

May 2007 - Issue 218



# CQ-TV

## 218

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# PIC On Screen Display Project Board

## The Versatile, Programmable On Screen Display System

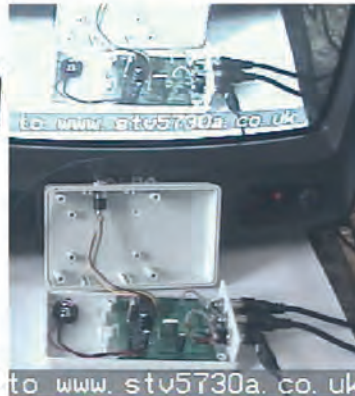
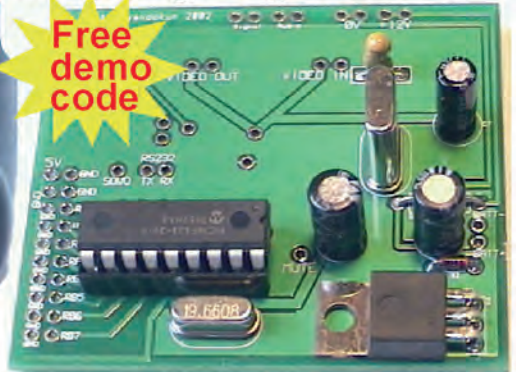


Ideal ATV  
callsign  
generator

The BlackBoxCamera™ Company Ltd. sponsors the CQ-TV caption competition. The winner will receive a keyboard text overlay unit.



Free  
demo  
code



- PIC 16F628 microcontroller
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- RS232 serial interface
- PAL or NTSC compatible
- Enclosure option available

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Caption  
Competition  
see page 11

*photo: Mike Busson GW8MER*

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# Vertical Interval Switching - A Tutorial

Mike Cox

One of the plus points of building your own kit is that, if you want to modify it, you need not worry about voiding the warranty, because there isn't one!

So once again it has become time to modify the SDI Routing Switcher [CQTVs 207, 215]. This tends to happen in the run-up to IBC, and this is again the case this year.

Because of the success of the Aston 7 last year [IBC2006], the SDI mixer [CQTVs *passim*] was not really used apart from the Cut bank. The thought for this year is to use a bank of the SDI Router for TX output – it has all the available sources as inputs, and followed by a simple Fade to Black facility.

All that needs to be done is to make the Router switch in the Vertical Interval [VI]. Before we get onto the technical bit, why do we need to do this? As always, it depends on the end use. If the Router is just setting up sources for say monitoring, the actual switch point is of no consequence. Similarly, if a source is being selected to record, when the switch occurs is also of no consequence, because the Record command will always follow the selection.

A vision mixer or presentation mixer however will switch sources directly to air.

Unless the switch occurs at a defined point, one picture will not be replaced cleanly by the next; the switch may occur half way down the field, with an unfortunate visual appearance. The best point will be during Vertical Interval. It is also necessary that the sources are synchronous, to avoid horizontal jumps at the switch point. If this is not possible then the V Fade approach can be used. The video is faded to black, the switch to a new source occurs, and the new video is faded up. Because the switch occurs at black, visual disturbance is minimised.

It would be nice if the Router carried on switching even if no Reference Video was available.

So two needs are established: - one, a circuit to derive a field pulse from Reference Video, and two, an oscillator which free-runs at just below field

frequency, and is locked by the field pulse if it is there.

Being a fairly idle sort of designer, the first thought is an **LM1881** [industry standard] to act as sync separator and field pulse former. In previous CQTVs, I have shown the use of an emitter follower with high-ish base resistor to filter off some of the burst component of a CBVS signal so that it does not interfere with slicing of the sync pulse. It also provides a low source impedance, which the internal dc restore circuit of the LM1881 likes.

However, I wanted to avoid the emitter follower, particularly as there was only a 5 volt rail available. The input was to be 75 ohms.

Thoughts then led to a constant impedance network, with one arm having a low pass filter output. This works well.

This shows the arrangement. At the left, the constant impedance network comprises two 75-ohm resistors, one with a 15 uH inductor to ground, the other with a 1n5 capacitor to ground. The values are chosen to have the same reactance at around 1 MHz. They display complementary frequency characteristics so that the input looks like 75 ohms over the video band. Signal for the sync separator is taken off from the capacitor, and behaves like a low pass filter to attenuate burst components. Across the L is a fairly good chroma waveform.

[See CQTV 217 p26]

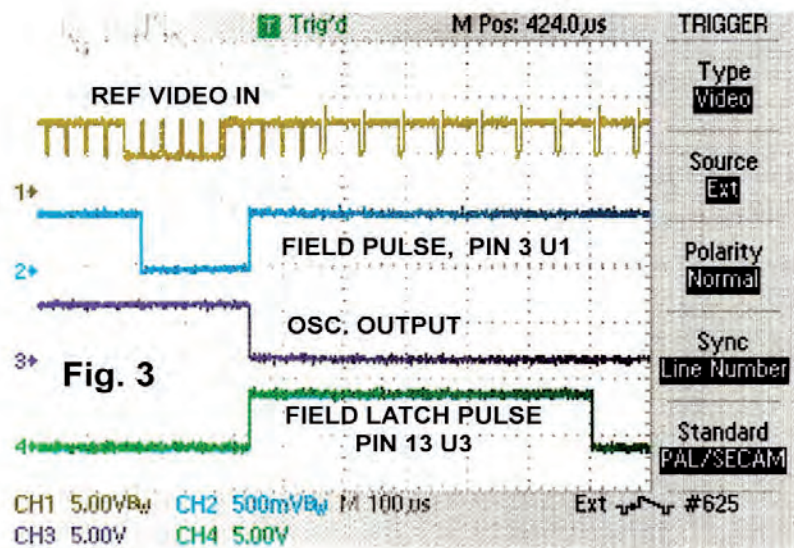
Only the field pulse output is taken from the LM1881. The latching of the Source, Destination, Load and Config information need to occur after the Vertical Interval portion of Sync Waveform. Therefore the VI latch needs to occur around the back edge of the field pulse. Differentiating the field pulse and selecting the back edge yields a pulse applied to the bottom end of the timing capacitor to terminate the ramp.

The oscillator is set with no Reference input to run at around 45 Hz, and when Reference is applied, speeds up to 50 Hz.

The 10-bit latch used [74LVC821] needs a 3.3 volt rail. A convenient "Zener" to drop 1.7 volts is a red LED. It is cheap and it works! The 74LVC821 can stand 5 volt input swings.

The circuit shows in and out 14-pin IDC connectors. This has been done to allow the system to be tried out on the Router, before a tidy-up PCB is commissioned. Using this system, all Router banks are now VI switching.

Although this is destined for the Gennum **GS9553** 8 x 8 SDI chip, it should be equally applicable to other matrix chips such as the Maxim **MAX459** 8 x 4 analog matrix mentioned in CQTV195, pp32 – 37.







# Circuit Notebook No. 93

by John Lawrence GW3JGA

The TEP IQ2 Microcontroller Board

This is a small fully assembled PCB with a PIC 16F817 8-bit Microcontroller, pre-loaded with a control program. It is intended for pupil use in schools, but could have applications in amateur radio and ATV, in fact, almost anything. You don't need a programmer to program it. A picture of the Microcontroller, with terminal blocks added is shown in Fig.1. and the layout is shown in Fig.2.

The main features include:

- Original simple on-board programming
- virtually unlimited control opportunities
- up to 248 lines of program
- retention of programs when switched off
- access to different programs
- 2 inputs to control running of programs
- 4 outputs giving direct drive of motors, relays, lamps etc
- (up to 800mA each output)
- direct stepper motor drive with speed and reverse facility
- variable speed control of programs
- compact size: 65mm x 60mm x 10mm
- battery or PSU operation 4.5V – 6V

## Programming

Programming of the IQ2 is very easy. First of all, to create a line of program, set each of the outputs to either on or off. The LEDs adjacent to each of the press button switches indicate on or off status. (These enable both programming and test runs of program before anything is actually connected.) When the four outputs have been set, press the 'save' switch. All the output LEDs flash momentarily to confirm

that this line of program has been saved. Re-set the outputs (or leave them alone) for the next line of program and press 'save' again. You can enter up to 248 lines of program in this way. However, you can only correct any errors by entering the whole program again.

To run the program, press the 'run' button and the green LED comes on. The output LEDs will light up in the sequence you programmed. The program loops continuously.

The rate of stepping through the program may be controlled by the 'speed control'. The fastest rate is about 100 steps/second and the slowest about 20 seconds/step.

Sample program: single flashing light

Turn on output 1 – i.e. press the button so that LED 1 lights up

Press 'save'

Turn off output 1 – i.e. press the button again to turn off the LED

Press 'save'

Press 'run'

You have created a two line program that turns output 1 on and off. Because the program always loops back to the beginning, the flashing is continuous.

If you disconnect the battery and reconnect, the program will run again. It will only be deleted when you start entering a new program. Full information is provided in an 8 page information document provided with the IQ2 microcontroller.

Amateur radio and ATV applications

The first that comes to mind is a morse code 'ident' generator, for portable or repeater use, where the call sign is programmed in line by line. One of the outputs could key the TX or tone generator. For example, the lines of program for the letter 'A' (dit-dah) would be ON-off-ON-ON-ON-. My call sign would occupy 76 lines of program.

There are 2 inputs. The inputs enable you to start, stop and jump between different sections of a longer program

and so allow you to select 4 separate sub-programs (Progs 0-3) which you have entered. Continuing from the above example, one program may have your call sign, another a 'K', another 'CQ' etc. and these could be selected by a switch as shown in Fig.3. and run independently.

In ATV, the IQ2 outputs could be used drive video/audio switches or multiplexers to switch sequentially, but in any order, up to 4 video sources and 4 audio sources or to switch a caption source on for a few seconds and the main signal on for an extended period. A suggested arrangement is shown in Fig.3. The input switch must be set to '0' when programming the IQ2.

The outputs are 'pull-down' open collector circuits, mainly suitable for relays etc but if used to drive other circuits then a 'pull-up' resistor of 10k ohms on each output will be required, as shown in Fig.3.

## Acknowledgement

To Professor John Cave of Middlesex University for permission to reproduce the diagram and other information from the IQ2 document.

## Figures and text

Fig.1. IQ2 Microcontroller with Terminal Blocks added

Fig.2. IQ2 Layout and connections

Fig.3. Suggested ATV use for the IQ2 Microcontroller

## References

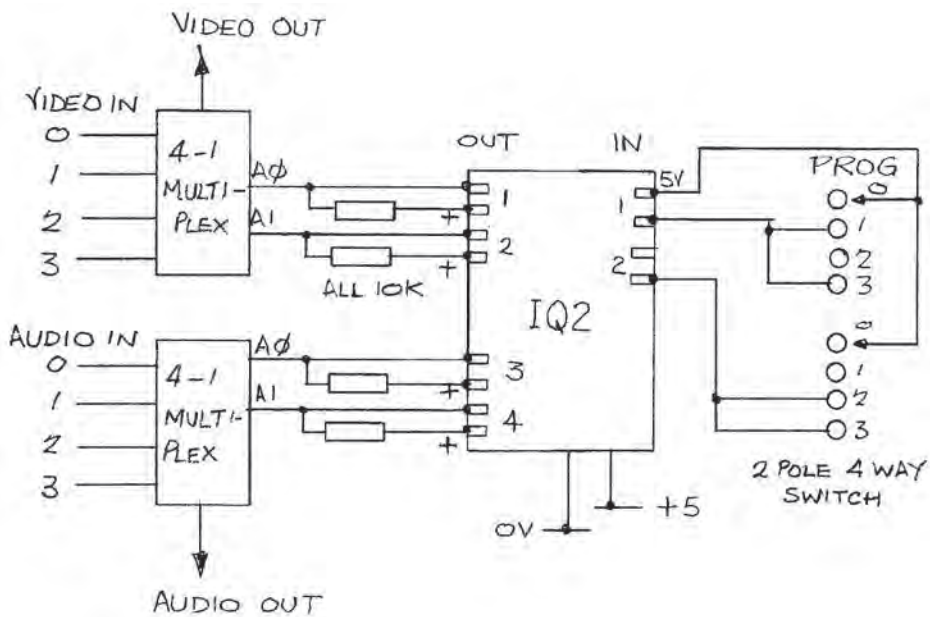
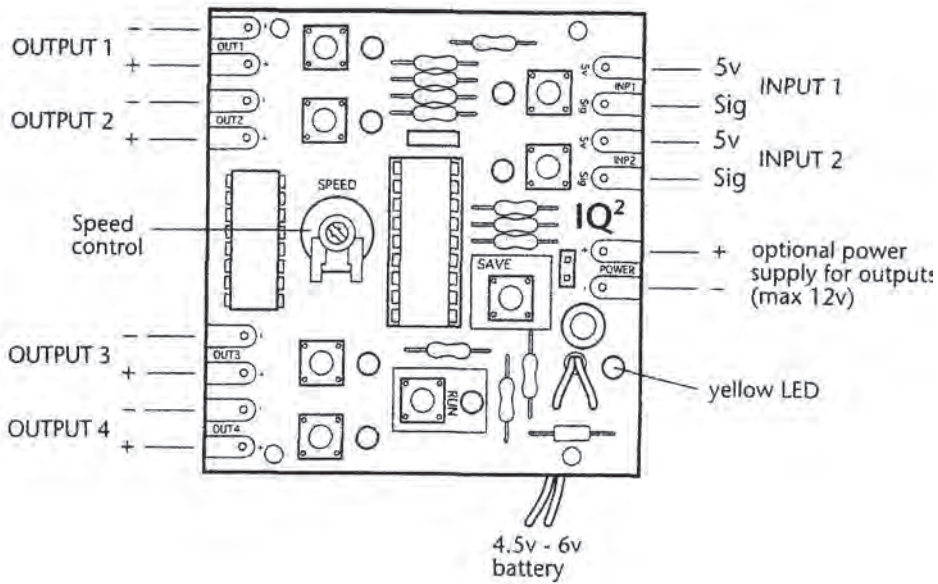
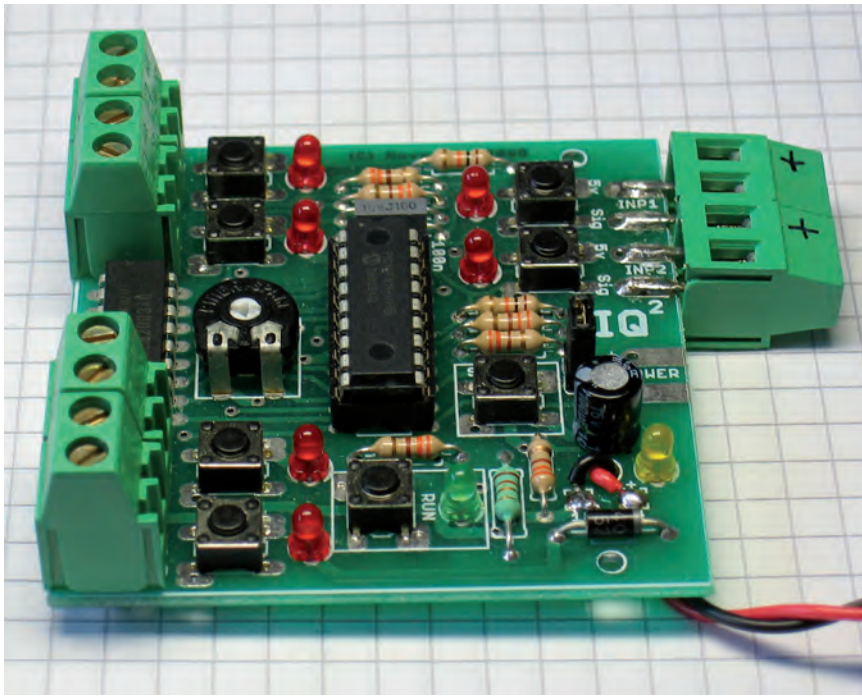
IQ2 Microcontroller Document  
Teaching Resources Ltd.

Unit 10, The IO Centre, Lea Road,  
Waltham Cross, Herts EN9 1AS  
Tel. 01992 716052

[www.mutr.co.uk](http://www.mutr.co.uk)

microcontroller (assembled)  
Teaching Resources Ltd

I Q  
002 Board £9.60 + £5.80 p&p + VAT  
(£18.10)



## Turning Back The Pages

by Peter Delaney.

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

CQ-TV 32 - "Spring 1957"

The main article in this issue - taking 3 whole pages, was the design for "The BATC Sync Generator" - 'a complete pulse generator for any number of lines' designed by G3CVO (Mike Barlow). This was part of a 'BATC standard waveform unit' which occupied four 15" x 2" panels, bolted together. The part described produced the complete mixed sync waveform, separate line and field syncs and mixed blanking. The article discusses the differences between '819 type' mixed syncs and '405 line' type syncs (at the time, France used the 819 line system, and the UK 405 lines), as well as 525 and 625 line systems, which need 'equalising pulses' to ensure line timebases do not get out of step during the frame sync period. The author recommended that for amateur use the 405 line type of waveform be used however many lines there were in the picture. A very simple generator was possible as in fig 1, for

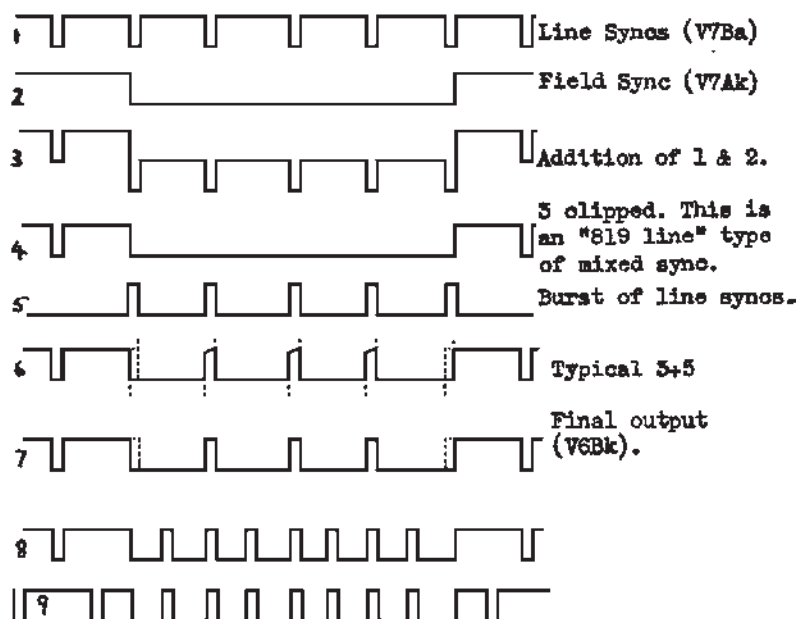
the 819 type mixed syncs, (waveform 4), but not all receivers would lock to a system like this, which used a relatively short frame pulse. The block diagram of the unit described (Fig 2) had just one control, for line frequency, the field pulses being locked (as was then commonplace) to the mains. It used 7 12AT7 type valves, and was said to be easily able to be genlocked. The two basic oscillators were cathode coupled multivibrators. Construction was based on tagboards - no printed circuit boards in those days. "Getting the unit to work is simplicity itself" - and was done by inserting only the first valve, aligning the line frequency to that received on a tv set, and then adding V2 -- etc. It was necessary to ensure that the HT rails were free of spurious pulses - the HT supply being about 65mA at 210volts. There was also a heater supply of about 2.1 amps. The typical waveforms 1 - 7 are shown in the diagram. The photographs show the sync generator bolted to the vision blanking - sync mixer and a test waveform monitor. Attention was drawn to the terminating plugs in the output sockets of the sync generator (on the right, in the view from the top). The form of construction using turret boards can be seen in the view from beneath the panel.

A report on the Television Society Exhibition reported that it had little to interest the amateur television enthusiast, and there was surprisingly no mention of G3CTS/T (the Society's amateur tv station), which had just started regular transmissions. The exhibition did, however, include an 'item of interest' - also a sync pulse generator. This one - together with a vhf distribution amplifier - used 21 OC71 18 OC45 and two RCA RF transistors. Including the power supply - 13.5V at 30mA from a battery - the whole thing went into a case 8" x 4" x 5".

*(Nowadays, all of this and more can be done in a single ic, such as the SAA1101 that draws 25mA at 5volts).*

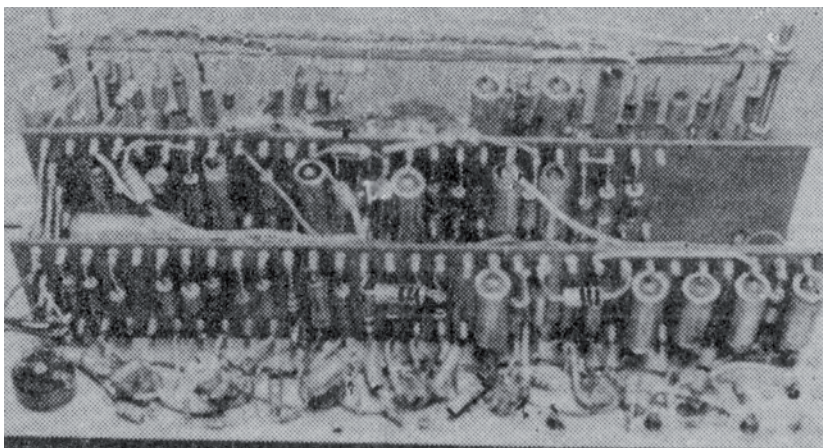
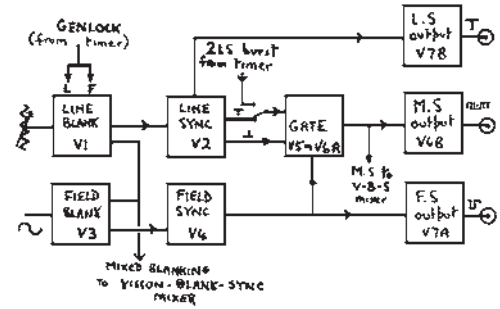
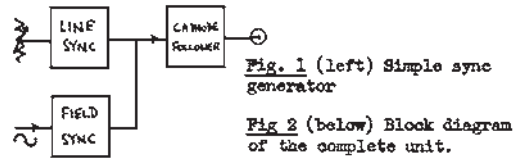
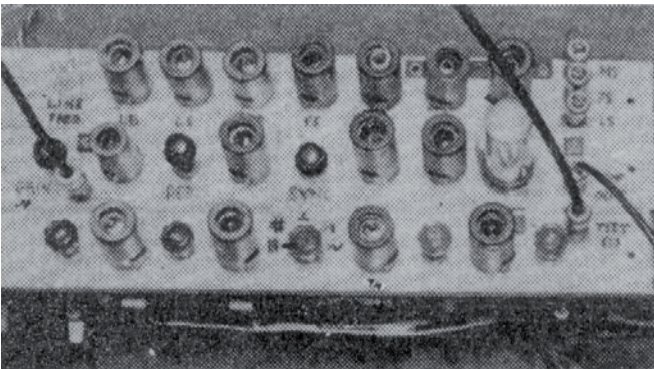
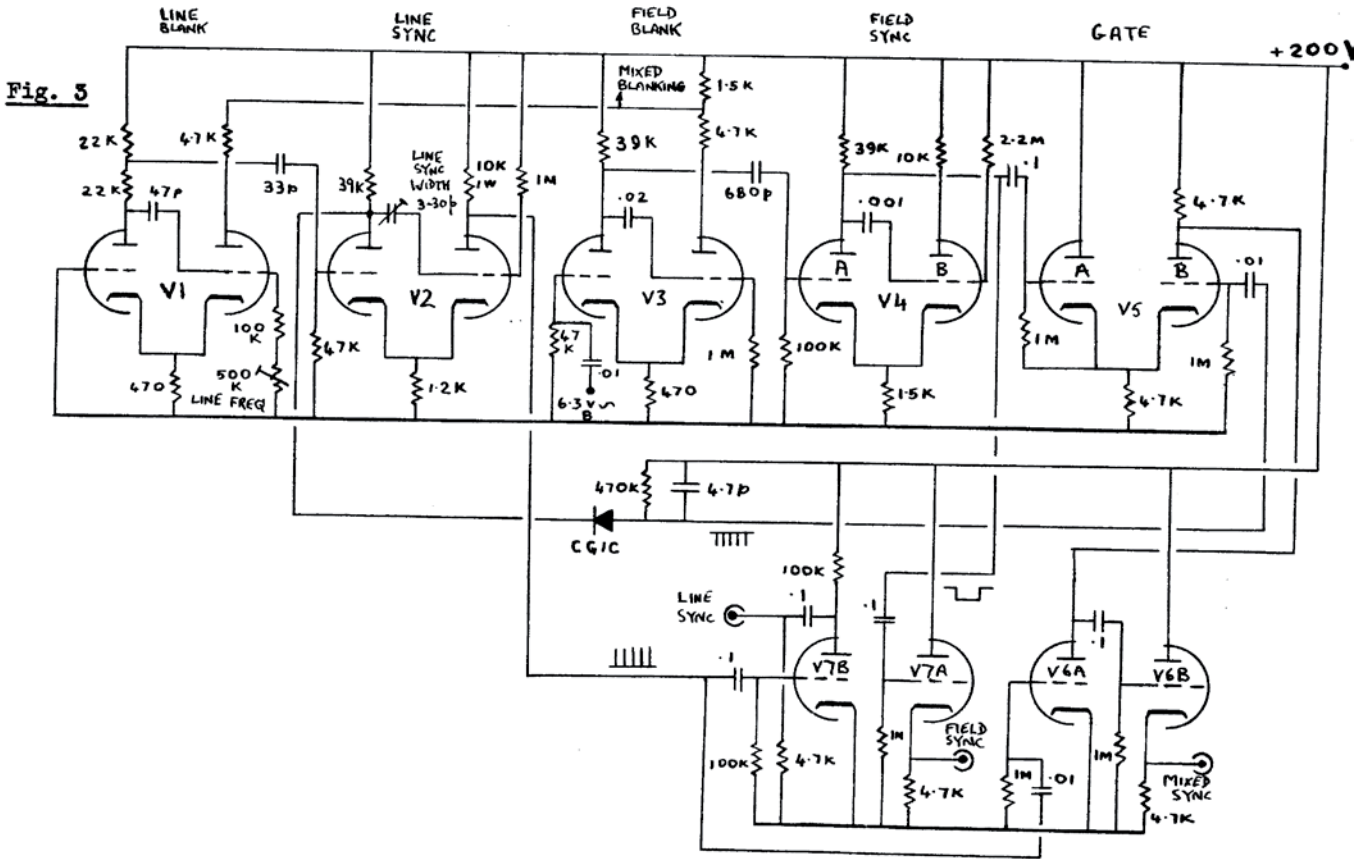
Club news included a 'Change of Editorship', as L A F Stockley, G3EKE was taking over as the London editor - the original editor, Mike Barlow, and family being due to emigrate to Canada later in the year. Mike was going to supply 4 pages per issue from Montreal, and the other 4 pages would originate in London - an appeal being made for a typewriter with Imperial Good Companion typeface, so the two parts would match! The results of a questionnaire sent to members with the previous issue had shown members were satisfied with Club activities. In CQTV, the technical articles were favourite, followed by 'other blokeisms', photographs, and 'beginner's pages' (similar to what would arise today in such a survey). This month's "BATC wrinkle" was that 'anything you can do with a pentode you can do with a double triode - if you think for long enough'. That probably does not have an 'equivalent' in today's technology.

Other news included the introduction by Telequipment Ltd of a 'grand little oscilloscope called the Serviscope, which is ideal for television applications.' It used a 3" crt, and under test we were able to view a few individual cycles of a colour subcarrier burst (*In 1957, note!*) 'Really worthwhile, this little scope costs £55 - a bit much for an amateur, unless a group buys one'. The High Wycombe group had built a static camera - which they mounted on a tripod made of broom handles !!!



When the timer unit is built, the burst of line syncs 5 is replaced by a burst of twice line frequency pulses, whose trailing edges are co-incident with the leading edges of line syncs. The waveforms for alternate fields are then as shown in 8 & 9, the displacement of the line syncs in 9 occurring since there is an odd number of lines per field.





## Aint No Dummy

In the best tradition of John Logie Baird, Dicky Howett proves that black and white tv is alive and well. Pictures are still being produced (3/3/07) by his EMI 203 4-1/2" 625-line image orthicon camera, despite some components having a sell-by date of 1959!

Dicky Howett

GOLDEN AGE TV

Phone

+44 (0) 1371 820155







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

The archive is constantly being updated as more of the old paper issues are converted to electronic format. Currently issues 1 to 134 and 161 to 216 are included along with a few odd ones. This DVD is updated 4 times a year, to include the current issue of CQ-TV.

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

The video section was prepared by Brian Kelly and contains videos

from Bletchley Park 1999, one from Shuttleworth 2002 and one from 2004. The cost for this DVD is £5.00 for current members and £10.00 for non-members.

## Caption Competition



Two people submitted more than one caption which I think is acceptable in view of the small number of entrants.

Cat says: "...of course I love you. How can you be so hard and cold towards me..." and Mouse says: "Oi, stop nibbling my ear. I bet you say that to all the peripherals.." - Keith Rainbow

Finally from Jack McKinney we have: "Tom was confused by Jerry's new look" and "A mouse certainly looked very different in my young days"

I think that mouse looks a bit tough to eat so I'm announcing the winner is Brian Summers. Congratulations Brian.

Entries for the last competition were:

"What do they mean my lunch is on the laptop?" - John Van Dyken

"I don't know, mice just don't taste the same these days!" - Mike Busson

"I think it needs another 20 minutes in the oven" - Brian Summers

"Which end takes the cheese then?" - Patrick Spelman

## Pixel Power

Once upon a time colour TV cameras were a little easier to understand than they are now.

They had tubes, one for each colour i.e. red green and blue. The posh ones even had a fourth one for luminance. The image was focused through the lens onto a dichroic block that directed all the colours to their relative tubes. Add a little electron scanning and we have a RGB video signals. Then matrix it and you have R-Y B-Y and Y. The images need registering i.e. adjusting so that the same picture is in the same position on each tube. These were always a little less than perfect hence the term registration errors. If you had the fourth tube for the luminance signal then the luminance signal was free of registration errors, if not it was made in the matrix and would contain registration errors.

Then the world changed and CCD image sensors now replaced tubes, but there are several types out there all with their own advantages and disadvantages. Let's start by looking at a three CCD camera. For standard definition we need 720x575 pixels and again three of these. As with the tubes, the light split into the three ways, this time into red, blue and luminance by what is now called an ice block. The matrix needs a little juggling to work out the green content by adding red to blue and subtracting it from luminance should we require the green signal. The scanning has been replaced by a side-ways shuffle of the charge on each pixel, but otherwise little has changed, or has it?

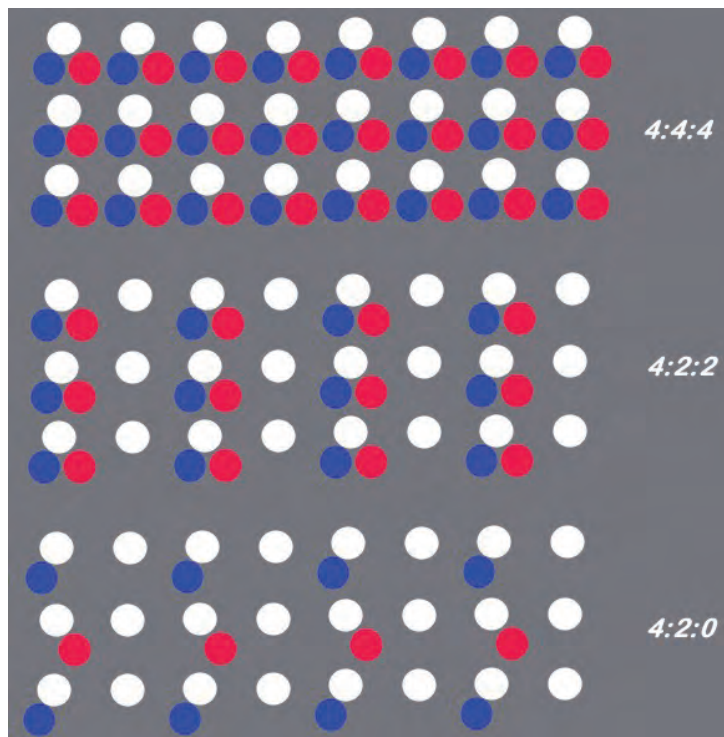
Before we start coding it into a digital signal where we walk into the large bandwidth of an uncompressed digital signal, let's start by revisiting the pixels and asking whether we need all of them. We'll start with 4:4:4 coding; this is the standard for high end video suitable for special effects work. More often we use 4:2:2 sampling which means we drop every other pixel in the blue and red channel. Reducing the colour resolution. This has become the broadcast norm and although it has reduced chroma resolution it will work with chroma key but not high end effects. If it's digital then it usually travels around the studio as SDI (Serial Digital Interface) 270 MB/s

There is another standard below that known as 4:1:0 and again we leave the luminance at full bandwidth hence the '4'. The other 2 digits refer to the colour channel, so does that mean we lose one of the colour signals? Well, not quite. We omit every alternate colour pixel as in 4:2:2 and also one of the colours per line, alternating on a line by line basis. So we have a red line followed by a blue line sequence. This reverses on each frame, but we have halved the vertical colour resolution. Not an ideal system for Chroma Key. This is a simple form of compression and it's how we reduce the size of digital files. It enabled the digital information to be stored on tape as DV Cam and it's used mainly for news.

Full Luma and Chroma Information is read from every pixel

Again full Luma but chroma is only sampled on every other pixel

In each horizontal line only one colour is sampled



It is also ideal for amateurs, the same signal can be stored on Mini DV (smaller tape with thinner tracks), but the same video quality is possible only with cameras equipped with Mini DV transport and are often more domestic

in their electronics and lens

This is also ideal for home editing as it can be imported in to a PC via a Firewire connection and edited on relatively inexpensive software and authored to DVD. It's ideal to give your ATV audience that polish that is so often missing from live ATV.

Let's jump now to single chip cameras. All sorts of systems have been used with a view to reducing cost and usually picture quality at the same time, but now high end cameras are revisiting some of the technology. The most interesting revisit is the a Bayer array, invented by Kodak some 20 years ago. It uses a mosaic of pixels laid out as RGRGRGRG on one line and GRGRGRGR on the next so for HD 1920x1080 you have 960x1080 of green and only 960x540 of blue and red.

The Bayer array has no dichroic or ice block to split the colours up for the individual. Furthermore, we can always increase the number of pixels

as there are already 2k pixels per line cameras on the market and this will shortly be followed by a 4k design.

Officially announced at NAB 2006 the Red One camera is the latest greatest project from Oakley founder Jim Jannard,

Typical high-end HD camcorders have 2.1M pixel sensors and record with 3:1:1 colour subsampled video at up to 30 fps. We deliver 11.4M pixels at up to 60fps and record RAW, or 2x over-sampled HD in 4:4:4 or 4:2:2 – it's



your choice. That's more than 5 times the amount of information available every second and a vastly superior recording quality

There are more green pixels than any other on the Bayer array and this problem would normally be addressed in the image processing, but then RAW

imaging came along, which records what the array produces and sorts it out in post production. This gives tremendous scope to post production grading to get the pictures to look like film. This is hardly surprising but then that is the way film is graded for television and it always gives it that high end look.

The Red One will truly be an electronic film camera and its results are eagerly awaited.

See [www.red.com](http://www.red.com)  
- Trevor Brown

## Terrestrial TV switch off

Is it me or do we have a problem with our Digital terrestrial TV system

I know it's old and has taken forever to get into operation but then there was no rush when the government of the day were promising not to switch off the analogue system until 95% coverage and 90% uptake on the technology. It was in the days before this government promised "things can only get better" I don't think that referred to Television although at this moment in time I am not sure what it referred to.

The original set top boxes were designed more than 10 years ago. remember Chris Tarrant was featured advertising them at I think around £100 if my memory serves me well. So good was the uptake that suddenly digital set top boxes became the Sport box with ITV promoting second rate football purchased at such inflated prices that the company went bust, and the clause that said it was to be underwritten by the then Granada share holders seemed to have disappeared from the final draft of the contract, much to the dismay of the sporting clubs busy spending, money that was never to turn up. Anyone still got a Monkey they did give them away.

The next deal was done with the BBC and the new channels appeared and some of the technical problems went ie there was what I think was called a re optimisation of the system. I suspect the elastic band of digital wizardry had been stretched too far. This did improve the lock ups blocking and general picture freezing and create a watchable system.

So now with the governments eyes fixed firmly on the prices that the freed up analogue spectrum will bring on the open market, we seem to be starting the long promised analogue switch off starting this year, with the 90% and 95% figures promised, lost in the spin.

Is this a problem well yes, not only for the analogue viewers of the present system but because we are trying to float a new TV system HDTV? The screens are certainly in every electrical retailer and say HDTV ready, ie they have an HDMI connector and yes it will plug into a Sky HDTV system, but what about the terrestrial viewers

The set top boxes which are now down to about £20 are at last selling but they are Mpeg2 technology, well - they have been around for 10 years or more. HDTV requires more bandwidth than standard definition TV and is best suited to Mpeg 4. The set top boxes that are now saturating the supermarket shelves are Mpeg2 only, if we revise the hardware presumably the prices will go back up to the point where they were not selling before. Not only do we have hardware problems, the current band plan has no provision for Mpeg4 HDTV channels, there is only one BBC Mpeg4 channel running HDTV on a temporary basis to some 700 users around the Crystal Palace transmitter on a temporary licence from Ofcom.

Once the space has been auctioned off how do we fit the HD channels into space already allocated to the narrower standard definition channels, surely we should revise the system allocating what space we need for a UK terrestrial HDTV system even if it means ring fencing frequency allocations and working on a transmission system after the auctions.

If we don't could we be the country hosting the 2012 Olympics viewed through out the world in HDTV while at the same time being the only country that does not have a terrestrial TV network for its own population to view it on ????

The BBC has suggested an invest to gain approach, similar to that

embarked upon for the original digital switch-over. In order to accomplish the original switch-over we actually had to increase the number of active channels to embrace the digital multiplexes. What they are proposing is similar with channels ring-fenced for HDTV terrestrial transmissions utilising MPEG 4 technology, over a period (probably 10 years or so) the existing channels will all be converted to MPEG4 transmission, in the case of SD this would allow 3 channels to occupy the same bandwidth currently used by 2 channels. Over time this would "free up" channels, which could then be auctioned off.

If this approach, or something similar is not adopted, because of the licence period for the auctioned off frequencies, the UK will not have the opportunity for a generation to establish terrestrial HDTV if ever! Suggestions that we might use alternative frequencies in the future would leave the UK as the only country not utilising the UHF band for its television service, with a market so small that no manufacturer would consider it viable.

The BBC have pointed out, in a free for all bidding war they could not, or even arguably should not, bid for the frequencies required to provide a free to air HDTV terrestrial service. I mentioned earlier the scenario that the UK would be the only country not able to receive terrestrial HDTV signals from the Olympics in 2012 even though as the host nation we would be transmitting them to the world in HD how embarrassing would that be? When questioned in The House about this matter, the minister concerned said that HDTV was "a matter for the broadcasters" well that may be the case but the delivery is a matter for Government.

- Trevor Brown

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# Signalling Protocol specification for the Advanced Repeater Project

by Brian Kelly

## **Electrical Specification.**

The signalling protocol used in the link between SYSPROC and host system follows the RS232/V.24 electrical recommendations.

Minimally, the communication interface consists of three wires linking the SYSPROC and host ports together. The wires are named: Ground, RXD and TXD. Optionally, an additional two wires named CTS and RTS may be used to coordinate the data flow (“handshaking”) between ports.

Ground is the zero voltage reference line. It should be electrically earthed at the host end of the link only. At the SYSPROC interface, the Ground pin is electrically isolated from the system supply and can withstand a constant 1kV potential difference from true ground.

TXD is the signal generated in SYSPROC, which conveys information to the host. It is connected to the data input (RXD) pin on the host systems serial port. It can withstand 30V potential with respect to the SYSPROC grounds pin in either polarity and indefinite short-circuit to SYSPROC ground.

RXD is the signal received from the host into the SYSPROC. It is connected to the host data output pin (TXD) on the host’s serial port. It can withstand 30V potential with respect to the SYSPROC grounds pin in either polarity and indefinite short-circuit to the SYSPROC ground.

CTS is the signal from the host system to announce it is ready to send information to the SYSPROC. When active, the SYSPROC will accept serial data arriving at its RXD input. When inactive, the SYSPROC may optionally ignore all signals from the host and accept them from the SAPROC controller instead. It can withstand 30V potential with respect to the SYSPROC grounds pin in either polarity and indefinite short-circuit to the SYSPROC ground

RTS is a signal from the SYSPROC to the host that can be used to delay the transmission of data to the SYSPROC until it is ready to accept it. Control of the RTS signal can be enabled and disabled by commands sent from the host. It can withstand 30V potential with respect to the SYSPROC grounds pin in either polarity and indefinite short-circuit to the SYSPROC ground

## **Signalling Specification**

The data flow between SYSPROC and host systems consists of a single flow of serial bits on each of the RXD and TXD wires. The bit rate is 38,400 bauds with each byte of data made up of eight signalling bits, one start bit and one stop bit. This format is compatible with almost all computer serial communication systems.

## **Command and Responses Reference**

Commands are signals from the host to the SYSPROC that change a condition inside the SYSPROC, in one of the attached peripherals or request the SYSPROC to return information about itself or an attached peripheral.

A Response is a signal from the SYSPROC to the host that announces its status or identifies the source of information being returned in its embedded data bits.

All commands and responses are eight bits long.

*Command structure:*

The most significant three bits of the command byte are used to identify the command type; the remaining bits hold either data bits or address bits. As the system data bus is only 4-bits wide, data is only carried in the least significant four bits. The system internal address bus, which selects which peripheral device is being accessed, is five bits wide so it uses the least significant five bits.



Command format:

7	6	5	4	3	2	1	0
Command	Command	Command	Addr/data	Addr/data	Addr/data	Addr/data	Addr/data

*Response structure:*

The most significant three bits of a response byte are used to identify the source of the responses data bits or to carry the five least significant bits of the last command sent to the SYSPROC if echo or loop-back were enabled.

Response format:

7	6	5	4	3	2	1	0
Source	Source	Source	Data	Data	Data	Data	Data

Commands are not the only cause of response bytes. They can also be produced by the system announcing it is ready for operation after being reset or by a valid MF tone pair being received.

Read port command:

7	6	5	4	3	2	1	0
0	0	0	X	X	X	X	X

The command bits are 000. The remaining bits are “don’t care”, they play no part in the command but will be echoed back untouched if echo mode is enabled.

This command requests that data from the last selected port address is returned. The port address is placed on the address bus and a read operation is performed. Data from the selected peripheral is read from the data bus and returned to the host as a “Data from port” response byte. The peripheral is then deselected.

Data from port response:

7	6	5	4	3	2	1	0
0	0	0	0	Data bit 3	Data bit 2	Data bit 1	Data bit 0

The response bits are 000. Bit 4 is always zero as all ports are 4-bits wide. This response can only be produced from a “Read port” command. Data from the last selected peripheral is returned in bits 3 through 0.

Read EE memory command:

7	6	5	4	3	2	1	0
0	0	1	X	X	X	X	X

The command bits are 001. The remaining bits are “don’t care”, they play no part in the command but will be echoed back untouched if echo mode is enabled

This command requests that data is read from the SYSPROC EE (Electrically Erasable) memory at the last selected EE address. Data from the selected address is read from the SYSPROC internal bus, the most significant four bits are discarded and the least significant four bits are then returned to the host as a “Data from EE memory” response byte. Note that internally, the memory is 64 bytes long and 8 bits wide but only the lowest 32 bytes and lowest 4 bits can actually be accessed because of the size of the address and data busses. The data in EE memory can be used to initialise the peripheral ports when the SYSPROC is reset if the mode byte is so configured.

Data from EE memory response:

7	6	5	4	3	2	1	0
0	0	1	0	Data bit 3	Data bit 2	Data bit 1	Data bit 0

The response bits are 001. Bit 4 is always zero, the least significant four bits contain data read from the selected EE memory address. . This response can only be produced from a “Read EE memory” command. Data from the last selected peripheral is returned in bits 3 through 0.

Write Port Command:

7	6	5	4	3	2	1	0
0	1	0	0	Data bit 3	Data bit 2	Data bit 1	Data bit 0

The command bits are 010. Bit 4 is ignored by the command but will be echoed along with the data bits if echo mode is enabled. The data held in the least significant bits is written to the port at the last selected port address. The port address is placed on the address bus, the data bits in the command are then placed on the data bus and the system “write enable” line is activated for about 6µS. This is long enough for a port polling the write enable line to recognise it has activated and retrieve the data from the bus. The port is then deselected. Unless echo mode is enabled, this command will not produce any response byte.

Write to EE memory command:

7	6	5	4	3	2	1	0
0	1	1	0	Data bit 3	Data bit 2	Data bit 1	Data bit 0

The command bits are 011. Bit 4 is ignored by the command but will be echoed along with the data bits if echo mode is enabled. The data held in the least significant bits is written to the EE memory at the address last selected. Data storage operations in EE memory take about 10mS to complete. Attempting a second write operation before the previous one has finished will result in the second operation being ignored. The “read mode byte” command allows the state of the write cycle and its error bits to be read by the host system. Only further EE write operations are subject to the 10mS pause, as soon as the write cycle has started the SYSPROC will respond to further commands. Note that there is a short period at the start of a write operation when commands may not be recognised. An unrecognised command will not invoke an echo response.

Select Port / EE address command:

7	6	5	4	3	2	1	0
1	0	0	Address	Address	Address	Address	Address

The command bits are 100. All the other bits hold the address of the port or EE memory to be used in the next read or write operation. No distinction is made between ports and EE addresses; the commands for reading or writing decide how the address is used. If echo mode is enabled, all the address bits are echoed back to the host system. It is not necessary to set the address before each read or write command if the same address is to be used. The last address set by this command is retained in the SYSPROC until this command is used again to change it or the SYSPROC is reset.

Read status command:

7	6	5	4	3	2	1	0
1	0	1	X	X	X	X	X

The command bits are 101. The remaining bits are “don’t care”, they play no part in the command but will be echoed back untouched if echo mode is enabled. The contents of the SYSPROC status byte are read and sent to the host in a “status” response. See the status bit definitions for more details on the function of each bit.



Data loopback command:

7	6	5	4	3	2	1	0
1	1	0	Data	Data	Data	Data	Data

The command bits are 110. This command is primarily for use as a diagnostic aid, it does not change any port or address selections or change any internal configuration. On receiving a data loopback command, the data bits are repackaged in a “loopback” response byte and sent back to the host system.

## Modifications to the Advanced ATV Repeater to replace the VCR with a Lite-On LVW5006 DVD Recorder.

At first this may seem a like the simple task of removing one unit and dropping the other in it's place. However, life is never as simple as that and several modifications have to be made.

The IR command codes are completely different between the original Toshiba VCR and the Lite-On unit but thankfully, both use the same carrier frequency (38KHz) and encoding system. There are also some differences in the command structure that require a different sequence of commands be used. For example, the 'stop' command on the VCR did just that while the DVD goes first into a pre-stop (pause) mode and needs a second stop command to completely end play or record mode. There is also an additional need on the DVD to be able to navigate through the menu to select individual recordings.

The user keypad, assuming a standard telephone style pad is utilised, has been mapped so it closely follows the functions of the real remote control. The centre '5' key becomes 'select' and the keys left and right of it (4 & 6) become navigate left and navigate right. Similarly, keys 2 and 8 become navigate up and navigate down respectively. The remaining corner keys are used for the stop, play, menu and record controls.

The column four tones that are not normally available from a keypad may be used if desired to cycle the mains power, initialise the unit and enter the 'setup' menu. The latter may be needed to periodically correct the time or date and occasionally to format new DVD media. Fig 1 shows the new keypad layout.

The changes to the IR commands

are achieved by reprogramming the IR-CTRL processor on the SYSPROC board and the changes to the command structure by reprogramming the SAP processor. No component changes are necessary.

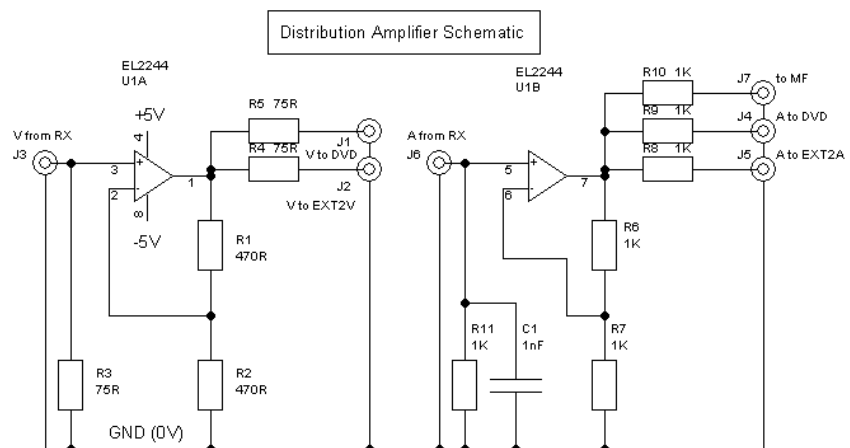
The second major problem with the conversion concerns the sync detector circuitry. When a VCR is used, in the absence of signal from the receiver, noise is passed through. The sync detector on seeing no recognisable video in the noise will tell the SAP (or external computer) that nobody is using the repeater and a testcard should be broadcast. The DVD recorder however, always produces syncs as in the absence of signal it substitutes it own so that the on-screen graphics and messages can be shown. This fools the sync detector into thinking the repeater is constantly in use.

The solution to the sync problem is to route the signal from the receiver to both the repeater RX inputs and the DVD recording inputs. The DVD output going to the EXT2A and EXT2V inputs instead. By moving the

DVD out of line of the RX inputs, its internally produced syncs no longer interfere with any signals from the receiver. The drawback to this method is that the receiver is now feeding two loads, the repeater logic and the DVD recording inputs. A distribution amplifier has to be added to maintain the video and audio levels. A bonus to this method is that the MF input which previously had to be connected to the receiver audio output before the VCR, can now also be produced by the distribution amp. The amplifier schematic is shown in fig 2.

The amplifier is external to the repeater logic housing. In GB3ZZ, the power for the amplifier was derived from the +12V output on the power supply. This was previously unused and is now connected to a socket on the rear panel via a 1A fuse to save using a separate mains adapter. The new connection diagram is shown in fig 3.b

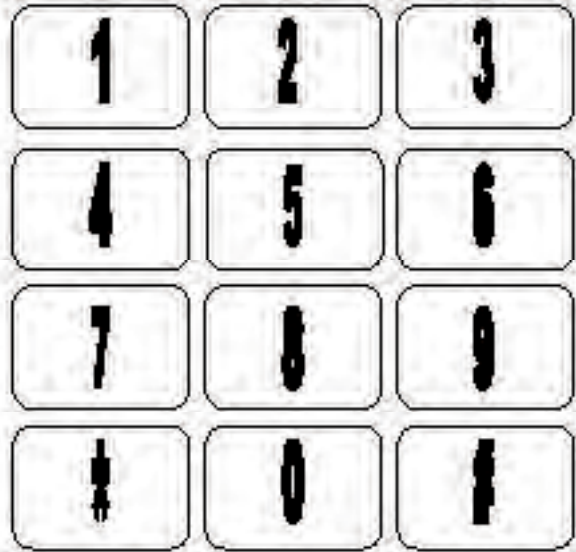
Comparing this with the one in the original hardware documentation (fig. 3a) will help explain the changes.



[REDACTED]

[REDACTED]

[REDACTED]



Note: there is a six second time-out between pressing the \* and the #, after which the function cancels and needs to be re-keyed. Pressing \* at any time acts like a cancel key to correct errors.



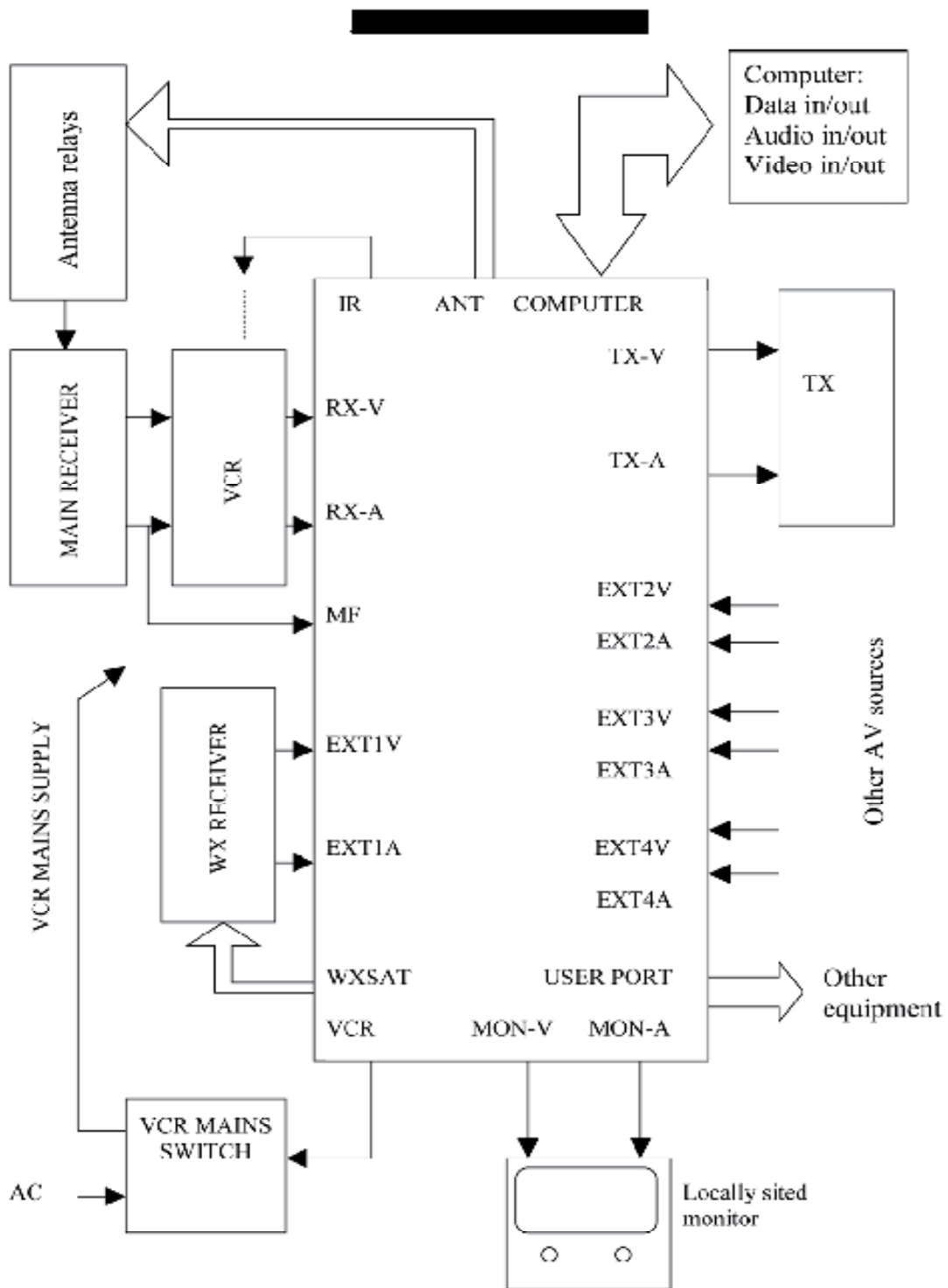


fig 3a - the original connections

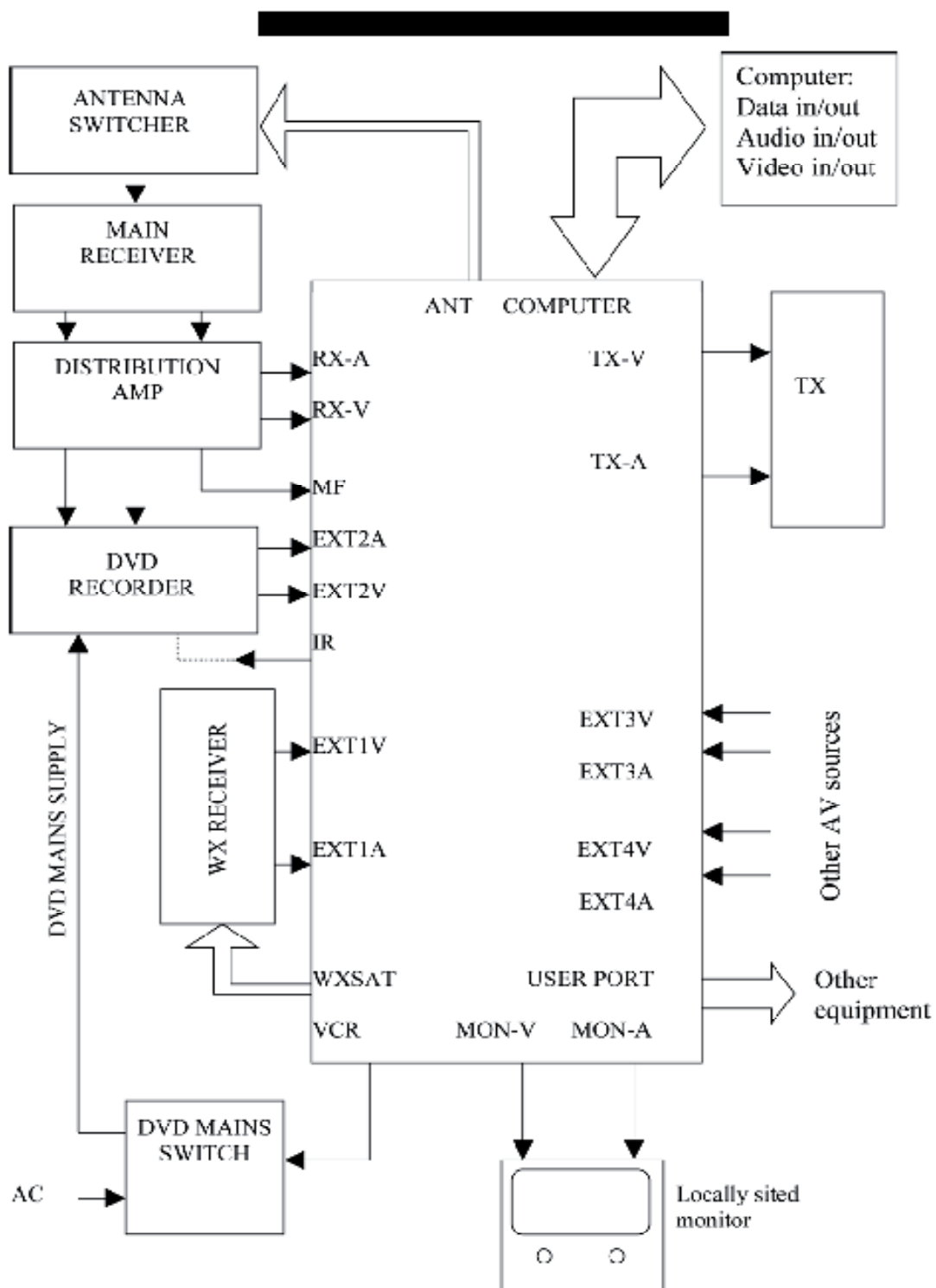


fig. 3b New interconnections to accommodate the DVD recorder.



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February	-	please submit by	December	31st
May	-	please submit by	March	31st
August	-	please submit by	June	30th
November	-	please submit by	September	30th

Please send your contributions in as soon as you can prior to this date. Don't wait for the deadline if you have something to publish as the longer we have your article, the easier it is for us to prepare the page layouts. If you have pictures that you want including in your article, please send them, in the highest possible quality, as separate files. Pictures already embedded in a page are difficult to extract at high quality but if you want to demonstrate your preferred layout, a sample of your finished work with pictures in place is welcomed. Please note the implications of submitting an article which are detailed on the contents page.

# Memories of Winter Hill

by John Lawrence GW3JGA

Recently, I was operating portable near Prestatyn, shown in Fig.1. Ross G6GVI/P and I were having a solid P5 ATV QSO on 23cms. Ross was located on Winter Hill (1400 ft a.s.l) near Bolton, near the site of the Northern ITA Transmitter.

The location, 'Winter Hill' brought back memories.

Over 50 years ago, in 1956, I regularly received a different TV signal from Winter Hill. It was G9AED the Experimental Television Transmitter operating in Band III, Channel 9 (vision 194.75 MHz, sound 191.25 MHz).

G9AED was a pilot transmitter operated by Belling & Lee Ltd., the TV aerial manufactures, to provide a test signal for TV dealers and aerial installers prior to the opening of the main ITA transmitter. The G9AED transmitter was installed in a caravan, shown in Fig.2. This had its own diesel generator for electricity supply. It was parked on the ITA site and its aerial fixed temporarily in position while work continued on the main ITA transmitter building and aerial mast.

The G9AED vision transmitter had a peak white e.r.p of about 1 kW and the associated sound transmitter had a carrier e.r.p of about 250W. The vision signal came from one of two monoscope test



2. G9AED Trailer

card generators, one gave information about the starting of transmissions and the other, shown in Fig.3. contained various features for setting up a TV receiver. These included a circle and castellated border for general picture adjustment and vertical wavy lines for identifying signal reflections which might cause 'ghosting'.

The sound signal consisted of a 600 Hz tone interrupted at 15 minute intervals by a short announcement of identity. This was similar to the requirements for ATV repeaters today.

It is most likely that the announcements were made 'live' by the duty engineer as the diesel generator engine could be heard running in the background. On one occasion the 600 Hz tone was absent and the duty engineer reported that the tone oscillator transformer had

developed an open circuit winding. The tone reappeared later in the day and he reported that he had been able to repair the broken connection!

I tape recorded one of the voice announcements in 1956 and it is transcribed below:

*This is G9AED transmitting on Channel 9*

*We are transmitting from the ITA site on Winter Hill near Bolton in Lancashire.*

*Our transmission times are as follows:*

*Monday to Friday inclusive, in the mornings from 10 o'clock until 1 o'clock and in the afternoons from 2 o'clock until 5.30*

*On Saturdays there is one transmission only from 10 a.m. until 1 p.m.*

*We do not transmit on Sundays*

*We welcome and appreciate your reports of reception.*

*Will you please address these reports to:*

*G9AED*

*Care of 540, that is five hundred and forty*

*Great Cambridge Road*

*Enfield*

*Middlesex*

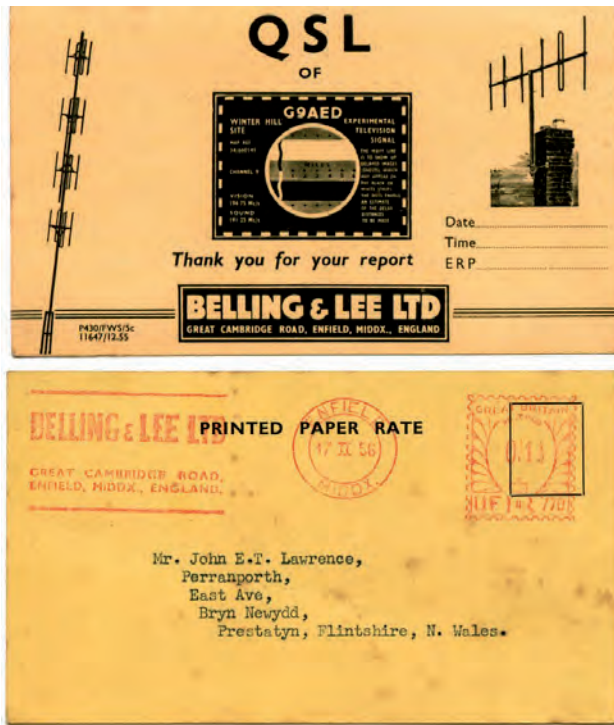
*Your report will be acknowledged by QSL card. This is G9AED*



1. GW3JGA Portable near Prestatyn



3. G9AED Test Card



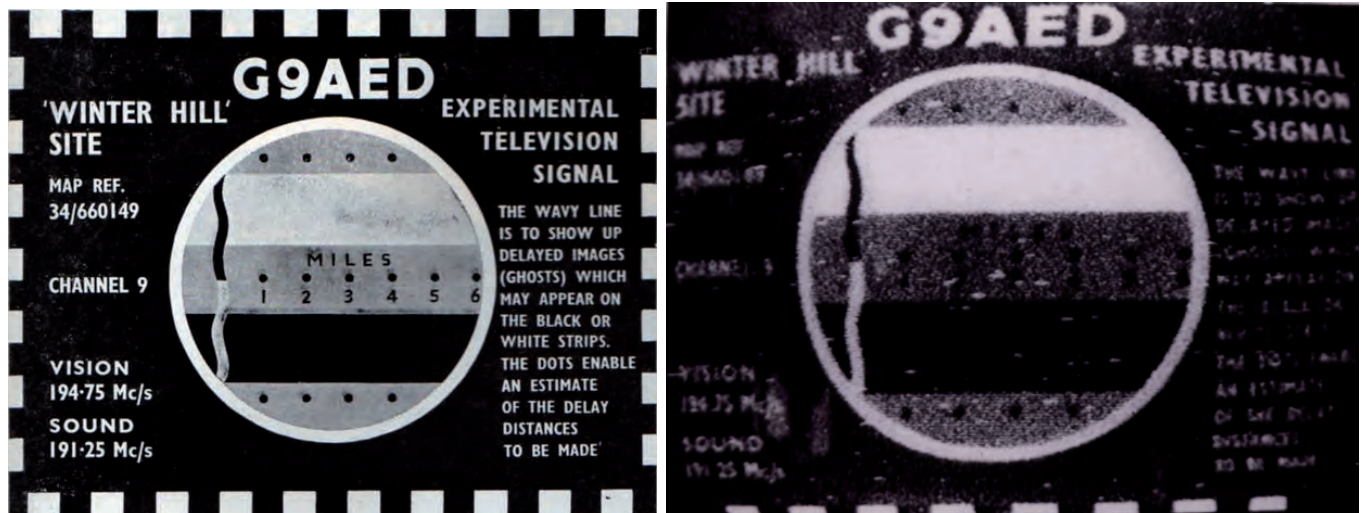
I sent in my report and received a QSL card date-stamped 17.11.56, this is shown in Fig.4.

I was working in the TV trade at this time and it meant that you had a tight schedule to get all your calls completed during the rather restricted transmission times. Fig.5. shows a typical 'P2' picture received at Rhyl, 65 miles from the transmitter using a 9 element Yagi aerial. When the main transmitter came on air later in 1957 the received picture was 'P5', roughly equivalent to a received signal level of about 1mV.

References:

1. G9AED Remembered Andy Emmerson G8PTH CQ-TV 133, pages 32-33
- 2 The Setmakers. Keith Geddes & Gordon Bussey
- BREMA (British Radio & Electronic Manufacturers Association
3. Belling & Lee Adverts Wireless World July 1955 p.27, Feb 1956 p.101, March 1956 p.101.

4. G9AED QSL Card (left), 5. G9AED at 65 miles(right)



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# What, Yet another ATV record attempt?

DanVK2GG and Jack VK2TRF

What , yet another ATV record attempt? Ho hum! But wait a Minute, what about an Australian ATV record using stock standard A/V sender/ receivers sold by Jaycar, utilizing 15 mW over 175Km? This is really a story about how you, the amateur, can get on 5.7GHz ATV with minimal equipment. Thanks to the Hornsby and District ARC (HADARC) for sharing the top of Mt Warralong (Watagan Forest) with us during the John Moyle Field Day contest.



Dan VK2GG and Graham VK2DWL found a spot looking south through some trees. Jack VK2TRF travelled to Mt Gibraltar 175km away. Mt Gibraltar is a very busy site, with all kinds of nasty RF installations which could hamper our record attempt, or swamp the puny 15mW from the transmitter. But Mt Warralong is a Forestry Fire tower site, with mainly forestry UHF yagis on it. It has a steep entry track, and a locked gate. As the HADARC had already made the necessary application on the variety of forms, safety requirements, etc, all we had to do was to approach HADARC with our request to share



Photographs:  
below - the homebrew horn antennas  
right - the view from Mount Warralong  
- the VK2TRF 'Golden' dish  
-the VK2GG 1.2m dish.





Ho hum how boring . Do you say ? But wait a Minute, what about an Australian ATV record using stock standard A/ V sender/ receivers sold by Jaycar, utilizing 15 mW over 175Km?

Remember these units are designed to show video from Foxtel set top boxes from room to room, say up to 100m. This is really a story how you the amateur, can get on 5.7GHz ATV with minimal equipment. The authors' 5.7GHz units are displayed in the photo. I purchase my set top box on eBay Australia for \$150. Jaycar's will set you back about \$250. An SMA socket was substitute for the original patch antenna. These are in the Amateur 6cm band.

We are indebted to Peter VK2TPK and the boys from Hornsby and District ARC for allowing us to share the top of Mt Warralong (Watagan Forest) with them during the recent John Moyle Field Day contest.

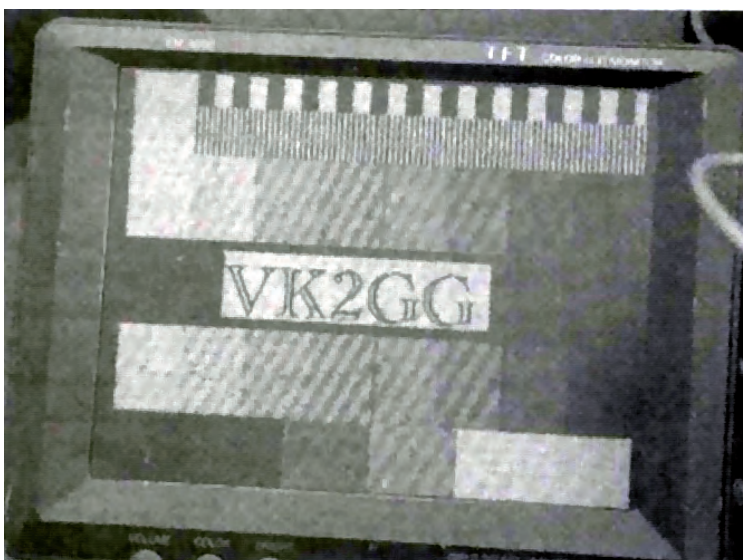
Dan VK2GG and Graham VK2DWL found a spot looking through the aperture between some trees, having a southerly aspect. Jack VK2TRF travelled to Mt Gibraltar, some 175 km away. As usual, jack brought the rain with him. Now Mt Gibraltar is a very busy site, with all kinds of nasty RF installations which could hamper our record attempt, or swamp the puny 15mW from the transmitter. On the other hand, Mt Warralong is a Forestry Fire tower site with mainly forestry UHF Yagis on it. It has a steep (possibly) 4X4 entry track, but first one has to gain entry past the locked gate. As the HADARC had already made the necessary application on the variety of forms, O.H. & S requirements, etc, all we had to do was to approach the HDARC with cap in hand.

We have been playing with 6cm ATV for several months. 76km was quite a thrill, but of course 175km was really exceptional. It seems that 5.7Ghz is a remarkable band. Dan had constructed a pair of 15dBi horns (HDLANT from ARRL web site) out of copper sheet and these proved reasonably effective over 10-25km paths, For this attempt Dan made a "tuppeny" feed out of WR 137 waveguide, which he attached to his .2m dish. Jack used a "Golden Dish" for improved gain over the original, a "Grid-Pack" style dish designed for use at 2.4 GHz The brass mesh covering prevents excessive loss due to the wide spacing between the elements of the original dish at the higher frequency.

The rain came down quite heavily at Mt Gibraltar toward the end of the record attempt session, but not before P5 pictures were received at each end of the link. How's that for minimising spurious RF emissions, using QRP for a record attempt? As usual, the hot sun melted the Tim-Tams at the Warralong end. Further successful ATV transmissions on 10 GHz and 2.4 GHz were made along the link for the purpose of the John Moyle event.

Equipment:

12-15 mW exciters (described above).  
Receivers as also described above. 1.2 metre dish with "penny feed" (G4ALN).  
Modified Gridpack dish with "Golden mesh"





# The Middlesex University Teaching Resources Televisor Kit

By Paul Godfrey – G&JBD

Email paulgodfrey@3lowry.fsnet.co.uk

I first heard about this product from the pages of the Narrow Bandwidth Television Association's newsletter Vol 32 No2 that arrived around Christmas 2006. In the newsletter were a few lines relating to a member's visit to the National Museum of Photography, Film and Television, now called the National Media Museum, in Bradford, West Yorkshire. In the museum shop he discovered a Televisor kit that they were selling for £29.99. One was purchased and subsequently built. The member suspected that the device used the NBTVA's 32 line standards and some its circuit designs and informed the NBTVA of his observations. Several other NBTVA members also purchased kits. One NBTVA member, Peter Smith looked at the circuitry etc and confirmed this. I was intrigued and after a Google search I discovered Middlesex University Teaching Resources marketed and manufactured the kit for £31.78 + carriage. An order was placed on-line and I eagerly awaited the delivery of the new toy.

After a wait of about seven weeks I made an email enquiry regarding my order and a few days later a parcel arrived. The unit came nicely packed and MUTR included a copy of their catalogue, this contains a vast amount of interesting kits/projects along with many pages of mechanical and electronic components. The Televisor kit was in a nicely labelled box that contained all the parts that included front and back plates plus fixing screws, a pre-drilled Nipkow disc, connecting lead, battery box, magnifier lens, 2 pcbs, a CD with some NBTVA images recorded, diffuser, label for the front panel and an instruction booklet.

The circuitry with the exception of the LED is all on one double side pcb. This is fully populated and built and no soldering is required. I managed to put the kit together in about half an hour using screwdrivers and a small spanner following the very clear instruction booklet. The trickiest part is putting the Nipkow disc onto the motor shaft. Care must be taken to ensure the optical sensor on the pcb is close enough to the printed area on the rear of the disc to

obtain a good sync and not too close so that it touches the disc. The front and back acrylic panels are covered with a protective film that must be removed before assembly. The finished Televisor bears a resemblance to an original Baird Televisor because of the shape the front panel. There is even a stick-on label that has a logo on it very similar to the Baird Company's "Eye of The World" trademark, a very nice touch. The completed Televisor looks very nice with its nicely cut acrylic panels and is good enough, with the permission of the XYL, to be displayed as a conversation piece in the home. Well I think so anyway.

Once assembled the 4 AA batteries that were not supplied were fitted. There is an on/off switch on the battery box and another on the main pcb. Upon switch on and the disc speed has stabilised, a pre-installed test card pattern that is part of the circuit appeared in the magnified window. It consists of a chequer board pattern and the words "TEST CARD". Adjustments to sync/disc speed and brightness can now be made by adjusting the two small pots on the pcb. Once you have got a good steady picture you can proceed to the next stage of connecting a personal CD player using the 3.5mm jack – 3.5mm jack lead supplied in the kit. The instructions recommend turning the battery power off and plugging the lead into one of the sockets on the pcb, the other socket is for headphone connection so that any audio content on the disc can be monitored. The instructions recommend a personal CD player with a line output and not using the headphone output of one these devices. The age of the Ipod has rather pushed aside these once popular "must have" gadgets and I have not seen any personal CD players for sale new that have a line out as well as the usual headphone output. It occurs to me that the audio line out of a cheap DVD player with could be employed but this seems to me a bit of an overkill using such a hi-tech device, but it may be worth a try.

I managed to find suitable personal CD player that was lying around the house and connected up. I tried the supplied CD that came with the kit. There are several sequences on the disc all preceded by a count down. Most of the sequences

are still pictures of celebrities including John Logie Baird, Winston Churchill and Margaret Thatcher to name but a few. There are also a couple of bits of moving picture footage including one of Dr Martin Luther King Jnr giving his famous "I have a dream" speech." The results were good. However I then put one of my Narrow Band TeleVision Association discs of test signals into the CD player and was rewarded with a good steady display of the NBTVA test card and other sequences that are on these discs. The results using these discs are better than the CD supplied with the kit and I would recommend anybody who wants good reliable 30 and 32 line signal sources to purchase at least one of these from NBTVA club sales.

Considering the small size of this Televisor, the use of a single red led and the low cost of the kit I think the results are very good. In the Vol 32 No 3 edition of the NBTVA Newsletter Peter Smith recommends some modifications.

1 Replace the diffuser with a piece of 10 thou thick double matt Mylar film. Available from NBTVA club sales.

2For a more authentic look, replace the single red LED with two orange ones in parallel with two 5.6 ohm resistors in series with each LED.

3Add a decoupling capacitor, 0.1 uf ceramic, between pins 8 and 16 of the 4046 IC.

4Also one of kits built by club members had a disc that did not run true and 22K had to be put across R17 to increase the sensitivity of the sync comparator. This was not a problem with the kit I built.

The kit is the first commercially made Televisor since the 1930s. It uses the NBTVA's 32 line scanning and synchronisation standards and published motor control circuits. It can be obtained from:- Teaching Resources Ltd, Unit 10, The IO Centre, Lea Road, Waltham Cross, Herts, EN9 1AS. I would recommend looking at their web site for details of cost and carriage charges. Delivery outside the UK looks expensive.

The Televisor works well and is an easy way to obtain a mechanical TV receiver. The price is reasonable and the results are good. I would recommend it to anybody who wants to experiment with something a bit unusual.

I would also like to take this opportunity to recommend membership of the NBTVA. Their newsletter alone is worth the cost of membership let alone the access to the club sales to obtain all sorts of useful parts and of course those Test Signal CDs that are superb. Their convention held annually in April at the University of Loughborough is also well worth a visit to see what members have built or are working on.

[www.mutr.co.uk](http://www.mutr.co.uk)

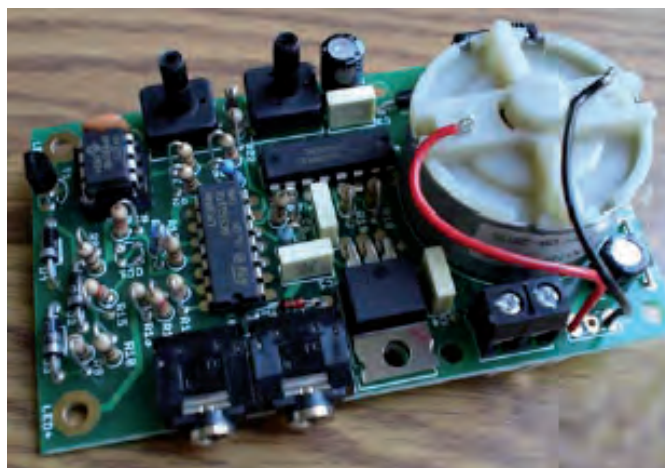
to purchase or for details on how to purchase the Televisor kit.

[www.nbtv.org](http://www.nbtv.org)

For membership information about NBTVA plus loads of stuff on NBTV in general.

[www.nationalmediamuseum.org.uk](http://www.nationalmediamuseum.org.uk)

The web site of the National Media Museum, in Bradford.



Photographs:  
 Top - The attractive packaging.  
 Centre - Printed Circuit Assembly.  
 Below - Rear view of the assembled kit.  
 Left - Contents of the kit.







#### EVERYTHING STOPS FOR TEA V.

Funny what turns upon EBAY. Dicky Howett reports, "I bought this recently, a teapot tv set with a b/w 'Interlude' image and bacon sarnies on the lid plus a ceramic copy of the 'Sport'". The glazing is a little cracked, but then, that says it all".





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## Contest News

### Contest Calendar

The following contests are planned for the rest of the year:

9/10 June 2007 – Summer Fun

8/9 September 2007 – IARU Region 1 Contest

All contests 1800 UTC Saturday until 1200 UTC Sunday.

### March ATV Repeater Contest

I have had a fine set of logs from the GB3TM group for the ATV Repeater Contest that was held on 24/25 March. If you participated but did not submit an entry, please at least send me an e-mail ([contests@batc.org.uk](mailto:contests@batc.org.uk)) to let me know how it went. I am considering running another similar contest in August – I just need some feedback!

### Summer Fun Contest 9/10 June

The Summer Fun contest on 9/10 June will be run with the same rules as the September International; put simply, you must exchange a 4-figure number by vision and then exchange reports and locators by vision or talkback. Scoring for a 2 way contact is:

70 cm – 2 points/km

24 cm – 4 points/km

Higher bands – 10 points/km

If you only manage one way, just halve the score.

The full rules are on Page 99 of the IARU VHF Managers' Handbook at:

[http://www.iaru-r1.org/VHF\\_Handbook\\_V5\\_11.pdf](http://www.iaru-r1.org/VHF_Handbook_V5_11.pdf)

Logs to me, by e-mail or post, by Monday 25 June please. Remember my postal address is:

D G Crump, Senior Course 110, NATO Defense College, BFPO 65. UK postage rates apply.

An Excel version of the logsheet is available on the BATC Website.

### Future Contests

Have you considered whether you might achieve more range by using narrow bandwidth DATV in your next contest? Tests between G8GTZ and myself a few years ago seemed to suggest that 2 MS/s DATV was more resilient than amplitude modulation on 70 cm. Worth a try in June?

## Streaming ATV Repeater Video on the Internet.

There are many repeaters around the world that stream their video on the internet. One of the newer and more popular video streaming servers is Camstreams. This is a free service both to the viewer and the provider.

See: <http://www.camstreams.com> and select Live Cams, People, many repeaters can be found in the list.

Some of the repeaters have a text chat facility that enables you to talk to the other viewers. See picture below:



The screenshot shows the Camstreams website interface. At the top right, the logo reads "camstreams easy streaming". A navigation menu contains "HOME", "LIVE CAMS", "SUPPORT", "ABOUT", and "USER AREA". The main content area is titled "GB3HV Amateur TV Repeater - Live". Below the title, there is a description: "GB3HV amateur television repeater run by the Home Counties amateur TV club with live video and audio and 144.750MHz talkback. Watch the RSGB news LIVE here every Sunday at 9:30GMT." To the left of the text is a video player showing a color calibration chart with "GB3HV" and "REPEATER 109100" overlaid. Below the video player, a "Playlist: Live Stream" is shown with a "00:40" duration. To the right of the video player, there are several information boxes: "Stream Location: IO9100 - High Wycombe, UK", "Broadcaster Since: August 16, 2006.", "Number of hits: 12290", and "Homepage: <http://www.gb3hv.com>". Below these boxes is a chat window with a scrollable area containing the text "User DaveG8ADM entered the room." and a "Send" button. To the right of the chat area is a "Change name" link. At the bottom of the page, a small disclaimer reads: "Broadcasters are required to agree to our Code of Conduct and Terms of Use. If the broadcaster is breaching these, see our Notice and Take Down Procedure."

There has been some criticism of using the internet to show ATV pictures, "It's Just Not Amateur Television". While there is some truth in this my excuse is that there are very few ATV'ers in the amateur community and this is a great way for the more distant stations to keep in touch and exchange ideas. It has also encouraged several new members into the ATV scene.

Here are some of the repeaters that can be seen on Camstreams:

<a href="http://www.camstreams.com">http://www.camstreams.com</a>	Camstreams home page.
<a href="http://g7vvf.camstreams.com">http://g7vvf.camstreams.com</a>	GB3EN Enfield, London, UK
<a href="http://gb3hv.camstreams.com">http://gb3hv.camstreams.com</a>	GB3HV High Wycombe, Bucks. UK
<a href="http://gb3bh.camstreams.com">http://gb3bh.camstreams.com</a>	GB3BH, Bushey Heath, Herts. UK
<a href="http://m0dts.camstreams.com">http://m0dts.camstreams.com</a>	GB3KM, Kirk Merrington, Co. Durham, UK
<a href="http://gb3gg.camstreams.com">http://gb3gg.camstreams.com</a>	GB3GG, Grimsby, Lincolnshire, UK
<a href="http://db0dtv.camstreams.com">http://db0dtv.camstreams.com</a>	DB0DTV, Hamburg, Germany
<a href="http://wb9kmo.camstreams.com">http://wb9kmo.camstreams.com</a>	WB9KMO, CA, USA
<a href="http://daytonaatv.camstreams.com">http://daytonaatv.camstreams.com</a>	Daytona, USA
<a href="http://kb9khm.camstreams.com">http://kb9khm.camstreams.com</a>	KB9KHM, Indiana, USA

I hope to see you on Camstreams, Dave G8ADM

# Zero Hunting Disc Monitor

## (Nipkow disc Monitor with Synchronisation of Video Data to the Disc)

This article, by Kevin Hadfield is reproduced by courtesy of the Narrow Bandwidth Television Association (NBTVA).

*For those not familiar with the Nipkow Disc system, it is a method of mechanically scanning a television picture. The position of the 'spot' being scanned at the camera and reproduced on the television is decided by a series of holes in a rotating disc. They are arranged in a single turn spiral so that as the disc turns, each hole 'scans' the image with a small displacement from the previous one, effectively producing scan lines. The major problem with Nipkow discs is their size and mass which makes them difficult to accurately synchronise. This article describes a way of electronically storing the image and playing it back at the speed of the Nipkow disc rather than trying to spin the disc at the rate of incoming video. - Editor.*

Traditionally one of the most difficult aspects of a disc monitor is maintaining synchronisation by careful control of motor speed and instantaneous angular position to match the video source. Several methods have been used with varying degrees of success- The popular method of using an optical switch to detect holes in the disc with a phase locked loop that controls the motor speed to synchronise the passing of the holes with the sync pulses works fairly well. However from my experience it is easy to get the speed right but not automatically the correct angular position even with one of the holes covered to correspond with the missing sync pulse.

Most of the synchronisation methods suffer from the same problem - they are attempting to control the rotation of a disc with a substantial mechanical inertia within very fine limits. Because of this many methods rely on the motor running close to the right speed then applying small corrections to bring it in to precise synchronisation, This could be thought of as adding or subtracting small amounts of rotational kinetic energy.

It occurred to me that allowing the motor and disc to run without speed control would avoid the problem of such fine control of a mechanical system. A Standard disc monitor running at an arbitrary speed would give a rolling or scrambled picture so I designed a circuit that would resynchronise the video signal to the disc. This circuit places each image from the video source in a memory and reads out the memory at line and field rates determined by two optical switches triggered by the rotating disc.

This arrangement allows the disc to run at an arbitrary speed though it was initially assumed this would be close to the usual speed of 12.5 revolutions per second so for simplicity

the pixel rate was fixed to correspond with this. As a result running the disc significantly faster or slower will affect the aspect ratio, respectively stretching or shrinking the picture vertically. A switch was added that allows the pixel rate to be increased to 1.5 times the standard rate. This provides the correct aspect ratio when the disc speed is about 18.75 revolutions per second and the image has much less flicker.

I demonstrated this monitor at the 2006 NBTVA Convention where the picture remained solidly locked without any need for adjustment or manual synchronisation

### Circuit Description

Since my video signal source is a CD player (Sony Discman D141) and the memory requires digital data to store video I decided it would be easier to take the digital data directly from inside the player rather than taking the analogue signal and digitising it. Three signals are brought out from inside the CD player, serial data, serial data clock and sample (Left/Right) clock buffered by IC1. A simple serial to parallel converter circuit (IC2 - IC5) results in video samples being presented as 16 bit wide signed binary values updated at sample clock rate. ICs 6 and 7 present this data to the memory at the appropriate time in the write cycle. For simplicity all subsequent circuitry uses only the clocks from the CD player. The sample clock is 44.1kHz and the serial clock is 48 times the sample clock, just over 2MHz (referred to as 2MHz in the circuit diagrams). 3V Zener diodes on the inputs provide rudimentary protection for the 3V circuitry in the CD player from my 5V design.

The circuit could easily be modified to accept an analogue input by adding an analogue to digital converter and appropriate clock sources in place of the CD player and serial to parallel

converter. The line and field rate syncs are extracted from the video source by ICs 8 to 11 (more on this later) and used to control two counter ICs that provide the memory write address. IC14 counts the line sync pulses (0 to 31) and is reset once per field. IC16 counts sample clock pulses and is reset once per line.

Two other counter ICs provide the memory read address. IC20 counts line sync pulses (0 to 31) generated by an optical switch that detects the 32 sync holes equally spaced around the disc. A second optical switch, this one being the reflective type, detects a shiny strip attached to the disc passing by once per revolution that resets this counter IC to zero. It is important that the second optical switch is not detecting a reflection at the same time as the first optical switch starts to detect a hole but this is easily avoided by suitable positioning of the shiny strip. The second read counter IC18 is reset by line sync pulses from the first optical switch and incremented by the serial clock divided by 3 or 2 (switch selectable - for 12.5 or 18.75 revolutions per second respectively). Ignoring the four lowest bits on this counter IC to provide a further divide by 16 the read address increments at the appropriate pixel rate.

A write to memory occurs during one out of every 48 sample clock cycles (corresponding to once per video sample). A read cycle occurs during each of the other 47 sample clock cycles. This ensures as the read counter increments there is only ever a very short delay (maximum of two serial clock periods, usually one) before the new value is read and displayed.

Most of the other circuitry is related to read and write operations for the memory or cleaning up the timing of the signals from the optical switches.



As data is read from the memory it is latched into registers (IC29 and IC30) and the top active 6 bits delivered to a resistor based Digital to Analogue converter. A conventional MOSFET driver circuit is then used to provide gamma correction and drive a bank of ultra bright white LEDs.

The motor was driven from a variable voltage power supply, the speed adjusted until the aspect ratio of the picture looked approximately correct. Some form of approximate speed control (which doesn't need to be precise) may be beneficial for fully automatic operation but for demonstration purposes manual control is perfectly adequate. The cassette player motor I used did become very hot when running at around 18.75 revs per second (it is a 9V motor running at 9 to 10V for this speed, but requiring a much lower voltage for 12.5 revs per second) so a different motor or indirect drive with a suitable ratio may be desirable for continuous use.

### Video Source Sync Extraction and DC Restoration.

Since the video signal is in digital format until it reaches the LED driver circuit the usual sync detection and DC restore circuits commonly used for analogue video could not be used. My original plan was to detect sync pulses using a digital comparator circuit - looking for when video sample values drop below a certain threshold value. I soon discovered that the standard club CDs were recorded with the video signal AC coupled. This is fine for analogue monitors that perform DC restore for which these discs were intended but this means there is no single digital value that can be used as a reliable sync detection threshold for the digital data.

Vic Brown came to my aid by supplying a CD with video tracks based on the colour standard that is currently being developed. Although I did not require the colour information this format has the DC level of the video very well controlled. In fact the sync pulses are very easy to detect because the digital values turn negative (MSB=1) during the sync pulse periods.

This provides easy access to the standard club format syncs with the usual one missing sync pulse for field synchronisation. While creating my design it became clear that it would be very useful to have access to the timing of the missing sync pulse but

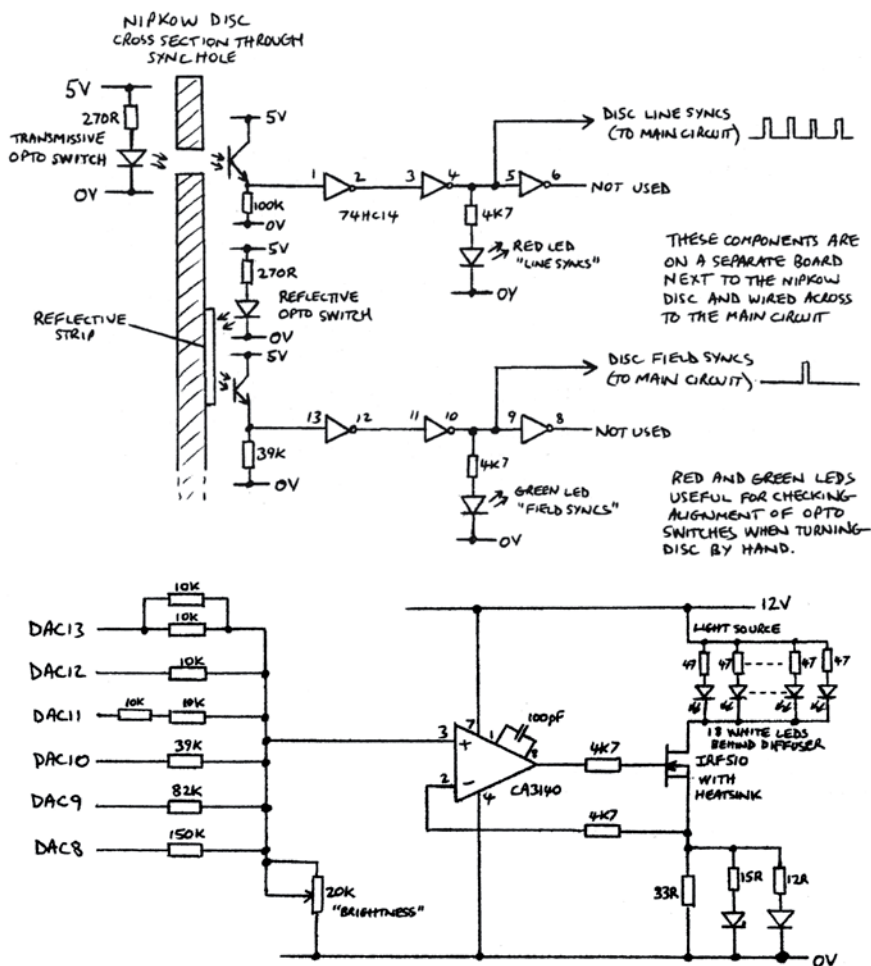
I also realised that regenerating it would significantly complicate my circuit, requiring many extra ICs to do it accurately. Vic and I came up with the idea of setting the digital code on the CD to a value of 8 during the time period corresponding to the missing sync pulse period. If values of 8 appear anywhere else in the video they are set to 7, a negligible change. A digital comparator detecting the value of 8 provides the timing information corresponding to the missed out sync pulse. This scheme is not currently included in the developing CD based colour standard but it is fairly easy to save a colour CD track to a computer as a wave file, modify the file according to this scheme and record it back to another disc.

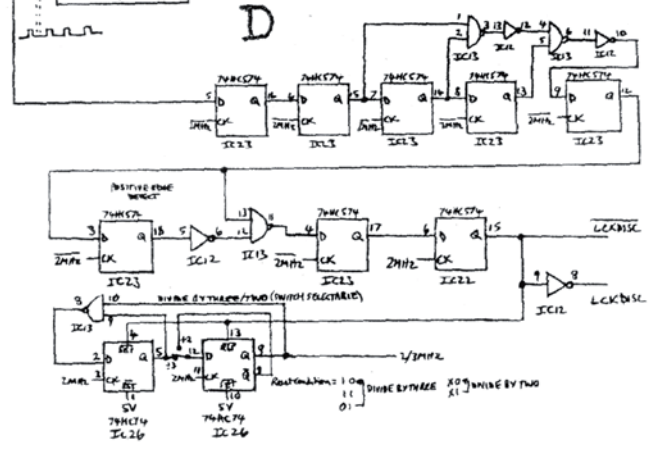
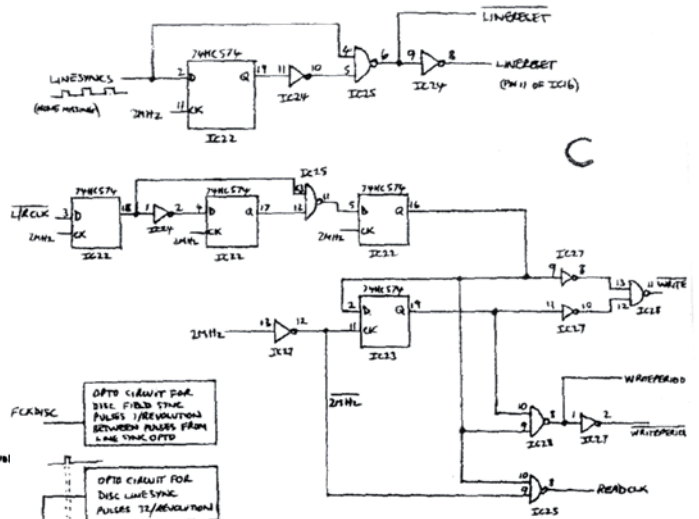
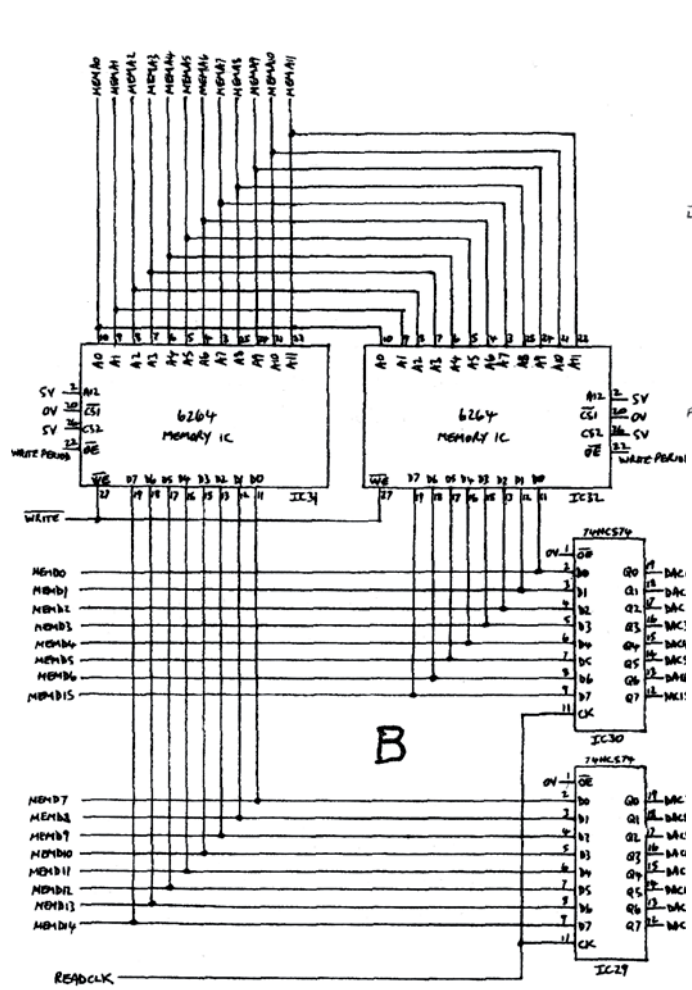
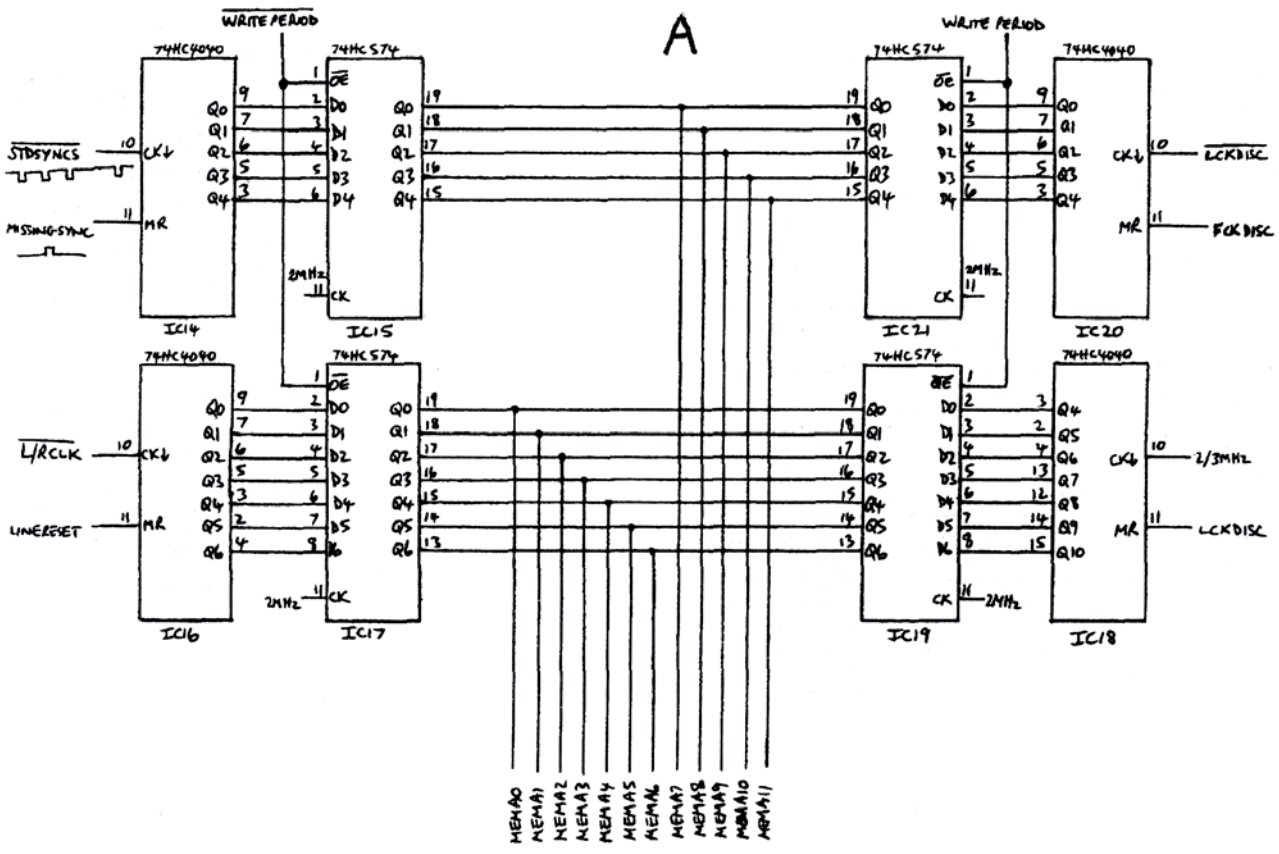
I hope to try modifying tracks from the standard club CDs so that they will play on this system. This requires shifting the digital video values so that the syncs have negative values, the active video has positive values and the value of 8 occurs during the period corresponding to the missed out sync pulse and nowhere else. So far this has proved to be more complicated than originally anticipated but progress is being made.

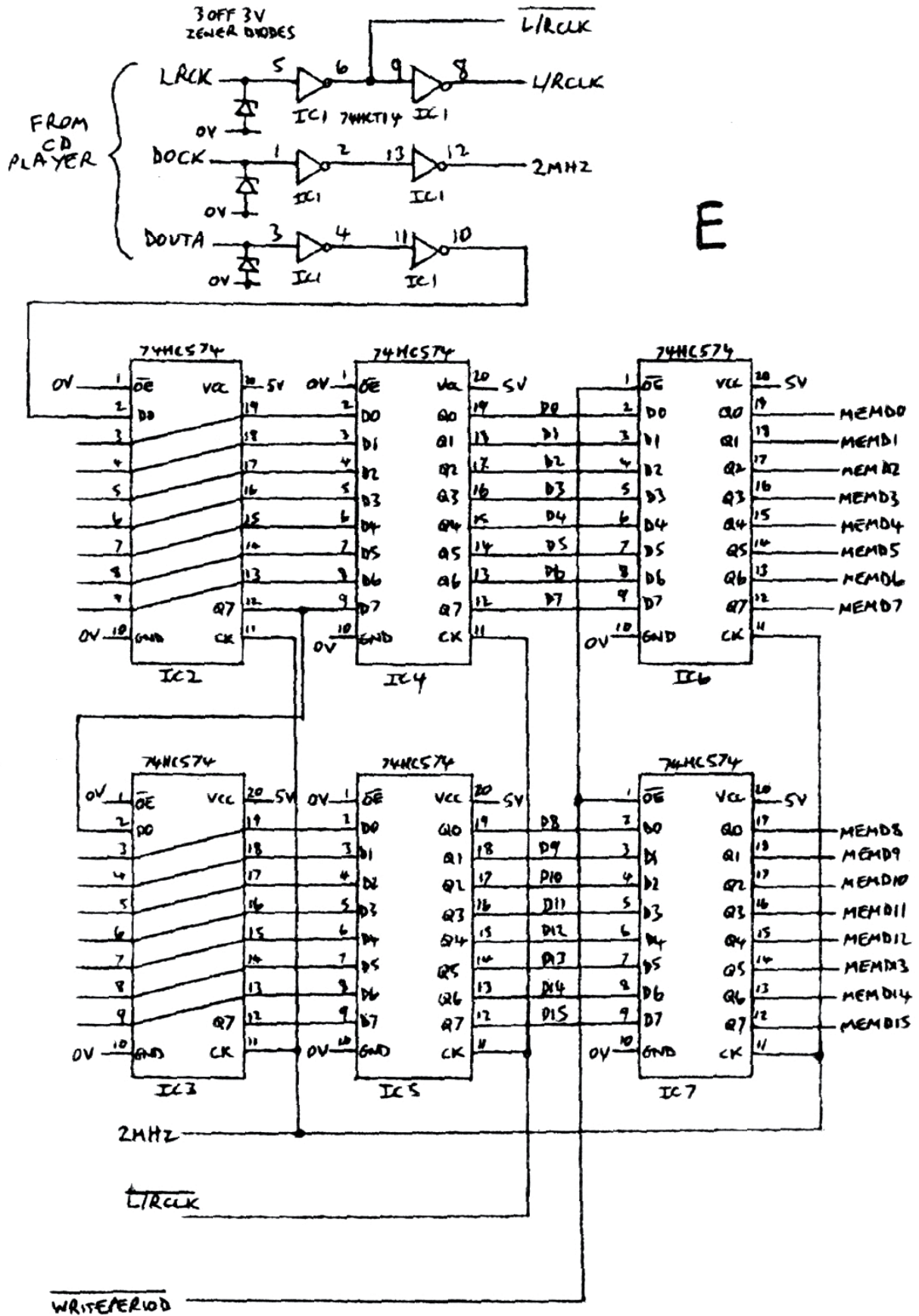
### Interlaced Displays

Some club members are interested in experimenting with interlaced images to help reduce flicker so I thought I'd point out that it should be very easy to modify this circuit to read out the image in an interlaced format (the original video source still being non-interlaced). It requires rewiring the five connections between IC20 and IC21. For double interlace (two fields per frame) connect Q0 to D1, Q1 to D2, Q2 to D3, Q3 to D4 and Q4 to D0. For quadruple interlace (four fields per frame) connect Q0 to D2, Q1 to D3, Q2 to D4, Q3 to D0 and Q4 to D1. The Nipkow disc would require corresponding spirals of holes to perform the interlaced scanning.

NOTE. Decoupling capacitors are required, I used eight 10nF capacitors on the 5V rail spread around the board and a 10uF tantalum capacitor on each of the 5V and 12V rails. Note that there must also be a ground connection between this circuit and the CD player. The LED driver circuit was constructed on a separate board because there was not sufficient space on the board with the logic ICs.



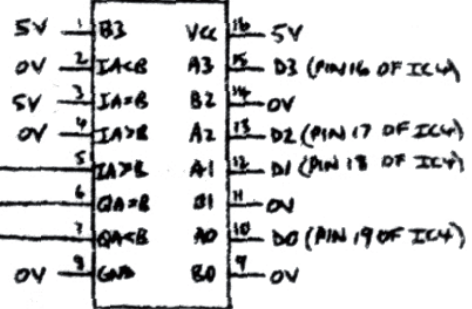






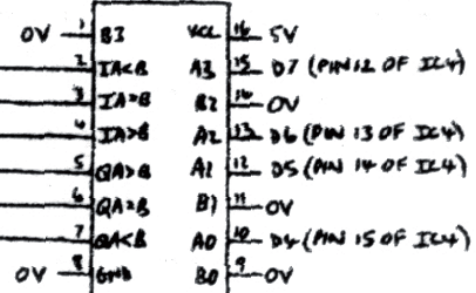
DETECT VALUE OF 8 & DECODE STALLS

74HC85



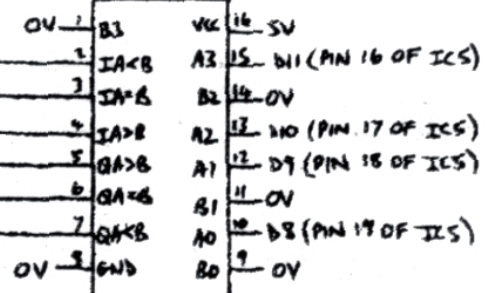
IC11

74HC85



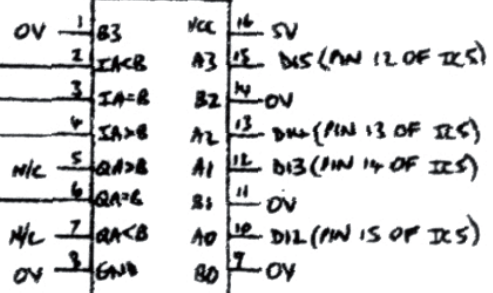
IC10

74HC85



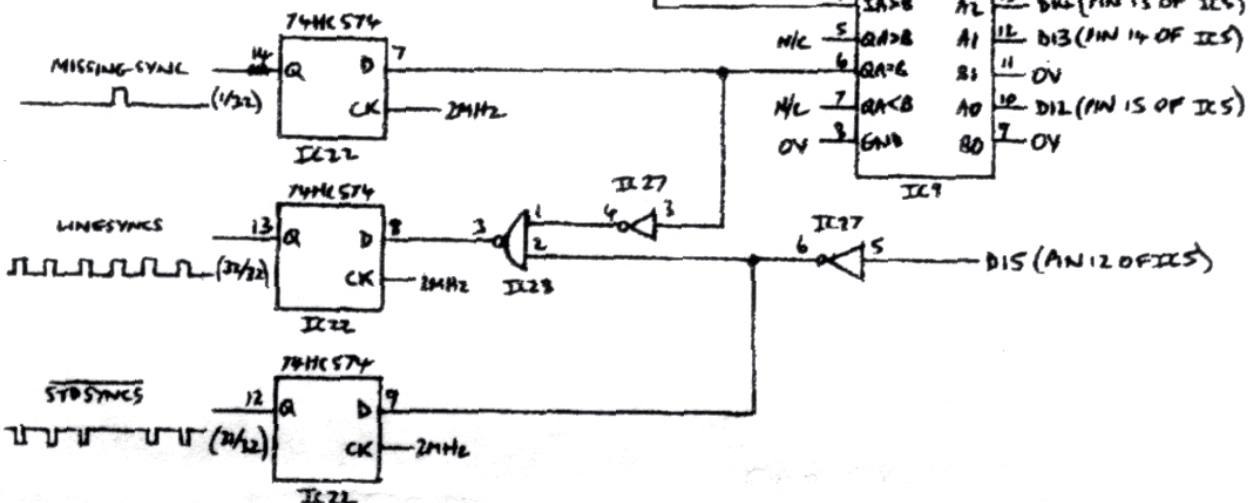
IC8

74HC85



IC9

F



# Get A Grip on Clamps, Bias and AC-Coupled Video Signals

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## APPLICATION NOTE 3303

This article explains clamps, bias, and AC-coupled video signals, the appropriate signals for each, the merits and drawbacks of dual and single power supplies, and why some circuits are inherently better for some applications.

### Why should you AC-couple your video signals?

If you haven't asked this question, you should. If the reason is government mandate, customer specification, or industry protocol, you're probably doing the right thing! In many cases, it's because the application has a single supply, and you feel that you must AC-couple. Maybe you still have dual supplies, because going to a single supply will involve AC-coupling the video, which will compromise the video quality.

So before we go any further, let's look at some facts. Single-supply circuits are fed by single-supply sources, such as a digital-to-analog converter (DAC), and the DAC's output can be level-translated (a DC operation) to ensure dynamic range above ground at the output. A common mistake in implementing this approach discretely is thinking that because an op amp can sense a signal below ground, it can reproduce it at the output. That's incorrect. Integrated, single-supply solutions are the real answer, but the industry will have to accept offset DC levels for their video outputs, similar to what SCART does in Europe (SCART is an industry standard for interconnecting audio-visual equipment, developed by the French company Peritel).

Of course, AC-coupling a video signal creates a problem. The signal's DC voltage level must be re-established afterwards to set image brightness and ensure that the signal falls within the linear region of the next stage.

That operation, called "biasing," employs different circuits, depending on the video signal's waveform and the accuracy and stability required of the bias point. Sine-wave signals, like audio, use resistor-capacitor (RC) coupling to establish a stable bias voltage.

Unfortunately, only the chroma signal (C) of S-Video even approximates a sine wave. Luma (Y), composite (Cvbs), and RGB are complex signals that vary in one direction from a reference level, below which a sync waveform may be attached. Such signals require a form of bias method unique to video called clamping, because it "clamps" one extreme of the signal to a reference voltage, leaving the other extreme to vary. The classic form of this is a diode clamp, where the diode is activated by the sync on the video. But there are others.

For example, the color-difference signals (Pb and Pr) and graphics RGB are better handled by a "keyed clamp." This circuit replaces the diode with a switch, allowing external control of where the video is clamped using an external (key) signal. The last biasing method, called a "DC restore," adds feedback to a keyed clamp to improve the bias point's accuracy, prior to an analog-to-digital converter (ADC).

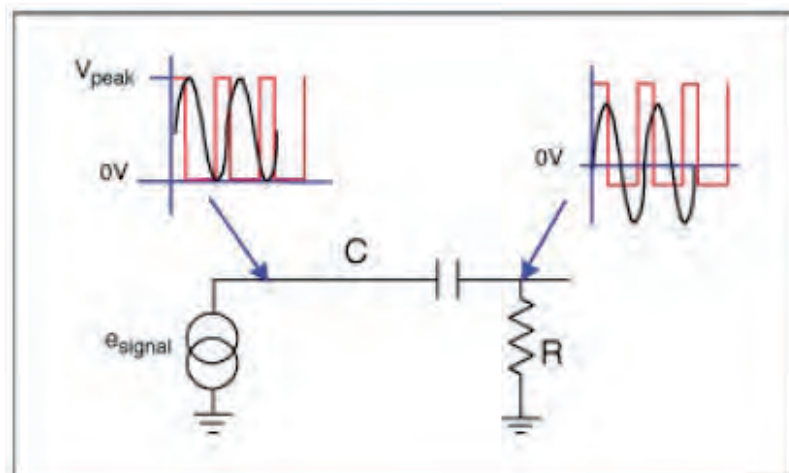
### AC-Coupling Of Video Signals

When any signal is AC-coupled, the coupling capacitor stores the sum of the (signal's) average value, and the difference in DC potential between the source and the load. To illustrate how this affects the stability of a bias point for different signals, look at Figure 1. Shown is the difference between a sine wave and a pulse when AC-coupled to a grounded resistor load.

Figure 1. Simple RC coupling for a sine wave and a pulse give different bias points.

Initially, both signals vary around the same voltage. But after passing through the capacitor, they differ. The sine wave varies around its half-amplitude point, while the pulse varies around a voltage that's a function of the duty cycle. This means that if you AC-couple, you need more dynamic range for a variable-duty-cycle pulse than for the same-size sine wave. For this reason, all amplifiers for pulse applications are DC-coupled to preserve dynamic range. Video is just like a pulse, and prefers DC-coupling.

The video signals you will likely encounter are shown in Figure 2, with the standard amplitudes found in video interfaces (see EIA 770-1, 2, and 3). Chroma in S-Video, and Pb and Pr in component video, resemble the sine wave varying around a reference point, as noted above. Luma (Y), composite, and RGB only vary in a positive direction from 0V (called the "black" or "blank" level) to +700mV. This is due to a tacit agreement within the industry and not to any standard. Note that they all are complex waveforms with a sync interval that may or may not be defined or even used. For example, Figure 2 shows RGB with sync as used in NTSC and PAL formats. In PC (graphics) applications, the sync is a separate signal, and RGB doesn't have it attached. In single-supply applications, such as a DAC output, the quiescent levels could be different during the sync interval. This will influence the choice of bias method. For example, if the quiescent level of chroma isn't 0V during the sync interval in a dual-supply application, it will be more pulse-like than sinusoidal.





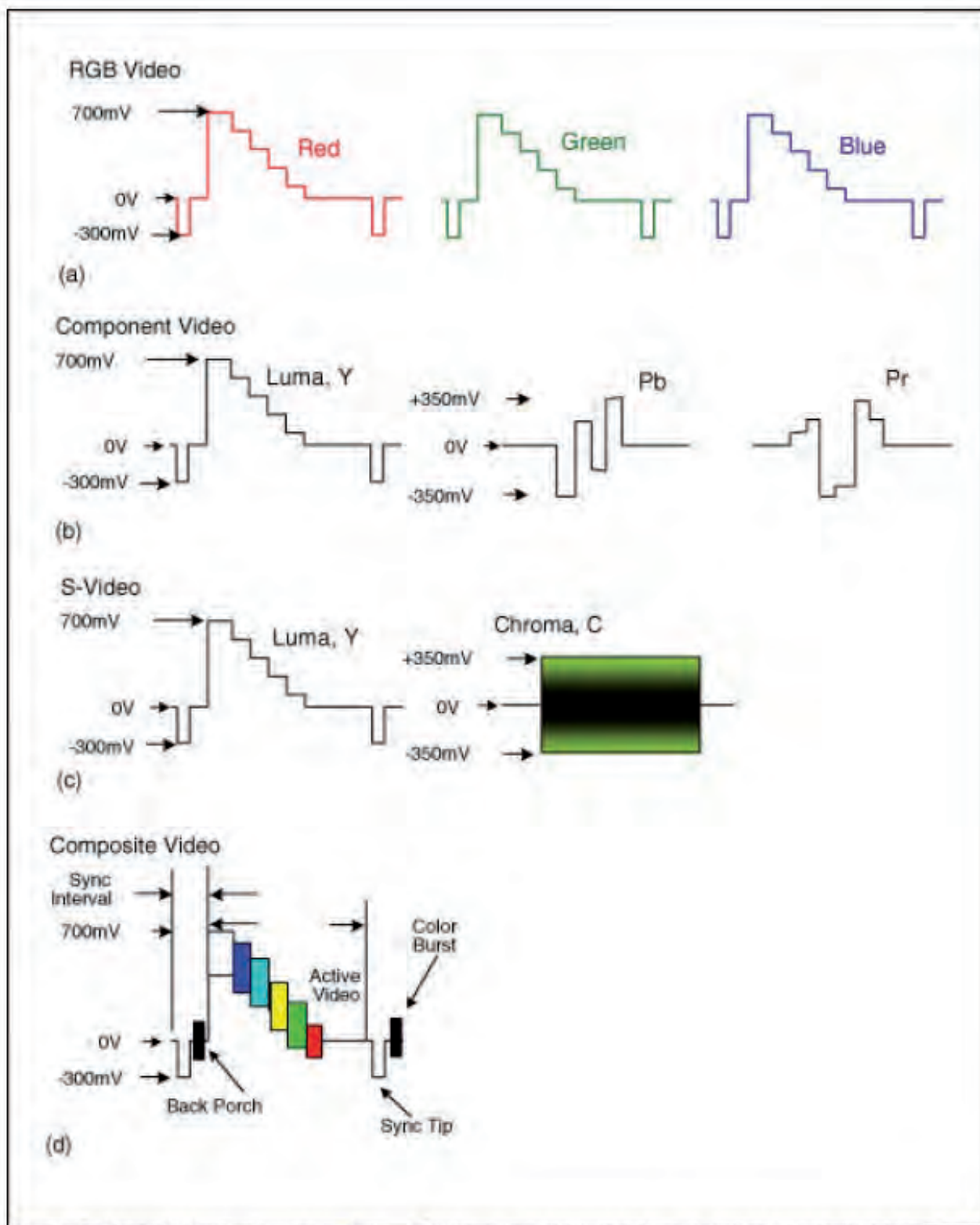


Figure 2. These RGB (a), Component (b), S-Video (c), and Composite (d) Video Signals show the Sync interval, Active video, Sync Tip, and Back Porch.

Despite these complications, video signals must be AC-coupled at the point where the voltage domains change. Connecting two different power sources through a DC connection is dangerous, and usually forbidden by safety regulations. Consequently, video-equipment makers have a tacit agreement to AC-couple the input of their equipment, and DC-couple the

output—requiring the next stage to re-establish the DC component (see EN 50049-1 for PAL/DVB [SCART] and SMPTE 253M section 9.5 for NTSC, which allow a DC output level). Failure to establish such a protocol leads to “double coupling,” where two coupling capacitors appear in series, or to a short where there are no capacitors. The sole exception to this rule is battery-powered

equipment, such as camcorders and still cameras, which AC-couple the output to minimize battery drain.

The next question is how large must this coupling capacitor be? In Figure 1, the assumption that the capacitor stores the signal’s “average voltage” is predicated on the RC product being greater than the minimum period of

the signal. So to ensure good averaging, the lower -3dB point of the RC network must be below the lowest frequency of the signal by a factor of 6 to 10 times. However, this results in a large range of capacitance values.

For example, chroma in S-Video is a phase-modulated sine wave whose lowest frequency is about 2MHz. Even with a 75 load, only 0.1 $\mu$ F is required, unless you need to pass the horizontal sync interval. In contrast, the frequency response of Y (luma), Cvbs (composite), and RGB extend down to the video frame rate (25Hz to 30Hz). Assuming a 75 load, and a 3Hz to 5Hz -3dB point, this requires greater than 1000 $\mu$ F. Using too small a capacitor causes the displayed image to darken from left to right, top to bottom, and can distort the image spatially (depending on the capacitor's size). In video, this is called line droop and field tilt. To avoid visible artifacts, their levels should be less than 1% to 2%.

### Single-Supply Bias Circuits For Video

RC-coupling, as shown in Figure 3a, works on any video signal, as long as the RC product is large enough. Also, the supplies on the op amp following it must have sufficient range to handle the negative and positive excursions around the signal's average value. In the past, this was accomplished by using dual supplies on the op amp. Assuming that RS is referred to the same ground as Ri, and equal to Ri in parallel with Rf, the op amp rejects any common-mode noise (that is, its common-mode rejection ratio [CMRR] is high) with minimum offset voltage. The lower -3dB point is  $1 / (21RSC)$ . Also, despite the coupling capacitor's size, the circuit retains its powersupply rejection ratio (PSRR), CMRR, and dynamic range. Most video circuits were built this way, and most ACcoupled studio applications still are built in this fashion.

With the advent of digital video and battery-operated devices, the negative supply became a cost and power burden. Early attempts at RC bias looked like Figure 3b, which uses a voltage divider. Assuming  $R1 = R2$  and VCC equals the sum of VCC and VEE in Figure 3a, the two circuits are similar. But they have different ac performance. To illustrate, any change in VCC in Figure 3b directly changes the op amp's input voltage by the divider ratio, while in Figure 3a it's absorbed by the power-supply headroom of the op amp. With  $R1 = R2$ , the PSRR of Figure 3b is only

-6dB. Consequently, the supply must be filtered and well regulated. A cheaper alternative inserts an isolating resistor (RX) to improve the ac PSRR (Figure 3c). However, this approach causes additional DC offset unless matched to the parallel value of Rf and Ri. Exacerbating this is the requirement that the  $RxC1$  and  $C2Ri$  products must be less than 3Hz to 5Hz as noted above. Although a larger bypass capacitor (C3) in this circuit allows a smaller RX and reduces the offset voltage, it also makes C1 larger. This approach can be seen in low-cost designs using electrolytic capacitors.

The alternative is Figure 3d, which replaces the voltage divider with a three-terminal regulator and extends the PSRR down to DC. The regulator's low output impedance allows RX to be closer to the parallel combination of Rf and Ri, reducing the circuit's offset voltage. Because the only purpose of C3 is reducing noise from the regulator and complementing the regulator's output impedance ( $Z_{out}$ ) as a function of frequency, its value is smaller than in Figure 3c. However, C1 and C2 can still be large, and CMRR is a problem for frequencies below the  $RiC1$  product, as is stability.

After all is said and done, AC-coupling with dual supplies is better than the single-supply methods (with respect to common-mode and power-supply rejection)—regardless of the application.

### Video Clamps

Luma, composite, and RGB signals vary from a reference level of black (0V) to a maximum (+700mV) with sync (-300mV) attached. But, like the variable-duty-cycle pulse in Figure 1, if these signals are AC-coupled, the bias voltage will vary with video content (called average picture level or APL) and the brightness information will be lost. What's needed is a circuit that holds the black level constant, regardless of the video or sync amplitude.

The circuit shown in Figure 4a, called a diode clamp, attempts to do this by replacing the resistor with a diode (CR). The diode acts as a one-way switch. Thus, the video signal's most negative-going voltage, the tip of the horizontal sync waveform, is forced to ground. Hence the circuit's other name, sync tip clamp. This will hold the reference (0V) constant, assuming the sync voltage (-300mV) doesn't change and the diode conduction potential is zero. Although

you can't control the sync level, you can reduce the conduction potential by putting the clamp diode in the feedback loop of an op amp to make an "active clamp." A major problem with these is that they tend to oscillate if improperly terminated, and are seldom used in discrete design. Integrated forms can be compensated, and are more reliable. (Examples include the MAX4399, MAX4089, and MAX4090.)

If the sync level varies or isn't present, the diode can be replaced by a switch—usually a FET controlled by an external signal (Figure 4b). This is a keyed clamp, and the control signal is the key signal. If the key signal is coincident with the sync pulse, then this becomes a sync tip clamp. But unlike the diode clamp, it can be activated anywhere in the sync interval, and not just during the sync tip. If the key signal occurs while the video is at the black level (Figure 4c), you get a "black-level clamp." This approach is versatile, practical, and closely approximates its ideal model. The switch doesn't have the diode's conduction voltage, and can actually implement a black-level clamp.

Adding a DC voltage source ( $V_{ref}$ ) makes it possible to set bias for signals like chroma, Pb, and Pr, as well as composite and luma. Its shortcomings are that it requires a sync separator to get the key signal, and it's not accurate enough for some applications. If you're digitizing video, you want the black level to vary less than  $\pm 1$  least-significant bit (LSB), or about  $\pm 2.75mV$ . Clamps can't achieve that level of accuracy.

The last method used to bias a video signal is called a DC restore, and it can achieve black-level accuracy approaching  $\pm 1$  LSB. The first thing you notice in Figure 4d is that this circuit doesn't have a coupling capacitor. Instead, U2 compares the DC output of the stage (U1) to a voltage ( $V_{ref}$ ), and applies negative feedback to U1 to force the output to track it regardless of the input voltage. Obviously, if the loop ran continuously, all you would get out is DC. Instead, a switch is inserted in the feedback loop. And it's only closed for an instant during each horizontal line at the point (sync tip or black level) we wish to set to  $V_{ref}$ . The voltage is stored on a capacitor (C), but it's not in series with the input. Instead it's in a sample-and-hold (S/H) formed by the switch in the feedback.

The practical implementation of Figure 5 actually has two capacitors (Chold



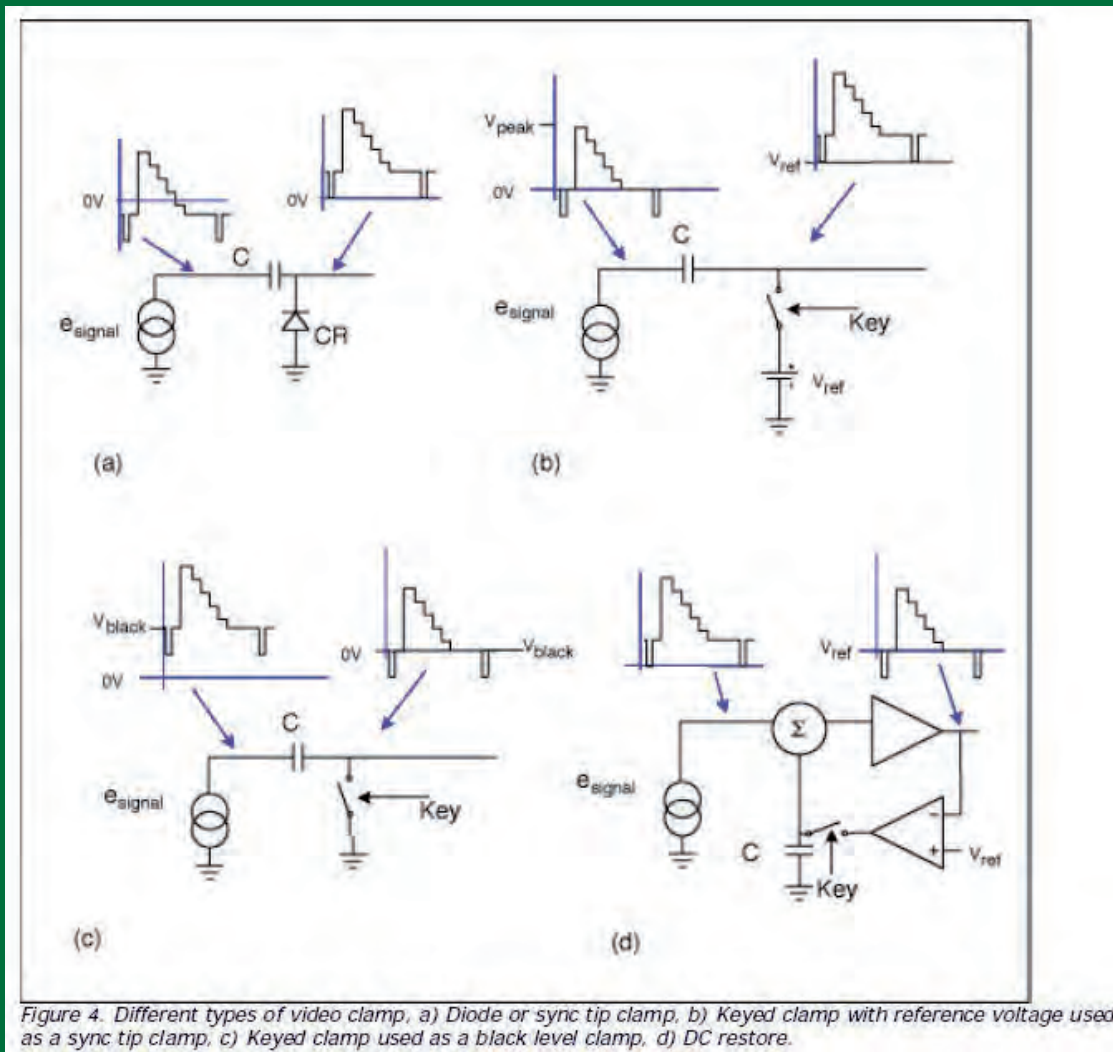


Figure 4. Different types of video clamp, a) Diode or sync tip clamp, b) Keyed clamp with reference voltage used as a sync tip clamp, c) Keyed clamp used as a black level clamp, d) DC restore.

and  $C_x$ ), two op amps (U1 and U2), and an S/H. The actual comparison and signal averaging is done by  $R_x$ ,  $C_x$ , and U2. The RC product is chosen for noise averaging. For a 16ms field (NTSC/PAL), the RC product should be greater than 200 ns. So U2 is a low-frequency device chosen for its low offset voltage/current, and stability—not its frequency response. (The MAX4124/25 are good candidates for this application.) U1, on the other hand, is chosen for its frequency response, but not its offset. The S/H and Chold itself are chosen for their leakage, which causes the voltage to change (droop) during a horizontal line. Although the circuit shown uses dual supplies, it can also be implemented in single-supply form using precision level translation. The biggest problem with a DC restore is that the level restored—black video to  $V_{ref}$ —is analog, and uncorrelated with its value in the digital domain. To correct this, a DAC is often used to generate  $V_{ref}$ . Like the keyed clamp, a DC restore can be used on any video signal (with or without sync) and activated anywhere on the waveform—assuming the amplifiers and the S/H are fast enough to follow.

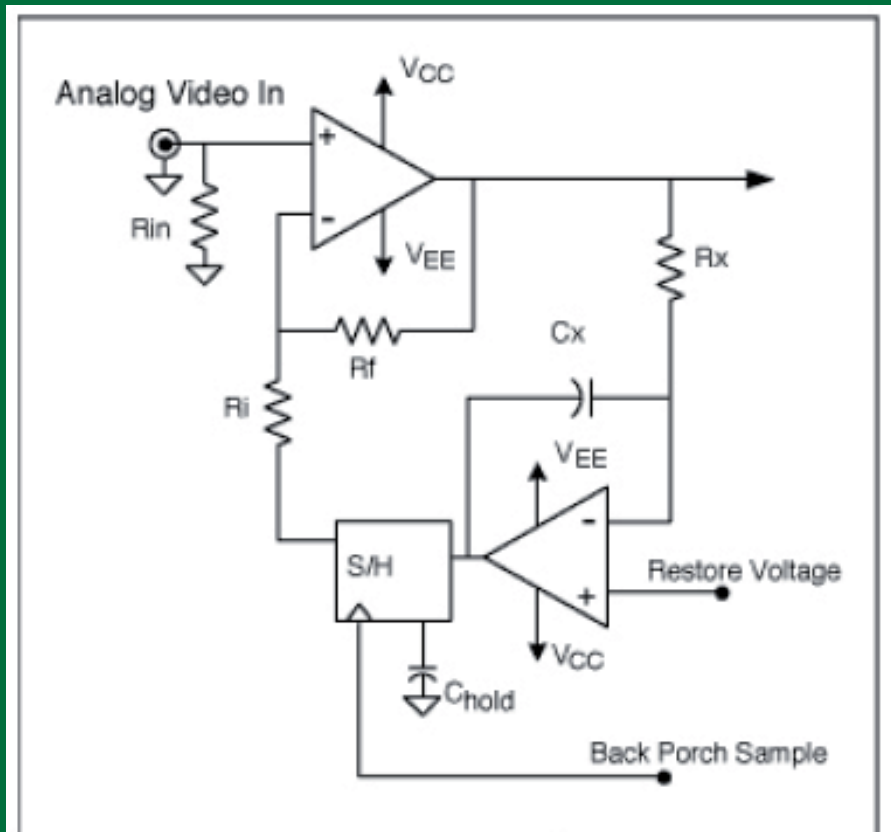


Figure 5 A practical implementation of a dc restore circuit uses two capacitors, two op amps, and an S/H.





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