

Contents

Contents.....	1
Committee Contacts.....	2
Chairman's Column.....	3
Introducing the new Membership Secretary	3
Letters and emails	4
Southend-on-TV	6
Prize writer?	7
Circuit Notebook 79.....	8
A Personal View of Digital Television – Part 3	9
A Look-through Filter for 23cms	14
A Seat in the TV Box.....	15
Jubilee display	17
Blocking Filters.....	18
70cm digital ATV in practice	21
Members only	24
Subscription rates.....	25
CQ-TV Commercial advertising rates.....	25
Deadline	25
Members' Services	26
BATC Publications.....	27
Satellite TV News.....	28
Contest News	33
Digital ATV	33
Television history: Farnsworth's Invention Turns Seventy-Five	35
Digital ATV tests with GB3ZZ	38
Video detector and 2 by 1 Switcher.....	42
Making Printed Circuit Boards at home.....	43
The Road to Digital.....	49
ATV - VT!	52
Rudolf Horkheimer Award 2002 for DATV Team	52
Index of Advertisers.....	52
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Chairman's Column

Times are a Changing, to quote Bob Dylan- well at least for Dave Lawton who is giving up the task of Membership Secretary. Dave has been Membership Secretary as long as I can remember. Before that, Brian Summers held the title and kept the records, but even then, Dave always printed the envelopes. This task involved making a steel Addressograph plate for each new member and - four times a year - loading this dustbin full of plates into the Addressograph machine and printing the envelopes for mailing CQ-TV. Dave was quick to embrace new technology and when home computers became affordable he pressed one into service, using database software to keep and update the BATC records. A dot matrix printer replaced the printing machine in the garage, and BATC moved into the computer age. Dave then took over both halves of the task, keeping records and printing the address labels. Dave is also retiring from professional TV at the BBC and hopes to spend more time globe trotting. I am sure we all wish him well and thank him for all his past work.

Our new committee member Pat Hellen will now maintain the computer database and be the contact point for new members joining the club. I am sure we all wish her every success in this new task. A new mailing system is also being introduced at the hand over. Pat will generate a CD-ROM of the mailing addresses each issue, instead of printing labels. This CD will go to the printers

along with the CD Ian makes of the finished magazine, and - starting with this issue - CQ-TV will be put into address printed envelopes by the printer at source. Brian Kelly previously did this task but, due to a house move well away from any convenient post office, is no longer able to. The change means we will lose our "Press-stream" discount. The Press-stream system had been adopted for the club by Paul Marshall, but it meant sorting CQ-TV into 120 different sacks and has for a number of reasons become unworkable.

CQ-TV has also changed as from this issue. For sale and wanted ads have moved from the magazine to the website, where most of you have asked for your ads to be posted. We used to mirror the ads in CQ-TV, but by the time we went to press we were revising the page each week as equipment changed hands. The letters column in CQ-TV has been re-launched and includes emails. Starting in the next issue, we will be presenting a prize to the best letter. Blackbox have kindly offered to supply one of their latest style electronic character generators as the prize; I hope we can review one in the next issue.

Other changes on the web are a downloadable logo, which has been made available to members for use on stationery and QSL cards; it may also be used for group newsletters, but not for any commercial purposes. The web site has now almost outgrown its allotted disc

space and is about to undergo surgery. The CQ-TV electronic archive will have to be removed but will still be available on CD. The last four issues will remain and will be available to members only, along with another issue which is presently available to everyone and will remain so; this I hope attracts new members to the club.

Let me end with a challenge for all you computer buffs. CQ-TV publishes ads for other magazines such as Repeater, B5 and ATVQ on a reciprocal basis. The ads they publish in return are looking very stale. We need a constant supply of new artwork for these magazines in order to attract members. If you are into computer graphics then we need you. Artwork needs creating in full, half and quarter page formats both colour and black and white. The focus of the ad is to attract new members to BATC. It could be just a simple picture and caption right up to the sort of flashy artwork some of you have on your websites. I don't have a prize to offer but we could print the best one in the next issue. All artwork needs to be supplied as window format file, and should include the clubs website www.batc.org.uk as a contact address, and or www.cq-tv.com where the free copy of the magazine can be downloaded. Please email your artwork direct to Ian, our editor.

Trevor Brown, BATC Chairman
email: Chairman@batc.org.uk

Introducing the new Membership Secretary

By Brian Kelly

After many years as membership secretary, Dave Lawton is standing down and Pat Hellen is filling the post. Many thanks are due to Dave for his sterling work. Pat is no newcomer to paperwork, having worked for the past 30 years in the insurance business. Her introduction to ATV came about when she was photographed for the review on the Kenwood portable SSTV equipment in CQ-TV a few years ago. Although not licensed yet, she has done some studying with a view to taking the RAE soon. She used to be secretary but is now treasurer



for the Severnside TV Group. Pat recently moved to Aberdyfi in Mid-Wales where she leads an eco-friendly lifestyle with her partner Brian.



Letters and emails

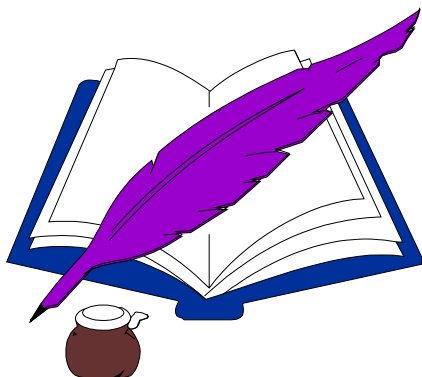
There are a few items in the August issue of CQ-TV, which have given me cause to put pen to paper.

The first is a lot of talk about digital ATV, The Chairman's Column and A Personal View of Digital Television. The second was an article from 'Repeater' magazine entitled Teletext Encoder, and the third was the report on Shuttleworth 2002.

What is the common link you may ask? Dealing with the report on Shuttleworth 2002, everyone who attended could not have failed to notice that there were very few trade stands and the smallest number of car boot sale stands I have ever seen. There was no mention of this in the report and I find this strange.

The article on a teletext encoder was very interesting but I suspect a little too specialised for PCB's to be made available from BATC. However how are those who have modest resources, and perhaps not in the electronics or television industry, ever able to make such a piece of kit? This is of course my concern regarding the use of digital ATV as described in the aforementioned articles. The common link is a concern as to whether the BATC is losing its way by ignoring the needs of ordinary television amateurs and, if the report on Shuttleworth is anything to go by, burying its head in the sand.

I quote, "Brian Summers explained the club's financial situation, which is very healthy, but we are suffering from a decline in the general membership of the club..." We know that in general terms amateur radio is on the decline but - and as members of the club we should ask ourselves this - what has CQ-TV and BATC got to offer a new member of the club? Is there sufficient information,



articles and pub's available to get him on the air? Perhaps back-to-basics is called for.

Whatever happened to the KISS principle? At least the old style A5 format of CQ-TV had this in abundance!

Yours provokingly

R. W. Giles, G4LBH

Dear Mr Giles,

Re your letter about CQ-TV199.

Editing means deciding what articles to uses, Ian never gets this luxury as the contributions to CQ-TV nearly always come up short of the material needed to complete the magazine.

The major contribution for CQ-TV 199 was from Mike Cox and was another instalment of building an SDI mixer. This digital system is now used in TV studios to replace PAL. I for one have found this a fascinating insight into how this digital signal is processed in a modern mixer.

The Teletext generator was re-printed from repeater magazine and was used to cover the short fall of material. If required I am sure I could track you down a PCB.

The 2.5 GHz Exciter was chosen to give an RF/Video balance to the magazine. The magazine was balanced further by reports of Shuttleworth and NAB, and carried the usual Circuit notebook.

The Plumbicon history may have been held over to another magazine had we had sufficient material.

I would love to publish KISS circuits all I ask is that they are innovative, as this is what our reader expect.

The magazine content has nothing to do with Shuttleworth, which had to compete with other rallies in the same area; it was a free admission rally, augmented with lectures, and excellent camera display not to mention the Southern OB truck.

I think we all try our best, sorry if we fail to please.

Trevor Brown, BATC Chairman



Dear Mr Giles,

Thank you for your letter. The delay in my replying is due to me passing it around the committee for their comments.

If I can deal with your comments on Shuttleworth. This was never planned as a rally, but as a convention, with lectures, and BGM for members. Thus there was no entrance charge. Any traders that attended were a bonus to members. All the comments so far received on this event have been very positive.

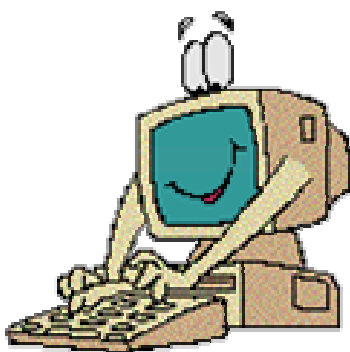
CQ-TV articles. I can only print what is sent in. I re-print articles from other amateur magazines when I think that they would be of interest to our members.

The reason that we no longer provide PCBs is simple. No one buys them. The era of building kit seems to have passed. These days' people want to buy 'black boxes' that just plug together to work.

The topics BATC members are interested in is very varied and CQ-TV has to reflect this. For instance, my main interest is video and I have little interest in RF. For others, repeaters are their main interest. We have published several 'basics' books (A5 sized) in the past. There seems little point in repeating these.

I am sorry that you do not like the changes to the club magazine, but we have to keep up with the times or stagnate.

Ian Pawson, Editor CQ-TV



Dear Trevor,

I was interested in your comments re digital television in the chairman's column. I have been following as have

many others the work of various groups in Europe re DATV. We here in Brisbane Australia have been very fortunate in obtaining on loan for evaluation a DVB-T system for testing on 70cm. These tests have proved very encouraging, however two problems were encountered. One was that not all set top boxes could be programmed to tune down to 70cm, the other problem being the cost of going down this road. Our next step is to try DVB-S and we hope to obtain a set of boards very soon. This has been talked over with other ATVer's and we believe it is a very positive way of going digital at a reasonable cost. We also believe that it is use on 23cm and above really relates to line of sight, therefore the slight

advantage that DVB-T has could be overlooked for amateur use. This would allow the use of digital satellite receivers as 23cm FM did for the analogue satellite receiver.

The days are gone when amateurs were at the forefront of technology changes, however we still need to keep up with these changes or lose people to other modes. The costs associated in going digital are high therefore a halfway solution is the only way. I have found the articles on digital by Mike Cox most enlightening

Kind Regards and 73's

Richard L. Carden

Hi Ian,

In the last CQ-TV the chairman's column there were a number of fundamental errors regarding the COFDM digital TV standard which I believe must be corrected.

Firstly, the statements that "ITV digital set top boxes are not built to a European standard" and "it is not possible to engineer a European DATV standard around surplus UK boxes" are totally incorrect. All digital terrestrial transmissions in the UK are to EN300 744, the DVB-T transmission standard which has been adopted by most countries around the world, except the USA and Korea.

I suspect that you have been confused by the fact that some countries, including the UK, have adopted the 2,000 carrier version of DVB-T, whilst others, such as Spain may adopt the 8,000 carrier version. However, it should be noted that most, if not all, of the current set top boxes on sale are switchable between either system.

Secondly the statement "it has its own engineering problems" without further explanation is misleading.

Here, I suspect you are referring to poor coverage experienced by some viewers of particular multiplexes. This is not due to a failing of the DVB-T technical standard but more to do with the imposed frequency planning requirements and the desire of the commercial operators to transmit as many services possible in the given channels. Let me explain -

The UK TV spectrum plan between channel 21 and 68 was drawn up to accommodate 4 planned UHF networks - namely BBC1, BBC2, ITV and Channel 4. Due to political pressure for another commercial channel, the plan was redrawn to accommodate a 5th channel (Channel 5) which was accommodated by transmitting at a lower power than the original 4 networks, hence the problems a lot of people still have receiving that network. It was then decided that up to 6 digital channels were required to be transmitted from each main UHF TV station, so the plan was redrawn yet again. In general, the channels adjacent to the existing PAL transmissions were chosen for digital, note that these are totally unusable for analogue transmission but due to the resilience of the system they can be used DVB-T.

However in order to minimise interference to PAL receivers and adjacent transmitter coverage areas, the DVB-T digital transmissions are radiated at much lower levels, typically 10 - 15dB lower than the analogue transmissions. For example my local transmitter, Hannington radiates analogue at 250 K Watts ERP and digital at 10 K watts. This situation is not quite as bad as it seems in that the DVB-T digital standard has the benefit of a coding gain of up to 10dB, depending on mode, over analogue.

This original digital network was planned using a DVB-T mode of 16QAM, FEC 2/3 and 1/32 guard interval giving a payload of around 16 Mbit/s, allowing for 3 or maybe 4 services to be transmitted using the video

compression technology available at that time. Unfortunately the potential coverage problems were then made worse by the commercial operators demanding more bit rate to allow more channels and so the final system was launched using 64 QAM modulation rather than 16 QAM on the individual OFDM carriers. This provided approximately 24 Mbit/s payload but a decrease of 5db in coding gain and hence the poorer than expected coverage for ITV digital.

It should be noted that just today (20th September 2002) it has been agreed that the new Free to View network may use the 16 QAM standard in order to provide increased coverage!

See www.dtg.org.uk for the latest facts and background technical articles.

Finally, it is totally incorrect to say that "it is not possible to engineer a European DATV standard around surplus UK boxes... and this will not come out of bargain basement equipment". As I said previously, the UK DTV transmissions are totally compliant with the international standard and I would suggest that surplus UK equipment is excellent basis on which to build a common standard.

If BATC is unhappy with the use of ex Ondigital boxes for amateur reception perhaps he should had ventured into any electrical retailer in the UK in the past few month he would have seen brand new, DVB-T standards compliant Pace and Grundig boxes on sale for £99 which, with an appropriate 1.3 or 2.4

GHz down converter, will do the job admirably - still very cost effective compared to the cost of even a 2metre mobile rig.

And quite what was meant in the final paragraph I'm not sure - I personally don't know of any amateur who is not using PAL as his video format, or indeed anyone who can afford to migrate to a full SDI plant in the shack! But we are not alone, probably 50% of the digital encoders used by professionals are driven with PAL/NTSC signals.

I apologise for the lengthy email but I do feel the article was badly researched and made some potentially damaging statements for the future of digital TV both in the amateur and commercial context.

CQ-TV is an influential publication and if BATC wishes to be seen as reputable organisation, both its magazine and the chairman must be seen to be knowledgeable and factual on the subjects covered, which unfortunately upon this occasion you were not.

I hope you will publish this in some form or other to redress the balance, if only so that the experiments we are doing on 1.3 and 2.4 GHz in South of England can be seen to have a future, because they are, of course, using UK manufactured ex commercial DVB-T and DVB-S equipment!

On another topic, if you wish for a small primer on the differences between DVB-T and DVB-S, I would be willing to pen a small article.

Regards, Noel Matthews - G8GTZ

Southend-on-TV

Dicky Howett has a few words with a cameraman

Television in the 1950s was live. In addition, being live it had to have regular doses of action and adventure. Outside broadcasts provided some ready-made thrills and, in those years, a favourite thrilling venue for both BBC and ITV was Southend-on-Sea.

Never a year seemed to go by without Southend Pier or its carnival being featured on Saturday afternoon telly, interspersed between the usual diet of wrestling, show jumping and boat racing.

In 1950, the BBC had Richard Dimbleby demonstrating a sea rescue off the end of Southend Pier. The nation held its breath as a weighty Dimbleby was seen suspended in a bosun's chair, dangling over a windswept sea. Then, on cue, he was hauled from a yacht to the waiting lifeboat, thus providing instant thrills - would the boson's chair break-would he fall into the water? - as well as the double bonus of a few hours of extremely cheap television. On the basis that any old excuse would do (from a bank holiday to a coronation), the TV companies would rush instantly, van loads of cameras and miles of cable to any likely festive vantage point. But not too far from London. Nation-wide television was still a few years away and ITV was several companies short of a network.

The actual subject matter seemed not to matter. Everything was new and it was all grist to the TV mill. Indeed, for years, a Southend seafront gypsy fortune-teller

had a sign displayed which read proudly: "As featured on BBC television". Doubtless the clientele were suitably impressed as they crossed palms with silver.

However, Southend carnival provided the ultimate black and white TV attraction. In 1956, ATV transmitted the festivities, setting up their cameras and control vans beside the old swimming pool at Westcliff. Included in the day's programme was a beauty contest (typical ITV) from the pool. Later in the afternoon, a proportion of the carnival procession was televised. Two Pye Mk 3 cameras were used, one mounted on a 'Paddock' dolly beside the road and the other, on a gantry using a Watson 5:1 zoom lens.

What all these Southend programmes actually looked like, I have only fragmentary recollections. Even in those days, our little 9 inch made-in-Southend Ekco television set was working overtime!

I seem to recall that these outside broadcasts were fraught with technical and artistic problems. Cameras would focus on the wrong item or break down at critical moments. Commentators would lose their sound-leads or microphones.

Interviewees would freeze-up in panic and forget their own names. Strange and inexplicable

pauses proliferated. Everything over-ran. In addition, it always seemed to be raining.

No recordings exist of those 1950s Southend outside broadcasts. They were not exactly historic, nor considered at the time worthy of any sort of archive preservation. However, oh to be able to see them now!

My memories of the 1956 Southend carnival are reinforced by the photographs my father and I took of the ATV technical gear. However, I shall always recall, fondly, the remark made to me by an ATV cameraman who was photographing the carnival. As a camera-mad 11-year-old, I confessed to him that I wanted to be a TV camera operator when I grew up.

"B--- off, can't you see I'm working?" he muttered helpfully.



Prize writer?

Starting next issue CQ-TV 201, we will be re-launching the letters and email column. (See the previous page for this month's contribution)

To give you all a little encouragement to put pen to paper, or should that be fingers to keyboard. Blackbox have kindly agreed to donate one of their new TV character Generators as a prize each issue. The winning letter or email will be selected by the editor, so try to keep

on his good side. No running down computers Ian is one of the few

who understands them, and no cracks about Tank Tops, he has been known to wear one. A final tip, keep your subscriptions up to date, or you will not be eligible, (we will be checking up).

For those of you who cannot wait you can read all about Blackbox character generators by visiting their website at <http://www.stv5730a.co.uk>



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Circuit Notebook 79

By John Lawrence GW3JGA

Using the I²C Bus Extender, Philips 82B715

Philips Semiconductors invented I²C in the late 1970s to provide a standardised interface to support a growing number of general purpose and application-specific ICs used in consumer electronics. I²C is a low rate serial bus initially designed to operate at 100 kHz (standard mode) and later upgraded to handle 400 kHz (fast mode) protocols and more recently to 3400 kHz. Two wires are required, one for clock and one for data. The beauty of I²C is that it offers a simple way for devices within a system to talk to one another. Several devices can be connected to the bus and addressed individually.

I²C was used in the 'Remote Control Modular ATV Station' described in the BATC publication 'An Introduction to Amateur Television' by Mike Wooding and Trevor Brown. This system forms the basis of a number of ATV Repeater Stations in the UK (including my local repeater GB3TM).

A limitation of the I²C system is the maximum length of cable that can be used. The I²C bus capacitance limit of 400 pF restricts practical communication distances to a few metres. This is not a problem when devices are located within the same piece of equipment.

Remote receiver tuning

At the recent BATC Convention, I purchased from G1MFG a 13 cms ENG Receiver and its associated Receiver Control Panel with LCD frequency display. The receiver is controlled from the control panel through a two-wire I²C bus. My intention is to mount the aerial and the receiver (in a box) on the mast and tune it remotely from the shack. The cable run is about 20 metres, which is too long for a normal I²C connection.

The Philips I²C Bus Extender, 82B715P, provides the solution (Farnell 550-258). Using one 82B715 at each end of longer cables reduces the cable loading capacitance on the I²C bus by a factor of about 10 times and may allow the use of low cost general purpose wiring to extend bus lengths.

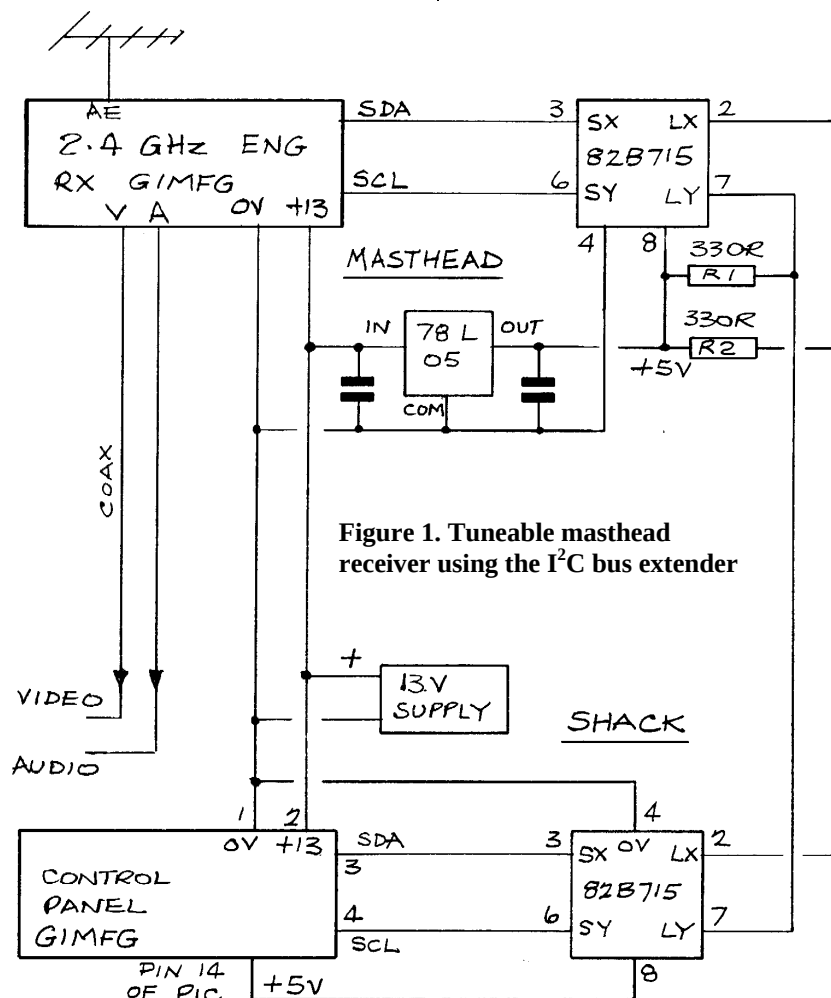


Figure 1. Tuneable masthead receiver using the I²C bus extender

In normal use, pull-up resistors are required on the open collector outputs of each device. If two Bus Extenders are permanently connected (as in my case), the circuit can be configured with only one pull-up resistor on each line of the buffered bus.

A method of calculating the resistor value is given in the 82B715 data sheet. The value for my system is 330 ohm. This will allow for a total cable capacitance of about 3000 pF, so for the cable I will be using, (capacitance = 110 pF / metre) it provides a maximum length of about 27 metres.

The general arrangement is shown in Figure 1. Mounted on the mast will be the aerial and, in a waterproof box, the receiver module, the I²C bus extender and its 5 volt supply regulator (both decoupling capacitors are 220 nF). R1 and R2 are the pull-up resistors for the extended I²C bus. Separate connecting cables are provided for the 13-volt

supply and the I²C bus with coax cables for video and audio.

In the shack are the 13-volt power supply, the control panel and its I²C bus extender. The 5-volt supply for this is taken from pin14 of the PIC socket; the control panel has an on-board 78L05 regulator with spare capacity (but check with G1MFG).

At the present time, DIL switches set the frequency of the associated G1MFG 2.4 GHz transmitter. This could also be remotely tuned from the control panel using revised software and a duplicate set of I²C bus extenders.

References

'An Introduction to Amateur Television' Mike Wooding G6IQM and Trevor Brown G8CJS, B.A.T.C, ISBN 0-9513779-2-2
I²C bus extender Philips Semiconductors Data Sheet 82B715, Jan. 1998
2.4 GHz ENG Receiver G1MFG.com
<http://www.G1MFG.com>

A Personal View of Digital Television – Part 3

By Mike Cox

With Update of the SDI Mixer Project

In the last article [CQ-TV 199], some suggestions were made for practical experimental work to learn about digital television. In this part, this will be expanded on, and then there will be a look at progress on the SDI mixer project.

Clock Generation

One of the first needs in an experimental set-up is a clock and housekeeping generator. Whether the input to the digital system is PAL, YPbPr or GBRS, clock, clamp and timing signals will be necessary. These have to be time-related to the input signal.

A practical set-up will be described to enable an experimenter to get started.

Since CQ-TV199 was published, one or two snags have come to light with the circuit shown there [Fig.10]. This came about after using the circuit with a real multiplexer and serialiser to give SDI out.

The first problem was the use of an LC oscillator with the SAA1101 SPG chip. I mentioned the problem of crosstalk from the 27 MHz oscillator into the 5 MHz SPG oscillator, which I thought had been cured. Obviously there was jitter between the two oscillators, and this was sufficient to upset the internal counters in the multiplexer device.

Accordingly, replacing the LC oscillator in the SPG by a 5 MHz crystal was tried. Past experience suggested that an error amplifier might be necessary to give some extra gain for the phase comparator. However, the ruse was tried of adding a second varicap diode in parallel with the original one; this will give twice the capacitance change per volt of error signal. This appeared to work well, and it reduced jitter dramatically.

When tried again with the multiplexer, it was found that the relative phase between the horizontal reset signal RLIN and the 27 MHz clock was critical. This depended on the precise adjustment of the centre frequency of the clocks, and is due to the use of the edge of Line Drive as the RLIN signal. It was relatively simple to re-jig the circuit so that the RLIN signal is clocked by the 1 MHz

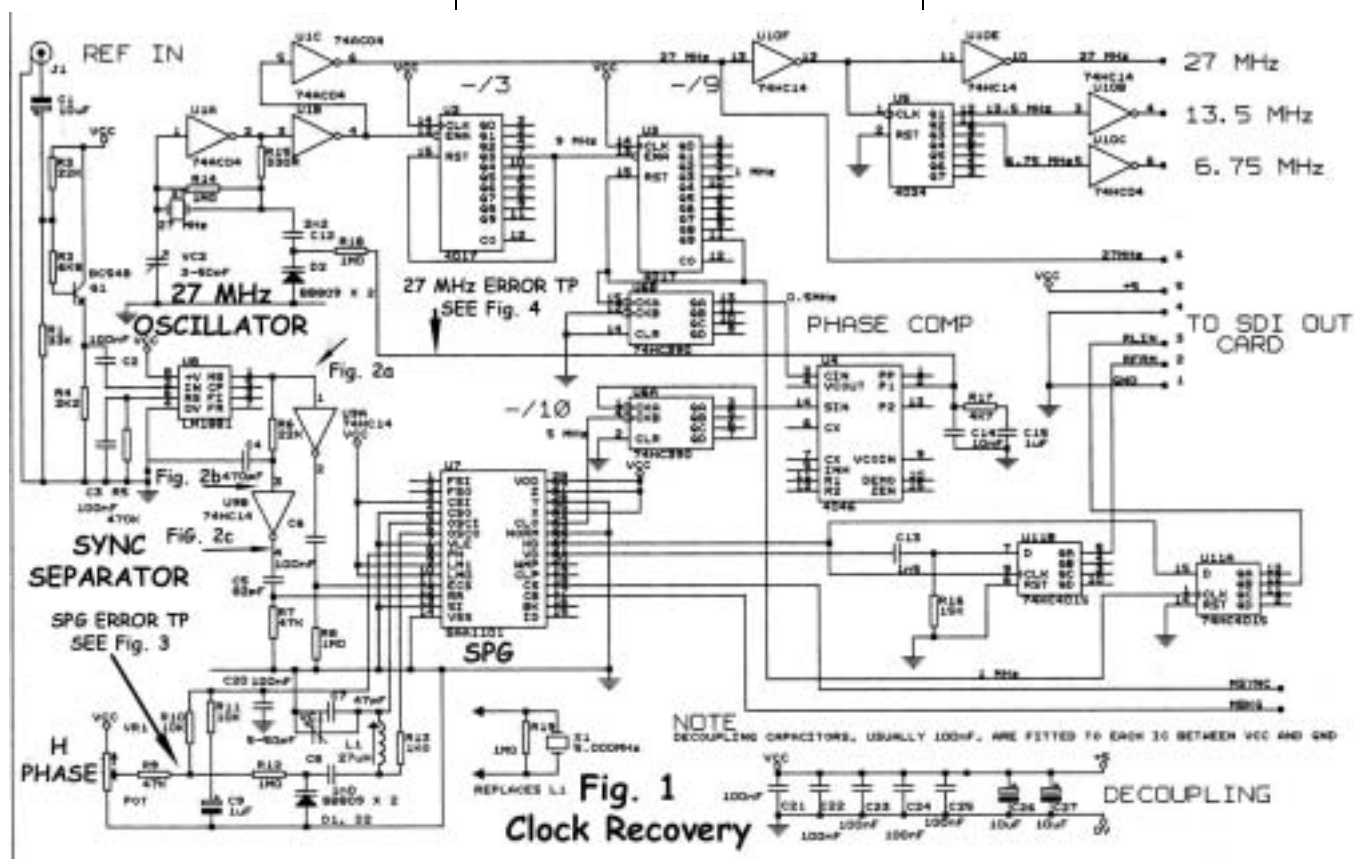
signal divided down from the 27 MHz clock.

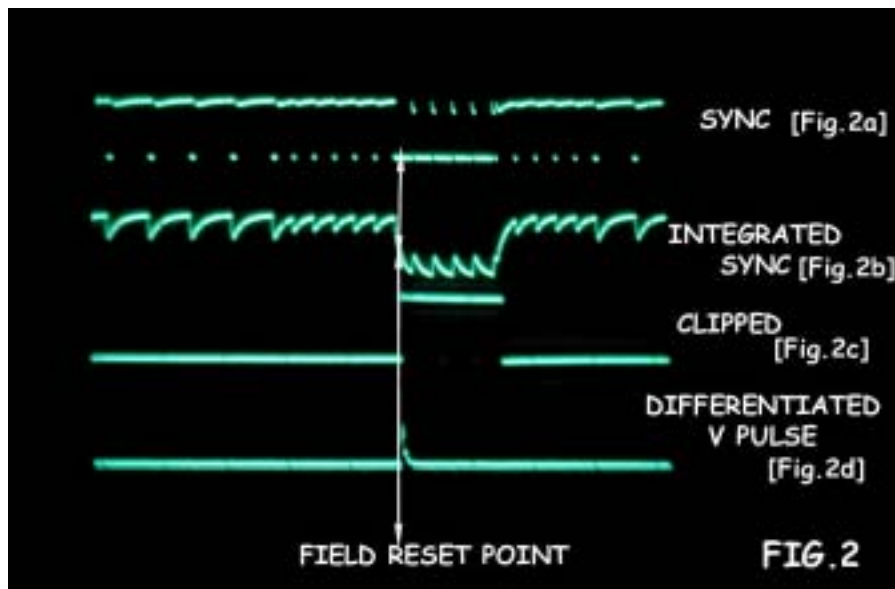
By such a process, the leading edge of RLIN must line up with the 27 MHz clock.

Once this had been done, the multiplexer behaved correctly. If you are not using an SCX6244 multiplexer/demultiplexer chip, this may not bother you and you can use the native signals from the SAA1101 for housekeeping.

Fig. 1 shows the revised circuit. Note that apart from the SAA1101, all other devices are common HCMOS types.

Referring to Fig.1, the input reference signal is buffered by Q1, with a high value base resistor to roll off burst components if a CVBS signal is used. The emitter follower drives the ubiquitous LM1881 sync separator [U8]. The sync out from the LM1881 is inverted and ac coupled into the SAA1101. This is done to avoid problems with leaving the ECS pin high [pin 11] if the reference input is removed for any reason. The sync signal is also integrated to produce a field pulse; this pulse is then differentiated to produce a narrow pulse during the first broad pulse.





This resets the field counter in the SPG chip. Fig.2 shows typical waveforms. By this means, field lock up is very quick.

Fig. 3 shows the error voltage before the varicap. This is normally a very thin line-rate spike either positive or negative going from around 2.5 to 3 volts. Put phase pot to middle and adjust trimmer capacitor to get this result.

The division from 27 MHz to 0.5 MHz is done in easy stages to keep it simple and to avoid jitter. 'HC4017 devices are simple to use as dividers as the Reset pin is taken to any of the counter outputs to give division by 2 to 10. The 27 MHz output is further divided by two and by four, to give 13.5 MHz and 6.75 MHz clocks for luminance and chrominance respectively. An 'HC4024 device does this simply.

The second phase comparator that controls the relation between H sync and the 27 MHz clock uses part of a 'HC4046, and operates at 0.5 MHz. An alternative is to use an Exclusive-OR gate such as a section of 'HC86. Fig. 4

shows the error waveform from such a phase comparator. Note that it has a triangular form, with 1 MHz frequency. When the C is correctly set the mean dc of this should be about 2.5 volts.

You may be pleased to read that the Mixer Project motherboard has arrived and the circuit described assembled on it, and the SPG and 27MHz clock generator locked up with the merest tweak of the variable Cs. (as at 4 – 8 – 02)

For further information on the SAA1101, there is an article in "Electronics World", February 1996, page 114, describing a genlocking colour SPG using it. You may recognise the author's name.

You may need a different clock frequency for a particular reason, such as 4 x PAL subcarrier [17.7734476 MHz]. You could use the colour lock facility of the SAA1101, with the 4Fsc divided down to 4.433619 MHz and input to pin 1. Pins 9 and 10 [LM0/LM1] will need to be taken low to invoke the colour lock mode. Philips published the "Desktop Video Data Handbook" in 1994. If you

can get a copy, it contains data on the SAA1101 and many other useful devices.

ADC

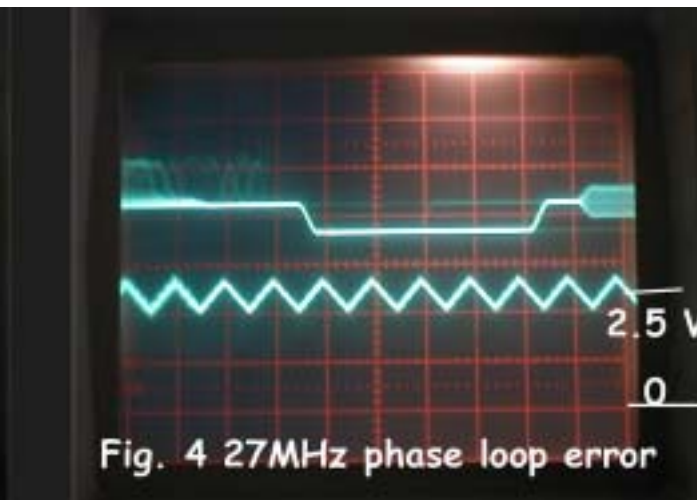
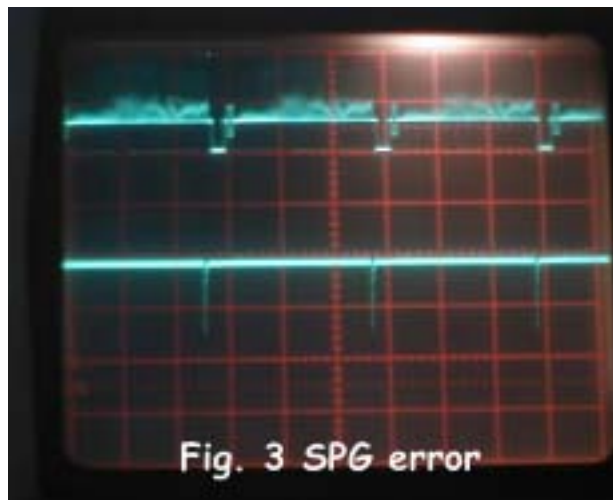
Having built the clock recovery circuit, the next step is to use it practically.

An ADC circuit is a good start. What chip do we use?

It needs to have sufficient speed for the sample rate we need. For 625 lines CCIR 601 standard, 13.5 MHz is used, so a 20 MSPS [Mega Samples Per Second] device is suggested. It needs to be readily available, and it should be affordable. The first ADC chips in the early 80s cost £500 each. Now they are about £4. The one I suggest is Texas instruments TLC5540.

It is available from Farnell; is a 40 MSPS device, and its only snag – if it is a snag, is that it is a 24-pin SM device. It has a 2.28 volt internal reference, which simplifies application. Because of this, the input signal has to be contained within this window. Fig. 5 shows a typical application that I used to digitise a key signal from a CCD camera. Gaussian [Dishal] filters are scaleable, so if you want to increase the bandwidth, divide all the elements by the ratio of new bandwidth to old [3 MHz]. This will keep the impedance at 75 ohms. Gaussian filters have a slow cut-off rate, but an excellent phase response, and a marked absence of ringing. The filter shown with a -3 dB point of 3 MHz will be -20 dB down at 9 MHz.

To work with a PAL signal, you might do better with a steeper cut filter with a cut-off of around 5.5 MHz and more or less "brick wall" thereafter. However these are tricky to design, and not too



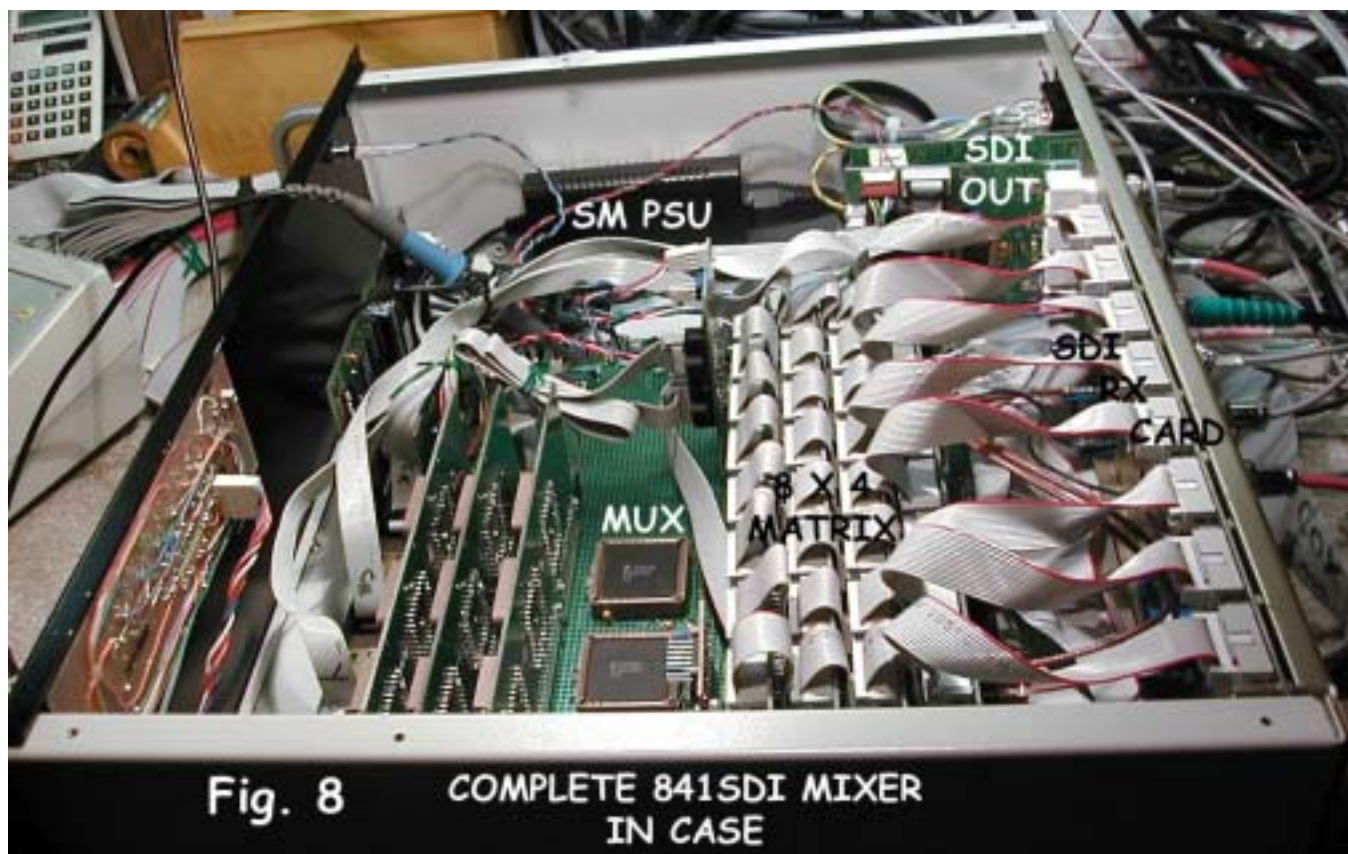


Fig. 8 COMPLETE 841SDI MIXER
IN CASE

Since then, a pc motherboard has been laid out, and assembled. The clock recovery design was re-thought and successfully transferred to the board, and most of the interconnects laid out on the board. An extra switch bank has been incorporated for use in copying sources from one machine to another. Because this is only an occasional requirement, the selection buttons are on the rack unit panel. They could easily be remoted if required later.

Power comes from a 5 volt 4A switch mode block. Most circuitry requires 5 volts; the only change from that is the control panel, which for historic reasons needs + and - 12 volts. Care has been taken to decouple the power feeds to different areas, in particular the SPG area to minimise jitter.

One of the common dc-dc converter blocks [NMH0512S] does the job compactly.

There was only one major snag on the board. [Fig. 7] The monitoring system I have is a DAC271 (Shootview) SDI to PAL converter which feeds a picture monitor and a 'scope.

The colour bar waveform looked odd - particularly the yellow bar. Switching off components at the source end showed that the error was in the Cb path. Removing the motherboard from its case and examining it carefully showed a rogue piece of track joining bits 5 and 6 on the Cb stream at the input to the limiters. A quick flick with a scalpel, and the problem was solved, with bars back to their pristine appearance.

A vision mixer has to have a name or number. Some of you will not be surprised that this unit has been designated "841SDI". Fig. 8 shows the complete unit in working form.

There are still a few snags to remove, but at the time of writing [August 15th 2002] there are still about 3 weeks left before

moving off to Amsterdam for IBC rigging.

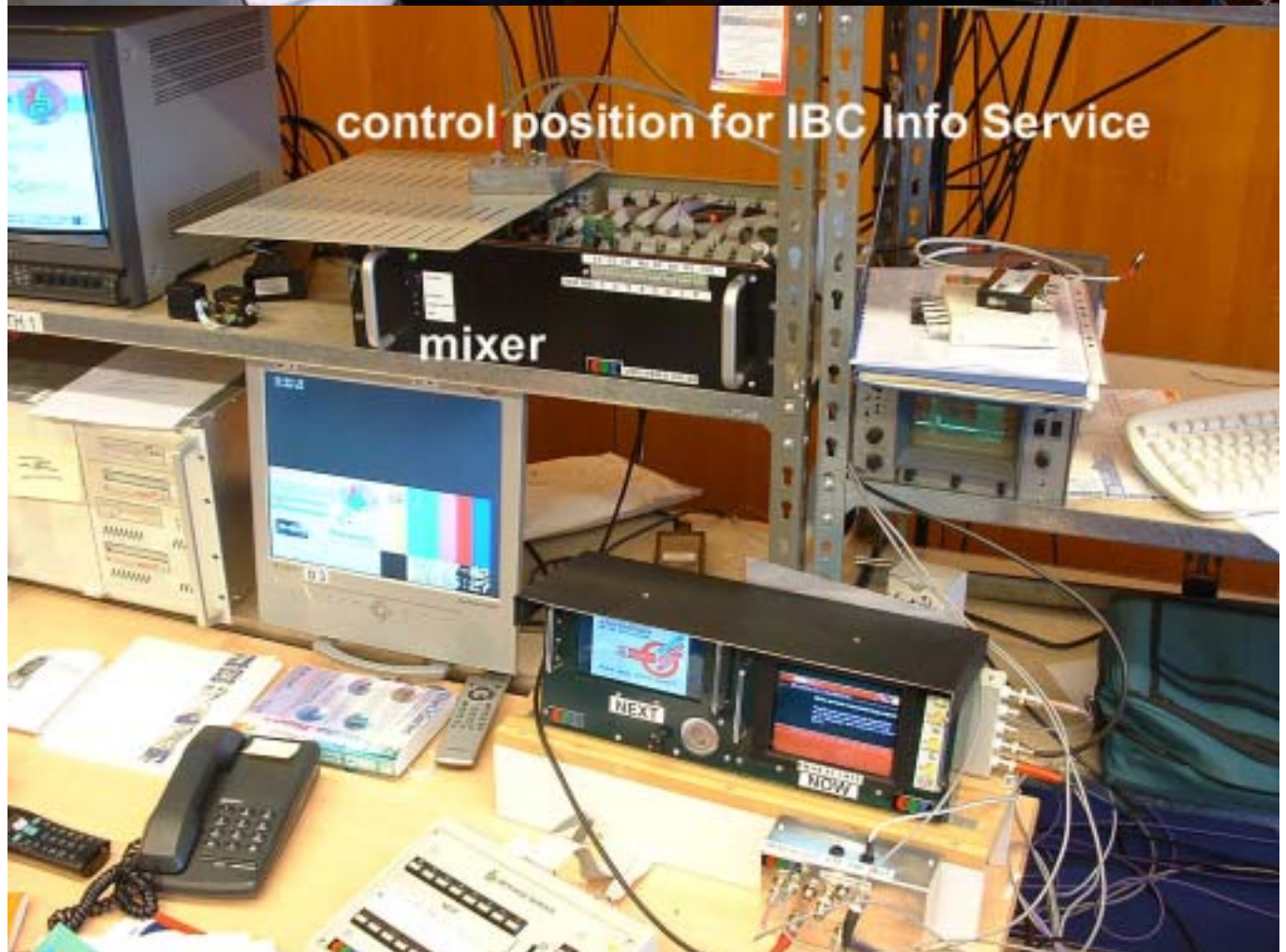
An interesting and absorbing project that has taught me a lot about the practicalities of digital television, and honed my skills in pc layout - 8 different boards are used.

The unit so far is a work in progress; it has just the facilities needed to do the job at IBC. It still uses the original control panel that controlled the analogue component switchers, the special effects side will only do a split screen although there is a fade in and out of the split, and there is as yet no keying facility.

Work for next year includes extending the range of effects, and perhaps adding a proper control panel, with an RS422 link.

With the Editor's blessing, in the next issue I will include a piece about a digital test generator, and let you know how it really went in Amsterdam.





A Look-through Filter for 23cms

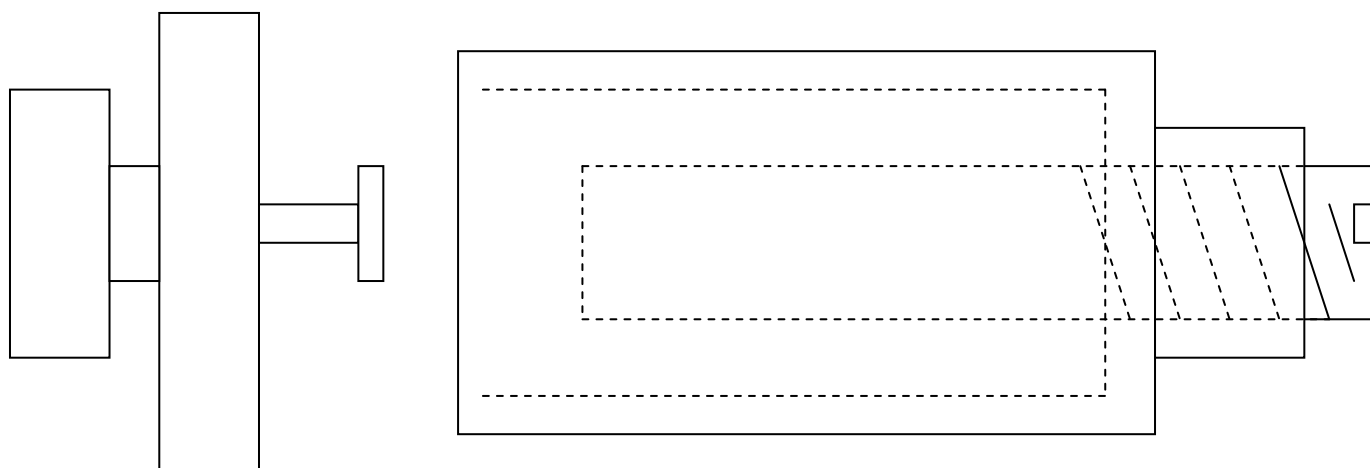
By John Douglas, G4DVG

Cavity resonators made by Pye, presumably for use in PMR combiners, can be picked up cheaply at most rallies. They seem to be designed for use between 400-500MHz, but can easily be modified to make an effective look-through filter at 23cms. The unmodified resonator is shown below.

The modifications are as follows:

Open up the resonator by removing the four screws and remove the coil inside, the tuning plunger and the nylon lock screw.

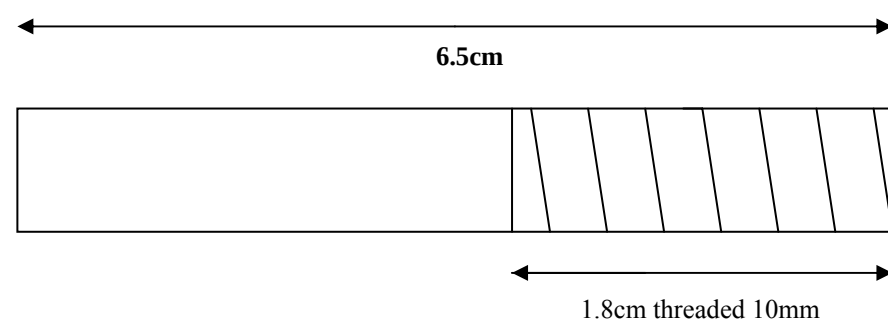
Drill out the plunger hole at the bottom



using a 9mm drill bit. Thread this enlarged hole with a 10mm tap (either 1.25 or 1.5 pitch will do). It is best to use a pillar drill for this work.

Take a 6.5 cm length of 9.6 mm brass rod (available at model shops) and cut a 10mm thread to suit the hole. Cut a screwdriver slot at the threaded end.

Insert the threaded rod and replace the cap with the BNC connectors. The nylon screw can be used as before to lock the rod in place after adjustment.



You should find that the cavity will resonate around 1250 MHz with the tuning rod pretty close to the end of the spill connected to the BNCs and will act as a very effective notch filter. A quick check indicated that the rejection at 1249 MHz was about 20dB with -3B points at +/- 6 MHz, ideal as a look-through filter.

Please visit our web site at www.cq-tv.com

A Seat in the TV Box

Dicky Howett recalls the television theatres.

The mid-1950s TV scene can best be characterised as an energetic expansion of air-time due to the creation of new programme companies. In 1955 the musty old BBC had commercial competition with a vengeance, initially in the shape of lusty old Associated-Rediffusion. Swiftly following were Granada, ATV and ABC (1956).

Frantically (or so it seemed), studio space was sought (only Granada built from scratch, with a dedicated studio centre in Manchester). As a stop-gap, the budding TV contractors decided to purchase 'off-the-peg' premises. And what better 'pegs' to purchase than old theatres or cinemas, ready and waiting for conversion? Although region-based, the early ITV companies decided on London premises (all the top-talent was in London). Granada used the Chelsea Palace (from whence came 'Chelsea at Nine' and 'The Army Game'). When Granada took over the Chelsea Palace, the London County Council decided to re-rate the premises and debated whether this new "TV Theatre" was a place of entertainment or in fact an industrial unit! (At the time -1956/7 - the rateable value on factories was higher than theatres). In the process, the LCC invoked "experts" to prove that an electronic signal was indeed a product, and that Granada was 'manufacturing' for sale a physical item of value.



A trio of Pye Photicons at the BBC Television Theatre in 1955. The old theatre decor is still visible

Electrons were measured and counted. Flummery and slides ruled. Eventually, to the relief of Granada, the LCC lost the argument.

ABC TV (Associated British Picture Corporation) owned - due to its film business - a plethora of large (and increasingly empty) cinemas. The Capitol at Didsbury near Manchester became ABC's production base. All the early 'Armchair Theatre' plays were produced there and in Birmingham the Astoria at Aston became the joint ABC/ATV Alpha Television studio, home to 'Thank Your Lucky Stars' and

'Crossroads'. ATV used the Alpha studios week-days (in the Midlands) and ABC trundled along for *weekends* (in the Midlands). This confusing and arcane arrangement lasted until 1968. Apart from the Midland weekday contract, ATV had also, for the weekends, the lucrative London contract. To facilitate this, ATV used its theatre contacts to acquire studio space in the metropolis. ATV converted two redundant theatres within its orbit; the Wood Green Empire and the Hackney Empire. The London Palladium was also wired with a permanent O.B. link for the weekly production of that highly popular "Sunday Night At..." programme

For completists and those of you who dote on arcane technical details, here are some facts of the TV theatres as they stood in 1957.

Wood Green Empire: The stage at 75 x 35ft (with its slight rake eliminated) was extended by 36 x 50ft to cover the entire stalls area. The original stage flies and fitments remained intact. The lighting consisted (up to a total of 300kW) of Mole Richardson flood 'scoops', incandescent spots and Strand carbon arcs, mounted on servo-controlled hoists. Also in place was a Bodie stereopticon back projection device. (Now there's something I bet you didn't know!)

The camera gear was Pye Mk3 three-inch Image Orthicons (3 channels in use



The Capitol Didsbury in 1996. Home to ABC tv before demolition a few years later



A Pye Mk 3 camera atop a Mole crane at Granada's Chelsea Palace studio

one spare) Vintens supplied Pathfinder dollies (these were mechanical short-rise - 7ft max - with a spring-thrust crane elevation mounted on a turntable base, used also in film production. In the USA this dolly was called the Fearless Panoram. In film production it was called the Velocilator and also the Edmonton). Vinten supplied ATV also with HP 419 pedestals. There was one Mole Richardson counter-balance camera crane and a few lightweight O.B. pedestals designed by an ex-cameraman called Proctor. Also installed at Wood Green was a telecine area comprising a Pye Staticon telecine scanner coupled to the American-made Gray "Teloprojector" multiplex system. There was also a new and prototype cue-dot generator which was on test in the studio. The Wood Green Empire was base for ATV's scenery and the outside broadcast fleet (how many CQ-TV readers own cameras from that very fleet...?) The Wood Green Empire studio produced (in 1957) about seven hours of live programming a week. A coaxial cable linked the studio via ATV's Highbury studios and the Post Office's Museum telephone exchange for switching to their Foley Street Master Control.

The Hackney Empire: Less in size and conversion. Similar technical gear (Pye, Strand, Mole Richardson). The stage area was modified by fitting a 15ft apron over the orchestra pit. The invited audiences

were seated in the circle and upper circle. Shows such as 'Wham!' and 'Oh Boy!' came from the Hackney Empire. .

As mentioned ATV and ABC shared a building in Aston, Birmingham called the *Alpha Television Studios*. This studio complex (sic) was a former theatre and cinema. As a cinema it was unusual inasmuch that the films were back-projected along a short brick tunnel from a rear projection box.

Apart from the stage area, this projection box was transformed into a small studio.



ABC TV's ob base at Didsbury

The studios were equipped with Marconi Mk III 4½ inch I.O. cameras and spares. As a footnote, in 1957 the ATV head in Birmingham was Philip Dorte (ex-BBC), the general manager at Alpha was Bernard Greenhead (ex-EMI) and the E.I.C was Dave Whittle (ex-Marconi). Quite a bit of expertise.

The Capitol Cinema: This was in Didsbury and stood opposite the Parrs Wood pub. ABC converted this cinema creating a ground floor studio space of approx 50ft x 100ft with a small upper-floor studio for regional stuff. Marconis equipped the main studio with Mk III IOs and Pye took their Mk III's upstairs. ABC had also their OB base there.

BBC Television Theatre: Formerly the Shepherds Bush Empire, (near Lime Grove in London). The BBC acquired this 1903 Edwardian property in 1953 to provide production space for mainly light entertainment shows with audience seating of 500. Initially, little was done to convert the theatre into a proper studio (apart from shifting a few rows of seats to make room for a dolly runway and the orchestra) The technical gear was typical BBC hand-me-down stuff, which consisted (in part) of a de-rigged O.B. van (in 1953 the BBC was in the first of its many 'austerity' modes). The Television Theatre cameras were a trio of Pye Photicons (Image Iconoscopes) mounted on Debie pedestals plus a Vinten Pathfinder dolly. This intractable equipment produced crude pictures and inflexible productions. Lighting levels were very high, necessitating extra generators parked along side the theatre



. Granada's Chelsea Palace theatre also known as Studio 10

to boost the current. All this clunky gear restricted creativity. As a consequence the cameras could hardly move anywhere or do anything interesting. The few existing recordings show for what the word 'lumbering' was invented.

In May 1956, the Television Theatre was closed for re-equipping, (the King's Theatre, Hammersmith filled in), and in

July 1957 the TV Theatre re-opened with four new Marconi Mk III 4½ inch Image Orthicon cameras, new Vinten and Mole Richardson mounts and a new lighting system. Productions looked much better and to prove the point, the 'Black and White Minstrel Show' was produced there (once known as the 'fastest show in television'). However it took another few years to correct the appalling theatre

acoustics (they never fully succeeded). The sound in the theatre came over as a distracting hollow echo, assisted by the occasional roar of jet planes and other traffic. This audio problem wasn't helped by having a large round vent in the roof which was opened occasionally to aid the 'air conditioning'. The present writer attended, in the late 1950s and early 1960s, many shows at the Television Theatre and can attest that the place was a bit of a technical lash-up with the added bonus of being extremely seedy. But it was live and exciting none the less.

So what's left? The Wood Green Empire went years ago. A shopping arcade now fills the gap in Wood Green. The Hackney Empire has been 'saved' recently by subscription and is now heading for immortality. Strangely its TV past is rarely mentioned. The Alpha 'Astoria' Studios became the home of local radio but the Capitol in Didsbury was demolished to make room for yet more housing (with pub opposite).

And as for the Television Theatre, well that too has gone, killed off by Terry Wogan actually. The Television Theatre closed in 1993, with a final Wogan show, but fortunately, (unlike all the others), the Television Theatre avoided the wreckers ball and crane and was reborn anew as the Empire on the Green which continues merrily these days as a respected venue for live music. Good show.

Jubilee display

On June 3rd 2002, Dicky Howett lined up a collection of his ancient TV kit to celebrate the Queen's Jubilee. Dicky says, "We decked our village hall (in Essex) with bunting plus a Marconi Mk 2 camera, the type of which photographed the Coronation in 1953. I had also a tape running of the Coronation broadcast. This was displayed on a Pye B18T set with an implant TV monitor, (Japanese of course). For added interest I displayed my Newman Sinclair 35mm movie

camera, (newsreels used these on the day), a Dallmeyer 'Folded 40' 1000mm tv camera lens (this was used to gain close-ups of the Queen at Buckingham Palace) and a 3inch Image Orthicon tube

with a CCD for size-comparison. On display boards I showed pictures of the BBC's Coronation broadcast technical kit plus other details. Visitors were interested generally and a few retired



Marconi employees gave me useful leads as to the whereabouts of Marconi items. One curious feature is that at least two people viewing my b/w display tape swore that they had viewed the original 1953 transmission of the Coronation in COLOUR!"

Blocking Filters

By Willem Lemmens – ON6LW

In connection with the installation of a 23 cm FM repeater in Antwerp, ON5DO has asked me to build blocking filters for 1291 and 1297 MHz. Two of these were needed, one for the transmission side and one for the receiver side of the repeater. These frequencies are spaced 6 MHz apart (see above), therefore the filter must be designed so that suppression of the transmission frequency will not cause signal attenuation at the receiver frequency, and vice versa. Therefore these filters were mainly targeted at better separation between the transmission and receiver sides - however, a few other useful applications were found straightaway, such as suppression of radar interference in the reception of ON0MN, the Antwerp ATV repeater, at 1255 MHz.

The filters described here are partly made out of brass and partly out of copper, coated with a 10µm silver layer afterwards. The silver plating will not be necessary if only copper is used for making the various parts. Just see to it that the surfaces are polished as finely as possible! Rough surfaces cause a higher surface resistance and result in lower Q-factors of the resonators, with higher transmittance losses and less attenuation at the blocking frequency. When constructing the filters, it is best to use SMA connectors, like I did, or N connectors. For reasons of stability, BNCs are better avoided. Screw-on connectors are always better, F connectors excepted – they are toys.

Dimensioning such a filter is not really difficult, but it would be a bit too involved for this article. I did the calculations for you and construction of

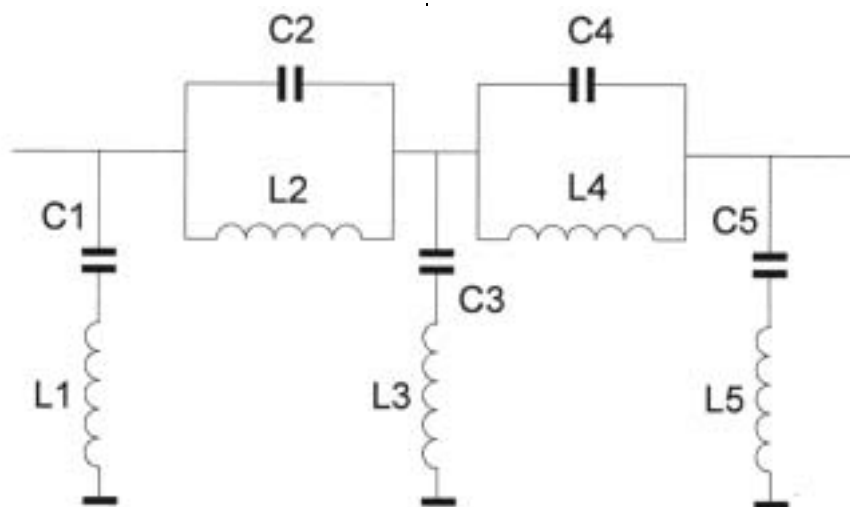


Fig. 1

the filter should be successful if you work carefully. People who want a copy of the calculations and/or the mechanical drawings, can obtain the 6 A3 pages by mail (see address in call book, or inquire by radio).

Basic electronics teaches us that, at its resonance frequency, a series resonator does not only have a purely resistive impedance, but its minimum impedance as well. By putting this series circuit in parallel between signal and ground (as in figure 1), the signal is practically shorted at the resonance frequency: presto, a blocking filter - maybe a simple way of putting it, but it is the working principle.

Here, a cascade of three such blocking circuits is used to enhance the effect. Of course, according to Thomson's formula, several LC combinations would result in the same series-resonance frequencies.

In the present filter, instead of coils and capacitors as such, distributed elements or transmission lines are used. This is

because, at higher frequencies, the so-called 'lumped components' show too much parasitic properties. Capacitor lead wires, for instance, constitute a parasitic self-inductance, while coil turns will give rise to undesirable capacitance.

In our case, the series circuit is a resonator at nearly one quarter of the wavelength. Nearly? Well, the design length is a bit shorter (frequency a mite higher), since the capacitive load of the resonator will lower the frequency slightly. This capacitive load is built up from the gap between the resonator bar and the transmission line between the input and the output of the filter. The distance between the resonators can't be just any value either. In figures 2 -3, the full equivalent diagram of the band blocking filter is shown.

The filter calculations were done in such a way that the main transmission line was exactly 50 ohm throughout. This poses no problems with filters with an odd number of resonators and considerably facilitates construction (routing).

The series circuits L1 C1, L3 C3 and L5 C5 were already described above. The circuits L2 C2 and L4 C4 are called impedance inverters and admittance inverters; these are transmission line sections of exactly $\frac{1}{4}$ wavelength. The equivalent diagram shows three series circuits and two parallel ones. The series circuits stand out clearly (as described above): they consist of a slightly shortened $\lambda/4$ resonator with capacitive

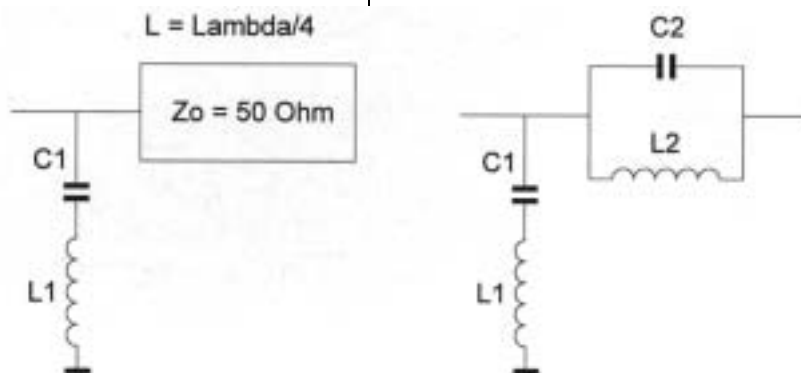


Fig. 2 - 3

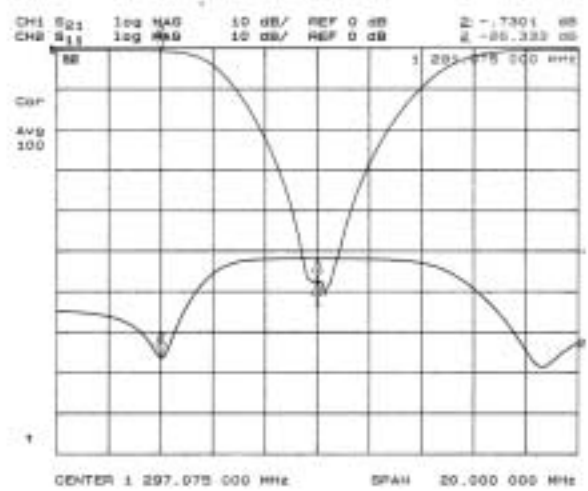
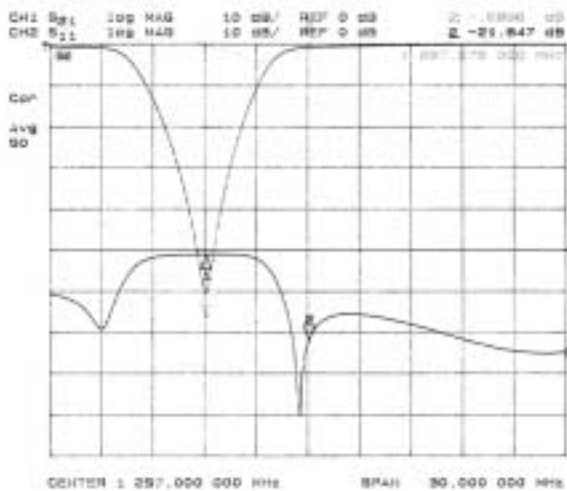


Fig. 4 - 5

load. The parallel circuits are in fact built up by transforming these series circuits into parallel components using the quarter-wavelength impedance transformers.

For people with an understanding of Smith diagrams, this will be easier to see. The main reason is separation of the resonators from each other. If these inverters were to be omitted, the three resonators simply would be connected in parallel, and could be regarded as one single resonator (series circuit) with different properties. The result would be way off target.

The effect of the finished filters may be judged from the plots shown in figures 4 - 5. The filters were adjusted to the

frequency and blocking band width required. The blocking factor is about 60 dB.

The transmittance losses at 6 MHz offset (repeater spacing) are about 0.75 dB, with the reflection attenuation at this frequency still at a nice 20 dB. Tests with other adjustment procedures yielded a blocking factor of 75 dB, but in those cases the reflection attenuation at 6 MHz offset was no better than 18 dB.

The blocking can, of course, be enhanced by using more resonators. This would also allow less coupling while the blocking factor remains the same, resulting in a narrower blocking band. This in turn makes a smaller offset between transmission band and blocking

band possible.

As will be apparent from the photographs, each resonator can be adjusted in two ways:

1. Resonator length
2. Coupling to main transmission line

I put M10 thread with fine pitch on the resonators. For the coupling to the main transmission line, two different approaches were used, an expensive one and a cheaper one.

The expensive - and, of course, better - solution uses special 'microwave tuning screws', while the cheaper method

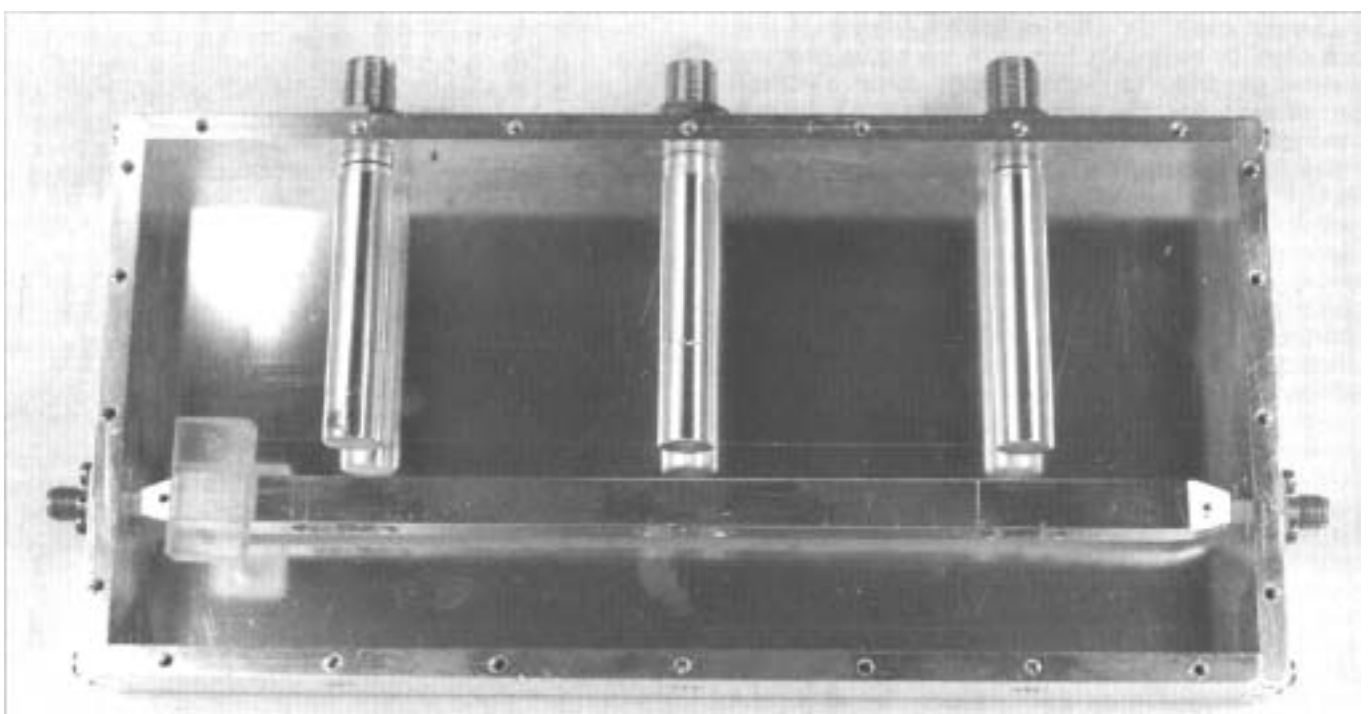


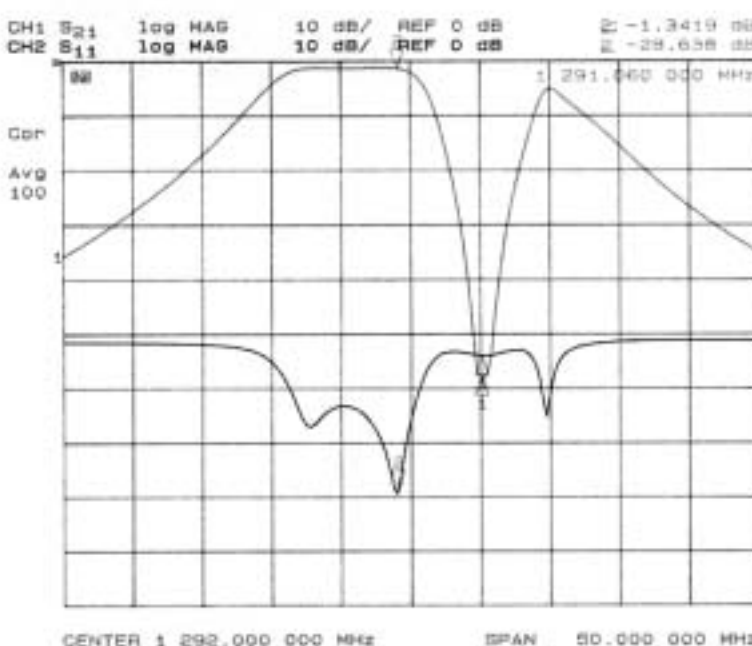
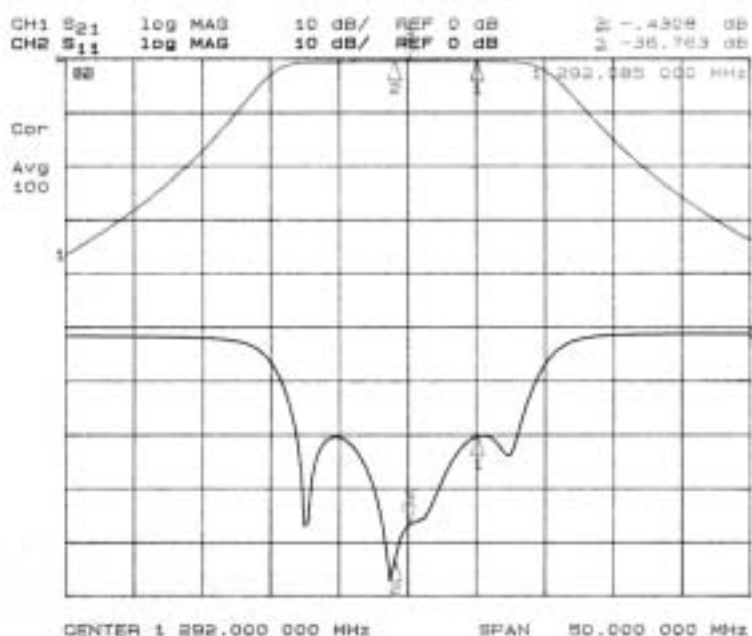
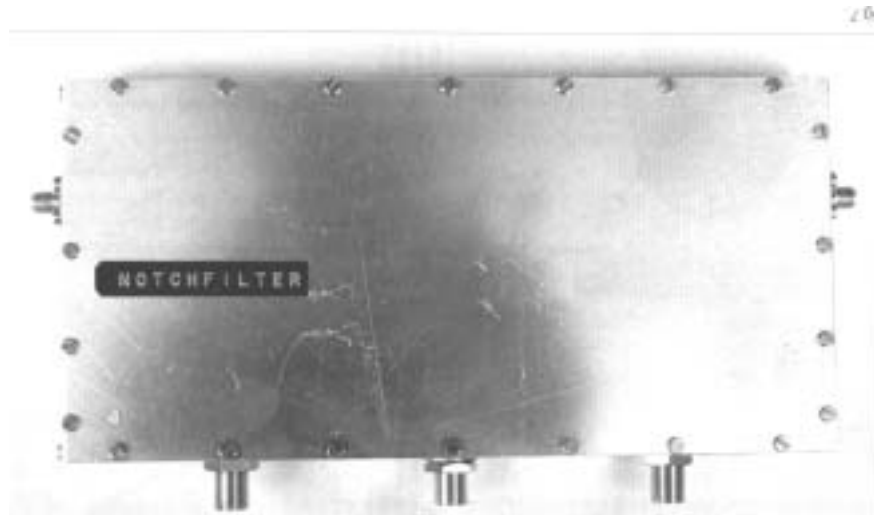
Fig. 6

utilizes M6/pitch 0.5 mm adjusters.

This version of the filter is quite practical for frequencies above 1 GHz. In other articles I have already described a number of other filters, such as for the 70 cm, 13 cm and 3 cm bands.

In view of the longer resonators used at < 1 GHz, a slightly different approach must be taken in order to prevent mechanical stability from becoming too low, since resonator vibrations would cause phase modulation of the signal passing through.

I am fully aware of the fact that not



everybody owns routing tools, but such equipment is indispensable for obtaining good results. It is actually possible to construct a filter such as described above out of soldered copper sheet, but its stability would be insufficient for several applications.

The graphs in figures 8 and 9 show the combined effect of a blocking filter described here and a band pass filter. I am using a similar combination to suppress interference near the output frequency of ON0MTV.

Sincere thanks to ON5DO (sk) and ON4BCB for taking the photographs and integrating the filters into the repeater.

References:

Microwave filters, impedance - matching networks and coupling structures; Matthei, Young & Jones - Artech House 1980.

Foundations for Microstrip circuit design; Terry Edwards - John Wiley & Sons, 1992.

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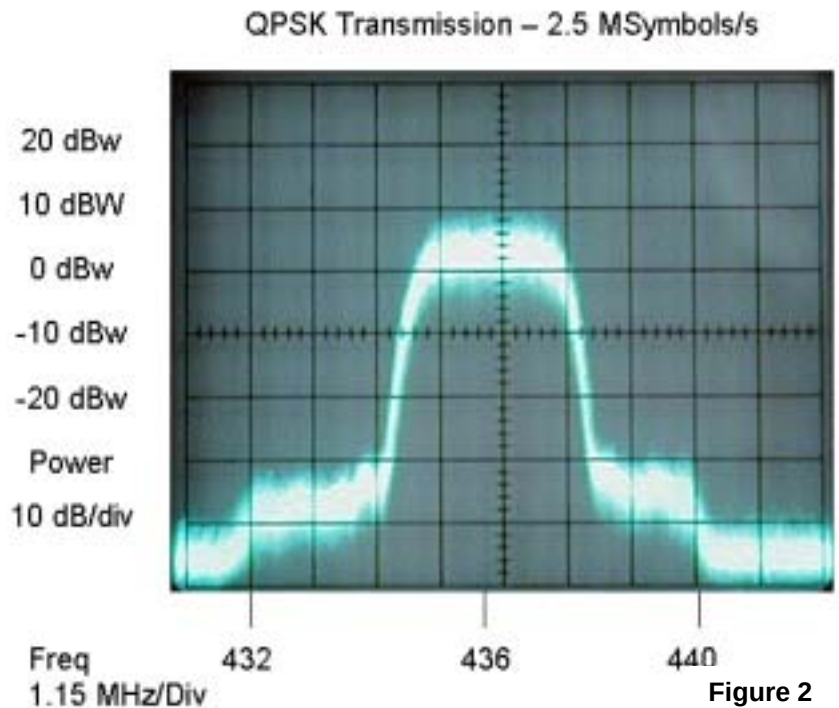
Fig.8 - 9

70cm digital ATV in practice

By Dave Crump, G8GKQ

Using ex-commercial equipment, Noel G8GTZ and I recently started tests of digital ATV in 70 cm. Initial results have been encouraging, with regular success over the 73 km obstructed path between us.

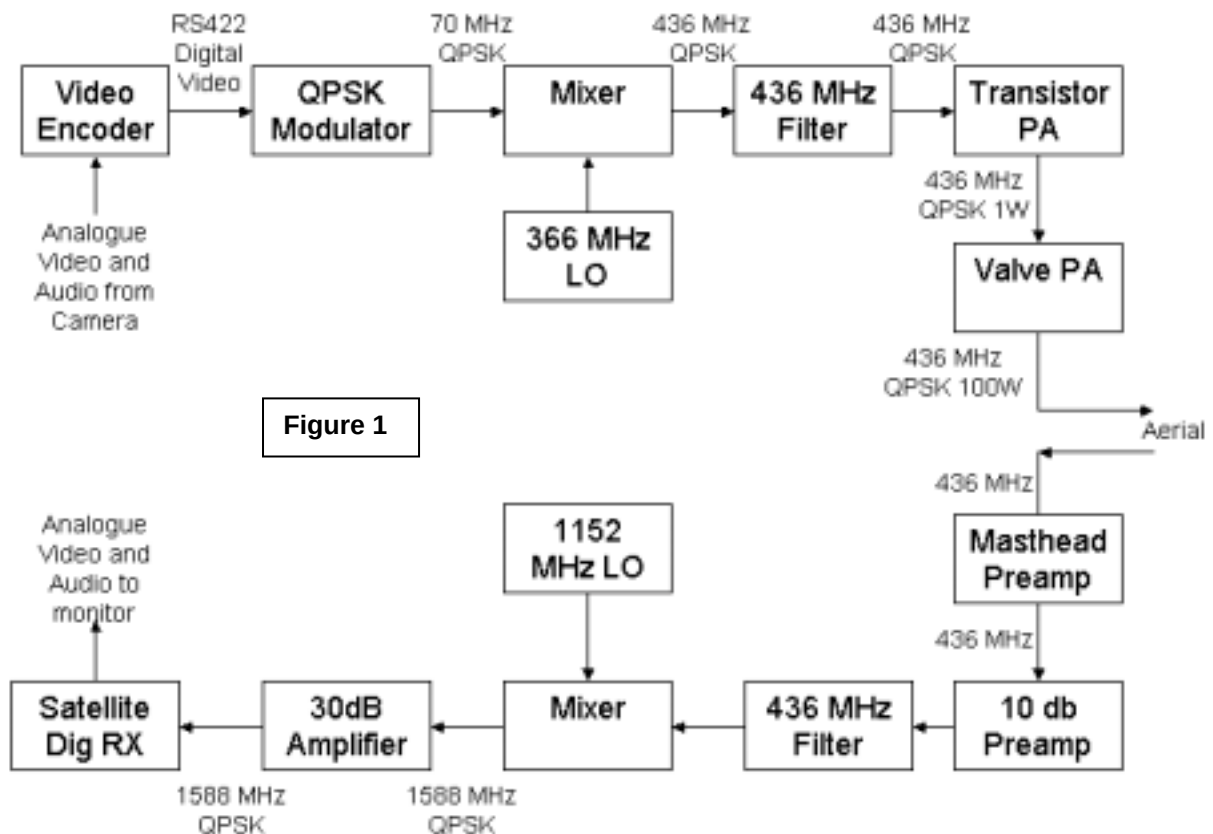
For these tests, we have been using QPSK (quadrature phase shift keying) modulation – the same as is used for DVB-S Digital Satellite transmissions. The advantage of this over OFDM (orthogonal frequency-division multiplexing, as used for terrestrial digital transmissions) is that the bandwidth can be reduced at the expense of moving picture quality. With a QPSK symbol rate of 2.5 mega-symbols/seconds, the transmitted bandwidth is less than 3 MHz and the actual compressed video bit rate is approximately 2 Mbit/s. The DVB-T terrestrial OFDM modulation standard has a fixed RF bandwidth of 8 MHz – too wide for 70 cm, but does allow up to 5 Mbit/s compressed video, even when used in its most rugged mode.



Equipment

The transmit and receive equipments are shown below in Figure 1; on the transmit side only a different local oscillator was required to modify my existing 70 cm

AM VSB Transmitter. For receive, a new converter had to be built to up-convert the signal to within the digital satellite receiver tuning range. As the satellite receiver was designed to be used with a high gain down-converter, lots of gain



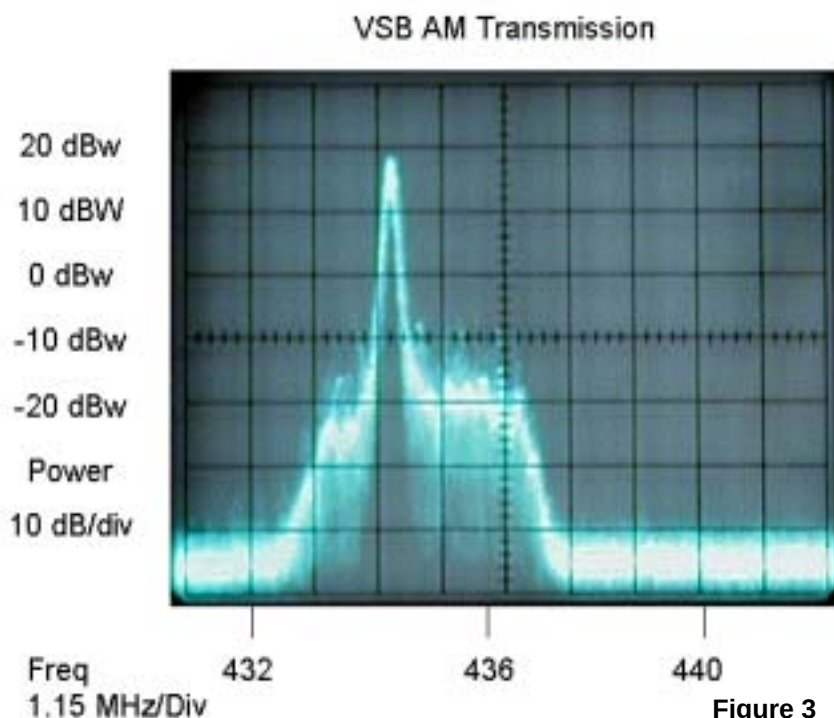


Figure 3

was included in the receive converter.

Spectrum

The transmitted spectrum is shown in Figure 2. The main signal is spread over 2.5 MHz; the 2 “step” sidebands are caused by non-linearity’s in the transistor PA. As can be seen, the power is evenly spread over the bandwidth. Figure 3 shows an amplitude modulated analogue (VSB) TV signal with the same power and the same analyser settings. Notice how the potential for interference to other narrowband users is significantly

reduced with the digital signal. The maximum power in any 25 kHz FM channel is over 20 dB below the total transmitted power.

Received Signal

The signal as received by G8GTZ is shown in Figure 4; notice how it is only 8 dB above the noise floor as shown in figure 5. The signal margin on this occasion was only about 3 dB. Reduction in transmitted power below 50W caused total loss of the digital signal.

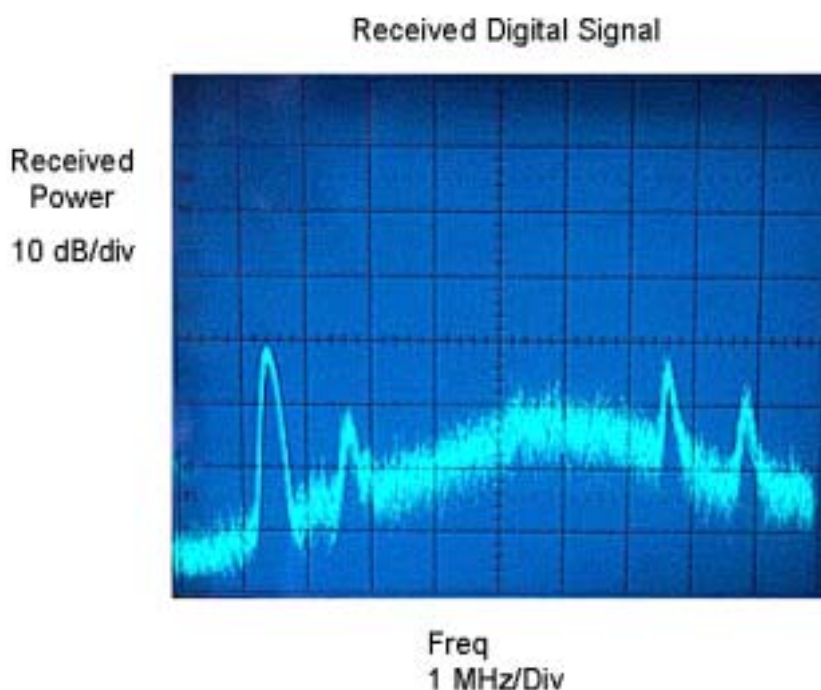


Figure 4

Comparisons with AM

Some initial comparisons with conventional AM transmissions have been carried out. Over the same path, AM signals are around grade 2 – and this for a monochrome picture with no sound. The digital signal though, when locked up, is grade 5 with 2 stereo sound channels. Of course, if fast moving images were to be shown, the limitations of the 2 Mbit/s video payload would become apparent, particularly when using 6 year old video compression technology as we are for our tests.

Multipath

QPSK is not commercially recommended for terrestrial links due to its poor performance under multipath conditions (OFDM performs a lot better). Not enough experience has yet been gained at low signal margins to assess the extent of this problem for amateur TV. However, it has been observed that aircraft flutter is very frequency dependent. Figure 6 shows the effect of aircraft flutter on the received signal. The peaks and troughs move along the spectrum. Digital lock is lost in when the flutter gets too deep.

24 cm

Using similar equipment, very early tests have been carried out in 24cm. The path between G8GKQ and G8GTZ is not good enough for 24cm, but a QPSK receiver has been installed at the GB3HV repeater and can be switched on using DTMF tones. Further tests are also planned using OFDM on 24cm.

Standards

We have been using the following standards: -

- 70 cm: Carrier freq 436 MHz (not critical), QPSK 2.5 Msymbols/s FEC ½
- 24 cm: Carrier freq 1250 MHz (not critical), QPSK 5.4 Msymbols/s FEC ½
- 24 cm OFDM: Carrier freq 1252 MHz (plus multiples of 8 MHz), Guard interval 1/8, FEC ½

The use of multiples of 8 MHz for OFDM transmission allows a single down-converter LO frequency with the channel being selected on the digital receiver.

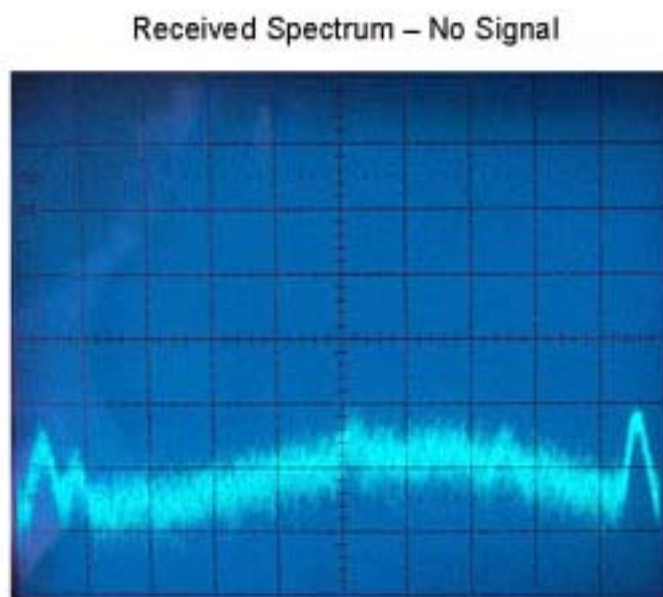
Is it ATV?

There are some within our hobby who are worried that Digital is not the way to go. In my view it complements analogue TV. In use, it does not seem like a data mode; the RF requirements are very similar to analogue AM TV (wide bandwidth, flat passband, good linearity) and the end result is an almost perfect picture. I think that it is just another aspect of the hobby – at least now those with the ex-studio cameras can transmit their pristine pictures and have them arrive in equally good shape! There will always be a need for AM on 70 cm for distance and FM on the microwave bands for simplicity. Digital does have the potential to revitalise 70 cm – that can't be a bad thing.

The Future

For long distance work, 70cm digital is very promising, for local work, 24cm

Received
Power
10 dB/div



Freq
1 MHz/Div

Freq
1 MHz/Div

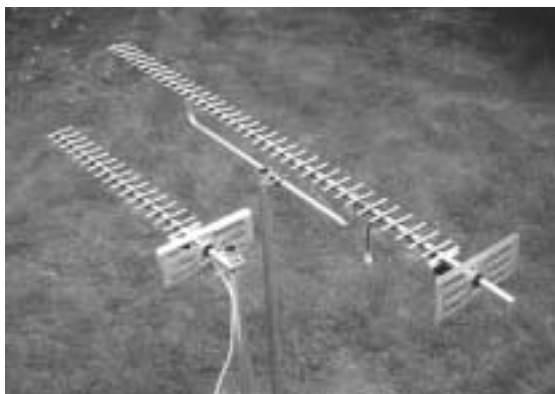
Figure 5

looks interesting, but its early days yet!
If you want any more information, please
e-mail me at
davidcrump@alumni.soton.ac.uk

Below is the digital picture as
received by G8ADM from G8GKQ
on 1250 MHz over a 12km path.
Note the lack of noise.



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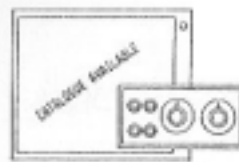
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- May 20th March
- November 20th June
- November 20th September.

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 1 so that you understand the implications of submitting an article for publication.

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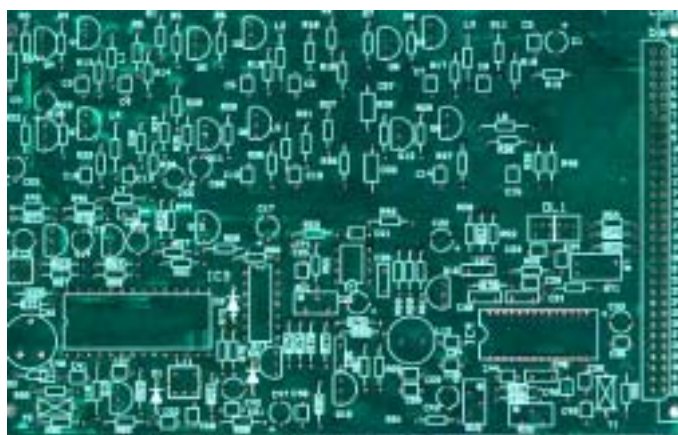
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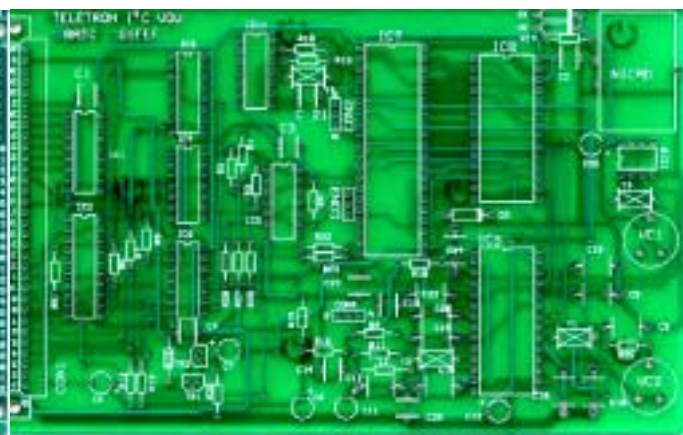
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A description of the various PCB's and components can be found in the 'What's What' guide, or on the CQ-TV Internet pages at www.cq-tv.com (A printed copy available on request, if you send a S.A.E.). Components for club projects are not available from Members Services unless contained within these lists. All club crystals are HC18/U (wire ended). To avoid delay and inconvenience, please be careful to include the correct payment with your order – please do **NOT** send stamps or cash. Post and packing costs are for despatch of one item to United Kingdom members.

Circuit Details can be found as follows:

An Introduction to ATV: PCB's 10, 40, 41, 47, 86. **CQ-TV 174:** PCB 7

CAMERA TUBES A tube guide appears in CQ-TV 149 and 150. Tubes are now difficult to obtain and members requesting information on availability, prices or other types of tubes or equivalents are asked to send a stamped addressed envelope for their reply.



The BATC cloth badge (item 74)

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PLEASE MAKE CHEQUES PAYABLE TO 'BATC'.

By Paul Holland G3TZO

Apologies for the disappearance of Satellite TV News in the last issue. As usual I am citing the same lame excuses of too many competing activities. This issue reports on some of the developments that have occurred in the intervening period and reflects the contributions from members who have answered the call of putting pen to paper – or just pounding that keyboard to send me an email.

Transponder News

As usual the following snippets of news only reflect a small proportion of the many changes happening all the time. Many of the channel changes reported nearly every day from one source or another will be out of date before you can check them out yourself. It appears that new digital services particularly, have a short period of free to air transmission before encrypting as part of one package or another. Similarly some services will go FTA for short periods and then encrypt again. Feeds, by their nature, are mostly sporadic and can not be relied on to appear at the time that you check a specific transponder where feed activity has been reported. I'm sure most readers already take this into account when searching themselves.

As usual for up to the minute news of changes I suggest you use the Internet to visit the following two excellent sites <http://www.lyngsat.com/> (for every satellite aloft) whilst Stefan Hagedorn provides daily email updates of the changes which are taking place at <http://stefan.hagedorn.de/transpon2.htm>.

Europe*Star 1 45.0 Deg E

Telly Track has started on 11.495 GHz/V, SR 3254, FEC 7/8, European beam

Astra 2 & Eurobird 28.5 Deg E

Arabic channels ART Europe, ART Aflam, ART Music and the Lebanese service LBC sat have all started transmissions on Eurobird at 11.527 GHz (V) SR 27500, FEC 2/3

Astra 1A,B, C etc 19.2Deg E

The European version of Fox News on 12.441 GHz (V) SR 27500 FEC 3/4 is now encrypted using Mediaguard 2.

Hot Bird 1-5 13 Deg E

Asianet has started on 12.437 GHz (H) SR 27500 FEC 3/4



Asianet

HCN - Hollywood Classics Network has started on 12.303 GHz (V) SR 27500 FEC 3/4. Jordan Satellite Channel has started on 12.673 GHz (V) SR 27500 FEC 3/4. The radio service ETBC Tamil has started tests on 10.722 GHz (H) SR 29900 FEC 3/4.



ESPN Classic Sport

Eutelsat W1 10 Deg E

Mihr TV (not the spacecraft) has started on 12.701 GHz (H), SR 2170, FEC 1/2.

Telstar 5 15 Deg W

The ADTH multiplex has moved from 12.608 GHz (H) to 12.595 GHz (H), SR 31830, FEC 3/4.

NSS & K 21.5 Deg W

The Reuters news feed service on 11.4895 GHz SR 5632 FEC 5/5 closed in August and was replaced with a feed on 11.605 GHz SR 4000, FEC 5/6.



Reuters daily feed

The Congolese and Senegalese channels RTNC and RTS 1 have moved from 11.685 GHz (H) to 11.002 GHz (H), SR 6515, FEC 3/4.



RTS 1 (Senegal)

Hispasat 1C 30.0 Deg W

Canal Andalucia Turismo has started on 11.891 GHz (V) SR 27500 FEC 3/4.

Launch News

Hot Bird 6 Launch

HOT BIRD 6 was launched in August from Cape Canaveral by an Atlas V launcher and entered service at 13.0 Deg E during September.

Built for Eutelsat by Alcatel Space and weighing in on the launchpad at 3990 kilos, HOT BIRD 6 is equipped with a 32-transponder payload and provides one Ku band and four different Ka band footprints over Europe. The new satellite will take on the channels currently broadcast by HOT BIRD 5, which has



solar array problems. HOT BIRD 5 will be relocated to a new orbital position, which as yet has not been published

Atlas V Launch Vehicle

Hot Bird 6 will enable direct access to the satellite for small on-ground terminals to access a new range of services using Ka-band in conjunction with the SKYPLEX on-board processing and multiplexing payload. This is intended to facilitate the development of new broadband services for connecting sites and for micro broadcasting for enterprises and regional authorities.

Hot Bird 6 profile

Constructor: Alcatel
Platform: Spacebus 3000 B3
Lifetime: 15 years
Launcher: Atlas V
Orbital position: 13° East
Coverage:

- 1 Ku band Widebeam
- 4 Ka band spots on the uplink
- 1 wide Ka band spot on the downlink

Payload 32 transponders:

- 16 x 33 MHz Ku band transponders
 - 12 x 36 MHz Ku band transponders
 - 4 x 72 MHz Ka band transponders
- 6 of the transponders are configured in SKYPLEX mode (2 Ku-Ku and 4 Ka-Ka)

Downlink frequencies:

- Ku-band: 10.7-10.95 GHz, 10.95-11.20 GHz, 11.45-11.70 GHz, and 12.5-12.75 GHz.
- Ka-band: 19.7-20.2 GHz

Atlantic Bird 3

Atlantic Bird 3, formerly known as Steliat 5, was launched successfully on 2nd July. At the time of writing (mid September) the satellite was becoming operational from its planned position at 5.0 Deg W. Atlantic Bird 3 is equipped with 35 Ku and 10 C tps and has now replaced Telecom 2C. Transponder frequencies are unchanged.

Intelsat 905

Intelsat 905 satellite was successfully launched aboard an Ariane 44L vehicle back in July. Intelsat 905 will be located at 24.5°W providing capacity for telephony, corporate networks, Internet, video and hybrid space/terrestrial solutions to customers on its 72 C-band and 22 Ku-band transponders (measured in 36 MHz equivalent units). The satellite will provide high power Ku-band spot beam coverage for Western Europe and much of North America and additional C-band capacity to customers in Europe, the Middle East, Africa, North America and South America. Intelsat 603, which was at 24.5°W, is to be moved to 178°E to create a new satellite role at that location. At the time of writing no transponders were active.

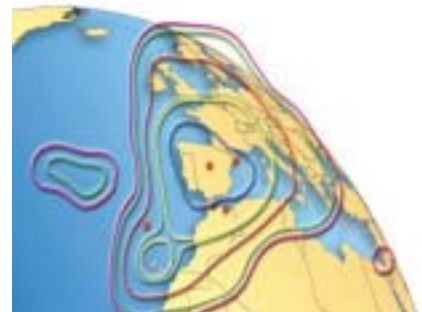
Atlantic Bird 1

Atlantic Bird 1 lifted off from the Spaceport's ELA-3 launch complex at Kourou aboard an Ariane 5 on 28th August. Atlantic Bird 1 is a three-axis stabilised telecommunications spacecraft for Eutelsat connectivity services from the eastern seaboard of the Americas into Europe, North Africa and the Middle East. Flight 155 had been delayed one day following a launch hold because of an indication of a computer dialog problem between the ground control network and Ariane 5's on-board computers. Atlantic Bird 1 carries a 24-transponder Ku-band payload and is now positioned at 12.5 degrees West -- serving Eutelsat's Atlantic Gate for telecommunications that span the European and U.S. continents. The spacecraft weighed 2,700 kg. at lift-off. On Flight 155, Atlantic Bird 1 was carried in the upper payload position and was released approximately 28 minutes into the mission, followed eight minutes later by deployment of the MSG-1 spacecraft. Arianespace aim to keep to their launch program for the remainder of 2002, with an Ariane 4 launch set on

September 6 carrying the Intelsat 906 satellite. It will be followed several weeks later by the first flight of an Ariane 5 with the increased-lift performance of 10 metric tons into geostationary transfer orbit. The "10-ton" Ariane 5's upcoming maiden mission will carry the Eutelsat Hot Bird 7 satellite.

Hispasat 1D

International Launch Services launched Hispasat 1D in September from Cape Canaveral. The payload, weighing approximately 7165 lbs. (3250 kg) at separation, was carried by an Atlas IIAS launch vehicle. HISPASAT 1D will be located at the 30° west orbital position and carries 28 Ku band transponders. Hispasat 1D's mission is to ensure the continuity of Hispasat 1A and 1B in the 30° W orbital window, thereby making it easier to transfer traffic when necessary given that the lifetimes of satellites 1A and 1B are forecast to end in 2003. The satellite provides a beam over the Middle East which by using a double hop link gives the access to Asian satellites for American and European customers (and vice versa).



Hispasat 1D Footprint

Coverage Zone	Min EIRP
3/4 Zone IA	53.5 dBW
3/4 Zone IA'	51.5 dBW
3/4 Zone IB	52 dBW
3/4 Zone IB'	46 dBW
3/4 Zone IC'	49 dBW
3/4 Zone EA	48 dBW
Tel Aviv	45 dBW

New services

RTR-Planeta

Russia's state-owned RTR television service will be launching a new channel called RTR-Planeta. The channel will be available in all European countries after later this year and will be FTA. The channel is aimed at Russians living

abroad who want Russian-language news and cultural programs. (AP)

Carlton Cinema

Carlton Cinema, the free-to-air film channel, looks set to join Sky Digital before the end of the autumn. The channel was reported to have been holding talks with British Sky Broadcasting about a possible launch as part of Sky Digital. The 24-hour film channel wants to be available on all digital TV platforms.

New Satellites

Amos 2

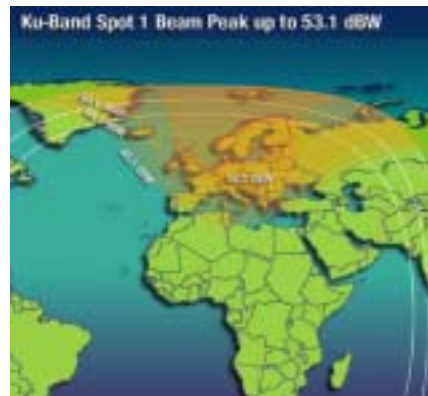
AMOS-2 is scheduled to launch in the first quarter of the New Year. Carrying 11 active transponders from a total of 14. AMOS-2 will offer "hot beam" coverage of Europe and the Middle East, cross-strapped to accommodate direct access from the Eastern United States. This connectivity is aimed broadcasters and programmers with material originating in the U.S. The satellite will be used for distribution to cable headends, direct-to-home TV, broadband services including IP connectivity distribution to local ISPs and business data transmissions for private and public networks.

AMOS-2 will be co-located with AMOS-1 at 4 degrees West, and will also enhance the backup capability at this position. The satellite is designed to provide full communication services for a minimum life of 11 years. AMOS-2 has a higher power than AMOS-1 (1320 watt P/L Power relative to 800 W, and each transponder holds 75 watts power relative to 37 watts on AMOS-1). Eirp will be 54 dBW at beam centre. Given that no footprint map has yet been published it will be interesting to see if reception is possible in the UK.

Intelsat X Series

It seems only a very short a time ago when Intelsat were still using their 5 series satellites. Intelsat has now signed two launch services contracts, one with Boeing Launch Services for a Sea Launch Zenit-3SL vehicle and the second with International Launch Services (ILS) for its Proton M/Breeze M vehicle, for the launch of the two Intelsat X series satellites (10-01 and 10-02). The 10-01 and 10-02 satellites, manufactured by Astrium, are scheduled for launch during the second and third

quarters of 2003. These spacecraft have a design life span of 13 years each and will be deployed over the Atlantic Ocean region. The X series are the first Intelsat satellites to use plasma propulsion for in-orbit station keeping. This more propellant-efficient design allows for an increase in the useful mass of the spacecraft by fifty percent over the Intelsat IX generation. This mass can be used for providing more transponders or more power per transponder. Both satellites will provide Internet, broadcast, corporate network and telephony/data solutions to Intelsat customers.



Intelsat 10-02 @ 1.0°W

The 10-01 is scheduled to be deployed at 50°W and has been designed to provide 23 Ku-band and 56 C-band transponders (measured in 36 MHz equivalent units). The 10-02 is planned for the 1.0°W location with 36 Ku-band and 70 C-band transponders (measured in 36 MHz equivalent units). E.i.r.p. power levels for the spacecraft are 37 dBW to 42 dBW for zone beams, 37 dBW to 41 dBW for hemi beams (Intelsat 10-02) and up to 54.9 dBW for spot beams.

Anti-piracy

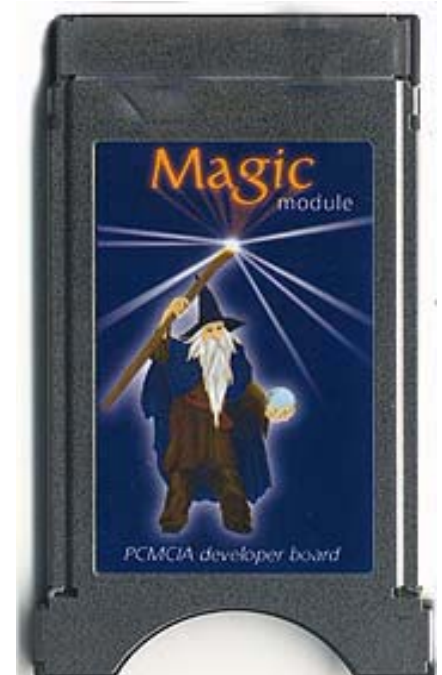
Viaccess, France Telecom's conditional access subsidiary has initiated harsh steps against companies that it views as having insufficient anti-piracy measures, revoking their licence to manufacture set-top boxes with Viaccess embedded encryption. The first casualties were Humax and Samsung Electronics. Korean-based Samsung Electronics has not been allowed to produce its DSR9000VICI, DSR9000VIA, DSR9500VICI and DSR9500VIA digital receivers since May, as Viaccess alleges that Samsung Electronics employees may have supported set-top box piracy and even sent out a 'hacker-friendly' software updates via satellite. The

Samsung Corporation, which is unaffected by the measures, can continue to manufacture its Viaccess-encrypted SVA-202, SVACI-202 and SVADCIP receivers. Humax, meanwhile, is accused of taking insufficient measures against the widespread piracy of its IRCI 5400 set-top box using a so-called "allcam patch". Although it had an embedded Irdeto conditional access module, the IRCI 5400 became very popular in the piracy scene after hackers managed to develop software that enabled the reception of most of Europe's digital pay-TV platforms, encrypted in various conditional access systems, without the need for an official smartcard. On 1 July, Viaccess withdrew the licence from Humax for "breaching licensing conditions". Both manufacturers are believed to be challenging the charges.

Magic Cams

So far there appears to be no let up in the introduction of innovative techniques for reception of digital services.

In recent months we have seen the introduction of a number of devices variously known as Magicams, Free Cams and Universals Cams all designed to mimic the combined functionality of the various proprietary CAMS for Viaccess, Irdeto etc. These PCMCIA devices are usually based on 30Mhz ARM7 processor with 256Kb of RAM and 2Mb Flash inside. The 68 pin PCMCIA connector slots into the CI slot of suitably equipped DVB receivers. The software is updated by use of an interface card inserted into the module and the use



appropriate loader software to flash it. The modules need power during programming process since RS232 is not capable of providing enough current for the job. Inserting the module into one of the receiver's CI sockets or a laptop PCMCIA slot achieves this. The devices will allow access to Seca 1 & 2, Viaccess 1 & 2, Nagravision, Irdeto Betacrypt and Cryptoworks all in one Module.

From the Post Bag

A short message was received from Pierre Binggeli, HB9IAM, who's QTH is Geneva. Pierre says he enjoys "Sat News" having read the column for 10 years – has it really been that long! He says he has just tested a monoblock LNB operating in conjunction with an Aston Xena 2000 and is planning to test a dual monoblock LNB in the near future. Please let us know what results you get Pierre.

Colin, G4OHV, wrote querying a good source of larger dishes over 1.3m in size. The really large dishes over 2.5m have tended to originate in the US where they were used for C Band reception. Given that C Band has never quite had the same popularity here with largely Ku band services targeted at Europe it has rarely been necessary in the UK to go over 2.0m. My recommendation to Colin, subsequently taken up was to look at the Channel Master range, which are readily available here. Colin uses a Manhattan DSR 2500 APCI analogue and digital reception and a Samsung DSR9500 VIA CI. In addition to the new Channel Master 1.2m antenna he also has a 95cm Funke with a 0.6db LNB. He also reports that he is playing with 10.0GHz ATV amongst other satellite-related projects. Keep up the good work Colin.

Arthur G2FUD has confirmed the demise of PI6ALK's channel on Eutelsat W2. The repeater feed has been on and off frequently this year but sadly looks as if it really has gone QRT this time. Allan G3TQA and Dave G6BIU also queried the position on PI6ALK as they searched vainly on 12.742GHz (H), symbol rate 3000, FEC 5/6 using an 85cm with H-H mount. I was able to confirm that had the transmission been there an 85cm dish would have been Ok – perhaps it will reappear. Perhaps somebody at PI6ALK will let me know and I can pass the news on.

Off Air

Having taken a few notes after reading Roger Bunnney's excellent "Satellite Search" in What Satellite Magazine I checked out a couple of the feed sightings reported. I can confirm that Intelsat 801 at 31.5 Deg W carries a number of interesting feeds on 10.957, 10.966, 10.974, 10.982, 10.990, 10.999, 11.008, 11.016, 11.024, 11.486, 11.494, 11.504 and 11.513 GHz (V) all using SR 5632 and FEC 3/4. The most active period seems to be between 17.00 and 18.30 where you will see Meridian and Anglia contribution feeds for their evening news.



Meridian News feed

NSS 7 at 21.5 Deg W which has now taken over from NSS K (now de-orbited) provides a rich source of feeds of all kinds. The test card below from the Australian PTT Telstra was captured in August on 12.674 GHz (H) SR 6110, FEC 3/4.



Telstra Feed on NSS 7

A satellite not often mentioned is the Russian Express 3A at 11.0 Deg W. It wasn't that long ago that nearly all Russian services were in C band or were using inclined orbit satellites that made location difficult. Express 3A has both a C band and Ku band payload with a mix of broadcast and occasional feed traffic. Kurdsat is carried here as well as Italian, Georgian and Serbian TV services.



Kurdsat on Express 3A

I'm always interested in reports of what readers are able to receive, particularly in respect of those satellites, which provide only a marginal footprint for the UK. One such bird is Nilesat which if its published footprint was to be believed was clearly not designed for reception here



Nilesat 1 & 2 Footprints

I am able to receive Nilesat on the 1.5m offset antenna however the signal fades during the day (approximately for the period 0900 – 1800 hrs) and then is received fine at night. Do any others readers have similar results? Showtime (pictured) is on 11.862 GHz (V) SR 27500, FEC 3/4.



Showtime on Nilesat

Launch News

As usual the launches in the table above are subject to revision. Given my comments earlier regarding the launch of the Intelsat X series of satellites it can be seen that even relatively new satellites

Launch Date	Satellite	Launcher	Deg	Payload
020828	Atlantic Bird 1	Ariane 5	12.5° W	28 Ku Tps replacing Eutelsat IIF4
020906	Intelsat 906	Ariane 4	27.5° W	14 Ku and 42 C band Tps replacing Intelsat 605
020918	Hispasat 1D	Atlas 2AS	30.0° W	28 tps covering 10.700-10.950 & 11.200-12.200 GHz replacing Hispasat 1A/B
0206	Hot Bird 7	Ariane 5	13.0°E	40 Ku tps will replace Hot Bird 3
0204-06	Astra 1K	Proton	19.2°E	Ka tps and 46 Ku tps will replace Astra 1B & 1C
0204-06	E-Bird	Ariane 5	25.5°E	20 Ku tps
030201	Hellas Sat 2	TBA	39.0°E	34 Ku tps
030406	Eutelsat W3A	TBA	7.0° E	50 Ka & Ku tps co-located with Eutelsat W3
030709	Intelsat 10-02	Proton	1.0° W	20 Ku and 36 C tps replacing Intelsat 707
030712	Hotbird 8	TBA	13.0°E	4 Ka and 44 Ku tps replacing Hot Birds 1 & 2

such as Hot Birds 1 & 2 are now coming up for replacement.

Web Watch

A useful and interesting site of satellite interest can be accessed via the Satellite Signals home page: <http://www.satsig.net>. Of particular interest is a Satellite finder with magnetic north, azimuth & elevation calculator accessed via <http://www.satsig.net/ssazelm.htm>

For those interested in online satellite calculations check out <http://home.online.no/~jensts/satellite.htm>. It was a little slow when I tried it (56Kbit/s modem) but worth the effort.

The Loral Skynet web site allows download of a general help tool for antenna aiming, link budget analysis, solar outage prediction and other important applications. Based on Satmaster Pro it gives a restricted subset of features but is a good opportunity to try out some of the features of Satmaster Pro before shelling out hard earned cash yourself. Check http://www.loralskynet.com/tech_resouces/tools/tool_us.asp

If you have any interesting sites you have found let me know and I will pass the on here.

Product News

A new range of high quality “F” type crimp connectors for CT100, WF100, CS 100 and similar sized cables should now be available from dealers. The range consists of two connectors, which provide an alternative to the traditional twist-on ones and are general-purpose, making them suitable for permanent and secure connections in all types of applications.

The first has a deep thread for secure fixing to the mating “F” type socket and a broad flanged nut for ease of tightening. Cables can be easily and correctly prepared using a suitable coaxial cable stripping tool. It is then a simple matter of pushing on the connector, until the dielectric is flush with the inner face of the connector, and crimping with a suitable crimping tool. The result is a very professional looking, secure and high performance connection that will give many years of reliable service, even in situations where connections are disconnected and reconnected on a regular basis.

The second connector is also of the same high quality and functionality but has the

added benefit of an internal “O” ring, providing moisture proof connections. This gives added protection to connections exposed to possible moisture ingress such as equipment housed within external equipment cabinets or “F” connector equipped masthead amplifiers. Whilst connections exposed to the elements, such as LNB connections, should continue to be protected by means of self amalgamating tape, the use of the moisture barrier “F” connectors provide a second line of defence against possible moisture ingress.



A USB connected multi-programmer

has just been launched for those interested in programming various smart cards. A key benefit of this is that the programmer also takes power from the USB (Universal Serial Bus) port, via a standard A-B USB-cable, eliminating the need for an additional DC-adaptor). The device is USB1.1 compliant and works on both USB1.1 and USB2.0 controllers, to ensure future compatibility.



USB Programmer

Conclusion

That's it's again for another issue of Satellite TV News. Thank you to those who wrote and emailed last time – its always nice to know what you are doing and passing on any tips or experiences you may have had. As usual the contact details are the same; email via paul.holland@btinternet.com or phone to 01948 770429 or even fax to 01948 770476.

Contest News

By Richard Parkes G7MFO

I am writing this article the week after the International contest and a day after this article should have been sent to Ian.

I will start off with the Summer Fun contest as you can see from the results below G7ATV group went portable comprising of Viv G1IXE and Ken G4BVK. The maximum distance they managed to work was 86km on 23 cm to G4UVZ which showed the conditions was poor or lack of stations on the air!

Roger GW4NOS also went portable on the Saturday evening with 24cm and managed to work the four stations within an hour, before packing up. He was using a G1MFG to an M68719 PA Brick to a 32 element DL6WU Yagi and managed to work G8SHF at a 81km.

Paul G6MNJ managed to send in logs for three bands even though he had a disastrous weekend with his preamps failing so he had use the TX Coax for both TX and RX which caused a lot of connector swapping. In addition, Paul had a failure with one of his PA in the last hour of the contest and was amassed that he was able to send in any log sheets with all the failures.

Congratulations go to Viv and Ken for winning the Summer fun. I would also like to thank Dave for sending in a log even though he only worked G6MNJ and all the people who took part in the contest.

Getting back to the International contest, I have received one station posted logs and five stations email logs. I hope to receive more before the cut off date of 20th October for the contest, as I know there were a lot more stations on the air over the weekend. It is the first time that I have organised the International, which involved sending out letters at the beginning of the year to the various European Radio Societies, and I am looking forward to receiving the results from the European ATV contest managers.

I decide to go up to the same hill that Clive G8EQZ and Richard G4YTV used to use on the Yorkshire Wolds. The only problem was that I could not get on to the Quarry site which we used to use as the farmer had a fence around the top of the Quarry due to insurance issues, that meant I had to use a public foot path further up on the Hill. This caused quite a problem with people asking me what I was up to. I even had to explain to the local police at 11pm on the Saturday

night, what I was up to on top of the hill with several aerials and dishes. The both of them had not heard of amateur radio before and were amazed that we were allowed to send TV pictures.

The radio conditions on 2m were poor over the weekend as I only heard one PE, which rapidly faded into the QSB. On 24cm my farthest contact was just over 200km which was not bad but not as good as I hoped with the weather people on TV saying we was going to have high pressure. Anyway, I really enjoyed myself at Water on top of the Yorkshire Wolds even though it was very hard putting a station together for four bands on my own. I would like to thank all the people I worked over the weekend especially the Lincoln amateur radio club members, as it would have been quite lonely on 2m without them. A more detailed article on the International will be in the next CQ-TV.

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

E-mail: contests@batc.org.uk

Summer Fun Results

Place	Call Sign	Locator	QSO 70cm	Score 70cm	QSO 23cm	Score 23cm	QSO 13cm	Score 13cm	QSO 3cm	Score 3cm	Total Score
1	G7ATV/P	IO81QG			11	1770	4	995			2765
2	GW4NOS/P	IO81FP			4	872					872
3	G6MNJ	IO91SR	4	103	5	518	2	145			766
4	G8GKQ	IO91TP	1	22	1	44					66

Digital ATV

By Richard Parkes G7MFO

I went over to Friedrichshafen again this year on holiday and was hoping to bring back a complete Digital ATV TX station on behalf of the BATC. Due to a problem with the modulator board, they were not for sale at the show and only a demonstration boards was present. Stefan

DG8FAC is going to send the boards when ready via the post. I was hoping to produce a full review with the help of others for this edition of CQ-TV. More information on the digital ATV boards can be found from: - <http://www.sr-systems.de>

Alternatively, contact Stefan DG8FAC at: -

Email: datv@sr-systems.de



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Caernarfon, Gwynedd, LL55 1YL.

Television history: Farnsworth's Invention Turns Seventy-Five

Peter J. Stonard notes the seventy-fifth anniversary of Philo T. Farnsworth's invention of all electronic television: 7th September 2002.

How Quickly People Forget

A couple of days ago my wife Judy's cell phone stopped working. It was transformed from her "communication lifeline to the world" in to an inert lump of plastic. Cellular phone technology is taken for granted, right?

I noticed odd aerials spouting from a few passenger cars while visiting Chicago in the late 1970s. Motorola, headquartered nearby, was conducting field trials of AMPS (Analogue Mobile Phone Service) the first use of radio "cells" to conserve the available radio spectrum.

That was twenty years ago, and the world has quickly come to depend upon cellular radio technology.

Parallel Inventions

The history of television is not so clear, and certainly not the result of one unified effort. In fact, a lot of controversy still surrounds the early television pioneers, who collectively invented "something" which today we call television.

During the first half of the 20th century many of the fundamental things that shape society were invented, developed, or legislated into existence.

Often similar ideas or needs occurred about the same time in both Europe and the USA. Without consultation the ideas followed separate paths to practicality. Sadly, we spent the second half of the 20th century suffering from these early decisions. For example: AC power line frequency: 60Hz in America, and 50Hz in Europe. Power line voltages: 120V in America and 220 to 240V, (depending on region) in Europe. Television transmission technical standards: 525/60 verses 625/50, NTSC verses PAL, etc. Even choosing which side of the road to drive our cars on.

Inventing Research labs

Early inventions were often the result of a single contributor, who had a dream to do something. Apart from mastering the

technology they also had to find financial backers, and then publicise their efforts if they were to succeed. Those few that were successful often sold their invention to a corporation for a personal fortune. On the other hand, large corporations that sprang up around key inventions of the previous century wanted to control their future, and avoid unpleasant surprises that might topple their empires

The invention process changed when Thomas Alva Edison, a self-taught lone inventor, invented the research lab. The organisation of a team, with a common purpose, and relief from the worries of everyday life (such as paying the bills and finding materials supplies), had a drastic effect on invention productivity. Edison patented anything and everything, hoping to generate royalty licence fees later on.

The industrial giants such as General Electric, DuPont, Eastman Kodak, EMI, GEC, and Marconi quickly adopted Edison's model. These new research labs were staffed with hundreds of trained scientists and engineers, who gave up their individual claims (Patents were assigned to the company) in exchange for steady pay and needed support staff, materials, and the well being of a corporate sponsor. Perhaps the biggest of these was the Radio Corporation of America (RCA).

Mechanical Verses Electronic TV

Early television pioneers Baird and Jenkins chose mechanical systems based on Nipkow's spinning disc, while Zworykin and Farnsworth applied all electronic techniques – the latter technology winning easily in the early side-by-side demonstrations.

David and Goliath

The story of electronic television pits a corporation, one that used the new model of research labs, against a lone inventor. The battle lines were drawn early as both parties filed US Patents in the 1920s each claiming an all-electronic television system.

Philo T. Farnsworth (1906 – 1971)



Figure 1 Philo T. Farnsworth
(Photo courtesy of MZTV)

Farnsworth is credited with the idea of scanning the image sequentially, an inspiration he got as a teenage boy while ploughing the fields of the family farm. He developed the idea into a system with a sending and a receiving end, and at age fifteen disclosed it to his high school science teacher.

By age nineteen he had seed money to start building the system, and in 1926, at age 20, he had filed two US Patents, one for the camera and another for the viewer.

With financial backing from San Francisco bankers, Farnsworth moved his family to San Francisco, and rented the loft at 202 Green Street, on 22nd September 1926. The roughly 7 by 10m (20 x 30ft.) space was turned into a lab, including apparatus to make radio valves (tubes) by hand.



Figure 2 202 Green Street, S.F.

7th September 1927

Every effort had been made to build both the receiver (even the hand made CRT) and a transmitter, which used Farnsworth's newly invented Image Dissector tube. The pioneers were ready for a test, and it was done on Wednesday, 7th September 1927.

Apparently they only had one axis of scanning built, and the experiment involved sending signals to light up a line on the CRT, by illuminating the camera. Most likely the transmitter and receiver were linked by wires, and not by radio waves. The equipment was placed in two rooms and was very crude; high voltage came from 'a rotary static machine' charging a capacitor, and scanning from a 'ten-cycle-per-second sine-wave (motor) generator'.

The team consisted of Philo; Elma 'Pem' (his wife and office manager); Cliff (Pem's brother, and the glassblower); Carl Christensen (hired as an engineer); and George Everson (a professional fundraiser) who arrived later. Everyone stood around the receiver - Philo called instructions to Cliff at the camera. "Put in the slide" "Okay it's in. Can you see it?" Turn the slide a quarter turn, Cliff" The receiver line also turned 90 degrees. "That's it folks! We've done it!" (The author transcribed these words from Pem's book, *Distant Vision*, but it's not clear if this is accurate, as they only had one axis scanning, a 90-degree turn seems unlikely).

The demonstration was repeated for George, and Philo then sent a wire (telegram) to George's partner, Les Gorrell, in Los Angeles, which simply read, "THE DAMN THING WORKS!"

David Sarnoff (1891 – 1971)



Figure 3 David Sarnoff
(Photo courtesy of MZTV)

While the lone inventor made steady progress with his invention during the 1920s, David Sarnoff, the new head of RCA, unleashed his energy to dominate television. NBC, the broadcaster and wholly owned subsidiary of RCA, was formed in 1926, and began mechanical television broadcasts in 1928.

No one could build a radio without a licence from RCA, and each and every

radio sale generated a royalty fee back to RCA. Sarnoff worried that new technology could disrupt the market. He learned of a very young inventor working in California, from a San Francisco Chronicle newspaper article, dated 3rd September 1928.

Sarnoff issued an essay that was published in the New York Times, on 18th November, 1928, titled "Forging an electric eye to scan the word", the message was clear: Television was still a long way off, and when it did arrive it would be at the hand of RCA. A month later he struck again with a New York Times article on 16th December; "Leaders Dispel Television Fears" noting that the latest radio sets would not become obsolete. He took the opportunity to urge everyone to buy a new radio for Christmas.

Vladimir K. Zworykin (1889-1982)



Figure 4 Vladimir K. Zworykin
(Photo courtesy of MZTV)

Sarnoff secretly hired Vladimir K. Zworykin, head of television research at Westinghouse, who had filed (but did not receive) an electronic television patent in 1923. Sarnoff sent Zworykin to see Farnsworth at the 202 Green Street lab in San Francisco, in April 1930, and he was welcomed as a Westinghouse representative, to whom Farnsworth wanted to licence his patents. It's likely that Farnsworth did not know that Zworykin was working for Sarnoff.

Zworykin stayed for three days and was shown how to make a camera tube. Farnsworth's Image Dissector tube was hand made by his small staff, which had to invent most of the equipment too. By trial and error they also learned how to

process the tube. This involved construction of electrodes, glass blowing to form the envelope, pumping to remove the air, and finally, introduction of purified potassium vapour to form a photocathode.

Upon his return to RCA in Camden New Jersey, Zworykin was given a \$100k budget and a one-year deadline to develop electronic television. So he set about trying to duplicate Farnsworth's tube, from his notes and memory.



Figure 5 Image Dissector
(Photo by the author)

RCA Goes to War

Sarnoff was angered by the lack of progress on electronic television, and RCA was in a tight business jam. Radio and phonograph sales had plummeted due to the great depression, and competition had driven the unit price of a radio down to around ten dollars. RCA stock lost 90% of value, after the US government forced RCA to slash its licensing fees.

So Sarnoff decided to pay a surprise visit to Green Street, in April 1931, and attempt to buy out Farnsworth.

Unfortunately for Sarnoff, Farnsworth was out of town, but Sarnoff made an offer of \$100k for the patents, and Farnsworth and his backers agreed this was an insult. Again, Sarnoff was furious and brought the full weight of RCA lawyers to battle Farnsworth.

No doubt this slowed the development of electronic television for years, as the legal battles raged on. Farnsworth was driven to drink (he was a Mormon and a teetotaler), and then suffered a bleeding ulcer. Farnsworth licenced his patents to Philco and to Baird Television in the UK, to stay afloat financially, until the Farnsworth patent was finally issued in 1935.

Sarnoff's RCA spent over thirteen million dollars from 1930 to 1939 to develop electronic television. This was a staggering sum of money, during the Great Depression.

1939 World's Fair

Sarnoff pulled a public relations coup at the 1939 World's Fair held in New York City, with a project called "The RCA Television Pavilion", and also by securing the rights to broadcast the opening ceremony on both radio and television. Local department stores offered new RCA television receiver sets for \$600 each.

"It is with a feeling of humbleness, that I come to this moment of announcing the birth in this country of a new art so important in its implications that it is bound to affect all society. Now, ladies and gentlemen, we add sight to sound!" Sarnoff said at the press conference before going on to announce that NBC would begin regular television broadcasts. Several days later, at the opening ceremony, Franklin D. Roosevelt became the first US president to be televised.

RCA Pays Out

Such blatant infringement of Farnsworth's patents would be grounds for a lawsuit, but instead Farnsworth sold RCA a non-exclusive licence for one million dollars. This was the first time that RCA had paid a licence fee to obtain a non-RCA invention.

America Goes To War

When the USA entered WW-II all development on television, including early broadcasts, was stopped. After the war about 6,000 TV sets existed in the USA, and this grew to some tens of millions by the mid 1950s.

Alas, Farnsworth's original patents expired in 1947, just months before the post war boom, in which RCA captured some 80% of the market. Farnsworth was forced to sell his assets to ITT, who decided to exit the television business.

Fast Forward to September 2002

To mark the seventy-fifth anniversary of the first all electronic television experiments, a small event was held at the 202 Green Street building. Actually,

it was held outside, as the current owner of the building decided not to participate. Sadly the world did not acknowledge this important event, having taken television for granted and let Philo T. Farnsworth drift in to obscurity. It was covered briefly in the local press and on a local magazine TV show that aired the next day. About one hundred people attended, including a couple of generations of Philo T. Farnsworth's family. In 1981 a State of California historical marker was erected.



Figure 6 & 7 TV Historian and collector Jerry Grulke

Also present was television collector Jerry Grulke, who brought with him a couple of historically significant television artefacts, and was dressed as a young Farnsworth. He wore a very nice brown suit of the era with matching brown shoes and fedora.

Mr. Grulke also had a Farnsworth brand 10" television receiver from 1948 and the actual Nipkow disc used to scan the "Felix the Cat" figurine used by Bell Labs in the 1920s.

Pending Honours

As of this writing, it is expected that Farnsworth will be honoured at the 2002 Emmy telecast hosted by the Television Academy.

Historical Marker Number 941

In a simple laboratory on this site, 202 Green Street, Philo Taylor Farnsworth, U.S. pioneer in electronics, invented and patented the first operational all-electronic "television system" on September 7, 1927. The 21-year-old inventor and several dedicated assistants successfully transmitted the first all-electronic television image, the major breakthrough that brought the practical form of this invention to mankind. Further patents formulated here covered the basic concepts essential to modern television. The genius of Green Street, as he was known, died in 1971.

It's For You!

Remember Judy's cell phone crisis? It appears that she put the phone on a wet counter top, and water caused the phone to die. When it dried out the phone returned to life. Whew, can you imagine life without that cell phone?

Acknowledgements

Thanks to Rich Diehl, for his photographs of the 75th Celebration. He is a Silicon Valley collector of early videotape machines and other TV artefacts. Visit his collection here: www.labguysworld.com/index.html

Also to Alex Magoun, curator of the David Sarnoff Collection in Princeton, New Jersey. He graciously hosted Judy and I on a visit to the collection. It's not everyday that one is granted hands on access to RCA historical artefacts!

Photos of the pioneers appear here with permission from MZTV Museum: www.mztv.com/

For an interesting account of Farnsworth's life, read the book *Distant Vision* by Elma "Pem" Farnsworth. ISBN: 0962327603

The author, who lives in California, is best reached by email: pstonard@ix.netcom.com

Digital ATV tests with GB3ZZ

By Ian F Bennett G6TVJ

Recently I had an opportunity to attempt some digital ATV experiments. I was fortunate enough to be able to borrow a digital satellite modulator and MPEG coder. The coder was able to operate at relatively low bit rates and the modulator produced a digital modulated signal directly in the 23cm amateur band. The 23cm signal was radiated using the GB3ZZ amplifier and antenna system under my call sign G6TVJ. A standard unmodified domestic digital satellite receiver was able to receive and decode the pictures at various stations with surprising results.

MPEG Coder

The coder used was a Tiernan TE6 professional MPEG coder. This unit is built for broadcast use, such as satellite news gathering, OB satellite contributions and programme distribution. The TE6 may be configured for a variety of uses; in the case of ATV a relatively slow bit rate was used to ensure the best chance of success and also to match a realistic P5 PAL equivalent picture in quality. A bit rate of

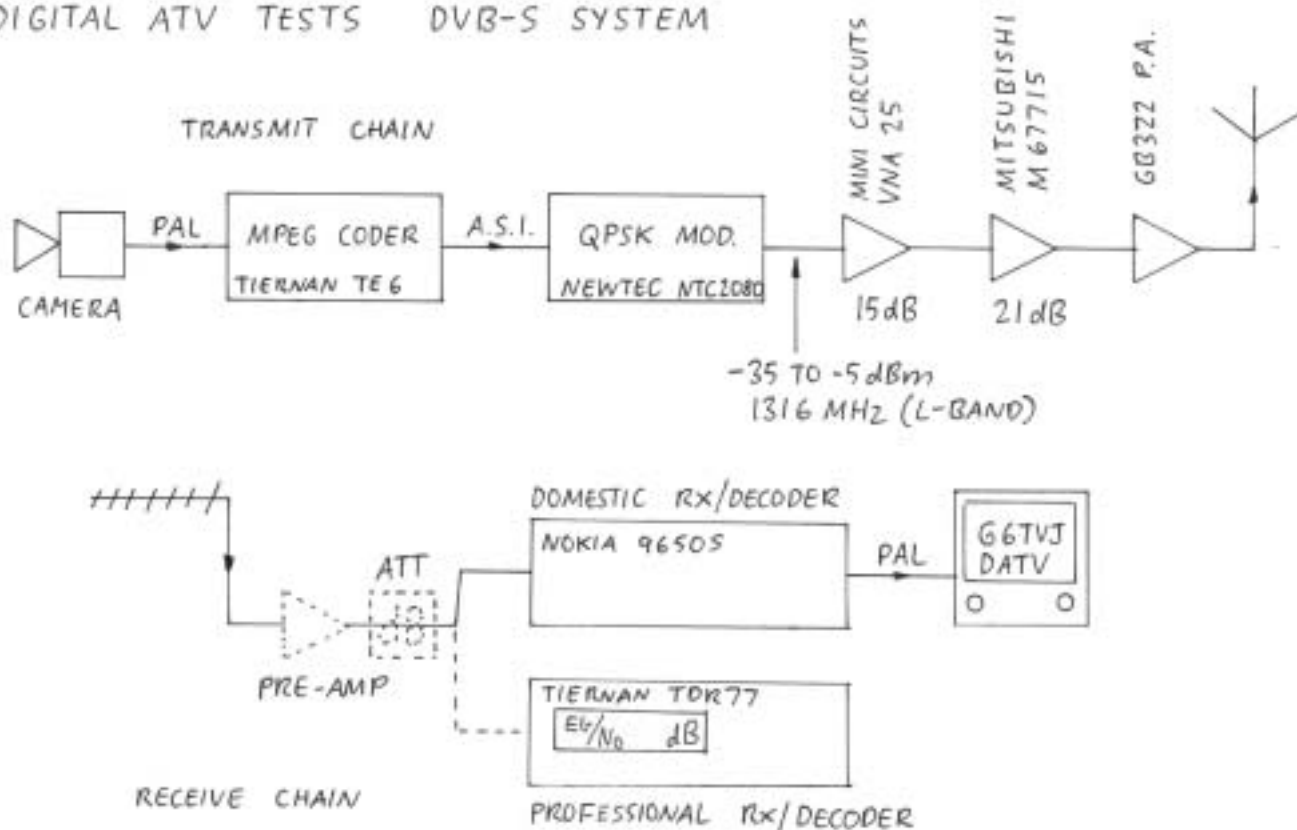


DATV equipment testing back to back, left bottom MPEG Coder, left top Modulator, right bottom professional RX and right top Nokia 9650S domestic receiver

6Mb/s was used, similar to broadcast off air signals such as the BBC News 24 service. The pictures undoubtedly look soft and occasionally pixelated compared to higher bit rates and contribution

quality signals, but they were also very good compared to the average “Shack” quality P5 picture received from a reasonably distant station such as an

DIGITAL ATV TESTS DVB-S SYSTEM



ATV repeater.

MPEG coders are incredibly complex devices; MPEG (Motion Picture Experts Group) is basically a frame work specification which defines a number of video compression techniques. The MPEG spec is scalable and configurable for different applications and picture resolutions. MPEG works by basically digitizing a TV picture and instead of sending the digital information to the decoder directly at a high bit rate, it sends a limited quantity of information at a lower bit rate, which allows a decoder to effectively synthesize an approximation of the original picture. At low bit rates errors and irregularities creep in and result in “artefacts” being displayed on the decoded picture. Effects such as “blockyness”, “pixelation” and noise can be seen on highly compressed images, especially during shot changes and movement. Another MPEG effect is the insertion of significant time delays which may be as long as $\frac{3}{4}$ of a second.

MPEG coding is at the heart off all modern digital TV systems - the technology and equipment has advanced much over the last few years. Coders and decoders rely on sophisticated processing power from LSI micro processors.

Stand alone MPEG coders are common in the broadcast industry. A rack mounted box accepts either a composite PAL coded signal or a serial digital signal from a source such as a vision



Receiver at home in the shack

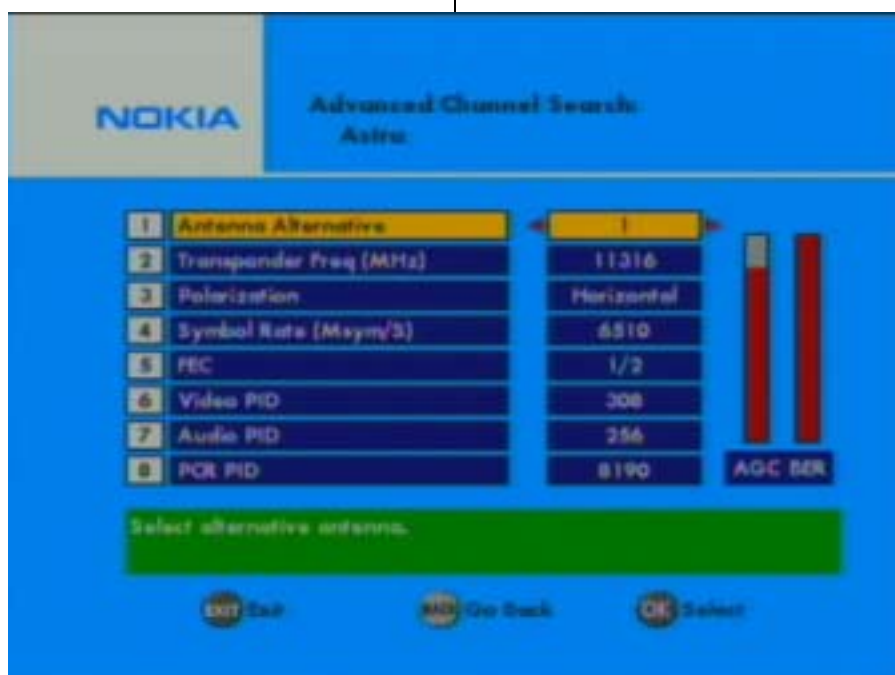
mixer or a camera. A special serial bit stream emerges from the coder in the form of 188 or 204 byte long data packets. These data packets carry the compressed picture, sound and other information from the coder ready for transmission over a medium such as a satellite link or in our case an ATV link.

Satellite Modulator

The modulator used is a Newtec NTC2080. Newtec provide modulators for satellite uplinks which are capable of

a number of different modulation schemes and provide an RF output in the L-band frequency range. L-band signals are usually upconverted to the region of 14.5 GHz and amplified for satellite transmission. The L-band range conveniently falls in the 23cm amateur band which makes this experiment much easier as no up conversion or down conversion was required. The modulator was simply programmed with the L-band frequency from front panel menu buttons.

The modulator accepts a data stream (referred to as a transport stream) from a source such as an MPEG coder. The modulator processes the data and adds some extra forward error correction (FEC) data to the incoming MPEG data before it is modulated onto a carrier. The data rate and amount of error correction may be configured for different applications. For ATV the maximum error correction ratio of $\frac{1}{2}$ was used to provide a robust signal. The error correction works by sending extra data to allow the receiver to detect and correct errors in the original data. The FEC figure defines the ratio between original data and error correction data. The modulation scheme used is QPSK. QPSK or Quaternary Phase Shift Keying is a common type of digital modulation and is used in other systems such as data modems and a similar system is used in mobile phones. QPSK is a kind of FM modulation; FM and phase modulation are mathematically related and arguably



Nokia 9650S Onscreen Parameter Display

the same thing. QPSK works by assigning four phase states to a carrier, each phase state is 90 degrees apart from the next and is known as a symbol. The four possible symbols 0, 90, 180 and 270 describe data of 00, 01, 10, and 11. By constantly changing the symbols a string of data bits can be sent. To carry 6 Mb/s of data from an MPEG coder it works out with $\frac{1}{2}$ FEC that 6.105 M symbols per second need to be transmitted. The RF bandwidth occupied depends on the type of modulation used, in the case of QPSK the bandwidth is about 1.5 times the symbol rate.

The combination of the MPEG coder and the modulator produce a DVB-S compliant signal, this may be received on a DVB-S compliant receiver. DVB stands for Digital Video Broadcasting and it defines the technical parameters for compatible devices. DVB-S is for satellite broadcasting. DVB-T is a similar standard for the terrestrial digital broadcasting and defines the parameters including the COFDM (Coded Orthogonal Frequency Division Multiplex) standard for off air signals. DVB-T is the digital equivalent of the PAL system I UK analogue TV spec. There is also a DVB-C standard which defines digital systems over cable networks (64 Quam Mod). In the USA they have their own digital system called ATSC using 8-VSB modulation (American TV Standards Committee) and in Japan yet another system exists.

The DVB-S signal is received by a digital satellite receiver. A Nokia 9650S domestic free-to-air receiver receives the 23cm (L-band) frequency directly, exactly in the same way as an analogue receiver is used to pick up 23cm ATV. A completely unmodified (except to lose the LNB volts supply) receiver decodes and displays the digital ATV signal. The modulation parameters must be first entered into the receiver, as digital



Transmit spectrum



Transmit equipment in shack with GB3ZZ

receivers cannot search and decode signals automatically. For ATV the receiver was set to 10 GHz LNB (not universal 9.75 GHz), a frequency of 11.316 GHz (For 1316 MHz), a FEC rate of $\frac{1}{2}$ to match the modulator and symbol rate of 6.510 Ms/s. The Nokia 9650S is a very good receiver. I bought it as a test bed for digital satellite and these experiments; at £200 it is good value for a digital f-t-a receiver.

Free-to-air receivers are primarily aimed at the European DTH (direct to home) satellite market; in the UK they are sold mainly to satellite enthusiasts. There are many f-t-a receivers made by companies such as Nokia, Echostar and Umax. I have investigated UK Sky digi boxes, these are DVB compliant but their internal software does not allow you to enter parameters other than the Astra 2 symbol rates (27.5 Ms/s and 22 Ms/s)

and FEC rates, so don't rush out and start buying up old digi boxes just yet! It may be possible to change the internal software in certain models of Sky box to make them more flexible.

GB3ZZ was used as a test bed for Digital ATV. The output from the modulator is only -5 dBm max in level, so this was increased by some intermediate amplifiers, firstly using a mini circuits VNA mmic amp and secondly by a Mitsubishi M67715 brick. QPSK modulation requires a certain degree of linearity so these amplifiers were operated up to about 3 dB below saturation. As saturation is approached, intermodulation in the form of sidebands is produced when QPSK is used. The IM products are often referred to as "Spectral Regrowth". In this case the worst regrowth was about -20 dBc. Excessive intermodulation introduced by



Received picture, the black shimmering effect may have been due to an unterminated input to the coder.

the amplifiers will produce errors in the decoded signal and should be avoided. GB3ZZ features an output filter which removes the outer portions of this energy. The modulation bandwidth is less than that of PAL at around 10 MHz for 6.5M QPSK.

The output of the intermediate amplifiers was fed to the GB3ZZ main PA. The power level from the modulator may be conveniently varied over a range of 30dB. The maximum antenna + feeder input power was around 20W.

The results were much better than expected. I had little experience of QPSK modulation in systems other than satellite up-links, where the effects of multipath are minimal. GB3ZZ was received at several stations; all but the most distant produced pictures. At local stations and my station a margin of 30dB was achieved. Over a range of 15 miles around a 13dB margin was achieved. The picture was of course P5 or P0, nothing in-between! A long distant contact of 50 miles unfortunately failed but subsequent un-modulated carrier tests suggest that it can be made to work. To some extent I was hampered by the fact that we only had one domestic receiver which had to be driven around from shack to shack. In my shack, which is upstairs and is not quite line of site to GB3ZZ, pictures were obtained with a 6" piece of wire in the back of the receiver, probably better than the equivalent PAL! As with analogue satellite receivers the Nokia

must have a poor input noise figure, so a 23cm pre-amp would have made things even better!

During tests a second professional receiver was used to provide a bit error figure. A Eb/No figure (Energy per bit to noise power density) was recorded and attenuators were interposed at the antenna input to reduce the signal and make it "fall over". A disadvantage of the Nokia f-t-a receiver is that it provides very poor crude signal strength and error rate indications. Another disadvantage of all digital receivers is that it is difficult to produce rolling or tearing pictures of which ATV is so fond.

I am very pleased with the results so far. This shows what can be achieved with the simple QPSK modulation (as apposed to more complex and difficult to produce modulation such as COFDM) and over reasonable paths. Although the transmit equipment is very costly, the receiver could be bought for £200 or less. A DATV project in Germany suggests an affordable QPSK modulator and coder could be produced for amateur use. GB3ZZ isn't going digital for a while yet I suspect, but some sort of licensed digital beacon perhaps on 13cm should be possible - watch this space.

Many thanks to the stations who took part and commented on these tests including: -

G1IXF, G1IXE, G7FEQ, G4BVK, G4UVZ and G8YMM.

Coder	Tiernan TE6
Sampling	4:2:0
Coding	MPEG Main Profile 720 pixels horizontal resolution
Coding Strategy	Optimum Quality (long delay)
Sound	2CH Stereo 256K
Input	Composite PAL (from a little JVC camera)
Output	6 Mb/s
Output Interface	A.S.I. (Asynchronous Serial Interface)
Video PID	308
Audio PIDs	256/7
Modulator	Newtec NTC2080 L-Band DVB-S Modulator
Modulation	QPSK
Symbol Rate	6105 Ms/s
Forward Error Correction (FEC)	1/2
Output Frequency	1316 MHz
Output level	-5 dBm maximum
Amplifier	MCL VNA25 followed by a Mitsubishi M67715 brick, followed by a Mitsubishi 2 x 18W brick, operated in backed off linear mode.
TX Antenna	GB3ZZ 6dB Alford slot erp 25W max
Receiver 1	Nokia 9650S DVB Free-to-air domestic receiver/decoder
Receiver 2	Tiernan TDR77 professional receiver/decoder for Eb/No (Error performance) measurements
RX Antennas	Various yagis, pre-amps and a 6" piece of wire

System Specification

Best contact so far: 15 miles but with over 16dB of fade margin.

Video detector and 2 by 1 Switcher

By Hans Bruin

The following circuit first appeared in the Dutch Magazine Repeater and was designed by Hans Bruin. It is a very elegant two input video switch, which monitors video input 1 (J1) and if a video signal is present selects J1. In the absence of a valid video signal at this input, (J2) is selected. This is an ideal building block for an ATV repeater, where (J1) can be used for the receiver and (J2) for the electronic beacon signal. The ENA signal is at TTL level and could be used by any additional equipment that needs to know the status of the repeater.

The circuit is in two halves - the video switch and the video detector. The video switch uses the Linear Technology video switch IC, LT1259 and is configured for +5 and -5 supply rails. R14, R13 and R16, R15 set the gain of U2a and U2b to 2. If ENA is low then U2a is enabled, if

ENB is low then U2b is enabled. The selected video signal is fed via the impedance build up resistors R17 or R18 to present a 75 ohm output at J3. When J3 is presented with a 75 ohm termination unity gain will result.

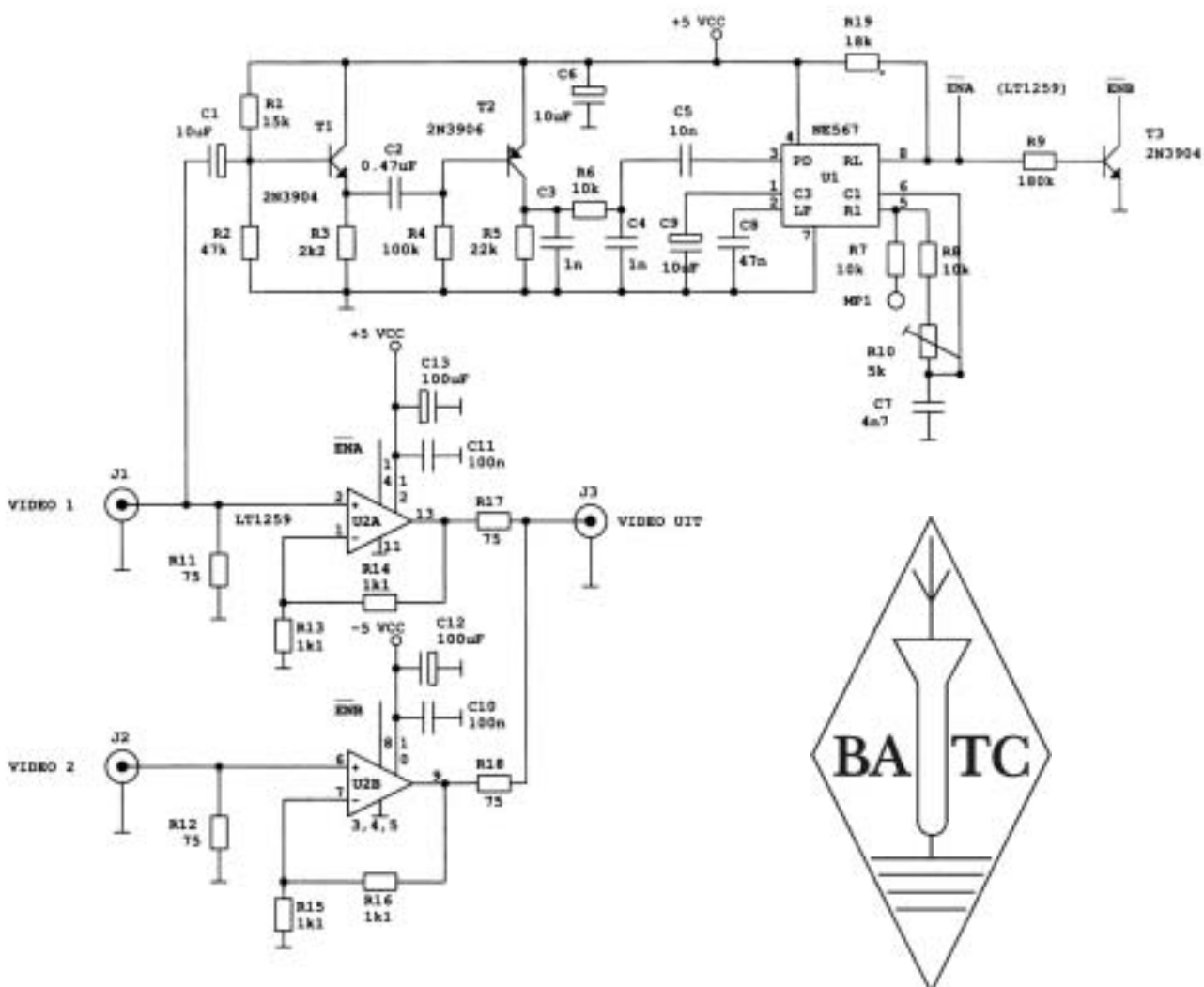
The video signal at J1 is ac coupled into T1 and on to T2, which is only just turned on. The sync pulses will turn T2 on, video will turn it off. The result is most, if not all, of the video will be removed by T2 and the remaining sync pulses filtered by C3, R6 and C4, What remains is a 15.625 kHz signal. This is then used to phase lock an NE567 phase locked loop (U1). The free run speed of this device can be set by R8 and monitored on MP1. This should be done without an input to J1. If an oscilloscope is not available then set R8 for best lock when a video signal is present. When the PLL locks, pin 8 will go to logic 0 to indicate this, and switch U2a on. TR3 inverts this signal and switches U2b off.

When the signal at J1 is removed pin 8 will go to logic 1 and turn off U2a and TR3 will invert this and turn U2b on.

The detection of video by the use of a PLL sync detector has a high noise immunity and can function through the white noise often present at the output of ATV receivers in the absence of signals.

My thanks to Hans Bruin and Repeater magazine for this circuit. Repeater magazine is published in Dutch and English, but this circuit was produced when Repeater was only available in Dutch, so apologies for any errors in the explanation, which is not a translation. For more data on the LT1269 visit the Linear Technology website www.linear-tech.com

Trevor Brown



Making Printed Circuit Boards at home

By Brian Kelly, GW6BWX

E-mail from a member was recently circulated around the BATC Committee for comments. One of the topics he raised was the lack of available circuit boards for BATC projects and how making boards at home was beyond the capabilities of many members. In this article, I hope to demonstrate that home made boards are actually quite easy and cheap to make.

What I'm going to describe is the method and equipment I use myself. The photographs and screen snapshot show the prototype of a simple test card generator from design through to testing stages. The principles you see here can be applied to almost any design, whether one of your own or one copied from a magazine or book article. I want to stress that my way of doing things isn't necessarily the most efficient or cost effective way, it just happens to be convenient for me to work in this fashion. The equipment I use to etch the copper is made entirely from salvaged parts and could be improved considerably. I'm deliberately not providing any design plans for my home made bits; I leave that to your own ingenuity but by explaining how I do things you should be able to make something at least as good and probably better!

I'll guide you through the stages in sequence:

The planning stage

If you are working from an existing design, such as one published in a book or magazine, skip the next stages entirely and go straight to stage three.

Firstly, make absolutely certain that a PCB is what you need. Often, especially for simple designs, it is easier to use Veroboard or a similar product. Also consider how many copies of your board are likely to be needed. The method I will describe allows you to make an unlimited number of identical copies and if stored safely, the master artwork will be as good as new even after decades of storage. If all you want is a one-off board, bear in mind that the time it takes to design and make it could far exceed the time to assemble it by other methods.

If you have convinced yourself that a PCB is the best solution, start gathering information on the components your design uses. A PCB is, for most designs, nothing more than a neat and repeatable gadget for mounting components, so it is a prerequisite to know how big the components are and where their legs lie with respect to their body outlines. I find it useful to lay the parts out on the bench top and move them around to find the best way of orientating them. The rules here are simple, components must not touch each other or cross over each other on the components side of the board and the same applies for the tracks on the copper side of the board. It is permissible to cross tracks on opposite sides of the board if you use double-sided board but there are complications in doing this.

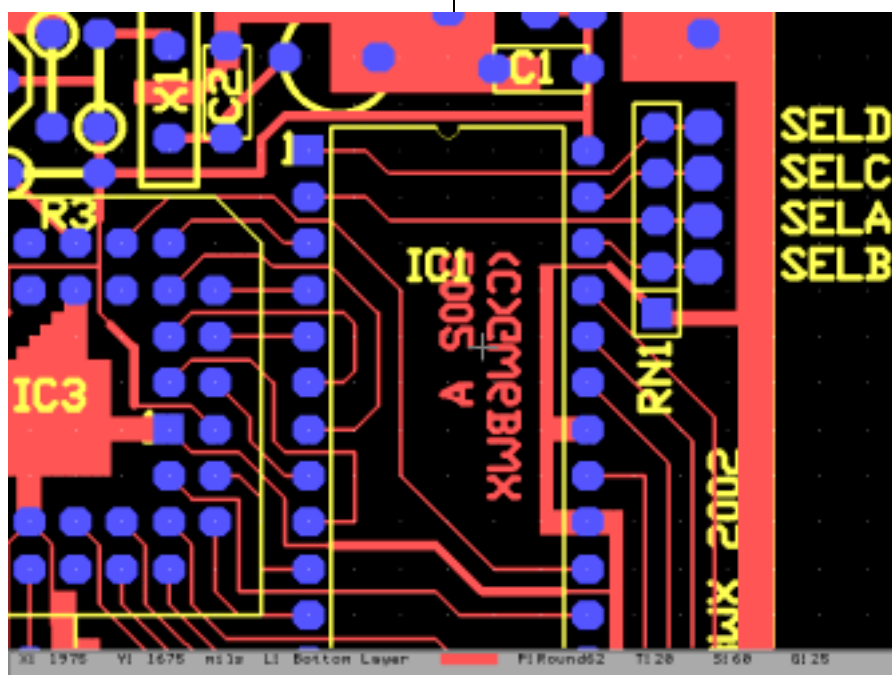
Double sided boards are made as two single sided ones back to back and it takes great care to get the two sides to align properly. It's also very difficult to put copper inside the drill holes so you end up having to solder both sides of the board to connect a track from one side to the other. Take my advice, until you have mastered single sided boards - leave double sided ones well alone!

The track layout

This is the step where a little artistic imagination comes into play. Other than being sensible about the placement of components that have to line up with something else or could interfere with

another parts operation, you are free to do just about anything you wish. All you have to do is join the appropriate component legs together with lines. It sounds a lot simpler than it really is but with practice it isn't too difficult. With all but the simplest designs I use a computer with a PCB design program. The one I use is Autotrax from a company called Protel. Its DOS based and by any stretch of the imagination, ancient and rather crude. It does the job though and as a freebie on Protel's web site several years ago I can't complain. There are many similar and more up to date packages around these days and their prices are very reasonable. I've seen someone design a PCB using the Windows Paint program but I would seriously recommend using one designed for the job.

What all the design packages give you is a library of component "footprints", the outline of the component when it's mounted on the board. They allow you to manoeuvre the outlines until you manage to fit everything into place and then add the lines between the component ends. The real advantage of using a computer is that the components and track lines can be erased or moved after being placed - it's akin to moving text around in a word processor but you move parts of a diagram around instead. Some packages will even "auto route" the board for you. All you do is provide a list of components and a list of which pins on them connect together, known as a



node list, and the computer takes over and puts the track lines in place. I must confess to having little faith in auto routers, I've seen some of them pick two points diagonally across the board, join them together and then refuse to connect anything one side of the line to the other because the new lines would cross the diagonal one. I always route boards by hand; I find it gives better results although it can take quite a long time to finish. Manually routing also gives you control over which connections can sensibly lie next to each other - for example, you would have the sense not to run a live mains track parallel to a microphone input signal but an auto router wouldn't realise this was a bad thing to do. These are the basic do's and don'ts when laying out the board:

Start by drawing an outline of the board, this gives you a visible boundary to stay within.

Remember to leave holes for mounting the board and leave a gap around the holes for screw heads and mounting pillars.

If any parts must occupy a fixed position, for example a switch that has a shaft that must pass through a hole in a panel, place those parts first. They can't be moved so shuffle the other parts around them.

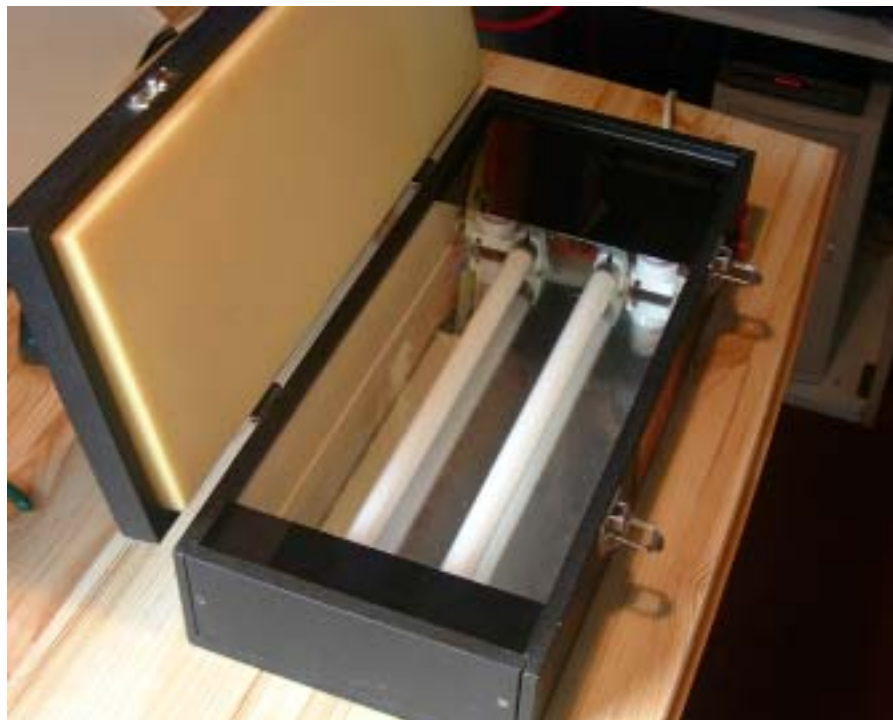
Leave a space around any parts that get hot so air can circulate and cool them. If heat sinks are being used, remember that no parts can cross the space they occupy.

Leave sufficient gaps around parts and tracks that carry high voltage so the chance of arcing is minimised.

Ensure track lines are "beefy" enough to carry the current expected through them. I use no less than 1mm wide per amp as a rule of thumb but it also depends on the thickness of the copper on the final board.

Try to fill large gaps between tracks with copper area and if possible connect it to a ground. This helps by providing extra screening, extra heat conducting area and as a bonus it means you dissolve less copper in the production stage so your etching chemicals last longer.

Finally, remember that PCBs are designed from the component side. Imagine you are looking at the



components and the PCB substrate is transparent so you can see the tracks on the far side. It is normal, but worrying until you see the reason for it, that your design will be a mirror image when you reach the next stage.

Transferring the track to copper

From now on we start to see something resembling the finished product. First, if you bought a huge expanse of board at a rally, cut it down to a manageable size. It ideally should be a little larger than your finished board will be. I always place a thin copper track around the outside edge of my designs so I can use it as a guideline for cutting and filing the board to its actual size.

If you use plain copper board, it should be spotlessly clean. Buy one of those abrasive blocks and gently polish the copper with it until it shines. Then use a solvent to make sure no fingerprints are left on it. I use Ultrasolve ULS for this. Then under dim lighting, spray the board with photo resist paint. The full instructions for this are on the paint can. Remember that from now on, the board is sensitive to bright light so don't switch the lights on to see if the paint has dried!

I use pre-prepared board. Most of the electronics suppliers stock it. This is board already painted and then protected with a peel-off black plastic coating, which also keeps light off the paint. It is much less hassle to use the ready-made stuff and it keeps for several years if you keep it cool and dry. You can cut it with

the protective film still on so the off cut can be kept for use in the future.

The process of transferring the design from computer screen to copper is quite clever and very similar to making photographic contact prints. What you need to do is print the track layout, in black, on to transparent film. I use the sheets designed for overhead projectors which most stationery stores can supply.

Be careful though, make sure the brand you choose is designed for use in your kind of printer. Usually, one side of the sheet is glossy and one side is matt, it's the matt side you print on or the ink will form droplets on the surface. If, like me, you use a laser printer, make sure the film is suitable for laser printing or for photocopying. Both these devices use heat to fix the toner to the film and the wrong sort of transparency will feed into your printer but never come out again. Instead you will find a seriously gummed up printer mechanism - you were warned!

If the printing was successful, you should see black areas where you want copper on the board and everywhere else should be see-through. Hold it up to a light and check for any unfilled areas, if there are any, use a black fibre tipped pen to touch them in. Unfortunately, even the latest printers tend to leave voids when they try to fill large areas.

When the ink has dried or the film has cooled down you can get ready to do some photography. The aim is to expose

the paint on the board to a source of ultra violet (UV) light but only in the places we want the copper removed from. The paint undergoes a chemical change when the light falls on it and it becomes soluble in developing solution. Where the black pattern on the film provided shade, preventing the light reaching the paint, it remains insoluble in developing solution.

You need a source of UV light for the next stage. I use a commercially made light box but it is very easy to make your own. You need a box; even my commercially made one is only made from plywood.

The box needs to be big enough that your biggest PCB can sit in its bottom. Mine is about 15cm front to back, about 30cm side to side and about 10cm deep. This comfortably holds a standard Eurocard (100 x 160mm) board, a size readily available. The top of the box must be clear glass and if possible it should either have a hinged lid or you should have a removable lid that sits flat on the glass. Fit some thin spongy foam to the underside of the lid. The plan is to place the printed film on top of the glass and then place the light sensitised board on top of it. The weight of the lid and the sealing effect of the sponge should hold the board and film flat against the glass. Its quite important if you hinge the lid that it doesn't shift the board relative to the film when you close it or the image will be in the wrong place or even off the edge of the board after exposure.

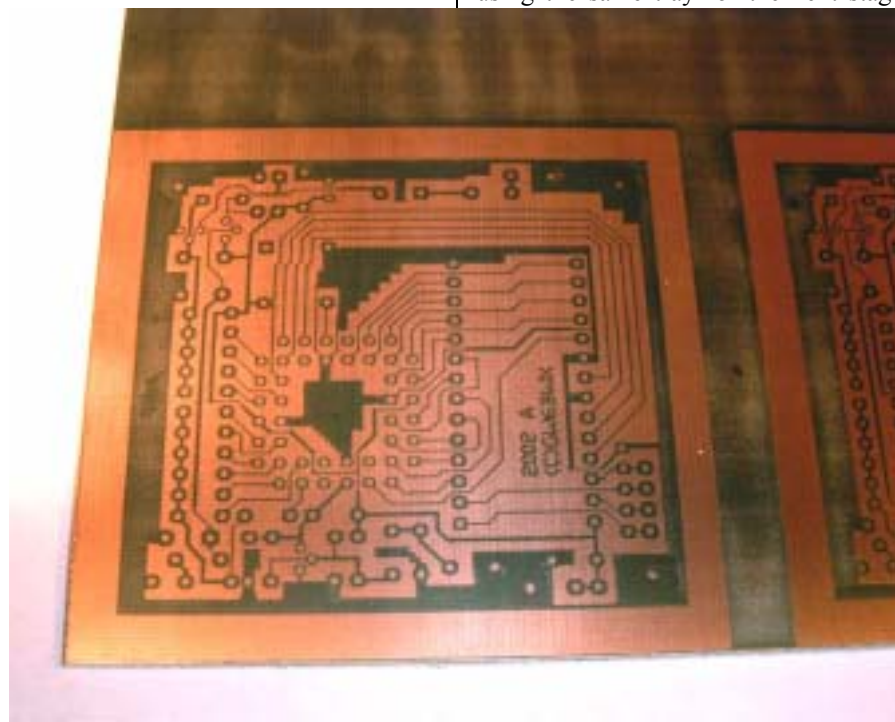
In the bottom of the box you need at least one UV strip tube as a light source. These are inexpensive and will last for hundreds of boards. The tubes are available from Farnell, Maplin and CPC amongst others but don't get the ones for disco lighting or EPROM erasers, they are unsuitable for this application. I use two 8W tubes, spaced about 5cm apart as this gives a more even coverage of light. The tubes should be at least 2cm from the glass and each will need a starter and choke. You can add a mains switch or timer if you want but I find that pulling the mains plug out works just as well.

The film goes on the glass with the printed side upward; the board goes on top of it with the painted side downward. This is why the image appears backward on the film; it is re-reversed when placed upside down. Doing it this way means the printed surface is in direct contact

with the paint so there is no space for the UV light to scatter and blur the image. Don't forget to remove the protective plastic coating if you use pre-prepared board!

With two tubes, my light box takes about four minutes to fully expose the board; your mileage may vary depending on the number of tubes and quality of glass.

Developing the negative



This stage is simple and quick. You need a plastic tank or tray and some developing solution. Like all the other tools and chemicals, this is easy to get hold of. I buy Farnell's ready prepared solution, which is already optimally diluted, but I'm almost certain it is actually caustic soda dissolved in water. Remembering that the board is still sensitive to bright light at this stage, remove it from the light box and place it copper side up in the developing tank.

Add enough developer to just cover the surface of the board and then swish it gently from side to side so the developer is constantly moving over the paint. Be careful with the chemical, it is corrosive and prolonged contact with skin can cause irritation. Be especially careful not to splash it into eyes where it can cause severe damage very quickly. After about a minute or so you should see the pattern of tracks starting to appear in the paint and after about five minutes the tracks should be clearly visible as paint areas against the plain copper background.

Its safe to leave the board in the developer a little longer than needed for complete removal of the exposed area's paint but don't leave it more than about ten minutes or the unexposed areas may also start to be attacked. Remove the board and rinse it under plenty of cold water. The developer can be saved if you wish and re-used at least one more time. If re-using it the time for development may be a little longer than before as the solution will be partly neutralised. If using the same tray for the next stage

you must wash it thoroughly; the etching chemical and developer combine to make an unpleasant brown sludge.

Etching the board

At this stage you should have a copy of your computer artwork painted on a bare copper base. The paint will protect the copper from being dissolved in the etching solution so the copper underneath it will remain and the rest will disappear.

You can do this in normal lighting; the board is no longer sensitive to light after the developing step. Put the board in a tank or tray of etching solution with enough present to cover the board to a depth of about 1cm. I use the same tank as before which was originally a container for chocolates. The solution needs agitating so fresh chemical (Ferric Chloride solution) passes over the copper. I speed the process up by placing the tank in a sink of hot water. The increased temperature speeds up the etching. I also put the lid back on the

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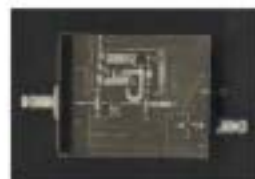
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this time it isn't wise to keep it in any longer than necessary because the etchant will start to eat under the edges of the paint and reduce the track widths. When finished, thoroughly wash the board in cold water and return the etchant to a plastic bottle so it can be reused. Depending on the amount of copper removed, it should be possible to use it about ten times. Ferric chloride doesn't only dissolve copper; it likes most metals, including stainless steel so take care to keep it from splashing over kitchen sinks.

Drilling lots of holes

You now have a bare substrate with copper tracks in the right places and paint still covering the tracks. Leave the paint there for now; it protects the copper from oxidising.

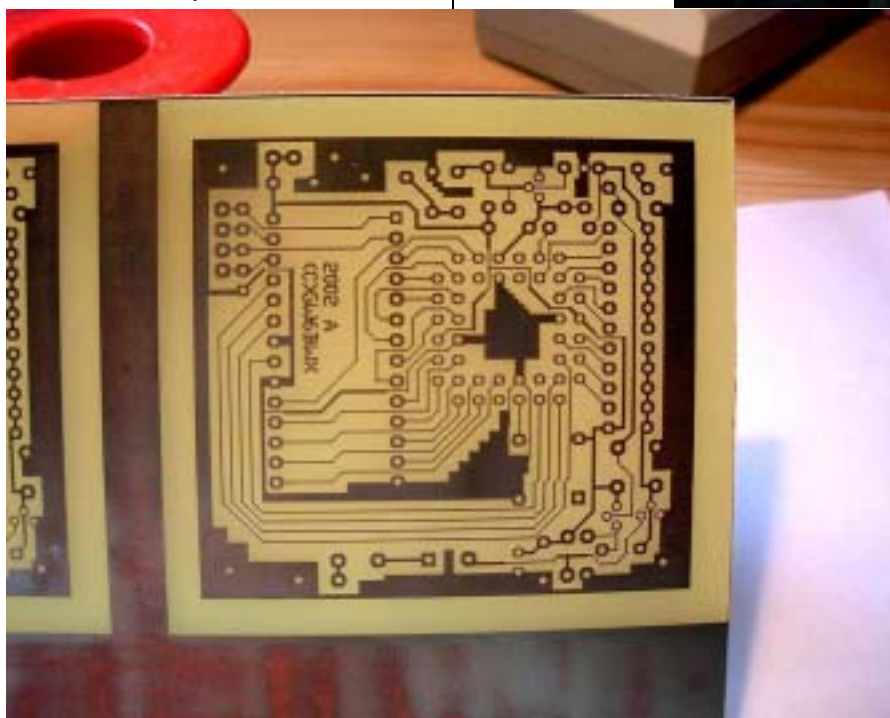
tank so my "stirrer" can work. This is actually a small 12V motor salvaged from a scrapped video recorder. It's screwed to the top of the lid so its shaft faces downward. The shaft is glued to a plastic rod which has a paddle fixed to its other end. The motor is fed via a resistor to slow it down; it should rotate about four or five times a second. Any faster than this creates the risk of it splashing if the lid is raised.

The intention is simply to keep the solution on the move. In hindsight, I would have fitted two motors and paddles to give better circulation. The etching takes about ten minutes, lift the board occasionally to see if it is finished,



You can either cut the board to size now or after drilling. I drill first while the board is a little larger and easier to handle. Drilling the holes is laborious and a bit messy. I use a small low voltage drill in a mini-pillar mount. Put a block of wood beneath the board to support it then manoeuvre the board beneath the drill bit.

The optimum size of hole for chip legs is 0.6mm and for resistors 0.8mm but larger holes can be tolerated if there is enough copper land surrounding them. It takes quite a long time to drill the holes and a quantity of dust will be created. Its best to use a vacuum cleaner after every 20 or so holes to suck the dust away as it can cause skin irritation. No matter how many times you check all the holes, I guarantee there will be one you missed until you try to fit a component through it!



Cleaning up

Wash the board again after drilling. It is safe to leave the paint in place until you are ready to start assembling the board. The paint is usually "solder through", it acts like flux and burns away when you apply a soldering iron to it. I find it leaves unsightly marks and does little to improve solderability so I use Ultrasolve ULS to dissolve the paint just prior to placing components.

This step is entirely optional

You can if you wish, coat the copper with tin to prolong its life and make it easier to solder to. You need another tank and some tin plating solution for this. Remove the paint and clean the board with ULS then immediately drop it in the plating solution. Leave it for several hours until a silvery film has settled on the copper. Remove the board from the solution and wash it in water. Tin-plating solution is very expensive and although I have plenty, I rarely use it. Making a PCB without plating takes about one hour from computer print to etched board, adding the plating stage makes this much longer and doesn't

really offer many benefits. The choice is yours of course. A spray of plastic lacquer or conformal coating does just as well and is quicker than plating.

Using existing designs

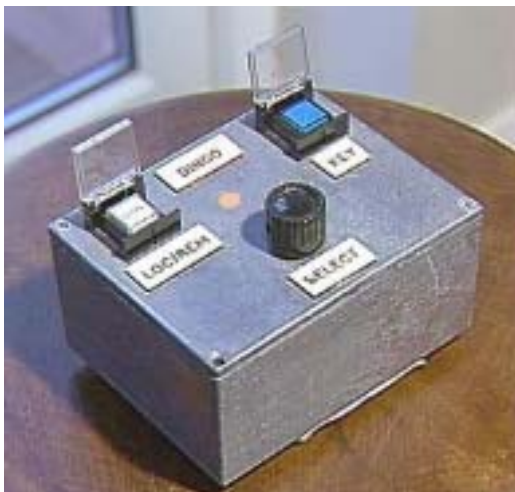
Copying designs from magazines or books is easy if you use the photographic method I've described. All you do is either photocopy the artwork from the page onto film or use a scanner and printer to do it via computer. You may need to adjust the scale of the copy if the article didn't show it at full size. Scaling is normally a feature of photocopiers and print programs so this shouldn't be a problem. Once you have the design on film, simply go to the UV exposing stage described earlier.

I hope I've managed to persuade you that no black magic is involved and nothing more complicated than pouring a few chemicals is demanded. It may sound a little complicated at first but in practice the whole operation is quick and gives professional results. The investment in equipment is very modest and it can be used time and time again. What you

don't make yourself is easy to find in component catalogues and the chemicals are readily available. I managed to flunk my 'O' levels at school but can still make boards so it can't be all that difficult. ☺

Editorial comments

- For those wishing to mix their own developer solution, 5gms caustic soda pellets per 1 litre of water is suitable – great care is needed when mixing this, as it generates heat.
- Goggles to protect the eyes when handling either developer or etchant would be a precaution considered wise by many.
- An alternative way to agitate the etchant is to insert a fish tank aerator block into the liquid, and a pump to bubble air through it – with the board suspended above the block (a vertical, rather than horizontal tank being used).



By jingo, it is a Dingo! So there! However, to be serious, as we all know, hard-pressed tv 'talent' needs a helping hand from time to time. So enter the Dingo! This natty device enabled the programme presenter, at the press of a knob, to change the exciting chromakeyed background whilst on air. For further useless information, contact BBC Southampton (of Studio 'S' fame) from whence this exciting invention emanated.



This novelty item should be near to the hearts of most right-thinking BATC chaps. Yes, it is none other than a Beer Handle. This detachable object (so nicknamed for obvious reasons) enabled focus to be adjusted on the venerable 1950s Marconi Mk II & III image orthicon cameras. Mind you after a few pints, who really cares about the focus...?

TV TRINKETS & TEASERS from Dicky Howett

The Road to Digital

By Richard L. Carden VK4XRL

A lot has been said in recent issues of CQ-TV on certain aspects of terrestrial digital television. Recent issues have also embraced the digital world and the articles by Mike Cox are one example and he should be congratulated. Having read his articles, and wanting to have some involvement as a learning curve, I decided to map out a plan of attack. It's not possible, due to the large outlay both in teams of cost and hardware to go completely digital at this stage. As the big boys have done, it will have to be a transitional period.

The system proposed is a four input 8 bit switcher, with two A/D converters being fed from the existing router/switcher, using the second A and B outputs. The third input could be for a number generator and the fourth perhaps a digital test signal. It would also be possible that the digital A&B inputs could be looped through to a simple effects generator and then feed back to the third switcher input. See the following block diagram.

There would be two outputs, one an analogue signal via a D/A converter giving a PAL monitoring feed while the other would be an 8 bit digital feed that could feed that digital transmitter down the track.

Well to get started I used the old frame store board that has an A/D and D/A already mounted. The UVC3130-08 is combined combination will give you an



Photo showing signal through the A/D and D/A.

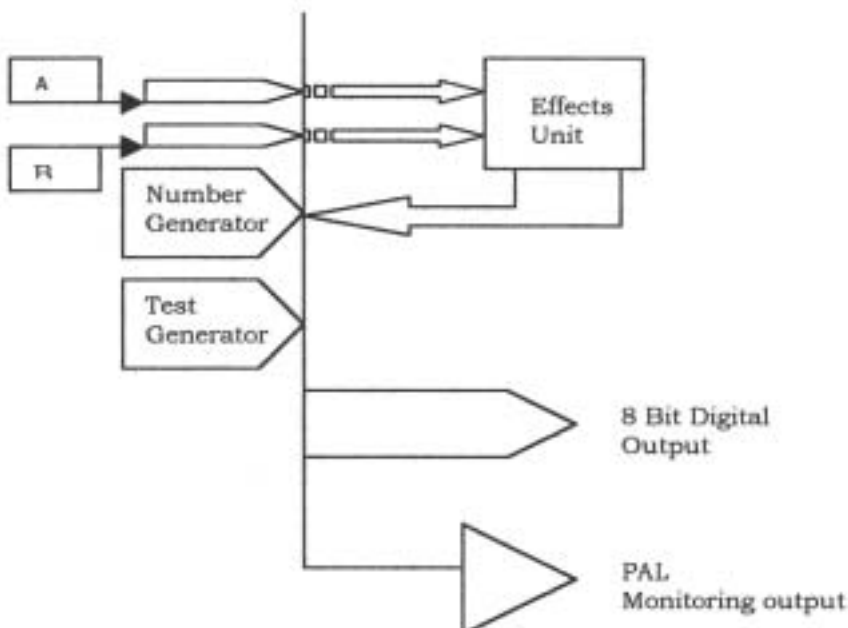
analogue PAL output for monitoring. The 8 bit digital signal has been fitted with a 10-pin IDC connector to enable patching to the digital switcher. Certain modifications have been made to the original board. Looking at the diagram you will see the LM318 has been replaced with a 2030. The clamp pulse needs to be set to clamp after the burst and the resistor from pin 15 of the first 74LS221 has been increased to 10K. Also pin 22 should be de-coupled with a 10nF capacitor. The sync level circuitry has been slightly modified to allow some adjustment of the sync output amplitude.

You will notice that the PAL output from pin 2 does not have any filtering; as Mike has pointed out some form of anti-aliasing filtering will be required. The application note shows a simple LP filter set at $F = \text{CLOCK}/2$, however I don't believe that it will provide the answer and a better filter will be needed. I found the output level a little low, but as it was only used for monitoring an extra amplifying stage was not added. The only other problem area was the clock generator, which was very hard to set to the required frequency of 13.5 MHz. This will be replaced at a later stage.

The 8 bit digital switcher was produced on similar lines to that described by Mike Cox in his articles.

I have also used the 10 pin IDC plugs and sockets and this makes it very easy to check or change things around for experimentation. At this stage I need to make some PC boards and would suggest a prototype board made on similar lines to that used by Mike Cox, however made for the plug in rack format. While on this subject this whole project could be made on plug in boards, just like the old BATC club analogue project by Trevor Brown.

The switcher board has a PAL monitoring port based around a TDA8702 (I was able to find some available in Australia). The output from



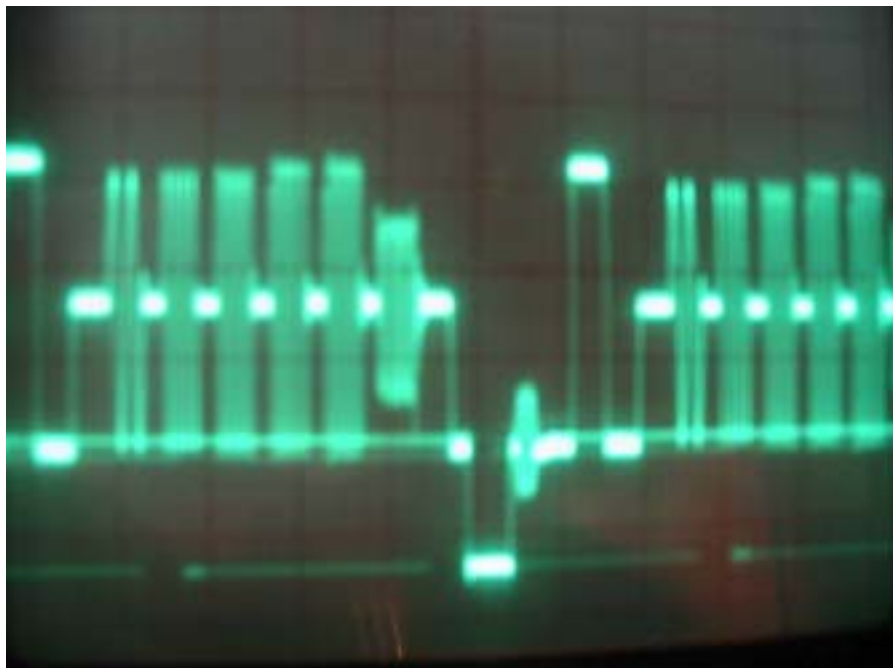
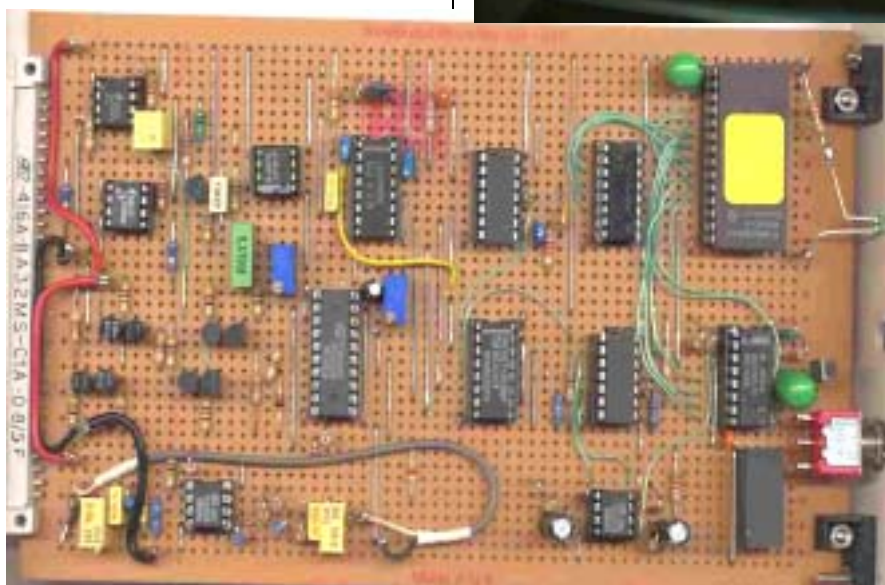
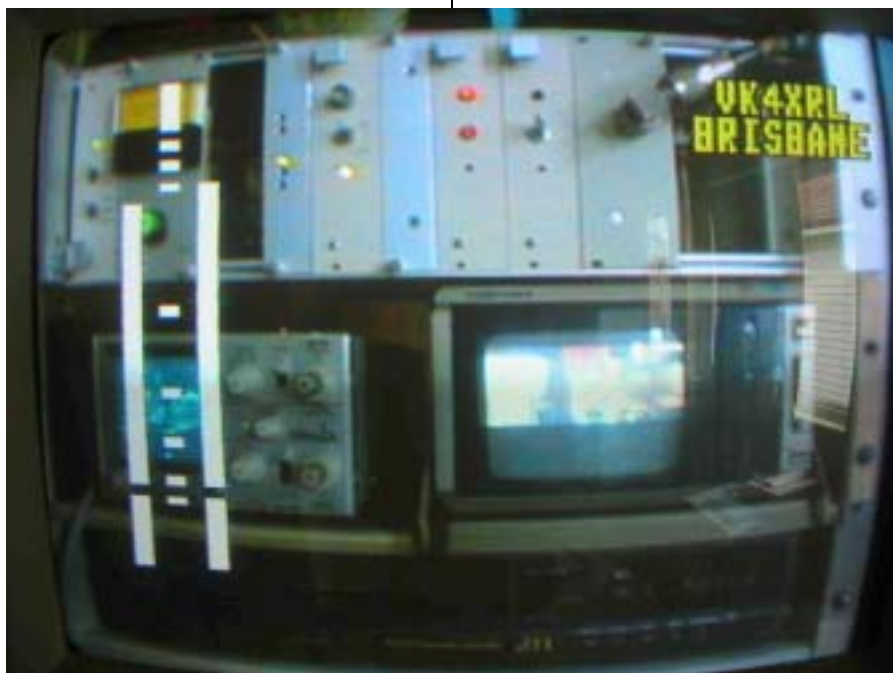


Photo showing multiburst through the A/D and D/A

the D/A can be single ended or doubled ended feeding another 2030 with gain control and of course with an anti-aliasing filter. The number generator has not been built yet but will be modelled on the unit in CQ-199. A hexadecimal readout will also be built; a suitable design using two EPROM's feeding 7 segment displays has been sourced from the internet at http://members.aol.com/mcpage0/cp_de.col.pdf

A project such as this is a good workhorse into the digital world. The following photo's show the in statues audio level indicator from CQ-189.



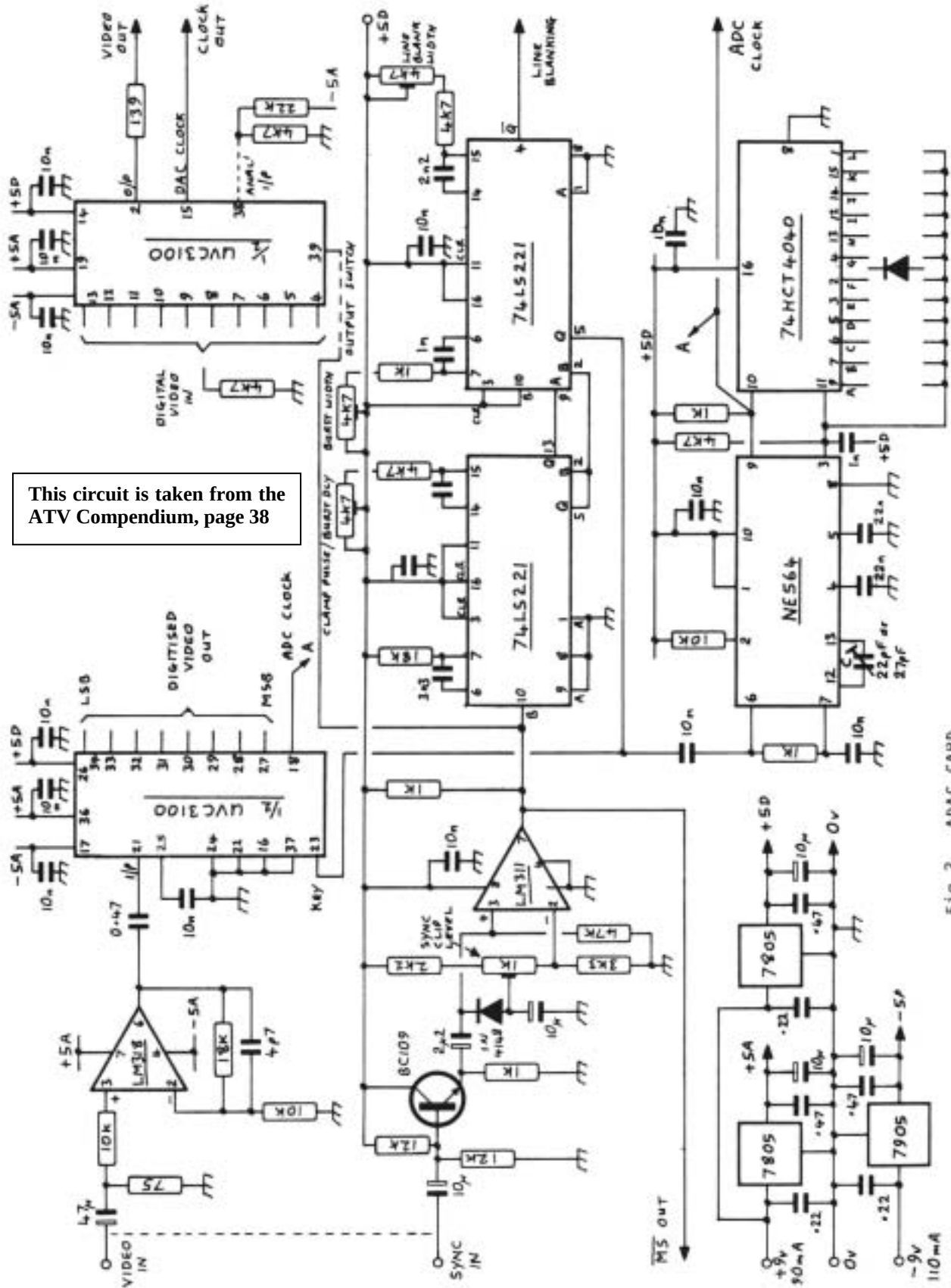


Fig.2 ADAC CARD

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ATV - VT!

By Graham Hankins G8EMX.

Primarily as a 'fun' exercise, but also to have something to make rally tables more interesting for newcomers, I have been producing an ATV video that might answer some of the questions potential new BATC members ask.

With S-VHS and standard VHS recorders at home (it's *amazing* how inexpensive even SVHS now is), a digital still camera, analogue Hi 8 camcorder, plus a Minidisk audio deck (I'll explain how useful *that* is later!) I have 'had a go' at preparing a short video to *simply* explain our hobby and how to 'get started' with the basics.

My first 'Producer's Decision' (!) was to cover only 70cm and 24cm ATV. I felt it important to mention 70cm as the first available band, also its dx capability, but then to concentrate on 24cm as the most used ATV band, and the first with repeaters. Including higher bands would

extend and complicate a video for beginners.

Initial attempts at 'shooting' an opening sequence were nothing short of disastrous! Even with a script prepared, and several 'takes' of speaking to the camcorder, results were useless - I could never remember what to say (oh for an Autocue!) and my attempt at a 'set' and 'lighting' was ridiculous. So, with my Director's Hat on I decided not to appear in vision, but to use ATV footage with a voiceover commentary. This set the pattern for the rest of the video, and tied in with my personal dislike of 'talking heads' on broadcast TV.

So with substantial camcorder footage already shot, and any stills taken with the digital camera and its video output, the actual programme sequence was compiled on the VHS VCR. Audio commentary was written on my PC then printed out - oh yes, it is *hopeless* trying to record impromptu - hesitation is

almost inevitable and forgetfulness rife. The 'script' was rehearsed and recorded on the Minidisk - SO much quicker than cassette tape for 'rewinding' and erasing - no contest, in fact - then played into the VCR, set to 'audio dub'.

Yes, I am doing all this in the 'analogue domain' onto VHS. When I build a new PC, this can either be digitised and burnt onto a CD, or re-shot with a digital camcorder. The tape will mention the BATC, but is my production and will be distributed at a couple of rallies as such. Only when I have improved some sequences and achieved the CD format, would I seek BATC committee approval as a 'BATC video'.

My thanks and acknowledgement to members of the North London Television Club (who look after repeater GB3EN) for their on-air footage - I have used a few minutes of it so far, and this project is, I emphasise, ongoing

Rudolf Horkheimer Award 2002 for DATV Team

By Klaus, DL4KCK

Prof. Dr.-Ing. Uwe E. Kraus, DJ8DW, received the DARC Rudolf Horkheimer award 2002 on behalf of the DATV working group at Bergische University Wuppertal. DARC board member Dr. Walter Schlink, DL3OAP, handed over

the award to Uwe Kraus, DJ8DW, and Hans-Juergen Schmitz, DJ8VR, during the opening event of HAM RADIO 2002 fair end of June in Friedrichshafen, Germany. In his speech, DL3OAP appreciated the outstanding development by the DATV group and stressed the fact that Uwe Kraus devoted himself to the UHF bands and the amateur television

technology soon after having received his licence in 1962.

Latest DATV lecture sheets from DJ8DW with block diagrams and pictures of the new 3rd generation MCBs, results from field tests on 70 and 23 cm and future developments are ready for download at www.datv-agaf.de/.

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