



CQ-TV

228

Premiere tv camera collector Paul Marshall displays to Hilary Kay and about six million Antiques Road Show viewers (8th Nov 2009) the delights of large electronics antiques of the Marconi kind



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Caption Contest

Here are the entries for last issues picture (shown below):

“If I cannot get this code to control the tripod stepper motors, we may have to resort to collapsing it by hand” - Trevor Brown (G8CJS)

“Stressed engineer adopts lotus position while performing Vulcan mind-meld with his laptop” - Brian Kelly

“A laptop ? The most userfriendly tool anyone can use, anywhen, anywhere, anyhow !” - Etienne Nisolle



“If they think I am going to finish setting up before I read my cyber copy of CQ-TV magazine they can think again!” - Wyn (MW0AQZ)

“I can't believe it! I have four laptops and I brought the only one WITHOUT Adobe Flash Media Encoder.” - Don Hill (KE6BXT)

and the winner has to be Brian, but only because I'm a Star Trek fan ;-)
Congratulations, a caption generator will be on its way shortly.

Unfortunately we are running out of suitable photos for the competition, so please send in any amusing photos (preferably ATV related) otherwise next issue may well be a testcard !! For this issue though, please email your thoughts on Paul Read pictured below to: editor@batc.org.uk



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Deadlines

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

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

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

Editors Preamble

Seasons greetings to all readers, as it is likely to be December by the time you receive the magazine! The date I get it to the printers is getting later and later each issue, mainly due to (you guessed it) lack of articles to publish - 'nuff said...

The job of editor has become more of a chaser-upper of late, trying to extract interesting articles from the membership. I quite enjoy the job of editing, but not so much the job of extraction of material from wherever I can find it.

So it got me thinking, perhaps a new perspective would help? Fresh eyes on a problem might help find copy from new and previously unthought of avenues.

Before anyone panics (or cheers), no I'm not offering to resign as editor, however I think an assistant editor, or if you prefer, co-editor, would be a great help. I could really do with some help in getting new articles together, as well as some new ideas on how to improve CQ-TV and move forward with the times.

So if anyone fancies helping with the production of CQ-TV please get in touch and we can talk about it.

My email is: editor@batc.org.uk

The successful applicant will be fully IT literate, preferably own a decent quality scanner and a good spec PC and know how to use them! They will be highly literate, good at spelling and have an

eye for spotting typo's and grammatical errors... Failing that, I'll accept help from anyone who offers!!

Enjoy this issue, have a great Christmas and I leave you with the view from the terrace at Helidon lakes - hope to see you all at the BGM next year.

73's Chris - GIFFE



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' as well as the Lighting eBook.

The archive contains all past issues of CQ-TV and 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 DVD is available to members for just £5 inc. postage to the UK and EEC.

http://www.batc.org.uk/club_stuff/pubs.html

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

Chairman's Column

Club BGM 2010

First let me give formal notice of the BATC BGM 2010 this will be held at

Hellidon Lakes Golf & Spa Hotel
Hellidon
Daventry
Northamptonshire
NN11 6GG

On Sunday the 6th of June

This is another chance to stay overnight in this four star hotel. We have negotiated special terms that I hope makes the unaffordable affordable. The normal rate for a double room at this venue is £160 per person per night. The rate for the 5th June (Saturday night) has been negotiated for BATC members to £75 per person per night single occupancy of a room and £85 per room per night for double occupancy. Both these rates include breakfast. Please mention BATC when booking a room direct with the hotel on 0845 0345 777 and check that you are paying at the special discounted rate.

If you did not attend our 60th birthday celebration this year which was held at the same venue then you can see what the hotel has on offer at:

<http://www.qhotels.co.uk>

The package does not include dinner, and that I am afraid is £29.99. The hotel is prepared however to provide a banqueting suite at no extra charge and make the dinner into a gala dinner in the same style we had this year.

It does not include wine, the club paid for a glass of wine per person at this year's event, I have asked the Treasurer to hide that in the accounts, so no embarrassing questions when he delivers his report please. For a £4 per annum membership there is only so much I can do.

We have the same meeting room we had last time and again we will be running a full lecture programme from 10am, this is open to everyone members or not, it is only the BGM at 2.30 that is members only. I will announce the lectures and events in the next magazine, at the moment it is still open if there is something you would like to see.

I hope many of you will attend it is a very good opportunity to meet fellow members, put your own input into the club and perhaps get a few brownie points for taking your partner to a four star hotel for the weekend.

We will be streaming the whole event on <http://www.batc.tv> I know we had problems last year in that the hotel internet collapsed and it is a cell phone black spot, but we are after all a communications club and will be better prepared this time to cope if these problems arise.

The BGM meeting will start at 2.30

The formal Agenda will be:

Chairman's Report
Treasurers Report
Secretary's report
Editor's report
Appointment of Auditors
Election of committee
Award Presentations

Please make the effort to attend it is only one weekend in the year, the venue is stunning and the company Well what else can I say !

Please email chairperson@batc.org.uk when you have booked so I can keep a tally on the number of rooms, we have a limited allocation, they are on a first come first served basis so book early.

I can also update you on the Dinner menu and see that everything is running smoothly. Looking forward to seeing you all in June

Trevor Brown



ATV Newsletter

The ATV Newsletter is a weekly publication covering World ATV News that I find interesting as well as events, projects and activities sent to me by my readers. You also get the latest Local ATV News from the repeater networks here in Southern California. And it's free. Plus information on Digital-ATV/ATV GUIDE, for weekly scheduled ATV events via Streaming Video/ATV Website Links/and more. To subscribe send me an email with your first name and call to atv-newsletter@hotmail.com and I will add you to the mailing list. You can also include any info about your ATV activities in your email, if you wish. I just might put it in the newsletter!

Bryon Foster - N6IFU (Editor & Publisher of the ATV Newsletter)

Circuit Notebook 102

by John Lawrence GW3JGA

Modifying the Maplin A/V Source Selector L62AB

The Source Selector L62AB from Maplin is a basic device with mechanical push-buttons to do the selecting, shown in Fig.1. All inputs and outputs (video and stereo audio) are on phono sockets at the rear, shown in Fig.2. Any of the 4 sets of inputs can be switched to either or both of the two outputs. It has a built in mains supply and provision for an alternative +18V dc input through a 2.1mm power connector. It was priced at a very competitive £14.99 until very recently (July 2009) when the price was increased overnight to £24.99. It would be difficult and time consuming to build a comparable switching unit, and so at £14.99 I bought one.



Figure 1



Figure 2

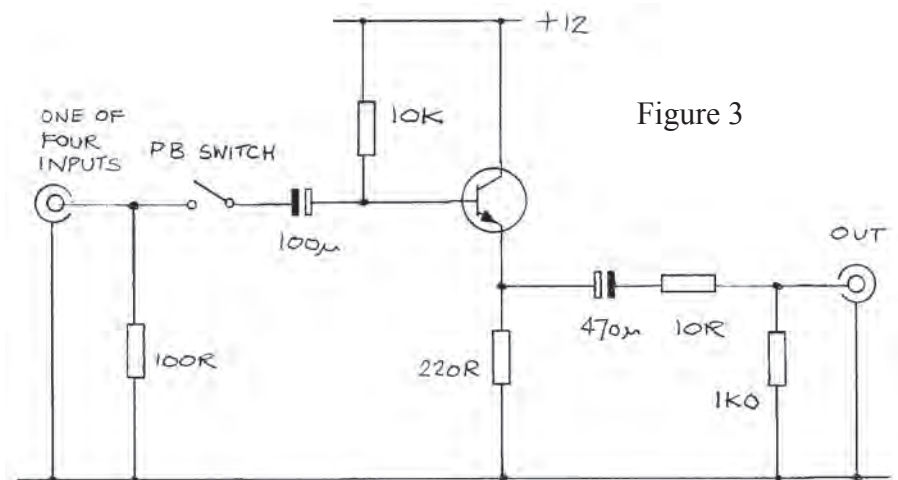


Figure 3

The L62AB was of particular interest because one output could, for example, be connected to a video monitor and the other to an ATV transmitter, thus allowing any of the 4 inputs to be previewed before switching it to the

transmitter. Also, the output from a receiver could be connected to one of the inputs and this could be viewed by selecting this input to the monitor. All this seemed ideal until I investigated the specification more closely.

The specification shows that there is a video insertion loss of 0.6dB. This represents a 7% loss of video voltage through the unit. In addition, measurements showed that although the video input impedance was approximately 75 ohms, the output impedance was 45 ohms instead of 75 ohms. This may not matter in a domestic situation, but I was intrigued to know why.

The other concern was that the DC supply requirement was 18V, rather than the usual +12V DC. I tried running it from +12V dc but the video output waveform showed sign of distortion. This precluded it from ATV portable use.

I contacted Maplin Technical Support for a circuit diagram for the L62AB but this was not available. So, I decided to find out for myself, even if it meant making the warranty void. A project not to be undertaken by the faint hearted.

Dismantling

I removed the 4 screws (two either side) and opened the case. I removed the four screws two each side of the front panel and removed the front panel, then the

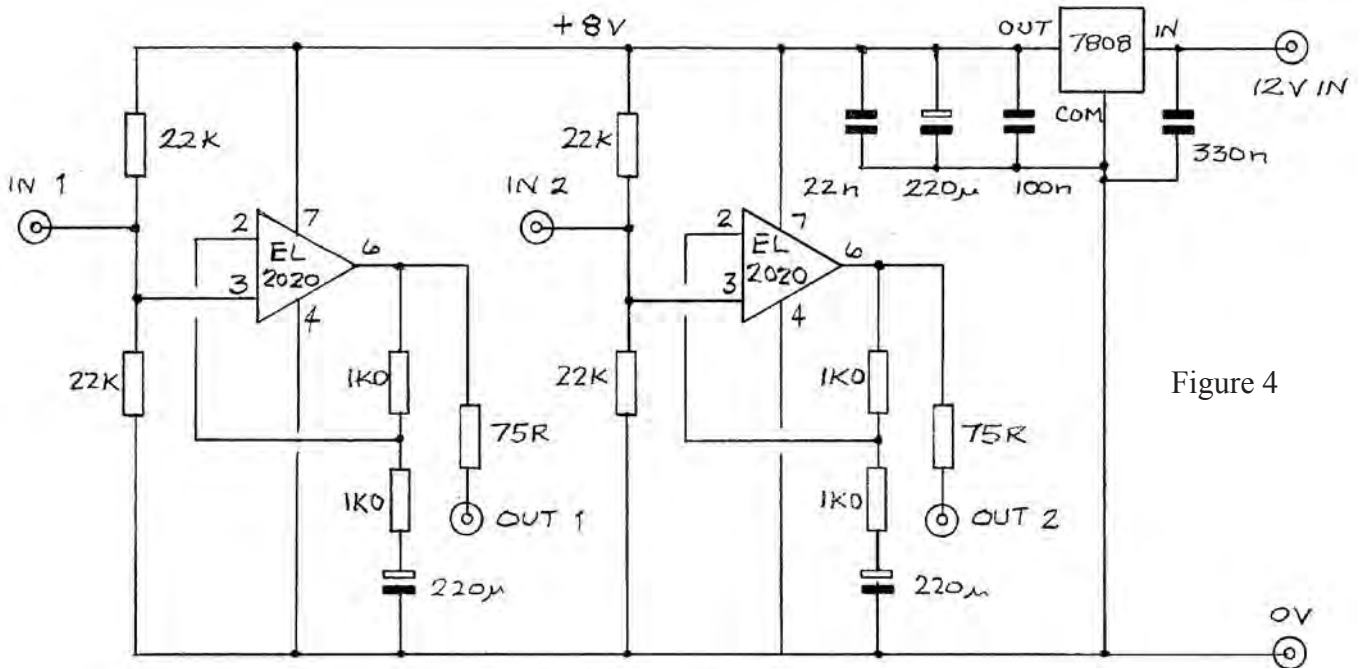


Figure 4

two M3 screws holding the PC board and the 6 black screws, at the rear, holding the blocks of phono sockets in place. I then removed the PC board with the push button units and phono sockets attached and started tracing out the wiring.

The PC board contained two transistors, each was connected as an emitter follower, one for each output. The circuit components had been cleverly chosen to minimise the loss of video signal whilst providing a compromise match to 75 ohms at both the input and the output. The basic emitter follower stage is shown in Fig.3.

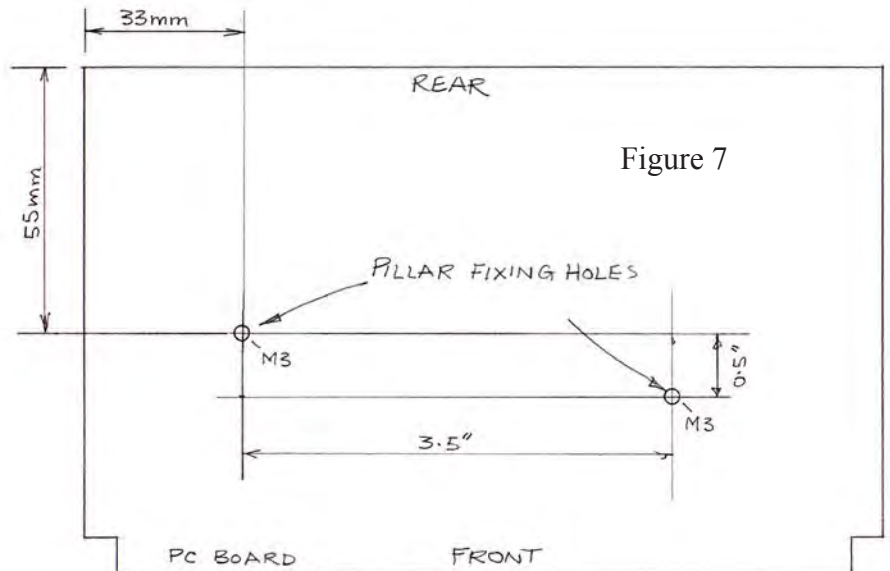


Figure 7

I decided to remove the two emitter followers altogether and to replace these with two conventional video op-amps (Circuit Notebook No. 90,

CQ-TV No.215) mounted on a piggy-back veroboard fitted above the main PCB. Each amplifier would have a high input impedance so as not to load

the input resistors, a gain of X2 and a sending impedance of 75 ohms. The op-amp circuit is shown in Fig.4 and the Veroboard layout in Fig. 5.

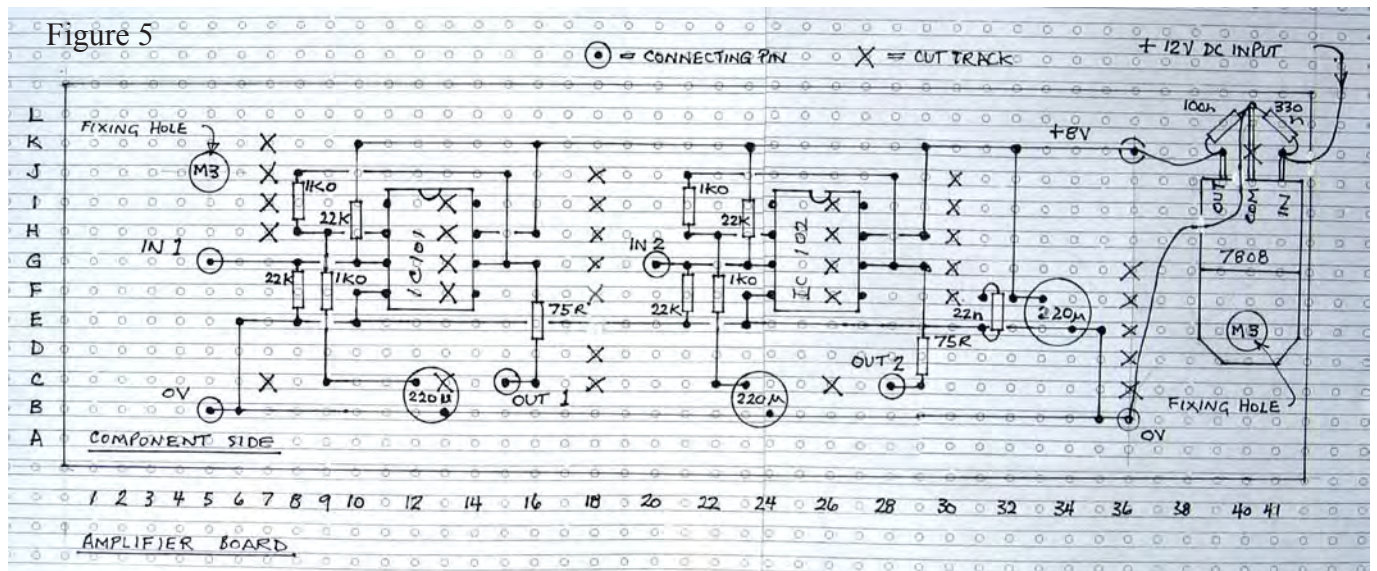


Figure 5

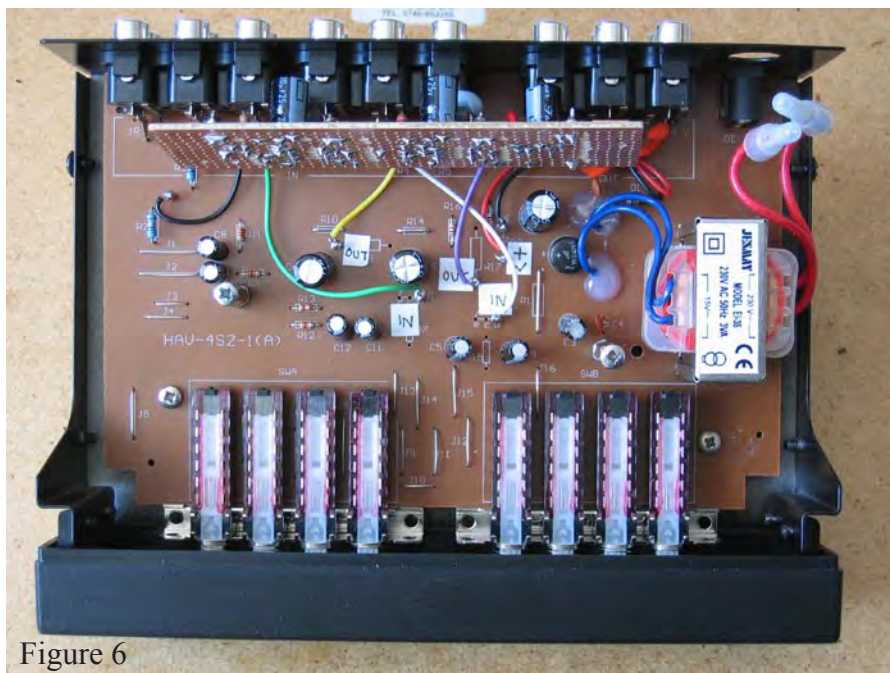


Figure 6

Video amplifier board

The video amplifiers and associated components are mounted on a piece of Veroboard, 12 strips wide by 41 holes long, as shown in Fig.5. An 8V regulator, 7808 or similar is mounted on the top of the Veroboard by an M3 screw. This screws into the right hand pillar which also supports that end of the Veroboard. There is no need for a heat sink as the power dissipation is very small. The position of the two mounting pillars is shown in Fig.7. Their position is critical so as to avoid damaging any of the PCB tracks on the underside. The position of the left hand pillar is given in mm, but the position of

the right hand pillar is referenced to it in decimal inches to match the 0.1 inch matrix of the Veroboard. The mounting pillar height should be about 18-20mm.

The input and output connections of the original emitter followers on the main PCB are wired to and from the amplifiers, including the DC supply, as listed below. Fig.8. shows the amplifier board installed above the main PCB.

DC Supply

Because the primary requirement was for portable use I decided to re-arrange the internal circuits to work from +12V upwards and to abandon the internal

mains power supply. The revised DC supply is shown in Fig.9. I also removed the mains lead to make it more portable but left the mains transformer in place. If I should need to run it from the mains in the future, then I would use a plug-top power supply.

The changes made to the PC board are given below:

1. Remove R2, R3, R4, R5 (100R) and replace each with 75R
2. Remove R10, R14 (10R) and replace each with a wire link
3. Remove R9, R17 (220R)
4. Remove R7, R15 (10k)
5. Remove R1 and replace with a wire link
6. Remove D2, V1, V2

Fit a connecting pin in the PCB hole where the component has been removed and solder on the track side, as follows:

7. Fit connecting pin to 'base connection of V1' connects to input of amp 1
8. Fit connecting pin to 'left hand end of R9' connects to output of amp 1
9. Fit connecting pin to 'base connection of V2' connects to input of amp 2
10. Fit connecting pin to 'lower end of R17' connects to output of amp 2
11. Fit connecting pin to 'cathode of D2' connects +V supply to input of 8V regulator
12. Fit connecting pin to 'anode of D2' connects 0V to COM on 8V regulator

The positions of the connecting pins are shown in Fig.6.

Audio Switching

No changes were made to the basic audio switching, which although not providing any proper input-output isolation, performs adequately. The basic audio switching is shown in Fig.9.

The modified assembly is refitted in its case by reversing the dismantling sequence.

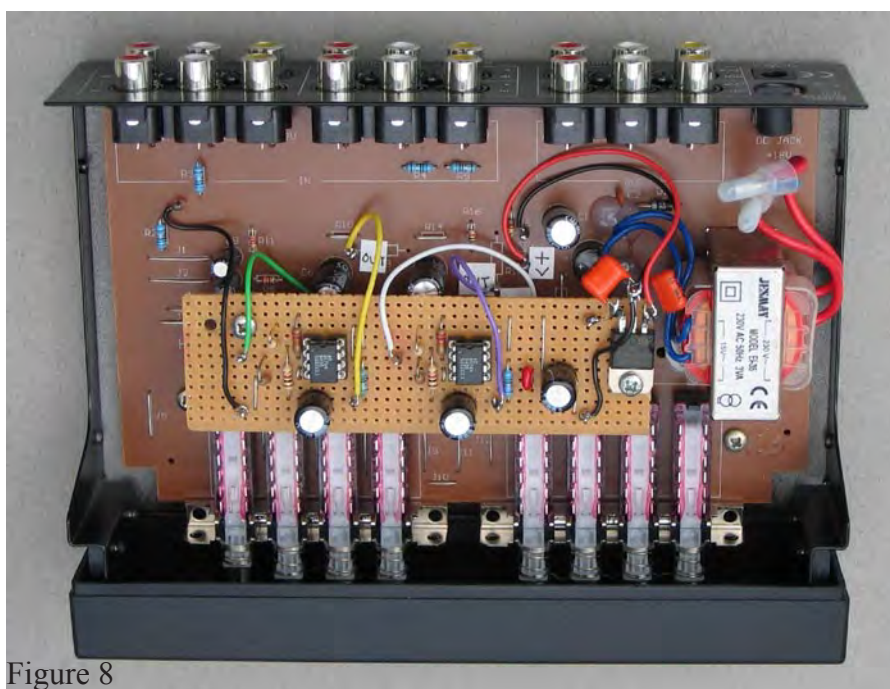


Figure 8

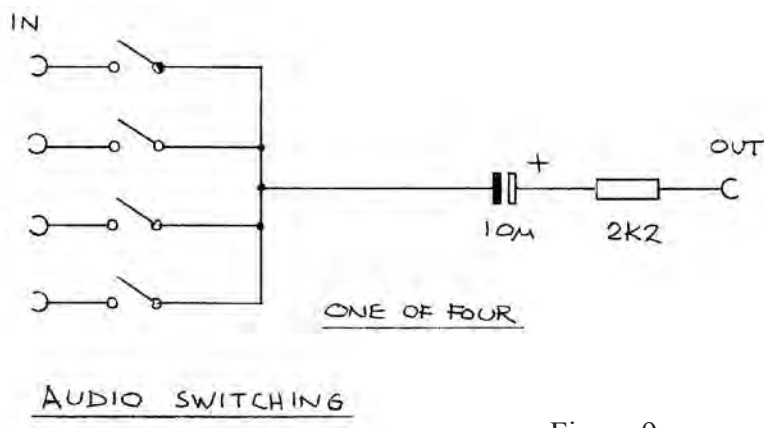


Figure 9

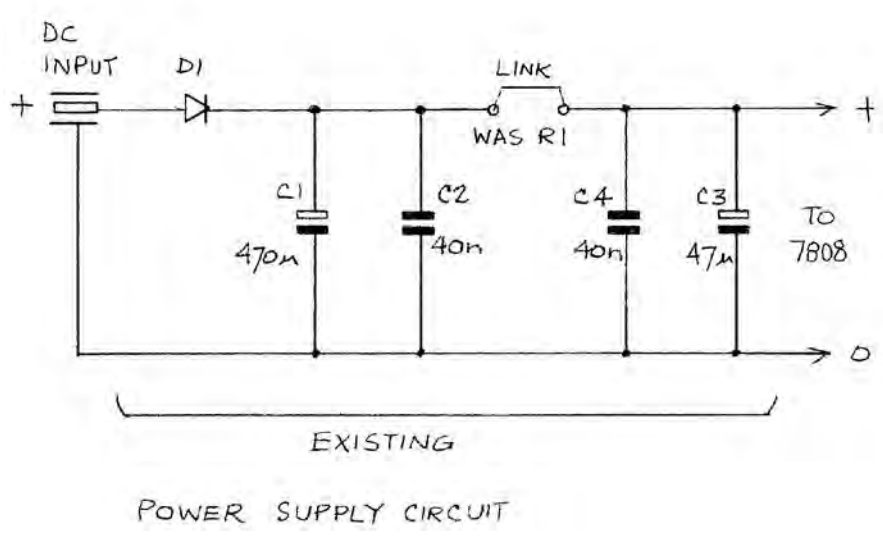
Conclusion

The video performance is as expected, unity gain into 75 ohms with a frequency response from 10Hz to beyond 6MHz. The 12V input current drain is 20mA.

The modified Maplin L62AB A/V Source Selector has proved to be a useful piece of kit when operating portable ATV.

My thanks go to David GW8PBX for input and output impedance measurements and for helpful comments whilst modifying his own unit using the above instructions.

- Fig.1. L62AB Source Selector Front
- Fig.2. L62AB Source Selector Rear
- Fig.3. Basic emitter follower stage
- Fig.4. Dual Op-amp Circuit
- Fig.5. Veroboard Layout
- Fig.6. PC Board modifications
- Fig.7. Position of Mounting Pillars
- Fig.8. Op-amps fitted to main PCB
- Fig.9. Basic Audio Switching and Power Circuits



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New mains supply for a new shack

by Drew Belcher G7DMO

How many of you have considered the electrical wiring of your home, your shack, the equipment around you? How many of you know if it is safe and fit for purpose and will stand up to the loads it is asked to carry? How many of you have started from scratch to establish a safe shack? These are the questions I found myself asking as I recently moved home.

A new home brought old wiring and poor electrical provision. The shack was to be placed at the end of the garden as the most sensible place and a new mains supply would be needed. The specification included a separate consumer unit, new underground cables and up to date electrical safety devices.

Overall design load for the shack was not to exceed 40A which helped cut down on cable sizes and determined the main safety device. The device selected was an RCBO to be fitted in a new consumer panel in the house.



Next up was the outdoor cable run. This was done by using reclaimed underground telecom ducting and Steel Wire Armoured cables so to add as much protection as possible. The photo shows the outdoor termination box.



So to the shack wiring. The wiring is all installed using metal clad sockets and plastic conduit and fittings. Conduit wiring made for a quick and simple job and also kept the costs down. It also offers a measure of extra protection from the knocks and bumps a shack can experience. The next photo shows the consumer unit in the shack.



Notice the lack of RCD's so not to overcomplicate the electrical protection as afforded by the RCBO in the first photo. The MCB's are adequate with the RCBO upstream at the main consumer unit

The MCB's are loaded thus:

- 6A Lighting circuit internal
- 6A Lighting circuit, external
- 16A Workbench sockets
- 32A Ring main 1
- 32A Ring main 2
- 32A Outdoor 32A socket

The next major problem for any amateur is having the right number of 13A sockets. In the past most of us will have gone down the multiple adaptors and extensions all leading to a single 13A socket. I am guilty of this myself hence my need to change my ways. The next photo shows my solution to this.



The photo shows my shack PC, external HDD and 3 off 4 way extension sockets. The large black box is a 1KVA UPS which powers the PC, HDD, Ethernet switch and monitor. There is a second UPS in the house to protect the ADSL router and print server and this has proved useful in recent brownouts.

The three separate power adaptors do different jobs. The left and centre adaptors are via a 32A ring main and are switched feeds only via a standard 13A double socket. The right hand adaptor is via the UPS and is shown powering the Ethernet switch and external HDD. The monitor and PC are directly linked to the rear of the UPS.

In conclusion all the shack loads are now protected and set out in a logical manner. The power distribution ensures that no overloads are created even when running at full loads on all the equipment. Yes it is a far cry from the old big switch on the wall that closed down the station but if needs be this can be done in a few seconds as the shack consumer unit is next to the door. The use of a UPS has greatly added to reliability and security of IT in the shack and I would suggest this to anyone who runs IT, it is something they cannot live without.

And before you ask yes it is designed to BS7671 Electrical Installation Wiring Regulations 17th Edition, Part P Building Regulations checked and tested and installed by a trained, competent, qualified electrician.



Rocking the boat Rocking the board!

By Brian Kelly. GW6BWX

This is not a full construction project but a demonstration of how parts from scrapped equipment can be put to use again to make a very useful tool. I am providing a schematic diagram and I have made the software for the microcontroller available, but the dimensions and mechanical construction depend upon salvaged parts. Being different from one construction to the next, these are left to the builders discretion.

Regular readers will know that I published an article some time ago in CQ-TV issue 200 on making printed circuit boards (PCBs) at home. The article showed my tank for developing and etching circuit boards which consisted of a plastic chocolate box (sans chocolates!) and a motor from a scrapped VCR. The motor turned a paddle which kept the chemicals in the box in motion. If the chemicals are not agitated they tend to concentrate and saturate unevenly and the board may be over processed in some places while others still need longer to become ready. The spinning paddle works very well but it does have two drawbacks, it isn't as effective in the corners of the tank as in the middle and unless switched off before being lifted from the tank it would spin rapidly when the resistance of the liquid was lost and it could flick dangerous chemicals around.

The most common method of ensuring the board gets equal treatment is to use a bubble tank. These are relatively cheap and rely on the board being suspended

vertically in the chemical while air bubbles rise around it. The bubbles are produced from an aquarium air pump and leak from a perforated pipe at the bottom of the tank. As the bubbles rise they stir the liquid, keeping it on the move. The drawback to this kind of tank is that it tends to be large and it uses lots of chemical to keep the board submerged. In some circumstances this isn't a problem but personally, I like to keep dangerous chemicals safely stored in sealed bottles and have as little as possible in use at any time.

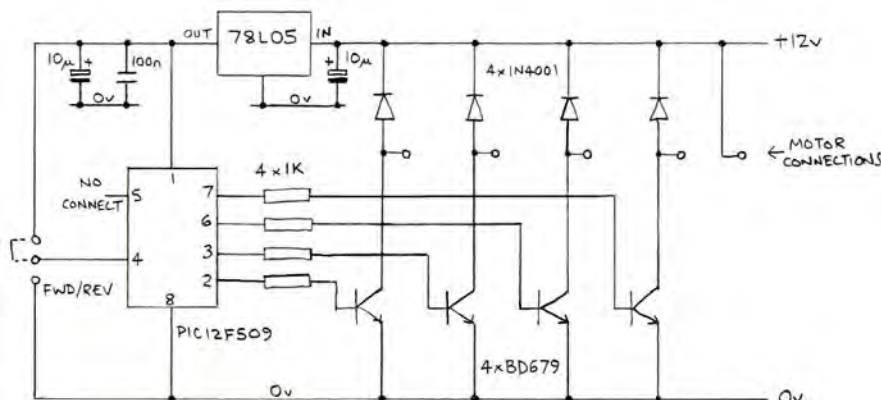
An alternative to moving the chemicals over a fixed board is to move the board, chemicals and container simultaneously, in other words rocking it from side to side. Doing this manually for long periods is very tedious but very economical on chemicals. Boards can lie flat on the bottom of the tank and only sufficient chemical to cover the board is needed. The latter approach was adopted in this design.

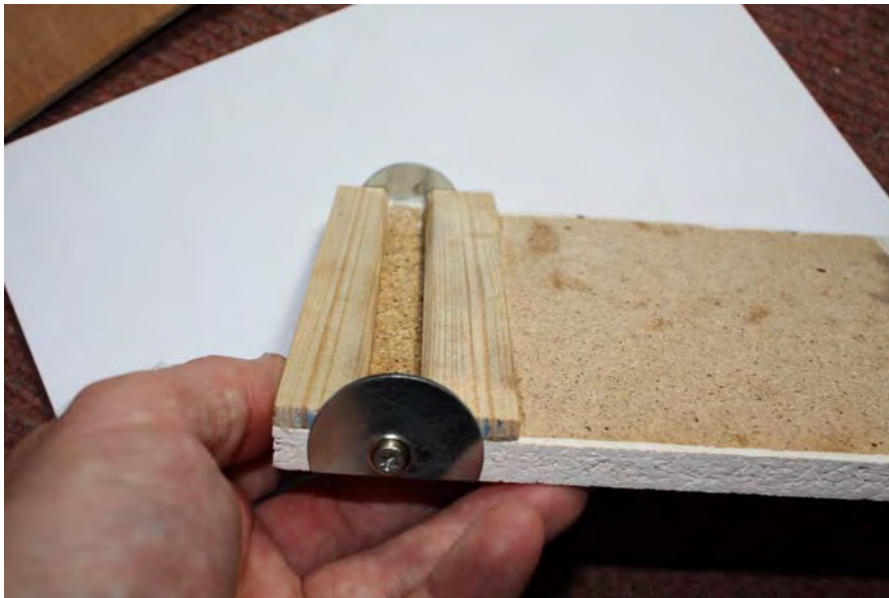
My first attempt at a rocking mechanism consisted of a base board made of MDF with two parallel brass rods pressed in to it. The rods pointed upward and protruded from the MDF by about 50mm. Mounted between the rods was a small 12V motor with its shaft facing upward. I fixed a threaded brass screw to the motor shaft so that it ran parallel and central between the rods. I then made another brass part, a 'platform' with three holes in it. The outer two holes were slightly larger diameter than the brass rods and the middle hole was threaded to match the screw. The intention was to use the rods as guide rails while the

and down, depending on the direction the motor ran. The theory was good and the prototype did work 'sort of'. What let it down was my inability to make it accurately enough, in my defence I did make it in the garden shed with hand tools, built in a proper workshop it may have worked much better. The problem was getting the rods exactly parallel and drilling the platform holes exactly on a parallel axis. Although it worked, the mechanism wobbled as the screw turned and it would sometimes momentarily jam. The motor polarity was reversed by a timer and after a while it would either lock down to the base or rise so high it fell off the screw thread. If it had worked, the next stage was to fit a hook to the platform so it could lift and lower the edge of the tank and achieve the rocking motion I was after.

Back to the drawing board. For my second attempt I decided to accept I can't drill holes very well and a design needing less precision was conceived. Everyone who knows me will tell you I never throw anything that might be useful away. If something breaks down and cannot or need not be repaired, I always salvage useful parts before sending the remainder off to the local recycling site. To the rescue this time was a bag of two plastic gear wheels and a stepper motor which used to be the mechanism for driving the sensor back and forth in a document scanner. If I remember correctly, the scanner was quite old and was not supported by the computer operating system so its owner bought a new one and gave me the old one 'for spares'. The gears nicely meshed with each other to give a 9:1 speed reduction and stepper motors have the wonderful property of producing lots of torque at whatever speed they are driven at. They also work equally well running clockwise and anti-clockwise, unlike conventional motors which tend to wear quickly when run backwards because their brushes are 'pushed' rather than 'dragged' by the commutator.

The problem now is how to turn the rotary motion of the gears into a reciprocating motion to rock the tank. A





off the base. With dangerous chemicals in the tank I thought this was not good. The fix was to think upside down and put the pivot on the underside of a plyboard platform. This also gave the opportunity to fit restrainers to ensure the platform and tank could never go astray.

The motor and gears were mounted on a folded sheet aluminium bracket. This had seen life as a heatsink in an ancient stereo amplifier years ago but thankfully none of the holes in it clashed with the new ones I had to drill. The motor was mounted first with its shaft protruding through the bracket, this made it easy to mark and drill the two fixing screws that hold it in place. With the motor

con rod and crank mechanism, similar to that used in a car engine could be used but would be difficult to make. I didn't want to expose my poor garden shed to any more bad language so I decided to keep it simple and use the rising and falling action of a peg on the final gear as the lifting device. Keeping it simple is usually the best solution!

In order to tip the tank it has to be pivoted and the mechanism has to lift the end of the tank on one side of the pivot and then lower it again. Rather than make a lowering mechanism, I decided that I would let gravity do the job for me. Gravity is free and I like free things. So, instead of placing the pivot under the centre of the tank, I offset it to the side away from the lifting mechanism. This meant that most weight would be on the side with the lifter and it would naturally fall as the lifter returned to its lowest position. If it had pivoted in the centre, it would have tipped over with no way of returning it.



I initially thought of attaching the pivot to the MDF base board but trials exposed a small problem. As the gear turned, the peg not only lifted and lowered the tank, it also pulled it slightly from side to side and after a prolonged time, the tank would have 'walked' far enough to fall

cog fitted, the next step was to find the mounting centres for the two plastic gear wheels. This is very easy, all I did was engage the gear teeth together then using a drill as the wheel axle, twisted it against the aluminium to mark the hole position. Drilling through the marks gave the exact position the axles had to be placed. The axles themselves are made from screws, sufficient thread was left to fit nuts to secure the bracket but the section inside the wheels was gently sanded to dull the thread and prevent it cutting into the plastic. The final gear wheel has the lifting peg attached to it. The peg is a 3mm socket screw fitted with a brass sleeve (a PCB spacer). The gear wheel is drilled to 2mm close to its edge, tapped to 3mm and has the screw fitted into it with about 1.5mm passing right through the wheel. It is then secured by tightening a nut against the wheel. If you follow my example, be careful not to overtighten the nut as





it will pull the screw and strip the thread from the plastic. To get the teeth to engage cleanly, thin washers were fitted to the shafts to control their distance from the axle nuts.

The 'slider' by which the platform is lifted is nothing more than a length of copper wire, the thick earth wire removed from an old 2.5mm T&E mains cable. It is bent into a wide 'U' shape with the ends pushed into the end of the platform. The middle (the base of the 'U') sits on the brass sleeve which lifts the slider as the peg rotates on the wheel.

The electronics is very simple, all it does is cycle a four phase driver so the stepper motor is pulled to the next angle periodically. The timing is 25mS per step, the step angle is 7.5 degrees so the motor completes one full rotation in: $(360 / 7.5) * 0.025$ seconds or 1.2 seconds. When the gearing is taken into account, the tank takes about 10 seconds to rock back and forth, five seconds rise then five seconds fall. The driver transistors are controlled by an inexpensive (about 50p) microcontroller and the program, written in Oshonsoft PIC10F BASIC is listed to the right.

It should be self-explanatory, the '1' and '0' in the phase settings are the states

of the pins driving the transistors and GPIO is the group name of the output pins on the chip. Although not used in this design, there was an unused input pin on the 12F509 so I used it to set the motor direction. Connecting it 5V or to ground will reverse the stepping direction. The compiled hex file is available at:

www.atv-projects.com

for those who do not have Oshonsofts compiler program. It is only about 120 bytes long. If you want the compiler, it is available from:

www.oshonsoft.com

and is very inexpensive.

Stepper motors:

There are several types of stepper motor, the type I used is a five wire type. This has one common wire and four wires going to individual coils. To rotate the motor, the current through the coils is switched on and off in such a sequence that the rotor turns to centre its core to align the magnetic fields from them. In this design, you cannot use a four wire motor. These work in the same way as five wire ones but the current through the coils has to be reversed

rather than just turned on and off. To reverse the current, a 'H-Bridge' driver has to be used which is somewhat more complicated and wasn't available in my 'junk box'.

The total cost of the agitator tank and hardware was under £10 (about 12 euros) of which most was for the plastic tank itself.

BASIC Listing

```
Define CLOCK_FREQUENCY = 4
```

```
Dim phase1 As Byte
Dim phase2 As Byte
Dim phase3 As Byte
Dim phase4 As Byte
```

```
phase1 = %010001
phase2 = %100001
phase3 = %100010
phase4 = %010010
```

```
TRISGPIO = %001000
```

```
direction:
If GPIO.3 = 0 Then Goto reverse
```

```
GPIO = phase1
WaitMs 25
GPIO = phase2
WaitMs 25
GPIO = phase3
WaitMs 25
GPIO = phase4
WaitMs 25
Goto direction
```

```
reverse:
GPIO = phase1
WaitMs 25
GPIO = phase4
WaitMs 25
GPIO = phase3
WaitMs 25
GPIO = phase2
WaitMs 25
Goto direction
```

We have now merged the old cq-tv.com website with the clubs primary website: <http://www.batc.org.uk>
Please update your bookmarks!

Return of the testcard

By Trevor Brown G8CJS

I suppose it was inevitable that the test card would return in these austere times when programme making budgets seem to be almost none existent and repeat and life style programming seem to be the order of the day.

This new or adapted test card is now being shown on the BBC HD service for 90 seconds every two hours, well at least it won't burn your plasma display. What has been retained in

this HD version of the test card is the very famous picture of Carole (George Hersee's daughter) re-scanned in high definition, otherwise its Richard Russell's well known widescreen test card, with just a few small changes First, white level has been reduced so the peak white box is not 100% (level 235 or 0.7v). The super white spot is now 100% and the linearity of the grey scale is now slightly inaccurate. However no domestic displays have the level of adjustment we expect a broadcast monitor to have, so this does

not affect the usefulness of the test card to help you line up a "normal" TV. Also the colour bars are slightly lower in colour level. One reason for this is to help protect screens from burn in. The full level test card will burn a screen in quite a short period so please heed this warning: Do NOT leave the test card on screen for more than 2 minutes if your screen is less than three months old or more than 5 minutes on older screens. Make sure you go back to the promo for several minutes before using the test card again.



Some useful links for test card history and setting up your HD receiver:

http://en.wikipedia.org/wiki/List_of_BBC_test_cards

<http://www.barney-wol.net/video/testcardw/testcardw.html>

<http://www.digitalspy.co.uk/forums/showthread.php?t=942385&page=4>

http://www.bbc.co.uk/blogs/bbcinternet/2008/12/a_christmas_present_from_the_h.html

Cyber-membership: CQ-TV beamed directly to your PC
four times a year for only £4

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Getting The Best From Film

by Andy Fremont

1.0 INTRODUCTION

I joined the Marconi Wireless Telegraphy Company as an apprentice over 50 years ago. In those days all those destined for the development laboratories were sent to Marconi College for the final few months of training. The end of the course either covered radio or TV. I had spent some time in the TV Test section and also frequented the local amateur TV establishment and generally found this interesting. I was therefore keen to study TV; however, I was told that I must take the radio option. Those used to large company training departments will not be the least surprised that my final placement was in the Colour TV development section; what a pity I had not been allowed to do what I wanted. At that time, 1962, all the TV development sections were housed in a set of wartime Nissan huts on the Pottery Lane site at Chelmsford. After taking part in the EBU/CCIR demonstrations that were set up to help in defining the UK colour standard I started on my first real design task. By then we had a purpose-built set of laboratories at Waterhouse Lane. Nowadays, when I want to remember where my office was, I can visit the local Homebase store plant section. How times have changed!

It had been decided for various reasons that we would design a four tube (YRGB) studio camera using 1" Plumbicons. It would be designated the Mark VII (Figure 1). At the start of design we had only ever seen one Plumbicon and this was to be the first transistorised design for all of us. While this may not have been a recipe for complete disaster it did mean a steep learning curve for all. My specific task was to design the Video Processing circuitry. Despite a number of difficulties we completed the work in a reasonably short time and about a year later I was transferred to the Telecine Department. This is where I stayed until 1986 when all Broadcast TV design at Marconi was stopped. My intention here is to cover our efforts to get the very best from film.

In preparing this article it was initially intended to run technical information within the main text describing what was done and when it was done. However, this just did not seem to work and for this reason the main technical data has been placed in an appendix. This leaves the reader with the option to select the depth of technical explanation as desired.

2.0 THE B3402 TELECINE PERIOD

2.1 Requirements in the 60s / 70s

Before I start to cover what we did in our efforts to reproduce film, I think it would be useful to outline the way in which telecines were being used as we began our task. In the late 60's and into the 70's the use of telecines was the only way you saw fresh news from outside the studio. TV cameras were used for preset events such as football and horse racing but unpredictable or remote news came in on 16mm film, in some cases after the programme had started; sometimes the film would not have even been processed. To make it a bit more difficult, the sound was on separate 16mm magnetic tape with sprocket holes. This was possibly more the case for ITN as the news was quite a long programme and there was time to get the film ready. Film was also used for drama inserts as cameras were still a bit bulky for outside use and video recorders were still in their early life.

For this particular case it was important to achieve a good match between the film and TV camera pictures. For example, an actor could be seen walking in the garden and then had to appear to have walked straight into a room. This had to be done as seamlessly as possible. A sudden change of colour or general display characteristics was not acceptable. Of course all your old favourites: The Sound of Music, The Great Escape etc. were on film. Shows that were made especially for TV only were sometimes on film, e.g. The Avengers. I seem to remember that this was printed low contrast (low gamma) making the job of the telecine somewhat easier. Just a little aside – the first time that I saw the Avengers running through a telecine was at the Teddington Lock studios. It was here that I first came across a keen young engineer called Mike Cox; you may have heard of him.

2.2 The Basic Design

The new telecine, the B3402, was to be typical of a number made around that time where one or more projectors shone a film image onto a modified studio camera; the MK VII in our case. In our system there were two film projectors which could be a Philips 35mm design or a Bauer 16mm plus a pair of Marconi designed 35mm slide projectors. The projectors were selected via a rather noisy optical multiplexer with mirrors

Figure 1



that clunked up and down. The film projectors could be fairly standard for 625 line operation but had to be modified for 2:3 pull down when working 525. In case some may be unfamiliar with this I shall elaborate a little. Cinema film is shot at 24 frames per second (fps) but in the UK it was always shown at the 25 fps TV frame rate, i.e. it was running 4% fast. The mains power supply frequency was close enough to the 50Hz TV field rate to allow the projectors to be driven by synchronous motors (they were actually sync-interlock types to allow external sound machines to be synchronised. Look up Selsyn on the internet if you want to know how they worked). For this case each film frame is exposed for two TV fields (you can call it 2:2 if you like) and the shutter obscures 50 times per second. You might think that the shutter only needs to close 25 times per second but it is important that each TV field receives the same exposure, otherwise horizontal bars will be seen; the film is only moved during every other obscuration. In the US we have a 30Hz TV frame rate and running the film at that speed would be unacceptably fast. The problem is overcome by exposing one film frame for two TV fields and then the next for three fields. This sequence is repeated, hence the 2:3. For this system the shutter obscures 60 times per second. A quick piece of arithmetic will show that this gives an average of 24 fps, i.e. the correct speed for cinema prints. The down side of this method is that the projector has less time to move the film and the 35mm sounded somewhat like a machine gun. It should be noted that the rival Rank-Cintel flying-spot system had no solution for 525 operation at that time.

As far as the camera head was concerned there was little change from the studio design; the mounting arrangements and the casing were the main alterations. Obviously the zoom lens was not required. However, for reasons that are explained in the Appendix, the RGB spectral characteristics were also changed. The main changes to the video processing electronics were an increase gamma correction range and the provision for black and white negative reproduction. With not a great deal of new design to do the new system was available quite quickly.

2.2 Initial Test

If I am honest I need to admit that the initial ideas and the design are the fun part. Making it work is less fun and getting it through production and into the field is the worst part.

Initial testing went reasonably well. Are we all happy that Gamma basically refers to a transfer characteristic with a power law ($V_{out} = V_{in}^\gamma$)? Good! Having done a number of tests a crucial one is always a check on gamma tracking. For this we usually used a square law chart so that a gamma of 0.5 produced a linear greyscale on the waveform monitor. We put our expensive film in and, to our surprise, the result certainly was not linear, more like a square law. I had painstakingly measured the video transfer characteristic and knew it was correct. A certain amount of head scratching followed. Who has heard of the Callier Q effect? With black and white film tiny particles of metallic silver are suspended over a finite distance within the film support medium. The amount of light that appears to be transmitted through the film is dependant upon the nature of both the illuminating system and camera or whatever is receiving the light. Where the illumination is diffuse, more light will find a way through the silver 'maze' than if the light is direct (specular). Similarly variations are seen with large angle and narrow angle collection. The difference between diffuse and specular reading can cause the apparent gamma of the film to change by a factor of up to 1.5. A telecine by its optical nature is double-specular. We were reading a cube law from our film that had been calibrated as a square law using a diffuse densitometer. Problem solved. Thankfully the effect does not apply to a dye (colour) image. Actually we need to look further into the subject of Gamma and now is possibly as good a time as any.

2.3 Studio vs Telecine Gamma

For a studio camera we were only trying to correct for the power-law characteristic of the shadow-mask display tube. We usually set to 0.45 gamma as the display tube was nominally taken as having a power law of 2.2. However this is not the whole story; the CRTs were in fact more like 2.8 gamma so, with our 0.45,

the nominal display characteristic was 1.26 overall i.e. a scene to displayed brightness characteristic with slight black crush. This is generally preferable to a linear transfer characteristic for the dim surround illumination viewing typical of a domestic living room. For viewing in the dark surround conditions of a cinema a steeper curve is preferred, say about 1.5. Thus normal release prints are made to achieve this and the telecine must correct for this as well as the display characteristic to give images suitable for home viewing. Thus a telecine might be set to 0.3 gamma ($0.3 \times 1.5 \times 2.8 = 1.26$). Ok, that is a simplified explanation but it should be sufficient for the moment. It might be useful to note that gamma is called contrast in the film industry (makers of the raw material that is, not the studios).

2.5 First Demonstrations

So returning to our development programme, we have progressed to the point where demonstrations are looming up on us.

With the use of film for drama inserts in mind it was decided by those on high that our ability to match film and studio images would be demonstrated. Easily said but not easily done in those days. We had shot some 35mm film of TV presenter Sheila Kennedy (I think it was her) some weeks previously and the plan was to inter-cut this with live images of Sheila doing the same routine as before. First of all the new film was aging daily and the colorimetry just did not seem right. I was an avid reader of the technical press and had gleaned information that pointed to the solution; a special colour corrector (masking) was needed. I approached my management with no success (the first of a number of technical disagreements). Knowing that I was right (as always!), I built a corrector at home. The Mark VII had a set of looping video In/Outs just before the gamma correction; my box was inserted at that point and, hey presto, I could match film with live. Remarkably management suddenly knew that was what we needed all along. By the formal demonstration I could manage to hold quite a good balance with a split screen image fed down to me. As agreed my image was on the right of the screen. Then the chap on the vision mixer decided to

get clever and started swapping left and right and then made full frame cuts. The problem was that I only had the one monitor and I no longer could be sure which image was mine. Anyway no one noticed any problems. Following this I now had the task of getting my corrector into production as soon as possible. Now the masking was acting on linear signals and this not what you really need to do the job properly; we needed Logarithmic Masking. (The reason for this is covered in the Appendix). To achieve this logarithmic and exponential converters were needed.

2.6 The Log Masking Update

Anyone who has had the task of designing a gamma corrector that is accurate and stable enough to produce quality colour performance will know that it is not all that easy. It used to be done with a series of resistors and diodes that switched in as the input voltage increased. For a gamma of 0.3 over a 50:1 contrast range the ratio of the black and white gains is about 50 and that is difficult enough. For the planned log convertor we were talking about considerably higher contrast and using the resistor / diode networks was just not going to work. It was decided that the new circuits would be based just on the characteristics of a single diode. This works because the relationship between diode current and voltage is an exponential one. To stand a chance of getting acceptable stability the diode would be put in a small temperature controlled 'oven'. For the log circuit the task was reasonably straight forward. The diode was fed from a fairly high value resistor (making it almost a current feed) and the voltage across the diode measured. However with a very high black gain there was a lot of noise on the usual clamping area and for this reason a pulse equal to peak white level was added prior to the log conversion. This was used as the clamp point for the rest of the processing. Making an exponential convertor was more of a challenge. Here we needed to apply a voltage across the diode and measure the current. Obviously the applied voltages we are talking about are small and a very accurate clamp is vital. Luckily matched pairs of transistors had become readily available in both NPN and PNP and this made it a little easier to implement

the necessary differential amplifiers (Video speed Operational Amplifiers had yet to appear). The telecine was to be demonstrated at IBC up in London and time was running short. Eventually, with only a couple of days to spare, the system was fully working.

It had been decided that the new system would provide improved gamma control and offer negative colour operation as well (a world first?). This was possibly not one of my brighter ideas as the edge shading of the Plumbicons was considerably emphasised in negative operation. The main problem was not just general parabolic shading but there was a bright edge effect on the positive signal. This was thought to be due to lateral leakage across the target. Before continuing a brief description of how the Plumbicon works might be useful to some. The tube basically operates as a PIN diode with the N element formed from tin oxide on the inside of the glass envelope and connected via an indium seal to the head amplifier. A voltage of about 40 is applied via a resistor. The next layer is lead oxide (I) followed by doped lead oxide (P). When the tube is exposed to light the photo sensitive PIN structure charges its own self-capacitance so the rear doped layer voltage rises toward the applied 40 volts. When the target is scanned (magnetic deflection is used) the capacitance is pulled back to the cathode voltage causing a current to flow in the external target connection. While there were optical masks to exclude light from outside the wanted image area, these needed to be a little over-size

to avoid the risk of clipping the image; note that the film is clear just outside the wanted image. Thus there was an area of the tube's target that was well illuminated but unscanned. It appeared that charge from this area could leak into the wanted video image area. After some thought it was decided that the cathode voltage could be lowered while the edges just outside the active video area were scanned. This provided a kind of signal drain and the negative step in the cathode voltage could be set to null out the charge leakage. This did offer some improvement.

In general I think it can be said that the new masking circuitry did improve the performance, particularly in giving a more consistent match to studio.

Early sales of the B3402 were to ITN and YTV.

With the Log Masking in place there was little else that offered room for improvement at that time and I moved to other work for a period.

3.0 THE MARK VIII ERA

While the Telecine Department was having bit of a rest, the Studio Camera Department were at work on the Mark VIII camera (Figure 2). This was the first camera to offer automatic set up. The adjustment of Focus, Twist, Skew, Linearity, Width, Height and Centring were automated. There were still manual adjustments for left-hand hook etc but the automatics did reduce the effort needed for the major tasks.



Figure 2

At this time TTL type logic elements were just starting to appear but there was nothing like flash memory or even static RAM of any size available; the only way to store the circuit settings was to use motorised potentiometers.

While I said we were having a rest, my team designed the Vertical Aperture Corrector for the VIII.

It was during the first IBC demonstration of the VIII that Arnold Weinstock (GEC) appeared on the scene and another company name change occurred. Carpenters appeared from the factory and the name on the stand was changed during the show.

3.1 The B3404 Telecine

With the Mark VIII Studio camera in place it was logical to include the new technology in a telecine. The B3404 was to move away from the old free-standing projector system and combine everything in a single unit (Figure 3). There would be two cine projectors, either 35mm or 16mm, and two side projectors were mounted under the desk section.

3.1.1 Optical System

The B3404 used a novel optical arrangement. It was based on the same principle as used for architectural photography where the lens is raised above the centre line of the image

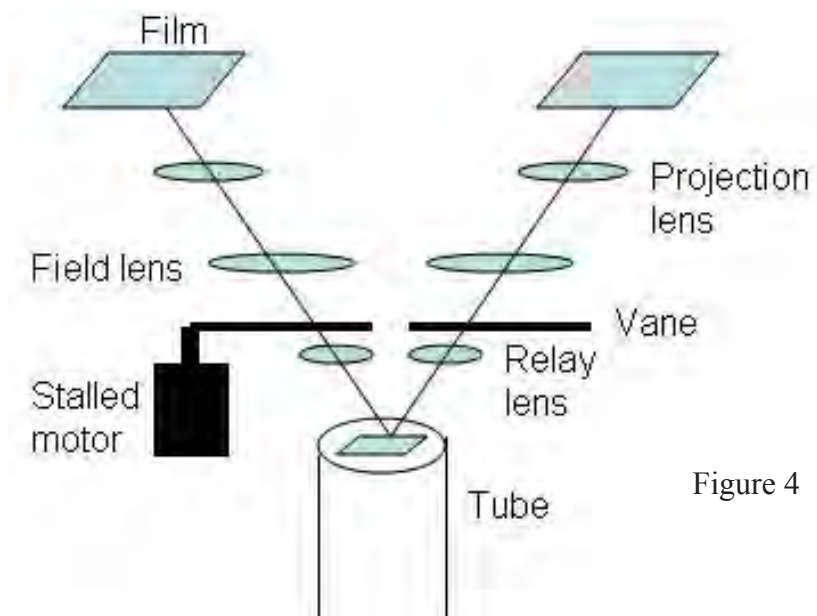


Figure 4

(Rising Front Camera or Tilt and Shift lens for Canon EOS devotees). Figure 4 shows a very much simplified version of the system with all the fold mirrors, the colour splitter block and two projectors removed. Basically the light passes through the system on an oblique path. You can think of the film as occupying a corner of the object field and the image on the tube as being just a corner of the overall image (obviously the rest is unwanted). So on the left the film is on the left hand side of the object field while the right hand portion of resultant image is formed on the camera tube. Similarly for the other projector the left hand side of the image is used. The relay lenses were only about $\frac{3}{4}$ " diameter and multiplexing could be achieved simply by shutting off the

unwanted path with a small vane driven by a stalled motor. As four projectors were to be accommodated the optical path was angled in two planes and, in effect, the other projectors would be behind the two paths shown in the diagram. Thus in actual fact a corner of each image was used. By adding a semi-reflecting surface just before the relay lens system it was possible to add a second relay lens / camera assembly to give pre-view option. This provided a neat solution to the requirement to combine the four picture sources. The downside was that the lenses needed to be small in diameter, resulting in a slight shortage of sensitivity. The small lenses also lead to an increased depth of focus and susceptibility to dust on surfaces close to the film (and at other image planes).



Figure 3

3.1.2 Projectors

3.1.2.1 Slide Projectors

The slide projectors were redesigned to provide a faster and reliable change mechanism. This used a system with a lead screw to drive the carriage. A significant amount of energy was needed to accelerate the screw and devising a mechanism to almost instantly destroy this energy provided a challenge. High speed film was used to analyse the operation and it was surprising to see how much the various parts flexed as the mechanism was brought to a halt. In the end Newton came to the rescue to tame a particularly wayward release solenoid. Most of the energy as it reset was destroyed by allowing it to strike a sizable mass that was free to move.

This worked in a similar way to those executive “Newton’s Balls” desk top toys. With simple digital chips now available the circuitry could be given a good update. While some thought had been given to the provision of random access this was not implemented.

3.1.2.2 Film Projectors

For the 35mm projector the parts from the same Philips mechanism used on the B4302 were fitted to a new design of plate. Hence this offered no advance in facilities for 35mm but the 16mm was different matter.

While it was seen that 35mm film will usually be a run for at least, say, 15 minutes (if it is commercial TV), 16mm could be used for short news clips lasting may be less than a minute. It was believed that the 16mm projector required more flexibility than had been previously provided. It was therefore decided that this would use a completely new design approach. The main requirements were set out to be true instant start from a still frame, variable speed projection with a full quality image (but no sound) and fast running spool to spool without the need to unlace the film. A lesser requirement was to be able to cue projector-to-projector.

It was decided that two mechanical designers would be set the task of proposing competing schemes. The selected design used a heart shaped cam to drive the shaft holding the film moving claw back and forth by on frame pitch while a surface cam rotated the shaft so as to cause the claw to enter and exit the sprocket holes. The clever part was a solenoid that could catch the surface cam follower on its high dwell (holding it against a spring) and thus prevent it from driving the claw into the film. The mechanism was driven at mains frequency (50 / 60 Hz according to country). Normal synchronous motors were used rather than the sync-interlock types used on the B3402 (sound followers were pulse-driven by now).

The film sprockets could either be driven by the same synchronous motor or by a variable speed dc motor. The motors were connected by magnetic

clutches to the film drive sprockets and a magnetic brake was also provided. While the sound flywheel was driven by the film in the usual way during normal speed operation it was driven by the synchronous motor at other times to allow instant sound start. For 625 line normal speed operation the claw was allowed to pull down on every other cycle of the heart cam. Similarly a 3:2 mode was available for 525 line use.

For all other projection speeds the film loop size was detected and pull-down operations were provided as need to keep a constant loop size. Detectors were provided before and after the gate to allow both forward and reverse projection. The film was only wrapped around the sound drum for normal forward projection. For fast running the gate pressure was released and the film loops removed before the drive speed was increased. When the mechanism was stopped from fast running the film loops were reset using the previously mention loop sensors.

In general the system worked well but later problems emerged when oil spinning out from some Oilite bearing got into the clutches, causing them to slip. This meant that the film speed and claw action were not necessarily matched at normal speed projection. This lead to film damage; obviously steps were taken to clear the problem. Unfortunately most of the early sales were in Australia and New Zealand and many air miles were clocked up by some of us as the problems were cleared.

Both projectors were equipped with a frame counting system that allowed automatic projector-projector cuing. A convenient 4-bit up-down counter had just appeared but my management thought this was too advanced and I was made to write to Texas Instruments to obtain assurance that they would continue manufacturing these “high” integration devices. Well the SN74192 still does appear to be available nearly 40 years on. Also just becoming available was a “massive” 16 x 4 bit RAM (64 bits!). (I chose not to mention this advanced technology to management). Previously we had been considering magnetic storage for the frame numbers; how we struggled in those days!

3.1.3 Video System

The video facilities provided by the new system used much of the circuitry from the studio camera but with the gamma and masking sections more or less following the B3402 design. Hence, apart from the advances offered by the Mk VIII studio camera, there was no real advance in video design for the B3404.

3.1.4 Automatics

The B3404 provided an improved automatic exposure / black level control system. One of the problems in providing this kind of facility for a telecine is in preventing it attempting to correct intentional effects in the film. If there is a fade to black the system could try to bring the image back to peak white. The effect looks a bit like the sky at night with any tiny scratch or spot glowing out. In the other direction “flash frames”, i.e. completely blank frames, are sometimes included to give a shock effect. The system must not make a panic dash to shut the light down in this case. A number of threshold and rate controls were devised and the system was made reasonably fool proof.

The system also had automatic colour balance and this came with another set of inhibits. White colour balance was based on the integrate-to-grey principle where it is assumed that the average of the image is neutral. Obviously one can think of many examples where this falls down, e.g. blue sea and blue sky. In this case the telecine would like to make the white wave tops yellow. In general if there were reasonable amounts of each of the three colours present balance could be applied without too much risk of getting a poor result.

3.2 First Demonstrations

The B3404’s first outing was to NAB in Washington DC. The prototype system, equipped with two 16mm projectors, was ready in reasonable time and needed only a little optical re-alignment of the slide projectors as we set up at the exhibition. As usual for these occasions a short demonstration routine had been prepared, the aim being to show off all the system facilities. The plan was to end with a little piece showing how a set

of adverts could be re-sequenced using the projectors' cuing and fast running facilities. Naturally we had rehearsed this a number of times with no hitch. Now it was the real first run for the delegates. All was well initially but as I got to the point where we were into the re-sequencing I heard nasty film tearing noises and my screen went blank. I could not actually see the machine from the control room and my only option was to cut to the closing slide sequence. We scrubbed the demo for the rest of the day and tried to see what went wrong once the show had closed for the day. No fault could be found. We tried again the next morning and it ripped the film up again. To cut a sad tale short, we eventually found that the electromagnet (see the "clever part" in 3.1.2.2 above) was not holding the surface cam follower off against the spring when all four projectors were on (as they were in the final demo sequence) and the supply in the hall was low when all exhibitors were drawing power; hence it did not happen when the show closed.

I should note that the relay was powered from the same unregulated supply as the projection lamps (did someone say colour temperature?). The spring was shortened a little and the demonstration ran perfectly for the last day. The equipment was now destined for Sydney but we manage to grab three days in Hawaii before heading down.

With the spring episode behind us and a good 230V Australian supply we confidently prepared for the visitors. With about a quarter of an hour to go the right hand spooling system took off at full speed. Luckily it was winding the film on to the spool and not dumping it all on the floor. We removed the spooling plate but the visitors were just arriving. We decided to start with just one film projector while I fixed the spooling plate in the back room. This did not take long so we bravely demonstrated ease of servicing to the guests by replacing the plate and actually got away with it with a round of applause.

3.3 Production

The First systems were to be delivered only a few months later and, as already noted, the first few systems all went down-under, either to Australia or

New Zealand. If you are going to have teething problems you really do not want then the other side of the world, but that is life.

The B3404 sold reasonably well into a number of parts of the world and a number of little incidents occurred.; Cairo was an example where the engineers were not that experienced and therefore had difficulty in maintaining the kit. General cleanliness was also a problem. One night a relatively small bug walked across a 16mm gate, however, it was relatively big compared to the 16mm film and apparently this massive alien looking beast caused a bit of a panic for some viewers. After this a man with a petrol driven crop sprayer was brought in to spray everything. There was brown slime everywhere.

Another problem related to the pita bread crumbs that were dropped all over the equipment. This attracted mice which set up nests on the printed boards (they were mounted horizontally in the Mark VIII system). Uric acid is an effective etchant but apparently it was our fault for not providing full mouse proofing and for mounting the boards in the wrong way.

On one occasion one of the ladies (the men did virtually nothing) asked me to look at her telecine because she thought that there was a fault on the magnetic sound. I told her to find the sound test film and I would check. There was virtually no mid or treble output. I suspected head miss-alignment but on inspection the head had been worn into a triangular shape and had delaminated. Somewhat unkindly I suggested that they put less sand in their magnetic striping machine.

On another occasion I came in to the horrific sight of three ladies changing a ¼ watt resistor. The sturdy one had a vice like grip on the edge of the board while a second gouged at the back using a soldering iron with an inch wide bit. The third applied a pair of combination pliers to the resistor. It was not surprising that what started as a simple fault often grew into major one that sometimes warranted a complete PCB replacement. They said "Mr. Everett (our contracts manager) doesn't like us"; are we surprised?

3.4 What Next?

I could ramble on endlessly about incidents around the world but for now we had gone as far as technology and the company's purse strings would allow. Our next big push would not come until my interests were stirred by some digital video tests in 1975.

APPENDIX

A.1.0 Introduction

This section is intended to cover the more technical aspects that must be understood when designing a telecine system. Some of the opening paragraphs may be well known to some and could be skipped.

A.2.0 Basic colour reproduction

Before diving into the subject of film reproduction, it seems sensible to talk a little about the optimisation of studio cameras. As I am sure you all know, colour TV systems attempt to reproduce all possible colours using a display that emits only red, green and blue light in various proportions. The light is

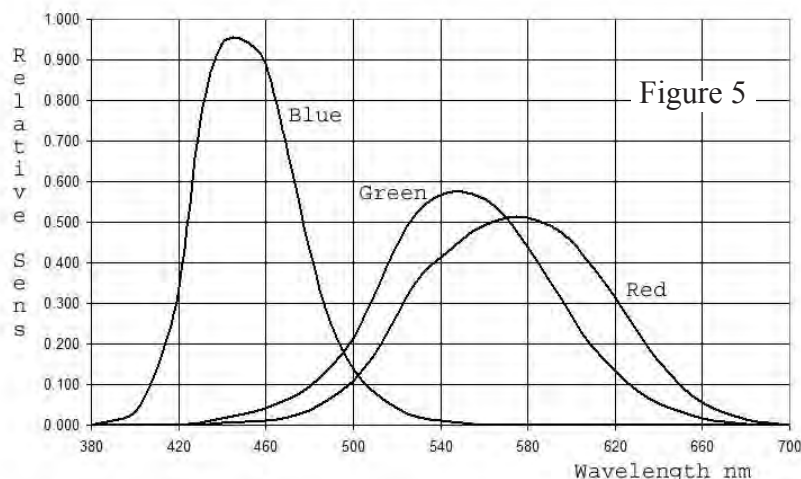


Figure 5

mixed additively whereas film attempts the same task using yellow, cyan and magenta dyes in a subtractive system; two very different things! Figure 5 shows the relative spectral sensitivity of the cone receptors of the human eye.

Immediately we can see that the red and green sensitivities have a significant overlap. It is may be surprising that we can differentiate colours in the yellow / orange range. If we look at the CRT phosphor spectrum shown in figure 6 we can see that switching on the green gun is not only going to stimulate the green cones but also will stimulate the red ones as well. The blue and red phosphors do a somewhat better job of exciting the blue and red cones respectively. If we now consider the task of reproducing a spectrally pure cyan, say at 500nm, we would drive the blue and green guns.

Unfortunately the eye will see a considerable amount of red in the result, giving a desaturated reproduction. If we look at the CIE Color Matching Functions in figure 7 we can see what the camera spectral sensitivity would ideally be for best reproduction. The negative lobe of the red characteristic can be created by taking a little of the blue and green signals from the red signal using a correction matrix. Of course this is fine provided that there is some red signal to subtract from. Hence cyan is always a bit of a challenge. In fact you end up adjusting all three colours. The correction values are calculated using the actual camera spectral response (colour splitter block, tubes and any filters) and a set of defined colours. The matrix is optimised to give the least errors overall. (Do you think the human neural system has an in-built colour correction matrix? We know it has auto-colour balance). As noted in the main text, the Mark VII had a set of video In/Outs where a matrix could be fitted but a matrix was not supplied in a studio camera until the Mark VIII came along.

A.3.0 FILM

A.3.1 Colour Film Basics

With an ever increasing amount photography using digital techniques there will be a decreasing number of people who have actually held a piece of film and even less that understand

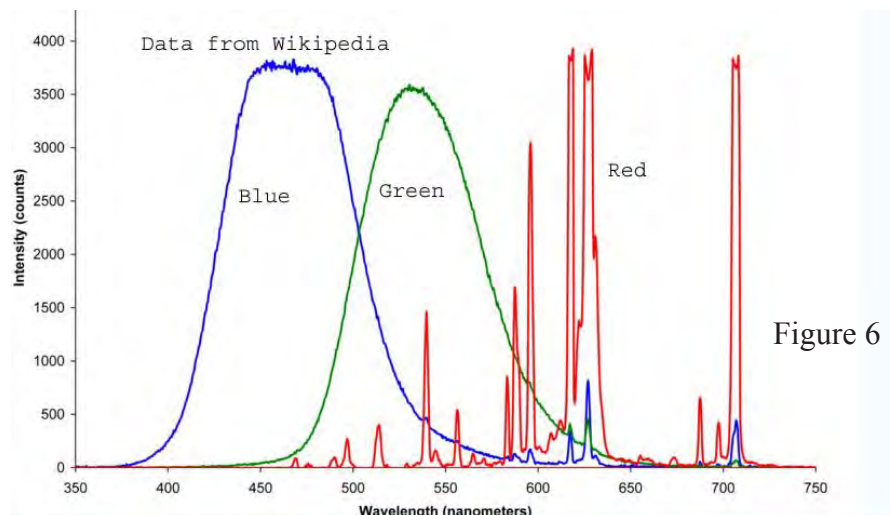


Figure 6

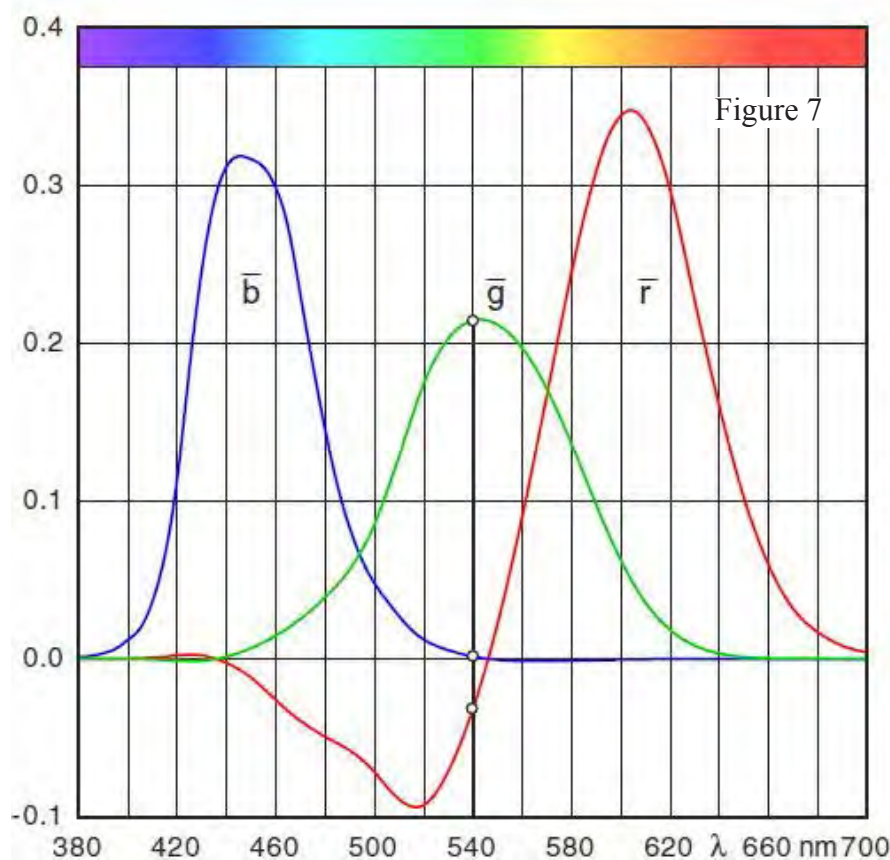


Figure 7

the processes involved in producing a film image. It therefore seems useful to give a brief description of a colour film and the processes. Figure 8 shows a simplified cross section of a film. The top most layer responds to a fairly broad spectral band of blue light. The next layer is a yellow filter that cuts all blue sensitivity from the layers below. Next is the green sensitive layer followed by the red sensitive layer. Modern material is more complex but what has just been described is the film that was available in period that I am covering. What happens when the film is processed will depend upon whether the material is negative, a print film or a reversal film (as used for home slides). The path for negative and

print film is much the same because both reverse the tone of the exposing light. A Colour Development, using special chemicals, is performed first. As each of the three layers develop a negative silver image is formed (as for black and white film) but a negative (negative relative to the exposing light) colour image is also formed. This gives (top to bottom) a yellow, magenta and cyan image whose density is proportional to the density of the silver image produced at each layer. The silver is then bleached away leaving just the dye image.

For reversal material a black and white development is applied first, resulting in a just a black and white negative

LIGHT



Figure 8

We should note that Technicolor printing is not a photographic process. These prints are produced in what could be described as a mini printing press with the printing rollers replaced by three films to carry the yellow, magenta and cyan inks.

A3.2 Film Density Characteristic Details

Having noted how film images are produced we now can look at the actual transfer characteristics. The film industry always plots film characteristics on a log / log basis. Actually it will be log exposure against density but density is given by $D = \log_{10}(1/\text{transmission})$. Figure 9 shows a plot for a negative colour film. The three lines give the density as measured in red, green and blue using filters with a narrow spectral bandwidth. The three curves do not overlay due to the orange colour mentioned above. You will note that the curves for this particular film are substantially straight over a log exposure range of about 2.5; this corresponds to an exposure range of about 300:1. The straight line tells us that the gamma is constant and in this case it is about 0.65 (actually -0.65 in TV terms); this means that we stand a better chance of accurate correction.

Figure 10 shows reversal film. We can see that whereas the negative gave density ranges of about 2 (100:1) the range of the reversal material is about 3, i.e. 1000:1. In the late 60s and 70s we were lucky to be able to display more than about 60:1 with a shadow mask tube; hence a lot of black stretch was needed to see a reasonable amount of black detail. Here there is little of the characteristic that is all that linear, indicating a varying gamma. The almost linear part in the central range of the curve shows a gamma of about 1.8. In general reversal material has more contrast than a release print. If we look again at figure 9 we can see that the shape of the three curves is much the same but the reversal film curves are noticeably different in the high density area. This is because the maximum achievable density for the individual film dyes is different. This lack of black tracking can be taken out by the telecine black balance control.

image at each layer. The film is then exposed to a flat white light so that any undeveloped silver halide crystals are now sensitised. A colour development is then undertaken followed by bleaching as before. The strength of the dye images produced will be proportional to the number of crystals that developed in the second development. For a bright subject area most crystals will have been developed in the first process, leaving relatively few for the second process. Thus a well exposed area will result in a light image i.e. a positive image.

Some may be familiar with the orange colour of negatives; this will be discussed elsewhere. There are in fact a number of different film types that are made for specific purposes. For example a master negative from a major production will be printed to a number of Inter-positive sub-masters for safety apart from anything else. These might then be printed onto a number of Inter-negatives before the final release prints are made. News film would almost always be reversal material.

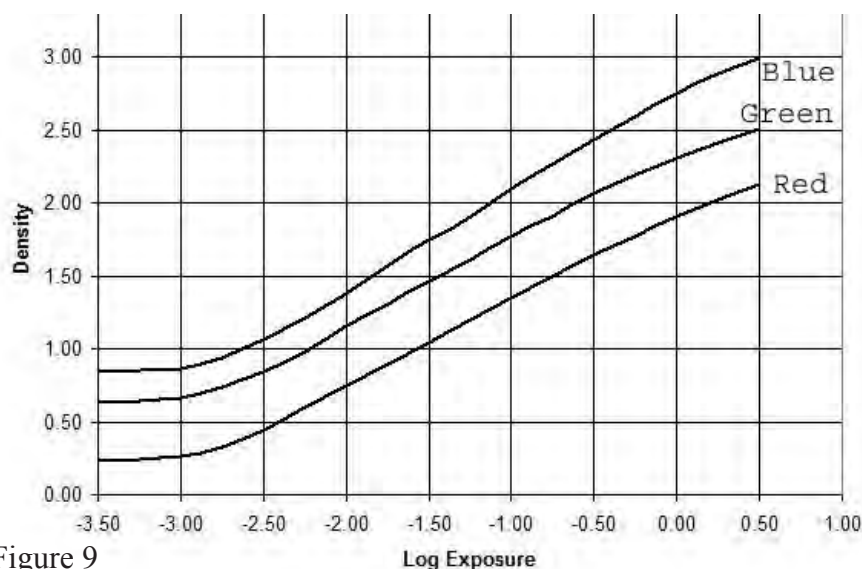


Figure 9

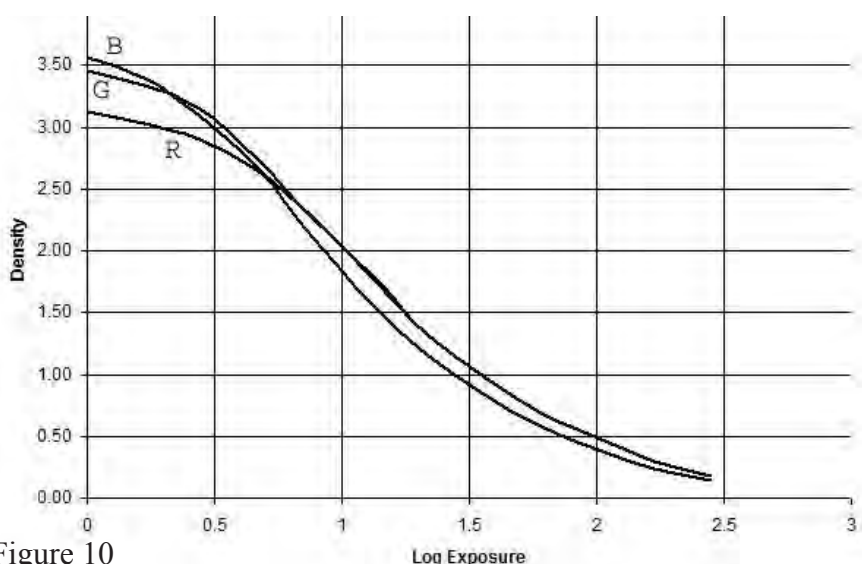


Figure 10

That description was a may be a little brief but it is important to know this sort of data when you are deciding what gamma ranges to design in.

A3.3 Reading Film

A3.3.1 What are we trying to do?

The telecine designer's task is to build a machine that achieves the best reproduction of a given film. One question is: are we trying to reproduce the projected film image or the original scene or maybe something else? So we find ourselves with both artistic and technical points to consider. I first tried to cover the issues that follow here in the late '60s during a TV symposium in Sydney. It caused a considerable stir amongst the delegates. "You cannot do that, you are interfering with what the director intended" I was told. The fact is that if you do not do something to modify the basic image that the telecine sees it would not make good television. In fact we basically did not attempt to reproduce the projected image and went towards getting back to the initial scene.

A3.3.2 Achieving the Best Reading

It is often impossible to know how the film passing through the telecine was made and it is certainly impossible to attempt to correct for all the processes. Moreover different film manufactures employed their unique chemical 'tricks' to make their film the best. This sort of thing did not help the task of matching film to studio (see 2.1 above).

If we look at a typical set of film spectral sensitivities (Figure 11) we will see that they are nowhere near the CIE curves of figure 7; this is a potential problem in itself. Should we put in a linear matrix to make them a better match to the CIE requirements? The answer is no, it is not that simple. This is mainly because we do not have access to the original exposure data (the equivalent of the camera signal in the studio case). What we do have is the result of an 'analysis' of the yellow / cyan / magenta dye images. Figure 12 shows a typical set of dye spectral curves. The curves are shown as Density (defined above). Ideally the dyes would have a block profile with, say, the cyan dye stopping red light only and passing all green and

blue light; clearly we are somewhat distant from that position. The total density at a given wavelength is the sum of all three densities. As we may remember from the distant past, adding log data is the same as multiplying. Hence any individual spectral reading gives a product related to the initial red, green and blue exposures (and other factors if it is not the original film). Getting a bit difficult? It gets worse! The readings obtained will include a gamma factor that varies as you move along the curves. Say you read the magenta dye on its peak at 540nm, you might read with a gamma of 1.5 (i.e. $1.5 \cdot \log(k/exposure)$). If you read the same curve at about 580nm (where the density is half the peak) the reading will have a gamma of 0.75. We can see that the 540nm reading also included a

cyan dye reading at about 0.25 gamma plus a yellow reading at around 0.35 gamma (I said it got worse). As a result of this the RGB signals will represent a summation of a complex range of YCM dye transmissions at different gammas, further modified by each colour channel's spectral sensitivity. Luckily the relative shape of the density curves does not change with the amount of dye present; e.g. the relationship of densities at 540 and 580nm for the magenta dye will always be 2:1 irrespective of the actual value of the peak density. Naturally the complex nature of the camera signal makes it extremely difficult to know what the initial film RGB exposures were. Obviously we need a way of making life a little simpler. An important step along this road is to make the spectral bandwidth of the

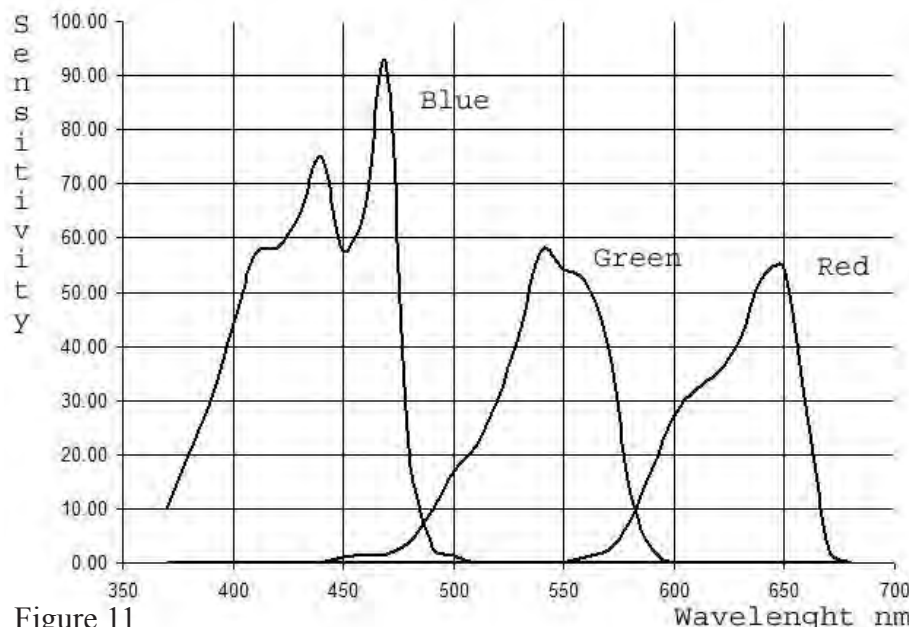


Figure 11

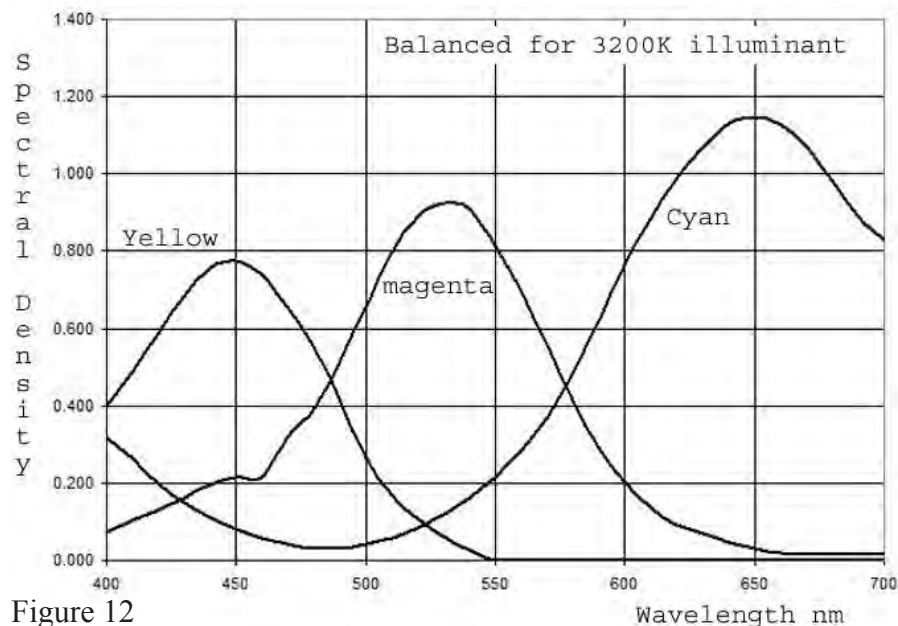


Figure 12

RGB sensors as narrow as possible, consistent with getting a reasonable amount of light through, say 20nm at half amplitude. The peaks of the spectral lobes are centred as closely as possible to the peak dye densities. In this way we can get as near as possible to reading the initial film RGB exposures.

Unfortunately lack of camera tube red sensitivity forced us to use a peak at about 615nm for the red channel, which was certainly not ideal and the level of 'crosstalk' from the G and B exposures was increased. This meant that the main red gamma was less than for the other two channels. There is still more work to do on the signals but the accuracy of what we can eventually achieve is improved by the narrow band philosophy. While the signals still have a complex mix of data from all three exposures, the gamma of the components does not vary so much over the narrow spectral ranges. The downside of narrow lobe reading is that the gamma read from the film is going to be higher and more black stretch (and increased noise as a result) will be needed. I am sure by now you will have realised that reading film accurately can be difficult but I want to note just one more complication before

moving on. I mentioned 'tricks' earlier on; it is possible to design a film where the development of one layer has an effect on a neighbouring layer. This is called Inter Image Effect. Agfa film was an example where this was used to provide a very strong red. Maybe it looked great for direct projection but in the context of telecine reproduction the effect had to be more or less removed to get a match to studio images. The Inter Image Effect is a little like having an additional set of dye curves added to the mix. So to sum up what I have just covered, the aim is to get to a situation where we can almost write:

$$VR = (\text{red exposure})^{\gamma_{rc}} * (\text{green exposure})^{\gamma_{rm}} * (\text{blue exposure})^{\gamma_{ry}}$$

Where γ_{rc} is the gamma of the red reading of the cyan dye, γ_{rm} is the gamma of the red reading of the magenta dye etc.

There are similar equations for green and blue. Obviously we do not really have single values for each gamma but our narrow lobes help us to approach that condition.

Now having got to this situation we still have the problem that the 'cross-talk' signals (green and blue for the red signal) multiply the main signal. If we pass the signal through a logarithmic converter the signals are then effectively added. We then pass the three colour signals to a nine-term linear matrix to remove the cross-talk factors. This done we can then convert the signal back to normal via an exponential conversion process. By adjusting the terms of the matrix we can perform the gamma correction process at the same time.

A 3.3.3 Negative Mask Layers

A comment was made earlier about the orange appearance of negative film. In order to improve the reading of the negative film during subsequent photographic printing, additional dye layers are provided that are depleted as neighbouring layers form images. I have to admit that after over twenty years I cannot remember which layers were involved but I would guess at cyan and magenta. Anyway, these additional dye images acted much like the electronic masking. In fact they were so effective that we had to partially cancel their effect to avoid excessive colour saturation.

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Update On Experimental 3D Camera

by Mike Cox

By a stroke of good fortune I heard of a friend who was re-furbishing his recording studio with HD cameras. He therefore had 4 Sony SD cameras to dispose of. I have bought two of these, and if any member would be interested in the other two, I can put them in touch.

The cameras are Sony DCR-TRV 355E, Digital 8 camcorders, but that is of no consequence as they have never had a tape in them, nor is that likely. The image quality from either Y/C or CVBS outputs is very good. My friend's studio is used for recording piano recitals with a small audience, and the video and audio output is transferred to DVDs that are sold to club members.

Unfortunately, these cameras are considerably larger than their Maplins predecessors, and have had to be mounted on the base block at 100 mm centres instead of 65 mm. (Fig. 1)

Camera cable posed a momentary problem as the original Maplins cameras had 5 metres of cable attached. A temporary arrangement was lashed up using some RG179 coax for the video, and some tougher cable for the power. However, I discovered that the current draw of the two cameras is only 200 mA, so light cable will do. An LM317 regulator takes the CCU 12 volt rails

down to 9 volts for the head supply. As we use one of the foldout LCD displays as a viewfinder, the original 4:3 5.6" LCD display has been removed, as the cameras are set to 16:9.

It has now been decided that VGA cable will be used as camera cable, and a 20-metre length of male/female cable is now used. VGA cables in longer lengths have 4 coax cores, together with 4 other cores. Two coax cores carry the left [L] and right [R] video [CVBS], while the other two are used for left and right audio. We might as well have some stereo audio as well as video. (Fig 2)

Power take up two cores, leaving two free for tally, talkback or what-have-you. To accommodate the VGA cable, HD15 plug and socket have been installed on the camera and CCU respectively, together with 4 pillars for the camera to stand on when it is not on a tripod. (Fig. 3)

So far the results look much better than with the Maplins cameras, as you might expect. At present, viewing using shuttered glasses is confined to CRT displays. Most LCD display use more or less sophisticated de-interlace circuitry to suit what is a native progressive display. This neatly defeats the field sequential signal! One of the ways round this is to look for interlace to progressive adaptors so that a pseudo field sequential sequence can



Fig. 2

be established at 50 or even 100 Hz. An advantage of the existing set-up is that PAL images can be recorded on a DV recorder and played back.

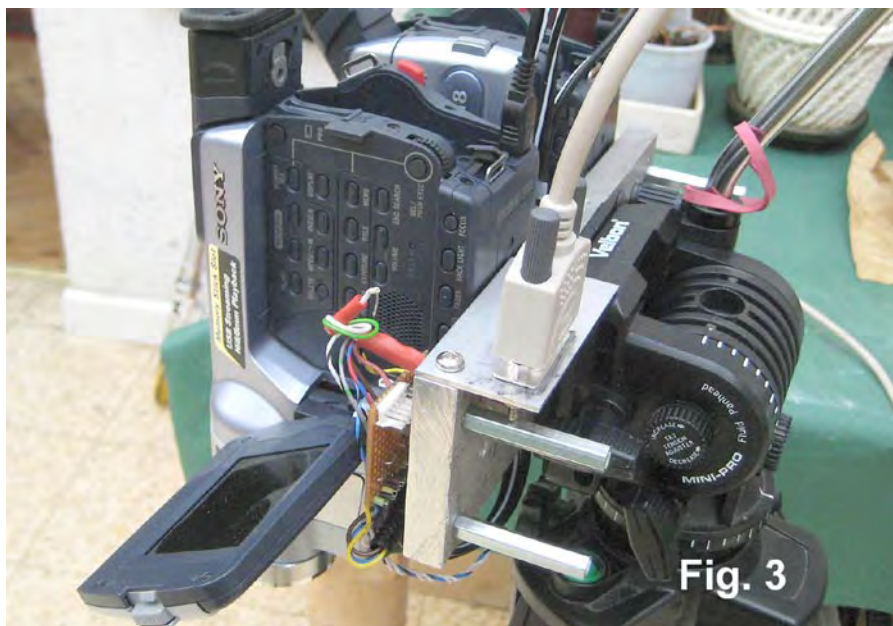
A practical point is that incident light is shuttered [by the glasses] and gives rise to flicker. The viewing room needs to be pretty dark. If the two camera images are matched, the only source of flicker will be the edge difference between L and R images.

Thought is being given to ways of handling the L and R signals so that they are both available simultaneously at the display. One thought is to use the technique used for stereo audio where a [L - R] channel is superimposed on the sum [L + R] channel. The [L + R] channel gives a compatible mono audio signal.

In our case, a better way will probably be to use the Y channels from the Y/C output, form an R - L signal, and at the far end, add L to this to separate out the R channel. The L channel would be sent direct. A cunning MPEG encoder could probably accommodate the R - L channel in the stream, thus giving a transmittable 3D signal. Bit rate would increase by a small amount.



Fig. 1



A simple [R – L] circuit has been built into the experimental CCU, and even if it does not lead to the MPEG solution above, it is a very useful alignment tool for setting up the cameras. (Fig. 4)

It is probably worth adding a switch so that occasionally, one of the audio coaxes can be used to send [R – L] up to the camera. Despite the very solid camera base, it has been found that the cameras, being largely plastic, are not as solid as they might be. Hence the need for shims under one or other camera to correct vertical mis-alignment

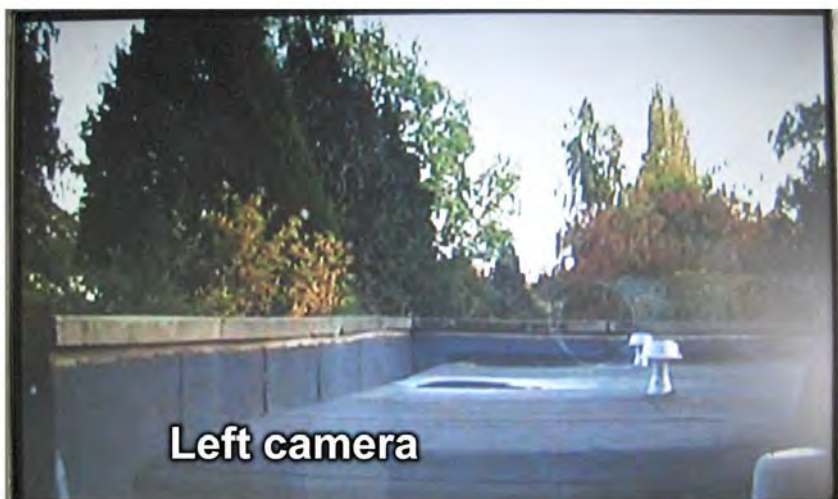
The Sum and Difference technique will give much greater flexibility for displaying. If the budget allowed, two projectors could be used, with appropriate polarising filters, or even the Dolby system, which uses very narrow band tri-colour filters.

These filters are made by a German company, Infitec [www.infitec.net].

The left eye filter has response peaks at 629 nm for red, 532 nm for green and 446 nm for blue, while the right eye has peaks at 615 nm for red, 518 nm for green and 432 nm for blue. By having similar filters at each of two projectors, the left and right images are very effectively separated.

Meanwhile, we soldier on with the field sequential system and the shuttered glasses. Experience gathered with the camera head will doubtless lead to mechanical refinements, and to simplify the alignment.

Remember that there are two more of these Sony cameras available. Get in touch with me via the Editor and I will try to sort it out.



!!! Your Club Needs You !!! Assistant Editor Wanted

Email: editor@batc.org.uk

Contest News

by Dave Crump

International IARU Contest

I was very pleased to receive 5 entries for the International IARU Contest this year – significantly better than 2008.

UK Results by band:

70 cm

Pos	Call	Locator	QSOs	Points	Best DX	QTH	QRB
1	G4PYD/P	IO93WH	2	30	2E0ODL	IO93VK	15

23 cm

Pos	Call	Locator	QSOs	Points	Best DX	QTH	QRB
1	M0DTS/P	IO94LI	5	2832	G8ACT	JO01DT	296
2	G4PYD/P	IO93WH	5	1494	M0DTS/P	IO94LI	130
3	G6GVI/P	IO83RO	5	696	G8VZT	IO82RQ	102
4=	GB80RBP	IO91TP	1	208	G3PYB/P	IO91PF	52
4=	G3PYB/P	IO91PF	1	208	GB80RBP	IO91TP	52

13 cm

Pos	Call	Locator	QSOs	Points	Best DX	QTH	QRB
1	G4PYD/P	IO93WH	2	1600	M0DTS/P	IO94LI	130
2	M0DTS/P	IO94LI	1	650	G4PYD/P	IO93WH	130

3 cm

Pos	Call	Locator	QSOs	Points	Best DX	QTH	QRB
1=	GB80RBP	IO91TP	1	260	G3PYB/P	IO91PF	52
1=	G3PYB/P	IO91PF	1	260	GB80RBP	IO91TP	52

Overall UK Results:

Pos	Call	Locator	70 cm	23 cm	13 cm	3 cm	Total
1	M0DTS/P	IO94LI		2832	650		3482
2	G4PYD/P	IO93WH	30	1494	1600		3124
3	G6GVI/P	IO83RO		696			696
4=	GB80RBP	IO91TP		208		260	468
4=	G3PYB/P	IO91PF		208		260	468

Congratulations to Rob, M0DTS whose portable forays on Saturday evening and Sunday morning gained him the top UK slot. The Grimsby ATV Group including Colin G4PYD, Lee G4TNX and John G0ATW came a very close second. Ross, G6GVI was also out portable with assistance from Bob, MINUS.

Although special event stations are not permitted in RSGB Contests, I could not find anything in the BATC or IARU rules about it. So, I was pleased to include Dave, G8ADM's entry from the special event station commemorating

I know that G8LES and G4IMO were active but did not achieve any scoring contacts, and that in addition to those submitting entries, M0YZA, G7AVU, G8ACT, G3KJX, 2E0GYO, M1EEV, G8VZT, M0ATV and M0OTE were on the air. Conditions on the Saturday

evening were reported as good, with a number of Dutch stations being heard on talkback, but none worked. By Sunday morning, conditions were back to normal.

80 Years of the RAF at Bentley Priory. Dave only managed to contact Peter, G3PYB/P, having had problems with getting his aerials to any reasonable height.

I had hoped to be able to publish the European results, but these are not yet available.

Contest Times

A reminder that the December Repeater Contest will start at 1200 on 12 December to give portable stations daylight operating time on both the Saturday and the Sunday.

Conclusion

I can be contacted through e-mail (contests@batc.org.uk), or through my BFPO address:

Wg Cdr D G Crump,
Mailbox Number ACT,
BFPO 63,
London

If you need printed logsheets, please send me a stamped addressed envelope, and I will be more than happy to send some to you.

Contest Calendar

1200 UTC 12 December 2009	1200 UTC 13 December 2009	BATC Repeater Contest
1200 UTC 20 March 2010	1200 UTC 21 March 2010	BATC Repeater Contest
1200 UTC 12 June 2010	1200 UTC 13 June 2010	BATC Summer Fun Contest
1800 UTC 11 September 2010	1200 UTC 12 September 2010	International ATV Contest

Lincoln Steam & Vintage Vehicle Rally August 2009



Big Bertha and friends

Pictures by Dicky Howett
(See also rear cover)



Snack time for the helpers.
They deserve it!

Steam Tv. A veteran Marconi Mk IV camera focuses on the trundling steam exhibits



A Tuneable 70 cm Narrowband Filter

by Ian Waters G3KKD.

Years ago when most ATV used 70 cm amplitude modulation we had the band almost to ourselves with little risk of interference from other transmissions. Today we have to compete with many other strong signals both amateur and others.

The filter described here is tuneable from 435 to 438 MHz, has a passband of 2 MHz and an insertion loss of 1.5 dB. It has a high Q such that at 2MHz above or below the edge of the passband it offers an attenuation of 20 dB increasing to 30 dB at 4 MHz. Fig 1 is a plot of this response.

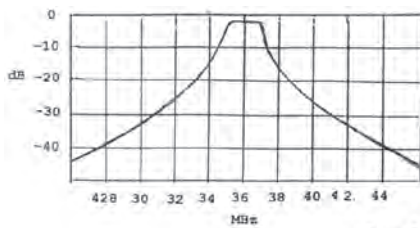


Fig 1

It has been found most useful in digging out weak 70 cm video from a mass of noise and beat patterns. Although I have no experience it should be of value to stations working weak DX in contests. It has enabled pictures from G4IMO in Wisbech, at a distance of 50 km, to be resolved at P2-3 whereas without it nothing could be seen. It is also anticipated that it could be valuable when receiving 70 cm DATV, although this has yet to be proved.

To test the filter I transmitted half a microwatt from the top of my garden, and with my receiving aerial pointing toward a direction of known strong signals, received the test transmission on the back of the beam.

Photo 1 shows the spectrum from 428 to 444 MHz with the test transmission barely visible on 436 MHz in the centre of the trace. What this does not show is that there were many other carriers appearing intermittently for a second or so. Probably some were car keys. I could not catch these with my camera. Photo 2 shows the same spectrum with the filter in circuit. It will be seen

that most of the other carriers, that were beating together to obliterate the picture have been eliminated. Photo 3 shows the TV screen without the filter with nothing to be seen except noise. Again I could not catch short duration bursts of patterning. Photo 4 shows a weak, but useable result, when the filter was in use. Of course the filter can do nothing to protect against signals close to the wanted frequency, which appear occasionally. One has been caught in Photo 5.

On the back cover of this magazine is a photo showing the general view of the filter unit as well as one showing the internal details.

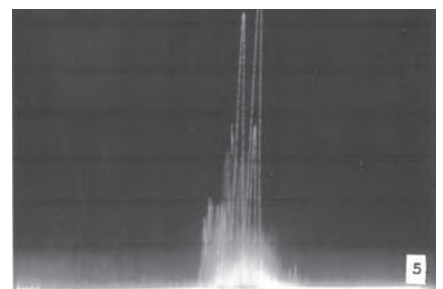
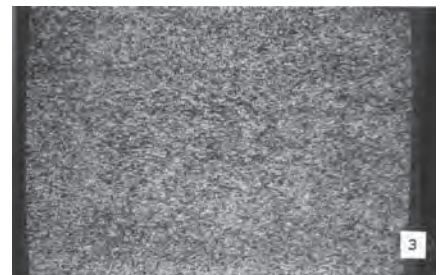
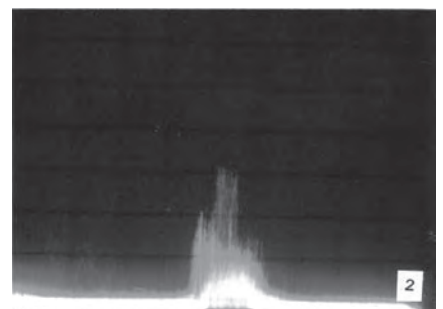
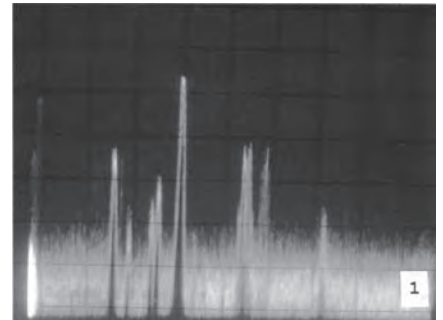
Fig 2 gives the essential dimensions. Standard 22 and 15 mm copper water pipe was used for the inner coupled resonator lines. The dimensions of the outer boxes were then calculated to give the optimum Q with a 22 mm diameter inner line.

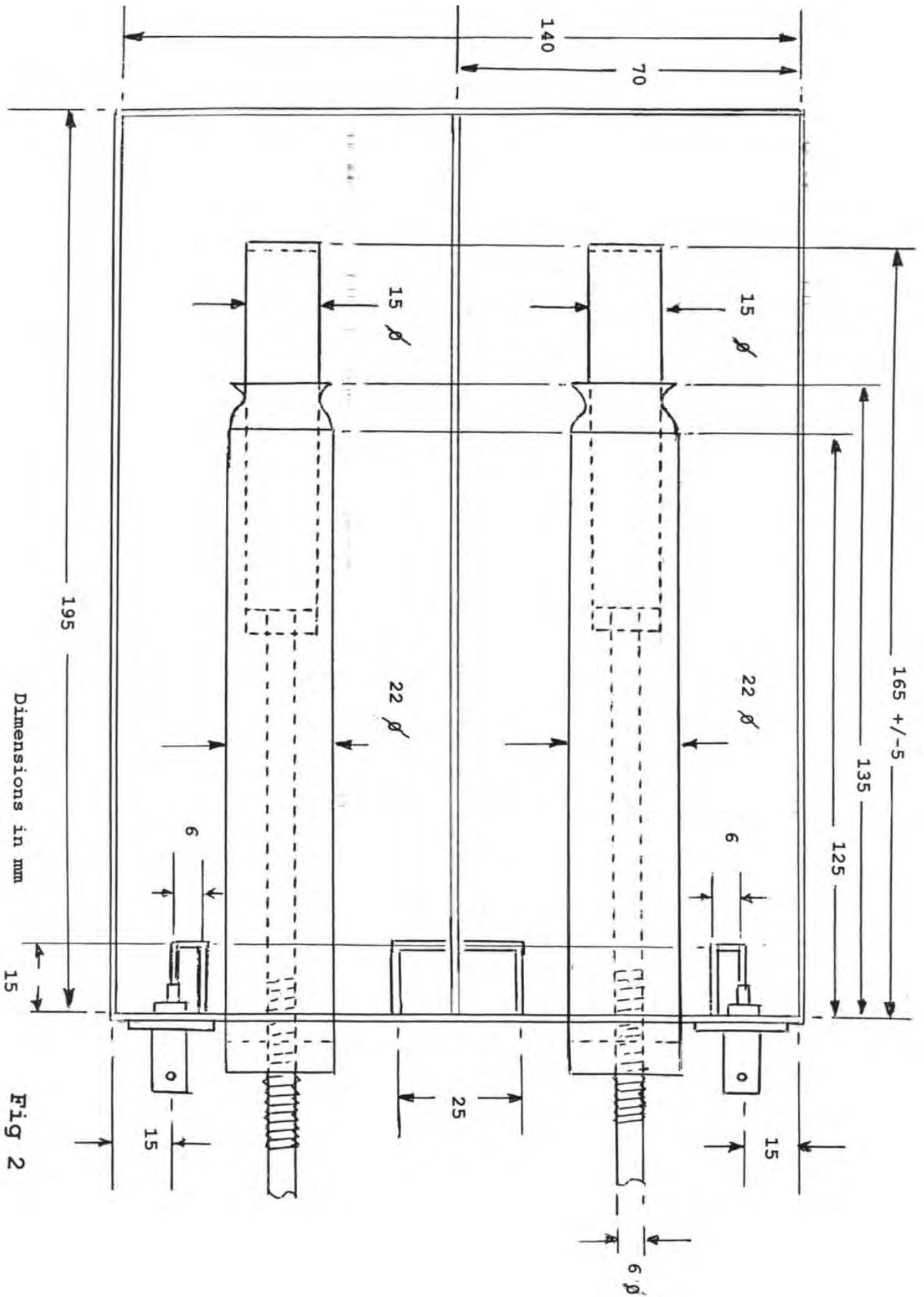
The outer ends of the 22 mm tubes were slotted and then bent as shown. Springs keep the slotted fingers in good contact with the inner line extensions.

The 15 mm lines are closed by discs soldered at both ends. Lengths of 6 mm threaded rod attached to the inner lines pass through tapped discs soldered into the outer ends to the outer lines to provide tuning adjustment.

With the exception of the front end, which is made from copper sheet for strength, the outer boxes are fabricated from copper clad PCB soldered together. Lengths of 6 mm square brass strip are soldered in for added strength and are tapped for the screws, which retain the cover.

The sizes of the input, output and coupling loops, made from 16 SWG copper wire, are as shown on the drawing. Silver plating would improve the performance, but is rather expensive.





Controller For Comtech Transmitter Modules

by Dave Crump G8GKQ

This article describes the design and construction of a simple PIC-based controller for the Comtech 23cm and 13cm transmitter modules.

Requirements

The controller was required to provide front panel control and display of the transmit frequency for the Comtech modules. Easy selection of preset channels, with the ability for manual control was also required. It was hoped to design one unit that would work for both 23cm and 13cm. Frequency control of the Comtech modules is achieved by setting 8 inputs either high or low with a binary number in the range 0-255.

Design

The design was based on G8CQZ's 30 MHz Frequency Counter as described in his book PIC Basics. This seems an odd choice at first, but it had many of the basic features required: an 8 digit display driven by simple hardware and software, the ability to convert binary to decimal, and the potential to handle frequency offsets. The PIC and display hardware for the frequency counter were first built and tested. The software and hardware were then modified in small steps (tested at each stage) to add the ability to output an 8-bit parallel code selectable from a channel switch or up/down buttons. The end result does not count frequency – it sets the desired frequency and displays what it thinks it has set.

My first homebuilt transmitters (were there any other sort?) had switched crystal-controlled frequencies. I still like the simplicity of this arrangement, but wanted to be able to manually control the frequency as well. I have chosen to have 8 preset channels selected by a rotary switch, but with the ability to adjust the frequency up or down by means of push buttons, and also to store frequencies overwriting the presets when required. The advantage of this arrangement is that if a preset channel is

selected, and the unit is powered off, it will return to the same frequency when powered on again. This arrangement is best explained by examining the front panel arrangement in Figure 1.

Circuit Description

The circuit is shown in Figure 2; note that I have not shown the essential supply decoupling capacitors – about 10nF as close as possible to each IC.

The 16F873A PIC runs at 1 million instructions per second using a 4 MHz crystal. The crystal frequency is not critical – anything in the range 3 – 5 MHz will work well. The PIC reads the channel number from the binary inputs RA0, RA1 and RA2 (pins 2-4). A simple diode matrix is used to derive 0-7 (binary) from an 8-way rotary switch. This arrangement could be simplified if you wanted to. The up, down and store buttons are connected to inputs RA3, RA4 and RA5 (pins 5-7). As with the outputs of the diode matrix, pull-up resistors are used. The 8-wire output to the Comtech module is taken directly from RB0 – RB7 (pins 21-28).

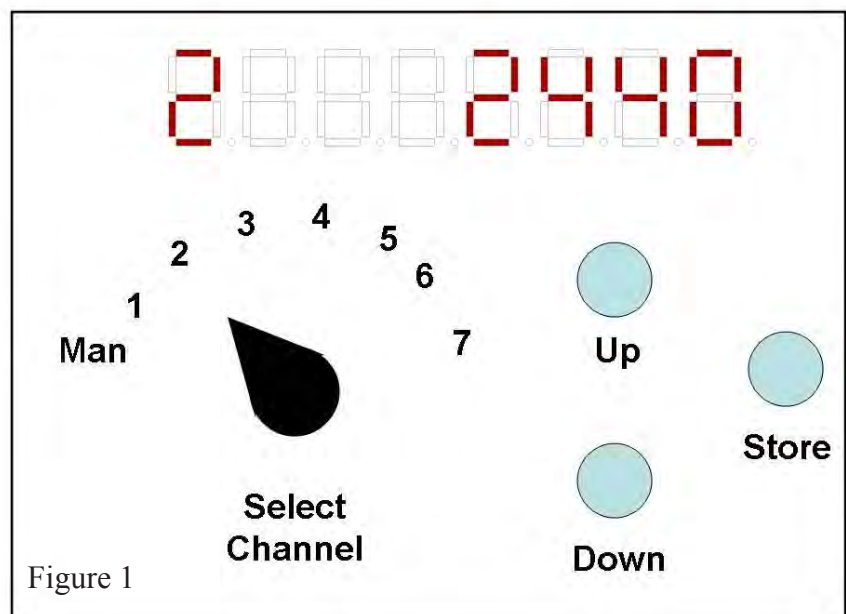
Lines RC0, RC1 and RC2 (pins 11-13) output, in binary, the position of the display digit to be turned on. This

binary is decoded by the 74LS138 to select which of its 8 outputs goes active low. The low output turns on one of the transistors Q1 – Q8 applying 5v to each of the common anode LED 7-segment display digits in turn. Lines RC4 – RC7 (pins 15-18) output, in binary, the number to be displayed by the digit that has been turned on. This is decoded for the seven segment displays by the 74LS47. Note that blank digits are sent binary 15, which is decoded as a blank. Finally, output RC3 (pin 14) directly drives the decimal point LEDs.

Operation

On start up, the controller will go the frequency last stored in the currently selected preset channel. If the channel selector is moved, the output and display will be updated within one tenth of a second.

If the up or down buttons are pressed, the current frequency is incremented or decremented. Note that the new frequency is not permanently stored until the "Store" button is pressed twice. The first press will cause the channel indication to flash, indicating that the channel to be overwritten with the new frequency should be selected. Once the required channel has been selected,



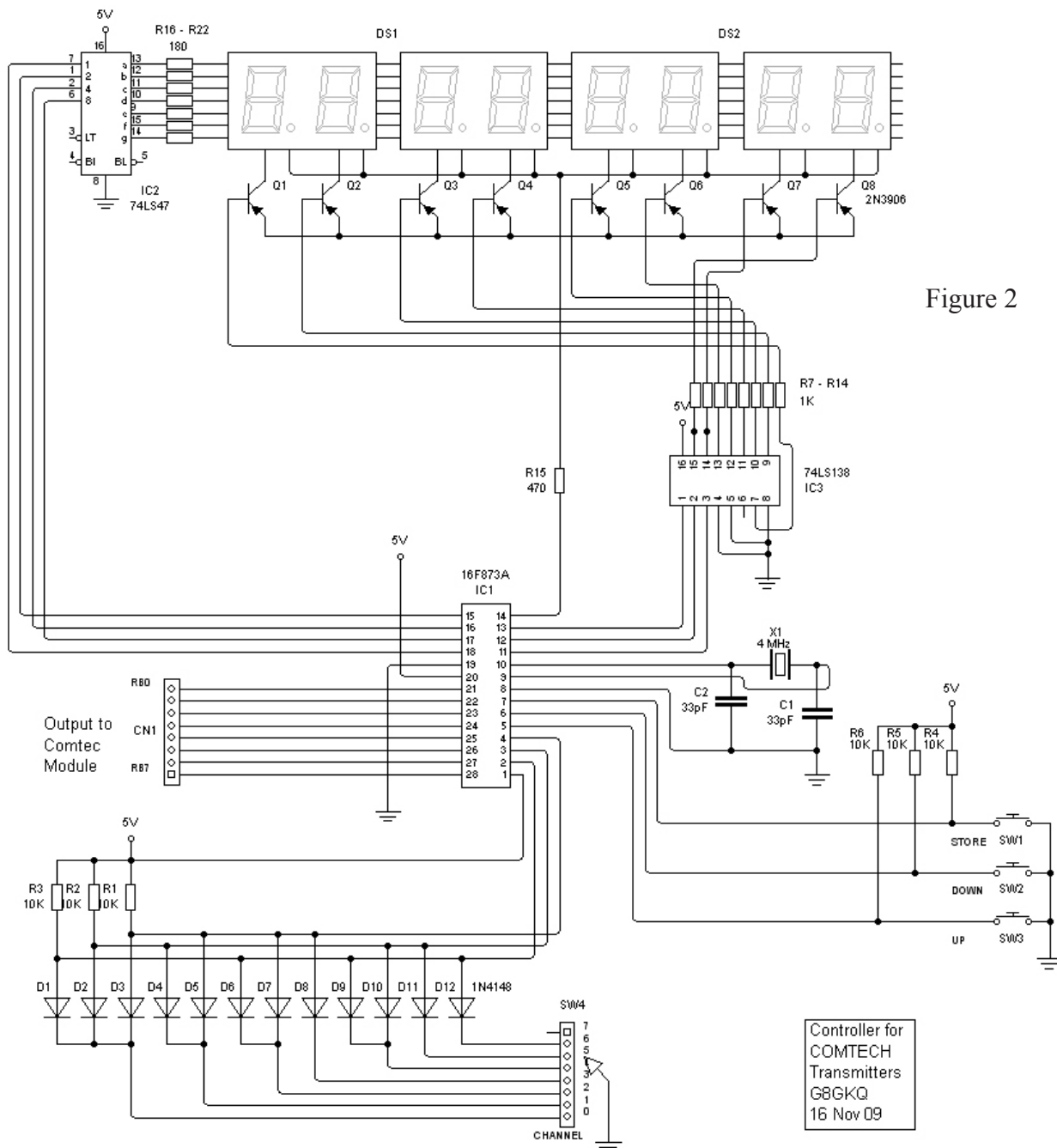


Figure 2

pressing the store button a second time will store the frequency.

I have nominated Channel 0 as the "Manual" channel for storing ad hoc frequencies, but there is no reason why other channels should not be overwritten in the same manner. Note that Channel 0 remembers the last "manual" frequency used since power-on.

By default, the preset channels and display are set for 13cm. The display has 3 other modes : 23cm, 3cm and binary.

The display can be changed for use on another band by storing the lowest available frequency (binary 0) in channel 7 twice in succession. This increments the band number as shown

in the table below and loads the presets for the new band. Thus, to set the controller to work with a 23cm module after initial setup, the lowest available frequency needs to be stored in channel 7 six times in succession. This selection of band persists through power-down and will only change if you repeat the band-change procedure.

Band	Binary Range	Displayed Frequency	Step size	Internal Band Number
Binary	0-255	000 - 255	1	0
23 cm	0-255	1240.0 – 1367.5	0.5 MHz	1
13cm	0-255	2300 - 2555	1 MHz	2
3 cm	0-255	9200 - 10220	4 MHz	3

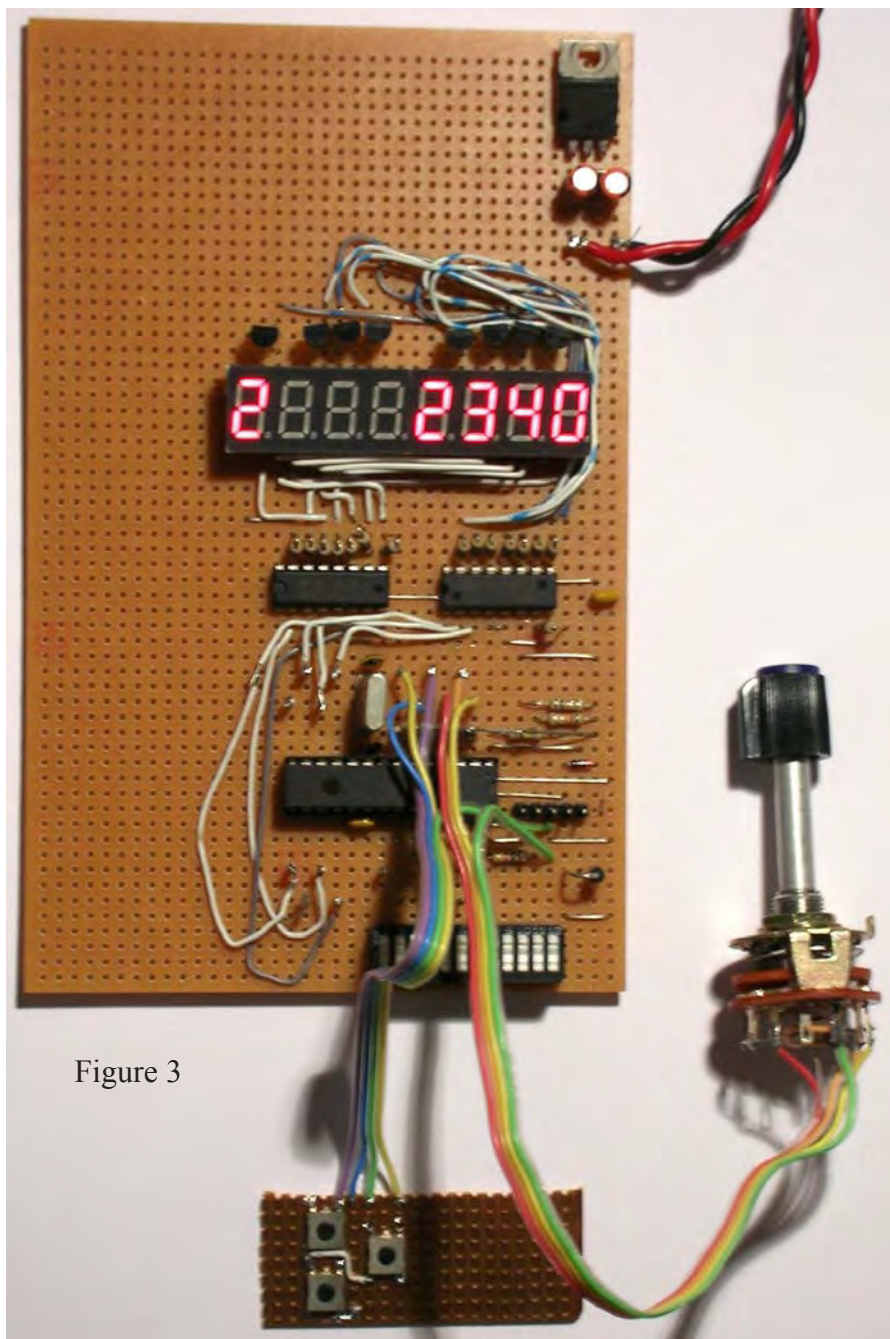


Figure 3

The 3 cm mode assumes that you are using a 13 cm module and a 4x multiplier to generate the 10 GHz signal.

Software Design

After start-up and initialisation, the program runs in a continuous loop; on each run through the loop it checks the channel switch and buttons, sets the binary output to the controller and then displays the frequency. It executes this loop approximately 10 times a second. On each occasion that it displays the frequency, it cycles through all the digits 12 times, displaying each in turn for about a millisecond.

I have published the assembler program listing on the BATC website. The listing is well-commented (I hope) and is easily modified.

Programming the PIC

I used the MPASM Compiler from Microchip Technology (the manufacturers of the PIC) to compile the source code and produce the Hex file to be programmed into the PIC. I have posted the Hex file on the BATC website, so that if you are using my design without modification, there is no need to use a compiler.

To program the Hex code into the PIC I used a Velleman K8048 programmer bought from Maplin. This connects to a PC serial port and is supplied with ProgPIC2 software to enable the Hex file to be downloaded to the PIC. This programmer is getting old now, and

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editor@batc.org.uk

serial ports are rare on new computers, but there are a number of USB-based alternatives available. It is worth noting that the K8048 programmer will not work with USB-to-RS232 adaptors, it needs a real serial port.

Construction

I built my prototype on veroboard, but for my finished transmitter I plan to split the circuit into 2 modules: the display module mounted on the front panel, and the PIC module mounted near the Comtech transmitter board. My prototype is shown in Figure 3. The 8-wire output from pins 21-28 of the PIC should be connected to the DIP switch on the Comtech module. The switch should be set to all "ones".

Components

I ordered most of the components from Futurlec (www.futurlec.com) who provide a competitive mail order service in the USA (where I am currently living). The veroboard and switches were sourced from Maplin in the UK. Please contact me by e-mail: (contests@batc.org.uk) if you would like me to purchase and programme PICs for you. Depending on the level of interest, I should be able to provide these for around £5 pounds each.

Component List

IC1	16F873A
IC2	74LS47
IC3	74LS138
DS1/2	7FR3641BS (or any combination of Common-anode LED Displays)
D1..8	1N4148 or similar
X1	4 MHz Crystal or similar
Q1..8	2N3906 or general purpose silicon PNP
R1..R6	10K (non-critical pull-up resistors)
R7..R14	1K
R15	470 (adjust for decimal point brightness)
R16..R22	180
C1	33pf
C2	33pf
C3-5	10nf decoupling capacitors (not shown on circuit diagram)
SW1..3	Push to make buttons
SW4	Single pole 8 way rotary switch

Further Information

I can be contacted at contests@batc.org.uk I recommend the book "PIC Basics" by Cliff Powlesland published by the RSGB. Data Sheets for the PIC can be downloaded from <http://www.microchip.com>. The source code and compiled hex files are on the BATC Website: <http://www.batc.org.uk/cq-tv/software.html>

Correction

Correction to "Symbol-Rates, FEC and RF Bandwidth" article in CQ-TV 227

Please note the following corrections on page 17 of CQ-TV 227

www.m0sts.co.uk/datv.htm SHOULD BE: www.m0dts.co.uk/datv.htm
www.d-stv.com SHOULD BE: www.d-atv.com

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Turning back the pages

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

by Peter Delaney

CQ-TV 42: Like the previous issue, this did not carry a date of publication, but included a reminder to members "Have you paid your 1960 subscription yet???"

In CQ-TV 227, the current editor commented on the need for articles on the 'how to get started' in amateur television. This is something that the magazine was good at doing 50 years ago - explaining the basics, normally assuming that the readers had some knowledge of electronics, and needed help with the aspects that were particularly needed for television, or in which tv circuitry was different to narrower band needs such as for audio work, or the rf circuits to handle such. In this issue, Mike Barlow, the Club's founder, answered the question "Why Pulses?"

The reason for using electrical impulses like this is that they could be used to switch other circuits on and off - maybe several circuits being switched at the same time. The ideal pulse would be perfectly rectangular, with sharp transitions, infinitely steep edges and a flat top. In reality, an electronically produced pulse will have a leading edge that is not infinitely steep. If such a pulse is to switch more than one circuit at the same time, then they must all be triggered at exactly the same amplitude point on the leading edge, or there will be a small time difference. Rise times of the order of 0.1 microseconds were needed for TV work.

Mike went on to say that "most readers who come to TV by way of audio Hi-Fi amplifiers, amateur radio and the like will be familiar with the problems of obtaining undistorted or linear amplification. When dealing with pulses we are usually concerned with highly non-linear circuits, in which severe distortion is often highly desirable. Some new thinking is obviously needed."



Fig.1: Ideal Pulse (L); practical reality (R).

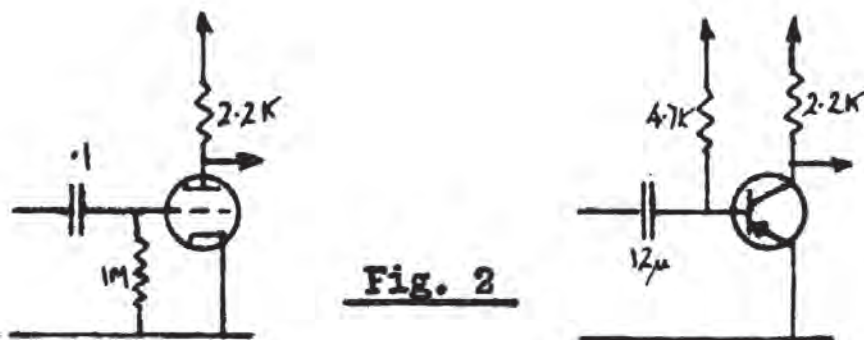
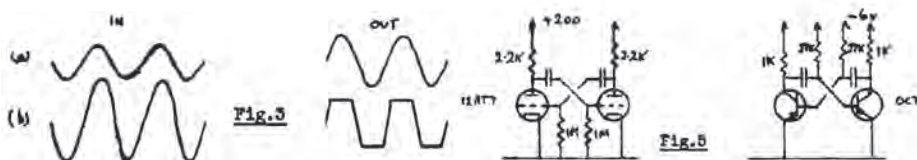


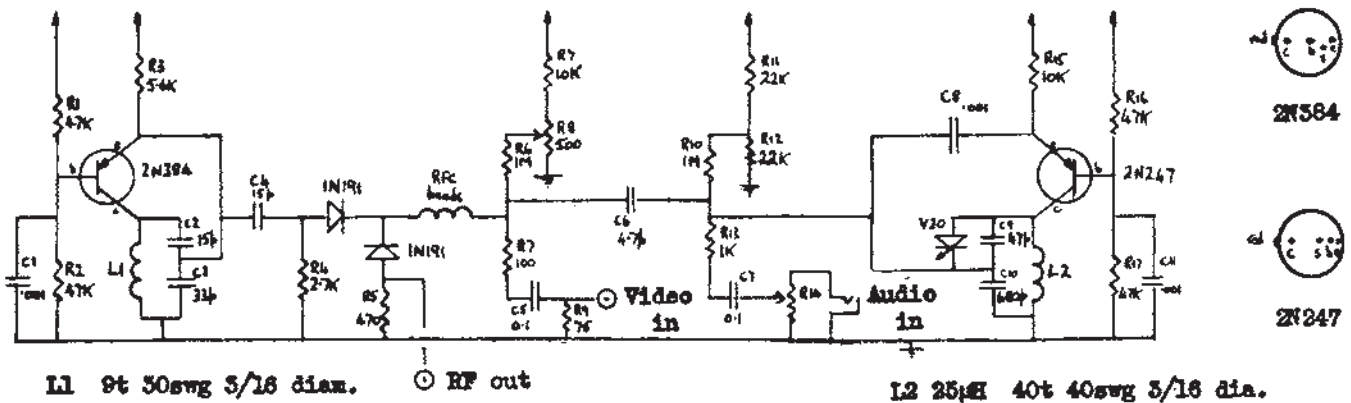
Fig. 2

He showed that if an amplifier handled a small signal, the output would appear amplified and inverted at the output, ideally undistorted, but if the amplitude were increased so that the peaks were clipped off (in one direction the amplifier being cut off, and in the other it saturates), a square wave would result - Fig 2 showed the basic circuits, and Fig 3 the waveforms for small (top line) or large (bottom line) inputs. By altering the bias, different mark-space ratios could be obtained. To obtain quicker rising edges, either the input must be made greater, or amplify the output and clip it in a following stage. To obtain an even steeper rising edge, positive feedback could be applied - as in Fig 5. This was the standard multivibrator. (*a circuit used in several designs of sync pulse generator to create the basic timing pulses used by a television system to control the scanning of the picture into the required lines and frames.*)

A transistorised RF distribution amplifier was said to be "one of the most useful

units to have at the amateur TV station". In effect, a low powered transmitter, it combined the video and audio signals so that they could be fed to any TV set, which could then act as a monitor. In this particular design, the RF carrier was set to between 50MHz and 60MHz, with a 4.5MHz subcarrier for FM audio (Mike - the designer living in Canada at the time). The 2N384 'drift transistor' was used as the Colpitts oscillator for the RF carrier, and the 2N247 as the audio subcarrier oscillator - (Mullard OC171 and OC170 respectively were suggested as European equivalents). V20 was a "varicap" - described as a voltage operated capacitor (an unusual item at the time). It was said that the "performance of the RF unit must be immaculate if the overall TV picture is not to be deteriorated" - and that the modulator should be screened from the oscillators, and the complete circuit housed in a metal box with a tight fitting lid, to minimise interference to other television receivers.





The longest article in this issue of CQ-TV was a set of notes on Slow Scan Television, compiled by Grant Dixon. Pluff Plowman, G3AST, in Yeovil, Somerset, was one of the leading SSTV enthusiasts, and a photograph of his then recently completed AM-FM slow scan monitor graced the cover of CQ-TV 42. Various valve circuits were shown, using either a photo-cell and a dc amplifier amplifier to drive a balanced modulator, or a 931A type photomultiplier to drive a balanced modulator direct. Circuits for timebases filters etc were also included. The tube suggested for display purposes was the 5FP7 - which

with an orange filter was said to 'give very fine results'. (*The P7 phosphor was blue short persistence, and yellow long persistence - so the filter was added to present the viewer with predominately the long persistence image - ideal in slow scan applications*). As the system runs at much slower frequencies than conventional domestic television, the EHT supplies for the cathode ray tube (typically 5kV - 7kV) could not be generated using an overwind on the line output transformer. It was suggested that either a dedicated RF EHT unit be used, or a standard mains transformer and rectifier.

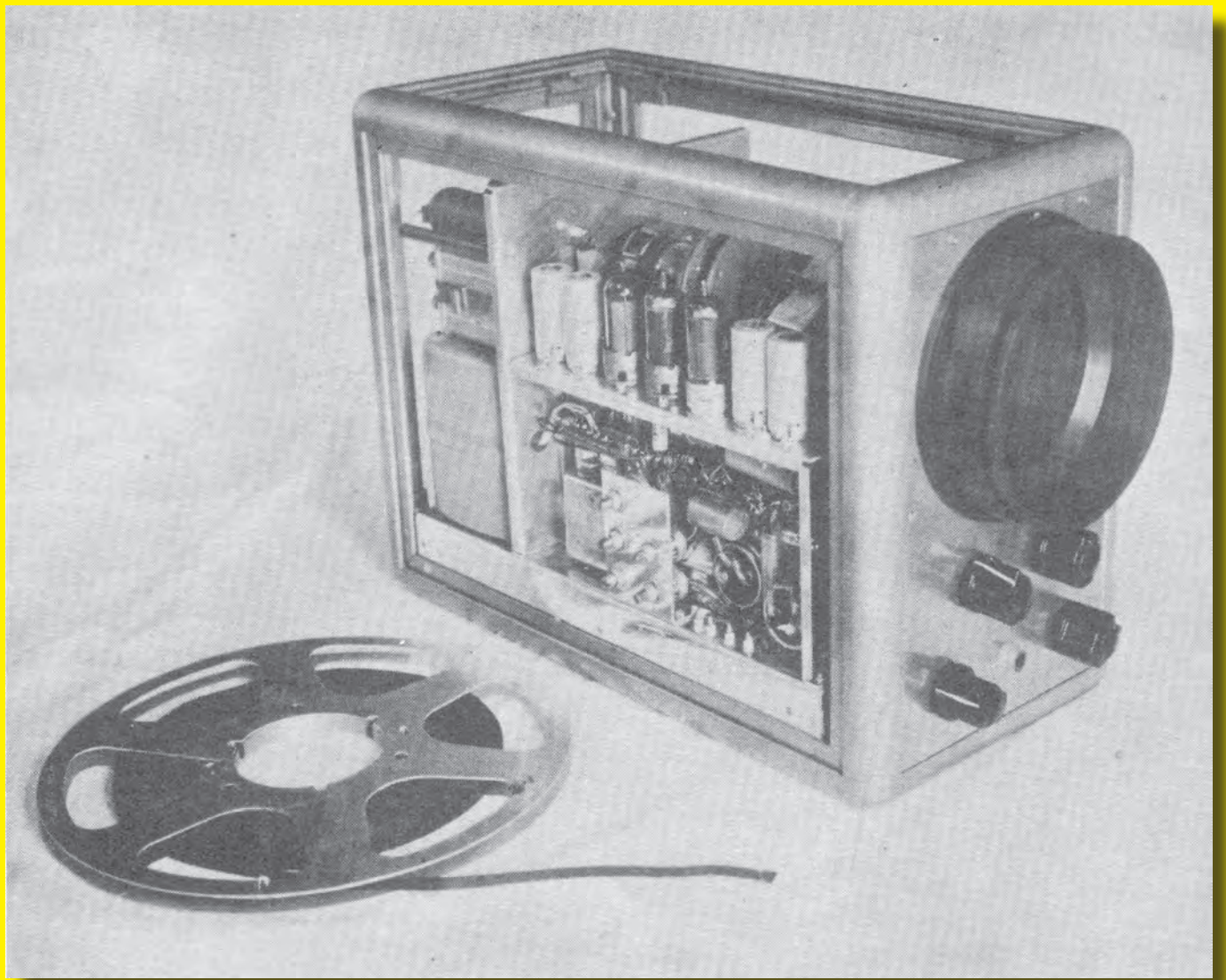
Both were available on the surplus market at the time - but CQ-TV also added that "From the safety point of view the RF EHT unit is to be recommended, but it will require careful screening". For those who do not remember such things as mains derived EHT in domestic television sets, it could be lethal.

The only other photograph in CQ-TV 42 showed the SSTV signals received by G3AST in Yeovil from WA2BCW in New York (mentioned in the last 'Turning Back the Pages'). The transmission had been in the 10 metre amateur band, by special permission of the American licensing authorities, with the transmitter running 25 W dc into the final amplifier. The picture on the monitor, it was noted, was sharply focussed all over - the 'apparent softness at the top and bottom being in the photograph' rather than the monitor image.

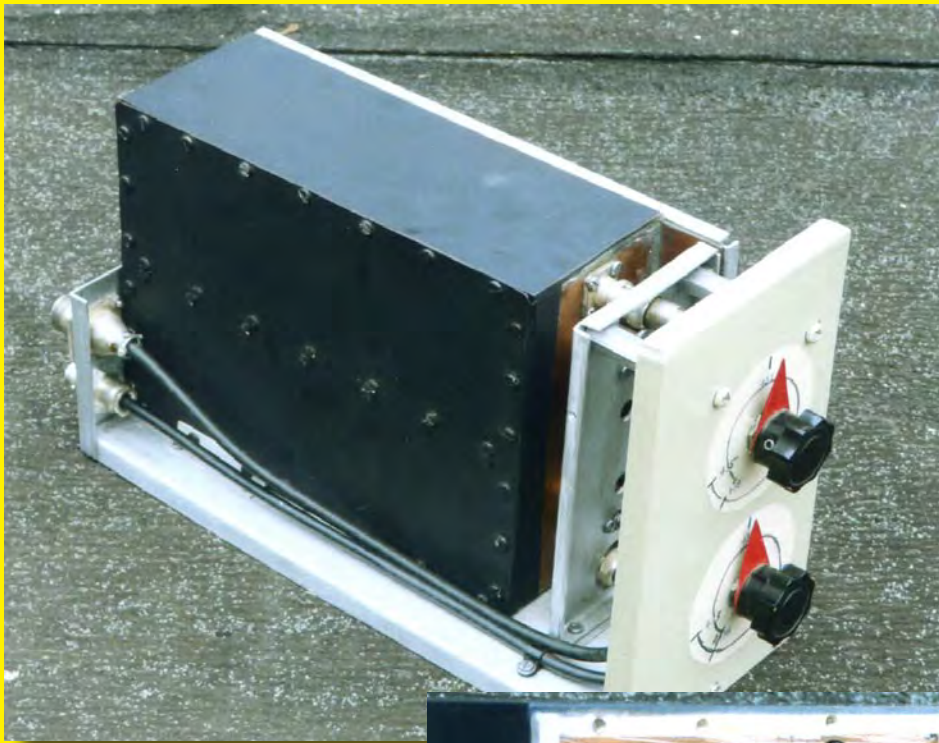
The "What the Other Chap is Doing" pages reported on the activities of well over 50 members. Although many were in the UK, active members were noted in Nigeria, Bermuda, Cyprus, India, Australia and New Zealand. (Although the note for Arthur Critchley was that he had been called up for National Service, he was reminded that RAF Locking had an Amateur TV Society!

The Cambridge Group, of which Arthur had been a member reported that "unhappily, Matilda now seems a total write-off." The magazine also reported 39 new members in the previous 3 months - with members in Italy, India, USA and Norway as well as within the UK - as well as HMS Ark Royal !!

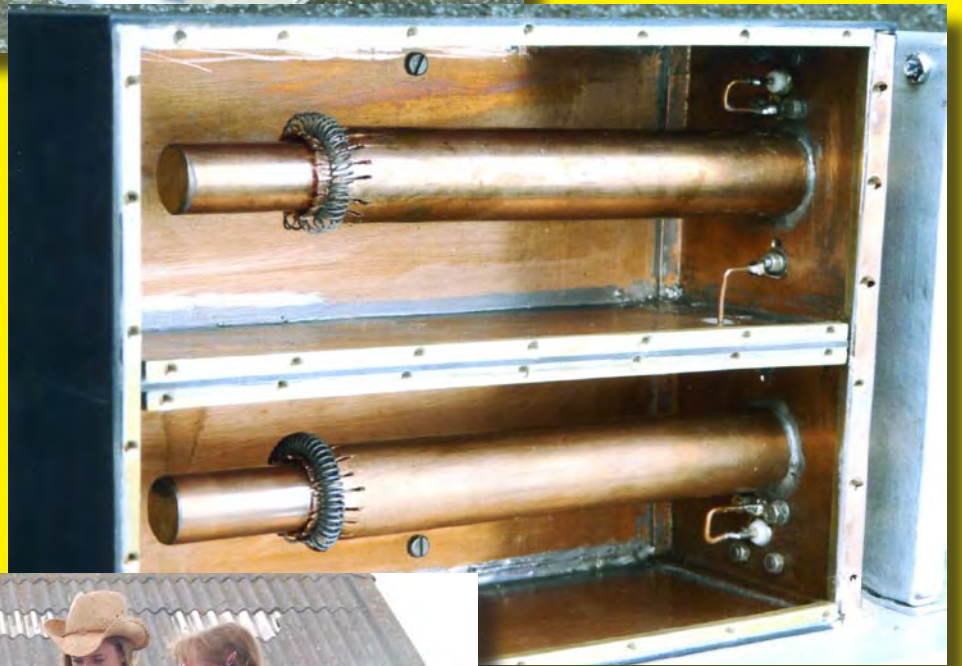




Modern Slow Scan image received on 20m
My how the technology has improved ! (ed)



A Tuneable 70 cm
Narrowband Filter



All the nice girls love a....
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