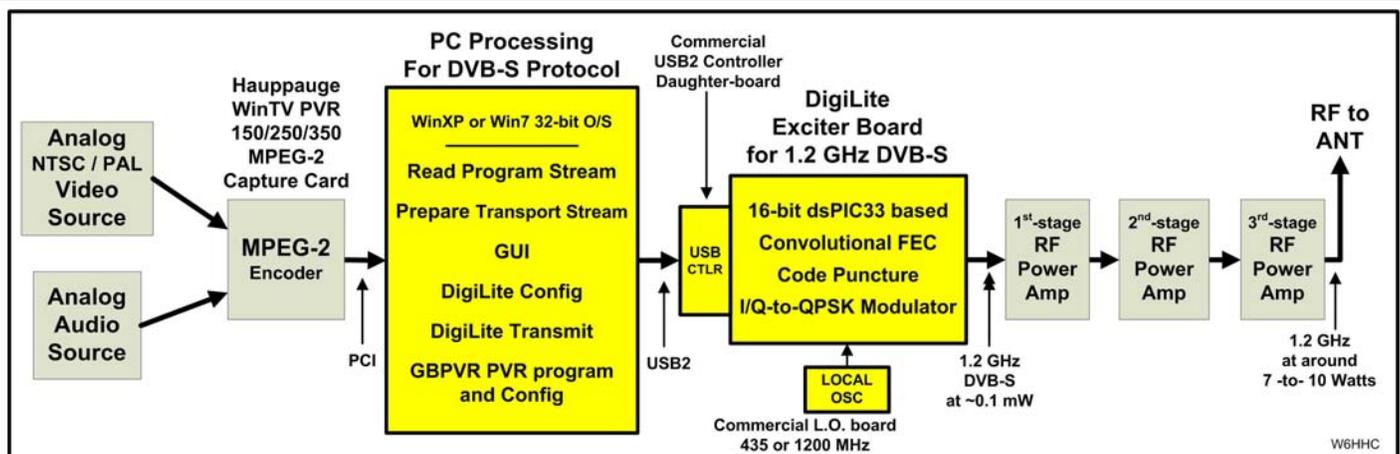


Fig 01 – System Block Diagram of DigiLite Project DVB-S Digital-ATV Transmitter

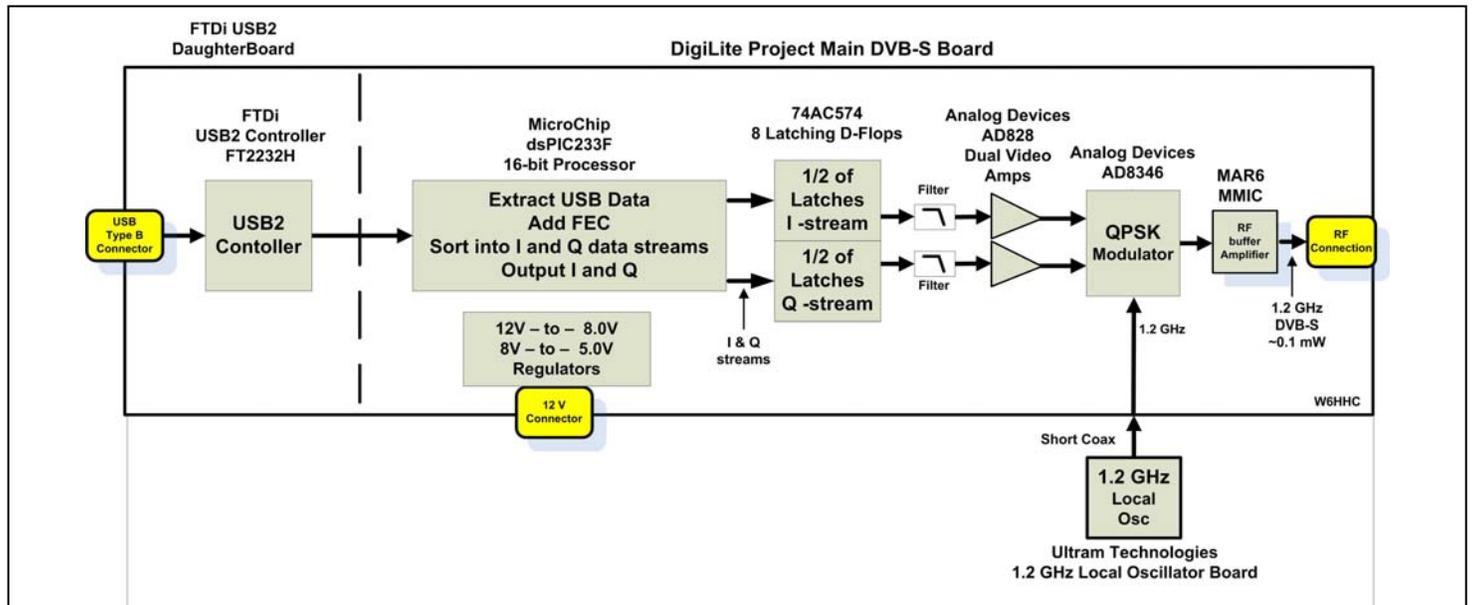


Fig 02 – Block Diagram of DigiLite Project 3-Board DVB-S Digital-ATV Exciter

DigiLite board. In Fig03, you can notice that the USB2 controller daughter-board plugs nicely onto the main DigiLite board using a pair of dual-inline connectors (in upper-left corner).

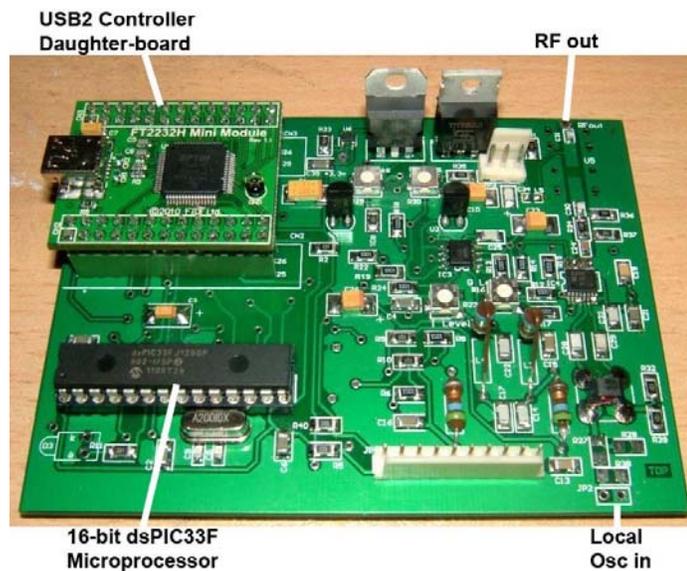


Figure 03 – Main DigiLite Board (Ver 5.6) with USB-daughter-board Plugged-in (Photo courtesy of Tony MØATV)

The dsPIC33F microprocessor is for digital signaling processing and is well suited for the design. The Nyquist filters can be seen in the Block Diagram, Fig02. My understanding is that these filters are used for anti-aliasing (I am sure someone will correct me if I am wrong).

My only surprise was when I looked for the expected

RF output SMA coax connector. I couldn't find it?? I had to follow the signal flow and the component flow to find it. The RF output connection is a solder-pad in the upper-right corner of Fig03.

The board shown in Fig03 is version 5.6 in a series of design/layout improvements made by the project team. The current DigiLite layout is Version 5.7. I expect more versions will follow as improvements (maybe new features?) continue to be made.

Software for DigiLite

The DigiLite project board is designed to run on a WinXP or Win7 computer. In addition to loading a number of drivers onto the PC, the following programs are used to send the video stream to the board and control the signal settings.

- **GBPVR Program** – the main freeware program for controlling the video-capture files.
- **GBPVR Config** – this utility allows entering the required settings for the PVR program
- **DigiLite Transmit** – this is the main program that looks for the video capture .MPG file (while it is still being written to disk) converts it to a Transport Stream format for DVB-S protocol and ships the data out the USB port to the Digi-Lite hardware board. The keyboard ESC key toggles the hardware board between XMT and OFF
- **DigiLite Config** – this utility configures the settings for the DVB-S transmission, such as the Symbol Rate (SR), selecting the TS name, and configuring the FEC settings.

The DigiLite firmware for the dsPIC33F microprocessor can be obtained already installed on the chip (from BATC) or the firmware and/or updates can be loaded onto the DigiLite board from the PC using a free utility software.

“Some assembly required”

The DigiLite main board is sold as a blank Printed Circuit Board (PCB) although it is pre-tinned (not sure if “tinned” is the correct word to use?). The main electronic components need to be purchased by the ham mainly from electronic distributors similar to DigiKey and Mouser. I do not believe that there is anyone selling a “kit full of parts” for the DigiLite board, yet.

Most of the parts are SMT (Surface Mount Technology) that do require dexterity and soldering experience. The hams in Europe who have bought out the first lot of boards (over 100) have shown that this design is capable of being assembled by many hams. (I may personally be disqualified...I have a tendency to use tweezers to shoot SMT capacitors across the room!)

The Nyquist filter inductor values for L1, L2, L3, L4 and the associated capacitors for these filters need to be selected differently for 70 cm operation when compared to the 23 cm operation.

As a final assembly note, the commercially available Local Oscillator board does require a little modification in order to be used. The on-board RF amplifier chip has to be removed to prevent overdriving the DigiLite QPSK modulator. The DigiLite forum discussion threads (see URL link at the end of the article) explain that L.O. overdrive can result in “transmitter noise” in the transmitted signal spectrum.

Where DigiLite Parts are sold

The BATC Shop is currently selling parts that are used with the DigiLite project construction. (see URL next page) Currently being sold are:

- DigiLite blank PCB
- Preprogrammed dsPIC33F μ processor
- USB2 daughter board (preprogrammed)
- VCO boards (437 MHz or 1249 MHz)
- T1 Balun

History of the Design

The DigiLite project is the result of an evolution of hams trying to provide a low-cost Digital-ATV transmitter. Credit for the earliest development goes back several years to a group of French amateurs

including Jean-François Fourcadier F4DAY. The earliest project name was “Poor Mans DATV”. The URL link of Rob MØDTS contains discussion and URLs back to the original project and his own successes with the early design. The current DigiLite board design is based on the serialiser board of Brian G4EWJ and the modulator board of Malcolm GØUHY. Much of the project software was developed by Brian G4EWJ. A group of motivated and skilled hams from the Bournemouth Amateur TV Group, including Dave G8AJN, took on the phase to combine the earlier separate boards into a single board, now called DigiLite.

Conclusion

The DigiLite Project team is to be congratulated on providing a great service to hams who want to “try Digital-ATV” without breaking their bank account.

The board works and produces good DVB-S protocol signals (see **Fig04**) that are capable of being received on the low cost Free-To-Air (FTA) Set-Top-Boxes (STB) to provide the foundation for a low cost DATV station.

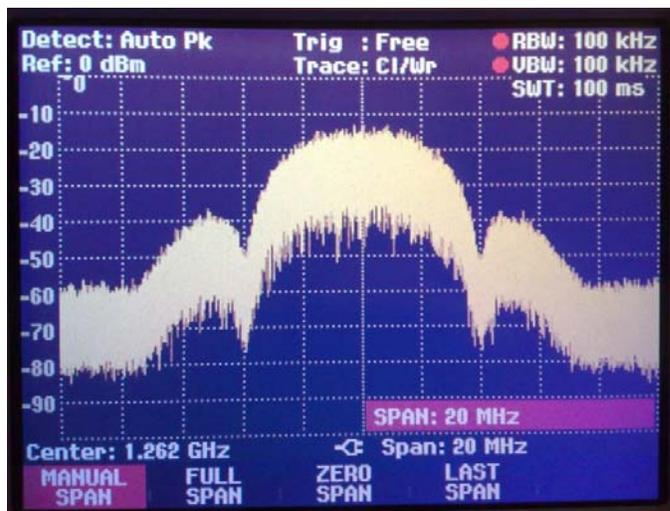


Figure 04 – An Spectrum Analyzer example of 1.2 GHz signal from DigiLite board for QPSK (Photo courtesy of Malcolm GØUHY)

I can see this project expanding the ranks of hams using DATV, especially analog-ATVers moving to digital technology.

For more details, an excellent series of articles on the DigiLite Project can be found in issue 235 of the BATC magazine called CQ-TV. The magazine can be purchased as an on-line download. I find CQ-TV magazine well worth the PDF yearly price.

-- See Related URLs on next page --

Interesting DATV Links

- British ATV Club – select from about 25 streaming repeaters – see www.BATC.TV/
- British ATV Club – Digital-ATV Forum – see www.BATC.org.UK/forum/
- British ATV Club – DigiLite Project Forum – see www.BATC.org.UK/forum/
- BATC Store – purchase PCBs and parts for DigiLite Project – see www.BATC.org.uk/shop/
- Rob-MØDTS D-ATV site including details of F4DAY-design
www.M0DTS.co.uk/datv.htm
- DigiLite Project for DATV (derivative of the “Poor Man's DATV”)
www.G8AJN.tv/dlindex.html
- DigiLite-ZL Project, experimental DVB-S modulator using FPGA
www.idesignz.org/DigiLiteZL/DigiLiteZL.htm
- DATVexpress Project - a Lower Cost Approach to Digital-ATV Transmitter
www.TAPR.org/pub_dcc30.html
- Orange County ARC newsletter entire series of DATV articles – see www.W6ZE.org/DATV/
- Yahoo Group for Digital ATV - see groups.yahoo.com/group/DigitalATV/