



Getting Started with RB-TV

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Introduction

This article is intended to help newcomers get started with Reduced Bandwidth TV (RB-TV) using some existing equipment together with recent new designs. The suggested approach is a step-by-step one to enable testing and confirmation of progress at each stage. The CQ-TV RB-TV Special provides very good background information and can be downloaded from here:

<http://www.batc.org.uk/cq-tv/>

What is RB-TV?

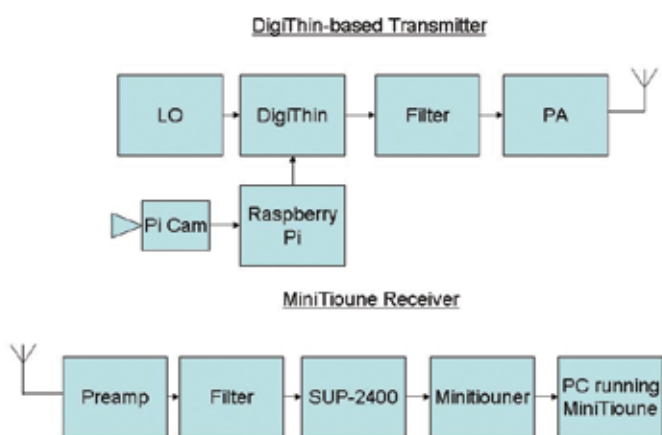
Reduced Bandwidth TV is normal DVB-S fast scan digital TV, but with the following modifications:

- ▶ The symbol rate is reduced so that the bandwidth occupied is less than 1 MHz. The BATC suggested standard is a symbol rate of 333KS/s, which occupies a bandwidth of about 450 KHz.
- ▶ MPEG-4 coding (rather than MPEG-2) is used for the TV signal as it performs much better within the low symbol rate.

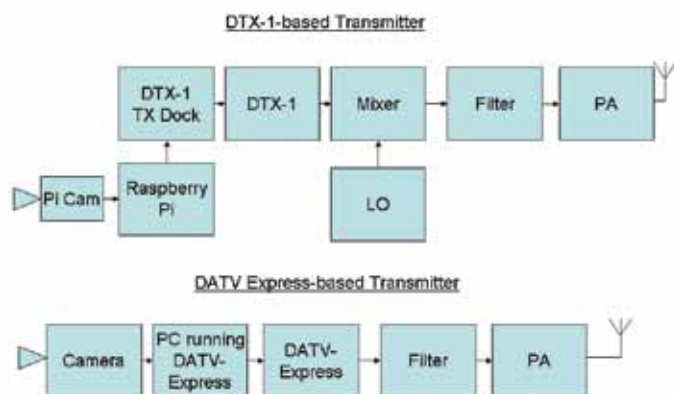
The reduced bandwidth means that the transmissions are compatible with the new (temporary) 146 MHz and 71 MHz bands, and the mode also gives a marked (>6 dB) signal to noise improvement over normal DATV in the higher bands. Sound is not transmitted in this mode – all the available bandwidth is used for vision.

Typical RB-TV Station

A typical RB-TV station is using a Raspberry Pi is illustrated here:



There are 2 other alternative transmitter configurations currently in use:



The entry-level Raspberry Pi station will be described here.

Putting it All Together

To allow a gradual learning curve and testing at each stage, it is recommended that the RB-TV station is put together in the following order:

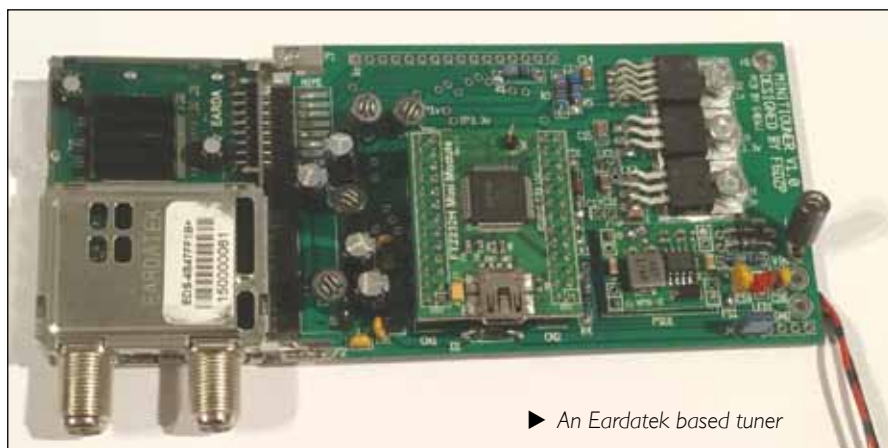
1. Build a MiniTiouner and install MiniTioune software on a PC. Test them with domestic satellite transmissions or an off-air amateur DATV signal. This is the only receiver currently available for RB-TV transmissions.
2. Modify an SUP-2400 up-converter and change the crystal in it to lower the local oscillator frequency. Test, using a standard 70 cms preamp, with a conventional 70 cms DATV station.
3. Get a Raspberry Pi working with a Pi camera. Load F5OEO's software and transmit pictures across the bench to the MiniTiouner using "Ugly DATV" mode.
4. Build a DigiThin plug-in board for the Raspberry Pi. Using a suitable Local Oscillator, transmit pictures across the shack from the DigiThin board to the MiniTiouner.
5. Apply for your NoV to allow you to transmit in the 146 MHz band.
6. Build 146 MHz PAs to raise the power level to achieve 25 W ERP.
7. Tidy up the system with filters and changeover relays.

Each of these steps is described below.

MiniTiouner

Domestic satellite receivers will not decode a DVB-S signal with a symbol rate of less than 1 MS/s, so are not useful for RB-TV. Currently, almost the only reception option is to use a PC with the TuTioune or MiniTioune software by Jean-Pierre, F6DZP, together with a compatible Digital Satellite receiver card, or an external MiniTiouner kit connected through USB.

The MiniTiouner is the best option and is described in detail on the BATC Forum at <http://www.batc.org.uk/forum/viewtopic.php?f=15&t=4225>. Printed circuit boards and tuners are available from the BATC shop. There are 2 compatible tuners, the Eardatek (which covers 950 – 2150 MHz) and the Sharp (which covers 650 – 2600 MHz). The latest software can be found on Jean-Pierre's Forum at <http://www.vivadatv.org/viewforum.php?f=60>. Note that you will need to register to download the software. The software accesses some system functions, and so is reported as malicious by some virus checkers.



► An Eardatek based tuner

An alternative to the external USB tuner is to use the internal (PCI card) tuners TT S2-1600 or TT S2-3200, although these are no longer available for purchase.

Once your tuner is built, you can verify correct operation by viewing any free-to-air transmission from Sky's Astra satellites. This MiniTioune or TuTioune based receiver is the best decoding solution for DATV transmissions and will also decode the HAM-TV from the ISS.

Up-converter

RB-TV transmissions on 146.5 MHz or 437 MHz are outside the tuning range of Satellite tuners (normally 950 – 2150 MHz, but 650 – 2600 MHz for the Sharp tuners sold by the BATC shop). The transmissions need to be up-converted to within the satellite band.

The SUP-2400 "B-Band Converters" sold by the BATC shop can easily be modified or commanded to up-convert

437 MHz to 1963 MHz. Hardware modifications to permanently enable this are described by Rob, M0DTS at <http://www.m0dts.co.uk/?tag=DATV&item=90>. Alternatively, the unit can be switched to up-convert using DiSEqC commands as described elsewhere in this issue.

The SUP-2400 can also up-convert 146.5 MHz to 2253.5 MHz, but suffers from poor sensitivity unless the 2400 MHz LO is lowered to below 2300 MHz as described in my article in this CQ-TV.

For best results, you will also need a preamp and a band-pass filter in front of the SUP-2400.

Raspberry Pi and Pi Camera

The Raspberry Pi and Pi Camera enable easy generation of the H264-encoded digital video signal required for RB-TV. Evariste, F5OEO has published some software which enables you to configure the output to start automatically, without the need for a keyboard or a monitor. You may also want to investigate using an HDMI lead to extend the cable on the Pi Camera.

First of all, make sure that your Raspberry Pi and Camera are working properly using the resources at <https://www.raspberrypi.org/>. Once you have a working camera, download the SD Card image of Evariste's software and put it on a new SD Card. Check the download instructions and initial configuration instructions on the BATC Forum at <http://www.batc.org.uk/forum/viewforum.php?f=97>.

One of the modes of Evariste's software allows direct generation of a (very dirty)

DVB-S signal from the GPIO port on the Raspberry Pi. Enter this mode and then, using your MiniTiouner with a short wire on the RF input loosely coupled to Raspberry Pi GPIO on pin 12, go to 1062.5 MHz and set SR=250K. You should be able to see an RB-TV DVB-S signal. Full details can be found at <http://f5oee.fr/UglyDATV01.pdf>.

At this stage, you have proved that your MiniTiouner and Raspberry Pi are both ready for RB-TV.

DigiThin

The signals from a Raspberry Pi in "Ugly DATV" mode are generated directly from square waves and nowhere near clean enough for transmission. Brian, G4EWJ has developed the DigiThin board which will provide about 1 mW of clean DVB-S signal at any frequency between 100 and 1000 MHz (when fed with an appropriate local oscillator). Full details of this board can be found on the

BATC Forum at <http://www.batc.org.uk/forum/viewforum.php?f=97>.

The PCBs for DigiThin are available from the BATC Shop. There are details on the forum of how to set the Raspberry Pi to program the local oscillator designed along with the DigiThin modulator. Once constructed, you can test your DigiThin by setting it to transmit on 146.5 MHz and receiving it on the MiniTiouner with the SUP-2400 up-converter.

Notice of Variation

Now is probably the time to apply from Notice of Variation (NoV) to authorise you to transmit in the 146 MHz band. You can apply online at the RSGB website: <http://rsgb.org/main/operating/licensing-novs-visitors/online-nov-application/>. No NoV is required for 437 MHz.

Power Amplifiers

The power limit for 146 MHz is 25 W ERP, so there is no need for massive power amplifiers, but typically 3 W will be required to achieve this ERP, and the DigiThin output is about 1 mw. It is very difficult to achieve much power amplification without distorting the transmitted signal, and even the smallest amount of distortion causes sidebands to appear at unacceptable levels potentially out-of-band.

Rob, M0DTS described 2 power amplifiers in CQ-TV 247 using FET amplifier transistors. These are capable of generating a reasonably clean 1 W, but must be well shielded otherwise the whole system can go unstable. Rob has also described a design using a higher power transistor to achieve 5 W here: <http://www.m0dts.co.uk/?tag=146MHz&item=148>.

Higher powers (to overcome feeder loss, or for use with low gain aerials) will need larger devices, or the use of pre-distortion – which is technically very difficult.

Filters and Changeover Relays

Filters are essential both in the transmit and receive paths. For transmit, the DigiThin produces reasonable harmonic content, and its close proximity to the Raspberry Pi means that it picks up some of the microcomputer's clock signals. The power amplifiers described above are reasonably broadband, so these signals can easily be amplified and transmitted if filtering is not employed. I use the RSGB VHF-UHF Manual 145 MHz filter described in this issue by Shaun, G8VPG.

On the receive side, tight filtering should be used to try to reject all but the wanted signal, as the Satellite Tuner itself is 27 MHz wide. The fewer unwanted signals it sees within that pass-band, the more sensitive it will be to weak, wanted, signals.

Clearly, you do not need to use changeover relays, and could just plug/unplug between transmit and receive. However, as you are probably going to be using the same aerial for voice talkback, the likelihood of attempting to transmit in the wrong configuration seems high. Best to spend some time fitting changeover relays, rather than repairing preamps at a later date!

Conclusion

Using the building-block approach proposed, an RB-TV station can be built from components that have some commonality with DATV and offer the potential of very long-range contacts, particularly during lift conditions.

