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BATC

CQ-TV 214

May 2006

www.cq-tv.com

Caption competition

Can you think of a caption for the above picture? (see page 12) If you can, then send your entry to chariman@ batc.org.uk. The winner will receive a Black Box caption generator

CQ-TV 214

Contents

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

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Chairman's Column

By Trevor Brown

BGM

The date for this years BGM will be September 24th and it will be held at QUY VILLAGE HALL, in the village of Stow-cum-Quy. National grid reference TL 519 603. Quy is on the B 1102 about 1/2 mile from its junction (J35) with the A14 trunk road, about 2 miles east of Cambridge. A word of warning for those of you approaching this venue from the west on the A14 (most probably will be) MUST take care to come off at the Quy junction. Anyone who overshoots has got 22 miles round trip to get back.

CQ-TV Editor

It is with great reluctance that I have had to accept Ian Pawson resignation as CQ-TV editor. Ian has produced more CQ-TV's than any previous editor and has guided the magazine through more change than any other editor. It has gone to full electronic production and delivery to the printers, and has evolved from A5 format to the A4 version you see today. I think we all owe Ian our thanks. Ian will be staying on the BATC committee and will be around to help the new editor slide into his chair. We don't have anyone ear marked for this position but if you have the time, skill and creative flair to continue Ian's work I am sure the committee would like to hear from you.

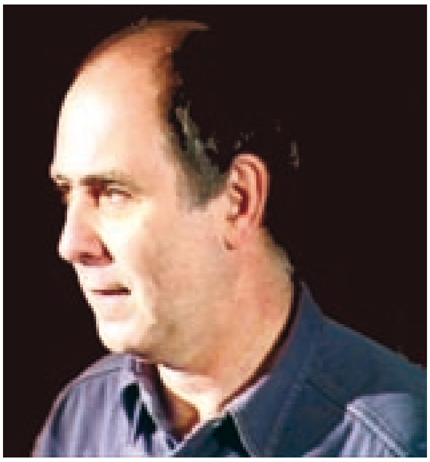
Artic Expedition

We have been approached by Pen Hadow whom you may remember made the first solo trek from Canada to the North Geographic Pole a couple of years ago.

He has an ambitious expedition planned for Spring 2007 which is concerned with disappearance of the Arctic Ocean ice cap due to carbon emissions. The expedition's start (81°N, 095°E) is the northernmost point of the Severnaya Zemlya archipelago off the central Russian mainland.

The route is a straight one, true North, to the North Pole at 90°North, and then continues (South) along 074°W to finish on the northernmost Canadian coast (approx 83°N, 074W) – a total distance of 955 nautical miles (1100 statute miles/1840 kilometres)

To enable a high profile national campaign (to be announced in the Spring) to emanate from his expedition on the ice cap via a wide variety of TV broadcasts over the 100 days of the expedition, Pen needs to resolve, by whatever means, the method by which he can transfer video footage with the minimum time delay from the Arctic



Ocean back to civilisation - i.e. to a high bandwidth telecomms network although it is not realistic to carry on his sledge more than approx 5kg max of kit to relay video footage. Ideally, the content would include a mix of short live one-to-one video interviews of say 2 mins duration daily back to the UK, uploading of say 30 mins of unedited video footage daily, and as much delayed-live webcam footage back to a website as possible.

The general purpose is to give people back home a feel for the day-to-day trials and tribulations of such an expedition, to illustrate the nature of the sea ice's unique ecosystem, to record major incidents en route (eg polar bear encounters), but most importantly to galvanise as many people in the UK as possible to participate in a national vote by phone, computer and inter-active TV in support of the campaign.

The expedition's remote location presents considerable communication challenges.

The Iridium array only enables voice comms and low grade still image transfer.

If you have any thoughts on how TV coverage from this remote location back to the UK can be achieved, then please let me have it and I will forward it to Pen. I know we all wish him luck on this ambitious expedition

NOAH – Design of an ARC [Aspect Ratio Converter]

By Mike Cox

Introduction

The subject of aspect ratio becomes more important by the day as we move into a "Widescreen" world. By Widescreen I mean 16:9. By default, most of the displays in my house are now 16:9. However, I have a lot of archival 4:3 material about, mostly on VHS, but some on DV. It would be convenient to archive this to DVD to save space.

As it will be played out on 16:9 displays, an ARC would be useful. [See CQ-TV 210 for article on Widescreen Signalling] [Fig. 1, Use of ARC]

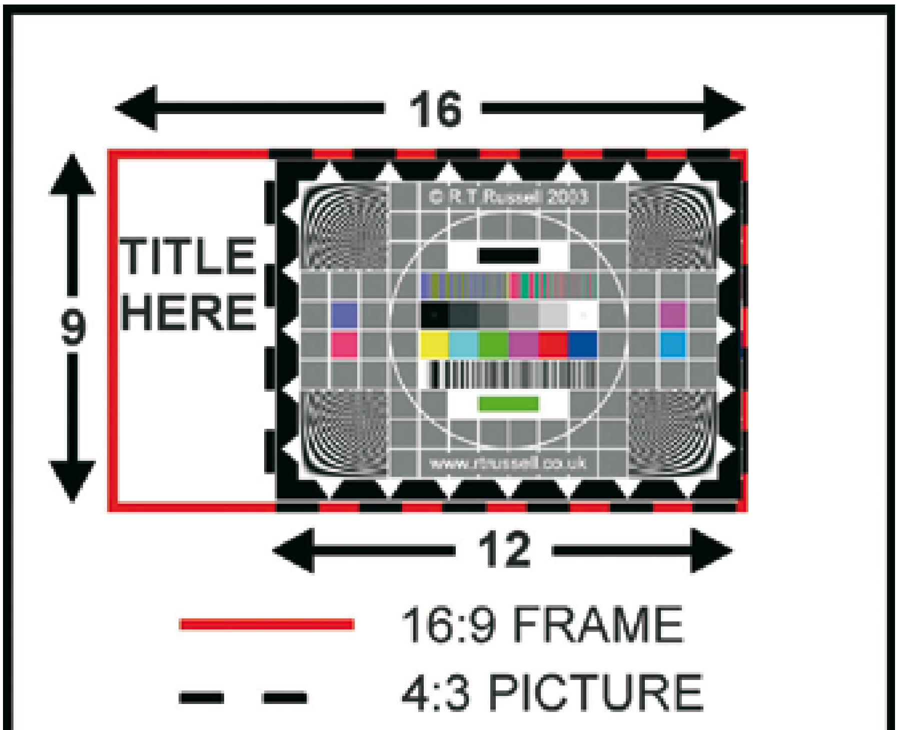


FIG. 1 USE OF ARC

As I have a Vistek Vega standards converter, synchroniser, TBC and general all-come-good unit around, and the Vega has YPbPr outputs [as well as CVBS, YC and SDI], the way forward suggested that the ARC should have YPbPr inputs. Further, the band limiting inherent in the Vega suggests that input band limiting filters are not needed in this particular ARC. The output options are to output YPbPr, and SDI, and subsequently PAL and YC when I can sort out how to programme the excellent ADV7171 encoder chip I have in the drawer. [CD – see below]

Architecture

The architecture of the ARC is starting to be defined. How does it work?

The heart of the unit is a device called a FIFO [First In, First Out memory]. [Fig. 2, FIFO block diagram]

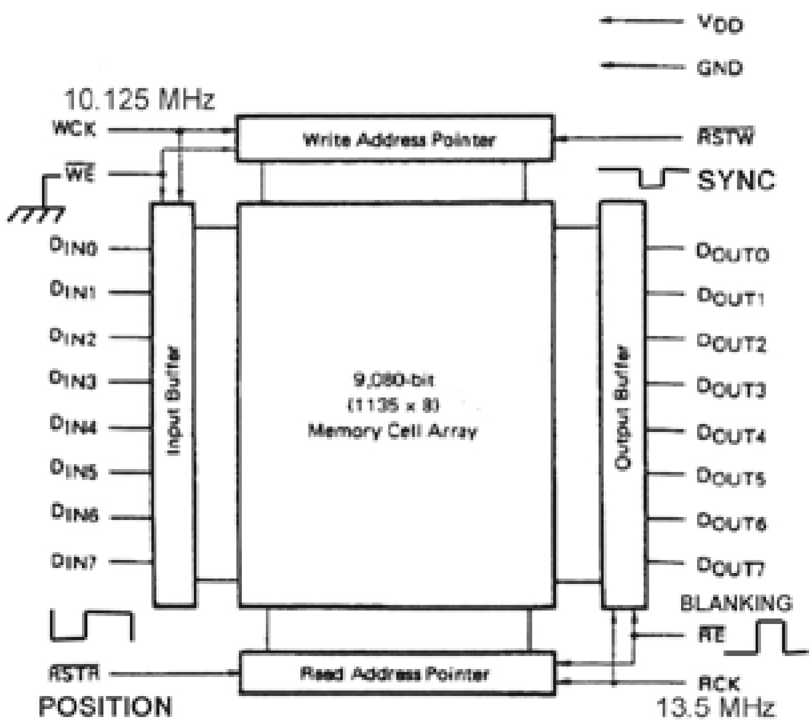


Fig. 2 FIFO Block Diagram

This memory can be written to at one clock rate, and read out at a different one.

Because we are dealing with line related clocks, the output is either expanded or contracted in a horizontal direction, depending on the ratio of the two clocks.

Straight away, we have highlighted the need for two clocks which are line related.

To fit a 4:3 picture into a 16:9 frame so that circles remain circular etc., and starting from the premise that 13.5 MHz is a good frequency to use for the read clock, as this will tie in with the ultimate SDI output, we arrive at 10.125 MHz [3/4 of 13.5 MHz]. This means that the input 4:3 picture is sampled to 540 pixels, to fit into 720 pixels of the 16:9 frame.

In my somewhat Capacious Drawers [CD], I found 3 NEC FIFO devices, PD42102, which were originally designed for use as 1-line delays in

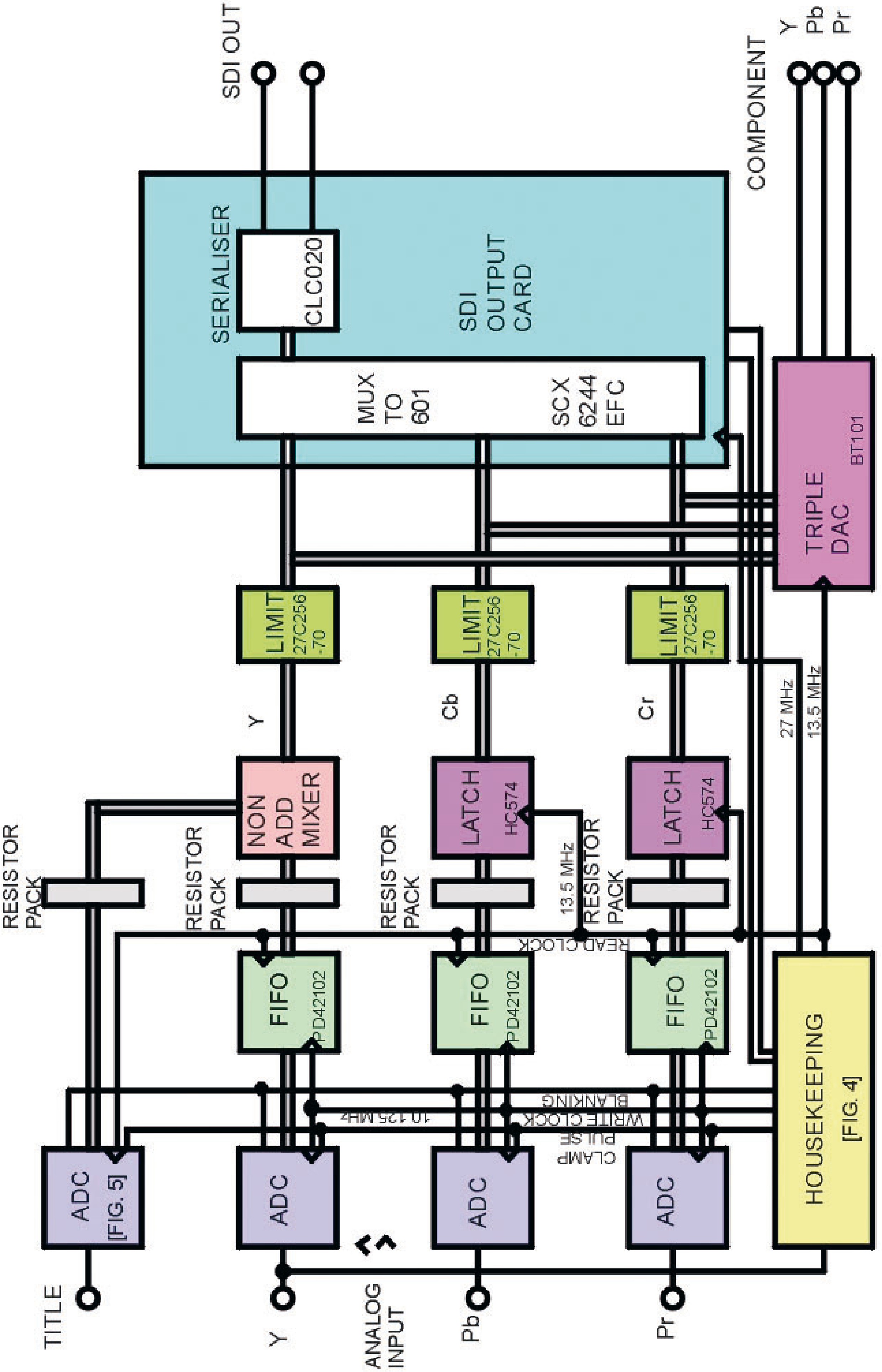


FIG. 3 "ARC" BLOCK DIAGRAM

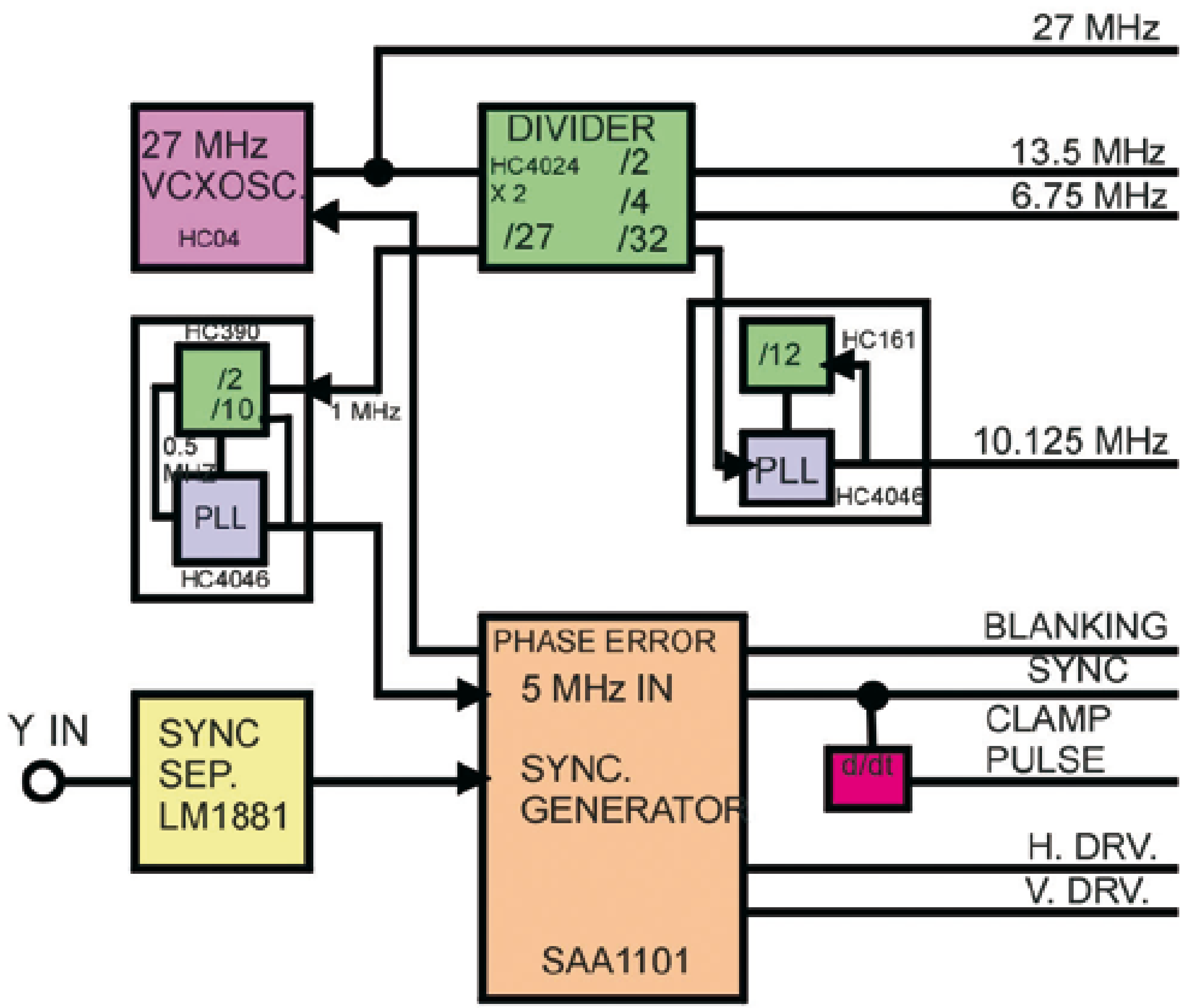


FIG. 4 HOUSEKEEPING BLOCK DIAGRAM

PAL decoding circuits. They have 1135 cells [= 64µS when clocked at 17.7 MHz, 4 x PAL subcarrier], and can be clocked up to 35 MHz. The write pointer {RSTW] is reset to zero each line by Sync, The read enable [/RE] is controlled by blanking and the position of the patch is set by the high portion of the waveform on /RSTR. This is derived from a monostable triggered by blanking. A front panel preset sets the width. One of the advantages of a FIFO, unlike other memories, is that it does not need any address counters.

Other companies such as Cypress, IDT and Texas make suitable FIFOs.

The NEC device is 8-bit wide, so perfectly adequate for the purpose, particularly as the CD contained a few Texas 8-bit fast ADCs [TLC5540], not to mention a few Gennum clamped buffers [GB4551] [Fig. 3 "ARC" Block Diagram]

Housekeeping

Before much further work can be done, there is the question of housekeeping. Various signals are required around the unit such as clamp pulses, blanking, sync, drives and two clock frequencies described above, as well as 27 MHz for the SDI output card. This is a similar unit to that described in the articles about the SDI mixer, based on the Philips SAA1101 SPG chip. These are nearly as rare as hen's teeth, but unlike chouk's choppers, can be found [EBAY?].

A master crystal oscillator runs at 27 MHz, and via various dividers and phase loops, provides a 5 MHz clock for the SAA1101. There is an unfortunate story here. Originally a 74HC40103 programmable divider was chosen for dividing down from 27 MHz, and again by 2 to give 0.5 MHz for the Phase Lock Loop [PLL] to lock the SPG. A full size 'HC40103 had worked well in the lash up version. However, when it came to the laid out version using SM devices, the 'HC40103 would work when first powered up, and then fail after a few minutes. Not very practical!

Accordingly, an 'HC4024 7 bit divider was built up, using diodes to get a count of 27. Does not look very nice but it works. Perhaps asking the 'HC40103 to work reliably at 27 MHz was a bit much.

At the same time, a divider provides 13.5 MHz and 6.75 MHz [if needed], together with 0.84375 MHz [27 -/-32]. Another divider [-/-12] takes the VCO output to produce 0.84375 MHz. The VCO therefore generates 10.125 MHz, phase locked to the 27 MHz master clock. Fed from a LM1881 sync separator, the SPG chip produces an error signal used to lock the 27 MHz oscillator. Hence all signals are phase locked to the reference video input, in this case the input Y signal. [Fig. 4 Block Diagram]

Input ADCs

The next item to be considered is the Analogue to Digital Conversion [ADC].

Myth has it that the animals went into Noah's Arc two by two; well these ADCs go in four by four. Three are needed for YPbPr signals and the fourth is for the Title Insert facility, to allow simple captioning of pictures, preferably in the left hand black border.

The ADCs are assembled on small pcbs 46 x 23 mm, and are plug-in using 20 pin connectors. [Fig. 5, circuit and picture of ADC card]

Development of these cards was the prompt for the Digital Measurement Technique mentioned in CQ-TV 213, and the design of a similar ADC can be found in CQ-TV 200, p11.

Two of the cards are set up for black level at 10h [16 in real numbers] and peak at EBh [235 real], and the other two set for black at 80h [127 real]. These latter ones are for the colour difference channels Cb and Cr.

Title insert

The Title Inserter uses a Non-Additive Mix arrangement. If this is not familiar to you, the basic principle is that of two video sources being combined in such a way that the highest amplitude signal at any pixel wins. Hence titles at peak level will always win through, but without any excess level, unlike a straightforward addition. The nearest approach is that of an OR gate.

In this unit, a digital comparator is used to compare the two 8-bit video streams, Y [Background] and Title. Each stream feeds a buffer, and the comparator output and complement control the output enable pins of each of these. At any pixel, if the Title video has a higher value than the Background, the Title buffer is turned on and the Background buffer turned off. The insert is very clean, and there is no excess level. [Fig. 6, Non-Additive Mixer]

The transit through the buffer will take some time, so to compensate for this, the colour differences signals [Cb and Cr] are taken via a latch [74HC574].

After this, all three digital streams pass through EPROMs arranged as limiters. They are programmed so that any values below 10h or above EBh are ignored, while maintaining a linear in to out characteristic from 10h to EBh. This is done to avoid compromising the TRS signals when the 3 streams are multiplexed to a 601 stream and then serialised to SDI on the output card.

The streams are also fed to a triple DAC [BT101, found in CD] that restores them to the analogue YPbPr signals. Clock for the DAC is 13.5 MHz for all channels. This reduces the filtering requirement for the Pb and Pr outputs..

Power for the unit comes from a 5-volt, 2A plug-top unit. A dual output dc-dc converter provides the +/- 12 volt supply for the ADC clamped buffers. All the rest of the circuit is fed from the 5-volt rail. Current draw excluding the

Triple DAC, which is not yet wired [10 – 3 – 06] is 0.8A at 5 volts.

Mechanical details

The unit is assembled on a 220 x 233 mm board with ground plane on the top side, and arrays of pads and power and ground busbars underneath. Inter chip wiring is done in the ubiquitous wire-wrap wire. The 4 ADCs plug into 20 pin sockets and the housekeeping card is arranged as a layer over the main board. As most of the components are standard, rather than surface mount, the total area may appear large, but it is a

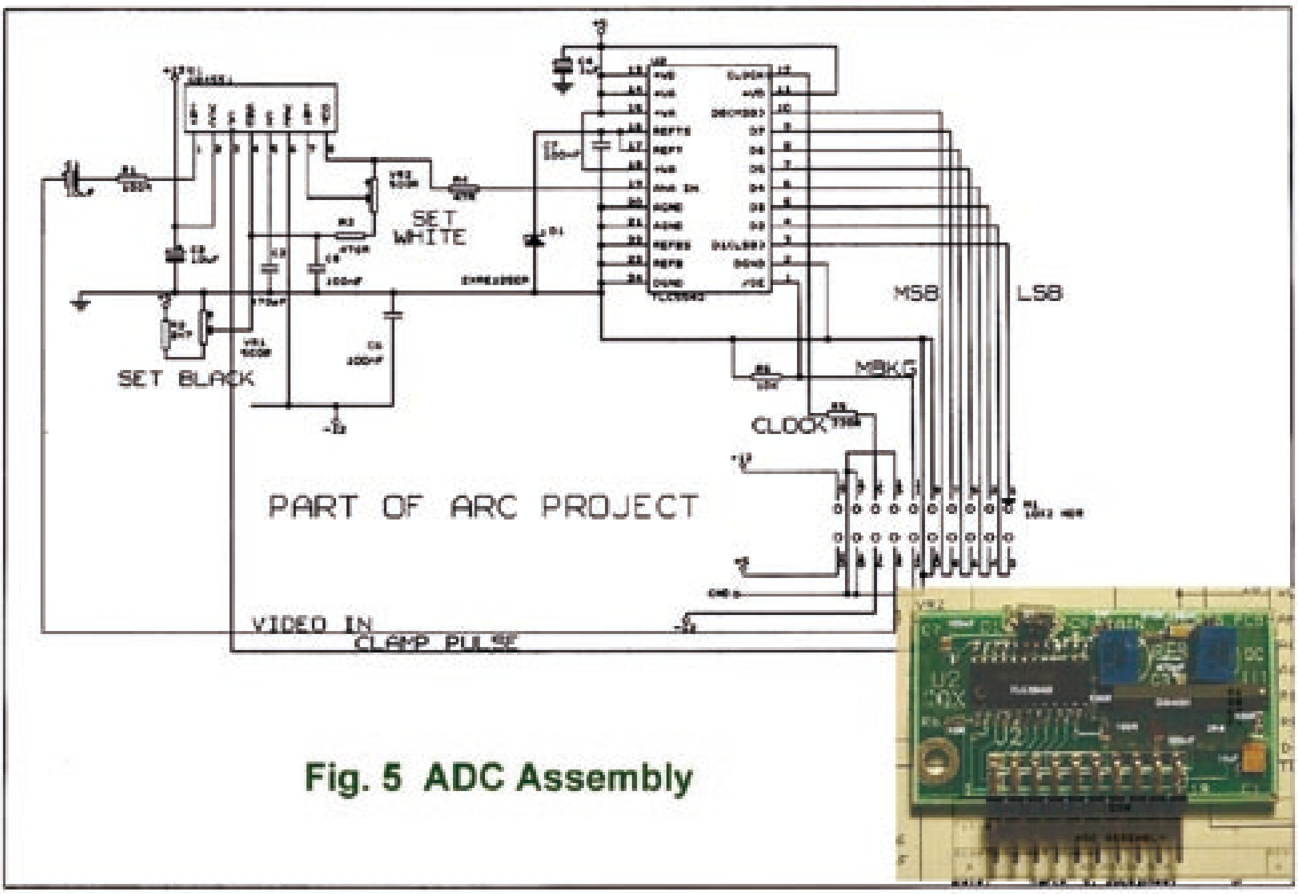


Fig. 5 ADC Assembly

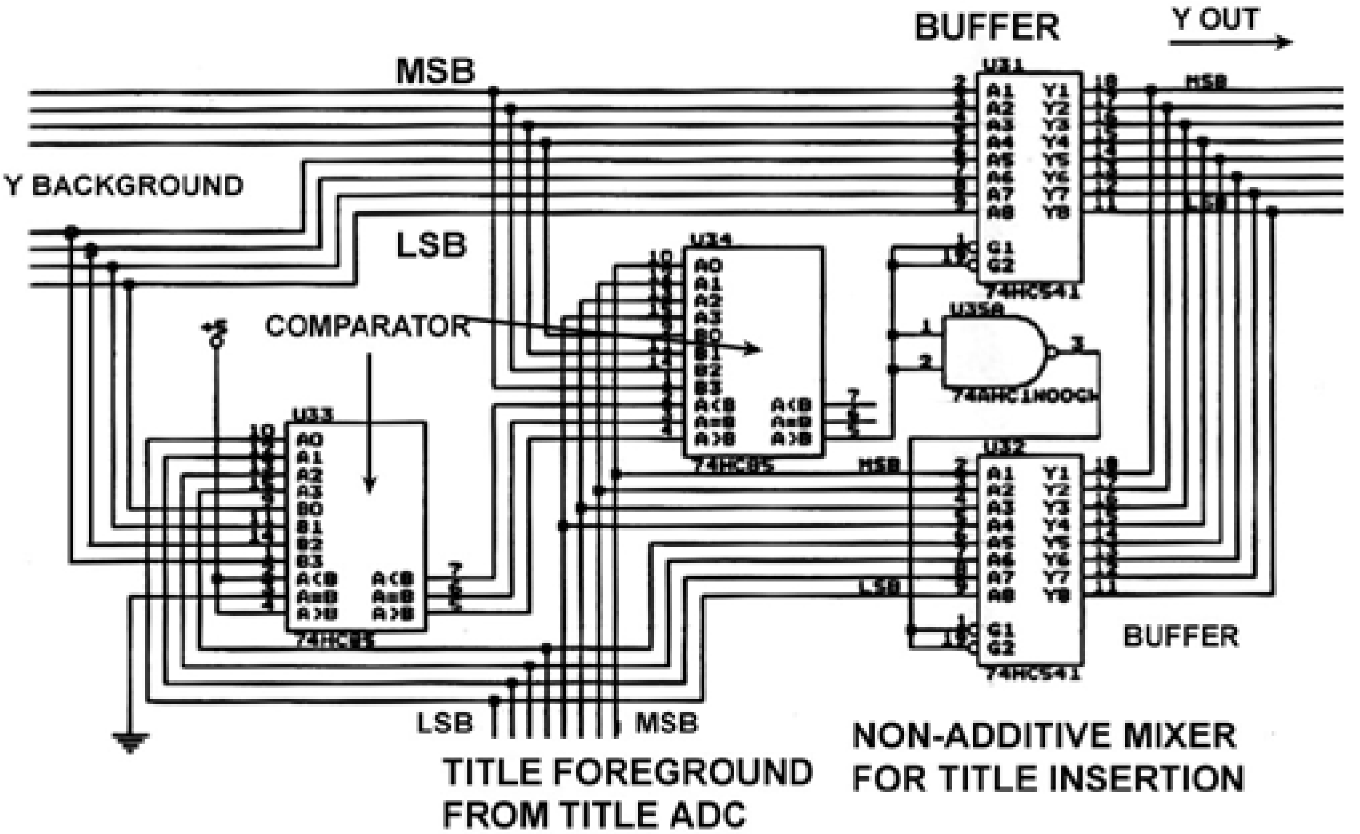


FIG. 6

flexible arrangement, that lends itself to further development. One of these is to add the Line 23 Wide Screen Signalling system described in CQ-TV 210.

After soldering about 150 wire-wrap interconnects, it seemed appropriate to power it up. The SDI Out card was patched up using the ubiquitous 10 way ribbon cables, component bars connected to the inputs, and a picture appeared on the SDI monitor. It was not good, with what appeared like bits missing. The Digital Measuring Unit [DMU] then came into its own. Changing the input from bars to ramp – conventional ramp on Y, bipolar ramp on Pb and Pr, what should have been linear outputs were stepped or not very clean looking. Probing with a scope on the Limiter ins and outs soon showed some shorts between pins on the underside of the board. After scraping these out, the result looked as expected, except that the black levels of the Pb and Pr ADCs could not reach the required level. A value change in a resistor from 2k4 to 1k8 brought the controls in range, and black levels could now be set to 80h. The DMU proved its worth for this set up. So the unit works, and Project "Noah" could be said to float.

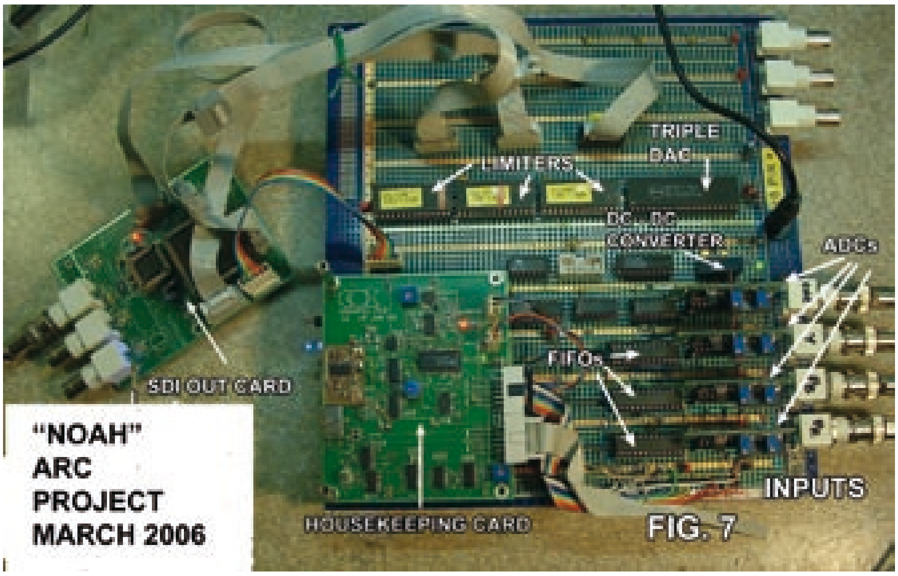


FIG. 7

Oh, and the Title NAM facility works well!

Fig. 7 shows the board on test, and Figs. 8 and 9 show some results, with title.

If your Editor wills, the complete unit in its case will appear in a future CQ-TV, when I have built the case.

The next project is to drag an old 1125/60 test signal generator that I built 20 years ago into the modern 1080i world, which is incidentally 1125/50 as far as Europe is concerned. I have obtained the correct frequency clock oscillator [74.25 MHz] from EuroQuartz so the first job is to re-create the divider down to 2 x Fh.

Component supply

If you need to get pc boards made fairly cheaply, I can recommend PCBTrain, operated by Newbury Electronics Ltd..

A board 10cm by 10cm will cost £30 + VAT. They take the Gerber files from you, and then consolidate them with others to make up a large sheet. The whole lot goes to China, is made, and your bit cut out and sent back to you. Good quality boards.

www.pcbtrain.com

If you have difficulty getting components in the UK, and I have found people like Farnell do not stock the available range of say 74HC surface mount parts, I can recommend DigiKey. They are a USA based company who issue a catalogue of 1336 pages packed with an amazing collection of components, priced in pounds. I ordered some parts on the web, and they arrived via UPS within 3 days. The only downside is handling charge for orders less than £75, and carriage for orders less than £100. Worth it though, if you cannot find the parts elsewhere.

www.digikey.com, and click on the Union flag on the home page – this brings you into pound pricing

Receiver pain from too much gain?

By Henry Ruhwiedel AA9XW

Your preamp may not be helping as much as you think; it may actually reduce your ability to receive weak signals.

Ah noise; there is the rub. To find that elusive signal in the noise takes skill, good equipment and antennas. But you may have too much of a good thing. Unfortunately, we are all limited by the familiar notion that noise increases with temperature and bandwidth. In theory, if we could have a zero degree Kelvin RF amp and an infinitely narrow pass band, we would have the ultimate receiver, able to recover any signal. Lacking Arecibo type equipment, with fraction of a degree K noise temperature, a really nice G/T ratio, and sliver thin digital signal resolving power, we opt for the next best thing but is that really optimum?

We know we can receive signals below the 270 degree Kelvin terrestrial noise floor. Every satellite receive system has an amplifier/converter with a noise figure in the under .5 db Ku band (12 GHz) and under 20 degree C band (4 GHz) ratings. We can get cheap Ham preamps for 70 CM and most other bands with impressive noise specs and typically 18-20 dB gain. When we say low noise, it actually means the amplifier input noise level is below the galactic noise level. But the term is often sloppily used to simply mean the amp is lower noise than our receiver.

Lets look at a typical receiver system. The receiver has a spec of 1 µV or better depending on bandwidth. For TV, the ultimate noise floor for 6 MHz bandwidth is 1.1 µV. That is the noise-limited threshold of reception. Signals above that we can receive, and signals below that we cannot receive. But the receiver also has an AGC circuit. There is a threshold, typically 100 µV where the AGC begins to reduce gain, and a saturation point usually in the .5 to 1 volt range. As the signal increases above the AGC floor, the gain is reduced to prevent overload of the IF and video/audio amplification stages. In FM modulation we reach the limiter saturation and no further increase in signal will make any difference. In amplitude modulation, once we reach the full depth of modulation, we get no more improvement.

Lets look at figure 1. and use a typical TV signal for the source. As the signal level increases it reaches the threshold of the AGC. Further increases in signal level create equal amounts of gain reduction over the range of the AGC. The result is the output of the circuit remains constant along the AGC range, and there is no gain reduction below threshold, and any level above the upper limit simply begins to overload the circuits.

We can look at this vs. a video signal in a similar manner. Using a long time constant, the AGC will change with the signal level in order to maintain a constant gain structure so the picture on the CRT, LCD whatever, is within the dynamic range of the display device.

Now lets add a noise floor. In figure 2, we have chosen a noise floor of about 1.1 µV. It is below the AGC level, so it has no effect on the system gain. So lets add some coax loss, and a preamp. Figure three shows the result. The coax loss is added db for db to the noise floor of the receiver to make the effective sensitivity much less. The preamp may be equal or better as the receiver at its input depending on its noise floor. Noise and signals passing through the preamp are amplified equally. Lets say 20 dB. If we have 6 dB of coax loss, the first 6dB of gain over comes the coax loss, but the remaining 14 dB gain has raised the noise signal at the receiver by 14 dB! That may be enough to cause the AGC to begin gain reduction. If the AGC puts in another 3dB of gain reduction, the signal and noise is reduced by 3 dB, but the noise level out of the preamp is still above the noise floor of the receiver. We have 11 dB more noise. But if we insert 11 dB of RF pad, the noise floor of the signal from the preamp, will be equal to the receiver noise floor, and there will be no gain reduction, and the signal sensitivity at the preamp input is now fully realized at the receiver. We have gained 6 db of signal by eliminating the coax loss, plus any improvement the preamp sensitivity/noise level has compared to the receiver sensitivity/noise level. The more gain we introduce, the more noise appears at the receiver, with no additional gain in signal to noise ratio.

We can determine the pad loss needed by measuring the signal at the output of the receiver, and with no signal present, we should see noise. If we see more noise with the preamp on, we need to reduce the signal until we see no change in noise level, or a very small increase in noise. There is an additional gain in added loss because the RF devices have a third order intermediation point. If we have a very strong signal, and we have too much gain, the signal will cause IM to be generated in the receiver, which results in interference, more noise, and your ability to find the weak signal is masked by the IM and gain reduction from the now non linear amplifier stage. But IM products are reduced by the cube when the signal is reduced. A loss of 3 dB in input level equals a 9 db reduction in IM.

If we look at the signal over noise floor diagrams, we show the S/N ratio with a signal above the noise floor. As the signal goes through the coax, the signal is lost but the receiver noise floor is unchanged, so the signal is now partly below the noise floor. Since SYNC is 100% power, it is the first part we see above the noise on a weak signal, about 2 dB = P1 visible sync bars. Video is AM modulation, and the depth of modulation changes with video level. At peak white we only have 12% power, well below the noise floor in our diagram.

Now lets add the mast-mounted preamp. The preamp amplifies the signal, it has its own noise floor, which is also amplified, so both signal and noise are higher out of the preamp. Following along, we subtract the coax loss, which is less than the preamp gain, and at the receiver we have a signal and noise that is above the receiver noise floor. Noise power is additive. The power of the noise from the preamp adds to the power of the receiver noise, so we have more “front end” noise, but also more signal. But if we then insert a pad to reduce the levels, both the noise and signal are reduced, but when the amplifier noise floor is reduced to or below the receiver noise, the noise is no longer additive, so we have an increase in S/N ratio because the noise power is reduced. Less noise in the receiver means the AGC is not affected by the noise power, and we are back to maximum sensitivity. If we cascade preamps, we generate even more noise, (Pn1+Pn2+Pn3) and thus more reason to add a pad before the receiver to reduce the additive nature of the noise and reduce the noise power at the

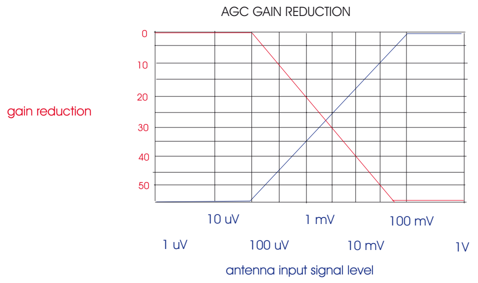
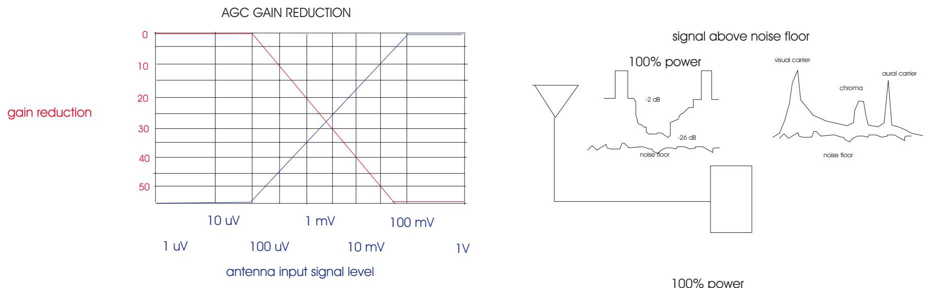
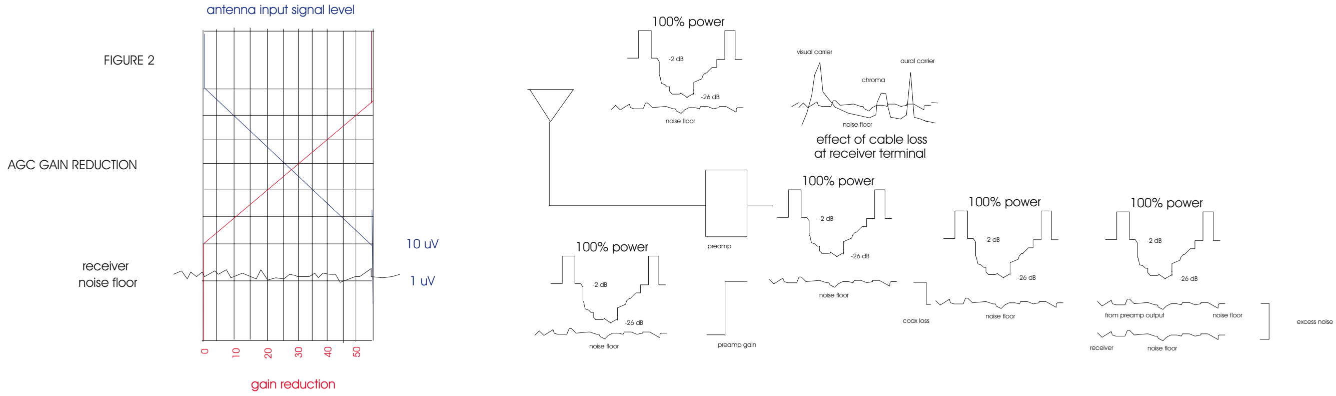
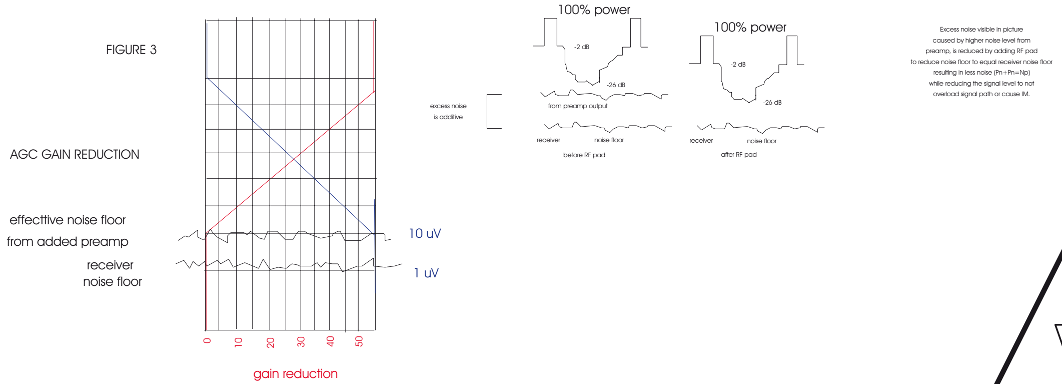


FIGURE 1







receiver so it does not trigger AGC gain reduction.

On weak signals, we can see that the bandwidth of the recoverable signal is less than 6 MHz wide. If we reduce the IF or RF bandwidth, we reduce the noise power by 3dB, (6 dB voltage) This increases the amount of signal recovered because the lower power sidebands are now above the noise by the same ratio. We can actually reduce the bandwidth by a factor of 4, since most of the video information is in the first 1.5 MHz. We can also get a similar affect by limiting the base band video to filter out the noise, and that does not affect the color or audio which are reduced if we use RF or IF bandwidth reductions. Use of a VHF or UHF "intercom channel" i.e. 144.34 reduces the need to recover the audio on the video signal and we can also use on-carrier FM for audio. . Also, depending on the shape factor of the bandwidth filter, the stronger color and aural carriers may still be above the noise enough to get through.

A little extra loss can be a good thing!

Lens to Lens- Part 2

By Brian Kelly

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

In the last article we looked at the preparatory work that should go into a video shoot and hinted at some of the pitfalls to avoid. This article will conclude the 'shoot' section and go into some detail on the editing procedures that 'glue' the shots together into a meaningful sequence.

Talking heads.

The human kind, not the tape ones! Many shoots will have a close-up of someone talking, whether in narrative or interview style. Obviously, miss-aiming the camera so part of somebody's face is missing is not a good idea but less obvious is the 'magic box' area that gives best viewing experience. In personal conversation we talk while looking eye to eye and the same principle applies when viewing someone in a recording. We focus our attention toward their eyes and keeping them within a particular part of the screen helps to concentrate that attention. Curiously, the scale of the face doesn't matter as much, forehead to nose or a full body shot makes little difference as long as the eyes stay in the magic box. The box extends from about one third to two thirds of the screen width and from half way up to two thirds up from the bottom.

The background.

For the most part, the background is incidental to the foreground and it should not distract from the topic of the video. Positioning the camera carefully can sometimes be used to put the topic in context though. For example someone describing a fence with a view of open countryside behind them would in most peoples minds infer it related to a wood fence in a farm or park while a view of a prison would more likely suggest a wire security fence.

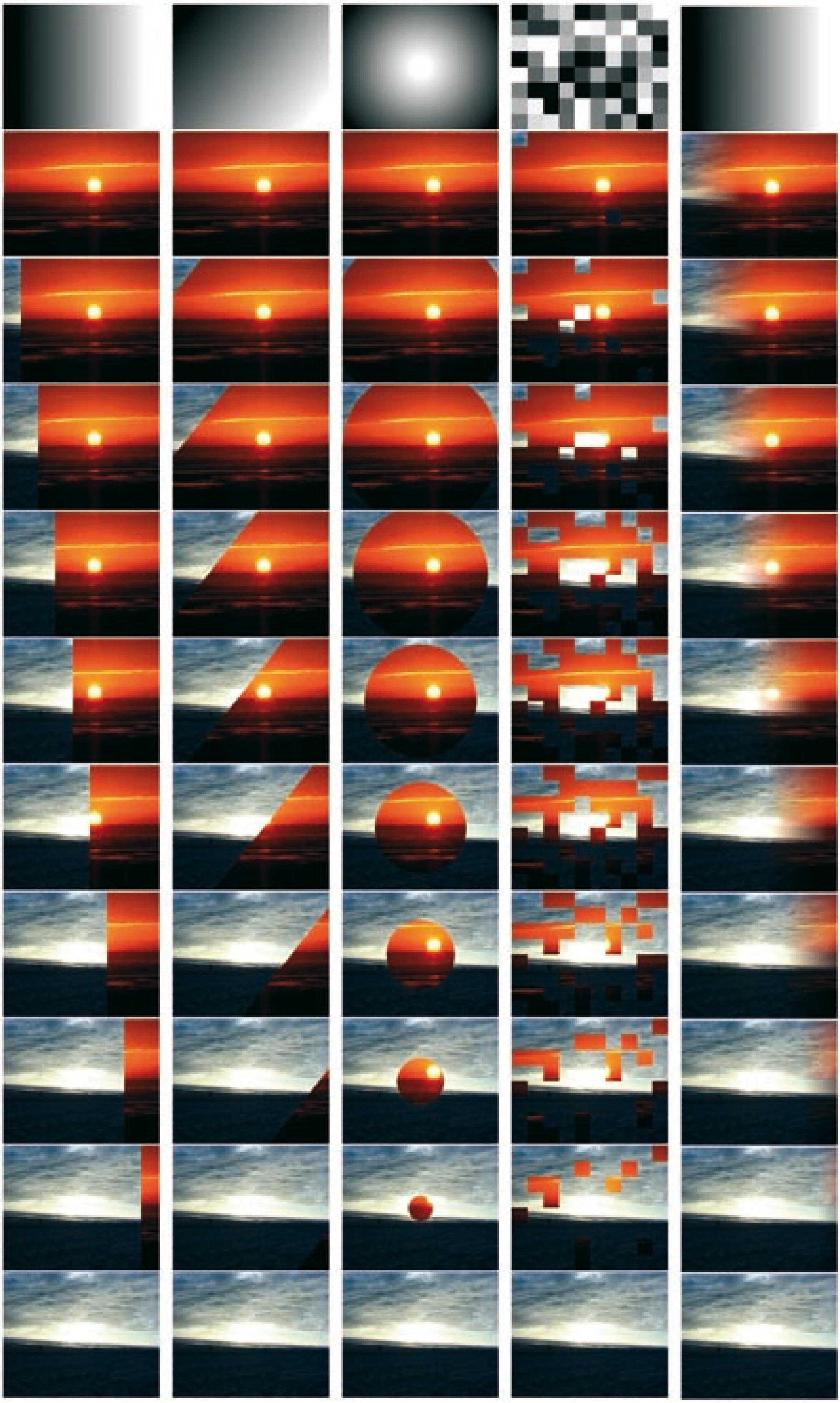
A common video trick is to use a 'virtual' background, that is, one which is electronically substituted for the real one. Usually this is done with 'chroma keying' where the real background is exclusively of a colour which does not appear in the foreground. By ensuring there are no common colours, it becomes very easy to separate the fore and backgrounds into two images, usually the foreground is then superimposed upon a new back drop. Chroma keying is by no means the only way of splitting the image; luminance keying and matte keying are also used. Luminance keying uses lightness rather than hue differences to define the border of the foreground and matte keying uses a completely different image which may not even be related to the main one. It's rather like using a stencil to paint one shape over another. If you ever wondered how transitions that follow curved edges work, they are probably matte keyed, a demonstration will be shown later.

Using more than one camera:

Most productions can be made with one camera but unless meticulously planned and scripted, and the scene can be precisely repeated so it can be shot twice from different angles, two or more cameras would be far more convenient. The big problem when you have more than one camera is making the pictures match each other in colour temperature and contrast. I have made my own 'disaster movie' using one DV camera and one 8mm analogue camera, both regarded as high quality models of their respective types. When viewed on their own, the pictures from both cameras played back with excellent quality but when edited together the differences were immediately obvious. DV was clean and sharp, the 8mm looked blurred and grainy. Cutting from one to the other made the differences only too obvious. Thankfully on that occasion, my customer never turned up to collect the finished DVD (or paid for it – grrr.)

There are a few tricks to minimise the differences between cameras, some correction can be made at the editing stages but making them as compatible as possible at the shoot is still the best way to save time later. Colour balancing is the first thing to get right. Different types of camera, possibly even different batches of the same model, will have different perceptions of colour and brightness scales. The idea of balancing colours is to align the cameras so their images are as closely matched as possible. Errors occur for various reasons, some electronic and some optical but there are ways to combat both forms. The first thing to do is record a few seconds of colour bars on the tape. Most good quality cameras have a built in colour bar generator which will be accurate enough for colour alignment. When playing back, any deviance from standard bars, caused by the tape and electronics, can be measured and compensated for electronically. That sorts out the hue and saturation matching but there is also a problem of what is white. We talk of 'warm' white and 'cold' white which in reality are just tints of red or blue, in themselves not that important but when clips with a reddish tint are interspersed with ones with a blue tint, even minor differences become plainly visible. The way to combat the tint discrepancies is to make all the cameras interpret the same white with the same levels of red, green and blue components. We call this 'white balance'. On virtually all cameras there is a facility called 'auto white balance' which attempts to constantly adjust the gains of the camera pick-up amplifiers to compensate for an overall tint in the image. For example, shooting in artificial incandescent (normal light bulb) light actually produces a very yellow tinted picture. Auto white balance sees the predominant red and green content (red and green mix to yellow) and reduces the gain of the red and green amplifiers while boosting the blue amplifier. Although useful for single camera work, the artificial re-tinting of the picture will not work equally across several cameras and will not help to align them together. To set the white balance accurately, the auto feature should either be turned off or if the camera supports it, it should be manually taught what white looks like. This is very easy to do and relies on nothing more than a sheet of white paper. Under ambient lighting conditions, each camera is pointed at the same piece of paper, and their white balance controls set to learn that they are actually seeing 'white'. With all the cameras seeing the same white, it is fairly safe to assume they will also see the same shades of grey right down to black. Now when edited, the colour bars can be used to match the hues and the paper used to set the luminance levels, giving a good correlation between shots.

Finally, a trick when using DV or DVCAM cameras. These cameras record the time, date and frame number in every frame of video they store. Normally, you don't see this but it can be electronically retrieved from the tape if needed. There are good and bad points about these time codes, the bad point is that if there is no video already on the tape, they start



The top image in each column is the matte used to cut between the two scenes. Note the line of the cut follows the contour of the lightness of the matte. The last column is the same as the first but has a soft edge applied to give a progressive fade instead of an abrupt change.

```
GENERIC EDL CREATED BY MEDIASTUDIO 8.0
SMPTE FRAME CODE
NON-DROP FRAME
TITLE: Test for CQ-TV
0001 BLANK      V  C   0303 00:00:00:00 00:00:12:03 00:00:00:00 00:00:12:03
0002 200001     B  C   1825 00:00:12:03 00:01:25:03 00:00:12:03 00:01:25:03
* 200001 IS LANTERN.AVI
0003 200001     B  C   2606 00:01:25:03 00:03:09:09 00:01:25:03 00:03:09:09
* 200001 IS LANTERN.AVI
0004 200001     B  C   1016 00:03:09:09 00:03:50:00 00:03:09:09 00:03:50:00
* 200001 IS LANTERN.AVI
0005 200001     B  C   2820 00:03:50:00 00:05:42:20 00:03:50:00 00:05:42:20
0005 100001  V  K  A   2820 00:00:00:00 00:01:52:20 00:03:50:00 00:05:42:20
* 200001 IS LANTERN.AVI
* 100001 IS AUX
0006 200001     B  C   8273 00:05:42:20 00:11:13:18 00:05:42:20 00:11:13:18

* 200001 IS LANTERN.AVI
* TRANSITION SUBFIELD: B- BORDER, S- SOFTEDGE, R- REVERSE
* KEY TYPE: R- COLOR KEY, L- LUMA KEY, C- CHROMA KEY, A- ALPHA KEY, G-GRAY KEY
* KEY SUBFIELD: T- SOFTEDGE, I- INVERT
* BLANK VIDEO IS WHITE VIDEO FRAMES
```

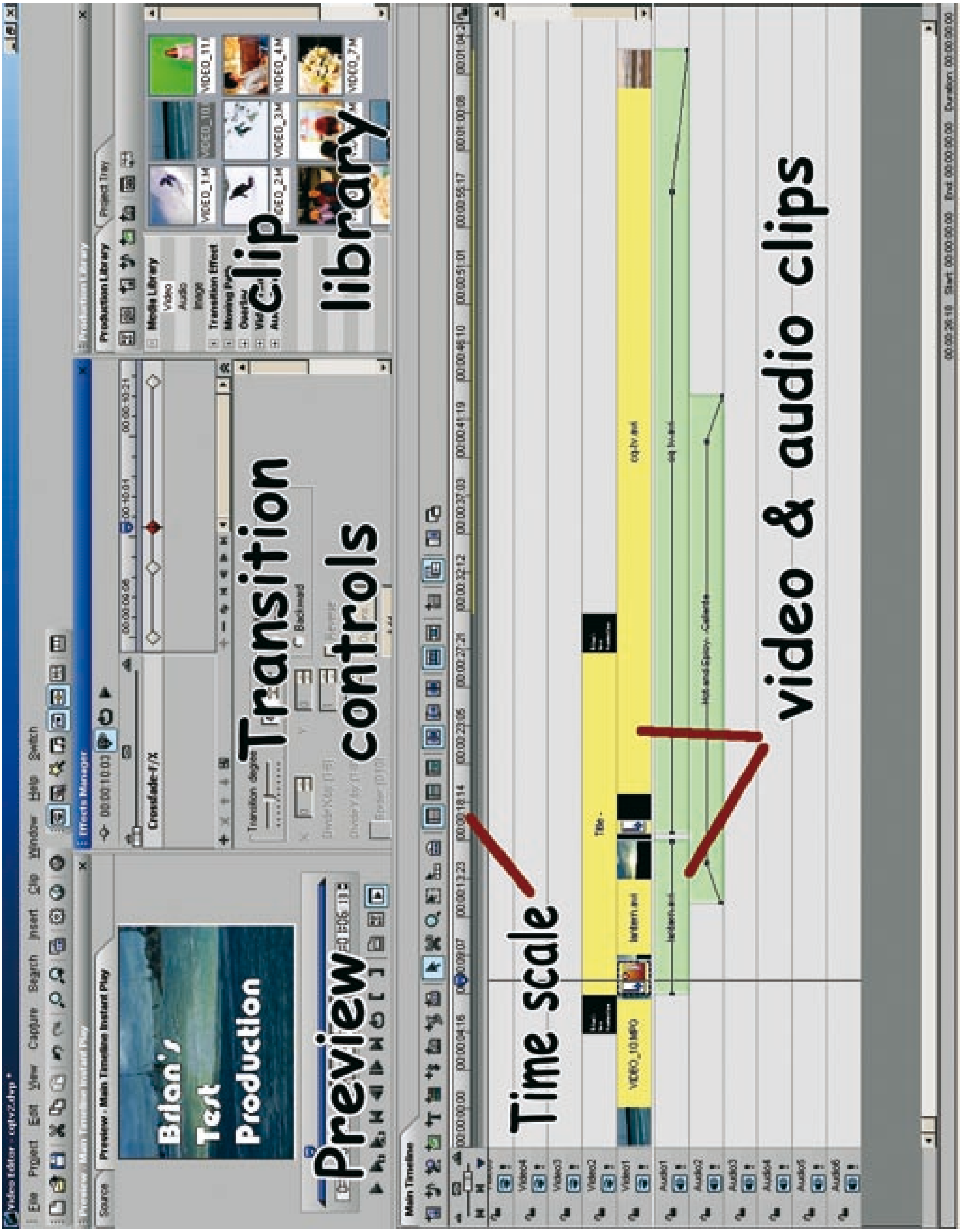
A sample edit decision list. The columns list the cut number, tape number and the insertion times and durations. Text following the '*' is a comment.

counting from frame zero. The good point is they make synchronisation between cameras really easy. Starting from frame zero can be a real nuisance because if the tape is played back in mid shoot, to check what was recorded and then moved beyond the end of the recording to be sure nothing would be overwritten, finding no video it restarts the counter again. When playing back the result is the time code is no longer continually increasing and there may be several scenes with the same time codes. Fixing the time code is very easy, simply make a dummy recording on all tapes when they are new. Leave the lens cap on if you like and switch the microphone off but rewind the tape and make a recording right to the end of the tape. Now the tape has a contiguous time count on it that will be picked up wherever the tape is left on its spools.

When its 'in the can' – the editing stage:

So your shoot is finished and you have one or more tapes in your hand, what next? You have two options, old fashioned linear editing or NLE, non-linear editing. Linear edits are achieved by lining up sections of tape and playing them back in sequence on to another recording machine. It is tedious and can be difficult to do accurately and without interruption to the sync pattern. You can think of it as being like cutting and splicing cine film. On the other hand NLE, which is normally done with a computer allows the edit 'cuts' to be put together exactly and seamlessly. What makes computer editing so convenient is that normally, all the video 'footage' is stored inside the computer at once, even if it originates on different tapes and in different formats. Rather than the old fashioned way of finding the cuts by hand and physically lining them up and joining them, we can now use 'mark-in' and 'mark-out' points on the stored video. These are nothing more than a note of the name under which the video is filed and a frame count into the file. Because computer files allow random access (meaning you can access anything at any time and in any sequence) you can jump from a 'mark-out' to a 'mark-in' instantly, even if they are in different files. The editing job essentially is putting the clips together by listing all the mark in and out points. When all the parts and cuts are decided, the computer simply makes a new file by copying the source files from the first mark-in to mark-out then from the second mark-in to mark-out then the third mark-in and so on. The resulting file is a seamless join of all the marked sections. Another plus to this method is that the list of mark-in and out points can be stored for later use or adjustment. It is of course important to keep the original video file or tape as knowing where to cut is useless without having something to cut into. The list of cuts is a plain text file called an EDL or 'Edit Decision List'.

Most, if not all computer video editing packages use a 'time line' principle. The idea here is to lay out the video and sound clips along a measuring scale, usually in frames or seconds. The scale shows the position of the clip in the finished production, so for example an event lined up with the 10 second marker will be seen or heard tens seconds from the start of the finished video. To ease clip alignment the time line is usually 'zoomable', that is, it can be expanded or contracted to a scale suited to the size and required accuracy of placement. If zoomed right in, the scale is usually in frames so that clips can be precisely aligned, zooming right out may show the whole production, maybe several hours of it, making it easier to visualise the placement of entire clips within the production. The time line will usually have several levels so that the position and duration of transitions and overlays can be aligned with the main video stream. There are also sound tracks of course and these are manipulated and cut in the same way as video but frequently not in the same places. For example the camera shot may change to one from a different angle while the same audio plays right through.



A typical timeline in a video editing package. This is the main editing window in MediaStudio Pro from Ulead Inc.

Being computer based and having instant access to all the video files makes it possible to view the finished production as you move through the edit, some people call this 'timeline scrubbing'. It also allows you to go back and change a cut point or even swap cuts around with instant viewing of the results. Video files can be huge though and require considerable computing power to view in real time so an alternative method of editing called 'proxy editing' which is faster but initially less precise is often available. Proxy editing relies on the fact that all we are normally interested in is building the list of mark-in and mark-out points, the quality of the picture isn't particularly important during the editing stage as long as the picture content is obvious. The proxy file is a low resolution copy of the video which uses smaller files and is much quicker to handle. When the cuts are decided, they are applied to the full quality version of the files to create the final production. This can be quite a slow process when high resolution pictures are being handled and frequently computers will be left running for many hours or even days to handle the full size files.

So far we have assumed that when a mark-out is reached, the following mark-in will happen immediately, there being an abrupt change from one source clip to another. Probably 95% of cuts are done this way but sometimes a gradual change from one clip to the next is desirable. The change may be a crossfade in which one scene fades out as the next fades in or fade to black followed by a slow rise to normal brightness. The change period is called a 'transition effect' and can be far more adventurous than just a fade. A clever trick is used to determine which part and how much of one clip encroaches on to the other. Take for example a sideways wipe in which picture 'A' is replaced by picture 'B' progressively from left to right. This could be achieved by selecting the second source at an equal time from the left edge on each line of the scan and and slowly increasing the selection delay to make the switchover happen later along the scan line. This works well for clean cuts from A to B but is useless if we want to put a soft edge on the changeover. It is also very difficult to do if we don't want a straight edge on the changeover as the delay would have to be different on each scan line. We get around this difficulty by using a third, usually static image, to determine where the border between A and B should be.

Imagine your picture is what you see looking directly down into a rectangular fish tank. For sake of animal welfare, please don't try this at home, just picture it in your mind. Now imagine the base of the tank is white and standing on the base are several white objects. Looking from above, all you see is white. Now imagine you are slowly pouring black paint into the tank. At first, the base changes from white to black but the objects, being higher are still above the paint line so are still white. As more paint is put in the tank, the level rises and from above the white objects seem to shrink as they submerge. Eventually everything is covered and all you see is black. Thinking of nothing except the white and black, what you really would see is white changing to black in areas determined by the height and shape of the objects. The principle of using the height of the object to decide the colour of the area is a direct analogy of the way an image matte works except the shade of the matte rather than height is used. To make a transition gradual, the contour of shade is followed over several video frames and the contour line becomes the switch point from video A to B. For example, if the matte image was black on the left and white on the right with a gradual rise across the image, the cut of the transition would follow the shade from left to right (dark to light) and cut the picture at the same position. The result would be a sideways wipe. If that sounds like a complicated way of doing a simple wipe, imagine the matte is white in the middle and fades to black around all the borders, now the transition appears as a circle, decreasing in size to a spot in the centre of the screen. That's not so easy to do other ways. Similarly a matte which is dark in one corner and lightens to white in the diagonally opposite corner would give a diagonal wipe. As you see, the possibilities of transitions using a matte are endless and inconceivably difficult to do with electronic switching.

What we have seen so far implies an abrupt change from one image to the other, all we have determined is the shape in which the change occurs. It gets a little more complicated now but instead of the transition being a direct switchover at a given shade in the matte, think of a simple mathematical operation. Lets call black 0% level and white 100% level. Now take video clip A and at every point in the picture, multiply it by the percentage level in the matte. So if at some position on the screen the matte is 30%, clip A level at the same point is also 30% of normal. Now take clip B and do the same except instead of using the matte level, use 100 minus the matte level instead, in other words a negative image of the matte (100% becomes 0% and vice versa). At that same point, Clip B is now set to 70% level. The combined picture is a composite of A and B with the mix determined by the matte. Using the earlier examples, we have a gradual change of A to B from left to right, a 'vignette' style with A in the centre and B around the edges or a gradual change from A to B across opposite corners of the screen.

Normally, the matte will be the same dimensions, that is number of pixels horizontally and vertically as the video clips themselves but this is not mandatory. It is also possible to use a moving image rather than a static one as the matte, in fact it can even be another video clip although it is easy to make a real mess of things unless care is taken. Normally a matte is a monochrome image as all we are really interested in is defining a shape by its shade. They can be used to provide some very clever keying effects though, for example the effect where one item in a clip is colour while everything else is monochrome. The trick is to duplicate the original colour video twice, once in monochrome and once as a matte. The matte has the item set to black (or white if you reverse the cutting direction) with everything else set to white – this is a fairly simple image painting operation. Now the matte is used to cut the colour image into the monochrome one. The desired colour object is switched in by the matte so it overlays the monochrome background. Clever and very eye-catching!

The other tool available at the editing stage is called overlaying. Unlike transitions where existing clips are mixed together, overlaying usually involves adding a new 'layer' to the video production. It is sometimes easier to imagine and edit session as lots of layers stacked on top of each other with a transition or effect on each level. The base level is a blank screen and the video is built up on top of it. The viewer sees the levels from above so anything below is visible over the blank background. The principle of overlaying is that something, usually text or a logo, is put on a higher level than the rest of the video. Because it is on a higher level, it obscures anything below it and is visible at all times unless something else is placed 'above' it on an even higher level.

Overlays are used extensively in commercial broadcasting to put identification logos or names in television pictures. Not only are they there to tell you what channel you are watching, they serve to preserve the copyright of the producer should recordings and duplicates be unofficially made. It is difficult, but far from impossible, to remove logos but the effort it requires makes the task economically unviable for pirates to bother with. There is no reason why the overlay should be static, it can also be another video clip, in fact when a sufficiently large overlay is placed in a picture we recognise it by a different name "Picture In Picture" or PIP. Scrolling titles and credits are another use of overlays, they are usually presented with a video clip behind them. They are nothing more than pre-made text files overlayed on the background scenes. The scrolling effect is present already in the overlay video, several software packages are available to help you put text into motion by applying 'moving paths' to the characters.

Sound edits use a system similar to overlaying but rather than one clip completely covering another, they will normally be blended together . There will be instant cuts from one sound recording to another just as there are instant video cuts but there may also be background noises or music which needs to be present throughout a scene. These are normally added to the audio tracks in the time line so they can be faded in, out or cut in alignment with the video.

That sums up the brief encounter with editing, next time we will look at what to do with the edited production in order to make it suitable for distribution and look at the mechanics of producing a DVD.

Actual video clips of the examples shown in this article will be posted on my web site www.atv-projects.com so you can see them as animated video rather than still images.

No fish were harmed while writing this article.

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Contest news

By Richard Parkes G7MFO

Congratulations again go to the Severnside Television Group for first place during the International ATV contest. I received five results this year the same as last years contest.

It was nice to receive a log from Jason G7KPM and Colin G4PYD who were operating under the callsign G0ATW-P who operated from the 'damp' Lincolnshire Wolds. They had the usual visit from the police, horse riders, cyclists and dog walkers. It was a shame that they had equipment for 70cm to 3cm and only managed to work stations on 23cm due to the lack of activity.

It was very brave of the three stations going portable due to the weather been very wet and windy over the weekend. In some places over the country it was torrential rain with the odd thunderstorm thrown in for good measures (not my fault). No European stations were worked over the weekend and the furthest contact was between the Severnside group and Mike G8LES at a total of 111Km on 23cm.

International 2005 Results

Place	Call Sign	70cm	23cm	13cm	3cm	Points
1	G7ATV-P		2456	770	650	3876
2	G0DPS-P		920	1250		2170
3	G8GKQ	144	532			676
4	G0ATW-P		660			660
5	G4NOS		284			284

The main feedback I got back from the five stations was about lack of activity over the weekend. It takes a lot of organising to put a station together especially a portable station over the weekend, so please send a few points in the next contest.

Over the last five years I have been the contest manager the Winter Cumulative and the Spring Vision has been dropped due to the lack of activity. In 1994 a total of 14 contest dates was listed in CQ-TV. We are down to two main contests dates a year now.

I think it is time another person took on the position of the contest Manager. I have run out of ideas of getting more people on during the contests

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E-mail: contests@batc.org.uk

Jason G7KPM and Colin G4PYD Portable from the Lincolnshire Wolds during the international (September) 2005.

The contest calendar is on page 42

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

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

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

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

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

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

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 28 - "Spring 1956"

The editorial of CQTV28 began by saying that that edition, like its predecessors, was late in appearing, but that this one had been held up by a printing strike. The cover photograph, courtesy of Ediswan, showed the amateur television exhibit at the 1954 RSGB Show. From left to right are G2WJ's vision transmitter, P Bendall sitting at the G2WJ CCU, watching a 9" monitor hidden by J Attew seated at the vision mixer, with a test card C monoscope and a 'high grade' oscilloscope alongside. Ian Waters is operating his own CCU, to the right of the Pye 14" monitor receiver, whilst J Royle G2WJ/T was lining up his camera on G4KD in the 'studio'. On the far right can be seen part of Ian's camera. The magazine added that '<u>all</u> of this equipment is not required to produce pictures!'.

AMATEUR USE OF COLOUR TELEVISION

PICTURE 13 MILES AWAY

British amateurs yesterday transmitted and received television pictures in colour. Transmitter and receiver were 13 miles apart.

Mr. M. W. S. Barlow, of Great Baddow, Essex, said that station G2WJ/T, at Dunmow, transmitted various colour patterns to station G3CVO/T, near Chelmsford, by means of home-made colour equipment built by Mr. C. G. Dixon, of Ross-on-Wye, Herefordshire. The pictures were seen on a domestic television set in black and white, and on a home-made colour receiver, using a rotating colour wheel alongside.

"Results were excellent," Mr. Barlow continued: "For these experiments a very short wavelength in the 70 centimetre amateur band was used for transmitting. Later in the day colour signals were sent in the opposite direction."

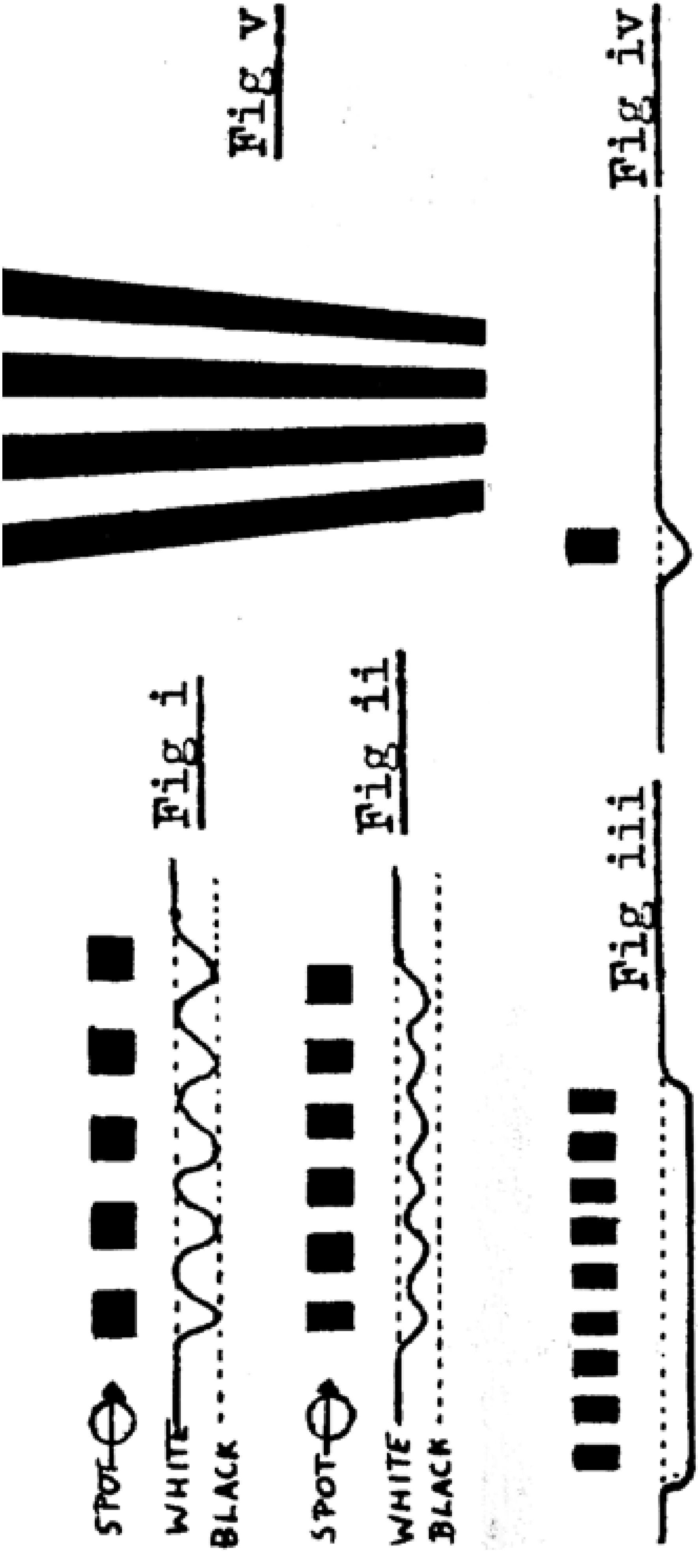
G2WJ/T is the transmission station operated by Mr. R. L. Royle and his son, Mr. Jeremy Royle, at Haydens End, Great Canfield, Essex. G3CVO/T is the station operated by Mr. Barlow, at his home in Baddow Place Avenue, Great Baddow.

The Club had produced 'An Introduction To Amateur Television Transmission" - 32 pages for 3/6d (*17½p*). A review of the book said that this was "the first contribution in book form to the art of amateur television. The cover presents an attractive appearance with a picture of Jeremy Royle, of G2WJ/T, whose winning smile will persuade even the most hesitant to part with his 3/6d ..." The reviewer (Grant Dixon) did however "wonder why 1000µµF is a large condenser and 0.001µF ia a small one." !!

The regular column, "What The Other Chap Is Doing" had two major items of news. "We've done it again! Since Christmas we have had the first two way live camera to live camera transmission AND the TV DX record has been put up to 38 miles - Ian Waters receiving pictures from G2DUS/T at Baldock. But on April 7th - 8th we really made history .... see the headlines:" The magazine noted that the event had been reported by the Daily Herald, Manchester Guardian, News Chronicle, Daily Mail, Daily Express and many provincial paper, as well as The Times (as shown here).

Grant had taken his colour bar generator from Ross to Great Canfield, Essex - not having room for the camera as well. The monitor was taken to Baddow, and the transmitter and receiver lined up using a monochrome signal.. A specially printed title "Colour Test Transmission" was then sent, and faded down and the black and white monitor lost sync as the colour bars came up.. Modifications were made to the sync separator, and then 'the colour bars were now excellent'. Grant gave a lecture to the Chelmsford group on the Sunday, which began with reception of colour bars from Dunmow, and then the generating equipment was moved to the lecture hall, so that the audience could make a comparison with closed circuit signals.

Apart from 'technical articles', with circuits for a vision blanking sync mixer,



a flying spot scanner amplifier and an RF feeder unit, there was information on test patterns - and in particular, the picture resolution handled by the system. Test patterns could be drawn onto paper or transparency with Indian ink, and could give a immediate check on:-

i) the definition being achieved

ii) horizontal and vertical linearity

iii) the gamma of the system

iv) the correct setting of black level

v) the correct 4:3 aspect ratio.

The article went on to explain that the question of ‘definition’ is one that is often imperfectly understood. A spot of finite size passing over similar sized black picture elements spaced at the diameter of the spot (Fig i) will make a sine wave output waveform, with an amplitude equal to the maximum black to white of the signal. If the spot is larger than the picture element (Fig ii), then full black or white is never reached, and if the spot is twice the size of the picture element, equal areas of black and white are covered - wherever the spot is, and the output is a 50% grey - and the sine wave of zero amplitude. The maximum definition of a tv system could be defined either as the frequency of the sine wave which reproduces black and white lines as full black to full white, or the frequency of the sine wave that reproduces black and white lines so they are discernible as individual lines to the eye (even though not full black and white). This is the case for a series of black and white lines - but for an isolated line (Fig iii), even if the spot is twice the size of the element, the element is still resolved as grey against a white background. However, two such lines spaced their own width apart would appear as one line of grey. For a real test of resolution, a series of lines is therefore required, with spaces equal to the line width. A useful way to obtain a measure of the resolution is a resolution wedge (Fig v), which is also useful as a focussing aid.

The article also discuses using rectangular patches low frequency response, to check for smearing and shading, and a colour scale to check the spectral response.

It pays to keep your eyes open!

Dicky Howett reports.

I visited recently, (after a break of about 20 years), London's famous Science Museum, situated in Exhibition Road, South Kensington. It was the Christmas holidays, so the place was heaving, but a merry time was had by all. However, it wasn't all fun and games. One of the many impressive exhibits included one called 'Making The Modern World'. This section featured 'everyday' objects which would have been available to you and me throughout these modern industrial times, (light bulbs, hair driers, mangles, Ipods etc.). However, certain displays appeared a little unsure of themselves, especially as the captioned information on some seemed to me to be quite wrong. As a self-appointed know-all, I contacted the museum by email (they issue a 'visitors comments' contact address). Below is (a): my email and (b); their reply. My italics have been inserted subsequently for clarification.

Dear Science Museum

Subject: MUSEUM VISIT COMMENTS. INCORRECT LABELLING

Date of visit. 30th Dec 2005. 2pm.

A few items caught my eye as being misleading or incorrectly labled. 'Age Of The Mass'. 1914-1939. Exhibit 23. The Newman Sinclair 35mm movie camera is facing the wrong way. Turn it 180 deg and we see the front with the 'taking' lens and the top viewfinder port. What we have at the moment is a rear view. (This would seem perhaps obvious, but the display looked entirely pointless showing the back end of an aluminium box perched on a high shelf, partially obscured by a box of cornflakes. As I own a similar camera, it was only myself who had a clue of what I was looking at.) 'Technology In Everyday Life' 1880-1939. Exhibit 188. This microphone was not used in BBC production studios as indicated. It has the vague 'shape' of a BBC Marconi AXBT ribbon mic but this EMI microphone is really only a cheap public address/ amateur mic of the period. (This mistake would be similar to that of attributing a Linx vidicon camera as being a 1960s BBC TV Centre image orthicon studio model!)

Ditto above. 1939-1968. Exhibit 159. The caption attached to the Bush TV 22 set seems to imply that BBC television had a network of five channels. In 1951 the BBC had one TV 'network' and three national radio 'network' channels. There were of course many regional frequencies including television, but these in 1951 were not 'networks'. The Bush TV set had it's tuner so it could be used in London to tune to the Alexandra Palace transmitter or the Midlands (1949) from the Sutton Coldfield transmitter. Of course by 1955, TV sets needed tuners in order to receive ITV. (The caption stated that the Bush TV 22, because it had the first tuner, could receive in 1951, all 5 BBC network channels. Why the figure '5' is mentioned remains a mystery).

Also, a little disappointed that the two 'shops' (one, a Science Museum novelty shop: the other a bookshop run by Ottakas) at the museum had no DVDs on sale. It would have been nice to see those old technology instruction films, wartime propaganda subjects, science subjects, or anything really. Also no 'primer' books on television technology. (There was only one TV book on sale and that a reprint of Baird's ' Sermons, Soap & Television'. I didn't point out that my own TV book will soon hit the stands! However, it does seem strange, indeed perhaps a lost opportunity, that several London museums, including the Imperial War Museum are loathe to offer for sale audio or video material from their carefully hoarded collections. I would really appreciate being able to see some of those wonderful GPO or Crown Film Unit documentaries, of which we see only tantalising clips-usually at the wrong aspect ratio- on RV.)

Reply

Dear Mr Howett,

Thank you for your comments. As one of the project team responsible for 'Making the Modern World' I'm always interested in visitor reaction to it.

The gallery covers a wide range of technologies and the small team of curators (about six) each had to deal with subjects not always of their particular specialisms. Sometimes this resulted in the kind of mis-identification of the kind you've spotted - I don't think there's many of them, though.

The microphone label is indeed a howler. I wish I'd noticed this at the time the labels were being proofed, but this particular showcase was developed by a colleague whose specialism was the medical collections. The microphone is one of a large collection of objects used for the teaching of psychology at Bedford College, and was conveniently available when he did his object selection for the showcase. If the curator of Radio at the time had been asked to provide a microphone representing broadcasting then I'm sure something more suitable would have been made available. A similar situation occurred with the TV22. Unfortunately, at the time I wasn't responsible for the Telecoms collections so wasn't asked to check the text of the labels.

Your comment re the Newman-Sinclair camera is interesting. I'm not sure if the arrangement of the camera was deliberate or not, but it does seem sensible to see the front rather than the back. I'll open up the showcase and have a look at the next convenient moment.

The shop stock is beyond my responsibility but I hope your comments will find their way to the buyer.

Thanks again for raising these points, which can easily get overlooked when so many other things are going on.

John Liffen, Curator of Communications, Science Museum, London, SW7 2DD

Television comes Home

By John Douglas G4DVG

November 2006 may see the resumption of 405-line transmissions from Alexandra Palace.

The world's first regular high-definition television service went on air from Alexandra Palace on 2nd November 1936 and the supporters of the British Heritage Television Project plan to mark the 70th anniversary by transmitting historic and archive programme material from the north London site.

The organisers of the project have received encouragement and support from BBC Heritage and the National Museum of Photography, Film and Television at Bradford.

What the BHTP is aiming to do could be considered a logical progression from what has already been achieved by the Alexandra Palace Television Society (APTS); namely their recreation of the pre-war programme "Picture Page" on the original studio floor. On that occasion the signal from the cameras was fed to a video recorder. The aim now is to go one step further and actually broadcast similar material using the original transmission standards.

Once suitable space at Alexandra Palace has been arranged, the BHTP will approach OFCOM to see whether exceptional permission could be obtained, on the occasion of this important anniversary, to transmit the programmes on Channel B1 in Band 1 (45.0 / 41.5 MHz) If so, a vintage television receiver switched on anywhere in the London area would work again - on that one magical occasion ! The rest of the country has not been forgotten and it is hoped to stream a 405-line feed on the internet.

Full information on this exciting project can be found at www.405-line.tv and the organisers would welcome offers of help and support from BATC members.

Caption competition 213 results

The winner is:-

"Quick Dr F, get him back in the box!"

- by Jeffrey Borinsky

Some other entries received were:-

"If you press the service button the engineer pops out" - Trevor Brown

"Paul Marshall wearing a test card" - John Douglas

"Quick the photicons are escaping" - Brian Summers

"Looking for those 'Amateur TV Nuts', are you? Funny, a small nut just fell inside this equipment…" - Peter J Stonard

Circuit Notebook No. 89

By John Lawrence GW3JGA

Experimental Audio Level on-screen Display

This is a development of the 'Flashing Cursor for ATV' in Circuit Notebook No. 87 and the 'Bar Display Audio Level Meter' in Circuit Notebook No. 88 which appeared in CQ-TV 212 and CQ-TV 213 respectively.

The on-screen display consists of a highlighted narrow vertical column at the left-hand side of the screen, the height of which indicates the level of the incoming audio signal. The display covers a range of over 24dB and has a fast rise and slow fall characteristic which can be altered by selecting component values.

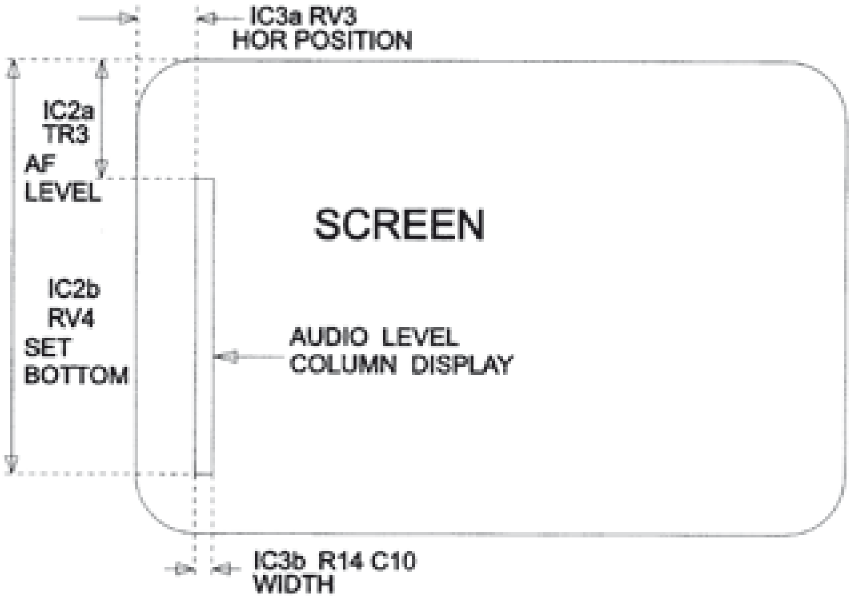


Figure 1 - Circuit components controlling the on-screen display

Circuit description

A diagram indicating the sections of the circuit which affect the position and size of the display is shown in Fig. 1. The full circuit is shown in Fig. 2. IC1 is a sync separator, IC2 and IC3 are dual monostable ICs

The audio input signal is fed to op-amp IC4, this amplifier has an adjustable gain of 0 to 40dB (x1 to x100) to bring the incoming signal to the required level. TR1 operates as an emitter-follower peak rectifier, conducting on the negative peaks of the incoming signal.

Capacitor C3 becomes rapidly charged to the peak value of the signal waveform causing a current to flow through R7 to the current mirror [1] formed by TR2 and TR3.

This circuit has the property of causing a current to flow in the collector of TR3 which is equal to the current flowing through R7. In this way it converts the voltage across C3 into a current flowing 'down' from TR3 into IC2a. R8 is included to maintain a small 'bleed' current for the current mirror. The rise/decay time can be altered by changing the value of C3.

The charging current flowing into IC2a, together with C8 define the timing period of the monostable circuit. The greater the amplitude of the incoming audio, the shorter will be the timing period of IC2a. IC2a controls the top of the on-screen column thus making the height of the column proportional to the audio level.

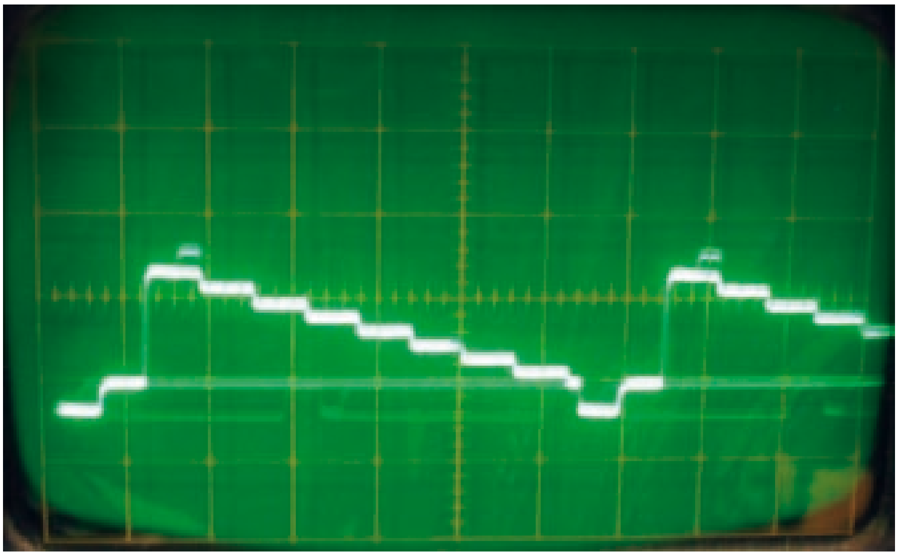


Figure 3 - Video waveform with vertical column pulse added

Video processing

Moving on now to the video processing, the video input signal passes to the sync separator IC1 which provides line and field synchronising signals. The line signal triggers IC3a which generates a delay, set by RV3, to control the position of the display with respect to the left hand side of the screen.

The field signal from IC1 pin 3 triggers both IC2a and IC2b. As mentioned above, IC2a controls the position of the top of the display column. IC2b together with RV4 sets the position of the bottom of the column.

IC3b generates pulses which form the column display. Delayed line trigger signals from IC3a are fed continuously to IC3b, but it is held in a reset condition until the end of IC2a timing period (determined by the audio level) after which IC3 generates pulses to form the column display. This continues until the end of the delay period set by IC2b and RV4, at which point the triggering of IC3b is inhibited, thus setting the bottom of the column display.

The output from IC3b is a positive pulse of about 1.5µs which is superimposed on the video waveform through D1 and R9. This pulse can be seen at the top

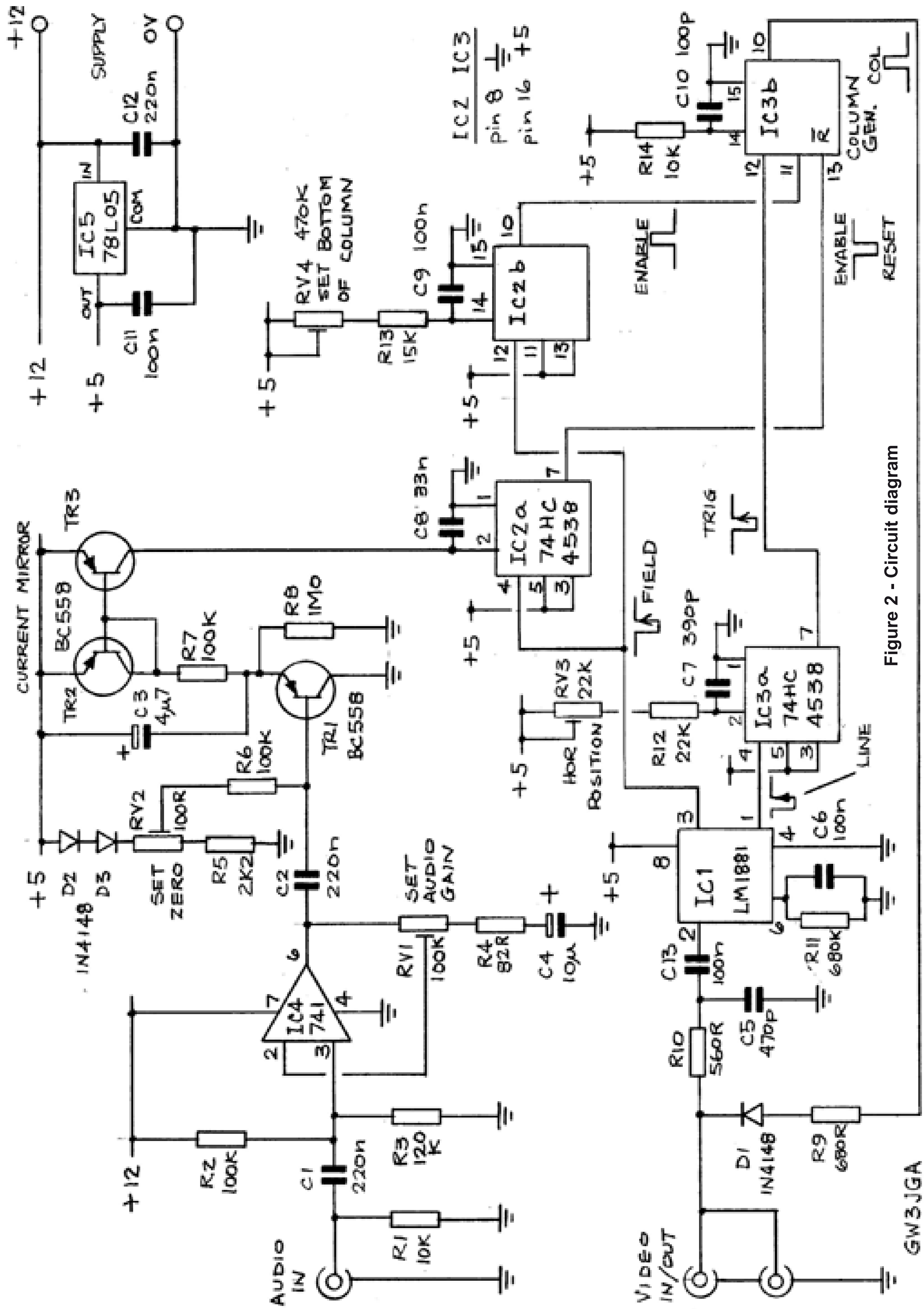


Figure 2 - Circuit diagram

of the line staircase waveform shown in Fig. 3.

A strip of masking tape was fixed to the monitor screen and marked in 3dB intervals, shown by the column height, as the input signal (1kHz sine-wave) was varied over a range of about 30dB, The result is shown in Fig. 4.

Power supply

A 12V supply is required for the 741 op-amp, although a more expensive op-amp with a 'rail-to-rail' output might just cope with a 5V supply. The signal voltage at the output of IC4 is about 3V p-p for full scale display. A 5V regulator, IC5, is included to feed the digital parts of the circuit.

Setting up

Set RV4 to maximum resistance so that initially the full length of the column is displayed. Set RV3 to position the column a suitable distance from the left hand side of the screen. With no audio input signal, adjust RV2 to set the top of the column near the bottom of the screen. Apply a suitable steady audio signal and adjust RV1 to set the top of the column near the top of the screen. Adjust RV4 to set the bottom of the column to a point a little below the zero signal position. The width of the column may be changed by changing the value of R14.

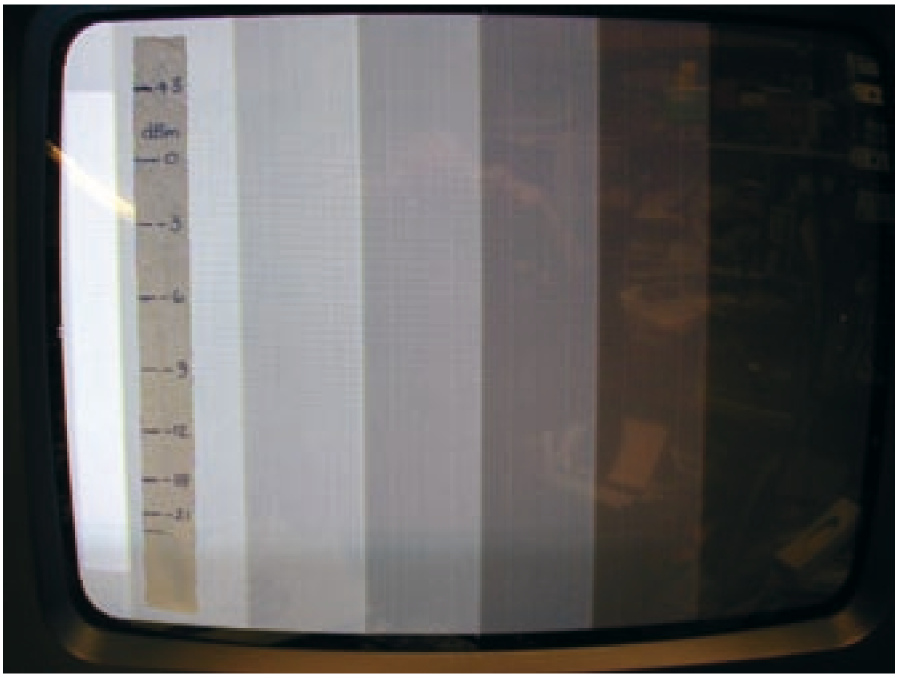


Figure 4 - Screen calibration of display

References

[1] Current mirror 'Microelectronics', Millman & Grabel, McGraw-Hill, p124.

Ofcom deregulates amateur radio licensing

By Clayton Hirst (ofcom)

14 February 2006

Ofcom today announced its conclusions in the reform of amateur radio licensing which is intended to reduce the administrative burden on the UK's 63,000 amateur radio users.

Ofcom is responsible under Section 1 of the Wireless Telegraphy Act 1949 for the authorisation of amateur radio in the UK. After public consultation, detailed research and discussions with amateur radio groups, Ofcom has decided to:

- issue amateur radio licences which will remain valid for life as long as the licence details remain correct or until the licence is revoked by Ofcom or surrendered by the licensee;
- require licensees to confirm their licence details at least once every five years;
- provide an online licensing service as an alternative to the postal service;
- issue electronic licences to users of the online licensing service; and
- continue to make paper licences available, subject to an administrative charge.

In addition to the formal consultation process, Ofcom commissioned MORI to conduct a survey of amateur radio licence holders' views of the Ofcom proposals. MORI received 1,572 completed questionnaires by 20 June 2005. When specifically asked by MORI whether they supported or opposed Ofcom issuing licences that remain valid for the life of the licensee, 58 per cent of respondents supported this proposal.

At present, the Royal Mail processes amateur radio licences through the Radio Licensing Centre. However, from 1 October 2006 Ofcom intends to take over this function, which will include issuing, renewing and amending licences.

Ofcom believes that this new approach to amateur radio licensing will reduce unnecessary bureaucracy with this popular international hobby.

The policy statement can be found at: http://www.ofcom.org.uk/consult/condocs/aradio/statement/

Ofcom is the independent regulator and competition authority for the UK communications industries, with responsibilities across television, radio, telecommunications and wireless communications services.

For further details please visit www.ofcom.org.uk

CONTACT:- Ofcom Media Office mediaoffice@ofcom.org.uk (+44) (0)20 7981 3033

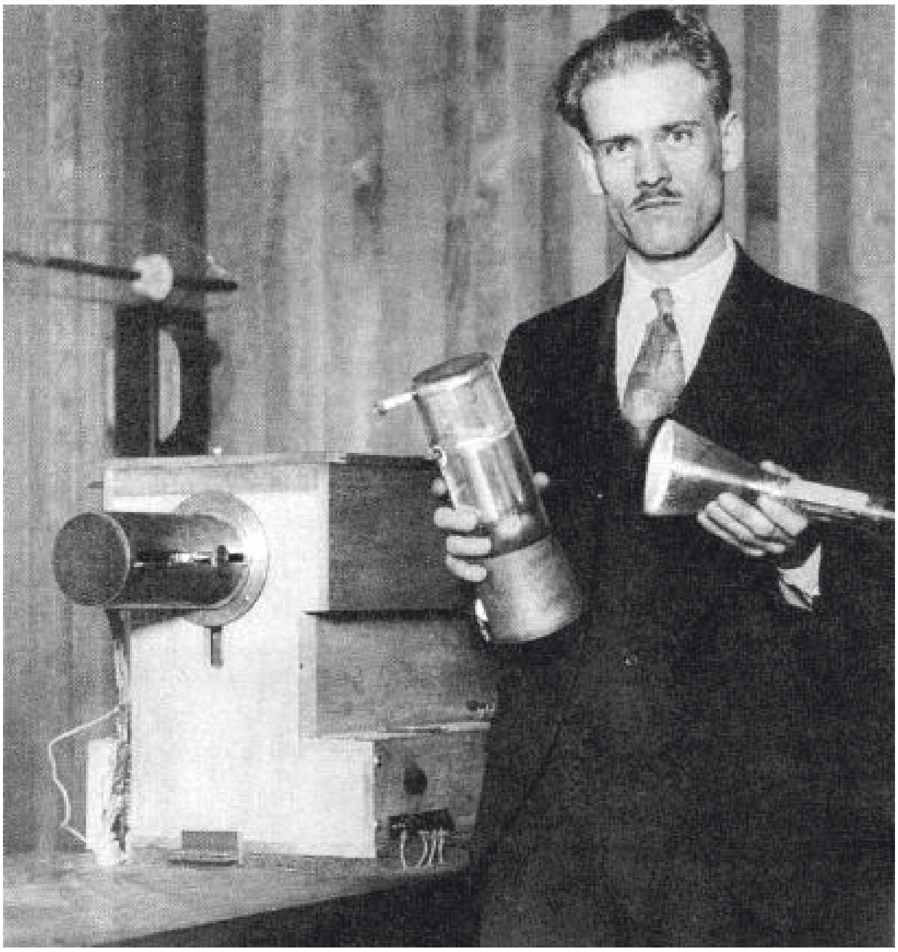
Television comes in threes

By Dicky Howett

No single individual invented television. During the 19th century, many important ideas and theories were formulated involving the key technologies of the telephone and telegraphy. Thus, the first 'television' notions (which actually pre-date motion pictures) involved systems of wire picture transmission, sending facsimile images down the phone line. Only later at the beginning of the 20th century did 'electric' pictures attempt to move via Nipkow discs and photo-electric cels. To illustrate the interdependency of television inventions and the actual execution of the idea, I've listed below three formative interconnections, (in this instance John Logie Baird, the BBC and Philo Taylor Farnsworth), which, for me illustrate that certain special beginnings can become a means to an end.

John Logie BAIRD. (1888-1946)

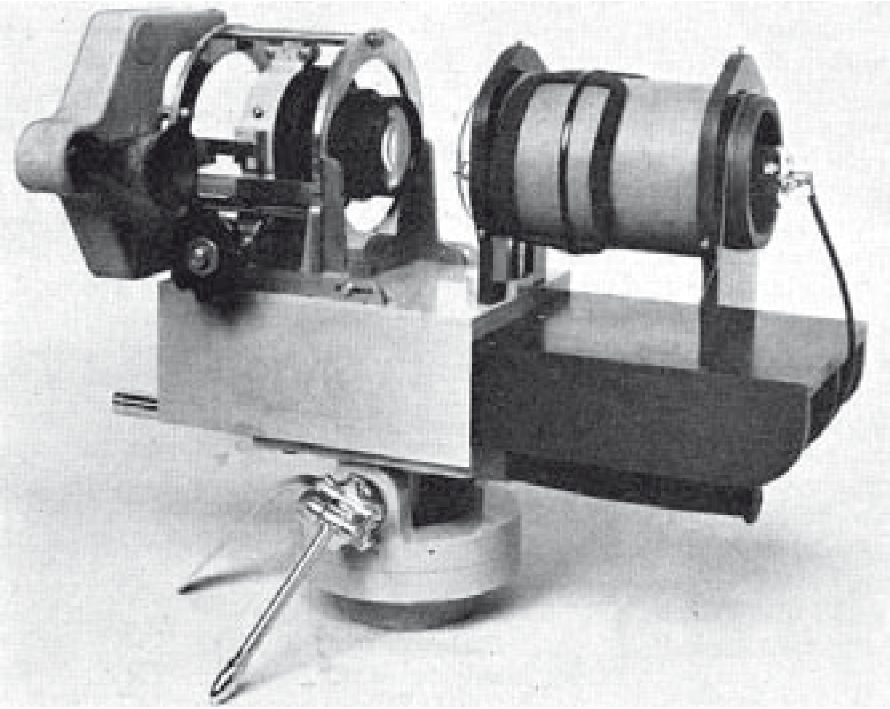
Although Scotland's amazing pioneer lost the 'race' for television, Baird's drive and energy (especially for a man who suffered poor health most of his life) resulted during the 1920s and 1930s in many exciting, and in some cases astonishing television developments. Baird's ideas were based on mechanical applications, but they included ground breaking innovations such as outside broadcasting, colour television, stereoscopic television, video disc recording, theatre (large screen) projection television and even 'night vision'. This was Baird's 'Noctovision' system, devised in 1926 using the principles of infrared in order to 'see' in the dark. The British Admiralty was interested and in 1927 were given a demonstration at Motograph House. In 1929, Baird sought (pestered would be nearer the mark) permission to use the BBC's medium wave transmitter in Oxford Street, London for a series of experimental and scheduled transmissions from his Long Acre studios. (Because only one BBC transmitter was available, sight and sound had to be alternated in two minute snatches). Three years later, Baird installed equipment and provided engineers for the BBC's official 30-line mechanical 'first regular' television service (this time using two simultaneous transmitters-one for sound the other for vision) which began from basement studios in Broadcasting House on August 22nd 1932. These BBC programmes, which contained genuine entertainment value and received good reviews, continued four evenings a week (11pm-11.30pm) until September 11th 1935. In the UK alone, an estimated 7,000 mechanical receivers were being used to view the service. (An important reason why Baird wanted the monopoly broadcaster BBC to begin television was so that he could sell his Televisors). Baird knew that the future prosperity of his 'invention' lay in the sale of receivers, and for those 7,000 at least, television broadcasting by the fireside was a reality.



Philo Taylor Farnsworth holding his 1928 dissector and picture tubes

BBC Television (1932-)

Still one of the world's leaders in television programme production, debate has always surrounded the BBC's claim that it started the worlds first 'high-definition' television service. This inauguration occurred on the afternoon of November 2nd 1936, witnessed by an estimated 400 viewers dotted around London. However, the BBC's 'first' claim has a legitimate foundation, based on several important points; one being that any television system must be out of the experimental stage and authorised as a service by the relevant national authorities and also, that such a service must be capable of being received electronically and not mechanically in the home by cathode ray tube receivers on general sale. (my italics). This was indeed the case and by June of 1936, 17 receivers by 10 different manufacturers could be purchased (or rented) from between 85 to 120 guineas (the actual price of a small car). Because two conflicting and incompatible transmission systems were to be used, those very expensive tv receivers needed to be dual-standard , capable of receiving Baird's 240-line mechanically generated signals and EMI's 405-line all-electronic signals. As it turned out, it was Baird's lower standard mechanical scanning system that was used first on Monday 2nd November 1936 to officially open the service. Baird's half hour programme (only a sound recording exists of the event) consisted of a few short official speeches, a current Movietone newsreel, singer Adele Dixon singing



A Farnsworth Image Dissector camera, one of two installed in 1936 by Baird at Alexandra Palace. This camera needed 1000ft-candles to produce any sort of picture. Described as being 'somewhat precarious' in performance, the cameras (one of which was present at the opening ceremony but not used) are said to have cost the Baird Company over £5,000 each

'Magic Rays Of Light' and an American variety act called Buck and Bubbles. (Chinese plate-spinning jugglers called the Lai Founs were scheduled to appear but were dropped for reasons of programme length). That same afternoon at 4pm, after a short break, the competing EMI system re-officially opened the service using the same line-up and three electronic cameras. For the next three months, the BBC's high-definition service (two or three hours a day) alternated weekly between Baird's 240-line non-interlaced 25 pictures-per-second (spotlight disc, intermediate film and a Farnsworth image dissector camera) and the all-electronic 405-line interlaced at 50th sec EMI/Iconoscope system. By February 1937, the Baird system was totally abandoned by the BBC (not helped when Baird suffered at the end of 1936 a disastrous fire at his Crystal Palace laboratories which destroyed all of his spare studio equipment and infrastructure) in favour of the more flexible and future-proof EMI system.

Philo Taylor FARNSWORTH (1906-1971)

Described as 'the boy who invented television', Philo Taylor Farnsworth was a self-educated, farm-dwelling, Utah-born inventor, working with little money but plenty of ideas. Despite these quaint and romantic beginnings, Philo Farnsworth can be credited as being the first to demonstrate 'all electronic' television, encompassing the entire chain from camera to receiver. His 'Image Dissector' camera had a workable pick-up tube but it was very insensitive, produced distorted and noisy images and crucially, it was of a non-storage type. Despite these drawbacks, Farnsworth by 1928 succeeded in transmitting (not over the air but to a receiver within the same building in his Green Street laboratory, Los Angeles), all-electronic, light and shade coherent images, including a $ sign, films and a photograph of his brother-in-law. By 1935, Farnsworth had greatly improved his electronic systems and in 1936 he sold an image dissector camera (plus spare) to Baird, for use in his studio (B) at Alexandra Palace. Reports indicate that this image dissector camera operated with only moderate degrees of success. However, Farnsworth's camera tube design (particularly the way in which the image was scanned within the tube) was of sufficient technical importance to interest the giant Radio Corporation of America. In September 1939, at the end of a long battle, RCA were forced, (against their usual policy- they only bought licences and patents), into an expensive cross-licensing agreement with Farnsworth. This agreement enabled RCA to proceed with improved television systems and camera tubes such as the image iconoscope of which some North American key patents were held by Farnsworth. It has been suggested that this time-consuming patent wrangle was one reason why US television as a public service was so late in starting (officially April 20th 1939 at the New York World's Fair). This in comparison to some European television services (particularly in Germany using technology contributed by Baird and Farnsworth) which had been transmitting since 1935.

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

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

Two-tone generator with 500 and 1000Hz

By Guenter Sattler, DJ4LB

Sound synthesizers are used for setting the sound of repeaters or links and for identification of different sound channels. As our new digital ATV transmitters have the standard possibility of two sound channels, the following circuit is designed for two different audio frequencies. 500 and 1000 Hz are derived from one crystal and give a harmonic sound when heard in stereo mode. Another 250 Hz signal available at the crystal generator is not used, as it could be misinterpreted for a 50 Hz mains harmonic...

The circuit diagram (Figure 1) details all components inclusive power rail for the ICs. The CMOS-Chip 4060 contains all active parts of crystal generator and binary counter which divides the clock frequency in 14 steps down to 1000 Hz (2 exponent 12) and 500 Hz (2 exponent 13) as a rectangle signal. In order to get a sinusoidal waveform there are two cascaded integrators following using the OpAmp TL074.

As shown in "Figure 2" the rectangular wave is first integrated to a triangle signal and thereafter to a sinusoidal waveform. In fact this is a parabolic wave with a harmonic distortion of 4,1 percent, but as we are speaking of "timbre" with musical instruments and do not call it "distortion", one might take this approach in our case too...

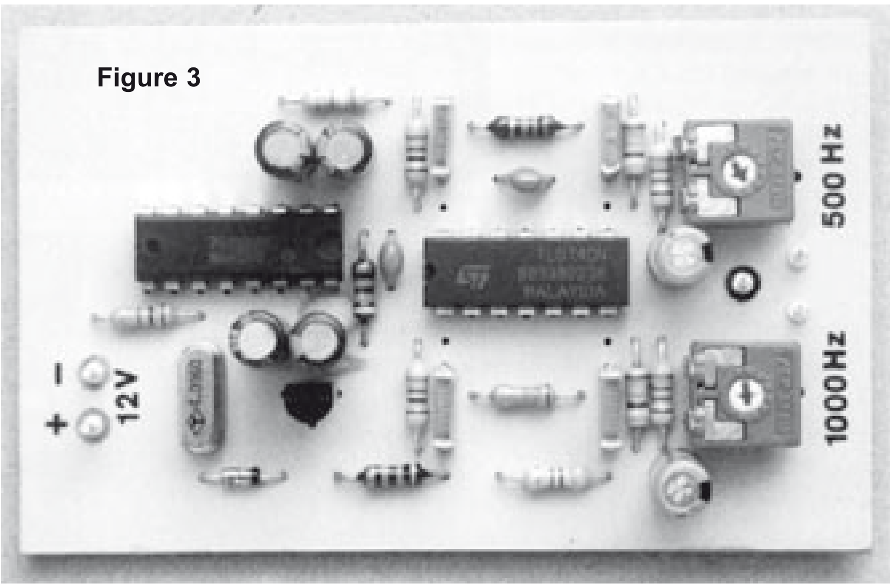
At the outputs there are audio levels of up to 1 V pp without a DC component. If needed you can also take the full 4 V ss from the second OpAmps outputs.

"Figure 3" shows the sound synthesizer on a prototype printed circuit board, added are layout (50x80 mm board) "Figure 4" and graphical parts list "Figure 5"

Reprinted from TV Amateur 139, Winter 2005

Translation: Klaus, DL4KCK

Figure 3



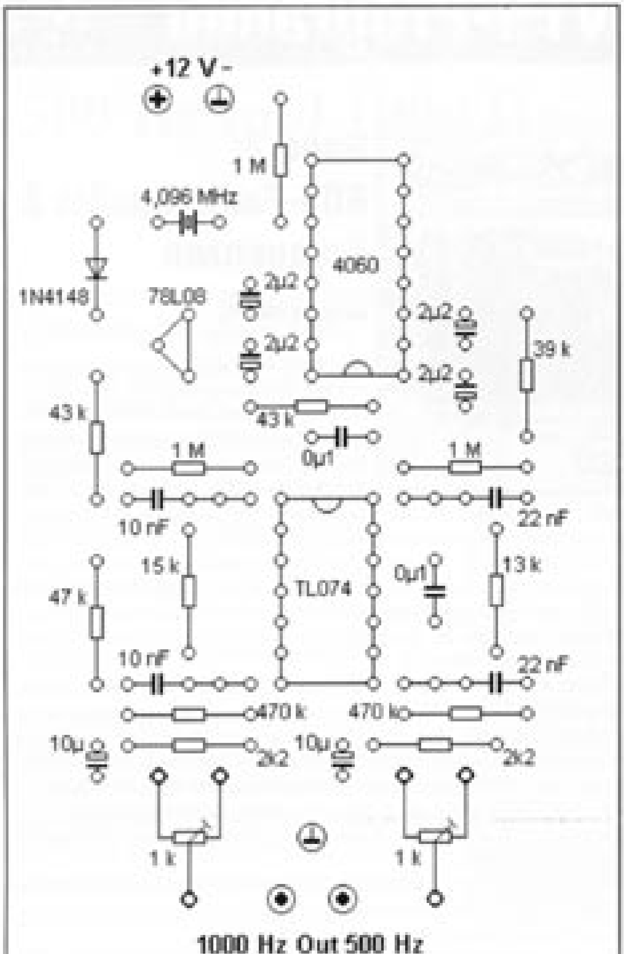


Figure 5

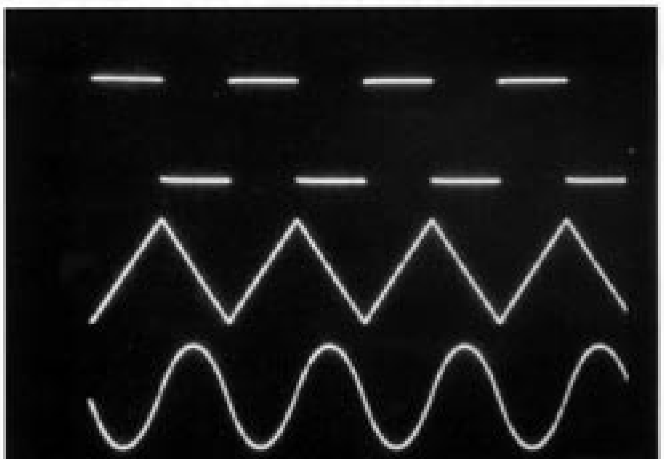


Figure 2

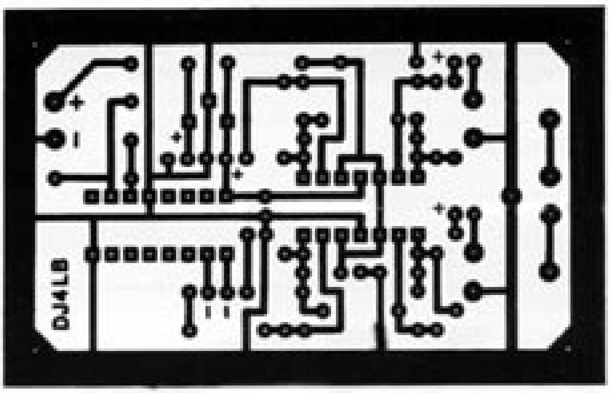


Figure 4

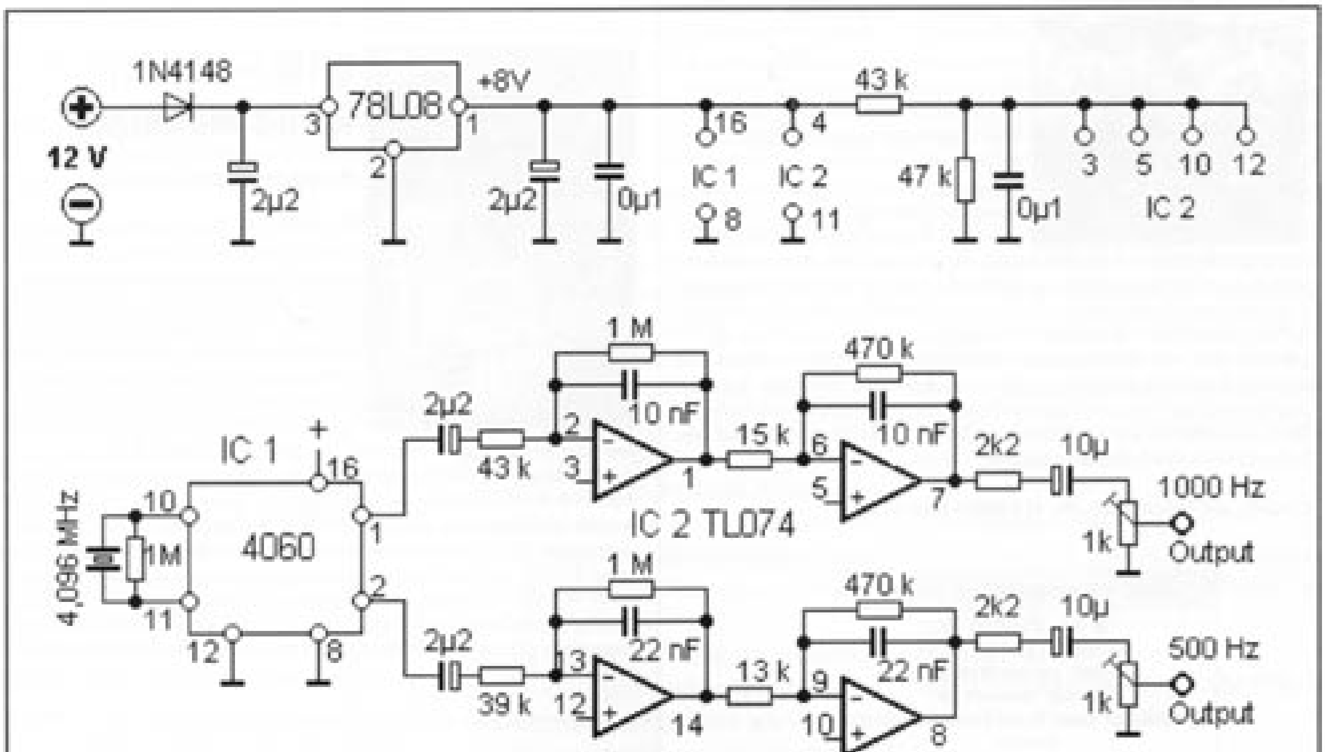


Figure 1

BVWS meeting in Harpenden

Dave Young, G8TVW, demonstrating the animation possibilities of the Dave Grant "Dinosaur Designs, Test Card - U - Like" Test Card Generator by making use of the 8-field image storage capacity of the colour test pattern EPROMs. Richard Russell's programmable Test Card Generator is visible in the photo (just in front of the Dave Grant TCG), it, too, has an 8-field image storage capacity and can also be used for animations. The two monitors are showing Test Card F (left) and Test Card J (right).

Internal view of the Test Card Generator showing the Dave Grant "Dinosaur Designs, Test Card - U - Like" PCB with four pairs of 27C801 8Mbit EPROM's. Two pairs can contain one 8-field colour (or mono!) image per pair, the other two pairs contain four mono images per pair, making a total of 10 images. Photos by Brian Summers at the BVWS meeting in Harpenden, November 2005.

Wanted

As you will see from the chairman's column, the club is in need of someone new to edit this august publication. I will be doing the next, August, issue but after that it could be you!!!

The job is not difficult (well I have been able to do it for several years) but it is time consuming. You will need a fairly potent PC running Windows XP to be able to use the clubs image editor (Photoshop) and DTP package (InDesign)

All applications to the chairman - chairman@batc.org.ok

Audio/Video Switch for Dual SCART Connector

Compiled by Ian Pawson

There have been several articles published in CQ-TV relating to I^2C and its use as a control system. Two new ICs from Maxim enable SCART switching using the I^2C interface bus.

General Description

The MAX4397 dual SCART switch matrix routes audio and video signals between an MPEG encoder and two external SCART connectors under I^2C* control, and meets the requirements of EN50049-1, IEC 933-1, Canal+, and BskyB standards.

The video and audio channels feature input source selection multiplexers, input buffers, and output buffers for routing all inputs to selected outputs. The MAX4397D audio encoder input is differential DC-coupled, while the MAX4397S audio encoder input is single-ended AC-coupled. Except for the MAX4397D's audio encoder input, all other inputs and outputs are AC-coupled with internal DC-biasing set to predefined levels.

The MAX4397 provides programmable gain control from +5dB to +7dB in 1dB steps for Red, Green, and Blue component video signals. All other video outputs have a fixed +6dB gain. Additional features include an internal Luma and Chroma (Y/C) mixer that generates a Composite video signal (CVBS) to supply an RF modulator output, and internal video reconstruction low-pass filters with a cutoff frequency of 6MHz. The MAX4397 TV audio channel features clickless switching and programmable volume control from -56dB to +6dB in 2dB steps. The VCR audio output also has programmable gain for -6dB, 0dB, or +6dB. The device also generates monaural audio from left and right stereo inputs. All audio drivers deliver a 3.0VRMS minimum output.

The MAX4397 operates with standard 5V and 12V power supplies and supports slow-switching and fast-switching signals. The I2C interface programs the gain and volume control, and selects the input source for routing.

The MAX4397 is available in a compact 48-pin thin QFN package and is specified over the 0°C to +70°C commercial temperature range.

Detailed Description

The MAX4397 is a switch matrix that routes audio and video signals between different ports using the I^2C interface. The ports consist of the MPEG decoder out-put, and two SCART connectors for the TV and VCR. Per EN50049 and IEC 933, the encoder can only input a

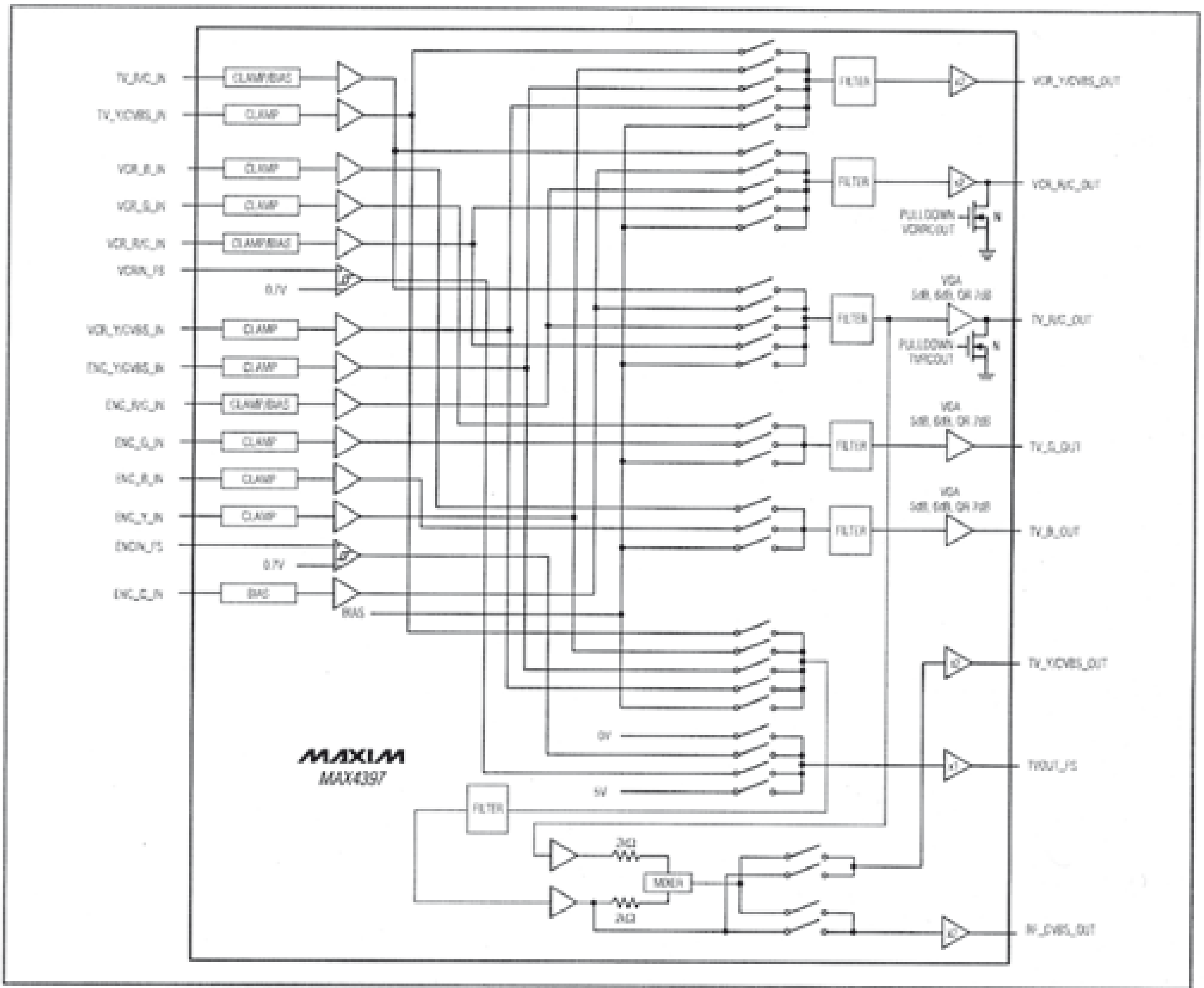


Figure 1. MAX4397 Video Section Functional Diagram

signal to the SCART connector, while TV and VCR SCART connectors are bidirectional.

The MAX4397 circuitry consists of four major sections: the video section, the audio section, the slow- and fast-switching section, and the digital interface.

The video section consists of clamp and bias circuitry, input buffers, reconstruction filters, a switch matrix, a Y/C mixer, and output buffers. All video inputs are AC-coupled through a 0.1µF capacitor to set an acceptable DC level using clamp or bias networks. The bidirectional Red/Chroma outputs can be connected to ground using I^2C control to make them terminations when Red/Chroma is an input (see the Video Inputs section).

The audio section features an input buffer, a switching matrix, volume- or gain-control circuitry, and output drivers. The audio inputs are AC-coupled through a 0.1µF capacitor. Only the audio encoder inputs of the MAX4397D are different from the MAX4397S. The MAX4397S has a single-ended audio encoder input while the audio encoder input for the MAX4397D is differential. The TV output audio path has volume control from -56dB to +6dB in 2dB steps, while the VCR output audio path has volume control from -6dB to +6dB in 6dB steps. The MAX4397 can be configured to switch inputs during a zero-crossing function to reduce clicks.

The slow-switching feature allows for bidirectional, trilevel, slow-switching input and output signals at pin VCR_SS and TV_SS, respectively. The slow-switching signals from the VCR set the aspect ratio or video source of the TV screen. See the Slow Switching section.

Fast switching consists of two inputs from the encoder and VCR, and one output to the TV to insert an on-screen display (OSD). Fast switching is used to route video signals from the VCR or from the encoder to the TV. In addition, the fast-switching output can be configured to a high or low voltage. Fast switching is con-trolled through the I2C interface.

The digital block contains the 2-wire interface circuitry, control, and status registers. The MAX4397 can be configured through an I^2C-compatible interface. DEV_ADDR sets the I2C-compatible address.

SCART Video Switching

The MAX4397 switches video signals between an MPEG decoder, TV SCART, and VCR SCART. The video switch includes reconstruction filters, multiplexed video amplifiers, and a Y-C mixer driver for an RF modulator. See Figure 1 for the functional diagram of the video section. While the SCART connector supports RGB, S-video, and Composite video formats, RGB, and S-video typically share a bidirectional set of SCART connector pins.

Video Inputs

All video inputs are AC-coupled with an external 0.1µF capacitor. Either a clamp or bias circuit sets the DC input level of the video signals. The clamp circuit positions the sync tip of the Composite (CVBS), the Component RGB, or the S-Video Luma signal. If the signal does not have a sync tip, then the clamp positions the minimum of the signal at the clamp voltage. The bias circuitry is used to position the S-video Chroma signal at mid level of the Luma (Y) signal. On the video inputs that can receive either a Chroma or a Red video signal, the bias or clamp circuit is selected through I^2C. See Tables 3–12 for loading register details.

The MPEG decoder and VCR uses the RGB format and fast switching to insert an on-screen display (OSD), usually text, onto the TV. The MAX4397 supports RGB as an input from either the VCR or the MPEG decoder and as an output only to the TV. The Red video signal of the RGB format and the Chroma video signal of the S-VHS format share the same SCART connector pin. Therefore, RGB and S-video signals cannot be present at the same time. Loop-through is possible with a Composite video signal but not with RGB signals because the RGB SCART pins are used for both input and output.

In SCART, there is the possibility of a bidirectional use of the Red/Chroma pin. When using the Red/Chroma pin as an input port, terminate the Red/Chroma output with a 75Ω resistor to ground. Thus, a ground state is provided by an active pull down to GNDVID on the Red/Chroma output to support the bidirectional Chroma or Red I/O, turning the output source resistors into terminations (see Figure 2). The active pull down also provides the "Mute Output" function, and disables the

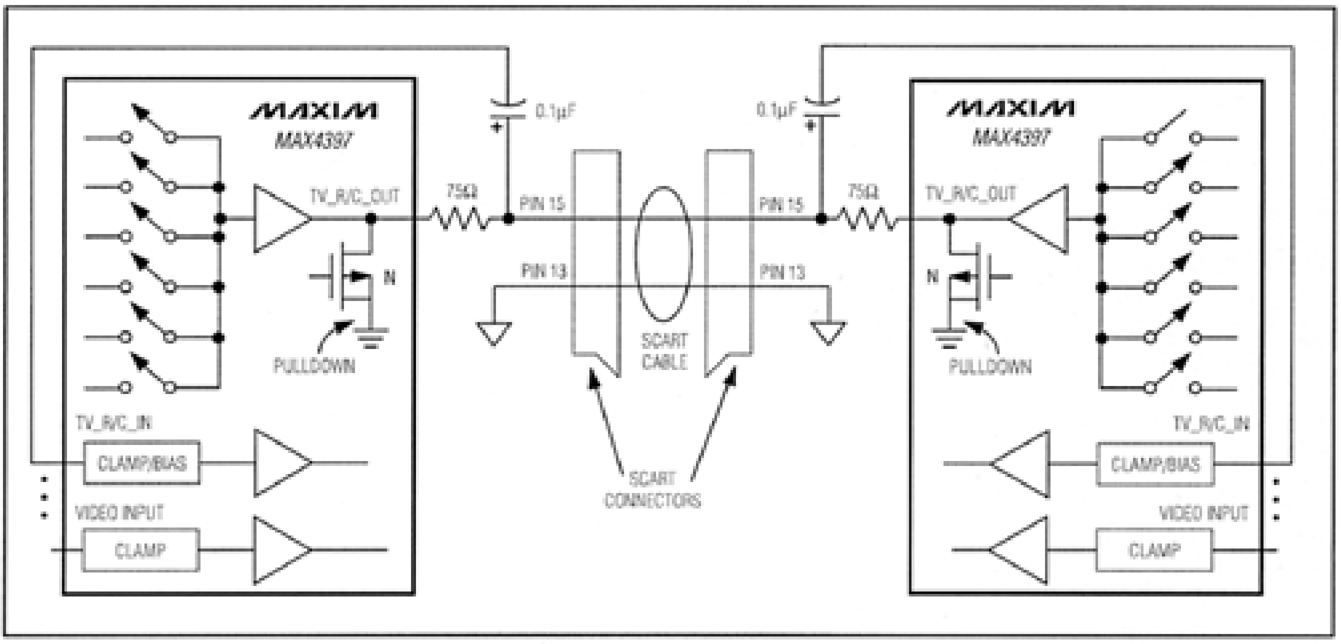


Figure 2. Bidirectional SCART Pins

deselected video outputs. The “Mute Output” state is the default power-on state for video.

For high-quality home video, the MPEG decoder, VCR, and TV use the S-video format. The MAX4397 supports S-video signals as an input from the VCR, the MPEG decoder, and the TV, and also as a separately switch-able output to the TV and VCR. Because S-video sup-port was not included in the original specifications of the SCART connector, the Luma (Y) signal of S-video and the CVBS signal share the same SCART connector pins. If S-video is present, then a Composite signal must be created from the Y and C signals to drive the RF_CVBS_OUT pin. For S-video, loop-through is not possible since the Chroma SCART port is used for both input and output.

The MAX4397 supports Composite video (CVBS) format, with inputs from the VCR, MPEG decoder, and TV. Full loop-through is possible to the TV and VCR only, since the MPEG decoder SCART connector has separate input and output pins for the CVBS format.

Video Outputs

The DC level at the video outputs is controlled so that coupling capacitors are not required, and all of the video outputs are capable of driving a DC-coupled, 150Ω, back-terminated coax load with respect to ground. Since some televisions and VCRs use the horizontal sync height for automatic gain control, the MAX4397 accurately reproduces the sync height to within ±2%.

Slow Switching

The MAX4397 supports the IEC 933-1, Amendment 1, tri-level slow switching that selects the aspect ratio for the display (TV). Under I^2C-compatible control, the MAX4397 sets the slow-switching output voltage level. Table 1 shows the valid input levels of the slow-switching signal and the corresponding operating modes of the display device.

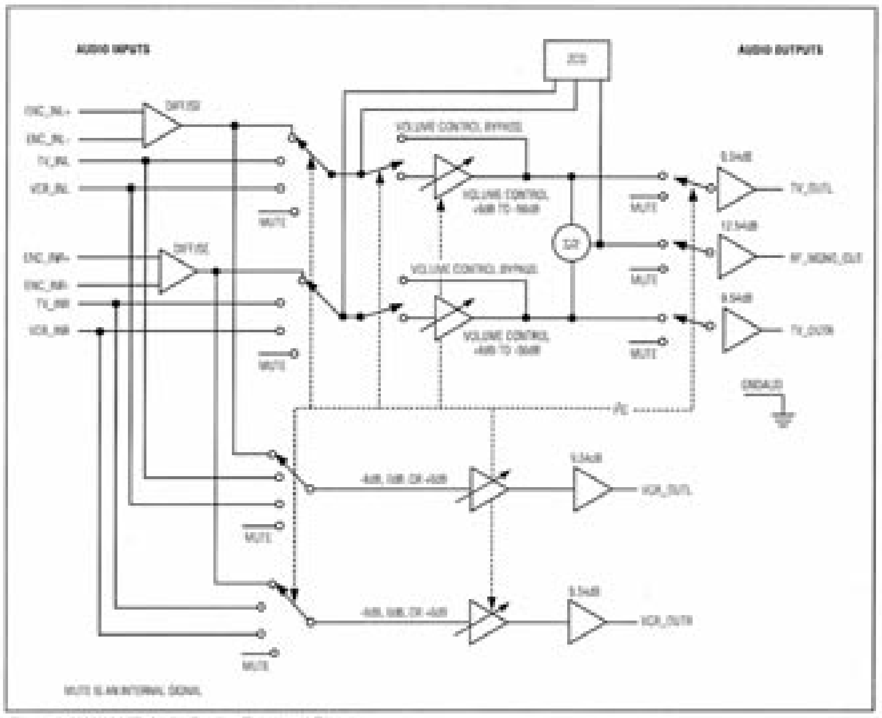


Figure 3. MAX4397D Audio Section Functional Diagram

Table 1. Slow-Switching Modes

SLOW-SWITCHING SIGNAL VOLTAGE (V)	MODE
0 to 2	Display device uses an internal source such as a built-in tuner to provide a video signal
4.5 to 7.0	Display device uses a video signal from the SCART connector and sets the display to 16:9 aspect ratio
9.5 to 12.6	Display device uses a signal from the SCART connector and sets the display to 4:3 aspect ratio

Two bidirectional ports are available for slow-switching signals for the TV and VCR. The slow-switching input status is continuously read and stored in the register 0Eh. The slow-switching outputs can be set to a logic level or high impedance by writing to registers 07h and 09h. See Tables 8 and 10 for details.

Fast Switching

The VCR or MPEG decoder outputs a fast-switching signal to the display device or TV to insert on-screen display (OSD). The fast-switching signal can also be set to a constant high or low output signal through the I^2C interface. The fast-switching output can be set through writing to register 07h.

Y/C Mixer

The MAX4397 includes an on-chip mixer to produce Composite video (CVBS) when S-video (Y and C) is present. The Composite video drives the RF_CVBS_OUT output pin. The circuit sums Y and C signals to obtain the CVBS component. A +6dB output buffer drives RF_CVBS_OUT.

Video Reconstruction Filter

The encoder DAC outputs need to be lowpass-filtered to reject the out-of-band noise. The MAX4397 integrates the reconstruction filter. The filter is fourth order, which is composed of two Sallen-Key biquad in cascade, implementing a Butterworth-type transfer function. The internal reconstruction filters feature a 6MHz cutoff frequency, and -35dB minimum attenuation at 27MHz. Note that the SET pin is used to set the accuracy of the filter cutoff frequency. Connect a 100kΩ resistor from SET to ground.

SCART Audio Switching

Audio Inputs

All audio inputs for the MAX4397S are single-ended and are AC-coupled. The MAX4397D audio inputs are singled-ended and AC-coupled except for the audio encoder input, which is differential DC-coupled.

The audio block has three stereo audio inputs from the TV, the VCR, and the MPEG decoder SCART. Each input has a 100kΩ resistor connected to an internally generated voltage equal to 0.23 x V12, except for the encoder input of the MAX4397D, where the DC bias is fixed externally.

Audio Outputs

Both right and left channels have a stereo output for the TV and VCR SCART. The monaural output, which is a mix of the TV right and left channels, drives the RF modulator, RF_MONO_OUT. The monaural mixer, a resistor summer, attenuates the amplitude of each of the two signals by 6dB. A 12.54dB gain block follows the monaural mixer. If

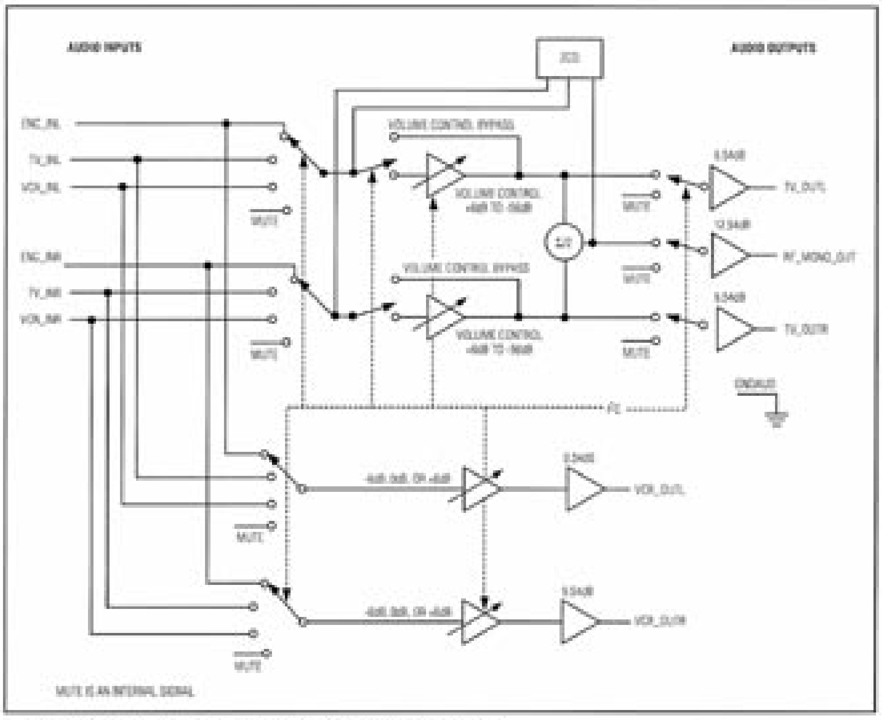


Figure 4: MAX4397S Audio Section Features Singled-Ended Encoder Input

the left and right audio channels were completely uncorrelated, then a 9.54dB gain block is used. See Figures 3 and 4 for the functional diagram of the audio section.

Clickless Switching

The TV channel incorporates a zero-crossing detect (ZCD) circuit that minimizes click noise due to abrupt signal level changes that occur when switching between audio signals at an arbitrary moment.

To implement the zero-crossing function when switching audio signals, set the ZCD bit by loading register 00h through the I^{2}C-compatible interface (if the ZCD bit is not already set). Then set the mute bit low by loading register 00h. Next, wait for a sufficient period of time for the audio signal to cross zero. This period is a function of the audio signal path's low-frequency 3dB corner (fL3dB). Thus, if fL3dB = 1kHz, the time period to wait for a zero-crossing detect is 1/2kHz or 0.5ms.

Volume Control

The TV channel volume control ranges from -56dB to +6dB in 2dB steps. The VCR volume control settings are programmable for -6dB, 0dB, and +6dB. These gain levels are referenced to the application inputs, where some dividers are present. With the ZCD bit set, the TV volume control switches only at zero-crossings, thus minimizing click noise. The TV outputs can bypass the volume control. Likewise, the monaural output signal can be processed by the TV volume control or it can bypass the volume control.

Digital Section

Serial Interface

The MAX4397 uses a simple 2-wire serial interface requiring only two standard microprocessor port I/O lines. The fast-mode I^{2}C-compatible serial interface allows communication at data rates up to 400kbps or 400kHz. Figure 5 shows the timing diagram of the signals on the 2-wire interface.

The two bus lines (SDA and SCL) must be at logic-high when the bus is not in use. The MAX4397 is a slave device and must be controlled by a master device. Pullup resistors from the bus lines to the supply are required when push-pull circuitry is not driving the lines.

The logic level on the SDA line can only change when the SCL line is low. The start and stop conditions occur when SDA toggles low while the SCL line is high (see Figure 5). Data on SDA must be stable for the duration of the setup time (tSU, DAT) before SCL goes high. Data on SDA is sampled when SCL toggles high with data on SDA stable for the duration of the hold time (tHD, DAT). Note that data is transmitted in an 8-bit byte. A total of nine clock cycles are required to transfer a byte to the MAX4397. The device acknowledges the successful receipt of the byte by pulling the SDA line low during the 9th clock cycle.

I^{2}C Compatibility

The MAX4397 is compatible with existing I2C systems. SCL and SDA are high-impedance inputs. SDA has an open drain that pulls the bus line to

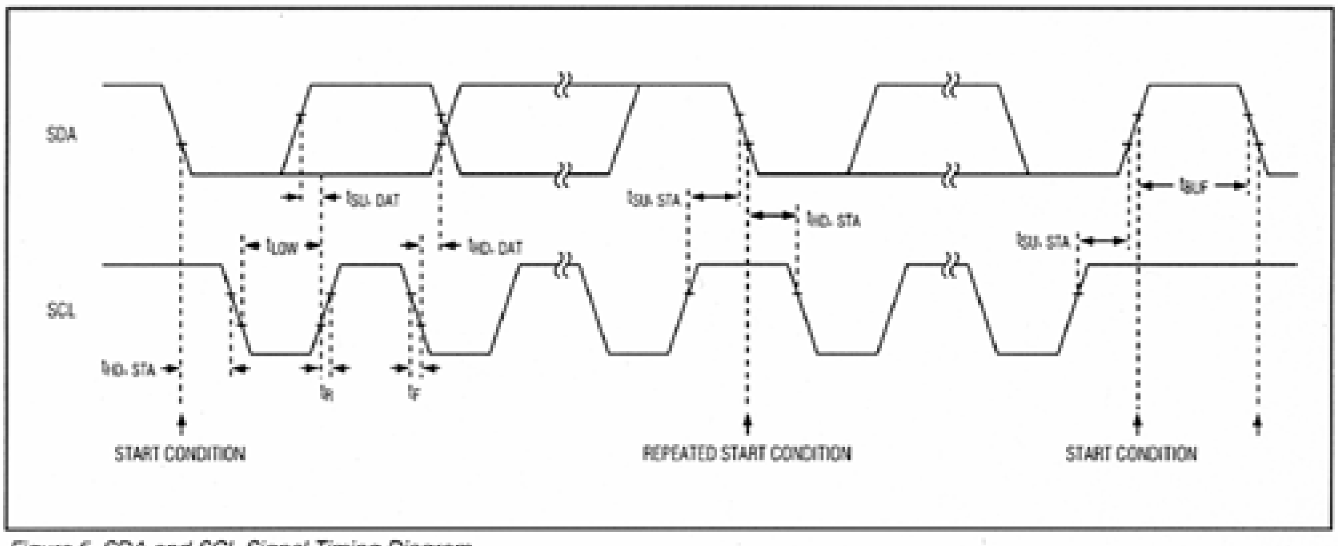


Figure 5. SDA and SCL Signal Timing Diagram

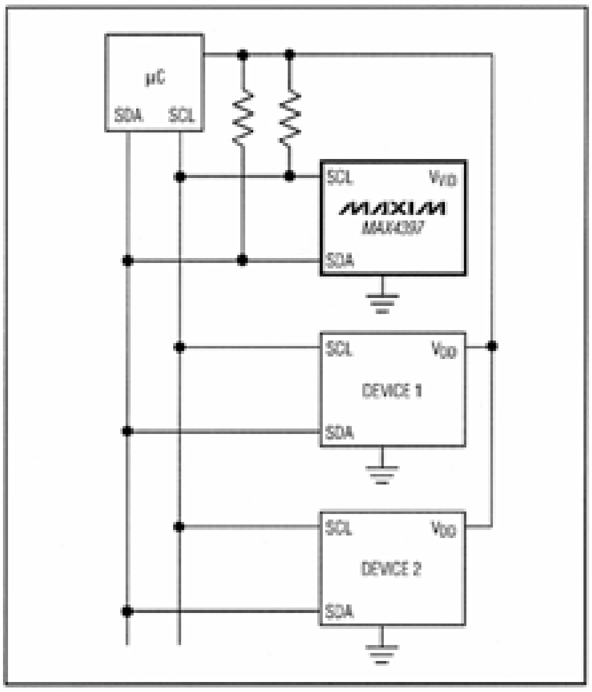


Figure 6. Typical I²C Interface Application

a logic-low during the 9th clock pulse. Figure 6 shows a typical I^2C interface application. The communication protocol supports the standard I^2C 8-bit communications. The MAX4397 address is compatible with the 7-bit I2C addressing protocol only; 10-bit format is not supported.

Data Register Writing and Reading

Program the SCART video and audio switches by writing to registers 00h through 0Eh. Registers 00h through 0Eh can also be read, allowing read-back of data after programming and facilitating system debugging. The status register is read-only and can be read from address 0Eh. See Tables 3–12 for register programming information.

Applications In formation

Hot-Plug of SCART Connectors

The MAX4397 features high-ESD protection on all SCART inputs and outputs, and requires no external transient-voltage suppressor (TVS) devices to protect against floating chassis discharge. Some set-top boxes have a floating chassis problem in which the chassis is not connected to earth ground. As a result, the chassis can charge up to 500V. When a SCART cable is connected to the SCART connector, the charged chassis can discharge through a signal pin. The equivalent circuit is a 2200pF capacitor charged to 31 1V connected through less than 0.1Ω to a signal pin. The MAX4397 is soldered on the PC board when it experiences such a discharge. Therefore, the current spike flows through the ESD protection diodes and is absorbed by the supply bypass capacitors, which have high capacitance and low ESR.

To better protect the MAX4397 against excess voltages during the cable discharge condition, place an additional 75Ω resistor in series with all inputs and outputs to the SCART connector. For harsh environments where ±15kV protection is needed, the MAX4385E and MAX4386E single and quad high-speed op amps feature the industry's first integrated ±15kV ESD protection on video inputs and outputs.

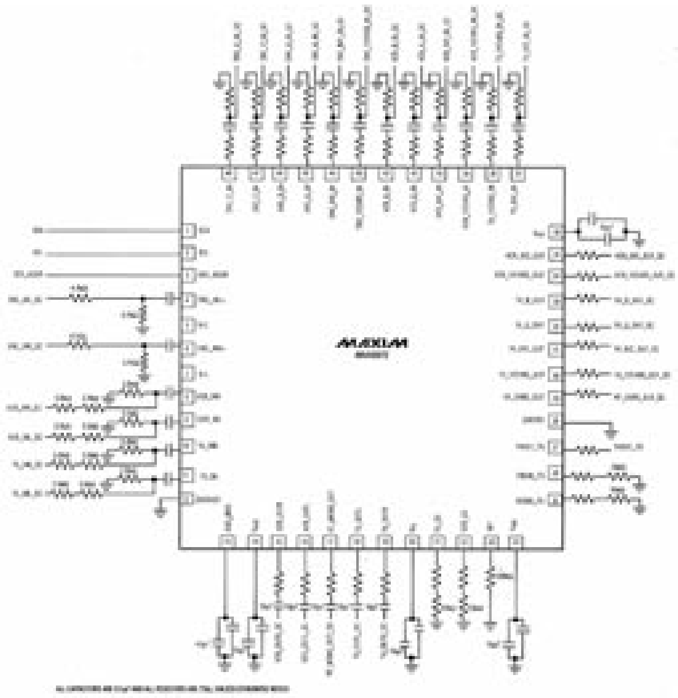
Power Supplies and Bypassing

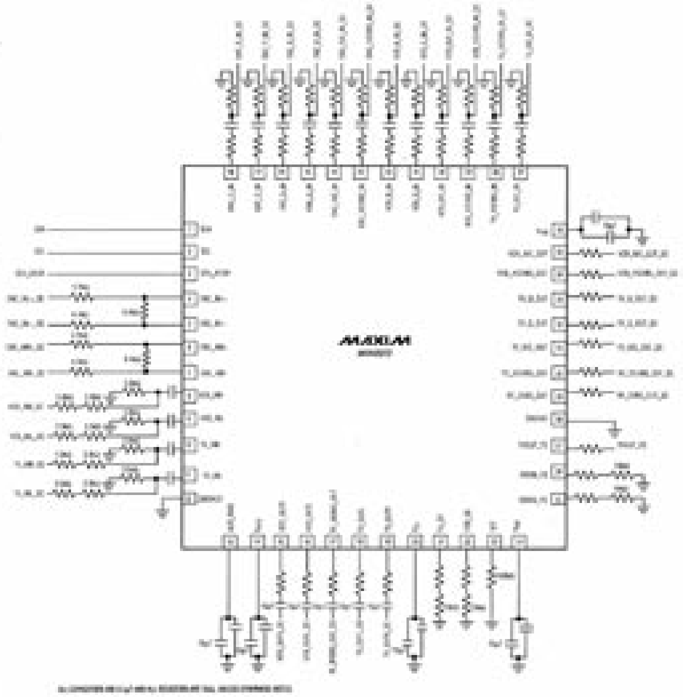
The MAX4397 features single 5V and 12V supply operation and requires no negative supply. The +12V supply V12 is for the SCART switching function. For pin V12, place all bypass capacitors as close as possible with a 10µF capacitor in parallel with a 0.1µF ceramic capacitor. Connect all VAUD pins together to +5V and bypass with a 10µF electrolytic capacitor in parallel with a 0.47µF low-ESR ceramic capacitor to audio ground. Bypass VAUD pins with a 0.1µF capacitor to audio ground. Bypass AUD_BIAS to audio ground with a 10µF electrolytic in parallel with a 0.1µF ceramic capacitor.

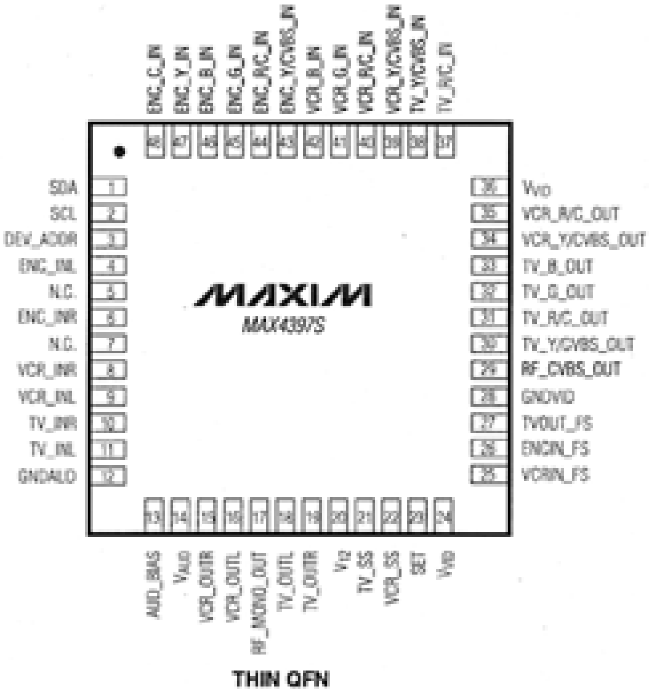
Bypass VDIG with a 0.1µF ceramic capacitor to digital ground. Bypass each VVID to video ground with a 0.1µF ceramic capacitor. Connect VVID in series with a 200nH ferrite bead to the +5V supply.

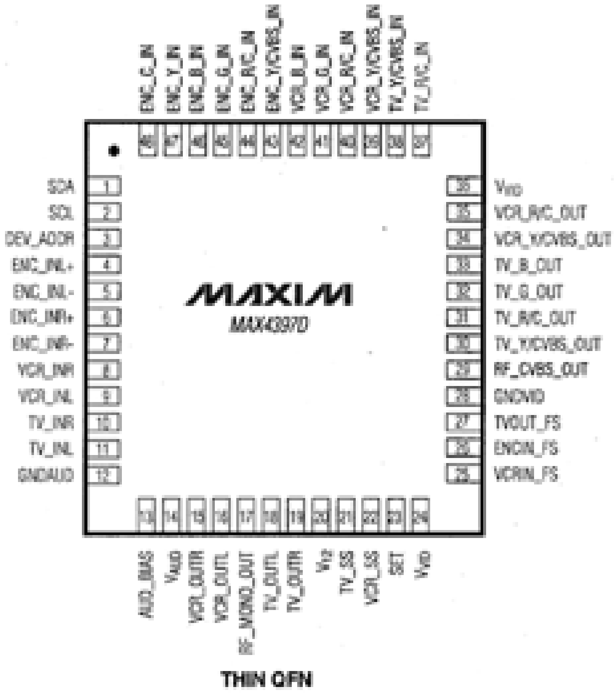
Layout and Grounding

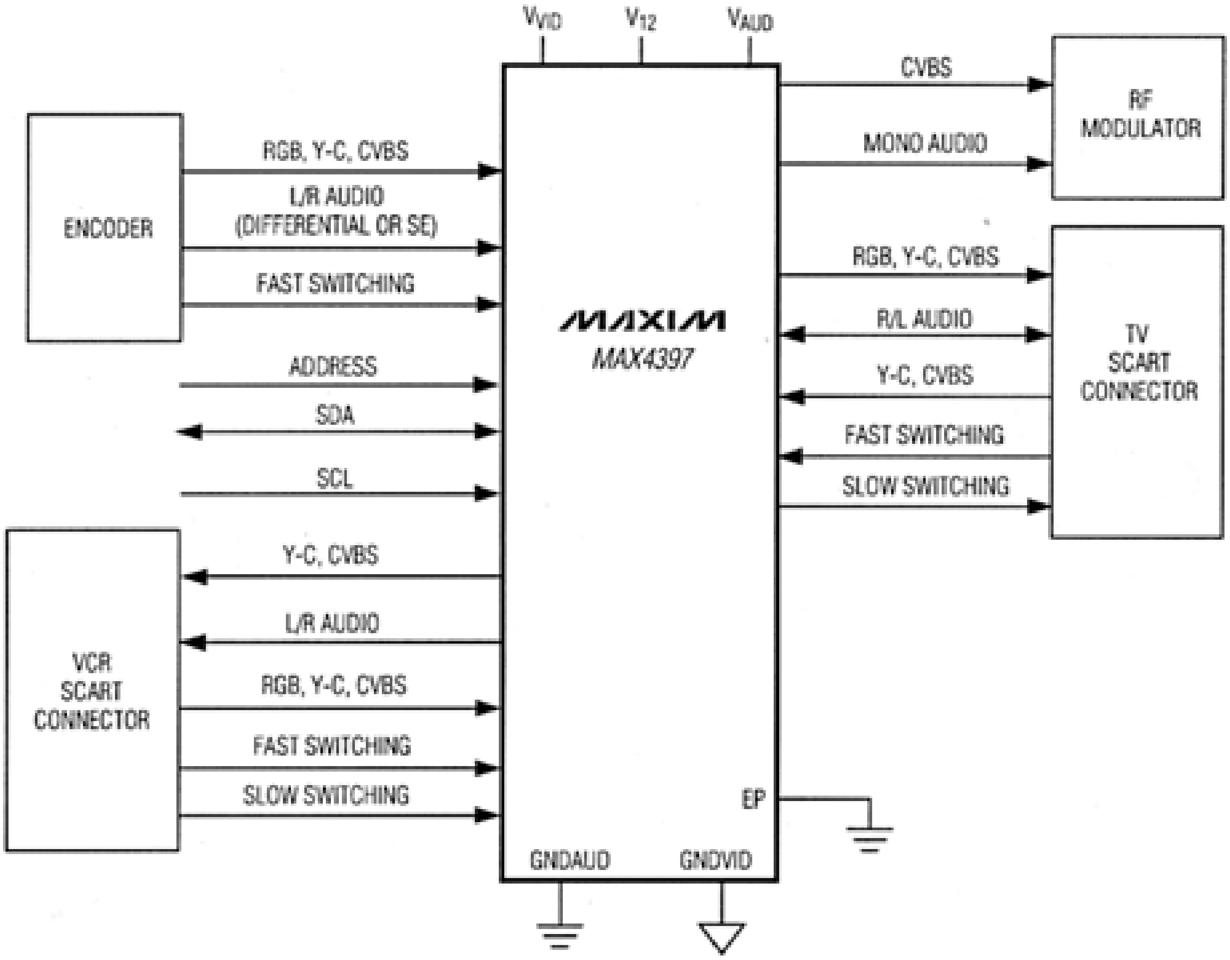
For optimal performance, use control led-impedance traces for video signal paths and place input termination resistors and output back-termination resistors close to the MAX4397. Avoid routing video traces parallel to high-speed data lines.











The MAX4397 provides separate ground connections for video, audio, and digital supplies. For best performance, use separate ground planes for each of the ground returns and connect all three ground planes together at a single point. Refer to the MAX4397 evaluation kit for a proven circuit board layout example.

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