

TechTalk #80
Comparing DATV Repeater Designs
– Part 2
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Last month, the TechTalk series from the OCARC newsletter described three DATV repeaters, located in Australia and United States. This latest TechTalk article on DATV (Digital-ATV) technology looks at the design of five more D-ATV repeaters. First we will look at GB3BH, GB3KM, and GB3PV in England and then look at DB0DLH and DB0SRS in Germany. We find it fascinating to study the different approaches that hams can use for DATV with repeaters!

GB3BH DATV Repeater Design

The South West Herts UHF Group operates the GB3BH repeater that is located in Bushey Heath, North London. As their Test Card shown in **Fig 2** states, 10 Million people live in range of their signals.

- DVB-S Uplink on 1.2 GHz
- DVB-S relaying from GB3TZ repeater
- FM relaying from GB3HV repeater
- Analogue FM Downlink on 2.4 GHz and 10 GHz
- Internet-streaming to BATC

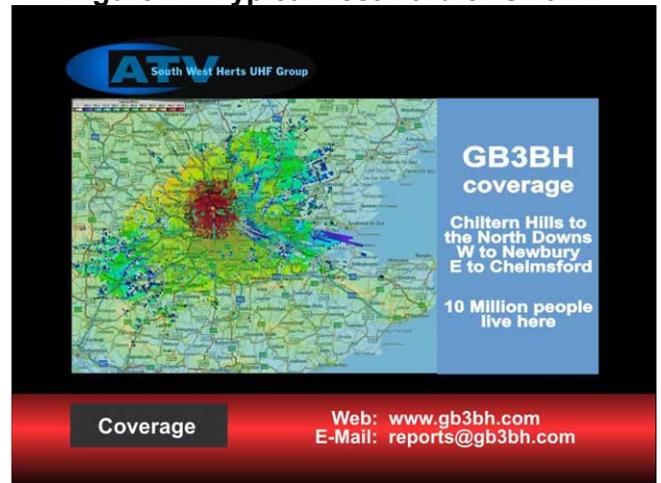
Fig 1 below shows that there is a DVB-S uplink receiver on 430 MHz and a 2.3 GHz DVB-S receiver to relay the signals from the GB3TZ repeater. 70cm DATV is a new band for the GB3BH members and it interesting for

them to be able to work long distances on that band.

Dave Mann G8ADM explains their choice of DVB-S for the GB3BH uplinks "...We do not use DVB-T on the amateur bands in the UK because of the high bandwidth requirements, 8 MHz. With DVB-S the RF bandwidth is similar to the symbol rate and the Power Amp linearity is not so critical."

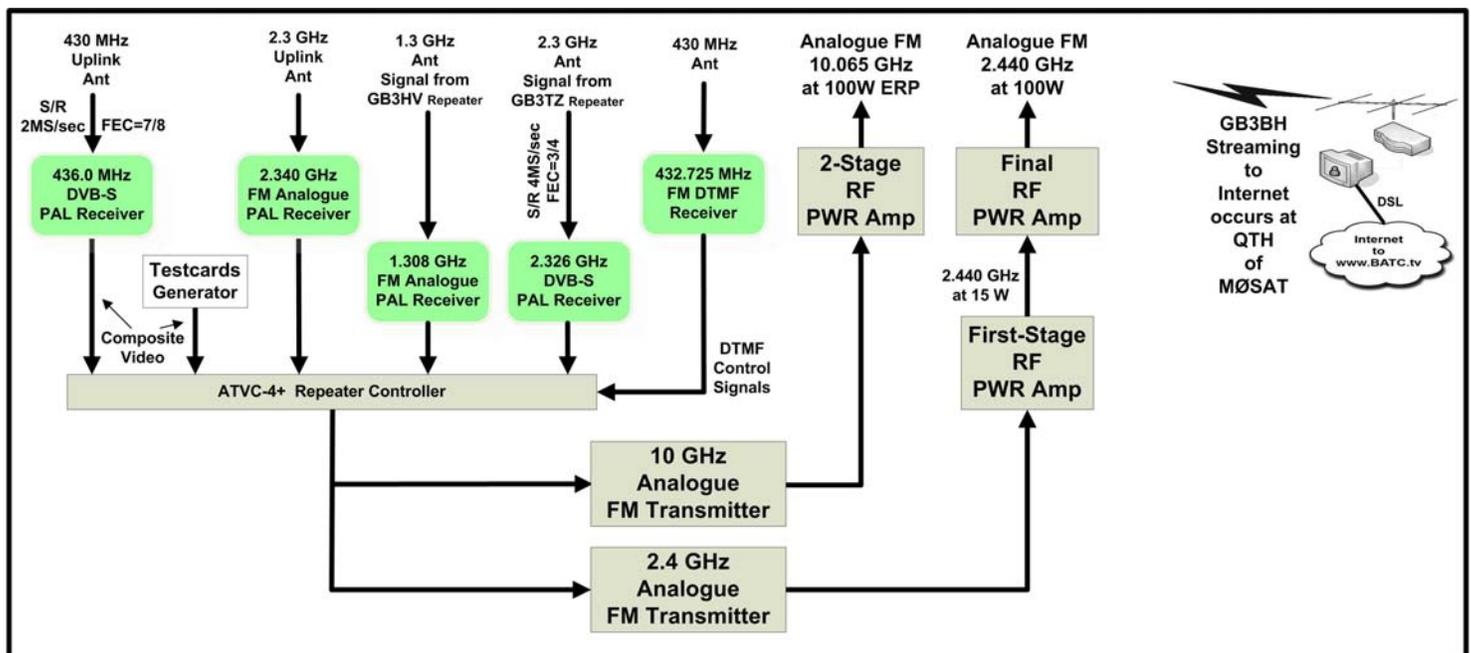
Dave G8ADM further pointed out that "...There are many repeaters in the UK that can be switched to digital or analogue using DTMF tones."

Figure 2 – Typical Test Card of GB3BH



Streaming to the internet, is performed by Dave M0SAT receiving the 10 GHz signal at his home station and uses Adobe Flash Encoder to direct the stream to the BATC.TV web site for viewing (See the **Internet-Streaming** side bar on the next page).

Figure 1 – Block Diagram of the DATV Repeater Design for GB3BH



GB3KM DATV Repeater Design

The Kirk Merrington DATV Repeater is located about 225 miles North of London. The block diagram for the GB3KM DATV repeater design is shown in **Fig 3**.

- DVB-S Uplink on 1.280 GHz
- Analogue Uplinks on 1.2 GHz, 2.3 & 10 GHz
- Analogue FM Downlinks on 2.4 and 10 GHz
- Internet-streaming to BATC

Currently the two output transmitters on the GB3KM repeater are both FM analogue. The same video is run simultaneously to the 2.4 and 10 GHz transmitters. Rob Swinbank M0DTS explains that "...We run a full duplex repeater so we have decided that a digital output is not the best option for us. This is due to the combined input and output delay in full duplex digital operation being in the order of 2 seconds.... not good enough for us!. Even 1 second of delay is not easy when more than two stations are in the same QSO with each other."

Rob reported that he is planning to add DATV on the 436 MHz band. "70cm seems to be the best choice over here for us as the digital signal is more 'friendly' to other users on 70cm band and should yield better DX!"

Streaming to the internet, is performed by Rob M0DTS receiving the 10 GHz signal at his home station and injects it into the internet to be viewed at www.BATC.TV. He also uses the free-download Adobe Flash Media Live Encoder 3 software program on his PC and his home DSL line to achieve the video-streaming to the BATC site.

Internet Streaming your Repeater

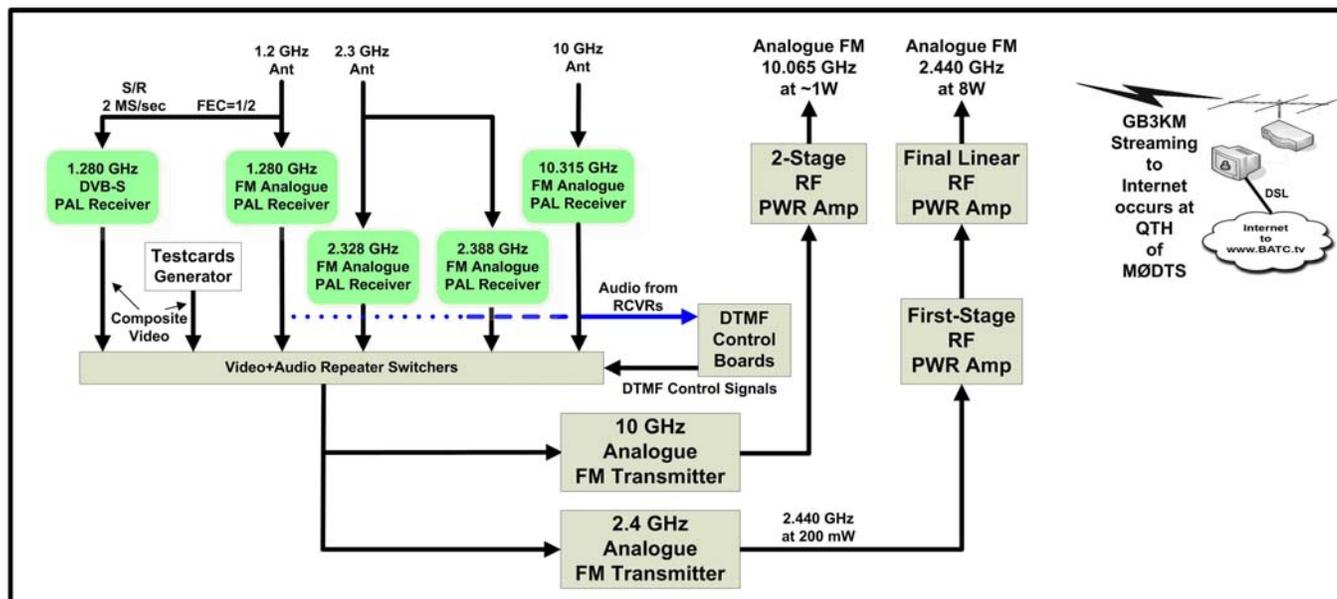
Ever wonder how to stream your video onto the internet? The DATV repeaters that we studied in this article all receive the ATV signal at a local ham station (where a DSL line exists) and then inject the received (composite) video into a PC using "video capture" hardware such as the typical USB unit seen below.



An application software program can then direct the video-and-audio stream from the PC to a remote WEB site. The app software favored by England is the Adobe Flash Media Live Encoder 3 (free download from Adobe). There are two app software programs favored by the German hams: open-source VideoLan Client (called VLC) and open-source NullSoft Video (called NSV). The viewing web-site runs a server type software to allow many people to watch at one time.

British hams stream to www.BATC.TV for viewing
German hams stream to www.D-ATV.net for viewing

Figure 3 – Block Diagram Showing GB3KM DATV Repeater Design



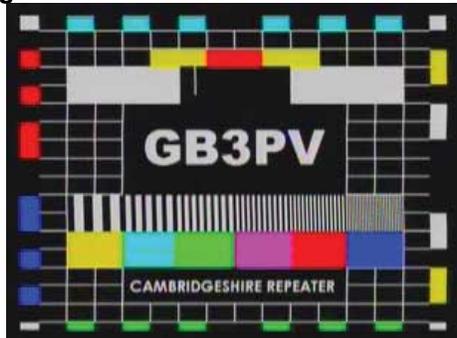
GB3PV DATV Repeater Design

The GB3PV DATV repeater is operated by Cambridge Repeater Group and is located in Madingley, Cambridgeshire - about 50 miles North of London. The block diagram for the GB3PV DATV repeater design is shown in **Fig 4**.

- Analogue FM Uplink on 1.2 GHz
- A planned DVB-S uplink for 1.2 GHz
- DVB-S Downlink on 1.3 GHz
- Analogue FM Downlink on 1.3 GHz
- Internet-streaming to BATC

As Gavin Nesbitt M1BXF explains "...The repeater group uses single RX and TX frequency on GB3PV mainly due to the restrictions from the CAA (Civil Aviation Authority). Using DTMF it is possible to switch the TX between analogue and digital. The beacon also alternates between analogue & digital."

Figure 5 – Test Card Stream from GB3PV



Ken W6HHC also had some interesting DATV RF Bandwidth conversations with Brian Shaw G6HFS of the Cambridge Repeater Group. Brian had even remeasured the GB3PV RF BW for Ken and reported that it was about 4.2 MHz, very close to their

SymbolRate (abbreviated as S/R) of 4.165 M Symbols/Sec. That was also the value of BW that Prof. Uwe Kraus DJ8DW of the German AGAF group had told the repeater group to expect. In our TechTalk76 article on DVB-S BW, we had reported that QPSK bandwidth is stated as

$$RF\ BW = \sim 1.33 \times SymbolRate$$

This formula would result in an expected BW of 5.6 MHz, not 4.2 MHz? Why is there a difference?? You may have noticed the hams at GB3BH equate DVB-S BW with S/R, too. See **Further BW Discussions** in the side bar below.

Further Discussions on DVB-S RF Bandwidth

Through searches on the internet, we have confirmed that there are three ways for defining RF BandWidth for QPSK modulation.

"minus 3 dB" bandwidth method

With this method, bandwidth is measured at the points that are down 3 dB. This is a typical method for measuring a filter bandwidth and represents the "half-power point" if you are looking at voltage on a spectrum-analyzer. (Symbol-Rate is shown as S/R.) Mathematically, $BW_{-3dB} \approx S/R$ for this definition.

"occupied" bandwidth method

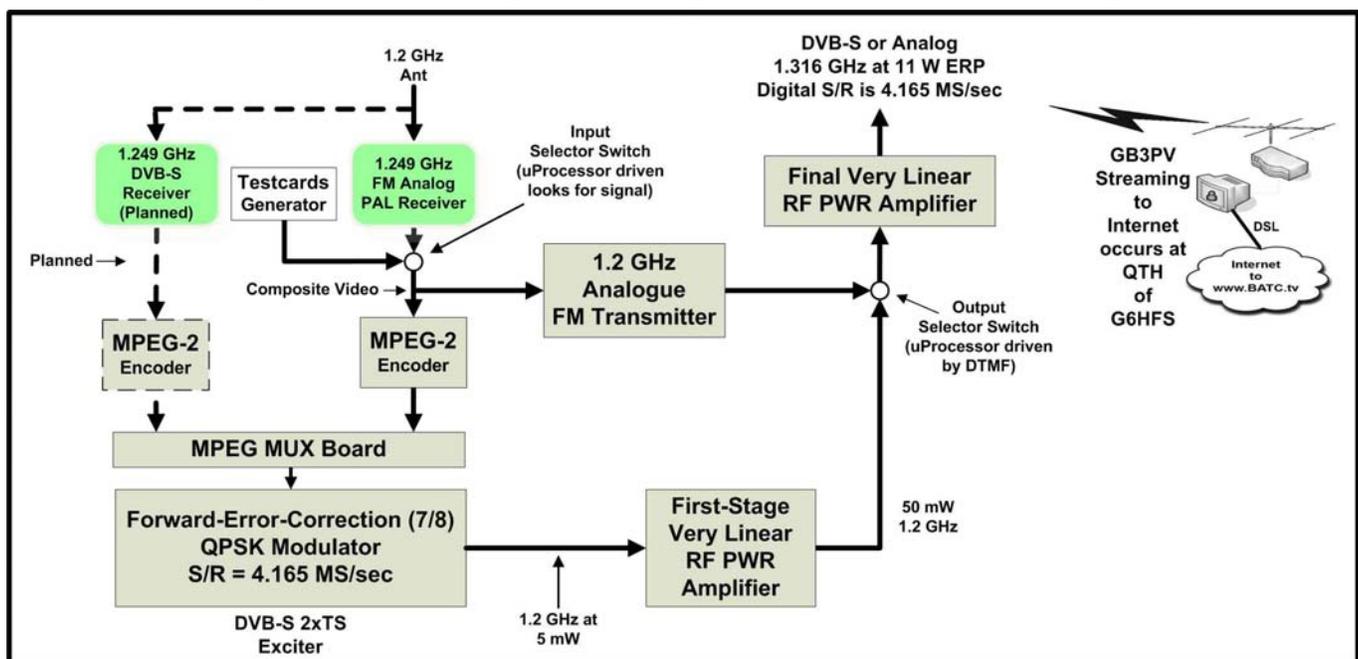
This occupied bandwidth is defined as $BW_{occupied} = 1.19 \times S/R$. The signal level is down by about 10dB at the edges of the occupied bandwidth

"allocation" bandwidth method

This method provides a little guard-band between adjacent DATV signals. Allocation bandwidth uses formula $BW_{allocation} = 1.33 \times S/R$. This formula is equivalent to measuring at down about 17 dB

An ONLINE BW CALCULATOR is listed in Related DATV Links. It seems to us that the "allocation" bandwidth is the most meaningful value of bandwidth for people trying to determine how many DATV stations to squeeze into a band plan. Significant power would overlap frequencies if we spaced several DATV stations on their 1/2-power-points...hence potential interference.

Figure 4 – Block Diagram Showing GB3PV DATV Repeater Design



DB0DLH DATV Multimedia Repeater Design

The DB0DLH DATV repeater is operated by the Lufthansa Amateur Radio Club Hamburg and located at the Hamburg-airport (HAM) in Northern Germany (near the Denmark border).

- 2 DVB-S uplinks on 2.355 GHz and 2.360 GHz
- 4 Analogue uplinks on 2.3 GHz and 10 GHz
- DVB-S relaying from six repeaters
- Analog downlinks on 5.7 GHz and 10 GHz
- DVB-S re-distribution by DB0FS repeater
- Internet Streaming by two external sources

We were very impressed that the DB0DLH repeater also has two SKYPE inputs that are selectable. Notice in **Fig 6** that the DB0DLH repeater relays six DATV signals coming from repeaters outside of Hamburg. These include DB0DAN, DB0EUF, DB0FS, DB0HEX, and DM0HMB repeaters. As Hans Hass DC8UE explains "... It is a living repeater and we are always modifying and changing the possibilities.....". Their selection and switching & "quadro-picture-in-picture" (see **Fig 7**) capabilities for DB0DLH are very impressive.

Hans DC8UE also explained that "...The 10GHz-signal is running a short way to the DB0FS repeater and is there received and coded to generate a digital DVB-S-signal. After muxing with three local produced videos, this signal is then digitally re-distributed on 1288MHz (DVB-S FEC 3/4) from the DB0FS tower to the DB0DAN & DB0EUF repeaters. The reason for this complex way is the

circumstance that the location of DB0DLH is not high enough...therefore DB0DLH cannot directly pass to the DB0DAN or DB0EUF repeaters."

Fig 7 - Typical DB0DLH "quadro" Live Picture on Internet-Stream

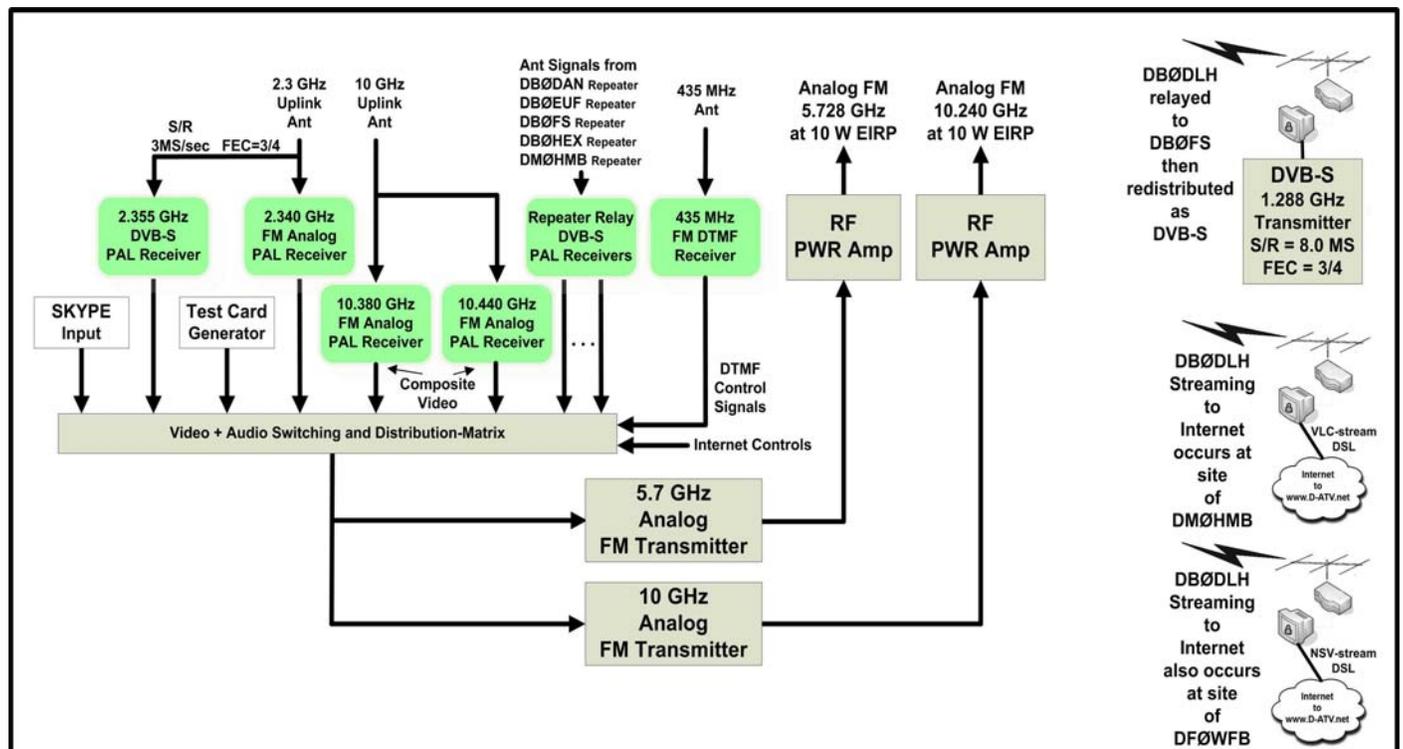
Upper-Left - Michael DF4HR from Hamburg

Lower-Left - Karl DM2BMB from Grabow via DB0EUF



Streaming to the internet occurs at two different locations. The DB0DLH signal is received over the air at the DM0HMB repeater site and then sent over the internet to www.d-atv.net/db0dlh.aspx in the VLC-mode (requiring a VLC-player to be watched). The DB0DLH signal is received over the air at the DF0WFB repeater site and then sent over the internet to www.d-atv.net/db0dlh.m3u in the NSV-mode (that requires a WinAmp-player to be watched).

Figure 6 – Block Diagram Showing DBØDLH DATV Repeater Design



DB0SRS DATV Repeater Design

The DB0SRS repeater, located in Steinau an der Strasse, about 60 KM East of Frankfurt, is one of several DATV repeaters operated by Stefan Reimann DG8FAC (of SR-Systems).

- FM Analog Uplink on 1,2 GHz
- DVB-T relaying from DB0LWK & DB0CWS repeaters
- DVB-S2 relaying from DB0NQ repeater
- FM relaying from DB0HAU & DB0HAU repeaters
- DVB-T Downlink on 3,4 GHz
- Six Transport Streams (6xTS) with 12 Pictures (PIDs)
- Internet-streaming to the DB0CWS repeater

Stefan DG8FAC explained that "...In D-ATV we don't need special LINK QRGs, we perform monitoring and filter out the PIDs which we don't need, so we select from 16 Programs for the repeater. The Ethernet connections from the MiniMUX Boards are connected to a standard D-Link 5-port 10/100Mbps switch, on this switch we have also connect the PC and D-Star. The 6xTS DB0SRS then transmits 12 Programs, each with net-Data-Rate of 2.5 Mbps in the D1 Resolution

(720*576 PAL) and 64kBit Audio Dual Channel mode."

Although there is no "internet streaming" to a central streaming location (such as D-ATV.net), DB0SRS does place a small Internet connection, on the other side is the DB0CWS repeater, this is the "Internet" entry point. Finally, note that the DB0NQ repeater is being received as DVB-S2, the modulation is 16APSK with FEC=8/9 and 13,5 MSymbolRate for total net-data-bit-rate of 47,56Mbit and 18 MHz Bandwidth.

Acknowledgements

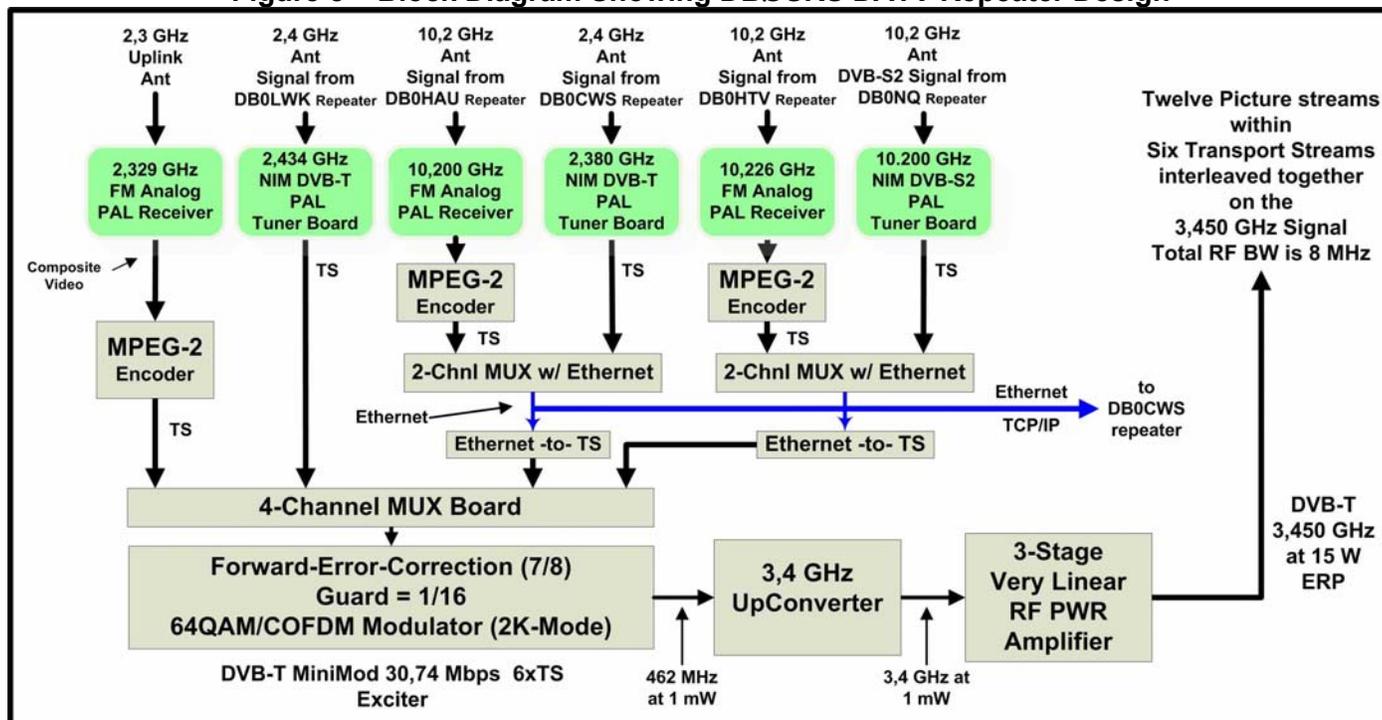
We would like to thank Darren G7LWT, Graham G3VZV and Klaus DL4KCK for suggesting DATV repeaters for this article and providing contact information.

A special thanks to:

Dave G8ADM for sharing info on GB3BH repeater
Gavin M1BXF and Brian G6HFS for sharing info on the GB3PV repeater

Rob MØDTS for sharing info on GB3KM repeater
Hans DC8UE for sharing info on DBØDLH repeater
Stefan DG8FAC for sharing info on DBØSRS repeater.

Figure 8 – Block Diagram Showing DB0SRS DATV Repeater Design



Related DATV Links

- South West Herts UHF Group – GB3BH – see www.GB3BH.com/
- Cambridge Repeater Group – GB3PV – see www.CambridgeRepeaters.net/?page_id=13
- Kirk Merrington ATV Repeater – GB3KM – see www.MODTS.co.uk/GB3KM/
- Lufthansa Radio Club Hamburg DB0DLH streaming via VLC-mode – see www.d-atv.net/db0dlh.aspx
- Lufthansa Radio Club Hamburg DB0DLH streaming via NVS-mode – see www.d-atv.net/db0dlh.m3u
- SR-Systems D-ATV boards for Hams – see www.D-ATV.org/
- British ATV Club – select from about 25 streaming repeaters – see www.BATC.TV/
- Orange County ARC newsletter series of DATV articles – see www.W6ZE.org/DATV/
- RF Bandwidth online calculator for DVB-S & DVB-S2 – see www.satellite-calculations.com/Satellite/bitrates.htm