TechTalk94

DATV Testing Report - Part 5 (KomplettSender DVB-S)

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We bench-tested the DVB-S home station for W6HHC in TechTalk83 last year, and then field tested the W6HHC DATV station during a COAR RACES emergency communications drill in TechTalk87 to transmit video from the field back to an Emergency Operations Center (EOC). The COAR RACES group in the city of Orange was very fortunate to obtain funding to purchase new Digital-ATV equipment to create a portable field station. This article describes the bench testing of the new DATV equipment that includes a KomplettSender DVB-S transmitter (from SR-Systems in Germany) and then reports the results of field testing this portable DATV equipment.

KomplettSender DVB-S Transmitter

If you look at the block diagram in **Fig 1**, you will see that KomplettSender DVB-S transmitter consists of three boards from SR-Systems (MPEG-2 encoder, MiniMOD DVB-S exciter, and an LCD control panel) and a first-stage RF power amplifier (PA) for the 1.2 GHz band. The first-stage PA is a 2W (FM rating) from DGØVE and is capable of running "barefoot" in many DATV situations.

The KomplettSender transmitter puts all of these components in a nice plastic cabinet for running on 12V DC with a BNC connector on the back for RF output. **Fig 2** shows the inside modules of the KomplettSender unit. The board in lower-right of the photo is the MiniMOD DVB-S exciter for 1.2 GHz.

Figure 2 – View of KomplettSender transmitter from rear with top cover removed

Fig 3 shows the front panel of KomplettSender transmitter that contains a very useful LCD Display and a PTT button as well as a jack for external PTT switch.

Figure 3 – Front panel of KomplettSender with LCD Display and Menu Controls

Figure 1 – Block Diagram Showing W6OPD DATV Field Station being Tested

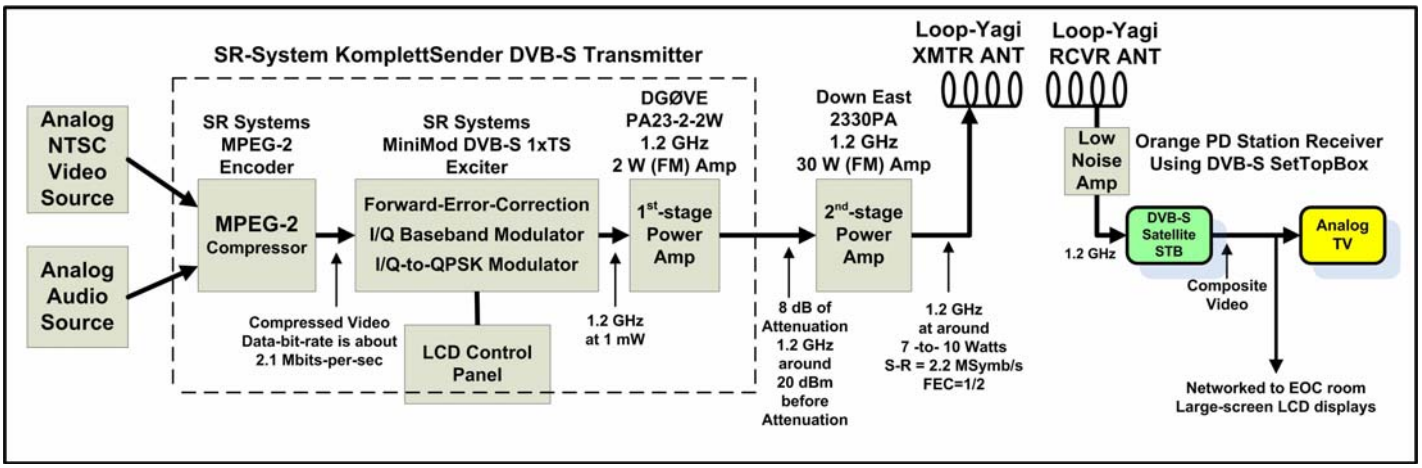

Table 1 – Power Output measurements from First-Stage RF Amplifier

KomplettSender	
MinMOD Gain Setting	**DG0VE amp Output dBm**
-	
-	
7	Not Measured
8	Not Measured
9	20
10	22
11	23
12	25
13	Not Measured
14	25.5
15	26.2

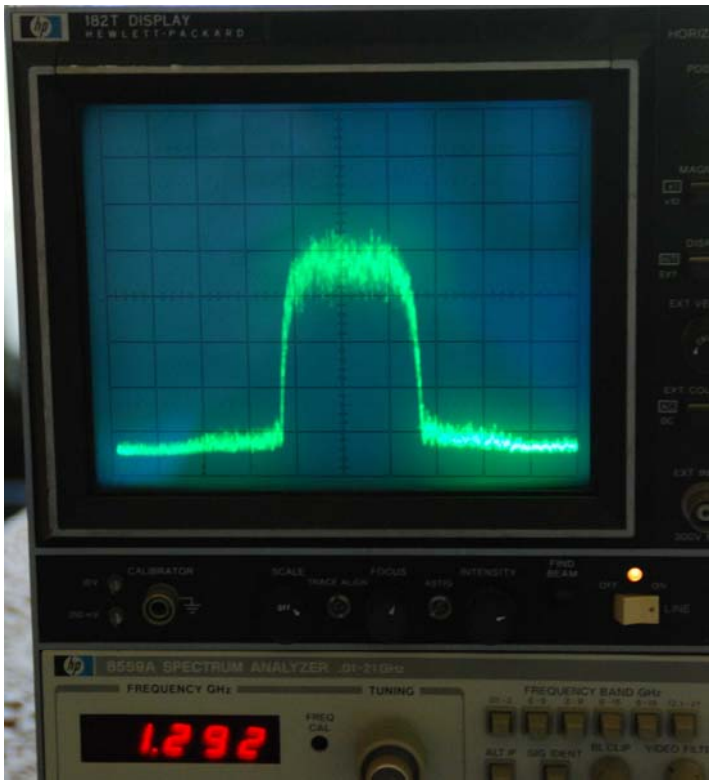

Figure 4 – HP Spectrum Analyzer looks at output from the DG0VE First-Stage RF PA

Fig 4 shows that the output signal quality of the DG0VE first-stage RF Power Amp was very clean (without spectral regrowth "shoulders") even when being driven to the maximum by the exciter RF output settings.

By running a Windows7 freeware application called uCon (like Hyper-Terminal), We can read out the settings on the KomplettSender boards and make changes to the settings via 9-pin RS-232 port. **Fig 5** is a typical display of the settings menu as seen on the notebook computer. I can also access the same settings readout/changes via the LCD panel controls.

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DVB MiniMod Firmware V54.52 LOWDVBT
(c) 2007-2010 maintech GmbH

SI570 XTAL: 114311869 Hz  REF: 100000000 Hz
OnBoard REF: SI570
OnBoard VCO: ADF4350
OnBoard Gain: I/Q
Real HF output range (on-board upconverter):
 * 68750 - 2300000 kHz
FPGA firmware v051.
Encoder firmware upload done (tvp5146,
0x01600625, low delay).
:
:
Modulation Settings
1) Modulation                (DVB-S)
2) TX Enable                 (stand by)
3) Output Frequency          (1292000 kHz)
4) Spectrum                  (normal)
5) Carrier Only              (no)
6) Output Gain               (9)
7) Symbolrate                (2200 ksym/s)
8) Coderate (FEC)            (1/2)
0) exit menu
```

Figure 5– Sample Screen-dump of RS-232 interface to MiniMOD Exciter Settings Menu

Second-Stage Power Amp

The block diagram in **Fig 1** shows that the final-stage 1.2 GHz PA is a model 2330PA 30W unit (the FM modulation rating) from Down East Microwave (in Florida USA). **Fig 6** shows the rugged well-cooled construction of the Down East Power Amp.

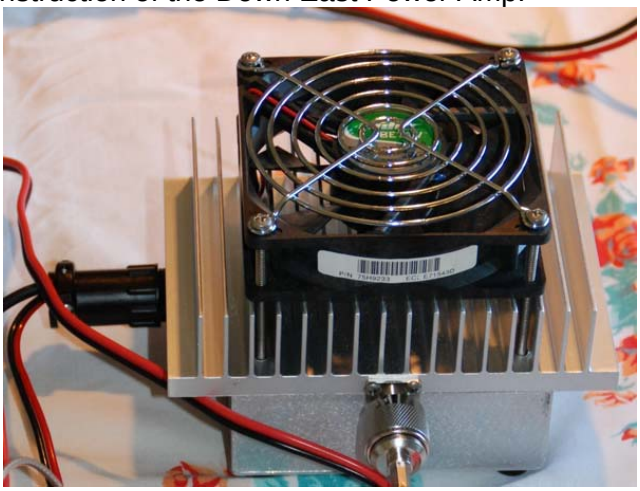

Figure 6 – Construction of Down East Model 2330PA Power Amplifier

Table 2 – RF Power Measurements for Transmitting Station

W6OPD Field Transmitter					
MiniMOD Gain Setting	**DG0VE PA Output dBm**	**Attenuator to final RF PA**	**PA Pwr Out dBm HP 432A**	**PA Pwr Out Watts HP 432A**	**DEMI Spectrum Quality**
7	Not Measured	6 dB	N/M	N/M	Good shoulders
8	Not Measured	6 dB	N/M	N/M	1 shoulder -30 dB
8	Not Measured	7 dB	36.5	4.7	1 shoulder -38 dB
8	Not Measured	8 dB	N/M	6.31	1 shoulder
9	20	0 dB	N/M	N/M	bad shoulders
9	**20**	**8 dB**	**41.0**	**12.6**	2 shoulder -27 dB **W6OPD** PA
9	20	8 dB	41.8	15.1	1 shoulder **W6HHC** PA

Table 2 shows power measurements made with the KomplettSender connected to the DEMI second-stage PA using a HP Model 432A Power Meter (a bolometer type). The final settings used are high-lighted in **Table 2** in **BLUE**. We chose to add an 8 dB attenuator between the DG0VE PA and the Down East Microwave PA. The attenuator allowed us to adjust gains for maximum output power with acceptable spectrum re-growth (spectrum distortion).

The identical DEMI 2330PA from the home station of W6HHC is also listed in **Table 2** where similar results were measured compared to the COAR W6OPD amplifier from DEMI.

Figure 7 – Robbie KB6CJZ is shown with HP Model 432A Power Meter and HP Model 8559A Spectrum Analyzer 0.01-to-21 GHz plug-in

Fig 8 shows the spectrum signal quality coming out of the second-stage DEMI PA using the final settings described in **Table 2**. Our goal was to keep the "shoulder" (distortion) down at least 26 dB below the carrier.

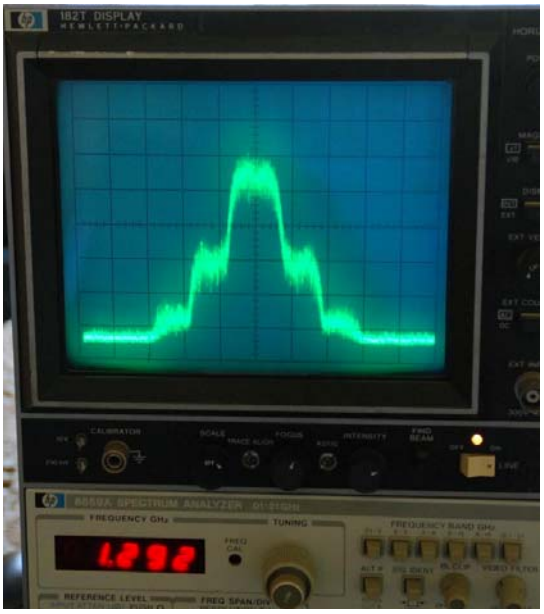

Figure 8 – HP Spectrum Analyzer looks at Down East output signal quality at 3MHz RF BWallocated

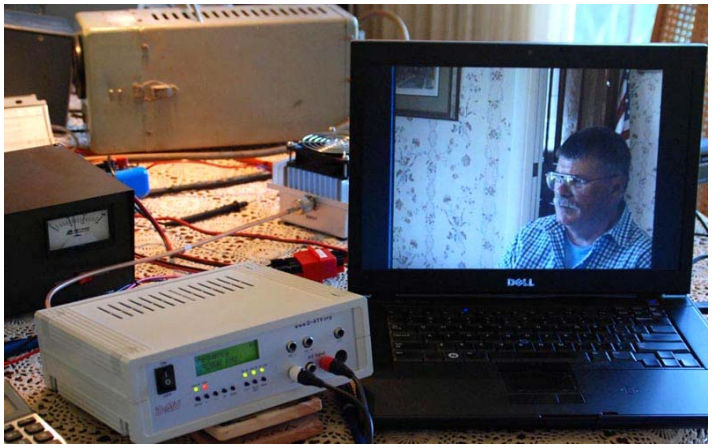

Figure 9 – First W6OPD DATV Video received during Bench-Tests (Ken W6HHC is shown)

Field Loop-Yagi Antenna

The SWR testing of the new DATV field antenna was successful….SWR at 1.292 GHz was about 1.5:1 using a Bird Watt meter. The center-mounted loop-yagi beam antenna is the model 2325LY from Directive Systems in Maine USA, has somewhere between 23 and 25 elements???…can you count the exact number of elements in **Fig 10**?? The beam weighs only 3 pounds (1.4 KG)!! This is essentially the same antenna that is used at the Orange PD building for receiving DATV.

Figure 10 – COAR Member KB6CJZ measures SWR on 1.2 GHz "Elephant Gun" Loop-Yagi

Cost of DATV Field Transmitter

Table 3 totals up the cost for the DATV portable field station that we have described. The most expensive item, the KomplettSender DVB-S, lists for 833 Euros in Europe. Outside of the EU, the VAT can be removed from the selling price.

Field Test

As we have said before, bench-testing is important …but results from the DATV field tests are exciting! The location chosen was a ridge up in the foot-hills of eastern part of the City of Orange that had been tried three years ago using 440 MHz analog-ATV. No video signals could be received from this ridge at the Orange PD building during the earlier analog-ATV field tests.

Figure 11- Photo of COAR RACES field test crew next to the 1.2 GHz Field Antenna up on the ridge

Table 3 – Cost of COAR DATV Portable Field Station

ITEM	Description	Manuf'r	Model	Cost	NOTES
1	NTSC Video Camera			N/A	Already owned by COAR
2	0.4 W DVB-S Transmitter in cabinet	SR-Systems	DVB-S KomplettSender	US$1300	includes shipping, Euro/$ fluctuations, wire-transfer and US duty fee (no VAT)
3	BNC-to-N coax cable	Pasternack	PE3061-18	US$35	
4	30W 2nd-Stage power amp	Down East Microwave	2330PA	$US240	plus shipping (tuned for 1.290 GHz)
5	1.2 GHz Loop-yagi antenna	Directive Systems	2325LY	US$140	with shipping
6	Andersen-connector 12V distribution block (8 outlets)	PowerWerx	PS-8	US$28	
	TOTAL			**~US$1750**	

The tests were conducted from near the QTH of Kathleen K6IBH (up on a ridge across Jamboree Road to the West from Loma Ridge) and great pictures were sent back to the Orange PD EOC Room. This ridge allows camera video to the East of the ridge toward Sierra Peak, Irvine Park, Loma Ridge, and Saddleback Peak. East is the direction that wild grass fires normally approach our city. The DATV signals were fairly weak because a hill was sloping down into the "line-of-sight" transmission path…and we probably had to "knife-edge" around the sloping hill side to reach the OPD EOC.

Figure 12 – Video being received during Field Test on large-screen LCD displays in EOC room

The critical DATV settings selected for DVB-S during these COAR field tests are listed below:

- **Frequency** - 1.292 GHz (center freq)
- **FEC** - 1/2
- **Symbol-Rate** - 2.2 MSymbols/sec
- **RF BW(allocated)** - 3.0 MHz
- **Camera** - NTSC
- **Video Resolution** - D1
- **MPEG-2 GOP Mode** - IBBP

In **Fig 13** below, the QUALITY level read 100% (P5), but the signal level read "only" 45%. This is a mis-leading SIGNAL level since background noise at the OPD usually produces a background SIGNAL level on the receiver to run at 40%. We disregard the value of the SIGNAL strength readout. (BTW quite a few neighbors dropped by to ask about what we were doing? Good opportunity for talking about EmmComm)

Figure 13 – The weak DATV signals received at EOC produced perfect DATV pictures with 100% QUALITY

Summary

The DVB-S field equipment COAR chose worked well. COAR's DATV field testing results have exceeded our expectations and has produced useful video from many difficult field locations. During the DATV planning efforts for COAR, we had many concerns whether DVB-S could handle the multi-path ghosts that had plagued earlier analog-ATV field tests. We were worried that DVB-T technology (with it very robust multi-path protection) might be the only useful DATV technology for COAR RACES.

The digital-ATV DVB-S video quality from the field is much improved over the older analog-ATV technology. This improvement is achieved because DATV technology uses Forward-Error-Correction (FEC) to overcome the "ghosts" and weak-signal conditions caused by elevated-freeways, buildings in the downtown area and the hills on the outskirts of our city.

Interesting 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** and **www.D-ATV.org**
- DGØVE microwave RF amps, up-converters, down-converters – see **www.DG0VE.de**
- Down East Microwave RF amplifiers – see **www.DownEastMicrowave.com**
- Kuhne Electronics (DB6NT) RF Amplifiers – see **www.Kuhne-Electronic.de**
- British ATV Club - Digital Forum – see **www.BATC.org.UK/forum/**
- British ATV Club – select from about 25 streaming repeaters – see **www.BATC.TV/**
- German ATV portal for streaming repeaters and forum – see **www.D-ATV.net/**
- Orange County ARC newsletter entire series of DATV articles – see **www.W6ZE.org/DATV/**
- TAPR Digital Communications Conference free proceedings papers – see **www.TAPR.org/pub_dcc.html**
- Darren-G7LWT site for "DATV Primer" – see **www.G7LWT.com/datv.html**
- Rob-MØDTS D-ATV site including details of F4DAY-design – see **www.M0DTS.co.uk/datv.htm**
- Yahoo Group for Digital ATV - see **http://groups.yahoo.com/group/DigitalATV/**