CQ-TV 205

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BATC

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Grant Dixon 1916 - 2003

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CQ-TV 205

Contents

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Chairman's Column

By Trevor Brown

It is with sad regret that I must announce the passing of Grant Dixon G8CGK. Grant died on 20th December 2003. Grant was the first Chairman of BATC and a personal friend. I will always remember Grant at IBC patiently explaining and demonstrating mechanical scan TV to all the delegates. Grant is someone I will sadly miss.

Never mind the quality count the pages CQ-TV 204 reached a record size with 68 pages if you examine your copy carefully you will see it needed an extra staple to assemble it.. My thanks to all the contributors, but I have already had my memo from the treasurer.. The articles may be in abundance but the letters are getting less every month either you have nothing to complain about or you have realised the folly of you ways.

To this end we have decided that the CQ-TV letters prize, "The Black Box Camera Companies electronic generator" will be awarded each issue the best contribution to CQ-TV which includes the letters. The prize for CQ-TV 203 went to Peter J Stonard for his excellent article "*TV Technology: The Image Orthicon Tube*". The CQ-TV 204 prize was awarded to Ian F Bennett for his article "*Digital Terrestrial Set top Boxes*". These decisions were not reached lightly with so many quality articles to choose from despite my glib opening comment, which is an adapted title from a TV programme, which more than shows my age.

With effect from January The RSGB HF, VHF and Microwave committees will cease and a new Spectrum Forum will handle the responsibility for band planning and spectrum allocation.

The BATC has been approached by the RSGB to sit on this new Spectrum Forum and represent ATV interests, Graham Shirville will be filling this seat, and at one of the most difficult times for ATV. These include the almost complete lack of action from the RA about new ATV repeater proposals on the 1.3, 2.3 and 10GHz bands and for digital ATV, the activity level of which is now rushing ahead on a number of bands. Many of these applications are well over a year old and the frustration levels are now running high. The new forum will need to work with the new OFCOM team, on this acute problem. I am sure we all wish Graham every success.

The CQ-TV Electronic Archive has been growing as visitors to the website will have seen. CQ-TV's 1 to 10 are now available in electronic format. It's interesting to read them and reflect that issue 1 first appeared in Oct 1949 followed by issue 2 in December 1949. The page count may have increased, the cover went colour and gloss paper was introduced. CAD replaced the original hand drawn circuits and word processing replaced the old type written script, but the format remained until February 1999 when Ian Pawson edited the first A4 format magazine.

Grant Dixon 1916 - 2003

It is with great sadness that we have to record the death, on December 20th 2003, of Grant Dixon, G8CGK.

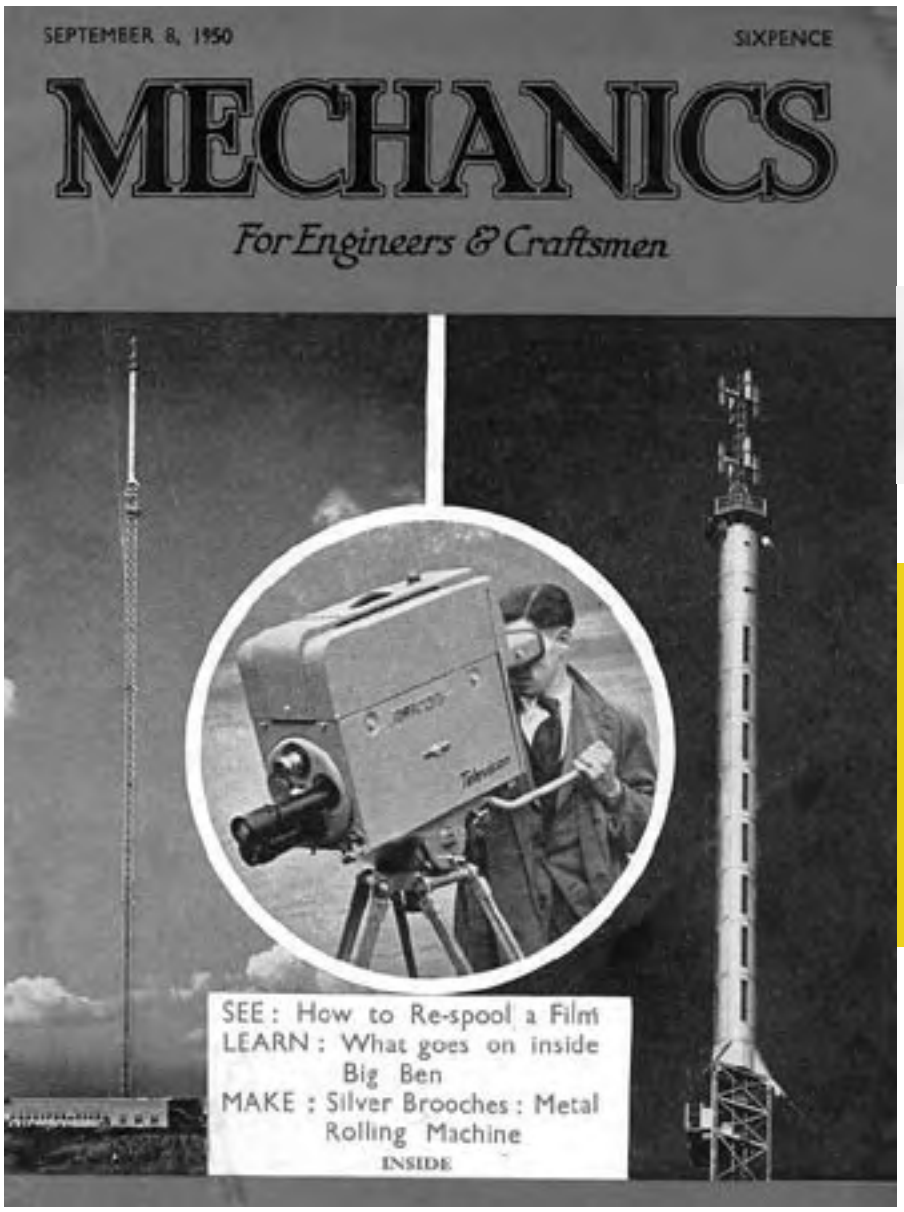
Grant's interest in radio began when he was a boy, and - aged 11 - he built his first radio receiver in 1927. Two years later the magazine 'Television' appeared - and Grant bought the first issue, and so became interested in television engineering too. Within a few years, whilst still at boarding school, he had built a television receiver, using 30 line disc. Grant did not just 'build' however, but was also an innovator. At that time, Baird was working on a colour system, using colour filters and a disc with 3 spirals of holes. Grant suggested improvements to this pioneering system, which were considered worthy of being patented. By 1934, Grant went to Cambridge University, and then followed war-time, when work on television was suspended.

After the war, in 1949, Grant moved to Ross-on-Wye in Herefordshire - where he was a schoolmaster. Television technology had changed from 30 line discs, but with war-time surplus radar equipment a set was soon built to receive the Alexandra Palace and Holme Moss transmitters. That very same year, the British Amateur Television Club was founded. Grant joined in early 1950 - when the total membership was about 25! As the Club grew, so it was found necessary to have a 'proper' committee to organise it - and in March 1952, Grant became the first Chairman. 1952 also saw Grant return to his colour television experiments, using a spinning colour filter disc in front of a cathode ray tube as a display and generating signals with 3 photomultiplier tubes fitted with matching colour filters. A colour camera followed the next year - with a synchronous spinning colour filter wheel locked to the frame sync pulses. Grant's work resulted in successful colour pictures by Christmas 1953 (as noted elsewhere in this CQ-TV). Two years later, the colour generating equipment was taken to the transmitter of Mike Barlow (BATC's founder) at Chelmsford for colour transmissions - the first ever colour transmissions by amateurs worldwide -- and reported as such in the national newspapers.

Grant was also keenly involved with slow-scan television - a mode he first heard of in 1959. He built a receiver, and was soon to be found demonstrating sstv at many shows and events. An SSTV vidicon camera was built in 1968, and a transistor monitor by 1970. He kept this interest for the rest of his life, and had many 'slow scan' friends across the world. Before the advent of readily available 'home computers', in 1979 Grant built a Triton computer, which he linked to his SSTV equipment. This enabled him to print onto paper his images (including the picture of himself above).

In September 1962, Grant retired as the Club Chairman. The new Chairman, John Ware, wrote in CQ-TV 49 of Grant "It is indeed a splendid chap who gave so much of his energies for such a very long period of years to deal with problems from Ohms Law to important policy matters of the club with such excellent results". However, Grant was not going to be an inactive member of the committee. He firstly took on the task of running the Club Library - with various books, journals, records and tapes of lectures. Then in 1968 he also took on what was then known as Club Sales. He continued to run both of these services for Club members until 1981 - when they had grown to such an extent that the Library and Club Sales were separated to be run by two members. On his retirement from the committee in 1983, Grant was - justly - made a Life Member of the BATC - and an award for the best article in CQ-TV was instituted, known as the 'Grant Dixon Award'.

Grant continued to support the Club, and television amateurs, and was to be regularly seen at Club Conventions and Rallies, and in recent times the IBC. As a schoolmaster, he was keen to encourage and share his enthusiasm -- and this applied equally in the ATV world - such as this comment from one member "Grant was a wonderful and generous amateur and teacher as I know when he helped me demonstrate Amateur Television at a Parents Open Day when I was at school in Malvern in the early 1960's. I simply wrote to him and asked if I could borrow one of his cameras - I think it was one that had been written up in CQ-TV - all 405 lines, valves and maybe a nuvistor front end? Anyhow next weekend he turned up with it." Grant was an innovator, an ambassador for amateur television, and an enthusiast who was always willing to find time - in a busy life - to 'help and encourage others'. The world of 'Amateur Television' has lost one of its pioneers.



Dicky Howett writes: A magazine cover from the days when we had engineers and craftsmen enough to teach the world how to make TV equipment and re-spool films. The aerial mast is Sutton Coldfield and the camera, a Marconi Mk One. Recently I rescued an original Marconi tv camera badge finished in blue enamel and stainless steel. Where are the craftsmen now?

THE GOLDEN AGE - Dicky Howett remembers.
The good old black and white tv days? Well, look at my picture of a toy windmill. This was my garden this summer and the picture is sourced from my 625-line EMI 203 Image Orthicon camera (yes still working). Let's face it, the windmill image is devoid of much interest, even for toy-windmill fans. Also the summer sunlight is far to much for the sensitive IO, which still makes everything look hard and gritty (even with an ND filter or two in place). So it's no wonder that not much of the golden age of tv gets repeated these days. I mean who'd watch dull old monochrome...?

IBC 2003 - A Brief Report

By Mike Cox

Unfortunately, due to my Info Channel commitments, I did not get as much time on the Exhibition floor as in previous years. Exhibitors were much happier this year, and many of those that have re-booked for IBC2004 have asked for more space. Perhaps the industry is set for a small upturn.

Attendance was up; the total of visitors and exhibitors was 36, 395, against 34, 356 for IBC2002, and the ratio of Visitors to exhibitors stand staff went up. The exhibitors used 9.7 MW of power. I did a sum a few years that calculated the power draw of the Plasma screens in the show at around 1 MW. This has probably doubled.

The usual topics were debated in the Conference, with important topics grouped together in Theme Days. These dealt with: -

- Delivery [Terrestrial, Satellite, IP networking}
- Digital Lifestyles [media in the home etc.]
- The Business of Archives
- Digital Cinema
- Digital Radio [DAB and DRM]

To support the Digital Cinema sessions, screenings were held in the RAI Auditorium using projectors from JVC [D-ILA] and Christie [Texas DLP]. There was also a screening of "Pirates of the Caribbean" one evening, as well as "Robin Hood". This was the 1933 production that had been digitally restored on a frame by frame basis, and probably looked better than it had ever done, even on a new print at the time of making. Both these were well received.

New compression systems were being promoted, chiefly MPEG-4 and Microsoft WM9.

There is renewed European interest in High Definition, with a number of facilities companies offering HD production and post-production capability. There is to be a European satellite HD channel, Euro1080 starting in 2004. It is suggested that migration

Figure 1 - View of the Halls

to MPEG-4 or WM9 would allow HD channels to have the same bit rate as current SD MPEG-2 uses, so that there would be no drop in numbers of channels that could be accommodated in a spectrum slot.

On the camera front, Sony launched the XDCAM range of cameras and editors using optical disks. Panasonic went solid state with their ING system. This uses 4 SD cards [as used in still cameras etc] each of 1 GB capacity mounted on a PCMCIA card, giving 4 GB of storage, equal to around 10 minutes recording time. One facility this offers is a continuous recording of a few seconds of video, so that it is difficult to miss some action because you did not push the record button quickly enough. Being entirely solid state, the storage should be very reliable and rugged. The Panasonic P2 camera will have 5 slots for these cards, giving

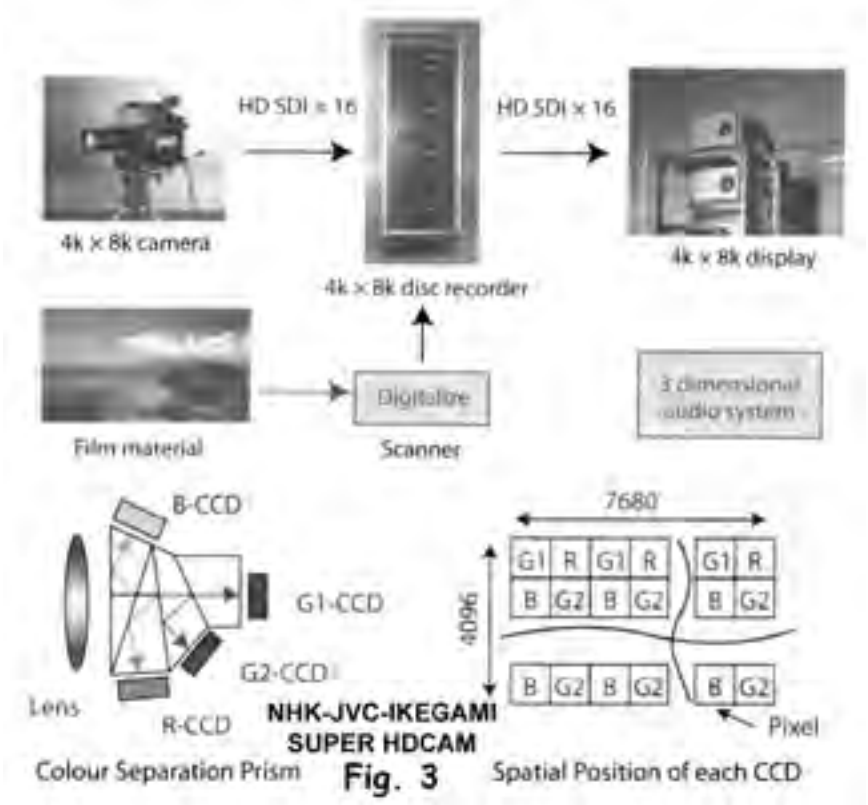


Fig. 3

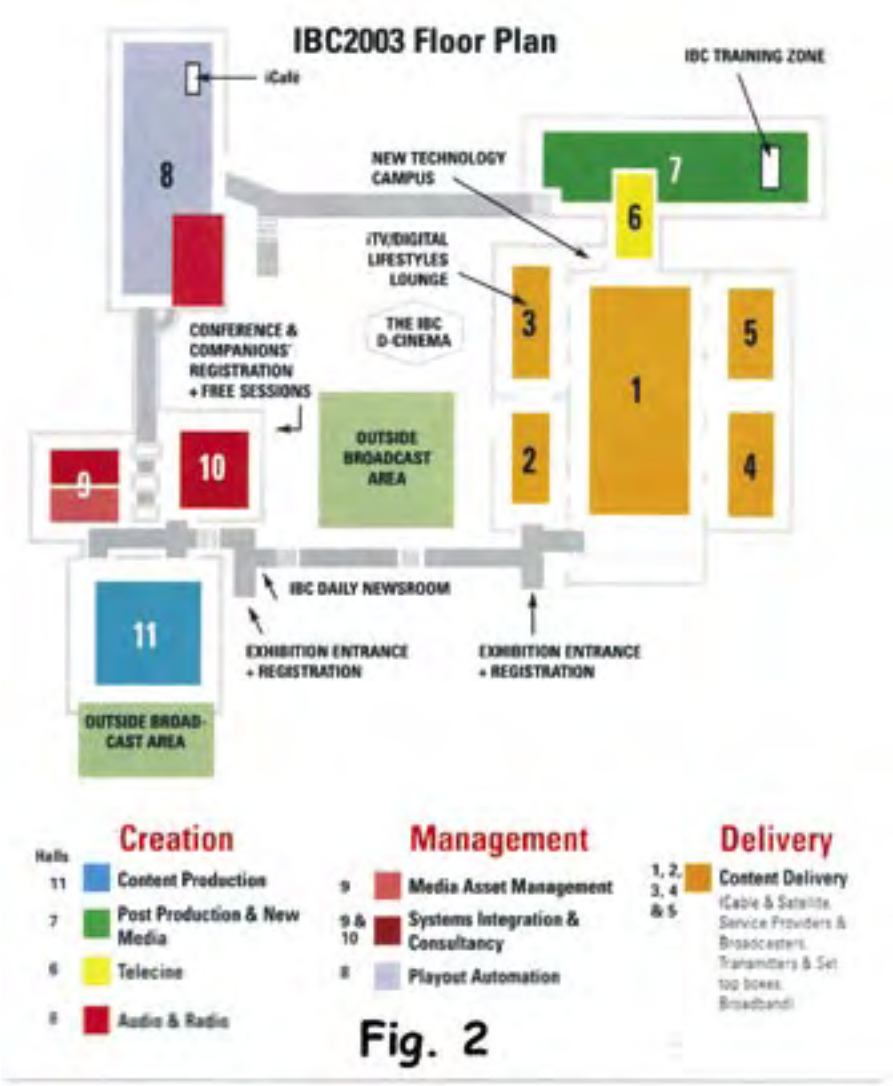


Fig. 2

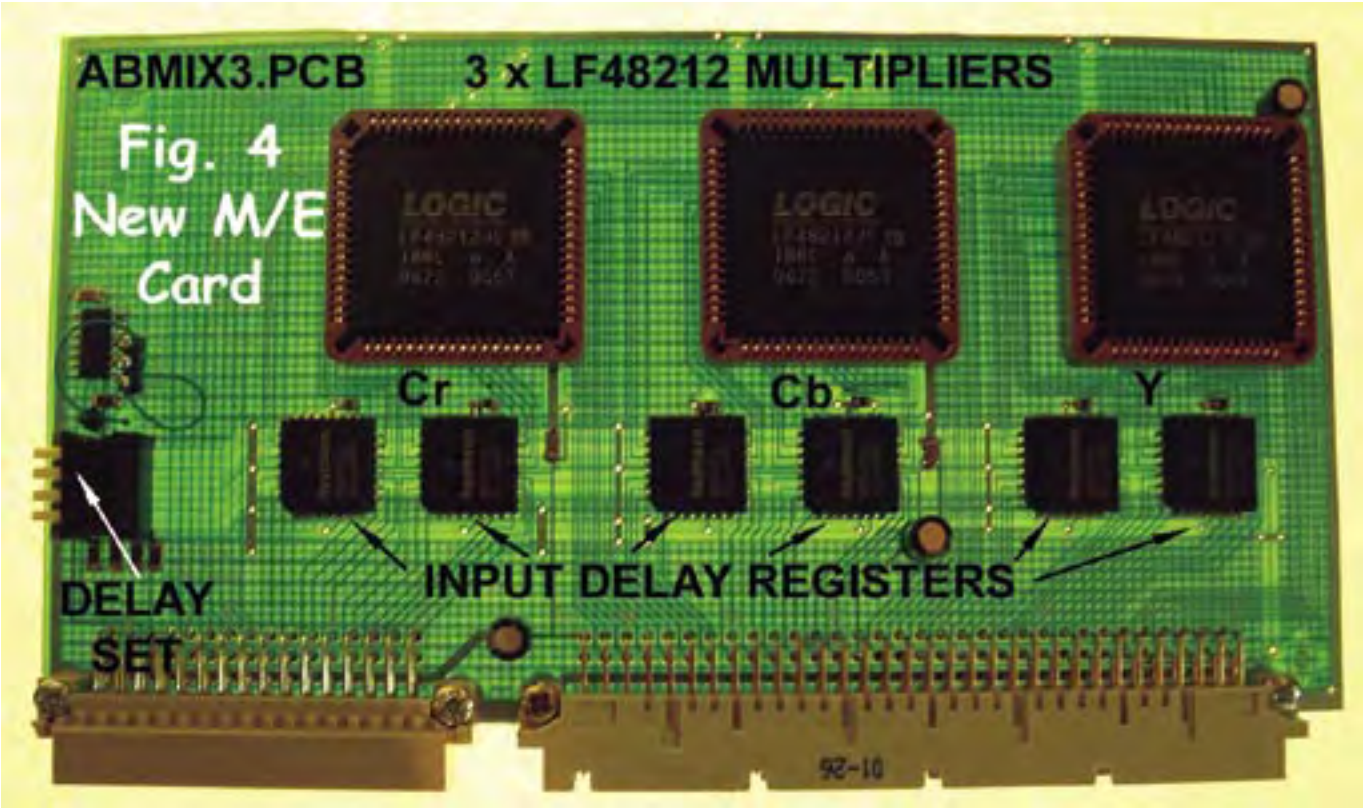
up to 90 minutes recording time for DVCPRO25, or around 45 minutes for DVCPRO50.

Ikegami were showing a similar Flash memory pack to replace the hard disk pack on its Editcam2 while JVC were also showing a hard disk pack for their cameras. Could tape be on the way out?

While talking of JVC and cameras, they were launching their JY-HD10E camcorder. This camera records on Mini-DV cassettes at 720p and 16:9, and can output this up-converted to 1080i. It can also operate in standard mode at 480/60p or 480/60i. The price is around £3500, and a PAL version is promised for next year (2004)

While still talking about cameras, a joint venture between NHK, JVC and Ikegami has produced an experimental camera with 7680 line resolution (8K x 4K). This is twice the resolution of 70mm film [IMAX]. They produced a recorder for the pictures and a projection display system.

At present, the camera weighs 76 Kg, but then so did the early colour cameras with 3 image orthicon tubes. The CCD panels (4 were used – 1 for red, 1 for blue, and 2 for green) in the camera were 2.5 inches across, so the lens has to have a large diameter, and hence weigh a bit. The link from camera to



recorder uses 18 HD SDI channels. As an HD SDI channel has a bit rate of 1.485 Gb/s, this gives some idea of the data rate involved in the project. Watch this space!

Other topics discussed included Digital Radio Mondiale (DRM) which involves applying digital coding and transmission techniques to Long, Medium and Short Wave bands, or from 100 KHz to 30 MHz. This is likely to be of interest to radio amateurs, at least on an experimental basis.

A number of transmitters are operating, and details of how to adapt an AM receiver to decode DRM signals in software can be found on http://www.drmrx.org.

There is an unfortunate downside to this. A number of European power companies are considering distributing broadband data for internet/web using their high voltage power lines. Radiation from these lines in the 100 KHz to 30 MHz spectrum will be considerable, and there is concern about the effect this will have on broadcasting and other communication in this band, AM, DRM or whatever. This must completely nullify the effect of CE marking of equipment for electromagnetic compatibility. As a taster, try listening to Radio 4 on 198 KHz in your car as you drive under or near high voltage lines. That noise is just local signalling and telemetry!

Final Thoughts on SDI Mixer

In CQ-TV204, I mentioned the problems with key timing in the SDI mixer. Since IBC, a new M/E card has been made with 6 programmable shift registers type TMC2111AR3C in the inputs to the multipliers. A simple DIL switch selects the delay. When the card was plugged in, it worked, and the key timing is now correct. Both Luminance (Y) and simple Chroma Keying (Cb only) now work reasonably well.]

At IBC, the mixer performed well for 7 days with power on 24 hours a day. One thing we learned was that the switching method used [SDI to “601” de-serialising, followed by switching the parallel stream then re-serialising.) gets rid of embedded audio, should one of the sources happen to have it. This was required for a separate recording job, and the mixer AUX bus was being used as a patch panel. We had to use the proper patch panel.

If any of you want any further and better particulars of the mixer, please get in touch via e- or snail mail. It will make a change from those who want to share a mythical African fortune with me, or who have concerns about my manhood!

Letters and Emails

Home-made FM-TV Baseband Exciter

By Thorsten, DG7RO

Translated by Klaus Kramer, DL4KCK

In order to transmit audio together with the video signal we have to combine them. In our baseband unit the sound is frequency modulated onto an 5.5 or 6.5 rf carrier MHz, that is mixed with pre-emphasized video and output to the TX modulator stage.

Functions

In the baseband unit the video signal is amplified and then the higher frequencies are raised in the "pre-emphasis" network (CCIR/PAL standard) 75 ohm/18 ohm and 9.5 uH, 300 ohm and 2 nF. This is done in order to expand the overall signal to noise ratio (the receiver has an equivalent stage called "de-emphasis" that reduces the higher frequencies together with the induced channel noise).

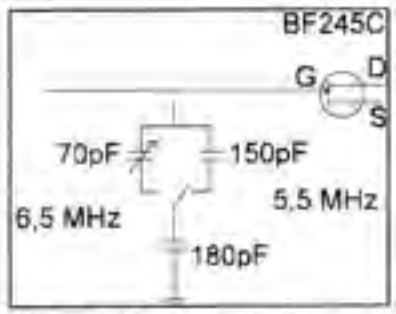


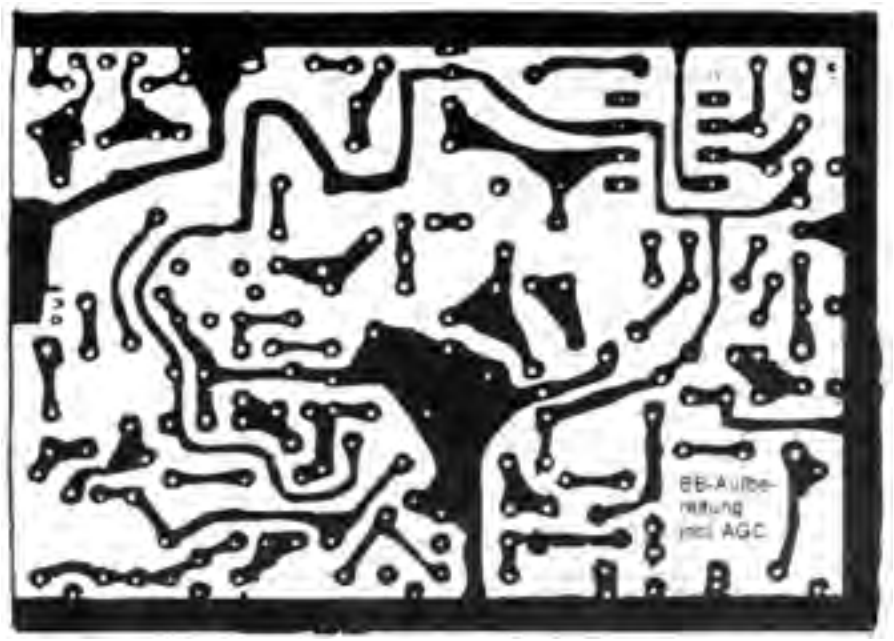
Fig 1 - Switching for sound subcarrier

The sound is levelled by a simple AGC (BF245A) and then frequency modulated onto the audio subcarrier (BF 245C/BF199) that is filtered by the following BV5056 and 120 pF tuned circuit.

Construction

There are different sound subcarrier frequencies in use in some regions, and this unit works well with 5.5 and 6.5 MHz. In order to switch between both frequencies, we have to exchange the 68 pF capacitor at the gate of BF245C with a combination of 180 pF and (switchable) 150 pF or a 70 pF trimmer. The leads have to be short, so best it is to solder it all to a miniature relay laid onto the AA119 diodes.

Stuffing of the board should be performed step by step - first the video part, then the audio. In between it is advisable to apply the supply voltage and measure the overall current (max. 100 mA) in order to isolate faulty parts.



Level trimmers for video and audio subcarrier (each 100 ohm each) are on-board; potentiometers for audio gain (1 M ohm) and audio deviation (1 k ohm) are mounted on the front panel. A lead-through for audio signals and supply voltage should be a feed-through capacitor, and for video and output use a teflon feed-through. A small heat-sink should be applied to the 7808 voltage regulator if possible.

Alignment

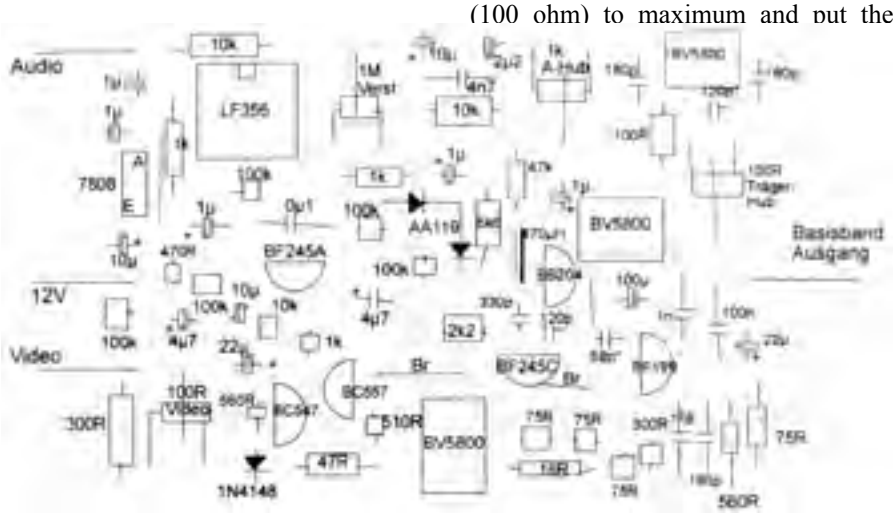
You need an oscilloscope and a frequency counter with at least 8 MHz capability; also helpful is a working receiver baseband unit and a video monitor. At first, video level is set near maximum and the coil cores to a middle position, and with a 12 V supply the current should read less than 100 mA. After placing a video signal to the input you should see a disturbed video on the monitor at the output.

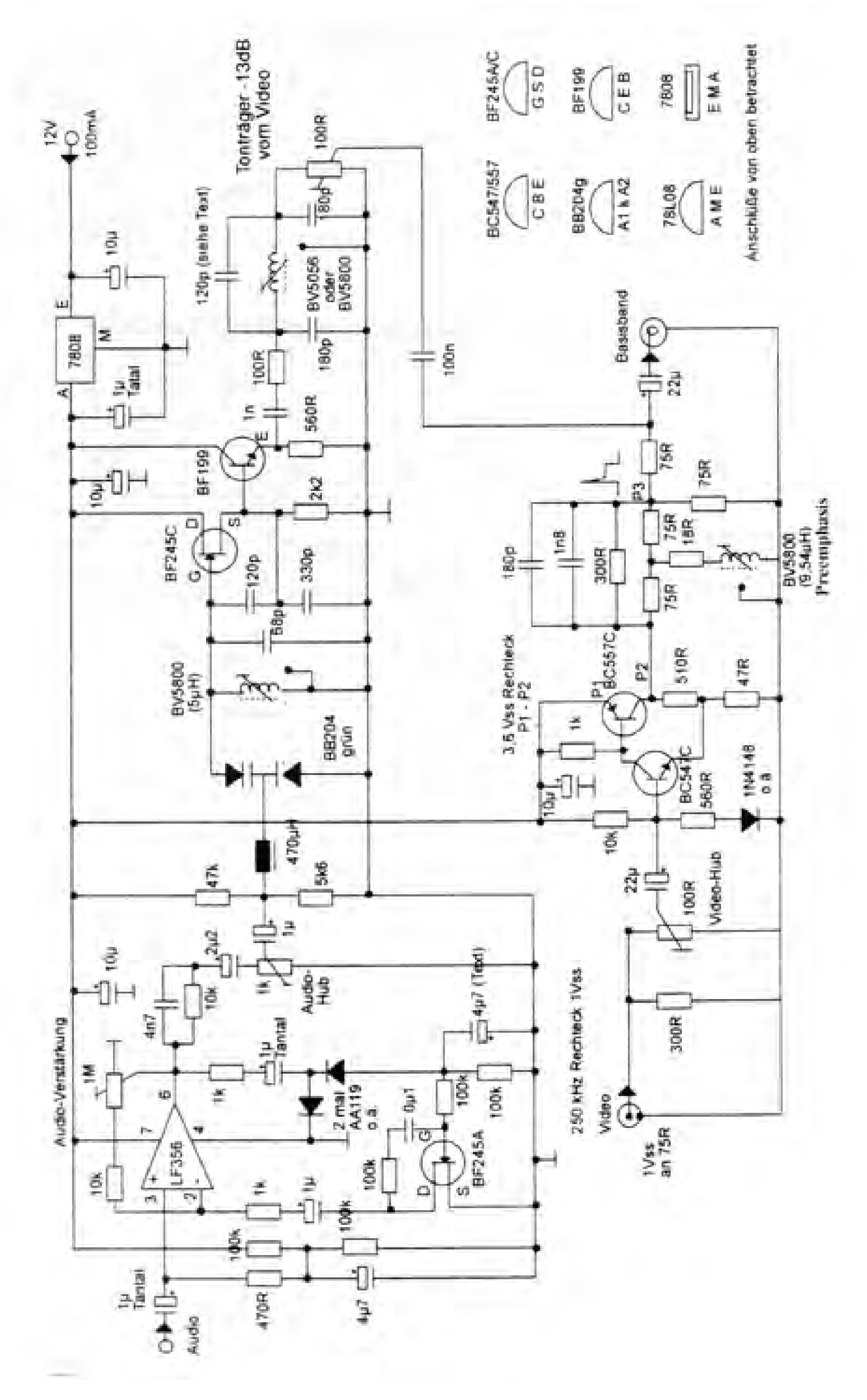
Video alignment

With the 100 ohm trimmer, the level is set so that distortions the edges between bright and dark parts of the picture are minimized - a better method is to measure 1 volt peak-peak at the output with an oscilloscope (without a load it should read 2 V pp). This way different baseband units are interchangeable, and video cameras (with automatic gain control) also have 1 V pp output standard at 75 ohm load. If the output signal looks like the input never touch the video level control again!

Audio alignment

Connect the baseband output to a working receiver baseband unit input and the audio input to a sound source (e.g. Walkman). Do not apply a video signal, since it would disturb the audio subcarrier`s waveform on the oscilloscope. Set the subcarrier level (100 ohm) to maximum and put the





12V
100mA
7808
Tonträger -13dB
vom Video
120p (siehe Text)
BV5056
oder
BV5800
BF199
BF245C
BV5800
(5µH)
BB204
grün
470µH
Audio-Verstärkung
LF356
Audio-Hub
2 mal
AA119
o.a.
BF245A
4µ7 (Tant)
1µ
Tantal
Audio
250 kHz Rechteck 1Vss
Video
1Vss
an 75R
Video-Hub
3,6 Vss Rechteck
P1 - P2
BC557C
BC547C
1N4148
o.a.
Basisband
BV5800
(9,54µH)
Preemphasis
BC547/557
C B E
BF245A/C
G S D
BB204g
A1 k A2
BF199
C E B
78L08
A M E
7808
E M A
Anschlüße von oben betrachtet

frequency counter probe to the 100 ohm resistor following the BF199 emitter. Turning the core of BV5800 (in parallel to the varicap diode BB204), you can adjust the subcarrier frequency to 5.5 or 6.5 MHz. Now the audio signal should be audible at the output of a compatible receiver.

If the subcarrier frequency is to be switchable you have to adjust the BV5800 to the lower one first (with 150 pF connected), and after switching to the 70pF trimmer capacitor, you can adjust this device to the 6.5 MHz subcarrier frequency. Now turn the subcarrier output filter core (BV5056) fully out and then slowly in until the higher frequency level begins to weaken on the connected oscilloscope at the output. You may have to change the 120 pF in parallel to the BV5056 to a smaller value in order to get enough subcarrier level.

Lastly, the video to subcarrier ratio is adjusted by setting the 100 ohm trimmer to the correct value (AM-ATV needs -13 dBc, FM-ATV around -18 dBc). Watch the video monitor at the output with a test pattern applied to the video input of the baseband unit, and reduce the audio deviation (1 k ohm trimmer) until no disturbance can be seen (sound in picture)

The Mk2 Low-Cost Testcard Generator

By Brian Kelly GW6BWX

The original testcard generator article appeared in CQ-TV issue 201 and feedback from constructors all over the world has been very positive about it. It was based on work done nearly 20 years ago by Colin Edwards but compacted into a single chip along with a digital PAL encoder. By carefully redesigning parts of the logic, it was possible to free some space that could be used for other features. The new design, imaginatively called 'mk2', is presented here. It is almost completely backward compatible with existing testcard EPROMS, so very few existing testcards will require editing. In the new design it is not only possible to use block colour graphics as before, but also all user defined graphics and characters can be in colour too. As a bonus, the colour burst is now 'cleaner', although it worked adequately before.

Hardware changes:

There are two changes to the hardware; one is the PLD itself but bear in mind the M4A5 can be erased and reprogrammed so you do not need to buy a new one. Just wipe it and put the new JEDEC codes in as replacements. The second change is just as easy; simply add one resistor, value 1k2 between the pin called TC_CLK (pin 14) and the junction of C5 and the seven chroma summing resistors (R8-R14). The resistor can be fitted on the copper side of the PCB. The TC_CLK function is no longer available, but I don't think anyone ever used it anyway.

Testcard design changes:

As mentioned earlier, very few existing testcards will need any modification. Only those that used any of the first 16 characters in the font table will see a difference. The visible effect is that most of these characters will now appear as solid blocks. There has always been caution in the documentation of the 'CROPEDIT' test card editor about using these characters, as they are also used to shape the sync pulses. If any were used, their patterns can be copied to any of the remaining font positions and they can be used from there instead.

The major change is in the way the 'control' character works. In all previous designs, including the original by Colin Edwards and those marketed by Cirkit, the Mendip Group and clones of these, the control character had to be inserted to change from graphics mode (with optional colour) to character mode (in white only). In the 'mk2' it does exactly the same, but leaving it out allows the current colour to run into any following characters up to the end of each line. It's a little difficult to explain in words, so take a look at the cover colour photographs; one is taken 'off-air' (figure 1, above) and the other is a screen snapshot of the 'Cropedit. com' testcard editing program (figure 2, left). The control character itself is still blanked (it appears grey in the editor) and colours picked from the menu still appear as solid blocks. Unfortunately, it is necessary to have at least one colour block to set the colour of any following characters, doing it any other way would lose backward compatibility. All lines start in white as before.

The new JEDEC file and cropedit.com will be available on the www.cq-tv.com web site and on my own site, www.atv-projects.com.

These pictures are reproduced in colour on the inside rear cover. - ED.

Cheap and Simple Test Card Generator

By Giles Read G1MFG

Many digital cameras have a video out function, which produces passable quality images. Many also have USB interfaces which let you download images to your PC. But what about uploading images to the camera? Most of the cameras "look" like a simple (if relatively small) disk drive to the PC. I tried some experiments with a couple of cameras and found that you can often upload images back to the camera, and then play them out through the video socket. This means that you can prepare a number of test cards; contest number sets and so on and uploads them to the camera for playout as required. There are some 'rules of the game' which usually have to be observed, though.

* Make sure your images are prepared in the same format as the camera's images, usually JPG.

* Make sure that your test card image(s) are named like the files which the camera generates. In the case of my Sony cameras, that means giving them file names like MVC-0015.jpg or DSC00588.jpg.

* Make the image size the same as a standard image taken by the camera, for instance if the camera outputs at 640 x 480 then make sure your images are 640 x 480. Most image editing packages these days are capable of scaling images if need be.

When you've made your images and uploaded them to the camera, it's a simple matter to switch the camera's video output into your transmitter and hey presto – a selection of high-quality stills on demand.

Severnside Television Group

Our 23cms antennas are specifically designed for ATV use although they can be used for other modes as well. Their wideband characteristics mean you only need one antenna to cover repeater input and output channels. Our famous wideband Yagis come fully assembled in two versions:

38-ELEMENT HIGH GAIN: 14db gain, 1.8m long, £28.50 plus P&P

18-ELEMENT STANDARD: 10db gain, 0.9m long, £15.00 plus P&P

Don't forget our

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TDC High Resolution Sensors

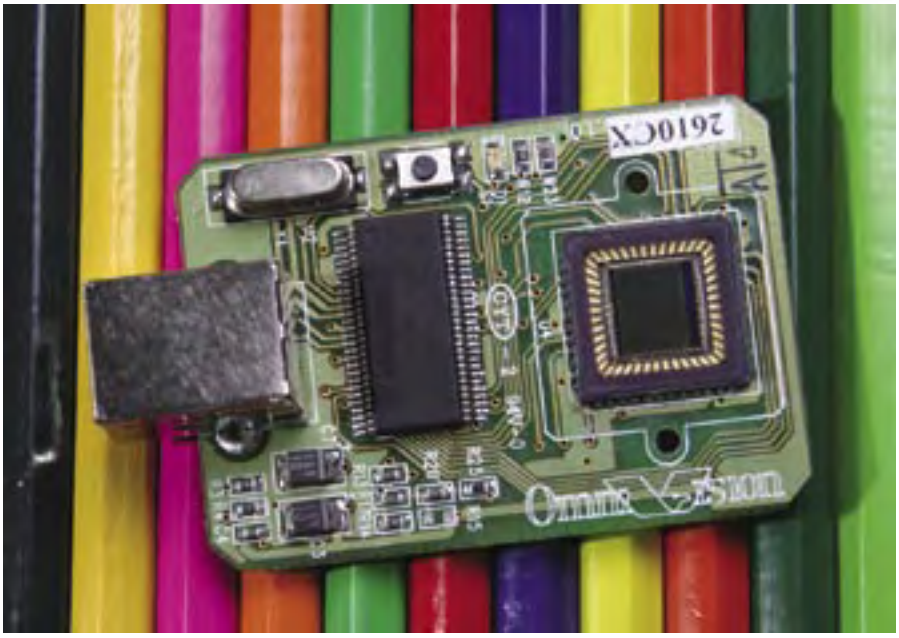
TDC (Telecom Design Communications) Ltd., specialist electronic technical distributor, announces the OV2610 CameraChip ? from OmniVision, a high performance CMOS image sensor highly suitable for digital still image and video/still camera products.

The OV2610 incorporates a 1600 x 1200 (UXGA) image array and on-chip 10-bit A/D converter capable of operating at up to 10 frames per second (fps) with full resolution and 40 fps at SVGA (800 x600) resolution. Proprietary sensor technology utilises advanced algorithms to cancel Fixed Pattern Noise (FPN) and provides superior black level calibration for optimal colour performance.

The device is easy to use, with not just the image sensor on-chip, but the complete image processing system and a fast data interface allowing direct access to the captured image information.

The control registers also allow for flexible control of timing, polarity and CameraChip operation, which in turn allows the engineer a great deal of freedom in product design.

Other features of the OV2610 include video or snapshot operation, programmable image windowing, variable frame rate control in addition to internal/external frame synchronisation.



Managing Director of TDC, Jerry Sandys comments, "The OV2610 brings high resolution sensors to the OEM market at a very low price with the best performance in terms of integration and low-light operation."

Notes

Editors Note: Telecom Design Communications is a technical component distributor specialising in Wireless & GPS components, Modems & Multimedia and Design Services. TDC engineers have been involved in the communications business since 1984, and with GPS since its commercial introduction in 1990. TDC's customers put as much value on the technical support the company provides, as the high quality products it distributes.

For further information contact:

Carlie Cohen/Simon Taylor
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Basingstoke
Hants RG24 8FN

Tel: 01256 332800, Fax: 01256 332810,
Email: marketing@tdc.co.uk

Issue Date: 4th November 2003

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NBTV Software

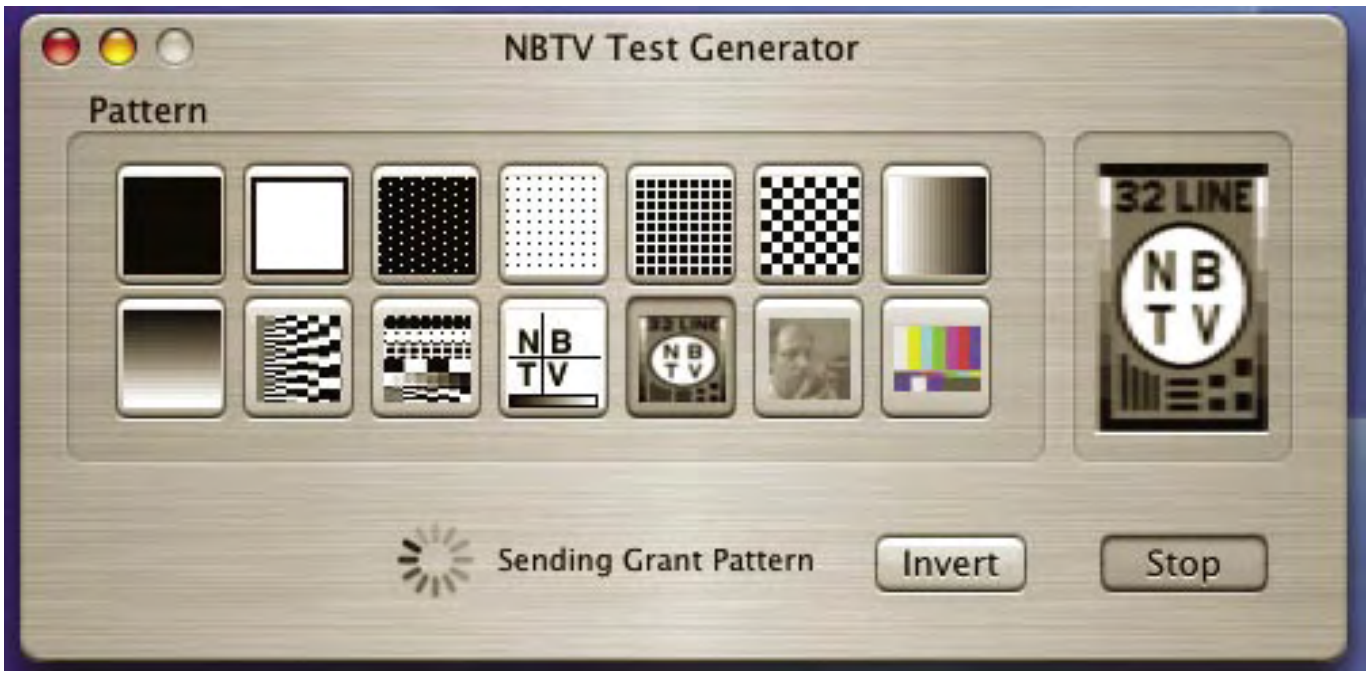
By Sergei Ludanov KD6CJI

For quite a while I had an interest in Narrow Band Television, but unfortunately being not very skilled in mechanics, I could not get completely involved in this part of the amateur television hobby. At the same time I always had an interest in learning how to program Macintosh computers. Why Macintosh, when "the entire world" uses Windows PCs? There are a few reasons, in addition to the fact that all computers I own are Macs: Windows programming is much more cumbersome than Mac OS X and will take more effort to accomplish the same goal; also I see a big future in the Mac platform for Amateur Radio and Amateur Television. Just recently a new organization called "International Association of Macintosh Amateur Radio Software Developers" was announced (http://www.dogparksoftware.com/IAMARSD/IAMARSD.html), the sole goal of which is to promote Macintosh in the amateur radio world.

So, naturally, when I started to learn a rich object oriented programming environment (called Cocoa) and Objective C language, it became obvious that writing programs useful for the NBTV hobby was a must.

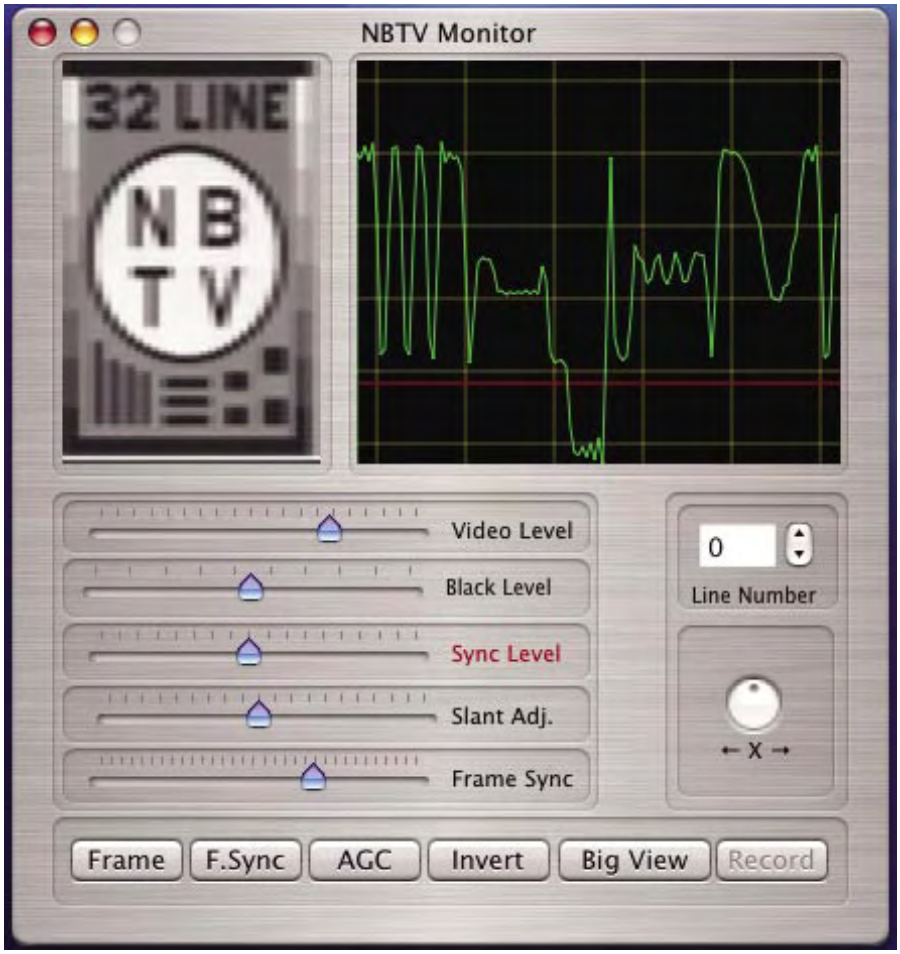
The first program that appeared from this effort was DiskDesigner. It is a relatively simple CAD program that allows design of a Nipkow Disk for mechanical TV, based on the user's specifications. Most of the input variables are either selectable from pop-up buttons or can be typed in directly. Disk type, number of scan lines, scan direction, aspect ratio and spacing between lines can be changed at will. The output parameters are also selectable. You decide what you want to see on the final image. In addition to the disk image itself, the program also creates the image of the mask. The final design can be saved in PDF, TIFF or DISK format (the later is really an XML file), but only DISK format can be loaded into the program - the others are intended for export purposes to use in other applications. Disk and Mask can also be printed directly from DiskDesigner. If the image is larger than the paper size that your printer can handle (which will happen in the majority of cases), the program will break it into several pages that you'll have to glue together after printing. Another feature that I thought might be useful was the ability to produce an image for printing onto transparency, but it turned out, that normal transparency film would not reproduce a uniform black colour. Nevertheless, this feature is there in case you want to buy an expensive backlight film to print on.

After I released DiskDesigner, I decided that if I am going to build an NBTV monitor, I would need some source of signals to test it. That led to the writing of NBTV Generator. This program will generate an NBTVA compliant signal, using the computer audio port. There are several standard predefined test patterns, selectable by the press of a button, and also the ability to load a JPEG image for transmission. At this stage, the JPEG image has to be pre-processed in some image editing software. It has to be scaled to 64 x 100 pixels using proportional scaling, and then scaled again to 32 x 100 pixels, but this time with the proportional scaling turned off. As a result you will see a narrow distorted image in the imaging program, but it will show up in the NBTV generator preview view and



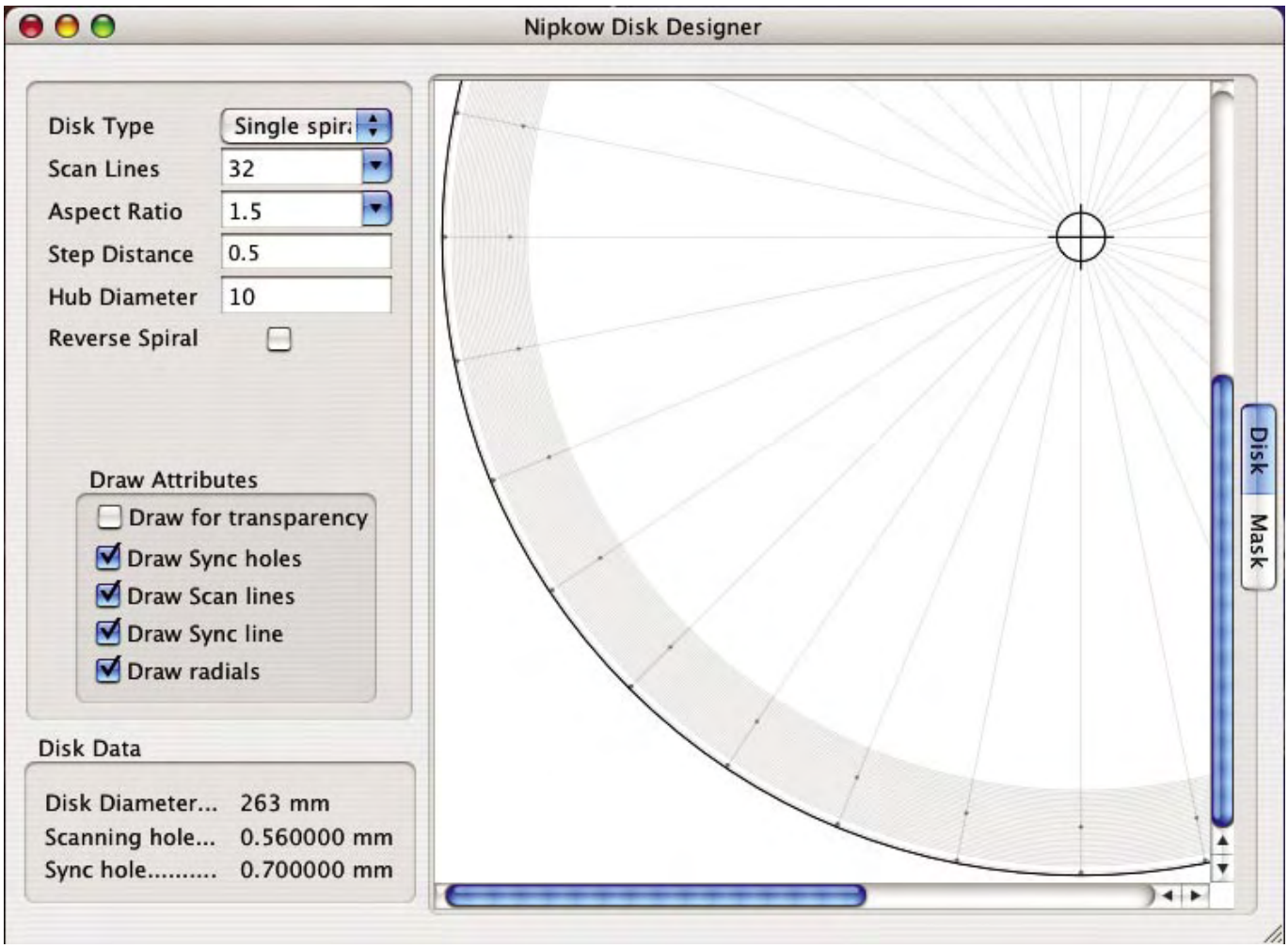
will be sent at the correct aspect ratio. The JPEG image can be in colour or black and white, but of course it will be transmitted in black and white.

After playing a little bit with the NBTV generator, I started to think that it would be more fun to generate moving pictures than still ones, and so NBTV Live was born. This program will read QuickTime movie files (which have to be resized to 160 x 120 pixels) and send them to the sound port as NBTV video. Unfortunately, normally recorded video in QuickTime has an aspect ratio of 4:3 instead of NBTV's 2:3, which means that not all of the movie image can be transmitted, but just a part of it. For this there is a "pan" control in the program, which allows you to select the portion of the screen that will be converted to audio. The movie file can also be in colour or black and white, but will always be converted to black and white for transmission. The program will play the movie in a loop until you press the stop button.



Now, playing QuickTime files is fun, but converting real time video to NBTV could be even more so. Thus the new project NBTV Camera was born. This program will work with any QuickTime compatible WebCam capable of producing at least 15 frames per second video, which probably would rule out most cheap USB cameras. I used Apple's iSight (auto focus FireWire WebCam, with built in microphone). This camera produces 640 x 480 pixels video at 30 frames per second, which is more than adequate for NBTV purposes. The video is scaled down by the program to 160 x 120, and then using "pan" control you can select which part of it is going to be converted to NBTV video. After the Start button is pressed, transmitted video will appear in the NBTV view (in black and white).

Now I had everything I ever wanted to send NBTV video and was ready to start building my first mechanical television monitor, but first I thought that it might be useful to have a computer program that could use the audio port to read NBTV video and display it on the screen. That would let me test my own programs, view NBTVA CD, and someone could use it to align a mechanical camera. It did not require any more justification to start working on NBTV Monitor; especially it was a good excuse to delay building



a real monitor! The NBTV monitor was a little bit more tricky to write than any transmit programs and was released last. NBTV monitor has many more controls than any transmit program, to adjust various parameters of the incoming video. Here I will briefly describe controls, but you'll have to play a bit with them to get used to them and be able to achieve good results. There are 5 sliders "Video Level", "Black Level", "Sync Level", "Slant Adj." and "Frame Sync" and 5 active buttons: "Frame", "F.Sync", "AGC", "Invert", "Big View". "Video Level" is to adjust the level of the incoming signal. The default setting should work with 1V peak-to-peak audio on most computers. "Black Level" allows variation of the contrast of the displayed video. "Sync Level" is to adjust the sync pulse amplitude to ensure a solid picture display. "Slant Adj." is there to compensate for variations in pixel rate of the incoming video signal. "Frame Sync" is to correctly position the image in the display view. If NBTV video has a missing last sync pulse, in most cases the frame will lock automatically in the right position. The "Frame" button can be used to try to lock the frame when a sync pulse in the correct position is missing. It may require several attempts and is not always successful, but is the preferred method for motion video. For stills the "Frame Sync" slider is good enough. The "F.Sync" button is used to select if video has a missing pulse or not - press if it does. "AGC" is to turn on or off automatic gain control. It works satisfactorily on most video signals, with the exception of "white field" or "black field", both of which will be displayed as grey when "AGC" is activated. "Invert" is to accommodate an inverted video signal. "Big View" will open a separate video display window, with the image scaled to 384 x 600 pixels. It may or may not be useful, but I added it because it was easy to do so. To provide some help in adjusting the controls, I added a Line Scope view which has its own controls. You can select the line of video to be displayed on the scope and use the "X position" knob to adjust the position of the line on the scope view. This made it easier to use the monitor adjustments. For example, if the pixel rate of the incoming video does not match the clock rate of the audio card, the video on the scope view will be moving and the "Slant Adj." slider can be used to stop it. When it is still, the pixel rates are perfectly matched. The red line on the scope view shows the position of Sync Level.

I think that this package of software is quite a comprehensive set of the programs for NBTV enthusiasts. All the programs are freeware and available for download at http://homepage.mac.com/kd6cji. This web page also contains screen shots, programs descriptions and some other information. I intend to continue development of NBTV software and am open to ideas, suggestions and feedback in general. I can be contacted by e-mail kd6cji@mac.com or snail mail to Sergei Ludanov, 9116 Greco Court, Sacramento CA 95829, USA

NBTV: http://www.nbtv.org

Turning Back the Pages

By Peter Delaney

A dip into the archives of CQ-TV, looking at the issue of 50 years ago.

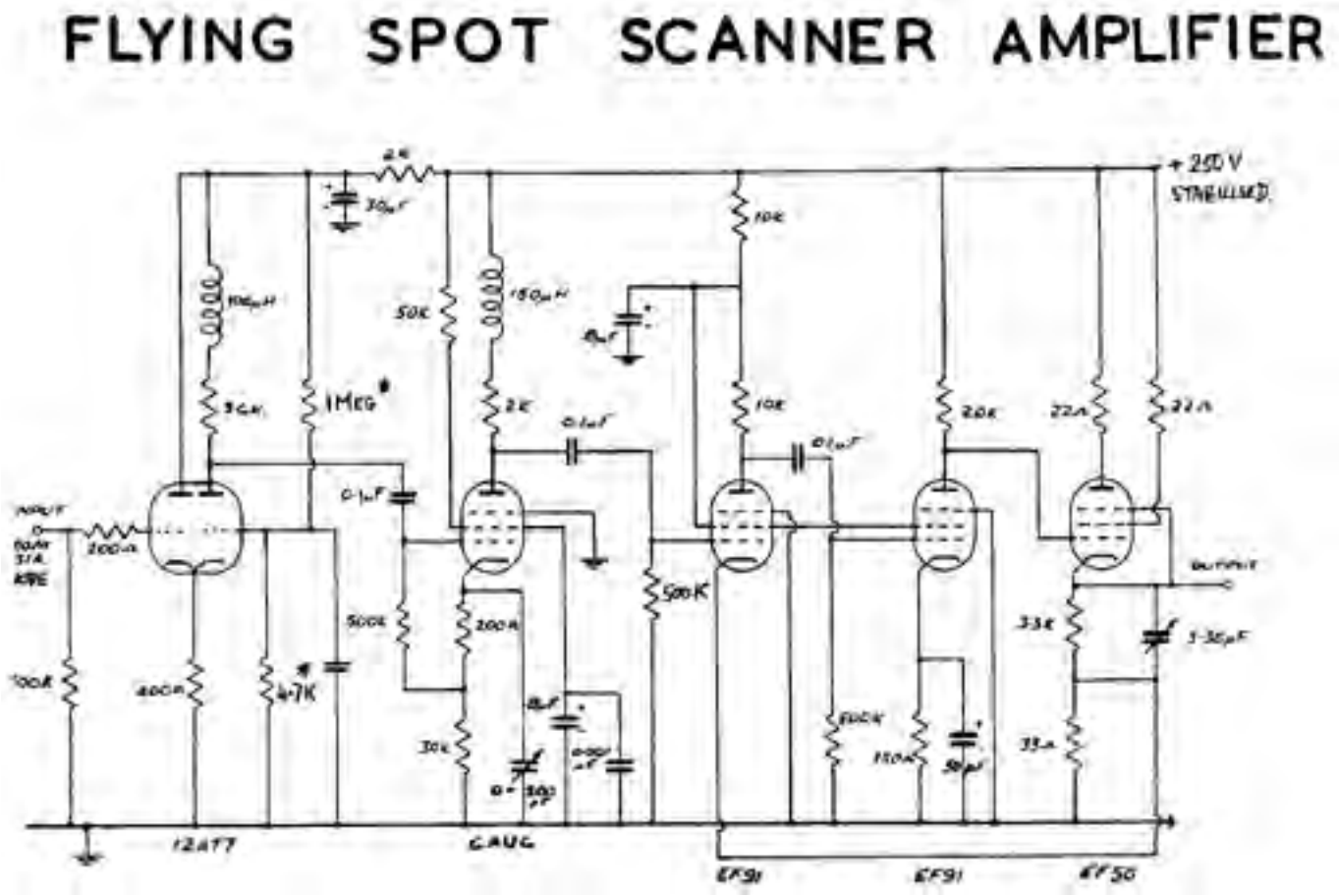
CQ-TV 19 - January 1954

The magazine reported that "Order forms for Monoscopes and Staticons can be obtained from G3CVO. These are now £7-10-0 and £25 respectively. The monoscopes are mainly test card C (others by request and with possible delay) and are perfect except that they must be magnetically focussed and deflected, the electrostatic focussing being unusable. Standard deflection and focussing yokes can be used, and here are further details: Heater 6.3V 0.3A, Anode 1kV (c 100µA) Target 5-25 V rel to anode, Grid 15-45 V rel to cathode. Signal current approx 5 µA, positive output, output capacity c 10 mmF. ... oa length c 16", max diameter 5⅜" neck diam 35mm. THESE TUBES ARE UNLIKELY TO BE AVAILABLE TO MEMBERS NOT RESIDENT IN THE BRITISH ISLES"

A monoscope tube. The picture was 'printed' onto the metal taget plate, visible inside the 'flat' end of the tube

(*For 'newer members' - a monoscope was a means to generate a 'still picture' (usually a testcard) and looked like a round cathode ray tube, whilst a staticon was a camera tube of the vidicon type -- and BATC were still supplying them at £25 each over 35 years later, despite inflation).*

There was an article on 'Multivibrators - using two triode valves, or triode - pentode pairs. "Multivibrators" - it began - "are very often used in TV pulsing equipment and a knowledge of their various designs and performances is of considerable value." Another article included details of a 'flying spot scanner amplifier'. The input came from a 931A photomultiplier tube, and "the



overall response using a 5FP7 scanner tube is 3.5 Mc/s with very nice picture quality". .... "Members are reminded that it is in their interest to build scanners to take 2" x 2" slides. A phase reversing stage can be added to permit the use of negative transparencies". ... "This circuit would presumably also be ideal for a monoscope amplifier, provided the signal at the anode of the 12AT7 is sufficient to over-ride noise in the amplifier".

(Again, for newer members, a flying spot scanner used a crt to scan a still slide, the light passing through the slide being detected by the photomultiplier. In the early days of amateur television, this was the only way for most people to generate a picture)

And then, headed 'STOP PRESS' was:-

"As we go to press, the exciting news arrives that Grant Dixon, of Ross on Wye, has at last succeeded in transmitting closed circuit TV pictures in COLOUR. On Christmas Day, he was able to resolve a test chart of coloured shapes satisfactorily. Although pictures are not yet sufficiently brilliant, and although one or two snags remain to be ironed out, Grant feels that he has now broken the back of the work involved, and that from now on things should be much easier. All units appear to be working satisfactorily, although some hum pickup is spoiling colour registration at times. Those members who were at the RSGB Show will have seen photographs of the equipment, which, unfortunately, Grant is not allowed to demonstrate in action. Since Grant has done all the work on his own, with very few tools, very little space, and no works of reference to hand, his success is all the more remarkable, and deserves heartiest congratulations."

Footnote: This article was prepared before we heard the news of Grant Dixon's death. We still include this as a tribute to him.

NBTV Gamma Correction Ideas

By Steve Anderson

Mention has been made in recent times of incorporating gamma correction into the NBTV signal chain. This is done in all professional cameras as well as domestic camcorders. See the NBTV Handbook or visit http://www.nbtv.wyenet.co.uk/gamma.html where the concept of gamma and the need for its application is explained.

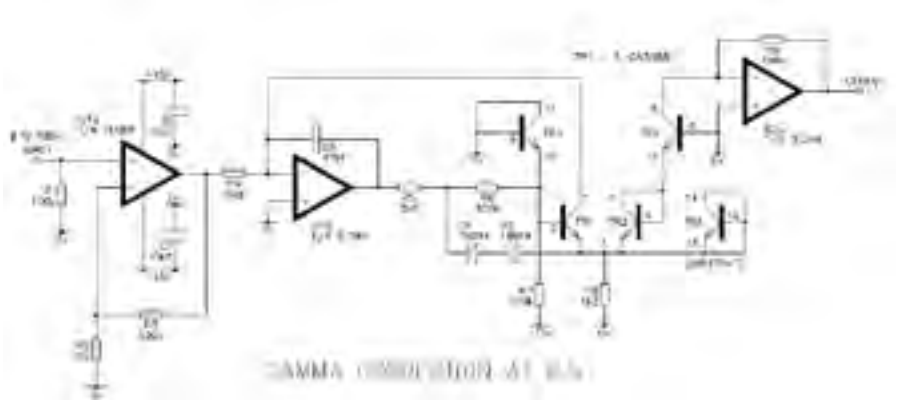
Two circuits are presented here, one with a gamma of 0.5 (circuit 1) providing a square root function, the other (circuit 2) with a gamma of 2.0 giving a squaring result.

The 0.5 circuit would normally be incorporated into a camera/scanner where the output voltage from the photosensor, whatever it is, and presumably after some amplification, is in direct proportion to the incident light falling upon it. The 2.0 circuit would be used in a display device whose light intensity is in proportion to the applied current or voltage; LED's for example. A CRT has an inherent gamma of 2.0 so this (2.0) correction is not needed if the display is any form of CRT, a 'scope tube, TV or computer CRT monitor.

These circuits are to be incorporated into a general purpose NBTV signal-processor/decoder currently under construction.

The circuits

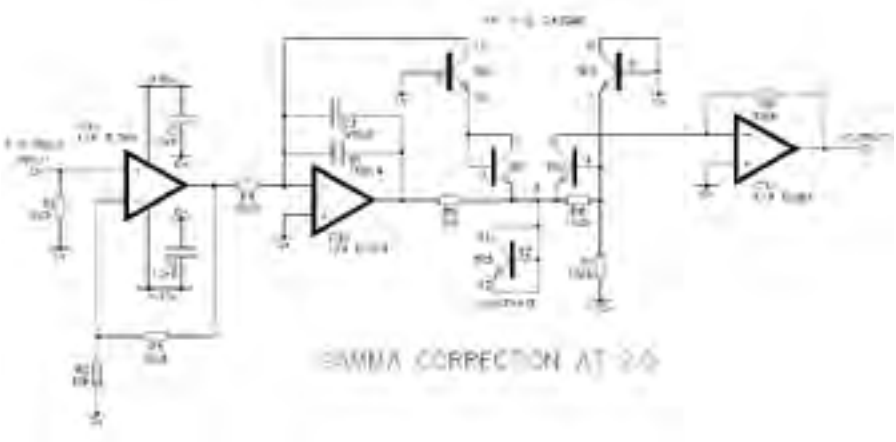
The concept of these two circuits revolves around the relationship between a transistor's base-emitter voltage and its collector current, which is a logarithmic function (assuming it's not cut-off or saturated). The detailed operation of the functions of these circuits is explained in the National Semiconductors Application Note, An222. See Acknowledgements at the end.



The LM394 put forward in An222 is a very well matched pair of NPN low-noise transistors in an 8-pin DIP package. Sadly it is not easy to find, perhaps it's no longer manufactured. If you do come across some, don't be surprised that it's a little bit expensive; I guess the production yield couldn't have been that good. Shop around.

The Analogue Devices SSM2210 (from RS) dual transistor could be a replacement, but so far I have not been able to get any data on the device except what's in the RS catalogue, even from the AD website.

Here the LM394 was replaced with a CA3086 which has the advantage of five transistors on the same substrate and in the same package, it's also easy to find and cheap. The drawback is that it's nowhere as well matched, but in this application it's fine; the LM394 used for NBTV gamma correction could be said to be a bit of an overkill. The CA3046 is essentially the same device, but lower gain and not recommended. The fifth transistor in the CA3086 is not used, but its emitter needs to be connected to the most negative voltage the package will see, as this is also the substrate connection.



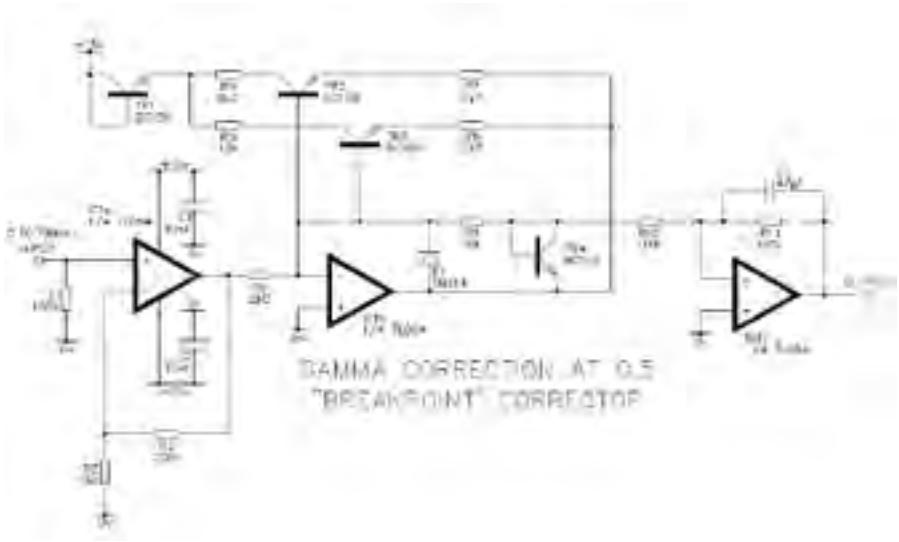
Several CA3086's were tried, but these three different samples were looked at carefully:-

Sample 1.	Gain, min. 144, max. 191. Medium gain, average matching.
Sample 2.	Gain, min. 231, max. 246. High gain, close matching.
Sample 3.	Gain, min. 105, max. 140. Low gain (but in spec.), average matching.

As expected the best results were obtained with the transistors with the closest matching in gain, the actual gain not seeming that important as long as it's above 100. The largest errors were in the low input volts range, the worst being about 8%, the average less than 2%. This should be more than adequate for NBTV gamma correction and some of the results could be put down to the calibration and resolution of the test equipment used.

Discrete devices were also tried, (BC109's) which were batch and gain matched, but without success, having very unpredictable results, even when left to soak at the same temperature for some hours. What does need to be matched apart from thermal tracking is Vbe against Ic; patience allowing it could be done - good luck!

To utilize the full range of these circuits over a 0 to 10 volt range, they are preceded by an op-amp with suitable gain to raise the input signal to that level. In this case the gain is set to 14.3, to turn a 700mV signal into 10V, other gains can be set by adjusting the ratio of R2 & R3. The output needs to be



attenuated back to 700mV and 300mV syncs added in the 0.5 circuit.

In the case of the 2.0 circuit the syncs, if present, will be lower than the usual amplitude at the output, so sync-stripping should be done prior to this circuit. Usually the display wouldn't care about the sync amplitude at this stage.

These circuits will not handle negative input voltages. No harm is done, and the output just sits at around 0V, so AC coupled signals will need to be DC restored prior to correction.

The transfer function of these circuits can be seen in Photo 1 (gamma = 0.5) and Photo 2 (gamma = 2.0). Also in each photo is the corresponding linear ramp input. Photo 1 is of one of the worst-case examples that were found, but it's still doing a reasonable enough job.

The 0.5 circuit has a bandwidth extending from DC to well beyond 150kHz. The 2.0 circuit is –3db at about 75kHz. This could be a limitation of the op-amps used, but it's more than needed in this application.

An alternative 0.5 gamma circuit

Here, (circuit 3), an alternative method of generating a 0.5 gamma transfer is presented. This arrangement uses 'breakpoint' shaping to approximate a square root function. The advantage is that matched transistors are not required - they just need to have a moderate amount of gain. BC109's being ideal.

The downside is it's nowhere near as accurate (Photo 3), but probably good enough for NBTV applications. The resistor values have been changed from those in the application note to give the function we require. The frequency response is –3db at about 35kHz primarily due to C3. Ic3c is configured as an inverter with a gain of 0.1. This is needed as the voltage at the base and emitter of TR4 is negative and reduces the 0-10V scale down to 1V.

A 2.0 version of this circuit has yet to be developed.

Supply voltages

This is an important issue. All three of these circuits are sensitive to the absolute supply voltage, both positive and negative. Here dedicated 78L15 and 79L15 regulators should be used for these circuits alone. (They're cheap enough).

A note on parts

Beyond the matched transistors already mentioned, nothing is critical. The op-amps could be replaced by virtually any type of FET-input op amp. In this case TL084's were used which only have a gain-bandwidth product of 3MHz. Bipolar input op-amps have higher input bias currents, which could upset the operation of these circuits, primarily in the current-to-voltage converter, IC1c, in both CA3086 circuits. So no 741's; no need to bother with CMOS or MOSFET types though.

Acknowledgements

National Semiconductor Application Note An222 for the 0.5 gamma Corrector, the square root circuit, Fig. 14, the drawing title is wrong, but the formula is correct. Fig. 15 for squaring circuit, gamma = 2.0, all correct here. The same circuits are within the LM194/394 datasheet, but without explanation.

National Semiconductor Application Note An4, "Non-Linear Amplifier", page 4, Figure 6, for the 'breakpoint' corrector.

These can be downloaded from the National Semiconductor website - do a search on 'LM194', the military spec version, which also applies to the LM394, the commercial equivalent.

I should apologize to National for using Texas op-amps and Harris transistor arrays. Sorry guys.

The author can be contacted via email at steveand@samart.co.th

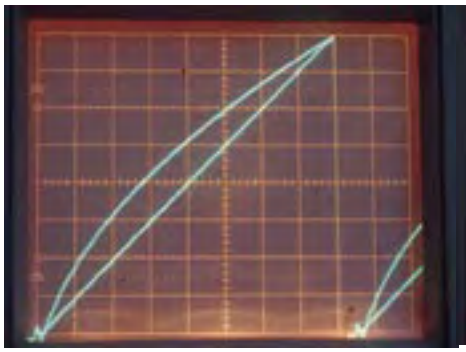


Photo 1

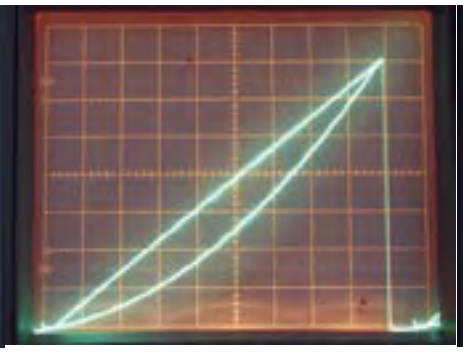


Photo 2

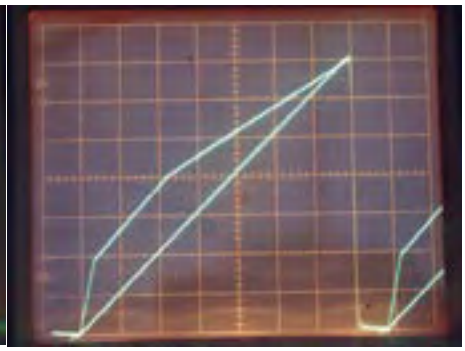


Photo3

BATC BGM and Convention 2004

By Paul Marshall

It's time to gather the clans and come on over to Shuttleworth in Bedfordshire for the big BATC event.

When

Informal gathering and evening dinner: Saturday 8th May 2004

Lectures, presentations, exhibition and BGM: Sunday 9th May 2004

Where

Shuttleworth Trust, Old Warden, Bedfordshire.

Accommodation

Various grades and prices of accommodation are available on site. This year the accommodation is solely for BATC use – there is no wedding reception on the Saturday evening so all the modernised class of accommodation is available to us. Please see the BATC website for details or 'phone Paul Marshall on 01522 703348.

Evening Dinner

Following the success of the last dinner in 2002 we are pleased to be able to offer another to chance to dine in style on the Saturday evening in the Shuttleworth manor house. Menu selection and prices will appear on the BATC website or 'phone Paul Marshall on 01522 703348

Late Bar

Subject to licence application, there will again be a late bar facility for all those deep discussions!

Lecture Programme

A full lecture programme is being put together with a strong emphasis on DATV and practical ways of going about it. Watch the BATC website in the coming months for more details and approximate times. Any offers of contributions please contact Paul Marshall by 'phone, e mail or mail.

The BIG stuff

At least one scanner, the 'Southern' truck will be there but wouldn't it be nice to have some 'friends' over to hook up to? Come on, I know where you are, get that engine turned over and some diesel in the tank . . .

Refreshments

Light meals and refreshments will be available throughout the Sunday, including breakfast.

Demonstrations

This is YOUR bit!

We would like to see as many demonstrations as possible and exhibitions of equipment, techniques, software and even programmes.

Whether it's analogue, digital, a bit of both, RF, video, NBTV, SSTV, computer, lighting, programming, systems, historical, fanciful or just plain interesting!

Please contact Paul Marshall for space and power requirements.

Trading

Once again, we are pleased to be able to offer a large car park for boot trading and more formal trade stand space inside in the Russell Hall at very reasonable prices. See the BATC website for more details or 'phone 01522 703348.

The BGM

The main event, (what it's all for) will be fairly late in the afternoon after the lecture programme has concluded. Provisionally this will be at 4.00pm in the Lecture Theatre.

The full agenda will be published in the next CQ-TV and on the BATC website.

The not so good bit

As we go to press, it would seem that a clash has developed between the BGM and the Dunstable Downs event on the 9th May. This is unfortunate but is due to venue availability and other factors. We'll keep you posted on the BATC website.

It might be possible to take in both events, the Dunstable Downs one is geographically close and also a fairly early morning one – all the bargain hunters are there at the crack of dawn!

BATC: http://www.batc.org.uk
Shuttleworth: http://www.shuttleworth.org

Maritime Mobile HDSSTV in the Med!

By Brian V Davies, GW4KAZ

About 12 months ago (January 2003) I received an ultimatum from my brother, Alun GW6MYY. He had offered some months previous that he was looking for two persons to complete a crew on his sailing boat "The Alderman". He wanted to sail from Spain to Greece; I had the offer of sailing from Spain to Sardinia. What a difficult decision, having to sail in the Med, blue seas and skies each day, with for me a once in a lifetime opportunity. Of course the answer had to be YES! An invite was also extended to John GW0AQR, who without hesitation, said "I'm packing". We were to sail late July early August 2003. We now had 3 radio amateurs in the crew of 5.

Brian GW4KAZ at operating position

It turned out that "The Alderman" was equipped with a HF marine transceiver; with minor modifications to the transceiver, HF maritime mobile operation on the amateur bands was a possibility.

I have been interested in SSTV for many years, and for about 2 years I have been operating on 20 metres with Idris GW3TLP and Gerry VK6GW sending SSTV pictures to each other almost daily - other amateurs have been joining in form time to time, such as Alfred DK1OT and Charlie 9H4CM. In CQ-TV 197 an article mentioned HDSSTV. We looked at this mode, and as software became available, activity on this mode became the order of the day. In fact the mode is now becoming popular.

The diagram below shows the equipment used on board. This enabled us to send digital pictures from "The Alderman" to other amateurs. Daily contacts were made on the 14MHz band, with Idris GW3TLP on the Isle of Anglesey. Contacts were also made with, Alfred DK1OT in Stuttgart, Charlie 9H4CM in Gozo, and Gerry VK6GW in Perth.

The Laptop Computer: The computer used was a Toshiba, however any laptop will provide the necessary audio signals, providing it has a sound card, and is able to run Windows 98 / XP. The processor speed needs to be in excess of 900MHz for reasonable decoding of the digital picture.

Interface Unit: This simply was a box, which incorporated a switch that provided a PTT signal for the transmitter, (it is possible to get the computer to provide a PTT signal) plus a changeover switch for a microphone input or the computer. It also provided a test point between the computer and the transceiver.

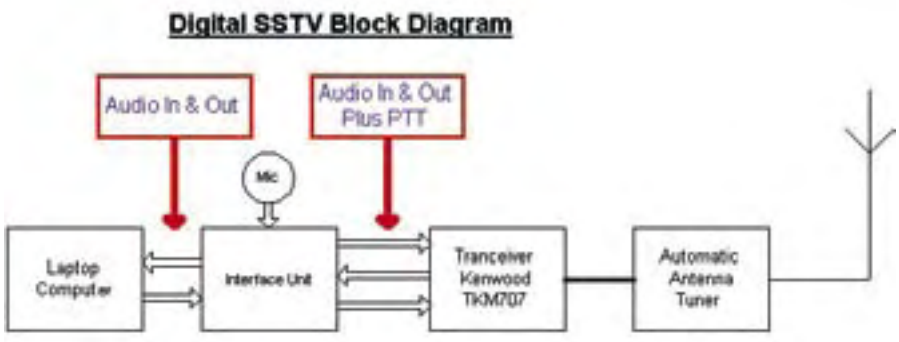
Transceiver: Aboard "The Alderman" was a Kenwood TKM707 - a marine band HF transceiver. The original frequency coverage was HF marine bands only; however having studied the circuit diagram, modifications were made to allow the transceiver to operate on the amateur bands. The TKM707 is capable of 150W PEP. This proved very useful on the amateur bands.

Automatic Antenna Tuning Unit: Since the antenna used on board was effectively an end fed sloping vertical (the mast's back stay) the automatic ATU was an essential part of the equipment. It provided a perfect match between the transceiver and the antenna on all bands.

Software: The software used was developed by Erik VK4AES and allows pictures to be encoded and decoded for transmission and reception. Pictures were taken using a digital camera, and downloaded into the computer. Text was simply added to the pictures before transmission by use of the paint software in Windows.

As mentioned previously, an article regarding HDSSTV appeared in CQ-TV 197. Since then software has been developed by Erik VK4AES and Rowland PY4ZBZ. The software we used on this trip was Erik's dated the 20th May 2003. Erik explains the development of the software.

"Some time ago I became interested in a new digital mode, then called "High Definition SSTV". It was the brilliant work of Barry Sanderson, KB9VAK. At that stage, the HDSSTV programs were for LINUX only, and stayed that way for some years. Recently, these



The Alderman (mast back stay as antenna)

programs were ported to Windows, so I could not resist the challenge to see if I could make up an easy to use GUI with these DOS executables. To use these routines "as is" was not for the faint hearted. I soon had a working program, and was delighted with the results. After a computer crash, when I lost all my source code, I made a fresh start and decided to make an all mode program, combining the usual analogue and digital. Thus SSTV-PAL MultiMode was born.

For the more technically minded, the "MMSSTV" engine by "Mako Mori" handled the analogue JE3HHT and the digital was handled by the DOS executables from Barry. There were many problems getting all the functions to work together. The C++ DLL and DOS executables were all having a fight with Visual Basic. It took many hours and cups of coffee to make the program stable. On the other hand it has also given me many hours of enjoyment. I hope this was also the case with the tireless team of beta testers. Thank you, thank you!! Receiving exact copies of the transmitted data, whether it be pictures or any other type of file, has opened up many new exciting possibilities.

The characteristic of slow digital decoding of the received picture can be a draw back for slow computers. I think this may be excused when it is realized just what the decoding entails. The file to be transmitted is encoded with a "Reed Solomon" redundancy routine. You might say that if the redundancy is set to 20%, then 20% of the file can be destroyed by band conditions, but can be repaired. These codes are particularly suited for radio as they perform well for "burst errors" where small segments are completely destroyed such as in a static burst. The "Reed Solomon" codes are already used in your HDD and CD drives. That is why a scratched CD might still work. The same system is used in many telemetry signals from satellites. This encoded file is then converted to a wav file, where the data is reordered by a Fast Fourier Transform to be frequency sorted. The bandwidth of this data is restricted so that the data can be sent 8 times (eight carriers in the waterfall display), each holding its own data, but with different frequency offsets. The bandwidth now nearly equals a normal SSB signal. Successful decoding only needs some of these carriers to survive fading, QRM etc. Even then, these "best of the bunch" carriers can contain some errors.

Imagine the work the computer has to do to decode this received audio mixture. Actually, the decoding is quite fast, the majority of the time is taken by conditioning the received file first. The slightest mistuning, drifting transceiver or soundcard mistiming will change the audio pitch, and make the decoding fail. The program can compensate considerably, by looking at the leader and changing the audio offset to bring it on tune. This gets everything on frequency at the start,

Alun GW6MYY the Captain

Brian GW4KAZ

John GW0AQR

The crew

HDSSTV pictures as received by GW3TLP. The originals were in JPEG2 format; they have been converted to JPEG. This may have reduced quality slightly.

from Capo de Salines Mallorca

Sailing

A dolphin visits

Fishing boats huts northern Ibiza

Sunset at Formentera

Crow's eye view of The Alderman

but what happens if the sound card timing is different at both ends? In this case the trailer will have moved in frequency, so by comparing the leader and trailer, sound card differences can be compensated for. The actual file is sent in "blocks" and each individual block has to be treated separately. This requires many passes through the file, so takes time. Now the decoding starts - more quickly if there are no errors. How the errors are corrected needs a university degree to understand; thanks Barry! These corrections may need thousands of comparisons for every byte of corrupted data, and there are eight sets. I can feel the CPU getting hot. Visit www.svs.wyman/examples/hdsstv/ for more information. Roland, PY4ZBZ has written a wonderful digital GUI called "DIGTRX". Be sure to add it to your program list.

My explanation is only a tiny part of what really goes on, and by presenting it so simply, there are many omissions and probably technical inaccuracies and approximations. Further development is taking place, so new things will always be coming up.

73's de Erik VK4AES."

Above are some examples of pictures received by Idris GW3TLP on the Isle of Anglesey, and myself following my return home. My home station is a Yaesu FT101, FL2100 linear amplifier and a TET 2 element beam at 8 metres. My computer is a Toshiba Satellite 3000, with a 933MHz processor.

A total of 570 miles was sailed in about 10 days, with daily temperatures in the high 20's low 30's. A catalogue of pictures taken by the crew, with further notes can be seen on my web site www.garth1.co.uk

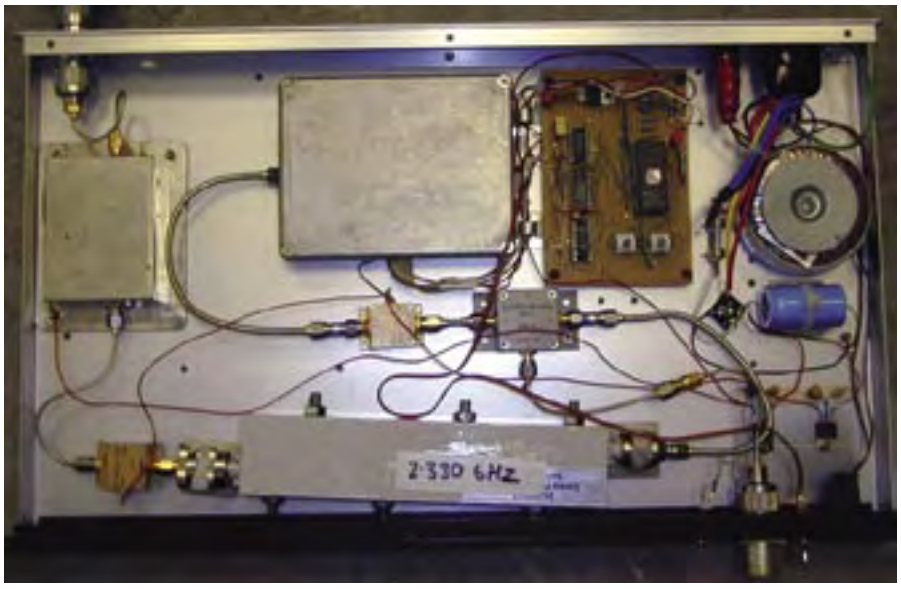
COFDM DVB-T DATV System

By Ian F Bennett G6TVJ/D

Recently I've been able to identify a digital set top box capable of receiving a terrestrial DATV signal. The value of this receiver is further enhanced with the addition of a cheap domestic MMDS downconverter to receive amateur 13cm transmissions. These components make up a complete and affordable DATV receive station capable of startling results. An affordable COFDM DATV transmitter still proves to be a challenge; I've been fortunate in being able to borrow a professional modulator and, in conjunction with a home brew up-converter transmit arrangement, a complete 13cm DATV link has been achieved.

Complete DVB-T DATV Recieve Station

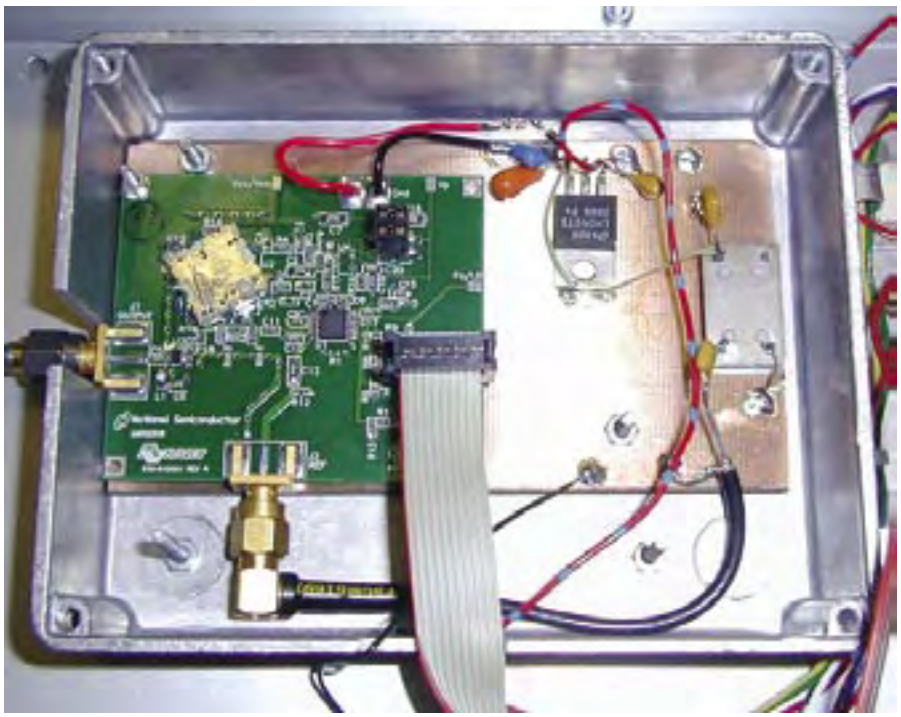
DVB-T is the European specification for the delivery of digital TV programmes terrestrially, i.e. not via satellite or cable. In the UK the service originally known as BDB (British Digital Broadcasting), launched as On Digital, then ITV Digital and finally Freeview operates with this system. DVB-T is to digits what system I is to analogue PAL. The DVB-T signal format consists of MPEG2 coded digital pictures multiplexed together to produce one or more TV services in a data stream known as a transport stream. The transport stream is made up of data packets which contain the picture, sound, teletext, service information and house keeping data. Before transmission, extra error correction data is added to the packets. In the case of DVB-T the transport stream is modulated on to a special multiple carrier signal called COFDM. COFDM stands for Coded Orthogonal Frequency Division Multiplex; this signal format was developed for terrestrial TV services and also digital radio (DAB). COFDM is a sophisticated modulation format; it is able to exhibit resistance to the effects of multi-path propagation, and the signal reflections (ghosting) often experienced with terrestrial links. A number of parameters within the COFDM signal may be varied to suit different applications and the level of robustness that is required. For DATV the most robust signal format is generally used.



13cm Synthesised up-converter

DVB-T although developed for broadcast to home services, it is increasingly finding applications in other TV systems such as wireless cameras, security TV systems and TV point to point links. In its most robust form, a signal using maximum error correction (FEC ½), QPSK carrier modulation and a 1/32 guard interval can carry a reasonable quality picture from a portable camera. In the past, traditional analogue wireless or radio cameras were subject to picture and sound break-up when experiencing reflections and multi-path propagation. DVB-T provides improved performance, and in many circumstances the appearance of a cabled camera. Seamless pictures may be provided up to the point at which the signal becomes un-decodable, and the picture then breaks up in the familiar pixelating manner. The packet nature of DVB-T signals enables a multi-way diversity reception system to be used; this picks the non-errored data packets from as many as four receive antennas. DVB-T, although tricky to optimise in a number of areas, is revolutionising wireless cameras systems at broadcast OB events.

In its least robust mode i.e. 64 QAM modulation and low error correction (FEC7/8), DVB-T can deliver up to 30 MB/s with favourable propagation conditions (similar to PAL). 30 MB/s is sufficient to provide two/three high quality broadcast contribution links



LMX2326 Synthesiser module

multiplexed together in only an 8MHz wide RF channel.

The DATV system consists of a number of modular units connected together to process the signal, transmit it, receive it and decode it. The video signal passes in at one end and emerges at the other. Putting these various units together is essentially a DATV system-engineering task.

MPEG Coder

A PAL video signal is coded digitally using an NDS (Tandberg) professional MPEG coder. This 19" rack mount unit is configured to produce a low-ish bit rate 4.2.0 sampled signal; this signal is compatible with a domestic set top box i.e. the Technisat unit used here. A bit rate of around 5.6 MB/s is produced and multiplexed with some audio data providing a stereo sound circuit at 192 kB/s. Programme service information and network information may also be entered into the coder for embedding into the transmitted signal. For DATV the station call-sign such as G6TVJ/P may be entered.

COFDM Modulator

A second 19" rack-mount unit accepts a transport stream from the coder and produces a 70 MHz COFDM modulated signal. The modulator is controlled from the coder; parameters are entered in to it via an LCD screen and push buttons. The modulator provides an RF output of 0dBm in level.

G6TVJ DATV Up-converter

The standard 70 MHz IF output from the modulator requires conversion to a frequency in the 13cm amateur band. A up-converter unit is used to convert the 70 MHz signal to the simplex ATV frequency of 2.330 GHz. This unit is home constructed in order to meet the 13cm band requirement. The heart of the up-converter is a low phase noise frequency synthesiser, the National LMX2326. COFDM signals are sensitive to phase noise and only the best stable oscillator sources may be used. Unfortunately, home-brew free running oscillators are out of the question - my own home-brew parallel frequency synthesiser, although a superb analogue TV modulator, also proved useless as a DATV local oscillator! In the form of a product evaluation PCB, the LMX2326 works well for DATV, but it was still found to be inadequate for proper 64QAM operation. In 64QAM mode, unstable MERs and BERs were noticed as indicated on a professional diagnostic receiver. A better spec VCO (Voltage Controlled Oscillator), or optimised loop filter might improve the phase noise further to enable 64QAM operation, but this is rather pointless for DATV. The MPEG 4.2.0 spec does not allow for bit rates above 15 MB/s anyhow.

The synthesiser provides a stable local oscillator source which is fed to a double balanced diode mixer. The 70 MHz IF is mixed with a low side 2.260 GHz LO to prevent frequency spectrum inversion (COFDM signals are sensitive to frequency inversion). The drive level to the mixer is adjusted for optimum linearity. A low local oscillator drive results in poorer linearity due to low saturation of the diode switching mechanism inside the mixer. A number of amplifiers are used to compensate for the conversion loss in the mixer and insertion loss in a sideband filter. The filter removes the LO and unwanted

DVB-T Transmit Equipment

13cm Down Converter

sideband and leaves just the 2.330 GHz signal. The levels throughout the system are carefully balanced for best linearity. A backed-off PA module provides about 100 mW drive to an outside mounted PA via a 30 ft Westflex 103 coax cable.

Amplifier linearity can be a big problem when using COFDM signals. The COFDM signal is made up of thousands of individually modulated carriers; these inter-modulate together and produce sidebands inside and outside the original signal spectrum. This effect is known as spectral re-growth; if severe, it will degrade the signal and make it harder to decode. Amplifier bias and drive levels may be adjusted for best re-growth results. Special linearised amplifiers are now available to professionals to enable more efficient systems to be operated.

The LMX2326 is a serially addressed frequency synthesiser. For development, the device may be controlled from a PC port; for field use, a system is needed to "load" the synthesiser with frequency information on power up. To avoid the need to develop a PIC based serial controller, a simple EPROM circuit is used. A clock and counter cycles an EPROM through a number of addresses sufficient to produce a simple repeating serial bit stream from one output data bit - a clock and register enable signal

Received DATV Signal P5!

N-Type Fitted

is also produced. Three 14 bit words are serially loaded into the synthesiser to set the reference division ratio, the VCO frequency and operating mode. This is required once on power up - continually loading the synthesiser works, but it was found that the phase noise performance deteriorates.

The LMX2326 evaluation board was ordered through the National website, and a design simulation was executed and the loop filter components determined on-line. The evaluation board also comes with some useful PC software to enable a real time simulation and bench operation together.

Amplifier/Antenna

The up-converter output is used to feed a power amplifier and antenna combination; this is mounted outside the shack and high up. About 30m of Westflex 103 separates the up-converter and PA module. This cable is remarkably low loss even at 2.3 GHz and may be recommended for this type of remote PA/Antenna installations. A German built Khune electronic 10W PA module is connected to a 6dB Alford

slot antenna; the PA is operated with a large output back-off and actually produces only 400 mW. This system was previously used for a DVB-S DATV system and an analogue FM system.

Receive Down-converter

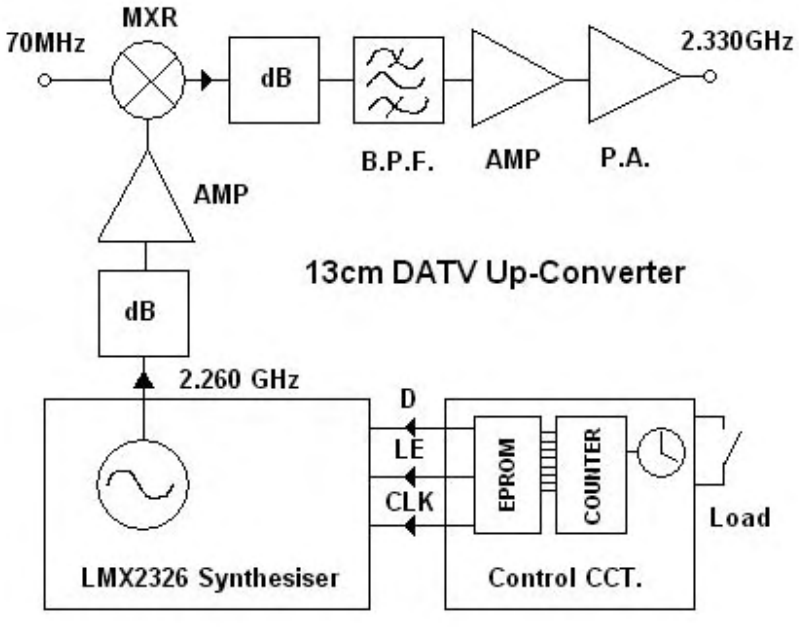
There are two key aspects to this project, the down converter and the set-top-box. Without these, the exercise is pretty pointless as simply reproducing a professional system with expensive equipment isn't really relevant to ATV. A domestic MMDS (Multipoint Microwave Distribution Service) down-converter made by Stella Doradus is used to receive the DATV signal and down-convert it from the 23cm band to the UHF 70cm band. The down converter is essentially an LNB type device with an 1830 MHz local oscillator. The converter is designed to form part of a corner reflector antenna and is fitted with a shrouded dipole feed arrangement. I've modified the LNB by removing the dipole and fitting a standard N-type connector.

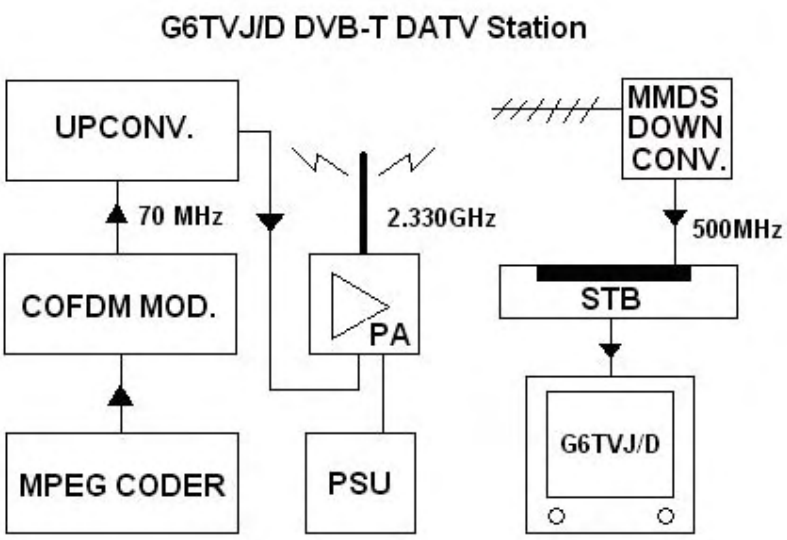
The down converter is a remarkable device. The local oscillator is synthesised using a 4046 PLL, a crystal reference and presumably a microwave pre-scaler. The down converter also contains a number of micro-strip filters - these display evidence of individual bench alignment. The total conversion gain is around 32 dB. This is sufficient considering the set top box is designed for direct antenna connections (unlike a satellite receiver) and has a reasonable noise figure. For DX applications you might ring another dB or so out of it by using an additional LNA. The input GASFET device in the converter is connected virtually to the antenna input and so the noise figure should be acceptable.

The down converter is a compact and lightweight unit - a number of different models are available from the manufacturer. I've tested the unit with professional equipment, the LO phase noise spec is sufficient for 64QAM operation with a low FEC.

Set Top Box Receiver

A set top box built by Technisat is used to receive the DATV signal (see CQTV 204). This German made receiver may be operated in a manual mode, whereby the receive frequency can be entered using the remote control without the receiver searching for standard UHF channels. The receiver also displays some very useful diagnostic information relating to signal strength and error rates. To





receive 2.330 GHz, the receiver is set to 500 MHz dead with a LO of 1830 MHz. The receiver also displays the service and network information entered on the MPEG coder, perfect to identify the station call-sign and location!

The STB does not provide power for the down converter so this has to be externally applied, ensuring - of course - it doesn't go back up the receiver front end!

Other STBs have been tried. A Ferguson unit although surprisingly allowing manual frequency entry, would not decode the DATV signal, A Pace box (bought as a Christmas present) does not provide for manual frequency entry at all. The Technisat unfortunately will not store the DATV channel for some reason and so the frequency needs re-entering each time receiver is to be used.

Results

The DVB-T DATV system has produced excellent results, with robust parameters chosen, the signal may be received with a carrier to noise ratio down to about 3dB.

System specification	
Coder	Tandberg E5410
Profile	MPEG ML@MP 4.2.0
Bitrate	5.8 MB/s
Modulator	Tandberg 3000
Mode	COFDM DVB-T
Constellation	QPSK
Guard Band	1/32
FEC	½
Bandwidth	8 MHz
Spectrum	Non-inverted
Up-converter LO	2.260 GHz
PA	10W backed off to 400mW
Transmit Antenna	6dB Alford Slot
Receive Antenna	Tonna 18 dB Yagi
Down-converter	Stella Doradus MMDS 2.3-2.5 GHz Input
Model No.	MGC121830
LO	1830 MHz
Gain	32 dB
PSU	12V via F-Type
Receiver	Technisat Interdigital-T STB
Frequency	500 MHz

When viewed on a spectrum analyser at 10 MHz sweep and a 30 kHz rbw, the signal virtually disappears into the noise floor before it stops decoding. All the time it decodes, P5 pictures result! The sound is of course CD quality too. At these signal levels an FM PAL signal would be below the receiver threshold, not even P1! Over a 3 mile path obstructed by local buildings a signal was still obtained with only a patch antenna.

It appears that COFDM exhibits an advantage over the simpler satellite DVB-S format when applied to DATV. 2-3 dB are gained from using COFDM and also more resilience to multi-path and ghosting. A simulated path test is needed on the bench to clarify this further. Although inferior to DVB-T, DVB-S appears significantly better than an analogue transmission saving both power and bandwidth at a bit rate of around 6 MB/s.

The future of ATV is digital?

See-

http://www.national.com/pf/LM/LMX2326.html

http://www.stelladoradus.com/

A Tale of Two ENG Cameras

By Peter J. Stonard

Peter explores the first ENG cameras – RCA's TK-76 and Ikegami's "Handy-Looky"

Television cameras can be seen everywhere today, but there was a time when cameras could only be found in the safety of a TV studio. But the desire to take the camera to the action, instead the other way around, was very tempting.

In fact, the productions of regular film newsreels, for theatre presentations, were made on location long before the first regular TV broadcasting from a studio had begun.

Because television is a visual and immediate medium, daily spot news pictures were needed. Film was rushed to air for the nightly TV news broadcasts. A popular remark heard in America (even today) is "Film At Eleven" – because the breaking news of the day, capture on 16mm black and white film, would be seen first on the eleven pm nightly broadcast, following early evening reading of the same news story with "Film At Eleven" teasers.

During the 1970s spot news changed when primitive (by today's standards) cameras and field recorders ventured out of the studio to capture the news on videotape. The demand for cameras was so great that it spurred an entire industry to gear up and make better products.

Standard bearers of the day, for shoulder mount field cameras, were the RCA TK-76 (Introduced in 1976, selling 2000 units by 1980) and the Japanese Ikegami HL77 (Introduced 1977, and replaced by the HL-79 series). Video cameras was paired with a U-Matic ¾ inch videocassette tape recorder, carried by the sound person – a true team effort as they were also tethered to the reporter by his or her microphone cable!

RCA Introduces A New Camera

RCA demonstrated a one-piece portable camera at the 1975 NAB. Although not officially named, that prototype was followed in 1976 by the TK-76. Figure 1.

"The TK-76 product concept was presented to RCA's board by Tony Lind. Who together with John Clark and contributions from Sid Bendell, Lou Bazin, and Fred Himelfarb of NBC, made it happen." According to former NBC Engineer Jay Ballard.

RCA By The Numbers

RCA applied logic to their sequential model number scheme of a two-letter prefix, starting with their first broadcast console for radio, the BC-1. When television products were introduced the first model letter changed to T, but as the letter C was already in play, so the phonetic K was used for camera – hence TK.

Early cameras soon ran past TK-10, so jumps were made to higher numbers for different product families. Clearly a new number sequence was justified for their first portable colour camera, making TK-70 logical. 1976 was also the American Bi-Centennial year, so the new camera was christened TK-76.

Figure 1 A Tired TK-76 Without Its Side Covers

Ikegami Handy-Looky

The initials HL stand for Handy Looky, and date back to 1962, when Ikegami produced a portable colour camera for CBS to cover the Aurora 7 space launch.

It could have been worse! The first roving camera from RCA was the 1952 "Walkie-Lookie". Followed by the Ultra-Cam, a roving portable camera used at the 1964 political conventions, which someone called a "Creepy Peepy"…

NHK Sponsors Ikegami

Development was continued by Japanese Ikegami under sponsorship of the Japanese National Broadcasting Company, NHK, and the author recently spotted this interesting two-piece camera and back pack at the NHK museum (Tokyo, Japan). Figure 2.

Figure 2A Ikegami NHK1 Camera Head

Figure 2B Ikegami NHK1 Back Pack

By 1972 Ikegami had reduced the portable field colour camera system to a shoulder mounted head weighing 7kgs (16 pounds), tethered to a backpack 14kgs (32 pounds) worn by the cameraperson, and called the HL-33. Figure 3.

Figure 3A HL-33 Camera Head

Ikegami kept the HL prefix for later portable camera models, and followed RCA's lead with the next few model numbers, by indicating the introduction

year. The next camera was a one-piece shoulder mounted camera called the HL-77 in 1977!

Figure 3B HL-33 Back Pack

Later Ikegami models stuck with this scheme, including the legendary HL-79, although the 'E' model was the last HL-79 version and introduced in 1986.

All of the first generation cameras were costly when new, justifiably so as they are a limited production, precision instrument, that met demanding specifications and had to be rugged. They must have cost a king's ransom to develop!

"Near Broadcast Quality"

During the 1970s and '80s complexity (and therefore costs) of television production fell due to the adoption of better technology, and creation of new broadcast outlets such as satellite delivery and cable-only channels. This placed a demand for more trained personnel, who in turn needed suitable equipment. Many non-broadcast applications spurred on a wider market for video cameras. Cable channel programmers, schools, corporate communications departments, all needed "Near Broadcast" performance on a "Non Broadcast" budget. Many of the new cameras were listed for only one quarter of the cost of the broadcast spec.'d models.

Electronic Field Production

The studio environment or the performance of early generation ENG cameras does not limit today's television production. Although modern portable cameras look like their older cousins that were aimed at spot-news gathering, they are truly studio performance cameras in a smaller, lighter, rugged box called EFP (Electronic Field Production) cameras.

The industry workhorse during the 1980s was the Ikegami HL-79D, see figure 4.

Figure 4 Ikegami HL-79D

Single Box Operation

By the mid 1980's cameras and video tape recorders were merged to form the now familiar Camcorder. Many of the early models were released while the industry was still busy inventing new tape formats. To avoid overnight obsolescence, smart camcorders were constructed from modules thus allowing the best tape and camera technology to be merged for a given task or budget. Still further improvements in size and power consumption occurred in the early 1990s with the widespread use of CCD sensors, finally making tube cameras obsolete.

Performance By Numbers

So how good were those first ENG cameras? How about the current crop of CCD EFP cameras?

Table 1 compares the HL-33 with the TK-76. Remember, the Japanese had their own testing methods that produced better numbers than the old RCA methodology. Today, as most cameras come from Japan, the testing is uniform and specs may be readily compared.

Table 2 shows the last HL-79E tube camera and a typical EFP CCD camera (HL-59) suitable for one-piece Camcorder operation.

Clearly the modern cameras do more for less. The RCA TK-76 drained batteries quickly, while the Ikegami cameras were fitted with many more adjustments to get the edge on specification.

The CCD cameras require no field set up for convergence, and the residual errors are both very small and uniform all the way to the corners. Power consumption is about 1/2 to 1/3 of the early tube cameras.

Conclusion

These cameras were the workhorses of the industry and many were passed down from networks to local stations and then on to non-broadcast service.

Table 1

Camera		Ikegami HL-33	RCA TK-76B
Pick Up Type		Three Tube Parallel Mirror Optics	Three Tube Prism
Plumbicon			XQ1427
Sensitivity (2k Lux)		f/4	F/2.8 @ 1250 Lux
Low Light Level			
Signal-To-Noise		>45dB	51dB
Resolution	Centre	500 TV lines	
	Corner	350 TV lines	
Registration	Zone 1	0.1%	0.1%
	Zone 2	0.3%	0.2%
	Zone 3	0.4%	0.5%
Geometric Distortion		<1.5%	
Temp Stability		0 to 40degC	
Power Consumption		12V DC 32W	12V DC 50W
Size (mm) Camera Head		100 x 192 x 318	267 x 109 x 406
Weight (kg)		7.4 (Incl. Lens & VF)	7.9 (incl. VF)
Size (mm) Back Pack		150 x 297 x 368	
Weight (kg)		13.5 (Incl. Battery)	

Table 2			
Camera		Ikegami HL-79E	Ikegami HL-59
Pick Up Type		Three Tube Prism	3 CCD Prism
Plumbicon		XQ-1427	
Diode Gun (opt)		XQ-2427	
LOC Diode Gun (opt)		XQ-3427	
SATicon			
Diode Gun (opt)		H-9386B	
LOC Diode Gun (opt)		H-9386D	
CCD			18mm 520k Pixel FIT
Sensitivity (2k Lux)		f/5 or better	f/8 or better
Low Light Level		f/1.4 20 Lux	f/1.4 1 Lux
Signal-To-Noise		57dB	59dB
LOC tubes		63dB	
Resolution	Centre	650 TV lines	>900 TV Lines
	Corner	500 TV lines	Same
Registration	Zone 1	0.05%	0.03%
	Zone 2	0.1%	0.03%
	Zone 3	0.3%	0.03%
Geometric Distortion		<1.5%	0.03%
Temp Stability		0 to 40degC	-20 to 50degC
Power Consumption		12V DC 26W	12V DC 16.5W
Size (mm)		95 x 165 x 339	105 x 230 x 155
Weight (kg)		6.0 + lens + battery	3.3 + lens + battery

Back when good cameras cost the same as a family home, theft of the cameras became an issue. Why steal a camera? Ransom? Well, many ended up in porno movies sets, or the local pawnshops.

If you'd like to have one of these as an Amateur TV camera or for nostalgia sake keep an eye on on-line auctions sites, or the next Hamfest/Flea Market/ Boot Sale!

Acknowledgements

The author would like to thank Jay Ballard for supplying details of the RCA TK-76 camera. Also, Peter Yanczer for the donation of the tired Tk-76 shown here, and Rich Diehl's boss Keith for parting with a treasured copy of the HL-33 manual.

Photos by the author, unless noted otherwise. The author lives in California, and is best, reached by email: pstonard@ix.netcom.com

NHK HQ and Museum
Perched on a hill, the broadcast aerials of the Tokyo Tower are just visible behind the NHK building.

HDTV with 1080 lines vertical resolution

Translated by Klaus Kramer, DL4KCK

Within the MPEG standard, the high resolution version is already commonplace in USA, Asia and Australia - for Europe the door to really cinema-like TV quality live at home opens on 1st January 2004. From that date, on the Belgian TV producer "Alfacam" will transmit two channels via the Astra satellite (19 degr east) under it`s brand "Euro1080": a daily 4 hours programme to European households, free-to-air with a mix of sports, music, shows and film / documentaries - in Dolby surround sound 5.1 of course. Part of the content will be acquired through an exchange pool with other HDTV channels around the world. At least twice a week an EVENT channel will distribute event programmes (live or delayed live) to so-called "event cinemas", equipped with electronic projection and 5.1 surround sound systems.

A demonstration transmission has been running since the IBC in Amsterdam on 12168 MHz vertical, SR 27500 Ms/s, FEC 3/4 under "MPEG2HD" in format 1080i (1920 x 1080 pixel at 50 Hz interlace). At least two compatible settop-boxes for the home have been announced for the end of 2003, and real HD screens (not 720, but 1080 lines vertical resolution) are already available from several vendors. But - clever programmers have developed the means to decode the high bitrate (19 Mb/s) live with software in a modern desktop PC! Luckily most computer monitors are already fit for HDTV.

What else is needed? 1. an inexpensive digital satellite TV PCI card without an embedded MPEG decoder (i.e. Technisat SkyStar2 TV) and the corresponding software "DVBViewer" version 1.99 or higher. The older TE version included by Technisat does not work for HDTV, but a full version download from the developer`s homepage costs only about 15 Euro and includes free updates. 2. a fast processor and memory, at least 2 GHz Athlon XP or 2,6 GHz P4 and 166 MHz FSB; graphics cards must have MPEG2 hardware acceleration. This way, TV-Sat-DX enthusiasts can view special transponders with studio feeds in full quality MPEG 4:2:2! With normal digital satellite TV channels, the CPU load is only around 20 percent, and then selecting the "MPEG2HD" channel, the optimum television pleasure can start (after having tweaked all the software parameters, i.e. enhanced, priority "highest").

The last hurdle within my installation routine was to declick "autom. audio detect" in the essential sub program "Marfi`s filter", and wow - a high resolution slow motion became a brilliant HDTV movie with about 50 percent CPU load. My cheap Geforce FX5200 graphics card does the job without problems (no jerking) in 1024x768, but would be able to show 1920x1080 on a high res display. The demo loop broadcast by "Euro1080" deploys a very broad range of content: classical music performances, operas, jazz festivals, pop & rock concerts, shows and sport events besides the technical background like Panasonic D5 HD recorders and some HDTV OB vans.

It is really exciting to view this on a TV projection screen of at least 150 cm width - you seem to be able to read the sheet of music in front of the musicians in the orchestra...

Links: http://www.euro1080.tv

http://www.dvbviewer.com (with a helpful forum, mostly english!)

http://www.rdkleinpowerb.de/computertrend/html/hdtv.html (with XVid HDTV-Clips 1280x720p, mostly german)

Reprinted from TV Amateur Nº 131 AGAF e.V. http://www.agaf.de

First DATV units Tested and Delivered

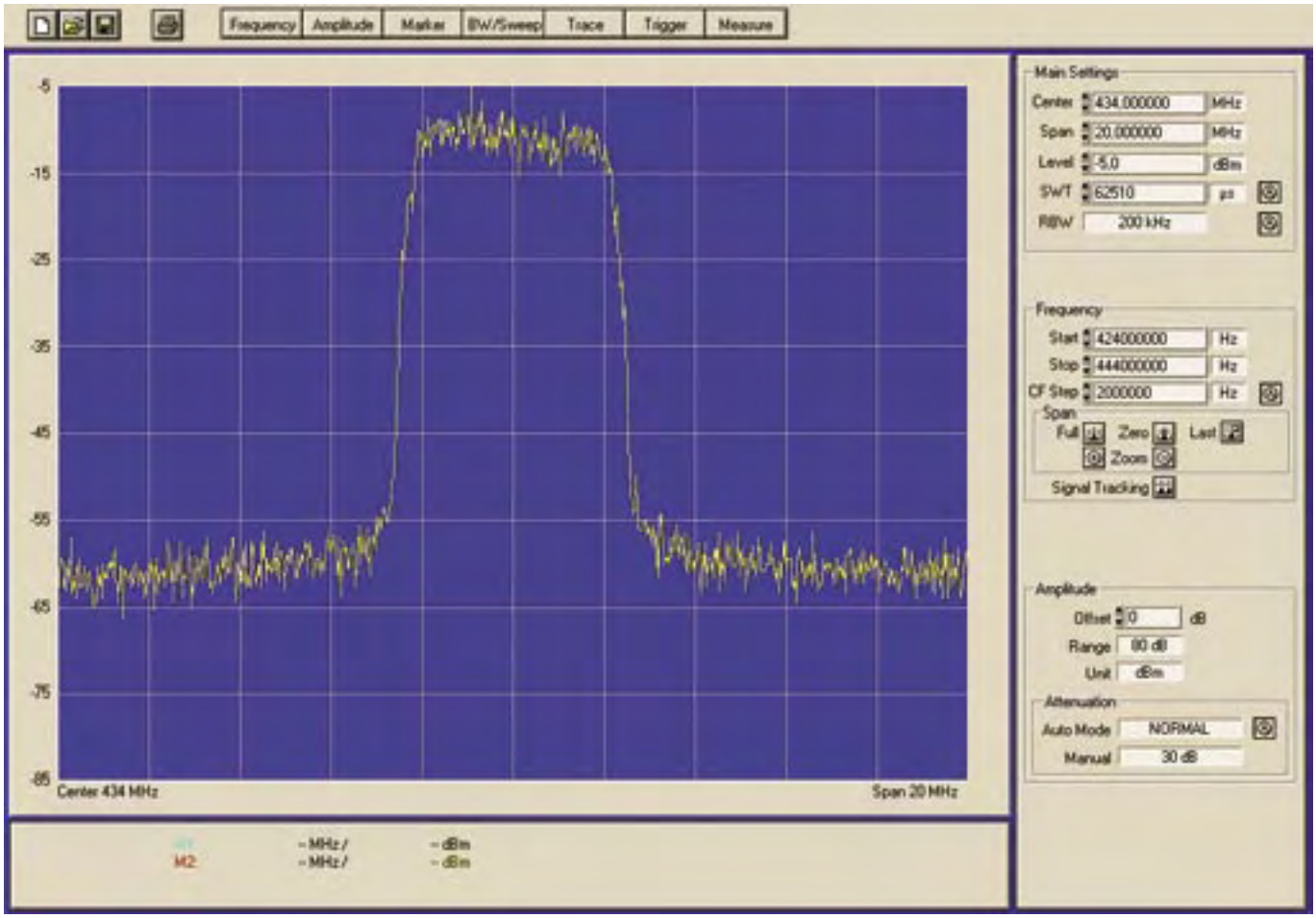
By Klaus Kramer DL4KCK

Students and volunteers in Wuppertal University have completed some of the 100 exciter boards, loaded the software and did the alignment, while the matching 4-layer MPEG-2 coder boards have been produced by the company near by. The units can produce a narrow GMSK signal (2 MHz bandwidth with video and 2-channel sound on 434 MHz, a matching GMSK receiver is in preparation) or a wider QPSK signal with higher video quality for use on 23 cm and above. For technical details see http://www.datv-agaf.de

DATV Up-Converter 70/23

Meantime the re-design of this up-converter is finished, and just readily available components are used now. Schematic diagram and layout may be found at http://www.datv-agaf.de/converter.htm. A small scale production is planned by AGAF early in 2004.

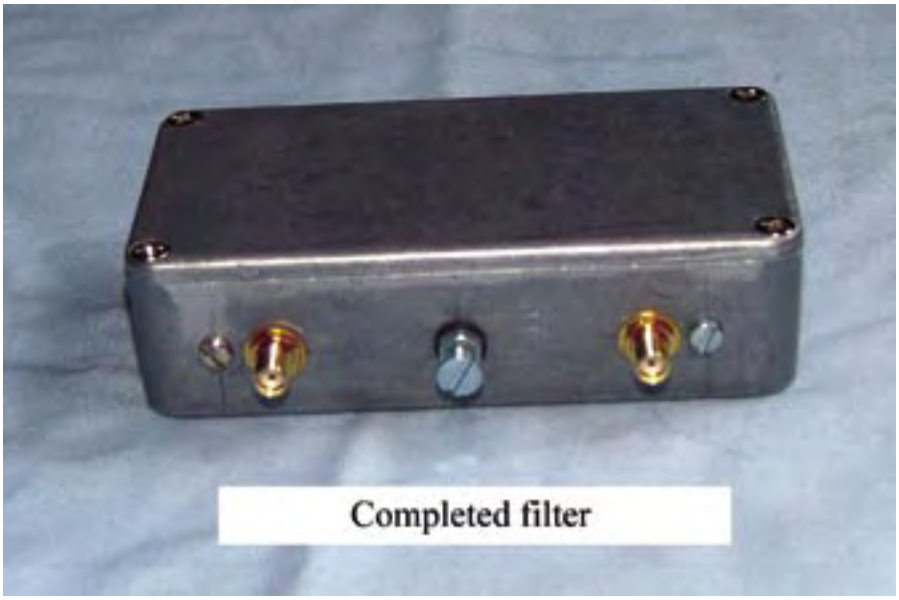
The picture below shows the output spectrum with QPSK



An Easy-build 23cm 'look through' Filter

By Steve Drury, G6ALU

A "look through" filter fitted in the receive path removes the unwanted transmit signal to allow viewing of the repeater output whilst transmitting on the input, a number have been described before but all required the use of lathes or milling machines. The idea of this easy to build filter came from the Internet pages of James Klitzing W6PQL[1], his unit was designed to follow a transverter so was too narrow a bandwidth for ATV but gave the idea for the use of a die-cast box.


Completed filter

Design

This inter-digital filter has three sections with the external connections made via. coupling loops, although lossy it's much easier to use loops than try and get an electrical connection to the rod. The out of band attenuation is reduced slightly due to the unwanted radiation they produce. With the use of an Internet design tool[2] it was easy to calculate the various dimensions. This tool proved to be very accurate, try the design parameters for your self and compare the results with the prototype's performance plot. A well-built and aligned filter will give a pass band loss of about 0.8dB whilst attenuating the transmit signal by about 50dB.

Design parameters used	
Number of elements	3
End plate to element	0.5"
Bandpass ripple	0.2dB
Centre frequency	1318MHz
Ripple bandwidth	16MHz
Ground-plane space (internal height of box)	1"

Through loss was calculated at 0.51dB, the extra 0.5dB loss of the prototype can be attributed to the method of coupling into the rods, material losses and poor workmanship! By "cleaning up" the construction mid band loss was improved to 0.8dB with less than 1dB across the pass band. The 16MHz bandwidth would seem too tight, remember though that the 3dB bandwidth calculates at 20MHz - wide enough for all ATV signals. Temperature stability appears good - I wasted half a can of freezer giving the box a frosty coating without a noticeable change in the centre frequency or through loss.

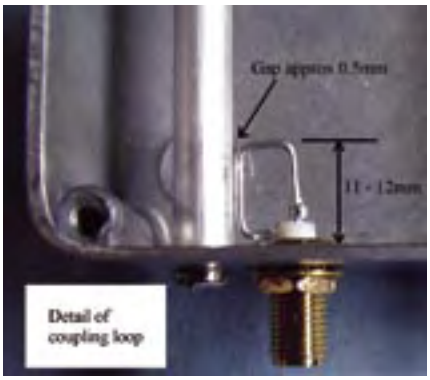
Construction

The prototype was made without the use of any special tools, but there are two measurements that are important - the rod length and their 40.5mm centres. Both these measurements were made with an inexpensive plastic vernier calliper available from DIY stores. Subsequent measurement showed that the rods had been finished to within 0.1mm of the designed length, for repeatability this accuracy is required but is easy to achieve.

All parts were easily obtained - part numbers given are from Farnell Ltd:

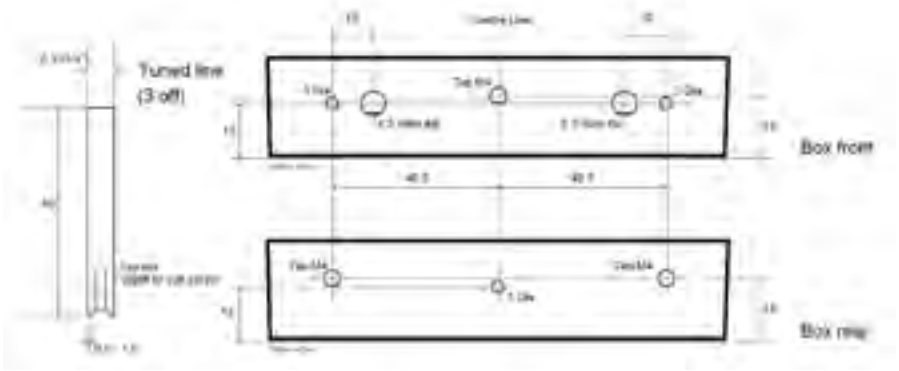
Die-cast box - Hammond 1590B (306-1590), bulkhead SMA connectors (410-8061), M3*15mm screws, M4*20mm screws, M4 nuts, 4mm spring washers and 1/4" aluminium rod.

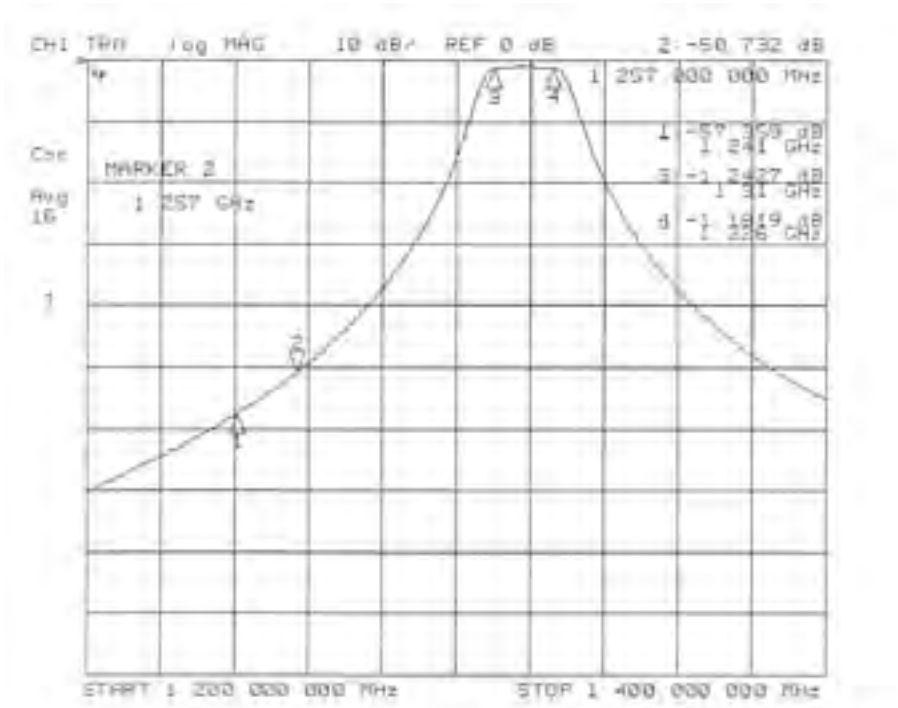
Firstly mark the box for drilling, as the box has draft angles around it's sides this is a little tricky; I found it easiest to mark the centre line on the bottom of the box (on the outside) using a square. From this, other lines can be projected down the front and rear of box. Lines are drawn at 13mm from the bottom of box (for rods and SMA sockets) and 15mm (tuning screws), the tuning screws are fitted higher up the side wall as due to the draft angle the rods won't be parallel with the box bottom.



Detail of coupling loop

Holes should be centre punched and then drilled to the correct size, note that a 2.5mm should be used for M3 and 3.3mm for M4 threads. The SMA sockets have a small anti-rotation flat,





Performance of first prototype

for this to work the holes should be drilled smaller and filed to size.

The trickiest job of all is the drilling of holes down the centre of the rods; I managed to do a reasonable job using a hand-held drill with the rods held in a vice. Drill the rods to take the 3mm thread before cutting to length, if you go too far off centre cut it off and try again! When successful use a large drill to countersink the hole, the reason for this is that the RF connection between the rod and box will be better defined.

Tuning screw detail

Once all drilled and tapped, the box and rods can be assembled together; clean the contact areas with fine glass paper first. Make up the coupling loops, I used 0.9mm tinned copper but larger diameter copper wire was also tested with similar results. The gap between tuned lines and coupling loops should be around 0.25 - 0.5mm, this is easy to set by placing several thickness of paper between loop and rod and pressing together with pliers. The tuning screws were fitted with spring washers and lock nuts, something more elegant could probably be arranged but this worked for me.

Finally fit the lid, firstly distort it across it's centre slightly (put a small bend in it) so when screwed into place contact with the side walls over the centre rod is assured.

Alignment

Fit the filter in line with the station receiver, this should be placed BEFORE any pre-amplifier as they will saturate with the transmit signal, high gain pre-amps should also be avoided. Transmit on the repeater output frequency into a dummy load; adjust each tuning screw for best results. As the signal becomes noise free reduce coupling between transmitter and receive antenna, finally peak up on the repeater signal. When correctly aligned the before and after signal strengths should be similar, in some circumstances an improvement in reception has been noted; this is probably due to the filtering out of mobile phone base station signals and terrestrial TV signals.

Development

The filter dimensions could be changed for use as an effective transmit filter - with a centre frequency of 1249MHz, the on-line calculator gave dimensions of 52mm (after a -2% allowance for tuning) for rod lengths with a spacing of 40mm.

In an attempt to improve the conductivity between box and lid an RF gasket was tried, this increased the loss to about 3dB so was abandoned.

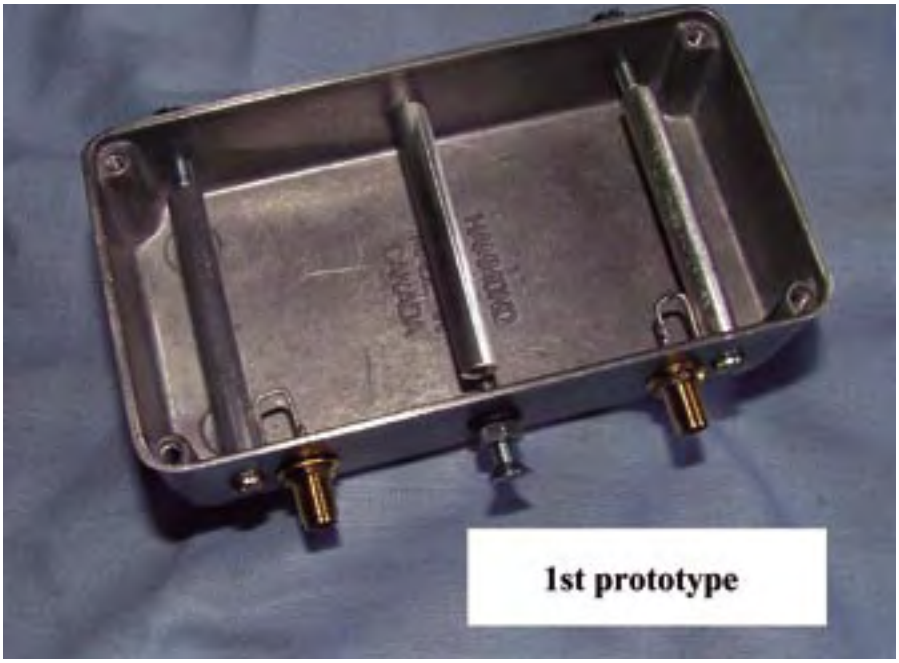
Conclusion

Building this filter and achieving the design goals on the first iteration certainly gives encouragement for future designs, any developments will be posted on my website www.radio-kits.co.uk, I may be also be contacted at cg@radio-kits.co.uk

References

1 Original design - http://www.w6pql.com/23cm_filters.htm

2 On-line design program - http://www.wa4dsy.net/cgi-bin/idbpf



1st prototype

Satellite TV News

By Paul Holland G3TZO

Welcome to the first Satellite TV News of 2004. The forthcoming year promises continuing growth in the use of satellites to deliver DTH broadcast and point to point TV and radio services. With the launch of e-bird we will hopefully see much greater availability of broadband Internet services aimed at domestic users. This growth in demand for satellite bandwidth is important for all satellite operators as improvements in video compression technology has left unused capacity on many satellites. This over capacity has led to something of a drought in the launch of major new satellite capacity over Europe this coming year. Those satellites that are going up now tend to be for resilience and back-up purposes or to serve a specific region such as Hellas Sat 2 at 39.0 Deg E.

HDTV to grow in Europe

Last year I forecast that at last we may soon see the introduction of HDTV broadcasts and that satellite delivery will be the key to early adoption. With Europe's first HDTV channel, Euro1080, launched in January, new research has revealed that by 2008, Europe is likely to account for approximately 4.7 million HD TV sets shipped, or about 15 per cent of total world-wide shipments.

Those behind Euro1080 hope it will become an early precursor to HD broadcasts becoming commonly available in Europe. Cheaper flat-panel displays and HD-DVD players will be important in building a base of potential European HD viewers. According to a recent study, the world-wide market for HDTV displays will to grow to over 33 million by 2008, up from just over 4.3 million in 2002. Currently, the US dominates the HDTV market and accounts for nearly half of worldwide sales, with Japan accounting for about 35per cent.

New HDTV Consumer Receiver

Taiwanese manufacturer Zinwell has just announced the launch of its HDX 410-HDCA HDTV receiver, which is being promoted in conjunction with the Euro1080 launch. Although details of a UK distributor are not yet available the receiver has an interesting specification as summarised below;

- Able to Decode DVBS QPSK Transmission
- Irdeto CAS Embedded
- * HDTV and SDTV Display Support
- Teletext
- AUX in for DVD/ VCD Composite Input
- Aspect Ratio Adjustment 4:3(16:9 Crop) 4:3(16:9 Letter Box), 16:9(4:3 Pillar Box)
- Video/Audio Connectivity Including YPbPr, Composite, S-Video, SPDIF Output
- Output Format 1080i, 720P, 576P and 576i
- User-Friendly OSD and Operation
- Favourite Channels Selection
- S/W Upgrade able Through RS-232
- Parental Guide and Rating Control
- Picture in Picture (PIP) Support
- Electronic Program Guide (EPG)
- DiSEqC 1.0
- Dolby (Ac3) Audio

The retail price is likely to be around £400.

RUSSIA ADOPTS DVB STANDARD

Russia has decided that it will adopt DVB (Digital Video Broadcasting) as its national standard of digital television for both satellite and terrestrial services. The decision was based a survey of all the other digital TV standards currently in use worldwide. The decision to go with DVB also reflects the results of detailed pilot studies and Russia's own domestic experience of digital ground-based and satellite TV broadcasting.

Transponder News

As usual the following snippets of news below represent a tiny fraction of the changes taking place on an almost hourly basis. For up to the minute news of changes visit the following two excellent sites; http://satcodx.com/uke/ and http://www.lyngsat.com/ whilst Stefan Hagedorn provides daily email updates of the changes which are taking place at http://stefan.hagedorn.de/transpon2.htm. For more detailed information on active feeds try http://www.satelliweb.com/.

Europestar 1 45.0 Deg E

A feed identified as Kingston UKI 706 has been noted on 12.656 GHz (V) SR 3398, FEC 3/4.

Hellas Sat 2 39.0 Deg E

With the Olympics being held this summer in Athens it is certain that Hellas Sat will carry a significant proportion of the enormous amount of traffic that will be generated by the games. At the time of writing the first multiplex is testing here on 12.524 GHz (V) SR 27500, FEC 3/4. It contains ERT, Cyprus Sat, MKTV Sat, RTS Sat and an OTE promo. All are free-to-air. A promo for Al-Islah TV has also started on 11.541 GHz (H) SR 8680, FEC 3/4.

Eutelsat W4 & Sesat 36.0 Deg E

Occasional feeds can be seen on 11.469 GHz (H) SR 6111, FEC 3/4 and 11.079 GHz (H) 5632 ¾.

Arabsat 2B 30.5ºE

Several channels have moved here recently. Sudan TV has left 12.525 GHz (H) for 12.520 GHz (H) SR 3000, FEC 3/4. ERI TV is now on 12.530 GHz (H) SR 3000, FEC 3/4. Algerie 3 has moved to 12.525 GHz (H) SR 3200, FEC 3/4 from 12.509 GHz (H)

25.8ºE Arabsat 2D

The Kuwait Space Channel has been replaced by KTV1, the Kuwaiti domestic channel, on 11.000 GHz (H) SR 3500, FEC 3/4. Al-Jazeera Sports has launched on 10.971 GHz (H) SR 17777, FEC 3/4 within the Qatar bouquet.

Astras 1 19.2 Deg E

Austria's TV6 has started regular programming on 12.226 GHz (H) SR 27500, FEC 3/4. 2M Maroc is currently free-to-air on 11.567 GHz (V) SR 22000, FEC. Television de Espana Internacional has opened on 11.597 GHz (V) SR 22000, FEC 5/6. The internet-service Sat@Once has launched on transponder 12.604 GHz (H) SR 22000, FEC 5/6.

Eutelsat W2 16 Deg E

7 Gold has launched on 11.025 GHz (H) SR 2894, FEC 3/4.

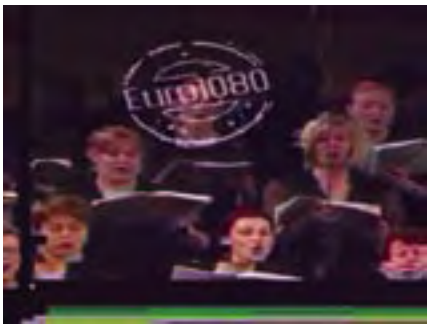
Hot Bird 6 13.0 Deg

Dance TV has launched within the RTV Slovenija package at 12.303 GHz (V) SR 27500, FEC 3/4. An Italian channel, Iride TV, has launched within the NTI bouquet at 11.200 GHz (V) SR 27500, FEC 5/6. Roma Uno and Videlook Channel promo have launched on 11.137 GHz (H) SR 27500, FEC 3/4. NASA TV seems to pop up on various feeds across the Clark Belt from time to time. This feed was observed on 10.949 (V) GHz SR 27500 FEC 3/4. Cubavision Internacional can be found now on 11.304 GHz (H) SR 27500, FEC 3/4.

Sirius 2 & 3, Astra 1A 5.0 Deg E:

Pro TV International has started on 12.449 GHz (H) SR 12130, FEC 7/8. ESPN Classic Sport Europe has started on 12.111 GHz (H) SR 27500,FEC 5/6, FTA with English sound and is likely to join Sky Digital some time later this year.

Euro1080 has been testing its wideband cinema link in HDTV on 12.188 GHz (H). SR 27500, FEC 3/4. The picture will not lock on my Nokia 9600 but transmissions could just be identified as seen below.



Thor 2A/Thor 3, 0,8 Deg W

FAN TV has started on 12169 GHz (H) SR 28000 FEC 7/8.

Atlantic Bird 2, 8 Deg W

The Syria Satellite Channel has started on 12.747 GHz (H) SR 2894, FEC 3/4.

Atlantic Bird 1 12.5 Deg W

D Gay TV has launched on 11.153 GHz (H) SR 2892, FEC 3/4 in free-to-air MPEG-2. It has replaced the al-Arabiyah feed stream which was available here previously.

Intelsat 901 18.0 Deg W

Check out 11.676 GHz (V) SR 6111, FEC 3/4 for various feeds. This feed from New York was captured back in November.

Telstar 1 21.5 Deg W

WorldNet Persian is now available in the US/Iranian package on 12.577 GHz (H) SR 13020, FEC 3/4 in free-to-air MPEG-2.

Intelsat 907 27.5 Deg W

Occasional news feeds can be seen on 10.959 GHz (V) SR 6140, FEC 7/8 and 11.558 GHz (V) SR 40000, FEC 7/8.

Hispasat 1 A-D, 30 Deg W

ManaSat 2 is now free-to-air on 11.682 GHz (V). Occasional news feeds are on 11.771 GHz (H) SR 27500, FEC 3/4,

Telstar 11 37.5 West

UKI-694 Feeds can be observed on 12.716 GHz (V) SR 13333 FEC 3/4.

Recent Launches

New Channels

Launch delay

The pre Christmas launch of the first South African channel NSAT on Sky Digital has been put back to the first quarter of this year. The reasons given by NSAT give an interesting insight into the process of launching on Sky Digital.

According to NSAT BSkyB can only launch 3 channels per week and each new channel is assigned 3 channel numbers. For example if the NSAT channel number is 270, they would also receive channel number 269 & 271 in reserve format in case they needed to add more channels later i.e. Discovery Channel and Discovery +1 Hour etc. There is apparently a huge waiting list for new channels to be launched, which means if you miss your initial agreed launch window you may have to wait several months for a new date.

BBC World on TB+

BBC World programming will be dubbed into Russian by TB+ a new satellite channel which was due to launch before the end of the year. Featuring news and lifestyle programming from BBC World together with documentary and factual programming from Russian programme makers, TB+ will initially broadcast 12 hours a day via the Hot Bird 2 satellite extending to a 24-hour service by spring 2004. TB+ will be available free to air across Europe and Russia broadcasting from the London Playout Centre.

Asian TV channel planning UK launch

Asian broadcaster Doordarshan is reported to be planning the launch of some of its services in the UK on Sky Digital. Doordarshan plans to go free-to-air according to press reports. The channels could include Doordarshan's 24-hour news channel.

Sky Digital

New channels for the UK are scheduled to launch in the New Year. FX UK, an entertainment channel from Fox International Channels was due to launch on Sky Digital in January. Separately, the Horror Channel, a new service dedicated to fans of the scary movie genre, will launch on Sky Digital in March. A sister channel, L'Amore, originally called the Romance Channel, will launch in October 2004. It will occupy the same EPG slot as the Horror Channel during the daytime. The channels will then be split into separate, 24-hour services, with the Horror Channel showing murder mysteries in the daytime.

AlbaniaSat

AlbaniaSat has launched on Eutelsat's W2 at 16.0 Deg E, 11.449 GHz (H) SR 14000, FEC3/4 with a mix of general entertainment and thematic channels from Albania, Kosovo, Montenegro and Macedonia. The platform is launching with five channels including TV Klan, Albania's leading commercial general entertainment channel, two thematic channels (family and film) and Fashion TV. AlbaniaSat's objective is to build up to 12 television channels and 10 radio stations. AlbaniaSat will encrypt in Irdeto 2 at some point early this year.

Upcoming Launches

As usual the launches in the table below are subject to revision.

AMOS 2

As we closed for press the Israeli AMOS 2 Satellite began integration with its Soyuz/Fregat launch vehicle. Lift-off of the telecommunications satellite, owned and operated by Israel-based SpaceCom, was targeted for late December from the Baikonur Cosmodrome in Kazakhstan. AMOS 2 had a lift-off mass of 1,370 kilograms and will be positioned at 4 Deg W over the Gulf of Guinea. The satellite carries a payload of 22 Ku-band transponders and will provide distribution of digital TV channels and business data for private/public networks.

Amos 2 Fact file

Orbital location - 4°W

Number of transponders - 11 active, 3 redundant

Transponder bandwidth - 72 MHz

Frequency band - Ku

Antenna Polarisation - Linear

Mission life - 12 years

European Beam Parameters;

- Number of transponders - Up to six
- EIRP at beam centre - 57 dBW
- G/T at beam centre - 14.5 dB/k
- Uplink Frequencies - 13 to 13.25 GHz & 13.75 to 14 GHz
- Downlink Frequencies - 10.7 to 10.95 GHz & 11.45 to 11.7 GHz
- Polarisation -
- Uplink - Vertical
- Downlink - Horizontal

Technology

Satellite Internet in UK

SES Astra has teamed up with AVC, a UK-based network and communications company, to launch a broadband satellite Internet service for the UK. This is the first truly nation-wide UK satellite Internet service according to the companies. The high-speed package provides 512k download speeds, with unlimited Internet access and will be available across the UK from 1 January 2004. The service is primarily targeted at the 29 per cent of UK households

Date	Satellite	Launcher	Location	Comments
030822	E-Bird	Ariane 5	33.0°E	20 Ku tps
0307-09	Yamal 202	Proton	49.0°E	18 C tps
0307-09	NSS 8	Zenit 3	57.0°E	36 Ku and 56 C tps
0312	Express AM 22	Proton	53.0°E	24 Ku tps
03 late	Eutelsat W3A	Proton	7.0°E	50 Ka & Ku tps co-located with Eutelsat W3
04	Europe*Star 2		45.0°E	30 Ku tps
0401	Amos 2	Ariane	4.W	11 Ku tps
0401-03	Intelsat 10-02	Proton	1.0°W	16 Ku and 45 C tps replacing Intelsat 707
Q1 04	AMC 12	Proton	37.5°W	72 C tps will replace Satcom C1
04	Africa-Mea Sat		5.7°E	12 Ku and 24 C tps
0408	Express AM 1	Proton	40.0°E	18 Ku and 9 C and 1 L tps will replace Express 1R
0507-12	Astra 1KR		19.2°E	32 Ku tps will replace Astra 1B and Astra 1C
0509-12	Hot Bird 7A	TBA	13.0°E	38 Ku tps will replace Hotbird 1
05-06	Rascom 1		2.9°E	12 Ku tps and 8 C tps 7 spot beams
06	Astra 1L		19.2°E	2 Ka tps and 29 Ku tps

who do not have access to terrestrial broadband services. There will be an initial installation and set-up charge, which covers the provision of a dish, cabling and USB satellite modem. AVC Broadband uses the regular phone line and modem for the return path (uploading), so customers can retain their existing ISP and email addresses. The service will use Astra's satellites located at 19.2 and 28.2 Deg E.

Sogecable to stay on two satellites

There is good news for those people with fixed dishes who receive either Canal Satelite Digital or Via Digital. Spanish pay-TV operator Sogecable has signed up with both Astra and Hispasat to broadcast its recently merged digital DTH platform Digital+ until 2017. By continuing the satellite contracts, Sogecable will not have to force half of its customer base to realign their dishes. Previously, Astra beamed services to Sogecable's Canal Satelite Digital, while Hispasat handled Via Digital.

Recent Launches

E-Bird Launch

On September 28 an Ariane 5 rocket from Kourou, French Guiana, successfully launched E-BIRD, the first satellite in the world to be specially designed for two-way broadband communications. After a series of in-orbit tests the satellite entered service in November at 33.0 Deg E providing coverage of Europe and Turkey.

The launch of E-BIRD is an important step in enabling satellites to bridge the digital divide by serving areas not currently served by ADSL and other terrestrial broadband technologies. The particular bandwidth efficiency of E-BIRD has been achieved through a mix of transponders that accommodate the asymmetric nature of Internet traffic between requests and content delivery. This configuration has been coupled with high gain beams so that users can have broadband connectivity for high-speed Internet access and Virtual Private Networks via sub one metre antennas.

Transmissions to service providers will be routed through the four 108 MHz bandwidth transponders and the return path will be routed through the sixteen 36 MHz bandwidth transponders. Hub stations connected to the Internet backbone will receive the signals from users and send content back in high-power. Through E-BIRD 's proximity to Eutelsat's EUROBIRD 1 satellite at 28.5 Deg E it will be possible to bundle digital television and radio channels with one-way broadband services by use of a twin-feed receive antenna. E-BIRD is pictured below during its manufacture by Boeing.

Off Air

The activities of the European Space Agencies Mars Express probe were headline news during late December. The ESA provided coverage of the event with daily new, features, images and videos on Astra 2C at 19.0 Deg E 10.832 GHz (H) SR 22000, FEC 5/6. Sadly at the time of writing the Beagle had not landed and scientists involved were trying to put a brave face on things.

Conclusion

That's it again for this edition. There was no Post Bag this time around but please do write in and let me know what you are doing and let me have your news and views on any satellite TV related news matters. As usual the contact details are the same; email via paul.holland@btinternet.com or phone to 01948 770429.

Members' Services

All prices in UK pounds (£)	Each	P&P	Qty	Total
Camera Tubes, Scan Coils, Bases & Lens Mounts				
3 One inch Vidicon base	£1.20	£0.30		
4 2/3 inch Vidicon base	£0.80	£0.30		
Video and I²C Circuit Boards/Components				
7 Sync pulse generator PCB	£14.00	£0.43		
40 I²C CPU PCB	£10.00	£0.43		
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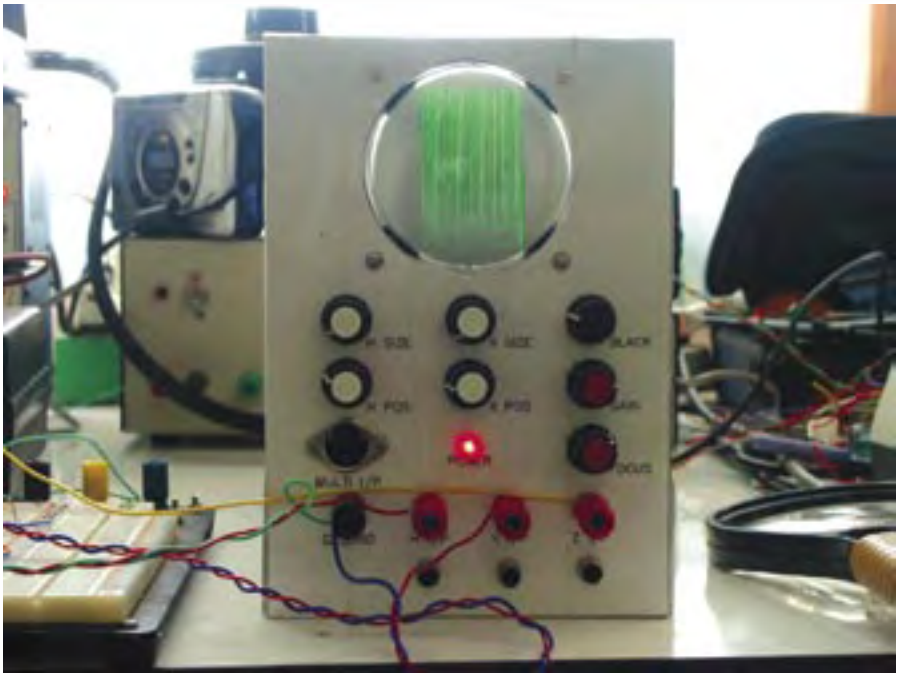
A NBTV Non-Mechanical Monitor

By Steve Anderson

Email steveand@samart.co.th



This article describes the construction of a non-mechanical display for NBTV signals using a low voltage 'scope tube. This unit is based around a 3in DG7-32 or a DG7-32/01. This tube has a medium persistence green phosphor. It is not that bright, and needs to be viewed in subdued lighting akin the J. L. Baird receivers, but you do not need to sit in darkness!

Caution

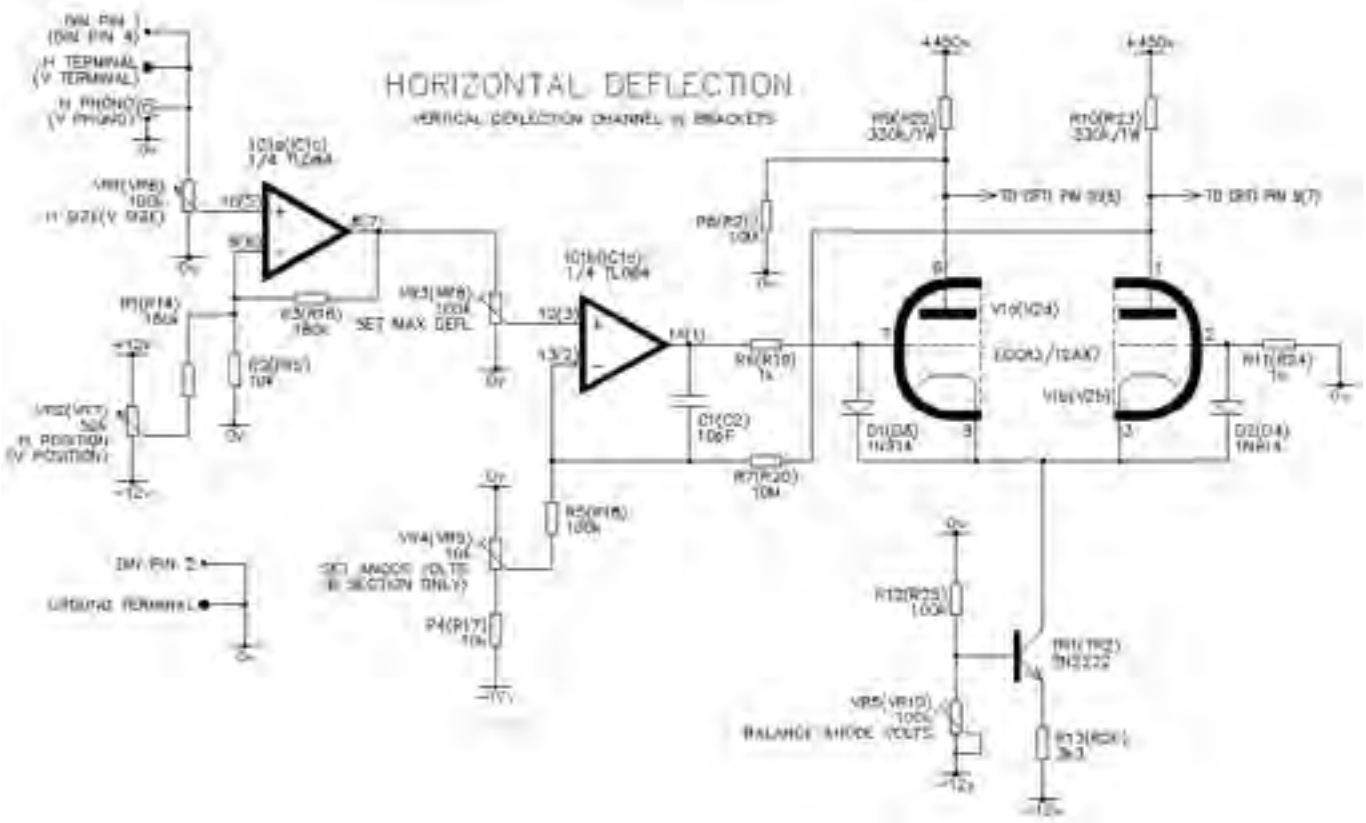
This unit uses both high AC & DC voltages as well as AC voltages biased at high DC voltages. The author in no way accepts responsibility for any injury, fatality or incident as a result of anyone attempting this project. There are at certain points in the power supply, deflection circuits, video circuits and others of well over 1000 volts of potential difference along with the 120/220/240V power input. Your safety is up to you. Do not work on this alone.

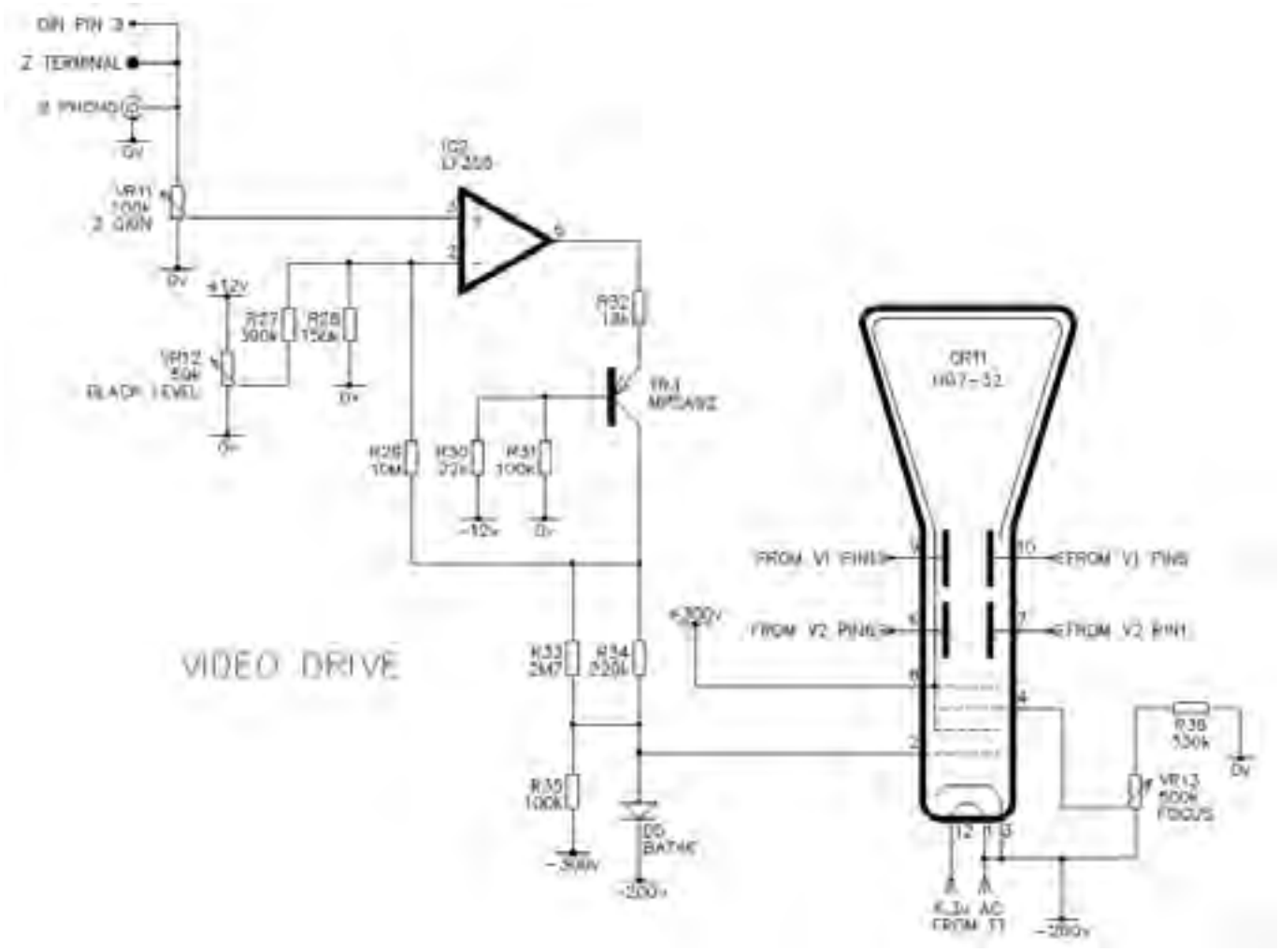
General description

This was built as two separate units, the display and a separate signal part. It is entirely possible to build it as a dedicated NBTV monitor as there is plenty of room within the chassis and capacity in the PSU to add the NBTV circuits.

The hardest part was generating the necessary CRT and valve voltages. Two transformers were used, one for the solid-state part, tube and CRT heaters, the other to generate the high voltages for the valves and CRT.

It would appear that there is no source of Mu-Metal screens for this tube. It is very sensitive to external magnetic fields, especially near its base. The transformers seen in the photographs were eventually removed from the chassis into an external PSU box. Toroidals are a possible alternative. Although the modulation created by these magnetic fields was not that excessive, it was annoying enough to





require them to be removed from the chassis.

The intention at first was to keep this an all solid-state device with the exception of the CRT, and indeed it is possible. But getting small high voltage transistors with a Vceo over 300V here is difficult. In Europe and the US there should be no problem.

The power supply and CRT circuit

The most important criteria for the CRT is to ensure that the electrostatic deflection plates are on average at the same potential as the a,g2,g4 (pin 8) voltage of the CRT. This will give a well-focused spot on the screen in addition to manually varying the g3 (pin 4, focus) voltage. This means differential drive to the deflection plates. A single-ended deflection plate drive can lead to a trapezoidal shaped display and de-focusing at the screen edges.

The DG7-32 has quite a wide spread of operation voltages, from 400V cathode to anode, up to 800V. The higher voltages yield a brighter trace at the expense of reduced deflection sensitivity. Another 100V or so is needed for the negative grid bias. Here the CRT is run at 500V plus 100V grid bias so that a +/-300V supply is adequate.

However, with the proviso that the deflection plates should ideally be at the same average potential as the CRT a,g2,g4, more positive voltage is required for the deflection circuits. Calculating the worst-case deflection factors about +450V is needed for the deflection circuits. AC coupling could be used to reduce the positive supply voltage, but there was a requirement to keep the deflection circuits DC coupled throughout for very slow waveforms (SSTV).

The power supply is very simple. Two identical transformers are used in a back-to-back arrangement and the output is voltage doubled to an approximate +/-570v. Simple Zener stabilization is employed as the current requirements are quite low, about 3mA maximum both positive and negative for the CRT, 2mA positive for the deflection output circuits, and 2mA negative for the video output and focus circuits.

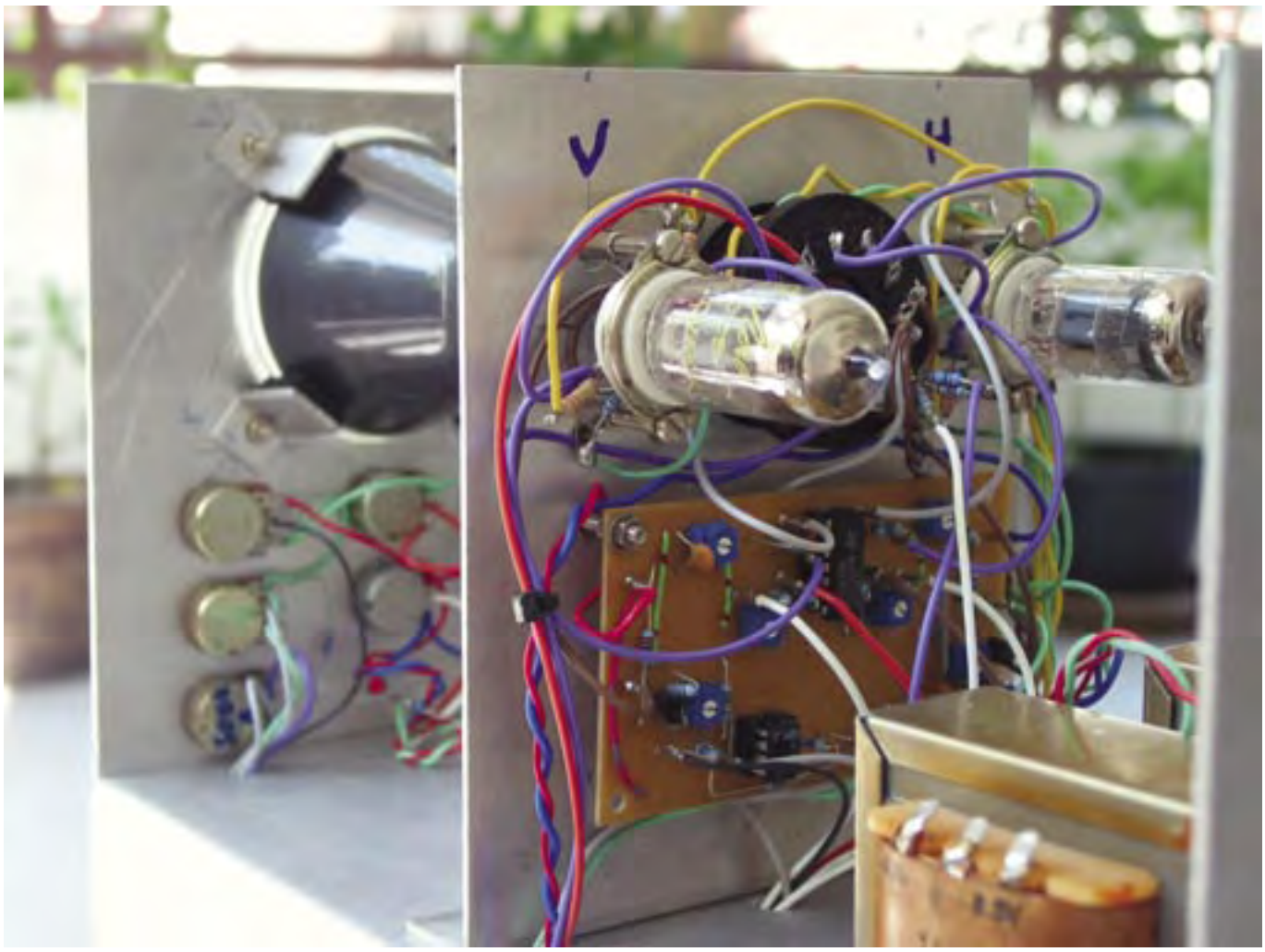
Quite large reservoir capacitors are used as these were to hand; anything upwards of 47uF should do fine. Two 400V units in series on the output of the doublers with voltage equalizing resistors across them are utilized, which also acts as a power-off discharge path, albeit with a long time constant, so give it time before putting your hand in there!

The +/-12V regulated supply is entirely conventional. The transformers can be standard 12-0-12 units for the +/-12v supplies. A 20VA or so transformer will supply a little over 12v RMS as the DC loading is so light, about 17mA positive, 21mA negative, and should also be fine for the 12.6v tube heaters, R38 & R39 could then be omitted or at least reduced in value.

The deflection circuits

Two ECC83/12AX7 valves are used for the deflection circuits in the absence of suitable transistors. They are run near the limit of their voltage ratings, but well within their dissipation limits. The valves and the sockets are still in current manufacture and easy to obtain.

The output impedance is quite high (about 77k) in an effort to keep the HT current low and coupled with the



inherent valve and stray capacitances does limit the bandwidth somewhat, but it's more than enough for NBTV or SSTV. Because the feedback is taken from only one of the valve's anodes, there is a slight imbalance in the frequency response at the extreme high-frequency end to the deflection plates, but it doesn't seem to be an issue for NBTV.

In an attempt to standardize things, it was chosen that the input to the monitor should provide full deflection from a +/-1V sawtooth or other waveform. Although given a suitable configuration the ECC83's might just provide the gain to do this on their own, it was desirable to incorporate some negative feedback, which requires higher open-loop gain than the valves on their own can provide. IC1b and IC1d provide this additional gain and the feedback is taken from one of the tube's anodes.

Diodes D1 to D4 are to prevent 'cathode stripping' during warm-up of the valves by ensuring that the grids only go positive relative to the cathodes by about 0.7V. Once the valves are warmed up the diodes are effectively out of circuit with a couple of volts of reverse bias.

IC1a & IC1c provide a gain of about 20, with the 'size' pot at about halfway and a +/-1V input waveform the IC output will be getting close to the supply rails. Any more input and the output will hit the supply rails and limit the deflection of the beam to the flared portion of the tube, which has the anode conductive coating. This was done to limit over-deflection when experimenting with external, sometimes faulty(?), circuits.

The two deflection circuits are identical and the valves are used in a differential circuit, fed via constant-current sources TR1 and TR2. The horizontal (Frame in NBTV) needs more drive than the vertical, but there is enough gain to do this. R8 & R21 are to balance the DC conditions in the anode circuits due to the feedback resistors R7 & R20.

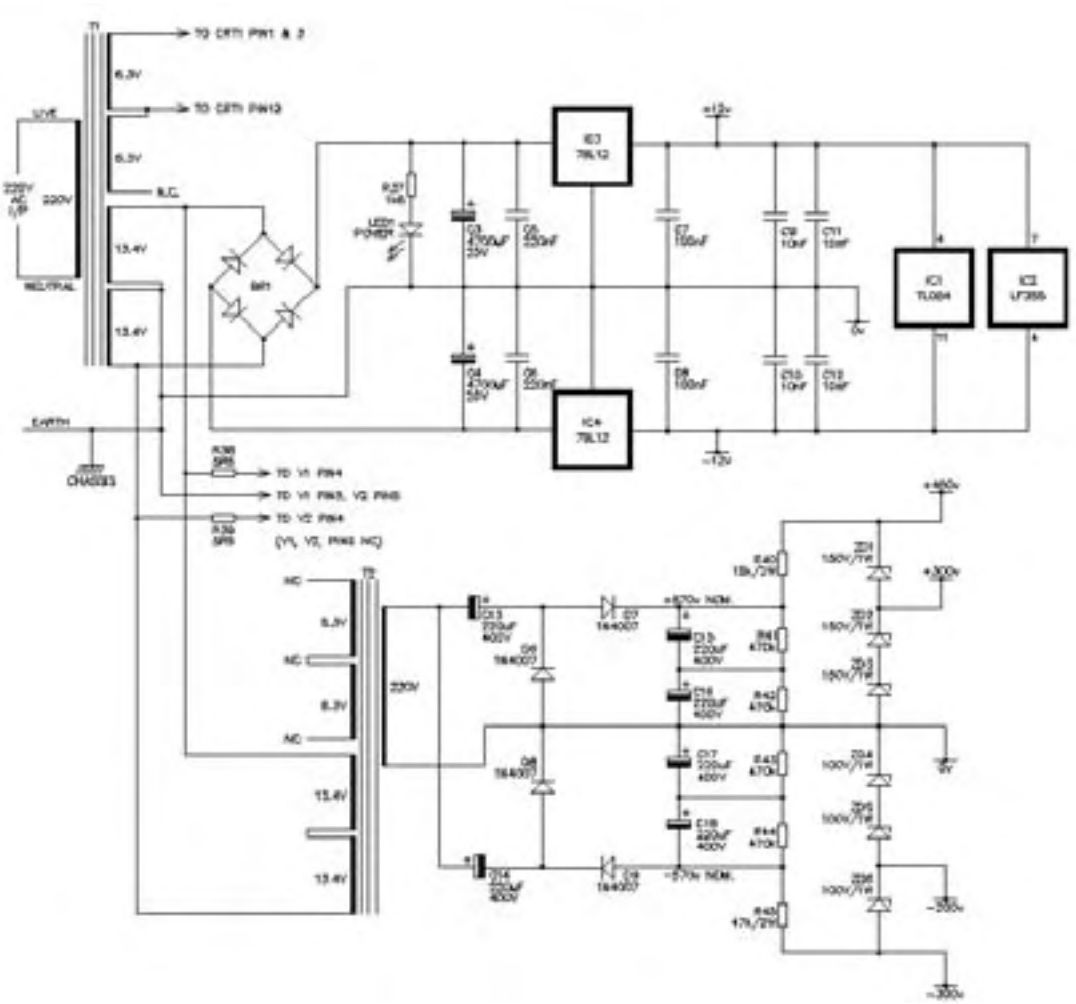
Layout is important, as there are several points that are of high impedance, particularly around the inverting input of IC1b, IC1d and the anode circuits of the tubes. C1 and C2 serve to limit the bandwidth of the amplifiers as well as keeping them stable. In the photographs you will notice that as much as possible has been 'flown' in this area to keep stray capacitance to a minimum. Also the 1k resistors in the grid circuits of the tubes must be right at the socket to stop parasitic oscillations.

The video drive for the tube grid

Here, in the absence of a 'pnp' vacuum valve (how I wish), an MPSA92 transistor (TR3) is used to drive the grid of the CRT with the video waveform. There is feedback from its collector to the input of the driving op-amp (IC2) making it linear. The output is attenuated by the combination of R33, R34 & R35 so that the grid of the CRT can never be driven positive relative to the cathode. D5 also ensures this. Tempting though it may be, do not use something like a 1N4004, as the junction capacitance is too high at around 30pF. A 1N914/4148 is also unsuitable as its reverse voltage rating is only 75v. Otherwise, the bandwidth at the CRT grid is in excess of 80kHz with a distortion figure similar to the deflection circuits (see later). Again, this circuit is DC coupled.

General notes & set-up

The unit should be built, tested, set-up and run for a while before fitting the CRT. Check everything is operating correctly and the voltages on the CRT base are also correct.



This circuit is DC coupled and care is needed when setting these circuits up, as even a 1Meg input DVM or a 10Meg 'scope probe can upset the circuit. Set VR4, VR5, VR9 & VR10 to mid-travel, VR3 & VR8 at the ground end of their tracks. Switch on without the CRT fitted, and let the unit warm up for 30 minutes or so, whilst doing so check that voltages are in the right ballpark. Set the anode volts of the 'b' section of each valve (Pin 1) by measuring between it and the +300v rail, aiming for a null with VR4 & VR9. Do the same between the two anodes, adjusting VR5 & VR10 for a null. Go back and check the anode volts and adjust if needed. An error of 5V or so is OK. This might need to be repeated once the CRT is fitted - it is worth checking anyway.

Apply two different signals to the H & V inputs and adjust to give about 100v p/p at each anode. Turn the black level to give the most negative at the CRT grid. Power off and wait for the capacitors to discharge.

The moment of truth…insert the CRT, power-up, wait thirty seconds or so then gradually ease up the black level. If all is OK an almost random trace should be seen on the screen. Adjust the focus, feed in a signal to the Z input to check that the grid modulation is working. After setting the anode volts and balance set VR3 and VR8 to take the trace just to the edge of the tube when an input signal is driving the outputs of IC1a and IC1c just to the point of clipping.

After a good soak, (the unit that is) check the valve anode volts and balance one last time, adjust if needed. If all is OK, it's time to move onto the sync and timebase circuits which will be covered in a future issue.

A note on parts

The op-amps could be replaced by the Burr-Brown OPA137/2137/4137 series, in single, dual or quad packaging. Also the Texas TL061/2/4 series, but being 1MHz gain-bandwidth devices the frequency response might be compromised, but probably still more than enough for NBTV. National Semiconductor LF356's could also be used, but they are a little power hungry and only in single packages. The quad LF347 is suitable too.

Resistors could all be 5%, perhaps with the exception of the valve anode load resistors at 1%. For the anode loads only 5% parts could be bought at this wattage, so they were matched as pairs from a batch of ten with a DVM to better than one percent, the actual value not being that important.

Transistors, with the exception of the video output transistor, are NPN small-signal generic, 2N2222, BC107, BC184 etc. There is not so much choice with the PNP video output transistor, but I think that the MPSA92 is easy to obtain. The 2N6520 and BF488 are also possible.

Valve selection is also important and although most from several suppliers were OK, there were a few suppliers tubes that just didn't make the grade, the worst being from Russia, even though these were new tubes they were nowhere near their specification. It is suggested you buy more than you need. With a good valve the deflection circuits, used as an audio amplifier to check their linearity, provided over 250V peak-to-peak at each anode (500V differential) at less than 0.1% THD. Although the output has an offset of +300V, which is needed here, it is DC coupled.

Further developments

It is also planned to try to operate the tube at a higher negative cathode/grid/focus voltage to obtain a brighter trace. This will require a rearrangement of the power supply (transformers already to hand) to give –500v on the cathode and –600v for the grid drive circuit, which will probably need an opto-isolated grid drive arrangement. There would appear to be plenty of deflection drive available from the existing circuits. Updates will be given in due course.

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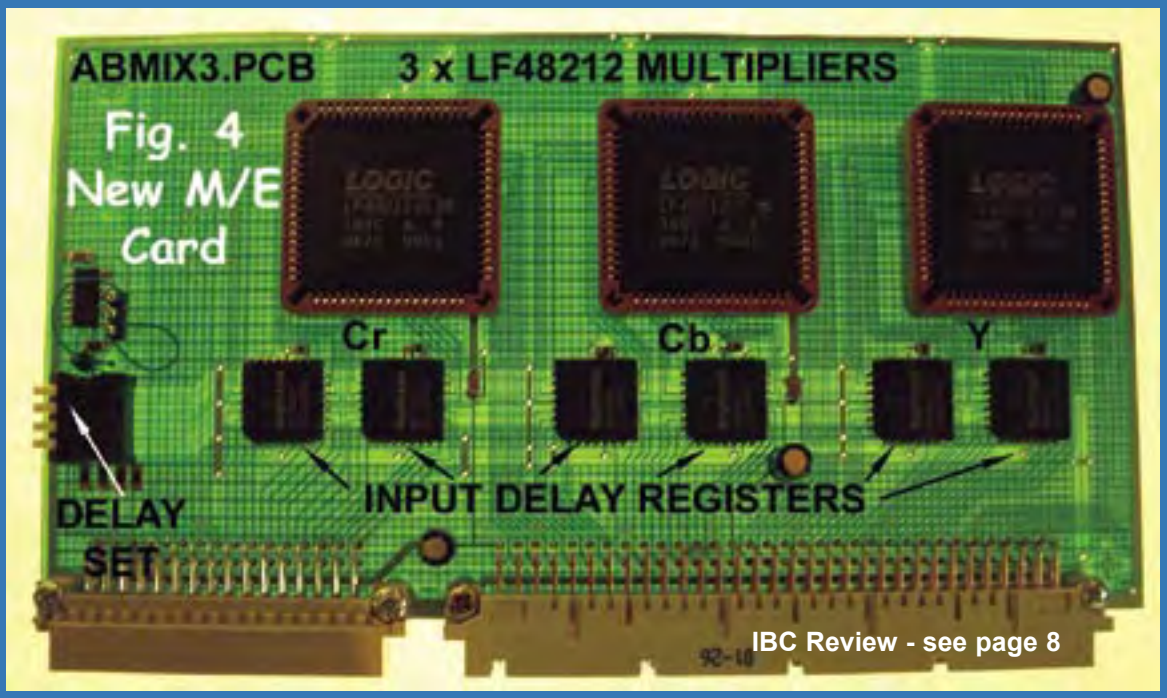
Figure 1

Figure 2

See Brian Kellys article on page 14



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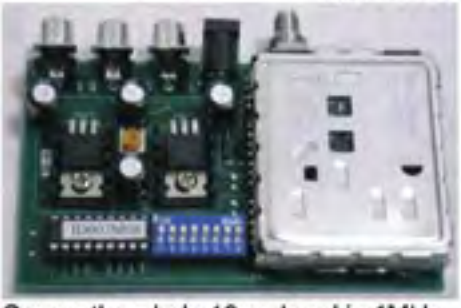

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