CQ-TV 203

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BATC

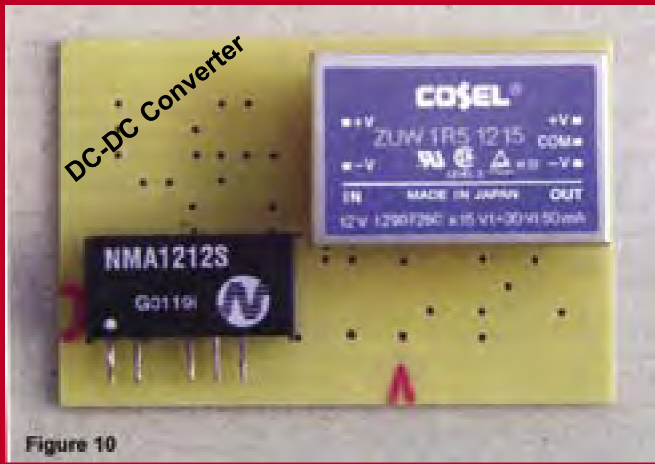
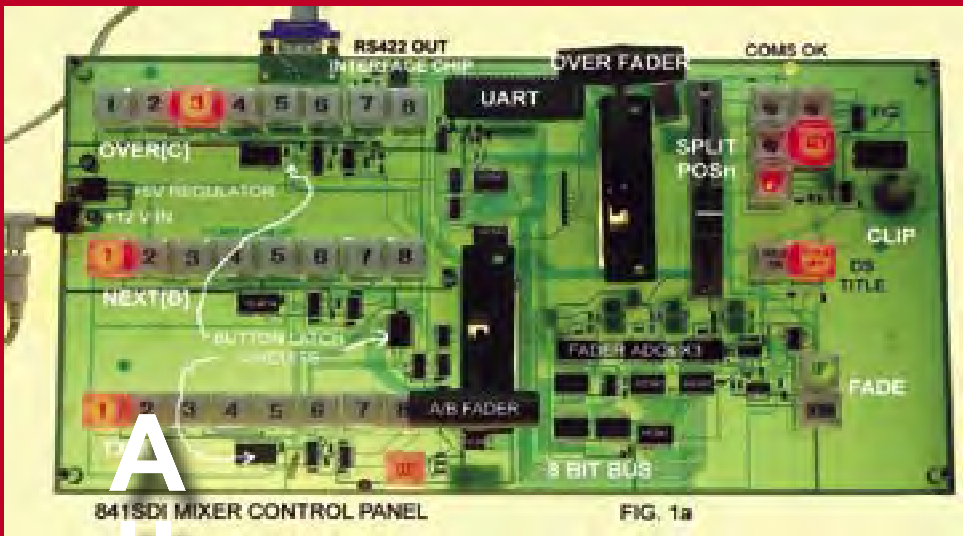


Figure 10



841SDI MIXER CONTROL PANEL FIG. 1a

August 2003

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Contents

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Chairman's Column

I think we have had what must amount to a record number of phone calls and emails, all asking the same question "*When is the BGM?*" I never realised it was such a popular event! The short answer is that we hold a BGM every two years and this is not a BGM year; the BGM is next year. But, with so much interest we thought we would put an event together this year, so on **August 31st** we will be holding a BATC Open Day.

This will take place at the RAF museum at Cosford, along with the Telford Amateur Radio Rally. The BATC has been offered the use of a room and will be running demonstrations, which I hope will include DATV. We are also looking into having a live lecture and all the other fun events which have been part of BGMs. The only part missing will be the official meeting to hear from the committee and to elect new committee members (you will have to wait until next year for that).

I hope the RAF museum, along with the Telford Amateur Radio Rally and the BATC Open Day, will create an interesting day out for all the family, and I look forward to meeting you all there.

Trevor Brown, (BATC Chairman)

Check for the latest information on the BATC web site - www.batc.org.uk

If any member is at IBC in September [12th -16th], and wants a word with the President, or would like to buy him a beer, he will be found in the Technical Facilities headquarters in Room M at the RAI

A Hexadecimal Reader for Digital Television Experiments

Richard L. Carden VK4XRL

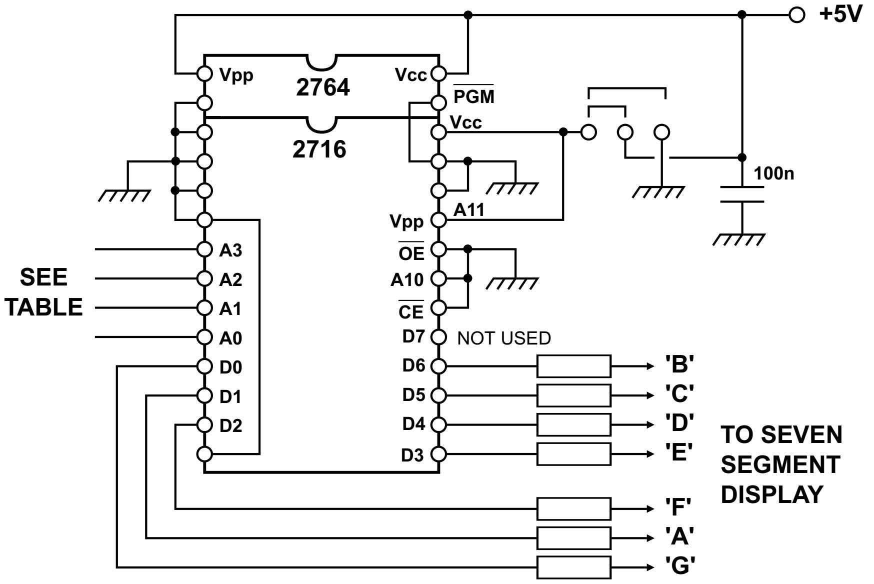
As a follow up to the digital articles from Mike Cox, this hexadecimal reader was built for testing the digital signal path as explained in those digital articles. Separate seven segment readers with in built decoders are available at RS (TIL311 P/N 586-734) but at a price. However most will have in their junk box an assortment of EPROMs and seven segment display units. The costs associated with this approach are very small.

Two EPROMs are used for decoding the 4-bit hexadecimal binary code to feed either separate or dual seven segment displays via suitable current limiting resistors. Room was left on the PCB to include a buffer if deemed necessary later on during experiments. 28 pin machine IC sockets have been used for the eproms, and the wiring arranged to allow for different EPROM types that maybe at hand.

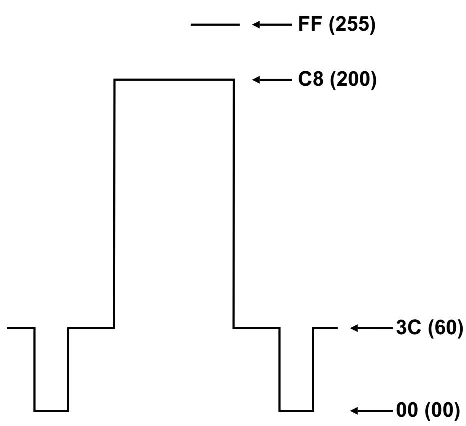
The EPROM table shown should be programmed into the EPROM and any unused cells must be filled with “00”. Wiring of the unit is straight forward and can be built on vero board or the like. The diagram shows how the EPROM 28-pin socket is wired to accommodate the different EPROMs. The seven segment displays should be wired so that the MSB display is on the left and the LSB display on its right. The input is supplied on an IDC10 connecter and is wired as per the standard set by Mike Cox. The waveform shows the hexadecimal values used for composite video inputs. The photo shows the wiring used on the prototype and space for the number generator.

EPROM PROGRAM

Byte	Hex	D6	D5	D4	D3	D2	D1	D0	Code
0	0000	1	1	1	1	1	1	0	7E
1	0001	1	1	0	0	0	0	0	60
2	0010	1	0	1	1	0	1	1	5B
3	0011	1	1	1	0	0	1	1	63
4	0100	1	1	0	0	1	0	1	65
5	0101	0	1	1	0	1	1	1	37
6	0110	0	1	1	1	1	1	1	3F
7	0111	1	1	0	0	0	1	0	62
8	1000	1	1	1	1	1	1	1	7F
9	1001	1	1	1	0	1	1	1	77
A	1010	1	1	0	1	1	1	1	6F
B	1011	0	1	1	1	1	0	1	3D
C	1100	0	0	1	1	1	1	0	1E
D	1101	1	1	1	1	0	0	1	79
E	1110	0	0	1	1	1	1	1	1F
F	1111	0	0	0	1	1	1	1	0F



IDC PIN	EPROM	
1	A0	LSB
2	A1	
3	A2	
4	A3	
5	A0	MSB
6	A1	
7	A2	
8	A3	
9	GND	
10	NOT USED	



Silent Key

Very sorry to report that Ken Wood died on May 20th. I had known Ken for many years dating back to the early days of Slow-Scan TV when Ken compiled a list of articles on SSTV appearing in American magazines. I was able to add to his list by referring to articles published on this side of the Atlantic, I stayed with Ken and his wife Christine in 1993 and was privileged to appear on the Amateur Television Network of Southern California. My last meeting with Ken was in July 2002 when his health was failing and he was on a permanent oxygen supply. His smoking habit had caught up with him. To his credit he did make an effort and gave up smoking but it was too late.

Ken was always a person with a sense of fun, he told everyone that all his equipment was made with his name on it ....”Kenwood”. His interests ranged from Amateur Radio to Amateur Television, including Slow Scan TV and weather satellite reception and he always regretted that the young people of today were not as interested in construction as he had been. “Kids need curiosity to succeed”

Ken and Christine came over to England on one occasion and attended the BATC Convention. Ken thoroughly enjoyed the trip and when he arrived back home in Fontana he told me that he stood on his own doorstep and thought “I shouldn’t be here, I should be back in England”. Ken had a zest for life which made him a lot of friends and he will be sorely missed.

From his friend, Grant Dixon

UK Repeaters – a report

By Graham Shirville, G3VZV

Having been involved with ATV repeaters since there inception in the UK some twenty years ago, I have been asked by the RSGB Repeater Management Committee to provide a general update on the present situation regarding the current applications that are in the pipeline.

When we first started with ATV repeaters, just on 23 cms, it took some three years for the original batch of applications to be cleared by the authorities but since the early days, the time taken to clear these applications through the "system" has varied greatly. At some times they have cleared in only three months and at others they have taken almost two years.

We now have almost forty ATV repeaters in operation on 23, 13 and 3cms and different "constraints" apply to each band.

On 23cms the primary user is the CAA who are responsible for all the air traffic control radars that we share the band with. Radio amateurs are only secondary users of the whole 23cms band and therefore we are obliged to accept all reasonable decisions arrived at by the CAA. None of us would want to be responsible for an ATC disaster I am sure. At some points in the past we have been able to plan our network in cooperation with the CAA but in recent times their responses have been almost 100% negative. This makes it exceedingly difficult to predict the likely outcome of any application and to predict the likely time periods involved.

On 13cms, a band where we have only recently been active with repeaters, the initial applications, a couple of years ago, went through amazingly quickly. More recent applications appear to have been stalled. Again the primary user, in this case the Home Office, is being very protective of the lower part of the band that we wish to use for inputs.

On 3cms the first applications were made some seven years ago and went very smoothly. Since that time the band has been changed twice and many of the repeaters had frequency changes forced upon them at the time. More recently there have been few new 10GHz applications so we do not have much experience of the current situation. There is however a new application in for an additional digital output for GB3RV so it will be interesting to see how this goes!

As at the beginning of May there have been no new repeaters, phone or ATV ones, cleared since the beginning of the year and you can see the situation in the table below

As you can see around half of the total outstanding applications are currently for ATV units and when they become operational they would add 25% to the number of TV repeaters!

It seems that, as in many things, this system seems to go through cycles, good and bad. What is clear is that presently we are in a bad one and there is understandably much frustration both within the RMC and the groups themselves at its current slow speed. It would appear that the Radio Communication Agency's impending incorporation into the OFCOM organisation and the development of the new Foundation and Intermediate licensing

Callsign	Chan		Keeper	Proposal type	Prop.Mgr	Ref	Batch	RIS	PU	NFAP	RA months
GB3AA	23cm		G4CJZ	NEW 23cm	05-Dec-02	197	Dec-02		19-Dec-02		4.7
GB3BH	13cm TV		M0SAT	NEW A/TV	29-Apr-03	205	May-03				latest batch
GB3BM	70cm		G4WPS	NEW WIDE 70	14-Jan-03	199	Jan-03	19-Feb-03	15-Apr-03		3.4
GB3CT	1312MHz		G4TVC	NEW A/TV	20-Feb-02	176	Feb-02	21-Mar-02	19-Dec-02		14.3
GB3DH	13cm TV	DERBY	G7MKS	NEW A/TV	31-Jul-02	187	Aug-02		19-Dec-02		8.8
GB3DN	RV51		G1BHM	2M SITE CH	24-Mar-03	202	Apr-03				1.0
GB3ET	RB13		G8GTZ	NEW 70cm	13-Nov-02	195	Nov-02		23-Jan-03	15-Apr-03	5.3
GB3FJ	RU76		G8LXI	70CM SITE CH	03-May-03						vetting
GB3FT	13cm TV		G8GTZ	NEW A/TV	22-Aug-02	190	Aug-02	14-Oct-02	09-Nov-02		8.1
GB3FV	23cm		M0CKE	NEW 23CM TV	04-Jul-02	185	Jul-02		14-Oct-02	15-Apr-03	REJECTED
GB3FY	23cm		G0AJQ	NEW 23CM TV	07-Apr-03	203	Apr-03				0.7
GB3IN	RV51		G4TSN	NEW 2M	17-Mar-03	201	Mar-03				1.2
GB3IR	RV61		G4FZN	NEW 2M	24-Mar-03	202	Apr-03				1.0
GB3IT	RU72		G6NHG	NEW WIDE 70	17-Dec-01	171	Jan-02	15-May-02	27-Jun-02		15.9
GB3KY	RV57	KINGS LYNN	G1SCQ	2M CHANGES	29-Apr-03	205	May-03				latest batch
GB3PT	23cm		G8CKN	NEW 23CM TV	07-Jun-02	183	Jun-02		14-Oct-02		10.6
GB3RB	70cm		G1SLE	NEW 70CM	20-Apr-02	181	Apr-02				12.2
GB3RV	10GHz		G8KOE	10GHz DIGITAL	07-Apr-03	203	Apr-03				0.7
GB3TT	23cm		M1ERS	NEW 23CM TV	29-Apr-03	205	May-03				latest batch
GB3TZ	13cm TV	LUTON	G8XTW	NEW A/TV	19-Aug-02	189	Aug-02	14-Oct-02	09-Nov-02		8.2
GB3UT	23cm	AVON		FREQ.CHANGE							vetting
GB3WJ	RU66		G3TMD	FREQ.CHANGE	16-Apr-03	204	Apr-03				0.2
GB3WM	70cm		G4AIJ	NEW 70cm							vetting
GB3YS	RB2		G3UGR	70CM SITE CH	17-Jan-03	199	Jan-03	19-Feb-03	15-Apr-03		3.4

programme may be taking their eyes off the other balls. As another example, the current repeater application form on their website was headed "Final draft August 2000" until it was recently removed. Trying to get a reasonable level of liaison with the primary users is also proving especially difficult.

So, as explained, it is proving very hard to provide anything like a reasonable level of service to groups who are hoping to put on an ATV repeater in their area. Perhaps, by the time you read this article, the situation may have changed for the better - lets hope so!

For the latest and most comprehensive information about all UK repeaters, the RMC website at http://www.coldal.org.uk/rmc.htm is the place to look! It also has a current application form which can be downloaded.

STOP PRESS as at 15th June - Four repeaters (2 on 70cms and 2 on 2 metres) have now been cleared. So there is something happening!

A Personal View of Digital Television - Part 6

By Mike Cox

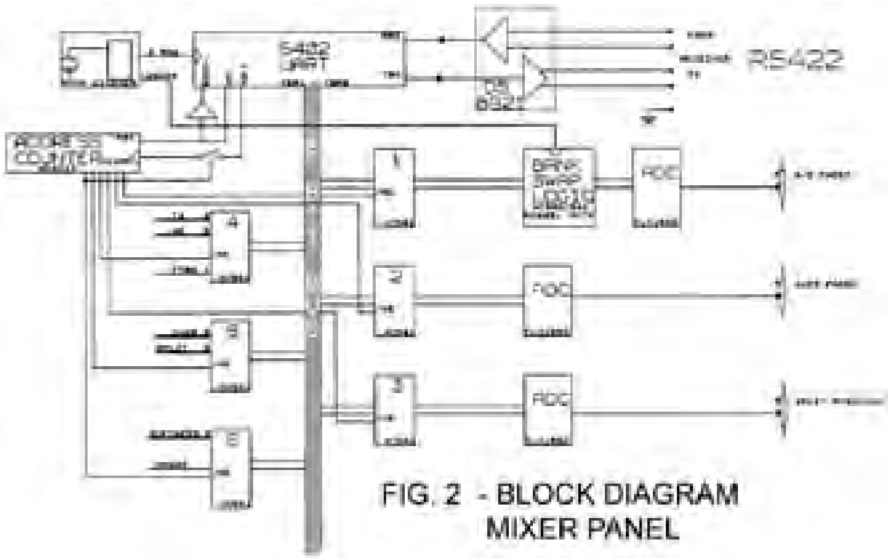


FIG. 2 - BLOCK DIAGRAM MIXER PANEL

I will start by thanking Peter Vince and Andy Woodhouse for their e-mail response to my plea for information [Letters, CQ-TV 202] about time base accuracy on the PAL output of a Panasonic DTT receiver box in my lab.

They make the point very clearly that the MPEG2 distribution chain was never designed to have the sort of accuracy that we have enjoyed with PAL transmission over the years.

As long as domestic receivers and VCRs lock up, there is no real need for higher accuracy, except for the oddball like me who wants a stable source for the lab.

I am in process of getting a time base corrector to bolt onto the back of the DTT box!

They reminded me of the very tortuous path an MPEG signal follows from the server, where most programmes are stored, the distribution chain, the multiplexing where several MPEG streams are combined, perhaps more distribution and then the DTT receiver.

Because of the "packet" nature of MPEG transmission, "time stamps" are used to ensure that the packets are correctly assembled at the receive point. It is this process that can impair time base accuracy to the extent I was looking for, ie 2 parts in 10^7. It is perhaps like the public electricity supply where the accuracy of the 50 Hz is very accurate over a 24 hour period, but can vary up to a Hz or so at peak periods, catching up at night.

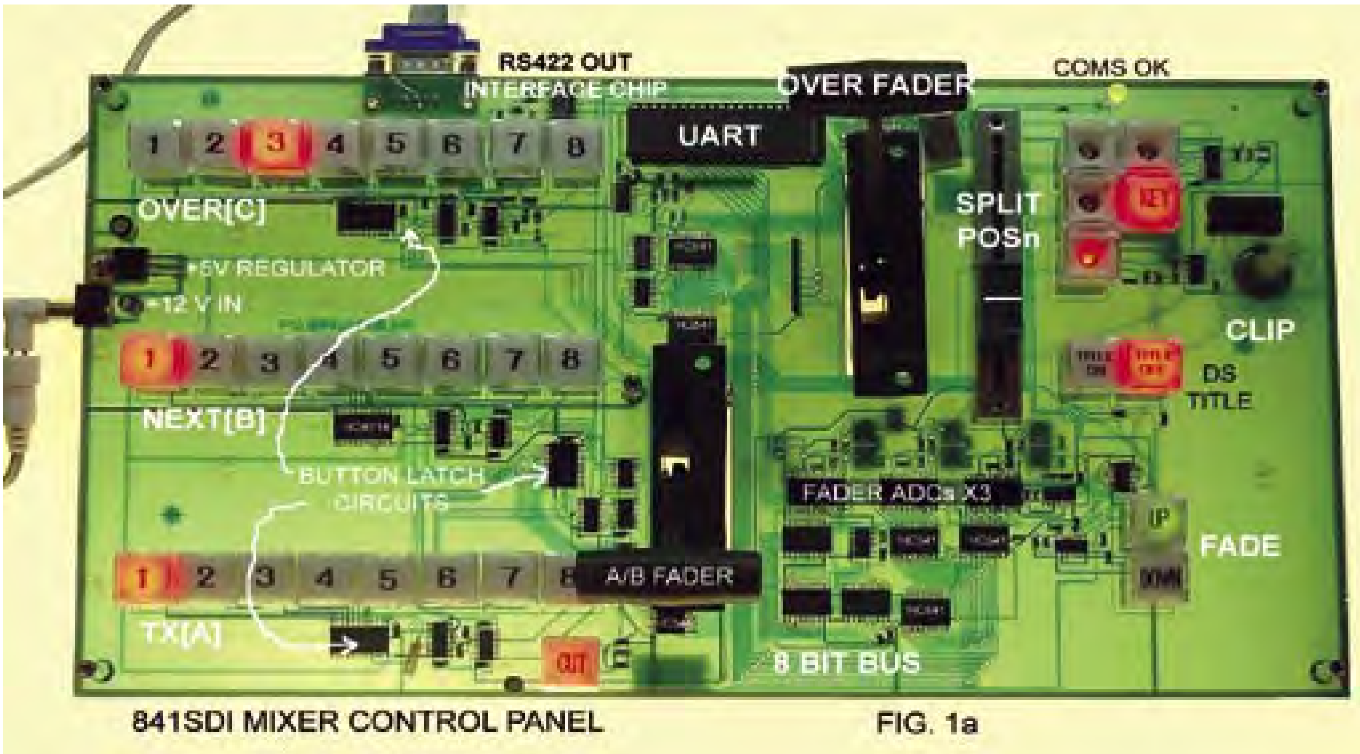
Progress on the SDI MIxer

In CQ-TV 202, I went on at some length about the UART and its use in the serial link between a mixer control panel and its electronics, together with some of the circuit elements used in the panel. The board has been laid out, made and assembled. This involved hand soldering 35 surface mount ICs, together with SM resistors and capacitors, not to mention the 35 switches, the 40 pins of the UART and the faders.

No wonder I wore out a Weller fine point soldering iron bit.

One or two 74HC series devices are disappearing, or are no longer available readily in SM packages. This is something that needs to be considered when starting out to design and build any electronics circuits. Distributor's catalogues can go out of date very quickly.

At least one device had to be replaced by a normal size IC on the rear of the board with its attendant rat's nest of



841SDI MIXER CONTROL PANEL

FIG. 1a

wire-wrap wire. Bear in mind that the 4000 CMOS series has been around for 30 years, and the 74HC series for around 20 years. How much longer are we going to be able to source these devices?

The serial receiver card was also built, and incorporated into the electronics.

The system works! The faders do what is expected, sources can be selected – just like the analog panel, but with a much smaller ribbon control cable.

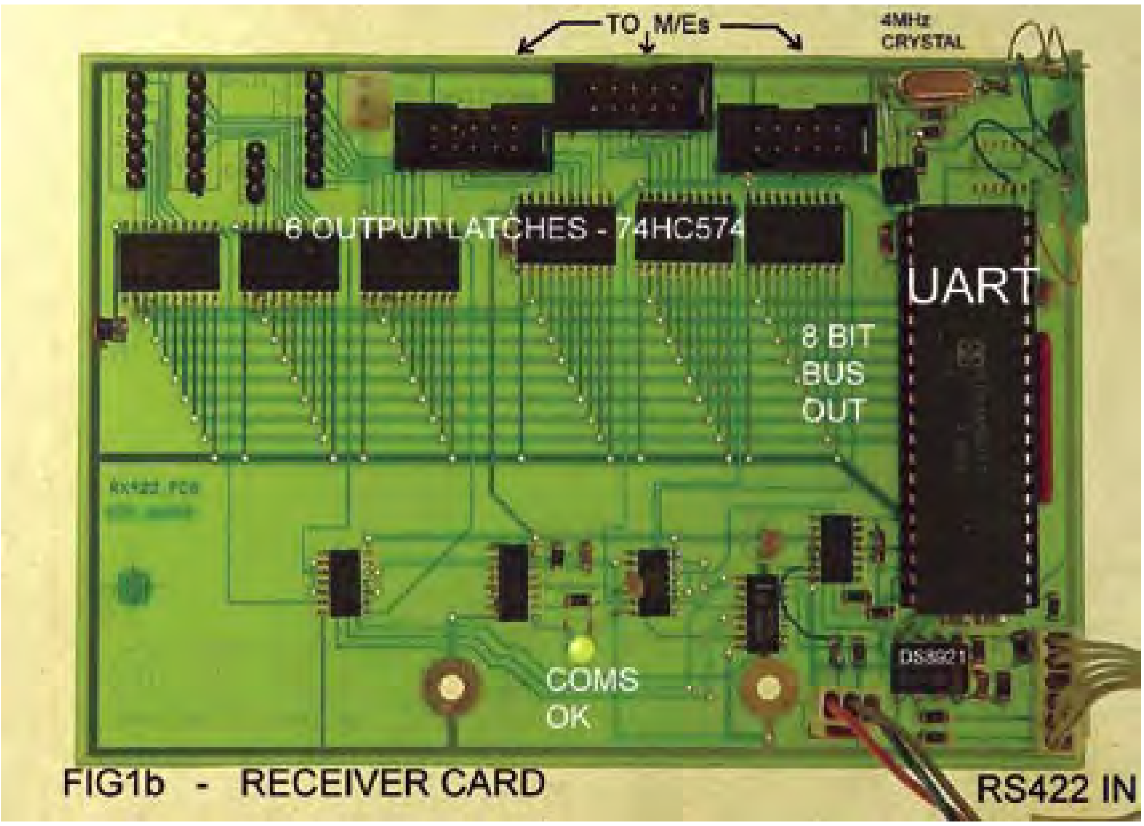


FIG1b - RECEIVER CARD

Fig 1a shows the panel PCB with buttons lit, and Fig1b shows the receiver card. Fig. 2 shows the block diagram of the panel system.

Note that 6 words are used for a complete panel snapshot; 3 words for the faders, and the other 3 for the 3 source select banks, pattern selection and split screen softness, and the odd spare "wire". Note that if I had enough time to master the CPLD programming kit that I bought in a burst of enthusiasm earlier, I might have got a lot of the

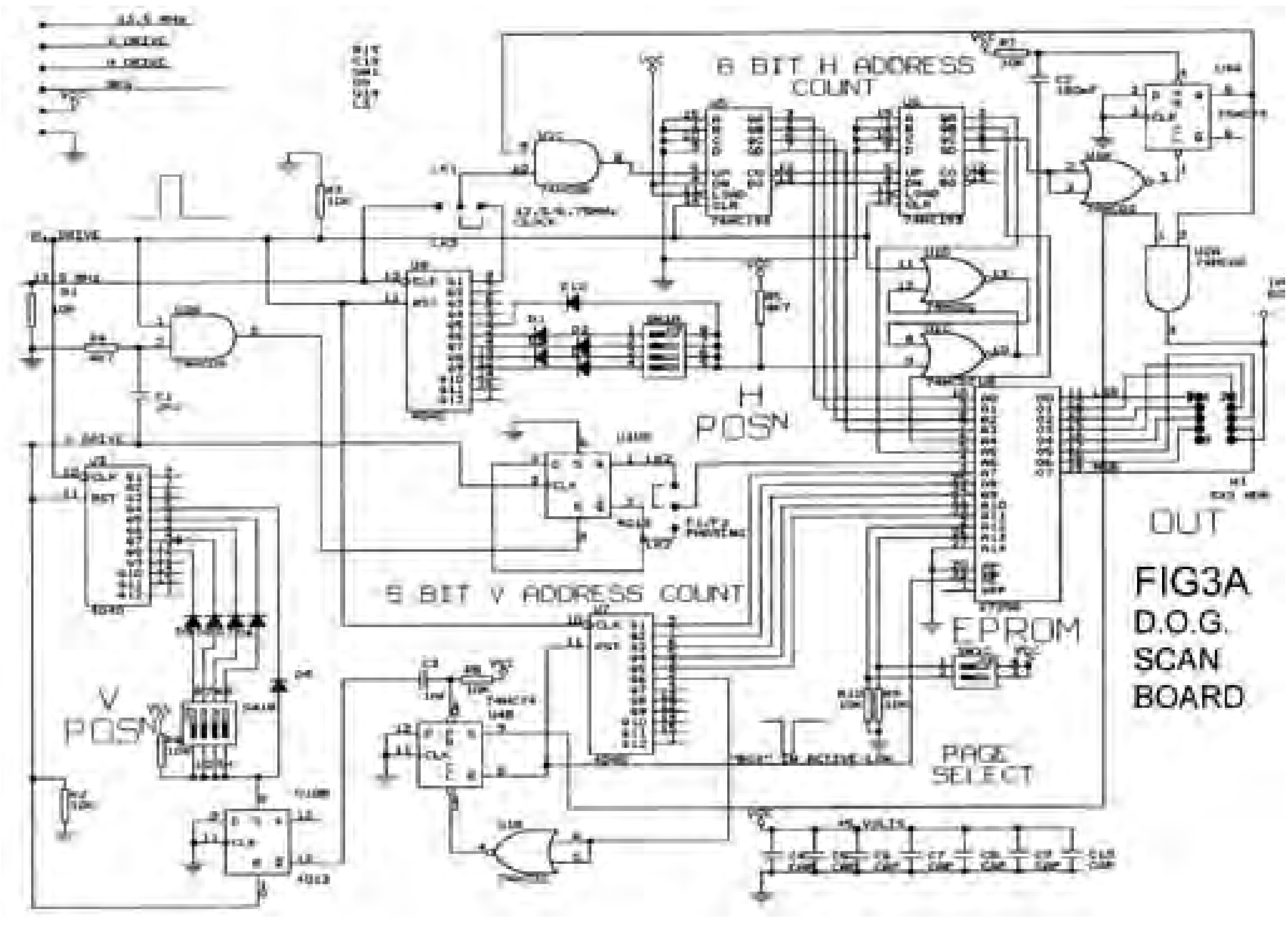


FIG3A D.O.G. SCAN BOARD

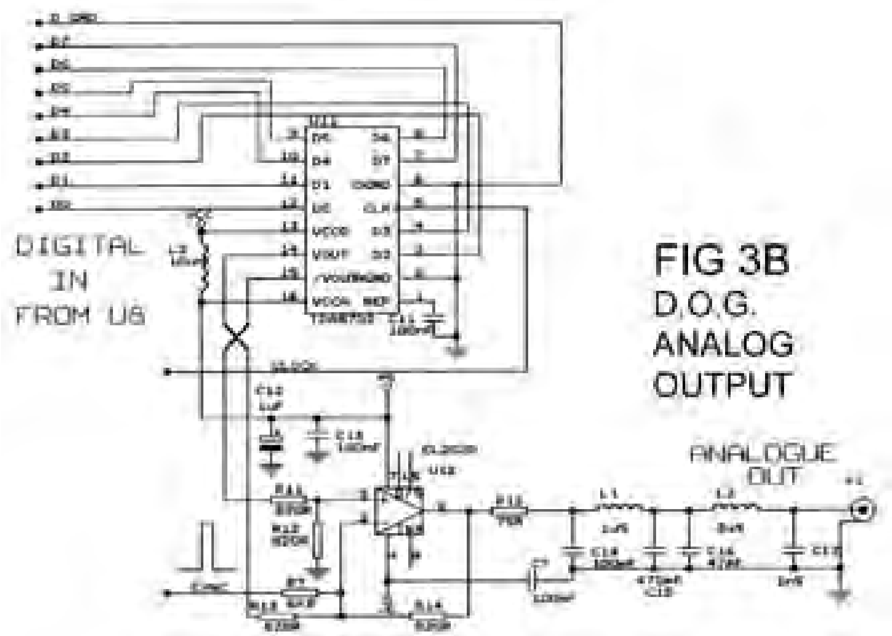


FIG 3B
D.O.G.
ANALOG
OUTPUT

logic into a CPLD or so. That will have to wait until after IBC now.

All that is needed now is the panel metalwork, which is currently being made.

In part 5, I mentioned briefly the title adder. This has now been laid out properly, with two dummy adders for Cb and Cr just to keep the timing right, and the active adder working in the Y channel. The EPROM limiters to keep the components from straying into forbidden territory below 10h or above F0h have been moved from the mother board to the title adder board. They can then ensure that high amplitude title plus luminance can never exceed F0h, and cause problems downstream. To drive this, a D.O.G. [Digital Onscreen Graphic] board has been designed, with the graphic blown into a 64 x 64 block in an EPROM. 4 pages can be programmed, albeit somewhat tediously into the EPROM. The full 8-bit range of the EPROM is available so that grey scale can be used if needed. [Fig. 3A and Fig. 3B]. The analog output is provided so that a cheap and cheerful monitor can show the output before it is sent to line.

Normally, the output is programmed at 80h maximum level.

A new split screen generator card has been laid out to offer both H and V split screen and V barn door facilities, together with a KEY facility which will be fed from the C bank via a separate demux card. All these new facilities can be seen in the updated mixer block diagram. [Fig. 4]

LCD Monitors

By the time this issue drops through your letterbox, the whole mixer should be more or less together again, with its two 7 inch LCD monitors mounted above the panel.

[Fig. 5 shows a wireframe version of the complete unit]. It will then be time to check it, and all the rest of the kit, ready for another IBC.

The two LCD monitors are home assembled, using panels from Display Solutions.

These take in PAL video, and require 12 volts dc. The panels are native 16:

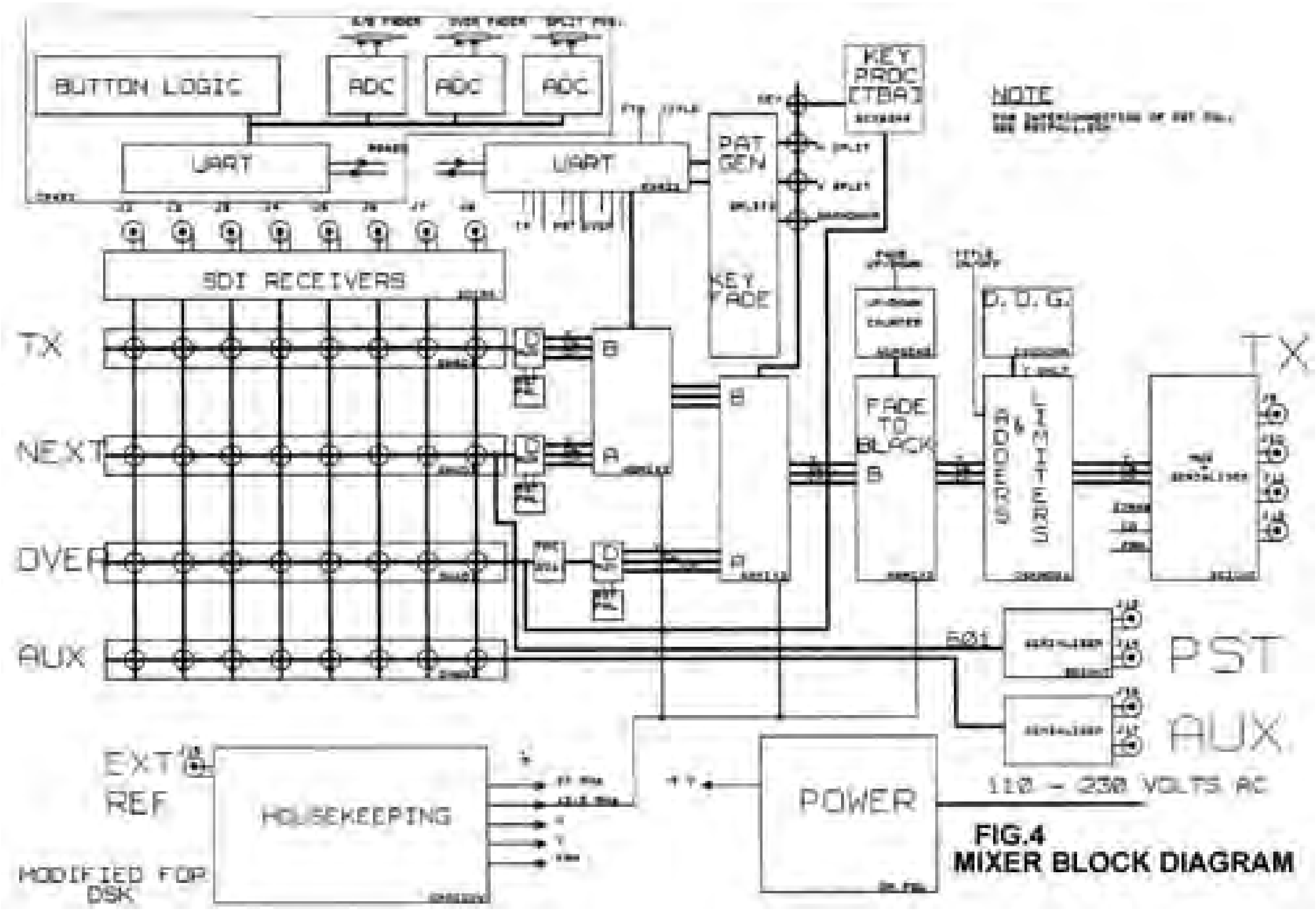


FIG.4
MIXER BLOCK DIAGRAM

9, with switching to 4:3 if required, which it is.

Because the monitors will be used with the SDI mixer, it seems logical to give them an SDI capability. One of my old colleagues, Cliff Ford, runs a company called Shootview who make various boxes such as PAL to SDI, SDI to PAL, SDI 4 x 1 switchers etc.

Cliff was good enough to let me have a couple of board only SDI to PAL units, which have been built into the monitor boxes. His cards require 7.5 volts dc at around 0.5A. Each card has two low drop-out 5 volt regulators. These were removed, and linked out by 3µ3 chokes. Thus the card now needs 5 volts dc. Accordingly a small card was laid out carrying a switch-mode buck regulator [LM2575T50] to convert 12 volts to 5 volts, at a considerable saving in current, and power dissipation, together with a video amplifier to give an output to the LCD panel and an external feed. There is also a switch to select either the PAL output from the SDI decoder card, or an external PAL feed. There are Y, Pb and Pr outputs from the SDI card available as well. The video amplifier used was the universal EL2020, and to give it and the CMOS switch a negative rail, a 7660SA device was used to provide a nominal –5 volt rail from the +5 volt rail. Fig. 6 shows the power arrangement. By using the switch mode down converter, the current draw for the SDI decoder is 0.29A from the 12 volt input, so that the whole monitor unit draws about 1.1A.

Final thoughts [for this part]

When I started this series of articles in CQ-TV 197, it was with a whinge about the conversion of the UK to digital TV, and the switch-off of analog services.

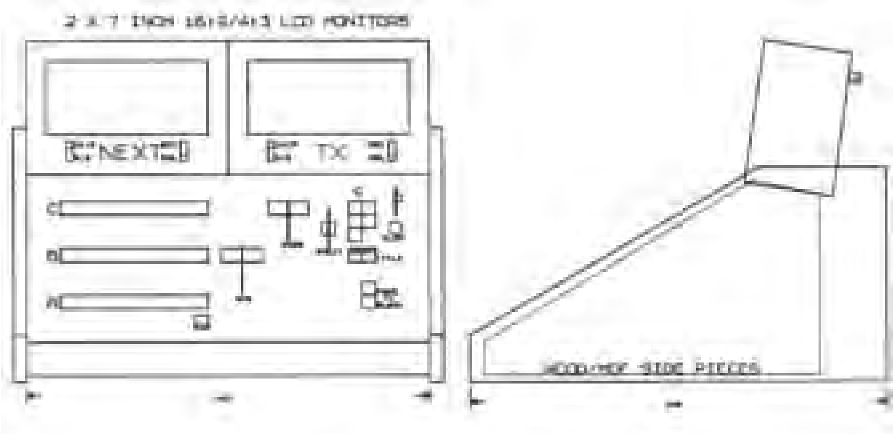


FIG 5 841SDI MIXER WIREFRAME VIEW

That was 18 months ago. Since then very little has changed. The Monkey went bankrupt, but then Freeview was launched in October, accompanied by a nauseous commercial of John Simpson morphing into Dot Cotton. We are still asked to pay about £99 for a DTT box. There is no sign of IDTV receivers smaller than 28", and none of the VCR/DVD recorders yet available have a DTT or satellite tuner built in. The only DTT box with a built in hard drive recorder currently available is made by Pace; other manufacturers are believed to have products ready when the technical issues with the Electronic Programme Guide [EPG] are resolved. Analog receivers are still being sold in large quantities, even in 4:3 format.

In Berlin, all the analog transmitters are being switched off this August before the IFA exhibition. The main transmitters were switched off in February and the frequencies re-allocated to DTV use. This had the enormous advantage that DTV power could as high as necessary, without having to worry about co-channel interference into analog channels.

I believe free boxes are being given to those who cannot afford to change. However, most viewers in Berlin are on cable so the number of boxes will not be enormous. The Berlin experience will be repeated throughout Germany by the various Lander.

My concern about digital television is that it offers great advantages in origination and storage, but I remain somewhat sceptical about advantages in digital terrestrial broadcast transmission, and to whose benefit it all is. It keeps engineers employed to a degree, but offers considerable disadvantages to the viewer who may have to pay to keep watching the TV he has hitherto enjoyed for free apart from his license fee, and even more if he wants to record anything.

What is to happen to the released spectrum? Could the example of the 3G mobile phone licence auction put bidders off?

I am sure I am not the only one who feels that the proliferation of channels has had a less than positive effect on the quality of current TV programmes. Yet the availability of more channels has been hailed as a plus for the new era.

As the old Chinese curse has it, we live in interesting times!

If you have any comments or questions, Mike can be contacted, via email, at president@batc.org.uk

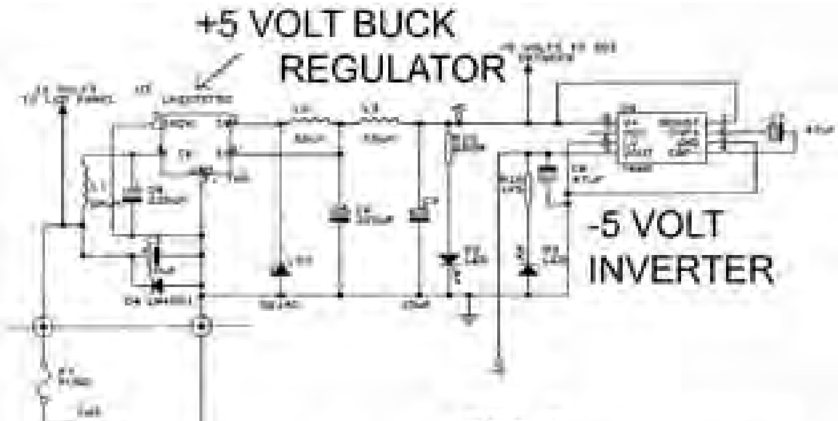


FIG. 6
POWER ARRANGEMENTS
7" LCD MONITOR

Repeater RIP

'Repeater' magazine is no more!!

It is with much sadness that I have to report that the last issue of the Dutch amateur television magazine 'Repeater' has just been set out to their members.

I have reproduced Rob Ulrich's editorial explaining his decision to stop publishing the magazine.

From a BATC perspective, I sympathize with his position. Our current membership is less than half what it was when I first joined the club. The committee has thought long and hard about what we can do to reverse this downward trend, but it does seem to be unstopable.

The club offers PCBs and other components for sale to members, but these days, orders are very few and far between. It would seem that the desire to 'build your own' no longer applies to our hobby. People obviously prefer to go the 'plug and play' route with kit bought ready made.

I would like to thank Rob for his past efforts on behalf of our hobby and I wish him well in his future work.

Ian Pawson - Editor

The last issue!

Before you lies the last issue of Repeater. This will hit most like thunder from a clear sky, but some may have seen it coming.

For a period of six years we have attempted to stimulate our hobby via Repeater. Many designs were published and fortunately we can see that many amateurs have made use of them.

This past year we have seen a turn around with many amateurs. DIY was traded in for buying ready made equipment. New designs were not made, and if the were, they're not shared. But there is more to the turn-around. Where Internet is an important source for new designs, the desire to subscribe even at the low cost of Repeater, seems to diminish. The number of subscribers made a dramatic free fall and we are left to conclude that our hobby is dying. The publisher has decided to stop publishing Repeater. Repeater Volume 6/issue 4 is the last issue to appear.

This hurts us quite a lot. Over the past years we were convinced that things would turn out right with our hobby. That we would be able to free many amateurs who blindly follow the trend laid out by amateur clubs (the use of HF). We confronted amateurs with an alternative but the support we received has proven insufficient.

A magazine like Repeater is obviously not appreciated enough.

The editors wish to thank all of those who contributed in our DIY hobby. Thanks to all the amateurs who made their designs available to Repeater we were able to produce a good looking and high quality magazine. We wish to express our gratitude to those amateurs in particular.

Rob Ulrich, Editor Repeater

Capturing analogue video onto CD

By Graham Hankins

I have been attempting - I say again 'attempting' - some video capturing on my new computer. The ultimate objective of the exercise was to transfer some of my own analogue videotape footage of Amateur Television (ATV) onto either a Video Compact Disc (VCD) or a DVD Digital Versatile Disc (DVD). It could then be replayed on a DVD player, the composite video output going into an ATV repeater for other stations to see. The VCD or DVD disc could be quickly duplicated with no transfer loss and distributed to ATV repeater groups. To ensure that the computer should be adequate for video capture, I had built a PC with a 2GHz processor, 256MB memory, a Universal Serial Bus (USB2) port and the Windows XP Operating System. Well, I needed a new PC anyway! But as I have now found out - from lots of reading - it is not so much what you have got, as what you want to do with it!

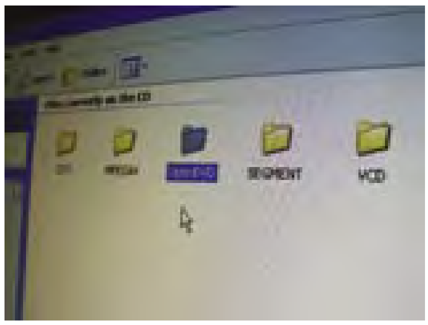
Because of its huge capacity, the recordable CD has become the popular medium for storing very large files to pass between computers. Vision files are big indeed - hundreds of megabytes for every few minutes of footage. But there are complications; the differing CD formats e.g. CD-R, CD-RW, DVD-RW, DVD+RW (to mention not all of them - I won't even attempt to explain them!), plus the several software packages that can capture and then write to a disc. There is usually some writing software bundled with a CD or DVD drive, plus many packages available from computer stores. This can all be tricky to sort out for the first time.

The 'bottom line' to this initial exercise in video capture and editing is that my ultimate end-point - a video CD that would play in a stand-alone DVD player - has not yet been reached, but I did manage to produce VCDs that would replay on the PC. Although what was by now a second and third generation tape played without problems into a TV, the digital capture process stopped twice with a 'no video detected' message and I do not know why that was. The single 15 minute video became saved onto hard disc (HD) as three segments (or 'chapters' as video editing software calls them) with a few seconds of sound missing. But at least these replayed, with a couple of hesitations, from the HD onto the PC's monitor.

Extrenal USB box for analogue video and sound to PC conversion

The phase that created the most difficulty was transferring the digitalised video from HD to CD and achieving PC replay from the CD. The software bundled with the drive was tried first; then the programme that had been on the capture disc. Now both of these told me that data was being written to the CD-R, and then eventually - several minutes later - that writing (or 'burning') had been satisfactory. But although there were files on the CD, these were not .mpg and neither my DVD player nor media player software on the PC recognised the disc.

Now I am sure there is nothing wrong with any of the software - at this stage the fault lies absolutely with me. But Windows XP came to my rescue. After viewing the .mpg files on the HD, I spotted XP asking the simple question "Do you want to write these files to CD?" I answered "yes" to this! Two more 'mouse clicks' and XP was doing the business. Examining the 'burnt' CD, there were the .mpg files! "Do you want to play these in RealOne Player" XP asked - yes, please! So, I now have 'just about watchable' (hi) video copied to several CD-R discs, which play through the computer with RealOne Player. If any readers can offer help or advice on this please note my new email address is g8emx@tiscali.co.uk



What was on the CD after 'burning' captured video

Plasma Displays

By Richard Stevens

Following his excellent talk and demonstration at the Kingswood Warren open day last year, Richard Stevens from BBC Research and Development provides a layman's guide to the technologies behind these increasingly popular large flat screen displays and some personal views as to what he is likely to be buying when the time comes to replace that TV in the corner of the living room.

This article is intended as a quick primer on plasma displays, providing useful background information for those who are not experts in this field. It is a deliberately simplified layman's guide, intended only as a rule of thumb aid to understanding the principles involved, so not all the details will necessarily apply to any one display device. The information has been derived from my own work on these devices and from the published literature, and I should warn readers that developments in this field are happening so quickly that published information can rapidly become out of date.

What is a PDP?

A plasma display panel is a thin sandwich of two sheets of optical grade glass. The meat of the sandwich is exceedingly thin, and filled with nothing much more than a rarified Neon and Xenon mixture, much the same as the content of a fluorescent tube. It is quite different to a Cathode Ray Tube or a Liquid Crystal or a Field Emissive Display. Some of the image forming electronics for PDP, LCD and FED can be the same, but this is more because of the geometry of cell structure being akin to a memory map than to any similarity in the function of the display. Figure 1 shows a diagram of a single cell. You notice that there is no gun structure, no focusing or aiming, no beam to deflect, in fact almost no controls at all. The cell can be either on or off. That is it. The plasma display is simply a flash gun. There are just three electrodes in a generic AC plasma display. One lies beneath the phosphor, the other two are in a pair on the other sheet of glass and covered by an insulating dielectric layer and a MgO layer. The space is filled with the Xenon and Neon. (10% : 90% ratio at about 600 torr) To prime the cell ready for excitation a small charge is trapped on the dielectric, ionising some of the gas. Excitation is performed by passing an AC current through this ionisation and so generating a plasma which has an ultra violet discharge. The UV stimulates the phosphor to produce the visible light. Once the excitation (or sustain) cycle has been completed, the cell needs to be "erased", so the charge is drawn back towards the conductor beneath the phosphor. Figure 2 shows the sequence of an AC plasma burst exciting the phosphor at the back of the cell. Notice that the surface of the phosphor that you view the image on is also the surface being excited, so only a relatively low energy is required compared with when one excites the back of a CRT phosphor with a high speed electron beam. The web site http://www.sni.net/siglo/examples.htm contains more examples in similar vein, including a co-planar cell system, which is the more common one in use these days.

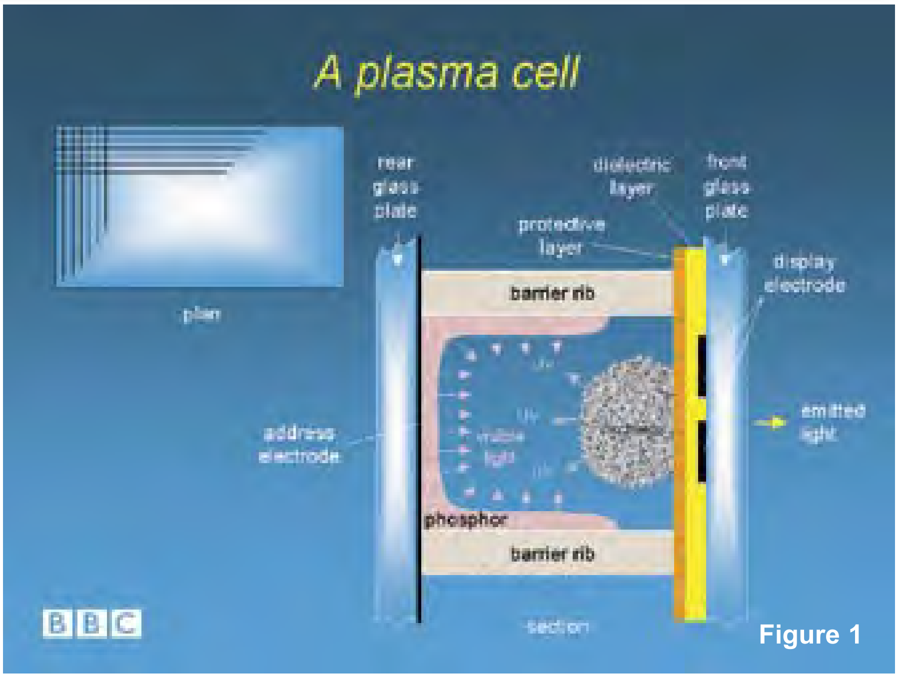


Figure 1

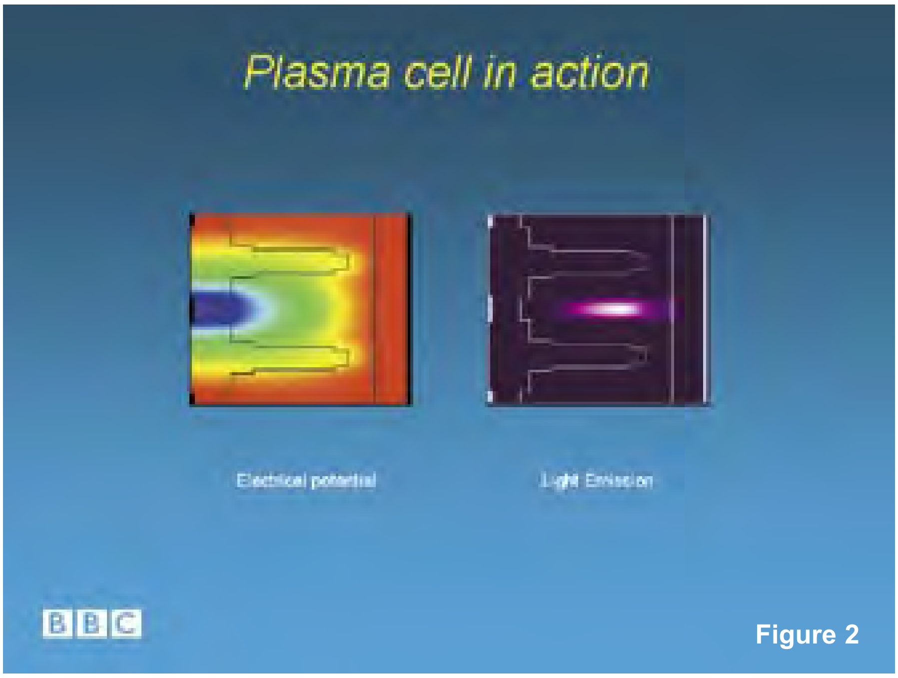


Figure 2

Display structure

Now the first thing we need to make a picture is some structure. Structure is defined by the physical layout of the cells in rows and columns, as in figure 3. It is all rather simple, spatial resolution is just a matter of mathematics; how many pixels would you like in your row, Sir? and how many rows? There are no focus or spot shape problems, no scan geometry correction

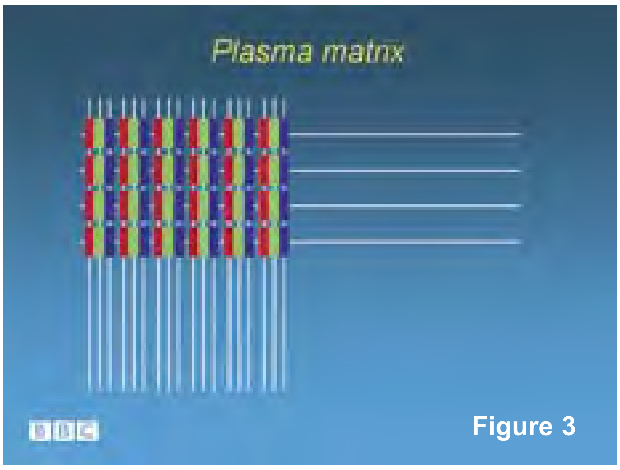


Figure 3

required. We could tailor the display to suit the sample structure of the picture source; Mr Nyquist stays happy, and all the scaling chip manufacturers would wring their hands in despair. In theory a 720 pixel by 576 row display would be ideal for Europe, and one manufacturer is even making an interlaced display, (but 1024 by 768, not 720 by 576). We need go no further if we forget HDTV and computer monitors

Practical constraints

The main difficulty is in making cells that are small enough, and that is mostly because of the current requirements on the excitation conductors, which in turn have a dependency on the work function of the phosphor. Small cells have a low work function, and so need higher currents to compensate for this, but, alas, small cells have to use thinner more resistive conductors. This means that major streaking problems can arise because of current starvation, and significant heat is generated within the panel, needing noisy fans to cool it. So the answer is to make bigger cells, with thicker conductors, in bigger panels, to be viewed from further away, and then you won't hear the fans, maybe! 1mm square for an RGB colour triad pixel seems to be a commonly used size. Figure 4 shows a different plasma matrix of pixels and rows. I can see some interesting possibilities for varia-

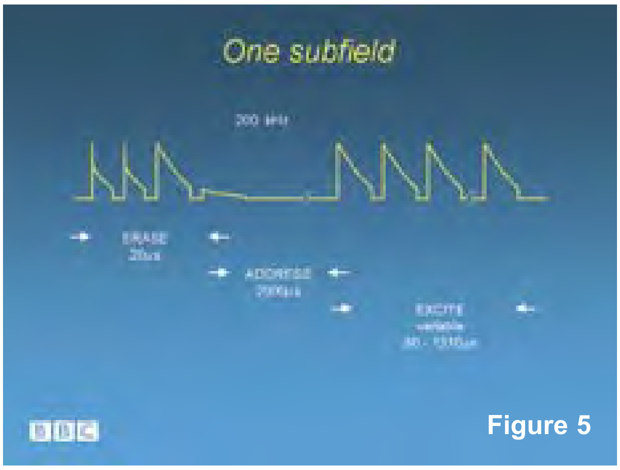


Figure 5

tions in colour rendition and improving resolution. We might not have to have the cells in RGB RGB sequence all the time. We might emulate a single chip CCD colour camera, with RG on one row and GB on the row below, useful for television with YUV sources and giving more than a 50% improvement in horizontal resolution, no loss in vertical luminance resolution, plus a reduction in aliasing and edge colouring. This would not, however, be so good for a computer display. A useful analogy is to compare

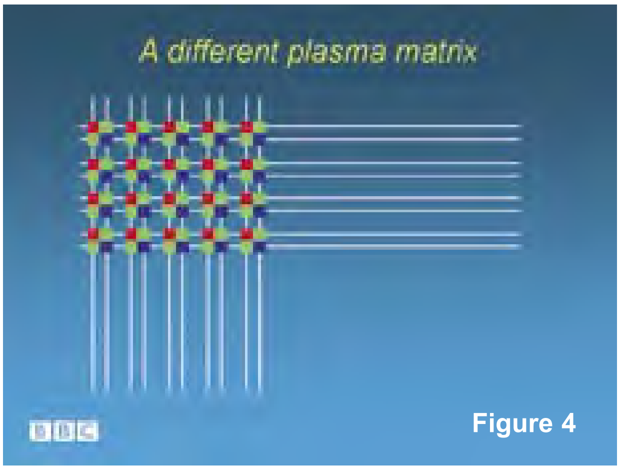


Figure 4

a CRT and PDP in the same way as in the past we might have compared tube cameras with CCD cameras; the newer technology eliminates a whole range of problems inherent with the old, but brings along its own baggage as well. So how do we turn on or off individual cells in a large array of cells in order to display a picture? As figure 5 shows, there is an addressing Figure 2: The plasma cell in action Figure 3: Plasma matrix showing pixels and rows Figure 4: a different plasma matrix of pixels and rows Figure 5: Waveform showing one subfield Figure 6: A 6 bit subfield sequence display tech 12/2/02 1:14 pm Page 25 26 screen may have the charge placed on the insulator. This is followed by an common excitation period, during which (for an AC plasma) the current is forced through all the primed cells, exciting the plasma and so the relevant phosphor. And of course preceding each address period there has to be an erase sequence which removes any space charges that may have been set for the last subfield. But this only means that the cells can be on, or off.

Dynamic range

The second thing we need to make a picture is some dynamic range. We need grey scale, we need lots of different colours. We do not want visible quantising levels, or posterisation. This is the very awkward bit. The plasma screens are nowhere near as good as a CRT on dynamic range. In fact the PDP can be On, or it can be Off. A good CRT might have a DC contrast ratio as great as 1000 to 1 with any value you want being possible between these limits, although one normally only expects an AC contrast of better than about 50 to 1. On a PDP the dynamic range, or brightness variation, is determined simply by changing the perceived duration of the flash.

Trickery

So we have to resort to some form of trickery; this can work to our advantage if done correctly, but unfortunately there are economic constraints. The usual way of varying the perceived brightness is to vary the number of AC excitation pulses applied to the cell. On a display with maybe a million cells it is not practical to control the times for which they are on individually and simultaneously. Accordingly the usual technique is to break up the display time into subfields, for example on a binary weighting scheme. So in a six subfield system like the one shown in figure 6, the least significant subfield is on for one 32nd of duration of the most significant one.

Measured results

Figures 7 and 8 show the results of some measurements I made a couple of years ago on a six subfield system. The problem with the six subfield method is that the light output from the display follows a linear law. Unfortunately all our current video sources are expected to be displayed on a CRT, which has gamma. So there is a discrepancy in the voltage to light transfer characteristic. This is one of the biggest single problems associated with plasma panels. Another of the problems with this kind of scheme is that the subfields may not be on a true binary sequence. The subfields are quantised by the AC excitation cycles, and so the grey scale

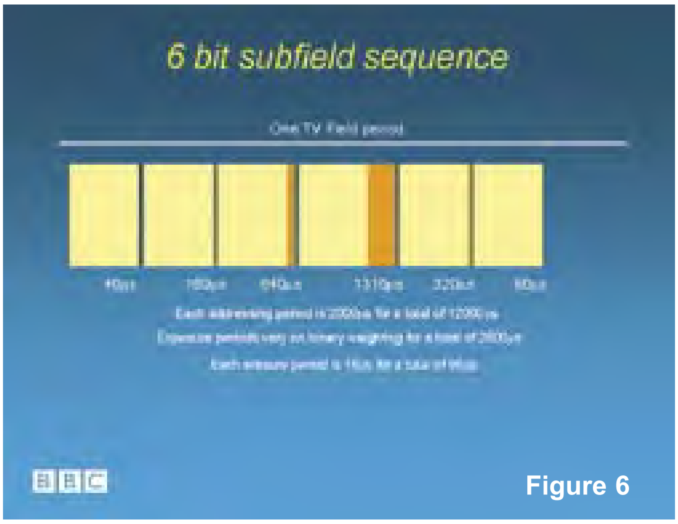


Figure 6

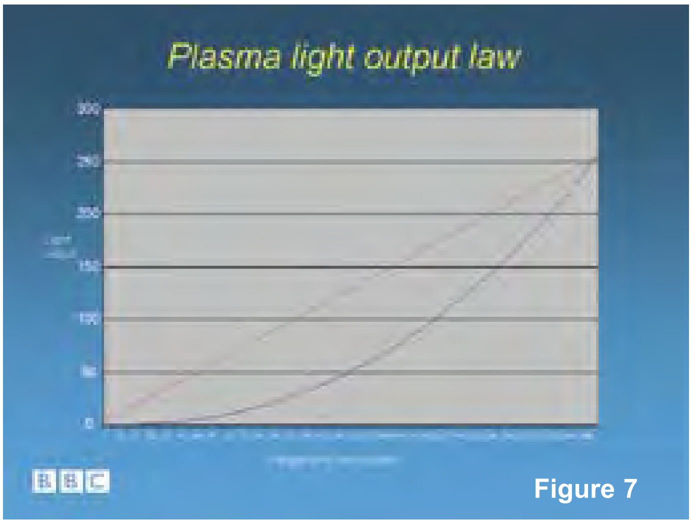


Figure 7

might not be monotonic. A reasonable 8 bit panel is typically only accurate to 6.5 bits or even worse, as you can see in figure 9, which was derived from measurements I made on a six bit system. Here the brightness variation is controlled by the total number of excitation cycles, but Figure 7: Plasma light output law: Linear curve and Gamma curve Figure 10: Ideal gamma law output from 16bits, and from 8bits and % error Figure 8 : Monotonicity errors Figure 9: 6 bit subfield - effects of brightness variations the total is unlikely to be properly divisible into the binary scheme.

Brightness variations

On some displays, as the total light output, or more accurately the power consumption, rises, there comes a point when a protection scheme comes in and the number of excitation cycles per subfield is reduced to protect the system. The monotonicity fails again, but differently! So if correction had been applied for the poor monotonicity in one way, now it might fail the other way but worse; for want of a better phrase I guess it could be called a differential gain effect. So I have found it is best not to attempt to correct for the monotonicity errors. It gets worse still. I mentioned before that the display is a linear device where the number in equates to the brightness level out. All our video source material is expected to be applied to a CRT which has a Gamma power law, where the number in equates to a lot more out as the numbers rise - figure 10 shows the ideal gamma law curves, and figure 11 provides a more detailed view, showing just the first 64 levels. Broadcast video is ten bit accurate and this gives very good results on a CRT, but when translated to the linear domain we need close to sixteen bits. The displays are generally only eight bit (although some of the more recent ones are ten or twelve bit, depending on refresh rate). Errors due to this restriction show up as poor resolution in the dark scenes and poor definition of subtle colours, in other words posterisation. We have the cartoon or comic book look.

Flicker problems, colour fringing

Things can get even worse! Having eight flash guns going off one after the other at maximum intensity for varying lengths of time fifty times a second or worse still - sometimes not, produces an objectionable amount of flicker, and the motion portrayal is awful, with heavily coloured fringes. This is because the flashes are at different points on the timeline, but the eye expects the timeline to have a smooth and even tempo, so will attribute a spatial error to the scene even though it is actually a temporal error. Hence the coloured fringes visible on some systems, as indicated in figure 12.

Reducing the number of subfields

Fortunately there are some tricks that can be used to get around most of these problems. One of them, reducing the number of subfields, kills several birds at once, and it is a standard feature on most manufacturers' products. At first sight you might think that the image would be degraded further, since the most significant six of the eight differ-

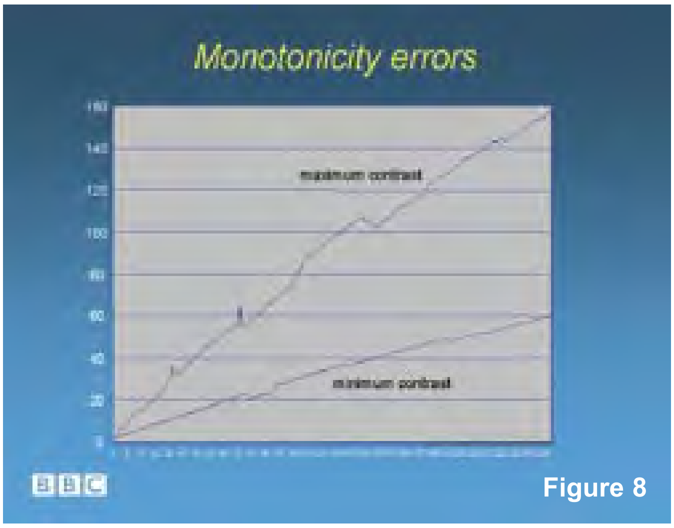


Figure 8

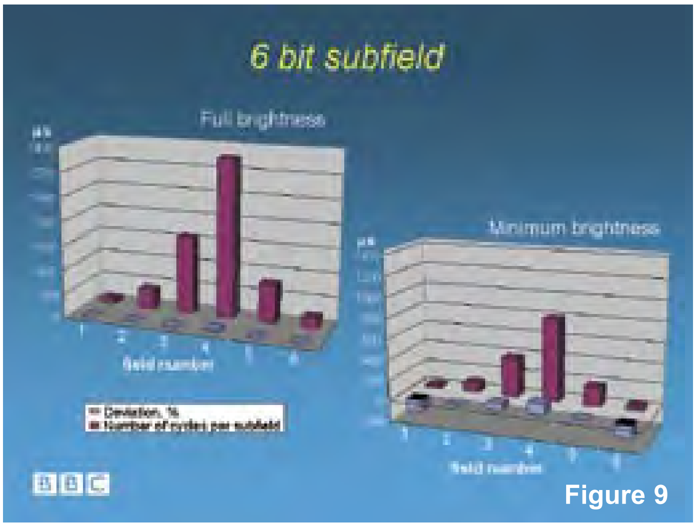


Figure 9

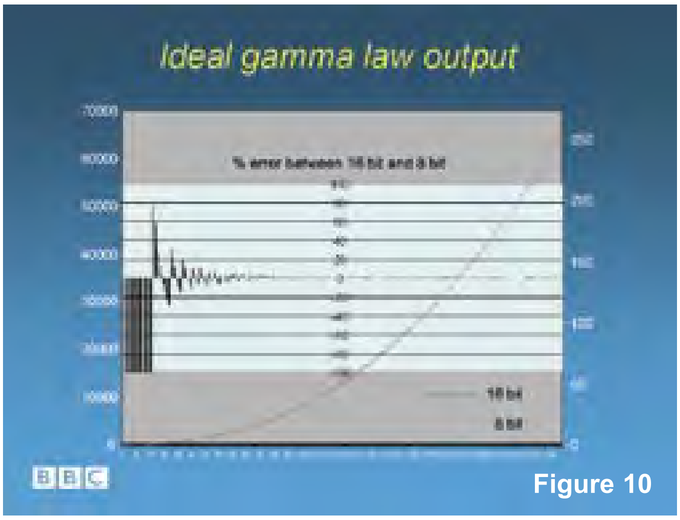


Figure 10

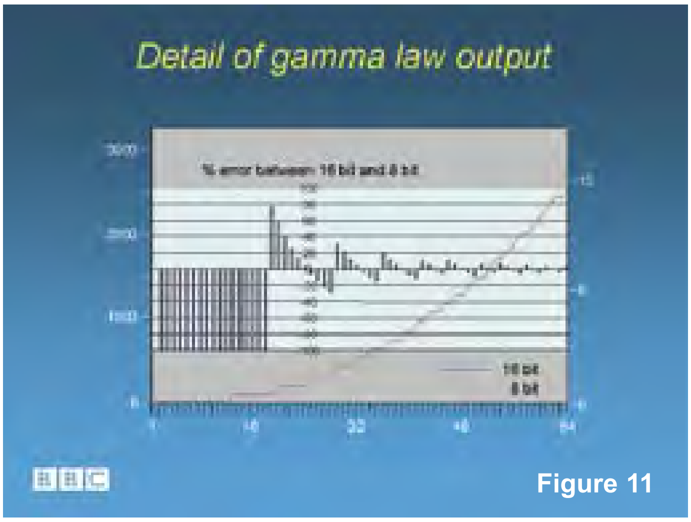


Figure 11

ent subfields are reduced to two identical sets of three, with the remaining two filling in the gaps. Figure 13 shows the amended subfield sequence of a 6 bit system. This has the effect of doubling the subjective flicker rate, in much the same way as a film projector shows the same frame twice or three times to reduce flicker. The image is still only refreshed at the original rate. The second big advantage is that the colour fringing on motion is greatly reduced, so much so that you only can see it if you are looking for it with an expectant eye. A third benefit, strangely enough, is that the monotonicity gets better, because with fewer subfields it is easier to make the sums right. In this instance cheaters prosper! The big compromise made is that there is some static dithering to spread the dynamic range spatially, providing an increase in fine grain noise, somewhat akin to a half toning system on a laser printer. It is still only an eight bit result, but can look as good as sixteen bit linear on appropriate displays which use some of the techniques I have developed, although pictures can still look posterised on some of today's standard displays. I have demonstrated pictures from a 1250-line interlaced High Definition source, down converted to Rec. 656/601 625 lines interlaced, which were then deinterlaced and scaled to fit on the panel as 480P with 852 pixels a line, and they were judged to be excellent by many critical BELOW: Figure 12: Coloured fringes on moving images Figure 11: Detail of gamma law output from 16bits, from 8bits, and % error , but just the first 64 levels RIGHT: Figure 13: 6 bit HQEN subfield sequence display tech 12/2/02 1:14 pm Page 27 28 Image Technology display technology viewers. There are no analogue bottlenecks restricting these signals in the 625 line domain.

Plasma panels in the home?

How likely is it that we shall be using plasma panels for our home TV displays in the near future? I think that it is very likely, with a few constraints. Firstly, viewers should be realistic about the viewing distance. It has been proven many times that a natural viewing distance for displays of this size is about 5 times the picture height, or about two and a half metres for a 42" 16x9 panel. This may be serendipitous, but I would like to think it is by design, since the resolution limit of the human eye at two and a half meters is about 1mm. (Remember that the most commonly used pixel size in PDPs is 1mm.) A 42 inch PDP is large compared with the CRT displays currently used in most homes, but being seen from a distance of about two metres or more should not prove difficult in many living rooms. At this distance most people will not notice the pixel structure, and the picture size is no longer intimidating. Instead the "Home Cinema" effect comes to life and one can get used to it very quickly indeed!

HDTV - not yet

Curiously enough, when I compared 1250 line High Definition images on a 38" HD CRT monitor and the same images downconverted to 625 line Rec.601 on the 42" PDP, at this distance of two metres I preferred the PDP, since it had more contrast and appeared to be just as sharp. Of course, as I walked up closer to the displays the HD CRT display continued to get better and better, and the PDP was just too many pixels and not enough picture. So we do not really need HD just yet, not until we go to bigger displays, say 50 to 80 inches or more. For those of you who have looked critically at the plasma displays currently on the market, it is important

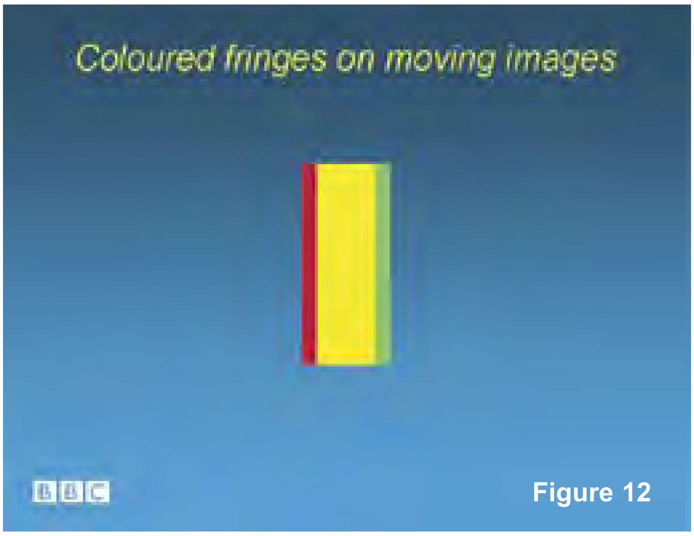


Figure 12

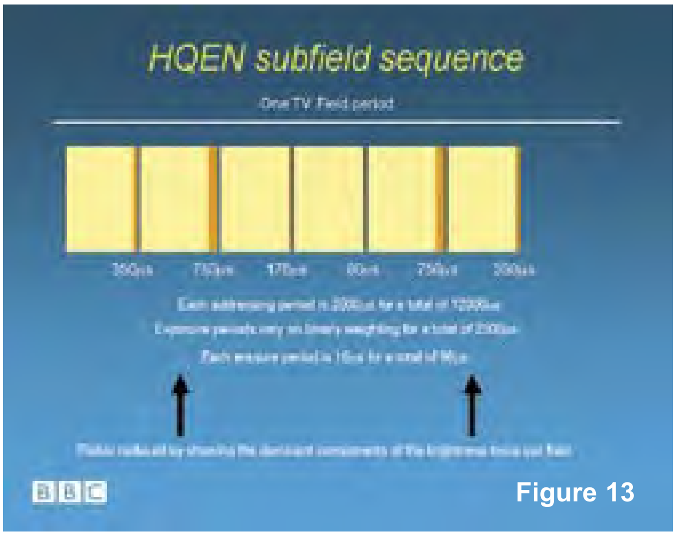


Figure 13

Summary of pros and cons

	DMD projection	CRT	PDP	LCD	FED
geometry	excellent	average	excellent	excellent	excellent
focus (detail size)	good	variable	good	excellent	excellent
picture placement	excellent	variable	excellent	excellent	excellent
picture size	big 60" to>360"	medium 2" to 38"	larger 21" to 60"	small 1" to 28"	medium?
chromaticity	excellent	excellent	good	poor	unknown
flicker	good	average	better	good	excellent
greyscale	average	excellent	average	poor	unknown
viewing angle	average	good	excellent	poor to OK	good
weight	medium	heavy	medium	light	medium
cost per square inch	high to medium	low to medium	medium to low	high to medium	unknown
box	bulky	bulky	slim	small	slim
spatial resolution	medium	high	medium	high	medium
contrast ratio	good	good	good	poor to average	good
noise	big fans	silent	fans likely	silent	silent
domestic receivers	yes	yes	yes	yes	not yet
future developments	yes	unlikely	yes	yes	probably
will I buy one? (2 to 3 years time)	no	no	likely	unlikely	maybe

BBC

Figure 14

to note that current generation PDPs are optimised as computer display devices, and they have a black mask around each pixel to make the text look sharper. This is a bad thing for a TV display as it contributes to high frequency aliasing by putting a lot of energy in to the system at the sample rate; it breaks the visual integration of the picture. I feel that when the market expands there will be displays optimised for TV, but that can also handle computer input, and different displays optimised for computers, but which can handle TV input. Some of the engineering sample prototypes that I have examined can produce extremely good TV pictures in spite of the lack of dynamic range, but the black mask on the production models makes the pictures so much poorer with the high energy 8MHz stimulating all the edge of band aliases. It was almost like the difference between a good shadowmask CRT and the early 30AX PIL CRTs, where you had to choose between sharp but dim pictures or bright pictures seen through a picket fence.

Comparing display technologies

It is always interesting to compare the various possible display devices, when considered for domestic viewing, and figure 14 attempts to show the pros and cons of each. It is important to note that there are some new developments on the addressable-matrix LCDs, especially to do with better contrast ratio and grey scale, but the costs are high and the probable target market will be workstations. There are also some new developments coming along using DMDs in much higher contrast ratio rear projection systems. Putting my theoretical ‘money where my mouth is’, you will see that I have indicated my preference for my future household TV display, and I shan’t be buying a large CRT!

Sound and pictures

A digital display of digital transmissions of digital pictures, with the full surround sound experience is the target. Removing all the restrictive quality bottlenecks of PAL and analogue transmitters, could signal as big a change as that from Vinyl to CDs.

What does the future hold?

As better programs become available on digital transmission, and DVDs, the requirements for a higher resolution display become more pressing. I don’t want anything less than a PDP with direct digital interface to a set top box with a direct digital output, or to a DVD player with a direct digital interface. I see a bright future for video separates. The display device now has a life in excess of ten years, but the transmission formats are in a state of flux. I will probably never again buy an integrated receiver as my main display device at home, but expect to change between better (and cheaper) set top boxes over the years.

This article was first published in BKSTS the journal of The Moving Image Society and is reproduced with their kind permission - Ed.

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TV Technology: The Image Orthicon Tube

Peter J. Stonard takes a look at the "World's Most Complex Vacuum Tube".

Even the non-technical visitors to our home marvel at this piece of glass – a four-and-a-half inch image orthicon (IO) tube that ruled the day in 1960s vintage broadcast television cameras.

Figure 1 - 4-1/2 Inch Tube & Coils

The IO camera tube has bragging rights that include complexity and size. The four-and-a-half inch oversize IO tube was developed in England by physically enlarging the successful USA (RCA 3 inch) camera tube - an unusual step - and not the normal trend in modern technology where we expect "smaller – faster – cheaper" from every new model.

Why so big?

The simple answer is performance, as we will explore in this article. Why so complex? Because no other means was known to make a camera tube with the desired characteristics and sensitivity suitable for high quality broadcast service. The IO tube reigned for more than two decades before further development of alternative camera tubes based on the vidicon (1950) produced the Plumbicon (1965) and SATicon (1974). See figure 2 and CQ-TV199.

The Image Orthicon operates by a photoemission principle, unlike the successor tubes that use photoconduction; both types use a storage mechanism to gather and save incoming light between scans. Storage greatly improves light sensitivity compared to the first practical TV camera tube, the image dissector tube (Farnsworth 1934).

Another great step with the orthicon tubes (RCA, 1939) was the perpendicular scanning of the image by an electron beam on the same axis as the optical image. This arrangement solves a lot of issues in the iconoscope, which has the electron gun offset by 30 degrees and demands tricky amplitude manipulation of the scanning currents to remove keystone distortion.

Figure 2 - 3 in. & 4-1/2 in. IO Tubes with a one inch Plumbicon Tube

As a practical matter, cameras built with IO tubes required more set up adjustment before operation compared to later tube cameras. They were never "instantly ready" as we have come to expect of modern CCD based cameras, because the IO tube faceplate could only be operated at elevated temperature. Requiring 35 degrees C. at a minimum, cameras used complex (for it's day) heaters and air plenums to maintain it.

Lifespan

An IO tube seldom lasted more than 1000 hours, which translates to about six months of daily operation. In fact, new tubes required an aging period (about 100 hours) to reach best performance. Although the broadcast industry is small compared with, say, home TVs, demand for fresh IO tubes were a big business in the 1960s and kept several manufacturers busy.

The author would like to hear from anyone who knows production data – the best guess is that "several thousand" tubes were required worldwide annually.

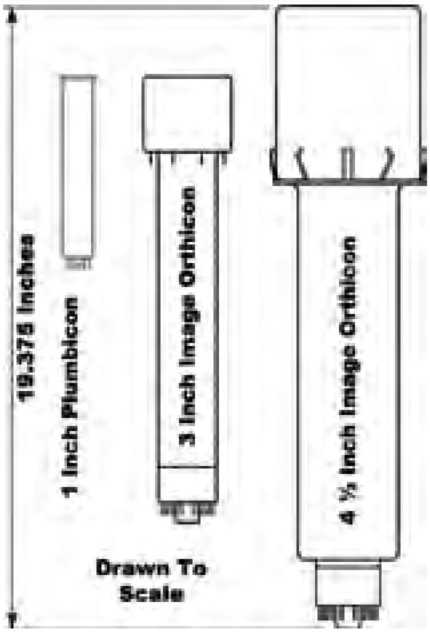


Figure 3 - Monster IO tubes

Image Sticking

Even with expert attention, the tubes can suffer image sticking (retention of the last scene), and so the cameras featured two tools to reduce the chance of this happening accidentally:

(1) Overscan which expands the scanned image (shrinks the monitor image) to prevent the on-air raster scan outline from being burned into the tube during rehearsal, and

(2) Orbiter to slowly shift the scanned area in a circle (a few percent of picture height) to prevent stationary images from burning into the tube.

Figure 4 - Packaging. Note: Non-tip box (L) keeps 3in. tube upright for shipping.

Mechanical orbiters actually moved the optical image by swivelling the lens, while electronic orbiters added slow sine and cosine currents to the deflection coils, and often used electric motors and sin/cosine potentiometers. Most careful observers could see the approximately one revolution per minute sweep of the orbiter operating on air, which was sometimes left on by mistake or used to get a few more hours life from a ‘sticky’ tube.

A Fresh Supply of Tubes?

As far as the author knows, there are no new IO tubes being made today, and existing supplies are limited to a very few NOS (New, Old Stock) tubes. Many tubes of questionable performance, that have run for the 1000 hours rated life, passed into the hands of collectors. The author has a few of these, some with attached index cards or remarks on the shipper boxes, indicating meticulous count of the operating hours, or noting defects in the tubes performance: “low emission”, “sticky”, “noisey” (sic) “burn at 6 o’clock”.

Maintenance Nightmare

Folklore suggests that changing the IO tubes (and later Plumbicon tubes for that matter) was a routine but delicate job for technicians and engineers in the broadcast business. Poor handling or incorrect set up would easily damage the new tubes, and the cost of a new IO tube was roughly equal to the annual salary of the person doing the work!

The 3-inch tube has seven pins projecting from the shoulder, requiring careful alignment to the coil assembly sockets. A slight error would break the glass seals ruining a tube. The larger IO tube has sliding contacts on the shoulder to avoid this problem.

Monochrome vs. Colour

The IO tube responds to light intensity, but can’t see ‘colour’. IO tubes were used in sets of three (or four) or in combination with vidicon tubes to populate early colour television cameras that split the incoming light with optical filters.

35mm Film Heritage

The first image orthicon tubes were designed to use the existing cinematic film camera lens optics in “35mm” format size. This can be traced back to Thomas Edison, who in 1889 experimented with Eastman Kodak roll film, which was supplied in a standard two and three-quarter inch width. The earliest TV cameras, based on the Iconoscope tube (1936) also used the 2 ¾ inch image size to avoid the invention of different size lenses to those already on hand.

Edison cut the film down the middle, to one and three-eights width, which today we know as “35mm film”. There are many film standards defining the image size on 35mm stock, but for the 4:3 aspect ratio of a TV screen the 35mm film requires approximately a 23mm high by 30mm wide image. The image diagonal is therefore 38mm (or roughly one and a half inches). Camera tubes require a one and five-eights inch diameter photo target to take advantage of existing 35mm camera lens kit.

Three Inch IO Tubes

To make tubes with the desired quality photo target, the tube head needs to be three inches in diameter. Power, size, and weight savings in the electronics and magnetic deflection coils can be had with a thinner body for the IO tube, of 2.0 inches diameter. Hence, the unique IO tube’s glassware shape. A three-inch IO tube is fifteen inches long.

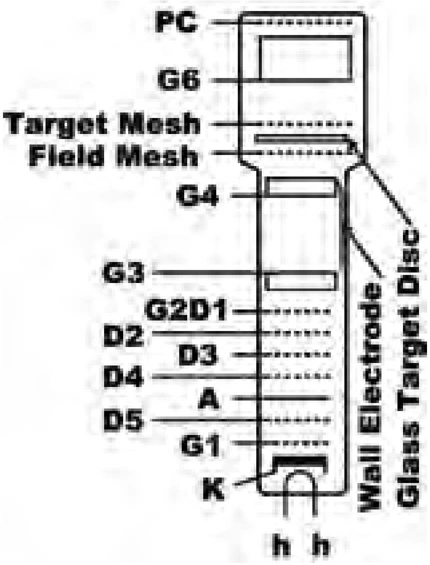


Figure 5 - IO Tube Electrodes

The three-inch IO tubes have two different but similar constructions, called non-field-mesh and field-mesh types, the latter having even more electrodes and internal parts to improve the images over those generated by the earlier non-field-mesh kind.

Inside The IO Tube

The IO tube can be divided into three activities, starting at the front with the image section where photoemission from the photo cathode (inside surface of the faceplate) converts the light photons into an electron image, which is transferred to an internal glass target disc.

The image section is really the second step of the process because a scanning electron beam from the Scanning Section is required first. The sensitivity of the tube is very good, better in fact, than early colour cameras that used vidicons or Plumbicons, but to get there the IO tube includes an electron amplifier, called the Multiplier Section, which boosts the internal weak image signal level by as much as one thousand times.

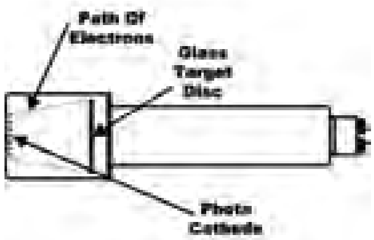


Figure 6 - Image Section

Let’s look at the detail of these three sections. The electrode names are in parentheses, and match figure 5 and the table data in figure 9.

Image Section

Conversion of incoming light photons takes place in a very thin photo-emissive material layer on the inside of the glass. The photo cathode operates continuously, although the light intensity value is read out periodically by scanning in TV raster format. In this way the light photons arriving between scans (at 1/25th second intervals) are stored (as electrostatic charges on the glass target disc).

Light photons liberate electrons, which are drawn towards a glass disc near the

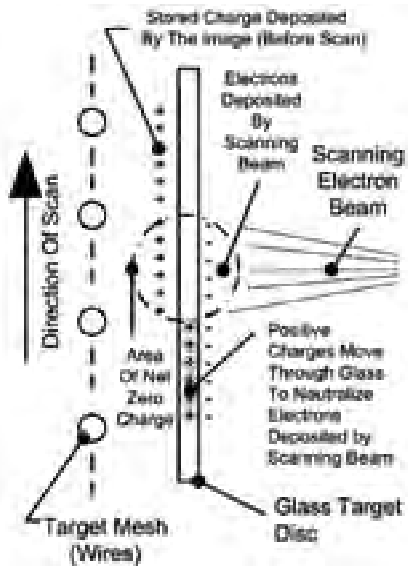


Figure 7 - Target Charges

Type No.	Tube Size	Field Mesh	Target	Spacing (Inch)	Cap (pF)	Sensitivity (Lum/Ft^2)	Resolution @ 400TV Lines (%)	Limiting Resolution (@ 2%)	Signal-to-Noise Ratio (dB)
5820	3	No	Glass	0.0022	100	0.02	60	600	34.5
7293	3	Yes	ELCON	0.0022	100	0.02	60	675	34
4492	4 1/2	Yes	Glass	0.002	300	0.025	75	800	38
4536	4 1/2	Yes	ELCON	0.001	600	0.04	60	800	40.5

Figure 8 - IO Tube Parameters

Electrode	Name	Adjustment Goal	5820 3in	7293 3in	4492 4.5in	4536 4.5in
PC	Photo Cathode	Max Resolution	-300 to -500	-325 to -475	-600	-600
G6	Accelerator	73% of PC & Min 'S' Distortion	-240 to -400	-210 to -360	-370 to -470	-370 to -470
Target Mesh		Target Volts	+2	+2	+2.3	+2.3 to 3
Field Mesh		Avoid Mesh Beats	None	15 to 25	15 to 25	15 to 25
G5	Decelerator	Minimise Corner Shading	0 to 125	0 to 40	40	40
G4	Beam Focus	Avoid Mesh Beats	140 to 180	140 to 180	70 to 90	70 to 90
G3	Multi Focus	Max Signal - Min Shading	225 to 330	260 to 300	250 to 275	250 to 275
G2D1	Dynode 1		300	300	280	280
G1	Beam Current	Set to just discharge highs	-45 to -115	-45 to -115	-45 to -115	-45 to -115
D2	Dynode 2		600	600	600	600
D3	Dynode 3	Orth Gain	800	800	800	800
D4	Dynode 4		1000	1000	1000	1000
D5	Dynode 5	Video Gain	1200	1200	1200	1200
Anode			1250	1250	1250	1250
Signal Current		Output Signal	3 to 24uA	5 to 30uA	~20uA	15 to 100uA

Figure 9 - Operating Voltages for Popular IO Tubes

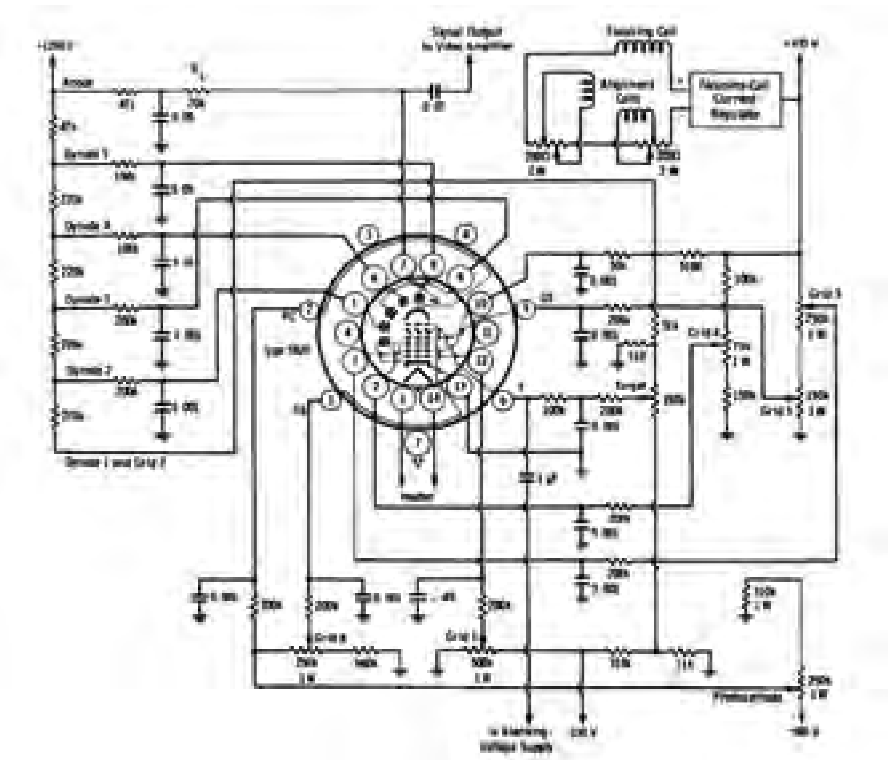


Figure 10 - Typical IO Tube Circuit (Non-Mesh 3in. Type 5820 Tube)

shoulder of the tube. The photo cathode (PC) is biased to about negative 600V, while the target mesh electrode adjacent and in front of the glass disc is near ground (set to about plus two volts). See figure 7.

An external magnetic field along the axis of the tube brings the electron image to focus on the glass target disc, while the bias on grid 6 (image accelerator) draws the liberated electrons towards the glass disc target by electrostatic attraction.

When the image electrons strike the glass target they cause secondary electrons to leave, which in turn are captured by the slightly positive target mesh electrode. This voltage difference is important, as it limits the range of charge possible under any lighting condition and makes the IO tube images stable (compared to the earlier iconoscope camera tube). The transition from linear response to saturation is called the "knee-point" set by the target mesh voltage (Typically a 1.5 to 3V range). In the four-and-a-half inch IO tube the electron image is also expanded 150% by the influence of the pancake coil, which is another external magnetic coil held in front of the tube faceplate. See figure 11.

Emission of the secondary electrons leaves the photo cathode side of the glass disc with a positive charge, and due to the thinness of the glass disc (typically one or two thousandths of an inch), there is a corresponding positive charge pattern on the far side of the glass disc, where the other two sections of the IO tube operate.

Scanning Section

A scanning beam of electrons originates from the far back end of the tube and travels forwards down the IO tube body, under the influence of two orthogonal magnetic fields operating at the line scan and the frame scan rates, that deflect the beam into a raster pattern on the far side of the glass disc.

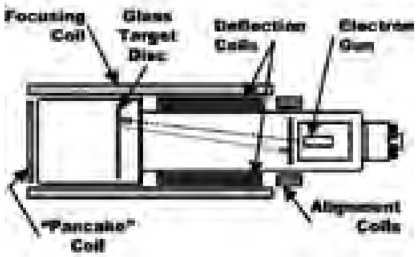


Figure 11 - Scanning Section

The beam is brought to focus on the glass disc by the external magnetic field and also by the bias on grid 4 (beam focus). To generate the beam a typical 4watts (6.3V at 600mA) heater and thermionic cathode (cathode), held at ground potential, is controlled by grid 1 (beam current), and accelerated by grid 2 (D1/G2) at positive 300V. Just before the beam reaches the backside of the glass disc, it slows down under the influence of another electrode, grid 5 (decelerator), at positive 40V.

Image Formation

The scanning electron beam creates a uniform negative charge over the far surface of the target disc. The glass disc is so thin that the charges on each side of the glass disc neutralize each other by conduction through the glass. (Remember that the front side of the glass disc was charged positively in proportion to incoming light). Electrons from the beam neutralise the positive charge in less time than one frame scan (About 1/25th of a second). In the target glass disc, areas that have no positive charge (i.e. the dark areas of the scene), the beam is repelled and returns towards the electron gun.

The return beam carries ‘video’ information in the form of varying beam current, with highlights of the scene giving positive charges on the glass disc, and therefore robbing the return beam of the charge needed to neutralize them. A decreasing return beam corresponds to brighter areas in the scene, and the maximum brightness (set by the lens iris) produces “no return beam current”. This sets an upper limit or clipping of the video signal, and explains the second IO tube characteristic – limited or compressed video whites. When incorrectly set the IO picture looks “chalky”.

Multiplier Section

Capturing the return beam and boosting the signal levels is the job of the multiplier section and it is the same for all IO tube types.

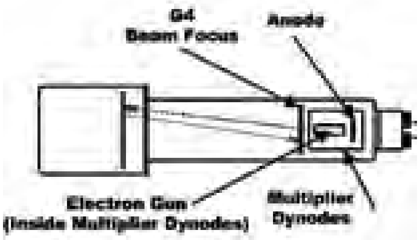


Figure 12 - Multiplier Section

Using the principles found in a photomultiplier tube, the weak electron beam passes through five stages, each generating secondary electrons that in turn are drawn to the next higher stage, building the signal 500 to 1000 times in strength. Special electrodes called dynodes are arranged in a stack at the far end of the tube, surrounding the same electron gun that originated the scanning beam.

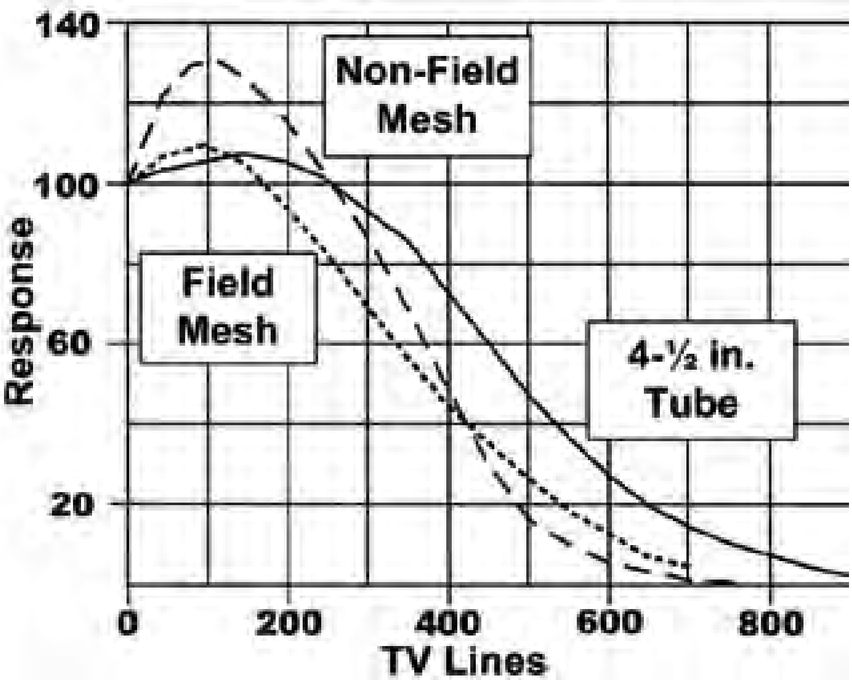


Figure 14 - IO Tube Resolution

After leaving the first dynode (positive 300V), which has a dual role because it is also the second grid (D1/G2) of the electron gun, the beam is concentrated by the grid 3 (multi-focus) electrode, and accelerated by each Dynode operating at positive 200V more than the previous dynode. Adjusting the voltage on dynode 3 sets the gain of the multiplier stages. Sometimes D3 and D5 are changed together using ganged pots.

Finally the resulting current is collected by the anode (anode) and feeds the load resistor, which is biased to about positive 1250V.

Four-and-a-Half Inch IO Tube Defined

The three-inch IO tube has limited resolution and a few annoying image defects such as the first distinctive IO tube characteristic – a halo around bright objects in the televised scene. Addressing these problems by further tube development made a larger target disc desirable, as we will see.

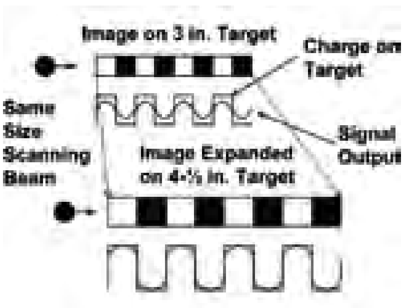


Figure 13 - Aperture Effect

IO tube resolution is limited due to the “aperture effect”; the scanning beam is of finite size. Resolution would improve with a decrease of the electron beam cross-section, but technology was not available then to make better electron guns.

Keeping the same optical lens from the existing cameras, a new tube design was developed which electronically expanded the photo cathode images (which already had acceptable resolution), and thus created the four-and-a-half tube size. Expanding the image on the target has the same effect as decreasing the beam diameter. This is shown graphically in figure 13.

The four-and-a-half inch tubes are 50% larger at the face, with a 3.125-inch body diameter, which demands a larger diameter deflection coil assembly. A four-and-a-half inch IO tube is nineteen and three-eights inches long. Cameras that use these tubes are obviously also very large and bulky. See figure 1 4-1/2 Inch Tube & Coils. (Note: tubes should not be placed or operated “face-down” - this was a dead tube). The outer mu-metal jacket was removed from the coils for clarity.

All this effort pays off with an improvement in resolution of about 25% over the 400 TV lines (50% modulation) performance of the three-inch tube. See figure 14.

Output Signal Polarity and Size

Unlike Plumbicons or the other photoconductive camera tubes, the output from the IO tube is positive equals white polarity of approximately 50mV peak-to-peak. (Plumbicons only produce around 200 nanoamps of signal current).

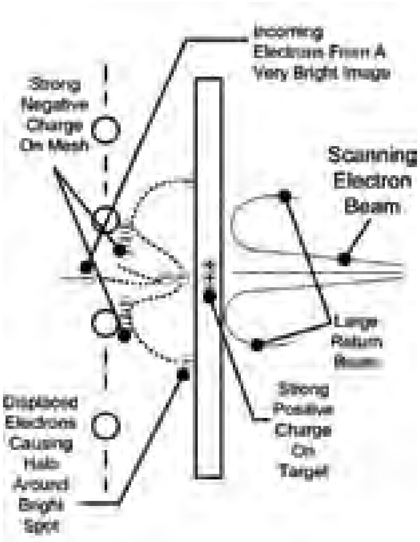


Figure 15 - Target Overload

Halo Effect

The IO tube has another characteristic problem, which an observant viewer will see in the TV picture, more so if the scene has bright highlights.

Around any bright object the image will develop a dark halo. The mechanism that causes the halo effect is in the image section, where the target mesh acted as a collector of secondary electrons that in turn were knocked off the glass disc by the electron image from the photo cathode. The target mesh acts as a floodgate, setting the upper limit on the tube's response to bright areas of the scene. However, under overload (scene too bright), when too many electrons from the cathode image reach the target mesh, the glass disc emits too many secondary electrons, and the glass disc charges more positive than the slight positive bias on the target mesh (of about two volts).

Secondary electrons that should have stayed on the target mesh, and be conducted away to ground through its external supply, are once again attracted back to the glass disc, where they land in a cloud around the most positive areas, corresponding to the scene highlight. This creates unnatural dark halos on the video image. See figure 15.

Edge Effects

The observant viewer of IO tube camera pictures will also notice a disturbance in high contrast transitions, especially on the outlines of objects. While there are several video signal errors (such as ringing and overshoot) in the path to the transmitter, that can cause similar artefacts, unfortunately the IO tube itself is the major source. The effect can be traced to beam landing errors on the far side of the glass disc. Since the scanning beam approaches the far side of the glass disc at near zero velocity, it becomes attracted to the more positively charged areas (resulting from highlights in the original scene), and this distorts the true position of any image transitions that are of high contrast.

A solution to prevent (or at least greatly reduce) this effect is incorporated in versions of the three-inch IO tube called field mesh IO tubes, and also in all four-and-a-half IO tubes. The added electrode (field mesh) is placed between the G5 (decelerator) electrode and the far side of the glass disc. Adjustment of this electrode's bias cancels the over-emphasis of scene outlines, by improving beam landing on the glass image disc.

Target Glass

The target glass disc is probably the hardest IO tube component to fabricate! How do you make a glass disc of two to three inches diameter and uniformly one thousandth of an inch thick?

Discs of glass were made by the same process a child uses to blow soap bubbles with a loop wand – except instead of soapy water we use molten glass, which melts at over four hundred degrees centigrade! Glass is drawn from a furnace pot and caught by two semi-circular wire arms that move to form an oversized circular film of glass, just like the soap bubble. The loop is lifted away from the surface and placed on top of a metal ring where it cools and bonds to the metal. Later on the same ring becomes the glass disc carrier inside the finished tube.

Charge equalisation between the two surfaces occurs by ionic conduction. IO tubes will eventually fail due to sticking images, caused by migration of the sodium ions to the far surface of the glass disc.

Brand	3 in	4 1/2 in
Du Mont	TE-124E	
EMI		203 206 207
Fernseh		K4OK91B
GE	PE-4A, PE-7A, PE-15, PE-26	PE-29 (?)
Marconi	Mk-II Mk-III (3in)	Mk-III (4-1/2in) Mk-IV
PYE	Mk-III Mk-IV	Mk-V Mk-VI Mk-VII
RCA	TK-10, TK-11/31, TK-30, TK-40, TK-41, TK-42, TK-43	TK-12 TK-60
Visual	MK-10	

Figure 16 - Cameras with IO Tubes

The disc is very fragile and tubes found on the surplus market usually contain broken glass target discs, or torn mesh electrodes. Because the glass disc is a very small distance from the target mesh and field mesh electrodes (when fitted), it's possible to permanently damage the IO tube by electrostatic attraction of the glass and mesh. Correct camera warm-up procedure must be observed.

The ELCON Tube

A development late in the IO tube's history (mid 1960s) was called the ELCON IO tube, following work at EEV in Chelmsford, UK. ELCON IO tubes are built with titanium doped conductive glass for the target disc, and these tubes last about three to five times longer than standard types. Making the

Figure 17 - 3 in. IO Tubes in Boxes

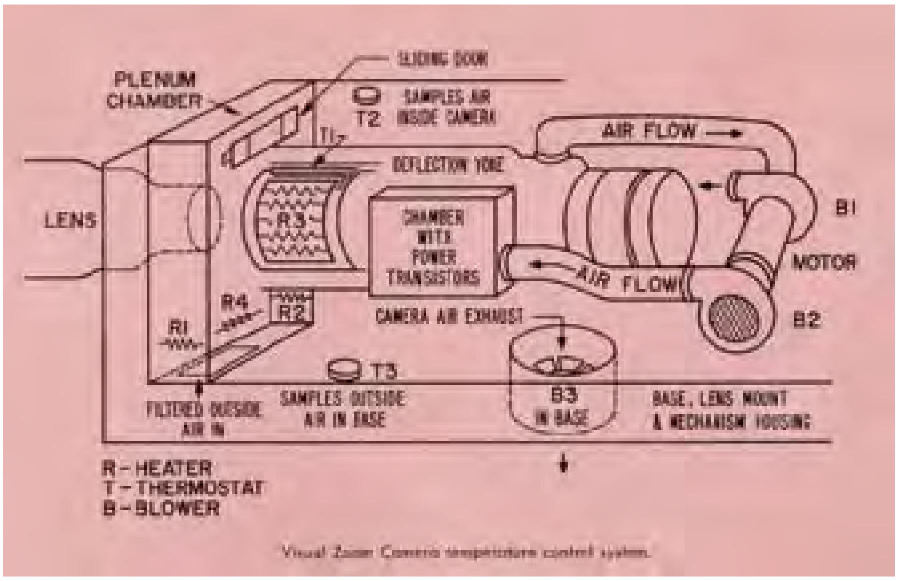


Figure 18 - IO Tube Heater System (*Visual Mk10*)

glass target discs was even more difficult, because the glass must be worked in an oxygen free environment using specially made tooling.

Design Compromises

Like many engineering problems, improvements of one parameter will 'cost' the reduction of another one. The best solution is often a compromise between two desirable features that end up in a tug-of-war. A strong tool to improve the IO tube performance is to increase the target disc capacitance – either by increasing the area and/or by reducing the spacing to the mesh target. The four-and-a-half inch IO tube obviously has greater glass disc size and about three times the capacitance. Various models of the three-inch IO tubes were made with "close target-to-mesh" of 0.001 inch through "wide target-to-mesh" of about three thousandths of an inch. There are practical limits to manufacturing such small spaces, and even if the space were reduced further the IO tube would suffer from microphonics (image distortion caused by mechanical vibration of the mesh, or even caused by loud noises in the studio).

Temperature Control

Before adjustment is possible the camera must reach operating temperature, and from then on the IO tube faceplate needs to be held to at least 35 degrees C. up to 45 degrees C., and no more than 5 degrees C hotter than any other part of the tube. Typically in a valve (tube) camera there is waste heat from the electronics so fans and ducts bring it to the faceplate of the IO tube.

In low power "transistorised" cameras such as the Visual Zoom Mk10 (figure 18), an elaborate heater and duct system is provided to capture the waste heat from the power transistors and if necessary heating from additional power resistors.

Set Up Adjustment

As can be deduced from the description above, the IO tube has many variable adjustments needed to get optimum performance. These are performed on the camera during TSU (technical set up) first thing in the morning, and were sometimes retouched during the day's work. Depending upon the type of IO tube in service (field-mesh or non-field-mesh), the procedure is different and harmful to the wrong tube type.

IO Tube Set Up Procedure

(1) Before starting with a fifteen to thirty minute warm up, first uncap and open the lens, and advance the beam current control a bit, and set the camera to over scan.

(2) Cap the lens again. This procedure will prevent the field mesh from being electrostatically pulled into contact with the glass target disk and destroying the IO tube!

(3) Once the camera has warmed up, uncap the lens again, open the iris part way, and advance the target control until information appears on the monitor.

(4) Adjust the beam focus, image focus, and optical focus until detail can be discerned in the picture.

(5) Adjust the alignment-coil controls to maximise the signal, and if the picture is in negative contrast, increase the beam current.

(6) Adjust the alignment-coils current again, so that the centre of the picture does not move when the beam focus is varied. Try to use the lowest beam current to prolong tube life.

(7) Focus on a test pattern and set the image corners to just fill the target ring. Adjust the deflection circuits to fill the TV raster on the monitor.

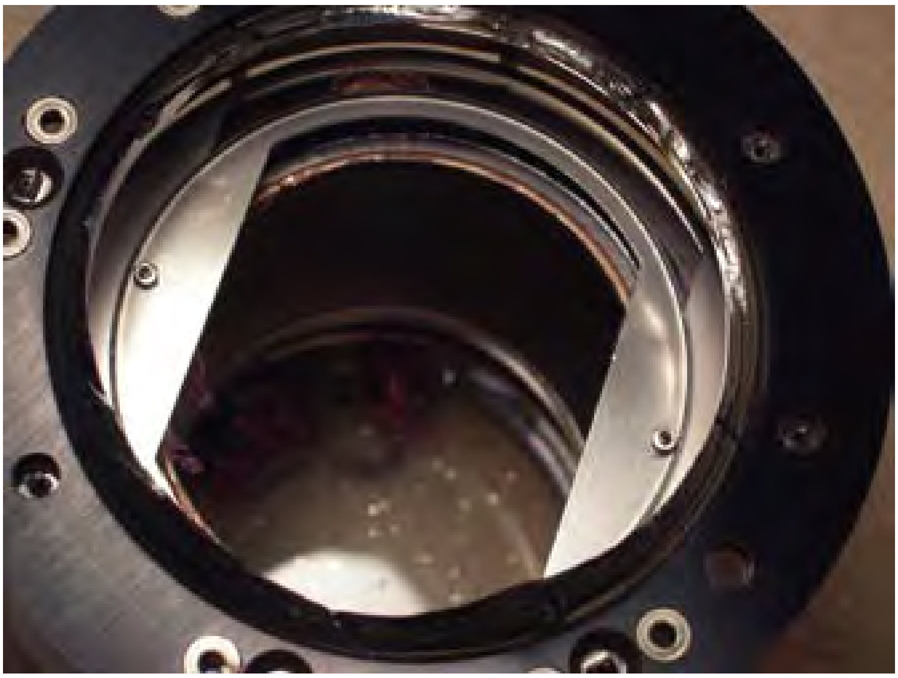


Figure 19 - Field Mesh Area

(8) Back off the Target control until the image fades almost completely – this is the target-cut-off voltage for this tube.

(9) Raise the Target voltage to exactly 2.0 volts (2.3 to 4V for the four-and-a-half inch tube) above cut-off; if necessary adjust the beam-current control to just discharge the image highlights.

(10) Adjust optical focus and both the photo cathode and G4 for the sharpest picture. Check the grid 4 voltage and reset to between 150 and 180V, to avoid mesh-beat in the video image.

(11) Accurately set the image accelerator (grid 6) voltage to 73% of that on the photo cathode.

(12) Adjust the decelerator (grid 5) voltage to balance between high signal output in the corners and best geometry. Bad geometry has 'S-Distortion' in the horizontal scan lines.

(13) Adjust the multi focus (grid 3) for maximum signal output.

(14) Rotate the yoke (if necessary) to set the image horizontal to the scene's horizontal.

(15) Recheck and adjust the target voltage to 2 volts above Image cut off.

(16) Open the lens one or two stops beyond the point at which the highlights of the scene reach the transfer knee (highlights limited).

Figure 20 - Multiplier (4 1/2 Tube)

Image Orthicon Autopsy

A rare opportunity to look inside a large IO tube came up recently (don't ask - the author did manage to break one during a relocation of his collection).

The tube broke quite cleanly at the shoulder, but cracks ran down the body. The mesh electrodes and glass disk vanished – probably torn to shreds by the sudden loss of vacuum The frame that held the target glass and the mesh electrodes can be seen in figure 19, note the remnants of the mesh around the hole and debris that fell on to the photocathode below.

The author carefully cut the barrel near the shoulder and also near the base using a diamond dust saw. The cut was quite clean.

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

Further Reading:

"Television" by Dr. V.K. Zworykin and Dr. G.A. Morton. (Wiley, 1940).

"Television Broadcasting Camera Chains" by Harold E. Ennes (Howard Sams,1971)

Circuit Notebook No. 82

By John Lawrence GW3JGA

Oscilloscope Converter for Narrow Band Television

This circuit will allow a NBTV (Narrow Band Television) picture to be displayed on an oscilloscope.

The circuit has been produced for use with a Tektronix 2215 oscilloscope and should be suitable for use with other oscilloscopes which have following features:

Two - DC coupled 'Y' inputs, one of which can be switched to be an 'X' input, so that the trace can be deflected vertically (Y) and horizontally (X).

One - 'Z' input, to modulate the brightness of the trace.

The NBTV signal (which conforms to the NBTV Association Specification) [1] has 32 scanning lines, each line occupying 2.5 ms and a field rate of 12.5 fields per second. Line scanning is vertical, from bottom to top, starting bottom right. Field scanning is from right to left. Video modulation is positive-going with negative-going sync. Each picture line (except one) ends with a line sync pulse of around 100-250 us.The end of a field scan is defined by the absence of a line sync pulse, known as 'missing sync'.

Circuit description

The circuit operates from +5 V and -5 V supplies and is shown in Fig. 1.

Consider first the scanning generators [2]. There are two scanning generators, IC3A with IC5 and C5 for the field scan and IC3B with IC6 and C6 for the line scan. The circuits are identical except for the values of C5 and C6. The op-amp IC5 has capacitor C5 connected between the output and the inverting input. A fixed positive current to the inverting input is defined by R9 and an equal and opposite negative charging current through C5 is provided by the op-amp output.

The result is an extremely linear negative-going output voltage that forms the scan output. The CMOS switch IC3A (part of a 4066 quad CMOS switch), produces the return scan or 'fly-back', when it is in the 'on' state, by rapidly discharging C5. When it is in the 'off' state it allows the scan to resume. The circuit is not free-running but is controlled by the incoming signal.

Now consider the input circuits. The incoming NBTV signal passes to the emitter-follower TR1. The signal is then coupled by C9 and DC restored by D1 which conducts on the bottom of each line sync pulse and clamps it to nominally -0.6 V. IC1 is used as a sync clipper. RV1 is set so that the sync is clipped at approximately half-way up the sync pulse. Clean sync pulses are fed to IC2A and IC2B the 4528 dual re-triggerable monostable. IC2A is triggered on the negative-going edge and IC2B on the positive-going edge.

IC2A is used as a missing pulse detector [3] [4] to generate a field reset pulse. The monostable period is set to approximately 3.5 ms. In this arrangement, the incoming line sync pulses keep retriggering the circuit and the monostable only completes its timing period when a line sync pulse is missing. Hence, it functions as a 'missing pulse' detector. During its timing period IC3A is 'off' and the field scan takes place. When the timing period ends IC3A is 'on' and the field fly-back occurs.

IC2B is triggered on the positive-going edge of the line sync pulse, causing IC3B to be held 'off' for 2.3 ms and the line scan to be generated. At the end of the timing period, IC3B is turned 'on'

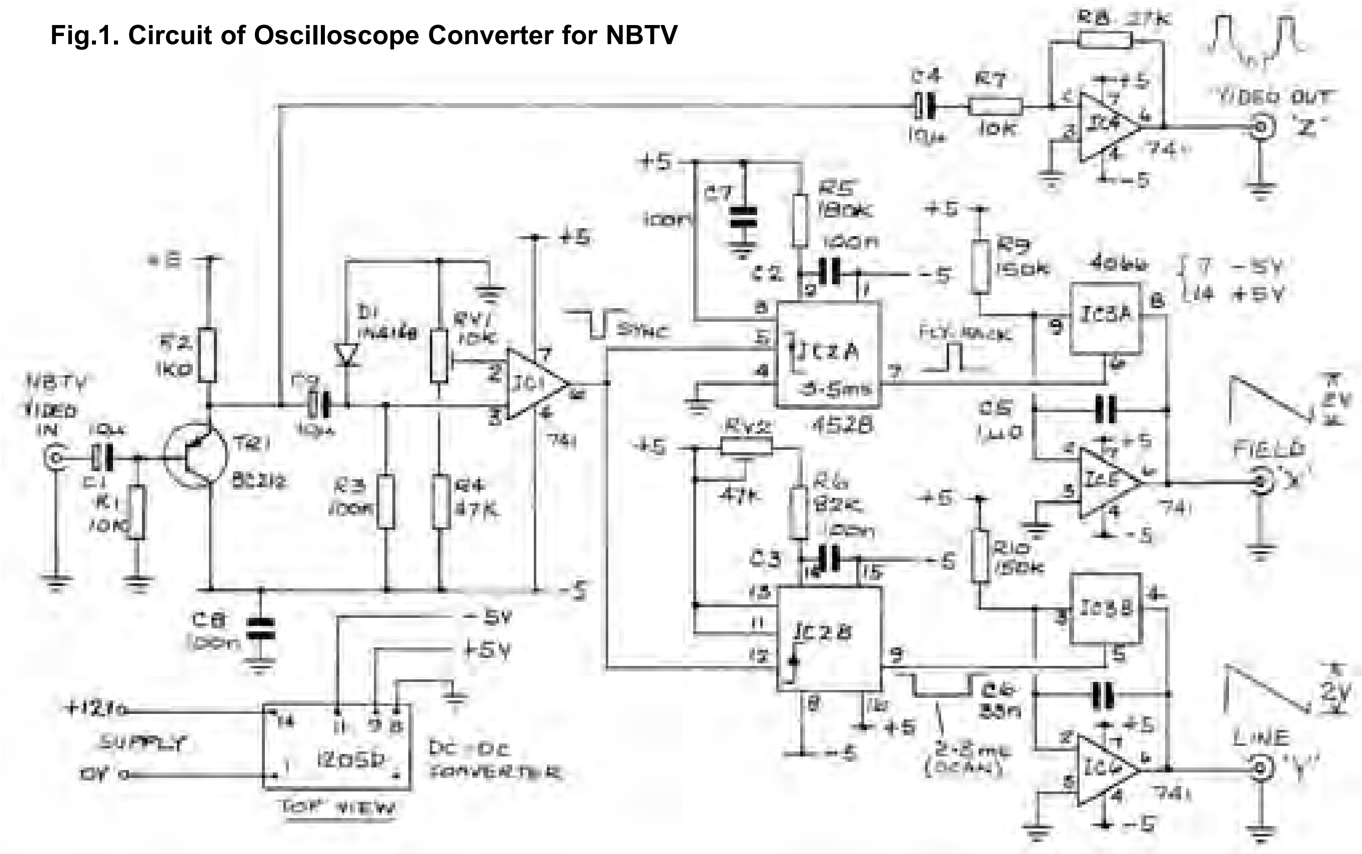
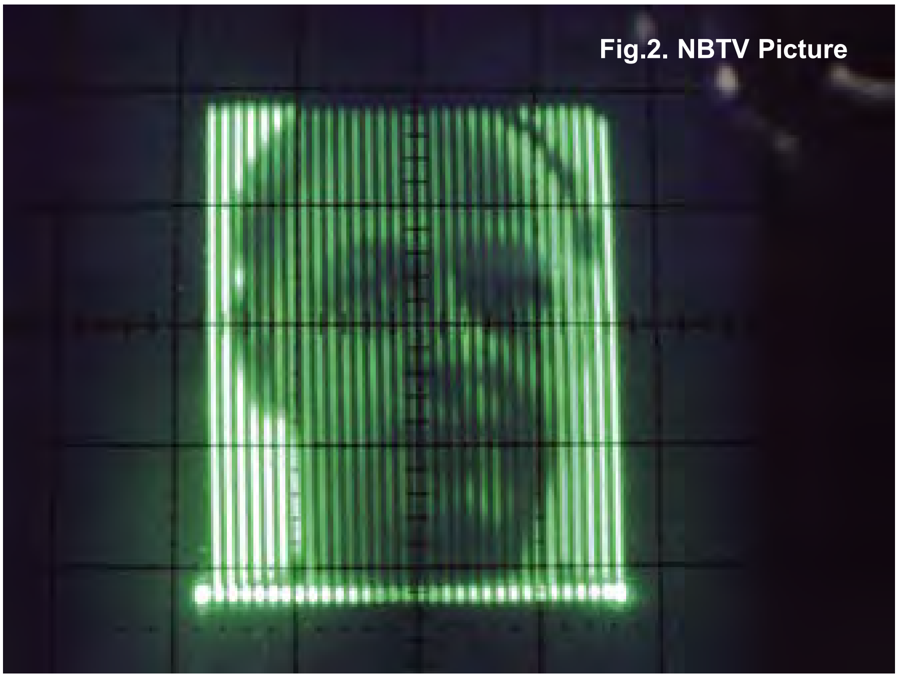


Fig.1. Circuit of Oscilloscope Converter for NBTV



and the line fly-back takes place. It may seem strange that the monostable is used to define the scan period, rather than the fly-back, but this ensures that during the 'missing sync' line the output is held at 0 V.

The circuit, as shown, generates negative-going scanning signals having an amplitude of 2 V p-p. These can easily be inverted to suit other oscilloscope requirements by taking, for example, R9 and/or R10 to -5 V instead of +5 V.

The video signal is taken to the inverting amplifier IC4 to provide a negative-going video signal for the oscilloscope 'X' input. The value of R8 can be changed, if necessary, to alter the signal amplitude. Although IC1, IC4, IC5 and IC6 are shown as individual op-amps they could be replaced by a quad version.

In this circuit, a DC-DC converter NMA1205D (Farnell 330-887) is used to generate the +5 V and -5 V supplies from the more usual 12 V supply.

The results are shown in Fig.2. The rather squashed picture is caused by the oscilloscope controls not being correctly adjusted. The correct NBTV aspect ratio should be 3:2, vertical to horizontal.

The NBTV Association produce several CDs, for their members, containing NBTV pictures and test signals. Details from the NBTV web site, http://www.nbtv.wyenet.co.uk

References

[1] NBTV Standards NBTV Handbook, Chris Lewis, Grant Dixon & Klass Robers - NBTV Association. Page 56.

[2] Low-frequency Sweep Generator IC Op-Amp Cookbook, Walter G. Jung - ISBN 0-672-22453-4, page 485.

[3] Missing Pulse Detector 555 & 556 Applications Data-Sheet, Signetics Corp.

[4] 4528 Dual Re-trig Monostable.CMOS Cookbook, Don Lancaster, ISBN 0-672-21398-2, page 250

UK / Holland 2003

By Bob Platts G8OZP

After last years cancellation the 3cms tests across to Holland are on again this year the weekend of 16 / 17th August.

If you operate 3CMs portable ATV and can get to the East coast you are welcome to join in. The more stations at different locations the better.

Good proven locations are: Southwold Harbour and Alderburgh on the East Anglian coast, Margate / Ramsgate area. Dungeness on the south coast looks promising but unproven.

Previous test of the sea surface ducting has indicated the when conditions are good signal are extremely strong. Holland has been worked from East Anglia with 10mW and a small horn / LNB for receive.

I shall again be going to Bridlington. This is a more demanding path but has been worked by myself and others many times.

Hans (ECO) and his team will again be at Westkapella on the coast of North West Holland.

Peter (DCD) will probably be again on the coast near Rotterdam.

It is hoped that other stations may be able to set up along the Channel and North Sea.

A 3CMs link from France to UK then across to Holland and linked on up to Brid would be a fine achievement.

For further info etc please contact me on 01283 813392 evenings 7 – 9PM or E-mail g8ozp@hotmail.com

On the event we use mobile phones. (they are more reliable than 2 meters or 70)

Image Grab Processing

By Peter Vince (G8ZZR)

Video cards for home computers are now available very cheaply, making it easy to grab interesting images from broadcast television signals. I have such a card on my Macintosh, and use it to grab the occasional unusual Test Card I see on satellite. Unfortunately the video grabber card suffers quite badly with interference from the computer circuitry, and so several grabs need to be taken and averaged together. The software supplied with the card also applies the wrong weighting to the B-Y component of the signal, apparently giving it the same gain as the R-Y, resulting in blues and yellows being desaturated by about 20%. It therefore takes a little more work on the grabbed and averaged images to correct this, but the results are worthwhile. Described below are the processes used, and while this is done on a Macintosh, they could easily be replicated on a Windows PC.

The software supplied with my particular card includes a frame grab option, but the red, green and blue in the resulting images are only quantised to 16 levels each - despite it giving the full 256 levels when displayed on a screen in a 24-bit mode! While this looks alright on pictures, it will turn a nice smooth ramp on a test signal into a staircase! The operating system's screen-grab function is therefore used, but that, too, has its problems - a lot of unwanted border around the picture. The popular shareware program GraphicConverter (see reference 1) has a batch conversion facility, and so that is used to trim the borders.

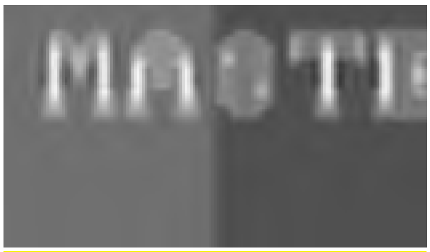
Thirty to forty frames are grabbed, more if there is movement, as there increasingly is on test signals these days. Having confirmed there are no bad images, these are then split into three groups, and the contents of each group averaged together. The ubiquitous Adobe Photoshop is used for this. All the images in the group are opened, and then copied into new layers in Photoshop. The opacity of each layer is then adjusted so that the result, when the image is "flattened" (to a single layer again), is an average of all the constituent layers. The opacity of each layer is set as follows: Photoshop considers the first image as the background. The second image becomes the first "layer", and the opacity of that is set to 50%. That way, the result is an exactly even average of the two images. The opacity of the third image (on layer 2) is set to 33%. This gives an almost exactly even average of the three, as the result consists of only one third of the last image, plus two-thirds of what is underneath - the even mix of the first two. The opacity of extra layers is reduced proportionately - 25%, 20%, 17%, 14%, 13%, 11%, 10%, and so on. Unfortunately the opacity can only be set in whole number percentages, but the error is insignificant. Noise (and cross-colour) is very quickly diminished by this averaging - the more frames that can be averaged, the better.

My video card has an AGC function which makes a brave attempt at setting the levels, but the result isn't perfect, particularly when the picture-sync ratio on the source is wrong. Had the B-Y weighting been correct, then it would now be a simple matter of adjusting the saturation, contrast, and lift ("brightness") to achieve a "perfect" picture. However, as it is, the averaged pictures are saved as uncompressed TIFFs, and I have written a BASIC program to re-code them into Y, U, & V. (Strictly speaking that should be Y, Cb, & Cr, as U and V refer to the weighted signals used to modulate the subcarrier). TIFF is a very flexible format, but when saving a 24-bit image in uncompressed mode, after the header, the image data is saved as straight-forward byte-triplets for the red, green and blue components of each pixel in turn, scanned, just like television, from top-left to bottom-right. Aside from the file-size (about 1.3 Megabytes!), handling these files is therefore very straightforward. Adobe maintains the TIFF standard (having taken it over from Aldus), and the formal specification can be downloaded as a (392 Kbyte) PDF file from their web site (reference 2).

Photoshop, at least the older versions, can't handle the Y, Cb, Cr colour-space, and so my program just replaces the R, G, & B bytes with the Cr, Y, & Cb components respectively. Photoshop is quite happy, thinking it is an ordinary RGB image, and while the colours look a little strange, this allows easy manipulation of those components. The subcarrier notch filter on the video card leaves some remnants, particularly on strongly coloured vertical edges - like colour-bars. On a television this isn't too important, as the eye will average out this pattern over time, but on a static frame-grab, it can be distracting. The averaging of several pictures dramatically reduces these dot-pattern remnants, but by also averaging several lines together, it can be removed completely. The PAL subcarrier frequency was carefully chosen so that the eye could average it out - particularly on monochrome receivers without notch filters. Subcarrier is thus locked to line frequency with the rather nasty relationship: Fcsc = Fline * 283.75 + 25Hz The dot pattern will thus repeat four-lines later on one field, and be inverted on the next or previous fields. The video card necessarily de-interlaces the pictures, and so the dot pattern on our grabbed images repeats every eight lines.

The picture above is a small section of the luminance component of some recently grabbed colour bars, showing the PAL dot-pattern on the green-magenta transition, and around the text. There is also some patterning interference on the plain areas of the bars.

By using the motion-blur filter in Photoshop, set to an angle of 90 degrees (straight up-down), and a distance of 7, then each line will become the average of eight adjacent lines, and any remnants of the PAL subcarrier will have gone. The immediately obvious problem is the tremendous vertical blurring, so this is where we get sneaky! Having copied the group of pictures into Photoshop layers and set the opacities, the image is then "flattened" back to a simple background layer. A new layer is created by duplicating this, and the



This second picture shows the result of blurring the image - the dot-pattern (and much of the patterning) is completely averaged out.

motion blur is applied to the new layer. A layer mask is then added and filled with black, which will completely hide the new layer. Suppose there is a band of colour-bars on the image where you are trying to eliminate the dot-pattern, a white window is cut into the layer mask over that area, and the merged layer will show through. However, at the top and bottom boundaries of this area, the bars will dim as they merge with the rest of the pattern, and so some cheating is called for! An area from the centre of the patch is copied and pasted over the top and bottom four lines. The motion-blurred layer can usefully be enabled over much of the image, not just coloured areas, as it will further average out noise. It can, however, be very time-consuming creating the mask and pasting solid areas up to the top and bottom boundaries, but it is time well spent.

A major advantage of re-coding the picture is that unwanted colour-difference information can so easily be removed. While averaging has dramatically reduced the cross-colour on frequency gratings, for example, it can be totally eliminated by blanking the Cb and Cr signals. In fact any area that does not specifically have colour can be so blanked, thus removing coloured noise. Not only does that improve the visual result, but it makes the final image more amenable to compression.

The image is then again flattened, and the levels of each colour adjusted. It is then saved as a TIFF, and a decoding program turns it back into R, G, and B. A disadvantage of coding the signal is that the colour-difference channels only have 8 bits. Minimum B-Y (solid yellow) to maximum B-Y (solid blue) is thus coded within the range of 256 levels. A blue ramp going from Black to maximum Blue can only use half that - 128 levels. (Blue ramps are not as uncommon as you might imagine - look closely at the sea on a weather map, this is almost invariably a subtly shaded blue!) This loss of quantisation resolution is why the original grabs were split into three groups, and all the above processing performed on each group: the decoded results are then re-loaded into Photoshop layers and averaged, which smooths over the coarse quantisation. (The mask so painstakingly created for the motion-blurred layer on one Photoshop file, can of course be copied to the other two files, saving a lot of time.)

And there you have it. As final icing on the cake, the image can be re-centred within the frame, as it is rarely exactly horizontally centred, and occasionally not vertically either. These techniques can be applied with advantage to even a single grabbed frame, but if many frames can be grabbed at the same time, a better result can be obtained. I referred above to some of the techniques as "cheating", but you need to ask yourself why are you doing this? Is it to demonstrate just how bad your aerial/receiver setup is, or is it to try and reproduce, as accurately as possible, the original test pattern? I have assumed the latter, and believe that exploiting the redundancy in the image is perfectly reasonable.

While all the above processing can clean up a grabbed image, particularly in the vertical direction by the judicious use of cut-and-paste in an image processing program like Photoshop, it isn't the final answer. The subcarrier-notch filter leaves its mark by causing ringing around fast vertical edges, and attenuating the higher frequency gratings, so there is more work to be done there. Side-stepping the problem slightly, as broadcast television is increasingly digital, there are digital TV cards, at least for DTT - "WinTV" from Hauppage for example (reference 4), that provides a clean RGB signal, and thus won't suffer from the PAL artefacts and need so much of the above processing.

Web links

Thomas Bergstam, a radio amateur (SM0ETV) who works for Swedish Television (SVT) in Stockholm, has a web site with over a hundred test card images, a few of which I have contributed after the processing described above (reference 5). Two other popular UK sites are Darren Meldrum's Test Card Gallery (reference 6) and Gerard Fletcher's "Test Card Circle" (reference 7). There is some information on the creation of the current BBC Test Cards J & W on my web site (reference 8). And finally, Richard Russell wrote the DOS and Z88 versions of BBC Basic, and he has also recently released a version for Windows, adding a modern interface to the familiar language (reference 9).

References

1) "GraphicConverter", the Macintosh shareware image manipulation program, is available with interfaces in a dozen languages from: http://www.lemkesoft.com/

2) TIFF specification version 6.0 is available as a 392 Kbyte PDF file from Adobe's web site: http://partners.adobe.com/asn/developer/pdfs/tn/TIFF6.pdf or as a 1 megabyte PostScript file from Silicon Graphics' site: ftp://ftp.sgi.com/graphics/tiff/TIFF6.ps

3) Another web page with information and links about TIFF is "The Unofficial TIFF Home Page" at: http://home.earthlink.net/~ritter/tiff/

4) WinTV cards for Windows' PCs are available from Hauppauge: http://www.hauppauge.co.uk/

5) Thomas Bergstam's web site with over a hundred test card images: http://www.thbe.nu/testcards/

6) Darren Meldrum's "Test Card Gallery": http://www.meldrum.co.uk/mhp/

7) Gerard Fletcher's "Test Card Circle": http://www.testcardcircle.org.uk/

8) The author's site with information on Test Cards F, J, & W, etc. : http://www.noctua.demon.co.uk/video/

9) Richard Russell's site with, amongst other things, BBC BASIC for Windows: http://www.rtrussell.co.uk/

Software

For anyone who would like to experiment with processing images as described in my article, I have adapted the programs I use to run under Richard Russell's "BBC BASIC for Windows", as that can save them as stand-alone executables. They can be downloaded in a 216KB zip file from: http://www.noctua.demon.co.uk/imageprocessing/processingprogs.zip

I appreciate that many may be nervous about running unknown .exe files, so the source text files are included which can be inspected, and they can be loaded and run if Richard's BASIC is installed on the reader's computer.

Four programs are included:

1) AverageTIFFs.exe

This creates an average of several source images, to save having to use the layers facility in Photoshop. Only uncompressed RGB TIFFs can be handled, but any image size up to 800 x 600 will be dealt with. (The limitation is somewhat arbitrary, but is defined by the memory set aside for loading in the images).

2) Encode320tiff.exe

This encodes an RGB TIFF to YUV. However, as programs that support TIFFs with YUV colour-space are rare, the encoded image is saved back using the original RGB header. The Luminance component is stored in the green channel, the R-Y in the red, and the B-Y in the blue. This looks rather unnatural, but the intention is to make processing the colour-difference channels possible.

3) DecodeVYUtiff320.exe

This performs the reverse operation, decoding a YUV file back to RGB.

4) CompareTIFFs.exe

This subtracts two images from one-another, displaying the differences about a mid-grey background.

Demonstration images

Some small demonstration images are included. "test.tif" has some 75% (EBU-style) colour-bars, and some ramps. "test_VYU.tif" is the result of encoding it, and "test_RGB.tif" is after decoding that. While this latter looks very similar to the original, the comparison program, with the gain set to 20, produced "test_diffs.tif". On this it can be seen that the encoding and decoding process has resulted in quite a lot of +/-1 errors in the levels. These are unlikely to be visible on the actual image, but are the reason for doing all the processing several times, and averaging the final decoded files, in order to try and even out these errors. Said errors could have been avoided by encoding the YUV files to 16 bits per channel, but there is very little software available that handles such files, and anyway, the noise on the originals largely masks these small errors.

Sample Images

A couple of sample image grabs are stored separately, as they are quite large. "before.tif" is one of 52 grabs I took of a Sky 16:9 test card recently, exhibiting all the problems described in the article. Even with LZW compression, the file is 976KB. "after.tif" is after all my processing efforts, and being much cleaner, compresses down to 540KB.

The zip file contains a Readme.txt file with more explanation than here. As I've said in that, these programs are not intended to be full singing and dancing applications, just small programs that do a specific job. I have supplied the .exe files so that anyone without Richard's BBC BASIC can run them, but with the source files also included, anyone with a mind can modify them to do just what they want. Richard's BBC BASIC is only £30, which should be affordable for anyone wanting to experiment. (http://www.rtrussell.co.uk/)

Peter has very kindly allowed us to put the zip file, and the before and after sample images, available on the CQ-TV web site - http://www.cq-tv.com/software

Dicky Howett writes, "Ignoring the two foreground posers, what ever happened to the wonderful world of High Definition Television? When this Royal Albert Hall family snap was taken in 1989 the European 'Eureka' project was up and running. To record a concert at the Proms the BBC had dragged along a scanner plus two BTS high def (1250 line) cameras. A whole concert with only two cameras? A kindly engineer explained that with such beautifully clear images, the viewer could enjoy wide screen views without all that tedious cutting to close-ups every three seconds Perhaps he's right. Would certainly make a change these days".

Attempting an ATV Contest

By Graham Hankins

There is nothing like a deadline for concentrating the mind and in June there were two! CQ-TV needed copy and the Summer Fun ATV Contest was in the diary for the week-end 14/15. With two transmitters, two receivers and four antennas there really was no excuse!

The G8SUY 24cm transmitter had been constructed (see back issues of CQ-TV), and rated at a couple of watts. Need a bit more really - was my 20W 'brick' PA still ok? The G1MFG 24cm receiver rested loose with 'no visible means of support' - how could it be secured? The 'MFG push button tuning module had not even been unwrapped! Could I 'get it all together' in a week?


20W 24cm power amplifier ready for action

The 'MFG Rx has no mounting holes, the r.f. module comes right up to the edge of the pcb, and there are no holes on the phono sockets. Even a visit to my local hardware store, which has a very interesting 'bits and pieces' coun-ter (never use anything for the purpose it was intended !) did not display any-thing that the most bending of the imag-ination could adapt into service. At last, it became obvious....use longer screws to hold the two voltage regulators and spacers to raise the pcb from the case. Sorted, thanks to the new Maplin store in the centre of Birmingham!


Portable setup for the Summer Fun ATV contest

The 'MFG tuning module DOES have holes, six of them. I removed the PIC from the Rx board, securde the mod-ule and wired as per instructions. No problem.

I then fired up the 20W PA. This had been simple to construct a few years ago from CQ-TV magazine and an article by a previous editor, John Wood G3YQC. A phone call and cheque to Icom had brought the 'black brick' amplifier. The remaining tasks were to add a few sundry 'discretes', scrape away unwanted copper to fashion the 'pcb' (no etching needed), screw onto a block of aluminium and then solder up. The thing works, with no 'testing' or 'alignment' involved. Connecting the 'SUY Tx to the input, 18W was measured out into the dummy load. However, it did need a fan so, again, the mechanics have to be considered. I finally settled on very long screws (thanks again, Maplin) and mounted the fan 'piggy back' over the PA.

Traditionally it seems, ATV contests are timed from 1800 on the Saturday to 1200 on the Sunday - why not earlier on the Saturday and on into the Sunday afternoon? I asked BATC Contest Manager Richard Parkes: "I can go back to CQ-TV 100. The date has always been the second full weekend in June for the Summer Fun and the times have always been from 18.00 Sat to 12.00 Sun UTC. These times are the same as for the other European coun-tries which take part and hopefully give everybody the best chance of working DX."

I have to go portable for any decent ATV takeoff, but no way am I going to be on top of a hill for Saturday evening and overnight! I arrived on Barr Beacon around 0800 on the Sunday morning, mounted the 24cm and 2m antennas and tuned to the calling frequency. Giles G1MFG was calling CQ contest from down south; I responded with 65W on 2m but without success - I did not hear him again.

I stayed on the hilltop until around 1100. Leicester ATV repeater GB3GV has been received here, but not that morning. The Stoke on Trent box, GB3UD, was alive and well in col-our at about P3. After a couple of "CQ ATV Contest" calls, stations in Telford, Sedgley and Wolverhampton responded. My camcorder was used to put out a 4-digit contest number, then gave a mug shot and pictures of the Rx, Tx and PA. A number could be see from the Sedgley and Telford contacts but no vision from Wolverhampton - that sta-tion was only running a basic 'MFG module. Then followed some general chat about ATV, BATC, 'CQ-TV', test card generators etc. I closed with these stations, and no other ATV activity was heard.


The Severnside 24cm 38 element antenna ready for action

It was good fun, and a great 'push' to get any gear ready! But making notes of contest data while setting up for camera, or Tx, or Rx can get tricky! So, let's get better organised for the IARU International in September

SR-Systems DATV Transmitter

By Ian F Bennett G6TVJ/D

During the autumn of last year I conducted some tests using professional digital satellite equipment to produce a Digital Amateur TV signal (DATV). Using the antenna of GB3ZZ, I was able to establish contact with a number of stations in the Bristol area. This proved the viability of DATV when using the DVB-S (QPSK Modulation) system. A German company called SR-Systems have now produced an affordable DATV transmitter, which operates in the same way as the equipment I used for the tests. I have purchased one of these and it works well. The DATV transmissions can be received using a standard digital satellite free-to-air receiver (FTA) and so a complete amateur system is now possible.

Digital TV transmissions systems are very complex, but they can be broken down into three main areas of signal processing. Firstly there is the video picture coding process e.g. MPEG, secondly there is an error correction and formatting process acting on the generated picture data e.g. packet multiplexing and forward error correction, finally there is the RF transmission modulation process e.g. QPSK modulation.

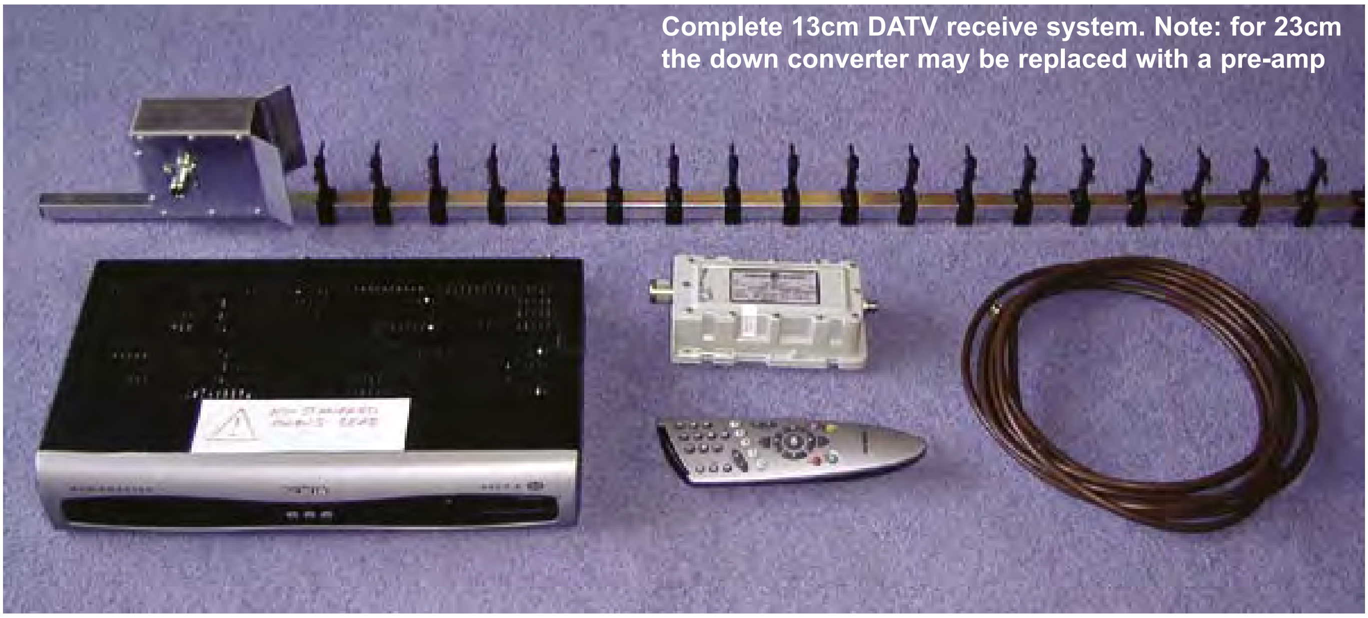
MPEG Coder

MPEG (Motion Picture Experts Group) is basically a specification laid down for a number of video compression techniques. Video signals when converted to digital signals create an enormous amount of data (Up to 270 Mb/s), which is generally too much for either transmission or storage. MPEG lays down a number techniques and processes which enable the amount of data generated in a coder to be compressed and significantly reduced in rate to a manageable level. MPEG coders are fantastically complicated devices, the original broadcast units were quite large and very expensive, and the Tiernan TE6 unit used for my GB3ZZ tests was originally sold for £90,000! (See CQ-TV 200) Domestic single chip coders are now possible with a board price of around £200.

MPEG coders work by first digitising the incoming video signal by dividing it up into pixels (dots) and sampling the pixels to form data, the data relates to the brightness and colour information in the picture. The number of pixels may vary from system to system depending on the required screen resolution; normal standard definition TV consists of 704 horizontal by 576 vertical pixels. The colour difference signals are sampled differently to the luminance signals in a way which initially conserves data. Two types of colour sampling exists in MPEG systems called 4:2:2 and 4:2:0. These relate to the resolution of the samples. 4:2:2 or MPEG Studio Profile @ Main Level uses 4X oversampling of luminance information and 2X over sampling of chroma information found on each line vertically. 4:2:0 or Main Profile @ Main Level is similar except the chroma samples are averaged vertically over two lines. The 4:2:0 system is used for all broadcast to home systems (DVB-S, DVB-T etc.) including DATV, the 4:2:2 system is used for higher quality Broadcast links and studio applications. Most satellite contributions are coded 4:2:2 and so cannot be displayed with domestic FTA receivers although professional receivers will automatically detect 4:2:0 and produce pictures with no problem. 4:2:2 prevents domestic TVRO systems from displaying satellite feeds, although - unless encrypted - the sound may still be received together with the DVB service information. Broadcasters now use 8PSK modulation for many transmissions, 8PSK makes better use of transponder bandwidth but is not receivable at all by domestic receivers.

The sampled picture data in an MPEG coder is divided into small macroblocks of pixels and then various mathematical and statistical functions are performed on them to reduce the data further and make use of redundancy in the data. Pixels, which form elements of a picture, sometimes differ little compared to adjacent pixels and so groups of pixels are described mathematically in terms of their frequency content i.e. groups of similar pixels are described by lower frequencies. High frequencies may describe finer detail. Fine detail often represents the edges of picture objects and is less sensitive to level changes, so the digital resolution is reduced by a technique called

Complete DATV Transmitter



Complete 13cm DATV receive system. Note: for 23cm the down converter may be replaced with a pre-amp

re-quantisation. These processes reduce the required amount of data which is transmitted by the coder. The amount of re-quantisation depends on the compression required by the coder, with low bit rates the re-quantisation and frequency description causes ripples and haloes around fine detail in the picture. These distortions are often referred to as picture "artefacts". The more compression used, generally, the more artefacts begin to show up. When the incoming data fed to a decoder is corrupted, the decoder "gets it wrong" and severe artefacts are produced and the picture breaks up.

MPEG makes use of the temporal redundancy in TV pictures. A particular picture element may not vary much (depending on the scene) from frame to frame, so the data to describe it need only be transmitted infrequently and not for every frame. MPEG constructs moving TV pictures from three different types of picture frame. A coder will transmit a series of frames in a special order; the decoder uses the frames to reconstruct the sequence. The frames are:-

I-frame: This is used as an initial starting point and consists of a spatially compressed but complete picture. These pictures are transmitted infrequently because they produce lots of picture data.

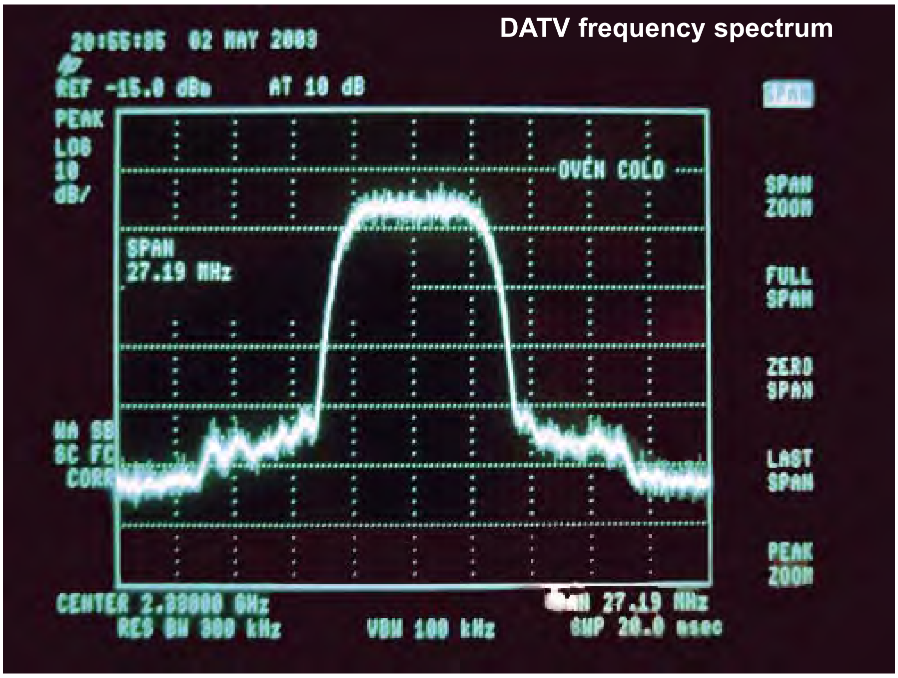
P-frame: The coder sends difference data to the decoder which it adds to it's own prediction of what the next picture frame will be. The coder cleverly uses it's own built in decoder as well to help create accurate data.

B-frame: These frames are made up by interpolating between I and P frames to create an approximation of the original picture. The B-frames are bi-directional interpolations of previous and post frames. This process takes up time and is one reason for the significant time delays associated with the MPEG system. MPEG streams can only be accessed at I-frame points and so "zapping" between channels takes longer as the decoder has to wait for the next I-frame to come along.

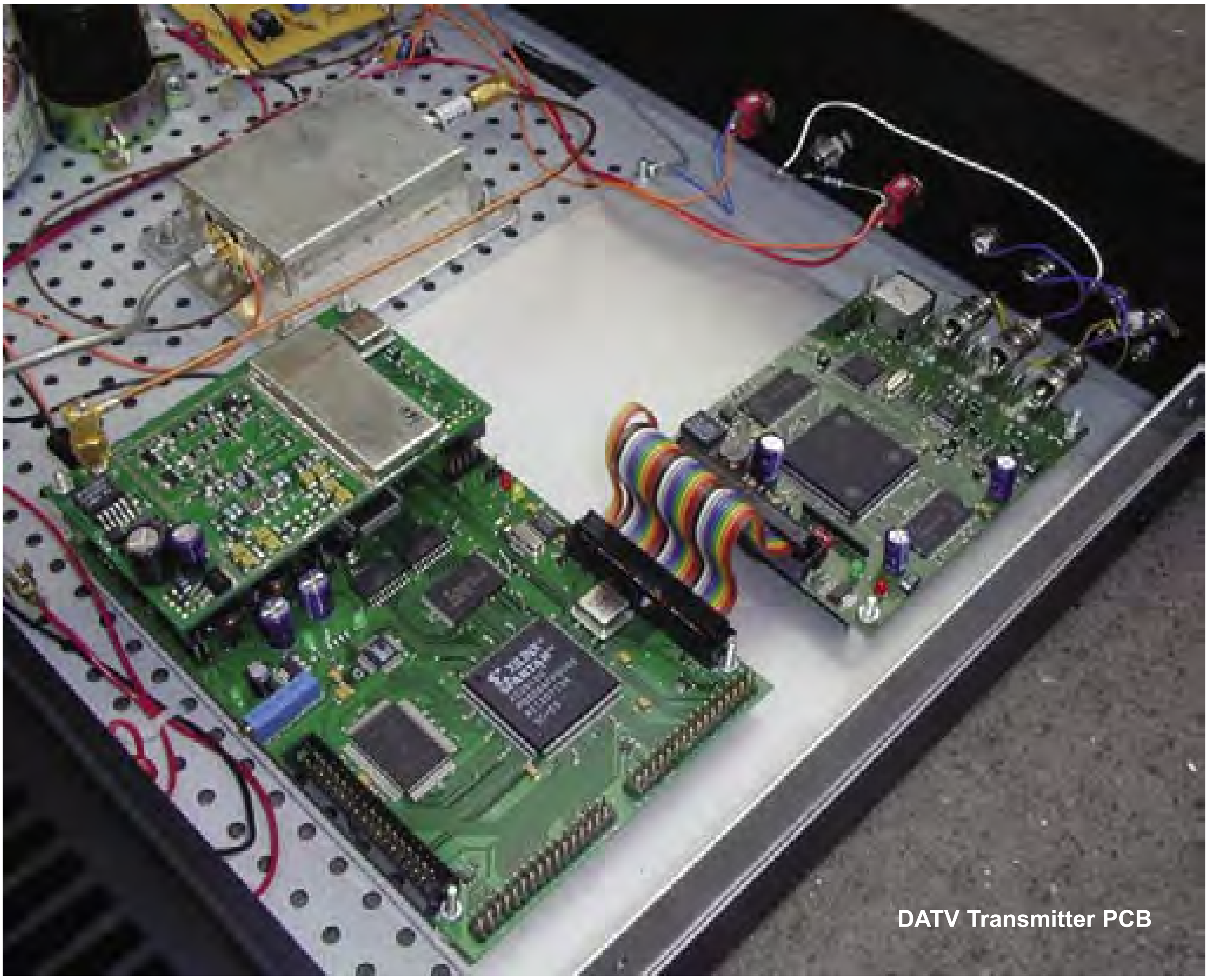
MPEG is a flexible system. Coders may be configured for different frame sequences, and these are called "groups of pictures" or GOPs. A typical GOP might be IBBPBBPBBPBB (standard high quality), for lower delays this sequence may be shortened to just IP but at the expense of more transmitted data. Low delay modes often produce more picture artefacts or "blockeyness" if the transmission data rate is insufficient. The DATV system may be configured for different GOPs but works well with IBBPBBPBBP. The length of frames before the sequence repeats itself is often referred to as the GOP length.

Further clever processing takes place in some advanced coders to compensate and estimate for the effects of motion in the transmitted picture.

The TV sound is often compressed to lower the data rate also as part of the MPEG coder system. Sound data rates compared to pictures are a lot less - typically 192kb/s for a stereo pair. Broadcast MPEG coders will allow linear (uncompressed) or even NICAM processing of the audio signal. The DATV system will carry one stereo pair and the data rate may be set over



DATV frequency spectrum



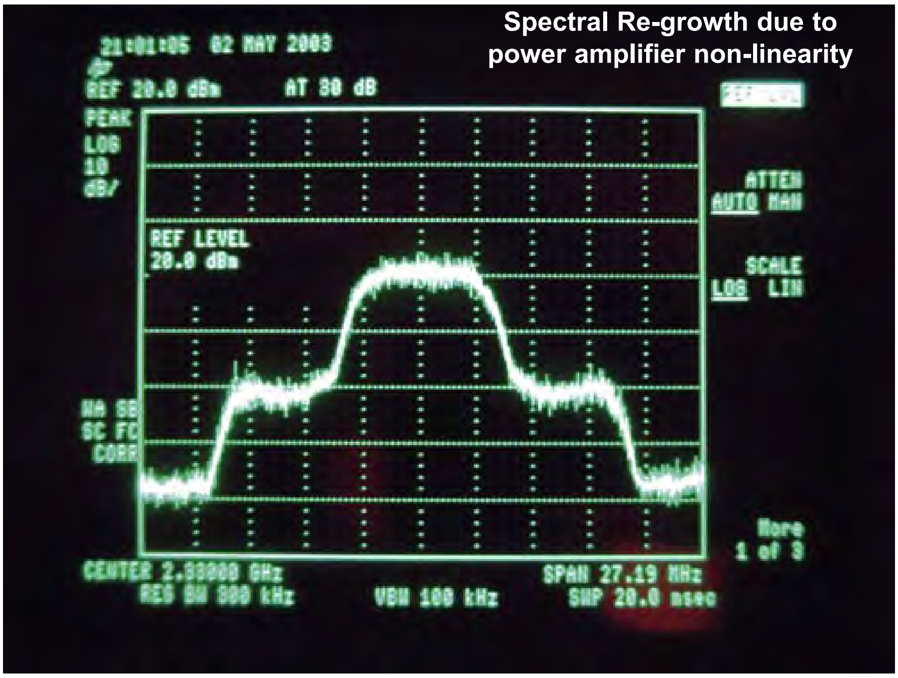
DATV Transmitter PCB

a wide range depending on the quality required.

Error Correction and Signal Format

All digital transmission and storage systems suffer from errors. Errors occur when the data becomes corrupted and therefore an incorrect representation of the original. The primary source of errors in digital transmission systems is noise, but also interference and distortions play a part in degrading a signal.

The data output of an MPEG coder is provided in the form of packets. The DVB spec defines a special format to which the data adheres. The data packets are formed from groups of 188 data bytes. The data packets carry special header information, which enables them to be identified, called PIDs (packet identifier). The packet structure of DVB systems is of fundamental importance and is the basis of all the features and interoperability of digital TV systems. The data packets are transmitted as a constant flow called a “transport stream”. Transport streams consist of many types of packet; the vast majority will be video and audio packets from which to make up the received picture. Transport streams also contain many other types of packet, which carry important system functions such as timing, program, service and network identification. PIDs all carry unique numbers to identify them; the basic PIDs can be accessed and displayed with a satellite receiver. A typical arrangement might be video PID 32, audio PID 256 and PCR (pro-



Spectral Re-growth due to power amplifier non-linearity

G6TVJ/D DATV Transmitter Configuration

Single Chip MPEG Coder Fujitsu type MB86390

Input	1V PAL or S-Video
Sampling	4:2:0
Resolution	704x576
GOP	IBBPBBPBBP
Video Bit rate	4800kb/s
Sound	192kb/s Stereo
Interface	Parallel Transport Stream
Output frequency	2.330 GHz (13cm ATV Simplex)
Modulation	QPSK (DVB-S)
Bandwidth	8 MHz
Symbol Rate	6000
FEC	1/2
PA	Khune Electronic MKU223 Gas Fet
Output Power	4W Max. 150 mW Min (QRP)
Antenna	Alford Slot

Receivers

Nokia 9650S, Technomate TM5000D
13cm down converter
California Amplifier “Arabsat” C31203 Low Noise Downconverter

Check Out-

www.sr-systems.de
www.linkres.co.uk
www.livetools.tv
www.tanbergtv.com
www.gigawave.co.uk
www.digitalradiocameras.co.uk

gramme clock reference) 8192. A second audio channel might be named 257. Data channels and teletext may also be carried by other PIDs. One of the most useful PIDs is a service information table packet; this enables a receiver to display a screen menu when the viewer selects a program to watch. The service name might be a channel name e.g.”BBC1” or a station call sign e.g. “G6TVJ/P ROYAL FORT”.

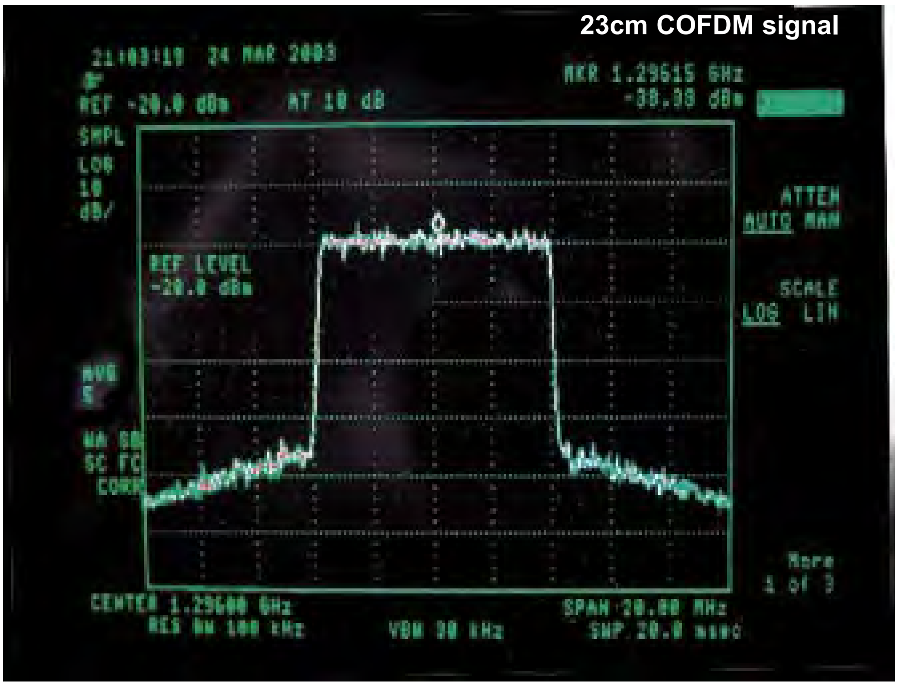
A transport stream may carry more than one programme service. Provided PIDs are not named the same (PID clash or conflict), more than one video service may be carried in one data stream. This is how many broadcast to home services work. BBC1, BBC2, News 24, and CBeebies are carried simultaneously all with different PIDs in one stream and then modulated onto a COFDM (DVB-T) carrier or DVB-S carrier. The SR-systems DATV unit is capable of generating a multiple programme transport stream as it has a multiplexer built in.

Transport stream packets for transmission are processed to protect them against errors. The 188 byte packet is expanded to 204 bytes by having an extra 8 byte header added to it. The header contains information, which allows errors to be protected and corrected. This is called outer error correction. The technique used is a complex system called Reed-Solomon coding. Depending on the system, bytes may pass between equipment when protected with this means. For transmission over RF paths an additional error protection system is also used. Inner forward error correction called Trellis encoding is used to provide a robust signal, which can cope with errors generated by noise. Forward error correction (FEC) works by transmitting large amounts of additional data, which enables the effects of errors to be detected and negated in the receiver. The ratio of original data to correction data is known as the FEC ratio. Transmissions such as satellite and terrestrial add FEC and depending on the system, different FEC ratios may be used. The FEC ranges from 7/8, 5/6, 3/4, 2/3, and 1/2, the 1/2 rate is the most effective. When setting up a receiver the FEC ratio for the expected transmission can be entered via a menu system; alternatively many satellite receivers will auto detect and work the parameter out for themselves.

The error correction system has the ability to reduce the effects of noise in the transmission path. A high error correction ratio negates the effect of noise and effectively adds gain to the system. An FEC of 1/2 adds an effect called “coding gain” and will allow around 5dBs less S/N ratio for error free operation. An initial error rate of $1x10^{-2}$ can be reduced with correction to $1x\ 10^{-10}$ error rate before the data is decoded. The error correction system with a reducing s/n ratio works well up to a point and then the decoder rapidly falls over. Errors cause big disturbances to the picture and sound, the kind of thing which is often seen on digital satellite news gathering (DSNG) feeds that sometimes fail whilst on air. DATV systems work best with FECs of 1/2 where robustness is the main consideration. Satellite systems may use smaller FECs depending on the strength of the transmission and the size of the receiving dish.

Modulation

There are many types of digital modulation but one basic principal dominates all the available systems. Phase modulation is used which can be considered to be a type of FM. The phase of an RF carrier is used to represent the state of a digital signal i.e. one phase represents a “1” and another represents a “0”. The most common system, and the system used for digital satellite broadcasts



23cm COFDM signal

DATV Transmitter PA and Antenna

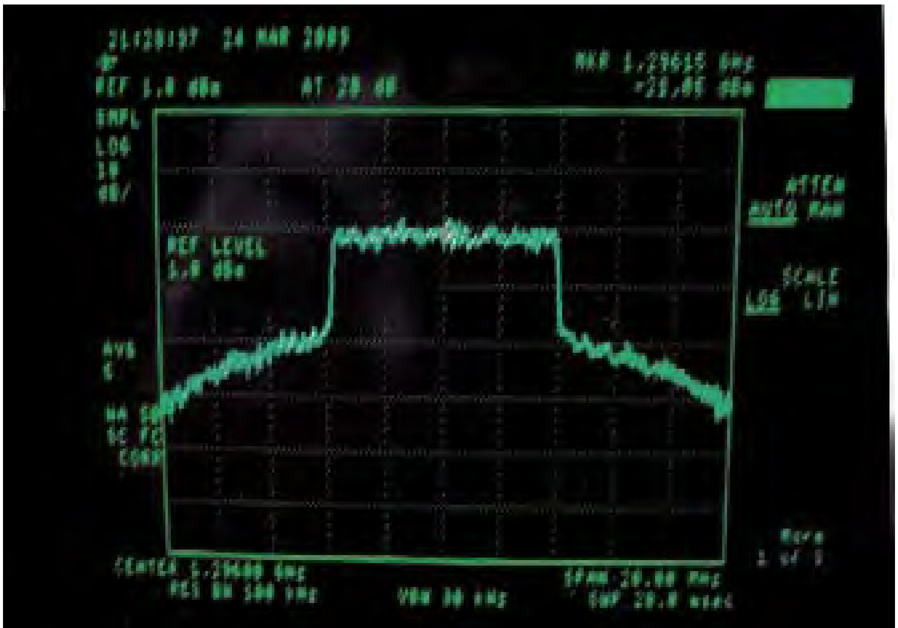
and DATV, is called Quaternary Phase Shift Keying (QPSK). The phase of an RF carrier is altered to produce four relative phase states of 0, 90, 180, and 270 degrees. These states can represent combinations of data 00, 01, 10, and 11; each state is referred to as a symbol. The transmitted symbol rate is a fundamental parameter that determines the RF bandwidth occupied by the digital signal. A QPSK system occupies a bandwidth proportional to about 1.2 times the symbol rate. E.g. a 6M symbols/s DATV transmission takes up about 8 MHz of bandwidth, - a significant improvement over a PAL system! Satellite transmissions vary widely; a SKY service may be 27,500 Ms/S (MCPC), and marginal single channel services may use only 4444 Ms/S (SCPC).

QPSK signals occupy four phase states. An x-y phase diagram that produces four points called a constellation may represent these, and this defines the 1s and 0s. More elaborate combinations of phase and also amplitude may be used to form more complex symbols, which in turn describe more data. 8PSK produces a constellation of 8 points; a single symbol may describe data ranging from 000 to 111. More complex modulation schemes such as 16 QAM and 64 QAM use 16 and 64 points respectively. Each symbol is much more efficient in terms of transmitting data but there is a penalty. The individual constellation points get closer together and so become more prone to errors due to noise. A greater signal to noise ratio is needed for higher order modulation schemes - "ya don't get summut for nothing!" In real systems the points don't really exist, the data forms clouds that - provided they are in the region of the original point - results in errors being kept to a manageable level. Complex digital signal processors and microprocessor devices are used to decide between the 1s and 0s. The constellation is formed into clouds because noise, non-linearity, multipath and group delay distort the modulation scheme. Error correction up to a point will remove all the effects of distortion, until the constellation points become too close together and the demodulator cannot decide between a 1 and a 0.

A common type of digital modulation is called coded orthogonal frequency division multiplex or COFDM. COFDM consists of a large number of individual carriers that carry a low data rate modulation each. The modulation may be QPSK or a higher order modulation such as 16 QAM or 64 QAM. Depending on the system, a group of around 2000 or 8000 carriers are transmitted to enable a high data rate to be carried. Another feature of COFDM is the carrier spacing. The modulated carriers are spaced so that the mutual interference or cross talk between them cancels out leaving a clean carrier. Another feature is a guard interval; a guard interval is inserted between successive symbols so that the receiver can avoid the corrupted portion of a symbol due to multipath distortion and delays due to reflections. A typical system such as a radio camera system might use 1705 carriers with QPSK modulation. A guard interval of 1/16 of a symbol period might also be used with a FEC ratio of 1/2.

COFDM is the modulation system adopted by the UK digital terrestrial TV service (Freeview). COFDM has been around for a number of years and was developed for broadcast services. The Digital Audio Broadcasting (DAB) system that has been around since the mid 1990s also uses this type of modulation. In recent times COFDM has found applications in digital wireless camera systems (Radio Cameras) these are used by broadcasters. A number of commercial systems are now available which consist of camera-back mounted transmitters operating in the 13cm band. These systems may be configured for different applications such as sport or news and the bit rates, modulation and FECs all tailored to suit. The most successful unit at the moment is made by a company called Link Research, but at around £18K they are not cheap! Several other systems exist from companies such as Livetools, Tandberg, and Gigawave . The BBC has also developed its own system using two COFDM signals together and DVCPRO video compression. A number of industrial quality units are now appearing; Wood and Douglas are now offering a CCTV type system but it is also very expensive.

Experience has shown that COFDM modulation, although resilient to multi-



Distorted 23cm COFDM signal due to amplifier non-linearity

path distortion effects, is not foolproof. To get the best bit rate, and hence best picture quality, 16 or 64 QAM symbols have to be used and if the FEC is reduced the signal becomes much less robust. A number of other potential problems exist:-

1. COFDM signals are difficult to amplify and suffer distortion from a lack of amplifier linearity. Power amplifiers are required to operate with a high output back off of up to 10dB. This makes them potentially inefficient. This is also a potential problem for amateur use.

2. For amateur use, generating COFDM signals is more complex than QPSK, due to the need for DSP techniques.

3. So far, COFDM signals do not work well above 3GHz, at higher frequencies, e.g. 10-12GHz, problems with Doppler effects make moving transmissions impossible.

4. The individual data carriers are susceptible to the effects of phase noise in local oscillators, which may lead to unwanted errors.

Amplifier non-linearity in COFDM signals manifests itself as the production of sidebands beyond the original modulation spectrum. These sidebands are sometimes referred to as spectral re-growth and are normally viewed on a spectrum analyser. Spectral re-growth up to about -30dBc may be acceptable, but care is needed as it occupies adjacent channels and may cause interference to other users. Spectral re-growth, if severe, will also cause a deterioration of the signal quality and errors will be created, leading a corrupted picture. A parameter known as the modulation error ratio (MER) is sometimes provided by the receiver to help gauge the quality of the received signal.

Linearity is also a problem in QPSK modulated signals such as DATV. Spectral re-growth also appears as an amplifier approaches its maximum power output. A typical back-off for QPSK might be around 3-6dB, much less than that required for COFDM. Linearity in pre-amplifiers and down converters may also be a problem so you can't simply saturate every thing like you could with good old analogue PAL FM.

An interesting way to improve COFDM systems makes use of diversity reception. The packet nature of DVB signals lends itself to diversity or multiple receivers. Several receivers with spaced antennas provide data streams to one decoder which picks out the "non-error" packets from the two streams and makes up one continuous stream for decoding back to a picture. A diversity system might also be possible with a QPSK DATV system.

SR-Systems DATV

The German transmitter does all the above-mentioned processing. It physically consists of three PC boards; one board forms the MPEG coder, a second board forms the error correction and multiplexing and a third board piggy-backed onto the second contains the modulator and RF stuff. A parallel interface between the coder and modulator transfers the DVB data packets in the form of a parallel transport stream. The transmitter is powered from 12V and the RF output power is in the region of 10mW - enough to drive an amplifier.

The DATV transmitter is DVB compliant, which means many different parameters may be set according to the application. The transmitter may be programmed by using a serial connection to a PC. A configuration file is written on the PC and a special utility programme called fwtool transfers the settings into the transmitter. Details of this are available on the SR-systems website. A standard configuration file (.txt file) is available which may be edited, saved and then uploaded to change single parameters without messing the rest of it up. Amazingly the transmitter is dual band and will work on 13cm or 23cm, this makes it even better value. I could struggle to build a decent analogue transmitter for £500! (That's decent, most ATV analogue transmitters are not.) The PC stuff is a bit tricky, you have to enter in a load of baffling DOS gobble-de-gook commands but you get the hang of it in the end. Fortunately the transmitter also has a diagnostic mode, which can be accessed from a VT100 protocol type hyperterminal set up.

I have used the transmitter on 13cm with a couple of power amplifiers. An under driven DL2AM 1W gasfet amp serves as a driver followed by 31m of Westflex 103, followed by a Khune 10W amp followed by an Alford slot antenna. With careful juggling of drive levels, I can get around 4W with spectral re-growth better than -35 dBc. This has been used as a portable operation in the middle of Bristol with excellent results. QRP operation with around 150mW has also proved successful when received at the home QTH - a path of around 6 miles. On 13cm the Westflex cable has proved particularly good, the loss at 2.330 GHz with 31m is only 7dB.

Received picture, P5 of course

The results with this transmitter have been very good. As proved with GB3ZZ, DVB-S makes a viable signal format for DATV. Contacts with a number of stations on 13cm have proved possible using a variety of receivers and down-converters. My Nokia 9650S and an "Arabsat" S-band LNB will work with a received carrier-to-noise ratio of only about 8dB, the equivalent analogue signal would be P1. A FTA receiver made by "Technomate" has also worked well, a WYZ.com down converter has worked and Ken G4BVK has used his own homebrew 13cm converter.

It looks like DATV has arrived thanks to SR-Systems. A second German system may become available this year, giving budding digital stations a second choice. If a parallel transport stream interface can be extracted from a receiver and connected directly to the transmitter, then an all-digital repeater system might be possible. The incoming signal could be re-transmitted without it being decoded with no degradation in picture quality.

I have experienced some slight "funnies" with the SR unit. I suffered a problem that I think was due to buffer overflow. The Fwtool software is supposed to prevent illegal configurations. I found that setting a certain theoretical coder bit rate would over flow the symbol rate and cause regular picture break up. 6Msym/s should allow a bit rate of 5300 kb/s, allowing for sound, but 4800 kb/s was the highest that worked reliably.

Many thanks to a number of stations who have participated in my DATV tests including Ivor G1IXF, Ken G4BVK, Ian G1XZD and Bazil G7FEQ. The future of ATV could be digital…………….

Broadcast MPEG COFDM transmitter (13cm)

Dicky Howett spotted this on the web. He writes, "Just to prove that not only BBC television was doing outside broadcasts in the mid-1930s, here we see a jolly Philips mobile tv wagon with its Iconoscope camera out on location somewhere in Holland. Observe the startling scanner decor and just look at that polypole cable snaking monstrously from the 'moderne' dolly. Trunks and pachyderms spring to mind as like as not."

Second digital ATV test at DB0HEX

By Jürgen, DL3FY

Translation by Klaus, DL4KCK

Second digital ATV test at DB0HEX (Brocken mountain, northern Germany)

At the end of January 2003, once again digital ATV was activated at DB0HEX, and the next day at DB0VER in Verden a digital satellite TV receiver was installed in order to forward the signal as analogue ATV to DB0OZ in Bremen. With some "linking" these digital activities were to be seen also via DF0HHH (Hamburg) in Schwerin and in Timmendorf (Baltic Sea) as well as via DB0WTV at DB0LTC (North Sea). The distance from DB0HEX to DB0VER is approximately 164 km.

At first, we tried two simple sat-receivers for home use at DB0VER, one of them being a HUMAX F1-Fox. The signal strength from DB0HEX was a bit "thin" resulting in "blocking" effects now and then. In the evening conditions went down and brought up a black screen until the next day. After a mains blackout at DB0VER, the HUMAX receiver lost its frequency setup, as the software sets the LO to 9750 MHz automatically after power on (and not to 0 MHz as preset).

Some days later, a commercial Philips satellite TV-RX was tried, but it showed no picture from DB0HEX. On February 21st the digital picture reappeared again, after exchanging the receiver for a "DR-1000". There were no blocking effects at all until the evening March 6th, when the picture "froze" for about three quarters of an hour and once again, later, for some minutes.

All in all, this experimental transmission was a fine success, and we have to thank the crew at DB0HEX. Some "glitches" should be noted: there were regular interruptions (every 10 or every 30 sec.) with a black screen and no sound. A noisy picture from the analogue input at DB0HEX was transmitted without additional digital side effects. Another possibility is mobile reception using DVB-S (QPSK) modulation.

My satellite TV receiver has a display for signal strength and one for quality (bit rate error). Above 17 percent "quality" a full picture is shown, although this may be different for other receivers. The RF preamplifier plays an important part here. Another astonishing effect was the audio delay - resulting in multiple echoes if someone replayed his relayed signal, and the delayed movement on the repeater output picture!

At the end of February some direct digital ATV contacts between OM in the Hamburg area could be observed via DF0HHH. After the end of the digital experiments at DB0HEX, we were able to see the difference - colour noise on strong received signals and the camera picture with analogue FM-ATV! Besides the noise free digital signal, there is an advantage in the possibility to choose from up to four "channels". From my observation, this is the state of the art - an additional analogue output would be fine (for some time), but is not possible everywhere.

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Electronic CQ-TV

This quarter's settings for access to the electronic versions at www.cq-tv.com/electronic are -

Username: amember **Password:** redman

Deadline

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

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

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

Will all prospective contributors please be sure to read the 'Notice to Contributors' on page 3 so that you understand the implications of submitting an article for publication.

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

Commercial adverts should be sent to Trevor Brown, the advertising manager, at 14 Stairfoot Close, Adel, Leeds, LS16 8JR. Tel: 01132 670115. Email: adman@cq-tv.com. Members' sales and wants should be sent to the Editor. Email: editor@cq-tv.com

Amateur Television - a Beginner's Guide

By Graham Hankins

Amateur Television - a beginner's guide to the basics of transmitting and receiving 625 line 50Hz PAL ATV.

Television is an exciting technology.

To send an electronic moving picture in colour across a radio link requires at least a camera, transmitter, receiver and monitor. The camera must provide synchronizing pulses plus picture brightness and colour signals; the transmitter must pass all these and produce useful power at microwave frequencies; the receiver must be sensitive to GHz frequencies and must decode the vision and sound. To these basic 'blocks' could be added multiple cameras, vision captions and effects - the expansion of a television system is almost boundless.

A fine tip, low power (15W) soldering iron is needed, plus small hand tools

But possession of a fully-equipped mobile ATV studio (and some members do hi!) can come later - this has been written for those of our new members who are keen to start transmitting and receiving ATV on some of the amateur radio bands. All bands from 70cm up are available for ATV, but as 24cm has the most simplex and repeater activity, this guide will concentrate on 1.3GHz ATV.

First, a few 'accepted practices' within ATV in Great Britain. With the exception of a repeater in Bath, all 24cm ATV uses frequency modulation of the vision carrier, with a 6MHz f.m. audio sub-carrier. This has greatly simplified power amplifiers at microwave frequencies and 'final frequency' oscillators. Another 'convention' is that antennas are mounted for horizontal polarization - this follows broadcast practice and helps reduce interference to others. Lastly, 144.75MHz is the 'ATV calling' frequency. Listen or put out a 'CQ ATV' call on 2m to make initial contact or establish activity. When a station has replied, please move off '750' to an unoccupied channel.

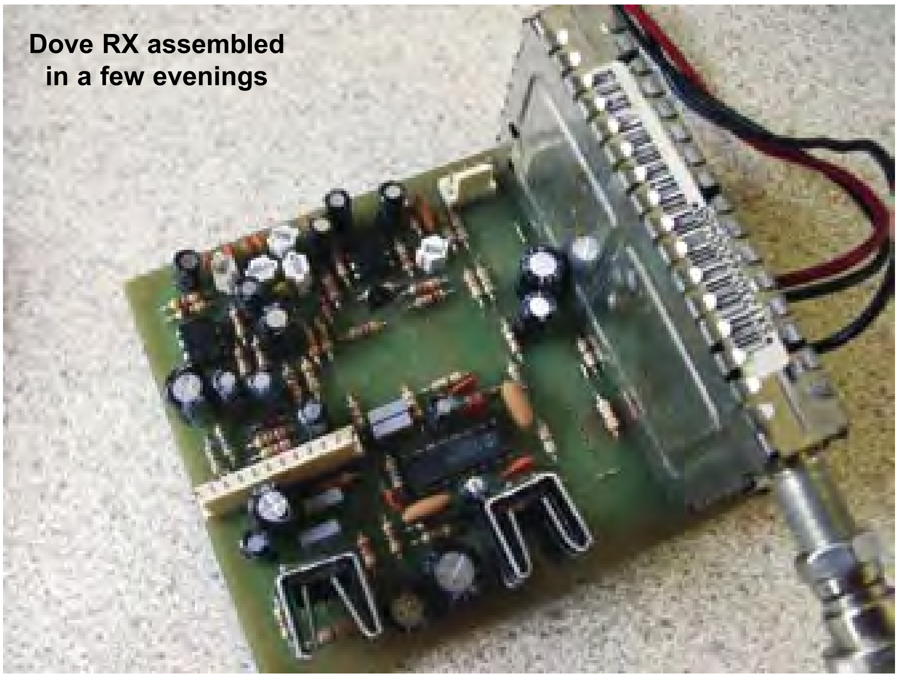
The cheapest method of receiving 24cm ATV is with an analogue satellite receiver. You will need to disable the d.c. feed from the antenna socket (intended for polarization switching of an lnb) because most antennas are a d.c. short-circuit. After this simple modification, if there is strong or local ATV out there, a satellite Rx should see it, but a purpose designed ATV receiver will give better results.

Your 'CQ-TV' magazine usually has adverts for transmitters and receivers. 24cm ATV really benefits from as much transmit power as you can afford - a few watts at least. The February 2003 edition carries the G1MFG ATV range, which includes a 50mW Tx; this will certainly get you on air with ATV, probably into a local repeater, but there is WysCom too - see back issues on the BATC CD! Other advertisers offer power amplifiers but remember, a PA need be little more than an active device on a heat sink! See the Severnside Group advert for a simple ATV yagi, or S Marshall for other antennas.

ATV repeaters around the country just need your incoming video on 1249MHz to access

But why not have a go at building a Tx and Rx from simple kits? Bob Platts G8OZP (g8ozp@hotmail.com) has a 'Dove' receiver kit available, Andy Parnell G8SUY (andy@atvroom.freeserve.co.uk) does transmitters with a 'get you going' service if problems arise. Kits provide a drilled, tinned printed circuit board with component locations marked, the components in plastic or antistatic packs, paperwork detailing the circuit diagram, how the kit works, maybe a recommended sequence of construction too. Provided you have suitable basic tools - small soldering

Dove 24cm receiver arrives by post with paperwork, components, tuner and PCB



Dove RX assembled in a few evenings

ron, tweezers, cutters etc, most circuits can be assembled in a few evenings.

Sending your first pictures.

Listen on 144.750 or adjacent frequencies and tune your ATV Rx around the 24cm simplex channels of 1255 - 1260MHz to find any ATV activity. Or call "CQ ATV" on the calling frequency. If any stations reply, plug the 'video out' from a surplus surveillance camera or home camcorder into the 'video' of your transmitter and away you go! Log keeping is similar to voice, except that your 'mode' will be for an analogue, double sideband vision modulation. Signal reports measure the picture quality - from a 'perfect' P5 down to P0!

G8SUY 24cm transmitter arrives, picture shows some of the components

Suybuilt kit assembled - care needed with the surface mounted components and semiconductors

1255 or 1260MHz are the usual frequencies for direct station-to-station (simplex) contacts, but 1249MHz is the common frequency to access ATV repeaters. Unlike voice machines, which need tones to open and access, the repeater will detect your incoming sync pulses and switch from its test card or other ident to relaying your own video. Listen on 144.750MHz or switch to receive - if any station is monitoring the repeater they may respond! Some stations have separate Tx and Rx antennas and feeders, but most use a single antenna, one feeder run (low loss 50 ohm coax; again, the best your budget can take) and a co-axial r.f. switch rated for power at 1.3GHz. Repeaters usually have omni-directional antennas and transmit towards the high end of the 24cm band, around 1310MHz, but check the RMC web site or your callbook for the output frequency of the repeater you are using.

ATV repeaters are usually radiating all the time, cycling test cards, info pages or other visuals. Some repeaters are very advanced with loads of 'bells and whistles' - a vcr maybe, switchable Rx antennas, remote control via DTMF, or a record of callsigns who have accessed. This is very handy for discovering when the most activity happens, 'nights on the air' or whatever. With repeaters without such facilities, watching, calling and listening for that first contact and asking about activity is probably the only way. Is there a local repeater in your area? Visit the RSGB web site, or the links from the BATC site, or see the lists in the CallBook.

There is almost endless scope for extending your basic ATV station. Better antennas, higher power, various vision generators, vision switchers, higher (or lower) bands. Plenty of circuits and ideas have appeared in past CQ-TVs - get the BATC CD to find them!

And if you have an idea or a circuit - send it to the magazine.

Home Counties ATV Repeater Group at the Epson Rally

By Brian Summers G8GQS

The HCATV group was at the Epsom rally, demonstrating the GB3HV repeater with Andy and Ruth Booker, G4WGZ & M0UYR, behind the table. You can see from the right monitor in the photo that good P5 pictures were being exchanged over a path of 50km. The feeders to the aerials from the stand to the roof were about 150ft. long, with a loss of at least 6dB. The GB3HV repeater has its own teletext generator system and that can be seen on the left monitor.

John Stockley G8MNY was also present and he explained the benefits of an ATV Rx with a narrow front end filter and "radar clippers" to reduce the effects of airport radar and other off channel interference. Radar clippers were described in CQ-TV 168

It was interesting to see how little interference was visible on the receiver even with Heathrow is sight with its erp of +500MW. Just a tad stronger than your average ATV signal.

Dicky Howett writes, "What have we here? A triple interest picture and no doubt about it with one for the tv camera fans, the steam train fans, and the steam-tv programme fans. This picture, taken in 1962, features Noele Gordon appearing on that famous and much-missed ATV show 'Lunch Box'. Noele is seen here introducing things live from the track bed of Ripley branch station. Seen also to full effect (in glorious high-contrast black and white) is a Midland compound loco plus a Pye Mk 3 camera and a skeletal 'Paddock' dolly. What more could anyone wish of a lunch break?"

Contest News

By Richard Parkes G7MFO

I'm writing this article the weekend after the Summer Fun (14th to 15th June) and just a few days before the deadline for CQ-TV going to the printers. I have received three entries up to now for the Summer Fun. Giles G1MFG has sent in a very excellent article on portable contesting during the Summer Fun. It was just a shame that more repeaters were on the air than radio amateurs for Giles!

I have received no entries for the Spring Vision contest.

Please make if you send your logs via Email that you send them via the email address below or they can get lost!

Please make an effort to get on the air for the International; I will be portable again at the same location as last year on the Yorkshire Wolds. Even if you cannot go portable please get on the air to give a few points away.

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

E-mail: contests@batc.org.uk

Contest Calendar 2003

IARU International ATV Contest 2003 Saturday September 13th – Sunday September 14th

From 1800 UTC Saturday to 1200 UTC Sunday

Fast Scan ATV all Bands

I read in CQ-TV 202 the letter from Barrie GM0KZX regarding how the amateur TV is few and far between, up here in Scotland ! or is it ? There may be lots of radio amateurs with ATV equipment like Barrie and myself and just don't get to use it as we don't know who else has the capability of sending or receiving T.V pictures.

I am putting together a web site where Scottish radio amateur that have ATV equipment or are interested in getting into ATV can register what bands they are active on. I am hope this will get ATV off the ground again in Scotland.

Also Barrie mentions he is trying to get together a ATV for the Dumbarton area, Myself and Simon GM4PLM have been gathering ATV equipment over the last year with the intent to get a ATV repeater up and running, but the big problem is getting a good site for a repeater and one that is not costly. So Simon has kindly offered that we can put the repeater on at his farm in Ayrshire, this will give coverage along the west cost of Ayr and out into the river Clyde over to the Isle of Arran. We are hoping this will be on 23cm and possibly with a 13cm input as well.

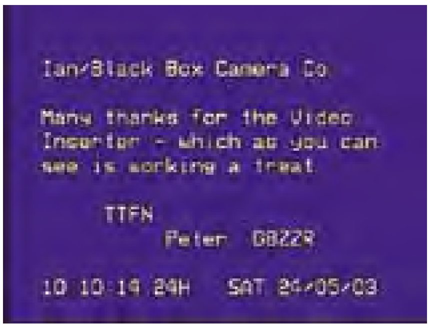
If you would like to register your interest, or if you are keen on making ATV contacts around the central belt of Scotland, then please visit my web site, http://www.andyhood.com/atv/atv.htm, on which I am hoping to build up a picture of ATV actives in Scotland and maybe we can get Scotland back on the ATV map.

Andrew Hood, GM7GDE email: mail@andyhood.com

'Smiling' BATC at Pickets Lock a couple of years ago. Brian G8GQS on temporary duty!

I was very surprised to be awarded the star letter prize of a BlackBoxCamera Co. video text inserter. As you can see from the attached screen grab - it works like magic - and is so small! Their website mentions a specific terminal emulator for a Windows PC, but I used my Macintosh with no problems at all. Thanks again!

TTFN, Peter Vince (G8ZZR)



G1MFG - Summer Fun 2003

By Giles Read (G1MFG)

I went out portable for the Summer Fun international contest this year. Other engagements on the Saturday meant that he didn't arrive on site until about 7pm and it took nearly an hour to erect the station. This meant that he missed a few of the people who only played for a couple of hours, which was a bit of a pity.

My general impression was that the bands were pretty quiet. I only worked a total of 8 stations on 23cm, plus a couple on 70cm and one on 13. I did manage to make contact with a few more by voice, but for various reasons it wasn't possible to work them on TV.

On the Saturday evening I got the impressions that the conditions were relatively flat, although I did manage to speak to F9ZG on 2m SSB. We arranged a sked for the following morning.

When I got up at about 5am on Sunday, the air was alive with signals! There were repeaters coming up all over the place, on both 23cm and 13cm. No amount of calling managed to wake any other amateurs, though – so that huge early-morning lift went to waste. Best repeater DX was a P4 from GB3VX at over 200km; just imagine what sort of range could have been achieved if there had been someone sitting on top of a hill with a yagi instead of VX's Alford slot!

I kept my sked with F9ZG and he managed to see my 23cm pictures at a P4. His setup only had a low power transmitter so although I was able to see syncs from him the signals weren't strong enough to be able to claim a two-way contact.

Several other stations were receive-only, which was OK – it's nice to be able to send pictures to someone (and claim the points!) and it's also nice to be on the receiving end of some pictures from an unusual place. Most portable stations have a camera and are happy to show mug shots and/or the local terrain.

Overall I must say I enjoyed the contest, although it was amazing how many people either didn't seem to know about it or couldn't be bothered to switch their TV gear on. Come on, everybody: the next contest is the IARU International

The new battle wagon, dressed to kill

Access to the antenna farm is via a permanent ladder at the back of the van. Notice the small Honda generator on the right.

23cm yagi (ANTEC)
2m HB9CV (Moonraker)
13cm yagi (G1MFG)

70cm yagi (unknown make)

23cm Alford Slot (left of mast)

2m 5/8? whip (right of mast)

Close-up view of the antenna farm

General view of the operating area

70cm (left) and 23cm monitors, 23cm camera on top

Computer for distance and bearing, monitor for 13cm, chocolate biscuits and bread for sandwiches!

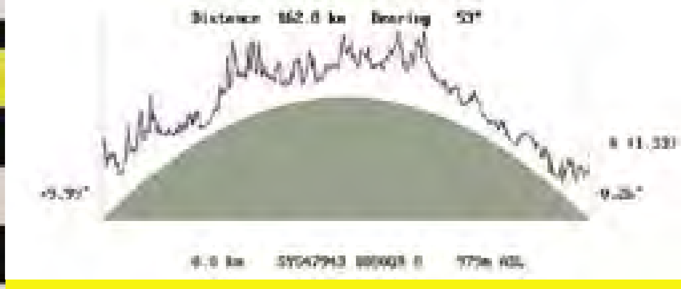
2m multimode rig, MM 70cm ATV Tx, MM 100W 70cm PA, 70cm ‘brick wall’ output filter, SSB Electronics 70cm preamp – all sitting on top of a 13.8V 40A linear PSU

Rotator controller plus simple 13cm gear – G1MFG transmitter and 6W PA, co-ax relay, G1MFG Microwave Video Receiver

Homebrew 23cm transceiver – G1MFG modules plus GH Engineering Quad PA

ATV Contest from 1800 UTC on Saturday 13th September until 1200 UTC on Sunday 14th September 2003: you don’t have to actually enter in order to have a lot of fun, working new people!

Repeaters seen during Sunday's morning lift -

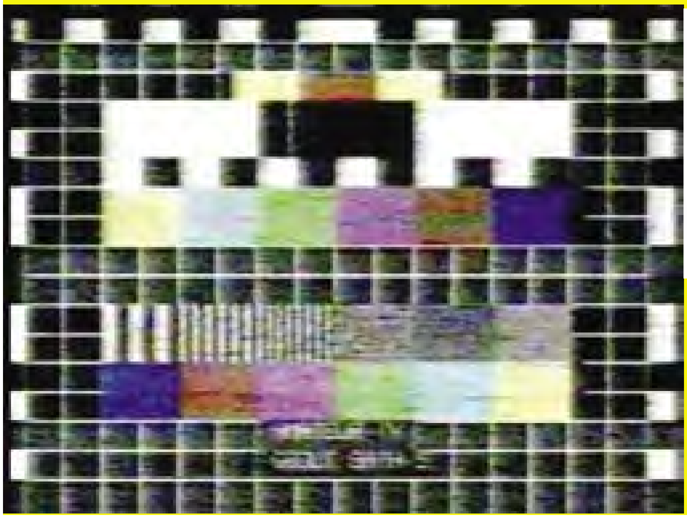


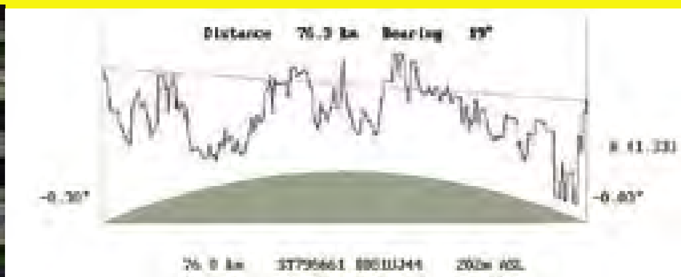
Free space path loss = 139 dB at 163 km

GB3HV at High Wycombe came storming in at a good P4+

Path loss = 131 dB at 68 km

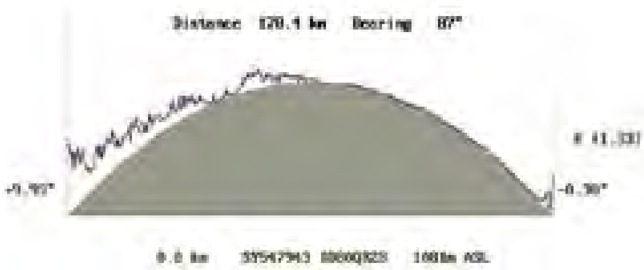
GB3TB at Torquay was an incredibly strong signal on 1316 because it was just across the water





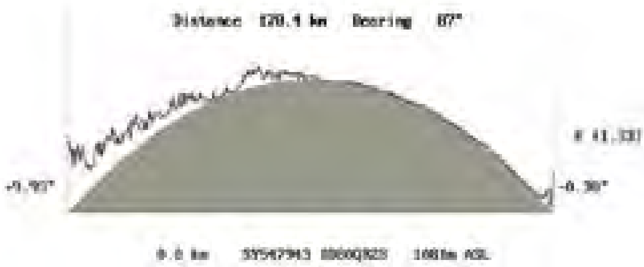
Path loss = 132 dB at 76 km

GB3UT at Bath was a good signal although it wasn't possible to beam up on it exactly: I had to offset the antenna to put GB3TB into a null to reduce interference



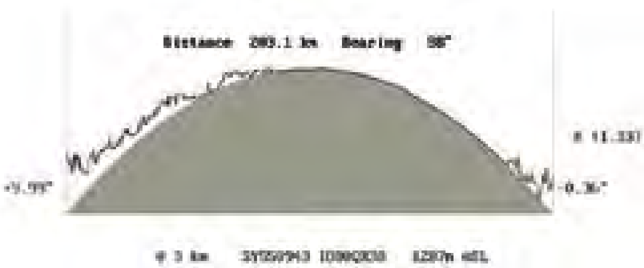
Path loss = 140 dB at 178 km

GB3VR at Brighton rivalled even the local GB3TB for signal strength and picture quality despite the fact that it is a LONG way away!Path loss = 145 dB at 178 km (1.3 GHz)



Path loss = 145 dB at 178 km (2.4 GHz)

Unbelievably, the Brighton 13cm repeater GB3VV came in at around P4



Path loss = 141 dB at 203 km

GB3VX at Eastbourne came in pretty well too!

The strong local signals from GB3TB on 1316MHz made it very difficult to see any other repeaters. All these pictures were originally recorded on VHS tape then digitally captured using a camcorder.

Film into TV

Dicky Howett traces the interaction of film with the development of video

Old fashioned movie film has always been involved with television. More than 75 years ago, back in the electronic dark ages, celluloid played a significant part in the development of transmittable video. Film proved indispensable. It was a quick way of achieving an image, especially as initially, 'live' electric pictures proved almost impossible. In the early 1920s, tv consisted mostly of 30 lines/ 12½ fps with mechanically generated pictures of moth-eaten ventriloquists' dummies or riveting silhouettes of toy windmills. By modern standards, resolution was almost non-existent. Those early tv images were created by whizzing discs with the output displayed on postage-stamp sized screens, lit by dim orange neon bulbs. No doubt it was jolly fun to watch for a minute or two, but realistically, nobody would buy into that plus the evident fact that the entertainment value was practically nil.


The Vinten IF camera used by Baird in Studio B at Alexandra Palace. This camera is now preserved at the NMPFT

Strange Shapes

Charles Francis Jenkins American cinematographic pioneer (and founder member of the SMP(T)E) was an early tv dabbler. He transmitted in 1928, crude shapes and films from his experimental Washington station W3XK. Resolution was getting better- at 48 lines/15fps- but still lacked the elusive 'live' and quality aspect

Later in London, Scottish inventor John Logie Baird projected before a paying audience, the 1932 Derby onto a 10x8ft screen at the Metropole cinema. This was a big achievement but the displayed tv image was relatively tiny. This consisted of three 30-line pictures projected in step, side-by-side to complete a whole frame. But at least it was real live actuality, even if the image showed only the winning post and the riders flashing by. A few years later, a company called Cinema Television (Cintel) perceived a big future for rediffused television and began installing tv projectors into several London News Theatres. (The 1937 Coronation procession was thus shown).

TV to go

In 1935, the British government gave the green cue-light to begin a 'high definition' public television service, starting sometime in 1936. John Logie Baird was invited to participate but couldn't get his mechanical 'spotlight' system to perform live as 'high definition'. Unfortunately, poor old Baird was up against a technological brick wall. Getting more resolution out of any mechanical tv system means bigger disks, faster spins (in a vacuum), more and smaller pin holes, and greater amounts of light. Naturally, none but the very brave relished sitting anywhere near such a potentially eyeball-bashing rotary tv scythe! Alas, mechanical television was due for the chop.

British television standards in 1935 had been set at a minimum of 240 lines, which was about 200 lines greater than Baird had achieved live up to then. Undaunted, John Logie turned to film for his salvation. His Nipkow disk flying-spot telecine had been cranked up to 240 lines sequential and it actually produced a very clean, bright, attractive film image. But Baird need another means to produce the elusive 'live' image, this in order to compete with EMI's all-electronic wonder, the mobile iconoscope camera, known to one and all down at Hayes as the 'Emitron'.

Intermediate

John Baird then invited W.Vinten Ltd to construct an intermediate film system (developed originally in 1927 in the USA by H.E.Ives & R.V.L Hartley at the A.T&T labs) similar to that used by the German television service at the 1936 Olympic Games. (One has to pause here and mention that although the BBC likes to think it was first in 1936 with a 'high definition' television service, the Nazi-controlled German Post Office ran a scheduled 180-line service in Berlin, a year earlier. They too, called their television system 'high definition'. Admittedly it was of a lower line standard, shown only at public places and not all-electronic, but then neither, in 1936 was the BBC who opened their service with Bairds mechanical I.F. 240-line film system and spotlight whizzing discs. It was a case of choosing your definition of definition).

German television covered the entire Berlin Olympics with five 'high definition' 180-line cameras. This modest technical array consisted of two prototype Iconoscopes, one Image Dissector, and two van-mounted mobile intermediate film cameras. The I. F. system was an ingenious delay mechanism which produced a reasonable quality image from motion picture film. The film was developed continuously in dedicated tanks, and whilst still wet, scanned through a glass-sided gate for immediate transmission. The German Fernseh company got their I. F. record-replay system down to an incredible 15 seconds. Baird for his BBC service at

The DuMont Electronicam full rig

Alexandra Palace chose a slightly more sedate 50 or 60 seconds.

Studio B

The Baird I.F. system used an adapted 35mm Vinten 'H' movie camera, converted to 17.5mm. The movie camera was bolted atop the developing tanks. The camera peered out of a glass-fronted booth into Studio B at Alexandra Palace. Real-time programmes running at a maximum of 20 minutes were filmed from this fixed location, with lens-turret swings in vision. The recorded image (scanned through a glass panel by the familiar Baird vacuum spotlight disc) had also a variable density sound track which suffered, along with the picture, when air bubbles encroached during playback. Baird used also a Farnsworth electronic Image Dissector camera, bought at great expense from the USA. This camera,apart from needing a vast amount of light, performed erratically. (Bairds Image Dissector camera was actually present in Studio B, Alexandra Palace at the opening ceremony on 2nd Nov 1936. Baird didn't switch the camera's image into the transmission, but instead relied throughout the initial programme on his I.F. plus his trusty spotlight system. If Baird HAD used the Image Dissector at the opening show then the BBC could have since justified an all-electronic 'first') Thus left only with his mechanical spinning spotlight system, (which some people begged not to appear on) it came as no surprise when in early 1937, Baird was trounced by the slick, EMI Emitron video camera with its live interlaced 405-line pictures, relative reliability, and promise of better things to come.

Mythful Thinking

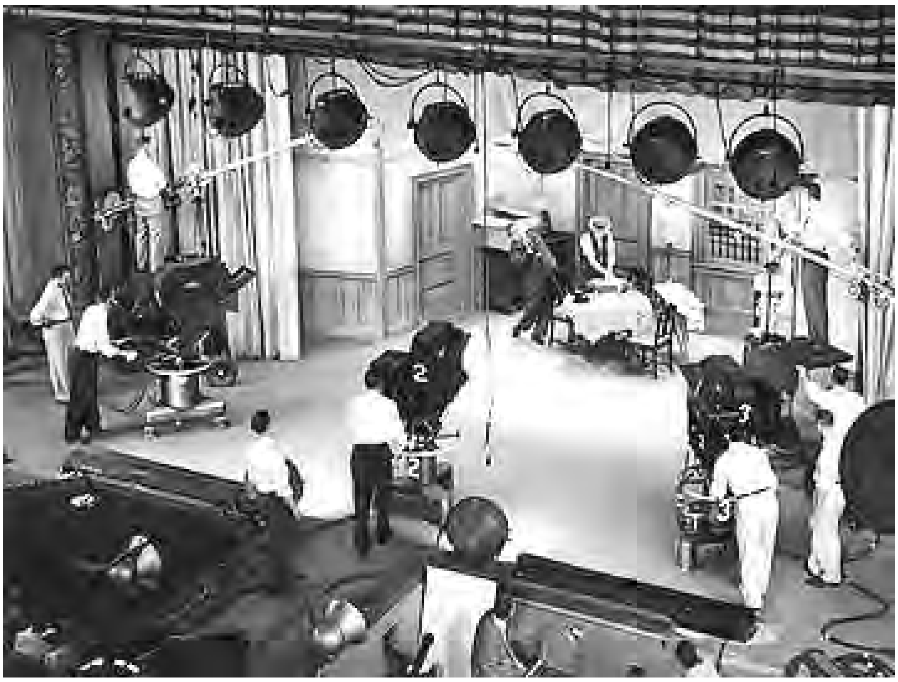
TV history is full of wishful thinking and science fictions. One perpetuated myth is that the movie business was, post war, dead afraid of television and wouldn't have anything to do with it. In fact Hollywood was fully apprised of the possibilities of television. Paramount Studios owned two tv stations and part-owned the electronics company A.B.DuMont which itself owned three tv stations. And a major stock holder of 20th Century-Fox was electronics company, General Precision Laboratories. Also MGM, Warners and Disney, all were considering 'diversifying' into tv by buying licences to transmit. However, US prevailing anti-trust legislation put the lens-cap on it. (These days the US network ABCtv is fully owned by Disney).

Hollywood TV

In the late 1940s, the idea of 'Cinema Television' emerged again. Hollywood saw in tv technology, a quick (and cheap) production tool. Entire movies made with a couple of tv cameras, and filming the result off a tv screen. Simple. The ultimate aim was for a system that could be used to transmit movies direct to cinemas.(This idea is again under consideration). But back then the quality of the recorded image wasn't up to large screen projection. Also the pictures were in black and white and in any case the general public preferred its tv viewing free of charge by the fireside.

Undaunted, the movie and video camera then formed another partnership. American tv had to cross immense distances and inconvenient time zones. Local stations proliferated and coast-to-coast networking wasn't achieved until 1951. Live shows produced in Hollywood couldn't conveniently be shown in New York or vice versa until the advent of off-screen 'kinescope' film recordings which were then posted to various tv stations for replay. These kinescopes were not ideal. What enticed producers was the thought that given a high quality method of recording, production costs could be recouped by reruns and foreign sales. The gravy was in the residuals. Shipping lots of jerky 525 line-30Hz-3" Image Orthicon halo-rimmed, grainy 16mm off-screen film recordings, was not the answer.

And then the A.B.DuMont company strapped one of its standard tv cameras to a blimped 35mm Mitchell and low, the 'video assist' was born! DuMont's called it the 'Electronicam'. It was a boon, especially to sit-coms which could be transmitted live and filmed before an audience simultaneously in one evening. Pristine 35mm edited prints could then be sold. It all paid off. Fifty years later, shows such as 'I Love Lucy' and 'Bilko' (filmed multi-cam and in front of living souls) are still in syndication earning the sauce. The 'video-assist' multi-movie camera technique persists to this day. A successful marriage of film and video. A quality solution. Ultimately, one assumes, the electron beam will consign Mr Mitchell and his cameras to the movie museum, but dear old celluloid will still be around your many years. I mean, haven't you ever heard of archiving?



A stage view of 3 Electronicams in operation. Jackie Gleason in' The Honeymooners' 1955.

DC-DC converter for use in Satellite Receivers

By Guenter Sattler, DJ4LB

Translation by Klaus, DL4KCK

In average receivers (for Satellite TV) the tuning voltage is taken from the on board switching supply without much effort. So stand alone DC-DC converters are not much in use, and special chips like the TCA720 (34V/1mA) or TL497 (adjustable) are not commercially available any more.

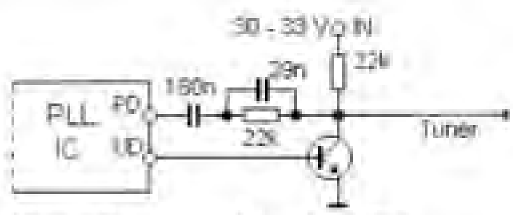


Figure 1 Standard-PLL

There are ATV DIY modules designed for 12 volt supply, which in addition need stable tuning voltages up to 33 V. These are high speed tunable satellite tuners, Gunn oscillators with varactor tuning and FM oscillators for 23 or 13 cm. Standard PLL circuits are also fed with 30 - 33 volts. Stability is not very important, but should be kept in mind with varying currents from 0 - 1.5 mA depending on the needed PLL frequency.

Table 1				
	L = 2.7mH		L = 33mH	
	R1	R2	R1	R2
1.5mA	82k	27k	56k	100k
4mA	27k	27k	27k	100k

The following DC-DC converters are suitable for self construction as they do not contain special ICs and transformers.

Voltage multiplier with capacitors

Here several capacitors are loaded with the supply voltage repeatedly and stacked onto the supply rail. This principle means that the output voltage is not variable but only available in multiples of the supply voltage. You can add a voltage regulator, but this is not a clever solution. Variations of the power supply are multiplied too, and so the minimum input voltage of the regulator as well as its maximum voltage (40 V) could be exceeded. With constant supply (12 V) triplers are able to produce up to 30 volt tuning voltage.

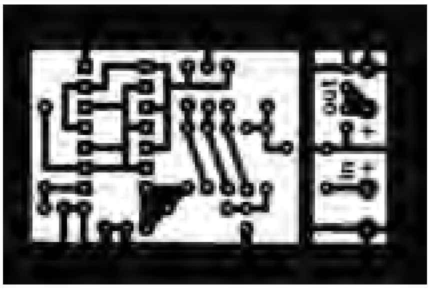
Construction

The figure 2 shows a voltage tripler using commercially available components. The unregulated version *circuit board 1* produces about 32 volts (with a protection diode at the input only 30 V) for PLL devices. Under a load of 1 mA the output decreases by 1 volt. Adding a regulator (a low power 317, which consumes about 3 mA itself) as shown with *circuit board 2,* it is possible to get a stabilized output of 1.2 - 30 volts. Four Schottky-diodes (BAT48) as multipliers can deliver 1.6 V more than universal diodes (1N4148). Instead of the internal 10k ohm potentiometer, an external 10k ohm fader can be connected.

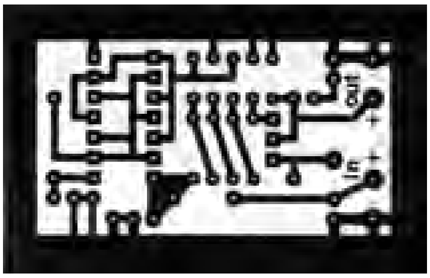
The main IC 40106 (6 inverters with Schmitt trigger inputs) generates switching pulses with a 250 kHz rate. At higher frequencies the efficiency factor decreases because the chip's own consumption is greater, while lower rates would require bigger capacitors in the multiplier chain. For building the circuit it is wise to follow the layout shown in *circuit board 1* or *circuit board 2*. Figures 3 and 4 show the equivalent component placement; photograph figure 5 shows both boards fully populated. An alternative layout with wire-wrapping would produce high switching pulses because of wire inductance, which can add to the output signal and radiate the switching frequency.

Voltage multiplier with coils

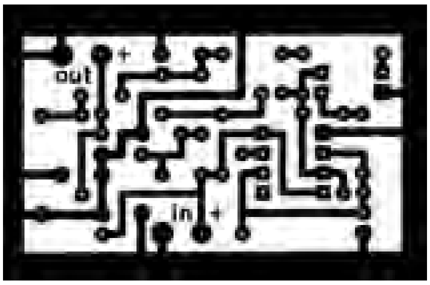
The details are shown in figure 7. Transistor BC546 switching the coil is controlled by an astable multivibrator (ICM7555, TS555CN). Its special wiring allows adjustment of the on- and off-time separately. If the output voltage of the converter decreases because of low supply voltage or high load current, the resistor R2 needs a higher value, in order to increase the loading time at the coil, and vice versa. This



Circuit board 1



Circuit board 2



Circuit board 3

regulation is done by photo coupler PC817 being in series with Z-diode Z-30 (Z33). The output voltage is formed by the Z-diode's rated voltage and the voltage drop at the IR diode inside the photo coupler.

Construction

Successful construction depends on a suitable coil and corresponding resistors R1 and R2. Two commercially available types of coils have been selected: a miniature inductance with 2.2 mH, 21 ohm, max. 105 mA produced by NEOSID (www.conrad.de) and a universal coil with 33 mH, 80 ohm, max. 30 mA (www.elv.de). Table 1 shows suitable resistor values with a load cur-

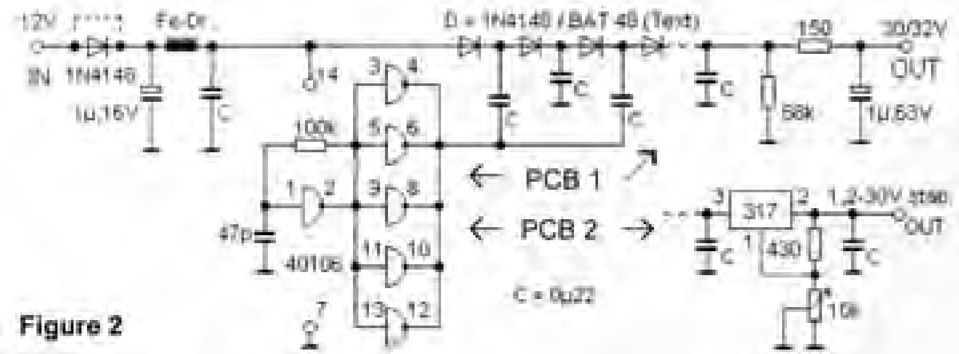


Figure 2

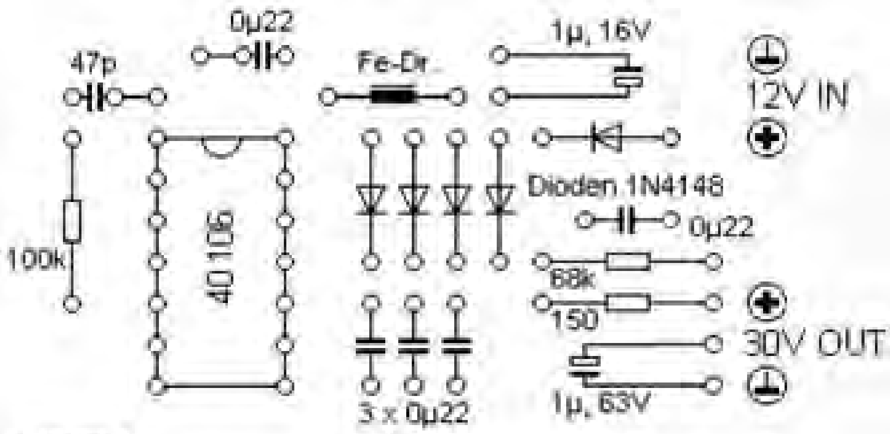


Figure 3

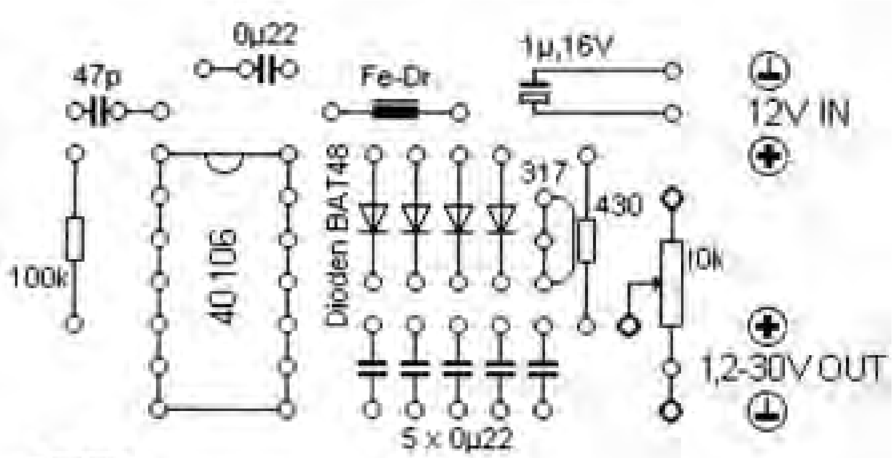


Figure 4

rent of 1.5 mA (PLL) and 4 mA (added 317LP regulator). If other coil types are tried, the R2 value should be chosen so that with a lowest possible supply voltage the maximum allowable coil current value is not exceeded. A well designed circuit behaves like a "real" switching power supply. An increasing supply voltage allows the input current to decrease - overall power consumption is about constant. With input voltages between 8 and 15 volts the output only changes by 0.3 volt, and similar behaviour is seen with varying load currents in the mA region. For exactly adjustable output voltages you need the additional components (values shown in brackets) around the 317LP regulator. The layout is shown with *circuit board 3*, and the component locations are is shown in figure 8. Photograph figure 9 shows four different types of boards, each fitting into tinplate housings 37 x 55 mm.

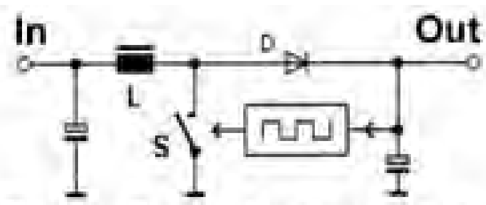


Figure 6. Upconverter

Commercially available DC-DC converters

These converters are designed for much higher power output than is needed at tuning pots or PLL devices. With such low currents they do not reach the efficiency factor of 80 percent given for 1.5 W output. Their electrically isolated in- and outputs can be beneficial, especially with very long cables supplying external devices where a changing voltage drop across the common ground can modify the tuning voltage sent along the cable.

The small DC-DC converter NMA1212S (www.conrad.de) produces a dual 12 volt output, which added together gives 24 V - sufficient for many tuning circuits. Varying load currents do not matter much, but an unstable supply voltage is not regulated! In contrast to this, the DC-DC converter made by "Cosel" compensates load variations as well as changing supply voltage. The 12 volt dual type "ZUW 1R5 12/15" (www.conrad.de) produces a stable dual 15 V output - equivalent to 30 V - with the tiny load from tuning pots or PLL devices even at supply voltages down to 5 V. Photograph figure 10 shows both modules on an unpopulated DIY converter board for comparison.

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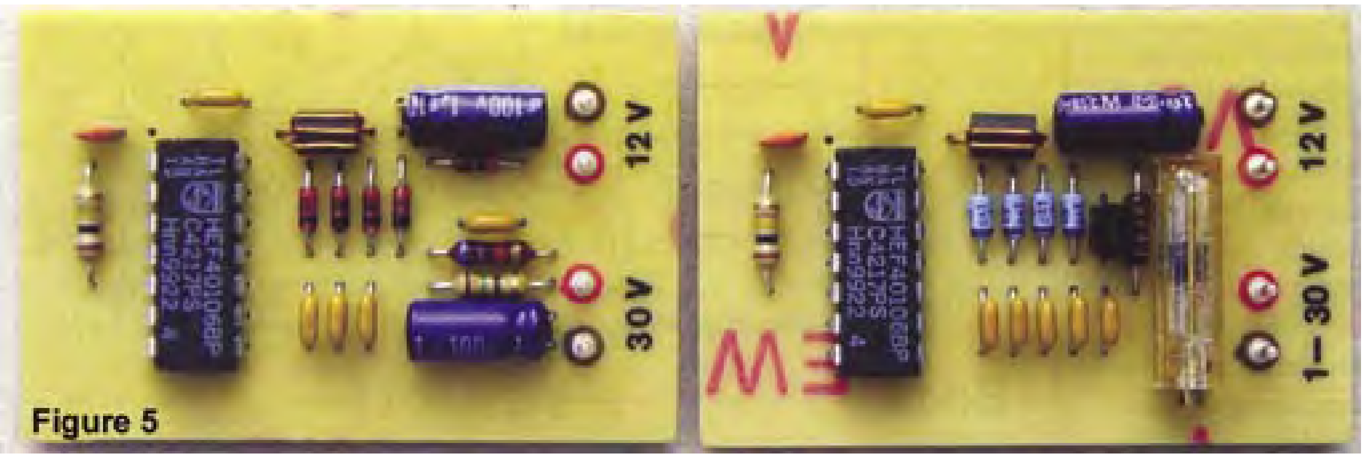

Figure 5

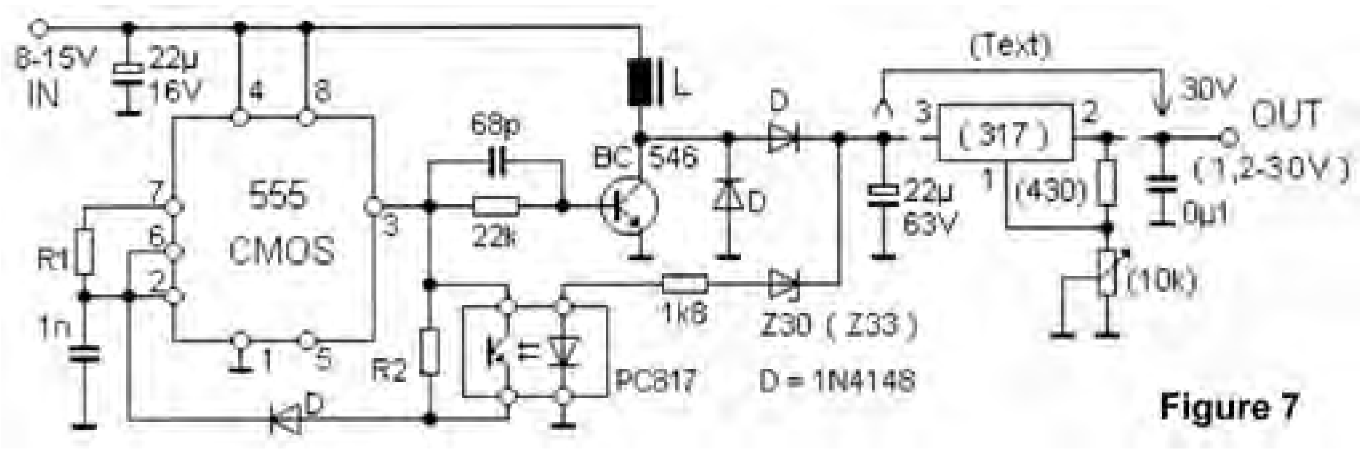

Figure 7

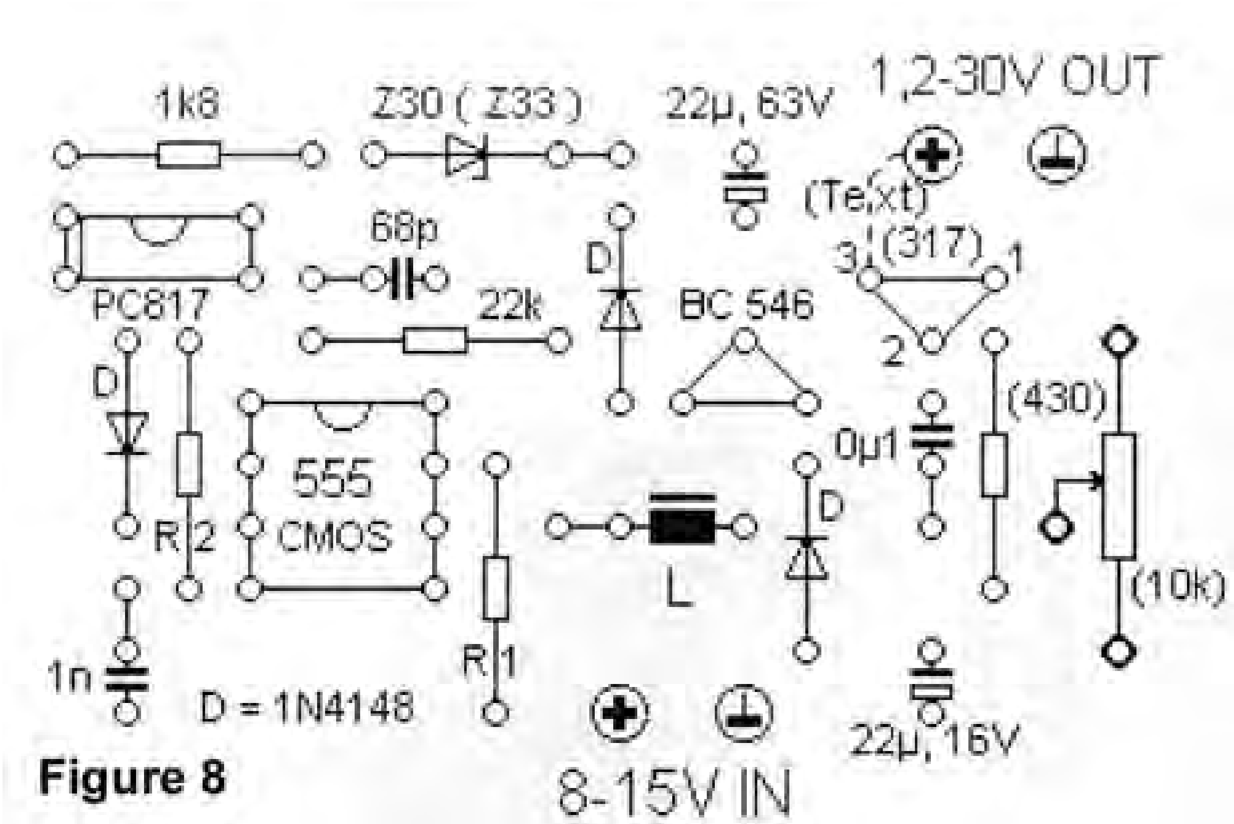

Figure 8

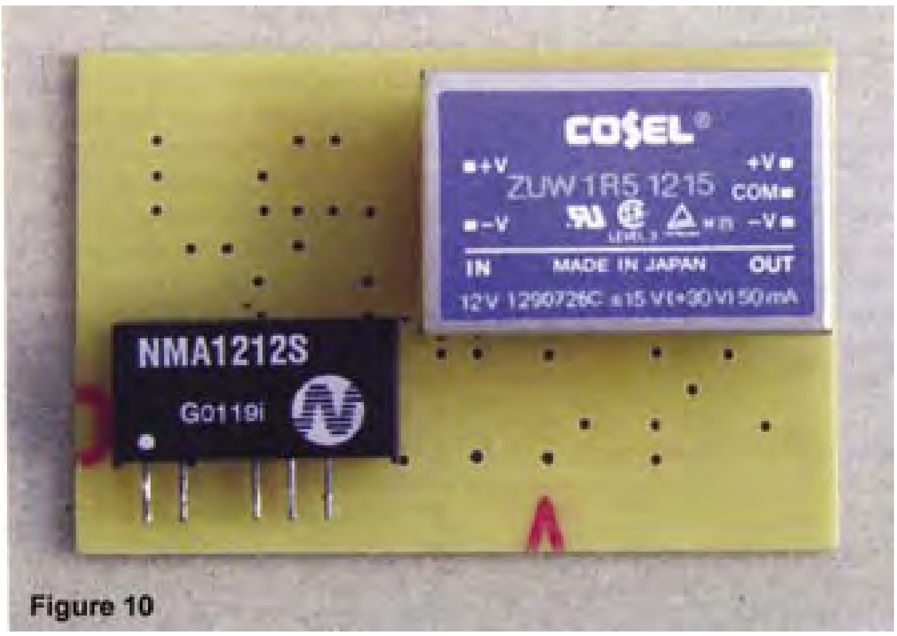

Figure 10

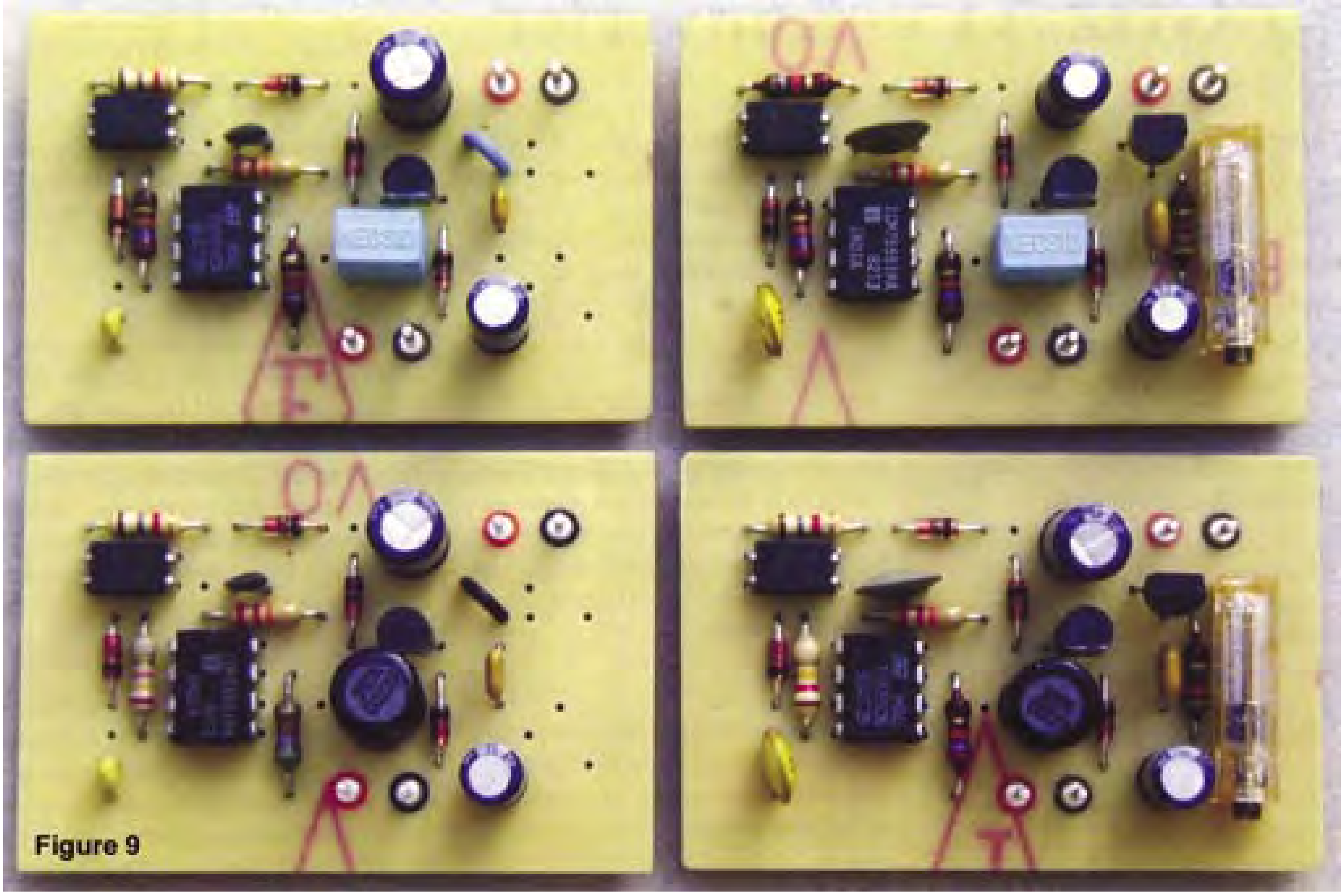

Figure 9

CQ-TV Commercial Advertising Rates

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BATC at the Stevenage rally, June 2003 - table manned for two days by Graham Hankins, G8EMX, table laid out 'in retail mode' on the Sunday by Brian Summer, G8GQS! Visitors to the rally very 'thin' compared to past times in Pickets Lock