

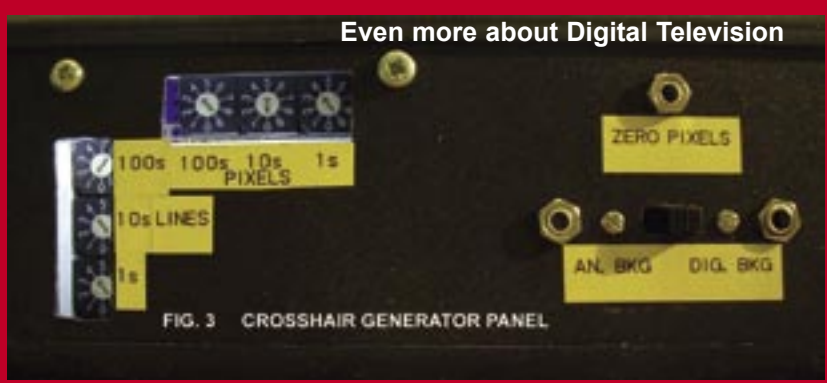
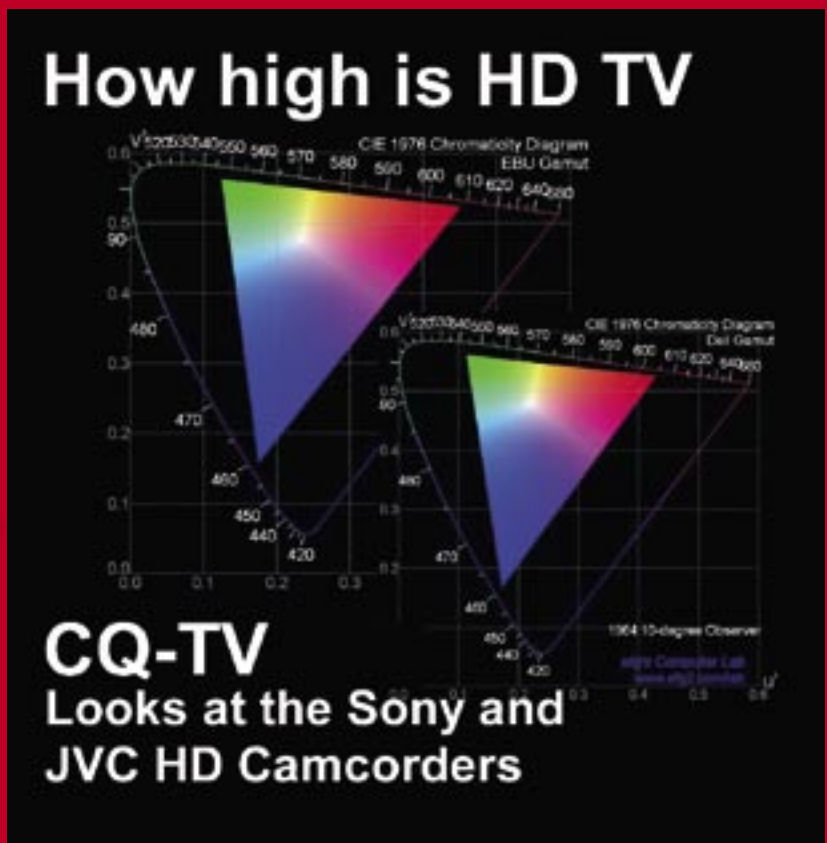
# CQ-TV 211

August 2005

ISSN 1466-6790



The completed simple repeater control board



[www.cq-tv.com](http://www.cq-tv.com)



## Caption competition

Can you think of a caption for the above picture? (see page 12) If you can, then send your entry to [chariman@batc.org.uk](mailto:chariman@batc.org.uk). The winner will receive a Black Box caption generator

## BlackBoxCamera™ Company Limited

The STVKBD unit allows control of the STV5730A's functionality from a PC keyboard. For full details of the unit's operation please see the documentation.

This unit features the ability to construct scrolling video text overlays from text typed on each of the units four available screen pages. Each message can be upto 308 characters long. Text, and the scrolling feature, are stored when the unit is switched off and scrolling will restart when power is restored. The unit uses the standard UK keyboard key mapping, see the documentation. There is no facility to change to the keyboard mappings of other countries.

The unit is housed in a smart ABS plastic enclosure with phono connectors for video in / out, a 2.1mm DC power socket and a 9V PP3 battery clip. It is designed to be powered from the same power supply as the camera and so the unit does not have a power switch. Keyboard connection is via a 6-pin mini DIN socket for a PS/2 keyboard.



- ▶ Compatible with colour and mono composite video signals. 1Vp-p. PAL or NTSC\*
- ▶ Dimensions 110 x 65 x 28mm LxWxH
- ▶ Power supply 9 - 12dc via on board regulator or 9V PP3 backup battery
- ▶ Power consumption 50mA (without keyboard)

\*By default the unit will be supplied compatible with the video standard of the country from which you make your order.

If you require further information please contact us: [sales@STV5730A.co.uk](mailto:sales@STV5730A.co.uk)

Visit our web site at - [www.stv5730a.co.uk](http://www.stv5730a.co.uk)

# CQ-TV 211

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## Committee Contacts

### President: Mike Cox, CEng., FIEE

E-mail: [president@batc.org.uk](mailto:president@batc.org.uk)

### Chairman: Trevor Brown, G8CJS

Club affairs, Videotape library, and Technical queries, especially relating to handbook projects. 14 Stairfoot Close, Adel, Leeds, LS16 8JR. Tel: 01132 670115. E-mail: [chairman@batc.org.uk](mailto:chairman@batc.org.uk)

### General Secretary: Paul Marshall, G8MJW

General club correspondence and business. Library queries relating to the borrowing or donation of written material. Fern House, Church Road, Harby, Notts., NG23 7ED. Tel: 01522 703348. Email [secretary@batc.org.uk](mailto:secretary@batc.org.uk)

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**Club Liaison:** - And anything of a political nature, co-ordination of ATV repeater licences. **Graham Shirville, G3VZV**, The Hill Farm, Potsgrove, Milton Keynes, Bucks., MK17 9HF. Tel: 01525 290343. E-mail [g3vzv@amsat.org](mailto:g3vzv@amsat.org)

**Contests:** - **Richard Parkes, G7MFO**, 7 Main Street, Preston, Hull, HU12 8UB. Tel: 01482 898559. Email: [contests@batc.org.uk](mailto:contests@batc.org.uk)

### CQ-TV Magazine: Editor Ian Pawson

Anything for publication in CQ-TV, Articles, Review items, Letters to the editor, and other material except as below. 14 Lilac Avenue, Leicester, LE5 1FN, England. Tel: 0116 276 9425, Email: [editor@cq-tv.com](mailto:editor@cq-tv.com)

Photographs for the CQ-TV covers: - Please send any photographs by post, electronic images by email, to the editor at the above addresses.

**TV on the Air:** - **Graham Hankins G8EMX**, 17 Cottesbrook Road, Acocks Green, Birmingham, B27 6LE. Tel: 0121 706 7384

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### Exhibitions

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By Trevor Brown

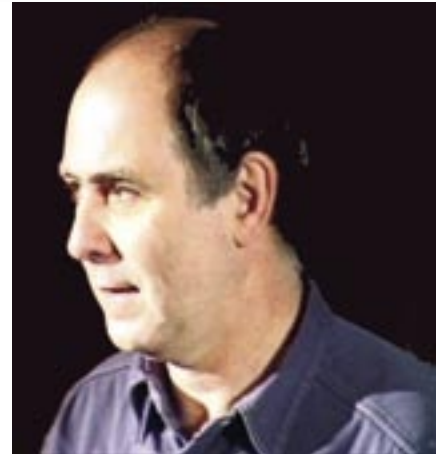
New in the last issue was a caption contest - thank you to all of you who sent in entries. They were very amusing, even those that we dare not publish. The winner is Ian Wade (see page 10) and a Black Box Camera Co character generator is on its way to you. If you have any pictures that you feel suitable for this spot, please let the editor have them.

Also in the last issue was a new project called Cat Box, which seems to have sparked of a lot of interest. I have already had suggestions for additions, such as pots to adjust the colorimetry of the pictures and a PAL coder for monitoring the component and SDI inputs. All of the suggestions are under consideration - it is just finding the engineering time to implement them.

As you may have heard, there is a plan to mount some extra amateur band antennas on the outside of a new European part of the ISS called Columbus, that should be launched next year. These will face the earth and cover 23 and 13cms, and also possibly 70cms. Their installation would enable ATV gear to operate from the ISS for the first time. Maybe this could be a "repeater" or show on board videos.... As a test bed for DATV it could be very useful. To this end, BATC has donated 500 Euros to the project.

2006 will be a BATC convention year, and we are looking for a suitable venue and organiser. Shuttleworth is possible, but we try to move the event around and feel it is time for a change. Bletchley Park is no longer available to us. Most of the previous venues belong to an era when we could draw in the crowds. We always hold a flea market and a lecture programme, and in some years we have managed to uplink these proceedings to satellite. One suggestion for this year is to webstream the lectures and meeting, in an attempt to reach a wider audience. Not every venue has broadband internet access, but there must be somewhere that we can use.

I also promised to keep you up to date on DATV. It is some 2 years since we bought the modules to evaluate this mode. The modules have a hardware MPEG2 encoder and QSPK modulation. We are still waiting for the GMSK stage of the development, but in the mean time things are on the move again. MPEG2 has been around since the mid 90's and does provide video compression of the order of about 50:1. Its been adopted by the broadcasters, but it does not stop there. We do not have as much bandwidth as the broadcasters to play with. In 1999 MPEG4 appeared and gave a 15 to 20% coding gain, which was not enough for the broadcasters to make changes to their hardware investment. In the last few years we have seen H264, Windows Media, Real Video, and On 2. These systems provide



a 50% reduction in bit rates for the same picture quality as MPEG2.

Where do we go from there? Well, enter the BBC and their new codec, Dirac, based on wavelets and capable of compressing data rates by a factor of 160 to 1! What is also interesting about Dirac is that it is open technology, which means the technology can be used by anyone without payment of royalties.

You might ask 'Why is it called Dirac?' It is named after the British physicist Paul Dirac (1902-1984), who was one of the most influential scientists of the 20th century. In 1933 he shared the Nobel Prize for physics with Erwin Schrodinger for his contribution to quantum mechanics. *A copy of the BBC research paper on Dirac is available from the CQ-TV web site - ED*



### Snap!

The wonderful world of ebay strikes again. Dicky Howett writes, "These two pictures of myself taken 45 years apart shows (a) a Keystone A7 16mm movie camera pictured in 1960 which was my very first movie camera and (b) the exact same model which I purchased on ebay last month, for which I paid £20, the same amount I paid in 1960, and even then it was a second hand camera. Naturally, it would be stretching serendipidy if this was the EXACT camera I owned in 1960. I would have recognised that, as I later had it adapted for a single frame shutter action by an obliging camera engineer at the BBC's Ealing Studios (where I used to work). Subsequently, I sold my original Keystone camera to a chap who planned to use it to film 'trick' shots for the BBC's 'VISION ON' programme. Think he did too"



## In the edit suite – part 5

By Trevor Brown

Although the new edit suite is up and running, changing from hardware based digital effects units to software based units does take some time. It's a long steep learning curve, and with new software finding its way into the market place all the time, this maybe a process that will never end. The manufacturer's do their best to help, and in the last issue I gave you the link so you could download and play with Combustion. It came complete with several tutorials and, although these were very helpful, I have to admit that due to pressure of work, I did not get through all the modules before my 30 day evaluation copy expired.

This time I have been looking at chroma key. Although Toaster, sorry - VT 3, has an inbuilt keyer, this does tend to give problems with DV cam pictures. 4.1.0 as opposed to 4.2.2 processes the colour at a higher compression ratio. This is not particularly evident in the picture, but the chroma keys do tend to show switching problems between foreground and background. There are various standard fixes around, the most popular being called Choke, in which the size of the hole in the foreground is reduced all round by one pixel to give an overlap between foreground and background. This helps, but still this format does not key as well as a 4.2.2.source.

Enter Serious Magic - <http://www.seriousmagic.com/> . If you go to the site and select virtual sets, there is a web streamed demonstration and a download demo that works.



Troy working on Lathe



Lightsabers in progress (with plastic lightsabers).

Not only is it an excellent keyer, as you can judge for yourself, but it also comes complete with virtual sets. If you have never used chroma key there are one or two do's and don'ts, the most important one being chose either a blue or green background and make sure that that colour is not part of your foreground, or you will get what has become known as the AOL effect, (remember the ad with the girl and the moving pattern on her dress?).

The second point is not to move the camera, because the background won't move with the foreground. This does tend to make the production boring and there is a fix, which is to change the camera picture size i.e. zoom and cut out

the zoom so that you get a picture size change in the foreground, and then adjust the size of the background to match. To this end, Serious Magic supply numerous virtual sets in various sizes. They show this on the web stream, but often cover the jump cut with a cut away, so maybe they had trouble in getting it to work.

Back to the new Toaster edit suite, and one engineering problem cropped up in DV transfers via Firewire - they kept freezing and stopping. I thought it might be a driver problem, as old equipment was involved. In the early days of Firewire, each piece of kit had its own drivers and then eventually a standard OHCI came along and found its way into Windows XP, and all the problems dissolved - well most of them. The Firewire is resident on the motherboard and the final cure was to add a Firewire PCI card, when all the problems were resolved. I don't have an explanation, but am pleased to be up and working.

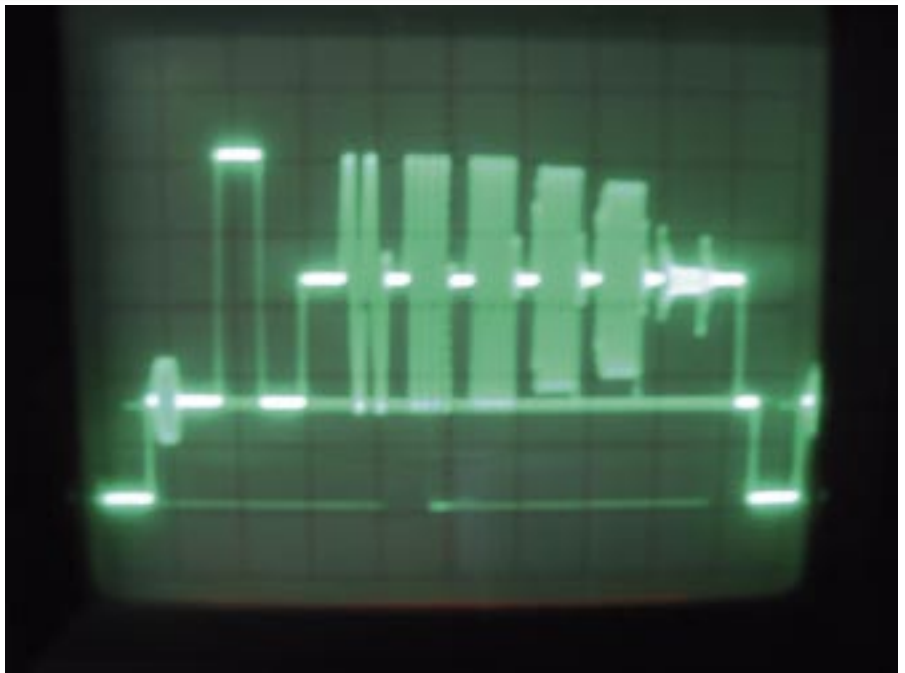
So far, I have only used the editor in VT 3, but it came complete with bundled software for Desk top motion graphics (Light wave) and Aurora, both of which are down on the list to play with and evaluate, but then this wonderful demo, in the form of a Student film project, appeared on the net and is completely made in Toaster. I know there are more of them than me and that they are younger and more used to the software world, but please download their offering 'Duke' and see what can be achieved from effects story acting and editing. I am not easily impressed these days, but I was this time <http://www.empyreus.net/DukeHTMLs/Downloads.htm>

George Lucas, eat your heart out.

# LP Video Filter for Digital/Analogue Television Experiments

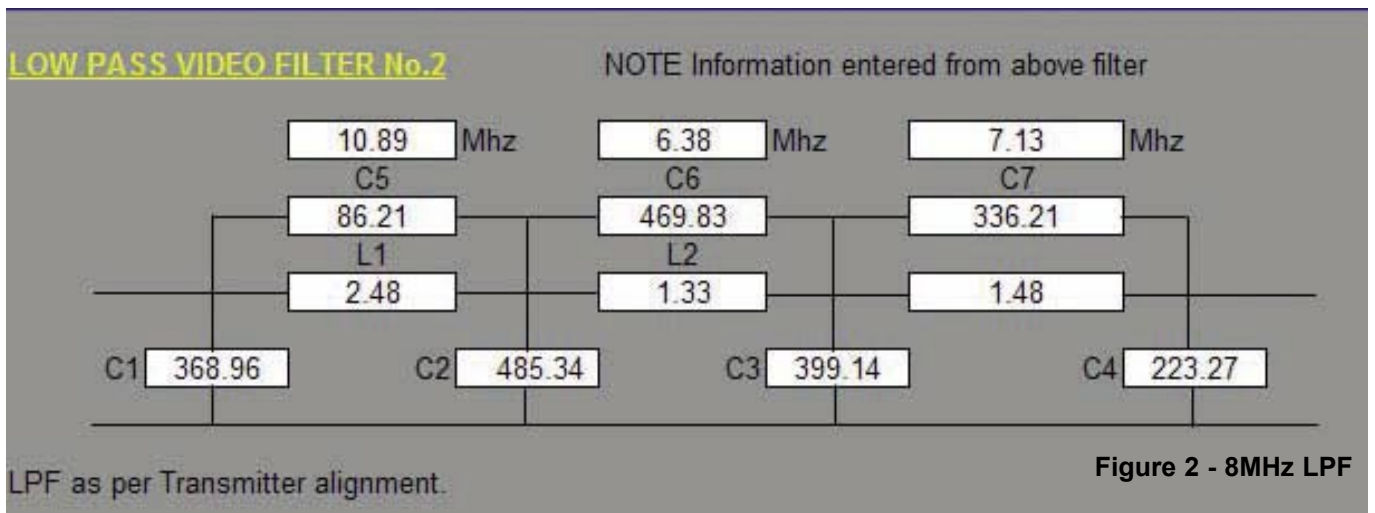
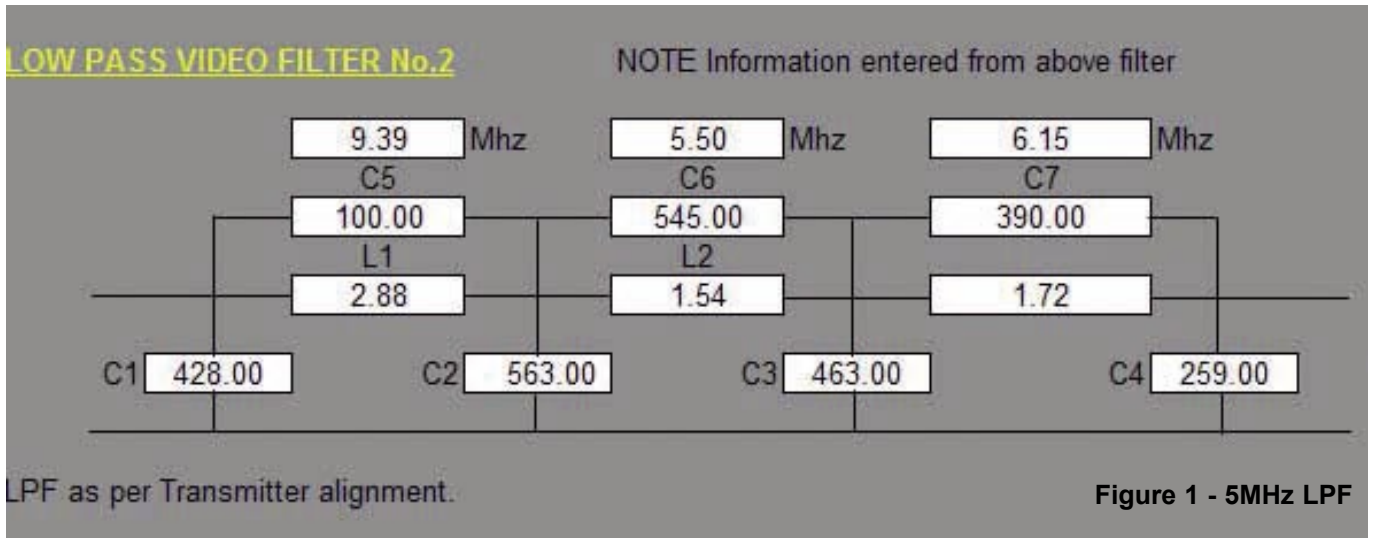
By **Richard L. Carden**  
VK4XRL

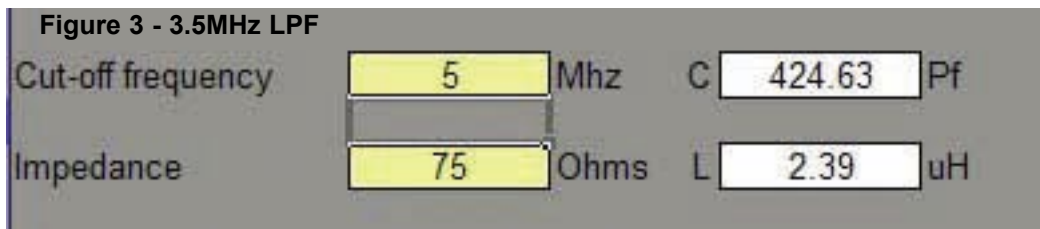
The following video filter design was prompted by a comment regarding buzz on the FM audio carries when using the Cropredy test-card generator or CQ-TV character generator. It is also applicable to computer generated graphics especially the old Vic20 and Commodore C64. If we had a spectrum analyser connected to the output of these devices then you would see a spectrum covering some 10 to 12 MHz. This is brought about by the fast rise-times uncounted with these units. Therefore it's possible that some of this energy will fall at 5.5 MHz and 5.74 MHz (or 6.0, 6.5 MHz) causing interference with the audio sub-carriers. Also with the advent of digital television experiments a low pass video filter will also be required to reduce the effects of "aliasing" where frequency components higher than half the sample rate beat with it and cause low frequency interference.



**5MHz built filter**

Therefore what is required in both cases is a video filter to remove these unwanted components from the video signal. The following circuit provides a 5 MHz

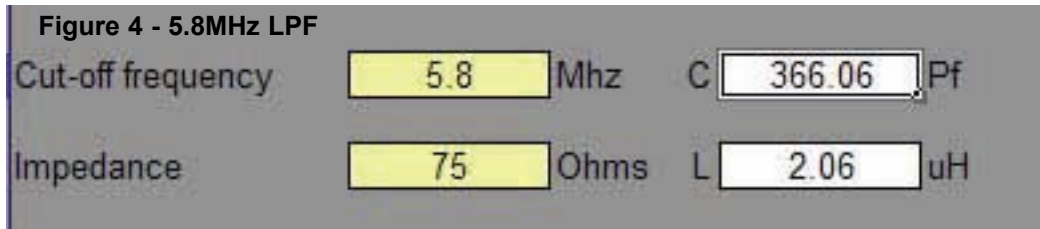




not yet been corrected, the chroma information therefore will be delayed compared to the luminance signal. The attenuation can be found as follows;

$$\text{Attenuation} = 20 \cdot \text{LOG}(\text{output/input})$$

The component values can then be found using the following formulas which again used an Excel spreadsheet as shown in Figure 5;



LPF with some frequency response equalization, however initially no phase equalization has been attempted. The filter has a loss of around 1.05db @ 4.0 MHz and -2.25db @ 4.8 MHz. These figures could be improved with better construction techniques. The filter can also be scaled to other frequencies as required.

Also for 5.8 MHz LPF;

$$C = 366.06 \text{ pF and}$$

$$L = 2.06 \text{ uH}$$

These are then used in an Excel program to determine the required component values Figures 1, 2, 3 and 4.

$$\text{Therefore } A = 10^{\text{Atten.}/20}$$

$$R1 \text{ and } R2 = 75 \cdot (1-A) / (1+A)$$

$$R3 = (75^2 - A^2) / (2 \cdot A)$$

$$C1 = \text{SUM} (10^6 / (2 \cdot 3.14 \cdot 75 \cdot 0.36 \cdot A))$$

$$L1 = \text{SUM} (\text{Atten} \cdot 75^2 / 10^6)$$

**Formulas for LPF**

$$C = \text{SUM} (1 / (2 \cdot 3.14 \cdot F_o \cdot Z_o)) \cdot 10^6$$

$$L = \text{SUM} (1 / (4 \cdot 3.14^2 \cdot F_o^2 \cdot C)) \cdot 10^6$$

Where for 5 MHz LPF;

$$C = 424.63 \text{ pF and}$$

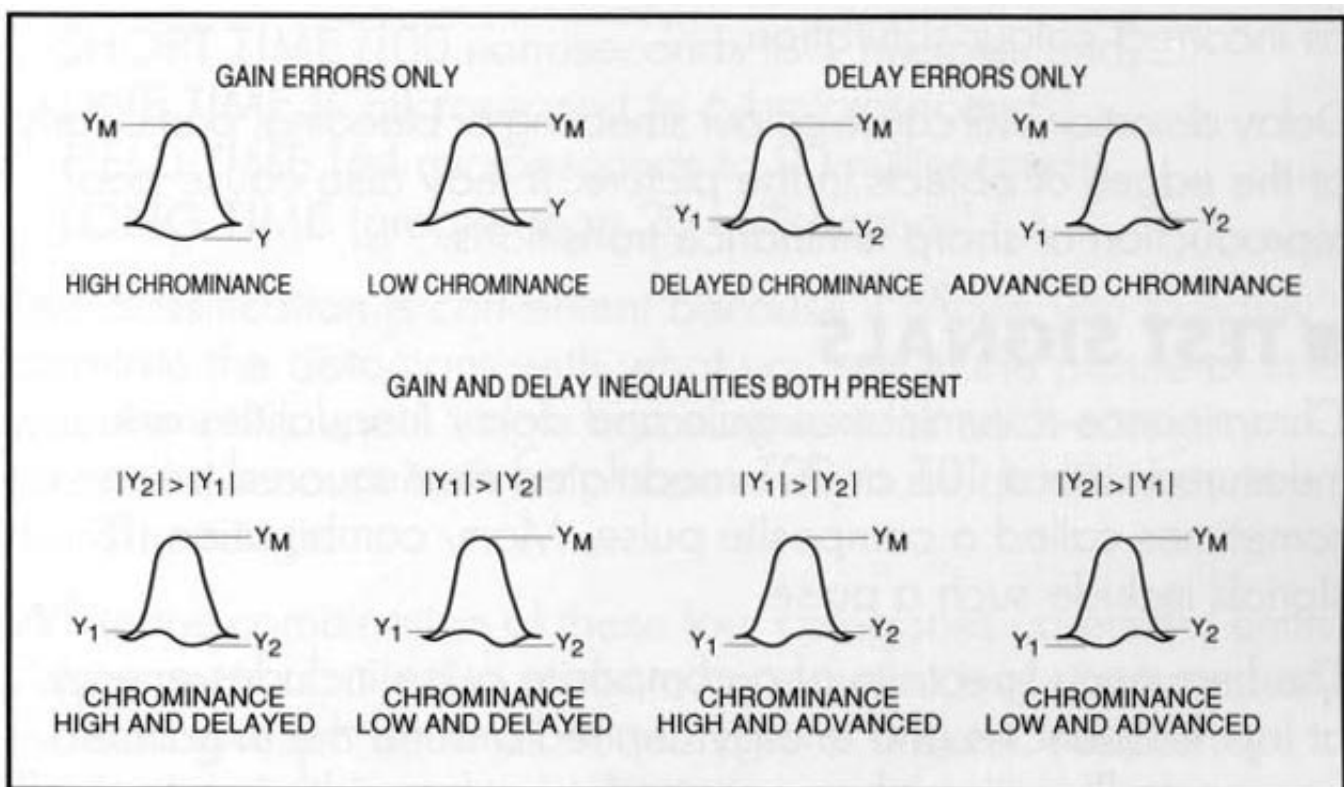
$$L = 2.39 \text{ uF}$$

Because the seven pole LPF as constructed has a fall in frequency response of around -2.25dB @ 4.8 MHz, a simple equaliser circuit has been included to flatten this response. This circuit has the inverse relationship to that of the filter and therefore the filter will now have a corrected response to 5 MHz, the total loss through the filter being around -2.85dB. Because the phase response or group delay has

**Video Equaliser**

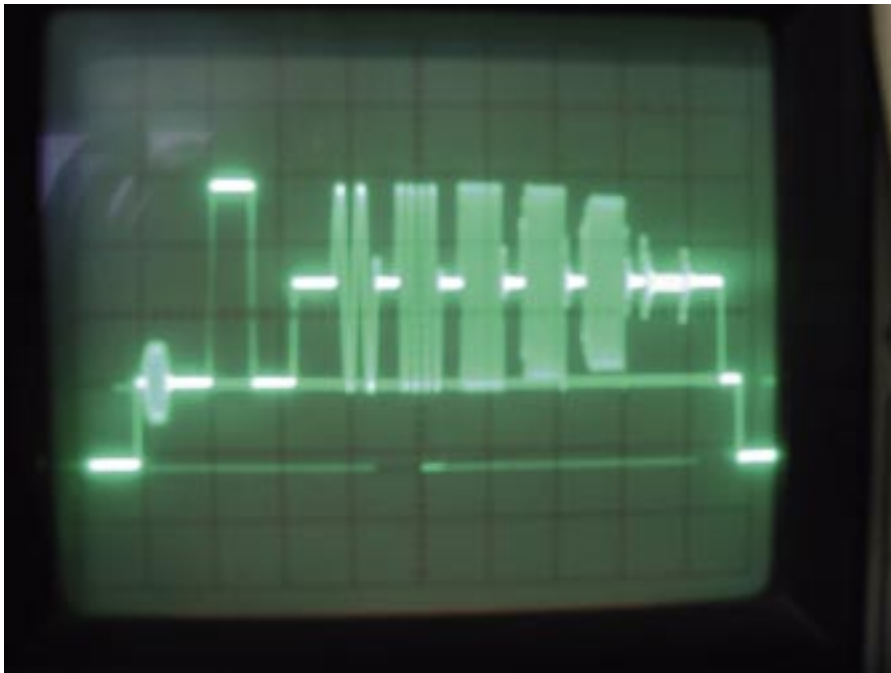
To further improve the performance of the above filter especially for digital (or for that matter any mode) an active equaliser circuit was developed and constructed to;

1. Improve the phase/group delay response



**Fig.7 Effects of gain & delay inequalities**





5MHz response

the second phase corrector is the same as the first except for the frequency of operation and therefore will not be described. The video signal is AC coupled to the base of the first transistor where the DC bias has been set so that the video output from the output stage transistor collector causes minimum distortion when a bounce signal (black to white transition) is applied. The video signal is then phase split with a 180 out of phase signal appearing at the collector. This signal is then fed via the tuned circuit and corrects the video spectrum at around 2.4 MHz. Therefore by adjusting the phase control from the emitter you can apply some out of phase signal and with the amplitude control adjust the level of required correction. The second phase corrector operates in the same way, but at a frequency of around 3.8.MHz. With careful adjustments of all four controls quite good results can be achieved (Figure 8 & 10) using 2T/20T pulse and bar, Figure 7 shows the effect of gain and delay inequalities. The output signal level can then be adjusted for 1v p/p output. This output stage could be replaced with an EL2030 or equivalent OP amplifier and be connected to a +/- supply for better performance (although

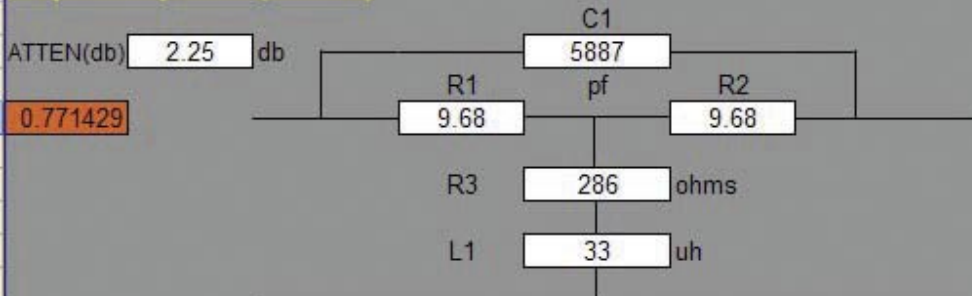
2. Provide gain for 1v P/P output

The circuit is fairly simple, and for amateur use simple phase splitters have been used. Emitter followers could have been added to the respective outputs but

it was felt that the extra circuitry wasn't warranted in this situation.

Looking at the active equaliser circuit shown in Figure 6, the output from the video filter is fed to the input of the first phase splitter.

Response equalizer ( 75 ohm)



Calculation	
INPUT	700 Mv
OUTPUT	540 Mv
Atten	-2.25 db

Figure 5 - Equaliser

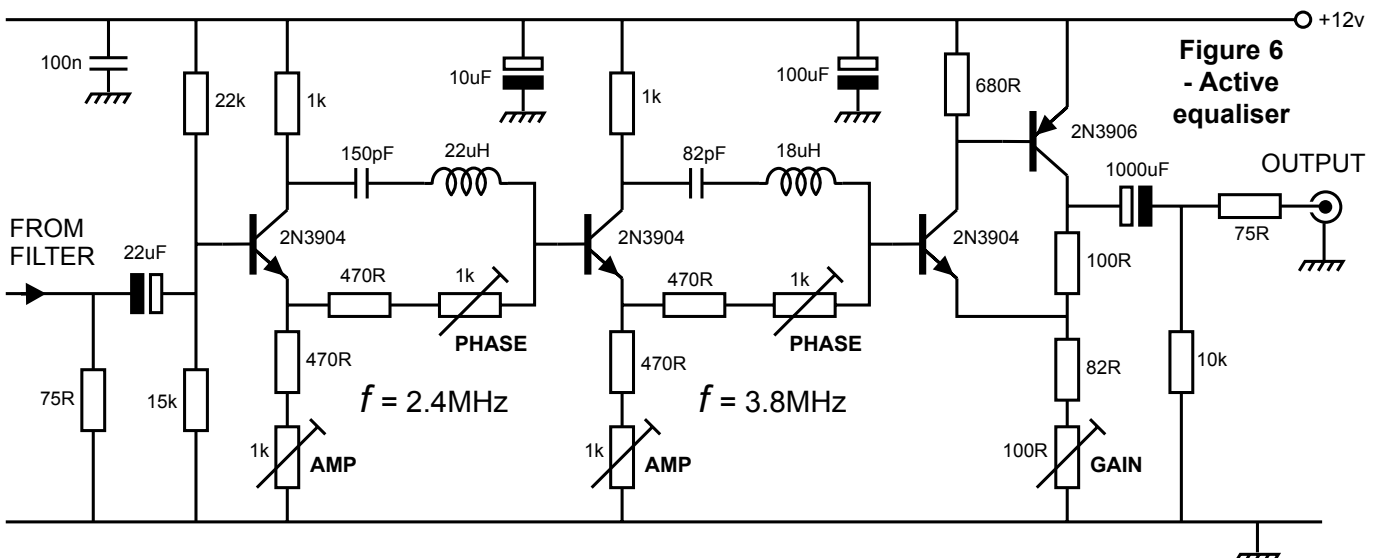
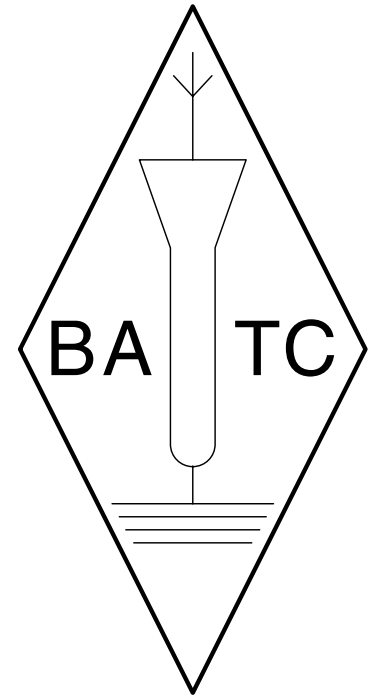


Figure 6 - Active equaliser



**Figure 8 - Output**



this has not been tried). Also the whole equaliser and output stage could be connected this way.

For digital television experiments the video filter can have its response extended to around 6 MHz i.e. half the clock frequency of 13.5 MHz. The circuit shown can therefore be used in this application also with some component scaling. For this design I used 5.8 MHz as the 3dB cut-off point.

**Reference:**

Understanding the Fundamentals of Passive Video filters. MICROWAVE & RF (May 1996)



**Figure 10 - Pulse and Bar**

**CQ-TV 210 caption competition**



Entries received were:-

“Hot cross Brian?” - Jeffrey Borinsky

“If it’s as tasty as he says it is, why is he hiding his behind his back” - Ian Wade (winner)

“Is this someone’s idea of a practical joke, all I ask for was donuts for the new PCB.” - Richard Carden

“One-arm bandit pays out in hot-cross buns allowing Treasurer to extend his juggling skills.” - John Van Dyken

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68	4.433618MHZ CRYSTAL	£3.25	£0.30		
69	5.0MHZ CRYSTAL	£3.25	£0.30		
86	24CM SOLID-STATE AMPLIFIER PCB	£10.50	£0.43		
<b>STATIONERY &amp; STATION ACCESSORIES</b>					
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The Amateur TV Compendium (155gm)	£3.50		
The BATC handbook featuring construction articles on video units, 24cm and 3cm ATV, a Digital Frame Store, and much more.			
The Best of CQ-TV (150gm)	£3.50		
A compilation of the best construction articles from CQ-TV's 133 to 146			
CQ-TV Back Issues:	£1.50		
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**PLEASE MAKE CHEQUES PAYABLE TO 'BATC'.**

## Harpenden in June.

Dicky Howett writes, "The well-attended British Vintage Wireless Society Swapmeet (one of many each year) at Harpenden Public Halls (June 5th) saw the fully-live exhibition of Paul Marshall's splendid 'Tyne Tees' ob van. Several cameras were running including a Marconi Mk 4. Much interest was expressed and everyone had a wonderful time



"So where's this lens turret?"



Paul Marshall describes the last of the Marconi cameras, the Mk 10.



"Now what would happen if I pressed this button?"

# Turning Back the Pages

By Peter Delaney

**A** dip into the archives of CQ-TV, looking at the issue of 50 years ago - CQ-TV 25 - "Summer 1955"

The big news of the month is that in view of the response to the suggestion that we hold a meeting this year, we have gone ahead and organised the Second Amateur Television Convention. This will be held at the Bedford Corner Hotel, Bayley St, just off Tottenham Court Road (and in those days, Tottenham Court Road housed many component and 'surplus equipment' shops!). Don Reid is doing the donkey work, and the proposed scheme is 10am exhibition of equipment - everyone is asked to bring what they can. BATC standard power supplies will be available ..... 2.15pm Short lectures on ATV subjects. Film show. 4.30 pm Tea (Cup of)."

For the particular benefit of newcomers, and to give everyone a starting point, we hope to publish in time for the Convention "An Introduction to Amateur Television" (a title also used for a BATC book some 30 years later). This will be a short booklet mainly of reprints from the RSGB "Bulletin" and probably will cost 3/6d (17½p)

There were as usual several technical articles - possibly the most 'surprising' was one entitled "Home-Made Zoom Lenses". At that date, zoom lenses were quite novel - if a camera was to be able to capture more than one type of shot of the scene, different lenses (telephoto

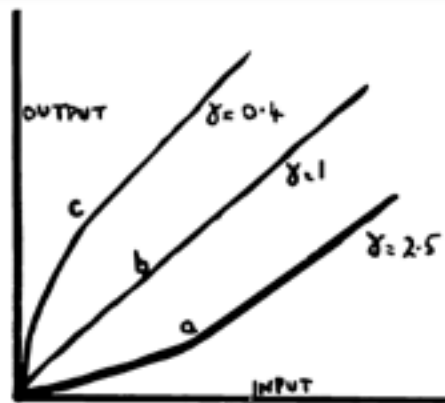
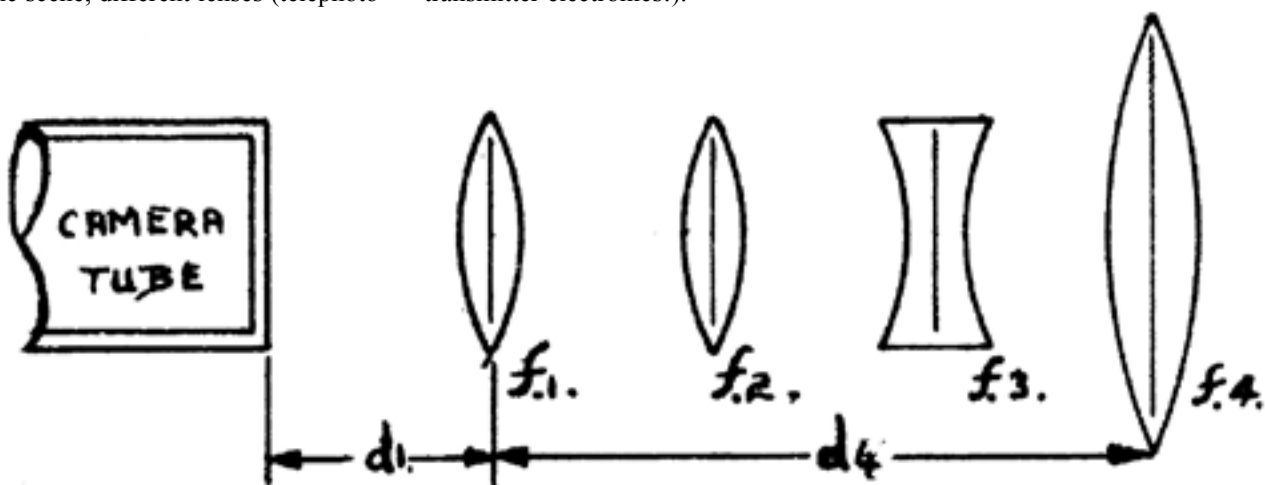


Figure 1: (a) shows a typical input-output curve for a CRT; (b) a linear characteristic (unity gamma); (c) the amplifier response required to convert (a) into (b).

or wide angle) could be mounted on a rotating turret for a 'quick change' - but "this means that the camera is out of service whilst the lens is changed and the scene refocussed". "The answer to all this is the zoom lens, a lens of variable focus, but constant aperture". The author explained that it was possible to obtain a zoom effect electrically, by underscanning the camera target, when the central part of the image would be enlarged to fill the monitor screen - although it was inadvisable to do this for long periods, and the definition would deteriorate. After exploring simpler optical methods, "the most practical and economical system, in the author's opinion is that shown in Figure 2". "Such a system is entirely practicable for the Staticon, where the zoom attachment will be only some 4" square and 9" long, but for a larger tube such as a Photicon, the size would be about 1 foot square and 3 feet long". (BATC members have long experimented in television engineering - in all aspects, not just the camera or transmitter electronics!).

The other 'main' technical articles in that issue answered 'What is Gamma?', and 'The Design of Television Transmitter Output Stages' - which discussed the choice of PA valve and then the choice of the PA valve operating conditions, and figures for the QQV06/40 and QQV03/20 were given. "If an attempt is made to obtain more bandwidth" (desirable for television work), in general, the power output and efficiency drop very considerably".

"Short Odds" included a list of stations 'currently active' G2WJ/T at Dunmow (running 60W, the most powerful station); G2DUS/T at Baldock; F3FNL/T, Upminster; G5ZT/T, Plymouth; G3BLV/T, Sunderland; G3CTS/T, Norwood; G3KFE/T and G3KBA/T, both in Birmingham, G3BAY/T in Leicester, G3JVO/T at St Albans, and GI3FWF/T, in Belfast, who not only operated on 437.75Mc/s, but also ran ½W on 2350Mc/s.



**Figure 2: The Preferred Zoom Lens Arrangement.**

## NBTV on a MAC - Update

By Sergei Ludanov KD6CJI

Some time ago you published my article about Mac NBTV programs (*CQ-TV 205 - page 18*). I have recently updated the applications, so I thought that I would share my findings.

Playing with new 10.4 APIs for image and video processing I rewrote NBTV programs that I released a while ago to take advantages of those APIs.

NBTVSource is used to generate NBTV video. It can use various sources for input: video from iSight camera, still images (need to be in folder ~/Pictures/NBTV Images) and QuickTime movies (need to be in folder ~/Movies/NBTV Movies). Also it generates test patterns and produces slide show from still images. Now program supports 22, 32, 44 and 64 line video in monochrome and 3 color formats. Output is transmitted through audio port.

NBTVMonitor is a companion application to NBTVSource is used to display video received from audio port.



	22 Lines	32 Lines	44 Lines	64 Lines
<b>Monochrome image</b>				
<b>2 Channel Color (Orange + Green/Blue) Image</b>				
<b>2 Channel Color (Red + Green) Image</b>				
<b>3 Channel Color (RGB) Image Red and Blue are at 1/2 resolution of Green</b>				

Supports all formats that NBTVSource generates.

Both programs use CoreImage framework and QuartzComposer compositions to process and render video, so they will run on OS X 10.4 only.

I am not sure if they will run on machines that do not support CoreImage and Quartz Extreme. My PowerBook happens to support them, so I have not try on Mac that does not.

Both programs are freeware and available for download from <http://homepage.mac.com/kd6cji> File names are *NBTV Monitor Tiger.zip* and *NBTV Source Tiger.zip*

Questions, comments, complaints, feedback will be greatly appreciated: [kd6cji@mac.com](mailto:kd6cji@mac.com)

The table above shows actual images received by NBTVMonitor in different formats and resolutions. All images are captured from monitor screen.

Visit our web site:-  
<http://www.cq-tv.com>

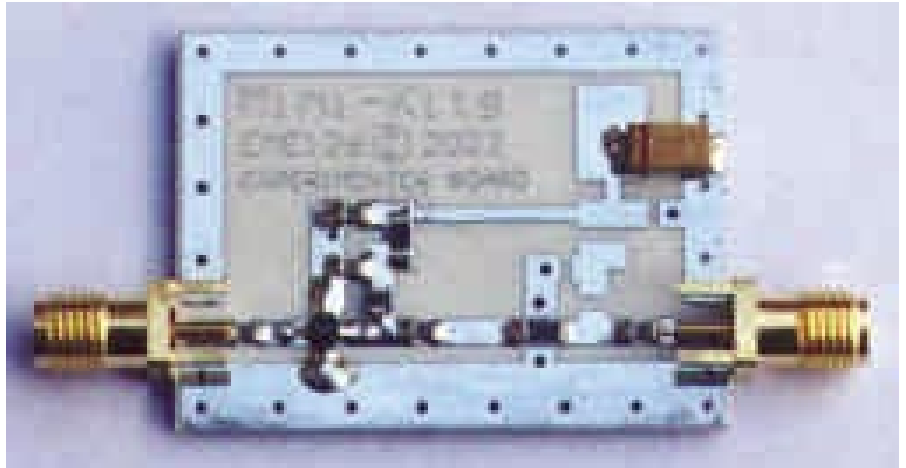
# 70cm DATV Down Under

By **Richard L. Carden**  
VK4XRL

It was interesting to read the article on 70cm DATV by Ian Waters in CQ-TV 208. Armed with this so to speak I decided to purchase a 70cm DATV modulator from SR-Systems. While I waited for it's delivery I contemplated what I would require to do to provide an up-converter from 70cm (428.5MHz) so that it could be received on a digital satellite receiver. The Block Diagram shows you the basic requirements.

## Up-Converter RF input stage

This ended up a very simple tuned amplifier stage using a BFR91 or the like. The reason I took this approach is that most people would use a suitable 70cm pre-amp and that would take care of any noise floor problems. The



ERA 70cm amplifier PCB

output from the RF stage feeds a 2 stage helical filter before feeding a mmic RF amplifier. The total gain of both units is around 27dB. The above combination now feeds the mixer, I used an RMS-

2 because I had one, however other types could be used depending on their operating frequencies.

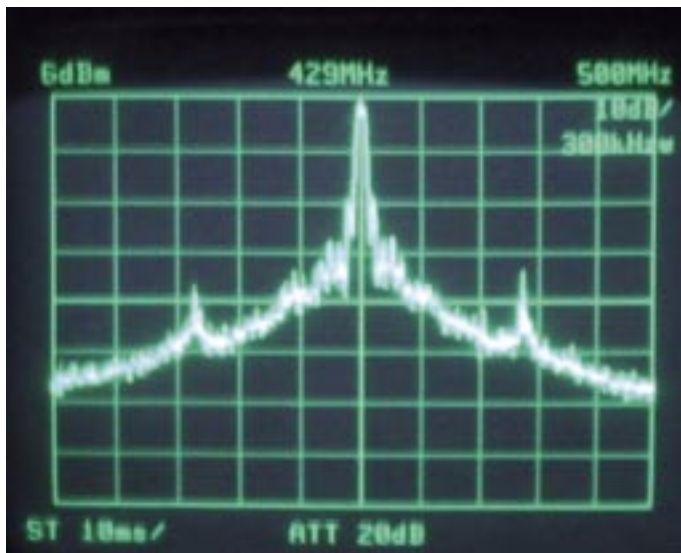


Figure 1 - 70cm Modulator Output

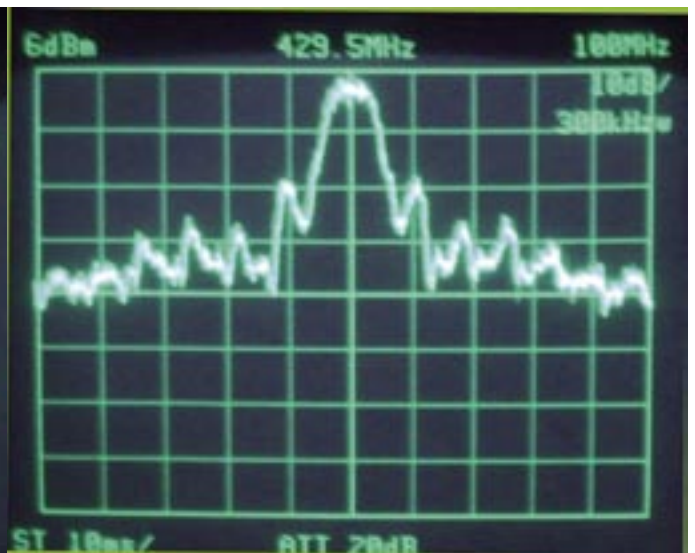


Figure 2 - 70cm Modulator Output

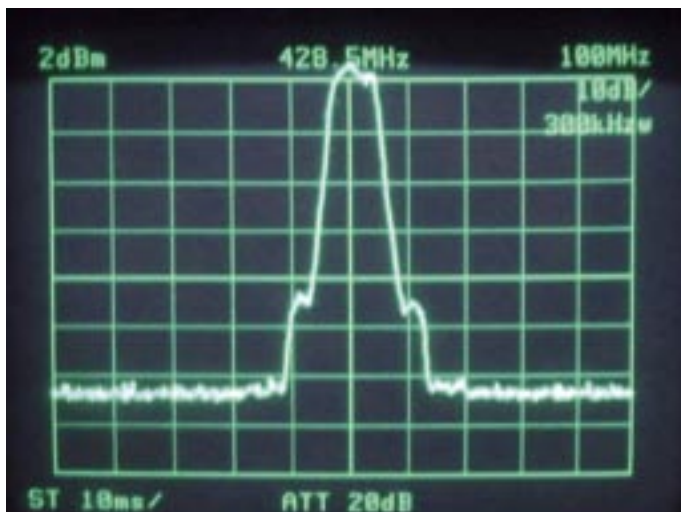


Figure 3 - 70cm Modulator via Filter

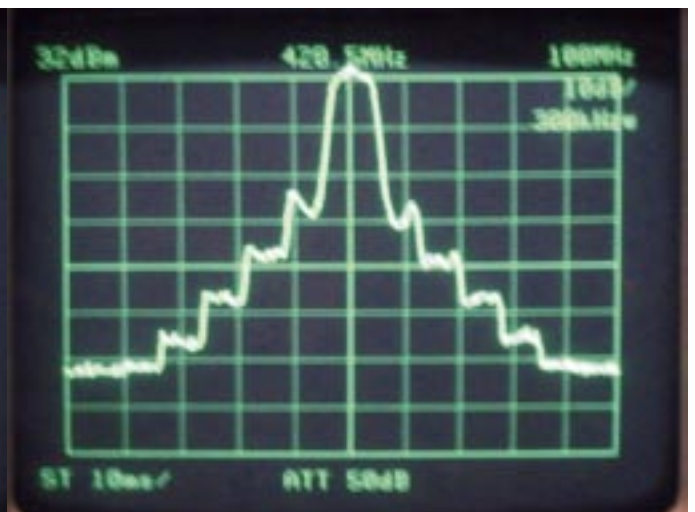


Figure 4 - 70cm Datv via 10w power module



**DATV 70cm Filter**

### Local Oscillator

I had on hand a PCB with a G4DDK-001 L.O. that I had been using at one stage for 23cm (this is very similar to the one shown on page 32 of CQ-TV 208. I also had a crystal of 80.525 MHz and when multiplied by 12, gave an L.O. frequency of 966.3 MHz. This therefore gives an operating frequency of 1394.8 MHz. Depending on the digital satellite receiver used this can be dialled directly in as the input IF

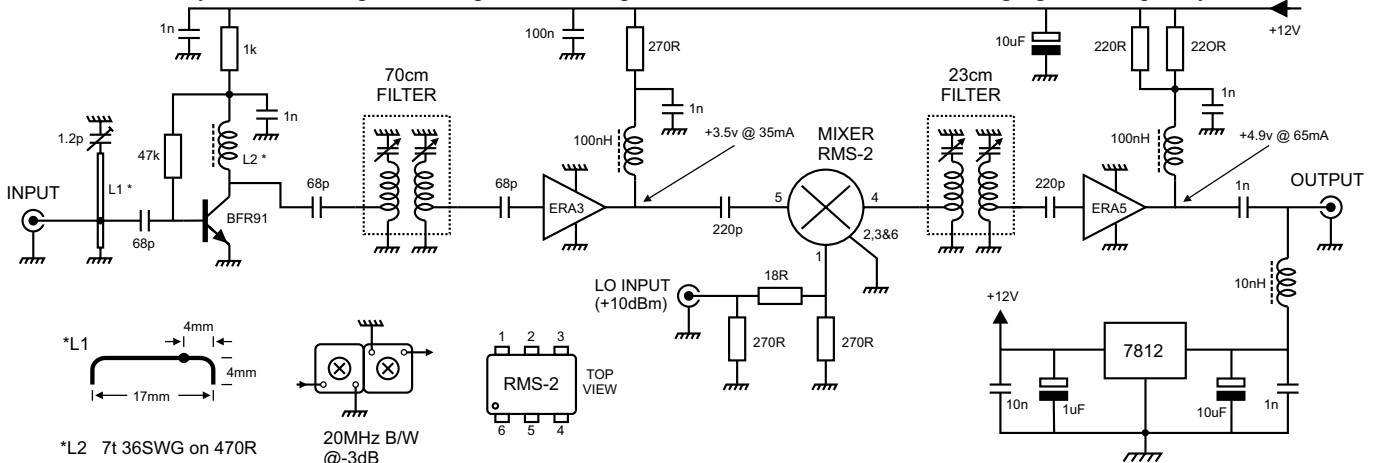
frequency or if like the one I used you will need to add the LNB oscillator frequency (11300) to the IF (1394.8) and then dial in 12694.8MHz. This setup allows only one DATV channel to be received.

The mixer output now feeds a 23cm helical filter feeding an ERA5 output RF amplifier. External power from the satellite receiver could also be used to power the up-converter. This means

that the up-converter can be mounted on the mast with the antenna. Note that you may have to trim the crystal used so that the IF output fits the output helical filter frequency of operation.

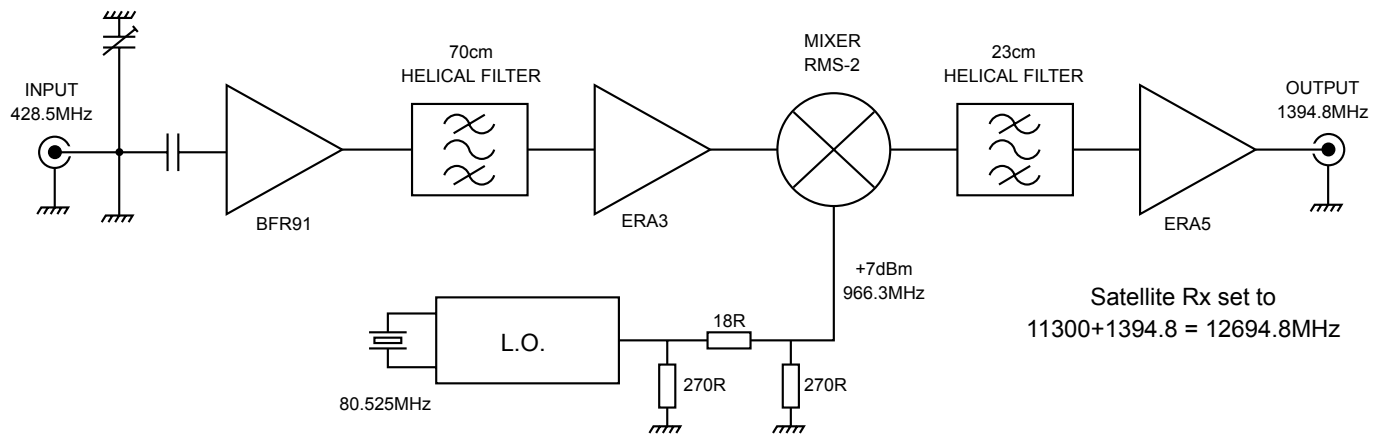
### 70cm DATV Transmitter

The new 70cm modulator duly arrived from SR-systems and was placed into position where the dual 23cm and 13cm modulator had been. Changing the frequency was done on



**70cm DATV up-converter Circuit diagram**





**Block Diagram 70cm Up-Converter**

the bench for testing purposes using the HyperTerminal program. Since our ATV frequencies in the 70cm and are set at 425 to 432 MHz and 443 to 450 MHz, the two DATV frequencies we can use are 428.5 MHz and 446.5 MHz. The unit was easily set to 428.5 MHz being our required repeater allocated channel. Measurements were then made from the modulator, the output was +4dBm with shoulders at -20dBc and the noise floor at -30dBc (Figure 1 & 2). These results showed we had a very serious problem compared to the dual 23/13cm modulator. After several emails to Stefan of SR-Systems and checking on required changes, Stefan agreed to exchange the board for a new one which should read according to his email, with an output of +6dBm with shoulders at -40dBc.

In the mean time while waiting for the new board the system still worked to a point therefore I could still check out the operation of the up-converter. To improve the performance I added a helical filter to the output of the

70cm modulator (Figure 3). Now connecting the 70cm modulator to the digital receiver via an attenuator (at least -50dB) produced an input of around -46dBm. Next we set the digital receiver to the required frequency (see above) and to the other parameters (since this was only bench testing these were left at SR 7500 and FEC  $\frac{3}{4}$ ) this produced a bandwidth of 10MHz which is larger than the required 7MHz here in Australia. Perfect P5 pictures were received after peaking the RF input stage and helical filters etc.

As a matter of interest the 70cm modulator was connected to a Mitsubishi power module type M55716, this unit is a nominal 10Watt device (+40dBm). If we allow a decrease of around -6dB then we could expect an output of around +34dBm. In fact with +4dBm input from the 70cm modulator an output of +33dBm was indeed obtained (Figure 4). Shoulders appeared at around -30dBc. Dual power amplifiers gave me around +36dBm, a little over 4Watts. The use of a band-

pass interdigital filter (as shown) or a combline filter as per CQ-TV 195 is highly recommended. Further testing is planned when the new modulator arrives, the results above may well change, however the overall results to date have been very encouraging. It however maybe worth trying the newer MOSFET power amplifiers, if these can indeed be obtained.

#### References:

CQ-TV 208 70cm DATV, CQ-TV 195 70cm Combline Filter - Ian Walters

Mini-circuits <http://www.minicircuits.com/index.shtml>

Mini-kits <http://www.minikits.com.au/index.html>

RSGB Microwave Handbook Volume 2

VK3UM Software Suite [www.qsl.net/vk3bez/VK3BEZ.htm](http://www.qsl.net/vk3bez/VK3BEZ.htm)

**Your article could appear here!!**  
**See page 25 for details on the submission requirements**

## Keep On Truckin'

Dicky Howett reports.

US tv kit collector Chuck Pharis now has his work cut out (as well as a considerable amount of cash flying from his bank account) in order to recreate and re-equip this classic American 1940s RCA TJ 48 'remote' tv truck. Chuck says he has most of the electronics (Image Orthicon cameras, monitors, switchers etc) but is looking for a microwave dish (see picture) plus all the internal structure fittings and



external trim. (The previous owner-actually a broadcast tv engineer- stripped it to make a campervan-sounds familiar). Chuck hopes to take the restored van to NAB in 2006 as a fully-functioning exhibit. We wish him well.

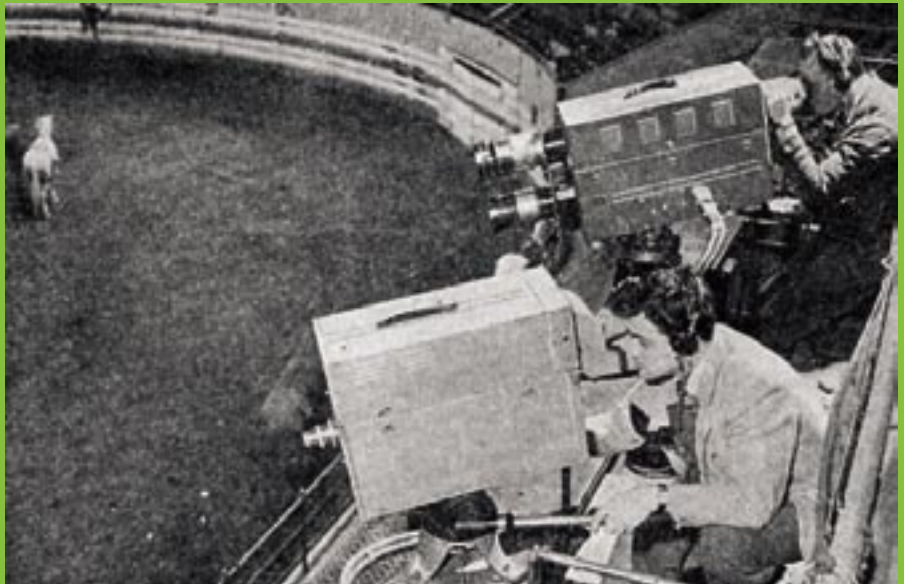
## All About Image

Dicky Howett writes:

Whereas in the 1940s, British television electronics manufactures were plugging away with outmoded

Iconoscopes and Orthicon tubes, the Americas were far ahead testing the image tube that would define monochrome television pictures for the next twenty five years. The 3"-inch Image Orthicon pickup tube, seen here in early 1946 was to revolutionise 'outside' tv. The picture, taken at rodeo at Madison Square

Garden, shows a prototype TK30 Image Orthicon camera with a single Kodak Ektar 50mm lens. (A four-lens turret was added later to all standard production models).The camera has an electronic viewfinder with a perisopic hood. Pictured behind is an RCA Orthicon camera from around 1940.



It too has only one objective lens, but the viewfinder here is an optical tunnel requiring a seperate-but ganged-lens. The genius of the design (on both cameras) is that the viewfinder units are detachable 'suitcases' making transportation easy.

The magazine RCA REVIEW reports that this test, ..."with the dark tan bark on the arena floor and the relatively low light level used so as not to blind the contestants had made this a relatively unsatisfactory program for orthicon cameras. The Image Orthicon camera was able to do an excellent job..."

Although early Image Orthicons suffered from poor signal to noise, sticking and lack of resolution, the ultimate incarnation-the 4-1/2" inch I.O.-could still be found hard at work well into the 1970s.

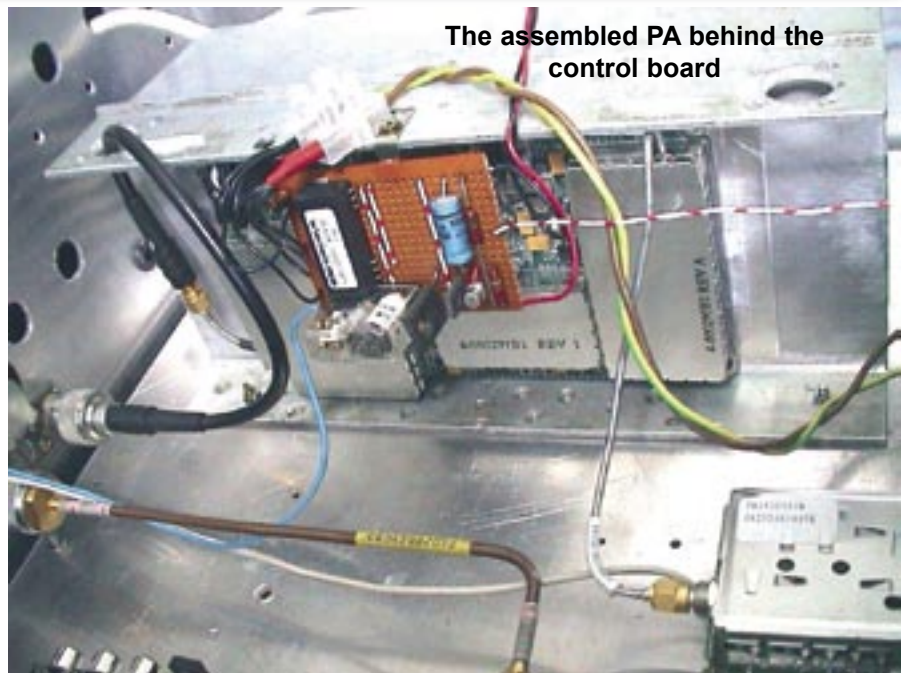
## Easy 30W on 13cms

By Keith Webster (G8VMP)

With the advent of the GB3BH 13cms ATV repeater covering much of London and the Home Counties, I decided to rekindle my ATV activity. Having moved to the RF 'black hole' of St Albans and 23cm activity proving impossible, I had been QRT for a few years - however a path plot to the new repeater showed it as 'line of sight' from St Albans at 12kms.

I obtained the 13cm ATV TX and RX modules for £65 and a 20dBi (wireless Lan) mesh dish and very soon an impressively strong P5+++ came storming in from the Bushey Heath repeater. (See photo) The Comtech transmitter was putting out 20mW, so I connected my old 1.5W DB6NT PA and put in a P4 picture to the repeater. I then discovered a few things about propagation on 2.3GHz. The bottom line was that if you want a steady signal, unaffected by the weather, you need a little more power.

I had heard about the Spectrian 2.3GHz power amplifiers available on ebay. (Search '30W class A linear'). There

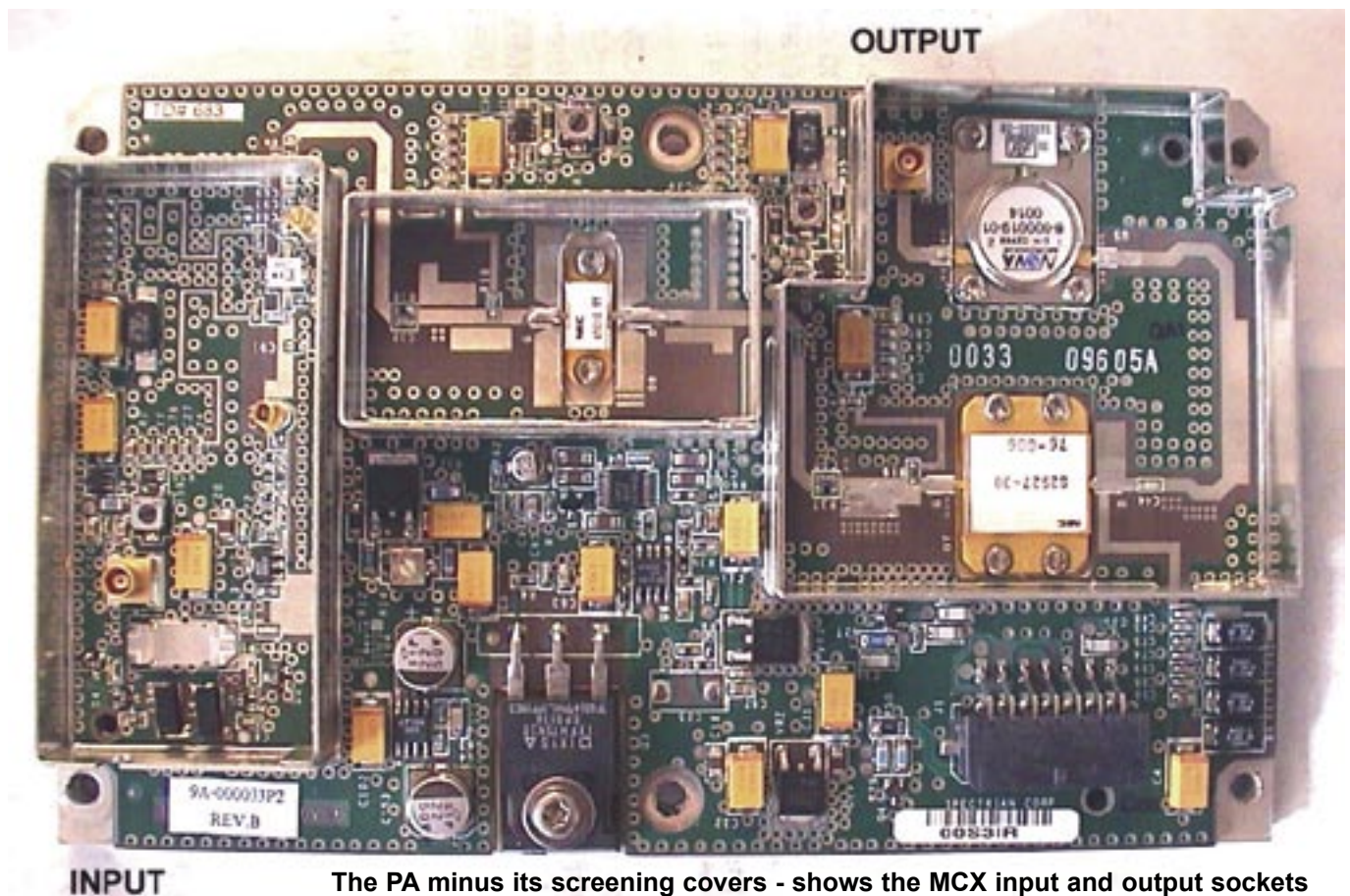


The assembled PA behind the control board

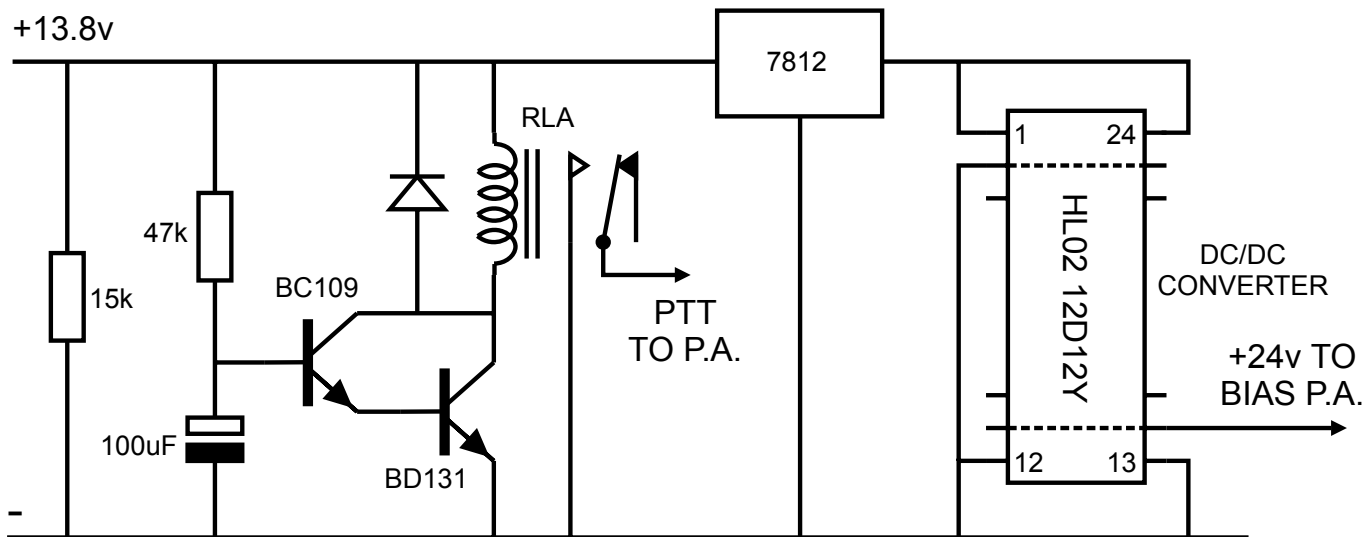
are 15W and 30W varieties needing about 10mW of drive and there is a 60W needing 1W of drive. (There is also a 180W power amplifier for those that want to cook the Sunday lunch whilst working DX on 2.3 GHz). The 15 and 30 watt varieties are the same module but with measured output

power differences. The write up on ebay is quoted below.

'This auction is for one very linear Class A RF amplifier which I have removed from a new Spectrian high power amp where it was used for driver for the main PA boards. This auction does



The PA minus its screening covers - shows the MCX input and output sockets



**PTT delay and bias circuit**

include the 24V 80mA bias supply as suggested below at no cost to you. This amplifier has been selected, setup and tested for an output power of 30W from 2.3GHz to 2.35GHz with a linear gain of 35dB. Great amplifier for CW,AM, FM, ATV or SSB use from 2300MHz to 2350 @ 30W and to 2450MHz @ 25W. Input power for 30W output is typically 10mW or less!

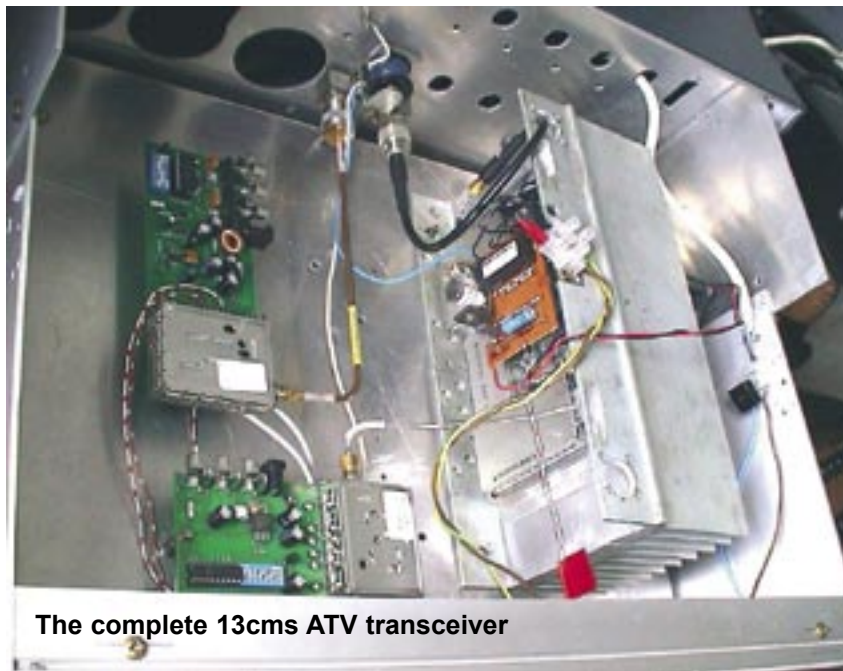
Power requirement is 13-14V @ 10A and + 24 to +28V bias @ 50mA. This bias is used for the gate voltage

the function 10.0mV/degree F, which measures the board temperature close to the 30W RF output GaAs FET (NEC S2527-30). Note that the output of this amplifier is protected by an internal 125W isolator!

Here are the pin functions for the DC connector: Pins 1,2,3,4 are all +12 to 13Vdc @ 7.5 or so amps. Pins 5, 6, 7, 8, 10 are all ground. Pins 12, 13 are N.C. Pin 11 is logic level - low enable, normally floats high. This turns on the +12V to the internal transistors.

shown. You will find it very easy to remove one of the MCX connectors from one end of these and replace it with a SMA .086 hard-line connector. Board dimensions are 6.5 x 4 inches.

So, I sent my £75 off to the States and four days later the 15W module arrived complete with the input and output cables and DC connector lead. It had a measured output power of 25 watts marked on it. So the building began.



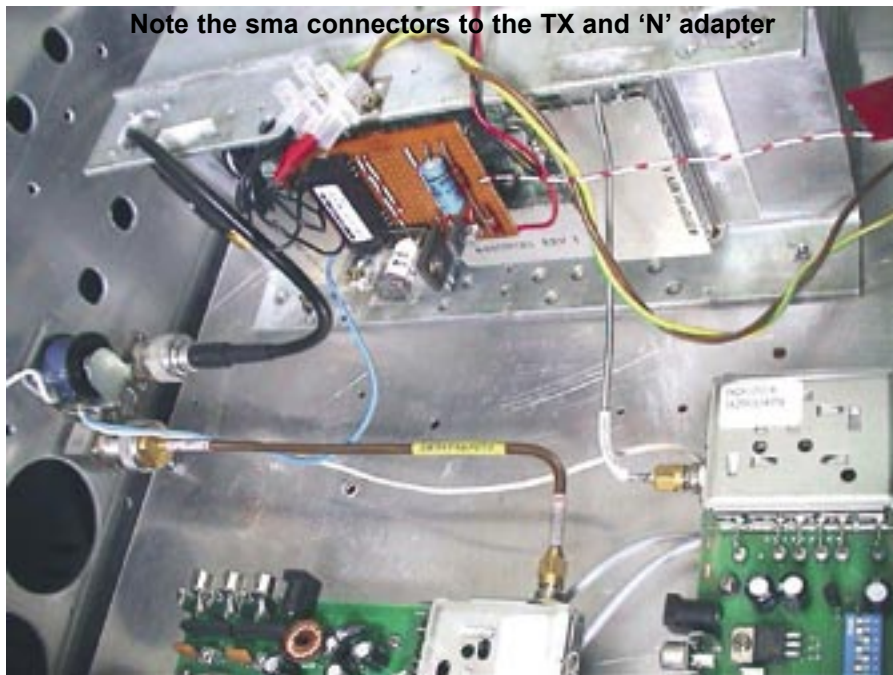
**The complete 13cms ATV transceiver**

circuit on the power control FET. I do supply a miniature DC-DC converter with this auction which takes 12-13V input with an output of 24-26V @ 80mA for generating this bias voltage. There is a logic level enable pin which requires grounding to enable power to this amplifier and can be used for a PTT/KEY control. The connector also has a direct temperature output pin with

Pin 14 is + 26V bias supply input @ 50mA. Pin 9 indicates temperature = 10mV/degree F. This board comes mounted on a 1/4 inch thick aluminium heat spreader which has 6 mounting holes for mounting to a heat-sink. I am also supplying the 2 MCX .086 hard-line sections as well as the mating bias connector as



**The mesh dish mounted on the domestic TV aerial mast**



picked up at the Kempton rally - not very pretty but it should do the trick. (See photo)

The module requires a bias supply of 24 volts at 50mA for the power mosfet output transistor. A DC-DC converter is supplied with the module, and having looked up its specification on the internet, decided to drive it through a 12v regulator.

The PTT line needs to be grounded for transmit and I decided that it may be wise for a slight delay when switching to TX before the PA is turned on. The reasons for this is that the PLL in the Comtech module needs a moment to lockup and the aerial changeover relay may need a moment to settle down too. I didn't really want to put 25watts straight into the receiver. The delay is a simple capacitor charge circuit which gives about 1 second delay. (See circuit and photo).

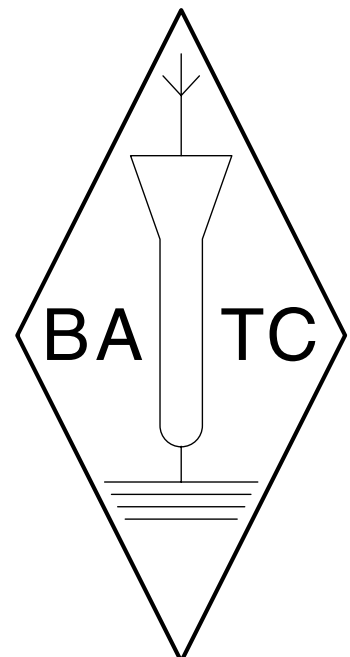
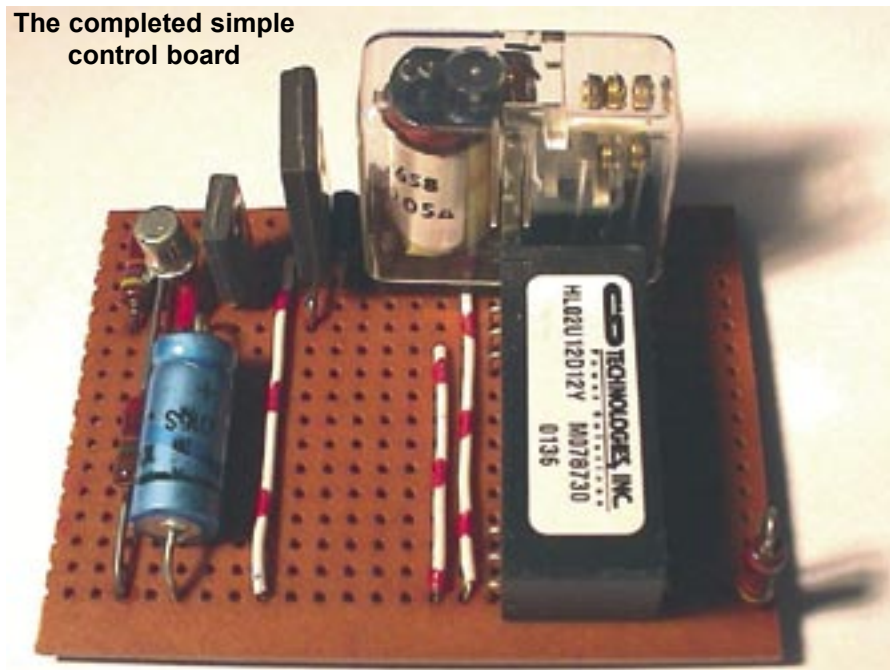
A large heatsink 10ins x 5ins x 5ins was put into service - it is very necessary as 100watts of power have to be lost somewhere! After some drilling and filing, the new PA module is bolted on with a dose of heat paste.

The next stage was to remove the MCX plugs from one end of the input and output semi rigid coax cables, and replace them with SMA plugs. The magnifying glass was very useful here. The output SMA plug then goes to an SMA to 'N' adapter that I



I put the electronics on an old piece of veroboard from the junk box, and used chocolate block connectors for the 13 - 14 volt 10 amp power supply requirement. (this proved to be about 8.5amps). The completed PA and the transmit and receive modules were bolted into an old 19inch rack unit that was rescued from redundant 23cm gear and I now have a complete 13cms 25watt ATV transceiver for approx. £140. Please note it is more useful than decorative! (See photo).

The completed simple control board



# Welcome to the Digital World

By Henry Ruh

Just because it is “digital” A: does not mean it is better, B: does not mean it is compatible, C: does not mean it has the same values. (Note, most numbers simplified to avoid math confusion)

All signal sources are not the same. Likewise not all displays are the same. Most programming we can watch on any channel, over-the-air (OTA) analog plain old TV (POTV) satellite, cable, DTV, started as an analog NTSC signal. Some new programming is produced in enhanced definition digital format (720) (Fox, ABC) or high definition format (1080i) (CBS, NBC, PBS).

Now consider this example: Take three US currency bills from your pocket, 1, 10, and 100. They are the same size, the same shape, the same ink, the same paper. But the value is different because of the content (picture numbers etc). Likewise, all TV signals have different content values, degrees of detail, but must fit into the same size, shape, delivery system. By adjusting the value (1, 10, 100) we can fit more than one signal (bill) into our TV receiver account. At our bank, we can carry in 10, 10's, 100's, or any combination of 1, 2, 5, 10, 20, 50 value bills that equal 100. In the TV receiver, the limit on the value number is 19.3 million. But no matter what we actually create, the TV is going to make the value equal to its display capability. What is called native format. A standard NTSC analog TV or the standard definition digital signal is about 3.5 million.

The TV set takes the 3.5 million and converts it to its native display, which may be 540 lines, 720 lines or 1080 lines high, and 350, 720, 1280 or 1940 pixels wide. A pixel is the smallest detail that can be displayed along one line. No matter what the line length is. Just as an analog TV set displays 480 lines, no matter if it is a 5” or 35” screen.

The digital transmission format allows the 19.3 million to be divided into “folders” each represents video, audio or data. The source decides how much value to put into each folder, and if the total is less than 19.3 million, the balance is just null packets to fill up the empty space. The TV receiver decodes the 19.3 million back into individual files,

and displays what channels (folders) are available. It takes a minimum of 8 million for 720 and 11 million for HD, and 3 million for SD. All this is done in IC chips, and is automatic. The TV set, then converts the channel content into its display capability. Every input is converted, broadcast, direct video input, to the same display values. When looking at TV displays at the store, check the actual digital values. Most are ED displays (720 x 1280) and only a few are true HD 1080 x 1780.

At the transmission end, all signals are converted to one format. It is not possible yet to directly mix different “values” SD, ED, HD because the home TV set would go nuts, every time it changed. The process, called MPEG 2 is electronic maths that takes the analog or digital signals and makes it into a uniform digital stream. In order to make large values small, it leaves out data that can be recreated at the other end. The process uses a GOP or group of pictures. It can send on every picture (BBBBBBBB) or every other picture (BPBPBPBPBP) or leave out several pictures at a time (BIIIIPIIIIIIIIIIP). The output is a constant value, mathematically derived by the amount of data reduction required to fit the 1, 10, 100 into the 3, 8, 11 pipe.

To confuse matter more, there are several versions of MPEG, (low, main, high) and MPEG 1, MPEG 2 and MPEG 4. None are compatible with the others. There is also at least 5 sampling rates, 4,4,4, 4,2,2, 4,2,0, 4,1,1, 4,0,0 which are the sample rates of the luminance, and the two chrominance channels. Again, none are compatible with each other.

There are also several transport stream formats: Composite, component analog, composite digital, component digital, and RGB. Composite means the signals are all mixed into one, similar to regular analog. Component means each set of data is sent in clusters in a serial form, using one of the MPEG sample rates just above (4,4,4, 4,2,0 etc). RGB is a parallel (three wires) system where red, green blue are sent simultaneously, along with sync (a 4th wire). The form is chosen based on the bandwidth (value) of the original signal. For highest quality 4,4,4 format is used but requires up to 3 Gigahertz of bandwidth. SDI serial digital requires 1.3 Giga for HD and 750 Meg for SD. At

the digital encoders, all of these must be reduced to fit into the 19.3 Meg pipe to the home TV. Data is also included that tells the TV set how to decode the signals, what the original format was, and the TV set uses that data to convert the signal into the native display it can produce.

Audio can also be in various forms, mono, stereo, AC-3 Dolby, Dolby E, and Dolby 5.1 surround sound. Obviously the ability to recreate the sound in the home depends on what was captured at the source. Synthesizers can create phase differences to create a pre selected pattern to make faux stereo, or surround, or if enough information is sent out, represent the true sound at the program source. However, it takes 6 channels of source audio to produce 5.1 surround sound, and few systems can record and play 6 channels. So it is usually encoded into AC-3 or Dolby E, to provide 3 channels of sound (L, C, and R). Many stereo systems and some TV sets have selections for audio to create different home sound environments from 2 to 6 channels.

Program sources can change the format themselves, thus controlling the output product, but paying for the costs of conversion or let the TV set do it for them at no cost.

Most choose to pass legacy programming (4:3 format NTSC) through an expensive standards converter to create ED or HD, change aspect ratio, and remix the original audio. Film is universally convertible since the format is usually 16, or 35 mm, and the camera/scanner can be of any format. Film audio is also always recorded in three stereo tracks, (6 channels) dialog, music and effects. This allows foreign language to be substituted without having to remix audio and effects. With THX SDDS, Dolby Digital and other surround audio systems, the stereo pair for the three channels, can actually be 6, 7 or 8 channels each (24 channels total). All of which must be mixed to mono for the home TV, plus stereo for the home TV, and now 5.1 for HD surround. All the more reason to make sure recordings and play outs have the correct level, balance and phase. The most historic goof was when NBC debuted stereo on Miami Vice in 1987. The stations had all built stereo facilities (TV was mono before this). At the precise moment after the intro, the announcement came

on screen "NOW IN STEREO." But the program mix was out of phase and gun shots sounded like pillow impacts on pillows, and some dialog was completely silent in mono because it was out of phase. Monitoring must be done in mono and stereo, and usually on an audio phase display either showing the traditional X-Y form (tilted or not) or positional display (circular space).

### Can you hide a second TV signal in an analog TV signal?

If we look at the structure of a standard NTSC TV signal, we find several discrete components. We call these sub carriers. There is one for sound, another for stereo, another for SAP and yet another for PRO channel audio, and of course, two for color. Two? Yep, the color signal is composed of two carriers at 90 degrees, called I for in phase, and Q for quadrature phase. All of these live happily as long as the amplifier is linear and we have minimum cross modulation or IM. But as crowded as this seems, there is room for more!

If we look back before the grand alliance, there were efforts to make ANALOG high definition TV. A system adopted by the Japanese used analog signals and several proposals using analog signals were proposed for the US HDTV service, but late in the process General Instrument suggested using a digital transmission format, similar to the MPEG format used by digital satellite signals, best known as Digicipher, and Digicipher II as subscription/scrambled signals. Today those can be decoded by a standard MPEG receiver, so more sophisticated encoding is required. The result was ATSC (Advanced Television Systems Committee) abandoned the analog solutions and jumped on the digital bandwagon (called the Grand Alliance) and developed the 8VSB signal used in the US today. (DVB format is used in Europe).

But the analog TV signal has lots of available spectrum holes. Just as it is possible to have two color sub carriers on the same frequency (3.579545 MHz) We can also transmit a second non interfering signal on the primary video carrier, say 439.25 MHz, by sending it in orthogonal phase. If the phase relationship remains a constant 90 degrees, the 2nd signal is completely invisible in the main NTSC signal, with some limitations.

We can't extend the second video information into the region of the color

or sound sub carriers, because the sound and color carriers are not phase stable, and are not phase coherent with the video. Color is off-set by  $\frac{1}{2}$  the horizontal rate, so the sidebands fall in between the video sidebands, it is also phase shifted because the two sub carriers, I and Q are rotated 45 degrees. The sound is FM; therefore it is almost never in phase with the video. But we can get clever.

We can reduce the bandwidth of the 2nd signal similarly to the way heterodyne color video recorders do, by shifting the color carrier to 688 KHz, or some other frequency, but we have the phase coherence problem with an FM signal. We can slip the 2nd video sidebands in between the first video sidebands, just as we do the color signals, and limit the upper frequency with a brick wall filter. So half way there. (For a full explanation of the RF spectrum of a TV signal and interleaving of the sidebands, see ATV Secrets Vol. II)

But what about a digital signal? The data rate for an NTSC equivalent in MPEG II is about 3 Mbps. Satellite and cable systems frequently reduce this to as little as 1 Mbps. So if we lower the data rate, we can fit the digital spectrum in the space below the color pass band (3.58 +/- .5/1.5 Meg). We can use several data modulation systems including versions of QAM. (Quadrature amplitude modulation) depending on the data rate we want to transfer, and to some degree, the relative coverage area we want. As long as we choose a symbol rate that provides a spectrum that is offset from the primary video to fit the sidebands in between each other, we got it made, almost.

If we try and generate the two signals in one exciter, we have a host of problems because the video is a constantly variable RF power level and the digital is a constant power level. Analog is an AM signal. During sync, it is at 100% power, black, about 2 db lower, and during white, 12% power. We have to amplitude modulate the digital signal, so the ratio of the digital to analog signals are the same, otherwise, the digital signal would be stronger than the analog signal. So we can't really use the amplitude function of QAM. Again, we can be clever. If we use a sample of the main video, we can amplitude modulate the digital amplitude, to keep a constant ratio. Now the signals are compatible, since the transmitter is not going to be putting out a carrier modulated by the digital amplitude, which would in

itself modulate the original video since the TV receiver is a simple voltage detector.

Imagine if you will, trying to detect and RF envelope that represents the original analog video, with some hundreds of digital pulses riding at a constant level, the screen would be filled with "static" like black hole noise that would vary with the strength of the analog video! Not pretty!

By having the amplitude of the digital signal be controlled by the analog signal, we can choose a C/N ratio (carrier to noise) and keep it constant. In the digital receiver, we can use the inverse of the analog video to restore the digital to a constant level. We know from tests and observational experiments that there is a threshold of visibility for noise in video. I.E. the difference between a P5 and a P4 picture. If the noise level is constant, similar to the noise in a VHS video, we TV watchers will tolerate a C/N ratio or noise floor about 40-45 db. If the noise is less than that (say 46 db or higher C/N ratio) we may notice some noise but it won't bother us, and with numbers above 50 db few see any noise. Remember db is logarithmic, so 10 db is a significant difference.

Now we can mix the digital signal with the analog signal, and it will be invisible to the analog NTSC viewer, because it is below the threshold of visibility. Now there is a trade off. While digital receivers can detect the digital signal at a lower C/N ratio than the analog (envelope) receiver can, there is a "gain" in how low the digital signal strength can be. Just as a 300 KW DTV signal is about equal to the 5 MW analog TV signal, because the DTV signal receiver only needs a 15-16 C/N ratio, while the analog TV needs 40+ db C/N ratios. So being 50 dBk (below carrier) is not all that bad. Consider that the analog video only has a modulation depth of 26 db; there is lots of analog power even during the lowest power white video. The next advantage is that a 50dBc signal is using less than 1% of the transmitter power, so only an insignificant power increase. In practical application, the hidden digital signal is able to be received to about the A contour of the analog signal.

If we try to mix the two signals in one exciter, we cannot correct for the constant non linearity caused by the amplifier chain and VSWR variances between stages. We can, however, correct for these if we use one RF feedback correction loop for the analog

exciter, and a second RF feedback correction loop for the digital signal. Since modern transmitters all use a low power exciter and one or more power amplifiers in parallel, there is only one common stage of amplification.

Therefore we want to mix the signals at the RF level rather than base band, or IF (45 MHz) level so we only have one active device to correct for. We adjust the injection level of the digital

signal to achieve the analog to digital carrier ratio desired, and it just becomes another sub carrier. The digital RF loop would provide information to the digital exciter to correct on an instant by instant basis, likewise the analog. And going back to the start of the process, a sample of the video base band signal, can be used to correct the phase and amplitude relationships, to maintain constant phase and amplitude ratio. Taa daa, we have done it. We have hidden

a complete second TV signal in the standard analog TV signal, consumed no additional bandwidth, and because the modulation is completely different, neither is visible in the other's receiver. Here's the secret. Your local PBS TV station may already be providing this, soon most will!

*Please note that this article refers to specifications etc. as they are in the USA -Ed*

## Reader Questionnaire - and here are the results...

In CQ-TV 210 we asked you to tell us a little more about yourselves by answering a few questions and leaving your comments. As a Committee we are responsible for deciding the general direction and pace the Club moves so it is important that we recognise the needs and concerns of the members we represent. The questions were designed primarily to discover how many of you are 'hands on' people and how many read because of technical interest but go no further. Going a stage beyond that, we attempted to see how many of you are experimenters, either self-motivated or using purchased kits. Finally, as we all have an interest in video, we tried to find out how many of you have capability to produce your own material and edit it. This is important to us because a camera and the ability to use it is in almost all cases a pre-requisite to broadcasting on the ATV bands as well as giving us insight to how popular articles on editing might be.

Thank you to all of those who replied. Sadly though, only one out of every 30 members bothered to respond. We would have preferred a much bigger sample to be sure the results covered a broader section of readers as the ones who reply tend to be the more active ones anyway, leaving the silent but no less important majority out of the calculation. A few replies had to be ignored as they were either unusable or unreadable. Typically, when asked for a reply on a scale of one to ten, replies would say 'sometimes' which we could not equate to a number. All the questionnaire answers in such cases were disallowed so that all questions had the same number of answers. We also ignored files sent in obscure formats - no are not installing dodgy looking computer programs just to read replies that could be sent in plain text.

Here is a summary of the results and some of the comments you added. Some of you wished to remain anonymous so no names have been added.

We asked if you considered yourself a hobbyist or a professional, 63% said hobby, 33% said professional and 4% said both.

70% of you have never worked in professional TV at all, 22% have worked in engineering, 8% in production.

85% hold an amateur radio licence, of these 55% use ATV at least once a month and 59% can 'see' at least one repeater. The majority (85%) support digital TV but most have reservations about it, see below.

63% design equipment themselves, 60% build from kits and only 11% never build at all. Some of those designing also use kits sometimes.

A fairly even divide between those who produce video material, 44% said yes, 56% said no. Only 18% have access to semi-pro or professional editing facilities.

81% have a camcorder or video camera.

The average result from 1 to 10 on interest in the history of TV was 6.2, the lowest being 1 the highest 10.

On the same scale, interest in RF aspects averaged 8.2 with a low of 2 and high of 10.

Interest in studio and production was lower at 5.5 with a low of -1 and a high of 10. Yes, someone gave a minus one, perhaps they only watch testcards!

### General comments received included:

"I feel the loss of the for sale section was a mistake and it should be included on a separate page like the BVWS magazine does"

"More on how local repeaters do it and on kits"

"What is reality nowadays? Not CQ-TV by e-mail I hope"

"We need to encourage more younger members to transmit ATV, but I do not know how. Perhaps activity eves?"

"What I need is a refresher on 'S' parameters" (followed by symbols I can't easily type in!)

"I would like to see more antenna projects, series on 10GHz ATV equipment/building/getting going - but nothing fancy."

"Any ideas on how those of us with poor sight can work on the ever smaller components."

"If you want to encourage beginners - a bit more for them please."

"More construction projects - very much less of studio and production techniques."

"No more of old studio camera photos."

"New member- interested in what's left of old broadcast kit and where technology is headed now."

"More reports on portable activity/equipment please. More information on mods to surplus equipment, especially Aes, TX and amplifiers for 13 & 9 cm bands please"



“SIMPLE transmitters and receivers for 23cm & 13cm. News from repeater groups, news from the repeater licencing process.”

“Very interested in producing video material, converting old family films to tape etc.”

“What I think is that the BATC should concentrate bringing digital television to the amateur radio user. Articles should therefore be to this end.”

“yes - support digital experiments ..... but need to be kept ‘in proportion’ to other aspects of atv. I think that, for most BATC members, the costs are still too high to implement a digital atv station.”

“Circuit Notebook is my favourite part of CQ-TV, followed by any Electronic or RF projects that are easy to build, e.g. video amps, Microwave aerials, the PIC Programming articles were good as well. More technical stuff please!”

“My main interest is experimenting with antennas & feeds at 10 GHz.”

“I am interested in the history of TV, especially keen on transmitting aspects, editing and studio production do not stimulate me much at all, but I would like a bit more covering the basics.”

“a. I admit to being just a passive member of the BATC. I belong mainly

to get the magazine and keep in touch with the subject. b. What has happened to Satellite TV News?

c. Would it be possible to cover DVD authoring techniques and software?”

“I am not keen on the articles on professional editing, etc. but see that they do have a place in the magazine due to the range of members the club has.

I like the magazine in its current format, and would be unhappy to see it changed to an electronic only format. I would be prepared to pay a little more to keep it in its current (or similar) format.”

“I would like to see supported projects with PCB’s etc. I made the I<sup>2</sup>C project but was disappointed that it was not progressed.”

“I like to see construction articles but appreciate that they can only be as frequent and of the quality that is received.”

“Would like construction articles on DATV, modern video mixing etc (but home brewable), better quality TV transmitters for 23cms and above.(ie no sound subcarrier intermod). More simple circuits like the 500 mW amp that can be home brewed.”

“I would like to see more on the topics that interest me most, but well

understand the editor can only publish what he can get Keep up the good work.”

“It is my belief that atv repeaters should strive to link with each other to keep up the interest of new faces!”

“I prefer a printed CQ TV than on line/cd version I regularly refer to old editions, and it is better to use printed matter, I keep discovering items that I’ve forgotten about.”

“I prefer constructional articles - especially on preamps, receivers, transmitters etc.”

“I have been a member of the BATC since 1980 and have always looked forward to CQ-TV arriving until all the digital articles started appearing which just leave me cold as I can’t get my head around the technology”

”Thanks for all of that essential work (which despite what you may think) we really do appreciate.”

With that kind remark we close the questionnaire. Thanks again to those who responded and our apologies for cropping some of the comments, they were all interesting but had to be edited to fit in the magazine!. We have to conclude that the 97% who didn’t reply are reasonably happy with the way things are..

## Send in your stuff!

### Material for publication in CQ-TV

We are striving to make CQ-TV better!

To this end, we would like to offer advice on how material can be submitted to relieve any production problems, and allow the artwork to be put together more easily.

Probably our biggest problem is with embedded pictures and diagrams which are submitted as a complete Word document.

Whilst this is great for you to visualise the layout of a particular article (although graphic considerations in the magazine as a whole may require the re-arrangement of any suggested layout) they are a pain to remove from the document, which we have to do in order to import them into our layout program

The upshot is: can you please supply text and photos as separate files.

Text is fine as a Word document, Notepad or as email - most formats can be accepted from Windows computers. Artwork should be scanned in at 300dpi (or as best you can manage) if at all possible. If in doubt, please feel free to email for advice.

If you would like to send photos/diagrams for inclusion, we will accept them through the post and that is fine as well.

Contact address for postal submissions is:- **CQ-TV Editor, 14 Lilac Avenue, Leicester, LE5 1FN, England.**

The email address is: [editor@cq-tv.com](mailto:editor@cq-tv.com)

## High Definition - what is it and how do I deal with it?

- or trying to get from scene to delivery in one easy lesson.....

By Mark Bloor

In the series of articles on editing, we talked about standard definition, but what about the burgeoning High Definition market? We thought it would be a good idea to review the current state of play, and try to distil the plethora of standards that are around and their strengths and weaknesses. HD has been around a lot longer than most people think. J L Baird was showing 1000 line systems before the second world war, and the French had their 819 line system in monochrome up to the late 60's / early 70's (i.e up to the time they went colour), but most of the "current standards" can probably be traced back to NHK's R+D, which started in the mid 1960's and culminated with the "MUSE" system which went on air around the mid 80's. This was an analogue system which was only ever transmitted over satellite. The generally accepted HD standards now revolve around a 720 (active line standard) or 1080 (active line standard), these come in a breathtaking variety of standards, interlace, progressive, 50 or 60 Hz frame/picture base, which are denoted by the suffix i or p (nice and simple that). They also use ITU 709 colour space as opposed to the more well known ITU 601 standard. We suppose you want to know what this is don't you? Well.....

Horizontally the standards are specified by pixels, either 1280 or 1920. Below is a table setting out these



standards. All formats are native 16x9. Note these are, for want of a better description "transmission standards" and do not describe tape formats, tape sampling structure or compression algorithms - more of these later on.

So where do we begin? Well the first thing we need to do is convert the scene into an electronic signal - this is obviously carried out in the camera. This will use either CCD or CMOS sensors; the resulting signals are then digitised (12 bit plus, usually) and applied to some form of digital processing, which

includes gamma correction, detail correction and so on. At this stage, the signals may be sent out in some form of uncompressed stream, or via D to A as baseband, or may be encoded to HD-SDI. Generally this will be "a clean feed" devoid of any of the compression applied to the signal to store it on tape (usually - but not always). Again it is usually in the form of YUV (Y Pr Pb), but in some cameras, eg the Thompson Viper system, it may be good old RGB (remember those RGB matrices from the BBC, Cox and Pye from the



HDV Format Specifications		
Media	Same as DV format (DV and/or Mini DV Tape)	
Video		
Video Signal	720/60p, 720/30p 720/50p, 720/25p	1080/60i, 1080/50i
Number of Pixels	1280 X 720	1440 X 1080
Aspect Ratio	16:9	16:9
Compression	MPEG2 Video (profile & level: MP@H-14) for both standards	
Sampling Frequency for Luminance	74.25MHz	55.7MHz
Sampling Format	4 : 2 : 0	4 : 2 : 0
Quantization	8 bits Y 8 bitsC	8 bits Y 8 bitsC
Bit rate after Compression	Approximately 19Mbps	Approximately 25Mbps
Audio		
Compression	MPEG1 Audio Layer II	MPEG1 Audio Layer II
Sampling Frequency	48kHz	48kHz
Quantization	16 bits	16 bits
Bit rate after Compression	384kbps	384kbps
Audio Mode	Stereo (2 channels)	Stereo (2 channels)
System		
Data Format	MPEG2 Systems	MPEG2 Systems
Stream Type	Transport Stream	Packetized Elementary Stream
Stream Interface	IEEE1394 (MPEG2-TS)	IEEE1394 (MPEG2-TS)

late 1960's?). Unfortunately, this is where our first "problem" may occur. Whilst the output may be for example, 1920x1080 the "inherent resolution" of the camera may be less, eg Sony FX1E which is 1440x1080. Higher end cameras should be the full 1920x1080. Why is this important? Well, it depends what you are going to do with the

signal. You may want to encode it (using for example the AJA, Black Magic or Miranda units) to record to a PC for later editing. Why would you want to do this? - after all it has got a tape recorder built in. As we shall see later, these can and do significantly compress the resulting "raw video" and this could have serious ramifications in

post production, especially compositing. So it is important to be aware of the camera's inherent resolution, and whether you can actually access it via some form of uncompressed output, if that is what you need.

## Recording formats

At the high end we have the HD cam and the new HDcamSR formats, used for the production of movies such as "Star Wars" and the like. George Lucas is a great proponent of "digital film", not surprising given the number of post effects in his movies, and that these are generally computer derived, it makes sense to have the raw material in a format that can easily be ingested into a PC for manipulation. HD cam samples the video at 3:1:1 and applies around 4.4:1 compression; moreover the quantising matrix of 1440x1080 means the horizontal definition is reduced by a 1/3rd on tape - are you beginning to feel a bit short changed? For "real pictures" the results are very good, but as you can see, the U and V have only a 1/3rd the resolution of the Y, so during compositing this can and has been a problem. To overcome this, Sony are about to launch an HDcamSR field recorder. It is based on MPEG4 compression, but no GOP and is capable of recording YUV as 4:2:2 or RGB as 4:4:4 sampling with a modest 2.7:1 in YUV, or 4.2:1 in RGB, compression. This product is undoubtedly aimed at

Item	Parameter	Value
1	Conceptual non-linear pre-correction of primary signals	$\Gamma=0.45$
2	Derivation of luminance signal Y'	$Y' = 0.2126 R + 0.7152 G' + 0.0722 B'$
3	Derivation of colour-difference component signals.  P'B, P'R are filtered and may be coded as C'B, C'R components for digital transmissions. For system 1 an example filter template is given in SMPTE 296M Figure B.2. For system 2 to 4 an example filter template is given in SMPTE 274-2004 Figure D.2.	$P'_B = \frac{0.5}{1 - 0.0722} (B' - Y')$ $P'_R = \frac{0.5}{1 - 0.2126} (R' - Y')$

Item	Parameter	Value												
1	Opto-electronic transfer characteristics before non-linear pre-correction	Assumed linear												
2	Overall opto-electronic transfer characteristics at source	$V = 1.099 L^{0.45} - 0.099$ for $1 \geq L \geq 0.018$ $V = 4.500 L$ for $0.018 > L \geq 0$ where: L : luminance of the image $0 \leq L \leq 1$ V : corresponding electrical signal												
3	Chromaticity coordinates (CIE, 1931) Primary:	<table border="1"> <thead> <tr> <th></th> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>- Red (R)</td> <td>0.640</td> <td>0.330</td> </tr> <tr> <td>- Green (G)</td> <td>0.300</td> <td>0.600</td> </tr> <tr> <td>- Blue (B)</td> <td>0.150</td> <td>0.060</td> </tr> </tbody> </table>		x	y	- Red (R)	0.640	0.330	- Green (G)	0.300	0.600	- Blue (B)	0.150	0.060
	x	y												
- Red (R)	0.640	0.330												
- Green (G)	0.300	0.600												
- Blue (B)	0.150	0.060												
4	Assumed chromaticity for equal primary signals (reference white):  - $E_R = E_G = E_B$	<table border="1"> <thead> <tr> <th colspan="2">D65</th> </tr> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>0.3127</td> <td>0.3290</td> </tr> </tbody> </table>	D65		x	y	0.3127	0.3290						
D65														
x	y													
0.3127	0.3290													

## Colorimetry ITU 709

EBU System	Nomenclature and abbreviation [samples horiz. x active lines/ Scanning/ frame rate]	Luma or R'G'B' Samples per active line (S/AL)	Active lines per frame (picture) (AL/F)	Frame rate, Hz	Luma or R'G'B' sampling <sup>3</sup> frequency (fs), MHz	Luma sample periods per total line (S/TL)	Total lines per frame	Net image Bit Rate (4:2:2, 10 bit) [Mbit/s]	Corresponding SMPTE system nomenclature
S1	1280x720/P/50 (abbreviated: 720/P/50)	1280	720	50	74.25	1980	750	921.6	Corresponds to SMPTE 296M System 3
S2	1920 x 1080/I/25 (abbreviated: 1080/I/25)	1920	1080	25 (50Hz field rate)	74.25	2640	1125	1036.8	Corresponds to SMPTE 274 System 6
S3	1920 x 1080/P/25 (abbreviated: 1080/P/25)	1920	1080	25	74.25	2640	1125	1036.8	Corresponds to SMPTE 274 System 9
S4	1920 x 1080/P/50 (abbreviated: 1080/P/50)	1920	1080	50	148.5	2640	1125	2073.6	Corresponds to SMPTE 274 System 3

**Table of EBU HD standards - HDTV systems 1 to 4**

the Panasonic HD-5, which can support up to 1080 30p. Panasonic also have DVCpro HD/DVC100 and, as with most Panasonic products, it is 10 bit depth - unlike most of the Sony range, which are 8 (on tape with 10 bit i/o). The DVCproHD has the most lightly applied compression of around 1.67:1. For us mere mortals HDV is the likely tape format. This comes in 2 flavours HDV1 which is 720 and HDV2 which is 1080. Both use long GOP (group of pictures), MPEG2 compression with the audio being MPEG1 layer 2 at 348 kbps. For HDV the bit rate is 19 Mbps for 720p or 25 Mbps for 1080i. Note that interlace only is supported at the higher line rate. The beauty of these formats, which are recorded as a transport stream, not a program stream, is that they can be Firewired into a PC and subsequently edited. Adobe, Avid, Canopus, Pinnacle, Sony, U-lead & Apple all have applications which can support this type of editing, but what about when it comes to compositing... well they all rely on 4:2:0 sampling. Anyone who has used PAL type DV will be aware of the problems when trying to chroma key - the edges are jagged and the same problem raises its ugly head again.

Undoubtedly software fixes for this will come, but at the moment if you are intending to do a significant amount of compositing, you may be better using the baseband video out of these cameras, digitising this, and recording to a computer direct, using the very cost effective Decklink range (specifically the Decklink Multibrige PCI express which has YUV inputs and can be used with FCP on the Apple and Premiere Pro from Adobe and Vegas from Sony).

This allows for uncompressed HD straight onto the PC, which can then be subsequently composited in one of the usual packages, such as Shake, After Effects, Combustion or Digital Fusion.

### Editing

Probably the first thing to decide is whether to use Apple or PC. If you go down the Apple route then Final Cut Pro is a very fine performer and is garnering lots of support from all areas of the production community and snapping at the heels of Avid in very many areas. It has good HD support and HDV should be here imminently. In the meantime, you may need to use the Lumiere plug-in to allow editing with native HDV files. A G5 dual 2.5G machine is probably the most sensible minimum to go for.

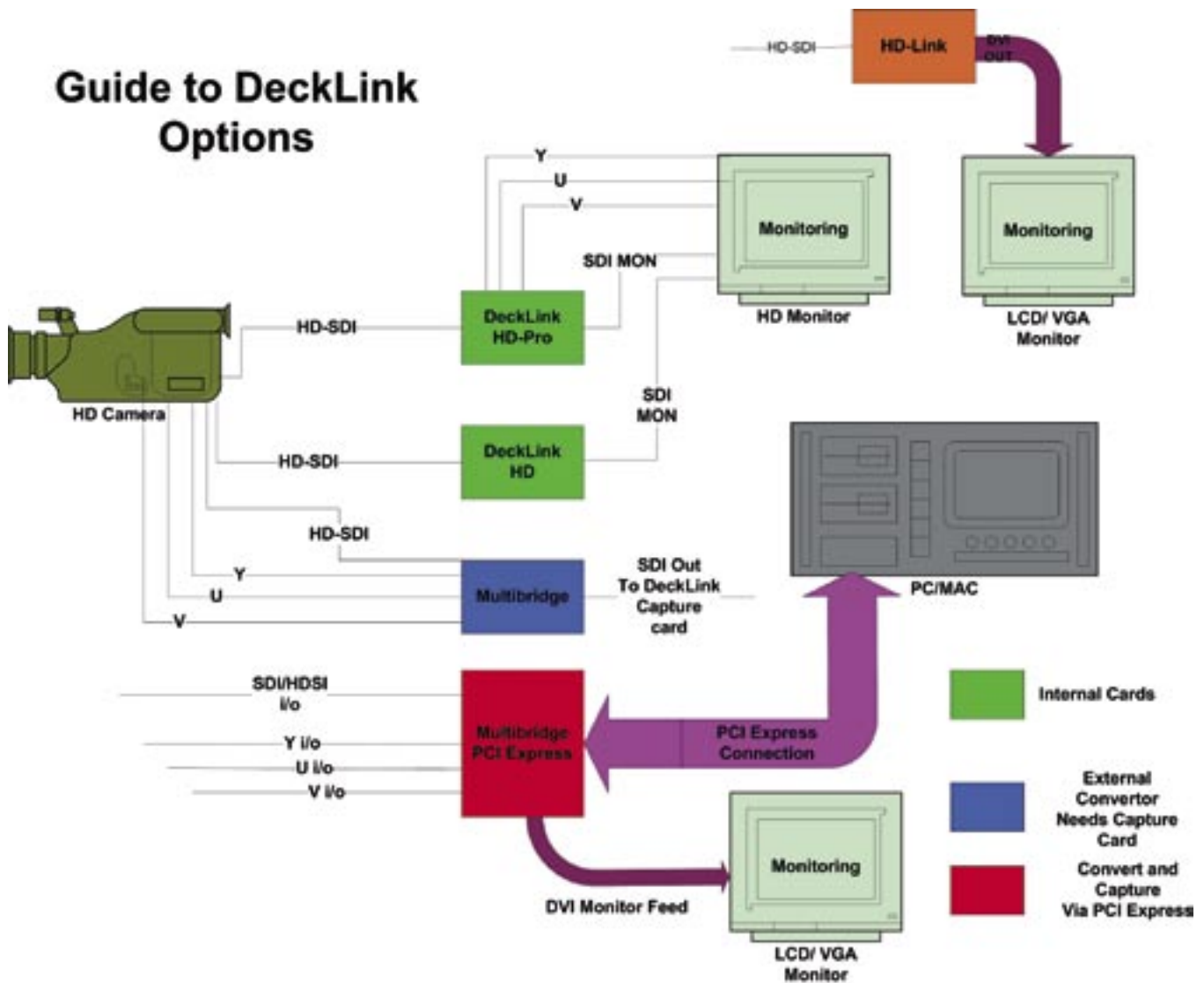
For a PC, a single P4, 3.2G, or - better still - dual Xeon, again 3.2 or better, but running the Nocona core (800 meg FSB) type Xeon with the Intel 7525 chipset. Adobe, U-lead, Canopus, Avid, Pinnacle and Sony all have HD capable editors. You may require a plug-in for HDV (like FCP) depending on your version. In this case the Mainconcept or Cineform plugins. The reason for these plugins is the MPEG 2 off tape is a transport stream and as such requires different handling to an MPEG 2 program stream (eg DVD). When choosing a package make sure that it has the ingest and egest format you require, for example Pinnacle Liquid can really only i/p and o/p in FireWire, whereas those cards that support Decklink eg Sony, Adobe and Final Cut Pro, can take a wider variety, such as HD-SDI or component HD, again dependent on the choice of Decklink card. Both

systems should probably have about 2GB of good quality RAM, with a good graphics card which supports as much RAM as you can afford and is open GL compliant. The reason for this is many editing applications now "off load" the rendering to the graphics card GPU (Graphic Processing Unit) to relieve the CPU workload - indeed this is why many can operate real time (but only to your PC screen). They may render the video files in the background. Our graphics card of choice would be the NVidia range. Note that the 3D performance does not need to be that high - after all video is only 2D! Indeed if you use the MAC with the MAC LCD 30" screen the NVidia is obligatory. Now for either of your platforms you will need storage and a lot of it, especially if doing uncompressed and compositing. If your machine is the primary compositor, you may only need 30 mins of storage for the clips, but by the time you have rendered out the composite about 3x that would be a good starting point. The table below will help you decide on the approximate amount you may require - note HDV requires approximately the same amount of storage as DV.

### Storage Requirements

The next issue is that of choice of drives. For HD uncompressed the drive of choice is SCSI 320; these are expensive however and for HDV probably not necessary, but a good multiple drive array as either a raid 0 or 5 should be adequate. Many of the external drive arrays (such as the Medea) now use SATA drives, but with a SATA to SCSI adapter internally, and these are adequate for HD uncompressed. It is likely that using something like the Raid Core SATA controller card

# Guide to DeckLink Options



(which supports multiple instances and 8 drives per card) with enough drives (between 8 and 16!!) will also be OK, but please note that this should be fitted to the PCIx 100 or 133 meg slots to allow adequate bandwidth - hence the reason for multiple processors, as these slot types are just not available in single processor machines. True SATA 2 drives (those that support NCQ) are preferable e.g Seagate, Western Digital.

Drives which are essentially PATA, with an adapter fitted are best avoided (no names.....). The Raid Core controller card mentioned here is producing very high sustained levels (easily approaching or indeed exceeding SCSI) and that's what you need for video sustained data. Bursting of data just won't cut it! Bursting of data is usually found in servers with hardware raid arrays. To give you some idea of the cost of such a

machine (at to-days prices, June 2005) a dual 3.2 Xeon machine with 2 GB RAM and 2 TB of SATA storage would cost around £2400 inc VAT, assuming self build - a lot of money, granted, but just take a look at HDCam VTRS! Assuming around 85% as an upper maximum for drive space, this gives about 5 - 5¼ hours of uncompressed 4:2:2 video! Next, we move on to audio monitoring. Generally this will be via the onboard sound; again it may be instructive to consider the number of channels. Many applications now have multiple sound track support and these should be supported by the motherboard. If you use a third party card such as the Decklink or AJA there is usually audio monitoring output, but in the case of the Decklink this is sometimes SPDIF. In this case, either use an audio amplifier with SPDIF in, or Edirol make near field monitor speakers, which have SPDIF in and are available for around £100 per

Storage Requirements					
Tape/Digital Source	CaptureRate Compression	Capacity	18 GB drive*	75GB drive*	
Material	in MB/sec	Ratio	in Min/GB	stores	stores
VHS or Off-Line	1.0	20:1	17.1	4.5 Hrs	18.5 Hrs
DV or HDV @ 25Mb/sec	4.0	5:1	4.3	70 min	4.85 Hrs
MPEG-2 @ 50Mb/s	6.0	3.3:1	2.8	45 min	3.1 Hrs
Digital Betacam	8.0	2.5:1	2.1	34 min	2.36 Hrs
D:1 Uncompressed (SD)	19.78	1.0:1	0.9	14 min	58.3 min
HD Uncompressed	95	1.0:1	0.1875	2.91 min	12 min
* Assuming 90% fill					



for the production and delivery of HD content and HD capable DVD players should be capable of playing this format. There are a few WMV9 capable DVD players available now, but if you have any recent XP based machine with a 2.8 G processor or better and 128 meg of RAM on your graphics card, you certainly should be able to play 1280x720 HD right now - indeed there are short clips available at [http://www.microsoft.com/windows/windowsmedia/content\\_provider/film/ContentShowcase.aspx](http://www.microsoft.com/windows/windowsmedia/content_provider/film/ContentShowcase.aspx).

This will allow you to check out if you can take advantage of WMV. Of course, if you have an XP media centre, then you can really take advantage of the format as it even includes 7:1 surround sound! Microsoft have even produced a guide to encoding and authoring WMV compliant DVD's with menu and navigation this can be found at [http://www.microsoft.com/windows/windowsmedia/content\\_provider/wmvhddvd/default.aspx](http://www.microsoft.com/windows/windowsmedia/content_provider/wmvhddvd/default.aspx). So there you have it - we made it.... from scene to delivery. Yes there are pit falls, multiple standards and a lot of potentially confusing "nomenclature". We hope this guide instils some sense of order, answers more questions than it creates about what is possible and work flows to create an end product. Finally we also hope it enables you to ask the right questions to create a solution that is right for you and your budget and that it guides you through the quagmire that is High Definition.

pair. Monitoring the picture in most cases will be on the PC screen in the usual editing window, but as with most editors at some point you may want to see what it actually looks like on a "real TV screen". In the future there will probably be some form of FireWire to video bridge (as is currently the case with DV bridges) for HD. You could do a test record to your HDV and replay that to your HD monitor from the YUV out or if your machine supports e-e, then that way, but there will be significant latency. In FCP with the Apple Cinema screen you will be able to get full resolution playback with a suitable card. With Decklink there are options to send YUV to a monitor (again HD) or as HD SDI again to an HSDI monitor. If you haven't got one, then Black Magic make an HD-SDI to VGA adapter (HD LINK), which when connected to the Apple Cinema display pixel matches 1920 to 1080. BPR also make a similar unit. Of course a decent size CRT computer monitor will also work and you can adjust the

height down to get 16x9! If you are using the Decklink Multibridge PCI express then the adapter is inbuilt and you just connect a monitor to the DVI output. This unit is very interesting as it is bidirectional, has inbuilt HD and SD capabilities and when plugged into a PCI express socket can be used as a capture device! Allowing editing in any standard it even supports 4:4:4 colour space with dual link HD-SDI.

### Delivery

Having finished our edit, we have got to deliver it to the client. You could hire an HDCAM recorder if that is what the client wants, output to HDV tape, or more likely in the future as a Hi Def DVD. Whilst Blu-ray and HD-DVD are still not available this may not seem like an option. However we do have dual layer DVD's and we have a free HD approved codec (well if you have Windows you do - its called Media 9 encoder). Media 9 encoder is not just for streaming. It is fully approved for use as an HD "DVD" codec.... approved

## Subscription Rates

Please note that the **surface** rate covers postage within the Europe, airmail rate is **NOT** required

If your subscription is due before the next issue of CQ-TV, you will soon be receiving a letter containing a personalised renewal form.

We hope that you will continue to support the Club and we look forward to receiving your renewal by post or via our web site.

Years	Surface	Airmail	Cyber
One	£15.00	£21.00	£10.00
Two	£29.50	£41.50	£20.00
Three	£44.00	£62.00	£30.00
Four	£58.50	£82.50	£40.00

Cyber membership is currently only available to members outside the UK. Cyber member will **not** receive a paper copy of CQ-TV, but will be able to download the electronic (pdf) version.

*Please note that these files require the Adobe Acrobat reader version 7 or above.*

## Even more about Digital Television

By Mike Cox

In CQ-TV 197, I went on a bit about Digital Terrestrial Television, and the government's attempts to get us to change to it so that they could sell off some spectrum. The article was just after the OnDigital collapse. In the interest of honesty, I must now plead guilty to owning 3 Freeview decoders, and they work. One is the lab off-air feed.

However, I am not wholly behind the government's switch off plans, even though OFCOM has published an analogue switch-off schedule. As for stores selling cheap plasma TVs on the back of possible Sky HD sport transmissions next year, heaven help the punters who buy them and wonder why an 852 x 480 pixel display does

not do justice to an HD transmission (or even an SD transmission!).

Meanwhile, digital TV will be coming to a phone near you.

Are there any figures of accidents caused by people walking along looking at their phones instead of where they should be going?

### Mixer Progress

The new output card mentioned in CQ-TV 210 is now built and mostly working. A PGM button board has been assembled and tested. My metal work colleague is building me a "speed bulge" that will go at the front of the mixer panel and carry the button board. [Fig. 1]

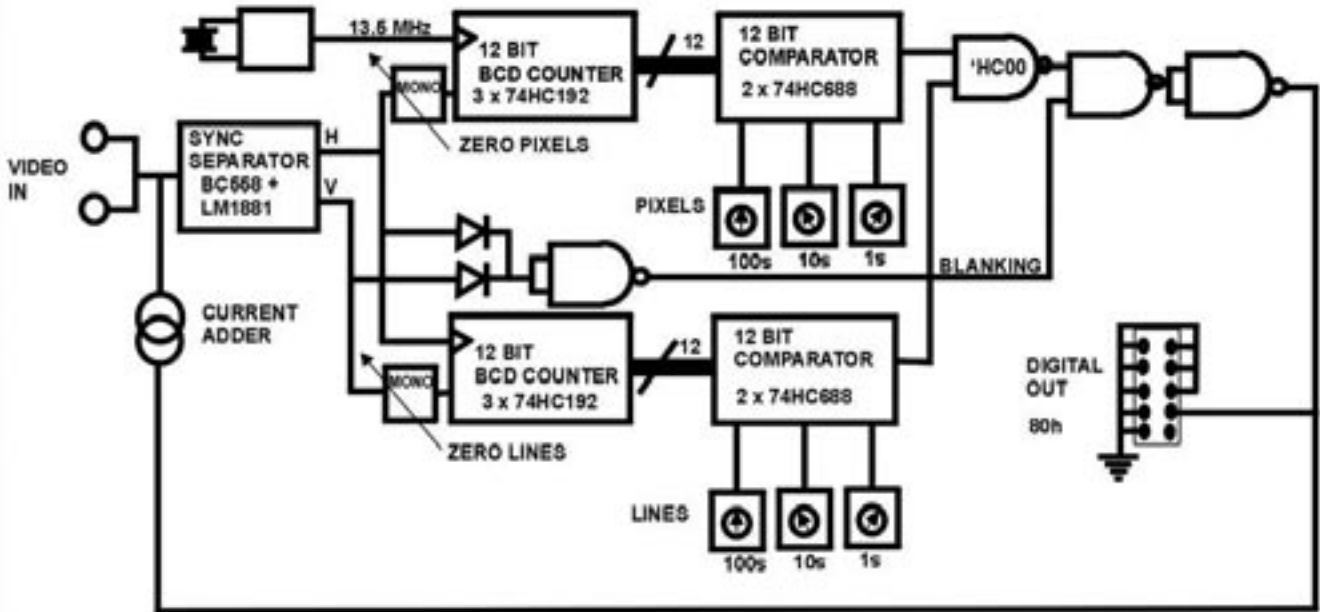
Presently, a separate ribbon cable has to be used to link the button board with its associated matrix card. In the fullness of time [whenever that may be], it should be possible to add an extra word to the RS422 data system, and do away with the extra cable.

The PGM bank delay card has been assembled and tested. It uses 5 TMC2111A 8-bit 16 stage programmable registers in series. This gives 3µS maximum delay, and is set so that there is no timing jump when cutting between a source direct, and via the M/E system.

### Other Work

You saw from CQ-TV 210 [p6, Fig. 1] that the IBC Info Channel screen is often split into three regions. As the graphics is prepared off-line, it is





**Fig, 2** CROSSHAIR GENERATOR BLOCK DIAGRAM

necessary to able to set the Split Screen generators easily and accurately.

To this end, a Cross hair Generator has been built that can be set in pixels and lines, as this is how the graphics are created.

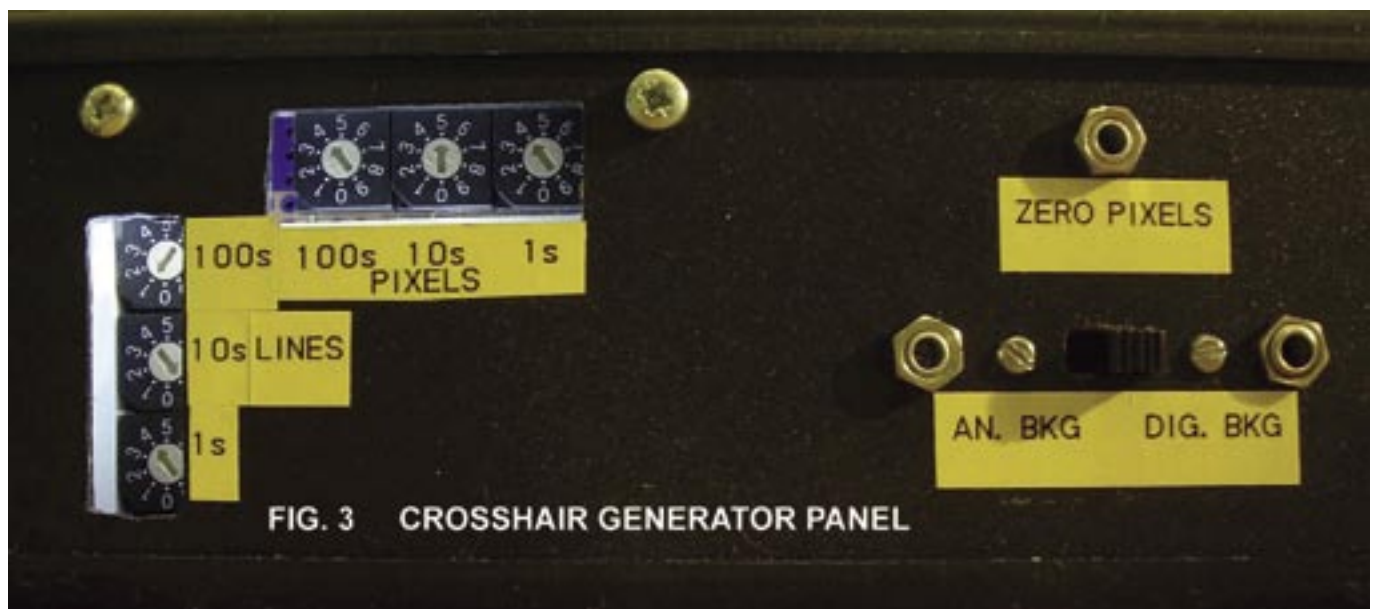
The generator is broadly similar to the Line 23 generator described in CQ-TV 210, as it uses a current add circuit [Fig.7, p38] with the very simple video path.

One of the embarrassments, if you like, of the original sync separator was the need for a negative supply for the emitter follower driving the LM1881 sync separator. To keep it simple, I chose a PNP emitter follower using the 5-volt rail only, and it seems to work. [Fig. 5, Input Section]

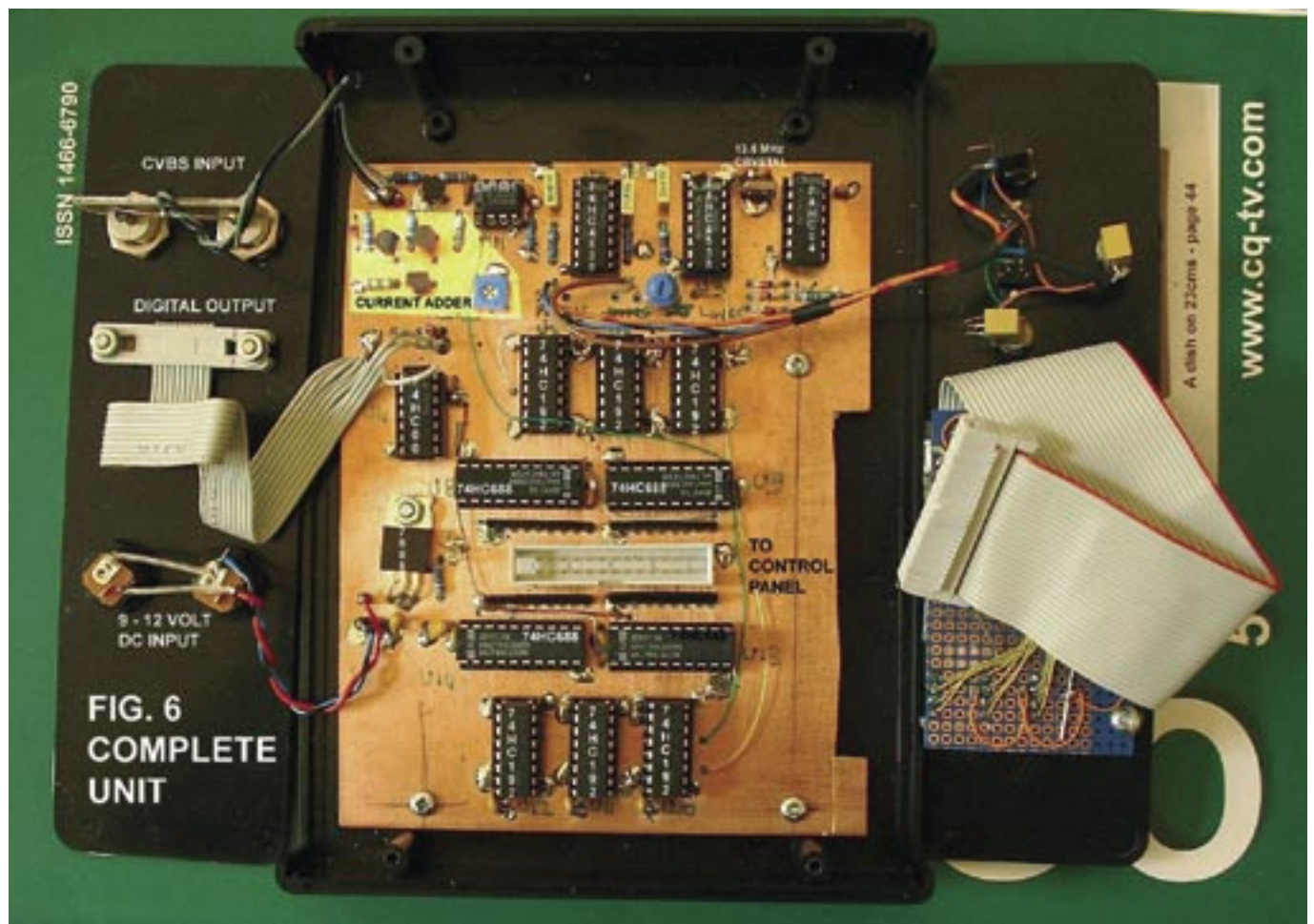
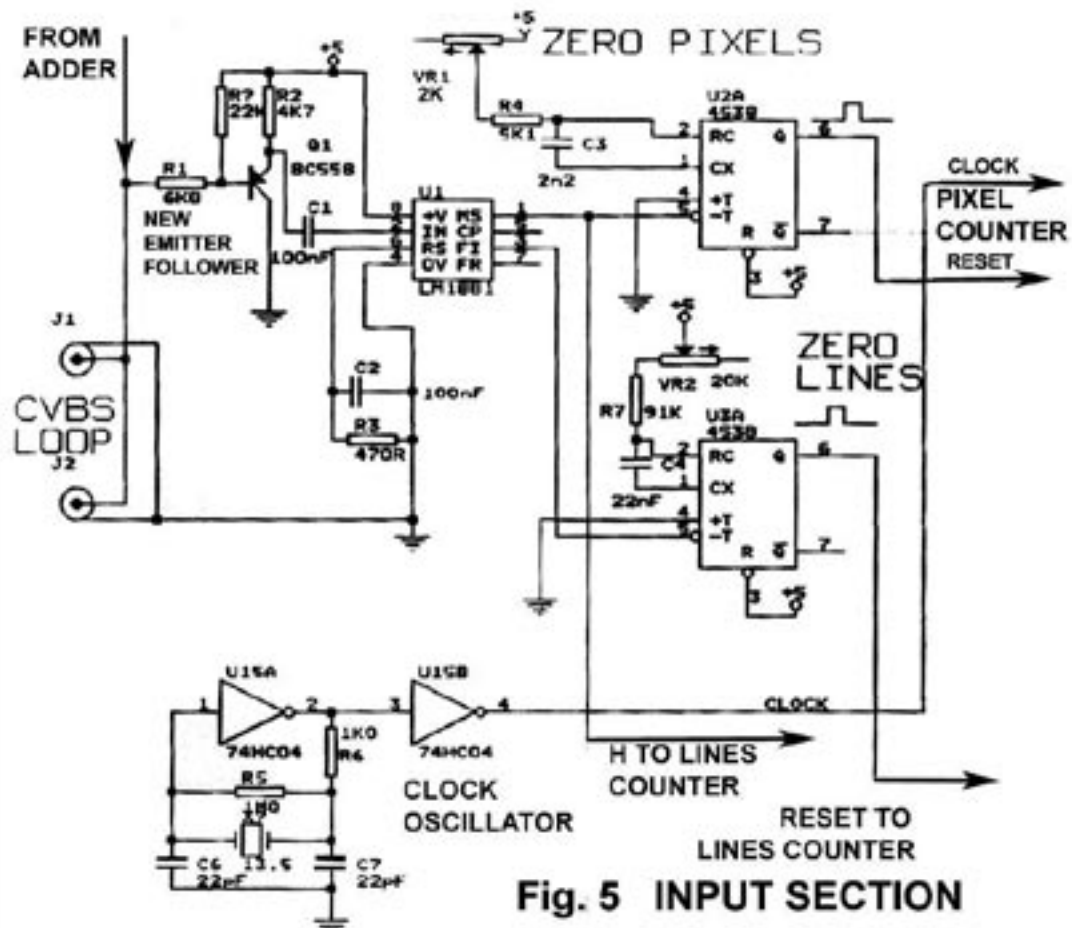
A free running 13.5 MHz clock oscillator is used, as it did not seem worth going to the trouble of phase locking it to H sync for the use it is put to.

The basis of the unit are BCD counters [74HC192] that operate at pixel rate, clocked by the 13.5 MHz oscillator, and at line rate, clocked by sync pulses from the separator. [Fig. 2]

The counter outputs are fed to digital comparators [74HC688]. The second inputs of these comparators are from BCD switches. Coincidence is marked by a comparator output one pixel or one line in width, thus forming the cross hair. As the Line cross hair will go for 64µS, the overhang will embarrass the sync separator and subsequent circuits.







It has therefore to be blanked. Also, because it would be nice to start the count at pixel 1 [left-hand side of active video] and line 1 [first line of active video], a pair of monostables are used in the H and V trigger feeds to allow zeroing of the counter start.

The BCD switches used are preset screwdriver adjust ones, mounted on a small sub-board behind the panel, and lit by a white LED, which acts as a power on indicator.

As the device will be used in both the analogue and digital world, two blanking width presets are fitted. This allows analogue blanking to be set to 704 pixels, and digital blanking to 720 pixels. (Peter Vince please note!)

[Fig. 4, Monitor Display, Fig. 3, Unit Front Panel]]

The picture shown is from the SDI mixer output, with the two split screens, H and V; and the Cross hair digital output fed into the Title Adder.

**The construction is simple.**

I laid out all the components in Boardmaker [PC layout package] but without tracks. This when printed out, is a pad template. However, I mirrored it so the print represented the underside of the board. The print was glued to the plain side of a bit of 0.8mm copper laminate (offcuts courtesy of my PCB maker) and used as a drilling template.



Ground connections were not cleared (pins 7 or 8 of ICs), while the others were cleared with a 2mm drill bit held in the hand. A bit of masking tape around the bit saves wear on the fingers. We have a Poor man's ground plane PCB!

IC Sockets were fitted with the ground pins folded out and soldered directly to the ground plane, as are any Rs or Cs that have one end to ground.

Interconnections are done on the reverse side using wire wrap wire.

The board goes into a cheap and cheerful Maplins case. Power is from the traditional 9 – 12 volt supply using 2.1mm connectors.

[Fig.6, complete unit]

With the Editor's blessing, I will give a brief report on the modified SDI mixer; and a report on the highlights of IBC 2005 in the next issue.

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## Contest News

### By Richard Parkes G7MFO

Congratulations again go to the Severnside Television Group for first place during the Summer Fun contest.

I have just got back from Friedrichshafen rally, if you are into building like most ATV Amateurs are!, I would recommend going. This year there were several traders selling ATV related equipment from the latest digital ATV setups, analogue, 1 watt amplifiers to 400w solid state. You might have had to take out a second mortgage for the 23cm 400w from dk2fd at €2500, but there were several surplus amplifiers which could be converted into the amateur bands amplifier for sale at give away prices. With cheap flight as low as £1.99 from RYANAIR from Stansted, if you can afford to book last minute you cannot go wrong.

Getting back to the summer fun contest, I received a few emails saying it was a shame that activity was down and that the ATV who are on mid-week were not available. It takes a lot of time and effort to run and organise a portable station, please give support by giving a few points away. I will try to advertise the International contest more in Radcom, Microwave newsletter and the RSGB news closer to the contest, I put in a plea for someone to take over the position in the last CQ-TV, and I still have had no reply!

It would be nice if a few of the amateurs who took part in the previous contests sent in a report with a few pictures for the next edition CQ-TV. Most stations are using the standard 20w on 23cm about the same power on 13cm and 1w on 3cm. You do not need the state of

the art- equipment, quite a few amateurs who have just got on the air are using basic aerials with the cheap 23/13cm modules on TX/RX with good results.

Please get in touch if you require any help with contests and don't forget to send in your results!

Richard Parkes G7MFO 7 Main Street, Preston, Hull. HU12 8UB. England. Tel:- 01482 898559

E-mail: [contests@batc.org.uk](mailto:contests@batc.org.uk)

### Mike G0DPS and Dave G4TIW DXpedition to Corney Fell South-West Cumbria

Encouraged by our experience of the Summer Fun competition in June 2004 (first place), Dave G4TIW and I decided to try to improve our equipment for the September International event. Dave had the idea of working from a greater height than the 400m site we used previously, which meant carrying all the gear up to the 550m hill about 2km from the van site. During the next 3 months, Dave designed and constructed miniaturised gear for three bands, to be carried in backpacks by his son and himself, including camping equipment to stay overnight for the duration of the contest, no mean achievement you will agree!. For my part, I set about building a set of four 36 element long yagis to replace the single yagi used on 23cms previously, after testing these, they gave an improvement of just over 5db over the single yagi which was most encouraging. We also made improvements to the system by the addition of a 2kw generator for power.

Leaving Leeds at 8 am on the Saturday morning, we arrived on site high in the

Cumbrian hills by 11am to find the site covered in low cloud and rather windy. Dave and son set off up the mountain at 1 pm, rapidly disappearing into the mist at about 50m distance. My station was set up by 2pm in my van so started to see what television conditions were like, hmmm!!! Not very good. The Anglesey repeater was only P1 and nothing at all was seen from the Belfast repeater, which had been P5 during the summer fun competition.

The weather gradually went from bad to horrible as the day wore on and despite regular calls, nothing was heard on the talkback channel, apart from Dave, trying his best to avoid having his tent and gear scattered all over Cumbria by the wind. By 10 pm, I turned the antennas downwind and decided to call it a draw for the night, but it was impossible to sleep in the conditions as at 2 am Sunday morning my van was lifted onto 2 wheels by the wind, lucky for me it landed back on 4 wheels, not a very pleasant feeling.

Daybreak saw a slight improvement in the weather and was quite surprised at 7.30am when I heard a call from Nigel GM7JZP/P from Glenluce South-West Scotland, and started to work him successfully on the 3 bands, when Dave and son returned from their hilltop perch looking rather worse for wear. Gave a few more calls but by 9.30 we were all feeling much worse for wear as no one had had any sleep, it was decided to call it a day and return home.

It transpired later that several stations were operating and looking for our stations later in the morning, and to those stations I offer my apologies, but we were in no state to continue, but WE SHALL RETURN.

### Contest Calendar 2005

**IARU International ATV Contest 2005 Saturday September 10<sup>th</sup>  
– Sunday September 11<sup>th</sup>**

**From 1800 UTC Saturday to 1200 UTC Sunday**

**Fast Scan ATV all Bands.**

## Preserving Yesterday for Tomorrow

### Dicky Howett visits Scotland's Museum of Communication

With at least eleven moves behind them and the core collection spread currently across seven locations, the splendid Museum Of Communication has settled finally at Burntisland in the Scottish Kingdom of Fife.

The Museum currently has stored (in private homes and in two large malodorous 'bunkers') over 2000 items spanning the 'communication' technologies of telegraphy, telephony, radio, radar and television plus many rare items of military electronic hardware, all destined for the Museums' new HQ at the Scottish holiday coastal town of Burntisland (pronounced Burnt island).

The nucleus of the Museums' collection belonged to the late Harry Matthews, who worked for many years at the Department of Electrical Engineering at Edinburgh University. Harry- who during the war was a back-room boffin with Barnes Wallis (and also Neville Shute) and was secretly parachuted into Holland to 'acquire' an item of electronics from the Phillips factory- first began collecting radios when in 1973 he found a discarded set in a dustbin. It was an old Ekco which Harry had, 30 years previously, helped to design.



The old club dance floor is being stripped to make way for display and storage.

Soon Harrys' collection of radios and electronic paraphernalia filled display cases in two crush halls at the University. As this collection was growing constantly, (Harry was being offered interesting items on a weekly basis) it was decided to move the entire collection to a more suitable location. Also, during that time a Trust was formed which became the Museum Of Communication.

In 1987 the Museum Trust moved various items to premises in the small town of Bo'ness on the Firth of Forth, some 20 miles west of Edinburgh.

During its 7-year stay at Bo'ness, the Museum instigated themed exhibitions locally and also long-term displays in Edinburgh and Glasgow.

By 1994, the Museum was on the move again (the Bo'ness peppercorn lease had expired) and with no permanent home on the horizon, Trust members undertook to store the more valuable and precious items in their own homes. Larger artefacts were ensconced at a former military munitions site in an area named, (with no intended irony), Bandedath. Later the collection moved to a very leaky (but free) storage site within the Longannet power station complex near the oil terminal of Grangemouth.

Finally, in 2003 the Museum purchased for £25,000, a redundant Services social club in the ancient port town of Burntisland. The club premises, (which is sited favourably on the high street), contains several large areas on two floors and even a cellar, all with potential for display plus plenty of space for the all important storage. The area upstairs is to be converted into an inviting tea-room and sales area. The Museums' new home has also all the necessary toiletry conveniences and fire exits.

A considerable amount of reconstruction and refurbishment is now being undertaken by a team of volunteers.. However, one display area is already open for business and although the scattered bits of the prime collection are still packed in boxes awaiting



Outside the Museum of Communication at Burntisland.



**One of the Museums' prize exhibits, a hefty EMI BTR2 tape machine, one of 750 used by BBC radio. This item came from the Pebble Mill studios in Birmingham**



**Harry Matthews with the Museums' preserved BBC Scotland radio studio control desk**



**Youngsters try a Pye 'Cambridge Station' vidicon tv camera.**

reinstatement, there are several interesting themed displays currently on view. Visitors (a recent open weekend attracted 250 people) can see examples of domestic radio, early experimental radar, Morse keys (one is dated 1913 and was rescued from the German battleship Grosser Kurfurst, scuttled at Scapa Flow), microphones, telephones, tv equipment, photographic apparatus and sound recording gear, plus computers and satellite technology.

Later, the Museum hopes to offer to research students, an on-site library service (it has many rare technical publications), an electronics workshop and a fully-illustrated catalogue detailing its more important acquisitions. An amateur radio society has been formed and will operate from the HQ's 'radio shack'.

The Museum (with President: Prof. Heinz Wolff) is now firmly and finally installed, but continues to seek new members and most importantly, funds. Today, the membership stands at around 120, with people from the UK, France, Germany, Japan and the USA. The Museum continues its policy of encouraging schools to be involved in various projects, as a necessary part of teaching the history and application of pre-and post war electronics.

### **Museum details**

Membership £12 per year including three issues a year of the Museums magazine 'Transmitting'. For full details phone 01506 823424

Museum address: 131, High Street, Burntisland, Fife KY3 9AA Scotland

Email: [mocenquires@tiscali.com](mailto:mocenquires@tiscali.com)

Website [www.mocft.co.uk](http://www.mocft.co.uk)

# BS2 STAMP Repeater Controller

By **Richard L. Carden**  
VK4XRL

This is not so much a constructional article, although enough information has been provided for those who would like to experiment. Therefore the aim of this project has been two fold, one was to provide a working ATV repeater controller while experimenting with the use of micro controllers and secondly to use or amend circuits previously published in

either Amateur Eye (was the publication of the SEQATV Group) or CQ-TV.

Now I am no software writer so I know that others out there could do a better job, but for me it was an introduction. I started this project

some time ago but I have just got back to it. You will notice that I am using a BS2 Stamp module, I thought this would be an easier way of getting into micro-processors. These devices are expensive compared to other micro's, however once working then the code could be down loaded to say a Picaxe 28 without much problem (I Hope). Any other micro could also be used depending on your ability to program them. Standard single DTMF tones are used for controlling the switching. It is hoped that dual digit codes would be used in the final system. This will give it greater ability not to be triggered by miscellaneous information. If anyone

can help in this regard it would be greatly appreciated.

## Block Diagram.

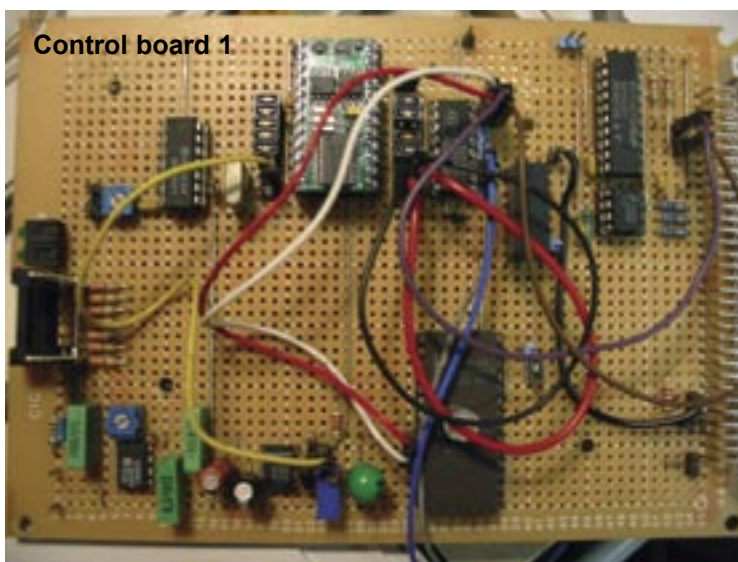
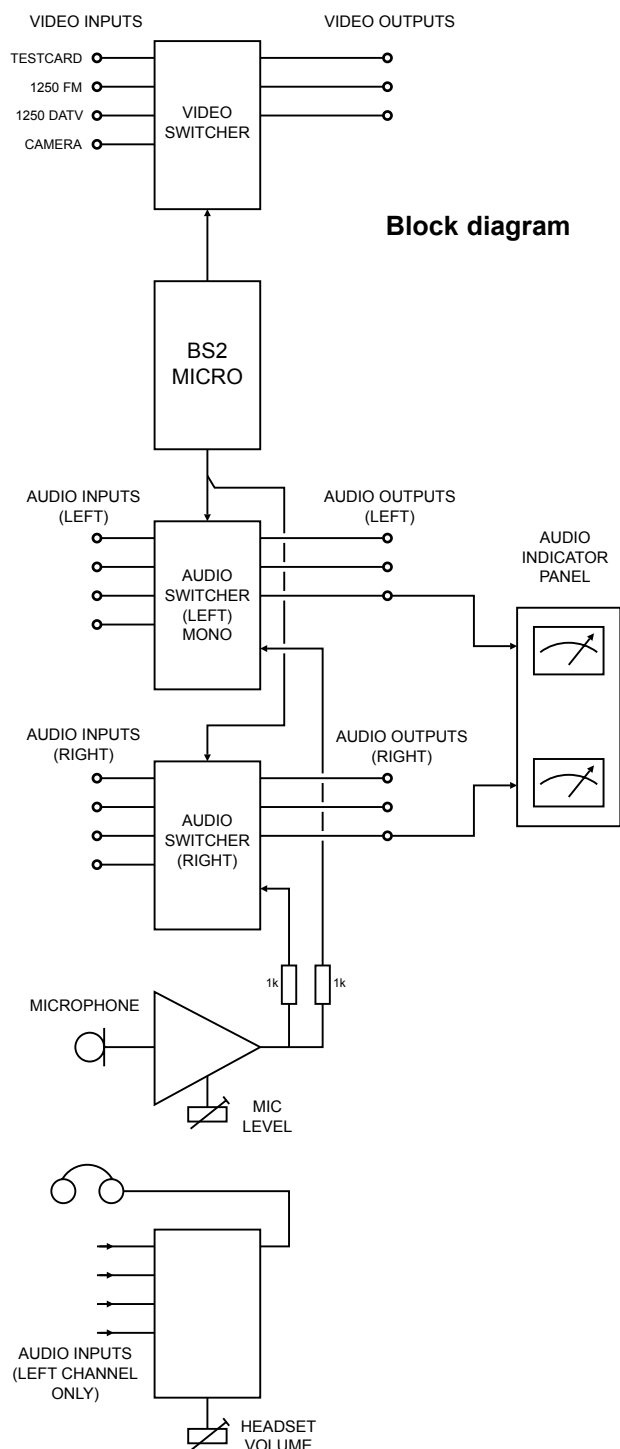
Let's now look at the block diagram, the video switcher allows for four inputs including stereo audio and each buss has three outputs. As the switching elements used have room for eight inputs further expansion can be accommodated.

For our requirements at this stage these inputs are arranged as follows,

1. Test-card (more on that later)
2. 1250MHz FM Receiver
3. 1250MHz DATV Receiver
4. Camera

The first board contains the video switcher and also has a sync detector which in our case was wired to input 2. The sync detector for the DATV signal is fitted in the DATV receiver and fed to this board. A 7 segment read out is provided for maintenance as are LED's for showing switching functions. The DTMF decoder is also fitted to this board.

Stamp output	P14	P15	Video Input	Input	Buffer O/P	A'	B'
1	1	1	1	T/Card	0	0	0
0	1	2	2	Analog Rx	1	0	0
1	0	3	3	Digital Rx	0	1	1
0	0	4	4	Camera	1	1	1



Control board 2

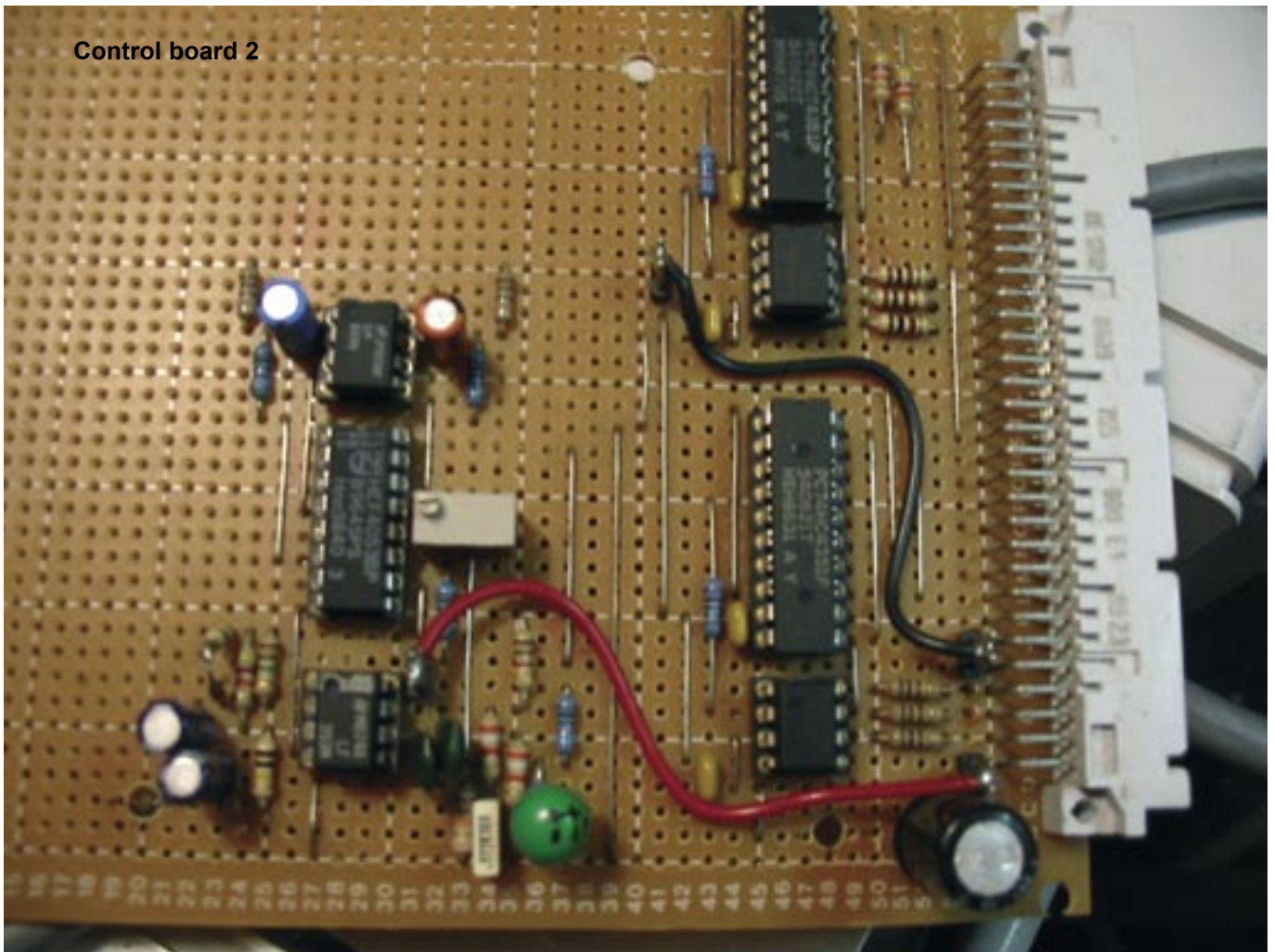


TABLE 2

DTMF Decoding

Button	Hex	BCD				
0	0	0	0	0	0	IN0
1	1	0	0	0	1	IN1
2	2	0	0	1	0	IN2
3	3	0	0	1	1	IN3
4	4	0	1	0	0	IN4
5	5	0	1	0	1	IN5
6	6	0	1	1	0	IN6
7	7	0	1	1	1	IN7
8	8	1	0	0	0	IN8
9	9	1	0	0	1	IN9
*	10	1	0	1	0	IN10
#	11	1	0	1	1	IN11
A	12	1	1	0	0	IN12
B	13	1	1	0	1	IN13
C	14	1	1	1	0	IN14
D	15	1	1	1	1	IN15

B S 2					
input		IN3	IN2	IN1	IN0 =INA
BCD		8	4	2	1

The second board contains the stereo audio switcher, Tone oscillator and stereo ident generator. Space has been left to include a headphone amplifier and Microphone for maintenance testing from the remote site.

The rack system has also a video monitor and VU meters for system alignment.

The third board is a Cropeady Test card Generator modified to use an AD723 encoder chip giving far superior output

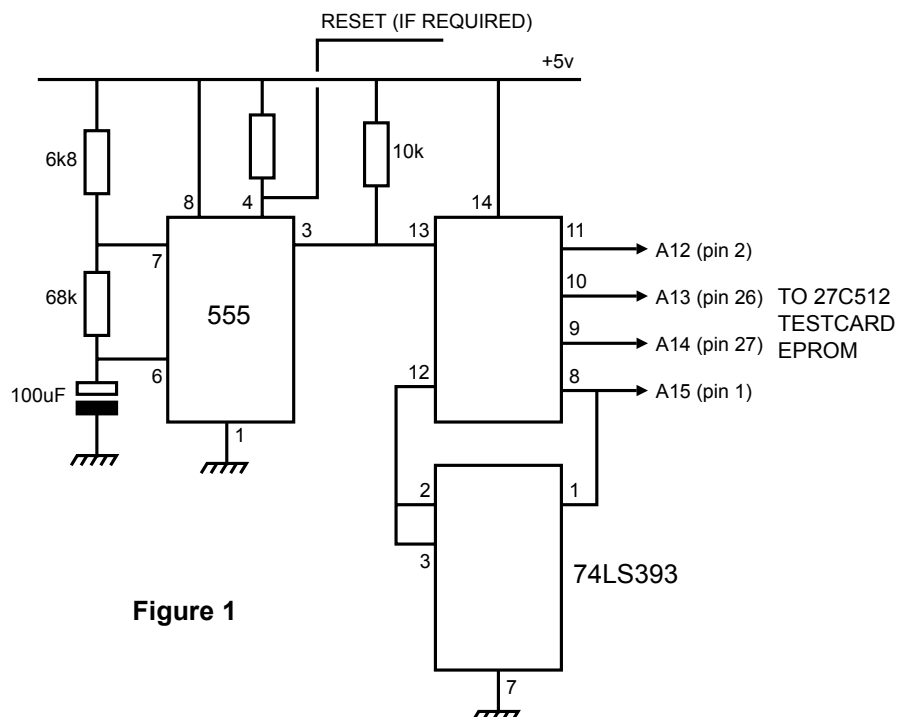


Figure 1

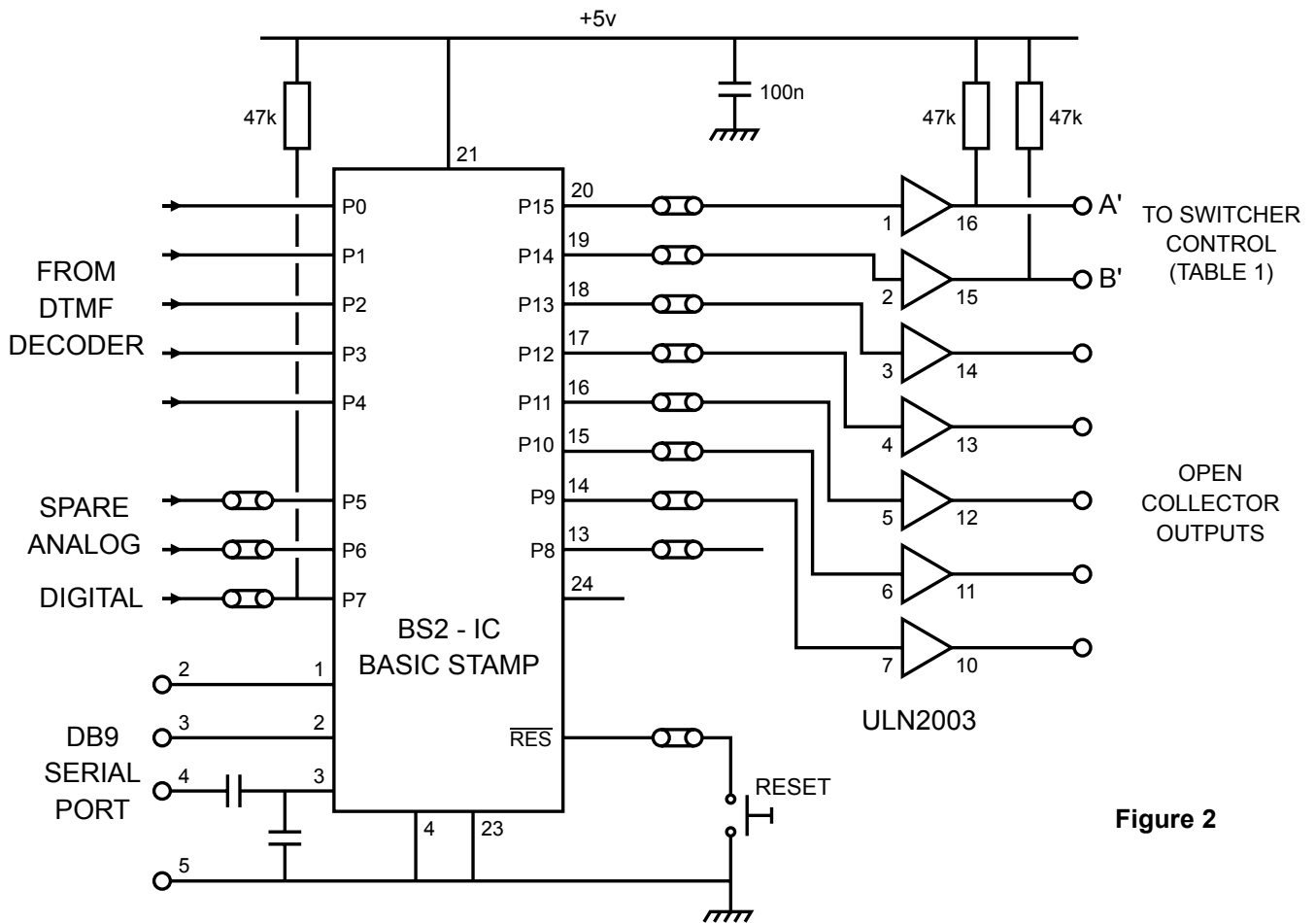


Figure 2

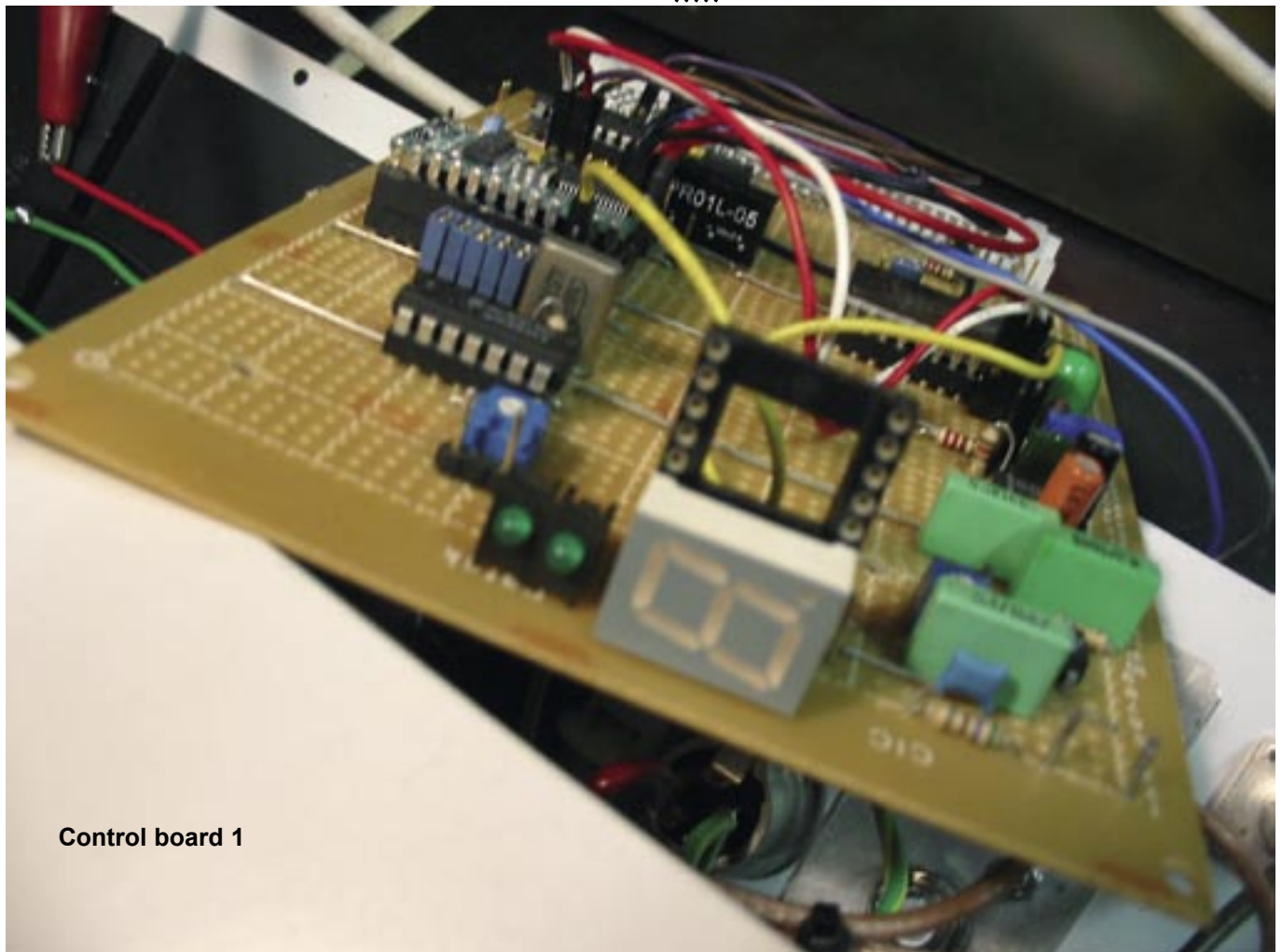




TABLE 3									
Switcher Indicator EPROM code									
Address	Req.No.	D6	D5	D4	D3	D2	D1	D0	CODE
0000	1	X	X						60
0001	2	X		X	X		X	X	5B
0010	3	X	X	X			X	X	73
0011	4	X	X			X		X	65
0100	5		X	X		X	X	X	37
0101	6		X	X	X	X		X	3D
0110	7	X	X				X		62
0111	8	X	X	X	X	X	X	X	FF
7 SEGMENT DISPLAY		b	c	d	e	f	a	g	

results. The EPROM has been enlarged via a piggy back arrangement to allow for different idents to be controlled via the micro controller if desired. A separate page generator could also be used instead of the above as per figure 1.

### BS2 Stamp Controller.

The heart of the repeater controller is the BS2. The reason for using this device was because I still had one, also it appeared easy to use. The device has 16 in/out ports that could be arranged as required. The ports used are as follows;

- Input P0 (All used)
- Input P1 (for
- Input P2 (DTMF
- Input P3 (Control
- Input P4 (Valid Key stroke
- Input P5 (Spare
- Input P6 (FM RX Detector
- Input P7 (DATV RX Detector
- Output P8 (Page Change
- Output P9 (Page Change
- Output P10 (Camera pan left
- Output P11 (Camera pan right
- Output P12 (Camera Zoom in
- Output P13 (Camera Zoom out

- Output P14 (Video and Audio Control
- Output P15 (Video and Audio Control

A sample of the software code has been provided. The remarks should indicate what is happening. At one stage audio was also going to come from the BS2, this has been left in but not activated. All outputs are interfaced via a ULN2003 hex buffer. All inputs and outputs are initialized via jumpers which in the event that you have a micro failure maybe jumpered around and still maintain some functions. It also aids as a maintenance and development tool. By-passing the BS2 micro would only allow for Analogue RX and Test-card operation. To effect by-passing the following jumpers would need re-routing.

1. The 'on board' sync detector (Input 2) is removed from Pin 11 (BS2) and placed on Pin 1 (ULN2003)
2. +5V is also then jumpered to Pin 2 (ULN2003) after removing the link.

Figure 2 shows the system set-up while the Switcher Output truth table (Table 1) shows the logic requirements.

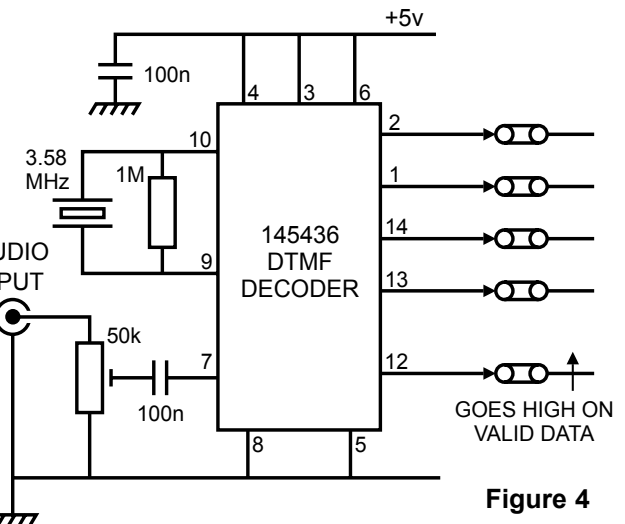
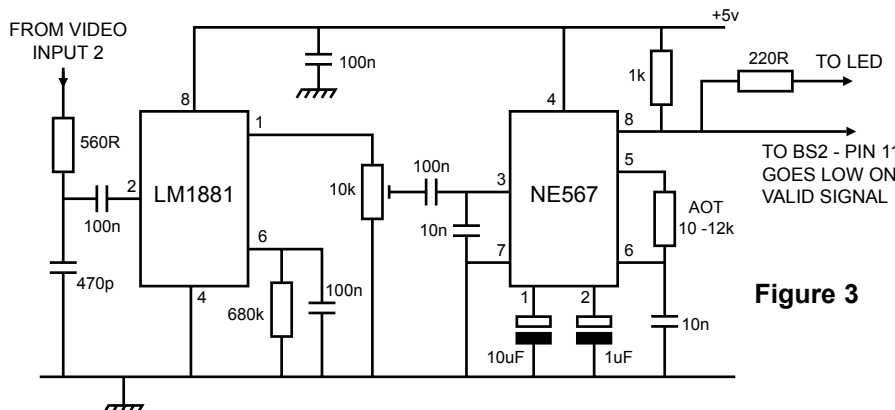


Figure 4

### Video Switcher

The video switcher, figure 6 uses a 74HC4351 feeding a 2030 or equivalent OP amplifier providing 3 outputs. The select inputs are held high and require the reverse logic from the micro to control it.

### Sync Detection

With reference to figure 3 the input is fed from video input 2 (it could be also wired to inputs 3 or 4 as required). A LM1881 sync separator IC is used and a low pass filter is formed by 560r and 470p on pin2 and is used to filter any noise and chroma information that may otherwise effect its operation. Sync from pin1 is then fed via a sensitivity level control to a NE567. It's setup so that the output, pin8 goes low on a valid 15625 video signal. All that's required is for the internal oscillator to be set via its frequency trim potentiometer. A LED is also included again for monitoring and maintenance purposes.

### DTMF Decoder

This is a 143436 (other IC's could also be used) and has all the hard work done for you. All that's required is an input signal, Xtal oscillator running at 3.58 MHz. Five outputs are used, 4 for decoding the tone sequence and the fifth to indicate a valid data signal which goes high. Figure 4 and Table 2 gives the required details. These signals are then used by the BS2 Stamp for repeater control. Input for the DTMF controller can either be via the left audio channel or from a separate 2m receiver.

### Audio Switcher

Two audio switchers are required for Left and Right audio channels. Each switcher uses a 74HC4351 and an OP amplifier feeding three outputs, see figure 6. Dual supply rails have been provided at -5 and +5v, with decoupling

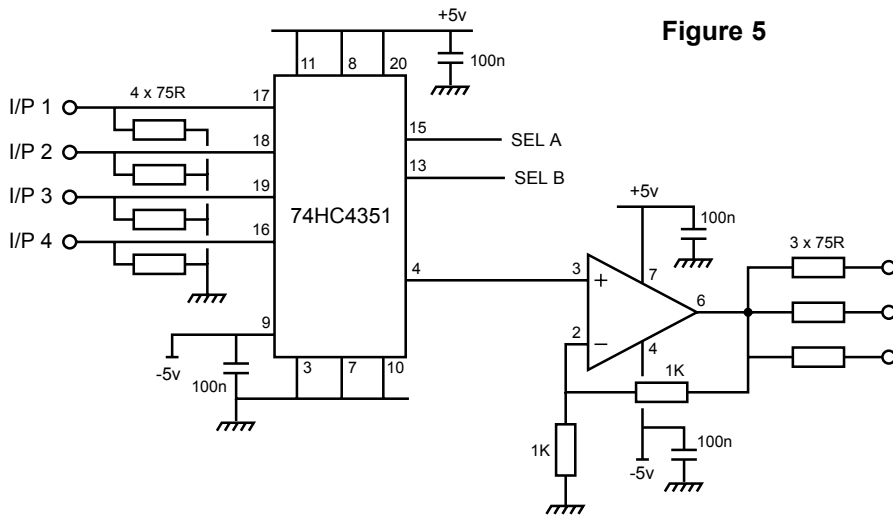


Figure 5

### Video Switcher Indicator

The seven segment display is controlled via an EPROM from the micro switching buss A & B see figure 7. This allows us to change the reading for different input codes (see switcher Indicator EPROM code Table 3). Provision has been made to fit either a 2716 or 2764 depending on what is available. This is mounted edge wise on the board with the two sync detect LED's.

### Conclusion

With a project like this the sky's the limit as far as add-on's are concerned. It would be nice to replace the seven segment display with an LCD read out, this would also have selectable functions such as voltage checks, input selection. It should also be possible to provide audio level indication for the two audio channels. Maybe someone could provide a circuit using a PIC to perform these functions. Another idea that I have seen is to provide a DTMF check using a separate EPROM in the test card generator see photos. The photo shows that button 1 has been selected, in this mode the video switcher would be non operative. If anyone has any further updates please drop me a line, also if anyone would like to upgrade the Stamp BS2 to a PIC or PICAXE28 etc. then also send it to the editor for publication.

### Reference:

CQ-TV 209 ITS Audio Part 2  
CQ-TV 175

<http://www.parallax.com/index.asp>

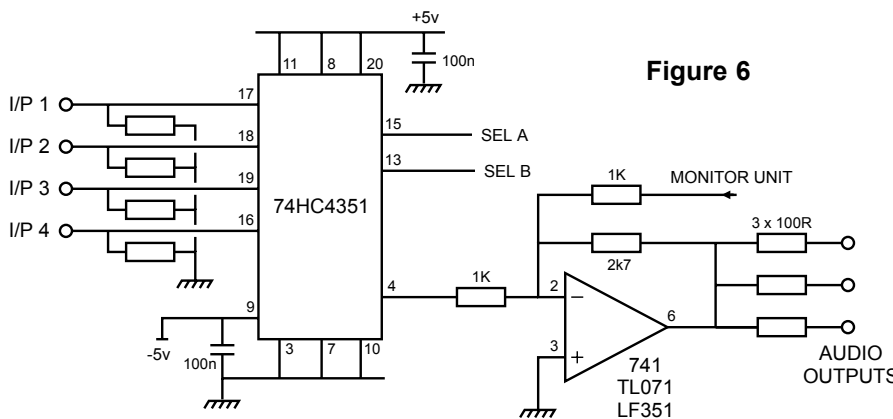


Figure 6

on all IC's. Control switching is via A and B select pins, C is not used and is grounded as we are only switching four channels. These controls are fed in parallel from the video card.

### Audio Oscillator and Switcher

It was decided to fit an audio oscillator to this audio board and feed audio to input 1 left and right direct. The circuits are identical to those provided for the ITS generator in CQ-TV 209. The audio oscillator is a dual T arrangement and with the values shown provides an output of around 400Hz. The second half of the dual Op amplifier is arranged as an astable M/V with a mark space ratio of 3:1.

The output from the audio oscillator feeds two inputs of a 4053, pins 1 and 13. The input to pin 1 is switched by the M/V circuit and it's output is then fed via another switch section to the output Op amplifier feeding the right audio channel. The left input is fed by the third switch section of the 4053. Pins 12 and 5 are fed from v/2 rails, however this can be changed to an audio ident if required.

### Audio Monitoring Unit

Room has been left on this board to add an audio monitoring unit allowing easy

interfacing to other audio circuits. Also a microphone amplifier is to be fitted allowing a ganged headset microphone unit to be used allowing input from the remote site via the normal audio channels. At this stage, this unit has not been built.

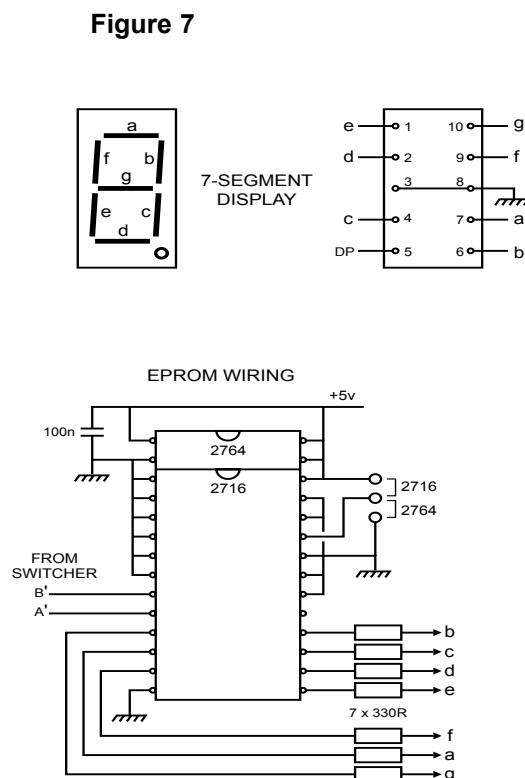
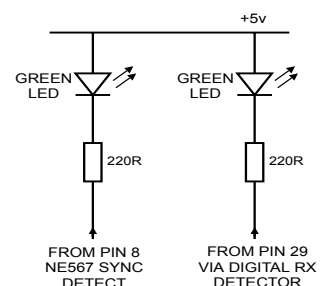
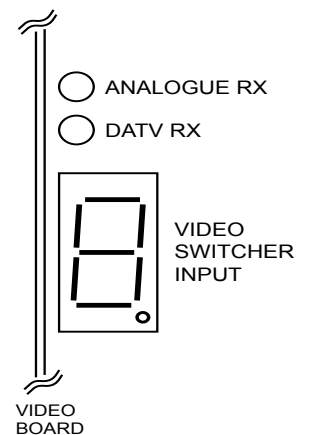


Figure 7



## ARISS for ATV?

By Graham Shirville G3VZV

As you may have heard there is a plan to mount some extra amateur band antennas on the outside of a new European part of the ISS called Columbus that should be launched next year.

These will face the earth and cover 23 and 13cms and also possibly 70cms.

Their installation would enable ATV gear to operate from the ISS for the first time. Maybe this could be a "repeater" or show on board videos....

Many amateurs and groups have already contributed to the funding but a little more is still needed.

Full details of the project are shown here <http://www.ariss-eu.org/columbus.htm> details of the current donations are shown here <http://www.ariss-eu.org/donations.htm>

The first page has details of how to donate easily using paypal.

Knowing that this is likely to be a once in a lifetime opportunity, could I ask our members to urgently consider this request for some financial support?

The slide is titled "TWO CONFORMAL ANTENNAS FOR ARISS" and includes the website "www.ariss-eu.org". It features two antenna designs:

- Top Antenna:** 1260/2400 MHz, 300x220 mm, RHCP. It has a purple square shape with a curved edge. A pink box specifies a curvature radius of 225 cm and a weight of less than 350g.
- Bottom Antenna:** 435 MHz, 340x340 mm, RHCP. It has a brown diamond shape with a curved edge.

The slide also includes a small logo in the top left and the text "BRUNEL UNIVERSITY OF TECHNOLOGY" in the bottom right.





# TV AMATEUR



## Nr. 137

37. Jahrgang

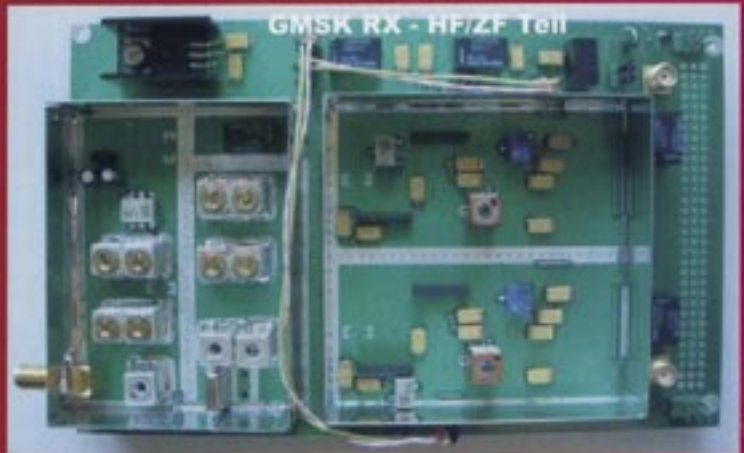
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## AGAF at Ham Radio fair 2005 in Germany

Translated by Klaus Kramer,  
DL4KCK

With 30 degrees Celsius outside we were lucky to have a cool atmosphere inside the hall A1 at the 30th International Exhibition for radio amateurs in Friedrichshafen at the end of June. Only the live video link from the Pfaender mountain in Austria beyond Lake Constance reminded us at the AGAF stand of the heat at that outpost. Some students from the Wuppertal University engaged in the DATV development were with us working as technical consultants or as cameramen like Andre, DO1AAW. When the DARC staff came around with officials from the Department of Trade and Industry, Uwe, DJ8DW, explained the status of digital amateur television. Many hams from different countries asked the AGAF team with Heinz DC6MR and Klaus DL4KCK for technical details or received their TV-AMATEUR issue #137 hot off the press. On a video monitor spectators saw themselves acting delayed because of the typical MPEG delay time through the DATV TX on display, and via laptop and graphical control software. The hard-disc integrated into the DATV exciter played back some of the scenes recorded previously.

On Saturday Uwe, DJ8DW, and Willi, DC5QC, realised this year's peak level of AGAF activities at HAM RADIO: live video sent via GMSK modulation on 434 MHz (2 MHz hf bw) with 7 Watt from the german bank of Lake Constance over 20 km to Pfaender mountain and from there back to the fair hall in Friedrichshafen over 28 km via QPSK modulation on 1255 MHz with 8 Watt. After a short lunch break another portable GMSK link was established from the Gehrenberg over 38 km. At the receiver monitor several OMs congratulated, i.e. DC0BV, DJ3DY and DK7EI.

Heinrich DC0BV was also delighted by encouraging news about ham radio in space, which he served in a very active



role at times of the russian space station MIR. But before the envisioned ATV links could emerge the whole station was dumped into the pacific ocean. Now ON4WF reported in his lecture at the HAM RADIO fair about future ARISS activities: in July 2005 the ISS astronauts will dump an old russian space suit equipped with electronics and ham gear into an orbit during a space walk. In the following weeks that "Suitsat" will transmit around the clock several greeting messages in different languages from children all over the world on 144,990 MHz with 500 mW, additionally an SSTV image stored in the same chips.

A much more impressive impact on the public is expected from the future ham radio traffic on board the new european ISS laboratory "Columbus" constructed now. It shall get ham radio antennas for 70 cm, 23 cm and 13 cm, enabling first ARISS contacts on SHF. With the Columbus module being located at some considerable distance from the other two ARISS stations, this will permit parallel operations on the new bands at the same time as the existing operations. The availability of these new frequencies will enable us to establish wideband and video operations for the first time. This facility will provide ATV facilities for School contacts and, additionally, continuous transponder operation. Uwe DJ8DW assured ON4WF face to face of

a donation of AGAF DATV equipment for ARISS. ESA has decided to cover the installation cost of the ARISS antennas on Columbus exceeding 100.000 euro (coaxial feedthroughs, coax cables on the hull of the module, etc.) completely, but for development and manufacturing of the antennas your donations are still needed, see <http://www.ariss-eu.org/columbus.htm>

<http://www.agaf.de>



## Deadlines

CQ-TV is published quarterly in February, May, August and November each year. The deadlines for each issue are as follows:

February	30th December
May	30th March
August	30th June
November	30th September.

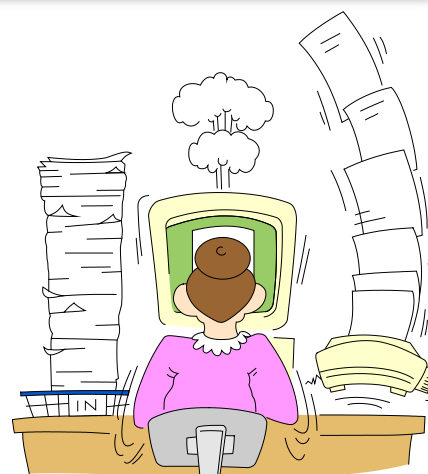
Please send your contributions in as soon as you can prior to this date.

Will all prospective contributors please be sure to read the 'Notice

to Contributors' on page 3 so that you understand the implications of submitting an article for publication.

If you have pictures that you want including in your article, then please send them, in the highest possible quality, as separate files.

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We have produced a DVD containing electronic versions of CQ-TV and the CQ-TV articles index. Also included are electronic versions of our three most recent handbooks, 'Slow Scan Television Explained', 'Amateur Television Handbook' and 'An Introduction to Amateur Television'.

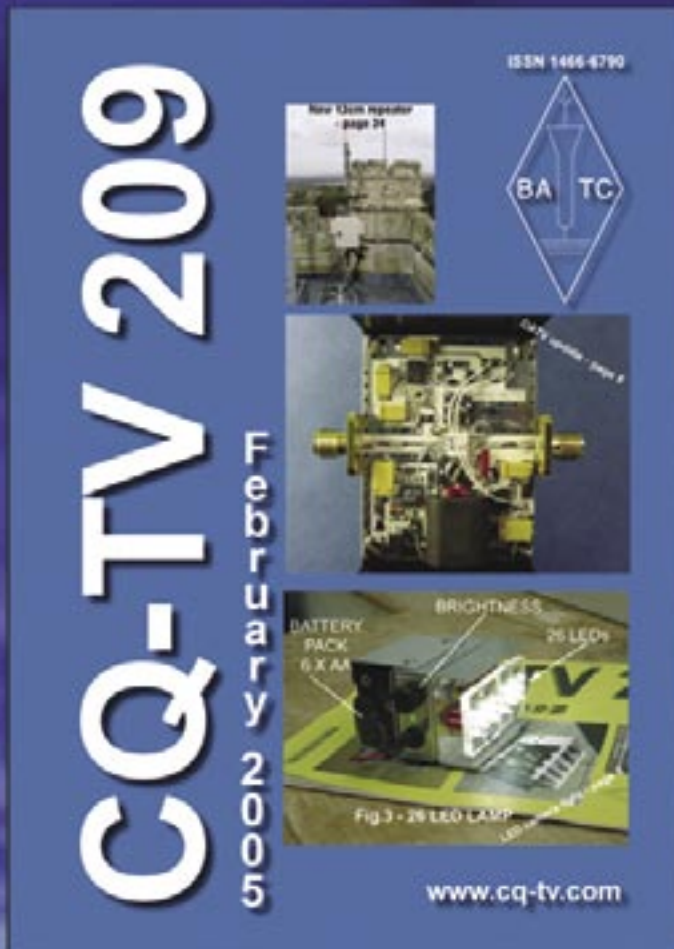
The archive is constantly being updated as more of the old paper issues are converted to electronic format. Currently issues 1 to 134 and 161 to 211 are included along with a few odd ones.

This DVD is updated 4 times a year, to include the current issue of CQ-TV.

The DVD is playable in a standard (domestic) DVD player (and on a PC with a DVD player) and the data files will 'auto-run' when the DVD is put into a PC.

The video section was prepared by Brian Kelly and contains videos from Bletchley Park 1999, one from Shuttleworth 2002 and one from 2004. The cost for this DVD is £5.00 for current members and £10.00 for non-members.

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