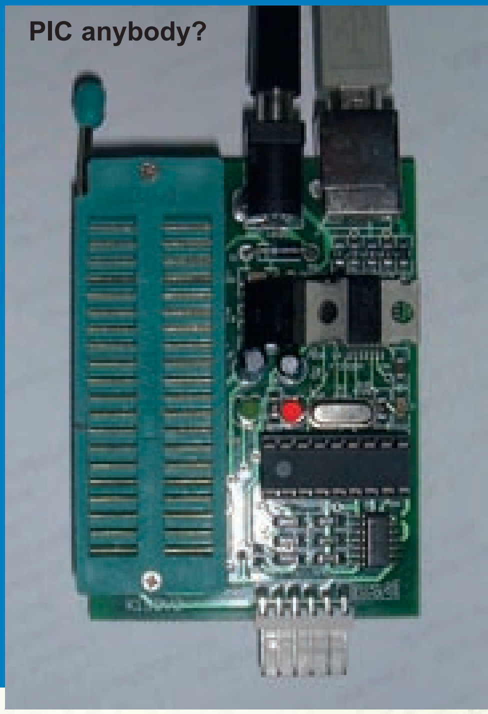
CQ-TV 213

February 2006



PIC anybody?

ISSN 1466-6790

BATC

The leftovers!

www.cq-tv.com

CQ-TV 213

Contents

Edited by Ian Pawson, circuits drawn by Allan Robinson, proofread by Peter Delaney.

Printed by Hastings Printing Company Ltd., Dury Lane, St Leonards on Sea, TN38 9BJ, England. Telephone: 01424 720 477.

Committee Contacts

President: Mike Cox, CEng., FIEE

E-mail: president@batc.org.uk

Chairman: Trevor Brown, G8CJS

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

General Secretary: Paul Marshall, G8MJW

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

Hon. Treasurer: Brian Summers, G8GQS

Enquiries regarding club finances, Donations, and constitutional enquiries. 9 Prior Croft Close, Camberley, Surrey, GU15 1DE. Tel: 01276 677879, Mobile077 4029 1191, Email: treasurer@batc.org.uk

Membership

Anything to do with membership, including new applications, queries about new and existing membership, non-receipt of CQ-TV, subscriptions, membership records etc. **Pat Hellen**, The Villa, Plas Panteidal, Aberdyfi, Gwynedd, LL35 0RF, UK. Telephone 01654 767702. E-mail: memsec@batc.org.uk

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

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

CQ-TV Magazine: Editor Ian Pawson

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

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

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

Satellite TV News: - Paul Holland G3TZO, Chatterton, Chapel Lane, Threapwood, Nr. Malpas, Cheshire, SY14 7AX. Tel: 01948 770429, Email: satnews@batc.org.uk

CQ-TV Advertising Manager: - Trevor Brown, 14 Stairfoot Close, Adel, Leeds, LS16 8JR. Tel: 01132 670115. Email: adman@batc.org.uk Members adverts for inclusion in CQ-TV should be sent directly to the editor and the above address, either by post or e-mail.

CQ-TV Awards: - Bob Webb G8VBA, 78 Station Road, Rolleston on Dove, Burton on Trent, Staffs., DE13 9AB. Tel: 01283 814582

Exhibitions

Graham Hankins G8EMX, 17 Cottesbrook Road, Acocks Green, Birmingham, B27 6LE.Tel: 0121 706 7384 Email: exhibitions@batc.org.uk

Club Sales

Members Services: - PCB's, components, camera tubes, accessories, etc. (NOT PUBLICATIONS). **Peter Delaney, G8KZG**, 6 East View Close, Wargrave, Berkshire, RG10 8BJ. Tel: 0118 940 3121. Email: services@batc.org.uk

Publications: - Handbooks, Back copies CQ-TV, and anything related to the supply of BATC publications. **Paul Marshall**, Fern House, Church Road, Harby, Notts., NG23 7ED, England. E-mail: publications@batc.org.uk

CQ-TV and BATC web masters

Anything to do with the CQ-TV web site Email: webmaster@cq-tv.com or for the BATCs web site. E-mail: webmaster@batc.org.uk

Chairman's Column

It is with great regret that I have to report that on 2nd December Steve Mitchell G8JMJ died

To say that Steve was an ATV enthusiast and BATC member would be and understatement, from his ATV number plates to all the help and support he gave others.

He could always be found at BATC events usually surrounded by test equipment sorting out the problems of others.

As I sat at his funeral in Malvern Priory surrounded by his family and friends I tried to remember where I had first met Steve. He used to appear from nowhere, at Amateur Radio Rallies and would always produce something he was designing from under his coat. Usually a black die cast box with an elegant PCB inside, (non of this Veroboard or

Cobble together construction for Steve). The one I remember most was a VSB TV transmitter with a SAW filter. I think they had just appeared on the market. At least two Rallies where he did not show went by, and then he suddenly reappeared, and pleaded car trouble and undid his shirt to show an operation scar from belly button to almost arm pit, from a car accident, he still brought a black die cast box with his latest offering inside.

Eventually the black box housed a more conventional TV transmitter and a commercial

Label "Fortop". Steve appeared at every Rally from this point on with his own stand, selling these transmitters, accompanied by his then business partner Steve, (Steve's business partners were always called Steve).

Out of Fortop grew Mitchell Electronics and Steve gave up his day job and went at it full time. In 1988 I hatched a plan with Andrew Emmerson to visit the worlds largest Hamvention in Dayton Ohio, the idea being to give out as many back issues of CQ-TV as possible and take lots of photos and write it up for CQ-TV. Steve his wife Christine, and daughter Beverley joined us and we spent several evenings as guests of Don and Sue Miller. Steve had to leave early to drive the family down to Disney world, not everyone stays in Indiana when visiting Disney world, but then Steve was not everyone.

The evenings at Dons were spent sitting out on the porch with a beer and throwing ATV ideas around. Don produced and sold ATV equipment in the States and is quite a figure, but Steve produced PCB's from every pocket and enlightened him on the future. The future is 23cms, the future is FM, and he did not add the future is bright or he would have made his fortune from advertising.

We waved Steve and family off to Disney on a warm April morning, was Mickey Mouse ready to meet Steve I wondered. The next time I met Steve was at a BATC BGM.

We had both gone down the night before and taken our wives. We started talking in the pub, but got thrown out at closing, and sat in a hall way talking, I assume he had a room booked, I know I did but I never saw it, dawn broke traders arrived, and I did my best to look bright eyed and sort out tables for them to set up on.

The next time we met he turned up at Yorkshire Television (my then work place) with Paul Bicknell sat on the settee in my edit suite while I finished something in double quick time so as to spend the rest of the afternoon showing them around the station and catching up on old times.

The last time I saw Steve was at his workshop in Malvern, he asked me to go down and look at his VT, he did not say there were several, he chatted to my wife Pauline while I tried to breathe some life into the ancient equipment. Steve had lots on the go and was particularly proud to show me an ad in the RS Components Catalogue for a Quad split video device and he showed me the prototype, "Mitchell Electronics by appointment suppliers to RS" he said. I also remember the small Yagi mounted on a tripod in the middle of the office, Steve's wireless phone went further than most, all the way to his house on the hill behind. His turn to wave us off and the last time I saw Steve.

Now my wife and I are sat in Malvern Priory listening to Beverley recounting to everyone what Steve was to her, I know if he could have seen her he would have been a proud father, she brought tears to us all.

Steve Mitchell was all the things Beverley said he was a Husband to Christine a Father to her James and Natalie, an engineer and G8JMJ, I would also add a supporter of BATC and a friend to me. The Steve I will always remember will be the one sitting on Don Miller's porch beer in one hand PCB in the other educating Don a PHD Scholar in the future of ATV, when Steve spoke we all listened for many a happy hour and I will miss him greatly.

Trevor Brown

Steve and I were cast in the same mould - we were the same age, give or take a month or two and had a similar upbringing. We were both unqualified and self-taught in electronics but both of us had heads full of ideas and inventions. To us, business interests always took second place, our real love was experimentation - playing with technology for interests sake rather than exploiting it. I held Steve in the highest regard, I take pride in knowing he also thought highly of me. His passing is a great loss, not only to ATV but to the electronics industry as a whole.

Brian Kelly

Tutorial on Video and Audio Switching

By Mike Cox

By the time you have read this, you should have a better understanding of the techniques used in switching video and audio in a clean manner.

It will deal with the basic concept of a crosspoint, expand several crosspoints into a switch matrix and look at the input and output constraints and the type of signal being switched. To conclude, we will look at crosspoint and matrix control.

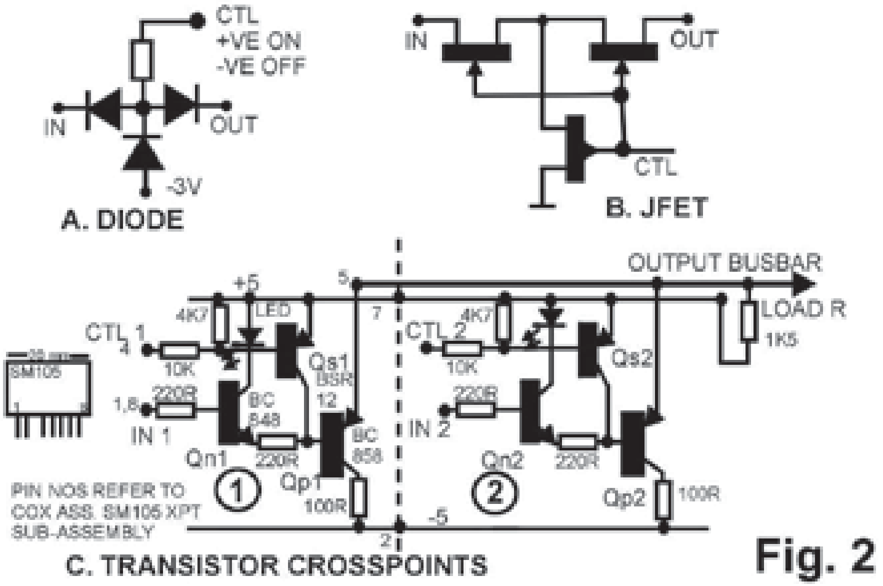


Fig. 2

The Crosspoint

The simplest crosspoint is a switch. Many of us have used double-throw toggle switches as a simple way of selecting one video from two at say a monitor input. Another example is the push button switch, often used in so-called “bang boxes” to select video or audio, or sometimes both. However such devices have limitations, particularly when more than one output of a signal is required. We need to consider other options.

We can get round the output feed problem by following the crosspoint(s) with a buffer amplifier. This will allow several isolated feeds to be taken. [Fig. 1]

An improvement on the direct switch is the relay. This allows control from a distance.

However all these mechanical crosspoints suffer from speed of operation limitations.

For many applications, the switching action needs to be completed in tens of nanoseconds. This dictates the use of semiconductors. These in turn can be divided into the passive semiconductor crosspoint such as that using diodes [Fig.2A] or FETs [Fig.2B], and the active kind using transistors, where they are used as impedance transformers. [Fig.2C shows an active crosspoint. Note the LED in the collector of Qn1. This indicates that crosspoint is on.] It is worth noting that for very simple applications, CMOS switches such as CD4051 or 74HC4051 can be very useful, but do not expect wonderful crosstalk performance at HF.

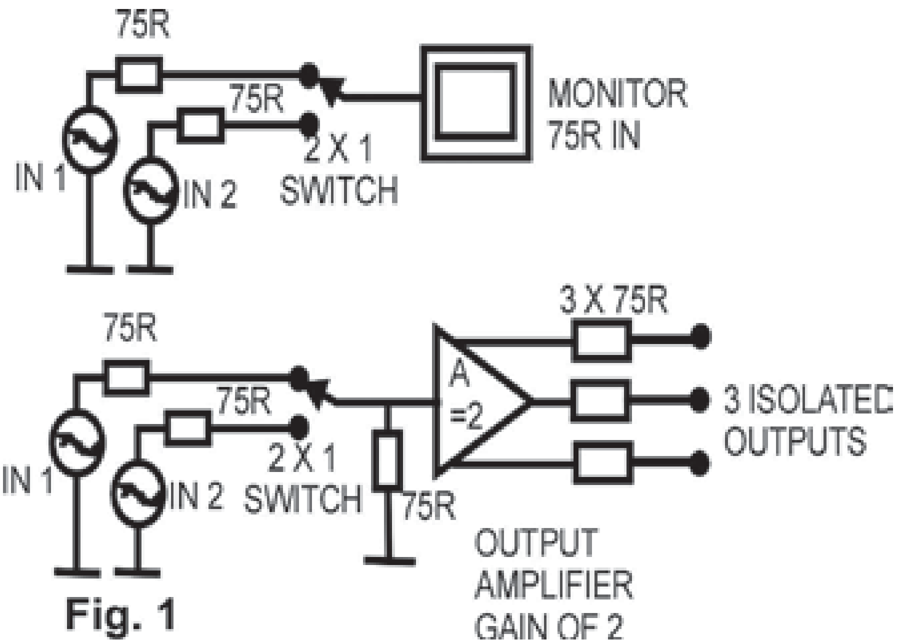


Fig. 1

Most of these considerations apply whether the signal being switched is analog or digital.

However with a digital signal we are not very concerned about linearity, whereas with analog, it is our main concern. With analog, our other concerns are frequency response, and in the case of more than two inputs, crosstalk between them.

Mechanical switches have very low series resistance, and capacitive loading at the output will have little effect at video frequencies. If we use diodes or FETs, the series resistance will be in the region of tens or hundreds of ohms, and the –3dB point could well be in the upper video band. Further, you cannot possibly use such crosspoints directly into a 75-ohm load. A buffer amplifier has to be used. The transistor crosspoint has some advantages in that two emitter followers in tandem offer a high input impedance, and a low output impedance together with practically zero dc offset. Obviously a mechanical switch should not have any dc offset.

Most of these remarks apply equally to audio switching, except that the levels in audio are higher than video. Video is normally 1 volt peak to peak, whereas audio, while nominally 0 dBm [0.778 V rms, 2.2 V pk-pk], can go up to +20 dBm. This is why audio switchers and buffer amplifiers need +/- 15-volt supply rails, while modern video switchers and amplifiers can work happily on +/- 5-volt rails. A technique that is sometimes used is to attenuate the audio input by 10 dB or so, and apply 10 dB of gain in the output buffer. This lowers the signal to noise ratio, and may not always be acceptable. When switching audio, care must be taken with any dc at switch inputs, or switching clicks or worse will result. As most audio circuits are ac coupled, this should not be too big a problem. It is perhaps why FET switches are popular for audio as they behave as a resistor that has either very high or very low value.

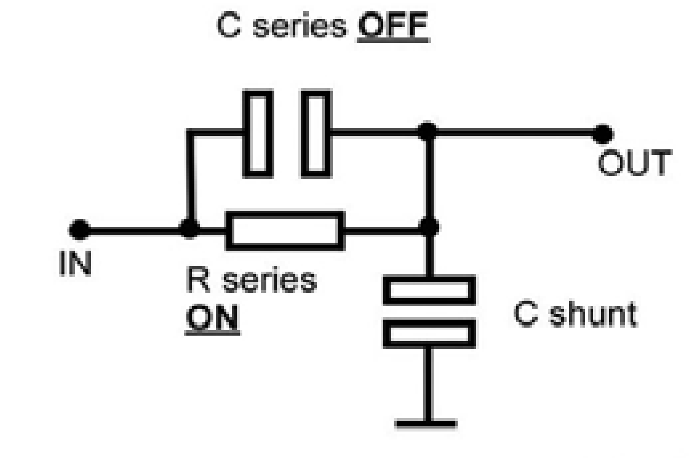
The Matrix

Let us consider a switcher with 5 inputs and 5 outputs, such as might form the heart of a vision mixer. [Fig. 3] There will be stray capacitance around the matrix, at the in and out of each crosspoint, and on the common rail feeding each output stage, called a busbar.

The –3dB point will be at the frequency

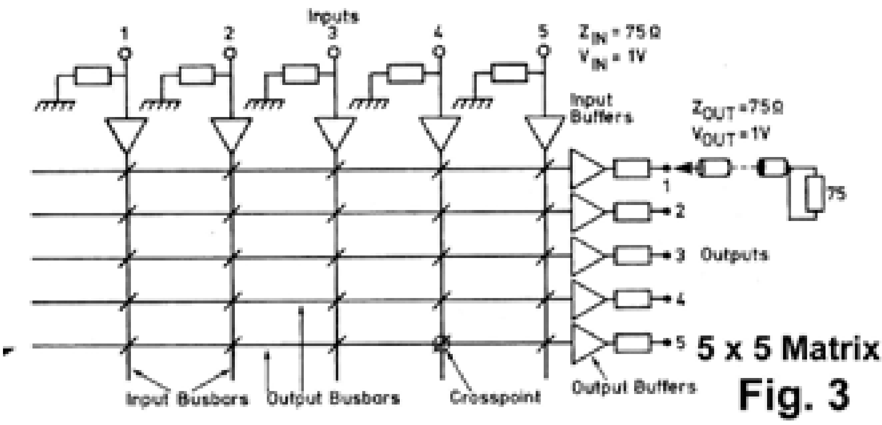
where $Xc_{shunt} = R_{series}$, and $X_c = \frac{1}{2}\pi fC$

Crosstalk will be dependent on Cseries, but with the 3-switch configuration, this is reduced to a minimum.



Crosspoint parasitic elements Fig. 4

There are other considerations in a matrix; if an input is selected to all outputs, the capacitative loading on the busbar may change and cause a change in frequency response. In the days of the IBA Code of Practice, response had to be within 0.1 dB at 4.43 MHz under all conditions and routes through a mixer or switcher.



5 x 5 Matrix Fig. 3

Any given on crosspoint [assuming only one input can be selected at a time for each output] will be feeding the output capacitance of all the other 4 crosspoints, and the input capacity of the output amplifier plus the capacitance of the busbar. In addition to this consideration, the feedthrough capacitance of each crosspoint into the output impedance of the on crosspoint will cause high frequency crosstalk, and has to be considered.

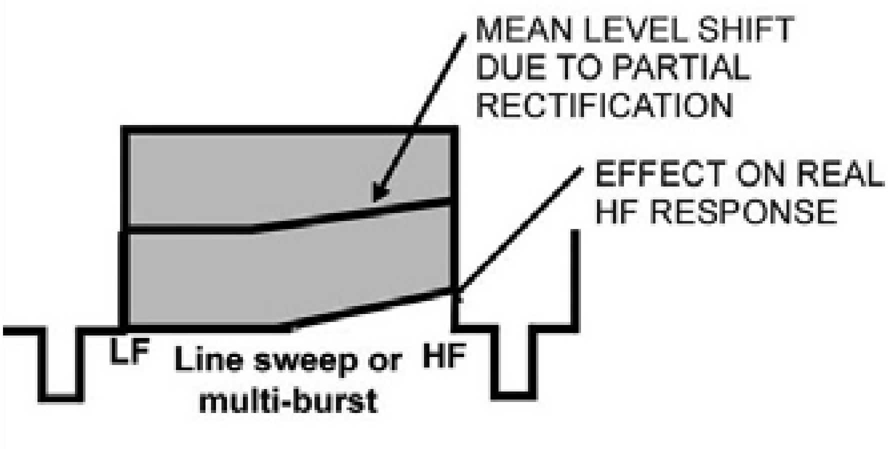
If we look in some more detail at the effective circuits of the on and off crosspoint [Fig. 4], the parasitic components of most concern are the R_{series} ON, the C_{series} OFF and the Cshunt. The R_{series} and the C_{shunt} constitute a low pass filter, and we must bear in mind that C_{shunt} is made up of the busbar capacitance and the off capacitance of the other crosspoints. R_{series} will be several tens of ohms with diode or FET crosspoints.

Another problem which can arise, particularly with active crosspoints such as the one shown in Fig. 2C, is that of axis shift. This effect is caused by partial rectification of HF components in the video signal giving a dc shift to that part of the waveform. For example, if the signal is a multiburst or line sweep, it may show an exaggerated HF response due to this effect. Equally the subcarrier envelope of colour bars will be moved up and make alignment difficult. With a number of possible routes through a mixer, alignment can be almost impossible if one is to satisfy the IBA Code requirements. I write from bitter past experience. The killer is an emitter follower sitting in inadequate current trying to drive a capacitative load. This is made up of the off C shunt of all the other crosspoints on the busbar plus strays. [Fig. 5, Fig. 5B]

Some of you may remember from valve days the infinite impedance detector, which was a cathode follower feeding a fairly large C and R load. Under certain conditions, that is what the emitter follower is doing. The problem was so bad in some complex mixers that a corrector was made up that added the opposite error so as to cancel the original.

Application

What is the matrix to be used for? If it is as a routing switch [US parlance – a “rowter”] , as long as the distortion



AXIS SHIFT Fig. 5

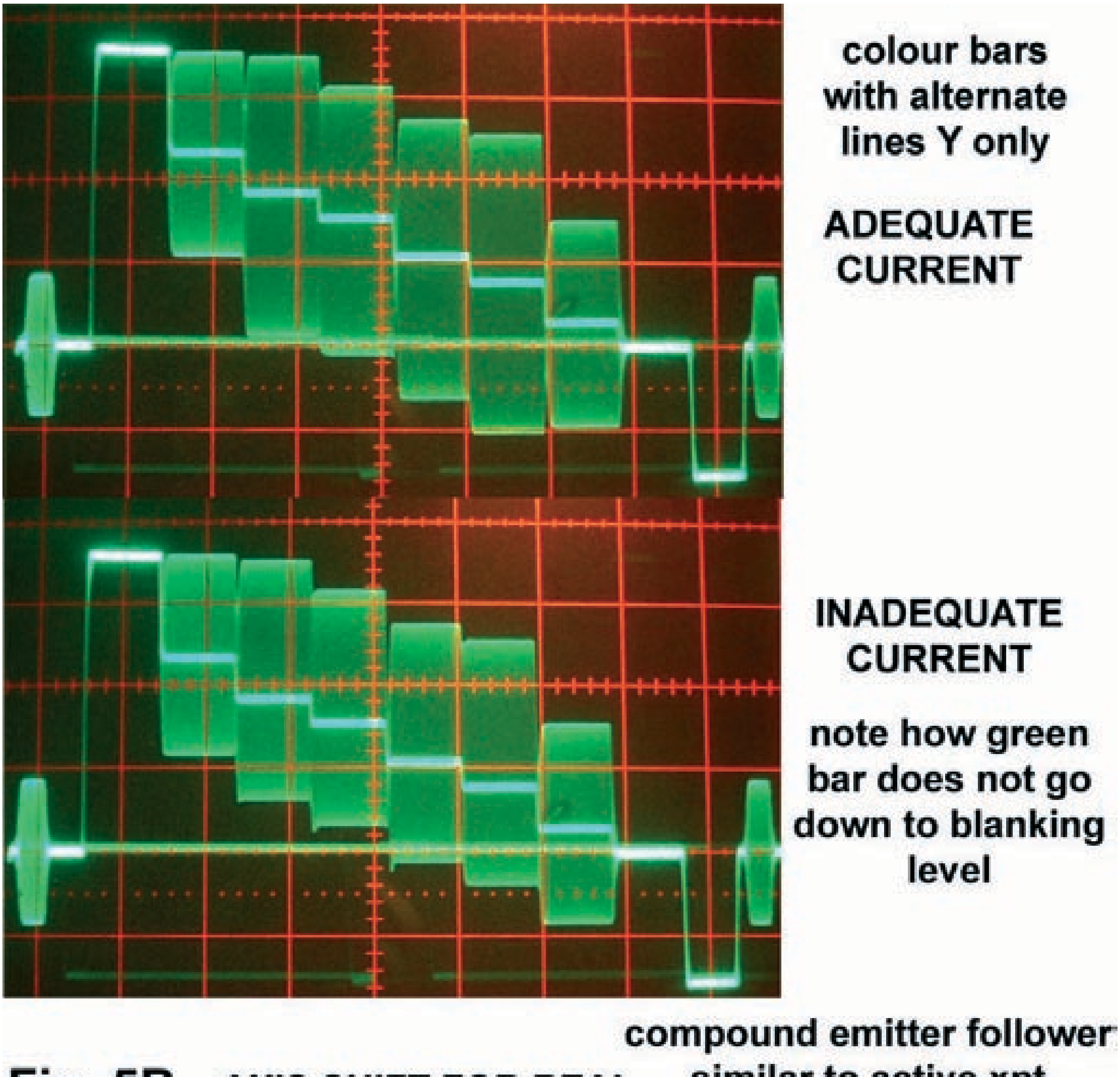


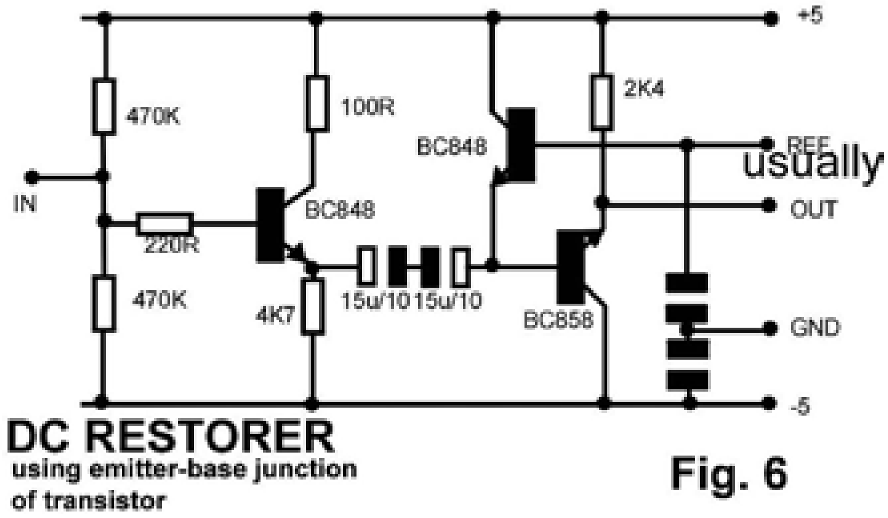
Fig. 5B AXIS SHIFT FOR REAL

and frequency response specification is met, we need not consider things like dc [within reason]. If it is part of a vision or presentation mixer where "live" switching is taking place, we need to consider this carefully.

Video sources have differing dc sits at their outputs. Some have the black level set carefully at 0 volts where it sits whatever the video Average Picture Level [APL]. Others are often ac coupled, where the black level dc changes with APL, and where the dc may be up by a volt or so. We are not usually in a position to do anything about this. Switching between two video signals with different black level dc will cause downstream sync separators to give a break in the sync stream at the vertical interval, causing a frame roll. The design of the input buffer amplifier for the matrix can put this right by incorporating a dc restorer. In its simplest form, this will use a diode [or transistor emitter-base junction] as a sync tip restorer [Fig. 6], or an individual sync separator driving a back porch clamp. Neither of these will work very well with a non-composite signal such as RGB. An external reference signal must be used to produce clamp pulses in such a case.

Luckily for the designer, there are a number of integrated circuit op amps that meet the needs of input and output buffers in a matrix. Some have disable pins that can help in the design of complex switchers, and most can drive more than 1 75-ohm load. Elantec and Gennum make dc-restored buffers that work well. Gennum also make active crosspoints in singles or groups of 4 in a 14 pin package, and Maxim make a range of switching ICs up to complete matrices, some including 75-ohm output drivers. [CQ-TV 195] [Fig. 7, Fig. 8]

The last consideration in a mixer matrix is timing. For a PAL mixer, any source to the mixer output should have a timing accuracy to 1 or 2 degrees of subcarrier phase. This requirement will dictate the physical layout of the matrix. Path lengths need to be equal for each source to the busbars. If this is not done it may be impossible to time the mixer up.

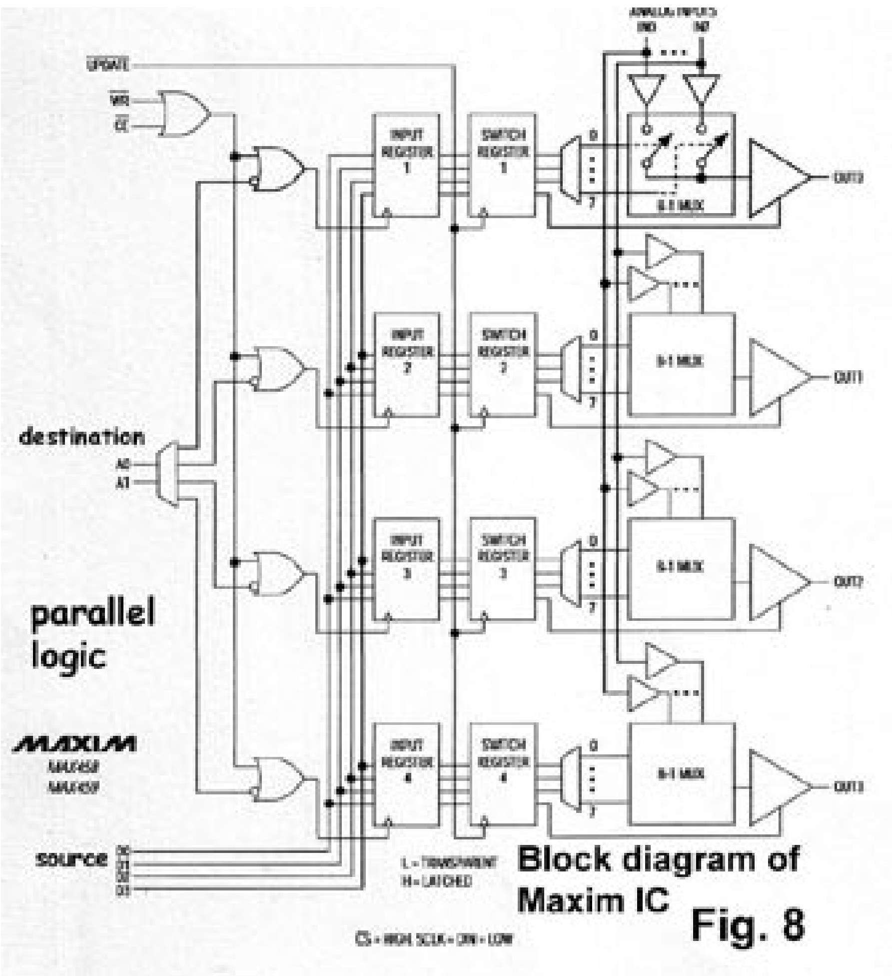


Control

Crosspoints need to be controlled so that when a source button is pressed, it is latched and the corresponding crosspoint turned on. Further, in a mixer, the time at which the crosspoint turns on may need to be on a defined line in the vertical interval. This is not essential in a routing switcher, as signals may be non-synchronous, and downstream equipment can take care of any picture disturbance.

The complexity of such circuitry will depend on the crosspoint design. Individual crosspoints need a wire per crosspoint, whereas grouped crosspoints such as the Gennum, Maxim and the CMOS 74HC405X series have binary control, which saves wires.

The first switchers that I was involved with used the active crosspoint [Fig.2C], with an SCR latch per crosspoint. However there are numerous logic ICs available that help decode binary to wire-a-function and conversely. ICs such as the 74HC4514 [4 wire to 16 decoder] spring to mind.



The ICs made by Maxim, and the SDI 8 x 8 IC made by Gennum [GS9533, see CQ-TV207] use a source and destination type of control. In the case of an 8 x 8 switcher like the GS9533, there are 3 destination lines, 3 source lines, Config and Load lines. The matrix is set up by selecting a source, selecting a destination and pressing a Load button. An article in CQ-TV208 showed how to add 7 segment read-outs to the panel.

If the control panel is to be some way from the matrix, some form of serial control is advisable using RS422 as this will simplify cabling. Use of UARTs [see CQ-TV 202/203] at each end makes implementation of RS422 relatively straightforward. Or you might persuade Brian Kelly to design a PIC circuit for you!

For more complex switchers, inputs and outputs can be increased by using many ICs with their corresponding enable pins. Analog Component Switchers need to have 3 layers controlled in parallel. [CQ-TV195] It is possible to have a 3-layer switch matrix on one card, which keeps all the channels in the same thermal environment. Successful 10 x 2 x 3-layer cards have been produced on a 220 x 233 Eurocard.

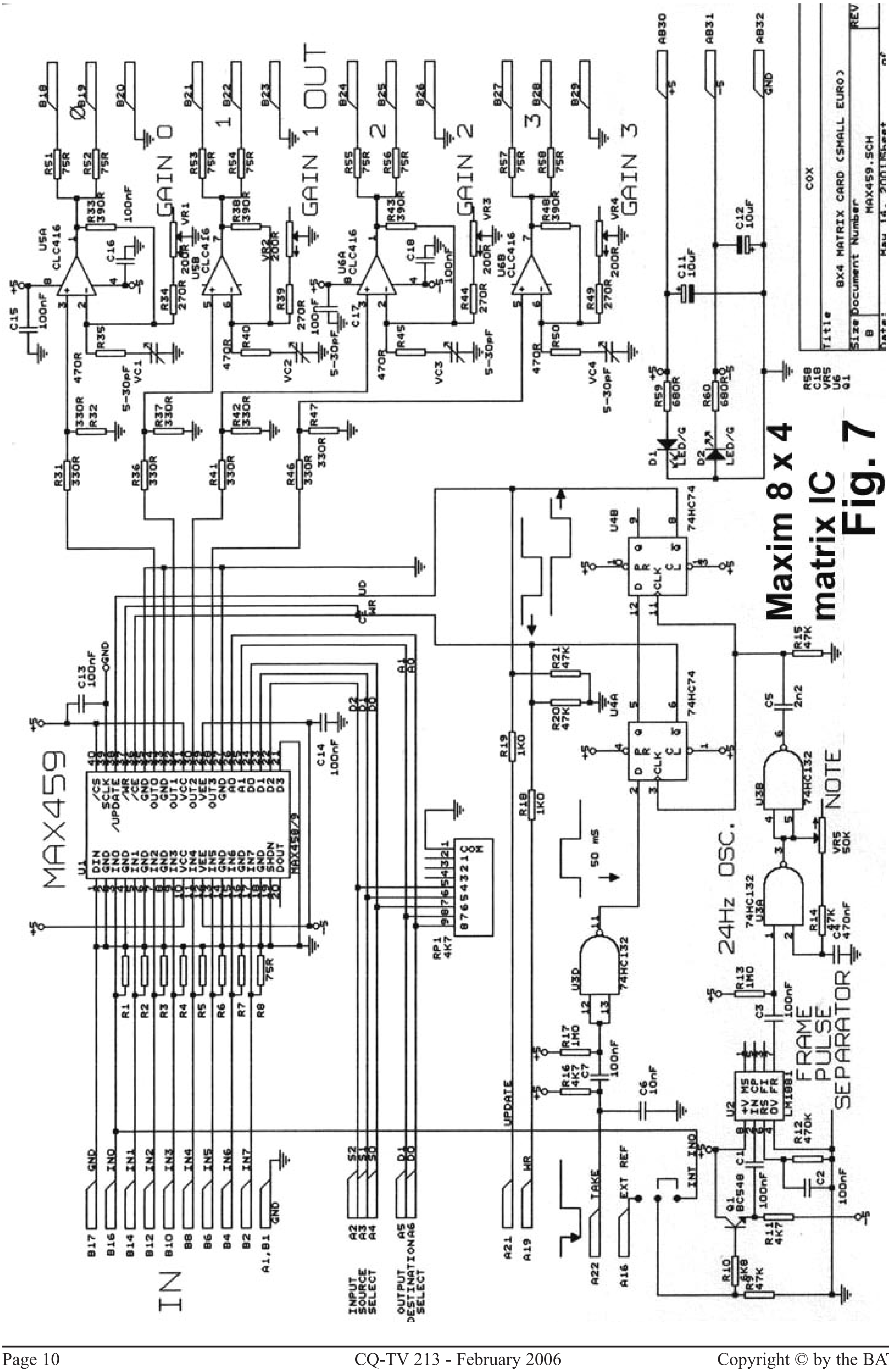
With these complex switchers, great care has to be taken with signal return currents so that they return down the coax outer directly to their output amplifier. This is why you sometimes see ferrite cores on coaxial cables at the connector end. This puts a high impedance to common mode signals on the cable. Any common path with other outputs can result in degraded crosstalk performance. Power supply routing and decoupling is also important. Just like RF really, and you know all about that anyway!

Conclusions

In this short piece, we have looked at the essentials of crosspoints, at the necessity of dc maintenance in some but not all cases, at considerations in design of a matrix, and some thoughts on control.

Reference has been made to earlier CQ-TV articles; buying the CQ-TV DVD means you will have all these articles and more in printable form to refer to; and the pictures will be in colour! The best £5 you will ever spend.

Have a go!



Maxim 8 x 4 matrix IC
Fig. 7

Members Services

All prices in UK pounds (£)		Each	P&P	Qty	Total
Camera Tubes, Scan Coils, Bases & Lens Mounts					
3	One inche Vidicon base	£1.20	£0.30	....	....
4	2/3 inch Vidicon base	£0.80	£0.30	....	....
Video and I^2C Circuit Boards/Components					
7	Sync pulse generator PCB	£14.00	£0.43	....	....
40	I^2C CPU PCB	£10.00	£0.43	....	....
41	I^2C VDU PCB	£10.00	£0.43	....	....
43	SAA5231 Genlock IC	£8.80	£0.30	....	....
44	SAA5243PE Teletext IC	£14.70	£0.30	....	....
45	PCF8583 Clock IC	£7.00	£0.30	....	....
39	LM1881N Sync separator IC	£3.50	£0.30	....	....
81	I^2C 27256 EPROM	£9.70	£0.30	....	....
38	PCF8574P Input expander IC	£4.70	£0.30	....	....
10	I^2C Relay PCB	£6.50	£0.43	....	....
9	PCF8574A Input expander IC	£4.70	£0.43	....	....
RX, TX and SSTV PCB's and General Components					
47	70cm up converter PCB	£13.50	£0.43	....	....
50	108.875 MHz crystal	£8.20	£0.30	....	....
68	4.433618MHz crystal	£3.25	£0.30	....	....
69	5.0MHz crystal	£3.25	£0.30	....	....
86	24cm solid-state amplifier PCB	£10.50	£0.43	……..	……..
Stationery & Station Accessories					
73	BATC blue diamond clutch pin badge	£1.75	£0.30	....	....
74	BATC cloth badge	£4.00	£0.30	....	....
75	BATC equipment label (6)	£0.25	£0.30	....	....
76	BATC square windscreen sticker	£0.10	£0.30	....	....
78	BATC test card	£0.50	£0.43	....	....
79	BATC reporting chart	£0.10	£0.43	....	....
		Total goods and postage - amount enclosed			£..…….…...

PLEASE MAKE CHEQUES PAYABLE TO 'BATC'.

BATC Publications

Publication	Each	Qty	Total
An Introduction To Amateur Television (225gm). The latest handbook full of detailed information on how to set up your ATV station, plus lots of new video and RF construction projects.	£5.00	. . . .	....
The Amateur TV Compendium (155gm). The BATC handbook featuring construction articles on video units, 24cm and 3cm ATV, a Digital Frame Store, and much more.	£3.50	. . . .	....
The Best of CQ-TV (150gm). A compilation of the best construction articles from CQ-TV's 133 to 146	£3.50	. . . .	....
CQ-TV Back Issues: The following issues are still available. Please circle those required: 142, 143, 144, 147, 150, 153, 154, 156, 158 159, 162, 163, 164, 166, 167, 168, 169, 170, 171, 173, 174, 175,176, 177,178, 179, 180, 181. 182, 183, 184, 185, 186, 187, 188,189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209	£1.50	. . . .	....
Special Offer: Any four of the above issues	£5.00	. . . .	....
210, 211, 212, 213	£3.75	. . . .	....
The BATC DVD	£5.00	. . . .	....
Lighting for Television and Film (ebook on CD)	£5.00	. . . .	....

All goods on this page can be ordered, with a credit card, via our online shop - www.batc.org.uk

Project Development with PICs

By Brian Kelly. GW6BWX

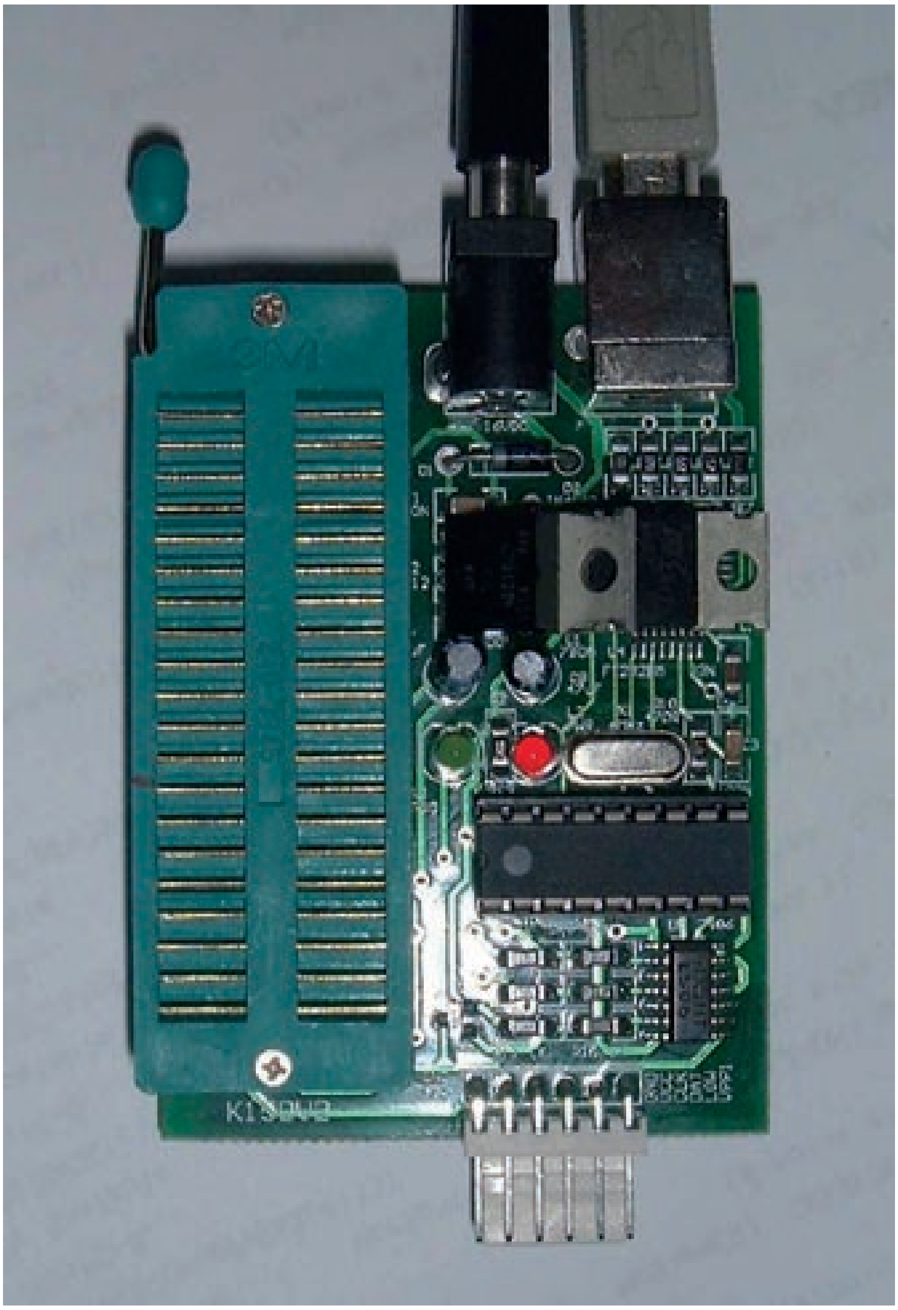
The family of PIC microcontrollers is now huge, there are several hundred different types although still all based around the same core functions. The different families are to cater for just about every users needs, some have just six pins while others have as many as 68, allowing them to control the simplest of circuits to highly complex ones. A wide variety of on-board interfaces are also available, ranging from single 'on/off' pins to Ethernet ports and amazingly, despite some running at 20MHz or more clock speeds, they draw barely a few milliamps of power. The smallest 10F series devices draw less than half a milliamp while running and only nano-amps in sleep mode. With such a broad choice of built in facilities it is unlikely you would find a family member that doesn't have everything you need for any controller application.

Most of the newer PIC devices use FLASH memory. This is not an optical phenomenon! it is a kind of memory that retains it's program or data even when power is removed from it. In fact most devices have a predicted memory life of 40 years, even after 100,000 reprogramming cycles. The fact that the chip can be reprogrammed is extremely useful, the chips effectively never become redundant, if the equipment using it becomes obsolete or is no longer needed, the chip can be erased and reprogrammed for an entirely new purpose. During program development it makes life ever so easy, if you find a bug or want to try something new you just wipe it clean and start again. Erasing and reprogramming takes just a few seconds and in many cases can be done without removing the chip from its circuit board.

Many of the smaller PIC devices have internal clock oscillators so that none of the limited number of pins have to be dedicated to setting their operating frequency. To make sure the on-board oscillator is 'tuned' to the right frequency, they are calibrated during manufacture although it is possible to recalibrate them later if ever needed. Most devices with internal oscillators can still be externally driven or connected to a crystal for applications needing non-standard frequencies or extreme stability.

Now that all the components that used to be necessary around the device are built into it, you can for example make a Morse callsign generator in just two components – and one of them is just a resistor to lower the volume!

The mere thought of writing a program scares most people away from PIC devices. The fear of programming is unfounded; they are extremely easy to use. The most complicated, although most versatile method of programming is to write in assembly language. In this language, you write individual instructions for the processor to run. To be fair, there are only 35 instructions to learn and of these, probably half are rarely used. Because you have total control of the program flow, you can write very efficient and fast running programs. These days there are many



The Quasar Electronics 3150 chip programmer. It can program chips smaller than the 40-pins of the ZIF socket. The connections at the top are for power and USB. The pins at the bottom can be used to program chips which are already mounted on a PCB so they don't have to be removed and placed in the ZIF socket. This is called 'in circuit serial programming'.

tools available that make it much easier to code more complicated tasks by using what are called ‘high level’ languages. These are computer programs that accept a more humanly readable set of instructions and convert them into one or more assembler instructions. When you use high level languages, you never have to see the underlying codes at all, everything at processor level is still there but hidden from you. Sadly, high-level languages seldom produce assembler code as efficiently as can be achieved by writing it by hand but the simplicity of the code far outweighs this disadvantage in all but the most critical applications.

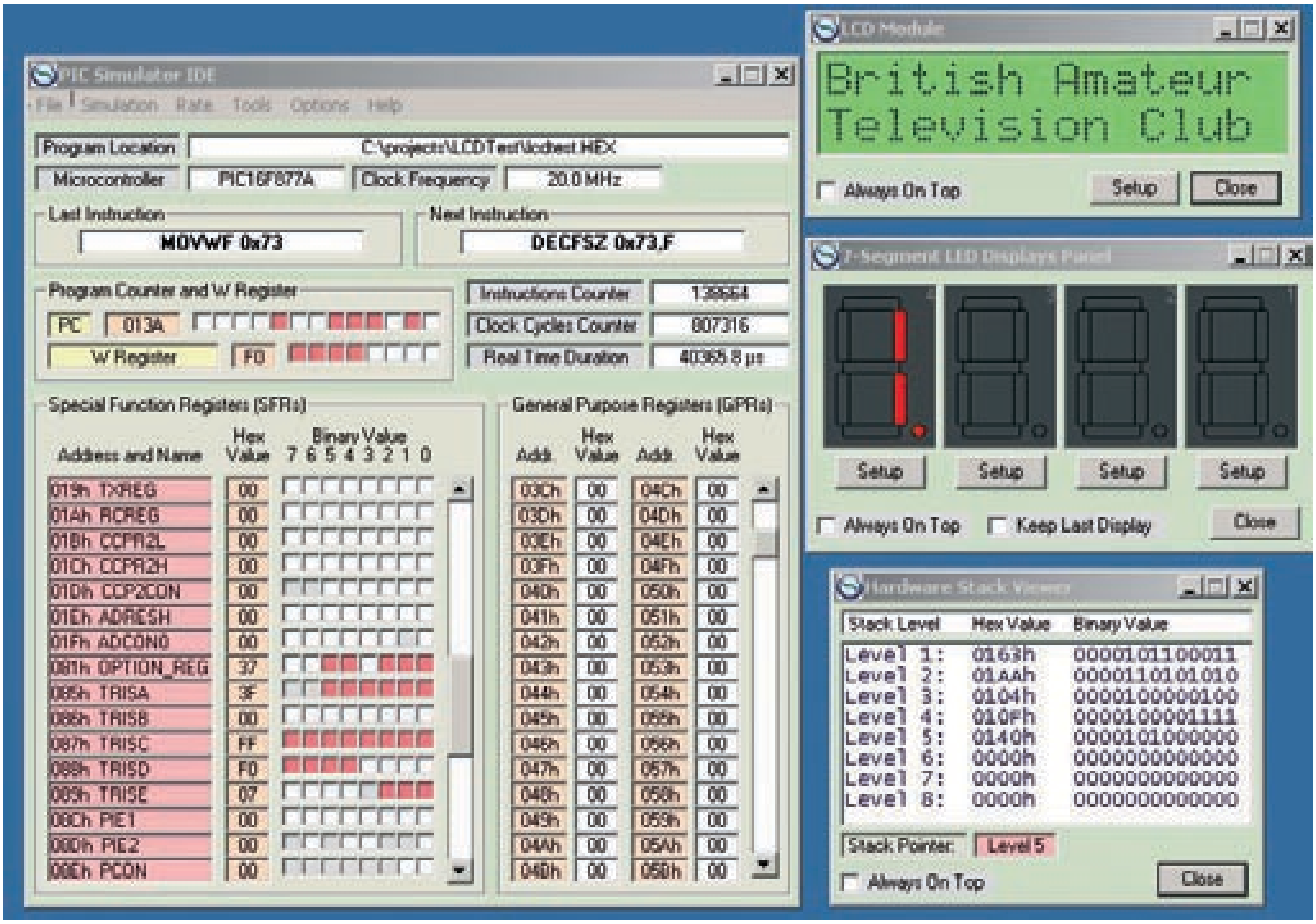
If you want to ‘play’ with PIC devices you will need two tools. One is the electronic circuit that actually takes the program from your computer and stores it into the silicon memory on the chip itself. The other is a tool to write the program in the first place. Not essential, but useful is a prototyping system that allows you to temporarily build a circuit around your programmed chip. This could be just to test a fragment of program or to verify a design before building it in more finalised form. The next sections look at what tools are available in more detail.

Programming the chip

There are many designs on the Internet for DIY PIC programmers and also many commercially marketed units. Most of these can handle several families of PIC chips, the more advanced ones can handle them all. For the average experimenter, one that can handle the 16F84A, 16F628A and 16F877A will suffice. Beware of ones that can’t manage devices with an ‘A’ at the end of their part numbers as the programming methods used with these later devices is different to their predecessors without the ‘A’. The simplest designs on the Internet use just a few common components and connect to the computer printer port. Some are self-powering but most also need 12V or more from a power supply or mains adapter. After looking at many commercially available units I chose one of the ones from Quasar Electronics for myself. Quasar are based in Bishops Stortford in the UK. They market several versions of their programmers, some for parallel (printer) port connection, some for serial port connection and the one I chose which hooks up to a USB port. When choosing a programmer, I advise getting or building one with a ZIF socket for the chip being programmed. ZIF stands for Zero Insertion Force, the chip drops into the socket and is then locked in place by lowering a small lever. Raising the lever releases the chip. Conventional sockets where you push the chip against springy side contacts are cheaper but quickly wear out. I have one ZIF socket that still works after more than 10 years of hard labour! The USB programmer costs £39.95 with a conventional socket or £54.95 with a ZIF socket. The non-USB versions are cheaper. It is ready built and has support software which is periodically updated on the Quasar web site: www.quasarelectronics.com

Writing programs

As mentioned earlier, there is a choice of languages to write programs in. For the smaller devices with little memory, it is probably easiest to write in assembly language. High-level languages tend to add extra instructions that eat into valuable memory space. If more than about 1Kb of memory is available, and most PICs have at least



Oshonsoft’s simulator with the program, LCD, LED and stack windows open. These are just some of the windows you can open to look at the inner workings of the program. The pink dots in the program window are a map of individual bits turned on in the processors internal registers.

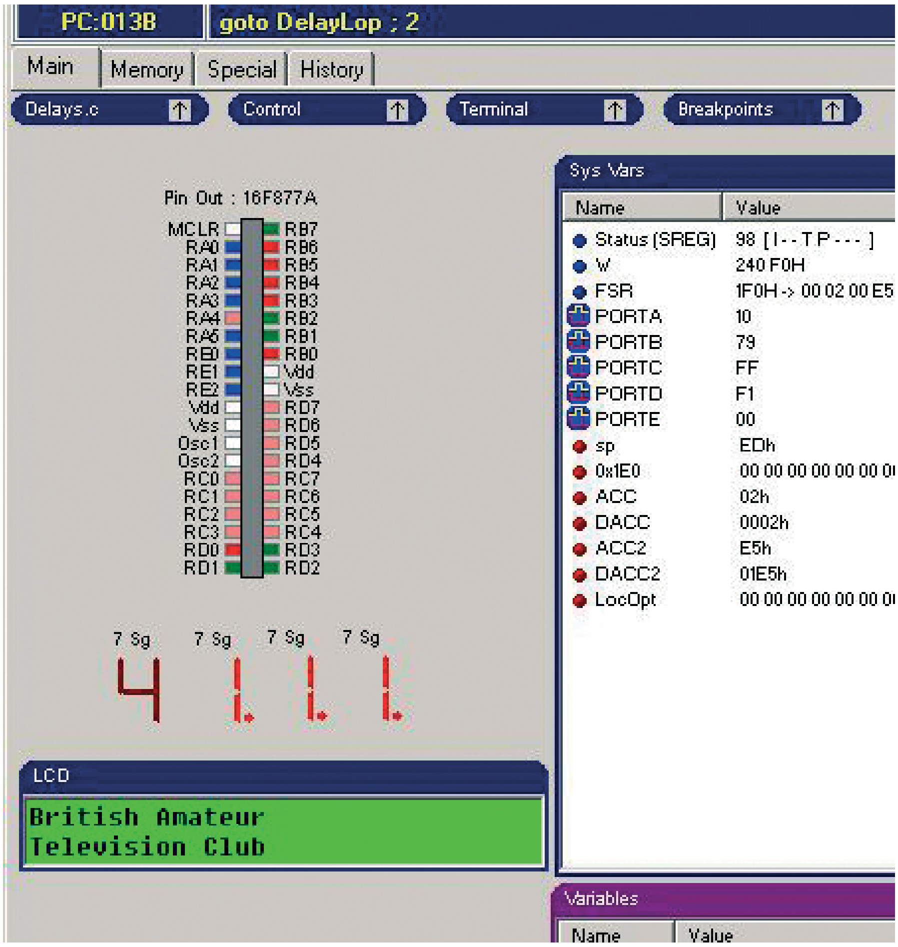
that much, you should consider high-level languages for their simplicity of use. Generally, the word 'assembler' is used to describe software that converts individual human readable instructions to PIC machine code on a one-to-one basis and the word 'compiler' describes software that converts high-level language instructions to possibly hundreds of PIC machine codes.

If assembly language is your choice, you can do no better than use the PIC manufacturers own program writing package called MPLAB. The current version is 7.22 but new releases come out every few months to add support for new chip types. MPLAB is a big program, weighing in at about 80Mb when installed but it does handle all the PIC varieties and it includes an editor to write the program and a powerful simulator that lets you 'run' the program from within MPLAB to make sure it behaves as expected before committing it to a real chip. You can download MPLAB free of charge from www.microchip.com.

If you prefer the convenience of high-level languages, there are two common ones available; they are BASIC and 'C'. BASIC is a simple language, originally written for beginners back in the 1970s but now adapted to work with PICs as well as PCs and larger computer systems. The 'C' language is a little more complicated to learn but is far more powerful and lends itself to being more 'convertible' to assembler instructions. Both languages introduce pre-built functions that are not normally present if you work directly in assembly language. These pre-built functions are a collection of assembly instructions coupled to a method of retrieving and passing back data. You pass data to the function and get data back from it, the function doing something useful with it in the middle. For example, to illuminate the digit 5 on a seven-segment display connected to the PIC in assembly language you would have to set the PIC pins connected to the appropriate LED segments to a high voltage and the PIC pin joined to the LED common pin to a low voltage. In a high-level language this might be written simply as "SetLED(5)". The outcome is the same but the high-level code is easier to write, understand and if necessary, edit later. Another strength of high-level languages is that you can make your own functions either from assembler instructions or by combining other functions together. Quickly, you stop thinking of making pins of the chip go high or low and start thinking in terms of what your program is intended to do. If it is a clock telling the time of day for example, you are more interested in knowing if midnight has been reached than the dozens of numbers in the PICs working registers. High-level coding gives you that degree of isolation from the inner workings of the chip.

Programming in BASIC

Several companies market PIC BASIC compilers but after looking at all of them, one stood out from the crowd for it's simplicity of use and it's low price. Written by Oshonsoft it is called "PIC Simulator IDE" and can be downloaded from www.oshonsoft.com. The 'IDE' part of its name stands for 'Integrated Development Environment', meaning you can do everything within the program to write, debug, simulate and test your work. Although this program doesn't have an operating manual in the normal sense, it does give examples of how to use each of it's commands and the graphical layout of the various display windows makes it very easy to understand. When a program has been written, it can be tested using a selection of commonly attached devices such as LCD displays, LED displays an oscilloscope and a waveform generator. All of these devices appear in their own windows on the computer screen and have 'setup' options to allow you to connect them to whatever pin you want on the PIC being simulated. When the simulation is run, the main program window shows the sequence of instructions being run and the contents of all the registers inside the chip, windows showing the attached devices update as the PIC sends signals to them. You can run the program at different speeds so you can see what's happening in slow motion and you can 'single step' your program one instruction at a time to see what effect the instruction is having. I even loaded programs written in an entirely different language into PIC Simulator IDE and it correctly emulated their operation. This is one of a very few programs that can read, reverse engineer and run programs



One corner of WIZ-C's simulation screen. The image is a representation of the pins of the 16F877 being simulated. The colours show whether the pin is an input or an output and the logic level on it. The numbers in the window on the left are the contents of some of the processors registers. Clicking on the oval buttons allows different selections of data to be shown.

from other sources. I find this feature alone invaluable because it lets me double check the operation of programs when I no longer have the original source language files to work from. Oshonsoft charge 29Euros (about £18) for a license to use the program but it can be evaluated for a limited time free of charge. They also sell similar products for other types of processor such as the Z80 and 8085 devices.

Programming in 'C'

As with BASIC, several companies sell C compilers. Most are more expensive than the BASIC counterparts but the language is better structured and allows more efficient code to be generated. I evaluated several compilers but decided to go with WIZ-C from Forest Electronic Developments in Hampshire. They sell WIZ-C in various forms from the 'Lite' version at £35 which only works with a limited number of PIC types (the common ones) through to the 'Pro' version at £100. The 'Pro' works with almost all PIC types and can even simulate several PIC types connected and 'talking' to each other while each runs different programs – complicated stuff! WIZ-C is a complete program writing solution, it lets you type your program into its editor by hand or guided by an 'auto code' facility which drops applicable chunks of code into place for you. It also features an 'application designer' which is a wonderfully useful tool that allows you to pick from a selection of commonly used elements and drop them into place on a picture of the chosen PIC. After doing this you connect the appropriate signals from the element to the pins of the chip by clicking on them and not only does the screen show how everything is wired up, it also writes the appropriate lines in the program for you. You still have to 'glue' the bits of program together to achieve your aim but much of the graft of telling the program what connects to what is done for you. WIZ-C has an excellent simulator and like the Oshonsoft program, it lets you build a circuit on the screen and see how it will behave in real life. It differs from Oshonsoft's simulator in that it allows you to create stimulus files in which you specify actions to perform at different times. These actions could for example be "send a serial byte at 9600 baud to pin 9 after 3 seconds" and while running, that is exactly what it would do. It allows you to mimic real life events that your final design might encounter and see how your program reacts to them. WIZ-C also has more devices to connect to the simulation than Oshonsoft's program. To be fair, Oshonsoft provide details of how to make your own devices to expand their product but experience with other programming tools is needed to do this. Forest Electronic Developments also sell an assembler program and similar product for AVR processors. They also have a support forum for users on the Internet. Their web site is www.fored.co.uk

Program examples

This is just to show you how simple it is to put a message on an LCD connected to a PIC16F877A in BASIC and in 'C'. In both examples, some of the preparatory code is not shown, only the part that actually writes to the LCD is.

As you can see they are very similar and both quite understandable.

In BASIC:

```
Lcdcmdout LcdClear                'clear LCD display
Lcdout "British Amateur"          'text for the line 1
Lcdcmdout LcdLine2Home            'set cursor at the beginning of line 2
Lcdout "Television Club"          'text for line 2
```

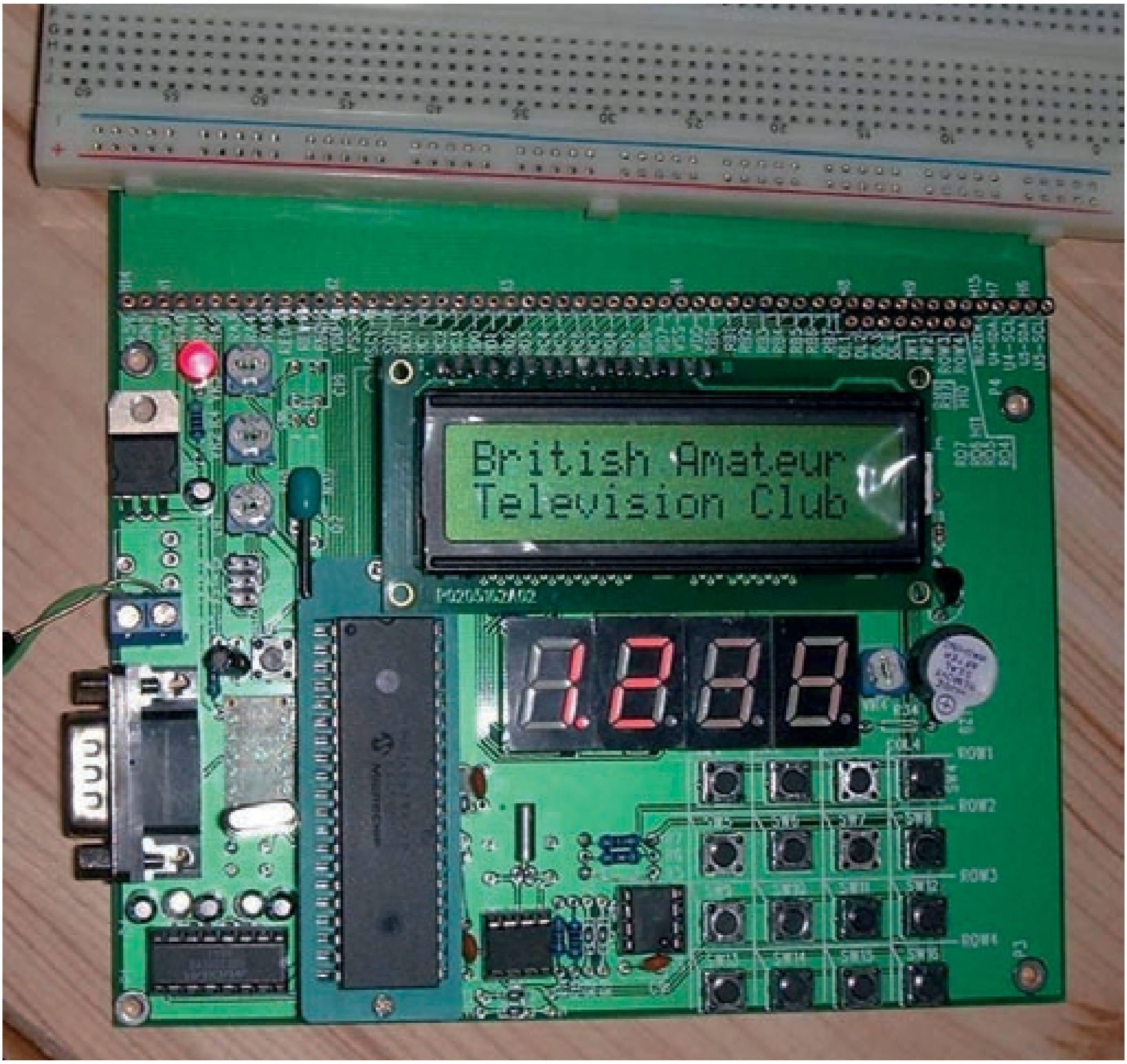
In C:

```
ShowMessage()
{
LCDClear();                        //clear the LCD display
LCDString("British Amateur");      //top line message
LCDPrintAt(0,1);                   //cursor to bottom line
LCDString("Television Club");      //bottom line message
}
```

Prototyping systems

If you are confident that your program will work, you do not need a prototyping system. If like me you write programs that rarely work first time, prototyping can save hours of frustration and anger. Sometimes, no matter how many times you check and double-check your work, you overlook the simplest of things. Frequently this is because you did not predict what signal might be present on a chip pin or you didn't appreciate a resistor was needed between a pin and the circuit it connected to. The only way to be absolutely sure is to build real hardware to try it out. The trouble is, you can easily get into a loop of hardware change causing a software change causing a hardware change again and so on. In order to try the design while still tweaking values and software, you need a method of rapidly building hardware in such a way that it can be modified easily, this is where prototype boards come to the rescue. They typically have a patch board area on which you build your circuit and link pins so you can connect to the PIC. Some have other devices on them to make it easier to hook-up some of the more commonly used circuits. Many prototyping boards are available but the one I chose for myself because of features and value for money is from a Hong Kong company called 'Momentumfire'. Their board has a ZIF socket for a 16F877 processor, a 4x4 keyswitch array, a two-line LCD, four seven-segment LEDs, an RS-232 serial port for connecting to a PC, a buzzer, a real time clock chip (time of the day clock) and a memory chip. The memory is advertised as being an 8Kb device but my board came with a 32Kb device, perhaps I was just lucky! As well as the main board, a separate patch board was supplied, this uses spring contacts to connect component legs without needing to use solder. The board is type MFC-1027 from www.momentumfire.com/258.html and costs about £40. This is about half the cost of buying the parts alone in the UK but there may be some variation in price as exchange rates vary.

The prototyping system will normally run at full speed, it is after all a 'normal' running circuit despite the



The prototyping board from Momentumfire. Shown here running the same program as simulated by WIZ-C and Oshonsoft programs. The LEDs were actually showing 1.234 with each digit shown in turn but the camera shutter was too fast to see them all.
The pins along the top row give access to all the processor pins and other signals necessary to connect to the board. The patchboard is at the top of the picture.

temporary construction method. Beware though that even on the fastest PCs, a simulation will run much slower than real time. WIZ-C is actually quite fast at simulating a real environment; Oshonsoft's simulator is considerably slower. They do however, agree exactly on functionality and on their assessment of execution times if real time could be achieved. Both programs accept code written in assembly language as well as their high-level counterparts.

You have seen here just a small sample of tools available to PIC developers. I use all the programs and the prototype board described here. The programs each have their strengths and weaknesses but together they make a potent collection of programming tools. I hope I inspire you to try your hand at using these versatile devices.

The Care and Feeding of Vintage Broadcast Cameras

By Brian Summers

Restoring an old broadcast television camera to working order is not something to be undertaken lightly, it is not that it is very difficult, more that there is a lot of it! If you are fortunate enough to be contemplating an old camera channel, read on. If not many of the comments and techniques are applicable to other restoration items, even radios! This article is illustrated by a recently restored Marconi MkIII and many of the comments relate to the work done on it.

Where to start?

I know it is a statement of the obvious, but you need to make sure you have all of it! Or at least enough to make a start. In general terms a camera channel comprises: -

A lens, zoom or fixed focal length. Fixed lenses go on a turret with 4 spaces (usually). Zooms have controls or servo demand units. Lenses should have rayshield hoods.

The Camera with its viewfinder, monocular or large, and viewfinder hood. Make sure the camera has all its internal plug in cards and modules, and that they are for the line (and colour) standard you want.

The CCU. Broadcast Cameras, except for the most recent models, connect to a CCU. Therefore, you will need the CCU and some cable of the correct type to connect them together. Multicore camera cable, with its co-ax cores, screened quads and single wires, is made to suit a particular camera or small range of cameras. Later cameras used the Triax cable, which is still in use today, so it is hard or expensive to get!

Very early cameras had a separate PSU which connected to the CCU with more cable. This is a standard multicore cable, but the connectors can be a challenge. Later models had the PSU in the same box as the CCU. If the PSU is of the switch mode type, they can be a challenge to fix.

The earliest cameras had the operators controls on the front of the CCU with only the most rudimentary provision for remote control. Then cameras had remote panel for operation of the controls wired back to the CCU. With the arrival of the microprocessor, the OCP and RCP became simpler and a MSU dealt with the now vast range of adjustments for a single or group of cameras. The MSU is often missing and setup of a modern camera is difficult without it.

That is the basic camera channel, but there may be auxiliary units needed. If the camera is older than about 1975 it is likely to need "drive pulses[1]" from an SPG. Most important is the

Figure 1. The Marconi MkIII camera

documentation. You will need the full handbooks or at the very least a full set of circuit diagrams and component layouts.

Safety Notice

You should be aware that all tube type cameras have an interesting selection of high voltages in them, even the transistorised cameras have voltages of the order of 700 volts in them! This can give you a nasty nip, possibly fatal! If you are not trained in safe working practices, you should NOT be working on this type of equipment. Also note that the wiring practices of the 1950's are a long way short of today's standards. The use of a mains isolating transformer in addition to the Variac is recommended.

You should not work alone!

Cleaning

I give a fairly good clean before I start, using a paintbrush in conjunction with an airline blower to get the worst of the dirt and spiders out! Some things can then be washed, even components with a degree of care and then blown out again with the airline. Some cameras (Pye & Marconi) have nice little labels on the individual parts (R35 C129 etc) and care has to be taken with these labels as they come off very easily. I leave the paint touching up until later. There will be a lot of time to do this when various bits are being soak tested. The complexity of the chassis and wiring mean that it is not practical to strip units down for repainting or plating, as is often done with vintage radios. It is my view that this destroys the originality of the item under restoration. It is restoration not rebuilding.

Preservation

I like to think I am saving these cameras for the future, so my approach is to replace as little as possible. Think of the "this is my great grandfathers axe, it's only had two new heads and 4 handles" syndrome. The other thing that really concerns me is keeping a channel complete. I have seen many instances were only the "photogenic" camera head is saved, the inconvenient CCU and PSU being lost for the future. To this end, I have been collecting complete cameras channels for my museum.

Components problems

People worry about valves but provided they have a good vacuum and light up they are probably going to work. Be careful when inserting and removing valves from their sockets, particularly

Figure 2. MkIII camera cable connector from 1953

with octal[2] valves as the centre spigot can break off. If the pins are corroded you can clean them with a fibreglass brush (available from Farnell etc.) The valve sockets are normally OK as they would have been good quality ones and they last well. Gently rotate an old faulty valve in the socket, with a few drops of contact cleaner to clean the socket. Take care with Top Cap connections. It is annoyingly easy to break the cement holding it on. For B7G and B9A glass valves there is sometimes a metal pin straightening socket.

Transistors do age slowly and can give an interesting range of cracks, pops, hisses and leakage. If the camera has been in a damp area, the transistor connections (legs) can go rusty and the transistor falls off. The wires are often plated steel, try a magnet! When sourcing replacements, if the correct type can't be found, a substitute with suitable ratings will often work satisfactorily.

Tubes (pickup) Try to make sure you get the correct tubes with your camera. Spare tubes are about and can be found with some effort. Strangely, the later small size Plumbicons[3] seem to be the hardest to find. Always keep the target (faceplate) uppermost when handling. Tubes do wear out, losing performance, with loss of emission and target deterioration. They rarely stop working completely and it is good to have some poor tubes for testing with as you can damage good tubes in a faulty camera.

Resistors go high in value, especially the green vitreous power kind. These go open circuit, and it seems to be a feature after 40 odd years, check them all! Small resistors of the carbon composition type also go high, but not all will need changing. The original types may be of 10% or 20% tolerance and the circuit may well work satisfactorily if the value has not changed too much. Variable resistors go intermittent and noisy. Try cleaning first and rotating


Figure 3. Faulty components removed

a lot. With use they often improve to a usable state. It is difficult to find suitable replacements.

Depending on the age of the camera there may be a number of TCC brown, oil filled paper capacitors with voltage ratings of 2,000 to 20,000volts. I have had trouble with these. Even apparently good ones have failed after some use. They get hot and leak nasty oil even splitting open in some cases. It is problematic to find suitable reliable replacements that look the part. I cannot recommend using the hollowing out tequnique sometimes advocated, as the oil is nasty stuff. The best bet is to make up a brown tube and fit a stud bolt to either end with filler compound (brown window sealer, the non acetic acid sort). I didn't have time or patience for this and just wired new capacitors in on tags for later attention.

Capacitors give endless problems, some makes more so than others. If you have any of the "Hunts" type, brown or black with thick plastic coating, best replace them all. I am deeply suspicious when I see them. Sometimes the plastic has cracked and shrunk back exposing the innards! If your camera has Tantalum[4] capacitors, red or blue bead type (1970ish), they will give trouble if they have not had voltage on them for a while. Paper capacitors go leaky and a judgement has to be made about which you replace. The leakage has more effect in certain grid circuits than in others parts of the circuit, where a small amount of leakage is of no consequence.

It is not unknown for capacitors to explode (burst open). Watch out for increasing leakage that leads to overheating and internal pressure. This is more likely to happen with electrolytic capacitors. They can make a dreadful mess, tinfoil and goo everywhere.

Transformers for broadcast cameras are well built and give little trouble with the exception of some in Pye cameras from the 1960s. Make sure you do not destroy a transformer by failure of another component leading to excessive current demand, overheating and failure. It will be difficult to replace a failed transformer as they were usually especially made to fit. Check carefully that all fuses are of the correct value and surge[5] rating.

The PSU

I like to start with the PSU, it is often big and has lots of nasty high voltages but fairly easy to get going. These notes relate to valve type equipment, but have relevance to later solid state equipment.

Check for mechanical damage, broken wires, resistors, valves (valves go white if the air gets in). Remove all valves and put to one side for later reinsertion. If the numbers have been rubbed off write the number on the base with felt tip. Check the mains input voltage selector is correctly set! Check carefully that all fuses are of the correct value and surge rating.

Re-form[6] the electrolitcs. Use an external variable HT power supply with a current limiting resistor(s) and a current meter. Connect to each capacitor in turn and start with a lowish voltage say 100 and watch the series current meter, which should fall to a low value. When it has settled increase the voltage and wait until it settles again. Repeat this until you have reached the working voltage of the capacitor. A certain amount of experience is needed to judge when electrolytic capacitors are satisfactory. A leakage of about 1mA. or less would mostly be acceptable. Watch out for parallel current paths which will make the leakage appear more than it really is. It is possible with some thought to do the re-forming without any disconnections. This is a good plan as the PSU, this article is based on, has 15 major electrolytics alone! At no time should the case of an electrolytic or any other capacitor get warm!

When you are happy with the electrolytics and have oiled the fan, checked the insulation of the mains input circuits and check that there are no short circuits cross the HT lines. You can apply some power. Use a Variac[7] to bring the voltage up slowly and check the secondary voltages on the mains transformer(s). It maybe that you will have to link two of the pins on the output connector as there is often an interlock to stop the PSU working if not connected to the CCU. If nothing has gone bang, plug the valves in and connect a dummy load to the output. This is important, as without a load the output voltage will go too high. I used a domestic 150w light bulb, it worked well and you could tell when the PSU was on! Check the regulation[8] of the output voltages with different amounts of load. They should not change by more that a few percent (1% to 5% typical range). Set the output voltage, I like to set it a bit low, perhaps 20 volts (for nominal 250v) low as it can be increased later.

Most early PSU had meters for measuring the output currents and voltages. A very careful watch of the output current should be kept. It is likely that the current will rise as the camera warms up and the leakage of capacitors increases. If it goes up much or quickly switch off and investigate!!

The CCU

Much of what has been said about the PSU applies here. Remove the valves and re-form all the electrolytics, check resistors, small capacitors and look for wires off and damage. It is likely that the CCU has it's own transformer for the 6.3volt heater supply, so if you connect the PSU to the CCU and remove the HT rectifiers you can plug the valves back in and power up with no HT from the PSU. Use the variable HT, supply used for re-forming the electrolitcs, to bring the voltage up slowly, looking for smoke as you go. It is a little known fact that most electronics works by smoke and if it escapes it stops working! Oh-Hum.

If your camera is a later solid state model you can do a variant on the above by plugging in the PCB cards one at a time watching for smoke. Remember the Tantalums! Make sure that you load the PSU suitably at all times so it is not upset by too little or too much load.

It's about now that you can connect the SPG feeds and see if there is an output? Some CCUs have to be fooled into thinking there is a camera connected. You could connect the camera at this stage in a minimalist way with most boards/units removed. Most CCUs have some arrangement for generating

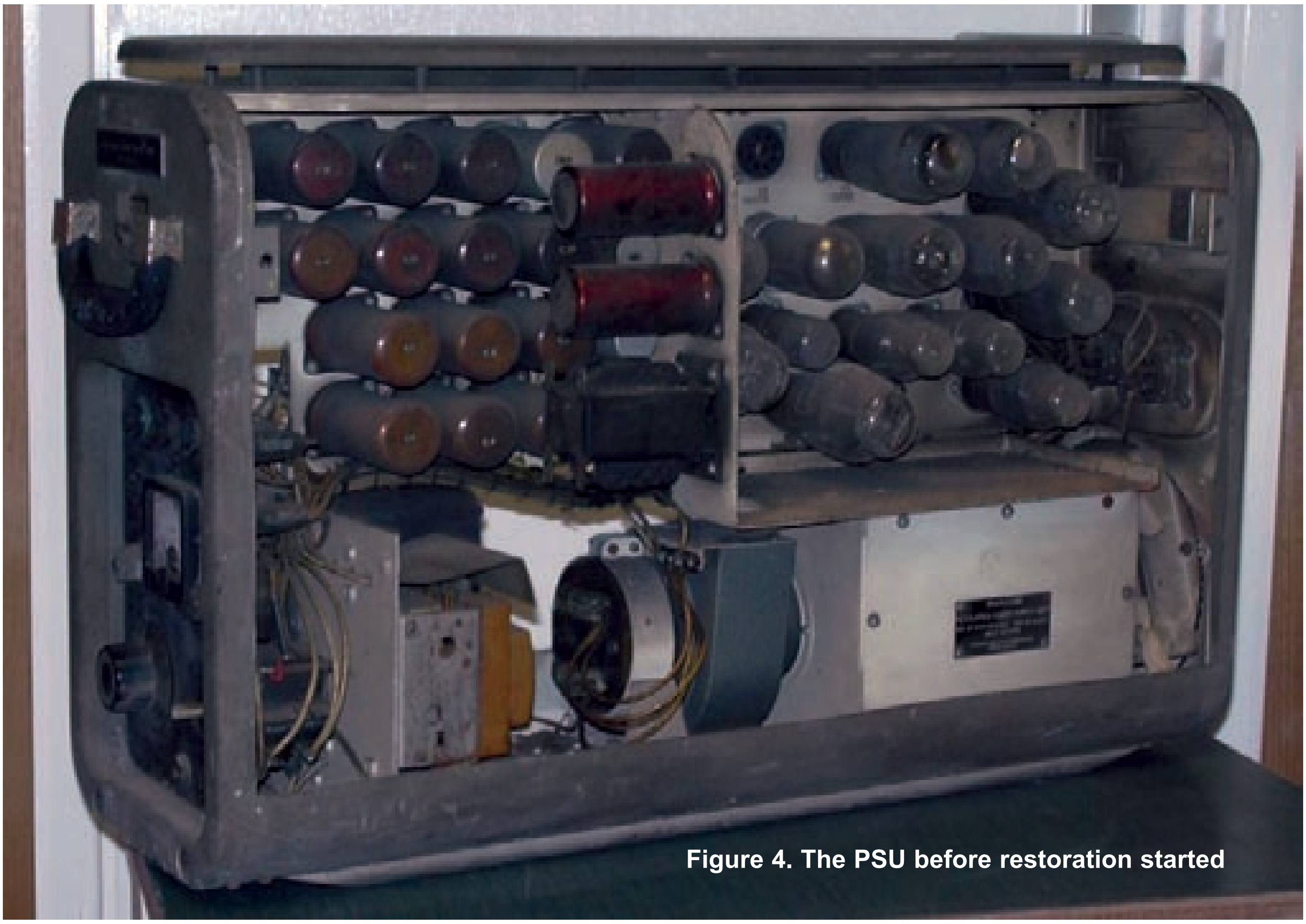


Figure 4. The PSU before restoration started

Figure 5. The CCU with it's picture and waveform monitor above

a local test signal and there is no point in working on the camera until the CCU is producing a correct output.

The video amplifier in the CCU processes the signal from the camera head, adding blanking[9], clamping[10], lift[11], control of the gain, white clipping, and finally sync pulses are added. All these processes will have to work. See suggested reading list.

Later cameras like the Marconi Mk8/9, the Phillips LDK5 and some Link cameras are a bit all or nothing as regards getting the PSU/CCU/camera to work independently. You have to tread carefully.

The Camera Head

As before inspect for mechanical damage, re-form electrolytics, etc. disconnect the viewfinder and lens for later attention. Remove the camera tube(s) noting carefully the orientation in the scanning yoke[12]. In a 3 or 4 tube colour camera you could consider just disconnecting the tubes, leaving them in place. This will make later registration[13] easier. Do not fiddle with the mechanical adjustment of the yokes for the same reason.

Image Orthicon cameras have +1400volts for the electron multiplier and –600volts around the Image section, mind your fingers! Plumbicon and vidicon cameras have 900 to 600volts on the wall anode. These voltages can come from the PSU or they can be locally generated in the camera.

Connect the camera to the CCU and having removed as much of the electronics as practical, bring the voltages up slowly watching for signs of distress or overheating. Plug the modules back in, checking things as you go.

If the camera has it's own PSU get this working now. Middle period cameras, 1965 to 1980, often sent a single high power supply to the camera which was converted to the range of voltages needed in the camera.

It will be possible to inject a test signal into the camera at the start of the video amplifier and you should get this working first, through the camera and CCU to the output.

Then move on to the scanning sections, high voltage generators, scan failure protection circuits and focus supplies. Check the voltages at the tube base connections and also that the scanning generators are actually working before inserting or connecting the camera tubes.

During all the work in progress keep an eye on the total current drawn by the camera channel. It is hard to get it down to the value stated in the specifications. How near you get to this is a measure of all the small leakages and extra valve current due to incorrect operating point caused by capacitor leakage or changed value resistors. A result of the extra current drawn is extra heat, leading to more leakage…

Viewfinder

The viewfinder is basically a small good quality picture monitor. Therefore normal monitor or TV servicing practice applies. Depending on the designers preferences and sometime the budget, the viewfinder can be more or less "stand alone" or it could be more integrated with the camera needing drive pulses and voltages from the camera. Cue lights and lens indicators are often integrated into the viewfinder. Late cameras could put text messages on to the viewfinder.

There is a problem with viewfinders from about 1970. A faulty batch of 7 inch tubes with bonded on flat glass faceplates were manufactured. The trouble did not become apparent for 2 decades, but the "gel" material between the tube and the faceplate goes very spotty and strange. You will know it when you see it. Later tubes of the same type are unaffected.

Marconi MkIII brief data

Valves: 91 valves in total plus 3 CRTs and the camera tube.

Weight: 170LBS (77Kgs.) camera only.

Power: 1000watts approximately

Models were available for 405 lines, 525/60 lines and 625/50 lines and with 3" or 4.5" tubes.

303 were made, 181 for the UK and the rest for export.

Camera Power Supply is the main power supply for the whole camera chain. It had a regulated output of 250volts DC at 1.25A. and 330volts at 330mA.

Additionally there were some miscellaneous outputs at lower voltages. It used 17 valves for rectification and stabilisation. It came in two forms, rack mounting or in the mobile case form. In order to keep the weight down, in the mobile form, a forced air-cooled mains transformer was used.

For more information on the Marconi Mk III go to:- http://www.bsvideo.dsl.pipex.com/marconimk3doc.pdf

Optical systems

The lens focuses the image of the scene onto the target of the pickup tube(s). On its way, it has to be controlled in intensity and colour temperature. All broadcast cameras will have a means of controlling the tubes exposure, normally a servomotor driven iris[14] In addition to the iris there will be a number of neutral density filters mounted in a rotating disk. This can be motor driven and controlled from the CCU. In colour cameras, a second ring contains coloured filters, minus blue or star filters. Turret cameras have 3 to 6 places for mounting lenses and when fitting them the iris gear ring arrangement should be moved, so that all the lenses are set to the same aperture, say f8, so that the lenses track. The Zoom lens will have controls for zoom and focus with local servo or mechanical operation, the iris control being remotely controlled. In some cameras provision was made for local iris control.

The optical path should be cleaned with care using a lint free cloth. Great care should be taken with mirrors and prismatic light splitters. It may be better not to clean! Filters, lenses and tube faceplates are more robust. Clean with care.

Operation and Alignment

At this point, the camera channel should be fault free, or nearly so. The scanning and video circuits must be working, as you will not get a picture if they are not satisfactory. Cap the Lens[15], insert and connect the tube(s). Do not adjust any of the pre-set controls in the camera or CCU as they are likely to be set to the correct value, or nearly so.

Turn the Beam control(s) to zero and set other front panel controls to the centre or as dictated in the setting up instructions in the documentation.

Figure 6. The Marconi MkIII Viewfinder

Suggested reading list

Practical Television Engineering,	by Scott Helt,	Pub. Rinehart Books	1950
Television Engineering,	by Amos and Birkinshaw, Vols. 1 to 4	Pub. Iliffe	1953*
Basic Television,	by Bernard Grob	Pub. McGraw-Hill	1954
Television Engineering Handbook,	by Donald Fink	Pub. McGraw-Hill	1957
Sound and TV Broadcasting	by K R Sturley	Pub. Iliffe	1961*
Principals of PAL Colour Television	by H V Simms	Pub. Iliffe	1969*
Television measurement techniques	by L E Weaver	Pub. Peter Peregrinus Ltd	1971*
Video Handbook, second edition	by Ru Van Wezel	Pub. Heinemann: London	1987

All of the above are heavy-duty technical handbooks, even the early valve ones have principals still in use today. * These books have been published in conjunction with the BBC and issued as training books.

All tubes, Vidicon, Plumbicon, Image Orthicons have a beam of electrons that scan over the tube's target. Many of the adjustments are to do with controlling this process. The beam must have the correct current, be aligned, focused, and deflected to scan the correct target area and arrive at the target with the correct velocity. In addition, the Image Orthicon tube has an image section in front of the target with more controls.

There can be as many as 4 separate focus adjustments, optical, image (Image Orthicons only), beam electrostatic and beam magnetic. Most tubes need an overall magnetic field, generated by a solenoid coil in the yoke with a stabilised current flowing in it and an adjustable voltage on the tube's focus electrode. There can be more than one focus node of the electron beam within the tube, one of them will give the best performance.

Glossary

ACT	Anti Comet Tail
CCU	Camera Control Unit
CRT	Cathode Ray Tube
BG	Burst Gate
FD	Field Drive
HOP	Highlight Overload Protection
HT	High Tension (voltage)
LD	Line Drive
LT	Low Tension. In valve parlance less than say, 10V or less than 100V in solid state areas.
MB	Mixed Blanking
MS	Mixed Syncs
MSU	Master Setup Unit. Complex controls for a group of cameras.
NTSC	National Television Standards Committee, The American (60Hz. Areas) colour system.
OCP	Operational Control Panel
PS	Pal Squarewave, also called VAS in BBC areas Vertical Axis Switch
RCP	Remote Control Panel, normally a less complex version of the OCP
SECAM	The French colour system.
SUB	Subcarrier (sinewave signal 1 volt PPk.)
SPG	Sync Pulse Generator
Triax	A coaxial cable with an extra overall insulated screen.
PAL	Phase Alternate Line, the European (mostly) colour system
PSU	Power Supply Unit
VAS	In BBC areas Vertical Axis Switch also called pal switch in other areas

When the camera has warmed up, say 5 minutes, and the test signal from the camera is Ok turn off the test signal, un-cap the camera and advance the beam control. If you are really lucky, a picture will appear, more likely not. As you advance the beam control, watch the output picture for a change in brightness or noise level. This is the start of the beam landing on the target. Don't use too much beam. It has to be enough, but too much will lead to poor results or even none. The correct point is to just "discharge the whites" in the picture.

If you have a colour camera from about 1975 onwards, it may have dynamic beam control to deal with light overloads which caused coloured trails to follow bright objects (comet tails). This was variously called ACT or HOP. The adjustment of these circuits must be correct or tube damage may result.

Make sure there is an optical image on the face of the tube and adjust the alignment and beam controls. When some sort of an image appears you can start the optimisation process. Image Orthicons have the image section to adjust as well. If there are no faults, maladjustment of the alignment and beam controls are the main reason for there being no picture.

A full line up of a camera can take a long time, a lot of experience and the manufactures set-up instructions should be followed. Colour cameras are much more complex as the coloured images have to match in amplitude, position and size. It helps a lot if you have not disturbed the optical positions of the 3 or 4 scanning yokes and tubes.

There is an alignment technique variously called minus Green (-G). This is used in the alignment of the image registration. The green signal is inverted and added to either the red or the blue signal. Where the pictures are in registration the signals will cancel to grey, the errors showing as bright edges. This is best displayed on a good underscanning[16] monochrome monitor.

Test Gear

You will need the usual set of servicing tools, testmeters, one digital and one analogue, an oscilloscope with at least 20MHz bandwidth.

A Megger with 250v & 500v operation for measuring capacitor leakage.

HT power supply, adjustable from 100v to 450v at, at least 100mA. LT power supply 0 to 50 volts 2A.

An LCR bridge.

A good monochrome picture monitor and a colour monitor as well if you have a colour camera.

A TV waveform monitor[17] and a vectorscope[18], TV test signal generator, an SPG.

A selection of test cards and an illuminated stand for them.

Notes

Experts and purists should note that there are many simplifications in the foregoing texts.

Footnotes

1 Drive pulses: (or just pulses) refers to the output pulses from a central SPG used to control the timing of a group of cameras. Most cameras used a subset of the full set of seven pulses, depending on the age and type. (LD FD MB MS BG PS SUB)

2 Octal: In this usage a valve with an 8 pin Bakelite base, glass or metal body

3 Plumbicon: A lead Oxide based camera tube made by Philips Trademark.

4 On this point if you have a “working” camera with these red or blue Tantalum caps in it, it is a good idea to power it up every few months to stop them going bang! Very tedious as it is likely to have dozens or even hundreds of them.

5 Surge: In this context fuses can be “quick blow” or “slow blow” surge resistant types.

6 Re-forming electrolytic capacitors, is a process of restoring the insulating layer to its original value by applying a voltage which is slowly increased.

7 Variac: A variable voltage auto transformer. Note that it is not an isolating transformer. The voltage is adjustable from 0 to 260 volts. It should have a current rating of at least 2 amps, ideally 5 amps.

8 Regulation: Refers to how well a stabilised power supply controls its output voltage.

9 Blanking: The raw picture from the camera is oversize and the edges are often poor, so these are blanked off to give nice crisp edges and a picture of the correct size.

10 Clamping: A process of picture stabilisation to give a defined black level.

11 Lift: The adjustment of the black level in the picture.

12 Scanning Yoke: In a broadcast camera this is a precision wound set of coils to do the horizontal and vertical deflection of the electron beam. There will be coils for adjusting the beam alignment, and overall beam focus.

13 Registration: The adjustments needed to make the scanned patch in each of the colour cameras tube match so that the coloured images are in alignment.

14 Iris: An arrangement of moving vanes to present a circular aperture of variable size in the light path of a lens

15 Lens Cap: An optical blanking arrangement to stop light reaching the tube(s). It is literally a cap on the end of the lens, but sometimes there is a blank position on the filter wheel or the lens iris can fully close.

16 Underscanning: On a picture monitor tube the amplitude of the scanning is reduced to show the edges of the picture. Engineering picture monitors are normally operated in this mode. There should be a switch for it.

17 Waveform monitor: A specialised oscilloscope for displaying television waveforms.

18 Vectorscope: A specialised oscilloscope to show the amplitude and phase of the colour subcarrier in a coded PAL or NTSC signal.

A progress report on the ATV project for the ISS

By Graham Shirville - G3VZV

As many members will remember, a campaign for funds was launched earlier this year to sponsor the addition of two antennas to be fitted on the outside of the new Columbus module which is scheduled to be added to the International Space Station in 2007 or 2008. This campaign has been successful and sufficient donations were collected to finance the manufacture of antennas for two bands. Each antenna will be identical and each will cover both L-band uplinks (1260-1270MHz) and S-Band downlinks (2400-2450MHz).

These antennas will be fitted underneath the module so that they are facing the earth. They will be transported to the ISS in the cargo bay of an American Shuttle. Since there is little room left between the module and the shuttle cargo bay doors, the ARISS antennas will be patches which only project a few millimetres. These patches will be fixed to the external Meteorite Debris Panels (MDP) which protect the hull of Columbus. On the conical end of the module, where it attaches to the ISS main structure, feedthroughs have been installed for the coax feeds to the antennas themselves.

The debris panels can be seen in Fig 1 and a small illustration of the patch antennas is shown in Fig 2.

The existing ARISS antennas on the Service Module are shared through diplexers and will not be especially effective on the microwave bands. Using the dedicated antennas on Columbus will, for the first time, permit viable ARISS operations on these useful bands.

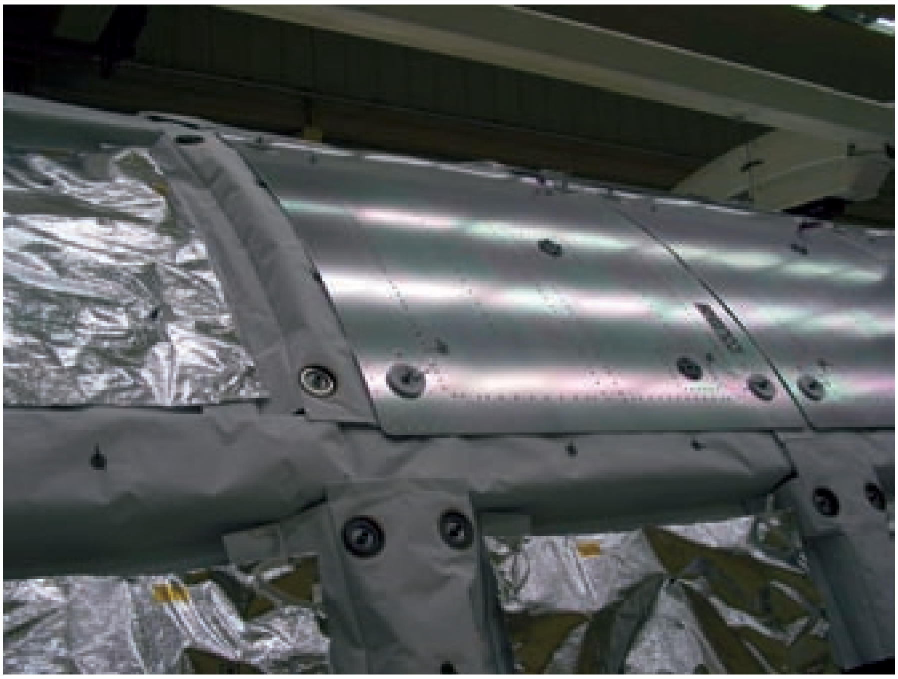


Figure 1

With the Columbus module being located at some considerable distance from the other two ARISS stations, this will permit parallel operations on the new bands at the same time as the existing operations.

The availability of these new frequencies will enable us to establish wideband and video operations for the first time. This facility will provide ATV facilities for School contacts and, additionally, continuous transponder operation.

The Columbus module is designed to undertake experiments but may also be used as temporary sleeping accommodation for the European astronauts. It is anticipated that most, if not all of them, will be licensed amateurs.

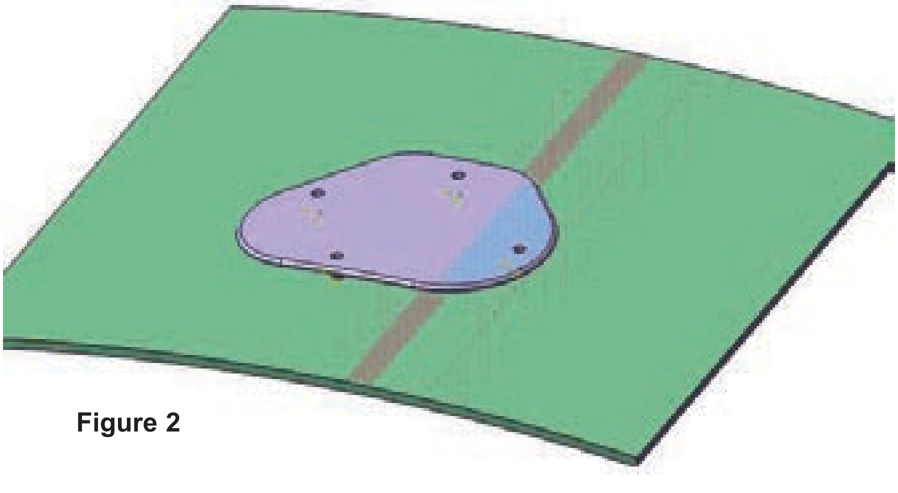


Figure 2

Different sleep patterns of the astronauts can restrict the existing operations so this “remote” facility would overcome this constraint.

To summarise, the addition of these new antennas will provide greatly enhanced opportunities for amateur radio operations on the ISS and an additional emergency communication facility for the astronauts.

The antennas have been developed by the Institute of Telecommunications and Acoustics of the Wroclaw University of Technology in Poland and they are expected to be installed onto the Columbus module at the EADS facility in Bremen Germany in January or February 2006.

The Columbus has a length of eight metres and a diameter of 4.5 metres. It will be equipped with ten standardised payload racks to accommodate experiment equipment. In addition, there will be three system racks, which, for instance, will serve for water supply control, and three storage racks. Launch mass of Columbus will be almost 13 tonnes including a payload mass of 2.5 tonnes. The laboratory provides sufficient space for three crew members to carry out research under microgravity conditions. Columbus is designed for a total service life of 15 years.

One new acronym has had to be created! As well as the Columbus module,

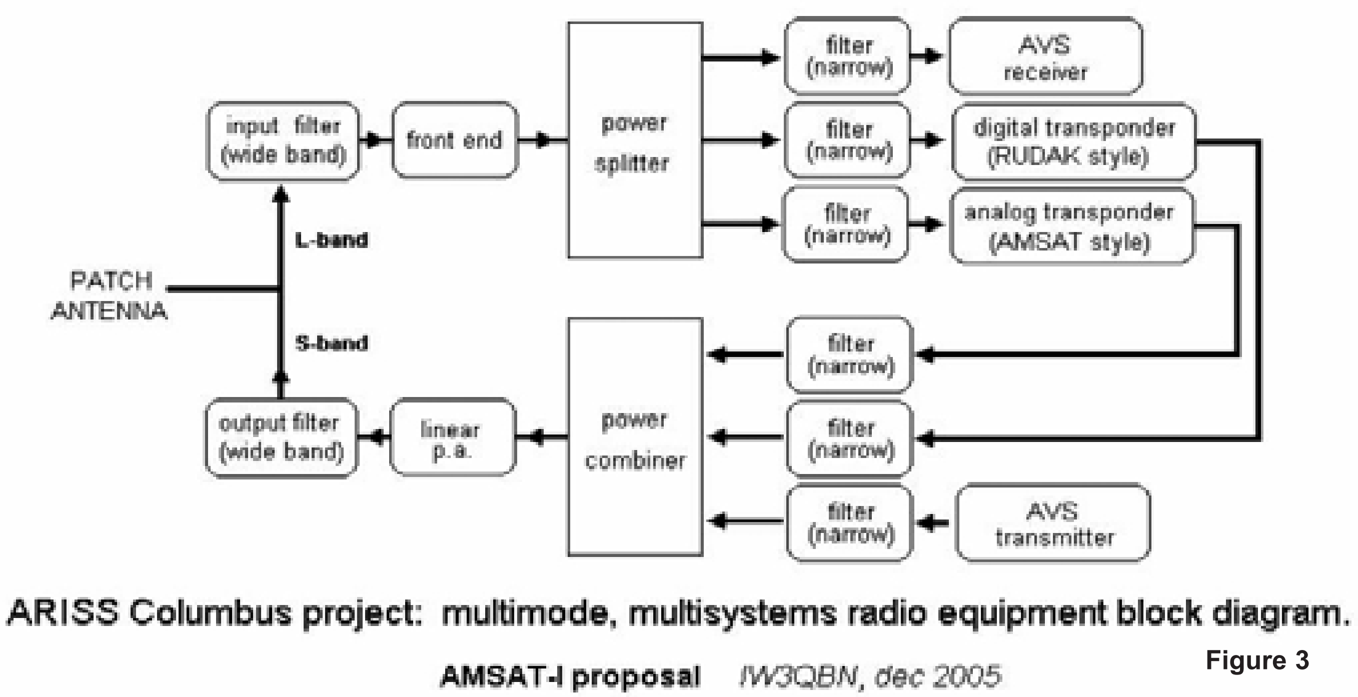


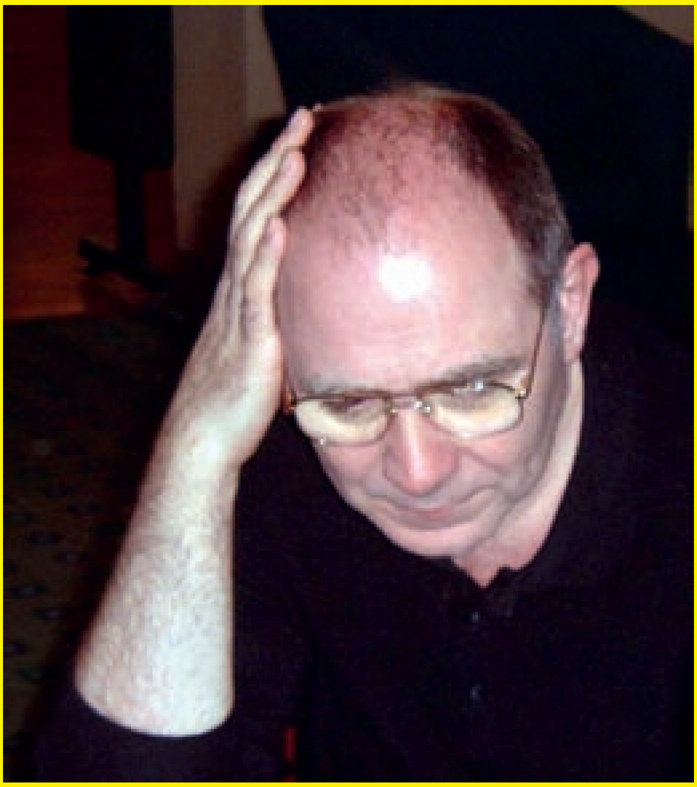
Figure 3

ESA are also developing a number of "Autonomous Transfer Vehicles" which will ferry equipment and stores to the ISS on Ariane 5 launch vehicles. These are, of course referred to as ATVs and we cannot really use ATV for "Amateur Television" without a large amount of confusion being created. Therefore ATV on the ISS is going to be referred to as the " Amateur Video System" or AVS for short.

A possible block diagram of the complete system is shown below and a meeting is expected to be held in Bremen in February or March to further the development of it. It is not expected that the Columbus module will actually be launched with the AVS gear already installed – we expect that this will be delivered to the ISS on a later flight – maybe in one of the ATVs!

As can be seen, this system would provide a wideband linear transponder for both analogue and digital signals, an AVS (aka DATV) system for downlink and maybe uplinking and, of course, a local video camera and microphone for the use of the astronauts.

The development team for this work includes the following amateurs: Gaston Bertels -ON4WF, Oliver Amend - DG6BCE, Florio dalla Vedova - IW2NMB, Paolo Pitacco - IW3QBN, Graham Shirville - G3VZV, Dave Mann –G8ADM, Carlos Eavis,- G0AKI, Jason Flynn – G7OCD, Christophe Mercier, Wolf-Henning Rech - DF9IC.



Caption competition 212 result

and the winner is:-

'A DAB hand with a S.O.A.R head '
sent in by Tom Roberts, GW0WHT

Some other entries received were:-
"Oh groan, too much forehead reflection... WHERE'S MAKE UP?"
From Mike G8LES

"Wish I could remember where I put the rest of my body"..
From Ralph W Gabbitas...G3KHU...ex G6AFN-T..

"What a brilliant idea"
From Peter Johnson G4LXC.

'Well, I used to have more hair than this! Where's it all gone?'
From Eric GW8LJJ, still with a full head of hair (just)!

Circuit Notebook No. 88

By John Lawrence GW3JGA

A Bar Display Audio Level Meter

An audio level meter is usually fairly low down the priority list of equipment in the ATV shack. This is probably because most camcorders (used as the station camera) have a built-in automatic audio level circuit which provides a fairly constant level audio output. Once the audio sub-carrier deviation at the transmitter has been set, it can usually be left alone. However, if you use several different audio sources, VCR, DVD, separate microphone, etc. then an audio level meter is useful for setting deviation and avoiding reports of distortion or low sound.

Display Driver

The audio level meter to be described is based on the National Semiconductor Dot/Bar Display Driver I.C. It senses an analogue voltage level and drives 10 LEDs or other types of displays. There are three versions available,

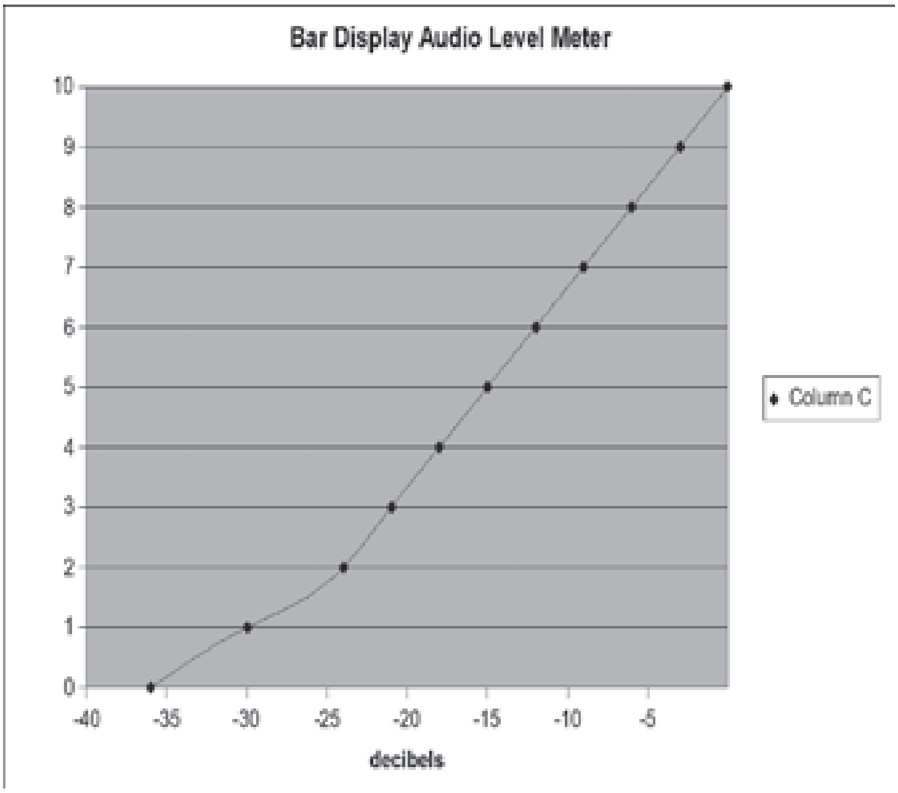


Figure 5 - Bar numbers versus signal level

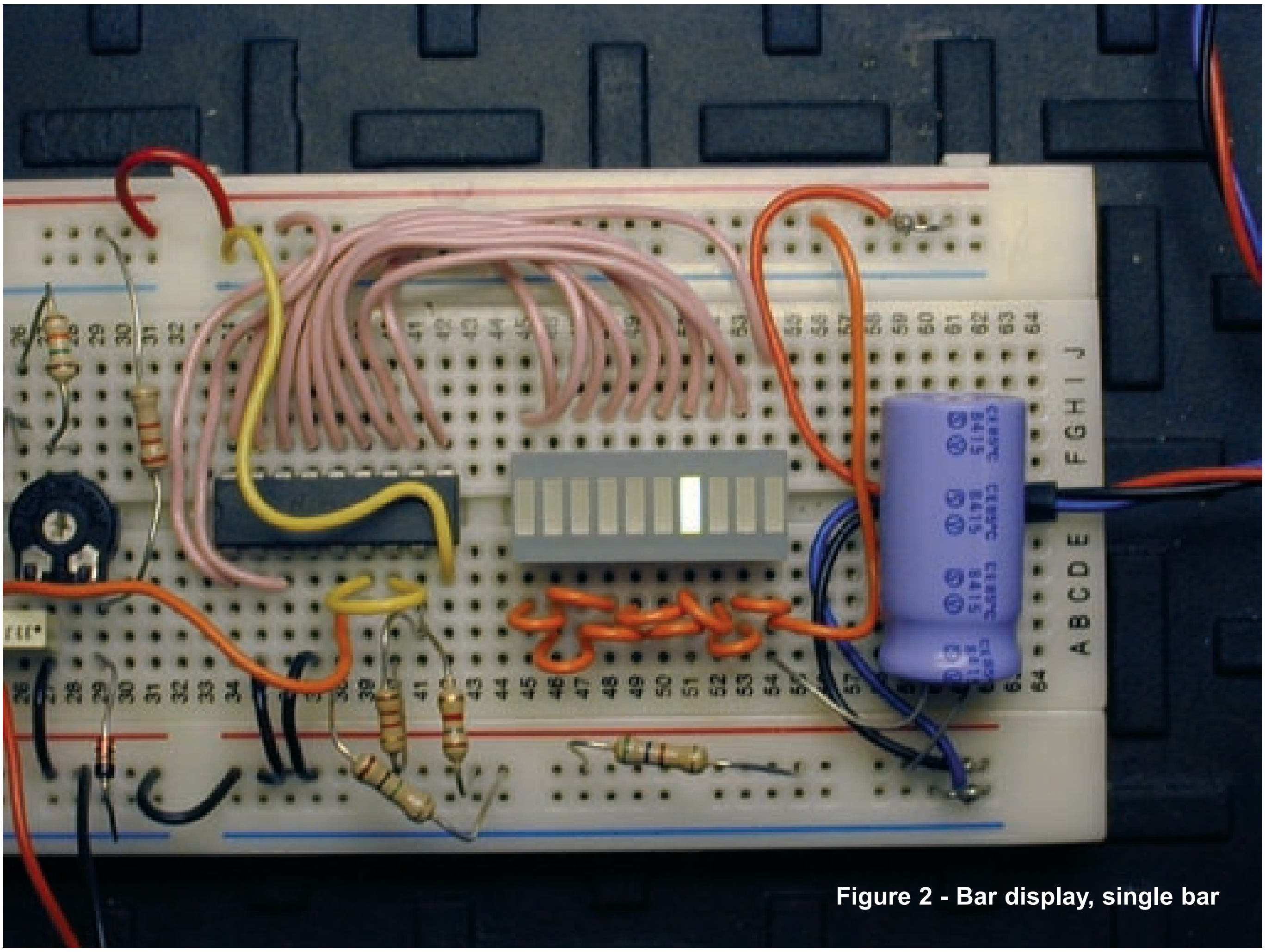


Figure 2 - Bar display, single bar

the LM3914, which provides a linear display proportional to input signal, the LM3915, which provides a logarithmic display and the LM3916 which provides a display equivalent to a 'VU' meter. Full details of the I.Cs are given in the National Semiconductor data sheet [1] which also includes lots of application information.

The LM3915 has been chosen for this level meter and each bar on the 10 bar display represents a change of 3dB in the input signal level. An application circuit is shown in Fig.1. It is possible to feed an audio signal directly into the LM3915 as it will respond to the instantaneous positive value of the waveform, but the results using this method are rather disappointing.

Ideally, the input requires a d.c. voltage proportional to signal level, so the audio signal first needs to be rectified. The display driver can be configured by pin 9, to give either a single bar (pin 9 no connection) shown in Fig. 2, or a column of bars (pin 9 to +12V) as shown in Fig. 3. The bar display shown is intended for audio application and has the top three bars (8, 9, & 10) red and the others (1 to 7) green. The display is RS components 247-3107. Alternatively, any 10 bar display could be used.

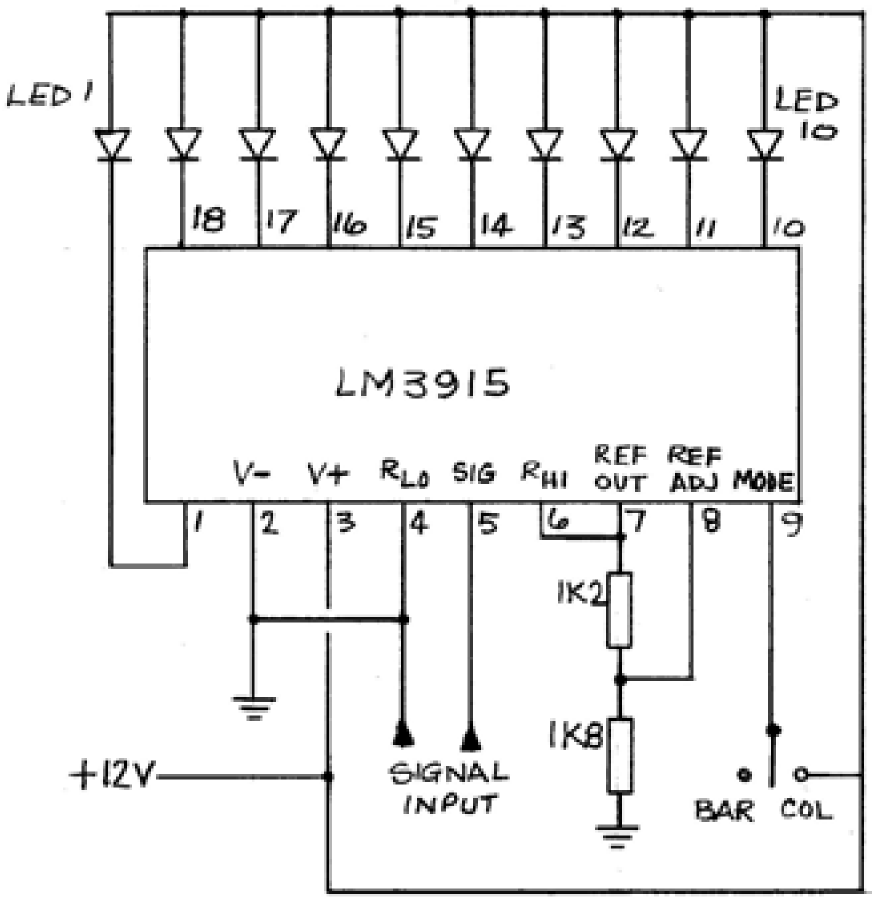


Figure 1 - LM3915N Bar Display Driver

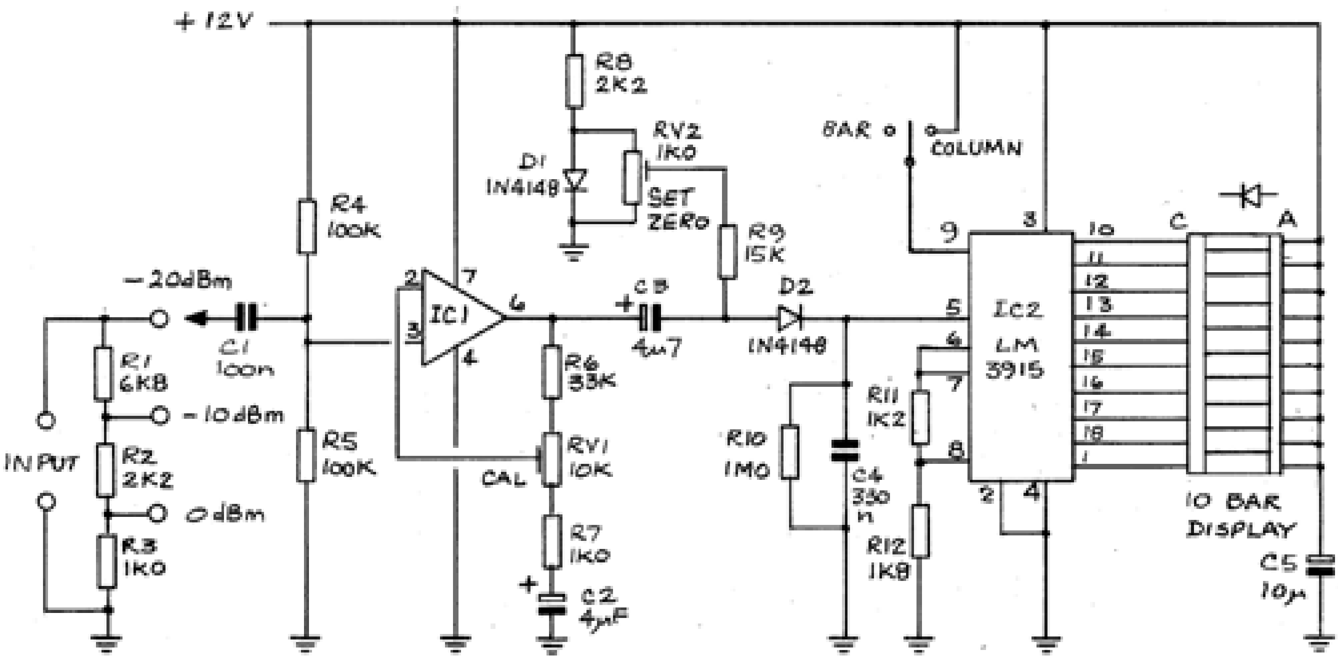
Audio signal rectifier

There are plenty of rectifier circuits and 'absolute value' circuits which would be suitable, including those given in the data sheet, but most use op-amps which require both positive and negative supplies [2][3]. The intention was to operate everything from a single +12V supply and to avoid the use of a DC-DC converter for generating the dual polarity op-amp supplies.

The complete circuit is shown in Fig. 4. The overall sensitivity for 'full scale' is -20dBm (77mV rms). At the input, R1, R2 & R3 provide an attenuator to allow -10 dBm and 0dBm to be accommodated. The audio signal is amplified by IC1 (741 or similar), the gain can be adjusted over a 20dB range by RV1, to allow calibration or setting up at some alternative or more convenient signal level.

The output signal from IC1 is half-wave rectified by D1 and the peak value stored in C4. To compensate for the diode turn-on characteristic, a

Figure 4 - Circuit diagram



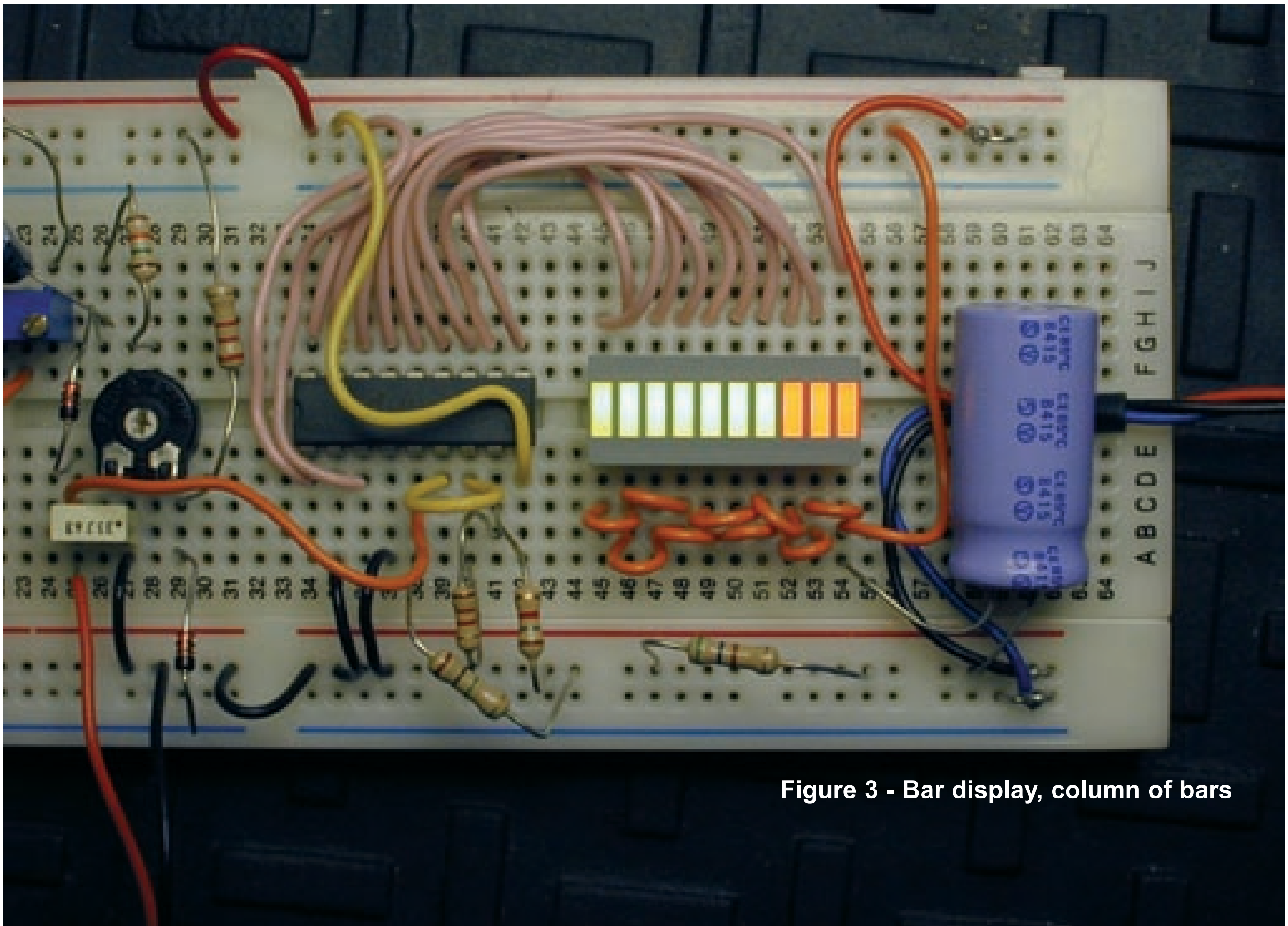


Figure 3 - Bar display, column of bars

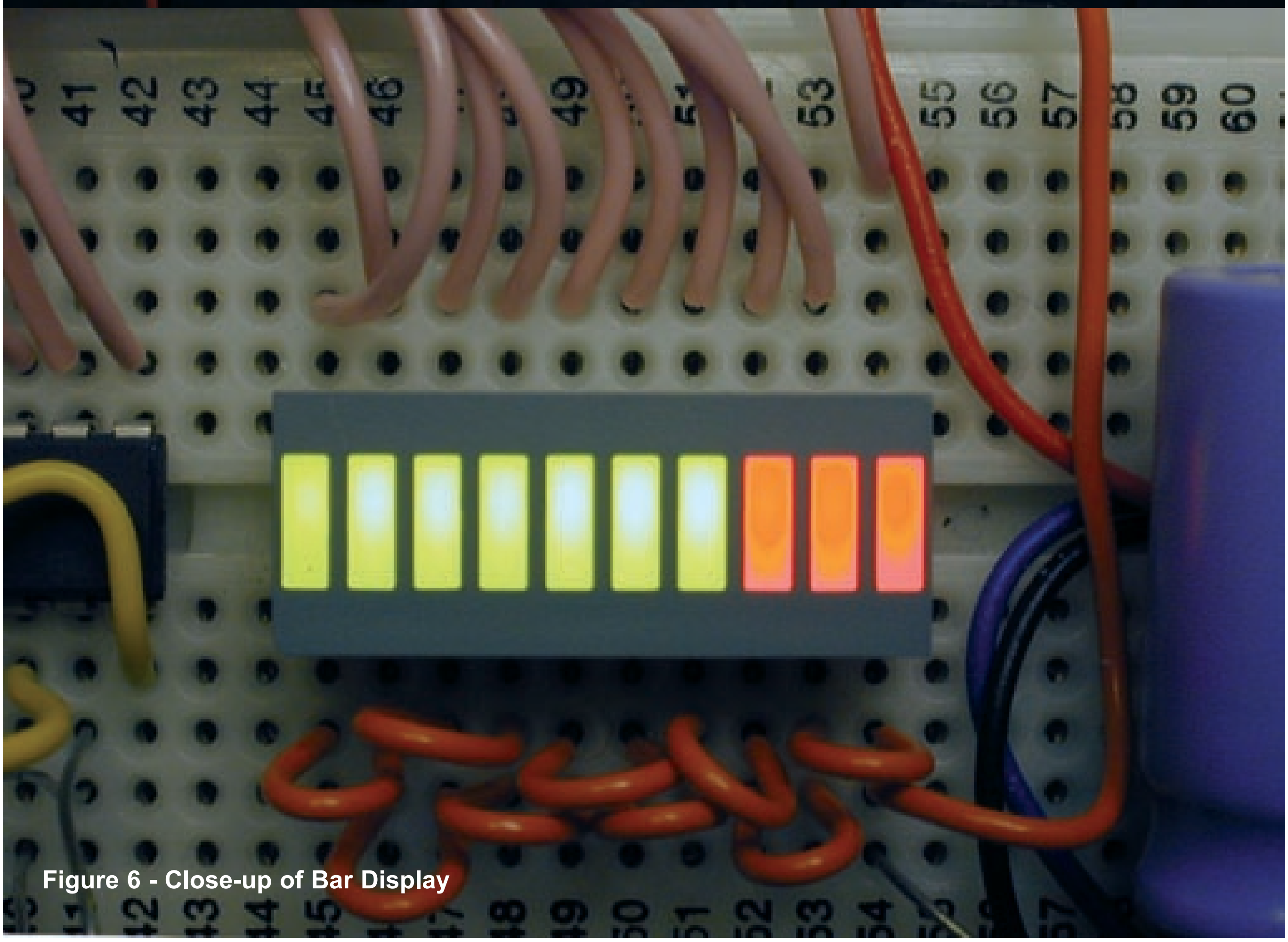


Figure 6 - Close-up of Bar Display

small positive bias voltage is provided by the voltage drop across D2 and the potentiometer RV2. In operation, RV2 sets the no signal condition to just below the illumination of bar 1 and RV1 the full scale with bar 10 illuminated. The relationship between signal level and illuminated bars is shown in Fig. 5. The accuracy is adequate down to about -30dB with slight errors below this.

The voltage across C4 is taken to the input of IC2. The 'attack', or rise-time of the display is quite short and the 'decay time' is about 0.3 seconds determined by R10 which is connected across C4.

On IC2, the display driver, R11 and R12 define both the current through each of the LEDs and the input sensitivity. With the values chosen, an input signal of +3.2 volts to pin 5 gives a full scale display (bar 10).

Operation

Connect the meter at the most appropriate place, for example, the audio input to the transmitter or the audio output of the receiver.

Calibrate the meter by setting RV2 so that under 'no signal' conditions, bar 1 is almost but not quite illuminated. Then, at the required level of signal, adjust RV1 for the appropriate bar to be illuminated. For example, you might set up your transmitter for full deviation and then adjust RV1 for illumination of Bar 10.

The circuit has only been constructed on a plug board so its susceptibility to RFI has not been checked. There are many web sites expressing strong opinions on average reading VU meters versus Peak Programme meters and how they should be calibrated. This level meter has been tested using a 1 kHz sine wave and is for general purpose amateur use.

References

[1] LM3915 Dot/Bar Display Driver
National Semiconductor
Application report
www.national.com/pf/LM/LM3915.html

[2] Detector and rectifier circuits
As above Figs 1, 2, & 3

[3] Precision rectifier circuits
IC Op-Amp Cookbook, Walter G. Jung
Howard W. Sams ISBN 0-672-22453-4 p.237

You're Been Served

By Richard L. Carden VK4XRL

A Simple Amateur Television Ident Server for home or repeater use

We are always looking for new projects to stimulate the ATV scene here in Brisbane, Australia. When surfing the internet one day I then came across an interesting article from Jean-Franci Fourcadie, F4DAY. He had an article titled "produce a Generator of video test-card using the SanDisk Viewer." This looked very interesting as it also could be used on a repeater site. I also had a 8Mb compact Flash card which was spare that came with my digital camera. As it happened a SanDisk Viewer was being sold on EBay, so now I had all the required parts to make up this project.

The first thing was to make up some idents using pictures I had, plus some test-cards to put on the CF card. The Idents and Testcards were modified using Photoshop where captions and call signs were added, also image sizing could also be carried out. With the software that came with the digital camera it allowed me to upload these images onto the CF card via the camera. Since starting this project I have required a card reader and writer which simplifiers the loading to the CF card. Having done this the next thing to do was to checkout the unit via the CRO and picture monitor. The pictures subjectively looked fine but the CRO showed a different story. The sync to picture ratio was appaualling. F4DAY does mention this problem and suggests changing R38 and R35, however no values are given.

R28 whose original value is 75r was in my case changed to 56r (this will effect the amplitude) while R35 whose original value is 150r was changed to82r (this effects the amplitude of the synchronization pulse levels). One problem with these changes is that the overall vision level is now only 250mv P/P (or thereabouts). What I then did was to feed this via a VDA using a very short cable left unterminated and adjusted the VDA for 1v p/p. The chroma amplitude is also a little low but this hasn't been a problem as my Panasonic AV5 mixer will compensate for this. Away around this is to use the S-VHS output and use two amplifiers one for luminance and the other for chrominance gain. Combining these will produce a composite output (note this hasn't been tried but the idea should work).

The composite project doesn't take long to get you up and running. The overall effort enhances the ATV output and therefore makes a very nice addition to the ATV station or repeater. Other units haven't been tried at this stage, however if anyone does please drop a line to the editor letting all know what problems you have had.

Lens to Lens- Part 1

By Brian Kelly. GW6BWX

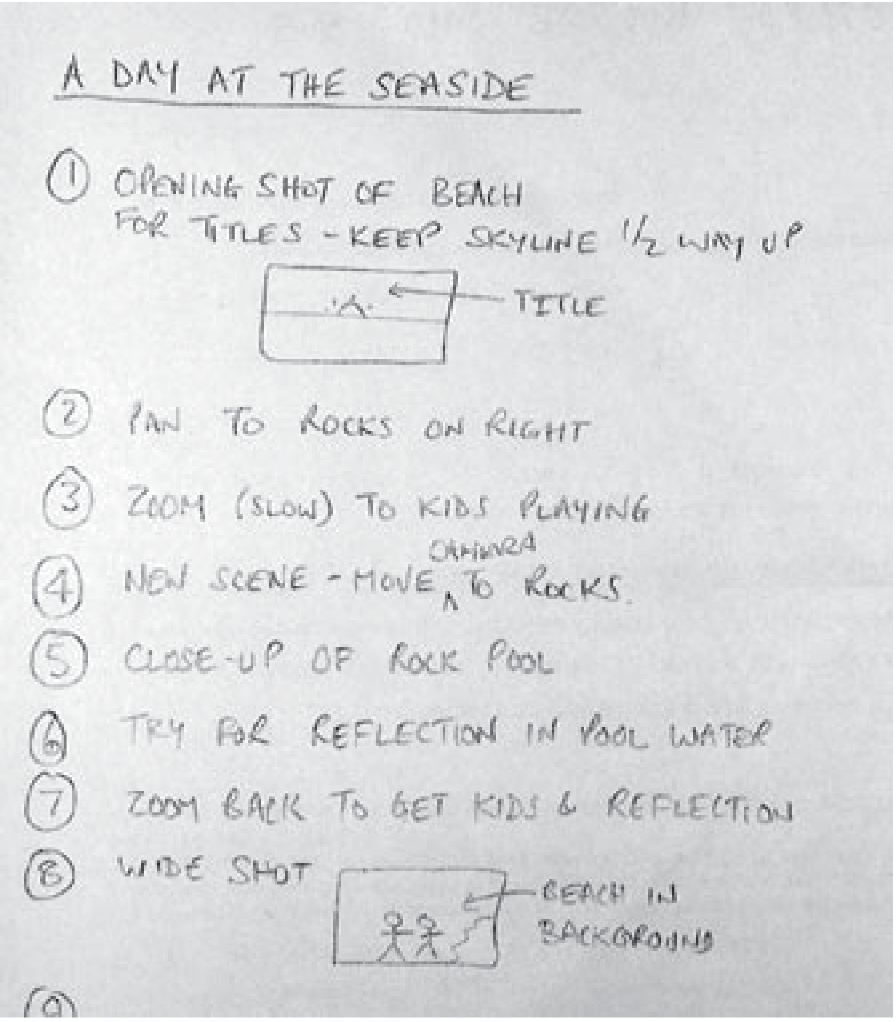
From concept to DVD, a flash of inspiration to flash of laser light

Ever watched a movie or TV show and thought 'I enjoyed that'? Afterwards, thinking of what actually made it good. Ever switched channel to avoid a programme knowing you wouldn't find it interesting? Ever thought of why, and what makes some presentations appealing and some disagreeable? In this series of articles I'm going to take you exploring and hopefully you will learn from my experience and from the tricks of the professionals, how to make eye-catching video and not sleep inducing monotony. Being technically minded, I'm not going to lecture on directing and producing without looking at why things are done as they are and how the limitations of equipment and media determine the outcome. It will be a mix of planning, organising, psychology and electronics – not easy to combine in a written article so bear with me if we occasionally wander off course.

Planning your production

Let me make it clear from the outset, when I mention 'production' I mean anything from shots of the kids playing in the garden to your epic 10-part serialisation of 'Lord of the Rings on Skateboards".

You should have an initial idea of what your production is about before going further. Some irritating people can just grab a camera and make a masterpiece. The majority, myself included, need to plan ahead and make first guesses at what will be needed in terms of location and equipment. What you need to establish from the outset is who will be watching your video. If you are filming your pet Tortoise for blind Aunty Maud to watch on her 5 inch portable TV, don't go for widescreen high-definition modes. On the other hand, if you are shooting for HD digital broadcast, put that single-tube VHS camcorder back in the bin where it belongs.



A simple storyboard. It's just a list of ideas and hints to guide you through the shoot.

Think also of the media your production will be stored and distributed on. If we sent out blue-ray, quad layer MPEG-4 video discs with this magazine, they may well contain 10 hours of state-of-the-art super pictures but nobody would have equipment to view them. Sending VHS tapes would grant a much wider audience but sacrifice the quality. As DVD is currently the most popular home media and can also meet broadcast quality specifications, that's what I'm going to concentrate on. VHS is now obsolete anyway, except for a few specialised needs; all VHS production worldwide has now ceased.

Incidentally, a DVD is a physical thing, it defines the shape and properties of a plastic ring. It has nothing to do with what is stored on it or in what way the storage is achieved. It's the container rather than the contents. There are many types of common DVD formats and it is even possible to use CD discs to store video. More of this when we get to the stage of preparing a disc for playing.

The basic steps to making any video production are:

- Plan
- Shoot
- Edit
- Record to media
- Distribute

Let us look at these in detail.

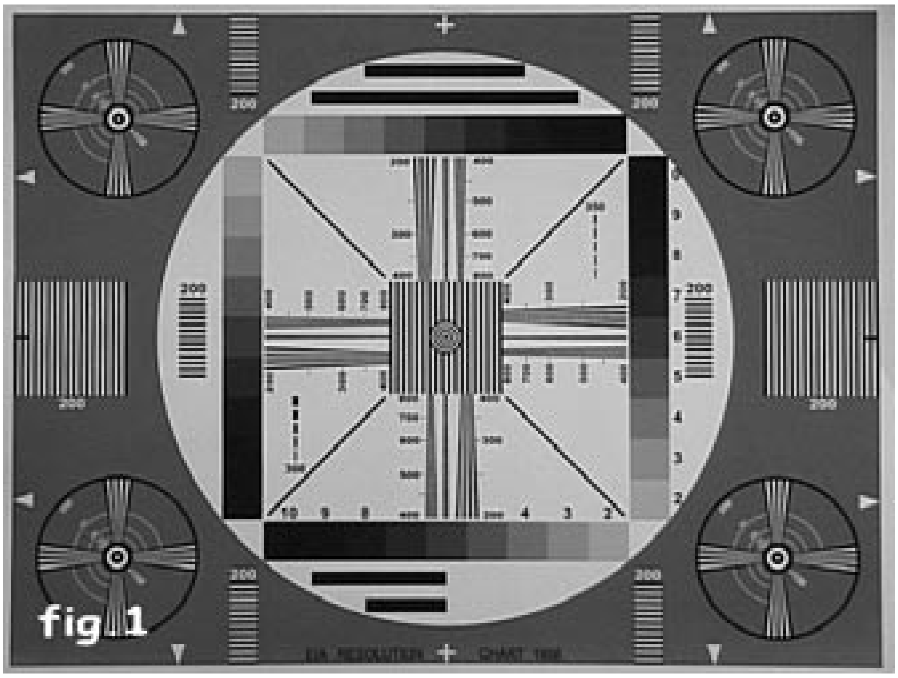
Storyboarding

This may seem like a trivial step that can be avoided to save time. My advice is spend more on this step than any other. Story boards are shorthand plans of your production. They can be entirely in the form of written notes or they can be sketches of the scenes you want to appear when shooting, usually, a mixture of the two are used. There are no rules about how you make them, they serve as hints to the camera operator and help you to group similar scenes together when more than one incidence of video from a location is needed. For example, there may be several scenes on a beach in your production but interspersed with scenes at other locations. By going back over the storyboard you can see how best to shoot all the beach scenes together rather than treating each of them in chronological order. The other advantage of storyboards is that they allow you to play around with the order of scenes, possibly adding to, or removing some of them to change the flow of the production. It is far easier to get it right in the planning stages than to go back and have to recreate scenes again on location when conditions may have significantly changed. At the shooting stage, it is vital to follow the storyboard instructions. It can be very tempting to make last minute changes or add an 'artistic bit' to a scene only to find it completely messes up the final production when all the shots are pieced together. A golden sunset in the background might look lovely on camera but doesn't slot in very well between two mid morning scenes!

Screen Format

Almost all professional video these days is shot in 16:9 (widescreen) format. The numbers are just the ratio of width to height of the picture, the actual units are irrelevant. It could be 16cm wide by 9cm high or 16inches by 9 inches, only the ratio is important. Older non-widescreen TV uses a ratio of 4 wide by 3 high and computer screens typically use 1.25 wide for 1 unit of height. It is important to know which format you are going to use for your final product as this effects every step from shooting to disc production. Probably the best format to shoot in is 16:9 as most TV sets and computers can be set to show the full picture in this mode, even if it means showing a border around it. A word of warning, some camcorders claim to be widescreen compatible, note the wording carefully. Being compatible with widescreen doesn't mean it actually is widescreen. In fact most 'compatible' cameras use a trick to scale the picture to fit the full area of a widescreen TV screen. They mask off the top and bottom of the picture, reducing its height, then add a signal top the tape to say it is a real widescreen picture. When played back, the picture size is expanded to fill the screen but at the expense of losing all the pixels hidden under the top and bottom masks.

From a shooting point of view, use 16:9 if possible but imagine a 4:3 box centred on the picture and try to keep any relevant action within it. Sometimes, drawing a 4:3 box on the viewfinder helps to show the compatible area. Most people watching 16:9 on a 4:3 screen will not see the area to the left and right of the box at all so avoid using it for anything other than background scenery and never let any action critical to your story fall within it. Computer screen format is close enough to 4:3 for no real problems to show so the same rules as for 4:3 should be followed.



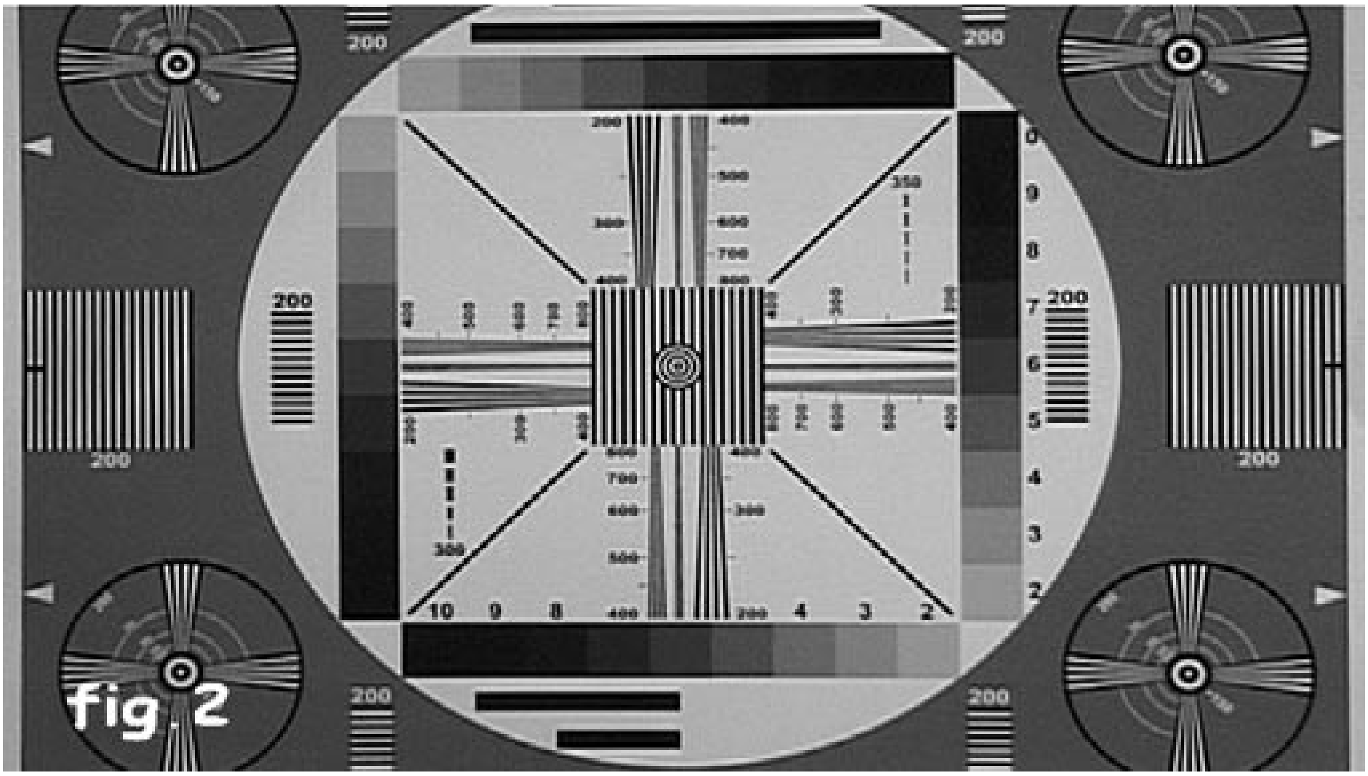
DV camera frame of a printed testcard. The testcard is 4:3 and the camera is set to 4:3. All the pixels are used and full resolution is achieved.

The distribution media should also be taken into consideration, DVD video is capable of telling the TV to be 16:9, 14:9, 4:3 and possibly others too. However, other types of video disc are used, particularly VCD in Asian countries and this does not allow all these formats to be selected. It does not stop them being used but it has no provision to automatically set the TV to the required mode. The view has to manually change the screen format if their TV allows it. For this reason 4:3 is more common on VCD. Because of the lower resolution of VCD pictures, it generally isn't satisfactory to view on widescreen by masking top and bottom out then stretching, the picture to fit as the individual picture pixels become annoyingly large. While on the topic of pixel size, the number of pixels across and down the screen depends on the TV standard being used, PAL or NTSC but the number is the same regardless of the picture being 4:3 or 16:9. When 16:9 is used, the pixels are elongated to make the picture wider, there are not actually any more there.

Access and resources

If your shoot is at home you should not have a problem with permission to use your camera but elsewhere you may need to enquire first. In fact, it is best to enquire anyway, a simple verbal request or letter will suffice and is rarely refused. You need to avoid the situation where someone recognises their property in your video and objects to it being shown to others. This is understandable if the property owner has had trouble with intruders for example and you are publicly displaying an advert for it to happen again. That letter could well save your bacon if an objection is raised and save you having to re-shoot again somewhere else. Other places to be aware of are near airports, military bases and government buildings. In these places the chances are that someone else's camera is trained on you and recording you recording them!

If your production requires specific lighting conditions, make sure that you can provide and sustain them. Using floodlights, spotlights or any lighting indoors will generally give a constant amount of illumination and from the same direction. If your shoot is outside though, and especially if using only natural light, you need to be careful that the amount and direction of the light will remain steady for long enough. Our eyes have a wonderful ability to adjust to different lighting conditions but cameras are annoyingly honest about what they see. For example, we



Exactly the same testcard and camera position as fig.1 but with the camera set to 16:9 mode. The picture size is correct but note that the top and bottom of the image are cropped. Because the cropped area is missing, the remaining pixels have been stretched to maintain the picture size. Fewer pixels implies lower resolution.

perceive items to be the same colour when viewed in daylight or artificial light but a camera would see things tinted blue or yellow under the same conditions. If you want to see how much we adjust our eyesight, try pointing a camera at a colourful object such as a flower and flick the white balance switch between its different settings, the amount of compensation the camera adds is amazing. If your shoot is likely to take more than an hour or so you may need to take into consideration that shadows will have moved. If this is the case, you may do well to shoot over more than one day so similar lighting directions can be expected. Keep an eye on the weather forecast if you do this or you may find your shadows have disappeared anyway!

Most shoots will need at least two cameras. You can manage with one but it is far more difficult to keep sound and picture in sync when shifting from one view to another. Take for example the classic TV dialogue between interviewer and interviewee, unless you can persuade them to freeze while you move the camera from looking at one face to the other, you will have a discontinuity. Nobody wants to see the effect of the camera swinging about and re-focussing because it distracts from the topic of conversation. What you would typically do is use two cameras, one trained on each person but only use one sound track. The sound could be from just one of the cameras or a mix from both or could be from a separate microphone. The sound would eventually run all the way through while the video would cut from one camera source to the other. The last thing you want is different background noises and tonal quality as you switch camera scene so keep to the same sound recording throughout if possible. If fixing is necessary to mask sound problems or align lip-sync it can be done at the editing stage which we will be visiting later.

For static shots always use a tripod, even with the ‘anti-shake’ facilities on newer cameras you still see some movement. There are two kinds of anti-shake cameras, one uses a mechanical damping system that actually moves the CCD and/or the lens structure so it can move independently of the camera body. The other system uses electronic compensation where the corner coordinates of the image are moved so the window they define appears to be stationary. The latter system often gives poorer performance, both because it sometimes misjudges which parts of the picture should and should not be in motion and because they ‘steal’ pixels from the image border to allow the slightly smaller visible window to move within the full sized picture.

If tripods are not appropriate, for example when the camera is travelling or is being used where the ground is too uneven, try to make it as heavy as you can manage. This may sound crazy when manufacturers strive to make cameras as lightweight as possible but the extra mass will dampen any sudden movement very effectively. Remember though, that the accessory sockets and mounting screw have limited strength so don’t hang house bricks on the headphone jack!

Finally, don’t forget the human element, two cameras probably need two cameramen!

Choice of camera

You don’t have to look far to see adverts for cameras and camcorders, all the daily newspapers and magazines are full of them and they all claim to be best. To some degree the claims are probably true, some cameras are best at some jobs, others are better at other jobs. What you need to decide is which has all the facilities you need for your productions and of course which is within your budget. What certainly is true is that most new camcorders, even at the budget end of the scale, surpass the quality of professional cameras of only 5 or 6 years ago.

Some cameras record to tape, some directly to DVD media, let's look at the pros and cons of each of the common types.

VHS – awful definition, poor colour rendition, poor sync stability. About 240 lines of resolution. Not a lot going for it really.

SVHS – records chroma and luminance signals separately which greatly improves resolution and colour quality. Resolution increases to about 400 lines. Tapes are fairly expensive.

VHSc and SVHSc – the same as VHS and SVHS in terms of quality but in smaller cases and with shorter running time.

Beta – plagued by so many different and incompatible types. Good to excellent quality, bulky tapes and expensive. 'max' and low band formats give about 350 lines of resolution, high band gives about 500.

MiniDV – digitises the picture and records the numbers. Excellent quality, small and very inexpensive tapes. MicroDV is an even smaller variant of the same system. Around 500 lines of resolution.

DVCAM – exactly the same recording method as MiniDv and MicroDV but uses a larger tape format with wider recording tracks to make drop-out less likely. This is probably the most widely used professional format at the moment.

DVD – excellent picture quality, media costs pennies. A serious drawback though is that they compress the picture using MPEG2 technology. This maximises the recording time but makes the resulting video very difficult to edit afterwards. Resolution depends on picture content but around 400 lines.

The type of imaging device plays a large part in the picture quality. Older vacuum tube types tended to give poor quality and suffered colour drift as the three tubes aged at different rates. They also tended to suffer from 'ghost' after images and trails following bright spots in the picture. Thankfully, most of these cameras have been 'retired' from service; I have seen them on sale for £5 and nobody taking interest in them! Later cameras use CCD (Charge Coupled Device) sensors that are much smaller and give dramatically better results. The issue now is whether to use a single CCD camera or a three-CCD camera. A camera with a single CCD uses a striped colour filter in front of the sensor. The stripes are arranged so they filter out unwanted colours from the image before the light falls on the sensor surface. One stripe passes red colours, one green and one blue. The area on the CCD chip on which each colour lands is electronically routed to the appropriate colour processing circuits. In a three chip system, instead of seeing each colour through a striped filter, the whole image is split and passed through optical filters, each allowing only one colour through to one of the CCD chips. This system gives better definition as the image isn't divided into three regions on one sensor but one region on three sensors. The downside is of course three times as many CCDs and processing circuits are needed so the cost is much higher. In my own opinion, the better quality is worth paying for.

No matter how many CCDs the camera has, they still have to be scanned to read the light levels focussed on each pixel of the chip. Two scanning methods are used, progressive scan and interlaced scan. Normal TV pictures are interlaced, that is, the even numbered lines and odd numbered lines are scanned alternately. Computer screens normally are progressively scanned, meaning all the lines are sequentially scanned from top to bottom of the picture. Mixing the two can give strange results. If you view progressive on an interlaced system and vice versa you see an effect rather like the teeth of a comb to the sides of moving objects. The teeth are on alternate scan lines and are caused because of the time delay between the odd and even scans of the CCD. Even at 50 or 60 scans per second, there can be significant movement in the target object between scans. When viewed on the wrong system, the image from the odd and even scans are displaced by the amount the target moved. When it is necessary to use the other scan system there are usually options to counter the effect. The simplest way is simply to discard either the odd or the even scan lines and duplicate the other ones in their place. It halves the vertical resolution but is still more pleasant to the eye. Most professional cameras use progressive scan so they are compatible with computer displays and high-end editing facilities. It is easy to convert progressive scanned pictures to interlaced ones for TV use but difficult to convert the other way around so being more versatile, progressive scan is the preferred system.

Regardless of how the picture is stored in the camera, you still have to be able to transfer it somewhere else to be edited. On most cameras there is a video and audio output which can be connected straight into a TV set. While this could be very useful for monitoring your shot on a bigger screen and listening to your audio on headphones or through an amplifier, it isn't really satisfactory for recovering your shoot so it can be edited or even viewed at home. The reason is simple, the playback is analogue and will be encoded into NTSC or PAL composite video format which limits the usable bandwidth. In the 'capture' process where the video is transferred to the editing facility, the encoded signal has to be decoded back to colour and luminance information, further limiting the bandwidth and adding other undesirable conversion effects. The solution to the problem is not to use analogue at all, use DV format whenever possible. Many models of DV cameras are available and as their popularity grows, analogue formats are being squeezed out of the market. DV, being digital is not compromised by the effects of tape drop-outs (unless very severe) and is relatively immune to minor tape transport variations, the effect that causes noise bands and pulling on VHS tapes. When it comes to transferring DV to computer for editing there are two choices, USB and IEEE1394 (also known as "i.Link" and "FireWire"), both connect by a thin cable. USB comes in two types, plain USB and USB2, the original 'plain' type is unsuitable for serious video work as its data carrying speed is much lower than needed for anything but the lowest quality video. USB2 does work fast enough for good quality video but the best performance comes from the IEEE1394 interface. This is the one to look for if you are buying a new camera or camcorder. Newer Apple computers have IEEE1394 sockets built in to them, on PCs, an extra card will usually have to be fitted but these only cost about £10. Incidentally, there is absolutely no difference in quality whatsoever between cheap and expensive IEEE1394 cards so go for the lowest cost one you can find.

When shooting at home, power your camera from a mains adapter if possible. Before doing any serious filming though, make a short trial video of a plain mid-grey background and under quiet conditions to make sure you do not have video hum bars or sound buzzing. You will see these when playing the tape back more than when recording. If you are using a computer to edit your video, try playing back into the computer beforehand too because sometimes a ground loop can be created through the cables and this can also cause hum problems. Running from batteries will of course remove any possibility of ripple in the supply voltage but do be careful that you have enough power capacity to complete your work. Older cameras used Nickel-Cadmium batteries which had an annoying tendency to work fine then suddenly go dead without warning. Lithium Ion batteries are much better at giving warning before dying and often, inside the battery casing, a small monitoring circuit checks the remaining power level and reports it back to the camera. Don't do what I did once – make a whole recording with the battery level icon superimposed on the picture !

Going back to the visual aspect of shooting, most cameras have evil functions in them called 'Automatic Level Control' and 'Automatic White Balance'. These are fine and can be useful if you have to shoot without prior setting-up, for example if you spot something unusual and just have to capture it quickly. For more serious work, turn these off and manually set the levels for best results. In the next article we will look at the optimum way of setting up the camera or cameras to make sure they give similar colour renditions.

Only the most expensive cameras have interchangeable lenses but virtually all cameras have the ability to have lens filters or adapters fitted to them. A tele-adapter giving x2 zoom and a wide-angle adapter are useful additions to your camera kit. These lenses are quite inexpensive and simply screw on the front of the cameras existing lens assembly. Mine uses a 52mm diameter mount which means I can use some of the filters and lenses from my stills camera. Beware of an optical effect of using adapters; you can sometimes chop the corners off the picture while zooming. It happens when the viewing angle takes in the edge of the lens mount. There's little you can do to stop it so get to know the point the corners will disappear and don't go beyond it. Remember too that the viewfinder on the camera often doesn't show the extreme edges of the picture so the corners may be chopped out slightly sooner than expected.

Never, never, never, never even dream of thinking of using digital zoom. Some cameras on the market boast of as much as '800x digital zoom' as though it is something to be proud of. When you consider that PAL format has the highest resolution at 720 wide by 576 pixels high, if magnified 800 times you get less than one pixel filling the whole screen! There is only one way of retaining all the pixels, and hence highest resolution, while zooming and that is to do it optically.

Earlier we looked at the cheating way of making 16:9 widescreen pictures from 4:3 by masking the top and bottom off the picture. In other words, not really making the picture wider, just making it less tall to get the right aspect ratio. Although the resulting picture fills the screen, some of the definition is lost because we are now enlarging a smaller picture by making the remaining pixels bigger. The real resolution changes from 720x576 down to about 720x405 and the screen is magnified by about 1.4 times. There is a way of preserving the full resolution but it is very expensive. The trick is to use an 'anamorphic' lens that sees the wide picture but optically squeezes it so it appears narrower. Now, the full widescreen shot can be made narrow enough to fit in the 4:3 frame and all the pixels are still being used. Of course, if you view this through the viewfinder or play it back on a normal TV, everything looks too thin but if you view in widescreen, the pixels are stretched horizontally to normal width again. Clearly this is a better way of shooting a widescreen picture but the lenses can cost almost as much as a new camera. If anyone has an unwanted anamorphic lens for a Sony TRV900E and is feeling exceptionally generous – please get in touch!

The next article in this series will look at transferring shots from camera to computer and some of the ways they can be edited together to produce a complete presentation.

ATV Repeater Update – December 2005

By Grhah Shirville - G3VZV

After many months of almost no movement, we have, in the past 6/7 weeks received a number of NOVs (Notice of Variations) for some of the long outstanding applications.

The latest ones include

GB3BH – Bushey Heath – additional 10GHz input and output

GB3TZ – Luton - additional 13cms DATV output

GB3ZE – Barnsley – new 13cms repeater

Currently the stats show that we have :

23cm TV Repeaters	29
13cm TV Repeaters	12
3cm TV Repeaters	10

The most up-to-date and accurate data can always be found on the RSGB Repeater Management Committee (RMC) website: http://www.coldal.org.uk (These 2 maps are from their site)

This month also sees the most fundamental change in the organisation of repeater approvals in the UK since the first ones appeared over 30 years ago. Since that the time the RSGB has worked with, firstly the Home Office, then the Radio Communications Agency and latterly with OFCOM to facilitate the organisation of the repeater network on the various bands and modes. They have had the RMC for many years and have also provided staff to manage the applications for new units and the NOV renewals for existing units. They have also overseen an insurance scheme for the groups which had set up the various units around the country.

In the past few months it has become obvious that OFCOM wanted to take this organisational role "in house" and indeed this is what will come to pass since January 1st 2006.

OFCOM issued this notice just before Christmas:

Notice of variation to amateur radio licences

From 1 January 2006 Ofcom will take over the administration of amateur radio licences.

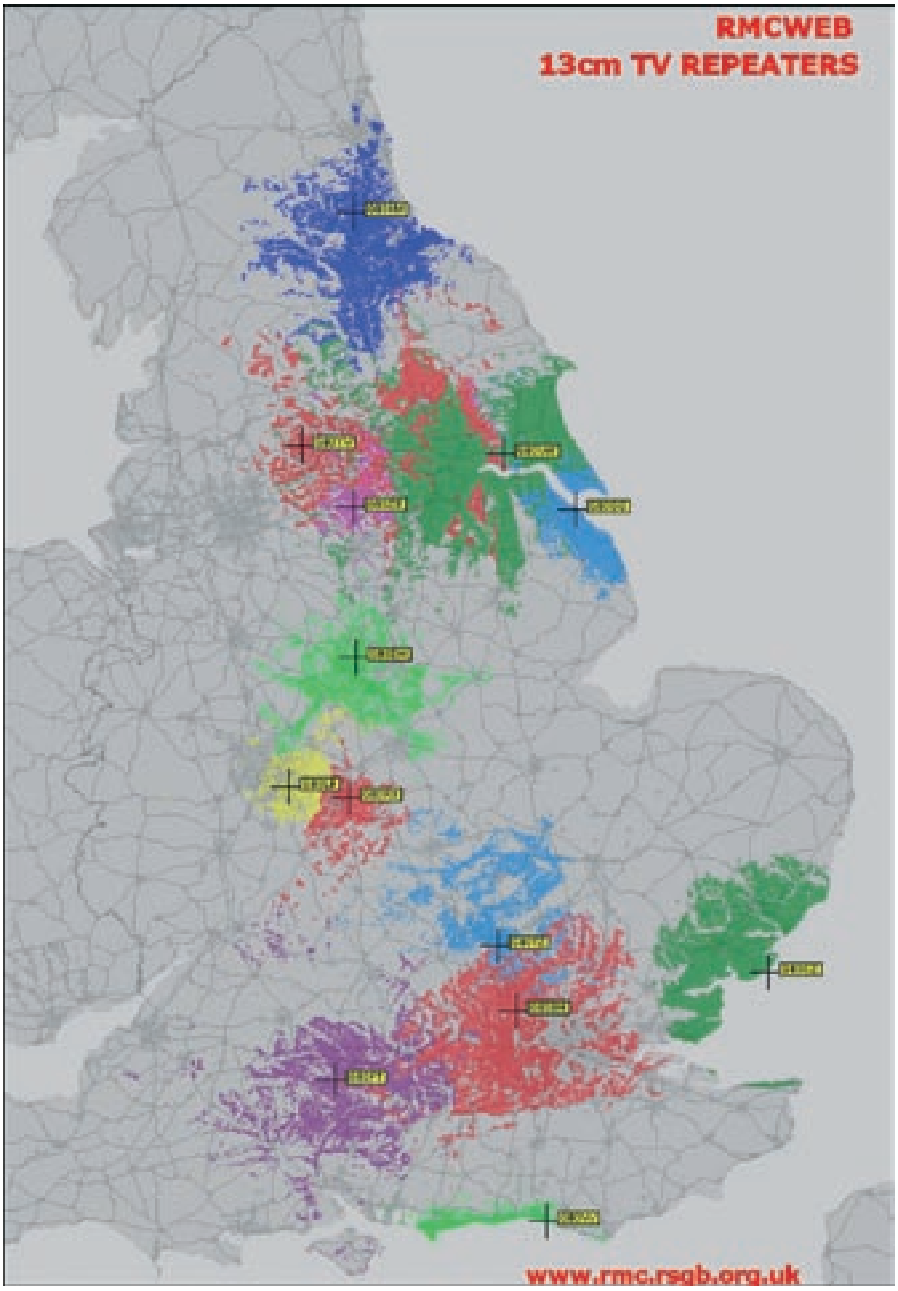
Ofcom strives to seek a balance between providing radio amateurs with the freedom to innovate and experiment whilst maintaining a sufficient level of regulatory control to ensure the most efficient use of radio spectrum and to protect radio spectrum users from interference.

Therefore, those licensees who wish to alter the terms of their full, intermediate or foundation licences by means of a Notice of Variation (NoV) should contact Ofcom at:

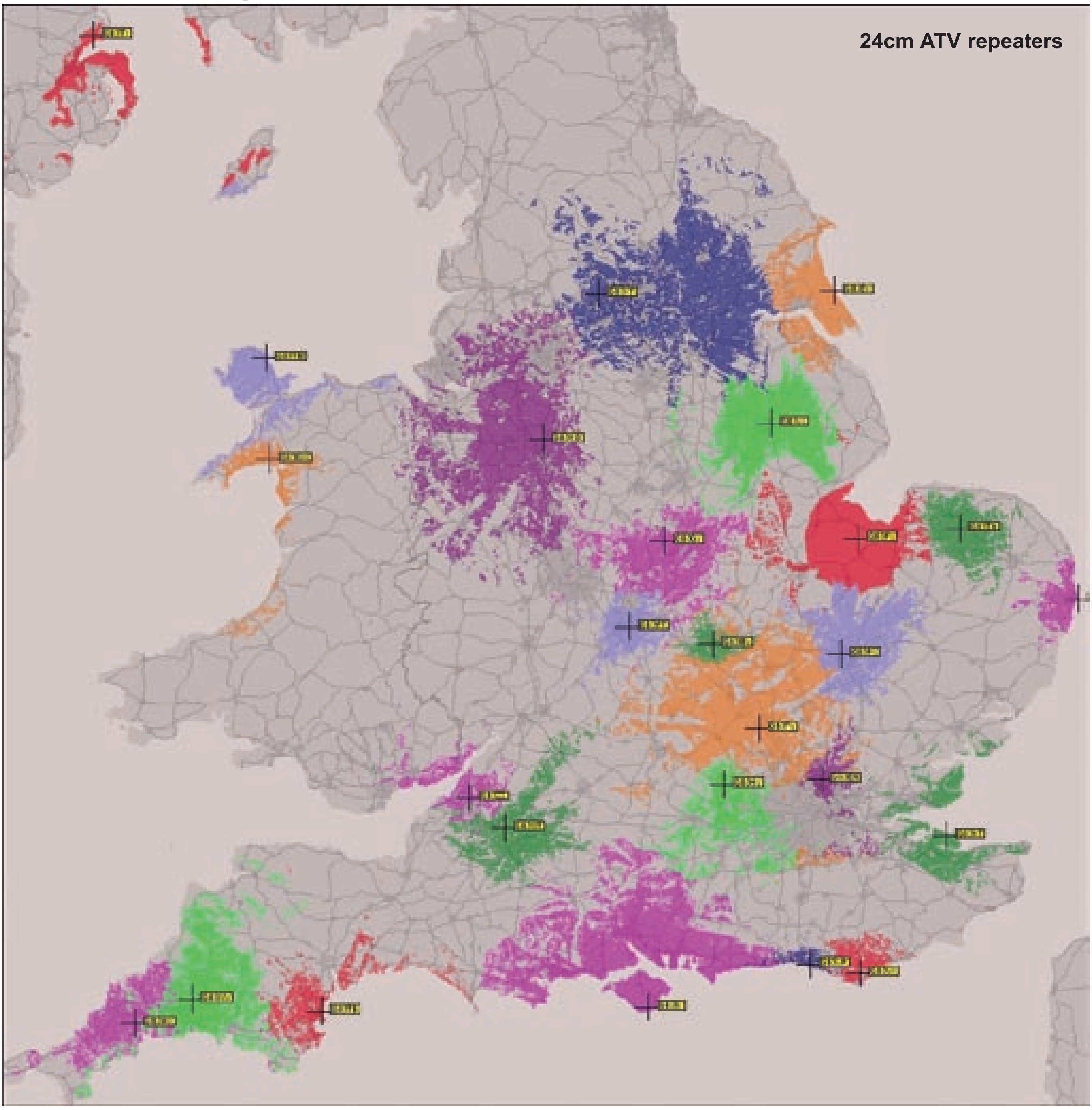
Amateur Radio Licensing
Ofcom Contact Centre
Email: amateurcb@ofcom.org.uk
Tel: 020 7981 3043
Fax: 020 7981 3333

One member of the RSGB staff is transferring to work at the OFCOM HQ so this should assist in minimising any disruption to repeater groups in the short term. It is anticipated that the RMC will also continue to assist with the development of new repeater systems and standards and provide an interface for the groups.

So if you are intending to apply for a NOV to operate an ATV repeater within the next few months, or already operate one, then you will need to understand these changes and be ready to pay in the future…….



Obviously I hope to be able to continue to help groups in their efforts to establish a useful network of ATV repeaters and if you have any questions please email me at g3vzv at amsat.org but please check the RMC website as detailed above first!



Subscription Rates

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

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

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

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

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

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

Turning Back the Pages

By Peter Delaney

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

CQ-TV 27 - "Winter 1955-6"

CQ-TV 27 was the first to have the covers printed with photographs - on the cover. The front included Grant Dixon, with his colour atv equipment, whilst on the back was Ivan G2DUS/T - 'adjusting the monoscope panel, above which are the mixing and RF panel'.

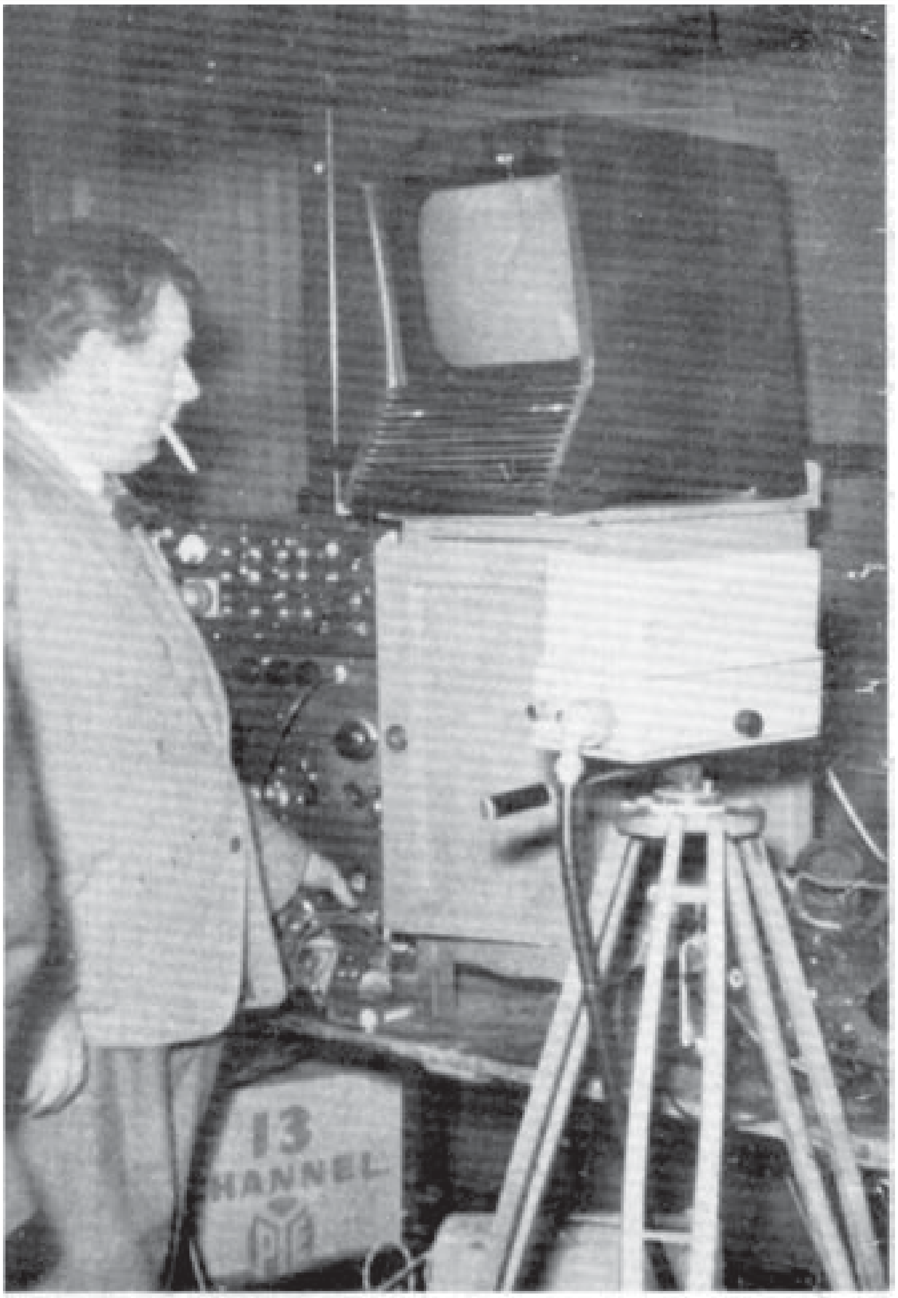
The Editorial page reviewed the Club stand at the 1955 RSGB stand, when Ivan Howard and Mike Cox 'did a fine job'. "Whilst the equipment was not so complex as last year ... no doubt this was something of a relief to the non-BATC visitors who can easily be put off by the sight of large numbers of valves apparently doing very little"

There were several 'technical' articles. The "Beginner's Page" began "Although most BATC members will have had lots of experience with wiring TV gear, perhaps a few notes will not be out of place). (the principles may help the current newcomers to ATV).

Remember that in TV circuits you are often trying to pass frequencies from DC to 5, 10 or possibly 20 Mc/s even, that is, right up into the medium radio frequencies. The circuit must therefore be laid out and wired in such a way that the balance of these frequencies is not altered in any way.

At zero (D.C.) and low frequencies, troubles arise in such things as the power supply. The reactance of the output smoothing condenser rises as the frequency decreases, causing motorboating and the like. The power supply should have at least 100 mF across it, or better still be electronically regulated. To pass LF waves without tilt, coupling condensers must have a very high leakage resistance; mica or good quality paper condensers should be used, but not normal electrolytics. To maintain accurate time constants, resistors may require to be high stability.

For the HFs, proceed as if designing an RF amplifier for the maximum video frequency, eg: screen stages, decouple heaters, run the heater wiring outside



the chassis, decouple all stages, etc. Due to the low gain per stage in video amplifiers (because of bandwidth considerations), these precautions are not always observed, but care must be taken to keep input and output leads well away from each other.

Any RC combination is 3dBs down when CxR= 1/2pf . In a normal video amplifier, R is the anode load, and C is the sum of the valve capacities plus the STRAY wiring capacities. Thus keep the input and output leads well away from earthed objects, and keep these leads short. Keep the coupling condenser away from the chassis, and NEVER cableform video leads at high impedance.

The valves used in video work often have a high Gm. They will therefore oscillate at the slightest opportunity, often at a very high frequency. Keep grid and anode leads SHORT and direct, and apart. Any grid or anode lead longer than 2" should be stoppered with 47 ohms right at the valve pin. Keep the components grouped around the valves; wire up as directly and as shortly as possible. Nothing except DC or low impedance wires should be of any length, or cableformed.

Take care with choice of components: inductive resistors and condensers, capacitative coils, almost anything running even slightly warm, all conspire to upset things. SO THINK. Beware

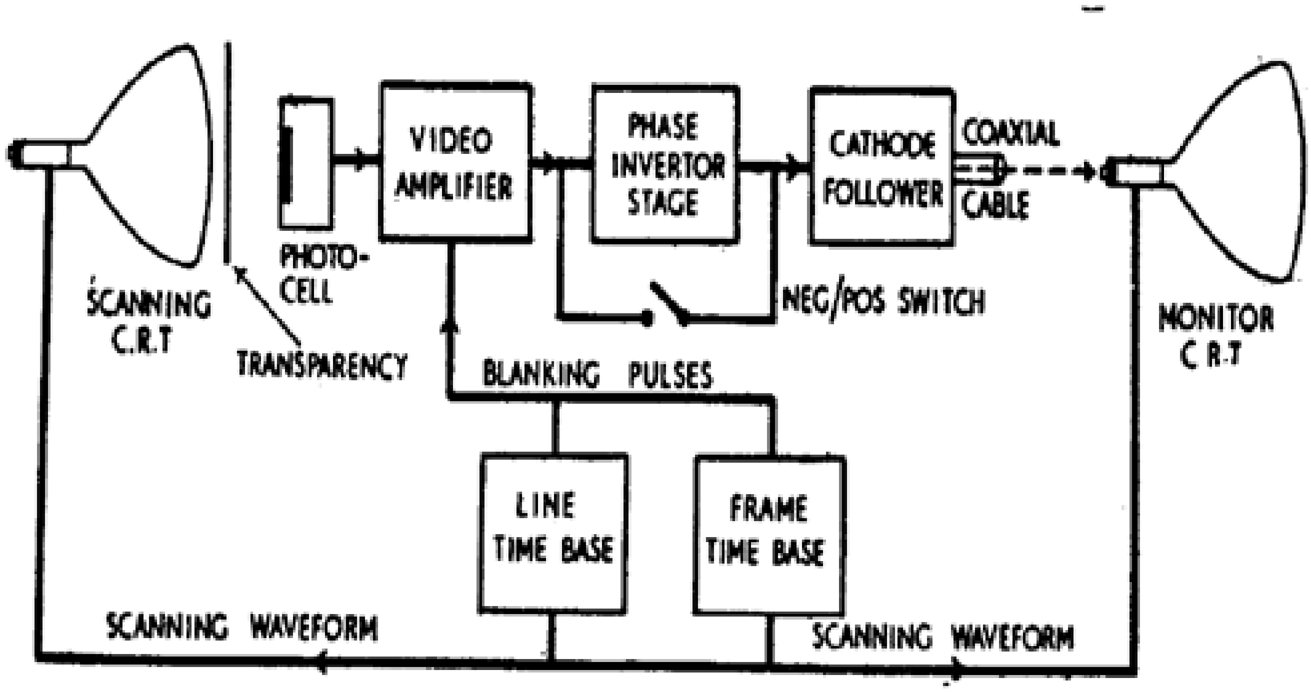


Figure 2

2/2: Block diagram of a complete FSS system

of paxolin valveholders, ceramicon condensers with high temperature coefficients being heated by circulating RF, noisy potentiometers, pick-up of broadcast programmes or hum on wiring or unscreened chassis, and interaction of valves not fitted with screening cans. Under-run high-stability resistors are less noisy in low level stages than normal types such as Erie type 8."

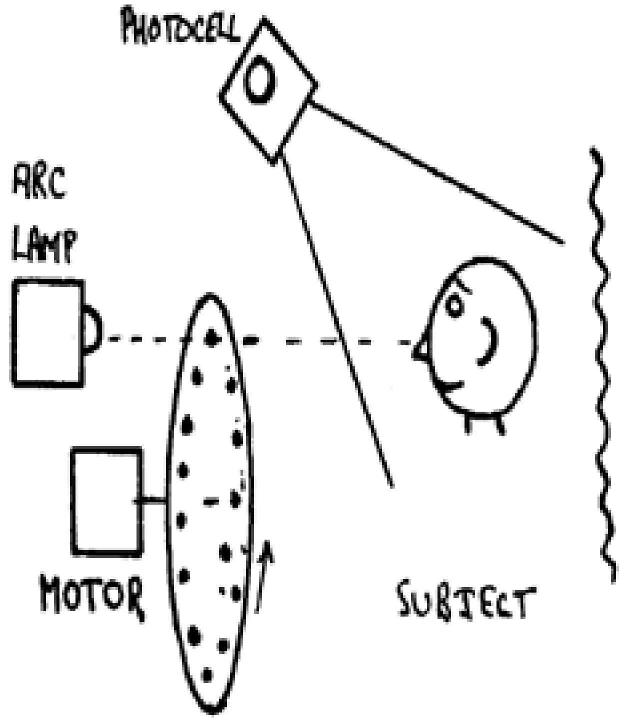
Another article was aimed at helping members get started - at a time when no suitable equipment was available 'off the shelf' for amateur television.

One of the simplest, cheapest and yet most satisfying pieces of ATV equipment is the Flying Spot Scanner. Far a very modest outlay, quite good pictures can be televised, whilst a really good scanner will give results which cannot be bettered by the best live camera. Highly economical in construction, a Flying Spot Scanner is an ideal unit with which to start on Amateur Television.

The Flying Spot Scanner originated in the earliest days of television, when a flying spot of light projected by an arc lamp through a rotating Nipkow disc scanned the scene to be televised, the reflected light being picked up on a photoelectric cell (Figure 1). By using mirrors instead of discs and with various other improvements, the Flying Spot Scanner (FSS) was in regular use until the coming of high definition all-electronic TV in the mid 1930s. The greatest snags were in the mechanics, for high definition working, although for some years the process was popular for film scanning.

The biggest step forward was the use of a cathode ray tube rather than the lamp-plus-scanning device formerly used. Spot size was the only factor governing definition, and once flat faced CRTs with the right phosphors

Figure 1



: Early mechanical Flying Spot Scanner.

were developed, Flying Spot Scanning came to stay. At the present time, FSS is mainly used for televising slides and captions (tele-still), cinefilms (telecine) or in specialist applications such as Flying Spot microscopes; there is also a suggestion that high intensity CRTs could be used for studio work in colour with advantage. We shall discuss the two main amateur applications only, that is telestill and telecine working.

Figure 2 shows the main units of' the complete Flying Spot Scanner, and we shall now go into some details.

The function of the scanner tube is to produce a blank raster of constant size and brightness, and to this end it should have the following properties:

(a) a bright, finely focussed trace over the whole raster;

(b) a spectral output that matches the photocell in use;

(c) a flat face of constant glass thickness;

(d) a phosphor free from blemishes or coarseness;

(e) linear time bases ;

(f) stable power supplies;

(g) an extremely fast phosphor decay time.

To these might be added the amateur requirements:

(h) a reasonable price;

(i) reasonable HT and scanning requirements.

Of the above requirements, (g) is certainly the most important. This will be understood it one considers what the photocell sees at any time: the spot of light on the CRT (modulated by passage through the optical system) together with any residual light from the rest of the CRT screen, in particular those parts that have just been scanned by the beam. Any finite decay time has the effect of decreasing the resolution or definition of the picture. The decay can be compensated by electrical means in the amplifiers, but such compensation must be kept low to prevent noise becoming excessive in the picture.

Specially designed CRTs for scanning are available from several manufacturers, in the price range £10 and upwards. These have decay times in the order of fractions of a microseoond, and the desirable features listed above. Far amateur use, blue trace oscilloscope tubes are quite satisfactory since these also have a fast decay time. Unfortunately they do not always have a flat face, and the EHT on them must often be increased to obtain enough brilliance, but they are reasonable in price.

There are also a number of Government surplus tubes that can be used, (which werewere then listed) or these, the most popular is the 5FP7 electromagnetic type.

A Good Year - from GW8PBX

We're all gradually taking aboard the digital television revolution, throwing our trusty analogue tellies in the bin or littering the lounge with add on boxes – as with the Band III converters of the 405 era.

There is however something far more sinister afoot – something that means we will all probably have to change our cars over the next few years.

Rumour has it that a new emerging technology is being tested on the roads of North Wales. The days of the analogue tyre are numbered as the new improved digital tyre is introduced in 2006.

A government sponsored trial maintenance terminal has been installed at the local Bangor Tesco forecourt to cope with these new devices. (See photo)

There is not much technical detail available yet. Compression will be used but Forward Error Correction is user selectable, and the whole system is nearly Free to Air.

Despite much pioneering work using transistors and FETs, the much respected and trusted valve technology will be retained – the wheel has come full circle, giving a fine balance between old and new technologies.

Prices are not yet available but will, no doubt, be linked to the continuing pressure of inflation. I'm sure we'll brace ourselves for this new technology in the true spirit of Amateur Radio when it is rolled out in 2006.

The Alford Slot

By Ian Waters G3KKD.

The Alford slot antenna will be well known to readers of this magazine as it is used frequently for TV repeaters. The basic design was developed by G3JVL and published in the RSGB Microwave Handbook Volume 3 (section 14.4.8) and no doubt elsewhere. It provides a horizontally polarised signal with a fairly circular horizontal radiation pattern (HRP).

I recently became involved in making one of these for the Cambridge 23 cm repeater GB3PV. The one that had been in use for some 18 years was suspected of malfunction as the signal received at my QTH was some 11 dB below normal. It was thought desirable to have a replacement available before arrangements were made to climb the tower. Ted G7NCG made a new antenna, essentially to the JVL design, which was then brought to me to measure its VSWR. I am fortunate in having a frequency sweep and rhotector and also a reflected power meter for 23 cm. Unfortunately the VSWR was not very good so I was asked if I could improve it.

Matching

I improved the match by resorting to the following expedients:

I suspected that the semi-rigid line that had been used for the balun and the connection to the bottom of the antenna was not actually 50 Ohm. Semi rigid line is available in many impedances that all look alike and it is very difficult to tell them apart either by measurement with a micrometer or electrically. I therefore purchased a length of known 50 Ohm line from Grant at G H Engineering and made a new balun etc.

As the antenna then appeared to be inductive, the next improvement was made by fitting a small capacitor across the feed point of the slot. This takes the form of two copper plates each 4x6 mm separated by about 2 mm. The exact value can be adjusted by bending the outer plate to vary the gap. The arrangement can be seen in drawing 1.

The third stage of improvement was made by fitting a variable matching section just below the active part of the antenna. It consists of a 150 mm (6”) length of roughly 50 Ohm line formed from a 6.35 mm (1/4”) copper rod inside a slotted copper tube, a piece of 15 mm water pipe, with a 13.2 mm internal diameter. A slug in the form of a cylindrical piece of PTFE can be slid along the line to provide capacitance at the necessary point. For convenience the matching section was fitted with N connectors, the lower one of which connects with the main feeder. The constructional details can be seen from drawing 2.

By carefully juggling these two adjustments it was found possible to obtain a good match. As with most things in engineering, the setting of the slug is a compromise. It could be set to give a VSWR of about 1.2:1 from below the input channel to above the output channel. However I opted to optimise the VSWR to be virtually perfect at the output frequency +/- 6 MHz. This was at the expense of the input, which seems less important. A plot of VSWR against frequency is shown in drawing 3. It is easy to get hung up on numbers when considering VSWR. One has to remember that a fairly poor VSWR of 1.5:1 is less than 5% reflected power. This would matter if we were running say a 100kW broadcast TX as something would be

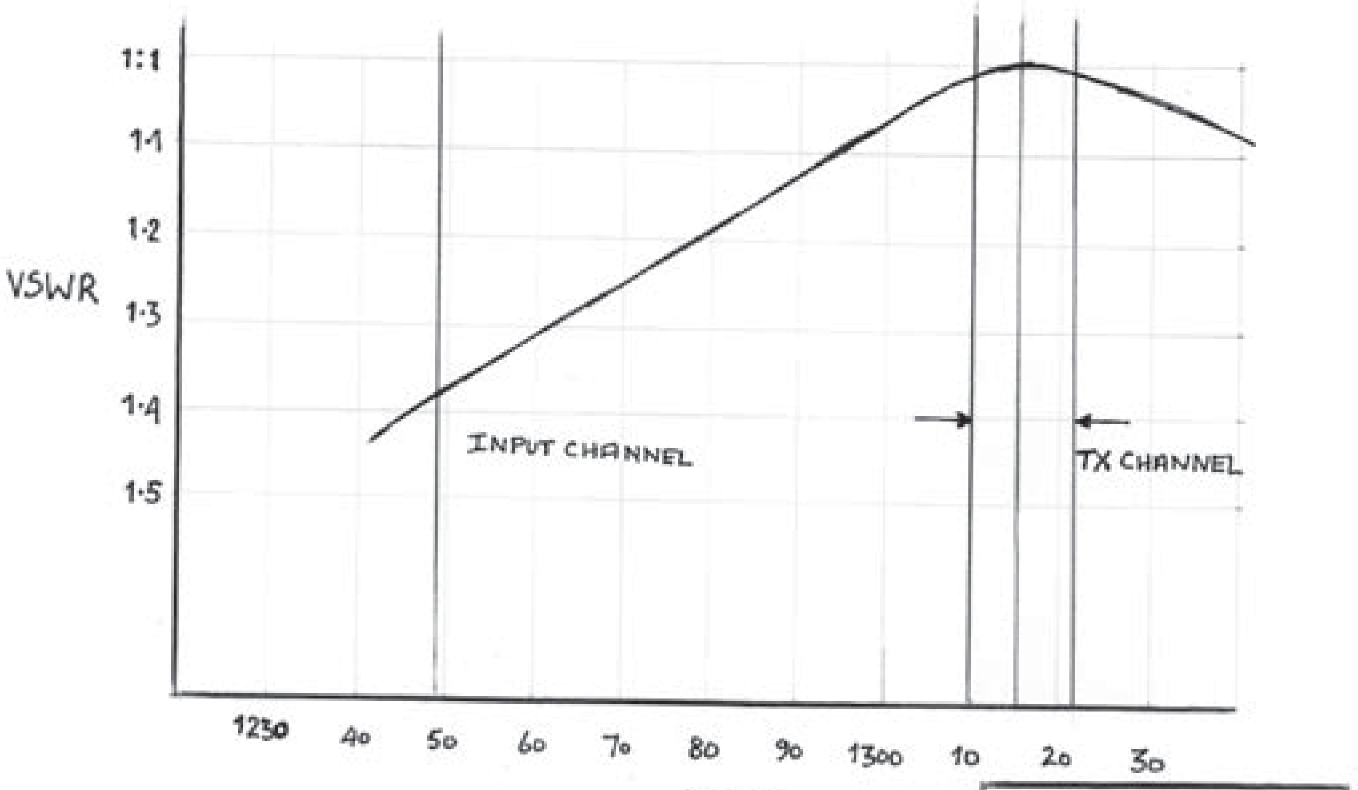


Fig 3 VSWR

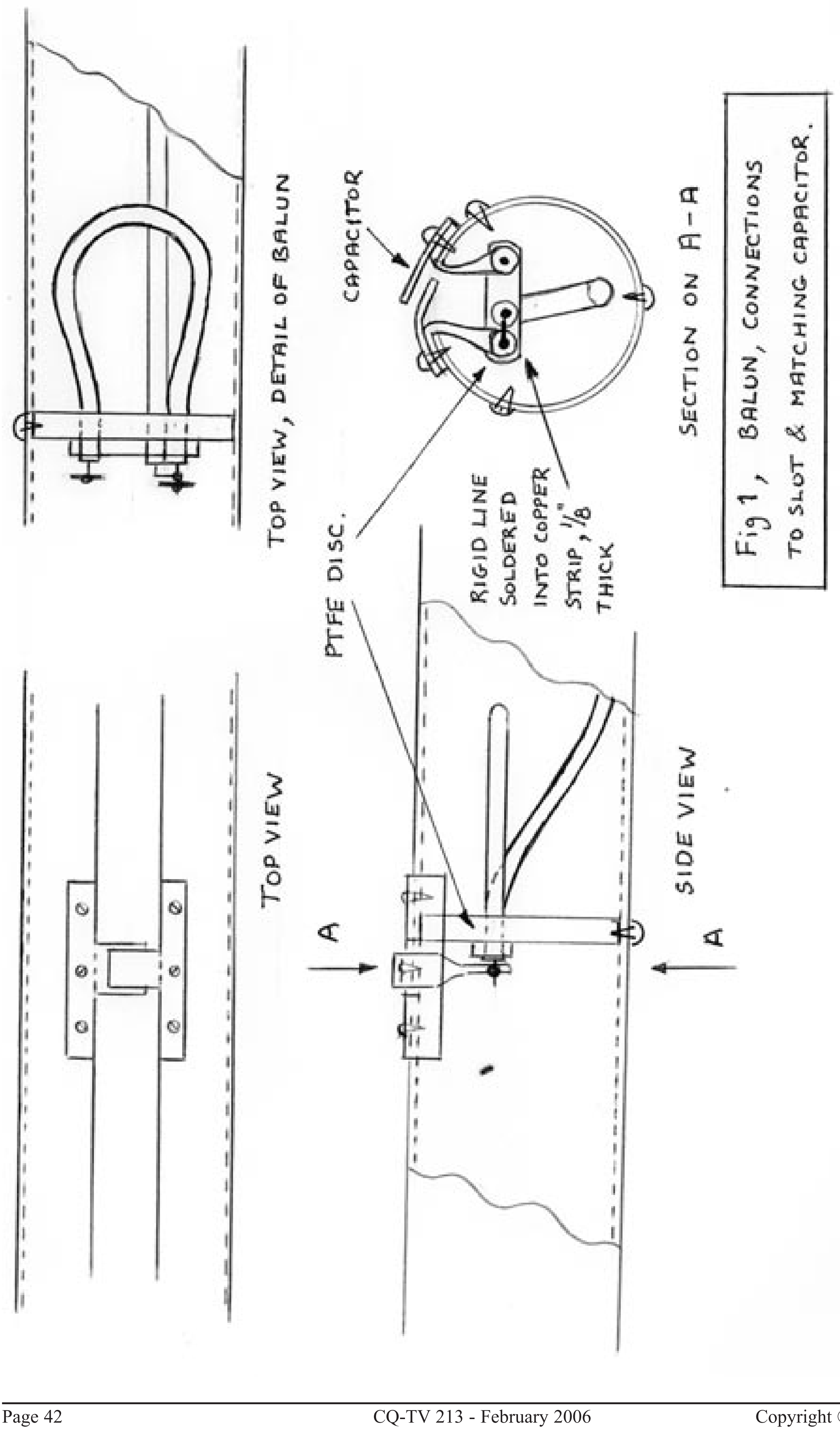


Fig 1, BALUN, CONNECTIONS TO SLOT & MATCHING CAPACITOR.

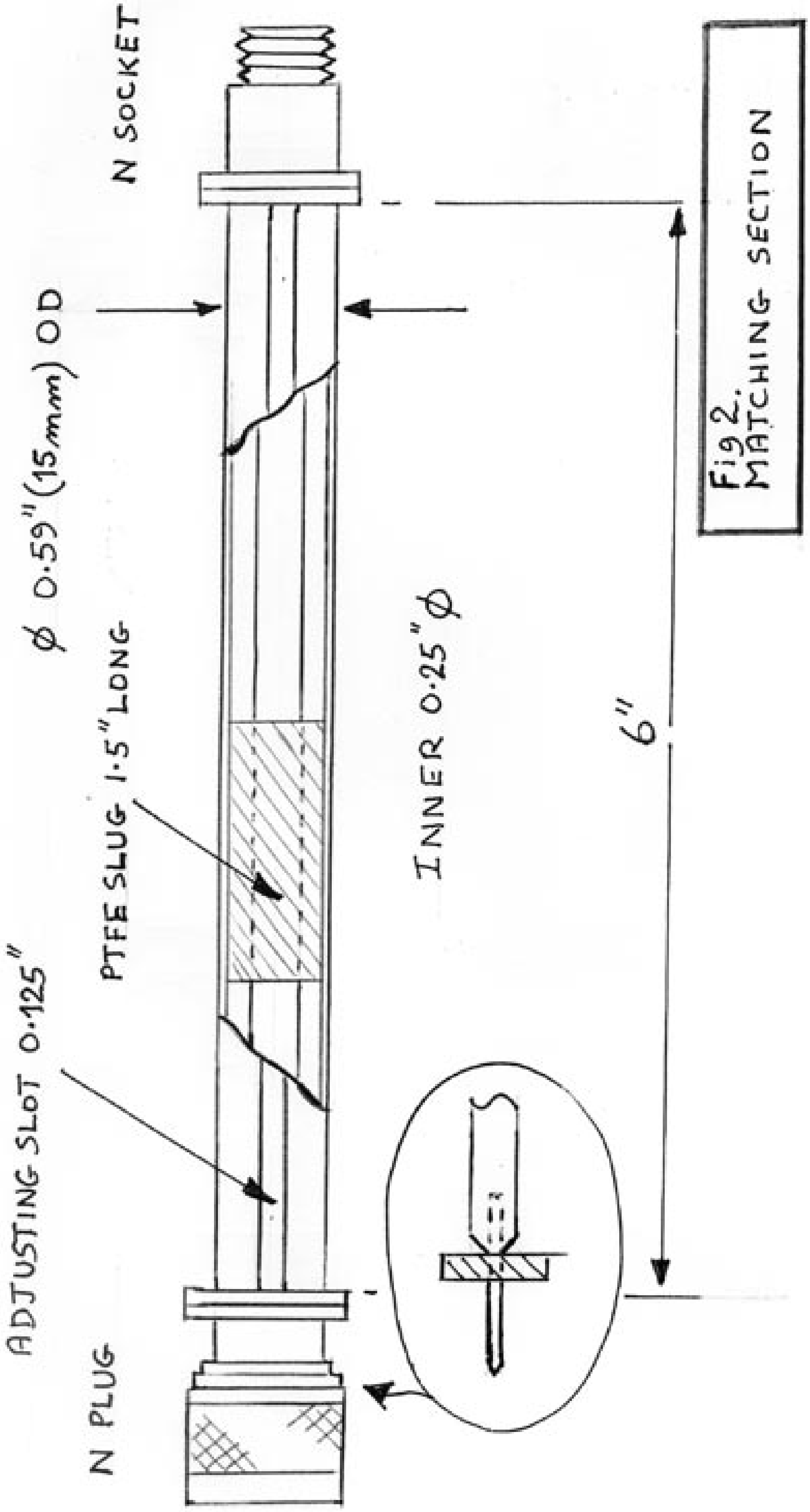
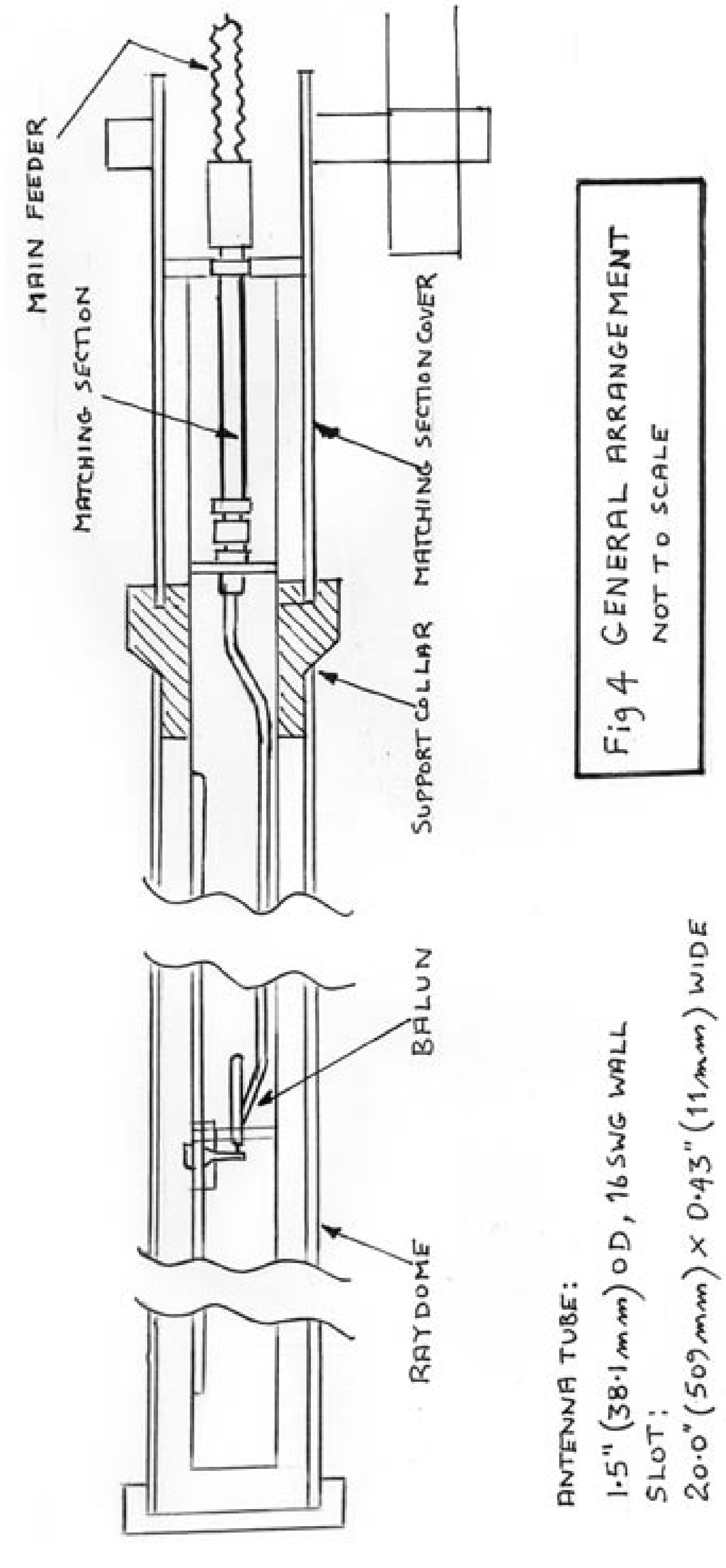


Fig2.
MATCHING SECTION



getting hot, but at our power levels it is of little concern.

Construction

The general arrangement of the antenna can be seen from drawing 4. Ted had made it using aluminium tube, but this presented a problem of connecting the balun to the sides of the slot in a way that it would be reliable for a long time. I would have liked to have used copper tube and to silver solder the connections, a method that should last well, but unfortunately no tube of suitable size could be obtained. I eventually resorted to fitting copper strips to the sides of the slot at the feed points and attaching them with 3 screws each. These have tabs, which are bent inwards to connect with the balun. The arrangement can be seen in drawing 1. I would also have liked to have zinc plated the copper parts as zinc is near to aluminium in the galvanic table and this would reduce the risk of corrosion. Unfortunately none of the plating shops in the district could offer zinc. The best I could do was to thoroughly cover the joints with a protective sealant to prevent the ingress of moisture.

G3JVL advocates making the 4:1 impedance transforming balun by slotting the outer of the end of the semi rigid feeder. As I found this tricky I resorted to the use of the other loop type balun made out of semi rigid line. Details of this can also be seen in drawing 1.

The whole antenna is protected by a length of plastic drain pipe with a top cap. I checked the loss of this by putting a slice in the microwave oven. As it did not get hot it must have a fairly low loss.

The Post Mortem

When the old antenna was taken down, despite its long exposure to the elements, it was found to be in generally good condition. Before taking it apart I speculated as to what had failed and thought it most likely that the feeder had become detached from the slot. That is exactly what I found. Vibration, humidity and temperature cycling had taken their toll and the soldered joint had failed. One really must make a strong mechanical joint before soldering! PV is back in service and the old antenna, refurbished, is in store against any future need.

A Digital Measurement Technique

By Mike Cox

One of my next digital projects is to make an “ARC” unit [Aspect Ratio Convert], which has the object of allowing an archive of old VHS material to be dragged into the16:9 world, albeit leaving a bit of blank space at left hand edge of frame. This may be used for captions, comments etc.

The “ARC” will take in YpbPr signals from a Vistek VEGA unit which gives noise reduction and a bit of aperture correction; useful for tapes shot many years ago using somewhat soggy cameras.

The first part of the ARC is the ADC section. There will be three of these, using Texas TLC5540 8-bit devices. I have a lash-up board with one of these on it driven by a Gennum clamped buffer GB4551. The problem was to check that the digital output had the correct levels for black and peak white.

After some thought, I remembered the old analogue measurement trick of time-sharing the signal being measured with a precise reference. Some of you may have come across the COX 138 Coder Line-up Calibrator; which used this technique. [Fig. 1] The charm of this method is that the accuracy does not depend on the calibration of the waveform monitor, but purely on that of the square wave generator, the attenuators and the mixing pad, which are all 0.1% resistors.

In earlier CQ-TVs [199], I mentioned a Number Generator on my Digital WorkBoard.

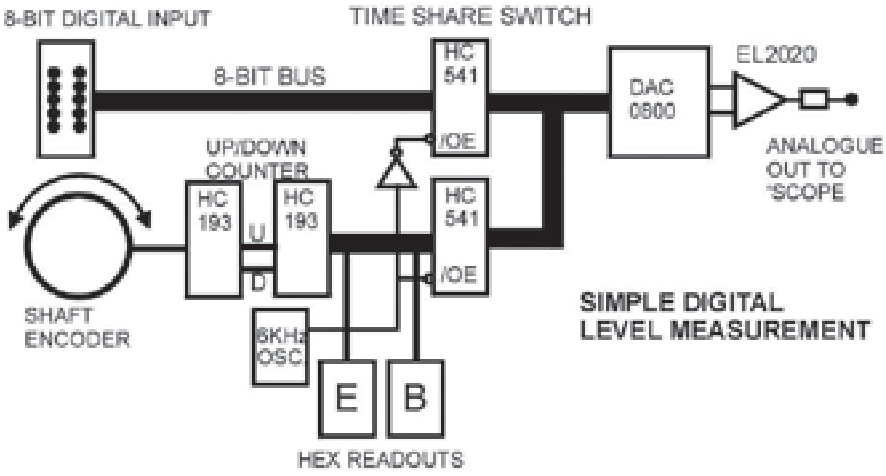


FIG. 2

There was also an 8-bit switcher, and a DAC with 75-ohm output. An external indicator connected to the Number Generator output shows the 8-bit number from 00h to FFh. The Digital Test Signal Generator [CQTV 201} is also on the board. A counter to drive the 2 x1 switch was wired, and the system patched up. You may recall that all the elements on the work board are connected using 10-pin IDC connectors and 10 way ribbon cable patch cords.

CODER LINE UP CALIBRATOR USING TECHNIQUE BELOW

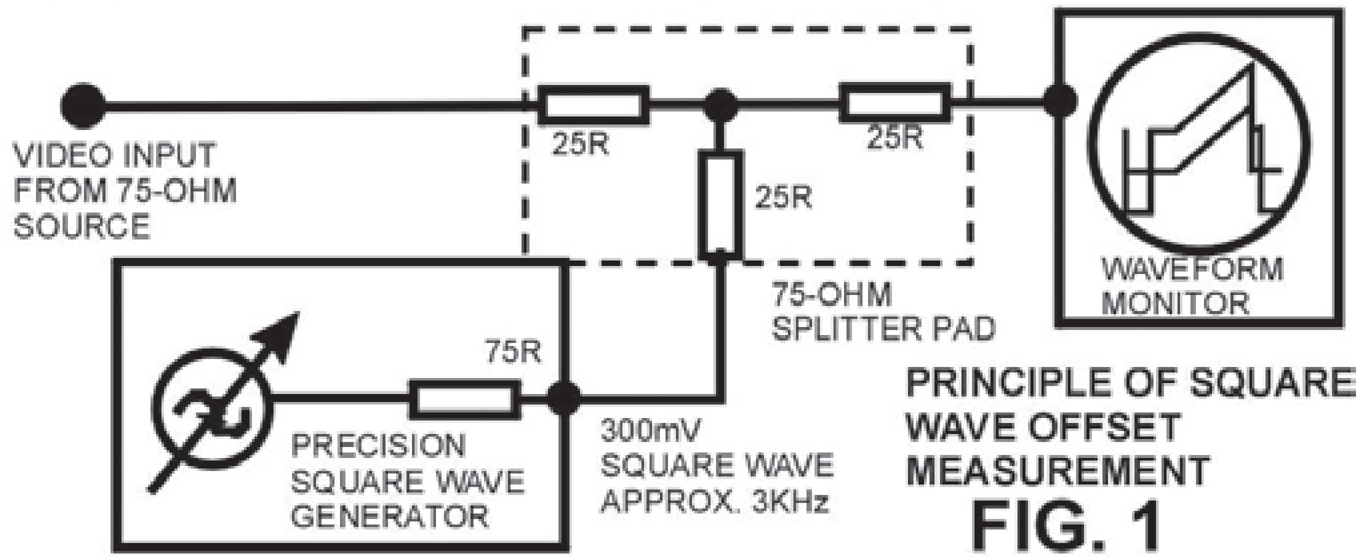
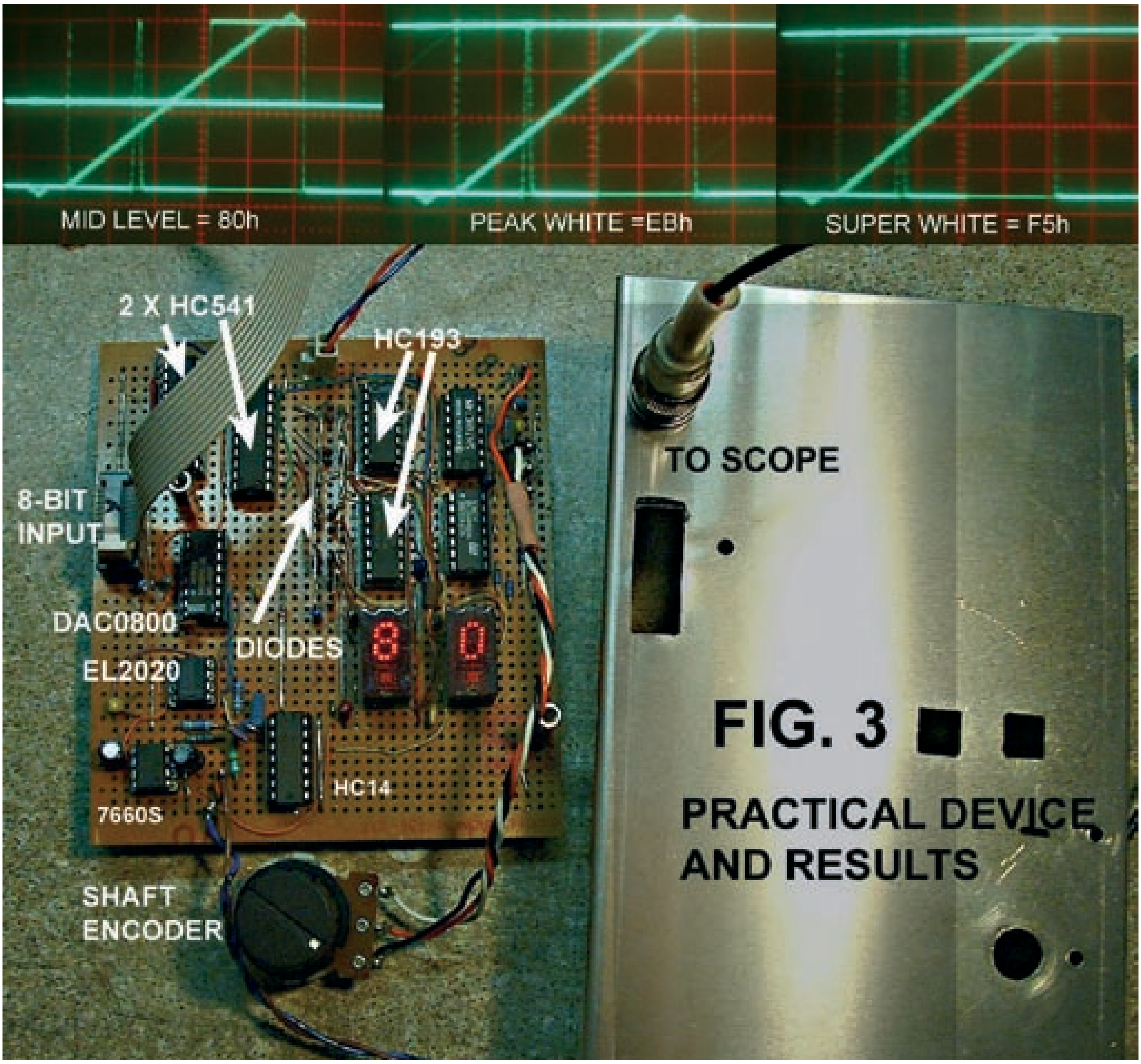


FIG. 1



It was a bit noisy but it worked. All the elements were now together for a practical device to set up the ADCs.

Fig.2 shows the block diagram of this unit.

Because the dc sits of the signals are under our control, a square wave [as in the 138 Calibrator] is not required. A single digital value from the number generator suffices.

Hunting around one of my boxes of boards, I came across a prototype Number Generator board that carried two Texas Hexadecimal readouts [TIL311]. There was room on the board for the switch made up of two 74HC541s, and a DAC with 75-ohm output driver. This last used a DAC0800, which is a non-clocked DAC to simplify matters, rather than the clocked Philips TDA8702 used on the work board. The absence of clock means that the unit will run at any clock rate up to around 18 MHz, particularly useful when the ARC input sampling frequency will be 10.125 MHz.

The switching between the input 8-bit digital signal [from the ADC] and the Number Generator output is controlled by a simple oscillator running at around 6 kHz driving a spare section of a D flip-flop.

The DAC drives an EL2020 amplifier, and gives around 1 volt into 75 ohms for 00h to FFh excursion. A 3rd order Gaussian filter at the output helps remove glitches.

A simple +5 volt to –5-volt converter provides –ve supplies for the DAC and the output stage, with the unit operating from a single +5 volt supply.

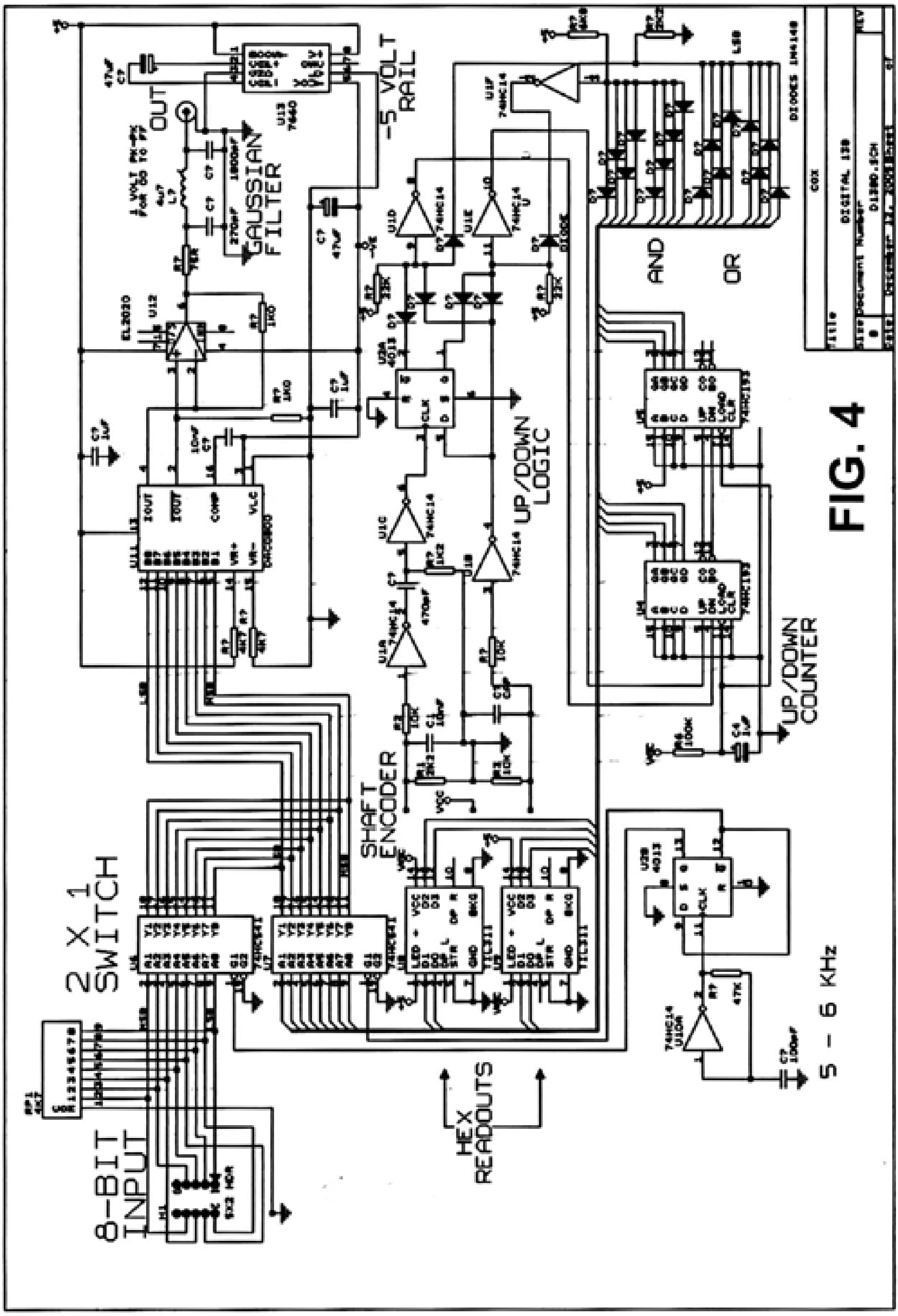
Fig. 3 shows the board on the bench, the case alongside, and some ‘scope traces above showing the unit in action.

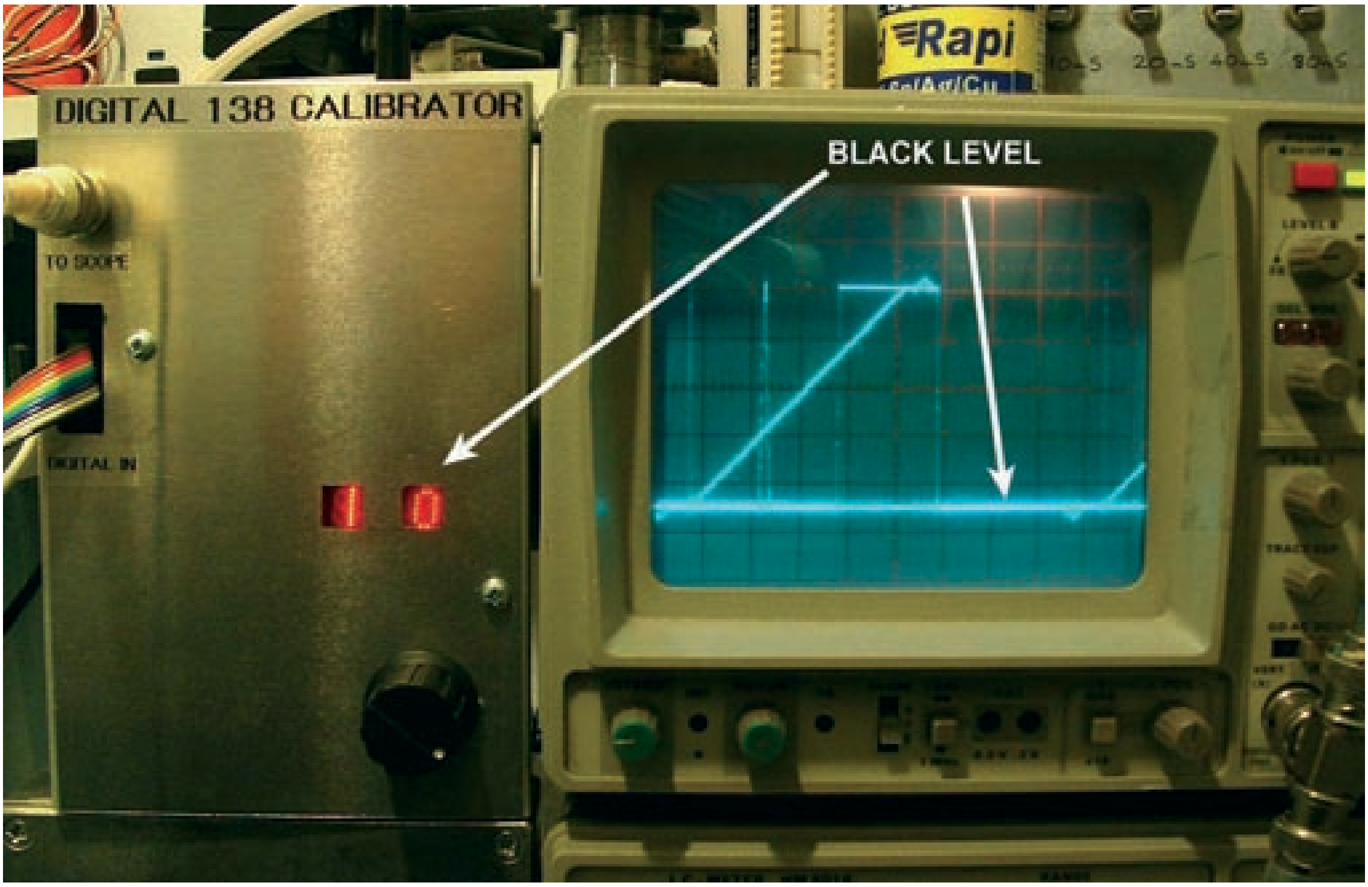
Fig. 4 gives the circuit of the complete unit.

It is relatively simple and uses industry standard parts. The shaft encoder drives the D flip-flop so as to provide up or down clock signals depending on the direction of rotation. The 8-bit counter is made up from 2 ’HC193 devices in tandem. They drive the Hex read-outs as well as one of the ‘HC541 switches.

The decoding around the counter uses diodes rather than AND /OR logic chips as they were there, and take up less board space.

With the Editor’s blessing, I will tell you more about the ARC unit when it is complete and working.


8-BIT INPUT
2 X 1 SWITCH
HEX READOUTS
SHAFT ENCODER
UP/DOWN LOGIC
UP/DOWN COUNTER
AND
OR
GAUSSIAN FILTER
OUT
-5 VOLT RAIL
5 - 6 KHz
DIODES 1N4148
FIG. 4



The calibrator in action

Feelings

By Graham Hankins G8EMX

I feel that the situation within ATV and the BATC has now reached such a state where something really has to be expressed concerning several aspects within the club and amateur television. Again this year I have attended some rallies for the BATC and I still think it important to do this – fly the flag – show that we are still here. But my perception is one of fewer visitors, less traders, more empty tables at rallies, traders packing up earlier etc. Also the more tangible returns are definitely fewer - less new members, less renewals, often nil of either. But, more critically, there is very little I can offer any new enquirer anyway, other than BATC membership itself and sometimes a few back numbers and the CD. Go to the Remote Imaging Group table and you will find weather satellite receiving kits for sale to anyone who joins the RIG.

What can I say to any radio amateur who wants to dabble in ATV? And yes, committee, I do mean 'radio amateur' because the hobby is not dead – ask any of the 40 plus ATV repeater groups. But I digress. There is only one ATV receiver currently being advertised, available only by mail order, similar with a transmitter. As for ATV antennas, Severnside has stopped advertising its simple yagis. The Worthing / Solent transmitter is long discontinued, Bob Platts has disappeared along with his Dove receiver. Only one 24cm ATV transmitter kit is available and that is not advertised, only by word-of-mouth.

I am therefore intending to draft some propositions for the General Meeting sometime in 2006, along the following lines:

That the BATC should make available a basic 24cm ATV receiver, adequate in performance for local or repeater contacts.

That the BATC should make available a basic 24cm ATV transmitter, adequate for local or repeater contacts.

That the BATC should seek or provide a source of basic Yagi antennas of adequate performance for local or repeater contacts.

Each of the above to be available in small quantities from any BATC rally table, or by mail order from its Members Services.

I am sure there is sufficient expertise within the many ATV repeater groups to assist in these projects - after all, these members are designing and developing entire repeaters.

I am prepared to make these items into formal Agenda propositions to any coming General Meeting for discussion by the wider membership and committee. If any member wishes to suggest wording amendments or suggest further propositions, please contact me or any other of the BATC committee.

Veteran Marconi

By Dicky Howett

Looking rather apprehensive in our photo, Paul Marshall and his ob van were featured recently on Anglia Television. This was in conjunction with a Marconi Studio veterans reunion evening at their Social Club in Chelmsford. Also on the day, (Friday 14th October) it was announced to much consternation that the erstwhile Marconi factory in New Street, Chelmsford is to close for good. However, Paul and chums put on a splendid display of old Marconi cameras and at 6 o'clock gave a live exhibition of themselves.

Deadlines

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

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

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

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

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

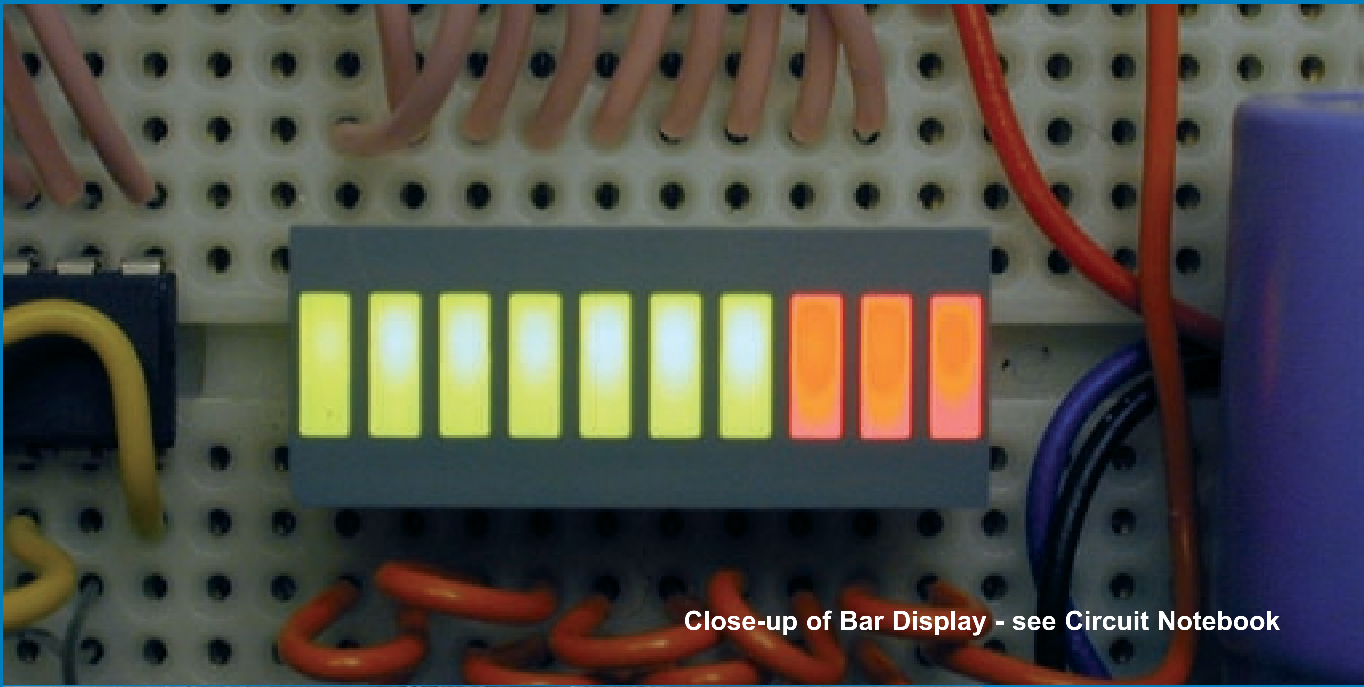
Commercial adverts should be sent to Trevor Brown, the advertising manager, at 14 Stairfoot Close, Adel, Leeds, LS16 8JR. Tel: 01132 670115. Email: adman@cq-tv.com. Members' sales and wants should be sent to the Editor. Email: editor@cq-tv.com

CQ-TV Commercial Advertising Rates

If you would like to advertise in CQ-TV, then please contact our advertising manager, Trevor Brown, 14 Stairfoot Close, Adel, Leeds, LS16 8JR, England. Telephone: +44 (0) 1132 670115. Email: adman@cq-tv.com

Size	Mono	Colour
Quarter page	£50	£75
Half page	£100	£150
Full page	£150	£200

Index of Advertisers



Close-up of Bar Display - see Circuit Notebook

Caption competition

Can you think of a caption for this picture? If you can, then send your entry to chariman@ batc.org.uk. The winner will receive a Black Box caption generator

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

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

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

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

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

Note: This DVD is supplied on +R media only.