



2012 ARRL/TAPR DCC

DATV-Express – an Update

by

- Charles Brain G4GUO
G4GUO@ARRL.net
- Ken Konechy W6HHC
W6HHC@ARRL.net

DATV-Express



The Presentation Authors....



Charles G4GUO



Ken W6HHC

DATV-Express



Status of Digital-ATV Today

- Video Quality of DATV far exceeds analog-ATV
- Very few hams transmitting DATV in USA today
- European DATV is very active and growing
- Australia/New Zealand has more DATV activity than USA
- Digital-ATV transmitters are currently expensive
- US\$1,000-to-US\$10K range for MPEG/DVB-S XMTR set
- Cost of DATV Transmitter is barrier to more ham use

DATV-Express



Goals of the Project

- Significantly reduce the price of Digital-ATV transmitters
- Provide an open platform for future DATV development
- Help educate the community about new technologies
- Get more DATV stations on-air
- Encourage a wider diaspora to get licensed
- Byproduct will be a Software Defined Transmitter for the 23 cms band with a B/W of up to 8 MHz.

DATV-Express



The DATVexpress Team

- Charles Brain - G4GUO Ferring, England
- Ken Konechy - W6HHC Orange, CA, USA
- Art Towslee - WA8RMC Columbus, OH, USA
- Tom Gould - WB6P Portland, OR, USA
- Charles Beener - WB8LGA Columbus, OH, USA

DATV-Express



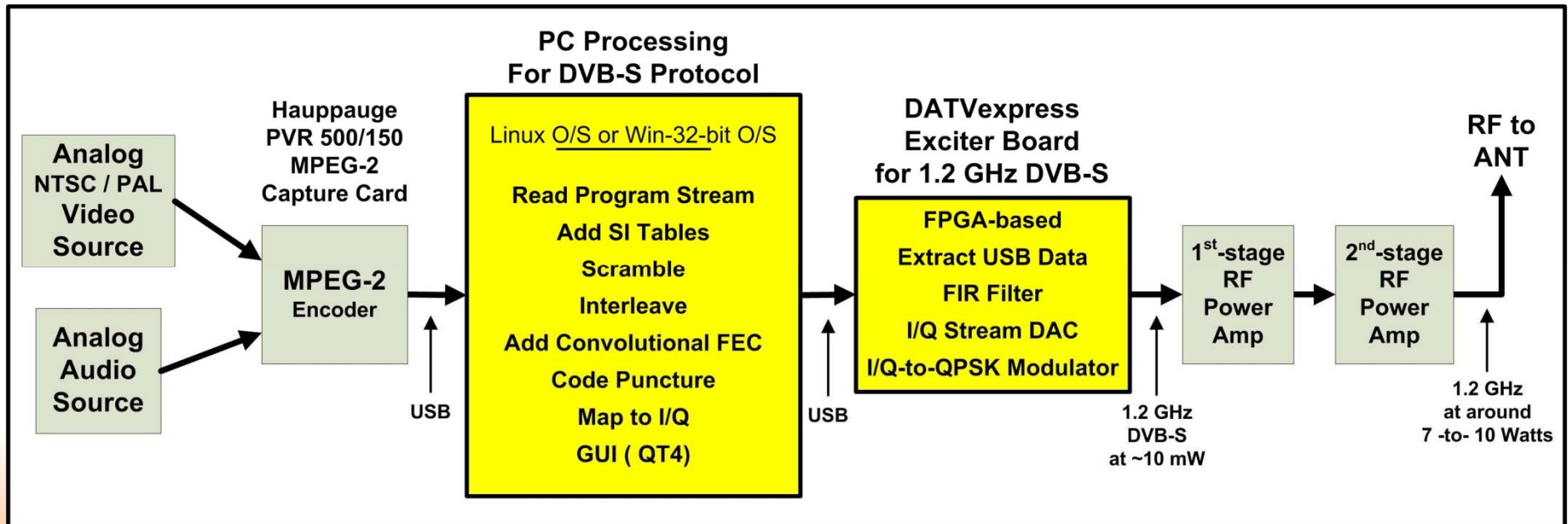
Overview of DATVexpress System

- Video Capture card for MPEG-2 encoding
- PC (Linux or Win) performs DVB-S processing and outputs I/Q stream
- Simple Hardware board exciter preps I/Q stream and does QPSK modulation at 1.3 GHz
- Just add RF Power Amps and Antenna

DATV-Express



Overview of DATVexpress System – cont'd



System Block Diagram for DATVexpress DATV Transmitter

DATV-Express



Overview of PC Software

- Operating System - Linux 32/64-bit then Win32
- Load FX2 firmware
- Load FPGA firmware
- Control 1.3 GHz PLL
- Control symbol rate generator
- I/Q offset calibration
- Provide GUI

DATV-Express



Overview of PC Software – cont'd

- Take program/transport stream from capture card
- Convert to transport stream with correct PIDS
- Add SI Table information
- Add FEC
- Do interleaving
- Keep symbol rate constant, no overruns or underruns by adding Null transport packets
- Generate either IQ symbols or a bitstream
- Talk to exciter board via Hi speed USB interface

DATV-Express



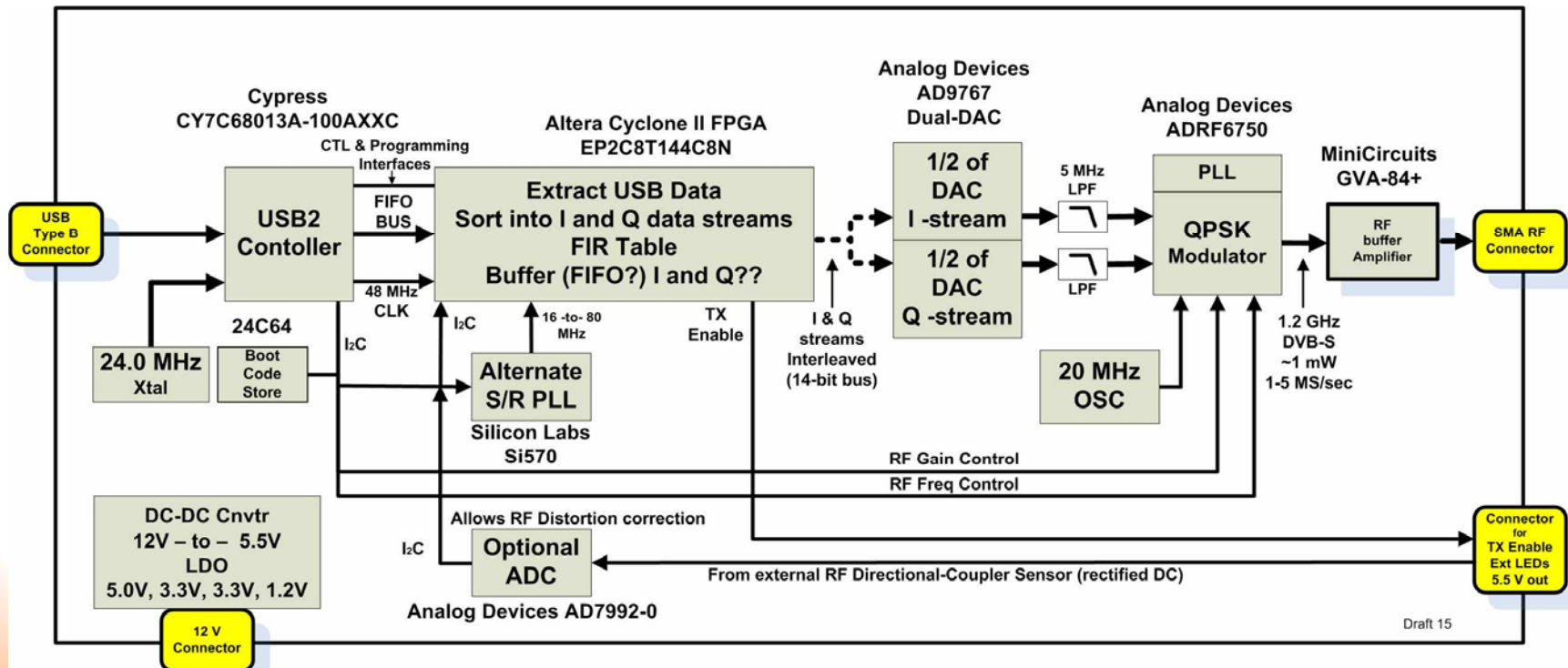
Overview of Hardware Board

- Single custom designed board preps I/Q stream and provides QPSK modulation at 1.3 GHz
- Interfaces to PC processing by USB2
- Contains PLL for the 1.3 GHz frequency control
- Controls Symbol-Rate
- Provides small buffer-RF amplifier to ~20 mW
- DC-DC power supplies allows single 12V input
- Connect to RF Power Amp stages and antenna

DATV-Express



Overview of Hardware Board – cont'd



Block Diagram for DATV-Express Hardware Board

DATV-Express



Overview of Hardware Board Coding

FX2 code (USB chip has 8051)

- Program FPGA
- Manage USB FIFO interface with FPGA
- I2C interface with 1.3 GHz PLL
- I2C interface with symbol rate generator
- I2C interface to FPGA
- General Housekeeping

FPGA code

- Interpolate symbols to final sample rate
- Channel filter
- Write to DAC

DATV-Express



DATV-Express System Specs

- DVB-S protocol
- QPSK modulation (will allow other modulations)
- Frequency Range:
 - 950–1575 MHz (allowed by ADRF6750 chip)
 - 1240–1300 MHz (allowed in USA)
 - 1240–1325 MHz (allowed in Europe)
- Symbol-Rate:
 - Adjustable: 1 MSymb/sec -to- 5 MSymb/sec
- Forward Error Correction is selectable
- RF output ~ 20 mW buffered (SMA connector)
- Video Capture card allows for NTSC or PAL
- Initially designed for one video stream
- Operating system – first Linux-32/64 then Win32

DATV-Express



Current Project Status

- Architecture – completed
- Schematic Capture – completed in DXdesigner tool
- PCB Layout – first-pass completed in PADS tool
- Two prototype first-article boards are assembled
- Design check-out and software integration has begun
- FX2 loader code completed
- Initial DVB-S transmission tests completed

DATV-Express



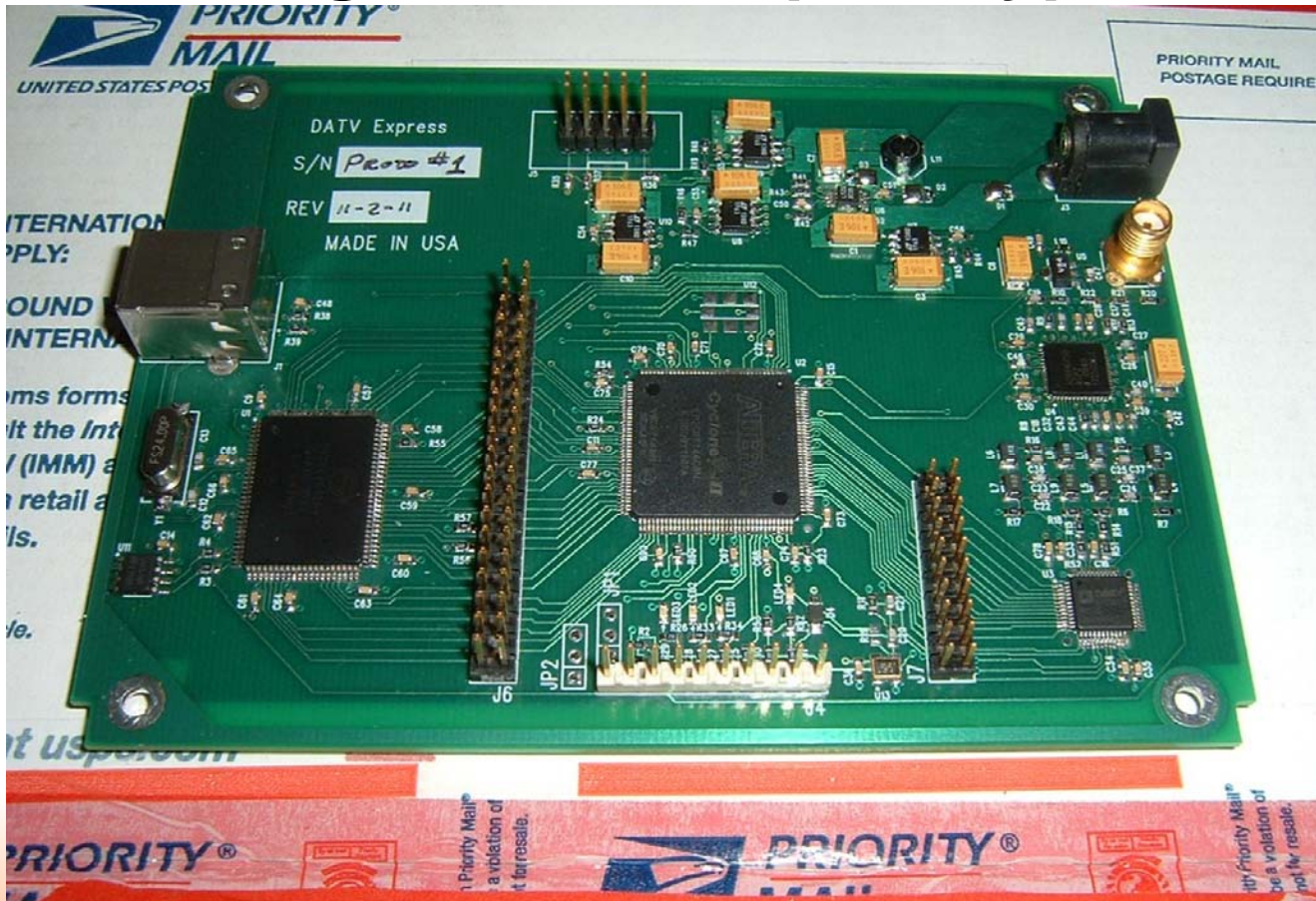
Current Project Status – cont'd

- A few jumpers were needed to fix USB FIFO hookup
- Two components were missing in PLL stability loop
- RF etch can be laid-out better – was self-osc 1.8 GHz
- Large 65 kHz noise sidebands being investigated
- Will create second-pass etch to clean up layout

DATV-Express



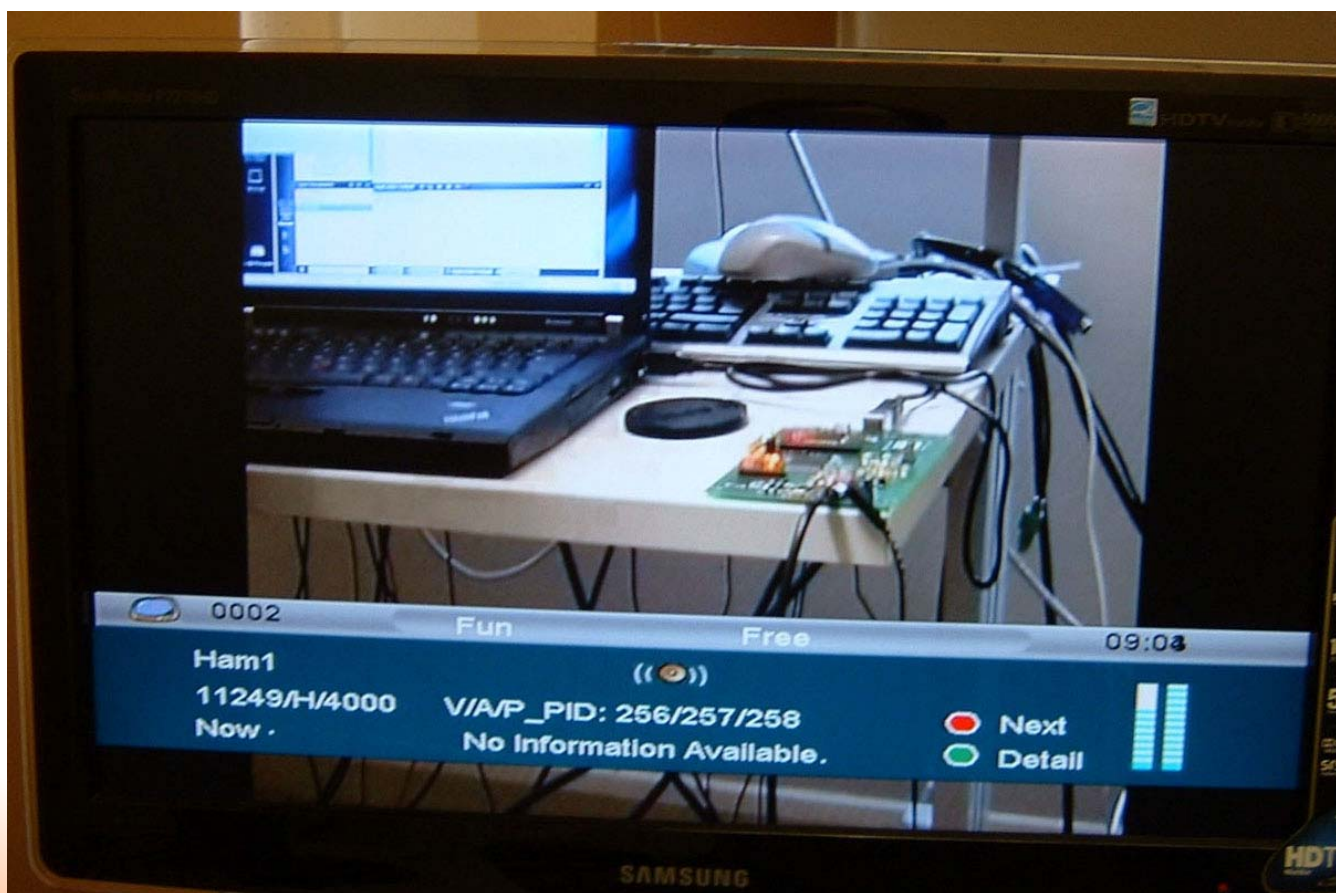
Proof-of-Progress – First prototype



DATV-Express



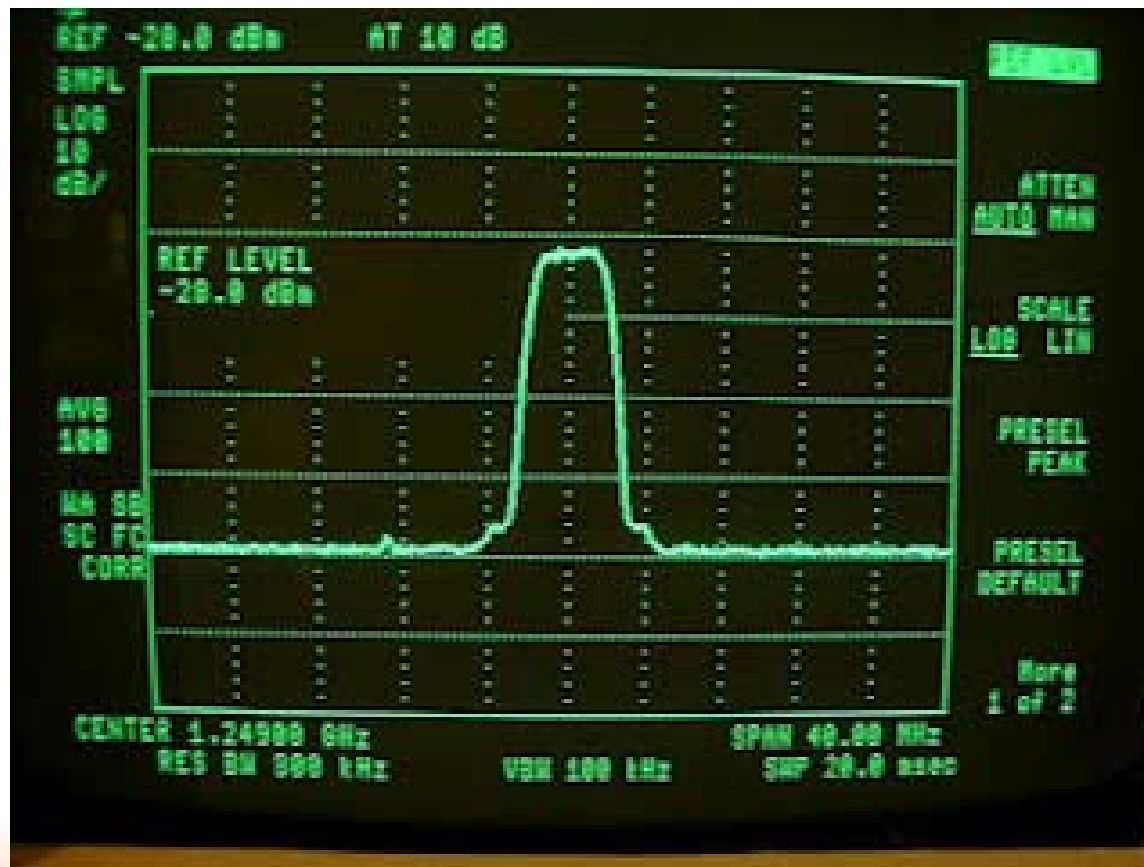
Proof-of-Progress – 1st DVB-S Transmission





DATV-Express

DVB-S 1.2 GHz spectrum



DATV-Express



QPSK constellation with sideband noise



DATV-Express



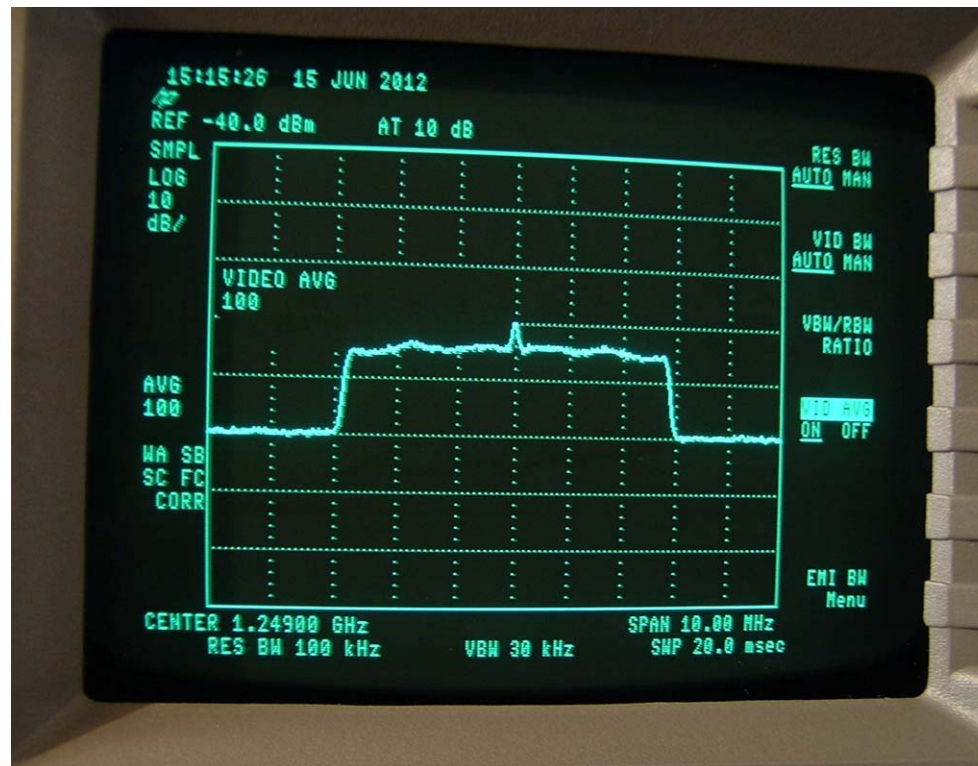
DVB-S video on Satlink WS-6918P





DATV-Express

6 MHz DVB-T spectrum with I/Q balance problem & filter passband ripple



DATV-Express



What about DVB-T, DVB-S2, 8VSB etc?

- “Yes, they are possible....”
- “But, the team has only committed to DVB-S”
- We do also have experimental support for Firewire/DV video input, text overlays, testcards, FFMPEG transcoding, 1080i HD and DVB-T.

DATV-Express



Conclusion and Plans

- Code written for the USRP2 needs porting finished
- Finish tweaking FPGA code
- Finish etch-clean-up layout
- Source files will be freely available with no restrictions (Software, FPGA, Schematic, PADS-files, etc)
- DATV-Express team on target for low-cost DVB-S board around Christmas time.

DATV-Express



Useful Links:

- Amateur Television of Central Ohio
www.ATCO.TV
- British ATV Club - Digital Forum
www.BATC.org.UK/forum/
- OCARC library of newsletter DATV articles
www.W6ZE.org/DATV/
- Charles-G4GUO blog on DATV-Express project development
www.g4guo.blogspot.com/
- 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
- AGAF D-ATV components (Boards)
www.datv-agaf.de and www.AGAF.de
- SR-Systems D-ATV components(Boards)
www.SR-systems.de and www.D-ATV.org
- Yahoo Group for Digital ATV
<http://groups.yahoo.com/group/DigitalATV/>